DESCRIPTIVE NOTES

INTRODUCTION

The Schultz Lake area (NTS 66 A) lies within the Archean Rae domain of the Western Churchill Province (Fig. 1). The map area is underlain by a variety of Archean through Paleoproterozoic supracrustal and intrusive rocks, and has been the subject of geologic study several times in the last 50 years. This Open File represents a compilation at 1:250 00 based on sources as noted in Figure 2, and represents the geologic mapping contributions of Al Donaldson (1963–65), Tony LeCheminant (1983;1987–88), Al Miller (1980–1987), Fred Taylor (1980), Jack and Mariette Henderson (1994), Eva Zaleski (1998–2000), Rob Rainbird (1988, 1999, 2001), Thomas Hadlari (1999, 2001), Bruce Kjarsgaard (1997–1998), Tony Peterson (1988), and Sally Pehrsson (1999). Lawrence Aspler contributed significantly to a previous draft compilation. Previous relevant reports include Henderson and Henderson (1991), Zaleski et al. (1997, 1999a, b), Kerswill et al. (1999). Outcrop exposure is very good over the Half Way Hills north of Whitehills Lake but is poor near Judge Sissons and Princess Mary Lakes, and particularly poor in areas underlain by the Barrensland Group. The hamlet of Baker Lake, Nunavut is situated in the southeast corner of the map sheet.

MESOARCHEAN ROCKS

The oldest rock unit in the Schultz Lake map sheet is a well-foliated, gneissic granodiorite (unit Agd), with rare inclusions of banded mafic through felsic gneiss (Zaleski et al., 2001a), which underlies an area north of the Half Way Hills. The locally schistose, carbonate and chlorite-altered granodiorite host has been dated at ca. 2870 Ma by Zaleski et al. (2001b), who considered it to be basement to the Neoarchean Woodburn group. The unit has not been differentiated west of the Thelon River, owing to the limit of recent mapping by Zaleski et al. (2001a). We note, however that sporadic outcrops of tonalitic gneiss were found in the southwest corner of the map sheet and to the west in the Aberdeen Lake map sheet, where LeCheminant et al. (1983) mapped other intermediate gneissic magmatic rocks.

NEOARCHEAN ROCKS

The Woodburn group

Deformed and metamorphosed supracrustal rocks of the Neoarchean Woodburn group (Ashton; 1981) underlie much of the central part of the map area. Zaleski et al. (2000) subdivided the group in two general successions: 1) a lower succession consisting of interlayered ultramafic through felsic volcanic and volcaniclastic rocks with minor iron-formation and muscovite-bearing quartzite (units Am, Afvc, Aif, Aqz), all overlain by an extensive sequence of volcaniclastic to turbiditic wacke (unit Awkq); and 2) an upper succession of interbedded ortho- and feldspathic-quartzite, slate, phyllite, conglomerate, with minor mafic volcanic and reworked felsic volcanogenic rocks.

Ultramafic, mafic and felsic volcanic rocks of the lower succession underlie a belt of volcanic rocks north of Whitehills Lake that is dated at ca. 2734 ± 1 Ma (Zaleski et al., 2001b). This belt has a greater proportion of mafic pillow lavas than the typical lower succession to the north (Kjarsgaard et al., 1997). Mafic through felsic volcanic and volcaniclastic rocks and associated wackes underlie the Amarulik dome area and the region to the southwest. These units extend to the southwest of the main Woodburn group belt in the Amer map sheet (NTS 66 H), where the volcanic rocks yield ages of ca. 2720 and 2710 Ma (Davis and Zaleski, 1998). Roddick et al. (1992) previously obtained an age of ca. 2.78 Ga for the Amarulik wackes, but Zaleski et al. (2001b) re-interpreted these rocks as largely reworked volcaniclastic sedimentary rocks of maximum 2.68 Ga, with an older detrital zircon population.

Rocks of the upper succession of the Woodburn group may be present just south of Schultz Lake where thick quartzites with interlayered mafic and minor felsic volcanic rocks occur. The upper succession is interpreted to be ca. 2630 Ma (Zaleski et al., 2001b), based on ages of zircons from an interbedded reworked felsic volcanic rock in NTS 66 H. Pehrsson et al. (2002) proposed that this represents a maximum age for deposition of the upper succession, and the upper succession may actually represent the metamorphosed equivalents of the Paleoproterozoic Amer Group, which has strikingly similar facies associations.

Intrusive rocks

The region south of Whitehills Lake is underlain by the Akutuak gneiss (unit Atng), a foliated to gneissic granodiorite-tonalite-amphibolite complex. First named by Schau (NTS 56 D; Schau et al., 1982) from his work in the Baker Lake map sheet, it is intruded by inferred Archean granites and contains mappable screens of amphibolite and quartzite (Zaleski et al., 2001a). The Akutuak gneiss typically has blue-grey quartz eyes, a low mafic mineral content and minor biotite typically altered to chlorite. An imprecise Archean age has been obtained from the granodiorite component (Schau, 1980) which could either represent a synvolcanic equivalent of ca. 2.7 Ga Woodburn group volcanogenic rocks or a correlative of the superficially similar MesoArchean granodiorite north of Whitehills Lake. To the east, the amphibolite component defines two extensive mappable subunits; an older Archean layered amphibolite occurring as 100s of metre-thick horizons in the tonalite, and kilometric-scale metamorphosed sills or flows of uncertain Archean or Proterozoic affinity.

The dominant Archean intrusive rock in the map area is a pink to buff, biotite ± hornblende-magnetite granite (unit Agt) that forms large, folded, sheet-like laccoliths north and northeast of Schultz Lake. These rocks have been dated at ca. 2599–2620 Ga (Ashton, 1988; Roddick et al., 1992; Davis and Zaleski, 1998) and are variably deformed and recrystallized. In NTS 56 D, they comprise the Tehek plutonic complex (Schau et al., 1982). Similar, K-feldspar-phyric intrusions, between Princess Mary and Whitehills lakes, are tentatively assigned to this unit, which is correlated with the suite of 2.62–2.58 Ga granites noted throughout the Rae Province (Davis and Zaleski, 1998).

A foliated to gneissic granitoid unit (unit Ag) comprising variably deformed and metamorphosed biotite ± hornblende-bearing granodioritic, granitic and tonalitic rocks, extends from the Half Way Hills to Princess Mary Lake. Granitic components include K-feldspar megacrystic phases that may be correlative with unit Agt. Southeast of unit Atng to the shore of Baker Lake, unit Ag exhibits discontinuous, variable to high strain, exemplified by cataclasis and locally abundant metamorphosed and deformed amphibolite lenses. Mafic minerals such as biotite are typically altered to chlorite throughout this area. An unpublished age of 2694 Ma (LeCheminant and Roddick) has been obtained from a syenogranitic component north of Pitz Lake.

ARCHEAN OR PROTEROZOIC

A small body of diorite to granodiorite underlies the area north of Princess Mary Lake (unit APgd). Although roughly stock-like in character, similar to some of the Proterozoic granitoid rocks, its age is presently uncertain and it is designated Archean or Proterozoic.

PROTEROZOIC ROCKS

Ketyet River group

The Ketyet River group was informally introduced by Schau et al. (1982) to describe all metasedimentary rocks north of Baker Lake in NTS 56 D and, by extension, NTS 66 A. The group was subdivided into a northern volcanic-dominated and a southern more clastic-dominated association. Subsequent work revealed that the northern association represents rocks temporally and lithologically correlative with the Archean Woodburn group, whereas much of Schau's southern association represents a hitherto unrecognized Paleoproterozoic supracrustal sequence (Pehrsson et al., 2002). The informal names Ketyet River group and Woodburn group have been retained for the Proterozoic and Archean sequences, respectively.

The Ketyet River group can be divided into three parts: 1) A lower succession of conglomerate (unit Pqcg), quartz- and feldspathic arenite (unit Pqz), iron-formation (unit Pif), and mafic volcanic rocks (unit Pmi); 2) a middle succession of interbedded polymictic conglomerate (unit Pcg), wacke and mudstone, locally with a carbonate cement (unit Pwk) and rare hematitic iron-formation; and 3) an upper succession of wacke, sulphidic to graphitic pelite-semipelite, iron-formation, minor marble and calc-silicate rocks. The lower succession has a maximum age of 2.45 Ga (Pehrsson et al., 2002), whereas the middle succession has a maximum age of 2.0 Ga (Davis and Zaleski, 1998) both from U-Pb detrital zircon analysis. Iron-formation occurs in both the upper and lower successions in NTS 56 D, but is noted only the upper succession in NTS 66 A. Sulphidic-graphitic pelites occur in the upper succession in drill core from the vicinity of the Kiggaviq uranium deposit (A. Miller, pers. comm., 2002).

Dubawnt Supergroup

The southern edge of the map sheet overlaps the north margin of the Baker Lake sub-basin of the Dubawnt Supergroup (Fig. 1; Rainbird et al., 2003), a large intracontinental basin that straddles the Snowbird Tectonic Zone. The Dubawnt Supergroup is divided into three unconformity-bounded sequences, from oldest to youngest: 1) Baker Lake Group; 2) Wharton Group; and 3) Barrensland Group (Donaldson, 1965; Gall et al., 1992, Rainbird et al., 2003).

Baker Lake and Wharton groups

The Baker Lake Group is represented by a moderately south-dipping sequence of interbedded ultrapotassic volcanic rocks, conglomerate, and sandstone of the Christopher Island Formation (unit PCI). The sequence unconformably overlies Archean gneissic and plutonic rocks of the Chesterfield Fault Zone north of Baker Lake and map unit Agt north of Princess Mary and Pitz lakes. The unconformity is marked by a several metre-thick carbonate-rich regolith (Rainbird and Hadlari, 2000). Present constraints from Ar-Ar, Pb-Pb and U-Pb age dating of flows, cogenetic intrusions, and diagenetic cements suggest that the Baker Lake Group was deposited between 1840 Ma–1790 Ma, although the older age limit is poorly constrained (Rainbird et al., in press.).

The Baker Lake Group is in turn, unconformably overlain by the Wharton Group, comprising subarkosic eolian sandstone of the Amarook formation (unit PA; Rainbird and Hadlari, 2000) and overlying rhyolite, conglomerate and sandstone of the Pitz Formation (unit PP). The sub-Wharton Group unconformity cuts down through the Baker Lake Group in the Princess Mary Lake area where the Pitz and Amarook formations rest directly on Archean basement. U-Pb zircon ages of felsic flows indicate that the Wharton Group was deposited between 1760 and 1750 Ma (Rainbird et al., 2001).

Barrensland Group

The Barrensland Group is represented in the map area by the flat-lying to gently-dipping Thelon Formation (unit PT), a fluvial-eolian sandstone and conglomerate deposited on a significant regolith marked by pervasive quartz-hematite-illite-kaolinite, or at lower levels, chlorite-muscovite-dolomite alteration (unit PTr; Chiarenzelli, 1983; Gall, 1994). This regolith is best developed on basement rocks where the Baker Lake and Wharton groups are absent. The distribution of the Thelon Formation in the Schultz and Baker lakes vicinities, presence of small outliers northwest of Pitz Lake, subcrop on the top of the Half Way Hills, and extensive development of regolith between indicates that the Barrensland Group once covered the most of the map sheet. Deposition of the Thelon Formation is estimated to have commenced by 1720 Ma, based on a U-Pb age of apatite cement in the sandstone (Miller et al., 1989).

Intense hematitic alteration produces a consistent positive total field aeromagnetic anomaly with a broad, gently sloping high that overprints or obscures the magnetic signature of underlying lithologies. The extensive regolith developed between Schultz and Judge Sissons lakes and formation outliers indicate that the sub-Thelon unconformity surface lay very close to the present day topographic surface. Regolith alteration is associated with uranium mineralization (U), including the Kiggavik (Lone Gull) deposit (Miller, 1983; Fuchs and Hilger, 1989).

Intrusive rocks

The oldest known Proterozoic intrusive rocks in the map area are deformed, boudined metadiabase dykes and lenses (unit Pdb) noted west of Thelon River that have yielded a U-Pb baddelyite age of 2153 ± 4 Ma (LeCheminant and Roddick, unpublished data). These dykes locally occur in unit Agt near Whitehills and Baker lakes, and are similar in age to the extensive Macquoid dykes of NTS 55 M to the south.

Several small bodies of massive to weakly foliated, leucocratic, pink monzogranite dated at ca. 1835 Ma (Roddick et al., 1992) occur north of Whitehills Lake (unit Pgt). Minor dykes, sheets and sills of the suite occur throughout the map area and cut all metamorphosed and deformed rock units. They form part of the 1.84–1.80 Ga Hudson granitoid suite that occurs throughout the western Churchill Province (Peterson and van Breeman, 1999), and are known from the Aberdeen Lake area immediately west (LeCheminant et al., 1983).

The ca. 1810 Ma Martell syenites (unit PM; Schau et al., 1982; Rainbird et al., 2002) underlie several small islands in Whitehills Lake. These brown to red, hypabyssal syenites have distinctive hornfelsed contact aureoles with surrounding Ketyet River group wackes and are interpreted to be the cogenetic with alkalic Christopher Island Formation volcanics. Related syenite and phlogopite-lamprophyre dykes are numerous in the Whitehills area, but have not been differentiated at the scale of this compilation.

Two sets of unmetamorphosed diabase dykes transect the area. The older, northeast-trending set has been delineated largely from its aeromagnetic expression and cuts all units except the Thelon Formation. It is thought to be part of the 1750 Ma MacRae dyke swarm in NTS 66 B, which is interpreted to feed amygdaloidal basalts of the Pitz Formation (LeCheminant et al., 1983), however it is not differentiated from unit Pdb, owing to insufficient detail at this scale. The second northwest-trending set includes dykes up to 50 m wide that crosscut all units of the map area (unit PMdb). These are considered to be part of the 1267 Ma Mackenzie dyke swarm (LeCheminant and Heaman, 1989).

STRUCTURE AND METAMORPHISM

All rocks of the Schultz Lake map area are deformed and metamorphosed with the exception of the Dubawnt Supergroup, Martell syenites and younger diabase dyke swarms. The regional foliation compiled on this Open File is typically an S_1 or S_2 fabric, as established by more detailed mapping in the Whitehills Lake area (Zaleski et al., 2001a). These authors distinguished four main phases of regional deformation (D_1–D_4), within the middle Ketyet River group, thus constraining the regional tectonothermal events as younger than 2.0 Ga. These structures include east-northeast to northeast-trending, tight to recumbent to isoclinal F_1 folds, and north-west vergent mapscale F_2 folds and related faults (Zaleski et al., 2001a); minor, open to tight folds outcrop-scale, southeast-vergent F_3 folds, and open to tight, northerly-trending, upright, F_4 folds, such as the prominent kink in the Ketyet River group at Whitehills Lake. Dykes of the 1835 Ma Hudson granite suite vary from undeformed (Roddick et al., 1992) to locally folded by F_4 (Davis, unpublished data), suggesting significant heterogeneity of later Proterozoic deformation.

Regional metamorphism varies from greenschist facies over the Whitehills greenstone belt and Ketyet River group to middle or upper-amphibolite facies in Archean units across the map area. Low-pressure andalusite-staurolite facies assemblages are known from wackes of the Ketyet River group north and south Whitehills Lake. High-pressure garnet-amphibolite-clinopyroxene assemblages locally occur in unit Agcfz, near the community of Baker Lake.

The contact between a large package of rocks assigned to the Ketyet River group and underlying Archean rocks south of Schultz Lake, is interpreted to be a south-vergent thrust (A. Miller, pers. comm.). The character of the contacts of adjacent smaller occurrences of Ketyet River group are unknown and are assumed to be stratigraphic, as is the contact below the large infold north of Whitehills Lake, itself underlain by a local basal conglomerate.

Several northwest-vergent, post-metamorphic peak, low-angle thrust faults juxtapose rocks of greenschist and amphibolite facies at Whitehills Lake and/or place older Archean units atop the Ketyet River group (Zaleski et al., 2001a). They are delimited by high strain zones,metres to 10s of metres wide and locally by carbonate-chlorite alteration zones. These cannot be traced with certainty west of the Thelon River.

Schau et al. (1982) interpreted a multistage Neoarchean and ca. 1.9 Ga deformation history for the Chesterfield Fault Zone, which may extend into the east part of the map sheet. Preliminary thermobarometric data (Berman and Pehrsson, unpubl. data) suggests that this cryptic zone is the locus of a significant Proterozoic paleopressure discontinuity. The relationship between reworking of the Chesterfield Fault Zone and the various northwest-vergent late thrusts is not presently known.

It is to be expected that Archean deformation and/or metamorphism occurred in the Woodburn group and older rocks, however, the penetrative nature of Paleoproterozoic deformation and metamorphism has made it impossible to differentiate these, except locally at the outcrop or thin-section scale. The variable state of deformation within the both Archean and Proterozoic granite suites largely reflects heterogenous Proterozoic strain partitioning (Ashton (1988), Davis and Zaleski (1998), Zaleski et al. (2000)).

The Baker Lake and Wharton groups are both crosscut by east-striking normal faults, and northwest striking strike-slip faults (Rainbird and Hadlari, 2000; Hadlari and Rainbird, 2001). Principle separation and tilting predate deposition of the sub-horizontal overlying ca. 1720 Ma Thelon Formation (unit PT), and occurred during and after deposition of the Wharton Group at ca. 1750 Ma. The north–northwest trending brittle faults were subsequently re-activated and crosscut the sub-Thelon regolith (e.g. Kiggavik) and Thelon Formation with relatively minor offset.

ECONOMIC GEOLOGY

Rocks of the Schultz Lake area are host to the Kiggavik uranium deposit and related occurrences south of Schultz Lake (Fuchs and Hilger, 1989; Miller et al., 1989). Uranium occurs at the base contact of the Thelon Formation and in underlying Archean to Paleoproterozoic basement rocks. Elevated background concentrations or occurrences of Pb ± Cu, Ag, Mo and U are known from the Ketyet River Group in the Whitehills Lake area (Pehrsson et al., 2002; Zaleski et al., 2001a). Minor uranium occurrences are also present in NTS 56 D (Schau et al., 1982). Taylor (1985) reports galena occurrences in a Mesoarchean granodiorite body, and a number of galena-bearing veins were also found southwest of Whitehills Lake in unit Ag.

Base metal and polymetallic occurrences are known from the Amarulik wackes and Whitehills greenstone belt (Zaleski et al., 2001a). Gold is present in iron-formation of the Woodburn Lake group immediately north of the map area at Third Portage Lake (Meadowbank gold deposit), and within volcanic rocks of the Whitehills greenstone belt and Ni-Cr occurrences are noted in the komatiitic rocks of the Woodburn group (Zaleski et al., 2001a).

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