DEPARTMENT OF ENVIRONMENTAL PROTECTION
LAND USE MANAGEMENT
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U. S. GEOLOGICAL SURVEY
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BEDROCK GEOLOGY OF THE JAMESBURG QUADRANGLE MIDDLESEX, MONMOUTH, AND MERCER COUNTIES, NEW JERSEY OPEN-FILE MAP OFM 72

INTRODUCTION

Bedrock of the Jamesburg quadrangle includes unconsolidated Coastal Plain formations that overlie metamorphic and sedimentary basement rocks. The Coastal Plain formations include sand, clay, and glauconitic clay laid down in coastal, nearshore marine, and continental shelf settings between 95 and 65 million years ago. The metamorphic rocks are much older and originated as marine sediments, laid down between 700 and 450 million years ago, that were later compressed and deformed several times. The sedimentary rocks were laid down in lakes and alluvial plains in a continental rift basin between 210 and 230 million years ago. The lithology and age of the formations are provided in the *Description of Map Units*. Age relations are also summarized in the *Correlation of Map Units*. Cross sections AA' and BB' show the subsurface geometry of the formations along the line of section. Further detail on the regional stratigraphy of the Coastal Plain formations is provided by Owens and others (1998). Regional relationships of the metamorphic and sedimentary basement rocks are described by Volkert and others (1996) and geophysical data on their extent and depth are provided by Sandberg and others (1996). Surficial sand and gravel deposits of Pliocene and Quaternary age overlie the Coastal Plain formations in most of the quadrangle. The surficial deposits are mapped by Stanford (2002).

DESCRIPTION OF MAP UNITS

Krb RED BANK FORMATION--Quartz sand, medium-grained, with minor glauconite, feldspar, and mica. Reddish-yellow where weathered, gray where unweathered. As much as 30 feet thick in quadrangle; full thickness in region 60 to 85 feet (Minard, 1964; Sugarman and others, 1991). Iron-cemented masses are common. Late Cretaceous (late Maestrichtian) in age based on calcareous nannofossils, planktonic foraminifera, mollusks, and strontium stable-isotope ratios (Sugarman and others, 1995). Grades downward into the Navesink Formation. On geophysical well logs, transition to Navesink is marked by increased gamma-ray intensity.

Kns NAVESINK FORMATION--Quartz glauconite sand, fine- to medium-grained, clayey and silty, with calcareous shell beds. Olive, green, black where unweathered; olive-brown to yellowish-brown where weathered. As much as 25 feet thick. Glauconite occurs primarily in soft grains of medium-to-coarse sand size, with botryoidal form. Pyrite, mica, and phosphatic fragments are minor constituents. Unconformably overlies the Mount Laurel Formation. The basal few feet of the Navesink, adjacent to the contact with the Mount Laurel, contain quartz granules and black phosphate pebbles. On geophysical well logs, contact with Mount Laurel is marked by a sharp peak in gamma-ray intensity (see well 25-218 on section AA'). Late Cretaceous (late Maestrichtian) in age based on calcareous nannofossils, planktonic foraminifera, and mollusks (Sugarman and others, 1995). Strontium stable-isotope ages range from 69 to 67 million years (Sugarman and others, 1995).

Kml MOUNT LAUREL FORMATION--Quartz sand, fine- to medium-grained, with some glauconite and traces of feldspar and mica. Yellowish-brown to reddish-yellow where weathered, gray where unweathered. As much as 30 feet thick. Late Cretaceous (late Campanian) in age based on calcareous nannofossils and strontium stable-isotope ratios (Sugarman and others, 1995). Grades downward into the Wenonah Formation. On geophysical well logs, transition to Wenonah is marked by slightly increased gamma-ray intensity.

Kw WENONAH FORMATION--Quartz sand, micaceous, with trace of glauconite, fine- to very fine-grained, silty. Yellow to very pale brown where weathered, gray to pale olive where unweathered. As much as 65 feet thick. Late Cretaceous (late Campanian) in age based on pollen (Wolfe, 1976) and ammonites (Kennedy and Cobban, 1994). Grades downward into the Marshalltown Formation.

Kmt MARSHALLTOWN FORMATION--Quartz glauconite clayey sand, fine- to medium-grained, silty, with traces of mica. Olive to dark gray where unweathered, brown to olive brown where weathered. As much as 25 feet thick. Late Cretaceous (middle Campanian) in age based on calcareous nannofossils, planktonic foraminifera, mollusks, and strontium stable-isotope ratios (Sugarman and others, 1995). Unconformably overlies the Englishtown Formation. On geophysical well logs, contact with Englishtown is marked by reduced gamma-ray intensity.

Ket ENGLISHTOWN FORMATION--Quartz sand, fine- to medium-grained, minor coarse sand, and thin beds of clay and silt. Sand is white, yellow, and light gray where weathered, gray where unweathered. Silt and clay are light gray to brown where weathered, dark gray to black where unweathered. Very fine to fine sand, silt, and clay are commonly thinly bedded to laminated; fine-to-coarse sands are commonly cross-bedded. As much as 100 feet thick. Sand contains minor glauconite, lignite and mica; mica, lignite, and pyrite are common in the clays. In the sand pits on the east edge of the quadrangle, south of Matchaponix, some exposures showed laminated sand and silt-clay within the Englishtown deformed by small-scale folds, faults, and ball-and-pillow structures. This deformation is restricted to select layers and does not extend into overlying beds. Thus, it is likely of syndepositional rather than tectonic origin. Late Cretaceous (early Campanian) in age, based on pollen (Wolfe, 1976) and ostracodes (Gohn, 1992). Grades downward into the Woodbury Formation. In wells, transition to Woodbury placed at change from gray sand, or gray sand and clay, to gray clay. On geophysical well logs, transition to Woodbury is marked by increased gamma-ray intensity.

Kwb WOODBURY FORMATION--Clay with minor thin beds of very fine quartz sand. Dark gray and black where unweathered, yellowish-brown to brown where weathered. As much as 110 feet thick. Clay is micaceous with some pyrite and lignite and traces of glauconite. Late Cretaceous (early Campanian) in age based on pollen (Wolfe, 1976) and ostracodes (Gohn, 1992). Grades downward into the Merchantville Formation. In wells, transition to Merchantville placed at change from gray clay to green clay or marl. On geophysical well logs, transition to Merchantville is marked by slightly increased gamma-ray intensity.

Kmv MERCHANTVILLE FORMATION--Glauconite clayey silt to sandy clayey silt. Olive, dark gray, black where unweathered, olive brown to yellowish-brown where weathered. As much as 40 feet thick. Glauconite occurs primarily in soft grains of fine-to-medium sand size. Non-glauconite sand is chiefly quartz with minor feldspar, mica, and pyrite. Iron cementation is common. Late Cretaceous (early Campanian) in age based on ammonite fossils (Owens and others, 1977).

Kcq CHEESEQUAKE FORMATION--Clayey silt, micaceous, slightly glauconitic, with minor laminas of very fine- to fine-grained quartz sand. Yellowish-brown, brown, reddish-yellow where weathered; gray to dark gray where unweathered. As much as 20 feet thick. Late Cretaceous (late Santonian to early Campanian) in age based on pollen (Litwin and others, 1994). Unconformably overlies the Magothy Formation. Not mapped southwest of Manalapan Brook owing to insufficient exposure. If present in this area, is included with the Merchantville Formation.

Kmg MAGOTHY FORMATION--Quartz sand, fine- to medium-grained, and beds of clay and silt. Sand is white to yellow where weathered, light gray where unweathered. Silt and clay are white, yellow, pink where weathered; gray to black where unweathered. Sand includes minor lignite, pyrite, mica, and feldspar. Silt and clay are commonly micaceous and lignitic. Sand is cross-bedded to laminated. Silt and clay are interlaminated or thinly interbedded with very fine to fine sand, or, less commonly, in beds and lenses as much as 3 feet thick. Total thickness of Magothy as much as 170 feet. Late Cretaceous (Turonian-Coniacian) in age based on pollen (Christopher, 1979, 1982; Miller and others, 2004). Unconformably overlies the Raritan Formation. In wells, contact with Raritan placed at change from gray sand and clay to white, brown, or yellow sand and clay. On geophysical logs, contact with Raritan marked by increased gamma-ray intensity and decreased resistance. In the Sayreville-South Amboy area, just northeast of the Jamesburg quadrangle, extensive clay-pit exposures permitted the naming and mapping of clay beds within the Magothy, which was formerly included in the Raritan Formation (Cook, 1878; Ries and others, 1904). Later, intervening sands in the same area were named as part of an aquifer investigation (Barksdale and others, 1943). Berry (1905) correlated the uppermost beds of the Raritan with the Magothy Formation of Maryland, based on their plant fossils. Owens and Sohl (1969), Wolfe and Pakiser (1971), Owens and others (1977), and Christopher (1979) provided more detailed biostratigraphic control for these beds, and redefined additional beds of the former Raritan as Magothy. In the South Amboy area the Magothy now includes, from oldest to youngest, the following informal members: South Amboy Fire Clay, Old Bridge Sand, Amboy Stoneware Clay, Morgan beds, and Cliffwood beds (Owens and others, 1977; Sugarman and others, 2005). These members may extend into the Jamesburg quadrangle but exposure and subsurface data are not sufficient to map them. Gamma-ray, electric, and lithologic logs of wells (sections AA', BB') show that the upper 50-100 feet of the Magothy are generally finer-grained than the lower part of the formation. This upper part may correspond to the Amboy Stoneware Clay, Morgan beds, and Cliffwood beds, which contain more clay and silt than the underlying Old Bridge Sand. This correlation is supported by pollen from a black fine sand and silt at a depth of 60-62 feet in the Stauffer 7 well (section AA'), which are zone VII, confirming an upper Magothy (Morgan beds equivalent) stratigraphic position (G. J. Brenner, written communication, 1991).

RARITAN FORMATION--Includes two informal members in this quadrangle: the Farrington Sand and the Woodbridge Clay. Another member, the "Raritan fire and potter's clay" of Cook (1878) and Ries and others (1904), underlies the Farrington Sand in the New Brunswick area. This unit includes a lower clay (the "potter's clay") which is predominantly a red, white, and gray clay derived from weathering of shale and mudstone (Stanford and others, 1998), and is here included with the Stockton Formation, and an upper, discontinuous, gray sandy clay (the "fire clay") which is near the base of the Farrington Sand and is here included in that member, or with the underlying Potomac Formation. Total thickness of the Raritan Formation in the quadrangle ranges from 220 feet in the northeast corner to about 120 feet in the southwest corner.

Krw **Woodbridge Clay**--Clay and silt, and minor thin beds and laminas of fine quartz sand. Clay and silt are gray to black where unweathered, white to brown where weathered. Sand is white, yellow, and light gray. Clay and silt are micaceous and lignitic, and contain pyrite. As much as 140 feet thick. Grades downward into the Farrington Sand. In wells, transition to Farrington is placed at change from gray clay and sand, to coarse sand, or sand and gravel. On geophysical well logs, transition to Farrington is marked by decreased gamma-ray intensity and increased resistance. The Woodbridge Clay is Late Cretaceous (late Cenomanian) in age based on pollen (Christopher, 1979) and ammonites (Cobban and Kennedy, 1990). Pollen from gray clayey silt at depths of 150-152, 210-212, and 240-242 feet in the Stauffer 7 well (section AA') are all zone IV, confirming assignment of this interval to the Woodbridge Clay (G. J. Brenner, written communication, 1991). In subsurface only. Subcrops beneath surficial deposits in northwestern corner of quadrangle.

Krf **Farrington Sand**--Quartz sand, fine- to coarse-grained, some thin beds of angular very coarse quartz sand to very fine pebble gravel, and minor clay and silt in beds and lenses as much as 3 feet thick. Sand is white, yellow, pink, and red where weathered, gray where unweathered. Clay and silt are white and yellow where weathered, gray where unweathered. As much as 90 feet thick. In subsurface only. Unconformably overlies the Potomac Formation and weathered basement rocks. In wells, contact with Potomac is placed at change from sand and gravel to interbedded sand and clay. On geophysical well logs, contact with Potomac is marked by slightly increased gamma-ray peaks and slightly decreased resistance. The Farrington Sand is Late Cretaceous (Cenomanian) in age based on pollen (Christopher, 1979). Pollen from a gray fine sandy clay at a depth of 290-292 feet in the Stauffer 7 well (section AA'), at the base of the Farrington Sand, just above the weathered Stockton Formation bedrock, is zone IIIB, indicating stratigraphic position in the Potomac Formation (G. J. Brenner, written communication, 1991). These beds, which are likely equivalent to the Raritan fire clay in outcrop, may be a thin erosional remnant of the Potomac.

Kp POTOMAC FORMATION--Quartz sand, fine-to-medium grained, and beds of clay and silt. Sand is white, yellow, light gray where weathered, gray where unweathered. Clay and silt are white, yellow, brown, reddish-yellow where weathered, gray to black where unweathered. As much as 110 feet thick in southwestern part of quadrangle, pinches out to north. Sand includes some lignite, and minor feldspar and mica. Silt and clay beds include abundant mica and lignite. The Potomac Formation in the map area is equivalent to the Potomac Formation, unit 3 (Doyle and Robbins, 1977), based on pollen (Owens and others, 1998), and is of Late Cretaceous (early Cenomanian) age. Unconformably overlies metamorphic basement rocks. In subsurface only, inferred from geophysical and lithologic well logs that record interbedded clay and sand beneath the Farrington Sand.

Trs STOCKTON FORMATION--Shale, siltstone, sandstone; reddish-brown to gray. Reddish-brown to gray clay and sandy clay where weathered. In subsurface only. Penetrated and sampled in the Stauffer 7 well (Volkert and others, 1996). Late Triassic in age. Unconformably overlies metamorphic basement rocks.

OCZu LATE PROTEROZOIC AND EARLY PALEOZOIC METAMORPHIC ROCKS, UNDIFFERENTIATED--Gray schist and gneiss, weathering to greenish-gray micaceous clay to sandy clay saprolite. In subsurface only, inferred from well logs and geophysical data. Age uncertain, may range from late Proterozoic to Ordovician.

MAP SYMBOLS

Contact of Coastal Plain formations--Approximately located. Triangle indicates contact observed in outcrop.

Contact of bedrock formations underlying Coastal Plain formations--Approximately located. Lettering indicates map unit on either side of contact.

Formation observed in outcrop or excavation, or penetrated in hand-auger hole.

Formation formerly observed in outcrop or excavation--Field notes on file at N. J. Geological Survey.

Formation covered by surficial deposits--Surficial deposits of Pliocene and Quaternary age continuous and generally more than 5 feet thick.

Sand or clay pit in Coastal Plain formation--Line shows perimeter of pit that exposed Coastal Plain formations in 1991-1992. Line through symbol indicates pit obscured by redevelopment in 2006.

23-232, ● 28-4106, G
160 Kmg
265 Krw
345 Krf
357 OCZu

Well showing formations penetrated--Location accurate to within 500 feet. Identifiers of the form 23-xxx, 21-xxx, and 25-xxx are U. S. Geological Survey Ground Water Site Inventory identification numbers. Lithologic and geophysical logs for most of these wells are provided by Gronberg and others (1989). Identifiers of the form 28-xxxx are N. J. Department of Environmental Protection well permit numbers. Identifiers of the form Sxx are borings made in the 1930s for a proposed ship canal; the logs are on file at the N. J. Geological Survey. Identifiers of the form JPOx are test borings made by J. P. Owens of the U. S. Geological Survey, the logs are on file at the N. J. Geological Survey. Identifiers of the form 28-xx-xxx are N. J. Atlas Sheet coordinates of records of wells or borings in the permanent note collection of the N. J. Geological Survey. "G" following the well identifier indicates that a gamma-ray log is available for the well, "E" following the well identifier indicates that an electric log is available. Number preceding formation symbol is depth, in feet below land surface, of base of unit, as inferred from lithologic and geophysical logs. Final number is total depth of well or boring rather than base of unit. Units joined with a hyphen cannot be separately identified in the drillers' description. For wells shown on sections, the formations penetrated are not listed on the map label. Drillers' logs vary in detail and accuracy. They are used in combination with outcrop data and geophysical well logs to map contacts, and so depths of some contacts inferred from the logs may not match those shown on the sections and map.

Geophysical log--On sections. Gamma-ray log is shown by red line, intensity increasing to right. Electric log is shown by paired blue lines, with spontaneous potential shown on left-hand curve (voltage increasing to right) and resistance shown on right-hand curve (resistance increasing to right). Horizontal scale varies from well to well.

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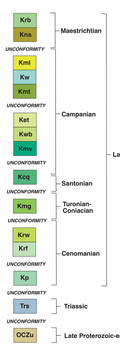
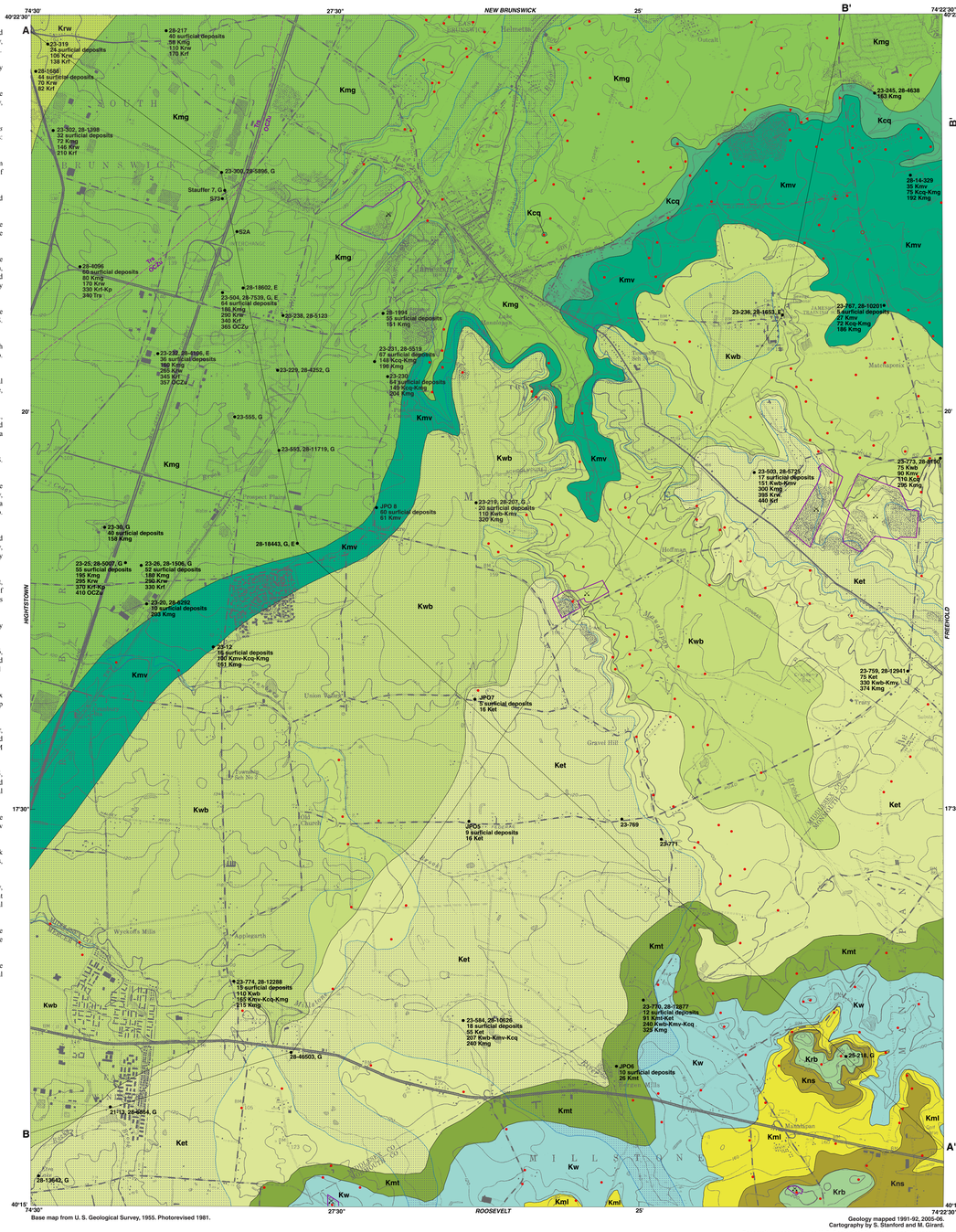
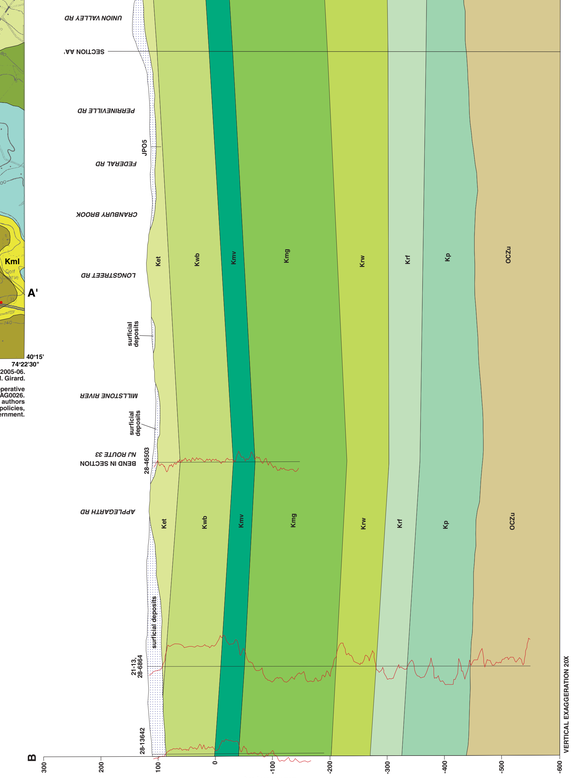
CORRELATION OF MAP UNITS







BEDROCK GEOLOGY OF THE JAMESBURG QUADRANGLE MIDDLESEX, MONMOUTH, AND MERCER COUNTIES, NEW JERSEY

by
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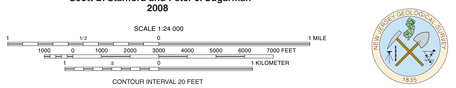
2008



Base map from U. S. Geological Survey, 1955. Photorevised 1981.

Geology mapped 1991-92, 2005-06.
Cartography by S. Stanford and M. Girard.

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VERTICAL EXAGGERATION 20X
Note: Geophysical logs for well 28-18443 show responses opposite to those expected for units Kmg and Krw. The logs may have been recorded incorrectly.