Geological Survey
of Canada

Current Research
2000-C9

Sequence stratigraphy and sedimentology of the Paleoproterozoic Baker Lake Group in the Baker Lake Basin, Thirty Mile Lake, Nunavut

T. Hadlari and R.H. Rainbird

2000

Natural Resources Canada   Ressources naturelles Canada

Canada

Catalogue No. M44-2000/C9E-IN
ISBN 0-660-18028-6

Available in Canada from the
Geological Survey of Canada Bookstore website at:
http://www.nrcan.gc.ca/gsc/bookstore (Toll-free: 1-888-252-4301)

A copy of this publication is also available for reference by depository libraries across Canada through access to the Depository Services Program's website http://dsp-psd.pwgsc.gc.ca. A list of these libraries can be consulted at this site or obtained by calling the toll-free number above.

Price subject to change without notice

Authors' addresses

T. Hadlari *(hikintom@passport.ca)*
Ottawa-Carleton Geoscience Centre
Department of Earth Sciences
Carleton University
Ottawa, Ontario K1S 5B6

R.H. Rainbird *(rrainbir@NRCan.gc.ca)*
Continental Geoscience Division
Geological Survey of Canada
601 Booth Street
Ottawa, Ontario K1A 0E8

Sequence stratigraphy and sedimentology of the Paleoproterozoic Baker Lake Group in the Baker Lake Basin, Thirty Mile Lake, Nunavut[1]

T. Hadlari and R.H. Rainbird

Continental Geoscience Division, Ottawa

Hadlari, T. and Rainbird, R.H., 2000: Sequence stratigraphy and sedimentology of the Paleoproterozoic Baker Lake Group in the Baker Lake Basin, Thirty Mile Lake, Nunavut; Geological Survey of Canada, Current Research 2000-C9, 10 p. (online; http://www.nrcan.gc.ca/gsc/bookstore)

Abstract: In the Thirty Mile Lake area of the Baker Lake Basin, lithofacies assemblages representing alluvial fan, gravel- and sand-bed braided stream, lacustrine, and ephemeral lacustrine depositional environments characterize the lower part of the ca. 1.83 Ga Baker Lake Group. Five depositional sequences that unconformably overlie Archean basement are identified from this interval. These depositional sequences record the following accommodation cycles: initial base-level drop, subsequent base-level rise, increase in gradient as accommodation increased, decrease in gradient as accommodation space filled, and continued base-level rise. Sequences stack in a retrogradational pattern indicating that, for the interval recorded, accommodation space creation exceeded sediment flux and the basin was underfilled. Subsidence probably was due mainly to normal faulting on the southern margin of the basin. Alkalic volcanism occurred throughout the early depositional history of the Baker Lake Basin.

Résumé : Dans la région du lac Thirty Mile du bassin de Baker Lake, des assemblages de lithofaciès représentant des milieux de dépôt de cônes alluviaux, de cours d'eau anastomosés à lit de gravier et de sable, de lacs et de lacs éphémères caractérisent la partie inférieure du Groupe de Baker Lake (1,83 Ga). On peut y reconnaître cinq séquences sédimentaires qui reposent en discordance sur le socle archéen. Ces séquences sédimentaires reflètent les cycles suivants : d'abord baisse du niveau de base, puis remontée du niveau de base, augmentation du gradient conjuguée à l'augmentation de l'accommodation, diminution du gradient lors du remplissage et remontée du niveau de base. Les séquences sont empilées dans une configuration de régression, ce qui suggère que pour l'intervalle conservé, la création d'espace par accommodation a dépassé l'influx de sédiments et le bassin n'a pas été rempli. La subsidence a probablement été causée principalement par fracturation normale sur la marge sud du bassin. Il y a eu volcanisme alcalin pendant toute la période initiale de l'histoire sédimentaire du bassin de Baker Lake.

[1] Contribution to the Western Churchill NATMAP Project

INTRODUCTION

This report is part of an ongoing study to characterize both sequence stratigraphy and chronostratigraphy of the Baker Lake Basin, for the purpose of constructing an integrated tectonostratigraphic model. Previous geological mapping of the Baker Lake Basin on a regional scale provided a lithostratigraphic subdivision of the Dubawnt Supergroup (Fig. 1) (Gall et al., 1992). In an attempt to decipher the tectonic evolution of the basin, we have investigated well exposed segments of the basin in detail emphasizing sequence stratigraphic analysis to identify genetic packages of strata related to tectonically controlled basin-filling rhythms. Relatively thick stratigraphic sections of the basin margin strata are exposed at the western edge of Thirty Mile Lake. Three sections have been measured and correlated, yielding data on five depositional sequences (Fig. 2, 3).

GEOLOGICAL SETTING

The Baker Lake Basin is one of a series of northeast-trending intracontinental basins hosting terrestrial siliciclastic and volcanic rocks that extends from Dubawnt Lake to Baker Lake (Fig. 1). Basin fill comprises the Dubawnt Supergroup. The strata dip into the basin, are bounded and rotated by brittle faults, and are unmetamorphosed. On the southern margin of the basin the Dubawnt Supergroup unconformably overlies rocks of the Archean MacQuoid–Gibson supracrustal belt (Tella et al., 1997) and the 1.9 Ga Kraminituar metamorphic complex (Sanborn-Barrie, 1994).

Three major unconformity bounded stratigraphic units in the Baker Lake Basin correspond to the three-part subdivision of the Dubawnt Supergroup proposed by Gall et al. (1992) and modified by Rainbird and Hadlari (2000)(Fig. 1), 1) the Baker Lake Group comprising the South Channel, Kazan, Christopher Island, and Kunwak formations, represent alluvial fan, fluvial-lacustrine, volcanic, and volcaniclastic deposits respectively (age is poorly constrained to ca. 1.83 Ga by intrusive equivalents of ultrapotassic volcanic rocks of the Christopher Island formation — *see* Peterson and van Breemen, 1999); 2) the Wharton Group comprises the Amarook Formation sandstone and overlying the 1.76 Ga Pitz Formation volcanic and sedimentary rocks (Rainbird and Hadlari, 2000); and 3) the lower parts of the Thelon Formation of the Barrensland Group, including conglomerate and sandstone that represent fluvial and eolian deposits.

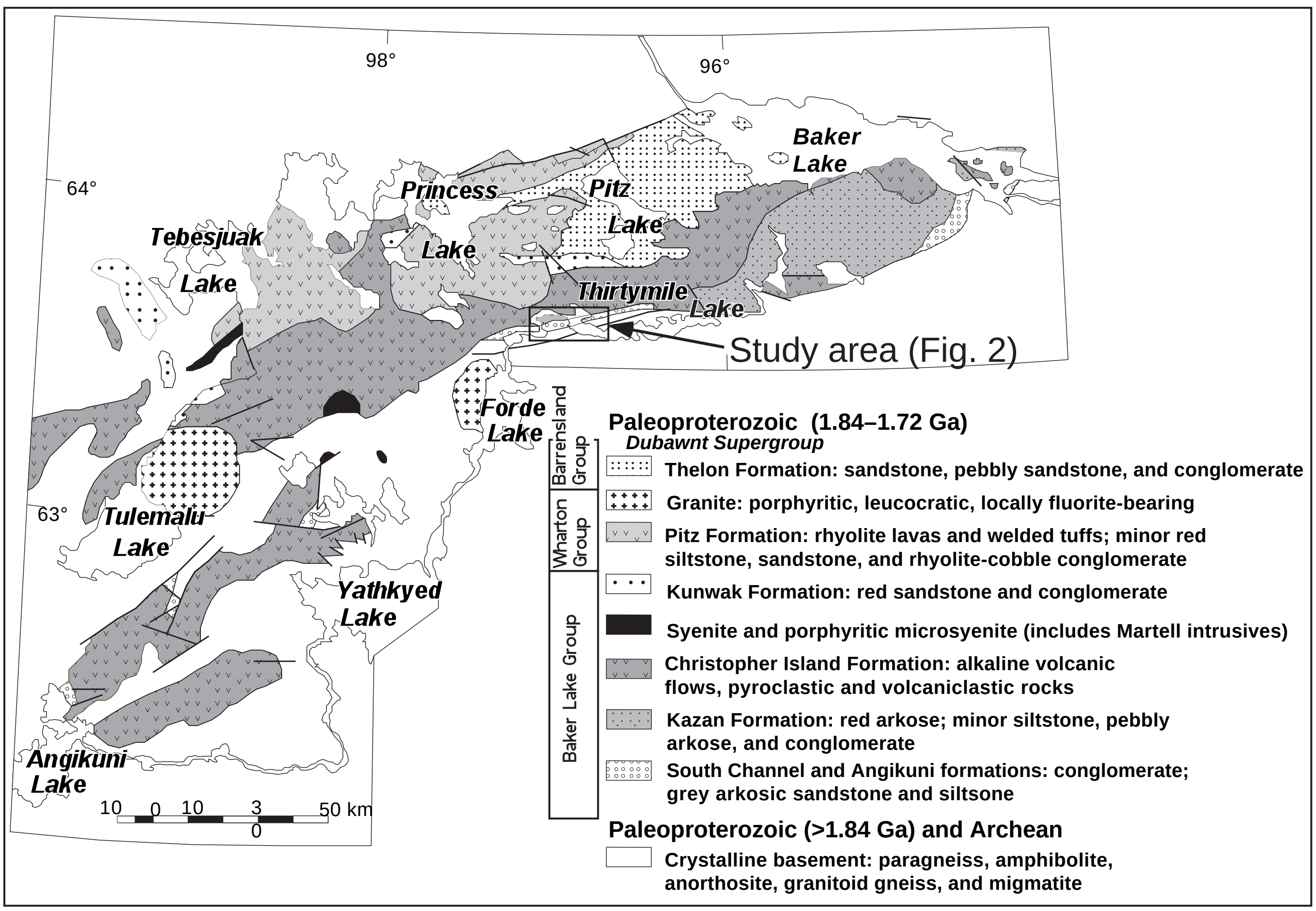

***Figure 1.** Geology of the Baker Lake Basin and the Thirty Mile Lake study area (*after *Donaldson, 1965, 1967; LeCheminant et al., 1979, 1981; Blake, 1980).*

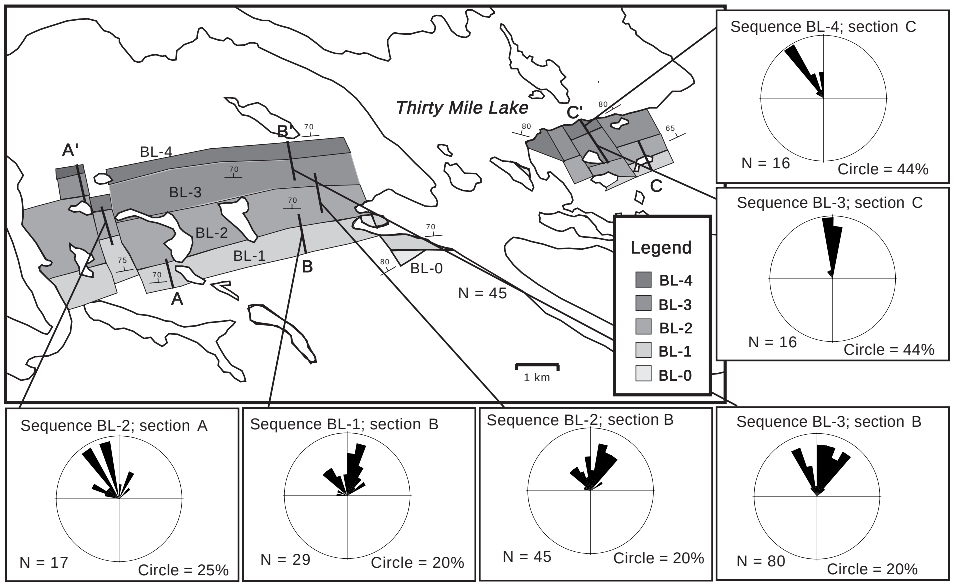

Figure 2. *Location of Thirty Mile Lake map area showing distribution of depositional sequences and corresponding paleocurrents.*

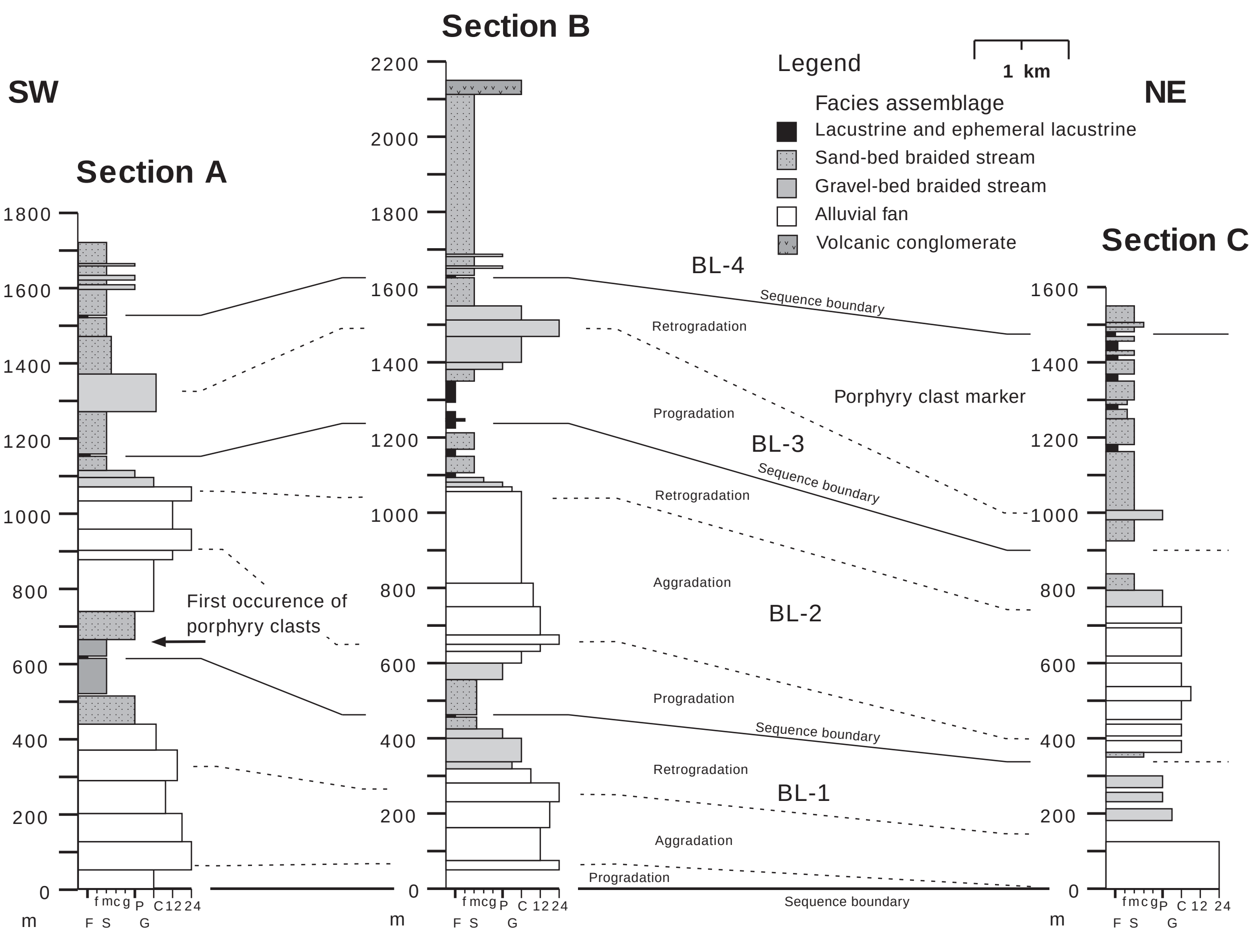

Figure 3. *Stratigraphic sections showing correlation of sequences BL-1 to BL-4 from the Thirty Mile Lake area. Grain size: F = silt and mud; S = sand; and G = gravel.*

In the Thirty Mile Lake area undeformed, east-north-east-trending units of conglomerate, sandstone, and volcanic strata of the Baker Lake Group unconformably overlie the Gibson–MacQuoid greenstone belt (Tella et al., 1997). Previous mapping (Donaldson, 1965, 1967; LeCheminant et al., 1979; Miller, 1980) has described a basal unit of sandstone termed the South Channel Formation conglomerate, Kazan Formation sandstone, and Christopher Island Formation volcanic rocks. Volcanology of the Christopher Island Formation from the northeast portion of the Baker Lake Basin, including the Thirty Mile map area, has been described in detail by Blake (1980).

FACIES ASSEMBLAGE DESCRIPTIONS AND INTERPRETATIONS OF THE LOWER BAKER LAKE GROUP, FROM THIRTY MILE LAKE

Facies assemblage 1: alluvial fan

Description

Facies assemblage 1 comprises clast-supported disorganized conglomerate (facies Gcd), clast-supported organized conglomerate (facies Gco), trough-filling conglomerate (facies Gt), trough cross-stratified sandstone (facies Stx), and minor parallel-laminated mudstone and siltstone (facies Fl) (Table 1).

The disorganized conglomerate (facies Gcd; Fig. 4) is cobble to boulder grade with an intact to condensed framework and a coarse- to fine-grained sand matrix. One metre to five metre beds contain diffuse internal stratification that often grades laterally to massive bedding. The lower surface of these beds is commonly erosional, and the beds vary laterally in thickness. Organized conglomerate (facies Gco; Fig. 5) describes thick to very thick beds (50 cm to 1 m) of cobble and pebble conglomerate that are horizontally stratified, and less commonly cross-stratified, with a condensed clast framework. Lenticular units of pebble and cobble conglomerate up to 1 m thick and 10 m wide are commonly cross-stratified and fine vertically and horizontally (facies Gt). Granite, tonalite, and amphibolite clasts appear to be locally derived from Archean basement, but a very minor component of sandstone and mudstone clasts of unknown source are also present.

The strata are vertically stacked in an organized manner. A typical bedset consists of 1) 1–3 m of disorganized conglomerate (facies Gcd) overlain by metre-scale channel-fill facies (facies Gt); or 2) a few metres of coarse, disorganized conglomerate (facies Gcd) succeeded by less coarse organized (facies Gco) conglomerate, channel-fill facies (facies Gt), and trough cross-stratified sandstone (facies Stx) or parallel-laminated mudstone and siltstone (facies Fl). Coupled fining-upward bedsets comprise fining-upward parasequences. Parasequences are stratigraphic units that are identified using

Table 1. Lithofacies of the Baker Lake Group. Facies codes are modified from Miall (1977) and Jo et al. (1997).

Facies	Description	Interpretation
Gm: matrix-supported conglomerate	Pebble- to cobble-grade clast; sand matrix; poorly sorted	Deposition by sediment gravity flows
Gcm: clast-supported massive conglomerate	Pebble-grade clast; coarse to medium sand matrix; moderately to well sorted; imbricated, intact framework; tabular geometry	Gravel bed, braided stream deposits
Gcd: clast-supported, disorganized to poorly organized conglomerate	Cobble- to boulder-grade clast; coarse to fine sand matrix; poorly to very poorly sorted; crude and irregular stratification; tabular geometry; erosional base	Gravel sheet or low-relief longitudinal bar deposits emplaced by high-magnitude flood flows
Gco: clast-supported, organized conglomerate	Pebble- to cobble-grade clast; granule to medium sand matrix; well to moderately sorted; organized framework; erosional base; wedge-shaped and tabular units	Gravel sheets and longitudinal bars emplaced by bedload processes during flood events
Gt: trough-filling conglomerate	Pebble- to cobble-grade clast; granule to sand matrix; normally graded; cross-stratified; lenticular units	Filling of channels, scours, and channel pools
Sh: horizontally stratified sandstone	Fine- to medium-grained sandstone; well to moderately sorted; may have pebble horizon at the base of units; planar lamination	Upper flow regime stratification
Stx: trough cross-stratified sandstone	Medium- to coarse-grained sandstone; medium to thick trough cross-stratification	Migration of 3-dimensional sandy dunes
St: trough cross-stratified sandstone	Fine- to medium-grained sandstone; inversely graded foresets; ripples preserved near bottomset; medium to very thick beds	Migration of subaerial 3-dimensional dunes
SFw: wavey bedded sandstone and siltstone-mudstone	Interstratified sandstone and siltstone-mudstone; asymmetric ripples and mud drapes; desiccation cracks; wavy bedding	Overbank, abandoned channel, or waning flood deposits
FSl: lenticular bedded mudstone and sandstone	Interstratified mudstone and fine-grained sandstone; symmetric ripples and mud drapes; lenticular bedding	Waning stages of bedload deposition and suspension deposition
Sr: sandstone with ripples	Mudstone with parallel laminated and/or cross-laminated siltstone or fine sandstone	Bedload deposition by low-velocity currents
Fl: parallel laminated siltstone and mudstone	Laminated sandstone with asymmetric ripples and minor mudstone	Prolonged periods of quiet-water suspension deposition
Sm: massive sandstone	Thin to thick beds, very poorly sorted sandstone and pebbly sandstone	Subaqueous deposition by high-density sediment gravity flows.

Figure 4. Clast-supported disorganized conglomerate (facies Gcd). Field book, for scale, is 20 cm long.

Figure 5. Clast-supported organized conglomerate (facies Gco). Horizontal stratification is defined by sandy bed tops. Boots for scale.

a hierarchical classification of bounding surfaces. Parasequences from facies assemblage 1 contain laterally discontinuous surfaces. They are bounded by laterally continuous, erosional surfaces that commonly overlie discontinuous units of cross-stratified sandstone (facies Stx) or laminated mudstone (facies Fl). Carbonate cement occurs predominantly as matrix infill within channel-fill facies (facies Gt).

Interpretation

Facies assemblage 1 is interpreted to have been deposited by high-magnitude floods and debris flows on an alluvial fan (cf. Jo et al., 1997). Disorganized conglomerate (facies Gcd) probably represents debris-flow deposits, or bed-load gravel sheet flood deposits. Organized conglomerate (facies Gco) may represent thin gravel sheets, or longitudinal braid bars. Lenticular units of cross-stratified conglomerate are interpreted to be channel-fill deposits (facies Gt). Small-scale sedimentary cycles described as parasequences are considered to be related to lobe accretion and channel switching processes. Carbonate cements are possible calcrete deposits.

Facies assemblage 2: gravel-bed braided stream

Description

Facies assemblage 2 comprises clast-supported, massive conglomerate (facies Gcm), and trough cross-stratified sandstone (facies Stx) (Table 1). Cobble and pebble conglomerate is massive, has a condensed clast framework, and coarse sand to granule matrix. Medium to thick, trough cross-stratified sandstone beds occur as distinct bedsets up to a few metres thick. Cobble conglomerate is laterally discontinuous, delineating 100 m scale channels. Constituent clasts of granite, tonalite, and amphibolite are similar to those in facies assemblage 1. However, at a distinct stratigraphic level (Fig. 3), porphyry clasts that are interpreted to be hypabyssal equivalents of the Christopher Island Formation volcanic rocks, form as much as about 40% of the conglomerate framework. This facies assemblage typically occurs between alluvial fan deposits of facies assemblage 1 and sand-bed braided stream deposits of facies assemblage 3.

Interpretation

The massive pebble conglomerate and trough cross-stratified sandstone units are probably gravel-bed braided stream deposits (cf. Miall, 1977). They lack the organized stacking pattern of the alluvial fan deposits, and were probably deposited on a lower gradient such as at, or beyond the toe of an alluvial fan system.

Facies assemblage 3: sand-bed braided stream

Description

Facies assemblage 3 comprises trough cross-stratified sandstone and pebbly sandstone (facies Stx), with minor horizontally stratified sandstone (facies Sh) and trough cross-stratified sandstone with inversely graded foresets (facies St). Medium to thick beds of medium-grained, trough cross-stratified sandstone and pebbly sandstone contain rare angular mud pebbles and granules. The stacking pattern is monotonous, although carbonate-cemented beds are present at irregular intervals. Where vertical patterns are discernable fine-grained, trough cross-stratified sandstone with inversely graded foresets, may occur as medium to thick beds at the top of fining-upward bedsets of pebbly sandstone and sandstone.

Interpretation

The predominance of medium-grained, trough cross-stratified sandstone and the absence of overbank fines or channel-lag conglomerate units suggest that this facies assemblage represents sand-bed braided stream deposits (cf. Miall, 1977). Inversely graded foresets of medium- to thick-bedded crossbeds are interpreted as wind ripple lamination (cf. Hunter 1977), indicating that the sand was subject to reworking by subaerial processes.

Facies Assemblage 4: Lacustrine and ephemeral lacustrine

Description

Facies assemblage 4 comprises wavy bedded sandstone and mudstone (facies Sfw; Fig. 6, 7), lenticular-bedded mudstone and sandstone (facies Fsl; Fig. 8), parallel laminated siltstone and mudstone (facies Fl), minor trough cross-stratified sandstone (facies Stx), and rare trough cross-stratified sandstone with inversely graded foresets (facies St; Fig. 9).

Asymmetric sandstone ripples and mud drapes of the wavy bedded sandstone and mudstone facies (facies SFw) are associated with desiccation cracks and carbonate-cemented horizons. Lenticular bedded mudstone and sandstone (facies FSl) is characterized by bifurcating symmetrical ripples, and the apparent absence of desiccation cracks and carbonate-cemented horizons.

Interpretation

Facies assemblage 4 is interpreted to represent a lacustrine to ephemeral lacustrine depositional environment (cf. Martell and Gibling, 1991). Desiccation cracks and asymmetrical ripples in the wavy bedded facies (facies SFw) indicate subaerial exposure between flood events. Water level was probably low enough that small-scale fluctuations in base level exposed the substrate.

The predominance of wave ripples within the lenticular bedded facies (facies FSl) and the apparent absence of desiccation cracks suggest that deposition occurred above storm wave base in a lacustrine environment. The wave-rippled sandstone laminae with mudstone drapes are inferred to record waning episodes of bedload deposition associated with wave action, followed by periods of suspension deposition.

Figure 6. *A starved ripple of sandstone on a substrate of siltstone overlain by laminated sandstone and siltstone, from the rippled sandstone facies (facies Sr).*

Figure 8. *Interstratified sandstone and mudstone-siltstone of the lenticular bedded facies (facies Fsl).*

Figure 7. *Asymmetric current ripples oriented perpendicular to symmetric wave ripples from the sandstone with ripples facies (facies Sfw).*

Figure 9. *Inversely graded foresets from a 1.5 m crossbed set. Interpreted as wind ripple lamination.*

Facies assemblage 5: turbidite

Description

Facies assemblage 5 consists of mudstone, sandstone, and conglomerate that form three broad associations that lack carbonate-cemented horizons, 1) interstratified sandstone and mudstone (facies Sr/Fl; Fig. 10, 11) with graded beds and laminae, climbing ripples, starved ripples, and mud microclast laminae; 2) massive to crudely stratified, very poorly sorted, sandstone and pebbly sandstone (facies Sm); and 3) sandy-matrix supported to crudely intact conglomerate (facies Gm), massive to crudely stratified, with prominent graded bedding.

Interpretation

Graded bedding, climbing ripples, and mud microclast laminae of lithofacies Sr/Fl resemble low-density sediment gravity flow deposits (cf. Stow and Shanmugan, 1980; Oaie, 1998). The sandstone (facies Sm) and conglomerate (facies Gm) resemble deposits of high-density sediment gravity flows (cf. Lowe, 1982). Within the context of the overlying alluvial-fluvial-lacustrine strata, a subwavebase, lacustrine delta front depositional environment is tentatively proposed.

Figure 10. *Laminated sandstone and very thin beds of low-angle cross-stratified sandstone, overlain by thin, graded beds.*

Figure 11. *Convolute lamination in the lower sandstone bed, interpreted as a soft-sediment dewatering structure. Note that overlying laminae of fine sand and silt are normally graded and undeformed.*

STRATIGRAPHY

The established lithostratigraphy of the Baker Lake Group consists of, from oldest to youngest, the South Channel, Kazan, Christopher Island, and Kunwak formations (Donaldson, 1965, 1967; LeCheminant et al., 1981, and Gall et al., 1992). Basal conglomerate was termed the South Channel Formation, and overlying sandstone and mudstone has been described as the Kazan Formation. Conformably overlying and interbedded volcanic, pyroclastic, and volcaniclastic rocks were described as the Christopher Island Formation. The Kunwak Formation refers to conglomerate that overlies Christopher Island Formation volcanic rocks.

In our measured sections from Thirty Mile Lake (Fig. 3), conglomerate typically dominates the lowest stratigraphic levels and sandstone the upper ones. However, there are several cycles capped by fine-grained rocks so this simple South Channel versus Kazan lithostratigraphic subdivision is inadequate for detailed field mapping and basin analysis. As well, alkalic porphyry clasts, similar to intrusive feeders to the Christopher Island Formation flows, occur in conglomerate mapped as South Channel Formation, only 400 m above the basal unconformity (Fig. 3). These strata therefore may be coeval with volcanic rocks of the Christopher Island Formation that outcrop north of the study area. Rainbird et al. (1999) suggested that, at the east end of Baker Lake, Christopher Island volcanism was coeval with sedimentation on the basis of soft-sediment deformation of the Kazan Formation sandstone adjacent to alkalic (minette) dykes. Clearly a layer-cake stratigraphic subdivision of the Baker Lake Group is inappropriate for detailed basin analysis. To communicate genetic relationships within a more detailed stratigraphic framework, a sequence stratigraphic approach has therefore been adopted for this study.

SEQUENCE STRATIGRAPHY: ANALYSIS AND DEFINITION

Within the study area, five stratigraphic units (BL-0 to BL-4), interpreted as depositional sequences (i.e. bounded by unconformities or correlative unconformities; Vail et al. 1977), have been mapped and correlated in three measured sections (Fig. 3).

In the Precambrian, the absence of hardground indicators such as rhyzoliths or burrows makes sequence boundary identification difficult. An interpreted hierarchy of bounding surfaces and stratigraphic pattern is therefore crucial. Sequence boundaries in sections A, B, and C (Fig. 3) occur in lacustrine facies with apparently conformable contacts. Each depositional sequence in the study area records initial progradation (basinward stepping of facies), subsequent aggradation (no vertical change in facies), and retrogradation (back-stepping of facies). These patterns are defined by the relative stacking of fluvial parasequences. Each fluvial parasequence is a fining-upward package on the scale of a few metres to tens of metres. An example from the alluvial fan facies assemblage would consist of coupled, fining-upward bedsets.

Sequence BL-0 was observed at one outcrop locality (Fig. 2). It consists entirely of the turbidite-facies assemblage that apparently underlies sequence BL-1, with a discordant bedding attitude. Contact relationships were not observed, but on the basis of bedding attitude and the presence of rounded mud clasts in the overlying sequence, an angular unconformity may exist between sequences BL-0 and BL-1.

Elsewhere, sequence BL-1 unconformably overlies crystalline basement. The progradational parasequence set of gravel-bed braided stream to alluvial fan facies assemblages, at the base of sequence BL-1, is thin and laterally discontinuous, perhaps a function of paleotopography. The aggradational parasequence set of the alluvial fan facies assemblage is thicker than the progradational set, and laterally continuous. Retrogradation is marked by a transition from alluvial fan deposits to gravel-bed braided stream, sand-bed braided stream, and ephemeral lacustrine deposits. The upper sequence boundary of sequence BL-1 is marked by the most distal unit, a thick mudstone bed.

In sequence BL-2 a relatively thin prograding parasequence set is marked by the transition from ephemeral lacustrine, to sand-bed braided stream, and alluvial fan deposits. Aggradation of the alluvial fan deposits is succeeded by retrogradation — alluvial fan, to gravel-bed braided stream, sand-bed braided stream, ephemeral lacustrine (facies SFw), and lacustrine (facies FSl) deposits. The upper sequence boundary is marked by a single 1.5 m thick eolian crossbed set (facies St) bounded by wave ripple dominated, lenticular bedding (facies FSl). Feldspar porphyry dykes are present within the lower sequences (BL-1, BL-2); the first porphyry clast occurs at the base of sequence BL-2 (Fig. 3).

At the base of sequence BL-3 is a prograding parasequence set of lacustrine through to gravel-bed braided stream deposits. The coarsest conglomerate in this sequence does not display features typical of alluvial fan facies (such as high-magnitude flood deposits, debris-flow deposits, and a high order of stratigraphic organization). Significant lateral variation over hundreds of metres is consistent with channelized flow, rather than unconfined flow as would be expected on an alluvial fan. Retrogradation to sand-bed braided stream deposits dominates the upper part of sequence BL-3. In a relatively proximal facies (section B, Fig. 3) the upper sequence boundary is marked by an eolian crossbed within a fluvial sandstone succession. At section A (Fig. 3) the upper sequence boundary, marked by an eolian crossbed set, is overlain by a thick bed of mudstone. In a more distal facies (section C, Fig. 3), it is marked by ephemeral lacustrine and overbank deposits of interstratified sandstone and mudstone, overlain by coarse sandstone and pebbly sandstone braided stream deposits. Feldspar porphyry clasts are abundant, locally composing up to about 40% of the conglomerate framework, and are a useful stratigraphic marker in the study area.

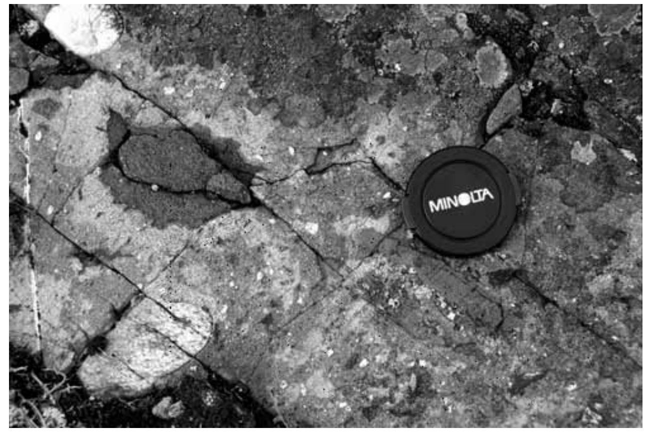

Figure 12. *Volcanic breccia with granitoid, volcanic, and cognate volcanic clasts.*

Sequence BL-4 is incomplete. It is best exposed at section B where it mainly consists of braided stream deposits of facies assemblage 3. At various intervals, medium beds of fine-grained eolian facies are interbedded with fluvial sandstone. At the northern limit of exposure volcanic breccia and conglomerate lie conformably above this succession of sandstone. Volcanic breccia with basement clast lithologies and volcanic clasts, and a variably siliciclastic to volcaniclastic matrix was observed at the contact, which may suggest that volcanism was coeval with sedimentation. Along strike from the volcanic conglomerate is a volcanic breccia zone crosscutting sandstone, both of which are overlain by stratified volcanic breccia which we interpret to represent a volcanic vent deposit of the Christopher Island Formation (Fig. 12).

DISCUSSION

Accommodation is defined as the space made available for a sedimentary system to fill. In nonmarine basins, subaqueous accommodation is controlled by base level (e.g. lake level) and subsidence. Subaerial accommodation is mostly subsidence driven, and is the space that the fluvial system has to fill in order to maintain, or establish, its grade to base level (Fig. 13) (*see* Krapez, 1996 and references therein). On the basis of a hierarchy of bounding surfaces and stratigraphic pattern, sequences BL-1 to BL-4 have been interpreted as third-order depositional sequences, or accommodation cycles. These accommodation cycles record a pulse, or pulses, of accommodation space creation, and the filling of that space by the alluvial-fluvial-lacustrine system.

In the Baker Lake Basin, generation of accommodation space and base-level change appear to be related, displaying a characteristic dynamic within each accommodation cycle. The first stage of a complete accommodation cycle is an initial base-level drop followed by base-level rise. This is most clearly expressed in section B (Fig. 3), at the sequence boundary between BL-2 and BL-3, where a single 1.5 m eolian crossbed (facies St) lies within a succession of wave ripple dominated lenticular-bedded mudstone and sandstone (facies FSl). Base level was high enough to support a lacustrine

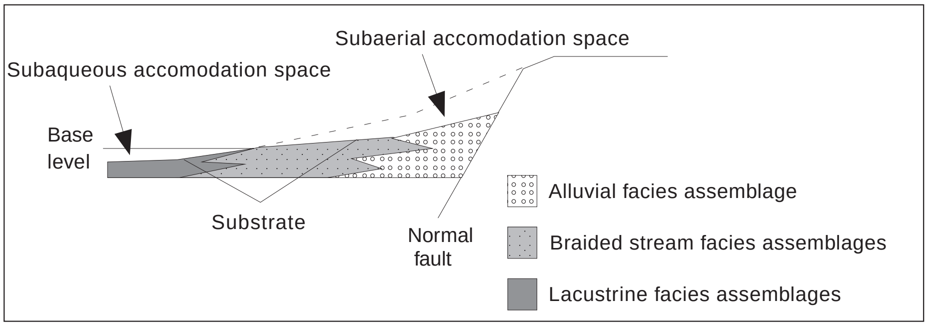

Figure 13. *Schematic diagram showing subaqueous and subaerial accommodation space, and relative facies locations with respect to basin margin fault.*

environment, but when it dropped the substrate was exposed to eolian processes as displayed by deposition of eolian crossbeds. Subsequent base-level rise restored the lacustrine environment.

Increasing accommodation space creation is recorded by progradation of facies responding to an increase in gradient. Progradational parasequence sets are thinner than the overlying aggradational or retrogradational parasequence sets, indicating that maximum gradient was achieved quite rapidly. In sequences BL-1 and BL-2, the maximum gradient is marked by an alluvial fan facies assemblage. In sequences BL-3 and BL-4, it is marked by gravel-bed and sand-bed braided stream facies assemblages respectively.

As accommodation space was filled, gradient decreased and facies retrograded. Where direct interaction with base level is not preserved, facies reflect a minimum gradient (overbank, abandoned channel, or drape deposits). During the latter stages of the accommodation cycle, base level continued to rise, until the next cycle begins with a sharp base-level drop, which may be marked by an eolian facies.

Going from sequences BL-1 to BL-4, relative base level at the southern margin of the Baker Lake Basin seems to have dropped, as indicated by an increase in eolian facies relative to fully lacustrine facies. The wave dominated lenticular-bedded facies (FSw) was not observed above sequence BL-2. This could have been due to an overall increase in the volume of the basin relative catchment area, or may be due to increased potential of the basin fill (relative to the crystalline basement) to act as a subsurface reservoir for transporting fluid basinward.

By determining the stacking pattern of depositional sequences, accommodation on the scale of the basin can be elucidated. Sequences BL-1 to BL-4 are stacked in a retrogradational pattern (Fig. 3). Therefore in the Baker Lake Basin, for the interval recorded, sediment flux was exceeded by accommodation space creation, and at the basin scale, accommodation was underfilled.

Rapid accommodation space generation can be achieved if the subsidence mechanism is normal faulting. For the Baker Lake Basin, the linear nature of the basin margin, paleocurrents directed normal to the basin margin (Fig. 2), and rapid increases in gradient recorded by alluvial fan deposits support this hypothesis. The central part of the map area (sections A and B) contains more proximal facies throughout the succession, suggesting that this area may have been a footwall-channel entrance into the basin. Continuity of the locus of proximal deposition argues against an appreciable strike-slip component to basin margin faulting.

CONCLUSIONS

Lithofacies assemblages representing alluvial fan, gravel- and sand-bed braided stream, lacustrine and ephemeral lacustrine depositional environments characterize the lower part of the Baker Lake Group along the southern margin of the Baker Lake Basin in the Thirty Mile Lake area. Depositional sequences BL-1, BL-2, BL-3, and BL-4 represent accommodation cycles defined by an initial drop and subsequent rise in base level, a pulse in accommodation space creation reflected by an increase in gradient, a decrease in gradient as accommodation space was filled, and continued base-level rise. Together these depositional sequences stack in a retrogradational pattern, indicating that accommodation space creation exceeded sediment flux.

These observations suggest that the primary subsidence mechanism on the southern margin of the Baker Lake Basin was normal faulting. This is supported by paleogeographic information such as paleocurrents directed northward into the basin, a linear basin margin, and high gradients recorded by alluvial fan deposits. The presence of porphyry clasts interpreted to represent hypabyssal equivalents to Christopher Island Formation volcanic rocks indicates that alkalic volcanism occurred during the early depositional history of the Baker Lake Basin.

ACKNOWLEDGMENTS

The authors would like to thank Boris and Liz Kotelowetz of the Baker Lake Lodge for dependable expediting and accommodation. The manuscript benefited from comments by and discussions with K. Bradshaw, J.A. Donaldson, S. Hanmer, and F.W. Chandler. Sandra Ookout provided valuable field assistance.

REFERENCES

Blake, D.H.
1980: Volcanic rocks of the Paleohelikian Dubawnt Group in the Baker Lake-Angikuni Lake Area, District of Keewatin, N.W.T.; Geological Survey of Canada, Bulletin 309, 39 p.

Donaldson, J.A.
1965: The Dubawnt Group, District of Keewatin and Mackenzie; Geological Survey of Canada, Paper 64-20, 11 p.

1967: Study of the Dubawnt Group; *in* Report of Activities, Part A; Geological Survey of Canada, Paper 67-1A, p. 23–25.

Gall, Q., Peterson, T.D., and Donaldson, J.A.
1992: A proposed revision of early Proterozoic stratigraphy of the Thelon and Baker Lake basins, Northwest Territories; *in* Current Research, Part C; Geological Survey of Canada, Paper 92-1C, p. 129–137.

Hunter, R.E.
1977: Terminology of cross-stratified sedimentary layers and climbing-ripple structures; Journal of Sedimentary Petrology, v. 47, p. 697–706.

Jo, H.R., Rhee, C.W., and Chough, S.K.
1997: Distinctive characteristics of a streamflow-dominated alluvial fan deposit: Sanghori area, Kyongsang Basin (Early Cretaceous), southeastern Korea; Sedimentary Geology, v. 110, p. 51–79.

Krapez, B.
1996: Sequence stratigraphic concepts applied to identification of basin-filling rhythms in Precambrian successions; Australian Journal of Earth Sciences, v. 43, p. 355–380.

LeCheminant, A.N., Iannelli, T.R., Zaitlin, B., and Miller A.R.
1981: Geology of Tebesjuak Lake Map Area, District of Keewatin: a progress report with notes on Uranium and base metal mineralization; *in* Current Research, Part A; Geological Survey of Canada, Paper 80-1A, p. 339–346.

LeCheminant, A.N., Leatherbarrow, R.W., and Miller, A.R.
1979: Thirty Mile Lake Map Area, District of Keewatin; *in* Current Research, Part B; Geological Survey of Canada, Paper 79-1B, p. 319–327.

Lowe, D.R.
1982: Sediment gravity flows: II. Depositional models with special reference to the deposits of high density turbidity currents; Journal of Sedimentary Petrology, v. 52, p. 279–297.

Martell, A.T. and Gibling, M.R.
1991: Wave-dominated lacustrine facies and tectonically controlled cyclicity in the lower Carboniferous Horton Bluff Formation, Nova Scotia, Canada; *in* Lacustrine Facies Ananlysis, (ed.) P. Anadon, L. Cabrera, and K. Kelts; Special Publication of the International Association of Sedimentologists, v. 13, p. 223–243.

Miall, A.D.
1977: A review of the braided river depositional environment; Earth Science Reviews, v. 13, p. 1–62.

Miller, A.R.
1980: Uranium geology of the eastern Baker Lake basin, District of Keewatin, Northwest Territories; Geological Survey of Canada, Bulletin 330, 63 p.

Oaie, G.
1998: Sedimentological significance of mudstone microclast intervals in Upper Proterozoic turbidites, central Dobrogea, Romania; Sedimentary Geology, v. 115, p. 289–300.

Peterson, T. D. and van Breemen, O.
1999: Review and progress report of Proterozoic granitoid rocks of western Churchill Province, Northwest Territories (Nunavut); *in* Current Research, Part C; Geological Survey of Canada, p. 119–127.

Rainbird, R.H. and Hadlari, T.
2000: Revised stratigraphy and sedimentology of the Dubawnt Supergroup at the northern margin of the Baker Lake Basin, Nunavut; Geological Survey of Canada, Current Research 2000-C8, 9 p. (online; http://www.nrcan.gc.ca/gsc/bookstore)

Rainbird, R.H., Hadlari, T., and Donaldson, J.A.
1999: Stratigraphy and Paleogeography of the Paleoproterozoic Baker Lake Group in the eastern Baker Lake basin, Northwest Territories (Nunavut); *in* Current Research 1999-C; Geological Survey of Canada, p. 43–54.

Sanborn-Barrie, M.
1994: Structural investigation of high-grade rocks of the Kramanituar complex, Baker Lake area, Northwest Territories; *in* Current Research 1994-C; Geological Survey of Canada, Paper 79-1A, p. 311–316.

Stow, D.A.V. and Shanmugan, G.
1980: Sequence of structures in fine-grained turbidites; comparison of recent deep-sea and ancient flysch deposits; Sedimentary Geology, v. 25. p. 23–42.

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

Vail, P.R., Mitchum, R.M., and Thompson, S.
1977: Global cycles of relative changes of sea level; American Association of Petroleum Geologists Memoir, v. 26, p. 83–97.

Geological Survey of Canada Project 970006-RR