

# Revised Stratigraphy and Correlations of the Niagaran Provincial Series (Medina, Clinton, and Lockport Groups) in the Type Area of Western New York

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been made in accordance with the NASC. Because the NASC does not allow use of the "submember" category, units that would be of this rank are treated as informal units and have been given alphanumeric designations. Informal units are discussed under the appropriate "member" categories.

The use of quotes for stratigraphic nomenclature in this report is restricted to units that have been misidentified or abandoned. If stratigraphic nomenclature for a unit has changed over time, the term for the unit is shown, with capitalization, as given in whatever reference is cited rather than according to the most recent nomenclature. For example, Second Creek Bed was formally named by Linn and Brett (1988) and in all references to their work, the bed is termed Second Creek Bed rather than Second Creek Phosphate Bed, as it has been renamed herein.

As has been previously discussed, this study builds on and partly revises the stratigraphic column of Rickard (1975), the most recent correlation of rocks of Silurian age for western New York to be published by the NYSGS. Units that are established in the nomenclature of the NYSGS but that have not been previously accepted by the USGS or are not proposed herein are footnoted where first mentioned in the text. Nomenclature different than that accepted by USGS in Pennsylvania is also footnoted where first used in the text. Several stratigraphic names that have been used informally in Ontario but were not previously used in New York have been proposed as formal names in this report—first usage of these terms in the text is also footnoted. There are no footnotes concerning any other usage of Canadian terms because neither the USGS nor the NYSGS has jurisdiction over usage of these terms.

A discussion of "first usage of nomenclature" is provided for each unit that is not revised or otherwise changed herein, or has been geographically extended herein, or has had a group assignment changed herein. For units that are revised herein, a section on "brief history of nomenclature" is included. A "background" discussion of nomenclature is provided for those units that are newly proposed herein.

### **MEDINA GROUP** (revised herein)

As revised herein, the Medina Group consists of 80–115 ft of white, green, and red, barren to moderately fossiliferous sandstone, siltstone, and shale. Carbonates are conspicuously absent east of Hamilton, Ont., and the amount of carbonate cement is minimal (Fisher, 1966). The Medina Group is the principal reservoir for natural gas in western New York. The type locality for the Medina Group is along Oak Orchard Creek in the Village of Medina, Orleans County, N.Y. Excellent reference sections crop out at the Genesee and Niagara River Gorges and at DeCew Falls, Ont.

The history of nomenclature of what is now termed the Medina Group, beginning with Conrad (1837) and ending with Bolton (1953), is presented in Fisher (1954); Bolton (1957, table 2) presents a detailed summary of this nomenclature for 1910–53. A historical summary of nomenclature of the Medina Group in the Niagara region is shown in figure 7. Early investigators of the Medina include Conrad (1837); Vanuxem (1840, first usage of Medina; 1842); Hall (1840, 1843); Gilbert (1899); Luther (1899); Fairchild (1901); Grabau (1901, 1905, 1908, 1909, 1913); Kindle and Taylor (1913); Kindle (1914); Schuchert (1914); Chadwick (1918, 1935); Williams (1919); Goldring (1931); and Swartz and others (1942). More recent workers include Fisher (1954, 1960); Bolton (1957); Martini (1971, 1974); Rickard (1975); Duke (1987a,b; 1991); Duke and Fawcett (1987); and Duke, Fawcett, and Brusse (1991).

To date, no consensus has been reached regarding the stratigraphic rank of the Medina sequence. The term Medina Group is used by the NYSGS; prior to this report, the same strata were designated Albion Group by the USGS, and termed the Cataract Group in Ontario by Bolton (1957). The Medina was referred to as a formation as early as Vanuxem (1840) and Hall (1840), both of whom used Medina Sandstone to refer to the interval including the Queenston Shale to the base of the Thorold Sandstone. The Medina has been referred to as a formation as late as Duke (1987a), who included the following members in the Niagara River Gorge area: Whirlpool, Cabot Head, Grimsby, Thorold, and Neahga. Conversely, it was given group rank by Fisher (1954) (fig. 7) and is considered a group by the NYSGS (Rickard, 1975) (figs. 7, 8). The Medina is herein considered a group (figs. 7, 8) because at least two scales of units are traceable within the traditional, formally recognized subdivisions of the Medina (for example, Grimsby Formation).

As defined herein, the base of the Medina Group is placed at the contact between the Whirlpool Sandstone and the Ordovician Queenston Shale; this contact is known as the Cherokee discontinuity (named by Dennison and Head, 1975), which separates the Ordovician from the Silurian Systems. It is a nearly planar surface that slopes gently northwestward, and it is described by Middleton (1987) and Brett and others (1990b). The disconformity is of unknown duration in the Niagara region (Rutka and others, 1991). At this unconformity across western and central New York, Lower Silurian formations assigned to the Medina Group progressively onlap the eroded Queenston surface eastward. Between Hamilton, Ont., and Medina, N.Y. (fig. 1), the Whirlpool Sandstone forms the base of the Medina Group, and the lower contact of the Medina Group is placed between the Queenston Shale and the overlying Whirlpool Sandstone. East of Medina, the basal units (Whirlpool Sandstone and Power Glen Shale) become condensed and their remnants have been mapped as basal units of the Grimsby Formation. At Rochester, N.Y., the basal units

		AUTHOR OR SOURCE					
		KINDLE AND TAYLOR (1913)	SWARTZ AND OTHERS (1942)	FISHER (1954)	BOLTON (1957)	RICKARD (1975)	THIS REPORT
NIAGARA GROUP	CLINTON FORMATION		NEAHGA SHALE	NEAHGA SHALE	NEAHGA SHALE	NEAHGA SHALE	NEAHGA SHALE
	THOROLD SANDSTONE (MEMBER)		THOROLD SANDSTONE	THOROLD SANDSTONE	THOROLD SANDSTONE	THOROLD SANDSTONE	CAMBRIA SHALE THOROLD SANDSTONE
MEDINA GROUP (UPPER PART)	ALBION SS (FORMATION)	ALBION GROUP	GRIMSBY SANDSTONE	GRIMSBY SANDSTONE	GRIMSBY SANDSTONE	GRIMSBY SANDSTONE	GRIMSBY FORMATION
			CABOT HEAD SHALE	CABOT HEAD SHALE	CABOT HEAD SHALE		
		MANITOULIN SHALE	FISH CREEK SHALE	POWER GLEN SHALE	POWER GLEN SHALE	POWER GLEN SHALE	
		WHIRLPOOL SANDSTONE	WHIRLPOOL SANDSTONE	WHIRLPOOL SANDSTONE	WHIRLPOOL SANDSTONE	WHIRLPOOL SANDSTONE	
		WHIRLPOOL SS. (MEMBER)					
							DEVILS HOLE SS.

**EXPLANATION**  
 SS. = Sandstone  
 DOL. = Dolomite

**Figure 7.** Historical summary of Medina Group nomenclature in the Niagara region.

pinch out, and the lower boundary of the Medina Group is placed at the contact between the Queenston Shale and the equivalent of the Devils Hole Sandstone that has been assigned previously to the Grimsby Formation.

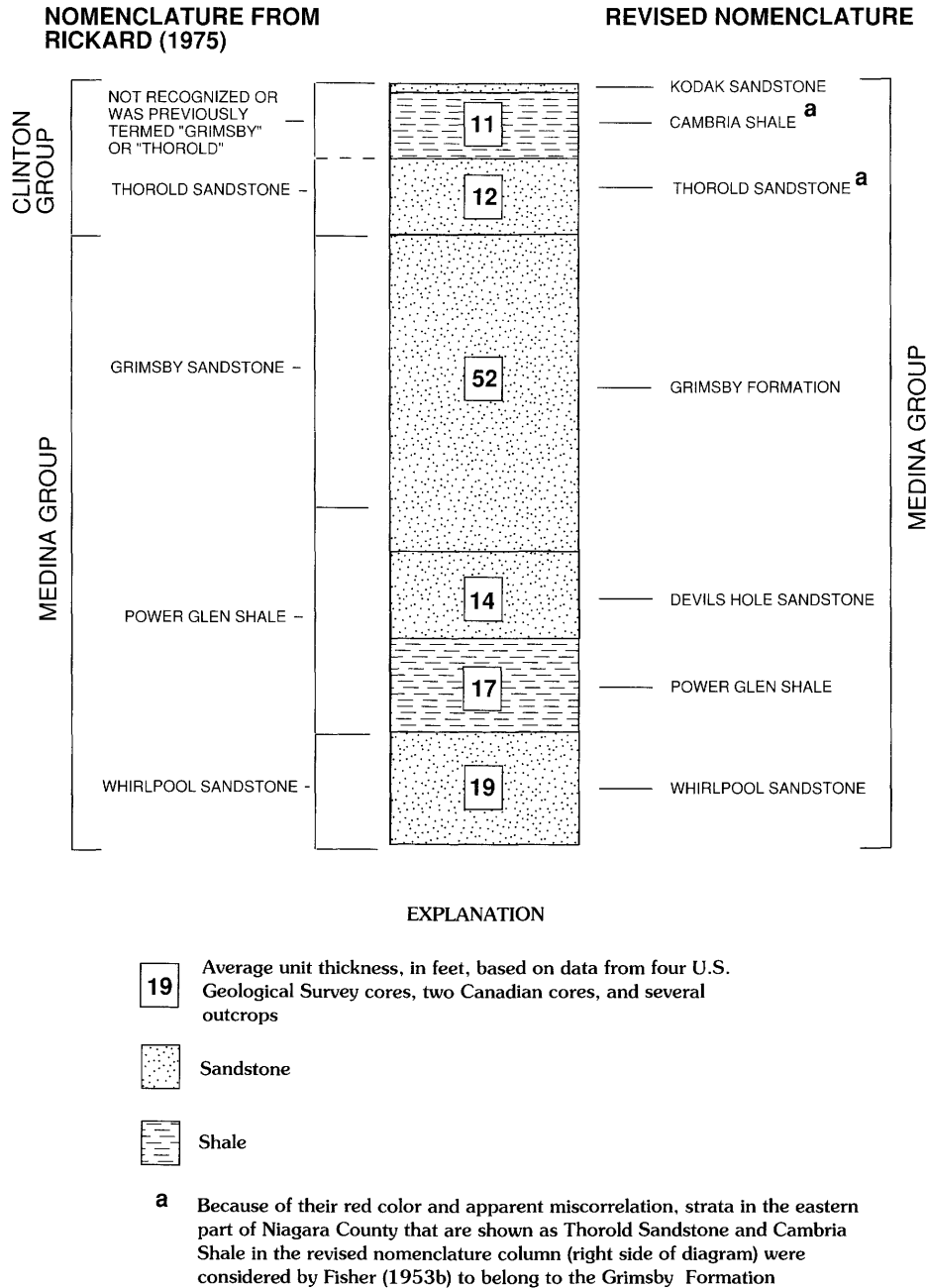
The stratigraphic placement of the Medina-Clinton Group contact has been controversial (fig. 7). On the basis of evidence of erosion at the Grimsby-Thorold contact in the Niagara River Gorge, several previous workers (for example, Bolton [1957] and Rickard [1975]) have suggested that the Thorold Sandstone and younger strata be included in the Clinton Group. Other stratigraphers (for example, Swartz and others [1942]), however, have placed the Medina Group contact at the top of the Thorold Sandstone in the Niagara area. Duke (1987a) used the relative predominance of siliciclastic beds over carbonate beds as a criterion and proposed that the Medina Group contact be placed at the contact between the Neahga Shale and the overlying Reynales Limestone.

The Thorold Sandstone, Cambria Shale, and Kodak Sandstone are herein considered part of the Medina Group, and the upper contact of the Medina Group is herein revised to be at the unconformable contact between the Kodak Sandstone and the Densmore Creek Phosphate Bed of the overlying Neahga Shale (fig. 8). The Medina Group contact is informally placed at this contact by Brett and others

(1991), Duke (1991), and LoDuca and Brett (1994). These authors recognize that the Thorold and Kodak are distinct sandstone intervals separated by the Cambria Shale, and that the Thorold interval can be traced below the Cambria Shale between Niagara County and the Rochester, N.Y., area. The Thorold-Cambria-Kodak succession appears to be relatively conformable.

These three units are progressively truncated along the low-angle regional unconformity that is marked by the Densmore Creek Phosphate Bed. Although the presence of phosphate pebbles at the Kodak Sandstone-Maplewood Shale<sup>6</sup> contact was noted as early as Hall (1843), the traceability of this phosphate bed was not fully appreciated until recently. Fisher (1953b) recognized the potential for tracing phosphate beds in the Clinton Group, but the stratigraphic complexity of the uppermost part of the Medina Group led to miscorrelation of phosphate horizons. The availability of the USGS cores has facilitated accurate correlations of phosphate horizons above the Kodak Sandstone and within higher units that are herein assigned to the lower part of the Clinton Group. Because the contact is an unconformity,

<sup>6</sup>Usage of the New York State Geological Survey; nomenclature not formally accepted by the U.S. Geological Survey.



**Figure 8.** Stratigraphic nomenclature from Rickard (1975) and revised nomenclature for the Medina Group in the Niagara region. Formation contacts and lithologic shading of units are based on the revised nomenclature.

different formations are juxtaposed along it. From Niagara County westward to St. Catharines, Ont., the Thorold Sandstone directly underlies the basal Clinton unconformity that is marked by the Densmore Creek Phosphate Bed. Eastward from Niagara County, the Cambria Shale and the Kodak Sandstone form the section between the Thorold and the basal Clinton unconformity.

The Medina Group sediments were deposited in deltaic and shallow marine environments, which are described in

detail in Martini (1971), Duke (1991), and Duke and others (1991). According to Brett and Calkin (1987), the sequence from the Whirlpool Sandstone through the Grimsby Formation records an Early Silurian marine transgression over the eroded Queenston deposits, followed by regression resulting from active progradation of the Medina fringe delta.

Conflicts in the current lithostratigraphic divisions of the Medina Group are discussed by Duke (1987a) and Duke and others (1991), who note that previously established

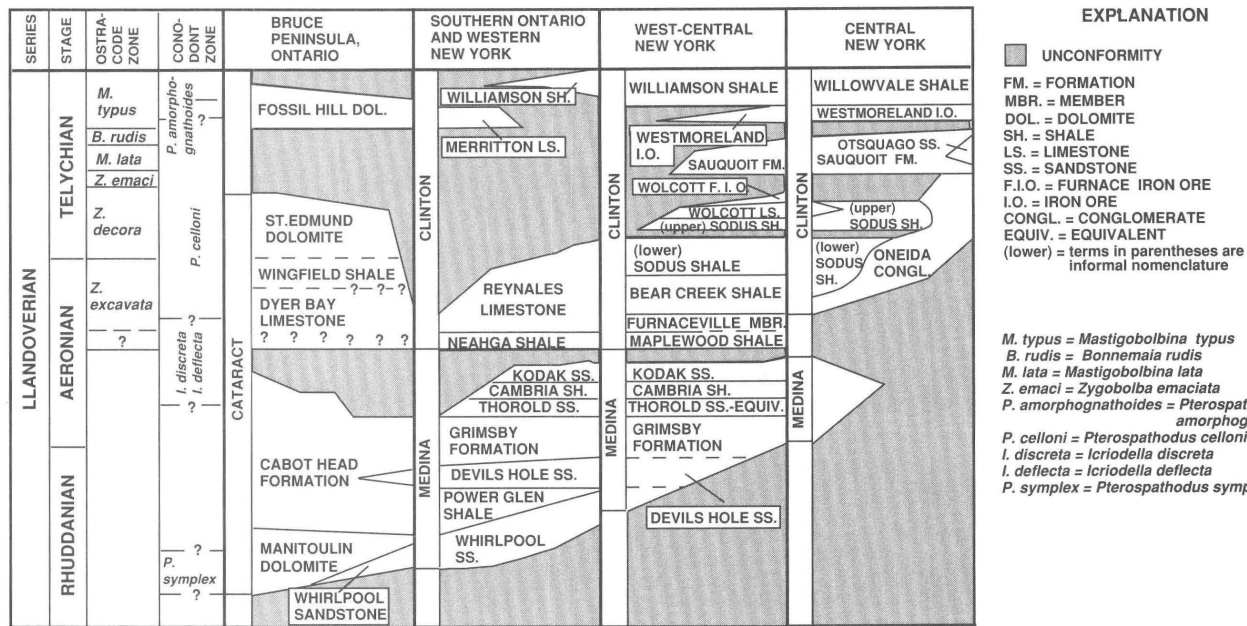


Figure 9. Stratigraphic correlations for the Medina Group and lower part of the Clinton Group in parts of Ontario and New York. (Modified from Brett and others, 1991, fig. 5.)

formations have been defined on the basis of regional color variation. These authors emphasize that these regional patterns of color variation do not necessarily match lithologic correlations and attribute the color variation in the Medina to patterns of secondary diagenetic reduction of strata that were oxidized when deposited.

As defined herein, the Medina Group consists of the following seven formations (fig. 8), in ascending order: the Whirlpool Sandstone, the Power Glen Shale, the Devils Hole Sandstone, the Grimsby Formation, the Thorold Sandstone, the Cambria Shale, and the Kodak Sandstone. New formations proposed herein (fig. 4) include the Devils Hole Sandstone and the Cambria Shale. In addition, a distinctive, laterally traceable phosphate-pebble bed at the base of the Grimsby Formation is herein formally proposed as the Artpark Phosphate Bed (fig. 4). Stratigraphic contacts of the Power Glen Shale and the Grimsby Formation are revised (fig. 4). The stratigraphic units of the Medina Group are described in the following sections.

A comparison of stratigraphic nomenclature from Rickard (1975) with revised nomenclature for the Medina Group is shown in figure 8. Stratigraphic correlations for the Medina Group are shown in figure 9, and a geologic section showing stratigraphic relations in the Medina Group with regional correlations between Hamilton, Ont., and Rochester, N.Y., is shown in figure 10. A descriptive stratigraphic column for the Medina Group at the Niagara River Gorge near Lewiston, N.Y., is presented in figure 11, and natural-gamma logs and stratigraphic correlations for units within the Medina Group are shown in figure 12.

*Summary of Revisions:* Rickard (1975) included only the Whirlpool Sandstone, Power Glen Shale, and the Grimsby Sandstone in the Medina Group. The contact between the Medina and Clinton Groups has been shifted formally herein from the contact between the Grimsby Formation and the Thorold Sandstone to the major unconformity between the Kodak Sandstone and the Densmore Creek Phosphate Bed, at the base of the Neahga Shale. New formations proposed herein include the Devils Hole Sandstone and the Cambria Shale. The Artpark Phosphate Bed is introduced at the base of the Grimsby Formation. Stratigraphic contacts of the Power Glen Shale and the Grimsby Formation have been revised. The Thorold Sandstone and the Kodak Sandstone are herein included in the Medina Group rather than in the Clinton Group.

**WHIRLPOOL SANDSTONE**  
(not revised or otherwise changed herein)

*First Usage of Nomenclature:* First used by Grabau (1909) for the white quartzose sandstone, which is 25 ft thick at its exposure in the Whirlpool in Niagara River Gorge (fig. 2). It was defined as the basal bed of the Upper Medina (later named Albion Sandstone); overlain by red, green, and gray sandstones and shale; and underlain by the Queenston Shale of the Richmond Group.

*Type Locality:* Exposures along the Canadian side of the Whirlpool and extending downstream to Lewiston, Niagara River Gorge (Niagara Falls quadrangle) (Grabau, 1909).