Wollaston Lake Project: Geology of the Wollaston Supergroup in the Rabbabou Bay–Wellbelove Bay Area, Northeast Wollaston Lake, Saskatchewan (parts of NTS 64L-6, -7, -10, and -11)

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Abstract

Geological remapping of the northeastern Wollaston Domain at 1:50 000 scale commenced at the northern end of Wollaston Lake in 2005. This area includes elongate structural domes of Archean migmatitic and granitoid rocks overlain by Paleoproterozoic Wollaston Supergroup metasedimentary rocks. Their contact is rarely exposed, but highly strained rocks on either side of the contact suggest a basement-cover décollement zone. The Wollaston Supergroup consists of three major subdivisions; a Lower Sequence (Courtenay Lake and Souter Lake group equivalent), a Middle Sequence (Daly lake Group equivalent), and an Upper Sequence (Geikie River Group equivalent). The Lower Sequence comprises quartzite/psammite, amphibolite, quartzofeldspathic (felsic volcanic) rocks, and iron formation. A similar assemblage of rocks in the Rabbit Lake–Hidden Bay area to the south has been considered part of the Hidden Bay Assemblage, and placed at the top of the Wollaston Supergroup; however, the Lower Sequence assemblage in northern Wollaston Lake is more consistent with the rift-related Courtenay Lake and passive margin-related Souter Lake groups at the base of the Wollaston succession. The Middle Sequence comprises the commonly graphitic basal pelitic unit, along with calc-silicate–marble–calcic arkose and calcic psammopelite/pelite, psammopelite-pelite, psammopelite-pelite-psammite with abundant feldspathic and cordierite faserkiesel, and arkose-quartzite/psammite units. The basal pelite is thickest in the west, where the proposed rift/graben basin occurs, and apparently thins to the east. The Middle Sequence correlates well with the Daly Lake Group of the Wollaston Supergroup. It is proposed that calc-silicate rocks of the Hidden Bay Assemblage in the Hidden Bay area, be considered part of the Daly Lake Group, because they overlie the proposed Lower Sequence rocks and underlie a conglomerate, which probably belongs to the Upper Sequence. The Upper Sequence comprises a basal conglomerate unit, overlain successively by pelite-calcic pelite-psammopelite, calc-silicate rocks and breccias–marble–calcic arkose, graphitic pelite-psammopelite, psammopelite-psammite-feldspathic psammite, and calcic feldspathic psammite-pebble conglomerate units. The Upper Sequence correlates well with the Geikie River Group.

The region has been profoundly affected by the ca. *1.84 to 1.77 Ga Trans-Hudson Orogeny during which four major deformation events are recognized. Accompanying metamorphism attained upper amphibolite to transitional granulite grade over most of the area. The Wollaston Supergroup were intruded by a variety of generally small, commonly magnetic granitoid rocks contemporaneous with* ca. *1.85 to 1.79 Ga Hudson granite suite found throughout the western Churchill Province.*

Disseminated base and precious metals are locally associated with quartzitic, calc-silicate–bearing, and iron formation host rocks. Uranium occurrences in pelitic and calc-silicate rocks indicate potential for unconformity-style, basement-hosted uranium mineralization in the area; however, the distance from the present edge of the Athabasca Basin could be a deciding factor. Corundum in paleolateritic basement may indicate the possibility for gem quality corundum (sapphire) in silica-deficient host rocks.

Keywords: *Wollaston Lake, Archean basement, Wollaston Supergroup, rift sequence, foreland basin sequence, Hudson granites, deformation, metamorphism.*

1. Introduction

The Wollaston Lake Project was initiated to update the geological and geophysical data sets east and northeast of the uranium-enriched eastern Athabasca Basin. The field component, begun in the 2005 summer, follows

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completion in 2004 of a multiparameter airborne geophysical survey of parts of the Peter Lake and northeastern Wollaston domains. The magnetic and radiometric survey, funded by Saskatchewan Industry and Resources (SIR) as part of the Mineral Exploration Incentive Program, was completed by Fugro Airborne Surveys. Data compilation and map production were undertaken by the Geological Survey of Canada (GSC), with digital and hard copy maps released jointly by SIR and GSC in spring 2005 (Ford *et al*., 2005).

An area of approximately 1350 km^2 was geologically mapped at 1:50 000 scale in 2005 across the north end of Wollaston Lake and around Klemmer Lake immediately to the east. This included parts of NTS map sheets 64L-6, -7, -10, and -11, located about 60 km northeast of Points North Landing and 30 km north of the village of Wollaston Lake (Figure 1). The area was accessed by float equipped aircraft from Points North, although boat access is also possible from the boat launch at Hidden Bay, adjacent to Highway 905.

2. Previous Work

The earliest geological reconnaissance in the area was by A.S. Cochrane in 1880-81 for the GSC (reported by Tyrrell and Dowling, 1896 and Tyrrell, 1897). Cochrane entered the area from the northeast, traveling up the Cochrane River (known then as Ice River) into Wollaston Lake and left via the Fond du Lac River (Stone River). Fahrig (1958) completed 1 inch to 4 mile mapping of the Wollaston Lake map sheet, 64L, in 1956. Two areas were mapped at 1:63,360 scale for the Saskatchewan Department of Mineral Resources; the Hidden Bay area (NTS 64L-4) by Wallis (1971) and the Charcoal Lake area (NTS 64L-16) by Scott (1972). Chandler (1978) carried out reconnaissance 1:50 000 scale mapping of the north-central part of Wollaston Lake for the GSC in 1974. In the late 1970s and early 1980s, the remainder of the Wollaston Lake sheet was mapped at 1:100 000 scale by Ray (1978, 1979), Scott (1980), and MacQuarrie (1980) for Saskatchewan Mineral Resources. At the same time, detailed mapping was carried out by Sibbald (1976, 1977, 1978, 1979a, 1979b, 1980, 1981, 1983) and Hoeve and Sibbald (1977, 1978) around the Rabbit Lake uranium deposit and adjacent areas forming part of the NEA/IAEA Test Area for unconformity uranium deposits. The Wollaston Lake map sheet is also included in the compilation bedrock (Thomas, 1983) and metallogenic (MacDougall, 1988) map series. The Quaternary geology was described by Schreiner (1984a, 1984b).

3. Regional Geology and Geochronology

The area investigated lies entirely within the Wollaston Domain, along the southeast margin of the Hearne province (Figure 1). The transition to the adjacent Mudjatik Domain to the northwest was not included in this year’s map area. Archean granitoids and less abundant supracrustal rocks of the Hearne Craton form the basement upon which the Paleoproterozoic Wollaston Supergroup (Yeo and Delaney, in press) was deposited. The Archean rocks typically form elongate, in part overturned, structural domes which protrude through the younger cover rocks. Although an unconformable relation is inherent, the contact between the two is typically highly strained suggesting a basement-cover décollement relationship. The Wollaston Supergroup in the current area comprises three major sequences: 1) a Lower Sequence (perhaps equivalent to the Courtenay Lake and Souter Lake groups of Yeo and Delaney, in press) of quartzite, amphibolite, quartzofeldspathic rocks, and iron formation; 2) a Middle Sequence (equivalent to the Daly Lake Group of Yeo and Delaney, in press) which includes the ‘basal’ graphitic pelitic sequence along with various calcareous rocks, psammopelites, pelites, psammites, and arkose; and 3) an Upper Sequence (equivalent to the Geikie River Group of Yeo and Delaney, in press) floored by conglomerate, and various non-graphitic and graphitic pelitic rocks, psammopelites, psammites, and calcareous rocks which also include some distinctive calc-silicate breccias.

The Wollaston Supergroup was intruded by various diorite-gabbro, to distinctly magnetic granodiorite, monzodiorite, to leucogranite-leucotonalite bodies along with several ages of pegmatite and mafic dykes. Distinctive northwest-trending magnetic lineaments (see Ford *et al.*, 2005) are believed to represent the *ca.* 1.27 Ga MacKenzie diabase dykes.

a) Geochronology

A number of rocks in the Wollaston Lake map sheet have been dated mainly by U-Pb methods and are listed in Table 1. Several of the basement granitic and tonalitic gneisses, from the western margin of the Wollaston Domain, have yielded ages ranging from *ca*. 2.706 to 2.726 Ga (Table 1, Annesley *et al*., 1997), which are in close agreement with similar rocks from the Hearne basement in the Phelps Lake map sheet (64M) to the north (Harper *et al*., 2004; Harper and van Breemen, 2004; van Breemen *et al*., in press). A single Rb-Sr age of *ca.* 2.6 Ga was obtained from granitic gneiss of the Shaganappie Island inlier (Chandler, 1978) which is similar to other *ca.* 2.57 to 2.59 Ga granitic rocks of the eastern Wollaston Domain (Annesley *et al*., 1999; Ansdell *et al*., 2000; Hamilton *et al*., 2000).

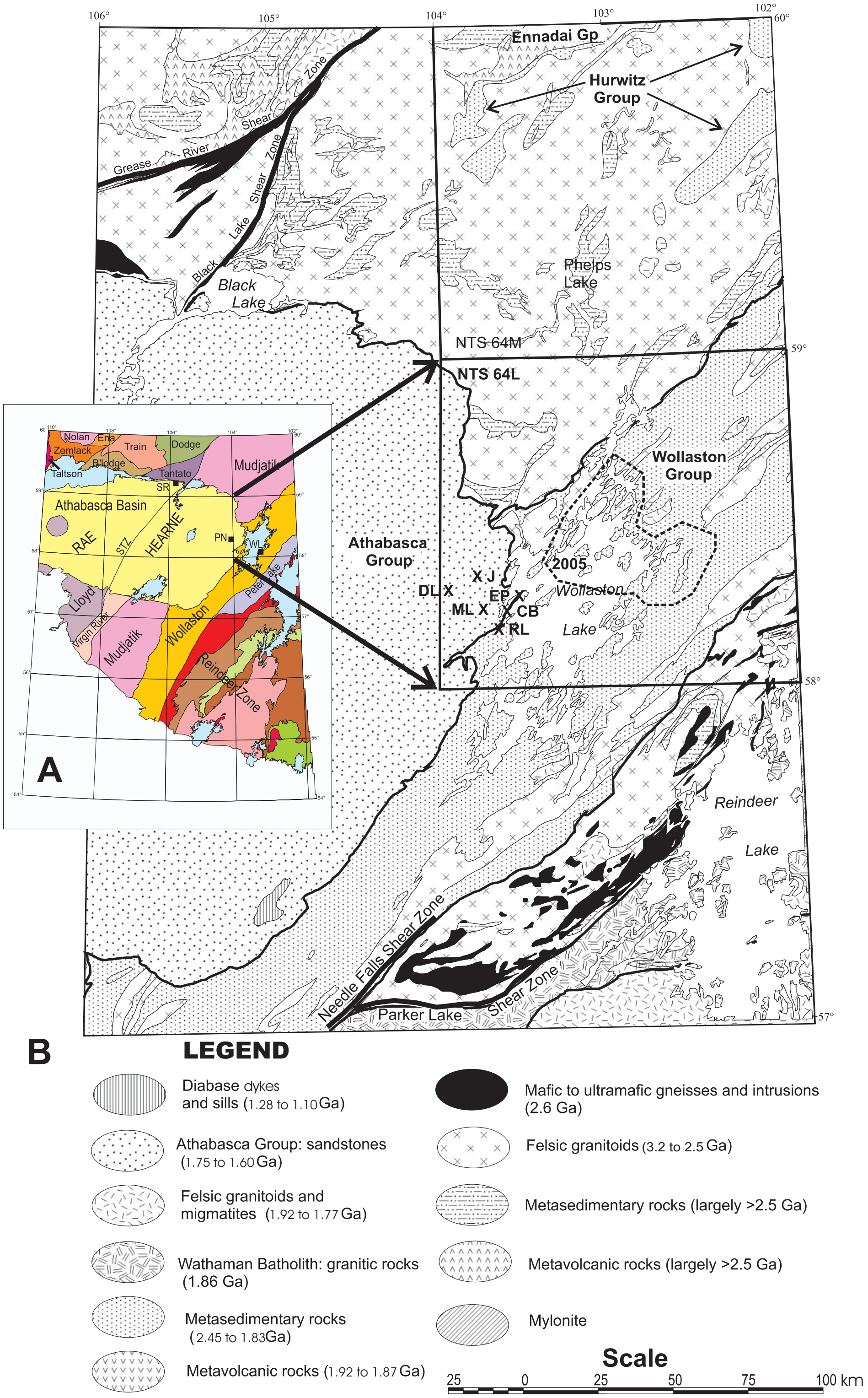

Figure 1 - Location and regional setting of the Wollaston Lake area. A) Wollaston Lake area with respect to domainal subdivision of northern Saskatchewan: B'lodge, Beaverlodge; and STZ, Snowbird Tectonic Zone. Communities: PN, Points North Landing; SR, Stony Rapids; and WL, Wollaston Lake. B) Regional geological setting of the Wollaston Lake area encompassing parts of the Mudjatik, Wollaston, and Peter Lake domains of the Hearne province. Dashed line indicates the area mapped in 2005. Past producing, producing, and future uranium mines (indicated by an X): CB, Collins Bay mine (A, B, and D zones); DL, Dawn Lake deposit; EP, Eagle Point mine; J, Jeb mine; ML, McClean Lake mine (Sue deposits); and RL, Rabbit Lake mine.

*Table 1 - Summary of U-Pb zircon, monazite, and titanite ages and Rb-Sr age from the Wollaston Lake area. UTM coordinates are from NAD 27 datum. UI, upper intercept; LI, lower intercept; *, Rb/Sr technique; **, Pb evaporation technique; all other dates are by standard U-Pb technique.*

Sample #	Rock Description	NTS Area	Easting	Northing	Mineral	Age (Ma)	Significance	Reference
Basement Rocks								
A93-036	Fife Island granite inlier	64L-6	596240	6476663	zircon	2726 ±5	Emplacement	Annesley *et al.* (1997)
PVS-9 ddh	Tonalite gneiss (West Collins Bay inlier)	64L-5	570290	6457950	zircon	2717 +12/-11	Emplacement	Annesley *et al.* (1997)
					monazite	1802 ±2	Metamorphism	Annesley *et al.* (1997)
S-566 ddh	Tonalitic gneiss	64L-5	570466	6458556	zircon	2706 ±5	Emplacement	Annesley *et al.* (1997)
					monazite	1804 ±8	Metamorphism	Annesley *et al.* (1997)
ST-1 ddh	Foliated trondhjemite (McClean Lake inlier)	64L-4	564493	6454320	zircon	>2600	Emplacement	Annesley *et al.* (1997)
					titanite	1752 ±2	Nueltin event	Annesley *et al.* (1997)
	Shaganappie Island Granite*	64L-6			whole rock	2600	Emplacement	Chandler (1978)
Wollaston Supergroup Detritus								
A90-005b	Tonalitic gneiss (Arkose of Wallis, 1971)	64L-4	586815	6438100	zircon	2689 +19/-18	Detrital sources	Annesley *et al.* (1992)
					zircon	2566 +23/-21	Detrital sources	
					titanite	1778 ±2	Metamorphism	
A90-006	Quartz Diorite gneiss (biotite-hornblende psammite of Wallis, 1971)	64L-4	587565	6444850	zircon	2602 +29/-26	Detrital sources	Annesley *et al.* (1992)
					titanite	1779 ±2	Metamorphism	
A89-116	Granodioritic gneiss (biotite psammite of Wallis, 1971)	64L-4	573125	6445480	zircon	2620 +10/-9	Detrital sources	Annesley *et al.* (1992)
					titanite	1789 ±2	Metamorphism	
A89-114a and c	Quartzite	64L-4	572990	6445200	zircon	2686 to 2863	Detrital sources	Annesley *et al.* (1992)
					monazite	1816 ±2	Metamorphism	
A93-055	Mylonitic orthogneiss (meta-arkose of Ray, 1978)	64L-5	584976	6458875	zircon	>2518 UI	Probably detrital	Annesley *et al.* (1997)
A94-051	Granitic gneiss (arkose of Wallis, 1971)	64L-4	582082	6446396	zircon	2520 to >2600	Probably detrital	Annesley *et al.* (1997)
		64L-4				LI 1837	Metamorphism	Annesley *et al.* (1997)
Wollaston Supergroup Rift Development								
	Quartz Feldspar porphyry**	64E-11			zircon	2075 ±2	Crystallization, rifting	MacNeil *et al.* (1997)
EPE-20A ddh	Foliated grey granite (dacite?)	64L-5	582340	6462485	zircon	2054 ±3	? Volcanism	Annesley *et al.* (1997)
		64L-5			zircon	1841 to 1851	Hudson suite intrusion	Annesley *et al.* (1997)
		64L-5			monazite	1803 ±4	Metamorphism	Annesley *et al.* (1997)
Pre-Trans-Hudson Intrusion								
230 ddh	Pegmatite Dawn Lake	64L-5	560734	6462976	zircon	1923 +8/-7	Emplacement	Annesley *et al.* (1997)
					monazite	1766 ±1	Metamorphism	Annesley *et al.* (1997)
					xenotime	1767 ±2	Metamorphism	Annesley *et al.* (1997)
Hudson Intrusions								
A93-037a	Foliated grey granite	64L-6	597570	6475893	zircon	1840 +11/-9	Emplacement	Annesley *et al.* (1997)
					monazite	1790 ±1	Metamorphism	Annesley *et al.* (1997)
A93-026a	Sandy Islands monzogabbro	64L-6	597963	6460386	zircon	1828 ±3	placement (metamorphis	Annesley *et al.* (1997)
					titanite	1795 ±3	Metamorphism	Annesley *et al.* (1997)
A90-012a	Metagabbro (garnet-amphibole gneiss of Wallis, 1971)	64L-4	583150	6452195	zircon	1820 ±5	Metamorphism	Annesley *et al.* (1992)
A93-037b	Pegmatite	64L-6	597570	6475893	zircon	1819 ±6	Emplacement	Annesley *et al.* (1997)
A89-100	Porphyry granite (pegmatite?)	64L-4	574540	6448860	zircon	1815 ±2	Emplacement	Annesley *et al.* (1992)
					titanite	1788 ±2	Metamorphism	
Q6-74 ddh	Migmatitic tonalite gneiss	64L-5	563210	6468721	zircon	1814 +5/-4	Emplacement	Annesley *et al.* (1997)
					monazite	1770 to 1778	Metamorphism	Annesley *et al.* (1997)
EPE-21 ddh	Foliated grey granite (dacite?)	64L-5	582263	6462356	monazite	1813 ±2	Metamorphism	Annesley *et al.* (1997)
A94-040a	Porphyitic granite	64L-5	585691	6463495	zircon	1812 ±3	Emplacement	Annesley *et al.* (1997)
A94-025a	Metasomatized pegmatite	64L-4	583268	6446044	titanite	1808 ±4	Emplacement	Annesley *et al.* (1997)
S-498 ddh	Pegmatite	64L-5	569498	6459575	zircon	1736 to 1773	Metamorphism	Annesley *et al.* (1997)
		64L-5			monazite	1810 ±3	Emplacement	Annesley *et al.* (1997)
Q9-25 ddh	Pegmatite	64L-4	561730	6454563	zircon	1803 ±3	Emplacement	Annesley *et al.* (1997)
					monazite	1776 ±3	Metamorphism	Annesley *et al.* (1997)
					monazite	1764 ±3	Nueltin event	Annesley *et al.* (1997)
Q6-72 ddh	Grey granite	64L-5	565196	6467804	zircon	1700 to 1800	Emplacement	Annesley *et al.* (1997)
Metamorphism								
A89-108	Pelitic gneiss	64L-4	573200	6445425	monazite	1812 ±2	Metamorphism	Annesley *et al.* (1992)

Archean source rocks are well represented in the detrital zircon populations in a number of Wollaston Supergroup metasedimentary rocks that have been analysed from the Wollaston Lake area. Unfortunately a full spectrum of detrital source ages was not obtained for several of these samples, because they were treated as orthogneisses (Annesley *et al*., 1992) instead of metasedimentary rocks as mapped by Wallis (1971).

A grey granite sample, from the Eagle Point mine area on Harrison Peninsula, yielded an intriguing U-Pb zircon age of 2.054 Ga (Table 1, Annesley *et al*., 1997), which could be interpreted as a crystallization age or possible inheritance. This age is, however, close to the 2.075 Ga age (MacNeil *et al*., 1997; Ansdell *et al*., 2000) obtained for quartz-feldspar porphyry associated with the rifting event along the southeastern Hearne margin. Perhaps this indicates that rifting events extended much farther onto the continental margin than previously suspected. The same granite sample also gave zircon ages of 1.84 to 1.85 Ga which Annesley *et al*. (1997, 2005) interpreted as the crystallization age of the granite. It also contained monazite which gave typically Trans-Hudson peak metamorphic ages of 1.811 to 1.814 Ga (Table 1).

A number of granitic and granitic pegmatite rocks have also been dated and yielded ages ranging from 1.8 to 1.84 Ga (Annesley *et al*., 1992, 1997), which corresponds to the main period of Hudson granite emplacement throughout the Western Churchill Province (Peterson *et al*., 2000, 2002). Many of the granitic rocks as well as the older rocks give monazite and titanite ages which show peak metamorphism *ca*. 1.810 to 1.815 Ga, cooling from 1.8 to 1.77 Ga and a younger cooling or thermal event *ca*. 1.76 Ga (Table 1; Annesley *et al*., 1992, 1997).

4. Geology

Bedrock exposure is generally poor throughout the map area, but is somewhat better in the Archean dominated areas in the west and where underlain by the Shaganappie Island basement inlier (Figure 2). Wollaston Supergroup rocks are generally better exposed on the smaller islands of Wollaston Lake; exposure was notably poorer on the larger islands, such as Gillies, Dransfield, Grant, and Gurney islands, and in the metasediment-dominated areas of Clark and Rabbabou bays and Klemmer and Leckie lakes. Previous geology maps that cover parts of the current map area, illustrate the extensive glacial cover. The map, that accompanies this report, includes interpretation of the underlying geology, based on both the new bedrock mapping and new airborne geophysical maps. As all of the rocks have undergone metamorphism to some degree, the prefix 'meta' is omitted from the following descriptions.

Topographic relief is generally less than 20 m, producing a gently undulating terrain and extensive development of peat and muskeg in the low-lying areas. Greater relief occurs in the west where hills rise 40 to 60 m above the level of Wollaston Lake. The glacial ice-flow record is indicated by striations, chatter marks, and stream-lined landforms. Two or three older directions of ice movement are indicated by striations trending southerly (160° to 180°), south-southwesterly (250° to 260°), and westerly (270° to 280°). The main ice-flow direction was southwest at about 220°, but ranged from 200° to 230°. Glacial deposits include various sandy to gravely to clayey sandy tills, which locally are relatively bouldery. A number of major esker and outwash systems occur and are notable for their lack of coarse (gravel to bouldery) material. Several pebbly raised beaches occur at elevations of 410 to 420 m above sea level on the flanks of some of the higher, generally flat-topped till ridges, indicating that glacial lakes existed for short intervals while the ice sheet was retreating. The elevations of more recent raised beaches are within a few metres of the present level of Wollaston Lake.

a) Archean Basement Rocks

Archean rocks generally occur in elongate, doubly plunging, generally northwest-verging, overturned structural domes or inliers, such the Fife Island–Wheeler Peninsula, Shaganappie Island, and Larsen Island inliers (Figure 2). The Archean basement is progressively more exposed to the west of Ross Channel–Killock Bay as the transition from the Wollaston Domain to the Mudjatik Domain, some 10 to 15 km farther west, is approached. The Archean rocks include tonalite gneiss and migmatite, granite gneiss, leucogranite, pegmatite, and rare amphibolitic gneiss of possible supracrustal origin.

Amphibolite Gneiss (Unit Am)

Amphibolite gneiss likely represents the oldest Archean rock type, as it apparently occurs as large xenolithic remnants up to 150 m wide in the basement orthogneisses. The largest and only mappable mass is on Shaganappie Island. It has a layered and fine grained character which suggests that it may be of mafic volcanic origin; however, an intrusive origin cannot be ruled out. These rocks are dark green to black, granoblastic, foliated, and composed mainly of hornblende, plagioclase and biotite, and a small amount of quartz locally. Elsewhere, thin (<30 cm) disrupted lenses of mafic rocks probably represent boudinaged dykes (Figure 3A).

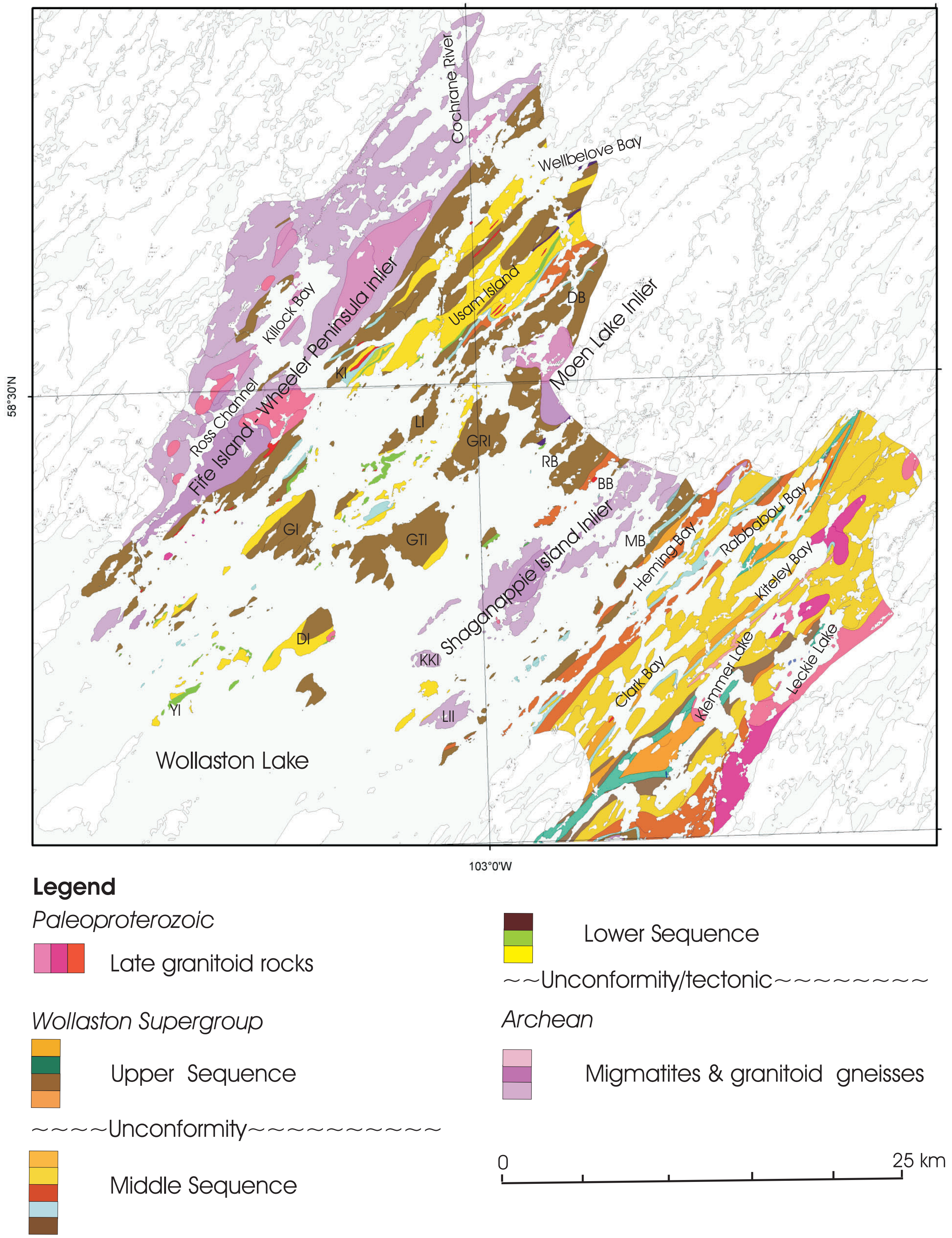

Figure 2 - Geology of the Rabbabou Bay–Wellbelove Bay area, Wollaston Lake. Abbreviations: BB, Broughton Bay; DB, Deception Bay; MB, McRae Bay; RB, Richardson Bay; DI, Dransfield Island; GI, Gillies Island; GRI, Gurney Island; GTI, Grant Island; KI, Kendel Island; KKI, Kukelko Island; LI, Lejour Island; YI, Young Island; and LII, Larsen Island inlier.

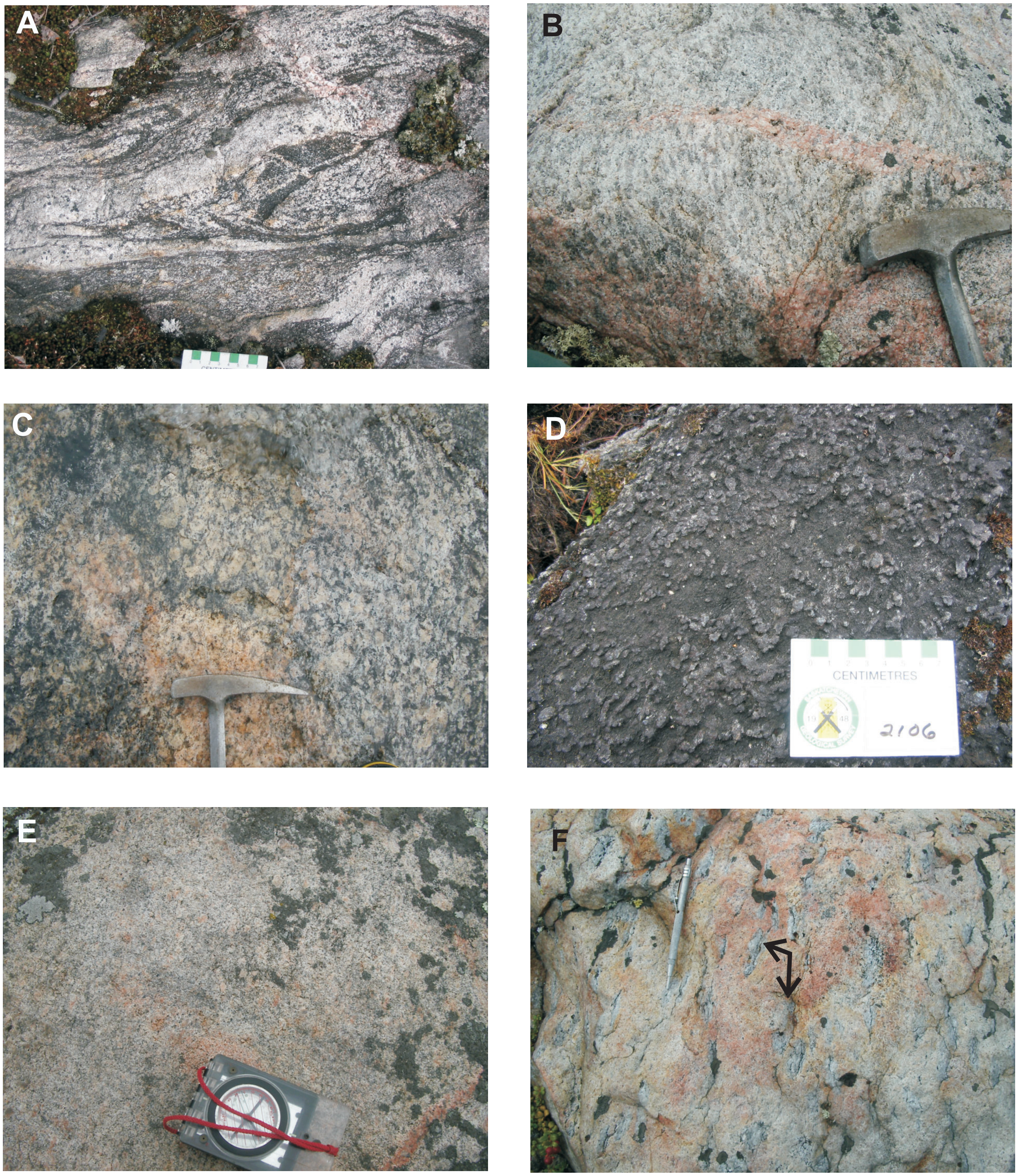

Figure 3 - Archean rock types. A) Multiphase, folded dioritic to tonalitic migmatite with possible dismembered mafic dykes (mafic-rich blocks and lenses), Fife Island, scale card in centimetres; B) Typical appearance of well-foliated tonalite gneiss, note flattened, rectangular nature of recrystallized plagioclase (white), south shore Shaganappie Island; C) Foliated megacrystic tonalite, a precursor stage to the well foliated tonalite of B, west shore of Shaganappie Island; D) Cordierite-spinel porphyroblasts standing in relief in biotite-rich schist, south shore of Kukelko Island; E) Foliated, megacrystic granite gneiss, northeast shore of Fife Island; and F) Sillimanite-quartz faserkiesel (arrows) in altered granite, east shore of Shaganappie Island.

Tonalite Gneiss and Migmatite (Unit At)

Tonalite gneiss and migmatite form a major component of the basement inliers. The migmatitic rocks comprise multiphase and multi-age orthogneisses (Figure 3A) including rocks of dioritic, tonalitic, granodioritic, and granitic compositions along with rare ultramafic to mafic inclusions. They are strongly foliated and commonly have a swirly folded habit and are cut by multiple generations of tonalitic to granitic pegmatite. These rocks typically have a relatively high magnetic susceptibility, and magnetite is readily visible on outcrop surfaces. Very coarse magnetite also occurs in some of the pegmatite veins and dykes.

The **biotite ±hornblende tonalite gneiss** is a distinctive light grey to white weathering rock, which is more homogeneous than the migmatitic unit, and has less complicated folding (Figure 3B). Tonalite gneiss is a major component of the migmatite, but also occurs as discrete intrusions. It is typically coarse grained and strongly foliated, but a low-strain window on the west side of Shaganappie Island and two elongate islands to the southwest are underlain by a megacrystic tonalite in which 1 to 4 cm long by 1 to 2 cm wide plagioclase crystals are preserved (Figure 3C). The megacrystic variety was traced laterally into the more strongly foliated variety (Figure 3B). On Kukelko Island, 3.75 km southwest of Shaganappie Island (Figure 2), the tonalite gneiss was traced into a sillimanite and cordierite-bearing high-strain zone, which includes highly strained sheets and dykes of granodiorite and diorite and an unusual biotite-rich, cordierite-hercynite schist (Figure 3D). These highly strained orthogneisses, misinterpreted in previous mapping (Ray, 1978) as part of the basal pelitic sequence of the Wollaston Supergroup, will form the basis of a B.Sc. honours thesis by C. Ebel at the University of Regina. A similar transition from foliated tonalite gneiss into highly strained, more biotitic tonalite was also documented this summer around the Larsen Island inlier (Figure 2), where previous mapping (Ray, 1978) had also misinterpreted these rocks as pelitic (on the west side of the inlier) and psammitic (on the east side of the inlier) gneisses of the lower Wollaston Supergroup. What these highly strained rocks do represent is the tectonic contact zone between the basement gneisses and the overlying Wollaston Supergroup.

The sillimanite-bearing granitoid rocks on Kukelko Island may represent the metamorphosed derivative of lateritic weathered basement, an idea put forward by Ray (1975) for rocks farther to the southwest in the Wollaston Domain. Chandler (1978) reported the presence of corundum and hercynite on the south side of Kukelko Island, also within the high-strain zone, which would lend support to the idea of aluminous lateritic weathering. In several places, including Kukelko Island, the tonalite gneisses are intensely limonite stained, but show little evidence of pyrite or pyrrhotite. This iron staining may also be a function of the metamorphism of lateritic weathered rocks.

The tonalite gneiss and migmatite rocks are very much like the tonalitic migmatite and tonalite gneiss of the Phelps Lake region to the north (Harper *et al*., 2001, 2002, 2003) where U-Pb zircon TIMS dating has yielded an age of *ca*. 2.82 Ga for tonalite migmatite (Harper *et al*., 2004) and SHRIMP dating has provided ages of 2.714 to 2.687 Ga for the tonalite gneiss (Harper and van Breemen, 2004; van Breemen *et al*., in press). Several tonalite gneisses in the Wollaston Lake area have yielded similar ages (Table 1, Annesley *et al*., 1992, 1997); therefore it is reasonable to suggest that the tonalite migmatite and tonalite gneisses in the area mapped would have similar ages.

Granite Gneiss (Unit Ag)

Granitic rocks intruded the migmatite and tonalite gneiss and are typically pink weathering, fine to coarse grained, with local megacrystic phases (Figure 3E). These intrusions are well foliated and generally have a moderate magnetic susceptibility. They commonly occur as elongate intrusions, such as on Wheeler Peninsula, Fife Island, and in the Shaganappie Island and Moen Lake inliers (Figure 2). The tear-drop-shaped granite intrusion that forms the core of the Shaganappie Island inlier is a good example of these intrusions. It shows gradation from a granodioritic margin to biotite granite and locally leucogranite. An interesting feature of this granite body is a splotchy yellowish white zone up to 30 m wide adjacent to a long narrow bay (fault trace?) on the east side of Shaganappie Island. It has remnant patches of pink-weathered granite and contains up to 25% white quartz-sillimanite faserkiesel up to 6 cm long and 2 cm wide, elongated parallel to the dominant northeast-trending Paleoproterozoic fabric (Figure 3F). Muscovite is also present. The protolith of this zone may have been subjected to lateritic weathering.

A megacrystic granite variety occurs south and east of Deception Bay in the Moen Lake inlier (Figure 2). It contains up to 25% pink K-feldspar phenocrysts 0.2 to 5 cm in length, along with 5 to 10% biotite and magnetite is a common accessory mineral.

Leucogranite (Unit Alg)

Light to dark pink-weathering, fine- to medium-grained leucogranite and granite pegmatite, that are generally only weakly foliated, intruded granite gneiss in the Fife Island inlier. These rocks are included with the Archean rocks, because they do not appear to intrude the adjacent Wollaston Supergroup pelitic gneisses. Similar Archean leucogranites are in the Mudjatik Domain in the Phelps Lake map sheet (Harper *et al*., 2001, 2002, 2003); however, they are also very similar to Hudson-aged leucogranites which do intrude Wollaston metasediments, thus their age is uncertain.

b) Paleoproterozoic Rocks

Paleoproterozoic rocks are the most abundant rocks exposed at surface, comprising sedimentary rocks of the Wollaston Supergroup and less abundant intrusive rocks probably related to the Trans-Hudson Orogeny. The Wollaston Supergroup supracrustal rocks occupy doubly plunging, elongate dome and basin structures, whereas the Paleoproterozoic intrusions tend to abruptly truncate the sedimentary rocks and commonly contain large xenolithic blocks of them. The contact between the Archean rocks and the Wollaston Supergroup was only exposed in one location, on Larsen Island, where it is a tectonic contact between tonalite gneiss and quartzite. High-strain zones at the margins of the basement inliers and in adjacent Wollaston sedimentary rocks indicate that a tectonic contact is the norm, and points to a basement-cover décollement zone or thrusting produced during the Trans-Hudson Orogeny. This high-strain relationship has been demonstrated by Tran and Yeo (1997) and Tran *et al*. (1998, 1999) in a number of localities in the southern part of the Wollaston Domain.

Wollaston Supergroup

One of the objectives of this project was to re-examine the stratigraphy in the Wollaston Lake area, and determine whether it was consistent with the stratigraphy developed farther south and southwest in the Wollaston Domain (*e.g*., Delaney *et al*., 1997; Tran and Yeo, 1997; Tran *et al*., 1998, 1999; Yeo and Savage, 1999; Yeo and Delaney, in press). In general, correlation with the major groups and some of the formations was possible, but given the distance from these other areas, there are also apparent regional differences. Also, reconciling the structural framework with the stratigraphy was a difficult task, particularly in the poorly exposed eastern part of the area. As this is the start of an ongoing project, some of these issues may be resolved in successive seasons. Three tentative subdivisions (sequences) are presented here for the Wollaston Supergroup (their equivalent group status as per Yeo and Delaney (in press) are shown in brackets): 1) a *Lower Sequence* (Courtenay Lake and Souter Lake groups), 2) a *Middle Sequence* (Daly Lake Group), and 3) an *Upper Sequence* (Geikie River Group).

Lower Sequence (Courtenay Lake and Souter Lake groups)

The Lower Sequence primarily comprises an interlayered succession of quartzite-psammite and amphibolite, with minor iron formation and possible felsic volcanic rocks and/or high-level felsic sills. These rocks are exposed in the western third of the area mainly in two northeast-trending zones, each 30 to 35 km in length and up to 5 km in width (Figure 2). The western zone extends beyond the map area northeast of Wellbelove Bay, and the eastern zone continues southwestward toward Hidden Bay. Several apparently isolated outcrops of these rocks occur near Richardson Bay, northwest of Shaganappie Island and between Kukelko and Larsen islands. In general, the Lower Sequence rocks appear to occur below the ‘basal’ pelitic unit of the Middle Sequence; however, there are some places where they appear to be interdigitated with, or possibly lie above, the pelitic unit. Early faulting (*i.e*., rifting) or thrusting and/or nappe development during the Trans-Hudson Orogeny likely played various roles in defining the outcrop patterns. The estimated maximum thickness of the sequence is about 1000 m assuming that fold repetition occurred.

The **quartzite-psammite unit (Wq)** includes ‘glassy’ orthoquartzite, sillimanite quartzite, and feldspathic quartzite to feldspathic psammite which contains up to 10% biotite ±garnet. Interlayers of psammopelite-pelite occur locally, especially in the more psammitic portions. The rocks are white, tan, orange grey to rusty brown weathering and typically white, light grey to tan on fresh surfaces, fine to coarse grained, generally well layered on a centimetre to decimetre scale and well foliated (Figure 4A). Sillimanite quartzite has thin layers of fibrous to coarsely crystalline sillimanite coating most foliation surfaces, which gives them a silky appearance. Rusty weathered quartzite typically contains trace amounts of pyrite. Quartzite, typical of this unit, occurs at the highly strained contact with the Larsen Island basement inlier on the west side of Larsen Island. The quartzite there is about 10 m thick and is overlain by graphitic, garnet-cordierite-sillimanite pelitic gneiss typical of the Middle Sequence. More quartzite-psammite occurs structurally west of this pelite unit and occupies the core of an east-northeast–trending synform. This probably represents fold repetition.

The quartzite-psammite unit is interlayered with the amphibolite unit and in places was intruded by dioritic to gabbroic phases of that unit. It is also associated with silicate facies iron formation.

The **amphibolite unit (Wam)**, with the exception of two isolated occurrences, is always associated with the quartzite-psammite unit. It occurs in bands from a few metres to about 350 m thick and is generally conformable with the quartzite-psammite unit. Locally there is some relief along their contact (Figure 4B), which may have

Figure 4 - Lower Sequence rocks. A) Thick layered, well foliated orthoquartzite exposed on southwest tip of small island, 3 km southwest of Lejour Island; B) Cliff exposure of amphibolite overlying quartzite with undulating contact (dashed line) east shore of long island 1.5 km north of Young Island; C) Splotchy, recrystallized diorite phase of amphibolite unit, exposed on small island 750 m southwest of Dransfield Island; D) Mafic fragments in tuff breccia in amphibolite unit on the east shore of a small island about 3 km north of Young Island; E) Felsic tuff breccia, interlayered with amphibolite unit on small island 3.5 km west of Dransfield Island; F) Garnetite layer (silicate facies iron formation) with 80 to 90% garnet interlayered with amphibolite and quartzite (chert?), on north shore of S-shaped island southwest of Lejour Island.

resulted from either depositional down-cutting, slightly discordant intrusion, or folding. The amphibolite unit is dark green, brown green, green grey to black, fine to coarse grained, and generally well foliated. Although hornblende and plagioclase predominate, biotite replacement of hornblende is locally extensive. The unit comprises dioritic to gabbroic (Figure 4C) phases, which locally are discordant and contain quartzite xenoliths, as well as layered, compositionally diverse phases that locally exhibit clastic textures. The latter types are interpreted as mafic flows and volcaniclastic rocks. The diorite-gabbro rocks were probably emplaced as sills; however, given the upper amphibolite grade of metamorphism, some of these rocks could be thick flows.

Many of the layered amphibolites are spotted, with either pink garnet porphyroblasts rimmed by plagioclase, or where the decompression reaction of garnet to plagioclase+hornblende has gone to completion, the spots are almost entirely white plagioclase. These porphyroblasts range from 1 to 2 mm to 2 to 3 cm in diameter and compose up to 10% of the rock. Pale green to yellow-green patches, pods, and lenses composed of calc-silicate minerals (diopside, epidote, ±calcite ±quartz ±plagioclase) are characteristic of calcareous, altered mafic volcanic rocks. Rocks believed to represent volcaniclastic facies (tuffs or tuff breccia) contain diffuse to well-defined mafic fragments ranging from 1 to 10 cm long by 1 to 2 cm wide occurring in a mafic to intermediate matrix (Figure 4D).

Quartzofeldspathic rocks (Unit Wfv) of uncertain igneous origin are associated with both the quartzite-psammite and amphibolite units. On Kendel Island, a garnetiferous quartzofeldspathic rock up to 250 m thick is associated with quartzite-psammite; however, no contacts were observed, partly due to masking of the contacts by intrusion of voluminous white tonalitic pegmatite. The garnet-bearing quartzofeldspathic rocks are white to light grey, fine to medium grained and are interpreted as a either an early high-level intrusion or massive flow/flow dome of dacitic-rhyodacitic composition. This rock was sampled for geochronological study.

On a number of the small islands between Dransfield and Young islands, white, fine-grained quartzofeldspathic rocks form a distinctive band about 3 m thick within the amphibolite unit. The felsic rocks are thin to thick layered, with the thick layered rocks having a fragmental texture resembling a tuff breccia (Figure 4E). The fragments are mainly of mafic and altered mafic (*i.e.*, like the adjacent amphibolites) composition, but felsic fragments also occur. These rocks are interpreted as felsic volcanic tuffs and tuff breccia.

Iron formation (Unit Wif), including silicate and mixed facies (silicate-oxide, silicate-sulphide) types, is intimately associated with the amphibolite-quartzite sequence. These rocks are typically medium to very coarse grained (2 to 3 cm diameter) and very garnetiferous up to 90% in some garnetite layers (Figure 4F). They commonly have alternating silicate mineral-rich ±magnetite ±iron sulphides and quartz-rich layering. Other associated minerals include: hornblende, anthophylite-cummingtonite ±gedrite, biotite, pyroxene, apatite, magnetite, and pyrite-pyrrhotite. Elevated magnetite contents in the mixed facies rocks in northeast Wellbelove Bay are responsible for a linear magnetic anomaly that can be traced for up to 20 km along strike (see MacDougall, 1988; Ford *et al*., 2005). The presence of iron formation indicates hydrothermal activity during deposition of the quartzite-amphibolite sequence, and suggests deposition of this succession in an extensional (rift/graben?) setting.

Middle Sequence (Daly Lake Group)

The Middle Sequence (Daly Lake Group) underlies much of the western two thirds of the area, and apparently thins to the east. The sequence comprises: a) psammite-calcic pelite, b) graphitic and non-graphitic pelites-psammopelites, psammite, c) calc-silicate rocks, d) psammopelite-pelite, e) psammopelite-pelite-psammite, and f) arkose-quartzite. Maximum thickness of the Middle Sequence ranges from 2000 to 3000 m.

The **psammite-calcic pelite unit (Wpq)** is apparently only locally developed on the southeast (McRae Bay) and northwest (Broughton Bay) sides of the Shaganappie Island inlier. The rocks are light to medium grey to black where hornblende bearing, laminated to thinly layered, and very fine grained (Figure 5A). The psammitic rocks are composed of quartz, feldspar, biotite ±garnet ±magnetite ±tourmaline. The calcic pelitic layers contain quartz, feldspar, and hornblende, a composition that suggests derivation from a more mafic source terrain than is evident in the adjacent basement rocks.

Graphitic and non-graphitic garnet, cordierite, sillimanite pelite unit (Wp) is the most extensively distributed facies of the LFBS, being thickest in the west and apparently thinning to the east where it is only found immediately adjacent to basement inliers, which lie beyond the current limits of mapping (see Ray, 1978, 1979; MacQuarrie, 1980). This pelitic unit is typically the first Wollaston strata encountered adjacent to the basement inliers. The pelitic gneisses are intensely folded and are generally of migmatitic character with abundant tonalitic leucosomal layers and veins, as well as larger pegmatitic veins and dykes of multiple ages (Figure 5B). The rocks are both graphitic and non-graphitic, typically contain ovoid to elongate porphyroblasts of garnet, cordierite, and sillimanite, which are typically deformed by D2 and later structural events (Figure 5C). Cordierite and garnet are also present in a younger generation of leucosome. A ferruginous pelitic horizon occurs on the islands west of Symons Island. It contains up to 15% centimetre-long feldspathic blebs cored by magnetite (Figure 5D). Similar rocks occur on the peninsula separating Heming and McRae bays. The pelitic rocks are interlayered with garnet- and cordierite-bearing

Figure 5 - Rocks of the Middle Sequence (Daly Lake Group). A) Well-laminated psammite-calcic pelite (unit Wpq) with pencil magnet lying on hornblende-rich layers, on small island on west flank of Shaganappie Island inlier. B) Graphitic, garnet-cordierite pelitic gneiss with abundant tonalitic leucosome D1 isoclinal fold (axial plane indicated by dashed line) refolded about northeasterly trending D2 fold (solid line); on west shoreline of channel separating Wheeler Peninsula and Usam Island. C) Pelitic gneiss with cordierite faserkiesel (white blebs indicated by arrows) which are deformed around hinge zones of northeast-trending D2 folds. Some of the fold limbs have small scale shear zones partially filled with granitic material, on small island about 2 km northeast of Larsen Island. D) Magnetite-cored feldspathic blebs in pelitic gneiss, longest blebs are about 1 cm long, photo taken through several centimetres of water on small island 1.5 km west of Symons Island. E) Slab of ripple-marked psammite taken from outcrop on southeast shore of Bird Island. F) Typical ribbed weathered surface of calc-silicate rocks on group of small islands 1.5 km west of Symons Island. G) Green and white calc-silicate rocks with coarse-grained diopside-rich layers under hammer and layered diopside-plagioclase rocks above hammer, on east shore, near northeast end of Heming Bay. H) Refolded calcitic marble (recessive grey layer) and calc-silicate rocks (light grey layers), note dismembered calc-silicate layer in the marble produces a tectonic breccia, on north shore of small island 2.5 km north of Young Island. I) Pink and green colour banded calcareous arkose exposed on east shore of peninsula separating Rabbabou and Heming bays. J) Feldspar and cordierite faserkiesel-rich psammopelite-pelite (unit Wpsf): the uppermost layer contains ~50% cordierite porphyroblasts. The arrows point to cordierite rimming K feldspar (A), cordierite as a core to K-feldspar (B), cordierite as both core and rim to K-feldspar faserkiesel (C) and individual cordierite faserkiesel (D). The photo also shows original layering, S0, and a layer parallel foliation, S1 (arrow with single heads, 060°); second generation foliation, S2 (double headed arrow), which flattened and reoriented faserkiesel into D2 axial plane (040°); and third generation fracture cleavage/foliation, S3, (015°, triple headed arrow). Exposed on west shore of Klemmer Lake. K) Irregular bordered granitic melt cuts across layering of psammopelite-pelite-psammite unit (Wpsf) and contains abundant blue cordierite (pitted) in quartz-rich (light grey) part of melt rock; west shore of Klemmer Lake. L) Arkose-quartzite unit (Waq) showing tight to isoclinal D2 fold, exposed on crest of large outcrop ridge on peninsula separating Rabbabou and Heming bays.

psammopelite and psammite, which locally are the dominant rock types. One such psammite layer, on the west flank of Shaganappie Island inlier, preserves ripple marks (Figure 5E) which indicate tops to the west. Minor calcareous layers are also present, and become more prevalent with the transition into the calc-silicate unit.

The **calc-silicate rocks unit (Wcs)** includes marble, calcic arkose, and calcic psammopelite-pelite. They are restricted in their distribution, with the more prominent zones being up 10 km long and up to 1 km wide. The rocks have a ribbed weathered surface (Figure 5F), with the more recessive layers typically being calcitic marble. As a group, the rocks are pale to dark green, pink and green, white to light grey, to dark grey, fine to coarse grained, thin to thick layered, and well foliated (Figure 5G).

The principal calc-silicate–bearing rocks are composed of diopside together with plagioclase, quartz ±K-feldspar ±carbonate ±biotite/phlogopite ±amphibole ±sphene. Marble layers are typically less than 10 to 20 cm thick, but locally are 1 to 2 m thick (Figure 5H). They are mainly composed of white or pink calcite, but some marble layers are dolomitic. They may also contain diopside, phlogopite, and sphene. Calcic arkose is characterized by alternating pink arkosic (K-feldspar–bearing) layers with green calc-silicate layers (Figure 5I). These rocks also contain quartz, plagioclase, ±biotite ±diopside ±amphibole ±sphene. The calcic psammopelite-pelite rocks have a similar suite of minerals, but are more biotitic, contain more plagioclase, and have the darker colours. In some of these rocks delicate lamination and graded bedding are preserved.

The **psammopelite-pelite unit (Wps)** is more prominent in the eastern third of the area (Figure 2). It is moderately migmatitic in the west and becomes less so eastward. Tonalitic leucosome veins and layers are typical. The rocks are light to dark grey, fine to medium grained, well layered and foliated, with some layers containing cordierite faserkiesel. They are composed of quartz, feldspar, biotite, ±cordierite ±garnet.

The **psammopelite-pelite-psammite unit (Wpsf)** occurs exclusively east of Heming Bay (Figure 2). It is distinguished by its pink and grey compositional layering, which has widely variable proportions, and contains abundant feldspar and cordierite ±sillimanite faserkiesel, and pink granitic leucosome or pegmatite (Figure 5J). In the dominantly pink rocks, pink K-feldspar faserkiesel, up to 4 cm long by 2 cm wide, compose up to 30% of the rock. Some feldspar faserkiesel have cores of, or are rimmed by cordierite, or show both. There are also cordierite faserkiesel which are white, blue grey and blue, typically ovoid, and generally less than 2 cm long. They are more common in pelitic-psammopelitic layers and compose up to 50% of the layer (Figure 5J). Cordierite faserkiesel commonly have a core of fibrolitic sillimanite. These faserkiesel were formed during the earliest metamorphic event and are commonly deformed by D2 and later deformation events. Coarse-grained, pale blue to deep blue cordierite is also abundant in a melt phase which cuts earlier structures.

In places, particularly along the west side of Klemmer Lake (Figure 2), the grey component of the unit, psammitic-psammopelitic-pelitic rocks (subunit Wgsf), forms a mappable unit. It is characterized by white plagioclase and cordierite faserkiesel. The white faserkiesel were misinterpreted as flattened quartz pebbles previously (Chandler, 1978).

The **arkose-quartzite/psammite unit (Waq)** locally overlies unit Wpsf, probably with gradational transition. It occurs in the Heming and Rabbabou bays area (Figure 2), where it forms some of the highest hills and is exceptionally well exposed. The unit is almost exclusively pink arkosic gneiss with abundant pink granitic pegmatite, and less abundant white to light grey quartzite/psammite. The rocks are generally fine grained, and exhibit a very strong to weakly mylonitic foliation. Faserkiesel are rare in this unit, but those that do occur comprise pink K-feldspar and creamy white sillimanite faserkiesel. This unit typically has a moderate magnetic susceptibility, as magnetite is a notable constituent.

Upper Sequence (Geikie River Group)

The Upper Sequence occurs exclusively east of Heming Bay (Figure 2). The sequence comprises: a) conglomerate; b) pelite-calcic pelite-psammopelite; c) calc-silicate rocks with a distinctive breccias; d) graphitic pelite, psammopelite; e) psammopelite-psammite, feldspathic psammite; and f) calcic feldspathic psammite-pebble conglomerate. The sequence has an estimated thickness of 1000 to 1500 m. The distinctive features of the Upper Sequence are the conglomerate and calc-silicate breccias.

The **conglomerate unit (WUcg)** is represented by a single small outcrop northeast of the portage into Leckie Lake (Figure 2), and by a number of angular boulders near the southwest end of Klemmer Lake. The grey to pink grey, polymictic conglomerate has a fine-grained arkosic to calcic arkosic matrix, which hosts the generally rounded, pebble to boulder-sized clasts of psammopelite-pelite and calcic psammopelite (Figure 6A). The matrix is composed of quartz, feldspar, biotite, ±diopside ±epidote ±actinolite ±hornblende. Conglomerate is interlayered with calcic arkose. Given the predominance of sedimentary clasts, this unit is believed to be equivalent to the Janice Lake Formation (Delaney *et al.*, 1995; Yeo and Delaney, in press) at the base of the Geikie River Group.

Figure 6 - Rocks of the Upper Sequence (Geikie River Group). A) Conglomerate unit with pebble to boulder-size (b) sedimentary rock clasts, exposed in northwest corner of Leckie Lake. B) Fine-grained calcic psammopelite (unit WUpc) cut by numerous calc-silicate veins which produce an alteration envelope in the adjacent host; exposed in northwest corner of Leckie Lake. C) Calc-silicate breccia with large clasts of layered calc-silicate rock (arrows) in coarser diopsidic (green) and pink arkosic (under flare pen) matrix; exposed on ridge crest about 200 m inland from southwest shore of Klemmer Lake. D) Presumed albitite breccia with pebble to cobble-size clasts (arrows) of albite-rich rock in calcic arkosic matrix; in east-central Rabbabou Bay. E) Well-layered marble with abundant bladed porphyroblasts of diopside and tremolite and lighter layers are composed of pink calcite; exposed in same area as C above. F) Laminated psammopelite (unit WUps) with starved ripples in light coloured layer, which indicate tops to the west; near west shore of southern Klemmer Lake. G) Folded tourmalinite layer encased in late granitic pegmatite; exposed on outcrop ridge on peninsula in north-central Rabbabou Bay. H) Channel scar (indicated by arrows) in ribbed weathered psammite with channel filled by thick bedded calcic feldspathic psammite; exposed on same ridge as G. I) Poorly defined feldspathic clasts (e.g., arrow and tip of blue pen cap) in massive calcic feldspathic psammite; same location as H.

The **pelite, calcic pelite-psammopelite unit (WUpc)** is grey to dark grey to green grey, very fine grained to medium grained, laminated to thinly bedded/layered, foliated and commonly cut by dark green calc-silicate (diopside) veins (Figure 6B). The rock adjacent to the veins is altered with development of a calc-silicate mineral assemblage and increase in grain size. This pelite shows little evidence of melting, or gneissic foliation typical of the Middle Sequence pelites. It is composed of quartz, feldspar, biotite, ±diopside ±epidote ±actinolite ±hornblende.

The **calc-silicate rocks unit (WUcs)** also includes calc-silicate breccia, marble, and calcic arkose. The rocks are pale to dark green, grey to brown to white, pink-green-white, and mottled pink and green, fine to very coarse grained (pegmatitic), laminated, layered to massive and have a highly variable mineral composition. The calc-silicate rocks are composed of diopside, plagioclase, quartz ±actinolite ±hornblende ±tourmaline ±sphene ±pyrite-pyrrhotite. In many places these rocks have recrystallized to a coarse-grained pegmatitic calc-silicate rock, in which the relict layering is faintly discernable.

The calc-silicate breccias consist of angular to rounded pebble to boulder-size clasts of the primary calc-silicate sediment in a typically recrystallized calcareous matrix (Figure 6C), which locally may be arkosic. This subunit also includes breccias composed of angular to rounded clasts which appear to be composed entirely of feldspar (probably albite) contained in a calcic arkosic matrix (Figure 6D). Comparable breccias in calc-silicate rocks overlying the conglomerate in the Geikie River Group in the southern Wollaston Domain provides a good regional marker (Delaney *et al*., 1995; Tran and Yeo, 1997, Tran *et al*., 1998, 1999).

The marble subunit is mainly calcite-bearing, but dolomitic varieties also occur. Marble is best developed along the west shore of southern Klemmer Lake (Figure 2). Large angular boulders along the shore of several islands in Leckie Lake suggest its presence there as well. These rocks are generally coarse grained and contain a diverse assemblage of accessory minerals, commonly present as euhedral porphyroblasts (Figure 6E), some up to 10 cm in length. They include: diopside, phlogopite ±tremolite-actinolite ±scapolite ±olivine ±serpentine (pseudomorphs after olivine) ±vesuvianite.

Calcic arkose consists of alternating pink arkosic and green calc-silicate layers respectively. The rocks are composed of quartz, feldspar, biotite ±diopside ±epidote ±actinolite ±hornblende.

A thin, 20 m thick, upward-fining **psammopelite-graphitic pelite unit (WUgp)** occurs on the west side of the major synform in the northern part of Rabbabou Bay (Figure 2). The light grey, fine-grained psammopelite conformably overlies the calc-silicate unit, is non graphitic, has splotchy iron staining, and is composed of quartz, feldspar, and biotite with a trace of pyrite. Overlying the psammopelite, the grey, fine- to medium-grained, thinly layered graphitic pelite contains quartz, feldspar, and biotite and shows no partial melt lenses, nor any garnet, cordierite, or sillimanite.

The **psammopelitic-psammite-feldspathic psammite unit (WUps)** is best exposed in the Rabbabou Bay synform, where it has a thickness of about 400 m (Figure 2). It also occurs in southern Klemmer Lake. The rocks are pink, pink grey, and light to medium grey, very fine grained to fine grained, laminated to thinly bedded, locally preserve starved ripples (Figure 6F), and are foliated. Pink and white pegmatite is locally abundant. The rocks consist of quartz, feldspar, biotite, and magnetite. Thin horizons, 10 to 30 cm thick, of black, **laminated tourmalinite**, are a minor, but distinctive component, in which tourmaline-rich layers alternate with quartz-rich layers (Figure 6G). Apatite and a non-magnetic opaque mineral are accessory minerals. These tourmalinite horizons suggest that hydrothermal activity was active in the basin of deposition. Tourmalinite rocks have not been recorded elsewhere in the Wollaston Domain.

The **calcic feldspathic psammite** and possible **pebble conglomerate unit (WUqf)** forms the core of the Rabbabou Bay synform, and may have an unconformable contact with the underlying unit. These rocks are about 50 m thick and vary from thinly layered with a ribbed weathered surface to a more massive or thickly layered rock. They are white with a very pale greenish hue, fine to medium grained, and generally well foliated. A large channel-like structure apparently cuts down through the ribbed type suggesting tops to the west (Figure 6H). The more massive type also contains rather faint pebble-like feldspathic aggregates (Figure 6I). The similarity to the host rock makes them almost indiscernible. The rocks are composed of quartz, plagioclase ±biotite ±actinolite ±hematite.

Discussion

In general, there is reasonable agreement between the stratigraphy in the Wollaston Lake area and that developed by Yeo and Delaney (in press) from areas to the south and southwest in the Wollaston Domain. Some changes are suggested here, mainly relating to the originally defined Hidden Bay Assemblage. Contrary to suggestions by previous workers (*e.g.*, Sibbald, 1976, 1979a, 1983; Ray, 1978) that the quartzite-amphibolite sequence of the Hidden Bay Assemblage (Wallis, 1971) sits at the top of the Wollaston Supergroup stratigraphy, it is proposed here, that this sequence should be at or near the base. The compositional maturity of the quartzite suggests that it probably formed at an early stage in the development of the Wollaston Supergroup, from a strongly weathered source terrain.

Its close association with, and the apparent restriction of the amphibolite and quartzofeldspathic (felsic volcanic) rocks and iron formation to this lower sequence, suggests that they may have formed in a rift or regional graben setting. The amphibolite unit was considered by Sibbald (1979a) and Ray (1978) to be of probable volcanic origin and certain garnet-amphibole rocks to be silicate facies iron formation. The current work has shown that the amphibolite unit is in part intrusive, probably emplaced as sills, and probably in part volcanic flows and volcaniclastic rocks. The presence and restriction of quartzofeldspathic rocks, of apparent felsic volcaniclastic origin as well as possible high-level felsic intrusions, to the quartzite-amphibolite succession, suggest a bimodal volcanic sequence. This type of assemblage is common to many other rift-related sequences, for example the graben-stage of the Damara Supergroup in South West Africa (Martin and Porada, 1977; Breitkopf, 1988) and the Murmac Bay Group in the Beaverlodge area of northwest Saskatchewan (Hartlaub *et al.*, 2004). Although lithogeochemistry is not yet available, these rocks more closely resemble the rift-related Courtenay Lake and passive margin Souter Lake groups (Fossenier *et al.*, 1994, 1995; Yeo and Delaney, in press) which occur along the southeast margin of the Wollaston Domain and have provided the *ca*. 2.075 Ga age (Delaney *et al.*, 1997; MacNeil *et al.*, 1997) for timing of rifting and early deposition of the Wollaston Supergroup.

The quartzite-psammite-amphibolite rocks of the Lower Sequence are traceable into the Rabbit Lake–Hidden Bay area to the southwest where they were included in and/or equated with the Hidden Bay Assemblage (Wallis, 1971; Sibbald, 1977, 1983; Ray, 1978). A detrital zircon study of a quartzite unit from the quartzite-amphibolite succession south of Rabbit Lake only yielded Archean age zircons (2686 to 2863 Ma, samples A89-114a and c, Table 1, Annesley *et al.*, 1992). A detrital zircon study of the Souter Lake Group quartzite also mainly contained Archean zircons ranging from 2620 to 2367 Ma with a peak at 2530 Ma (Hamilton *et al.*, 2000) indicating that there was mainly an Archean source terrain from which to derive the sediments. This would suggest that the two quartzites are time equivalent and that the quartzite-amphibolite sequence of the Rabbit Lake–north Wollaston Lake area predates deposition of the Daly Lake Group sediments which contain both Archean and Paleoproterozoic zircon populations (Tran, 2001). Detailed mapping around the Rabbit Lake mine site by Sibbald (1976, 1977, 1978, 1979a, 1983), however, suggests that the structural and apparent stratigraphic position of the quartzite-amphibolite succession was at the top of the Wollaston stratigraphy. The structurally underlying succession, which hosted the Rabbit Lake uranium mine, comprised arkose, calcareous arkose, calc-silicate rocks, and breccias and plagioclasites (Hoeve and Sibbald, 1978; Sibbald, 1983), and they structurally overlie a graphitic pelitic unit. The mine succession is remarkably similar to the Upper Sequence, but if this succession truly represents older rocks than the quartzite-amphibolite sequence, then they would have to represent an older fluvial-deltaic-evaporitic succession (see Yeo and Savage, 1999), which predated development of the proposed rift/graben sequence. A similar succession predates volcanism in the Damara Orogen rift settings (Breitkopf, 1988).

The other point of contention is placement of the calcareous component assigned to the Hidden Bay Assemblage to be in the uppermost part of the Geikie River Group. According to Wallis (1971), the carbonate and calc-silicate unit of the Hidden Bay Assemblage sits structurally above the quartzite-amphibolite units and structurally below a polymictic conglomerate (Wallis's unit 6g) associated with arkose and other calcareous psammites and calc-silicate rocks. Wallis' (*ibid*) polymictic conglomerate is dominated by metasedimentary clasts; therefore, it is more likely equivalent to the base of the Upper Sequence (Geikie River Group), *i.e.*, a possible correlative with the Janice Lake Formation (Yeo and Delaney, in press). The conglomerate has a calcic matrix and its association with arkosic, calcic arkosic, and calc-silicate rocks is indeed similar to the Geikie River Group. The current mapping has demonstrated that calc-silicate and marble-bearing units occur in both the Middle (Daly Lake Group) and Upper (Geikie River Group) sequences. They have similarities, but the Upper Sequence calc-silicate unit contains distinctive calc-silicate and albitite(?) breccias which are not found in the Middle Sequence calc-silicate unit. These breccias are probably correlative with the Rafuse Lake Formation which overlies the Janice Lake Formation (Yeo and Delaney, in press). In this context, the calcareous component of the Hidden Bay Assemblage, as originally defined, would be part of the basal pelite-dominated Karen Lake Formation of the Daly Lake Group (Yeo and Delaney, in press). Therefore, by reassigning the quartzite-amphibolite and the calcareous-carbonate successions of the Hidden Bay Assemblage to the Lower (Courtenay Lake and Souter Lake groups) and Middle (Daly Lake Group) sequences respectively, it is proposed that the enigmatic Hidden Bay Assemblage could be dropped from the stratigraphic nomenclature.

Rocks lying above the calc-silicate–marble unit (unit WUcs) in the upper most part of the Upper Sequence have not been defined or recognized elsewhere or given formational status. It is proposed that those rocks which include: psammopelite-graphitic pelite, psammopelite-psammite-feldspathic psammite, and calcic feldspathic psammite and possible pebble conglomerate units, be assigned to the Geikie River Group.

c) Intrusive Rocks

Paleoproterozoic intrusive rocks include: diorite-gabbro, granodiorite, monzodiorite, leucogranites-leucotonalite, pegmatites, and diorite-gabbro dykes. They mainly occur in the Rabbabou Bay–Klemmer Lake area (Figure 2), with another group of small intrusions occurring both east and west of the Fife Island inlier. They are apparently related to the Trans-Hudson Orogeny and existing geochronology on a few granitic, gabbroic, and pegmatitic rocks indicates an age range of *ca*. 1.84 to 1.8 Ga (Table 1), which is also characteristic of the age range of the Hudson suite of granites (Peterson *et al*., 2000). Many of these rocks in the Wollaston area are notably magnetic and produce pronounced, well-defined anomalies (see aeromagnetic maps, Ford *et al*., 2005). Local place names will be used informally to designate several of these plutons.

Diorite-Gabbro (Unit Dg)

Diorite-gabbro rocks are a minor component of the Leckie Lake pluton. Numerous large angular gabbro erratics occur on the islands in central Leckie Lake and along the east central shoreline of that lake, suggesting that gabbro may form a marginal phase to that pluton. A large xenolith, in a granodioritic-monzonitic phase at the mouth of the river entering southwest Klemmer Lake (Figure 7A), indicates the diorite-gabbro phase was emplaced earlier. The rocks are grey to dark grey, coarse grained to porphyritic, and generally massive. They contain hornblende, plagioclase, biotite, magnetite ±quartz.

Granodiorite-Monzonite-Monzodiorite (Unit Gd)

Granodiorite-monzonite-monzodiorite form the southern half of the Leckie Lake pluton, and granodiorite-monzodiorite form the northeastern part of the north Klemmer Lake intrusion and are the main rock type of the Kiteley Bay intrusion (Figure 7B). They contain rare xenoliths of mafic to ultramafic rock and foliated pelitic-psammopelitic rocks. These rocks have a somewhat patchy distribution and are commonly gradational to one another such that subdivision is difficult. They are light to dark grey to pink grey and become notably reddened adjacent to faults; medium to coarse grained, massive to weakly foliated, and strongly magnetic. They are composed of plagioclase, hornblende, biotite, magnetite ±quartz ±K-feldspar.

Late Granitic Rocks (Unit Lg)

A suite of late granitic rocks includes: pale to dark pink to red leucogranite (subunit Lgl) and syenogranite (subunit Lgs, ≥60% K-feldspar), and white to pale pink leucotonalite (subunit Lgt). As a group they are fine to coarse grained to pegmatitic, massive to weakly foliated, all contain less than 5% biotite, and are exceptionally xenolithic in places. Some of the intrusions, such as the syenogranite which forms an ovoid part of the Leckie Lake pluton, are magnetic and produce sharp magnetic anomalies. Others, like the central Klemmer Lake intrusion, are non-magnetic (Figure 7C). A small leucogranite intrusion in east-central Rabbabou Bay intruded calc-silicate rocks and produced a bleached alteration zone in the calc-silicate rocks adjacent to the contact (Figure 7D).

Pegmatite (Unit P)

Pegmatite veins and dykes and larger elongate intrusions have a wide range of ages. There are two main varieties; a white granodioritic to tonalitic pegmatite (subunit Pw) and a pink granitic pegmatite (subunit Pp). White pegmatites are plagioclase dominant, and include quartz, biotite ±muscovite ±magnetite ±tourmaline ±garnet ±cordierite ±sillimanite ±diopside. Many of the larger pegmatite intrusions are of the white variety and appear to be axial planar to D2 regional folds; they may also occur along the attenuated to sheared D2 fold limbs. They are commonly well foliated. The pink pegmatites are K-feldspar dominant and include quartz, plagioclase, biotite, muscovite ±magnetite ±tourmaline ±garnet ±cordierite ±sillimanite ±diopside. They are rarely of mappable size and must have been emplaced earlier as they are commonly folded and have a well-developed foliation. The accessory mineral assemblage of the pegmatites is governed by the composition of the rocks they intrude.

Diorite-Gabbro Dykes (Unit db)

A few mafic dykes of dioritic to gabbroic composition have intruded Wollaston Supergroup metasediments. They are generally small and unmappable, however, several in the Klemmer-Crampean lakes area are indicated on the accompanying map. There was an early period of mafic dyke emplacement, represented by a pair of *en echelon* dykes less than 30 cm in width, which were folded and boudinaged and show a well-developed calcareous alteration envelope in the adjacent psammopelitic rocks (Figure 7E). The larger gabbroic dykes, up to 5 m wide, are massive, coarse to pegmatitic in grain size (Figure 7F), and comprise hornblende, plagioclase, magnetite ±biotite ±K-feldspar. Their northerly trend suggests they are related to a D3 folding event or to emplacement along Tabbernor related faults.

5. Structure and Metamorphism

The structural and metamorphic history in the Wollaston Lake area involves both Archean and Paleoproterozoic components. The Archean history includes formation of the tonalitic migmatite complex, which is similar to the *ca.*

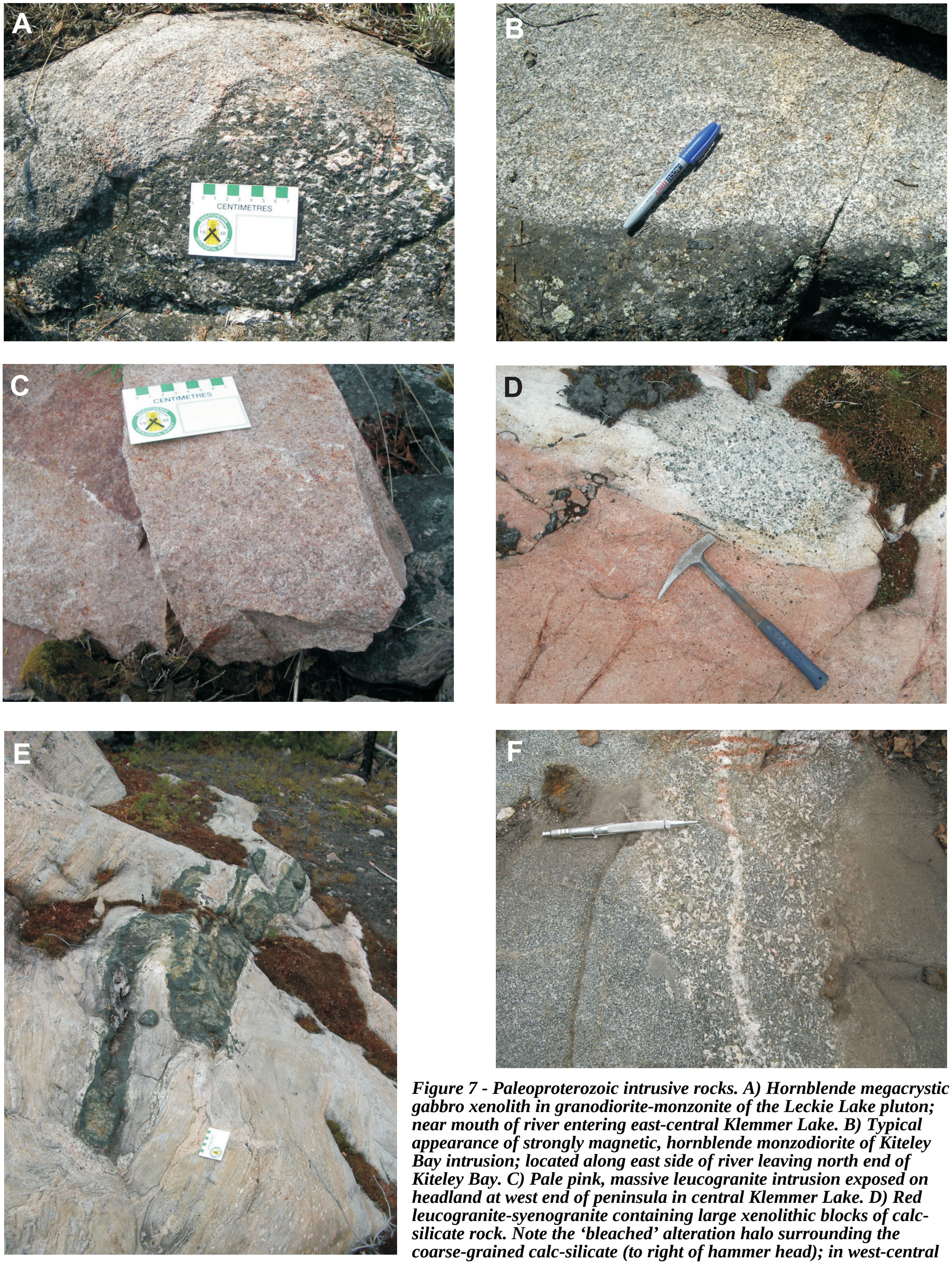

Figure 7 - Paleoproterozoic intrusive rocks. A) Hornblende megacrystic gabbro xenolith in granodiorite-monzonite of the Leckie Lake pluton; near mouth of river entering east-central Klemmer Lake. B) Typical appearance of strongly magnetic, hornblende monzodiorite of Kiteley Bay intrusion; located along east side of river leaving north end of Kiteley Bay. C) Pale pink, massive leucogranite intrusion exposed on headland at west end of peninsula in central Klemmer Lake. D) Red leucogranite-syenogranite containing large xenolithic blocks of calc-silicate rock. Note the 'bleached' alteration halo surrounding the coarse-grained calc-silicate (to right of hammer head); in west-central Rabbabou Bay on peninsula separating Rabbabou and Heming bays. E) Folded, boudinaged and altered mafic dyke intruded into faserkiesel-rich psammopelite-pelite-psammite unit (Wpsf) note the narrow alteration halo in psammopelite along dyke margins; exposed near centre of peninsula separating Kiteley Bay from Klemmer Lake proper. F) Hornblende-biotite diorite dyke with pegmatitic core/vein in centre of 5 m wide north-trending dyke; exposed in subvertical, 2 m cliff west of southern end of Klemmer Lake.

3.0 to 2.7 Ga migmatite complex in the Phelps Lake area to the north (see Harper *et al*., 2003, 2004; Harper and van Breemen, 2004). Development of a migmatite complex implies existence of an early Archean deformation, referred to as AD1, and high-grade metamorphic (AM1) event to develop a foliation and capable of melting the orthogneissic components to produce a leucotonalitic leucosome (Figure 3A). In the Phelps Lake area the older Archean fabrics are cut by *ca*. 2.715 to 2.69 Ga tonalite gneisses (Harper and van Breemen, 2004) and granitic gneiss of *ca*. 2.68 Ga (Harper *et al*., 2004; Harper and van Breemen, 2004). In the Wollaston Domain *ca*. 2.58 Ga granites (Hamilton *et al*., 2000) intrude the older Archean rocks. Thermotectonism (AD2 and AD3) apparently accompanied both of these periods of granite emplacement, with a high-grade metamorphic event (AM3) recorded by ages of *ca*. 2.55 Ga along the southeastern Hearne margin in the Peter Lake Domain (Maxeiner *et al*., 2004). Foliations present in the Archean rocks are undoubtedly composite fabrics combining both Archean and Paleoproterozoic thermotectonism. The late Archean (*ca*. 2.55 Ga) foliation is believed to be preserved in the tonalite and granite gneisses as a shallow-dipping, undulating feature, which was refolded into small scale dome and basin structures by the Paleoproterozoic deformations. This weak biotite fabric might also have formed during the early Paleoproterozoic D1 deformation.

In the Wollaston Supergroup, primary sedimentary structures, such as laminations and bedding, are relatively abundant; however, structures that are helpful in determining way-up directions, such as starved ripples, ripple marks, channel scours, and graded bedding (Figures 5 and 6), are rare. The few top-determining structures are most common in the eastern third of the area, where deformation and metamorphism appear to have been less intense.

The earliest regional deformation event, D1, that affected the Wollaston Supergroup produced a generally layer parallel foliation and in many of the rocks was accompanied by melting and the formation of a granitic to tonalitic leucosome depending on the composition of the host sediment. The basement-cover décollement zone and the associated high-strain zones were initiated at this time (*c.f.* Tran and Yeo, 1997; Tran *et al*., 1998, 1999 for the southern Wollaston Domain). Large scale D1 folds are difficult to recognize, but may have been nappe-like with subhorizontal to shallow dipping axial planes. Small-scale D1 folds are typically isoclinal. D1 was accompanied by upper amphibolite to transitional granulite facies metamorphism, M1, during which: garnet, cordierite, and sillimanite porphyroblasts were crystallized in the pelitic and psammopelitic rocks; diopside, olivine, and hornblende in calc-silicate rocks; hornblende and garnet in amphibolite; and sillimanite in quartzite. Sillimanite and cordierite-spinel formed in the basement rocks affected by lateritic weathering. Hypersthene was not found in any of the rocks, but has been reported from adjacent areas (*e.g.*, Scott, 1972, 1980; Ray, 1978; MacQuarrie, 1980). Peak M1 conditions probably occurred *ca*. 1.83 to 1.82 Ga (Table 1, Annesley *et al*., 1992, 1997; *c.f.* Harper and van Breemen, 2004), which is coincident with Hudson suite magmatism (Peterson *et al*., 2000, 2002; Harper and van Breemen, 2004; Harper *et al*., 2005).

The second regional deformational event, D2, was responsible for the dominant northeast trend of the Wollaston Domain. In the basement rocks, D2 produced open to tight refolding of the presumed late Archean fabric and the development of a strong penetrative fabric, S2, parallel to the axes of basement gneiss dome as originally defined by Lewry and Sibbald (1980). In the Wollaston sediments, D2 produced tight to isoclinal, upright to steeply dipping doubly plunging folds, with hinges defined by S0/S1 (Figures 5B, 5C, and 5L), related leucosomes and early pegmatites, and developed a penetrative fabric, S2. The S2 fabric is defined by flattening of quartzofeldspathic minerals, by the growth (M2a) and preferred orientation of biotite and hornblende, and in a few pelitic rocks by the alignment of magnetite-cored felsic blebs (Figure 5D). On the limbs of the D2 folds, S2 is indistinguishable from S0/S1. Feldspathic, cordierite, and sillimanite faserkiesel and garnet porphyroblasts were folded and/or transposed into the F2 axial planes (Figure 5C and 5J). The F2 axes are generally very shallow and doubly plunging to both northeast and southwest. Faulting and/or shearing are believed to have occurred along attenuated limbs of F2 folds, and may have provided the loci for emplacement of some exceptionally large white tonalitic pegmatites. Post-D2 static recrystallization, (M2b) and melting (Figure 5K) produced new generations of garnet, cordierite, sillimanite, diopside, scapolite, tremolite, sphene, and spinel. Peak M2 conditions were probably attained *ca*. 1.815 to 1.81 Ga (see Table 1; Annesley *et al*., 1992, 1997).

A third deformational event, D3, is characterized by open, generally upright, northerly striking and plunging folds. A steeply dipping fracture cleavage and/or micaceous foliation are developed locally. Northerly trending small-scale shear zones, sometimes accompanied by quartzofeldspathic veining is believed to be associated with this event. The northerly trending Tabbernor faults may have been initiated at this time as well as emplacement of northerly trending diorite gabbro dykes. A fourth deformation event, D4, is indicated by very open, steeply dipping, westerly striking and plunging folds. Transposition of the composite S2 foliation is developed preferentially in more biotitic layers to produce a weak S4 fabric.

In general the deformation history of this part of the Wollaston is very similar to that described by previous workers in the region and elsewhere in the Domain (Wallis, 1971; Hoeve and Sibbald, 1978; Ray, 1978; Lewry and Sibbald, 1980; Sibbald, 1983).

Several periods of faulting post-dating the major structural events have trends ranging from west to northwest to north. These offset contacts with both vertical and subhorizontal displacements. Repeated fault movements have occurred along the northerly trending Tabbernor fault system, as indicated by sinistral offsets of interpreted, northwest-trending McKenzie diabase dykes (*ca*. 1270 Ga, LeCheminant and Heaman, 1989), which occur just beyond the limits of the present mapping. Sinistral displacement is typical of these faults and a tightly spaced cleavage and brecciation is developed in the wall rocks to these faults.

6. Economic Geology

A number of prospects and minor showings are known in the northern Wollaston Lake area (MacDougall, 1988). The main occurrences are uraniferous pegmatites, commonly accompanied by molybdenum and thorium, and disseminated Cu and Zn sulphides; both of these types are hosted in clastic metasedimentary rocks (Table 2).

Uranium in fractures in metasedimentary rocks on the peninsula southwest of Fife Island (Figures 1 and 2) is on strike with the Collins Bay–Rabbit Lake unconformity-type uranium deposits (*e.g.*, Rabbit Lake; Collins Bay A, B, and D; Eagle Point; see Saskatchewan Geological Survey, 2003) about 20 to 25 km southwest. These minor uranium occurrences may represent minor, basement-hosted mineralization. As noted above, however, most other uranium showings are in pegmatites.

Disseminated copper and other sulphides hosted in Wollaston metasediments at Richardson Bay (SMDI 635b), Keeler Peninsula (SMDI 635a and 635c) and Wellbelove Bay (SMDI 636a) are associated with iron-formation (MacDougall, 1988), traceable for up to 20 km on aeromagnetic maps.

Corundum, along with cordierite and hercynite, was reported by Chandler (1978) in possible aluminous weathered basement rocks at the margin of the Shaganappie Island inlier on Kukelko Island. Whether gem quality corundum (*e.g.*, sapphire) could be present in these biotite-rich, quartz-poor rocks or other silica-deficient host rocks has never been investigated. Of related interest are recently discovered sapphire occurrences on Baffin Island in calc-silicate lenses in marble of the Lake Harbour Group (LeCheminant *et al*., 2005), which is of similar age as the Wollaston Supergroup sediments.

Table 2 - Mineral prospects in northern Wollaston Lake area. See MacDougall (1988) for locations of these and other minor showings. Note coordinates are UTM NAD 27, Zone 13.

SMDI	Prospect	Easting	Northing	Elements	Deposit Type	Assessment Report
–	Peninsula northeast of Snowshoe Island			U, Cu	Disseminated and in fractures in metasediments	MacDougall (1988)
624a	Fife Island northwest	600983	6481913	Cu, Mo	Shear in pelite	64L06-0025,-0030,-0031, -0038, -0039,-0040,-0051, and -0052; 64L11-0001, -0002, and -0003
628a	Cleveland Island Trench No. 6	606008	6481334	U, Mo	Pegmatite in pelite	64L-0015; 64L03-0004 and-0007; 64L06-0016 and -0021; 64L07-0001
628b	Cleveland Island boulder train	606008	6481334	U, Th	Pegmatite in metasediment	64L03-0004 and -0007
629a	Gillies Island north	606557	6479647	U, Th, Mo, Zr	Pegmatite in metasediment	64L03-0004 and -0007
629b	Gillies Island southwest	606557	6479647	U, Mo	Pegmatite in metasediment	64L-0015; 64L03-0004 and -0007; 64L06-0014, -0015, and-0029; 64L07-0001
630	Shaganappie Island east	620089	6473260	Mo, Ag, Zn, Pb	Pegmatite in granite	64L-0005; 64L07-0001
635a	Deception Bay (Denison DDH 6 and 7)	624062	6493006	Cu, Zn	Metasediment-hosted disseminated sulphides	64L-0002, -0003, and -0004; 64L10-0001 and -0006
635b	Deception Bay Cu-Zn (Richardson Bay)	624062	6493006	Cu, Zn	Metasediment-hosted sulphides	64L-0002,-0003,-0004, and -0012; 64L07-0001; 64L10-0001 and-0006
635c	Deception Bay Cu-Zn (Keeler Peninsula)	624062	6493006	Cu, Zn	Metasediment-hosted sulphides	64L-0002, -0003, and -0004; 64L10-0001 and -0006
636a	Wellbelove Bay (Denison DDH 8)	623112	6499011	Cu, U, Th	Metasediment-hosted sulphides	64L-0002, -0003, and -0004; 64L10-0001, -0006, 0018, and -0019

7. Summary

Geological remapping at 1:50 000 scale of the northeastern Wollaston Domain commenced in the northern part of Wollaston Lake in the summer of 2005. This area includes elongate structural domes of Archean migmatitic and granitoid rocks overlain by Paleoproterozoic metasedimentary rocks of the Wollaston Supergroup. The region has been profoundly affected by the *ca*. 1.84 to 1.77 Ga Trans-Hudson Orogeny and intruded by a variety of generally small, commonly magnetic granitoid rocks contemporaneous with the *ca*. 1.85 to 1.79 Ga Hudson granite suite (Peterson *et al*., 2000, 2002), which is found throughout the western Churchill Province. Some of these granitoids may also be related to emplacement of the *ca*. 1.86 Ga Wathaman Batholith.

Similarity of the basement rocks with those of the Phelps Lake area suggest they comprise an older tonalitic migmatite complex (*ca*. 3.0 to 2.8 Ga), intruded by younger tonalitic (*ca*. 2.72 to 2.69 Ga) and granitic (*ca*. 2.68 and 2.58 Ga) gneisses and leucogranites, and rare amphibolite gneisses of possible supracrustal origin. The contact between the basement rocks and Wollaston Supergroup is rarely exposed; however, the development of highly strained rocks at the interface between the basement rocks and Wollaston Supergroup suggests that the contact is largely tectonic and might represent a basement-cover décollement zone as has been suggested elsewhere in the Wollaston Domain (Tran *et al*., 1998, 1999; Tran, 2001). Post-Archean lateritic weathering of the basement is suggested by aluminosilicates (*e.g*., sillimanite) in granitic and tonalitic gneisses at the contact.

The Wollaston Supergroup comprises three major subdivisions; a Lower Sequence (Courtenay Lake–Souter Lake groups), a Middle Sequence (Daly Lake Group), and an Upper Sequence (Geikie River Group). The Lower Sequence comprises quartzite/psammite, amphibolite, quartzofeldspathic rocks, and generally mixed facies iron formation. This assemblage has traditionally been considered part of the Hidden Bay Assemblage (Wallis, 1971) and placed by previous workers at the top of the Wollaston Supergroup. This succession is, however, more consistent with the Courtenay Lake and Souter Lake groups which occur at the base of the Wollaston succession and represent rift–passive margin stages (Tran, 2001; Yeo and Delaney, in press).

The Middle Sequence (Daly Lake Group) comprises the commonly graphitic basal pelitic unit with locally developed psammite-calcic pelite, calc-silicate-marble-calcic arkose and calcic psammopelite/pelite, psammopelite-pelite, psammopelite-pelite-psammite with abundant feldspathic and cordierite faserkiesel, and arkose-quartzite/psammite. The basal pelitic sequence is thickest in the west part of the area, where the proposed rift basin occurs, and apparently thins to the east. The upper part of the Middle Sequence is better preserved in the eastern third of the area, but this may be a function of the depth of erosion, rather than original distribution.

The Upper Sequence (Geikie River Group) comprises a basal conglomerate, overlain successively by pelite-calcic pelite-psammopelite, calc-silicate rocks and breccias-marble-calcic arkose, graphitic pelite-psammopelite, psammopelite-psammite-feldspathic psammite, and calcic feldspathic psammite-pebble conglomerate. This sequence is exclusively exposed in the eastern third of the area and tends to have more primary sedimentary features preserved, has more brittle types of deformation and less intense metamorphism, as might be expected in a structurally and stratigraphically higher sequence.

Archean thermotectonism, although inherently present in the basement rocks, was relatively insignificant compared to the Paleoproterozoic Trans-Hudson Orogeny, which controlled the structural framework in the Wollaston Domain. Four major deformation events are recognized that affected the Wollaston Supergroup and underlying basement. The first deformation, D1, produced a layer parallel foliation, S1, and isoclinal folding. Folding of S0/S1 during D2 produced the characteristic, doubly plunging, elongate dome-and-basin style structural patterns of the Wollaston Domain. The D2 folds are tight to isoclinal, northeast-trending, and have a strong axial planar foliation, S2. Subsequent deformations, D3 and D4, produced open upright northerly and westerly trending folds respectively. West-, northwest-, and north-trending faulting events account for generally brittle displacement of the rocks. Two high-grade metamorphic events, concurrent with D1 and D2, are indicated by the garnet-cordierite-sillimanite and melt assemblages in the metasedimentary rocks of the Wollaston Supergroup. They indicate that low-pressure, high-temperature upper amphibolite to transitional granulite facies conditions, were attained. Emplacement (*ca*. 1.85 to 1.80 Ga) of various diorite-gabbro, granodiorite-monzodiorite, leucogranite-syenogranite-leucotonalite, and tonalitic and granitic pegmatite intrusions, include pre-, syn-, and post-tectonic ages.

No new mineral occurrences were found. Mineral occurrences that do exist include: disseminated Cu and Zn associated with iron formation in the Lower Sequence; uraniferous pegmatites with Mo and Th; fracture-fill uranium in pelitic rocks; and corundum in possible paleolateritic weathered basement. The iron formations indicate that hydrothermal activity may have existed while the proposed rift sequence was developing and may have implications for base and precious metal potential. The uranium occurrences may indicate that unconformity-style, basement-hosted uranium mineralization, like that at Eagle Point, may exist in this area. Such uranium mineralization has been found at depths of up to 400 m below surface. Thus at 20 km distance from the edge of the Athabasca Basin, the sub-Athabasca unconformity would be about 500 m above the current lake surface, thus the distance from the edge of the Athabasca Basin and the role of faulting are important factors in the preservation of potential uranium deposits.

Existence of corundum might provide impetus for the search for gem quality corundum (ruby or sapphire) in silica-deficient host rocks, such as aluminous paleolateritic basement rocks or Wollaston calc-silicate rocks. The recent staking of large land tracts of the northeast Wollaston Domain, attest to its attractiveness for mineral exploration.

8. Acknowledgments

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