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DESCRIPTIVE NOTES

INTRODUCTION

The Ungava Orogen is an arc-continent collisional belt of Paleoproterozoic age that represents the northern Quebec segment of the Trans-Hudson Orogen (Hoffman, 1989). It has been the focus of two major Geological Survey of Canada (GSC) mapping projects since 1985. Fieldwork for the first project was undertaken between 1985 and 1987 in the eastern half of the Cape Smith Belt, and resulted in the publication of fifteen 1:50 000-scale maps (St-Onge and Lucas, 1990a) as well as a GSC Memoir (St-Onge and Lucas, 1993) and numerous papers in scientific journals (see St-Onge and Lucas, 1990b; St-Onge et al., in press). The second project, with fieldwork from 1989 to 1991, was undertaken to examine the rocks in the internal zone of the Ungava Orogen (i.e. north of the Cape Smith Belt, Fig. 1) through regional bedrock mapping and associated multidisciplinary research (Lucas and St-Onge, 1991; St-Onge and Lucas, 1990c, 1992). The resulting six 1:100 000-scale maps present a fundamentally new view of the Precambrian bedrock geology of the northernmost part of the Ungava Peninsula in Quebec and the adjacent islands of the Northwest Territories. The only previous regional work in the internal zone was a helicopter reconnaissance project resulting in seven 1:250 000-scale maps and a GSC Memoir (Taylor, 1982). Systematic bedrock mapping of the western part of the Cape Smith Belt at 1:50 000-scale was completed by the Ministère de l'Énergie et des Ressources du Québec in 1989 (Lamothe et al., 1984, 1986; Lamothe and Picard, 1994).

The Ungava Orogen comprises Paleoproterozoic tectonostratigraphic assemblages accumulated on or accreted to the northern margin of the Archean Superior Province during more than 200 Ma of divergent and convergent tectonic activity (Lucas et al., 1992; St-Onge et al., 1992). Preserved within the orogen are: (1) (par)-autochthonous (3.22-2.74 Ga) plutonic and supracrustal rocks of the Archean Superior Province; (2) autochthonous and allochthonous sedimentary and volcanic units (>2.04-1.92 Ga Povungnituk and Chukotat groups) thought to be associated with Paleoproterozoic rifting of the Superior craton; and (3) allochthonous Paleoproterozoic crustal assemblages interpreted as an ophiolite (2.00 Ga Watts Group), a fore-arc clastic apron (Spartan Group) and a magmatic arc terrane (1.86 Ga Parent Group, 1.90-1.84 Ga Cape Smith suite plutons intrusive into the Watts and Parent groups, and 1.86-1.80 Ga Narsajuaq arc and Sugluk Group).

TECTONOSTRATIGRAPHIC UNITS

SUPERIOR PROVINCE (Au-Abs)

The Archean Superior Province represents the stratigraphic basement to the Povungnituk and Chukotat groups and the structural basement to the Watts, Spartan, and Parent groups as well as to the Narsajuaq arc (Fig. 1). Superior Province rocks are exposed in two basement half-windows north of the Cape Smith Belt, the eastern one of which is connected in contiguous outcrop with the Superior Province rocks exposed at the east end of the belt and to the south of it (Fig. 1). The basement rocks are principally amphibolite to granulite facies plutonic gneisses interpreted as the mid-crustal core of a magmatic arc on the basis of pluton composition and tectonomagmatic history (St-Onge et al., 1992; Harvey, 1995). Although the Archean domain contains distinct intrusive units which range in composition from diorite (Aqd) to syenogranite (Abs), it is dominated by tonalite (Aht, Ahtq, Abt, Abte). The voluminous tonalite bodies contain outcrop to map scales enclaves and screens of mafic to ultramafic intrusive rocks (Aqd) and siliciclastic metasedimentary rocks (As), and are intruded by granitic plutons (Abm, Abg). The principal structural element in the Superior Province basement is a pervasive, steeply inclined foliation commonly defined by compositional banding at both map and outcrop scales which developed during plutonism (Lucas and St-Onge, 1995). The Archean foliation in the basement is truncated by an unconformity and/or a thrust fault at the base of the Paleoproterozoic cover sequence (Povungnituk Group).

Mineral assemblages in the Superior Province basement record conditions ranging from amphibolite to granulite facies (St-Onge and Lucas, 1995; St-Onge and Ijewliw, 1996). However, all lithological units contain, at least locally, granulite-facies assemblages: orthopyroxene-clinopyroxene-hornblende-plagioclase-quartzofeldspathic pods-ilmenite±quartz±biotite in dioritic to tonalitic gneisses; orthopyroxene-clinopyroxene-hornblende-K-feldspar plagioclase-quartz-ilmenite±biotite in granitic plutons; and garnet-sillimanite-cordierite-biotite-K-feldspar-plagioclase-quartz-quartzofeldspathic pods in pelitic units. The granulite-facies assemblages occur either in local pockets within regional lower grade zones, or in regional high grade zones characterized by the presence of orthopyroxene (St-Onge and Lucas, 1995). A minimum age for the granulite-facies metamorphism is 2740 Ma based on U-Pb geochronology of metamorphic zircons (Scott and St-Onge, 1995; R. Parrish pers. comm., 1992), whereas a maximum age is given by the age of the tonalites (>2780 Ma). In contrast, growth of overprinting amphibolite-facies assemblages (St-Onge and Lucas, 1995) has been dated at 1810-1790 Ma (U-Pb in titanite; Scott and St-Onge, 1995).

As a significant proportion of the rocks in the Superior Province basement, as well as the Cape Smith Belt and the Narsajuaq arc, contains a tectonic foliation and non-primary mineralogy, the prefix 'meta' applies to most rock units, but is dropped from the ensuing text for simplicity.

Quartz Diorite and Mafic-Ultramafic Units (Aqd)

Mafic and ultramafic intrusive units are found as map-scale screens between, and as enclaves and rafts within, the voluminous tonalite bodies and granitic plutons. On an outcrop-scale, mafic and ultramafic rocks present two distinct relationships with the tonalite: (1) diorite interlayered and apparently comagmatic with tonalite; and (2) diorite, amphibolite, pyroxenite, and peridotite forming angular, low-aspect-ratio enclaves in tonalite (agmatitic texture). A diorite inclusion in tonalite (Abte) from the Fisher Bay area has yielded a U-Pb zircon age of 2810±11 Ma (Parrish, pers. comm., 1993). Amphibolites are also interlayered with siliciclastic rocks (see below) at outcrop scale, but their origin (extrusive vs. intrusive) remains equivocal.

Rare, late diorite plutons cut the tonalite plutons and form relatively small (hundreds of metres to several kilometres in diameter), equigranular, and medium-grained bodies. A small composite mafic intrusive complex emplaced in tonalite was mapped on the northeastern side of Deception Bay, and has a U-Pb zircon age of 2740±10 Ma (Parrish, pers. comm., 1992). The complex is dominated by a hornblende-biotite quartz diorite which grades into hornblende-biotite tonalite toward the interior of the pluton. The quartz diorite contains inclusions of pyroxenite, diorite and tonalite. Associated with the quartz diorite is a mafic diorite phase dominated by large ovoid plagioclase phenocrysts up to 3 cm in length. The plagioclase phenocrysts are cored by hornblende, and garnet inclusions are locally present. Clinopyroxene-hornblende±biotite pyroxenite forms a second distinct intrusive phase associated with, and marginal to the quartz diorite. All units of the intrusive complex are crosscut by monzogranite veins. Foliated margins and a massive core dissected by discrete shear zones characterize the complex.

Sedimentary rocks (As)

Fine-grained clastic sedimentary rocks are preserved as large screens within tonalite and monzogranite plutons, and are principally found east of Deception Bay. Rusty semipelite is volumetrically the most important unit, wheras locally, bands of pelite and amphibolite, less than 1 m thick, are intercalated with the semipelite. A well developed layering is characteristic of both the semipelite and pelite. Small pods (0.5 m in thickness) of calcite marble occur within tonalite and monzogranite bodies of the Wakeham Bay area.

In the western Archean basement tectonic window, sedimentary rocks are volumetrically minor, but locally form mappable bands with significant strike lengths. The sedimentary sequence is dominated by pelite and semipelite, which are rarely interlayered with quartzite, suggesting a relatively deep water depositional environment. Field relations indicate that the sedimentary rocks are preserved as screens between and/or within tonalite plutons. The sedimentary sequence is cut by granitoid veins derived from adjacent or enveloping plutonic bodies, and apparently also by local partial melting.

Biotite±hornblende tonalite (Abte, Abt, Ahtq, Aht)

Biotite±hornblende tonalite is the dominant plutonic rock type of the Superior Province basement. The tonalite is grey, medium grained, and equigranular in general, although it is locally plagioclase megacrystic. Two distinct generations of tonalite plutons are recognized on the basis that they largely pre- and post-date granitic veining. The older tonalites have been grouped into three principal map units: (1) biotite±hornblende tonalite with abundant mafic to ultramafic enclaves (Abte); (2) biotite±hornblende tonalite (Abt); and (3) hornblende-biotite tonalite with interlayered quartz diorite (Ahtq). Several U-Pb zircon ages have been obtained for these tonalite units (Parrish, 1989, pers. comm., 1993): 2780±4 Ma and 2882+44/-28 Ma for samples of biotite±hornblende tonalite (Abt) from the area between François Malherbe Lake and Deception River; 2905+4/-3 Ma for tonalite with abundant enclaves (Abte) from the area between Wakeham Bay and Fisher Bay; and 3220+32/-23 Ma for a sample of biotite±hornblende tonalite with abundant enclaves (Abte) from the western basement window. A tonalite (Abte) from the Wakeham Bay area that is deformed in the Proterozoic basal shear zone of the Cape Smith Belt (see below; Lucas, 1990; St-Onge and Lucas, 1995) has a U-Pb zircon age of 2869+50/-33 Ma (Parrish, pers. comm., 1992).

The tonalite units generally display a well-developed tectonic foliation, commonly defined by nonequidimensional, high-grade metamorphic minerals (e.g. orthopyroxene, clinopyroxene, hornblende), and also by elongate quartz grains and polycrystalline feldspar aggregates. The older tonalite units are typically interlayered with granite and granodiorite veins, which are variably deformed and locally contain granulite-facies mineral assemblages (Lucas and St-Onge, 1995). The tonalites contain metre-scale enclaves to kilometre-scale rafts of quartz diorite, amphibolite, pyroxenite, and siliciclastic sedimentary rocks. The larger rafts within the tonalite units are probably country rock units forming screens or roof pendants between tonalite intrusive sheets or plutons. Southwest of Foul Bay, two distinct plutons of hornblende±biotite tonalite (Aht) are emplaced in the older tonalites. These younger tonalites are medium grained, equigranular, and foliated. The two plutons contain abundant enclaves of amphibolite and quartz diorite. A relatively minor proportion of monzogranite veins (compared to the older tonalites) suggests that the younger tonalites may have been intruded concurrently with the monzogranite plutons (Abm).

Biotite±hornblende granitic rocks (Abg, Abm, Abs)

Granitic plutons intrude the tonalites and are generally characterized by granulite-facies mineral assemblages and a variably developed tectonic foliation, with some plutons being massive or having massive cores. The granitoid rocks are generally medium to coarse grained but vary from equigranular to K-feldspar porphyritic. Although the granitic units clearly intrude the tonalites, they contain a variably developed foliation parallel to that in the tonalites and mafic rocks. The granitic plutons commonly contain centimetre-scale to kilometre-scale xenoliths of tonalite, quartz diorite, amphibolite, and pyroxenite (St-Onge et al., 1992). Both foliated and massive granitic plutons are tabular in shape and trend east-west. They appear to have been emplaced roughly parallel to the easterly trend of the tectonic foliation in the tonalites. U-Pb geochronology of a monzogranite sample from the Foul Bay area has revealed a complex history, with 3618+35/-33 Ma zircons as well as 2740 Ma zircons (Parrish, pers. comm., 1992). Although the zircon morphology suggests that the 3618 Ma grains are igneous and therefore could represent the crystallization age, field relations indicate that the monzogranite plutons intrude the tonalite, which to the south contains 2810 Ma diorite enclaves. The preferred interpretation is that the plutons intruded at 2740 Ma, concurrent with granulite facies metamorphism, but contain inherited Mesoarchean zircons.

The granitic rocks range from granodiorite (Abg) to syenogranite (Abs), although monzogranite (Abm) is overwhelmingly the more common type. Based on pluton geometry and deformation state, the oldest units appear to be granodiorites and monzogranites, and that the youngest pluton is a syenogranite. Individual monzogranite plutons, however, can range from granodiorite at the margins to syenogranite near the centre. The plutons commonly contain centimetre-scale to kilometre-scale inclusions of tonalite, quartz diorite, amphibolite, and pyroxenite. Variably deformed granitic veins are observed in all older map units, and are interpreted as being related to this episode of voluminous, syn-deformation granitic plutonism (Lucas and St-Onge, 1995). This is consistent with the relative absence of granitic veins cutting the granitic bodies and the similar variable bulk deformation states of the granitic veins and plutons.

CAPE SMITH BELT (Ppos-Pcsg)

Five Cape Smith Belt tectonostratigraphic units are exposed in the map area: the Povungnituk (Ppob, Ppos), Chukotat (Pcb), Spartan (Psp), Parent (Ppaa, Ppab), and Watts groups (Pwb). These units have been described extensively by Hynes and Francis (1982), Francis et al. (1983), Parrish (1989), Picard et al. (1990), St-Onge and Lucas (1990a, b, 1993), Scott et al. (1991, 1992), St-Onge et al., (1992), Machado et al. (1993), Barrette (1994), Dunphy (1994), and Dunphy et al. (1995a). Brief summaries of their lithological and stratigraphic characteristics in the map area, as well as their age and tectonic significance as determined by U-Pb geochronology, geochemistry and isotopic studies, are presented here.

Povungnituk Group (Ppos, Ppob)

North of the Cape Smith Belt, the Povungnituk Group occurs in narrow (<10 to 100s of metres) thrust imbricates sandwiched between autochthonous Superior Province basement and overlying allochthons of either the Watts/Parent group or Narsajuaq arc (Fig. 1), and consists principally of siliciclastic sedimentary rocks (Ppos) and highly deformed mafic rocks (Ppob). The siliciclastic units are dominated by semipelite interbedded with minor quartzite and graphitic pelite. These relatively fine-grained, uniformly bedded sedimentary rocks probably represent a deeper-water facies of the continental-rift margin units of the lower Povungnituk Group found in the southern part of the Cape Smith Belt (St-Onge et al., 1992; St-Onge and Lucas, 1993). The mafic rocks generally overlie the siliciclastic units, and are best described as amphibolites. Based on correlations with contiguous stratigraphy in the Cape Smith Belt, these mafic rocks represent deformed and metamorphosed basalt flows and gabbro sills of the upper Povungnituk Group. The correlative mafic volcanic rocks in the low-grade Povungnituk Group have been described as continental tholeiites by Hynes and Francis (1982), Francis et al. (1983), and Picard et al. (1990), and are locally capped by alkaline volcanic and volcaniclastic rocks (Gaonac'h et al., 1992).

A minimum age for the lower Povungnituk Group is given by a U-Pb zircon age determination of 2038+4/-3 Ma on a gabbro sill emplaced in semipelite in the southwest part of the Cape Smith Belt (Machado et al., 1993). A granodiorite pluton that intrudes upper Povungnituk Group pillow basalts has an age of 1991±2 Ma (Machado et al., 1993). A rhyolite sampled from near the top of the preserved Povungnituk Group basalt sequence in the Cape Smith Belt is dated (U-Pb on zircon) at 1959±3 Ma (Parrish, 1989). U-Pb zircon analyses of detrital grains from two lower Povungnituk Group samples have yielded only Archean ages, consistant with derivation from the adjacent Superior Province basement.

Chukotat Group (Pcb)

The Chukotat Group is restricted to the footwall of the orogen-scale Bergeron Fault in the Cape Smith Belt (Fig. 1) and is characterized by relatively little deformed basalts (Pcb). The pillowed and massive basalt flows of the Chukotat Group structurally overlie sedimentary and volcanic rocks of the upper Povungnituk Group along the length of the Cape Smith Belt. In contrast to the upper Povungnituk Group, the Chukotat Group is essentially devoid of sedimentary rocks. Primary textures and volcanic structures, such as variolitic pillow margins, ropy lava, pillow tubes, and flow top breccias are well preserved and suggest submarine accumulation (Hynes and Francis 1982; Francis et al., 1983). Three distinct basalt types (olivine-phyric, pyroxene-phyric, and plagioclase-phyric) can be recognized within the Chukotat Group based on the presence of the dominant pseudomorphic phenocryst type (Hynes and Francis 1982; Francis et al. 1983; Picard et al. 1990). The volcanic rocks of the Chukotat Group range in composition from komatiitic basalts to tholeiitic basalts equivalent to modern n-MORBs (Mid Oceanic Ridge Basalts) (Francis et al., 1983; Picard et al., 1990).

The Povungnituk Group and the lower part of Chukotat Group are host to numerous layered peridotite-gabbro sills (St-Onge and Lucas, 1993, 1994). The major-element chemistry and the distribution of the lithophile elements in the sills suggest that they are comagmatic with the lower Chukotat Group olivine-phyric basalts and may represent their feeder system (Bédard et al., 1984; Barnes et al., 1992). A sample of quartz ferrogabbro from a layered sill intruding the lower Povungnituk Group sedimentary rocks at Cross Lake (100 km west of Wakeham Bay) has yielded a U-Pb age on baddeleyite of 1918+9/-7 Ma (Parrish, 1989).

Parent Group (Ppab, Ppaa)

The northwestern part of the Cape Smith Belt contains a sequence of volcanic and volcaniclastic rocks (Parent Group) sandwiched between thrust sheets of Povungnituk Group and Chukotat Group rocks and the Purtuniq ophiolite. The Parent Group is a succession of felsic to intermediate volcanic rocks and associated volcaniclastic deposits, largely mapped in the western portion of the Cape Smith Belt by the Ministère de l'Énergie et des Ressources du Québec (Lamothe et al., 1986; Picard et al., 1990; Barrette, 1994; Lamothe and Picard, 1994). Two map units have been delineated in the Parent Group on compositional grounds, as determined in the field by mineralogy, composition and primary feature associations: Ppaa includes volcanic rocks of rhyolitic to andesitic composition as well as associated felsic to mafic volcaniclastic units; Ppab comprises basalt, basaltic andesite, and mafic volcaniclastic rocks.

Parent Group volcanic rocks vary in composition from rhyolite to basalt, with andesite and andesitic basalt being most common. Flows are either equigranular or contain plagioclase, carbonate, and/or biotite porphyroblasts (after phenocrysts?). Both massive and pillowed flows were observed in outcrops where primary features are not obliterated by the layer-parallel foliation. A Parent Group rhyolite has been dated at 1860±2 Ma (Machado et al., 1993). Volcaniclastic units vary from felsic tuffs and agglomerates, with rhyolite, rhyodacite and porphyry clasts, to more intermediate and mafic tuffs. The volcaniclastic rocks are well foliated metamorphic rocks, and tuffs of intermediate composition are commonly marked by centimetre-scale, radiating sprays of hornblende. Machado et al. (1993) dated a clastic unit in the Parent Group that yielded ages of 2417-1917 Ma from zircons displaying a wide variety of morphologies, leading to the interpretation that it is either a terrigenous sedimentary rock or a volcaniclastic rock with an extrabasinal detrital component.

Spartan Group (Psp)

Terrigenous sedimentary rocks of the Spartan Group (Psp) are structurally sandwiched between the ophiolitic Watts Group and the Chukotat Group (Fig. 1; Lamothe et al., 1984; St-Onge and Lucas, 1993). The Spartan Group clastic sedimentary sequence comprises mostly laminated dark pelites interbedded with semipelite. Minor fine-grained quartzites occur towards the structural top of the Spartan Group thrust sheet. The clastic rocks of the Spartan Group are intruded by a set of fine-grained mafic sills, which are not dated.

Watts Group (Pwb)

The Watts Group (Pwb) comprises a distinct assemblage of layered mafic and ultramafic rocks, massive and pillowed basalt flows, mafic sills and sheeted dykes, and plagiogranite intrusions, collectively interpreted as the Purtuniq ophiolite suite (Scott et al., 1991, 1992). Within the ophiolite suite, layered mafic and ultramafic rocks generally overthrust strongly foliated extrusive and intrusive mafic rocks. In one relatively little-deformed and well-exposed locality, the primary relationships between pillowed volcanic rocks, sheeted mafic dykes and a plagiogranite intrusion are well preserved and demonstrate their consanguineity (Scott and Bickle, 1991; Scott et al., 1992). The Watts Group is fault-bound and occurs at the structurally highest level of the Cape Smith Belt, overlying units of the Narsajuaq arc and the Povungnituk, Parent, and Spartan groups (Fig. 1; Lucas, 1989; Lucas and St-Onge, 1992).

Layered gabbroic rocks form the volumetrically most important unit of the Watts Group, and are characterized by centimetre- to metre-scale compositional layering defined by hornblende (after primary pyroxene) and plagioclase-zoisite (after primary plagioclase). Petrographic studies on the layered gabbroic rocks indicate a cumulate origin, whereas their geochemistry is in general consistent with a n-MORB source, suggesting that this unit represents mafic cumulates of oceanic layer 3 (Scott et al., 1991, 1992; Hegner and Bevier, 1991). U-Pb analyses of zircons from two layers of gabbroic composition in the mafic cumulates have yielded ages of 1998±2 Ma and 1998±2.5 Ma (Parrish, 1989). Layered ultramafic rocks contain centimetre- to metre-scale layers which correlate with modal variations in metamorphic mineral assemblages after olivine or pyroxene, and have been interpreted as ultramafic cumulates (Scott et al., 1991, 1992). Kilometre-scale pyroxenite bodies intrude the mafic-ultramafic cumulate sequences, and show no internal layering. Tectonized harzburgite (i.e. upper mantle rocks) has not been observed in the eastern portion of the Ungava Orogen (Scott et al., 1992).

Cape Smith Suite Plutons (Pcsg)

The Watts, Parent and Spartan groups are intruded by a number of plutons ranging from diorite to monzogranite (Taylor,1982; Lamothe et al., 1986; Feininger,1986; St-Onge and Lucas ,1990b; Picard et al., 1990; Lamothe and Picard, 1994;). These plutons, termed the Cape Smith suite by Dunphy (1994; Dunphy et al., 1995a), occur as distinct bodies having sharp intrusive contacts with their host rocks, although locally they may be in fault contact. They form a distinctive medium-K, calc-alkaline to tholeiitic suite of isotopically juvenile granitoids (Dunphy, 1994; Dunphy et al., 1995a). The Cape Smith suite plutons are variably deformed and vary from massive, homogenous bodies to well-foliated or gneissic intrusions. They range from small plugs (<1 km diameter) to larger, compositionally zoned bodies (10 km diameter).

U-Pb (zircon) dating of several of the intrusive bodies (Parrish 1989; Machado et al. 1990; Parrish, pers. comm., 1994) has documented two distinct geochronological suites: (1) an older suite of foliated plutons ranging from 1898 to 1870 Ma; and (2) a younger suite of weakly foliated to massive plutons ranging from 1859 to 1839 Ma. Plutons intruding the Watts Group include monzogranite (1898+12/-9, 1876±1.5, 1848+6/-5, 1840±2 Ma: Parrish, 1989, pers. comm., 1994), tonalite (1870±15: Parrish, 1989) and diorite (1859±2 Ma: Machado et al., 1993; 1839+6/-4 Ma: Parrish, 1989). A pluton that cuts Spartan Group sedimentary rocks on the west shore of Watts Lake locally contains muscovite ± garnet (St-Onge and Lucas, 1993), and has been dated by Parrish (1989) at 1888+6/-4 Ma. Two quartz diorite plutons intruding the Parent Group have been dated (U-Pb zircon) by Machado et al. (1993), yielding ages of 1874+4/-3 Ma and 1860±2 Ma. A granodioritic phase of a large composite pluton centered on Lanyan Lake (Pcsg) has been dated at about 1845±6 Ma (Machado et al., 1993). The geochronological data, coupled with compositional similarities, suggest that the Cape Smith suite plutons are intrusive equivalents to the Parent Group volcanic rocks (Picard et al., 1990; Dunphy, 1994). In total, the plutons and the Parent Group supracrustal rocks are thought to represent an arc built on the Watts Group oceanic crust at 1898-1839 Ma (Picard et al., 1990; St-Onge et al., 1992; Dunphy, 1994, 1995).

NARSAJUAQ ARC (PNmg - PNm)

The Narsajuaq arc comprises high-grade (amphibolite- to granulite-facies) plutonic rocks and associated minor supracrustal rocks (Sugluk Group; St-Onge et al., 1992) that were accreted to the Superior Province margin at ca. 1.80 Ga (Lucas and St-Onge, 1992). The plutonic rocks range from diorite to monzogranite and from 1863 to 1800 Ma (Parrish, 1989, pers. comm., 1994; Dunphy et al., 1995 a, b). Geological field relations (including deformation state, lithological association, nature of intrusive contacts) and geochronological data have been used to divide the Narsajuaq plutonic rocks into two main groups: (1) Older suite (1863-1844 Ma), and (2) Younger suite (1836-1800 Ma). A comprehensive study of the petrography, geochemistry, and isotopic character of the Narsajuaq arc is presented in Dunphy (1995).

Older Suite (PNmg, PNtg)

The principal lithology of the Older suite, and Narsajuaq arc as a whole, is a well-layered sequence of tonalite and quartz diorite that is intruded by and interlayered with granitic veins (St-Onge et al., 1992; Dunphy, 1995). Although the actual composition of the diorites ranges from quartz-absent to quartz-rich, the dominant lithology is quartz diorite which is used throughout for simplicity. Similarly, the tonalites also include granodioritic compositions and the granitic veins range from granodiorite to syenogranite, with monzogranite being most common. The layered tonalite-quartz diorite unit is dominated by tonalite (70 to 80%; PNtg) and layered on a decametre to centimetre scale. Units with sub-equal portions of quartz diorite and tonalite are relatively rare (PNmg). Preserved crosscutting relationships are rare but indicate that tonalite commonly intrudes diorite, although the converse is observed locally. More commonly, quartz diorite layers are disrupted through boudinage within the enveloping tonalite. A tonalite layer from this unit has a U-Pb zircon age of 1863±2 Ma whereas a quartz diorite layer from the same outcrop has an age of 1845±2 Ma; a quartz diorite layer from near this outcrop has a similar age of 1844±12 Ma (Parrish, pers. comm., 1994).

Amphibolite, pyroxenite, and peridotite occur within the layered sequence as both discrete bands, presumably representing veins (sills, dykes) and/or deformed xenoliths, and more equant xenoliths. However, in general these are not cognate xenoliths or microgranitoid enclaves because in lower strain areas they are observed to have angular, blocky shapes. Rare peridotite sills intrude the Older suite lithologies and range in size from metre- to kilometre-scale; they postdate the granitic veins but are cut by Late suite pegmatites (St-Onge and Lucas, 1990b).

A penetrative, granulite-facies tectonic foliation that parallels the outcrop-scale compositional layering characterizes most of the plutonic rocks in the Narsajuaq arc. All rock types in the Older suite layered units are intruded by granitic veins (Lucas and St-Onge, 1995). The granitic veins are generally sub-parallel to foliation/layering in the host rocks and locally include xenoliths derived from the country rocks. A granodiorite vein, which was sampled near the 1863±2 Ma tonalite outcrop, has been dated at 1861±2 Ma (Parrish, pers. comm. 1992), indicating contemporaneous emplacement of tonalite and granodiorite sheets. A U-Pb zircon age of 1848±5 Ma was obtained for a monzogranite vein from the same outcrop as the 1861 Ma granodiorite vein and the 1844 Ma quartz diorite layer (Parrish, pers. comm. 1992). A monzogranite vein with a strongly developed, granulite-facies tectonic foliation has yielded a U-Pb zircon age of 1835±1 Ma (Parrish, 1989). The geochronology, coupled with geochemical and isotopic data, indicates that the granitic veins are related to both Older and Younger suite magmatism (Dunphy, 1995). Lucas and St-Onge (1995) have proposed that the veins were emplaced synchronously with intra-Narsajuaq deformation and metamorphism (1.86-1.83 Ga), and that they were intruded sub-parallel to compositional layering, presumably at high angles to the regional shortening direction.

The Older suite layered units show a remarkable consistency in composition and texture along the entire strike length (>250 km) of Narsajuaq arc (Dunphy, 1995). The relatively fine-scale of layering in the unit, coupled with locally preserved intrusive relationships, suggest that it may be a primary magmatic feature which was enhanced by high temperature deformation (Lucas and St-Onge, 1992, 1995). The layered tonalite-quartz diorite sequence is interpreted as the middle crust of a magmatic arc (Lucas et al., 1992; St-Onge et al., 1992), built in part on Paleoproterozoic oceanic basement and in part on Archean continental crust (Dunphy, 1995; Dunphy et al., 1995a).

Sugluk Group (Pss)

The Sugluk Group (Pss) comprises highly deformed quartzites, semipelites, pelites, ironstones, marbles, and calc-silicate rocks which predominantly outcrop in the northern portion of the Narsajuaq arc. Semipelite is the most abundant rock type, whereas pelite, marble, and calc-silicate rocks are relatively rare. Relatively homogeneous quartzite can be interlayered with semipelite and mafic bands, or with thin (millimetre-scale) pelite bands (e.g. west of Nouvelle-France Cape). On Charles Island and north of Sugluk Inlet, the quartzite layers can contain abundant magnetite and grade locally into ironstone. Although no primary structures are preserved in the deformed sedimentary rocks, the predominance of graphitic, sulphidic semipelites suggests a relatively deepwater depositional basin. The depositional environment of the quartzite and carbonate units is difficult to constrain given the granulite-facies deformation that the rocks experienced, but these units could also represent basinal deposits (distal turbidites and marls). U-Pb studies of the Sugluk Group (Parrish, 1989) document that: (1) a semipelite north of Sugluk Inlet (Fig. 1) has zircon cores recording ages of >2230 Ma, whereas (2) a quartzite (also north of Sugluk Inlet) has a population of young detrital igneous grains (1863-1830 Ma) and a population of older detrital grains (>2525 Ma). The two detrital zircon populations in the quartzite suggest a mixed provenance from both an older source and a younger source, possibly recording unroofing of Narsajuaq arc units or their eruptive equivalents.

The sedimentary rocks occur in bands of relatively limited width (<1 km) but significant strike lengths (up to 65 km). The distribution of Sugluk Group bands in Narsajuaq terrrane and outcrop-scale observations argue against simple depositional contacts. Some of the bands of Sugluk Group rocks display only intrusive contacts and therefore are interpreted as large map-scale screens between Younger suite tonalite plutons or collisional monzogranites (e.g. Ivujivik). However some of the Younger suite units and all Older suite orthogneisses are concordant with the well-foliated bands of Sugluk Group rocks. This observation, coupled with evidence for local truncation of units, suggests that at least some of the contacts between sedimentary and plutonic rocks are tectonic. Lucas and St-Onge (1992) have suggested that these tectonic contacts are thrust faults, although whether they are related to late intra-Narsajuaq deformation (1830-1820 Ma) and/or to the collison with the Superior Province margin (1820-1800 Ma) remains unresolved.

Younger Suite (PNqd, PNt, PNm)

Younger suite plutons are intrusive into Older suite layered plutonic rocks and sedimentary rocks of the Sugluk Group (see below; St-Onge et al., 1992; Dunphy, 1995). In contrast to the Older suite plutonic rocks, they consist of discrete, kilometre-scale bodies that are generally tabular and sheet like. The Younger suite plutons include quartz diorite, monzodiorite, tonalite, and monzogranite, with approximately 50% monzogranite, 35% mafic (diorite, quartz diorite, monzodiorite), and 15% tonalite by area (Dunphy, 1995). U-Pb zircon geochronology shows two main episodes of plutonism (Parrish, 1989, pers. comm., 1994): (1) 1836-1821 Ma, marked by monzodiorites (1836±0.5, 1834±0.6 Ma), monzogranite (1835±1, 1835±1 Ma), tonalite (1830±2, 1826±1, 1825±3 Ma), and diorite (1821±1 Ma); and (2) 1803±3 and 1800±2 Ma monzogranites.

The Younger suite plutons vary in deformation state from massive to well foliated, generally as a function of age. The 1836-1821 Ma plutons are metamorphosed at amphibolite to granulite facies and record pre-collisional intra-Narsajuaq deformation (Lucas and St-Onge, 1992; Monday, 1994; Dunphy, 1995). In contrast, the ca. 1800 Ma plutons do not contain high temperature metamorphic assemblages and are generally massive, which coupled with their highly evolved Nd-isotopic signatures, suggests that they are syn-collisional granites (Dunphy, 1995; Dunphy et al., 1995a). Although the Younger suite plutons generally trend parallel to the regional tectonic fabric, they locally have irregular shapes that crosscut both outcrop- and regional-scale layering associated with the Older suite units; this is particularly true for the ca. 1800 Ma collisional granites in the Ivujivik area.

The Younger suite plutons contain enclaves of Older suite, Sugluk Group and deep crustal (e.g. anorthosite) lithologies as well as comagmatic phases (pyroxenite, diorite, tonalite). The plutons can contain large country rock screens, which are commonly not significantly misoriented from the regional layering attitude, suggesting that the plutons may have been emplaced as broadly concordant sheets. However, the size and homogeneity of the Younger suite plutons contrast markedly with the finely layered aspect of the Older suite plutonic rocks, and suggest that the younger plutons may have been emplaced at higher crustal levels.

Map-scale bodies of hornblende-biotite tonalite (PNt) are emplaced in the Narsajuaq arc north of Sugluk Inlet and on Charles Island. The kilometre-scale tabular bodies are foliated and lie parallel to the layering in the Older suite tonalite-quartz diorite unit. The tonalites are generally medium grained and equigranular, and contain abundant, centimetre- to tens of metre-scale enclaves of Sugluk Group sedimentary rocks, Older suite gneisses, pyroxenite, amphibolite, and anorthosite. Layer-parallel to crosscutting veins of biotite monzogranite intrude the tonalite bodies. One of the gneissic tonalite bodies north of Sugluk Inlet has an interpreted igneous crystallization age of 1830±2 Ma (Parrish, 1989). A weakly foliated, orthopyroxene-bearing tonalite vein that crosscuts the layering in 1830±2 Ma tonalite gneisses has a U-Pb zircon age of 1826±1 Ma (Parrish, 1989; St-Onge et al., 1992).

Monzogranite bodies (PNm) are interlayered with the Older suite gneisses and Younger suite tonalites, and are equigranular and medium grained at their margins and commonly K-feldspar megacrystic towards their cores. The granites are foliated and locally display gneissic layering. A monzogranite body north of Sugluk Inlet has a U-Pb crystallization age of 1835±1 Ma (Parrish, pers. comm., 1992) identical to the age of a monzogranite vein with a granulite-facies tectonic foliation (Parrish, 1989). Monzodiorite compositions are restricted to two kilometre-scale plutons along the Narsajuaq Valley south of Sugluk Inlet. These plutons contain hornblende biotite±clinopyroxene and range from equigranular to K-feldspar megacrystic. Parrish (pers. comm., 1992) has obtained U-Pb igneous crystallization ages of 1836±0.5 Ma and 1834±0.6 Ma for the two monzodiorite plutons.

Plutons of dioritic composition (PNqd) are found predominantly in the southern portion of the Narsajuaq arc, near its tectonic contact with the Cape Smith Belt, and range in deformation state from highly deformed to massive (Dunphy, 1995). Deformation state varies to some degree as a function of proximity to collisional faults, including both the basal décollement and the normal fault juxtaposing the Watts Group on the Narsajuaq arc west of Watts Lake. The large quartz diorite to diorite body north of Kovik Bay has a U-Pb zircon igneous crystallization age of 1821±1 Ma, with inherited grains yielding ages of 1837±1 Ma and 1859±1 Ma (Parrish, pers. comm., 1994).

The collisional granites of the Ivujivik and Nouvelle-France Cape areas (PNm) are the youngest and least-deformed of the Younger suite plutons. These bodies are extensive, with strike lengths of tens of kilometres, and are characteristically pink weathering and weakly foliated to massive, except where they are in structural contact with other units (e.g. Nouvelle-France Cape; Lucas and St-Onge, 1991). The Ivujivik and Nouvelle-France Cape granites are remarkably similar in their overall bulk composition and mineralogy despite being separated by more than 100 km (Dunphy, 1995). The composition varies within individual plutons from monzogranite to syenogranite, and the texture from equigranular to K-feldspar megacrystic. The Ivujivik plutons locally contain cordierite±sillimanite where they have intruded Sugluk Group sedimentary rocks. U-Pb zircon dating has yielded ages of 1803±3 Ma for the Nouvelle-France Cape granite and 1800±2 Ma for one of the Ivujivik granites (Parrish, pers. comm., 1994). Small, intermediate intrusive complexes (PNqd) are spatially associated with the granites in the Nouvelle-France Cape area. The bodies are hundreds-of-metres in scale and are predominantly clinopyroxene-hornblende-biotite monzonite. The mafic plutonic bodies are emplaced in the granitic rocks, are not crosscut by granitic veins, and are generally massive although their margins contain a weak foliation.

LATE SUITE (Psy, Pbm)

Plutonic rocks of the Late suite consist of small granitic plutons and veins/dykes that are late to post-tectonic with respect to the collision and accretion of Narsajuaq arc to the Superior Province margin (St-Onge et al., 1992; Dunphy, 1995). These rocks vary from monzogranites (Pbm) to syenogranites (Psy) and in texture from equigranular to pegmatitic. The veins/dykes are unmetamorphosed in general, but range from weakly foliated to undeformed and from layer-parallel to crosscutting (Lucas and St-Onge, 1995). Although some of the granitic veins are probably related to the Younger suite collisional granites (1803-1800 Ma), much of this intrusive material is attributed to post-collisional, post-peak metamorphic magmatism. Some of the muscovite ± garnet-bearing pegmatites are notable for their spectacular amphibolite-grade alteration haloes in the granulite-grade host rock, indicating that emplacement post-dated granulite-grade metamorphism (Lucas and St-Onge, 1992). Parrish (1989) obtained a 1758±1 Ma U-Pb zircon age on a pegmatitic syenogranite dyke from the Sugluk Inlet area.

One post-collisional monzogranite (Pbm) from the Duquet Lake area has been studied in detail by Dunphy et al. (1995b). This ovoid, undeformed, and unmetamorphosed pluton is approximately 2.5 km in diameter, and crosscuts the basal detachment of Narsajuaq arc that overrides an imbricate of Povungnituk Group rocks. The equigranular, biotite±muscovite monzogranite also cuts a D_3 fold, thereby providing a minimum age for late cross-folding (see below; Lucas and St-Onge, 1992). U-Pb zircon dating of the pluton indicates a crystallization age of 1742.2±1.3 Ma, with inherited grains ranging from 3.2-1.7 Ga, including populations corresponding to known ages for Narsajuaq arc, the Povungnituk Group, and the Superior Province basement (Dunphy et al., 1995b). The Duquet Lake monzogranite is high K, peraluminous, and shows geochemical characteristics similar to crustally derived granites. Isotopic studies indicate the incorporation of a significant amount of older material (Narsajuaq arc, Superior Province basement) in the petrogenesis of the pluton (Dunphy et al., 1995b).

TECTONIC SYNTHESIS (1.86-1.74 Ga)

The tectonic history of the Ungava Orogen is characterized by structural-metamorphic episodes that are inferred to both predate and postdate a collision between the Narsajuaq arc and the northern continental margin of the Superior Province (Lucas and St-Onge, 1992). Different pre-collisional tectonic histories are documented for Paleoproterozoic rocks forming the lower plate (Povungnituk and Chukotat groups) and the upper plate (Watts, Spartan and Parent groups and Narsajuaq arc) of the Ungava Orogen. The lower-plate pre-collisional tectonic history, as well as that for upper plate units within the Cape Smith Belt, has been summarized by Lucas and St-Onge (1992) and St-Onge and Lucas (1993). Here we present a summary of the pre-collisional structural-metamorphic history for Narsajuaq arc as well as the collisional and post-collisional histories for the entire orogen.

INTRA-ARC DEFORMATION AND METAMORPHISM (NARSAJUAQ ARC, 1.86-1.82 Ga)

The Narsajuaq arc contains evidence for an intra-arc tectonic episode characterized by granulite-facies metamorphism and dextral transpression that was coeval with 1.86-1.82 Ga arc magmatism (Parrish, 1989; Lucas and St-Onge, 1992, 1995; St-Onge et al., 1992). Narsajuaq arc rocks contain mineral assemblages that range from middle amphibolite to granulite facies. However, all plutonic (Older and Younger suites) and sedimentary (Sugluk Group) units of the arc, at least locally, contain assemblages consistent with granulite-facies conditions (Lucas and St-Onge, 1992; Monday, 1994). Mafic rocks contain subsets of the maximum phase assemblage orthopyroxene-biotite-hornblende-plagioclase±clinopyroxene ±garnet±quartz. Tonalites and granites contain subsets of the maximum phase assemblage orthopyroxene-hornblende-biotite-plagioclase-quartz±garnet±clinopyroxene (plus K-feldspar in the granites). In general, however, the granulite-facies tonalites and granites are characterized by biotite-orthopyroxene±hornblende assemblages, with clinopyroxene and garnet appearing in zones rich in quartz diorite xenoliths. Pyroxenite enclaves commonly contain orthopyroxene-clinopyroxene ±hornblende.

A variety of mineral assemblages are present in the sedimentary rocks of the Sugluk Group (Lucas and St-Onge, 1992; Monday, 1994). Pelites generally contain sillimanite-K-feldspar-garnet-biotite-plagioclase-quartz-granitic pods, but locally contain the relatively high pressure sillimanite-hypersthene-cordierite-K-feldspar-garnet-biotite-plagioclase-quartz granitic pods assemblage. Calc-silicate rocks contain diopside-garnet-phlogopite-calcite spinel assemblages, and semipelites, in general, are marked by garnet-biotite-quartz plagioclase±granitic pods. Quartzites are garnet, orthopyroxene and/or clinopyroxene bearing, whereas quartzites with thin pelitic interlayers are marked by garnet-sillimanite-biotite assemblages. The mineral assemblages in the Sugluk Group sedimentary rocks are consistent with the granulite-facies assemblages documented in the adjacent Narsajuaq arc plutonic rocks.

Two principal observations support a model of syntectonic magmatism during construction of the Narsajuaq arc (Lucas and St-Onge, 1995). First, the Older suite must have been deformed prior to emplacement of the younger plutons (1836-1821 Ma) because the younger plutons locally crosscut compositional layering and foliations. Second, within the Older suite layered sequence, there are contrasts in the relative state of strain between individual layers that cannot be solely attributed to competency contrasts, but instead suggest that in general the older layers had accumulated more strain and that at least some of the younger layers were emplaced as foliation-parallel sheets. In total, deformation and metamorphism in the Narsajuaq arc appear to have been coeval with the bulk of the 1863-1821 Ma magmatism, resulting in emplacement of veins, sheets and larger plutonic bodies in anisotropic (foliated or layered) country rock (Lucas and St-Onge, 1995). The age of high-grade metamorphism is constrained by U-Pb geochronology at 1830-1825 Ma based on the age of metamorphic zircons and zircon overgrowths (Parrish, 1989). Relatively slow cooling of these rocks is constrained by monazite (1820-1815 Ma) and xenotime (1792±1 Ma) ages (Parrish, 1989).

1.82-1.80 Ga COLLISIONAL (D_1) TECTONICS

Contractional deformation in response to collision of arc and oceanic assemblages with the north-facing Superior Province continental rift margin led to the development of the Cape Smith (thrust) Belt (Fig. 1), which may have initially formed at ca. 1.87 Ga, but had culminated by ca. 1.80 Ga (Lucas, 1989; St-Onge and Lucas, 1990a; Lucas and St-Onge, 1992). Within the thrust belt, the Paleoproterozoic tectonostratigraphic assemblages were progressively juxtaposed, internally imbricated and translated southward across the Archean Superior Province crystalline basement (Lucas, 1989; St-Onge and Lucas, 1990a). The lower-plate units preserved in the external part of the orogen (Cape Smith Belt) record the development of a (1.87-1.82 Ga) thrust belt characterized by (D_{1a}) south-verging faults ramping up from a basal décollement (Lucas, 1989). The regional (D_{1a}) décollement, localized at the basement/cover interface, separates the underthrust basement from the thrust belt and is associated with ductile shear fabrics in both its hangingwall and footwall (basal shear zone; Lucas, 1990). The ophiolitic and arc units were accreted at ca. 1.82-1.80 Ga (St-Onge et al., 1992; Parrish, per. comm., 1992) onto the older thrust belt along (D_{1b}) south-verging faults, which re-imbricated the thrust belt, and which resulted in ≥100 km of displacement of upper-plate units with respect to the autochthonous basement (Lucas and St-Onge, 1992). Thickening and consequent exhumation resulted in relatively high-P, greenschist- to amphibolite-facies metamorphism of lower-plate Paleoproterozoic cover units (St-Onge and Lucas, 1991; Bégin 1992; Bégin and Carmichael, 1992).

Collisional deformation within the Narsajuaq arc was localized along (D_{1b}) thrust-related shear zones at amphibolite-facies conditions, even where the thrust sheets contain granulite-facies assemblages (Lucas and St-Onge, 1992; Monday, 1994). Intense ductile deformation within these shear zones is indicated at outcrop-scale by the transposition of all units and a marked decrease in layer thickness, and in thin sections by deformation microstructures. The hydrous amphibolite-facies overprint is related to thrusting of the relatively dry granulite terrane over the dehydrating continental margin sequence (Lucas and St-Onge, 1992; Monday, 1994). Retrogression of the granulite-facies gneisses becomes more diffuse with increasing structural distance upwards from the terrane's sole fault. This may be attributed to increasing distance of arc granulites from the underlying Povungnituk Group sedimentary rocks.

The regional gneissic foliation in the Archean basement was penetratively reworked adjacent to the contact with Povungnituk Group supracrustal rocks, resulting in the development of an amphibolite-facies mylonitic foliation and an extension lineation parallel to that in the cover rocks (Lucas, 1989, 1990; St-Onge and Lucas, 1995). The Archean basement is characterized by regionally extensive amphibolite-facies mineral zones that broadly parallel the basal décollement of the overlying Cape Smith Belt (St-Onge and Lucas, 1995). Deformation/mineral growth relationships in the amphibolitized basement indicate that extensive hydration and re-equilibration of the Archean granulites occurred during thrust belt deformation (St-Onge and Lucas, 1995). The transition between granulite-facies and amphibolite-facies assemblages is characterized by the growth of garnet-hornblende-quartz±cummingtonite coronas between plagioclase and orthopyroxene-clinopyroxene (St-Onge and Ijewliw, 1996), as well as titanite coronas on ilmenite which have U-Pb ages of 1810-1790 Ma (Scott and St-Onge, 1995). The source of fluids for basement hydration/metasomatism is interpreted to be dehydrating clastic rocks in the overlying thrust belt, with fluid flow probably focused along the basal décollement (Lucas, 1990; St-Onge and Lucas, 1995).

POST-COLLISIONAL (D_2 AND D_3) DEFORMATION (1.80-1.74 Ga)

Following arc-continent collision, both the Paleoproterozoic thrust belt and its footwall basement were deformed into regional-scale folds during two post-thrusting folding episodes (D_2: east-trending, D_3: northwest-trending; cf. St-Onge and Lucas, 1990a; Lucas and Byrne, 1992). Our geological mapping indicates that the Superior Province rocks exposed north of the Cape Smith Belt lie in the core of a major, regional-scale (D_2) antiform. D_3 cross-folding of this structure has generated a regional fold-interference geometry in which the antiformal axis now defines a structural saddle (SPC Fig 1). Cross-cutting relations with post-collisional intrusive rocks indicate that the northwest-trending (D_3) cross-folds predated 1742 Ma (Dunphy et al., 1995b). Along the antiformal axis, a depression in the central part of the orogen passes up-plunge into the two basement-cored culminations (EBW and WBW Fig 1). Thus mid-crustal rocks of both the Superior Province basement and Paleoproterozoic Narsajuaq arc are exposed in oblique section in the Ungava Orogen, due to the post-collisional folding (Lucas, 1989; Lucas and Byrne, 1992).

ECONOMIC GEOLOGY

The most important economic mineralization in the Ungava Orogen is Ni-Cu-(PGE) mineralization in the eastern Cape Smith Belt, hosted by ultramafic and differentiated mafic-ultramafic bodies (Barnes et al., 1992; Giovenazzo et al., 1989; Giovenazzo, 1991; St-Onge and Lucas, 1994). These units are associated with both volcanic and sedimentary rocks of the Povungnituk Group and lowermost Chukotat Group. Important deposits occur in the Raglan horizon (Kattiniq) located near the tectonic boundary between the Povungnituk and Chukotat groups. A second mineralized zone, termed the Delta horizon, occurs within the Povungnituk Group and contains smaller sulphide showings. The distribution of proximal-distal sedimentary facies in the Povungnituk Group represents an important control on the localization, grade, and size of the sulphide deposits and showings (St-Onge and Lucas, 1994). Deposits in the Raglan horizon are associated with relatively distal sedimentary units of the Povungnituk Group. In contrast, the Delta horizon occurs in a more proximal (quartz-rich) facies of the Povungnituk Group which is interlayered with volcanic rocks and marked by a profound decrease in the proportion of fine-grained, sulphidic beds relative to the Raglan horizon. The regional extent of the mineralized horizons is controlled by the thrust (D_1) structure of the Cape Smith Belt (Lucas, 1989; St-Onge and Lucas, 1994).

Potential for Ni-Cu-(PGE) mineralization north of the Cape Smith Belt is linked to the narrow imbricates of Povungnituk Group rocks which everywhere separate autochthonous Superior Province basement from the Narsajuaq arc orthogneisses. Ultramafic rocks are present in the Povungnituk Group imbricates in association with both mafic and sedimentary units.

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Canada

LEGEND

This legend is common to maps 1911A to 1916A. Some units and symbols may not appear on each map

PALEOPROTEROZOIC

LATE SUITE

Pbm	*Biotite monzogranite*
Psy	*Syenogranite*

- - - - - *intrusive contact* - - - - -

NARSAJUAQ ARC

YOUNGER SUITE

PNm	*Biotite ± hornblende monzogranite to syenogranite; clinopyroxene ± hornblende ± biotite monzodiorite*
PNt	*Hornblende-biotite tonalite to granodiorite; biotite monzogranite veins*
PNqd	*Hornblende ± biotite quartz diorite; hornblende-biotite diorite to monzodiorite; clinopyroxene-hornblende-biotite pyroxenite; biotite monzogranite veins*

- - - - - *intrusive contact, fault* - - - - -

SUGLUK GROUP

Pss	*Semipelite, quartzite, ironstone, pelite, marble, calc-silicate rock, amphibolite*

- - - - - *fault, contact relation uncertain* - - - - -

OLDER SUITE

PNtg	*Layered biotite ± hornblende tonalite and hornblende ± biotite quartz diorite; biotite granodiorite; biotite monzogranite veins*
PNmg	*Layered hornblende-biotite quartz diorite and biotite ± hornblende tonalite; biotite monzogranite veins*

- - - - - *fault* - - - - -

CAPE SMITH BELT

CAPE SMITH SUITE

Pcsg	*Biotite granodiorite*

- - - - - *intrusive contact* - - - - -

WATTS GROUP

Pwb	*Basalt, gabbro, peridotite, pyroxenite, amphibolite*

- - - - - *fault* - - - - -

SPARTAN GROUP

Psp	*Pelite, semipelite, quartzite, gabbro*

PARENT GROUP

Ppaa	*Andesite, rhyolite, rhyodacite, felsic and mafic tuff and agglomerate*
Ppab	*Basalt, andesitic basalt, mafic tuff*

- - - - - *fault* - - - - -

CHUKOTAT GROUP

Pcb	*Basalt, gabbro, peridotite*

- - - - - *fault* - - - - -

POVUNGNITUK GROUP

Ppob	*Basalt, gabbro, peridotite, amphibolite*
Ppos	*Semipelite, quartzite, ironstone, pelite, basalt, gabbro, peridotite, amphibolite*

- - - - - *unconformity* - - - - -

ARCHEAN

SUPERIOR PROVINCE (Archean rocks in the Ungava Orogen)

Abs	*Biotite ± hornblende syenogranite*
Abm	*Biotite ± hornblende monzogranite*
Abg	*Biotite ± hornblende granodiorite*
Aht	*Hornblende ± biotite tonalite; biotite monzogranite veins*
Ahtq	*Hornblende ± biotite tonalite and quartz diorite; biotite monzogranite veins*
Abt	*Biotite ± hornblende tonalite (rare enclaves); biotite monzogranite veins*
Abte	*Biotite ± hornblende tonalite (abundant enclaves); biotite monzogranite veins*
As	*Semipelite, pelite, marble; biotite monzogranite veins*
Aqd	*Hornblende-biotite quartz diorite; hornblende-biotite amphibolite; peridotite; pyroxenite; biotite monzogranite veins*
Au	*Tonalite, monzogranite; undivided*

Geological boundary (defined, approximate)	
Normal fault (solid circle indicates downthrown side)	
Oblique-slip fault (dextral slip indicated)	
Thrust fault (teeth on upthrust side; defined, approximate)	
Archean foliation (inclined)	35
Archean stretching lineation	35
Archean fold hinge	35
Bedding (inclined)	45
Paleoproterozoic D_1 foliation (inclined)	60
Paleoproterozoic D_1 stretching lineation	65
Paleoproterozoic D_2 foliation (inclined)	40
Paleoproterozoic D_2 fold hinge	30
Paleoproterozoic D_3 foliation (inclined)	45
Paleoproterozoic D_3 fold hinge	50

Lithology

Amphibolite	■	*Peridotite*	▽
Basalt	▲	*Pelite*	◑
Calc-silicate	●	*Pyroxenite*	⊞
Conglomerate	⊕	*Quartz diorite*	◪
Dolomite	○	*Quartz monzonite*	◧
Felsic volcaniclastic rock	◭	*Quartzite*	◓
Gabbro	▼	*Rhyolite*	◭
Granodiorite	◆	*Semipelite*	◐
Ironstone	◇	*Syenogranite*	◨
Micaceous quartzite	◒	*Tonalite*	⬘
Mafic volcaniclastic rock	△	*Ultramafic rock*	◫
Monzogranite	⬙		

Mineral

Andalusite	a	*Kyanite*	k
Biotite	b	*Muscovite*	m
Chlorite	ch	*Magnetite*	mag
Cordierite	co	*Orthoamphibole*	oa
Epidote	ep	*Orthopyroxene*	opx
Clinopyroxene	cpx	*Sillimanite*	s
Garnet	g	*Staurolite*	st
Hornblende	h		

Association

Tonalite with inclusions of quartz diorite	⬘(◪)
Tonalite and monzogranite	⬘,⬙
Tonalite intruded by monzogranite	⬘/⬙

Example

⬘b(◪cpx,h)/⬙b *biotite tonalite, with inclusions of clinopyroxene-hornblende quartz-diorite, intruded by biotite monzogranite*

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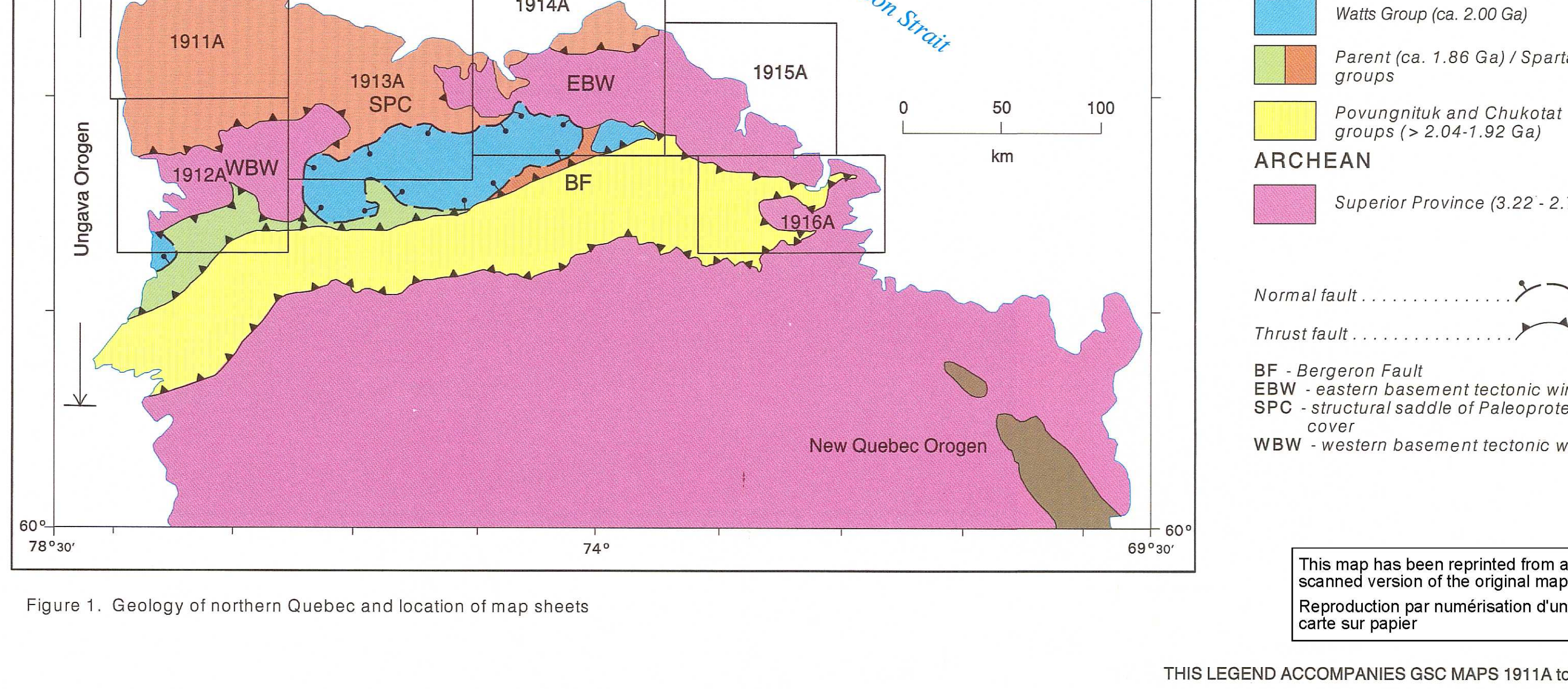

Figure 1. Geology of northern Quebec and location of map sheets

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THIS LEGEND ACCOMPANIES GSC MAPS 1911A to 1916A

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