GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

LEGEND

NOTE: Areas of outcrops are shown by deep colour; inferred extensions are shown by a lighter tint of the same colour.

PALAEOZOIC

ORDOVICIAN

MIDDLE ORDOVICIAN

18 — *OTTAWA FORMATION: sandy shale, fine-grained grey limestone, sandy limestone*

LOWER ORDOVICIAN

17 — *OXFORD AND MARCH FORMATIONS: dolomite and limestone, sandy dolomite*

LOWER ORDOVICIAN OR CAMBRIAN

16 — *NEPEAN FORMATION: sandstone and conglomerate;* **16a**, *arkose and conglomeratic arkose*

PRECAMBRIAN

15 — *Diabase;* **15a**, *porphyritic andesite*

14 — *Red pegmatite*

13 — *Coarse grained leucocratic red monzonite, syenite, quartz monzonite, granodiorite;* **13a**, *Rideau Lakes monzonite pluton;* **13b**, *Lyndhurst quartz monzonite pluton;* **13c**, *Crow Lake quartz monzonite pluton*

12 — *White pegmatite, always associated with crystalline limestone (1);* **12a**, *white leucocratic granite and syenite*

11 — *Poorly foliated migmatite and intermixed granitic and metamorphic rocks, associated fine-grained biotite schist*

10 — *Diorite, quartz diorite;* **10a**, *Donaldson Bay quartz diorite*

9 — *Gabbro, gabbroic anorthosite*

8 — *Fine-to medium-grained, massive, quartzo-feldspathic granulite, granite in part*

GRENVILLE METAMORPHIC SERIES
(NOT IN STRATIGRAPHIC SEQUENCE)

7 — *Pyroxene gneiss, pyroxene-biotite gneiss;* **7a**, *amphibolite*

6 — *Stratiform quartz-biotite-feldspar gneiss, commonly with cordierite and sillimanite;* **6a**, *granitic and charnockitic quartz-feldspar gneiss*

5 — *Garnet-sillimanite gneiss, garnet-hypersthene gneiss, garnet-cordierite gneiss, garnet lit-par-lit gneiss*

4 — *White to buff quartzite*

3 — *Interlayered quartzite and siliceous crystalline limestone, usually finely laminated; calc-silicate rocks*

2 — *Rusty paragneiss; contains quartz, pyroxene, phlogopite, graphite and pyrite*

1 — *Crystalline limestone and dolomite, siliceous limestone, skarn; includes fragments of white pegmatite (12), rusty gneiss (2) and diorite (10)*

Sand and gravel
Small outcrop
Bedding, tops known (inclined, overturned)
Bedding, tops unknown (inclined, vertical)
Stratiform foliation (horizontal, inclined, vertical, dip unknown)
Gneissosity (inclined, vertical)
Lineation (horizontal, inclined, vertical)
Minor fold (arrow indicates plunge)
Lineament (from air photographs)
Fault (defined, assumed; solid circle indicates downthrow side)
Zone of cataclasis (width indicated)
Mylonite (dip of laminae; known, unknown)
Anticline (defined)
Syncline (defined)
Fossil locality
Glacial striae (direction of ice movement known)
Quarry or mineral pit

MINERALS

Apatite	ap	*Magnetite*	mag
Barite	ba	*Mica*	mi
Feldspar	fel	*Quartz crystals*	q
Galena	gn	*Radioactive minerals*	ra
Graphite	gf	*Silica*	sc
Hematite	hem		

Palaeozoic geology by M. E. Wilson, 1928, 1929; G. M. Brownell, 1927, 1928

Precambrian geology by H. R. Wynne-Edwards, 1957, 1958

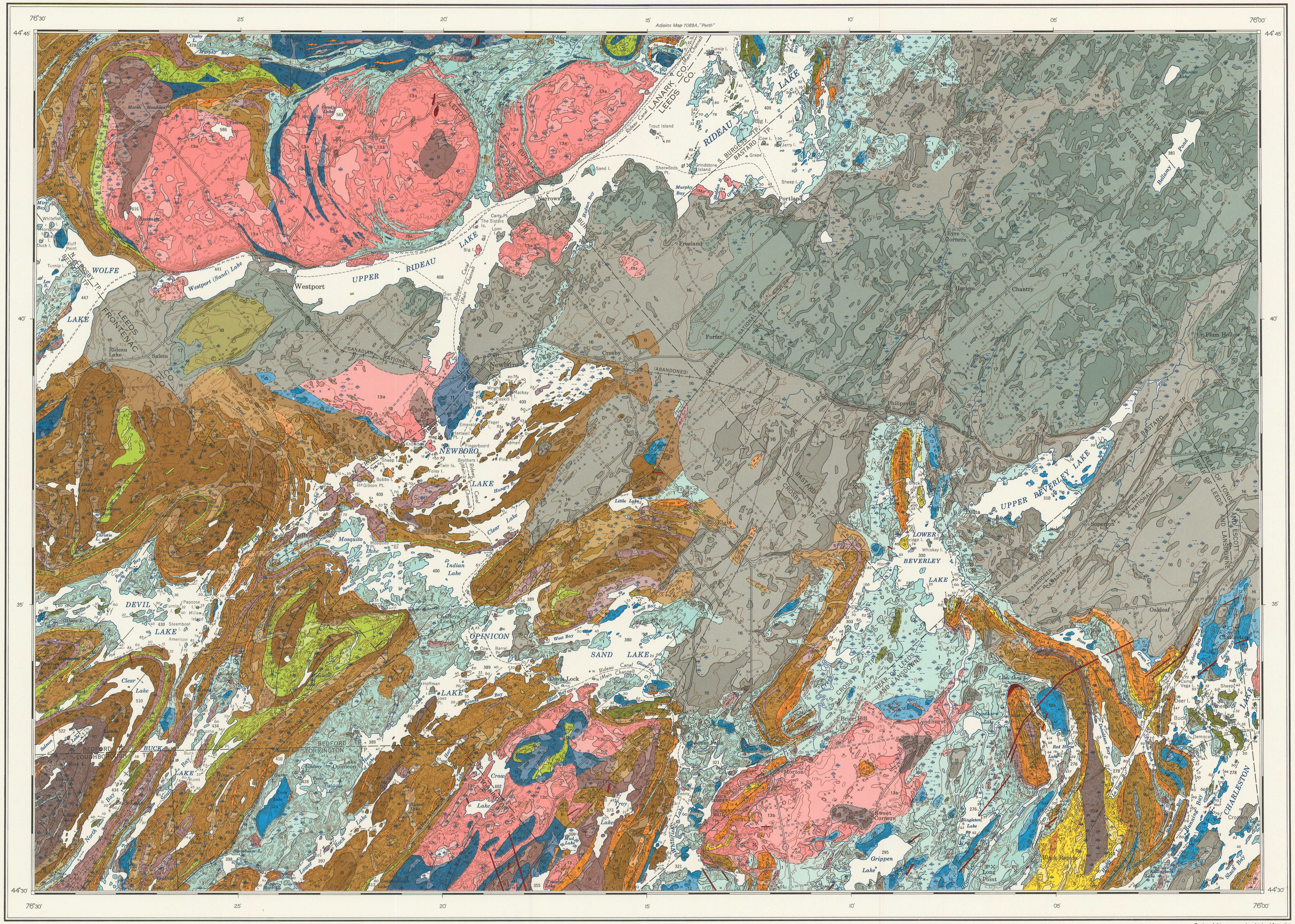
Compiled by H. R. Wynne-Edwards, 1958

To accompany G. S. C. Memoir 346 by H. R. Wynne-Edwards

Geological cartography by the Geological Survey of Canada, 1966

Base-map cartography by the Geological Survey of Canada, 1965 from maps published by the Army Survey Establishment, R. C. E. Department of National Defence, 1953, with revisions by the Geological Survey of Canada, 1965

Approximate magnetic declination, 12°16′ West, decreasing 0·3′ annually.



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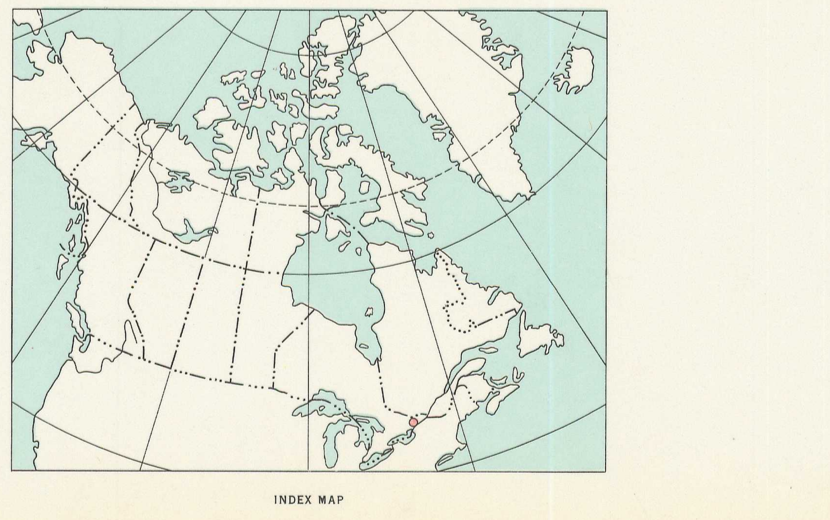
MAP 1182A
GEOLOGY
WESTPORT
ONTARIO

Scale 1:63,360
1 inch to 1 mile

Miles 1 0 1 2 3 Miles
Kilometres 1 0 1 2 3 4 5 Kilometres



INDEX MAP

REFERENCE

Road, all weather — Route 15
Other roads
Trail
Railway
Abandoned railway
County boundary
Township boundary
Power transmission line
Telephone line
Post Office — P
Horizontal control point
Marsh
Intermittent stream
Contours (interval 25 feet) — 4000
Height in feet above mean sea-level — 369

Copies of this map may be obtained from the Director, Geological Survey of Canada, Ottawa
Printed by the Surveys and Mapping Branch

DESCRIPTIVE NOTES

The Palaeozoic rocks in the northeastern part of Westport map-area lie in the Ottawa-St. Lawrence Lowland[1], an area of flat-lying sediments confined to eastern Ontario and northern New York State. The Precambrian rocks form a part of the Frontenac Axis, a narrow neck of the Canadian Shield that connects the Laurentian Plateau with the Adirondack Mountains, and separates the Palaeozoic sedimentary rocks of southern Ontario into two basins, which lie to the east and west. Striae and rock ridges show that the area has been glaciated by ice that moved southwestward, parallel to the prevailing trend of the Precambrian gneisses. The Palaeozoic rocks were more susceptible to erosion and are more deeply drift-covered than the Precambrian gneisses, so that the eastern part of the area is dominantly agricultural and the western part dominantly wooded with large areas of exposed bedrock. Most of the drainage is southward to the St. Lawrence River, but the Rideau Lakes drain northwest to the Ottawa Valley. The two systems are joined at Newboro by the Rideau Canal (Ottawa to Kingston).

Flat-lying Nepean sandstone (16) unconformably overlies a Precambrian erosion surface of low relief, similar to the present erosion surface in the western part of the area. In many places a zone of deep weathering, which formed on the ancient pre-Palaeozoic landscape, is preserved below the sandstone. A quartz pebble conglomerate of varying thickness is commonly present at the base of the Nepean Formation, which is otherwise white, buff, or red pure silica sandstone. A greenish arkose and arkosic conglomerate overlying Precambrian rocks around Rideau Lake is correlated with this formation. The arkosic nature of these sediments is attributed to rapid deposition along the base of a scarp along the Rideau Lake fault. The Nepean sandstone passes upward through sandy dolomite into thick-bedded, grey-or buff-weathering dolomite (March and Oxford Formations, 17). Isolated outcrops of fossiliferous sandy shale and limestone near Westport overlie the Oxford Formation and are correlated with the Ottawa Formation (18). The contact between these rocks and the Oxford Formation is not exposed.

Units 1 to 7 are metamorphic rocks characteristic of a large part of the Grenville province and, apart from pyroxene gneiss (7), which may be in part of metavolcanic origin, consist of metamorphosed sedimentary rocks. Crystalline limestone (1) is a coarse calcite marble with individual grains averaging 3 mm. in diameter. It generally contains less than 10 per cent MgO. Small amounts of graphite, phlogopite, diopside, serpentine, apatite, pyrite, tourmaline, and scapolite are common. Highly contorted and fragmented thin layers of rusty graphitic gneiss (2), as well as numerous blocks of lime-silicates and white pegmatite, were distributed through the crystalline limestone during tectonic flowage. A layering marked by trains of graphite or lime-silicate minerals is the only structure in the limestone, except at the noses of major folds, where bedding is generally preserved.

Pure quartzite (4) is commonest in the southeastern part of the map-area. It is a pure white, vitreous and massive rock, which in places resembles vein quartz. Faint bedding marked by slight accumulations of iron oxide grains is the only structure present. The iron oxide may be concentrated along the base of a bed that grades upward into pure quartzite, and this feature has been used in determining stratigraphic tops. In many places the quartzite is separated from overlying crystalline limestone by a finely laminated zone of interbedded quartzite and limestone (3), which apparently represents a transition between the facies. The dolomitic varieties of this rock contain talc and tremolite.

The Grenville gneisses (5-7) consist of quartz, oligoclase/andesine, fine string perthite, and biotite, with garnet-sillimanite and pyroxene- or hornblende-rich members. Quartz-feldspar-hypersthene gneiss and hypersthene-garnet gneiss are found in the western part of the area and are commonest south of Devil Lake. East of Lake Opinicon, these rocks are not present and cordierite-sillimanite and cordierite-garnet assemblages occur instead. Further study shows that west and northwest of Lake Opinicon the rocks are metamorphosed to granulite facies, and that to the east they are in some part of the amphibolite facies in which cordierite + garnet is a stable assemblage. All the gneisses contain interlayered granite, and are highly granitic in the area of granulite facies.

Diorite (10) and granulite (8) resemble certain phases of the gneisses, but are massive and coarser in grain. Hornblende is the commonest mafic mineral of the diorite. The granulites consist of quartz and oligoclase with lesser amounts of fine string perthite. The gabbros (9) are coarse grained and massive, and contain about 60 per cent andesine as well as pyroxene, biotite, magnetite, and ilmenite. All the gabbros are iron-rich, and considerable concentrations of iron oxide occur in gabbro near Newboro.

The granitic layers and lenses in the gneisses are red or pink, and made up of quartz and fine string microperthite in which either orthoclase or microcline may form the host. Mafic minerals are absent except where porphyroblasts of metamorphic minerals present in the enclosing gneiss have developed. Small bodies of white granite with a similar mineralogy are present in crystalline limestone, which they closely resemble in colour, texture, and appearance. Like the red variety, they may contain large crystals of metamorphic silicates present in the rocks around them. The white granite forms rounded masses ranging from a few inches to hundreds of feet in diameter, the largest with a medium- or fine-grained fabric, the smaller ones with a pegmatitic texture.

Red monzonite and quartz monzonite (13) form large, almost homogeneous plutons. The rock is coarse grained and generally massive, and consists essentially of albite/oligoclase and microcline in equal proportions, commonly intergrown as a coarse patch perthite. Both quartz-rich and quartz-poor plutons are present. Where these bodies are enveloped in siliceous rocks there is a zone of granite intermixed with pre-existing material (11), but they generally occur within thick belts of crystalline limestone.

Foliation in the gneisses is defined by interfaces between layers of different composition and is parallel to, and apparently coincident with, the original bedding planes. Layers between these foliation surfaces are homogeneous and massive. They range in thickness from a fraction of an inch in sillimanite gneisses to many feet in pure quartzite. There is a prominent corrugation or mullion structure on many foliation surfaces, which is commonly accentuated by trains of mineral segregations. This lineation is parallel to the adjacent major and minor fold axes.

Three consecutive stages of deformation are recognized:

1. A stage when all the metamorphic rocks behaved plastically, forming upright similar folds with dominantly northeastward-plunging axes, typified by the structures around Devil Lake. At Bedford Mills the fold axes plunge 50 degrees northeast, but flatten as they are followed southwest, and ultimately plunge southwest near Buck Lake. The gneisses around Crow Lake are also doubly plunging and outline a broad dome, with quartz monzonite (13c) forming the crest.
2. A stage when linear zones of crystalline limestone behaved plastically and moved differentially against more rigid gneiss units. Examples are the crystalline limestones around Lake Opinicon and Lyndhurst. Mylonites were produced in the gneisses along the borders of these zones. The syncline at Morton and the anticlinal buckle at Little Long Lake are interpreted as complimentary drag-folds in the gneisses against the limestone around Lyndhurst. The concordant plutons (13) north of the Rideau Lakes and at Lyndhurst lie in flexures in linear belts of crystalline limestone, and there is evidence that their position is controlled by steeply plunging concentric structures (vortices) formed there by flowage of the limestone at this stage and before the emplacement of the granites[2].
3. A stage of local cataclasis and faulting during which movement was confined to narrow zones of weakness such as those through Morton and Westport. These three stages appear closely related. Palaeozoic sediments are downfaulted against the Precambrian by subsequent movement on the fault through the Rideau Lakes.

Numerous deposits of large apatite and mica crystals were worked 50 to 100 years ago, but little work is in progress at present. These occur at or near the boundary between crystalline limestones and siliceous rocks and are most abundant in the noses of major folds. The mica and apatite are generally found in calcite lenses enclosed in diopside rock, and in some cases they occur in veins crosscutting crystalline limestone and white pegmatite. Associated minerals are pyroxene, sphene, graphite, and calcite. Lenses of crystalline limestone northeast of Westport were worked for graphite about 1920.

Small pockets of hematite south of Delta were mined as early as 1810 and supplied a smelter at Furnace Falls, the present site of Lyndhurst. The ore occurs in Nepean sandstone. Titaniferous iron ore was produced from the Chaffey and Matthews properties one mile west of Newboro from 1858 to 1871. Interest in these deposits was renewed in 1957 and development work is currently underway. The ore occurs as concentrations of titaniferous magnetite and ilmenite in gabbro.

Late calcite veins containing galena and barite occur within the area and those at Long Point were worked for lead at intervals between 1858 and 1875. Quartz crystals in vugs in brecciated Precambrian gneisses near Black Rapids are being explored at present[3].

Both granite and sandstone have been quarried for building stone within the area and the Nepean sandstone has also been investigated as a possible source of glass sand and foundry moulding sand.

[1]Wilson, A. E.: Geology of the Ottawa-St. Lawrence Lowland, Ontario and Quebec; Geol. Surv. Can., Memoir 241 (1946).
[2]Wynne-Edwards, H. R.: The structure of the Westport concordant pluton in the Grenville, Ontario; Jour. Geol., vol. 65, p. 639 (1957).
[3]Harrison, J. M., and Fortier, Y. O.: Occurrences of quartz crystals, Leeds county, southeastern Ontario; Geol. Surv. Can., Paper 44-8 (1944).