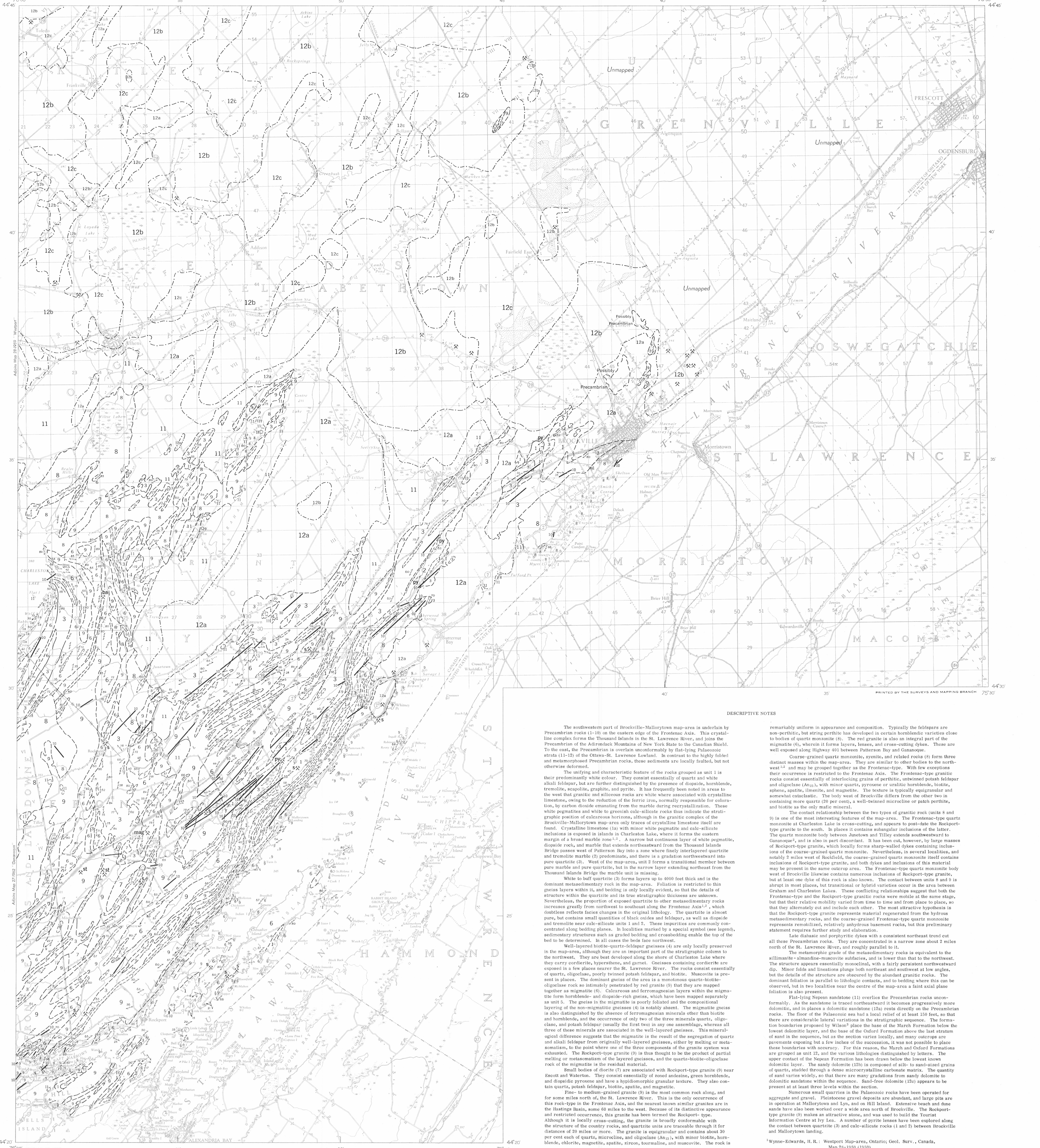
GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PRELIMINARY SERIES

SHEETS $31\frac{B}{12}$ AND $31\frac{B}{5}$ (PART OF)



PUBLISHED, 1963
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LEGEND

PALAEOZOIC

ORDOVICIAN

LOWER ORDOVICIAN (BEEKMANTOWN)

12	MARCH AND OXFORD FORMATIONS: 12a, calcareous and dolomitic sandstone, minor dolomite; 12b, sandy, blue-grey dolomite; 12c, fine-grained blue-grey dolomite and dolomitic limestone

CAMBRIAN OR ORDOVICIAN

11	NEPEAN FORMATION: sandstone, minor conglomerate

PRECAMBRIAN

10	Diabase and andesite dykes
9	Fine- to medium-grained, leucocratic red granite (Rockport type)
8	Coarse-grained, massive, leucocratic, pink to brownish grey monzonite, syenite, quartz monzonite, granodiorite, and syenodiorite (Frontenac type)
7	Diorite
6	Migmatite: poorly foliated intermixed granitic rocks (9) and metamorphic gneisses (4,5)
5	Well-foliated hornblende-plagioclase gneiss, minor diopside gneiss
4	Well-layered biotite-quartz-feldspar gneiss, locally containing cordierite, garnet, hypersthene, or sillimanite
3	White homogeneous quartzite
2	Interlayered quartzite-marble transition rock, generally finely laminated and associated with calc-silicates and white pegmatite (1)
1	Associated white pegmatite and calc-silicate rocks, minor marble, graphitic rusty gneiss, and white granite; 1a, crystalline limestone (marble)

Geological boundary (defined, approximate, transitional)
Foliation (parallel to bedding), horizontal, inclined, vertical
Bedding, tops known
Lineation (direction and plunge; may be combined with other symbols)
Minor fold, plunge of fold axis
Lineament (from air photographs)
Mineralized zone (pyrite) . . . py
Glacial striae
Sand and gravel
Quarry or mineral prospect

MINERALS

Barite . . . ba
Stone . . . st
Pyrite . . . py
Sand, gravel . . . s
Magnetite . . . mag

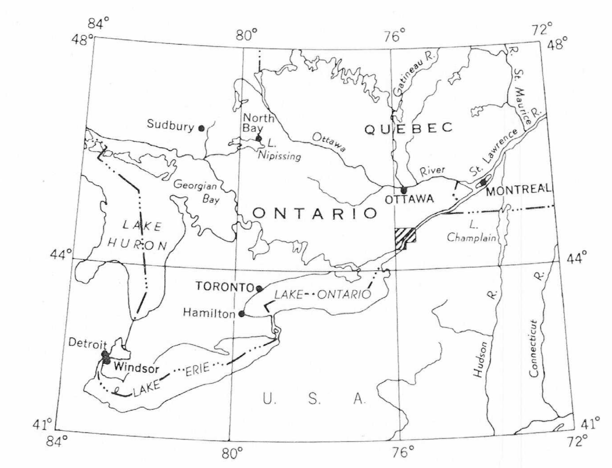
Geology by H. R. Wynne-Edwards, 1962

Cartography by the Geological Survey of Canada, 1963

Road, all weather
Other roads
Trail
Railway
Telephone line
Buildings
Post office
Lighthouse
Horizontal control point
International boundary
County boundary
Township boundary
Marsh
Height in feet above mean sea-level . . . 354

Base-map by the Army Survey Establishment, Department of National Defence

Approximate magnetic declination, 12° 25' West, decreasing 0.3' annually



INDEX MAP

DESCRIPTIVE NOTES

The southwestern part of Brockville-Mallorytown map-area is underlain by Precambrian rocks (1-10) on the eastern edge of the Frontenac Axis. This crystalline complex forms the Thousand Islands in the St. Lawrence River, and joins the Precambrian of the Adirondack Mountains of New York State to the Canadian Shield. To the east, the Precambrian is overlain unconformably by flat-lying Palaeozoic strata (11-12) of the Ottawa-St. Lawrence Lowland. In contrast to the highly folded and metamorphosed Precambrian rocks, these sediments are locally faulted, but not otherwise deformed.

The unifying and characteristic feature of the rocks grouped as unit 1 is their predominantly white colour. They consist essentially of quartz and white alkali feldspar, but are further distinguished by the presence of diopside, hornblende, tremolite, scapolite, graphite, and pyrite. It has frequently been noted in areas to the west that granitic and siliceous rocks are white where associated with crystalline limestone, owing to the reduction of the ferric iron, normally responsible for coloration, by carbon dioxide emanating from the marble during recrystallization. These white pegmatites and white to greenish calc-silicate rocks thus indicate the stratigraphic position of calcareous horizons, although in the granitic complex of the Brockville-Mallorytown map-area only traces of crystalline limestone itself are found. Crystalline limestone (1a) with minor white pegmatite and calc-silicate inclusions is exposed in islands in Charleston Lake, where it forms the eastern margin of a broad marble zone[1,2]. A narrow but continuous layer of white pegmatite, diopside rock, and marble that extends northeastward from the Thousand Islands Bridge passes west of Patterson Bay into a zone where finely interlayered quartzite and tremolite marble (2) predominate, and there is a gradation northwestward into pure quartzite (3). West of the map-area, unit 2 forms a transitional member between pure marble and pure quartzite, but in the narrow layer extending northeast from the Thousand Islands Bridge the marble unit is missing.

White to buff quartzite (3) forms layers up to 4000 feet thick and is the dominant metasedimentary rock in the map-area. Foliation is restricted to thin gneiss layers within it, and bedding is only locally evident, so that the details of structure within the quartzite and its true stratigraphic thickness are unknown. Nevertheless, the proportion of exposed quartzite to other metasedimentary rocks increases greatly from northwest to southeast along the Frontenac Axis[1,2], which doubtless reflects facies changes in the original lithology. The quartzite is almost pure, but contains small quantities of black oxides and feldspar, as well as diopside and tremolite near calc-silicate units 1 and 2. These impurities are commonly concentrated along bedding planes. In localities marked by a special symbol (see legend), sedimentary structures such as graded bedding and crossbedding enable the top of the bed to be determined. In all cases the beds face northwest.

Well-layered biotite-quartz-feldspar gneisses (4) are only locally preserved in the map-area, although they are an important part of the stratigraphic column to the northwest. They are best developed along the shore of Charleston Lake where they carry cordierite, hypersthene, and garnet. Gneisses containing cordierite are exposed in a few places nearer the St. Lawrence River. The rocks consist essentially of quartz, oligoclase, poorly twinned potash feldspar, and biotite. Muscovite is present in places. The dominant gneiss of the area is a monotonous quartz-biotite-oligoclase rock so intimately penetrated by red granite (9) that they are mapped together as migmatite (6). Calcareous and ferromagnesian layers within the migmatite form hornblende- and diopside-rich gneiss, which have been mapped separately as unit 5. The gneiss in the migmatite is poorly foliated and the compositional layering of the non-migmatitic gneisses (4) is notably absent. The migmatite gneiss is also distinguished by the absence of ferromagnesian minerals other than biotite and hornblende, and the occurrence of only two of the three minerals quartz, oligoclase, and potash feldspar (usually the first two) in any one assemblage, whereas all three of these minerals are associated in the well-layered gneisses. This mineralogical difference suggests that the migmatite is the result of the segregation of quartz and alkali feldspar from originally well-layered gneisses, either by melting or metasomatism, to the point where one of the three components of the granite system was exhausted. The Rockport-type granite (9) is thus thought to be the product of partial melting or metasomatism of the layered gneisses, and the quartz-biotite-oligoclase rock of the migmatite is the residual material.

Small bodies of diorite (7) are associated with Rockport-type granite (9) near Escott and Waterton. They consist essentially of zoned andesine, green hornblende, and diopsidic pyroxene and have a hypidiomorphic granular texture. They also contain quartz, potash feldspar, biotite, apatite, and magnetite.

Fine- to medium-grained granite (9) is the most common rock along, and for some miles north of, the St. Lawrence River. This is the only occurrence of this rock-type in the Frontenac Axis, and the nearest known similar granites are in the Hastings Basin, some 60 miles to the west. Because of its distinctive appearance and restricted occurrence, this granite has been termed the Rockport- type. Although it is locally cross-cutting, the granite is broadly conformable with the structure of the country rocks, and quartzite units are traceable through it for distances of 20 miles or more. The granite is equigranular and contains about 30 per cent each of quartz, microcline, and oligoclase (An_{15}), with minor biotite, hornblende, chlorite, magnetite, apatite, zircon, tourmaline, and muscovite. The rock is remarkably uniform in appearance and composition. Typically the feldspars are non-perthitic, but string perthite has developed in certain hornblendic varieties close to bodies of quartz monzonite (8). The red granite is also an integral part of the migmatite (6), wherein it forms layers, lenses, and cross-cutting dykes. These are well exposed along Highway 401 between Patterson Bay and Gananoque.

Coarse-grained quartz monzonite, syenite, and related rocks (8) form three distinct masses within the map-area. They are similar to other bodies to the northwest[1,2] and may be grouped together as the Frontenac-type. With few exceptions their occurrence is restricted to the Frontenac Axis. The Frontenac-type granitic rocks consist essentially of interlocking grains of perthitic, untwinned potash feldspar and oligoclase (An_{25}), with minor quartz, pyroxene or uralitic hornblende, biotite, sphene, apatite, ilmenite, and magnetite. The texture is typically equigranular and somewhat cataclastic. The body west of Brockville differs from the other two in containing more quartz (20 per cent), a well-twinned microcline or patch perthite, and biotite as the only mafic mineral.

The contact relationship between the two types of granitic rock (units 8 and 9) is one of the most interesting features of the map-area. The Frontenac-type quartz monzonite at Charleston Lake is cross-cutting, and appears to post-date the Rockport-type granite to the south. In places it contains subangular inclusions of the latter. The quartz monzonite body between Junetown and Tilley extends southwestward to Gananoque[2], and is also in part discordant. It has been cut, however, by large masses of Rockport-type granite, which locally forms sharp-walled dykes containing inclusions of the coarse-grained quartz monzonite. Nevertheless, in several localities, and notably 2 miles west of Rockfield, the coarse-grained quartz monzonite itself contains inclusions of Rockport-type granite, and both dykes and inclusions of this material may be present in the same outcrop area. The Frontenac-type quartz monzonite body west of Brockville likewise contains numerous inclusions of Rockport-type granite, but at least one dyke of this rock is also known. The contact between units 8 and 9 is abrupt in most places, but transitional or hybrid varieties occur in the area between Graham and Charleston Lakes. These conflicting relationships suggest that both the Frontenac-type and the Rockport-type granitic rocks were mobile at the same stage, but that their relative mobility varied from time to time and from place to place, so that they alternately cut and include each other. The most attractive hypothesis is that the Rockport-type granite represents material regenerated from the hydrous metasedimentary rocks, and the coarse-grained Frontenac-type quartz monzonite represents remobilized, relatively anhydrous basement rocks, but this preliminary statement requires further study and elaboration.

Late diabasic and porphyritic dykes with a consistent northeast trend cut all these Precambrian rocks. They are concentrated in a narrow zone about 2 miles north of the St. Lawrence River, and roughly parallel to it.

The metamorphic grade of the metasedimentary rocks is equivalent to the sillimanite - almandine-muscovite subfacies, and is lower than that to the northwest. The structure appears essentially monoclinal, with a fairly persistent northwestward dip. Minor folds and lineations plunge both northeast and southwest at low angles, but the details of the structure are obscured by the abundant granitic rocks. The dominant foliation is parallel to lithologic contacts, and to bedding where this can be observed, but in two localities near the centre of the map-area a faint axial plane foliation is also present.

Flat-lying Nepean sandstone (11) overlies the Precambrian rocks unconformably. As the sandstone is traced northeastward it becomes progressively more dolomitic, and in places a dolomitic sandstone (12a) rests directly on the Precambrian rocks. The floor of the Palaeozoic sea had a local relief of at least 150 feet, so that there are considerable lateral variations in the stratigraphic sequence. The formation boundaries proposed by Wilson[3] place the base of the March Formation below the lowest dolomitic layer, and the base of the Oxford Formation above the last stratum of sand in the sequence, but as the section varies locally, and many outcrops are pavements exposing but a few inches of the succession, it was not possible to place these boundaries with accuracy. For this reason, the March and Oxford Formations are grouped as unit 12, and the various lithologies distinguished by letters. The upper contact of the Nepean Formation has been drawn below the lowest known dolomitic layer. The sandy dolomite (12b) is composed of silt- to sand-sized grains of quartz, studded through a dense microcrystalline carbonate matrix. The quantity of sand varies widely, so that there are many gradations from sandy dolomite to dolomitic sandstone within the sequence. Sand-free dolomite (12c) appears to be present at at least three levels within the section.

Numerous small quarries in the Palaeozoic rocks have been operated for aggregate and gravel. Pleistocene gravel deposits are abundant, and large pits are in operation at Mallorytown and Lyn, and on Hill Island. Extensive beach and dune sands have also been worked over a wide area north of Brockville. The Rockport-type granite (9) makes an attractive stone, and was used to build the Tourist Information Centre at Ivy Lea. A number of pyrite lenses have been explored along the contact between quartzite (3) and calc-silicate rocks (1 and 2) between Brockville and Mallorytown landing.

[1] Wynne-Edwards, H. R.: Westport Map-area, Ontario; Geol. Surv., Canada, Map 28-1959 (1959).
[2] ______ Gananoque Map-area, Ontario; Geol. Surv., Canada, Map 27-1962 (1962).
[3] Wilson, A. E.: Geology of the Ottawa-St. Lawrence Lowland, Ontario and Quebec; Geol. Surv., Canada, Mem. 241 (1946).

MAP 7-1963
GEOLOGY
BROCKVILLE-MALLORYTOWN AREA
ONTARIO

Scale: One Inch to One Mile = $\frac{1}{63,360}$

Miles

MAP 7-1963
BROCKVILLE-MALLORYTOWN AREA
ONTARIO

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