

MANITOBA - ONTARIO

Scale 1:250,000 Échelle

Transverse de Mercat

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ntermittent or dry. ...intermittent ou à sec ...

Marsh or swamp..... Marais ou marécage Intermittent lake ... Lac intermittent ...

Depression contours...Courbes de cuvette.....

Rapides; chute

Spot Elevation in feet. Repère de nivellement en pieds 2550.

ISLAND LAKE MAP-AREA (53E), MANITOBA AND ONTARIO

Island Lake map-area lies on the drainage divide between Hudson Bay and the Great Lakes. Boreal forest covers all of the map-area. The northern and southern parts of the map-area lie on the extremities of large river systems best developed to the north and southeast, but the central part consists of muskeg with few well developed streams. Consequently, northern and southern parts of the area can be reached by long established canoe routes, but such routes are rare and difficult in the central part of the area. Access to the area is presently mainly by aircraft. No permanent roads cross the map-area, although several winter roads lead to Island Lake.

Bedrock in the Island Lake map-area can be best examined along river and lake shores and on numerous islands. Outcrop occurs in the swampy central portions, but these sparse exposures can be readily seen and reached only by aircraft. Overburden consists mainly of sandy to bouldery glacial deposits. The latest direction of glacial advance was southerly. Prominent raised beaches occur in the east central part of the area.

The bedrock geology of Island Lake map-area falls into two contrasting parts, namely the narrow, intricately contorted belts of sedimentary and volcanic rocks ("greenstone belts"), and the broad intervening expanses of plutonic rocks. The greenstone belts have been studied in considerable detail (Godard 1963, Ermanovics et al 1975, Herd and Ermanovics 1976, Weber et al 1982), but relatively little is known about the plutonic rocks. The oldest most commonly as discontinuous fringes along greenstone belts, or as septa of wall rock between younger plutons, but also occurring as rafts and schliers in migmatites of unit $\mathbf{A}_{\mathbf{m}}.$ Post-greenstone deformation has produced parallelism or near-parallelism between layering in the tonalitic gneiss and bedding of adjacent supracrustal rocks. However the tonalitic gneiss is migmatitic,

demonstrating development from an earlier generation of tonalitic material absent in the adjacent supracrustals. The migmatite contains deformed and boudined amphibolitic dykes not found in the supracrustal rocks. Such gneisses are readily distinguished from the younger tonalitic plutons (unit $\boldsymbol{A}_{\underline{e}})$ which locally cut the greenstone belts and consist of homogeneous material (orthogneiss). The tonalitic migmatites may represent basement upon which the supracrustal rocks of the greenstone belts were deposited. A U-Pb zircon age from Stevenson Lake yielded an age of 2895 Ma for this unit (Ermanovics and Wanless 1983).

In the northern part of the Island Lake map-area the supracrustal sequence (map units $\mathbf{A}_{\underline{i}}$ and $\mathbf{A}_{\underline{h}})$ consists of two groups separated by an unconformity (Hayes 1928) and a period of igneous intrusion. In order of decreasing age, these units are called the Hayes River Group, the Early Plutonic suite and the Island Lake Group. In the southern and eastern greenstone belts these units cannot be distinguished, probably due to strong deformation and metamorphism. Such rocks have all been compiled as equivalent to Hayes River Group. The lowest parts of the Hayes River Group consist largely of dark green, fine to medium-grained material varying from massive to schistose. Pillows, amygdules, flow and flow-top breccia and other primary features can be recognized locally, but toward the contact with the surrounding tonalitic gneiss the mafic volcanics become more schistose or gneissic and take on the appearance of emphibolites rather than supracrustal rocks. Such gneisses are common in the narrow portions of greenstone belts, such as the Cobham River-Gorham River belt. Petrographic examination suggests the rocks displaying primary volcanic features. The mafic volcanic unit contains large amounts of hornblende, pleochroic in brownish green, and oligoclase to andesine, with varying amounts of magnetite, epidote, sphene and apatite. Rocks with primary volcanic features commonly contain chlorite and calcite, and may contain actinolite in addition to hornblende. Godard (1963) and subsequent workers attempted to distinguish andesite from basalt on the basis of various field criteria involving colour, texture and mineralogy. However a collection of 185 chemical analyses from Knight, Stevenson, Bigstone and Island Lakes demonstrates a marked silic gap from about 54 to 62 percent There are noticeable differences between the several areas, but the overall average is about 52 percent SiO_2 , and 14.5 percent $\mathrm{Al}_2\mathrm{O}_3$, or tholeiltic basalt according to the Irvine-Baragar classification. Not only is there a scarcity of andesite analyses, but none of the field criteria consistently identify the rocks giving such analyses.

Felsic volcanic rocks (map unit A_{hf}) occur as narrow discontinuous layers up to a few meters in thickness interlayered with the basalts. They can readily be identified in the field by pale colour. Flow banding and prominent quartz eyes occur locally. Quartz-feldspar porphyries correlative to felsic volcanics form large lenticular bodies in Island Lake. Tuff, agglomerate and tuff-breccia almost invariably occur in association with felsic volcanic and hypabyssal rocks. Many occurrences mapped as felsic volcanics consist of fine grained quartz-sericite schists, and may be blastomylonites of granitoid rocks, especially in the Cobham River belt.

The predominantly sedimentary unit of the Hayes River Group (map unit $\mathbf{A}_{\mathbf{h}\mathbf{s}})$ forms the stratigraphically highest portion of the group. Fine to mediumgrained, thickly layered, greenish-grey greywacke, locally interbedded with tuffs or flows, constitutes the bulk of the unit. Bedding may be accentuated by weathering, giving some outcrops a ribbed appearance. Microscopically the greywackes all display schistosity with moderately to strongly elongate quartz and plagioclase grains, as well as aggregates of quartz and plagioclase grains (lithic debris). Chlorite and biotite are abundant and strongly aligned. Pebbly conglomerates occur with sheared pebbles of felsic volcanics and porphyry

up to 5 cm in length, but conglomerate beds are thin and lenticular. Thinly laminated black slate and argillite occur locally in interbeds up to 15 cm thick, and chert, iron formation and rusty carbonate occur in narrow bands commonly displaying intricate small scale folding. 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 constitutes much of the Cobham River-Gorham River belt. The mineralogy of the schist and gneiss (quartz, alkali feldspar, muscovite) resembles that of the more obviously metasedimentary rocks, except that homblende is locally abundant, presumably indicating the presence of tuffaceous material.

Near Carden Hill in the northeastern part of Island Lake a suite of fine to medium-grained clastic sedimentary rocks comprising greywacke, argillite, minor conglomerate, felsic flow rocks and tuffs appears to grade into conglomerate of the Island Lake Group. These sediments are here assigned to the Island Lake Group since detailed examination of the section in Bigstone Lake proves conclusively that volcanic rocks occur in the Island Lake Group, contrary to the position of Weber et al (1982) and earlier workers.

The Early Plutonic Suite (map-unit A and A) is here defined to include both the (mainly) concordant high-level mafic intrusions within the greenstone belts $(A_{{\color{black} U}})$ and the batholithic masses of hornblende-dominant granitoid rocks which surround and intrude the belts. Tabular sill-like bodies of peridotite pyroxenite, gabbro and diorite (and serpentinized, deformed equivalents) occur within and adjacent to the Hayes River Group. Locally the bodies appear dyke-like or irregular, but the predominant form is sill-like. West of Garden Hill spinifex texture is preserved in some ultramafic rocks, implying very near-surface emplacement. Ultramafic rocks commonly display complex fracture patterns on weathered surfaces, whereas feldspathic varieties display clots or clusters of plagioclase in a weakly to moderately foliated matrix. Strongly deformed mafic to ultramafic rocks form actinolite-talc schists. Gabbroic and ultramafic intrusions have not been recognized in the Cobham River-Gorham River belt, possibly due to the generally high degree of deformation and metamorphism.

The supracrustal rocks of the greenstone belts are enveloped by a

carapace of tonalitic to granodioritic rocks whose thickness varies with the thickness of the greenstone belt. These tonalitic plutons (unit A_{ϱ}) clearly cut the supracrustal rocks, but appear to be intimately connected with them, since they are not found remote from such belts. Rocks of similar composition occur with the supracrustals as concordant, apparently synvolcanic sills. The lower mafic volcanic unit of the Hayes River Group passes through amphibolitic gneiss into tonalitic gneiss in an apparently completely gradational way. Ermanovics et al (1978) pointed out that the composition of the plutons fills the gap in the bimodal volcanic chemistry. These broad scale considerations suggest that the origin of the plutons must be intimately connected with the evolution of the greenstone belts. The shape and disposition of the plutons appears controlled by the original shape of the supracrustal belts (Park and Ermanovics 1978, Fyson, Herd and Ermanovics 1978). Typically the plutons consist of strained blueish quartz, twinned oligoclase to andesine, hornblende, and minor amounts of biotite and sphene. Some of these plutons have undergone subsequent remobilization, leading to very complex petrography and field relations. The Bella Lake body, northeast of Island Lake, shows complete gradation from quartz diorite unconformably overlain by the Island Lake Group through granodiorite to granite and syenite which migmatizes the Island Lake Group. Other less well-known bodies appear to show similar relations. n general, older and more mafic phases display good cataclastic foliati which becomes progressively less obvious in more salic phases. A U-Pb zircon age on the Chapin Bay tonalite returned 2765 Ma (Ermanovics and Wanless 1983). This age gives a minimum age for formation of the northern greenstone belts

The base of the Island Lake Group (map units ${\bf A_{is}}$ and ${\bf A_{iv}}$) lies on an unconformity exposed intermittently for a distance of more than 130 km from Island Lake to Ponask Lake west of the map-area. The lower sedimentary part of the group exhibits a basal quartz wacke regolith particularly well-exposed east of Willow Lake (Herd, Chandler and Ermanovics 1976). Much of the sedimentary part of the unit consists of coarse conglomerate packed with cobbles and boulders up to 3 m across, mainly derived from the Early Plutonic Suite, but also including clasts of Hayes River Group. The conglomerates of the Island Lake Group can be easily distinguished by the clasts of Early Plutonic Suite which do not occur in conglomerates of the Hayes River Group. The sedimentary portion of the Island Lake Group also contains subordinate amounts of argillite and siltstone. Tuff and agglomerate occur in this unit in Bigstone Lake and, by interpretation, near Garden Hill. The Island Lake Group is locally strongly metamorphosed and migmatized around younger plutons. At the east end of Cochrane Bay and around McGowan Lake the pelitic parts of the unit contain staurolite+sillimanite. The age of the Island Lake Group is not directly known, but a K-Ar age on hornblende from the regolith on Collins Bay returned 2592 Ma, which gives a minimum age for the Island Lake Group.

Bigstone Lake contains a unit of intermediate volcanic rocks (unit A v) which clearly overlie the conglomerate sequence. This unit contains abundant tuff and agglomerate near the base and andesitic to basaltic flows intercalated with sandstone and pyroclastic rocks toward the top. The maximum thickness of this unit is estimated to be about 2200 m.

Much of the Island Lake map-area is underlain by generally granitoid rocks of unit Am and Al. Am is a "sack" unit for all plutonic rocks of mixed character including lit-par-lit gneiss, migmatite, agmatite and mixtures of rock types not readily described. Commonly the rocks exhibit pale buff to pink colour, crude to perfect gneissosity, and a mixed character on

outcrop scale. The mixing may be due to lits, schliers, blocks or nebulous bodies of mafic metavolcanics, amphibolite, paragneiss or tonalitic gneiss, or to the presence of younger granitoid rocks (unit A1) in the form of dykes, lits or diffuse neosome. The boundaries of this unit against both older and younger plutons appears to be completely gradational and cannot be closely fixed. In both cases the migmatite gradually loses its component of other rock types as the border is approached. The migmatite is found in contact with supracrustal rocks only south of Island Lake where the contact appears to be intrusive. The migmatite locally contains mappable masses of tonalitic migmatite of an older generation (unit A_t) which may represent the protolith to the younger migmatite.

The migmatite complex contains poorly defined large areas of homogeneous porphyritic rocks ranging from tonalite through two-mica granite but commonly falling in the monzogranite range (unit A_1). In addition to their generally porphyritic character, these plutons are distinguished by biotite-dominant mafics, weakly foliated to massive character (although the margins are commonly foliated), and a distinct, relatively high, magnetic signature. In general the plutons consist of microcline, oligoclase, quartz and biotite+hornblende. Sphene, typical of the older plutons, is absent. In addition to the large, poorly defined plutons, such rocks occur as small, sharply defined bodies within the Hayes River and Island Lake Groups. The small bodies include the only two mica granites observed in this map area.

The ambiguous relations between late plutons and earlier plutons suggest repeated reactivation of crystalline material in this region. Younger potash-feldspar bearing rocks are gradational to or form migmatites with older tonalites in a bewildering variety of relationships. Polyphase origin seems to be demonstrated by stratigraphic relationships in the Bella Lake region and is considered probable elsewhere.

In addition to the homogeneous massive to porphyritic plutons, leucocratic granitoid rocks occur in the form of homogeneous granitic gneiss along the north side of the Cobham River-Gorham River and Stevenson River greenstone belts. Although the gneiss occurs in strongly tectonized regions, it cannot be simply a teconized equivalent of the late plutons, because in both cases it has developed at the expense of the migmatite complex. Some process enabled the developing gneiss to rid itself of the mafic inclusions typical of the migmatite belts.

The dyke suite in the Island Lake map-area (unit A_d) is quite varied and extensive, and probably of several ages. All members of the suite appear to cut the late plutons. Acid dykes (Adh) appear confined to the vicinity of the Island Lake greenstone belt and may be connected with its evolution. These dykes consist mainly of north-trending quartz-feldspar porphyry but also include aplite and "felsite". Older mafic dykes form an east-west trending swarm of amphibole-rich rocks (unit A_{dc}) locally spectacularly porphyritic with plagioclase. The youngest dykes comprise a north-trending swarm of rather fresh gabbro, diabase and biotite-porphyritic lamprophyre (unit Ada). These dykes probably correlate with the well-known Molson dykes (Ermanovics and February 1975). One of these dykes was traced from Benson Bay southward for more than 50 km. Some large dykes tend to fall on or close to major lithologic boundaries, suggesting that the dykes occupy faults or zones of weakness. Dykes of different age tend to cluster together, implying that the structural factors controlling their emplacement were long-lived. The structure of greenstone belts in the northern part of the Island

Lake map-area has been considered by Park and Ermanovics (1978) and Fyson, Herd and Ermanovics (1978). The belts show two major periods of deformation. D1 produced major northeast-southwest to east-west synclines and a pervasive foliation developed under greenschist to low amphibolite conditions. Intrusion of the Early Plutonic Suite commenced before D1 deformation and partially controlled it by forming rising diapiric blocks. D2 deformation produced smaller, steep east-west folds with a crenulation cleavage which locally cuts the Late Plutonic Suite. Late deformation resulted in conjugate shear belts, chevron folds and major, through-going high strain zones marked by broad belts of mylonite and cataclastic gneiss. The largest mylonite belt, which roughly follows the Cobham River-Gorham River greenstone belt, separates the Berens River sub-province of mainly granitoid plutons to the south from the Sachigo River sub-province to the north which is rich in greenstone belts (Ermanovics and Davidson 1976). The major cataclastic zone along Stevenson River may also separate two disparate terranes with a more migmatitic terrane to the north.

Overall the Island Lake map-area consists of narrow belts of polydeformed supracrustal rocks separating large plutonic/metamorphic complexes which have risen repeatedly in diapiric fashion. This style of mobilization appears to involve essentially the whole thickness of the crust. The result of the process is groups of plutons separated by curvilinear screens of host rocks. The present strong west-northwest trending "grain" in the plutonic rocks probably resulted from a combination of northwest trending synkinematic to postkinematic intrusions, presumably following a regional tectonic trend, and later cataclastic deformation. The age of this late deformation may be given by a K-Ar age of 2400 Ma on biotite from cataclastic gneiss near Azure Lake (Ermanovics and Wanless 1983). If so, the Island Lake map-area displays a tectonic history of about 500 Ma dominated by repeated reworking of a dioritic to tonalitic substrate and probably cognate supracrustals.

The greenstone belts have been repeatedly prospected for gold and base metals. Gold occurrences generally lie in acid volcanic rocks and prophyries

of the Hayes River Group (see Weber et al 1982 for references on the Island Lake region and Quinn 1956 for references on Stevenson, Bigstone and Knight Lakes). Gold also occurs in quartz veins cutting hybrid gneiss on the south side of the Cobham River-Gorham River belt, 10 km southwest of Varveclay Lake (Quinn 1956). Despite the number of occurrences, the only production was from the Island Lake Mine which produced for 11 months in 1934-35. Ni and Cu mineralization occurs in ultramafic and related rocks of unit $\mathbf{A}_{\mathbf{U}}$. Repeated exploration has not defined significant deposits. Polyphase plutons around Bella Lake contain minor Mo-Cu mineralization.

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- DYKE SUITE: a-Molson dykes, gabbro, diabase, lamprophyre; b-quartz-feldspar
- Tonalitic gneiss and migmatite with rafts and schlieren of all older units ISLAND LAKE GROUP (A_{is},A_{iv})
- Mainly andesite flows, tuff and agglomerate, minor basalt and siltstone

 -conformable contact
 Quartz wacke (regolith), conglomerate, siltstone, turbiditic greywacke and
- EARLY PLUTONIC SUITE (A_e, A_u) Weakly to strongly foliated, hornblende-dominant tonalite, diorite and minor granodiorite and trondjhemite
- Gabbro, diorite, peridotite, serpentinite, spinifex komatlite
 -intrusive contact
 -intrusive contact
 -intrusive contact
 -intrusive contact
 -intrusive contact
 -intrusive contact-
- Greywacke, siltstone, conglomerate and correlative schist and paragneiss; minor chert, iron formation, carbonate and tuff
- -conformable contact-conformable contactFelsic volcanic and hypabyssal rocks; porphyritic dacite and rhyolite, tuf
 and tuff breccia; sodic schists and gneiss derived from felsic volcanics
- Basalt, andesite, volcanic breccia; correlative apmpibolitic schist and gneiss Tonalite gneiss and migmatite with rafts and schlieren of amphibolite
- Gneissositv with dip, inclined, vertical Cataclastic foliation and shearing, inclined, vertical → Joint, inclined vertical
- Bedding, inclined, tops known, unknown
- Pillows, tops known Lineation and plunge
- Minor fold with plunge Rock outcropping, area of abundant outcrop (shown only in regions of sparse outcrop) Geological contact, approximate, gradational, assumed
- ~~ Fault, assumed Mylonite zone 2895z Radiometric age determination in millions of years. z=U-Pb isochron on zircon,

h=K-Ar on hornblende, b=K-Ar on biotite

Geology by I.F.Ermanovics, G.Park, J.Hill, P.Goetz 1974, I.F.Ermanovics, R.K.Herd, W.Fyson, G.Delany 1975, J.D.Goddard (1963), W.Weber et al (1982) Geological compilation and interpretation by K.L. Currie 1984

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OTTAWA

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