GEOLOGICAL SURVEY OF CANADA COMMISSION GÉOLOGIQUE DU CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES
MINISTÈRE DE L'ÉNERGIE, DES MINES ET DES RESSOURCES

LEGEND

CENOZOIC — QUATERNARY

Qu — *Areas of drift cover*

APHEBIAN — DYKE SUITE

Ad, Add — *Ada, Molson dykes, gabbro, diabase, lamprophyre; Adb, felsite, quartz-feldspar porphyry; Adc, amphibolite, plagioclase porphyritic; Add, diorite and syenite, gabbro plugs, locally zoned and brecciated*

ARCHEAN

LATE PLUTONIC SUITE

AL — *Biotite granodiorite, granite and leucotonalite, minor biotite-muscovite granite. Plutons are commonly porphyritic, locally megacrystic, and show marked positive magnetic anomalies ALg, granitic orthogneiss*

MIGMATITE

AM — *Granitic gneiss with rafts and schlieren of older units, and neosome of AL or AE*

ISLAND LAKE GROUP

AIV — *Mainly andesite flows, tuff and agglomerate, minor basalt, siltstone and conglomerate*

AIS — *Conglomerate, quartz wacke (regolith), siltstone, turbiditic greywacke and argillite*

EARLY PLUTONIC SUITE

AE — *Weakly to strongly foliated, hornblende-dominant granodiorite, tonalite, diorite and trondhjemite*

AU — *Gabbro, diorite, peridotite, serpentinite; includes spinifex komatiite of AHV*

HAYES RIVER GROUP

AHS — *Greywacke, siltstone, conglomerate and correlative schist and paragneiss; minor chert, iron formation, carbonate and tuff*

AHF — *Felsic volcanic and hypabyssal rocks; porphyritic dacite and rhyolite, tuff and tuff breccia; albitic schists and gneiss derived from felsic volcanics*

AHV — *Basalt, andesite, volcanic breccia; correlative amphibolitic schist and gneiss*

EARLY GNEISS AND MIGMATITE

AT — *Granodiorite-tonalite gneiss and migmatite with rafts and schlieren of amphibolite*

Rock outcrop
Geological boundary (approximate, assumed)
Bedding, inclined (tops known, unknown)
Pillow, tops known (inclined, overturned)
Gneissosity (inclined, vertical)
Cataclastic foliation and shearing (inclined, vertical)
Lineation (arrow indicates plunge)
Minor fold (arrow indicates plunge)
Fault (assumed)
Joint (vertical)
Mylonite zone
Radiometric age determination in millions of years — 2895z
z = U-Pb isochron on zircon
h = K-Ar on hornblende
b = K-Ar on biotite

Geology by I.F. Ermanovics, R.G. Park, P.A. Goetz, J.D. Hill, D. Brown, 1974; I.F. Ermanovics, R.K. Herd, G.D. Delaney, P. Hum, R. Plummer, P. Ruck, L. Jones, F. Chandler, W.K. Fyson, T. Rivers, 1975; Reports by J.D. Godard 1963; W. Weber et al. 1982

Geological compilation and interpretation by I.F. Ermanovics, 1975; R.K. Herd, 1975, 1976, 1980-1983, 1986; and K.L. Currie, 1984

Geological cartography by M.G. Méthot, Geological Survey of Canada

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

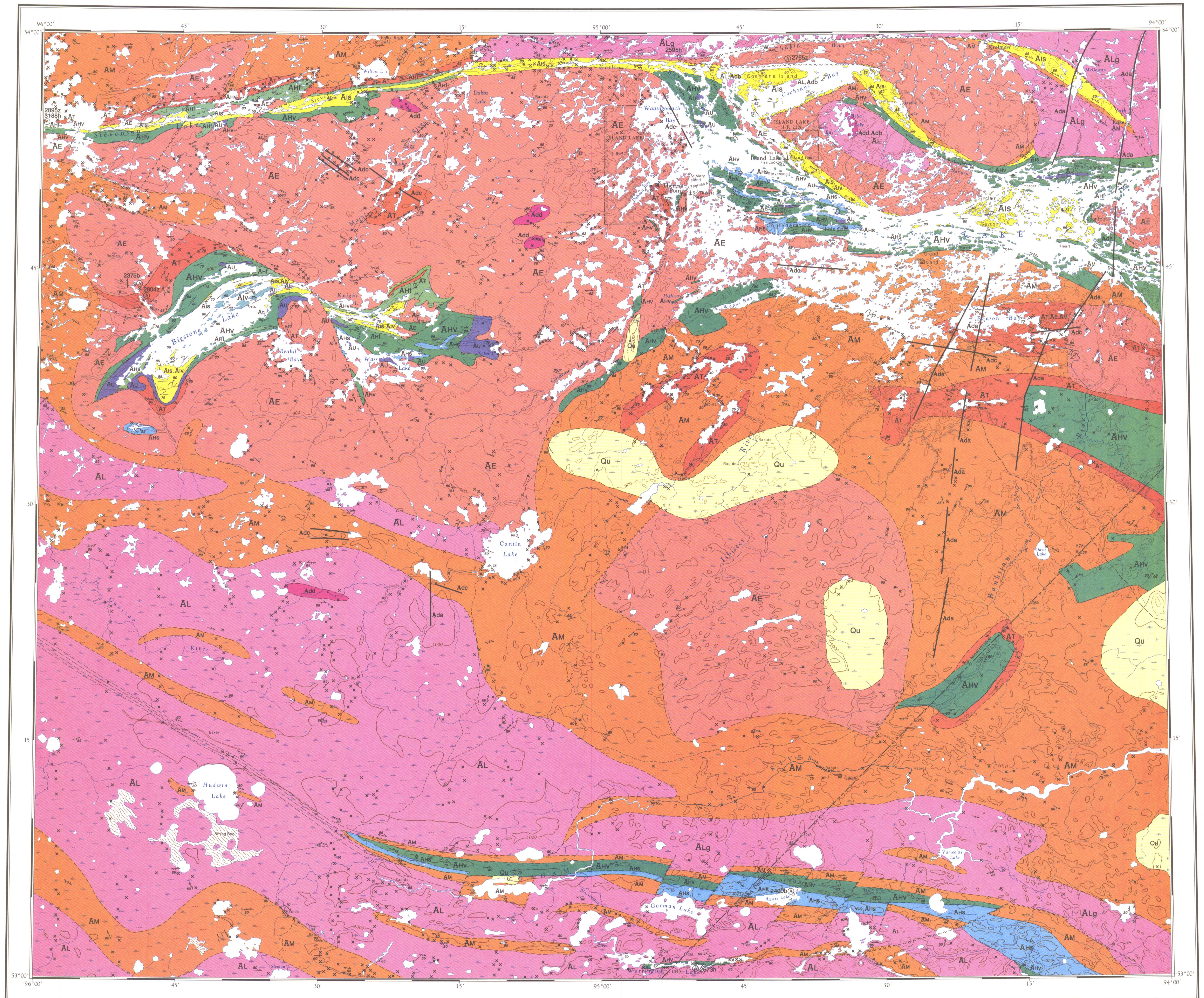
Base map at the same scale published by the Surveys and Mapping Branch in 1965

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

Mean magnetic declination 1986, 3°56′ East, decreasing 17.2′ annually. Readings vary from 2°33′ in the NE corner to 5°13′ in the SW corner of the map area

Elevations in feet above sea level

Recommended citation:
Herd, R.K., Currie, K.L., and Ermanovics, I.F.
1987: Geology, Island Lake, Manitoba-Ontario; Geological Survey of Canada, Map 1646A, scale 1:250 000



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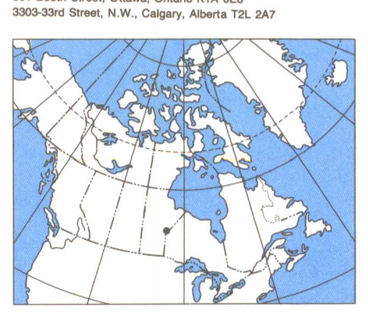


INDEX MAP

MAP 1646A

GEOLOGY

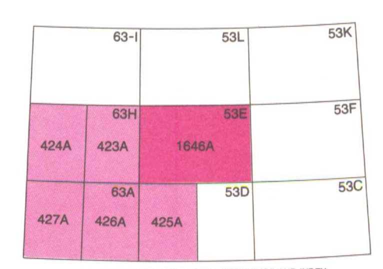
ISLAND LAKE

MANITOBA-ONTARIO

Scale 1:250 000 - Échelle 1/250 000

Kilometres 5 0 5 10 15 20 Kilomètres

Transverse Mercator Projection
CM 93°, Scale Factor 0.9996



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS

DESCRIPTIVE NOTES

Island Lake map area lies on the drainage divide between Hudson Bay and the Great Lakes. Boreal forest cover is general. Large river systems drain the northern and southern edges of the area but the central part consists of muskeg with few well developed streams. Northern and southern parts of the area can be reached by long established canoe routes, but access to all parts of the area is now mainly by air. There are no permanent roads, although several winter roads lead to Island Lake.

Bedrock can best be examined along river and lake shores, on numerous islands, and on rocky ridges in the north and south. Outcrop is sparse in the swampy central portions. Sandy to bouldery glacial overburden obscures the bedrock and controls the vegetation. Three rectilinear moraine complexes, extensively modified and terraced, record a Late Wisconsinan southward advance and retreat of ice (Nielsen, 1980).

Bedrock forms part of the Archean Superior Province. The Cobham-Gorman River supracrustal belt separates late granitoid plutons and migmatite with sparse relics of supracrustal rocks in the Berens batholithic belt to the south from the Sachigo volcanic belt to the north (Ermanovics and Davison, 1976) which consists of narrow, curvilinear supracrustal belts separating granitoid plutons. The Stevenson Lake-Island Lake supracrustal belt separates this granite-greenstone terrane from granitoid plutonic rocks to the north. The supracrustal belts have been studied in considerable detail (Godard, 1963a,b; Ermanovics et al., 1975; Herd and Ermanovics, 1976; Weber et al., 1982; Gilbert and Weber, 1983; Gilbert, 1984,1985; Neale, 1984,1985) but much less is known about the intervening plutonic rocks.

The oldest rocks are remnants of heterogeneous tonalite-granodiorite gneiss (unit **AT**) found as discontinuous marginal fringes to the supracrustal belts, as septa separating younger plutons, and as rafts or schlieren in migmatites (unit **AM**). Late deformation has generally produced near parallelism between layering in the gneiss and bedding/foliation in adjacent supracrustal belts, although discordant trends are locally preserved. The migmatitic tonalitic gneiss contains deformed and boudined amphibolitic dykes not found in adjacent supracrustal rocks. The gneiss probably represents basement upon which the supracrustal rocks were deposited, although any unconformable relations have been obscured by intrusion of homogeneous tonalitic orthogneiss (unit **AE**). A U-Pb zircon age from amphibolite in unit **AT** gave 2895±25 Ma (Ermanovics and Wanless, 1983).

In the northern part of the Island Lake area the stratigraphic sequence in the supracrustal belts consists of two groups separated by an unconformity (Wright, 1928) and a period of intrusion. In order of decreasing age these units are called the Hayes River Group (unit **AH**), the Early Plutonic Suite (unit **AE**) and the Island Lake Group (unit **AI**). In the Cobham-Gorman River belt these units cannot be distinguished, probably due to strong deformation and metamorphism, and all supracrustal rocks have been compiled as equivalent to Hayes River Group.

The lowest parts of the Hayes River Group consists largely of dark green, massive to schistose, fine- to medium-grained mafic volcanic rocks (unit **AHV**). Pillows, amygdules, flow-top breccia and other primary features can be recognized locally, but towards the margins of the supracrustal belts the rocks are schistose or gneissic and take on the appearance of amphibolites. Gneissic amphibolites predominate in the narrow Cobham-Gorman River belt. The mafic volcanic rocks, whether gneissic or not, consist mainly of brownish-green hornblende and oligoclase to andesine, with varying amounts of magnetite, epidote, sphene and apatite. Rocks exhibiting primary volcanic features commonly contain chlorite and calcite and may contain actinolite rather than hornblende. Godard (1963 a,b) and later workers attempted to distinguish andesite from basalt on the basis of various field criteria. A collection of 185 chemical analyses of volcanic rocks from Knight, Stevenson, Island and Bigstone lakes exhibits a marked silica gap from 54 to 62%. Not only are andesite analyses scarce, but none of the field criteria adequately discriminate andesite from basalt. There are no noticeable chemical differences among basalts from the several areas, but the overall average of about 52% SiO_2 and 14.5% Al_2O_3, corresponds to tholeiitic basalt in the classification of Irvine and Baragar (1971).

Felsic volcanic rocks (unit **AHF**) form narrow discontinuous layers up to a few metres thick interlayered with basalt. Tuff, agglomerate and tuff breccia, as well as flows marked by flow banding and prominent quartz eyes, can be locally identified, but many occurrences mapped as felsic volcanics in the Cobham-Gorman River and Stevenson Lake belts consist of fine grained quartz-sericite schists, and may be blastomylonites of granitic rocks. Quartz-feldspar porphyries, thought to be correlative to the felsic volcanic rocks, form large lenticular bodies in Island Lake. These bodies have been equated to the Early Plutonic Suite (Weber et al., 1982) and dated by U-Pb on zircon at 2768±22 Ma (Turek et al., 1986).

The upper part of the Hayes River Group consists mainly of fine-to medium-grained, thickly layered, greenish-grey greywacke locally interbedded with tuffs or flows (unit **AHS**). Bedding may be accentuated by weathering, giving some outcrops a ribbed appearance. The greywackes consist of aligned, moderately elongate quartz, plagioclase, biotite and chlorite grains as well as lithic debris. Thin, lenticular conglomerate beds contain pebbles of felsic volcanics and porphyry up to 5 cm in length. Laminated black slate and argillite, chert, iron formation and rusty carbonates occur in interbeds up to 15 cm thick, which may be intricately folded on a small scale. All of the sedimentary rocks are locally converted to well laminated siliceous schist and gneiss which display striking persistence of compositional layers. Such schist and gneiss compose much of the Cobham-Gorman River belt, which is a continuation of the Favourable Lake belt of Ontario. The gneiss consists mainly of quartz, alkali feldspar, plagioclase and muscovite. Local abundance of hornblende may indicate a tuffaceous protolith.

The Early Plutonic Suite is here defined to include the mainly concordant high-level mafic to ultramafic intrusions (unit **AU**) within the supracrustal beltsand the batholithic masses of hornblende-dominant granitoid rocks (unit **AE**). Tabular sill-like to dyke-like or irregular bodies of peridotite, pyroxenite, gabbro and diorite (and serpentinized deformed equivalents) occur within and adjacent to the Hayes River Group. West of Garden Hill spinifex texture is preserved, implying near-surface emplacement. Ultramafic rocks commonly display complex fracture patterns on weathered surfaces, and actinolite-talc schists and soapstone occur in minor amounts. Mafic rocks display clots of plagioclase in a weakly to moderately foliated matrix. Theyer (1985) pointed out that emplacement of mafic rocks around Island Lake appeared to be controlled by the unconformity between the Hayes River and Island Lake groups. Mafic intrusions have not been found in the Cobham-Gorman River belt.

Tonalite-granodiorite plutons (unit **AE**) envelope the supracrustal rocks. Although the plutons clearly intrude the supracrustal rocks, there appears to be an intimate genetic connection between them. Concordant, apparently synvolcanic, plutons occur within the volcanics and the mafic volcanic unit of the Hayes River Group passes gradationally through amphibolitic gneiss into tonalitic orthogneiss. Ermanovics et al. (1979) noted that the composition of the plutons fills the gap in the bimodal volcanic chemistry. The shape of the plutons appears to be controlled by the original shape of the supracrustal belts (Park and Ermanovics, 1978; Fyson et al., 1978). The plutons consist of strained bluish quartz, oligoclase-andesine, hornblende, and varying amounts of chlorite, epidote, biotite and sphene. Some plutons have undergone remobilization leading to complex field relations. The Bella Lake pluton, northeast of Island Lake, shows complete gradation from quartz diorite unconformably overlain by the Island Lake Group through granodiorite to granite and syenite which migmatize the Island Lake Group. Age determinations on this body by U-Pb on zircon have demonstrated a range of ages from 2886±15 to 2765±18 Ma (Turek et al., 1986; Ermanovics and Wanless, 1983), a range which covers most of the known igneous activity in this region.

The Island Lake Group (unit **AI**) occurs in synclinal keels within the Hayes River Group bounded below by an unconformity exposed intermittently for more than 130 km from Island Lake to Ponask Lake west of the map area. The sedimentary part of the group, mainly coarse conglomerate packed with boulders of tonalite-granodiorite up to 3 m across and clasts of the Hayes River Group, locally exhibits a basal quartz wacke regolith (Herd et al., 1976). Subordinate amounts of siltstone and argillite occur in the Island Lake Group.

An unconformity at Bigstone Lake separates two sequences of supracrustal rocks. The 2200 m sequence of intermediate volcanic rocks, including basal tuff and agglomerate, andestic and basaltic flows with sandstone and pyroclastic rocks (unit **AI**), which overlies the Hayes River Group and a basal conglomerate, is here correlated with the Island Lake Group (Ermanovics et al., 1975), although other workers have included it in the Hayes River Group (Neal 1984). We have re-interpreted the mapping of Godard (1963 a,b) around Island Lake to include a volcanic unit in the Island Lake Group. Late porphyritic rocks intruding the Island Lake Group gave a U-Pb age on zircon of 2729±2 Ma, fixing its minimum age (Turek et al., 1986)

Much of the Island Lake area is underlain by generally granitoid rocks of units **AM**, and **AL**. **AM** includes all plutonic rocks of mixed character including migmatitic gneiss, migmatite, agmatite and lit-par-lit gneiss. The neosome varies from granite to tonalite and the paleosome includes layered gneiss, metasediments, metavolcanics, amphibolite and older granitoid gneiss. Locally the migmatite contains mappable areas of older tonalitic gneiss and migmatite (unit **AT**) which may represent the protolith of the younger migmatite. The boundaries of this unit against older and younger plutons are gradational and cannot be closely fixed. The migmatite intrudes the Hayes River Group.

The migmatite contains large, poorly defined areas of homogeneous porphyritic rocks, commonly of monzogranite composition but varying from tonalite to two-mica granite. These plutons (unit **AL**) are distinguished by porphyritic character, biotite as the dominant mafic phase, massive to weakly foliated structure (margins are commonly foliated), and distinct, relatively high magnetic and radiometric signature. The plutons consist of microcline, oligoclase, quartz, biotite and minor opaque oxides. Sphene, typical of older plutons, does not occur, but hornblende is locally present in small amounts, and garnet occurs in some leucogranites. Similar lithologies, including small amounts of two-mica granite, occur as small, sharply defined plutons within the Hayes River and Island Lake groups. Turek et al. (1986) dated late intrusive rocks at 2699±4 Ma.

Leucocratic granitic orthogneiss (unit **ALg**) forms a mappable unit along the margins of the Cobham-Gorman River belt and on the north side of the Stevenson Lake belt. These rocks probably represent interplay between intrusion and strong deformation, and may date deformation on these major structural boundaries.

The dyke suite in the Island Lake area is varied, extensive, and of several ages. Early plagioclase-porphyritic amphibolitic dykes (unit **Adc**) trend west northwest and cut the margins of the supracrustal belts and the fringing tonalites. A late intrusive suite (unit **Add**) of zoned gabbroic to syenitic dykes occurs west and southwest of Island Lake, where it can be traced by its high magnetic anomaly. Units **Adc** and **Add** appear to be associated with mineralization around Bella Lake. Late felsitic, aplitic and syenitic dykes and plugs (unit **Adb**) occur around the Island Lake and Stevenson Lake belts, and may be connected with their evolution. They are locally associated with sulphide and gold mineralization. The youngest dykes (unit **Ada**), a north-trending swarm of fresh gabbro, diabase an biotite-porphyritic lamprophyre, are correlative with the well known Molson dykes (Ermanovics and Fahrig, 1975). One dyke was traced south from McGowan Lake for 80 km, and another through York Lake can be followed for 50 km.

The structure of supracrustal belts in the northern part of the area was described by Park and Ermanovics (1978) and Fyson et al. (1978). Tectonic patterns appear to be consistent throughout the map area. At least three periods of deformation can be recognized. D1 produced major northeast-southwest to eastwest synclines whose shape was partly controlled by rising diapiric plutons of the Early Plutonic Suite. D2 produced smaller, steeply dipping, isoclinal east-west folds with an associated crenulation cleavage which locally cuts the Late Plutonic Suite. D3 produced conjugate shear belts, chevron folds and major high-strain zones marked by mylonite. Major mylonite zones along the Cobham-Gorman River and Stevenson Lake belts separate the central granite-greenstone terrane from marginal migmatite terranes. Numerous small structures suggest that the whole of this central terrane underwent major dextral movement. The pervasive east-west to east southeast-west northwest cataclastic foliation observed over all of this region appears to be highly composite, developed during all three periods of deformation, and exhibiting a variable lower greenschist to lower amphibolite grade overprint. North of the Stevenson Lake-Island Lake belt and south of the Cobham-Gorman River belt metamorphic grades are higher, commonly upper amphibolite.

Rocks in the Island Lake area appear to have been repeatedly remobilized with large plutonic-metamorphic complexes rising in diapiric fashion into supracrustals. Ambiguous relations between early and late plutons suggest repeated reactivation of crystalline material. The polyphase origin of the Bella Lake pluton probably is typical of many other plutons. This form of activity apparently ceased in Late Archean time, but hornblende and biotite ages were reset through much of the western Superior Province due to Hudsonian events in the Churchill-Superior boundary zone (Ermanovics and Wanless, 1983). They reported biotite ages as low as 2010±46 Ma from the Island Lake belt.

The supracrustal rocks have been repeatedly prospected for gold and base metals. Gold occurs in felsic volcanic rocks and porphyries of the Hayes River Group (see Weber et al., 1982, for references on the Island Lake region; Quinn, 1960, Ermanovics et al., 1975, and Neale, 1985, for references on Stevenson Lake, Bigstone Lake, Knight Lake and Cobham-Gorman River belts). Gold also occurs in quartz veins southeast of Varveclay Lake (Quinn, 1960) and associated with felsite dykes and quartz veins south of Willow Lake (Reed, 1962). Despite the number of known occurrences, the only production was from the Island Lake Mine which produced for 11 months in 1934-35. Ni and Cu mineralization in ultramafic and related rocks of unit **AU** is associated with tonalite-granodiorite or quartz porphyry-felsite intrusions. Repeated exploration has discovered no economic deposits. The polyphase Bella Lake pluton displays porphyry-type Cu and Mo mineralization (Haskins, 1977).

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