Ministry of Natural Resources
Ontario

Hon. James A. C. Auld
Minister

Dr. J. K. Reynolds
Deputy Minister

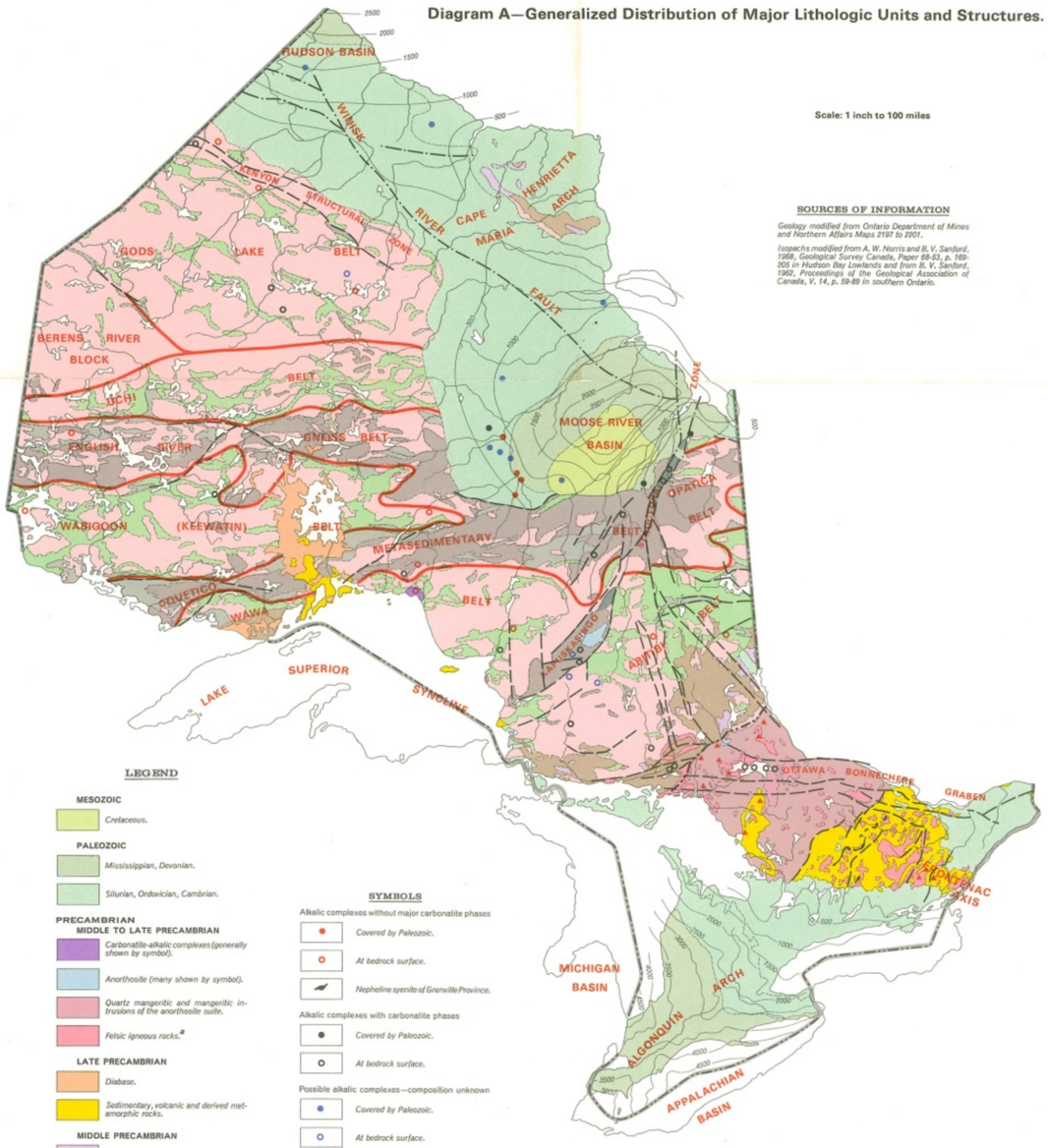
Ontario Geological Survey
Map 2391
ONTARIO GEOLOGICAL MAP

Scale 1:1,013,760 or 1 Inch to 16 Miles

10 0 10 20 30 40 50 60 70 80 Miles

20 0 20 40 60 80 100 120 Kilometres

Diagram A—Generalized Distribution of Major Lithologic Units and Structures.



Scale: 1 inch to 100 miles

SOURCES OF INFORMATION

Geology modified from Ontario Department of Mines and Northern Affairs Maps 2197 to 2201.

Isopachs modified from A. W. Norris and B. V. Sanford, 1968, Geological Survey Canada, Paper 68-53, p. 169-205 in Hudson Bay Lowlands and from B. V. Sanford, 1965, Proceedings of the Geological Association of Canada, V. 14, p. 59-89 in southern Ontario.

LEGEND

MESOZOIC
- Cretaceous.

PALEOZOIC
- Mississippian, Devonian.
- Silurian, Ordovician, Cambrian.

PRECAMBRIAN
MIDDLE TO LATE PRECAMBRIAN
- Carbonatite-alkalic complexes (generally shown by symbol).
- Anorthosite (many shown by symbol).
- Quartz mangeritic and mangeritic intrusions of the anorthosite suite.
- Felsic igneous rocks.*

LATE PRECAMBRIAN
- Diabase.
- Sedimentary, volcanic and derived metamorphic rocks.

MIDDLE PRECAMBRIAN
- Diabase.
- Sedimentary, volcanic and derived metamorphic rocks.
- Metasediments, minor metavolcanics and related migmatitic rocks.

EARLY PRECAMBRIAN
- Felsic igneous rocks.
- Kapuskasing granulite complex.
- Migmatitic metasediments.
- Metasediments and minor metavolcanics.
- Metavolcanics and minor metasediments.

*Shown only in Grenville and Southern Provinces. Includes norite of Sudbury irruptive.

SYMBOLS

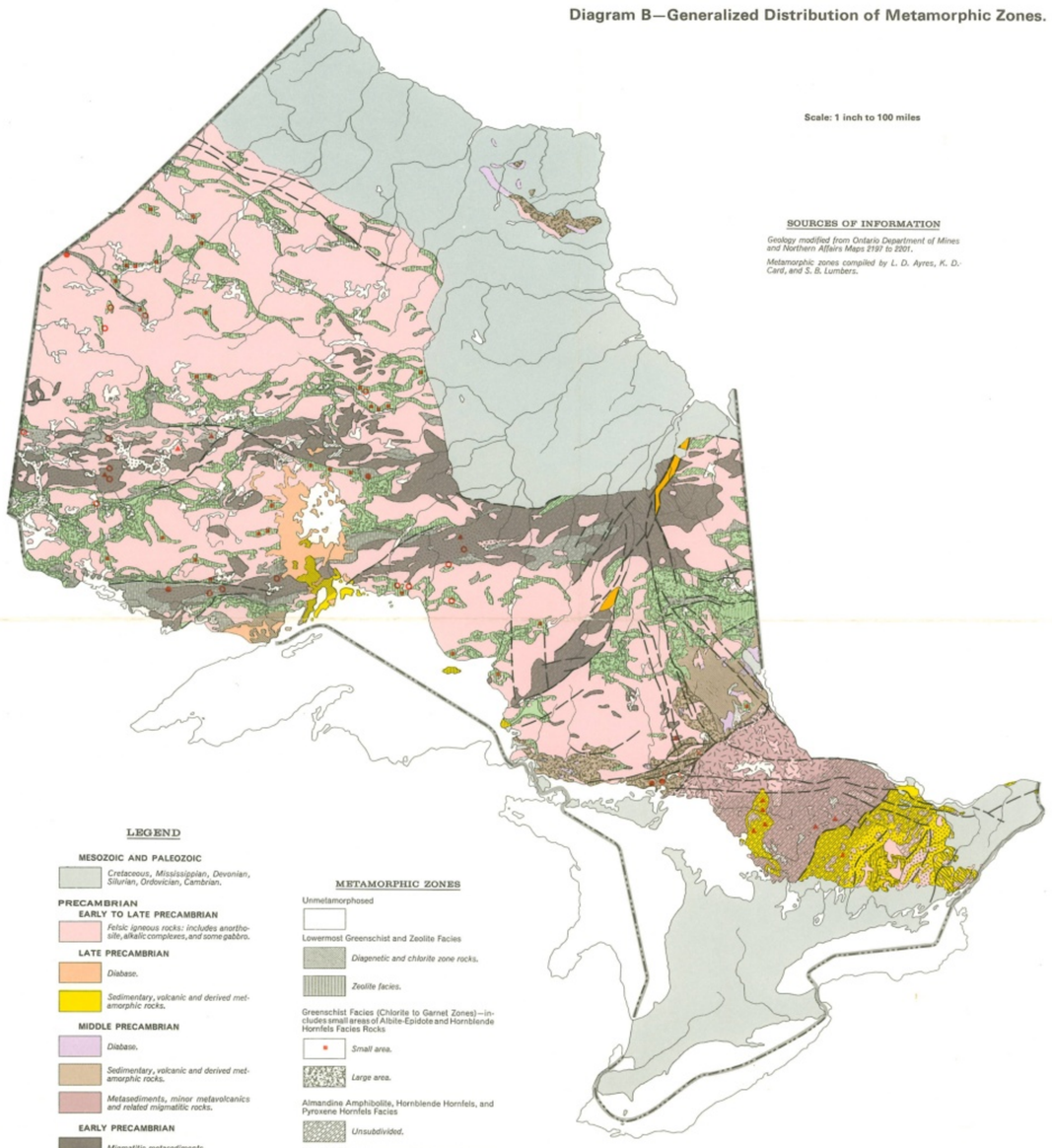
Alkalic complexes without major carbonatite phases
- Covered by Paleozoic.
- At bedrock surface.
- Nepheline syenite of Grenville Province.

Alkalic complexes with carbonatite phases
- Covered by Paleozoic.
- At bedrock surface.

Possible alkalic complexes—composition unknown
- Covered by Paleozoic.
- At bedrock surface.
- Anorthosite.
- Geological boundary.
- Boundary between major structural and lithologic subdivisions of the Superior Province.
- Approximate edge of Middle Precambrian strata beneath Paleozoic of Hudson Bay Lowlands.
- 1000 Isopachs on Phanerozoic rocks.
- Fault.
- Fault in Precambrian, covered by younger rocks.
- Grenville Front.
- Niagara Escarpment.

ODM 6685

Diagram B—Generalized Distribution of Metamorphic Zones.



Scale: 1 inch to 100 miles

SOURCES OF INFORMATION

Geology modified from Ontario Department of Mines and Northern Affairs Maps 2197 to 2201.

Metamorphic zones compiled by L. D. Ayres, K. D. Card, and S. B. Lumbers.

LEGEND

MESOZOIC AND PALEOZOIC
- Cretaceous, Mississippian, Devonian, Silurian, Ordovician, Cambrian.

PRECAMBRIAN
EARLY TO LATE PRECAMBRIAN
- Felsic igneous rocks: includes anorthosite, alkalic complexes, and some gabbro.

LATE PRECAMBRIAN
- Diabase.
- Sedimentary, volcanic and derived metamorphic rocks.

MIDDLE PRECAMBRIAN
- Diabase.
- Sedimentary, volcanic and derived metamorphic rocks.
- Metasediments, minor metavolcanics and related migmatitic rocks.

EARLY PRECAMBRIAN
- Migmatitic metasediments.
- Metasediments and minor metavolcanics.
- Metavolcanics and minor metasediments.

SYMBOLS
- Geological boundary.
- Assumed boundary of metamorphic zone.
- Fault.
- Grenville Front.

METAMORPHIC ZONES

Unmetamorphosed

Lowermost Greenschist and Zeolite Facies
- Diagenetic and chlorite zone rocks.
- Zeolite facies.

Greenschist Facies (Chlorite to Garnet Zones)—includes small areas of Albite-Epidote and Hornblende Hornfels Facies Rocks
- Small area.
- Large area.

Almandine Amphibolite, Hornblende Hornfels, and Pyroxene Hornfels Facies
- Unsubdivided.
- Andalusite zone (includes minor kyanite-bearing rocks in Grenville Province).
- Small area of andalusite zone rocks.
- Kyanite zone with local sillimanite zone rocks.
- Sillimanite zone.
- Sillimanite occurrence (Superior Province only).
- Kyanite occurrence (Superior and Southern Provinces only).

Granulite Facies
- Primary rock known.
- Kapuskasing granulite complex—primary rock unknown.
- Orthopyroxene occurrence indicating possible local granulite facies development.

ODM 6686

INTRODUCTION

The geological map of Ontario was compiled from many sources including published and unpublished maps and reports of the Ontario Department of Mines and Northern Affairs and the Geological Survey of Canada; published reports of the Manitoba Mines Branch, the Minnesota Geological Survey, and the Quebec Department of Mines in border areas; unpublished data on file with the Ontario Department of Mines and Northern Affairs; unpublished theses; and papers published in professional journals. Aeromagnetic maps, topographic maps, and aerial photographs were freely used in the interpretation of unmapped or drift-covered areas.

Inevitably any compilation map is a compromise influenced by scale, data sources of varying detail and reliability, and conceptual bias. As a result many subjective decisions must be made in order to produce a uniform map. For example, in order to show many small units that are important for economic, structural, or stratigraphic reasons, these units have been exaggerated in size, whereas other units of similar size, but of less significance, have been omitted. The following notes delineate general areas where compromise was necessary and also amplify the legend.

PRECAMBRIAN TIME SCALE

The Precambrian succession of Ontario contains two regional unconformities that can be used as a basis for sub-division of the succession into three eras: Early, Middle, and Late Precambrian. Rocks of Early Precambrian age were formally classified as Archean, whereas rocks of Middle to Late Precambrian age were formally classified as Proterozoic. Available geochronologic data on igneous and metamorphic rocks related to regional folding, plutonic, and metamorphic events suggest tentative time boundaries between Early, Middle, and Late Precambrian at 2500 million years and 1500 million years, but revisions of these boundaries can be anticipated as new data become available in the future.

SUPERIOR AND SOUTHERN PROVINCE

Early Precambrian

Early Precambrian metavolcanics have been subdivided into two groups—mafic, and felsic to intermediate—on the basis of composition. Where composition was uncertain or where units in adjacent map-areas disagreed, mode of eruption was used as a secondary means of classification. Thus, sequences composed predominantly of flows are shown as mafic metavolcanics, whereas sequences composed predominantly of tuffs and breccias of pyroclastic origin were placed in the felsic to intermediate group. Minor trachytic metavolcanics, although not designated on the legend, have been included with the felsic to intermediate metavolcanics.

In some parts of Ontario, Early Precambrian metasediments form two or more distinct age groups but subdivision is only possible in restricted areas and cannot be extended to other parts of the province. Consequently all Early Precambrian, non-migmatitic, metasediments have been placed in one unit.

Migmatitic metasediments underlie large areas of the Superior Province, but in general they have received only cursory examination. On many maps migmatites have been shown as granite gneiss, biotite gneiss, or grey gneiss, and have not been distinguished from gneissic granitic rocks of intrusive origin. Consequently migmatitic units on the compilation map are highly generalized, having been extrapolated from areas of reconnaissance mapping on the basis of aeromagnetic data. However, this generalization does give a representative picture of metasediment distribution within the Superior Province.

As shown on Diagram B, granulite facies metamorphism occurred locally in many of the areas underlain by migmatitic metasediments. However, only the Kapuskasing granulite complex is sufficiently large and distinctive to be illustrated and a separate code and pattern have been used for this purpose. Sedimentary, volcanic, and intrusive rocks are known to be present in the complex, but details of rock type and metamorphic distribution are presently unknown. The southern part of the complex has been defined almost completely from aeromagnetic data and the boundaries shown on the map are subjective. This part of the complex is closely associated with migmatitic metasediments that appear to be of lower metamorphic grade, but may also be part of the Kapuskasing structural zone.

The large granitic batholiths that underlie most of the Superior Province are complex and are composed of many individual plutons of variable size and composition. In areas of detailed mapping, rocks in this large group can be subdivided on the basis of composition, intrusive relationships, and tectonic style. No subdivisions have been made in this compilation because of lack of detailed information in most areas and because of conflicting terminology in others.

Middle Precambrian

The Middle Precambrian Huronian sequence was originally subdivided into lower and upper parts based upon an unconformity at the base of the Cobalt Group. Recent work has shown that the Lower Huronian can be subdivided into the Elliot Lake, Hough Lake, and Quirke Lake Groups, but because these subdivisions have not yet been extended to all Huronian rocks, the original two-fold subdivision is used in this compilation. Volcanic rocks are present locally near the base of the Lower Huronian, but these rocks have not been shown separately on the map because of insufficient data.

Late Precambrian

Keweenawan rocks are restricted to the Lake Superior region where volcanic rocks of the Osler Group overlie sedimentary rocks of the Sibley Group. Volcanic rocks are restricted to Black Bay Peninsula and the offshore islands to the east, along the north shore of the lake, and to the islands and shoreline in eastern Lake Superior. Sedimentary rocks of the Sibley Group have not been found east of Schreiber.

GRENVILLE PROVINCE

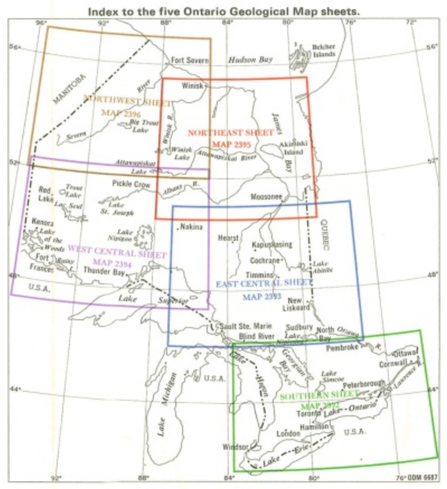
Middle to Late Precambrian

Little geological mapping has been done in the Grenville Province between latitude 46°00'N and a line joining Lake Simcoe and Pembroke on the Ottawa River. The geology shown in this region was compiled from aeromagnetic and airphoto interpretation supplemented by geological reconnaissance data.

The Grenville Province contains two major depositional units: (1) a Middle Precambrian, dominantly clastic metasedimentary accumulation which extends from the northwest boundary of the Grenville Province to a major structural zone, marked by northeast to east-northeast trending faults, extending from the Paleozoic cover in southwestern Dalton Township, through northern Havelock, and through Clyde, Lyell, Sherwood, and North Algoma townships to the Ottawa River near Pembroke; and (2) south of this structural zone, a Late Precambrian metavolcanic-metasedimentary accumulation containing abundant marble. All the clastic metasediments have been included in a single map-unit because details of the Middle Precambrian clastic metasediment distribution are unknown.

The Middle Precambrian metasediments unconformably overlie Early Precambrian rocks exposed within the Grenville Province between Lake Timiskaming and the south end of Lake Timagami. A probable Late Precambrian metavolcanic-metasedimentary sequence, extending northeast from Georgian Bay to Pringle Township, occurs within the main region of the Middle Precambrian metasediments but contacts between the Middle and Late Precambrian metasediments have not been defined. These Late Precambrian metasediments typically contain thin, intercalated marble units, a rock type which is rare in the Middle Precambrian metasediments. Mafic flows dominate the Late Precambrian metavolcanic sequences, but in the upper parts of these sequences felsic pyroclastic and flow material is common.

Index to the five Ontario Geological Map sheets.



ODM 6687

MIDDLE TO LATE PRECAMBRIAN
(All Geological Provinces)

Late Felsic Igneous Rocks

Within the Superior Province many late granitic stocks can be recognized on aeromagnetic maps by their circular to oval shape and high magnetic intensity. The precise age of these intrusions is unknown; many of these intrusions may be only late phases of Early Precambrian granitic intrusions, but several of the better defined stocks have been classified as Middle to Late Precambrian because they have been forcibly intruded into the large Early Precambrian batholiths. In some areas, where petrologic information is not available, there is also difficulty in distinguishing rocks of this unit from the late alkalic rocks.

Within the Grenville Province, Middle to Late Precambrian felsic stocks and batholiths vary greatly in composition and age, and, except for a few post-tectonic stocks within the Late Precambrian succession in southeastern Ontario, all are regionally metamorphosed. Many of the felsic intrusions within the Middle Precambrian country rocks are also Middle Precambrian in age, but some stocks, and a few batholiths, are of Late Precambrian age, particularly northeast of Lake Nipissing and near the northern margin of the Late Precambrian rocks in southeastern Ontario. A few Late Precambrian quartz mangeritic batholiths and stocks, which are silicic members of the anorthositic suite, are present in some of the zones of anorthosite intrusion, as shown on Diagram A. Most of the Middle to Late Precambrian felsic intrusions are quartz monzonitic but granodioritic to trondhjemitic intrusions predominate in metavolcanic areas. In the most southerly part of the Grenville Province near the St. Lawrence River, Late Precambrian monzonitic and syenitic stocks, containing early mafic phases, are abundant.

Late Mafic Igneous Rocks

All mafic intrusions which postdate the Early Precambrian granitic batholiths have been included in this group; thus they range in age from late Early Precambrian to Late Precambrian. Five distinct types can be recognized: (1) Middle Precambrian sheets intruded into the Huronian sedimentary sequence, (2) Late Precambrian sheets intruded into the Animikie and Keweenawan rocks of the Thunder Bay-Lake Nipigon and Sutton Lake areas, (3) Late Precambrian stocks which postdate the high rank regional metamorphism in the Grenville Province, (4) stocks, sheets and funnel-shaped intrusions of various ages, and (5) dike swarms of various ages.

All these intrusions have been included in one group because the precise age of many of them is unknown; the distribution of Middle and Late Precambrian sheets is shown on Diagram A. Some of the stocks and many of the dikes have been defined from aeromagnetic data. However, some dike swarms do not have distinctive magnetic expressions and in unmapped areas some of these dikes may have been overlooked. In areas where dikes are abundant those shown on the map are generalized.

Carbonatite-Alkalic Complexes

Alkalic stocks and dikes that vary greatly in composition and range in age from Middle Precambrian to Cambrian have intruded rocks of the Superior, Southern, and Grenville Provinces. All of these intrusions, except those in southeastern Ontario and in Bigwood Township southwest of Lake Nipissing, are postorogenic; intrusions in southeastern Ontario and Bigwood Township are predominantly synorogenic nepheline and associated syenites. Many of the alkalic intrusions are poorly exposed and several have been defined solely from aeromagnetic data.

Metavolcanics, metasediments, and most of the intrusive rocks within the Grenville Province underwent high rank regional metamorphism during Late Precambrian time. This regional metamorphism varied in intensity, as shown on Diagram B, and one area of low rank metamorphism is present within the Late Precambrian rocks of southeastern Ontario. Commonly, the clastic metasediments in high rank metamorphic areas of the Grenville Province are migmatitic due to partial melting.

Early mafic and ultramafic intrusions were emplaced before the culmination of the Late Precambrian metamorphism and they are largely recrystallized, except for those within the low rank metamorphic area. These intrusions vary greatly in age and composition but most are either gabbroic or dioritic, with dioritic intrusions predominating within and near metavolcanic sequences. Ultramafic rocks are present mainly as minor phases of the gabbroic and dioritic intrusions and rarely form separate bodies. Anorthosite intrusions occur in six major zones as shown on Diagram A.

PALEOZOIC

Paleozoic formations are defined by lithology, and formational boundaries do not everywhere coincide with the series boundaries that form the map-units. Some contacts on the map have thus been placed within formations in order to closely approximate series boundaries. Many of the formations shown as Cambrian are unfossiliferous sandstones and their time-stratigraphic designation is tentative.

FAULTS

Many major faults have been defined solely from aeromagnetic and topographic data. Some faults contain diabase dikes but, because fault and dike symbols could not be superimposed, such faults are shown as either dike or fault; the symbol used depending upon the size and continuity of the diabase.

High rank metamorphic gneisses of the Grenville Province are separated from lower rank metamorphic rocks of the Southern and Superior Provinces by northeasterly trending fault zones. These fault zones are shown on the map by a generalized fault symbol. The northeast trending fault zones are displaced by other faults but only the more major of these are shown. Rocks of both the Southern and Superior Provinces are commonly mylonitized near the Grenville Province boundary.

SYMBOLS
- Geological boundary.
- Grenville Front.
- Fault.
- Railway.
- International and Interprovincial boundary.
- District and County boundary.
- Township boundary, base or meridian line; surveyed.
- Township boundary; unsurveyed.

Revised compilation by S. B. Lumbers and V. G. Milne, Geological Branch, 1976. Original compilation by I. D. Ayres et al, 1970.

Geology compiled from published and unpublished maps and reports of the Ontario Division of Mines, Geological Survey of Canada, unpublished data on file with the Ontario Division of Mines, interpretation of aeromagnetic maps and other sources.

Revised cartography by P. A. Wisbey and C. R. Syrett, Surveys and Mapping Branch, 1977. Original cartography by D. W. Robeson, 1970.

Further information on the geology and mining regulations may be obtained from the Ontario Division of Mines, Ministry of Natural Resources, Parliament Buildings, Toronto.

LEGEND

CENOZOIC
QUATERNARY
PLEISTOCENE AND RECENT
- *Sand, gravel, clay.*

MESOZOIC[a]
CRETACEOUS
LOWER CRETACEOUS[r]
- 28 *Clay, sand, lignite, fireclay, kaolinitic quartz sand.*

PALEOZOIC[a]
MISSISSIPPIAN
LOWER MISSISSIPPIAN
- 28 *Shale, sandstone.*

DEVONIAN
UPPER DEVONIAN
- 27 *Black shale.*

MIDDLE DEVONIAN
- 26 *Limestone, dolomite, shale, gypsum.*

LOWER DEVONIAN
- 25 *Sandstone; arkose, conglomerate, siltstone, shale, limestone.*

SILURIAN
UPPER SILURIAN
- 24 *Limestone, dolomite, siltstone, shale, mudstone, sandstone, gypsum, salt.*

MIDDLE SILURIAN
- 23 *Dolomite, limestone.*

LOWER SILURIAN
- 22 *Sandstone, shale, dolomite.*

ORDOVICIAN
UPPER ORDOVICIAN
- 21 *Shale, limestone, dolomite, sandstone.*

MIDDLE ORDOVICIAN
- 20 *Limestone, shale.*

LOWER ORDOVICIAN
- 19 *Dolomite, sandstone.*

CAMBRIAN
UPPER CAMBRIAN
- 18 *Conglomerate, sandstone, shale.*

LOWER AND MIDDLE CAMBRIAN
- 17 *Sandstone, conglomerate, shale.*

PRECAMBRIAN
MIDDLE TO LATE PRECAMBRIAN
CARBONATITE-ALKALIC COMPLEXES[b]
- 16 *Carbonatite, nepheline and alkalic syenites, fenite and associated mafic and ultramafic rocks.*

LATE MAFIC IGNEOUS ROCKS[c]
- 15 *Diabase, gabbro, diorite, ultramafic rocks and granophyre.*

LATE FELSIC IGNEOUS ROCKS[d]
- 14 *Granodiorite, trondhjemite, quartz monzonite, granite, syenite, quartz porphyry, pegmatite, aplite, derived gniesses and migmatites.*
- 14A *Anorthosite suite rocks; anorthosite, gabbroic anorthosite, tonalite, monzonitic and syenitic rocks, quartz monzonite, minor gabbro, ultramafic rocks and derived gniesses.*

GRENVILLE PROVINCE
MIDDLE TO LATE PRECAMBRIAN
EARLY MAFIC AND ULTRAMAFIC IGNEOUS ROCKS
- 13 *Diorite, gabbro, peridotite, pyroxenite, anorthosite, and derived metamorphic rocks.*

METASEDIMENTS[ef]
CARBONATE METASEDIMENTS
- 12 *Marble, calc-silicate rocks, skarn.*

CLASTIC METASEDIMENTS
- 11 *Conglomerate, greywacke, orthoquartzite, arkose, siltstone, chert, minor iron formation and metavolcanics.*

METAVOLCANICS[f]
MAFIC TO FELSIC METAVOLCANICS
- 10 *Flows, tuff, breccia, minor iron formation and metasediments.*

SUPERIOR AND SOUTHERN PROVINCES
LATE PRECAMBRIAN
KEWEENAWAN
SEDIMENTARY AND VOLCANIC ROCKS[g]
- 9 *Conglomerate, greywacke, arkose, ornate rocks, tuff, basalt and rhyolite flows, quartz porphyry.*

MIDDLE PRECAMBRIAN
ANIMIKIE[h]
- 8 *Greywacke, shale, argillite, iron formation, limestone.*

HURONIAN
COBALT GROUP[j]
- 7 *Conglomerate, greywacke, orthoquartzite, siltstone, argillite.*

ELLIOT LAKE, HOUGH LAKE AND QUIRKE LAKE GROUPS[k]
- 6 *Conglomerate, greywacke, arkose, orthoquartzite, argillite, limestone, dolomite, basalt, rhyolite.*

EARLY PRECAMBRIAN
EARLY FELSIC IGNEOUS AND METAMORPHIC ROCKS[d]
- 5 *Granodiorite, trondhjemite, quartz diorite, quartz monzonite, granite, syenite, quartz and feldspar porphyries, pegmatite, aplite, undifferentiated migmatite; SM predominately migmatitic metasediments and minor metavolcanics.*

KAPUSKASING GRANULITE COMPLEX
- *Granulite facies metasediments, metavolcanics and granite.*

EARLY MAFIC AND ULTRAMAFIC IGNEOUS ROCKS[mq]
- 4 *Diorite, gabbro, norite, pyroxenite, peridotite, dunite, serpentinite.*

METASEDIMENTS[n]
- 3 *Conglomerate, greywacke, arkose, orthoquartzite, argillite, slate, marble, chert, iron formation, minor volcanics and related migmatites.*

METAVOLCANICS
FELSIC TO INTERMEDIATE METAVOLCANICS[p]
- 2 *Rhyolite, rhyodacite and dacite (flows, tuffs, and breccias), chert, iron formation, minor metasediments and intrusive rocks, and related migmatites.*

MAFIC METAVOLCANICS[pq]
- 1 *Basalt, andesite (flows, tuffs and breccias), chert, iron formation, minor metasediments and intrusive rocks, and related migmatites.*

a A few small intrusive bodies of this age have been identified by radiometric age dating methods.
b May be in part post-Precambrian.
c A generalized distribution of diabase dikes is shown.
d Formerly classified as Algoman and/or Laurentian.
e Formerly classified as Grenville and/or Hastings Series.
f Rocks in these groups are subdivided lithologically and the order does not necessarily imply age relationship within or among groups.
g Includes Osler and Sibley Groups.
h Includes Gunflint and Rove Formations, and the formations of the Whitewater Group. The Whitewater Group formations in the Sudbury area may be of Archean age.
j Includes Gowganda, Lorrain, Gordon Lake, Bar River Formations.
k These three groups collectively were formerly classified as Bruce Group. Included in these groups are the Matinenda, McKim, Ramsay Lake, Pecors, Mississagi, Bruce, Espanola, Serpent, Aweres Formations. Some of the rock units along the north shore of Lake Huron may be of Archean age.
m Formerly classified as Haileyburian.
n Formerly classified as Timiskaming, Windigokan, Seine, Steeprock, Keewatin, Linklater, Marshall Lake, Manitou, Couchiching.
p Formerly classified as Keewatin, Windigokan.
q Komatiitic and ultramafic volcanic flows have been included with these rocks in some localities.
r Middle Jurassic rocks are known to underlie the Lower Cretaceous rocks in the northern part of the Cretaceous basin.