Map Unit Descriptions

Source: Rader, E. K., and Evans, N. H., editors, 1993, Geologic Map of Virginia – Expanded Explanation: Virginia Division of Mineral Resources, 80 p.

al *alluvium* (Holocene). Fine to coarse gravelly sand and sandy gravel, silt, and clay, light- to medium-gray and yellowish-gray. Deposited mainly in channel, point-bar, and flood-plain environments; includes sandy deposits of narrow estuarine beaches, and mud, muddy sand, and peat in swamps and in fresh and brackish-water marshes bordering tidewater rivers. Grades into colluvium along steeper valley walls at margins of unit. Mostly Holocene but, locally, includes lowlying Pleistocene (?) terrace deposits. As much as 80 feet thick along major streams.

td *terrace deposits, undifferentiated*. Poorly sorted clay, sand, and rounded pebbles and cobbles; deeply weathered.

QTu *Quaternary and Tertiary deposits, undifferentiated.* Tabb through Windsor Formations and alluvial/tidal prism deposits.

Qts *Tabb Formation-Sedgefield Member* (Johnson, 1976). Pebbly to bouldery, clayey sand and fine to medium, shelly sand that grades upward into sandy and clayey silt; locally channel fill at base of unit includes as much as 50 feet of fine to coarse, cross-bedded sand and clayey silt and peat containing in-situ tree stumps. Sandy bay facies commonly contains *Crassostrea biostromes, Mercenaria, Anadara, Polynices, Ensis,* and other mollusks. Specimens of the coral *Astrangia* have yielded estimated uranium-series ages averaging 71,000 ± 7,000 yrs B.P. (Mixon and others, 1982). Unit constitutes surficial deposit to river and coast-parallel plains (altitude 20-30 feet) bounded on landward side by Suffolk and Harpersville scarps. Thickness is 0 to 50 feet.

QTw *Windsor Formation* (lower Pleistocene or upper Pliocene, Coch, 1968). Gray and yellowish - to reddish-brown sand, gravel, silt, and clay. Constitutes surficial deposits of extensive plain (altitude 85-95 feet.) seaward of Surry scarp and of coeval, fluvial-estuarine terraces west of scarp. Fining upward sequence beneath plain consists of a basal pebbly sand grading upward into cross-bedded, quartzose sand and massive, clayey silt and silty clay; lower and upper parts of sequence were deposited, respectively, in shallow-marine or open-bay and restricted-bay or lagoonal environments. In terraces west of Surry scarp, fluvial-estuarine deposits comprise muddy, coarse, trough cross-bedded sand and gravel grading upward to sandy silt and clay. Thickness is 0 to 40 feet.

Qc *Chuckatuck Formation* (middle(?) Pleistocene, Johnson and Berquist, 1989). Light - to medium-gray, yellowish-orange, and reddish-brown sand, silt, and clay and minor amounts of dark-brown and brownish-black peat. Comprises surficial deposits of mid-level coast-parallel plains (altitude 50-60 feet) and equivalent riverine terraces. Eastward, unit is truncated by the Suffolk scarp; westward, along major stream drainages, unit is separated from the younger topographically lower Shirley Formation by the Kingsmill scarp and equivalent estuarine scarps. Fluvial-estuarine facies includes, from bottom to top, (1) channel-fill deposits of poorly sorted, cross-bedded, pebbly and cobbly sand interbedded, locally, with peat and sandy silt rich in organic matter, (2) moderately well-

sorted, cross-bedded to planar bedded, fine- to medium-grained sand grading up ward into (3) clayey silt and sandy and silty clay. Bay facies of coastwise plain includes a basal gravelly sand filling shallow paleochannels, a thin but extensive pebbly sand containing heavy mineral laminae and *Ophiomorpha* burrows, and an upper, relatively thick, medium- to fine-grained silty sand and sandy silt. Thickness is 0 to 26 feet.

Qcc *Charles City Formation* (lower Pleistocene (?), Johnson and Berquist, 1989). Light- to medium-gray and light to dark yellowish and reddish-brown sand, silt, and clay composing surficial deposits of riverine terraces and coast-parallel plains at altitiudes of 70 to 80 feet. Unit is adjacent to, and inset below, the Windsor Formation and older deposits. Bay or shallow shelf facies of the Charles City (Johnson and Peebles, 1984), present beneath flat to gently seaward-sloping plain in Suffolk area, includes a thin, basal, gravelly sand grading upward into fine- to medium-grained sand and an uppermost clayey and sandy silt; lower and middle parts of unit contain clay-lined, sand-filled burrows. Fluvial-estuarine facies in terrace remnants along major rivers consists of cross-bedded gravelly sand and clayey silt. Thickness is 0 to 55 feet, or more.

Tb1 / Tb2 *Bacons Castle Formation* (upper Pliocene, Coch, 1965). Gray, yellowish-orange, and reddish-brown sand, gravel, silt, and clay; constitutes surficial deposits of high plain extending from Richmond, eastward to the Surry scarp. Unit is subdivided into two members: Tb1, massive to thick-bedded pebble and cobble gravel grading upward into cross-bedded, pebbly sand and sandy and clayey silt, and Tb2, predominantly thin-bedded and laminated clayey silt and silty fine-grained sand. Tb2 is characterized by flaser, wavy, and lenticular bedding and rare to common clay-lined burrows including *Ophiomorpha nodosa*. Thickness is 0 to 70 feet.

Tc *Chesapeake Group* (upper Pliocene to lower Miocene, Darton, 1891). Fine-to coarse-grained, quartzose sand, silt, and clay; variably shelly and diatomaceous, deposited mainly in shallow, inner- and middle-shelf waters. Ages of units based on studies of foraminiferal, nannofossil, diatom, and molluscan assemblages in Virginia and adjacent states (Andrews, 1988; Gibson, 1983; Gibson and others, 1980;Poag, 1989; Ward and Blackwelder, 1980; Ward and Krafft, 1984). Includes the following formations, from youngest to oldest:

Chowan River Formation (upper Pliocene, Blackwelder, 1981). Gray to dusky-blue-green sand, fine - to medium-grained, clayey and silty, commonly very shelly; grades laterally into laminated, silty clay and upward into cross-bedded, biofragmental sand, clayey silt, and silty clay. Discontinuous pebbly to bouldery sand at very irregular base of unit. Mollusks include; *Glycymeris hummi, Noetia carolinensis,* and *Carolinapecten eboreus bertiensis*. Thickness is 0 to 50 feet. Recognized only in southeasternmost Virginia and North Carolina.

Yorktown Formation (lower upper Pliocene to lower Pliocene, Clark and Miller, 1906). Bluish-gray and brownish-yellow sand, fine- to coarse-grained, in part glauconitic and phosphatic, commonly very shelly, interbedded with sandy and silty blue-gray clay. In lower York and James River basins, unit includes cross-bedded shell hash. Mollusks include; *Glycymeris subovata, Chesapecten jeffersonius, Chesapecten madisonius, Mercenaria tridacnoides, Panopea reflexa.* Coarse-grained sand and gravel facies of the Yorktown in updip areas is mapped separately as unit psg. Thickness is 0 to 150 feet.

Eastover Formation (upper Miocene, Ward and Blackwelder, 1980). Dark-gray to bluish-gray, muddy sand, very fine to fine, micaceous, interbedded with sandy silt and clay. Lower part of unit is dominantly medium- to very-thin-bedded and laminated silt and clay interbedded with very-fine sand, lenticular and wavy bedding common; upper part is mainly very-fine- to fine-grained sand containing abundant clay laminae. Typical mollusks include *Chesapecten middlesexensis, Marvacrassatella surryensis, Glossus fraterna*. Thickness is 0 to 270 feet.

St. Marys Formation (upper and middle Miocene, Shattuck, 1902). Bluish- to pinkish-gray, muddy, very-fine sand and sandy clay-silt, locally abundantly shelly. *Chesapecten santamaria, Buccinofusus parilis,* and *Ecphora gardnerae* are characteristic mollusks. Occurs northeast of Mattaponi River. Thickness is 0 to 40 feet.

Choptank Formation (middle Miocene, Shattuck, 1902). Olive-gray sand, fine to very-fine, clayey and silty, shelly, and diatomaceous clay-silt; commonly forms fining-upward sequences. Mollusks include *Chesapecten nefrens, Mercenaria cuneata, Ecphora meganae*. Thickness is 0 to 50 feet. *Calvert Formation* (middle and lower Miocene, Shattuck, 1902). Commonly consists of 2 to 7 fining-upward sequences. Each sequence includes a light- to dark-olive-gray basal sand, very fine to fine, clayey and silty, very sparsely to abundantly shelly; grades upward to sandy, diatomaceous clay-silt and diatomite. Typical molluscs include *Chesapecten coccymelus, Crassatella melinus, Ecphora tricostata*. Thickness is 0 to 600 feet

Tl *Lower Tertiary deposits* (Oligocene, Eocene, and Paleocene). Mostly fine- to coarse-grained glauconitic quartz sand and clay-silt, shelly in part; includes lesser amounts of sandy limestone and limey sand. In outcrop, unit comprises the Pamunkey Group (Brightseat, Aquia, Marlboro, Nanjemoy, and Piney Point Formations) and the Old Church Formation. In subsurface, unit includes Eocene and Oligocene strata not included in the Pamunkey and Old Church. Ages of formational units based on foraminiferal, nannofossil, dinocyst, pollen, and molluscan studies (Frederiksen, 1979; Gibson and others, 1980; Gibson and Bybell, 1984; Edwards, 1984, 1989; Edwards and others, 1984; Poag, 1989; Ward, 1985; Ward and Krafft, 1984). Stratigraphic sections vary widely, comprising one or more of the following formations:

Old Church Formation (Ward, 1985) and unnamed glauconitic sands (upper Oligocene). In inner and middle Coastal Plain, unit is 0 to 5 feet of olive-gray, fine- to coarse-grained, shelly, very sparsely glauconitic quartz sand of the Old Church Formation; typical fossils include *Anomia ruffini, Lucina sp.,* and *Mercenaria capax*. In subsurface of outer Coastal Plain, unit includes about 45 feet of dark-olive-gray to greenish-black glauconite sand with lesser amounts of quartz; sand has olive-brown clay-silt matrix.

Lower Oligocene beds. Olive-gray to grayish-olive sand, very-fine-grained, clayey and silty, micaceous, glauconitic; coarsens upward to a very-fine- to fine-grained sand. Unit is 0 to 50 feet thick; identified only in subsurface of Eastern Shore area (Exmore, core hole, R. B. Mixon and D. S. Powars, personal communication).

Chickahominy Formation (upper Eocene, Cushman and Cederstrom, 1945). Predominantly olive-gray clayey silt and silty clay, very compact, glauconitic, micaceous, contains abundant finely crystalline iron sulfide. Coarsens downward to a very-fine- to

fine-grained sand, pebbles at base. Rare fragmental shell, microfossils very abundant. Thickness is 0 to 100 feet; present in subsurface of southeastern Virginia.

Piney Point Formation (middle Eocene, Otton, 1955). Olive-gray and grayish-olive-green, glauconitic quartz sand, medium-to coarse-grained, poorly sorted, contains scattered quartz pebbles, interbedded with carbonate-cemented sand and moldic limestone. Unit is characterized by large, calcitic shells of the oyster *Cubitostrea sellaeformis*, a middle Eocene marker. Aragonitic mollusks are generally leached, leaving only molds and casts. Thickness is 0 to 60 feet.

Nanjemoy Formation (lower Eocene, Clark and Martin, 1901). Dark-olive-gray, greenish-gray, and olive-black glauconitic quartz sand, fine- to coarse-grained, very clayey and silty, intensely burrowed, sparsely to abundantly shelly, interbedded with sandy clay-silt. Sand in upper part of unit is less clayey, very micaceous, and contains scattered quartz pebbles. Typical mollusks include *Venericardia potapacoensis, Venericardia ascia,* and *Macrocallista subimpressa*. Unit is 0 to 140 feet thick.

Marlboro Clay (lower Eocene (?) and upper Paleocene, Clark and Martin, 1901). Light-gray, pinkish-gray, and reddish-brown kaolinitic clay, massively bedded to laminated, interbedded with lesser amounts of laminated and ripple cross-laminated silt and very-fine-grained sand. Contains rare molds of small mollusks and arenaceous foraminifera. Thickness is 0 to 30 feet.

Aquia Formation (upper Paleocene, Clark and Martin, 1901). Light- to dark-olive gray, glauconitic quartz sand, fine- to coarse-grained, clayey and silty, thick- to massively bedded, sparsely to abundantly shelly. Lower part of unit is more poorly sorted and more calcarious than upper part and contains a few thin to medium beds of olive-gray, white, and pale greenish-yellow limestone. Upper part of unit is moderately well sorted and characterized by thin beds of the large, high-spired gastropod *Turritella mortoni*. Other common mollusks in clude *Cucullaea gigantea, Ostrea sinuosa,* and *Crassatellites alaeformis*. Thickness is 0 to 130 feet.

Brightseat Formation (lower Paleocene, Bennett and Collins, 1952). Olive-gray to olive-black, micaceous quartz sand, fine- to very fine-grained, clayey and silty, variably glauconitic. Thickness is 0 to 20 feet.

psg *Pliocene sand and gravel*. Interbedded yellowish-orange to reddish-brown gravelly sand, sandy gravel, and fine to coarse sand, poorly to well-sorted, cross-bedded in part, in cludes lesser amounts of clay and silt in thin to medium beds. Commonly caps drainage divides (altitude 250-170 feet) in western part of Coastal Plain. Lower part of unit, showing flaser and lenticular bedding and containing rare to abundant *Ophiomorpha nodosa*, represents deposition in marginal-marine environments and is, in part, a nearshore equivalent of the more downdip, marine facies of the Yorktown Formation. In the northern part of the Coastal Plain, the more poorly sorted and less cleanly washed upper part of unit, which lacks fossils, comprises fluvial-deltaic sediments that prograded eastward across the shelf during a regressive phase of the Yorktown. To the south, the upper part of unit is massively bedded clayey sand in places containing heavy mineral concentrations that average 8 percent or more; the sands are nearshore, beach and dune

origin; interstitial clay was derived, in part, from in-situ weathering of feldspar sand. Thickness is 0 to 50 feet.

Kp *Potomac Formation* (Lower and Upper(?) Cretaceous, McGee, 1886). Light-gray to pinkish- and greenish-gray quartzo-feldspathic sand, fine- to coarse-grained, pebbly, poor ly sorted, commonly thick-bedded and trough cross-bedded. Sand is interbedded with gray to green, massive to thick-bedded sandy clay and silt, commonly mottled red or reddish-brown. Includes lesser amounts of clay-clast conglomerate and thin-bedded to laminated, carbonaceous clay and silt. In the inner Coastal Plain, unit was deposited mainly in fluvial-deltaic environments, intertongues eastward with thin glauconitic sands of shallow-shelf origin. Spore and pollen assemblages and leaf impressions of ferns and cycads indicate an Early Cretaceous age (Doyle and Robbins, 1977). In some downdip areas, uppermost part of unit may be of earliest Late Cretaceous age. Thickness ranges from a feather edge at western limit of outcrop to more than 3500 feet in subsurface of outermost Coastal Plain.

Newark Supergroup (Upper Triassic) c, cs, s1, ss

c *conglomerate, mixed clasts*. Rounded to subangular pebbles, cobbles, and boulders of mixed lithologies including quartz, phyllite, quartzite, gneiss, schist, greenstone, and marble in a matrix of medium- to very-coarse-grained, reddish-brown to gray, locally arkosic, sandstone.

cs *sandstone, siltstone, shale, and coal, interbedded.* Sandstone, fine-to coarse-grained, reddish-brown to gray, arkosic in places, micaceous, displays channel-type primary features. Siltstone light- to dark-gray, micaceous. Shale, light- to dark-gray, carbonaceous, micaceous, fossiliferous. Coal, bituminous, banded, moderate- to well-developed, fine- to medium-cleat, partings and inclusions of shale, siltstone, and sandstone; high methane concentrations recorded in the Richmond and Taylorsville basins. This lithologic unit occurs in the Richmond, Taylorsville, Farmville, Briery Creek, and Danville basins.

s1 *sandstone, arkosic*. Light-gray to light-reddish-brown, medium- to coarse-grained, micaceous.

ss *sandstone, siltstone, and shale, interbedded.* Sandstone, very fine- to course-grained, reddish-brown to gray, micaceous, minor conglomerate beds. Siltstone, reddish-brown to gray, micaceous. Shale, reddish-brown, greenish-gray, gray, yellowish-brown, laminated, fossiliferous. Upward-fining sequences, discontinuous vertically and horizontally.

my *mylonite*. Includes protomylonite, mylonite, ultramylonite, and cataclastic rocks. Lithology highly variable, depending on the nature of the parent rock, and on intensive parameters and history of deformation. In most mapped belts of mylonite and cataclastic rock (**my**), tectonized rocks anastomose around lenses of less-deformed or undeformed rock. In the Blue Ridge, some of these lenses are large enough to show at 1:500,000 scale. In many places mylonitic and cataclastic rocks are gradational into less deformed or undeformed adjacent rocks, and location of contacts between tectonized rocks (my) and adjacent units is approximate or arbitrary. These boundaries are indicated on the map by color-color joins with superimposed shear pattern.

Most mapped belts of mylonite represent fault zones with multiple movement histories. In the Blue Ridge, Paleozoic age contractional deformation fabrics are superimposed on Late Precambrian extensional fabrics (Simpson and Kalaghan, 1989; Bailey and Simpson, 1993). Many Piedmont mylonite zones contain dextral-transpressional kinematic indicators that formed during Late Paleozoic collisional tectonics (Bobyarchick and Glover, 1979; Gates and others, 1986). Paleozoic and older faults were reactivated in many places to form extensional faults during the Mesozoic (Bobyarchick and Glover, 1979).

Mpg *Petersburg Granite*. Light- to dark-gray to pink, fine- to coarse-grained, equigranular to porphyritic, foliated to nonfoliated, ranges from granite to granodiorite in composition; multiple intrusive phases are present. The granite contains xenoliths of biotite gneiss and amphibolite. Mineralogy: quartz + sodic plagioclase + potassium feldspar + biotite ± hornblende; accessory minerals include ilmenite, magnetite, pyrite, zircon, apatite, titanite, muscovite, and fluorite (Goodwin, 1970; Daniels and Onuschak, 1974; Wright and others, 1975).

Current mapping restricts the Petersburg Granite to a contiguous unit that crops out in the Cities of Richmond and Petersburg; this roughly corresponds to one of four discrete plutons mapped as Petersburg Granite on the 1963 Geologic Map of Virginia. Samples from within this pluton were dated at 330±8 Ma (U-Pb zircon; Wright, and others, 1975). The northwestern edge of the pluton is mylonitized along the Hylas fault zone (Bobyarchick and Glover, 1979).

Ymd *porphyroblastic garnet-biotite gneiss*. Heterogeneous layered sequence is dominantly garnetiferous biotite gneiss and porphyroblastic gneiss, migmatitic in part, with subordinate interlayered amphibolite and amphibole gneiss **(Ya)**, pelitic-composition gneiss, calcsilicate gneiss, biotite hornblende-quartz-plagioclase gneiss, and garnetiferous leucogneiss. These lithologies contain amphibolite-facies metamorphic mineral assemblages consistent with rock chemistry. Farrar (1984) reports relict granulite-facies assemblages in some rocks.

This unit underlies a wide area that surrounds the State Farm antiform (Poland, 1976; Reilly, 1980; Farrar, 1984) and two subsidiary antiforms to the northeast; the unit includes the Maidens gneiss and portions of the Sabot amphibolite of Poland (1976), the eastern gneiss complex and Boscobel granodiorite gneiss of Bobyarchick (1976), and the Po River Metamorphic Suite of Pavlides (1980).

Poland (1976) and Reilly (1980) proposed that the Maidens gneiss and Sabot amphibolite were a Late Precambrian- to Early Paleozoic-age volcanic-sedimentary cover sequence unconformably overlying the State Farm gneiss. Farrar (1984) interpreted relict granulite-facies mineral assemblages to have equilibrated during Grenville-age regional metamorphism; this contributed to his conclusion that the Sabot and Maidens, in addition to the State Farm, are Grenville or pre-Grenville in age. Porphyroblastic garnet-biotite gneiss **(Ymd)** is intruded by rocks of the Carboniferous-age Falmouth Intrusive Suite (Pavlides, 1980).

v *mafic and felsic metavolcanic rocks*. Heterogeneous layered metavolcanic sequence includes crystal and lithic tuff, dacite porphyry, chert, phyllite, and greenstone

metabasalt; greenschist-facies metamorphic mineral assemblages occur in the various lithologies. This unit correlates with the Roanoke Rapids volcanogenic complex of the eastern slate belt in North Carolina (Farrar, 1985a, 1985b; Geologic Map of North Carolina, 1985; Horton and Stoddard, 1986). To the extent that correlation with lithologically similar Carolina slate belt rocks is valid, mafic and felsic metavolcanic rocks (v) are Late Proterozoic to Cambrian in age.