DEPARTMENT OF ENVIRONMENTAL PROTECTION
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INTRODUCTION

The Chester 7.5-minute quadrangle is situated in the southwest part of Morris County, in the New Jersey Highlands physiographic province. Although the bedrock geology of the quadrangle has been the subject of study for more than a century (Cook, 1868; Bayley, 1910; Bayley and others, 1914; Sims, 1958; Minard, 1959; Volkert and others, 1990; Herman and Mitchell, 1991), the geologic maps shown in these studies lack continuity with the more recent detailed mapping of adjacent quadrangles, as well as conformity with the present geologic framework proposed for Mesoproterozoic rocks in the New Jersey Highlands. The geologic map and interpretations presented here therefore supersede those shown on all previous bedrock geologic maps of the area of this map.

This report provides updated, detailed geologic information on the stratigraphy, structure and description of geologic units in the map area from geologic mapping in 2009 that is combined with prior mapping from 1985-1987. Cross-section A-A' shows a vertical profile of the geologic units and their structure. Rose diagrams in figures 1-6 provide a directional analysis of selected structural features.

STRATIGRAPHY

Mesozoic rocks

The youngest bedrock is interpreted as Mesozoic in age and forms thin residuum and slope wash preserved on the crest of Mount Paul, in the southeast part of the map. This residuum is predominantly reddish-brown quartz pebble conglomerate that likely correlates to conglomeratic facies of the Upper Triassic Passaic Formation that crops out in the Gladstone quadrangle south of the map area (Houghton and Volkert, 1990).

Paleozoic rocks

Middle Paleozoic bedrock in the quadrangle consists of the Green Pond Conglomerate of Silurian age that crops out in the valley south of Succasunna. It comprises one of the formations of the Green Pond Mountain Region, a fault-bounded, northeast-trending belt of Paleozoic rocks that extends southwest from New York State to Hunterdon County, New Jersey (Herman and Mitchell, 1991; Drake and others, 1996).

Lower Paleozoic rocks of Cambrian through Ordovician age of the Kittatinny Valley sequence are present beneath the German (Long) Valley, Lamington River Valley and the unnamed valley south of Ralston (here named the Peapack-Ralston Valley) where they are in fault contact with, or unconformably overlie Mesoproterozoic rocks. Locally, Paleozoic rocks of the Jutland klippe sequence are unconformably overlain by Mesozoic rocks on Mount Paul. The Kittatinny Valley sequence was previously considered to be part of the Lehigh Valley sequence of MacLachlan (1979) but was reassigned by Drake and others (1996). It includes the Hardyston Quartzite and Kittatinny Supergroup, of which only formations through the Beekmantown Group crop out in the map area. Lower Paleozoic rocks west of the Peapack-Ralston fault correlate lithologically and also correlate temporally to the Hensfoot Formation of the Jutland klippe sequence (Monteverde and Volkert, 2015). They are confined to the Peapack-Ralston Valley where they are in fault contact with Mesoproterozoic rocks on the west, as well as with Paleozoic rocks of the Kittatinny Valley sequence on the east. Rocks of the Jutland klippe sequence were folded and thrust over rocks of the Kittatinny Supergroup during the Taconian orogeny.

Neoproterozoic rocks

Dark greenish-gray, medium-grained diabase dikes of Neoproterozoic age intrude Mesoproterozoic rocks in the northwestern part of the map area but not Paleozoic or younger rocks. The dikes strike northeast and range in thickness from about 1 ft. to possibly as much as 20 ft. They display coarse-grained interiors and fine-grained chilled margins against Mesoproterozoic rocks. Locally, they contain xenoliths of foliated Mesoproterozoic rocks and magnetite ore. Diabase dikes were emplaced into a rift-related extensional tectonic setting in the Highlands about 600 million years ago (Ma) (Volkert and Puffer, 1995).

Mesoproterozoic rocks

Rocks of Mesoproterozoic age of the New Jersey Highlands are present throughout the quadrangle. They include a heterogeneous assemblage of granites, gneisses and rare marble. Mesoproterozoic rocks were metamorphosed to granulite facies at about 1045 Ma (Volkert and others, 2010) during the Ottawan phase of the Grenville orogeny. Estimated temperature for this high-grade metamorphism is constrained from regional calcite-graphite thermometry to 769°C (Peck and others, 2006). The oldest units in the quadrangle include calc-alkaline rocks of the Losee Suite interpreted as having formed in a continental-margin magmatic arc and spatially associated supracrustal rocks formed in a back-arc basin, inboard of the Losee magmatic arc (Volkert, 2004). In the map area, the Losee Suite includes metamorphosed plutonic rocks mapped as quartz-oligoclase gneiss, albite-oligoclase alaskite and diorite, and metamorphosed volcanic rocks mapped as biotite-quartz oligoclase gneiss, hypersthene-quartz-plagioclase gneiss and amphibolite. Elsewhere in the Highlands, rocks of the Losee Suite have yielded sensitive high-resolution ion microprobe (SHRIMP) U-Pb zircon ages of 1282-1248 Ma (Volkert and others, 2010). Supracrustal rocks include quartzofeldspathic rocks mapped as potassic-feldspar gneiss, monazite gneiss, biotite-quartz-feldspar gneiss, clinopyroxene-quartz-feldspar gneiss, calc-silicate rocks mapped as pyroxene gneiss and metacarbonate rocks mapped as marble. Monazite gneiss is unique to the map area where it is confined to the flanks of the Fox Hill Range, west of the Tanners Brook fault. It contains abundant monazite and is interpreted as sediment that formed as a small fluvial placer eroded from a monazite-rich, continentally-derived source (Markewicz, 1965; Volkert and Drake, 1999). Supracrustal rocks have yielded SHRIMP U-Pb zircon ages of 1299-1251 Ma (Volkert and others, 2010) that closely overlap the age of the Losee Suite.

Granite and related rocks of the Byram and Lake Hopatcong Intrusive Suites that comprise the Vernon Supersuite (Volkert and Drake, 1998) form a complete differentiation series that includes monzonite, quartz monzonite, granite, and alaskite of the Byram Suite and of the Lake Hopatcong Suite. Rocks of both suites intrude the Losee Suite and supracrustal rocks. Byram and Lake Hopatcong rocks yielded similar SHRIMP U-Pb zircon ages of 1185-1182 Ma (Volkert and others, 2010). Large bodies of hornblende- and clinopyroxene-bearing granite mapped as microantiperthite granite and minor microantiperthite alaskite crop out in the central and northern part of the area. Although undated, microantiperthite granite appears to grade along strike into hornblende granite of the Byram Suite suggesting, but not proving that it may share a common age and origin with the Vernon Supersuite. For this reason it and alaskite are shown as having an uncertain correlation to other granitic rocks in the map area. Similarly, a small body of biotite-plagioclase gneiss in the eastern part of the area is of uncertain age and correlation. It is deformed by a penetrative metamorphic foliation so all that can be said at this time is that it is older than the 1045 Ma high-grade metamorphism.

The youngest Mesoproterozoic rocks are irregular bodies of granite pegmatite too small to be shown on the map. They are undeformed, contain xenoliths of foliated gneiss and intrude most other Mesoproterozoic rocks in the map area. Pegmatites elsewhere in the Highlands yielded U-Pb zircon ages of 1004 to 986 Ma (Volkert and others, 2005) indicating they were emplaced following the metamorphic peak of the Grenville orogeny.

STRUCTURE

Paleozoic bedding and cleavage

Bedding in Paleozoic rocks of the Green Pond Mountain Region and the Valley and Ridge part of the map area is fairly uniform and strikes northeast at an average of N 48°E (fig. 1) and dips northwest or southeast at 24° to 90° and averages 74°. Bedding in Paleozoic rocks of the Peapack klippe strikes northeast at an average of N 55°E (fig. 2) and dips northwest or southeast at 32° to 81° and averages 62°.

Cleavage (closely-spaced parallel partings) is present in most Paleozoic rocks but is best developed in finer-grained lithologies such as shale and slate of the Jutland klippe sequence. A single spaced cleavage in Paleozoic rocks of the Green Pond Mountain Region and the Valley and Ridge strikes northwest at N 65°W and dips northeast at an average of 62°. Slaty cleavage predominates in rocks of the Peapack klippe. It strikes an average of N 53°E, nearly parallel to the trend of bedding, and dips northwest or southeast at 38° to 86° and averages 63° (fig. 3). A secondary cleavage that crenulates and cuts the primary cleavage strikes northeast at an average of N 46°E and dips northwest or southeast at an average of 30°.

Proterozoic foliation

Crystallization foliation (the parallel alignment of mineral grains) in the Mesoproterozoic rocks formed from compressional stresses that deformed the rocks during high-grade metamorphism at about 1045 Ma. The strike of crystallization foliations is fairly uniform throughout most of the map area, but locally is varied because of deformation of the rocks by folding. They strike mainly northeast at an average of N 46°E (fig.4) and dip predominantly southeast, and less commonly northwest, at 9° to 90° and average 57°. Locally, in the hinge areas of major folds, foliations strike northwest and dip gently to moderately northeast.

Folds

Folds in Paleozoic rocks of the area postdate the development of bedding and formed during the Taconian and Alleghanian orogenies at about 450 Ma and 250 Ma, respectively. Folds in rocks of the Green Pond Mountain Region and Valley and Ridge are characterized by a broad, open and upright, northeast-plunging syncline that deforms rocks of Cambrian through Silurian age. Paleozoic rocks of the Peapack klippe were deformed into open to tight, upright anticlines and synclines that plunge an average of 15° toward N 57°E and less commonly S 42°W.

Folds that deform penetrative metamorphic foliation in Mesoproterozoic rocks resulted from compressional stresses during the Ottawan phase of the Grenville orogeny. Characteristic fold patterns include broad to tight, predominantly northeast-plunging to locally southwest-plunging, upright to northwest overturned antiforms and synforms and, less commonly, east-plunging, upright to north overturned antiforms and synforms. Relative timing of these fold phases is uncertain but they clearly predate the development of folds in the Paleozoic rocks of the quadrangle and thus are of Mesoproterozoic age. Throughout the map area the dominant plunge of mineral lineations in Mesoproterozoic rocks is parallel to the axes of major folds. Lineations plunge 40° to 45° toward N 52°E. Minor variations of the dominant trend plunge an average of 27° to N 79°E and 22° to S 30°W.

Faults

The structural geology of the Chester quadrangle is dominated by a series of northeast-trending faults that deform both Mesoproterozoic and Paleozoic rocks. From the northwest they include the Reservoir fault, Turkey Brook fault, Longwood Valley fault, Berkshire Valley fault, Picatinny fault, Tanners Brook fault, Black River fault, Rockaway Valley fault, Powder Mill fault, Mendham fault, and Peapack-Ralston thrust fault.

The Reservoir fault extends beneath Budd Lake in the northwest corner of the map area and is not exposed. However, it is known to be present from mapping in the adjacent Hackettstown quadrangle (Volkert and others, 1994) and the Stanhope quadrangle (Volkert and others, 1989) where it contains Mesoproterozoic rocks on both sides. The fault strikes northeast and dips steeply southeast to vertically. It is characterized by ductile deformation fabric in the center of the fault zone and overprinted by a pervasive brittle deformation fabric that envelops the mylonite over a width of as much as 1,000 ft. The fault records a history of multiple reactivations dating from the Mesoproterozoic involving normal, strike slip, and reverse movement, with latest movement sense being normal.

The Turkey Brook fault extends through Musconetcong Mountain where it contains Mesoproterozoic rocks on both sides. The fault strikes northeast and dips southeast about 75°. It is characterized by brittle deformational fabric that consists of brecciation, recrystallization and low temperature retrogression of mafic mineral phases, chlorite or epidote-coated fractures or slickensides, and (or) close-spaced fracture cleavage. The latest movement sense is normal.

The Longwood Valley fault borders the northwest side of Long Valley where it contains Mesoproterozoic rocks on both sides. The fault strikes northeast and dips southeast about 75°. It is characterized by brittle deformational fabric similar to that of the Turkey Brook fault. The latest movement sense on the Longwood Valley fault is normal.

The Berkshire Valley fault contains Paleozoic rocks on both sides along its entire length. It is not exposed in the map area or along strike and its occurrence was inferred by Herman and Mitchell (1991) based on missing stratigraphic units. In the map area it appears to be cut off by the Longwood Valley fault. The Berkshire Valley fault strikes N 40°E and dips southeast about 45°. The fault is characterized by brittle deformation fabric of indeterminate width. The latest movement sense appears to be reverse.

The Picatinny fault extends along the southeast side of Green Pond Mountain (Herman and Mitchell, 1991) and continues southwest through the central German Valley where it contains Paleozoic rocks on both sides along most of its length. The fault strikes N 40°E and dips southeast about 50°. It is characterized by brittle fabric that has a total width of not more than a few hundred feet. The latest movement sense appears to be reverse.

The Tanners Brook-Green Pond fault is here interpreted as the merged Green Pond fault that extends from the Newfoundland quadrangle to the Dover quadrangle (Kümmel and Weller, 1902; Barnett, 1976; Herman and Mitchell, 1991) and the Tanners Brook fault that extends through the map area (Volkert and others, 1990) and continues southwest. In the map area the fault contains mainly Paleozoic rocks on both sides to the northeast and both Mesoproterozoic rocks and Paleozoic rocks to the southwest. The fault strikes N 40°E and dips northwest about 75°. It is characterized by brittle deformation fabric that has a width of 300 to 400 ft. The latest movement was predominantly normal, although evidence for reverse movement is also seen in the Dover quadrangle (Herman and Mitchell, 1991) and the map area.

The newly-recognized Black River fault extends along the southeast side of the Lamington River Valley where it contains Mesoproterozoic rocks on the footwall and Paleozoic rocks on the hanging wall, and along strike to the northeast Paleozoic rocks on both sides. The fault is not exposed and is known mainly from drill hole and test well data (Lancy Laboratories, 1984). The fault strikes northeast and dips southeast about 70°. It is characterized by brittle deformation fabric of indeterminate width and the latest movement sense is normal.

The Rockaway Valley fault extends through the eastern part of the map area where it bifurcates and contains Mesoproterozoic rocks on both sides. It does not appear to continue and may lose displacement and end in the south-central part of the area. The fault strikes northeast and dips southeast about 65° to 70°. It is characterized mainly by brittle deformation fabric that overprints an earlier, steeply-dipping ductile deformation fabric. The latest movement sense is normal.

The Powder Mill fault extends through the southeastern part of the area where it merges with, or is cut off by the Mendham fault. It contains Mesoproterozoic rocks on both sides. The fault strikes N 40°E and dips southeast about 60°. It is characterized by an earlier ductile deformation fabric that is overprinted by a brittle deformation fabric. The latest movement sense is reverse.

The Tewksbury fault extends through the southern part of the area where it contains Mesoproterozoic rocks on the footwall and the hanging wall. It is interpreted as a Proterozoic fault that is cut off to the east by the Mesozoic-age Flemington fault. The Tewksbury fault strikes east-northeast and dips southeast about 50°. It is characterized by brittle deformation fabric that overprints an earlier steeply southeast-dipping ductile deformation fabric. The latest movement sense is normal.

The Flemington fault borders the west side of Peapack-Ralston Valley where it places Paleozoic and Mesozoic rocks of the hanging wall against Mesoproterozoic rocks of the footwall. The fault strikes northeast and dips southeast about 50°. It is characterized by brittle deformation fabric along most of its length, but at Pottersville, in the Gladstone quadrangle, a thick zone of ductily deformed Mesoproterozoic rocks is preserved on the footwall of the fault (Houhton and Volkert, 1990). The latest movement sense is normal with a component of right-lateral strike-slip.

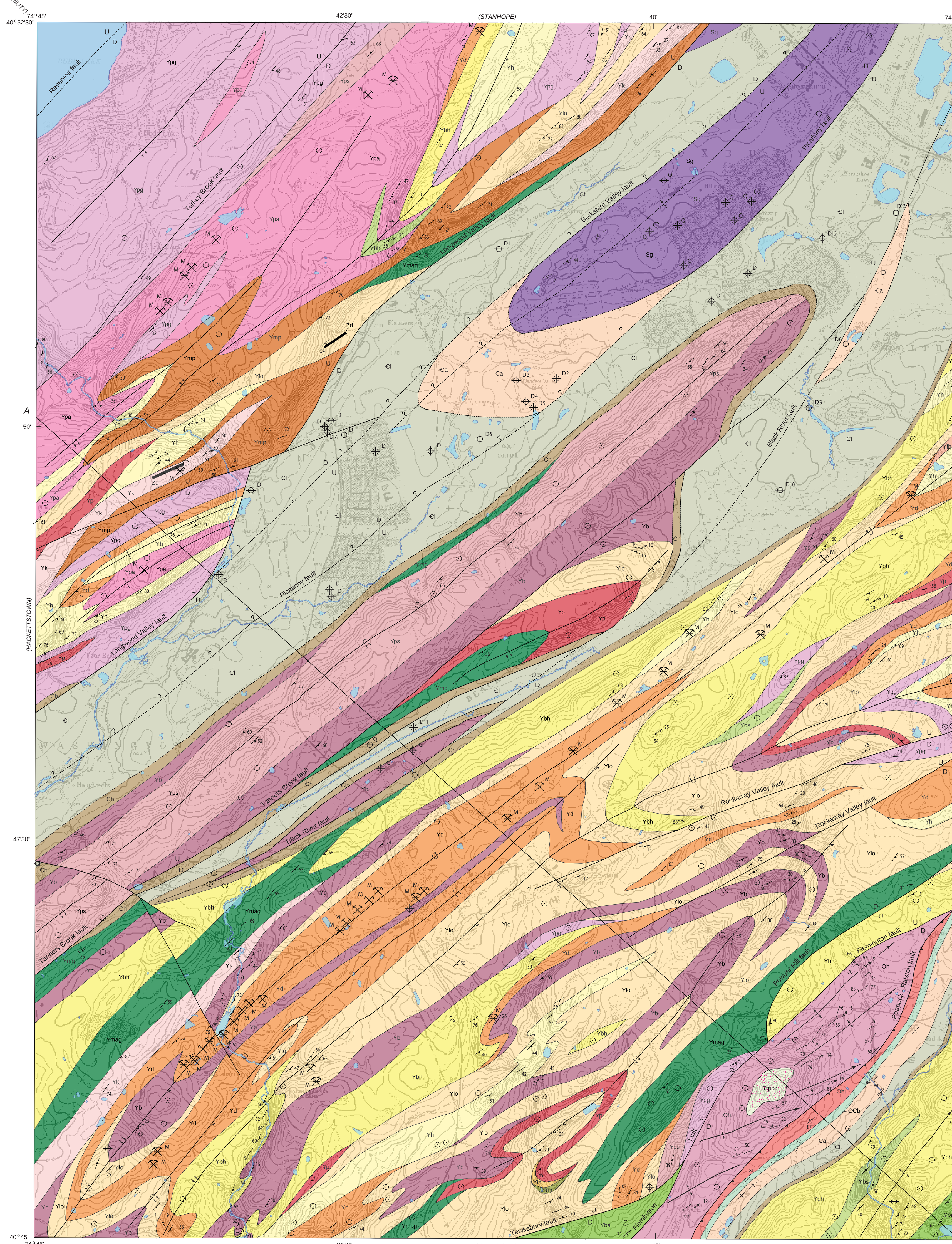
The Peapack-Ralston thrust fault extends through the southeastern part of the map area where it contains Mesoproterozoic and Paleozoic rocks of the Kittatinny Valley Sequence on the hanging wall and Paleozoic rocks of the Peapack klippe on the footwall. The fault strikes northeast and dips southeast about 40°. It is characterized mainly by brittle deformation fabric but may also contain an earlier ductile deformation fabric as well. The latest movement sense is reverse.

Joints

Joints are a ubiquitous feature in all rocks of the quadrangle. They are characteristically planar, moderately well formed, moderately to widely spaced, and moderately to steeply dipping. Surfaces of joints are typically unmineralized, except where near faults, and are smooth and less commonly slightly irregular. Joints are spaced from a foot to several feet apart. Those developed in massive rocks such as granite tend to be more widely spaced, irregularly formed and discontinuous than joints in the layered gneisses and finer-grained Paleozoic rocks. Those formed near faults are typically spaced <2 feet apart.

Joints are developed in all Paleozoic rocks, but are more common in massive rocks such as limestone, dolomite and sandstone. Two main joint sets are present, one of which is nearly parallel to the strike of bedding and the other is a cross joint (fig. 5). Bedding-parallel joints strike northeast at an average of N 59°E and dip northwest at an average of 50°. The cross joints strike at an average of N 35°W and dip northeast and, less commonly, southwest at an average of 71°.

The dominant joints in Mesoproterozoic rocks are nearly perpendicular to the strike of crystallization foliation, a consistent feature in Mesoproterozoic rocks throughout the Highlands (Volkert, 1996). Therefore, their strike is somewhat varied because of folding. The dominant joints in Mesoproterozoic rocks strike northwest at an average of N 52°W (fig. 6) and dip moderately to steeply nearly equally northeast or southwest. A minor strike joint set trends northeast at an average of N 65°E and dips mainly northwest. The average dip of all joints in the Mesoproterozoic rocks is 71°.



Base map from U.S. Geological Survey, 1954. Photorevised 1981.

SCALE 1:24000

1 1/2 0 1 mile
1000 0 1000 2000 3000 4000 5000 6000 7000 feet
1 1/2 0 1 kilometer

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

APPROXIMATE MEAN DECLINATION, 1999

LOCATION IN NEW JERSEY

Bedrock geology mapped by R.A. Volkert in 2009,1985-1987
Digital cartography by M.W. Girard
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The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U. S. Government.
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BEDROCK GEOLOGIC MAP OF THE CHESTER QUADRANGLE MORRIS COUNTY, NEW JERSEY

by
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2018

ECONOMIC RESOURCES

Mesoproterozoic rocks in the Chester quadrangle host economic deposits of iron ore (magnetite) mined predominantly during the 19th century, with most of the important ones concentrated in a belt that extends along the south side of the Lamington River Valley. Descriptions of most of the mines are given in Bayley (1910). Graphite was mined from a single, small prospect east of Peapack Brook (Bayley and others, 1914). Attempts to locate the graphite workings were unsuccessful because they are likely covered over by development.

Paleozoic rocks were quarried from small abandoned operations in the Green Pond Conglomerate in the German Valley, from dolomite of the Kittatinny Valley Sequence and also from rocks of the Peapack klippe in the Peapack-Ralston Valley. Deposits of sand and gravel were worked at a number of locations in the German and Lamington River valleys, mainly in the vicinity of Succasunna (Witte, 2008).

DESCRIPTION OF MAP UNITS

Newark Basin

Trpcq — **Passaic Formation (conglomerate lithofacies) (Upper Triassic) –** Dark-reddish-brown weathering, grayish red to dark-reddish-brown, medium-bedded, pebble conglomerate in fine- to medium-grained sand and silt matrix. Clasts are subrounded and composed of vein quartz, quartz sandstone and siltstone and shale. Unit is confined to the crest of Mount Paul where it does not crop out and was mapped on float. Lower contact is unconformable on rocks of the Peapack klippe. Thickness is unknown.

Green Pond Mountain Region

Sg — **Green Pond Conglomerate (Middle and Lower Silurian)** (Rogers, 1836) – Medium- to coarse-grained quartz-pebble conglomerate, quartzitic arkose and orthoquartzite, and thin- to thick-bedded reddish-brown siltstone. Grades downward into less abundant gray, very dark red, or grayish-purple, medium- to coarse-grained, thin- to very thick bedded pebble to cobble-conglomerate containing clasts of red shale, siltstone, sandstone, and chert; yellowish-gray sandstone and chert; dark-gray shale and chert; and white-gray and pink milky quartz. Quartz cobbles are as much as 4 in. long. Unconformably overlies the Leithsville Formation, Allentown Dolomite or Mesoproterozoic rocks. Unit is about 1,000 ft. thick in the map area.

Jutland Klippe Sequence

Oh — **Hensfoot Formation (Upper to Lower Ordovician) –** Interbedded red, tan, gray, and green, thin bedded shale and less abundant siltstone, fine-grained sandstone, pinkish-gray quartzite, and quartz pebble conglomerate. Locally contains interbedded dark-gray, fine-grained to aphanitic, thin- to medium-bedded limestone; limestone can be crossbedded, contain floating quartz sand grains and edgewise conglomerate. Unit correlates to the Hensfoot Formation in the High Bridge quadrangle (Monteverde and others, 2015) and Jutland klippe upper unit B (Perissoratis and others, 1979). The upper part of the shale coontains the graptolite faunas of the *Nemagraptus gracilis* to *Climacograptus bicornis* zones of Ross and others, 1982 (S. Finney written commun. to R. Dalton, 1991 [on file at New Jersey Geological and Water Survey]) now considered the lower part of the Upper Ordovician. Lower dolomite beds contain conodonts of North Atlantic Province *Oepikodus eve* to *Baltoniodus navis* (Harris and others, 1995) high E to 2 and are late Early Ordovician to early Middle Ordovician. Thickness varies and may be as much as 1,500 ft.

Kittatinny Valley Sequence

Obu — **Beekmantown Group, upper part (Lower Ordovician) –** Light- to medium-gray- to yellowish-gray-weathering, medium-light to medium-gray, aphanitic to medium-grained, thin- to thick-bedded, locally laminated, slightly fetid dolomite. Locally light-gray- to light-bluish-gray-weathering, medium- to dark-gray, fine-grained, medium-bedded limestone occurs near the top of unit. Grades downward into medium- to dark-gray on weathered surface, medium- to dark-gray where fresh, medium- to coarse-grained, medium- to thick-bedded, strongly fetid dolomite contains pods, lenses and layers of dark-gray to black rugose chert. Lower contact conformable and grades into the fine-grained, laminated dolomite of Beekmantown Group, lower part. Contains conodonts of North American Midcontinent province *Rossodus manitouensis* zone to *Oepikodus communis* zone (Karklins and Repetski, 1989), so that unit is Ibexian (Tremadocian to Arenigian) as used by Sweet and Bergstrom (1986). In map area, unit correlates with the Epler and Rickenbach Dolomite of Drake and others (1985) and the Ontelaunee Formation of Markewicz and Dalton (1977). Unit averages about 200 ft. in thickness and is as much as 800 ft. thick.

OЄbl — **Beekmantown Group, lower part (Lower Ordovician to Upper Cambrian) –** Upper sequence is light- to medium-gray- to dark-yellowish-orange-weathering, light-olive-gray to dark-gray, fine- to medium-grained, very thin- to medium-bedded locally laminated dolomite. Middle sequence is olive-gray- to light-brown- and dark-yellowish-orange-weathering, medium- to dark-gray, aphanitic to medium-grained, thin-bedded, locally well laminated dolomite which grades into discontinuous lenses of light-gray- to light-bluish-gray-weathering, medium- to dark-gray, fine-grained, thin- to medium-bedded limestone. Limestone has "reticulate" mottling characterized by anastomosing light-olive-gray- to grayish-orange-weathering, silty dolomite laminae surrounding lenses of limestone. Limestone may be completely dolomitized locally. Grades downward into medium dark- to dark-gray, fine-grained, well laminated dolomite having local pods and lenses of black to white chert. Lower sequence consists of medium- to medium-dark-gray, aphanitic to coarse-grained, thinly-laminated to thick-bedded, slightly fetid dolomite having quartz-sand laminae and sparse, very thin to thin, black chert beds. Individual bed thickness decreases and floating quartz sand content increases toward lower gradational contact. Contains conodonts of North American Midcontinent province *Cordylodus proavus to Rossodus manitouensis* zones (Karklins and Repetski, 1989) as used by Sweet and Bergstrom (1986), so that unit is Ibexian (Tremadocian). Entire unit is Stonehenge Limestone of Drake and others (1985) and Stonehenge Formation of Volkert and others (1989). Markewicz and Dalton (1977) correlate upper and middle sequences as Epler Formation and lower sequence as Rickenbach Formation. Unit is about 600 ft. thick.

Єa — **Allentown Dolomite (Upper Cambrian)** (Wherry, 1909) – Upper sequence is light-gray- to medium-gray-weathering, medium-light- to medium-dark-gray, fine- to medium-grained, locally coarse-grained, medium- to very thick-bedded dolomite; local shaly dolomite near the bottom. Floating quartz sand and two series of medium-light- to very light-gray, medium-grained, thin-bedded quartzite and discontinuous dark-gray chert lenses occur directly below upper contact. Lower sequence is medium- to very-light-gray-weathering, light- to medium dark-gray, fine- to medium-grained, thin- to medium-bedded dolomite and shaly dolomite. Weathered exposures characterized by alternating light- and dark-gray beds. Ripple marks, oolites, algal stromatolites, cross-beds, edgewise conglomerate, mud cracks, and paleosol zones occur throughout but are more abundant in lower sequence. Lower contact gradational into Leithsville Formation. Unit contains a trilobite fauna of Dresbachian (early Late Cambrian) age (Weller, 1903; Howell, 1945). Approximately 1,800 ft. thick regionally.

Єl — **Leithsville Formation (Middle to Lower Cambrian)** (Wherry, 1909) – Upper sequence, rarely exposed, is mottled, medium-light- to medium-dark-gray-weathering, medium- to medium-dark-gray, fine- to medium-grained, medium- to thick-bedded, locally pitted and friable dolomite. Middle sequence is grayish-orange or light- to dark-gray, grayish-red, light-greenish-gray- or dark-greenish-gray-weathering, aphanitic to fine-grained, thin- to medium-bedded dolomite, argillaceous dolomite, dolomitic shale, quartz sandstone, siltstone, and shale. Lower sequence is medium-light- to medium-gray-weathering, medium-gray, fine- to medium-grained, thin- to medium-bedded dolomite. Quartz-sand lenses occur near lower gradational contact with Hardyston Quartzite. Archaeocyathids of Early Cambrian age are present in formation at Franklin, New Jersey, suggesting an intraformational disconformity between Middle and Early Cambrian time (Palmer and Rozanov, 1967). Unit also contains *Hyolithellus micans* (Offield, 1967; Markewicz, 1968). Approximately 800 ft. thick regionally.

Єh — **Hardyston Quartzite (Lower Cambrian)** (Wolff and Brooks, 1898) – Medium- to light-gray, fine- to coarse-grained, medium- to thick-bedded quartzite, arkosic sandstone and dolomitic sandstone. Contains Scolithus linearis (?) and fragments of the trilobite *Olenellus thompsoni* of Early Cambrian age (Nason, 1891; Weller, 1903). Thickness ranges from 0 ft. to a maximum of 200 ft. regionally.

New Jersey Highlands

Zd — **Diabase dikes (Neoproterozoic)** (Volkert and Puffer, 1995) – Light gray- or brownish-gray-weathering, dark-greenish-gray, aphanitic to fine-grained dikes. Composed principally of plagioclase (labradorite to andesine), augite, and ilmenite and (or) magnetite. Locally occurring pyrite blebs are common. Contacts are typically chilled and sharp against enclosing Mesoproterozoic rocks. Dikes are as much as 20 ft. wide.

Vernon Supersuite (Volkert and Drake, 1998)
Byram Intrusive Suite (Drake, 1984)

Ybh — **Hornblende granite (Mesoproterozoic) –** Pinkish-gray- to buff-weathering, pinkish-white or light-pinkish-gray, medium- to coarse-grained, foliated granite composed principally of microcline microperthite, quartz, oligoclase, and hornblende (hastingsite). Some variants are quartz monzonite or quartz syenite. Unit commonly includes bodies of pegmatite too small to be shown on the map.

Yba — **Microperthite alaskite (Mesoproterozoic) –** Pinkish-gray- to buff-weathering, pinkish-white or light-pinkish-gray, medium- to coarse-grained, foliated alaskite composed principally of microcline microperthite, quartz, and oligoclase. Locally contains small clots and disseminated grains of magnetite.

Ybs — **Hornblende monzonite (Mesoproterozoic) –** Pinkish-gray- to buff-weathering, pinkish-gray or greenish-gray, medium- to coarse-grained, foliated monzonite and less abundant quartz monzonite composed of microcline microperthite, oligoclase, hornblende (hastingsite), and quartz. Locally contains clinopyroxene (hedenbergite) and hornblende.

Ybb — **Biotite granite (Mesoproterozoic) –** Pinkish-gray- to buff-weathering, pinkish-white or light pinkish-gray medium- to coarse-grained, foliated granite composed of microcline microperthite, quartz, oligoclase, and biotite.

Lake Hopatcong Intrusive Suite (Drake and Volkert, 1991)

Ypg — **Pyroxene granite (Mesoproterozoic) –** Buff- or white-weathering, greenish-gray, medium- to coarse-grained, foliated granite containing mesoperthite to microantiperthite, quartz, oligoclase, and clinopyroxene (hedenbergite). Common accessory minerals include titanite, magnetite, apatite, and trace amounts of zircon and pyrite.

Ypa — **Pyroxene alaskite (Mesoproterozoic) –** Buff- or white-weathering, greenish-buff to light pinkish-gray, medium- to coarse-grained, massive, foliated alaskite composed of mesoperthite to microantiperthite, quartz, oligoclase, and sparse amounts of clinopyroxene (hedenbergite). Common accessory minerals include titanite, magnetite, apatite, and trace amounts of zircon.

Yps — **Pyroxene monzonite (Mesoproterozoic) –** Gray to buff- or tan-weathering, greenish-gray, medium- to coarse-grained, massive, indistinctly foliated rock of syenitic to monzonitic composition. Composed of mesoperthite, microantiperthite to microcline microperthite, oligoclase, clinopyroxene (hedenbergite), titanite, magnetite, and local apatite and quartz.

Back-Arc Basin Supracrustal Rocks

Yk — **Potassic feldspar gneiss (Mesoproterozoic) –** Light-gray- or pinkish-buff-weathering, pinkish-white or light-pinkish-gray, medium-grained and locally coarse-grained, foliated gneiss composed of quartz, microcline microperthite, oligoclase, and varied amounts of biotite, garnet and magnetite.

Ymg — **Monazite gneiss (Mesoproterozoic) –** Buff weathering, light-greenish-gray to greenish-buff, medium-grained, foliated gneiss composed of microcline microperthite, quartz, oligoclase, biotite, and monazite. Locally contains hornblende, zircon, and magnetite.

Yb — **Biotite-quartz-feldspar gneiss (Mesoproterozoic) –** Gray-weathering, locally rusty, gray, tan, or greenish-gray, medium- to coarse-grained, layered and foliated gneiss containing microcline microperthite, oligoclase, quartz, and biotite. Locally contains garnet, sillimanite, and magnetite. Graphite and pyrrhotite are present in rusty gneiss. Commonly contains interlayers of light-gray, vitreous, medium-grained, massive to foliated quartzite composed principally of quartz and variable amounts of graphite.

Ymp — **Clinopyroxene-quartz-feldspar gneiss (Mesoproterozoic) –** Pinkish-gray- or pinkish-buff-weathering, white, pale-pinkish-white, or light-gray, medium- to locally coarse-grained, foliated gneiss composed of quartz, microcline, oligoclase, clinopyroxene, and trace amounts of epidote, biotite, titanite, and magnetite.

Yp — **Pyroxene gneiss (Mesoproterozoic) –** White- or tan-weathering, greenish-gray, medium-grained, well layered and foliated gneiss containing oligoclase, clinopyroxene, and sparse amounts of hornblende, epidote, titanite, or scapolite. Quartz content is highly variable. Unit is commonly interlayered with pyroxene-bearing amphibolite.

Ymr — **Marble (Mesoproterozoic) –** White, coarse-crystalline, calcitic marble with accessory clinopyroxene, serpentine and phlogopite. Unit is confined to one very small occurrence along the east side of Peapack Brook, but does not crop out and was mapped on the basis of rare float.

Magmatic Arc Rocks
Losee Suite (Drake, 1984; Volkert and Drake, 1999)

Ylo — **Quartz-oligoclase gneiss (Mesoproterozoic) –** White-weathering, light-greenish-gray, medium- to coarse-grained, moderately layered and foliated gneiss to indistinctly foliated gneiss and less abundant granofels composed of oligoclase or andesine, quartz, and variable amounts of hornblende, biotite, and clinopyroxene. Locally contains thin, conformable layers of amphibolite.

Yla — **Albite-oligoclase alaskite (Mesoproterozoic) –** White-weathering, light-greenish-gray, medium- to coarse-grained alaskite and local granite composed of characteristic pink and white albite or oligoclase, quartz, and variable amounts of hornblende and (or) augite, and magnetite. Appears to be spatially related to quartz-oligoclase gneiss from which it may have formed through sodium metasomatism. Unit is confined to a single, small body along Peapack Brook in the southern part of the map.

Ylb — **Biotite-quartz-oligoclase gneiss (Mesoproterozoic) –** White- or light-gray-weathering, medium-gray or greenish-gray, medium- to coarse-grained, moderately well layered and foliated gneiss composed of oligoclase or andesine, quartz, biotite, and trace amounts of garnet. Some outcrops contain hornblende. Locally contains thin, conformable layers of amphibolite.

Yh — **Hypersthene-quartz-plagioclase gneiss (Mesoproterozoic) –** Gray- or tan-weathering, greenish-gray or greenish-brown, medium-grained, moderately well layered and foliated, greasy lustered gneiss composed of andesine or oligoclase, quartz, clinopyroxene, hornblende, and hypersthene. Commonly contains thin, conformable layers of amphibolite and mafic-rich quartz-plagioclase gneiss.

Yd — **Diorite (Mesoproterozoic) –** Light-gray- to tan-weathering, greenish-gray or greenish-brown, medium- to coarse-grained, greasy lustered, massive, moderately foliated rock containing andesine or oligoclase, augite, hornblende, hypersthene, and magnetite. Unit commonly contains thin mafic layers or schlieren having the composition of amphibolite and leucocratic to mafic layers of quartz-oligoclase gneiss.

Other Rocks

Ymag — **Microantiperthite granite (Mesoproterozoic) –** Tan- to buff-weathering, light-greenish-gray, medium- to coarse-grained, massive, foliated granite composed of microantiperthite to microperthite, quartz that is locally brown rust-stained, oligoclase, and hornblende. Locally contains minor amounts of biotite, altered clinopyroxene, and magnetite. Unit is tentatively interpreted to be petrogenetically related to intrusive rocks of the Byram and Lake Hopatcong Suites.

Yu — **Mesoproterozoic rocks, undifferentiated –** Shown in cross section only.

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BEDROCK GEOLOGIC MAP OF THE CHESTER QUADRANGLE
MORRIS COUNTY, NEW JERSEY
OPEN FILE MAP OFM 120

EXPLANATION OF MAP SYMBOLS

Contact - Dotted where concealed

Faults - Dotted where concealed. Queried where uncertain

U/D — High angle fault - U, upthrown side; D, downthrown side

Inclined thrust fault - teeth on upper plate

FOLDS

Folds in Proterozoic rocks showing trace of axial surface, direction and dip of limbs, and direction of plunge.

Antiform

Synform

Overturned antiform

Overturned synform

20 — Minor asymmetric fold – showing rotation sense viewed down plunge

Folds in Paleozoic rocks showing trace of axial surface, direction and dip of limbs, and direction of plunge. Folds in bedding and/or cleavage.

Anticline

Syncline

PLANAR FEATURES

Strike and dip of crystallization foliation

75 — Inclined

Vertical

Strike and dip of mylonitic foliation

70 — Inclined

Strike and dip of beds

10 — Inclined

Vertical

30 — Overturned

80 — Strike and dip of cleavage in Paleozoic rocks

LINEAR FEATURES

30 — Bearing and plunge of mineral lineation in Proterozoic rocks

20 — Bearing and plunge of intersection of bedding and cleavage

OTHER FEATURES

M — Abandoned mine – M, magnetite; G, graphite

D — Abandoned rock quarry – G, gneiss; Q, quartzite; D, dolomite; Sh, shale

Location of bedrock subcrop or float used to draw unit contacts

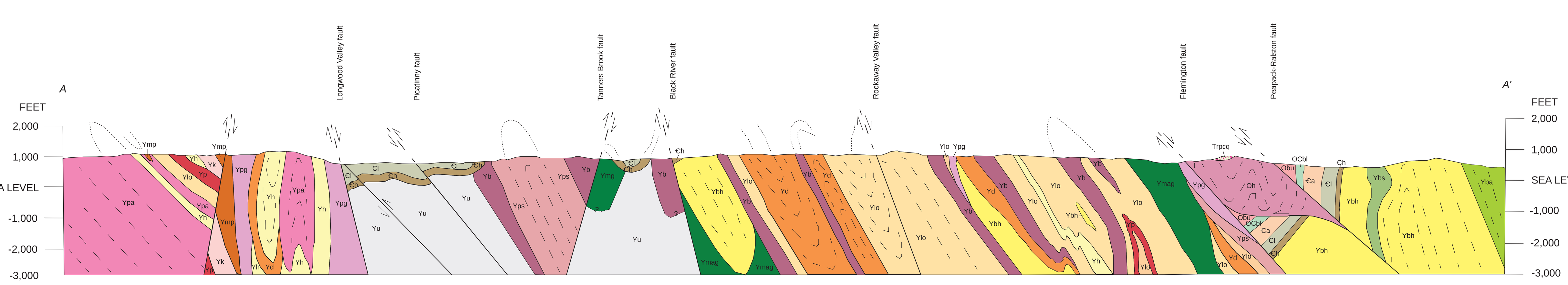
D — Well bottoming in dolomite, D; quartzite, Q. Number corresponds to numbering on Table 1.

Form lines showing foliation in Proterozoic rocks in cross section

TABLE 1. Records of wells in dolomite in the German Valley (GV) and Lamington River Valley (LV)*

Well no. (location)	Total depth (ft.)	Log or bedrock drilled (depth in ft. below ground surface)
1 (GV)	unknown	Bottomed in Leithsville Fm.
2 (GV)	400	Bottomed in Allentown Dolomite
3 (GV)	250	Bottomed in Allentown Dolomite
4 (GV)	unknown	Bottomed in Allentown Dolomite
5 (GV)	250	0-152 – overburden
		152-178 – Allentown Dolomite
		178-250 – Leithsville Fm.
6 (GV)	303	0-125 – overburden
		125-180 – Allentown Dolomite
		180-303 – Leithsville Fm.
7 (GV)	unknown	Bottomed in Leithsville Fm.
8 (LV)	708	0-275 – overburden
		275-450 – Allentown Dolomite
		450-708 – Leithsville Fm.
9 (LV)	504	0-200 – overburden
		200-504 – Leithsville Fm.
10 (LV)	422	0-195 – overburden
		195-422 – Leithsville Fm
11 (LV)	242	0-155 – overburden
		155-242 – Leithsville Fm
12 (LV)	700	0-122 – overburden
		122-603 – Dolomite
		603-607 – Dolomite + voids
		607-700 – Dolomite
13 (LV)	223	0-211 – overburden
		211-223 – Dolomite

* Table modified from Volkert and others, (1990). Wells logged by F.J. Markewicz.



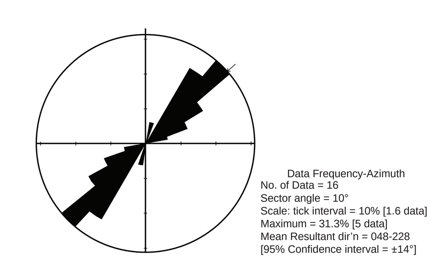


Figure 1. Rose diagram of the strike of bedding in Paleozoic rocks of the Green Pond Mountain Region and Valley and Ridge.

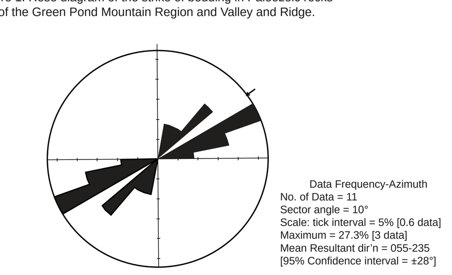


Figure 2. Rose diagram of the strike of bedding in Paleozoic rocks of the Peapack Klippe.

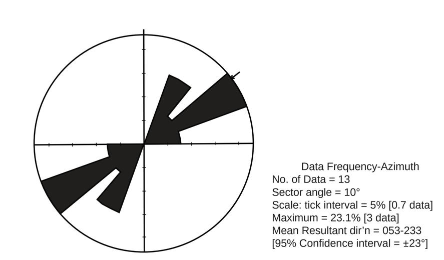


Figure 3. Rose diagram of the strike of slaty and spaced cleavage in Paleozoic rocks from the Peapack Klippe.

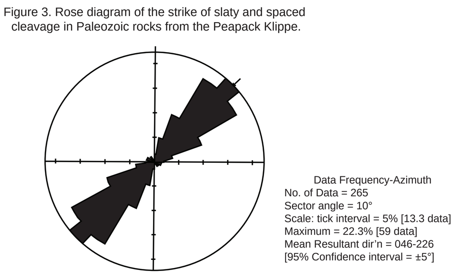


Figure 4. Rose diagram of the strike of crystallization foliations in Mesoproterozoic rocks.

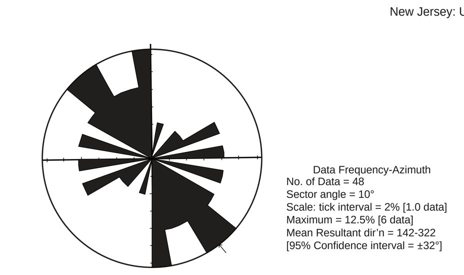


Figure 5. Rose diagram of the strike of joints in all Paleozoic rocks.

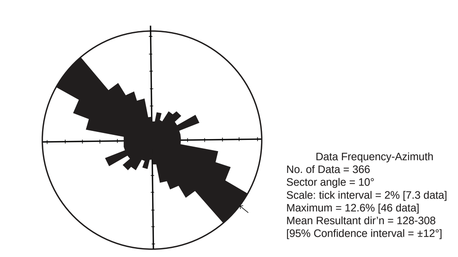


Figure 6. Rose diagram of the strike of joints in Mesoproterozoic rocks.

CORRELATION OF MAP UNITS