



GEOLOGICAL SURVEY OF CANADA  
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

ORDOVICIAN  
MIDDLE ORDOVICIAN (BLACK RIVER)  
16 GULL RIVER FORMATION: Pamela beds, light grey to white, microcrystalline to cryptocrystalline dolomitic limestone and limestone; 16a, Riddau beds below Pamela beds: green shale and sandstone, minor conglomerate and fragmental layers; 16b, Lovellville beds (above Pamela): grey brown, well bedded, fossiliferous limestone

PRE-CAMBRIAN  
LOWER ORDOVICIAN OR CAMBRIAN  
15 POTSDAM OR NEPEAN FORMATION: sandstone, some conglomerate

14 Porphyritic and amygdaloid andesite dykes

13 Diabase dykes

12 Coarse-grained, massive, leucocratic, pink to brownish grey monzonite, syenite, quartz monzonite, granodiorite, and syenodiorite

11 Medium-grained, leucocratic red granite

10 White pegmatite, everywhere associated with marble or lime-silicate rocks; 10a, white granite; 10b, white diorite

9 Gabbro

8 Migmatite: poorly foliated intermixed granitic and metamorphic rocks

7 Pyroxene granulite: fine-grained, leucocratic, generally massive rocks, rich in quartz and feldspar and containing minor diopside

6 Pyroxene gneiss: well-foliated diopside-rich gneiss, minor amphibolite

5 Stratiform biotite-quartz-feldspar gneiss with granitic layers, generally contains hypersthene, cordierite, or sillimanite

4 Well-layered garnet-biotite-quartz-feldspar gneiss, containing hypersthene, cordierite, or sillimanite

3 White homogeneous quartzite

2 Interlayered quartzite-marble transition rock, generally finely laminated and associated with lime-silicates

1 Crystalline limestone (marble), siliceous crystalline limestone and skarn, includes fragments of white pegmatite (10); 1a, rusty-weathering, quartz-diopside-feldspar gneiss

Geological boundary (defined, assumed) . . . . .

Stratiform foliation (parallel to bedding) . . . . .

Lineation (inclined, vertical, dip unindicated) . . . . .

Gneissosity (inclined, vertical, dip unindicated) . . . . .

Lineation (inclined, may be combined with other symbols) . . . . .

Mylonite lamination (inclined, vertical) . . . . .

Minor fold (arrow indicates plunge) . . . . .

Lineament (from air photographs) . . . . .

Fault (defined) . . . . .

Mylonite zone (width indicated) . . . . .

Anticline . . . . .

Glacial gravel . . . . .

Sand and silt . . . . .

Quarry or mineral pit . . . . .

MINERALS  
Galenite . . . . . gn  
Silica . . . . . sc  
Mica . . . . . mi  
Sphalerite . . . . . sp  
Pyrite . . . . . py  
Stone . . . . . st  
Quartz crystals . . . . . q  
Sand . . . . . s

Geology by H. R. Wynne-Edwards, 1961

Cartography by the Geological Survey of Canada, 1962

Main highway . . . . .

Other roads . . . . .

Trail . . . . .

Railway . . . . .

International boundary . . . . .

County boundary . . . . .

Telephone line . . . . .

Post Office . . . . .

Cliff . . . . .

Marsh . . . . .

Height in feet above mean sea-level . . . . .

Base-map by the Army Survey Establishment, R. C. E., Department of National Defence.

Approximate magnetic declination, 12° 03' West, decreasing 0.2' annually



PRELIMINARY SERIES



DESCRIPTIVE NOTES

The map-area lies astride the Frontenac Axis, a narrow neck of Precambrian rocks (1-14) connecting the Canadian Shield to the Adirondack Mountains of New York State, and separating Palaeozoic strata of the Ottawa - St. Lawrence Lowland to the northwest from similar strata to the southeast (15-16).

Units 1-7 are metamorphosed sedimentary rocks typical of large parts of the Grenville province. Crystalline limestone (1) is dominantly coarse-grained marble containing small amounts of diopside, serpentine, quartz, feldspar, scapolite, apatite, and tourmaline. Small masses of white pegmatite and diopside skarn, as well as contorted and broken layers of pyrite, rusty-weathering, quartz-diopside feldspar gneiss (1a), are distributed throughout the marble and are included in this unit. North of Ganoque Lake, and west of Ganoque, the marble becomes highly serpenitinous and siliceous, marking a gradual transition from marble to quartzite. These transitional rocks are mapped as unit 2. Where best developed, this unit consists of thin, alternating layers of marble, quartzite, and calc-silicate, but large masses of each of these, as well as white pegmatite, are present. The white pegmatite (10) west of Ganoque and just south of Highway 401 is a part of this unit where feldspathic rocks predominate.

Quartzite (3) is a hard, white, massive rock, which forms prominent ridges. In many places it displays undisturbed bedding marked by disseminated magnetite and specularite. Units 4 and 5 are layered gneisses that consist predominantly of quartz, oligoclase, microcline perthite, and biotite. Layers containing garnet form persistent marker horizons and have been mapped separately (4a, cordierite, hypersthene, sillimanite, magnetite, and green spongy rock are common in these rocks, typically forming small, elliptical lenses or pods about an inch long. Pyroxene gneiss (6) is a foliated green rock consisting essentially of quartz, diopside, and oligoclase, with minor sphene, and scapolite, perthite, and grossularite in some varieties. The granulite of unit 7 is similar in mineralogy to unit 8, but is more leucocratic, finer grained, and other massive or only poorly layered. Migmatite (8) forms an envelope of varying thickness around large bodies of syenite and granite, and consists of units 5, 6, and 7 intermixed with granitic rocks.

The gabbro (9) around Horsehoe and Traverser Lakes is a brown to black-weathering rock consisting mainly of undifferentiated pyroxene and biotite. That northwest of South Lake is less altered, contains less biotite, and generally displays ophitic texture. The small associated mass south of Scoble's Bay has a fine-grained margin, presumably the result of rapid cooling, and the presence of wollastonite in the marble nearby may be a contact-metamorphic effect. The gabbro grades into syenite (12), and their relative ages were not established with certainty. Both are cut by quartz-perthite-tourmaline dykelets, and by diabase (13).

White pegmatite (10) and granite (10a) occur within marble (1) and have the same composition as the pink granitic material in the gneisses. Their white colour is due to the reduction of ferric iron, normally responsible for the pink colour of the feldspars, by carbon dioxide emanating from marble, so that these white rocks are an undulating indicator of the presence of marble, and units 1 and 10 may be grouped together for stratigraphic correlation purposes. The white pegmatite and white granite bodies are generally small in size, and contain the mafic minerals present in the adjacent crystalline limestone. White diorite (10b) contains olive-green hornblende and amphibole, zoned andesine feldspar.

The medium-grained granite of unit 11 is uniform in appearance and composition over wide areas. Grey, yellowish, and white phases are locally developed, but otherwise the rock is an attractive rose red. The granite is potash-rich and consists of an equigranular mosaic of quartz, microcline, albite, and biotite. Perthite is not developed.

Coarse-grained syenitic and related rocks (12) occur in four large bodies. Of these, the syenite south of Perth Road village, the syenite that extends from Kingston Mills northeast to South Lake, and the syenite that extends from Ganoque to the east edge of the map-area, are similar in composition and appearance. Each of these is characterized by a pink, leucocratic outer rim, and a dark grey, more dioritic core. The rocks consist essentially of an inequigranular interlocking mosaic of perthite and oligoclase. Quartz is locally present in amounts up to 15 per cent. The varietal minerals typically include biotite, clinopyroxene altered to hornblende or to a chlorite-carbonate intergrowth, sphene, magnetite, apatite, and zircon. The similar mass north of Battersea village differs from the others in containing 20 to 40 per cent quartz. At two localities east of the map-area the syenite contains inclusions of fine-grained granitic lithologically identical with unit 11, which indicates that the coarse-grained syenite of unit 12 is the younger rock.

Late diabase dykes (13) cut all these Precambrian rocks. With few exceptions, they trend north-northeast, and are concentrated in a swarm between Ganoque and South Lake. They are believed to occur mainly in fractures along the culmination of the Frontenac Axis. Younger fine-grained andesite dykes (14), in many places containing large phenocrysts of andesine, are chilled against diabase and have a consistent northeast trend, and are not found on the west side of the Axis.

Pure quartz sandstone (15) unconformably overlies the Precambrian rocks (1-14) on an erosion surface similar in topography to that of the present day. The deep weathering of this ancient landscape is preserved in many places beneath the sandstone. Numerous outcrops show that the sandstone once covered the Frontenac Axis. Conglomerate lenses are locally present at the base of the formation, which is otherwise a white to red silica sandstone composed of well-rounded quartz grains cemented by hematite, quartz, or calcite. Sandstone of this lithology underlies a large area in northern New York State and southern Ontario, on both sides of the Frontenac Axis. It was termed 'Potsdam' in St. Lawrence County, New York in 1828, and this name was later applied over its whole extent, the formation being assigned to the Upper Cambrian. East of the Frontenac Axis in Ontario, where the sandstone is overlain conformably by sandy dolomite of the Bookmans and thus may be Lower Ordovician in age, it was redefined as the Nepean by Wilson.

Limestone of Black River age (Gull River Formation of Okolitch<sup>1</sup>) (16) directly overlies both the Potsdam Sandstone and the Precambrian rocks in Ganoque map-area on the west side of the Axis, showing that the relationship between the two sedimentary units (15, 16) is disconformable. Occurring at the base of the limestone where it overlies Precambrian rocks, is a conformable green clastic unit, designated the Riddau beds (16a) by Kindel<sup>2</sup>, with its type locality in the railway cut at Kingston Mills. Its maximum known thickness is 30 feet. On the south shore of Loughborough Lake, a mile east of Battersea, these beds rest on Potsdam Sandstone, but this is the only locality where this was observed. Apart from a capping of brownish limestone (Lovellville beds, 16b) just north of Kingston, the rest of the Ordovician strata in the map-area consists of the Pamela beds (16), with a total thickness of approximately 110 feet. These are the thickly bedded, dove-grey dolomitic limestones used in many of the older buildings in Kingston.

The structure of the Precambrian rocks is similar to that in Westport map-area immediately to the north<sup>3</sup>, except that the plunge of the fold axis is shallow and changes in short distances from southwest to northeast. Northwest of the crest of the Frontenac Axis, in Westport map-area, the folds plunge north-east at an average of 35 degrees. In Ganoque map-area, on the crest of the Axis or southwest of it, the folds most commonly plunge gently southwest. This difference must be due to the uplift of the Frontenac Axis itself.

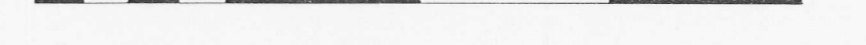
Apart from the rocks in the northwestern corner of the area, which are in true granulite facies, the grade of metamorphism of units 1-7 is probably intermediate between amphibolite and granulite facies, but does not fit into the present metamorphic facies classification. It is characterized especially by abundant cordierite, the assemblage cordierite + garnet, the predominance of diopside over hornblende, and the local appearance of hypersthene in the gneisses. Similar rocks are found in Westport map-area<sup>4</sup>.

Numerous sand and gravel pits are in operation, as are quarries for crushed limestone aggregate in the Ordovician rocks (16). These rocks, as well as granite (11), syenite (12), and sandstone (15) have all been quarried for building and paving-stone in the past, but the only dimension stone being produced at present is striped sandstone from quarries east of Joyceville. The Potsdam Sandstone is also a potential source of silica sand. No other economic deposits were being worked in 1961.

<sup>1</sup>Wilson, A. E.: Geology of the Ottawa - St. Lawrence Lowland, Ontario, and Quebec, Geol. Surv., Canada, Mem. 241 (1946).  
<sup>2</sup>Okolitch, V. J.: The Ordovician Section at Coblenk, Ontario; Trans. Roy. Can. Inst., No. 48, pt. 2, pp. 319-339 (1939).  
<sup>3</sup>Baker, M. B.: The Geology of Kingston and Vicinity, Appendix 1: "The Ordovician Limestones of the Kingston Area" by E. M. Kindel; Ont. Bur. Mines Ann. Rept., vol. 75, pt. 3 (1916).  
<sup>4</sup>Wynne-Edwards, H. R.: Westport Map-area, Ontario; Geol. Surv., Canada, Map 28-1959, with descriptive notes (1959).

MAP 27-1962  
GEOLOGY  
GANOQUE  
ONTARIO

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



MAP 27-1962  
GANOQUE  
ONTARIO

31° 8'

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