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Ontario Geological Survey
Report 228

Geology of the

Sharbot Lake Area

Frontenac and Lanark Counties
Southeastern Ontario

1985

Ministry of
Natural
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by
J.M. Wolff

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FOREWORD

SHARBOT LAKE AREA

In the early settlement of Ontario small-scale mining operations were a significant part of general development in southeastern Ontario. However, a succession of major mineral discoveries, cheap transportation and availability of crown land gradually shifted exploration and supporting geological investigations northwards.

More recently, interest in uranium and upward trends in transportation costs have rekindled interest in the mineral potential of southeastern Ontario. The geology of much of the area is inadequately known for modern exploration decision-making purposes and mineral potential evaluations. A series of detailed geological survey projects was initiated in 1975 in the Grenville Province of the Precambrian Shield in southeastern Ontario. A resource potential exists in the Grenville Province for industrial minerals such as calcium carbonate, talc, gypsum, graphite, nepheline syenite, feldspar, marble, mica, and abrasives; and for precious and base metals.

V.G. Milne
Director
Ontario Geological Survey

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GEOLOGICAL MAP

(back pocket)

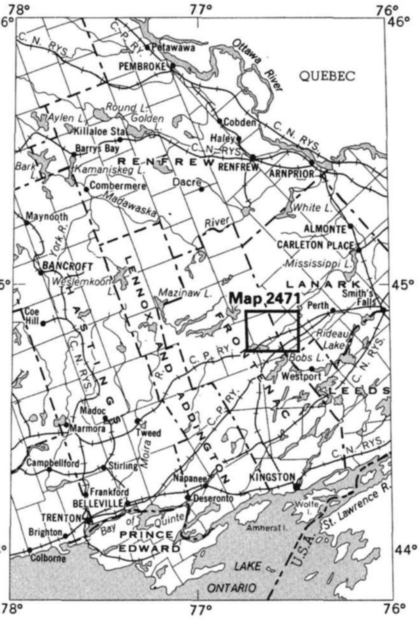

Figure 1–Key map showing location of the Sharbot Lake Area. Scale 1:3 168 000 (1 inch to 50 miles).

ABSTRACT

The Sharbot Lake map area lies some 70 km by road north of the city of Kingston and about 105 km by road west of the city of Ottawa and covers approximately 250 km^2.

Bedrock is of Late Precambrian age. The oldest rocks of the area are likely the high grade mafic to silicic anatectic gneisses and related migmatites and/or the metavolcanics and metasediments. The metavolcanics are mainly of a tholeiitic basalt affinity with minor intermediate calc-alkaline members. Metasediments in the map area consist of clastic siliceous gneisses and schists, amphibole-rich gneisses and schists, and carbonate metasediments. These appear to be derived from quartzite, quartzose wacke, feldspathic wacke, and carbonate feldspathic wackes plus carbonate sediments formed in a relatively stable basin. The high grade gneisses are granodioritic in composition, with minor amphibolite and carbonate units. They may represent lower level metamorphic assemblages equivalent to the metavolcanics and metasediments, although the concept that they are older basement must not be rejected.

Syntectonic intrusives in the area include the composite Northbrook Batholith (of which only the trondhjemitic portion outcrops) and the granodiorite to granite Addington Pluton.

Late tectonic intrusive rocks include the early mafic intrusive rocks, the late granitic intrusive rocks, and the late mafic intrusive rocks. The early mafic intrusive rocks include the Lavant gabbro body and the Lanark-Oso anorthosite body. The first represents a high level gabbroic intrusion while the second represents a deeper level intrusion, likely the residue from partial melting of a tonalitic to granodioritic gneiss assemblage, rather than the product of igneous differentiation. The late granitic intrusive rocks are chiefly granodiorite to quartz monzonite in composition and were likely derived by the partial melting of crustal material. Pegmatite dikes all have granodiorite compositions and are considered to be a late manifestation of this granitic intrusive event. The youngest late tectonic intrusive rocks are diabase dikes.

The area is structurally divided into two different tectonic zones separated by a major shear zone exhibiting protomylonites, mylonites, and mylonite gneiss. The western structural zone is the IVb Hastings Basin segment of the Central Metasedimentary Belt and only outcrops in the very northwest corner of the map area. The bulk of the map area is contained within the IVc Frontenac Axis segment and is typified by a dominant S_1 foliation which is essentially parallel to the S_0 bedding, and is folded into isoclinal folds (F_2) with essentially vertical plunges. Well-developed quartz and hornblende rodding (L_3) and boudinage is not uncommon. Small scale deformation is most evident in the metasedimentary units. A major healed shear zone separates medium grade lithologies from high grade lithologies within the IVc segment. Metamorphic grade increases from the northwest corner of the map area to the southeast. Rocks in the northwest half of the map area have been metamorphosed within the low temperature field of medium grade metamorphism whereas those in the southeast half have assemblages indicative of the regional hypersthene zone or high grade granulite zone.

In the past, mineral exploration for gold and base metals has been concentrated in the metavolcanic and metasedimentary rocks. The late-stage granitic rocks have been the focus of exploration for phosphate, mica, feldspar, and uranium. None of these ventures has as yet outlined any economic deposits. Areas of current interest include potential talc deposits in the metavolcanics and feldspar in the Lanark-Oso anorthosite body.

Surficial Pleistocene deposits are most prominent in valleys associated with the major shear zones and within and adjacent to the Bolton Creek Valley.

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CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

If the reader wishes to convert imperial units to SI (metric) units or SI units to imperial units the following multipliers should be used:

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)/ton (short)	20.0	pennyweights/ton (short)
1 pennyweight/ton (short)	0.05	ounce (troy)/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 co-operation with the Coal Association of Canada.

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Sharbot Lake Area

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Southeastern Ontario

by

J.M. Wolff[1]

INTRODUCTION

The Sharbot Lake map area lies between Latitudes 44°45'N and 44°52'30''N and Longitudes 76°30'W and 76°45'W, and is situated in Frontenac and Lanark Counties in Southern Ontario. The area covers about 250 km^2. The village of Sharbot Lake is located in the southwest portion of the area and the village of Maberly is located in the northwest portion of the area. Sharbot Lake is about 70 km by road north of the city of Kingston and Maberly is about 105 km by road west of the city of Ottawa.

Access

Access to the map area is excellent. Provincial Highways Nos. 7, 38 and 509 transect the map area east-west and north-south. Stemming from these arteries are a number of north-south and east-west secondary roads. Lake access in the western portion of the area, especially by Sharbot Lake and White Lake is good. In the eastern part of the map area Silver Lake, Deer Lake, and Rock Lake in particular, although isolated, locally contain good exposures. Portions of the Fall River also contain some outcrops. An abandoned railway bed (formerly belonging to the C.P.R. and presently a Bell Canada underground communication line) essentially parallels much of Highway 7 except near Sharbot Lake where it passes south of the western portion of the lake. The current main line of the Canadian Pacific Railway passes through the southeast portion of the map area and provided access to otherwise relatively remote areas.

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[1]Geologist, Precambrian Geology Section, Ontario Geological Survey, Toronto. Manuscript approved for publication by the Chief Geologist, February 27, 1981. This report is published with the permission of V.G. Milne, Director, Ontario Geological Survey.

Mineral Exploration

Mineral exploration in the map area has been sporadic since just before the turn of the century. The period circa 1900 saw interest in vein-type apatite deposits south of Silver Lake, and some small pyrite showings on the northeast shore of White Lake, but no economical concentrations were delineated. The second period circa 1910 saw development of some small mica and feldspar pits, mainly of a prospect nature in the map area. The third period circa 1940 saw prospecting for gold in the map area and several pyritiferous late-stage quartz veins were prospected, three of which assayed less than 0.01 ounces of gold in selected samples (Harding 1967). Again none of these prospects yielded economic concentrations. The fourth period of exploration circa 1959 involved exploration for base metals and gold. Although several holes were diamond drilled in metasediments at Sharbot Lake, no economical concentrations were found. The latest period of exploration activity in the map area was from 1977-1979. The focus has been on potential uraniferous zones delineated by the joint Federal-Provincial Uranium Reconnaissance Project (Geological Survey of Canada 1976, 1979). The zones of highest potential lie just to the north of the present map area northwest of Clarendon Station.

Previous Geological Work

The earliest recorded geological survey in the Sharbot Lake map area is that of Murray (1852), who under the direction of William Logan, reported examining the rocks in Oso and Olden Townships. Murray identified the rocks of the "Metamorphic Series" (Laurentian Series) but did not attempt to subdivide them further. H.G. Vennor (1872) described rocks found in Olden and Oso Townships as both sedimentary and igneous types. J. White (1893) traced a mass of limestone eastward from Olden into Oso Township. R.W. Ells (1901) presented the geology of parts of Olden and Oso Townships on G.S.C. Map No. 789.

The work of Harding (1947) was the only comprehensive geological survey in the map area prior to the present study. Harding assigned the metasediments in the map area to the Grenville Series and realized the distinction between older mafic intrusive rocks and somewhat younger granites and gneisses.

The present study area was included in the regional compilation of the Madoc-Gananoque Area (Hewitt 1964). The Long Lake Area (Wolff 1979) and the Kaladar Area (Wolff 1978), which are immediately adjacent and to the southwest of the Sharbot Lake Area, were mapped by the author in 1978 and 1977 respectively. The Tichbourne Area which is located immediately to the south of the present study area was mapped by Wynne-Edwards (1964). These latter three works should be consulted for data relevant to rocks found in the present study area.

Present Geological Survey

Geological Map 2471 (back pocket, scale 1:31 680) presents the results of the geological survey carried out by the author and his assistants during the summer of 1979. Preliminary map P.2373 at a scale of 1:15 840 was released in 1980.

The field maps were prepared at the scale of 1:10 000 on base maps produced by the Cartography Unit, Ministry of Natural Resources from the National Topographic Series, provisional map 31 C/15 (scale 1:50 000). Field data were plotted on acetate overlays on vertical air photographs at the same scale as the base maps. These 1:10 000 maps were then machine reduced to 1:15 840. The data was primarily collected along pace-and-compass traverse lines run at right-angles to strike, approximately 400 to 500 m apart. In areas of poor outcrop, traverses were run between outcrops visible on the air photos. In areas of massive outcrop (i.e. map units 1 and 8) only areas examined in some degree of detail are outlined on the map. Data was also collected from roadcuts in the area. Samples from map units 6, 7, 8 and 9 were cut and stained for K-feldspar in the field to help identify the feldspar composition in these rock types.

Topography and Drainage

Elevations in the map area range from 163 m above sea level at Bolingbroke to 255 m in the higher portions of the Lavant gabbro body east of Highway 509 in the northwest part of the map area. The maximum relief is about 45 m and found at the contacts of the Lavant gabbro, especially in the vicinity of Bolton Creek. The bulk of the map area is of low relief and represents a highland area between the Tay River drainage system on the south and the Mississippi River drainage system to the north. Sharbot Lake is drained by the Fall River which flows northeasterly and meets the Mississippi River northeast of the map area.

Acknowledgments

The author was assisted in the field by A.G. Choudhry, A.E. Heagy, S. Trueman, and J.E. Mountjoy. Mr. Choudhry as senior assistant carried out independent traverses throughout the field season. Discussions with K. Ford of the Geological Survey of Canada concerning the relationship between the results of medium altitude gamma ray spectrometry surveys and associated geology proved most helpful during the field season.

Except where otherwise stated, all chemical analyses that appear in this report were done by the Geoscience Laboratories of the Ontario Geological Survey, Toronto.

GENERAL GEOLOGY

Terminology

In order to avoid possible ambiguities a number of terms used in the discussion of the general geology are defined below.

Migmatite, Metatexite, Diatexite, Anatexis, Leucosome, Melanosome, Stromatitic, Schlieren, Nebulitic

Migmatite terminology is taken after Mehnert (1971). Migmatite is used to describe a megascopically composite rock consisting of two or more petrographically different parts, one is the country rock in a more or less metamorphic stage and the other is of pegmatitic, aplitic, granitic, or generally plutonic appearance. Metatexite refers to a rock which is formed by metatexis: the partial, differential, or selective anatexis (melting of rock) of the low-melting components of a rock (generally quartz and feldspar). Diatexite refers to a rock which is formed by diatexis: high-grade anatexis which includes the mafic minerals. Leucosome refers to the leucocratic part of a migmatite, and is generally rich in quartz and feldspar. Melanosome signifies the melanocratic part of a migmatite, and is rich in mafic minerals. Stromatitic is a modifier which describes those migmatites with a layered structure or stroma. Schlieren is used to describe irregular streaks or masses with blended outlines in migmatites or hybrid migmatites. Nebulitic is a modifier which describes those migmatites with ghost-like relics of preexisting rocks. Readers not familiar with any of the above terminology are encouraged to consult Mehnert (1971) for more detailed descriptions and illustrations.

Precambrian Time Scale

The Precambrian time scale used is that suggested by Ayers *et al.* (1971), which divides Precambrian time into three eras: Early (>2500 m.y.), Middle (2500 m.y. to 1500 m.y.) and Late (<1500 m.y.).

Foliation, Schistosity, Gneissosity, Cleavage

Foliation is used to describe all types of megascopically recognizable structural surfaces of metamorphic origin (Turner and Weiss 1963, p.97). Several distinguishable types of foliation include compositional layering, preferred orientation of mineral grains and localized slip features. Gneissosity and schistosity are the most common varieties of foliation in the map area. As used in this study, schistosity imparts a planar structure in a metamorphic rock due to abundant, preferentially oriented grains especially micas. Schistosity is accompanied by a fissility in the rock and is best developed in medium-grained rocks rich in micaceous minerals. Gneissosity denotes a layering of metamorphic origin defined by the alternation of layers, streaks or lenticles of contrasting mineralogical composition or texture. Cleavage is also developed and denotes a parting in the rock resulting from the incipient parallel growth of micaceous or elongated minerals (usually under regional metamorphism) in fine-grained rocks and is most common in lower grades of metamorphism.

Metamorphic Grade, Isograd, Isoreaction-Grad

Metamorphic petrochemical terminology used in this study is after that of Winkler (1976). The term metamorphic grade is used essentially in place of the more commonly used facies terminology (Winkler 1976). Metamorphic grade refers to large pressure-temperature zones which are subdivided with respect to increasing temperature and the associated coexisting mineral assemblages which exist for a given bulk composition. Generally four metamorphic grade divisions are referred to, these are very low, low, medium, and high. The term isograd is used in its original sense (Tilley 1924) to define the line on a map joining points which designate a definite degree of metamorphism by the first appearance of an index mineral in rocks of a particular bulk composition. This definition is also extended to include lines which join points designating the disappearance of index minerals as well, (Thompson 1973). Isograd is a general term in the sense that the kind of reaction producing this mineral change is not necessarily observable petrographically. When the minerals involved in the reaction are observable the term isoreaction-grad is used.

Granolite, Granoblastite, Enderbitic

High grade metamorphic terminology is taken after Winkler (1974, 1976). Granolite is defined as a rock which is within the regional hypersthene high grade metamorphic zone and contains a mineral assemblage diagnostic of this zone. Granoblastite is a rock which belongs in the regional hypersthene high grade metamorphic zone but lacks a mineral assemblage characteristic of this zone. Enderbitic refers to those granolites which are essentially hypersthene-bearing trondhjemites. Rocks similar to this have been called charnockites by other authors.

Protomylonite, Mylonite, Mylonite Gneiss

Terminology used for dynamically metamorphosed rocks is taken from Spry (1969). The term protomylonite is used to describe those foliated rocks containing 10-50 percent crushed matrix. Mylonite defines those foliated rocks containing a 50-90 percent crushed matrix. Mylonite gneiss refers to those foliated rocks with a 50-90 percent crushed matrix and discrete porphyroclasts or augens which are not recrystallized material.

Gabbro, Anorthositic Gabbro, Gabbroic Anorthosite, Anorthosite

The field terminology for basic intrusive rocks in the Grenville Province has lacked consistency in the past. Notably Miller (1899) and Buddington (1939) have used terminology which differs in some criteria from currently used terms for these rocks. In this study gabbro refers to a mesocratic intrusive rock possessing a colour index greater than 30 and an appropriate mode. Similarly, anorthositic gabbro is used for a leucocratic basic intrusive rock with a colour index of between 20 and 30, and gabbroic anorthosite for a leucocratic basic intrusive rock with a colour index between 10 and 20. Since these last two rock types were difficult to distinguish in the field, the term anorthositic gabbro-gabbroic anorthosite is used for leucocratic basic intrusive rocks possessing a colour index between 10 and 30. Anorthosite is used for leucocratic basic intrusive rocks possessing a colour index less than 10 and more than 75 percent plagioclase feldspar.

Geological Summary

The map area lies within the Central Metasedimentary Belt as defined by Wynne-Edwards (1972). Specifically, the area is mainly located within the IVc Frontenac Axis segment, however the northwest corner belongs to the IVb Hastings Basin segment. Major units present are mafic to silicic anatectic gneisses and related migmatites, metasediments and metavolcanics of Late Precambrian age (Grenville Supergroup equivalents), and Late Precambrian felsic and mafic intrusive bodies. Late tectonic pegmatite dikes and irregular masses cut the supracrustal rocks locally. The general succession of the rocks is given in Table 1.

The most highly metamorphosed and possibly the oldest rocks in the map area are the mafic to silicic anatectic gneisses and related migmatites of map unit 1 (*see* Map 2471, back pocket). These rocks contain metatexites and diatexites plus quartzo-feldspathic gneisses which have undergone partial melting. The bulk of these rocks are essentially granodioritic in composition and could represent lower crustal equivalents of the metasedimentary and metavolcanic rocks described below, with which they are in fault contact.

The metavolcanics and metasediments occur in the northwestern part of the map area and are confined to a zone bounded by major shear zones to the northwest and southeast. Although similar in some regards to the metasediments and metavolcanics of the structure known as the Clare River Synform or Kaladar-Dalhousie Trough (Hewitt 1956), these rocks represent a distinct and separate structural entity. The metavolcanics appear to be tholeiitic basalt which tends to be subalkalic, and minor calc-alkaline rhyodacite. Although similar in composition, it is difficult to correlate these rocks directly with metavolcanics of the Tudor formation as defined by Lumbers (1969); rocks more directly on strike with these metavolcanics were simply assigned to the "Grenville Series" by Wynne-Edwards (1964). The metasediments of the map area are composed of hornblende-rich gneisses and schists (hornblende, plagioclase $\pm$ quartz), carbonate metasediments (calcite, dolomite, and calc-silicate bearing phases) and clastic siliceous gneisses (quartz and feldspar plus biotite-muscovite). The hornblende-rich gneisses and schists represent mature calcareous sediments which under metamorphism formed hornblende, creating hornblende-plagioclase-biotite gneisses. The clastic siliceous gneisses have quartzite to quartzose wacke, to feldspathic wacke, to carbonate-bearing feldspathic wacke compositions. The carbonate metasediments include a large part of the area exposed as metasediments and suggest an origin in a stable carbonate basin. This basin was in part contemporaneous with an environment of less stable sediment deposition as evidenced by the presence of carbonate minerals in the clastic siliceous and amphibole-rich metasediments. Minor stability fluxes in the carbonate bank are evidenced by discontinuous fragmental marbles within the carbonate metasediments.

The intrusive rocks in the map area can be grouped into two tectonic groups: syntectonic and late tectonic, and two compositional groups: mafic and felsic (granitic). The syntectonic intrusives are felsic and include the Northbrook Batholith and the Addington Pluton located in the northwestern corner of the map area. The Northbrook Batholith is a composite batholith containing trondhjemite to granite compositions (Wolff 1978, 1979), but is chiefly trondhjemite in the Sharbot Lake map area. The Addington Pluton is granodiorite to granite in composition but chiefly quartz monzonite, and often displays a *lit-par-lit* relationship with the supracrustals it intrudes. The late tectonic intrusions are of mafic and granitic compositions. The mafic intrusives include large expanses of gabbroic and anorthositic bodies and very late-stage diabase dikes. The main gabbroic body is the Lavant gabbro (northern gabbro body) which ranges from gabbro to anorthositic gabbro in composition and appears to be a high-level gabbroic intrusion. Smaller gabbro bodies are associated with the Lanark-Oso mafic intrusive body which is primarily anorthosite to gabbroic anorthosite with little gabbro. This anorthosite body appears not only to be a deeper level intrusive but possibly the result of anatexis rather than igneous differentiation. Specifically it may represent the residue after melting seventy-five percent of a granodioritic (tonalite) gneiss of appropriate composition. The granitic intrusions of the late tectonic stage are chiefly granodiorite to quartz monzonite in composition, with local syenite phases and pegmatitic granodiorite dikes. These rocks are very late stage and intrude along existing major shear zones and fracture systems. They are very similar to the MacLean Granitic Pluton in the Long Lake Area (Wolff 1979) and, similarly, probably represent a partial melt derived from crustal assemblages.

The rocks in the map area underwent regional metamorphism during the Late Precambrian. The metasediments and metavolcanics have been metamorphosed to the low temperature field of medium grade metamorphism (Winkler 1976). Assemblages in the high grade gneisses are indicative: (1) of the regional hypersthene zone or high grade granolite zone as described by Winkler (1976), and (2) that pressures in this zone are somewhat higher than those within this similar zone in the Long Lake Area (Wolff 1979).

Structurally, the map area is composed of essentially two entities segmented by a major shear zone, trending north-northeast, located in the northwest corner of the map area, which separates the IVb segment from the IVc segment of the Central Metasedimentary Belt. Another northeast trending shear zone in the central part of the area separates the medium grade gneisses

TABLE 1 | TABLE OF LITHOLOGIC UNITS FOR THE SHARBOT LAKE AREA.

PHANEROZOIC

CENOZOIC

QUATERNARY

RECENT

Organic swamp and alluvial deposits.

PLEISTOCENE

Outwash deposits: sand, silt, clay, till.

Unconformity

PRECAMBRIAN

LATE PRECAMBRIAN

LATE TECTONIC METAMORPHOSED INTRUSIVE ROCKS

LATE MAFIC INTRUSIVE ROCKS

Mafic (diabase) dikes.

Intrusive Contact

LATE GRANITIC INTRUSIVE ROCKS[a]

Biotite granite, quartz monzonite; biotite granodiorite; leucocratic granodiorite; syenite ± hornblende ± biotite ± epidote; porphyritic and muscovite-bearing varieties; shear zone protomylonite, mylonite, and mylonite gneiss varieties; pink, white granodiorite pegmatite dikes and irregular masses; unsubdivided metasedimentary and metavolcanic inclusions; quartz veins, dilation fillings.

Intrusive Contact

EARLY MAFIC INTRUSIVE ROCKS

LAVANT AND LANARK-OSO MAFIC INTRUSIONS

Gabbro, anorthositic gabbro to gabbroic anorthosite; anorthosite; quartz gabbro; monzonite; syenite; porphyroblastic and glomeroporphyroblastic varieties; granodiorite and biotite trondhjemite phases; aplitic phases; pyroxenite, peridotite.

Fault and/or Intrusive Contact

SYNTECTONIC METAMORPHOSED FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

ADDINGTON PLUTON[b]

Leucocratic quartz monzonite; shear zone protomylonite, mylonite, and mylonite gneiss varieties; biotite quartz monzonite; granite; biotite granodiorite.

NORTHBROOK BATHOLITH[b]

Biotite trondhjemite.

Fault and/or Intrusive Contact

METASEDIMENTS AND METAVOLCANICS

AMPHIBOLE-RICH GNEISSES AND SCHISTS[cde]

Hornblende-plagioclase gneiss; amphibolite; calcite porphyroblasts and/or layers; biotite-chlorite schist; biotite-hornblende schist; quartz-plagioclase-hornblende gneiss; plagioclase-hornblende gneiss; potassium feldspar-hornblende gneiss; almandine garnet porphyroblasts; biotite-hornblende-quartz-feldspar schist; shear zone protomylonite, mylonite, and mylonite gneiss varieties.

CARBONATE METASEDIMENTS[cde]

Calcite marble; dolomite marble; dolomite-calcite marble; laminated calcite marble; calc-silicate assemblages (tremolite, diopside, talc, apatite, sphene); fragmental dolomite-calcite marble containing flags of quartzite, quartz-feldspar, and calc-silicate material; quartzite, quartzo-feldspathic blocks, broken beds, and flags; chert beds; mafic hornblende-rich segmented layers; coarse-grained varieties; contact skarn phases (tremolite, diopside, apatite, talc, and phlogopite); calcite-graphite schist.

CLASTIC SILICEOUS GNEISSES AND SCHISTS[cde]

Biotite-quartz-feldspar paragneiss; biotite-hornblende-plagioclase-quartz paragneiss; banded quartzite ± biotite ± muscovite ± feldspar layers; epidote-biotite-potassium feldspar-plagioclase-quartz paragneiss; pyritic rusty quartz-feldspar paragneiss; muscovite-bearing varieties; muscovite-quartz-feldspar ± garnet schist; biotite-calcite-quartz-feldspar paragneiss, locally schistose; garnetiferous porphyroblastic varieties; shear zone protomylonite, mylonite, and mylonite gneiss; leucocratic biotite-magnetite-muscovite-quartz-feldspar gneiss.

MAFIC TO INTERMEDIATE METAVOLCANICS[cde]

Quartz-epidote-plagioclase-hornblende ± chlorite amphibolite and amphibolite gneiss; hornblende porphyroblastic varieties; biotite-hornblende-quartz-feldspar ash tuff; talc-tremolite-calcite schist; shear zone protomylonite varieties.

MAFIC TO SILIC MIGMATITES AND ANATECTIC GNEISSES[f]

Granodiorite metatexite; labradorite-hornblende-pyroxene diatexite; quartz-feldspar rich ± biotite ± pyrite gneiss; quartz-plagioclase-biotite ± pyroxene ± garnet gneiss; well differentiated migmatite (metatexite) with distinct leucosome and melanosome; quartz-plagioclase-biotite ± hornblende ± pyroxene syenitic to granodioritic diatexite; gabbroic ± biotite ± hornblende gneiss; pegmatoid leucosomes.

Notes:

a) This unit is interpreted as correlative with the MacLean Granitic Pluton in the Long Lake Area (Wolff 1978, 1979).
b) No relative age difference is implied between the Addington Pluton and the Northbrook Batholith.
c) No relative age is implied between these rock types.
d) The convention of metamorphic nomenclature used for these rock types is with the least plentiful mineral placed first.
e) Metamorphic textural terminology is after Spry (1969).
f) Migmatite and anatectite terminology is after Mehnert (1971).

and is located in the southeast central part of the map area. Rocks within these shear zones are typically protomylonites and mylonites. The foliation within the supracrustal rocks is considered to be an S_1 foliation which is generally parallel to the S_1 bedding. These units are folded into isoclinal folds (F_2) with generally vertical plunges. A well developed L_3 lineation (quartz and hornblende rodding) along the dip direction of bedded units is also found. Boudinage is common in the metasedimentary units and combined with rodding produces pseudoconglomerate phenomena. Late-stage jointing is developed in two major vertical joint sets, southeast-northwest and north-south, with a minor horizontal set.

Late Precambrian

MAFIC TO SILICIC MIGMATITES AND ANATECTIC GNEISSES

Map unit 1 represents mafic to silicic migmatites and anatectic gneisses. Rocks of this unit are among the best exposed in the map area (locally reaching 80% exposure) and cover approximately 75 km^2 or 30 percent of the map area. Geographically, these rocks outcrop on the eastern part of Sharbot Lake, with the western contact of this unit occurring in Cranberry Bay and just west of Hawley Bay. These rocks strike to the north-northeast over a distance of 6.5 km to where the strike changes to northeast, near the benchmark coined Ungava, for another 11.3 km through the village of Maberly, and eastward out of the map area, approximately 1.2 km north of Highway 7, north of McGowan Lake. With the exception of some carbonate metasedimentary units (map unit 4) and the Lanark-Oso anorthosite massif (map unit 8) and late granitic intrusive rocks (map unit 9), this map unit comprises the entire southwestern portion of the map area. As a general rule the northwestern contact of map unit 1 (outlined geographically above) is in contact with rocks of map unit 9; although, metasedimentary lenses or slices of map units 3 and 4 can locally be found along this contact and surrounded by unit 1 material. The most commonly occurring rock types of this map unit are described under units 1a, 1b, 1c, and 1d. The other rock types are found outcropping less often, but map unit 1e is often the most striking in appearance.

Map unit 1a represents medium- to coarse-grained granodiorite gneiss which locally contains augens of plagioclase feldspar and contains inclusions and schlieren of map unit 1b. This rock weathers a distinctive grey with a steel grey to purplish lustre on the fresh surface, and contains dark streaky inclusions and schlieren imparting a nebulitic appearance. Table 2 shows the modal abundances of two granodiorite samples of this unit and the modal abundance of a sample of schlieren. Note that samples M606-79-1 and M606-79-2 come from the same outcrop. The granodiorite phases typically contain 35-65 percent quartz, 10-25 percent plagioclase (sericitized oligoclase), and 15-25 percent biotite as the major phases. Minor phases include diopside, muscovite, and opaques (pyrite), ranging from 5-10 percent in abundance. Grain size ranges from 0.5 mm to 4.0 mm with augens of oligoclase reaching a maximum length of 8.0 mm. Textures in this unit are primarily idioblastic with zones displaying augen structure. These augen-bearing zones represent protomylonites with some samples displaying fine ribbons of recrystallized quartz (*see* Photo 1). Such augen-bearing zones are concentrated near the northwestern contact of this unit. The mafic schlieren in this unit typically contain 45 percent plagioclase (oligoclase), 34 percent hornblende, 9 percent biotite and 12 percent opaques (pyrite). Textures tend to be granoblastic to idioblastic with grain sizes ranging between 1.0 mm and 4.0 mm. Mineralogically, these schlieric phases are very similar to lithologies of unit 1b. On average the schlieren are 10 cm in width and range up to 5 m in length along strike.

Map unit 1b represents medium- to coarse-grained plagioclase (labradorite)-hornblende-pyroxene diatexite, usually displaying plagioclase augens

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Photo 1–Photomicrograph (plane-polarized light) of augen-bearing (protomylonite) granodiorite gneiss (metatexite) of map unit 1a. Augens are composed of plagioclase feldspar coloured white to greyish; biotite, defining foliation-gneissosity, is dark grey, finer-grained light material is quartz. Sample (M641-79-1) was taken from an augen-rich zone adjacent to the healed fault zone near the contact of units 1 and 9. The augen measures 2.5 mm in length.

and/or a stromatic structure. This rock weathers a dark green with well-defined but discontinuous grey-greenish-white stroma. Table 2 indicates that the major mineral phases of this unit are hornblende (25 to 35 percent), plagioclase (oligoclase-labradorite, 30-35 percent), and biotite (10-25 percent). Quartz is generally absent but may reach concentrations of 10 percent. Diopside is usually present in low concentrations (less than 5 percent). Opaques are typically pyrite and constitute 10 percent of the rock. Grain size ranges from 0.5 mm to 3.0 mm with augens of quartz and plagioclase reaching 8.0 mm maximum. Similar to map unit 1a, the augen-bearing phases of unit 1b are most dominant near the northwestern contact of this unit, and represent protomylonites. Typical textures in this unit are idioblastic with the mafic portion (melanosome) constituting approximately 90 percent of the stroma, and the felsic portion (leucosome) being composed of fine-grained to medium-grained layers of granodiorite with a granoblastic texture.

Map unit 1c represents a fine-grained quartz-feldspar ± biotite ± pyrite gneiss. This unit is of distinctive appearance in outcrop as it weathers a white to dirty white, and if pyrite is present, it weathers a distinctive rusty white. Although mineralogy tends to be quite variable in this unit, the total quartz plus feldspar content is greater than 50 percent and often greater than 70 percent. Plagioclase is usually labradorite. The variable mineral phases include biotite, hornblende, diopside, muscovite, sphene, and pyrite (*see* Table 2). Grain size ranges from 0.1 mm to 2.5 mm. Textures are typically granoblastic; however, locally sheared phases of this unit contain excellent cataclastic textures indicative of protomylonites. Such cataclastic textures include recrystallized quartz ribbons with resistant plagioclase and/or orthoclase grains. The lack of mafic mineral concentrations in this unit gives it an appearance that is not typical of classical differentiated migmatites.

Map unit 1d represents a commonly encountered medium-grained quartz-plagioclase-biotite-pyroxene-garnet gneiss typically associated with map unit 1c. This unit differs from unit 1c in that biotite is always present and is medium-grained. The dominant mineral phases are quartz (35-45 pecent), plagioclase (oligoclase, 20-30 percent), and biotite (10 percent). Minor phases include epidote, muscovite, diopside, and magnetite. Garnet is locally heavily concentrated in this unit as typified by a garnet-rich sample (A293-79-1) in Table 2. Rocks of this unit contain a well-developed foliation-gneissosity and display a granoblastic to porphyroblastic texture. Grain size varies from 0.5 mm to 4.0 mm with garnet porphyroblasts typically reaching 7.5 mm. Both map units 1c and 1d appear to be gneisses of metasedimentary origin, based both on texture and mineralogy, and do not appear to have undergone anatexis to the same degree as other rock types in unit 1. The lack of mafic material in these rock types has limited the development of metamorphically differentiated migmatites.

Map unit 1e represents a locally developed rock type of striking appearance, described as a well-differentiated migmatite containing a fine- to medium-grained leucosome of quartz and feldspar, and a fine- to medium-grained melanosome of hornblende and plagioclase ± biotite. This unit displays a distinctive stromatitic structure and is a good example of a metatexite weathering in alternating bands of pink-white and dark-green black. Outcrops are very limited and are confined to areas close to the northwest contact of unit 1 with unit 9. An excellent exposure of this rock type occurs on the west side of Lanark County Bi-Way 4 in the village of Maberly between Highway 7 and the south Sherbrooke Township garage. The modal abundances of two samples of the leucosome and one sample of the melanosome are given in Table 2. The leucosome contains quartz (35-60 percent), plagioclase (labradorite, 20-30 percent), and biotite (8-23 percent) as the major phases. Hornblende, if present, does not exceed 10 percent. Opaques typically constitute 10 percent and include both pyrite and magnetite. In general these rocks have an idioblastic texture and are aplitic. The melanosome contains hornblende as the major phase (56 percent) plus plagioclase (labradorite, 18 percent) and biotite (12 percent). Minor phases are quartz (8 percent) and pyrite (6 percent). The texture is similarly idioblastic and generally aplitic. Both the leucosome and melanosome occur repeatedly across strike and vary from 5 cm to 20 cm in thickness and are continuous along strike on an outcrop scale.

Map unit 1f represents medium-grained quartz-plagioclase-biotite-

TABLE 2 | MODAL ABUNDANCES OF ROCKS OF MAP UNIT 1 FROM THE SHARBOT LAKE AREA.

SAMPLE	M641-79-1	M606-79-1	M606-79-2	M535-79-2	M532-79-1	M535-79-1	M1225-79-1	M630-79-1	M541-79-1	A293-79-1	M789-79-1	A275-79-1	M789-79-2	M1111-79-1
Quartz	37	58	–	10	–	–	12	50	45	25	57	34	8	–
Plagioclase	25	12	45	35	36	32	41	39	32	9	22	27	18	8
	sericitized	oligoclase	oligoclase	oligoclase	oligoclase	labradorite	labradorite	sericitized		sericitized	labradorite	labradorite	labradorite	labradorite
Orthoclase	–	–	–	–	–	–	–	–	18	–	–	–	–	30
Biotite	25	15	9	11	19	22	22	5	–	11	8	23	12	–
Hornblende	–	–	34	28	35	32	5	–	–	–	–	8	56	–
Diopside	5	5	–	2	2	2	8	–	–	–	–	–	–	12 augite
Almandine Garnet	–	–	–	–	–	–	–	–	–	55	–	–	–	–
Muscovite	–	5	–	–	–	–	5	–	3	5	–	–	–	–
Epidote	–	–	–	–	–	–	–	–	–	–	–	–	–	35
Sphene	–	–	–	–	–	–	–	3	–	–	–	–	–	–
Opaques	8	5	12	8	8	12	12	3	2	6	13	8	6	15
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Granodiorite Phases		Schlieren Phase							Garnetiferous	Leucosome Phase		Melanosome Phase	
	←— MAP UNIT 1a —→			←— MAP UNIT 1b —→			←— MAP UNIT 1c —→			MAP UNIT 1d	←— MAP UNIT 1e —→			MAP UNIT 1f

hornblende-pyroxene, syenitic to granodioritic diatexite displaying locally a poorly defined stromatitic structure. This rock type differs from rocks of unit 1a in that it usually weathers pink (syenitic phases) to greyish (granodioritic phases) with apple green streaks or wisps of epidote. Where this unit is augen-bearing, the epidote is deformed around the augens. A syenitic phase was sampled and the modal abundances (Table 2) are orthoclase (30 percent), epidote (35 percent), augite (12 percent), plagioclase (labradorite, 8 percent), and pyrite (15 percent). Grain size is typically 1.0 mm to 4.0 mm and the texture is granoblastic to augenized, the latter representing protomylonite phases. Excellent exposures of unit 1f can be found on the west side of the cottage road which runs to Antoine Point on the southwest side of Sharbot Lake, reached via Shibley Road off Highway 38 south of the map area.

Map unit 1g represents poorly developed rock types consisting of medium-grained gabbroic ± biotite ± hornblende gneiss. It weathers a dark green colour and outcrops with gabbro of map unit 8 in the southeastern corner of the map area where the Canadian Pacific Railway and Lanark County Bi-Way 4 meet north of the Tay River. Dominant mineral phases include plagioclase and pyroxene. This unit usually contains pyrite and biotite and hornblende as minor phases. Grain sizes range from 1.0 mm to 3.0 mm. Outcrops of this unit are usually poorly exposed except along rail cuts.

Map unit 1h represents pegmatoid leucosome segregations paralleling gneissosity. These segregations are typically of quartz, plagioclase, and potassium feldspar and contain few inclusions. Contacts are usually abrupt but diffuse and often "books" of biotite are concentrated along the contacts with the adjacent rocks. Whether or not these pegmatoid leucosomes are different in source and origin than the pegmatites of the late granitic intrusive rocks (map unit 9) is dubious, but the diffuse nature of the contacts suggests the country rocks were not completely cool when the pegmatoid leucosome was formed.

METASEDIMENTS AND METAVOLCANICS

Mafic to Intermediate Metavolcanics

Map unit 2 represents rocks which are essentially mafic to intermediate metavolcanics with minor amounts of intercalated metasedimentary material (map units 3, 4 and 5). Rocks of this unit outcrop south and west of the hamlet of Clarendon Station and west of Highway 509. No rocks of unit 2 occur west of the major shear passing through Clarendon Station. This unit is bounded to the south by carbonate metasediments (map unit 4) and late-stage granitic intrusive rocks of map unit 9, and to the east by a narrow zone of carbonate metasediments adjacent to the Lavant Mafic Intrusion (map unit 8). Rocks of this unit are similar to the mafic to intermediate metavolcanic rocks in the Long Lake Area (Wolff 1979) and occupy the same structural position as metavolcanics in the Long Lake Area.

The most abundantly occurring rock type of this unit is represented by map unit 2a, and consists of foliated, subidioblastic, fine-grained, quartz-epidote-

TABLE 3	MODAL ABUNDANCES OF ROCKS OF MAP UNIT 2 FROM THE SHARBOT LAKE AREA.			
SAMPLE	M052-79-1	A056-79-1	A064-79-1	M062-79-1
Hornblende	34	—	33	—
Plagioclase	33 sericitized	30 sericitized	30 oligoclase	18 oligoclase
Quartz	6	10	10	—
Biotite	12	—	—	—
Epidote	—	40	—	—
Chlorite	8	10	15	—
Talc	—	—	—	70
Calcite	4	—	—	—
Sphene	4	—	—	—
Tremolite	—	—	—	5
Opaque	—	10	12	7
TOTAL	100	100	100	100
	MAP UNIT 2a		MAP UNIT 2b	MAP UNIT 2d

plagioclase-hornblende ± chlorite amphibolite and amphibolite gneiss. These rocks weather a green-grey to dark green colour in outcrop and exhibit a colour index of 35 on the fresh surface. The grain size is typically 0.1 mm to 0.2 mm with some hornblende grains as large as 0.6 mm. The mineralogy of this unit is given in Table 3. Subhedral to anhedral hornblende is the dominant mineral phase and plagioclase is usually heavily sericitized. Common accessory minerals are biotite, chlorite, quartz, calcite, and sphene. Occasionally, phases of unit 2a display prominent concentrations of epidote. In such phases the dominant mineral phases are subhedral to anhedral plagioclase (heavily sericitized), and epidote. Typical grain sizes of both these mineral constituents are 0.1 mm to 0.2 mm, but glomeroporphyroblasts of epidote are typically 1.0 mm to 2.0 mm. Accessory minerals in this rock type are chlorite, quartz, and pyrite. Since a few crystal faces are preserved, the grains are described as subidioblastic, but the texture is granoblastic and generally equigranular with rare glomeroporphyroblasts.

Map unit 2b represents rocks rich in hornblende and weathering dark green in colour. The colour index is 35 and these rocks are more dense than those of unit 2a. Table 3 shows the modal abundance of a sample (A064-79-1) of unit 2b. Usually, the proportion of hornblende is higher than in this sample (45-50 percent plus); however, gradations between map unit 2a and 2b are common as the two units grade into one another both along and across strike. The grain size is medium-grained (3.0 mm) for the hornblende constituent which is surrounded by a fine-grained matrix (0.1 mm to 0.2 mm) of plagioclase (oligoclase), hornblende, quartz, pyrite, and epidote. Typically this rock has a knobby appearance in outcrop.

Map unit 2c represents rocks composed of intermediate metavolcanic rocks. These are fine-grained (0.1 mm to 0.2 mm) and weather a buff grey colour. The colour index is 15-30 and the mineralogy is principally quartz and plagioclase (heavily sericitized), accounting for 40-50 percent of the rock. The remainder is equally divided between hornblende, biotite, epidote, and pyrite. The grains are subidioblastic in thin section imparting a granoblastic texture. In hand specimen the fine-grained nature and mineralogy are suggestive of a meta-ash tuff, although this is complicated by the shearing and epidotization that this rock type has undergone. This rock type is rare and is discontinuous along strike.

Map unit 2d represents fine-grained talc, tremolite, and calcite schist. This rock unit weathers a streaky grey to green and white with a distinctive pearly lustre where well-exposed, more typically it is covered by thick accumulations of vegetation. This unit is fine-grained (0.5 mm to 1.0 mm) and schistose. Table 3 indicates the mode is dominated by talc and plagioclase, with minor amounts of tremolite, pyrite, and limonite. The particular sample examined contained no calcite as it was selectively chosen to examine the talc-bearing phases. Comparison of this unit and one several kilometers north of the map area near Robertsville revealed similarities in size, texture, and mineralogy. Talc-tremolite (see "Economic Geology" section) from the Robertsville unit is currently being extracted by RAM Petroleum Limited.

In the map area, the majority of the strike-length of map unit 2 is bounded on the west by the major shear zone which underlies the hamlet of Clarendon Station. Because of their close proximity to the zone, many of the units described above display shear strain features associated with this shear zone. Shear strain features occurring in unit 2 are coded as 2e and include protomylonite (*see* Photo 2), mylonite, and mylonite gneiss with porphyroblasts locally containing potassium feldspar. Rocks of unit 2 which have been strained typically display chlorite in their modes; and, if epidote is present, it illustrates strain features on a microscale chiefly by the parallel alignment of the long axes of individual grains. This chlorite and epidote mineralogy is also typical of the mafic to intermediate metavolcanic units in the Long Lake Area where they have suffered shearing strain deformation immediately adjacent to the major shear zone which underlies and runs through the village of Mountain Grove (Wolff 1979).

Due to the sheared and altered nature of the rocks belonging to map unit 2, it is difficult to compare them with the Tudor metavolcanics, as described by Lumbers (1969), either texturally or mineralogically, and chemical analysis would be tenuous. However, this unit can be closely compared mineralogically, texturally, and structurally with certain mafic to intermediate metavolcanic units of the Long Lake Area (Wolff 1979). To the extent that the Long Lake Area metavolcanics do exhibit phases similar to the Tudor metavolcanics, the author suggests that the metavolcanic units of map unit 2 in the Sharbot Lake Area may also be similar and related to the Tudor formation.

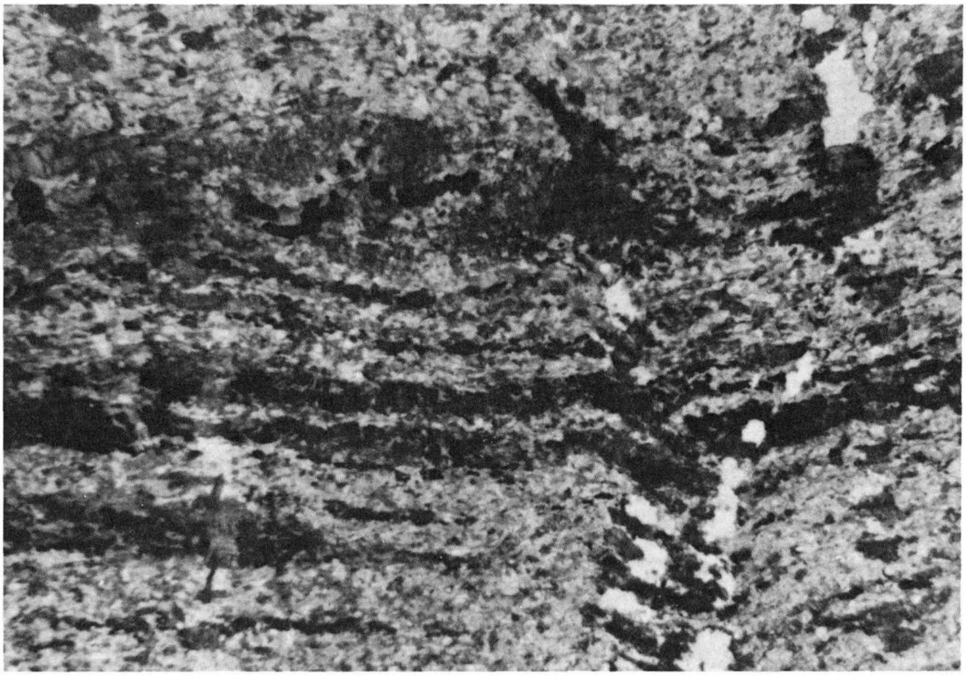

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Photo 2–Photomicrograph (plane-polarized light) of protomylonite (map unit 2) from the major shear zone near Clarendon Station (sample M070-79-1). The very fine-grained nature and small scale layering formed by high shear stresses; darkest material is pulverized pyrite grains; the medium-grained material is biotite and hornblende; and the lightest coloured grains are plagioclase and epidote. The photo covers a distance of 6 mm in length.

Clastic Siliceous Gneisses and Schists

Map unit 3 represents rocks comprised of clastic siliceous gneisses and schists which outcrop in the belt of metasediments that extends from the southwest corner of the map area, through Sharbot Lake, where the strike changes to northeast, and thence eastward north of Silver Lake. Rocks of this unit are intercalated with those of map units 4 and 5 and are intruded by discontinuous sills and/or subparallel dikes of pegmatite of unit 9. Prominent outcroppings of map unit 3 occur on the shores of Sharbot Lake and along Highway 7 just south of White Lake. Map unit 3 is bounded to the north by map units 9, 8, and 4 and to the south by map units 9 and 1. Rocks of map unit 3 display a weak to well-developed foliation, minor pinch-and-swell structures, minor fold structures, and distinct brittle fracture, and rodding phenomena.

The three most abundant rock types of map unit 3 are 3a, 3b, and 3c. Map unit 3a represents foliated, granoblastic, fine- to medium-grained, biotite-quartz-feldspar paragneiss. This map unit weathers to a whitish grey-buff with rusty weathering of the biotite. The biotitic and quartzo-feldspathic layers define the compositional layering and the biotite defines the preferred mineral orientation. The layering is generally 1 cm plus in thickness. Within unit 3 there is much repetition of this rock type across strike on an outcrop scale. Discontinuous garnetiferous horizons are locally present. The grain size ranges from 0.1 mm to 2.0 mm and the texture is well-foliated granoblastic with garnetiferous varieties being poikiloblastic. Modal abundances in this map unit are typically quartz 30-60 percent, plagioclase (andesine) 10-45 percent, and biotite 10-25 percent. Hornblende, almandine garnet, muscovite, epidote, and tourmaline are accessory, and opaques are either pyrite or iron oxides. This rock type likely represents a metamorphosed feldspathic wacke.

Rocks represented by map unit 3b have a mode of occurrence similar to that of unit 3a rocks, and often occur on the same outcrop. Unit 3b represents foliated, granoblastic, fine- to medium-grained biotite-hornblende-plagioclase-quartz paragneiss. These rocks weather a streaked greenish-grey colour. The biotite-hornblende and plagioclase-quartz layers define the compositional layering with the mafic component defining the preferred mineral orientation. The layering is generally 1 cm plus in thickness. The grain size varies from 0.1 mm to 2.0 mm and the texture is well-foliated granoblastic. Local garnet-bearing phases commonly display poikiloblastic textures. Table 4 summarizes the mineral abundances of this rock type. Quartz is usually 10-25 percent, plagioclase (sericitized andesine) 10-20 percent, hornblende 25-35 percent, and biotite 10-20 percent. Accessory minerals are calcite, apatite, tremolite, and talc. Opaques are generally limited to pyrite and iron oxides. This rock type likely represents a metamorphosed carbonate-bearing feldspathic wacke.

Rocks of map unit 3c have two main modes of occurrence: as thin (5 cm thick) discontinuous layers within map units 3a, and 3b; and as discrete thick (outcrop scale) lenses within the metasedimentary sequence. Map unit 3c is defined as a fine-grained banded quartzite with accessory biotite, muscovite, and feldspar. This rock type weathers a distinctive white to white-grey colour. The banding or layering is defined by biotite and/or muscovite where these platy minerals are present, and often by subtle grain size variations across layers. Layering generally ranges from 0.5 cm to 2 cm in thickness. Grain sizes of all minerals present range from 0.1 mm to 0.2 mm and the texture is granoblastic. Table 4 illustrates the modal abundances of map unit 3c. Quartz is the most abundant mineral and varies from 70-80 percent, and biotite or muscovite constitute 15-25 percent. Accessories include plagioclase, microcline, calcite, and pyrite none of which exceed 5 percent. Locally, when unit 3c rocks occur as thin layers within rocks of units 3a or 3b, the 3c phases occur as severely rodded and segmented blocks. These brittle fracture and dip-slip shearing phenomena create structures which appear to be not unlike metaconglomerate units. When traced along strike however, these blocks become continuous quartzite layers and lenses representing continuous beds. The fragmentation features are perhaps representative of regional unconformities and uplifts.

Map unit 3d represents foliated, granoblastic, fine- to medium-grained epidote-biotite-potassium feldspar-plagioclase-quartz-paragneiss. This rock type weathers a buff-grey to pinkish-grey with green streaks; and has been separated out as a discrete lithologic unit because of its small amount of biotite (<10 percent), but near equal amounts of quartz (40-50 percent) and total felds-

TABLE 4 | MODAL ABUNDANCES OF ROCKS OF MAP UNIT 3 FROM THE SHARBOT LAKE AREA.

SAMPLE	M200-79-1	M290-79-1	MQ41-79-1	M260-79-2	M466-79-1	M1059-79-1
Quartz	15	10	26	76	71	78
Plagioclase	20 sericitized andesine	10 sericitized andesine	15 sericitized andesine	—	—	2
Hornblende	35	35	28	—	—	—
Muscovite	—	—	—	—	23	18
Biotite	15	18	22	18	—	—
Calcite	—	8	—	—	<1	—
Apatite	—	6	—	—	—	—
Tremolite	—	5	—	—	—	—
Microcline	—	—	—	—	1	2
Talc	—	—	1	—	—	—
Opaque	15	8	8	—	5	—
TOTAL	100	100	100	100	100	100
	← MAP UNIT 3b		→	← MAP UNIT 3c		→

par (30-40 percent), plus prominent amounts of epidote (5-10 percent). The grain size is (0.1 mm to 1.0 mm). Layering is weakly defined and the texture is granoblastic with a well-developed foliation. The plagioclase is usually saussuritized andesine and potash-feldspar is well-preserved microcline. Minor phases are anhedral rutile and opaques.

Significant modifiers to the above units, especially map unit 3a, have been included in the lithologic code of the legend on Geological Map 2471, back pocket. Map unit 3e represents pyritic varieties. Pyrite may reach proportions of 33 percent but the high degree of weathering creates massive rusty staining on the weathered surface. Map unit 3f is used to delineate those phases of map units 3a and 3c which contain significant amounts of muscovite. When this code is employed the muscovite content is usually between 25 and 40 percent of the rock, and in outcrop occurs as discrete muscovite layers producing, upon exfoliation, massive surfaces of muscovite.

Locally within map unit 3 there occur aluminous schists containing muscovite (<50 percent) and quartz (20-35 percent) as the major mineral phases, and plagioclase, epidote, almandine garnet, and magnetite as minor mineral phases. This rock type is discontinuous along strike and is represented by map unit 3g

Map unit 3h represents foliated fine- to medium-grained biotite-calcite-quartz-feldspar paragneiss which is locally schistose. In short, this rock type can be considered as a calcitic variety of 3a. Because of the proportion of biotite and calcite present, and the contrasting competencies of these minerals with respect to the quartzo-feldspathic component of this rock type, it is usually schistose. Unit 3h grades across and along strike into map unit 3a.

Map units 3a, 3b, and 3d above are locally garnetiferous and porphyroblastic, and delineated so by map unit 3i. Invariably the garnet is almandine and poikiloblastic. Rotated garnets were not observed in this map-unit.

Those rocks of map unit 3 which occur within or bordering the major shear zone which underlies the hamlet of Clarendon Station are designated by map unit 3j. High shearing stresses have created local protomylonites and mylonites with only local mylonitic gneiss. A thin sectioned sample was found to contain 26 percent quartz, 37 percent plagioclase (sericitized andesine), 28 percent biotite, and less than 5 percent each of: apatite, calcite, and pyrite. The rock is fine-grained (0.5 mm to 2.0 mm) with the quartz grains being strained and elongated, and locally displaying mortar texture. In outcrop these rocks show high shear strain features typical of dynamically metamorphosed rocks, as described by Spry (1969).

Map unit 3k represents leucocratic, foliated, granoblastic, fine-grained biotite-magnetite-muscovite-quartz-feldspar gneiss. This unit is very fine-grained (<0.5 mm), hence it is often difficult to detect any layering except on close examination of the weathered surface which reveals very thin laminations (<0.5 mm). In hand specimen magnetite can be found in these laminations. The dominant mineral phases are quartz, plagioclase (andesine, highly sericitized), potassium feldspar (microcline and orthoclase), muscovite, and biotite. Minor phases are magnetite and zircon. Texturally, these rocks are granoblastic to granoblastic polygonal with quartz grains displaying interlocking textures. The fine grain size and thinly laminated nature implies that this rock type may be in part a volcanogenic sediment, perhaps representing recrystallized varieties of felsic tuffs similar to gneisses of andesitic and rhyolitic to rhyodacitic compositions in the Kaladar Area (Wolff 1978). Unit 3k is not abundant in the map area.

Carbonate Metasediments

Map unit 4 represents rocks composed of carbonate metasediments. The main outcroppings occur in three major parts of the map area. The first is as intercalated beds and thick units within the metasedimentary units which pass through Sharbot Lake. The second area of outcropping is a zone which stretches essentially across the entire map area from Highway 509 and the hamlet of Oso in the west to the northeast corner of the map area north of Fagan Lake. This area of outcropping, locally reaching 4 km in exposed width, is generally quite flat and parallels Bolton Creek. The third zone of outcropping is a northeast-trending zone stretching from Elbow Lake, at the northeast end of Sharbot Lake, to Clear Lake. The majority of outcrops in this zone are bounded to the north by the Fall River, and to the south by rocks of unit 8 (Early Mafic Intrusive Rocks) and reach a maximum width of 0.8 km. In addition to these zones, outcrops of this unit can be found within map unit 1 (Mafic to Silicic Migmatities and Anatectic Gneisses) particularly between the village of Bolingbroke and Little Silver Lake. Rocks of unit 4 are best exposed where farmland has been cleared, otherwise they are obscured by dense vegetation. Locally the rocks are typically highly deformed and exhibit flowage type structures.

The carbonate metasediments have been divided into three main groups: calcite marble (map unit 4a), dolomite marble (map unit 4c), and dolomite-calcite marble (map unit 4d). Disseminated quartz is generally absent in the carbonate metasediments; however, local skarn phases are developed.

Map unit 4a represents white-grey weathering calcite marble. It is usually medium- to coarse-grained (3 mm to 5 mm) and displays a granoblastic texture. In general this unit is massive. Locally the calcite marble unit displays thin laminations (0.5 cm to 2.0 cm thick) which are quite continuous. The occurrence of this feature has been coded as map unit 4b (*see* Photo 3). The calcite rhombs are idioblastic to subidioblastic in form.

Map unit 4c represents the dolomite marble. This unit is medium-grained (1 mm to 5 mm), mostly massive, granoblastic textured, and tends to weather a snow white to blue colour. The dolomite rhombs are idioblastic to subidioblastic.

Rocks represented by map unit 4d are very similar to, and a combination of the end member units 4a and 4c. This unit has a somewhat mottled grey colour and is medium-grained (1 mm to 5 mm) with a granoblastic texture. Map units 4a, 4c, and 4d can occur on the same outcrop over short distances both along and across strike, the dominant phase or phases being shown on the geological map (back pocket). Similarly, outcrops of entirely one of the above types can be found.

The legend (*see* Map 2471, back pocket) does not delineate the mineralogical variations in the above rock types created by different degrees of metamorphism. Several thin-sectioned samples of high grade marbles display the min-

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Photo 3–Finely laminated calcite marble (map unit 4b), looking northeastward along the foliation plane. The nodular features immediately left of the pick are calc-silicate (tremolite-diopside) siliceous nodules (map unit 4e) occurring in this unit. This outcrop is located on the east side of the gravel road running north from Zealand, just south of Bolton Creek, Oso Township.

erals diopside, phlogopite, and/or apatite, and a general absence of dolomite. Grain sizes of the metamorphic high grade marbles are generally coarse-grained.

The remaining map units in this category (4e to 4L) represent various mineral assemblages and intercalated rock types which occur as significant varieties of the three main groups of lithologies in the carbonate metasediments (units 4a, c, d).

Map unit 4e is used to distinguish calc-silicate mineral assemblages. These are fine-grained (0.5 mm) to medium-grained (5 mm) subidioblastic groupings of tremolite ± diopside ± talc ± apatite ± sphene. Tremolite is by far the most common calc-silicate mineral encountered. It is green-whitish-grey in colour and occurs in randomly oriented needles and radiating bundles typically less than 2.5 cm in length. Other calc-silicate minerals include very well-preserved diopside idioblasts, typically 5 mm long and brownish green in colour; talc and apatite are less common, green in colour, less than 1 cm in size, and typically subidioblastic to idioblastic in form; sphene is widely distributed in unit 4e and typically subidioblastic in form.

Map unit 4f represents fragmental dolomite-calcite marble containing flags of quartzite, quartz-feldspar, and calc-silicate (unit 4e) material. This map unit usually occurs as a continuous horizon on the outcrop scale. The quartzite zones are medium-grained (1 mm to 5 mm) and usually contain some areas of massive quartz. The contact between the quartzite zones and the adjacent dolomite-calcite marble is heavily masked by pervasive calc-silicate material (unit 4e). Formation of these calc-silicate phases occurred during metamorphism which resulted in reequilibration and intermixing of carbonate and quartz-rich materials. The quartzite blocks and flags are separated, and flowage of the carbonate material between flags is intimate. Quartzite blocks are typically 15-20 cm thick and 20-30 cm in length; however, some of the quartzite beds locally reach 0.5 m in thickness. This map unit is significant in that it reflects local paleotopographic highs and depositional instabilities in a carbonate bank environment (Wolff 1978).

Map unit 4g represents quartzite and quartzo-feldspathic blocks, broken beds, and flags. Rocks of this unit are very different from those of unit 4f in thickness, grain size, mineralogy, and habit. Rocks of unit 4g are not greater than 10-15 cm in thickness, are fine-grained (<1 mm), contain feldspar; and appear outwardly as clean feldspathic wackes and quartzose wackes typical of map unit 3. The blocks are angular with clear-cut contacts, possess a positive relief, and are essentially equidimensional and discontinuous along strike. Broken beds of this material are generally thin (<2 cm thick) and parallel to foliation in the surrounding carbonate metasediments. Photos of the habit of this map unit are presented by Wolff (1979).

Map unit 4h represents recrystallized chert beds. These are less than 5 cm thick and discontinuous along strike.

Map unit 4i represents mafic hornblende-rich segmented layers. These are typically less than 25 cm thick and discontinuous along strike. This unit is probably related to map unit 5 (amphibole-rich gneisses and schists).

Rocks of map unit 4j are comprised of very coarse-grained (2 cm) varieties of the main carbonate units 4a, 4c, and 4d. Spatially these only occur in zones of a higher metamorphic grade. The calcite rhombs are very large and idioblastic.

Map unit 4k delineates areas of contact skarn phases containing tremolite, diopside, apatite, talc, and phlogopite. These rocks are heterogenous and, although phlogopite is ubiquitous, any combination of the other minerals may be present. Skarn phases typically contain coarse-grained calcite rhombs and fine-grained to medium-grained (0.5 mm to 1.5 mm) subidioblastic to idioblastic grains of diopside, talc, tremolite. Unit 4k is usually discontinuous along strike and less than 0.5 km in thickness. Often these zones are somewhat sheared.

Map unit 4L represents calcite graphite schist. This unit is confined to those carbonate rocks intercalated with map unit 5 along Highway 509 south of Clarendon Station. Calcite in this rock type is generally subidioblastic, fine-grained to medium-grained (0.1 mm to 1.0 mm), and completely surrounded by graphite. Unit 4L rocks are quite friable and often accompanied by disseminated pyrite.

Not included in the above code but listed on the geological map (back pocket) are a number of occurrences of phlogopite, graphite, and pyrite within unit 4 rocks.

Amphibole-Rich Gneisses and Schists

Map unit 5 represents amphibole-rich gneisses and schists. The rocks outcrop primarily in the metasedimentary belt which passes through Sharbot Lake, and the better outcrops can be found on the shores of the western part of Sharbot Lake, and along the Zealand Road between Highways 38 and 7. Smaller outcrops can be found intercalated with rocks of units 2 and 4 along Highway 509 just south of Clarendon Station. Unit 5 is typically closely associated with map units 3 and 4 in the metasedimentary succession.

Map unit 5a represents foliated fine-grained (0.5 mm) hornblende-plagioclase ± biotite ± epidote ± calcite gneiss which is locally boudinaged. The rocks weather greenish grey with local apple green concentrations of epidote. Modal abundances are listed in Table 5. Plagioclase typically varies from 40-45 percent and ranges in composition from andesine to oligoclase; hornblende is typically 30-35 percent of the rock. Minor constituents include biotite, calcite, apatite, sphene, and opaques, none of which exceeds 10 percent. The texture is granoblastic with hornblende grains being subidioblastic and, along with the biotite component, defining the foliation-gneissosity and compositional layering. Locally the rocks are boudinaged.

Map unit 5b represents massive, medium- to coarse-grained (1 mm to 7.5 mm), idioblastic amphibolite (possibly metagabbro). In outcrop this is a distinctive rock type which appears to be a deformed gabbro; good examples can be seen along the northwestern shore of Sharbot Lake at and near Sharbot Lake Provincial Park. Table 5 gives the modal abundances of two samples of this unit. The dominant mineral is hornblende which varies in abundance from 65 to 70 percent. The hornblende occurs both as large (7.5 mm porphyroblasts and idioblasts) and as smaller (1.0 mm) disseminations in the matrix. Plagioclase is the next abundant mineral and varies from 15 to 25 percent in abundance, and in composition from andesine to oligoclase. Minor phases include calcite, apatite, and opaques (pyrite), none of which exceed 10 percent in abundance. The composition, texture and outcrop habit of unit 5b suggest it may be a metagabbro. Rocks of this unit commonly occur in similar rocks to the southwest of the Sharbot Lake Area where they also have the appearance of a metagabbro (Wolff 1979, 1978).

Map unit 5c represents calcite porphyroblasts and/or calcite layers which occur locally in rocks of unit 5a. Unit 5c rocks weather more cream green than those of unit 5a and react with dilute hydrochloric acid. Table 5 shows the modal abundances of unit 5c rocks which differ from those of unit 5a in calcite content and by the presence of accessory diopside.

Occurring locally throughout map unit 5 are a number of discontinuous schist units. These units have been divided into biotite-chlorite schist (map unit 5d) and biotite-hornblende schist (map unit 5e). Typically, these schists are composed of 50-60 percent biotite which locally forms subhedral to euhedral books up to 6 cm in size. Hornblende and chlorite comprise the remainder of these rocks and are fine- to medium-grained (1.0 mm to 5.0 mm). Apatite and pyrite are minor phases in the two schist units.

Map unit 5f is used to define a foliated, fine- to medium-grained, subidioblastic plagioclase-hornblende ± biotite ± epidote gneiss. This unit is essentially the same as map unit 5a but hornblende is present in greater abundance

TABLE 5 | MODAL ABUNDANCES OF ROCKS OF MAP UNIT 5 FROM THE SHARBOT LAKE AREA.

SAMPLE	M004-79-1	M499-79-1	M421-79-1	A176-79-1	M836-79-1	M1271-79-1
Plagioclase	42	40	28	22	18	25
	andesine	andesine		andesine to oligoclase		oligoclase
Hornblende	33	35	35	65	70	38
Biotite	5	—	15	—	2	18
Calcite	8	18	15	5	—	—
Quartz	—	—	—	—	—	14
Apatite	4	—	—	5	—	—
Pyroxene	—	—	5 diopside	—	—	—
Sphene	—	2	2	—	—	—
Opaque	8	5	—	2	10	5
TOTAL	100	100	100	100	100	100
	← MAP UNITS 5a, and 5ac →			MAP UNIT 5b		MAP UNIT 5g

than plagioclase. Consequently, the rocks weather greyish green with local apple green concentrations of epidote. Plagioclase compositions vary from andesine to oligoclase and minor phases include biotite, calcite, apatite, sphene, and epidote. This unit grades quickly into map unit 5a both along and across strike and is included for completeness in describing variations on an outcrop scale.

Map unit 5g represents fine-grained to medium-grained granoblastic quartz-plagioclase-hornblende gneiss. The rocks weather a grey-whitish green, often display a "salt and pepper" weathering, and possess a definite hornblende foliation. They differ from unit 5a rocks in that the granoblastic texture is clearly visible in hand specimen, and the grains appear less deformed. The main mineral phases are hornblende (35-40 percent), plagioclase (20-30 percent oligoclase), biotite (15-20 percent), and quartz (10-15 percent) (see Table 4). The only minor phase present is subhedral pyrite (less than 10 percent). Grain size varies from 0.1 mm to 1.0 mm, and well-defined compositional layering and boundinage are absent.

Map unit 5h represents foliated subidioblastic, fine- to medium-grained plagioclase hornblende gneiss (80 percent hornblende). This rock type weathers a dark green-brown and ranges in grain size from 0.5 mm to 5.0 mm. Containing less than 20 percent plagioclase, the rock has hornblende as the dominant mineral phase. Biotite and epidote are minor phases. This unit is only mappable over short distances and often associated with units 5a and 5f.

Map unit 5i represents a foliated fine- to medium-grained potassium-feldspar-hornblende gneiss. It is similar to unit 5b but contains up to 20 percent potassium-feldspar (orthoclase). Quartz and plagioclase (albite) are also present. This unit is only mappable over short distances.

Map unit 5j is a qualifier to distinguish the presence of almandine garnet porphyroblasts in map units 5a, 5f, and 5g. These garnets typically contain inclusions of quartz in thin section but no apparent rotation is noted.

In addition to the discontinuous schists delineated by map units 5d and 5e, poorly developed biotite-hornblende-quartz-feldspar schists occur in the map area and are represented by map unit 5k. Hornblende and/or biotite comprise 50 to 85 percent of the rock. Quartz and plagioclase (usually heavily sericitized) are each less than 15 percent of the rock. Minor phases include apatite and epidote plus pyrite. Schists of this unit not only differ from the previous two in mineralogy but also in grain size which ranges from 0.1 mm to 0.3 mm.

Map unit 5L represents those units described above which have been sheared and recrystallized to form protomylonites, mylonites and mylonite gneiss. These are located adjacent to and on the eastern side of the major shear zone which passes through the hamlet of Clarendon Station. In hand specimen, rocks of this unit are highly "stretched" and in thin section the minerals most resistant to the shear stress have been quartz, plagioclase, hornblende, and almandine garnet. The biotite has freely flowed around the almandine garnet and hornblende grains. The quartz grains have been crushed, and fracturing of the other minerals resistant to the shearing stress is common. Calcite, epidote, and pyrite are minor phases in this rock type.

Whereas it can be shown in the Long Lake and Kaladar Areas that rocks of this unit are most closely affiliated with immature volcanogenic sediments (Wolff 1979, 1978); the amphibole-rich gneisses and schists of the Sharbot Lake Area are more closely associated with a much more mature sedimentary sequence originally containing a thin calcium carbonate content which, upon metamorphism, was incorporated in the hornblende phase.

SYNTECTONIC METAMORPHOSED FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

Northbrook Batholith

Situated in the northwest corner of the map area are a number of outcrops of the Northbrook Batholith (map unit 6). This unit covers a very minor portion of the map area (0.25 km^2) but a large expanse of this body occurs in the Kaladar Area to the southwest and is described in detail by Wolff (1979, 1978).

Of the several phases of the Northbrook Batholith that occur, the only phase present in the map area is a lineated to weakly foliated, medium-grained biotite trondhjemite (map unit 6a). This unit weathers a grey-white and is medium-grained (0.5 mm to 2.0 mm) and granoblastic in texture. The principle mineral phases are plagioclase (andesine which is slightly sericitized along twin lamellae), biotite and quartz. Minor phases include muscovite, sphene and epidote. The epidote grains sometimes contain allanite cores, and muscovite needles are usually confined to plagioclase grain boundaries. This unit is cut by pink-white pegmatite dikes of map unit 9.

Addington Pluton

Map unit 7 represents the Addington pluton which outcrops in the northwest corner of the map area and is bounded on the west by the Northbrook Batholith, and on the east by the major shear zone which passes through the hamlet of Clarendon Station. The unit reaches a maximum width of 2 km and contains discontinuous inclusions of metasedimentary material of map units 3, 4, and 5. Along the western boundary of this unit is a continuous sill or subparallel dike of unit 9, pink-white pegmatite. This unit has been described in greater detail in the Kaladar Area (Wolff 1978), and comparison of the body in the two areas reveals striking similarities both in mineral compositions and in the *lit-par-lit* intrusive nature of the pluton into the metasedimentary inclusions.

Map unit 7a represents the most abundantly outcropping phase of the Addington pluton in the map area. It contains foliated to gneissic, medium-grained, leucocratic quartz monzonite. In outcrop this rock type weathers pinkish-white. The grain size is typically 1.0 mm to 1.5 mm and the dominant mineral phases are quartz, plagioclase (untwinned albite), orthoclase, and microcline. The plagioclase and orthoclase grains are sericitized. Muscovite is the dominant mica present acounting for 10 percent of the rock. Biotite, sphene, and pyrite each seldom exceed 5 percent in the mode. The muscovite grains display vermiform growth patterns, and the texture of the rocks is granoblastic to foliated and locally gneissic.

Rocks of map unit 7b are commonly developed in areas where rocks of unit 7 are in close proximity to the major shear zone which passes through the hamlet of Clarendon Station. Unit 7b rocks consist of protomylonite, mylonite, and mylonite gneiss which contains porphyroclastic phases of quartz monzonite to granodiorite, and usually contains epidote. Dominant mineral phases include quartz, plagioclase, and orthoclase. Similar to unit 7a, the plagioclase is untwinned albite and both the plagioclase and the orthoclase components are sericitized. Muscovite and biotite cumulatively account for 20-25 percent of the rock. Opaques are pyrite and magnetite which account for a maximum of 10 percent of the mode. This rock type is usually fine-grained (0.5 mm to 1.0 mm), and the shearing stresses during dynamic metamorphism have resulted in formation of quartz ribbons paralleling the foliation-gneissosity. Muscovite is also present in trains and is best developed where the feldspar grains are adjacent to the shearing planes (represented by the quartz ribbons). Muscovite is probably formed by the complete sericitization of plagioclase and/or orthoclase, and the degree of sericitization in these phases drastically increases towards the shear planes defined by the quartz ribbons. In samples where the shearing stress was somewhat less, the quartz grains are strained and are all aligned with long axes parallel to the foliation defined by muscovite and biotite orientation.

Map unit 7c represents foliated to gneissic, medium-grained, biotite-quartz monzonite with biotite less than 25 percent of the mode. In outcrop this rock type weathers a brown-(rusty)-pink-white colour. The chief difference between unit 7a and this unit is its greater abundance of biotite. Grain sizes in unit 7c rocks range from 1.0 mm to 1.5 mm. The essential mineral phases include quartz, plagioclase (untwinned albite), orthoclase, microcline, and albite. The plagioclase and orthoclase grains are sericitized, and biotite accounts for up to 25 percent of the rock. Epidote, sphene, and pyrite are the accessory minerals. The texture of this rock type is granoblastic to foliated and locally gneissic.

Map unit 7d represents weakly foliated, leucocratic, medium-grained, pink granite. The major mineral phases in this rock are quartz, plagioclase (andesine), orthoclase, and microcline. Biotite, epidote, sphene, pyrite, and magnetite are minor phases. The texture of this rock type is granoblastic and the rock is weakly foliated and weathers pink. Grain size varies from 1.0 mm to 1.5 mm.

Map unit 7e represents foliated to gneissic, medium-grained, biotite granodiorite containing less than 25 percent biotite. This rock type weathers a whitish grey with dark streaks (biotite). The major mineral phases are quartz and plagioclase (andesine), plus biotite. The minor mineral phases include orthoclase, epidote, pyrite, and magnetite. Grain size varies from 1.0 to 1.5 mm.

LATE TECTONIC METAMORPHOSED INTRUSIVE ROCKS

Early Mafic Intrusive Rocks

LAVANT AND LANARK-OSO MAFIC INTRUSIONS

Map unit 8 is used to delineate rock suites belonging to the Lavant and Lanark-Oso Mafic Intrusions. These intrusive bodies collectively range in composition from gabbro to anorthosite to pyroxenite. Each body outcrops in a different geographical and structural location in the map area. The Lavant body is exposed mainly along the northern boundary of the map area east of Highway 509 and north of Bolton Creek, with smaller outcroppings in the carbonate metasediments immediately adjacent to this body. The Lanark-Oso mafic intrusion outcrops along a northeast trend, parallel to regional foliation-gneissosity, and within the high-grade gneisses of unit 1 south of Highway 7. Although grouped under one map unit, these bodies display significant mineralogical variations and may not be contemporaneous bodies of a common petrogenetic origin.

Map unit 8a is used to delineate medium- to coarse-grained gabbro which possesses a colour index greater than 30. This unit is found in both bodies and the modal abundances are given in Tables 6 and 8. The major mineral phases include plagioclase (sericitized labradorite, 35-45 percent), pyroxene (12-35 percent), and hornblende (0 to 50 percent). The pyroxene enriched phases of this unit are hornblende-poor, and the hornblende-rich phases are pyroxene-poor; such that the combined totals of hornblende and pyroxene fall in the range 30-55 percent, and hornblende is likely an alteration product after pyroxene. Thin-sectioned samples indicate that the pyroxene compositions vary between the Lavant and Lanark-Oso bodies. In the Lavant body augite is the clinopyroxene present, and hypersthene the orthopyroxene present; while the samples from the Lanark-Oso body contain diopside only. The minor mineral phases present include epidote, apatite, pyrite, and ilmenite in the Lavant gabbros; while biotite, olivine, muscovite, pyrite, and ilmenite are found in the Lanark-Oso body. With the exception of epidote these mineral phases do not exceed 10 percent in abundance. These rocks typically weather a dark green to drab olive green and vary in grain size from 1.0 mm to 4.0 m. Grains are usually subhedral and the texture is interlocking, with relict subophitic textures locally preserved.

Map unit 8b represents medium- to coarse-grained anorthositic gabbro to gabbroic anorthosite which possess a colour index between 10 and 30. The anorthositic gabbro and gabbroic anorthosite phases have been grouped into one unit because of the gradational nature of these two rock types in outcrop, and the resultant difficulty in delineating consistently between the two types in field mapping. Unit 8b is present in the Lavant body but is best developed and of a more common occurrence in the Lanark-Oso body. Table 8 depicts the modal abundances of several thin sectioned samples of this rock type from the Lanark-Oso body. Subhedral plagioclase is the most abundant mineral phase present and ranges in concentration from 75 to 85 percent. The plagioclase is

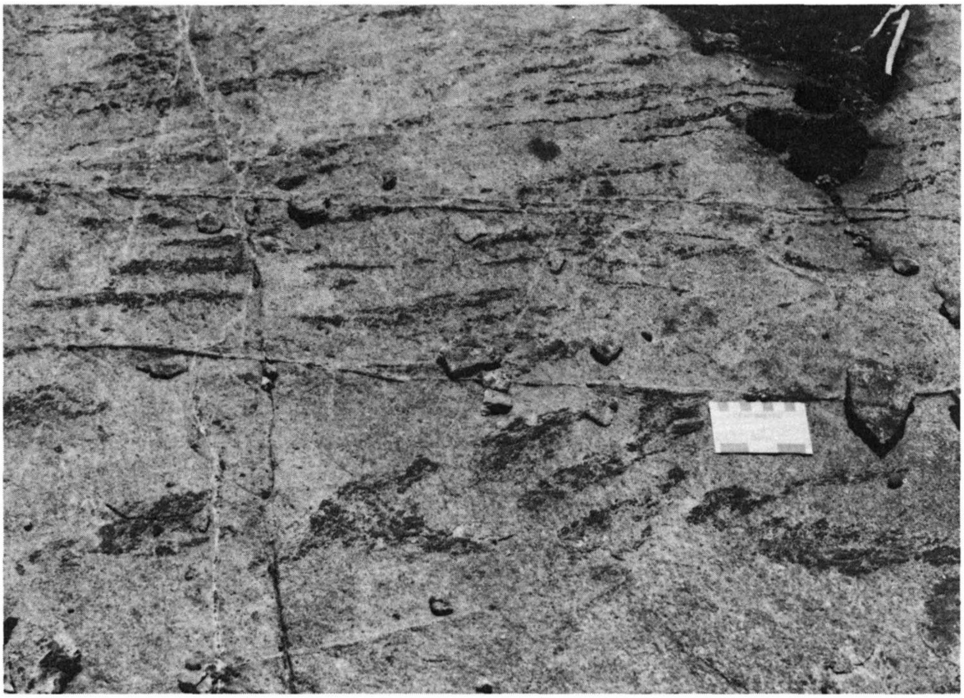

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Photo 4–Typical outcrop of anorthosite (map unit 8c) in the Lanark-Oso mafic intrusive showing one of the most contaminated zones; the dark discontinuous wisps are local concentrations of pyroxene. This outcrop is located on the north shore of Rock Lake.

typically weakly sericitized and is labradorite in composition. Minor phases include diopside/enstatite (0 to 13 percent and sometimes altering to hornblende), hornblende (0 to 12 percent), biotite (0 to 5 percent), olivine (0 to 5 percent), and pyrite and ilmenite (0 to 5 percent). Grain size ranges from 1.0 mm to 5.0 mm and the rocks weather green to dark green. Texturally, the minerals are primarily interlocking although some subophitic textures exist.

Map unit 8c represents medium- to coarse-grained anorthosite with a colour index of less than 10 percent. This unit is very well-developed and exposed in the Lanark-Oso body, but is essentially absent in the Lavant body. The rock type is a greyish-greenish-pearl colour in outcrop. Table 8 shows the modal abundance of five thin-sectioned samples of this unit. Plagioclase is the major mineral phase accounting for 90 percent of the rock. The composition is labradorite and individual grains are slightly to completely sericitized. Minor mineral phases include diopside, hornblende, biotite, quartz, pyrite, and ilmenite. A sample from a highly sericitized variety of unit 8c (sample M727-79-1 in Table 8) was found to contain 92 percent labradorite, 20 percent of which is completely altered to sericite. Although this rock type generally lacks any mineral alignment, two types of preferred orientation exist. First, within the interior of the Lanark-Oso body, anorthosites similar to those described above contain thin (less than 1 cm thick), discontinuous (2 m maximum) concentrations of py-

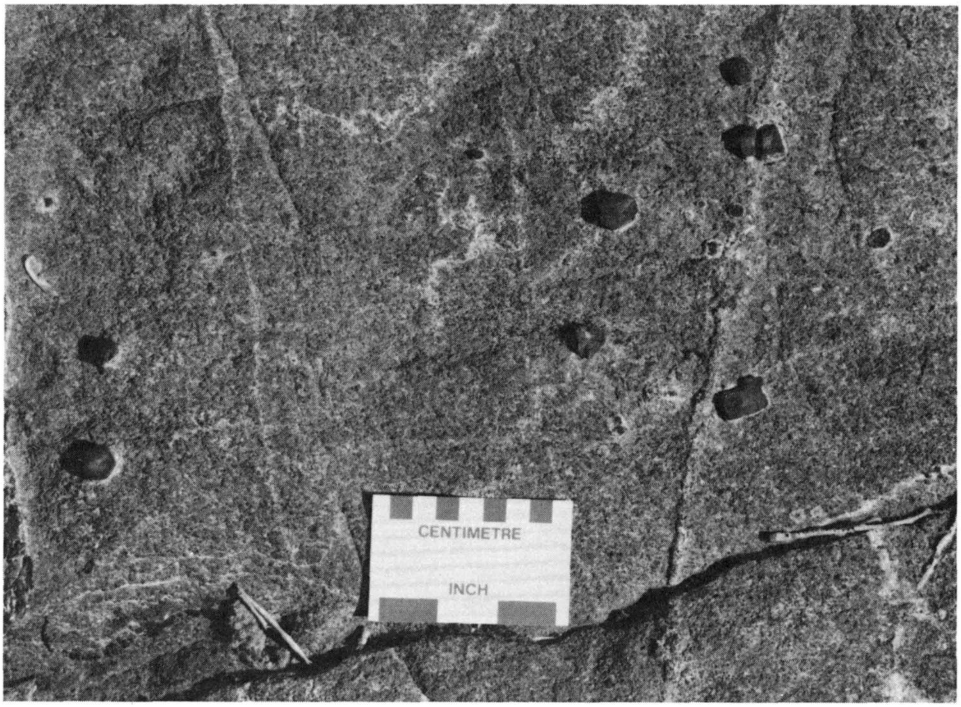

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Photo 5–Corundum-bearing phases of map unit 8C. Set within uncontaminated anorthosite these crystals are extremely euhedral with a positive relief and usually weather black. Such corundum-bearing zones tend to be continuous along strike over distances of 1 km plus, but generally disappear across strike within 100 m. This outcrop is located on the north shore of Rock Lake.

roxene (*see* Photo 4). Sample M657-79-2 in Table 8 shows the modal abundances of this pyroxene-rich variety of unit 8b. These concentrations of pyroxene usually parallel the regional foliation-gneissosity in orientation. The second type of preferred orientation occurs near the border of the Lanark-Oso body with the gneisses of map unit 1. This zone shows the development of feldspar metacrysts which are locally altered to sericite and stretched parallel to the regional foliation-gneissosity, which also parallels the contact of the body with the gneiss units. The altered metacrysts of plagioclase also form a weak foliation in outcrop. The grain size of unit 8c rocks typically ranges from 0.5 mm to 1.0 mm with metacrysts reaching 1 cm in length. The texture is allotriomorphic-granular with local development of metacrysts as described above.

In addition to these minor pyroxene concentrations, another phase of unit 8c was found to contain euhedral coarse-grained corundum. These grains reach a maximum cross-sectional width of 2 cm and samples up to 3 cm in length were plucked from outcrops (*see* Photo 5). Although a greyish-purple-green colour on the fresh rock surface, the corundum weathers black on outcrop. Both corundum-bearing and corundum-free zones occur in unit 8c as evidenced by the absence of corundum in the modes of thin-sectioned samples in Table 8. Two other thin-sectioned samples of corundum-bearing unit 8c revealed the presence of spinel associated with the corundum. The corundum from rocks of unit 8c displays microscopic mantling by rims of spinel and opaques (possibly chromite in part). A sample from unit 8b was also found to contain spinel, corundum, almandine garnet, and magnetite ± chromite as co-existing mineral phases.

Map unit 8d represents medium-grained quartz gabbro. This rock type is best developed in the Lavant body and essentially absent in the Lanark-Oso body. A thin-sectioned sample of this rock type showed that heavily sericitized plagioclase comprised 31 percent of the rock, hornblende 22 percent, biotite 14 percent, quartz 12 percent, microcline 8 percent, and pyrite and ilmenite 8 percent. Hypersthene was the least common mineral accounting for 5 percent of the mode (*see* Table 6). This rock is similar to those of unit 8a in weathering colour, grain size, and texture; but contains quartz.

Rocks of map unit 8e consist of medium- to coarse-grained monzonite phases which are generally limited to the Lavant body. These rocks weather greyish-green and are not significantly different in habit from the gabbros of unit 8a. As shown in Table 6, plagioclase (sericitized oligoclase) and orthoclase form the bulk of the rock. Biotite, epidote, pyrite, and ilmenite are the main mafic components. Textures are interlocking.

Map unit 8f represents fine-grained varieties of unit 8a. Rocks of this unit are present in virtually every outcrop of the Lavant body. Unit 8f rocks weather a darker green and occur as streaks and irregular phases within the coarse-grained and medium-grained gabbros. Mineralogically this rock type contains significant amounts of epidote (*see* Table 6). Rocks of unit 8f likely represent later stage, but essentially penecontemporaneous intrusions into the gabbro body at higher levels within the crust.

Map unit 8g represents syenite-bearing phases of units 8a to 8f inclusive. These rocks contain both pink weathering and grey weathering potassium-feldspar, and are dominantly associated with the Lavant body especially where it is in close association with rocks of map unit 9 (Late Granitic Intrusive Rocks). Table 6 depicts the modal abundance of this rock type. Major phases are plagioclase (oligoclase-labradorite, 35 percent), sericitized orthoclase which weathers pink (29 percent), and hornblende (22 percent); coexisting with minor concentrations of epidote (8 percent), augite (4 percent), and pyrite and ilmenite (3 percent). Grains are subhedral and vary in size from 0.5 mm to 5.0 mm, and the texture is allotriomorphic-granular.

Map unit 8h represents the occurrence of: (1) porphyroblasts and glomeroporphyroblasts of altered pyroxene and hornblende (after pyroxene) in the rock types of units 8a, 8b, and 8d; and, (2) in the case of unit 8c, the occurrence of coarse-grained plagioclase grains in a medium-grained anorthosite. Although the first type represent true metamorphic textures the second may not as no recrystallization is typically evident.

Map unit 8i represents medium-grained biotite granodiorite to biotite trondhjemite phases occurring primarily within the Lavant body. These rocks weather a grey-white with rusty streaks and have generally abrupt contacts with the adjacent gabbro phases, although diffuse contacts also can be found. Plagioclase is the major mineral phase (see Table 7) varying from 30-40 percent and is sericitized andesine to oligoclase. Potassium-feldspar is generally present in the form of orthoclase and varies from 10-15 percent. Biotite is ubiqui-

TABLE 6 | MODAL ABUNDANCES OF THE GABBRO TO PYROXENITE PHASES, LAVANT MAFIC INTRUSIVE SHARBOT LAKE AREA.

SAMPLE	A070-79-1	M123-79-1	A067-79-1	A153-79-1	M089-79-2	A111-79-1	A119-79-1
Plagioclase	40 saussuritized	37 saussuritized labradorite	31 sericitized	53 oligoclase sericitized	35 oligoclase-labradorite	8 sericitized	8 oligoclase
Pyroxene							
CPX	7 augite	32 augite	—	—	4 augite	15 augite	50 diopside altering to amphibole (tremolite)
OPX	5 hypersthene	—	5 hypersthene	—	—	—	
Hornblende	43	—	22	—	22	—	—
K-feldspar	—	—	8 microcline	15 orthoclase	29 orthoclase sericitized	—	—
Biotite	—	—	14	15	—	8	—
Epidote	—	22	—	4	8	—	—
Apatite	—	4	—	—	—	—	—
Quartz	—	—	12	—	—	—	—
Tremolite	—	—	—	—	—	59	—
Olivine	—	—	—	—	—	—	30
Perovskite	—	—	—	—	—	—	4
Opaque	5	5	8	5	3	10	8
TOTAL	100	100	100	100	100	100	100
	MAP UNIT 8a	MAP UNIT 8af	MAP UNIT 8d	MAP UNIT 8e	MAP UNIT 8g	MAP UNIT 8k	

tous and along with hornblende (if present) accounts for 20-35 percent of the rock. Quartz grains are typically subhedral to anhedral and comprise 15-30 percent of the mode. Minor phases are muscovite, epidote, and opaques (pyrite and magnetite). Grain sizes generally range from 0.5 mm to 3.0 mm and the texture is granoblastic. Where contacts of this unit with the surrounding gabbro are diffuse, the gabbro contains quartz and may reach quartz gabbro in composition (as represented by sample M144-79-2, Table 7), and also may contain almandine garnet.

Map unit 8j is used to delineate aplitic granodiorite phases of unit 8i which generally contain little biotite, have a grain size of less than 1.0 mm, and weather a white colour.

Map unit 8k represents coarse-grained pyroxenite to peridotite. This unit occurs in both the Lavant and Lanark-Oso bodies but never with the anorthositic phases of the latter. Rocks of this unit are very dense, weather a dark green, and are poorly developed in both bodies. Grain size is usually 5 mm to 4 cm. Two samples of this unit, thin-sectioned from the Lavant body, are shown in Table 6. These samples show alteration of the pyroxene to tremolite. In one, the the alteration is almost complete (tremolite/pyroxene: 4/1), while the other has pyroxene grains with only alteration at the boundaries. The pyroxene is clinopyroxene and represents 50 to 75 percent of the rock. The other major mafic mineral is olivine which varies from 0 to 30 percent in abundance. Minor phases include plagioclase (sericitized oligioclase, 8 percent), biotite (0 to 8 percent), perovskite (0 to 8 percent), and pyrite (less than 10 percent). Table 8 indicates the modal abundance of a sample of unit 8k from the Lanark-Oso body. The majority of the rock is composed of orthopyroxene (32 percent), hornblende (20 percent), and olivine (25 percent). Plagioclase, spinel, and pyrite are minor phases each present in quantities less than 10 percent.

In consideration of the above descriptions it becomes apparent that the Lavant and Lanark-Oso bodies represent two different mafic intrusions. The Lavant body is basically a gabbro body which contains fine-grained gabbro phases (8f), felsic late-stage intrusives (8i and 8j), and no anorthosite. Common within the body are rafts and slices of carbonate metasediments (unit 4). The Lavant body lacks corundum and spinel, and the pyroxene present is augite and/or hypersthene. The Lavant body is viewed as a high level gabbro intrusion which penetrated a carbonate cover. The initial phases cooled slowly and fractured, but the late phases cooled quickly filling fractures within the body. No evidence exists that the intrusion is completely differentiated, but late-stage felsic fluids were present. The Lanark-Oso body is essentially a well-differentiated mafic intrusion containing pyroxenite-peridotite, gabbro, anorthositic gabbro to gabbroic anorthosite, and anorthosite phases. Corundum and spinel are common in certain zones, and anorthositic phases are common in outcroppings. Pyroxene is mainly composed of diopside and enstatite. No roof pendants of crustal material are present and fine-grained phases are rare. The occurrence of spinel suggests that residual chromium is present in the chemistry of this intrusion. In summary, it appears that the Lanark-Oso body is a deeper level intrusion than the Lavant intrusion. The Lanark-Oso body shows little recrystallization within the anorthositic phases. The only exception is along the southern contact where plagioclase metacrysts have formed and are pervasively altered to sericite. Despite the fresh appearance of the body in general, it would seem that

TABLE 7 | MODAL ABUNDANCES OF THE FELSIC PHASES, LAVANT MAFIC INTRUSIVE, SHARBOT LAKE AREA.

SAMPLE	**M253-79-1**	**M144-79-1**	**A104-79-1**	**A132-79-1**	**M144-79-2**
Quartz	15	14	15	30	5
Plagioclase	39	35	32	35	53
	heavily sericitized	sericitized oligoclase	sericitized	sericitized andesine	sericitized oligoclase
K-feldspar	—	10	15	15	—
		orthoclase	orthoclase	orthoclase	
Biotite	26	8	22	18	18
Hornblende	—	28	5	—	8
Garnet	—	—	—	—	12
Muscovite	8	—	—	—	—
Apatite	—	—	—	—	1
Epidote	—	—	—	2	—
Opaque	12	5	5	—	4
TOTAL	100	100	100	100	100
	← MAP UNIT 8i			→	MAP UNIT 8d

TABLE 8 MODAL ABUNDANCES OF THE GABBRO—ANORTHOSITE—PYROXENITE PHASES, LANARK-OSO MAFIC INTRUSIVE, SHARBOT LAKE AREA.

SAMPLE	M575-79-1	A481-79-1	M716-79-1	A-362-79-1	A317-79-1	M656-79-1	M727-79-1	M636-79-1	M657-79-1	M547-79-1	M657-79-2	A458-79-1
Plagioclase	42	34	91	90	91	90	72	82	83	75	75	5
	labradorite	sericitized	labradorite	labradorite	labradorite	labradorite	labradorite	labradorite	labradorite	labradorite	labradorite	
Pyroxene												
CPX	32 diopside	—	—	5 diopside	—	5 diopside	—	—	12 diopside	4 altering to hornblende	—	—
OPX	—	—	—	—	—	—	—	—	—	—	20 altered enstatite	32 enstatite
Hornblende	—	48	—	—	—	—	—	10	—	12	—	20
Biotite	8	5	4	—	—	—	8	—	5	4	—	—
Olivine	8	—	—	—	3	—	—	5	—	—	—	25
Sericite	—	—	—	—	—	5	20	—	—	—	—	—
Muscovite	—	3	—	5	—	—	—	—	—	—	—	—
Corundum	—	—	4	—	—	—	—	—	—	—	—	—
Spinel	—	—	—	—	—	—	—	—	—	—	—	10
Quartz	—	—	—	—	3	—	—	—	—	—	—	—
Opaque	10	10	1	—	3	—	—	3	—	5	5	8
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100
	MAP UNIT 8a		← MAP UNIT 8c →					← MAP UNIT 8b →				MAP UNIT 8k

emplacement occurred before the waning period of regional metamorphism in the map area. It is doubtful that intrusion occurred prior to regional metamorphism as only the contacts are metamorphosed. It is possible that intrusion was post-metamorphism and the body moved into the crust as a relatively cool passive mass with metamorphism near the contacts being generated by the intrusive event itself. The author favours the latter sequence of events as it accounts for both the lack of metamorphism within the interior of the anorthosite mass, and for high grade metamorphic rocks surrounding the body. The Lanark-Oso body is classified as a labradorite-type massif under the classification of Anderson and Morin (1968).

GEOCHEMISTRY OF THE LANARK-OSO ANORTHOSITE MASSIF

Eight samples of the anorthosite phases of unit 8 located in the Lanark-Oso Anorthosite Massif were analysed for their major element, CO_2, S, and loss on ignition concentrations. The results of these analyses are presented in Table 9. The most apparent chemical characteristics of this suite of anorthosites are the high concentration of alumina, typically 30-33 percent, and the high concentration of lime with respect to soda (2 to 6.7 times). These values reflect in part the high percentage of plagioclase in these rocks, the relative abundance of plagioclase of labradorite composition, and the absence of anorthite. Comparison of the abundances of silica, potash and magnesia with respect to four other Grenville anorthosites is given in Figure 2. With respect to these three major oxide concentrations the Lanark-Oso body is most like the Morin in SiO_2 content; similar to the Morin, Lac St. Jean, and the Marcy bodies in K_2O content; and similar to the Lac St. Jean, Nain, and Marcy bodies in MgO content. In fact none of these anorthosite bodies have consistent common characteristics with respect to chemical fingerprinting.

Like most Grenville anorthosite bodies the Lanark-Oso body lacks a sufficient volume of exposed gabbro and gabbroic-anorthosite to account for its evolution from a basaltic melt via differentiation alone. However, the body is essentially surrounded by large volumes of silicic gneisses which mineralogically correspond to granodioritic to tonalitic compositions. In this respect the Lanark-Oso body is similar to the Lac St. Jean body studied by Kehlenbeck (1974), and Frith and Currie (1976). Table 10 presents a comparison of the major oxide concentrations of an original tonalite starting material and residual compositions of the tonalite material after 25 percent anatectic melt; after 75 percent anatectic melt; average Lanark-Oso anorthosite composition; average Adirondack anorthosite composition (Buddington 1939); and average Lac St. Jean anorthosite composition (Kehlenbeck 1974). This comparison shows that the main differences in the major element compositions of the Lanark-Oso anorthosite body relative to that of the average Adirondack and Lac St. Jean bodies are the relative SiO_2 depletion, Al_2O_3 enrichment, CaO enrichment, and Na_2O depletion. Table 10 shows that as anatexis progresses, silica continues to be depleted while alumina and lime are enriched, soda remains virtually unchanged. The data indicate that assuming an original tonalite composition A (*see* Table 10) as given by Frith and Currie (1976), the Lanark-Oso body compo-

TABLE 9 | CHEMICAL COMPOSITION OF ANORTHOSITE SAMPLES FROM THE LANARK-OSO MAFIC INTRUSION, SHARBOT LAKE AREA.

SAMPLE	A362-1	M677-1	A357-1	M360-1	M747-1	M716-1	M727-1	M656-1
				Weight Percent				
SiO_2	50.3	50.5	47.6	46.8	47.1	48.6	50.6	46.2
Al_2O_3	30.3	29.8	30.4	32.7	31.8	30.2	23.9	31.6
Fe_2O_3	0.89	1.16	1.15	0.57	1.11	1.99	4.94	1.06
MgO	0.75	0.96	1.07	0.51	0.93	1.31	3.32	1.02
CaO	12.2	13.0	13.0	15.3	15.0	12.8	9.47	13.2
Na_2O	3.45	3.45	3.02	2.31	2.24	3.03	4.48	2.46
K_2O	0.83	0.08	0.74	0.13	0.19	0.81	0.99	1.12
TiO_2	0.11	0.15	0.20	0.13	0.17	0.26	0.58	0.14
P_2O_5	0.04	0.03	0.04	0.04	0.04	0.05	0.04	0.10
MnO	0.02	0.01	0.02	0.01	0.02	0.02	0.03	0.02
CO_2	0.39	0.14	0.26	0.14	0.14	0.16	0.27	0.31
S	0.01	0.01	0.01	0.01	0.03	0.02	0.03	0.02
LOI	1.3	0.07	1.0	0.4	0.8	1.0	1.9	1.7
TOTAL	100.2	99.9	98.2	98.9	99.4	100.0	100.2	98.6

sition, D in Table 10, would be attainable only at levels much greater than 75 percent anatectic melt. However, with an original tonalite composition of approximately 63 percent silica, 21 percent alumina, 7.6 percent lime, and 3.0 percent soda, the Lanark-Oso composition would be attainable with close to 75 percent anatectic melt in a closed system. Thus, theoretically, the Lanark-Oso anorthosite composition could be achieved with no less than 75 percent anatectic melt.

Petrogenesis involving a residual anatectic melt for the Lanark-Oso anorthosite body is favourable from several standpoints. This model precludes the necessity for large volumes of gabbroic magma in order to generate the observed volume of anorthosite by magmatic differentiation alone; also, the body is surrounded by anatectic gneisses and migmatites which indicate that fusion of rock components occurred. Additionally, many of the gneisses are granodioritic in composition and represent possible pre-anatectic starting rock compositions. However, the starting tonalite composition suggested for the Lanark-Oso body in Table 10 requires a higher CaO concentration, which is quite feasible given the presence of high-grade marbles throughout the high-rank metamorphic sequence. Petrogenesis in a semiclosed system involving a residual phase derived from 75 percent anatectic melt of country rocks accounts for the

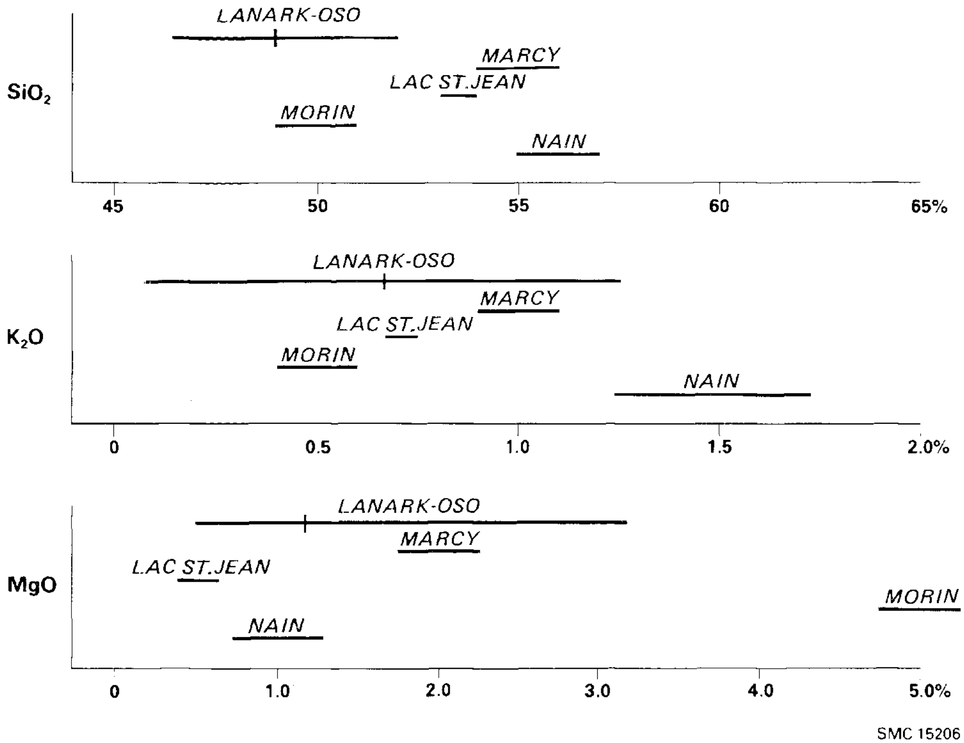

Figure 2–Comparison of the abundances of SiO_2, K_2O, and MgO of the Lanark-Oso anorthosites of the Sharbot Lake Area with those of other Grenville anorthosites. Lanark-Oso values are the mean and range based on 8 samples; Nain, Morin, and Marcy anorthosite values are after deWaard (1968); Lac St. Jean value is after Kehlenbeck (1974). Chemical analyses of Lanark-Oso samples by the Geoscience Laboratories, Ontario Geological Survey, Toronto.

apparent late-stage metamorphic nature of the Lanark-Oso body. The residuum was implaced passively, and only secondary alteration (sericitization) occurred along the contacts. Presence of corundum in the body represents discrete sites where the silica content was lower, and the alumina content higher than that required to form feldspar. Another feature of petrogenesis involving a residual anatectic melt is that the model explains the great geochemical differences between various anorthosite bodies in the Grenville Province and elsewhere. Clearly, variations in the geochemistries of original starting materials can account for resultant variations in anatectically derived anorthosite residuals.

TABLE 10 COMPARISON OF AVERAGE ANORTHOSITE COMPOSITIONS AND RESIDUAL COMPOSITIONS FROM THE ANATECTIC MELTING OF TONALITE

	A	B	C	D	E	F
			Weight Percent			
SiO_2	70.31	68.28	55.81	48.5	54.6	53.62
Al_2O_3	17.26	18.74	26.40	30.8	25.1	27.31
TiO_2	0.22	0.26	0.22	0.21	1.3	0.79
FeO	1.69	2.22	1.87	1.87*	3.1	1.59
MgO	0.53	0.40	0.65	1.23	1.0	0.45
MnO	0.02	0.02	0.09	0.18	0.0	0.02
CaO	3.62	4.44	8.99	12.99	8.7	9.75
Na_2O	5.10	5.21	5.37	3.07	5.4	4.45
K_2O	1.12	0.43	0.67	0.61	0.7	0.71

A – Starting Material Tonalite T-50; B – Residual Composition after extraction of 25% anatectic melt at hematite-magnetite buffer; C – Residual composition after extraction of 75% anatectic melt; D – Average Lanark – Oso anorthosite composition (8 samples); E – Average Adirondacks anorthosite (Buddington 1939); F – Average Lake Rouvary anorthosite (western Lac St. Jean massif, after Kehlenbeck 1974).

* Total iron reported as Fe_2O_3.

Starting and Residual Tonalite Compositions after Frith and Currie (1976).

Late Granitic Intrusive Rocks

Map unit 9 represents late-stage felsic rocks and related pegmatitic rocks which are granitic in composition and intrude essentially all the above rock units. This unit outcrops in three different habits within the map area. The most prevalent is a continuous band which essentially flanks the southern border of the metasedimentary belt comprised of metasediments of units 3, 4, and 5. This band runs from the southwestern shore of Sharbot Lake in a northeast direction through Silver Lake and Maberly passing just south of Fagan Lake on the northeastern boundary of the map area. The band has a maximum width of approximately 1.5 km and usually separates the high grade gneisses of map unit 1 from the metasediments of units 3, 4, and 5. A second mode of occurrence of unit 9 is as large (3 km maximum) irregular shaped bodies in the southwest portion of the map area in the vicinity of Black Lake, White Lake, Warren's Lake, and Twin Lakes, where the unit is also intrusive into the metasediments of units 3, 4, and 5. The third mode of occurrence of unit 9 is as pink and white pegmatite dikes and sills intrusive into any of the rock types described previously, but most spectacularly as resistant subparallel dikes and irregular masses in the carbonate metasediments of map unit 4. Unit 9 is very similar in intrusive character, structural setting, and composition to the MacLean Granitic Intrusive in the Long Lake Area (Wolff 1979), and is considered a contemporaneous northeasterly extension of this intrusion.

Map unit 9a represents fine- to medium-grained, massive to foliated, biotite granite and quartz monzonite with biotite abundance greater than 15 percent. These two rock types are grouped together here because of their intimate association, and the relatively small proportion of the first. Unit 9a weathers a pink-brown-rust colour and grain sizes typically vary from 0.5 mm to 2.0 mm. The modal abundance of this unit is given in Table 11. Plagioclase is mainly oligoclase in composition and both microcline and orthoclase comprise the potassium feldspar component. Epidote, sphene and opaques (pyrite) are the minor mineral phases. The texture is hypidiomorphic granular.

Map unit 9b represents medium- to coarse-grained, equigranular, massive, biotite granite and quartz monzonite with biotite less than 10 percent of the rock. This rock weathers a pink colour with only a small amount of dark streaks. Grain size is typically 0.1 mm to 2.0 mm and the modal abundances are given in Table 11. The only difference between units 9b and 9a is the biotite content, textures are similarly hypidiomorphic granular.

Map unit 9c defines a fine- to medium-grained, massive to foliated, biotite granodiorite. This unit weathers a pinkish to whitish grey. Grain size ranges from 0.2 mm to 2.5 mm and modal analysis indicates plagioclase (oligoclase) 47 percent, with equal amounts of orthoclase and quartz (12 percent). Biotite is 15 percent of the rock and hornblende, apatite, and pyrite are minor constituents. The texture of unit 9c is typically hypidiomorphic granular.

Map unit 9d represents fine-grained, leucocratic granodiorite. This unit is locally well-developed and excellent exposures occur along Highway 7b across from and immediately west of the entrance to Sharbot Lake Provincial Park. Unit 9d weathers a distinctive chalk white and is often pyritiferous and stained by limonite weathering. Modal abundances of this unit are included in Table 11 and indicate the major phase to be plagioclase (albite to oligoclase) 50-60 percent, potassium feldspar (microcline/orthoclase) 10 to 35 percent, and quartz 10-20 percent. Minor phases are biotite, muscovite and pyrite each of which are less than 5 percent. Where orthoclase occurs it is perthitic, and the texture of unit 9d is hypidiomorphic granular.

Map unit 9e is medium-grained, massive to foliated, syenite ± hornblende ± biotite ± epidote. This unit differs from map unit 8g which contains 50 percent or more mafic minerals, while unit 9e contains 30 percent or less mafic minerals. The mode of a sample of unit 9e is included in Table 11. The major phases are plagioclase (oligoclase) 16 percent, orthoclase 40 percent, and microcline 20 percent. Quartz, biotite, apatite, and pyrite are minor phases, each being less than 10 percent of the rock by volume. The texture is hypidiomorphic granular and the unit weathers a pink to salmon pink colour.

Map unit 9f represents porphyritic varieties of the above map units, but chiefly this texture is limited to map units 9a, and 9b. Phenocrysts present can be either quartz or feldspar, and usually microcline is the chief feldspar phenocryst. The size of the phenocrysts varies but typically ranges from 2.0 mm to 6.0 mm.

TABLE 11 | MODAL ABUNDANCES OF LATE STAGE GRANITIC INTRUSIVES FROM MAP UNIT 4, SHARBOT LAKE AREA.

SAMPLE	M231-79-1	M255-79-1	M519-79-1	M515-79-1	M473-79-1	M258-79-1	A005-79-1	A031-79-1
Quartz	12	14	12	18	12	8	38	35
Plagioclase	35	35	47	60	53	16	28	35
	oligoclase	oligoclase	oligoclase	oligoclase	albite	oligoclase	albite	albite
K-feldspar								
Microcline	15	25	—	12	—	20	—	—
Orthoclase	8	8	12	—	35	40	18	20
							perthitic	perthitic
Biotite	15	8	15	4	—	8	8	6
Muscovite	1	—	2	—	—	—	—	4
Hornblende	—	4	—	—	—	—	—	—
Epidote	2	—	—	—	—	—	—	—
Sphene	5	—	—	—	—	—	—	—
Apatite	—	2	—	—	—	2	—	—
Opaque	8	9	8	4	—	5	8	—
TOTAL	100	100	100	100	100	100	100	100
	MAP UNIT 9a	MAP UNIT 9b	MAP UNIT 9c	MAP UNIT 9d		MAP UNIT 9e	MAP UNIT 9j	MAP UNIT 9i

Map unit 9g is used to code rock types containing visible muscovite, usually greater than 10 percent of the mode.

Along the major shear zone which passes through the hamlet of Clarendon Station there occur rocks of unit 9 which are highly sheared. Map unit 9h represents shear zone quartz monzonite and granodiorite phases including protomylonite, mylonite, and mylonite gneiss ± porphyroclasts, and usually containing epidote. Protomylonite types typically contain a bimodal grain size distribution of quartz comprised of 0.2 mm mortar texture matrix fragments, with larger 2.5 mm resistant grains of quartz, plagioclase (andesine) and potassium-feldspar (orthoclase). The quartz monzonite has a foliation defined by biotite grains and contains 10-50 percent matrix. Usually, the quartz is bimodal as above, but a much higher proportion is fine-grained as the percentage of matrix increases. Micas also tend to be high in concentration in mylonite, 10-15 percent, as compared to 10 percent in protomylonite. Mylonite gneiss samples show a definite alignment of quartz and feldspar grains and an extremely well-developed foliation gneissosity. The mineralogy of these rocks is dependent upon the original rock type, hence most of the sheared phases of map unit 9 are quite felsic.

The pegmatite dikes and irregular intrusive masses and sills found throughout the map area are considered to be phases related to the late-stage granitic intrusion represented by rocks of unit 9. Map unit 9i represents pink granodiorite pegmatite dikes and irregular masses or sills, locally containing tourmaline ± biotite ± muscovite. Map unit 9j represents white granodiorite pegmatite dikes and irregular masses/sills, locally containing muscovite ± biotite ± almandine garnet. Despite the colour difference and the difference in accessory mineral content, Table 11 shows that the major mineral compositions of these two rock units are quite similar each containing 35-40 percent quartz, 25-35 percent plagioclase (albite), and 15-20 percent perthitic orthoclase. Dikes of the above material vary in width from 0.2 m to 0.8 m but local 5.0 m wide dikes can be found. Perhaps the most outstanding dikes occur in the carbonate metasediments (unit 4) along the Zealand Road between Zealand and Highway 7, and along the Zealand-Oso Road west of Zealand. The high relief (6 m to 8 m) of these dikes is due to the large contrast in resistance to erosion between the granitic and carbonate materials. Irregular masses of pegmatitic material vary in width but seldom extend for more than 500 m in length.

Along the contact of the main band of map unit 9 and the metasedimentary rocks of units 3, 4 and 5 there occur conspicuous and randomly distributed inclusions, xenoliths and slices of unsubdivided metasedimentary rocks of map units 3 and 5. In zones where the concentration of these are high, a weak "ghost stratigraphy" can be seen, but is usually discontinuous. Where the included material is less than 0.5 m wide, a well-defined but discontinuous gneissosity is locally developed. Such metasedimentary inclusions and assimilations are coded as unit 9k.

Map unit 9L represents quartz veins and dilation fillings ± magnetite. These are typically less than 25 cm in width and vary in length from 0.3 m to 0.7 m for dilation fillings, to several meters for veins.

Locally, map unit 9 displays excellent horizontal jointing. Orthogonal to this is an essentially vertical jointing which creates a spectacular jointing array in the third dimension. Outcrops displaying well-developed orthogonal

OGS 10 550

Photo 6–Well-exposed outcropping of a diabase dike (map unit 10) cutting carbonate metasediments (map unit 4abeg) at the junction of Highways 509 and 7. The dike is 125 m west of the junction on the north side of Highway 7, and cuts the metasediments at a low angle.

jointing without foliation can be found along Highway 7, along the shore of Silver Lake.

Late Mafic Intrusive Rocks

Map unit 10 is used to code unsubdivided mafic (diabase) dikes. The most prominent of these is located at the junction of Highways 509 and 7. At this location a dike of somewhat sheared diabase cuts carbonate metasediments of unit 4 at a shallow angle (*see* Photo 6). This rock was thin-sectioned and found to contain 18 percent quartz, 31 percent plagioclase (albite), 28 percent hornblende, 10 percent sphene, 8 percent pyrite, and 5 percent biotite. The dike is approximately 1 m in width. These late-stage mafic dikes are very uncommon in the map area.

Cenozoic

QUATERNARY

Pleistocene and Recent

The bulk of the Cenozoic sediments in the map area were deposited during the Pleistocene epoch in glacial and postglacial lakes. Most of these deposits are outwash deposits of sand, silt, clay, and till. Perhaps the most striking Pleistocene deposit in the map area is a narrow band of glacial, glaciofluvial and glaciolacustrine deposits which occupy the major shear zone which passes through the hamlet of Clarendon Station. Henderson (1973) described these deposits as "ice-contact stratified drift; sand, gravel, minor till in eskers, kames, kame moraines; topography generally hummocky, but may be locally subdued by wave action". This glaciofluvial system was traced by Henderson (1973) northeastward through Snow Road Station, Palmerston Township, and Frontenac County, accounting for a total strike-length of some 80 km in the Precambrian Shield, and is described to the southwest through the village of Mountain Grove by Wolff (1979), and Henderson (1973). The nature of this Pleistocene deposit, as it occurs in the present map area and in the Long Lake Area, suggests that the major shear zone may itself extend for a similar distance because the glaciofluvial deposits have infilled the shear zone which provided a low relief pathway. Other glaciofluvial Pleistocene deposits in the map area occur on the edges of the Bolton Creek Valley which traverses, west to east, the entire north half of the map area. Two notable concentrations occur between Highway 509 and the Pennick Lake Road immediately south of Bolton Creek, and spotted occurrences flank Bolton Creek to the east and west of the road running north from the hamlet of Zealand. Pleistocene deposits in the remainder of the map area include ground moraines and sandy till (Henderson 1973). Glacial striae do not abound in the map area but general trends given by Henderson (1973) indicate southwesterly-oriented trends.

Recent deposits in the map area are comprised of alluvial and organic swamp deposits, or, as described by Henderson (1973), include bog deposits, muck and peat, areas of fen vegetation, marsh, and meadow. The main areas covered by Recent deposits include the Bolton Creek Valley; the eastern portion of the major shear zone passing through the hamlet of Clarendon Station north of Pennick Lake; an east-west oriented zone passing through the hamlet of Oso; a grossly circular area surrounding Chambers Lake immediately north of Highway 7 near the junction with Highway 38; a prominent trough trending northeastward from Graceys Island in Sharbot Lake and extending for some 5.2 km; much of the area immediately flanking the Fall River including the entire east end of Silver Lake; and irregular areas within the Lanark-Oso Anorthosite Massif and surrounding high grade gneisses (unit 1).

METAMORPHISM

Rocks in the map area have undergone regional metamorphism during the Late Precambrian. Mineral assemblages vary with the large number of rock chemistries present and with the grade of metamorphism and subsequent alteration.

In general, the map area can be divided into two metamorphic zones: (A) the metasediments of units 3, 4, 5 and the metavolcanics of units 2 situated north of the contact of units 1 and 9, and the healed major shear zone which parallels this contact; (B) the rocks of map units 1 and 4 which lie south of this contact.

The best metamorphic mineral indicators in the map area occur in the metasediments and metavolcanics, and in the granoblastites (high grade gneisses). Unfortunately, the clastic siliceous metasediments are alumina-poor, hence the alumino-silicate indicator assemblages cannot be utilized. The late felsic intrusives (unit 9), the syntectonic felsic intrusives (units 6 and 7), and the mafic intrusives (units 8 and 10) are only weakly metamorphosed, usually to the extent that plagioclase is sericitized to varying degrees.

Zone A

Metamorphic zone A contains the following metamorphic mineral assemblages:

Clastic Siliceous Gneisses (map unit 3)

(1) quartz + plagioclase + biotite ± muscovite
(2) quartz + plagioclase + biotite + almandine ± muscovite

Carbonate Metasediments (map unit 4)

(3) calcite + dolomite + diopside + tremolite + quartz

Amphibole Rich Gneisses and Schists (map unit 5)

(4) plagioclase (oligoclase-andesine) + hornblende + biotite ± quartz
(5) plagioclase (oligoclase-andesine) + hornblende + calcite ± apatite
(6) plagioclase (oligoclase-andesine) + hornblende + calcite ± biotite ± diopside.

The above mineral assemblages indicate that rocks of this metamorphic zone lie in the low temperature (500°-550°C) field of medium-grade metamorphism (Figure 3), as given by Winkler (1976). Assemblage (1) places this zone

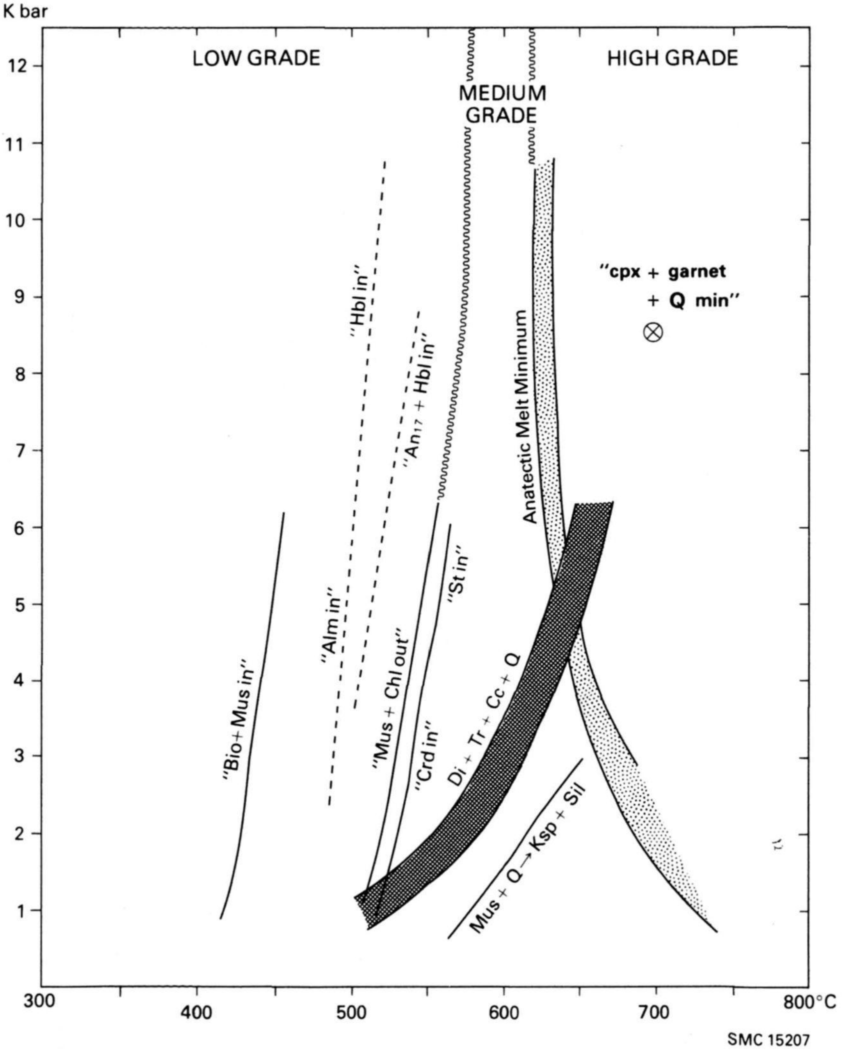

Figure 3–Metamorphic pressure-temperature composite indicating pertinent metamorphic zones and isograds in the Sharbot Lake Area (after Winkler 1976). *Bio = biotite, Mus = muscovite, Alm = almandine, Hbl = hornblende, An = plagioclase, Chl = chlorite, Ctd = chloritoid, Crd = cordierite, St ≈ staurolite, Di = diopside, Tr = tremolite, Cc = calcite, Q = quartz, Ksp = K-feldspar, Sil ≈ sillimanite, Cpx = clinopyroxene, O = orthoclase.*

above the "muscovite-chlorite out" isoreaction-grad, but below the "muscovite + quartz-potassium feldspar + sillimanite" isoreaction-grad. Assemblage (2) places these rocks above the "almandine in" isoreaction-grad. Assemblage (3) defines limits for the pressure of 2-4 Kbar. The plagioclase composition in assemblages (4), (5), and (6) positions these rocks above the "An_{17} + hornblende" isoreaction-grad.

Zone B

Metamorphic zone B contains mineral assemblages and textures which are diagonistic of the regional hypersthene zone or high grade granolite zone as described by Winkler (1976). It should be noted that rock units occurring in this zone are mainly mafic to silicic migmatites and anatectites of unit 1. Local zones of high grade carbonate metasediments of unit 4 are also present in this metamorphic zone. Also present are gabbroic and anorthositic phases of unit 8 which in themselves do not show explicit signs of metamorphism. The typical metamorphic mineral assemblages present in this metamorphic zone are:

Mafic Migmatites and Anatectites (map unit 1)

(7) diopside + biotite + hornblende + plagioclase (oligoclase-labradorite) ± quartz

Silicic Migmatites and Anatectites (map unit 1)

(8) diopside + biotite + plagioclase (oligoclase) ± hornblende ± quartz

Carbonate Metasediments (map unit 4)

(9) calcite + dolomite + tremolite + diopside + quartz.

The lack of hypersthene in these rock types, combined with lack of the mineral assemblage almandine garnet + diopside + quartz allows these rocks to be classified as granoblastites rather than granolites (Winkler 1976). The lack of hypersthene in zone B, particularly in the mafic rocks, deserves some attention. DeWaard (1965) has shown that the assemblage orthopyroxene + plagioclase becomes unstable if load pressures exceed a critical value at constant temperature. The reaction:

[hypersthene + plagioclase] = [clinopyroxene + garnet + quartz]

eventually stabilizes the mineral assemblage:

clinopyroxene + garnet + quartz + either plagioclase or hypersthene

Thus, mineral assemblage (7), present in metamorphic zone B, is indicative

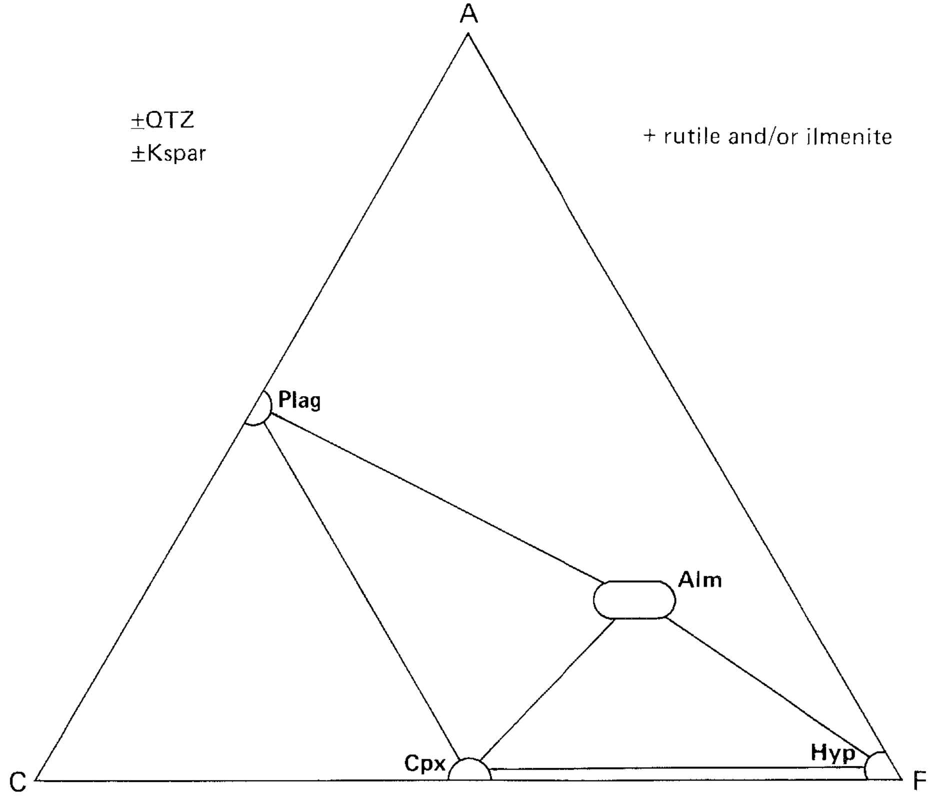

Figure 4–ACF Diagram for the clinopyroxene-almandine-quartz-granolite subzone of the regional hypersthene zone (after Winkler 1976).

of the higher pressure clinopyroxene-almandine garnet-quartz granolite subzone of the regional hypersthene zone. The presence of hornblende and biotite indicates that the mafic rocks of metamorphic zone B are in a transitional state and specifically lie on the clinopyroxene-plagioclase tie-line (Figure 4). This is in contrast to the Long Lake Area (Wolff 1979) which contains mafic rocks of the regional hypersthene zone that are diagnostic of true granolite. This indicates that although metamorphic temperatures in the high-grade metamorphic rocks of the Sharbot Lake Area and the Long Lake Area were probably similar, pressures were higher in the Sharbot Lake Area, suggesting the Sharbot Lake high grade gneisses represent an even lower crustal level assemblage than those of the Long Lake Area.

The silicic migmatites and anatectites or pelitic granoblastite mineral assemblages in metamorphic zone B indicate the presence of clinopyroxene + hornblende + biotite (assemblage (8)). These rocks are similar to granoblastites described by Reinhardt and Skippen (1970) in the Westport Area (south and east of the present map area). The lack of sillimanite and kyanite in rocks of the Sharbot Lake Area does not suggest lower pressures in this area, but compositional differences involving the lack of excess Al_2O_3 in the rock chemistry.

The carbonate metasediments in this metamorphic zone do not show significant differences from those of zone A (compare assemblages (3) and (9)). This is typical as $P_{[H_2O]} << P$ [Total in granolite metamorphism] (Winkler 1976).

A range of pressure and temperature conditions for metamorphic zone B would have a lower limit from 5 Kbar and 650°C to accommodate metamorphic assemblage (9), to an upper limit of 8 Kbar and 700°C, the minimum stability of clinopyroxene + garnet + quartz (Green and Ringwood 1967); *see* Figure 3.

STRUCTURAL GEOLOGY

Regional Setting

The map area lies within the Central Metasedimentary Belt of the Grenville Structural Province as defined by Wynne-Edwards (1972); and specifically lies mainly within the IVc segment, with the very northwest corner being part of the IVb segment. The contrast in structural geology between the two zones is poorly displayed in the map area because of the small exposure of the IVb segment, and the lack of supracrustal rocks due to the dominance of intrusive rocks in that part of the map area. The two zones are separated by the major shear zone that passes through the hamlet of Clarendon Station and strikes to the southwest through the Long Lake Area. A description of the contrast in structural geology between the IVb and IVc segments is presented in "Geology of the Long Lake Area" (Wolff 1979). Thus, regionally the map area lies mainly within the Frontenac Axis or IVc segment of the Central Metasedimentary Belt and contains the paragneissic, plutonic, and gneissic terranes indicative of this segment as described by Wynne-Edwards (1972).

Foliation, Folding, Boudinage, and Gneissosity

With respect to these structural elements the entire map area can be considered as a single structural entity. The foliation is best developed in the supracrustal assemblages (units 2, 3, 4 and 5) and strikes northeast (040°-060°) with moderate dips (025°-055°E). Locally a foliation-gneissosity is developed, but the rocks cannot be considered to have reached the metamorphic state of bona fide gneisses. The foliation is considered to be a S_1 foliation which is essentially parallel to the S_0 bedding. The strike of foliation is very continuous and the only perturbation of it occurs in the vicinity of Sharbot Lake. In this area, starting from the southwest corner of the map area, the supracrustals strike east-northeast (060°-080°), swing to the north-northeast (030°-045°), then swing back to a northeast (040°-060°) orientation in the remainder of the map area. This elongated "S" perturbation represents the deformation of the supracrustals around the southern portion of a late-stage granitic intrusion situated east of White Lake and north of Black Lake. The more structurally competent intrusive body created a resistant "island" about which the less competent supracrustals were deformed.

These supracrustal units are foliated into synclinal folds (F_2) which plunge shallowly (25°-35°) northeast (040°), and are essentially axial planar to the F_2 fold axis. These minor folds are poorly developed and difficult to trace because of the steep dip of the units themselves. Slippage during deformation is evidenced by quartz and hornblende rodding giving L_3 lineations (130°/35°) which are essentially a dip-slip component. Such rodding features are best developed in units exposed in the stretched "S" structure around Sharbot Lake. Another structural feature often found in these supracrustals is boudinage. This mainly occurs in the more quartz-feldspar rich metasediments which display "pinch-and-swell" structures in the quartzo-feldspathic layers. The boudinage is locally coupled with brittle fracture which creates segmented boudining in three dimensions. Figure 5 depicts the sequence of events. Stage I indicates a quartzo-feldspathic layer surrounded by more micaceous layers. Boudinage and rodding promote the development of "pinch-and-swell" type structures elongated in the c dimension (Stage II). Brittle fracture, first paralleling the b-c plane, creates segmented boudins. Because of their short a and b dimensions with respect to the longer c dimension, the segments are weak in the c dimension, and are further segmented parallel to the a-b plane creating rodded clasts as depicted in Stage III. The potential for confusion of the resultant structure with pebbles associated with conglomerates is evident. Fortunately, in the map area whenever Stage III "boudin-clasts" were located, Stage II and eventually Stage I situations were traceable along strike, confirming that these features are the result of plastic flow followed by brittle deformation (*see* Photos 7 and 8).

The existence of foliation and foliation-gneissosity (S_1) parallel to the original bedding or compositional layering, the absence of axial planar foliation, and the absence or existence of few minor folds and lineations (L_2) parallel to major fold axes suggest that structurally the map area has been subjected to flow folding as described by Wynne-Edwards (1963).

The supracrustals described above are not part of the Clare River Synform (Schwertdner 1977; Wolff 1978, 1979). Although the supracrustals within the Clare River Synform and those described above have similar mineralogies and modes of occurrence, the Clare River Synform structure is not continuous into the map area, but truncated by a major shear zone (*see* below). Thus the Clare River Synform structure has an eastern limit situated between Mountain Grove and Clarendon Station (most probably west of White Lake; and does not extend for 95 km from its closure near Madoc to Carleton Place as a structural entity, as suggested by Reinhardt (1964).

The mafic to silicic migmatites and anatectic gneisses of map unit 1 possess well-developed gneissosities. These parallel the foliation orientations mentioned above and strike 040°-060° with moderate dips (025°-055°E).

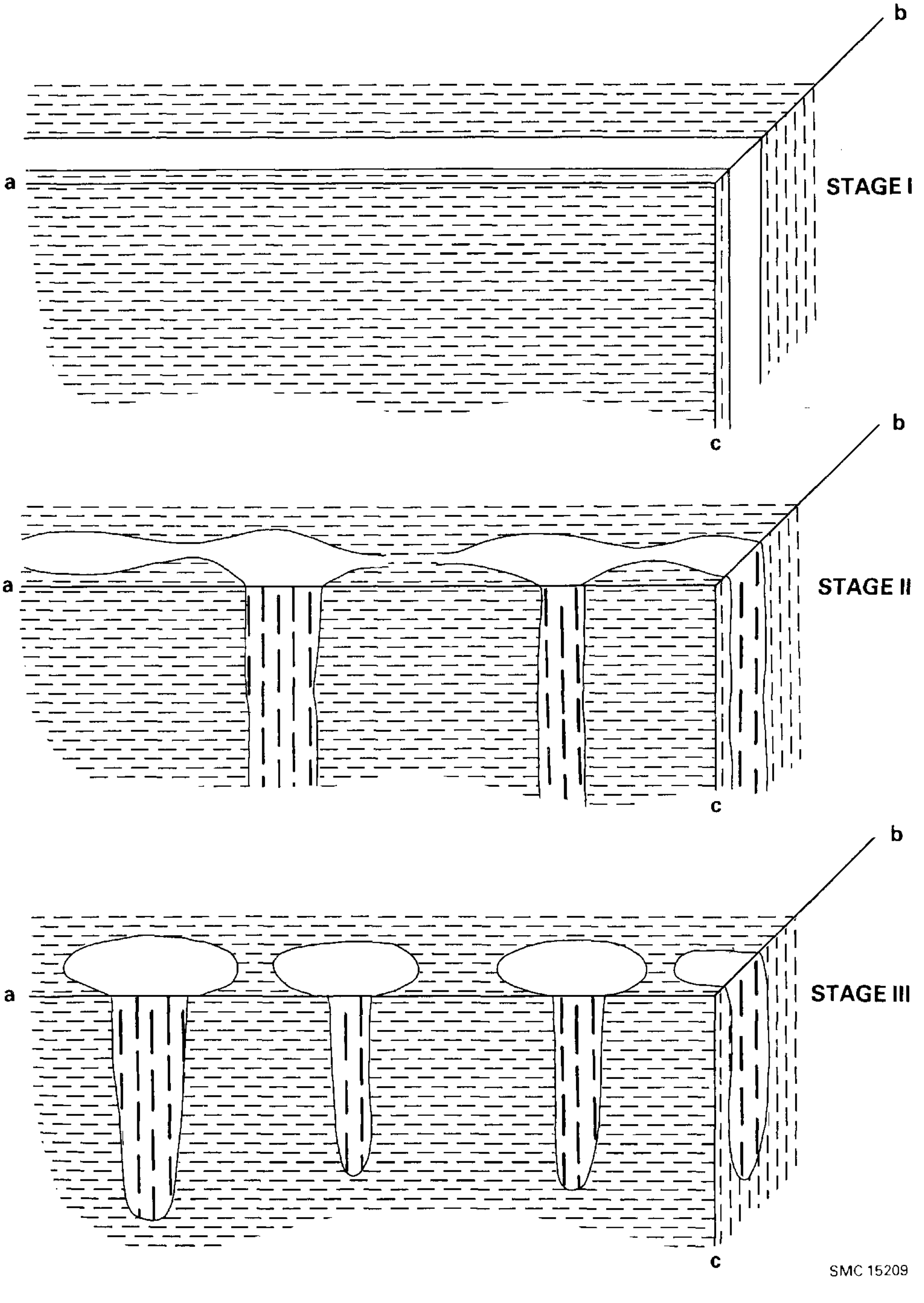

Figure 5–Deformation stages required for "boudin-clast" formation.

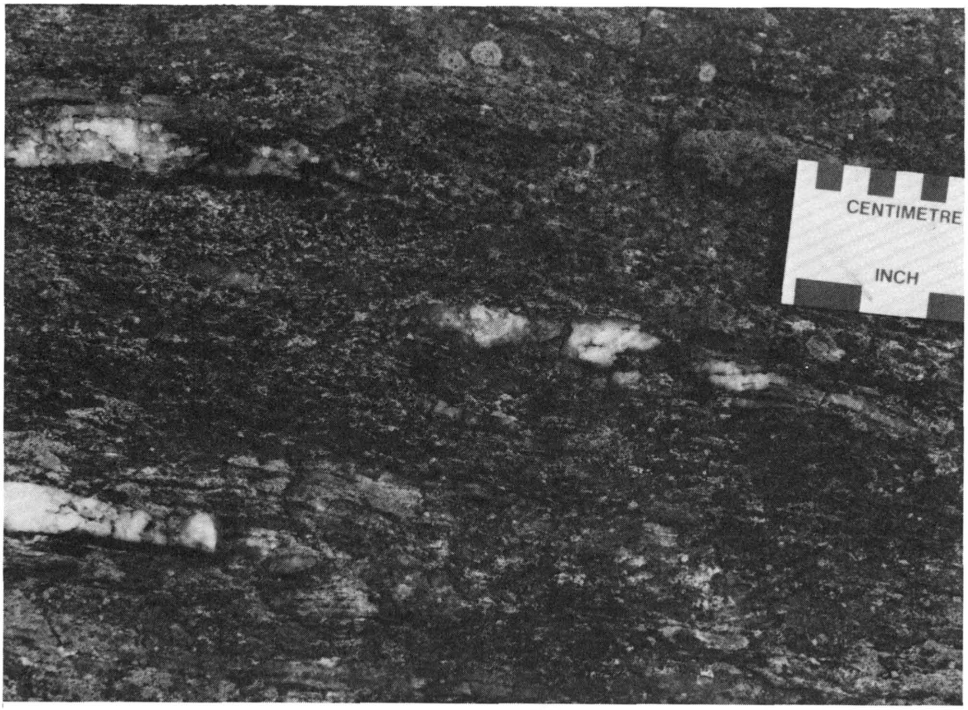

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Photo 7–"Boudin-clasts" or pseudoconglomerates produced within map unit 3 between layers of quartzite and less quartz-rich lithologies by the deformation sequence: boudinage, rodding, and brittle fracture. Short and medium length boudin-clasts shown here can be traced along strike into continuous beds. This outcrop is located along the power line some 800 m north of Highway 7, west of Silver Lake in Oso Township.

Structurally these gneisses are quite monotonous containing no boudinage, rodding or minor folds in outcrop.

Faults, Fractures, Dikes, and Lineaments

The most strikingly developed of these features in the map area is faulting. Two faults of regional scale transect the map area. The first and most physically prominent is the major shear zone, located in the northwest corner of the map area, that passes through the hamlet of Clarendon Station. Although this feature has a strike length of 6 km in the map area, it extends to the southwest and northeast for a total length of some 80 km. A description of the physiography and geology of this zone in the Long Lake Area is given in some detail by Wolff (1979). In the present map area, the shear zone is approximately 0.5 to

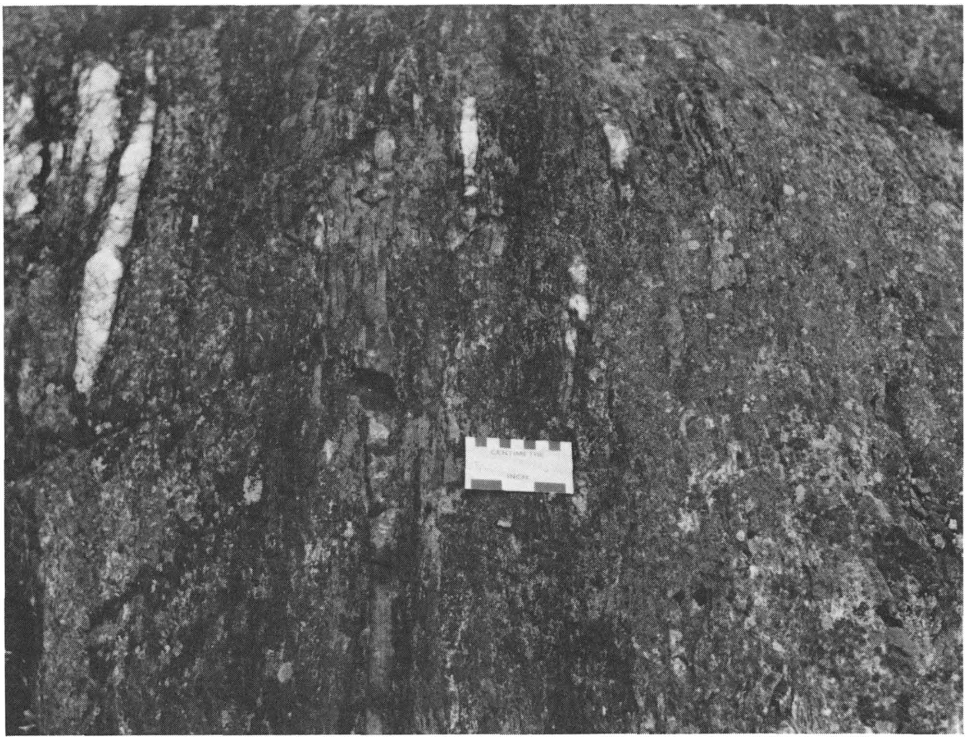

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Photo 8–"Boudin-clast" features at the White Lake Rearing Station (western boundary of the map area). The outcrop is located west of the path at the base of a small rise about half-way between the main office and the boathouse on White Lake. The heavily rodded nature of the clasts occurs in a variety of sizes and shapes. Clasts at this location are primarily quartzite and/or metamorphosed quartz wacke set in a muscovitic quartzo-feldspathic paragneiss and finely banded quartzite (unit 3caf).

1.0 km in width. Lithologies within the shear zone are dominantly protomylonite and mylonite. Mylonite gneiss is indeed rare but may be present in the more intensely deformed portions of the shear zone, much of which is covered by Pleistocene and, to some extent, Recent sediments. The movement on the shear appears to be primarily dip-slip with the relative movement being west-side-up, east-side-down in places where slickensides were discernable. However, this may represent a local block within the shear as the geology suggests that the eastern side represents lower level lithologies both in the present area and the Long Lake Area. Nevertheless, the shear seems to be a normal dip-slip fault. The shear zone itself strikes northwards at 05° to 65°.

The second major fault is not as obvious in physiographic expression, but is well-developed geologically. This fault represents a major shear zone which has been partially annealed by late-stage felsic intrusives. This shear zone occurs at the contact of unit 9 and unit 1 and extends, within the map area, from Sharbot Lake to the eastern boundary of the survey area for a total strike length of approximately 17.8 km. There is no evidence concerning the southern extent of this feature into the Tichbourne Area. Geological evidence for this shear zone is the excellent development of augen-bearing gneisses immediately adjacent to the contact and extending up to 1.5 km across strike from the contact. A typical augen-bearing texture is shown in Photo 1. The shear zone has no equivalent deformation structures on the north side of the contact and the unit 9 granitic intrusives have been injected along the shear and have effectively healed the original fault. The lack of augens and similar cataclastic structures in unit 1 supracrustals north of the contact can be attributed to the relative competency contrast between the metasedimentary gneisses of unit 1 and the metasediments of units 3, 4 and 5 which also occur in the area; and/or, the replacement by massive granitic material (typically 1 km in cross-strike dimension) totally obscuring any highly deformed lithologies that may have existed in the metasediments at, or within approximately 1 km of, the fault zone face. The movement on the shear zone is likely east(south)-side-up and west(north)-side-down as the unit 1 gneisses to the south and east represent lower level assemblages.

Jointing is best displayed in the intrusive rocks and generally trends southeast-northwest, or north-south with vertical dips. A third, essentially horizontal, joint set is locally developed in the rocks of unit 9 south of Silver Lake. Any minor faulting on outcrop scale appears to parallel the southeast trending joint set. Late-stage quartz veins are found to parallel both vertical joint sets. The most abundant dikes are the pegmatite dikes of map units 9i and 9j. These generally trend north to northeast (020°-045°) and are not typically related to any of the above joint sets. In comparison to the Long Lake Area (Wolff 1979) and Kaladar Area (Wolff 1978) the vertical joint sets of the present map area correspond to the second and third joint sets of the Long Lake Area, with the northeast-southwest set (pegmatite filled) being absent in the present area. In comparison to the Kaladar Area, the north-south and southeast-northwest joint sets are present, but the east-northeast set is absent in the present map area.

Numerous lineaments can be traced on air photographs and on the surface in the map area; a number of these can be ascribed to faulting and fracturing. Due to insufficient stratigraphic and structural control none of these can be assigned relative directions of movement. The more prominent lineaments along which fault movements may or may not have occurred are indicated on Geological Map 2471, back pocket.

AEROMAGNETIC DATA

Comparison of Geological Map 2471 (back pocket) and the available aeromagnetic survey (G.S.C. 1952) indicates a reasonable correlation between aeromagnetic patterns and rock type. The aeromagnetic patterns can be divided into three gross types: (1) wide contour spacing and low flux (300-1200 gammas); (2) dense contour spacing and high flux (1000-3000 gammas); and (3) moderate spacing and moderate flux (900-2500 gammas).

The first pattern is typical of the large outcroppings of carbonate metasediments (unit 4) and the Lavant Gabbro body (unit 8) in the north half of the map sheet. These two rock types are essentially indistinguishable from one another in the magnetic values because of relatively low and overlapping concentrations of magnetic minerals in these two particular rock types. This aeromagnetic pattern is also typical of the carbonate metasediments outcropping in the vicinity of Bolingbroke in the southeast corner of the map area.

The second type of aeromagnetic pattern is found in three major areas of the map sheet: a continuous zone adjacent to the Fall River, a zone immediately west of Rock Lake, and an area immediately north of Maberly. Four zones including one immediately north of Maberly, and three immediately south can be associated directly with the outcropping of gabbro and anorthositic gabbro (unit 8). The isolated domal nature of the aeromagnetic patterns created by these bodies suggests that the other similar-shaped anomalies, that is two zones between the abandoned CPR track and Clear Lake, and the zone west of Rock Lake, actually represent concentrations of gabbro and anorthositic-gabbro (unit 8) masked by the overlying gneisses of unit 1. Thus the aeromagnetic data may indicate the presence of unexposed gabbroic bodies.

The third pattern represents the bulk of the rock types in the map area including units 1, 2, 3, 5, 6, 7, the anorthositic phases of unit 8, and unit 9. Unit 10 displays no aeromagnetic expression. None of these rock types are aeromagnetically distinguishable from one another at the scale (1:63 360) and spacing of the available aeromagnetic maps.

In general the aeromagnetic data does not reflect any of the faulting in the map area.

ECONOMIC GEOLOGY

The Sharbot Lake Area contains a variety of metallic and non-metallic mineral deposits. In 1979 the only mineral production was local sand and gravel extraction for road bed construction and maintainance.

Metallic mineralization consists mainly of gold, copper, nickel, iron, and uranium. The known gold occurrences are limited to pyritiferous late-stage quartz veins which cut clastic siliceous metasediments (unit 3) and are associated with copper, nickel, and iron concentrations. Uranium concentrations are associated with the Addington Pluton (unit 7), but only reach background levels within the map area. The anomalously high concentrations in this unit are situated just to the north of the map area and are similar to the uraniferous concentrations encountered in the Kaladar Area (Wolff 1978). Unless otherwise stated, all assay values and details of exploration are from files in the Assessment Files Research Office, Ministry of Natural Resources, Toronto.

Nonmetallic mineral concentrations are more abundant and include apatite, mica, feldspar, corundum, garnet, talc, and marble. Apatite has a number of modes of occurrence including disseminations within carbonate metasediments (unit 4) and more massive concentrations in the skarn phases of this unit. Another mode of occurrence is that of massive dikes of apatite within phases of migmatites and anatectic gneisses (unit 1) reported by Harding (1947). This unit is also host to local concentrations of mica in the map area.

Concentrations of feldspar are abundant in map-unit 8. The anorthosite phases of this unit contain large, well-exposed volumes of feldspar, with minor amounts of corundum in well-defined zones. Concentrations of garnet are mainly limited to phases of unit 1 in the southeast corner of the map area, near the hamlet of Bolingbroke. Minor concentrations of talc can be found in skarn phases of the carbonate metasediments (unit 4), but a very promising occurrence for possible economic extraction is found within the metavolcanics (unit 2) immediately adjacent to the major zone just west of Pennick Lake. Concentrations of marble abound within the map area. Because the mapping technique differentiated between calcite-rich phases and dolomite-rich phases, zones of either can be delineated on the map by tracing units 4a and 4b respectively.

Prospecting and Mining Activity

Recorded data on mineralization in the area date back to the late 1800s in the works of Murray (1852), Vennor (1868), and White (1893) who all mapped for the Geological Survey of Canada. These investigations saw the mining of vein-type apatite for phosphate circa 1900. Circa 1910 a concentrated search for mica and feldspar was undertaken in the map area. Although no significant deposits of feldspar were revealed, one mica occurrence was worked for a short period of time. A third period of exploration circa 1940 entailed prospecting for gold in southeastern Ontario. A number of minor test pits were sunk in the map area, none of which became economically productive. During the period 1957-59 there was a renewed interest in base metal and gold exploration in the area, as well as an interest in uranium-bearing lithologies. This resulted in some diamond drilling in the map area, but no economical finds were recorded. A renewed interest in uranium was sparked in 1969 resulting in some airborne geophysical work in the northwest corner of the map area. The latest period of exploration activity in the map area centered on the uraniferous zones bordering the map area to the north, and was performed by the joint Federal-Provincial Uranium Reconnaissance Project (G.S.C. 1976, 1979), but yielded only background values within the map area proper.

Metallic Mineralization

GOLD

Gold mineralization found within the map area occurs in late-stage quartz veins and/or granite dikes cutting metasediments of unit 3. Gold in these occurrences is present in trace concentrations and is associated with other base metal sulphides of Cu, Ni and Fe. The gold appears to have been concentrated in these late-stage fillings from the surrounding metasediments as quartz veins in other types of lithologic units are barren.

Description of Deposits

BOURK, R.T. OCCURRENCE (1)

LOT 23, CONCESSION I, OSO TOWNSHIP

Harding (1947) assayed chip samples of chalcopyrite, pyrite and malachite for gold values from a small test pit (2 m deep), sunk by William Duffy on the farm of R.T. Bourk during the early part of the century. The chip samples are reported to have contained low gold values. The mineralized zones were within quartz-rich phases of a granite dike cutting metasediments and metavolcanic units.

MARROW A. OCCURRENCE (5)

LOT 15, CONCESSION II, OSO TOWNSHIP

This showing is situated between Highway 38 and the abandoned branch of the Canadian Pacific Railway running north from Sharbot Lake to Clarendon Station. The occurrence is composed of disseminated pyrite in a late-stage quartz vein cutting quartzites of unit 3. A pit 1 m deep and 5 m in length was worked by Marrow between 1941 and 1944. Harding (1947) reports that low gold values (0.01 ounce/ton or .017g/t) were reported from this pit.

McVEIGH R. OCCURRENCE (6)

WEST-HALF, LOT 18, CONCESSION IV, OSO TOWNSHIP

In 1937 a pit 4 m deep was sunk by R. McVeigh in a narrow dike of fine-grained late-stage granite (unit 9) cutting carbonate metasediments (unit 4). The dike is less than 1 m wide and contains disseminated pyrite. Harding (1947) reports that McVeigh reported low gold values from this occurrence.

CREMAC SURVEYS COMPANY LIMITED [1959] (2)

WEST-HALF, LOT 14, CONCESSION I, OSO TOWNSHIP

In 1959 Cremac Surveys Company Limited sunk a number of diamond-drill test holes in metavolcanics and metasediments in the Mountain

Grove-Sharbot Lake Area (Wolff 1979). A 93 m hole in metasediments of unit 3 intersected sporadic disseminations of pyrite, pyrrhotite and chalcopyrite. The sulphides were most concentrated adjacent to granite pegmatite veins (unit 9) cross-cutting the metasediments, and 0.6 m of mineralized section indicated trace amounts of gold in assay.

CREMAC SURVEYS COMPANY LIMITED [1959] (2)

NORTH-WEST 1/4, LOT 12, CONCESSION X, OLDEN TOWNSHIP

In 1959 Cremac Surveys Company Limited sunk a 72 m diamond-drill hole into metasediments of unit 3. Quartz veins and stringers in the metasediments contained mineralized zones of pyrite and pyrrhotite. A 0.6 m section of this core yielded trace amounts of gold.

BASE METALS: Ni, Cu, Fe

The base metals Ni, Cu, and Fe have been grouped for description because of their close association and the small number of occurrences of these metals in the map area.

Ni, Cu, and Fe occur in the area in the minerals pyrrhotite, chalcopyrite, malachite, and pyrite. Concentrations of these minerals are essentially limited to the metasediments of unit 3, and assayed values of these metals are chiefly associated with searches for gold. Pyrite is a common mineral within the metavolcanics (unit 2), the clastic siliceous metasediments (unit 3), the carbonte metasediments (unit 4), the amphibole-rich gneisses and schists (unit 5), and the late-stage felsic intrusives (unit 9).

Magnetite and hematite mineralization is not uncommon in the late-stage quartz veins (unit 9).

Description of Deposits

CREMAC SURVEYS COMPANY LIMITED [1959] (2)

EAST-HALF, LOT 14, CONCESSION I, OSO TOWNSHIP

In 1959 Cremac Surveys Company Limited sunk a 122 m diamond-drill hole on this property which intersected four zones of quartz veining containing abundant sulphide minerals within unit 3 metasediments. The first, Zone One, 1.4 m in thickness, assayed 0.03 percent Ni and 0.03 percent Cu; Zone Two, 0.6

m thick, assayed 0.09 percent Ni and 0.05 percent Cu; Zone Three, 1.0 m thick, assayed 0.02 percent Ni and 0.05 percent Cu; and Zone Four, 0.6 m thick, assayed 0.04 percent Ni and 0.07 percent Cu. The sulphide mineralization included pyrite, pyrrhotite, and chalcopyrite.

CREMAC SURVEYS COMPANY LIMITED [1959] (2)

WEST-HALF, LOT 14, CONCESSION I, OSO TOWNSHIP

This occurrence is the same as that described above under gold mineralization. The three sulphide zones encountered yielded the following base metal values; Zone One, 0.6 m thick, assayed 0.01 percent Ni and 0.04 percent Cu; Zone Two, 1.2 m thick, yielded 0.05 percent Ni and 0.05 percent Cu; and Zone Three, 0.75 m thick, assayed 0.03 percent Ni and 0.06 percent Cu. Sulphide mineralogy included pyrite, pyrrhotite, and chalcopyrite.

CREMAC SURVEYS COMPANY LIMITED [1959] (2)

NORTH-WEST 1/4, LOT 12, CONCESSION X, OLDEN TOWNSHIP

This occurrence is the same as that described above under gold mineralization. Three sulphide zones intersected contained the following base metal concentrations: Zone One, 0.75 m thick, contained 0.02 percent Ni; Zone Two, 1.5 m thick, contained 0.02 percent Ni; and Zone Three, 1.0 m thick, contained 0.03 percent Ni. Sulphide mineralization included pyrite and pyrrhotite.

URANIUM

Although the Sharbot Lake Area contains no uraniferous occurrences proper, the very northwest corner of the map area contains the Northbrook Batholith and Addington Pluton which contain uraniferous deposits north and immediately adjacent to the map area. Consequently, this corner of the map area (4) has been included in various surveys for radioactivity. The earliest activity was that of Iso Uranium Mines Limited in 1957, consisting of 13 diamond-drill holes totalling 272 m. Further work on this ocurrence in 1968 by Guardian Mines Limited included scintillometer and geological surveys, sampling, trenching, and diamond-drilling totalling 1160 m. In 1969 the Keevil Mining Group Limited conducted an airborne radiometric survey over the area. The latest airborne geological survey over the area was that of the joint Federal-Provincial Uranium Reconnaissance Project (G.S.C. 1976, 1979), which delineated the anomalous zones in more detail.

Nonmetallic Mineralization

TALC

Talc mineralization within the map area has two modes of occurrence. The most common, but least voluminous, occurs in the skarn phases of the carbonate metasediments (unit 4), while the least common, but most voluminous, occurs in the metavolcanics (unit 2) where they are immediately adjacent to the prominent shear zone just west of Pennick Lake.

Description of Deposit

PENNICK LAKE OCCURRENCE (7)

WEST-HALF, LOT 25, CONCESSION II, OSO TOWNSHIP

This occurrence was discovered by the field party during the 1979 field season. In outcrop the unit is composed of a north-striking talc-tremolite-serpentine-calcite schist enclosed by metavolcanics (unit 2) and minor amounts of carbonate metasediments (unit 4). The outcrop itself is composed of a low ridge (maximum relief of 7 m) which is some 100 m wide and could be traced for 500 m along strike. The ridge is intersected by several northwest-trending fractures which allow examination of the lithologies across strike. Access by road is excellent as a wagon trail leads west from the Pennick Lake Road along one of these fractures. The outcrop is heavily vegetated and in a wooded area of mature maples.

A thin section of one of the more talc-rich phases yielded 70 percent fine-grained (0.05-0.10 cm) talc bundles and sheaves with a diffuse groundmass of plagioclase (18 percent), tremolite (5 percent), iron oxide (5 percent), and opaques, pyrite (2 percent).

This occurrence is of economic interest as talc is currently being processed at the RAM Petroleum Limited talc-tremolite plant south of Robertsville on Highway 509, just north of the map area.

FELDSPAR

Feldspar concentrations in the map area are found in two main units. Minor concentrations occur in the pegmatite phases of the late-stage felsic intrusives (unit 9). The most significant occurrences, however, are found within the massive anorthosite phases of the early mafic intrusives (unit 8).

Description of Deposit

ROCK LAKE-DEER LAKE OCCURRENCE (8)

LOTS 6-13, CONCESSION VI, SOUTH SHERBROOKE TOWNSHIP

LOTS 7, 8, CONCESSIONS VI AND VII, OSO TOWNSHIP

This occurrence is composed primarily of anorthosite and anorthositic gabbro. In outcrop large areas contain 90 percent plus of feldspar with minor amounts of pyroxene. This body is very massive especially in its interior. Near the contacts with the gneisses of unit 1, a well-defined lineation to weakly developed foliation can be found, and in general the amount of mafic material (mainly pyroxene) increases. Selected thin sections of various phases indicate the plagioclase content is calcic with the anorthite component varying from 65-75 percent. The feldspar grains are interlocking, and the only intergranular material is pyroxene, biotite, and trace opaques (ilmenite) in the more contaminated phases. The most feldspar-rich phases appear to contain only minor biotite. In outcrop, excellently formed, coarse-grained, euhedral corundum can be found. Chemical analysis of eight samples of anorthosite show the purest phases to contain 30-33 percent Al_2O_3. The corundum, however, is limited to discrete zones which could be easily avoided during mining. This deposit is very well-exposed and is readily accessible by road.

GARNET

Concentrations of garnet are most prevalent in the gneiss units (unit 1) west of Bolingbroke.

Description of Deposit

SUCKER LAKE OCCURRENCE (9)

NORTH-HALF, LOTS 3, 4, 5, CONCESSION III, SOUTH SHERBROOKE TOWNSHIP

SOUTH-HALF, LOTS 3, 4, 5, CONCESSION IV, SOUTH SHERBROOKE TOWNSHIP

LOTS 3 and 4, CONCESSION VIII, OSO TOWNSHIP

This occurrence of garnet concentration lies within unit 1 gneiss phases. These gneisses contain well-differentiated beds of garnet (locally 80 percent plus), biotite, and quartz-feldspar. Garnet units have a maximum thickness of 0.5 m but are continuous along strike over several hundred metres, and beds often repeat within 5-10 m across strike.

MARBLE

Large portions of the map area are comprised of gently rolling knolls of carbonate metasediments (unit 4). This unit has a variety of different carbonate and calc-silicate assemblages, but the majority of the outcrops are composed of: (1) calcite-rich marble; (2) dolomite-rich marble; and (3) calcite-dolomite bearing marble (units 4a, 4c, and 4d, respectively). Since the mapping was carried out using this classification in a systematic manner, each of these rock types can be readily delineated on Geological Map 2471 (back pocket), and potential areas for calcite and/or dolomite marble deposits maybe identified and located.

MICA

Mica concentrations of note are mainly limited to the higher metamorphic grade gneisses (unit 1). Small scattered phlogopite flakes in the carbonate metasediments (unit 4) are of insignificant concentration.

Description of Deposit

HAWLEY WM. OCCURRENCE (3)

LOT 8, CONCESSION II, OSO TOWNSHIP

This occurrence is described by Harding (1947) and consists of a small prospect pit (6 m long and 2 m deep) which was worked on in 1925 by William Hawley, and later between 1930 and 1935 by C. Stoness. About one ton of marginal mica is reported to have been recovered from the 0.6 m vein containing calcite, pyroxene and phlogopite mica.

APATITE

Apatite occurs as disseminations and small concentrations in various phases of the unit 4 carbonate metasediments in the map area. In addition, Harding (1947) reports that some apatite was extracted from pits south of Silver Lake in the migmatites and anatectic gneisses of unit 1 where these rocks are in contact with gabbros of unit 8. These pits yielded 250 tons of phosphate. The apatite was a brown colour and the pits apparently exhausted the entire reserve of apatite mineralization.

CORUNDUM

Corundum mineralization occurs in the anorthosite phases of the early mafic intrusives (unit 8) and is described above under feldspar mineralization. The corundum is coarse-grained and euhedral and of interest mainly for mineralogical specimens.

SAND AND GRAVEL

Local pits of sand and gravel have been worked by various operators for local uses in road building and construction in the area. No single deposit is strikingly large but the chief sand and gravel concentrations are located in Bolton Creek Valley and near the village of Maberly.

Suggestions for Future Exploration

In view of the results of the present study and previous work in the area it would appear that the map area may be of particular interest for nonmetallic mineral resources.

METALLIC MINERAL RESOURCES

The occurrences of gold and base metals in the late-stage quartz and/or granite pegmatite veins and dikes which cut the metasediments of unit 3 are of interest; but these have, in the past, yielded very low concentrations and very small volumes.

Significant uranium mineralization has not been detected in the map area, and the main focus of exploration for this commodity should be concentrated in anomalous areas to the immediate north of the map area, as delineated by the joint Federal-Provincial Uranium Reconnaissance Project (G.S.C. 1976, 1979).

NONMETALLIC MINERAL RESOURCES

The occurrence of the talc deposit west of Pennick Lake is of immediate interest for future exploration and should be examined as soon as practicable, especially in light of the existence of a talc-tremolite processing mill close by.

The anorthosite-feldspar deposit of Rock Lake-Deer Lake is also an important deposit because of its large size, purity and accessibility. Not only should this deposit be considered for its feldspar content but its potential for building stone material should not be overlooked.

The marble deposits of the area also possess a future mineral resource potential for calcite and/or dolomite.

The minerals garnet, corundum, mica, and apatite are not considered by the author to be of economic significance at this time as their concentration and volume in the map area, with respect to deposits currently being worked for these commodities, are very small.

ROCKS AND MINERALS FOR THE COLLECTOR

Like much of the Grenville Province the map area hosts a variety of rocks and minerals for the interested mineral collector. The carbonate metasediments (unit 4) contain well-deformed calc-silicate minerals locally including tremolite, diopside and talc. The late-stage pegmatite dikes and the pegmatoid leucosome phases of unit 1 contain good feldspar and biotite books. Perhaps the best-developed mineral samples, however, are the euhedral corundum crystals from the anorthosites of unit 8 (*see* Photo 5). These crystals are of excellent form and are not difficult to locate; similarly, their anorthosite hosts are among some of the purest anorthosite material obtainable in Ontario. Massive beds of garnet (unit 1d) are also found in the map area near Sucker Lake, and, although seldom euhedral, they are striking in their high garnet content. Collectors interested in cataclastic petrofabrics will find the augen-bearing phases of unit 1 hosting a profusion of excellent augens (*see* Photo 1), and protomylonite and mylonite textures can be collected from the major shear zone which passes through the hamlet of Clarendon Station.

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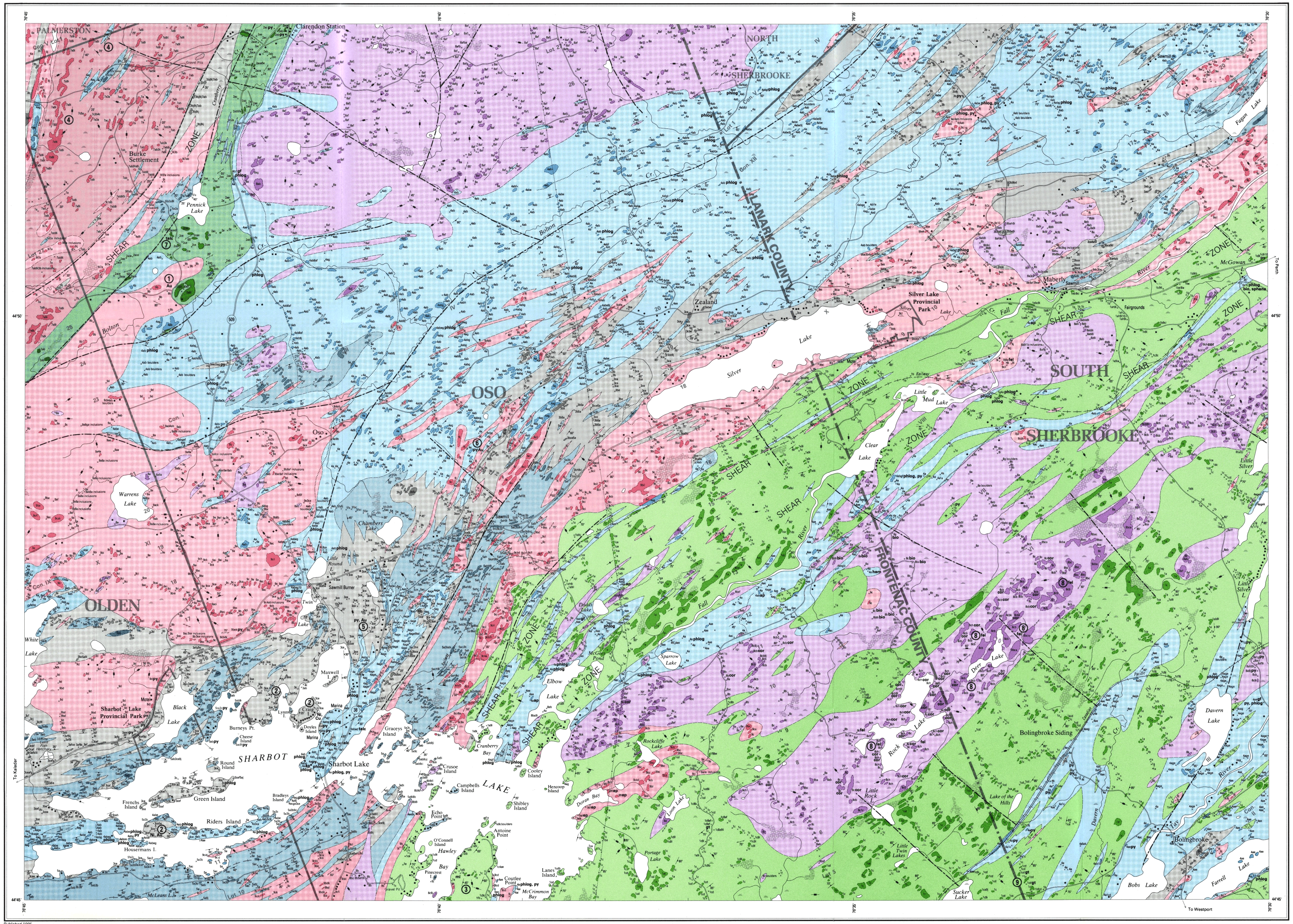
INDEX

Ministry of Natural Resources
Ontario

Ontario Geological Survey
Map 2471
Sharbot Lake



Published 1985

Scale 1 inch to 50 miles
N.T.S. Reference 31 C/15

SYMBOLS

- Glacial striae. Glacial fluting or drumlin.
- Esker.
- Bedrock; (small outcrop, area of outcrop).
- Bedding, horizontal.
- Bedding, top unknown; (inclined, vertical).
- Bedding, top indicated by arrow; (inclined, vertical, overturned).
- Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).
- Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).
- Bedding, top (arrow) from relationship of cleavage and bedding; (inclined, overturned).
- Lava flow; top (arrow) from pillows shape and packing. Lava flow; top in direction of arrow.
- Direction of paleocurrent.
- Schistosity; (horizontal, inclined, vertical).
- Gneissosity; (horizontal, inclined, vertical).
- Foliation; (horizontal, inclined, vertical).
- Banding; (horizontal, inclined, vertical).
- Lineation with plunge.
- Geological boundary; (observed, position interpreted, deduced from geophysics).
- Magnetic contour; value in gammas. Magnetic attraction.
- Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.
- Lineament.
- Jointing; (horizontal, inclined, vertical).
- Drag folds with plunge.
- Anticline, syncline, with plunge.
- Drill hole; (vertical, inclined, projected vertically, projected up dip). Overburden shown.
- Location of sample.
- Vein, vein network. Width in inches, feet or metres.
- RA Radioactivity.
- Swamp.
- Inundated land
- Motor road. Provincial highway number encircled where applicable.
- Other road. Trail, portage, winter road.
- International or Provincial boundary.
- County, District, Regional or District Municipal Boundary, with mile post.
- Municipal Boundary, (City, Town, Improvement District, Incorporated Township), with milepost.
- Township, Indian Reserve, Meridian, Base Line, Provincial Park, with milepost, (surveyed, unsurveyed).
- Mining property, surveyed. Mineral deposit or mining property, unsurveyed.
- Surveyed line. Unsurveyed line.

All boundary and survey lines are approximate position only.

Some symbols may not occur on this map.

SOURCES OF INFORMATION

Geology by J.M. Wolff and assistants, Ontario Geological Survey, 1979.

Geology is not tied to surveyed lines.

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Aeromagnetic Map 69G, Sharbot Lake, Ontario. 1948.

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Cartography by C. McLean, B. McQuaid and assistants.

Base map from National Topographic System, sheet 31c/15, with additional information by J.M. Wolff.

Magnetic declination was 10° 26′W in 1979.

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

Wolff, J.M.
1985 : Sharbot Lake; Ontario Geological Survey Map 2471, Precambrian Geology Series, scale 1 inch to 1/2 mile, geology 1979.

PROPERTIES, MINERAL DEPOSITS

1. Bourk R.T., occurrence
2. Cremac Surveys Ltd. [1959]
3. Hawley Wm., occurrence
4. Keevil Mining Group
5. Marrow A., occurrence
6. McVeigh R., occurrence
7. Pennick Lake occurrence
8. Rock Lake – Deer Lake occurrence
9. Sucker Lake occurrence

Information current to December 31st, 1979. Former properties on ground now open for staking are only shown if exploration data is available. A date in square brackets indicates last year of exploration activity. For further information see report.

Ontario Geological Survey

Map 2471

SHARBOT LAKE

SOUTHERN ONTARIO

Scale 1:31,680 or 1 Inch to ½ Mile

Chains 80 60 40 20 0 1 2 Miles
Metres 1000 0 1 2 3 Kilometres
Feet 1000 0 5,000 10,000 Feet

[a]*Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured parts of the map.*

[b]*Bedrock geology. Outcrops and inferred extensions of each rock map unit are shown respectively in deep and light tones of the same colour.*

[c]*This unit is interpreted as correlative with the McLean Granitic Pluton in the Long Lake Area (Wolff 1978, 1979).*

[d]*No relative age difference is implied between the Addington Pluton and the Northbrook Batholith.*

[e]*No relative age is implied between these rock types.*

[f]*The metamorphic convention is used in naming these rocks with the least plentiful mineral placed first.*

[g]*Metamorphic textural terminology is after Spry (1969).*

[h]*Migmatite and anatectite terminology is after Mehnert (1971).*

CI Colour Index.

LEGEND

PHANEROZOIC

CENOZOIC[a]

QUATERNARY

RECENT

Organic swamp and alluvial deposits.

PLEISTOCENE

Outwash deposits, sand silt, clay and till.

PRECAMBRIAN[b]

LATE PRECAMBRIAN

LATE TECTONIC METAMORPHOSED INTRUSIVE ROCKS

LATE MAFIC INTRUSIVE ROCKS

10 *Mafic (diabase) dikes.*

INTRUSIVE CONTACT

LATE GRANITIC INTRUSIVE ROCKS[c]

9a *Fine to medium grained massive to foliated biotite granite, quartz monzonite (biotite≥15%).*
9b *Medium to coarse grained equigranular, massive, biotite granite, quartz monzonite (biotite 10%).*
9c *Fine to medium grained, massive to foliated, biotite granodiorite.*
9d *Fine-grained, leucocratic granodiorite.*
9e *Medium grained, massive to foliated, syenite ± hornblende ± biotite ± epidote.*
9f *Porphyritic (quartz or feldspar phenocrysts) varieties of 9b.*
9g *Muscovite-bearing varieties of above rock types.*
9h *Shear zone quartz monzonite and granodiorite phases including protomylonite, mylonite, and mylonite gneiss ± porphyroclasts, usually containing epidote.*
9i *Pink granodiorite pegmatite dikes and irregular masses/sills, locally containing tourmaline ± biotite ± muscovite.*
9j *White granodiorite pegmatite dikes and irregular masses/sills, locally containing muscovite ± biotite ± garnet.*
9k *Unsubdivided metasedimentary and metavolcanic inclusions, (mainly assimilated material from units 2 and 3).*
9l *Quartz veins and dilation fillings ± magnetite.*

INTRUSIVE CONTACT

EARLY MAFIC INTRUSIVE ROCKS

LAVANT AND LANARK-OSO MAFIC INTRUSIONS

8a *Medium to coarse grained gabbro (CI > 30).*
8b *Medium to coarse grained anorthositic gabbro, gabbroic anorthosite (CI 10-30).*
8c *Medium to coarse grained anorthosite (CI < 10).*
8d *Medium grained quartz gabbro.*
8e *Medium to coarse grained monzonite phases.*
8f *Fine grained varieties of 8a.*
8g *Syenite-bearing phases of above rock types.*
8h *Porphyroblastic, glomeroporphyroblastic phases.*
8i *Medium grained biotite granodiorite to biotite trondhjemite phases.*
8j *Aplitic granodiorite phases.*
8k *Coarse grained pyroxenite to peridotite.*

FAULT AND/OR INTRUSIVE CONTACT

SYNTECTONIC METAMORPHOSED FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

ADDINGTON PLUTON[d]

7a *Foliated to gneissic, medium grained, leucocratic quartz monzonite.*
7b *Shear zone quartz monzonite – granodiorite phases including protomylonite, mylonite, and mylonite gneiss ± porphyroclasts usually containing epidote.*
7c *Foliated to gneissic, medium grained, biotite-quartz monzonite (biotite < 25%).*
7d *Weakly foliated, leucocratic, medium grained pink granite.*
7e *Foliated to gneissic, medium grained, biotite granodiorite (biotite > 25%).*

NORTHBROOK BATHOLITH[d]

6a *Lineated to weakly foliated, medium grained biotite trondhjemite.*

FAULT AND/OR INTRUSIVE CONTACT

METASEDIMENTS AND METAVOLCANICS

AMPHIBOLE-RICH GNEISSES AND SCHISTS[e,f,g]

5a *Foliated, fine to medium grained, subidioblastic hornblende-plagioclase ± biotite ± epidote ± calcite gneiss, locally boudinaged.*
5b *Massive, medium to coarse grained, idioblastic, amphibolite ± plagioclase (possibly gabbro).*
5c *Calcite porphyroblasts and/or calcite layers locally occurring in unit 5a.*
5d *Biotite-chlorite schist.*
5e *Biotite-hornblende schist.*
5f *Foliated, fine to medium grained, subidioblastic plagioclase-hornblende ± biotite ± epidote gneiss, locally boudinaged.*
5g *Fine to medium grained, granoblastic quartz-plagioclase-hornblende gneiss.*
5h *Foliated, fine to medium grained, subidioblastic plagioclase-hornblende gneiss (80% hornblende).*
5i *Foliated, fine to medium grained, potassium feldspar-hornblende gneiss.*
5j *Almandine garnet porphyroblasts in units 5a,f,g.*
5k *Biotite-hornblende-quartz-feldspar schist.*
5l *Shear zone phases of above units including prolomylonite, mylonite and mylonite gneiss ± porphyroblasts.*

CARBONATE METASEDIMENTS[e,f,g]

4a *Medium to coarse grained, granoblastic calcite marble.*
4b *Fine to medium grained, granoblastic laminated calcite marble (0.5 to 2 cm thick layers).*
4c *Medium grained, granoblastic dolomite-marble.*
4d *Medium grained, granoblastic, dolomite-calcite marble.*
4e *Fine to medium grained, subidioblastic, calc-silicate assemblages containing tremolite, diopside, talc, apatite, sphene.*
4f *Fragmental dolomite-calcite marble, containing flags of quartzite, quartz and calc-silicate (unit 4e material).*
4g *Quartzite, quartzo-feldspathic blocks, broken beds and flags.*
4h *Chert beds (5 cm thick).*
4i *Mafic hornblende-rich segmented layers.*
4j *Coarse-grained (2 cm) varieties of 4a,c,d.*
4k *Contact skarn phases containing tremolite, diopside, apatite, talc, phlogopite.*
4l *Calcite-graphite schist.*

CLASTIC SILICEOUS GNEISSES AND SCHISTS[e,f,g]

3a *Foliated, granoblastic, fine to medium grained, biotite-quartz-feldspar paragneiss (biotite 10 – 25%).*
3b *Foliated, granoblastic, fine to medium grained, biotite-hornblende-plagioclase-quartz paragneiss.*
3c *Fine grained banded quartzite ± biotite ± muscovite ± feldspar (0.5 to 2 cm thick layers).*
3d *Foliated, granoblastic, fine to medium grained epidote-biotite-potassium feldspar-plagioclase-quartz paragneiss.*
3e *Pyritic varieties of 3d, rusty quartz-feldspar paragneiss.*
3f *Muscovite-bearing varieties of units 3a,3c.*
3g *Muscovite-quartz-feldspar ± garnet schist.*
3h *Foliated fine to medium grained biotite-calcite-quartz-feldspar paragneiss, locally schistose.*
3i *Garnetiferous porphyroblastic varieties of units 3a,3b,3d.*
3j *Shear zone phases of above units including protomylonite, mylonite, and mylonite gneiss.*
3k *Leucocratic, foliated, granoblastic, fine grained biotite-magnetite-muscovite-quartz-feldspar gneiss.*

MAFIC TO INTERMEDIATE METAVOLCANICS[e,f,g]

2a *Foliated, subidioblastic, fine grained quartz-epidote-plagioclase-hornblende ± chlorite amphibolite and amphibolite gneiss, gneissic varieties usually have up to 20% biotite (CI > 35).*
2b *Foliated, subidioblastic, fine to medium grained, epidote-plagioclase-hornblende amphibolite containing porphyroblasts of hornblende (CI > 35).*
2c *Foliated, subidioblastic, fine grained, biotite-hornblende quartz-feldspar ash tuff (CI = 15-30).*
2d *Fine grained talc-tremolite-calcite schist.*
2e *Shear zone phases of above units including protomylonite, mylonite and mylonite gneiss, porphyroblasts, locally containing potassium feldspar.*

MAFIC TO SILICIC MIGMATITES AND ANATECTIC GNEISSES[h]

1a *Medium to coarse grained granodiorite gneiss, locally augen-bearing and contains inclusions of unit 1b and schlieren (CI < 20).*
1b *Medium to coarse grained plagioclase (labradorite)-hornblende-pyroxene diatexite usually augen-bearing (plagioclase) displaying a stromatitic structure.*
1c *Fine grained quartz-feldspar ± biotite ± pyrite gneiss.*
1d *Medium grained quartz-plagioclase-biotite ± pyroxene ± garnet gneiss.*
1e *Well differentiated migmatite metatexite containing a fine to medium grained leucosome of quartz and feldspar and a fine to medium grained melansome of hornblende-plagioclase-biotite, display distinctive stromatic structure.*
1f *Medium grained quartz-plagioclase-biotite ± hornblende ± pyroxene, syenitic to granodioritic migmatite displaying a stromatitic structure and no xenoliths or schlieren (diatexite).*
1g *Medium grained gabbroic ± biotite ± hornblende gneiss.*
1h *Coarse grained pegmatite segregations paralleling gneissosity.*

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ap	*Apatite*
bio	*Biotite*
Cu	*Copper*
cor	*Corundum*
ep	*Epidote*
fel	*Feldspar*
gt	*Garnet*
Au	*Gold*
gf	*Graphite*
hem	*Hematite*
mi	*Mica*
Ni	*Nickel*
phlog	*Phlogopite*
py	*Pyrite*
talc	*Talc*