RG 2004-05

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Waterfall along the Rivière Decoumte, south of the Povungnituk area.

2005

Québec

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Abstract

The geology of the Povungnituk area (NTS 35C and the southeastern part of 35F) was mapped at the 1:250 000 scale during the summer of 2002. It was subdivided into two lithodemic complexes, two volcano-sedimentary belts, six intrusive suites, one lithological unit and four lithodemes, all emplaced between 2.8 and 1.8 Ga. The Povungnituk and Mézard complexes, as well as the Duquet Belt, contain various types of volcano-sedimentary rocks, metamorphosed to the amphibolite and the granulite facies and enclosed in different granitoid units. Volcano-sedimentary rocks of the Juet Belt are metamorphosed to the greenschist and the amphibolite facies, and are not intruded by felsic plutonic suites. Plutonic units were grouped into suites which, from the oldest to the youngest, are: *(i)* mafic and ultramafic rocks of the Couture Suite; *(ii)* tonalites-trondhjemites-granodiorites-granites of the Rochefort Suite (2830 to 2766 Ma); *(iii)* granites-granodiorites of the La Chevrotière (2732 Ma) and Pinguq (2727 Ma) suites; *(iv)* enderbites-opdalites-charnockites of the Qilalugalik Suite (2730 Ma); *(v)* diatexites of the Bylot Suite (2737 to 2722 Ma). These units are cut by four sets of Paleoproterozoic gabbro and diabase dykes, namely the Klotz (2209 Ma), Payne River (> 2000 Ma), Irsuaq River and Pointe Raudot dykes.

Rocks in the area have undergone polyphase deformation. A first phase of ductile deformation (D_1) is responsible for F_1 folds and an S_1 fabric oriented E-W to WNW-ESE, which are only locally preserved in volcano-sedimentary units. This deformation was reworked by a second phase of regional deformation (D_2), responsible for the prominent N-S to NNW-SSE-trending fabric. A phase of dextral shearing (D_3) affects all the rocks in the area, albeit in a heterogeneous manner. This phase of deformation resulted in the formation of a synmetamorphic mylonitic fabric oriented WNW-ESE. It is coeval with the emplacement of porphyroclastic granitoids of the Pinguq Suite and diatexites of the Bylot Suite. Following these three Archean phases of deformation, a Paleoproterozoic anorogenic episode occurred, during which the Klotz, Payne River and Irsuaq River dyke swarms were emplaced along brittle faults (D_5). Then, three phases of Paleoproterozoic deformation related to the Ungava Orogen (D_6) affected Archean rocks just south of the orogenic front.

The economic potential of the area is outlined by two types of mineral occurrences: 1) gold occurrences associated with sulphide-facies iron formations in the Juet Belt, and 2) Cu ± Ag occurrences in quartz-rich veins with semi-massive sulphides, observed in the Mézard Complex.

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INTRODUCTION

Objectives

The geological survey of the Povungnituk (NTS 35C) and Kovik Bay (NTS 35F, southeastern part) areas – hereafter referred to as the "Povungnituk area" – is part of the geological mapping program of the *Ministère des Ressources naturelles, de la Faune et des Parcs* in Québec's Far North (north of the 55[th] parallel; Figure 1). The objectives of the Far North program are to establish a regional geological framework for the Archean bedrock in order to open up this vast (> 350,000 km²) territory to mineral exploration. The area covered by this survey conducted during the summer of 2002 corresponds to NTS sheet 35C and map sheets 35F/01 and 35F/02, located west of the Lac Couture area (NTS 35B; Madore *et al.*, 2004), and northwest of the Lac Anuc area (NTS 34O; Berclaz *et al.*, 2003).

The main objectives of mapping the Povungnituk area are to upgrade our geological knowledge, establish the

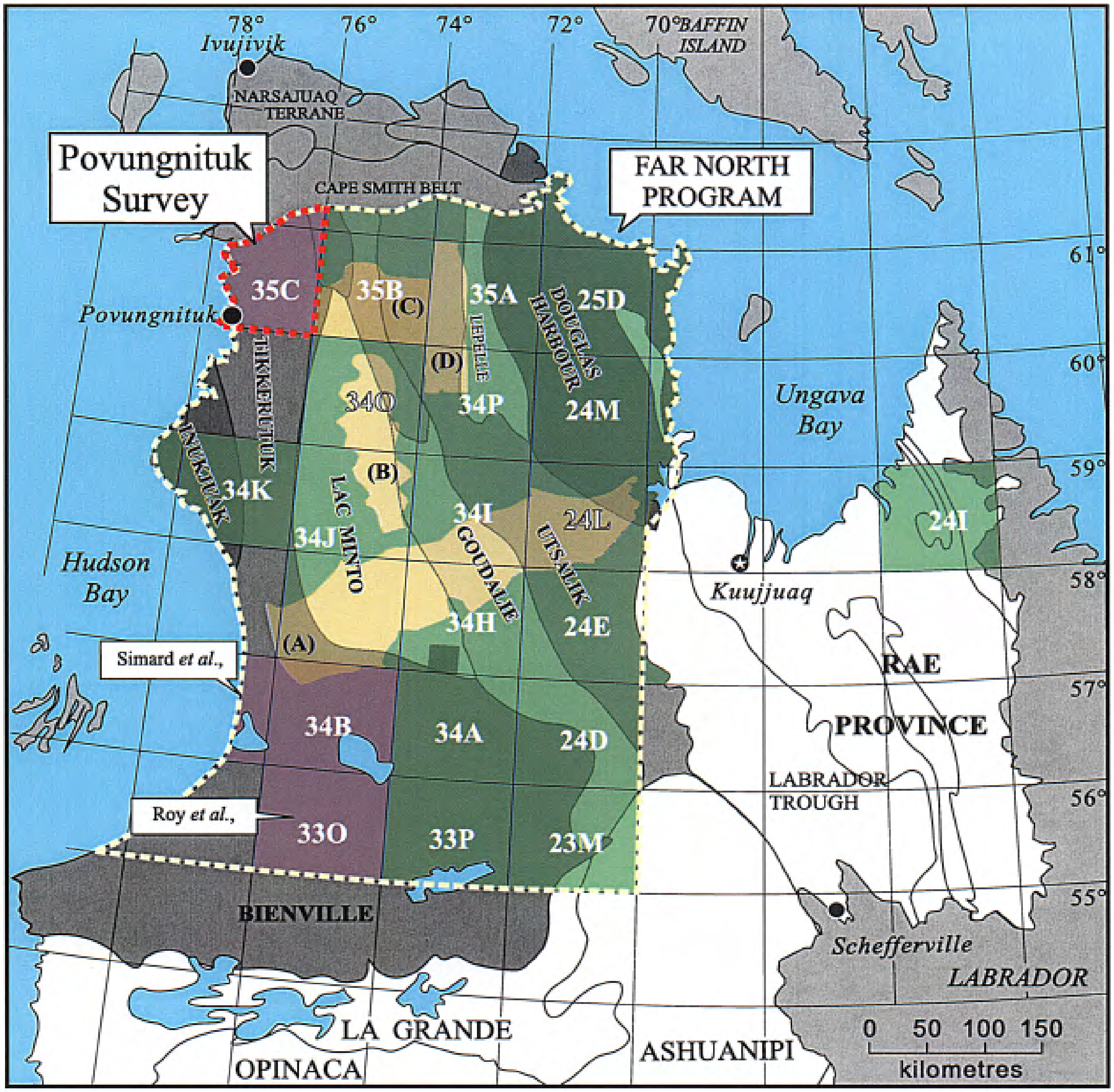

FIGURE 1 - Location of the Povungnituk mapping survey (NTS 35C, 35F/01 and 35F/02). Mapping surveys conducted in the summer of 2002 by the MRN in Québec's Far North are shown in purple. Areas in green were mapped from 1998 to 2001 by the MRN: 23M- Gosselin and Simard (2001); 24D- Simard *et al.* (2002); 24E- Berclaz *et al.* (2002); 24I- Verpaelst *et al.* (2001); 24M- Madore *et al.* (2000); 25D- Madore and Larbi (2001); 33P- Gosselin *et al.* (2004); 34A- Gosselin *et al.* (2002); 34H Parent *et al.* (2001); 34I- Leclair *et al.* (2002a); 34J- Parent *et al.* (2003); 34K- Simard *et al.* (2004); 34P- Cadieux *et al.* (2003); 34O- Berclaz *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). Map sheet 34H/03 (in dark green) was mapped by Lamothe (1997). Lithotectonic subdivisions for the northeastern Superior Province are taken from Percival *et al.* (1997b).

lithostratigraphy and assess the economic potential of the area. This report contains descriptions and interpretations of geological phenomena observed within the scope of the mapping campaign carried out in this area.

Location, Access and Topography

The centre of the map area is located about 65 km NNE of the town of Povungnituk, in an isolated part of Nunavik, along the eastern coast of Hudson Bay. The area, situated in the Arctic tundra, is devoid of forest cover, and roughly 40% of its surface is under water. The main bodies of water in the area include lakes Bylot and Juet to the northeast, Lac Tasirjuarusiq in the centre, Lac Tasirruarusiq in the southeast and Lac Povungnituk in the southwest. The main watercourses include the Korak, Sorehead, Povungnituk and Irsuaq rivers, which drain vast segments of the area. The map area covers a surface of roughly 10 300 km^2, and is bounded by latitudes 60°00' and 61°00'N and longitudes 76°00' and 78°00'W for NTS sheet 35C, and by latitudes 61°00' and 61°15' N and longitudes 76°00' and 77°00'W for NTS sheets 35F/01 and 35F/02. The area is accessible by floatplane, by helicopter and by boat from Povungnituk. Water bodies in the area are free of ice for water landings in mid-July.

Topographic relief is low to moderate, with altitude variations of less than 150 metres, except in the northern part, where the highest peaks formed by Proterozoic rocks of the Cape Smith Belt tower at 500 metres above sea level. Outcrops are variable in size (100 to >1000 m^2) and are generally covered with lichen, which gives them a dark uniform colour, making geological observations quite difficult at times. The ENE part of the area is dominated by fields of erratic boulders and contains a series of eskers oriented E-W to NW-SE; outcrops are rather scarce and restricted in size. The central part of the area is covered with De Geer moraines that form a series of longitudinal bands broadly oriented N-S. Between these bands, outcrops are abundant. The western part of the area is characterized by elevations of less than 50 metres above sea level, and by extensive swampy areas where outcrops are scarce and restricted in size (< 25 to 100 m^2).

Methodology

Fieldwork was carried out in the Povungnituk area over a period of 10 weeks. Mapping was performed by 6 teams composed of one geologist and one assistant. The teams were transported into the field by a Long Ranger 206-L helicopter from the base camp (Rivière Irsuaq; 60°38'22.2"N - 76°20'43.2"W). Outcrops accessible from the Rivière Irsuaq were mapped by boat from the base camp. Geological observations were made along traverses ranging from 8 to 12 km in length, spaced every 5 to 10 km depending on the access and the physiography of the map area. Certain zones were mapped in greater detail given their mineral potential. Several helicopter spot checks were carried out to complete the mapping coverage, on aeromagnetic targets and in areas with low outcrop density.

The lithological classification used herein corresponds to the general legend for geological maps (Sharma, 1996). The geological interpretation was made on topographic maps at the 1:125 000 scale. It incorporated remote sensing data as well as, wherever possible, units extrapolated from calculated vertical magnetic gradient maps. The final geological map was compiled to 1:250,000 scale (NTS 35C and 35F) and 1:50 000 scale (NTS 35F/01 and 35F/02). The collected data were digitized and integrated into the SIGÉOM database of the *Ministère des Ressources naturelles, de la Faune et des Parcs du Québec*.

During the 2002 field season, 1,200 rock samples were collected and cut. Among these, 556 granitoid samples were stained with sodium cobaltinitrite to determine the modal proportions of feldspar and quartz. Among the most representative samples, 65 were selected for litho-geochemical analysis, 61 for analysis of economic elements, and 191 were used to produce thin sections. Analytical results are available via the SIGÉOM database. Nine samples were collected for geochronology determinations and analyzed for U/Pb (TIMS and LA-MC-ICP-MS) at the GÉOTOP laboratory, *Université du Québec à Montréal*. The results will be discussed in the section entitled "Stratigraphy".

Previous Work

The first geological survey of Archean rocks in the northeastern Superior Province was carried out within the scope of a heliborne reconnaissance survey between latitudes 56°00' and 61°00' N and longitudes 70°00' and 79°00' W (Stevenson, 1968). This first effort at the 1:1 000 000 scale was based on information collected from the helicopter itself, as well as isolated observations made along flight-lines about 240 km long and spaced 10 km apart. Each flightline included about 20 stations, for an average grid spacing of one observation site per 12 kilometres. Subsequently, reconnaissance work by Taylor (1982) at 1:250 000 scale covered the rest of Québec's Far North above the 61st parallel. This work includes the northeastern part of the Superior Province as well as the northern part of the Trans-Hudson Orogen (Cape Smith Belt and Narsajuaq Terrane). Within the study area, the work of Taylor (1982) covers map sheets 35F/01 and 35F/02.

More recently, the Geological Survey of Canada released regional maps at the 1:500 000 scale covering the rocks along the Rivière aux Feuilles (Percival and Card, 1994), and at the 1:250 000 scale covering the Rivière Kogaluc (Percival *et al.*, 1995a), Lac Couture (Percival *et al.*, 1996a) and Lac Nantais and Lac du Pélican (Percival *et al.*, 1997a) areas (Figure 1). Lamothe (1997) mapped the Lac Dupire area at the 1:50 000 scale (NTS 35H/03; Figure 1). And from the summer of 1998 on, four geological mapping projects (at the 1:250 000 scale) were conducted each year within the scope of the Far North Program, and three during the 2002 campaign (Figure 1).

Mapping conducted by the *Ministère de l'Énergie et des Ressources* at 1:50 000 scale in the Povungnituk area was focussed on Proterozoic rocks of the Cape Smith Belt, although part of the Archean basement was also covered during these surveys. More specifically, Togola (1992) mapped the northwestern part of NTS sheet 35C, and Moorhead (1988, 1996) mapped the southeastern part of NTS sheet 35F. The maps enclosed with this report include the results of work conducted by Taylor (1982), Moorhead (1988), and Togola (1992).

To date, no assessment work reports have been submitted to the Department concerning prospecting or exploration in Archean rocks of the Povungnituk area. Within the scope of the Far North Program, all Archean terrains in Québec's Far North were covered by a lake sediment geochemistry survey (MRN, 1998). The results outline several anomalies likely to become exploration targets.

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REGIONAL GEOLOGY

The Povungnituk area is located in the northeastern Superior Province, previously defined as the "Minto Subprovince" (Card and Ciesielski, 1986), then as the "Minto Block" (Percival *et al.*, 1992). This part of the Archean craton was initially described as composed of high-grade (granulitic) granitoids, outlined by a structural pattern and positive magnetic anomalies broadly trending NW-SE (Stevenson, 1968; Percival *et al.*, 1992; Card and Poulsen, 1998).

Mapping surveys conducted since the early 1990s led to the recognition of a series of Paleoarchean to Neoarchean plutonic and volcano-sedimentary assemblages. The area was subdivided into domains, predominantly on the basis of structural and aeromagnetic criteria (Percival *et al.*, 1997b; Figure 1). Based on mapping along the Rivière aux Feuilles, the Tikkerutuk, Lac Minto, Goudalie and Utsalik lithotectonic domains were defined (Percival *et al.*, 1991, 1992; Percival and Card, 1994). Later, on the Inukjuak, the Philpot, Qalluviartuuq, Lepelle and Douglas Harbour domainswere identified (Percival *et al.*, 1995a, b, 1996a, b, 1997a, b). Plutonic assemblages characterized by vast negative and positive aeromagnetic anomalies consist of tonalite, granodiorite, granite and diatexite, which enclose diorite, gabbro, pyroxenite and peridotite enclaves and intrusions. Volcano-sedimentary sequences are generally pre- to syn-plutonic, and are mainly enclosed in tonalites characterized by a negative aeromagnetic signature. These sequences occur in the form of narrow keels (1-5 km wide) that extend in a more or less continuous fashion over distances of up to 150 km. These upper amphibolite and granulite-grade sequences are composed of basalt, pelite, greywacke and iron formation, with minor amounts of ultramafic rocks, andesite, rhyodacite, dacite, rhyolite, sandstone, conglomerate and marble.

The tectonomagmatic and metamorphic evolution of the Archean craton in the northeastern Superior Province (above the 55th parallel) took place over a period of nearly 2 billion years (3.8 to 2.0 Ga[1]: Machado *et al.*, 1989; Parrish, 1989; Percival *et al.*, 1992; Stern *et al.*, 1994; Buchan *et al.*, 1998; Madore *et al.*, 2000, 2002; Gosselin and Simard, 2001; Parent *et al.*, 2001, 2003; Madore and Larbi, 2001; Berclaz *et al.*, 2002; Gosselin *et al.*, 2002; Leclair *et al.*, 2002a; Percival *et al.*, 2001; Simard *et al.*, 2002; Cadieux *et al.*, 2002; David *et al.*, 2002; Gosselin *et al.*, 2004; Berclaz *et al.*, 2003; Simard *et al.*, 2004; David, in preparation). This succession

[1] Only ages obtained within the scope of this survey are mentioned with the analytical uncertainty. All other ages in the text are approximate, and the reader is referred to cited references for details.

of tectonomagmatic events was outlined by Leclair *et al.* (2001, 2002b), and may be summarized as follows:

(i) The oldest rocks consist of Paleoarchean volcanic and plutonic units that formed in a very early protocraton in the Porpoise Cove area (3.8-3.6 Ga) (David *et al.*, 2002; Simard *et al.*, 2004; David *et al.*, in preparation).

(ii) Elements representing the remains of a Mesoarchean (> 3.1-2.9 Ga) protocraton are essentially identified by inherited zircon cores and rare enclaves of tonalitic gneiss.

(iii) From 2.89 to 2.74 Ga, tonalites-trondhjemites and volcanic rocks were emplaced. During this time, a first phase of deformation (D_1) and metamorphism (M_1) occurred between > 2.85 and > 2.73 Ga (Berclaz *et al.*, 2003). From 2.790 to 2.745 Ga, plutonic activity appears to have taken place in a diachronous fashion, from the northeast to the southwest of the area, and volcanism evolved from a tholeiitic to a calc-alkaline affinity. The end of this period (2.76-2.74 Ga) is marked by the emplacement of discrete syenite plutons and volcano-sedimentary rocks which may be related to a phase of rifting atop a continental platform.

(iv) The period from 2.73 to 2.72 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).

(v) Simultaneously, enderbitic-opdalitic-charnockitic magmatism began in the northeastern part of the area at about 2.74-2.73 Ga, and spread throughout the area between 2.73 and 2.69 Ga. This magmatic episode is inferred to be responsible for granulite-grade metamorphism (M_2) recorded in associated volcano-sedimentary complexes (D_2 in Berclaz *et al.*, 2003).

(vi) From 2.690 to 2.675 Ga, the area underwent an important recycling of early lithologies. This period is marked by the emplacement of voluminous bodies of monzonite, granite, granodiorite, diatexite and pegmatite, accompanied by major tectonic readjustment (D_3) and a metamorphic episode at the upper amphibolite facies (M_3).

(vii) In the time frame between 2.68-2.62 Ga, important hydrothermal activity was channelled along dominantly brittle faults (D_4 and D_5), and late anorogenic magmatism resulted in a series of carbonatite and nepheline syenite alkaline intrusions (2.66-2.64 Ga; Skulski *et al.*, 1997; Berclaz *et al.*, 2003), followed by several swarms of subalkaline diabase and gabbro dykes (2.510 to 1.875 Ga; Buchan *et al.*, 1998), as well as a Paleoproterozoic alkaline complex (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).

(viii) Finally, complex Paleoproterozoic deformation (D_6) associated with the Trans-Hudson Orogen is observed west of the Labrador Trough (Berclaz *et al.*, 2002), northeast of the Douglas Harbour domain (Madore and Larbi, 2001), and south of the Cape Smith Belt (Lucas, 1989; St-Onge and Lucas, 1990; Goulet, 2001).

STRATIGRAPHY

The Povungnituk area is underlain by Archean and Proterozoic rocks subdivided into lithodemes and lithostratigraphic units, which are grouped into complexes or suites (Figure 2). The stratigraphic order presented herein was defined based on cutting relationships observed in the field, on U/Pb age dating results from nine samples collected in the area (Table 1) and on the extrapolation of interpretations based on mapping in adjacent areas.

Supracrustal Rocks

In the Povungnituk area, mafic and felsic volcanic rocks and abundant migmatized sedimentary rocks form units within the various granitoid suites. Units of volcanic origin are generally restricted in size (< 4 km wide by < 10 km long), and primary textures are rarely preserved. These units commonly form lenticular enclaves from 1 cm to 100 m in size within the granitoids. Volcanic and sedimentary rocks of the Povungnituk area are grouped into two complexes (Povungnituk – *Apov* and Mézard – *Amez* complexes), two belts (Duquet – *Aduq* and Juet – *Ajut* belts) and a lithological unit (Figure 2). All volcano-sedimentary rocks in the area are metamorphosed from the upper greenschist facies to the granulite facies[2]. A detailed interpretation of the mineralogy, textures and metamorphic assemblages of supracrustal rocks is provided in the section entitled "Metamorphism".

Povungnituk Complex (*Apov*)

The Povungnituk Complex comprises bands of supracrustal rocks < 4 km wide by < 10 km long, found in the western part of the area. These bands, which correspond to weak, moderate and strong magnetic anomalies (figures 2 and 3), are enclaved in tonalites of the Rochefort Suite (*Arot*) and are intruded by granitoids of the Pinguq Suite (*Apin*). Compared to other volcano-sedimentary belts in the area, the rocks in this complex are characterized by high-grade, generally granulite-facies, metamorphic assemblages.

Metavolcanic Rocks (Apov1)

Basaltic rocks are characterized by weak to moderate magnetic signatures. These rocks are strongly recrystallized and exhibit a nematoblastic or homogeneous granoblastic texture. They are composed of stubby green hornblende crystals and plagioclase, locally accompanied by variable proportions of clinopyroxene, orthopyroxene, biotite and garnet. Accessory minerals include epidote, cummingtonite and opaque minerals. These rocks are migmatized and

[2] The prefix "meta" is implied for the purpose of conciseness.

TABLE 1 - Results of U/Pb age dating analyses conducted on samples collected in the Povungnituk area. Sample locations are shown in Figure 2.

#	Sample	Lithology	Analytical technique*	Age(s) of crystallization**	Inherited age(s)**	Secondary age(s)**	UTM coordinates Northing	Easting
1	02-OR-6100	Tonalitic diatexite - Abyl1	I	2807.2 ±9.2 (6 / 1,8) 2829.8 ±4.6 (6 / 1,6)		2737 ±13 (6 / 2.0)	6717600	398477
2	02-CM-2097	Biotite tonalite - Arot1	I	2766 ±3 (7 / 1,6)			6688164	360911
3	02-VB-8151	Paragneiss mobilizate - Amez2	I	2758 ±11 (5 / 4,4)	to ~2820	2668 ±22 (4 / 0.29)	6666038	415377
4	02-VB-8179	Monzogranite - Alcv1	T	~ 2732		2694 ±6	6780636	445640
5	02-CM-2090	Enderbite - Aqil3	I	2730.6 ±1.9 (5 / 0.91)	~2780 and ~2810	2711 ±3.6 (3 / 0.75)	6685034	399553
6	T1 / 433-18	Opdalite - Aqil3	S	2720 to 2736	2765 to 2848	2709 ±9	6676177	400735
7	02-OR-6106	Monzogranite - Apin1	I	2727.0 ±2.1 (5 / 1.3)	2752 ±3 (4 / 1,09)		6717173	390613
8	02-MS-5020	Quartz monzonite - Apin1	I	2725.2 ±4.4 (9 / 0.24)	between 2742 and 2774		6692345	356242
9	02-FL-4027	Tonalitic diatexite - Abyl1	I	2722.5 ±1.8 (6 / 0.78)		~ 2710	6750505	412148
10	02-AL-1512	Granodioritic diatexite - Abyl2	T			2686 ±3	6742332	434543
11	T2 / 433-46	Granodioritic diatexite - Abyl2	S		2765 ±9	2704 ±7	6752196	420698

* Analytical technique I: U/Pb zircon analysis by in situ laser ablation and multiple collector inductively coupled plasma mass spectrometry (LA-MC-ICP-MS).
T: U/Pb titanite analysis by isotopic dilution and thermal ionization mass spectrometry (TIMS).
S: SHRIMP analysis (Sensitive High Resolution Ion Microprobe; Percival *et al.*, 2001).

** Age = In millions of years (Ma), with an uncertainty (±) representing a confidence interval of 2 standard deviations (95%).
The results are derived from linear regression analysis according to Davis (1982) for dilution analyses and according to Ludwig (2000) for ablation analyses.
In parentheses: the number of analyses and the probability % or the MSWD (mean squared weighted deviation) respectively obtained for each type of regression analysis.

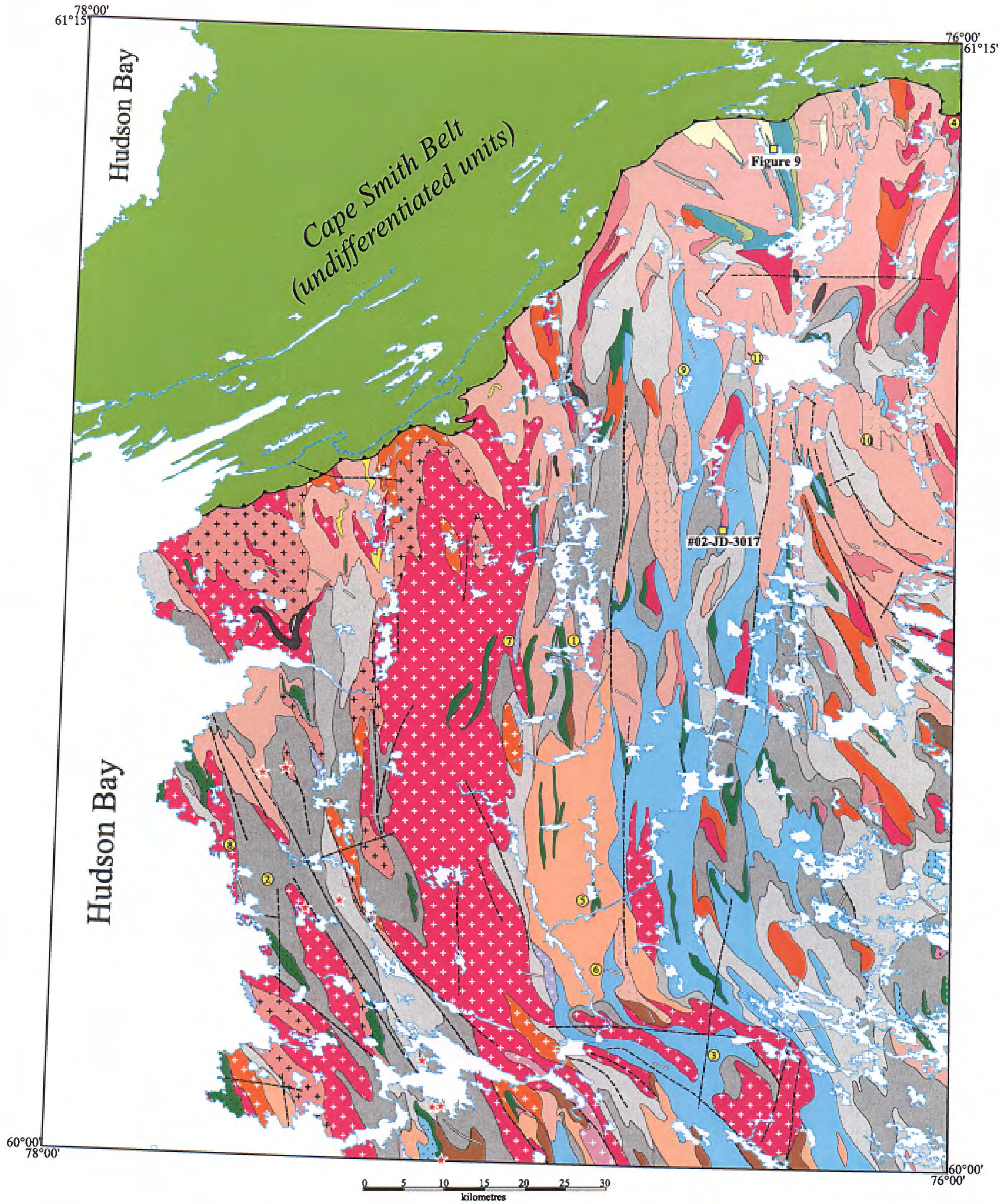

FIGURE 2 - Simplified geology of the Povungnituk area (NTS 35C) and the southeastern part of the Kovik Bay area (NTS 35F).

Fault
Geochronology sample
Proterozoic diabase dykes (*pPktz, pPpay, pPirs and pPra*)
Carbonatite

LITHOLOGICAL LEGEND

Felsic volcaniclastic rocks

STRATIGRAPHIC LEGEND

Juet Belt (*Ajut*)
Mafic metavolcanic rocks (*Ajut4*) and gabbro (*Ajut4a*)
Felsic volcaniclastic rocks (*Ajut3*)
Sedimentary and metasedimentary rocks (*Ajut1*) and phyllite (*Ajut2*)

Bylot Suite (*Abyl*)
Intermediate to mafic rocks (*Abyl3*)
Granitic to granodioritic diatexite (*Abyl2*)
Tonalitic to trondhjemitic diatexite (*Abyl1*)

Pinguq Suite (*Apin*)
Diorite (*Apin5*)
Quartz syenite (*Apin4*)
Granodiorite (*Apin3*)
Granite (*Apin2*)
Porphyroclastic monzogranite (*Apin1*)

Qilalugalik Suite (*Aqil*)
Enderbite (*Aqil3*)
Mangerite (*Aqil3a*), orthopyroxene-bearing diorite (*Aqil3b*), gabbronorite (*Aqil3c*) and ultramafic plutonic rocks (*Aqil3d*)

La Chevrotière Suite (*Alcv*)
Granodiorite (*Alcv3*)
Granite (*Alcv2*)
Porphyritic monzogranite (*Alcv1*)

Couture Suite (*Acot*)
Gabbroic anorthosite to gabbro (*Acot2*)

Rochefort Suite (*Arot*)
Granitized heterogeneous tonalite
Heterogeneous hornblende tonalite (*Arot2*)
Homogeneous biotite tonalite (*Arot1*)

Mézard Complex (*Amez*)
GR-BO diatexite (*Amez2*)
Granitic pegmatite (*Aduq2a*)
Metavolcanic rocks (*Amez1*)

Duquet Belt (*Aduq*)
Paragneiss (*Aduq2*)
Granitic pegmatite (*Aduq2a*)
Metavolcanic rocks (*Aduq1*)

Povungnituk Complex (*Apov*)
Paragneiss (*Apov2*)
Metavolcanic rocks (*Apov1*)

FIGURE 2 - Continued.

injected with clinopyroxene ± orthopyroxene-bearing felsic mobilizate and late granitic veins (Appendix 1, Photo 1).

Ultramafic units associated with basaltic rocks of the Povungnituk Complex were observed in the southern part of the area. These rocks are dark green to black in fresh surface and buff brown in weathered surface. They exhibit a medium-grained metamorphic texture. They appear to be extrusive, given their geochemical signature (see section entitled "Lithogeochemistry") and their spatial association with basaltic rocks and paragneisses. These ultramafic rocks contain fractured elongate olivine porphyroblasts riddled with magnetite veinlets. The porphyroblasts are separated by granoblastic clinopyroxene and orthopyroxene crystals, overgrown by green spinel.

Layers of intermediate to felsic volcaniclastic rocks from 1 to 100 m thick locally overlie the basaltic units. Contacts between the two lithologies are marked by sulphide-rich horizons and carbonate layers. Primary lapilli textures are locally observed in the volcaniclastic rocks. The rocks exhibit a granoblastic texture and a metamorphic mineral assemblage essentially composed of quartz, plagioclase, microcline, clinopyroxene, biotite and hornblende. The foliation is defined by reddish biotite and clinopyroxene porphyroblasts in optical continuity, which contain quartz and plagioclase inclusions. Rare hornblende-biotite aggregates replace and rim clinopyroxene crystals. Locally, microcline porphyroblasts contain globular inclusions of quartz, plagioclase and biotite.

Paragneiss (Apov2)

Paragneisses are associated with iron formation horizons, and therefore occur in areas characterized by positive magnetic anomalies. A single unit of paragneiss was identified and mapped in the southwestern part of the area. This unit borders a volcanic band, and is composed of migmatized garnet-biotite paragneiss.

Duquet Belt (*Aduq*)

The Duquet Belt (*Aduq*) groups volcano-sedimentary units observed by Stevenson (1968) and Percival *et al.* (1996a) in the southwestern part of the Lac Couture area (NTS 35B) (Madore *et al.*, 2004). Volcano-sedimentary units range from a few hundred metres to over 30 kilometres in length by less than 5 km wide, and occur around the border of dome structures in tonalites of the Rochefort Suite (*Arot*; Madore *et al.*, 2004). In the Povungnituk area, units of the Duquet Belt occur as bands from 1 to 100 m thick, associated with aeromagnetic troughs in the southeastern part of the map area (Figure 3).

Metavolcanic Rocks (Aduq1)

Unit *Aduq1* is composed of basalts and mafic gneisses, locally intercalated with layers of ultramafic, intermediate or felsic rocks and discontinuous sedimentary units

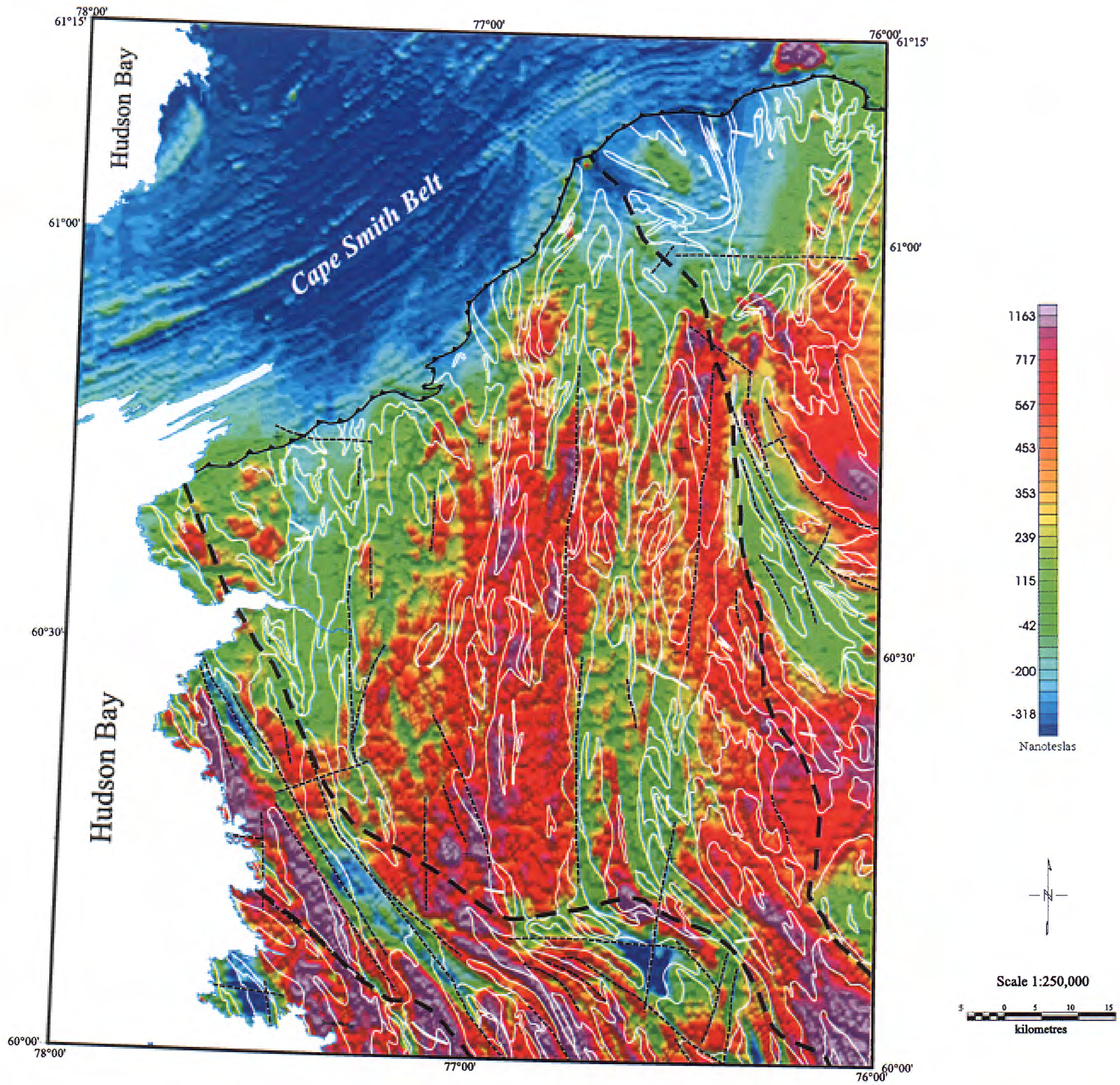

FIGURE 3 - Total residual magnetic field map of the Povungnituk area (NTS 35C) and the southern part of the Kovik Bay area (NTS 35F). Lithological contacts are shown in white, faults are shown in black thin dashed lines, and structural domain boundaries are in black thick dashed lines (figure prepared by Denis-Jacques Dion).

(Madore *et al.*, 2004). Ultramafic, basaltic and andesitic rocks as well as felsic crystal tuffs outcrop in the southeastern part of the Povungnituk area. Basaltic rocks are foliated, granoblastic, and composed of 60% nematoblastic hornblende and 35% fine-grained plagioclase, with minor amounts of quartz, epidote, titanite and opaque minerals. Ultramafic rocks form m-scale massive and foliated horizons. They are composed of light green amphibole, orthopyroxene, olivine, spinel ± chlorite. They are compositionally similar to Al-rich magnesian basalts (see section entitled "Lithogeochemistry"). Andesitic layers contain 15% hornblende and greater amounts of quartz + plagioclase + biotite. Two rhyolite samples from the Lac Duquet and Lac Akuaraaluk areas (NTS 35B) yielded respective ages of 2822 and 2828 Ma (Percival *et al.*, 1996a; Bourassa, 2002; David, in preparation).

Paragneiss (Aduq2)

Unit *Aduq2* is composed of paragneiss, with minor proportions of conglomerate, calc-silicate rocks and iron formation in discontinuous layers, as well as rare marble horizons (Madore *et al.*, 2004). The paragneisses are rusty and schistose to variably migmatized (10 to 75% felsic leucosome; Madore *et al.*, 2004). These rocks exhibit banding composed of fine-grained granoblastic quartzofeldspathic material with a variable assemblage of biotite + garnet ± aluminous minerals (cordierite, sillimanite, andalusite, staurolite, spinel) (Madore *et al.*, 2004). An outcrop of polymictic conglomerate with volcanic and granitoid clasts was observed (02-JD-3020), intercalated with felsic crystal tuffs and foliated amphibolite layers, near the eastern margin of the map area.

Mézard Complex (*Amez*)

The Mézard Complex was introduced by Berclaz *et al.* (2003) to designate volcano-sedimentary rocks trending NNW-SSE in the western part of the Lac Anuc area (NTS 34O). In the Povungnituk area, rocks of the Mézard Complex trend broadly NW-SE in the south, and N-S toward the north. These rocks are found in areas characterized by a weak to moderate magnetic intensity (Figure 3). They are bounded by enderbites of the Qilalugalik Suite (*Aqil3*) to the west, by tonalites of the Rochefort Suite (*Arot*) to the northwest, southwest and east, and laterally grade into diatexites of the Bylot Suite (*Abyl*) to the north. They are also intruded by granites of the Pinguq (*Apin*) and La Chevrotière (*Alcv*) suites.

Rocks of the Mézard Complex have undergone moderate to intense migmatization, which namely translates into the presence of abundant sedimentary diatexite. In fact, the Mézard Complex completes, in the northern Superior Province, an important band of migmatitic paragneiss that trends NW-SE over more than 300 kilometres (Parent *et al.*, 2003; Berclaz *et al.*, 2003). These rocks are commonly associated with voluminous EOC-type intrusions (enderbite-opdalite-charnockite) grouped in the Le Roy Complex (*Aroy1*) and the Qilalugalik Suite (*Aqil3*) (Parent *et al.*, 2002; Berclaz *et al.*, 2003).

Metavolcanic Rocks (Amez1)

Volcanic rocks of the Mézard Complex (*Amez1*) form thin elongate bands (< 1 km thick) mainly composed of mafic rocks, with rare m-scale horizons of intermediate and felsic rocks. These volcanic rocks are fine to medium-grained, foliated, banded and granoblastic. They are commonly migmatized and are characterized by the presence of minor proportions of felsic anatectic veins, locally clinopyroxene ± orthopyroxene bearing. The foliation is defined by olive green to brown-green nematoblastic hornblende and locally by orange-brown lepidoblastic biotite. Plagioclase is granoblastic and commonly altered to sericite and clinozoisite. In higher-grade units, a combination of granoblastic clinopyroxene and/or orthopyroxene crystals complete the mineral assemblage. Accessory minerals consist of finely disseminated opaque minerals, apatite, quartz and epidote.

Coarse-grained mafic bands, compositionally similar to the volcanic rocks but enriched in magnetite, were mapped in certain locations. These may represent the remains of metamorphosed ferrobasalt or ferrogabbro units. Furthermore, mafic volcanic rocks are strongly assimilated by intruding tonalites, enderbites and granites, and form heterogeneous clinopyroxene-bearing hybrid rocks that contain very little quartz.

Biotite-Garnet Diatexite (Amez2)

Sedimentary rocks of the Mézard Complex underwent considerable melting, as illustrated by the presence of < 80% trondhjemitic to granodioritic mobilizate. 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 (mesosome) and mm-scale to cm-scale biotite schlieren (melanosome) stretched parallel to the foliation (Appendix 1, photos 2 and 3). Magmatic flow textures define a wavy foliation. The protolith of these diatexites consists of banded rusty brown (pelites) to grey (sandstones and psammites) layers, composed of variable proportions of granoblastic quartz + plagioclase ± microcline, accompanied by garnet + biotite ± cordierite ± sillimanite.

Two zircon populations recovered from a sample of felsic mobilizate reveal a complex history. The edges of well-crystallized magmatic zircons yielded an age of crystallization of 2758 ±11 Ma, whereas the cores yielded inherited ages going back to 2820 Ma (sample # 3; Figure 2 and Table 1). Homogeneous zircon crystals exhibit features typical of solid-state crystallization, and reveal an age of 2668 ±22 Ma, interpreted as a minimum age for the melting of metasedimentary rocks.

Oxide-facies iron formations constitute a relatively refractory facies in diatexites, and form linear positive magnetic anomalies or strings of isolated anomalies. In the map area, these iron formations are 10 cm to 1 m thick, and are not as extensive as those observed in the Lac Anuc area (NTS 34O; Berclaz *et al.*, 2003). The oxide facies is dominant. It consists of mm-scale to cm-scale laminations of quartz and magnetite, locally accompanied by silicate-facies laminations rich in pyroxene, hornblende and grunerite. Locally, garnet porphyroblasts are associated with the iron formations. Sulphide-facies rocks are very rare in the Povungnituk area.

Juet Belt (*Ajut*)

The Juet Belt (*Ajut*) designates all volcano-sedimentary rocks associated with a magnetic low characterizing the northeastern part of the map area (figures 2 and 3). These rocks were respectively described by Taylor (1982) and

Moorhead (1996) as the "Juet band" and the "Juet formation". This assemblage forms a single band that is folded and dragged along a NW-SE-trending fold. This band is composed of sedimentary (*Ajut1* and *Ajut2*) and volcaniclastic (*Ajut3*) rocks accompanied by minor amounts of mafic volcanic rocks (*Ajut4*) and gabbro (*Ajut4a*). White tourmaline-bearing pegmatitic granite dykes and quartz veins cut all units. The limbs of the belt are 4 km wide at the most, whereas the hinge zone thins out to about 1 km in the southern part (Figure 2).

Volcano-sedimentary units of the Juet Belt are enclosed in diatexites of the Bylot Suite and granites of the La Chevrotière Suite; they are thrusted to the north by basal units of the Cape Smith Belt. The western part of the Juet Belt was interpreted as an east-facing upright homoclinal sequence unconformably overlying the granitic basement (Moorhead, 1996). The facing direction was inferred from the presence of a monomictic conglomerate unit some 125 metres thick outcropping along the western contact of the sequence with granitoids of the Bylot Suite (*Abyl1*).

Sedimentary and Metasedimentary Rocks: Quartzite, Siltstone, Sandstone, Conglomerate, Paragneiss, Iron Formation (Ajut1), and Phyllite (Ajut2)

A conglomerate lens located west of the main volcano-sedimentary band, in the northern part of the area, contains about 70% angular to subrounded granitoid clasts (1 to 40 cm) set in a weakly schistose biotite-rich quartzofeldspathic matrix (Moorhead, 1996). Conglomeratic horizons within the sequence itself are much thinner and contain small (< 5 cm) fragments of other sedimentary lithologies as well as minor amounts of granitoids. Siltstones and sandstones form an important proportion of the Juet Belt. They are light grey to dark grey-green in fresh surface. Horizons with a greater sulphide and biotite content are altered to hydroxides, giving the rock a rusty brown colour in weathered surface. These rocks display primary laminations from 0.5 to 20 mm thick, characterized by variations in the grain size and in the relative proportions of felsic minerals (10-20% quartz and 40-50% plagioclase) and micas (biotite, muscovite and chlorite) (Moorhead, 1996). Bedding is transposed and subparallel to the well-developed schistosity. In thin section, these rocks are recrystallized; however, the edges of detrital plagioclase and quartz grains and rare quartzite clasts are occasionally preserved in coarser-grained rocks (Taylor, 1982). These detrital grains are subangular to subrounded, and plagioclase compositions range from An_{30} to An_{44}, whereas recrystallized plagioclase grains are not twinned and are more sodic (An_{21} to An_{33}; Taylor, 1982). Phyllite units are interbedded with sandstones and siltstones, and often form mm-scale laminations composed of alternating layers of muscovite-biotite-chlorite and quartz-plagioclase. During this survey, banded iron formation horizons <10 m thick were observed intercalated with mafic volcaniclastic rocks (Appendix 1, photos 4 and 5). These horizons are locally sulphide-rich and gold-bearing (see section entitled "Economic Geology").

Although volcano-sedimentary rocks of the Juet Belt are relatively well preserved and metamorphosed to the upper greenschist facies in the northern part of the eastern limb, the southern part is more strongly deformed, and the western limb, oriented WNW-ESE, contains deformed amphibolite-grade garnet-biotite paragneisses. These paragneisses most likely have the same origin as sedimentary rocks found along the N-S axis, but may also include volcaniclastic rocks where primary textures have been obliterated.

Volcaniclastic Rocks (Ajut3) and Hornblende-Bearing Felsic Tuffs

Mafic to felsic volcaniclastic units were observed on either side of the eastern limb along the main band of the belt, as well as in smaller bands (< 4 km thick) near the contact with rocks of the Cape Smith Belt.

Fine-grained mafic volcaniclastic rocks are medium to dark green in weathered surface and dark green to black in fresh surface. These tuffs are aphanitic, thinly laminated and are composed of mm-scale to cm-scale bands characterized by concentrations of hornblende or actinolite + epidote ± biotite ± chlorite, alternating with bands slightly enriched in quartz + plagioclase. Several horizons of massive aphanitic mafic rocks do not exhibit primary textures and may represent massive basalt flows (Moorhead, 1996). Crystal tuffs contain pyroxene pseudomorphs (locally up to 15%) composed of hornblende + actinolite ± epidote replaced by biotite and chlorite (Moorhead, 1996).

Intermediate to felsic tuffs form 10-cm to 1-km-thick units of lapilli tuff and aphanitic tuff. Lapilli tuffs are characterized by subrounded to rounded clasts (< 3 cm) composed of quartz or plagioclase. The weathered surface of these rocks is typically beige to light brown and is riddled with cavities, whereas the fresh surface is medium grey to grey-green. The rocks consist of a heterogeneous assemblage of finely recrystallized quartz (± carbonate) and plagioclase strongly altered to sericite, accompanied by biotite + muscovite ± chlorite ± actinolite ± epidote. Tourmaline locally forms a late phase that cuts across other minerals. Aphanitic felsic tuffs probably represent recrystallized ash tuffs, and are distinguished from lapilli tuffs by their pearly white colour due to the preferential orientation of micas, and by their well-developed schistosity.

N-S-trending felsic tuffs, in bands < 2 km thick and with similar characteristics to those in the main band of the Juet Belt, were observed about 50 km to the west (Figure 2). Hornblende is stable however in these rocks, which suggests they reached the amphibolite facies. Given the distance between these bands and the Juet Belt, these rocks were grouped in a distinct lithological unit (Figure 2).

Mafic Metavolcanic Rocks (Ajut4) and Gabbro (Ajut4a)

Mafic volcanic rocks (*Ajut4*) are scarce in the Juet Belt. Although one outcrop of strongly transposed and flattened pillowed basalt was reported in the northern part of the belt (Moorhead, 1996), primary textures are rarely preserved. These rocks are most often represented by 1-m to 100-m layers of dark green, fine to medium-grained foliated amphibolite, with a weak to nil magnetic susceptibility. The rocks are mainly composed of actinolite (to the north), green hornblende (to the south) and plagioclase, locally accompanied by biotite. Massive amphibolite bands were mapped along the western limb of the main band, but the latter may represent aphanitic mafic tuffs where primary structures have been obliterated by deformation and metamorphism.

Metamorphosed gabbro intrusions (*Ajut4a*) occur as dykes from 1 to 10 m thick and a few hundred metres long. They intrude both plutonic rocks and supracrustal rocks of the Juet Belt (Moorhead, 1996). These intrusions display chilled margins along the contact with country rocks, a subophitic texture that is locally well preserved, an Archean schistosity and a metamorphic mineral assemblage dominated by plagioclase, hornblende and epidote. Moorhead (1996) suggested these gabbros may represent the feeder dykes of the volcanic pile in the Juet Belt. This hypothesis is supported by the geochemistry of one of the dykes, sampled a few kilometres to the west of the belt (02-VB-8149C). This sample displays chemical characteristics similar to those of volcanic units and may therefore represent a feeder conduit of the sequence (see section entitled "Lithogeochemistry"). These dykes therefore confer an autochthonous origin and emplacement of the volcanic pile that postdates regional metamorphism, since they cut diatexites of the Bylot Suite, dated at about 2722 Ma.

Intrusive Rocks

In the Povungnituk area, intrusive rocks are very heterogeneous in terms of composition, structure and magnetic signature. They were grouped into six suites. Mapping conducted during the summer 2002 led to the definition of suites composed of: *(i)* tonalite-trondhjemite-granodiorite/granite (TTGG; Rochefort Suite, *Arot*), *(ii)* granite-granodiorite (GG; La Chevrotière Suite, *Alcv*, and Pinguq Suite, *Apin*), *(iii)* enderbite-opdalite-charnockite (EOC; Qilalugalik Suite, *Aqil*), *(iv)* diatexite (Bylot Suite, *Abyl*), and *(v)* mafic to intermediate rocks (Couture Suite, *Acot*).

Tonalite-Trondhjemite-Granodiorite-Granite (TTGG) - Type Suite: Rochefort Suite (*Arot*)

The Rochefort Suite (*Arot*) was defined by Leclair *et al.* (2002a) to designate tonalitic rocks with biotite, hornblende and epidote, that cover about 40% of the Lac La Potherie area (NTS 34I). Tonalites in the latter area have an age of crystallization of 2768 Ma, and an inherited age of 2824 Ma (Leclair *et al.*, 2001a; David, in preparation). Rocks of this suite were also observed in the Lac du Pélican area (NTS 34P; Cadieux *et al.*, 2003), the Lac Anuc area (NTS 34O; Berclaz *et al.*, 2003) and the Lac Couture area (NTS 35B; Madore *et al.*, 2004), where ages of crystallization ranging from 2848 to 2758 Ma were obtained (David, in preparation). Certain tonalite samples were affected by several magmatic pulses and recorded ages inherited from earlier lithologies. These results show that the Rochefort Suite constitutes the oldest plutonic unit in this part of the northeastern Superior Province. As a whole, the ages indicate the existence of several generations of tonalitic magmatism and recycling over a time span of at least 90 Ma.

The Rochefort Suite extends into the Povungnituk area, where it forms units of homogeneous biotite tonalite (*Arot1*), heterogeneous hornblende tonalite (*Arot2*), and granitized heterogeneous tonalite (*Arot3*).

Homogeneous Biotite Tonalite (Arot1)

In the Povungnituk area, the homogeneous biotite tonalite unit (*Arot1*) is observed throughout the map area, and namely corresponds, although not exclusively, to zones with a weak to moderate aeromagnetic signature. Tonalites in this unit are homogeneous and characterized by the presence of biotite as the dominant mafic phase. The rock is either weakly foliated, banded, mylonitic or weakly migmatized. Weakly deformed facies exhibit well-preserved igneous textures, whereas several samples display a granoblastic texture with patches of recrystallized quartz grains.

Tonalites are medium grey, medium-grained, and generally contain less than 20% enclaves from 10 cm to 1 m in size, of mafic gneiss or amphibolite, that are subrounded or stretched parallel to the foliation. Local strings of mafic gabbroic to dioritic enclaves are probably derived from dismembered dykes. White trondhjemitic facies (with < 10% mafic minerals) are only sporadically observed.

In thin section, the foliation is defined by mafic minerals, which are dominated by green to brown biotite, locally associated with green hornblende and epidote. The core of epidote crystals sometimes consists of zoned allanite and shows radial fractures. Muscovite, titanite, apatite and zircon form accessory phases. Sericite partially or completely replaces plagioclase grains, whereas chlorite partially replaces biotite. Interstitial microcline grains are locally observed between quartz and plagioclase grains.

A sample of massive homogeneous biotite tonalite was collected in the western part of the area. It contains a homogeneous zircon population, which yielded an age of crystallization of 2766 ±3 Ma (David, in preparation; sample #2; Figure 2 and Table 1).

Heterogeneous Hornblende Tonalite (Arot2)

The heterogeneous hornblende tonalite unit (*Arot2*) is composed of mesocratic, medium to coarse-grained tonalite, which contains abundant (< 40%) enclaves of mafic gneiss and rare ultramafic rocks. This unit is distinguished from unit *Arot1* by the presence of hornblende as the dominant mafic phase, as well as by the number of enclaves, stretched and folded along the foliation direction, which give the tonalite a gneissic and heterogeneous aspect. Mappable bodies of unit *Arot2* are rare and do not exhibit a distinct aeromagnetic signature. In the Lac Anuc area (NTS 34O), this unit is most commonly observed in the vicinity of volcanic belts (Berclaz *et al.*, 2003), but this type of relationship was not observed in the Povungnituk area. Rocks of unit *Arot2* may thus represent tonalites that have nearly completely assimilated great volumes of mafic volcanic material. A number of isolated bands of heterogeneous hornblende tonalite alternate with bands of unit *Arot1*, but these cannot be shown at the scale of the map.

Other than the greater hornblende content relative to biotite, microscopic features vary from outcrop to outcrop, and are similar to those observed in unit *Arot1*. In thin section, brown biotite occasionally contains rutile needles that form a tight mesh. Furthermore, biotite rims hornblende grains, or it occurs intergrown with muscovite.

Granitized Heterogeneous Tonalite (Arot3)

The granitized heterogeneous tonalite unit (*Arot3*) was observed throughout the area, but especially in zones with a moderate to strongly positive aeromagnetic signature. This unit is differentiated from the other two tonalitic units due to the injection of granitic material in the form of bodies, dykes or veins with sharp or diffuse contacts. In strongly deformed facies, the granitic material occurs as 10-cm augen-shaped aggregates or isolated K-feldspar phenocrysts (< 10 cm). Granitic phases are leucocratic to hololeucocratic, medium to coarse-grained and locally porphyritic; biotite is the dominant mafic phase. They are similar to granites and granodiorites of the La Chevrotière Suite (*Alcv*). The absence of a melanocratic interface (melanosome) between the granitic and tonalitic phases suggests these granitic bodies represent synkinematic injections – of the La Chevrotière (*Alcv*) and Pinguq (*Apin*) suites – into tonalitic protoliths (units *Arot1* and *Arot2*), rather than metamorphic mobilizate derived from a migmatization process (Berclaz *et al.*, 2003).

Granite-Granodiorite (GG)-Type Suites: LaChevrotière (*Alcv*) and Pinguq (*Apin*) Suites

La Chevrotière Suite (Alcv)

The La Chevrotière Suite (*Alcv*) was introduced by Parent *et al.* (2001) in the Lac Nedlouc area (NTS 34H) to designate a series of sheets or elongate or lenticular plutons greater than 10 km^2 in size. These rocks are usually associated with positive magnetic anomalies. The La Chevrotière Suite (*Alcv*) extends into the Lac La Potherie area (NTS 34I; Leclair *et al.*, 2002a), the Lac Klotz area (NTS 35A; Madore *et al.*, 2002), the Lac Couture area (NTS 35B; Madore *et al.*, 2004), the Lac du Pélican area (NTS 34P; Cadieux *et al.*, 2003) and the Lac Anuc area (NTS 34O). It includes: 1) porphyritic monzogranites, granodiorites and quartz monzonites (*Alcv1*), 2) homogeneous coarse-grained granites (*Alcv2*), and 3) biotite granodiorites (*Alcv3*). In the Povungnituk area, granitoids of the La Chevrotière Suite are exclusively exposed in the eastern part of the area.

Porphyritic Monzogranite, Granodiorite to Quartz Monzonite (Alcv1)

These rocks are pinkish to reddish grey in fresh surface and yellowish pink in weathered surface. They are characterized by the local presence of microcline or orthoclase megacrysts reaching up to 10 cm, the alignment of which defines a foliation ranging from igneous to tectonic from one outcrop to the next. These rocks are leucocratic to melanocratic, generally homogeneous and medium to coarse-grained. Leucocratic units are weakly to non-magnetic whereas melanocratic units are strongly magnetic. Diorite and gabbro xenoliths form a minor proportion of outcrops.

In thin section, these rocks exhibit igneous textures, and quartz is locally recrystallized under the influence of deformation. Coarse-grained K-feldspar and plagioclase (locally antiperthitic) crystals coexist with abundant microcline or orthoclase phenocrysts. Myrmekitic textures commonly occur between plagioclase and K-feldspar grains. Fine to coarse-grained quartz occurs as interstitial aggregates between feldspar grains, or forms ribbons in strongly deformed rocks. Mafic minerals are dominated by brown to green biotite, accompanied by allanite and rare green to blue hornblende. Accessory minerals include apatite, zircon, titanite and opaque minerals. Epidote replaces mafic minerals and plagioclase. Secondary chlorite, muscovite and carbonate locally replace biotite and hornblende, whereas sericite partially replaces feldspar phases. Porphyritic monzogranites sampled in the Lac La Potherie (NTS 34I; Leclair *et al.*, 2002a) and the Lac Klotz (NTS 35A; Madore *et al.*, 2002) areas respectively yielded ages of crystallization of 2732 and 2734 Ma (David, in preparation).

A titanite-bearing monzogranite sample was collected in the northeasternmost part of the area for geochronology purposes. Four titanite grains yielded two ages, of about 2732 and 2694 ±6 Ma, interpreted as the ages of crystallization of two distinct magmatic pulses (sample #4; Figure 2 and Table 1). The sampled outcrop is located near the southern contact with rocks of the Cape Smith Belt. These results show that the thrusting of Paleoproterozoic rocks onto the

Archean basement did not disturb the isotopic system of granitoid rocks.

Granite (Alcv2) and Granodiorite (Alcv3)

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

In the Povungnituk area, the granites (*Alcv2*) form, along with the granodiorites (*Alcv3*), a series of individual intrusions, randomly scattered throughout the eastern half of the map area, or else occur in transitional contact with porphyritic units (*Alcv1*). These rocks are homogeneous, equigranular, massive to foliated, medium to coarse-grained and pinkish white. They enclose rare diorite and amphibolite xenoliths that are rounded and stretched parallel to the foliation, or locally reduced to thin biotite or hornblende schlieren. Partially digested tonalitic enclaves are locally observed. Microcline and plagioclase occasionally form porphyroclastic aggregates surrounded by smaller polygonized and granoblastic grains. Quartz forms monocrystalline lenses and ribbons parallel to the foliation in strongly deformed rocks. Brown biotite occurs as fine disseminated flakes; magnetite is common; allanite and zircon are very fine-grained. Carbonate, sericite and muscovite develop in plagioclase grains and form the main alteration minerals.

Pinguq Suite (Apin)

The Pinguq Suite is a new suite that groups voluminous bodies of porphyroclastic granitoids, granites, granodiorites, syenites and diorites observed in the western part of the Povungnituk area. These rocks are preferentially associated with areas marked by a high to very high magnetic signature, except in the northern part of the area, where the magnetic intensity is much weaker.

Porphyroclastic Monzogranite, Granodiorite and Quartz Monzonite with Blue Quartz (Apin1)

Apart from its geographic situation, this unit is distinguished from porphyritic granitoids of the La Chevrotière Suite by the fact that it forms a single, fairly extensive body (< 10 x 80 km), by the ubiquitous presence of microcline porphyroclasts, and the common occurrence of blue quartz and protomylonitic augen textures (Appendix 2, photos 1, 2 and 3). The origin of the blue tinge of quartz crystals was recently investigated. Zircon (Burmester and Barker, 1970), rutile (Frazier and Gobel, 1982), and magmatic ilmenite, recently identified as submicroscopic inclusions in the crystalline structure (Zolensky *et al.*, 1988; Goreva and Rossman, 2001), were all suggested to explain the presence of this colour.

The modal composition of rocks in this unit ranges from that of a granodiorite to a quartz monzonite, with monzogranite being the predominant rock type. These rocks are foliated to protomylonitic, and frequently contain quartz ribbons and rounded microcline porphyroclasts (augen) that show apparent sinistral movements as a result of intense plastic deformation. The degree of deformation is not homogeneous; strongly deformed rocks consist of bands from 10 cm to 10 m wide within homogeneous outcrops, or cover entire outcrops along intrusive margins. These rocks are locally altered to such a degree that only elongate microcline porphyroclasts subsist in a greenish fine-grained epidote and chlorite-rich groundmass. Rounded to elongate enclaves of diorite (*Apin5*) and amphibolite (< 5%) roughly 10 cm in size constitute a minor proportion of this unit.

In thin section, green to brown biotite is the most abundant mafic mineral, whereas green hornblende and rare clinopyroxene appear in the more mafic varieties. Myrmekitic grains overgrow and partially rim microcline porphyroclasts, which contain biotite and sericitized plagioclase inclusions. Deformation was partially absorbed by microcline porphyroclasts, which are surrounded by ground or recrystallized quartzofeldspathic material. Accessory minerals include apatite, titanite, zircon and opaque minerals. Secondary minerals commonly include sericite and epidote, in replacement of plagioclase crystals, as well as aggregates of chlorite and carbonate.

A monzogranite sample of the Pinguq Suite was collected in the central part of the map area (sample #7; Figure 2). It yielded an age of 2727 ±2.1 Ma and an inherited age of 2752 ±3 Ma (David, in preparation; Table 1). Another sample of quartz monzonite from the western part of the area (sample #8; Figure 2) yielded a similar age of crystallization of 2725.2 ±4.4 Ma from tabular, colourless zircons, and inherited ages ranging from 2742 to 2774 Ma from rounded zircon grains with dulled edges (David, in preparation; Table 1).

Homogeneous Granite (Apin2) and Granodiorite (Apin3)

In the western part of the Povungnituk area, granites (*Apin2*) and granodiorites (*Apin3*) of the Pinguq Suite form small intrusions generally related to the large granitoid bodies of unit *Apin1*. These rocks are very similar to granitic and granodioritic units of the La Chevrotière Suite (*Alcv2* and *Alcv3*), except for the local presence of bluish quartz crystals and a greater proportion of mafic to ultramafic enclaves. They are homogeneous, equigranular, massive to foliated, locally mylonitic, medium-grained and white to pinkish. These rocks contain up to 30% enclaves of diorite, amphibolite and ultramafic rocks, which are rounded and stretched parallel to the foliation and locally reduced to thin mafic mineral schlieren. Brown to green biotite is the dominant mafic phase; it may be associated with hornblende and rare clinopyroxene. Allanite forms mm-scale crystals and magnetite is commonly observed.

Quartz Syenite (Apin4)

This unit forms a band < 2 km wide by 15 km long in the south-central part of the map area. The rocks are moderately magnetic, fine to medium-grained and have a modal composition of 5 to 20% plagioclase, 5 to 15% quartz, > 60% K-feldspar and < 5% biotite. They are characterized by a strong mineral lineation defined by stretched quartz and aligned biotite grains, typical of an "L-tectonite".

Biotite Diorite (Apin5)

Biotite-bearing diorites occur as: 1) isolated homogeneous bodies that host amphibolite enclaves of supracrustal origin, 2) dykes that cut supracrustal rocks and enderbites of the Qilalugalik Suite, or 3) enclaves in porphyroclastic monzogranites of the Pinguq Suite. They have a fine to medium-grained granular texture, and contain relics of primary plagioclase crystals. Green or brown biotite is the dominant mafic mineral; it is occasionally replaced by light green amphibole. Biotite observed in coarser-grained facies contains fine needles of rutile that form a mesh texture. Magnetite forms about 5% of the rock, and titanite is fairly common (2 to 5%). Thus, these rocks are characterized by a high magnetic susceptibility and a high titanium content (~ 2% TiO_2).

Enderbite-Opdalite-Charnockite (EOC)-Type Suite: Qilalugalik Suite (*Aqil*)

The Qilalugalik Suite (*Aqil*), defined in the Lac Vernon area (NTS 34J; Parent *et al.*, 2003), was also encountered in the Rivière Innuksuac area (NTS 34K and 34L; Simard *et al.*, 2004) and the Lac Anuc area (NTS 34O; Berclaz *et al.*, 2003). Only the heterogeneous enderbite unit (*Aqil3*) was observed in the Povungnituk area.

Heterogeneous Enderbite (Aqil3)

The heterogeneous enderbite unit (*Aqil3*) describes orthopyroxene-bearing intrusive rocks in the Povungnituk area. These rocks, which as not as heterogeneous as those originally described in the Lac Vernon area, are nevertheless interpreted as equivalent, since they were emplaced at the same time as those mapped in the Innuksuac area (Simard *et al.*, 2003). The enderbites, which for the most part outcrop in the central and southern parts of the Povungnituk area, are characterized by positive magnetic anomalies. They are resistant to erosion, and form rounded outcrops in positive relief. These enderbites are typically golden brown, moderately to strongly magnetic, homogeneous and massive to strongly foliated or locally heterogeneous and banded. Their grain size, generally medium to coarse, is locally fine or porphyritic (plagioclase or K-feldspar phenocrysts). Enderbites are leucocratic to mesocratic (5 to 30% mafic minerals). Red biotite and orthopyroxene are predominant, whereas hornblende and clinopyroxene occur in minor proportions. In thin section, antiperthitic plagioclase and local grains of interstitial microcline were observed. Red biotite is lepidoblastic and defines the foliation. Accessory minerals include apatite, titanite and zircon.

The effects of deformation locally translate into the presence of granulated plagioclase and quartz crystals and dislocated plagioclase grains. As the degree of deformation increases, plagioclase forms porphyroclasts surrounded by neoblasts. Due to late alteration, orthopyroxene is replaced by an assemblage of talc + iddingsite + magnetite + carbonate + hornblende, whereas plagioclase is replaced by an assemblage of sericite + epidote + carbonate. Rocks with more than 10% medium-grained or porphyritic K-feldspar (opdalite to charnockite) were observed as dykes or non-mappable bodies within the enderbites. Enderbites laterally grade into quartz-poor mangerite units (*Aqil3a*) and contain up to 10% mafic (diorite, amphibolite, gabbro) to ultramafic enclaves stretched parallel to the foliation. The latter may form more extensive bodies of hypersthene diorite (*Aqil3b*), gabbronorite (*Aqil3c*) and ultramafic rocks (*Aqil3d*), which may be represented on the geological map. Ultramafic rocks consist of pyroxenite variably transformed into hornblende.

A sample of enderbite mixed with charnockite was collected in the central part of the area (sample #5; Figure 2). Most of the zircons in this sample exhibit complex magmatic zoning patterns. Ages of 2731 ±2 Ma and 2711 ±4 Ma were obtained and are respectively interpreted as the age of crystallization of the enderbite and the age of late potassic magmatism (regional "granitization") (David, in preparation; Table 1). The 2711 Ma age was obtained from clear zircon fragments derived from coarse crystals. Two age clusters at about 2780 and 2810 Ma obtained from clear rounded zircons reflect ages inherited from earlier lithologies.

A sample of orthopyroxene-bearing granodiorite (opdalite) taken from the archive collection of Stevenson (1968) and collected about 10 km south of sample #5 contains similar zircons (sample #6; Figure 2 and Table 1; Percival *et al.*, 2001). The earliest elements are recorded in zircon cores, with inherited ages between 2848 and 2765 Ma, whereas rims and overgrowths are dated from 2831 to 2825 Ma. The analysis of zircon crystal edges suggests a first episode of crystallization, estimated between 2736 and 2720 Ma, followed by a second episode established at 2709 ±9 Ma (Percival *et al.*, 2001). Another sample of homogeneous enderbite (without a potassic component) from the

Innuksuac area (to the south) yielded an age of crystallization of 2732 Ma, coupled with an inherited age of 2837 Ma (Simard *et al.*, 2003).

In summary, the three samples collected to determine the age of orthopyroxene-bearing intrusive rocks of the Qilalugalik Suite yielded similar results indicating that: 1) these rocks were emplaced in a basement formed of a series of tonalitic magma pulses (inheritance between 2848 and 2765 Ma), 2) the enderbitic portion of the EOC-type magma crystallized at about 2730 Ma, and 3) the later regional potassic magmatism occurred at about 2710 Ma. The age of this "granitization" was also documented in a tonalite sample (2714 Ma) collected in the Rivière Innuksuac area (Simard *et al.*, 2004) and in diatexite samples of the Bylot Suite (see below).

Based on field relationships, ages of about 2710 Ma obtained for EOC-type rocks (Percival *et al.*, 2001; this report) cannot correspond to the age of crystallization of enderbitic components, since enderbitic enclaves are observed in granitoids of the Pinguq Suite, dated at about 2725 Ma (Appendix 2, Photo 1).

Diatexite-Type Suite: Bylot Suite (*Abyl*)

The Bylot Suite (*Abyl*) is a unit introduced herein to group all migmatitic rocks with a tonalitic to trondhjemitic (*Abyl1*) or granodioritic to granitic (*Abyl2*) composition. These rocks also contain isolated bodies of intermediate to mafic rocks (*Abyl3*).

Trondhjemitic to Tonalitic (Abyl1) and Granodioritic to Granitic (Abyl2) Diatexites

Tonalitic to trondhjemitic diatexites (*Abyl1*) are mainly exposed in the northeastern and northwestern parts of the area, whereas granitic to granodioritic rocks (*Abyl2*) are more closely associated with sedimentary diatexites of the Mézard Complex (*Amez2*) in the central part of the area (Figure 2). These rocks are characterized by their heterogeneous aspect, a wavy to locally gneissic foliation, a variable grain size and a saccharoidal texture (Appendix 2, Photo 4). They typically contain enclaves of mafic gneiss, diorite and paragneiss, which are commonly reduced to biotite aggregates and schlieren.

In thin section, brown to green biotite constitutes the most abundant mafic mineral; it is locally accompanied by muscovite flakes and rare green hornblende. Felsic minerals (quartz and plagioclase) show textures ranging from magmatic to metamorphic, and quartz is locally ground. Plagioclase grains are variably altered to sericite and late poikiloblastic epidote locally forms up to 10% of the rock.

Three samples were selected for geochronology purposes, to provide some insight on various phenomena observed in rocks of the Bylot Suite (David, in preparation; samples #1, 9 and 10; Figure 2 and Table 1). Sample #1 was collected in the central part of the area, on a heterogeneous tonalitic outcrop. It yielded three zircon populations of distinct ages. Ages of 2829.8 ±4.6 Ma and 2807.2 ±9.2 Ma obtained from similar zircons are associated with two episodes of tonalitic magmatism related to tonalites of the Rochefort Suite. Another population of homogeneous zircons with characteristics typical of solid-state recrystallization yielded an age of 2737 ±13 Ma. This age is interpreted as the age of migmatization of an early tonalite (sample #1; Figure 2 and Table 1).

Sample #9 was collected on a fairly homogeneous outcrop where only biotite schlieren subsist. Analyzed zircon grains exhibit complex morphologies. An age of 2722.5 ±1.8 Ma is interpreted as the age of a melting event related to the formation of the diatexite. This first age is followed by another, at about 2710 Ma, determined from zircon overgrowths. A few dulled colourless cores yielded inherited ages greater than 2730 Ma (David, in preparation; Table 1).

A sample from the collection of Stevenson (1968) was analyzed using the SHRIMP technique (sample T2 in Percival *et al.*, 2001; sample #11 in Figure 2 and Table 1). This sample, described as a hornblende-biotite granodiorite by Stevenson (1968), was collected a few hundred metres northwest of station 02-AB-068, where the outcrop exhibits features and textures typical of diatexites. Analytical results from zoned zircon cores in this sample indicate an age of 2765 ±9 Ma, whereas the edges yielded an age of 2704 ±7 Ma (Percival *et al.*, 2001), coeval with the overgrowths dated in sample #9.

Titanite grains recovered from the granitic phase in a diatexite outcrop sampled in the east-central part of the area yielded an age of crystallization of 2686 ±3 Ma (sample #10; Figure 2 and Table 1). This result suggests that potassic magmatism enriched in incompatible elements (*i.e.* TiO_2) persisted until the end of the Archean. Alternatively, given the fact that the closing temperature of exchanges associated with the U-Pb system in titanite is lower than in zircon, it is possible that the event recorded in titanites may be related to the magmatic event recorded in zircons at about 2710 Ma.

Intermediate to Mafic Units (Abyl3)

Units of intermediate to mafic rocks less than 2 km thick were observed, primarily in the tonalitic to trondhjemitic diatexite unit (*Abyl1*). These rocks are migmatized and injected with felsic mobilizate, locally hornblende ± clinopyroxene-bearing. Two facies were observed. The first, non-magnetic and altered to chlorite, contains biotite as the only mafic phase and is characterized by the local presence of plagioclase porphyroblasts. The second is strongly magnetic. It hosts ultramafic enclaves and restites and contains clinopyroxene, hornblende and biotite as mafic phases. These intermediate to mafic units may represent "rafts" of refractory mafic material that were not homogenized by more felsic diatexite units.

Suite of Intermediate to Mafic Rocks: Gabbroic Anorthosite of the Couture Suite (*Acot1*)

The Couture Suite was defined by Madore *et al.* (2004), to designate small units of mafic (*Acot1*) to ultramafic (*Acot2*) rocks mainly exposed in the vicinity of volcano-sedimentary belts in the western part of the Lac Couture area (NTS 35B). Only unit *Acot1* (outcrops 02-FL-4206 and 02-FL-4207) was recognized along the east-central margin of the Povungnituk area (Appendix 2, Photo 5). These rocks are foliated and locally exhibit a brecciated aspect due to the presence of dislocated plagioclase megacrysts. Intense tectonic banding is sometimes developed along contact zones with enclosing granitoids. In thin section, these rocks are composed of coarse (mm-scale to cm-scale) twinned plagioclase phenocrysts set in a schistose and granoblastic groundmass of plagioclase, amphibole, chlorite, biotite and muscovite. Sericite, clinozoisite, epidote and carbonate partially to completely replace plagioclase phenocrysts.

Carbonatite Dykes

Carbonatite dykes were observed in intrusive units in the western part of the area. These rocks were observed at eight different locations along a NW-SE axis, near to or along the extension of faults with the same orientation (Figure 2). Intrusive country rocks take on a bleached, pinkish to green colour, probably due to intense fluid circulation. The carbonatite dykes either extend in a continuous fashion over several tens of metres, or are boudined and dismembered to the point of forming a string of rounded or stretched enclaves (Appendix 1, Photo 6). In outcrop, carbonatites occur in negative relief relative to the intrusive country rocks, which in turn also occur as xenoliths within the dykes. The dykes commonly host enclaves of dark green clinopyroxenite.

The carbonatites are essentially composed of carbonate, Mg-rich olivine replaced by talc and serpentine, and variable proportions of spinel (gahnite?), clinopyroxene and phlogopite. Amphibole is more abundant in clinopyroxene-phlogopite-rich facies where it is coarse-grained. Spinel grains exhibit magnetite exsolution textures, whereas carbonates occasionally host inclusions of early carbonate phases, the alignment of which defines a flow texture. Apatite, magnetite and other opaque minerals complete the mineral assemblage.

Late Dykes (Paleoproterozoic)

Archean units of the Povungnituk area are cut by Paleoproterozoic dyke swarms associated with faults or brittle fractures that postdate Archean deformation and regional metamorphism. These dyke swarms are: the Klotz dykes (*pPktz*), the Pointe Raudot dykes (*pPra*) (Buchan *et al.*, 1998), the Payne River dykes (*pPpay*) (Fahrig *et al.*, 1986), and the Irsuaq River dykes (*pPirs*) (new lithodeme introduced herein). The Klotz and Payne River dykes form major swarms that transect the entire northeastern Superior Province. They were mapped in areas corresponding to NTS sheets 24M (Madore *et al.*, 2000), 25D (Madore and Larbi, 2001), 35A and 35H (Madore *et al.*, 2002), 35B and 35G (Madore *et al.*, 2004), 24E (Berclaz *et al.*, 2002), 34P (Cadieux *et al.*, 2003) and 34O (Berclaz *et al.*, 2003). Pointe Raudot dykes form a somewhat smaller swarm, observed only along the northernmost tip of the Ungava Peninsula, near the contact with rocks of the Cape Smith Belt.

The dykes form tabular bodies from 10 cm to several tens of metres thick; the largest dykes extend over several kilometres along strike. They generally exhibit a greenish brown to blackish brown weathered surface and a bluish grey fresh surface. They are homogeneous, massive, commonly mesocratic, and their magnetic susceptibility is generally weak to moderate, but locally higher. The core of the widest dykes is medium to coarse-grained and shows textures ranging from subophitic to ophitic, whereas the borders consist of aphanitic chilled margins from 1 to 10 cm wide. Contacts with country rocks are sharp and occasionally lobate.

All these dykes exhibit a similar mineralogy that evolves based on the degree of magmatic differentiation and alteration. They are mainly composed of clinopyroxene phenocrysts and idiomorphic plagioclase laths, with green to khaki green hornblende or bluish green actinolite and rare orthopyroxene (Appendix 2, Photo 6). Clinopyroxene grains are variably uralitized and are sometimes rimmed by amphibole. Locally, olivine occurs as isolated grains or as inclusions in clinopyroxene. Mafic minerals are locally cut by orange-red lepidoblastic biotite. Accessory minerals include interstitial quartz, muscovite, apatite, Fe-Ti oxides, pyrite, zircon and titanite. Magnetite is fine-grained and occasionally rimmed by brown biotite or leucoxene. As in all other rock types bordering fault zones, gabbro dykes may be altered to actinolite, chlorite, epidote and sericite.

Klotz Dykes (*pPktz*)

The Klotz dykes (*pPktz*) were dated at 2209 Ma (Buchan *et al.*, 1998). These dykes may represent part of a giant dyke swarm derived from a mantle plume that was active at about 2.22 Ga to the southeast of Ungava Bay (Buchan *et al.*, 1998). In the Povungnituk area, this swarm forms a set of at least eight dykes, subparallel and spaced about 20 to 30 km apart. These dykes are associated with fault zones trending ESE-WNW to E-W. They range from 1 to 100 m in thickness, but are generally about 30 m thick. They appear in positive relief in the landscape and extend in a continuous fashion over a few tens of kilometres.

Payne River Dykes (*pPpay*)

The Payne River dykes (*pPpay*) were dated using the K-Ar method, which yielded imprecise ages of 1790 ±240 and 1875 ±240 Ma (Fahrig *et al.*, 1986). These dykes trend NW-SE, *i.e.* parallel to the Labrador Trough. In the Povungnituk area, they are typically 10 cm to 1 m thick, but may nevertheless reach up to 30 m in thickness. These dykes are interpreted as intrusions that were emplaced during an extension phase coeval with the deposition of early sedimentary rocks in the Labrador Trough (Fahrig, 1987). Given the fact that the Povungnituk area lies 350 km away from the rocks of the Labrador Trough, evidence of this extension event is scarce.

Irsuaq River Dykes (*pPirs*)

The term Irsuaq River dykes (*pPirs*) is used herein to designate N-S to NNE-SSW-trending dykes observed in the Povungnituk area. These dykes were documented by Togola (1992), although no lithodemic term had been suggested to group them under a single name and a single definition. As opposed to the Payne River and Klotz dykes, theses dykes are systematically fairly thick (20 to 200 m) and locally exhibit a cleavage, which suggests their emplacement is coeval with the formation of N-S-trending fracture sets. In the absence of a radiometric age, these dykes are inferred to be Paleoproterozoic in age since they do not cut rocks of the Cape Smith Belt.

Pointe Raudot Dykes (*pPra*)

Pointe Raudot dykes (*pPra*) were reported across the entire Ungava Peninsula, near the southern contact with rocks of the Cape Smith Belt (Buchan *et al.*, 1998; Madore and Larbi, 2001; Madore *et al.*, 2002, 2004). This swarm, which trends N040°, is inferred to be Paleoproterozoic in age and is rarely exposed. A single occurrence was identified in the Povungnituk area (02-VB-8151), near rocks of the Cape Smith Belt.

Rocks of the Cape Smith Belt

For a description of Proterozoic rocks in the Povungnituk (NTS 35C) and Kovik Bay (NTS 35F) areas, we invite the reader to refer to the work of Taylor (1982), Baragar (1983), Picard (1986; 1989), Barrette (1987; 1990a, b), Moorhead (1988; 1996), Togola (1989; 1992), and Baragar *et al.* (1992; 2001). The work of Baragar *et al.* (1992; 2001), in particular, describes a carbonatite complex located in the Lac Leclair area.

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; Bédard, 2003). Volcano-sedimentary rocks of the Povungnituk area (NTS 35C and 35F) contain mineral assemblages indicating metamorphic conditions ranging from the greenschist facies to the granulite facies. Thus, our efforts will be focussed on the description and analysis of diagnostic metamorphic assemblages in these rock types.

Metavolcanic Rocks

Mafic volcanic rocks of the Povungnituk (*Apov*) and Mézard (*Amez*) complexes and the Duquet Belt (*Aduq*) are metamorphosed to the middle and upper amphibolite facies, and up to the granulite facies. These rocks contain assemblages with hornblende + plagioclase ± biotite ± clinopyroxene ± orthopyroxene ± garnet. Their composition varies from homogeneous to migmatitic, and they exhibit a mineral foliation defined by green to brown, fine to medium-grained nematoblastic hornblende, granoblastic and polygonal plagioclase grains, and orange to red interstitial biotite grains. Disseminated quartz, titanite, apatite, magnetite, pyrite and rare zircon complete the mineral assemblage. In granulite-grade metamorphic rocks, the orthopyroxene and clinopyroxene content may exceed the hornblende content. These minerals form granoblastic grains in homogeneous rocks, or are coarse to very coarse-grained in the leucosome of migmatitic rocks (Photo 2, Appendix 2). Garnet is rare and where present, forms late porphyroblasts that contain amphibole and plagioclase inclusions.

Mafic volcanic rocks and gabbros of the Juet Belt (*Ajut*) contain a greater variety of assemblages. Rocks in the southern part of the belt contain assemblages with hornblende + plagioclase ± epidote, typical of recrystallization conditions at the middle amphibolite facies. Rocks further north contain assemblages with actinolite + epidote + biotite + chlorite, indicating metamorphic conditions did not exceed the upper greenschist facies. This suggests that rocks in the northern part of the Juet Belt postdate the peak of metamorphism represented by surrounding diatexites of the Bylot Suite, dated at 2722 Ma (Table 1).

Ultramafic volcanic rocks of the Povungnituk Complex (*Apov*) and the Duquet Belt (*Aduq*) exhibit porphyroblastic to granoblastic textures and contain assemblages with olivine + clinopyroxene + orthopyroxene + spinel, typical of the granulite facies. Compositional banding is characterized by the presence of laminations rich in coarse-grained to porphyroblastic olivine alternating with laminations rich in granoblastic orthopyroxene + clinopyroxene + light green amphibole. Green to khaki spinel grains form discontinuous trains with olivine, or are recrystallized and disseminated along foliation planes.

Intermediate to felsic volcanic rocks of the Povungnituk Complex (*Apov*) and the Duquet Belt (*Aduq*) contain granoblastic assemblages with quartz + plagioclase + microcline + biotite + hornblende ± clinopyroxene. The groundmass consists of granoblastic quartz and calcic plagioclase with lepidoblastic biotite, which are overgrown by microcline poikiloblasts and clinopyroxene porphyroblasts in optical continuity. On the other hand, volcaniclastic rocks of the Juet Belt (*Ajut*) differ in that primary volcanic textures are preserved, as illustrated by the presence of quartz, plagioclase and K-feldspar phenocrysts set in a very fine-grained and generally granoblastic quartzofeldspathic groundmass. An assemblage of biotite + muscovite + sericite + chlorite is observed, locally overgrown by epidote and allanite especially along ductile shear planes.

Metasedimentary Rocks

Metasedimentary rocks contain diagnostic assemblages indicating metamorphic conditions also ranging from the greenschist facies to the granulite facies. Migmatitic paragneisses assigned to the Povungnituk (*Apov*) and Mézard (*Amez*) complexes and the Duquet Belt (*Aduq*) are mainly composed of quartz, plagioclase and microcline, forming a mosaic of granoblastic crystals. In sandy rocks, brown to red lepidoblastic biotite is associated with garnet occurring as small poikilitic grains and rare mm-scale to cm-scale poikiloblasts aligned parallel to the foliation. In pelitic rocks, an assemblage of biotite + cordierite + sillimanite + garnet is frequently observed, typical of the middle to upper amphibolite facies, as well as an assemblage of biotite + orthopyroxene + garnet ± sillimanite ± cordierite, typical of the granulite facies. Nematoblastic sillimanite is generally fibrous to acicular, and locally forms prismatic grains. Cordierite crystals are coarse to fine-grained, generally porphyroblastic and moderately altered to pinite. In the Mézard Complex, the order of appearance of aluminous minerals indicates a prograde metamorphic evolution from the middle to the upper amphibolite facies. This evolution is accompanied by the formation of cordierite with inclusions of sillimanite + spinel + magnetite. Inversely, the evolution may also be retrograde, from the upper to the middle amphibolite facies, with the early formation of cordierite, later superposed by biotite, fibrous sillimanite and finally poikiloblastic garnet. Minor proportions or trace amounts of muscovite, chlorite, sericite, tourmaline, magnetite, apatite, pyrite and carbonate complete the mineral assemblages.

Like the mafic volcanic rocks and gabbros, metasedimentary rocks (*Ajut1*) and phyllites (*Ajut2*) of the Juet Belt contain a variety of assemblages. Sandy paragneisses in the southern part of the belt are weakly migmatized and contain biotite + garnet assemblages indicating recrystallization conditions at the amphibolite facies, whereas metasedimentary rocks and phyllites in the northern part contain biotite + muscovite + chlorite ± tourmaline assemblages, which suggests the metamorphic grade did not exceed the upper greenschist facies. This implies these rocks were deposited and deformed late relative to the peak of metamorphism.

Silicate-facies iron formations of the Mézard Complex (*Amez*) are more commonly granulite-grade rather than amphibolite-grade. They exhibit compositional banding marked by gradual variations in the relative proportions of quartz±plagioclase, magnetite, pyroxene (orthopyroxene and clinopyroxene), hornblende and garnet. Polygonal quartz grains form ribbons or a granoblastic mosaic. Magnetite is disseminated or occurs as trains of isolated grains. The two types of pyroxene form nematoblastic crystals and are locally associated with green-brown to olive green hornblende. Garnet is particularly abundant in rusty layers, and forms post-kinematic porphyroblasts that contain inclusions of quartz and pyroxene or hornblende in optical continuity.

Oxide-facies iron formations of the Juet Belt (*Ajut*) are metamorphosed to the amphibolite facies and exhibit compositional banding marked by variable proportions of magnetite, quartz, hornblende and grunerite. Quartz-rich laminations are generally composed of granoblastic grains or rare monocrystalline ribbons. Hornblende-rich laminations contain more oxides than grunerite-rich laminations. However, hornblende and grunerite are occasionally intimately associated in certain laminations and quartz is interstitial.

Plutonic Rocks

Although plutonic units enclosing supracrustal rocks commonly exhibit well-preserved igneous textures, they also show metamorphic textures ranging from porphyroclastic to granoblastic to porphyroblastic. The presence, within a single stratigraphic unit, of both magmatic and metamorphic textures indicates that plutonic units locally underwent subsolidus metamorphic neoblastesis, interpreted as synmagmatic (Berclaz *et al.*, 2002, 2003; Cadieux *et al.*, 2003; Parent *et al.*, 2003; Bédard, 2003). Most tonalite-trondhjemite units of the Rochefort Suite (*Arot*) exhibit porphyroclastic and granoblastic textures. Granites and granodiorites of the La Chevrotière Suite (*Alcv*) have largely preserved their igneous textures, whereas granites and granodiorites of the Pinguq Suite (*Apin*) generally exhibit porphyroclastic textures interpreted as synmetamorphic, since these rocks are the same age as diatexites of the Bylot Suite (*Abyl*). Enderbites of the Qilalugalik Suite (*Aqil*) form bodies where igneous-textured orthopyroxene and clinopyroxene are predominant, but laterally and longitudinally grade into zones where the rocks exhibit recrystallization textures indicating granulite-grade stability conditions.

Retrograde Metamorphism

Secondary mineral assemblages superimposed up on higher-temperature mineral assemblages indicate retrograde metamorphism at the greenschist facies, derived from one or several post-metamorphic hydrothermal circulation events, essentially focussed along late fault zones. Commonly, iddingsite, serpentine, chlorite, talc, magnetite and carbonate replace orthopyroxene and olivine; sericite, zoisite and clinozoisite replace feldspar phases; chlorite replaces biotite. A few samples contain tourmaline and rutile as a result of very low-temperature events.

STRUCTURAL ANALYSIS

The structural analysis of the area (figures 4 and 5) is based on the study of structural trajectories and on cutting relationships observed between primary and tectonometamorphic (ductile and brittle-ductile) structures in all lithodemic units. Primary structures (pillowed basalts, porphyritic or massive basalt flows, channelled lapilli or block tuffs, cross-bedding in sandstones, graded bedding in conglomerates) observed in volcano-sedimentary units of the Povungnituk (*Apov*) and Mézard (*Amez*) complexes or the Duquet (*Aduq*) and Juet (*Ajut*) belts are only locally preserved. These primary structures underwent penetrative deformation and were transposed by several episodes of deformation; moreover, they were considerably modified by metamorphic recrystallization and more locally by hydrothermal fluid circulation. In plutonic units, planar structures include: *(i)* lithological contacts, *(ii)* a foliation defined by the preferential alignment of mafic minerals (biotite, hornblende, pyroxene) or felsic minerals (K-feldspar, plagioclase) of magmatic or tectonic origin, *(iii)* tectonic to mylonitic banding due to an increase in the degree of deformation, *(iv)* gneissosity or migmatitic layering derived from *in situ* partial melting, defined by alternating leucosomes and restites, most commonly occurring as mafic schlieren, *(v)* shear zones, *(vi)* a local crenulation cleavage, and *(vii)* folds. Linear structures include stretching lineations, tectonometamorphic lineations and rare magmatic lineations, fold axes, quartzofeldspathic rods (elongated objects) and late fault striations.

Phases of Ductile Deformation D_1 to D_3, Aeromagnetic Characteristics and Structural Domains

The Povungnituk area (NTS 35C and 35F) underwent complex polyphase deformation. This deformation is reflected in the various aeromagnetic signatures (Figure 3) and the orientation of the structural trend (figures 4 and 5).

The area was affected to varying degrees by three phases of ductile deformation (D_1, D_2 and D_3). All lithological units show at least an S_2 foliation which is axial to F_2 folds and associated with D_2 deformation. On a regional scale, lithological units and the S_2 foliation are oriented NNW-SSE to N-S. The S_2 foliation is reworked by a third deformation D_3, associated with the formation of isoclinal folds transposed along a NW-SE-trending mylonitic S_3 fabric, where S_2 commonly becomes parallel to S_3. The NNW-SSE to NW-SE-trending structural grain is warped in many locations – namely in volcano-sedimentary and tonalitic-trondhjemitic units in structural domains 1, 2 and 4 – where they follow a WNW-ESE to E-W axis. This orientation corresponds to the first phase of deformation D_1, where F_1 axial traces – parallel to the S_1 foliation or gneissosity locally oriented WNW-ESE to E-W – are cross-folded by F_2 folds (oriented NNW-SSE to N-S), and where S_1 is crenulated by S_2 or more commonly transposed into S_2. Structures associated with D_1 generally have an amplitude of less than 1 km, except in the Juet Belt (*Ajut*) where they exceed 10 km in size.

Domains 1 and 4 (figures 3 and 4), in the eastern and southwestern parts of the area, are characterized by weak aeromagnetic signatures cut by positive N-S-trending anomalies (D_2) or transposed along a NW-SE axis (D_3). The S_2 foliation and F_2 fold axes are transposed along a NW-SE orientation and are locally cut by S_3 shear zones, dominantly NW-SE-trending. Linear elements (L_{1-2}) are subvertical or steeply plunging to the SE (Figure 5).

Domain 2, in the central part of the map area (figures 3 and 4), is more homogeneous in terms of structural orientations. It is represented by negative aeromagnetic anomalies in the western part and positive in the eastern part, and contains N-S to NNW-SSE-trending structures (D_2). S_2 fabrics are essentially tectonic to migmatitic in volcano-sedimentary and tonalitic-trondhjemitic units, or magmatic to tectonic in enderbitic, granitic-granodioritic and diatexitic units. They refold an early S_1 foliation, where S_1 is commonly parallel to S_2 and is itself overprinted by an S_3 crenulation cleavage or is cut by ductile faults oriented NW-SE. Linear features (L_{1-2}) are subvertical or steeply plunging mainly to the NW (Figure 5).

Domain 3 (figures 3 and 4) is characterized by negative and positive anomalies strongly transposed along a NW-SE to WNW-ESE axis (D_3). It corresponds to a ductile deformation zone some 15 to 35 km wide, which forms a map-scale sigmoidal shape. The deformation is dominated by a mylonitic fabric. In the western part, a magmatic to tectonic or metamorphic (porphyroclastic) fabric is oriented NW-SE and is outlined by shear zones and faults. This fabric is associated with subvertical or steeply E-plunging linear features. In the southern part of the area, the fabric shifts to a WNW-ESE to E-W trend. It is ultramylonitic, defines an L > S or L-tectonite and is associated with linear features that are either subhorizontal or very shallowly plunging to the NW to WNW rather than to the SE (Figure 5).

Domain 4 (figures 3 and 4) is characterized by subvertical structures broadly trending NNW-SSE to N-S (D_2) and truncated by those in domain 3. Structures that predate phase D_2 are recognizable in units of the Povungnituk Complex. F_1 folds, oriented WNW-ESE to E-W, are

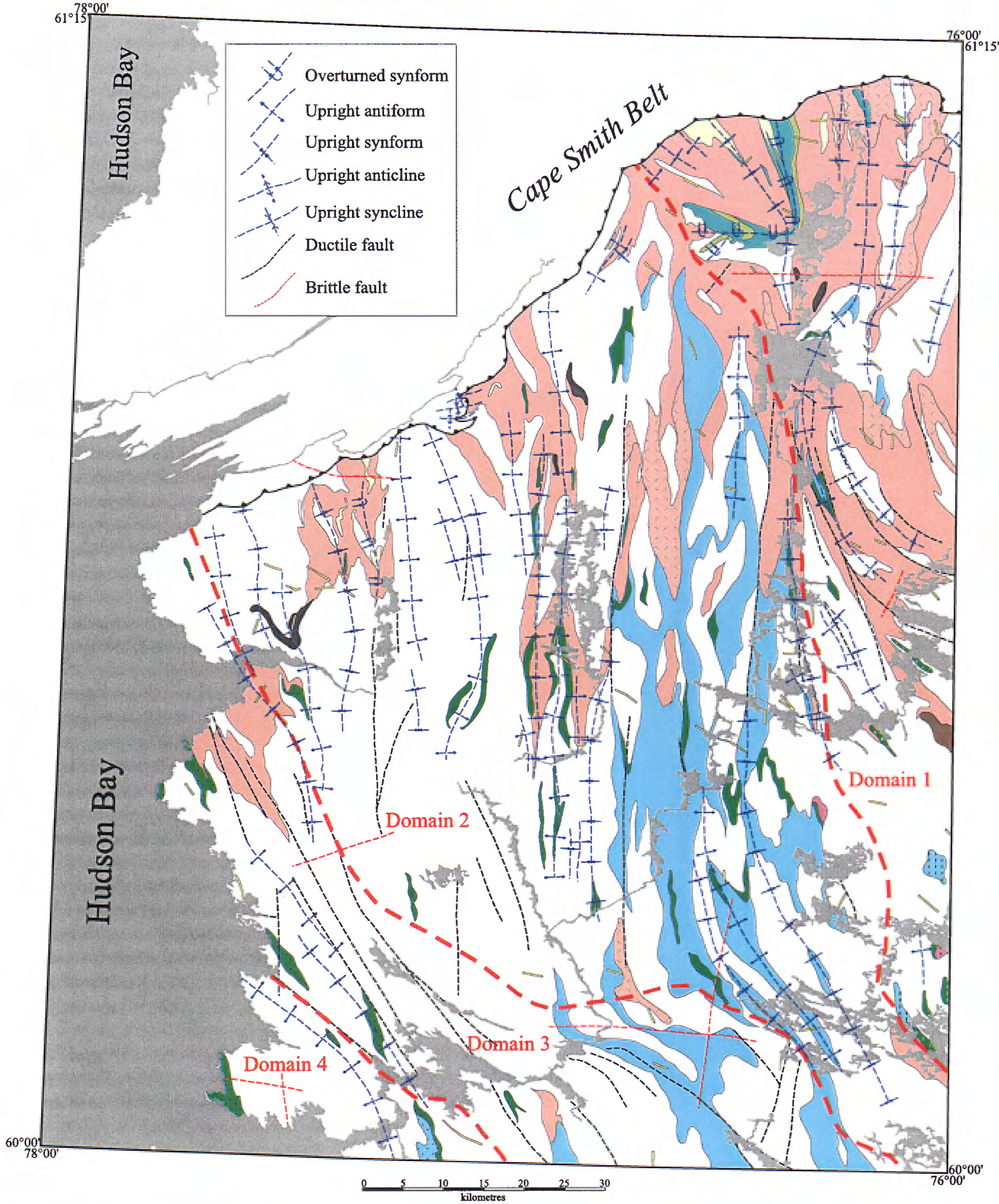

FIGURE 4 - Structural map of the Povungnituk area (NTS 35C) and the southeastern part of the Kovik Bay area (NTS 35F), showing the location of structural domains (1 to 4), folds, faults, supracrustal rocks and diatexites. (see Figure 2 for stratigraphic legend).

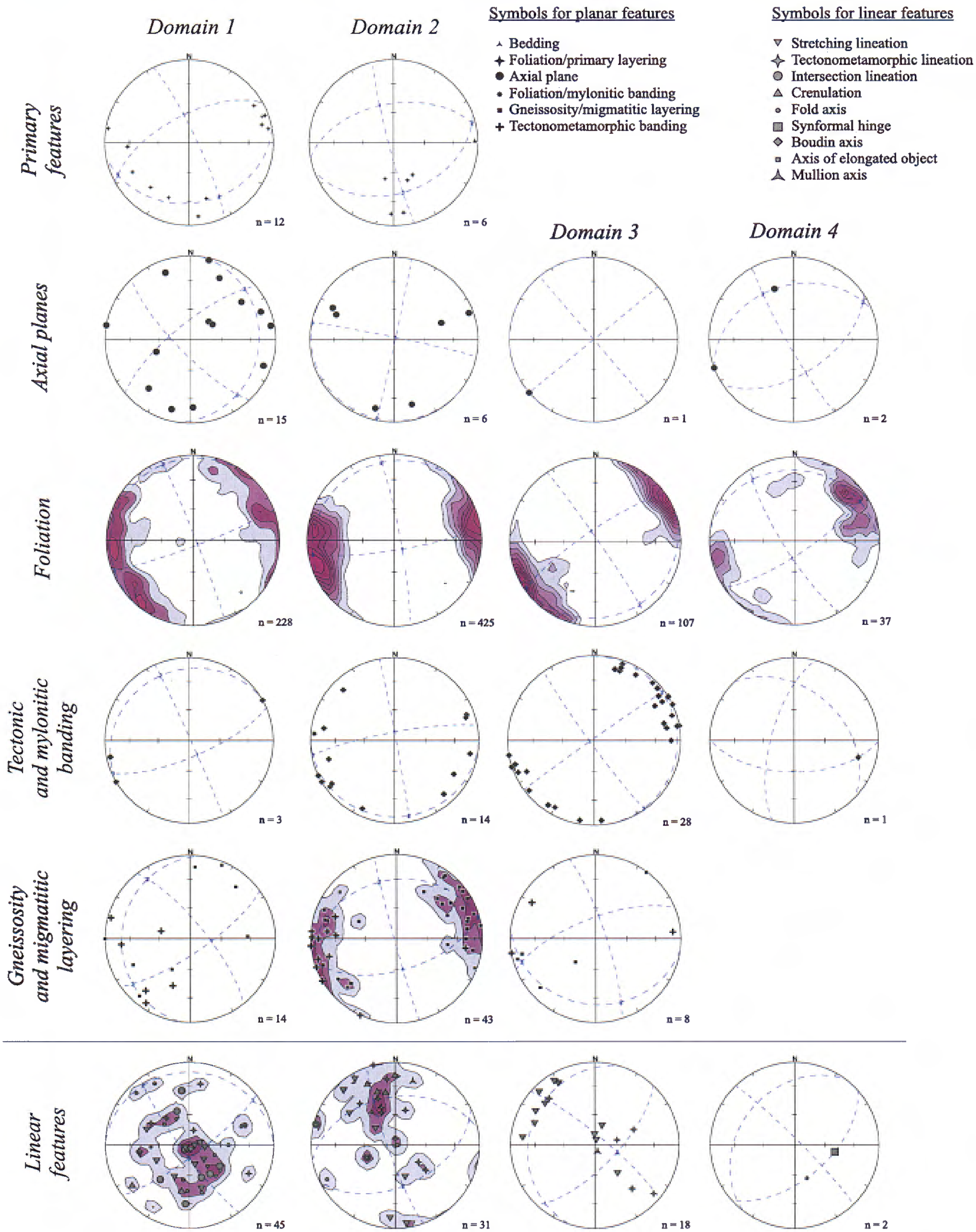

FIGURE 5 - Stereographic projections of structural features (planar and linear) for all domains (1 to 4) in the Povungnituk area (NTS 35C) and the southeastern part of the Kovik Bay area (NTS 35F).

cross-folded by F_2 folds trending NW-SE to N-S, to form dome-basin or crescent-form interference patterns. F_2 axial planes are parallel to the S_2 foliation, which ranges from tectonic to magmatic and is locally outlined by a mylonitic fabric, gneissosity or migmatitic layering. The different linear features (L_{1-2} or L_2) are coaxial and are moderately to steeply plunging, mainly to the ESE or the SSE (Figure 5).

Phase of Deformation D_4

At the scale of the northeastern Superior Province, lithodemic units and ductile structures (D_1, D_2 and D_3) are truncated by E-W-trending structures that form an anastomosing network of protomylonitic to brittle-ductile shear zones, pseudotachylites and faults. In the Lac Anuc area (NTS 34O), the Tasiat-Pavy deformation zone may have controlled the emplacement of the Tasiat Syenite (*Atst*; Berclaz *et al.*, 2003) at about 2643 Ma (Skulski *et al.*, 1997; David, in preparation). Such structures are also reported further south in the Lac Vernon area (NTS 34J), the Lac Minto area (NTS 34G), the Rivière Innuksuac area (NTS 34K and 34L) and the Lac à l'Eau Claire area (NTS 34B). They correspond to phase of deformation D_{5b} (Parent *et al.*, 2003; Simard *et al.*, 2004) and appear to control the emplacement of alkaline rocks (Simard *et al.*, 2004) and of ultramafic to mafic rocks of the Qullinaaraaluq Suite (Parent *et al.*, 2003), known for their Ni-Cu potential (Labbé *et al.*, 2000).

Phases of Brittle Deformation D_5

D_1 to D_4 structures are cut by brittle-ductile faults and shear zones. These late structures contain greenschist-grade metamorphic assemblages of hydrothermal origin, and are oriented WNW-ESE to E-W (D_{5a}), NW-SE (D_{5b}) and N-S to NNE-SSW (D_{5c}). Phases D_{5a} and D_{5b} respectively control the emplacement of the Klotz dyke swarm (*pPktz*; *ca.* 2209 Ma; Buchan *et al.*, 1998) and the Payne River dyke swarm (*pPpay*; 1875-1790 Ma; Fahrig *et al.*, 1986). Phase of deformation D_{5c} controls the emplacement of Irsuaq River dykes (*pPirs*), the age of which has yet to be determined although they do not seem to cut the orogenic front of the Cape Smith Belt (1.8 Ga).

Phases of Deformation Related to the Ungava Orogen (D_6)

Structures related to phases of deformation D_1 to D_5 are overprinted by three other phases of deformation related to the Ungava Orogen (1.8 Ga). The first phase (D_{6a}) led to the S and SSE-directed thrusting of the entire Cape Smith Belt package and is responsible for the formation of NE-SW-trending folds overturned to the SE. This thrusting episode is also responsible for the transposition of Archean units of the Superior Province along a NNE-SSW orientation, observed along a corridor less than 10 km wide immediately to the south of the Ungava orogenic front. All lithologies in the Cape Smith Belt and all D_{6a} structures are reworked by open folds with subhorizontal ENE-WSW-trending axial traces (D_{6b}). Structures D_{6a} and D_{6b} are then cut by NNE-SSW and NW-SE to E-W-trending faults (D_{6c}).

LITHOGEOCHEMISTRY

In order to better characterize the main lithological units in the Povungnituk area, a total of sixty samples were collected and analyzed for major, trace and rare earth elements by Acme Analytical Laboratories in Vancouver. Major elements and certain trace elements (Ba, Cr, C_{total}, S_{total} and Sc) were determined by ICP-AES, whereas elements Ag, As, Au, Ba, Bi, Cd, Co, Cs, Cu, Ga, Hf, Hg, Mo, Nb, Ni, Pb, Rb, Sb, Se, Sn, Sr, Ta, Tl, V, W, Y, Zn, Zr and rare earth elements were determined by ICP-MS. All analytical results are available via the SIGÉOM database.

The lithogeochemical interpretation was not an easy task, given the fact that these Archean rocks may have undergone several postmagmatic events (metamorphism, late hydrothermal circulation, spilitic alteration, metasomatism). Alkalis (*e.g.*: Na, K, Rb) and alkaline earth metals (*e.g.*: Sr, Ba) appear to have been mobile and their magmatic evolution is not well defined on Harker variation diagrams, particularly for volcanic rocks. Incidentally, only major elements showing a clear magmatic evolution, high-field-strength incompatible elements (Zr, Y) and rare earth elements will be used in sections dealing with volcanic rocks. These elements are considered to be 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 Povungnituk area range from ultramafic to rhyodacitic in composition (Figure 6a).

Ultramafic to Mafic Rocks

Ultramafic horizons associated with mafic volcanic rocks and paragneisses were mapped in the Povungnituk and Mézard complexes and the Duquet Belt. In the Povungnituk Complex, two ultramafic samples show high MgO contents (28 and 29%), Al_2O_3/TiO_2 ratios of 13 and 21, low incompatible element contents and flat rare earth element patterns (Figure 6b and d; Table 2). These chemical characteristics are typical of Archean komatiites in the southern Superior Province (Fan and Kerrich, 1997). Ultramafic horizons sampled in the Duquet Belt and the Mézard Complex show substantially different compositions. These rocks have lower MgO contents (16 and 19%), very high Al_2O_3/TiO_2 ratios

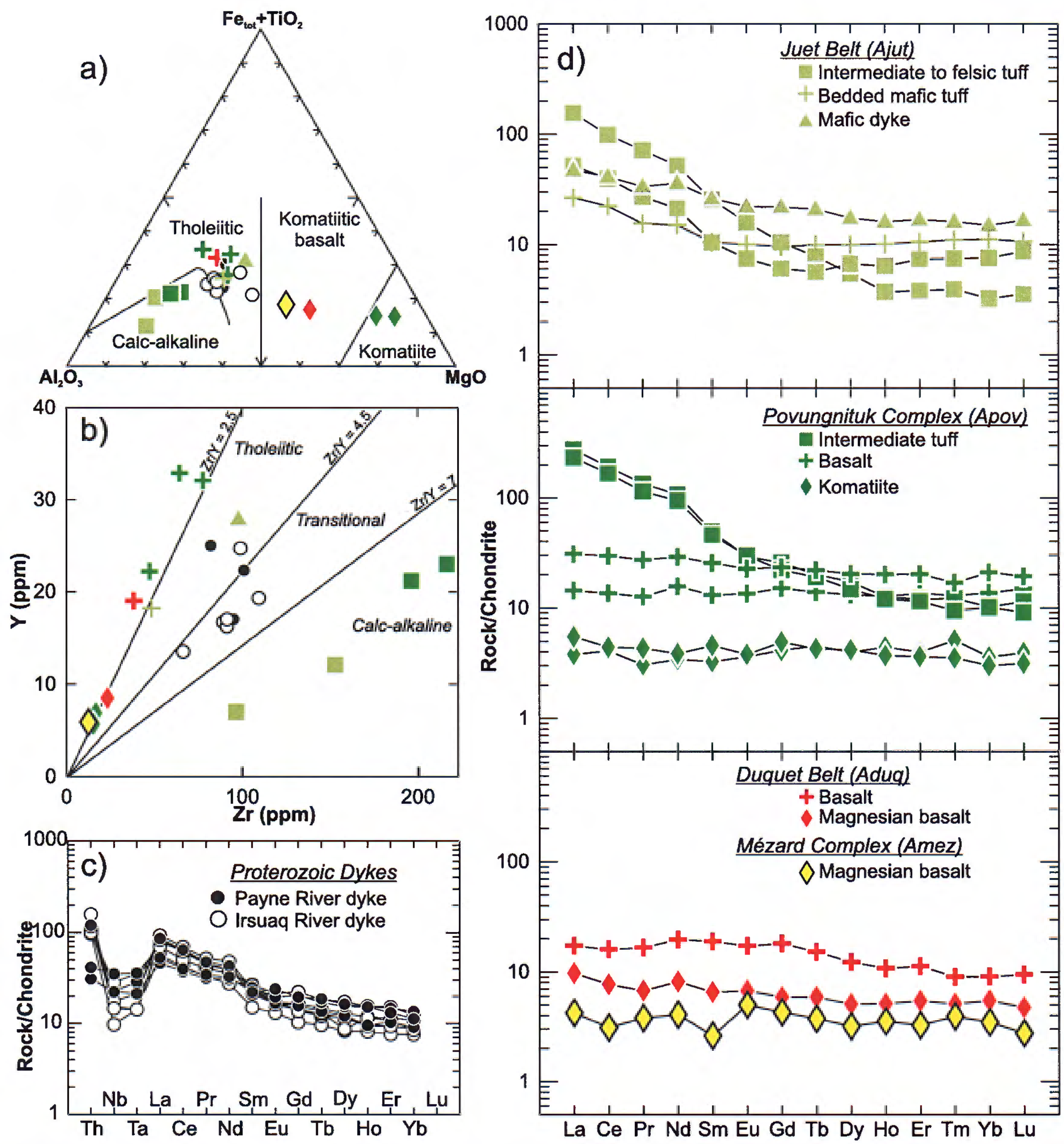

FIGURE 6 - Geochemical diagrams showing the results of major and trace element analyses for volcanic rocks and diabase dykes of the Povungnituk area: **a)** Jensen discrimination diagram (1976), **b)** Y versus Zr, showing the boundaries of the tholeiitic, transitional and calc-alkaline fields, **c)** spiderdiagram showing rare earth elements and Th, Nb and Ta normalized to chondrites for diabase dykes, and **d)** chondrite-normalized rare earth element diagrams for volcanic rocks. Diagrams c and d are normalized using data from Sun and McDonough (1989).

(32 and 55) and rare earth element patterns that are flat to slightly enriched in light rare earth elements ($[La/Yb]_n$ = 1.22 and 1.77) (Figure 6d). These rocks may represent Al-rich magnesian basalts.

Basaltic rocks of the Povungnituk Complex and the Duquet Belt have a tholeiitic affinity, generally low Zr/Y ratios (2.5), Zr contents lower than 80 ppm, and rare earth element patterns that are flat to very slightly enriched in light rare earth elements ($[La/Yb]_n$ = 1.05 to 1.91) (Figure 6b and d). These characteristics are similar to those observed in most volcanic belts in the northeastern Superior Province.

The Juet Belt is distinct from the Duquet Belt and the Povungnituk and Mézard complexes, given the abundance of volcaniclastic material and the lower metamorphic grade. A unit of bedded mafic tuff shows a tholeiitic affinity and a relatively high SiO_2 content (~54%) associated with low incompatible element concentrations (Figure 6b and d; Table 2). Rare earth element patterns are enriched in light rare earth elements, similar to those obtained for gabbroic dykes that cut granitoids near the belt (Figure 6d). These dykes may be derived from an enriched source similar to that which formed the mafic tuffs.

TABLE 2 - Representative analyses of volcanic rocks and Proterozoic dykes in the Povungnituk area.

Unit	Apov1	Apov1	Apov1	Ajut3	Ajut4a	Ajut3	Aduq1	Aduq1	pPirs	pPpay
Lithology	**V4 [ME]**	**V3B-M16**	**V2 [TU]**	**V3 [TU]**	**Dyke I3A**	**V1 [TU]**	**V3F-M16**	**V3B-M16**	**I3B**	**I3B**
Major elements										
SiO_2	45.03	49.29	58.53	54.06	49.25	69.19	45.91	48.2	53.87	49.05
TiO_2	0.3	0.98	1.3	0.54	1.62	0.33	0.4	1.36	0.69	1.75
Al_2O_3	6.3	14.85	16.36	14.09	12.86	15.05	12.82	15.19	14.17	14.07
Fe_2O_3*	11.07	12.99	7.49	11.65	14.8	3.47	11.15	15.5	10.62	13.27
MnO	0.16	0.18	0.1	0.19	0.18	0.04	0.15	0.19	0.14	0.18
MgO	27.91	7.34	3.34	6.55	8.08	2.35	18.94	6.04	5.98	6.55
CaO	5.48	11.43	5.72	7.73	6.28	1.43	9.04	10.65	8.58	10.58
K_2O	0.07	0.53	2.77	0.28	1.29	0.7	0.03	0.5	1.09	0.62
Na_2O	0.43	1.6	3.02	2.7	3.28	6.55	0.39	1.63	2.66	2.08
P_2O_5	0.04	0.07	0.38	0.05	0.14	0.12	0.05	0.03	0.13	0.18
LOI	2.4	0.6	0.8	2.1	2.1	0.7	0.8	0.6	1.9	1.5
Total	99.19	99.86	99.81	99.94	99.88	99.93	99.68	99.89	99.83	99.83
Trace elements										
Ba	5	64	662	34	135	196	9	57	336	140
Cr	2484	266.8	130	34.21	116.3	54.74	1498	171.1	225.8	150.5
Cu	33.8	118.1	27.5	93.5	38.4	4.9	33.6	96	81.6	52.4
Ga	8.7	17.5	19.7	15.8	19.3	17.2	11.3	22.5	17.3	20.5
Hf	0.6	1.5	5	1.4	2.8	3.4	0.9	1.4	3	2.7
Nb	0.5	2.4	12.8	1.8	6.4	5.5	1.2	1.5	3.6	8.6
Ni	1278	65.5	75.7	26.4	49.1	33.2	80.2	104.1	59.2	28.9
Pb	0.8	1.9	5.5	1.3	1.8	2.3	6.5	2.4	4.1	1.8
Rb	1.8	6.4	118.7	13.2	51.6	18.7	1	4.6	38.6	20.1
Sc	21	39	15	41	37	6	18	25	24	34
Sr	7.8	116.9	370.2	193.9	141.9	346.9	85.1	197.4	313.8	318
Ta	0.1	0.2	0.8	0.1	0.4	0.7	0.1	0.1	0.2	0.5
Th	0.1	0.3	8.1	1.5	1	9.2	0.2	0.3	3.4	1.2
U	0.1	0.1	1.1	0.5	0.3	2.6	0.1	0.1	0.8	0.3
V	137	313	128	242	400	41	126	245	172	328
Y	6.9	22.2	21.2	18.2	27.9	7	8.5	19	17.1	22.4
Zn	6	25	91	53	71	47	2	44	44	67
Zr	16.9	47.6	196.6	48.5	98.2	96.9	23.5	38.6	91.2	100.9
Rare earth elements										
La	0.9	3.4	55.2	6.3	11.2	37	2.3	4.1	19.8	12.5
Ce	2.5	8.3	102.3	13.6	25.2	60.4	4.7	9.8	38.1	24.4
Pr	0.29	1.2	10.87	1.47	3.19	6.78	0.64	1.58	4.28	3.26
Nd	1.6	7.3	44.1	7	16.8	24.2	3.8	9.2	17.8	15.2
Sm	0.5	2	7	1.6	4	3.9	1	2.9	4	3.4
Eu	0.21	0.78	1.72	0.58	1.28	0.92	0.39	1	1.03	1.39
Gd	0.85	3.1	4.52	1.97	4.49	2.15	1.21	3.73	2.81	4.02
Tb	0.17	0.52	0.71	0.37	0.78	0.29	0.22	0.57	0.49	0.7
Dy	1.01	3.35	3.75	2.52	4.41	1.38	1.29	3.12	2.2	4.15
Ho	0.25	0.72	0.68	0.57	0.91	0.21	0.29	0.61	0.65	0.86
Er	0.66	2.24	1.9	1.74	2.78	0.63	0.9	1.86	1.79	2.18
Tm	0.13	0.33	0.24	0.28	0.41	0.1	0.13	0.23	0.23	0.33
Yb	0.61	2.32	1.72	1.89	2.54	0.55	0.93	1.54	1.44	1.92
Lu	0.1	0.38	0.23	0.27	0.42	0.09	0.12	0.24	0.25	0.31

Intermediate to Felsic Volcaniclastic Rocks

Volcaniclastic rocks in the Povungnituk Complex show intermediate to felsic compositions. Two analyzed samples have Zr/Y ratios of about 9 and fractionated rare earth element patterns ($[La/Yb]_n = 23$ and 27) (Figure 6b and d).

Two samples from the Juet Belt have rhyodacitic compositions and Zr/Y ratios of 12.6 and 13.8 (Figure 6b). These two samples however show rare earth signatures indicating distinct sources and petrogenetic processes (Figure 6d). Sample 02-AB-103A1, from the northern part of the belt, has a $[La/Yb]_n$ ratio of about 7, whereas sample 02-AB-083A, taken 8 km further south, has a much higher $[La/Yb]_n$ ratio, around 48. Based on these observations, it seems that the felsic volcaniclastic rocks in the northern part of the belt were derived from a source that differentiated at lower pressure conditions relative to similar rocks located further south.

Felsic Plutonic Rocks

BO[3] Tonalites-Trondhjemites (*Arot1*) and HB-BO[3] Tonalites (*Arot2*) of the Rochefort Suite

Tonalites and trondhjemites (< 10% mafic minerals) of the Rochefort Suite show a wide range of chemical signatures. In this section, the tonalites will be divided into two groups, in order to stress the importance of the mineralogy and of petrogenetic processes on the geochemical signature. These two groups include: tonalites and trondhjemites where biotite is the only mafic phase (*Arot1*) and tonalites with

[3] HB = hornblende; BO = biotite

hornblende and biotite (*Arot2*). In a diagram showing normative compositions (O'Connor, 1965), rocks of the Rochefort Suite plot in the field of tonalites and trondhjemites (Figure 7a). Tonalites have a metaluminous composition (ACNK[4] < 1.0), whereas trondhjemites have a slightly peraluminous composition (Figure 7b). Based on the classification of Frost *et al.* (2001), tonalites and trondhjemites of the Rochefort Suite are overall magnesian and calc-alkalic (Figure 7c and d). Similar to rocks in the Lac Anuc area (NTS 34O; Berclaz *et al.*, 2003), hornblende tonalites of the Povungnituk area have lower SiO_2 concentrations and generally higher CaO, TiO_2, Fe_2O_3 and MgO than biotite tonalites and trondhjemites (Table 3 and Figure 9 in Berclaz *et al.*, 2003).

In spiderdiagrams, biotite-hornblende tonalites systematically exhibit Nb and Ta anomalies ($[Th/Nb]_n > 1$) and similar light rare earth element concentrations. Biotite tonalites have slightly fractionated heavy rare earth patterns ($[Dy/Lu]_n = 1.4$ and 1.9), whereas hornblende tonalites have flat heavy rare earth patterns ($[Dy/Lu]_n = 0.9$ and 1.1; Figure 8).

Trondhjemites show distinct patterns relative to tonalites. All samples show positive Eu anomalies and heavy rare earth patterns (HREE) more strongly fractionated than in biotite tonalites. A few samples do not exhibit Nb and Ta anomalies ($[Th/Nb]_n \sim 1$), suggesting fractionation of a Th-rich phase or a source depleted in high-field-strength elements (HFSE[4]: Nb, Ta, Th; Figure 8). The heavy rare earth depletion in trondhjemites and biotite tonalites may be explained by the fractionation of hornblende. Also, systematically high Eu contents in trondhjemites may suggest these rocks are plagioclase cumulates.

In summary, hornblende tonalites are more mafic and enriched in incompatible elements relative to biotite tonalites and trondhjemites. They may represent: 1) less differentiated rocks where hornblende was not fractionated, or 2) rocks that have assimilated greater proportions of mafic material from volcanic belts, as proposed by Berclaz *et al.* (2003).

BO Granodiorites of the La Chevrotière Suite (*Alcv3*)

Other than higher K_2O concentrations, biotite granodiorite samples collected in the Povungnituk area show chemical compositions similar to those of biotite tonalites-trondhjemites of the Rochefort Suite (Table 3; Figure 7). In the diagram showing the alumina saturation index (Figure 7b), the granodiorites straddle the boundary between the metaluminous and peraluminous domains (ACNK ~ 1.0). In descriptive diagrams by Frost *et al.* (2001), these rocks show magnesian and calc-alkalic compositions (Figure 7c and d). In spiderdiagrams, the two samples collected exhibit Nb and Ta anomalies and similar LILE[4] and light rare earth concentrations (Figure 8). However, distinct heavy rare earth element contents are probably related to variable degrees of hornblende or garnet fractionation in the source region of the magma.

Porphyroclastic Monzogranites and BO Diorites of the Pinguq Suite (*Apin*)

Monzogranites of the Pinguq Suite have normative compositions straddling the granodiorite/granite fields (Figure 7a). They show moderate to high incompatible element concentrations (K_2O = 2.5 to 4.0%, TiO_2 = 0.4 to 1.3%, Zr = 140 to 660 ppm) and relatively low SiO_2 concentrations of 62 to 64%. Overall, these rocks are metaluminous, ferrous and alkali-calcic to calc-alkalic (Figure 7c and d). These chemical characteristics are typical of certain A-type granites associated with mafic intrusive rocks and dykes (Frost *et al.*, 2001). Rare earth element patterns show a slight fractionation of heavy rare earth elements, and a few samples do not have negative Nb and Ta anomalies, which implies the fractionation of a Th-rich phase (Figure 8).

Biotite diorites of the Pinguq Suite are enriched in K_2O, due to the high mica content (Figure 7a; $K_2O/Na_2O = 0.83$). These rocks have high alkali element concentrations ($CaO+K_2O+Na_2O \sim 12.0$ and 13.5%), as well as high TiO_2 (~ 2%) and Zr (< 420 ppm) (Table 3). Spiderdiagrams outline relatively high incompatible element concentrations, negative Nb and Ta anomalies and rare earth element patterns parallel to those obtained for monzogranites, which suggests similar genetic processes. High incompatible element concentrations combined with relatively low SiO_2 concentrations (50 and 55%) suggest these rocks are derived from an enriched source.

Enderbites of the Qilalugalik Suite (*Aqil3*)

The two samples of enderbite that were analyzed show normative tonalite compositions on the AB-AN-OR diagram (Figure 7a) and compositions straddling the metaluminous and peraluminous fields (ACNK ~ 1; Figure 7b). Based on the classification of Frost *et al.* (2001), these samples are exclusively magnesian and calcic (Figure 7c and d). The two profiles obtained on the spiderdiagrams are identical (Figure 8). Heavy rare earth element patterns are flat ($[Dy/Lu]_n \sim 1$) and parallel to those of hornblende tonalites, albeit less differentiated. These enderbites do not exhibit positive Nb and Ta anomalies and have $[Nb/Th]_n$ ratios of about 1 (Figure 8).

Diatexites of the Bylot Suite (*Abyl*) and the Mézard Complex (*Amez2*)

Three samples of tonalitic diatexite (*Abyl1*) and one sample of granitic diatexite associated with paragneisses (*Amez2*) were analyzed in order to characterize their geochemistry. Samples of unit *Abyl1* show normative compositions typical of tonalites to granodiorites. They

[4] ACNK – Molar proportions of $Al_2O_3/(CaO+Na_2O+K_2O)$
HFSE - High field strength element
LILE - Large ion lithophile element

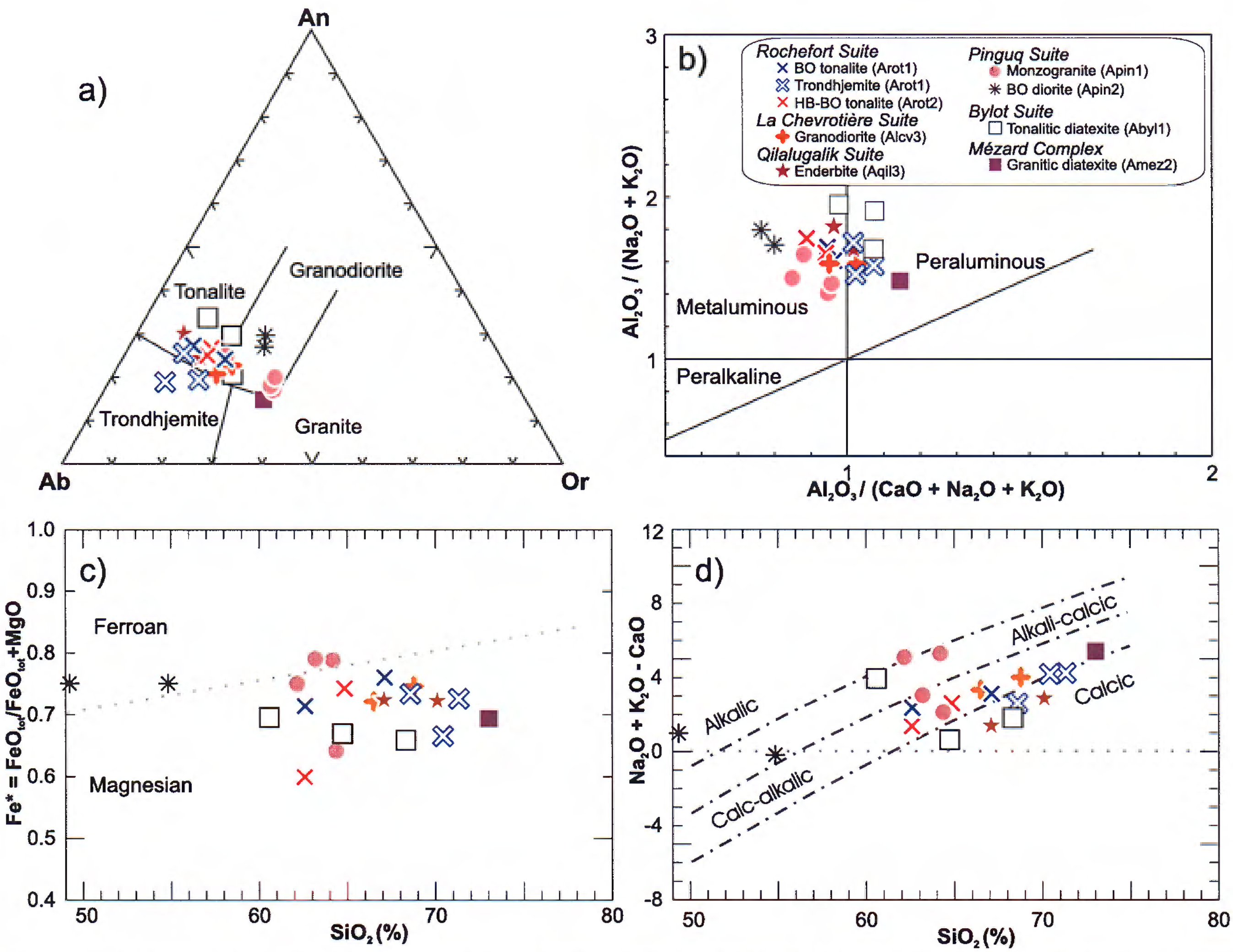

FIGURE 7 - Geochemical diagrams showing the results of major element analyses for felsic plutonic rocks of the Povungnituk area: **a)** classification diagram based on normative albite, anorthite and orthoclase (O'Connor, 1965), **b)** alumina saturation index by Maniar and Piccoli (1989), **c)** FeOtot/FeOtot + MgO (Fe*) versus SiO_2 by Frost *et al.* (2001), and **d)** modified alkali-lime index by Frost *et al.* (2001).

straddle the metaluminous and peraluminous fields, and are distinguished from felsic intrusive rocks by their high Al_2O_3/ Na_2O+K_2O ratio (1.6 to 2.0; Figure 7b). These samples have magnesian compositions ranging from calcic to alkali-calcic (Figure 7c and d). In spiderdiagrams, tonalitic diatexites show variably fractionated heavy rare earth patterns ($[Dy/Lu]_n$ = 1.6 to 2.2) and negative Nb and Ta anomalies.

The sample of granitic diatexite (*Amez2*; 02-VB-8151) has a normative granite composition, a strongly peraluminous signature (ACNK > 1.1) and a high SiO_2 content (Figure 7). These characteristics are typical of S-type peraluminous leucogranites derived from the melting of a sedimentary protolith (Frost *et al.*, 2001). Spiderdiagrams for this sample show low rare earth element concentrations, fractionated heavy rare earth elements ($[Dy/Lu]_n$ = 3.7), a positive Eu anomaly and a negative Nb and Ta anomaly.

Proterozoic Diabase Dykes

In the Povungnituk area, geochemical data are available only for the Irsuaq River and Payne River dyke swarms. These dykes have chemical signatures ranging from tholeiitic to transitional (Figure 6a and b). Six samples from the Irsuaq River swarm show Zr/Y ratios of about 5.5, whereas three samples from the Payne River swarm have ratios ranging from 3.3 to 5.6 (Figure 6b). All samples have slightly fractionated rare earth patterns similar to continental plateau basalts (Figure 6c). Two samples from the Payne River swarm exhibit less fractionated rare earth patterns ($[La/Yb]_n$ = 3.4 and 4.3) than those of the Irsuaq River swarm ($[La/Yb]_n$ = 5.6 to 9.5). Samples from these two dykes also exhibit low Th, which suggests the magma may have assimilated less continental crust material during its ascent.

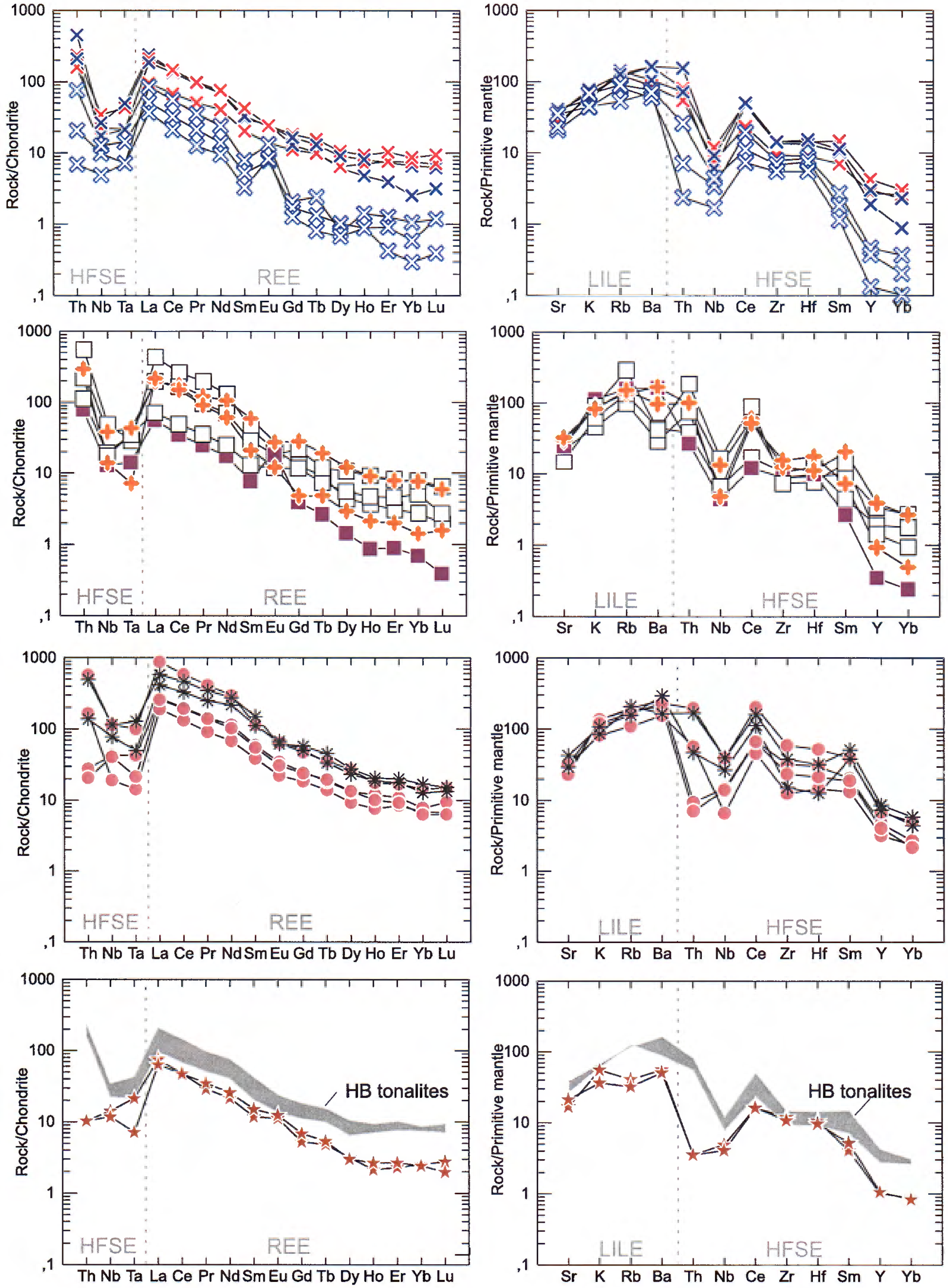

FIGURE 8 - Spiderdiagrams normalized to chondrites and to the primitive mantle. Normalization figures are taken from Sun and McDonough (1989). Symbols correspond to those listed in Figure 7.

TABLE 3 - Representative analyses of plutonic rocks in the Povungnituk area.

Unit	Arot1	Arot1	Arot2	Alcv3	Apin1	Apin2	Aqil3	Abyl1	Amez2
Lithology	**I1E**	**I1D-BO**	**I1D-HB**	**I1C-BO**	**I1M [PJ]**	**I2J-BO**	**I1T**	**M21-I1D**	**M21-I1B**
Major elements									
SiO_2	68.59	67.13	62.6	66.51	64.2	54.83	67.09	68.31	73.03
TiO_2	0.38	0.41	0.47	0.48	0.85	2.04	0.49	0.47	0.15
Al_2O_3	16.01	15.47	15.96	16.05	15.92	14.28	16	14.86	14.63
Fe_2O_3*	3.12	3.87	5.02	3.79	4.95	11.22	4.24	4.7	1.43
MnO	0.03	0.04	0.07	0.04	0.06	0.12	0.04	0.04	0.01
MgO	1.02	1.11	3.02	1.32	1.2	3.38	1.46	2.19	0.57
CaO	3.52	3.53	4.83	3.72	3	5.9	4.3	3.56	1.84
K_2O	1.32	2.32	1.82	2.62	4.07	2.59	1.1	1.88	3.45
Na_2O	4.8	4.33	4.37	4.42	4.21	3.13	4.61	3.49	3.79
P_2O_5	0.08	0.17	0.12	0.23	0.3	1.52	0.12	0.08	0.06
LOI	1	1.4	1.5	0.5	0.9	1.3	0.4	0.5	0.5
Total	99.87	99.78	99.78	99.68	99.66	100.31	99.85	100.08	99.46
Trace elements									
Ba	414	1136	607	1164	1769	1156	355	314	1158
Ga	23	20.9	21.9	21.3	23.3	25.3	21.9	22.3	19.1
Hf	2.6	4.7	2.8	3.4	9.3	9.9	3	3.9	3.1
Nb	2.4	6.5	5.5	9.4	10.6	28.1	2.9	4.8	3.2
Ni	9.1	10.1	39.2	12.5	3	36.5	10.5	22.7	8.3
Pb	5	5.9	42.6	4.6	8.3	6.3	9.8	3.5	12.1
Rb	52.7	80.4	79	87.1	124.9	131.5	20.5	86.2	101.6
Sc	2	3	9	5	10	18	6	8	2
Sr	441.5	747.3	566.7	629.7	483	621.1	448.2	320.2	508.1
Ta	0.1	0.7	0.3	0.6	0.6	1.8	0.1	0.5	0.2
Th	0.6	13.1	4.6	8.2	0.8	14.3	0.3	3.3	2.3
U	0.1	1.3	0.8	0.9	0.7	2.3	0.1	0.6	0.6
V	43	45	77	48	41	171	55	64	19
Y	2.1	13.6	12.4	17.6	21.4	39	4.8	8.8	1.6
Zn	49	57	56	52	64	128	38	56	25
Zr	87.1	159.7	103.4	138	360.6	426.1	121.2	120	100.6
Rare earth elements									
La	20.2	56.5	22.7	46.2	63.2	137.1	15	17.1	13.4
Ce	34.1	88.8	41.4	106	121.6	284.8	28.8	30.6	21.7
Pr	3.35	9.38	4.82	11.53	13.7	32.58	3.31	3.41	2.38
Nd	11.2	33.5	18.9	49.3	53.1	130.1	12	11.8	8.2
Sm	1.2	5	3.1	9	9	22.8	2.3	2	1.2
Eu	0.77	1.37	0.8	1.58	2	3.59	0.72	0.7	1.21
Gd	0.43	3.41	2.27	5.78	5.15	11.82	1.41	2.44	0.82
Tb	0.09	0.49	0.37	0.71	0.69	1.69	0.2	0.28	0.1
Dy	0.2	2.31	1.64	3.07	3.36	7.04	0.76	1.42	0.37
Ho	0.08	0.46	0.4	0.51	0.68	1.17	0.15	0.27	0.05
Er	0.21	1.21	1.26	1.3	1.81	3.33	0.44	0.77	0.15
Tm	0.05	0.17	0.17	0.16	0.23	0.44	0.06	0.1	0
Yb	0.18	1.13	1.27	1.3	1.32	2.88	0.41	0.88	0.12
Lu	0.03	0.16	0.18	0.15	0.24	0.39	0.05	0.07	0.01

ECONOMIC GEOLOGY

In the northeastern Superior Province, the main zones of economic interest are located within volcano-sedimentary belts. Two new Au and Cu-Ag showings were discovered in the Juet Belt (*Ajut*) and in the Mézard Complex (*Amez*) while mapping the Povungnituk area in 2002. At the time of writing this report, no exploration program had been undertaken in the Archean rocks in the area.

Au Mineralization in the Juet Belt (*Ajut*)

The Juet Belt (*Ajut*) hosts the most promising mineral potential in the Povungnituk area. This belt consists of mafic and felsic tuffs, amphibolitized basalts, terrigenous sedimentary rocks, oxide-facies iron formations and a tourmaline-bearing pegmatite unit that cuts all other units (see section entitled "Stratigraphy").

Iron formations are known to host gold occurrences in the Lac Vernon area (NTS 34J; Parent *et al.*, 2003) and the Lac Anuc area (NTS 34O; Berclaz *et al.*, 2003), as well as in the southern Superior Province (Goutier *et al.*, 2002). In the Juet Belt, high gold grades were obtained in iron formations mapped on outcrop 02-AB-103 (Figure 9). These iron formations, enclosed in a mafic tuff unit, are predominantly oxide-facies rocks, but they laterally grade to a sulphide facies (Appendix 1, photos 5 and 6). Assays of grab samples collected in the sulphide facies yielded grades of 6400 and 234 ppb Au. In thin section, the two facies exhibit mm-scale to cm-scale banding, and contain variable proportions of polygonal quartz, plagioclase, blue-

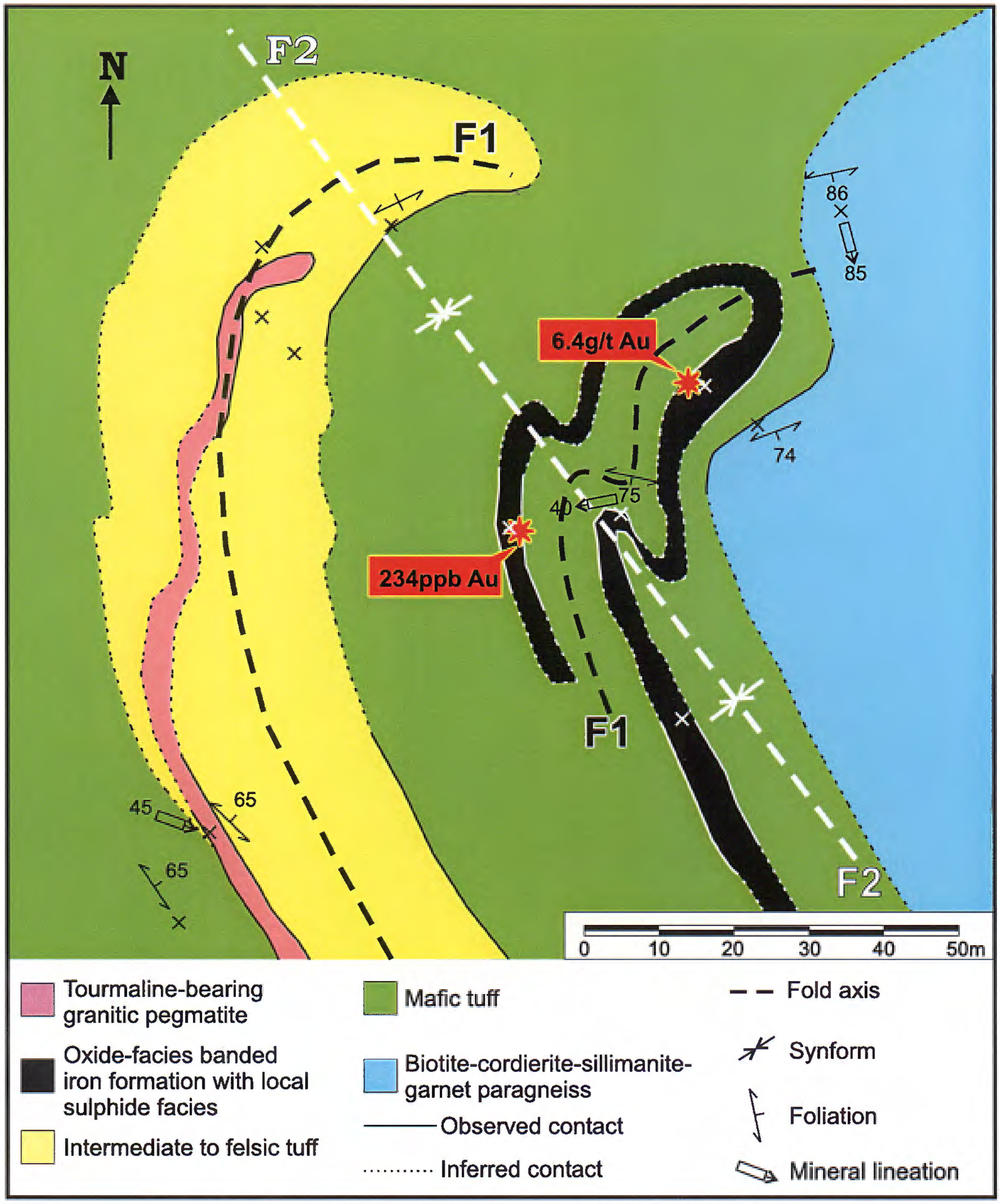

FIGURE 9 - Geology of outcrop 02-AB-103, in the Juet Belt. See Figure 2 for location.

green or light green amphibole, grunerite, biotite and magnetite. Sulphide-facies iron formations contain about 25% disseminated to semi-massive opaque minerals. Xenomorphic pyrite is altered to goethite and is associated with marcasite. Automorphic arsenopyrite contains pyrite and magnetite inclusions. Magnetite is concentrated in amphibole-rich bands. Opaque minerals in sulphide-poor samples essentially consist of magnetite with xenomorphic arsenopyrite inclusions.

Cu-Ag Mineralization in the Mézard Complex (*Amez*)

Sedimentary rocks of the Mézard Complex were the focus of exploration in the Lac Anuc area (NTS 34O; Francoeur and Chapdelaine, 1999; Berclaz *et al.*, 2003), where several gold showings associated with iron formations were identified. In the Povungnituk area however, iron formations of the Mézard Complex do not host significant gold grades.

Mapping conducted in the summer of 2002 led to the discovery of anomalous Cu and Ag grades. These were obtained from a sample collected in a quartz vein with semi-massive sulphides, hosted in amphibolite. The amphibolites are themselves enclosed in leucogranites probably derived from the melting of a sedimentary protolith. A grab sample from a sulphide lens (02-JD-3017) yielded 0.6% Cu and 3.8 g/t Ag. In thin section, the veins contain 50% medium-grained polygonal quartz, surrounded by 10% fine-grained quartz and 15% plagioclase. Trace amounts of chlorite, epidote, magnetite and hematite are also observed. Opaque minerals consist of 20 to 25% altered subautomorphic pyrite and 2 to 5% chalcopyrite. Pyrite grains enclose quartz grains, and chalcopyrite occasionally occurs as inclusions in pyrite.

CONCLUSIONS

Archean rocks (2.83 – 2.69 Ga) of the Povungnituk area were subdivided into two lithodemic complexes, two volcano-sedimentary belts, six intrusive suites and one lithological unit, intruded by four sets of Paleoproterozoic dykes (< 2.2 Ga). The Povungnituk (*Apov*) and Mézard (*Amez*) complexes and the Duquet Belt (*Aduq*) contain a variety of volcanic and sedimentary rocks metamorphosed to the amphibolite and the granulite facies, and enclosed in granitoid units. The Rochefort Suite (*Arot*) consists of tonalitic and trondhjemitic units emplaced between 2830 and 2766 Ma, in a series of magmatic events. A first phase of ductile deformation (D_1), responsible for F_1 folds and an S_1 fabric oriented E-W to WNW-ESE, is locally preserved in volcano-sedimentary and tonalitic-trondhjemitic units. This first deformation was reworked by a second phase of regional deformation (D_2), responsible for the prominent N-S to NNW-SSE regional fabric.

The oldest units are intruded by granitoids of the La Chevrotière (*Alcv*) and Pinguq (*Apin*) suites, composed of monzogranite-granite-granodiorite, and by enderbites of the Qilalugalik Suite (*Aqil*). These suites were emplaced between 2732 and 2725 Ma, and are associated with generally positive aeromagnetic anomalies. A phase of dextral shearing (D_3) variably affects all rocks in the area. It is responsible for a synmetamorphic mylonitic fabric oriented WNW-ESE and is coeval with the emplacement of porphyroclastic granitoids of the Pinguq Suite (*Apin*) (2727-2725 Ma) and diatexites of the Bylot Suite (*Abyl*) (2737-2722 Ma). The Juet Belt (*Ajut*) is dominated by sedimentary and volcaniclastic units, metamorphosed to the amphibolite and the greenschist facies. These units were emplaced after 2722 Ma, *i.e.* after the peak of metamorphism represented by diatexites of the Bylot Suite (*Abyl*). Finally, between 2710 and 2690 Ma, all rocks in the area underwent the effects of a late "granitization".

All these units and ductile structures (D_1, D_2 and D_3) are truncated by E-W-trending D_4 structures, which form anastomosing networks of protomylonitic to brittle-ductile shear zones, pseudotachylites and faults. These Archean phases of deformation were followed by a Paleoproterozoic anorogenic episode during which the Klotz dykes (*pPktz*), Payne River dykes (*pPpay*), Irsuaq River dykes (*pPirs*) and Pointe Raudot dykes (*pPra*) were emplaced along brittle faults (D_5). Then, three phases of Paleoproterozoic deformation related to the Ungava Orogen (D_6) affected the Archean rocks immediately to the south of the orogenic front. The economic potential of the area is related to gold occurrences associated with iron formations in the Juet Belt, and Cu±Ag occurrences associated with quartz and semi-massive sulphide veins in the Mézard Complex.

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APPENDIX 1 - PHOTOGRAPHS

PHOTO 1 - Migmatized volcanic rock and clinopyroxene-bearing felsic mobilizate in the Povungnituk Complex (Apov1).

PHOTO 2 - Migmatized paragneiss with garnet porphyroblasts in the Mézard Complex (Amez2).

PHOTO 3 - Diatexite with biotite schlieren in the Mézard Complex (Amez2).

PHOTO 4 - Oxide-facies iron formation in the Juet Belt (Ajut1).

PHOTO 5 - Sulphide-facies iron formation in the Juet Belt (Ajut1).

PHOTO 6 - Dismembered carbonatite dyke enclosed in tonalites of the Rochefort Suite (Arot).

APPENDIX 2 - PHOTOGRAPHS

PHOTO 1 - Enderbitic enclave from the Qilalugalik Suite (Aqil3) enclosed in porphyroclastic monzogranite of the Pinguq Suite (Apin1).

PHOTO 2 - Porphyroclastic monzogranite of the Pinguq Suite (Apin1).

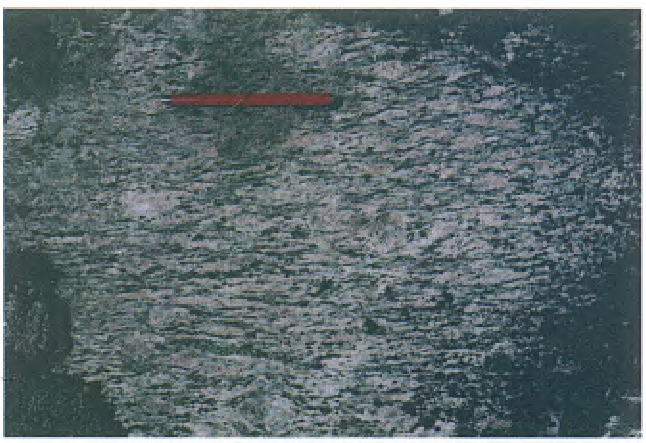

PHOTO 3 - Protomylonite derived from the porphyroclastic monzogranite unit of the Pinguq Suite (Apin1).

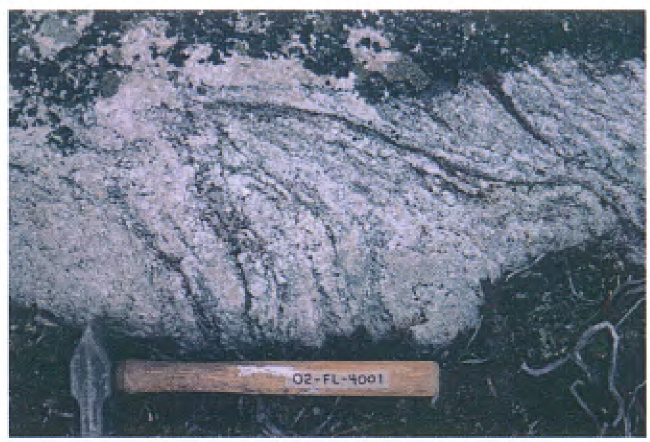

PHOTO 4 - Tonalitic diatexite of the Bylot Suite (Abyl1).

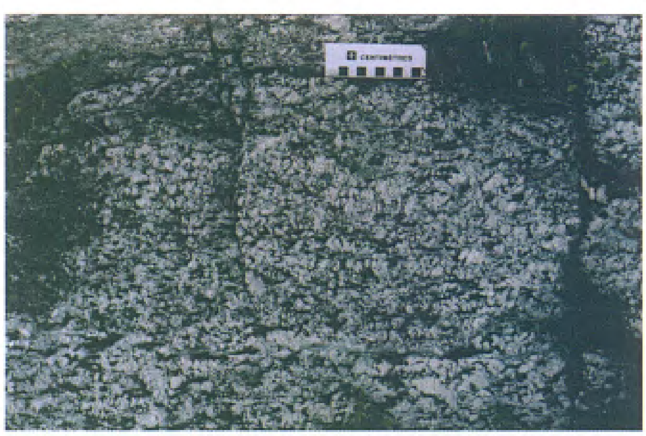

PHOTO 5 - Gabbroic anorthosite of the Couture Suite (Acot1).

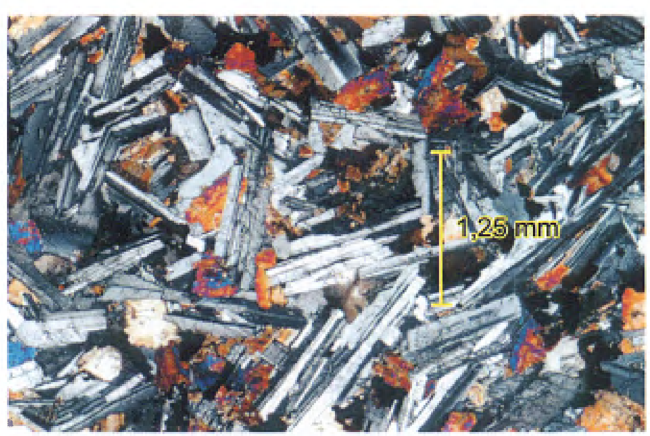

PHOTO 6 - Photomicrograph in polarized light of a diabase dyke from the Irsuaq River swarm (pPirs).

ABSTRACT

The geology of the Povungnituk area (NTS 35C and the southeastern part of 35F) was mapped at the 1:250 000 scale during the summer of 2002. It was subdivided into two lithodemic complexes, two volcano-sedimentary belts, six intrusive suites, one lithological unit and four lithodemes, all emplaced between 2.8 and 1.8 Ga. The Povungnituk and Mézard complexes, as well as the Duquet Belt, contain various types of volcano-sedimentary rocks, metamorphosed to the amphibolite and the granulite facies and enclosed in different granitoid units. Volcano-sedimentary rocks of the Juet Belt are metamorphosed to the greenschist and the amphibolite facies, and are not intruded by felsic plutonic suites. Plutonic units were grouped into suites which, from the oldest to the youngest, are: *(i)* mafic and ultramafic rocks of the Couture Suite; *(ii)* tonalites-trondhjemites-granodiorites-granites of the Rochefort Suite (2830 to 2766 Ma); *(iii)* granites-granodiorites of the La Chevrotière (2732 Ma) and Pinguq (2727 Ma) suites; *(iv)* enderbites-opdalites-charnockites of the Qilalugalik Suite (2730 Ma); *(v)* diatexites of the Bylot Suite (2737 to 2722 Ma). These units are cut by four sets of Paleoproterozoic gabbro and diabase dykes, namely the Klotz (2209 Ma), Payne River (> 2000 Ma), Irsuaq River and Pointe Raudot dykes.

Rocks in the area have undergone polyphase deformation. A first phase of ductile deformation (D_1) is responsible for F_1 folds and an S_1 fabric oriented E-W to WNW-ESE, which are only locally preserved in volcano-sedimentary units. This deformation was reworked by a second phase of regional deformation (D_2), responsible for the prominent N-S to NNW-SSE-trending fabric. A phase of dextral shearing (D_3) affects all the rocks in the area, albeit in a heterogeneous manner. This phase of deformation resulted in the formation of a synmetamorphic myloniticfabric oriented WNW-ESE.

It is coeval with the emplacement of porphyroclastic granitoids of the Pinguq Suite and diatexites of the Bylot Suite. Following these three Archean phases of deformation, a Paleoproterozoic anorogenic episode occurred, during which the Klotz, Payne River and Irsuaq River dyke swarms were emplaced along brittle faults (D_4). Then, three phases of Paleoproterozoic deformation related to the Ungava Orogen (D_5) affected Archean rocks just south of the orogenic front.

The economic potential of the area is outlined by two types of mineral occurrences: 1) gold occurrences associated with sulphide-facies iron formations in the Juet Belt, and 2) Cu ± Ag occurrences in quartz-rich veins with semi-massive sulphides, observed in the Mézard Complex.

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