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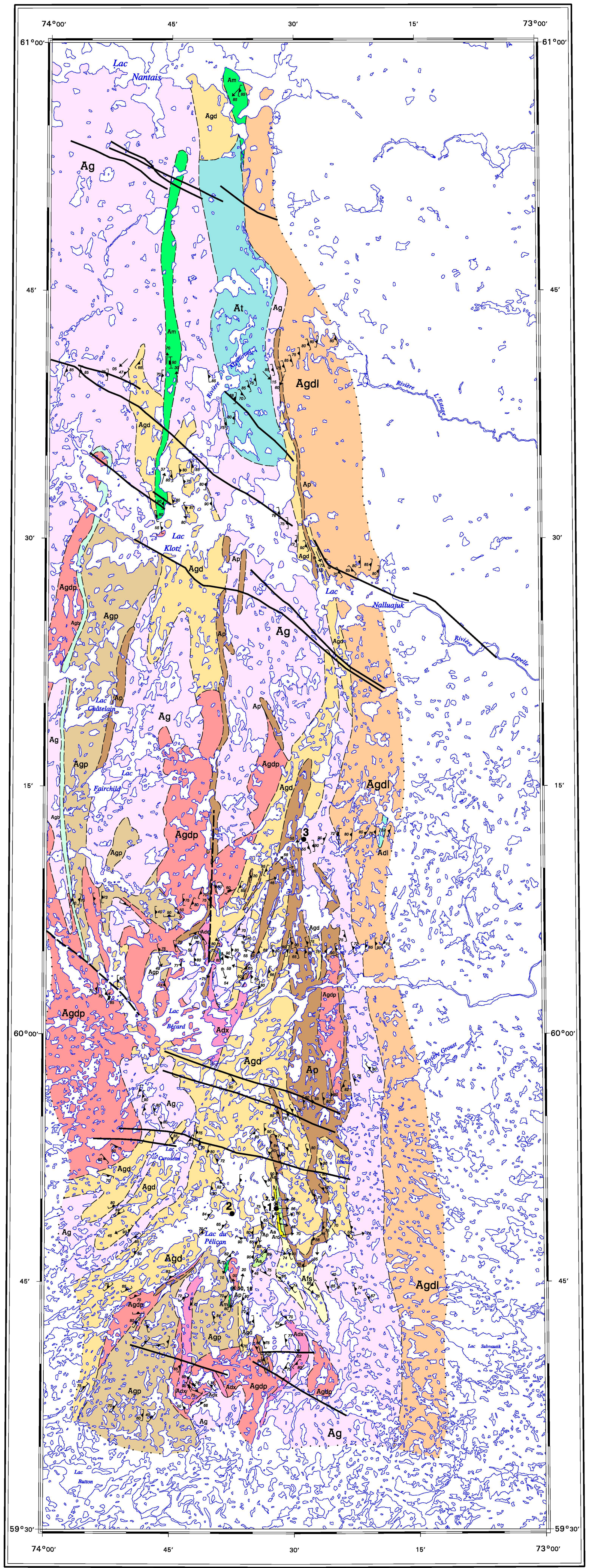

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LEGEND

PALEOPROTEROZOIC

Diabase dykes: *medium to coarse-grained diabasic gabbro dykes, 5 to 50 m wide, trending 290° to 325°. Dykes constitute part of the Klotz swarm (2210 Ma)*

ARCHEAN

LEPELLE IGNEOUS COMPLEX

Agdl — *Orthopyroxene-Clinopyroxene Granodiorite: medium-to coarse-grained, massive, foliated or gneissic orthopyroxene-clinopyroxene-biotite granodiorite containing abundant enclaves (0.1 to 10 m scale) of mafic gneiss and less common paragneiss*

Adl — *Clinopyroxene-hornblende Diorite: medium-grained, massive to weakly foliated clinopyroxene-hornblende diorite, quartz diorite*

UTSALIK DOMAIN

INTRUSIVE ROCKS

Ag — *Biotite +/- Hornblende Granite: medium-to coarse-grained, homogeneous, massive to weakly foliated granite. The unit generally contains (5-10%) biotite, with some hornblende-bearing phases. Megacrystic phases containing up to (30%) pink K-feldspar phenocrysts up to 2 cm are common. A megacrystic unit was dated at 2719 ± 1 Ma (U-Pb zircon age). Unit includes some pegmatite*

Agd — *Hornblende-biotite Granodiorite: medium-grained, homogeneous, massive to weakly foliated hornblende-biotite granodiorite, quartz diorite and rare diorite. Unit contains rare cognate xenoliths of gabbro and diorite. Pyroxene is present locally as cores to hornblende. A granodiorite has a maximum age of 2720 ± 2 Ma (U-Pb zircon age)*

At — *Biotite Tonalite: medium-grained, homogeneous, foliated biotite tonalite; cut by abundant massive granitic dykes*

Agp — *Orthopyroxene-Clinopyroxene Granite: medium- to coarse-grained, homogeneous, massive to weakly foliated orthopyroxene-clinopyroxene-biotite +/- hornblende granite. Variably equigranular or K-feldspar megacrystic (to 1.5 cm) phases. Grades to granodiorite*

Agdp — *Orthopyroxene-Clinopyroxene Granodiorite: medium- to coarse-grained, homogeneous, massive to weakly foliated orthopyroxene-clinopyroxene-biotite +/- hornblende rocks ranging in composition from monzodiorite, through granodiorite, to quartz diorite. Grades to granite through K-feldspar megacrystic (to 2 cm) phases. Aligned phenocrysts in massive matrix suggests magmatic flow*

Agb — *Pyroxene gabbro: medium- to coarse-grained, homogeneous orthopyroxene-clinopyroxene-hornblende gabbro with local anorthositic pods*

Adx — *Diatexite: medium- to coarse-grained inhomogeneous biotite +/- garnet +/- orthopyroxene granodiorite with abundant variably disaggregated paragneiss enclaves*

SUPRACRUSTAL ROCKS

Ap — *Paragneiss: medium-grained, biotite-plagioclase-quartz +/- garnet +/- cordierite +/- sillimanite +/- orthopyroxene rocks with migmatitic layering on 1-10 mm scale. Probably derived from psammitic and pelitic protoliths. The unit grades to inhomogeneous diatexite*

Afs — *Felsic Schist: fine- to medium-grained, homogeneous, intensely foliated biotite-plagioclase-quartz +/- hornblende +/- garnet schist. Probably derived from felsic to intermediate metavolcanic and metasedimentary rocks*

Ard — *Rhyolite-Dacite: fine-grained, homogeneous biotite-muscovite-quartz plagioclase rocks with well developed foliation and sporadic lineation. Contains local relict quartz phenocrysts and gossan zones with up to (5%) disseminated pyrite. Dated at 2742 ± 1 Ma (U-Pb zircon age). Grades to felsic schist*

Aa — *Andesite: fine-grained homogeneous hornblende-biotite-plagioclase rocks, with variably developed foliation and hornblende mineral lineation. Contains local relict plagioclase phenocrysts and fragmental textures suggestive of tuff breccia. Grades to felsic schist. Associated with coarse clastic metasedimentary units*

Am — *Amphibolite, Mafic Gneiss: fine- to medium-grained hornblende-plagioclase rocks, with well developed foliation and sporadic lineation. Contains patches with relict gabbroic textures. Varies to fine- to medium-grained well foliated to gneissic orthopyroxene-clinopyroxene-hornblende-plagioclase rocks. Includes rare peridotite*

Geological contact, approximate

Fault

Limit of mapping

Shear zone: dextral; sense unknown — 60, 90

Minor fold: Z S U geometry — 55, 40, 45

Mineral or stretching lineation (simple and composite) — 35

Foliation (simple and composite) — 75

Igneous layering — 80

Gossan, gold value, ppb — ✳ 2,3

U-Pb age site
- *2742 ± 1 Ma (zircon); 2668 ± 5.5 Ma (titanite).* — ● 1
- *2720 ± 2 Ma (zircon maximum age).* — ● 2
- *2719 ± 1 Ma (zircon).* — ● 3

Geology by J.A. Percival, T. Skulski, and L. Nadeau, 1996

Digital cartography by J.A.Y. Pratt, Geoscience Information Division

Electrostatic plot produced by Geoscience Information Division

Any revisions or additional geological information known to the user would be welcomed by Geological Survey of Canada

Digital base map from data compiled by Geomatics Canada, modified by Geoscience Information Division

Copies of the topographic maps for this area may be obtained from Canada Map Office, Natural Resources Canada, Ottawa, Ontario, K1A 0E9

Magnetic declination 1997, 29°37'W, decreasing 11.1' annually. Readings vary from 28°52'W in the SE corner to 30°26'W in the NW corner of the map

INTRODUCTION

The Ungava Peninsula of Quebec is one of the last frontiers of reconnaissance investigation in the Superior Province. On the basis of helicopter-supported reconnaissance mapping (Stevenson, 1968), the region was considered to consist of high-grade plutonic rocks devoid of supracrustal successions or mineral potential. However, more recent reconnaissance- scale maps and geochronology (Percival and Card, 1994; Percival et al., 1995b; 1996b) have revealed greenstone sequences of similar age and origin to those of the southern Superior Province (Percival et al., 1994). This remote, largely unexplored part of the shield contains a geological record that is important for assessing the mineral potential of the region as well as contributing to the tectonic framework for the Superior Province. For example, radiogenic isotopic studies (e.g. Stern et al., 1994; Skulski et al., 1996) have demonstrated the widespread influence of protocratonic (3.0-2.8 Ga) crust in the formation of ca. 2.7 Ga magmatic rocks of the Minto block.

Granitoid rocks are dominant in the Minto block (Fig. 1). The supracrustal belts provide a wealth of information on geological evolution, as well as being the focus of mineral exploration. Previously considered to be isolated supracrustal remnants in a sea of granite (Stevenson, 1968), the supracrustal rocks form belts of significant strike length (40-100 km) and width (1-10 km; e.g. Percival et al., 1996a and references therein). Many of the amphibolite-facies belts occur within a central north-northwest trending corridor ("Goudalie trend"; Fig. 1), marked by low aeromagnetic anomalies, and flanked by magnetically high massifs of pyroxene-bearing plutonic rocks. East of the central zone and separated by wide granitoid massifs, are magnetically low troughs, including one that contains the newly described Pelican-Nantais supracrustal belt. The information presented on the map was aquired during a two-week field season in 1996. Work was hampered by poor weather conditions and for this reason parts of the area ("B" in Figure 3) were compiled from existing maps, supplemented by spot checks.

REGIONAL GEOLOGICAL SETTING

The Minto block has been divided into several northwest-trending lithotectonic domains (Fig. 1; Percival et al.,1997). Inukjuak domain in the west consists of granite with metasedimentary enclaves. To the east, Tikkerutuk domain consists of plutonic rocks with ages of 2707-2693 Ma (Percival et al., 1992). Further east, Lake Minto domain contains sediment-dominated supracrustal remnants, including the Kogaluc greenstone belt (~2760 Ma), in a composite plutonic terrain of calc-alkaline granodiorite (2780, 2725 Ma), peraluminous granodiorite (2725-2696 Ma) and monzogranite (2690 Ma; Percival et al., 1992; Stern et al., 1994; Skulski et al., 1996). The composite Goudalie domain consists of tonalitic rocks (3010-2900 Ma) and the Vizien greenstone belt, itself a composite of oceanic and continental arc fragments assembled at ~2700 Ma (Skulski and Percival, 1996; Lin et al., 1996). Utsalik domain to the east consists of calc-alkaline granodiorite and granite with ages in the range of 2755-2725 Ma. Further east, Douglas Harbour domain is dominated by ca. 2880-2780 Ma plutonic rocks (Parrish, 1989).

Extrapolation of aeromagnetic anomalies (Fig. 2) indicates continuation of domains, including the supracrustal-rich Goudalie, to the north. The Qalluviartuuq (Percival et al., 1995a; b) and Duquet (Percival et al., 1996b) greenstone belts occur within the Goudalie aeromagnetic trend, but have few geological characteristics of the Goudalie domain. Recent work indicates the presence of additional domains in the north, including Philpot, a region of relatively young (< 2755 Ma) gneissic plutonic rocks, and Qalluviartuuq, a zone of ca. 2.8 Ga juvenile volcanic and intrusive rocks (Skulski et al., 1996). In 1996, mapping was extended east of the Lac Couture map-sheet (Percival et al., 1996a,b) into the Pelican-Nantais region (Fig. 3), in order to: 1) determine the eastern extent of juvenile, 2.84-2.775 Ga rocks of the Qalluviartuuq domain; 2) assess its relationship to equivalent-age (2.88-2.78 Ga) rocks in the Douglas Harbour domain; and 3) establish the extent of the intervening Utsalik domain. Reconnaissance maps (Stevenson, 1968; Taylor, 1982) and industry geologists active in the region reported scattered occurrences of supracrustal rocks in these areas. The 1996 field season and subsequent compilation established the geometry of the 220 km long Pelican-Nantais belt.

PELICAN-NANTAIS REGION

UTSALIK DOMAIN

Supracrustal rocks (Am, Aa, Ard, Afs Ap)

Supracrustal rocks occur as < 5-km-wide, north-trending septa enclosed by hornblende- biotite and pyroxene-bearing granitoid rocks. Although strongly foliated and metamorphosed to amphibolite and granulite facies, primary volcanic and sedimentary features are preserved locally.

A < 2-km-wide belt of dominantly mafic composition is present in the northern part of the region, between Nantais and Klotz lakes. The fine-to medium-grained amphibolites (Am), inferred to be derived from homogeneous basalt and gabbro, have a well developed, vertical, north-south foliation and a steep hornblende elongation lineation. The belt contains minor lenses and layers of metagreywacke, as well as some quartz-feldspar porphyry and rare pods of peridotite. Metamorphic grade varies along the length of the belt from prograde lower amphibolite facies (andalusite-muscovite) near Nantais Lake, to granulite facies (orthopyroxene- clinopyroxene-hornblende) near Klotz Lake. In a 6-km-wide extension north of Nantais Lake, Taylor (1982) reported interlayered amphibolite (with rare pillowed and fragmental textures) and metagreywacke with minor calcareous beds. A 3 x 0.1 km enclave of granulite-grade mafic gneiss (Am) and paragneiss (Ap) is also present in plutonic rocks at Pelican Lake.

Metavolcanic rocks of felsic- to intermediate composition (Aa, Ard) and associated metasedimentary schists are present in a 3 x 15 km belt in the eastern Pelican- Becard lakes region. A number of primary structures are preserved in the east-central Pelican Lake area: 1) rhyolites and dacites (Ard) containing quartz phenocrysts; 2) plagioclase-phyric andesites (Aa) with fragmental textures suggestive of tuff breccia; and 3) matrix-supported conglomerate (not shown on map) with rounded and angular clasts of coarse-grained tonalite up to boulder (0.5 m) dimensions. The rhyolite hosts a significant stratiform gossan zone, approximately 20 x 800 m, characterized by disseminated sulphides in sericitic schist. Grab samples returned negligible (2 ppb) gold values. Primary structures and textures are poorly preserved to the north and south along the belt, where flaggy schists of felsic and intermediate composition (Afs) are thought to be derived from these metavolcanic and metasedimentary units. A quartz-phyric rhyolite adjacent to the gossan yielded a U-Pb zircon age of 2742± Ma.

Rocks of sedimentary origin occur both in association with volcanic units and as discrete migmatitic belts up to 3 km wide. Although dominantly psammitic, sedimentary facies range from conglomerate to pelite, the latter being common northeast of Becard Lake. Metamorphic grade varies from amphibolite to granulite facies; the highest-grade rocks are orthopyroxene- garnet migmatite and diatexite. The metasedimentary units are characterized by a prominent steep foliation and migmatitic layering.

Intrusive rocks (At, Agd, Ag, Agdp,Agp)

Two main suites of intrusive rocks are recognized in the region, distinguished by the presence or absence of pyroxene(s). The units occur mainly in discrete plutons, although gradational relationships between the two suites occur within some bodies in the southern Pelican Lake area.

Pyroxene-bearing suite (Agdp,Agp)

Pyroxene-bearing plutonic rocks are common in an area extending from south of Pelican Lake to north of Klotz Lake. They range in composition from monzodiorite, through granodiorite (Agdp) and monzogranite, which are the predominant phases. The granodiorite, quartz monzodiorite and monzodiorite phases are homogeneous, medium to coarse-grained and massive to weakly foliated. Aligned phenocrysts of K-feldspar and pyroxene in otherwise massive rocks suggest that the foliation is the product of magmatic flow. Mafic minerals (orthopyroxene, clinopyroxene, biotite, magnetite, hornblende) constitute up to 25% of rocks in this compositional range. Pyroxenes vary in habit from fresh phenocrysts to resorbed cores in hornblende. K-feldspar occurs as megacrysts up to 2 cm in length in proportions up to 25 %. A unique pyroxene-bearing gabbroic sill (Agb), up to 30 m thick and ~30 km long, occurs in the western part of the map area. It contains diffuse anorthositic pods and is cut by pyroxene-bearing granodiorite. Pyroxene-bearing granite (Agp) (charnockite sensu stricto) occurs as zones within large plutons and as discrete pegmatite dykes.

Hornblende-biotite suite(At, Agd, Ag)

Plutons of hornblende-biotite granodiorite (Agd), biotite tonalite (At) and biotite granite (Ag) are common throughout the region. The granodiorite is homogeneous, medium grained and generally weakly foliated. Pyroxene is present locally in cores of hornblende and biotite grains. Compositions vary gradationally to quartz diorite and diorite with increasing mafic content and to granite with increasing proportions of K-feldspar. Rare enclaves of diorite and gabbro of probable cognate origin are present within some bodies. Several varieties of granite are recognized: K-feldspar megacrystic (to 3 cm) units occur as tabular bodies and are commonly well foliated, whereas pink biotite (0-2%) leucogranite is generally medium grained to pegmatitic and massive.

Two units from the southern part of the map-area have been dated. East of Becard Lake a K-feldspar megacrystic granite yielded a U-Pb zircon age of 2719±1 Ma. A weakly foliated hornblende-biotite quartz diorite from north-central Pelican Lake has a similar zircon age (maximum) of 2720±2 Ma. Distinctive granites occur in association with metasedimentary sequences. In the southern Pelican Lake area, coarse-grained, biotite-rich, inclusion-charged diatexites (Adx) with sparse garnet are interpreted as being derived from sedimentary sources. In eastern Klotz Lake, concordant boudinaged veins of biotite granite are inferred to be late syntectonic with respect to the main deformation fabric.

A large body of homogeneous, foliated, medium-grained biotite tonalite (At) southeast of Nantais Lake is cut by thin dykes of massive, leucocratic pink granite and pegmatite.

Correspondence of lithologic and aeromagnetic patterns

A general correspondence is evident between pyroxene-bearing granitoid rocks and positive aeromagnetic anomalies (Fig. 2; GSC NO-19-M; NP-17-18-M), but some magnetic features have no apparent lithologic control. For example, a distinct magnetic gradient in central Pelican Lake occurs within homogeneous hornblende-biotite granodiorite. Supracrustal units generally correspond to low aeromagnetic anomalies. However, not all low anomalies are caused by supracrustal belts, and lows are commonly several times wider than the exposed width of supracrustal units. Magnetic patterns are useful as first-order guides to lithology, but valid interpretation requires systematic ground control.

Structure

The structural chronology of the Pelican-Nantais region is comparable to that of belts in the "Goudalie trend" (Lin et al., 1995; 1996; Percival et al., 1995a; 1996a). Supracrustal units occupy narrow linear zones and are characterized by prominent, possibly composite, tectonic fabrics.

A dominant north-south trending, steep, penetrative foliation (S_1) and sporadic down-dip mineral lineation (L_1) characterize supracrustal and some plutonic units throughout the region. Where preserved, bedding is parallel to the S_1 foliation. The fabric varies from a pronounced mineral alignment foliation in schists and foliated plutonic units, through to migmatitic layering in paragneiss. Mafic units in the north have a strong, locally phyllonitic, fabric. In general, the foliation in all units is defined by biotite and hornblende alignment. Garnet porphyroblasts overgrow migmatitic layering in paragneisses north of Becard Lake. In the east-central part of the map-area, supracrustal units and foliated megacrystic granite (2719 Ma) are deformed into a complex, tight, map-scale fold interference pattern with flattened mushroom geometry. Stretching lineations (L_2) and minor folds (F_2) are well developed in the eastern fold closures (73°25′, 59°43′; 73°28′, 60°17′) and suggest a fold plunging 45°-80° east- northeast in the north and 40-75° east-southeast in the south. Well developed foliations in these hinge regions may be composite D_1-D_2 fabrics. The central closures of the fold (near 73°37′, 59°47′; 73°38′, 60°02′) are poorly defined owing to disruption by plutonic units and water cover in Becard and Pelican lakes. Metamorphic grade varies significantly within the regional- scale fold structure, with dominant granulite facies on the western limbs and amphibolite facies on the east. Based on the map-scale geometry, the fold is either a F_1-F_2 interference structure, or a regional F_2 sheath fold resembling that reported in the Kogaluc belt (Lin et al., 1995). The relative ages of rock units and structures were established in the vicinity of the map- scale fold. A tentative chronology, subject to verification by further geochronology, includes: 1) deposition of supracrustal rocks (2742 Ma); 2) emplacement of hornblende-biotite granodiorite plutons (2720 Ma) and sheets of megacrystic granite (2719 Ma); 3) D_1 deformation and 4) D_2 folding. Metamorphism of supracrustal units was probably protracted, related to the numerous plutonic emplacement events.

Late, brittle faults with northerly trends are evident from sheared, epidote-, chlorite- altered units in linear valleys. Some zones, particularly in the central part of the map area, correspond to apparent offsets of aeromagnetic patterns.

LEPELLE IGNEOUS COMPLEX

This large (200 x 40 km) plutonic complex (Lepelle Igneous Complex) east of the Pelican- Nantais belt corresponds to a prominent positive aeromagnetic anomaly (Fig. 2; GSC NO-19-M; NP-17-18-M). Observations on its western margin, as well as Stevenson's (1968) map, indicate predominantly granodioritic compositions, with some granite and granitic gneiss. The relatively mafic, coarse-grained plutonic rocks are dominated by pyroxene-bearing assemblages. A 5-km- wide western marginal zone contains up to 40% granulite-facies enclaves (cm to 5 m scale) of probable supracrustal origin. The generally northerly-trending mafic, dioritic and paragneissic enclaves have a gneissic to migmatitic fabric (S_1) that was folded by open F_2 warps prior to incorporation into the largely massive granodiorite and granite of the Lepelle complex, which may be comparable in age to the pyroxene-bearing granitoid suite in the Pelican Lake area to the west. The Lepelle complex is separated from the Douglas Harbour aeromagnetic high to the east by a north-trending aeromagnetic low (Fig. 2) containing amphibolite-facies supracrustal belts (Percival et al., 1997).

DIABASE DYKES

Diabase dykes trending west-northwest (285°-305°) attain a width of 90 m in the region. They range from fresh (pyroxene-plagioclase) to altered (chlorite, epidote) and commonly have irregular trends with pronounced bends through 30° of strike. A U-Pb zircon age from a site south of Klotz Lake is 2210+/-1 Ma (K.L. Buchan and J.K. Mortensen, unpublished data).

REGIONAL STRUCTURE AND CORRELATIONS

The regional aeromagnetic pattern (GSC NO-19-M; NP-17-18-M; Fig. 2) of broad (40-100 km) positive anomalies and intervening narrow (10-20 km) troughs reflects the contrast between relatively magnetic plutonic rocks, particularly pyroxene-bearing varieties, and relatively less magnetic supracrustal belts and adjacent plutons. On a regional scale, geobarometric studies of pelitic assemblages in supracrustal belts yield metamorphic pressures of 2.5-4.5 kb, whereas high-grade enclaves in plutonic massifs indicate higher values (5-6 kb; Percival and Berman, 1996), suggesting uplift of massifs relative to greenstones.

The relationship between supracrustal belts and structural sequences in different domains is the subject of ongoing study. Volcanic and plutonic rocks of the Qalluviartuuq domain (2840-2775 Ma) and tonalitic rocks of the Goudalie domain (2900-3010 Ma) are clearly older than the supracrustal and plutonic rocks of the Pelican-Nantais belt (2742-2719 Ma). The boundary is cryptic and probably located within the ca. 90-km-wide region of Utsalik domain granitoid rocks separating the supracrustal belts (Percival et al., 1996a,b). Plutonic rocks in the 2720 Ma range within the Pelican-Nantais region may also represent part of the Utsalik domain plutonic suite. Although the Qalluviartuuq and Douglas Harbour domains contain units of similar age, they are separated by younger units of the Pelican-Nantais belt and Leppelle Igneous Complex. Deformation appears to be somewhat older (mainly pre-2725 Ma) in Lake Minto domain than in the Pelican-Nantais belt (< 2719 Ma). Although a lower limit has not been established, the deformation could correspond to structural events in the Vizien (ca. 2700 Ma) or Qalluviartuuq (ca. 2675 Ma) belts (Percival and Skulski, 1997). Potential lithological and structural correlations between isolated supracrustal belts are being evaluated through further geochronological studies of deformation and metamorphism.

CREDITS

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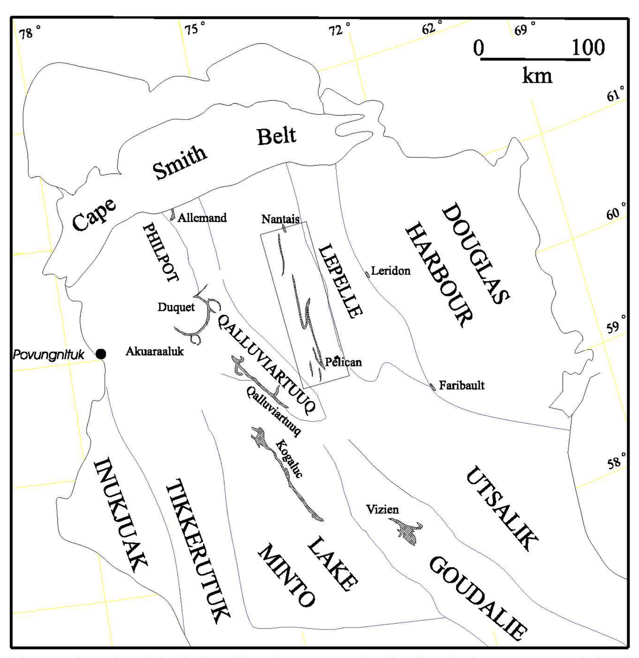


Figure 1: Location of the Pelican-Nantais map area (outlined) and other greenstone belts of the Minto block referred to in the text.

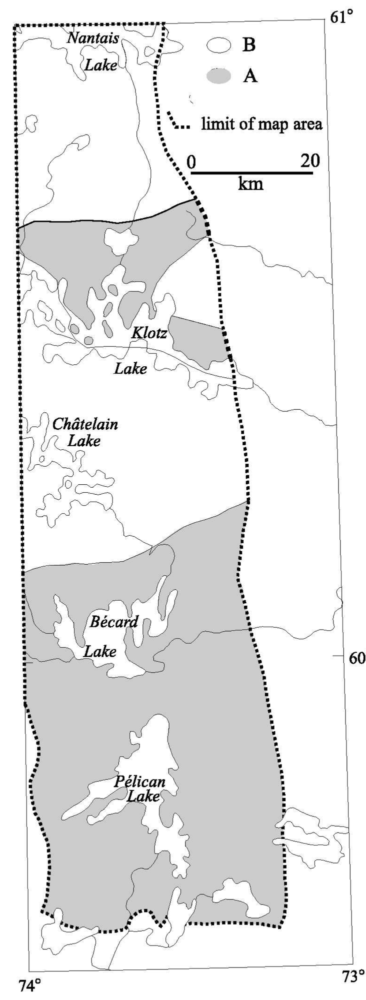


Figure 3: Sources of information. A: compiled from foot and boat traverses by J.A. Percival, T. Skulski, L. Nadeau and S. Gilliss (summer, 1996); B: compiled from field notes and representative samples from Stevenson (1968) with spot checks (1995 and 1996).

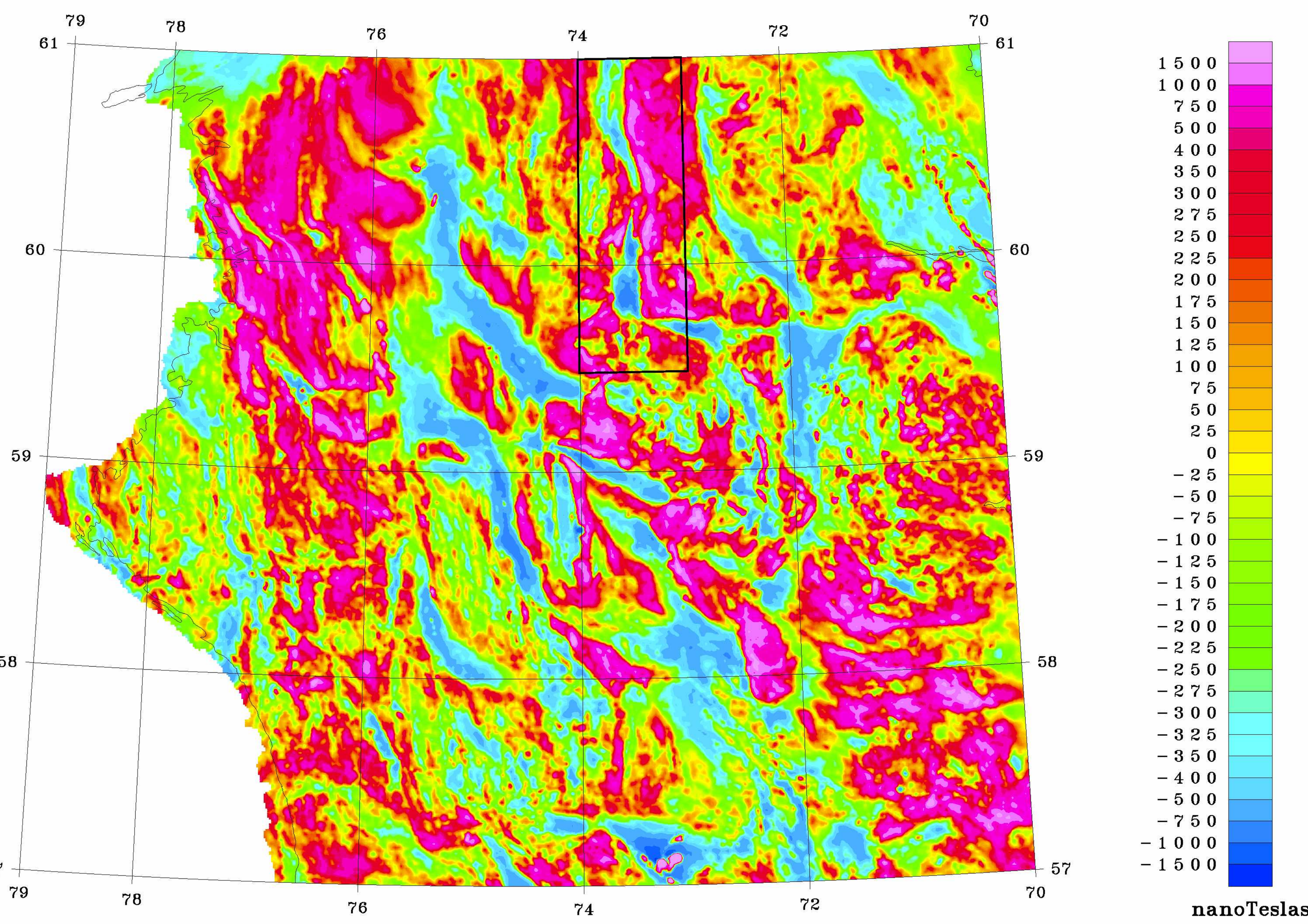
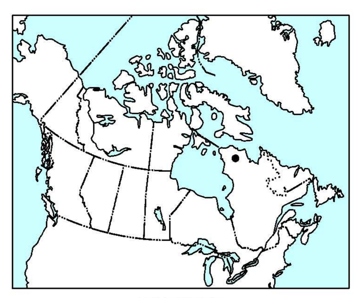


Figure 2: Total field aeromagnetic map of the Minto block showing magnetic features referred to in the text. Outlined area corresponds to Fig. 3 and the geological map.



LOCATION MAP

OPEN FILE 3525

GEOLOGY

RECONNAISSANCE GEOLOGY OF THE PELICAN-NANTAIS BELT, NORTHEASTERN SUPERIOR PROVINCE

QUEBEC

Scale 1:250 000 - Échelle 1/250 000

Kilometres 5 0 5 10 15 20 Kilomètres

Universal Transverse Mercator Projection — Projection transverse universelle de Mercator
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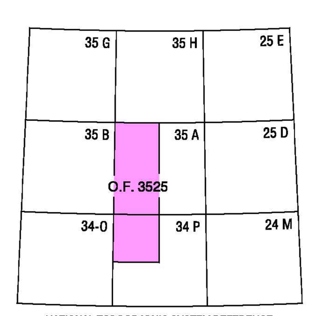

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