DEPARTMENT OF ENVIRONMENTAL PROTECTION WATER RESOURCES MANAGEMENT NEW JERSEY GEOLOGICAL AND WATER SURVEY

INTRODUCTION The New Jersey and New York portions of the Milford and Port Jervis South 7.5' quadrangles lie in the Valley and Ridge Province of the central Appalachians. The rocks exposed in the map area range in age from Ordovician to Devonian (458-388 Ma, million years ago) and record the history of the Taconic, Acadian and Alleghenian orogenies. The oldest rocks of the mapped area include the foreland basin flysch-turbidite assemblage of the Upper Ordovician Martinsburg Formation capped by an unconformity that resulted from regional uplifting after the Taconic orogeny. This unconformity, commonly called the Taconic unconformity, marks the complete erosion of overlying shallow water and terrestrial sediments of Upper Ordovician and lower Silurian age in New Jersey. Units of this age with similar shallow water and terrestrial depositional environments still exist in Pennsylvania (Juniata Formation, Darton and Taff, 1896), New York (Queenstown Formation, Fisher and others, 1970) and farther westward. The uplift also beveled the underlying Martinsburg Formation. Early to early Middle Devonian formations record several relative sea level cycles including the deep-water shale of the Marcellus Formation, the youngest rocks in the map area. The rocks have a general monoclinal dip to the northwest, interrupted in the east by a few moderately tight folds. Post Taconic orogeny comprised a series of gentle Taconic folds in the Martinsburg Formation (Offield, 1967; Herman and others, 1997). These gently folded rocks were further deformed during the Carboniferous to Permian Alleghenian orogeny forming localized steeply dipping to slightly overturned beds in the Shawangunk Formation and the Bloomsburg Red Beds and gentle northwest dipping beds in the younger mapped units. STRATIGRAPHY Upper Ordovician through Middle Devonian bedrock crops out in the map area. These units are overlain by unconsoli-

dated glacial, fluvial and colluvial deposits of Quaternary age (Witte 2012, 2013). The Martinsburg Formation contains the oldest rocks in the mapped area. Dominantly deposited as turbidites, these sedimentary rocks have been subdivided into four members (Drake and Epstein, 1967; Drake, 1991), two of which crop out in the map area with another in cross section. The Bushkill Member (Drake and Epstein, 1967) is a ribbon slate which contains fossils at its base suggesting a shallow marine environment (Paris and others, 2001) that deepens into the overlying Ramseyburg Member. The Ramseyburg Member (Drake and Epstein, 1967) consists of gravwacke sandstone and interbedded siltstone and shale. The overlying High Point Member (Drake, 1991), equivalent to the Sandstone at Pine Bush of Epstein and Lyttle (1987), consists of thick bedded coarse sandstone with minor graded beds and shale rip ups in the middle of these thick sandstone beds. Extensive erosion removed parts of the Martinsburg Formation and any overlying shallow water and terrestrial sediments that are no longer found in New Jersey. Continued uplift and erosion of the Taconic Mountains deposited sediment

forming a thick cover of molasse sediment over the eroded Martinsburg. These sediments, found in the Shawangunk Formation, were deposited in braided steams in continental environments (Epstein and Epstein, 1972). Large quartz clasts within the Shawangunk contain zircon that was dated using U/Pb at 950-1200 Ma (Gray and Zeitler, 1997). These ages and west flowing paleocurrent data within the Shawangunk led Grav and Zeitler (1997) to suggest the sediment was sourced from Grenville-aged rocks from the New Jersey Highlands, east of Kittatinny Mountain. Less common chert and shale clasts within the lower part of the Shawangunk Formation suggest provenance from lower Paleozoic sediment. Fluvial deposition continued in the overlying Bloomsburg Red Beds. Kummel (1909, 1940), Lewis and Kummel (1910-1912) and Spink (1967) correlated the red sandstone, siltstone and shale above the Shawangunk Formation with the High Falls Shale of New York. They considered the High Falls Shale coeval with the Bloomsburg Red Beds of Pennsylvania. Subsequently Epstein and Lyttle (1987) and Epstein (1993), based on detailed mapping southward from the High Falls Shale type area in eastern New York through New Jersey and into Pennsylvania, stated that the High Falls Shale correlates with the overlying Poxono Island Formation in New Jersey and not the Bloomsburg Red Beds. Their conclusion agreed with the earlier work of Barnett (1970) who called the red bed sequence the Bloomsburg Formation and further stated that the Poxono Island Formation thins northeastward from New Jersey into the dolomite of the High Falls Shale of New York. Mapping by Monteverde (1992) and Drake and others (1996) also correlated this red bed package with the Bloomsburg Red Beds of Pennsylvania. Other studies (Epstein and Lyttle, 1987; Prave and others, 1989; Alcala, 1990; and Epstein, 1993) have demonstrated the interfingering of several tongues of the middle Silurian Shawangunk Formation and middle and upper Silurian Bloomsburg from the New Jersey-New York border northeastward (Figure 1). Epstein and Epstein (1972), Epstein and Lyttle (1987) and Epstein (1993) interpreted the Shawangunk Formation basal conglomerate and overlying interbedded shale,

sandstone and conglomerate as a braided fluvial deposit. The Shawangunk Formation grades upwards into the Wurtsboro tongue of the Bloomsburg Red Beds. Prave and others (1989) and Alcala (1990) defined the Wurtsboro as a series of a red, fining-upwards sequences with a basal fine- to coarse-grained sandstone grading up through fine-grained sandstone, siltstone and capped by mudstone. The Wurtsboro tongue, an intertidal deposit, marks the beginning of a marine transgression. Slight deepening to subtidal conditions are indicated by the overlying gray, fine- to medium-grained quartz arenite, minor pebble lags and shale of the Ellenville tongue of the Shawangunk Formation (Prave and others, 1989; Alcala, 1990), Thinning outcrops of the Ellenville tongue were traced approximately 1000 ft southwest of the New Jersey state border where the tongue terminates. Approximately 3 miles southwestward along strike a similar lithology crops ou in a small stream suggesting the possible redevelopment of the Ellenville tongue. Till blankets the region (Witte, 2012, 2013) and prevents tracing of this lithology away from the stream cut. Shallowing after deposition of the Ellenville tongue resulted in deposition of intertidal to subtidal shaly siltstone and siltstone of the Basher Kill tongue of the Bloomsburg (Epstein 1993) Southwest of the northern New Jersey area the several tongues of the Bloomsburg and Shawangunk are not present and a simpler sequence of Bloomsburg Red Beds overlying the Shawangunk Formation is present (Fig ure 2). Generally, the Shawangunk and Bloomsburg are braided to meandering stream and marginal marine sediments (Epstein, 2001) with evidence of paleosols capping fining-upwards cycles in the Bloomsburg similar to the Bloomburg in central Pennsylvania (Driese and others, 1992). Their sediment source was to the east and southeast and consisted of uplifted Lower Paleozoic and Grenville rocks probably from the Taconic Orogeny (Gray and Zeitler, 1997; Epstein, 2001). The Bloomsburg grades upward into interbedded shale, dolomite and limestone of the Poxono Island Formation (White and Lesley, 1882: Depman and Parrillo, 1969). The Poxono Island Formation is entirely covered by glacial deposits in the mapped area but is exposed to the south. It is overlain by the Bossardville Limestone, which is dominated by laminated limestone, locally containing desiccation columns. Both formations are of late Silurian age. These units formed near sea level in highly saline and/or brackish water, intertidal to supratidal flats and lagoonal paleoenvironments (Epstein and others, 1967; Barnett, 1970; Epstein, 1986, 2001).

The Decker Formation of late Silurian age, combined with the Rondout Formation on this map, overlies the Bossardville Limestone. The Decker Formation consists of two members - the basal Clove Brook and the overlying Wallpack Center Members (Epstein and others 1967) The Clove Brook contains a local biohermal facies that grades laterally into more evenly bedded limestone of the nonbiohermal facies. Bioherms are medium- to coarse-grained and lack muddy matrix material, suggesting moderate water currents. Interbedded with the nonbiohermal limestone are lenses of fine- to coarsegrained quartz sandstone and shale. The Clove Brook Member becomes increasingly quartz-rich to the southwest until it is completely replaced by the arenaceous Wallpack Center Member of the Decker Formation at Hainesville, NJ, at the southern boundary of the mapped area (Epstein and others, 1967; Monteverde, 1992). The nonbiohermal limestone facies has been interpreted as a biostromal bank to shallow subtidal crinoidal meadow (Epstein and others, 1967; Barnett, 1970; Denkler and Harris, 1989). The clastic lithofacies that thickens to the southwest is interpreted as a barrier bar deposit (Epstein and others, 1967; Denkler and Harris, 1989). The Rondout Formation overlies the Decker Formation. Epstein and others (1967) and Epstein and Epstein (1969) subdivided the Rondout Formation into three members. From older to younger, the Rondout consists of laminated and locally mud-cracked limestone, calcareous shale and dolomite of the Duttonville Member that grades into mud-cracked argillaceous dolomite of the Whiteport Dolomite Member. The interbedded mud-cracked shale and argillaceous limestone of the Mashipacong Member is the uppermost member. The Rondout Formation lithologies suggest very shallow brackish water conditions that periodically dried up such as restricted lagoonal and tidal flat paleoenvironments (Herpers, 1951a; Epstein and others, 1967; Epstein and Epstein, 1969; Barnett, 1970). Denkler and Harris (1989) used conodonts for age

cong Member of the Rondout Formation. The Manlius Limestone, the oldest unit of the Helderberg Group, overlies the Rondout Formation. The Helderberg Group as used in southern New York consists from oldest to youngest units of the Manlius, Coeymans and Kalkberg Limestones, New Scotland and Alsen Formations, Minisink Limestone and the Port Ewen Shale, The Manlius is combined with the overlying Coeymans Limestone and Kalkberg Limestone on this map. The Manlius, Coeymans and Kalkberg limestones of New York all correlate to the Coeymans Formation of Pennslvania (Figure 2). The Thacher Member of the Manlius Limestone contains a sequence of dominantly fine-grained ribbon limestone and stromatoporoid biostromes. Epstein and others (1967) suggested the Manlius Limestone represents increased water circulation where more open water conditions replaced the brackish water of the Rondout Formation. In New York within the main body of the Manlius Formation, sedimentary structures clearly define a tidal environment (C. Ver Straeten, written communication, 2021). Barnett (1970) interpreted the Manlius as a subtidal environment. The Manlius grades upward into the argillaceous and, less commonly, arenaceous, limestone of the Depue Limestone Member of the Coevmans Formation. Epstein and others (1967) selected an arbitrary cutoff between the Depue Limestone Member of the Coeymans Formation and the Thacher Member of the Manlius Formation in the covered region between Hainesville and Montague, west-northwest of Shaytown (fig. 2). Coming from the southwest the Shawnee Island Member of the Coeymans Formation overlies both the Depue and the Thacher at the New Jersey-New York boundary. It was subdivided into two facies, a fine- to coarse-grained limestone with as much as 30 percent quartz sand comprising the nonbiohermal facies, which contrasts with very coarse- to coarse-grained biogenic limestone containing massive tabulate corals and stromatoporoid reefs of the biohermal facies (Epstein and others, 1967; Precht, 1982, 1984, 1989; Finks and Raffoni, 1989; Raffoni and Finks, 1989). Two bioherms occur between Montague and Four Corners (Epstein and others, 1967; Spink, 1967) (fig. 2).

control and placed the Silurian-Devonian boundary within either the Whiteport Dolomite or at the base of the Mashipa-

Northeastward, the medium- to coarse-grained limestone of the Ravena Member of the Coeymans Limestone lies atop the Thacher (Epstein and others, 1967). Chert bearing, argillaceous limestone of the Kalkberg Limestone overlies the Ravena and the Shawnee Island Member. It also grades southwestward along strike into the upper Shawnee Island. The transition into the Shawnee Island occurs on the Culvers Gap quadrangle (Figures 2 and 4). Locally capping this sequence is the calcareous quartz-pebble conglomerate and calcareous sandstone of the Stormville Member of the Coeymans Formation. The Shawnee Island and Ravena Members both formed under high-energy, shallow subtidal conditions (Epstein and others, 1967; Spink, 1967; Barnett, 1970). The overlying, finer grained Kalkberg Limestone was deposited under storm wavebase conditions. Shawnee Island bioherms formed as shallow water patch reefs (Precht, 1982, 1984, 1989; Finks and Raffoni, 1989; Raffoni and Finks, 1989). Due to high quartz clastic content, Epstein and others (1967) interpreted the Stormville as a barrier beach deposit. All these units from the Manlius Formation through the Stormville were mapped as a single unit on this map. The overlying units, from oldest to youngest, the New Scotland and Alsen Formations, the Minisink Limestone and the

Port Ewen Shale (all of which are combined on this map) and consists of a thick sequence of siliceous laminated shale

containing lenses of argillaceous limestone The New Scotland Formation was deposited in deeper water conditions than the Kalkberg. Argillaceous limestone between the New Scotland and the overlying Port Ewen was named the Minisink Limestone by Epstein and Epstein (1969). The name was extended to Wallpack Center, N.J., and carried farther northeastward by Monteverde (1992) and Drake and others (1996). However, within the Port Jervis South and Milford quadrangles, this interval is occupied by medium- to fine-grained fossiliferous limestone and is well exposed at the Nearpass quarry. Weller (1902) named these rocks the Becraft Limestone, but Rickard (1962) and Barnett (1970) indicated a lithologic affinity to the Alsen Formation, the name used in this report. The Alsen developed in subtidal waters shallower than the underlying New Scotland. The Port Ewen caps the Helderberg Group in the mapped area. A decrease in carbonate content and a corresponding increase in clay content in the lower part of the Port Ewen indicated a deepening of sea level. The upper part of the Port Ewen displays a slight increase in grain size. Epstein and others (1967, 2001) suggested that relative sea level dropped as the Port Ewen Formation was deposited based on this coarsening upward change in the upper Port Ewen. Sea level continued to lower during regional deposition of the calcareous shale and sandstone of the Oriskany Formation (not shown on map but found to the south in New Jersey and Pennsylvania, and to the north in New York), that overlies the Glenerie Limestone. A major regional unconformity, the Wallbridge Unconformity (Sloss, 1963) identified in Pennsylvania and New York did not develop in New Jersey due to a deeper basin that allowed continued deposition of the Glenerie Limestone (C. Ver Straeten, written communication, 2004). At Peters Valley (Culvers Gap Quadrangles, Figure 1) the Glenerie has completely replaced the Oriskany Formation (Spink, 1967, Monteverde, 1992). Spink (1967) suggests that the Glenerie Formation formed under a similar paleoenvironment to the upper part of the Port Ewen Shale. In New York, the Port Jervis Limestone has been described by Rickard (1981) as lying between the Port Ewen Shale and Glenerie Limestone. Most descriptions of this unit dealt with its paleontology as related to the underlying Helderberg Group and overlying Glenerie Limestone. Rickard (1981) describes the Port Jervis Limestone as "fossiliferous argillaceous and siliceous calcisilitie similar in facies and origin to the New Scotland". This unit was not mapped in this study due to limited outcrop exposure and lithic similarity to the Port Ewan and Glenerie. The dark gray to black shale through argillaceous siltstone to fine-grained sandstone of the Esopus Formation conform-K-bentonites (altered volcanic ash beds) located in New York in the basal Esopus have yielded 207Pb/208Pb ages of

408.3+1.9 Ma (Tucker and others, 1998; Ver Straeten, 2004a, b). Water depths deepen upward through the black shales of middle Esopus deposition and then slowly shallow through the argillaceous siltstones into the sandstones to the contact with the Schoharie (Ver Straeten, 2001a). Ver Straeten (2001b) divided the Esopus into three members, each representing a single major upwards-coarsening cycle. Over the duration of the three members, relative sea level deepens initially and gradually lowers through the upper two members (Ver Straeten, 2001a). These members are not recognized in the mapped area. Two similar sequences occur within the Schoharie which overlies the Esopus. The lower one contains siliceous to locally calcareous mudstone, siltstone and sandstone. The upper sequence contains a coarsening-upwards cycle from mudstone to fine-grained sandstone with occasional interbedded limestone (Ver Straeten, 2001b). Like the Esopus, both Schoharie sequences record a major transgressive-regressive sea-level cycle (Ver Straeten, written communication,



Topographic map produced by the United States Geological Survey North American Datum of 1983 (NAD83) World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 18T 10 000-foot ticks: Pennsylvania Coordinate System of 1983 (north zone), New Jersey Coordinate System of 1983 UTM GRID AND 2013 MAGNETIC NORTH DECLINATION AT CENTER OF SHEETNAIP, July 2020 - July 2010 Imagery J.S. National Gr ...©2006-2012 TomTomGNIS. 2013 Names..... Hydrography... 00.000-m SquareNational Hydrography Dataset, 2010 Contours.. ...National Elevation Dataset, 2002 Boundaries... ...Census, IBWC, IBC, USGS, 1972 - 2012



Prepared in cooperation with the U.S. GEOLOGICAL SURVEY NATIONAL COOPERATIVE GEOLOGIC MAPPING PROGRAM

SCALE 1:24 00 CONTOUR INTERVAL 20 FEET NORTH AMERICAN VERTICAL DATUM OF 1988

BEDROCK MAP OF THE NEW JERSEY AND NEW YORK PORTIONS OF THE MILFORD, PA-NJ AND PORT JERVIS SOUTH, NJ-NY-PA QUADRANGLES, SUSSEX COUNTY, NJ AND ORANGE COUNTY, NY

By

Donald H. Monteverde² and Jack B. Epstein¹ 2022









BEDROCK GEOLOGIC MAP OF THE NEW JERSEY AND NEW YORK PORTIONS OF THE MILFORD, PA-NJ AND PORT JERVIS SOUTH, NJ-NY-PA QUADRANGLES, SUSSEX COUNTY, NJ AND ORANGE COUNTY, NY **GEOLOGIC MAP SERIES GMS 22-1** PLATE 1 OF 2

74°37'30"

17'30

74°37'30"

J.B. Epstein¹ in 1992-2013

Digital cartography by D.H. Monteverde

¹deceased, United States Geological Survey

² retired, N.J. Geological and Water Survey

Bedrock geology mapped by D.H. Monteverde in 1999, 2014-2015

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The views and conclusions contained in this document are those of the authors

100 Marchae Hale (Mode Decesion) Contract is not a contract is		DESCRIPTION OF MAP UNITS
 Construction of the second seco	Dm	Marcellus Shale (Middle Devonian) – Dominantly black shale, weathers medium gray; fissile, thin-bedded though locally thick-bedded and massive; limonite-stained, and sparingly fossiliferous. Upper contact with the Mahantango Formation not exposed but elsewhere is gradational through several feet and marked by an abrupt change from dark gray, soft, silty shale of the Marcellus into lighter colored harder siltstone of the Mahantango (Alvord and Drake, 1971; Herpers, 1951b). Lower contact is not exposed (Alvord and Drake, 1971; Epstein, 1973).
 Sincher formiten der Nameel - Neuer Sincher der Sincher der Sincher der Sincher der Sincher Sinch	Do	Onondaga Limestone (Middle to Lower Devonian) - Medium gray, thin- to medium-bedded, fine-grained limestone, fossiliferous, weathering light gray. Middle part contains slightly argillaceous limestone. Black chert more abundant in the upper half. Lower contact gradational into limestone and calcareous siltstone of the Schoharie Formation. Thickness approximately 200 feet.
 Bern Formation (as off potential sectors) and any streps st	Ds	Schoharie Formation (Lower Devonian) - Medium- to thick-bedded, calcareous siltstone containing local thin stringers or pods of black chert, weathers yellowish gray to pale-olive. Interbedded with medium- to dark-gray calcareous siltstone. Grades downward into medium- to dark-gray calcareous siltstone at base. Contains the trace fossil <i>Zoophycos</i> . Lower contact is placed below the last occurrence of calcareous siltstone (Alvord and Darke 1974).
 Texters dependence between Texters dependence between	De	Esopus Formation (Lower Devonian) - Medium-to dark-gray shaly siltstone. Laminated to medium-bedded, local massive thick-bedded layers. Weathers medium-gray, limonite-stained in places. Bioturbated including the trace fossil <i>Zoophycos</i> . Lower contact is abrupt and unconformable overlying coarse sandstone of the Oriskany Formation (Epstein, 1984). The Oriskany is rarely seen in the mapped area and if present is included in Glenerie Formation. Where the sandstones of the Oriskany Formation are absent, the lower contact grades over several feet from arenaceous and calcareous siltstones to silty limestone of the Glenerie Formation (Spink, 1967).
Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Internet with Tole Manual Parkets Inte	Dg	Thickness approximately 300 feet. Glenerie Formation (Lower Devonian) - Upper part is medium- to dark-gray, fine-grained silty limestone, containing a 1-inch-thick tan-gray weathering rind. Wavy bedded, medium-bedded, fossiliferous and contains local zones of siliceous limestone. Lower part is medium- to dark-gray, fine-grained silty limestone; laminated to thin-bedded and generally trough cross-bedded and fossiliferous. Lower contact is gradational (Epstein and
Construction Construction	Dpj	others, 1967). Total thickness 170 feet. Port Jervis Formation (in New York) (Lower Devonian) - Lithologically similar to the underlying Port Ewen Shale and overlying Glenerie Formation making it very difficult to map. Rickard (1981) describes the Port Jervis Limestone as "fossiliferous argillaceous and siliceous calcisilitie similar in facies and origin to the New Scotland". Unit generally discerned through paleontological differences. Due to poor exposures in the mapped area and unfamiliarity with the unit, it was not mapped. It has probably been mapped within the Port Ewen Shale and Glenerie Formation. Not shown on map or crossections
Image: Construction of the second o		Helderberg Group (Lower Devonian to upper Silurian) Consists of seven formations, youngest to oldest, respectively: Port Ewen Shale, Minisink Limestone, Alsen Formation, New Scotland Formation, Stormville Member of the Coeymans Formation, Kalkberg Limestone, Coeymans Formation and Manlius Formation. All are Lower Devonian, except the Manlius Formation, which is arrely upper Silurian in New York (personal communication, C. Ver Straeten, 10/2021)
 Ministe Lineacore, Alare Towarian and the Social Formation, multiple and the social of a second of a more action of a home action of a home action of a home action of a home action. However, the social of a second of a more action of a home action of a home action of a home action. However, the social of a second of a more action of a home action of a home action of a home action. Home action action of a home action of a home action of a home action of a home action. Home action action of a home action. Home action action of a home action of a home	Dp	Port Ewen Shale (Lower Devonian) - Upper part is dark- to medium-dark gray, calcareous siltstone and shale; locally fossiliferous. Lower part is medium-dark gray, calcareous silty shale; thin to medium bedded, and non-fossiliferous. Lower contact is abrupt and placed at the top of the highest limestone of the Alsen Formation (Epstein and others, 1967). Thickness approximately 150 feet.
Marker Terministic Row Devolution of Marker Use divergence, The Torte Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres Strengtheres Marker Terministic Row Devolution of Marker Use Strengtheres	Dam	Minisink Limestone, Alsen Formation and New Scotland Formation, undivided Minisink Limestone (Lower Devonian) – Medium-gray, fine grained argillaceous limestone, medium bedded, some nodules and lenses of a more calcium-rich limestone. Lower contact covered but gradational elsewhere in the region (Epstein and others, 1967). Maintains a uniform thickness of 20 feet (Epstein and others, 1967).
Image: Section of promotion (section operation), the promotion of promotion of promotion of produce section operations. The section operation of promotion of produce section operations of promotion of promotion. The promotion of promotion. The promotion of promotion o	1	Alsen Formation (Lower Devonian) - Medium- to dark-gray, fine- to medium-grained limestone; medium-bedded, black chert in beds and lenses, fossiliferous. Lower contact is placed at bottom of lowest fine-to medium-grained fossiliferous limestone overlying argillaceous limestone of the New Scotland Formation. Thickness approximately 20 feet.
		New Scotland Formation (Lower Devonian) - Upper part is dark-gray, siliceous, laminated shale containing medium-dark gray, very fine-grained limestone pods; also scattered beds and lenses of medium-gray, fine-grained argillaceous, fossiliferous limestone. Limestone contains small dark-gray chert nodules. Lower part is medium-dark-gray, siliceous, calcareous, fossiliferous shale containing beds and lenses of medium-gray, fine-grained, argillaceous, very fossiliferous limestone. Contains nodules, lenses and locally irregularly bedded dark-gray chert. Total thickness approximately 75 feet. Lower contact is abrupt and placed at top of highest calcareous quartz sandstone of the Stormville Member of the Coeymans Formation. Where the Stormville is absent, the contact is gradational into chert-bearing, massively bedded limestone of the Kalkberg Limestone.
Ceymans Fermatine (Laree Devention). Modure light to reduce programs of light parts of head in the source of light parts of li	Dc	Kalkberg Limestone, Coeymans Formation and Manlius Limestone, undivided Kalkberg Limestone (Lower Devonian) - Medium-dark-gray, fine-grained argillaceous limestone; massively bedded and fossiliferous, containing very thin to thin beds and lenses of fine-grained quartz sandstone and dark-gray chert. Lower contact is gradational into the coarser-grained Coeymans. Contact is placed at the base of the lowermost chert bed. Thickness approximately 40 feet.
 Manusa Lineatone, Tasabre Menher (poper Sluting) - Moulum-datus to ade gray, way then the parabolic division for singup to gradiance in the exclusiones of the Rombau Formation. Unlike 32 heat thekk (Paper and Construct) to gradiance in the exclusiones of the Rombau Formation. Unlike 32 heat thekk (Paper and Construct) to gradiance in the exclusiones of the Rombau Formation. Unlike 32 heat thekk (Paper and Construct) to gradiance in the exclusiones of the Rombau Formation. Unlike 32 heat thekk (Paper and Construct) to gradiance in the paper and the		Coeymans Formation (Lower Devonian) - Medium light- to medium-gray, fine- to medium-grained, locally coarse-grained, irregularly bedded argillaceous and arenaceous limestone (non-biohermal facies). Fossiliferous, including the guide fossil <i>Gypidula coeymanensis</i> . Contains local bioherms consisting of light gray to light-pinkish-gray, very coarse- to coarse-grained, massive biogenic limestone that grades along strike into nonbiohermal facies. Lower contact is gradational and placed at base of lowest argillaceous limestone above the Thacher Member of the Manlius Limestone (Epstein and others, 1967). Thickness approximately 30 feet.
Readed Formation (upper Sharba) - Upper per la median-during the per la median-during the per la median during the median during the per la median during the m	DSrd	Manlius Limestone, Thacher Member (upper Silurian) - Medium-dark to dark gray, very fine-to fine-grained limestone; few medium-grained limestone beds. Unit is undulatory bedded and flaggy to massive, and fossiliferous. Laterally thins and transitions into a Coeymans facies to which it is then assigned. Lower contact varies from sharp to gradational into the calcareous shale of the Rondout Formation. Unit is 35 feet thick (Epstein and others, 1967).
 Decker Formation (upper Slutria) - Medium-gay medium- in catase-granule, this to medium-bedied instance containing cyr holise biol. Bools: Cost-Bedded, Lowe contact is gradiational (Epsen and others, 197). Bossardville Lineatone (upper Slutria) - Medium-gay to medium-daik gray, wearhors medium hish-gay, wearhors regime to a the optication of the low Approximation. Third Hickness approached by 100 feed and particular in the low Approximation. Third Hickness approached by 100 feed and particular in the low Approximation. Third Hickness approached by 100 feed and particular in the low Approximation. Third Hickness approached by 100 feed and particular in the low Approximation. Third Hickness approached by 100 feed and particular in the low Approximation and particular interpretation. Third Hickness approached by 100 feed and particular interpretation. The state of the low Approximation and particular interpretation and particular interpretation. The state of the low Approximation and the low Approximation and particular interpretation. The state of the low Approximation approximatio		Rondout Formation (upper Silurian) - Upper part is medium-dark-gray, very fine-to fine-grained, medium-bedded, calcareous shale and massive argillaceous limestone. Middle part is medium-gray, argillaceous dolomite, weathering grayish-orange, medium-bedded, massive to laminated. Basal beds consist of medium- to dark gray, very fine- to fine-grained limestone and calcareous shale; medium-bedded, generally massive. Unit is fossiliferous. Lower contact is gradational and marked by medium to coarse grained limestone of the Decker Formation. Total thickness approximately 40 feet.
 Besardville Lineatone (upper Sluring) - Medam gray to medium-date (pay, weathers medium-dull-gray, weithers medium-dull-gray, weathers medium-dull-gray, weithers medium-d	5	Decker Formation (upper Silurian) - Medium-gray, medium- to coarse-grained, thin- to medium-bedded limestone containing very thin shale beds. Locally interbedded with light gray to medium-gray shale, calcareous siltstone to coarse-grained sandstone; locally cross-bedded. Lower contact is gradational (Epstein and others, 1967). Total thickness approximately 70 feet.
 discontinuous lenses of disseminated number of upper Sturian). Local quarts and store and split. 1997. Unit patient, 1997. The split is mit to medium bedied, and flaggin, Their et al. and the split 1997. Unit patient of the split of the sp	Sbv i Sp	Bossardville Limestone (upper Silurian) - Medium-gray to medium-dark gray, weathers medium-bluish-gray, very fine-grained, argillaceous limestone and limestone. Thin bedded to laminated. Lower contact is gradational and placed at top of uppermost dolomite of the Poxono Island Formation. Total thickness approximately 100 feet in the southwest; thins to 10 feet at the New York border. Poxono Island Formation (upper Silurian) - Greenish gray, finely crystalline to aphanitic dolomite containing
 medium gray and greeniser gas, very fine- to coarse grained, cross bedded to laminate pair of lattered grayth red shale probles as much as 0.8 inches in diameter and lattered grayth red shale probles as much as 0.8 inches in diameter and lattered grayth red shale probles as much as 0.8 inches in diameter and lattered grayth red shale probles as much as 0.8 inches in diameter and lattered grayth reductions gosts, complexous bedded analysis of the shale of the busy term devices gosts, complexous and base data shale with red bases and the busy term devices gosts, complexous and based and busyts the devices with a devices lass the shale of the busyts the devices that shale of the busyts the devices that and the devices lass the busyts. Shale shows the devices that the shale of the busyts the devices that and the shale of the busyts. Complexous and does not an explored the the shale of the base of the busyts the device shales. The shale shale busyts in the device shales in an 20 test above the obset of the busyts. The device shales are devices and the regranded patient of modernately sorted, massive, with local plant to trough creas-basis, limitations and device and the provide the device patient in the term graven at the term graven at the term of the base of the busyts and the device shales and the shale patient is the base of the busyts. The devices 370 test. Wurbbor Congue of the Bloomsburg Red Bed (upper Sluring) - Graytshered, medium-alvie-gray, to the base of the bloomsburg Red Bed (upper Sluring) - Graytshered, massive, and the device patient is the device shales to the device shales and the shale patient is the shale patient is the shale of the shale of the device shale to the device the shale and the shale patient is the device shale to the device the shale patient is the shale of the device shale and the shale patient is the shale of the device shale and the shale patient is the shale of the device shale and the shale patient is the shale of the shale and the shale patient is the	Sh	discontinuous lenses of disseminated rounded quartz grains, local quartz sandstone and argillaceous dolomite beds. Unit is thin to medium bedded, and flaggy. Thickness is as much as 500 ft (Epstein and Lyttle, 1987). Unit thins toward the northwest. Lower contact thought to be gradational (Spink, 1967; Alvord and Drake, 1971; Epstein, 1973). Not exposed in mapped area. Bloomsburg Red Beds. undivided (upper Silurian) - Pale red to gravish-red, gravish red purple, and lesser
 Basher Alcourt 1,500 (pretrict). Basher Kill Tongue of Bioomsburg Red Backs (upper Siturian) - Grayish-red, thin-to thick-backded mudstone, fine to coarse and subcompa of the same toruly across-backs. Congiomeratic candidate of quartz, grain and red shale pabble in graysh red, thin to thick-backded mudstone, Screen Siturian 1, Grayish-red, Theiro Coarse and Siture (Lower and the Same Siture). Same Siture and the Case Siture and the Legenerits, poorly to well sotted. Lower the base of the first persistence or sates of autocardiad grains of quartz and their Legenerits, poorly to well sotted. Lower Siture 1, Same Siture		medium-gray and greenish-gray, very fine- to coarse-grained, cross bedded to planar bedded, thin- to thick-bedded, partly conglomeratic sandstone with quartz grains as much as 0.4 inches in diameter and flattened grayish red shale pebbles as much as 0.8 inches in diameter; poorly bedded to laminated, pale red, light brown to moderate brown, and greenish-gray shale and siltstone with scattered green reduction spots, conspicuous cleavage, partly mud cracked and with scattered ferroan dolomite concretions about 0.5 inches in diameter. Fining upward cycles with basal channel sandstones are abundant. Minor medium gray, fine-grained, planar bedded sandstone. Lower contact, placed at the base of the lowest red bed, is transitional. In some places a
 Wurtsboro Tongue of the Bioomsburg Red Beds (upper Siurian) - Grayish-red, medum-olive-gray to information and moderney of the Bioomsburg Red Beds (upper Siurian) - Grayish-red, medum-olive-gray to ingrayish red, fine to carse sandstone, and totakens, altistone, fine to carse sandstone, and upper comparison and multicase. Congiomerate consists of matrix-supported quartice, grand in the grayish red, fine to carse sandstone matrix. Sandstone consists of subrounded grains of quartz and lithic fragments, poorly to well-sorted consists of matrix-supported quarts, green and red sales pebbles in grayish red, fine to carse sandstone matrix. Sandstone consists of subrounded grains of quartz and lithic fragments, poorly to well-sorted beds (Epstein, 1993). At Route 84 in Port Jervis, Prave and others (1989) and Atalan (1990) measured consists of matrix-supported quartz and subcrimates shale pebbles in grayish-indiced at provide the gray to take greenish gray. Indices and pebble conglomerate having well counded grains, some inmonte saining. Conglomerate consists of matrix-supported quarts and subcrimates shale pebbles in grayish-indiced at lowest in the subscript (1986) and Atalani (1990) measured 207 tetor this unit. Shawangurk Formation (upper to middle Silurian) - Upper part is medium-dameter and subcrimate shale pebble in the indice database in the indice database in the indice database shale pebble indiced at andstone (1980) and Atalani Consists of matrix-supported quarts. and bubcrimate shale pebbles conglomerate having well conded grains, and moderately well sorted. Contains sparse graphte fakes. Lover part is light- to medium-dark-gray, matrix-supported quarts. And biologathic sandstone, quartzize and quartz-pebble conglomerate. Incide consists of matrix-supported gray and red sites and shale pebbles and quarts and biologic conglomerate. Near the indice database and the consist of matrix and subcrimes in the consel consel consete consel shale pebbles and quarts and biologic conglomerate.	Sbb	Basher Kill Tongue of Bloomsburg Red Beds (upper Silurian) - Grayish-red, thin-to thick-bedded mudstone, siltstone, fine to coarse sandstone, and lesser local quartz-pebble conglomeratic sandstone, poorly to moderately sorted, massive, with local planar to trough cross-beds, laminations and desiccation cracks. Conglomerate consists of quartz, green and red shale pebbles in grayish red, fine to coarse matrix supported sandstone. Sandstone consists of subrounded grains of quartz and lithic fragments, poorly to well sorted. Lower contact is probably gradational with the underlying Ellenville tongue of the Shawangunk Formation and placed at
 fragments, poorly to well sorted, planar tabular to trough cross bedded. Unit contains repetitive fining upwards through fine to coarse sandstone and silestone, and terminating in muddracked mudstone (Prave and others, 1998). The congiomerate resembles the light-to medium-gray valutz-pebble congiomerate of the Shawangunk Formation. The finer grained beds consist of red to medium-gray and lesser greenible gray is plantenated bed in a sequence of abundant tred beds (Epstein, 1993). At Route 64 in Port Jervs, Prave and other (1998) and Alacia (1990) measured 207 field that unit. Shawangunk Formation (upper to middle Silurian) - Upper part is medium-to medium-dark gray, or degenerish-gray, thin-bedded shale near upper contact. Middle part is interbedded shales, some limonite staining. Conglomerate consists of matrix-supported quartz and subordinate shales pebbles (maximum diameter 2 inches) in poorly. to well-sorted, planar tabular to trough cross-bedded. Graits are well rounded quart, and teldspath is analysobe, cost-bedded (Singta are well rounded quartz, and teldspath is analysobe, cost-bedded (Singta are well rounded quartz, and teldspath is analysobe, cost-bedded (Singta are well rounded quartz, and teldspath is analysobe, and the singta and the near upper contact. Middle part is interbedded shardstone. Local is approaches arkees in composition. Lower contact unconformable. Thickness approximately 1.400 feet at southwest border of map area and thins to 1.200 feet towards the northeast border. Stol Ellenville Tongue of Shawangunk Formation (upper Silurian) - Light- to medium-dark-gray, medium- to thick-bedded conglomerate, fire, to medium-gray aphtensition to the prosposition. Lower contact unconformable. Thickness approximately 1.400 feet at southwest border of map area and thins to 1.200 feet towards the northeast border. Stol Ellenville Tongue of Shawangunk Formation (upper Ordovician) - Dark to medium-gray, sphanitis to finely-ops	Sbw	the base of the first persistent red bed (Epstein, 1993). Estimated thickness 370 feet. Wurtsboro Tongue of the Bloomsburg Red Beds (upper Silurian) - Grayish-red, medium-olive-gray to light-olive-gray, thin- to thick-bedded mudstone, siltstone, fine to coarse sandstone, and local quartz-pebble conglomeratic sandstone, poorly to moderately sorted, massive, with local planar to trough cross-bedded laminations and mudcracks. Conglomerate consists of matrix-supported quartz, green and red shale pebbles in grayish red, fine to coarse sandstone matrix. Sandstone consists of subrounded grains of quartz and lithic
 Shawangunk Formation (upper to middle Silurian) - Upper part is medium-to medium-dark-gray, or dark-greenish-gray, medium- to thick-bedded sandstone and pebble conglomerate having well rounded grains, some limonite staining. Conglomerate consists of matrix-supported quartz and subordinate shale pebbles (maximum diameter 2 linches) in poort- to well-sorted, planar tabular to trough cross-bedded sandstone. Local black to dark-greenish-gray, thin-bedded shale near upper contact. Middle part is intrebedded Thin-bedded thate and sandstone, planar to tabular to trough cross-bedded. Grains are well rounded and moderately well sorted. Contains sparse graphite flakes. Lower part is light-to medium gray to light-tolive-gray, thin- to thick-bedded quartz and feldspatitic sandstone, quartzite, and quartz-pebble conglomerate, matrix-supported, poorly- to well-sorted, tross- to planar-bedded. Clasts are primarily quartz, some dark-gray argillie and black tort. Sandstone, guarta and leidspatitic and locally approaches arkose in composition. Lower contact unconformable. Thickness approximately 1,400 feet at southwest border of map area and thins to 1,200 feet towards the northeast border. Scot Ellenville Tongue of Shawangunk Formation (upper Ordovician) - Light- to medium-dark-gray, medium- to thick-bedded conglomerate, fine- to medium-grained quartz, here were ynew York border and tocarser grained sized sand. The top of the highest graysh red bed marks lower contact with he Wutsboro tongue of the Bioomsburg Red Beds. Unit is approphyre dikes upper very York border and tocarser grained sized sand. The top of the highest graysh red bed marks lower contact with provide and there, 2012. Set the data the New Jersey – New York border and thicknes to the northeset. Unit pinches out the southwest. Scot Lamprophyre dikes (Lower Silurian to Upper Ordovician) - Dark- to medium-gray, aphanitic to thick-bedded conglomerate, light-Yellowisherga (near 4722 Ma (Ratcillie and totars, 2022). As the dakes		fragments, poorly to well sorted, planar tabular to trough cross bedded. Unit contains repetitive fining upward sequences, consisting of an erosional base beneath a discontinuous basal pebble lag, grading upwards through fine to coarse sandstone and siltstone, and terminating in mudcracked mudstone (Prave and others, 1989, Epstein, 1993). The conglomerate resembles the light- to medium-gray quartz-pebble conglomerate of the Shawangunk Formation. The finer grained beds consist of red to medium-gray and lesser greenish gray to grayish-orange, medium-bedded, fine sandstone and siltstone. Lower contact is abrupt and placed at lowest significant red bed in a sequence of abundant red beds (Epstein, 1993). At Route 84 in Port Jervis, Prave and ethers (1989) and Alcala (1990) measured 207 foot of this unit.
 Indeutrative upper discrete of the source of	Ss	Shawangunk Formation (upper to middle Silurian) - Upper part is medium-to medium-dark-gray, or dark-greenish-gray, medium- to thick-bedded sandstone and pebble conglomerate having well rounded grains, some limonite staining. Conglomerate consists of matrix-supported quartz and subordinate shale pebbles (maximum diameter 2 inches) in poorly- to well-sorted, planar tabular to trough cross-bedded sandstone. Local black to dark-greenish-gray, thin-bedded shale near upper contact. Middle part is interbedded thin- to black to dark-greenish-gray, thin-bedded shale near upper contact.
 See Ellenville Tongue of Shawangunk Formation (upper Silurian) - Light- to medium-dark-gray, medium- to thick-bedded conglomerate, line- to medium-grained quartzite, and lesser greenish-gray and red siltstone and thick-bedded containing individual foresets of alternating finer and coarser grained sized sand. The top of the highest grayish red bed marks lower contact with the Wurtsboro tongue of the Bloomsburg Red Beds. Unit is approximately 12 feet thick at the New Jersey – New York border and thickens to the northeast. Unit pinches out to the southwest. Soil Lamprophyre dikes (Lower Silurian to Upper Ordovician) – Dark- to medium-gray, aphanitic to finely-crystalline and locally contains porphyritic plegioclase crystals in alkalic to calcic-alkalic dikes and sills. Unit pinches out to the southwest. Soil Lamprophyre dikes (Lower Silurian to Upper Ordovician) – Dark- to medium-gray, aphanitic to finely-crystalline and locally contains porphyritic plegioclase crystals in alkalic to calcic-alkalic dikes and sills. The top of und intruding into Martinsburg Formation toxis in New Jersey the older age of Ratcliffe and others, 2012) is accepted here as the most accurate age. Average thickness is 3 feet. Migh Point Member of Martinsburg Formation (Upper Ordovician) - Medium-dark-gray, thin-bedded shale, siltstone and fine-grained sandstone, containing turbidite sequences. Toke to Toke of Bouma (1962). Neerase in average grain size, absence of shale rip-ups and medium-grained sandstone, and siltstone of Martinsburg Formation (Upper Ordovician) - Medium-dark-gray, thin-bedded shale, carintusive bodies unit is thermally metamorphosed (Omhph, Omhpsh). Beds within the High Point Member are not shown on cross sections. Grades along strike into Ramseyburg Member of Martinsburg Formation by Contains Tab to Ta turbidite sequences. Neera intusive bodies unit is thermally netamorphosed (Omhph, Omhpsh). Beds within the High Point Member are		moderately well sorted. Contains sparse graphite flakes. Lower part is light- to medium gray to light-olive-gray, thin- to thick-bedded quartz and feldspathic sandstone, quartzite, and quartz-pebble conglomerate, matrix-supported, poorly- to well-sorted, cross- to planar-bedded. Clasts are primarily quartz, some dark-gray argillite and black chert. Sandstone is feldspathic and locally approaches arkose in composition. Lower contact unconformable. Thickness approximately 1,400 feet at southwest border of map area and thins to 1,200 feet towards the northeast border.
 SOI Lamprophyre dikes (Lower Silurian to Upper Ordovician) – Dark- to medium-gray, aphanitic to finely-crystalline and locally contains porphyritic plagioclase crystals in alkalic to calcic-alkalic dikes and sills. Only intrudes either the Ramseyburg or High Point Members of the Martinsburg Formation. K-Ar date of 422±14 Ma from biotite phenocrysts in a minette lamprophyre dike suggest an Early Silurian age (Milton, 1972, written communication) A related intrusion just over the southerm border of the mapped area has been dated at 435±20 m.y. (Zartman and others, 1967) and a TIMS age on titanite of 447±2 Ma (Ratcliffe and others, 2012). As the dikes are only found intruding into Martinsburg Formation rocks in New Jersey the older age of Ratcliffe and others, (2012) is accepted here as the most accurate age. Average thickness is 3 feet. Omhp Ramseburg Member of Martin	Sse	Ellenville Tongue of Shawangunk Formation (upper Silurian) - Light- to medium-dark-gray, medium- to thick-bedded conglomerate, fine- to medium-grained quartzite, and lesser greenish-gray and red siltstone and shale. Generally cross-bedded containing individual foresets of alternating finer and coarser grained sized sand. The top of the highest grayish red bed marks lower contact with the Wurtsboro tongue of the Bloomsburg Red Beds. Unit is approximately 12 feet thick at the New Jersey – New York border and thickens to the northeast. Unit pinches out to the southwest.
Omhp Omhp <t< td=""><td>SOI</td><td>Lamprophyre dikes (Lower Silurian to Upper Ordovician) – Dark- to medium-gray, aphanitic to finely-crystalline and locally contains porphyritic plagioclase crystals in alkalic to calcic-alkalic dikes and sills. Only intrudes either the Ramseyburg or High Point Members of the Martinsburg Formation. K-Ar date of 422±14 Ma from biotite phenocrysts in a minette lamprophyre dike suggest an Early Silurian age (Milton, 1972, written communication) A related intrusion just over the southern border of the mapped area has been dated at 435±20 m.y. (Zartman and others, 1967) and a TIMS age on titanite of 447±2 Ma (Ratcliffe and others, 2012). As the dikes are only found intruding into Martinsburg Formation rocks in New Jersey the older age of Pateliffe and</td></t<>	SOI	Lamprophyre dikes (Lower Silurian to Upper Ordovician) – Dark- to medium-gray, aphanitic to finely-crystalline and locally contains porphyritic plagioclase crystals in alkalic to calcic-alkalic dikes and sills. Only intrudes either the Ramseyburg or High Point Members of the Martinsburg Formation. K-Ar date of 422±14 Ma from biotite phenocrysts in a minette lamprophyre dike suggest an Early Silurian age (Milton, 1972, written communication) A related intrusion just over the southern border of the mapped area has been dated at 435±20 m.y. (Zartman and others, 1967) and a TIMS age on titanite of 447±2 Ma (Ratcliffe and others, 2012). As the dikes are only found intruding into Martinsburg Formation rocks in New Jersey the older age of Pateliffe and
 Commphism Containing rip-ups of medium- to dark-gray shale and siltstone (Omhps). Contains Tab to Ta turbidite sequences. Near intrusive bodies unit is thermally metamorphosed (Omhph, Omhpsh). Beds within the High Point Member are not shown on cross sections. Grades along strike into Ramseyburg Member of Martinsburg Formation by decrease in average grain size, absence of shale rip-ups and medium-grained sandstone, and absence of siliceous cement. Lower contact gradational and placed at base of lowermost thick-bedded graywacke or amalgamated graywacke containing shale rip-ups. Unit assigned to <i>Orthograptus ruedemanni</i> Zone to <i>Climacograptus spiniferus</i> Zone of Riva (1969, 1974) and graptolites studied by Parris and Cruikshank (1992). Maximum thickness 4,500 feet. Omr Ramseyburg Member of Martinsburg Formation (Upper Ordovician) - Interbedded medium- to dark gray, to brownish-gray, fine- to medium-grained, thin-to thick-bedded graywacke sandstone and siltstone and medium- to dark gray, laminated to thin-bedded shale and slate. Unit may form complete Bouma (1962) turbidite sequences Tabcde, but basal cut out sequences Tcde dominate. Basal scour, sole marks, and soft-sediment distortion of beds are common in graywacke. Lower contact placed at bottom of lowest thick- to very-thick-bedded graywacke, but base locally grades through sequence of thin-bedded shale and slate and minor thin- to medium-bedded discontinuous and lenticular graywacke beds in the Bushkill Member (exposed outside of map area). Parris and Cruikshank (1992) correlate unit with <i>Orthograptus ruedemanni</i> to lowest part of <i>Climacograptus spiniferus</i> Zones of Riva (1969, 1974). Thickness approximately 3,500 feet at the New Jersey -New York boundary. Omb 	Omhp Omhps	billistone and fine-grained sandstone, containing turbidite sequences Tbcde to Tcde of Bouma (1962). Interbedded with less abundant light-yellowish-gray weathering, medium gray to medium-dark-gray, medium-grained sequences to the thick-bedded and massive quarts and calcorrows compared superior sequences and the sequences to the thick-bedded and massive quarts and calcorrows compared superior sequences to the se
 Maximum thickness 4,500 feet. Omr Ramseyburg Member of Martinsburg Formation (Upper Ordovician) - Interbedded medium- to dark gray, to brownish-gray, fine- to medium-grained, thin-to thick-bedded graywacke sandstone and siltstone and medium- to dark gray, laminated to thin-bedded shale and slate. Unit may form complete Bouma (1962) turbidite sequences Tabcde, but basal cut out sequences Tcde dominate. Basal scour, sole marks, and soft-sediment distortion of beds are common in graywacke. Lower contact placed at bottom of lowest thick- to very-thick-bedded graywacke, but base locally grades through sequence of thin-bedded shale and slate and minor thin- to medium-bedded discontinuous and lenticular graywacke beds in the Bushkill Member (exposed outside of map area). Parris and Cruikshank (1992) correlate unit with Orthograptus ruedemanni to lowest part of Climacograptus spiniferus Zones of Riva (1969, 1974). Thickness approximately 3,500 feet at the New Jersey -New York boundary. Omb Bushkill Member of the Martinsburg Formation (Upper Ordovician) – Medium to dark gray, laminated to thin-bedded slate with thin beds of quartzose to graywacke siltstone and carbonaceous slate in fining-upward sequences. Variations in grain size and sedimentary structures within neighboring beds gives unit a 	+ + Omhph + + Omhpsh + +	containing rip-ups of medium- to thick-bedded and massive, quartz and calcareous-cemented quartz sandstone, containing rip-ups of medium- to dark-gray shale and siltstone (Omhps). Contains Tab to Ta turbidite sequences. Near intrusive bodies unit is thermally metamorphosed (Omhph, Omhpsh). Beds within the High Point Member are not shown on cross sections. Grades along strike into Ramseyburg Member of Martinsburg Formation by decrease in average grain size, absence of shale rip-ups and medium-grained sandstone, and absence of siliceous cement. Lower contact gradational and placed at base of lowermost thick-bedded graywacke or amalgamated graywacke containing shale rip-ups. Unit assigned to <i>Orthograptus ruedemanni</i> Zone to <i>Climacograptus spiniferus</i> Zone of Riva (1969, 1974) and graptolites studied by Parris and Cruiksbank (1992).
Omb Bushkill Member of the Martinsburg Formation (Upper Ordovician) – Medium to dark gray, laminated to thin-bedded slate with thin beds of quartzose to graywacke siltstone and carbonaceous slate in fining-upward sequences. Variations in grain size and sedimentary structures within neighboring beds gives unit a	Omr	Maximum thickness 4,500 feet. Ramseyburg Member of Martinsburg Formation (Upper Ordovician) - Interbedded medium- to dark gray, to brownish-gray, fine- to medium-grained, thin-to thick-bedded graywacke sandstone and siltstone and medium- to dark gray, laminated to thin-bedded shale and slate. Unit may form complete Bouma (1962) turbidite sequences Tabcde, but basal cut out sequences Tcde dominate. Basal scour, sole marks, and soft-sediment distortion of beds are common in graywacke. Lower contact placed at bottom of lowest thick- to very-thick-bedded graywacke, but base locally grades through sequence of thin-bedded shale and slate and minor thin- to medium-bedded discontinuous and lenticular graywacke beds in the Public Member (support extints of extints o
obgraatariatia rikkaa alata anaasanaa Doddikista da	Omb	 Bushkill Member of the Martinsburg Formation (Upper Ordovician) – Medium to dark gray, laminated to thin-bedded slate with thin beds of quartzose to graywacke siltstone and carbonaceous slate in fining-upward sequences. Variations in grain size and sedimentary structures within neighboring beds gives unit a gebraderes.

generally less than 2 inches. Lower contact gradational and marked by increase in argillaceous content into a slate unlike the underlying argillaceous limestone to limestone of the Jacksonburg Limestone. About 1,400 feet

thick. Unit shown on cross section C-C'.

DEPARTMENT OF ENVIRONMENTAL PROTECTION WATER RESOURCES MANAGEMENT NEW JERSEY GEOLOGICAL AND WATER SURVEY















Prepared in cooperation with the U.S. GEOLOGICAL SURVEY NATIONAL GEOLOGIC MAPPING PROGRAM



BEDROCK GEOLOGIC MAP OF THE NEW JERSEY AND NEW YORK PORTIONS OF THE MILFORD, PA-NJ AND PORT JERVIS SOUTH, NJ-NY-PA QUADRANGLES, SUSSEX COUNTY NJ AND ORANGE COUNTY, NY

Donald H. Monteverde² and Jack B. Epstein¹







BEDROCK GEOLOGIC MAP OF THE NEW JERSEY AND NEW YORK PORTIONS OF THE MILFORD, PA-NJ AND PORT JERVIS SOUTH, NJ-NY-PA QUADRANGLES, SUSSEX COUNTY, NJ AND ORANGE COUNTY, NY **GEOLOGIC MAP SERIES GMS 22-1** PLATE 2 OF 2

