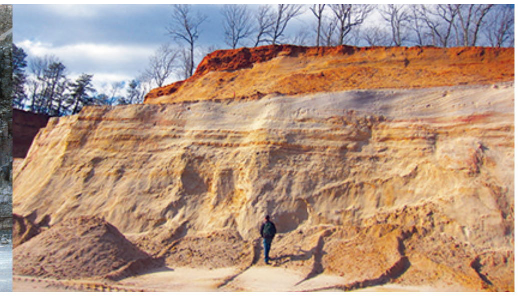


Generalized Stratigraphic Table for New Jersey

New Jersey stratigraphic units are commonly grouped into surficial sediments resulting from coastal, alluvial, colluvial, glacial, and periglacial processes of the past 10 million years (fig. 1) and older, generally thicker bedrock units within structural and physiographic regions resulting from major tectonic events of the past 1.6 billion years (fig. 2).

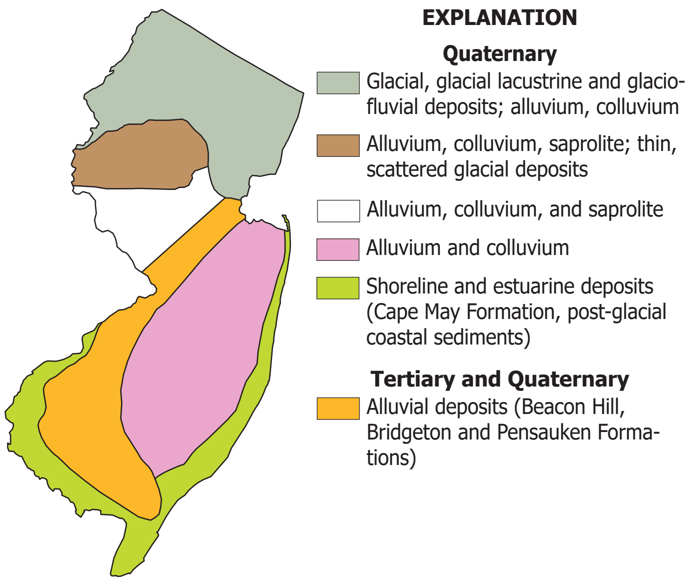


Figure 1. Predominant surficial materials.

The oldest rocks in New Jersey are granulite-facies metamorphic and granitic igneous rocks exposed in the Highlands and Trenton prong (Drake, 1984; Volkert and Drake, 1986). These form the crystalline basement northwest of the limit of highly metamorphosed Paleozoic and Mesoproterozoic rocks (Volkert and others, 1996) (fig. 3). They are part of the Grenville terrane, which accreted to older rocks during the Grenville orogenic cycle (table 1) to form the North American craton.

Unconformably above the Grenville rocks are sedimentary rocks of the Iapetus Ocean, which opened in the Late Precambrian and closed during the Taconic orogeny. Stratigraphic units shown here are from Drake and others (1997), and Markewicz and Dalton (1980). Rocks of the western margin of Iapetus are exposed in the Valley and Ridge and in linear belts within the Highlands. The Hardyston Quartzite shows initial clastic sedimentation. Subsequent development of a carbonate platform resulted in deposition of the Kittatinny Supergroup. Contemporaneous deeper-water continental margin and oceanic environments are represented to the east by the Jutland sedimentary units and metasedimentary and metaigneous rocks within the Manhattan and Trenton prongs (Perissoratis and others, 1979; Drake and others, 1997.

Change from a trailing margin to a convergent margin in the late Early Ordovician led first to uplift and unconformity, then to submergence and deposition of the shallow marine and submarine slope Jacksonburg and deeper-water Martinsburg. The Taconic orogeny led to closing of the Martinsburg foreland basin, uplift, low-grade metamorphism in northwestern New Jersey, amphibolite facies metamorphism to the east, and to folding and northwestward thrusting.

From the Taconic orogeny into the Middle Devonian, shallow marine sediments and alluvial clastics indicate that northwestern New Jersey was near the eastern margin of a shifting interior sea. Middle Paleozoic units shown here are from Drake and others (1997) and Herman and Mitchell (1991). Above these units is an unconformity representing Middle Devonian to Upper Triassic time.

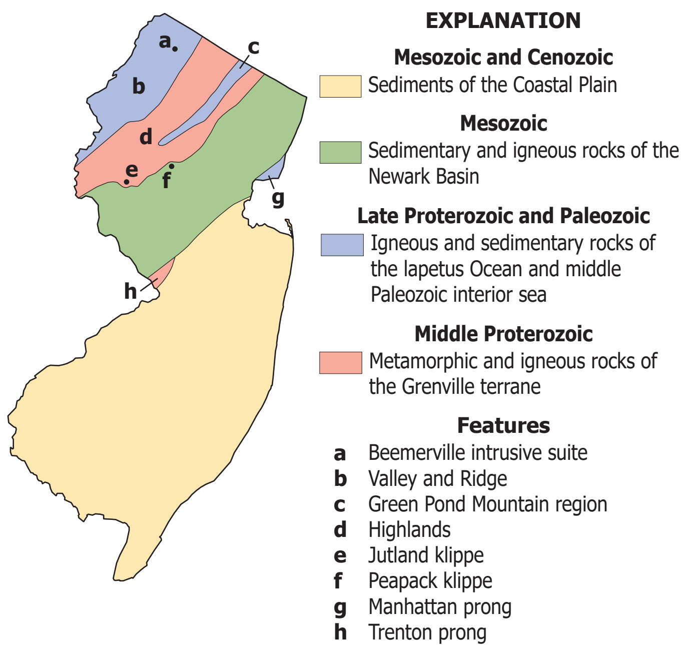
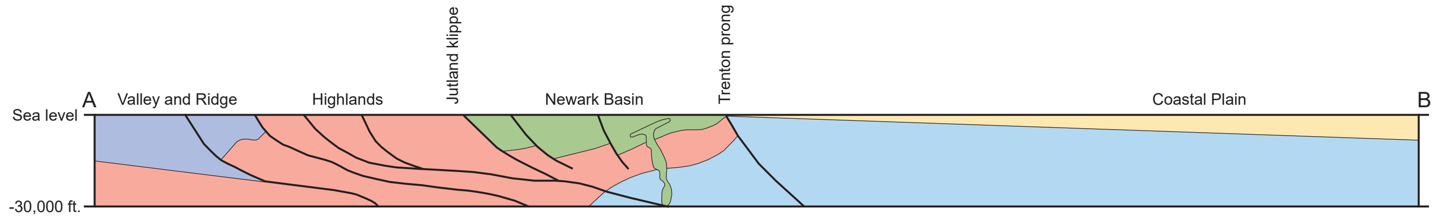
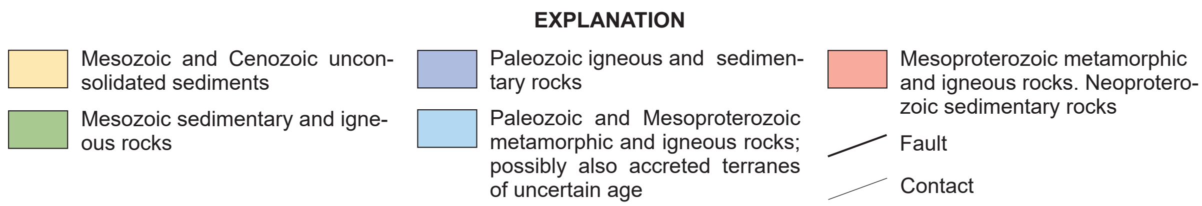


Figure 2. Generalized bedrock geologic map.

The late Paleozoic Alleghanian orogeny, the result of collision between the North American and African continental plates, was expressed in New Jersey through uplift and renewed faulting and folding of Taconic structures (Herman and Monteverde, 1989).

Triassic and Jurassic crustal extension and shearing associated with early stages of the formation of the Atlantic Ocean created continental fault-block basins. The Newark Basin was filled with





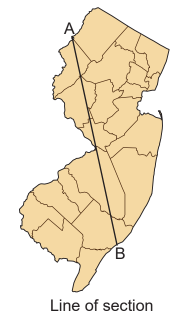


Figure 3. Geologic cross section through New Jersey.

Table 1. Ages of geologic events.

Eon	Era	System/ Period	Series/ Epoch	Time (millions of years before present)	Geologic Events
PHANEROZOIC	CENOZOIC	Quaternary	Holocene	PRES-0.0117	Postglacial rise of sea level; shoreline, alluvial, and marsh sedimentation
			Pleistocene	0.0117-2.58	Cyclic glaciation, associated rise and fall of sea level
		Neogene	Pliocene	2.58-5.333	
			Miocene	5.333-23.03	Alluvial sedimentation (Beacon Hill, Bridgeton, Pensauken)
		Paleogene	Oligocene	23.03-33.9	Sedimentation on subsiding Atlantic continental margin
			Eocene	33.9-56	
			Paleocene	56-66	
	MESOZOIC	Cretaceous		66~145	unconformity
		Jurassic		145-201.4	Rifting, deformation of Newark basin, opening of Atlantic Ocean basin
		Triassic		201.4-251.9	Basaltic magmatism, sedimentation (Newark Supergroup) Shear and extension prior to opening of Atlantic
	PALEOZOIC	Permian		251.9-298.9	
		Pennsylvanian		298.9-323.2	unconformity Alleghanian orogeny
		Mississippian		323.2-358.9	
		Devonian		358.9-419.2	
		Silurian		419.2-443.8	Epicontinental sea to west; clastic sedimentation from east
		Ordovician		443.8-485.4	unconformity Taconic orogeny Submergence of continental margin; carbonate sedimentation (Jacksonburg) followed by deeper-water clastic deposition (Martinsburg) unconformity Iapetus continental margin changes from passive to convergent
		Cambrian		485.4-538.8	Continental margin sedimentation in west (Hardyston, Kittatinny), deeper-water and oceanic sedimentation to east (Jutland, protoliths of Manhattan and Wissahickon) unconformity
PROTEROZOIC	Neo-PROTEROZOIC			538.8-1,000	Sedimentation, volcanism (?) (Chestnut Hill)
	MESO-PROTEROZOIC			1,000-1,600	unconformity Grenville orogenic cycle (metamorphism, plutonism, several phases of tectonism, post-kinematic emplacement of Mount Eve Granite) Emplacement of protoliths of layered metasedimentary rocks (graywacke, arkose and carbonate) unconformity Emplacement of losee protolith (probably dacite, keratophyre and spilite)

GENERALIZED STRATIGRAPHIC TABLE FOR NEW JERSEY

Eon	Era	Period	Epoch	Stratigraphic unit		Predominant lithology	Aquifer name or hydrogeologic characteristics
PHANEROZOIC	CENOZOIC	Quaternary	Holocene	alluvial, coastal, marsh and eolian deposits		sand, gravel, silt, mud and peat	under water-table conditions at most locations
			Pleistocene	COASTAL AREAS Wisconsinan alluvium, Cape May Formation, colluvium	INLAND, NORTHERN NEW JERSEY Wisconsinan and pre-Wisconsinan alluvial, colluvial, glacial, lacustrine, and eolian deposits	sand, gravel, silt, clay (statewide), till and till-like deposits (northern New Jersey)	includes glacial valley-fill aquifers and Cape May aquifer system/Holly Beach aquifer
		Neogene	Pliocene	Pensauken Formation		sand, gravel	under water-table conditions at most locations
			Miocene	Bridgeton Formation			
				Beacon Hill Gravel		gravel, sand	
				Stone Harbor Formation		interbedded gravel, sand and clay	Kirkwood-Cohansey aquifer system
				Cohansey Sand		sand, some clayey silt	
				Kirkwood Formation	Belleplain Member	sand, gravel, clayey silt	confining unit
					Wildwood Member		Rio Grande water-bearing zone
					Shiloh Marl Member		confining unit
					Brigantine Member		Atlantic City 800-foot sand
		Paleogene	Oligocene	Atlantic City Formation		sand, some glauconitic sand	composite confining unit: Piney Point Aquifer
				Sewell Point Formation			
			Eocene	Shark River Formation		clayey silt, fine quartz sand, glauconite sand	
				Manasquan Formation			
				Absecon Inlet Formation			
			Paleocene	Vincentown Formation		sand, clayey silt, glauconitic sand, calcarenite	Vincentown Aquifer
				Hornerstown Formation		glauconite sand	
	MESOZOIC	Cretaceous	Upper Cretaceous	Tinton Sand		sand, glauconite sand	
				Red Bank Sand		sand, clayey silt, some glauconitic sand	Red Bank Sand
				Navesink Formation		glauconitic sand	
				Mount Laurel Formation		sand	Wenonah-Mount Laurel aquifer
				Wenonah Formation		silty sand, some glauconite	Marshalltown-Wenonah confining unit
				Marshalltown Formation		clayey silt, glauconitic sand	
				Englishtown Formation		sand, clayey silt	Englishtown aquifer system
				Woodbury Clay		clayey silt	Merchantville-Woodbury confining unit
				Merchantville Formation		clayey silt, glauconitic sand	
				Cheesequake Formation		clayey silt	
				Magothy Formation		sand, clayey silt	Potomac-Raritan-Magothy aquifer system: upper aquifer
							confining unit
				Raritan Formation			middle aquifer
			Lower Cretaceous	Potomac Formation	Unit 3	gravel, sand, silt, clay	confining unit
					Unit 2		lower aquifer
					Unit 1		
		Jurassic	Lower Jurassic	Newark Supergroup, Brunswick Group: Boonton Formation		sandstone, siltstone, shale, conglomerate	groundwater occurs along bedding surfaces, joints, faults, intergranular spaces, and other openings
				Hook Mountain Basalt	diabase	basalt	
				Towaco Formation		sandstone, siltstone, shale, conglomerate	
				Preakness Basalt	diabase	basalt, intercalcated sedimentary rock	
				Feltville Formation		sandstone, siltstone, shale, conglomerate, limestone	
		Triassic	Upper Triassic	Orange Mountain Basalt	diabase intrusives	basalt; diabase	
				Passaic Formation		sandstone, siltstone, shale, conglomerate	
				Lockatong Formation		siltstone, mudstone, sandstone	
				Stockton Formation		arkosic sandstone, siltstone, shale, conglomerate	

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Eon	Era	Period	Epoch	Valley and Ridge: Stratigraphic unit	Valley and Ridge: Predominant lithology	Green Pond Mountain Region: Stratigraphic unit	Green Pond Mountain Region: Predominant lithology	Hydrogeologic characteristics
PHANEROZOIC	PALEOZOIC	Devonian	Middle Devonian			Skunnemunk Conglomerate	conglomerate	groundwater occurs along bedding surfaces, joints, faults, intergranular spaces, solution cavities, and other openings
						Bellvale Sandstone	sandstone, siltstone, shale	
				Marcellus Shale	shale, siltstone	Cornwall Shale	shale, siltstone	
						unconformity	unconformity	
				Buttermilk Falls Limestone / Onondaga Formation	argillaceous limestone / limestone	Kanouse Sandstone	conglomeratic sandstone, siltstone	
			Lower Devonian	Schoharie Formation	calcareous siltstone			
				Esopus Formation	sandstone	Esopus Formation	sandstone	
						unconformity	unconformity	
				Oriskany Group: Ridgely Sandstone	sandstone	Connelly Conglomerate	conglomeratic quartzite	
				Oriskany Group: Shriver Chert	shale, siltstone, chert			
				Oriskany Group: Glenerie Limestone	limestone			
				Helderberg Group: Port Ewen Shale	calcareous shale, siltstone	unconformity	unconformity	
				Helderberg Group: Minisink Limestone	limestone, calcareous shale			
				Helderberg Group: New Scotland Formation	calcareous silty shale			
				Helderberg Group: Kalkberg Limestone	limestone			
				Helderberg Group: Coeymans Limestone	limestone, sandstone, conglomerate			
				Helderberg Group: Manlius Limestone	limestone			
				Helderberg Group: Rondout Formation	limestone, calcareous shale, dolomite			
		Silurian	Upper Silurian	Decker Formation	calcareous sandstone, limestone	Berkshire Valley Formation	calcareous siltstone, dolomite	
				Bossardville Limestone	argillaceous limestone			
				Poxono Island Formation	calcareous shale, dolomite	Poxono Island Formation	calcareous shale, dolomite	
				Bloomsburg Red Beds	shale, siltstone sandstone	Longwood Shale	shale	
			Middle Silurian	Shawangunk Formation	conglomeratic quartzite	Green Pond Conglomerate	conglomeratic quartzite, siltstone	

Eon	Era	Period	Epoch	Stratigraphic unit	Predominant lithology	Hydrogeologic characteristics
PHANEROZOIC	PALEOZOIC	Ordovician	Upper Ordovician	Nepheline syenite, Ouachitite breccia	intrusive and extrusive alkalic igneous rocks	groundwater occurs along bedding surfaces, joints, faults, intergranular spaces, solution cavities, and other openings
				Martinsburg Formation: High Point Member	shale, siltstone, sandstone	
				Martinsburg Formation: Ramseyburg Member	slate, graywacke	
				Martinsburg Formation: Bushkill Member	slate, graywacke	
				Jacksonburg Limestone	limestone	
			Mid.Ordovician	unconformity	unconformity	
			Lower Ordovician	Kittatinny Supergroup: Beekmantown Group: Upper: Ontelaunee Formation	dolomite, limestone	
				Kittatinny Supergroup: Beekmantown Group: Upper: Epler Formation	dolomite, limestone	
				Kittatinny Supergroup: Beekmantown Group: Lower: Rickenback Dolomite	dolomite	
				unconformity; Jutland klippe units (not part of the Martinsburg or Kittatinny Supergroup) ?—?—?	unconformity; shale, limestone, chert (Jutland) ?—?—?	
		Cambrian	Upper Cambrian	Kittatinny Supergroup: Allentown Dolomite	dolomite	
			Middle Cambrian	Kittatinny Supergroup: Leithsville Formation	dolomite, calcareous shale	
			Lower Cambrian	Hardyston Quartzite	arkosic quartzite, conglomerate	
		Ordovician and Cambrian		Wissahickon Formation / Manhattan Schist serpentinite	schist, metagraywacke, amplibolite, altered ultramafics (Wissahickon); sillmanite-garnet-muscovite-biotite schist (Manhattan); serpentinite	
PROTEROZOIC	Neo-Proterozoic			Chestnut Hill Formation	metasedimentary and metavolcanic (?) rock	groundwater occurs in joints, faults, foliation surfaces, solution cavities, and other openings
	Meso-Proterozoic			Bryam Instrusive Suite, Lake Hopatcong Intrusive Suite, Mount Eve Granite	granite, quartz syenite, syenite, monzonite and granodiorite	
				metasedimentary rocks	metasedimentary rocks including Franklin and Wildcat Marble	
				Losee Metamorphic Suite	highly sodic gneissic and granitoid rocks; amphibolite	

clastic fluvial and lacustrine sediments, and basalt and diabase magma. During final separation of the North American and African continental plates, the Newark Supergroup rocks were tilted to roughly their present attitude (Manspeizer and Cousminier, 1988).

Coastal Plain sediments, predominantly deltaic, shallow marine, and continental shelf clastics, record several major transgressive cycles. Units are generally thicker and reflect deeper water to the southeast. The units shown here are from Owens and others (1998), and Johnson (1950).

Surficial deposits of New Jersey are generally no more than a few feet, rarely as much as 300 feet, thick. The Bridgeton and Pensauken reflect a persistent drainage pattern: to the southwest along the inner margin of the Coastal Plain, then to the southeast parallel to the Delaware River (Owens and Minard, 1979).

Pleistocene and Holocene deposits record fluctuating conditions related to cyclic glaciation. Alluvial, coastal and estuarine deposits of the Cape May Formation record rise and fall of sea level due to changes in global ice volume (Newell and others, 2000). Northern New Jersey glacial deposits record at least three ice advances (Stone and others, 2002). Colluvial, residual and eolian deposits formed most rapidly under periglacial conditions, but also date from interglacial and postglacial times.

Postglacial sediments include lake and marsh deposits (most extensive in areas of glacially-disrupted drainage), estuarine and shoreline deposits post-dating rapid sea-level rise, alluvial sands and gravels, and anthropogenic materials.

STATE OF NEW JERSEY
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Kim Guadagno, *Lieutenant Governor*

Department of Environmental Protection
Bob Martin, *Commissioner*

New Jersey Geological and Water Survey
Jeffrey L. Hoffman, *State Geologist*

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Banner Photos *(left to right)*:

Looking across Kittatinny Valley (Cambrian and Ordovician, 444 to 541 million years old, carbonate rock and sandstone, siltstone and shale) from Kittatinny Mountain (Silurian, 419 to 444 million years old, quarzite and quartz-pebble conglomerate) to the New Jersey Highlands (Middle Proterozoic, 1,000 to 1,600 million years old, metamorphic rock), Sussex County. *Photo by R. Witte*

Basal contact of the Orange Mountain Basalt (Triassic, basalt, approximately 201 million years old) with the Passaic Formation (Triassic, sandstone, siltstone and shale, 201 to 217 million years old) in the Chimney Rock Quarry, Somerset County. *Photo by D. Monteverde*

Sand and gravel pit (Cohansey Formation, Middle Miocene, sand, silt and clay, 14 million years old) overlain by Bridgeton Formation (Miocene, sand, gravel, 8 to 5 million years old), Monmouth County. *Photo by P. Sugarman*

REFERENCES

Drake, A.A., Jr., 1984, The Reading Prong of New Jersey and eastern Pennsylvania: an appraisal of rock relations and chemistry of a major Proterozoic terrane in the Appalachians: Geological Society America Special Paper 194, p. 75-109.

Drake, A.A., Jr., Volkert, R.A., Monteverde, D.H., Herman, G.C., Houghton, H.F., Parker, R.A. and Dalton, R.F., 1997, Bedrock geologic map of northern New Jersey: U.S. Geological Survey Miscellaneous Geologic Investigations Series Map I-2540-A, scale 1:100,000.

Herman, G.C., and Mitchell, J.P., 1991, Bedrock geologic map of the Green Pond region, Dover to Greenwood Lake, New Jersey: New Jersey Geological Survey Geologic Map 91-2, scale 1:24,000.

Herman, G.C., and Monteverde, D.H., 1989, Tectonic framework of Paleozoic rocks of northwestern New Jersey: Bedrock structure and balanced cross sections of the Valley and Ridge province and southwest Highlands area: *in* Grossman, I.G., ed., Paleozoic geology of the Kittatinny Valley and southwest Highlands area N.J., Proceedings Geological Association N.J. annual meeting (6th), p. 1-57.

Johnson, M.E., 1950, Geologic map of New Jersey: N.J. Geol. Survey State Atlas Sheet 40, scale 1:250,000.

Manspeizer, W., and Cousminier, H.L., 1988, Late Triassic-Early Jurassic synrift basins of the U.S. Atlantic Margin: *in* Sheridan, R.E., and Grow, J.E., eds., The Atlantic Continental Margin: Geol. Society America, The Geology of North America, v. 12, p. 197-216.

Markewicz, F.J., and Dalton, R., 1980, Lower Paleozoic carbonates, Great Valley: *in* Manspeizer, Warren, ed., Field studies of New Jersey geology and guide to field trips, New York State Geol. Society annual meeting (52nd), p. 54-68.

Newell, W.L., Powars, D.S., Owens, J.P., Stanford, S.D., and Stone, B.D., 2000, Surficial geologic map of central and southern New Jersey: U.S. Geological Survey Miscellaneous Investigations Series Map I-2540-D, scale 1:100,000.

Owens, J.P., and Minard, J.P., 1979, Upper Cenozoic sediments of the lower Delaware Valley and the northern Delmarva Peninsula, New Jersey, Pennsylvania, Delaware, and Maryland: U.S. Geological Survey Professional Paper 1067-D, 47 p.

Owens, J.P., Sugarman, P.J., Sohl, N.F., Parker, R.A., Houghton, H.F.,Volkert, R.A., Drake, A.A., Jr., Orndorff, R.C., 1998, Bedrock geologic map of central and southern New Jersey: U.S. Geological Survey Miscellaneous Investigations Series Map I-2450-B, scale 1:100,000.

Perissoratis, C., Brock, P.W.G., Breuckner, H.K., Drake, A.A., Jr., and Berry, W.B.N., 1979, The Taconides of western New Jersey - New evidence from the Jutland klippe [summary]: Geol. Society America Bulletin, v. 90, p. 10-13.

Stone, B.D., Stanford, S.D., and Witte, R.W., 2002, Surficial geologic map of northern New Jersey: U.S. Geological Survey Miscellaneous Investigations Series Map I-2540-C, scale 1:100,000.

Volkert, R.A., and Drake, A.A., Jr., 1986, Some Middle Proterozoic rocks of the New Jersey Highlands: *in* Geology of the New Jersey Highlands and Radon in New Jersey: Proceedings Geological Association N.J. annual meeting (3rd), p. 1-17.

Volkert, R.A., and Drake, A.A., Jr., and Sugarman, P.J., 1996, Geology, Geochemistry, and Tectonostratigraphic Relations of the Crystalline Basement Beneath the Coastal Plain of New Jersey and Contiguous Areas, U.S. Geological Survey Professional Paper 1565-B, 48p.