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Whitestone Lake Area

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E.G. Bright

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Foreword

The map area lies within the Central Gneiss Belt of the Grenville Province in southern Ontario and is located near Parry Sound. No mineral deposits have been documented in the map area. A small amount of mineral exploration has occurred in the Whitestone Lake area.

The geologic mapping of the Whitestone Lake area was initiated in 1986 by the Ontario Geological Survey. This is part of an ongoing program to improve geologic map coverage of the province in order to assist exploration in poorly studied areas. In addition to geologic mapping, the COMDA and ERDA programs also require studies of the surficial geology and metallic and nonmetallic mineral potential of the Parry Sound region.

This study has shown that the area consists of three major lithotectonic domains, each with distinctive lithologic, metamorphic and structural characteristics, separated from each other by major tectonite zones. Mineral potential varies between the domains, and the geology of the area is controlled by large scale tectonic features. The area has potential for industrial minerals, including anorthosite for use as a filler and marbles as a source of agricultural lime.

V.G. Milne

Director
Ontario Geological Survey

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CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
		LENGTH			
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
		AREA			
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
		VOLUME			
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
		CAPACITY			
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
		MASS			
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
		CONCENTRATION			
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in cooperation with the Coal Association of Canada.

Precambrian Geology
Whitestone Lake Area

E.G. Bright

Geologist, Precambrian Geology Section, Ontario Geological Survey, Toronto.

Manuscript approved for publication by A.C. Colvine, Chief Geologist, Ontario Geological Survey, September 19, 1988. Report published with the permission of V.G. Milne, Director, Ontario Geological Survey.

Abstract

The Whitestone Lake map area lies about 225 km north-northwest of the city of Toronto, and covers approximately 280 km^2.

Middle Proterozoic rocks of the Central Gneiss Belt, which are part of the Grenville Province, underlie the area. The map area straddles the boundaries between three lithotectonic terranes (domains), each characterized by distinctive lithologies, structural styles and metamorphism. These diagnostic geological features are truncated at domain boundaries that are sites of high-strain tectonites. The tectonites probably formed through northwesterly directed ductile thrusting of one terrane over the other during the Grenville (Ottawan) Orogeny. From west to east, across the map area, the lithotectonic domains are: 1) the Britt Domain, in the northwest corner of the area; 2) the Parry Sound Domain, in the central two-thirds of the area; and 3) the Ahmic Domain, along the east-central boundary of the area. During the thrusting event at *circa* 1160 Ma in the area, which led to the complex pattern of domains and domain boundaries now exposed in the map area, the Middle Proterozoic rocks were regionally metamorphosed, and in some places retrograded, to middle to upper amphibolite facies. The metamorphosed rocks in all three domains are cut by late to posttectonic, unmetamorphosed granite pegmatites.

The Britt Domain, and the strikingly similar Ahmic Domain, are characterized by migmatitic, layered granitoid gneisses of indeterminate protolith, and to a lesser extent by interlayered bands of locally migmatitic quartzofeldspathic and biotite gneisses of possible metasedimentary origin. Granitic plutons were intruded into and deformed with the older layered granitoid gneisses. Major, continuous units of massive to foliated, in places migmatitic, granitic orthogneiss occur along the margins of both the Britt and Ahmic domains, and separate the migmatitic layered granitoid gneisses in both domains from the Parry Sound Domain and its associated boundary zones. The amphibolite-grade rocks in the Britt Domain dip moderately to steeply eastward beneath the western Parry Sound Domain Boundary Zone. In the eastern part of the map area, the amphibolite grade rocks of the Ahmic Domain dip steeply westward beneath the eastern Parry Sound Domain Boundary Zone. The two domains may be continous beneath the Parry Sound Domain.

Away from its boundary zones, which contain high-strain tectonites, the interior part of the Parry Sound Domain is characterized by supracrustal and metaplutonic gneisses in relict granulite facies and in a retrograde amphibolite facies overprint on granulite facies. Younger, prograde, amphibolite facies metaplutonic rocks are locally present. Supracrustal gneisses, the oldest rocks in this domain, comprise retrograde amphibolite facies quartzofeldspathic gneiss, quartzose gneiss and marbles, the latter mainly tectonic breccias. Metaplutonic gneisses of predominantly mafic composition were emplaced, probably as sills or near-concordant dikes, at successive stages. In approximate order of decreasing age these metaplutonic gneisses are: 1) granulite and retrograded granulite facies, corona-textured, plagioclase-rimmed garnet amphibolites which may represent subvolcanic sills with some extrusive equivalents; 2) an early tectonic suite of relict high-grade mafic to intermediate and intermediate to felsic orthogneisses; 3) younger suites of less deformed, mafic to intermediate metaplutonic rocks consisting of a relict granulite facies diorite suite and a younger prograde amphibolite facies anorthosite suite, which form sill-like bodies throughout the area; and lastly 4) syntectonic to late tectonic, amphibolite facies, felsic and mafic dikes. The southwestern part of the Parry Sound Domain is underlain by the northern half of the large, igneous layered, Whitestone Lake Intrusive Complex.

The structural geology of the area is dominated by the major tectonic zones which serve to separate the various domains. The protolith of the amphibolite grade, mafic and felsic (tectonic) gneisses and layered tectonites in these boundary zones is unknown. Most of the protolith was derived from the less deformed supracrustal and metaplutonic gneisses presently preserved in the interior part of Parry Sound Domain. Within these boundary zones, the gneisses and layered tectonites contain large, isolated tectonic blocks and lenses of lithologies similar to those observed in the interior of the domain, particularly the anorthosite suite rocks.

The interior part of the Parry Sound Domain is cut by the fault-bounded Whitestone Lake Structural Complex, a major north-trending zone of marble tectonic breccia containing a chaotic melange of large tectonic inclusions of supracrustal and metaplutonic gneiss. West of this structural complex, the western segment of the Parry Sound Domain is characterized by a regionally banded series of north-northeasterly trending layered gneisses. East of the structural complex, the eastern part of the Parry Sound Domain has a more podiform to locally layered, northerly trending regional fabric.

The western part of the Parry Sound Domain and its adjacent boundary zone are offset by a series of north-northeast-trending faults, whose age relative to the similarly trending Whitestone Lake Structural Complex is not known. These faults, the Whitestone Lake Structural Complex, and the boundary zones between the various domains are all offset by a series of east-trending normal faults. A steep, southeast-plunging lineation is well developed in parts of the marginal granitic orthogneisses of the Britt and Ahmic domains, and increases in intensity toward the boundary of the Parry Sound Domain. This same fabric is poorly developed in the mafic tectonites, but is locally common in the felsic tectonites of the boundary zones. Similar southeast- to east-trending, moderately to steeply plunging lineations occur in many of the supracrustal and metaplutonic gneisses in the interior part of Parry Sound Domain.

The map area contains no documented mineral deposits; however, certain rock types such as anorthosite, marble and granite pegmatite should be considered as potential exploration targets for a variety of industrial minerals.

Résumé

La région du lac Whitestone se situe à 225 km environ au nord-nord-ouest de la ville de Toronto et la zone cartographiée couvre approximativement 280 km^2 (Figure 1).

Les roches du Protérozoïque moyen de la Ceinture de Gneiss Centrale appartenant à la province de Grenville, affleurent dans la région. La zone cartographiée se situe à cheval sur les limites de trois terrains lithotectoniques (domaines), chacun d'eux étant caractérisé par des roches, des styles structuraux et un métamorphisme distincts. Ces caractéristiques géologiques sont tronquées aux limites des domaines qui représentent des sites de tectonites de forte contrainte. Les tectonites ont probablement été produites par un charriage ductile de direction nord-ouest d'un terrain sur l'autre au cours de l'orogénèse Grenvillienne. En allant d'ouest en est à travers le secteur cartographié, les domaines lithotectoniques sont : 1) le domaine de Britt dans le coin nord-ouest; 2) le domaine de Parry Sound dans les deux-tiers au centre; et 3) le domaine d'Ahmic le long de la limite centre-est de la région. Pendant la phase de charriage qui s'est déroulée il y a environ 1160 Ma, et qui a contribué à l'assemblage complexe des domaines et de leurs limites dans la région étudiée, les roches du Protérozoïque moyen ont été métamorphisées à l'échelle régionale. Certaines de ces roches ont été affectées par un métamorphisme rétrograde. Le degré de métamorphisme correspond au faciès à amphibolite moyen et supérieur. Les roches métamorphiques dans les trois domaines sont recoupées par des pegmatites granitiques tardives à post-tectoniques.

Le domaine de Britt, et le domaine d'Ahmic qui possèdent des ressemblances frappantes, sont caractérisés par des gneiss granitiques rubanés migmatisés issus d'un protolite indéterminé, et par des zones moindres de gneiss quartzo-feldspathiques et de gneiss à biotite qui, à l'origine, étaient peut-être des roches sédimentaires. Des plutons granitiques ont été intrudés dans les gneiss granitiques rubanés plus anciens et ont été déformés avec ces derniers. Des unités continues majeures formées d'orthogneiss granitique massif à folié et parfois migmatitique, sont situées en bordure des domaines de Britt et d'Ahmic. Ces unités séparent les gneiss granitiques rubanés dans les deux domaines, du domaine de Parry Sound et ses limites. Les amphibolites du domaine de Britt plongent vers l'est sous la limite occidentale du domaine de Parry Sound avec un pendage allant de modéré à fort.

Dans la partie orientale du secteur cartographié, les amphibolites du domaine d'Ahmic plongent avec un fort pendage vers l'ouest sous la limite orientale du domaine de Parry Sound. Les deux domaines peuvent se prolonger sous le domaine de Parry Sound. La partie interne du domaine de Parry Sound qui n'a pas été sujette à la forte contrainte subie en bordure, est caractérisée par des gneiss d'origine supracrustale et plutonique se trouvant dans des granulites résiduelles et dans des amphibolites régressives au sein d'un faciès à granulites. Des roches métaplutoniques plus jeunes de faciès métamorphique à amphibolite ont été trouvées par endroits. Des gneiss supracrustaux considérés comme appartenant à ce domaine, comprennent des gneiss quartzofeldspathiques (faciès à amphibolites régréssif), des gneiss quartzeux et des marbres, ces derniers étant surtout des brèches tectoniques. Des gneiss métaplutoniques de composition essentiellement mafique, représentent probablement des filons-couche ou des dikes presque concordants qui ont été injectés à des stades successifs. Par ordre d'âge décroissant ces gneiss métaplutoniques sont: 1) Des amphibolites à structure orbiculaire et avec des grenats entourés de plagioclase, de faciès à granulites et granulites régressif. Ceux-ci représentent peut-être des filons-couche subvolcaniques avec des équivalents extrusifs. 2) Une suite tectonique ancienne d'orthogneiss de composition mafique à intermédiaire et intermediaire à felsique avec des résidus à fort degré de métamorphisme. 3) Des suites plus jeunes de roches métaplutoniques mafiques à intermédiaires moins déformées qui représentent d'une part une suite de diorites métamorphisées de faciès à granulites et d'autre part une suite d'anorthosites de faciès à amphibolite formant des intrusions en forme de filons-couche à travers le secteur cartographié. 4) Des dikes mafiques et felsiques syn- à tardi-tectoniques de faciès à amphibolite. La partie sud-ouest du domaine de Parry Sound est recouverte par la moitié nord du large complexe igné stratifié du lac Whitestone.

La géologie structurale du secteur cartographié est dominée par les zones tectoniques majeures qui délimitent les différents domaines. Dans les zones périphériques, le protolite, correspondant aux gneiss mafiques et felsiques (tectoniques) et aux tectonites rubanées de faciès à amphibolite, est inconnu. La plupart du protolite a été dérivée de gneiss supracrustaux et métaplutoniques qui affleurent dans la partie interne du domaine de Parry Sound. Au sein des zones périphériques, les gneiss et tectonites rubanées contiennent des gros blocs et des lentilles tectoniques isolés dont les caractéristiques lithologiques sont similaires à celles qui ont été observées à l'intérieur du domaine, et particulièrement aux anorthosites.

La zone intérieure du domaine de Parry Sound est recoupée par le complexe structural du lac Whitestone qui est délimité par des failles. Ce complexe représente une zone de brèche de marbre tectonique d'orientation nord-sud contenant un mélange chaotique de larges inclusions tectoniques de gneiss supracrustaux et métaplutoniques. À l'ouest de ce complexe structural, le segment occidental du domaine de Parry Sound est caracterisé par des séries de gneiss rubanés orientés nord-nord-est. À l'est du complexe structural, la partie orientale du domaine de Parry Sound de structure plus massive à localement rubanée possède une foliation orientée nord-sud.

La partie occidentale du domaine de Parry Sound et sa périphérie sont décalées par une série de failles d'orientation nord-nord-est dont l'âge relatif par rapport au complexe structural du lac Whitestone, d'orientation similaire, n'est pas connu. Ces failles, le complexe du lac Whitestone, et les zones délimitant les différents domaines sont décalés par une série de failles normales d'orientation est-ouest. Des linéations fortement inclinées vers le sud-est sont bien développées dans certaines parties des orthogneiss granitiques en marge des domaines de Britt et Ahmic. Ces linéations deviennent plus prononcées en se rapprochant de la périphérie du domaine de Parry Sound. Les linéations sont plus atténuées dans les tectonites mafiques, mais sont localement plus communes dans les tectonites felsiques des zones périphériques. Des linéations similaires d'inclinaison modérée à forte et d'orientation sud-est à se retrouvent dans beaucoup de gneiss supracrustaux et metavolcaniques de la partie interne du domaine de Parry Sound.

Il n'y pas de gisements métallifères documentés dans le secteur cartographié. Cependant les anorthosites, les marbres et les pegmatites granitiques représentent des cibles potentielles pour l'exploration des minéraux industriels.

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Introduction

In 1986, the Ontario Geological Survey began the Parry Sound project, a three-year interdisciplinary geoscience study of the Muskoka–Parry Sound–Nipissing area. This program was funded by the Canada–Ontario Mineral Development Agreement (COMDA), which is a subsidiary agreement to the Regional and Economic Development Agreement (ERDA) signed by the governments of Canada and Ontario. Geological mapping of the Whitestone Lake area is the first phase of this three-year project to be conducted by the Precambrian Geology Section of the Ontario Geological Survey.

Location and Access

The map area is located 225 km north-northwest of the city of Toronto and is 33 km north of the town of Parry Sound (Figure 1). It includes parts of Croft, Ferrie, Hagerman and McKenzie townships in the district of Parry Sound. The area covers about 280 km² and is bounded by longitudes 79°45′00″W and 80°00′00″W, and by latitudes 45°37′30″N and 45°45′00″N. The village of Dunchurch is located in the south-central part of the area. Access is provided from Parry Sound by Highway 124, which traverses the south-central and eastern parts of the map area. At Dunchurch, Highway 124 connects with Highway 520, which traverses the west-central part of the area.

Numerous county, concession, farm and private cottage roads provide additional access to most of the southern part of the area except the region to the southwest of Whitestone Lake. In the area, most lakes are small and rivers and creeks connecting them are only partly navigable. Access in the northern part of the area, particularly north of the Magnetawan River, is mainly by means of boat or float-equipped aircraft. Limited road access into the north-central part of this region is afforded by a forest-access road leading north from the village of Maple Island (local name).

Physiography

Relief in the map area is low to moderate with a maximum overall relief of approximately 40 m. More rugged terrain, where relief locally exceeds 50 m, is encountered mainly in the western part of the area. Specifically, this terrain occurs west and southwest of Whitestone Lake in the region underlain by the Whitestone Lake Intrusive Complex (WLIC); and east of Wahwashkesh Lake, in the northwestern part of the area, which is underlain by the northeasterly trending tectonic boundary zone. This zone separates the granitoid gneiss-rich Britt Domain to the west from the mafic gneiss-rich Parry Sound Domain (PSD) to the east. In the eastern part of the map area, the overall relief is lower than in the western part, but locally, northeasterly trending ridges have relief in excess of 40 m. These ridges are generally underlain either by diorite sills or dikes, or by granitoid gneisses cut by diorite dikes.

The largest areas of low relief (less than 20 m) are localized along the main drainage systems in the map area. Several north- and east-trending river and creek valleys, some with interconnecting lakes and swamps, lie along major faults. The largest of these low areas traverses the central part of the map area from Whitestone Lake in the south, through Maple Island, and along Fer-

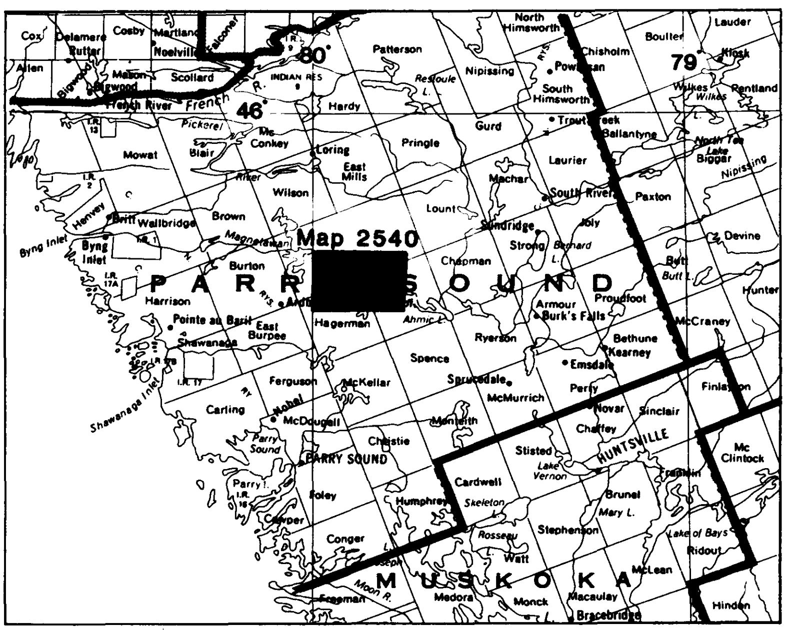


Figure 1. Key map showing the location of the Whitestone Lake area.

rie Creek in the north. This area is underlain by the marble-rich Whitestone Lake Structural Complex (WLSC).

Lakes, creeks and rivers throughout the map area drain northward and southward and then flow westward, with Wahwashkesh Lake in the northwest being the major drainage for the Magnetawan and Whitestone River drainage basins.

Present Geological Survey

Geological mapping of the Whitestone Lake area, at a scale of 1:15 840 or 1 inch to 1/4 mile, was carried out by the author and his assistants during the summer of 1986. Pace and compass traverses were run approximately 400 to 600 m apart, and at right angles to the strike of rock units. The less accessible northeastern and northwestern corners of the area were mapped in less detail, with traverses being spaced 600 to 1000 m apart. The large Whitestone Lake Intrusive Complex (WLIC) in the southwestern part of the area was previously mapped by Mason (1969), and during the present survey, the central part of this large intrusive complex was only mapped in a reconnaissance style. The contacts and margins of this complex were examined in detail along Whitestone, De Bois and Snakeskin lakes.

Field data were plotted on 1:15 840 scale aerial photographs supplied by the Air Photo Library, Ministry of Natural Resources, and transferred to the Forest Resources Inventory base map at the same scale. Recent information concerning roads was added to the base map. A preliminary geological map for this area was published at a scale of 1:15 840 or 1 inch to 1/4 mile (Bright 1987).

Previous Geological Work

Parts of the area were examined by Satterly (1943) during a study of the mineral occurrences in the Parry Sound District for the Ontario Department of Mines. His reconnaissance map, published at a scale of 1 inch to 1/2 mile (1:31 620) shows the distribution of the abundant granitic and mafic gneisses in the area, and more importantly, the presence of several regional marble units. Concurrent with this regional study, reconnaissance geological mapping by W.F. Lacy was carried out in the McKellar–Dunchurch–Ahmic Harbour area during the summers of 1940 and 1941. The results of this survey, which includes most of the present map area, were described in a later paper accompanied by a generalized geological map (Lacy 1960).

Mason (1969) mapped the WLIC west of Highway 124 from the village of McKellar to the village of Dunchurch. In his unpublished PhD thesis, he described the petrology, chemistry and possible petrogenesis of this intrusion, part of which underlies much of the southwestern part of the area. Kretchmar (1968) studied the opaque minerals of the WLIC as part of an MSc thesis at McMaster University.

The Geological Survey of Canada initiated in 1980 an ongoing reconnaissance mapping program of the northwestern Grenville Province, east of Georgian Bay. In places, the mapping undertaken was detailed, and included the map area. Preliminary results of this regional survey, as well as the lithologic, metamorphic and tectonic framework of this part of the Grenville Province were reported by Davidson and Morgan (1981) and Davidson et al. (1982). Subsequent results of the regional survey were reported by Culshaw et al. (1983) and Davidson et al. (1985).

In conjunction with the present mapping project, Marmont (1986) started a three-year program in 1986 to evaluate the industrial mineral and rare earth element deposits in the Parry Sound region, including the map area, for the Ontario Ministry of Northern Development and Mines.

Acknowledgments

Capable and enthusiastic field assistance was rendered by Gordon D. McRoberts as senior assistant, and Steven G. Parker, Michael Murr and Tracy S. Workman as junior assistants. Discussions with B.O. Dressler and R.M. Easton of the Ontario Geological Survey, Toronto, A. Davidson and S. Hanmer of the Geological Survey of Canada, Ottawa, and C. Marmont, Geologist, Ministry of Northern Development and Mines, Huntsville, were most helpful.

Terminology

Rocks within the Whitestone Lake area consist mainly of a variety of gneissic rocks and tectonites. No standard rock classification schemes apply to these rocks. The classification scheme used in this report is based on a combination of texture, layering characteristics, metamorphic grade, tectonic features, rock composition and preservation of relict features. Where a plutonic origin is indicated, the rock classification follows that of Streckeisen (1976). In addition, the rock units shown on Map 2540 (back pocket) and described in this report have been grouped so as to emphasize the major tectonic subdivisions in the area. This approach does lead to some repetition in the text, and a large number of map units and sub-units. The grouping of the rock units effectively illustrates the geology of this map area and also provides a rational framework for mineral exploration.

USE OF THE TERM GNEISS

In this report, the term “gneiss” is used in a strictly textural sense with no connotation as to origin, whereas the term “orthogneiss” refers to a “gneiss” derived from an igneous precursor. As used in this report, a gneiss is:

> A massive-looking to foliated rock formed by regional metamorphism, and in places tectonism, in which bands or lenticles of predominantly granular minerals alternate with bands or lenticles of mainly flaky or elongate prismatic minerals. This unit need not be banded. Varieties are distinguished by other textures (e.g., layered or augen gneiss), characteristic minerals (e.g., biotite gneiss), or general composition, but not origin (granitoid, granodioritic or mafic gneiss). In this report the term paragneiss is seldom used and compositional modifiers such as quartzofeldspathic, quartzose and calc-silicate-rich are used to indicate gneisses of metasedimentary origin.

USE OF THE TERM TECTONITE

A significant amount of the rocks in the Whitestone Lake area are tectonites, in the sense that most of their textural and structural features can be ascribed to tectonism, particularly in the "tectonite zone" that borders the Parry Sound Domain. The term "tectonite" is used in a general sense to include all tectonic rock types, and may be modified by such textural terms as homogeneous, massive-looking and layered. The characteristic features of the main tectonic rock types, i.e., mylonite, mylonite gneiss, porphyroclastic gneiss or layered tectonic gneiss are described later in this report within the tectonite terminology section of the Parry Sound Domain Boundary Zone.

USE OF THE TERMS SILL AND DIKE

In the regionally banded, in places podiform, series of metasedimentary and metaplutonic gneisses in the Parry Sound Domain, the relatively homogeneous composition, uniform grain size and massive to foliated character of many of these bands and pods (megaboudins) strongly suggest an igneous protolith. The protolith was probably originally emplaced as sills or near-concordant dikes. Contacts between adjacent orthogneisses or orthogneiss and metasedimentary gneiss are generally concordant and most of these rocks have been tectonically modified. Infolding, at all scales, of these various gneiss bands, (i.e., transposed gneiss) is common. Small dikes or layers (transposed dikes) in these layered gneisses locally show crosscutting relationships.

Throughout the map area, and in particular in the interior part of the Parry Sound Domain, the terms "sill" and "dike" are used to describe the inferred emplacement shape of the intrusive rock. Nevertheless, most of these rocks have been tectonically modified, particularly the large bodies. These bodies include the anorthosite suite rocks. Many of the smaller mafic to felsic plutonic bodies have also been tectonically modified. Most of the larger orthogneiss bands and pods, many of which are presently in the retrograded granulite facies, were probably emplaced as sills or near-concordant dikes into a deep crustal setting of previously deformed supracrustal and metaplutonic rocks. This hypothesis cannot be rigorously tested.

General Geology

REGIONAL GEOLOGICAL SETTING

The area is underlain by Precambrian rocks of Middle Proterozoic age which form part of the Central Gneiss Belt (CGB) of the southwestern Grenville Province (Wynne-Edwards 1972) (Figure 2). A table of lithologic units is shown in Table 1. Recent reconnaissance mapping within and near the map area (Davidson and Morgan 1981); Davidson et al. 1982; Culshaw et al. 1983) indicates that this part of the CGB is composed of a number of lithotectonic terrains (domains and subdomains) (Figure 3), each having distinctive lithologies, structural styles and metamorphism. These distinctive lithologies, structural styles and metamorphism are truncated at terrain boundaries. The boundaries are sites of high-strain tectonites formed through repeated northwesterly directed ductile thrusting of one terrain over the other during the Grenville (Ottawan) Orogeny.

The Precambrian rocks in the map area occur in three major lithotectonic terrains which, from west to east, are: the Britt Domain, the Parry Sound Domain, and the Ahmic Domain or subdomain (Davidson et al. 1982) (Figures 3 and 4). The age of the dominant lithologies within each terrain is unknown and the order of domain presentation in this report does not necessarily imply any age relationship.

Figure 3 shows the main tectonic features of the Parry Sound region. Figure 4 is a generalized geology map of the Whitestone Lake area. Figures 5 and 6 show the location of geochemical samples in the Whitestone Lake area. Figure 7 outlines the general distribution of medium to high prograde and retrograde facies rocks in the various domains within the map area.

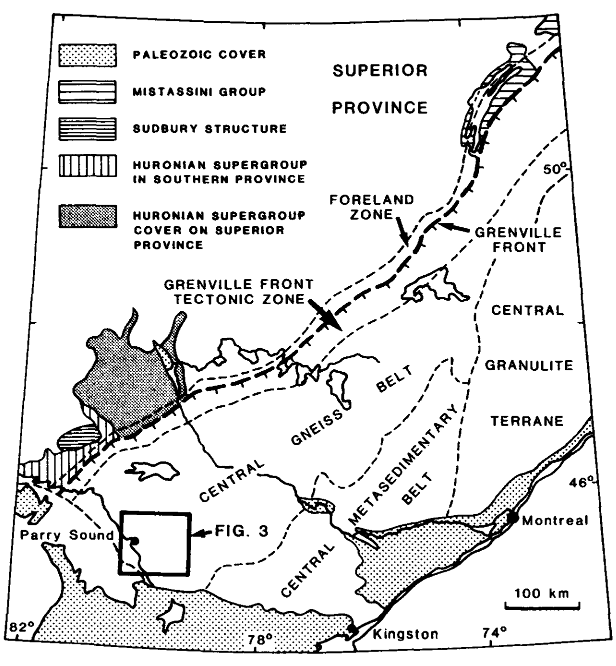


Figure 2. Structural subprovinces in the western Grenville Province, Ontario, after Wynne-Edwards (1972).

The Britt Domain (units 1 to 5), near Wahwashkesh Lake in the northwestern part of the map area, consists mainly of a series of migmatitic, thinly to thickly layered, granitoid gneisses of granitic to granodioritic composition (unit 1) and indeterminate protolith, and to a lesser extent of interlayered units of biotite-rich and quartzofeldspathic gneisses (unit 2) of possible metasedimentary origin. Granitic plutons (unit 3) were intruded into and were deformed with the older migmatitic layered gneisses. The north to northeast-trending, tightly folded, amphibolite-grade, layered granitoid gneisses and granitic orthogneisses are overturned to the northwest and dip moderately to steeply eastward beneath the Parry Sound Domain.

The gneisses of the Britt Domain near Wahwashkesh Lake are structurally bounded on both sides by major ductile shear zones. To the west, within the Britt domain, a 150 to 200 m wide zone of mylonitic granitic gneiss (unit 5) occurs in the extreme northwest corner of the map area. This internal ductile shear zone separates the layered granitoid gneisses on and to the east of Wahwashkesh Lake from a major unit of relatively massive granodioritic to tonalitic orthogneiss that is exposed on this lake just beyond the margins of the current area. Farther to the east of Wahwashkesh Lake, the marginal granitic orthogneiss, in places layered granitoid gneiss of the Britt Domain, is truncated and structurally overlain by a broad, (1.8 to 3 km wide) easterly dipping zone consisting of high-strain mafic to felsic tectonites. This zone of tectonites is referred to as the western Parry Sound domain boundary zone (PSDBZ) (Figure 4).

Within the Britt Domain, along and to the west of the western PSDBZ, is an apparently continuous, major unit of relatively massive, monzogranitic to granodioritic orthogneiss (unit 3). This marginal orthogneiss appears to represent a deformed, flattened pluton, or possibly several closely spaced, *en échelon*, deformed plutons that intruded rocks of the Britt Domain before overthrusting of the Parry Sound Domain rocks took place. Toward the eastern contact of the marginal orthogneiss with the base of the western PSDBZ, the orthogneiss becomes layered, in places migmatitic, exhibits a general grain size reduction and commonly has flattened, elongated quartz grains. Southwest of the map area, on Highway 69 north of Parry Sound, a strikingly similar marginal granitic orthogneiss in the Britt Domain yielded a Rb-Sr isochron age of 1330 Ma (Connare and McNutt 1985) and a U-Pb zircon age of 1346^{+69}_{-39} Ma (van Breemen et al. 1986).

Mafic orthogneiss (unit 4) occurs as minor, boudinaged, in many places disrupted, dikes or layers in the granitoid gneisses. Unit 3 also occurs in the marginal orthogneiss of the Britt Domain that is younger than unit 3.

TABLE 1. TABLE OF LITHOLOGIC UNITS FOR THE WHITESTONE LAKE AREA.

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Till, sand, silt, gravel, and organic swamp and alluvial deposits

Unconformity

PRECAMBRIAN

MIDDLE PROTEROZOIC

LATE TECTONIC TO POSTTECTONIC FELSIC INTRUSIVE ROCKS

PEGMATITIC GRANITE

Coarse grained to pegmatitic granite dikes

Intrusive Contact

CENTRAL GNEISS BELT–PARRY SOUND DOMAIN

PARRY SOUND DOMAIN BOUNDARY ZONE (PSDBZ)

Mafic and felsic gneisses, in part recrystallized high-strain tectonic gneisses; mafic and felsic layered tectonic gneisses of varied thickness and proportions of mafic, felsic, and in places intermediate and pelitic gneiss; locally contains porphyroclastic gneiss and block tectonite

Fault Contact?

WHITESTONE LAKE STRUCTURAL COMPLEX (WLSC)

MARBLE TECTONIC BRECCIA

Metre– to house–sized and larger, round to subround blocks, lenses of supracrustal gneiss and mafic to felsic plutonic orthogneiss; in many places gneisses of indeterminate protolith, set in a smaller clast–sized matrix of marble tectonic breccia

Fault Contact

SYNTECTONIC TO LATE TECTONIC MAFIC AND FELSIC DIKES

MAFIC INTRUSIVE ROCKS

Amphibolite dikes; in places showing varying degrees of boudinage, cataclasis or disruption

Intrusive Contact

FELSIC INTRUSIVE ROCKS

Leucogranite dikes or layers, pegmatitic granite dikes; in places showing varying degrees of boudinage, cataclasis or disruption

Intrusive Contact

EARLY TO SYNTECTONIC MAFIC TO INTERMEDIATE METAPLUTONIC ROCKS

ANORTHOSITE SUITE ROCKS AND RELATED TECTONITES

Gabbroic anorthosite, anorthosite and gabbro; in many places displaying primary igneous texture and layering; locally gneiss, layered gneiss, protomylonitic gneiss and tectonic inclusions in PSDBZ and WLSC

Intrusive Contacts

DIORITE SUITE ROCKS AND RELATED TECTONITES

Pyroxene–bearing diorite, hornblende ± pyroxene–bearing diorite and layered gneiss; in places protomylonitic and layered tectonic gneiss; locally as tectonic inclusions in WLSC

Intrusive Contact

EARLY TECTONIC MAFIC TO FELSIC METAPLUTONIC ROCKS

INTERMEDIATE TO FELSIC ORTHOGNEISSES

Granodioritic to granitic orthogneiss, in places containing mafic to intermediate gneiss layers; locally protomylonitic and layered tectonic gneiss

MAFIC TO INTERMEDIATE ORTHOGNEISSES

Gabbroic to dioritic orthogneiss, quartz dioritic to tonalitic, in places granodioritic orthogneiss; protomylonitic gneisses, layered tectonic gneisses; locally tectonic inclusions in WLSC

Intrusive Contact

TABLE 1. CONTINUED.

PORPHYROBLASTIC ORTHOAMPHIBOLITE

Porphyroblastic plagioclase-rimmed garnet amphibolite, garnet-plagioclase-streaked amphibolite, layered amphibolite gneiss; layered mafic and felsic tectonic gneiss; in places protomylonitic amphibolite gneiss; locally tectonic inclusions in PSDBZ and WLSC

METASEDIMENTARY ROCKS AND GNEISSES

CLASTIC SILICEOUS METASEDIMENTARY ROCKS

Quartzofeldspathic gneiss, quartzose gneiss, biotite gneiss and schist; metasedimentary gneisses with orthoamphibolite layers; protomylonitic gneiss, layered tectonic gneiss

CARBONATE-RICH METASEDIMENTARY ROCKS

Calcitic marble, marble with amphibolite and calc-silicate gneiss layers; marble tectonic breccia

Fault Contact

CENTRAL GNEISS BELT-BRITT AND AHMIC DOMAINS

MAFIC INTRUSIVE ROCKS

Amphibolite dikes, in places hybrid quartz dioritic to dioritic orthogneiss phases; sheared and disrupted dikes

Intrusive Contact

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

Monzogranitic to granodioritic orthogneiss

Intrusive Contact

GRANITOID GNEISSES AND RELATED MIGMATITES

Locally migmatitic, massive to layered granitic to granodioritic gneiss; locally migmatitic, massive to layered quartzofeldspathic gneiss; in places with biotite gneiss interlayers, minor interlayers of mafic gneiss

Contact Unknown

CENTRAL GNEISS BELT-BRITT DOMAIN

GNEISSES AND TECTONITES

Interlayered granitic to granodioritic and mafic tectonic gneiss, protomylonitic to mylonitic granitic gneiss

Fault Contact

MAFIC INTRUSIVE ROCKS

Amphibolite and gabbro dikes; commonly disrupted

Intrusive Contact

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

Monzogranitic to granodioritic orthogneiss

Intrusive Contact

GRANITOID GNEISSES AND RELATED TECTONITES

Locally migmatitic, massive to layered granitic to granodioritic gneiss; locally migmatitic biotite gneiss with quartzofeldspathic gneiss interlayers; minor mafic gneiss interlayers

NOTES:

a) The Precambrian legend is lithologic; stratigraphic order is not implied by the order in which the rocks are described.

b) All Precambrian rocks except unit 22 have been subjected to regional metamorphism, some nonmetamorphic terms are used for the sake of brevity and where protolith is established.

c) Plutonic rock classification follows the IUGS subcommission on the systematics of igneous rocks (Streckeisen 1976).

d) Tectonic inclusions in the marble breccias of the Whitestone Lake Structural Complex range from centimetre-size clasts to kilometre-size blocks and lenses.

e) Most intrusive contacts have been tectonically reworked; in places transposed.

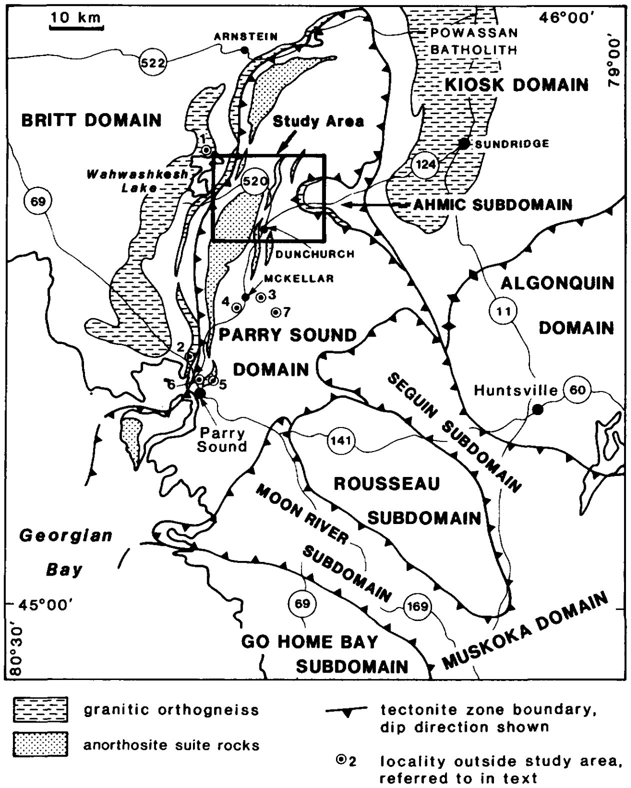


Figure 3. Lithotectonic domains and subdomains in the southwestern part of the Central Gneiss Belt, Grenville Province, after Davidson et al. (1985). Selected regional lithologies are shown only in the Britt, Parry Sound, Ahmic and Kiosk domains.

The western part of the Ahmic Domain (units 6 to 9) is a domical shaped area, exposed along the east-central boundary of the map area (Figure 4). At its southwestern, western and northern margins, amphibolite-grade gneisses dip steeply westward beneath high-strain tectonites of the eastern PSDBZ. The dominant lithologies are migmatitic, layered granitoid gneisses and granitic orthogneisses (units 6 and 8 respectively). In the map area these rocks are almost indistinguishable from those previously described in the Britt Domain (units 1 and 3). In contrast to the Britt Domain, the dominant series of migmatitic layered granitoid gneisses (unit 6) of the Ahmic Domain contains several large, interlayered units of massive to foliated leucocratic quartzofeldspathic gneiss (unit 7) of probable metasedimentary origin. These pink to salmon pink, quartz-rich gneisses are commonly hematite-stained, contain up to 1 percent magnetite and contain ubiquitous accessory garnet. Biotite gneiss and schist locally form minor thin interlayers in these quartzofeldspathic gneisses.

Because of their lithologic similarity and the fact that rocks of the Ahmic Domain dip westerly beneath the Parry Sound Domain, Davidson and his co-workers regard the Ahmic Domain as a subdomain of the easterly dipping Britt Domain and have suggested that the two might be connected beneath the Parry Sound Domain (Davidson et al. 1982). Since the age relationship between the Britt and Ahmic lithotectonic terrains remains uncertain, major rock types in each domain (units 1 to 5 and 6 to 9, respectively) are discussed separately in this report.

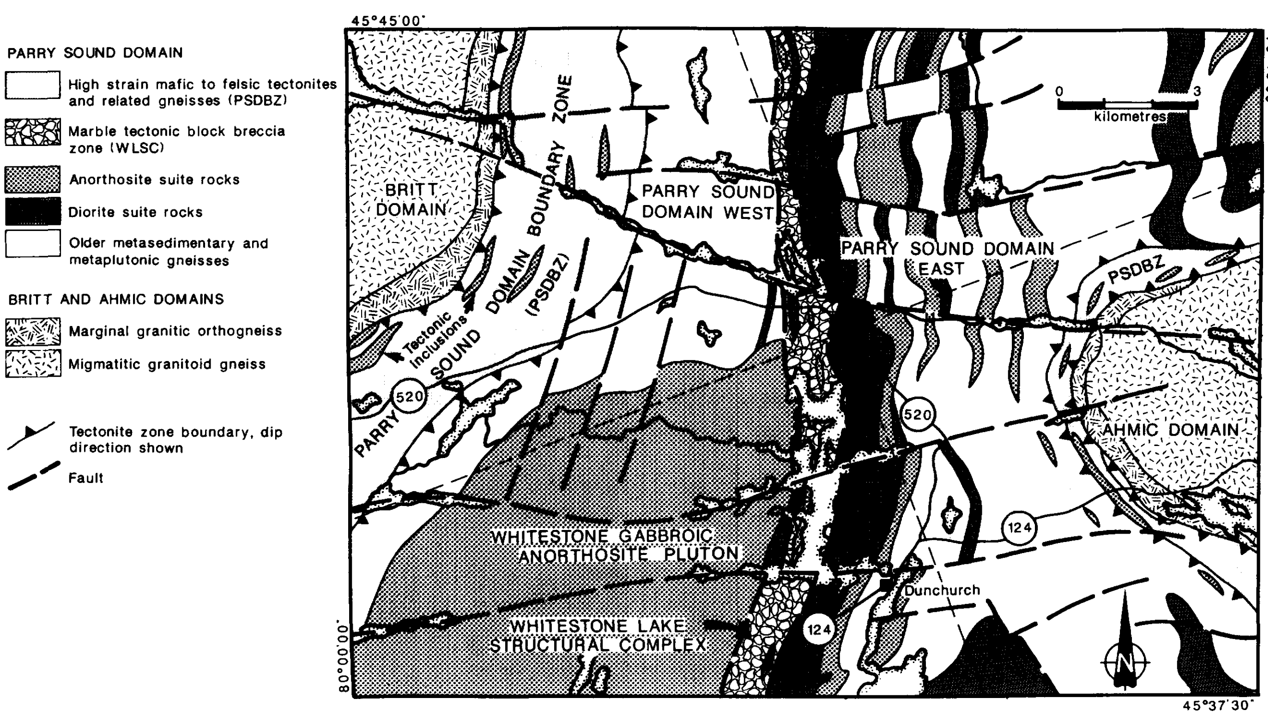


Figure 4. General geology and structural subdivisions in the Whitestone Lake area.

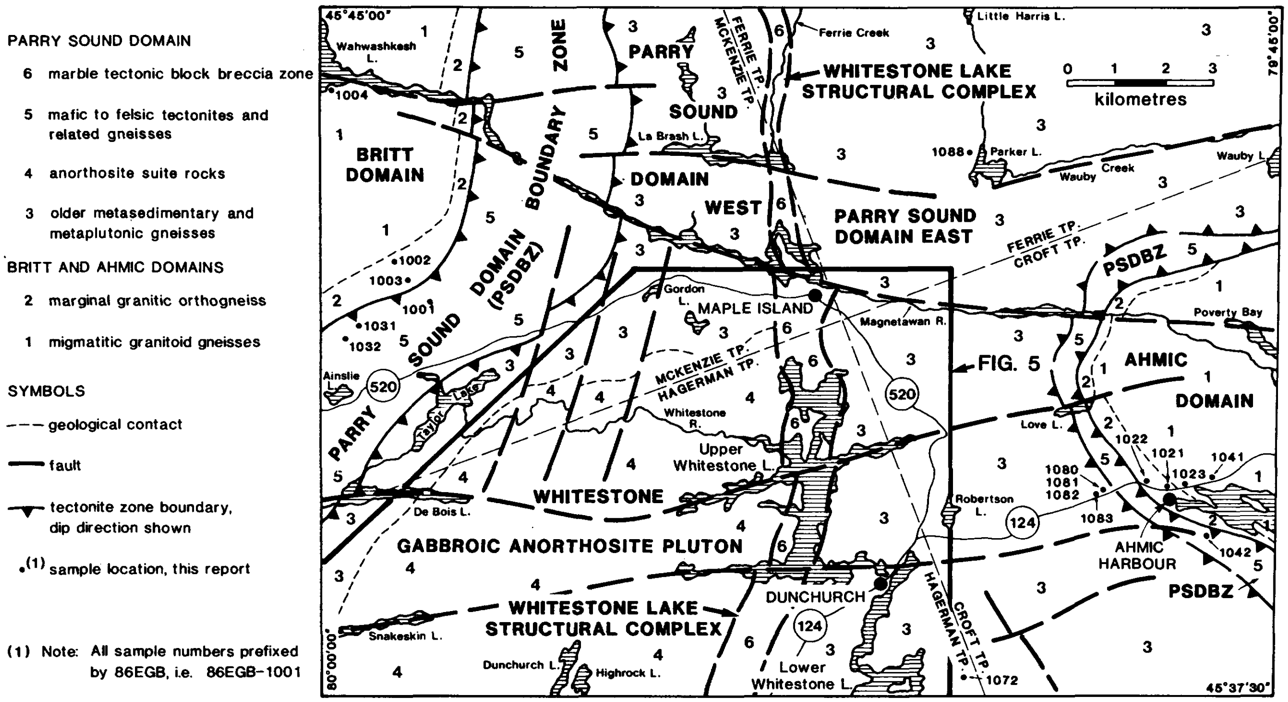


Figure 5. Geochemical sample locations, Whitestone Lake area. For samples located in inset area, see Figure 6.

The north to northeast-trending Parry Sound Domain (units 10 to 18) (PSD) underlies the central two-thirds of the map area (Figure 4). It is bounded along its western and eastern margins by ductile shear zones, the Parry Sound Domain Boundary Zones (PSDBZs), described later in the text. In the interior part of the PSD, the moderately to highly deformed, in places mylonitic and disrupted, older gneisses have been subdivided into five main groups, which in order of interpreted decreasing age are:

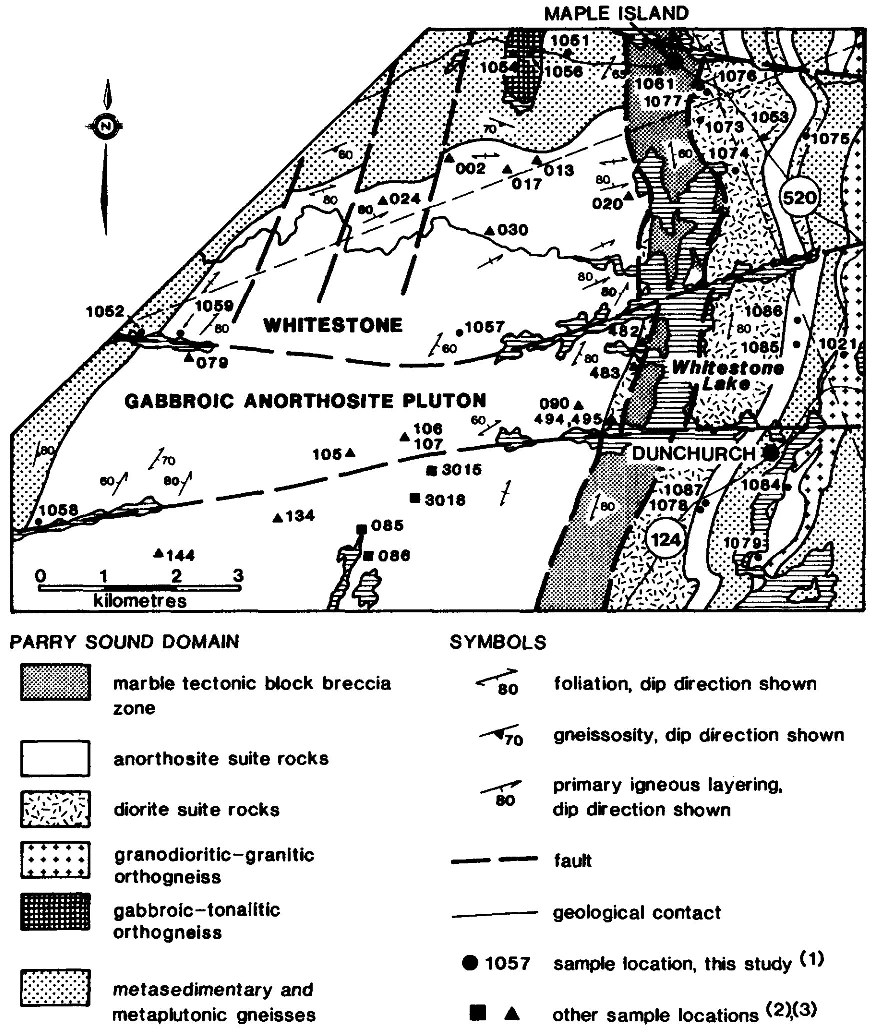
1. metasedimentary gneisses (units 10 and 11)
2. porphyroblastic mafic orthogneiss (unit 12) which may be wholly intrusive or in part extrusive
3. early tectonic mafic to felsic metaplutonic rocks (units 13 and 14)
4. early to syntectonic mafic to intermediate metaplutonic rocks (units 15 and 16)
5. syntectonic to late tectonic felsic and mafic dikes (units 17 and 18)

The interior part of the PSD can be structurally subdivided into western and eastern segments by the centrally located WLSC (*see* Figure 4). The distribution of the older four main lithologic groups varies markedly on opposite sides of this syntectonic structural feature, which is described later in the text.

Metasedimentary gneisses (units 10 and 11), the interpreted oldest rocks in the PSD, comprise at least 30 percent of the gneisses in the interior part of this domain. In the western segment of the PSD, the amphibolite-grade metasedimentary gneisses consist of interlayered units of quartzofeldspathic gneiss (feldspathic arenites and wacke) and quartzose gneiss derived from quartz arenite (unit 11). In the eastern segment of the PSD, the metasedimentary gneisses consist mainly of quartzofeldspathic gneiss (unit 11) and moderately to highly disrupted marble units (unit 10); thin quartzose gneiss units are locally present. However, the general absence of quartzose gneiss in most of the eastern segment of the PSD made it difficult to distinguish quartzofeldspathic gneisses of metasedimentary origin (unit 11) from similar looking, interlayered units of granitic orthogneiss (unit 14).

Porphyroblastic orthoamphibolite (unit 12) is abundant in the western segment of the PSD, but is not common in the eastern segment. This unit forms tectonic inclusions in the tectonites of both the western and eastern PSDBZs, as well as in the WLSC. These orthogneisses are mainly massive to foliated, porphyroblastic, plagioclase-rimmed garnet amphibolites. Many outcrops of this metamorphic, corona-textured, porphyroblastic garnet amphibolite are cut by narrow, anastomosing shears. Near these deformation zones, the relatively massive-looking porphyroblastic amphibolite grades rapidly into garnet-plagioclase-streaked amphibolite and layered amphibolite gneiss. Metamorphic grade in these amphibolites is a relict granulite facies or a retrograde amphibolite facies overprint on granulite facies.

Within the western part of the PSD, and beyond the margins of the map area, the garnet amphibolite forms several large, relatively continuous, northeast-trending bands that in places are tectonically deformed megaboudins. These amphibolite bands (unit 12) are regionally infolded with bands of interlayered metasedimenta-



Note: (1) All sample numbers prefixed by 86EGB, i.e. 86EGB–1086.
(2) From Marmont (1986), prefixed 86CCM or 86MMJ.
(3) From Mason (1969), prefixed 69IMM, i.e. 69IMM–002.

Figure 6. General geology in and adjacent to the Whitestone Lake Intrusive Complex (WLIC), Whitestone Lake area. Numbers refer to geochemical sample locations.

ry quartzofeldspathic and quartzose gneiss (unit 11). Within these individual amphibolite bands, many outcrops consist of interlayered units of amphibolite as well as the rock types of unit 11. The regional distribution of the garnet amphibolite suggests that it may represent a series of deformed, subvolcanic sills. There may also be some extrusive equivalents of the subvolcanic sills in the garnet amphibolite.

An early tectonic series of massive to layered, in places protomylonitic, mafic to felsic orthogneisses (units 13 and 14) occurs mainly in the eastern segment of PSD. These rocks have been subdivided into two main groups:

1. Mafic to intermediate gneisses (unit 13) consist predominantly of massive to layered, grey, gabbroic to dioritic, in places interlayered quartz dioritic to tonalitic orthogneisses. These rocks form several large bands or sill-like bodies in the eastern segment of the PSD, but only two smaller sills or megaboudins in the western segment of the PSD.
2. Intermediate to felsic orthogneisses (unit 14) consist mainly of foliated and lineated, pink to pinkish grey rocks having a granodioritic to granitic composition. These rocks were only identified in the eastern segment of the PSD, where they form several large bands or sill-like bodies. In the eastern segment of the PSD, major bands of these mafic to intermediate and felsic orthogneisses are interlayered with each other. Within some orthogneiss bands, both groups (units 13 and 14) can be observed in contact on a single outcrop. Since most intrusive contacts have been tectonically modified, the rela-

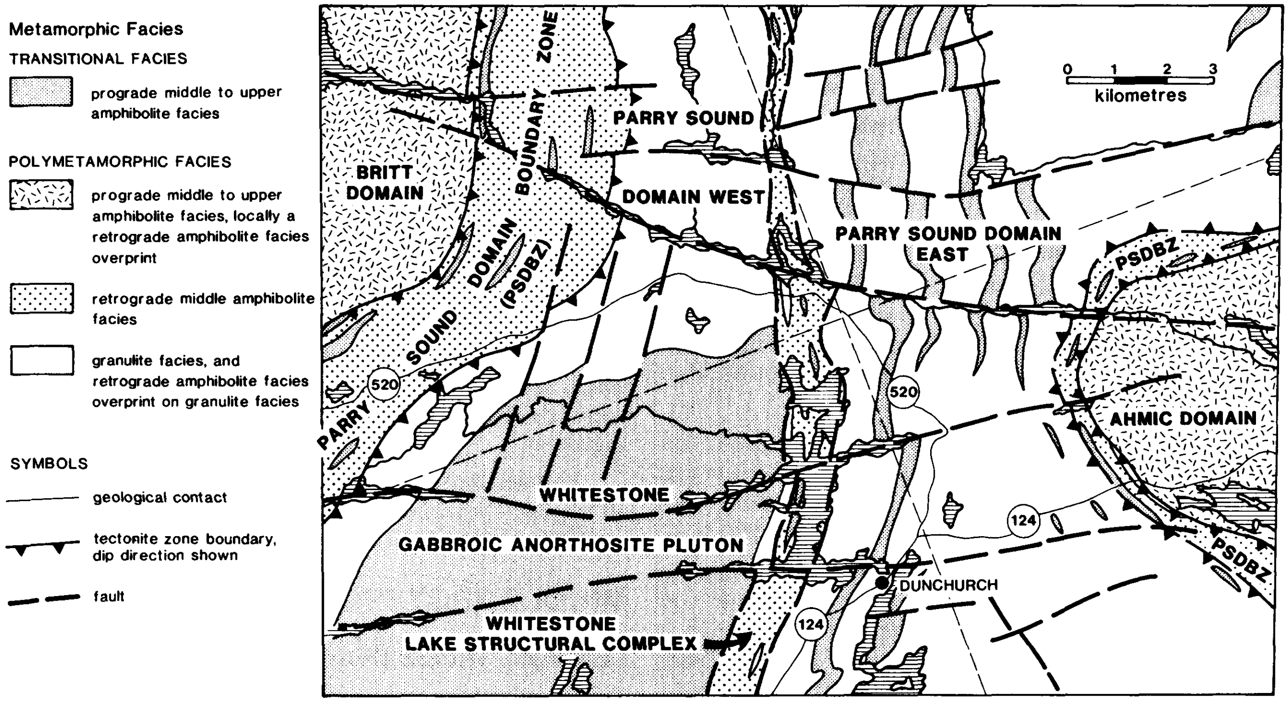


Figure 7. Polymetamorphism in the Whitestone Lake area.

tive age of emplacement of these two metaplutonic groups (units 13 and 14) is uncertain. However, along Highway 124 between Dunchurch and Ahmic Harbour, these mafic to felsic orthogneisses are concordantly to discordantly intruded by numerous, massive-looking amphibolite to diorite dikes (unit 15). The metamorphic grade of the older mafic to felsic orthogneisses (units 13 and 14) is generally amphibolite facies that has retrograded from granulite facies. Relict granulite facies mineral assemblages are locally preserved. In contrast to this, the metamorphic grade of the younger mafic sills and dikes (unit 15 described below) is generally that of a relict granulite facies.

Younger suites of less deformed mafic to intermediate metaplutonic rocks (units 15 to 16) were emplaced at successive stages into the interlayered, supracrustal and metaplutonic gneisses of the PSD (units 10 to 14). These metaplutonic rocks consist of an older diorite suite (unit 15) and a younger anorthosite suite (unit 16). These metaplutonic rocks, most of which are large sills or near-concordant dikes, locally crosscut the older gneisses of the PSD. However, most contacts have subsequently been tectonically modified.

The diorite suite (unit 15) consists mainly of massive, orthopyroxene-bearing diorite and to a lesser extent, foliated to layered hornblende diorite and quartz diorite. The more massive, waxy green to greenish grey rocks exhibit mineral assemblages indicative of a relict granulite facies. Foliated to layered or sheared, grey, hornblende diorite is locally abundant and shows assemblages indicative of the amphibolite facies. These gneissic diorites form several large and numerous small sills as well as minor dikes; in places these rocks form dike swarms in the eastern segment of the PSD. However, only two small sills were identified in the western segment. They also occur as numerous isolated tectonic blocks and lenses in the marble breccias of the WLSC.

The author has correlated this diorite suite of rocks with the McKellar dioritic pluton, i.e., the McKellar sill described by Lacy (1960) near the village of McKellar, approximately 13 km to the south of the map area. A U-Pb zircon age of 1425 ± 75 Ma was obtained from the McKellar sill (van Breeman et al. 1986). The same body yielded an Rb-Sr isochron age of 1241 Ma (Connare and McNutt 1985), probably reflecting isotopic resetting after intrusion. In the map area, the large McKellar-type diorite sill (unit 15) that outcrops along Highway 520 in the northwest corner of Croft Township yielded Ar^{40}/Ar^{39} hornblende and biotite ages of 980 and 940 Ma respectively (Dallmeyer and Sutter 1980), again possibly reflecting isotopic resetting.

The anorthosite suite (unit 16), in contrast to the diorite suite and older supracrustal and metaplutonic gneisses (units 10 to 15), was subjected only to the late amphibolite facies metamorphism that accompanied a late overthrusting event. This suite of rocks consists mainly of massive to foliated, in places protomylonitic, gabbroic anorthosite and anorthosite, locally containing well preserved oikocrystic to subophitic phases. Gabbroic phases are present locally. The largest body of these rocks is the WLIC in the western segment of the PSD (*see* Figure 4), but many smaller bodies are present in the eastern segment of the PSD. Some of the smaller sill-like bodies that occur in the eastern segment of the PSD are disrupted. Many of the larger ones in both parts of the domain, particularly the WLIC, exhibit well preserved primary textures and compositional layering.

U-Pb zircon ages obtained from an anorthositic body in the PSD south of the map area, near Parry Sound, yielded an age of 1350 ± 50 Ma (van Breemen et al. 1986).

Massive to highly deformed rocks of the anorthosite suite also form variably sized tectonic inclusions in: 1) the western and eastern PSD boundary zones; 2) the WLSC, and 3) local mylonitic shear zones within the supracrustal and older metaplutonic gneisses (units 10 to 15) of the interior part of the PSD.

Moderately to highly deformed amphibolite-grade felsic and mafic dikes (units 17 and 18 respectively) were observed to intrude concordantly, and in places crosscut, rocks of the diorite and anorthosite suites.

The WLSC, (unit 19) is a fault-bounded, marble tectonic breccia zone (*see* Figure 4) that separates the western and eastern segments of the PSD. This 0.5 to 1.2 km wide lithodemic structural complex (NACSN 1983) consists of a chaotic melange of isolated clasts, lenses and large blocks of supracrustal and metaplutonic gneiss set in a matrix of mylonitic marble, or more commonly set in a smaller clast-size matrix of marble tectonic breccia similar to unit 10. Some of the larger tectonic inclusions are up to 1 km long and 300 m wide and generally have their long axes parallel to the northly trend of this complex. The protolith of many of the smaller clasts and lenses in this breccia cannot always be identified; however, gabbroic anorthosite (unit 16), diorite (unit 15), mafic to intermediate orthogneiss (unit 13), porphyroblastic garnet amphibolite (unit 12), and interlayered quartzofeldspathic and quartzose gneiss (unit 11) are present.

The western and eastern parts of the PSDBZ (units 20 and 21) are broad zones of ductile, shear-related, high-strain tectonites that truncate adjacent rocks in the Britt and Ahmic domains.

In the map area, the boundary zone rocks (units 20 and 21) comprise a medium to thickly layered and thinly interlayered series of tectonites which are described below:

1. mafic and felsic, to a lesser extent, intermediate gneisses that are massive to foliated and represent in part recrystallized tectonic gneisses
2. irregularly to straight layered mafic and felsic layered tectonic gneiss
3. porphyroclastic gneisses (mylonitic gneisses) containing isolated feldspar and pegmatite clasts in a matrix of mafic and felsic composition

Layering in these tectonic gneisses occurs on both an outcrop and a regional scale. In general, the protolith of these amphibolite-grade gneisses and layered tectonites is unknown; however, it is probable that most of these rocks were derived from the less deformed supracrustal and metaplutonic gneisses exposed in the interior part of the PSD. Within this regionally layered series of gneisses and layered tectonites in the boundary zones are: large, isolated, less deformed tectonic inclusions of anorthosite suite rocks (unit 16); porphyroclastic, plagioclase-rimmed garnet amphibolite (unit 12); and aluminosilicate-bearing mica tectonic gneiss and schist (units 20f and 29e).

U-Pb zircon ages obtained from several sheared granite pegmatites, emplaced during the development of the western PSDBZ to the southwest of the map area, yielded ages of 1120 to 1160 Ma (van Breeman et al. 1986). These ages approximate the time of thrusting which led to the complex pattern of domains and domain boundaries presently exposed in the map area (*see* Figure 4).

Unmetamorphosed granite pegmatite dikes intrude all Middle Proterozoic rocks in the Britt, Parry Sound, and Ahmic domains.

MIDDLE PROTEROZOIC

CENTRAL GNEISS BELT–BRITT DOMAIN

The northwestern corner of the map area, near Wahwashkesh Lake, is underlain by a 2 to 3 km wide segment of the Britt Domain (Davidson et al. 1982, 1985). Most of this 20 to 30 km wide domain (*see* Figure 3) lies west of the study area and has a north to northeast regional trend. This domain consists of a complex of highly deformed quartzofeldspathic (granitoid) gneisses and migmatites of both supracrustal and plutonic origin that was intruded, following an early migmatization event, by a suite of younger granitic plutons (Davidson et al. 1982). All these rocks were subsequently deformed, metamorphosed and, in places, exhibit evidence of another migmatization event. In the map area, the Britt Domain also consists of a series of highly deformed, migmatitic, layered granitoid (quartzofeldspathic) gneisses and, in places, locally migmatitic orthogneisses. The layered granitoid gneisses and orthogneisses in this part of the domain are structurally bounded on both sides by zones of ductile shear. To the west, a prominent mylonite zone occurs in the Britt Domain in the extreme northwestern corner of the map area. This zone separates the layered granitoid gneisses on and to the east of Wahwashkesh Lake from a unit of relatively massive, intermediate in composition orthogneiss that is exposed on Wahwashkesh Lake just beyond the limits of the study area (*see* Figure 3, locality number 1). East of Wahwashkesh Lake, the marginal granitic orthogneisses, and in some places the layered granitoid gneisses of the Britt Domain, are truncated by, and structurally overlain by, a broad (1.8 to 3 km wide) east-dipping zone of ductile shear, referred to as the western PSDBZ (*see* Figures 4, 5 and 7).

Within this faulted-bounded marginal segment of the Britt Domain, the tightly folded amphibolite-grade migmatitic gneisses trend north to northeast and are overturned to the northwest. Units dip moderately to steeply eastward beneath the PSD. The gneisses in this part of the Britt Domain have been subdivided into two main groups: an older group of granitoid gneisses and related migmatites (units 1 and 2); and a younger group of felsic to intermediate intrusive rocks (unit 3). Minor lithologies present include mafic intrusive rocks (unit 4), and gneisses and tectonites (unit 5).

Granitoid Gneisses and Related Migmatites (units 1 and 2)

MIGMATITIC GRANITIC TO GRANODIORITIC GNEISS (unit 1)

Granitoid gneisses of granitic to granodioritic and, in places, tonalitic composition (unit 1) underlie most of the Britt Domain in the map area. These gneisses of indeterminate protolith are thinly to thickly layered, layering being defined by variations in grain size and modal composition. Many of these gneisses are anatectic migmatites as indicated by the presence of quartz + feldspar + biotite ± hornblende mobilizates that form discontinuous lamellae and bands within the rocks. These layered gneisses have been subdivided into two main varieties: pink, migmatitic, granitic to granodioritic gneiss (unit 1a); and grey, migmatitic, granodioritic gneiss (unit 1b). Outcrops containing interlayered units 1a and 1b, (unit 1c) are locally abundant. Many outcrops of pink gneiss (unit 1a) and interlayered pink and grey gneiss (unit 1c) contain minor interlayers, boudins and discontinuous lamellae of mafic gneiss, in places biotite gneiss, and schist of indeterminate protolith (unit 1d). Good exposures of these layered granitoid gneisses and their migmatitic phases can be seen on Wahwashkesh Lake.

Unit 1a The most common type of layered granitoid gneiss present within the Britt Domain. Near Wahwashkesh Lake, the rock is a white to pinkish white weathering, pink to pinkish grey coloured rock of granitic to granodioritic composition. This pink gneiss is generally fine to medium grained, foliated and locally migmatitic. Individual gneiss bands are composed of oligoclase (30 to 50 percent), microcline (15 to 35 percent), quartz (20 to 30 percent), biotite (3 to 10 percent) and hornblende (1 to 5 percent, if present). In thin section, the pink gneiss exhibits a heteroblastic fabric. Xenoblastic oligoclase is locally saussuritized and most grains are untwinned. Microcline occurs as small interstitial xenoblastic grains and most quartz grains show weak undulatory extinction. Light to dark green and locally light brown pleochroic biotite define the foliation. When present, hornblende exhibits a light green to bluish green and locally greenish brown pleochroism. Common accessory minerals are apatite, titanite and magnetite. Interstitial grains of secondary epidote are locally present in hornblende-bearing varieties. Small grains of poikiloblastic garnet were observed in a few samples.

Unit 1b This is the second most common type of layered granitoid gneiss. The rock is a white weathering, light to medium grey rock of granodioritic to locally tonalitic composition. Most grey gneiss units are strongly foliated, migmatitic and tend to be coarser grained (2 to 5 mm) than the pink gneisses. These darker coloured granitoid gneisses also contain less microcline (5 to 15 percent). Textural variants that occur locally include a lineated type containing centimetre-sized potassium feldspar augen in a medium-grained background gneiss of granodioritic composition; and a discontinuously layered variety with mafic-mineral-rich layers on the order of a centimetre thick, interlayered with leucocratic layers.

In thin section, the granodioritic to locally tonalitic gneiss (unit 1b) is texturally similar to the pink gneiss (unit 1a). Light to dark green and reddish brown pleochroic biotite, together with some elongated xenoblastic grains of poikiloblastic hornblende, define the foliation. In places, the brown hornblende is partly recrystallized to secondary blue-green pleochroic hornblende, epidote and green biotite. Interstitial secondary epidote and titanite are conspicuous minor components of these hornblende-bearing grey gneisses. Common accessory minerals are apatite, iron ore and rutile.

BIOTITE GNEISS AND QUARTZOFELDSPATHIC GNEISS (unit 2)

Within the Britt Domain, biotite gneiss and schist (unit 2a), and to a lesser extent, interlayered biotite gneiss and quartzofeldspathic gneiss (unit 2b) form a northeast-trending, 200 m wide band on Wahwashkesh Lake. This thinly to medium-layered (< 3 to 30 cm) gneissic sequence (Photo 1) is possibly of metasedimentary origin. On the north shore of the lake, north of the east-trending fault, the biotite gneiss in this band is commonly migmatitic, as are the surrounding layered granitoid gneisses (unit 1). However, on the south shore of Wahwashkesh Lake, the rocks within and near this same biotite gneiss band are not migmatitic. Elsewhere within the Britt Domain similar-looking but minor units of biotite gneiss, in places biotite schist, form discontinuous layers and lenses (up to 0.5 m wide) in the abundant layered granitoid gneiss (unit 1) of this domain. The protolith of these minor biotite gneiss and schist occurrences is uncertain. These minor occurrences in the layered granitoid gneisses, with or without other mafic gneiss interlayers, is indicated on the map face (Map 2540, back pocket) as unit 1d.

Biotite Gneiss (unit 2a) This is the predominant rock in the locally migmatitic biotite gneiss band on Wahwashkesh Lake. The gneiss is a medium grey and greenish grey weathering, medium to dark grey, fine- to medium-grained rock. Individual units are massive to thinly laminated (less than 0.5 cm thick). Schistose bands, which in places are interlayers, occur locally. Biotite gneiss is composed of variable amounts of feldspar and quartz and generally contains between 10 to 30 percent biotite, or in places biotite occurs with subordinate amounts of hornblende. Biotite schist varieties are generally coarser grained, contain up to 50 percent biotite(± hornblende) and in places contain garnet porphyroblasts.

Thin section examination reveals that biotite gneiss is heteroblastic; locally biotite schist lamellae have a le-

Photo 1. Thin- to medium-layered biotite gneiss containing minor thin interlayers of quartzofeldspathic gneiss; southwest shore of Wahwashkesh Lake near western map boundary, McKenzie Township.

pidoblastic texture. The most common mineral assemblage in the gneiss is plagioclase + quartz + microcline + biotite + epidote + titanite ± hornblende. Common accessory minerals are apatite, rutile and magnetite. Plagioclase is generally untwinned and partly saussuritized. Xenoblastic quartz exhibits a weak to moderate undulatory extinction; however, a few highly strained quartz ribbons were noted in some samples. Microcline generally forms small interstitial xenoblastic grains; however, in one thin section anhedral porphyroblasts of untwinned potassium feldspar rimmed by "mortar" grains of microcline occur in a fine-grained groundmass of xenoblastic plagioclase, microcline and quartz. Ragged laths of light to dark brown and locally reddish brown biotite, and in places elongated grains and aggregates of blue-green pleochroic hornblende, define the foliation. Epidote, the least abundant major component of this gneiss, forms xenoblastic to subidioblastic interstitial grains or inclusions in biotite. Epidote and titanite are much less abundant in the subordinate hornblende-rich varieties of biotite gneiss than in the more abundant biotite gneiss. In these latter-mentioned gneisses, the hornblende content may locally exceed that of biotite, and the light to dark brown, xenoblastic to subidioblastic hornblende is partly recrystallized to secondary blue-green pleochroic hornblende.

Quartzofeldspathic Gneiss (unit 2b) This rock is a subordinate lithology in the biotite gneiss band on Wahwashkesh Lake. The rock is a pinkish white and light grey weathering, fine- to medium-grained pink to pinkish grey rock. Individual units are massive to foliated and in some places show compositional and textural layering on a centimetre scale. The rock consists of quartz and feldspar with 1 to 5 percent biotite, in places minor hornblende and garnet. In thin section, fine- to medium-grained quartzofeldspathic gneiss has a heteroblastic texture. The most common mineral assemblage in this gneiss is plagioclase + microcline + quartz + biotite + epidote. Common accessory minerals are titanite, apatite and iron ore. Plagioclase is generally untwinned and partly saussuritized; quartz grains show undulatory extinction. A foliation is defined by ragged laths of light to dark green and locally light brown biotite. Hornblende, where present, exhibits a light to dark brown and in places a blue-green pleochroism.

Textural variants of unit 2b include a "coarser grained" type, in which the hornblende content is commonly higher (up to 10 percent). Feldspar locally forms porphyroblasts up to 5 mm in diameter. These coarser grained quartzofeldspathic gneisses within this biotite gneiss band are somewhat similar in texture and composition to the adjacent pink and pinkish grey, granitoid gneisses of unit 1a. Boundaries between units 2 and 1 shown on Map 2540 (back pocket) therefore are somewhat gradational, and hence are equivocal. In other parts of the Britt Domain, similar-looking coarser grained quartzofeldspathic gneisses of indeterminate protolith form thinly to medium layered exposures in the more thickly layered and locally migmatitic granitoid gneisses of unit 1. In the absence of abundant, continuous interlayers of biotite gneiss (unit 2a), these quartzofeldspathic gneisses were not assigned to unit 2, but are arbitrarily included on Map 2540 (back pocket) within units of pink and interlayered pink and grey granitoid gneiss (units 1a, 1c and 1d).

Felsic to Intermediate Intrusive Rocks (Orthogneisses) (unit 3)

Metamorphosed felsic to intermediate plutonic rocks (unit 3) in the Britt Domain consist of massive to foliated and lineated, in places layered and migmatitic, units of monzogranite and granodiorite. These relatively homogeneous orthogneisses form an apparently continuous, 300 to 900 m wide marginal band within the Britt Domain along and to the west of the western PSDBZ (*see* Figures 3 and 4). Contacts with the adjacent migmatitic layered granitoid gneisses (unit 1) are semiconcordant and relatively sharp to gradational over a few metres. This marginal orthogneiss band appears to represent a deformed, flattened pluton, or possibly several closely spaced, *en échelon*, deformed plutons that intruded rocks of the Britt Domain prior to overthrusting of the PSD. Toward the eastern contact of this marginal orthogneiss with the PSDBZ, the orthogneiss commonly becomes layered, in places migmatitic, exhibits a general grain size reduction, and generally has flattened, elongated quartz grains. Minor screens and lenses of unit 1 were locally observed in the orthogneiss, at its eastern contact with unit 1.

To the southwest of the map area, on Highway 69 north of Parry Sound, (*see* Figure 3, locality 2) a strikingly similar marginal granitic orthogneiss in the Britt Domain yielded a Rb-Sr isochron age of 1330 Ma (Connare and McNutt 1985) and a U-Pb zircon age of 1346^{+69}_{-39} Ma (van Breemen et al. 1986). In the Highway 69 area, this marginal orthogneiss is referred to as the Nobel gneiss.

Unit 3a This rock is a massive to foliated, in places lineated, pinkish grey hornblende-biotite monzogranite with local light to medium grey phases of granodiorite, and in places, phases of pink biotite monzogranite. These orthogneisses weather white to light pinkish grey, and are generally medium to coarse grained (1 to 5 mm).

Thin section examination reveals that these rocks have a heteroblastic texture and are composed of oligoclase (30 to 65 percent), microcline (20 to 50 percent), quartz (20 to 30 percent), and combined biotite and hornblende (3 to 15 percent). Common accessory minerals are epidote, titanite, apatite and magnetite. Partly saussuritized, xenoblastic plagioclase generally shows albite twinning, and xenoblastic quartz displays strong undulatory extinction. Ragged laths of light to dark green and light brown pleochroic biotite, in places with elongated quartz grains, define a foliation. Poikiloblastic hornblende varies from light to dark brown and in many places is recrystallized to secondary blue-green pleochroic hornblende containing aggregates of reddish brown biotite, epidote and titanite. Secondary xenoblastic to subidioblastic epidote and titanite also occur as small interstitial grains. Textural variants of unit 3a include the following:

1. Layered, and in places migmatitic, fine- to medium-grained monzogranite to granodiorite orthogneiss (unit 3b) generally occurs near the regional contacts of the marginal granitic orthogneiss. Flattened, elongated quartz grains (ribbons) commonly define a strong lineation.
2. Mafic-mineral-rich phases of massive to layered monzogranite to granodioritic orthogneiss (unit 3c), locally containing abundant mafic xenoliths, are generally localized near the eastern regional contact of the orthogneiss. These granitic orthogneisses generally contain more hornblende, and are closely associated with screens and discontinuous layers of mafic gneiss (in places up to 3 m wide) in the orthogneiss. Porphyroblasts of garnet are locally present in both the melanocratic and leucocratic interlayers in these "hybrid gneisses". Also included in unit 3c are sheared and protomylonitic phases of monzogranite to granodiorite orthogneiss. These pinkish grey to medium grey, fine- to medium-grained tectonites form minor, discontinuous zones (up to 30 cm wide) in the orthogneiss and "hybrid" orthogneiss near its eastern structural contact with the western PSDBZ.

Chemical analyses for two specimens of the Britt Domain granitic orthogneiss (unit 3a) are given in Table 2 as well as three specimens of the similar-looking granitic orthogneiss present in the Ahmic Domain (described later in text).

Mafic Intrusive Rocks (unit 4)

Unit 4 consists of a relatively homogeneous, massive to foliated mafic rock of gabbroic composition. This unit, which is believed to be a mafic orthogneiss, forms concordant, boudinaged to highly disrupted dikes or layers that in places are isolated boudins. These dikes, boudins, or layers range from 0.5 to 4 m wide (Photo 2) and intrude the gneisses of the Britt Domain in the following areas:

1. On the southwest shore of Wahwashkesh Lake, near the western margin of the area, several disrupted mafic dikes or layers, in places mafic boudin trains related to the dikes, occur in a sequence of thinly to medium layered biotite gneiss (unit 2).
2. In the same region, on an adjacent island in the lake, a train of isolated mafic boudins occurs in more thickly layered units of pink granitoid gneiss (unit 1a).
3. Farther north of this island, on the north shore of Wahwashkesh Lake, tightly folded pink granitoid gneiss contains several closely spaced trains of isolated mafic boudins.
4. To the south of Wahwashkesh Lake, on the secondary access road to this lake, a 0.5 m wide, concordant to locally discordant mafic dike intrudes the marginal granitic orthogneiss (unit 3).

TABLE 2. CHEMICAL ANALYSES OF THE GRANITIC ORTHOGNEISS IN THE BRITT AND AHMIC DOMAINS (units 3 and 8 respectively), WHITESTONE LAKE AREA.
For sample locations see Figure 5.

	BRITT DOMAIN			AHMIC DOMAIN		
Sample Number	86EGB-1002	86EGB0-1003	(A)*	86EGB-1021	86EGB-1022	86EGB-1041
SiO_2 (wt%)	71.50	64.40	69.89	70.40	71.90	70.00
Al_2O_3	13.40	18.90	14.55	3.60	14.80	13.90
Fe_2O_3**	3.66	2.87	3.81	4.64	21.90	4.84
MgO	0.53	0.76	0.87	0.15	0.65	0.70
CaO	1.63	4.13	1.60	1.77	1.91	2.54
Na_2O	2.29	5.25	3.06	1.73	3.32	3.35
K_2O	5.01	1.31	5.05	5.97	4.53	2.50
TiO_2	0.56	0.41	0.40	0.48	0.31	0.66
P_2O_5	0.11	0.16	0.09	0.09	0.06	0.17
MnO	0.07	0.04	0.50	0.12	0.05	0.09
CO_2	0.14	0.60	0.10	0.18	0.11	
S	0.02	0.07	0.01	–	0.01	0.03
H_2O^+	–	–	–	–	–	–
H_2O^-	–	–	–	–	–	
LOI	0.50	0.70	–	0.20	0.3	0.30
total	99.00	99.00	–	99.20	100.00	99.00
TRACE ELEMENTS						
Co (ppm)	10	6	–	6	11	10
Cr	< 10	< 10	–	< 10	12	< 10
Cu	12	12	–	12	9	15
Ni	< 5	< 5	–	< 5	< 5	< 5
Pb	25	< 10	16.8	18	17	17
Zn	69	50	–	89	41	73
Nb	13	< 5	14.6	16	76	12
Rb	175	16	99.4	161	154	85
Sr	140	1081	132.6	163	251	231
Y	78	15	39.6	97	28	73
Zr	295	214	–	437	166	317
Th	17	< 10	–	< 10	20	14
Ba	–	–	887.5	–	–	–
Ce	–	–	95.3	–	–	–
Ld	–	–	49.1	–	–	–
Nd	–	–	45.4	–	–	–

* *Sample Number (A) represents average of 15 analyses of the marginal granitic orthogneiss (i.e., Noble Gneiss) in the Britt Domain, on Highway 69 north of Parry Sound, after Connare and McNutt (1985). Sample locations are near Locality No.2, Figure 3 (this report).*
** *total iron as Fe_2O_3*

Contacts of the narrower dikes are generally sharp; however, contacts of the larger dikes or related boudins vary from sharp to locally gradational over widths as great as 20 cm. Gradational contact phases consist of coarser grained recrystallized and locally metasomatized gneiss of dioritic to quartz dioritic composition. In places where the contact of a larger dike (up to 4 m wide) appears to be sharp, the adjacent wall rock gneiss commonly contains abundant mafic schlieren and concordant to discordant xenoliths of mafic orthogneiss (*see* Photo 2). Granitoid mobilizate emanating from the adjacent granitoid gneiss locally crosscuts both the mafic xenoliths as well as the tectonically modified contact of the mafic dike.

The mafic orthogneiss has been subdivided into two phases: amphibolite (unit 4a) and gabbro orthogneiss (unit 4b). Narrow dikes (less than 0.5 m wide) consist mainly of the finer grained amphibolite phase. Dikes and isolated boudins wider than 0.5 m consist of massive to layered gabbro orthogneiss with local contact hybrid phases; in places, the central zones of the dikes consist of gabbro orthogneiss that grades outward into finer grained amphibolite.

Amphibolite (unit 4a) This rock is generally a massive to foliated, fine- to medium-grained (0.1 to 2 mm), dark grey rock that weathers dark greenish grey. The main mineral phases are hornblende and plagioclase with minor biotite. Elongate laths of hornblende and, in places, elongate aggregates of plagioclase define the foliation. Thin section examination reveals that this rock has a heteroblastic texture. The mineralogy consists of dark green to dark brown and locally reddish brown pleochroic hornblende (50 to 60 percent), locally saussuritized xenoblastic plagioclase (40 to 50 percent), and light green to brown pleochroic biotite (1 to 5 percent). Minor phases are epidote, quartz, chlorite, magnetite, titanite

Photo 2. Disrupted contact between amphibolite dikes (unit 4), and non-migmatitic, massive to layered granitoid gneiss, Britt Domain; southwest shore and islands on Wahwashkesh Lake, near western boundary of map area, McKenzie Township.

TABLE 3. CHEMICAL ANALYSES OF MAFIC INTRUSIVE ROCKS IN THE BRITT AND AHMIC DOMAINS (units 4 and 9 respectively), WHITESTONE LAKE AREA.
For Sample location see Figure 5.

	BRITT DOMAIN	AHMIC DOMAIN	
Sample Number	**86EGB–1004**	**86EGB–1023**	**86EGB–1024**
SiO_2 (wt%)	42.70	48.40	48.30
Al_2O_3	14.10	13.60	14.00
Fe_2O_3*	17.40	15.30	14.80
MgO	6.40	5.85	5.10
CaO	8.66	9.65	8.65
Na_2O	2.33	2.16	2.22
K_2O	1.32	0.82	1.92
TiO_2	3.44	2.01	1.98
P_2O_5	0.53	0.28	0.30
MnO	0.25	0.21	0.31
CO_2	0.11	0.21	0.11
S	0.24	0.09	0.02
LOI	1.00	0.50	0.70
total	98.20	98.80	98.40
TRACE ELEMENTS			
Co (ppm)	57	55	54
Cr	85	114	108
Cu	177	86	9
Ni	59	50	52
Pb	< 10	< 10	< 10
Zn	158	147	250
Nb	11	< 5	< 5
Rb	32	21	56
Sr	255	242	254
Y	49	46	51
Zr	196	158	170
Th	< 10	< 10	< 10

* *total iron as Fe_2O_3*

and apatite. Locally, the biotite is altered to chlorite, epidote and quartz.

Gabbro Orthogneiss (unit 4b) This unit is generally a foliated to layered, in places massive, medium- to coarse-grained (1 to 5 mm), dark greenish grey to grey rock that weathers dark green or mottled white and greenish grey. Elongate laths of hornblende and plagioclase aggregates define a foliation. A relict hypidiomorphic inequigranular to subophitic texture is locally preserved in the more massive-looking central part of a large dike exposed along the southwest shore of Wahwashkesh Lake. In thin section, the gabbro orthogneiss is texturally and compositionally very similar to the amphibolite (unit 4a); however, in this coarser-grained phase of the mafic orthogneiss, secondary aggregates of light to dark brown pleochroic hornblende, epidote and quartz are pseudomorphic after clinopyroxene. Anhedral, poikiloblastic garnet is also present in some specimens.

Mineral assemblages present in rocks of unit 4 indicate that they have been subjected to middle to upper amphibolite facies metamorphism. Later, these rocks were locally retrograded to upper greenschist to amphibolite facies, possibly during late stage fracturing and faulting.

The results of a chemical analysis for one specimen (86EGB-1004) of mafic orthogneiss in the Britt Domain is given in Table 3. Also given in this table, for comparative purposes, are chemical analyses of two specimens of similar looking mafic orthogneiss from the Ahmic Domain.

Gneisses and Tectonites (unit 5)

Unit 5 is a series of highly deformed, in places sheared, gneisses and tectonites that occur in the extreme northwestern corner of the map area. These rocks occupy a 150 to 200 m wide zone of ductile shear within the Britt Domain. In the study area, this internal tectonite zone separates the migmatitic, layered granitoid gneisses (units 1 and 2) exposed on Wahwashkesh Lake from a major unit of relatively massive granodioritic to tonalitic orthogneiss that is exposed to the west, just beyond the map area. The distribution of this intermediate orthogneiss outside the study area is shown as locality number 1, Figure 3. In the map area, the boundaries of this internal tectonite zone are gradational over widths of as much as 15 m. The tectonic gneisses and layered tectonites within this deformation zone are in part derived from both the layered granitoid gneisses and intermediate orthogneisses within the Britt Domain.

Unit 5a occurs mainly in the western part of this tectonite zone. It consists mainly of irregularly layered, in places sheared and porphyroclastic, gneisses of granodioritic to tonalitic composition. These gneisses are pinkish grey to medium grey, vary from fine to medium grained and are recrystallized tectonites. Locally interlayered with these pink to grey tectonites are minor discontinuous, in places folded, sheared and porphyroclastic units of fine- to medium-grained mafic gneiss of indeterminate protolith (Photo 3).

Unit 5b is found mainly in the eastern part of the tectonite zone. Here, the tectonites consist mainly of a series of very thinly layered, in places laminated, protomylonitic to mylonitic gneisses having a granitic to granodioritic composition. These layered mylonitic gneisses are fine to locally medium grained and vary from layer to layer from pink, pinkish grey to medium and dark grey. Flow folds in these mylonitic outcrops are common, and, in places, free-floating internally folded lenses of mafic gneiss are present in the mylonitic gneiss.

CENTRAL GNEISS BELT–AHMIC DOMAIN (units 6 to 9)

The east-central boundary of the map area is underlain by the western part of the Ahmic Domain (Davidson et al. 1982, 1985) (*see* Figure 3). In the map area, the Ahmic Domain forms a 5 km wide, westerly tilted, dome-like structure (Figure 4). At its fault-bounded southwestern, western and northern margins, amphibolite-grade gneisses dip moderately to steeply beneath the adjacent tectonites of the 1 to 2.5 km wide eastern PSDBZ. The trend of the mafic to felsic tectonites within the PSDBZ parallels that of the Ahmic Domain granitoid gneisses to the east; however, to the west of the PSDBZ, the strikes and dips of the metaplutonic gneisses and paragneisses within the nearby interior part of the PSD are highly varied.

The gneisses in the Ahmic Domain are strikingly similar to those observed in the Britt Domain near Wahwashkesh Lake. The gneisses of the Ahmic Domain in the area have been similarly divided into two main groups; an older group of granitoid gneisses and related migmatites (units 6 and 7), and a younger group of felsic to intermediate intrusive rocks (unit 8). Mafic intrusive rocks (unit 9) are a minor lithology.

Because of the lithologic similarity of the main rock types in the Ahmic and Britt domains and the fact that gneisses of the Ahmic Domain dip westerly beneath the PSD, Davidson and his co-workers regard the Ahmic Domain as a subdomain of the easterly dipping Britt Domain (Davidson et al. 1982). Furthermore, these authors suggest that the two domains might be connected at depth beneath the PSD. Since further detailed work is needed to determine the structural relationship between the Britt and Ahmic domains, major rock types in

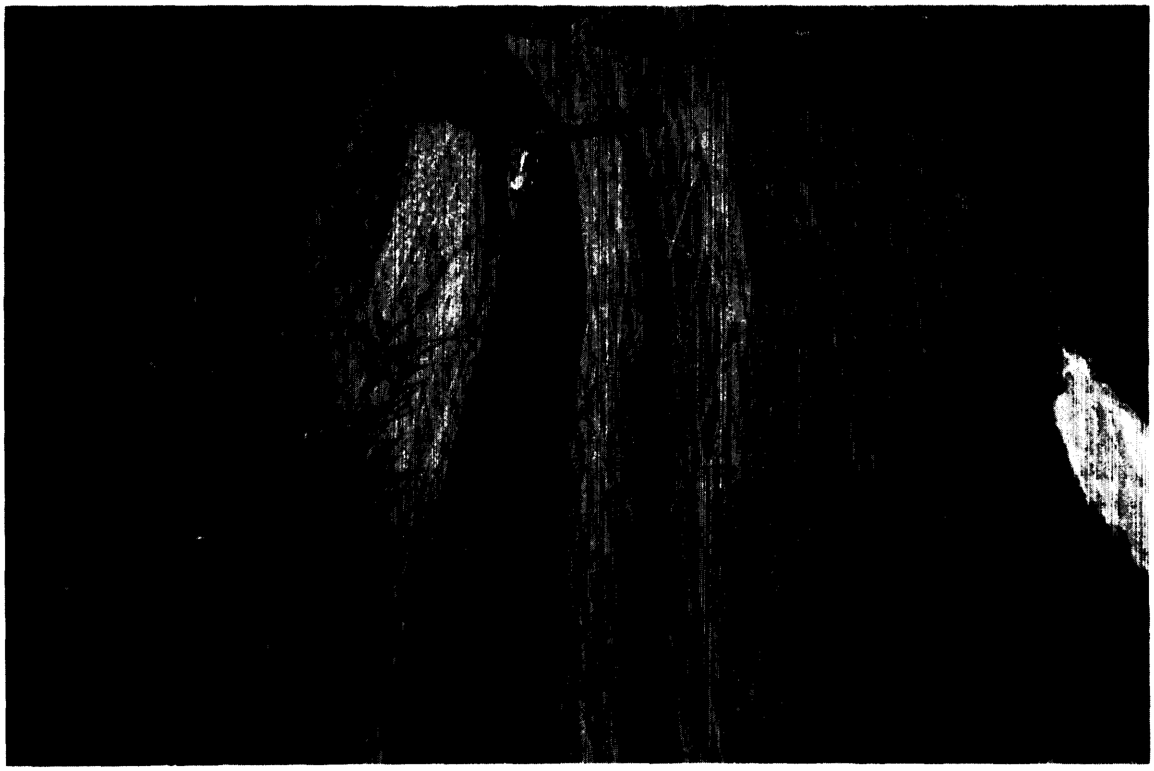


***Photo 3.** Centimetre-scale shear zones in interlayered, fine-grained granitic to granodioritic mylonite gneiss and mafic tectonic gneiss; Wahwashkesh Lake, extreme northwestern corner of map area, McKenzie Township.*

each domain (units 1 to 5 and 6 to 9 respectively), although similar, are shown separately on Map 2540 (back pocket). The major and minor lithologies in the Ahmic Domain are described only briefly in the following text.

Granitoid Gneisses and Related Migmatites (units 6 and 7)

MIGMATITIC GRANITIC TO GRANODIORITIC GNEISS (unit 6)

The migmatitic, layered, pink and grey granitoid gneisses of granitic to granodioritic composition (units 6a to 6c) that form the predominant lithology in the Ahmic Domain are almost indistinguishable from the layered granitoid gneisses previously described in the Britt Domain (units 1a to 1d). Therefore, the rocks of unit 6 are not discussed in detail here and the reader is referred to the description of the analogous rock types (unit 1) in the Britt Domain.

Quartzofeldspathic Gneiss and Biotite Gneiss (unit 7)

In contrast to the Britt Domain, the dominant series of migmatitic, layered granitoid gneisses (unit 6) in the Ahmic Domain contains several large distinctive bands, in places smaller lenses, of quartzofeldspathic gneiss (unit 7) that are probably of metasedimentary origin. Within these bands are minor, continuous to discontinuous interlayers of biotite gneiss and schist. Two large bands of this quartzofeldspathic unit, one 200 m and the other 440 m wide respectively, are exposed in several roadcut outcrops on Highway 124 to the east of the village of Ahmic Harbour. Contacts of the quartzofeldspathic gneisses (unit 7) with the granitoid gneisses of unit 6 range from relatively sharp to zones (up to 5 m wide) in which rocks of units 6 and 7 are interlayered, or possibly infolded with one another (unit 7c).

Leucocratic Quartzofeldspathic Gneiss (unit 7a) This unit is the dominant lithology and is generally a massive to weakly foliated, fine to medium grained, white to pinkish white weathering, pink to salmon-pink coloured rock. This relatively homogeneous gneiss consists mainly of equigranular feldspar and quartz (25 to 40 percent) with minor biotite (less than 1 percent), is commonly hematite-stained, and contains magnetite (in places up to 1 percent) and ubiquitous accessory garnet. Locally, some outcrops exhibit a thin, discontinuous layering that is defined by grain-size variation and by variations in the degree of hematite-staining. In some of the outcrops exposed along Highway 124, a pseudo-layering is imparted to the massive-looking quartzofeldspathic gneiss by swarms of thin, late tectonic granite pegmatite dikes (unit 22).

In thin sections of quartzofeldspathic gneiss, the texture ranges from heteroblastic to locally homeoblastic. The most common mineral assemblage is plagioclase + quartz + microcline + biotite ± garnet and muscovite. Common accessory minerals are hematite, magnetite, titanite and apatite. Plagioclase exhibits Albite and combined Albite-Carlsbad twinning and is partly saussuritized. Microcline is locally sericitized and quartz displaces a weak undulatory extinction. Dark green to light brown pleochroic biotite generally forms small, interstitial laths; where it is more abundant, biotite defines a weak foliation. Muscovite occurs as secondary interstitial laths and aggregates or interleafed inclusions in biotite laths.

Unit 7b This unit comprises outcrops of quartzofeldspathic gneiss (unit 7a), containing continuous to discontinuous, thin- to medium-layered units of biotite gneiss and schist that are texturally and compositionally similar to the Britt Domain biotite gneiss (unit 2c) described earlier. Minor interlayered units, and in places lenses, of mafic gneiss of indeterminate protolith are locally present. In these layered outcrops, the predominant quartzofeldspathic gneiss (unit 7a) may be locally migmatitic. Similarly, in outcrops of unit 7c (i.e., interlayered units 7 and 6) all the rock types may be locally migmatitic.

Felsic to Intermediate Intrusive Rocks (unit 8)

Relatively homogeneous, pinkish grey to light grey, monzogranitic to granodioritic orthogneiss (unit 8) in the Ahmic Domain is texturally and compositionally similar to the granitic orthogneiss (unit 3) of the Britt Domain. As in the Britt Domain, the granitic orthogneiss in the Ahmic Domain (unit 8) forms a 100 to 600 m wide unit along most of the margin of the domain, immediately east of the eastern PSDBZ (*see* Figures 3 and 4). A separate lens or megaboudin of this orthogneiss occurs within the layered granitoid gneisses near the northeastern margin of the Ahmic Domain.

Textural variants of the more common massive to foliated and lineated medium- to coarse-grained phase (unit 8a) include the following: 1) a finer grained and layered, in places migmatitic phase (unit 8b), present near the margins of this deformed pluton, or as a flattened series of *en échelon* plutons; 2) units 8a and 8b, locally containing minor lenses and discontinuous layers of mafic gneiss (unit 8c) of indeterminate protolith; and 3) sheared, in places protomylonitic, phases (unit 8d) of the orthogneiss that occur in the contact zone of the deformed pluton exposed along Highway 124, near the village of Ahmic Harbour.

In this same highway, a cross section of the marginal orthogneiss, as well as along secondary road outcrops in the village of Ahmic Harbour to the south, a large (100 to 120 m wide) screen of mafic gneiss is exposed. Contacts between this mafic screen and the surrounding granitic orthogneiss were not observed. This mafic screen of thinly layered, fine to medium-grained hornblende -biotite gneiss, in places migmatitic gneiss, is interpreted to be a tectonic inclusion (unit 20) of the PSD. Its present position within the deformed marginal orthogneiss of the Ahmic Domain possibly resulted from the ductile thrusting event that juxtaposed these two domains.

The results of chemical analysis for three specimens of the Ahmic Domain marginal granitic orthogneiss (unit 8), as well as two specimens of similar-looking marginal orthogneiss (unit 3) from the Britt Domain are given in Table 2.

Mafic Intrusive Rocks (unit 9)

Massive to foliated amphibolite (unit 9) is present as a series of narrow, concordant, mafic dikes or layers in the layered granitoid gneisses (unit 6) and quartzofeldspathic gneisses (unit 7) of the Ahmic Domain. Individual dikes or layers range from 0.25 to 1 m in width and are fine to medium grained. These rocks are structurally conformable with the enclosing gneisses and were deformed with them. Contacts with the pink, leucocratic quartzofeldspathic gneiss are generally sharp to locally schistose. Contacts with the layered granitoid gneisses vary from sharp to gradational over distances as great as 10 cm. In these places, the contact zone, or contaminated marginal phase of the amphibolite, is coarser grained than the core of the dike and is massive to schistose. Excellent exposures of these amphibolite dikes or layers can be seen in several road outcrops of granitoid and quartzofeldspathic gneiss (units 6 and 7) along Highway 124 north of Ahmic Lake. North of these localities, near Love Lake, a concordant layer of similar-looking, homogeneous amphibolite occurs in the marginal granitic orthogneiss (unit 8). This mafic rock is tentatively assigned to unit 9; however, it may represent a tectonic inclusion of indeterminate protolith. Unit 9 is subdivided into three subunits; these are described below.

Amphibolite (unit 9a) Amphibolite is the most common subunit. It is generally a massive to foliated, fine- to medium-grained, dark grey to black rock that consists mainly of hornblende and plagioclase with minor biotite. Thin section examination reveals that the texture is heteroblastic and that the most common mineral assemblage is hornblende + plagioclase + garnet + magnetite + biotite. Common accessory minerals are titanite and apatite. Xenoblastic plagioclase is generally untwinned and is locally saussuritized. Garnet forms poikiloblasts in hornblende. Light to dark brown pleochroic hornblende and brown to reddish brown pleochroic biotite define a foliation.

Hybrid Mafic Orthogneiss (unit 9b) Hybrid mafic orthogneiss, which is of quartz dioritic to dioritic composition, is present along the margins of the dikes. In places, this rock forms some mafic dikes or layers, and probably developed during partial melting and assimilation of the granitoid gneisses. This hybrid phase is a medium- to coarse-grained, medium to dark grey and mottled white rock. Texturally, it varies from layered to locally schistose near the contact with a dike, to a more massive-looking hybrid phase in the central parts of an altered amphibolite dike. Plagioclase and hornblende are still the main mineral components; however, biotite and quartz are more abundant than in unit 9a. Thin section examination reveals that the texture ranges from heteroblastic to nematoblastic. In one specimen, the mineral assemblage is plagioclase + biotite + hornblende + microcline + quartz + titanite + epidote. Common accessory minerals are magnetite and apatite. Xenoblastic plagioclase is locally twinned and in places is myrmekitic adjacent to interstitial microcline. Dark brown hornblende is locally recrystallized to secondary blue-green pleochroic hornblende, and light brown to dark green pleochroic biotite commonly contains xenoblastic inclusions of epidote and titanite.

Unit 9c This unit represents sheared, commonly biotite-rich schistose varieties of the finer grained amphibolite (unit 9a) and the coarser grained hybrid gneiss (unit 9b).

The results of chemical analysis for two specimens of the Ahmic Domain mafic orthogneiss are given in Table 3.

DISCUSSION OF METAMORPHIC MINERAL ASSEMBLAGES IN BRITT AND AHMIC DOMAINS

The presence of green-brown hornblende, reddish brown biotite, garnet and migmatitic phases in the granitoid gneisses and orthogneisses is taken to indicate attainment of prograde upper amphibolite facies. However, the presence of brown hornblende partly recrystallized to secondary blue-green hornblende or aggregates of blue-green hornblende, green biotite and epidote ± titanite indicates a second, younger, lower grade retrograde metamorphism of lower to middle amphibolite facies rank that is probably related to the overthrusting of the Parry Sound Domain onto the Britt Domain.

A third, late stage metamorphic alteration in the layered granitoid gneisses is localized within easterly trending, narrow (1 to 8 cm wide), brittle fracture shear zones that cut these gneisses along the shore of the northeast arm of Wahwashkesh Lake. In these sheared rocks, biotite is altered to chlorite. This late metamorphic alteration is probably related to the late east-trending normal faults.

CENTRAL GNEISS BELT–PARRY SOUND DOMAIN (PSD) (units 10 to 21)

The northern part of the PSD underlies the central two-thirds of the map area (*see* Figures 3 and 4). This lithotectonic subdivision, rich in mafic rocks, forming part of the northwestern Central Gneiss Belt (Davidson et al. 1982, 1985), is bounded along its margins by wide zones of shear-related high-strain tectonites. In the map area, the western PSDBZ separates the PSD from the Britt Domain to the west, and likewise the eastern PSDBZ separates the PSD from the Ahmic Domain to the east. The tectonites (units 20 and 21) within these ductile shear zones are described later in the text. In the interior part of the PSD, the moderately to highly deformed, in places mylonitic and disrupted, older gneisses were derived from a variety of supracrustal and plutonic rocks. These older gneisses have been subdivided into five main groups which in order of interpreted decreasing age are:

1. metasedimentary gneisses (units 10 and 11)
2. porphyroblastic mafic orthogneiss (unit 12)
3. early tectonic mafic to felsic metaplutonic rocks (units 13 and 14)

4. early to syntectonic mafic to intermediate metaplutonic rocks (units 15 and 16)
5. syntectonic to late tectonic mafic and felsic intrusive rocks (units 18 and 17)

The interior part of the the PSD can be subdivided into western and eastern segments by a marble breccia zone referred to by the author as the Whitestone Lake Structural Complex (WLSC) (unit 19) (*see* Figures 4, 5 and 7). The distribution, form and fabric of the older four main lithologic groups varies markedly on opposite sides of this lithodemic structural complex. The WLSC is considered by the author to be part of the PSD.

Metasedimentary Rocks and Gneisses (units 10 and 11)

Metasedimentary rocks, consisting of carbonate and clastic siliceous metasedimentary rocks (units 10 and 11 respectively), are the interpreted oldest rocks in the PSD. Together these rocks compose at least 30 percent of the gneisses in the interior part of this domain. Clastic siliceous metasedimentary rocks (unit 11) occur throughout most of the Parry Sound Domain. The carbonate metasedimentary rocks, most of which are marble breccias, however, are restricted in the map area to the eastern segment of the PSD and the WLSC. Although the carbonate metasedimentary rocks in each of these two structural subdivisions of the PSD are part of the same series, the author has subdivided (Map 2540, back pocket) them on the basis of their regional structural setting into two major lithologic units. Unit 10 represents carbonate metasedimentary rocks in the eastern part of the PSD. Unit 19 represents similar, but structurally more coherent, carbonate metasedimentary units in the WLSC (*see* Figures 4 and 5). Unit 19 is described later in the text. In the following description of the carbonate metasedimentary rocks of unit 10, the mineralogy and many of the local textural features of these marbles also apply in general to the individual marble exposures of unit 19.

CARBONATE METASEDIMENTARY ROCKS (UNIT 10) (MARBLE AND CALC-SILICATE GNEISS)

Distribution and Contact Relationships

Carbonate metasedimentary rocks in the eastern segment of the PSD (units 10a to 10d) consist mainly of marble tectonic breccia and locally, massive to gneissic layered marble. These rocks are poorly exposed and generally form small, scattered outcrops in the drift-covered low areas and creek valleys located between higher, more resistant, north-trending ridges of quartzofeldspathic, mafic and granitic gneiss. Marble is best exposed along lakeshores, river courses and in roadcuts along Highways 124 and 520. Marble breccia generally forms continuous to discontinuous, commonly boudinaged bands or large lenses ranging from 20 to 400 m in width in the clastic siliceous metasedimentary gneiss (unit 11) to the east of the WLSC. Near the contacts of these marble bands, which are shown approximately on Map 2540 (back pocket). Marble also forms thin, in places folded, layers 2 to 30 cm wide in the adjacent clastic siliceous metasedimentary rocks. In the eastern segment of the Parry Sound Domain, marble also forms discontinuous bands, and in places, megaboudins ranging up to 200 m wide and 2 km long that are interlayered with sill-like bodies of younger granitic orthogneiss (unit 14), dioritic orthogneiss (unit 15) or anorthositic orthogneiss (unit 16). Contacts with the adjacent orthogneisses, although relatively sharp, are tectonically modified. This latter type of marble occurrences are mainly concentrated in the metasedimentary gneiss-rich western part of the eastern PSD.

Petrology and Lithologic Subdivisions

The matrix of the tectonic breccias and the massive-looking marbles consists mainly of medium- to coarse-grained, white to grey, locally pink and pale green calcite. Disseminated silicate minerals, which generally constitute less than 10 percent of the breccia matrix or massive marble, are principally diopside, chondrodite, phlogopite and graphite. Hornblende, biotite and garnet are locally present in mafic inclusion-bearing breccias. In thin sections of relatively undeformed marble, the mineral assemblage is calcite + serpentinized olivine + spinel ± magnetite. These mineral assemblages indicate that the marble originally attained upper amphibolite to granulite facies metamorphic conditions, but during subsequent tectonism was retrograded to lower amphibolite facies.

Subdivisions of the marbles in the eastern PSD are based primarily on texture, i.e., brecciated, nonbrecciated, or mylonitic varieties, and secondly on the dominant type of fragment (or inclusion) present in the breccias. In the eastern PSD, the marble tectonic breccias characteristically contain 10 to 40 percent, round to subround, fist to metre-sized blocks and lenticular fragments of massive to layered marbles, calc-silicate gneiss, amphibolite, siliceous clastic metasedimentary rocks and locally a variety of mafic gneiss and granitoids (Photo 4). Subdivisions of the marbles, which are listed in reverse order of abundance are:

Massive to Layered Calcitic Marble (unit 10a) This rock is the least abundant textural variety. Local areas of the outcrop may be brecciated, in places mylonitic. The dominant fragment type is generally marble or mafic-mineral-rich metasedimentary gneiss where such interlayers are present in the less deformed part of the outcrop (unit 10b). The best examples of this rock type occur on Highway 124 east of Robertson Lake, and on Highway 520 south of Maple Island, near the eastern boundary of the WLSC.

Unit 10b This unit is a massive to layered calcitic marble similar to unit 10a but having locally abundant interlayers of calc-silicate gneiss (diopside + quartz ± hornblende), para-amphibolite, and in places biotite gneiss and schist. Relatively undeformed units of these lithologies are exposed in the first marble band exposed on Highway 124, east of Robertson Lake.

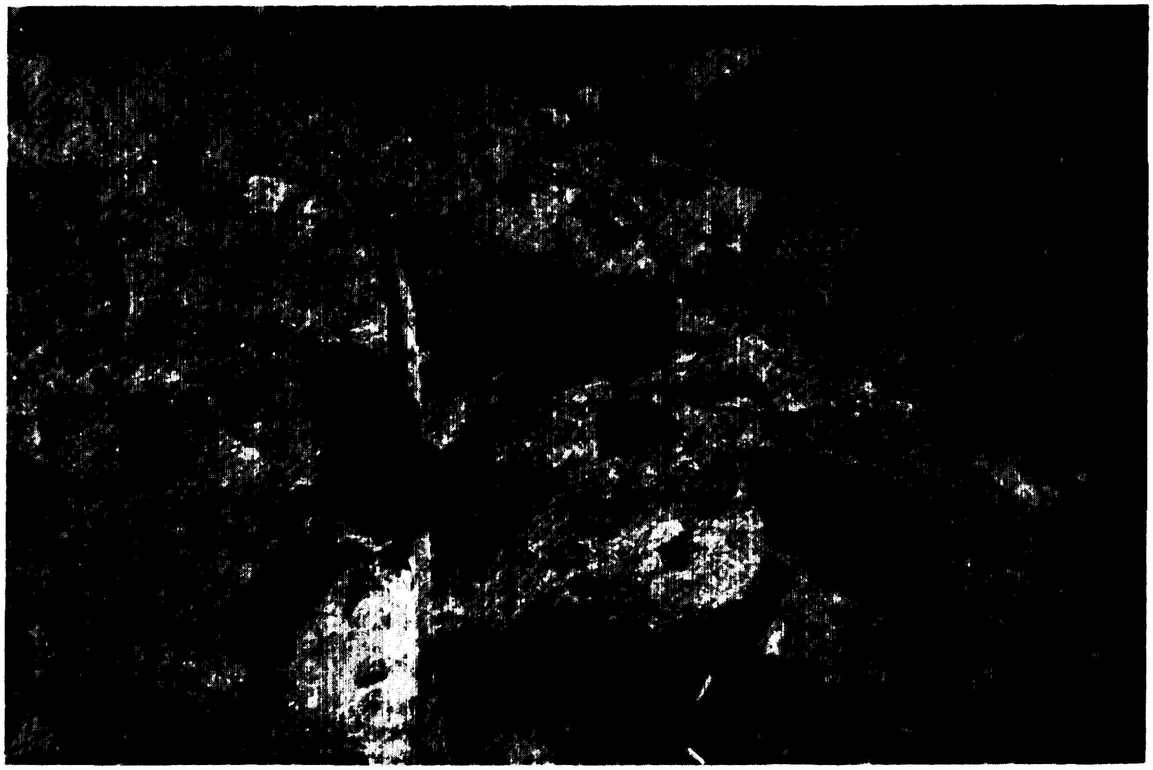


Photo 4. Calcitic marble tectonic breccia with small marble and para-amphibolite fragments, a large angular block of layered calc-silicate gneiss (top/centre) and several variably sized round to angular blocks of massive orthoamphibolite (lower left and right) eastern segment of the Parry Sound Domain (PSD); Highway 520 north of Dunchurch, Croft Township.

Calcitic Marble Tectonic Breccia (unit 10c) This rock contains many metasedimentary, quartzofeldspathic and quartzose gneiss fragments. This unit occurs in parts of the marble band exposed along Highway 520 north of Dunchurch and in several places along the shoreline of lower Whitestone Lake.

Calcitic Marble Tectonic Breccia (unit 10d) This rock contains abundant fragments, in places deformed fragments of para-amphibolite and calc-silicate gneiss, in places biotite gneiss (Photo 4). Good exposures occur in several places along Highways 124 and 520 near Dunchurch.

In several places along Highway 520, north of Dunchurch, unit 10d also contains small inclusion trains (probably disrupted dikes) of massive to foliated, fine- to medium-grained, dark grey orthoamphibolite (possibly unit 15 or 18). Contacts with the enclosing calcite matrix of the breccia are generally very sharp and the margins of these subangular, dark grey, mafic inclusions weather rusty brown. The distinction between inclusions of para-amphibolite and orthoamphibolite in the brecciated marbles of the eastern PSD could not always be made. In addition to being intruded by the above inferred younger orthoamphibolite dikes (unit 15 or 18), the marbles (brecciated and nonbrecciated varieties) are concordantly to locally discordantly intruded by minor, boudinaged, in places disrupted, metamorphosed granitic dikes (unit 17), most of which are too small to be shown on Map 2540 (back pocket).

The results of chemical analysis of three marbles from the eastern part of the PSD are given in Table 4.

CLASTIC SILICEOUS METASEDIMENTARY ROCKS (QUARTZOFELDSPATHIC, QUARTZOSE AND BIOTITE GNEISS) (UNIT 11)

Distribution and Contact Relationships

Clastic siliceous metasedimentary rocks (unit 11) constitute the bulk of the metasedimentary rocks in the interior part of the PSD. These metamorphosed epiclastic rocks consist mainly of thinly to thickly layered units of quartzofeldspathic gneiss (unit 11a), probably derived from feldspathic arenite. In the western segment of the PSD, the quartzofeldspathic gneisses contain, in many places, subordinate interlayered units of quartzose gneiss (unit 11b) probably derived from quartz arenite (Photo 5). Minor interlayers of biotite gneiss and schist (unit 11c), presumably derived from wacke and mudstone, are also present in the quartzofeldspathic gneisses. These subordinate lithologies are not common in the eastern part of this domain.

In the western segment of the PSD, clastic siliceous metasedimentary rocks form several relatively continuous, northeast-trending bands, up to 1 km wide, in the regionally banded series of interbanded supracrustal rocks and metaplutonic gneisses. These rocks are pres-

TABLE 4. CHEMICAL ANALYSES OF MARBLES (unit 10) IN THE EASTERN SEGMENT OF THE PSD, WHITESTONE LAKE AREA (after Marmont and Johnstone 1987).

Sample Number	86CCM-0160	86CCM-0161	86CCM-0162
SiO_2 (wt%)	1.84	1.71	3.04
Al_2O_3	0.55	0.45	0.44
Fe_2O_3*	0.33	0.48	0.38
MgO	3.11	4.01	0.08
CaO	52.90	52.00	55.80
Na_2O	0.04	0.11	0.07
K_2O	0.06	0.02	0.00
TiO_2	0.02	0.05	0.03
P_2O_3	0.00	0.02	0.01
MnO	0.02	0.02	0.02
CO_2	40.60	41.30	38.20
S	0.01	0.02	0.01
LOI	41.20	41.00	38.20
total	100.00	99.00	98.10

**Total iron as Fe_2O_3*

86CCM-0160 - Croft Township, Concession 11, lot 34, on Highway 520 north of Dunchurch
86CCM-0161 - Ferrie Township, Concession 7, lot 32, on Highway 520 south of Maple Island
86CCM-0162 - same as above

ent around the western and northern margins of the younger WLIC (*see* Figure 5). These quartzofeldspathic gneiss bands are infolded at all scales with bands of porphyroblastic orthoamphibolite (unit 12), and locally with bands or megaboudins of mafic to intermediate orthogneiss (unit 13). Contacts between the various bands are somewhat equivocal because within and particularly near the contacts between bands of quartzofeldspathic gneiss and porphyroblastic orthoamphiblolite interlayered units of these two major rock groups are present in many individual outcrops (Photos 5 and 6). Farther to the east, clastic siliceous metasedimentary rocks also form several minor, discontinuous bands in the banded gneiss series of the western segment of the PSD, along the eastern margin of the WLIC. Farther east of this complex, in the WLSC, are several large, isolated, tectonic inclusions of clastic siliceous metasedimentary rocks in the marble tectonic breccias of unit 19.

In the eastern part of the PSD, clastic siliceous metasedimentary rocks are concentrated in the western part of this domain segment. Here, the quartzofeldspathic gneisses form several continuous to discontinuous, north-trending bands which are as much as 500 m wide. These bands, which in places are megaboudins, are infolded at all scales with discontinuous narrow bands of marble tectonic breccia (unit 10). These quartzofeldspathic gneisses are also interlayered, in places possibly infolded, with several large, relatively continuous sill-like bodies of younger mafic to felsic metaplutonic gneiss (units 13, 14, 15 and 16).

Layering in the tightly folded strata of the quartzofeldspathic gneiss bands is better developed in the western segment of the PSD than in the eastern segment. Primary compositional layering in the quartzofeldspathic gneiss, on a scale of 1 to 5 cm, is locally defined in many outcrops by variation in grain size, mafic mineral content and colour on the weathered surface. In general, the thin to thickly layered nature of the clastic siliceous metasedimentary rocks in the western segment of the PSD is best defined where the quartzofeldspathic gneisses contain subordinate interlayers of quartzose gneiss and biotite gneiss and schist (*see* Photo 5). In places, these tightly folded, massive to layered metasedimentary gneisses have been further deformed into thinly layered tectonites along local shear zones. The layering in these tectonites is defined by variation in grain-size, colour and composition within bands, or alternating bands of recrystallized tectonic gneiss and protomylonitic to mylonitic gneiss (unit 11f). Mylonite flow folds, in places mylonite turbidity flow folds, are locally present in these quartzose and quartzofeldspathic tectonites. Good examples of these features can be seen on the islands of Taylor and De Bois lakes.

In contrast, in the eastern segment of the PSD, most outcrops of clastic siliceous metasedimentary rocks consist of massive-looking quartzofeldspathic gneiss. Primary compositional layering in this gneiss was locally observed near contacts with thick, in places thin, interlayered bands of marble tectonic breccia. Small outcrops of quartzofeldspathic gneiss containing minor interlayers of quartzose gneiss occur in a few places within the quartzofeldspathic gneiss band that underlies the area near the village of Dunchurch. The general absence of quartzose gneiss interlayers in the quartzofeldspathic gneisses in the eastern segment of the PSD, however, made it difficult to distinguish quartz-feldspar-rich gneisses of metasedimentary origin (unit 11) from similar looking, interlayered major and minor units of granitic orthogneiss (unit 14). Furthermore, discontinuous, narrow, ductile, cataclastic shear zones, i.e., zones of thinly layered protomylonitic to mylonitic gneiss, impart a pseudo-primary compositional layering to both of these granitic-looking rock types. This is particularly noticeable near the tectonically modified contacts with younger sill-like bodies of diorite gneiss (unit 15) and gabbroic anorthosite gneiss (unit 16). Therefore, in the more marble-rich western part of the eastern PSD, small granitic outcrops in the bush containing no quartzose gneiss interlayers, or outcrops of layered granitic tectonic gneiss, have quite possibly been mapped as granitic orthogneiss (unit 14) rather than as quartzofeldspathic gneiss.

Petrology and Lithologic Subdivisions

Quartzofeldspathic Gneiss (unit 11a) This rock is the most abundant lithology in this unit, and is foliated to locally layered, fine- to medium-grained (0.1 to 3 mm), weathers light grey or buff and locally contains rusty weathering layers and lenses. Fresh surfaces may be pinkish white to grey or light to medium grey. This rock consists mainly of equigranular to inequigranular feldspar and quartz and also 1 to 10 percent biotite. In places, biotite and hornblende, and minor amounts of garnet and mag-

Photo 5. Interlayered units of internally folded, thinly layered quartzofeldspathic gneiss and subordinate quartzose gneiss and orthoamphibolite (units 11a, 11b and 12c respectively), western segment of the Parry Sound Domain (PSD). Note contact between quartzofeldspathic unit (top) and other gneisses is occupied by locally discordant late tectonic granite pegmatite dike (unit 22); east side of rapids on creek leading north from Short Bay on Magnetawan River, McKenzie Township.

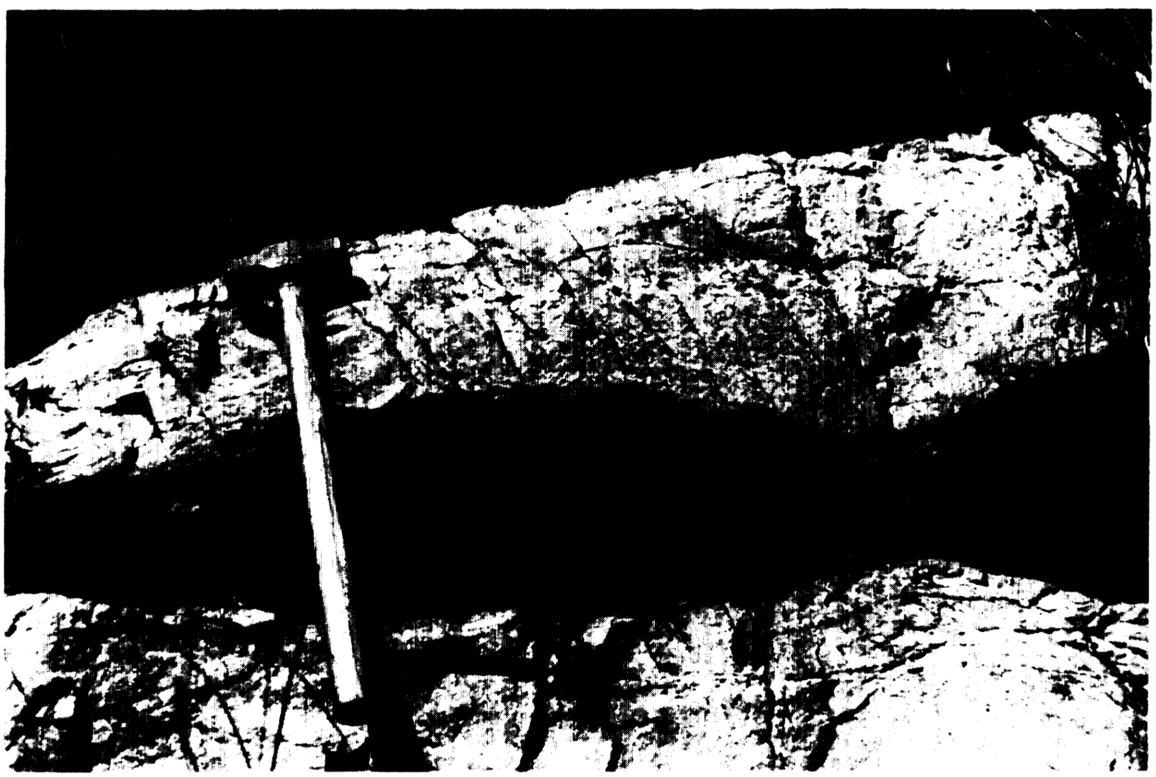


Photo 6. Boudinaged orthoamphibolite layer (unit 12c) (centre) in sequence of thin- to medium- layered quartzose gneiss (quartz arenite); location same as Photo 8.

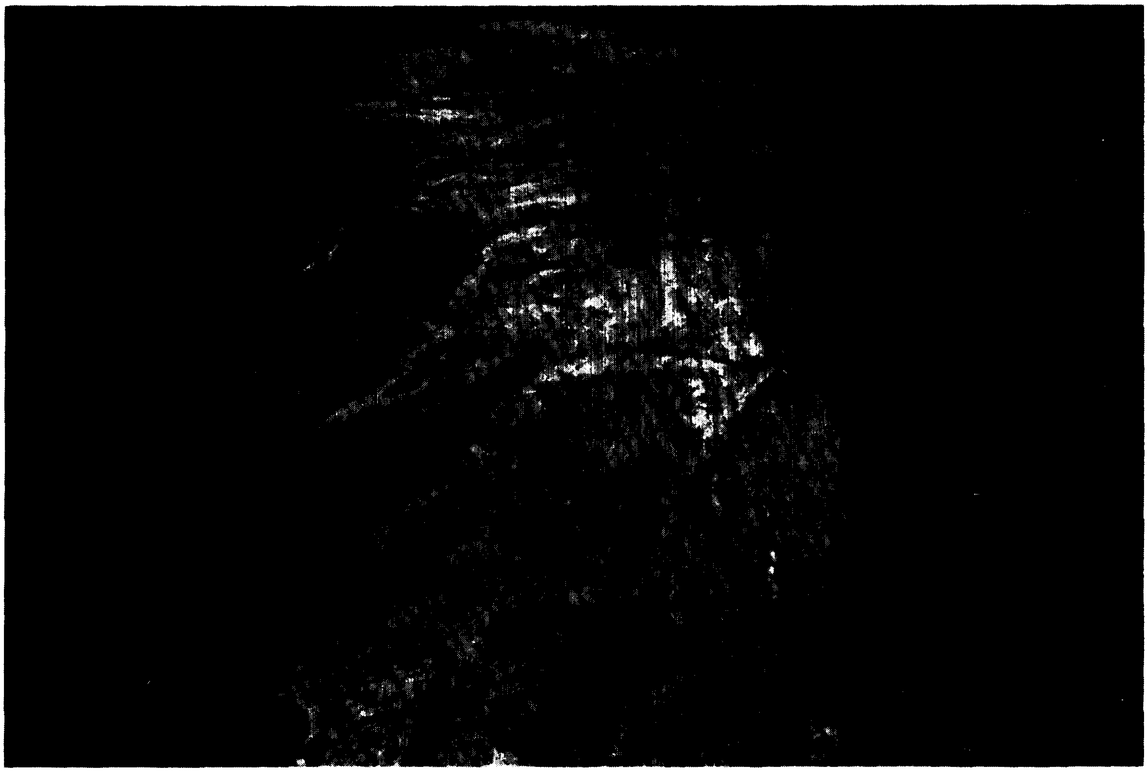


Photo 7. Strongly disrupted orthoamphibolite dikes or layers (unit 12c) (on left), in a sequence of interlayered quartzose and quartzofeldspathic mylonite gneiss (on right), western segment of the Parry Sound Domain (PSD); southeast shore of Taylor Lake, McKenzie Township.

netite are present. Quartz usually constitutes 25 to 35 percent of the rock. In thin sections, the texture varies from homeoblastic to heteroblastic and the most common mineral assemblages are: 1) plagioclase + quartz + potassium feldspar + biotite ± hornblende, titanite; 2) plagioclase + potassium feldspar + quartz + biotite + hornblende + epidote + garnet; and 3) plagioclase + potassium feldspar + quartz + hornblende + biotite + epidote + titanite ± magnetite. Plagioclase is locally saussuritized and xenoblastic quartz generally exhibits a weak to moderate undulatory extinction. In places, elongate quartz grains or quartz ribbons may be present. Light brown to reddish brown biotite and irregular elongate grains of hornblende or aggregates of biotite and brown hornblende define the foliation. The dark brown hornblende is retrograded in many places to pseudomorphic aggregates of brown-green hornblende, reddish brown biotite, epidote and magnetite.

Quartzose Gneiss (unit 11b) This is the second most abundant lithology and is a massive to foliated, in places layered, medium- to coarse-grained (0.2 to 5 mm) rock containing more than 80 percent quartz with minor amounts of feldspar, biotite and locally diopside and hornblende. The rock ranges from white to medium grey and generally weathers white and whitish grey (*see* Photo 6). In places, compositional layering is defined by colour banding and a marked variation in feldspar and biotite content. Individual gneiss layers or lamellae range in composition from quartz arenite to locally feldspathic quartz arenite. The mica defines a weak to moderate foliation. Thin section examination reveals that the texture of these quartzose gneisses ranges from heteroblastic to quartz ribbon textured, highly strained varieties. The most common mineral assemblages are quartz + plagioclase + microcline + biotite and quartz + plagioclase + microcline + diopside + biotite. Minor minerals are hornblende, muscovite, epidote, magnetite and calcite. In the quartz ribbon textured varieties, the elongate quartz grains commonly contain inclusions of biotite and elongate to lenticular grains of feldspar. The long axis of these inclusions parallels the fabric in the rock.

Biotite Gneiss and Schist (unit 11c) This unit generally occurs as minor interlayers, less than 10 cm wide, in the quartzofeldspathic gneisses. Thicker interlayers, 30 to 60 cm wide, occur locally in the western PSD: 1) at the east end of Taylor lake (Photo 7); 2) along the western shores of Short Bay on the Magnetawan River; and 3) along the north-central shore of La Brash Lake. The rocks consist mainly of foliated to layered, fine- to medium-grained, light to medium grey and greenish grey biotite + quartz + feldspar gneiss and hornblende + biotite + quartz + feldspar gneiss. These gneisses generally contain 10 to 30 percent combined biotite and hornblende; schistose varieties contain up to 50 percent mafic minerals, mostly biotite. In thin sections of biotite gneiss, the texture is generally heteroblastic and the most common mineral assemblage is plagioclase + quartz + microcline + biotite + hornblende ± garnet and epidote. Minor minerals are titanite, magnetite and apatite. Dark green to brown and reddish brown biotite together with some elongate grains of reddish brown to dark brown hornblende define a foliation. Dark brown hornblende is locally retrograded to aggregates of blue-green pleochroic hornblende, green biotite, epidote and magnetite.

In one thin section of garnetiferous biotite schist, the mineral assemblages present in the various lamellae are: 1) microcline + quartz + garnet + biotite ± kyanite and cordierite (porphyroblasts); 2) microcline + quartz + plagioclase + biotite + muscovite + sillimanite ± kyanite (porphyroblasts); and 3) microcline + plagioclase + quartz + muscovite + biotite locally with garnet poikiloblasts. In the first assemblage, the corderite, which is partly altered to a retrograde mixture of sericite and chlorite, forms inclusions in garnet and embayed xenoblasts adjacent to garnet porphyroblasts. Microcline in this assemblage is locally altered to muscovite. In assemblages 2 and 3, the muscovite, in places sillimanite, is generally interleaved with biotite laths.

Unit 11d This unit is composed of interlayered units of quartzofeldspathic gneiss and subordinate quartzose gneiss: in places there are minor interlayers and lamellae of biotite gneiss and schist. Good, accessible, exposures of this subunit can be seen at the first rapids along the small creek north of Short Bay on the Magnetawan River. On the east side of the rapids, just south of the secondary road, boudinaged units of thinly layered quartzose gneiss are interlayered with subordinate units of quartzofeldspathic gneiss and locally abundant narrow boudinaged bands of orthoamphibolite (Photo 7). Individual units of layered quartzose gneiss range in size from 10 cm to 1 m and some units show internal folding. Other similar occurrences of unit 11d in the western segment of the PSD are present at the following places: 1) on the northeast shore of Short Bay on the Magnetawan River; 2) along Highway 520 east of Gordon Lake; 3) along the southeast shore of Taylor Lake; and, 4) on La Brash Lake.

Unit 11e This unit is composed of mafic gneiss interlayers (5 cm to 1 m wide) in quartzofeldspathic and quartzose gneisses, in many places interlayered with units of both lithologies. Contacts of the mafic gneiss with the adjacent metasedimentary gneisses are sharp to locally disrupted and the mafic interlayers themselves are commonly boudinaged (*see* Photo 6). In some of the more highly deformed areas of unit 11e, the wall rocks have been selectively transformed into protomylonitic to mylonitic gneisses enclosing isolated boudins of less deformed mafic gneiss. Most of the mafic gneiss interlayers or boudins are massive to foliated, in places layered, fine- to medium-grained, dark grey and greenish grey amphibolite. In some of the larger amphibolite units, the finer grained phase near the margin grades into a central, less deformed phase of medium- to coarse-grained, porphyroblastic, plagioclase-rimmed garnet amphibolite that is strikingly similar to the mafic orthogneiss of unit 12. It is therefore concluded that most outcrops of subunit 11e represent tightly infolded rocks of units 11 and unit 12. This subunit is ubiquitous in the quartzofeldspathic gneiss bands of the western segment of the PSD and is particularly well exposed on Taylor Lake, at the west end of Short Bay on the Magnetawan River, and at the west end of La Brash Lake.

Unit 11f This unit is composed of tectonites occurring in local, generally concordant zones of ductile deformation in the clastic siliceous metasedimentary rocks (units 11a to 11e) of both the western and eastern segments of the PSD. Examples of these high-strain tectonites, i.e., protomylonitic to mylonitic gneisses, and in places recrystallized tectonic gneisses of unit 11, have been previously described in several places throughout the preceding text.

Geochemistry

The results of chemical analysis of four samples of the clastic siliceous metasedimentary rocks (Mummery 1972) from the western segment of the PSD, occurring along and to the west of the disrupted western contact of the WLIC, are given in Table 5. Also given at the right-hand side of this table, for comparison purposes, are three samples of metasomatized metasedimentary gneiss (Mason 1969). These samples were taken from a narrow band of unit 11 near the non-disrupted eastern contact of the WLIC. These metasomatized gneisses, which have anomalously high values of iron, magnesium and titanium, occur within the locally deformed, *in situ*, eastern contact metamorphic aureole of the WLIC, where they are also interlayered with an older series of diorite sills (unit 15) (*see* Figure 6). Mineral assemblages in both the metasomatized gneisses and the diorite sills (units 11 and 15, respectively) indicate that they were recrystallized under contact metamorphic conditions prior to metamorphic retrogression during the late thrusting event. The source of the metasomatizing fluids was probably the WLIC. Some components, however, may also have been added to the gneisses during the earlier emplacement of the magnetite-rich diorite suite (unit 15), or during the regional granulite facies metamorphic event that is interpreted to have occurred after the emplacement of the diorite suite but prior to emplacement of the WLIC.

Porphyroblastic Orthoamphibolite (unit 12)

DISTRIBUTION AND CONTACT RELATIONSHIPS

Porphyroblastic orthoamphiblolite (unit 12), consists of a highly deformed, in places disrupted, series of varied textured amphibolites ranging from porphyroblastic, plagioclase-rimmed garnet amphibolite to recrystallized, foliated to layered, in places massive, amphibolite. These amphibolites are abundant in the western segment of the PSD, but are not common in the eastern segment. These rocks, particularly the porphyroblastic garnet phase, also form large tectonic inclusions in the tectonites of the PSDBZ, as well as in the breccias of the

TABLE 5. CHEMICAL ANALYSES OF THE CLASTIC SILICEOUS METASEDIMENTARY ROCKS (unit 11) AND RELATED METASOMATIZED GNEISSES IN THE PSD, WHITESTONE LAKE AREA.

Rock Type	Quartzofeldspathic and Biotite Gneisses				Metasomatized Gneisses		
Sample Number	(1) 72RCM-L3-6	(2) 72RCM-5-6	(3) 72RCM-5-32	(4) 72RCM-5-33	(5) 69IMM-480	(6) 69IMM-494	(7) 69IMM-495
SiO_2 (wt%)	67.03	74.32	78.99	69.89	60.67	58.36	59.25
Al_2O_3	14.00	11.97	11.11	12.27	12.43	12.63	13.68
Fe_2O_3*	3.83	1.25	1.44	3.42	12.71*	15.27*	8.78*
FeO	4.93	2.54	1.19	3.68	-	-	-
MgO	0.85	0.35	0.14	0.52	1.20	1.75	4.77
CaO	3.67	1.71	0.12	2.52	5.44	7.04	7.00
Na_2O	1.84	2.77	1.92	2.68	3.54	2.00	3.97
K_2O	2.74	4.57	4.92	4.52	1.44	0.42	0.58
TiO	1.05	0.49	0.27	0.60	1.67	2.11	0.86
P_2O_5	0.25	0.07	0.02	0.12	-	-	-
MnO	0.20	0.09	0.03	0.13	-	-	-
CO_2	0.15	-	-	-	-	-	-
H_2O^+	0.68	0.36	0.22	0.44	-	-	-
H_2O^-	0.15	0.08	0.03	0.10	-	-	-
total	101.37	100.57	100.40	100.89	99.08	99.58	98.89

**Total iron as Fe_2O_3*

(1): between Highway 520 and northeastern contact of the WLIC, and west of WLSC

(2): on north shore of Snakeskin Lake, west of disrupted western contact of the WLIC

(3): on south shore of Snakeskin Lake, near disrupted western contact of the WLIC

(4): location same as above.

(5): on the west shore of upper Whitestone Lake, between the two long western arms of this lake; rock occurs within non-disrupted, eastern contact aureole of the WLIC (unit 16) and is interlayered with several small sills of diorite (unit 15)

(6): on north shore of southwestern arm of upper Whitestone Lake, within non-disrupted, eastern contact aureole of the WLIC; rock forms thin band, less than 10 m wide, between small diorite sill (on the east) and large WLIC (on the west); see Figure 6

(7): location as above

WLSC. Metamorphic grade in these orthoamphibolites is mainly a retrograde amphibolite facies overprint on granulite facies; relict granulite mineral assemblages are preserved locally.

Within the western segment of the PSD, units showing the range of most textural variations in this amphibolite are well exposed on: 1) De Bois Lake; 2) Snakeskin Lake; and 3) along Highway 520, approximately 1.8 km east of Gordon Lake. These porphyroblastic amphibolites have been described in petrographic and geochemical theses by Mason (1969) and Mummery (1972).

In the western part of the PSD, and beyond the map area, porphyroblastic orthoamphibolite forms several, relatively continuous, northeast-trending bands. In places, megaboudins as much as 1.5 km wide occur in the regionally banded series of gneisses. In the past, this banded series of orthoamphibolites and quartzofeldspathic paragneisses around the western margin of the WLIC has been referred to as the Lac du Bois Formation by Mason (1969), and Mummery (1972). Within this banded gneiss series, the orthoamphibolite bands (unit 12) are infolded with bands of metasedimentary quartzofeldspathic gneiss, in many places with interlayered quartzose gneiss (unit 11). Within individual orthoamphibolite bands, interlayered units or lenses of both main rock types of unit 11 are present in many individual outcrops of transposed gneiss. Contacts between units of orthoamphibolite with the metasedimentary rocks are concordant, usually sharp, and in many places are strongly disrupted (*see* Photos 6 and 7). The marginal phase of the orthoamphibolite unit varies from massive to layered and the host rock metasedimentary gneiss may be a protomylonitic to mylonitic gneiss (Photo 7). Contacts between the larger bands of orthoamphibolite and the metasedimentary gneisses are somewhat arbitrarily drawn on Map 2540 (back pocket), because of small-scale infolding in the transposed gneisses. The regional distribution of the porphyroblastic orthoamphibolite in the banded gneiss series along the western flank of the WLIC—from the study area to the town of Parry Sound, 33 km to the south (*see* Figure 3)—suggests that these orthoamphibolites may represent a series of deformed, flattened, possibly subvolcanic mafic sills and some extrusive equivalent of these sills.

The main subdivisions of the porphyroblastic orthoamphibolite, made on the basis of the presence of corona texture, fabric and form, are described in the next section.

Corona-textured Garnet Amphibolite (units 12a and 12b)

Porphyroblastic Plagioclase-rimmed Garnet Amphibolite (unit 12a) This rock is a massive to foliated, in places layered, medium- to coarse-grained, dark greenish grey to black, metamorphosed igneous rock. It contains up to 30 percent garnet porphyroblasts that are almost completely rimmed by coronas of white feldspar (Photo 8). The round to lenticular coronas are set in an inequigranular groundmass of hornblende and pyroxene. The garnets are up to 1 cm in diameter. As deformation increases, a reaction appears to have taken place in which hornblende and plagioclase almost completely replace the garnet and pyroxene, and the rock is transformed into garnetiferous, foliated to layered amphibolite (units 12b and 12c). This porphyroblastic rock, as well as its recrystallized textural variants, occurs locally in the orthoamphibolite bands (unit 12) throughout the western segment of the PSD. It is not restricted, as suggested by Mason (1969) and Mummery (1972), to a 2 km wide zone around the contact of the WLIC. However, the author does agree with Mummery (1972) that the plagioclase-rimmed garnet coronas in this rock were initially developed during regional granulite facies metamorphism, and that they were subsequently recrystallized during a later retrogressive metamorphic event. They are not the result of contact metamorphism associated with the emplacement of the WLIC, as proposed by Mason (1969).

Individual hand specimens of porphyroblastic, plagioclase-rimmed garnet amphibolite (unit 12a) from the same outcrop can, in general, be grouped into two main types: Type I, a massive-looking pyroxene-rich type in which the garnets have very thin rims (< 1 mm wide) of white feldspar; and Type II, a massive to foliated hornblende-rich type in which the plagioclase rims on the garnet are much thicker, up to 3 mm wide, and in places have almost completely replaced the garnet in the core of the corona.

Type I Corona-textured Garnet Amphibolite In thin sections of Type I, the main mineral constituents are garnet (25 to 60 percent), hornblende (10 to 25 percent), plagioclase (5 to 15 percent), clinopyroxene (5 to 20 percent) and hypersthene (1 to 10 percent). Minor constituents include ilmenite and apatite. Four kinds of metamorphic reaction coronas or partial coronas are present: 1) plagioclase rims on garnet; 2) hypersthene-plagioclase rims on garnet; 3) hypersthene rims on garnet; and, 4) hypersthene rims on ilmenite. The most common kind of corona consists of embayed, subround to equant garnet (1 to 5 mm in diameter) surrounded by a shell of polycrystalline, twinned plagioclase. In general, the plagioclase shell completely separates the garnet porphyroblasts from an inequigranular granoblastic groundmass of clinopyroxene, hornblende, hypersthene and smaller amounts of ilmenite. The garnet commonly contains small inclusions of plagioclase, clinopyroxene, ilmenite, and in places, hypersthene. Locally, hornblende forms inclusions in the garnet near its embayed margin with plagioclase. According to Mummery (1972), microprobe analyses indicated that in several of the garnet

Photo 8. Anastomosing shear-bounded lens of relatively massive, porphyroblastic, plagioclase-rimmed garnet amphibolite (to right of hammer) in sharp, locally discordant contact with more highly deformed and recrystallized phases of this same rock (units 12b and 12c), western segment of PSD; south-central shore of La Brash Lake, McKenzie Township.

porphyroblasts, the composition of the rim compared to the core is lower in the grossular and higher in the pyrope and almandine components. Similarly, the composition of the polysynthetically twinned plagioclase in the plagioclase shell ranges in composition from An_{40} to An_{50} (Mummery 1972). Within the plagioclase shell, particularly along its outer margin, occur small xenoblasts of clinopyroxene, ilmenite and hornblende. Small xenoblasts of garnet, if present, occur in the inner part of this shell near the embayed margins of the central garnet. In the hornblende-pyroxene groundmass surrounding the plagioclase shell, clinopyroxene and hypersthene, which generally forms inclusion in the latter, tend to be concentrated toward the margin of the plagioclase shell. In general, the clinopyroxene separates the bulk of the abundant hornblende in this groundmass from the plagioclase shell. Regardless of this general distribution, some of the brown to dark reddish brown pleochroic hornblende xenoblasts occur locally along the outer margin of the plagioclase shell, and in places within it. Inclusions of hornblende and plagioclase are locally abundant in the clinopyroxene. Some of these inclusions are oriented with their long direction parallel to the cleavage direction in the clinopyroxene. Hypersthene xenoblasts and inclusions are partly altered to secondary blue-green pleochroic hornblende and magnetite. In places, secondary blue-green hornblende also rims xenoblasts of ilmenite as pseudomorphs of a former orthopyroxene reaction corona on this oxide, i.e., the fourth kind of reaction corona.

The second and third kind of metamorphic reaction corona were observed together in pyroxene-rich types of porphyroblastic orthoamphibolite which contain up to 10 percent hypersthene. The more common, first kind of corona that has been described above usually contains much less than 5 percent hypersthene. Here, the embayed garnet, which may be inclusion free, is surrounded by a shell consisting of hypersthene that initially was intimately intergrown with small subidioblastic grains of plagioclase. These small plagioclase grains recrystallized to even smaller polycrystalline pseudomorphs of plagioclase. The hypersthene is partly retrograded to blue-green pleochroic hornblende and minor magnetite. This composite shell generally separates the corroded garnet in the core of the corona from the inequigranular granoblastic groundmass of clinopyroxene and dark reddish brown pleochroic hornblende. The clinopyroxene contains inclusions, in places oriented, of hornblende and plagioclase. Ilmenite forms small xenoblasts in the hornblende-pyroxene groundmass and forms inclusions in hypersthene, clinopyroxene and locally hornblende.

Studies of similar porphyroblastic plagioclase and orthopyroxene-rimmed garnet amphibolites in Sweden by Quensel (1952) and in the Adirondack Highlands by de Waard (1965, 1967) suggest that the reaction coronas in the porphyroblastic orthoamphibolite within the map area are the result of progressive metamorphism of mafic rocks from almandine amphibolite facies to granulite facies. The alteration of the hypersthene to secondary amphibole and the replacement of garnet and clinopyroxene by plagioclase and hornblende indicates a retrograde amphibolite facies overprint on the earlier granulite facies assemblage.

Type II Corona-textured Garnet Amphibolite The above mentioned retrogressive amphibolite facies is more apparent in type II corona-textured garnet amphibolite, the massive to foliated hornblende-rich type. In thin sections of this type, the main mineral constituents are hornblende (30 to 50 percent), garnet (20 to 40 percent), plagioclase (10 to 25 percent), clinopyroxene (1 to 10 percent) and minor hypersthene. Accessory minerals are ilmenite, titanite and apatite. The garnet in the core of the coronas is strongly corroded, contains abundant inclusions of plagioclase, hornblende and ilmenite, and is surrounded by a thick rim, up to 3 mm wide, of polycrystalline plagioclase. Within this plagioclase shell, xenoblasts of hornblende are locally abundant, and in places, are in contact with the garnet. Clinopyroxene, in places containing small altered inclusions of hypersthene, occurs mainly in the hornblende-clinopyroxene-plagioclase groundmass. The garnet is separated from the dark reddish brown pleochroic hornblende-rich groundmass not only by plagioclase, most of which is concentrated in the shell, but also by hornblende that has partly replaced the clinopyroxene. Accessory ilmenite forms numerous small xenoblasts in the inequigranular granoblastic and locally heteroblastic groundmass.

Garnet-plagioclase-streaked Amphibole and Layered Amphibole Gneiss (unit 12b) These rocks represent a more highly deformed and recrystallized phase of the type II corona-textured garnet amphibolite described above in unit 12a. These foliated to layered rocks vary in grain size from fine to medium grained and are medium to dark grey and speckled white. In both outcrop and hand specimen, one of the obvious features of this rock is the high plagioclase content, up to 40 percent. The streaks and rounded to lenticular knots of plagioclase are pseudomorphs after garnet porphyroblasts. Plagioclase-rimmed garnets are locally present and small, isolated grains of pink garnet are present in many of the polycrystalline plagioclase knots, particularly in the layered phases. Foliated and layered units are common in many outcrops, and some outcrops have a podded structure, in which lenses of massive plagioclase-rimmed garnet amphibolite (unit 12a), remain between narrow anastomosing shears (Photo 8).

In thin sections, the main mineral constituents are hornblende (50 to 70 percent), plagioclase (20 to 40 percent), garnet (5 to 20 percent) and clinopyroxene (1 to 15 percent). Important minor constituents are ilmenite and titanite. Minor secondary minerals are scapolite, calcite and biotite. The texture of the rock varies from heteroblastic to nematoblastic heteroblastic. In this last texture, the hornblende defines the foliation. In places, the rock is augen textured where elongated aggregates of plagioclase are abundant. Light to dark brown, in places reddish brown pleochroic hornblende forms: 1) ragged, equant to elongated xenoblasts adjacent to plagioclase, garnet and clinopyroxene if present; and 2) ragged poikiloblastic grains charged with abundant ameboid-shaped grains of plagioclase. A significant feature of the hornblende is the presence of abundant exsolved blebs of ilmenite and, in places, rutile (Mummery 1972) along its cleavage traces. Subround to equant garnet porphyroblasts are strongly embayed by both plagioclase and hornblende and most contain inclusions of these minerals, as well as smaller inclusions of ilmenite and titanite. Small, intergranular xenoblasts of ilmenite and titanite are common in the groundmass and, in places, titanite forms reaction rims around subrounded grains of ilmenite. According to Mummery (1972), microprobe analyses of the plagioclase indicate a composition range of An_{30} to An_{40}.

The mineral assemblage hornblende + plagioclase + garnet + titanite + ilmenite + clinopyroxene indicates that these foliated to layered amphibolites developed during a period of almandine amphibolite facies metamorphism. The metamorphism was retrograde in this instance.

The results of chemical analysis of rocks of units 12a, 12b and 12c are given in Table 6.

Other Amphibolites and Related Rocks (units 12c to 12f)

Unit 12c In the western segment of the PSD this unit designates small, isolated units of amphibolite that generally contain no plagioclase-rimmed garnet porphyroblasts or recognizable pseudomorphic aggregates of polycrystalline plagioclase after former garnet porphyroblasts. These dark grey to black amphibolites are massive to foliated, and in places are layered and generally fine to medium grained. Plagioclase streaks and porphyroblasts as well as unrimmed garnet porphyroblasts are locally present. These rocks form isolated outcrops in the bush within the large porphyroblastic orthoamphibolite bands (unit 12), and locally, interlayers in lenses or megaboudins of metasedimentary gneiss units within the orthoamphibolite bands, in the western segment of the PSD.

Unit 12d This unit is composed of outcrops of massive to layered, medium- to coarse-grained porphyroblastic plagioclase-rimmed garnet amphibolite (unit 12a) and related, finer grained mafic orthogneisses (units 12b and 12c respectively), containing interlayers or probably infolded units of locally mylonitic quartzofeldspathic and quartzose gneiss (unit 11). This lithologic assemblage is very common near the contacts of major garnet porphyroblastic orthoamphibolite bands with metasedimentary gneiss bands. In the above assemblage, the relatively homogeneous and massive character of the finer grained mafic amphibolite interlayers (unit 12c) compared to the protomylonitic to mylonitic character of many of the adjacent metasedimentary gneisses suggests that some of the mafic amphibolite interlayers have undergone extensive grain reduction during ductile deformation (*see* Photos 6 and 7). The finer grained mafic gneiss (unit 12c), and its analogous unit in the metasedimentary gneiss subdivision (unit 11d) probably represent completely recrystallized mylonitic orthoamphibolites.

Unit 12e This unit is composed of local zones of high-strain mafic tectonites that in places are schistose mafic rocks, within subunits 12a to 12c. This unit also locally represents the amphibolite layers in subunit 12d. These centimetre to metre sized zones of ductile deformation, grain size reduction and recrystallization are developed along anastomosing shears. These mafic tectonites are generally fine- to medium-grained, medium to dark grey gneisses that vary in texture from plagioclase augen-textured hornblende gneiss to thinly layered and laminated amphibolite. The mafic tectonites may be either porphyroclastic, containing isolated feldspar and pegmatite clasts presumably derived from unit 17c, or are cut by concordant to discordant, metamorphosed granitic dikes (unit 17a), which in places intrude along the narrow curvilinear traces of anastomosing shears (*see* Photo 8). Thin section examination of a thinly laminated amphibolite gneiss reveals that the rock consists of alternating, in places *en échelon* lamellae of a medium-grained heteroblastic assemblage of hornblende + plagioclase + titanite + magnetite; and a much finer grained nematoblastic to locally flaser-textured assemblage of plagioclase + hornblende + titanite and magnetite.

Unit 12f This unit is composed of tectonic inclusions of varied textured, porphyroblastic orthoamphibolite (units 12a to 12e) in a gneiss or tectonite. The best example of this unit occurs in the eastern PSDBZ, within a large outcrop exposed on Highway 124, approximately 1 km west of the western turn-off to Ahmic Harbour. In this outcrop, part of the western margin of a larger, tectonic inclusion of porphyroblastic orthoamphibolite is in relatively sharp contact with mylonitic gabbroic anorthosite (unit 16f), which is itself part of a large tectonic inclusion within the eastern PSDBZ. At this inclusion contact the gneissic orthoamphibolite is porphyroclastic and smaller, metre-sized inclusions of this same rock also occur in the adjacent tectonic lens of thin- to medium-layered, mylonitic anorthosite gneiss.

Early Tectonic Mafic to Felsic Metaplutonic Rocks (units 13 and 14)

A series of early tectonic, foliated to layered, in places mylonitic, mafic to intermediate and intermediate to felsic orthogneisses (units 13 and 14 respectively), occurs mainly in the eastern segment of the PSD. Here, these rocks form several large bands or sill-like bodies in the gneisses that characterize this eastern part of the PSD. These orthogneisses have undergone retrogressive metamorphism. These rocks have been subdivided into two main groups; gabbroic to tonalitic orthogneisses (unit 13); and granodioritic to felsic granitic orthogneisses (unit 14).

In the eastern PSD, thick bands or sill-like bodies of both metaplutonic groups are interlayered with each other. Within some bands both groups can be observed in contact on a single outcrop. Since most intrusive con-

TABLE 6. CHEMICAL ANALYSES OF PORPHYROBLASTIC ORTHOAMPHIBOLITE (unit 12) IN THE WESTERN SEGMENT OF THE PSD, WHITESTONE LAKE AREA.

Rock Type	Porphyroblastic Plagioclase-rimmed Garnet Amphibolite (unit 12a)					Massive to Layered Amphibolite (units 12b-12c)			
Sample Number	86EGB-1051	72RCM-L3-3	86EGB-1052	72RCM-C34	72RCM-L3-199	72RCM-L3-159	72RCM-L3-31	72RCM-C28	72RCM-L2-61
SiO_2 (wt%)	43.50	46.73	43.90	47.68	44.14	45.70	46.89	47.31	47.69
Al_2O_3	14.40	14.81	16.10	14.74	16.02	16.76	13.87	13.29	14.91
Fe_2O_3*	17.70*	2.17	14.70*	2.44	1.22	2.71	1.90	2.79	2.73
MgO	-	10.22	-	10.74	13.75	9.62	11.65	10.27	11.21
CaO	6.59	6.83	7.52	7.42	7.44	8.63	7.51	9.47	6.75
Na_2O	10.60	12.83	12.00	12.64	10.10	11.84	12.57	10.46	10.93
K_2O	2.06	2.93	2.03	2.22	2.68	2.53	3.02	2.44	3.18
TiO_2	0.51	0.49	0.20	0.43	0.49	0.82	0.70	0.54	0.60
P_2O_5	2.81	1.82	1.75	1.64	2.63	1.29	1.68	2.03	2.04
MnO	0.39	0.18	0.24	0.20	0.54	0.17	0.20	0.23	0.27
CO_2	0.28	0.20	0.20	0.25	0.24	0.20	0.20	0.23	0.23
S	0.12	0.01	0.28	-	-	0.03	0.05	0.54	-
H_2O^+	0.11	-	0.01	-	-	-	-	-	-
H_2O^-	-	1.74	-	0.99	1.07	1.35	0.86	1.24	1.32
LOI	0.40	0.27	0.20	0.12	-	0.08	0.14	0.21	0.12
total	99.20	100.93	98.80	101.51	100.32	101.73	101.24	101.05	101.98

Trace Element Listing

Sample Number	86EGB-1051		86EGB-1052
Co (ppm)	55	-	61
Cr	196	-	137
Cu	91	-	37
Ni	13	-	74
Pb	< 10	-	25
Zn	31	-	130
V	391	-	-
Nb	< 5	-	< 5
Rb	< 5	-	< 5
Sr	270	-	234
Y	58	-	36
Zr	184	-	125
Th	< 10	-	< 10
Au (ppb)	< 2	-	-
Pt	< 1	-	-
Pd	< 1	-	-

**Total iron as* Fe_2O_3

86EGB-1051 - Highway 520, west of Maple Island (see Figure 6), McKenzie Township
72RCM-L3-3 - south of above, from Mummery (1972, Figure 4.1), McKenzie Township
86EGB-1052 - north shore De Bois Lake (see Figure 6), Hagerman Township
72RCM-C34 - north shore De Bois Lake, west of above, from Mummery (1972, Figure 4.1), McKenzie Township
72RCM-L2-199 - south shore Snakeskin Lake, from Mummery (1972, Figure 4.1), Hagerman Township
72RCM-L3-159 - north shore Taylor Lake, from Mummery (1972, Figure 4.1), McKenzie Township
72RCM-L3-31 - southwest of 86EGB-1051 above, from Mummery (1972, Figure 4.1), McKenzie Township
72RCM-C28 - north shore De Bois Lake, west of 86EGB-1052 above, from Mummery (1972, Figure 4.1), McKenzie Township
72RCM-L2-61 - south shore De Bois Lake, southeast of above

Photo 9. Homogeneous gabbroic to dioritic orthogneiss (unit 13a) in retrograde amphibolite facies containing relict granulite facies ilmenite-pyroxene-plagioclase metamorphic segregations, eastern PSD; Highway 124 about 1 km east of MTC gravel yard, Croft Township.

tacts have been tectonically modified, the relative age of emplacement of these two metaplutonic groups is uncertain. Along Highway 124 to the east of Dunchurch and west of Ahmic Harbour, several bands containing both groups of orthogneisses are exposed in a number of roadcuts. In many of these outcrops, the foliated to layered, mafic and intermediate to felsic orthogneisses are concordantly to discordantly cut by numerous, massive-looking orthoamphibolite to diorite dikes (unit 15, in places unit 18) that range from 30 cm to 6 m in width. The metamorphic grade of the older mafic to felsic orthogneisses is generally amphibolite facies retrograded from granulite facies, but relict granulite facies mineral assemblages are present locally. In contrast, the metamorphic grade of the younger, massive mafic dikes, particularly unit 15, is more commonly relict granulite facies.

MAFIC TO INTERMEDIATE GNEISSES (UNIT 13)

Gabbroic to Dioritic Orthogneiss

This mafic rock type (unit 13a) was only identified in the eastern segment of the PSD, where it is the predominant lithology within the various 100 to 600 m wide bands of mafic to intermediate orthogneiss. Retrograde amphibolite facies assemblages predominate. The gabbroic orthogneiss is mainly a medium to dark grey weathering, white-speckled grey to black rock. It is fine- to medium- to coarse-grained in places and is foliated to locally layered. Textural variants in some outcrops include plagioclase-streaked and augen-textured amphibole gneiss. In thin sections of grey, amphibolite facies gabbroic orthogneiss, the texture is heteroblastic to locally nematoblastic. The most common mineral assemblage observed in the more gabbroic units is hornblende + plagioclase ± biotite, quartz and garnet. Common accessory minerals are ilmenite, rutile and apatite. Dioritic phases contain more plagioclase than hornblende, varied amounts of biotite, and minor quartz.

Many of the larger outcrops of gabbroic orthogneiss contain layers or lenses of relict granulite facies gneiss between centimetre-sized concordant ductile, in many places anastomosing, shears. This relatively more homogeneous, higher grade phase of the orthogneiss is a medium- to coarse-grained, massive to foliated rock that weathers medium to dark grey and is greenish grey to locally olive green on its fresh surface. It is composed of inequigranular grains of plagioclase, varied amounts of black or brownish coloured pyroxene, hornblende and opaque minerals. In places, this greenish grey to green, retrograded granulite facies orthogneiss contains small, lenticular metamorphic segregations or sweats of either coarse-grained, inequigranular subidioblastic plagioclase and black pyroxene with minor intergranular opaque minerals and garnet (Photo 9), or coarse-grained, xenoblastic to subidioblastic pyroxene ± hornblende surrounding a core of weakly magnetic opaque minerals, presumably ilmenomagnetite. Similar relict granulite facies sweats were observed locally in outcrops of grey, amphibolite facies, gabbroic orthogneiss.

Thin section examination of relict granulite facies gabbroic orthogneiss reveals that the texture is inequigranular granoblastic and locally heteroblastic. The most common mineral assemblage is plagioclase + clinopyroxene + hornblende + hypersthene ± ilmenite. Accessory minerals include biotite, quartz, apatite, pyrite and calcite. The larger plagioclase xenoblasts are commonly antiperthitic and many grains exhibit deformed twin lamellae. Clinopyroxene, containing inclusions of hypersthene and ilmenite, is intimately intergrown with secondary, brown to blue-green pleochroic hornblende, which partly replaces both pyroxenes. Locally, the hornblende itself is replaced by pseudomorphs of reddish brown biotite and opaque minerals. In places, prograde and retrograde metamorphic reaction coronas are present on some pyroxenes. In one thin section, a high-grade metamorphic corona structure is preserved. This structure consists of equant grains of colourless hypersthene surrounded by an inner shell of light green clinopyroxene, which in turn is surrounded by a shell of polycrystalline plagioclase and in places antiperthitic plagioclase. In places within the same thin sections, a thin, secondary, i.e., retrograde, reaction corona of acicular blue-green amphiboles and opaque minerals separates the hypersthene from the inner shell of clinopyroxene. In other places, the outer plagioclase shell is replaced by a secondary corona of xenoblastic brown to blue-green hornblende containing numerous small, lenticular plagioclase inclusions. This outer hornblende shell separates the inner clinopyroxene shell from the groundmass of xenoblastic hornblende, plagioclase and clinopyroxene. Ilmenite and apatite form small xenoblasts in the groundmass and inclusions in the clinopyroxene.

Quartz Dioritic to Tonalitic, in Places Granodioritic Orthogneiss

This unit (unit 13b) is predominantly an intermediate rock type, and forms the second most abundant lithology within the mafic to intermediate orthogneiss bands in the eastern PSD. However, in the western PSD, where in general this unit occurs only locally, this lithology is the predominant rock type in two narrow sill-like bodies of mafic to intermediate orthogneiss between Maple Island and Short Bay on the Magnetawan River. In both segments of the PSD, intermediate orthogneiss is generally a light to medium grey weathering, medium grey amphibolite facies gneiss with plagioclase, hornblende and varied amounts of quartz and biotite. The rock is fine to medium and locally coarse grained, and foliated to layered. In thin section, the texture is generally heteroblastic and the most common mineral assemblage is plagioclase + quartz + hornblende + biotite + epidote ± potassium feldspar. Common accessory minerals are titanite, opaques, apatite and zircon. Aggregates of brown to blue-green pleochroic hornblende, biotite and epidote are secondary pseudomorphs after former pyroxenes. In the eastern part of the PSD in the map area, the intermediate orthogneiss is commonly interlayered with units of gabbroic to dioritic orthogneiss (*see* Photo 14), and in some of the more massive-looking outcrops of unit 13, these two lithologies grade into each other over distances up to several metres. Greenish grey lenses and patches of relict granulite facies pyroxene-bearing phases of the intermediate orthogneiss are locally present in some of the more massive-looking outcrops of amphibolite facies grey orthogneiss.

In contrast, relict granulite facies intermediate orthogneiss is locally abundant in the larger sill-like body near and to the south of Short Bay in the western part of the PSD. Good exposures of this relatively homogeneous medium- to coarse-grained, greenish grey to beige weathering, green-grey rock can be seen on Highway 520, approximately 1 km east of Gordon Lake. Here, this higher grade rock is massive to foliated and locally contains retrograde phases of grey feldspar augen-textured and layered gneiss, particularly where the outcrop is cut by narrow zones of ductile shear. The more massive, high-grade intermediate orthogneiss consists of an inequigranular granoblastic mosaic of plagioclase and quartz with subidioblastic porphyroblasts of black clinopyroxene surrounding irregular cores of brownish green pyroxene. The black pyroxene rims on these porphyroblasts are partly altered to hornblende. The quartz content ranges widely between 10 to 40 percent, and minor biotite and garnet are present locally. In places, this rock contains small metamorphic segregation stringers and lenses with large porphyroblasts of black clinopyroxene up to 10 cm in diameter set in an inequigranular granoblastic groundmass of smaller grained plagioclase, pyroxene and quartz (Photo 10).

In thin sections of this retrograded high-grade intermediate orthogneiss, the texture is generally heteroblastic. The most common mineral assemblage present is plagioclase + quartz + clinopyroxene + hornblende, with varied amounts of garnet, biotite and minor orthopyroxene. Accessory minerals are titanite, opaque minerals and apatite. The clinopyroxene is partially replaced by brown hornblende and pseudomorphic aggregates of brown to blue-green pleochroic hornblende, green to brown biotite and opaque minerals. Garnet, in places containing inclusions of titanite and opaque minerals, occurs as irregular, intergranular xenoblasts. Garnet is strongly corroded against plagioclase grains, and in places is rimmed by patches of intergrown acicular blue-green amphibole and brown biotite as pseudomorphs of a former pyroxene.

Metamorphic reaction coronas on the clinopyroxene are occasionally preserved. These coronas consist firstly of an altered subidioblastic clinopyroxene, around a core of orthopyroxene. Surrounding the clinopyroxene is a partial outer shell of xenoblastic brown to reddish brown hornblende. Secondly, these coronas may consist of an altered subidioblastic clinopyroxene surrounded by a shell of xenoblastic, brown to reddish brown and locally blue-green pleochroic hornblende containing intergranular smaller grains of titanite and opaque miner-

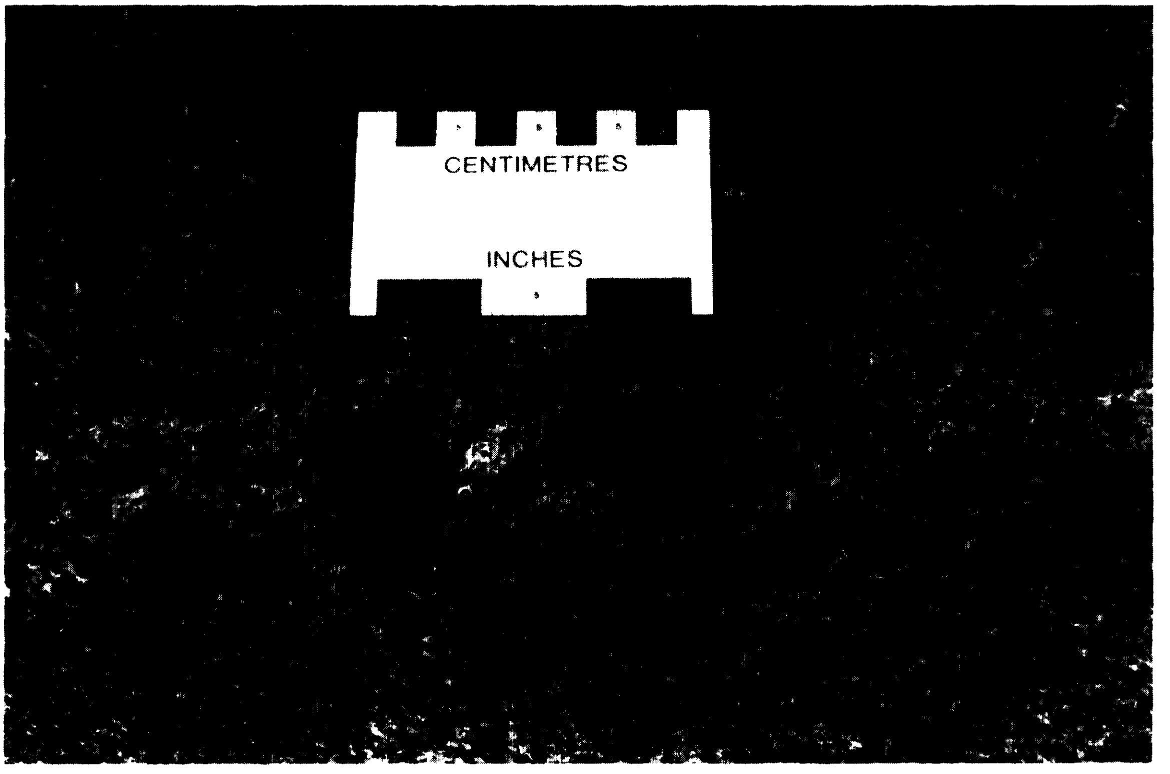


Photo 10. Homogeneous quartz dioritic to tonalitic orthogneiss (unit 13b) in retrograded granulite facies containing a relict granulite facies quartz + pyroxene + plagioclase metamorphic segregation veinlet, western PSD; south of Highway 520 to the east of Gordon Lake, McKenzie Township.

als. These hornblende shells completely separate the clinopyroxene from the plagioclase-rich groundmass. In both coronas, the clinopyroxene is partly altered to light brown to blue-green pleochroic hornblende containing abundant blebs and ameboid-shaped inclusions of plagioclase. Orthopyroxene, when present, is altered to acicular blue-green amphiboles and opaque minerals.

The results of chemical analysis of the mafic to intermediate orthogneisses are given in Table 7.

OTHER GNEISSES AND RELATED TECTONITES

Unit 13c This unit represents amphibolite-grade amphibolite and hornblende gneiss of uncertain origin, which occur within large sill-like bands of mafic to felsic orthogneiss (units 13 and 14). These rocks occur only in the eastern PSD as thin interlayers or small isolated outcrops. One notable occurrence is the narrow band of amphibolite that is interlayered with larger bands of quartzofeldspathic gneiss, diorite and gabbroic anorthosite on Highway 520 north of Dunchurch. These dark grey mafic gneisses are generally fine to medium grained, foliated to layered, and consist mainly of hornblende and plagioclase with varied amounts of biotite, and in places, porphyroblastic garnet.

Unit 13d This unit represents outcrops of mafic to intermediate orthogneiss (units 13a and 13b, in places 13c) containing intermediate to felsic gneiss interlayers (probably unit 14). This unit occurs in the eastern part of the PSD in the map area.

Unit 13e This unit represent local zones of high-strain, mafic to intermediate, tectonic layered gneisses, that in places are protomylonitic, and which occur in subunits 13a to 13d. These tectonites occur in both segments of the PSD and are localized along and within millimetre- to metre-sized, concordant to anastomosing shears cutting the mafic to intermediate orthogneisses. Where the outcrop is a transposed gneiss containing interlayers of intermediate to felsic gneiss, the granitic interlayers are preferentially more strained and have been transformed into protomylonitic to mylonitic gneisses.

Unit 13f This unit represents tectonic inclusions of mafic to intermediate orthogneiss (units 13b and 13c, in places 13a) that were identified in the WLSC near the north end of upper Whitestone Lake.

INTERMEDIATE TO FELSIC GNEISSES (UNIT 14)

Granodioritic To Granitic Orthogneiss

This intermediate to felsic unit (unit 14a) is only present in the eastern segment of the PSD, where it forms several large bands or sill-like bodies that traverse the map area. These bands range from 150 to 900 m in width in the central part of the eastern PSD to wider bands, in part composite bands, up to 4 km wide in the northeastern and southeastern parts of the eastern PSD. The

TABLE 7. CHEMICAL ANALYSES OF THE EARLY TECTONIC MAFIC TO INTERMEDIATE AND FELSIC METAPLUTONIC ROCKS (units 13 and 14) IN THE PSD, WHITESTONE LAKE AREA.
For sample locations see Figures 5 and 6.

Terrain	Eastern Parry Sound Domain				Western Parry Sound Domain		
Rock Unit	13a	13a	13b	14a	13b	13a	13a
Sample Number	86EGB–1089	86EGB–1081	86EGB–1080	86EGB–1071	EGB–1054	86EGB–1056	86EGB–1055
SiO_2 (wt%)	47.30	53.80	68.50	63.20	66.50	71.80	74.70
Al_2O_3	23.30	18.20	16.80	19.30	16.90	12.70	10.80
Fe_2O_3*	5.93	8.60	2.17	3.72	3.11	4.66	4.92
FeO	–	–	–	–	–	–	–
MgO	7.04	3.88	0.79	0.91	0.83	0.99	0.89
CaO	10.00	7.44	3.46	4.60	5.57	4.09	3.10
Na_2O	2.51	4.28	4.75	5.40	3.37	3.03	2.47
K_2O	1.45	1.05	1.62	1.04	0.50	0.33	0.96
TiO_2	0.29	0.99	0.30	0.57	0.76	1.62	1.12
P_2O_5	0.02	0.28	0.04	0.16	0.86	0.20	0.20
MnO	0.11	0.14	0.08	0.05	0.05	0.07	0.04
CO_2	0.27	0.19	0.13	0.27	0.23	0.17	0.16
S	0.03	0.06	0.01	0.01	0.01	0.05	0.01
LOI	1.80	0.20	0.30	0.50	0.40	0.20	0.20
total	99.70	98.90	98.80	99.50	99.20	99.70	99.40
TRACE ELEMENTS							
Co (ppm)	40	25	8	10	12	12	11
Cr	52	36	12	<10	<10	<10	<10
Cu	29	49	9	21	12	15	13
Ni	163	14	5	<5	<5	<5	<5
Pb	<10	<10	<10	<10	<10	<10	<10
Zn	62	121	36	81	45	62	71
V	46	161	32	–	–	–	–
Nb	<5	<5	<5	<5	<5	5	7
Rb	57	<5	10	9	<5	<5	28
Sr	459	866	605	998	513	407	298
Y	19	37	10	15	22	11	25
Zr	88	198	140	189	202	142	631
Th	<10	<10	<10	<10	<10	<10	<10
Au (ppb)	<2	<2	<2	–	–	–	–
Pt	<1	<1	<1	–	–	–	–
Pd	<1	<1	<1	–	–	–	–

* *Total iron as Fe_2O_3*

wider bands or composite band segments locally contain: 1) discontinuous bands of possibly older mafic to intermediate orthogneiss (unit 13); 2) discontinuous sills or megaboudins (podiform bodies) and numerous small dikes of diorite (unit 15); and 3) discontinuous sills or megaboudins of anorthosite suite rocks (unit 16).

The predominant rock type is an intermediate to felsic orthogneiss having a mineral assemblage of the amphibolite facies. This rock was formed from an older high-grade granodiorite which in places was a granite. This orthogneiss is white to light pinkish grey and grey weathering, and is pink to pinkish grey on the fresh surface. The rock is quartzofeldspathic in composition and contains biotite, varied amounts of hornblende and minor garnet. This rock is generally medium to coarse grained, foliated and lineated, and in places is augen-textured and layered. Flattened and elongated quartz grains, in places quartz aggregates up to 2 cm long, define a prominent, shallow to moderate, east-southeast plunging lineation. This fabric is a common feature of the granodioritic to granitic orthogneiss.

Thin section examination reveals that this foliated and lineated intermediate to felsic orthogneiss is flaser textured. Here, lenses and ribbon-like crystals of highly strained quartz, as well as ovoid to lenticular xenoblasts of feldspar, are set in a finely crystalline matrix of feldspar, quartz and mafic minerals. The most common mineral assemblages are: 1) plagioclase + quartz + potassium feldspar + biotite + hornblende ± garnet; 2) microperthite + quartz + plagioclase + biotite + hornblende ± garnet, muscovite; and locally 3) plagioclase + quartz + microcline + muscovite ± biotite. Common accessory minerals present are titanite, magnetite and apatite. Light to dark green and locally brown pleochroic biotite defines the foliation. Light to dark brown hornblende is locally replaced by pseudomorphs of fibrous actinolite and chlorite. Garnet, when present has strongly corroded grain boundaries when in contact with plagioclase.

Patches of rock having minerals indicative of a relict granulite facies metamorphism, which in places form shear-bounded and less deformed lenses, occur locally in the pink-grey amphibolite facies orthogneiss. The relict granulite facies, intermediate to felsic orthogneiss, having a mineralogy indicative of a relict granulite facies metamorphism, is a beige to light olive-green weathering, light greenish grey quartzofeldspathic rock. This rock contains varying amounts of pyroxene and garnet. This rock is medium to coarse grained and massive to foliated. In thin section, the more massive varieties are inequigranular seriate textured. Foliated rocks are heteroblastic, and locally flaser textured where lenticular grains, in places aggregates of quartz, feldspar and pyroxene, define the foliation. Mineral assemblages are antiperthite + plagioclase + quartz + clinopyroxene + hornblende + garnet ± potassium feldspar ± biotite, and perthitic microcline + quartz + plagioclase + clinopyroxene + hornblende + garnet ± biotite. Accessory minerals are opaques and apatite. In one thin section of relatively undeformed, high-grade orthogneiss, the large antiperthitic plagioclase xenoblasts are generally surrounded by smaller mortar grains of recrystallized plagioclase ± quartz which separate the antiperthite from nearby large xenoblasts of quartz, antiperthite and clinopyroxene. The clinopyroxene commonly exhibits a metamorphic reaction corona consisting of a thin shell of hornblende and quartz symplectite which separates the pyroxene from the mortar grains around nearby grains of antiperthite and, in places, quartz. In one case, a thicker, outer shell of brown hornblende partly rims the inner hornblende-quartz symplectite around the clinopyroxene. In the same specimen, a subidioblastic garnet crystal is partly rimmed by a shell of hornblende and quartz symplectite that separates the garnet from xenoblastic quartz. Where the reaction corona is missing on this same crystal, the garnet is corroded by plagioclase. The garnet commonly contains abundant fine-grained opaque inclusions and, in places, is partly rimmed by radiating laths and aggregates of brown biotite. The secondary hornblende replacing the clinopyroxene displays a brown to blue-green pleochroism.

The results of chemical analysis of one sample of granodioritic orthogneiss is given in Table 7. Good examples of this orthogneiss are exposed in roadcuts to the north and east of the junction of Highway 520 and 124.

Other Gneisses and Related Tectonites

Unit 14b This unit represents granodioritic to granitic orthogneiss (unit 14a) containing interlayers of mafic to intermediate gneiss.

Good examples of unit 14b can be seen along Highway 124, south of Robertson Lake and 0.6 km east of the Ministry of Transportation and Communications (MTC) gravel yard on Highway 124.

Unit 14c This unit designates a granodioritic to granitic orthogneiss that is locally cut by steeply dipping, concordant, in places anastomosing ductile shear zones. These shear zones range in width from 1 to 30 cm. The former medium- to coarse-grained orthogneiss within these local internal shear zones has been transformed into thinly layered, fine-grained protomylonitic gneiss and in places to a fine- to medium-grained quartz-feldspar augen gneiss. Adjacent to these mylonite zones, the granodioritic to granitic (unit 14a) orthogneiss exhibits all gradations from massive to layered orthogneiss to layered tectonic gneiss. The layered tectonite commonly consists of subordinate, sharply bounded interlayers of mafic gneiss in a uniformly fine- to medium-grained, massive-looking felsic gneiss. These layered tectonites are similar to those in the PSDBZ (unit 21) described later in the text.

Early to Syntectonic Mafic to Intermediate Metaplutonic Rocks

Younger suites of less deformed mafic to intermediate metaplutonic rocks were emplaced successively into the previously described supracrustal and metaplutonic gneisses of the PSD (units 10 to 14). In order of interpreted decreasing age these younger metaplutonic rocks consist of an earlier diorite suite (unit 15) and a younger anorthosite suite (unit 16).

DIORITE SUITE ROCKS AND RELATED TECTONITES (UNIT 15)

Distribution, Contact Relationships and Geochronology

In the map area, the diorite suite rocks typically consist of relatively homogeneous, high-grade diorite that in many places has been subjected to varying degrees of deformation and recrystallization during a regional retrograde metamorphic event. These massive to foliated and locally layered diorites occur mainly in the eastern part of the PSD, where they form: 1) large, 100 m to 1.2 km wide, continuous to discontinuous sill-like bodies or podiform megaboudins; 2) the northern part of a large, 2.5 to 3.5 km wide ovoid body along the southeastern boundary of the map area, which probably represents an extremely large megaboudin (tectonic slice); and 3) numerous, small, 30 cm to 10 m wide concordant dikes, in places dike swarms. In the western PSD, only a few small disrupted sills were identified along the northeastern and eastern margin of the WLIC. These diorites also form numerous, isolated tectonic blocks and lenses up to 140 m wide and 1 km long in the WLSC. Within this complex, these large tectonic inclusions display a north-trending inclusion-train pattern that parallels the regional trend of the WLSC as well as the regional fabric of the gneisses in the PSD to the east and west.

Contacts of the diorite sills and megaboudins with the enclosing older supracrustal and metaplutonic gneisses (units 10 to 14), as well as with the younger anorthosite suite rocks (unit 16), are concordant and generally tectonically modified. Contact phases in the larger bodies are typically foliated to layered amphibolite facies dioritic orthogneisses that are locally cut by narrow, concordant, protomylonitic shear zones. In many places near the contact between a diorite sill and a quartzofeldspathic or granodioritic orthogneiss (units 11 and 14 respectively), there is a concordant zone between the diorite sill and country rocks up to several metres wide that consists of thinly layered mafic and felsic tectonites similar to those found in the PSDBZ (unit 20e, described later in text). Contacts of the narrower dikes or layers are generally sharp and concordant to locally discordant to the fabric of the country rock. Boudinaged dikes are common; however, dikes and sills in the marble breccias (unit 10) are even more disrupted.

The author has correlated this diorite suite of rocks with the McKellar dioritic pluton described by Lacy (1960) near the village of McKellar, approximately 13 km to the south of the map area (*see* Figure 3, locality 7). A U-Pb zircon age of 1425±75 Ma was obtained from the McKellar plutonic mass or sill (van Breemen et al. 1986). The same pluton (*see* Figure 3, localities 3 and 4) yielded a Rb-Sr isochron age of 1241 Ma (Connare and McNutt 1985), probably reflecting isotopic resetting after intrusion. In the map area, the large diorite sill (unit 15) that outcrops along Highway 520 in the northwest corner of Croft Township (*see* Figures 5 and 6), which in the past has been referred to as the "Whitestone diorite" by Lacy (1960), Mason (1969) and Ueno et al. (1975), yielded average $^{40}Ar/^{39}Ar$ hornblende and biotite ages of 980 Ma and 940 Ma respectively (Dallmeyer and Sutter 1980). The Rb-Sr and K-Ar ages possibly reflect isotopic resetting after regional northwest-directed thrusting.

Lithologic Subdivisions and Petrology

The diorite suite rocks (unit 15) in the Whitestone Lake area consist mainly of high-grade pyroxene-bearing diorite and to a lesser extent retrograde hornblende-bearing diorite and minor quartz diorite. This suite of rocks does not include granodioritic to granitic phases that, in the past, have been considered to be comagmatic phases of the diorite within the "McKellar gneiss" or "plutonic mass" by Lacy (1960), Connare and McNutt (1985), and van Breemen et al. (1986). The author considers these spatially associated, more felsic orthogneisses to be part of an older metaplutonic series, and has assigned most of them to units 14 and 13.

In contrast to the older, weakly magnetic, gabbroic to dioritic orthogneiss (unit 13), hand specimens of these younger diorites (unit 15) contain appreciably more magnetite (up to 1 percent) and strongly attract a hand-held magnet. The magnetic property of unit 15 is also clearly demonstrated on aeromagnetic maps of the region (ODM 1953a, 1953b; GSC 1965). In the eastern segment of the PSD, most large diorite sills and to a lesser extent some smaller sills and dike swarms in the older supracrustal and metaplutonic gneisses (units 10 to 14) can be identified and traced along strike on the aeromagnetic maps.

All gradations from massive to foliated and layered grey diorite in the amphibolite facies to waxy olive-green relict granulite facies diorite can be seen on Highway 520, about 700 m south of the secondary road turn-off to the village of Maple Island (local name).

The results of chemical analysis for six samples of the diorite suite rocks in the eastern part of the PSD are given in Table 8. Also shown in this table are analyses for two titanium oxide-enriched samples of metasomatized diorite (from Mason 1969), taken from a small sill near the eastern contact of the WLIC in the western part of the PSD.

Pyroxene-bearing Diorite This unit (unit 15a) is the predominant rock type and is typically a dark greenish-grey weathering, waxy olive-green to greenish grey hornblende-pyroxene-plagioclase rock. This relatively homogeneous, high-grade mafic orthogneiss is medium to coarse grained, locally retrograded and massive to weakly foliated; small, lineated metamorphic segregations, consisting of relict granulite facies patches and veinlets of coarser grained pyroxene and feldspar are locally present. In thin sections of olive-green diorite, the texture is commonly inequigranular interlobate-granoblastic and is locally inequigranular seriate. The main mineral constituents are plagioclase, orthopyroxene and clinopyroxene with variable amounts of secondary hornblende and minor quartz. Magnetite and apatite are the main accessory minerals. Plagioclase is generally antiperthitic; there are seriate-textured varieties. Large lensoid to ovoid plagioclase xenoblasts are surrounded by heteroblastic aggregates of finer grained plagioclase. The twin lamellae in the larger xenoblasts are invariably deformed. Poikiloblastic orthopyroxene, probably hypersthene, is pleochroic from greenish to pale reddish grey and is partly altered along its grain boundaries and cleavage traces to brown and blue-green pleochroic hornblende. Poikiloblastic clinopyroxene is neutral to pale greenish and is altered in varying degrees to brown and blue-green pleochroic hornblende: aggregates of brown hornblende and biotite occur around magnetite inclusions. Reaction coronas of brown to blue-green hornblende and quartz symplectite are present around clinopyroxene.

Hornblende±Pyroxene-bearing Diorite This unit (unit 15b) is generally a dark grey weathering, greenish grey to dark grey hornblende-plagioclase rock containing variable amounts of pyroxene and minor amounts of quartz and biotite. This grey retrograde amphibolite facies equivalent of unit 15a is medium to coarse grained, in places fine to medium grained, and massive to foliated and layered. Locally, plagioclase porphyroblasts and augen may be present. In thin section, massive to foliated grey diorite is heteroblastic; layered varieties are nematoblastic. The main mineral constituents are plagioclase and hornblende with subordinate amounts of clinopyroxene and minor biotite and quartz. Common accessory minerals are magnetite and apatite with very minor amounts of secondary epidote, calcite and chlorite. In places, the combined primary and secondary quartz content of this grey orthogneiss is sufficient to term the rock a quartz diorite. Plagioclase is generally not antiperthitic and most of the clinopyroxene is strongly altered to brown and blue-green pleochroic hornblende, and in places to pseudomorphic aggregates of hornblende, biotite and opaque minerals. Reaction coronas of hornblende-quartz symplectite around clinopyroxene are present locally and orthopyroxene is rare or absent.

TABLE 8. CHEMICAL ANALYSES OF THE DIORITE SUITE ROCKS (unit 15) IN THE PSD, WHITESTONE LAKE AREA.
For sample locations see Figures 5 and 6.

BODY	Dunchurch Diorite Sill (eastern PSD)				Other Diorite Sills (eastern PSD)		East Contact Diorite Sill (western PSD)	
Sample Number	86EGB–1073	86EGB–1074	86EGB–1076	86EGB–1077	86EGB–1072	86EGB–1075	69IMM–482	69IMM–483
SiO_2 (wt%)	53.50	53.60	57.00	47.00	54.80	51.80	45.56	49.54
Al_2O_3	18.90	18.80	17.70	13.80	18.80	18.90	12.43	19.31
Fe_2O_3*	8.41	8.34	7.65	14.10	7.88	9.37	19.27	3.00
FeO	–	–	–	–	–	–	–	7.21
MgO	3.83	4.12	3.66	5.69	3.19	4.42	3.86	4.81
CaO	7.55	7.85	6.54	10.40	7.14	8.05	11.91	9.07
Na_2O	4.27	4.01	3.84	3.46	4.78	4.31	2.20	3.86
K_2O	0.72	0.75	1.02	1.19	1.06	0.56	0.29	0.57
TiO_2	0.83	0.74	0.76	1.69	0.93	0.80	3.26	1.08
P_2O_5	0.20	0.15	0.14	0.27	0.30	0.19	–	–
MnO	0.12	0.15	0.14	0.21	0.13	0.17	–	–
CO_2	0.72	0.50	0.29	0.47	0.18	0.17	–	–
S	0.14	0.05	0.03	0.29	0.01	0.04	–	–
LOI	0.40	0.70	0.50	0.40	0.20	0.80	–	–
total	98.70	99.20	99.00	98.50	99.30	99.30	98.78	98.45
TRACE ELEMENTS								
Co (ppm)	31	27	24	51	25	29	–	–
Cr	43	59	47	52	30	48	–	–
Cu	92	51	28	34	26	30	–	–
Ni	29	25	20	48	11	21	–	–
Pb	< 10	< 10	< 10	43	< 10	< 10	–	–
Zn	105	107	89	139	100	109	–	–
Nb	–	170	141	–	–	194	–	–
Rb	< 5	< 5	< 5	< 5	< 5	< 5	–	–
Sr	< 5	< 5	< 5	24	< 5	< 5	–	–
Y	720	758	559	567	1038	719	–	–
Zr	26	25	28	44	42	29	–	–
Th	202	174	179	171	203	163	–	–
Ba	< 10	< 10	< 10	< 10	< 10	< 10	–	–
Ce	–	< 2	< 2	–	–	< 2	–	–
Ld	–	< 1	< 1	–	–	< 1	–	–
Nd	–	< 1	< 1	–	–	< 1	–	–

* *Total iron as* Fe_2O_3

Other Gneisses and Related Tectonites This unit (unit 15c) represents massive to foliated, fine- to medium-grained, dark grey to black mafic dikes or layers of dioritic composition in the older supracrustal and metaplutonic gneisses within the eastern part of the PSD. These dioritic units characteristically attract a hand-held magnet, in contrast to the much weaker magnetic character of the older amphibolite orthogneiss dikes or layers of unit 13. However, these diorite dikes cannot always be distinguished by this feature alone from younger, late to syntectonic amphibolite dikes (unit 18). Good examples of these diorite dikes intruding granodioritic orthogneiss (unit 14) are exposed on Highway 124 south of Robertson Lake.

Unit 15d This unit designates foliated to layered grey diorite cut by thin, generally less than 10 cm wide, concordant to locally anastomosing ductile shear zones marked by units of thinly layered, fine-grained protomylonitic mafic gneiss. This unit also forms outcrops that in whole or part consist of layered tectonic gneiss composed of homogeneous, fine- to medium-grained mafic gneiss with subordinate interlayers of quartzofeldspathic gneiss of indeterminate protolith. These layered tectonites are similar to those described in the PSDBZ (unit 20e, described later in the text), and occur mainly near the contact of a diorite sill with quartzofeldspathic gneiss (unit 11) and granodioritic to granitic orthogneiss (unit 14).

Unit 15e This unit represents tectonic inclusions of massive to layered, grey diorite orthogneiss, in places containing patches of waxy olive-green pyroxene-bearing diorite, that generally occur in the WLSC. Several large tectonic lenses of diorite orthogneiss can be seen along Highway 520 to the west of Maple Island, and on the secondary road south of northern Whitestone Lake.

ANORTHOSITE SUITE ROCKS AND RELATED TECTONITES (UNIT 16)

Distribution, Contact Relationships and Geochronology

In the map area, anorthosite suite rocks (unit 16) consist predominantly of amphibolite-grade gabbroic anorthosite with subordinate phases of anorthosite and gabbro (units 16b, 16e and 16g respectively). These rocks form intrusive bodies within the PSD and locally are present as large tectonic inclusions in the PSDBZ. In the western part of the PSD, anorthositic rocks form the northern part of the large WLIC, a 30 km long, tadpole-shaped body extending from near Dunchurch south towards the town of Parry Sound (*see* Figure 3). In contrast, anorthositic rocks in the eastern part of the PSD form numerous, smaller, up to 1 km wide, continuous to discontinuous sill-like bodies or megaboudins. Contacts with the enclosing older supracrustal and intrusive complex gneisses are concordant and generally tectonically modified. In places along its east-central margin, the contact of the WLSC with the enclosing gneisses is relatively intact. Here, along this contact (*see* Figures 4 and 6), the wall rocks consist of contact metasomatized supracrustal gneisses (*see* Table 5) containing at least two small, interlayered sills of diorite (unit 15) in pyroxene-hornfels facies. In other places along the eastern margin of the WLIC, the contact is truncated by the fault-bounded WLSC (*see* Figure 6 and Map 2540). Rocks along the contact of most anorthositic bodies are typically well foliated and exhibit a variety of textures ranging from layered gneiss to finer grained protomylonitic and mylonitic gneiss. All these anorthositic bodies are deformed and recrystallized to various degrees; however, away from their highly deformed contacts relict primary igneous textures and compositional layering can be recognized in many places throughout the WLIC and smaller sill-like bodies near Dunchurch (*see* Figure 6). Similar primary structures were observed locally in individual outcrops within many of the other smaller units throughout the northeastern part of the map area. Primary and metamorphic structures in parts of the larger WLIC have been described in detail by Mason (1969) and Nadeau (1984).

The anorthosite suite, in contrast to the previously described older, high-grade diorite suite (unit 15), and the older series of retrograded supracrustal and metaplutonic gneisses (units 10 to 14), was only subjected to the late-stage amphibolite facies metamorphism that appears to have accompanied the late overthrusting event. South of the map area, near Parry Sound (*see* Figure 3, locality 5), anorthosite suite rocks from the Mill Lake body yielded a U-Pb zircon age of 1350 ± 50 Ma (van Breemen et al. 1986).

Lithologic Subdivisions and Petrology

The anorthositic rocks in the map area show a wide variation in the mode of their preserved primary mineralogy from anorthosite to gabbro. In this report, the following terms are used to designate the bulk compositional range of the various phases in this suite of metamorphosed igneous rocks: 1) anorthosite contains less than 10 percent mafic minerals; 2) gabbroic anorthosite, which in this report includes the more mafic transitional phase anorthositic gabbro, contains 10 to 35 percent mafic minerals; and 3) gabbro contains more than 35 percent mafic minerals. The broader range for gabbroic anorthosite was used because at both outcrop and map scale, all phases, particularly gabbroic anorthosite and anorthositic gabbro are intimately associated and somewhat erratically distributed. Also, the development of garnet at the expense of clinopyroxene and plagioclase in the recrystallized and deformed facies of gabbroic anorthosite tends to increase the colour index of these rocks. In the least deformed and recrystallized anorthositic rocks, the relict primary mineralogy consists of plagioclase (labradorite), clinopyroxene (augite) and minor amounts of quartz and opaque iron-titanium oxides. Uncommon orthopyroxene is present and most clinopyroxenes exhibit an outer hornblende metamorphic reaction corona, and in places, an inner corona of hornblende and quartz symplectite. In deformed gabbroic anorthosite and gabbro, recrystallized plagioclase, in places primary plagioclase, hornblende, garnet and varied amounts of altered clinopyroxene constitute the essential minerals. These minerals are accompanied by small amounts of secondary quartz, scapolite, epidote, biotite, calcite, muscovite and chlorite. Accessory minerals are iron-titanium oxides, apatite and titanite.

The three main lithologic groups, gabbroic anorthosite, anorthosite and gabbro, together with their primary and metamorphic textural variants shown on Map 2540 (back pocket) and illustrated in Photos 11 to 15 are described below. Descriptions are brief, the prefix "meta" is assumed, and the reader is referred to Mason (1969) and Nadeau (1984) for more detailed descriptions of the petrology and mineralogy in the anorthositic rocks of the WLIC.

Gabbroic Anorthosite The predominant lithology in the WLIC and smaller sill-like bodies is a massive to foliated, medium- to coarse-grained, greyish white rock (unit 16b) (Photos 11 and 14). The most common textural variants are relict hypidiomorphic granular and subophitic. A former hypidiomorphic inequigranular texture in the rock is not always apparent because most of the plagioclase has recrystallized. In places, relict primary bluish grey and pink plagioclase laths up to 2 cm long may occur locally and the rock has a pseudo-porphyritic aspect. In subophitic-textured rocks, the outline of the former plagioclase laths, in places up to 5 cm, is still distinct although the plagioclase has been completely recrystallized. Pegmatitic phases of gabbroic anorthosite with subhedral clinopyroxene megacrysts up to 10 cm long were observed locally in the WLIC. Where present, these pegmatites generally form sharp to gradationally bounded, concordant to locally discordant layers and lenses in compositionally layered units; however, in places they form crosscutting, relatively sharply bounded narrow dikes and veinlets which in one place were seen to emanate from a concordant, gradationally bounded pegmatitic gabbroic anorthosite layer in the rock.

Gabbroic Anorthosite Gneiss and Layered Orthogneiss This rock (unit 16c) is shown in Photo 12. These orthogneisses are concentrated near the margins of large plutons and form the predominant rock type in smaller sheets, megaboudins or tectonic inclusions (unit 16k).

Photo 11. Massive gabbroic anorthosite in eastern margin of the Whitestone Lake Intrusive Complex (WLIC), western part of the Parry Sound Domain (PSD); northwest arm of upper Whitestone Lake, Hagerman Township.

Oikocrystic Gabbroic Anorthosite This rock (unit 16d) is one of the most abundant and widely distributed phases in the northern, eastern and western parts of the WLIC, and occurs locally in the smaller sill-like bodies in the eastern PSD (*see* Figure 4 and 6). This massive to foliated rock consists of spherical clots, ranging from 1 cm to 30 cm in diameter (Photo 13), of clinopyroxene crystal(s) which subophitically enclose recrystallized former laths of plagioclase. Mason (1969) described this texture as "glomeropoikilitic"; however, in thin section this pyroxene structure can be seen to consist of large, single, optically continuous clinopyroxenes that include small relict plagioclase laths. In some pyroxene clots, opaque minerals are intergrown with the clinopyroxene and locally partly or completely enclose small relict plagioclase laths. The primary textures in this oikocrystic phase indicate that here, the crystallization of the euhedral and subhedral plagioclase occurred first and was followed successively by that of interstitial anhedral clinopyroxene and iron-titanium iron oxides.

Anorthosite This rock (unit 16e) contains less than 10 percent mafic minerals, is massive to layered, and generally occurs interlayered with the more abundant gabbroic anorthosite in all map area sill-like bodies. However, anorthosite is the predominant rock type in the south-central part of the WLIC between Snakeskin and Highrock lakes (*see* Figures 5 and 6). Massive to foliated anorthosite is fine to medium grained and white, light bluish grey, and in places green. In general the plagioclase is completely recrystallized and in the WLIC near Dunchurch and Highrock lakes along the southern boundary of the area, the anorthosite commonly contains less than 1 percent mafic minerals and the rock typically displays an equigranular to inequigranular granoblastic texture.

Oikocrystic Pyroxene-bearing Anorthosite This rock (unit 16f) forms subordinate primary interlayers and in places gradational phases with the variously textured units of gabbroic anorthosite (units 16a and 16d) in the outer parts of the WLIC, and occurs sporadically near Highrock Lake.

Gabbro Gneiss This rock (unit 16g) is a foliated to layered, in places massive, medium- to coarse-grained, medium to dark grey hornblende-pyroxene-plagioclase rock. This gneissic unit may be more abundant than anorthosite in many of the smaller bands in the eastern PSD; however, it is a minor phase in the WLIC. In this body, several deformed layers of gabbro can be seen in an outcrop of strongly foliated oikocrystic anorthosite on the north-central shore of De Bois Lake. Here the former spherical pyroxene clots are elongated in a northeasterly trending direction; this fabric in the enclosing anorthosite now lies at an acute angle to the more northerly trending primary igneous layering defined by the gabbro interlayers.

Primary Igneous Layered Anorthositic Rocks This unit (unit 16h) occurs locally in most sills within the PSD.

Photo 12. Layered gabbroic anorthosite gneiss (unit 16c), eastern Parry Sound Domain (PSD); in band north of Wauby Lake, Ferrie Township.

This primary feature was observed in many places near the margin of the WLIC. Some of the localities are shown on Figure 6, all others are shown on Map 2540 (back pocket). The relict igneous layering generally consists of interlayered units or alternating layers of variably textured gabbroic anorthosite or anorthosite or both and, in places, gabbro (Photo 14). Locally, an indistinct primary layering is defined by variations in size of pyroxene clots in oikocrystic phases. Primary layers vary from 5 to 60 cm in thickness in thin to medium interlayered or alternating units of massive, subophitic, and in places oikocrystic, gabbroic anorthosite and massive anorthosite. In thicker layers (up to several metres) primary layers consist of alternating units of massive to oikocrystic gabbroic anorthosite and anorthosite, which is in places oikocrystic anorthosite. Primary gabbroic interlayers if present seldomly exceed 1 m in thickness.

Garnet-bearing Phases These phases (unit 16i) are common in deformed units of gabbroic anorthosite, gabbro (units 16d and 16g) and, in places, oikocrystic anorthosite (unit 16f) near the margins of the sills. The garnet has formed at the expense of some of the primary clinopyroxene and plagioclase in the rock during deformation and recrystallization. It forms scattered grains and fine- to medium-grained polycrystalline aggregates with plagioclase in or near deformed, amphibolitized clinopyroxene clots and megacrysts. The garnet may constitute up to 10 percent of the gabbroic anorthosite; elongated garnet-rich aggregates help to define the foliation. In the WLIC, garnetiferous rocks are widespread along the deformed northern and eastern margins of the unit. However, although the rocks along the western margin of this body appear to be just as deformed, garnet is only developed locally and epidote is more common in the deformed mafic mineral-bearing phases of the body.

Epidote-bearing Phases This alteration phase (unit 16j) of the foliated to layered gabbroic anorthosite occurs in several places on De Bois Lake, near the fault-bounded western margin of the WLIC. These fine- to medium-grained, greenish grey and green phases of strongly deformed and recrystalllized gabbroic anorthosite are particularly common near narrow (up to 3 m wide) gradationally bounded zones. These zones are composed of thinly layered mafic gneiss and in places, protomylonitic gneiss near the above contact. At the east end of De Bois Lake, approximately 200 m from the main fault-bounded western contact, a second deformation zone of this epidote-bearing anorthosite is present. This zone trends parallel to and forms part of one of the northeasterly trending fault zones that offset the northern contact of the WLIC (*see* Figures 5 and 6). Within this 10 to 15 m wide deformation zone can be seen all gradations from medium-grained, greenish grey gabbroic anorthosite gneiss to fine-grained green, massive to thinly layered epidote-rich protomylonite. In contrast to this, epidote is generally a minor interstitial phase in the foliated to layered, and in places protomylonitic, gabbroic anorthosite along the northern and eastern margins of the WLIC.

Sheared Varieties This unit (unit 16k) designates anorthositic rocks (units 16b to 16g), as well as large tectonic inclusions of these same main rock types (unit 16l) that are cut by steeply dipping and concordant to more shallow dipping and anastomosing ductile shear zones ranging from centimetres to metres in width. In the narrower shears, the rock is generally transformed into a finer grained protomylonitic gneiss (*see* Photo 14). Along the western and eastern margins of the WLIC, the massive to foliated rocks in this sill-like body near and up to 200 m from its fault-bounded contacts are cut by zones of closely spaced, northerly trending narrow ductile shears. These local zones of deformation are commonly concentrated near several northerly trending faults (*see* Figure 6 and Map 2540) which cut the pluton, offset its northern contact and parallel the regional trend of the WLSC. Wider ductile shear zones are more common near the tectonically modified contacts of the WLIC, as well as in parts of the larger tectonic inclusions within the WLSC. In the latter, the rocks are commonly transformed into mylonitic transposed gneisses (*see* Photo 15), that may display locally disrupted internal folds and mylonitic flow folds.

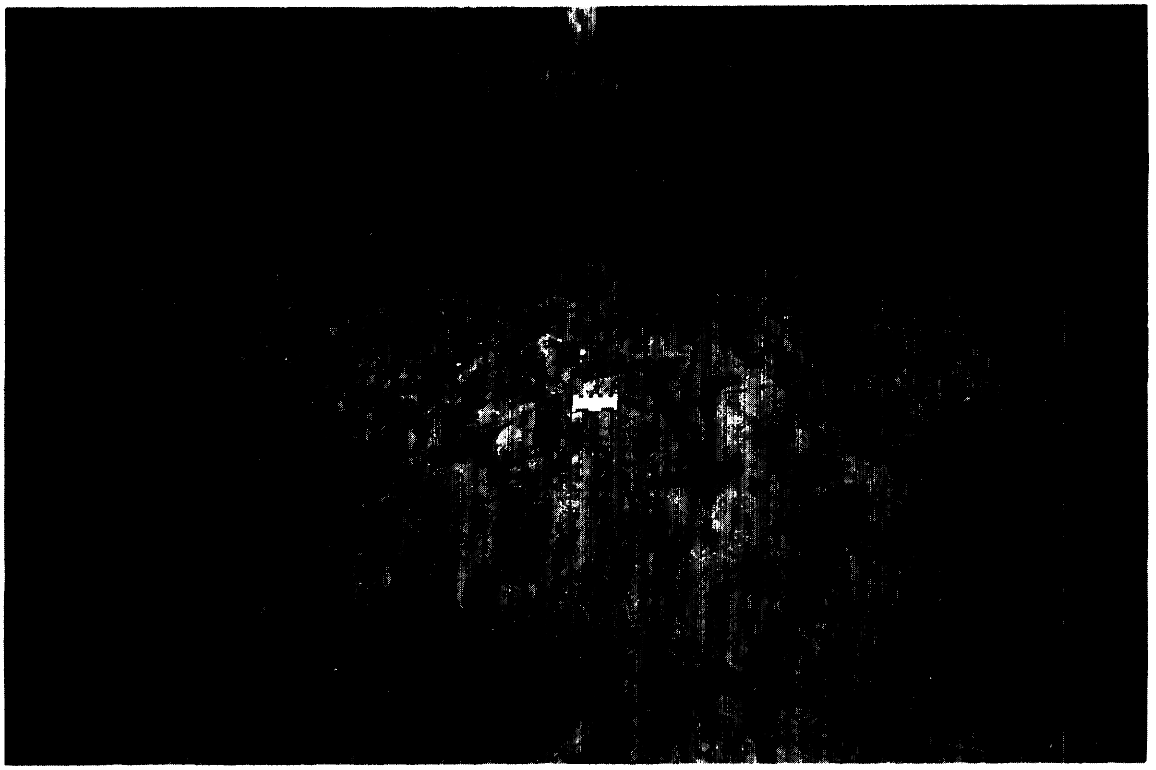


Photo 13. Oikocrystic pyroxene-bearing gabbroic anorthosite in Whitestone Lake Intrusive Complex (WLIC), western Parry Sound Domain (PSD); Hagerman Township.

Photo 14. Protomylonitic gabbroic anorthosite gneiss (left) truncating deformed, primary compositionally layered, subophitic gabbroic anorthosite and anorthosite at northeastern faulted contact of the Whitestone Lake Intrusive Complex (WLIC), western Parry Sound Domain; northwest shore of upper Whitestone Lake, Hagerman Township.

Photo 15. Mylonitic gabbroic anorthosite, an outcrop of transposed gneiss within a large anorthositic tectonic inclusion in the Whitestone Lake Intrusive Complex (WLSC); on upper Whitestone Lake, Hagerman Township.

Unit 16l This unit represents tectonic inclusions of deformed, in places massive and recrystallized, rocks of the anorthosite suite (units 16b to 16k). These inclusions generally occur in the PSDBZ and the WLIC, and range in size from metre-sized blocks to lenses 1 km long and 300 m wide. Good examples of the boundary zone tectonic inclusions occur in the eastern PSDBZ along Highway 124, about 800 m west of the western secondary road turnoff to Ahmic Harbour; and in the WLSC along the west-central shore of upper Whitestone Lake. Several small, isolated tectonic inclusions of gabbro to gabbroic anorthosite gneiss up to 2 m wide and bounded by anastomosing shears were observed within the interior gneisses in the eastern PSD. These tectonic inclusions occur in local protomylonitic shear zones within the older supracrustal and metaplutonic gneiss bands exposed along Highway 124 west of the eastern PSDBZ. These inclusions possibly represent relatively "*in situ*" but strongly disrupted segments of minor sill-like bodies in the older gneisses.

Geochemistry of the Anorthosite Suite

Whole rock and selective major mineral chemical analyses of the rocks in the WLIC have been discussed by Mason (1969). The results of major element chemical analysis of 12 selected samples from Mason's study that occur in the map area are given in Table 9a. For comparison purposes, major and trace element analyses of seven additional samples from the WLIC collected by the author and Marmont and Johnson (1987) are given in Table 9b.

The results of major and trace element chemical analysis of the anorthosite suite rocks within smaller units in the eastern PSD, as well as from tectonic inclusions within the various boundary zones of this domain are given in Table 10.

Syntectonic to Late Tectonic Felsic and Mafic Dikes (units 17 and 18)

Moderately to highly deformed amphibolite grade felsic and mafic dikes (units 17 and 18 respectively) were observed to intrude concordantly, and in places crosscut, rocks of the diorite suite (unit 15) and the anorthosite suite (unit 16). Similar crosscutting relationships were also observed in some of the diorite and anorthosite suite tectonic inclusions in the WLIC. Subdivisions in these two groups of younger dikes are shown on the map (Map 2540, back pocket) and are briefly described below. The age relationship between them is uncertain.

FELSIC INTRUSIVE ROCKS AND RELATED TECTONITES (UNIT 17)

Leucogranite Dikes These dikes (unit 17a) consist of white and pinkish light grey weathering, pink, salmon pink and light grey granitic rocks that generally contain less than 2 percent biotite. These rocks are fine to medium grained and massive, in places sugary textured to foliated. Contacts are generally sharp and locally tectonically modified. These felsic dikes, which occur in the interior part of the PSD, range from 1 cm to 1 m wide, are locally boudinaged and in places strongly disrupted. Good examples of these leucogranite dikes can be seen on Highway 520, in the first large outcrop of diorite (unit 15) south of the secondary road turnoff to the village of Maple Island (local name), and farther south on the same highway at the junction with the secondary road to Cody Rapids on the Magnetawan River.

Coarse-grained to Pegmatitic Dikes These dikes (unit 17b) are white and light grey weathering, pinkish grey and light grey and have a granitic to granodioritic composition. Plagioclase is the dominant feldspar. Most units contain between 3 to 10 percent combined biotite and hornblende as well as minor magnetite. Some dikes are massive-looking, but most are strongly foliated, boudinaged and locally strongly disrupted. These coarser grained dikes, which occur mainly in the interior part of the PSD, average between 10 to 40 cm in width. Strongly deformed examples of this unit can be seen cutting layered diorite gneiss (unit 15), opposite La Brash Lake on the secondary road leading north from Maple Island.

Unit 17c This unit represents finer grained varieties of the leucogranite and pegmatitic granite dikes (units 17a and 17b respectively), and shows various degrees of

TABLE 9a. SELECTIVE CHEMICAL ANALYSES OF THE ANORTHOSITE SUITE ROCKS (unit 16) IN THE WLSC, WESTERN SEGMENT OF THE PSD, WHITESTONE LAKE AREA; FROM MASON (1969).
For sample locations see Figure 6.

Rock Type	Anorthosite					Gabbroic Anorthosite and Gabbro						
Sample Number	69IMM-144	69IMM-134	69IMM-105	69IMM-080	69IMM-013	69IMM-017	69IMM-020	69IMM-002	69IMM-106	69IMM-107	69IMM-90	69IMM-24
SiO_2 (wt%)	52.16	52.51	52.29	52.19	53.81	54.00	51.68	51.73	48.08	48.62	51.12	48.87
Al_2O_3	27.86	27.11	28.21	27.35	22.46	21.99	22.71	20.53	26.60	19.50	21.10	21.11
Fe_2O_3	0.64	0.66	0.67	0.61	1.28	1.10	1.50	2.86	0.89	1.52	1.72	3.24
FeO	0.92	1.81	0.68	1.46	4.70	3.81	5.41	6.46	1.90	3.55	6.40	7.45
MgO	1.06	1.37	0.82	1.00	1.99	2.07	1.56	1.99	2.39	5.22	2.57	3.09
CaO	12.03	11.57	11.97	11.55	9.69	11.03	10.37	9.76	16.19	17.96	10.50	10.06
Na_2O	4.06	3.92	3.91	3.80	4.03	3.60	3.88	3.21	2.15	1.79	3.30	3.07
K_2O	0.61	0.45	0.56	0.44	0.56	0.81	0.52	0.92	0.42	0.20	0.60	0.38
TiO_2	0.14	0.26	0.14	0.25	0.92	0.72	1.12	1.51	0.31	0.51	1.43	1.73
P_2O_5	-	-	0.01	-	-	-	-	-	0.02	0.03	0.11	-
MnO	-	-	0.02	-	-	-	-	-	0.04	0.08	0.12	-
CO_2	-	-	0.21	-	-	-	-	-	0.35	0.48	0.56	-
S	-	-	0.01	-	-	-	-	-	0.02	0.02	0.04	-
Cl	-	-	0.01	-	-	-	-	-	0.01	0.01	0.01	-
H_2O^+	-	-	0.47	-	0.51	-	0.48	-	0.42	0.46	0.49	-
LOI	-	-	-	-	-	-	-	-	-	-	-	-
total	99.66	99.48	100.00	98.65	99.95	99.13	98.96	98.97	100.06	99.96	100.06	99.00

TABLE 9b. MAJOR AND TRACE ELEMENT ANALYSES OF THE ANORTHOSITE SUITE ROCKS (unit 16) IN THE WLSC, WESTERN SEGMENT OF THE PSD, WHITESTONE LAKE AREA; FROM THIS REPORT AND MARMONT AND JOHNSTON (1987).
For sample locations see Figure 6.

Rock Type	Gabbroic Anorthosite			Anorthosite			
Sample Number	86EGB-1057	86EGB-1058	86EGB-1059	86CCM-085	86CCM-086	86MMJ-3015	86MMJ-3018
SiO_2 (wt%)	50.60	50.80	52.70	51.60	51.70	51.50	51.70
Al_2O_3	25.20	22.40	27.00	29.30	29.30	28.80	29.40
Fe_2O_3*	3.27	5.81	2.49	1.09	1.06	1.13	1.05
FeO	-	-	-	-	-	-	-
MgO	2.24	4.38	0.39	0.14	0.05	0.18	0.00
CaO	13.80	9.94	10.90	12.10	12.10	12.10	11.99
Na_2O	3.26	3.48	3.96	4.14	4.19	4.22	4.27
K_2O	0.34	0.66	0.56	0.44	0.47	0.45	0.71
TiO_2	0.27	0.28	0.25	0.15	0.05	0.14	0.15
P_2O_5	0.02	0.01	0.05	0.01	0.01	0.01	0.03
MnO	0.09	0.14	0.07	0.01	0.01	0.02	0.02
CO_2	0.27	0.33	1.14	0.19	0.35	0.19	0.20
S	0.03	0.02	0.08	0.02	0.02	0.01	0.01
LOI	0.20	1.20	0.50	-	-	-	-
total	99.20	99.10	98.80	99.19	99.26	98.75	99.56
TRACE ELEMENT LISTING							
Co (ppm)	16	25	6	-	-	-	-
Cr	62	62	< 10	< 10	< 10	< 10	< 10
Cu	22	13	26	-	-	-	-
Ni	13	28	< 5	-	-	-	-
Pb	< 10	< 10	< 10	-	-	-	-
Zn	31	62	35	-	-	-	-
V	57	65	18	2	< 1	7	3
Nb	< 5	< 5	< 5	-	-	-	-
Rb	< 5	8	< 5	-	-	-	-
Sr	485	475	543	-	-	-	-
Y	6	6	9	-	-	-	-
Zr	78	80	105	-	-	-	-
Th	< 10	< 10	< 10	-	-	-	-
Au (ppb)	< 2	< 2	< 2	-	-	-	-
Pt	< 1	< 1	< 1	< 1	< 1	-	-
Pd	< 1	< 1	< 1	< 1	2	-	-

* *Total iron as Fe_2O_3*

shearing and cataclasis. A good example of this deformation occurs in the previously mentioned large outcrop of diorite on Highway 520, just to the south of the turnoff to Maple Island. Here, a coarse-grained to pegmatitic granitic dike emplaced along the contact between marble and layered diorite gneiss has been, in places, transformed into a fine-grained, massive protomylonite or thinly layered protomylonite containing porphyroblasts of allanite up to 1 cm in diameter.

Cataclastically deformed, in many places disrupted, thin dikes or layers (0.5 to 15 cm thick) of leucogranite and pegmatitic granite which are similar to some of the rocks of unit 17, are common in the highly strained layered tectonites (units 20 and 21) of the PSDBZ. These dikes or transposed dikes, which are generally too small to be shown separately on the map are, however, incorporated into the descriptions of units 20 and 21. They may have been in part intruded at the same time as those of unit 17, which are only shown (Map 2540, back pocket) cutting the supracrustal and metaplutonic gneisses of the interior part of the PSD.

MAFIC INTRUSIVE ROCKS (UNIT 18)

Amphibolite Dikes This rock (unit 18a) forms concordant to locally discordant dikes up to 4 m wide. These amphibolitic units are generally dark grey to black, fine to medium grained and massive to foliated; plagioclase porphyroblasts may be present (Photo 16). Many dikes are boudinaged and contacts are locally tectonically modified; however, sharp contacts, in places chilled margins as shown in Photo 16, are locally preserved. Where these amphibolite dikes are strongly deformed, showing varying degrees of cataclasis, shearing, and in places disruption, they have been subdivided as unit 18b.

Good examples of these amphibolite dikes can be seen: 1) cutting anorthosite suite rocks (unit 16) on Highway 124, approximately 1 km south of the village of Dunchurch; 2) cutting diorite suite rocks (unit 15) on Highway 520, approximately 600 m south of the second-

TABLE 10. MAJOR AND TRACE ELEMENT ANALYSES OF THE ANORTHOSITE SUITE ROCKS (unit 16) FROM THE EASTERN SEGMENT OF THE PSD, AS WELL AS FROM TECTONIC INCLUSIONS WITHIN THE PSDBZ(S) AND WLSC, WHITESTONE LAKE AREA.
For sample locations see Figures 5 and 6.

Body	Dunchurch Area Units in eastern PSD				Parker Lake Units in eastern PSD	Tectonic Inclusions in PSDBZ(S)		Tectonic Inclusions in WLSC	
Sample Number	86EGB-1085	86EGB-1086	86EGB-1087	86EGB-1084	86EGB-1088	86EGB-1042	86EGB-1031	86EGB-1032	86EGB-1061
SiO_2 (wt%)	49.50	56.70	57.40	44.30	44.90	51.30	52.40	48.30	41.40
Al_2O_3	14.80	25.50	19.80	13.30	27.20	19.60	14.20	15.70	13.00
Fe_2O_3*	8.77	1.48	6.10	18.10	5.90	9.85	11.70	14.50	14.90
FeO	-	-	-	-	-	-	-	-	-
MgO	6.57	0.57	2.59	7.27	3.35	2.37	6.19	5.96	10.40
CaO	14.00	7.03	6.37	10.10	12.70	7.90	8.90	9.05	13.00
Na_2O	2.65	5.41	4.50	1.93	2.09	4.24	2.27	2.08	1.83
K_2O	0.57	1.10	0.90	0.38	0.91	1.06	1.12	0.90	1.53
TiO_2	1.07	0.13	0.36	2.42	0.89	1.50	1.29	2.00	1.52
P_2O_5	0.00	0.00	0.10	0.50	0.01	0.99	0.14	0.20	0.18
MnO	0.18	0.07	0.14	0.28	0.10	0.19	0.21	0.22	0.20
CO_2	0.46	0.38	0.27	0.14	0.56	0.16	0.22	0.36	0.23
S	0.08	0.03	0.05	0.07	0.02	0.01	0.01	0.02	0.15
Cl	-	-	-	-	-	-	-	-	-
H_2O^+	-	-	-	-	-	-	-	-	-
LOI	0.60	0.70	0.60	0.04	0.18	0.0	0.70	0.50	0.70
total	98.70	98.70	98.8	99.00	99.80	99.0	99.1	99.4	98.7
TRACE ELEMENTS									
Co (ppm)	42	9	22	65	27	26	40	50	57
Cr	68	< 10	19	58	18	< 10	47	45	415
Cu	76	20	25	47	9	109	11	29	48
Bi	58	5	14	71	20	< 5	62	31	106
Pb	< 10	< 10	< 10	< 10	< 10	< 10	1 < 10	< 10	< 10
Zn	94	23	< 90	175	42	114	136	144	173
V	274	17	< 85	439	177	731	180	407	350
Nb	< 5	< 5	< 5	< 5	< 5	< 5	5	< 5	10
Rb	< 5	8	< 5	< 5	14	< 5	23	24	8
Sr	571	1364	814	385	845	698	270	317	341
Y	24	< 5	12	51	16	45	54	40	53
Zr	114	119	119	108	114	133	95	171	121
Th	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Au (ppb)	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Pt	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1
Pd	< 1	< 1	< 5	< 1	< 1	< 1	< 1	< 1	< 1

Photo 16. Chilled margin of porphyroblastic plagioclase amphibolite dike (unit 18).

ary road to the village of Maple Island; and 3) cutting the still older felsic to intermediate orthogneisses (unit 14) on Highway 124, south of Robertson Lake.

The results of chemical analysis of five syntectonic to late tectonic mafic dikes and one felsic dike in the eastern PSD are given in Table 11.

Whitestone Lake Structural Complex (WLSC) (Marble Tectonic Breccia Zone) (unit 19)

DISTRIBUTION AND CONTACT RELATIONSHIPS

In the central part of the map area, the PSD is traversed by a major fault-bounded zone containing a heterogeneous mixture of tectonically disrupted and interlayered units of metasedimentary gneiss, principally marble, and a variety of metaplutonic gneisses which the author has termed the Whitestone Lake Structural Complex (WLSC) (Bright 1987) (*see* Figures 4 and 7). This northerly trending tectonic zone underlies most of upper Whitestone Lake and extends northward through Maple Island on the Magnetawan River across the map area following the course of Ferrie Creek. From north to south, the WLSC varies from 0.5 km in width near Ferrie Creek to 1.2 km in width beneath and to the south of upper Whitestone Lake. This complex separates the western and eastern segments of the PSD. To the east, this complex lies in faulted contact with a large, parallel, northerly trending sill-like body of diorite (unit 15) that extends beyond the limits of the study area. However, to the west, the WLSC locally truncates the northerly trend of some of the major lithological units in the western PSD, in particular the eastern margin of the WLIC (unit 16). To the south, beyond the limits of the study area, this 13 km long marble tectonic block breccia zone follows along the eastern margin of this body for at least another 9 km before thinning out between Shawanaga and Lorimer lakes, just to the northwest of the village of McKellar (*see* Figure 3). The strike extension distance of the narrow northern part of this tectonic zone is not known.

The WLSC has been defined as a lithodemic unit on the basis of its lithologic heterogeneity and structural character (NASCN 1983), and in many respects is very similar to the Denna Lake Structural Complex (DLSC) of the Central Metasedimentary Belt Boundary Zone in the Grenville Province near Minden, Ontario (Easton 1986a). Like the DLSC, the WLSC can be characterized as a chaotic melange of isolated lenses, layers and large tectonic blocks of metasedimentary and metaplutonic rocks and gneisses set in a matrix of smaller fragment sizes in a marble tectonic breccia. Or alternatively, the WLSC is a mylonitic marble that is similar to the marbles previously described in unit 10. Like their counterparts in the eastern PSD, the marbles in the WLSC have been subdivided on the basis of dominant clast lithology (units 19a to 19d), or alternatively by clast dimensions (unit 19c to 19f). These calcitic marble breccias and block tectonites are best exposed along the shoreline of upper Whitestone Lake. For the petrography of the marble matrix of these tectonites, the reader

TABLE 11. CHEMICAL ANALYSES OF SYNTECTONIC TO LATE TECTONIC FELSIC AND MAFIC DIKES (units 17 and 18) IN THE PSD, WHITESTONE LAKE AREA.
For sample locations see Figures 5 and 6.

Rock Type	Felsic Dike (unit 17)	Mafic Dikes (unit 18)				
Sample Number	(1) 86EGB–1053	(2) 86EGB–1082	(3) 86EGB–1083	(4) 86EGB–1077	(5) 86EGB–1078	(6) 86EGB–1079
SiO_2 (wt%)	76.10	49.00	48.60	47.00	48.30	47.60
Al_2O_3	13.40	13.40	18.20	13.80	12.90	14.40
Fe_2O_3*	0.48	15.20	9.38	14.10	15.90	12.90
FeO	–	–	–	–	–	–
MgO	0.17	5.09	7.18	5.69	5.63	7.10
CaO	0.80	10.30	9.53	10.40	10.60	11.30
Na_2O	2.32	2.66	2.66	3.46	2.48	1.71
K_2O	5.99	0.65	0.82	1.19	0.44	0.93
TiO_2	0.12	1.96	0.97	1.69	1.94	1.41
P_2O_5	0.02	0.22	0.11	0.27	0.20	0.18
MnO	0.01	0.23	0.15	0.21	0.25	0.19
CO_2	0.01	0.21	0.07	0.47	0.20	0.59
S	0.01	0.22	0.05	0.29	0.25	0.15
LOI	0.20	0.20	1.10	0.70	0.20	0.80
total	99.70	98.90	98.70	98.5	98.80	98.50
TRACE ELEMENTS						
Co (ppm)						
Cr	< 5	47	46	51	51	52
Cu	< 10	59	57	52	90	210
Ni	6	103	59	34	77	104
Pb	< 5	37	122	48	43	68
Zn	62	< 10	< 10	43	34	< 10
Nb	< 10	193	88	139	152	122
Rb	< 5	< 5	< 5	< 5	< 5	< 5
Sr	147	8	15	24	< 5	5
Y	92	281	457	567	256	255
Zr	6	49	21	44	50	38
Th	79	149	117	171	143	114

* *Total iron as Fe_2O_3*

(1): Granitic dike in diorite (unit 15b)
(2): Amphibolite dike or layer in gabbroic to dioritic orthogneiss (unit 13a)
(3): Amphibolite dike or layer in gabbroic to dioritic orthogneiss (unit 13a)
(4): Amphibolite dike in diorite (unit 15a)
(5): Amphibolite dike in gabbroic anorthosite (unit 16c)
(6): Amphibolite dike in gabbroic anorthosite (unit 16b)

is referred to the general description of the marbles in unit 10.

Lithologic Subdivisions of Rocks in the Whitestone Lake Structural Complex (WLSC)

Massive to Layered, in places Mylonitic Calcitic Marble This rock (unit 19a) forms layers, lenses or large blocks within marble breccia (units 19b to 19d). Small isolated outcrops of this type of massive-looking marble occur in the heavily drift-covered areas to the south and north of upper Whitestone Lake. These isolated occurrences are taken to represent parts of relatively non-tectonized blocks of marble within an unexposed marble breccia matrix.

Unit 19b This unit consists mainly of differentially weathered calcitic marble fragments in a coarsely crystalline calcite matrix containing minor disseminated diopside, phlogopite, chondrodite and graphite. Mylonitic flow banded, finer grained marble may be present around and between some fragments.

Unit 19c This unit is a marble tectonic breccia containing not only marble clasts, but also abundant subround to elongate and lenticular fragments (1 to 60 cm long) of para-amphibolite and calc-silicate gneiss. Locally some subangular inclusions of relict igneous-textured orthoamphibolite may also be present.

Unit 19d This unit is a breccia in which the predominant fragments are clastic siliceous metasedimentary rocks, presumably derived from unit 11. Quartzofeldspathic gneiss fragments generally form subrounded to elongate clasts, whereas fragments of quartzose gneiss and thinly interlayered quartzose and quartzofeldspathic gneiss are much more elongated, in places are protomylonitic, and locally are strongly contorted. Outcrops of this type of breccia are most common along the western shore of northern Whitestone Lake.

Unit 19e This unit represents isolated tectonic lenses and large blocks (up to the size of a house) of locally migmatitic, felsic to intermediate gneiss set in a marble tectonic breccia matrix (units 19b to 19d). The matrix breccia is not exposed everywhere and the protolith of the lenses and blocks is uncertain.

Unit 19f This unit represents isolated tectonic lenses and large blocks of mafic gneiss, amphibolite and layered amphibolite set in a matrix of units 19b to 19d. The enclosing matrix units are not exposed everywhere. Again, as in the previous unit, the protolith of these amphibolites is indeterminate.

Large Tectonic Inclusions in the Whitestone Lake Structural Complex

In addition to the six main units and or block breccias described above, the marble tectonic breccias in the WLSC also enclose even larger tectonic inclusions of known protolith that are as large as 300 m wide and 1 km long and are shown separately on the map (Map 2540, back pocket). Larger tectonic inclusions, which differ in metamorphic grade, include in order of decreasing abundance:

1. diorite suite rocks (unit 15) in retrograded granulite and retrograde amphibolite facies
2. anorthosite suite rocks (unit 16) in prograde amphibolite facies
3. clastic siliceous metasedimentary rocks (unit 11) in retrograde amphibolite facies
4. porphyroblastic mafic orthogneiss (unit 12) in relict granulite and retrograde amphibolite facies
5. mafic to intermediate orthogneiss (unit 13) in retrograde amphibolite and locally granulite facies

Contacts between these larger tectonic inclusions and the breccia matrix are seldom exposed. This is a reflection of the more easily eroded nature of the marble tectonic breccias. The long axis of larger tectonic inclusions generally parallels the northerly trend of the WLSC. Individual inclusions or outcrops within the boundaries of large inclusions may be internally deformed, and fabric trends, i.e., foliation and gneissic layering, locally lie at an acute angle to the northerly trending long axis of the inclusion. Near their boundaries, many inclusions are internally brecciated; remobilized marble or marble breccia veins and minor dikes occupy these late tectonic fracture zones. Phases of protomylonitic to mylonitic gneiss have developed near the margins of some inclusions, particularly inclusions of anorthosite suite rocks. These phases also form local networks of thin, straight to curvilinear anastomosing shears cutting many parts of an inclusion.

Some of the above tectonic inclusions are concordantly, to locally discordantly, intruded by metamorphosed granitic dikes (unit 17). These deformed, in places disrupted, felsic dikes appear to have been emplaced prior to or synchronous with the development of the WLSC.

Parry Sound Domain Boundary Zone(s) (PSDBZ) (units 20 and 21)

REGIONAL SETTING AND GEOCHRONOLOGY

The boundaries of the PSD, as shown in Figure 3, are characterized by regionally banded zones of ductile, shear-related gneisses and high-strain tectonites (Davidson and Morgan 1981; Davidson et al. 1982, 1985). These tectonite zones separate the less deformed rocks in the interior part of the PSD from adjacent domains and subdomains. The structurally "outer", in many places "lower", boundary of the PSDBZ is sharply defined against adjacent lithotectonic terrains; however, the boundary with the PSD is gradational. Scattered throughout these tectonite zones are large isolated tectonic inclusions, predominately gabbroic to anorthositic gneiss, that are relatively less deformed than the enclosing tectonites.

Several sheared granite pegmatites, emplaced during the development of the PSDBZ and located near Parry Sound, southwest of the map area (Figure 3, locality 6), yielded U-Pb zircon ages of 1120 to 1160 Ma (van Breemen et al. 1986). These ages give the approximate approximate time of thrusting which led to the development of the PSDBZ.

Terminology

The massive-looking and layered gneisses in the PSDBZ are tectonites, to the extent that most of the textures and structural features in these gneisses are the result of tectonism.

Some of the more important terms that have recently been introduced to describe tectonites (Davidson et al. 1982; Hanmer and Ciesielski 1984) and which proved useful in mapping within the Whitestone Lake area are discussed below and illustrated in Photos 3 and 17 to 21.

"Mylonite and Mylonite Gneiss" The term mylonite is applied to predominantly fine-grained tectonites that are generally very thinly layered, contain mineral augen or porphyroblasts, and in many places exhibit pronounced internal flow folding (*see* Photo 5). With increasing irregularity of grain size, mylonite and mylonite gneiss may grade into layered tectonic gneiss (as defined below).

"Porphyroclastic Gneiss" This coarser grained tectonic gneiss (tectonoclastic gneiss) consists of a matrix or background gneiss of varied composition (felsic to mafic, and in places pelitic) containing isolated potassium feldspar and plagioclase clasts and feldspar aggregates and streaks aligned in the foliation (*see* Photo 17). The more discrete clasts can be seen in many places to be mechanically and mineralogically disaggregated, coarse-grained quartz-feldspar pegmatite. Locally, some feldspar porphyroblasts are present, and in places there are large garnet porphyroblasts.

"Irregularly to Straight-layered Gneiss" This field term is collectively used to encompass the well-layered tectonic gneisses, i.e., the "straight gneiss" of Davidson et al.

Photo 17. Porphyroclastic mafic gneiss (unit 20d) consisting of isolated feldspar and pegmatite clasts in background mafic tectonic gneiss, western PSDBZ; on secondary road to Wahwashkesh Lake, about 700 m north of Highway 520.

(1982), through to the "transposed gneiss" of Hamner and Ciesielski (1984). These layered tectonites consist of continuous, centimetre to decimetre thick, fine- to medium-grained gneissic layers of varied composition, generally mafic and felsic gneiss, and to a lesser extent, gneisses of intermediate and pelitic composition. The layering is straight to undulating in the thinly layered tectonites and sheath folds; tight isoclinal folds may be present. In the more thickly layered tectonites the layering is less irregular, with marked variations in thickness between adjacent layers or groups of layers. In this tectonite, the layering is locally discontinuous and folds with axes oblique to the layering are present (*see* Photos 18, 19, 20 and 21).

"Block Tectonite" This coarse, tectonoclastic gneiss generally consists of mafic blocks in a less competent matrix gneiss of varied composition, commonly felsic (i.e., quartzofeldspathic), or in places pelitic (*see* Photo 20).

LITHOLOGIC SUBDIVISIONS AND PETROLOGY

In the map area, a western and eastern PSDBZ (*see* Figures 4 and 6) are present. Both tectonic zones dip moderately to steeply inward toward the PSD.

These tectonic zones were only subdivided into mappable units of predominately mafic or felsic rocks, because the mafic, felsic, intermediate and pelitic tectonites in the western and eastern parts of the PSDBZ are heterogeneous, but have a regionally banded character. Because of this, the various tectonic rock types present in these two main rock groups, i.e., mafic gneisses and tectonites (unit 20) and felsic gneisses and tectonites (unit 21), are described below.

Mafic Gneisses and Layered Tectonites (unit 20)

Mafic Gneiss This unit (unit 20a) is a massive to foliated, fine- to medium-grained, dark greenish grey to black rock of amphibolitic to locally dioritic composition (the matrix gneiss in Photo 19). This relatively homogeneous rock probably represents a recrystallized mafic tectonic gneiss that may have been strongly foliated to layered. It forms the predominant rock type in outcrops of the layered mafic tectonites (units 20d to 20g), as well as many isolated outcrops within the larger bands of mafic gneiss and tectonite, particularly in the central and eastern parts of the western PSDBZ.

Unit 20b This unit represents mafic gneiss, as described above, that locally contains thin dikes or layers, usually less than 15 cm thick of fine-grained leucogranitic gneiss (possibly unit 17c). In places these leucogranitic layers are boudinaged and very strongly disrupted and the rock may grade into porphyroclastic mafic gneiss (unit 20d).

Layered Mafic Gneiss This unit (unit 20c) represents a layered, possibly more strongly tectonized variety of units 20a and 20b. This tectonic rock type is common throughout the eastern PSDBZ and is particularly abundant near the western boundary of the western PSDBZ, where layered mafic tectonites (unit 20e) are more common.

Porphyroclastic Mafic Gneiss This unit (unit 20d) consists of a mafic matrix or mafic gneiss (units 20a, and in places units 20b to 20c) containing isolated feldspars and granite pegmatite clasts, possibly related to unit 17c. This tectonoclastic gneiss occurs throughout the PSDBZ as subordinate interlayers in outcrops of layered mafic, in places felsic, tectonites. It is notably more abundant in the western and eastern PSDBZs near their respective boundaries with the Britt and Ahmic domains. Good examples of this tectonite are exposed north of Highway 520 near Ainslie Lake, and along the secondary access road to Wahwashkesh Lake, about 400 and 600 m, respectively, north of Highway 520.

Irregularly to Straight-layered Mafic and Felsic Tectonite This tectonite (unit 20e) consists of thin- to medium-grained and thinly layered mafic tectonic gneiss (units 20a to 20c) containing up to 50 percent felsic, in places intermediate, layers (unit 21a) (*see* Photo 18). These rocks (Photo 18) are the predominant rock type in both the western and eastern PSDBZs. Both types of layered mafic tectonite, i.e., irregularly or straight-layered, can occur in the same outcrops, and in places along strike they grade into one another. In other places, these layered mafic tectonites grade along strike into outcrops

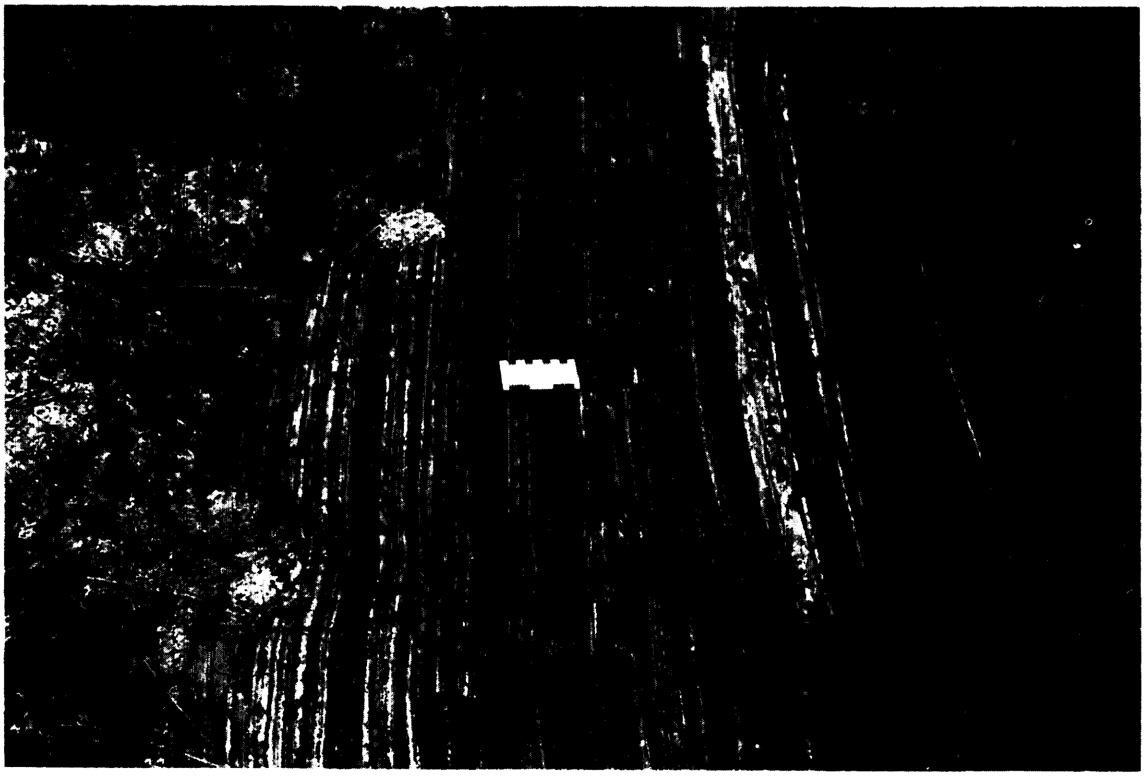


Photo 18. Straight-layered mafic and felsic tectonic gneiss (unit 20e), western PSDBZ; near northwestern margin of western PSDBZ, McKenzie Township.

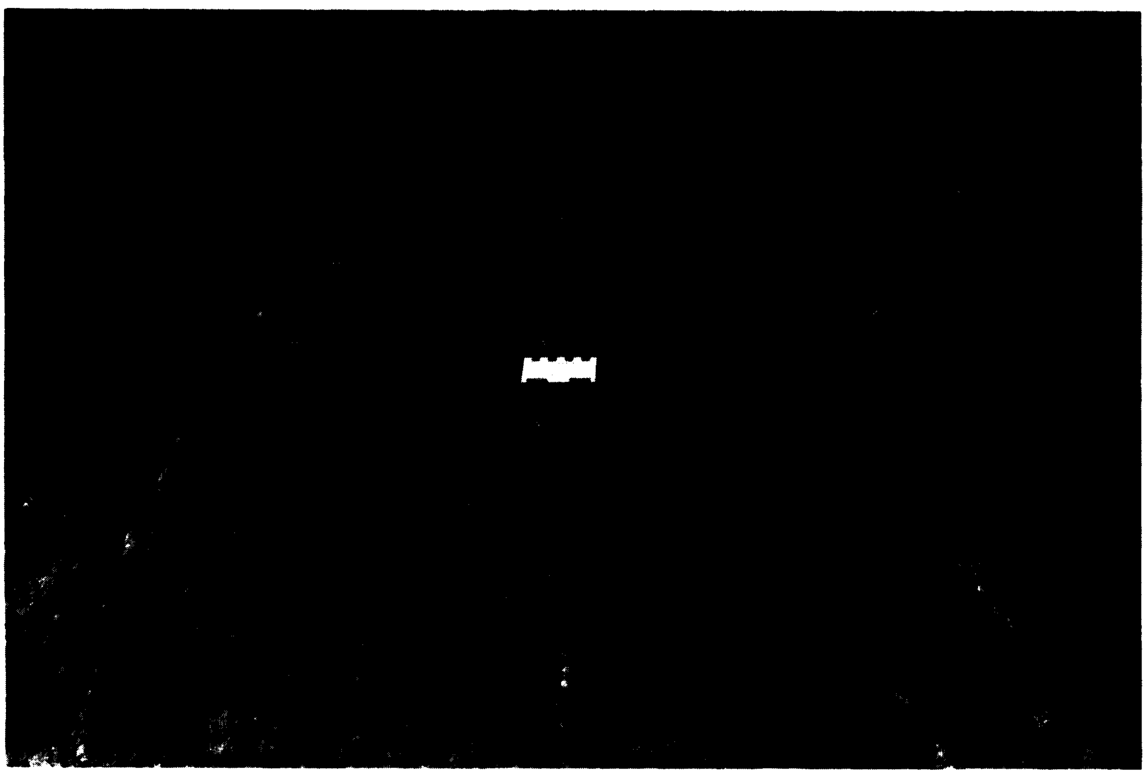


Photo 19. Irregularly layered felsic and mafic tectonic gneiss (unit 21d), western PSDBZ; near northwestern margin of PSDBZ, McKenzie Township. Note concordant northerly trending unmetamorphosed granite pegmatite dike at scale card.

Photo 20. Block tectonite (unit 20h), consisting of isolated and internally deformed blocks of mafic tectonic gneiss (unit 20b), enclosed by a background porphyroclastic pelitic gneiss, western PSDBZ; near northwestern margin of PSDBZ, McKenzie Township.

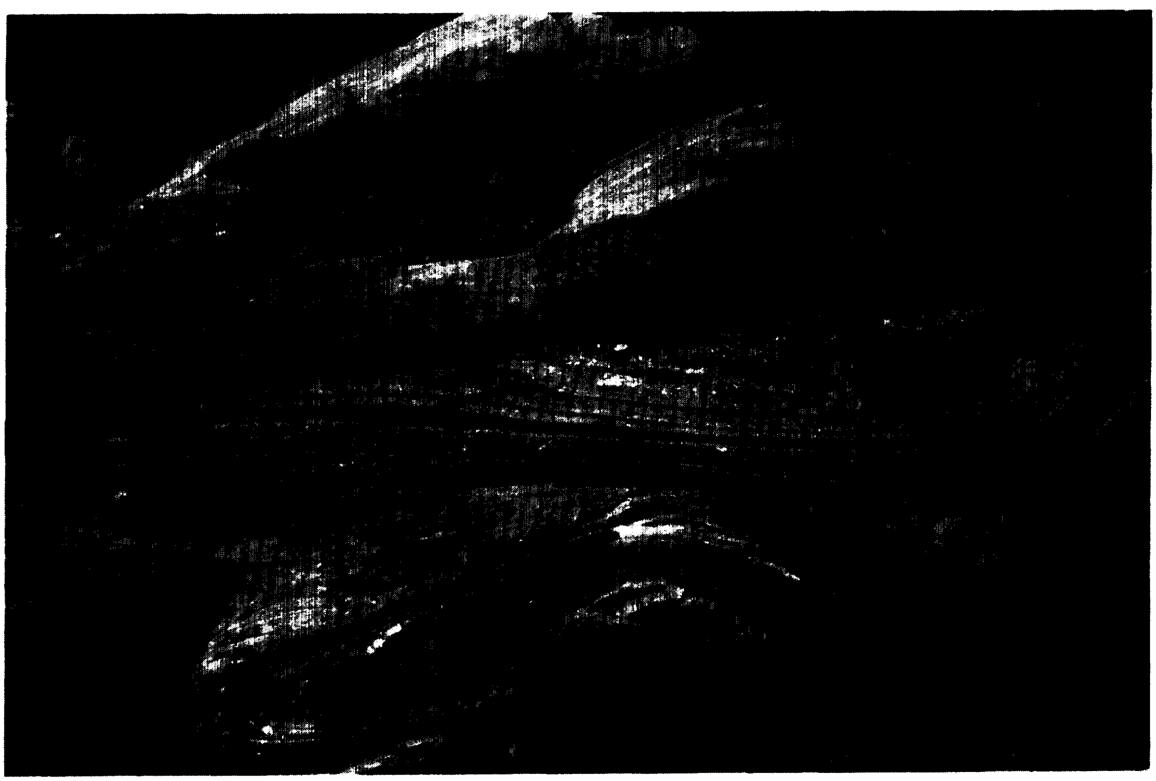


Photo 21. Sheath folds in high-strain unit of straight-layered felsic and intermediate tectonic gneiss, western PSDBZ; near northwestern margin of PSDBZ.

where felsic gneiss is the predominant rock type. Where this lithologic change is sufficiently large along and across strike, a separate band of felsic gneiss and tectonites (unit 21) is shown on Map 2540 (back pocket). Good examples of these layered mafic tectonites in the western PSDBZ can be seen along Highway 520, between Whitestone River and Ainslie Lake.

Unit 20f This unit consists of interlayered mafic and felsic tectonite (unit 20e), and in places porphyroclastic mafic gneiss (unit 20d) as described above, containing subordinate, commonly porphyroclastic interlayers of biotite gneiss and schist and biotite-amphibolite gneiss. Good examples of this lithological package can be seen north of Highway 520, southwest of Ainslie Lake. The more aluminous tectonites, i.e., muscovite-biotite schist and gneiss have been assigned to a subdivision of the felsic gneisses and tectonites (unit 21d).

Unit 20g This unit designates local, centimetre-sized mylonitic shear zones cutting mafic gneiss, layered gneiss and locally mafic tectonites (units 20a to 20e), as described above. In places, particularly in thicker units of mafic gneiss (units 20a to 20c), the rock contains anastomosing, shear-bounded lenses of less deformed mafic gneiss whose internal fabric may be discordant to that of the immediately enclosing mylonitic gneiss or layered tectonites.

Block tectonite This tectonite (unit 20h) consists of mafic blocks isolated in a less competent matrix gneiss. Several outcrops of this type of tectonite were observed very close to the western boundary of the western PSDBZ to the north of the Magnetawan River, near the northern boundary of the map area. Here, blocks of internally deformed mafic gneiss (unit 20b) occur in a matrix of garnetiferous muscovite-biotite gneiss and schist (Photo 20).

Felsic Gneisses and Tectonites (unit 21)

Felsic Gneiss, in Places Intermediate Gneiss This rock (unit 21a) is a massive to foliated, and in places lineated, fine- to medium-grained, pink, pinkish grey and light grey quartz-feldspar rock that generally contains less than 10 percent biotite with or without minor hornblende. This relatively homogeneous felsic rock is probably a recrystallized tectonic gneiss that may have been strongly foliated to layered. It forms the predominant rock type in outcrops of the layered felsic tectonites (units 21c to 21e), and locally small outcrops in the numerous tectonite bands of this unit. An exception to this, however, is the easternmost band in the western PSDBZ, near the northern margin of the map area. In this faulted-off band, most of the outcrops are massive, fine- to medium-grained and consist of inequigranular, granoblastic, biotite-poor, quartz-feldspar gneiss. This band may represent a tectonic inclusion of granite.

Layered Felsic Gneiss This rock (unit 21b) is a textural variant particularly common adjacent to areas of felsic gneiss cut by thin, concordant, ductile shear zones of thinly layered or laminated protomylonitic gneiss. It also occurs where the felsic gneiss contains interlayers of porphyroclastic felsic and pelitic gneiss (units 21c and 21e respectively). Small outcrops of units 21a and 21b are exposed on the access roads near Ainslie Lake, along the western boundary of the map area.

Porphyroclastic Felsic Gneiss This rock (unit 21c) consists of a background felsic to intermediate gneiss containing isolated feldspar and pegmatite clasts. Good exposures occur at the small rapids west of Needle Eye Rapids on the Magnetawan River and in the bush near the western boundary of the western PSDBZ.

Irregularly to Straight-layered Felsic and Mafic Tectonite This rock (unit 21d) is a thin- to medium-layered felsic tectonic gneiss containing up to 50 percent mafic gneiss layers (unit 20a) (Photos 20 and 21). Exposures of this type of layered tectonite can be seen in some of the felsic tectonite bands (unit 21) along Highway 520 to the west of the Whitestone River, and locally in several felsic tectonite-rich outcrop areas in some of the adjacent mafic tectonite bands (unit 20) in this same area.

Unit 21e This rock consists of subordinate interlayers of porphyroclastic biotite and muscovite-biotite + garnet gneiss and schist in units 21b to 21d, and locally in some layered mafic tectonites (unit 21c and 20f). The garnet in these gneisses and schists is characteristically mauve coloured. These aluminous tectonic gneisses and schists are most abundant in the layered tectonites near the northwestern boundary of the western PSDBZ. These rocks are also locally present along the boundary of the eastern PSDBZ with the Ahmic Domain where they are included in units 20e to 20f. In this eastern zone, several small exposures of locally porphyroclastic, garnet-muscovite-biotite schist occur along the secondary access road along the west side of Ahmic Lake, at a point about 0.6 km south of the village of Ahmic Harbour.

The results of chemical analysis of six samples of mafic to felsic tectonic gneiss (unit 20 and unit 21) collected by Mummery (1972) in the western PSDBZ are given in Table 12.

Metamorphic Mineral Assemblages in Tectonites

The gneisses and layered tectonites in the western and eastern PSDBZ developed in a ductile regime under regional amphibolite facies conditions. The mafic rocks and most of the felsic rocks in these tectonites generally exhibit no microscopic textural evidence of this high-strain deformation. Massive-looking mafic gneiss has a heteroblastic texture, whereas strongly foliated to layered gneiss is commonly nematoblastic. The felsic gneiss may be heteroblastic or inequigranular granoblastic, and in places where the rock is lineated, it is quartz ribbon textured. In thin sections of protomylonitic felsic to intermediate gneiss, the rocks are flaser textured and large ovoid to augen-like feldspar grains are present in the finer grained polycrystalline quartz-feldspar matrix between the quartz ribbons. Amphibolite facies mineral assemblages observed in the mafic, felsic and pelitic components of the various tectonites are provided for the rock types listed below:

TABLE 12. CHEMICAL ANALYSES OF MAFIC TO FELSIC TECTONIC GNEISSES (units 20 and 21) IN THE WESTERN SEGMENT OF THE PSDBZ, IN AND NEAR THE WHITESTONE LAKE AREA, AFTER MUMMERY (1972).

Rock Type	Mafic Tectonic Gneiss		Felsic to Intermediate Tectonic Gneiss				
Sample Number	(1) 72RCM–C23	(2) 72RCM–C20	(3) 72RCM–L2–48	(4) 72RCM–T–7	(5) 72RCM–T–8	(6) 72RCM–S–17	(7) 72RCM–S–14
SiO_2 (wt%)	49.02	52.00	49.33	70.23	71.82	70.88	70.53
Al_2O_3	20.44	13.65	17.07	14.10	13.27	12.99	14.51
Fe_2O_3	2.33	2.79	2.00	3.10	1.12	2.15	1.35
FeO	7.00	13.08	10.26	1.12	2.34	2.87	2.40
MgO	6.87	4.39	5.50	0.20	0.65	1.09	0.53
CaO	10.67	7.01	10.46	1.50	1.62	2.82	1.54
Na_2O	2.32	0.87	2.45	3.55	3.49	2.23	2.72
K_2O	0.84	1.99	0.87	6.04	5.16	4.24	6.07
TiO_2	0.57	3.46	2.02	0.39	0.49	0.73	0.37
P_2O_5	0.07	0.59	0.28	0.05	0.10	0.15	0.04
MnO	0.17	0.27	0.23	0.09	0.07	0.08	0.20
CO_2	0.02	0.14	0.07	–	0.01	0.01	–
H_2O^+	1.79	1.59	0.86	0.33	0.56	0.64	0.34
H_2O^-	0.25	0.37	0.05	0.13	0.11	0.10	0.08
total	102.16	102.20	101.45	99.83	100.81	100.98	100.68

(1): On north shore of De Bois Lake, approximately 1.3 km west of map area
(2): On north shore of De Bois Lake, approximately 1.9 km west of map area
(3): On Highway 520, approximately 3 km west of map area
(4): In map area, approximately 1.9 km north of Taylor Lake at outlet of Whitestone River
(5): In map area, approximately 1.6 km north of same point above
(6): On south shore of Snakeskin Lake, approximately 2.8 km west of map area
(7): On south shore of Snakeskin Lake, approximately 3.2 km west of map area

Mafic Gneisses This rock contains the amphibolite facies mineral assemblages: 1) hornblende + plagioclase + epidote + titanite ± quartz; and 2) hornblende + plagioclase + biotite + quartz ± titanite.

Felsic Gneisses This rock contains the amphibolite facies mineral assemblages: 1) plagioclase + microcline + quartz + biotite ± muscovite, epidote; and 2) plagioclase + quartz + microcline + biotite ± hornblende, epidote.

Pelitic Gneisses This rock contains the almandine-amphibolite subfacies mineral assemblages: 1) quartz + plagioclase + biotite + garnet; 2) plagioclase + quartz + potassium feldspar + biotite + muscovite + garnet; 3) quartz + plagioclase + muscovite + biotite + garnet + cordierite; and 4) quartz + plagioclase + muscovite + biotite + garnet + kyanite + cordierite.

In general, the protolith of these amphibolite-grade gneisses and tectonites is unknown; however, it is probable that most of these rocks were derived from the less deformed supracrustal and metaplutonic gneisses exposed in the interior part of the PSD. Within this regionally layered series of tectonites are isolated, less deformed tectonic inclusions of anorthosite suite rocks (unit 16); porphyroblastic plagioclase-rimmed garnet amphibolite (unit 12); and aluminosilicate-bearing mica tectonic gneiss and schist (in part unit 11c). In places near the lower boundaries of the PSDBZ, some mafic tectonites (unit 20) contain lenses of less deformed granitoid gneiss that possibly were derived from the Britt and Ahmic domains. Near Ahmic Harbour, an isolated tectonic inclusion of mafic tectonite (unit 20) occurs in the marginal granitic orthogneiss (unit 8) of the Ahmic Domain.

Boundary Relationships of the Western and Eastern PSDBZs

The western PSDBZ trends north-northeast, dips moderately to steeply east, and ranges in apparent width from 2.5 to 4 km. The western boundary of this tectonic zone is sharply defined against the granitic orthogneiss of the Britt Domain (*see* Figure 4). The structural trend of the various gneisses in this part of Britt Domain are drawn into parallelism with that of the western PSDBZ. In contrast to this, the concordant eastern boundary of this tectonic zone is somewhat gradational and was drawn on Map 2540 (back pocket) on the basis of the following structural, lithologic and metamorphic features. Accordingly, the eastern boundary of the western PSDBZ marks:

1. the approximate eastern limit of locally abundant porphyroclastic gneiss interlayers in the layered tectonites
2. the approximate eastern limit of large metaplutonic tectonic inclusions in the gneisses and layered tectonites
3. the area beyond which the protolith of the similarly north-northeasterly trending mafic and in many places the quartzofeldspathic and quartzose gneisses start to become discernable
4. the metamorphic transition between relict granulite facies mineral assemblages in the supracrustal

and metaplutonic gneisses to the east and the pervasive amphibolite facies retrogression of the tectonites to the west in the PSDBZ proper

In the eastern part of the map area, the 300 to 800 m wide eastern PSDBZ dips steeply in a westerly direction beneath the interior part of the PSD, as this tectonic zone swings around the domical-shaped part of the Ahmic Domain (*see* Figure 4). The eastern boundary of this tectonic zone is sharply defined against the marginal granitic orthogneiss of the Ahmic Domain. The structural trend and dip of the various gneisses in this domain are concordant to those in the curvilinear eastern PSDBZ. At the present level of erosion, the rocks in Ahmic Domain appear to dip beneath this eastern tectonic zone.

If the same parameters listed above are used, the western (inner) boundary of this eastern zone can be more sharply defined than the inner boundary of the western PSDBZ. Other structural features to note in and near the eastern PSDBZ, however, are; 1) within 100 to 200 m of the western boundary of the eastern PSDBZ, many of the gneisses just to the west in the interior part of PSD dip moderately to steeply eastward, towards this westerly dipping structural feature; and 2) along the northwestern part of this eastern PSDBZ, the structural trend of the rocks in the interior part of the PSD, to the north of Poverty Bay on the Magnetawan River, has been abruptly drawn into parallelism with the trend of the tectonic zone.

Even though more detailed structural analysis of the eastern PSDBZ is needed, some of the structural features of the zone suggest that it could represent a fundamental break in the crust, separate from that of the western PSDBZ. Alternatively, this part of the eastern PSDBZ could be a listric fault zone associated with the western tectonic zone.

Late Tectonic to Posttectonic Felsic Intrusive Rocks (unit 22)

PEGMATITIC GRANITE DIKES

Late to posttectonic, unmetamorphosed, potassic pegmatitic granite dikes intrude all the Middle Proterozoic rocks in the Britt, Parry Sound and Ahmic domains. Most dikes are not shown on Map 2540 (back pocket) and no consistent trend is observed; however, north and northeast-trending dikes are most common. These white weathering, pink and pinkish grey dikes are coarse grained to pegmatitic. These dikes are composed of pink and white potassium feldspar, in places graphic-textured potassium feldspar, white plagioclase and quartz, less than 5 percent biotite and minor amounts of hornblende and magnetite.

Phanerozoic

CENOZOIC

QUATERNARY

Pleistocene and Recent

The bulk of the Cenozoic sedimentary rocks in the map area were deposited during the last (Late Wisconsinan) glacial advance over the Parry Sound region. The direction of this last advance trends south-southwest, with ice-flow indicators, primarily striae, ranging predominantly between 185° and 220° azimuth (Kor 1986). The Parry Sound area was deglaciated for the last time at about 11.5 Ka, at which time it was submerged in an expanding glacial Lake Algonquin. The main Algonquin Lake phase, at about 10 Ka and an elevation of about 335 m above sea level (a.s.l.) (Kor 1986), would have submerged almost the entire map area (average elevation less than 300 m). Drainage outlets changed and subsequently lowered the lake level rapidly, thus exposing parts of the map area to erosion and selective reworking of the glacial deposits. At about 5.5 Ka, a new transgression of glacial Lake Algonquin, the Nipissing phase, once again inundated much of the map area. During the subsequent regression of glacial Lake Algonquin to the present level of Lake Huron after 3 Ka, the glacial deposits in the study area were extensively reworked, and in many places removed from bedrock elevations above about 265 m a.s.l.

The distribution and thickness of glacial drift in the map area varies greatly. Large tracts of bare bedrock having minor pockets of Pleistocene and Recent sediments dominate the following high relief terraines. These are the mafic and granitoid gneiss-rich area to the west of the WLSC and the granitoid gneiss-rich Ahmic Domain along the east-central boundary of the map area. Surficial deposits typically consist of a thin, discontinuous veneer of stony sand till and local glaciofluvial and glaciolacustrine sand and silt. Immediately east of the high western bedrock terrain, the central marble-rich part of the map area is traversed by the much lower relief terrain (1 to 2 km wide) that flanks and follows along the northerly trending WLSC. Glaciolacustrine valley-fill deposits of sand and silt occur scattered throughout this terrain and are locally concentrated around northern Whitestone Lake and between this part of the lake and the west shore of southern Whitestone Lake. These deposits probably represent sediments from the higher ground to the west and east of the WLSC redeposited by streams into local, late, lowering phases of glacial Lake Algonquin. To the east of the WLSC, the surficial deposits in the moderate relief terrain in the northeastern and southeastern parts of the area, excluding the Ahmic Domain bedrock high, consist of a thin veneer of locally reworked stony sand till, sand and silt in broad areas between scattered bedrock ridges and knobs. Only in one localized area between Robertson Lake, Highway 124 and Love Lake is the ground moraine thick enough to mask the underlying bedrock topography. This thicker stony sand till zone and the glaciolacustrine sand and silt deposits near Whitestone Lake are the chief sources of aggregate in the map area.

The recent deposits in the map area are composed of organic swamp and alluvial deposits. Most swamps in the western and central parts of the area are linear. The swamps trend north to northeast, parallel to the regional foliation. Larger, irregular-shaped swampy areas underlie the northeast and southeast corners of the area. Minor alluvial deposits are associated with the Magnetawan River and the numerous smaller streams and creeks draining the lakes and swampy areas.

Metamorphism

Some of the Middle Proterozoic rocks in the map area have been subjected to at least two periods of medium- to high-grade regional metamorphism. The general distribution of granulite and retrograde granulite versus amphibolite grade rocks is shown in Figure 7. Specific metamorphic mineral assemblages in the major rock units of the Britt, Parry Sound and Ahmic domains are discussed in the main body of the text and are only summarized here.

Metamorphic grade in the migmatitic granitoid and mafic gneisses of the Britt and Ahmic domains (units 1 to 5 and 6 to 9 respectively) is upper amphibolite facies. No evidence of granulite facies mineral assemblages was found.

Mineral assemblages in the older supracrustal and metaplutonic gneisses (units 10 to 15) of the PSD, however, indicate an early granulite facies metamorphism; and a later retrograde amphibolite facies overprint on granulite facies rocks. Relict granulite facies mineral assemblages are particularly preserved in the McKellar-type diorite suite of rocks (unit 15), and to a lesser extent in the older mafic and mafic to felsic orthogneisses (units 12, 13 and 14). In the general distribution of metamorphic facies shown in Figure 7, there is some distinction made between a prograde amphibolite facies and a retrograde amphibolite facies overprint on granulite facies rocks within the PSD, and its tectonic zones. Metamorphic grade in the rocks of the WLIC is prograde amphibolite facies. In contrast, the tectonites (units 20 to 21) in the PSDBZ(s) and the country rock breccia matrix in the WLSC are mainly amphibolite facies, retrograded from granulite facies. Included in the PSDBZ(s), and shown on Figure 7, are tectonic inclusions of anorthosite suite rocks (unit 16) that are in prograde amphibolite facies. In the eastern PSDBZ is a lens of porphyroblastic orthoamphibolite (unit 12) which is in retrograde granulite facies, and in places, retrograde amphibolite facies. Similarly, the WLSC contains a wide variety of tectonic inclusions (units 12, 13, 15 and 16) of various metamorphic grades, depending upon age of emplacement.

Structural Geology

REGIONAL STRUCTURAL SETTING

Recent mapping in the western part of the Central Gneiss Belt of the Grenville Province (*see* Figure 3) has revealed the presence of a large-scale network of tectonite zones that subdivide the Central Gneiss Belt into discrete lithotectonic domains (Davidson and Morgan 1981; Davidson et al. 1982, 1985). Each of the domains or subdomains shown on Figure 3 is characterized by distinctive lithologic, structural, metamorphic, aeromagnetic, and in places, gravity signatures. The intensely deformed character of the boundary tectonite zones implies that they are the product of ductile shearing. The attitudes of these zones suggests that some domains/ subdomains structurally overlie others. Davidson and his co-workers interpreted this regional structural arrangement of the Central Gneiss Belt as a series of stacked thrust sheets, which were emplaced from the southeast during a period of northwest-directed thrust faulting associated with the Ottawan phase of the Grenville Orogeny. This northwest-directed tectonic transport took place under conditions of high pressure and temperature. Further, Davidson and Grant (1986) concluded that the PSD was thrust over a lower series of stacked thrust sheets consisting of, in no implied order of emplacement, the Britt, Kiosk, Ahmic and Algonquin domains and the Rosseau and Go Home Bay subdomains (*see* Figure 3). In turn the Muskoka Domain (including its Moon River and Seguin subdomains) was emplaced above the PSD.

STRUCTURAL GEOLOGY IN THE WHITESTONE LAKE AREA

The subdivision of the Middle Proterozoic rocks in the map area into three major lithotectonic terrains, which from west to east, are the Britt Domain, the PSD and the Ahmic Domain or Subdomain (Davidson et al. 1982), is justifiable. Each of these domains is bounded by high-strain tectonites, referred to in this study as the western and eastern PSDBZ (*see* Figure 4 and 5). The distinctive lithologies, structural styles and high-grade metamorphism of the centrally located PSD greatly contrasts with the very different, lower grade lithologies and structures in the Britt Domain on the west and the strikingly similar Ahmic Domain to the east (*see* Figure 7).

Britt and Ahmic Domains

The structural style of the migmatitic granitoid gneisses of the Britt Domain near Wahwashkesh Lake consists of a series of north- to northeast-trending and moderately to steeply southeast-dipping, foliated to layered gneisses. Concordant, small scale, northwesterly overturned, isoclinal folds occur in several places within interlayered units of fine to medium-grained and mafic finer grained biotite gneisses exposed on the north shore of the northeast arm of Wahwashkesh Lake. In most places, the limbs of these southeasterly plunging folds are attenuated. Also within many of the foliated, migmatitic granitic interlayers, the leucosome layers are internally deformed (*see* Photo 1), however, the mineral foliation in the paleosome is not, indicating that the migmatization event took place prior to the development of the northerly trending regional fabric. These older migmatic granitoid gneisses were intruded by and subsequently deformed with a series of younger granitic plutons. The age of emplacement of these granitic orthogneisses relative to the main migmatization event that affected the layered granitoid gneisses is uncertain. The largest plutonic body in the Britt Domain in the map area is the granitic orthogneiss that generally marks the western limit of the PSD. This relatively continuous, major unit of massive-looking granitic orthogneiss appears to represent a deformed, flattened pluton, or possibly several closely spaced *en échelon*, deformed plutons that intruded the previously deformed rocks of this domain (Davidson et al. 1985) prior to the overthrusting of the PSD. Within the Britt Domain, the fabric of both the layered granitoid gneisses and the younger marginal granitic orthogneiss dip moderately to steeply southeastward beneath the western PSDBZ. Both the gneisses and orthogneisses are locally cut by concordant minor shear zones. In the northwest corner of the map area, a major zone of ductile shearing concordantly cuts the gneisses.

Most of the previously described mesoscopic structural relationships in the Britt Domain can also be observed in the similar looking granitoid gneisses and younger marginal granitic orthogneiss of the Ahmic Domain, along the east-central tectonic boundary of the PSD. The western part of the Ahmic Domain in the map area (*see* Figures 3 and 4) is a westerly tilted domical structure. The amphibolite-grade gneisses along the southwestern, western and northwestern margins of this dome dip moderately to steeply westward beneath the tectonites of the eastern PSDBZ. This west-dipping fabric persists, but progressively decreases in magnitude inward (to the east) from the margins of the dome towards its centre, in the area of Poverty Bay where the fabric of the granitoid gneisses dips subhorizontally to the west, and in places to the east.

A southeast-plunging lineation is developed in parts of the granitic orthogneisses and, in places, in some of the adjacent layered granitoid gneisses of both the Britt and Ahmic domains. This LS fabric, which is defined by flattened, elongate quartz grains and, in places, by feldspar-quartz augen, increases in intensity toward the contact of the marginal orthogneiss with the base of the PSDBZ. Further detailed work, however, is needed to determine whether the lithologic and structurally similar Britt and Ahmic domains are connected at depth beneath the PSD as proposed by Davidson et al. (1982, 1985).

Parry Sound Domain

The western and eastern margins of the PSD are broad zones of high-strain tectonites in retrograde amphibolite facies. In the wider western PSDBZ, the relatively continuous north-northeast-trending series of gneisses and rather thinly layered tectonites sharply separates the less deformed relict granulite facies rocks in the interior part of the PSD from the amphibolite facies rocks present in the Britt Domain to the west. However, within the PSD, the eastern boundary of this western tectonic zone is transitional. In the eastern part of the study area, the much narrower eastern part of the PSDBZ is sharply bounded to the east by the Ahmic Domain, and varies from being gradational to sharp locally to the west with the interior part of the PSD. Tectonites similar to those developed in the boundary zones, however, are locally abundant throughout the interior part of this domain. Their abundance decreases abruptly away from the western and eastern PSDBZ. The western and eastern PSDBZ could represent one continuous tectonite zone beneath the PSD, as suggested on the basis of gravity modelling by Davidson et al. (1982, 1985). The boundary zones could also be a listric fault system along which the Ahmic Domain was separately thrusted against the PSD after the emplacement of the PSD over the Britt Domain.

The interior part of the PSD is subdivided into western and eastern segments by the north-trending WLSC, a 0.5 to 1.2 km wide, fault-bounded marble tectonic breccia zone (*see* Figures 4, 5 and 7). The structural style of the gneisses in the interior of the PSD varies markedly on opposite sides of this complex. The western segment of the PSD is characterized by a banded north-northeast-trending series of supracrustal and metaplutonic gneisses that surround the tectonically modified northern contacts of the younger WLIC. On the other hand, the north-trending gneisses of the eastern PSD have a more podiform to locally layered character. Here, a discontinuously banded series of highly deformed, older supracrustal and metaplutonic gneisses surround numerous large and small pods (megaboudins) of younger, relatively massive, mafic to intermediate metaplutonic and anorthositic gneiss. Most contacts between these younger metaplutonic units and the older gneisses have been tectonically reworked.

Mafic tectonites, the dominant rock type in both the western and eastern parts of the PSDBZ, generally show a poorly developed, southeasterly plunging hornblende lineation. This is compared to a strong quartz ribbon L > S fabric developed in some of the felsic tectonites and in many parts of the adjacent marginal granitic orthogneisses of Britt and Ahmic domains. However, to the east of the western PSDBZ, the quartzofeldspathic and quartzose gneisses in the western PSD have locally developed a steep southeasterly plunging lineation defined by quartz ribbons and blades. In contrast to the above locally observed southeasterly plunging fabrics, many of the mafic to felsic metaplutonic rocks and, in places, the quartzofeldspathic gneisses throughout the eastern segment of the PSD, exhibit an east- to southeast-trending, shallow to moderate plunging lineation. In addition to this dominant trend, north- and south-trending, shallow-plunging lineations were also locally observed in the diorite suite of rocks (unit 15) and the older felsic orthogneisses (unit 14), particularly where these units exhibit relict granulite facies mineral assemblages. These sporadic north-south plunging lineations may therefore represent relicts of an earlier deformation that developed prior to the ubiquitous east-southeast plunging lineation present in the area.

Most of the above structures, including a few kinematic indicators, i.e., rotated feldspar porphyroclasts, that were observed in the western PSDBZ are consistent with the model of northwest-directed thrusting of the PSD over the Britt Domain proposed by Davidson et al. (1982).

The steeply dipping, fault-bounded WLSC trends subparallel to the western PSDBZ and does not offset it in the study area. For about 9 km to the south of the map area, towards the village of McKellar (*see* Figure 3), this structure more or less follows along the eastern, sheared and locally disrupted margin of the WLIC. Near McKellar, marble breccia, the diagnostic rock type in the WLSC, becomes rare or absent. From this point southward, the extension of the WLSC is subjective. Farther to the south, near Parry Sound, about 25 km south of the map area, the WLIC tails out and the shear zone along its eastern margin concordantly passes into and eventually forms part of the eastern margin of the southwesterly trending western PSDBZ at Parry Sound. Accordingly, the WLSC probably developed during the same period of northwest-directed thrusting that produced the western PSDBZ.

The western part of the PSD, its adjacent boundary tectonite zone, but not the WLSC, are offset by a series of north-northeast-trending faults. The age of these faults is probably later than the fault system that developed along and within the WLSC. These faults may represent a slightly younger period of renewed faulting along this previously developed plane of weakness in the interior of the PSD. These faults, the WLSC and the boundary zones (PSDBZ) between the various domains are all offset by a series of easterly trending normal faults. In the locally fractured, in places sheared, areas of outcrops adjacent to these later faults, the medium-grade mineral assemblages of the rocks in the Britt and Ahmic domains, and the locally higher grade assemblages in the PSD, have been overprinted by a retrograde greenschist facies metamorphism. This younger series of faults may be related to the Ottawa–Bonnechere graben system (Wynne-Edwards 1972) that passes easterly through Lake Nipissing about 80 km to the north of the map area (*see* Figure 2).

Correlation Between Geology and Aeromagnetic Data

The Geological Survey of Canada aeromagnetic map 1485G, (GSC 1965) at a scale of 1:63 360, includes the map area, and the earlier Ontario Department of Mines aeromagnetic maps, Croft and McKenzie sheets (ODM 1953a, 1953b), at a scale of 1 inch to 1/4 mile, also cover the area. A number of magnetic features, particularly on the earlier larger scale maps, can be related to bedrock geology.

The granitoid-rich rocks of the Britt and Ahmic domains (units 1 to 4 and 6 to 8 respectively), stand out weakly against the mafic to felsic tectonites in the PSDBZs. All three generally have magnetic values of 3700 to 4000 gammas (ODM 1953a, 1953b); however, the much closer spacing and northerly trend of the magnetic intensity contours of the tectonites in the PSDBZ(s) tend to distinguish these rocks from the adjacent granitoid gneisses in the Britt and Ahmic domains.

In the western PSD, the thicker bands, in places megaboudins, of porphyroblastic garnet orthoamphibolite (unit 12) generally stand out sharply against the metasedimentary gneisses and layered mafic to felsic tectonites (units 11 and 20 to 21 respectively) to the west and northwest, and the WLIC (unit 16) to the east and southeast. Magnetic contours are more compressed in the orthoamphibolites and range between 3700 to 4400 gammas, whereas the metasedimentary gneisses and the layered tectonites are usually less than 3800 gammas. In the anorthosite-gabbroic anorthosite of the WLIC, the contours are less than 3600 gammas.

In the eastern part of the PSD, the diorite suite rocks (unit 15) are the most magnetically distinct in this or any other part of the map area. These diorites form large and small, continuous to discontinuous, sill-like bodies with close magnetic contours ranging between 3800 to 4500 gammas. These characteristic features allow one to discern even smaller diorite sills or sill swarms from the older mafic to intermediate and felsic orthogneisses in the eastern PSD whose magnetic intensities average about 3600 gammas.

In the eastern PSD, in addition to the strongly magnetic diorite suite rocks, there are scattered podiform to sill-like bodies of moderately to strongly magnetic gabbroic anorthosite to gabbro (unit 16). These more mafic phases of the anorthosite suite have magnetic intensity values ranging from 3600 to 4200 gammas. These phases of the anorthosite suite cannot be always distinguished on the aeromagnetic map from the diorite suite rocks (unit 15), particularly where the two lithologies are interlayered. The smaller size and podiform shape of the magnetic anomalies over anorthosite suite rocks may distinguish them in areas of more broadly contoured, lower magnetic intensity rocks of the older mafic to felsic orthogneiss (units 13 and 14).

Even though the marble tectonic breccias have a low magnetic intensity value and range from 3400 to 3600 gammas, the aeromagnetic data does not readily distinguish major bands or megaboudins of marble from adjacent bands of quartzofeldspathic gneiss or granodioritic orthogneiss (units 11 and 14), which have slightly higher magnetic intensity values.

Economic Geology

MINERAL POTENTIAL OF THE STUDY AREA

At the commencement of this mapping program, the Whitestone Lake area contained no mineral deposits which had been previously documented. The results of this survey have not significantly added to the mineral deposit inventory. Certain lithologies in the area, however, are potential exploration targets for specific types of metallic and industrial mineral deposits. The mineral potential of rock groups such as the anorthosites, granite pegmatites and marbles in the map area has been discussed in some length in the preliminary report of a mineral deposit study by Marmont and Johnston (1987). The results of this report with its emphasis on industrial minerals are summarized below, but have been augmented with the results of this mapping survey.

ECONOMIC POTENTIAL OF ANORTHOSITE SUITE ROCKS

Metallic Mineral Deposits

The igneous layered WLIC as well as the smaller, in places layered, anorthositic units in the eastern part of the map area represent potential sources of iron, titanium, vanadium, manganese and platinum group metals. In the WLIC, no iron sulphides were observed. However, ilmenite and magnetite occur as disseminations, in places small patches up to 3 percent by volume, (Lacy 1960, Mason 1969) in the broad gabbroic anorthosite marginal phase of the WLIC. The smaller units in the eastern part of the PSD are predominantly gabbroic anorthosite; gabbroic phases are more abundant than in the WLIC. Minor disseminated pyrite was locally observed in the gabbroic anorthosite to gabbro phases of the WLIC exposed along the southeast shore of lower Whitestone Lake.

Selective samples of pyrite and magnetite-bearing anorthosite suite rocks were assayed for their copper, nickel, cobalt, manganese, vanadium, titanium oxide, gold, platinum and palladium content. The assays are given in Table 13; however, no significant values were obtained. A research of the published data on the oxide mineralogy of the WLIC by Marmont and Johnston (1987) indicated that the potential for titanium and vanadium in this body is low.

Industrial Mineral Deposits

Anorthositic rocks have potential applications in the insulation, glass, ceramics and filler industries. In general, low iron (less than 1 percent iron) and high-feldspar raw materials are required in these various applications. The mafic mineral-poor, i.e., low iron-bearing, anorthosite in the south-central part of the WLIC between Little Snakeskin and Highrock lakes, is a potential target of raw material in the above applications. The mafic mineral-poor, recrystallized anorthosites in this region are predominantly medium to coarse grained and white, light bluish grey and locally pinkish and greenish grey. The bright white varieties could possibly provide finely ground plagioclase products as fillers and extenders.

Use of the recrystallized anorthosite and gabbroic anorthosite phases of the WLIC as building stone material may be limited by their granular and friable nature. This feature, however, does not preclude their use as a source of road metal.

Anorthosite has, in the past, been considered as a potential source of alumina. Although considerable metallurgical work has been done to explore this possibility, this application is not seen as an economic proposition in the foreseeable future.

ECONOMIC POTENTIAL OF GRANITE PEGMATITES

Granite pegmatites are potential sources of high purity silica, potassium feldspar, mica and rare earth elements. Pegmatite dikes, particularly late tectonic potassic granite pegmatite dikes, occur in all the structural domains of the map area. Most of them are too small to be shown separately on Map 2540 (back pocket), and in general, they have relatively simple mineralogy. Late tectonic pegmatites containing radioactive minerals, lithium and beryllium minerals, or tantalum-bearing minerals have not been found in the area. Some of the older, cataclastically deformed, syntectonic granite pegmatites (unit 17c) within the tectonic gneisses and layered tectonites of the PSD, however, contain porphyroblasts (up to 1 cm long) of allanite, a source of rare earth elements. These deformed pegmatite dikes have been transformed, in whole or in part, into finer grained protomylonitic gneiss. Those dikes containing allanite characteristically produce a reaction recorded on a scintillometer. A good example of one of these 1 to 40 cm wide, allanite-bearing mylonitic pegmatites can be seen in a large outcrop on Highway 520, about 700 m south of the secondary road turnoff to the village of Maple Island. At the northern end of an outcrop on the west side of the highway, a radioactive mylonitic pegmatite occurs at the tectonically modified contact between marble and diorite. The contact is near the eastern fault-bounded boundary of the WLSC.

ECONOMIC POTENTIAL OF MARBLE

Marble is a potential source of high-purity calcite, which is used: 1) in agriculture and environmental applications; 2) in cement; 3) as fillers and extenders; 4) as basic refractories; and, 5) as a flux.

In the map area, most of the smaller marble units in the eastern segment of the PSD are marble tectonic breccias containing abundant, variably sized (1 cm to several metres long) inclusions of mafic, felsic and carbonate rock-rich gneiss. However, the 0.5 to 2 km wide

TABLE 13. ASSAYS FROM THE WHITESTONE LAKE AREA; GEOSCIENCE LABORATORIES SECTION, ONTARIO GEOLOGICAL SURVEY, TORONTO.

Assay	Host Rock	Sample Number	Location
118 ppm Cu, 24 ppm Ni, 52 ppm Co; 2850 ppm Mn, 445 ppm V; 2.43 percent TiO_2; 2 ppb Au, 1 ppb Pt, < 1 ppb Pd	diorite (unit 15)	86GDM-25-2	sill-like body about 600 m northeast of Moulton Lake, Croft Township
346 ppm Cu, 38 ppm Ni, 62 ppm Co, 2650 ppm Mn, 275 ppm V; 0.40 percent TiO_2; < 2 ppb Au, < 1 ppb Pt, < 1 ppb Pd	gabbro (unit 16) (pyritic)	86EGB-46-13A	west-central contact of small sill on east shore of lower Whitestone Lake, Hagerman Township
775 ppm Cu, 114 ppm Ni, 92 ppm Co, 2590 ppm Mn, 275 ppm V; 0.35 percent TiO_2; < 2 ppm Au, < 1 ppb Pt, < 1 ppb Pd	gabbro (unit 16) (pyritic)	86EGB-46-13B	location same as above
66 ppm Cu, 34 ppm Ni, 44 ppm Ni, 1520 ppm Mn, 555 ppm V; 2.52 percent TiO_2; < 2 ppm Au, < 1 ppb Pt, < 1 ppb Pd	gabbroic anorthosite (unit 16) (pyritic)	86EGB-9-2D	small sill-like body, 1.2 km east of Highway 520, on secondary access road to Cody Rapids on Magnetawan River, Croft Township
59 ppm Cu, 36 ppm Ni, 46 ppm Co, 1560 ppm Mn, 555 ppm V; 2.85 percent TiO_2; < 2 ppb Au, < 1 ppb Pt, < 1 ppb Pd	gabbroic anorthosite (unit 16) (pyritic)	86EGB-9-2B	location as above
33 ppm Cu, < 5 ppm Ni, 44 ppm Co, 1990 ppm Mn, 720 ppm V; 3.25 percent TiO_2; < 2 ppb Au, < 1 ppb Pt, < 1 ppb Pd	gabbro (unit 16) (magnetite-rich)	86EGB-17-15A	near northern margin of Whitestone Pluton about 1.8 km southwest of Gordon Lake, McKenzie Township; occurrence shown on Map 2540
26 ppm Cu, 12 ppm Ni, 78 ppm Co, 2060 ppm Mn; 3.05 percent TiO_2; < 2 ppb Au, < 1 ppb Pt, < 1 ppb Pd	gabbro (unit 16) (magnetite-rich)	86EGB-17-15B	location as above
75 ppm Cu, < 5 ppm Ni, 14 ppm Co, 286 ppm Mn, 65 ppm V; 0.45 percent TiO_2; < 2 ppb Au, < 1 ppb Pt, < 1 ppb Pd	gabbroic anorthosite (unit 16) (pyritic)	86GDM-56-5	small sill-like body about 600 m east of the Maple Island forest fire access road, at a point about 1.2 km northeast of village of Maple Island, Ferrie Township
332 ppm Cu, 24 ppm Ni, 30 ppm Co, 890 ppm Mn, 165 ppm V; < 2 ppm Ag	pyritic quartzofeldspathic gneiss (unit 11)	86GDM-29-32	metasedimentary gneiss band, north of Magnetawan River, about 500 m west of Porter rapids,on Magnetawan River, Ferrie Township
404 ppm Cu, 72 ppm Ni, 42 ppm Co, 525 ppm Mn, 145 ppm V; < 2 ppm Ag, < 2 ppb Au, < 1 ppb Pt, < 1 ppb Pd	pyritic quartzofeldspathic gneiss (unit 11)	86EGB-27-28B	metasedimentary gneiss band, south-central shore of Short Bay on Magnetawan River, Hagerman Township

WLSC (unit 19) contains a wide variety of large (up to 1 km long and 300 km wide) country rock inclusions, some of which are relatively undeformed marble. In the drift-covered areas south and north of Whitestone Lake, some of the more massive marble outcrops may represent parts of an unexposed, isolated, relatively non-tectonized block of marble that may be of sufficient size and quality to warrant testing for the above-mentioned industrial mineral uses. To the south of the map area, similar marble occurrences near McKellar (*see* Figure 3), within the author's southward extension of the WLSC, were quarried and tested as a potential source of high purity calcite; however, no production was achieved (Assessment Files Research Office, Ministry of Northern Development and Mines, Toronto). Marmont (1987) has evaluated some of these prospects for their use as agricultural lime.

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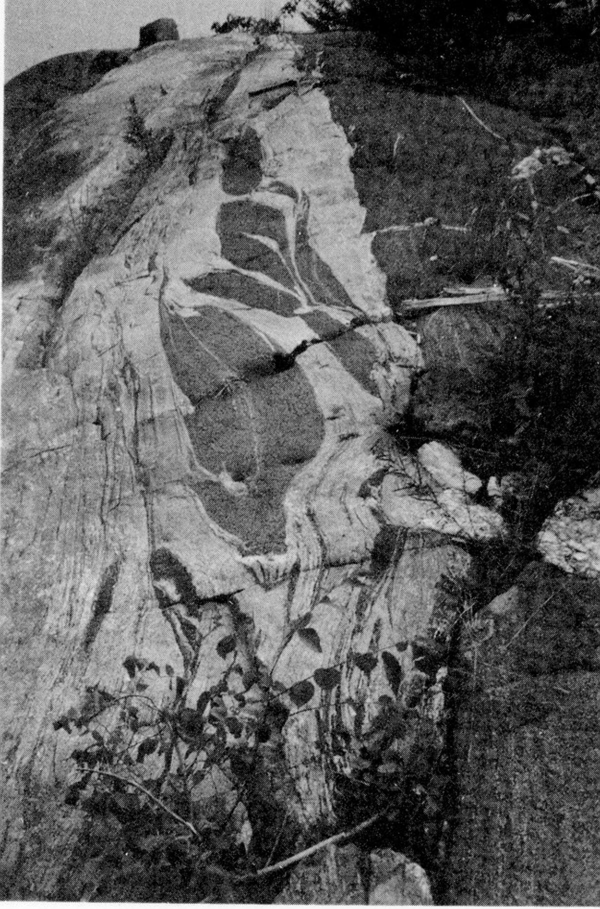

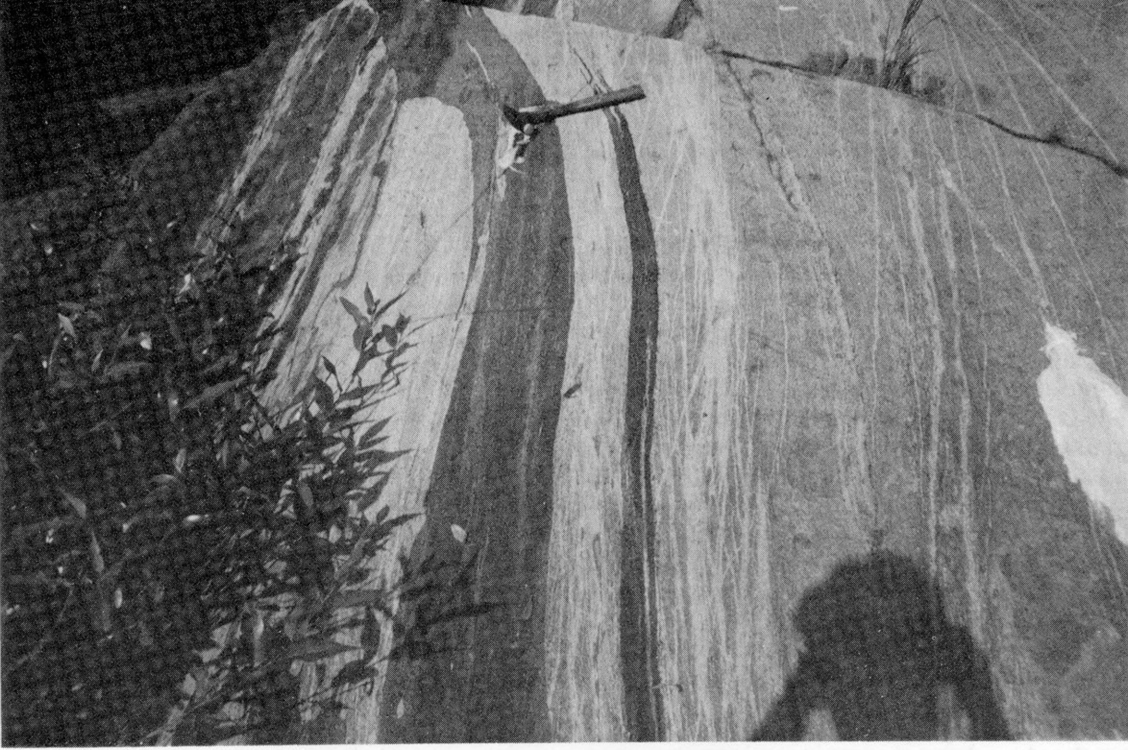

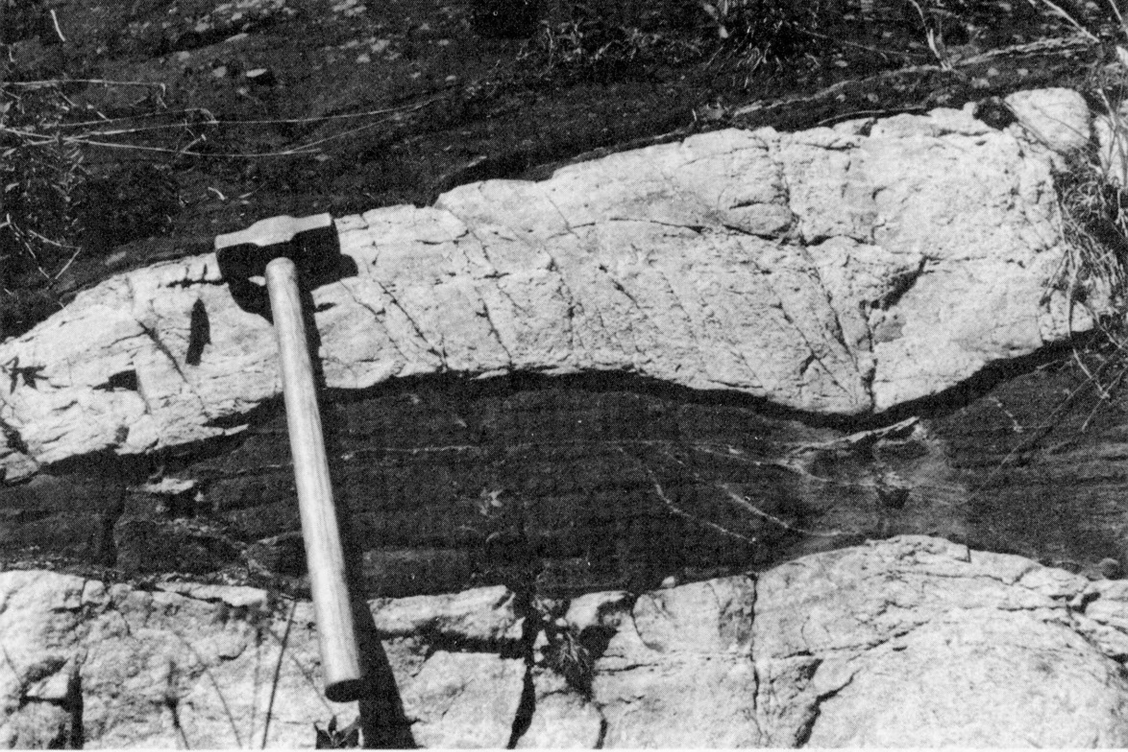


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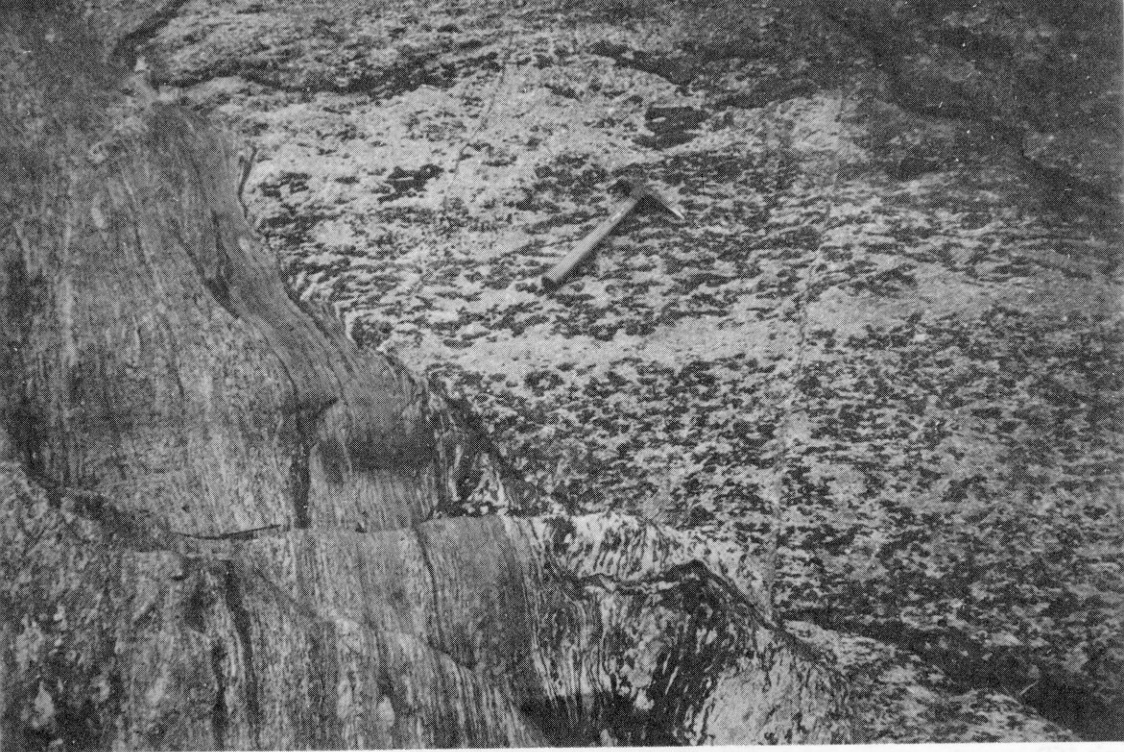


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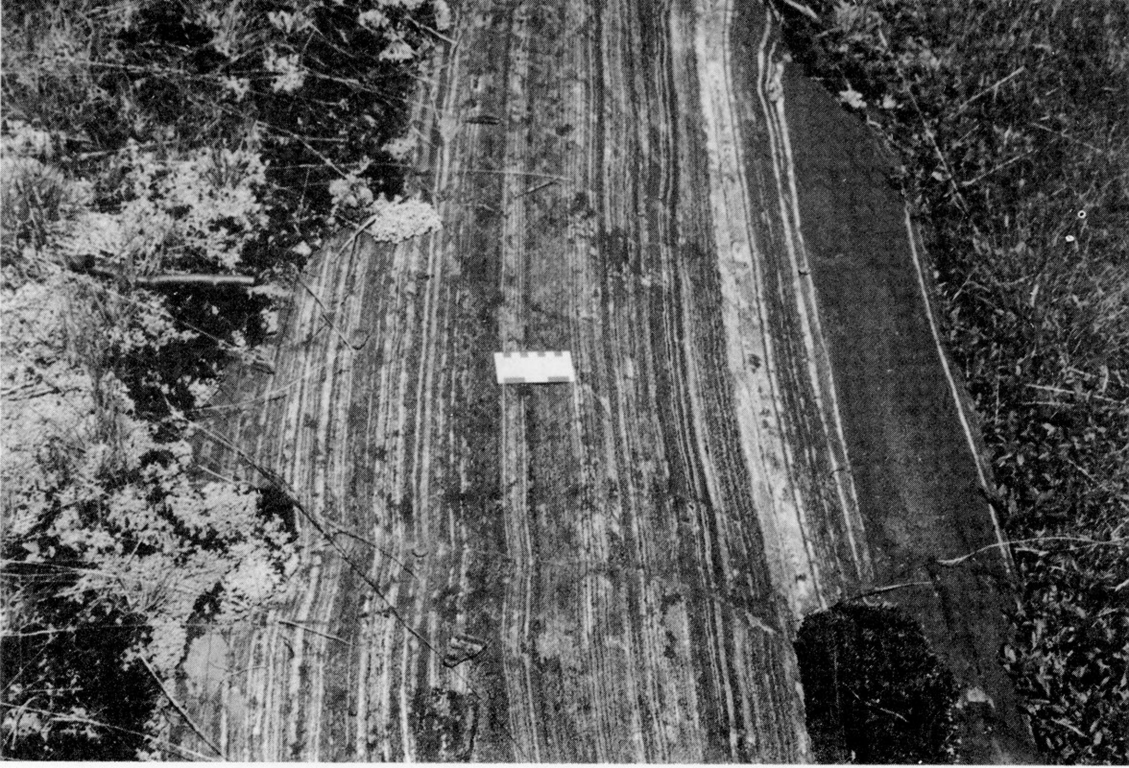
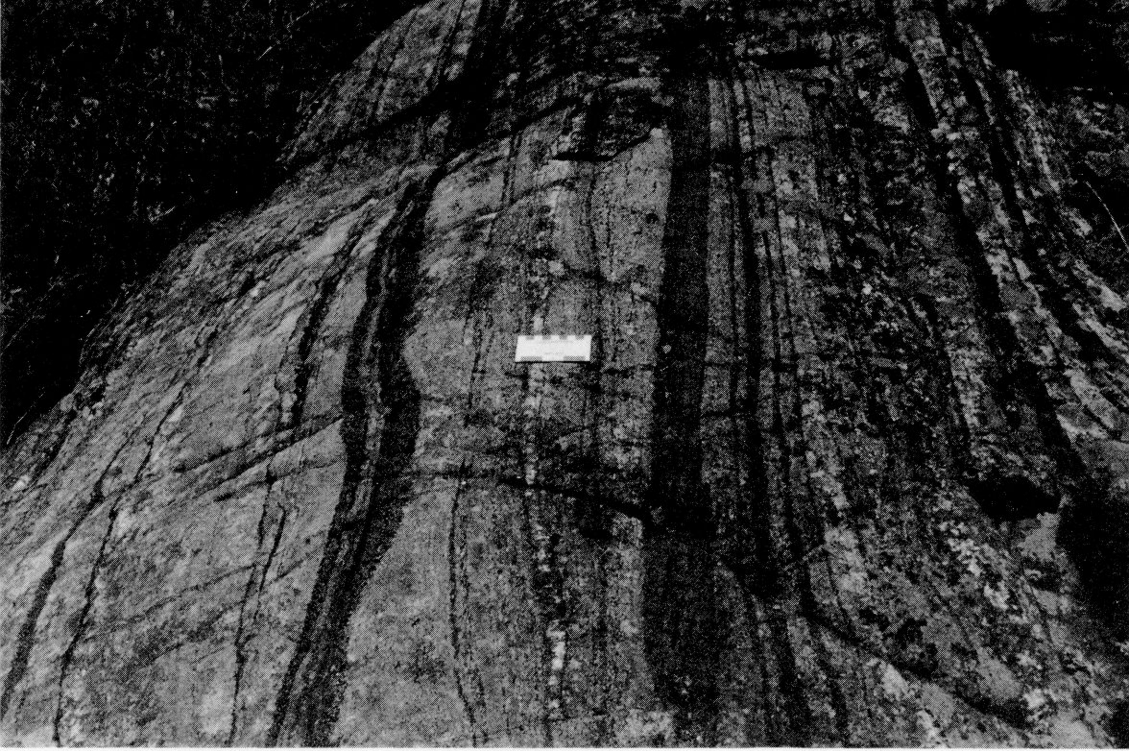




LEGEND

PHANEROZOIC
CENOZOIC
QUATERNARY
PLEISTOCENE AND RECENT
Till, gravel, sand, and organic deposits

UNCONFORMITY

PRECAMBRIAN[abc]
PROTEROZOIC
MIDDLE PROTEROZOIC

Late Tectonic to Posttectonic Felsic Intrusive Rocks

22 **Pegmatitic Granite**[d]: Granite dikes, coarse grained to pegmatitic, undeformed

INTRUSIVE CONTACT

CENTRAL GNEISS BELT—PARRY SOUND DOMAIN

Parry Sound Domain Boundary Zone

21 **Felsic Gneisses and Tectonites**[e]
- 21a Felsic, in places intermediate, gneiss, massive to foliated, fine to medium grained
- 21b Unit 21a, layered gneiss, in places sheared and protomylonitic
- 21c Porphyroclastic felsic gneiss, unit 21b containing isolated feldspar and pegmatite clasts
- 21d Irregularly to straight-layered felsic and mafic tectonite, units 21a to 21c containing up to 50% mafic gneiss layers (unit 20)
- 21e Units 21b to 21d, containing layers of porphyroclastic biotite and muscovite-biotite ± garnet gneiss and schist, in places layers of porphyroclastic intermediate gneiss

20 **Mafic Gneisses and Tectonites**[e]
- 20a Mafic gneiss of amphibolitic to dioritic composition, massive to foliated, fine to medium grained
- 20b Unit 20a, containing thin dikes or layers of fine-grained leucogranite, in places boudinaged and locally disrupted
- 20c Units 20a and 20b, layered mafic gneiss
- 20d Porphyroclastic mafic gneiss, units 20a to 20c containing isolated feldspar and pegmatite clasts
- 20e Irregularly to straight-layered mafic and felsic tectonite, units 20a to 20d containing up to 50% felsic, in places intermediate, gneiss layers (unit 21)
- 20f Units 20c to 20e, containing layers of porphyroclastic biotite schist and biotite-amphibole gneiss and schist, clasts as in unit 20d
- 20g Sheared units 20c to 20f, in places containing shear-bounded lenses of less deformed mafic gneiss (units 20a and 20b)

FAULT CONTACT

WHITESTONE LAKE STRUCTURAL COMPLEX[f]

19 **Marble Tectonic Breccia**
- 19a Calcitic marble, massive to layered, in places mylonitic
- 19b Marble breccia, with marble fragments predominant, mylonitic marble
- 19c Marble breccia, containing abundant fragments of calc-silicate gneiss, para-amphibolite, and in places orthoamphibolite
- 19d Marble breccia, with clastic siliceous metasedimentary gneiss fragments predominant
- 19e Isolated tectonic lenses and large blocks of felsic to intermediate gneiss set in a matrix of units 19b to 19d; matrix breccia not always exposed
- 19f Isolated tectonic lenses and large blocks of mafic gneiss and amphibolite set in a matrix of units 19b to 19d; matrix breccia not always exposed

FAULT CONTACT

Syntectonic to Late Tectonic Mafic and Felsic Intrusive Rocks[d]

18 **Mafic Dikes**[d]
- 18a Amphibolite dikes, massive to foliated, fine to medium grained
- 18b Unit 18a, showing varying degrees of cataclasis, in places disrupted

INTRUSIVE CONTACT[g]

17 **Felsic Dikes**[d]
- 17a Leucogranite dikes and layers, massive to foliated, fine to medium grained
- 17b Pegmatitic granite (± biotite, magnetite and hornblende) dikes, massive to foliated
- 17c Unit 17b, showing varying degrees of cataclasis

INTRUSIVE CONTACT[g]

Early Tectonic to Syntectonic Mafic to Intermediate Metaplutonic Rocks

16 **Anorthosite Suite Rocks and Related Tectonites**
- 16a Interpreted[h]
- 16b Gabbroic anorthosite, massive to foliated, medium to coarse grained, in places subophitic, pegmatitic
- 16c Gabbroic anorthosite gneiss, in places layered
- 16d Units 16b and 16c, with oikocrystic pyroxene
- 16e Anorthosite, massive to foliated, medium to coarse grained
- 16f Unit 16e, with less than 10% oikocrystic pyroxene
- 16g Gabbroic gneiss, foliated to layered, medium to coarse grained
- 16h Layered and interlayered gabbroic anorthosite and anorthosite, in places gabbro, primary igneous layering
- 16i Units 16b, 16e and 16g, garnetiferous
- 16j Units 16b and 16c, epidote-bearing, in places fine-grained, epidote-plagioclase gneiss
- 16k Units 16b to 16g, sheared, in places protomylonitic
- 16l Units 16b, 16c and 16g, as tectonic inclusions

INTRUSIVE CONTACT[g]

15 **Diorite Suite Rocks and Related Tectonites**
- 15a Hornblende ± pyroxene diorite, massive to foliated and lineated, medium to coarse grained, waxy green to grey
- 15b Diorite gneiss, foliated to layered, in places plagioclase augen gneiss, medium to coarse grained, grey
- 15c Fine- to medium-grained mafic dikes or layers, may in part be transposed units
- 15d Units 15a and 15b, as sheared and layered gneissic tectonites, in places protomylonitic
- 15e Units 15a and 15b, as tectonic inclusions

INTRUSIVE CONTACT[g]

Early Tectonic Mafic to Felsic Metaplutonic Rocks

14 **Intermediate to Felsic Orthogneisses**[i]
- 14a Granitic to granodioritic orthogneiss, medium to coarse grained, in places augen and layered gneiss
- 14b Unit 14a, with mafic to intermediate gneiss interlayers
- 14c Units 14a and 14b, as sheared and layered gneissic tectonites, in places protomylonitic and porphyroclastic gneiss

13 **Mafic to Intermediate Orthogneisses**[j]
- 13a Gabbroic to dioritic orthogneiss, medium to coarse grained, in places layered
- 13b Quartz dioritic to tonalitic, in places granodioritic, orthogneisses, medium to coarse grained, in places layered
- 13c Mafic gneiss, fine to medium grained, in places compositionally layered, indeterminate protolith
- 13d Units 13a, 13b and 13c, with felsic gneiss interlayers
- 13e Units 13a to 13d, as sheared and layered gneissic tectonites, in places protomylonitic gneisses
- 13f Units 13a to 13d, as tectonic inclusions

12 **Porphyroblastic Orthoamphibolite**
- 12a Porphyroblastic garnet amphibolite, massive to foliated, medium to coarse grained, in places compositionally layered, plagioclase rims on garnets common
- 12b Garnet- and plagioclase-streaked amphibolite, layered amphibolite gneiss, medium to coarse grained
- 12c Mafic gneiss, massive to foliated, in places layered, fine to medium grained
- 12d Units 12b and 12c, with interlayers of quartzofeldspathic and quartzose gneiss (units 11a and 11b, respectively)
- 12e Sheared units 12a to 12c, in places unit 12d, protomylonitic
- 12f Units 12a to 12e, as tectonic inclusions

Metasedimentary Rocks and Gneisses

11 **Siliceous Clastic Metasedimentary Rocks**
- 11a Quartzofeldspathic gneiss (feldspathic arenite), foliated to layered, fine to medium grained, in places rusty weathering
- 11b Quartzose gneiss (quartz arenite), foliated to layered, medium to coarse grained
- 11c Biotite gneiss and schist (wacke and mudstone), foliated to layered, fine to medium grained, in places migmatitic
- 11d Units 11a and 11b, in places interlayered with unit 11c
- 11e Mafic interlayers in units 11a, 11b and 11d, mafic interlayers probably related to unit 12
- 11f Augen-textured quartzofeldspathic gneiss
- 11g Sheared units 11a to 11f, in places protomylonitic

10 **Carbonate-rich Metasedimentary Rocks**
- 10a Calcitic marble, massive to layered, in places brecciated and mylonitic
- 10b Unit 10a, with locally abundant interlayers of mafic mineral-rich metasedimentary gneiss and schist
- 10c Calcitic marble breccia, containing many quartzofeldspathic and quartzose gneiss fragments
- 10d Calcitic marble breccia, with para-amphibolite, calc-silicate gneiss, and biotite gneiss fragments predominant

FAULT CONTACT

CENTRAL GNEISS BELT—AHMIC DOMAIN

9 **Mafic Intrusive Rocks**[d]
- 9a Amphibolite dikes, foliated to layered, fine to medium grained, in many places boudinaged and locally disrupted
- 9b Hybrid mafic orthogneiss phases of unit 9a, felsic material assimilated from units 6 and 7
- 9c Sheared units 9a and 9b

INTRUSIVE CONTACT[g]

8 **Felsic to Intermediate Intrusive Rocks**
- 8a Monzogranitic to granodioritic orthogneiss, foliated to lineated, medium to coarse grained, in places augen gneiss
- 8b Unit 8a, layered and fine to medium grained, in places migmatitic
- 8c Units 8a and 8b, containing screens and discontinuous layers of mafic gneiss
- 8d Sheared units 8a to 8c, in places protomylonitic

INTRUSIVE CONTACT[g]

Granitoid Gneisses and Related Migmatites

7 **Quartzofeldspathic and Biotite Gneiss**
- 7a Leucocratic, pink quartzofeldspathic gneiss (± magnetite, hematite and garnet), massive to layered, fine to medium grained, in places migmatitic
- 7b Unit 7a, containing interlayers of mafic gneiss and biotite gneiss, in places biotite schist
- 7c Unit 7a, in places interlayered with units 6a and 6b

6 **Migmatitic Granitic to Granodioritic Gneiss**
- 6a Pink, migmatitic, granitic to granodioritic gneiss, foliated to layered, medium to coarse grained, generally less than 15% granitic leucosome
- 6b Grey, migmatitic granodioritic, in places tonalitic, gneiss, foliated to layered, medium to coarse grained, 10 to 20% granodioritic leucosome
- 6c Units 6a and 6b, interlayered
- 6d Units 6a to 6c, containing interlayers of mafic gneiss, in places biotite gneiss and schist

CONTACT UNKNOWN

CENTRAL GNEISS BELT—BRITT DOMAIN

5 **Gneisses and Tectonites**
- 5a Interlayered, granitic to granodioritic and mafic tectonic gneiss, in places sheared and porphyroclastic
- 5b Protomylonitic to mylonitic granitic gneiss, in places intermediate to mafic gneisses

FAULT CONTACT

4 **Mafic Intrusive Rocks**[d]
- 4a Amphibolite dikes, foliated to layered, fine to medium grained, commonly disrupted
- 4b Gabbroic gneiss, foliated to layered, medium to coarse grained, generally occurs as isolated boudins, or in places as disrupted dikes

INTRUSIVE CONTACT[g]

3 **Felsic to Intermediate Intrusive Rocks**
- 3a Monzogranitic to granodioritic orthogneiss, foliated to lineated, medium to coarse grained, in places augen gneiss
- 3b Unit 3a, layered, fine to medium grained, in places migmatitic
- 3c Units 3a and 3b, containing screens and discontinuous layers of mafic gneiss
- 3d Sheared units 3a to 3c, in places protomylonitic

INTRUSIVE CONTACT[g]

Granitoid Gneisses and Related Migmatites

2 **Biotite Gneiss and Quartzofeldspathic Gneiss**
- 2a Grey, migmatitic, biotite-quartz-feldspar ± hornblende gneiss, foliated to layered, fine to medium grained, 10 to 30% granodioritic leucosome
- 2b Unit 2a, with interlayers of pink, fine- to medium-grained quartzofeldspathic gneiss, in places migmatitic biotite schist

1 **Migmatitic Granitic to Granodioritic Gneiss**
- 1a Pink, migmatitic, granitic to granodioritic gneiss, foliated to layered, fine to medium grained, generally less than 15% granitic leucosome
- 1b Grey, migmatitic, granodioritic gneiss, foliated to layered, medium to coarse grained, 10 to 20% granodioritic leucosome
- 1c Units 1a and 1b, interlayered
- 1d Units 1a to 1c, containing interlayers of mafic gneiss, in places biotite gneiss and schist

[a] *Subdivision of major rock units does not imply age relationships.*

[b] *All Precambrian rocks except unit 22 have been subjected to regional metamorphism; some nonmetamorphic terms are used for the sake of brevity and where protolith is established.*

[c] *Multiple codes are listed on the map in order of decreasing abundance, e.g., 21a,d,20b,e: 21a is most abundant, 20e is least abundant.*

[d] *Most units are too small to be shown separately on the map; multiple code occurrences are common.*

[e] *Protolith indeterminate.*

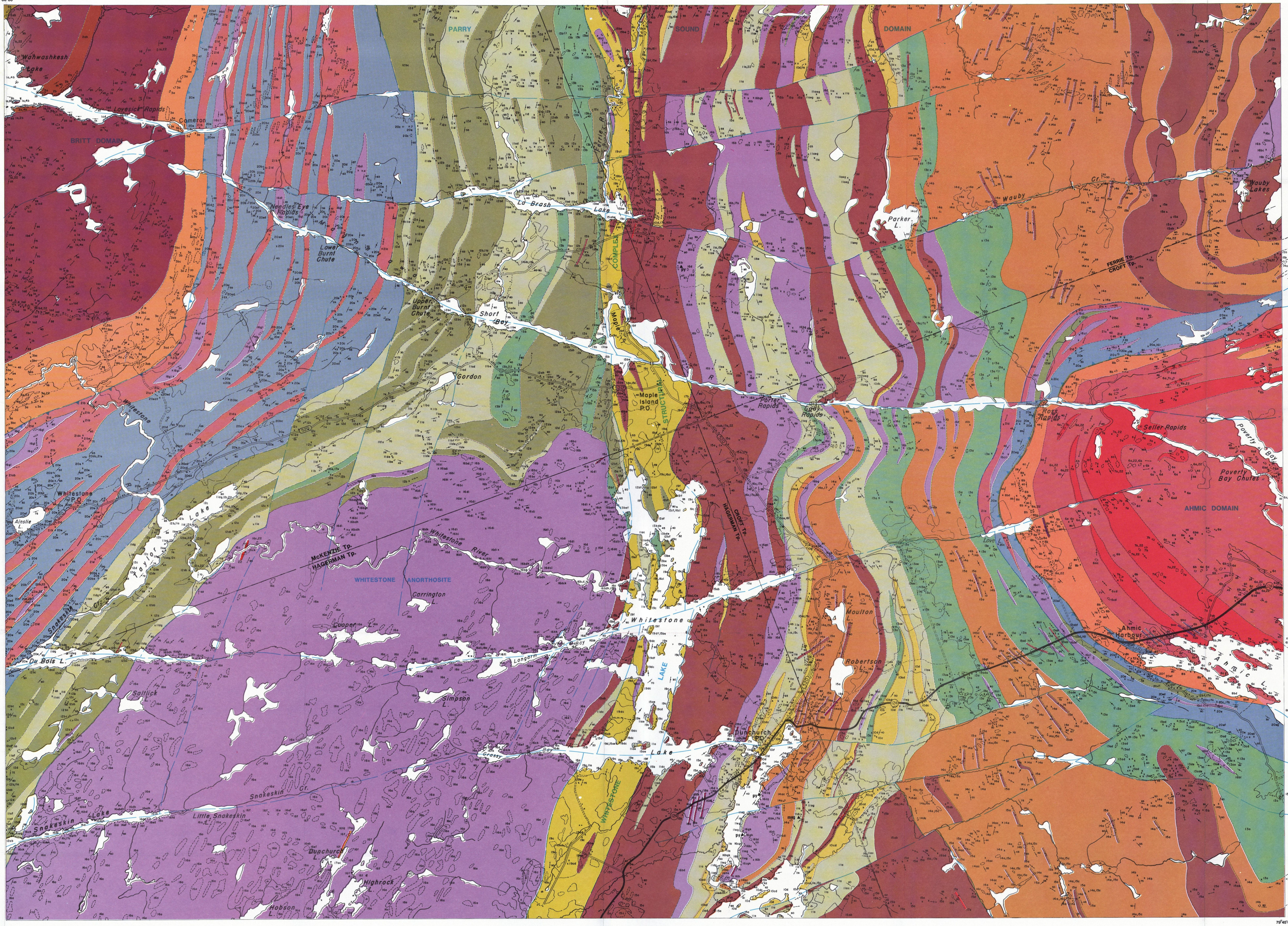
[f] *Tectonic inclusions in the marble breccias of the Whitestone Lake Structural Complex range from centimetre-sized clasts to kilometre-sized blocks and lenses.*

[g] *Most intrusive contacts have been tectonically reworked and in places transposed.*

[h] *Outcrops observed on aerial photographs; lithology inferred but unsubdivided.*

[i] *Protolith is probably igneous; some quartzofeldspathic gneisses derived from metasedimentary rocks are probably included.*

[j] *Mainly igneous protolith.*



Ministry of Northern Development and Mines
Ontario

Mines and Minerals Division
Ontario Geological Survey

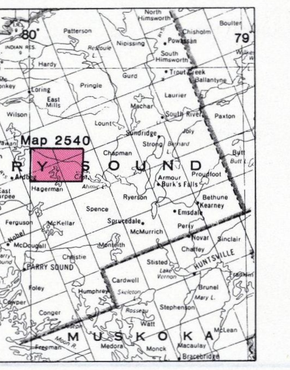
MAP 2540

PRECAMBRIAN GEOLOGY

WHITESTONE LAKE AREA

Scale 1:20 000
500 m 0 0.5 1 km

NTS Reference: 31 E/12



LOCATION MAP Scale: 1:1 584 000 or 1 inch to 25 miles

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CANADA ONTARIO Mineral Development Exploitation Minérale

This project is part of the five-year Canada-Ontario 1985 Mineral Development Agreement (COMDA), a subsidiary agreement to the Economic and Regional Development Agreement (ERDA) signed by the governments of Canada and Ontario.

SYMBOLS

- Small bedrock outcrop
- Area of bedrock outcrop
- Schistosity (horizontal, inclined, vertical)
- Gneissosity (horizontal, inclined, vertical)
- Gneissosity, with orientation and plunge of mineral lineation
- Banding (horizontal, inclined, vertical)
- Lineation with plunge
- Foliation (horizontal, inclined, vertical, dip unknown)
- Foliation, with orientation and plunge of mineral lineation
- Geological boundary, observed
- Geological boundary, interpreted
- Geological boundary, deduced from geophysics
- Fault (observed, assumed)
- Thrust fault, triangles on down-dip side
- Secondary folds with plunge
- Mineral occurrence

ABBREVIATIONS

mag .... magnetite
py .... pyrite

SOURCES OF INFORMATION

Base map derived from Map FRI 456794 of the Forest Resources Inventory, Lands and Waters Group, Ontario Ministry of Natural Resources.

ODM–GSC aeromagnetic map 1485G, scale 1:31 680.

ODM geological compilation Map 2441, scale 1:800 000.

Magnetic declination approximately 11°W in 1986.

Geology not tied to surveyed lines.

CREDITS

Geology by E.G. Bright and assistants, 1986.

Drafting by Skyline Mapping Services.

Cartographic production by S. Daniel.

Every possible effort has been made to ensure the accuracy of the information presented on this map; however, the Ontario Ministry of Northern Development and Mines does not assume any liability for errors that may occur. Users may wish to verify critical information.

This is one of a group of transitional stage, computer-assisted cartographic publications. The appearance of subsequent maps may change as technological refinements and modified production procedures are implemented.

Issued 1990.

Information from this publication may be quoted if credit is given. It is recommended that reference to this map be made in the following form:

Bright, E.G. 1990. Precambrian geology, Whitestone Lake area; Ontario Geological Survey, Map 2540, scale 1:20 000.

Stock number 10 736