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# Bedrock mapping in the Walmsley Lake area, southeastern Slave Province, Northwest Territories

S.R. Cairns

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**Abstract:** Bedrock mapping in the Walmsley Lake map sheet (NTS 75 N) was completed during the 2002 field season. Highlights include the identification and delineation of an Archean mafic to ultramafic gabbro-anorthosite suite, and delineation and closure of the Cook volcanic belt. Deformation fabrics in the southern and western portions of the map sheet, where mapping was concentrated in 2002, define broad, open domes and basins, and metamorphic assemblages indicate temperatures above minimum melting conditions. Field relationships suggest the peak of metamorphism and synmetamorphic deformation occurred later in this area than farther north, where greenschist facies assemblages formed before ca. 2605 Ma. Mapping of Proterozoic mafic dykes revealed evidence that at least two dyke swarms may have seen multiple generations of intrusion. The fracture systems that host the mafic dyke swarms may have served as conduits for more than one generation of mantle-derived magma.

**Résumé :** Pendant la saison de travaux sur le terrain 2002, on a complété le levé géologique du substratum rocheux dans la région cartographique de Walmsley Lake (SNRC 75 N). Parmi les faits saillants de cette campagne, mentionnons l'identification et la délimitation d'une suite de gabbro mafique-ultramafique et d'anorthosite de l'Archéen, ainsi que l'établissement des limites latérales et de la terminaison de la ceinture volcanique de Cook. Dans les parties sud et ouest du feuillet cartographique, là où la plupart des travaux de cartographie ont été exécutés en 2002, les fabriques de déformation définissent des dômes et des bassins évasés et ouverts, tandis que les paragenèses métamorphiques indiquent des températures aux conditions minimales de fusion. Les relations de terrain laissent supposer que, dans cette région, le métamorphisme maximal et la déformation concomitante se sont déroulés plus tard qu'au nord, là où des paragenèses du faciès des schistes verts se sont formées avant 2 605 Ma environ. La cartographie de dykes mafiques du Protérozoïque a révélé qu'au moins deux essaims de dykes sont présents et qu'ils sont probablement le résultat de nombreux épisodes d'intrusion. Le magma d'origine mantellique a pu remonter à plus d'une reprise dans les conduits nourriciers que constituent les systèmes de fractures hôtes des essaims de dykes mafiques.

## INTRODUCTION

The Walmsley Lake project is a Targeted Geoscience Initiative (TGI), funded jointly by the C.S. Lord Northern Geoscience Centre and the Geological Survey of Canada. This project, currently in its third and final year, comprises bedrock mapping (MacLachlan et al., 2001a, b, c, d, 2002), isotopic and geochronological studies (MacLachlan et al., 2002; Renaud et al., 2002), magnetotelluric studies (Jones et al., 2001; Jones et al., in press), and teleseismic investigations (Snyder et al., 2002; Snyder et al., in press). The program also supports M.Sc. and Ph.D. theses aimed at resolving the metamorphic history of the area (S. Cairns, M.Sc., University of Alberta; Cairns et al., 2000; Cairns, 2001); the stratigraphy and mineral potential of the Aylmer volcanic belt (J. Renaud, M.Sc., University of Western Ontario; Renaud et al., 2000; Renaud and Duke, 2001; Renaud et al., 2001; Renaud et al., 2002); surficial mapping (F. Hardy, Ph.D., Centre Géoscientifique de Québec); and mafic dyke geochemistry (N. Petrizak, M.Sc., University of Western Ontario). Proterozoic mafic dykes were sampled for baddeleyite isotopic dating in collaboration with J. French, University of Alberta. The project was initiated to provide an improved understanding of the assembly and deformation history of the Slave Craton, through the acquisition of a modern dataset in the southeastern Slave Province for comparison with datasets from the Yellowknife Domain (Bleeker, 1996; Henderson, 1985) and the northern Slave Province (eg. Relf et al., 1999). Fieldwork in 2002 concentrated on the southern portion of the Walmsley Lake map sheet ( Fig. 1). Traverse coverage was designed to outline the extent of supracrustal rocks and investigate an areally extensive plutonic suite. This paper describes the results of 2002 bedrock mapping, and integrates this data with data collected in 2000 and 2001.

## REGIONAL GEOLOGICAL SETTING

The Slave Province is a small Archean craton containing a rock record spanning approximately 1.5 billion years of the Earths' history (Padgham and Fyson, 1992; Isachsen and Bowring, 1994; Bleeker and Davis, 1999). The Slave Province has been divided into eastern and western terrains, based on the presence of Mesoarchean sialic basement in the west and the apparent absence of Mesoarchean basement in the east (Kusky, 1989; Thorpe et al., 1992; Davis and Hegner, 1992; Bleeker et al., 1999). Mesoarchean basement in the western Slave Province is overlain by a ca. 2.85 Ga quartzite–banded iron-formation succession, in turn overlain by ca. 2.73 to 2.70 Ga tholeiitic mafic volcanic rocks that are unconformably overlain by calc-alkaline bimodal volcanic rocks (Isachsen et al., 1991) and a thick sequence of interbedded greywacke and mudstone. Neither the quartzite–banded iron-formation nor the tholeiitic successions are known to occur in the eastern Slave Province. The Neoarchean supracrustal succession of both the eastern and western Slave Province is affected by Neoarchean metamorphism, deformation, and plutonism, which is roughly synchronous across the entire Slave Province at ca. 2630 to 2585 Ma (Davis and Bleeker, 1999).

## GEOLOGY OF THE WALMSLEY LAKE AREA

The Walmsley Lake area comprises minor metavolcanic rocks, overlain and stratigraphically intercalated with interbedded extensive greywacke and mudstone metasedimentary rocks. In the 2002 field area, supracrustal rocks are intruded by pre- to syntectonic and post-tectonic plutonic rocks ranging in composition from cumulate-textured gabbro and anorthosite through syenogranitic pegmatite dykes. Metamorphic grade ranges from sub-biotite (lower to middle greenschist facies) in the northwest (MacLachlan et al., 2001b) to migmatite (upper amphibolite facies) in the south (MacLachlan et al., 2002). Supracrustal rocks in the 2002 map area consist of partially melted paragneiss derived from the greywacke-mudstone succession, which grades into 'schlieric' granite composed of locally derived anatectic melt and abundant paleosome rafts. Amphibolite-grade metavolcanic rocks also occur as rafts within the granitoid rocks. Melt proportions in the interbedded greywacke-mudstone largely reflect the bulk composition of the protolith rather than variations in metamorphic grade. In the 2002 map area, all but the volcanic rock types and the most psammitic of the sedimentary rocks have undergone some degree of partial melting.

## LITHOLOGICAL DESCRIPTIONS

A simplified geological map representing data from all three summers of mapping in the Walmsley Lake area is shown in Figure 2. The descriptions presented in this section focus on those rock types encountered in the 2002 map area. Detailed descriptions of rock units in the 2000 and 2001 map areas can be found in MacLachlan et al. (2001b, 2002) and Renaud et al. (2002).

### *Supracrustal rocks*

Delineation of the full extent of the Cook volcanic belt, as described by MacLachlan et al. (2002), was completed south and east of Cook Lake. The belt forms a thin (approx. 800 m thick), discontinuous succession of mafic volcanic rocks, amphibolite, intermediate volcaniclastic rocks, and allied (?)subvolcanic gabbroic rocks. The Cook volcanic belt northeast of Lac la Prise forms a complex fold interference pattern of close to isoclinal, overturned to recumbent folds modified by open to tight, upright, northeast-trending folds. The Cook volcanic belt continues east toward Artillery Lake as an approximately 1 km wide, continuous, overturned, northward-younging succession of volcanic rocks that extends to the edge of NTS area 75 N. The eastern segment comprises a steeply dipping sequence of pillowed and massive mafic volcanic rocks, overlain by intercalated mafic to intermediate, massive and fragmental volcanic rocks and intermediate volcanogenic sedimentary rocks. The belt is capped by a thin (approx. 40 m thick), discontinuous band of massive felsic volcanic rocks and intermediate to felsic volcanogenic sedimentary rocks. Thin, discontinuous pyrite and pyrrhotite lenses occur within the mafic and intermediate rock units.

The stratigraphy of this section of the Cook volcanic belt is similar to that described for the Aylmer volcanic belt (Renaud et al., 2001; Renaud et al., 2002).

Paragneiss comprises psammitic greywacke, semipelitic material, and neosome (anatectic melt). Primary sedimentary structures, including crossbedding and scour surfaces ( Fig. 3A), can locally be observed in the psammitic beds. Psammitic beds contain the metamorphic assemblage quartz-plagioclase-biotite ±garnet±sillimanite±cordierite. Neosome in psammitic compositions has been injected and forms ragged- or smooth-walled dykes that, at least in part, crosscut primary and/or early tectonic fabrics. Semipelitic sedimentary rocks contain the metamorphic

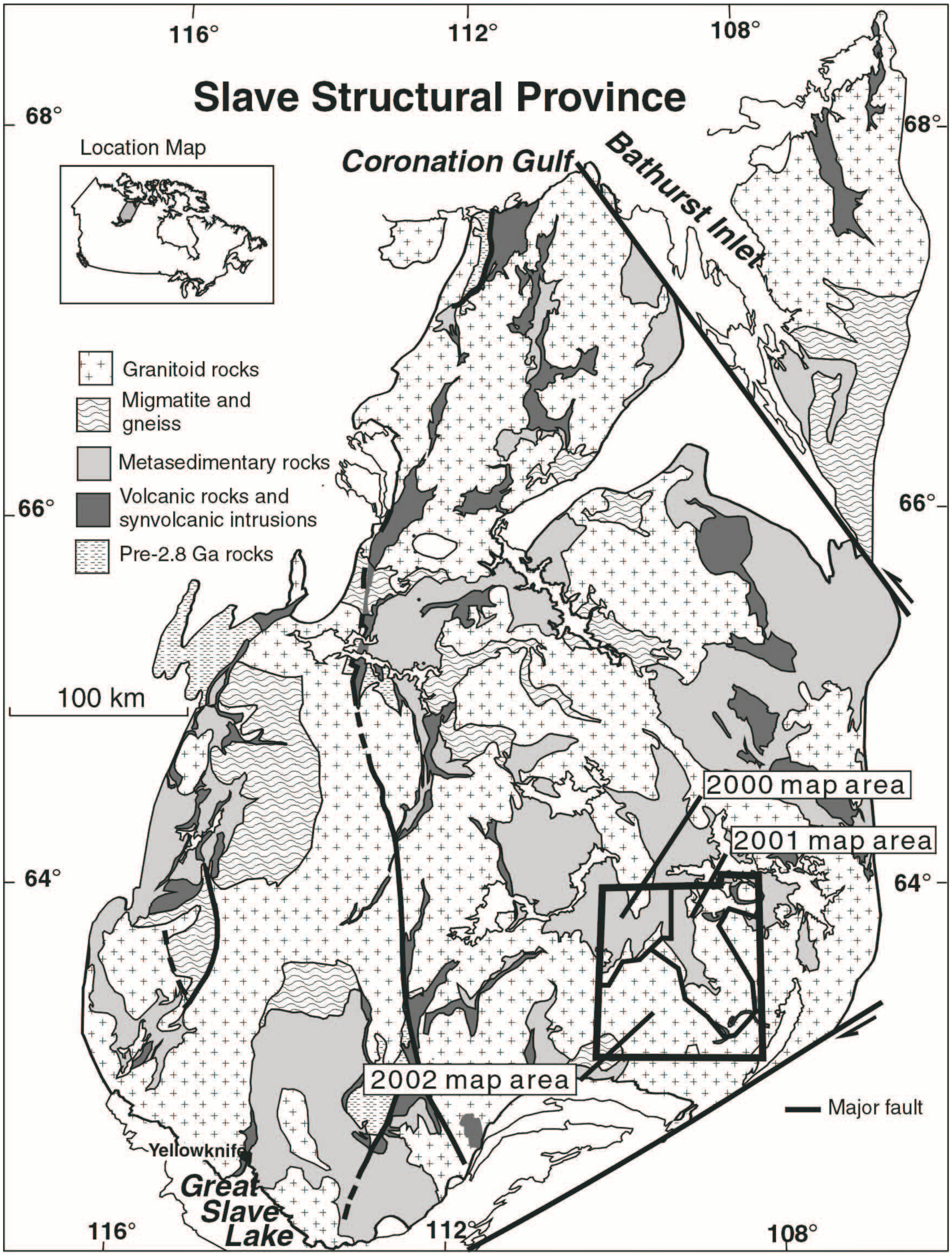


***Figure 1.*** *Simplified geology of the Slave Province, showing the Walmsley Lake area (NTS 75 N).*

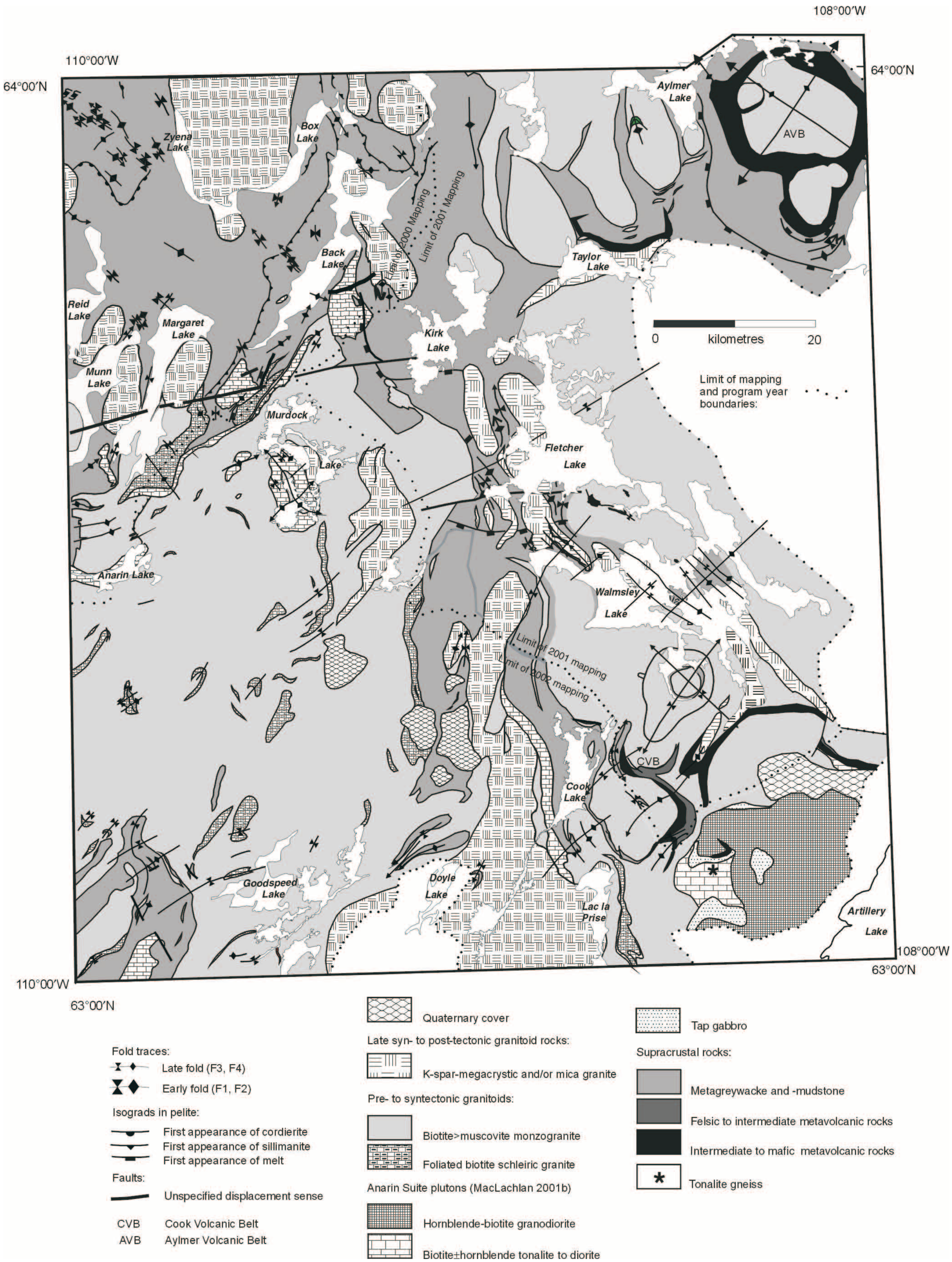


***Figure 2.*** *Simplified geology of the Walmsley Lake area (NTS 75 N), southeastern Slave Province.*

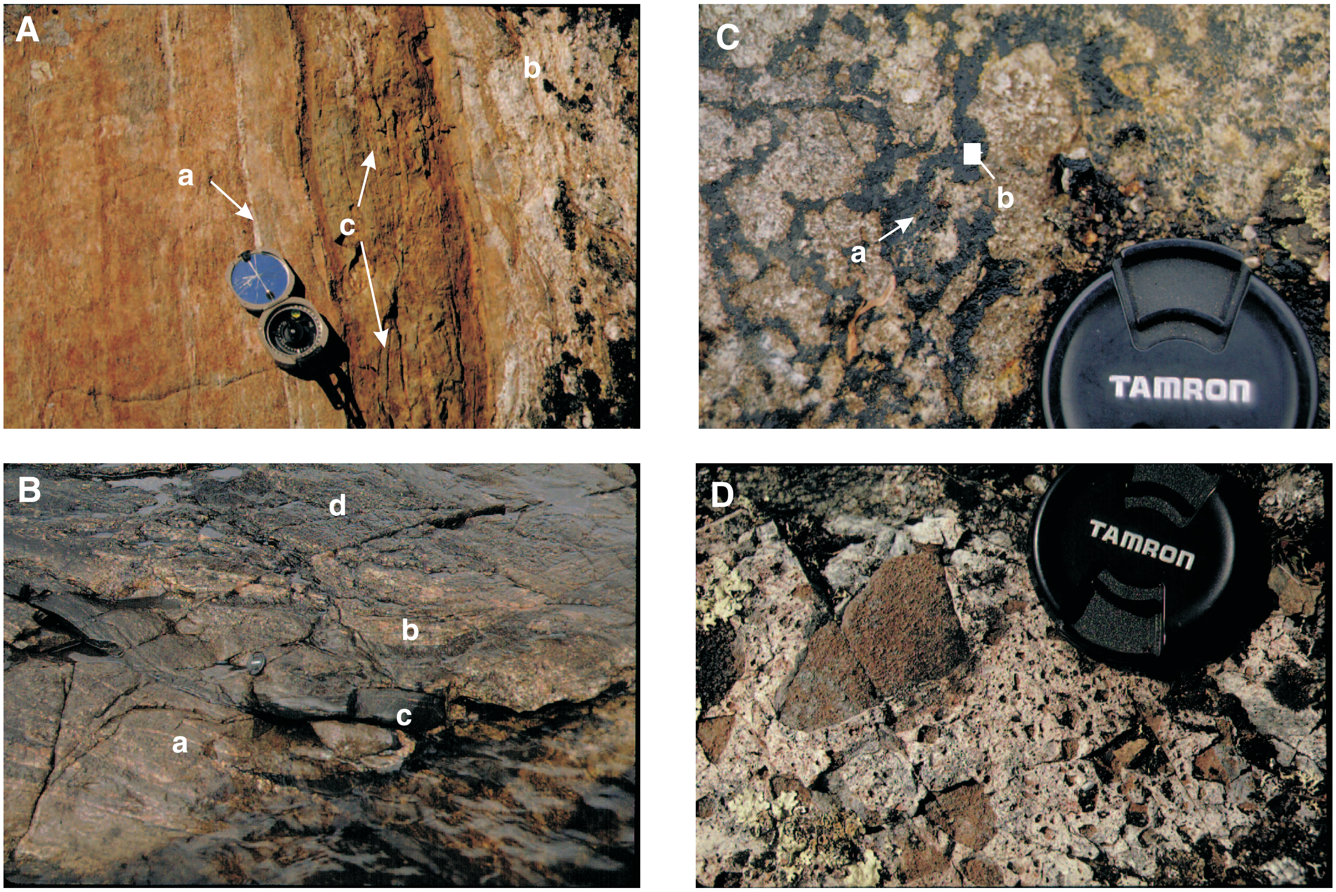


*Figure 3.* ***A)*** *Anatectic greywacke-mudstone with thin, melted pelitic layers (a) and a thick, locally derived, injected granodiorite layer (b). Crossbedded lenses defined by thin, recessive-weathering biotite layers in psammite (c) preserve younging direction (to right). Compass indicates north.* ***B)*** *Medium-grey, isoclinally folded tonalite (a) cut by strongly foliated leucotonalite (b) with deformed (?) mafic dyke or (?) amphibolite xenolith (c), and all units cut by cumulate-textured gabbro (d). Lens cap approximately 5 cm in diameter.* ***C)*** *Coarse-grained, cumulate-textured gabbro with subhedral plagioclase in hornblende matrix. Contains approximately 1% orthopyroxene (a) and clinopyroxene (b) interstitial to hornblende. Lens cap approximately 5 cm in diameter.* ***D)*** *Brecciated diabase dyke trending 022°. Angular diabase fragments are entrained in a fine-grained, leucocratic matrix. Lens cap approximately 5 cm in diameter.*

assemblage quartz-plagioclase-biotite±sillimanite±cordierite (nodular variety)±andalusite±cordierite (iolite)±tourmaline± apatite. Nodular cordierite and andalusite porphyroblasts are partially replaced, to wholly pseudomorphed, by sillimanite and are therefore lower grade relicts. Iolite occurs as variably pinnitized blue-grey crystals of similar size to the groundmass. Neosome occurs as abundant, foliation-parallel blebs and foliation-parallel lenses of anatectic melt, as well as varying proportions of locally derived, injected melt. Anatectic melt within the migmatite varies in composition from haplogranitic through tonalitic. Neosome near the melt-in isograd (first appearance of anatectic material) is commonly monzogranitic. Up-grade of the melt-in isograd, neosome compositions show more variability, ranging from biotite-muscovite± iolite±garnet±sillimanite±tourmaline monzogranite through biotite±muscovite±garnet±iolite tonalite. Of these two endmembers, intermediate granodioritic compositions are most common. Metasedimentary rocks containing melt show a textural and compositional continuum with the schlieric granite (described below).

## *Plutonic rocks*

### Tonalite gneiss

A small outcrop of tonalite gneiss was mapped east of Cook Lake (Fig. 2), in close spatial association with a composite gabbro-anorthosite body, the Tap gabbro (*see* below). The unit is fine-grained, grey tonalite gneiss containing an isoclinally folded foliation and layering defined by biotite alignment and compositional banding. Folds are centimetre to metre scale with steeply dipping, west-northwest-striking axial surfaces. The isoclinal folds have been modified by open folds with steeply dipping, northeast-striking axial planes. The unit contains medium-grained, folded amphibolite lenses, which could be deformed mafic dykes and/or deformed amphibolite xenoliths. The tonalite is also intruded by dykes of less-deformed biotite leucotonalite, granodiorite, and the Tap gabbro (Fig. 3B). The high degree of deformation, presence of deformed amphibolite lenses, and diverse suite of intrusive phases suggest that the tonalite could be basement to the Walmsley supracrustal succession. The unit was sampled for U-Pb zircon geochronology to test this hypothesis.

### Tap gabbro

The Tap gabbro is a medium- to coarse-grained, cumulate-textured hornblende gabbro, with subordinate gabbronorite and anorthosite, located between Lac la Prise and Artillery Lake (Fig. 2, 3C). Plagioclase (labradorite) occurs as subhedral to euhedral crystals, up to 7 cm in length, in coarse-grained domains. Hornblende occurs as small intercumulus crystals, and as large poikilitic overgrowths on small plagioclase and orthopyroxene oikocrysts. The modal percentage of hornblende varies from 2 to 85%; anorthosite makes up only about 5% of the suite. Locally, the unit contains up to 5% combined orthopyroxene+clinopyroxene, with orthopyroxene greater than clinopyroxene. The pyroxenes occur as intercumulus minerals and as oikocrysts within hornblende crystals. The hornblende gabbro phase locally contains up to 3% sulphide minerals (pyrite much greater than chalcopyrite), as fine-grained blebs interstitial to hornblende, or as earlier segregating amoeboid blebs, up to 4 mm, with fine-grained orthopyroxene haloes. This unit is texturally and mineralogically similar to the 2686 ± 3 Ma Clinton-Colden hornblende-gabbro anorthosite (MacFie, 1987; MacFie et al., 1990).

The Tap gabbro intrudes the tonalitic gneiss described above, as well as metavolcanic rocks, and contains abundant rafts of fine-grained amphibolite. Fine- and medium-grained phases have a variably developed foliation, and high-strain zones are common throughout the intrusion. Well exposed areas of the pluton show gradational contacts between texturally and lithologically distinct phases, and do not exhibit a layered appearance. The intrusion is cut by numerous tonalitic to granitic dykes. The close spatial association of the Tap gabbro with metavolcanic rocks suggests that the unit is genetically related to the metavolcanic belt. Gabbro-anorthosite sills also occur on the south side of the Aylmer volcanic belt and at Snap Lake (W. Bleeker, pers. comm., 2002).

### Biotite  hornblende tonalite to diorite

Several plutons of biotite±hornblende tonalite, with subordinate compositions to diorite, occur in close spatial association with supracrustal rocks. These are variably deformed, well foliated, and have a low mafic mineral content. They are texturally and compositionally similar to the Anarin suite (MacLachlan et al., 2001b), with which they are tentatively correlated.

### Hornblende-biotite granodiorite

A large pluton of massive to weakly foliated, hornblende-biotite granodiorite occurs west of Artillery Lake (Fig. 2). The freshest looking areas of the pluton contain little biotite. Biotite, where present, invariably occurs on the margins of hornblende crystals, suggesting that it may not be a primary magmatic mineral. Sparse outcrop obscures contact relationships with most of the surrounding plutonic units; however, the pluton is intruded by biotite monzogranite (*see* below).

### Schlieric granite

Anatectic migmatite exhibits a gradational continuum of melt percentage into granite (sensu lato) of similar composition to the in situ anatectic melt within the migmatite. The schlieric granite unit comprises biotite±muscovite±sillimanite±garnet ±tourmaline monzogranite to tonalite with abundant rafts of greywacke (restite). Schlieric granite occurs as foliation-parallel sheets, on a scale of metres to several kilometres, within the anatectic migmatite and in plutonic phases proximal to the anatectic migmatite. Contacts between the schlieric granite and the partially melted sedimentary rocks vary from sharp to gradational; this is interpreted to reflect a continuum in the abundance of injected anatectic melt that makes up the units.

### Biotite monzogranite

Biotite monzogranite underlies much of the area mapped in 2002. The plutons are largely homogeneous, massive to weakly foliated, medium- to coarse-grained biotite granite to granodiorite. They contain small areas with abundant K-feldspar phenocrysts and megacrysts, and local pegmatitic areas. Their mineralogy is largely uniform, although the granite may locally contain low modal abundances of muscovite and/or garnet. The granite occurs as thick, flat-lying, foliation-parallel sheets and typically contains abundant supracrustal xenoliths close to contacts with metasedimentary or metavolcanic rocks.

### K-feldspar megacrystic granite

Two large plutons of pink-weathering, coarse-grained, biotite±muscovite, K-feldspar porphyritic to megacrystic monzogranite occur east of Murdock Lake and north of Doyle Lake. Micas within the granite do not show a preferred orientation; however, imbrication and/or alignment of the K-feldspar megacrysts is common. The megacryst imbrication is attributed to igneous rather than tectonic processes.

## *Proterozoic dykes*

Four common orientations of Proterozoic mafic dykes occur in the Walmsley Lake area: striking approximately 080°, 050°, 022°, and 340° (all orientations ±10°). The 340° set consists of red-brown–weathering, coarse-grained, massive or locally plagioclase porphyritic, highly magnetic diabase. These dykes are correlated with the 1.27 Ga Mackenzie Dyke Swarm (LeCheminant and Heaman, 1989). The sets striking 022°, 050°, and 080° show a wider range of textural diversity. Dykes trending 022° are light brown weathering with pinkish tinged feldspar, massive, ophitic textured, internally homogeneous, and weakly magnetic. At the northwestern end of Goodspeed Lake, one dyke with this orientation contains abundant internal chilled margins, zones of flow differentiation, and internal breccia zones of coarse-grained diabase fragments infilled with a fine-grained leucogabbro (Fig. 3D). Dykes striking 080° are brown weathering, coarse grained, and contain abundant internal chilled margins, epidote-rich lobate structures (up to 30 cm in diameter), and coarse-grained, pyrrhotite-rich domains. Several massive, structureless examples of the 080° set were also found. Intermediate members with less abundant or less conspicuous structures were not noted between end members of the 022° or 080° sets. Dykes striking 050° are typically brown weathering, fine to coarse grained (depending on width), massive or sparsely porphyritic, moderately magnetic, and have rare internal chilled margins. Several light brown weathering diabase dykes of this orientation were found to contain abundant (approx. 20%) plagioclase phenocrysts in a moderately magnetic matrix. In one case, a porphyritic phase formed a discrete dyke, with well defined chilled margins, intruded wholly within a larger dyke striking 050°.

Textural differences have been interpreted as variations within a single mafic dyke set, and the dyke sets are grouped by orientation and by geochronology on a small fraction of the similarly oriented members (LeCheminant, 1994). The presence of multiple, texturally distinct phases, the absence of intermediate textural phases, and the presence of chilled margins on a texturally distinct phase within an enclosing dyke all suggest the possibility of unrecognized, temporally discrete, multiple intrusive events. Fracture systems hosting mafic-dyke swarms potentially served as conduits for more than one generation of mantle-derived magma. Sampling was carried out in 2002 to obtain material for baddeleyite dating on several mafic dykes of the 022°, 050°, and 080° sets. This work will be carried out in collaboration with J. French from the University of Alberta.

## STRUCTURAL ELEMENTS

Structures belonging to the D1 and D2 deformations are preserved mainly in the northern, greenschist and lower amphibolite grade portions of the Walmsley Lake sheet (MacLachlan et al., 2001b; Renaud et al., 2002). Both D1 and D2 comprise upright isoclinal folds and associated cleavages. The S2 cleavage is defined by the alignment of peak metamorphic minerals within metasedimentary rocks. The F1 folds in metasedimentary rocks were recognized by reversals in younging direction, where S2 cleavage maintains the same angular relationship with bedding across both limbs. The S1 cleavage is sparsely preserved as a crenulation fabric, and as aligned inclusion trails in peak metamorphic porphyroblasts. The S2 cleavage is axial planar to isoclinal folds of bedding F2. Peak metamorphic minerals often define a strong lineation parallel to F2 fold axes (MacLachlan et al., 2001b). At higher metamorphic grade, the predominant style of deformation is overturned to recumbent, tight to isoclinal (F3) folds with a locally developed axial-planar cleavage (MacLachlan et al., 2002). These are readily observed as mesoscopic and map-scale folds defined by granitoid sheets within migmatite. Open, upright, northeast- and northwest-trending F4 folds, and local development of an upright S4 fabric, produce plunge reversals of F3 folds and folding of F3 axial planes, and are largely responsible for the gross dome-and-basin geometry of the map sheet (MacLachlan et al., 2002).

Structural studies carried out in 2002 support the structural interpretation of MacLachlan et al. (2002). A weak S4 cleavage, defined by biotite, is locally preserved as a steeply dipping fabric within migmatite; the upright fabric was observed crenulating a shallow-dipping S3 fabric southwest of Goodspeed Lake. Large areas of plutonic rocks in the southern part of the map sheet are variably foliated, and typically do not contain multiple generations of fabric development. In areas with abundant entrained supracrustal xenoliths, large-scale structures can be traced through plutonic units using fabric relationships and mesoscopic-scale fold asymmetries within the supracrustal screens.

## MINERAL POTENTIAL

The recognition of the Tap gabbro, a cumulate-textured mafic complex with up to 3% intermediate- and late-crystallizing iron- and copper-sulphide minerals, suggests potential for magmatic nickel–copper–platinum-group element deposits. Results of grab-sample assays of the Tap gabbro are pending. Diamond potential remains high, and numerous diamond-exploration companies are working in the area. Several small gossans in metavolcanic or metasedimentary rocks and shear zones in plutonic rocks have returned no significant assay results. Although initial assays are disappointing, the Aylmer and Cook volcanic belts remain targets for volcanogenic massive-sulphide and shear zone–hosted gold deposits.

## DISCUSSION

New data collected during mapping, quantitative and qualitative P-T determinations (Cairns, 2001), and geochronology (MacLachlan et al., 2002; Renaud et al., 2002) all indicate a protracted metamorphic history in the Walmsley Lake area. In the northern part of the map sheet, deformation and timing relationships are similar to those in the Yellowknife Domain, where D1 and D2 events are constrained to 2650 to 2634 Ma and ca. 2600 to 2590 Ma, respectively (Davis and Bleeker, 1999; Bethune et al., 1999). In the northwestern Walmsley Lake area, D2 is constrained to post ca. 2614 Ma (MacLachlan et al., 2002). Similar to the Yellowknife Domain, high-temperature metamorphism is driven by thermal aureoles of granitoid plutons overprinting a regional crustal thermal regime. At the upper crustal levels exposed in the northern Walmsley Lake sheet, metamorphism is largely attributable to discrete plutonic aureoles. Metamorphic and structural style change gradationally southward. At the mid-crustal levels exposed in the central and south portions of the Walmsley Lake sheet, the ca. 2585 Ma (Schultz, 2002; MacLachlan et al., 2002) peak metamorphic age is much younger than in the north. Coincident with the younger metamorphic ages, the main deformation style switches from upright, isoclinal folds of bedding, with a penetrative axial-planar fabric, to overturned to recumbent isoclinal folds of the main foliation (S2) and compositional layering, with weakly developed, local, axial-planar cleavage.


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## REFERENCES


**Bethune, K.M., Villeneuve, M., and Bleeker, W.**
1999: Laser $^{40}Ar/^{39}Ar$ thermochronology of Archean rocks in the Yellowknife Domain, southwestern Slave Province: insights into the cooling history of an Archean granite greenstone terrane; Canadian Journal of Earth Sciences, v.7, p.1189–1206.

**Bleeker, W.**
1996: Thematic structural studies in the Slave Province, Northwest Territories: the Sleepy Dragon Complex; Geological Survey of Canada, Current Research 1996-C, p. 37–48.

**Bleeker, W.B. and Davis, W.J.**
1999: The 1991–1996 NATMAP Slave Province Project: introduction; Canadian Journal of Earth Sciences, v. 36, p. 1033–1042.

**Bleeker, W., Ketchum, J.W.F., Jackson, V.A., and Villeneuve, M.E.**
1999: The central Slave Basement Complex, Part 1: its structural topology and autochthonous cover; Canadian Journal of Earth Sciences, v. 36, p. 1083–1109.

**Cairns, S.R.**
2001: Metamorphism and porphyroblast timing relations in meta-turbidites in the Walmsley Lake area, Northwest Territories; 29th Yellowknife Geoscience Forum, Abstracts Volume, p. 66–67. Cairns, S.R., Relf, C., and MacLachlan, K.
2000: Field relationships of metasedimentary rocks in the Walmsley Lake area, parts of NTS 75 N/5, /11, /12, /13, /14); 28th Yellowknife Geoscience Forum, Abstracts Volume, p. 66–67.

**Davis, W.J. and Bleeker, W.**
1999: Timing of plutonism, deformation and metamorphism in the Yellowknife Domain, Slave Province, Canada; Canadian Journal of Earth Sciences, v.36, p.1169–1187.

**Davis, W.J. and Hegner, E.**
1992: Neodymium isotopic evidence for tectonic assembly of late Archean crust in the Slave Province, Northwest Canada; Contributions to Mineralogy and Petrology, v.111, p. 307–313.

**Henderson, J.B.**
1985: Geology of the Yellowknife–Hearne Lake area, District of MacKenzie: a segment across an Archean basin; Geological Survey of Canada, Memoir 414, 135 p. and one map at 1:250 000 scale.

**Isachsen, C.E. and Bowring, S.A.**
1994: Evolution of the Slave Craton; Geology, v. 22, p. 917–920.

**Isachsen, C.E., Bowering, S.A., and Padgham, W.A.**
1991: U-Pb zircon geochronology of the Yellowknife volcanic belt and subjacent rocks, NWT, Canada: new constraints on the timing and duration of greenstone belt magmatism; Journal of Geology, v.99, p.55–67.

**Jones, A.G., Lezaeta, P., Ferguson, I., Chave, A., Evans, R., Garcia, X., and Spratt, J.**
in press: The electrical structure of the Slave craton; *in* A Tale of Two Cratons, Proceedings of the Slave-Kaapvaal Workshop, September 5–9, 2001, Merrickville, Ontario; Lithos Special Issue.

**Jones, A.G., Snyder, D., and Spratt, J.**
2001: Magnetotelluric and teleseismic experiments as part of the Walmsley Lake project, Northwest Territories: experimental designs and preliminary results; Geological Survey of Canada, Current Research 2001-C6, 16 p.

**Kusky, T.M.**
1989: Accretion of the Archean Slave province; Geology, v.17, p.63–68.

**LeCheminant, A.N.**
1994: Proterozoic diabase dyke swarms, Lac de Gras and Aylmer Lake areas, District of Mackenzie, Northwest Territories; Geological Survey of Canada, Open File 2975, one map at 1:250 000 scale.

**LeCheminant, A.N. and Heaman, L.M.**
1989: Mackenzie igneous events, Canada: Middle Proterozoic hotspot magmatism associated with ocean opening; Earth and Planetary Science Letters, v.96, p.38–48.

**MacFie, R.I.**
1987 : The Clinton-Colden hornblende-gabbro anorthosite intrusion, Artillery Lake map area, District of MacKenzie; *in* Current Research, Part A; Geological Survey of Canada, Paper 87-1A, p. 681–698.

**MacFie, R.I., van Breeman, O., and Loveridge, W.D.**
1990: Late Archean U-Pb zircon age for the Clinton-Colden gabbro-anorthosite intrusion, eastern Slave Province, District of MacKenzie, Northwest Territories; *in* Radiogenic Age and Isotopic Studies: Report 3; Geological Survey of Canada, Paper 89-2, p .45–48.

**MacLachlan, K., Relf, C., Cairns, S., Renaud, J., Mills, A., and Davis, W.J.**
2001a: New mapping and U/Pb Geochronology in the Walmsley Lake area: post-metamorphic crustal overturning in the southeastern Slave Province? 29th Yellowknife Geoscience Forum, Abstract Volume, p. 50–51.

**MacLachlan, K., Relf, C., Cairns, S., Hardy, F., and Davis, W.J.**
2001b: New multidisciplinary geological investigations in the Walmsley Lake area, southeastern Slave Province, Northwest Territories; Geological Survey of Canada, Current Research 2001-C4, 10 p.

**MacLachlan, K., Relf, C., Cairns, S., Renaud, J., Hardy, F., and Davis, W.J.**
2001c: New results of bedrock and surficial mapping components of the Walmsley Lake TGI project, southeastern Slave Province, Northwest Territories; 29th Yellowknife Geoscience Forum, Abstracts Volume, p. 49–50.

**MacLachlan, K., Relf, C., and Cairns, S.**
2001d: Preliminary geology map of the Back Lake area, parts of NTS 75N/5, /11, /12, /13 and /14; Indian and Northern Affairs Canada, Northwest Territories Geology Division, EGS Open File 2001-02, map at 1:125 000 scale.

**MacLachlan, K., Relf, C., Cairns, S., Renaud, J., and Mills, A.**
2002: New bedrock mapping and preliminary U/Pb geochronology in the Walmsley Lake area, southeastern Slave Province, Northwest Territories; Geological Survey of Canada, Current Research 2002-C1, 10 p.

**Padgham, W.A. and Fyson, W.K.**
1992: The Slave Province: a distinct Archean craton; Canadian Journal of Earth Sciences, v.29, p. 2072–2086.

**Relf, C., Sandeman, H.A, and Villeneuve, M.E.**
1999: Tectonic and thermal history of the Anialik River area, northwestern Slave Province, Canada; Canadian Journal of Earth Sciences, v. 36, p. 1207–1226.

**Renaud, J. and Duke, N.**
2001: Stratagraphic reconstruction and geochemistry of the Aylmer Lake volcanic belt, east-central Slave Province, Northwest Territories; 29th Yellowknife Geoscience Forum, Abstracts Volume, p. 62–63.

**Renaud, J., Armstrong, K., Gochnauer, K., and Duke, N.**
2000: The stratigraphy and economic potential of the Aylmer Lake volcanic belt, central Slave Province, Northwest Territories; 28th Yellowknife Geoscience Forum, Abstracts Volume, p. 56–57.

**Renaud, J., MacLachlan, K., and Cairns, S.**
2002: Stratigraphy and structure of the Aylmer Lake volcanic belt and surrounding metasedimentary rocks, Northwest Territories; Geological Survey of Canada, Current Research 2002-C2, 11 p.

**Renaud, J., MacLachlan, K., Relf, C., and Duke, N.**
2001: Volcanic stratigraphy and mineral potential of the Aylmer dome, southeastern Slave Province, Northwest Territories; Geological Survey of Canada, Current Research 2001-C5, 16 p.

**Schultz, M.**
2002: Application of Th–U–total Pb chemical dating by electron microprobe to a polygenetic late Archean terrane, Walmsley Lake area, Slave Province, Northwest Territories, Canada; B.Sc. thesis, University of Alberta, 39 p.

**Snyder, D.B., Asudeh, I., Darbyshire, F., and Drysdale, J.**
2002: Field-based feasibility study of teleseismic surveys at high northern latitudes, Northwest Territories and Nunavut; Geological Survey of Canada, Current Research 2002-C3, 10 p.

**Snyder, D.B., Bostock, M.G., and Lockhart, G.D.**
in press: Two anisotropic layers in the Slave Craton; *in* A Tale of Two Cratons, Proceedings of the Slave-Kaapvaal Workshop, September 5–9, 2001, Merrickville, Ontario; Lithos, Special Issue.

**Thorpe, R.I., Cumming, G.L., and Mortensen, J.K.**
1992: A significant Pb isotope boundary in the Slave Province and its probable relationship to ancient basement in the western Slave Province; *in* Project Summaries, Canada–Northwest Territories Mineral Development Agreement 1987–1991; Geological Survey of Canada, Open File 2484, p. 179–184.

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Geological Survey of Canada Project 000013