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Quartzite sequences and their relationships, Woodburn Lake group, western Churchill Province, Nunavut[1]

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Abstract: Archean orthoquartzite units of the Woodburn Lake group are part of a diverse volcanic and volcanogenic sedimentary package, in contrast to the cratonic sedimentary rocks of the Paleoproterozoic Amer group. Woodburn Lake quartzite is interbedded with pyritic quartz-pebble conglomerate, chloritoid-kyanite slate, and iron-formation, none of which have been described from the Amer group. Pyritic conglomerate presents a potential for paleoplacer and modified placer gold, which could have had a local source in underlying mineralized volcanic and sedimentary rocks. The presence of pyritic conglomerate is consistent with deposition in the reducing atmosphere characteristic of Archean time and may prove to be a diagnostic tool for discriminating Archean from Paleoproterozoic quartzite successions in the region. Archean ultramafic rocks and gossanous iron-formation can be traced discontinuously south of the Amer belt, considerably extending the strike-length of the suite, which is known to host gold occurrences.

Résumé : Des unités d'orthoquartzite archéen du groupe de Woodburn Lake font partie d'un assemblage sédimentaire volcanique et volcanogène varié, contrairement aux roches sédimentaires cratoniques du Groupe d'Amer du Paléoprotérozoïque. Le quartzite du groupe de Woodburn Lake est interlité avec du conglomérat pyriteux à cailloux de quartz, de l'ardoise à chloritoïde et disthène et de la formation de fer; aucune de ces unités n'a été décrite dans le groupe d'Amer. Le conglomérat pyriteux à cailloux de quartz présente un potentiel pour l'or de paléoplacers et de placers modifiés qui pourrait avoir comme source locale les roches minéralisés volcaniques et sédimentaires sous-jacentes. La présence de conglomérat pyriteux est compatible avec une sédimentation sous atmosphère réductrice caractéristique de l'Archéen et pourrait servir comme outil diagnostique pour différencier les successions de quartzites archéennes des successions paléoprotérozoïques dans la région. On peut suivre de façon discontinue les formations de fer enrichis et les roches ultramafiques archéennes au sud de la ceinture d'Amer, ce qui prolonge considérablement l'étendue longitudinale de cette suite renfermant des indices aurifères.

[1] Contribution to the Western Churchill NATMAP Project

INTRODUCTION

An ongoing debate concerns the ages and depositional and tectonic relationships of supracrustal rocks throughout the Rae Province (western Churchill Province, Fig. 1) north of the Baker Lake basin. The tilted, but undeformed, ca. 1.85 Ga continental deposits of the Dubawnt Supergroup (Gall et al., 1992) limit the minimum age of pervasive ductile deformation in the region. Deformed cratonic cover represented by the Amer group is generally accepted to be of Paleoproterozoic age based on stratigraphic comparisons with the ca. 2.45–2.1 Ga Hurwitz Group (Aspler and Chiarenzelli, 1997) to the south, and on locally preserved unconformable relationships to underlying Archean granite (Tella et al., 1984; LeCheminant and Roddick, 1991). Between the Amer belt and the Baker Lake basin, deformed volcanic and sedimentary rocks of the Woodburn Lake and Ketyet River groups comprise bimodal komatiite-felsic volcanic assemblages, mafic, intermediate and felsic volcanic and volcaniclastic rocks, orthoquartzite, slate, wacke and chemical sedimentary rocks. The age and stratigraphic position of these rocks, particularly of orthoquartzite units, which have many similarities to those of the Amer group, have been more problematic. If Archean ages are established for all the units presently assigned to the Woodburn Lake and Ketyet River groups, then these will represent the most extensive accumulations of Archean quartzite and conglomerate in the Canadian Shield (Donaldson and de Kemp, 1998).

Quartzite units dominate the Woodburn Lake and Ketyet River groups in three main areas. 1) North of Meadowbank River (Fig. 2), quartzite was interpreted to be of Archean age by Tella (1994) in part based on its association with komatiitic volcanic rocks. 2) South of the Meadowbank River, the depositional age of quartzite units between Ukalik Lake and Third Portage Lake is bracketed by ca. 2.81 Ga detrital zircon and by 2.6–2.62 Ga granite and porphyry intrusions (Ashton, 1988; Davis and Zaleski, 1998). 3) North of Whitehills Lake, and toward Quoich River (Fig. 1), quartzite units of the Ketyet River group were interpreted to be of Archean age by Schau (1983) and Taylor (1985) based on comparisons with the ca. 2.8 Ga Prince Albert group. All three of these areas were mapped from 1996–1999 as part of the Woodburn Project (Zaleski et al., 1997a, b; 1999a, b, c, d). In this paper, we focus on quartzite and associated units extending from the southern margin of the Amer belt to Third Portage Lake.

GEOLOGY OF THE WOODBURN LAKE GROUP

The name 'Woodburn Lake group' was applied informally to metavolcanic and metasedimentary rocks in the southern Amer Lake map area (NTS 66 H) that were interpreted to be distinct from, and older than, the Paleoproterozoic Amer group (Ashton, 1981) (Fig. 1). In the Baker Lake map area (NTS 56 D) south of Tehek Lake and east of Whitehills Lake, Schau (1983) applied the name 'Ketyet River group' to a similar succession of rocks which he interpreted to be correlative with the Woodburn Lake group.

The Woodburn Lake group comprises four main lithostratigraphic associations. 1) Spinifex-textured komatiitic flows interlayered with quartz-porphyritic felsic volcanic rocks and iron-formation underlie large areas northwest of the Meadowbank River (Zaleski et al., 1999c, d) and west of Pipedream Lake (Kjarsgaard et al., 1997; Zaleski et al., 1997a, b) (Fig. 2). 2) Felsic, intermediate, and mafic volcanic rocks, and associated volcanogenic wacke, iron-formation, and cherty tuff are extensively distributed along the Meadowbank River and south to Third Portage Lake. The distribution and relationships suggest more than one cycle of volcanism and associated sedimentation, possibly of significantly different ages. The volcanic rocks comprise plagioclase-pyroxene-porphyritic intermediate to mafic flows and possible subvolcanic intrusions, and felsic to intermediate volcanic rocks, including pyroclastic or hydroclastic rocks transitional to reworked sedimentary deposits. Northeast of Third Portage Lake, felsic lapilli tuff associated with wacke gave a U-Pb zircon age of 2710 +3.5/-2.1 Ma (Davis and Zaleski, 1998), and similar ages have been derived from felsic rocks associated with komatiite units (W.J. Davis, unpub. data, 1998). 3) Orthoquartzite is interbedded with oligomictic and minor polymictic conglomerate, slate, and phyllite. 4) Arkosic wacke interbedded with thin iron-formation and associated with minor quartzite and possible volcanic rocks are exposed in the Amarulik structural dome between Third Portage Lake and the Ketyet River group on Whitehills Lake (Zaleski et al., 1999a, b) (Fig. 1).

Three or four phases of ductile deformation (D_1–D_4) affected the Woodburn Lake group after the intrusion of 2620 +3/-2 Ma quartz-feldspar porphyry (Davis and Zaleski, 1998), and 2.62 Ga granite (Ashton, 1988). The deformation sequence is a revision of the three-phase history of Zaleski et al. (1997a, b). In addition, evidence is accumulating in support of deformation that may have predated the emplacement of granite (*see* section titled 'Ukalik Lake to Third Portage Lake').

The dominant regional structural grain trends east-northeasterly to northeasterly, defined by southeastward-dipping schistosity and tight to isoclinal, F_1 and F_2 folds (Fig. 2, 3). The fold generations are distinguished based on their relationship to the dominant schistosity. The dominant schistosity is axial planar to F_1 folds, whereas F_2 folds deform layer-parallel foliation and are associated with crenulation cleavage and local transposition of S_0/S_1. High-strain zones are commonly developed on the limbs of F_1 and F_2 folds. The similarity in style and orientation of D_1 and D_2 structures suggests that they may represent phases of a single progressive deformation event. D_3 structures comprise mesoscopic, open to tight folds of schistosity that verge toward the southeast and have subhorizontal to shallow southwesterly plunges. The folds are associated with crenulation cleavage and a nearly ubiquitous crenulation lineation. While minor D_3 structures are widely distributed, their association with any map-scale structures is uncertain. D_4 structures comprise open to tight, northerly to northeasterly trending, upright

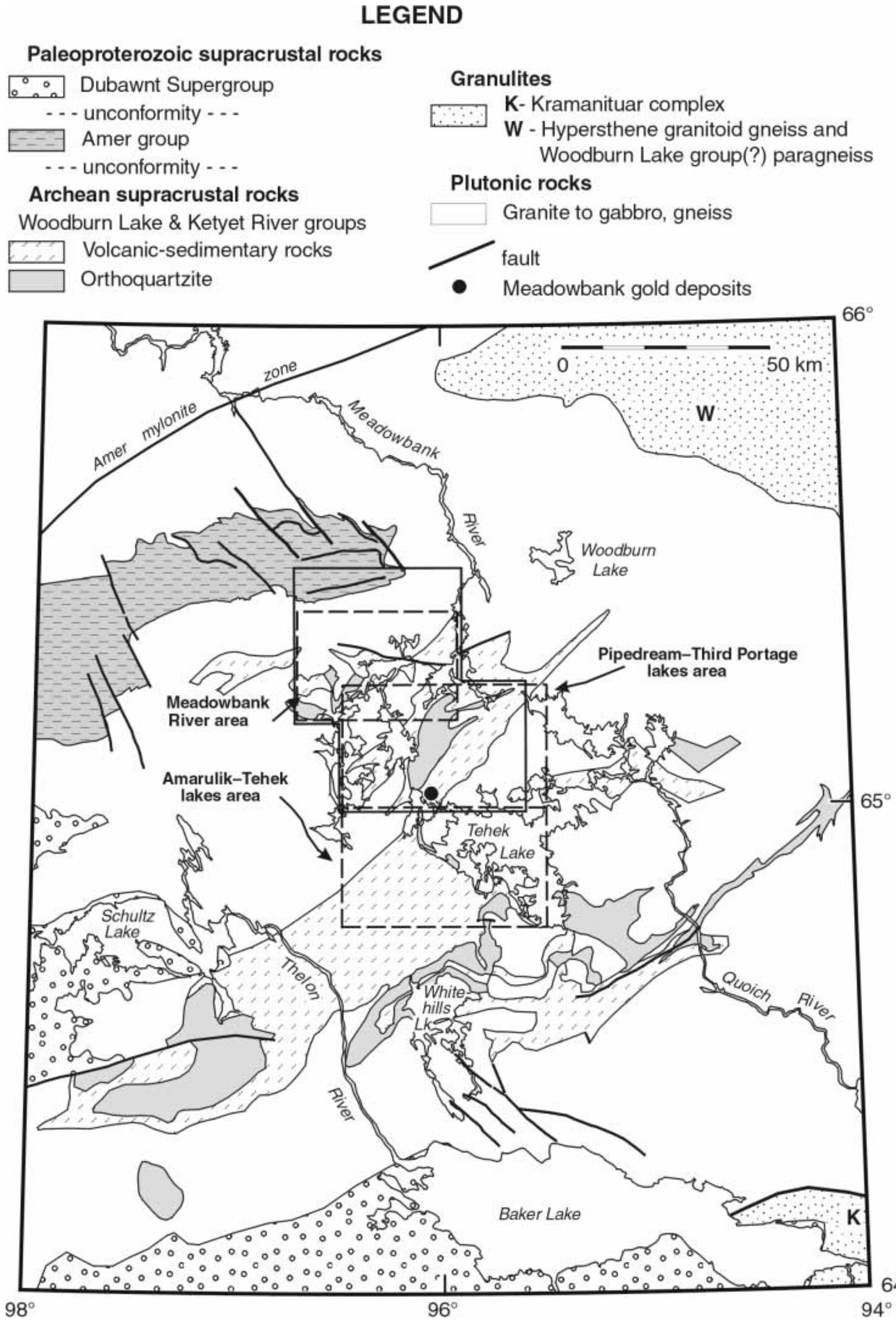


Figure 1. Regional setting of the Woodburn Lake and Ketyet River groups in the Amer Lake (NTS 66 H), Woodburn Lake (NTS 56 E), Baker Lake (NTS 56 D) and Schultz Lake (NTS 66 A) areas. The Ketyet River group includes quartzite and associated rocks from the Thelon River to the Quoich River. Dashed rectangles outline maps produced by the Woodburn Project, including the Meadowbank River area (Zaleski et al., 1999c, d), the Pipedream–Third Portage lakes area (Zaleski et al., 1997a, b) encompassing the Meadowbank gold deposits, and the Amarulik–Tehek lakes area (Zaleski et al., 1999a, b). The area of Fig. 2 is shown by a continuous line. The regional map is adapted from an unpublished compilation (L. Wilkinson, 1997) based on Donaldson (1966), Schau (1983), Fraser (1988), Taylor (1985), Tella (1994), and a compilation map in progress for the Schultz Lake area based on unpublished mapping by GSC geologists.

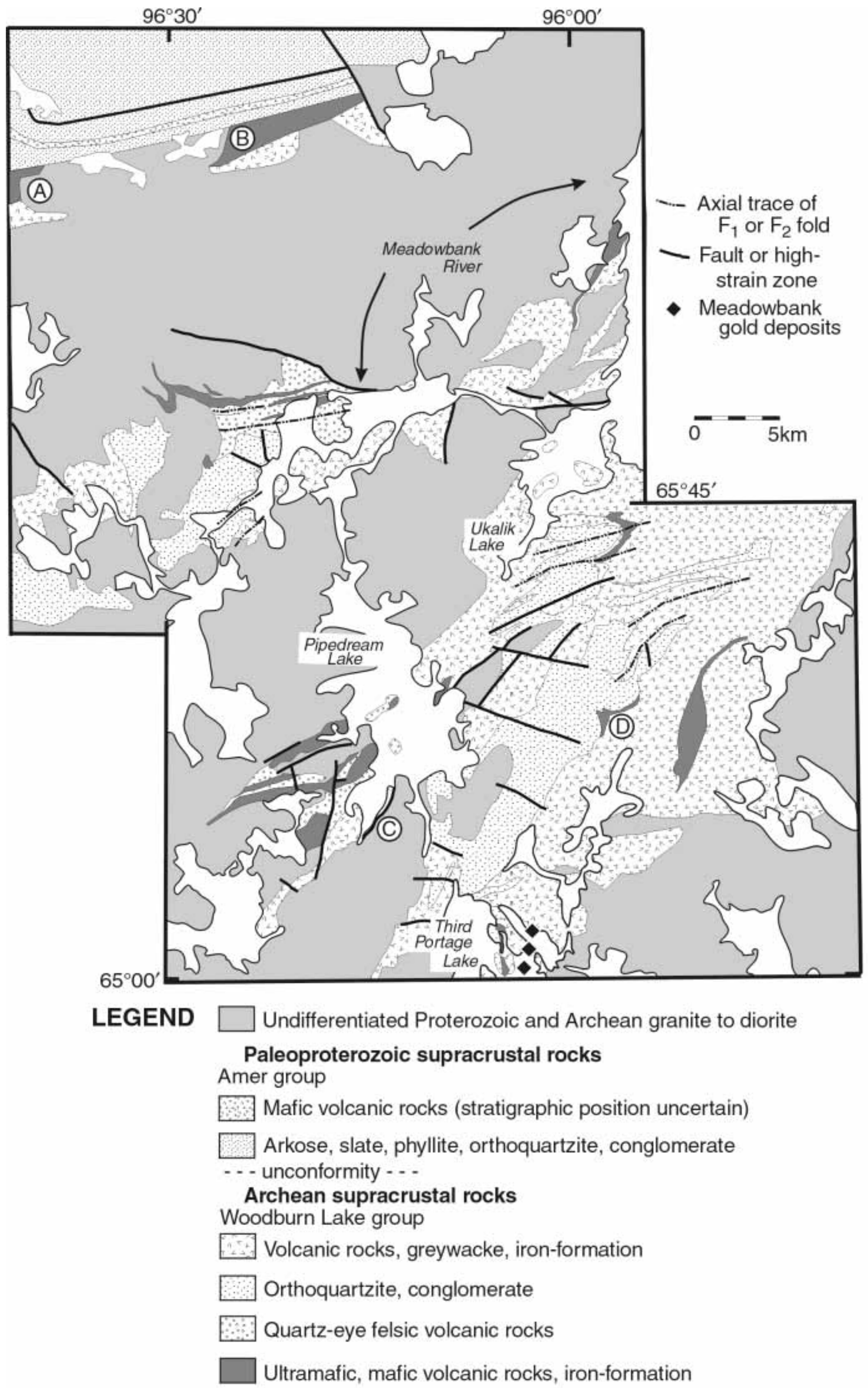


Figure 2. *Generalized geology of the Woodburn Lake group from Third Portage Lake to the Amer belt. The geology of the Amer group is based partly on Patterson (1986). The circled letters refer to localities discussed in the text.*

Figure 3. *Aerial view looking northeasterly at F_1 and F_2 folds of interbedded quartzite and slate south of Ukalik Lake.*

folds of schistosity, earlier fold generations, and crenulation cleavage and lineations. F_4 folds and fold interference patterns are defined by iron-formation in the vicinity of the Meadowbank gold deposit (Fig. 2) and, in this area, F_4 folds are associated with development of crenulation cleavage and lineation.

Regional metamorphic grade varies from upper greenschist facies north of Third Portage Lake (chloritoid-kyanite-muscovite-chlorite, Ashton, 1988; Zaleski et al., 1997a), to amphibolite facies along the northern Meadowbank River (amphibole-garnet, Zaleski et al., 1999d) and south of Third Portage Lake (amphibole-garnet-biotite, Zaleski et al., 1999b). Upper greenschist- to lower amphibolite-facies assemblages have been reported south of Whitehills Lake (chloritoid-staurolite, Schau, 1983). Porphyroblasts typically overgrow the dominant schistosity. Metamorphic grade increases to upper amphibolite facies (sillimanite–K-feldspar–muscovite, Schau, 1983; sillimanite-garnet-biotite, Zaleski et al., 1999b) near Tehek Lake.

MEADOWBANK RIVER TO AMER BELT

Northwest of the Meadowbank River, crossbedded orthoquartzite unconformably overlies a bimodal package of interlayered komatiite and quartz-plagioclase-porphyritic felsic volcanic flows, and is structurally overlain by mafic to intermediate volcanic flows and interbedded felsic tuff, chert and iron-formation (Zaleski et al., 1999a, c). This area was revisited in an effort to further constrain structural and stratigraphic relationships (Fig. 4, locality A). Basal conglomerate locally marks the contact between quartzite and both felsic and ultramafic volcanic rocks. Uranium-lead dating of zircon from the underlying volcanic flows (W.J. Davis, unpub. data, 1999) shows that the volcanic rocks are about 80 million years younger than the previously reported imprecise age of 2.8 Ga (Tella et al., 1985). Preliminary results from the basal conglomerate show that the youngest detrital zircons have ages similar to the volcanic substrate (W.J. Davis, unpub. data, 1999). Hence, despite zones of high strain along parts of the contact, the field interpretation of an erosional depositional relationship is supported by geochronology. The unconformable contact is repeated about easterly trending, doubly plunging folds (Zaleski et al., 1999c, d). The folds are D_2 structures, based on deformed schistosity in volcanic rocks and quartzite. The unconformity and fold traces are cut by coarse-grained, equigranular, alkali granite that shows a foliation only immediately adjacent to the contact (within about 1 m).

The quartzite is interbedded with minor oligomictic conglomerate that locally has a gossanous pyritic matrix which, in some cases, also contains fuchsitic mica and kyanite. In some beds, quartz granules resemble the quartz eyes in the underlying felsic volcanic rocks. In two areas, conformable or nearly conformable mafic layers, about 50–350 m thick, are present in the quartzite. The mafic layers have fine- to coarse-grained ophitic textures with local strain transitions to a mafic schist. The southern layer has been interpreted as a sill or a dyke (Zaleski et al., 1999c, d), and it may be that the northern layer has a similar origin. To the east and south, near the stratigraphic top of the quartzite, quartz wacke is interbedded with thinly layered chloritic schist and chert-hematite-magnetite iron-formation (Fig. 4, locality B). Mafic to intermediate volcanic rocks and quartz-eye schists interpreted to lie at the base of the upper volcanic and sedimentary succession are exposed adjacent to quartzite. In one area (Fig. 4, locality C), conglomerate containing quartz eyes and clasts of chert, fuchsitic quartzite, and hematitic iron-formation is present between the quartzite and the volcanic rocks, suggesting an unconformable relationship with the upper succession. The distribution of units along the Meadowbank River shows that the contact cuts down into the quartzite to the north, consistent with either a continuation of the unconformity or a fault.

A large area of plutonic rocks extends north from the Meadowbank River supracrustal suite to the Amer belt (Fig. 2). The lowermost stratigraphic unit of the Amer group exposed along the southern margin is typically a quartz-clast conglomerate with a muscovitic matrix and minor amounts of green mica. Rare occurrences of polymictic conglomerate contain granite and mafic clasts (Tippett and Heywood, 1978). Archean basement rocks structurally overlie the quartzite and conglomerate, and the contact is marked by a prominent scarp of quartzite. The contact has been interpreted as a high-angle reverse fault (Patterson, 1986), but local C-S fabrics in sheared conglomerate and quartzite are consistent with a south-side-down (basement-side-down) sense of movement.

South of the Amer belt (Fig. 2, locality A), massive ultramafic rocks (Annesley, 1989) are interlayered with medium- to coarse-grained gabbro, possibly sills. The ultramafic rocks show polyhedral jointing (Fig. 5a) but, in contrast to the spinifex-textured flows near the Meadowbank River, only one instance of possible spinifex was observed. Schistose and

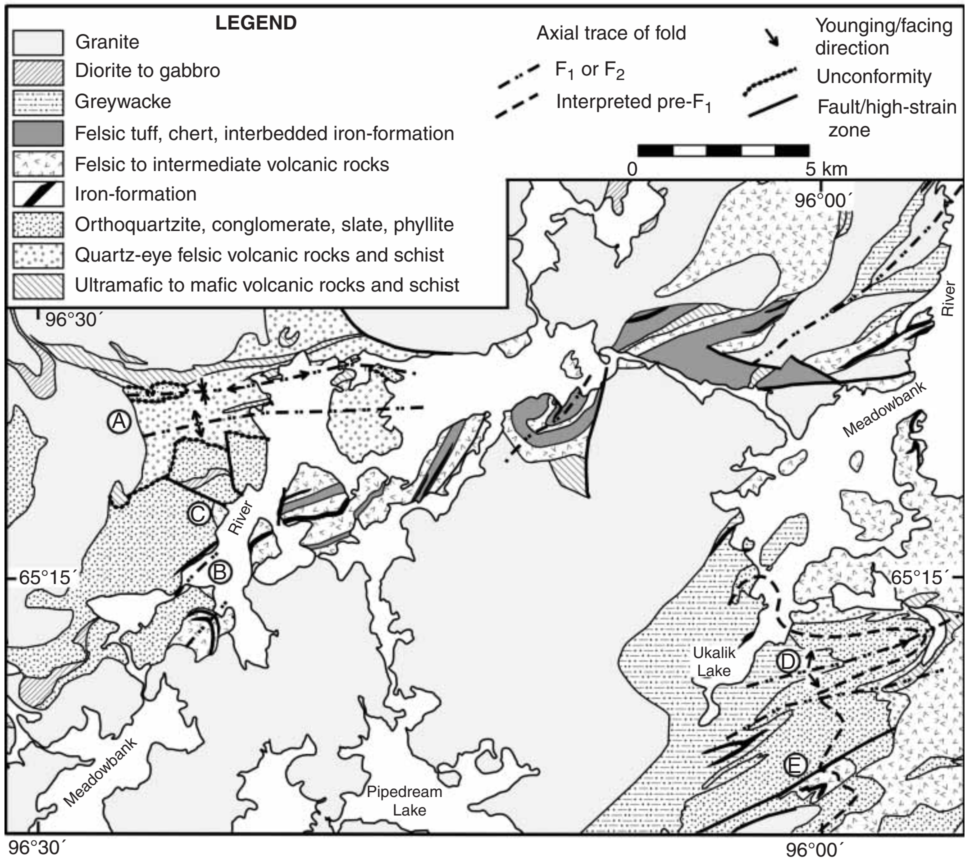


Figure 4. *Generalized geology of the Woodburn Lake group from the Meadowbank River to Ukalik Lake. The circled letters refer to localities discussed in the text.*

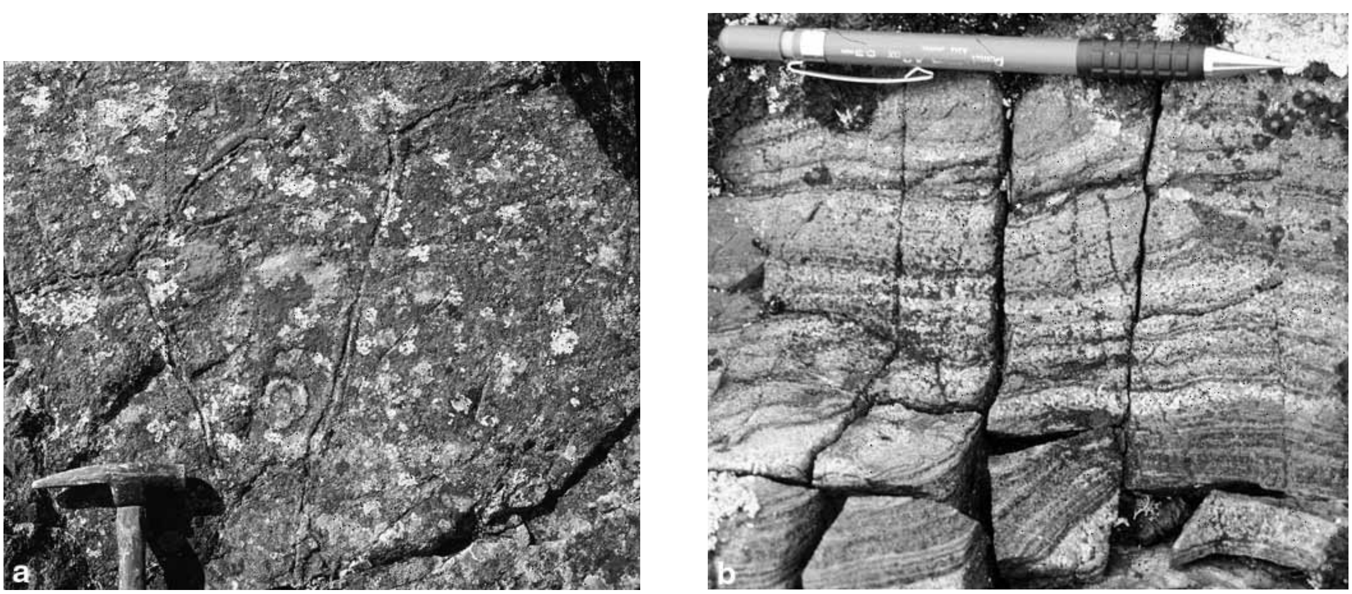


Figure 5. a) *Polyhedral jointing in ultramafic rocks near the Irv gold occurrences south of the Amer belt.* ***b)*** *Coarsely recrystallized banded iron-formation associated with ultramafic rocks near the southeastern margin of the Amer belt.*

protomylonitic zones are present on some contacts and, locally, strain increases toward the Amer belt. There is a southward transition from ultramafic-mafic rocks to mafic to intermediate tuff. The ultramafic-mafic suite is truncated a few hundred metres to the east by hornblende granite to diorite. However, the suite continues about 15 km to the east, represented by massive ultramafic rocks interleaved with gabbro and iron-formation over a strike-length of at least 7 km (Fig. 2, locality B). Thin units of banded magnetite-chert-silicate iron-formation are common (Fig. 5b) interlayered with ultramafic rocks and as septa in plutonic rocks.

UKALIK LAKE TO THIRD PORTAGE LAKE

The depositional age of quartzite between Ukalik Lake and Third Portage Lake (Fig. 2) is bracketed by ca. 2.81 Ga detrital zircon and by 2.6–2.62 Ga granite and porphyry intrusions (Ashton, 1988; Davis and Zaleski, 1998). However, the complex structural history, which likely includes both pre-granite and post-granite ductile deformation, has made it difficult to establish the stratigraphic succession.

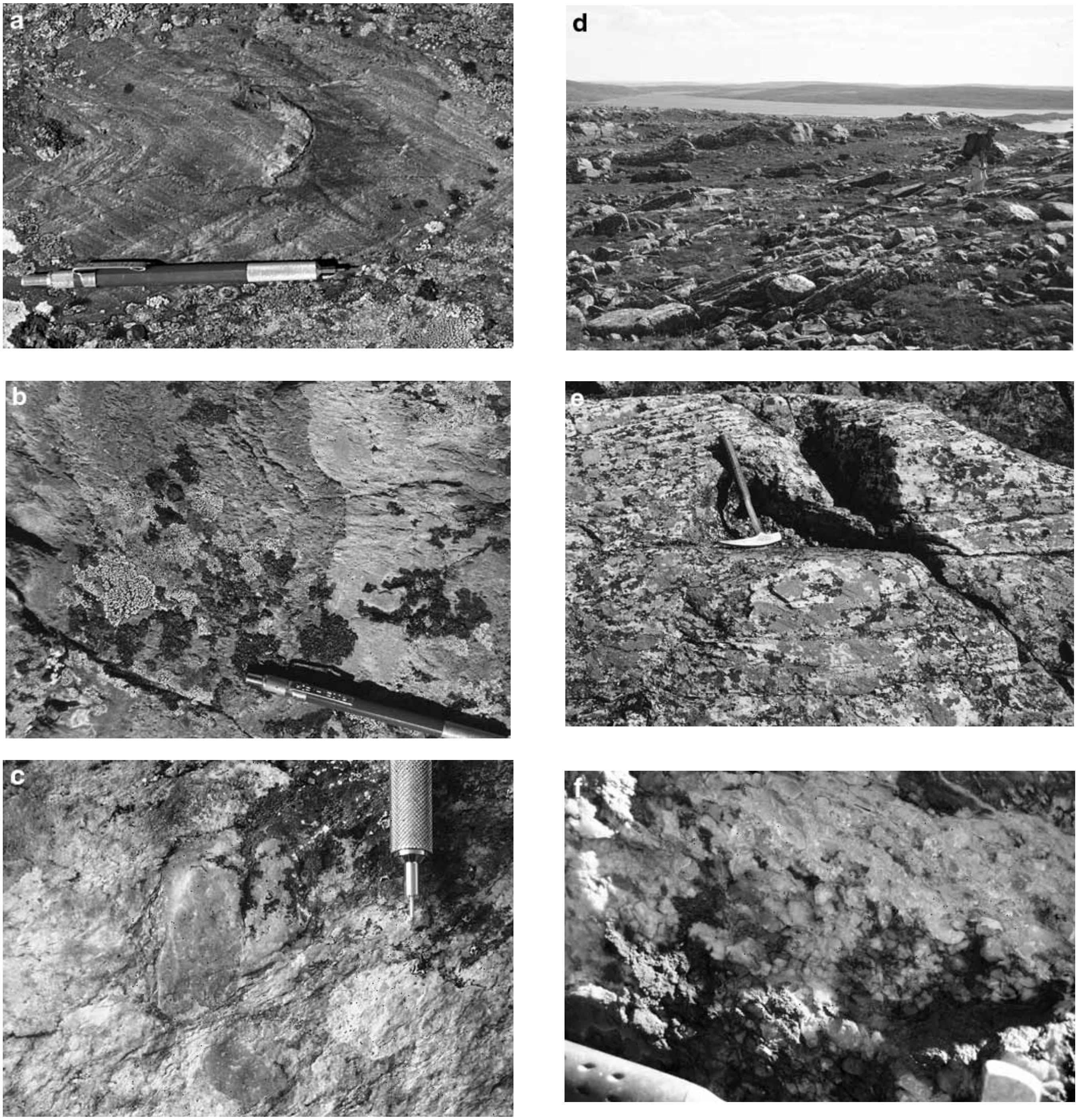
Quartzite is present in two main panels, separated by volcanic and volcaniclastic rocks, and iron-formation. East of Ukalik Lake, an east-northeasterly trending fold deforms the supracrustal rocks, and, in most cases, the dominant schistosity visible on the outcrop has an axial-planar relationship to the fold (F_1 and S_1 of Zaleski et al., 1997a, 1999d) (Fig. 6a, b). The sequence of units from west to east along the fold trace (Fig. 4, locality D), i.e. from the inner hinge to the outer hinge, is wacke and interbedded iron-formation, oligomictic and polymictic conglomerate, quartzite with slate and phyllite interbeds, quartz-eye felsic phyllite, massive and schistose ultramafic rocks with iron-formation, and felsic to intermediate volcanic and volcaniclastic rocks. Graded bedding indicates outward younging (east facing) in the wacke and conglomerate, in agreement with crossbedding in the middle of the quartzite (R. Rainbird, pers. com., 1999). Younging indicators were not seen further to the east. The polymictic conglomerate contains clasts of quartz porphyry, massive granite, quartzite and vein quartz, and fine-grained felsic to intermediate clasts of possible volcanic origin (Fig. 6c). The younging indicators support the interpretation of the conglomerate in the inner fold as the basal unit of the quartzite, and correlation with the conglomerate-quartzite sequence north of the Meadowbank River. However, on the Meadowbank River, the basal conglomerate overlies ultramafic and felsic volcanic rocks. Comparison with the Meadowbank River sequence implies that the ultramafic and associated felsic rocks on the outside of the Ukalik Lake fold are stratigraphically underneath the quartzite. A possible interpretation of this geometry involves an earlier 'pre-F_1' episode of deformation resulting in repetition of stratigraphy along the F_1 axial trace, either by early folding or by fault juxtaposition or both.

The asymmetry of the lithological sequence along the F_1 axial trace and the distribution of ultramafic schist suggest an early fault rather than a refolded fold. However, a number of structural observations support the presence of early folds. These include locally preserved mesoscopic folds which are crenulated and refolded by F_1 folds, especially in iron-formation and metavolcanic schist. Also, across the Ukalik Lake fold, systematic changes in the attitude of S_1/S_0 intersection lineations indicate that F_1 folds are doubly plunging (e.g. Fig. 5b in Zaleski et al., 1997a), possibly as a result of pre-existing folds of S_0 surfaces. Similarly, the map pattern suggests the presence of fold interference structures. For example, the hook-shaped culmination of conglomerate and quartzite on the northwest side of Ukalik Lake, and the 'window' in which volcanic rocks and iron-formation are exposed in quartzite to the southeast (Fig. 4, locality E).

The southeast side of the Ukalik Lake quartzite panel is bounded by mylonitic and schistose high-strain contacts against foliated K-feldspar megacrystic granite, and volcanic and volcanogenic sedimentary rocks. The contact zone is one of several northeasterly trending high-strain zones involved in shuffling of lithological units subparallel to the dominant schistosity. The granite can be traced to the southwest across Pipedream Lake (Fig. 2, locality C) where a narrow (several metres) mylonitic contact against supracrustal rocks shows south-side-up (granite-side-up) kinematics (Ashton, 1988). The intrusive contact is locally preserved, suggesting that the amount of displacement was minor (Ashton, 1988).

A second quartzite panel extends northeasterly from Third Portage Lake. Its northwestern contact cuts at a low angle across the underlying volcanic and sedimentary units, including iron-formation, and has been interpreted as an unconformity (Ashton, 1988). This interpretation is consistent with locally preserved crossbeds on the northwestern side of the quartzite panel that show upward younging to the southeast (Fig. 6d, e). The quartzite is interlayered and interfolded with pyritic quartz-pebble conglomerate (Fig. 6f), phyllite, chloritoid-kyanite slate, and quartz-feldspar porphyry. Two layers of banded, locally pyritic, magnetite-chert iron-formation are present in the quartzite to the northeast. Quartzite adjacent to the iron-formation contains pyrite, fuchsite, and magnetite, suggesting transitional contacts to iron-formation.

To the southeast, quartzite is structurally overlain by volcanic and volcanogenic sedimentary rocks, including felsic lapilli tuff dated at 2710 +3.5/-2.1 Ma (Davis and Zaleski, 1998). Southeasterly younging in the upper sequence, and the presence of quartz-rich clasts in debris-flow deposits, suggested that the volcanic rocks stratigraphically overlie quartzite (Zaleski et al., 1997a, b). However, petrographic examination indicates that the clasts are likely fragments of chert. The quartzite contact is marked by local truncations of interlayered phyllite, discontinuous occurrences of komatiite and pillowed mafic rocks, and by development of ultramafic-mafic schist (Fig. 2, locality E), all supporting structural juxtaposition of the volcanic and sedimentary sequence over quartzite.



a) *Folded bedding in chloritoid-kyanite slate in the hinge region of the Ukalik Lake fold. Axial planar schistosity is parallel to the pencil.*

b) *Compositional grading in bedded chloritoid-kyanite slate with axial planar schistosity parallel to the pencil. Light zones contain more quartz, and dark zones contain more chloritoid, suggesting primary grading defined by an upward decrease in clastic quartz and increase in clays.*

c) *Polymictic conglomerate at the base of quartzite in the Ukalik Lake area. The pencil points to a clast of quartz porphyry.*

d) *Southeasterly dipping bedding and schistosity in quartzite north of Third Portage Lake.*

e) *Crossbeds in quartzite showing upright, southeasterly younging.*

f) *Rusty pyritic quartz-pebble conglomerate interbedded with quartzite.*

Figure 6.

ECONOMIC POTENTIAL

Iron-formation and ultramafic rocks north of the Meadowbank River

Gold, base-metal, and polymetallic occurrences in the area from Ukalik Lake to Third Portage Lake, including the Meadowbank iron-formation-hosted gold deposit, have been summarized by Kerswill et al. (1998). North of the Meadowbank River, pyrite, chalcopyrite, and galena are present in quartz veins in ultramafic-mafic schists (Calvin occurrences, Zaleski et al., 1999d). Further to the north along the southern margin of the Amer belt, ultramafic-mafic rocks are host to two gold occurrences (Irv Main showing and Irv South, Fig. 2, locality A) associated with iron-formation(?), carbonate-actinolite and silicic alteration, and sulphidation. The Main showing returned assay values of up to 21.7 g/t Au from surface samples (Wollex Exploration, 1990). Limited interest in further investigation of the Irv occurrences has apparently been partly due to the limited extent of the mineralized zones and host rocks, which are truncated to the east by plutonic rocks. However, ultramafic rocks, gabbro, and iron-formation continue 15 km to the east of the mineralized suite (Fig. 2, locality B). Gossan zones are extensive, especially in iron-formation, accompanied by Fe-carbonate alteration in ultramafic-mafic schist.

Pyritic quartz-pebble conglomerate

The occurrence of pyritic quartz-pebble conglomerate in the Woodburn Lake group quartzite presents a potential for paleoplacer and modified placer gold concentrations (under investigation by E. Greiner, M.Sc. in progress, University of Western Ontario). Quartzite units on the Meadowbank River unconformably overlie volcanic rocks that are host to mineralized quartz veins, and a similar stratigraphic relationship is likely for the quartzite panels south of Ukalik Lake, providing a potential source of gold. The conglomerate units are known to have anomalous levels of gold, but whether the gold is associated with heavy mineral concentrations remains to be established. Some patchy disseminations of euhedral pyrite suggest metamorphic recrystallization. However, in many cases, pyrite is confined to the matrix surrounding barren quartz clasts. This, and the link with conglomerate horizons argues for depositional concentration of pyrite. In some cases, pyritic zones are associated with green mica and aluminosilicate minerals (kyanite, pyrophyllite?), and local pods of near-massive, coarse-grained kyanite in strongly sulphidic quartzite, suggesting hydrothermal alteration along conglomerate beds and the potential for secondary gold enrichment.

COMPARISON OF QUARTZITE SEQUENCES

The quartzite units of the Amer, Woodburn Lake, and Ketyet River groups have many features in common. For example, primary structures such as crossbedding are reported in all these sequences, and wave ripple marks are locally preserved in the Amer and Ketyet River groups (Taylor, 1985; Patterson, 1986). The identification of particular primary structures is partly a function of preservation and deformation and, hence, of limited reliability as a basis for correlation. All the quartzite sequences are interbedded with oligomictic conglomerate that contains clasts of fuchsitic quartzite, and fuchsitic mica in the matrix. Polymictic basal conglomerate is present locally, and basal units are locally in contact with ultramafic rocks. All of the quartzite units contain aluminosilicate minerals derived through metamorphic recrystallization of minor amounts of pyrophyllite or kaolinite.

The Amer group comprises mature cratonic sedimentary rocks dominated by terrigenous sources. Volcanic rocks (of arguable age, Patterson, 1986; Tella, 1994) are confined to a narrow synform along the southern margin of the Amer belt (Fig. 2) and, on the basis of major-element geochemistry, were interpreted as continental tholeiite (Linnen, 1979). Quartzite between Ukalik and Third Portage Lake, the age of which is bracketed by 2.81 Ga detrital zircon and 2.62 Ga intrusive porphyry (Davis and Zaleski, 1998), is part of a notably more varied volcanic and volcanogenic sedimentary package. The quartzite is interbedded with pyritic quartz-pebble conglomerate, chloritoid-kyanite slate, and iron-formation, none of which have been described from the Amer group. The presence of pyritic conglomerate, if the pyrite proves to be of detrital origin, would be consistent with deposition before the development of an oxygenated atmosphere (Roscoe, 1973). It may prove to be a diagnostic tool for discriminating Archean from Paleoproterozoic quartzite successions in the region. Donaldson and de Kemp (1998) discussed the Archean quartz budget and the role of intense chemical weathering of granitoid rocks in the generation of Archean quartzite. Chloritoid-kyanite slate is the product of metamorphism of ferruginous-aluminous clay-rich protolith, a probable byproduct of the same weathering processes that generated the quartz-rich component. The absence of slate of this composition in the Amer group perhaps suggests that reworked Archean quartzite was an important source of second-cycle detritus.

Several features support the interpretation of orthoquartzite along the Meadowbank River as Archean and part of the Woodburn Lake group. Detrital zircons younger than the age of the underlying volcanic assemblage have not been identified in the polymictic conglomerate at the base of the quartzite. While the absence of evidence can never be viewed as definitive, given the abundance of 2.6–2.62 Ga granite units in the area, it is to be expected that these would contribute detritus to the basal units of overlying sedimentary rocks. The quartzite is interbedded with pyritic conglomerate and, near the top of the section, with iron-formation. Like the Archean quartzite between Third Portage and Ukalik Lakes, it is part of a diverse volcanic and sedimentary sequence.

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