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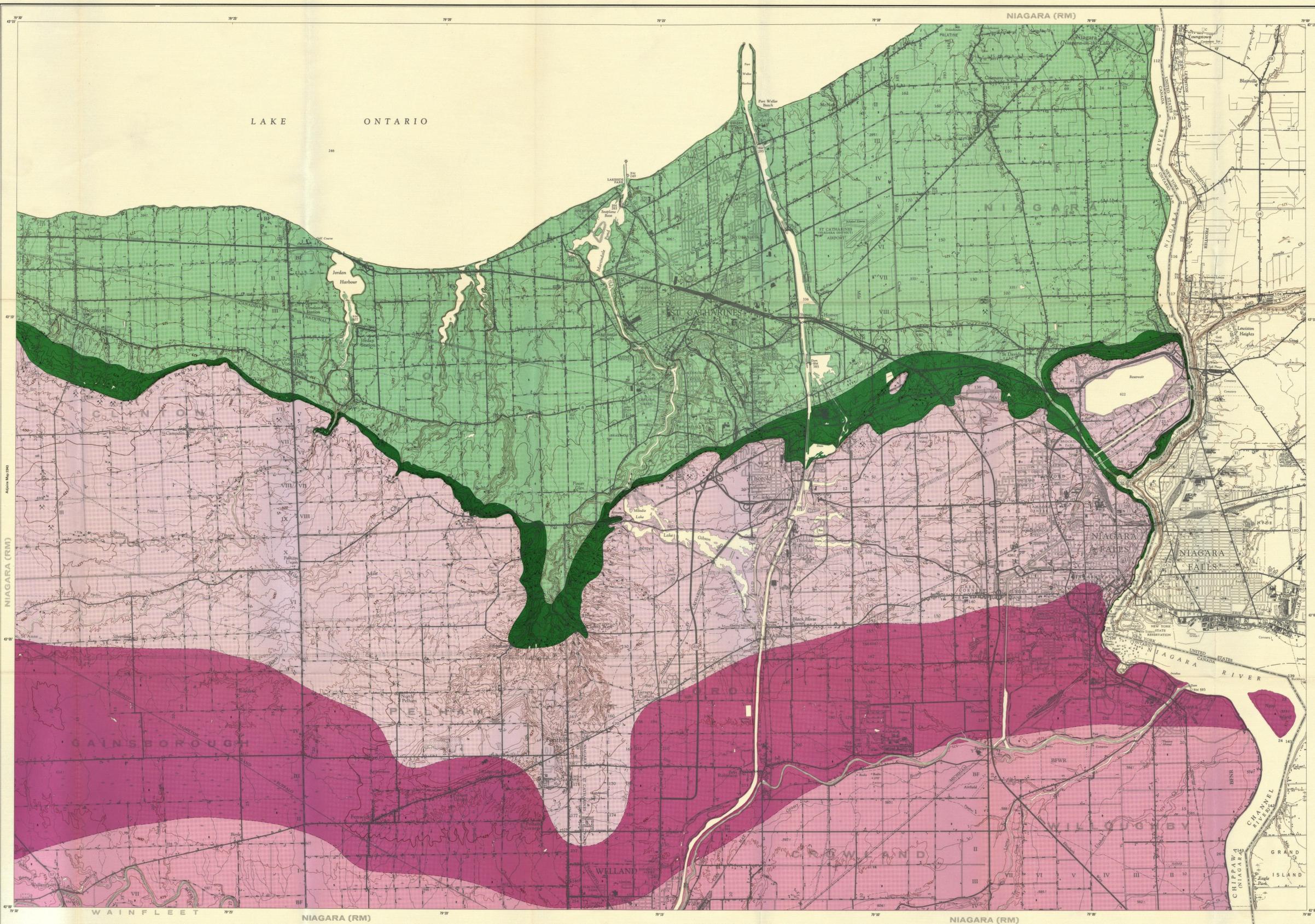
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Physiography of the Niagara area is dominated by three main features, viz. the Niagara Escarpment trending west to east, Lake Ontario to the north, and the deeply incised Niagara River forming the eastern margin of the area. The escarpment edge is a sequence of Silurian dolomites and calcareous limestones from the Escarpment. Below this feature more easily eroded Ordovician shales produce hummocky topography much dissected by small northward draining streams. The Ordovician strata are covered by a veneer of Pleistocene sediments forming a northward trending plain that extends to Lake Ontario.

The Niagara River has cut a narrow bedrock valley (commonly termed Niagara Gorge) some 300 feet deep, which extends upstream from Queenston to the present site of the Niagara Falls. The gorge has a complicated history. Downstream from the Whirlpool it is a relatively recent feature, as the Niagara River formerly flowed through an older bedrock valley, now known as St. David's Gorge (Hobson and Thomas, 1969).

STRATIGRAPHY

Georgian Bay Formation (Upper Ordovician-Richmondian) This unit forms the bedrock of the major portion of the map-area north of the Escarpment and to the Niagara Gorge. It is dominantly red, brown, fessile and micaceous calcareous shale. Reduction zones having a green coloration occur parallel and discordant to bedding. The true thickness of the unit cannot be determined from outcrop studies but a thickness of about 700 feet is estimated from subsurface data. The upper contact of the unit with the Whirlpool Formation is sharp and disconformable.

Cataract Group (Lower Silurian-Alexandrian)

Whirlpool Formation This unit outcrops near the base of the Escarpment throughout the map-area, occasionally forming a prominent lower bench. It is composed of medium to thick bedded, brown weathered, light tan to grey, quartz sandstone. The sandstone varies from fine to very fine grained; the grains are subrounded and well-sorted. Thin shale partings and seams can occur. Sedimentary features include symmetrical and asymmetrical ripple marks and ripple cross-laminations. At its reference section at the Whirlpool in Niagara Gorge (see Bolton, 1957) the unit is 25 feet thick. Its upper contact with the Cabot Head Formation is transitional but is usually clear at the top of the massive sandstone bed.

Cabot Head Formation This unit is poorly exposed throughout the map-area, but can be seen at Decoy Falls and the Sir Adam Beck Power Station access road. It is composed of fine grained green and green shale with interbeds of subfoliographic or finely crystalline limestone and occasional dolomite. Because of the soft weathering nature of the shale the lower part of the unit is usually overgrown. At Decoy Falls the unit is 18 feet in thickness. The upper contact with the Glimby Formation is transitional.

Glimby Formation This unit is poorly exposed throughout the map-area, but can be seen at Decoy Falls and the Sir Adam Beck Power Station access road. It is composed of fine grained green and green shale with interbeds of subfoliographic or finely crystalline limestone and occasional dolomite. Because of the soft weathering nature of the shale the lower part of the unit is usually overgrown. At Decoy Falls the unit is 18 feet in thickness. The upper contact with the Glimby Formation is transitional.

Clifton Group (Middle Silurian-Niagaran)

Thorold Formation This unit can be observed at several localities in the map-area, e.g. the type section at Look 4 of the Welland Canal near Thorold. Decoy Falls, Sir Adam Beck Power Station access road at Niagara Gorge. It is composed of the bedded greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Niagara Formation This unit can be observed at only a few localities, between Decoy Falls and the Sir Adam Beck Power Station access road at Niagara Gorge. It is composed of green, and olive-green shale, minor, very fine crystalline, cherty limestone and greenish shales are present at the Niagara Gorge locality. The unit is 7 feet thick at the latter locality, thinning to 2.5 feet at Decoy Falls, and wedging out west of this area. Lower and upper contacts, with the Thorold and Reynolds Formations, are sharp and conformable.

Reynolds Formation This unit is well exposed along the Niagara Escarpment from near the base of the Escarpment to the west of the Niagara Gorge. It is composed of green, and olive-green shale, minor, very fine crystalline, cherty limestone and greenish shales are present at the Niagara Gorge locality. The unit is 7 feet thick at the latter locality, thinning to 2.5 feet at Decoy Falls, and wedging out west of this area. Lower and upper contacts, with the Thorold and Reynolds Formations, are sharp and conformable.

Rochester Formation This unit is well exposed along the Niagara Escarpment from near the base of the Escarpment to the west of the Niagara Gorge. It is composed of green, and olive-green shale, minor, very fine crystalline, cherty limestone and greenish shales are present at the Niagara Gorge locality. The unit is 7 feet thick at the latter locality, thinning to 2.5 feet at Decoy Falls, and wedging out west of this area. Lower and upper contacts, with the Thorold and Reynolds Formations, are sharp and conformable.

Onondago Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Lockport Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Anabel Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Devonian

Rochester Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Onondago Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Cayuga Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Tonawanda Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Niagara Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Whirlpool Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Cataract Group

Cabot Head Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Mantoulin Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Whirlpool Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Ordovician

Georgian Bay Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Whitby Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Lindsay Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.

Verulam Formation This unit is well exposed in the Escarpment face in the map-area, e.g. Decoy Falls and Niagara Gorge. It often forms a secondary scarp between the main Escarpment face and the Niagara Gorge. It is composed of greenish, very fine grained sandstone (almost siltstone). On weathered and well surfaced the color is distinctly greenish. There is considerable amounts of very thin, green shale partings. Fragments of the marlucate brachiopod *Lingulella* are common. Thickness of the unit varies from 4.5 to 11 feet. Its lower boundary with the Glimby is marked and is indicated by both textural change and colour.



- LEGEND**
- PALEOZOIC**
- SILURIAN**
- 1 Salina Formation
 - 1a Argillaceous dolomite, evaporites.
 - 2 Guelph Formation
 - 2a Brown or tan dolomite.
 - 3 Lockport Formation*
 - 3a Silurian Member: dark brown or black, aluminous dolomite.
 - 3b Anabel Member: (Economic shale) argillaceous dolomite and shale. Guelph Member: argillaceous dolomite. Gastoport Member: siliceous dolomite.
 - 4 Anabel Formation*
 - 4a Economic Member: dark brown or black, aluminous dolomite.
 - 4b Unconformable member: blue-grey to buff dolomite.
- DEVONIAN**
- 5 Onondago Formation Grey dolomite.
 - 6 Rochester Formation Dark grey shale, interbedded limestone.
 - 7 Onondago Formation Grey and black shale.
 - 8 Cayuga Formation Grey shale.
 - 9 Tonawanda Formation Greenish sandstone and shale.
 - 10 Niagara Formation Greenish sandstone and shale.
 - 11 Whirlpool Formation Red sandstone and shale.
 - 12 Cabot Head Formation Grey and green shale, interbedded limestone.
 - 13 Mantoulin Formation Grey-green argillaceous dolomite.
 - 14 Whirlpool Formation Tan or grey quartz sandstone.
- DISCONFORMITY—UNCONFORMITY**
- ORDOVICIAN**
- Georgian Bay Formation**
- 15 Red shale.
- Georgian Bay Formation**
- 16 Grey-green shale, siltstone, limestone.
- Whitby Formation**
- 17 Grey-brown and black shale.
- Lindsay Formation**
- 18 Grey subfoliographic limestone, minor dolomite.
- Verulam Formation**
- 19 Grey limestone, minor shale.

- SYMBOLS**
- County or Regional Municipality boundary.
 - Geographic township boundary.
 - Topographic contours.
 - Bedrock outcrop.
 - Geological boundary, observed.
 - Geological boundary, position approximated.
 - Geological boundary, position interpolated.
 - Quarry.
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For other conventional signs refer to 1:50,000 National Topographic Map System.

SOURCES OF INFORMATION

Geology by B. A. Liberty, 1971.
 Additional geologic information by B. H. Fenstra, 1975. Compilation by P. G. Fellows, 1975.
 Cartography by C. A. Love and assistants, Ontario Ministry of Natural Resources, 1975.
 Topography from Map 2844 (East and West sheets) of the National Topographic System.
 Magnetic declination in the area was approximately 2° West in 1970.

Map 2844
Paleozoic Geology
NIAGARA
SOUTHERN ONTARIO

