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Superposed folds in a banded iron formation of the Qalluviartuuq-Payne Complex.

2005

Québec

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Abstract

The Lac Anuc area (NTS 34O), mapped at 1:250,000 scale during the summer 2001, was subdivided into four lithodemic complexes, eight intrusive suites and four lithodemes, all emplaced between *ca.* 2.85 and 1.8 Ga. The Qalluviartuuq-Payne Complex, the Kogaluc Complex, and the Mézard Complex contain a variety of rocks that form volcano-sedimentary belts (< 30 km wide by 150 km long, bracketed between *ca.* 2851 and > 2729 Ma), enclosed in different granitoid units. Plutonic units were grouped into a number of magmatic suites or magmatic complexes, which, from the oldest to the youngest, are composed of: 1) tonalite-trondhjemite-granodiorite-granite (TTGG-type) in the Rochefort Suite (*Arot*; *ca.* 2848 to 2758 Ma), the Kakiattuq Suite (*Akkk*; *ca.* 2740 Ma), and the Châtelain Suite (*Achl*; *ca.* 2760 to 2723 Ma), 2) granite-granodiorite (GG-type) in the La Chevrotière Suite (*Alcv*; *ca.* 2732 to 2723 Ma), 3) mafic to ultramafic rocks (MU-type) in the Lac Calme Suite (*Aclm*), and 4) enderbite-opdalite-charnockite (EOC-type) with associated diatexites, in the MacMahon Suite (*Acmm*; *ca.* 2729 to 2704 Ma), the Qilalugalik Suite (*Aqil*; *ca.* 2709 Ma), the Le Roy Complex (*Aroy*; *ca.* 2698 Ma) and the Lac Minto Suite (*Amin*; *ca.* 2713 to 2682 Ma). These units are intruded by the late Archean (*ca.* 2643 Ma) Lac Tasiat Syenite (*Atst*) and by three sets of Paleoproterozoic dykes: the Klotz gabbro dykes (*pPktz*; *ca.* 2209 Ma), the Payne River diabase dykes (*pPpay*; *ca.* 1875 to 1790 Ma) and the Kogaluc River diabase dykes (*pProg*).

Lithologies in the Lac Anuc area (NTS 34O) underwent three episodes of ductile deformation (D_1 to D_3) and metamorphism, which penetratively transformed plutonic units and volcanic or sedimentary primary structures in supracrustal rocks. Phase of deformation D_1 (*ca.* 2851 to > 2732 Ma) is coeval with the emplacement of volcano-sedimentary units and tonalitic units of TTGG-type suites. Phase of deformation D_2 is also synplutonic and synvolcanic, but controls the emplacement of GG, MU and EOC-type suites (*ca.* 2732 to 2691 Ma). The superposition of D_2 folds (oriented NNW-SSE to N-S) on D_1 folds (oriented E-W to ESE-WNW) produced complex interference patterns essentially preserved within NW-SE-trending corridors characterized by weak aeromagnetic anomalies. Phase of deformation D_2 is responsible for the striated pattern formed by a series of positive aeromagnetic anomalies oriented NNW-SSE to N-S. Phase of deformation D_3 is late (2693 to 2675 Ma), and resulted in the formation of NW-SE to NNW-SSE-trending shear zones. Three phases of brittle-ductile deformation (D_4 to D_6) followed these ductile episodes. Phase of deformation D_4 resulted in the formation of E-W-trending shear zones, one of which (the Tasiat-Pavy deformation zone) hosts the Lac Tasiat Syenite (*ca.* 2643 Ma). Two different sets of lineaments oriented WNW-ESE (D_5) and NW-SE (D_6) outline brittle-ductile type structures that respectively channelled the emplacement of the Klotz (*pPktz*; *ca.* 2209 Ma) and Payne River (*pPpay*; *ca.* 1875-1790 Ma) dyke swarms.

The economic potential of the area is outlined by the presence of four types of mineralization: 1) volcanogenic Zn-Cu occurrences, 2) Cu-Au±Ag occurrences in synvolcanic glomeroporphyritic anorthosites, 3) gold-bearing iron formations, and 4) Au-Ag-Cu occurrences in shear zones (associated with phase of deformation D_3). These occurrences form 18 showings, all hosted in volcano-sedimentary units of the Qalluviartuuq-Payne (*Aqlp*), Mézard (*Amez*) and Le Roy (*Aroy*) complexes.

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INTRODUCTION

Objectives

Mapping of the Lac Anuc area (NTS 34O) was conducted within the scope of the geological mapping program launched by the Ministère des Ressources naturelles du Québec in 1998 in Québec's Far North (north of the 55th parallel). The purpose of the Far North Program is to build a regional geological framework at 1:250,000 scale, in order to open to mineral exploration a vast (> 350,000 km^2) yet geologically little-known territory. The area covered by this survey is located along the extension of areas previously mapped by Madore *et al.* (2004) to the north (NTS 35B), Cadieux *et al.* (2003) to the east (NTS 34P), and by Parent *et al.* (2003) (NTS 34J) to the south (Figure 1).

This report contains the results and interpretations derived from a geological survey carried out in the summer 2001. The objectives of the Lac Anuc project are to increase the geological knowledge of the area, define its lithostratigraphic

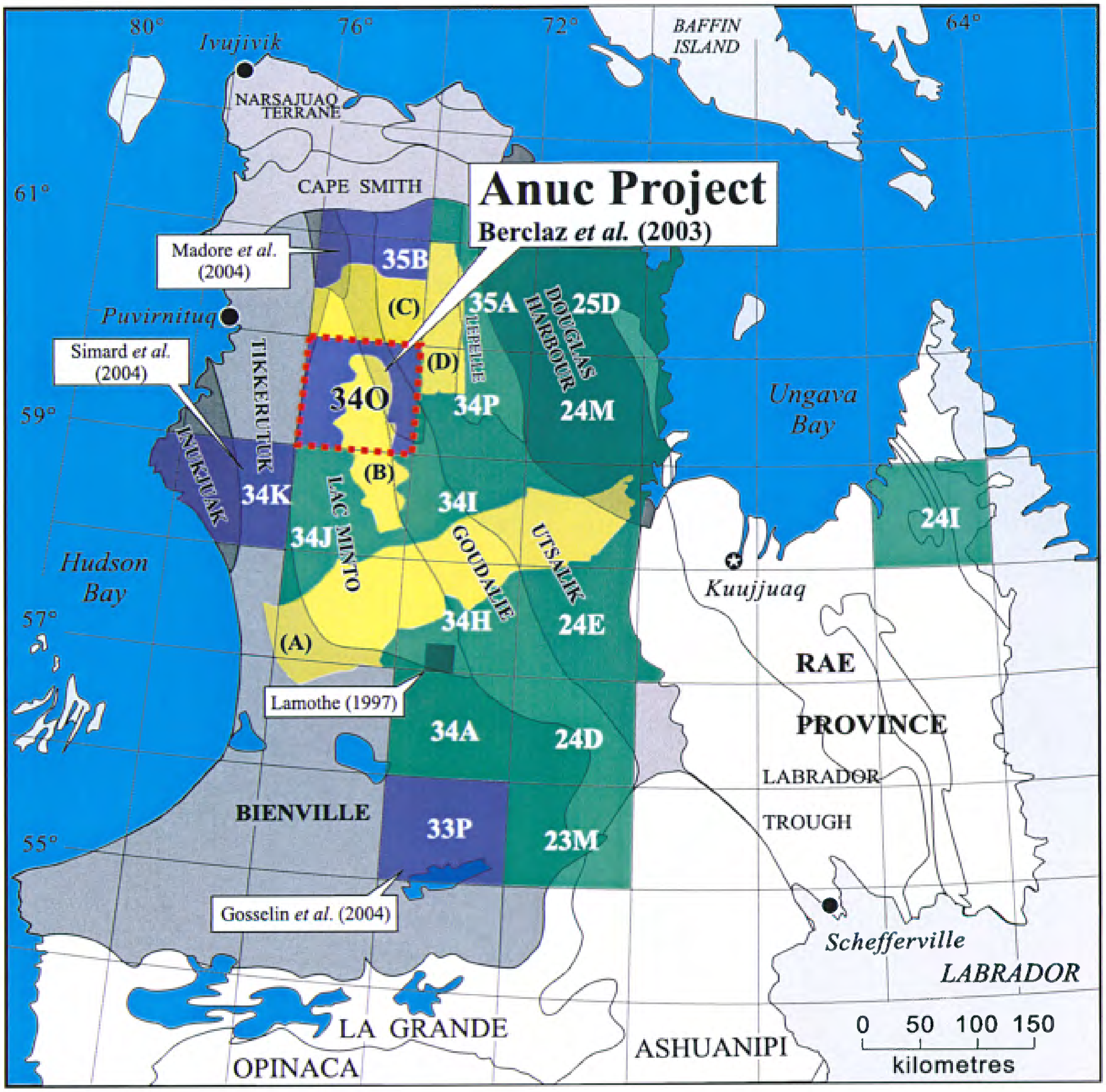

FIGURE 1 - Location map for the Lac Anuc project (NTS 34O). Mapping projects carried out by the MRN in Québec's Far North during the summer 2001 are shown in blue. Areas in green were mapped during the 1998, 1999 and 2000 field seasons by the MRN: 23M - Gosselin and Simard (2001); 24D - Simard *et al.* (2002); 34A - Gosselin *et al.* (2002); 24E - Berclaz *et al.* (2002); 24I - Verpaelst *et al.* (2001); 24M - Madore *et al.* (2000); 25D - Madore and Larbi (2001); 34H - Parent *et al.* (2001); 34I - Leclair *et al.* (2002a); 34J - Parent *et al.* (2003); 34P - Cadieux *et al.* (2003); 35A - Madore *et al.* (2002). Areas in yellow were mapped by the Geological Survey of Canada: A - Percival and Card (1994); B - Percival *et al.* (1995a); C - Percival *et al.* (1996a); D - Percival *et al.* (1997a). Lithotectonic subdivisions for the northeastern Superior Province are taken from Percival *et al.* (1997b).

nature and determine the metallogenic setting of the area. It incorporates mapping carried out by Percival *et al.* (1995a) in the central part of the map area, and mineral prospecting carried out by Cominco, SOQUEM and Virginia Gold Mines (see Figure 2).

Location, Access and Topography

The Lac Anuc area (NTS 34O) is located in an isolated part of Québec's Far North, in the heart of Nunavik. It contains Lac Qalluviartuuq in the north, Lac Payne in the east, and Lac Anuc and Lac Tasiat in the southern part of the area (see Figure 3). The centre of the area is located 235 km east-southeast of Puvirnituq, along the eastern coast of Hudson Bay. The study area is bounded by latitudes 59°00' and 60°00'N and by longitudes 74°00' and 76°00'W, and covers a total surface area of about 12,900 km^2 (112 by 115 km). It is accessible by floatplane, by short-airlift aircraft (Twin Otter) or by helicopter. Water bodies in the area are totally free of ice for water landings in early July. For short-airlift aircraft, the Lac Qalluviartuuq landing strip is located in the north-central part of the area (59°41.85'N - 74°52.55'W).

The Lac Anuc area (NTS 34O) lies in the arctic tundra, north of the treeline. Roughly 50% of the area is covered by water bodies. Topographic relief is low to moderate, with altitude variations on the order of less than 200 m. Outcrops are of variable quality and are generally covered with lichen, which gives them a uniform dark colour, making geological observations quite difficult at times. The northeastern part of the map area is mainly composed of fields of erratic boulders; outcrops are nevertheless fairly abundant and variable in size (100 to 1000 m^2). The southeastern part of the area contains vast swamplands where outcrops are scarce (< 1 to 5%) and small (< 25 m^2). The western part of the map area is dominated by zones of "DeGeer moraines" that form a succession of 10-km-wide longitudinal bands oriented E-W, that transect small N-S trending eskers, composed of small "annual moraines" (Michel Parent, 2003; personal communication). Between these bands, outcrops are very abundant and extensive (> 1000 m^2), with continuous exposure over several kilometres.

Methodology

The Lac Anuc area (NTS 34O) field mapping campaign took place over a period of ten weeks. Mapping was carried out by 6 to 8 teams formed of two persons (one geologist and one assistant) who were transported in the field by a Long Ranger 206-L helicopter from the base camp located on an island in Lac Qalluviartuuq (59°42.62'N - 74°56.50'W). The geological survey was performed along traverses ranging from 8 to 12 km long, spaced every 5 km on average. Certain areas were the focus of more detailed work, given their mineral potential; helicopter spot checks were also conducted in several locations in order to complete the mapping coverage. The geological interpretation was made on 1:125,000 scale topographic base maps, using aeromagnetic and remote sensing data, then was later compiled to 1:250,000 scale. The geological map of the Lac Anuc area (NTS 34O) and the data collected in the field (from more than 3,000 locations) were digitized and integrated to the SIGÉOM database of the Ministère des Ressources naturelles du Québec.

During the summer 2001 field campaign, some 1,500 rock samples were collected and systematically sawn; of these, 811 granitoid samples were stained with cobaltinitrite to help determine feldspar and quartz contents. Among the most representative samples, 152 were selected for lithogeochemical analyses, 202 for assays, and 320 were used to prepare thin sections. Analytical results are available in the SIGÉOM database. Six samples were collected for U/Pb geochronology analyses (TIMS and LA-MC-ICP-MS), conducted at the GÉOTOP laboratory, Université du Québec à Montréal.

Previous Work

The first geological survey to cover the Lac Anuc area (NTS 34O) was a 1:1,000,000 scale reconnaissance survey carried out by Stevenson (1968). This survey was based solely on data collected from observation sites spaced every 10 km or so. Later on, Percival *et al.* (1995a and b) mapped at 1:250,000 scale the central part of NTS sheet 34O (figures 1 and 2).

Several prospecting and exploration programs were carried out in the 1990s, on properties successively and jointly held by Cominco, SOQUEM and Virginia Gold Mines (Figure 2; Cattalani and Heidema, 1993; Lum, 1993; Grosl, 1993; Poirier, 1994; Chapdelaine and Poirier, 1996; Cuerrier, 1998; Chapdelaine, 1999; Francoeur and Chapdelaine, 1999; Cuerrier, 1999). These surveys were carried out at different scales (1:50,000 to 1:1000) and led to the discovery of several showings in a variety of geological settings (see section entitled "Economic Geology").

Within the scope of the Far North Program, the Lac Anuc area (NTS 34O) was covered by a lake sediment geochemistry survey (MRN, 1998) carried out by SIAL in the summer 1997. During this geochemical survey funded by the MRN and five industry partners, samples were collected along a 3.5-km grid spacing on average. The results outline several anomalies likely to become exploration targets (see Figure 13).

From 1998 on, *Géologie Québec* has carried out four geological mapping projects per year (Figure 1). In 1998, three projects were completed in the northeastern Superior Province (Madore *et al.*, 2000; Gosselin and Simard, 2001; Parent *et al.*, 2001) and one project (Verpaelst *et al.*, 2001) in the Rae Province (as defined by Hoffman, 1988 and 1989). In 1999 and 2000, eight additional projects were carried out in the northeastern Superior Province (Madore and Larbi,

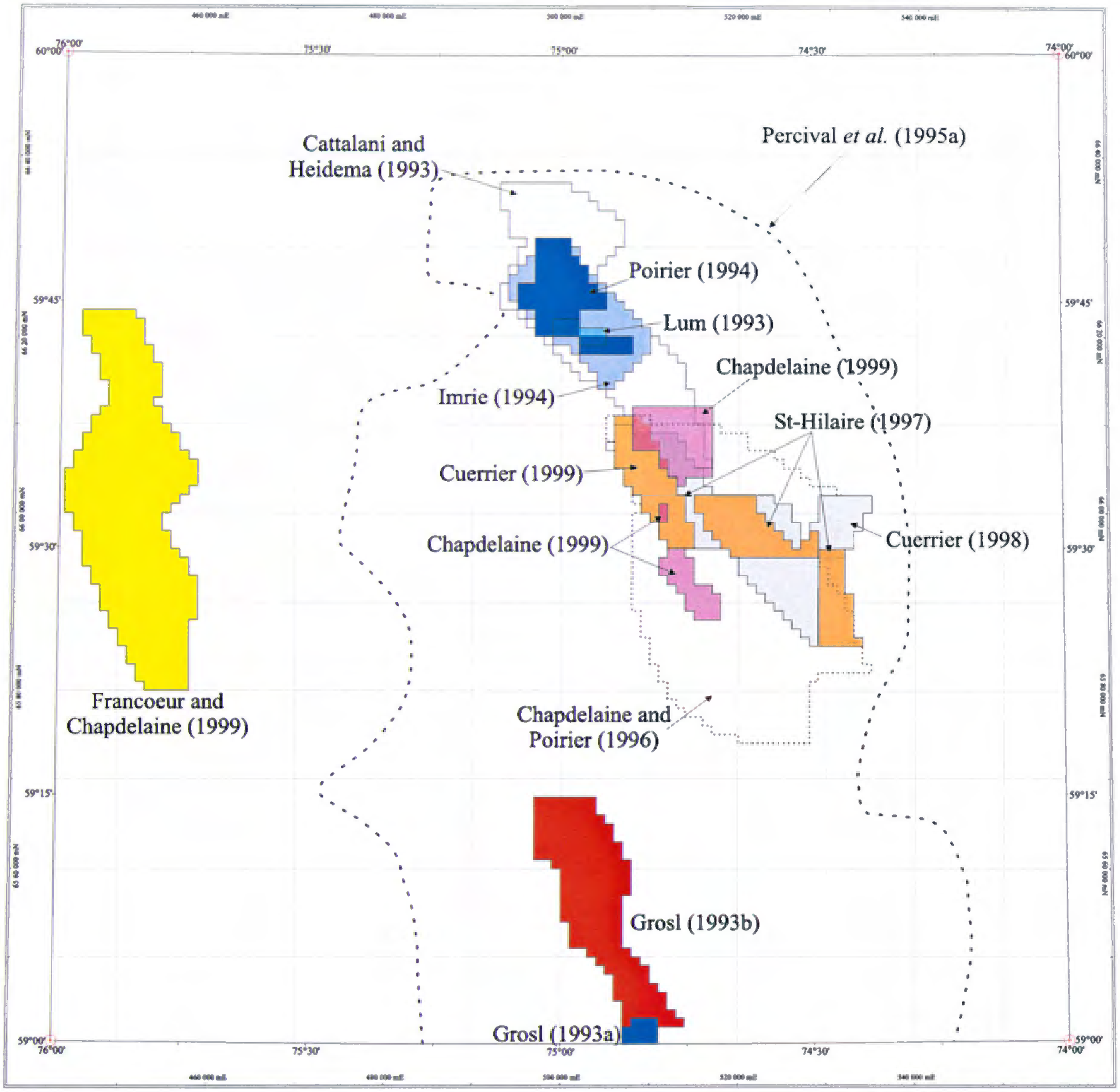

FIGURE 2 - Location of previous work (GM series) carried out in the Lac Anuc area (NTS 34O). Grosl (1993a): GM 52252; Grosl (1993b): GM 52253; Cattalani and Heidema (1993): GM 52254; Lum (1993): GM 55063; Imrie (1994): GM 52793; Poirier (1994): GM 52818; Chapdelaine and Poirier (1996): GM 54571; St-Hilaire (1997): GM 55884; Cuerrier (1998): GM 55885; Cuerrier (1999): GM 58011; Francoeur and Chapdelaine (1999): GM 56437; Chapdelaine (1999): GM 56553.

2001; Berclaz *et al.*, 2002; Gosselin *et al.*, 2002; Leclair *et al.*, 2002; Madore *et al.*, 2002; Simard *et al.*, 2002; Parent *et al.*, 2003; Cadieux *et al.*, 2003).

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REGIONAL GEOLOGY

The Lac Anuc area (NTS 34O) is located in the northeastern part of the Superior Province, formerly known as the "Minto Subprovince" (Card and Ciesielski, 1986), then as the "Minto Block" (Percival *et al.*, 1992). This part of the Archean craton in the Superior Province was initially described as being primarily composed of high-grade (granulitic) granitoid rocks, characterized by a prominent NW-SE structural grain and strongly positive magnetic anomalies (Stevenson, 1968; Percival *et al.*, 1992; Card and Poulsen, 1998).

Mapping conducted since the 1990s in this part of the Superior Province has outlined a series of Neoarchean plutonic assemblages and volcano-sedimentary sequences, with relics of Mesoarchean tonalitic and volcanic rocks. This area was initially subdivided into several domains based on lithological, structural and aeromagnetic criteria (Percival *et al.*, 1997b; Figure 1). The Tikkerutuk, Lac Minto, Goudalie and Utsalik lithotectonic domains were defined based on a transect along the Rivière aux Feuilles (Percival *et al.*, 1991 and 1992; Percival and Card, 1994); the Inukjuak, Philpot, Qalluviartuuq, Lepelle and Douglas Harbour domains were later added to the lot (Percival *et al.*, 1995a, b, 1996a, b, 1997a, b). These authors describe the different domains as the result of the juxtaposition of an amalgamation of lithotectonic domains of various origins and ages, in sharp contrast with the make-up of the southern part of the Superior Province (Percival *et al.*, 1992; Stern *et al.*, 1994; Percival and Skulski, 2000). Plutonic assemblages, characterized by vast negative and positive aeromagnetic anomalies, are essentially composed of tonalite, granodiorite, diatexite and granite, with enclaves and intrusions of diorite, gabbro, pyroxenite and peridotite. Volcano-sedimentary sequences are primarily enclosed in tonalites characterized by a negative aeromagnetic gradient. They occur as narrow (1-5 km wide) troughs, more or less continuous over distances reaching 150 km in length, and are mainly composed of basalt, pelite, greywacke, iron formation, with minor amounts of andesite, rhyodacite, dacite, rhyolite, sandstone, conglomerate and ultramafic rocks. These units are generally metamorphosed to the upper amphibolite and the granulite facies.

The tectonomagmatic and metamorphic evolution of the Archean craton in the northeastern Superior Province (north of the 55th parallel) took place over a time frame from > 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.*, 2000 and 2002; Gosselin and Simard, 2001; Parent *et al.*, 2001 and 2003; Madore and Larbi, 2001; Berclaz *et al.*, 2002; Gosselin *et al.*, 2002; Leclair *et al.*, 2002a; Simard *et al.*, 2002; Cadieux *et al.*, 2003; David, 2002). This succession of tectonomagmatic events is as follows (Leclair *et al.*, 2002a, 2001, 2002b; Percival *et al.*, 2001):

(i) The earliest recognizable elements are the remains of a Mesoarchean protocraton (*ca.* > 3.1-2.9 Ga) essentially identified by inherited zircon cores and by rare enclaves of tonalitic gneiss.

(ii) From *ca.* 2.89 to 2.74 Ga, tonalites-trondhjemites and volcanic rocks are emplaced in a series of magmatic pulses. During this time, a first phase of deformation (D_1) and metamorphism (M_1) is recorded between > 2.851 and > 2.732 Ga (this report). Between *ca.* 2.79 and 2.745 Ga, plutonic activity appears to take place in a diachronous fashion, from the northeast towards the southeast of the area, and volcanism evolves from a tholeiitic to a calc-alkaline affinity. The end of this period (*ca.* 2.76-2.74 Ga) is marked by the emplacement of discrete syenite plutons (associated with carbonatites?) as well as volcano-sedimentary rocks which may be related to a phase of rifting atop a continental platform.

(iii) The time span from *ca.* 2.732 to 2.715 Ga is marked by the onset of potassic magmatism, with the emplacement of granite-granodiorite-diatexite plutons. These units characterize a major episode of intracrustal melting and the onset of a second phase of deformation (D_2) and metamorphism (M_2) (Cadieux *et al.*, 2003).

(iv) Concurrently, essentially enderbitic-opdalitic-charnockitic magmatism, until then (at *ca.* 2.74-2.73 Ga) apparently restricted to the northeastern part of the area, where it formed voluminous granulitic complexes, also appears to have spread to the entire area between *ca.* 2.73 and 2.69 Ga. This syntectonic magmatic episode (D_2; this report) is interpreted as being responsible for granulite-grade metamorphism (M_2) recorded in the different volcano-sedimentary complexes.

(v) From *ca.* 2.69 to 2.675 Ga, the area witnessed considerable recycling of early lithologies. This period is marked by the emplacement of voluminous bodies of monzonite, granite to granodiorite, diatexite and pegmatite, accompanied by a major tectonic readjustment (D_3) and a metamorphic episode (M_3) at the upper amphibolite facies.

(vi) Then, between 2.68 and 2.62 Ga, important hydrothermal activity was channelled along dominantly brittle faults (D_4 to D_6), and the occurrence of late anorogenic magmatism is shown by the presence of alkaline intrusions of carbonatite and nepheline syenite alkaline intrusions (*ca.* 2.66 to 2.64 Ga; Skulski *et al.*, 1997), several subalkaline diabase and gabbro dyke swarms (*ca.* 2.51 to 1.875 Ga; Buchan *et al.*, 1998), as well as a Paleoproterozoic alkaline complex (*ca.* 1.94 Ga; David, in preparation), composed of carbonatite, ultramafic to mafic lamprophyre and ultramafic kimberlite dykes (Berclaz *et al.*, 2002; Lemieux *et al.*, 2001).

(vii) Finally, complex Trans-Hudsonian deformation (D_7) is recorded west of the Labrador Trough (Berclaz *et al.*, 2002), northeast of the Douglas Harbour domain (Madore and Larbi, 2001), and south of the Ungava Orogen (Lucas, 1989; St-Onge and Lucas, 1990; Goulet, 2001).

STRATIGRAPHY

The Lac Anuc area (NTS 34O) consists of Archean and Paleoproterozoic rocks that were subdivided into lithodemes and lithostratigraphic units, grouped into complexes and suites (Figure 3 and SIGÉOM map). The stratigraphic sequence shown here was defined based on cross-cutting relationships observed in the field, as well as new U/Pb age dating results obtained from six samples collected in NTS sheet 34O (Table 1) and in adjacent areas (David, 2002). These results are combined with geochronology data taken from Percival *et al.* (1995 and 2001).

Volcano-Sedimentary Complexes

In the survey area, bands of mafic volcanic rocks (basalt, amphibolite, mafic gneiss), intermediate (andesite) to felsic (rhyodacite, dacite) volcanic rocks and metasedimentary rocks (paragneiss, iron formation, conglomerate) form volcano-sedimentary belts enclosed in various granitoid suites and complexes. Since all volcano-sedimentary rocks in the area are metamorphosed, the prefix "meta" is omitted for the purpose of conciseness. The belts are composite and reach several kilometres in size. Elsewhere, volcano-sedimentary sequences are reduced to lenticular enclaves ranging from 100 m in size down to cm-scale, hosted in granitoids. Belts in the Lac Anuc area (NTS 34O) are grouped into three volcano-sedimentary complexes: the Qalluviartuuq-Payne Complex (*Aqlp*), the Kogaluc Complex (*Akog*) and the Mézard Complex (*Amez*) (Figure 3).

Qalluviartuuq-Payne Complex (*Aqlp*)

The Qalluviartuuq-Payne Complex (*Aqlp*) is introduced herein to designate all volcano-sedimentary rocks included in the Qalluviartuuq and Payne belts, which were described by Percival *et al.* (1995a and b), Winski *et al.* (1995), and Percival and Skulski (2000). This complex extends from the northern part of Lac Qalluviartuuq southward to Lac Pavy and into the northeastern part of the Lac Vernon area (NTS 34J), for a total extension of > 150 km in length by < 30 km in width. Based on observed relationships between several stratigraphic horizons that locally contain very well-preserved primary structures, on the different geochemical signatures recorded, on the metamorphic assemblages developed and the different phases of deformation that affect the Qalluviartuuq-Payne Complex, the tectono-stratigraphic setting of the complex appears to be characterized by at least two volcano-sedimentary cycles and several phases of deformation. Stratigraphic units associated with the two cycles are common and nearly continuous from the Lac Qalluviartuuq area to the northern part of Lac Pavy. This indicates that units associated with the Qalluviartuuq and Payne belts as defined by Percival *et al.* (1995) need not be dissociated, but in fact represent a single belt – the Qalluviartuuq-Payne belt – referred to herein as the Qalluviartuuq-Payne Complex (*Aqlp*).

To the north, in the Lac Qalluviartuuq area, this complex forms a structural pattern composed of four folded limbs (< 2 km thick) essentially composed of volcanic rocks. From the south of Lac Le Breuil to the southwest of Lac Payne, the complex widens and forms a NNW-SSE-trending band (< 8 km thick) dominated by migmatized paragneisses, from which a folded limb (< 3 km thick) oriented N-S and essentially composed of volcanic rocks branches out. South of Lac Pavy and in the Lac Vernon area (NTS 34J), the complex consists of a series of bands (< 3.5 km thick) composed of paragneisses and volcanic rocks.

To the north, east and partly to the south, volcano-sedimentary units of the Qalluviartuuq-Payne Complex are enclosed in tonalitic (*Arot*: Rochefort Suite) or granitic (*Alcv*: La Chevrotière Suite) intrusive rocks and are metamorphosed to the middle to upper amphibolite facies. To the west and south, these volcano-sedimentary units are in contact with enderbitic to charnockitic rocks (*Acmm* and *Amin*: MacMahon and Lac Minto suites) and are metamorphosed to the granulite facies.

Metavolcanic Rocks (Aqlp1)

Volcanic rocks of the Qalluviartuuq-Payne Complex are dominated by a basaltic unit (*Aqlp1*) interdigitated with three sub-units of intermediate to felsic volcanic rocks (*Aqlp1a*, not mappable at the scale of the SIGÉOM map),

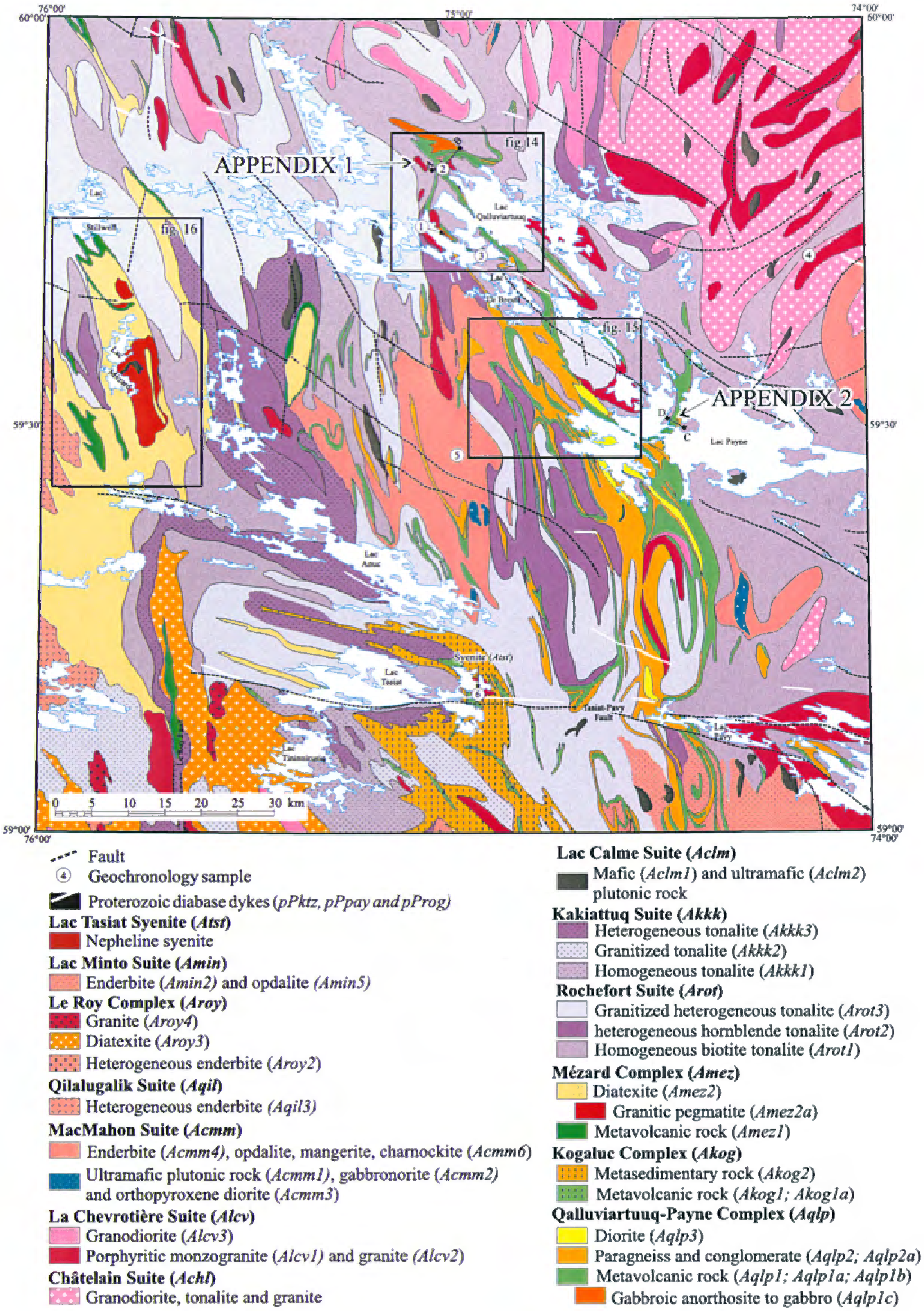

FIGURE 3 - Simplified geological map of the Lac Anuc area (NTS 34O). Cross-sections A-B and C-D correspond to stratigraphic sections shown in Appendix 1 and 2.

ultramafic volcanic rocks (*Aqlp1b*), and plutonic rocks composed of gabbroic anorthosite or gabbro (*Aqlp1c*) and diorite (*Aqlp3*). All these units form two volcanic cycles (see Appendix 1 and 2). Garnet-anthophyllite-cordierite alteration zones are commonly associated with these units.

Volcanic Cycle 1 (tholeiitic)

Volcanic cycle 1 comprises mafic volcanic rocks (*Aqlp1*), ultramafic volcanic rocks (*Aqlp1b*), gabbroic anorthosite or gabbro (*Aqlp1c*) and diorite (*Aqlp3*).

Mafic volcanic rocks (*Aqlp1*) form homogeneous horizons of massive amphibolite, or heterogeneous horizons of foliated to banded and locally strongly migmatized mafic gneiss. Units in volcanic cycle 1 are metamorphosed to the middle to upper amphibolite facies and are strongly transposed, to the point where preserved primary structures such as pillows are locally transformed into mere mafic rims (Photo 1, Appendix 1). Massive horizons are dark green, fine to medium-grained and exhibit a weak to nil magnetic susceptibility. They are mainly composed of olive green to brownish green hornblende and plagioclase, locally accompanied by clinopyroxene, biotite and cummingtonite. In certain locations, garnet overprints the tectonic fabric along mylonitic shear zones. A detailed description of the mineralogy and textures of these supracrustal rocks is provided in the section entitled "Metamorphism".

Ultramafic volcanic rocks (*Aqlp1b*) of the Qalluviartuuq-Payne Complex are dark green to black in fresh surface, with a buff brown weathered surface and a clearly metamorphic medium-grained texture. Their extrusive origin is confirmed by their komatiitic geochemical signature (see section entitled "Lithogeochemistry") and their spatial association with mafic lavas and paragneisses. In these ultramafic rocks, olivine and orthopyroxene are predominant, and a pale green amphibole is preferentially developed around orthopyroxene grains. The foliation is locally well defined by iddingsite alteration zones and trains of fine-grained spinel. In strongly deformed rocks, serpentine and magnetite are abundant. Minor amounts of lepidoblastic phlogopite and chlorite as well as sulphides complete the mineral assemblage.

Units of equigranular to glomeroporphyritic gabbroic anorthosite and gabbro (*Aqlp1c*) occur intercalated at the base and within volcanic rock units. These plutonic units are predominant in the Lac Qalluviartuuq area. In the Lac Payne area, Percival *et al.* (1995b) reported the presence of thin discontinuous units of oikocrystic pyroxenite, anorthositic gabbro intrusions, magnetite-rich peridotite and ferrogabbro associated with these glomerophyric gabbros. These lithologies exhibit igneous layering (Photo 6, Appendix 1). In glomeroporphyritic gabbroic anorthosites and gabbros, plagioclase megacrysts are associated with interstitial orthopyroxene oikocrysts, which give the rock a "leopard-skin" texture. Interstitial biotite flakes, magnetite and zircon complete the mineral assemblage. A sample of megaphyric gabbroic anorthosite was collected to the north of Lac Qalluviartuuq [#01-AB-067; UTM (NAD83): 499073E, 6621909N; sample #1 in Figure 3; Table 1]; it yielded an age of crystallization of 2851.2 ± 4.2 Ma (David, in preparation). This age suggests unit Aqlp1c is the oldest in the Lac Anuc area (NTS 34O).

Areas to the south of Lac Le Breuil and to the west of Lac Payne contain dioritic rocks (*Aqlp3*) that form bands (< 2 km thick) intercalated between mafic volcanic rocks and paragneisses. These bands either represent synvolcanic sills or amphibolite-grade andesites. They are fine to medium-grained. Plagioclase and quartz form a groundmass of granoblastic and more rarely porphyroclastic grains. The foliation is defined by green nematoblastic hornblende and yellow to green lepidoblastic biotite. Epidote grains with allanite cores superimpose both phases. Green tourmaline completes the mineral assemblage.

Volcanic Cycle 2 (calc-alkaline)

Volcanic cycle 2 comprises mafic volcanic rocks (*Aqlp1*) and intermediate to felsic rocks (*Aqlp1a*).

In contrast with volcanic cycle 1, formed of strongly recrystallized upper amphibolite-grade mafic to intermediate rocks, volcanic cycle 2 is formed of less deformed mafic to felsic rocks recrystallized and metamorphosed to the greenschist facies, in which volcanic textures and structures are remarkably well preserved. This second volcanic cycle is also observed from the area north of Lac Qalluviartuuq southward to Lac Payne, and shows a stratigraphic younging direction towards the northeast.

In the Lac Qalluviartuuq area (Appendix 1), volcanic cycle 2 is composed of (from the base upwards): *(i)* mafic pillow lavas, locally amygdaloidal (Photo 2, Appendix 1), overlain by an epidote-rich mafic pillow breccia, overlain in turn by massive mafic lavas with local aggregates of glomeroporphyritic plagioclase crystals at the base, by mafic lapilli or block tuffs and crystal tuffs (Photo 3, Appendix 1); *(ii)* a sedimentary unit composed of sandstone and minor amounts of aluminous paragneiss (metapelites), topped by a felsic volcanic tuff, overlain by an epiclastic sequence formed of rounded to flattened blocks of tonalite and amphibolite; *(iii)* argillaceous sandstone beds (> 60 cm thick) overlain by a polymictic conglomerate (Photo 4, Appendix 1) formed of rounded tonalite and amphibolite (metabasalt) blocks, in intrusive contact with a biotite tonalite unit of the Rochefort Suite (*Arot1*; Photo 5, Appendix 1); *(iv)* all the supracrustal units are cut by a dolerite dyke swarm (< 1 m thick) oriented subparallel to the regional NNW-SSE foliation.

In the area west of Lac Payne (Appendix 2), volcanic cycle 2 is composed of (from the base upwards): *(i)* massive to banded and coarse to medium-grained mafic lavas; *(ii)* a volcaniclastic sequence including mafic lapilli-block tuffs (Photo 5, Appendix 2), with graded bedding and occasional channels (where the mafic groundmass contains more felsic cm-scale stretched and flattened blocks), mafic tuffs with a few felsic lapilli, mafic to intermediate laminated tuffs, mafic garnet-bearing tuffs, mafic tuffs with plagioclase crystals (Photo 4, Appendix 2) and heterogeneous felsic tuffs, locally garnet-bearing; *(iii)* mafic pillow lavas (Photo 3, Appendix 2); *(iv)* oxide and sulphide-facies banded iron formation horizons from 30 cm to 10 m thick (Photo 2, Appendix 2) intercalated with pillowed or massive mafic lavas; *(v)* polymictic conglomerate (Photo 1, Appendix 2) overlain by fine-grained and thinly laminated sandy to semi-pelitic metasedimentary rocks with chert and quartzite beds; *(vi)* all these supracrustal units are also cut by dolerite dykes (< 1 m thick). These dykes are characterized by very fine-grained granoblastic plagioclase crystals, green granoblastic to nematoblastic hornblende and rare green to brownish lepidoblastic biotite. Recrystallized glomeroporphyritic plagioclase aggregates represent former magmatic porphyritic crystals.

Paragneiss (Aqlp2) and Conglomerate (Aqlp2a)

Sedimentary rocks of the Qalluviartuuq-Payne Complex (*Aqlp2*) are dominated by quartzofeldspathic paragneisses accompanied by psammites, sandstones, iron formations and conglomerates. The more aluminous layers exhibit a wide variety of mineral assemblages, with garnet + biotite ± aluminosilicates (sillimanite, cordierite, staurolite, andalusite, kyanite), which indicate metamorphic conditions ranging from the lower to the upper amphibolite facies (see section entitled "Metamorphism"). These rocks are exposed in m-scale to km-scale bands reaching more than 80 km in length. They are generally intimately associated with volcanic rocks and iron formations. Grey-brown to rusty brown paragneisses are either leucocratic to mesocratic, heterogeneous and medium or coarse-grained (pelites), or melanocratic, homogeneous and fine-grained (psammites). They are weakly to moderately migmatized, with < 50% felsic mobilizate. The non-migmatized protolith consists of variable proportions of quartz, plagioclase, biotite, garnet, muscovite and aluminosilicates. Very fine-grained disseminated magnetite occurs in many places.

The paragneisses are locally intercalated with iron formation horizons from 1 to < 40 m thick, occasionally associated with volcanic rock units. Banded iron formation horizons are commonly dismembered and folded; oxide-facies rocks are more common, although silicate-facies rocks are also observed in certain locations. In thin section, these rocks are foliated, granoblastic and occasionally exhibit tectonic banding modified from primary bedding. *Oxide-facies* iron formations are composed of mm-scale to cm-scale bands of magnetite (± amphibole) and recrystallized quartz. *Silicate-facies* iron formations are very siliceous and contain little magnetite. They are characterized by their less continuous banding consisting of cm-scale felsic and mafic horizons, as well as by the presence of hornblende and/or grunerite porphyroblasts (< 2 cm). Felsic horizons are mainly composed of quartz and feldspar, whereas mafic horizons contain variable amounts of garnet, biotite, cordierite, sillimanite, hornblende and grunerite. Cordierite and garnet are often poikilitic. The section entitled "Economic Geology" deals with gold occurrences associated with these iron formations.

Polymictic conglomerates (*Aqlp2a*) form graded sequences (about 10 m thick on average) at the interface between intrusive tonalitic units and volcano-sedimentary sequences. The conglomerate is generally coarse-grained, monomictic and supported by lenticular tonalite blocks (< 1 m diameter); finer-grained conglomerates are polymictic and supported by a sandy matrix with clasts (< 25 cm diameter) of tonalite, mafic to intermediate volcanic rock, dark grey to pinkish white quartzite, black chert and pyroxenite. Clasts are highly stretched to form subvertical pencil structures (L-tectonites). We suggest that: 1) coarse monomictic conglomerates represent intraformational cover sequences within the Qalluviartuuq-Payne Complex (Percival *et al.*, 1997b), similar to Timiskaming-type collapse sequences in the southern Superior Province, rather than a major Archean unconformity in the northeastern Superior Province, as suggested by Winski *et al.* (1995); and 2) that finer-grained polymictic conglomerates are the result of an intraformational and tectonic (syn-D_1) mélange between volcano-sedimentary sequences, gabbros and synvolcanic tonalites.

Kogaluc Complex (*Akog*)

The Kogaluc Complex (*Akog*) was defined south of our map area, in the Lac Vernon area (NTS 34J) by Parent *et al.* (2003). It corresponds to the Kogaluc-Tasiat belt discovered by Percival *et al.* (1995a and b). This complex is formed of a series of discontinuous volcano-sedimentary bands (1 to 8 km in width) outcropping along a NNW-SSE-trending axis roughly 150 km long by < 15 km wide, which corresponds to a negative aeromagnetic signature (Domain 5, Figure 4). Units in this belt may be traced from the northern part of Lac Tasiat (NTS 34O), where they trend WNW-ESE, to the southeastern part of the Lac Vernon area (NTS 34J; Grosl, 1993; Francoeur and Chapdelaine, 1994; Percival *et al.*, 1995a; Parent *et al.*, 2003) (Figure 3).

The northern part of the Kogaluc Complex is largely dominated by metasedimentary rocks (*Akog2*), whereas further south, volcanic rocks (*Akog1* and *Akog1a*) are more abundant (Parent *et al.*, 2003). Similar to the Qalluviartuuq-Payne Complex, the emplacement of units of the Kogaluc Complex probably reflects a succession of volcano-sedimentary cycles. These units are enclosed in tonalites of the Rochefort Suite (*Arot*) to the east, tonalites of the Kakiattuq Suite (*Akkk*) to the west, and are truncated by the Tasiat-Pavy fault to the north (see Figure 6).

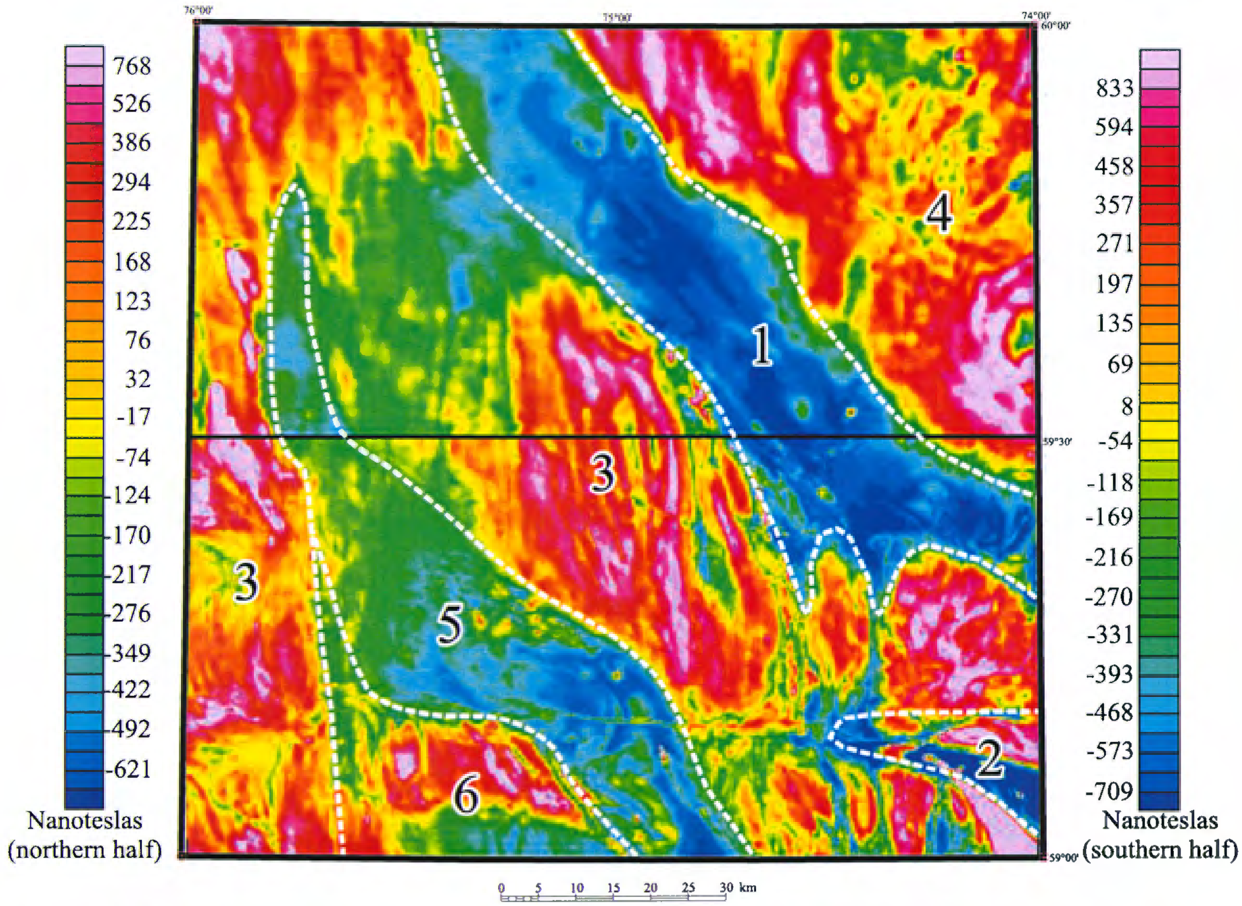

FIGURE 4 - Map showing the total residual magnetic field for the Lac Anuc area (NTS 34O). Aeromagnetic data taken from Dion and Lefebvre (2000) for the northern half of the map, and from Natural Resources Canada - Ministère des Ressources naturelles du Québec (2001) for the southern half. Subdivisions 1 to 6 refer to structural domains shown in Figure 6.

Metavolcanic Rocks (Akog1)

In the Lac Tasiat area, undifferentiated volcanic rocks of the Kogaluc Complex (*Akog1*) form discontinuous m-scale to km-scale (< 2 km) thick bands interbedded with paragneisses. They are dominated by dark green, fine to medium-grained basaltic rocks that are foliated and sheared, associated with rare intermediate to felsic horizons (*Akog1a*). Similar to mafic rocks in volcanic cycle 1 of the Qalluviartuuq-Payne Complex (*Aqlp1*), primary structures in volcanic rocks are rarely preserved. The basaltic rocks are generally strongly recrystallized and exhibit a homogeneous granoblastic or nematoblastic texture. They are mainly composed of green stubby hornblende crystals, plagioclase, and minor proportions of opaque minerals, epidote and trace amounts of cummingtonite. However, plagioclase-phyric andesites, relics of pillowed basalts and andesites – possibly equivalent to rocks in volcanic cycle 2 of the Qalluviartuuq-Payne Complex – and gabbroic textures are well preserved in the southern part of the complex (Grosl, 1993; Francoeur and Chapdelaine, 1994; Percival *et al.*, 1995a and b).

Very few occurrences of intermediate to felsic rocks (*Akog1a*) were mapped in the Lac Anuc area (NTS 34O) during the summer 2001; they are restricted to very rare m-scale layers associated with mafic rocks. Percival *et al.* (1995) did observe however, southward in the Lac Vernon area (NTS 34J), units of rhyolite, rhyolitic tuff and rhyolitic quartz-eye tuff. A rhyolite sample yielded a maximum age of 2759±1 Ma (Skulski *et al.*, 1996).

Metasedimentary Rocks (Akog2)

The northern part of the Kogaluc Complex (*Akog*) is dominated by sedimentary rocks (> 80%) consisting of biotite paragneiss, iron formation, sandstone, siltstone, quartzite, argillite, and rare conglomerate (Grosl, 1993a and b; Percival *et al.*, 1995b; Parent *et al.*, 2003). Primary structures such as laminations, cross-bedding and graded bedding are locally preserved in less deformed horizons (Parent *et al.*, 2003). The most common lithology consists of *migmatized* (locally > 50% felsic mobilizate) *aluminous paragneiss (metapelites)*, with compositional banding marked by alternating mica-rich and garnet-rich bands. These rocks are rusty brown to grey, and composed of quartz + plagioclase + biotite ± muscovite ± aluminosilicates. Accessory minerals include apatite, carbonate, chlorite, graphite, magnetite, monazite, tourmaline, zircon and rutile.

Both oxide and silicate-facies *iron formations* occur in the Kogaluc Complex; both exhibit granoblastic textures. Oxide-facies iron formations are more abundant; they can be traced over several kilometres along strike, ranging from 10 to 15 metres in width (Parent *et al.*, 2003). They consist of mm-scale to cm-scale bands of quartz and magnetite where well-preserved, and of massive magnetite horizons from 1 to 10 cm thick where strongly migmatized. Silicate-facies iron formations consist of dismembered discontinuous horizons, from 10 cm to 1 m thick and from 1 to 10 m long. Silicate-facies rocks, dark grey-green in fresh surface and rusty brown in weathered surface, show alternating cm-scale bands composed with variable proportions of garnet, quartz, biotite, cordierite, sillimanite and grunerite.

Mézard Complex (*Amez*)

The Mézard Complex (*Amez*) is introduced here to define volcano-sedimentary units oriented NNW-SSE encountered in the western part of the Lac Anuc map sheet (NTS 34O) (Figure 2), and initially discovered by Francoeur and Chapdelaine (1999). Units of the Mézard Complex are enclosed by heterogeneous enderbites of the Qilalugalik Suite (*Aqil3*) to the west, by tonalites of the Kakiattuq Suite (*Akkk*) to the south, and by tonalites of the Rochefort Suite (*Arot*) to the east and north. As opposed to rocks of the Qalluviartuuq-Payne and Kogaluc complexes, rocks of the Mézard Complex are mainly found in zones with a moderate to strong magnetic intensity (Zone 3, Figure 4). Intense linear anomalies correspond to thick sequences of banded iron formation (*e.g.* 59°30'). Furthermore, these rocks have undergone moderate to intense partial melting (presence of > 50% felsic mobilizate), as indicated by the abundance of sedimentary-derived diatexite.

Metavolcanic Rocks (Amez1)

Volcanic units of the Mézard Complex (*Amez1*) form elongate bands (< 2 km thick) mainly composed of mafic rocks, with m-scale felsic volcanic horizons intercalated locally.

On the scale of the outcrop, mafic volcanic rocks of the Mézard Complex are differentiated from those of the Qalluviartuuq-Payne and Kogaluc complexes by the presence of low to moderate proportions of felsic anatectic veins, which are locally orthopyroxene-bearing. In the host rock, the foliation is defined by olive green to brownish green nematoblastic hornblende, or locally, by orange brown lepidoblastic biotite, and in a few locations, by coarse-grained clinopyroxene crystals. Plagioclase is granoblastic and is commonly altered to sericite and clinozoisite. The remaining accessory minerals consist of disseminated opaque minerals, apatite, quartz, epidote and zircon.

Felsic rhyodacite horizons are equigranular, fine-grained, completely recrystallized and mainly composed of a granoblastic assemblage of quartz-plagioclase-microcline. Evidence of deformation lies in the foliation defined by orange brown biotite, and by minor proportions of dark green to brown tourmaline. Locally, the fabric becomes mylonitic, and mainly affects quartz grains. Randomly oriented muscovite grains are common, whereas apatite, carbonate, epidote, sphene and zircon complete the mineral assemblage.

Biotite-Garnet Diatexite (Amez2) and Granitic Pegmatite (Amez2a)

Sedimentary rocks of the Mézard Complex underwent considerable partial melting, as indicated by the presence of < 80% trondhjemitic to granodioritic mobilizate (diatexites; Photo 1, Appendix 3). Biotite-garnet diatexites (*Amez2*) are heterogranular and medium to very coarse-grained. The neosome forms leucocratic injections (leucosome) that isolate fine to medium-grained melanocratic paragneiss enclaves (melanosome). These enclaves, 1 to 10 cm in size, are stretched parallel to the foliation. Magmatic flow structures result in a wavy foliation. The protolith (mesosome) of these diatexites consists of banded rusty brown (pelites) to grey (psammites) layers. These horizonscontain variable proportions of granoblastic quartz and plagioclase, as well as a variety of aluminosilicates that display different textures (see section entitled "Metamorphism" for a detailed mineralogical description).

Iron formations (*Amez2*) constitute a relatively refractory protolith in diatexites, and form strongly positive magnetic anomalies (Figure 4). These iron formation horizons are 1 to 10 m thick on average, reaching up to 50 m in fold hinges (Francoeur and Chapdelaine, 1999). *Oxide-facies* iron formations are predominant, and consist of mm-scale to cm-scale laminations of quartz and magnetite. *Sulphide-facies* rocks are much less common but locally host gold occurrences (see section entitled "Economic Geology").

In the diatexite unit (*Amez2*), granitic to trondhjemitic pegmatites (*Amez2a*) form bodies reaching up to 75 km^2 (Figure 3), from which a number of apophyses and dykes branch out. These pegmatitic bodies are hololeucocratic, white in fresh surface and pinkish white in weathered surface. They typically contain aggregates of muscovite-biotite phenocrysts, and occasional red to pinkish garnet and black idiomorphic tourmaline. Their mineralogy and their association with diatexites suggest these rocks are anatectic products (S-type granite) derived from the melting of a sedimentary protolith.

Granitoid Intrusive Suites and Complexes

In the Lac Anuc area (NTS 34O), granitoid assemblages contain highly heterogeneous units in terms of magnetic signature (ranging from negative to strongly positive), and in terms of structure and lithology (grouped into nine suites or complexes). Mapping carried out in 2001 led us to define new units, which were grouped into four types of suites, composed of: 1) tonalite-trondhjemite-granodiorite/granite [TTGG: Rochefort Suite (*Arot*); Kakiattuq Suite (*Akkk*); Châtelain Suite (*Achl*)], 2) granite-granodiorite [GG: La Chevrotière Suite (*Alcv*)], 3) mafic to ultramafic rocks [MU: Lac Calme Suite (*Aclm*)], and 4) enderbite-opdalite-charnockite [EOC: MacMahon Suite (*Acmm*); Qilalugalik Suite (*Aqil*); Le Roy Complex (*Aroy*); Lac Minto Suite (*Amin*)].

Tonalite-Trondhjemite-Granodiorite-Granite (TTGG)-Type Suites

Rochefort Suite (Arot)

The Rochefort Suite (*Arot*) was defined in the Lac La Potherie area (NTS 34I) to the southeast of our map area by Leclair *et al.* (2002a). It designates tonalitic rocks with green biotite, epidote and hornblende, that cover roughly 40% of the Lac La Potherie area (NTS 34I) and about 10% of the Lac du Pélican area (NTS 34P; Cadieux *et al.*, 2003). Tonalites of the Rochefort Suite extend into the Lac Anuc area (NTS 34O) along a central axis that runs NW-SE, which corresponds to a negative aeromagnetic signature (figures 3 and 4). We have identified a homogeneous biotite tonalite to trondhjemite unit (*Arot1*), a heterogeneous hornblende tonalite unit (*Arot2*) and a unit of granitized heterogeneous tonalite (*Arot3*).

Homogeneous Biotite Tonalite (Arot1)

All tonalites grouped into unit *Arot1* are homogeneous; they range from weakly foliated to tectonically banded to mylonitic. Biotite is the dominant mafic phase. Two varieties of tonalite can be differentiated in unit *Arot1*, based on the grain size and mafic mineral content:

1) The first tonalite variety is leucocratic to mesocratic (< 40% mafic minerals), medium grey, medium-grained and locally contains intermediate to mafic enclaves, subrounded to stretched parallel to the foliation. The groundmass consists of plagioclase + quartz + biotite ± hornblende - epidote - apatite - zircon - sphene; leucoxene and sericite are accessory phases. Less deformed facies exhibit well-preserved igneous textures and alternate with granoblastic facies. This first variety of tonalite was sampled in the northern part of the Qalluviartuuq-Payne Complex (outcrop #01-FL-6004; UTM (NAD83): 498355W - 6630921N; sample #2 in Figure 3; Table 1]; it yielded an age of crystallization of 2848±11 Ma (David, in preparation), similar to the age of emplacement obtained for an anorthosite in the Qalluviartuuq-Payne Complex (*Aqlp1c*).

2) The second variety of biotite tonalite to trondhjemite is leucocratic, white, coarse-grained to locally porphyritic. Mafic (dioritic to gabbroic) enclaves are more abundant and locally form trains probably resulting from dismembered sills or dykes (synplutonic ?). The tonalitic matrix is typically heterogranular, and mainly composed of coarse plagioclase and quartz grains with smaller interstitial microcline. Mafic minerals (< 15 %) are dominated by green to red-brown biotite, locally associated with green hornblende and epidote cored by allanite. Muscovite, sphene, apatite and zircon are accessory phases. A good example of this variety of foliated and coarse-grained homogeneous biotite leucotonalite occurs in the core of an antiform (F_1) oriented WNW-ESE in the Lac Le Breuil area, along the southwestern margin of the northern part of the Qalluviartuuq-Payne Complex. This homogeneous coarse tonalite was sampled on an island in Lac Qalluviartuuq [outcrop #01-CH-3067; UTM: 503184E - 6619060N; sample #3 in Figure 3; Table 1]. Zoned zircons yielded ages of crystallization corresponding to two magmatic events: 2810.8 ±2.2 Ma and 2757.7 ±4.3 Ma (David, in preparation). The first age is identical to that obtained from a tonalite injected in a WNW-ESE-trending shear zone in the Lac Payne area (2809 ±1 Ma; Percival and Skulski, 2000). The second is markedly younger than that obtained from the tonalite sampled at the type locality for the Rochefort Suite (2769 +6/-4 Ma; Leclair *et al.*, 2002a; David, 2002), but is identical to the age obtained for a tonalite of the Bottequin Suite (Lac du Pélican area, NTS 34P; Cadieux *et al.*, 2003; David, 2002).

Heterogeneous Hornblende Tonalite (Arot2)

The heterogeneous hornblende tonalite unit (*Arot2*) is composed of mesocratic, medium to coarse-grained tonalite with hornblende as the dominant mafic phase. It contains abundant enclaves of mafic gneiss (Photo 2, Appendix 3). At the scale of the map, this unit forms halos around the various volcano-sedimentary complexes (Figure 3). The proportion and size of mafic enclaves decreases away from the contact with mafic metavolcanic units, to eventually form minor lenses and hornblende schlieren. This relationship suggests that the hornblende tonalites (*Arot2*) reflect the gradual disaggregation and assimilation of mafic rocks as a result of the injection of tonalitic magma.

In thin section, the groundmass of these tonalites is characterized by a greater hornblende content relative to biotite. In more homogeneous facies, hornblende forms phenocrysts with inclusions of biotite – apatite – sphene – magnetite. Biotite also rims hornblende grains or is intergrown with muscovite. In strongly foliated to mylonitic facies, hornblende occurs as sub-grains or else forms a neoblastic groundmass with the other felsic minerals (plagioclase – quartz – microcline).

Granitized Heterogeneous Tonalite (Arot3)

The granitized heterogeneous tonalite unit (*Arot3*) is differentiated from the homogeneous biotite tonalite unit (*Arot1*) due to the injection of granitic material occurring as bodies, dykes or veins, with sharp to diffuse contacts, and in more deformed facies, as decimetre-scale augens or simply K-feldspar phenocrysts (< 10 cm) (Photo 3, Appendix 3). These granitic bodies are leucocratic to hololeucocratic, medium or coarse-grained to porphyritic, and contain biotite as the dominant mafic mineral. They are similar to granites and granodiorites of the La Chevrotière Suite (*Alcv*; see below). At the scale of the unit, massive to weakly foliated granitic phases with intrusive and diffuse contacts alternate with augen-textured foliated phases to even mylonitic phases, with sharp tectonic contacts with the tonalite. The lack of a melanocratic interface (melanosome) between the granitic and tonalitic phases suggests that the granitic bodies represent synkinematic injections [of the La Chevrotière Suite (*Alcv*)?] into a tonalitic protolith, equivalent to the homogeneous tonalite unit (*Arot1*). In the tonalitic groundmass, the foliation is commonly defined by muscovite, biotite and epidote. Muscovite occurs as phenocrysts and neoblasts around plagioclase and biotite grains.

Kakiattuq Suite (Akkk)

The Kakiattuq Suite (*Akkk*) was introduced by Parent *et al.* (2003), to designate tonalitic rocks exposed in the western half of the Lac Vernon area (NTS 34J), to the south of our map area. As opposed to tonalitic rocks of the Rochefort Suite (*Arot*), tonalites of the Kakiattuq Suite (*Akkk*) correspond to a moderate aeromagnetic anomaly that pinches out in the southern part of the Lac Anuc area (NTS 34O) (figures 3 and 4). Parent *et al.* (2003) subdivided the tonalites of this suite into a homogeneous tonalite unit (*Akkk1*), a granitized tonalite unit (*Akkk2*) and a strongly heterogeneous tonalite unit (*Akkk3*).

The homogeneous tonalite unit (*Akkk1*) includes biotite tonalites (*ca.* 2740±4 Ma; Parent *et al.*, 2003; David, 2002) and biotite-hornblende tonalites. The rock is leucocratic (light grey in fresh surface and whitish grey in weathered surface). Under the microscope, these tonalites are identical to medium-grained homogeneous tonalites of the Rochefort Suite (*Arot1*) described above.

The granitized tonalite unit (*Akkk2*) is differentiated from the homogeneous tonalite unit by the injection of bodies, dykes or veins of leucocratic to hololeucocratic, medium to coarse-grained to porphyritic (< 10 cm) biotite granite. These granitic bodies are identical to those observed in the granitized heterogeneous tonalite unit of the Rochefort Suite (*Arot3*). They are also interpreted as representing synkinematic granite injections [of the La Chevrotière Suite (*Alcv*)?] into homogeneous tonalites of unit *Akkk1*.

Unit *Akkk3* consists of very heterogeneous lithologies, ranging from medium to coarse-grained. This unit is characterized by the presence of hololeucocratic granitic-granodioritic material, interdigitated with tonalitic to trondhjemitic phases, with abundant enclaves of paragneiss and mafic to intermediate gneiss, and only rare enclaves of gabbronorite, ultramafic rock (hornblendite, pyroxenite) and iron formation. The foliation is generally wavy, and is defined by a wide variety of mafic minerals (biotite – muscovite – hornblende – magnetite ± clinopyroxene) that form laminations or schlieren. These features give the rock a diatexitic aspect. Parent *et al.* (2003) called upon the phenomena of migmatization of homogeneous tonalites (*Akkk1*) or of granitized tonalites (*Akkk2*) to explain the extreme heterogeneity of unit *Akkk3*. Similar to the tonalitic Rochefort Suite (*Arot*), we suggest this heterogeneity is the result of a two-part process: 1) the assimilation of supracrustal rocks (mafic metavolcanic gneisses, meta-sedimentary rocks, iron formations) or plutonic rocks (mafic to ultramafic), and 2) the synkinematic injection of granodioritic to granitic phases [possibly associated with the La Chevrotière Suite (*Alcv*)]. However, unit *Akkk3* is much more heterogeneous than unit *Arot3*, with a migmatitic to diatexitic aspect; it also contains a greater proportion of paragneiss enclaves. On the scale of the map, unit *Akkk3* is commonly adjacent to metasedimentary units of the various volcano-sedimentary complexes [Kogaluc (*Akog2*), Le Roy (*Aroy3*), Mézard (*Amez2*)]. Consequently, the strong heterogeneity and diatexitic aspect are interpreted as the result of the assimilation and digestion of an important proportion of melted metasedimentary rocks.

Châtelain Suite (Achl)

The Châtelain Suite (*Achl*) was introduced in the Lac Klotz area (NTS 35A) by Madore *et al.* (2002) and in the Lac du Pélican area (NTS 34P) by Cadieux *et al.* (2003) to describe a suite essentially composed of granodiorite. In the northeastern part of the Lac Anuc area (NTS 34O), this unit, which roughly corresponds to a high magnetic signature (Figure 4), is injected with porphyritic monzogranite, granodiorite and quartz monzonite of the La Chevrotière Suite (*Alcv*).

The Châtelain Suite (*Achl*) is granitized and is dominated by *granodiorites* that laterally grade into *tonalites* associated with *granites*. These rocks are reddish grey to grey and leucocratic. They are massive to weakly foliated, coarse-grained and weakly magnetic. They contain minor proportions of cm-scale diorite and amphibolite enclaves, elongated and stretched parallel to the foliation. Biotite schlieren are commonly observed. Plagioclase grains exhibit a very distinctive burgundy colour, caused by the presence of inclusins of fine oxidized acicular hematite, and hornblende commonly contains bottle green primary clinopyroxene cores. Under the microscope, these rocks consist of a heterogranular assemblage of quartz, plagioclase, microcline, green hornblende commonly cored by clinopyroxene, green to red biotite (locally altered to chlorite), and opaque minerals. Plagioclase crystals are generally antiperthitic and occasionally exhibit Carlsbad twinning. Deformation is weak in this unit; it is locally illustrated by the presence of porphyroclastic quartz grains surrounded by sutured polycrystalline neoblasts. Accessory minerals include apatite, zircon, sphene, epidote, muscovite and carbonate.

A heterogeneous granodiorite was sampled in the eastern part of NTS sheet 34O [#01-AB-012A; UTM (NAD83): 546890E, 6617286N; sample #4 in Figure 3; Table 1]. A first population of zircons showing magmatic zoning yielded an age of magmatic crystallization of 2760.3 ± 4.3 Ma. Some of these zircons exhibit brownish cores, which yielded an inherited age of 2774.7 ± 9.9 Ma. Another population of clear zircons yielded an age of crystallization of 2723 ± 16 Ma (Table 1; David, in preparation). Granodiorites of the Châtelain Suite are interpreted as the product of the emplacement of a tonalitic unit (at about. 2760 Ma), followed by a synkinematic episode of granitic injection (at about. 2723 Ma).

Granite-Granodiorite (GG)-Type Suite: La Chevrotière Suite (*Alcv*)

The La Chevrotière Suite (*Alcv*), introduced to the southeast by Parent *et al.* (2001) in the Lac Nedlouc area (NTS 34H), designates a series of sheets or elongate lenticular plutons greater than 10 km^2 in size, outlined by positive magnetic anomalies. This suite was extended into the Lac La Potherie area (NTS 34I; Leclair *et al.*, 2002a), the Lac du Pélican area (NTS 34P; Cadieux *et al.*, 2003) and the Lac Anuc area (NTS 34O), to include porphyritic monzogranites, granodiorites and quartz monzonites (*Alcv1*), coarse-grained homogeneous granites (*Alcv2*) and biotite granodiorites (*Alcv3*).

Porphyritic Monzogranite, Granodiorite to Quartz Monzonite (Alcv1)

These rocks are grey-pink to reddish in fresh surface and yellowish pink in weathered surface. They are characterized by the presence of microcline or orthoclase megacrysts reaching up to 10 cm in length, the alignment of which defines a foliation ranging from igneous to tectonic (Photo 5, Appendix 3). These rocks are heterogeneous to homogeneous and leucocratic to melanocratic. Leucocratic units are weakly magnetic to non-magnetic, whereas melanocratic units are strongly magnetic. Diorite and gabbro xenoliths are common in homogeneous units, or reduced to schlieren in heterogeneous and deformed facies. In thin section, coarse K-feldspar and plagioclase (locally antiperthitic) grains coexist with abundant microcline or orthoclase phenocrysts. Myrmekite frequently appears between plagioclase and K-feldspar grains. Quartz is fine to coarse-grained and forms interstitial aggregates between feldspar grains, or ribbons in mylonitic units. Mafic minerals are dominated by brown to green biotite, accompanied by allanite, opaque minerals and rare green to blue hornblende. Accessory minerals include apatite, zoned zircon and sphene. Epidote replaces mafic minerals and plagioclase. Secondary chlorite, muscovite and carbonates locally replace biotite and hornblende, whereas sericite partially replaces feldspar phases. A porphyritic monzogranite sampled in the Lac La Potherie area (NTS 34I) yielded an age of crystallization of 2732 +4/-2 Ma (Leclair *et al.*, 2002a; David, 2002).

Granite (Alcv2)

The granitic unit of the La Chevrotière Suite (*Alcv2*) is equivalent to granites of the La Potherie Batholith (*Alpo*) defined by Leclair *et al.* (2002a) in the Lac La Potherie area (NTS 34I). The La Potherie Batholith was integrated to the La Chevrotière Suite (*Alcv*) by Cadieux *et al.* (2003) given that, in the Lac du Pélican area (NTS 34P), this type of granite is intercalated or in transitional contact with units *Alcv1* and *Alcv3*, and that an age of crystallization (2723 ±2 Ma; David, 2002; Leclair *et al.*, 2002a) suggests it may be related to the same tectonomagmatic event.

In the Lac Anuc area (NTS 34O), these granites (*Alcv2*) form, along with granodiorites of unit *Alcv3*, a series of intrusions randomly distributed throughout the map area, with greater concentrations to the northwest, south and in the east-central part of the map area. They are homogeneous, massive to foliated, pinkish white and equigranular, and typically coarse-grained. Similar to the porphyritic monzogranite unit (*Alcv1*), they contain diorite and amphibolite xenoliths, which are locally reduced to biotite or hornblende schlieren. Microcline and plagioclase occasionally form porphyroclastic aggregates surrounded by fine polygonized granoblastic grains. Quartz occurs as monocrystalline lenses and ribbons parallel to the foliation; brown biotite occurs as small flakes; magnetite is common; allanite and zircon are very fine-grained. Carbonate, sericite and muscovite, found in plagioclase grains, are the main alteration minerals.

Granodiorite (Alcv3)

The granodiorites represent non-porphyritic and less deformed equivalents of porphyritic granodiorites in unit *Alcv1*. They show transitional contacts and hybrid facies with the porphyritic unit (*Alcv1*) and the granitic unit (*Alcv2*). The granodiorites are homogeneous, massive to foliated, leucocratic, light reddish grey and medium-grained. They enclose gabbro, diorite and amphibolite xenoliths, rounded and stretched parallel to the foliation. They typically contain medium to coarse grains of locally antiperthitic plagioclase and microcline. Plagioclase grains are slightly sericitized and epidotized. Quartz is locally coarse-grained; it occurs as an interstitial phase to the feldspars or forms lenses parallel to the foliation in more deformed facies. Green to brown biotite constitutes the dominant mafic mineral; it defines a weak foliation. A few muscovite grains are associated with the biotite. Sphene, magnetite, allanite, apatite, zoned zircon and rare sulphides are accessory phases in this unit. Chlorite and epidote locally replace biotite.

Mafic-Ultramafic (MU)-Type Suite: Lac Calme Suite (*Aclm*)

The Lac Calme Suite (*Aclm*) was introduced in the Lac Couture area (NTS 34B; Madore *et al.*, 2004) and the Lac Anuc area (NTS 34O) to describe small (< 30 km²) mafic to ultramafic intrusions mainly enclosed in units of the Châtelain and La Chevrotière suites, in the eastern part of the map area (Figure 3). Two units are identified: a unit of mafic plutonic rocks (*Aclm1*) and a unit of ultramafic plutonic rocks (*Aclm2*).

Mafic Rocks (Aclm1)

The mafic rock unit (*Aclm1*) forms small elongate bodies less than 30 km² in size, composed of diorite, quartz diorite and rare gabbro. These lithologies are homogeneous and commonly foliated, however the core of certain plutons is massive. Although primary igneous textures are preserved in coarser-grained plagioclase and clinopyroxene phases, the various rock types commonly exhibit a granoblastic texture formed of plagioclase – clinopyroxene – hornblende – quartz. Olive green hornblende also forms porphyroblasts rimmed with biotite. Magnetite, apatite, sphene and zircon are disseminated in the groundmass.

Ultramafic Rocks (Aclm2)

The ultramafic rock unit (*Aclm2*) forms small (< 10 km²) homogeneous intrusions of foliated and generally coarse-grained rocks. They are primarily composed of clinopyroxenite, websterite and their hornblendized equivalents (hornblendite), laterally grading to plagioclase websterite or brecciated gabbro to gabbronorite. Clinopyroxenites and websterites exhibit well-preserved primary cumulate textures. The cumulates are composed of aggregates of clinopyroxene and orthopyroxene, locally in optical continuity, with interstitial pods of plagioclase and magnetite. In hornblendites, pyroxene cumulates are variably replaced by olive green hornblende porphyroblasts. Pyroxene grains exhibit Schiller textures. Red biotite overgrows the various mafic minerals. In more deformed rocks, cumulates are resorbed at the expense of subgrains and neoblasts. Gabbronorites may be distinguished from ultramafic rocks due to their greater plagioclase and biotite content. Overall, orthopyroxene is preferentially replaced by talc, chlorite, iddingsite and calcite.

Enderbite-Opdalite-Charnockite (EOC)-Type Suites or Complexes

MacMahon Suite (Acmm)

The MacMahon Suite (*Acmm*) was defined to the southeast of our map area, in the Lac Nedlouc area (NTS 34H; Parent *et al.*, 2001) and later recognized in the Lac Aigneau (NTS 24E; Berclaz *et al.*, 2002), Lac du Pélican (NTS 34P; Cadieux *et al.*, 2003) and Lac Klotz (NTS 35A; Madore *et al.*, 2002) areas. This suite is referred to herein to describe orthopyroxene-bearing rocks in the Lac Anuc area (NTS 34O) outlined by strongly positive ovoid magnetic anomalies (figures 3 and 4). The MacMahon Suite is composed of six units, three of which are minor. The suite is dominated by homogeneous, foliated, medium to coarse-grained enderbites that contain biotite and magnetite. In the Lac Aigneau area (NTS 24E), Berclaz *et al.* (2002) differentiated a unit of golden brown orthopyroxene-biotite enderbite (*Acmm4*), and a unit of greenish enderbite poor in little orthopyroxene but with abundant clinopyroxene and hornblende (*Acmm5*). In the Lac du Pélican area (NTS 34P), these two units laterally grade into units with a greater K-feldspar phenocryst content (opdalite, mangerite and charnockite: *Acmm6*). Two massive opdalite samples from the Lac du Pélican area yielded an age of crystallization of about 2717 Ma (Percival *et al.*, 2001; Cadieux *et al.*, 2003; David, 2002). These enderbitic and opdalitic units contain a few enclaves of variably hornblendized ultramafic rocks (*Acmm1*; mainly composed of pyroxenite), gabbronorite and leuconorite (*Acmm2*; *ca.* 2723 Ma; Cadieux *et al.*, 2003; David, 2002), and orthopyroxene-bearing diorite (*Acmm3*). The reader is referred to Cadieux *et al.* (2002) for a complete description of these ultramafic and mafic units.

In the Lac Anuc area (NTS 34O), enderbites largely fall in the orthopyroxene-rich biotite unit (*Acmm4*). These enderbites are typically golden brown, moderately to strongly magnetic, either homogeneous and massive to strongly foliated, or locally heterogeneous and banded (Photo 4, Appendix 3). Their grain size, most commonly medium to coarse, may locally be fine or even porphyritic (plagioclase or K-feldspar phenocrysts). These enderbites may contain up to 30% coarse-grained orthopyroxene-bearing mobilizate. They often contain enclaves of diorite, locally of amphibolite, gabbro or ultramafic rock, stretched parallel to the foliation. Enderbitic rocks are generally leucocratic (5 to 25% mafic minerals). Red biotite and orthopyroxene are predominant, whereas hornblende and clinopyroxene occur in minor amounts. Magnetite generally represents an important proportion of the mafic mineral content, making the rock strongly magnetic. In thin section, homogeneous enderbites contain antiperthitic plagioclase and interstitial quartz grains with local microcline. Red biotite is lepidoblastic; it defines the foliation. Primary pyroxene grains are well preserved and the orthopyroxene content exceeds the clinopyroxene content. Accessory minerals include magnetite, apatite, sphene and zoned zircon. The early effects of deformation translate into the dislocation of plagioclase grains and the appearance of kink bands. At a higher degree of deformation, plagioclase forms porphyroclasts surrounded by neoblasts. Due to late alteration, orthopyroxene is replaced by an assemblage of talc + iddingsite + magnetite + carbonate + hornblende; the replacement of plagioclase yields an assemblage of sericite + epidote + carbonate. An enderbite was sampled in the central part of NTS sheet 34O [#01-CM-4043; UTM (NAD83): 500735E, 6592147N; sample #5 in Figure 3; Table 1]. A first population of zoned zircons with dulled edges yielded an age of 2766.7 ±4.9 Ma, interpreted as an inherited age. Another population of clear and uncoloured subautomorphic zircons is typical of EOC-type units. This type of zircon yielded an age of crystallization of 2728.8 ±6.5 Ma, interpreted as the age of emplacement for the lithology (Table 1; David, in preparation).

Unit *Acmm6* groups all orthopyroxene±clinopyroxene-bearing units that also contain more than 10 % K-feldspar. This unit is dominated by opdalites, which laterally grade into mangerites, charnockites and hornblende-biotite enderbites, observed in minor proportions. Opdalites and charnockites are golden brown and slightly pinkish in fresh surface. They are massive, foliated or banded and exhibit leucocratic quartz-feldspar layers alternating with melanocratic biotite-rich layers. The grain size is generally medium to coarse, and K-feldspar phenocrysts range from 1 to 10 cm in size. Mafic minerals observed in these opdalites include orthopyroxene, clinopyroxene and biotite, with local hornblende. The heterogeneity of this unit is marked by irregular successions of leucocratic and melanocratic phases, and by abundant 10-cm to 1-m enclaves of diorite, amphibolite and orthopyroxene and/or hornblende-bearing ultramafic rock, stretched parallel to the foliation. In thin section, opdalites are heterogranular. Primary antiperthitic plagioclase and microcline occur as coarse grains or as finer, broken or recrystallized grains. Orthopyroxene is either coarse or finer-grained, fractured to partially polygonized. It is commonly altered to iddingsite + talc + magnetite + carbonate. Clinopyroxene, where present, is in contact with orthopyroxene, locally occurring as rims. Igneous-textured orthopyroxene and clinopyroxene are commonly intergrown and in optical continuity. Red, brownish red or orange red biotite is lepidoblastic to locally poikilitic; it cuts pyroxene grains and defines the foliation. Quartz forms interstitial grains. Magnetite is common, whereas zircon (zoned to occasionally clear), apatite and sulphides are accessory phases.

Qilalugalik Suite (Aqil), Le Roy Complex (Aroy) and Lac Minto Suite (Amin)

The Qilalugalik Suite (*Aqil*) and the Le Roy Complex (*Aroy*), defined by Parent *et al.* (2003) in the western part of the Lac Vernon area (NTS 34J), are composed of various units that extend into the western and southwestern parts of the Lac Anuc area (NTS 34O), and that broadly correspond to a moderate to high aeromagnetic signature (figures 3 and 4). The Lac Minto Suite (*Amin*), on the other hand, was defined by Leclair *et al.* (2001a) in the Lac La Potherie area (NTS 34I) and recognized by Parent *et al.* (2003) in the eastern part of the Lac Vernon area (NTS 34J). It is composed of five units: orthopyroxene diatexites (*Amin1*), hornblende-biotite diatexites (*Amin4*) and enderbitic-opdalitic-charnockitic-type rocks (*Amin2*, *Amin3*, *Amin5*). Three of these units (*Amin1*, *Amin2*, *Amin5*) extend into the southeastern part of the Lac Anuc area (NTS 34O), where they pinch out along the Tasiat-Pavy deformation zone (Figure 3). Geochronology data from various lithologies in these three suites or complexes reveal ages of crystallization bracketed between *ca.* 2713 and *ca.* 2682 Ma (David, 2002; Parent *et al.*, 2003; Percival *et al.*, 2001; Leclair *et al.*, 2002a; Percival and Card, 1994; Percival *et al.*, 1992). The main characteristics of these units are described below. For a more detailed description, the reader is referred to the work of Parent *et al.* (2003).

Southward in the Lac Vernon area (NTS 34J), Parent *et al.* (2003) subdivided the Qilalugalik Suite (*Aqil*) into three units: hornblende-clinopyroxene tonalites (*Aqil1*, *ca.* 2709 Ma) and granites (*Aqil2*), and heterogeneous enderbites (*Aqil3*). In the southwestern part of the Lac Anuc area (NTS 34O), only the heterogeneous enderbite unit (*Aqil3*) is represented. Unit *Aqil3* cuts diatexites of the Mézard Complex (*Amez2*). It is dominated by enderbites alternating with tonalites, granodiorites and cross-cutting veins of orthopyroxene-bearing felsic mobilizate, which give it a heterogeneous aspect. Unit *Aqil3* also contains variable proportions of diorite and amphibolite enclaves occasionally transformed into schlieren. The rock is medium-grained, generally leucocratic and golden brown in weathered surface. Under the microscope, enderbites are fine to medium-grained. Granoblastic and porphyroclastic plagioclase is the only feldspar phase. Several plagioclase grains show deformed albite twinning lamellae. The foliation is defined by orange to red biotite. Orthopyroxene forms coarse primary porphyroclasts surrounded by smaller broken grains or perfectly recrystallized neoblasts (with triple junctions). Magnetite, apatite and zoned zircon are accessory phases.

Parent *et al.* (2003) subdivided the Le Roy Complex (*Aroy*) into four units: paragneiss (*Aroy1*), heterogeneous enderbite (*Aroy2*), diatexite (*Aroy3*), and granite (*Aroy4*). In the southwestern part of the Lac Anuc area (NTS 34O), three of these units (*Aroy2*, *Aroy3*, *Aroy4*) outcrop on either side of the Le Roy fault (Figure 3). Cordierite-garnet-sillimanite diatexites (*Aroy3*) (> 50% mobilizate) have a sedimentary origin and form two heterogeneous bodies (< 100 km²) with rafts of paragneiss and locally gold-bearing iron formations (see section entitled "Economic Geology"). Ages of 2731 ±13 and 2698±1 Ma were obtained from a diatexite sample (David, 2002; Parent *et al.*, 2003). These diatexites laterally grade into small (< 10 km²) intrusions of heterogeneous enderbite (*Aroy2*) or granite (*Aroy4*). The heterogeneous nature of enderbites in unit *Aroy2* is due to the presence of coarse-grained opdalitic-charnockitic (< 20%) or medium-grained granodioritic (20-50%) mobilizate and of partially assimilated enclaves of clinopyroxene-orthopyroxene-hornblende-biotite-bearing mafic rocks (Parent *et al.*, 2003). Unit *Aroy4* consists of leucocratic to hololeucocratic granite, pink to red in fresh surface and light pink in weathered surface. The presence of biotite-muscovite ±garnet aggregates and the transitional contacts with diatexites (*Aroy3*) suggest the diatexite and the granite are genetically related (Parent *et al.*, 2003).

Among the three units of the Lac Minto Suite (*Amin*) that extend into the souteastern part of the Lac Anuc area (NTS 34O), the enderbite unit (*Amin5*) is largely predominant. Unit *Amin5* is dominated by enderbites associated with opdalites. Inversely, unit *Amin2* is dominated by opdalites associated with enderbites. The two units contain < 25% mafic enclaves. Orthopyroxene-biotite diatexites (*Amin1*; 2713±2 Ma; Percival *et al.*, 2003) are restricted to a thin band along the southern limb of the Tasiat-Pavy deformation zone.

Lac Tasiat Syenite (*Atst*)

A 2 x 3 km pluton of nepheline syenite [01-CM-4141; UTM coordinates (NAD83): 503545E, 6558903N; sample #6 in Figure 3; Table 1] outcrops near Lac Tasiat. The pluton is composed of aegirine-augite essexite and nepheline-biotite syenite (Percival *et al.*, 1995b). These rocks are medium to coarse-grained and exhibit textures ranging from igneous layering to a strong foliation (Percival *et al.*, 1995b). Identical ages of crystallization of 2643+7/-6 Ma and 2643.4±7.6 Ma were respectively obtained from Pb/Pb (Skulski *et al.*, 1997) and U/Pb (Table 1; David, in preparation) analyses. The pluton is cross-cut by pegmatitic syenite veins and by the Tasiat structure, along which a Paleoproterozoic diabase dyke assigned to the Klotz dyke swarm (*pPktz*) was injected.

In thin section, igneous textures are remarkably well preserved. Plagioclase and microcline are medium to coarse-grained and exhibit sutured margins where the two types of feldspar are in contact. Plagioclase grains are zoned, with a more albitic composition near margins. Interstices between the two types of feldspar grains are occupied by nepheline, which commonly contains minute inclusions of plagioclase and microcline. The relationship between these minerals indicates that plagioclase was the first mineral to crystallize, followed by microcline then nepheline. Biotite is the main mafic mineral although it occurs in minor proportions (< 3%); it is pleochroic from yellowish to green to dark olive green and is partially rimmed by muscovite. Fine to coarse-grained zircons are zoned and locally form aggregates. Apatite is rare.

Feldspar phases are fresh, whereas nepheline is variably altered. The core of nepheline grains locally contains cancrinite and is peppered with a very fine-grained alteration product (unidentified), whereas the marginal parts are replaced by sericite-muscovite.

Late Dykes (Paleoproterozoic)

All Archean units in the area are cross-cut by Paleoproterozoic dyke swarms, associated with brittle faults or fractures that postdate the Archean regional deformation and metamorphism. These dykes correspond to the Klotz dykes (*pPktz*) and the Payne River dykes (*pPpay*) – names respectively introduced by Buchan *et al.* (1998) and Fahrig *et al.* (1985) – as well as the Kogaluc River dykes (*pProg*) (new unit introduced herein).

Klotz Dykes (*pPktz*)

Klotz dykes (*pPktz*) are dated at *ca.* 2209 Ma (Buchan *et al.*, 1998) and form a major swarm that transects the entire northeastern Superior Province. They were recognized in NTS sheets 24M (Madore *et al.*, 2000), 35A and 35H (Madore *et al.*, 2001), 24E (Berclaz *et al.*, 2002), 34P (Cadieux *et al.*, 2003), and 35B and 35G (Madore *et al.*, 2004). In the Lac Anuc area (NTS 34O), the swarm is represented by a set of at least eight parallel dykes spaced about 15 km apart. These dykes are gabbroic and associated with WNW-ESE-trending fault zones. They range from 10 to 100 m in thickness. They occur in positive relief in the landscape, over continuous distances reaching up to 50 km. These gabbros are homogeneous, massive and strongly magnetic. They are medium to coarse-grained and exhibit a subophitic to ophitic texture. The dykes display cm-scale to m-scale aphanitic chilled margins. They are generally mesocratic but locally leucocratic. They are mainly composed of clinopyroxene phenocrysts, idiomorphic plagioclase laths and amphiboles ranging from a green or khaki green hornblende to a bluish green actinolite. Clinopyroxene grains are uralitized and rimmed by amphibole. Locally, olivine occurs as isolated grains or as inclusions in clinopyroxene. Accessory minerals include red-brown biotite, interstitial quartz, sericite, muscovite, apatite, Fe-Ti oxides, zircon, leucoxene and sphene. As is often the case in rocks that border fault zones, the gabbro dykes are generally altered to actinolite, chlorite, epidote and sericite.

Payne River Dykes (*pPpay*)

Payne River dykes (*pPpay*) are diabase dykes dated at *ca.* 1875 and 1790 Ma (Fahrig *et al.*, 1985), preferentially oriented NW-SE. These dykes have an isotropic texture and well-developed chilled margins. Most are discontinuous and range from 10 to 65 m in width. They are homogeneous, massive and generally very magnetic. They exhibit a greenish brown to blackish brown weathered surface and a bluish grey fresh surface. Contacts with the country rocks are sharp but may be lobate. The diabase, generally fresh, commonly exhibits an ophitic, even trachytoidal fabric, in which case flow textures are defined by the planar orientation of plagioclase + clinopyroxene ± olivine ± orthopyroxene phenocrysts in an aphanitic or microlitic groundmass of plagioclase + clinopyroxene ± brown hornblende, rich in disseminated magnetite. The manetite is fine-grained and surrounded by brown biotite or leucoxene. Clinopyroxene is often uralitized and overgrown by green hornblende. Orthopyroxene and olivine are cut by orange-red lepidoblastic biotite. Apatite, muscovite, sericite, epidote, chlorite, leucoxene and pyrite represent accessory phases.

Kogaluc River Dykes (*pProg*)

Kogaluc River dykes (*pProg*) were exclusively observed in the southwestern part of the map area. This unit consists of late, randomly oriented, thin (< 3 m) mafic dykes that cross-cut Klotz dykes (*pPktz*). They are dark grey to black in fresh surface and grey-green to rusty brown in weathered surface. These dykes have an aphanitic matrix, a conchoidal fracture, exhibit flow textures and contain abundant mm-scale to dm-scale fragments of country rock (Photo 6, Appendix 3).

Under the microscope, a brown aphanitic matrix is predominant; only a few very fine plagioclase microlites, very fine-grained chlorite, disseminated pyrite and rare clinopyroxene microphenocrysts are identifiable. Very fine-grained carbonates also form spots in the matrix and along microfractures. Abundant (5 to 25%) granitic fragments scoured from the country rock are angular to subangular and show evidence of cataclastic deformation.

METAMORPHISM

Archean rocks in the northeastern Superior Province are generally characterized by metamorphism at relatively low-pressure and high-temperature conditions (Percival and Skulski, 2000). Rocks in the Lac Anuc area (NTS 34O) contain metamorphic assemblages ranging from the upper greenschist facies to the granulite facies. Although granitoid rocks generally lack diagnostic metamorphic assemblages, most *plutonic units* nevertheless locally exhibit porphyroclastic to granoblastic textures, indicating the plutonic units have locally undergone subsolidus metamorphic neoblastesis, interpreted as synmagmatic (Berclaz *et al.*, 2002; Bédard, 2003; Bédard *et al.*, 2003). Most tonalitic units in the area exhibit porphyroclastic and granoblastic textures, whereas granites and granodiorites of the La Chevrotière Suite (*Alcv*) and granodiorites of the Châtelain Suite (*Achl*) more commonly preserve an igneous texture. Enderbites of the MacMahon (*Acmm*) and Qilalugalik (*Aqil*) suites form bodies where igneous-textured orthopyroxene and clinopyroxene dominate, but laterally grade into zones where rocks exhibit recrystallization textures indicating stable conditions at the granulite facies.

Mafic volcanic rocks in the Lac Anuc area (NTS 34O) commonly contain the assemblage hornblende + plagioclase ± garnet ± clinopyroxene ± biotite ± cummingtonite, typical of the middle to upper amphibolite facies. Orthopyroxene was locally observed in mafic volcanic units enclosed in enderbitic suites or complexes. Mafic volcanic rocks are generally homogeneous and exhibit a mineral foliation, locally mylonitic, defined by green to brown fine to medium-grained nematoblastic hornblende and by granoblastic polygonal plagioclase grains. Disseminated quartz, sphene, apatite, magnetite, pyrite and rare zircon as well as variable amounts of alteration minerals such as sericite and epidote complete the mineral assemblage. However, volcanic rocks occurring in the core of F_1/F_2 folds that form interference patterns (see section entitled "Structural Analysis") contain the assemblage chlorite + actinolite + tremolite + plagioclase, which suggests that metamorphism in these zones did not exceed the upper greenschist facies.

Paragneisses contain diagnostic assemblages that indicate variable metamorphic conditions. The assemblage garnet + biotite + sillimanite ± cordierite, typical of the middle amphibolite facies to the granulite facies, is commonly observed. Overall, paragneisses exhibit a well-developed mineral foliation defined by brown to red lepidoblastic biotite and nematoblastic sillimanite in prismatic or acicular grains, and even skeletal locally. Granoblastic plagioclase and quartz grains are found between these elongate minerals. Coarse to fine-grained cordierite crystals are often altered to pinite. Garnet occurs either as small poikilitic grains aligned parallel to the foliation or as mm-scale to cm-scale poikiloblastic grains that host inclusions of earlier phases. More often than not, cordierite is the first aluminous phase to crystallize, followed by biotite, sillimanite, and garnet. Mineral phases present in minor or trace amounts include muscovite, chlorite, sericite, tourmaline, magnetite, apatite, pyrite and carbonate.

Since volcano-sedimentary rocks are better suited to characterize metamorphic conditions, our efforts will be focussed on the description and analysis of assemblages observed in these rock types. A comparison with geothermobarometry data obtained by Percival and Skulski (2000) is also provided.

Qalluviartuuq-Payne Complex (*Aqlp*)

Volcano-sedimentary rocks in this complex are largely metamorphosed to the middle and upper amphibolite facies. The geothermobarometry study conducted by Percival and Skulski (2000) on a dozen or so samples of aluminous paragneiss from the Qalluviartuuq-Payne and Kogaluc complexes shows peak pressure and temperature conditions bracketed between 4.4 and 8.0 kbar and between 585 and 820°C.

In the central and northern parts of the Qalluviartuuq-Payne Complex, metamorphic assemblages evolving from garnet + sillimanite + biotite + staurolite + andalusite [#1139 in Percival and Skulski, 2000; assemblage A in Figure 5] to garnet + sillimanite + biotite + staurolite [#01-CM-4028; assemblage B in Figure 5] indicate prograde conditions locally shifting from the lower to the middle amphibolite facies (3.3 to 4.4 kbar and 530 to 585°C). Moreover, the assemblage garnet + biotite + sillimanite + cordierite +

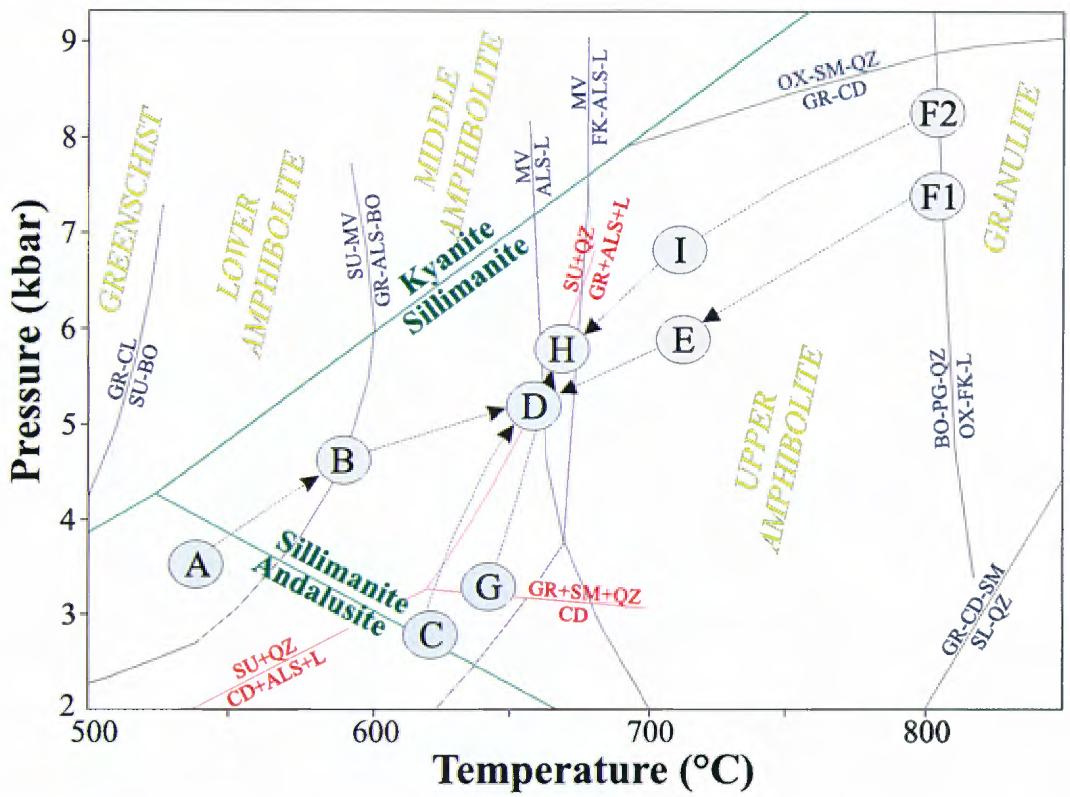

FIGURE 5 - Petrogenetic grid for pelitic rocks, showing stable metamorphic assemblages (A to I) at the amphibolite and granulite facies. ALS = aluminosilicate (andalusite, sillimanite or kyanite), BO = biotite, CD = cordierite, GR = garnet, FK = K-feldspar, L = liquid, MV = muscovite, OX = orthopyroxene, PG = plagioclase, QZ = quartz, SL = spinel, SM = sillimanite, SU = staurolite. Grid taken from Percival and Skulski (2000), based on data from Holdaway and Lee (1977), Davidson *et al.* (1990), and Carrington (1995).

andalusite occurring in the south-central part of the complex [#01-EN-5029; assemblage C in Figure 5] suggests pressure conditions lower than 3 kbar and temperature conditions of ~600-650°C. However, a few kyanite relics locally observed in paragneiss units in the centre of the complex (Percival and Skulski, 2000) indicate that the area underwent a multiphase retrograde metamorphic history. Two samples with the respective assemblages garnet + staurolite + sillimanite + kyanite + biotite [assemblage D in Figure 5] and garnet + sillimanite + kyanite + cordierite + biotite [assemblage E in Figure 5] respectively yielded peak re-equilibrium conditions of 4.9 kbar/665°C and of 5.8 kbar/ 720°C (Percival and Skulski, 2000). Southwest of Lac Payne, the presence of orthopyroxene-bearing mobilizate in supracrustal rocks suggests higher temperature metamorphic conditions. The highest pressure and temperature conditions (7.3 to 7.4 kbar and 810 to 820°C; Percival and Skulski, 2000; assemblage F1 in Figure 5) were in fact recorded within a radius of 4.5 km and 11 km northwest of Lac Payne. South of the Tasiat-Pavy deformation zone (Figure 3), in the southeastern part of the map area, mafic volcanic rocks also contain orthopyroxene and are cut by orthopyroxene-bearing felsic mobilizate, also indicating high-temperature conditions at the granulite facies. This appearance of orthopyroxene is interpreted as being associated with an important increase in the thermal gradient, related to enderbite-opdalite-charnockite intrusions of the Lac Minto Suite (*Amin*). A sample of aluminous paragneiss from this area also recorded pressure conditions of 8.4 kbar and temperature conditions of 805°C (Percival and Skulski, 2000; assemblage F2 in Figure 5), suggesting certain zones underwent, during their history, burial at a deeper level than the current level of erosion. In the western part of the Qalluviartuuq-Payne Complex, supracrustal units enclosed within voluminous enderbitic bodies of the MacMahon Suite contain orthopyroxene and are locally cut by orthopyroxene-bearing leucosome, also suggesting metamorphic conditions at the granulite facies.

Kogaluc Complex (*Akog*)

The assemblage garnet + sillimanite + biotite ± cordierite ± staurolite (assemblage G in Figure 5), typical of the amphibolite facies, is ubiquitous in paragneisses in the northern part of the Kogaluc Complex. Staurolite locally overgrows the biotite + sillimanite assemblage, but shows signs of instability and is resorbed into a fine-grained alteration product. Peak pressure and temperature conditions corresponding to the middle to upper amphibolite facies (5.1 to 6.5 kbar and 660 to 710°C) were recorded in four samples with the assemblages garnet + sillimanite + biotite (assemblage H in Figure 5) and garnet + staurolite +

andalusite + sillimanite + cordierite + biotite (assemblage I in Figure 5) (Percival and Skulski, 2000).

Mézard Complex (*Amez*)

Much like paragneisses of the Kogaluc Complex, diatexites of sedimentary origin in the Mézard Complex (*Amez*) contain the assemblage garnet + sillimanite + biotite ± cordierite ± staurolite [assemblage G in Figure 5] typical of the amphibolite facies. Supracrustal units of the Mézard Complex (*Amez*) contrast with those in the northern Kogaluc Complex however, due to a greater proportion of mobilizate, locally orthopyroxene-bearing, which cross-cuts mafic units, as well as the presence of a porphyroblastic garnet + cordierite assemblage, with crystals reaching up to 5 cm in paragneisses (Photo 1, Appendix 3).

Retrograde Metamorphism

Several units contain secondary minerals superimposed upon higher temperature mineral assemblages. Commonly, iddingsite, chlorite, talc, magnetite and carbonates replace orthopyroxene; sericite replaces feldspar phases; zoisite and clinozoisite replace plagioclase; chlorite replaces biotite. These substitutions are typical of greenschist-facies retrograde metamorphism, associated with regional cooling following one or several events of post-metamorphic hydrothermal circulation. Certain samples show the late appearance of tourmaline and rutile, indicating very low-temperature events.

STRUCTURAL ANALYSIS

Lithostructural Subdivisions and Aeromagnetic Characteristics

The Lac Anuc area (NTS 34O) underwent complex polyphase deformation, as reflected by its various aeromagnetic signatures (Figure 4) and its different structural fabrics (figures 6 and 7), as is the case in all lithologies in the northeastern Superior Province. The central part of the area is characterized by weak aeromagnetic signatures, oriented NW-SE (domains 1 and 5; figures 4 and 6) broadly corresponding to the oldest granitoid units in the area, namely TT-type units (*ca.* 2848 to 2740 Ma), which enclose the Qalluviartuuq-Payne and Kogaluc volcano-sedimentary complexes (*ca.* 2851 to > 2729 Ma). These weak aeromagnetic signatures are cross-cut by a series of positive aeromagnetic anomalies oriented E-W (Domain 2; figures 4 and 6) or NNW-SSE to N-S (domains 3, 4 and 6; figures 4 and 6). Domains 3 and 4 correspond to strongly positive aeromagnetic patterns. Domain 6 is separated from domain 3 to the west by the Le Roy fault; it corresponds to a more striated aeromagnetic pattern marked by alternating aeromagnetic ridges and troughs. All these positive anomalies correspond to younger MU, GG and EOC-type plutonic units (*ca.* 2732 to 2682 Ma).

The structural analysis of the area (Figure 7) is based on the analysis of structural trajectories and cross-cutting relationships between primary and tectonometamorphic (ductile and brittle-ductile) structures in all lithodemic units. *Primary structures* (pillowed basalts, layered porphyritic or massive basalt flows), channelled lapilli or block tuffs, cross-bedded sandstone, graded conglomerates) observed in volcanic and sedimentary units of the Qalluviartuuq-Payne, Kogaluc and Mézard complexes are locally well-preserved. These primary structures were penetratively deformed and transposed by several episodes of deformation; moreover, they were considerably modified by metamorphic recrystallization and hydrothermal circulation. In plutonic units, *planar structures* include: *(i)* lithological contacts mainly within supracrustal sequences, *(ii)* a magmatic or tectonic foliation defined by the preferential orientation of mafic (biotite, hornblende, pyroxene) or felsic (K-feldspar, plagioclase) minerals, *(iii)* tectonic to mylonitic banding caused by more intense deformation, *(iv)* a gneissosity or migmatitic layering due to *in situ* partial melting of the rock, defined by alternating leucosomes and restites (generally represented by mafic schlieren), *(v)* shear zones, *(vi)* a local crenulation cleavage, and *(vii)* folds. *Linear structures* include stretching lineations, tectonometamorphic or rarely primary (magmatic) lineations, fold axes, quartzofeldspathic rods (elongated objects) and late fault striations.

Phases of Ductile Deformation D_1 to D_3

Domains 1 and 5 were affected by three phases of deformation (D_1, D_2 and D_3). All lithological units exhibit at least an S_2 foliation axial to F_2 folds and associated with D_2 deformation. On a regional scale, lithological units and the S_2 foliation strike NNW-SSE to N-S. The S_2 foliation is reworked by a third deformation D_3 associated with the formation of isoclinal microfolds transposed along a NW-SE-striking S_3 mylonitic fabric, and where S_2 then commonly becomes coplanar with S_3. The NNW-SSE to NW-SE orientation of the structural grain is warped in many locations - namely in the Qalluviartuuq-Payne volcano-sedimentary belt – along a WNW-SSE or E-W axis. This implies that a first phase of deformation D_1, where the axial trace of F_1 – coplanar with an S_1 foliation and oriented WNW-ESE to E-W – is refolded by F_2 folds (oriented NNW-ESE to N-S) and where S_1 is crenulated by S_2. Phases D_1 and D_2 show evidence of synmagmatic deformation, characterized at the scale of the outcrop by tectonic to magmatic S_1 and S_2 foliations; these foliations are defined by shear zones, mylonitic banding, gneissosity and migmatitic layering. The shifting orientation of axial traces of F_1 folds as well as

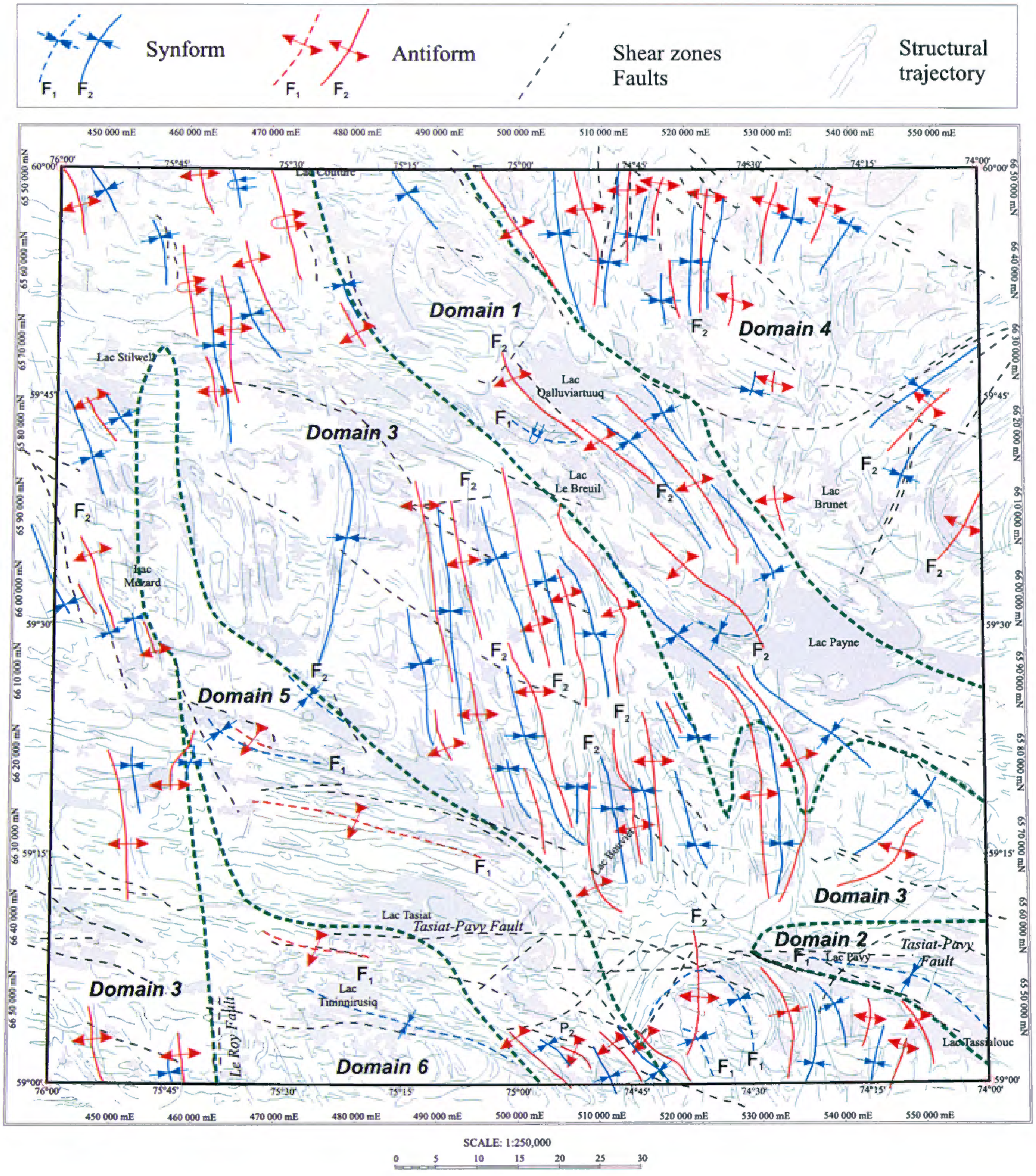

FIGURE 6 - Structural map of the Lac Anuc area (NTS 34O), showing the location of structural domains (1 to 6), folds (F1, F2), structural trajectories, faults and major lakes.

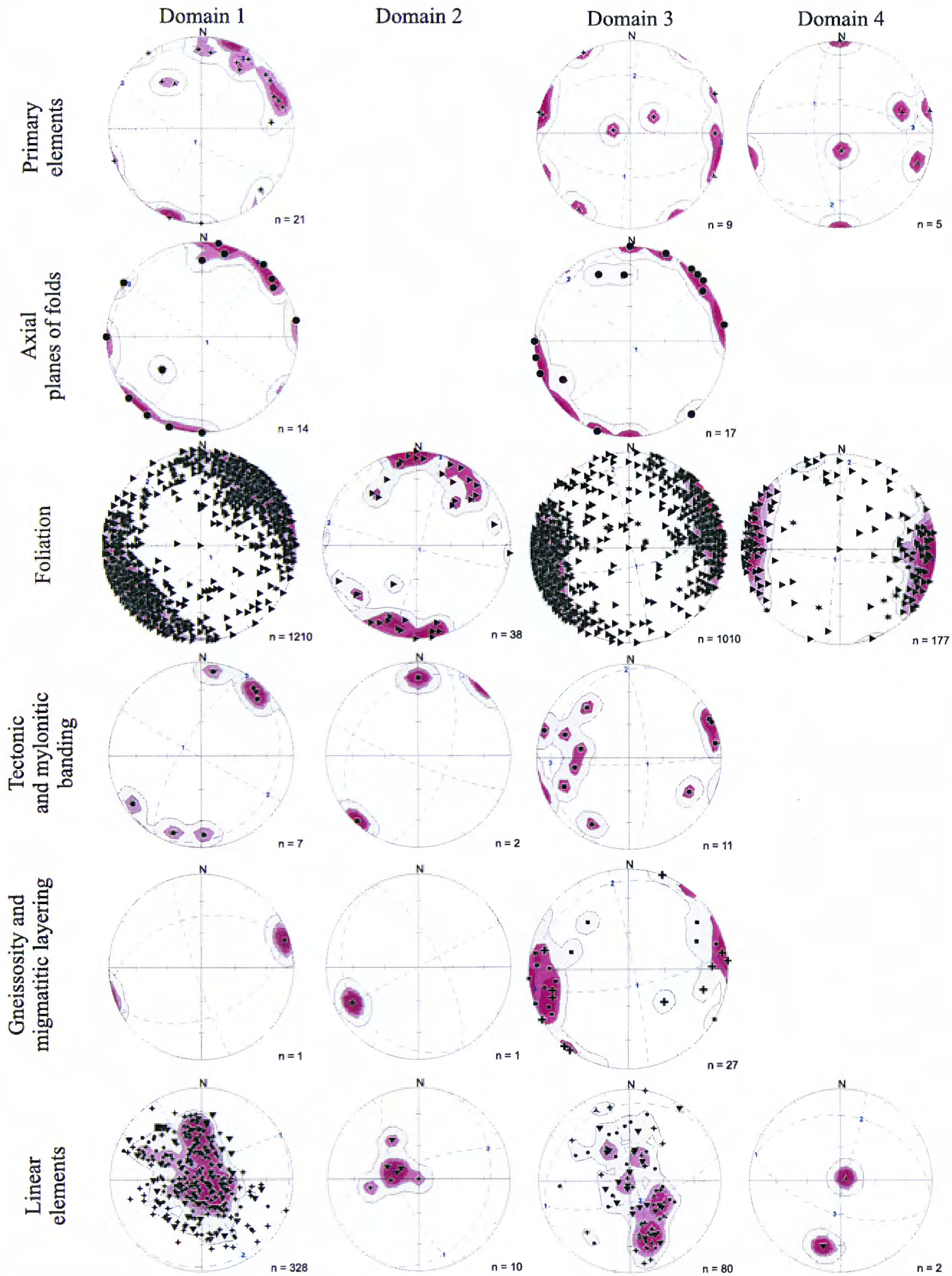

FIGURE 7 - Stereographic projections of ductile structural elements (planar and linear) for all domains (1 to 6) and dykes in the Lac Anuc area (NTS 34O).

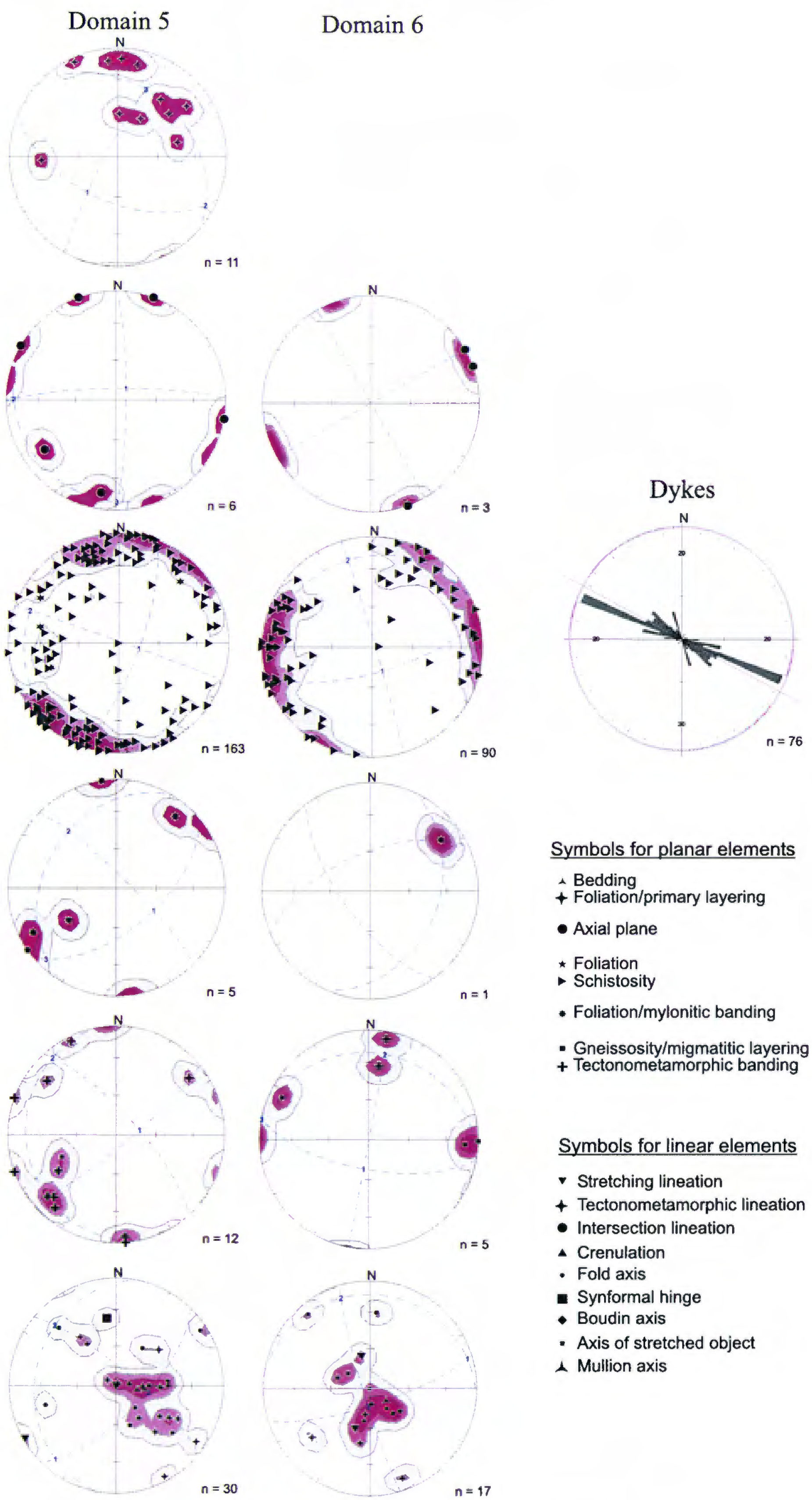

FIGURE 7 - Stereographic projections (continued).

the folding of linear features (L_1) caused by D_2 define m-cale to km-scale interference patterns, for the most part intermediate between a dome-basin pattern and a crescent form. Linear features (L_{1-2}) show subvertical to moderate plunges.

Domain 2, in the southeastern part of the map area (figures 4 and 6), is the extension of domain 2 in Cadieux *et al.* (2003; Lac du Pélican area) and of domain 5 in Leclair *et al.* (2002a; Lac La Potherie area). Domain 2 comprises volcano-sedimentary units (*Aqlp*) and tonalites (*Arot*) folded along an E-W to WNW-ESE axis (F_1) (Figure 6). These F_1 folds are subvertical and accompanied by an S_1 foliation axial to F_1 folds (Figure 7). The different linear features are coaxial and plunge steeply to the west (Figure 7). The S_1 foliation is folded and cross-cut by S_2 shear zones, dominantly trending NW-SE, along which porphyritic granites of the La Chevrotière Suite (*Alcv1*) are injected. In these granitic bodies, the foliation, defined by the preferential orientation of K-feldspar phenocrysts, varies from magmatic to mylonitic, suggesting S_2 is synmagmatic.

Domains 3, 4 and 6 are characterized by subvertical structures generally oriented NNW-SSE to N-S (D_2), which cross-cut structures in domain 2. In domain 6 and in the southern part of domain 3, structures that pre-date phase D_2 are preserved. F_1 folds, oriented WNW-ESE to E-W, are refolded by N-S-trending F_2 folds (Figure 6), to form dome-basin or crescent-form interference patterns. Axial planes of F_2 folds are parallel to the S_2 foliation, which varies from tectonic to primary (magmatic) in origin, and which is locally defined by a mylonitic fabric, gneissosity or migmatitic layering (Figure 7). The different linear features (L_{1-2} or L_2) are coaxial and plunge steeply to moderately to the NNW or SSE (Figure 7).

Interpretation of Phases of Ductile Deformation D_1 to D_3

Synmagmatic planar structures associated with D_1 are oriented WNW-ESE and are overprinted by two other phases of deformation, also synmagmatic: 1) primarily by planar structures (S_2) and folds (F_2) oriented NNW-SSE to N-S (D_2); and 2 more locally by planar structures (S_3) and microfolds (F_3) oriented NW-SE (D_3).

In the Lac Anuc area (NTS 34O), domains 1 and 5 are characterized, from a structural standpoint, by dome-basin or crescent-form interference patterns involving D_1 and D_2 structures. Stratigraphically, these domains contain the oldest lithodemic units in the map area: the Qalluviartuuq-Payne (*Aqlp*) and Kogaluc (*Akog*) complexes, and the Rochefort (*Arot*) and Kakiattuq (*Akkk*) tonalitic suites. Further east in the Lac du Pélican area, domain 1 defined by Cadieux *et al.* (2003) exhibits the same structural and stratigraphic characteristics as domains 1 and 5 in the Lac Anuc area (NTS 34O). Interference patterns involving D_1 and D_2 structures are observed in the oldest units, namely the Pélican-Nantais Complex and the Bottequin tonalitic Suite (2768±3 Ma; David, 2002). This indicates that deformation D_1, coeval with the emplacement of tonalitic to trondhjemitic and volcanic units, developed between *ca.* 2850 and 2740 Ma, over a period of at least 110 Ma.

The emplacement of GG-type intrusions – the La Chevrotière (*Alcv*) and Châtelain (*Achl*) suites between *ca.* 2732 and 2723 Ma (David, 2002; in preparation) – is contemporaneous with the metamorphism recorded in a diatexite (*ca.* 2733 Ma; David, 2002) in the Pélican volcano-sedimentary belt (Cadieux *et al.*, 2003). These synkinematic intrusions are controlled and affected by deformation D_2. The *ca.* 2732 Ma age therefore represents a minimum age for phase of deformation D_1.

N-S-trending D_2 structures also affect units from MU and EOC-type suites (*ca.* 2729 to 2682 Ma). These intrusions are also synkinematic relative to phase of deformation D_2. This suggests that phase of deformation D_2 developed between *ca.* 2732 and 2682 Ma, over a period of at least 50 Ma.

Phase of deformation D_3 is locally associated with shear zones with a mylonitic fabric, oriented NW-SE to NNW-SSE, along which granitic pegmatites bracketed between *ca.* 2693 and 2675 Ma are injected (Lin *et al.*, 1995 and 1996).

Phase of Deformation D_4

In the southern part of the Lac Anuc area (NTS 34O), all lithodemic units and ductile structures (D_1, D_2 and D_3) are truncated by the Tasiat-Pavy deformation zone, oriented E-W (Figure 6). This structure consists of an anastomosing network of brittle-ductile to locally protomylonitic shear zones, pseudotachylites and faults. It hosts the Tasiat Syenite (*Atst*), dated at *ca.* 2643 Ma (Table 1), and may have controlled its emplacement.

Phases of Brittle Deformation D_5 and D_6

All D_1 to D_4 structures are cross-cut by faults and brittle-ductile shear zones. These late structures contain greenschist-grade hydrothermal metamorphic assemblages and are oriented WNW-ESE to E-W (D_5) and NW-SE (D_6). Phases D_5 and D_6 respectively control the emplacement of the Klotz dyke swarm (*pPktz*; *ca.* 2209 Ma; Buchan *et al.*, 1998) and the Payne River dyke swarm (*pPpay*; *ca.* 1875-1790 Ma; Fahrig *et al.*, 1985).

LITHOGEOCHEMISTRY

In order to better characterize the main lithologies in the Lac Anuc area (NTS 34O), 128 samples were collected and analyzed for major and trace elements (major elements, Ga, Nb, Rb, Sr, Y and Zr by X-ray fluorescence, and As, Ba, Co, Cr, Cs, Ni, Sc, Th and U by neutron activation) at the Consortium de recherche minérale (COREM). A sub-set of 54 samples was submitted to the Institut national de la recherche scientifique (INRS) for ICP-MS analyses in order to determine rare earth element (REE) concentrations. REE results are not discussed in this report. All analytical results are available in the SIGÉOM database. In addition to this data, a few analytical results from unaltered rocks were recovered from the first exploration campaign in the Lac Qalluviartuuq area (Cattalani and Heidema, 1993) and from a study of prospective settings for volcanogenic occurrences (Labbé and Lacoste, 2001). SOQUEM and Virginia Gold Mines also analyzed rock samples from the Lac Payne area in order to characterize and document alteration patterns (Chapdelaine and Poirier, 1996; Cuerrier, 1998); results from this work are not included in this section.

The chemical interpretation of Archean rocks is not an easy task, since these rocks may have undergone several post-magmatic episodes (amphibolite and/or granulite-grade metamorphism, late hydrothermal circulation, spilitic alteration, metasomatism). Alkalis (*e.g.* Na, K, Rb) and alkaline earth metals (*e.g.* Sr, Ba) appear to be mobile, and do not follow well-defined magmatic evolution trends on Harker diagrams, particularly in the case of volcanic rocks. Incidentally, only major elements showing a magmatic evolution (Al, Ca, Fe, Mg, Si, Ti) and incompatible high-field-strength elements (Th, Nb, Zr, Y, Sc, Hf) will be discussed in this section. All these elements are considered as being relatively immobile during alteration and metamorphism up to the amphibolite facies (Ludden *et al.*, 1982; MacLean and Barrett, 1993).

Volcanic Rocks

Volcanic rocks in the Lac Anuc area (NTS 34O) range from ultramafic to rhyolitic in composition (Figure 8a).

Ultramafic to Intermediate Volcanic Rocks

Ultramafic volcanic rocks (*Aqlp1b*) sampled during the 2001 field season are for the most part located to the southwest of Lac Payne. Analytical results show $Mg/(Mg+Fe^{2+})$ (Mg#) ratios of ~0.8, Al_2O_3/TiO_2 > 15, CaO/Al_2O_3 < 1.2 and low incompatible element concentrations (Figure 8b and c). These compositions are similar to those of 2.7-Ga komatiites from the western Abitibi belt (Herzberg, 1992; Fan and Kerrich, 1997). Magnesian basalts are absent from the compositional spectrum of rocks in the Lac Anuc area (NTS 34O), as is the case for most Archean volcanic belts (St. Seymour *et al.*, 1983). Basalts in the Qalluviartuuq-Payne (*Aqlp1*) and Mézard (*Amez1*) complexes follow a tholeiitic evolutionary trend, marked by an enrichment in iron and titanium, reflecting the lack of Fe-Ti oxide fractionation in anoxic conditions (Figure 8a and b). These rocks generally have low Zr/Y ratios (2.5 to 3.5), Zr contents < 100 ppm, and TiO_2 contents ranging from 0.5 to 2 % (Figure 8b and c). Basalts in unit *Aqlp1* show a wider range in TiO_2 and Zr contents than those in unit *Amez1* (Figure 8b; Table 2), which may reflect greater fractionation of the parent magma. A few basalts have a calc-alkaline signature (Zr/Y > 6; Figure 8a and c). Most of these "calc-alkaline" basalts show evidence of post-volcanic contamination by felsic veinlets, potentially enriched in incompatible elements. This signature is therefore not considered to be a primary feature. On the other hand, samples from the diorite unit in the Qalluviartuuq-Payne Complex (*Aqlp3*) exhibit a calc-alkaline signature (Figure 8a and c) akin to andesites (SiO_2 = 58 to 60%).

Felsic Volcanic Rocks

Andesitic volcanic rocks are rare, whereas dacitic rocks (*Aqlp1a*) were only documented in the Lac Payne area by Chapdelaine and Poirier (1996). Felsic volcanic rocks of the Mézard Complex (*Amez1*) are characterized by higher Mg# (0.40 to 0.46) and Zr/Y (14 to 17) ratios than those of the Qalluviartuuq-Payne Complex (*Aqlp1a*; Mg# = 0.24; Zr/Y = 12), but show similar silica contents (SiO_2 = ~72%). Furthermore, felsic volcanic rocks of the Mézard Complex have MgO concentrations similar to those of associated basalts. This suggests that felsic volcanic rocks of the Lac Mézard area cannot have evolved directly from the same parent magma than that of associated basalts, and that these felsic volcanic rocks come from a different source than felsic volcanic rocks of the Qalluviartuuq-Payne Complex (Figure 8b).

Porphyritic Dolerite Dykes

Plagioclase-phyric dolerite dykes from 10 cm to 1 m wide that cross-cut supracrustal rocks of the Qalluviartuuq-Payne Complex (*Aqlp*) are compositionally distinct from the basalts. These rocks show a calc-alkaline signature (Na_2O+K_2O = 4.1 to 5.7%; Zr/Y ~ 4.4 to 8.8), higher Al_2O_3 and lower TiO_2 contents, and higher Mg# (0.61 to 0.70) than the tholeiitic basalts (Figure 8a, b and c). In the absence of a significant crustal contamination signature, these mafic dykes may be derived from: *(i)* the same magmatic episode than that which formed the *Aqlp3* diorite unit; or *(ii)* thecalc-alkaline volcanic cycle 2 of unit *Aqlp1*; or *(iii)* a calc-alkaline volcanic episode that postdates volcanic cycle 2 of unit *Aqlp1*, the remains of which have all been eroded or have simply not be recognized in the field. A sequence of calc-alkaline andesitic basalts and felsic tuffs (*ca.* 2740 Ma) compositionally identical to the porphyritic dolerite dykes was recognized by Cadieux *et al.* (2003) in the Lac du Pélican area (NTS 34P).

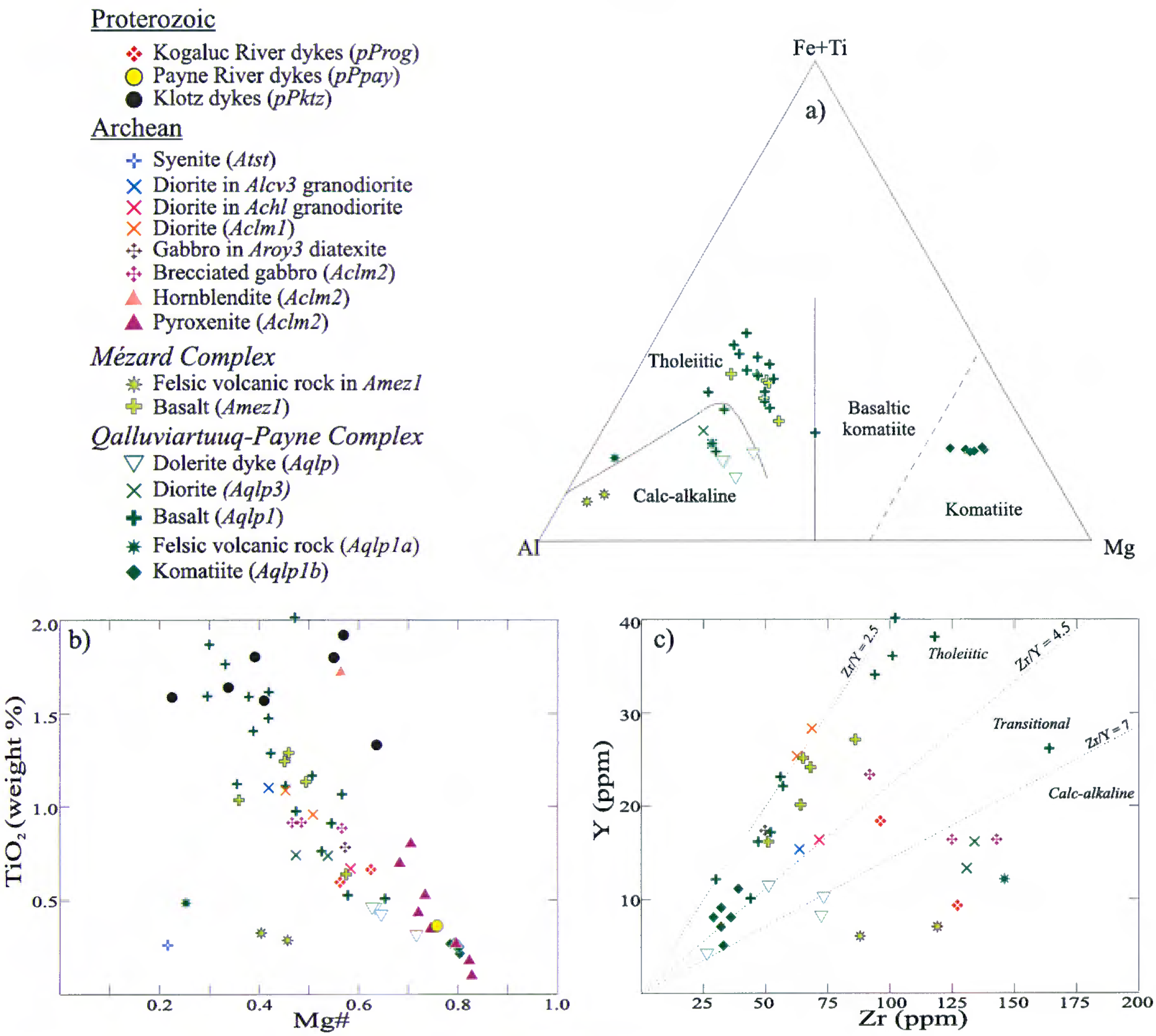

FIGURE 8 - Geochemical diagrams showing major and trace element analytical results from mafic and ultramafic volcanic and plutonic rocks of the Lac Anuc area (NTS 34O): **a)** Jensen (1976) discrimination diagram for volcanic rocks; **b)** TiO_2 vs Mg# (Mg/Mg+Fe) for mafic and ultramafic volcanic and plutonic rocks; **c)** Y vs Zr for mafic volcanic and plutonic rocks.

Felsic Plutonic Rocks

On diagrams that accompany this section (figures 9 and 10), felsic plutonic rocks of the Rochefort (*Arot*) and Kakiattuq (*Akkk*) suites in the Lac Anuc area (NTS 34O) are grouped on the basis of their mafic mineral content (biotite, hornblende, clinopyroxene). Tonalites are subdivided below into two groups: hornblende + biotite ± clinopyroxene tonalites ($I1D_{hb}$) and tonalites that exclusively contain biotite as a mafic phase ($I1D_{bo}$). This emphasizes the importance of mineralogy and petrogenetic processes on the geochemical signature. Felsic plutonic rocks of the Châtelain, La Chevrotière and MacMahon suites, on the other hand, are plotted with their own symbols.

HB-BO ± CX Tonalites ($I1D_{hb}$) and BO Tonalites ($I1D_{bo}$) from TTGG-Type Suites

$I1D_{hb}$ show a metaluminous composition (ACNK< 1.0) and a higher ANK index than $I1D_{bo}$ (ACNK > 1.0; Figure 9b). On the discrimination diagram by Bachelor and Bowden (1985; Figure 9c), $I1D_{hb}$ define a straight line above $I1D_{bo}$, in the field of pre-collisional granitoids. At a similar Al_2O_3 content, $I1D_{hb}$ have lower SiO_2 and generally higher CaO, TiO_2, P_2O_5, FeO and MgO (Figure 10) than $I1D_{bo}$. $I1D_{hb}$ therefore represent less differentiated products than $I1D_{bo}$.

Distribution coefficients for scandium and yttrium in clinopyroxene and hornblende are much higher than

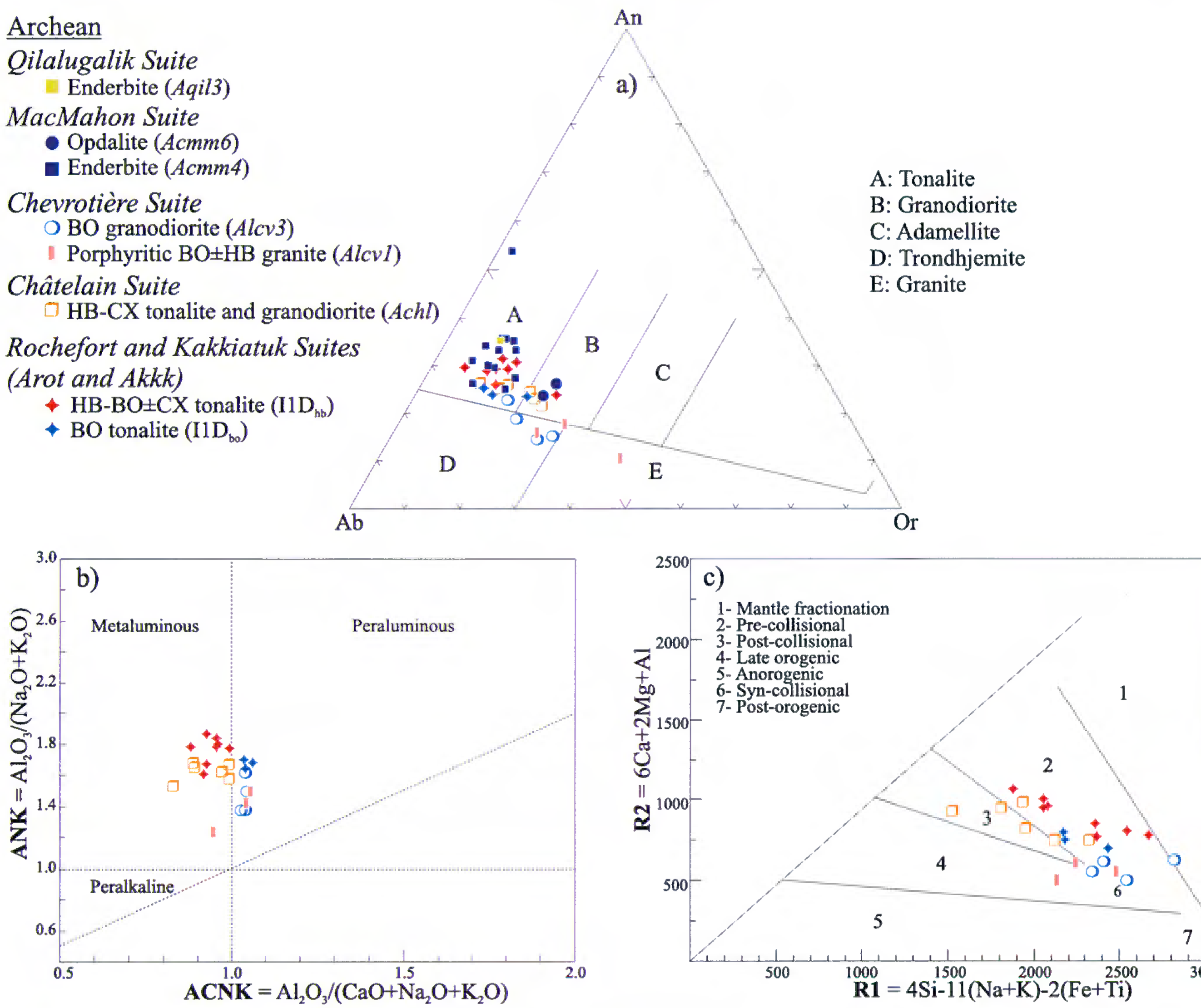

FIGURE 9 - Geochemical diagrams showing major element analytical results for felsic plutonic rocks of the Lac Anuc area (NTS 34O): **a)** Classification diagram based on normative albite (Ab), anorthite (An) and orthoclase (Or) mineral calculations (O'Connor, 1965); **b)** Alumina saturation index by Maniar and Piccoli (1989); **c)** Discrimination diagram by Bachelor and Bowden (1985).

in biotite (*e.g.* $D^{cpx}_{Sc} \sim D^{hb}_{Sc} \gg D^{bo}_{Sc}$; Rollinson, 1993). Consequently, $I1D_{hb}$ are enriched in Sc and Y compared to $I1D_{bo}$. Not only is it possible to discriminate intrusive rocks on this basis, but it is also possible to observe a common evolutionary trend relative to silicium (Figure 10). In the field, $I1D_{bo}$ are generally found at a certain distance from volcanic belts, whereas $I1D_{hb}$ form halos around the belts and often contain abundant mafic enclaves. Lower SiO_2 concentrations in $I1D_{hb}$, the coexistence of hornblende and biotite, as well as their spatial association with volcanic belts suggest that the presence of hornblende and clinopyroxene is due to variable degrees of assimilation of basalts or pyroxenites during the emplacement of tonalitic magmas.

Granodiorites and Granites from the TTGG-Type Châtelain Suite (*Achl*) and the GG-Type La Chevrotière Suite (*Alcv1* and *Alcv3*)

On the normative diagram An-Ab-Or (Figure 9a), tonalites-granodiorites of the Châtelain Suite (Achl) form a continuous series across the tonalite and granodiorite fields, whereas porphyritic granites of the La Chevrotière Suite (*Alcv1*) straddle the field of trondhjemites, granodiorites and granites. Granitoids of the Châtelain Suite have lower SiO_2 and K_2O, and higher Al_2O_3, Na_2O, CaO, P_2O_5, FeO and MgO concentrations than granites of the La Chevrotière Suite (Figure 10 and Table 3 in appendix). Despite a relatively low sample density for granitoids of the Châtelain Suite, it is possible to identify an apparent change in the mineral

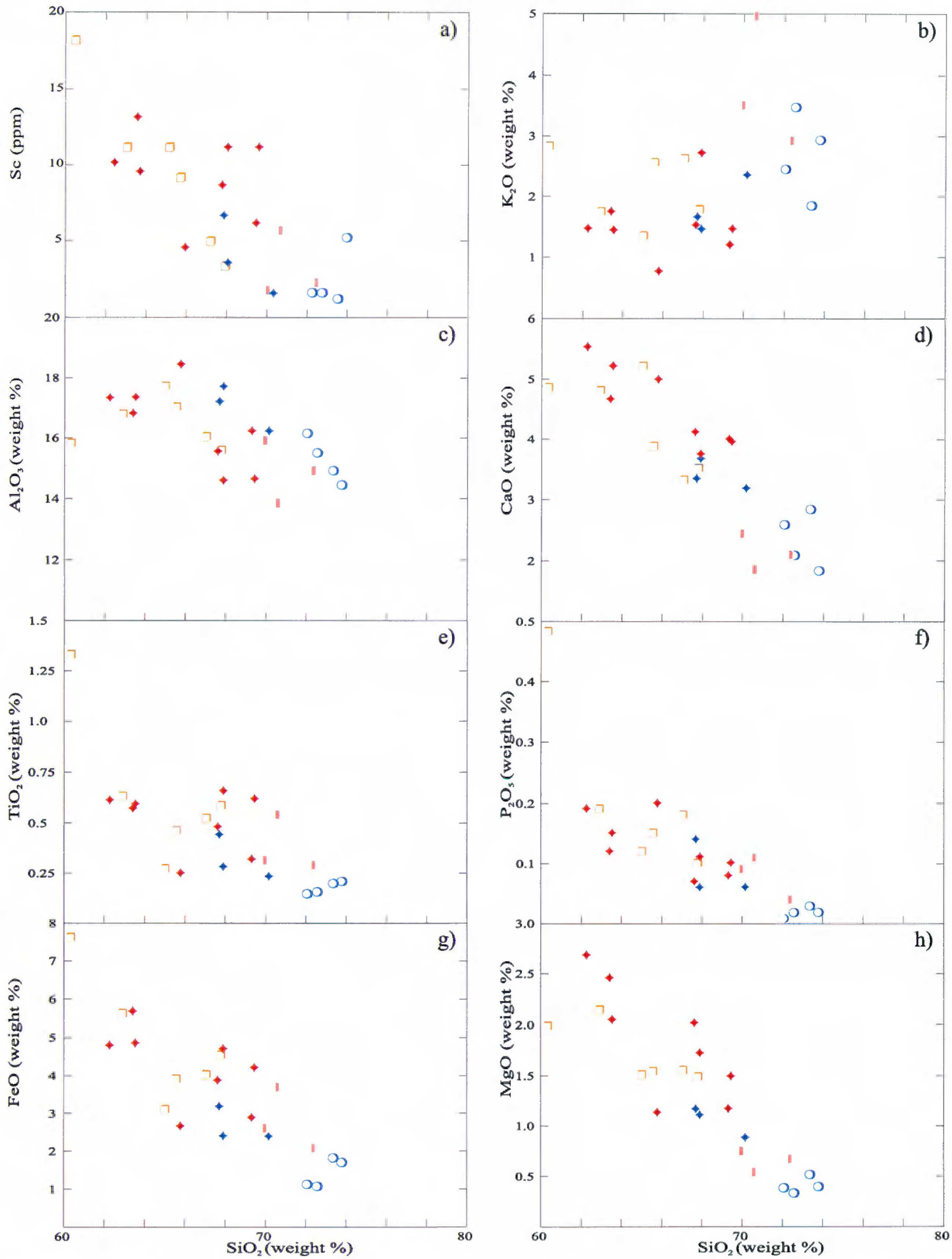

FIGURE 10 - Harker diagrams showing major element and scandium variations as a function of silica for felsic plutonic rocks of the Lac Anuc area (NTS 34O). The symbols are described in Figure 9.

phases involved in crystallization at about 65% SiO_2 (Figure 10). On the diagram showing the alumina saturation index (Figure 9b), rocks of the Châtelain Suite show a metaluminous composition (ACNK < 1.0), whereas granites of the La Chevrotière Suite are weakly peraluminous (ACNK > 1.0; Figure 9b and Figure 8 in Cadieux *et al.*, 2003). The discrimination diagram by Bachelor and Bowden (1985; Figure 9c) shows that rocks of the Châtelain Suite (*Achl*) straddle the fields of post-collisional to pre-collisional intrusive rocks, whereas porphyritic granites of the La Chevrotière Suite (*Alcv1*) plot in the field of syn-collisional granitoids.

Biotite granodiorites of the La Chevrotière Suite (*Alcv3*) have tonalitic and trondhjemitic normative compositions (Figure 9a). These granodiorites are the most differentiated intrusive rocks in the area: they show the highest SiO_2 concentrations and the lowest TiO_2, P_2O_5, FeO and MgO contents (Figure 10; Table 3 in appendix). Like $11D_{bo}$, they are weakly peraluminous (ACNK > 1.0), but show a lower ANK index (1.4 to 1.6; Figure 9b). On the discrimination diagram by Bachelor and Bowden (1985; Figure 9c), these granodiorites plot near porphyritic granites of the La Chevrotière Suite (*Alcv1*), in the field of syn-collisional granitoids, suggesting a similar origin.

Rocks from EOC-Type Suites (*Acmm*, *Aqil*)

Most analyses discussed in this section are from samples of the MacMahon Suite (*Acmm*); only two analyses are from the Qilalugalik Suite (*Aqil*). Most felsic rocks (enderbite, opdalite, tonalite) have normative tonalite compositions in the Ab-An-Or diagram (Figure 9a). However, two opdalites, characterized by abundant myrmekitic textures, exhibit K_2O enrichment (Figure 11a) coupled with anomalous Ba, Rb, Nb and Y. Enderbites form a fairly tight cluster and a differentiation pattern that falls midway between a tonalitic-trondhjemitic pattern (T-T; Figure 11a) and a classic calc-alkaline pattern (C-A; Figure 11a). One sample with anomalously high calcium (9044A2; Figure 11a) shows a marked enrichment in Cr, Sc, U and Th, and depletion in P, Sr and incompatible elements. These characteristics may reflect the presence of a clinopyroxene cumulate in the rock. In the MacMahon Suite, the local presence of magmatic epidote, the abundance of hornblende and the absence of pyroxene suggest the existence of tonalite *sensu stricto*. These tonalites are associated with hornblende-rich dioritic phases, apparently comagmatic, that contain biotites distinct from those associated with enderbites.

Despite mineralogical differences (±OX), all felsic rocks in the MacMahon Suite plot along a common evolutionary trend (Figure 11b and c). They are magnesian (Figure 11b), metaluminous and form an evolution series that straddles the line separating the calc-alkaline and tholeiitic fields on the Jensen diagram (1976; not shown) and that plots in the calc-alkaline field on the discrimination diagram by Irvine and Baragar (1970; not shown).

Orthopyroxene-bearing mafic rocks of the MacMahon Suite (*Acmm2* and *Acmm3*) were subdivided based on the quartz + hornblende (quartz diorite) versus pyroxene (gabbronorite) content and on the degree of differentiation measured by their MgO and CaO contents relative to alkalis. Diorites and gabbronorites usually contain pyroxene and are typically associated with enderbitic mobilizate. They may represent a source cogenetic with the enderbitic series, or relics of the digestion of another earlier suite of rocks.

Ultramafic rocks of the MacMahon Suite (*Acmm1*) most likely represent variably hornblendized pyroxene cumulates (mica-amphibole websterites), since they contain high concentrations of compatible elements such as Cr, Ni and MgO, and are depleted in incompatible elements (Figure 11c). One particularly mica-rich websterite sample (9002C) shows high K_2O, Ba, Sr, Cs and Rb values (Figure 11a). This high mica content may be: 1) metasomatic in origin, due to the circulation of a metasomatic fluid (deuteric) or a residual magma enriched in K_2O (*e.g.* Bédard *et al.*, 1987), or 2) related to a K-rich magma similar to the parent magma of shoshonitic plutons in the Douglas Harbour Domain (Madore *et al.*, 2000).

Lac Tasiat Syenite (*Atst*)

A single analysis from the Lac Tasiat Syenite (*Atst*; *ca.* 2643 Ma) shows a low TiO_2 content (0.25%) and high Al_2O_3 (21.5%), Na_2O (7.9%) and Zr (455 ppm) values (figures 8b and 12; Table 3 in appendix). The normative mineralogy reveals orthoclase and nepheline concentrations on the order of 31 and 13% respectively.

Mafic to Ultramafic Plutonic Rocks

Diorites and Gabbros

Chemical analyses of mafic plutonic rocks from the Lac Anuc area (NTS 34O) come from fine-grained diorites (*Aclm1*) and brecciated gabbros (*Aclm2*) of the Lac Calme Suite (*Aclm*), from coarser-grained diorites enclosed in grano-dioritic units of the Châtelain (*Achl*) and La Chevrotière (*Alcv3*) suites, and from a gabbroic layer enclosed in diatexites of the Le Roy Complex (*Aroy*).

Overall, these units contain higher Na_2O contents than basalts, which probably reflects the higher sodic content of plagioclase. TiO_2 concentrations range from 0.7 to 1.4%, and MgO concentrations from 4.6 to 10.3%. Incompatible trace element concentrations are relatively low (Zr = or < 75 ppm), except for brecciated gabbros of the Lac Calme Suite (*Aclm2*) (Zr = 89 to 140 ppm), which show high Zr/Y ratios (3.9 to 8.8) typical of calc-alkaline rocks (Figure 8c; Table 2 in appendix). Fine-grained diorites (*Aclm1*) show the

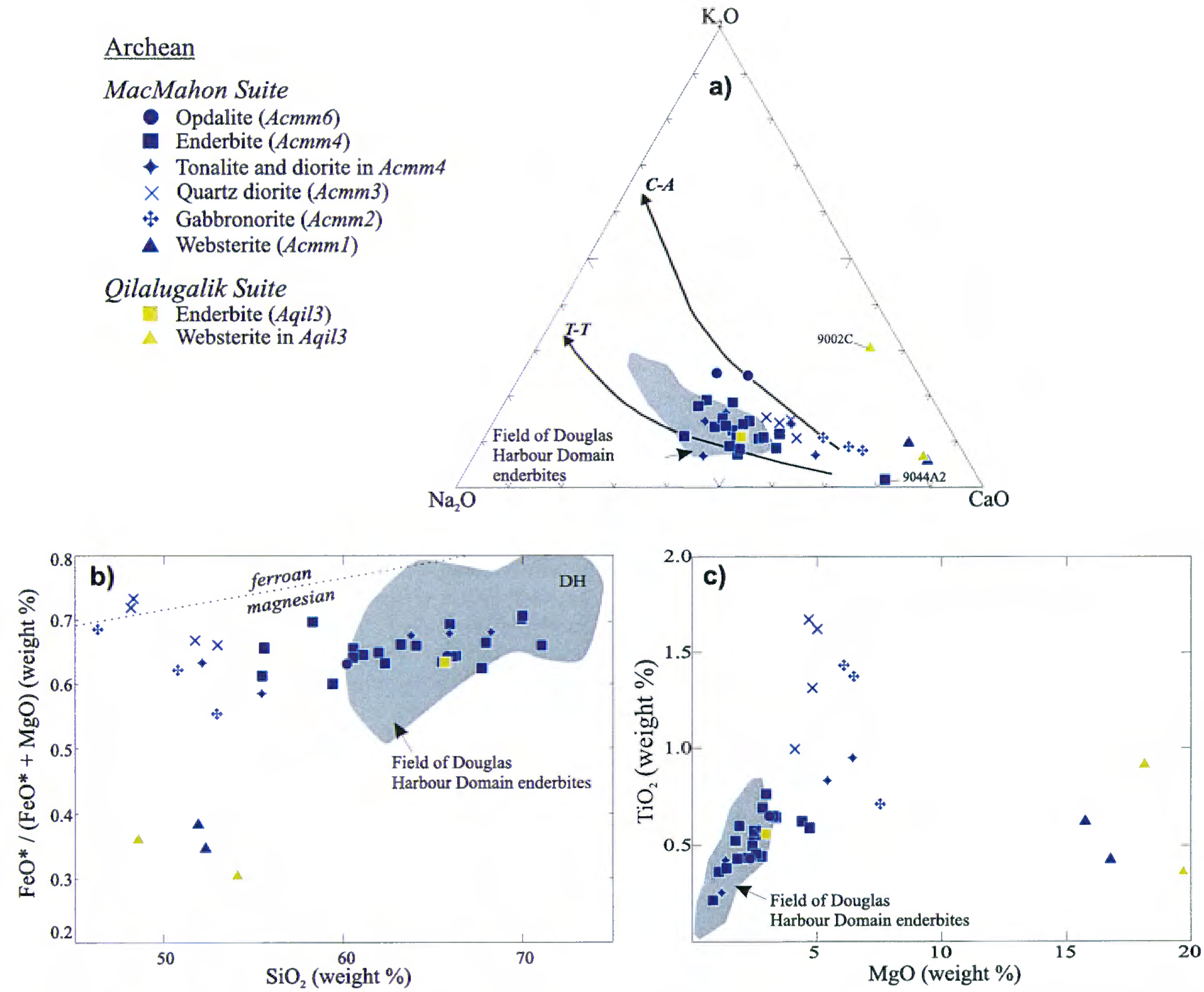

FIGURE 11 - Geochemical diagrams showing major element analytical results for rocks from enderbitic complexes and suites of the Lac Anuc area (NTS 34O): **a)** Na_2O-K_2O-CaO diagram comparing analytical results from Lac Anuc facies with the field of Douglas Harbour Domain enderbites (DH), as well as typical calc-alkaline (C-A) and tonalitic-trondhjemitic (T-T) differentiation trends (after Barker and Arth, 1976). Sample # 9044A2 is enriched in calcium and may correspond to a clinopyroxene cumulate. **b)** FeO*/(FeO*+MgO) vs SiO_2 diagram (after Frost *et al.*, 2001). Note that most enderbitic rocks are magnesian. Enderbitic rocks of the Lac Anuc area (NTS 34O) are slightly more primitive than Douglas Harbour Domain enderbites. **c)** TiO_2 vs MgO variation diagram.

lowest Zr/Y ratios (~2.4), are enriched in Fe_2O_3t (13.5 to 14.8%) and have low SiO_2 concentrations (~47.5%) (Table 2 in appendix). Diorites enclosed in *Achl* and *Alcv3* granodiorites, as well as the gabbro in *Aroy3* diatexites show higher Zr/Y ratios (2.8 to 4.3) and important variations in major element concentrations (Figure 8b and c; Table 3 in appendix).

Ultramafic Plutonic Rocks

Ultramafic plutonic rocks with hornblende + clinopyroxene ± orthopyroxene ± biotite (pyroxenites to hornblendites) of the Lac Calme Suite (*Aclm2*) form bodies from 100 m to 1 km in size, enclosed in various units (tonalites, granodiorites, diatexites, supracrustal belts). Pyroxenites contain 16 to 24% MgO (Mg# = 0.69 to 0.82) and low incompatible element concentrations (TiO_2 = 0.09 to 0.78%; Zr = 10 to 48 ppm) (Figure 8b; Table 2 in appendix). One body of clinopyroxene-bearing hornblendite of the Lac Calme Suite (*Aclm2*) however shows higher Fe (Mg# = 0.55) and incompatible element concentrations (TiO_2 = 1.7 % and Zr = 75 ppm).

On the Al versus Si cation plot (Figure 12), ultramafic plutonic rocks plot along a straight line with a negative slope and a high correlation coefficient (R^2 = 0.8). On this type of diagram, silicium (Si) constitutes a magmatic differentiation index, whereas aluminium (Al) is indicative of melting or crystallization processes. On an experimental

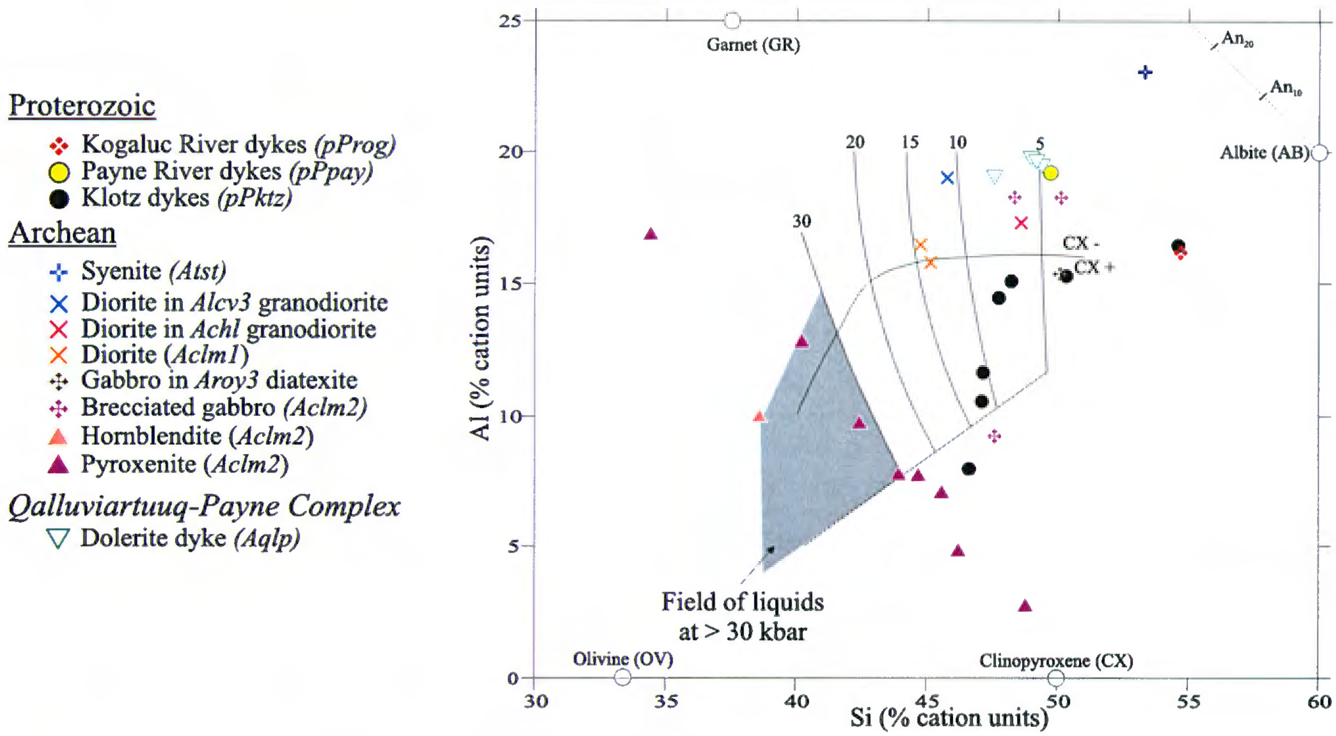

FIGURE 12 - Al vs Si diagram for mafic and ultramafic plutonic rocks of the Lac Anuc area (NTS 34O). The grid (taken from Francis and Ludden, 1990; Francis, 1995) shows approximate experimental liquid compositions coexisting with mantle peridotites during experiments at different pressure conditions (5, 10, 15, 20 and 30 kbar).

grid showing the melting of a peridotitic source at different pressure conditions (Figure 12), certain ultramafic rocks show compositions indicating derivation from a liquid produced at > 30 kbar. The remaining analyses show compositions typical of cumulates derived from the fractionation of clinopyroxene. Although the samples exhibit coarse textures typical of cumulates, the most Al-rich samples may represent compositions derived from the melting of a mantle source at great depths. Analyses that plot in the shaded field of "liquid" compositions correspond to ultramafic rocks associated in the field with supracrustal rocks. Rocks enclaved in felsic plutonic bodies generally show lower aluminium concentrations. Although the linear relationship between Al and Si makes it possible to infer the type of genetic process involved in the formation of these rocks, the low sample density makes it impossible to establish a relationship between the two types of ultramafic rocks.

Proterozoic Diabase Dykes

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

Only one chemical analysis is available for unit *pPpay*, but observations described herein confirm those derived from samples collected in the Lac du Pélican area (Cadieux *et al.*, 2003). For a similar SiO_2 content, Klotz dykes (*pPktz*) shows higher Fe_2O_3, Na_2O, TiO_2 and Zr, and lower Al_2O_3 and Zr/Y, Zr/Ti, Al_2O_3/TiO_2 ratios and Mg# than Payne River Dykes (*pPpay*) (Figure 8b, Table 2 in appendix). The widely variable Mg# of Klotz dykes (0.21 to 0.63) suggests variable degrees of fractionation at depth prior to emplacement at shallower crustal levels. The most primitive compositions (Mg# = 0.55 to 0.63; MgO = 9.6 to 13%) come from two samples collected from the same dyke, which is itself cut by brecciated dykes of the Kogaluc River swarm.

Kogaluc River Dykes (*pProg*)

Brecciated Kogaluc River dykes (*pProg*) cross-cut both Archean units and Klotz dykes (*pPktz*). They are small (a few cm to 3 m wide) and exhibit flow textures. The amount of felsic xenoliths scoured by the magma is very significant (Photo 6, Appendix 3), making their geochemical characterization that much more difficult. Despite careful sample preparation to remove this debris, microscopic studies reveal the presence of quartz microfragments (< 1 mm). Thus, the high SiO_2 contents (58.5 to 64.2%) do not represent the original composition of the magma. The two analyzed samples reveal calc-alkaline compositions and low MgO concentrations (5 to 6%) at a relatively high Zr content (124 and 93 ppm) (Figure 8b and c). Compared to Klotz dykes, the brecciated dykes show lower TiO_2 and Fe_2O_3 but similar MgO concentrations, suggesting a different origin (Table 2 in appendix). The presence of a few carbonate nodules in the aphanitic matrix of these dykes, as well as the relatively high loss on ignition (LOI) (3.36 to 4.17 %) suggest a particularly volatile-rich source.

ECONOMIC GEOLOGY

In the Lac Anuc area (NTS 34O), the main zones of economic interest are located within the Qalluviartuuq-Payne (*Aqlp*) and Mézard (*Amez*) volcano-sedimentary complexes and the Le Roy Complex (*Aroy*) (figures 3 and 13). Eighteen showings are described in mineral deposit files; this information is available on GM-type digital maps in SIGÉOM. Table 4 in appendix lists a few details on these occurrences.

Figure 13 shows the location of geochemical anomalies derived from lake sediment samples (MRN, 1998), as well as 21 geochemical anomalies derived from rock samples collected in the field (Table 5 in appendix).

Reconnaissance mapping by Percival and Card (1994) considered regional aeromagnetic troughs as likely to contain volcano-sedimentary rocks. Cominco and SOQUEM later carried out a joint regional exploration program, which led to the discovery of volcanic rocks near lakes Qalluviartuuq and Payne (NTS 34O), Kogaluc (NTS 34J) and Duquet (NTS 35B).

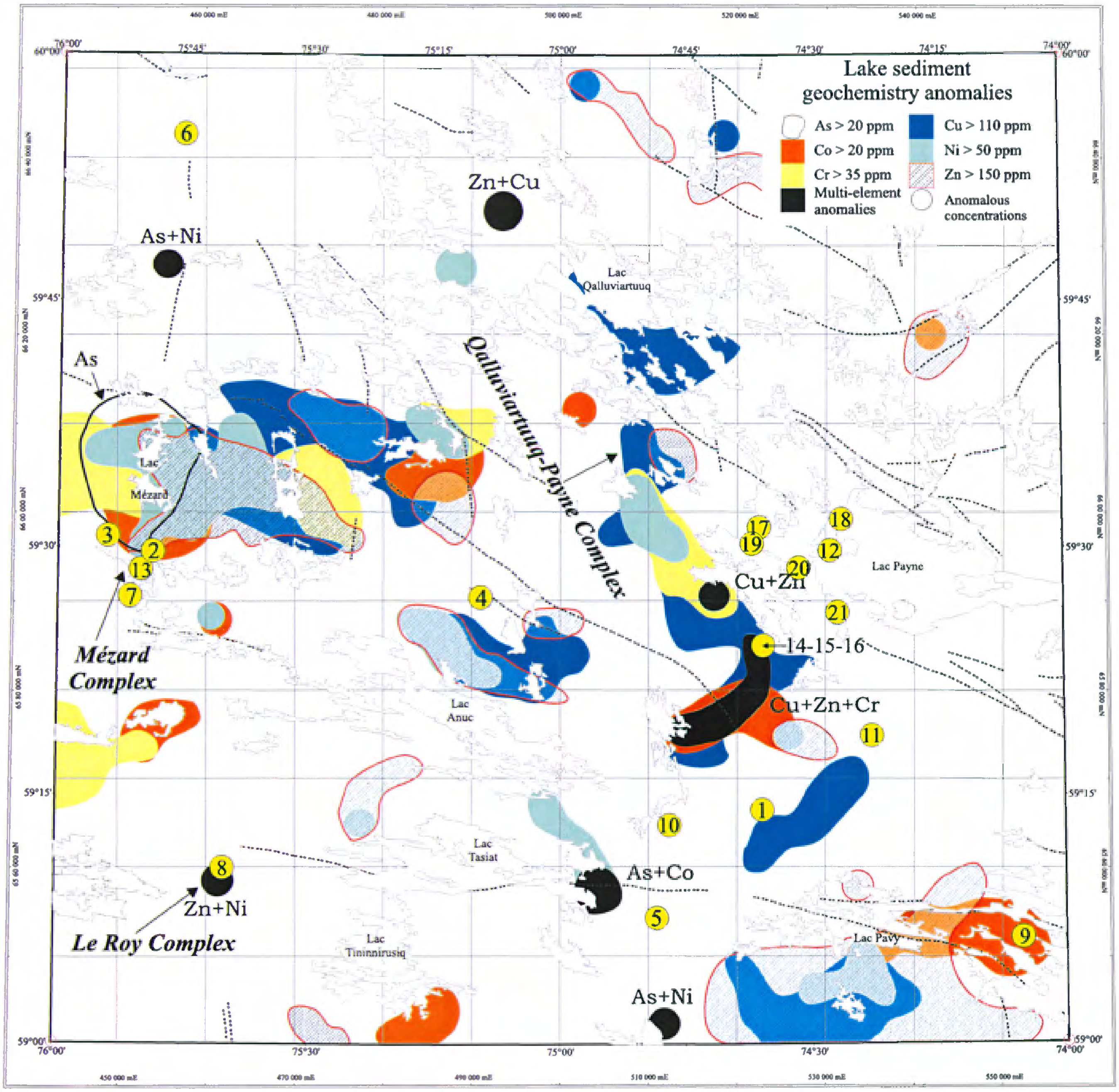

FIGURE 13 - Map showing the location of 21 anomalous results listed in Table 5 in appendix. In the background, the map shows lake sediment geochemistry anomalies (taken from MRN, 1998), major faults and major lakes in the area.

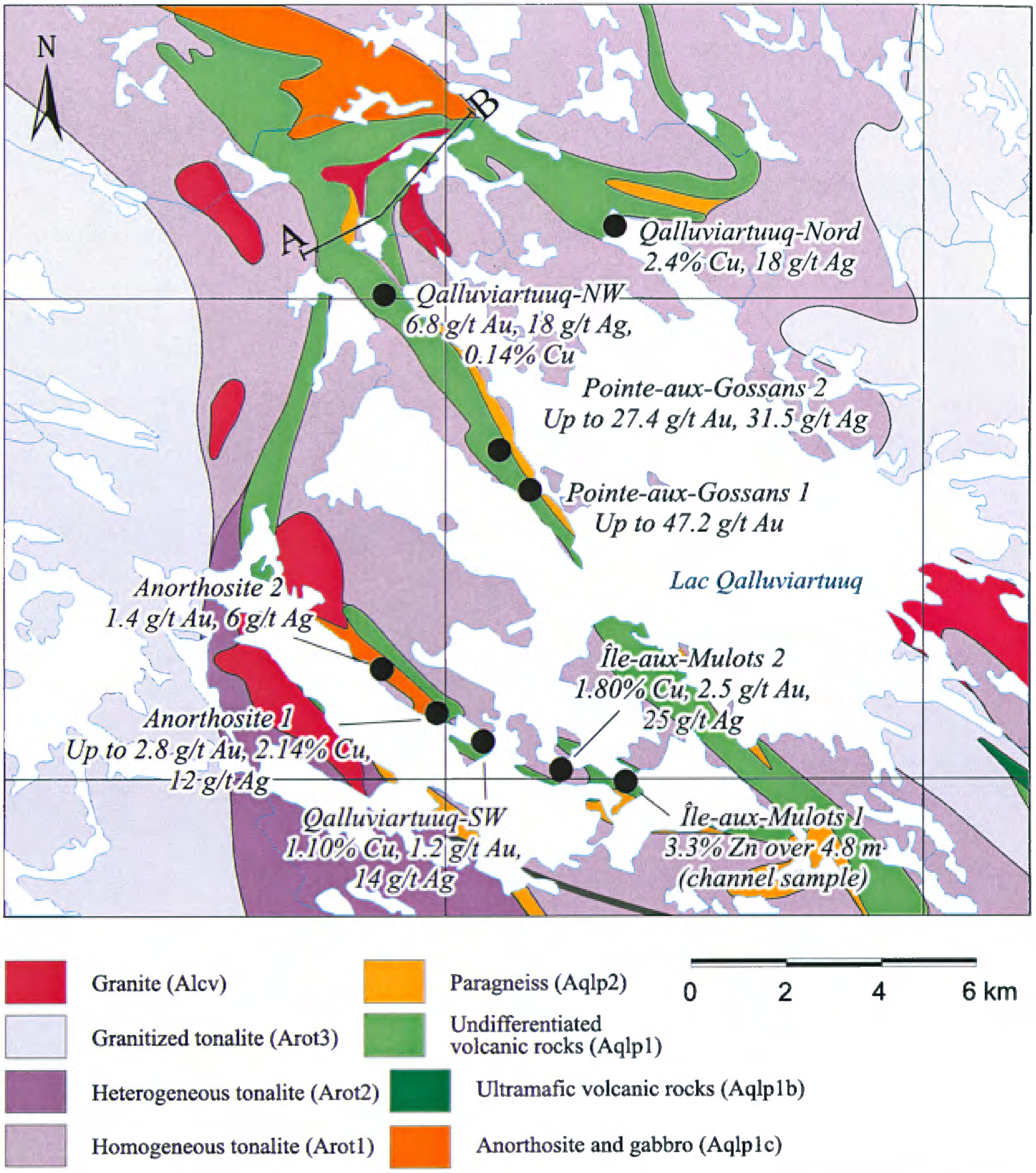

FIGURE 14 - Simplified geological map of the Lac Qalluviartuuq area, showing the location of mineral occurrences (inset shown in Figure 3). See Table 4 in appendix. Cross-section **A-B** corresponds to the stratigraphic section in Appendix **1**.

Qalluviartuuq-Payne Complex (*Aqlp*)

Since the early 1990s, reconnaissance work carried out by exploration companies in the Lac Qalluviartuuq area led to the discovery of a few copper and gold showings (Figure 14 and Table 4 in appendix). In the spring of 1993, ground geophysical surveys (magnetic, VLF, HLEM) were conducted in mineralized areas (Lum, 1993; Figure 2). In the summer 1993, prospecting, sampling and mapping outlined a prospective geological setting for volcanogenic massive sulphide-type polymetallic occurrences (Cattalani and Heidema, 1993). In 1994, a regional aeromagnetic and electromagnetic survey was completed (Imrie, 1994; Figure 2), along with additional exploration (Poirier, 1994). Later exploration efforts in this area are scarce, as interest shifted south to the Lac Payne area. In 2000 and 2001, showings in the *Pointe-aux-Gossans* and *Île-aux-Mulots* areas (Figure 14 and Table 4 in appendix) were sampled for lithogeochemistry, petrography and ore microscopy studies (Labbé and Lacoste, 2001). This study of alterations confirmed the setting as typical of volcanogenic polymetallic occurrences. Furthermore, in contrast with other volcanic belts studied in Québec's Far North, the Qalluviartuuq-Payne Complex (figures 3 and 14) is characterized by the presence of Mesoarchean (*ca.* 2851 Ma) anorthositic to gabbroic intrusions associated with mafic volcanic rocks.

The Lac Payne area (Figure 15) was the focus of detailed mapping and drilling (Chapdelaine and Poirier, 1996; Cuerrier, 1998; Chapdelaine, 1999; Francoeur and Chapdelaine, 1999; Cuerrier, 1999; Figure 2). Gold mineralization in this area is intimately associated with pyrite-rich silicate-facies iron formations. Reconnaissance surveys and exploration were undertaken in this area by Cominco and SOQUEM in 1993, and for a few days in 1994 and 1995. Following the discovery of an iron formation-hosted gold showing in this area (Cattalani and Heidema, 1993), Virginia Gold Mines joined up with SOQUEM and Cominco, and discovered several anomalous gold grades (> 550 ppb Au) scattered along a 2-km-plus segment (Chapdelaine and Poirier, 1996). In 1997, a prospecting campaign in the *Amaruk* and *Avingaluk* areas (Figure 15), followed by a drill program, defined a Au-bearing deformation zone more than 12 km long (Cuerrier,

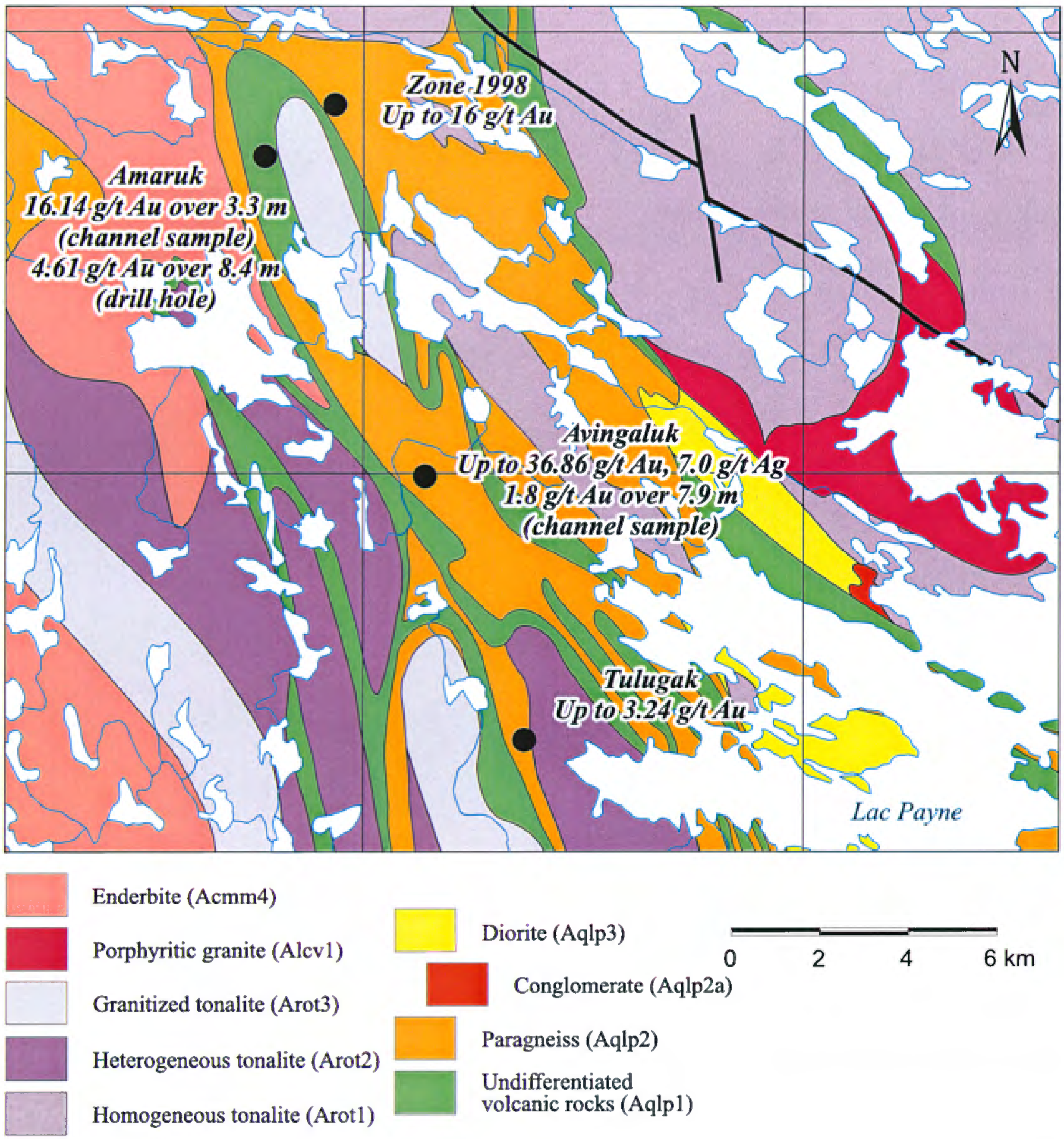

FIGURE 15 - Simplified geological map of the Lac Payne area, showing the location of mineral occurrences associated with iron formations (inset shown in Figure 3). See Table 4 in appendix.

1998). In 1998, detailed mapping (1:1,000 to 1:50) essentially focussed on the *Amaruk* and *Avingaluk* areas, while prospecting work was carried out in the *Tulugak* area (Chapdelaine, 1999). Finally, in 1999, channel sampling and drilling were carried out to test the extension of gold-bearing structures; the results indicate the north zone at *Amaruk* shows the greatest potential (Cuerrier, 1999).

Au-Ag-Cu Mineralization

A Au-Ag-Cu-rich zone in the *Pointe-aux-Gossans* area (*Pointe-aux-Gossans 1* and 2 showings; Figure 14) extends for more than one kilometre along strike, for about 200 metres in width. This area is characterized by a sequence of strongly deformed basalts altered to chlorite, biotite and garnet. Where alteration is less intense, the rocks contain hornblende relics replaced by chlorite. The Au-Ag-Cu mineralization occurs in rusty layered bands less than 1 m thick that are more siliceous than the surrounding basalts. These bands may represent thin felsic layers or horizons of silicified basalt. The mineralization generally consists of minor amounts of disseminated sulphides or thin stringers parallel to the schistosity. Pyrrhotite is the dominant sulphide phase, chalcopyrite is fine-grained and disseminated or encloses pyrrhotite, pyrite is associated with pyrrhotite, and magnetite is present in minor amounts. A few cm-scale horizons of massive to semi-massive sulphides were observed. Grab samples yielded up to 47 g/t Au and > 50 g/t Ag (Poirier, 1994). A few samples contained anomalous Cu (up to 1.3%). To date, no mineral resource has been calculated.

The *Qalluviartuuq-Nord*, *Qalluviartuuq-NW* and *Qalluviartuuq-SW* showings are located around Lac Qalluviartuuq (Figure 14). North of the lake, rusty zones less than 1 m thick are hosted in mafic volcanic rocks. The *Qalluviartuuq-Nord* showing, discovered by Poirier (1994) in mafic gneisses, graded 2.4% Cu and 18 g/t Ag. Very little work has been carried out on this showing. The *Qalluviartuuq-NW* showing is a new showing discovered during the 2001 field survey, which yielded grades up to 8 g/t Au, 18 g/t Ag and 0.14% Cu. The rusty zone (< 1 m thick) occurs at the interface between basalts and altered paragneisses that contain cordierite, sillimanite and garnet along with cm-scale quartz veins. The mineralization mainly consists of disseminated to semi-massive pyrite with traces of chalcopyrite. Pyrite grains are subrounded and partially resorbed between polygonal quartz grains. This type of mineralization is similar to that observed at *Île-aux-Mulots*. The *Qalluviartuuq-SW* showing is hosted in mafic schists or volcanic rocks, where cordierite porphyroblasts are scattered in a groundmass of biotite, anthophyllite and sillimanite, with quartz and garnet, indicative of intense volcanogenic hydrothermal alteration. A grab sample yielded assays of 1.1% Cu, 1.2 g/t Au and 14 g/t Ag.

Volcanogenic Zn-Cu Mineralization

A rusty zone in the *Île-aux-Mulots* area (*Île-aux-Mulots 1* and *2* showings; Figure 14) occurs in the northern part of the island, over a strike length of nearly 60 metres. In this area, the main alteration mineral is anthophyllite (up to 50%), locally associated with biotite, cummingtonite, gahnite and tourmaline (Labbé and Lacoste, 2001). No cordierite or garnet porphyroblasts were observed in these rocks. However, cordierite-anthophyllite-sillimanite-biotite alteration zones are reported west of Île-aux-Mulots (Cattalani and Heidema, 1993; *Qalluviartuuq-SW* showing). The volcanogenic Zn-Cu mineralization is associated with mafic volcanic rocks altered to anthophyllite. Disseminated to semi-massive sulphides consist of pyrite, pyrrhotite, sphalerite, chalcopyrite (inclusions in sphalerite) and galena. Channel samples yielded 3.3% Zn and 0.3% Cu over 4.8 m, and 14.2% Zn over 0.8 m (Poirier, 1994). Note that the most impressive alteration zones are found on islands; therefore, felsic volcanic and even massive sulphide horizons may occur underwater.

Cu-Au Mineralization

Another type of mineralization was observed west of Île-aux-Mulots (*Anorthosite 1* and *2* showings; Figure 14). This Cu-Au mineralization consists of sulphides disseminated in quartz veins associated with anastomosing shear zones in an anorthositic intrusion. The sulphides essentially consist of pyrite and traces of chalcopyrite. The degree of deformation increases where the texture shifts from granoblastic to mylonitic, with idiomorphic garnet locally observed in the anorthosite. A grab sample yielded 1.1% Cu and 1.9 g/t Au (Poirier, 1994); other samples also graded up to 2.8 g/t Au, 2.14% Cu and 12 g/t Ag.

Gold-Bearing Iron Formations

The *Amaruk* area (Figure 15) contains biotite + garnet ± hornblende paragneisses, amphibolites and iron formations trending NNW-SSE. Iron formation horizons are folded and recrystallized and may be traced over nearly 2 km along strike. They are 3 to 5 m thick on average, locally up to 20 to 25 m. Lode gold mineralization is controlled by D_3 shear zones associated with iron formations. The most significant gold grades were obtained from channel samples (8.86 g/t Au over 3.16 m and 16.14 g/t Au over 3.30 m) and in drillhole (4.61 g/t Au over 8.40 m, 5.28 g/t Au over 1.30 m, and 24.36 g/t Au over 0.75 m) (Figure 15 and Table 4). Gold is fine-grained and intimately associated with sulphides (Cuerrier, 1998). The structural model proposed for the emplacement of gold mineralization in this area involves folding (D_2) of the regional foliation, followed by hydrothermal fluid circulation (late to post-D_2?). Later on, a late phase of deformation (D_3?), oriented NNW-SSE, concentrated the gold in thin stringers along shear planes (Chapdelaine, 1999).

The *Avingaluk* area (Figure 15) is similar to the Amaruk area, both lithologically and structurally. However, it seems to be only weakly or not at all affected by the NNW-SSE deformation (D_3). This may explain the weaker gold grades obtained at Avingaluk compared to Amaruk. In the Avingaluk area, the iron formation, less than 10 m thick, extends for more than 4 km along strike. Several assays yielded anomalous gold grades (Table 4). The mineralization appears to be preferentially associated with the silicate and sulphide facies in the iron formation. This iron formation is interpreted as representing a skarn derived from an episode of calc-silicate metasomatism (Chapdelaine, 1999).

Grab samples from the *Tulugak* area (Figure 15) yielded grades of 629 ppb, 3.24 g/t and 2.44 g/t Au (Cuerrier, 1998). Very little work was carried out in this area, but additional samples collected in 1998 yielded grades of 100, 553 and 1124 ppb Au. The mineralization is similar to Amaruk and Avingaluk, but appears to be less widespread (Chapdelaine, 1999).

The lithologies and structural geology of *Zone 1998* (Figure 15) are similar to the Amaruk area. Gold grades (up to 16 g/t Au) were obtained from garnet-diopside-rich paragneiss samples. The mineralization consists of disseminated pyrite and arsenopyrite, associated with oxide-facies iron formations some fifteen metres thick (Cuerrier, 1998).

Mézard Complex (*Amez*)

Lake sediment analyses indicate anomalous arsenic concentrations (210 and 270 ppm) in the Mézard Complex (MRN, 1998; Figure 13). The supracrustal sequence ranges from 1 to 4 km in thickness, and contains iron formation horizons reaching up to 50 m thick in fold hinges (Francoeur and Chapdelaine, 1999). The *Mézard* showing, located along the western shore of Lac Mézard (Figure 16), yielded grades of 1.6 g/t Au and 1.6 g/t Ag, from a 10-cm pyrite lens in a metabasalt (Francoeur and Chapdelaine, 1999; Figure 2). Our work in the Lac Mézard area uncovered other iron formations to the south and north, and extended the gold-bearing zone. Three new showings were discovered (Figure 16 and Table 4). The *Stillwell* showing, located about 15 km north of the Mézard showing, yielded grades of 0.59 and 0.95 g/t Au. The *Mézard-NE* showing, located 5 km northeast of the Mézard showing, graded 0.7 g/t Au. The *Perronel* showing, located 0.8 km south of the Mézard showing, yielded grades of nearly 1 g/t Au. In this area, iron formations reach nearly 75 m in thickness; they mainly consist of thinly banded oxide-facies rocks which are locally strongly recrystallized. They contain a few sulphide layers, from 1 to 10 cm thick, consisting of disseminated (5 to 15%) to locally semi-massive (60%) pyrrhotite. Elsewhere, sulphides occur in thin stringers or are disseminated in magnetite layers.

Le Roy Complex (*Aroy*) – Lac Tininnirusiq Area

The Lac Tininnirusiq area is located in map sheet 34O/03. It is mainly composed of migmatized paragneisses, with an oxide-facies banded iron formation some 10 m thick. A few silicate-facies horizons with sulphide mineralization graded 2.9 g/t Au and trace copper (*Tininnirusiq* showing; Table 4). This area was not documented in detail.

CONCLUSIONS

The Lac Anuc area (NTS 34O), in the northeastern Superior Province, was subdivided into four lithodemic complexes, eight intrusive suites and one lithodeme, all Archean in age and emplaced between *ca.* 2.85 and 2.64 Ga. Archean units are cut by three sets of Paleoproterozoic dykes (< 2.2 Ga).

The Qalluviartuuq-Payne Complex (*Aqlp*), the Kogaluc Complex (*Akog*) and the Mézard Complex (*Amez*) comprise a variety of volcanic and sedimentary rocks (dated between *ca.* 2851 and > 2729 Ma) that form belts enclosed in a number of granitoid suites. The oldest plutonic units (*ca.* 2848 to 2740 Ma) are composed of tonalite and trondhjemite (TT) and were grouped in TTGG-type suites [Rochefort (*Arot*), Kakiattuq (*Akkk*) and Châtelain (*Achl*)]. These TT-type plutonic units exhibit an early WNW-ESE-trending structural fabric associated with a first phase of ductile deformation D_1. They are intruded by granodioritic to granitic units (GG) [GG-type La Chevrotière Suite (*Alcv*)], mafic to ultramafic plutonic rocks [MU-type Lac Calme Suite (*Aclm*)] and enderbites associated with opdalites and charnockites [EOC-type MacMahon (*Acmm*) and Qilalugalik (*Aqil*) suites, Le Roy Complex (*Aroy*), Lac Minto Suite (*Amin*)]. These units, emplaced between *ca.* 2732 and 2691 Ma, form a structural pattern oriented NNW-SSE to N-S (D_2), outlined by positive aeromagnetic anomalies. Phase of deformation D_2 is interpreted as coeval with the emplacement of GG, MU and EOC-type units.

Lin *et al.* (1996) associated phase of deformation D_2 with the preferential NNW orientation of regional structural and magnetic patterns as well as the regional amphibolite and granulite-grade metamorphism recorded in volcano-sedimentary belts. This regional tectonometamorphic event was originally interpreted as the result of a lateral accretion (collision) of the Utsalik, Goudalie and Minto domains, which took place between 2.693 and 2.675 Ga (Lin *et al.*, 1996). This event was later reinterpreted as the result of the collision (at ~2.77 Ga) of the Utsalik, Goudalie and Minto domains, followed by the burial of these domains (at ~2.69 Ga) related

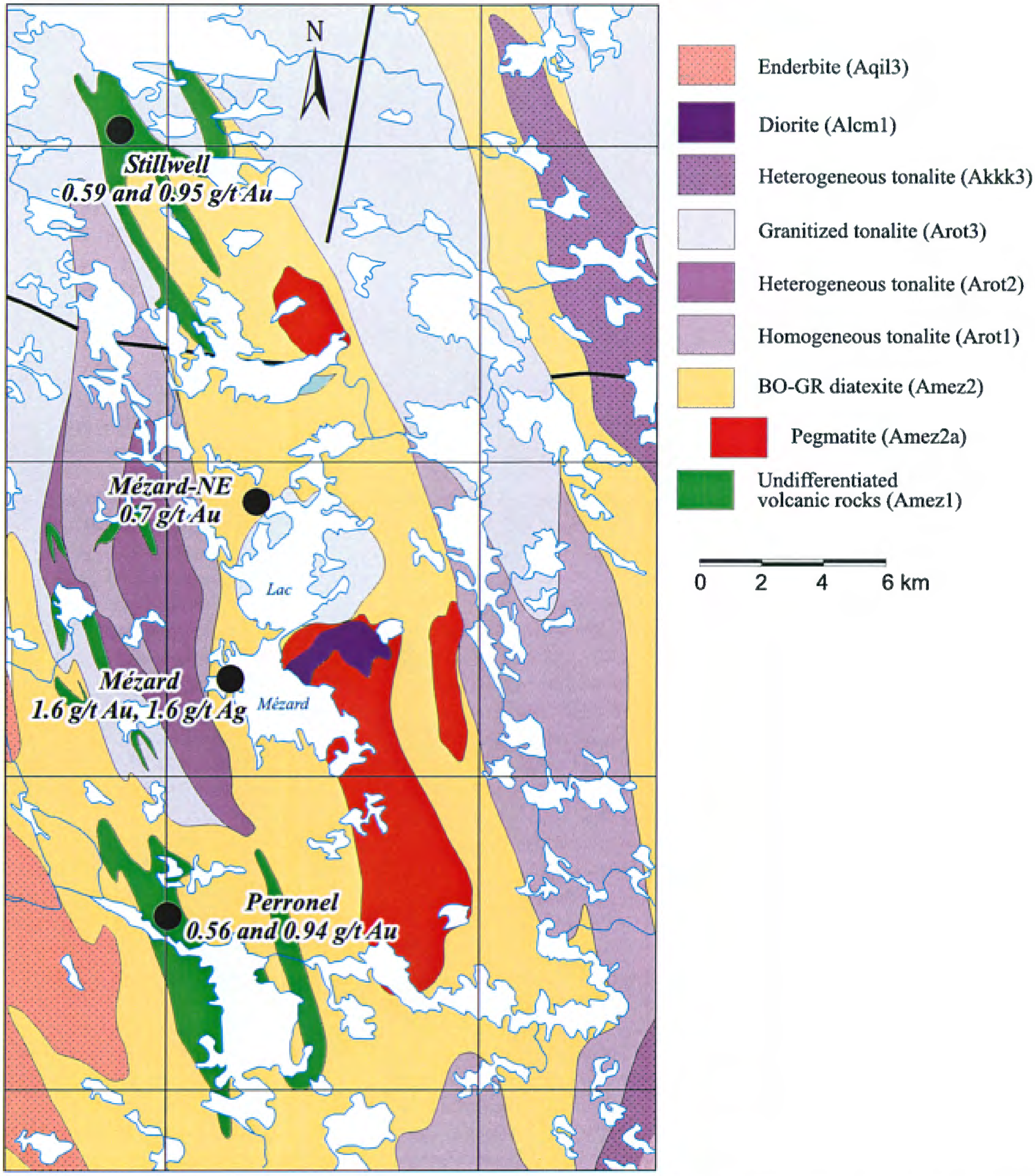

FIGURE 16 - Simplified geological map of the Lac Mézard area, showing the location of mineral occurrences (inset shown in Figure 3). See Table 4 in appendix.

to the thrusting of a magmatic arc (Tikkerutuk Domain) formed at 2.71-2.70 Ga (Percival and Skulski, 2000; Percival *et al.*, 2001). However, relationships between primary and tectonometamorphic structures recorded in volcano-sedimentary complexes and plutonic units, as well as geochronology data from the Lac Anuc area (NTS 34O) and adjacent areas, shed new light on the complex polyphase structural and metamorphic history of the area and help establish new tectonostratigraphic relations.

Plutonic TT-type units (2.85 to 2.74 Ga) and volcano-sedimentary complexes (2.85 to > 2.73 Ga) were affected by a first phase of synvolcanomagmatic deformation D_1. Structures associated with D_1 (oriented E-W to ESE-WNW) were reworked by a second phase of synmagmatic deformation D_2, responsible for sharply discordant structures (oriented N-S to NNW-SSE). Phase D_2 is also synmagmatic and synvolcanic. It controls the emplacement of GG, MU and EOC-type plutonic units, is coeval with the emplacement of calc-alkaline volcanic units (such as the 2nd volcano-sedimentary cycle of the Qalluviartuuq-Payne and Pélican complexes). Furthermore, the superposition of D_1 and D_2 phases of folding led to the formation of complex interference patterns which are only visible in the oldest units (> 2.74-2.73 Ga). These observations indicate that the regional NNW-SSE structural grain (so typical of the northeastern Superior Province) is the result of a tectono-metamorphic, synmagmatic and synvolcanic event that took place in a continuous fashion from *ca.* 2735 to 2690 Ma. A late-magmatic phase of deformation D_3 (2.693-2.675 Ga) led to the formation of penetrative shear zones, preferentially oriented NW-SE.

These three phases of ductile deformation (D_1 to D_3) are overprinted by three phases of brittle-ductile deformation (D_4 to D_6). Phase of deformation D_4 resulted in the formation of E-W-trending shear zones, one of which (the Tasiat-Pavy deformation zone) hosts the Lac Tasiat Syenite (*Atst*; *ca.* 2643 Ma). Two different sets of lineaments oriented WNW-ESE (D_5) to NW-SE (D_6) outline brittle-ductile structures that respectively channelled the emplacement of Klotz dykes (*pPktz*; *ca.* 2209 Ma) and Payne River dykes (*pPpay*; *ca.* 1875-1790 Ma). These two dyke swarms are cut by the Kogaluc River dyke swarm (*Akog*), formed of brecciated dykes.

Based on the results of metallogenic exploration conducted since the early 1990s, the mineral potential of the area is outlined by four types of mineralization: 1) volcanogenic Zn-Cu occurrences; 2) Cu-Au±Ag occurrences in synvolcanic porphyritic anorthosites; 3) Au-Ag-Cu occurrences in shear zones (associated with phase of deformation D_3); and 4) gold-bearing iron formations. These occurrences total 18 showings, all hosted in volcano-sedimentary units of the Qalluviartuuq-Payne (*Aqlp*), Mézard (*Amez*) and Le Roy (*pProg*) complexes. Thick sequences of iron formation mapped in the Mézard Complex constitute a new potential target for gold deposits. Furthermore, several anomalous assays were identified, which may represent additional areas of interest.

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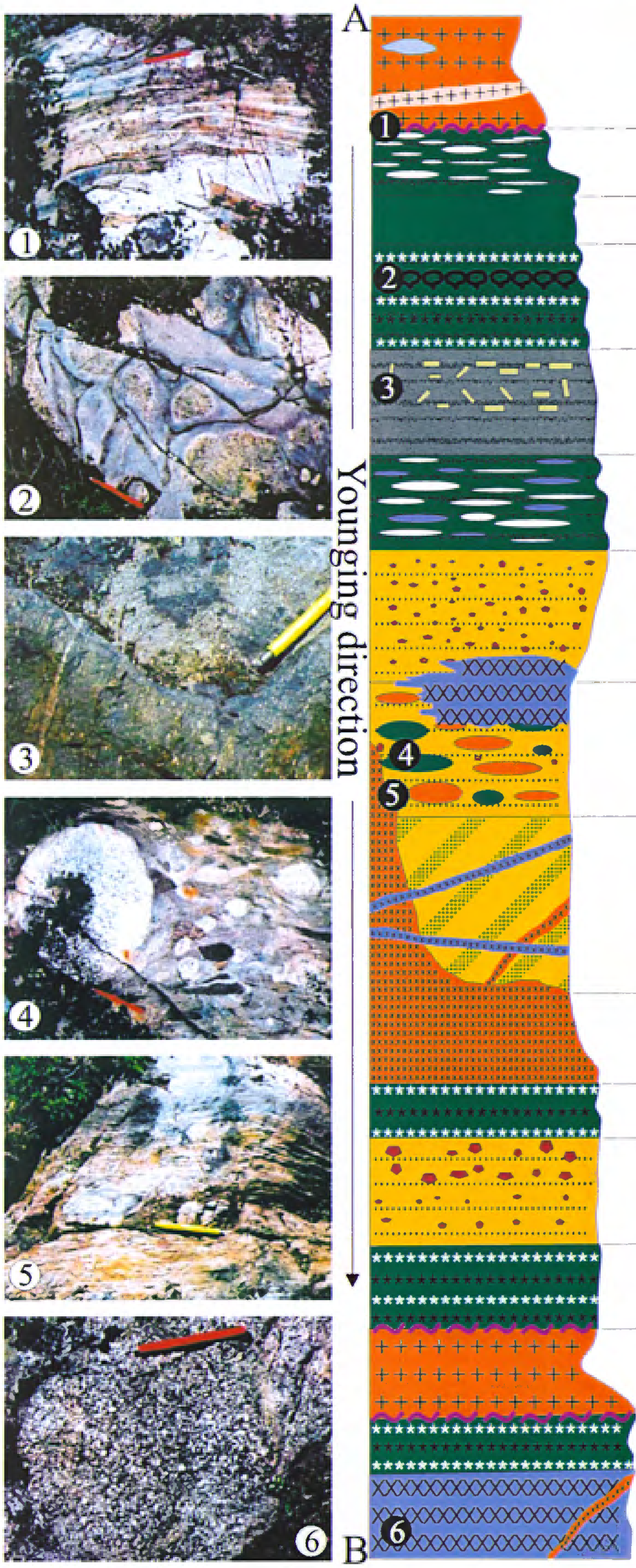
APPENDIX 1 - Qalluviartuuq-Payne (*Aqlp*) Complex - Lithostratigraphic column of the Lac Qalluviartuuq area.

(taken from Leclerc, 2004; location shown in figures 3 and 14)



Biotite tonalite, leucocratic, fine-grained, homogeneous and foliated, injected with granitic and occasionally pegmatitic material; locally contains diorite enclaves. The contact with the volcanic rocks is strongly foliated and lineated **(Photo 1)**.

Felsic to intermediate lapilli-block tuff; the groundmass is mafic and aphanitic.

Mafic volcanic rocks, aphanitic, with bands of stretched quartz veins transposed parallel to the foliation.

Mafic volcanic rocks, foliated, including epidotized pillows **(Photo 2)**, massive flow's with glomeroporphyritic crystals, flow breccias, mafic lapilli or block tuffs, and crystal tuffs **(Photo 3)**.

Plagioclase crystal and ash tuff with an aphanitic or fine-grained mafic, intermediate to felsic groundmass. Locally preserved cross-laminations suggest epiclastic resedimentation.

Mafic to intermediate lapilli-block tuff with an aphanitic foliated groundmass. Lapilli and blocks are composed of leucocratic and epidotized clinopyroxene gabbro and intermediate volcanic rock.

Garnet-biotite quartzofeldspathic paragneiss, homogeneous, foliated, medium or fine-grained. The contact between these metasedimentary rocks and underlying conglomerates is marked by an intrusion of hornblende ± clinopyroxene gabbro.

Polymictic conglomerate **(Photo 4)**, supported by a foliated sandy matrix, locally with garnet-biotite-cordierite. Clasts, which are stretched (L-tectonites), consist of tonalite, granodiorite, mafic to intermediate volcanic rock, quartzite, and magnetite pebbles.

Heterogeneous mixture of volcano-sedimentary rocks, including (1) mafic to intermediate volcanic rocks, mesocratic, fine-grained or aphanitic, and (2) foliated quartzofeldspathic paragneisses, medium to fine-grained. These rocks are injected by foliated leucocratic biotite-hornblende tonalites **(Photo 5)** and by dolerite dykes.

Hornblende tonalite, leucocratic, homogeneous, foliated, medium-grained.

Mafic to intermediate volcanic rocks, foliated, aphanitic or fine-grained, locally including epidotized pillows and flow breccias.

Foliated paragneiss with almandine garnet porphyroblasts (from 2-3 mm in sandy layers to 5-6 mm in pelitic layers) rimmed by cordierite.

Assemblage of mafic to intermediate volcanic rocks, foliated, aphanitic or fine-grained, alternating with flow breccias.

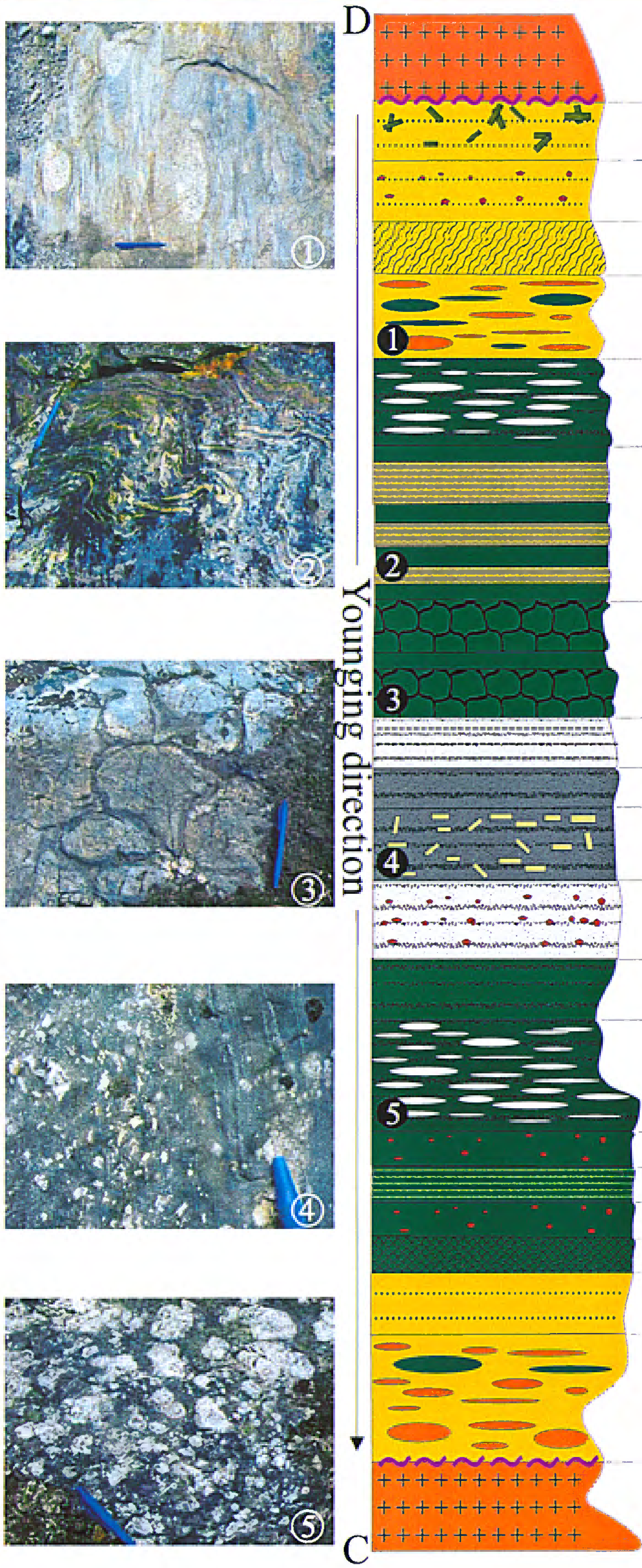
Biotite tonalite, leucocratic, medium-grained, homogeneous and foliated.

Mafic to intermediate volcanic rocks, foliated, aphanitic or fine-grained, alternating with epidotized pillows and flow breccias.

Hornblende ± clinopyroxene gabbro, medium-grained, homogeneous, foliated (to locally mylonitic). Magmatic textures generally well preserved **(Photo 6)**.

APPENDIX 2 - Qalluviartuuq-Payne (*Aqlp*) Complex - Lithostratigraphic column of the area to the west of Lac Payne.

(taken from Leclerc, 2004; location shown in figure 3)



Biotite tonalite, leucocratic, homogeneous, foliated, white to light grey.

Staurolite-bearing metapelite.

Biotite-garnet quartzofeldspathic paragneiss.

Pink homogeneous quartzite.

Polymictic conglomerate with blocks and clasts of tonalite (essentially), volcanic rocks and feldspars **(Photo 1)**.

Mafic tuff with felsic lapilli and blocks.

Oxide and sulphide-facies banded iron formation, with MG-PY-CP-BN-CV-PO mineralization, alternating with massive aphanitic mafic lava flows. Cherty horizons alternating with magnetite bands occur within or at the top of iron formations **(Photo 2)**.

Mafic pillow lavas alternating with massive aphanitic mafic lava flows. Pillows are chloritized and weakly deformed **(Photo 3)**.

Heterogeneous felsic tuff, foliated and bedded.

Massive mafic tuff with a heterogeneous grain size.

Crystal tuff **(Photo 4)**. Black aphanitic mafic groundmass with mm-scale automorphic plagioclase crystals.

Felsic tuff, foliated and heterogeneous, with a light grey aphanitic groundmass and mm-scale garnets.

Homogeneous mafic tuff.

Mafic tuff with felsic lapilli and blocks **(Photo 5)**, locally shows graded bedding and channels.

Green aphanitic mafic lava with mm-scale garnets.

Heterogeneous banded mafic lava (felsic bands).

Green aphanitic mafic lava with mm-scale garnets.

Green coarse-grained mafic lava.

Biotite paragneiss, fine-grained, homogeneous and foliated.

Poorly sorted conglomerate: monomictic at the base, with tonalitic clasts. Gradually becomes polymictic upsection, where it contains clasts of tonalite, mafic volcanic rock, black chert and dark grey and pinkish quartzite. The quartzofeldspathic matrix contains muscovite, biotite and fuchsite.

Biotite tonalite, leucocratic, heterogeneous grain size, foliated. Porphyritic biotite granodiorite, homogeneous, foliated, with diorite enclaves.

APPENDIX 3 - Photographs

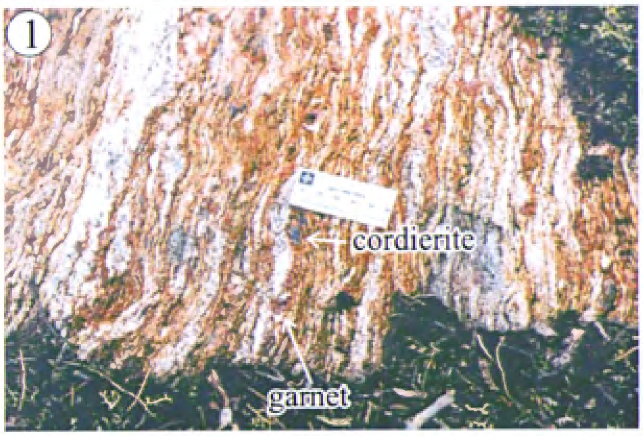


Photo 1 - Migmatized biotite-garnet-sillimanite-cordierite paragneiss of the Mézard Complex (Amez2).

Photo 2 - Hornblende tonalite assimilating boudinaged amphibolite enclaves (Arot2).

Photo 3 - Tonalite injected with granite (Arot3), most likely during D2 deformation.

Photo 4 - Foliated enderbite of the MacMahon Suite (Acmm4).

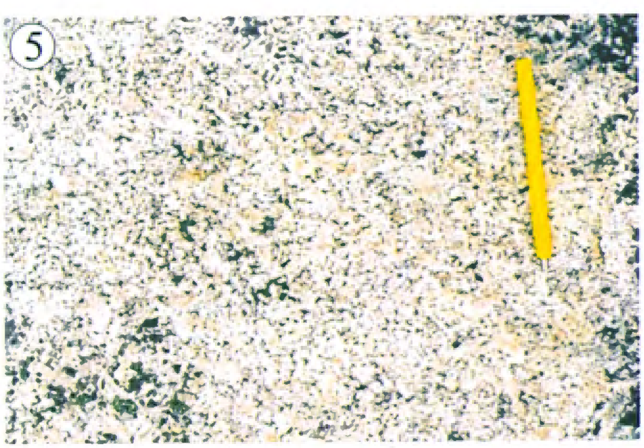


Photo 5 - Porphyritic monzogranite of the La Chevrotière Suite (Alcv1).

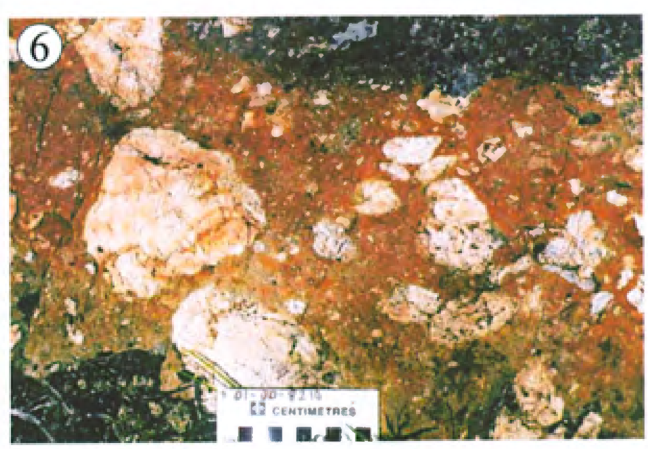


Photo 6 - Brecciated mafic dyke of the Kogaluc River swarm (pProg).

TABLE 1 - U/Pb age dating results for samples from the Lac Anuc area (NTS 34O).

Stratigraphy	Lithology	Analytical technique	Age of crystallization (Ma)	Inherited age (Ma)	Secondary age	Sample (SIGÉOM)	UTM coordinates	
							Easting	Northing
1- Qalluviartuuq-Payne Complex (Aqlp)	Megaphyric anorthosite (Aqlp1c)	1	2851.2 ±4.2 (10 / 0.15)*	-	-	01-AB-067	499 073	6 621 909
2- Rochefort Suite (Arot)	Medium-grained mesocratic biotite tonalite (Arot1)	1	2848 ±11 (9 / 33)*	-	-	01-FL-6004	498 355	6 630 921
3- Rochefort Suite (Arot)	Coarse-grained leucocratic biotite tonalite (Arot1)	1	1) 2810.8 ±2.2 (7 / 0.62)* 2) 2757.7 ±4.3 (25 / 1.4)*	-	-	01-CH-3067	503 184	6 619 060
4- Châtelain Suite(Achl)	Hornblende-clinopyroxene granodiorite (Achl)	1	1) 2760.3 ±4.3 (9 / 1.5)* 2) 2723 ±16 (5 / 13)*	2774.7 ±9.9 (7 / 9.6)*	-	01-AB-012	546 890	6 617 286
5- MacMahon Suite (Acmm)	Orthopyroxene enderbite (Acmm4)	1	2728.8 ±6.5 (7 / 3.1)*	2766.7 ±4.9 (3 / 0.11)*	-	01-CM-4043	500 735	6 592 147
6- Tasiat Syenite (Atst)	Nepheline syenite (Atst)	1	2643.4 ±7.6 (7 / 9.7)*	-	-	01-CM-4141	503 545	6 558 903

Analytical technique = 1: U-Pb analysis by in situ laser ablation multiple collector inductively coupled plasma mass spectrometry (LA-MC-ICP-MS).

Age = In million years (Ma) with an uncertainty (±) representing a confidence interval of 2 standard deviations (95%).

Results are derived from linear regression analysis according to Ludwig (2000).

* = (10/0.15): the number of analyses and the probability (%) or the MSWD (mean squared weighted deviation) respectively obtained for each type of regression.

Numbers 1 to 6 refer to sample locations shown in figure 3.

TABLE 2 - Compositional range for volcanic rocks of the Qalluviartuuq-Payne and Mézard complexes, mafic and ultramafic plutonic rocks of the Lac Calme Suite, and Proterozoic Klotz, Payne River and Kogaluc River dykes (Lac Anuc area, NTS 34O).

Stratigraphy	Qalluviartuuq-Payne Complex (*Aqlp*)					Mézard Complex (*Amez*)	
Unit	Aqlp1	Aqlp1a	Aqlp1b	Aqlp3	Aqlp	Amez1	
Lithology	V3 (M16)	V1	V4	V2 (I2I)	Dolerite (dyke)	V1	V3
Num. of samples	8	1	6	2	4	2	5
Major elements							
SiO_2	46.81 - 53.8	71.9	43.41 - 48.61	58.1 - 60.09	51 - 53.29	71.2 - 72.2	47.9 - 57.29
TiO_2	0.5 - 2	0.48	0.21 - 0.27	0.71 - 0.72	0.3 - 0.44	0.28 - 0.32	0.62 - 1.27
Al_2O_3	13.4 - 19.4	14.2	5.35 - 7.9	15.1 - 15.3	17.3 - 18.2	14.6 - 16	13.4 - 15.9
Fe_2O_3*	8.62 - 16.2	3.96	12.5 - 14.31	6.95 - 7.65	5.31 - 8.15	1.76 - 2.08	12.1 - 15.21
MnO	0.16 - 0.3	0.03	0.18 - 0.24	0.1	0.07 - 0.1	0.03 - 0.04	0.16 - 0.26
MgO	3.56 - 10	0.71	24.81 - 29.5	3.71 - 4.33	5.9 - 7.83	0.64 - 0.94	3.85 - 8.8
CaO	7.34 - 12.2	2.53	2.57 - 5.27	4.34 - 5.87	8.57 - 10.7	2.26 - 3.5	7.9 - 11.2
K_2O	0.1 - 0.69	1.6	0.4 - 0.81	2.45 - 2.75	0.5 - 1.6	1.05 - 2.36	0.36 - 1.18
Na_2O	1.18 - 3.44	4.47	0.12 - 0.71	2.87 - 3.65	3.04 - 4.24	4.08 - 4.74	1.42 - 2.72
P_2O_5	0.01 - 0.1	0.04	0.01	0.26 - 0.27	0.01 - 0.08	0.04 - 0.07	0.02 - 0.09
LOI*	0.06 - 1.07	0.34	0.7 - 5.24	1.32 - 1.34	0.93 - 2.27	0.64 - 0.67	0.27 - 1.71
Total	99.31 - 100.44	100.26	99.5 - 100.07	98.73 - 99.24	99.66 - 100.58	99.51 - 99.99	99.28 - 99.97
Trace elements							
Cr	20 - 760	20	2000 - 2800	81 - 300	150 - 300	20 - 53	20 - 270
Co	37 - 58	6	85 - 140	21 - 24	26 - 42	5 - 8	46 - 63
Ni	100 - 180	100	660 - 920	100	100 - 190	100	100 - 250
Sb	0.1 - 1.2	0.1	0.1	0.2 - 1.9	0.1 - 0.8	0.2 - 2.1	0.1
Rb	06 - 12	91	5 - 35	94 - 107	7 - 97	62 - 113	9 - 60
Sr	89 - 132	179	2 - 47	558 - 626	203 - 275	232 - 584	82 - 214
Ba	50 - 190	520	50	810 - 860	50 - 210	130 - 800	50 - 160
Ga	13 - 25	16	6 - 9	18 - 20	14 - 17	16 - 19	16 - 19
Sc	35 - 57	8	18 - 24	19	8 - 21	3.5 - 6.5	28 - 59
Nb	-	-	-	-	7 - 11	-	-
Zr	28 - 116	144	27 - 37	129	24 - 71	86 - 117	49 - 84
Th	0.2 - 3	5.4	1.0 - 1.8	6.7	0.3 - 1.1	0.7 - 5.6	0.2 - 1.3
Y	6 - 38	12	5 - 11	13	4 - 11	6 - 7	16 - 27
Br	0.5 - 2	2	0.5 - 9	0.5	0.5 - 1	0.5	0.5 - 1
Element ratios							
Al_2O_3/TiO_2	7.2 - 27.6	29.58	23 - 30.4	21 - 21.6	40.45 - 60.67	50 - 52.14	11.02 - 25.65
CaO/Al_2O_3	0.55 - 0.88	0.18	0.44 - 0.88	0.28 - 0.39	0.48 - 0.59	0.15 - 0.22	0.55 - 0.81
Mg#	0.29 - 0.64	0.24	0.77 - 0.79	0.46 - 0.53	0.61 - 0.70	0.39 - 0.45	0.35 - 0.56
Th/Nb	-	-	-	-	-	-	-
Ti/Zr	100 - 298	21	44 - 49	34	39 - 78	17 - 20	76 - 121
Zr/Y	2.33 - 4.20	12	3.36 - 3.38	8.25 - 9.92	4.36 - 8.75	14.3 - 16.7	2.52 - 3.11

* Total Iron expressed as Fe_2O_3
LOI = Loss on ignition (weight %)

TABLE 2 – continued

Stratigraphy	Lac Calme Suite (*Aclm*)				Proterozoic dykes		
Unit	Aclm1		Aclm2		pPktz	pPpay	pProg
Lithology	I2J. HB±CX [GF]	I3A	I4B	I4A	I3B	I3B	I3
Num. of samples	2	3	8	1	7	1	2
Major elements							
SiO_2	47.5 - 47.6	50.4 - 53.5	38.1 - 52.8	40.6	49.2 - 55.8	53.5	58.5 - 64.2
TiO_2	0.93 - 1.07	0.87 - 0.90	0.09 - 0.78	1.7	1.3 - 1.86	0.35	0.56 - 0.63
Al_2O_3	14.1 - 14.8	8.24 - 16.60	2.4 - 15.8	8.86	7.08 - 14.2	17.5	11.3 - 14.6
Fe_2O_3*	13.5 - 14.79	9.93 - 14.79	8.64 - 15.8	18.2	13.7 - 16.99	5.19	5.56 - 8.55
MnO	0.2 - 0.21	0.14 - 0.22	0.13 - 0.2	0.17	0.16 - 0.24	0.08	0.08 - 0.11
MgO	6.54 - 7.44	4.63 - 10.30	15.70 - 24.09	12.5	2.13 - 13	8.52	4.93 - 5.87
CaO	10.2	6.87 - 11.90	4.07 - 13.9	14.01	5.84 - 10.50	9.99	1.57 - 4.93
K_2O	0.78 - 0.82	0.86 - 2.73	0.04 - 0.96	1.06	0.06 - 0.82	1.12	0.77 - 0.44
Na_2O	3.28 - 3.37	1.91 - 4.19	0.29 - 1.23	1.51	2.2 - 3.64	2.23	2.73 - 6.91
P_2O_5	0.03 - 0.04	0.08 - 0.40	0.01 - 0.1	0.29	0.08 - 0.35	0.01	0.09
LOI*	0.34 - 0.42	0.35 - 0.37	1.12 - 1.97	1.07	0.58 - 2.4	1.64	3.36 - 4.17
Total	98.53 - 99.62	99.7 - 99.94	99.28 - 100.35	99.97	99.53 - 100.2	100.13	99.59 - 99.64
Trace elements							
Cr	180 - 220	31 - 140	200 - 2800	110	20 - 1300	340	240 - 360
Co	51 - 56	32 - 60	65 - 120	70	26 - 86	34	24 - 26
Ni	100 - 140	100	100 - 1100	100	100 - 520	240	100 - 120
Sb	0.1	0.1	0.1 - 0.2	0.1	0.1 - 0.2	0.1	0.1
Rb	9 - 11	32 - 100	3 - 25.4	21	5 - 35	64	5 - 17
Sr	137 - 157	282 - 1000	2 - 240.9	460	116 - 364	290	88 - 255
Ba	50	280 - 920	50 - 313	230	50 - 230	90	70 - 120
Ga	16 - 17	17 - 21	6.0 - 14	19	13 - 23	14	20
Sc	42 - 51	27 - 63	9.1 - 70	68	19 - 47	7.3	12 - 13
Nb	-	-	1.33 - 7	-	11 - 24	-	9 - 13
Zr	60 - 66	89 - 140	10.0 - 48	75	98 - 275	34	93 - 124
Th	0.6 - 0.7	1.1 - 4.3	0.2 - 3.11	0.7	0.8 - 4.1	0.6	3.3 - 7.3
Y	25 - 28	16 - 23	3 - 14.2	19	16 - 51	4	9 - 18
Br	0.5	0.5 - 0.8	0.5 - 2	0.5	0.5 - 3	1	0.5
Element ratios							
Al_2O_3/TiO_2	13.83 - 15.16	9.47 - 18.44	16.57 - 26.67	5.21	5.33 - 9.16	50	20.18 - 23.17
CaO/Al_2O_3	0.69 - 0.72	0.42 - 1.44	0.88 - 1.70	1.58	0.41 - 1.48	0.57	0.14 - 0.34
Mg#	0.44 - 0.50	0.45 - 0.55	0.69 - 0.82	0.55	0.21 - 0.62	0.75	0.55 - 0.62
Th/Nb	-	-	0.08 - 0.44	-	0.07 - 0.29	-	0.37 - 0.56
Ti/Zr	97 - 101	40 - 60	53.96 - 97.42	142	35 - 114	64	32 - 38
Zr/Y	2.36 - 2.4	3.87 - 8.75	1.8 - 3.52	3.95	3.77 - 7.24	8.5	5.17 - 13.78

* Total Iron expressed as Fe_2O_3
LOI = Loss on ignition (weight %)

TABLE 3 - Compositional range for granitoids and mafic rocks associated with the various complexes and suites of the Lac Anuc area (NTS 34O).

Stratigraphy	Rochefort Suite (*Arot*)		Châtelain Suite (*Achl*)		La Chevrotière Suite (*Alcv*)			Le Roy Complex (*Aroy*)	Tasiat Syenite (*Atst*)
Unit	**Arot1**	**Arot2**	**Achl**	**Achl**	**Alcv1**	**Alcv3**	**Alcv**	**Aroy3**	**Atst**
Lithology	**I1D-BO**	**I1D-HB-BO±CX**	**I1D à I1C**	**I2J, CX-HB [GM]**	**I1M**	**I1C-BO**	**I2J, HB [GM]**	**I3A**	**I2D**
Num. of samples	**3**	**8**	**6**	**1**	**3**	**4**	**1**	**1**	**1**
Major elements									
SiO_2	67.1 - 69.0	61.6 - 69.0	59.7 - 66.8	52.1	68.9 - 72.2	71.5 - 73.0	48.3	52.0	58.7
TiO_2	0.23 - 0.44	0.25 - 0.65	0.27 - 1.32	0.65	0.29 - 0.54	0.15 - 0.21	1.08	0.76	0.25
Al_2O_3	16 - 17.6	14.4 - 18.4	15.4 - 17.6	15.7	13.8 - 15.7	14.3 - 16.1	17.0	13.7	21.5
Fe_2O_3*	2.35 - 3.16	2.65 - 5.64	3.08 - 7.56	9.19	2.08 - 3.68	1.09 - 1.83	13.5	10.8	2.85
MnO	0.02 - 0.03	0.03 - 0.08	0.04 - 0.11	0.14	0.02 - 0.05	0.01 - 0.03	0.13	0.17	0.08
MgO	0.87 - 1.16	1.13 - 2.66	1.47 - 2.13	6.89	0.54 - 0.74	0.34 - 0.52	5.21	7.72	0.41
CaO	3.14 - 3.65	3.7 - 5.49	3.29 - 5.18	8.68	1.85 - 2.41	1.83 - 2.84	8.15	8.38	0.92
K_2O	1.45 - 2.32	0.77 - 2.68	1.34 - 2.81	1	2.92 - 4.94	1.85 - 3.48	1.6	0.98	5.17
Na_2O	4.39 - 5.37	3.71 - 5.71	4.39 - 5.51	4	3.59 - 4.48	4.4 - 4.94	3.5	2.76	7.95
P_2O_5	0.06 - 0.14	0.07 - 0.20	0.1 - 0.48	0.12	0.04 - 0.11	0.01 - 0.03	0.18	0.3	0.06
LOI*	0.39 - 0.85	0.39 - 1.11	0.4 - 0.89	1.07	0.31 - 0.76	0.23 - 0.58	1.34	1.31	1.63
Total	99.22 - 99.78	99.05 - 100.17	99.28 - 99.88	99.53	99.09 - 100.18	98.82 - 100.16	99.99	99.68	99.52
Trace elements									
Cr	-	-	-	-	-	-	-	-	-
Co	6 - 8	7 - 17	10 - 14	39	5 - 6	5	36	5	5
Ni	-	-	-	110	-	-	-	-	-
Rb	48 - 82	32 - 80	28 - 72	14	66 - 208	45 - 106	54	182	182
Sr	392 - 548	186 - 947	624 - 898	713	235 - 517	334 - 567	634	398	398
Ba	200 - 830	260 - 710	380 - 1500	210	690 - 1400	530 - 910	400	250	250
Ga	19 - 22	16 - 22	20 - 23	20	18 - 20	19 - 21	25	22	22
Sc	1.4 - 6.5	4.4 - 13	3.2 - 18	27	1.6 - 5.5	1.1 - 5.1	41	0.5	0.5
Nb	6 - 8	6 - 10	7 - 18	10	5 - 25	5 - 13	-	26	26
Zr	117 - 148	65 - 218	122 - 433	69	93 - 332	76 - 125	61	455	455
Th	4.3 - 8.4	0.3 - 9.2	0.5 - 5.1	0.6	0.9 - 14	1.9 - 8.5	1.7	1.5	1.5
Y	3 - 10	7 - 22	5 - 38	16	3 - 33	3 - 5	15	3	3
Br	0.5 - 7	0.5 - 2	0.5 - 1	2	0.5 - 1	0.5	0.5	4	4
Element ratios									
Al_2O_3/TiO_2	38.9 - 69.6	22.15 - 73.6	11.9 - 65.2	24.15	25.6 - 51.4	68.1 - 107.3	15.7	18.0	86.0
CaO/Al_2O_3	0.19 - 0.21	0.25 - 0.32	0.21 - 0.31	0.55	0.13 - 0.15	0.13 - 0.19	0.48	0.61	0.04
Mg#	0.39 - 0.45	0.39 - 0.50	0.32 - 0.47	0.57	0.22 - 0.36	0.32 - 0.38	0.41	0.58	0.21
Th/Nb	0.72 - 1.40	0.04 - 0.95	0.06 - 0.64	0.06	0.18 - 0.72	0.32 - 0.65	-	0.15	0.06
Ti/Zr	10 - 19	17 - 30	14 - 28	59	10 - 20	11 - 12	111	150	3
Zr/Y	14.4 - 49.3	9.3 - 19.0	11.1 - 27.4	4.3	10.1 - 53.3	25.0 - 34.7	4.1	2.76	151.67

* Total Iron expressed as Fe_2O_3
LOI = Loss on ignition (weight %)

TABLE 4 - Characteristics of 18 showings in the Lac Anuc area (NTS 34O). See figures 14, 15 and 16 for showing locations.

Showing	Location map	Location Easting, Northing	Main commodity (secondary)	Mineralization*	Host rock	Alteration*	Grade	Mineral deposit file number	Comments*	Note
Mézard	Figure 16	452028, 6603075	Au (Ag)	PY	Mafic volcanic rock	GR	1.6 g/t Au, 1.6 g/t Ag, 589 ppm Cu	34O12-0001	2% disseminated sulphides, 10-cm pockets	GM-56437
Mézard-NE	Figure 16	452857, 6608708	Au	PY	Silicate-facies iron formation	Not observed	0.7 g/t Au	34O12-0002		GM-56437
Perronel	Figure 16	450050, 6595532	Au	PO, PY	Iron formation	Not observed	0.94 g/t Au and 0.55 g/t Au	34O05-0001	Rusty PO-PY layers (<1 m) in oxide-facies iron formation	Samples 01-9081A1 and A2
Stillwell	Figure 16	448475, 6620488	Au	PY	Iron formation	Not observed	0.59 g/t Au and 0.95 g/t Au	34O12-0003		GM-56437
Amaruk	Figure 15	507743, 6607166	Au (Ag)	PO, PY, (AS)	Iron formation	GR, BO, CL, DP, AC, GN	1997 drillholes: 4.61 g/t Au over 8.4 m; 24 g/t Au over 0.75 m; 5.28 g/t Au over 1.3 m. 1997 channel samples: 8.86 g/t Au over 3.16 m and 16.14 g/t Au over 3.3 m; several assays between 2 and 17 g/t Au. 1999: sample 14143 = 19.06 g/t Au, and sample 14139 = 5.07 g/t Au	34O10-0002	2-15% disseminated to massive sulphides in alteration zones along the contact between iron formations and paragneisses	GM-55885, (GM-56553)
Avingaluk	Figure 15	511377, 6599942	Au (Ag)	PO, PY	Iron formation	GR, BO, CL, GN	36.86 g/t Au, 7.0 g/t Ag; 15.67 g/t Au, 3.7 g/t Ag; Channel sample: 1.57 g/t Au over 8.0 m (1.8 g/t Au over 7.9 m)	34O10-0006	2-15% disseminated sulphides in alteration zones along the contact between iron formations and paragneisses. Less deformed than Amaruk	GM-55885, (GM-56553)
Tulugak	Figure 15	513629, 6593968	Au	PO, PY, AS	Iron formation	GR, GN, DP, BO	3.24 g/t Au, 2.44 g/t Au	34O07-0001	1-2% disseminated sulphides in alteration zones along the contact between iron formations and paragneisses	GM-55885
Zone 1998	Figure 15	509340, 6608353	Au	PY, AS	Paragneiss and iron formation	GR, DP, HB	16.08 g/t Au and 4.68 g/t Au	34O10-0007	Similar to Amaruk, disseminated sulphides	GM-56553
Anorthosite-1	Figure 14	499800, 6621350	Au, Cu, Ag (Zn)	PY, CP	Quartz veins associated with shear zones	QZ	1.9 g/t Au, 1.1% Cu; 2.8 g/t Au, 2.14% Cu, 12 g/t Ag; several grades especially in the SE	34O11-0001	Vein-hosted sulphides, disseminated or in pods	GM-52254
Anorthosite-2	Figure 14	498661, 6622283	Au, Cu, Ag	PY, CP	Quartz veins associated with shear zones in anorthosite	QZ	1.4 g/t Au, 5360 ppm Cu, 6 g/t Ag	34O11-0002	Vein-hosted sulphides, disseminated or in pods	GM-52254
Ile-aux-Mulots-1	Figure 14	503815, 6619933	Zn, Cu, Ag (Au)	SP, PY, CP, PO	Mafic gneiss	AT, SM, BO, GR	Channel samples: 3.3% Zn over 4.8 m; 14.2% Zn over 0.8 m	34O10-0003	VMS-type massive to disseminated sulphides in metabasalts	GM-52254
Ile-aux-Mulots-2	Figure 14	502433, 6620208	Cu, Au, Ag (Zn)	PY, CP	Mafic gneiss and paragneiss	AT, CD, GR, BO	1.80% Cu, 2.5 g/t Au and 25 g/t Ag	34O10-0005	Massive to disseminated sulphides	GM-52254
Pointe-aux-Gossans-1	Figure 14	501787, 6626025	Au, Cu, Ag	PO, PY, AS, CP	Felsic horizons in amphibolite	GR	47.21 g/t Au, >50 g/t Ag, 5262 ppm Cu Channel sample: 2.18 g/t Au, 0.3 g/t Ag, 958 ppm Cu over 0.8 m	34O15-0001	Disseminated to semi-massive sulphides in felsic to intermediate horizons (cm-scale to 15 m thick) enclosed in metabasalt sequence	GM-52818
Pointe-aux-Gossans-2	Figure 14	501114, 6626867	Au, Cu, Ag	PO, PY, AS, CP	Felsic horizons in amphibolite	GR	27.43 g/t Au, 31.5 g/t Ag; 7.5 g/t Au, 3 g/t Ag, 0.1% Cu Channel sample: 0.51% Cu over 0.15 m	34O15-0002	Disseminated to semi-massive sulphides in felsic to intermediate horizons (cm-scale to 15 m thick) enclosed in metabasalt sequence	GM-52818
Qalluviartuuq-Nord	Figure 14	503534, 6631517	Cu, Ag	PY, CP	Mafic gneiss	Not observed	2.4% Cu, 18 g/t Ag	34O15-0003		GM-52254
Qalluviartuuq-NW	Figure 14	498724, 6630093	Au, Ag (Cu)	PY, CP	Quartz veins in paragneiss	CD, SM, GR	6.8 g/t Au, 18 g/t Ag, 610 ppm As, 0.14% Cu, 173 ppm Co	34O14-0001	Disseminated to semi-massive sulphides in paragneisses associated with QZ veins	Sample 01-6002D1
Qalluviartuuq-SW	Figure 14	500773, 6620770	Cu, Au, Ag	PY, CP	Mafic gneiss	AT, SM, BO, GR	1.10% Cu, 1.21 g/t Au et 14 g/t Ag	34O10-0004	Massive to disseminated sulphides	GM-52254
Tininnirusiq	Figure 13	473713, 6550364	Au (Cu)	PO, PY	Iron formation	Not observed	2.9 g/t Au, 210 ppm Cu	34O03-0001	Disseminated sulphides in silicate-facies iron formation within a migmatized paragneiss sequence	Sample 01-5157C1

* See Sharma (1996) for the mineral codes

TABLE 5 - Characteristics of 21 anomalous samples from the Lac Anuc area (NTS 34O). Sample locations shown in Figure 13.

Anomalous zone (Figure 13)	Sample	NTS	Location (Easting - Northing) (Zone 18, NAD 83)	Grades	Comments
1	01-3182C	34O/02	522564, 6565405	0.23 g/t Au, 28 ppm As	Iron formation (magnetite-grunerite) in partially migmatized volcano-sedimentary sequence
2	01-5038G	34O/05	453546, 6595567	1.7 g/t Ag, 0.11 % Cu	20-cm-wide exhalite with pyrite and chalcopyrite
3	01-5033C	34O/05	449511, 6596111	720 ppm Cu	30-cm-wide exhalite with pyrite
4	01-9057A	34O/06	491001, 6590240	4.6 g/t Ag, 342 ppm Cu, 133 ppm Zn	GR-BO-MG paragneiss with pyrite and chalcopyrite stringers and coatings
5	01-5107A	34O/02	511060, 6642310	4.3g/t Ag, 203 ppm Cu, 129 ppm Zn	Banded and altered (chlorite, epidote) metabasalt, with traces of pyrrhotite and magnetite
6	01-5147A	34O/13	457506, 6642310	3.3g/t Ag, 695 ppm Cu, 497 ppm Ni, 105 ppm Co	Tectonized metabasalt with disseminated pyrite and pyrrhotite
7	01-8161B2	34O/05	451245, 6590192	1.4 g/t Ag, 475 ppm Cu, 238 ppm Ni, 104 ppm Co	Felsic horizon with disseminated pyrite and pyrrhotite, in diatexite derived from a sedimentary protolith
8	01-5179B2	34O/04	461809, 6559712	627 ppm Cu, 241 ppm Zn	Biotite-garnet paragneiss, with disseminated pyrrhotite and pyrite
9	01-8220A	34O/01	550535, 6552367	612 ppm Cu, 405 ppm Zn	Garnet-sillimanite paragneiss
10	01-10115C	34O/02	512443, 6564266	0.17 % Zn	Pyrite-bearing iron formation
11	01-8002E	34O/08	534824, 6574369	455 ppm Zn	Garnet-grunerite-bearing iron formation
12	01-6062C1	34O/08	530150, 6595597	387 ppm Zn, 386 ppm Cu	Iron formation with pyrite, pyrrhotite and chalcopyrite
13	01-5167D2	34O/05	452523, 6594315	308 ppm Zn, 80 ppm U	Garnet-bearing iron formation, with pyrite, pyrrhotite and chalcopyrite
14	01-8039N	34O/07	522863, 6585849	0.48 g/t Au, 1.3 g/t Ag, >500 ppm As, 0.12 % Cu	Subcrop of massive sulphides in garnet paragneisses interlayered with oxide-facies iron formation
15	01-8039O	34O/07	523002, 6585799	0.20 g/t Au, >500 ppm As	Disseminated pyrite (> 10%) in garnet paragneiss sequence
16	01-8039J	34O/07	523098, 6585117	1.7 g/t Ag, 447 ppm Cu	Fine disseminated pyrite (< 1%) in paragneiss sequence
17	GM-55885	34O/10	521495, 6597250	0.5 g/t Au	Sericitized felsic volcanic rock; sample 97-69957
18	GM-55885	34O/09	531500, 6598400	2.5 g/t Ag, 268 ppb Au, 0.37 % Cu	Epidotized and silicified metabasalt with disseminated pyrrhotite; sample 97-699967
19	GM-55885	34O/10	521550, 6596950	0.18 % Cu	Epidotized metabasalt, with pyrite, pyrrhotite and chalcopyrite
20	GM-55885	34O/10	527490, 6593900	0.27 % Zn and 0.12 % Zn	Silicified and sericitized metabasalt, with pyrite, pyrrhotite and chalcopyrite
21	GM-55885	34O/10	530850, 6588700	0.10 % Cu	Epidotized metabasalt; sample 96-525582

Résumé

The Lac Anuc area (NTS 34O) was mapped at 1:250,000 scale in the summer 2001, within the scope of the Far North Project. The area lies 150 km east of Puvirnituq, between latitudes 59 00' and 60 00'N and longitudes 74 00' and 76 00'W.

The Lac Anuc area was subdivided into four lithodemic complexes, eight intrusive suites and four lithodemes. It underwent three episodes of ductile deformation (D1 to D3) and three episodes of brittle-ductile deformation (D4 to D6). Phase of deformation D1 is coeval with the emplacement of volcano-sedimentary units (grouped into three complexes of < 30 km x < 150 km in size and dated at ca. 2851 to > 2729 Ma), as well as tonalite-trondhjemite units (ca. 2848 to > 2740 Ma). Phase of deformation D2 is also synplutonic and synvolcanic, but it controls the emplacement of granite-granodiorite units (ca. 2732-2723 Ma), mafic to ultramafic rocks (MU) and enderbite-opdalite-charnockite-diatexite units (ca. 2729-2682 Ma). Phase of deformation D3 is late (2693-2675 Ma) and is responsible for the formation of NW-SE to NNW-SSE-trending shear zones. Brittle-ductile deformation events (D4 to D6) control the emplacement of a late Archean syenite (ca. 2643 Ma) and three sets of Paleoproterozoic dykes (< ca. 2209 Ma).

The economic potential of the Lac Anuc area is outlined by the presence of volcanogenic Zn-Cu occurrences, Cu-Au±Ag occurrences in synvolcanic glomerophyric anorthosites, gold-bearing iron formations, and Au-Ag-Cu occurrences in shear zones. These occurrences form 18 showings, all hosted in volcano-sedimentary units.

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