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GEOLOGICAL SURVEY OF CANADA | COMMISSION GÉOLOGIQUE DU CANADA

Introduction

The Whitehills-Tehek Lakes area is located in the District of Keewatin north of Baker Lake. The area was chosen for study in order to provide a geological map of an area partially mapped by several previous geological surveys (see below), and to establish the regional distribution of iron formation that hosts gold mineralization in the Third Portage Lake area (Barham & Mudry, 1990). Recent high resolution aeromagnetic total field and vertical magnetic gradient maps (Energy Mines and Resources Canada, 1990a, b, c, d) were useful to correlate iron formations and other magnetic lithologies. The map area comprises portions of four adjoining National Topographic System (NTS) 1:250 000 scale maps: 56D (Baker Lake), 66A (Schultz Lake), 66H (Amer Lake), and 56E (Woodburn Lake).

Location and Access

The south margin of the Whitehills-Tehek map area is 25 km north of Baker Lake village, which is served by regularly scheduled aircraft from Rankin Inlet. Baker Lake is accessible by ship from Hudson Bay and Chesterfield Inlet. The Thelon River, which empties into Baker Lake, provides shallow-draft boat access to the southwestern corner of the map area. Many lakes in the region are large enough for ice and water landings by fixed-wing aircraft, but there are very few natural sand and gravel air strips suitable for landing with wheeled aircraft.

Previous Work

The Whitehills-Tehek area comprises part of the central Keewatin region mapped in the 1950's by Wright (1955, 1957). Geological mapping at 1:250 000 scale in the western part of the Whitehills-Tehek area was done by Donaldson (1966, Schultz Lake, NTS 66A), in the northwest by Tella and Heywood (1983, Amer Lake, NTS 66H), in the northeast by Fraser (1988, Woodburn Lake, NTS 56E), and in the east by Schau (1983, NTS 56D). Previous geological mapping at 1:50 000 scale that overlaps wholly or in part with the present map was done by Taylor (1985, NTS 66A/9), and Ashton (1988, NTS 66H/1). In addition, Nadeau (1981) mapped NTS 56D/12.

General Geology

Whitehills-Tehek area is located within a region composed mainly of deformed Archean supracrustal rocks of the Woodburn Lake group (Ashton 1981, 1982, 1988; Fraser, 1988) that have been metamorphosed to middle greenschist facies, and are intruded by Late Archean granitic batholiths. U-Pb geochronology on zircon indicates that dacitic metavolcanic rocks occurring near the structural base of the Woodburn Lake group erupted at 2787±9 Ma (Roddick et al. 1992). Near Amer Lake, 20 km northwest of the map area, (Tella 1984) obtained a 2801±20 Ma U-Pb zircon age from dacite porphyry. Supracrustal rocks of similar age and lithology assigned to the Prince Albert Group (Heywood, 1967) can be traced discontinuously 800 km northeast of the Whitehills-Tehek area (Fig. 1; Schau, 1982; Jefferson and Schau, 1992). Probably correlative rocks assigned to the Mary River Group (Jackson and Taylor, 1972) occur in northern Baffin Island.

Rocks older than the Woodburn Lake group have not been identified in this study. Late Archean (Kenoran) granitic batholiths intruding the supracrustal rocks have been dated by the U-Pb method on zircon at 2621±2 Ma (Ashton, 1988) and 2612±4 Ma (Roddick et al., 1992). Regional metamorphism, folding and foliation-forming events occurred prior to intrusion of the 2612 Ma granite, which is not foliated. A discordant titanite $^{207}Pb/^{206}Pb$ age of 2739±3 Ma (Roddick et al., 1992) from metadacite is considered to be a maximum age for biotite-grade regional metamorphism. A concordant $^{207}Pb/^{206}Pb$ monazite age of 1835±1 Ma (Roddick et al., 1992) from an undeformed three-metre-wide granite dyke cutting Woodburn Lake group metagreywacke indicates the time of crystallization of the dyke. This age is similar to 1.83-1.81Ga ages of abundant late-kinematic Hudsonian granites (LeCheminant et al., 1987) intruding multiply-deformed sillimanite grade (upper amphibolite facies) early Proterozoic Penrhyn Group rocks north of Wager Shear Zone, and is distinctly older than ca. 1.76-1.74 Ga magmatic activity mentioned by LeCheminant (1992) associated with formation of the Thelon and Baker Lake basins south and west of the Whitehills-Tehek area.

Stratigraphy of Woodburn Lake group

Stratigraphic succession in the Woodburn Lake group is uncertain because few younging indicators were found, few bedding measurements were obtained, formations are discontinuous, and a consistent sequence of lithologic formations was not observed. Taylor (1985) considered the structural sequence in the Half Way Hills area to comprise a lower polymictic conglomerate, overlain by slate, metagreywacke, a thin complex horizon of iron formation-komatiite-slate-dolomite, greenstone, quartzite, and greenstone. Fraser (1988) concluded that in the Woodburn Lake area, the Woodburn Lake group comprises a conformable succession consisting of a lower sequence of metavolcanic rocks, and an upper sequence of shallow-water-platform type metasedimentary rocks. A similar stratigraphy for the Woodburn Lake group was proposed by Ashton (1988), but with an inferred unconformity between the metavolcanic-dominated lower sequence and the quartzite-dominated upper sequence.

In the Whitehills-Tehek area, structural superposition in the Woodburn Lake group south of Amarulik Lake comprises 2787±9 Ma dacitic metavolcanic and volcaniclastic rocks with some discontinuous magnetic iron formation and greywacke lenses centred in a dome around Amarulik Lake (Fig. 2), which are overlain to the south by poorly-bedded metagreywacke. Detrital zircons separated from a sample of tuffaceous metagreywacke collected from the metavolcanic rocks (Roddick et al., 1992). To the south, black slate, spinifex-textured komatiite, and magnetic iron formation discontinuously overlie metagreywacke, and these rocks are overlain by mafic metavolcanic rocks. A thick unit of massive quartzite and quartz-muscovite schist overlies the mafic metavolcanic unit north of Whitehills Lake, and is overlain by a lens of graphitic slate and a quartz-feldspar porphyry. Mafic metavolcanic rocks occur to the south of the felsic porphyry, and continue to the west of longitude 96°W into the area mapped by Taylor (1985). According to Taylor's (1985) map, quartzite is repeated on the south limb of a very large overturned synform north of Whitehills Lake, and is overthrust by polymictic conglomerate. The conglomerate is interpreted by Taylor (1985) to be the oldest unit of the Woodburn Lake group, and to contain cobbles of syenite derived from underlying basement which crops out nearby.

East and south of Whitehills Lake, Late Archean granitic rocks intrude the Woodburn Lake group and obscure the structural sequence, but to the north of Amarulik Lake and south of Third Portage Lake, intermediate metavolcanic and volcaniclastic rocks are overlain by metagreywacke, magnetic iron formation, and quartzite. Intermediate metavolcanic and volcaniclastic rocks to the north of the metagreywacke are interpreted to be repeated on the north limb of a tight synform cored by quartzite and magnetic iron formation that apparently closes in Third Portage Lake. The area around Third Portage Lake is structurally very complex. This region was mapped also by Ashton (1988), but the present mapping could not confirm the sequence of either Ashton or Fraser (1988). However, their two-fold subdivision of the group is fundamentally the same as Taylor (1985), and this study, but in this study the unconformity and thrust faults of previous workers were not documented.

Lithological Units

Intermediate volcanic & volcaniclastic rocks

Massive fine-grained grey meta-andesite and very poorly-bedded andesitic volcaniclastic rocks characterize this rock unit, which dominates the area around Amarulik Lake, and to the north in the Third Portage Lake area. U-Pb zircon dating indicates a time of volcanism at 2787±9 Ma (Roddick et al., 1992).

Metagreywacke, slate and metapelitic rocks

Metagreywacke is psammitic and characterized by thick beds; in very few localities normal graded beds were recognized, but pelitic tops to turbidites are rare. Black meta-argillite and slate occur in association with BIF and ultramafic schist between metagreywacke and pillowed metabasalt south of Amarulik Lake. North of Third Portage Lake metagreywacke, slate and metapelitic rocks appear to be absent from the Woodburn Lake group. Detrital zircons from this unit south of Amarulik Lake indicate a source terrane about 2770 Ma (Roddick et al., 1992).

Banded iron formation

Magnetic iron-formation (BIF) is black, fine-grained, and composed of cm-thick magnetite-rich and quartz-rich beds. It occurs as lenses within intermediate volcaniclastic rocks and metagreywacke south of Third Portage Lake. In and around Third Portage lake BIF is generally associated with metakomatiite and quartzite, where it forms several regionally-extensive horizons. Where pyrrhotite and/or pyrite occur, BIF may be auriferous in the Third Portage Lake area (Barham & Mudry, 1990).

Metakomatiite, ultramafic schist and marble

A thirty-metre-wide layer of spinifex-textured komatiite occurs between BIF and pillowed basalt about five km north of Whitehills Lake. This remarkably unaltered exposure is described by Taylor (1985, p.8). Northwest of the Whitehills-Tehek area, spinifex-textured komatiite occurrences have been well-documented by Ashton (1981,1982,1988) and Annesley (1981a, 1981b, 1989). Generally, ultramafic rocks are altered to chlorite-talc-serpentine schist and dolomitic marble.

Pillow basalt, greenstone

Pillowed metabasalt extensively overlies BIF, komatiite and metagreywacke north of Whitehills Lake. This unit is altered to chlorite-actinolite-plagioclase schist, and pillow-structures are poorly-preserved. Similar mafic schist overlies quartzite and quartz-feldspar porphyry north of Whitehills Lake. Mafic schist forms an important component of the unit mapped as ultramafic schist around Third Portage Lake.

Polymictic conglomerate

Polymictic conglomerate occurs along the northwest shore of Whitehills Lake (Taylor, 1985). It is characterized by well-rounded cobbles and boulders of granite, syenite, quartzite and dolomite according to Taylor (1985, p. 3-4), and overlies syenite in several exposures. Taylor considered the syenite to comprise basement to the Woodburn Lake group, however, this assignment has never been confirmed by radiometric dating.

Quartzite and muscovite schist

Massive, white to grey, medium-grained, poorly-bedded quartzite, muscovite quartzite and quartz-muscovite schist apparently overlies the majority of intermediate and mafic volcanic and turbiditic rocks in the south of the map area. In the north part of the map area, quartz-rich metasedimentary rocks are associated mainly with ultramafic schist.

Quartz-feldspar Porphyry

Felsic porphyry is a distinctive white to pale-orange weathering, massive volcanic rock. It occurs at several apparent stratigraphic horizons within the Woodburn Lake group: a large mass overlies quartzite and underlies mafic volcanic rocks north of Whitehills Lake, and in the north of the area several stratiform felsic porphyries occur with intermediate and ultramafic volcanic rocks, as well as quartzite. In Third Portage Lake several small bodies of quartz-feldspar porphyry occur on islands.

Metagabbro

Massive, coarse-grained, unfoliated hornblende gabbro occurs as small plutons in the area of Third Portage Lake.

Granitic rocks

Coarse grained, pale weathering biotite and biotite-hornblende granitic batholiths surround and intrude Woodburn Lake group. Contacts generally are abrupt, xenoliths are not common, and dykes rarely emanate into the supracrustal rocks. Batholiths intruded late in the deformation history of the group, and are generally unfoliated to weakly foliated. Granitic rocks shown on the map are late Archean (Kenoran). Uncommonly, undeformed granitic dykes intrude the group, but are too small to show on the map. Monazite from one dyke gave an early Proterozoic (Hudsonian) U-Pb age (Roddick et al., 1992).

Syenite

Numerous plutons of syenite crop out on several islands in Whitehills Lake, and have been described and assigned to the post-Hudsonian Proterozoic Martell Intrusive Suite by Taylor (1985). East of the map area, Nadeau (1981) mapped numerous post-tectonic syenite plutons intruding late Archean granite. Taylor (1985) shows numerous small lamprophyre dykes in the Halfway Hills area that are too small to portray on the present map.

Diabase dykes

Several diabase dykes form east-west-trending magnetic anomalies between Amarulik and Whitehills Lakes. The dykes are probably the youngest rocks in the Whitehills-Tehek area, but they have not been dated or assigned to any recognized swarm.

Structure

Structural fabric elements recorded in the field are bedding, mineral foliation (S_1), mineral lineation (L_1), crenulation cleavage (S_2), and crenulation lineation (L_2). Bedding attitudes were difficult to obtain due to the strong overprint of S_1, which is invariably parallel to bedding in rocks where both structures were observed, as well as a general absence of well-bedded rocks. Mesoscale F_2 folds are common, and axial planes and axes were recorded.

The largest structures observed in the area are F_2 folds (Fig. 2): a north-vergent synform is located north and west of Whitehills Lake, an upright elliptical dome trending east-west occurs in the centre of the sheet, a north-vergent synform is north of Amarulik Lake, and the lower limb of a north-vergent antiform appears to be present north of Third Portage Lake. Major, north-north- east trending, upright F_2 folds overprint the older folds north of Whitehills Lake and in Third Portage Lake. The latter structure is a tight W-shaped synform in Third Portage Lake, and loses amplitude and definition to the north and south.

North of Third Portage Lake S$_1$ foliation dips to the southeast in an area of several-hundred km^2, strongly suggesting that D_2 deformation was north-vergent, like F_2/D_2 to the south.

Metamorphism

Throughout the Whitehills-Tehek area, Woodburn Lake group rocks exhibit upper greenschist to lower amphibolite grade metamorphism. In metapelites, biotite is ubiquitous, and in siliceous iron-formation garnet and amphibole commonly occur. Mafic volcanic rocks contain actinolite, chlorite and plagioclase, ultramafic volcanic rocks commonly are carbonatized or altered to chlorite- talc-serpentine schist. Quartz and muscovite are common in quartzite, but not present in adjacent silicate-rich iron-formation. Armitage (1992) assigned the rocks in Third Portage Lake area to greenschist metamorphic conditions in the range 370-520°/C and pressures above 2.3 kbars.

Economic Geology

Gold occurrences are spatially associated with pyrrhotite-pyrite-bearing parts of magnetite-bearing BIF in the Third Portage Lake area. Extensive prospecting has been carried-out in the region, and the most promising exploration target found is indicated onThird Portage Lake , where diamond drilling has been done (Barham & Mudry, 1990).

Acknowledgments

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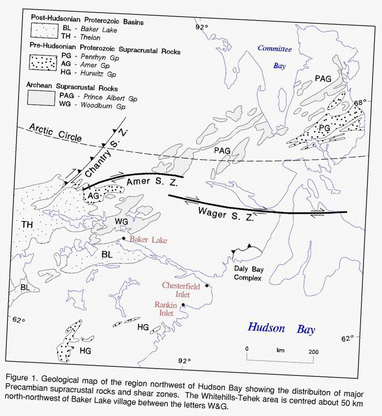


Figure 1. Geological map of the region northwest of Hudson Bay showing the distribuiton of major Precambrian supracrustal rocks and shear zones. The Whitehills-Tehek area is centred about 50 km north-northwest of Baker Lake village between the letters W&G.

Granite (2.62 - 2.61 Ga)

Woodburn Lake Group (ca. 2.79 Ga)

Bedding (inclined)

Mineral foliation (inclined)

Fold Axial Surface Traces

F_2 Synform (north vergent)

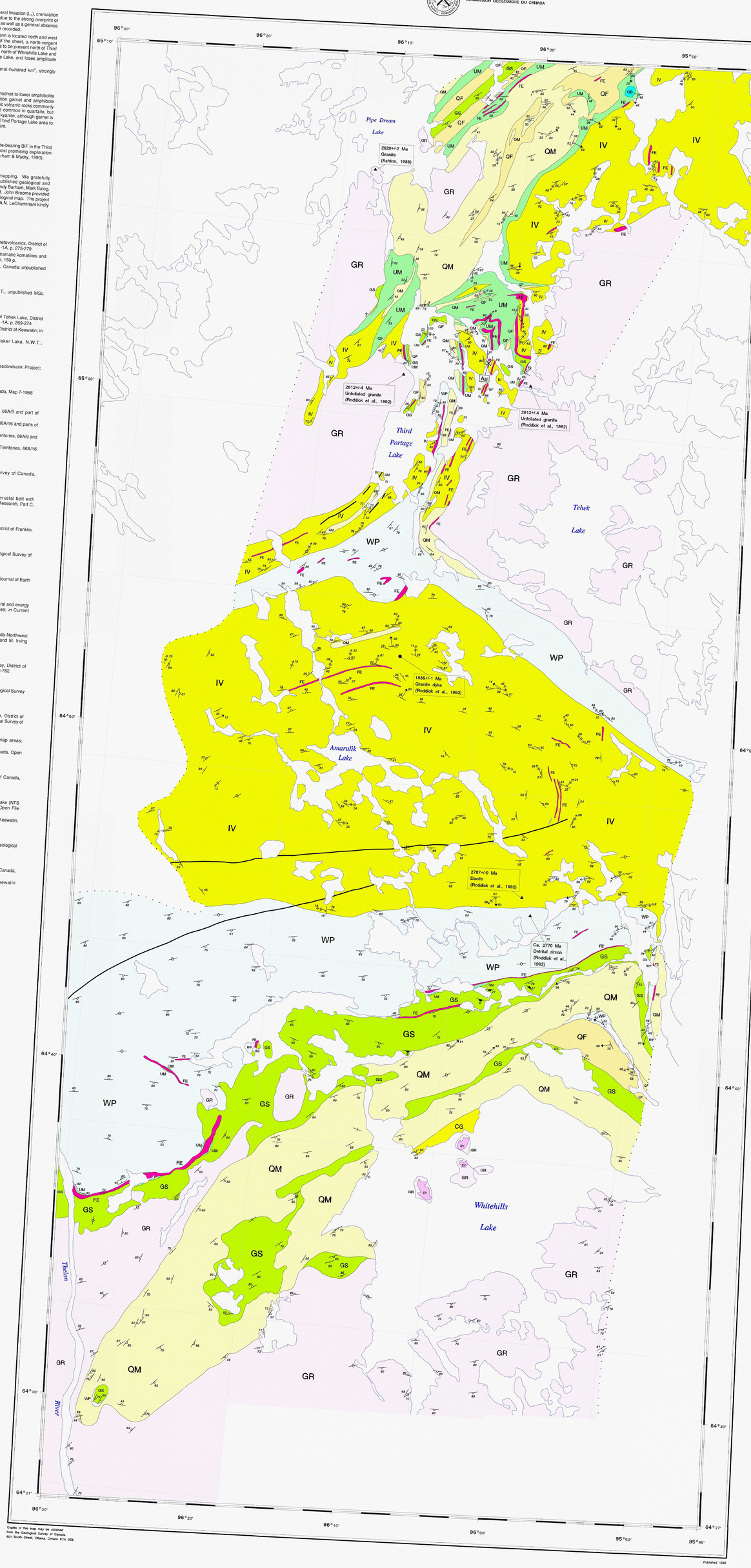
F_2 Antiform (north vergent)

F_2 Antiform (upright)

F_3 Antiform

F_3 Synform

Figure 2. Major structures of the Woodburn Lake group in the Whitehills-Tehek area (after Henderson, et al., 1991; Taylor, 1985; Nadeau, 1981; Ashton, 1988, and J.R. Henderson, unpublished). Bedding-parallel mineral foliation (S_1) is the most common structural element, and reveals a north-vergent F_2 synform in the southwest, an upright dome around Amarulik Lake, and north-vergent antiform north of Whitehills Lake and at Third Portage Lake. These folds are deformed by north-northeast-trending upright folds north of Whitehills Lake and at Third Portage Lake.



Copies of this map may be obtained from the Geological Survey of Canada: 601 Booth Street, Ottawa, Ontario K1A 0E8

Published 1994

LEGEND

PROTEROZOIC

- Diabase dyke
- SY Syenite

ARCHEAN

- GR Granitic rocks
- GB Metagabbro

WOODBURN LAKE GROUP (not in stratigraphic order)

- QF Quartz-feldspar porphyry
- QM Quartzite and muscovite schist
- CG Polymictic conglomerate
- GS Pillow basalt and greenstone
- WP Metagreywacke, slate and metapelitic rocks
- UM Metakomatiite, ultramafic schist and marble
- FE Banded iron formation
- IV Intermediate volcanic and volcaniclastic rocks

Geological boundary (defined and/or approximate)

Limit of mapping

Bedding (inclined, vertical, younging known, overturned)

Pillowed flow top (inclined, younging known)

S_1 foliation (inclined, vertical)

L_1 mineral lineation (plunging)

Intersection lineation of bedding and S_1 (neutral, right vergent)

S_2 crenulation cleavage (inclined)

Intersection lineation of S_1 and S_2 (neutral, right vergent)

Locality where radiometric age (Ma) has been determined (U-Pb method)

Igneous zircon

Igneous monazite

Mineral prospect (Third Portage Lake Gold Deposit)

Geology by J.R. Henderson, M.N. Henderson, L.L. Pryer and R.G. Cresswell 1990; additional data from F.C. Taylor (1985), Geological Survey of Canada

Map compilation by J.R. Henderson

Digital cartography by J. Dohar, Geological Survey of Canada

Electrostatic plot produced by the Geological Survey of Canada

Any revisions or additional information known to the user would be welcomed by the Geological Survey of Canada

Base map produced by the Geological Survey of Canada

Copies of the topographical editions covering this map area may be obtained from the Canada Map Office, Natural Resources Canada, Ottawa, Ontario, K1A 0E9

The proximity of the North Magnetic Pole causes the magnetic compass to be erratic in this area. Mean magnetic declination 1994, 0°55' W, increasing 12.4' annually. Readings vary from 0°25' E in the SW corner to 2°21' W in the NE corner of the map

OPEN FILE 2923

GEOLOGY

WHITEHILLS - TEHEK LAKES AREA

DISTRICT OF KEEWATIN

NORTHWEST TERRITORIES

Scale 1:100 000 - Échelle 1/100 000

Kilometres 2 0 2 4 6 8 Kilomètres

Transverse Mercator Projection
CM 96°07'30", Scale Factor 1.0
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Projection transverse de Mercator
M.C. 96°07'30", facteur d'échelle 1.0
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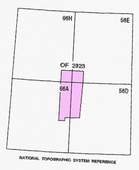
LOCATION MAP



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02/1995

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