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Precambrian geology, Victory and Mackenzie lakes, Nunavut, and significance of ‘Mackenzie Lake metasediments’, Paleoproterozoic Hurwitz Group[1]

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Abstract: Siliciclastic remnants in the Victory–Mackenzie lakes area (‘Mackenzie Lake metasediments’) correlate with the lower Hurwitz Group (Paleoproterozoic; Noomut and Padlei formations; Maguse Member, Kinga Formation). Hurwitz strata and basement are tightly infolded about steeply dipping axial surfaces. However, northwest of Mackenzie Lake, screens of mafic volcanic and immature supracrustal rocks within leucogranite are likely Kaminak Group (Neoarchean), and display shallowly dipping folds, fabrics, and shear zones. The Mackenzie–Victory lakes area may represent a suprastructure preserving the Hurwitz Group in basement-cover infolds; the northwestern area may represent an infrastructure with intrabasement high-strain zones. Deformation occurred before ca. 1.85–1.83 Ga (age of pristine lamprophyre dykes), and after ca. 2.45 Ga (age of foliated Kaminak dykes). Clasts in Hurwitz conglomerate lack internal tectonic fabrics despite penetratively deformed source rocks, hence the primary tectonic imprint was Paleoproterozoic. Base-metal prospects discovered by Comaplex Minerals Corp. in Kaminak Group volcanogenic strata display features characteristic of volcanic massive sulphide deposits.

Résumé : Des lambeaux silicoclastiques dans la région des lacs Victory et Mackenzie («métasédiments du lac Mackenzie») peuvent être mis en corrélation avec la partie inférieure du Groupe d’Hurwitz (Paléoprotérozoïque; formations de Noomut et de Padlei; Membre de Maguse, Formation de Kinga). Le socle et les strates du Groupe d’Hurwitz sont replissés en plis serrés autour de surfaces axiales à fort pendage. Toutefois, au nord-ouest du lac Mackenzie, des écrans de roches volcaniques mafiques et de roches supracrustales immatures au sein de leucogranite appartiennent vraisemblablement au Groupe de Kaminak (Néoarchéen) et présentent des zones de cisaillement, des fabriques et des plis à pendage faible. La région des lacs Mackenzie et Victory peut représenter une superstructure ayant conservé le Groupe de Hurwitz à l’intérieur de replis du socle et de la couverture; la région au nord-ouest peut représenter une infrastructure comportant des zones intrasocle à forte contrainte. La déformation a eu lieu avant environ 1,85 à 1,83 Ga (l’âge des dykes de lamprophyre non altérés) et après environ 2,45 Ga (l’âge des dykes de Kaminak foliés). Les clastes dans le conglomérat du Groupe d’Hurwitz sont dépourvus de fabrique tectonique interne malgré la déformation pénétrative des roches mères, et la surimpression tectonique primaire remonte donc au Paléoprotérozoïque. Les prospects de métaux communs mis à jour par la Comaplex Minerals Corp. dans les strates volcanogènes du Groupe de Kaminak présentent des éléments caractéristiques des gîtes de sulfures massifs volcaniques.

[1] Contribution to the Western Churchill NATMAP Project

INTRODUCTION

Determining the stratigraphic affinity of supracrustal remnants isolated within the Hearne domain of the western Churchill Province (Fig. 1) is critical for evaluating current Archean and Paleoproterozoic paleogeographic, tectonic, and metallogenic models. Remnants that are exposed near Kaminuriak, Mackenzie, and Victory lakes (Fig. 1) consist of highly strained quartzite, arkose, conglomerate, and pelitic schist, and have been referred to as the "Mackenzie Lake metasediments" (Bell, 1968). These rocks are spatially associated with Neoarchean volcanogenic deposits comprising the north-central segment of the Ennadai–Rankin greenstone belt (Kaminak Group). However, from reconnaissance mapping (Davidson, 1970; Bell, 1971) it remained uncertain if the 'Mackenzie Lake metasediments' are interbedded with the Kaminak Group or if they constitute an outlier of the Hurwitz Group, an assemblage of continental to shallow marine strata deposited in an intracratonic basin that covered much of the Hearne domain during the early Paleoproterozoic. Resolution of this uncertainty is important, for if the 'Mackenzie Lake metasediments' are part of the Kaminak Group, they would imply an extensive continental platform in the north-central segment of the Ennadai–Rankin greenstone belt. In addition, the depositional environments reflected by the 'Mackenzie Lake metasediments' would have significant bearing on the origin of base-metal massive sulphide deposits in Kaminak Group volcanogenic strata. If, however, the 'Mackenzie Lake metasediments' preserve the most northwestern segment of Hurwitz Basin, understanding local facies that depart from regional patterns could contribute to a better understanding of basin evolution. Furthermore, in the absence of stratigraphic markers, separating the effects of Paleoproterozoic and Archean deformation in the western Churchill Province is problematic. If Paleoproterozoic, the 'Mackenzie Lake metasediments' would provide such a marker.

Recent work by Hanmer et al. (1998b) suggested that rocks originally mapped as 'Mackenzie Lake metasediments' contain components of both the Kaminak and Hurwitz groups, a conclusion confirmed by the present study. Herein we summarize the results of 1:50 000 scale mapping in the belt of 'Mackenzie Lake metasediments' that extends from southwest of Mackenzie Lake to Victory Lake (area 1, Fig. 1; Fig. 2). Comparison to less deformed strata exposed in central Hurwitz Basin (Aspler and Chiarenzelli, 1997) indicates that these rocks correlate with parts of the lower Hurwitz Group (Noomut and Padlei formations; Maguse Member, Kinga Formation). However, ancillary work to the northwest of this main belt (area 2, Fig. 1) shows that large areas originally mapped as 'Mackenzie Lake metasediments' consist primarily

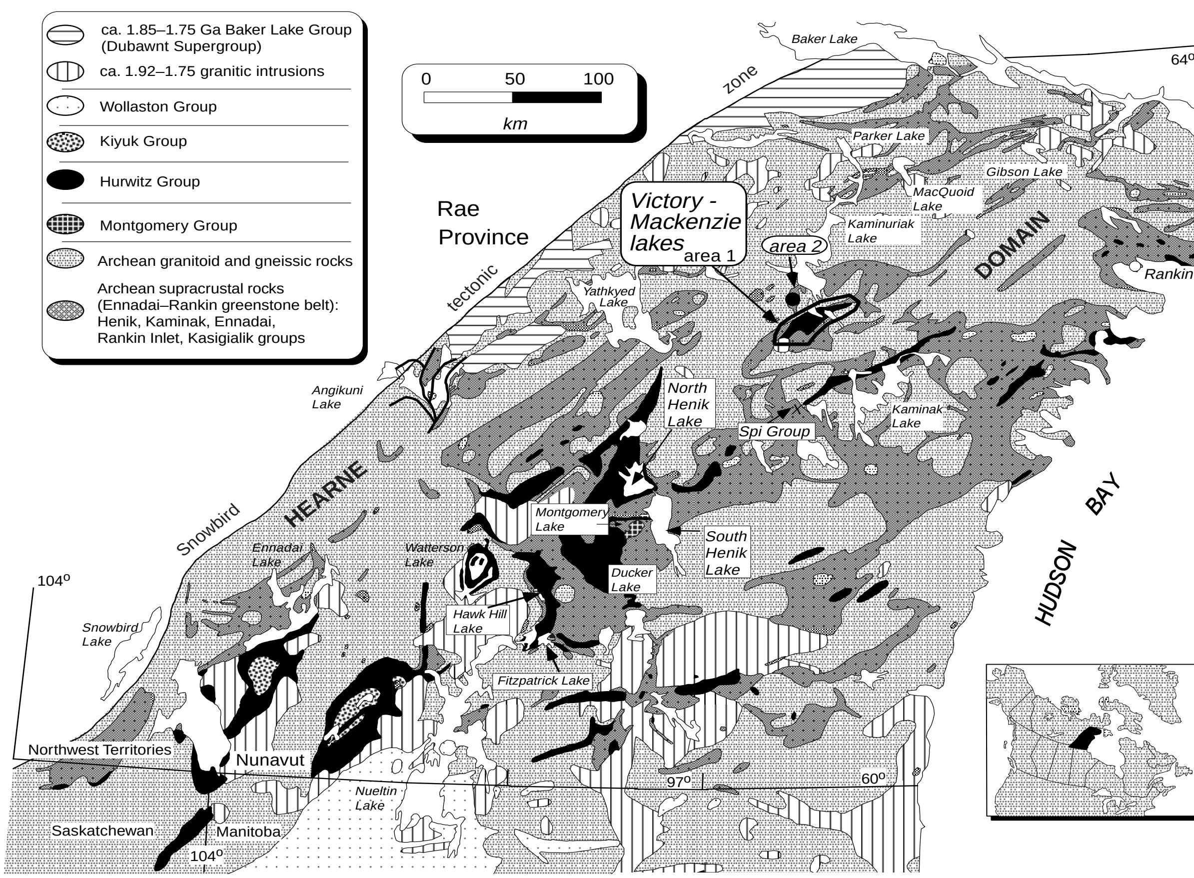

Figure 1. *Simplified geology of the Hearne Province, Nunavut, showing location of study areas (after Aspler and Chiarenzelli, 1996a).*

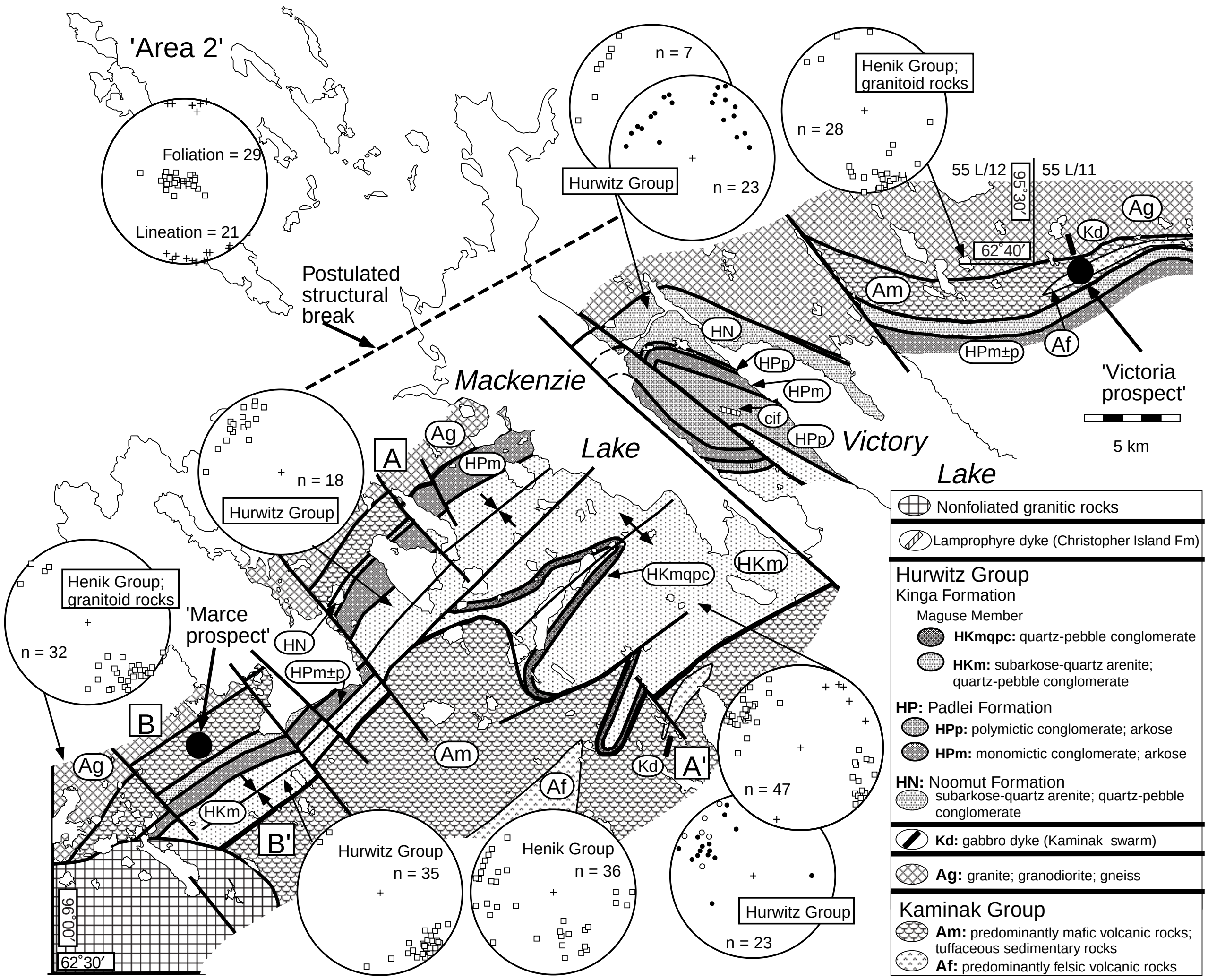

Figure 2. *Simplified geological map, Mackenzie and Victory lakes area. Key to stereonets: solid circles = upright bedding, open circles = overturned bedding; open boxes = foliation; crosses = lineation.*

of shallowly dipping leucogranite sheets containing local screens of amphibolite and immature siliciclastic rocks that are likely Kaminak Group. Furthermore, a major structural difference accompanies lithological changes northwest of Mackenzie Lake. On the southeast, Archean and Proterozoic rocks are tightly to isoclinally folded about steeply dipping axial surfaces and shallowly plunging hinge lines, contain shallowly plunging stretching lineations and are cut by steeply dipping faults, whereas rocks to the northwest display intense folds, fabrics, and shear zones that are shallowly dipping, yet display similar shallowly plunging stretching lineations.

Below, we 1) describe the geology of Archean and Proterozoic rocks in the Mackenzie–Victory lakes area, considering the implications for paleogeographic reconstructions of the Hurwitz Group and for distinguishing Archean and Paleoproterozoic deformation; 2) outline Kaminak Group-hosted base-metal massive sulphide prospects held by Comaplex Minerals Corp. north of Victory Lake and south of Mackenzie Lake; 3) summarize studies in the area northwest of Mackenzie Lake; and 4) evaluate the possible significance of changes in lithology and structure in a transect northwest of Mackenzie Lake.

MACKENZIE–VICTORY LAKES AREA

Kaminak Group and allied granitic rocks

The oldest lithostratigraphic unit in the area comprises a succession of bimodal mafic-felsic volcanic rocks and volcanogenic sedimentary interbeds. The volcanic rocks form a continuum that ranges from mafic flows with local felsic intercalations to felsic flows and tuffs with minor mafic layers. The mafic volcanic rocks are typically massive but locally contain pillowed and brecciated beds. Similarly, quartz-phyric felsic beds are generally massive and, unlike felsic units in the Kaminak Lake area (e.g. Hanmer et al., 1998a), contain only rare proximal-type volcanic breccia. Highly cleaved tuffs and tuffaceous sandstone and siltstone units form metre-scale beds within mixed mafic-felsic units. Mafic volcanic and tuffaceous units commonly contain coarse hornblende-plagioclase±garnet; some pelitic beds within tuffaceous units are cordierite bearing.

On the northwestern and northern margins of the map area, granitic to dioritic rocks are in fault contact with the supracrustal sequence (Fig. 2). Intrusive relationships are inferred because, adjacent to the contacts, the granitic bodies contain numerous supracrustal enclaves and the supracrustal rocks are cut by granitic satellite dykes.

Gabbro dykes (Kaminak swarm)

Rare north- and northeast-trending gabbro dykes, locally containing feldspar megacrysts, crosscut the Archean supracrustal and granitic rocks (Fig. 2). Significantly (*see* 'Structure' below), the dykes contain a penetrative foliation that is concordant with fabrics in the host rocks. They are likely part of the ca. 2.45 Ga (Heaman, 1994) Kaminak swarm, extensively exposed near Kaminak Lake (Davidson, 1970; Christie et al., 1975).

'Mackenzie Lake metasediments', lower Hurwitz Group

A sequence of siliciclastic rocks originally mapped as 'Mackenzie Lake metasediments' outcrops in a belt that extends for at least 40 km, from southwest of Mackenzie Lake to northeast of Victory Lake (Fig. 2). Contacts of this sequence are faulted, but a basal unconformity is inferred because 1) conglomerate-bearing beds in the sequence contain clasts derived from subjacent granitic and volcanogenic rocks; 2) granitic dykes and megacrystic gabbro dykes which cut Archean volcanogenic strata are lacking; and 3) the change from exclusively volcanogenic rocks in the Kaminak Group to exclusively siliciclastic rocks is abrupt and signifies a dramatic change in depositional regime. Three main units are defined (Fig. 2). As described below, individually and collectively these units bear strong resemblance to lower Hurwitz Group strata better preserved elsewhere (*see* Aspler and Chiarenzelli, 1997).

The lowest unit consists of massive, parallel-stratified and locally trough cross-stratified subarkose to quartz arenite, local quartz-pebble conglomerate, and rare semipelite. The maximum thickness of this unit is about 600 m, but locally only a few metres are preserved because of fault cut-out adjacent to basement (Fig. 2, 3). This unit, considered equivalent to the Noomut Formation (Aspler and Chiarenzelli, 1996b), signifies fluvial sedimentation during initial stages of Hurwitz Basin subsidence.

The middle unit defines a thick (up to 1000 m) section consisting predominantly of cobble-boulder conglomerate. These conglomerate units are typically massive and thickly bedded, but locally define channels and graded sheets, and contain parallel and trough cross-stratified wedges and sheets of subarkose and arkose (Fig. 4, 5). Clasts (up to 1 m in diameter) are generally subrounded to well rounded and are self-supporting in a coarse arkosic matrix. Clast compositions vary dramatically over short distances, both along and across strike. Some sections consist almost exclusively of different types of granitic clasts (fine- to coarse-grained, locally pegmatitic) with rare amphibolite and gabbroic fragments (Fig. 4), whereas others contain a diverse suite including granitic, quartzite, chert, felsic volcanic, and mafic volcanic clasts (Fig. 5). Significantly, the clasts lack a pre-existing tectonic fabric (*see* 'Structure' below). Granite-clast and polymictic conglomerate units locally define discrete mappable subunits (Fig. 2). Discontinuous zones of epidote alteration occur within the granite-clast conglomerate.

The appearance of stratified conglomerate and immature arenite above a section of relatively mature arenite containing quartz-pebble conglomerate (Noomut Formation) in the Mackenzie–Victory lakes area is one of the features that characterize the Padlei Formation (Bell, 1970a) in other parts of Hurwitz Basin, although local rhythmite units containing cold-climate and/or glacial indicators are lacking. Similar to

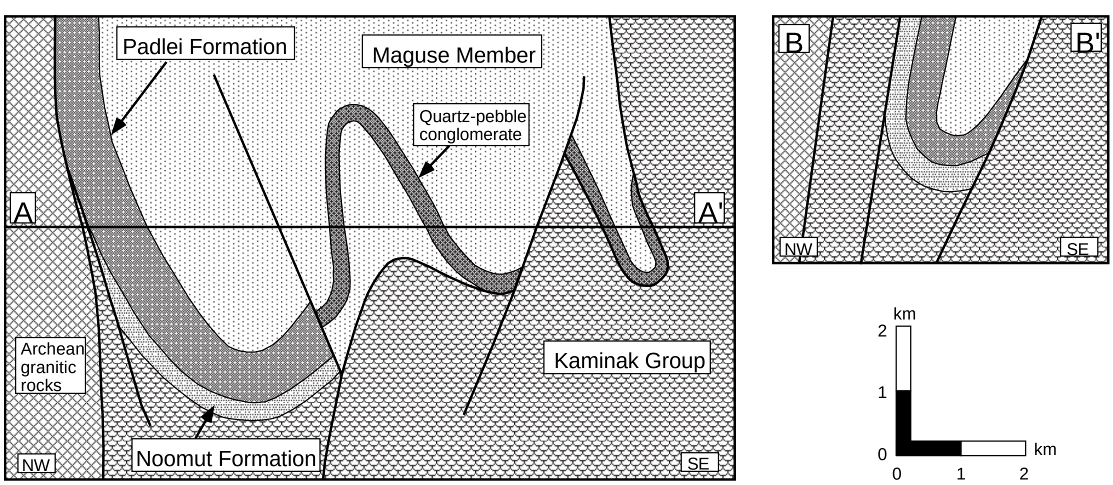

Figure 3. *Structural cross-sections, south of Mackenzie Lake (*see *Fig. 2 for location of section lines).*

Padlei Formation deposits elsewhere, the stratified conglomerate and arkose are interpreted to be periglacial fluvial deposits filling paleovalleys incised into Archean basement (*see* Aspler and Chiarenzelli, 1997), although the thickness and lateral continuity of these strata, and the abundance of soft-sediment deformation structures, could also imply fault-generated relief during sedimentation. The interlayering of monomictic and polymictic beds is intriguing, and could signify either reworking of glacially transported material previously deposited in differently sourced till sheets, or changes in source areas due to divide migration and stream piracy.

The upper unit (about 1000 m thick) consists of grey (locally white) subarkose to quartz arenite that contains beds of quartz-pebble conglomerate. Primary sedimentary structures are generally obscured by a penetrative cleavage, but

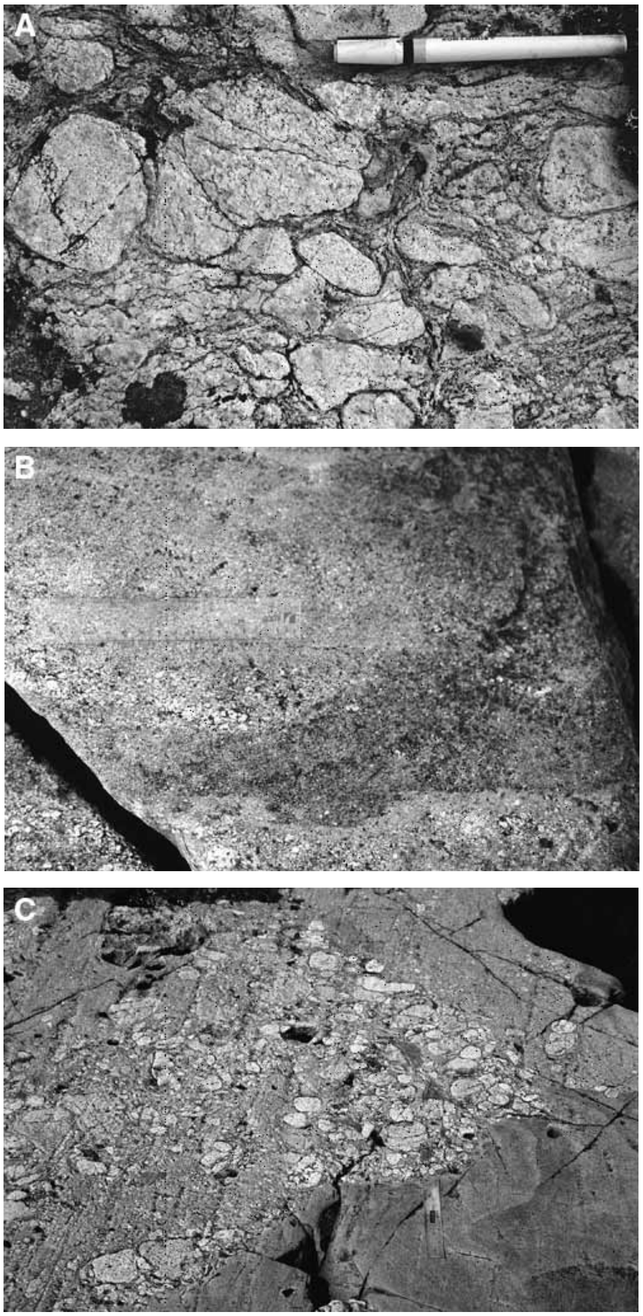

Figure 4. *Monomictic conglomerate facies, Padlei Formation (Hurwitz Group).* ***A****) Framework-intact granite-cobble conglomerate with coarse arkose matrix.* ***B****) Granulestone layer scoured into arkosic layer.* ***C)*** *Granite-cobble conglomerate-filled channel cut into parallel-stratified arkose; soft-sediment deformation of arkose layers (lower right).*

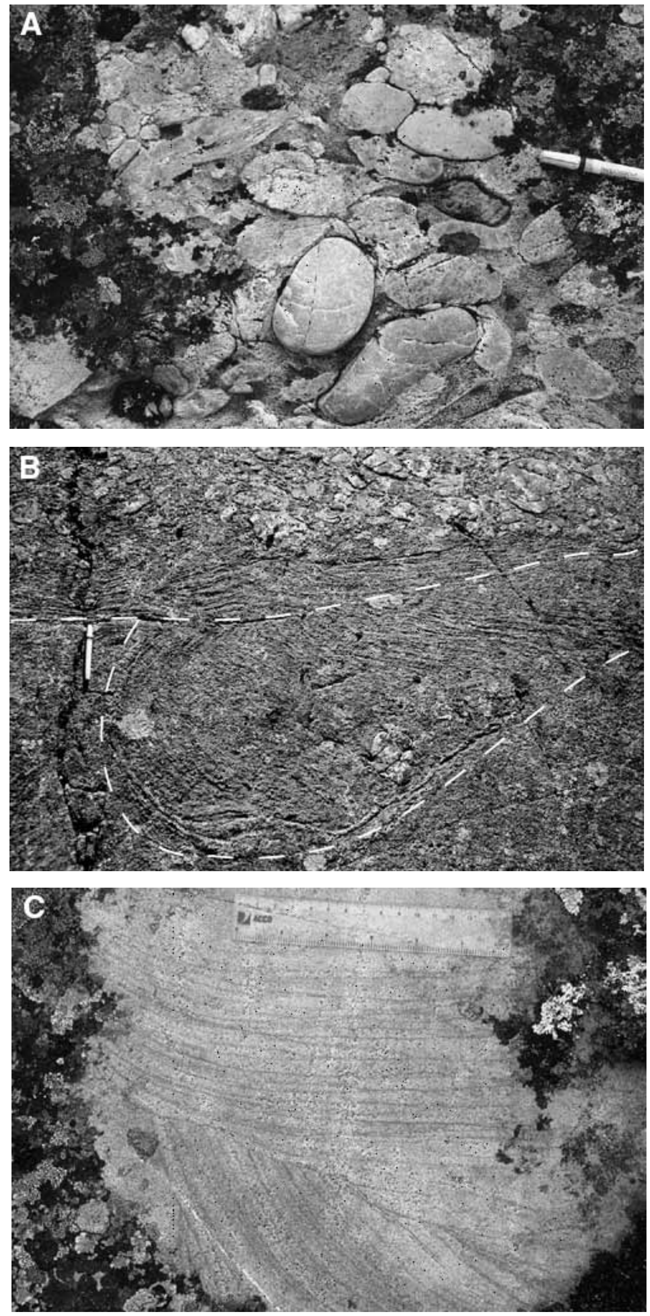

Figure 5. *Polymictic conglomerate facies, Padlei Formation (Hurwitz Group).* ***A****) framework-intact cobble conglomerate with diverse suite of well rounded clasts in arkosic matrix.* ***B****) Soft-sediment deformed arkose at base of photograph truncated by parallel-stratified arkose which is in turn cut off by conglomerate-filled channel.* ***C****) Cross-stratified arkose.*

local parallel and trough cross-stratified heavy mineral layers are preserved (Fig. 6A). Some of the subarkose to quartz arenite beds contain kyanite. Beds with quartz-chert pebbles, either as isolated clasts or concentrated in metre-scale framework-intact beds, occur sporadically throughout the unit. One approximately 100 m thick horizon, containing thickly bedded (20 cm to 10 m) sheets of framework-intact quartz-pebble conglomerate (Fig. 6B, C) proved to be a useful marker (Fig. 2, 3). The upper unit is virtually identical to parts of the Maguse Member (Kinga Formation; Bell, 1970a) exposed elsewhere in Hurwitz Basin. It is interpreted to represent sedimentation on an extensive alluvial plain in a wet paleoclimate. The paucity of coarse-grained detritus and restriction of clast types to durable lithologies are indicators of low topographic relief and a long residence time for chemical weathering and abrasion before final sedimentation. The kyanite likely resulted from metamorphism of aluminous phyllosilicate minerals found elsewhere in the Maguse Member and considered the products of tropical weathering (Bell, 1970b; Young, 1973).

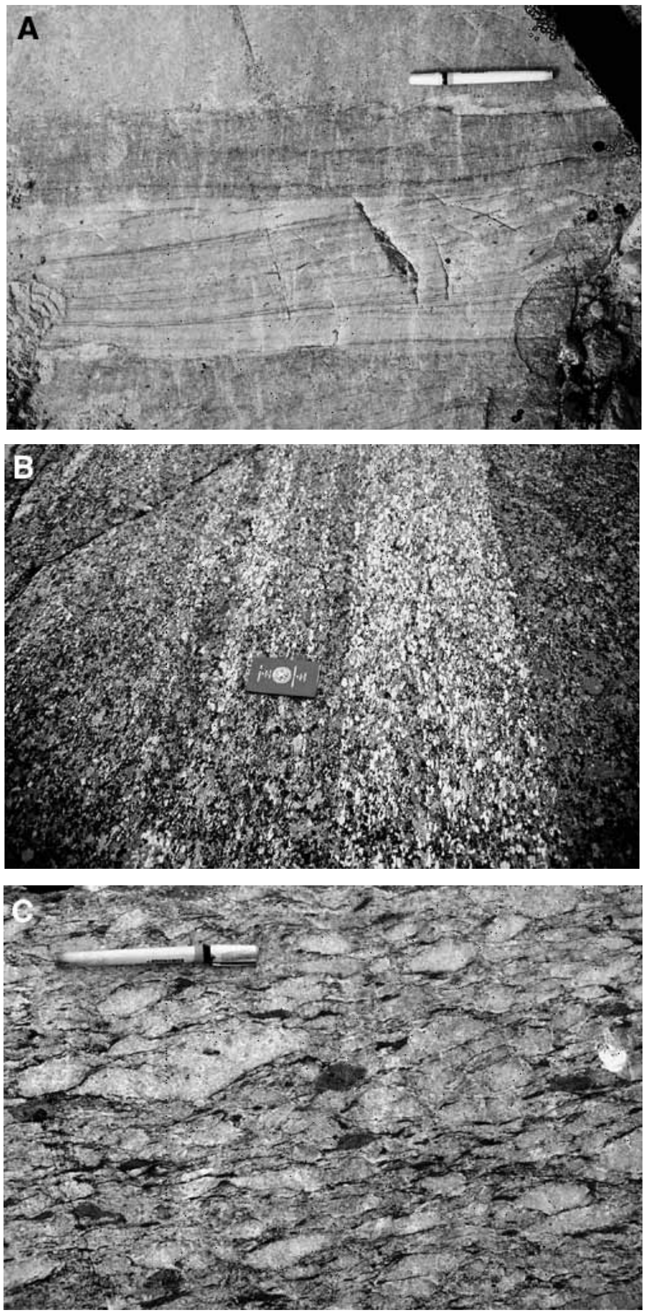

***Figure 6.** Maguse Member, Kinga Formation (Hurwitz Group). **A**) Parallel and planar cross-stratified subarkose-quartz arenite. **B**) Highly strained sheets of quartz-pebble conglomerate with bedding (subparallel to foliation) defined by variation in clast concentration. **C**) Close-up of B) illustrating highly strained light and dark quartz and chert pebbles with foliation anastomosing around clasts.*

In summary, the lithological and sedimentological characteristics of siliciclastic rocks previously mapped as the ‘Mackenzie Lake metasediments’ in the Mackenzie and Victory lakes area, as well as the stratigraphic order in which these rocks are arranged, strongly suggest correlation to parts of the lower Hurwitz Group. Conceivable correlation to siliciclastic-bearing sequences that have been demonstrated to lie unconformably between Archean greenstone units and the Hurwitz Group is considered unlikely. Both the Montgomery Group at Montgomery Lake (Fig. 1; Eade, 1974; Aspler and Chiarenzelli, 1996b) and Fitzpatrick Lake (Aspler et al., 2000), and the Spi Group near Kaminak Lake (Beavon 1976; Patterson, 1991) lack the stratal arrangement and voluminous mature arenite units found at Mackenzie and Victory lakes, and the Spi Group contains mafic volcanic rocks in addition to fluvial conglomerate and arenite. From previous mapping of the lower Hurwitz Group, initial stages of basin subsidence are thought to have resulted from lithospheric extension-induced regional sagging (Aspler and Chiarenzelli, 1997). In the absence of rift-type assemblages, slow growth of a radially expanding, low-relief continental depression was attributed to a supradetachment origin, such as described for other intracratonic basins (e.g. Gibbs, 1987; Friedmann and Burbank, 1995). Rocks in the present study area are consistent with this model, with the possible exception that thick, laterally extensive coarse conglomerate beds may indicate that faults breached the surface during deposition of the Padlei Formation.

Lamprophyre dykes (Christopher Island Formation); post-tectonic granitic plutons

At one locality between Mackenzie Lake and Victory Lake, an east-trending undeformed and unmetamorphosed lamprophyre dyke cuts penetratively foliated Hurwitz Group polymictic conglomerate and sandstone (Fig. 2). Presumably part of the Christopher Island swarm, the dyke is significant because it demonstrates deformation and metamorphism in the area was before Christopher Island Formation magmatism, currently estimated at 1850+30/-10 Ma (U-Pb zircon, Tella et al., 1985); 1825 ± 12 Ma (^{40}Ar/^{39}Ar hornblende, Roddick and Miller, 1994), and 1832 ± 28 Ma (Pb/Pb isochron, apatite, MacRae et al., 1996). In the southwestern part of the map area, a nonfoliated fluorite- and/or tourmaline-bearing granite pluton (and associated satellite dykes) cuts penetratively deformed Hurwitz Group (Fig. 2), likely one of the post-tectonic granitic blooms within the western Churchill Province defined by Peterson and van Breemen (1999; ca. 1.83 Ga Hudson suite; ca. 1.76 Ga Nueltin suite).

Structure

South of Mackenzie Lake, basement and Hurwitz Group define a northeast-trending synclinorium that tapers to the southwest between two basement-cover faults (Fig. 2, 3). On the western side of the synclinorium, a high-angle intra-basement fault juxtaposes granitic rocks against the Kaminak Group. Near the 'Marce prospect' (Fig. 2), the granitic rocks are structurally above a relatively thick Kaminak Group section (section B–B′, Fig. 3), whereas to the northeast they are structurally beneath, and the Kaminak Group is cut out against a high-angle basement-cover fault (section A–A′, Fig. 3). The dip of this basement-cover fault also changes through the vertical along strike, resulting in basement-over-cover juxtaposition in the south, and cover-over-basement relationships in the north. This fault is near the Noomut Formation–basement contact in the south (section B–B′), but cuts upsection northward and eliminates the Noomut Formation near section A–A′(Fig. 2, 3). In the interior of the synclinorium, tight to isoclinal folds in Hurwitz Group strata (Fig. 7) display steeply dipping axial surfaces and penetrative planar fabrics and shallowly plunging hinge lines and stretching lineations. In the south, near the 'Marce prospect', the synclinorium comprises a narrow southeast-vergent syncline caught between two faults (Fig. 2; section B–B′, Fig. 3). To the northeast, the synclinorium broadens markedly and exposes higher stratigraphic levels as a basement-cover fault splay cuts upsection and is folded together with the Hurwitz Group. Rocks on the isthmus between Mackenzie and Victory lakes are separated from the southern synclinorium by a northwest-trending cross-fault adjacent to which relatively low-strain Hurwitz Group rocks are folded (Fig. 2). Farther east, at the 'Victory prospect', highly strained Archean granitic and Kaminak Group rocks are faulted above the Hurwitz Group, and all three map units define a south-vergent overturned package.

Figure 7. *Isoclinally folded Maguse Member subarkose-quartz arenite.*

We interpret the structures postdating the Hurwitz Group in the Mackenzie–Victory lakes area to represent an extreme example of a style of deformation found elsewhere in the Hearne domain (e.g. Aspler et al., 2000), in which complex structures arise from space restrictions in the cores of major basement-cover infolds. Deformation occurred before ca. 1.85–1.83 Ga because an undeformed and unmetamorphosed lamprophyre dyke cuts structures in the Hurwitz Group, and after ca. 2.45 Ga, because Kaminak dykes contain a penetrative fabric (*see* above). Archean basement rocks adjacent to the Hurwitz Group generally bear a penetrative fabric. Despite this, basement clasts within voluminous Hurwitz Group conglomerate units lack a predepositional tectonic fabric. Hence we conclude that structures in the Mackenzie–Victory lakes area reflect intense Paleoproterozic deformation, and that the effects of Archean strain are not obvious.

Base-metal massive sulphide prospects

Base-metal massive sulphide mineralization hosted by Kaminak Group volcanogenic rocks have recently been discovered by Comaplex Minerals Corp. on their Victory Lake property. At the 'west zone' of the 'Victoria prospect' (Fig. 2), massive and stringer pyrite, sphalerite, chalcopyrite, and galena extend for a strike length of about 450 m. They are hosted by silicified and quartz-veined amphibole-garnet schist (up to 25 m thick) thought to be metamorphic equivalents of hydrothermally altered (chloritic and silicic) mafic to intermediate volcanic rocks. Averaged chip samples from trenching across a 4 m thick lens of massive mineralization assayed 6.77% Zn, 0.2% Cu, 0.2% Pb, 24 g/t Ag, and 0.054 g/t Au. Diamond drilling tested the downdip extension of this mineralization; samples from one drill core yielded 8.28% Zn, 0.38% Cu, and 17.48 g/t Ag over an interval of 5.12 m. Stringer to disseminated chalcopyrite has assayed as high as 0.37% Cu over 7.6 m. The 'main zone' of the Victoria prospect is a 1000 m long alteration horizon containing massive and stringer pyrite, sphalerite, and galena in felsic to intermediate volcaniclastic strata. Metre-scale zones of strongly pyritic muscovite-quartz±andalusite±staurolite±gahnite are interpreted to have been derived from metamorphism of tuffaceous beds that previously underwent intense sericite hydrothermal alteration. Samples from a massive sulphide lens yielded up to 19.1% Zn, 3.5% Pb, and 240 g/t Ag; those from stringer mineralization yielded up to 0.92% Zn, 0.35% Pb, and 64 g/t Ag. At the 'Marce prospect', southwest of Mackenzie Lake (Fig. 2), surface samples from sulphide zones hosted by mafic to intermediate volcanic rocks averaged 9.6% Zn, 1.5% Cu, and 259g/t Ag. Gold assayed as high as 7.2 g/t.

The geological and mineralogical characteristics of base-metal mineralization in the Mackenzie–Victory lakes area are typical of volcanic massive-sulphide deposits. The Marce and Victoria prospects may represent a single horizon that was disrupted by Archean plutonism and Archean and/or Paleoproterozoic deformation.

NORTHWEST OF MACKENZIE LAKE

Current and previous (Hanmer et al., 1998b) work in the region northwest of Mackenzie Lake (area 2, Fig. 1, 2) indicate that extensive areas previously mapped as 'Mackenzie Lake metasediments' are underlain mainly by shallowly dipping sheets of monzogranite, and that these granite bodies contain only minor screens of supracrustal rocks. Furthermore, unlike the succession in the Mackenzie–Victory lakes area, the supracrustal rocks comprise amphibolite, immature psammite, and pelite, minor calc-silicate-bearing horizons (tremolite-biotite schist), and contain only local layers of relatively mature arenite. Similar mafic volcanic-bearing, semipelitic to psammitic packages with local quartz-rich arenite have been mapped in the Kaminak Group near Kaminak Lake (Hanmer et al., 1998a, b). These sequences also resemble neighbouring supracrustal successions in the Parker–MacQuoid–Gibson lakes area to the north (Fig. 1; Armitage et al., 1995; Tella et al., 1997; Hanmer et al., 1999) and the Yathkyed Lake area to the west (Fig. 1; Relf et al., 1999). In agreement with Hanmer et al. (1998b), we consider that the supracrustal rocks northwest of Mackenzie Lake are part of the Kaminak Group. These rocks suggest that shelf-type conditions inferred for Archean supracrustal rocks in the Rae domain (e.g. Schau, 1997; Donaldson and de Kemp, 1998) extended well into the Hearne domain.

Differences in rock types exposed in area 2 are accompanied by differences in structure. Based on lithological composition and relative state of strain, area 2 is divided into two domains. The southeastern domain comprises highly strained, shallowly dipping, layered monzogranite within panels of mixed supracrustal rocks (Fig. 8). The oldest granite is a red- to orange-weathering, hornblende-bearing augen monzogranite. It is strongly foliated and intensely lineated (bordering on mylonitic), and bears a resemblance to Archean augen granite units in the MacQuoid Lake area (Tella et al., 1997). A younger, biotite monzogranite, contains the same strong shallow foliation, and the intense north-south, subhorizontal stretching lineation (Fig. 2) defined by mats of recrystallized biotite. The foliation undulates gently, forming low-amplitude dome-and-basin structures. Lineation-parallel sheath folds of granitic veins in metasedimentary layers (Fig. 8B) show the transport azimuth (north-south) of this high-strain zone, but it is unclear if contractional or extensional deformation is indicated. Establishing the age of the high-strain zone will have a significant bearing on the regional deformation history. The sheared granite has a similar geochemical signature to known ca. 1.83 Ga granite bodies in the Gibson Lake area (H. Sandeman, unpub. data, 1999), and has yielded a preliminary U/Pb monazite age of ca. 1.83 Ga (W. Davis, unpub. data, 1999). The granite will be analyzed further to evaluate if this age represents magmatic crystallization, or tectonothermal overprinting of an older protolith. A young suite of pink monzogranite cuts the strongly foliated and lineated granite bodies, and is undeformed (Fig. 8A, C). One such granite forms a 1 km wide massive intrusion. Geochronological investigation of this intrusion is underway.

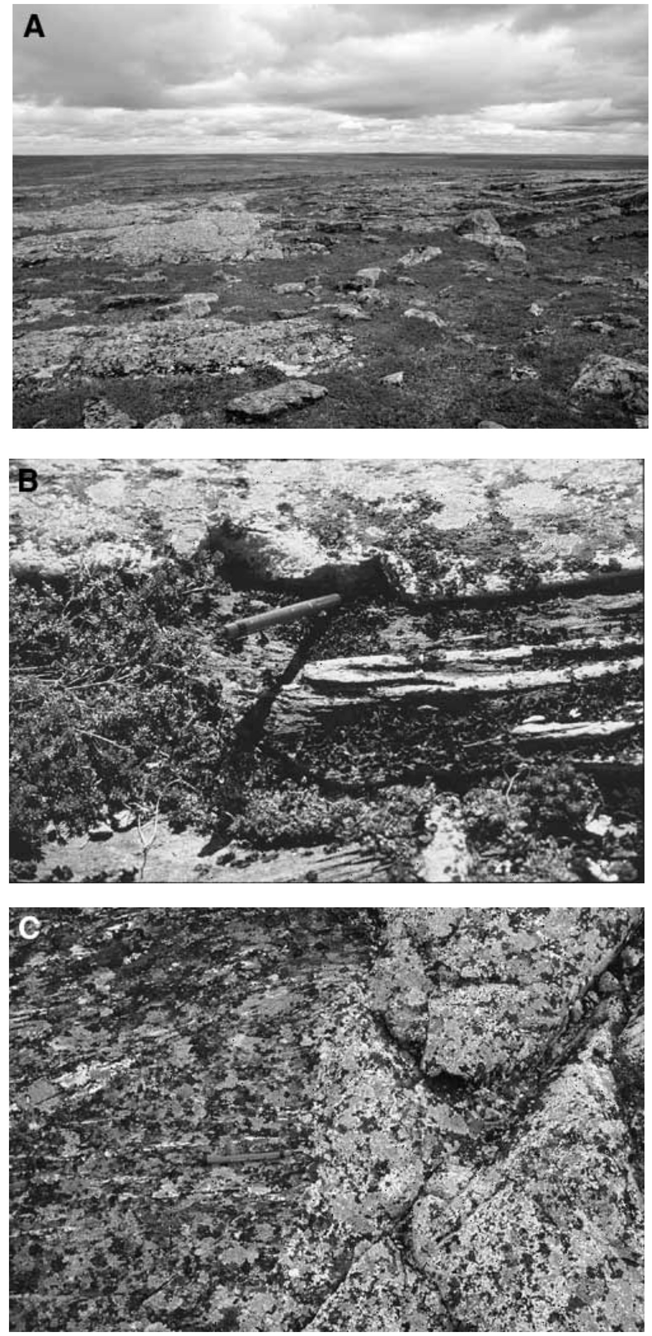

Figure 8. *Structural relationships northwest of Mackenzie Lake.* ***A****) Undeformed monzogranite (left) cutting gently undulating highly sheared metapelitic rocks and granitic sheets.* ***B****) Close-up of the highly strained, gently dipping granite sheets. Extension lineation (parallel pen) is interpreted as the overall shear direction in the high-strain zone.* ***C****) Late granitic body cutting highly sheared and horizontally lineated (parallel pen) quartzofeldspathic schist-gneiss. It is unclear if the gneiss represents highly strained granitic rocks or quartzofeldspathic metaclastic rocks.*

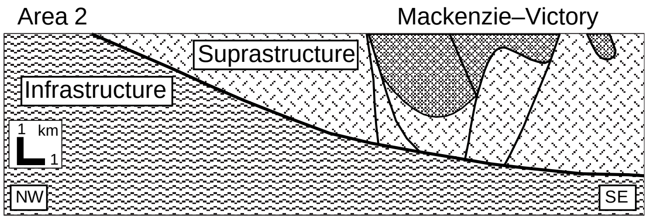

Figure 9. *Schematic cross-section illustrating possible link between Mackenzie–Victory lakes area and 'area 2'. Shortening in suprastructure with shallow-level basement-cover infolding about steeply dipping axial surfaces is balanced in infrastructure by shallowly dipping high-strain zones.*

The northwestern domain comprises granodioritic to tonalitic orthogneiss, with rafts of grey quartzofeldspathic gneiss and biotite-semipelitic schist. In southern exposures, the rocks are similar to those in the southeastern domain, displaying an intense foliation and lineation and locally, appearing as straight gneiss. To the north however, (beyond the northwestern limit of Fig. 2) this younger overprint dies out, and weakly foliated biotite-tonalite sheets (locally gneissic) with subordinate rafts of host semipelite are the predominant rock types. Farther north, the regional foliation dips shallowly to moderately north, and contains a weak regional extension lineation. These rock types and deformational style are typical of the Archean packages with Archean fabric elements at MacQuoid (Tella et al., 1997) and Yathkyed (Relf et al., 1999) lakes.

Regional mapping (Davidson, 1970; Bell, 1971) indicates that domains of gently undulating, highly strained granitic sheets containing a shallowly plunging extension lineation occur in regions to the northeast and southwest of the areas studied. As illustrated schematically in Figure 9, we speculate that the lithological and structural changes from the Mackenzie–Victory lakes area northwest to 'area 2' reflects a change in structural level. Rocks exposed on the southeast are considered to represent a suprastructure, preserving the Hurwitz Group in basement-cover infolds with steeply dipping axial surfaces. Shortening from shallow-level basement cover infolding is balanced at depth by shallowly dipping intrabasement high-strain zones and distributed ductile strain. Rocks to the northwest ('area 2') are considered to represent where this infrastructure intersects the surface along postulated faults that may follow lineaments expressed by regional aeromagnetic data. The northwestern domain of 'area 2' probably represents Archean rocks with Archean fabrics, exposed structurally below the postulated faults.

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REFERENCES

Armitage, A.E., Miller, A.R., and MacRae, N.D.
1995: Geological setting of the Sandhill Zn-Cu-Pb-Ag showing in the Gibson Lake area, District of Keewatin, Northwest Territories; *in* Current Research 1995-C; Geological Survey of Canada, p. 147–156.

Aspler, L.B. and Chiarenzelli, J.R.
1996a: Stratigraphy, sedimentology and physical volcanology of the Ennadai-Rankin greenstone belt, Northwest Territories, Canada: Late Archean paleogeography of the Hearne Province and tectonic implications; Precambrian Research, v. 77, p. 59–89.
1996b: Relationship between the Montgomery Lake and Hurwitz groups, and stratigraphic revision of the lower Hurwitz Group, District of Keewatin; Canadian Journal of Earth Sciences, v. 33, p. 1243–1255.
1997: Initiation of ca. 2.45-2.1 Ga intracratonic basin sedimentation of the Hurwitz Group, Keewatin Hinterland, Northwest Territories, Canada; Precambrian Research, v. 81, p. 265–297.

Aspler, L.B., Höfer, C., and Harvey, B.J.A.
2000: Geology of the Henik, Montgomery, and Hurwitz groups, Sealhole and Fitzpatrick lakes area, Nunavut; Geological Survey of Canada, Current Research 2000-C12, 10 p. (online; http://www.nrcan.gc.ca/gsc/bookstore)

Beavon, R.V.
1976: Early Aphebian basaltic volcanism in the southern District of Keewatin, Northwest Territories; Canadian Journal of Earth Sciences, v. 13, p. 1003–1005.

Bell, R.T.
1968: Preliminary notes on the Proterozoic Hurwitz Group, Tavani (55K) and Kaminak Lake (55L) areas, District of Keewatin; Geological Survey of Canada, Paper 68-36, 17 p.
1970a: Preliminary notes on the Hurwitz Group, Padlei map area, Northwest Territories; Geological Survey of Canada, Paper 69-52, 13 p.
1970b: The Hurwitz Group-a prototype for deposition on metastable cratons; *in* Symposium on Basins and Geosynclines of the Canadian Shield, (ed.) A.J. Baer; Geological Survey of Canada, Paper 70-40, p. 159–169.
1971: Geology of Henik lakes (east half) and Ferguson Lake (east half) map-areas, District of Keewatin; Geological Survey of Canada, Paper 70-61, 31 p.

Christie, K.W., Davidson, A., and Fahrig, W.F.
1975: The paleomagnetism of Kaminak dikes - no evidence of significant Hudsonian plate motion; Canadian Journal of Earth Sciences, v. 12, p. 2048–2064.

Heaman, L.M.
1994: 2.45 Ga global mafic magmatism: Earth's oldest superplume? *in* Abstracts of the Eighth International Conference on Geochronology, Cosmochronology and Isotope Geology, (ed.) M.A. Lauphere, G.B. Dalrymple, and B.D. Turrin; United States Geological Survey, Circular 1107, p.132.

Davidson, A.
1970: Precambrian geology, Kaminak Lake map-area, District of Keewatin; Geological Survey of Canada, Paper 69-51, 27 p.

Donaldson, J.A. and de Kemp, E.A.
1998: Archean quartz arenites in the Canadian Shield: examples from the Superior and Churchill Provinces; Sedimentary Geology, v. 120, p. 153–176.

Eade, K.E.
1974: Geology of Kognak River area, District of Keewatin, Northwest Territories; Geological Survey of Canada, Memoir 377, 66 p.

Friedmann, S.J. and Burbank, D.W.
1995: Rift basins and supradetachment basins: intracontinental extensional end-members; Basin Research, v. 7, p. 109–127.

Gibbs, A.
1987: Development of extension and mixed-mode sedimentary basins; *in* Continental Extensional Tectonics, (ed.) M.P. Coward, J.F. Dewey, and P.L. Hancock; Geological Society of London, Special Publication 28, p. 19–33.

Hanmer, S., Peterson, T.D., Sandeman, H.A.I., Rainbird, R.H., and Ryan, J.J.
1998a: Geology of the Kaminak greenstone belt from Padlei to Quartzite Lake, Kivalliq Region, Northwest Territories; *in* Current Research 1998-C; Geological Survey of Canada, p. 85–94.

Hanmer, S., Rainbird, R.H., Sandeman, H.A.I., Peterson, T.D., and Ryan, J.J.
1998b: Field contributions to thematic studies related to the Kaminak greenstone belt, Kivalliq Region, Northwest Territories; *in* Current Research 1998-C; Geological Survey of Canada, p. 77–84.

Hanmer, S., Tella, S., Sandeman, H.A., Ryan, J.J., Hadlari, T., and Mills, A.
1999: Proterozoic reworking in western Churchill Province, Gibson Lake–Cross Bay area, Northwest Territories (Kivalliq region, Nunavut). Part I: general geology; *in* Current Research 1999-C; Geological Survey of Canada, p. 77–84.

MacRae, N.N., Armitage, A.E., Miller, A.R., Roddick, J.C., Jones, A.L., and Mudry, M.P.
1996: The diamondiferous Akluilâk lamprophyre dyke, Gibson Lake area, N.W.T.; *in* Searching For Diamonds in Canada, (ed.) A.N. LeCheminant, D.G. Richardson, R.N.W. DiLabio, and K.A. Richardson; Geological Survey of Canada, Open File 3228, p. 101–107.

Patterson, J.G.
1991: The Spi Group: a post-Archean, pre-2.1 Ga rift succession, Trans-Hudson hinterland; Canadian Journal of Earth Sciences, v. 28, p. 1863–1872.

Peterson, T.D. and van Breemen, O.
1999: Review and progress report of Proterozoic granitoid rocks of the western Churchill Province, Northwest Territories (Nunavut); *in* Geological Survey of Canada, Current Research 1999-C, p. 119–128.

Relf, C., MacLachlan, K., and Irwin, D.
1999: Tectonic assembly and Proterozoic reworking of the northern Yathkyed greenstone belt, Northwest Territories (Nunavut); *in* Current Research 1999-C; Geological Survey of Canada, p. 139–146

Roddick, J.C. and Miller, A.R.
1994: An ^{40}Ar-^{39}Ar age from the REE-enriched Enekatcha ultrapotassic intrusive suite and implications for timing of ultrapotassic magmatism in the central Churchill Province, Northwest Territories; *in* Current Research 1994-F, Geological Survey of Canada, p. 69–74.

Schau, M.
1997: Geology of the Archean Prince Albert Group in the Richards Bay area, northeastern Melville Peninsula, District of Franklin, Northwest Territories; Geological Survey of Canada, Bulletin 385, 44 p.

Tella, S., Heywood, W.W., and Loveridge, W.D.
1985: A U-Pb age from a quartz syenite intrusion, Amer Lake, District of Keewatin; a part of the Churchill structural province; *in* Current Research, Part B; Geological Survey of Canada, Paper 85-1B, p. 367–370.

Tella, S., LeCheminant, A.N., Sanborn-Barrie, M., and Venance, K.E.
1997: Geology and structure of parts of MacQuoid Lake map area, District of Keewatin; *in* Current Research 1997-C; Geological Survey of Canada, p. 123–132.

Young, G.M.
1973: Tillites and aluminous quartzites as possible time markers for Middle Precambrian (Aphebian) rocks of North America; *in* Huronian Stratigraphy and Sedimentation, (ed.) G.M. Young; Geological Association of Canada, Special Publication 12, p. 97–127.