Manitoba
Energy and Mines
Geological Services

Geological Report GR83-1D

Geology of the Gods Lake, Munro Lake, Webber Lake Area, Manitoba

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Winnipeg, 1992

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GR83-1-13:	Gods Lake, NTS 53L/9	in pocket
1973H-11:	Joint Lake (north half), NTS 53L/6 (north half), 1:50 000	in pocket
1973H-12:	Kanuchuan Rapids, NTS 53L/7, 1:50 000	in pocket
1973H-13:	Murray Lake, NTS 53L/8, 1:50 000	in pocket
1973H-14:	Sharpe Lake (west half), NTS 53K/5 (west half), 1:50 000	in pocket

INTRODUCTION

This report presents the findings of geological mapping of a 2800 km^2 area centred on the southern half of Gods Lake. Field work commenced in 1973 as part of the "Greenstone Project" (Elbers, 1973). The mapping was conducted at a scale of one inch and half mile. The report was completed by W. Weber with assistance from H.P. Gilbert from a draft manuscript left by the author in 1974 after his eleven months employment with the Department. A preliminary report was published by Marten (1973).

The map area (Fig. 1) is located at the eastern end of the Oxford Lake-Gods Lake greenstone belt. The area is divided into two structurally distinct terranes by the major east-southeast-trending Gods Lake Narrows shear belt that passes through Gods Lake Narrows. The area north of the shear belt is underlain by the thick, relatively weakly deformed Hayes River Group volcanic sequence and by the younger Oxford Lake Group metasedimentary rocks. The terrane south of the shear belt is characterized by a well defined structural grain that is parallel to the shear belt. It comprises the Bayly Lake Complex granitoid and gneissoid/migmatitic rocks and two narrow greenstone belts, the Webber Lake and Munroe Lake belt. The supracrustal rocks in these greenstone belts are intensely deformed, and have been provisionally assigned to the Hayes River Group. The Webber Lake and Munroe Lake belts merge at Sharpe Lake, east of the map area, where they form part of the Stull-Kistigan lakes greenstone belt.

The lithostratigraphic framework of the "Greenstone Project" area is defined and described in geological reports on the adjacent Oxford Lake (Hubregtse, 1985) and Knee Lake-Gods Lake (Gilbert, 1985) areas. Elbers (1976) discussed hydrothermal mineralization of plutonic and volcanic rocks of the "Greenstone Project" area. A compilation of exploration activities has been published by Southard (1977). A review of the exploration history up to 1960 is contained in Barry (1960).

This report is accompanied by six, 1:50 000 scale geological maps that correspond to the following areas.

GR83-1-12	Vermilyea	NTS 53L/10
GR83-1-13	Gods Lake	NTS 53L/9
1973H-11	Joint Lake (north half)	NTS 53L/6 (north half)
1973H-12	Kanuchuan Rapids	NTS 53L/7
1973H-13	Murray Lake	NTS 53L/8
1973H-14	Sharpe Lake (west half)	NTS 53K/5 (west half)

The maps were derived from preliminary maps at the scale of half mile to one inch; the 1973H series are re-issues, with the original legend, but have been reduced to the metric 1:50 000 scale. The two GR series maps are new with a revised legend that is also applicable to previously published reports on the "Greenstone Project" (Hubregtse, 1985; Gilbert, 1985). In this report, unit numbers that refer to the H series maps are identified by an asterisk, whereas those that refer to the GR series stand alone.

A 1:250 000 scale compilation map (Manitoba Energy and Mines, 1987) depicts the geology of the map area, except the eastern part that extends into NTS 53K/5.

Every possible effort has been made to ensure accurate presentation of the original data. However, the editorial process may have lead to unintentional changes of the original descriptions and interpretations and introduced errors. Manitoba Energy and Mines does not assume liability for any such errors or changes.

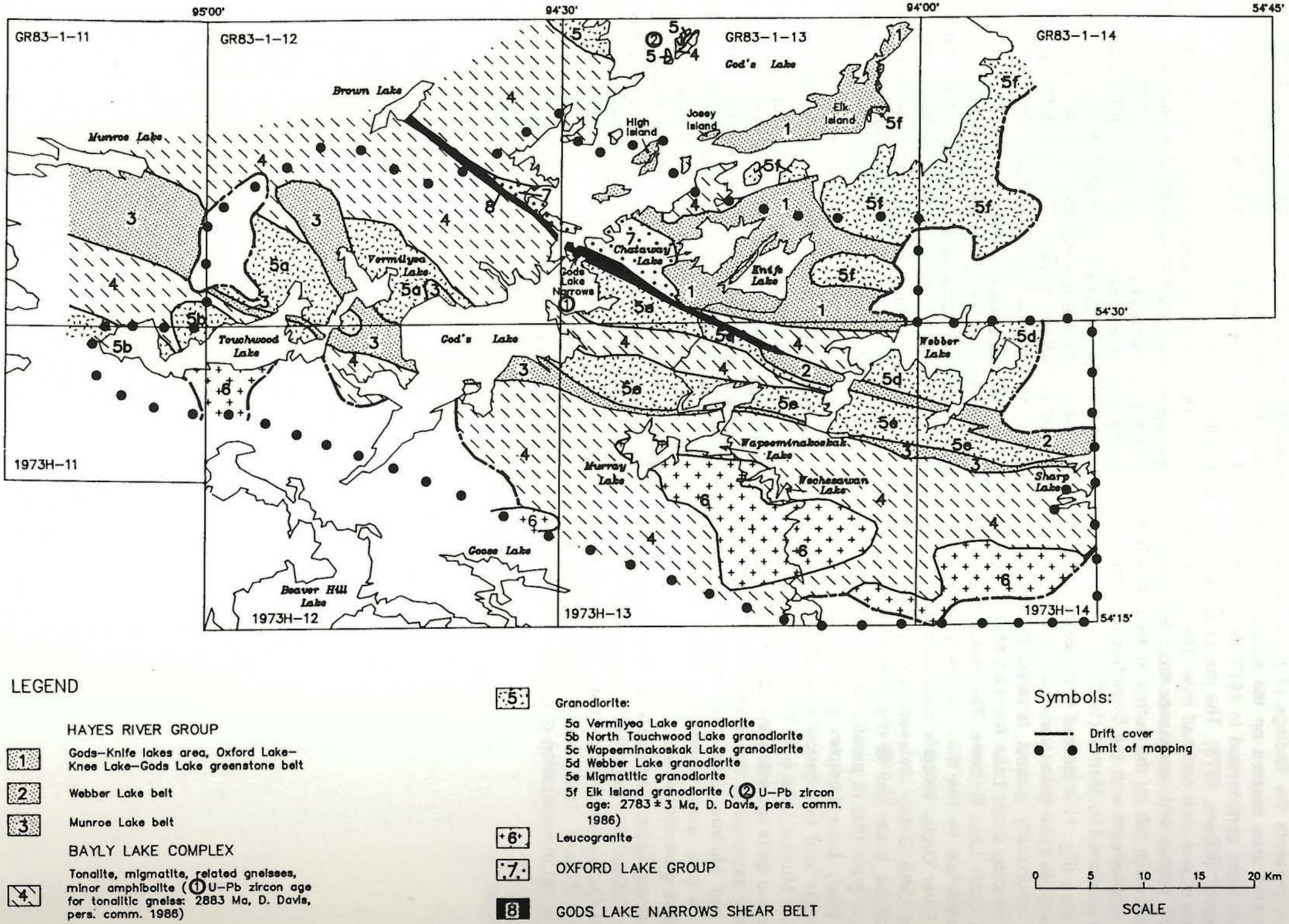

Figure 1: Map area, showing geological subdivisions (belts, groups, major units) and geological maps discussed in this report.

HAYES RIVER GROUP

The Hayes River Group east of Gods Lake Narrows forms a steeply-dipping, northwest-facing homoclinal sequence with an apparent thickness of approximately 8 km. The sequence is bounded on the southwest by the Oxford Lake Group and the Gods Lake Narrows shear belt, and on the northeast by a granodiorite pluton (7b). The stratigraphic base of the sequence is poorly exposed. It is intruded by a granodiorite (6a, 8*). The top, exposed on islands in Gods Lake, is inferred to be bounded by a northeast-trending shear zone.

The Hayes River Group is composed dominantly of pillow metabasalt. A prominent unit of felsic and intermediate volcanic rocks occurs in the upper half of the succession at Knife Lake.

GODS LAKE-KNIFE LAKE AREA (Oxford Lake-Knee Lake-Gods Lake belt)

MAFIC METAVOLCANIC AND MINOR METASEDIMENTARY ROCKS (1)

Metabasalt (1b) Pillow metabasalt ($1b_2$, $1b_4$), pillow breccia ($1b_5$)

Pillow metabasalt ($1b_2$, $1b_4$) is dark greyish green and fine grained. Pillows average 60 by 100 cm and are generally bun shaped. The direction of elongation of pillows is parallel to the regional strike of schistosity, even where there is no tectonic fabric; this suggests that pillow shapes are in part a primary feature. In many areas (*e.g.* Chataway Lake) pillows are equidimensional and thus poor top indicators.

Chilled pillow margins are represented by pale greenish epidotic selvages approximately 1 cm thick. The pillow interstices are in places fine grained quartzite (metachert) or carbonate, notably north of Chataway Lake.

In thin section pillow metabasalt ($1b_4$) consists of a fine grained (0.2 mm) aggregate of randomly oriented fibres and prisms of pleochroic, pale green amphibole, interstitial plagioclase and scattered plagioclase (An_{10-34}) laths up to 0.3 mm long. Glomeroporphyritic texture is locally developed. Minor amounts of epidote occur as scattered grains and granular aggregates; pyrite, ilmenite and sphene are common accessory minerals.

Amygdaloidal pillow metabasalt ($1b_4$) is characterized by amygdales that are concentrated at pillow margins and tend to be elliptical and radially oriented. The amygdales are composed of quartz, plagioclase, amphibole and epidote. Massive- to poorly-pillowed metabasalt at Knife Lake contains scattered quartz and albite amygdales. Large amygdales (up to 3 cm in diameter) occur in metabasalt on a small island in the northern part of Knife Lake. Scattered fragments (4-6 cm) of pumiceous basalt were noted in metabasalt exposed on the east point of a larger island to the west, close to the contact with overlying metasediment. Due to the presence of approximately 60 per cent ovoid quartz- and/or quartz and plagioclase amygdales the pumice is pale coloured.

Pillow breccia ($1b_5$) occurs in small interpillow pockets, or in lenses up to approximately 3 m in thickness. The breccia consists of isolated pillows (15-50 cm in diameter) and fragments of broken pillows in a matrix of coarse aquagene tuff. The isolated pillows vary from 50 to 15 cm in diameter.

Unit 1 is generally weakly foliated and pillows generally show little evidence of tectonic flattening. The foliation becomes more intensely developed within approximately 1 km of the contact with the Oxford Lake Group conglomerate.

Foliation is defined principally by chlorite, and schistose lithologies consist of a chlorite-epidote-carbonate assemblage. Metamorphic grade increases towards the contact with Oxford Lake Group, as indicated by hornblende and biotite replacing chlorite. Textural evidence indicates that chlorite-epidote assemblages in strongly foliated zones postdate the amphibole-plagioclase assemblage.

Rare, fine grained laminated argillitic mafic tuff and iron formation occur as layers within the metabasalt. Layers are generally less than 3 m thick and most are in the order of 30 cm. The tuff is dark green, laminated and contains cherty interbeds. It is composed dominantly of very fine chlorite.

Oxide facies iron formation occurs 4 km north of High Island in the uppermost part of the Hayes River Group. It consists of 0.5 to 2.5 cm thick black, very fine grained, magnetiferous argillite and alternating bands and chert.

Andesite ($1c_2$)

Andesite, identified on the basis of texture and mineralogical composition, forms a unit of up to 450 m apparent thickness in Chataway Lake, and occurs on the east shore of Gods Lake close to the Oxford Lake Group contact. The andesite on Chataway Lake is pillowed and pale green; it is composed of very fine grained felted plagioclase laths (An_{54}), tremolite-actinolite, epidote and accessory carbonate and sphene. The plagioclase laths are visible with a hand lens on clean weathered surfaces, and scattered plagioclase phenocrysts up to 3 mm in diameter occur locally. Sparse, relict pyroxene(?) phenocrysts pseudomorphed by chlorite and epidote are visible in thin section.

Altered metabasalt (1g)

Altered metabasalt is pale greenish grey, abnormally rich in epidote and locally silicified. Altered metabasalt forms (at least) one mappable unit between Knife Lake and Chataway Lake. This unit strikes into Dix's (1951) "Rhyolite" units. In thin section altered metabasalt consists of very fine grains of epidote and clinozoisite and a subordinate amount of randomly oriented, fibrous tremolite-actinolite. In places, relict groundmass plagioclase laths are pseudomorphed by clinozoisite. One section contains relict olivine crystals pseudomorphed by a mosaic of clinozoisite containing inclusion trails that represent relicts of alteration seams in olivine.

Pale grey epidote or tremolite-actinolite-rich metabasalt occurs on the west shore of Knife Lake. In thin section this rock consists of very fine grained, parallel aligned chlorite that defines S_1, fine lenticular carbonate grains, and varying proportions of epidote. Very fine scattered interstitial grains of feldspar, (and quartz?) and pyrite and sphene are accessory minerals.

Chemical analyses (Table 1) indicate that the altered rocks are depleted in alkalies, total iron and magnesium, and enriched in calcium (samples 2, 4, 5, 6). The altered rocks contain more iron in the ferric state than unaltered basalt. Sample 7 is from an apparently unaltered metabasalt, but it is cut by anastomosing chlorite veins, on the west shore of Knife Lake; the analysis indicates magnesium enrichment in comparison with unaltered basalt (1, 3).

Mafic schist (1h)

A belt of amphibolitic schist occurs between metasedimentary rocks (3a) and the mylonite zone that bounds the Gods Lake Narrows section. It attains a maximum width of 1 km east of Gods Lake Narrows.

The amphibolite varies in fabric from fairly homogeneous and schistose to laminated. The lamination is caused by 1 to 2 cm thick colour variations in shades of dark greenish grey, but in many localities parallel quartzofeldspathic layers (up to 40 cm thick) that are concordant to lamination add to the layering effect. North of the map unit, pillow basalt is intruded by foliated porphyritic dacite dykes (up to 5 m thick). The deformation becomes more intense southwards and pillows are no longer distinguishable. Layering and lamination in the amphibolite is believed to represent transposed lithological variation in pillow flows, notably pillow selvages. Likewise, the quartzofeldspathic layers are interpreted as transposed dykes and in a few localities are recognizable as such, *e.g.* on a point in the Narrows (UTM 6046650N/404250E).

Layered, fine grained, mafic to intermediate grey rocks with pale, fine grained, porcelaneous textured felsic layers (up to 3 m thick) occur within the mafic sequence at Gods Lake Narrows. These may represent stratigraphically or structurally incorporated metasedimentary rocks with transposed felsic dykes.

In thin section the mafic schist consists of aligned prismatic hornblende (0.2-0.5 mm) in a mosaic of interstitial xenomorphic quartz and untwinned plagioclase (0.2 mm in grain size). Accessory minerals are epidote and ilmenite commonly rimmed by sphene.

FELSIC METAVOLCANIC, SUBVOLCANIC AND RELATED METASEDIMENTARY ROCKS (2)

Rhyolite (2a)

Rhyolite is aphanitic and flinty and varies from grey to pale grey. Pale grey rhyolite is best exposed on the islands in the west side of Knife Lake. It consists of an extremely fine grained quartzofeldspathic mosaic that contains very fine grained biotite and amphibole, sparsely scattered saussuritized plagioclase phenocrysts, and corroded quartz

Table 1: Chemical analyses of Hayes River Group metabasalt

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SiO_2	50.20	49.70	52.75	50.15	54.45	55.05	53.20
Al_2O_3	15.70	15.25	16.85	16.25	14.55	14.45	13.70
Fe_2O_3	2.19	3.40	1.25	3.50	3.93	2.90	1.34
FeO	10.42	5.76	7.96	4.48	5.48	4.24	7.30
CaO	7.13	17.50	9.60	18.1	11.65	15.50	9.15
MgO	5.89	3.80	4.85	3.40	4.57	2.62	8.62
Na_2O	3.76	0.30	3.75	0.33	0.26	2.67	3.08
K_2O	0.98	0.82	0.90	0.84	0.96	0.70	0.53
TiO_2	0.98	0.82	0.90	0.84	0.96	0.70	0.53
P_2O_5	0.12	0.11	0.08	0.10	0.10	0.19	0.08
MnO	0.23	0.23	0.21	0.22	0.14	0.33	0.17
H_2O	2.86	1.72	1.00	1.29	2.44	0.78	2.11
S	0.26	0.10	0.10	0.09	0.90	0.05	1.02
CO_2	0.18	1.70	0.16	1.49	0.67	1.12	0.26
Total	100.05	100.4	99.72	100.25	100.75	100.75	100.20
Total Fe as Fe_2O_3	13.65	9.74	10.01	8.43	9.96	7.56	9.37
Cu (ppm)	128	58	107	112	132	25	
Zn (ppm)	90	34	37	14	108	17	

(1) dark green, unaltered basalt (6048200N/421150E)
(2) pale green altered basalt from same outcrop as (1)
(3) dark green, unaltered basalt (6049275N/423875E)
(4) pale green, altered basalt (6049025N/423600E)
(5) pale green, altered basalt (6048875N/422050E)
(6) pale green, altered basalt (6048950N/425550E)
(7) basalt cut by anastomosing chlorite veins (same location as (6))

phenocrysts (up to 5 mm). Elsewhere plagioclase and subordinate quartz phenocrysts occur in a very fine grained, trachytic-textured groundmass of plagioclase microlites, disseminated very fine grained epidote, chlorite, amphibole and accessory minerals.

Much of the rhyolite is brecciated. Irregular patches of breccia with 0.5 to 30 cm fragments merge into blocky areas with 1 m or larger irregular masses of rhyolite; these breccia zones in turn grade into massive rhyolite. Local incipient brecciation is outlined by carbonate-filled fractures in otherwise massive rocks. In two places the breccia merges with a conglomeratic rock in which well rounded cobbles of grey rhyolite (up to 35 cm) weather out of a carbonate and calcareous rhyolitic grit or fine breccia matrix (Fig. 2). The conglomerate is framework supported. The cobbles are considered to have been shaped by mechanical abrasion.

The very irregular and patchy distribution of breccia and the occurrence of pockets of conglomerate within these patches precludes this brecciation as being part of flow emplacement mechanisms. A high pressure gas or steam brecciation mechanism is therefore believed responsible, and the rounding of cobbles can be explained by the milling of fragments (pea in a whistle effect) in pockets as gas and fluidized tuffisite streams through fractures and pipes. The matrix commonly contains small amounts of disseminated pyrite, and fine grained massive pyrite locally forms the matrix in pockets of brecciated rhyolite.

Breccia fragments are locally deformed into ellipsoids in western Knife Lake. Northeastward, toward the outlet of the Knife River, the foliation becomes more intense and the metamorphic grade increases slightly. In the vicinity of Mokonami Rapids (above the inlet of the Knife River into Gods Lake) biotite flakes define a strong penetrative foliation and on Gods Lake, at the mouth of Knife River, small garnets (0.1-0.3 mm) were noted in banded rhyolite that contains layers of massive pyrite that are concordant with the penetrative foliation.

Microscopic features

Plagioclase phenocrysts are partly to completely saussuritized. Quartz phenocrysts show typical magmatically corroded ovoid cross-sections and are partly or entirely granulated into a quartz mosaic. Parallel aligned fine biotite and chlorite flakes and acicular tremolite-actinolite in the groundmass define a foliation. Sericite, instead of biotite, is prominent locally and patchy sericitization of quartzofeldspathic groundmass was noted in one thin section. The plagioclase microlites that form the groundmass of the trachytic rocks are partly obscured by fine grained epidote, amphibole and mica; these minerals have the same extinction angle, possibly because of an original flow orientation. Apatite, sphene, pyrite and ilmenite mantled by sphene are prominent accessory minerals.

The more intensely recrystallized rhyolite in northern Knife Lake has coarser grained groundmass in which a small amount of microcline occurs.

Intermediate to felsic volcanic rocks, not divided (2b)

Volcanic rocks of varying composition and texture occur in a largely drift covered area immediately north and northeast of Knife Lake. Because of poor exposure these rocks are grouped into one unit. Sparsely scattered outcrops in the banks of the broad river flowing out of Knife Lake constitute the best cross-section of this unit.

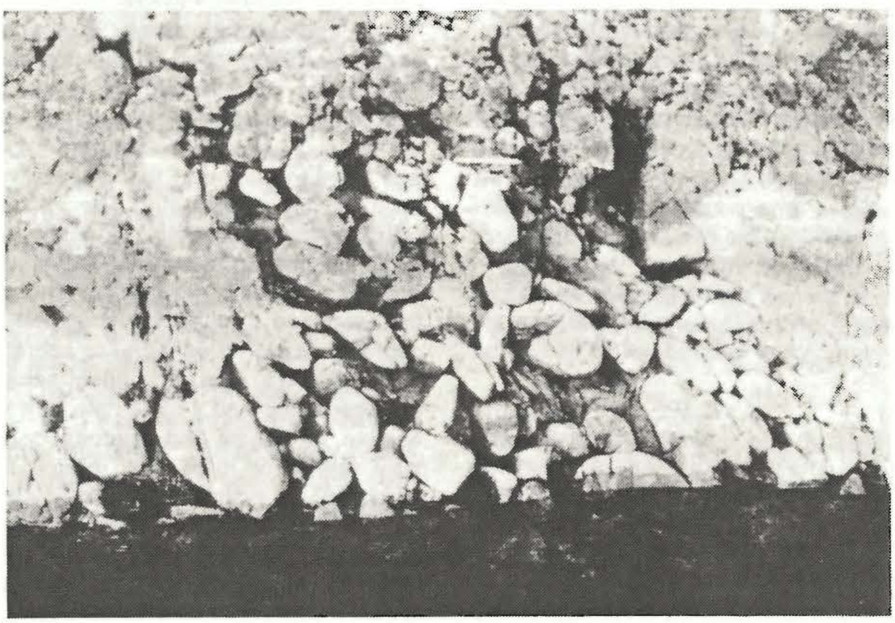

Figure 2: Rhyolite breccia (2a); Knife Lake (pen is 15 cm long).

Pale grey flinty rhyolite forms one outcrop at the south end of the section. Scattered outcrops further north comprise fine grained grey, dacitic rocks with local 1 cm quartz phenocrysts. Weathered surfaces are locally pitted suggesting unevenly developed alteration.

Pale grey to grey flinty dacitic breccia is exposed in the Mokonami Rapids and 2.5 km east of the northeast end of Knife Lake, and also 4 km further east. The rock contains flattened vaguely defined lenticular fragments (up to 45 cm long and 25 cm thick). The fragments are paler than the matrix but otherwise there is little lithological distinction, especially on fresh surfaces. Some dacite fragments contain small plagioclase phenocrysts (0.3 mm) and the paler rhyolitic fragments contain flattened quartz phenocrysts. Colour variation between individual fragments and between fragments and matrix is caused by variations in hornblende and/or biotite content; a strong preferred orientation of these minerals defines a foliation parallel to the plane of flattening of the fragments.

One kilometre southeast of the Mokonami Rapids, intermediate agglomerate (30 m thick) that contains folded, flattened fragments is associated with feldspar porphyry (7 m wide) and a 25 cm wide gossan zone. Two kilometres further southeast foliated, fine grained, grey, intermediate rocks contain quartz and epidotic lenses and mafic amphibolite with local garnets. The mineral assemblage in these rocks is plagioclase, quartz, biotite, hornblende, epidote, garnet and microcline. Metamorphic textures display two foliations. Microcline crystallized after the second foliation, suggesting that the former is the result of K-metasomatism related to the nearby granodiorite.

Microscopic features

The dacitic breccia consists of a very fine grained xenomorphic quartz and feldspar mosaic with evenly scattered oriented biotite flakes and aligned acicular hornblende (up to 0.4 mm). Epidote occurs as fine granular aggregates and scattered grains; relict plagioclase crystals (0.3 mm) are largely recrystallized to a mosaic. Relict quartz phenocrysts are represented by lenticular quartz aggregates up to 1 mm long, but less than 0.1 mm thick.

Garnet crystals, noted in one outcrop of grey dacite, are xenomorphic (up to 2 mm) and contain straight and sigmoidally curved inclusion trails that represent the S_1 foliation. The S_2 foliation wraps around them. Microcline, which occurs at the same locality, forms xenomorphic crystals that overgrow and include S_2.

Iron formation (2c)

Iron formation consists of 1 to 6 cm layers that comprise white fine grained quartzite (metachert) alternating with massive pyrite, pyrite-graphite and magnetite-rich bands. Outcrops are heavily gossaned, particularly the massive pyrite bands.

This banded sulphide and oxide facies iron formation occurs at two stratigraphic levels in the Knife Lake area. Airborne magnetic and E.M. surveys (Manitoba Energy and Mines, Cancelled Assessment Files No. 91799) show that pronounced linear anomalies are associated with both iron formations. The lower one is up to 20 m thick and has been mapped for 640 m along the west shore of an island on the west side of Knife Lake. The geophysical data indicates that this zone does not extend far beyond mapped limits. The upper iron formation is exposed at two widely separated localities, but the geophysical evidence indicates lateral continuity. One outcrop occurs at the neck of the long peninsula in the west side of Knife Lake, and the other approximately 1 km west of the rapids at the outlet of Knife Lake. The maximum exposed width of the upper zone is approximately 17 m but the aeromagnetic anomalies indicate greater thickness locally.

Greywacke, pebble conglomerate (3b)[1]

Greywacke is massive, poorly bedded, fine grained, grey and relatively homogeneous. It is composed of plagioclase, quartz and minor varying proportions of epidote and biotite. A weak foliation is defined by microscopic biotite flakes that impart a characteristic dull sheen to the rock. Local interbeds of conglomerate and the presence of detrital quartzite grains indicate a sedimentary origin. Euhedral plagioclase phenocrysts suggest incorporation of pyroclastic material.

Alteration is locally prominent. On the east shore of Knife Lake, 2 km south of the rapids at the exit of the lake, epidotization and silicification resulted in the formation of siliceous rib-like and angular clast-like shapes, which stand out on weathered surfaces. Greywacke grades into pale greenish siliceous rock that locally contains disseminated pyrite and irregular siltstone relicts (0-70 cm).

Pebble conglomerate is interlayered with greywacke and is best developed on the islands in the western part of Knife Lake. The conglomerate is not bedded and the texture varies from framework- to matrix-supported. The pebbles are moderately sorted, subangular to subrounded and average 2 cm in diameter, though locally scattered clasts range up to 30 cm in diameter. The pebbles comprise pale grey orthoquartzite, feldspathic quartzite, and darker grey andesite to dacite fragments that locally contain quartz and epidote or carbonate amygdales. The pebbles are moderately flattened and prominently stretched. The dark grey matrix contains scattered euhedral to subrounded plagioclase crystals (up to 0.5 mm). It is finely schistose and contains fine grained biotite and subordinate quartz, plagioclase, chlorite, epidote, carbonate and opaques; conglomerate in the southwest corner of Knife Lake has a mafic matrix composed dominantly of actinolite. Quartzitic clasts have a characteristic dark grey biotite rim. The rim comprises very fine grained biotite that has nucleated in the interstitial cement of the quartzite causing diffuse clast boundaries.

1 Unit 3b is not separated on Map GR83-1-13.

Microscopic features

Greywacke consists of a very fine inequigranular quartzofeldspathic mosaic with 10 to 15 per cent biotite flakes (1 mm long). Epidote occurs as very small disseminated granules.

Irregular, poorly sorted grains and aggregates of quartz and plagioclase are scattered throughout the matrix. Scattered euhedral plagioclase crystals are largely recrystallized to a very fine grained mosaic containing fine grained biotite.

Quartz grains (0.2 m) are well rounded, and marginal dust trails outline optically continuous partial overgrowths on some grains. These overgrowths demonstrate that the quartz grains were derived in part from orthoquartzite, pebbles of which occur in the conglomerate units interlayered with greywacke. However, some may be quartz phenocrysts derived from a pyroclastic rock.

The felsic pebbles consist of rounded sand grains (0.2-0.7 mm) outlined by dust rims and authigenic quartz cement that is largely broken down to a sutured microcrystalline mosaic. Orthoquartzite pebbles are composed dominantly of heteroblastic quartz. Feldspathic quartzite pebbles comprise grains of xenomorphic quartz and plagioclase. Andesite fragments consist of fine grained xenomorphic granular epidote (up to 60%), quartz, plagioclase, amphibole and minor carbonate, and scattered, partly saussuritized, euhedral plagioclase phenocrysts (up to 0.3 mm).

WEBBER LAKE BELT

Mafic metavolcanic and minor metasedimentary rocks (3b*, 3e*, 3f*)

The Webber Lake belt consists dominantly of fine grained, schistose metabasalt (3b*) that extends from south of Knife Lake through Webber Lake to the north shore of Sharpe Lake. It can be traced further east into the Stull Lake area of northwestern Ontario. The belt attains a maximum width of approximately 3 km. Exposure is moderate at the west end, but is extremely poor elsewhere; the best section is exposed in the southeast area of Webber Lake.

Two unexposed ultramafic bodies were drilled by Freeport Canadian Exploration Company (Manitoba Energy and Mines, Cancelled Assessment File No. 91806). They may be part of the Hayes River Group, similar to ultramafic rocks from the Oxford Lake area (Hubregtse, 1985).

At its western end the belt is in contact with a blastomylonite (1k) to the north. Eastward the northern margin is intruded by fairly homogeneous granodiorite (8*); granodiorite is interbanded with mafic metavolcanic rocks at this contact, and xenoliths of similar metavolcanic rocks occur in the granodiorite further away from the contact. The contact zone is strongly foliated, but the amount of deformation decreases sharply northward.

The south margin of the belt is intruded by strongly foliated granodiorite (7*) at its west end; eastward a strongly foliated to mylonitic contact is developed between the Webber Lake belt and gneissic granodiorite (7*). Between Webber Lake and Sharpe Lake this contact develops into a blastomylonite, which characterizes the southern margin of the belt throughout the Sharpe Lake area.

Strongly flattened pillows are locally developed in metabasalt (3b*) of the Webber Lake belt. The mineral assemblage varies from hornblende-plagioclase-quartz to tremolite-actinolite and/or chlorite-epidote-plagioclase (An_{10})-quartz. The amphibolitic assemblage is dominant and is characterized by fine grained, dark green grey, foliated or schistose rocks. Strongly flattened pillows (2 m x 0.2 m) are best seen north of the west end of Sharpe Lake, and pillow outlines have been noted elsewhere. At the west end of the belt the amphibolite is extremely fine grained, finely schistose and of argillitic aspect in hand specimen; the fine grain size is believed to be due to more intense grain reduction as the Gods Narrows shear belt is approached. Medium grained foliated amphibolite (3e*) occurs locally and is interpreted as metagabbro (*e.g.* west of Sharpe Lake).

Fine grained, grey greenish chloritic and tremolitic/actinolitic-chloritic schist (3f*) occurs in the Webber Lake area and is concentrated along the southern margin of the belt. These rocks represent localized shear zones in tightly folded amphibolite, where the hornblende-plagioclase assemblage is retrogressed to tremolite-actinolite, chlorite and epidote-bearing rocks. Stilpnomelane was noted in one thin section. Light green cobble-sized nodules occur in a schistose matrix southwest of Webber Lake; the nodules probably represent relict epidotized pillow cores.

Dykes

Schistose, sericitic, greenish grey, quartz and quartz-feldspar rhyolite porphyry occur in metabasalt (up to 25 m in thickness). In places quartz phenocrysts are milky blue (up to 4 mm), but are more commonly flattened to lenses of quartz in a fine grained quartzofeldspathic groundmass with sericite, chlorite and minor epidote. Inhomogeneous deformation and development of sericitic foliation planes produce subtle colour banding. The contact relationships of these bodies with the metabasalt are not exposed in the vicinity of Webber Lake, but similar dykes (unit 5*) of up to 3 m in thickness intrude metagabbro and metabasalt north of Sharpe Lake, suggesting that these porphyries are intrusive. However, similar rocks intersected in diamond drill holes are apparently associated with banded chert and graphitic sulphide facies iron formation (Manitoba Energy and Mines, Cancelled Assessment File No. 91806); these porphyries may be extrusive or sills, the emplacement of which was controlled by the banded iron formation.

MUNRO LAKE BELT

The eastern extension of the Munro Lake belt straddles southern Gods Lake, and has been mapped as a narrow linear belt to Webber Lake where it pinches out.

At Gods Lake and Vermilyea Lake two salients diverge northwestward from the main belt and terminate in the granitoid terrane. The areas between these salients and the main belt are occupied by homogeneous granodioritic plutons.

The portion of the Munro Lake belt described in this report consists of fine grained amphibolite and amphibolitic schist (3f*, 1h), with local vestiges of intensely flattened pillows, and bedded metagreywacke (3i*, 3f). The two lithologies are structurally conformable.

The southern margin of the belt is structurally in conformable contact with layered gneisses. The contact is gradational over 1 to 15 m with interlayering of gneiss and amphibolite generally on a 0.1 to 1 m scale in the contact zone. This relationship is best exposed on a peninsula on the east side of Gods Lake. Amphibolite layers in the gneiss are spatially, and to some extent lithologically, associated with the southern contact of the belt.

The northern margin of the Munro Lake belt shows two types of contact relationships. The belt is in contact with foliated granodiorite (7*) from Murray Lake to Webber Lake. The actual contact was not observed, but is inferred to be sharp and intensely foliated. To the west, on either side of Gods Lake, the belt has a sharp or locally sheeted intrusive contact with homogeneous granodiorite (7b).

The Vermilyea Lake salient of amphibolite (1h) and metagreywacke (3f) appears to have a gradational intrusive contact with adamellite (7b) on its east side. Two outcrops in the northern end of Vermilyea Lake show disoriented rafts of schistose amphibolite up to 5 m in diameter "floating" in massive granodiorite. These outcrops are inferred to be part of the contact zone. Further west all other contacts between the salient and the belt are interpreted from sparse outcrops and aeromagnetic signatures. The northern termination of the Vermilyea Lake salient is not exposed, but scattered outcrops in the area comprise greywacke cut by irregular stockwork-like dykes and bodies of granodiorite indicating an intrusive contact gradational over a wide zone.

Amphibolite, amphibolitic schist (3f*, 1h)

Amphibolite (1h) is best developed north of Touchwood Lake where it attains an apparent thickness of 1 km. It is in this area that a pillow basalt precursor of this unit is most apparent. The amphibolite is fine grained, dark greenish grey to black with a laminar schistosity, and strongly flattened pillows occur locally. Axial ratios of approximately 1:24 were measured in one horizontal outcrop surface. In places an ill-defined banding composed of 1 to 2 cm thick layers occurs, and relict pillow selvages were identified as an element of this banding, indicating that even more intense flattening is common. A few outcrops show moderately flattened pillows grading into more strongly schistose rock without pillow structures.

East of Touchwood Lake amphibolite (3f*) is thin layered; relict pillow structure occurs in only one outcrop. Excellent exposures occur in the arc of islands strung across Gods Lake. Here the amphibolite has a pervasive laminar schistosity, and varies from massive to banded on a 1 to 3 cm scale. The banding represents subtle variations in hornblende content (Fig. 3). Individual bands cannot be traced along strike for more than a few metres. Greenish epidotic lenses averaging 14 by 8 cm are locally abundant and the foliation wraps around them. Where the epidotic lenses are abundant, fine dark hornblendic streaks outline narrow tentacles that may represent relict pillows. On one island differential weathering reveals an irregular layering. More resistant boudinaged amphibolite layers occur in a more schistose hornblende-biotite-cummingtonite amphibolite, in which

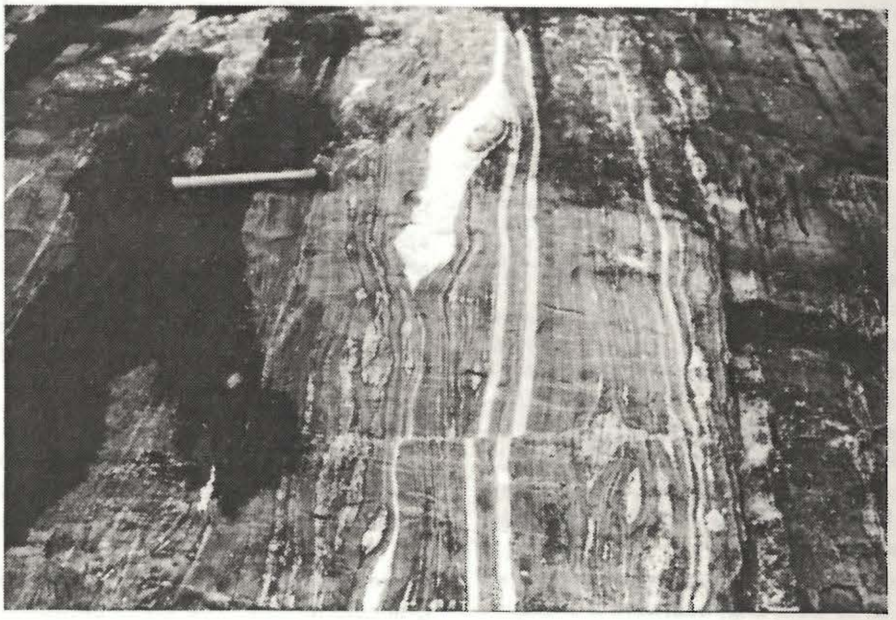

Figure 3: Thin-layered amphibolite (3f, 1h) derived from pillow basalt; Gods Lake.*

plagioclase is locally replaced by white mica. This lithological variation is believed to be due to variable metamorphic/metasomatic effects.

The laminar schistosity in the amphibolite is shown by field and petrographic relationships to be a composite two-phase fabric. In the field this is demonstrated by local tight folds in the compositional banding that itself is believed to have been derived by intense flattening of pillow basalt. The laminar aspect of this schistosity in both hand specimen and thin section is indicative of transposition of an earlier S_1 fabric that is preserved as inclusion trails in pre-S_2 hornblende crystals.

Under the microscope hornblende occurs in three growth stages. The earliest is represented by scattered ovoid crystals wrapped by a penetrative foliation, which is defined by prismatic hornblendes (0.2-1 mm long) forming the second growth stage. This population is overgrown by randomly oriented prisms or skeletal poikiloblasts of the youngest stage. Plagioclase and quartz form a fine grained mosaic. Varying abundances of hornblende and plagioclase produce vaguely defined modal lamination or layering. Fine grained opaque platelets (ilmenite?) oriented in S_1, sphene and, in places, epidote are accessory constituents.

Greywacke (3i*, 3f)

Greywacke is in sharp contact with amphibolitic schist. Contacts between units 3f and 1h are exposed on Vermilyea Lake, and between units 3i* and 3f* on the eastern shore of Gods Lake. The contact is characterized by prominent rusty weathering outcrops; the rusty weathering is caused by the presence of disseminated pyrite in a 1 to 3 m wide zone of greywacke bordering the amphibolite. Graded bedding at the Gods Lake contact exposure indicates that the greywacke stratigraphically overlies amphibolite.

The greywacke is grey to dark grey brown, medium grained, quartzofeldspathic, but with variable proportions of biotite. It is generally well bedded. Graded bedding is exposed in the eastern part of Gods Lake where a significant silt fraction, represented by dark semi-pelitic biotite schist forms the upper part of beds; beds are 5 to 15 cm thick. Flame structures and rip-ups were noted in one outcrop. Scattered quartz and feldspar granules (3-4 mm) and rare granodiorite pebbles (0.5 cm) occur in the basal portions of graded beds. In thin section the biotite schists locally contain muscovite, garnet and andalusite porphyroblasts (2-10 mm), and aggregates of fibrolite. Muscovite porphyroblasts (up to 3 mm) were observed locally on the west shore of Vermilyea Lake.

A penetrative foliation is defined by a preferred orientation of biotite flakes and of lensoid quartz and feldspar grains. The foliation is parallel to bedding and to S_2 in the adjacent amphibolitic schist. There is no evidence that, as in the amphibolitic schist, the foliation is a composite two-phase fabric. However, thin section data from biotite-hornblende greywacke north of Murray Lake suggest that the schistosity is a combination of the S_1 and S_2 fabrics. The foliation is locally cut by a younger, late tectonic strain slip cleavage.

Under the microscope plagioclase and quartz form an inequigranular subpolygonal mosaic that ranges in grain size from 0.2 to 0.5 mm with scattered ovoid grains (up to 1 mm or more). The plagioclase is generally untwinned except for the larger grains; the latter commonly contain small quartz blebs. Biotite occurs as evenly distributed flakes 0.5 mm long that show a strong degree of preferred orientation.

Sillimanite occurs in kinked sheaves of fibres included within large (1 cm) nonoriented muscovite flakes that form lens-shaped aggregates aligned in the foliation. The muscovite poikiloblastically overgrows and includes the foliation and is thus younger than the S_1 foliation.

Sillimanite is also interleaved with biotite in biotitic lenses in the form of sheaves and knots of bent fibres that appear to replace the biotite, and it occurs as single crystals (up to 1.5 x 0.2 mm). Andalusite is xenomorphic to subprismatic and poikiloblastic. Some intergranular amoeboidal grains are partly to wholly sericitized. The crystals (up to 1 cm long) contain a helicitic biotite-quartz fabric that is continuous with the fabric in the matrix. However, the fabric in the matrix is in places sharply bent across the included fabric due to crenulation subsequent to andalusite growth.

Conclusions

The Munro Lake belt is bounded by a tectonic contact on the south, and by both intrusive and tectonic contacts to the north. On the east side of Gods Lake a synclinal structure is suggested by the symmetrical disposition of mafic metavolcanic rocks on the north and south contacts, and south-facing greywacke on the north side of the belt.

Outcrops west of Touchwood Lake demonstrate that intense flattening of pillow flows can produce layered hornblende schist.

BAYLY LAKE COMPLEX

TONALITE AND MIGMATITE COMPLEX (6*, 6a)

A tonalite and migmatite complex occurs north of the Munro Lake belt and extends westward from Knife River. It is well exposed on the shores of Gods Lake and comprises strongly foliated, coarse grained tonalite with irregular bodies of nebulitic gneiss and partially migmatized layered gneiss rafts (Fig. 4).

The tonalitic complex appears to be in sharp (though unexposed) contact with Webber Lake granodiorite (8*). The contact with migmatitic granodiorite (7*) is gradational.

Tonalite locally contains parallel aligned boudinaged amphibolite lenses (Fig. 5) and irregular amphibolite pods with an earlier foliation. These amphibolite inclusions occur in nebulitic relicts of layered gneiss and appear to represent restite. The migmatitic part of the complex shows magmatitic, diktyonitic and nebulitic structures.

The tonalite is composed of anhedral-subhedral plagioclase (An_{25}, that average 4 mm and ranging up to 1 cm) with lenticular aggregates of quartz mosaic and generally about 5 per cent interstitial microcline (1 mm). Plagioclase crystals are partly recrystallized into lensoid augen that together with scattered biotite flakes and hornblende crystals (up to 3 mm) define a strong pervasive gneissic foliation. Sparsely scattered microcline porphyroblasts or phenocrysts (up to 2 cm) occur locally; they predate the foliation that wraps around them.

LAYERED GNEISS (6a, 1*)

Layered gneiss (1*) forms a zone up to 2 km wide that flanks the south margin of the Munro Lake belt. It also occurs in lenses, up to approximately 300 m wide and possibly 1 to 2 km long, within the tonalitic and granodioritic migmatites (6*, 6a). These lenses are particularly abundant in a zone that trends northwesterly through Gods Lake between the Munro Lake belt and Gods Lake Narrows. Minor occurrences of partially migmatized layered gneiss occur throughout the migmatitic complexes.

The contact between the Munro Lake belt and the layered gneiss is gradational over 1 to 3 m and consists of intercalated gneiss and amphibolite layers 1 to 30 m thick. The layered gneiss contains amphibolite layers of variable widths and has identical contact relationships as does the main Munro Lake belt. These amphibolites are believed to have been derived from the Munro Lake succession and they are similar to hornblende schists of the Munro Lake belt, but most are coarser grained, particularly the thicker layers. The thinner layers are in places boudinaged, and the internal foliation of the layered bodies tends to be athwart the external foliation.

Baragar and McGlynn (1976) suggested that layered gneiss (1*) represents basement to the greenstones. However, Unit 1* shows the same deformational and metamorphic history as the rocks of the Munro Lake belt. Structural or metamorphic events older than those developed in the

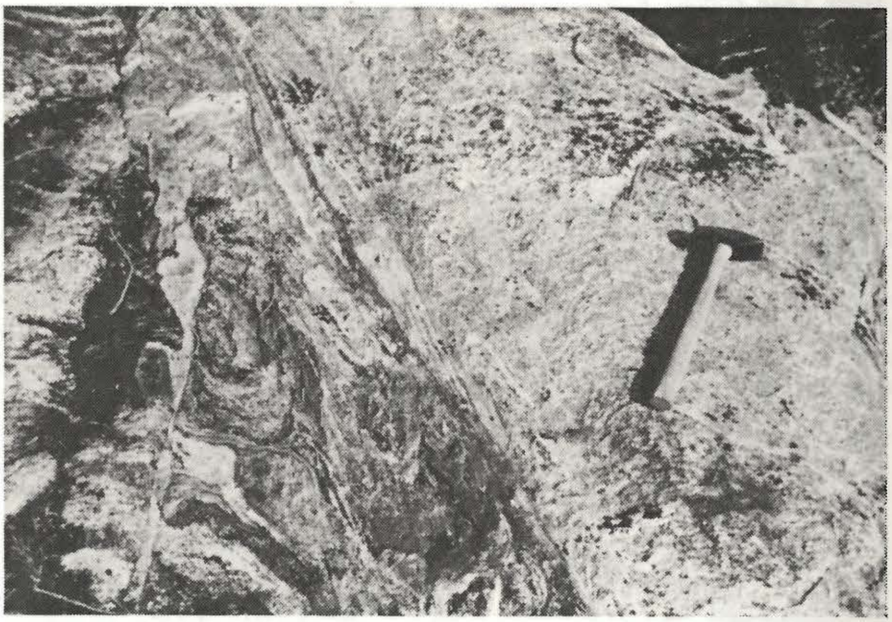

Figure 4: Tonalite and migmatite complex (6, 6a) comprising strongly foliated, coarse grained tonalite (right side of photo) and migmatized layered gneiss (left side); Gods Lake.*

Munro Lake belt have not been detected and the layered gneisses are structurally concordant to rocks of the Munro Lake belt.

The layered gneiss comprises two lithologies: a) grey tonalitic gneiss with an intense regular planar foliation parallel to a 2 to 3 cm scale colour banding, and with plagioclase augen (up to 8 mm) (Fig. 6); and b) fine grained tonalitic gneiss with more pronounced lithological variations.

Microscopic Features

The fine grained tonalite gneiss (b) is composed of quartz, plagioclase (An_{20-30}), biotite and hornblende; variations in the proportions of the mafic minerals define a strongly planar 2 mm to 10 cm layering . The rock has recrystallized to hypidiomorphic granular texture and has no petrographic features that would be diagnostic of its origin. In contrast, the grey tonalitic gneiss (a) shows textural evidence of derivation from a homogeneous tonalite with minor leucocratic veins. Plagioclase augen are set in a heteroblastic quartz and plagioclase mosaic in which the intense foliation is defined by thin lenticular aggregates of fine grained quartz, and aligned biotite and hornblende crystals. Regular leucocratic laminae and bands have aplitic textures and contain up to 20 per cent microcline as interstitial grains and small (1-3 mm) augen. The colour banding appears to be the result of zonal differential flattening, and some leucocratic laminae may result from recrystallization along foliation planes.

AMPHIBOLITE INTERLAYERS

Amphibolite interlayered with layered gneiss are divided into two subunits: a) prominent, generally medium grained amphibolite within the main zone of layered gneiss that flank the Munro Lake belt; and b) relatively thin, fine grained amphibolite layers in migmatitic tonalite gneiss north of the Munro Lake belt.

Medium grained amphibolite

Foliated, medium grained amphibolite occurs in units up to 280 m thick that are parallel to, and flank the southern contact of, the Munro Lake belt. Amphibolite of identical lithology forms a lensoid body up to 1 700 m thick south of Webber Lake. The amphibolite is dark green grey to black and is composed of hornblende, plagioclase, quartz, minor

Figure 5: Tonalite and migmatite complex (6, 6a) with boudinaged amphibolite lenses (pen is 15 cm long); Gods Lake.*

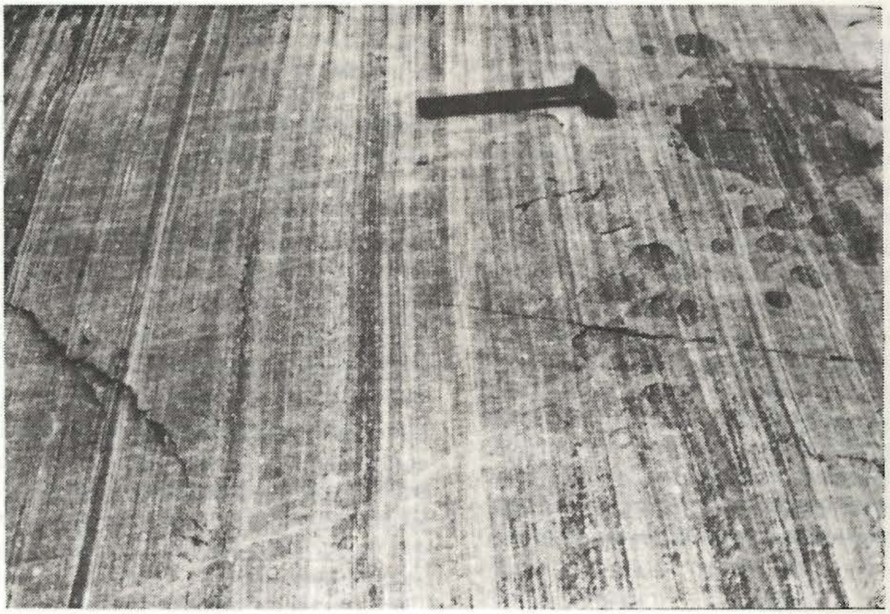

Figure 6: Intensely thin-layered, grey tonalitic gneiss (6a, 1) with plagioclase augen.*

biotite and accessory sphene, in similar proportions as in Munro Lake belt metabasalt. A 0.5 to 1.5 cm layering, defined by slight variations in feldspar content is parallel to a penetrative foliation defined by parallel aligned hornblende crystals. Quartz and quartzofeldspathic lenticles and streaks are common; granodiorite veins (average 10 cm thick) and units of granodioritic gneiss occur in the large lensoid body south of Webber Lake.

On the east side of the peninsula in south Gods Lake the amphibolite generally has only one foliation . In lenses of coarse (2 mm) calcsilicates (relict pillow rims) diopside is intergrown with tremolite-actinolite, and is partly replaced by hornblende. The foliation in the host rocks wraps around the lenses, suggesting that the epidote was the result of an earlier amphibolite facies metamorphism (Hubregtse, pers. comm.).

The compositional layering is believed to be a transpositional feature, similar in origin to the layering in the intensely deformed Munro Lake belt metabasalt. The relatively coarse texture is considered to be a product of a more intense recrystallization that took place in the main part of the Munro Lake belt.

In thin section, hornblende is subidiomorphic, shows a weak to moderate degree of preferred orientation and contains scattered ovoid inclusions of plagioclase. Many of the crystals contain fractures healed by quartz and carbonate. Plagioclase is xenomorphic and commonly ovoid. Some are strongly zoned, but others are strained, and show well developed glide twins. Quartz is interstitial and occurs in aggregates of xenomorphic grains (up to 1 mm). Flakes of brownish green/brown pleochroic biotite (2 mm) are marginal to, and partly included by, hornblende. Sphene commonly has an ilmenite core. The rock was probably strongly strained after the main fabric was formed and subsequently annealed.

Fine grained amphibolite

Fine grained, partly layered amphibolite forms layers a few centimetres to 40 m thick. Amphibolite in the thicker layers is a fine grained hornblende schist identical to that in the Munro Lake belt, locally with fine banding with laminae 3 to 8 mm thick. Amphibolite that occurs close to the contact with the tonalite, or in small gneiss domains in the tonalite, comprises medium grained amphibolite that is interlayered with finer grained amphibolite. The amphibole is ferrohastingsite that occurs in inequigranular prisms up to 2 mm long. Scattered subidiomorphic epidote associated with pink garnets (up to 0.5 mm) occurs locally. Ovoid boudins (up to 10 cm long) composed of coarse clinopyroxene (up to 2 cm) wrapped by the foliation occur close to the contact. The boudins contain minor interstitial plagioclase and epidote. As discussed earlier these boudins probably represent metamorphosed epidotic domains. The mineralogical and textural features observed in these units may represent contact metamorphic effects associated with the formation of the tonalitic complex.

GRANODIORITE

Homogeneous granodiorite plutons vary in composition from tonalite to adamellite and intrude the Munro Lake belt at Touchwood Lake, Vermilyea Lake and in the Wapeeminakoskak Lake area. These rocks also intrude the Webber Lake belt, on its north side, from the Webber Lake area eastward. Associated bodies of migmatitic granodiorite occur south of Gods Lake Narrows and in poorly exposed areas south of the Munro Lake belt. These granodiorites postdate the layered gneiss and the tonalitic migmatite, and two early deformational phases in the greenstone belts. They have been affected by a weak regional penetrative deformation and local mylonitization.

Vermilyea Lake granodiorite (7b)

This pluton is exposed on Vermilyea Lake where it occupies the area between the northern prong of the Munro Lake belt and the Vermilyea salient.

The contact with the northern margin of the Munro Lake belt is exposed on the east shore of Gods Lake, where a structurally concordant sheeted intrusive contact is gradational over approximately 10 m. The contact zone consists of sills of granodiorite that become more numerous as the granodiorite is approached (Fig. 7). Xenolith-rich exposures along the creek at the north end of Vermilyea Lake suggest that there the contact is more irregular; xenoliths of hornblende schist are disoriented indicating that the intrusion post-dated development of the schistosity. Garnet, muscovite, andalusite and sillimanite in greywacke on the west shore of Vermilyea Lake and the east shore of Gods Lake are believed to represent contact metamorphic effects of the pluton.

The granodiorite is coarse grained, equigranular and grey to pinkish grey with 15 per cent hornblende and biotite. Some large plagioclase (An_{33}) that are crudely subhedral are moderately zoned. The local pinkish tinge is caused by minor amounts of microcline. Sphene, ilmenite and apatite are accessory minerals. Scattered mafic xenoliths (up to 30 cm) occur in the tongue of granodiorite that intrudes the north margin of the Munro Lake belt; one 10 m long raft on the east shore of Gods Lake consists of metabasalt with relict pillow outlines. A weak to moderate foliation is developed. The granodiorite is weakly to moderately foliated and is cut locally by irregular medium grained grey aplite dykes that postdate the foliation.

Amphibolite to diorite with up to 1 cm long hornblende occur at the entrance to a bay on the east side of Vermilyea Lake and on an island in Gods Lake approximately 5 km along strike to the southeast. They are intruded by granodiorite sills and dykes and are believed to represent large rafts of Munro Lake belt mafic volcanic rocks that recrystallized by contact metamorphism related to intrusion of granodiorite.

Touchwood Lake granodiorite (7c)

This body is very similar to the Vermilyea Lake pluton in composition and in its contact relationship with the host rocks. It extends between the Vermilyea Lake salient and the Munro Lake belt at the northern end of Touchwood Lake. Its contact with the metavolcanic and sedimentary rocks is not exposed, but is inferred to be mainly concor-

Figure 7: Sheeted intrusive contact zone between Vermilyea Lake granodiorite (7b) and Munroe Lake belt amphibolite (3f, 1h).*

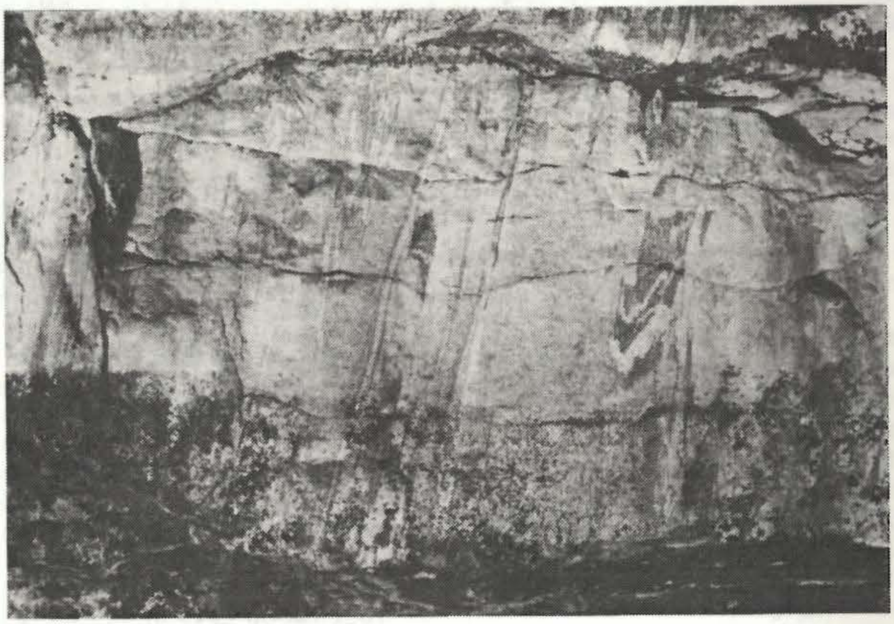

Figure 8: Migmatized granodiorite (7, 6a) with wisps and inclusions of tonalitic migmatite and veined gneiss (hammer is 30 cm long).*

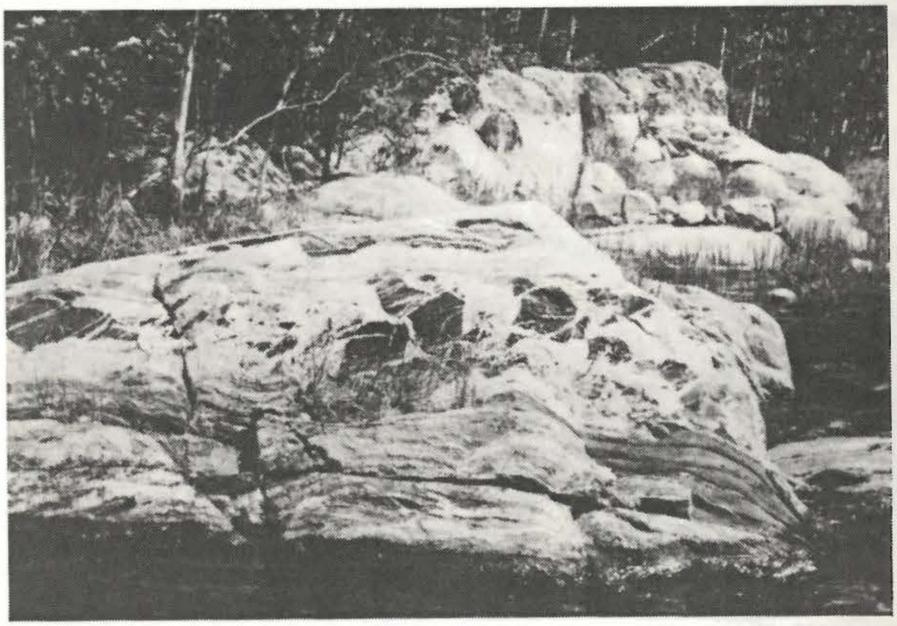

Figure 9: Migmatitic granodiorite (7, 6a) with amphibolite inclusion intruded by granodiorite.*

dant, except in the reentrant between the salient and the main belt where it is assumed to be discordant. Greywacke that forms the north end of the Vermilyea Lake salient is intruded by many irregular dykes and bodies of medium grained granodiorite assumed to be related to the main pluton. Exposures are virtually lacking northwest of Touchwood Lake, and the relationship of the pluton to the migmatitic gneiss terrane is unknown.

The granodiorite is coarse grained, pinkish grey and varies from massive to well foliated. Faint, dark, biotitic schlieren and sparsely scattered mafic xenoliths up to 5 cm in diameter occur locally. The rock contains up to 15 per cent microcline as small xenomorphic interstitial grains and in places poikilitic phenocrysts (up to 1 cm). Biotite (5-10%) forms aggregates (1-2 mm) of fine grained flakes associated with epidote and sphene. Weakly developed 'quartz-eye' texture was observed at one locality on Touchwood Lake.

Wapeeminakoskak Lake granodiorite (7*, 7b)

The Wapeeminakoskak Lake granodiorite forms an elongated pluton between the Webber Lake belt and the Munro Lake belt. It lenses out to the west and grades into migmatitic granodiorite to the northwest[1] and in the extreme east. It has a sheeted intrusive contact with the Munro Lake belt in the Wapeeminakoskak Lake area. The granodiorite is similar to the Vermilyea Lake pluton, but in the Wapeeminakoskak Lake area it is porphyritic with microcline crystals up to 1.5 cm in length, and locally it has granitic composition. Locally the Wapeeminakoskak Lake granodiorite contains nebulitic gneiss.

The Wapeeminakoskak Lake granodiorite is well foliated. In the southwestern arm of Webber Lake local shear zones are developed within the pluton. The contact with the Munro Lake belt is locally intensely deformed, and mylonitization has occurred along the contact with the Webber Lake belt southeast of Webber Lake, that gives rise to a zone of blastomylonite similar to the Gods Narrows shear belt.

Migmatitic granodiorite (7*, 6a)

Migmatitic granodiorite (7*) intrudes the migmatitic tonalite complex (6*). It was mapped as a large lens-shaped body extending from the Gods Lake Narrows area eastwards to the Webber Lake belt on the original Preliminary Map 1973H-9, but is not separated and is shown as unit 6a on Map GR83-1-13[2]. Unit 7* also underlies poorly exposed and poorly defined areas south of the Munro Lake belt. The Gods Lake Narrows shear belt (6a, 6*) forms the northern contact of the body in the Gods Lake Narrows area; the contact is gradational and is characterized by progressive flattening and mylonitization of the migmatite as the shear belt is approached. The southern contact with the tonalite migmatite (6*) is a diffuse gradational zone in which veining of younger granodiorite (forming the main rock type of migmatitic granodiorite) gradually disappears.

The migmatitic granodiorite consists of locally homogeneous, generally equigranular grey to pinkish-grey granodiorite with schlieren and wisps of nebulitic gneiss, and irregular rafts of strongly foliated tonalite, tonalitic migmatite and irregularly veined gneiss (Fig. 8). Amphibolite in the tonalitic migmatite is commonly disrupted by veins of granodiorite (Fig. 9). The rafts of veined migmatitic tonalite generally vary from 1 to 15 m in diameter, but locally appear to form large bodies up to approximately 60 m wide. These bodies tend to show diktyonitic structure in which younger granodiorite intruded axial planes of warps and kink folds of preexisting foliation and banding. The axial planar veins tend to be more leucocratic than the granodiorite plutons. Diffuse and irregular patches of pegmatite and pegmatitic granodiorite are locally abundant. Younger pegmatites and aplites form crosscutting but irregular dykes.

Granodiorite that forms the neosome in the tonalite and migmatite complex (6*) is distinguished from earlier tonalite by its generally finer grain size (average 3 mm), a pinkish tinge due to the presence of more abundant microcline (10-15%), and by the absence of the strong gneissic foliation that characterizes the tonalite. Where the two phases are in contact, the foliation in the tonalite is truncated and disrupted by the granodiorite. The granodiorite neosome is similar in texture and composition to the homogeneous granodiorite bodies into which the migmatitic granodiorite locally grades, *e.g.* north of Murray Lake. Locally it contains scattered microcline phenocrysts or porphyroblasts (up to 1 cm).

In the Bog Lake area and to the east, the migmatitic granodiorite shows a close relationship with the leucogranite into which it locally appears to grade. Irregular granitic dykes in the migmatitic granodiorite indicate that the leucogranite is a later but related phase.

Granodiorite neosome consists of a hypidiomorphic granular aggregate of subhedral largely untwinned and weakly zoned plagioclase crystals (An_{20-25}), minor anhedral microcline and irregular interstitial quartz grains that are recrystallized to a mosaic. Most of the microcline is present as smaller sized interstitial crystals. Brownish-green biotite generally shows a preferred orientation and occurs in scattered flakes and aggregates of fine flakes associated with epidote, apatite and sphene. Minor hornblende is present locally.

Nebulitic gneiss is texturally similar, but contains a smaller proportion of gneiss; the dark bands contain a higher proportion of biotite as flakes up to 3 mm in length, associated with minor hornblende. The amphibolite pods that represent relict disrupted amphibolite units in the gneiss have recrystallized to medium grained amphibolite in which amphibole is strongly coloured ferrohastingsite, and acces-

1 This unit is not separated on Map GR-83-1-12; it is part of unit 6a.

2 Unit 7* probably occupied the northern part of unit 6* in Map 1973H-13.

sory epidote, sphene and apatite have recrystallized (up to 0.8 mm).

Elk Island granodiorite (7b)

This pluton intrudes the Hayes River Group and consists of two main phases: (i) equigranular, leucocratic biotite granodiorite, north and northeast of Knife Lake; and (ii) a quartz-phyric granodiorite - the "quartz eye granite" of Wright (1932), Baker (1935), and Dix (1951), west of the power line to Elk Island. The two phases are gradational into one other.

Cobbles and boulders of the quartz-phyric phase occur in the Oxford Lake Group conglomerate at Gods Lake Narrows and the pluton is therefore considered to be older than the Oxford Lake Group. At the contact northeast of Knife Lake the intrusion appears to postdate an early foliation in the Hayes River Group, and Gilbert (1985) reports xenoliths of foliated metabasalt in the body northeast of Elk Island. This suggests that intrusion post-dated a deformational and metamorphic event in the Hayes River Group.

South of Elk Island the pluton is a tabular body that reaches successively higher stratigraphic levels of the Hayes River Group to the west. The fact that the quartz-phyric phase intruded the upper part of the Hayes River Group suggests that it represents an original high level portion of the pluton. This may indicate that the rocks of the Hayes River Group were not appreciably deformed prior to emplacement of this intrusive body. This is confirmed by the attitudes of flow layering described below, which are parallel to the regional strike and dip of the Hayes River Group.

Equigranular granodiorite

Equigranular granodiorite is leucocratic, homogeneous, and coarse grained. It contains biotite and is massive to weakly foliated. The contact with the Hayes River Group volcanic rocks is vertical, sharp, and shows little evidence of chilling; it is subparallel to the stratigraphic succession east of Knife Lake, but swings northwards and is discordant to the stratigraphic succession at Gods Lake.

Poorly exposed equigranular biotite granodiorite intrudes the Hayes River Group east of Knife Lake. This granodiorite is massive to weakly foliated, medium grained (1-2 mm) and leucocratic; a few metabasalt xenoliths (up to 3 m) were noted in one outcrop.

There is some evidence that a narrow thermal aureole of amphibole facies metamorphism is associated with the (unexposed) intrusive contact northeast of Knife Lake. A weak foliation parallel to the contact is developed in the granodiorite and adjacent volcanic rocks. In the latter it is defined by (contact metamorphic) hornblende and is superimposed upon an earlier fabric; garnet also occurs in the thermal aureole. The superimposed fabric is believed to represent minor buttressing effects of the intrusion.

Quartz-phyric granodiorite

Quartz-phyric granodiorite is massive, leucocratic and coarse grained with prominent quartz phenocrysts averaging 5 mm in diameter; it varies in composition from granodiorite to tonalite. Rare inclusions of an earlier dark grey-green, quartz-phyric phase occur locally. The contact with metavolcanic rocks is gradational. With increasing volume of xenoliths the rocks grade into volcanic rocks intruded by numerous irregular dykes, which become less frequent and finally are absent away from the contact.

Igneous layering defined by 5 to 70 cm colour variations occurs at several localities and is parallel to regional strike and dip of Hayes River Group strata. An early magmatic phase of a dark greenish-grey, quartz-phyric rock occurs in marginal zones of the intrusion and as rounded scattered xenoliths (up to 1 cm). The marginal zones of the early phase are commonly 30 cm to 1 m wide. Contacts with the main leucocratic granodiorite are fairly sharp (gradational over 1 cm), though local interdigitation occurs. The darker phase locally contains xenoliths of leucocratic quartz-eye granodiorite indicating that the darker phase did not entirely predate the main phase; its associations suggest that it originated from contamination by the mafic host rock. The quartz-phyric granodiorite locally contains accessory pyrite that cause rusty staining on outcrops.

Two diatreme breccia pipes occur 3.8 km west of High Island. They are subcircular in outcrop section and 3.5 and 10 m in diameter, respectively. The breccia comprises blocks of quartz-phyric granodiorite (10-30 cm) in a dark differentially weathered matrix. Locally the granodiorite that borders the pipes shows incipient brecciation. A dyke of the breccia cuts massive and brecciated granodiorite and a large raft of volcanic rocks. It is suggested that the brecciation formed by sudden escape of late stage hydrothermal fluids and/or gas.

The main body of the quartz-phyric granodiorite is generally nonfoliated, or very weakly foliated, but on the islands to the west a weak to moderate penetrative foliation is zonally developed. This foliation is intensified in shear zones that are prominent in the most westerly string of small island. The granodiorite in these shear zones is transformed to sericitic schist.

Dykes and sills

Dykes and sills (up to 100 m thick) of quartz-phyric granodiorite, and quartz and feldspar porphyry are abundant in the metavolcanic rocks peripheral to the Elk Island pluton, particularly on the islands west of Green Island. These dykes and sills are lithologically and spatially related to the quartz-phyric granodiorite and can be traced into the pluton in the contact zone. It is inferred that dykes of similar lithology that occur in more distant parts of the Hayes River Group are of the same generation.

The associated dykes in the Hayes River Group are affected by shearing. Local boudinage of dykes and transverse quartz-tourmaline tensional veins are associated with this deformation.

Webber Lake granodiorite (8*)

The area north of the Webber Lake belt is underlain by generally massive homogeneous, pale pinkish-grey biotite-granodiorite. Scattered outcrops occur along the shore of Webber Lake, but inland exposure is virtually lacking. The rock is mostly equigranular, but locally scattered irregular quartz grains (up to 5 mm) impart a weak quartz porphyritic texture.

This rock is similar to the quartz-phyric granodiorite of the Elk Island pluton, but the quartz grains lack the simple ovoid or subhedral shape.

Xenoliths of metagabbro and mafic schist (1-10 cm) occur locally, particularly near the contact with the metavolcanic rocks of the Webber Lake belt. That contact was formed by *lit-par-lit* intrusion of granodiorite sills. It is similar to the contact of the Vermilyea Lake granodiorite with the north margin of the Munro Lake belt on Gods Lake, but is more intensely foliated. A weak foliation is locally developed in the granodiorite and this becomes more intense toward the contact with the Webber Lake belt.

Well foliated, coarse grained, homogeneous granodiorite also intrudes the southern contact of the Webber Lake belt at its west end. Here the contact is sharp and locally interdigitated.

At the west end of the pluton intensity of the foliation increases rapidly northward and the granodiorite passes into a blastomylonite, which represents the eastward extension of the Gods Narrows shear belt.

LATE INTRUSIVE ROCKS

Leucogranite (12*)

Leucogranite occurs in the granitoid terrane south of the Munro Lake belt (Unit 6 on Fig. 1). The largest unit is irregularly shaped and extends southeast from Murray Lake. The northern part of another pluton occurs to the southeast and a third straddles the central part of Touchwood Lake. Another unit is exposed in a few outcrops in a heavily drift-covered area southwest of Murray Lake.

Leucogranite varies from nonfoliated to very weakly foliated. Phenocrysts are locally aligned parallel to the foliation. Alignment and foliation are probably associated with emplacement of the pluton in a semicrystalline state. The weak foliation is parallel to the regional foliation trend, but is discordant with the margin of the plutons, suggesting the leucogranite is a late tectonic intrusion. Leucogranite is considered the youngest plutonic unit in the granitoid terrane.

Leucogranite commonly has granitic composition and variable texture. Generally the rocks are leucocratic, pinkish, coarse grained and porphyritic. The unit 12* southeast of the Murray Lake pluton lacks potassium feldspar phenocrysts.

At the northeast margin of the Murray Lake pluton, a zone of nebulitic gneiss with relict layering has diktyonitic structure suggesting a high degree of assimilation. However, crosscutting dykes of pink leucogranite in the host rocks suggest that leucogranite crystallized from an intrusive magma.

Diffuse pegmatitic patches, vaguely defined xenoliths and wisps of nebulitic gneiss occur in some outcrops. Phenocrysts in the pegmatite are anhedral carlsbad twinned potassium feldspars (up to 2 cm).

OXFORD LAKE GROUP

The Oxford Lake Group rests with marked unconformity on the Hayes River Group in the Gods Lake Narrows area. The base of the Oxford Lake Group comprises a thick polymictic conglomerate overlain by intermediate volcaniclastic rocks, greywackes including pebbly or agglomeratic layers, thin iron formation, and rare mafic and felsic volcanic rocks. The stratigraphic uppermost part of the Oxford Lake Group is bounded on the south by dominantly mafic schists and mylonites of the Gods Lake Narrows shear belt and it pinches out in the east against this belt. The basal conglomerate is truncated in the west by a shear zone that is believed to be a splay of the Gods Lake Narrows shear belt.

CONGLOMERATE (9b)

Conglomerate, up to 1 000 m thick forms the base of the Oxford Lake Group; it overlies the Hayes River Group with a marked angular unconformity. The unconformity is exposed on Chataway Lake where it is knife sharp. Sedimentary top indicators in the conglomerate consistently face south, whereas the Hayes River Group faces northwest and strikes into the basal contact of the conglomerate where Hayes River Group metavolcanic rocks, south of Chataway Lake, are truncated. The basal 5 to 10 m of conglomerate has abundant mafic volcanic clasts and has an amphibolitic matrix.

The conglomerate is framework supported and is characterized by well rounded tonalite and granodiorite boulders, and by abundant mafic and felsic volcanic fragments, that have bimodal size distribution and can be correlated with lithologies in the underlying Hayes River Group. The matrix is a dark biotite-hornblende greywacke. The felsic plutonic and felsic volcanic boulders are generally larger in diameter than the mafic volcanic clasts; plutonic boulders average 20 cm, range from less than 2 cm up to 75 cm in diameter and constitute 30 to 40 per cent of the clast population. The volcanic clasts were more ductile and have been deformed into flattened ellipsoids that tend to wrap around nondeformed granodiorite boulders. Metabasalt clasts overlying the unconformity on Chataway Lake tend to be subangular, but these appear to be locally derived.

Granitoid clasts comprise massive coarse leucocratic granodiorite (light and dark phases), coarse, well foliated granodiorite (some boulders contain post foliation aplite dykes), medium grained aplogranite, porphyritic granodiorite (some boulders with amphibolite xenoliths) and coarse tonalite with a gneissic foliation. Clasts of possible plutonic origin include medium grained amphibolite with quartz veins, and fine grained, black hornblendites.

Mafic volcanic clasts are dominantly greenish-black metabasalt, and subordinate fine- to medium-grained metagabbro and coarse grained metagabbro. Clasts of rusty, banded, fine grained quartzite derived from iron formation, and bedded greywacke occur locally.

Clasts derived from felsic hypabyssal and volcanic rocks are fine grained, pale grey feldspar porphyry that contain 1 to 2 mm phenocrysts or coarse euhedral 1 cm phenocrysts; other porphyry clasts contain scattered hornblende crystals (1-3 mm). The feldspar porphyry is probably derived from hypabyssal dykes of the Hayes River Group. Grey and pale grey aphyric clasts, probably derived from extrusive felsic rocks, are also common.

Discontinuous greywacke layers (5 cm to 1 m thick, up to 20 m long) commonly occur in the conglomerate, 3 to 8 m apart. These greywacke layers are even grained and tend to be massive, though some are internally laminated and rarely crosslaminated. Some of the beds contain isolated cobbles and pebbly bands.

METAGREYWACKE (3a)

Metagreywacke is grey to dark grey and bedded; beds vary in thickness beds from 1 to 40 cm. Internal parallel 1 to 3 mm laminations are common. Cross-lamination and graded bedding are rare.

Grey, thin bedded, cherty metasiltstone with dark grey silty intercalations, spaced at 3 to 7 cm intervals, occurs on a small island on the east side of the north entrance to the Gods Lake Narrows. Rare dark grey metasiltstone that contain finely disseminated graphite and minor pyrite are also interbedded in the sequence.

Bedding reflects variations in biotite and amphibole content, and fluctuations in grain size. Colour banding reflects variations in the proportion of hornblende and biotite. The dark metasedimentary rocks appear to represent tuffaceous sediment in which epiclastic detritus was mixed with ash derived from mafic volcanism. The pale grey quartzofeldspathic sedimentary rock was probably derived from a granodioritic terrane, though derivation in part from felsic volcanic rocks is also possible.

A penetrative foliation is developed parallel to bedding. Inclusion trails in garnets, and an earlier schistosity folded around the hinges of intrafolial folds indicate that this is a composite foliation that represents two stages of fabric development, S_1 and S_2.

Microscopic features

The metasedimentary rocks are composed of quartz, plagioclase (An_{20-40}) and biotite, with varying amounts of hornblende, sericite and epidote. Carbonate, sphene, tourmaline, apatite and opaques are accessories; garnet occurs locally. The average grain size is approximately 0.2 mm, and scattered plagioclase crystals and hornblende porphyroblasts are up to 1 mm long.

Quartz and plagioclase form a xenomorphic inequigranular mosaic (0.1-0.2 mm) that rarely shows subpolygonal grain boundaries. Carbonate may be interspersed with quartz and feldspar. In a graphitic unit the outlines of original detrital grains are defined by fine graphite dust rings indicating an original grain size of 0.2 to 0.3 mm. Many of these grains have not been recrystallized and orthogenic quartz overgrowths can be distinguished.

Biotite and subordinate sericite occur in scattered aligned flakes (up to 0.3 mm). M_1 growth is represented by lensoid porphyroblasts (0.5 mm) with (001) oblique to the F_2 schistosity that wraps around porphyroblasts. More rarely in F_2 fold hinges, an early penetrative biotite (F_1) fabric is overprinted by M_2 biotite nucleated in the axial planes of strain-slip crenulations.

Epidote occurs as scattered fine granules (0.2 mm); it is locally abundant (up to 15%). Hornblende (0.3 mm) is aligned in S_2. It also occurs as pre- and post-S_2 porphyroblasts (up to 1 mm). Amphibole is subordinate to biotite and is commonly absent, but locally forms up to 80 per cent of the mafic mineral content. At one locality amphiboles have an irregular shaped olive green core that contains fine opaque inclusions (exsolutions?) and paler actinolitic rims. The cores of these crystals appear to be detrital grains, pseudomorphic after pyroxene, and the rims are metamorphic overgrowths.

Detrital plagioclase grains are subrounded (up to 2 mm) and have poorly developed albite twinning. The foliation wraps around them and most are partly granulated to a diffuse sutured mosaic. Where the deformation is relatively weak, rounded detrital quartz grains (1 mm) can be distinguished and are recrystallized to a subpolygonal quartz mosaic. In most outcrops they are represented by lensoid quartz aggregates.

Mafic tuff and breccia

Beds of mafic tuff and breccia that vary from 1 m or less to 10 m thick are interlayered with metagreywacke. Tuff is composed of amphibole, plagioclase and quartz with sparsely scattered larger plagioclase (1 mm long). Beds are generally massive, but some have crudely developed 5 cm scale lamination.

These mafic units are closely associated with mafic flows. An agglomerate is interbedded with greywacke on the southern tip of an island northeast of the Narrows in Gods Lake. The agglomerate consists of lensoid clasts of sparsely porphyritic metabasalt (7-10 cm x 1-3 cm) in a mafic tuff matrix and likely represents proximal debris of a pillowed flow. A similar mafic agglomerate unit (up to 150 m thick) occurs southwest of Chataway Lake. These rocks grade into a crescent-shaped unit (1h) composed of massive basalt (typical of the Hayes River Group) and laminated hornblende schist.

Microscopic features

Mafic tuff is completely recrystallized and is petrographically distinct from mafic flows. Texturally it is akin to mafic greywackes from which they differ by a higher amphibole content. Amphibole is commonly poikiloblastic (up to 1.5 cm). It has overgrown quartz and plagioclase grains that define the S_1 schistosity of the groundmass. The amphibole is locally altered to biotite, which is itself chloritized in places.

Metabasalt clasts in agglomerates are petrographically similar to Hayes River Group pillow basalt to the north.

Banded oxide facies iron formation

Locally, banded oxide facies iron formation is intercalated with greywacke. It is about 1 m thick and consists of interlayered laminated garnet amphibolite and fine grained quartzite (metachert), and very fine grained magnetite forms 3 to 15 per cent of the unit. This iron formation is poorly exposed over 30 m in a bay 2 km east-northeast of the Gods Lake Narrows settlement.

In thin section metachert layers consist of a xenomorphic granular or subpolygonal mosaic of quartz and in places with minor interstitial carbonate. Thin metachert layers commonly contain clusters of radiating tremolite-actinolite. The amphibolitic layers comprise tremolite-actinolite with subordinate strongly pleochroic hornblende, fine grained magnetite and subidiomorphic garnet. The coloured hornblende becomes more abundant several millimetres away from garnet porphyroblasts. The garnets contain colourless amphibole and straight inclusion trails of fine opaques. Bedding and schistosity wrap around the porphyroblasts, which locally have quartz-filled tension gashes.

Conglomerate

Greywacke includes discontinuous conglomerate (to breccia) beds that contain sparse to abundant lensoid, pale grey dacitic to rhyolitic clasts. These beds vary from 15 m in thickness to discontinuous lenticles 5 to 10 cm thick. The clasts average 10 cm in length and 2 cm in thickness, but they are poorly sorted and in some thicker units clasts up to 130 cm by 10 cm occur. Pale grey, fine grained felsic clasts dominate; fine grained, grey feldspar porphyry and dioritic clasts are less common.

RHYOLITE (7g)

Quartz- and feldspar-phyric rhyolite (approximately 150 m thick) is in contact with the Oxford Lake Group conglomerate at two localities north of Gods Lake Narrows, and southwest of Chataway Lake. The rock is pale grey with scattered ovoid quartz phenocrysts (average 1.5 mm, up to 5 mm), and subhedral plagioclase phenocrysts (up to 1 cm). Faint colour banding is defined by 5-10 m thick bands of various shades of pale grey. A strong penetrative fabric defined by fine biotite flakes and sericite is a combination of S_1 and S_2 foliations. Flattened lenticular blocks up to 30 cm long can be distinguished in places.

Microscopic features

Quartz phenocrysts are strained and usually recrystallized into subgrains. Where deformation is very intense they are granulated to lenses and stringers of quartz mosaic. Plagioclase phenocrysts have undulose extinction, subboundaries and some are broken by fractures healed with quartz. The groundmass is a fine grained xenomorphic quartz-feldspar mosaic with scattered aligned fine grained biotite and sericite flakes and discontinuous biotite aggregates that define a foliation that wraps around phenocrysts. Epidote, tourmaline and sphene are accessory minerals.

Figure 10: Flattened and transposd inclusiones in banded gneiss (6a, 7); Gods Lake Narrows.*

Figure 11: Banded gneiss (6a, 7); Gods Lake Narrows.*

GODS LAKE NARROWS SHEAR BELT

The Gods Lake Narrows shear belt separates the Webber Lake belt and the Hayes River Group at Knife Lake. The shear belt is best exposed at Gods Lake Narrows where it is represented by a deformation zone, up to 4 km wide, with localized tectonic reconstitution and mylonitization of rocks in the core of the zone. Variations in strain and fabric development, particularly on the northern side of the shear belt, are similar to those described by Ramsay and Graham (1970) in typical shear belts; however, in the Gods Lake Narrows shear belt, these variations appear to be the result of two deformational phases. Three lithological units resulted from the deformation: (i) banded gneiss produced by flattening of migmatitic rocks and gneisses; (ii) blastomylonite; and (iii) mafic schist containing slices of Oxford Group rocks.

Banded gneiss (6a, 7*)

The foliation in layered tonalitic to granodioritic gneiss (6a), migmatitic granodiorite (7*) and unit 6* south of Gods Lake Narrows intensifies as the shear belt is approached. This is associated with increased flattening of tonalite and gneiss rafts, and a transposition of the earlier layering, foliation and dykes of tonalite, granodiorite and pegmatite, into the plane of superimposed foliation (Fig. 10). Thus the migmatite grades northward into a belt of banded gneiss that is up to 400 m wide. It is best exposed on the shore at Gods Lake Narrows near Barney Lamb's fishing lodge (Fig. 11). The original texture is partially preserved in this rock, though coarse feldspar is augen-shaped, has mortar texture and is set in a recrystallized, fine grained quartz and feldspar mosaic containing chlorite (retrogressive after biotite) and scattered aggregates and grains of epidote.

The northern contact of the banded gneiss is faulted at Gods Lake Narrows; however, inland approximately 4 km to the northwest, the rocks of the north margin of the unit are more intensely deformed and cataclastic. More intense flattening has caused a higher degree of recrystallization leading to a fine grained quartzofeldspathic mosaic with scattered relict feldspar augen, but relict, flattened, coarse granitoid textures are locally preserved on weathered surfaces. Pegmatites are represented by paler pinkish bands with fine mylonitic laminations.

Blastomylonite (1k)

Blastomylonite forms a laterally persistent unit approximately 35 km long and up to 200 m thick, along the northern contact of the gneiss terrain (6a). The two related units (1k and 6a) are tectonically interleaved with mafic schist in the Gods Lake Narrows section.

Blastomylonite is a white weathering, fine grained, quartzofeldspathic felsite with scattered subhedral to euhedral microcline crystals averaging 1 cm across (maximum 3 cm) (Fig. 12). Locally scattered ovoid plagioclase crystals (up to 3 mm) occur. The matrix is a fine grained, sutured, quartzofeldspathic mosaic with scattered fine grained flakes of chlorite after biotite, epidote grains and accessory apatite. Colour banding on a 2 to 30 cm scale occurs in places; it is interpreted as the last vestige of transposed original lithological variation in the Bayly Lake complex. Microcline

Figure 12: Blastomylonite (1k) with microcline porphyroblasts (pen is 15 cm long).

crystals are generally stained and fractured and the second foliation phase of the shear belt wraps around them producing an augen texture. This second foliation phase is axial planar to minor folds defined by colour banding. The microcline crystals are believed to represent porphyroblasts postdating the initial mylonitization, as they are in places nondeformed and straddle the boundaries of the colour banding. Field relationships suggest that the blastomylonite was derived from unit 6a through more intense deformation and recrystallization than those affecting gneiss (6a).

The contact with the banded gneiss is gradational over 2 m: felsitic textured blastomylonite is interbanded with gneiss in which relict granitoid texture is preserved. Blastomylonite was mapped previously as felsite (Barry, 1961) and as acidic crystal tuff (Campbell *et al.*, 1972).

Mafic schist (1h)

Mafic schist is composed dominantly of basic volcanic rocks that have been intensely deformed, mylonitized and tectonically reconstituted to a very fine grained hornblende schist. Units of the blastomylonite have been tectonically intersliced with these schists. A lense of highly sheared Oxford Lake Group (9b) conglomerate (north of the air strip at Gods Lake Narrows) and very fine grained layered grey rocks that resemble metasedimentary rocks of the Oxford Lake Group are associated with these intersliced mafic schists.

Locally the mafic rocks appear to have escaped extreme deformation, and foliated metagabbro cut by feldspar porphyry dykes can be recognized. On the east shore of the Narrows, 1 km north-northeast of the Hudson's Bay store at Gods Lake Narrows, sheared metabasalt with relict pillow selvages is intruded by feldspar porphyry dykes that are up to 5 m thick. The feldspar porphyry dykes at these localities can be correlated with dykes that cut Hayes River Group rocks; they have not been recognized cutting Oxford Lake Group rocks. This suggests that the mafic volcanic rocks are probably part of the Hayes River Group. Layers of fine grained quartzofeldspathic rocks (1-30 cm thick) that are interbanded with mafic schist are interpreted as transposed porphyry dykes; locally they contain isoclinal F_1 folds refolded by F_2. The mafic schist unit represents a wedge of Hayes River Group rocks that are tectonically reconstituted and intersliced with Oxford Lake Group rocks and with blastomylonite.

STRUCTURE AND METAMORPHISM

The earliest recognized structural event is a phase of intense penetrative deformation that affected the greenstone belts and layered gneisses south of Gods Lake Narrows. This was accompanied by metamorphic mineral growth in the upper greenschist to middle amphibolite facies. Subsequent widespread migmatization and plutonism formed the granitoid complexes and was in part syntectonic with a regional deformation that gave rise to the east-southeast trend and linear form of the Munro-Murray Lake and Webber Lake greenstone belts. These belts, therefore, are second phase synclinal structures.

North of the Gods Lake Narrows shear belt, the Hayes River Group forms a homoclinal northwest-facing sequence. In general the rocks lack a penetrative fabric, though they have been metamorphosed to upper greenschist and lower amphibolite facies.

The shear belt passing through Gods Lake Narrows is a zone of intense deformation and tectonic reconstitution that is up to 4 km wide. Structural trends in the Hayes River Group to the north swing dextrally into this zone; the swing is accompanied by progressive development of a penetrative schistosity and intense flattening. Tonalitic rocks to the south of the shear belt also become intensely foliated as the shear belt is approached, passing rapidly into a zone of mylonite and blastomylonite that is up to 200 m thick. In the Gods Lake Narrows section blastomylonite units are tectonically intersliced with intensely schistose lithologies derived from the Hayes River Group. The shear belt appears to represent a movement zone between two major crustal blocks, with relative upward movement of the block to the south, which exposes a deeper structural level of the Archean terrane.

The Oxford Group conglomerate appears to postdate initial formation of the shear belt, but was involved in a subsequent phase of rejuvenated movement that transposed the early fabric related to the shear belt into a composite second phase penetrative schistosity.

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