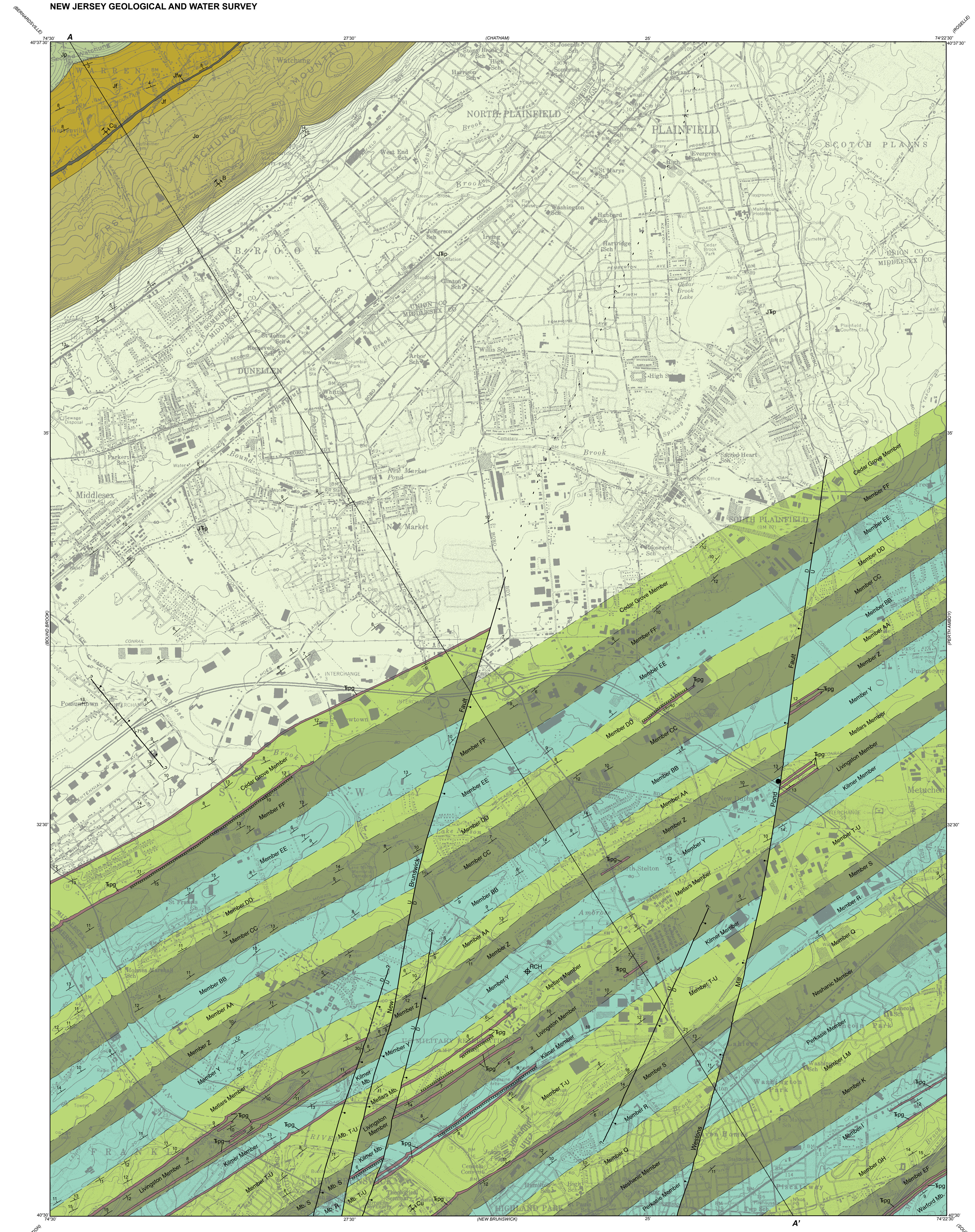
DEPARTMENT OF ENVIRONMENTAL PROTECTION
WATER RESOURCES MANAGEMENT
NEW JERSEY GEOLOGICAL AND WATER SURVEY



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Topography from aerial photographs by photogrammetric methods.
Aerial photographs taken 1942. Field check 1943. Culture revised by
the United States Geological Survey 1954.

Polyconic projection. 1927 North American datum 10,000-foot grid
based on New Jersey coordinate system 1000-meter Universal
Transverse Mercator grid ticks, zone 18.

SCALE 1:24,000
1 1/2 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

Bedrock geology mapped by R.A. Volkert, D.H. Monteverde and S.M. Silvestri
in 1984, 1996 and 2011.
Digital cartography by N.L. Malerba.
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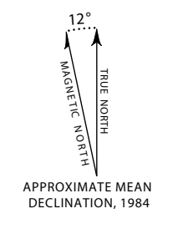
Bedrock Geologic Map of the Plainfield Quadrangle
Union, Middlesex and Somerset Counties, New Jersey

by
Richard A. Volkert, Donald H. Monteverde and Shay Maria Silvestri
2013


LOCATION IN NEW JERSEY



APPROXIMATE MEAN DECLINATION, 1984

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

INTRODUCTION

The Plainfield quadrangle is located in the north-central part of the state, in Union, Middlesex and Somerset Counties, in a mixed commercial, industrial and residential setting. It is situated entirely in the Piedmont Physiographic Province. The dominant topography is in the northwest part of the map area and consists of two parallel ridges, the First and Second Watchung Mountains, with elevations of as much as 540 feet above sea level. The central and southern parts of the quadrangle are characterized by subdued topography with elevations of 100 feet or less above sea level. The south-flowing Raritan River is the dominant drainage, and streams of smaller order, such as Green Brook, Bound Brook, and Ambrose Brook also drain the area.

STRATIGRAPHY

The quadrangle is underlain by bedrock of Mesozoic age that was deposited in the Newark basin, a northeast-trending rift basin that contains approximately 24,600 feet of interbedded sedimentary and igneous rocks. These consist of conglomerate, sandstone, siltstone, and shale of fluvial and lacustrine origin, and three tholeiitic basalt formations of igneous origin. However, only the middle and upper parts of this succession crop out in the map area. The bedrock consists of progressively younger formations from south to north. Sedimentary units include the Upper Triassic Lockatong Formation, Upper Triassic to Lower Jurassic Passaic Formation and Lower Jurassic Feltville Formation. The Lockatong Formation does not crop out in the area and is shown in cross section only. It is overlain by the Passaic Formation that underlies most of the area. The Feltville Formation crops out in the northwest, in the valley between the First and Second Watchung Mountains.

Stratigraphic correlation of gray bed sequences was facilitated by geologic mapping in adjacent quadrangles that includes Monmouth Junction (Parker and Houghton, 1990), Chatham (Monteverde and Volkert, 2005), New Brunswick (Stanford and others, 1998), and Bound Brook (Volkert and Monteverde, 2011). Measured sections by Silvestri (unpublished data), the Rutgers corehole, drilled to -3,096 feet as part of the Newark Basin Coring Project (NBCP) (see map for core hole location), and the NBCP Weston and Somerset cores (Olsen and others, 1996) were used for stratigraphic control of members in the Passaic Formation. An additional 15 members are recognized above the Cedar Grove Member in the Passaic Formation based on stratigraphic correlation of NBCP cores (Olsen and others, 1996). Because of sparse bedrock exposure in the northern part of the map area they are not shown, although the members are likely present. Members are colored on the map, but not in the map unit descriptions, to aid in their visual recognition. A generalized log of the Rutgers core is shown in figure 1.

Igneous units include the Orange Mountain Basalt, Preakness Basalt and diabase, all of Lower Jurassic age. Orange Mountain Basalt underlies the First Watchung Mountain and Preakness Basalt the Second Watchung Mountain in the northwest part of the map. Preakness Basalt contains a thin sedimentary unit above the first flow, and also coarse-grained to locally pegmatitic layers mapped as gabbroid that occur at several stratigraphic intervals. Gabbroid and pegmatite layers are interpreted as forming through fractionation from fine-grained basalt in the Preakness (Puffer and Volkert, 2001). Diabase does not crop out in the quadrangle but was drilled in the lowermost part of the Rutgers corehole. Although it was interpreted as a sill (Olsen and others, 1996), it may be a dike similar to the thin diabase dike that intrudes the Passaic Formation directly to the south, along the Raritan River (Stanford and others, 1998).

STRUCTURE

Bedding

The overall trend of the bedrock units is controlled by their location on the south end of the Watchung syncline, a regional, northeast-plunging fold structure (Drake and others, 1996). Bedding strikes uniformly at an average of N.55°E. (fig. 2). Beds dip northwest at 3° to 21°, and average 12°, except for one dip of 71° along a small fault.

Faults

Several northeast-trending brittle faults deform the Passaic Formation. They are mainly in the southern part of the area, and may extend into the northern part as well, but cannot be traced there because of the sparse bedrock exposure. The faults are characterized by closely-spaced fractures, thin zones of breccia and (or) clayey gouge and slickensides locally coated by chlorite or calcite. The westernmost faults may be splays, or en-echelon segments, of the New Brunswick Fault, mapped to the south in the New Brunswick quadrangle (Stanford and others, 1998), and to the north in Chatham quadrangle (Monteverde and Volkert, 2005). These fault segments dip southeast at 60° to 70°. Slip lineations on fault surfaces indicate that the predominant movement was normal on most fault segments and reverse on one. The Westons Mill Pond Fault strikes N.10°E. and dips northwest at about 60°. It is characterized by closely-spaced fractures a few inches apart and by the offset of thin gray beds. Kinematic indicators show normal movement. The fault is exposed to the south at Westons Mill Pond near the City of New Brunswick, and was briefly exposed in the map area along Route 287 near New Durham during construction in 1994 (fig. 3).

Joints

Joints are a common feature in all of the bedrock formations. Two main sets were measured in the sedimentary rocks. They include a strike joint that averages N.36°E. and dips southeast and, less commonly, northwest; and a cross joint that averages N.55°W. and dips southwest and, less commonly, northeast (fig. 4). The dip of all joints ranges from 40° to 90° and averages 82°, but most joints dip 75° to 90°. All joints are planar, moderately well formed, and variably spaced from less than 1 foot to several feet apart. Those formed near faults are spaced less than 1 foot apart. Surfaces are unmineralized, except near faults. Joints in sandstone are better developed and more continuous than those in fine-grained rocks, such as siltstone and shale, in which joints are commonly discontinuous over short distances.

Joints in igneous rocks consist of two types, columnar (cooling) and tectonic. Columnar joints are present in both basalt formations in the map area. They are characteristically polygonal, arrayed radially, and are varied in height and spacing. A comprehensive study of the origin and geometry of cooling joints in the Watchung basalts was made by Faust (1978). Tectonic joints occur in both basalt formations, but they are commonly obscured by the more pervasive cooling joints. Tectonic joints are planar, well formed, smooth to slightly irregular, steeply dipping, generally unmineralized, and spaced from a few feet to tens of feet apart. In outcrops that are near faults, joints are spaced one foot or less apart. The principal tectonic joint trend in the basalt formations strikes north to northeast, like the predominant faults, and dips 77° to 90° east.

ECONOMIC RESOURCES

Copper deposits in the map area that contain native copper, cuprite, malachite, azurite, and chrysocolla were mined mainly during the 19th century, and possibly also during the 18th century, at one site in the Passaic Formation, in the south part of the quadrangle, and at another in the Feltville Formation. Descriptions of the mines and the history of their workings are given in Woodward (1944). Copper mineralization also occurs as thin laminas in gray bed sequences in at least five members of the Passaic Formation. Orange Mountain Basalt was quarried for use as aggregate and dimension stone from a site west of Washington Rock State Park.

NATURALLY OCCURRING RADIOACTIVITY

Background levels of naturally-occurring radioactivity were measured in outcrops using a hand-held Micro R meter and the results are given under the individual rock unit descriptions. In general, basalt yields consistently low readings of about 5 Micro R/Hr regardless of the formation, stratigraphic position, texture, or composition. Sedimentary units yield higher and somewhat more varied readings that range from 8 to 27 Micro R/Hr and appear to be controlled mainly by grain size. Values from outcrops of sandstone and pebbly sandstone are lower than those in siltstone and shale, suggesting that clay minerals may host the radiogenic phases.

DESCRIPTION OF MAP UNITS

Jd **Diabase** (Lower Jurassic) – Dark-greenish-gray to black, fine-grained, massive, hard diabase. Composed mainly of calcic plagioclase, clinopyroxene and opaque oxide minerals. Contacts are aphanitic and display chilled, sharp margins with enclosing sedimentary rocks. Not exposed in the map area and known from the Rutgers core hole, where it was drilled at a depth of -3,096 feet. May be a dike or a sill; contact relationships and thickness are unknown.

Jp **Preakness Basalt** (Lower Jurassic) (Olsen, 1980a) – Dark-greenish-gray to black, fine-grained, dense, hard basalt composed mainly of calcic plagioclase, clinopyroxene and iron-titanium oxides. Contains small spherical to tubular gas-escape vesicles directly above scoriaceous flow contacts, some of which are filled by zeolite minerals or calcite. Dark-gray, coarse-grained gabbroid composed of clinopyroxene grains as much as 0.5 in. long and plagioclase grains as much as 1.0 in. long occurs at several stratigraphic intervals in the unit but is most abundant in the lowest flow. Gabbroid has sharp upper contacts and gradational lower contacts with fine-grained basalt. Unit consists of at least three major flows, the tops of which are marked by prominent vesicular zones as much as 8 ft. thick. Radiating slender columns 2 to 24 in. wide, due to shrinkage during cooling, are abundant near the base of the lowest flow. Maximum thickness regionally is about 1,040 ft. Levels of natural radioactivity range from 4 to 6 (mean=5) Micro R/Hr.

Jf
Jfw
Feltville Formation (Lower Jurassic) (Olsen, 1980a) – Reddish-brown, or light-grayish-red, fine- to coarse-grained sandstone, siltstone, shaly siltstone, silty mudstone and mudstone; and light- to dark-gray or black, locally calcareous siltstone, silty mudstone, and carbonaceous limestone. Upper part of unit is predominantly thin- to medium-bedded, reddish-brown siltstone and locally cross-bedded sandstone. Reddish-brown sandstone and siltstone are moderately well sorted, commonly cross-laminated, and interbedded with reddish-brown, planar-laminated silty mudstone and mudstone. Two thin, laterally continuous sequences, each as much as 10 ft. thick, of dark-gray to black, carbonaceous limestone, light-gray limestone, and medium-gray calcareous siltstone, and gray or olive, desiccated shale to silty shale occur near the base, and along with the red beds between, make up the Washington Valley Member (Jfw) of Olsen (1980b). Gray beds contain fish, reptiles, arthropods, and diagnostic plant fossils. As much as several feet of unit have been thermally metamorphosed along their contact with Preakness Basalt. Maximum thickness regionally is 510 ft. Levels of natural radioactivity from reddish-brown sandstone and siltstone range from 11 to 17 (mean=14.5) Micro R/Hr.

Jo **Orange Mountain Basalt** (Lower Jurassic) (Olsen, 1980a) – Dark-greenish-gray to black, fine-grained, dense, hard basalt composed mainly of calcic plagioclase, clinopyroxene, and iron-titanium oxides. Locally contains small spherical to tubular gas-escape vesicles above base of flow contacts, some of which are filled by zeolite minerals or calcite. Unit consists of three major flows that are separated in places by a weathered zone, a bed of thin reddish-brown siltstone, or by volcaniclastic rock. Lower part of upper flow is locally pillowed; upper part has pahoehoe flow structures. Middle flow is massive to columnar jointed. Lower flow is generally massive with widely spaced curvilinear or columnar joints and is pillowed near its top. Individual flow contacts are characterized by vesicular zones as much as 8 ft thick. Maximum thickness of unit is 590 ft. Levels of natural radioactivity range from 4 to 6 (mean=5) Micro R/Hr.

JT̶Rp
T̶Rpg
Passaic Formation (Lower Jurassic and Upper Triassic) (Olsen, 1980a) – Interbedded sequence of reddish-brown and, less commonly, maroon or purple, fine- to coarse-grained sandstone, siltstone, shaly siltstone, silty mudstone, and mudstone (JTrp), separated by gray bed sequences composed of olive-gray, dark-gray, or black siltstone, silty mudstone, shale, and silty argillite (Trpg). Top of unit in the map area is marked by as much as 4 ft. of massive, coarse-grained sandstone directly beneath Orange Mountain Basalt. Reddish-brown sandstone and siltstone are thin- to medium-bedded, planar to cross-bedded, micaceous, and locally mudcracked and ripple cross-laminated. Root casts and load casts are common. Shaly siltstone, silty mudstone, and mudstone are fine-grained, very-thin to thin-bedded, planar to ripple cross-laminated, locally fissile, bioturbated, and contain evaporite minerals. They form rhythmically fining-upward sequences as much as 15 ft. thick. Thickness of gray bed sequences ranges from 1 ft. to 40 ft. As much as several ft. of unit have been thermally metamorphosed along their contact with Orange Mountain Basalt. Regionally is as much as 11,480 ft. thick. Levels of natural radioactivity measured from reddish-brown siltstone and shaly siltstone range from 8 to 24 (mean=16.7) Micro R/Hr, reddish-brown and purple silty mudstone and mudstone range from 10 to 20 (mean=15.5) Micro R/Hr, and gray siltstone, silty mudstone and shale range from 14 to 27 (mean=20) Micro R/Hr.

T̶Rl **Lockatong Formation** (Upper Triassic) (Kümmel, 1897) – Cyclical sequences of mainly gray to greenish-gray and reddish-brown siltstone to silty argillite and dark-gray to black shale and mudstone. Siltstone is medium- to fine-grained, thin-bedded, planar to cross-bedded with mud cracks, ripple cross-laminations and locally abundant pyrite. Shale and mudstone are very-thin-bedded to thinly-laminated, platy, with local desiccation features. Maximum thickness regionally is about 2,200 ft. Not exposed in map area and shown in cross section only.

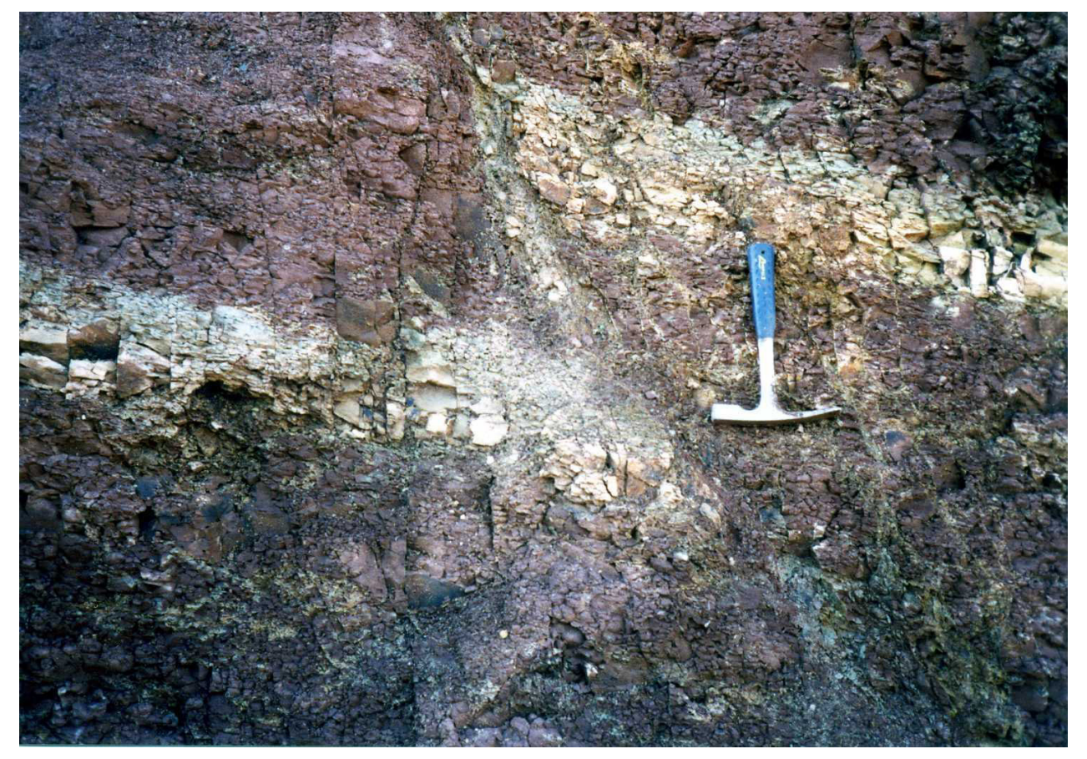


Figure 3. Exposure of an antithetic northwest-dipping fault related to the Westons Mill Pond fault viewed looking south. Note steeply-dipping, closely-spaced fractures that cut bedding on each side of the fault.

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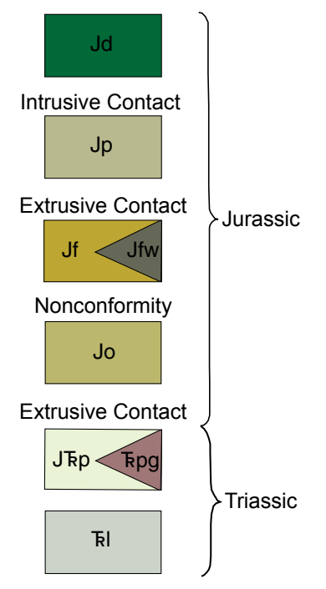
CORRELATION OF MAP UNITS



EXPLANATION OF MAP SYMBOLS

Contact - Dashed where uncertain.

Fault - Dotted where concealed. Queried where uncertain. Bar and ball show direction of dip of fault plane.

Normal fault - U, upthrown side; D, downthrown side.

Reverse fault - U, upthrown side; D, downthrown side.

PLANAR FEATURES

40 **Strike and dip of inclined beds**

OTHER FEATURES

xxxxxxx **Zone of copper mineralization**

Cu **Abandoned copper mine**

B **Abandoned basalt quarry**

RCH **Location of Rutgers core hole**

● **Location of figure 3**

BEDROCK GEOLOGIC MAP OF THE PLAINFIELD QUADRANGLE
UNION, MIDDLESEX AND SOMERSET COUNTIES, NEW JERSEY
GEOLOGIC MAP SERIES GMS 13-5

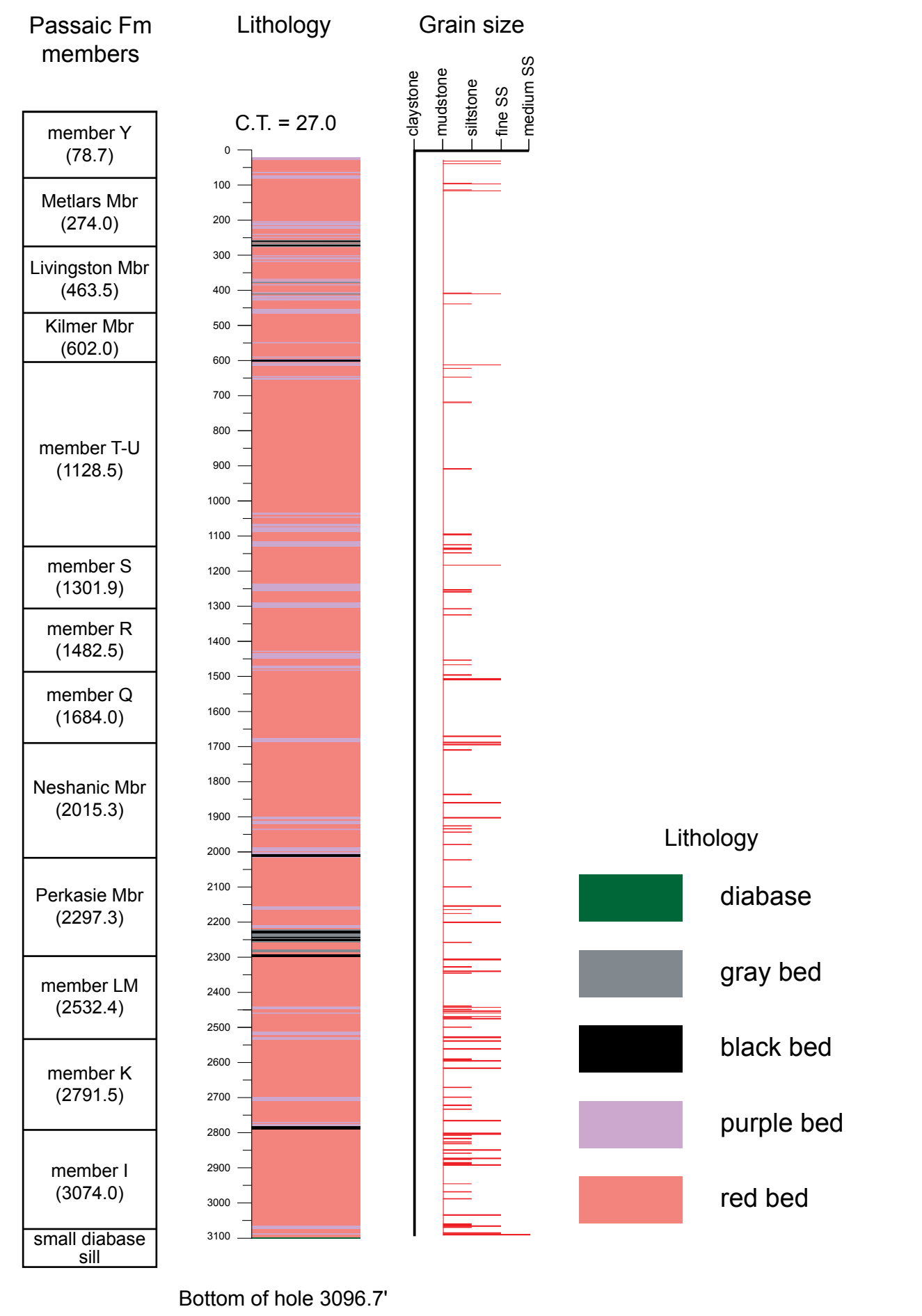


Figure 1. Abbreviated log of the Rutgers core hole from Olsen and others (1996). Abbreviations: Mbr, Member; Fm, Formation; SS, Sandstone. Numbers in parentheses are depths below ground surface.

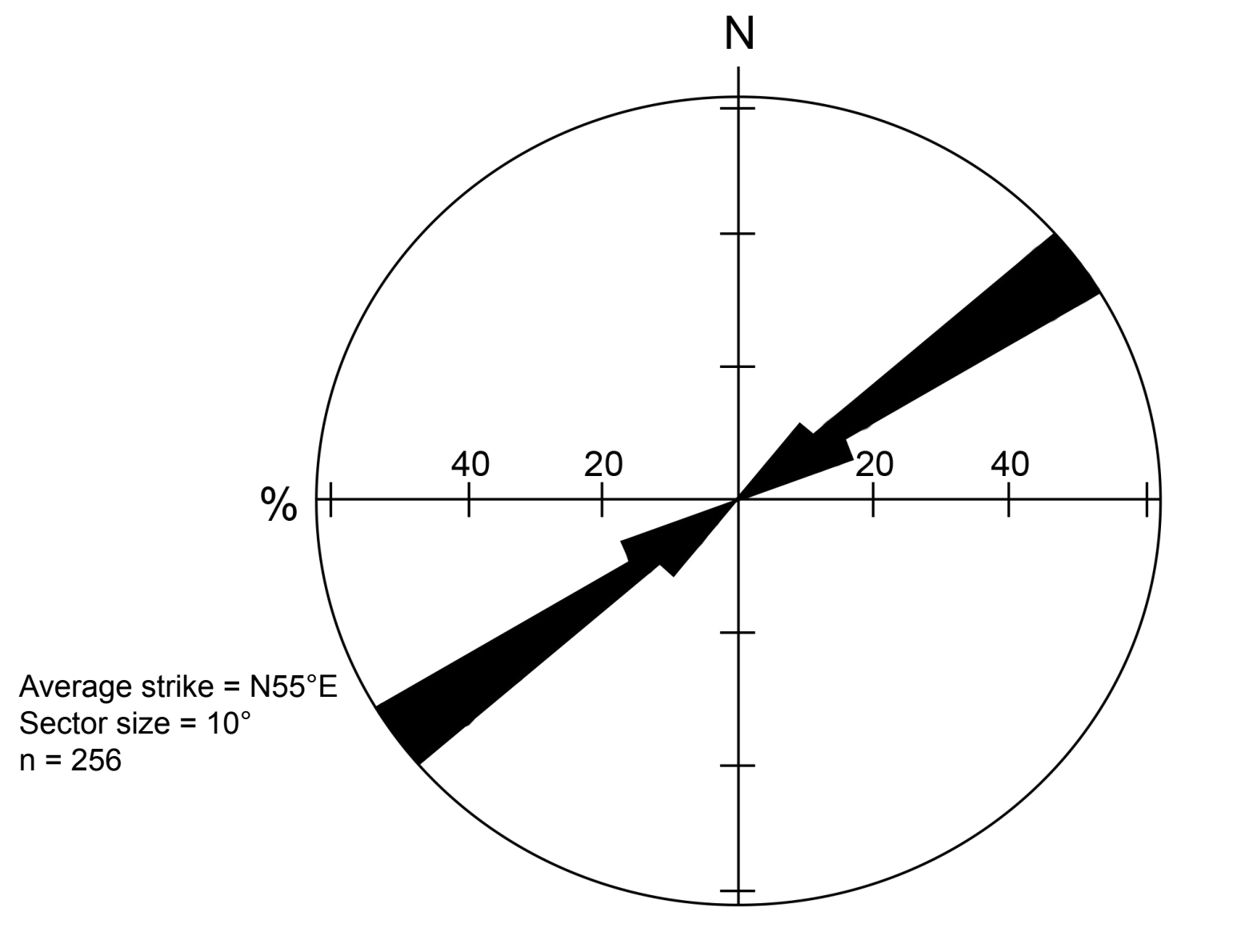


Figure 2. Rose diagram of bedding strikes in sedimentary rocks.

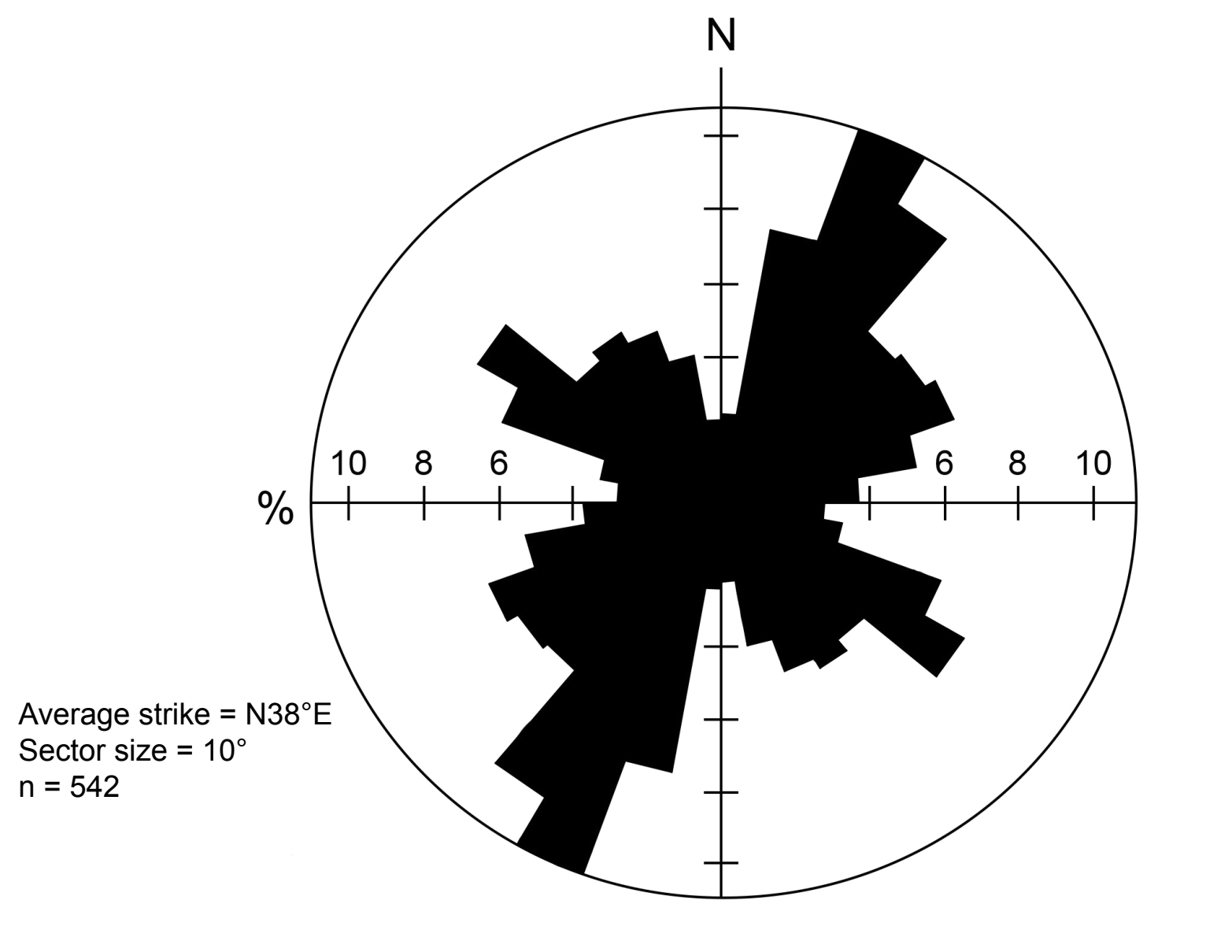


Figure 4. Rose diagram of joint strikes in sedimentary rocks.