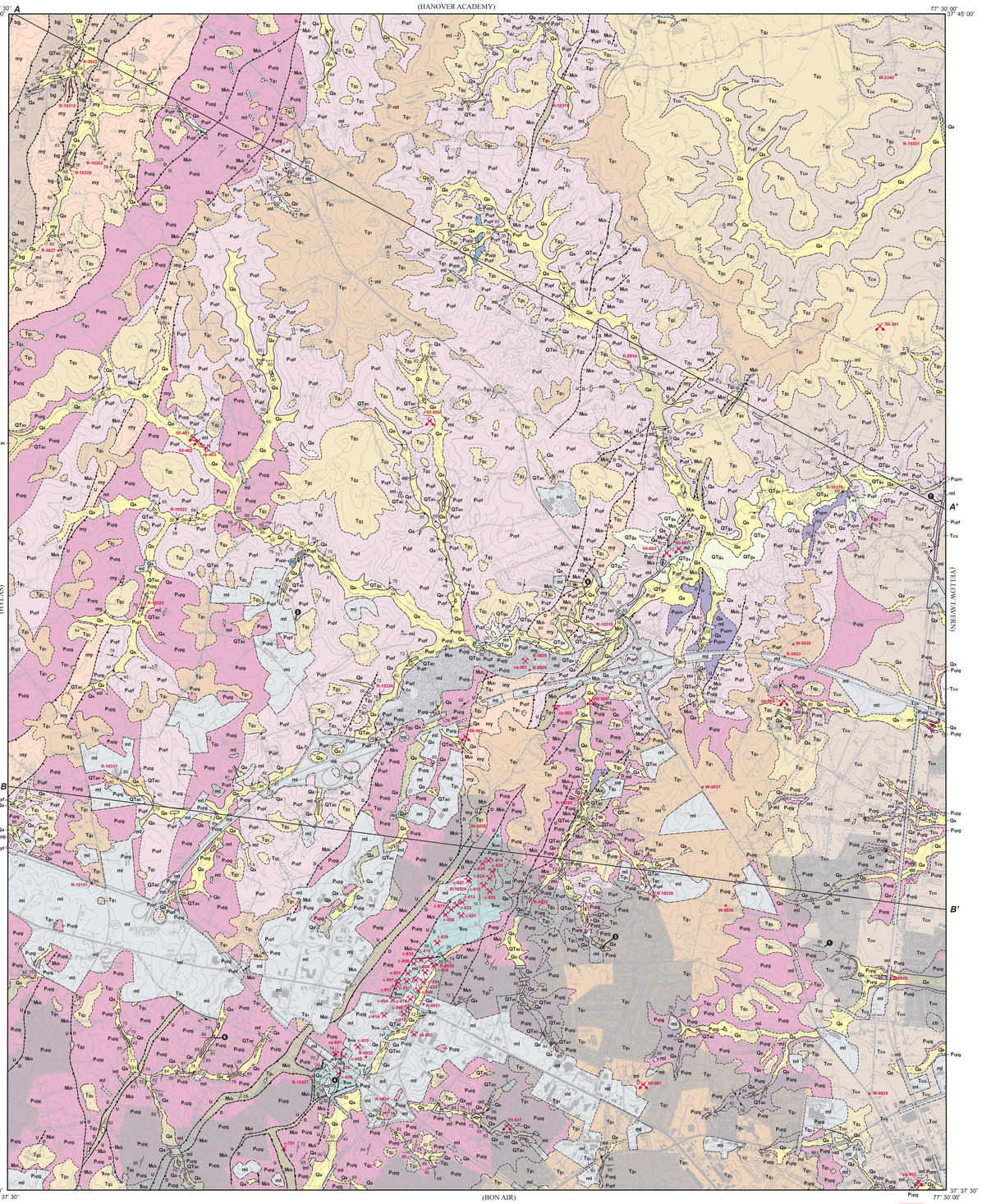
Virginia Department of Mines, Minerals and Energy

Open-File Report 10-07
Geologic Map of the Glen Allen Quadrangle, Virginia
Virginia Division of Geology and Mineral Resources

GEOLOGIC MAP OF THE GLEN ALLEN QUADRANGLE, VIRGINIA

Mark W. Carter
with additional data compiled from Bruce K. Goodwin (1981)
2010



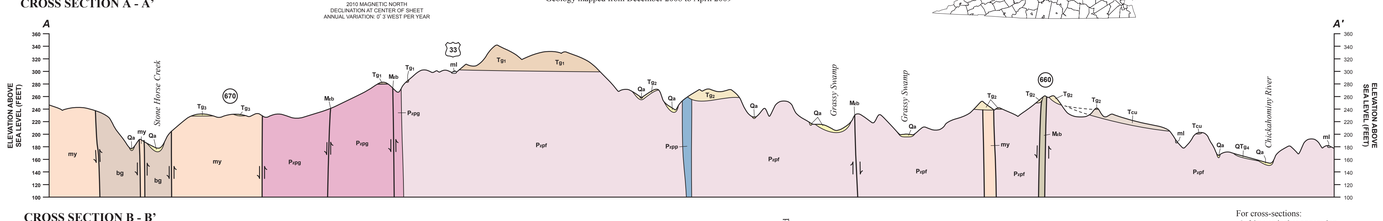
Basemap modified from U.S. Geological Survey DRG
Glen Allen quadrangle, Virginia, 1963, Revised 1994
Projection: Modified UTM, NAD 1927 Datum
Digital Cartography by Mark W. Carter and Aaron Cross

2010 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET
ANNUAL VARIATION: 0° 3' WEST PER YEAR

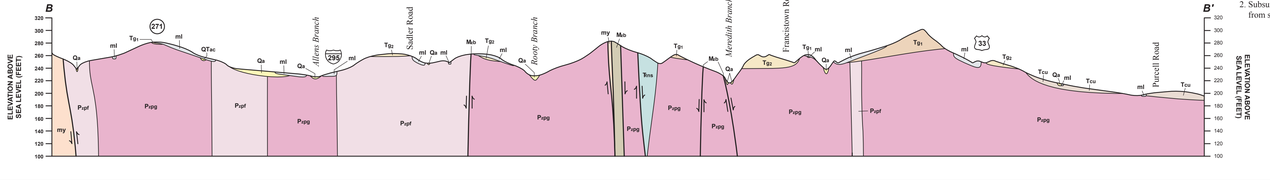
SCALE 1:24000

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
Geology mapped from December 2008 to April 2009

CROSS SECTION A - A'



CROSS SECTION B - B'



For cross-sections:
1. 20x vertical exaggeration
2. Subsurface structures interpreted from surface measurements

DESCRIPTION OF MAP UNITS

SURFICIAL UNITS

ml — **Modified Land** – Extensive cut and/or fill related to grading and excavation. Widespread modified land in heavily urbanized areas is not shown. Holocene. Variable thickness.

Qa — **Alluvium** – Floodplain deposits ranging from clay to gravel. Holocene to Pleistocene. Variable thickness.

cb — **Carolina Bay** – One elliptical depression occurring above Tertiary sand and gravel of the upper Chesapeake Group (T_{CU}), south of Laurel Park in the southeastern corner of the quadrangle. Interpreted to be a Carolina Bay of the central and southern outer Atlantic Coastal Plain (Goodwin and Johnson, 1970). Similar depressions (to the southwest on the Bon Air quadrangle) are filled with 5 to 10 feet (1.5 to 3.0 meters) of massive, brownish-gray silty clay, with scattered rounded quartz pebbles, surrounded by a low ridge or rim of fine sand (Goodwin, 1980).

QTac — **Quaternary-Tertiary Alluvial and Colluvial Valley Fill** – Channel fill and side-slope deposits of alluvium and colluvium in drainageways, at elevations ranging from 190 to 280 feet above sea level. Variably lithified pebbly feldspathic sand is very light gray to pinkish-gray to yellowish-gray, and fine- to medium-grained. Subangular to well-rounded pebbles, cobbles, and boulders of quartz, quartzite (many containing the trace fossil *Skolithos*), and granite are scattered throughout. The matrix contains very few mica minerals. Feldspar is variably weathered to clay, which, with hematite, carbonate, and silica, contributes to cementation. Sediment consists of quartz, plagioclase, potassium feldspar, clay minerals, hematite, ilmenite/magnetite, and carbonate. Locally bedded; basal gravel lag deposit, up to about 1 foot (0.3 meter) thick, typically occurs at the contact with underlying Paleozoic granite, and is commonly iron-oxide cemented. Degree of lithification and a generally higher elevation distinguish this unit from younger Holocene to Pleistocene surficial alluvium. The unit is interpreted to be remnants of periodic debris flows that mixed granite saprolite with reworked gravels from older or more distal units. Pleistocene to Pliocene. Maximum thickness is about 10 feet (3 meters).

COASTAL PLAIN UNITS

QT_{Gc} — **Quaternary-Tertiary Gravels** – Gravel and sand deposits that occur on low hills and in paleo-drainageways at elevations ranging from 160 to 220 feet above sea level along Chickahominy River. Rounded quartz and quartzite pebbles and cobbles, most with the trace fossil *Skolithos*, make up the coarse-grained portion of the unit. Correlates with at least part of the lower Pleistocene to upper Pliocene Windsor Formation (Coch, 1968) along James River (Mixon and others, 1989). Maximum thickness is about 5 feet (1.5 meters).

T_{G3} — **Low-Level Tertiary Gravels** – Gravel and sand deposits that cap hills at elevations about 230 feet above sea level, along Stone Horse Creek (a tributary of Pamunkey River) in the northwestern corner of the quadrangle. Gravel includes rounded quartz and quartzite pebbles, cobbles, and boulders, many with the trace fossil *Skolithos*. Correlates with at least part of the upper Pliocene Bacons Castle Formation (Coch, 1965) to the east (Mixon and others, 1989; Carter and others, 2007). Maximum thickness about 10 feet (3 meters).

T_{G2} — **Mid-Level Tertiary Gravels** – Sand and gravel deposits that cap hills and mantle slopes throughout the quadrangle, at elevations ranging from 250 to 280 feet above sea level in the western part of the quadrangle, and 220 to 260 feet above sea level in the eastern part of the quadrangle. Gravel consists of rounded quartz and quartzite pebbles, many containing the trace fossil *Skolithos*, in a sandy to clayey sand matrix. Pebbles are locally stained and cemented with iron-oxide, but sand is more common in this unit than in equivalent deposits on the Bon Air quadrangle to the south (Carter and others, 2008); locally bedded. Commonly, the base of the unit is lithologically similar to Quaternary-Tertiary alluvial and colluvial valley fill (QTac). The sediment consists of quartz, sericite and other clay minerals, hematite, potassium feldspar, plagioclase, and carbonate, with traces of ilmenite/magnetite, biotite and muscovite (as detrital grains). In the eastern part of the quadrangle, these deposits overly, and are slightly younger than upper Chesapeake Group sediments (T_{CU}). This unit is interpreted to have been deposited during Pliocene sea-level regression (Carter and others, 2007). Maximum thickness is about 30 feet (10 meters).

T_{CU} — **Upper Chesapeake Group Sand and Gravel** – Reddish-brown to grayish-yellow silty sand and gravel occurs on the low, relatively flat topographic surface along the eastern edge of the quadrangle, at elevations ranging from of about 245 feet above sea level in the southern part of the quadrangle and 260 feet above sea level in the northern part. Fine sand, with scattered, rounded quartz granules and pebbles, is the dominant lithology. Locally, sand is finely laminated, cross-bedded, or bedded with gravel stringers and layers up to several feet (about 1 meter) thick. Gravel consists of well-rounded, clast-supported quartz and quartzite pebbles and cobbles. Iron-oxide mottling and cement is common. Base of unit is locally lithologically similar to Quaternary-Tertiary alluvial and colluvial valley fill (QTac). Fine (pea-size) gravel typically mantles the surface, distinguishing this unit from the T_{G1-3} gravels that typically contain cobbles and boulders. Overlies, and is younger than high-level Tertiary gravels (T_{G1}) on the Bon Air and Chesterfield quadrangles to the south. This unit is interpreted to have been deposited in fluvial, nearshore, and strandline environments (Daniels and Onuschak, 1974; Goodwin, 1980). Correlates with the Pliocene upper Chesapeake Group as the nearshore equivalent of the marine Yorktown Formation (Newell and Rader, 1982). Maximum thickness is about 50 feet (15 meters).

T_{G1} — **High-Level Tertiary Gravels** – Extensive sand and gravel deposits that cap hills in the southeastern, northeastern, and west-central portions of the quadrangle, at elevations ranging from about 260 to 350 feet above sea level. Yellowish-brown to reddish-brown sediment consists of abundant, well rounded pebbles and cobbles in a sandy to clayey sand matrix. Sand is far more common in this unit than in equivalent deposits on the Bon Air quadrangle to the south (Carter and others, 2008); gravel is primarily vein quartz and quartzite (a few clasts contain the trace fossil *Skolithos*), with few metamorphic and igneous clasts; quartzite clasts are commonly deeply weathered to decomposed, partially iron-oxide cemented matrix; locally bedded. Commonly, the base of unit is lithologically similar to Quaternary-Tertiary alluvial and colluvial valley fill (QTac). Interpreted to have been deposited during Pliocene to Miocene sea-level regression (Carter and others, 2007). Maximum thickness is about 70 feet (20 meters) in the north-central part of the quadrangle.

CATACLASTIC ROCKS

Mzb — **Silicified Cataclasite** – White to very light-gray brecciated quartz is the dominant rock type of this unit. Quartz fragments range from pebble- to cobble-size; fractures and voids between fragments are filled with botryoidal masses, concentric growths, and vugs of drusy quartz crystals. Slickensides are common on some fracture surfaces. Locally, fragments of country rock are also common within brecciated quartz. Silicified cataclasite is resistant to weathering and erosion, and occurs as outcrops or abundant float that caps many hills within the outcrop belt. Also included within this unit are zones of intensely fractured country rock, cross-cut by abundant swarms of approximately 0.1 inch (2.5 millimeters) thick chalcedony and quartz-filled joints and fractures. In these zones, granule- to boulder-size fragments of country rock dominate. Locally, chalcedony- and quartz-filled fracture swarms grade into thicker zones of brecciated quartz. Several silicified cataclasite zones portrayed on the geologic map are exaggerated, and many more are too small to map separately at this scale. Age of formation and deformation of at least one silicified cataclasite zone is well constrained: on the adjacent Bon Air quadrangle to the south, a 2-foot (0.6 meter) thick silicified cataclasite zone cross-cuts and brecciates Jurassic diabase (Carter and others, 2008). Many silicified cataclasite zones appear to have been reactivated during the Cenozoic, as basal elevations of several Tertiary sand and gravel deposits are offset along silicified cataclasite zones throughout the quadrangle.

my — **Mylonitic Gneiss**[1] – Mylonite and protomylonite of this unit are dark gray to grayish green, weathering to yellowish gray, and typically fine-grained. Feldspar porphyroclasts, 0.5 to 1 inch (1 to 2.5 centimeters) in length, occur locally in a finer-grained matrix of quartz, biotite and feldspar, and are strongly foliated, with fluxion structure locally well-developed. In the northwestern corner of the quadrangle, mylonite gneiss grades laterally across contacts into mylonitic biotite gneiss (bg). The Petersburg Granite is the protolith of the unit and mylonite gneiss grades into well-foliated granite. Thin, cross-cutting zones of Mesozoic silicified cataclasite (Mzb) occur throughout mylonite gneiss and form most of the boundaries of the unit in the central part of the quadrangle (silicified cataclasite zones internal to the unit are not shown on the geologic map). Paleozoic.

NEWARK SUPERGROUP

T_{Rns} — **Newark Supergroup, Undivided** – Newark Supergroup (Froelich and Olsen, 1984) sandstone, shale, and coal occurs in the south-central portion of the quadrangle within the Mesozoic Deep Run sub-basin. Sandstone is very pale-orange to brownish-gray to brownish-black (weathers to moderate yellowish-brown to dusky yellowish-brown); medium- to coarse-grained, locally granule conglomeratic to pebble conglomeratic; arkosic, micaceous, and carbonaceous. Consists of quartz, plagioclase, potassium feldspar, sericite, biotite, epidote, carbonate, and traces of muscovite, chlorite, hematite, and zircon. Shale is brownish-black to dusky-red (weathers to moderate reddish-brown), laminated to thin bedded, and fossiliferous. Both rock types are interbedded with thin, but abundant seams of black coal. Unconformably overlies the Paleozoic Petersburg Granite (Goodwin and others, 1986) along eastern boundary; the western boundary of the sub-basin is faulted. Upper Triassic. Despite the narrow width of the Deep Run sub-basin, thickness on the Glen Allen quadrangle is greater than 300 feet (90 meters).

IGNEOUS INTRUSIVE ROCKS

PETERSBURG GRANITE

The Petersburg Granite underlies a large region of east-central Virginia, from near Ashland in Hanover County to the north, to Dinwiddie in Dinwiddie County to the south. Its outcrop belt is bounded to the north and west by the Richmond-Taylorsville Mesozoic basins, and is covered by Coastal Plain sediments to the south and east. Dated at approximately 330 Ma (Mississippian) by Wright and others (1975), and approximately 315 Ma (Pennsylvanian) by Lee and Williams (1993). On the Glen Allen quadrangle, five facies of the Petersburg Granite are recognized:

P_{zpg} — **Subidiomorphic Granite** – Light bluish-gray, fine- to medium-grained, locally coarse-grained, with a homogenous, uniform subidiomorphic texture; locally weakly foliated. Consists of quartz, plagioclase, potassium feldspar, muscovite, biotite, hornblende, zircon, epidote, carbonate, and traces of ilmenite/magnetite, apatite, and garnet. Locally porphyritic, with pale-pink potassium feldspar phenocrysts less than 0.5 inch (1 centimeter) in length; locally contains pods, lenses, zones, and enclaves of foliated granite, porphyritic granite, and layered granite gneiss; cross-cut by aplite and pegmatite dikes; well jointed.

P_{zpp} — **Porphyritic Granite** – Grayish-blue, medium- to coarse-grained, porphyritic, with pale-pink potassium feldspar phenocrysts over 1 inch (2.5 centimeters) in length, commonly oriented and aligned subparallel to a weak to strong biotite foliation within the matrix. Consists of quartz, plagioclase, potassium feldspar, biotite, muscovite, zircon, epidote, carbonate, and traces of hornblende, hematite, and ilmenite/magnetite. Quartz and plagioclase dominate the matrix; quartz is typically medium-gray to light bluish-gray. Potassium feldspar phenocrysts are locally deformed to porphyroclasts. Commonly associated with coarse- to very coarse-grained, medium-gray to light bluish-gray quartz and pale-pink potassium feldspar pegmatite, which also cross-cuts older facies; also cross-cut by grayish-yellow aplite dikes. Well jointed.

P_{zpf} — **Foliated Granite** – Light bluish-gray, medium- to coarse-grained, locally fine-grained, weakly to strongly foliated. Phyllosilicate and quartz-feldspar alignment defines foliation. Unit locally contains pods, lenses, zones, and enclaves of layered granite gneiss, subidiomorphic granite, and rarely porphyritic granite. Cross-cut by aplite and pegmatite dikes. Well jointed.

P_{zpm} — **Megacrystic Granite** – Granite of this unit consists of coarse- to very coarse-grained pale-pink potassium feldspar phenocrysts, up to 1 foot (30 centimeters) in length, within a light bluish-gray, fine- to medium-grained, subidiomorphic matrix composed of quartz, plagioclase, potassium feldspar, muscovite, biotite, hornblende, zircon, epidote, carbonate, and traces of ilmenite/magnetite, apatite, and garnet. Locally, texturally and compositionally layered. Layering ranges from 0.5 inch (1 centimeter) to more than 1 foot (3 decimeters) thick, and consists of alternating layers of abundant coarse- to very coarse-grained feldspar phenocrysts, and fine- to coarse-grained, subidiomorphic to locally porphyritic, biotite-quartz-feldspar-rich layers. Occurs with layered granite gneiss, and contains pods, lenses, zones, and enclaves of foliated granite and felsic gneiss (fg) locally. Well jointed.

P_{zpl} — **Layered Granite Gneiss** – Light bluish-gray to medium bluish-gray to medium-gray granite; compositionally layered. Layering ranges from 0.5 inch to several inches (1 centimeter to 1 decimeter) thick. Composition ranges from quartz-feldspar- to biotite-quartz-feldspar-rich layers; individual layers are fine- to coarse-grained, subidiomorphic to locally porphyritic (potassium feldspar phenocrysts are less than 0.5 inch, or 1 centimeter in length). Unit locally contains pods, lenses, zones, and enclaves of subidiomorphic granite, foliated granite, and megacrystic granite. Cross-cut by aplite and pegmatite dikes. Well jointed.

METAMORPHIC ROCKS

Metamorphic rocks on the Glen Allen quadrangle consist of biotite gneiss within mylonitic gneiss in the northwestern corner of the quadrangle, and felsic gneiss occuring as enclaves or xenoliths within Petersburg Granite in the central-eastern portion of the quadrangle. Stratigraphic relationships between biotite gneiss and felsic gneiss are unknown, but the units are likely not equivalent.

fg — **Felsic Gneiss** – Compositionally layered rock consisting of contrasting quartz-feldspar- and phyllosilicate-rich layers, 0.5 inch (1 centimeter) thick. Quartz-feldspar-rich layers are bluish-white to yellowish-gray, medium- to coarse-grained, and granoblastic to locally porphyroclastic. Phyllosilicate-rich layers are medium dark-gray to dusky-brown to very dusky-red; fine- to medium-grained; lepidoblastic; strongly foliated to locally mylonitic. Associated with, and occurs as xenoliths within, megacrystic granite (P_{zpm}). Felsic gneiss is older than the granite, but maximum age constraints are lacking.

bg — **Biotite Gneiss**[1] – Light- to dark-gray, fine- to medium-grained, and strongly foliated. Typically crenulated and commonly mylonitic throughout. Well layered; layering is about 0.5 inch (1 centimeter) thick, and consists of lighter gray, coarser-grained quartz-plagioclase-biotite-rich layers, with small (less than 0.5 inch, or 1 centimeter in length) pale-pink potassium feldspar porphyroclasts, alternating with darker gray, finer-grained biotite-muscovite-chlorite-rich layers. Biotite gneiss is wholly bounded by mylonitic gneiss (my). Weems (1974) interprets similar gneisses on the Hanover Academy quadrangle to have been originally graywackes. Bobyarchick (1976) considers biotite gneiss to be correlative, in part, with the Maidens Gneiss farther west.

MAP SYMBOLS

For all line symbols: lines are solid where the location is exact, long-dashed where the location is approximate, short-dashed where the location is inferred, and dotted where covered. For geologic observation symbols, observation sites are centered on the strike bar, or are at the intersection point of multiple symbols.

Line Symbols on Map

Stratigraphic Contacts

Fault Contacts - High-angle reverse or normal faults labeled "**Mzb**" are Mesozoic silicified cataclasites; faults not labeled are Cenozoic brittle structures.

High-Angle Reverse - "U" on upthrown block; ornaments show dip direction

Low-Angle Reverse - ornaments show dip direction

Normal - "D" on downthrown block; ornaments show dip direction

Geologic Observations

11 — Strike and dip of inclined beds in Coastal Plain sediments and Triassic sedimentary rocks

59 — Strike and dip of inclined foliations in Petersburg Granite and gneiss units

56 — Strike and dip of inclined aplite and pegmatite dikes

57 — Strike and dip of inclined joints

68 — Strike and dip of inclined chalcedony-filled fractures or joints

64 — Trend and plunge of mineral lineations

50 — Trend and plunge of mesoscale fold hinges

Geologic References

R-10321 — Rock repository sample

W-2340 — Water well drill cuttings

2 — Location of Geologic Reference Photographs (location at tip of arrow)

Mineral Resources

Commodity letter symbol precedes identification number (identification numbers are preceded by "127A-" in Mineral Resources of Virginia database). Commodity letter symbols: c - coal; cs - crushed stone; fill - saprolite or earth material; sg - sand and gravel.

cs-501 — Active mine or quarry

fill-301 — Active borrow pit

c-613 — Abandoned or reclaimed mine or quarry

fill-901 — Abandoned or reclaimed borrow pit

c-635 — Abandoned prospect

Cross Section Symbols

Stratigraphic Contact

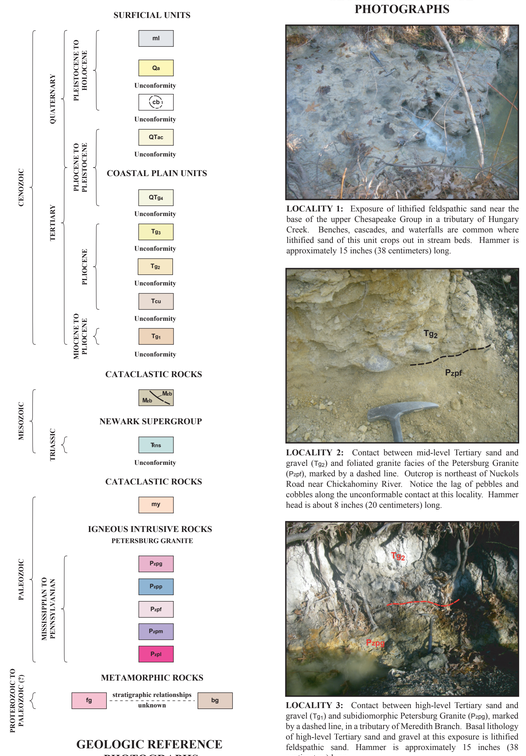
Fault Contact; arrows show relative displacement

Eroded Contact

FOOTNOTES

[1]Description of map unit modified from Goodwin (1981)

CORRELATION OF MAP UNITS



GEOLOGIC REFERENCE PHOTOGRAPHS

LOCALITY 1: Exposure of lithified feldspathic sand near the base of the upper Chesapeake Group in a tributary of Hungary Creek. Benches, cascades, and waterfalls are common where lithified sand of this unit crops out in stream beds. Hammer is approximately 15 inches (38 centimeters) long.

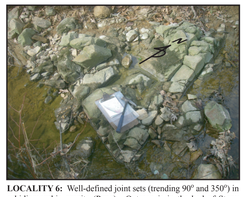
LOCALITY 2: Contact between mid-level Tertiary sand and gravel (T_{G2}) and foliated granite facies of the Petersburg Granite (P_{zpf}), marked by a dashed line. Outcrop is northeast of Nuckols Road near Chickahominy River. Notice the lag of pebbles and cobbles along the unconformable contact at this locality. Hammer head is about 8 inches (20 centimeters) long.

LOCALITY 3: Contact between high-level Tertiary sand and gravel (T_{G1}) and subidiomorphic Petersburg Granite (P_{zpg}), marked by a dashed line, in a tributary of Meredith Branch. Basal lithology of high-level Tertiary sand and gravel at this exposure is lithified feldspathic sand. Hammer is approximately 15 inches (38 centimeters) long.

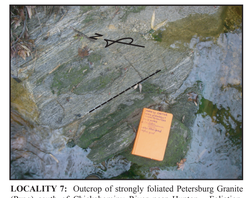
GEOLOGIC REFERENCE PHOTOGRAPHS

LOCALITY 4: Float block of silicified cataclasite in a tributary of Deep Run. Botryoidal masses of quartz are present on the fracture surface. A line of silicified cataclasite outcrops and float mark the trace of a Mesozoic fault cutting Triassic sediments of the Deep Run sub-basin in this area. Hammer is approximately 15 inches (38 centimeters) long.

LOCALITY 5: Small exposure of mylonitic granite (within the mylonitic gneiss unit) in a tributary of Chickahominy River. The rock has a strong porphyroclastic foliation, marked by a dashed line. Hammer head is about 8 inches (20 centimeters) long.



LOCALITY 6: Well-defined joint sets (trending 90° and 350°) in subidiomorphic granite (Pzpg). Outcrop is in the bed of Stony Run, south of Church Road. Hammer is approximately 15 inches (38 centimeters) long.



LOCALITY 7: Outcrop of strongly foliated Petersburg Granite (Pzpg) south of Chickahominy River near Hunton. Foliation, marked by a dashed line, trends approximately 315° northwest and dips steeply to the northeast. Long edge of fieldbook is about 7.5 inches (19 centimeters).

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