Preliminary geologic map, District of Columbia

by

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The western part of the District of Columbia lies in the Piedmont province and the eastern two-thirds lies in the Coastal Plain physiographic province. The north-northeast trending fall line zone, which separates the Piedmont from the Coastal Plain, passes through the center of Washington. Much of the District is intricately dissected by erosion, having flat to gently rolling uplands, steep valley walls, and widely separated interstream divides. Most public buildings and memorials in downtown Washington are constructed on nearly flat lowlands formed on river terrace deposits, alluvium, and artificial fill.

All of the drainage is into the Potomac River, which flows southeasterly and forms the natural southern boundary of the city. South-flowing streams and their tributaries form an intricate dendritic drainage network, with Rock Creek and the Anacostia River being the principal tributaries of the Potomac. Swift and turbulent Rock Creek, incised in a narrow precipitous valley draining the Piedmont, is in striking geomorphic contrast with the sluggish Anacostia River, which meanders in the flood plain of a broad gently sloping valley across the Coastal Plain.

Elevations range from sea level where the Potomac and Anacostia are tidal estuaries to as much as 415 feet (126 m) at Tenleytown. Interstream ridges are highest in the Piedmont of the western part of the city, descending gradually to the Coastal Plain to the south and east where hill top elevations rarely exceed 230 feet (70 m).

The Piedmont section of the city is underlain by ancient metamorphosed igneous and sedimentary rocks, and the Coastal Plain part is underlain by much younger, poorly consolidated sediments. Limited areas in both provinces are covered by unconsolidated terrace and alluvial deposits. Most of the interstream uplands of the Piedmont are formed on saprolite, a weathered mantle of red-brown earthy, porous, spongy material which retains the structure of the original metamorphic rock but which can readily be dug by shovel. Saprolite is predominantly a sticky, sandy, silty and micaceous clay which grades downward into unweathered rock at depths that average 50 feet (15 m) but locally exceed 160 feet (50 m). Saprolite is largely absent along the valley walls of Rock Creek, its tributaries, and the Potomac River where bold gorges are incised in fresh bedrock.

Metamorphic rocks of the Wissahickon Formation of the Glenarm Series (Higgins and Fisher, 1971) are the predominant rocks which crop out in the Piedmont. They include quartzose boulder gneiss (diamictite), mica (pelitic) schist and impure quartzite (metagraywacke). The schists and gneisses are intimately associated with mafic igneous rocks of the Georgetown Complex, and with ultramafic rocks (soapstone, serpentinite, etc.). The metamorphic and mafic rocks are intruded by younger igneous rocks, mainly quartz diorites of the Georgetown and Kensington gneisses (Hopson, 1964). Minor intrusive dikes and veins of quartz, aplite and pegmatite locally cut all older crystalline rocks. The igneous and metamorphic rocks are found in north-trending belts which reflect the complex folds on both flanks of the Baltimore-Washington anticlinorium, which plunges to the south near the Potomac River at Georgetown (Cloos and Cooke, 1953). The crystalline rocks are variably cleaved and foliated, the mica

schists most intensely, layered and massive feldspathic quartz diorite and gneisses least intensely; all of the crystalline rocks are jointed. Most of the crystalline rocks have been quarried for building stone, rip-rap, and fill.

Poorly consolidated Coastal Plain sediments overlie the saprolite formed on crystalline rocks east of Rock Creek, and erosional outliers cap some interstream ridges west of Rock Creek, principally near Tenleytown. Coastal Plain strata thicken to the southeast from a feather edge at the fall line zone to more than 1,000 feet (330 m) along the southeast margin of the District.

The oldest Coastal Plain deposits are the basal beds of the non-marine Potomac Group of Cretaceous age; they dip to the southeast at about 100 feet per mile (19 m per km). The Potomac Group thickens to more than 700 feet (212 m) along the southeastern border of the District, where it includes beds formerly mapped as the Raritan and Magothy Formations by Darton (1947). The lower part of the Potomac Group (the Patuxent Formation of Clark and Bibbins, 1897) consists mostly of fluviatile, channel-fill, sand and gravel facies (Kps), but locally it contains lenticular bodies of silt and clay. The gravel is generally poorly sorted, containing subrounded quartz and quartzite pebbles and minor sandstone and weathered lithic fragments in a medium-to coarse-grained quartzose sand matrix. Average diameter of the pebbles is 3/4 inch (1.9 cm) but elongated subrounded cobbles as much as 10 inches (25.4 cm) are also present. Crossbedded sand with minor amounts of pebble gravel is abundant, occurring as lenses and extensive layers, and thin silt and clay beds and lenses are widespread; hard concretionary iron oxide layers are common. The sand and gravel facies (Kps) crops out chiefly on hillsides in a belt between Rock Creek and the B and O Railroad.

The silty and sandy clay facies (Kpc) (mainly the Arundel Clay and Patapsco Formation of Clark and Bibbins, 1897), with minor amounts of interbedded sand and gravel makes up the upper part of the Potomac Group. The clay is mainly mottled red and green, or gray to black where locally carbonaceous; it contains scattered limonite and siderite lenses. The principal clay minerals are kaolinite and illite, and the clays in the northern part of the District were once used as a source of brick clay, as at Terra Cotta. Minor amounts of montmorillonite and other mixed-layer clays form part of the clay facies (Kpc) in the southeastern part, where slope failures due to slump, creep, and landsliding have commonly occurred. The clays are generally poorly drained with moderate to high shrink-swell characteristics and may pose hazards to construction on steep slopes or where used as fill or artificially cut. The clay facies (Kpc) crops out principally on both sides of the Anacostia River. Plant spores and carbonaceous impressions, large logs, and rare dinosaur remains are the chief nonmarine fossils preserved in the Potomac Group beds.

According to Darton (1947), the upper Cretaceous Monmouth Formation unconformably overlies the Potomac Group. The Monmouth consists of as much as 50 feet (15 m) of pebbly, micaceous, glauconitic sand, dark-gray silty clay, and fossiliferous shelly marl of marine origin. The Formation is limited in distribution to a small area chiefly on the slopes of Good Hope Hill southeast of the Anacostia River.

The Paleocene Aquia Formation is mapped by Darton (1947) on the southeast side of Good Hope Hill; it reportedly consists of weathered gray to reddish-brown glauconitic sand with ironstone concretions and sparse chalky white marine fossil shells in places. The thickness ranges from zero to less than 50 feet (15 m).

According to Darton (1947) the Miocene Calvert Formation unconformably overlies the Aquia Formation and overlaps it locally to rest unconformably on the Monmouth and the Potomac Group. The Calvert reportedly is mostly fine-grained sands and clays which are compact, dark gray to greenish gray where fresh, but are soft, meal-like gray or buff where weathered; it is locally fossiliferous, with mainly remnants of marine organisms. The thickness ranges from 20 to 80 feet (6 to 24 m) and is thickest near Good Hope Hill (Darton, 1947).

Miocene(?) to Pliocene(?) upland gravel and sand overlies the marine strata unconformably and overlaps the Cretaceous Potomac Group as well as saprolite of the Piedmont crystalline rocks. This unit, possibly equivalent to the Brandywine Formation, caps remnants of a formerly extensive plateau in this area; the upland gravel and sand, which is found in a weathered orange loam matrix, was apparently deposited by an ancestral Potomac River (Hack, 1955; Schlee, 1957). It is a local source of sand and gravel but is commonly deeply weathered.

Gravel and sand in a gray or brown loam matrix are found in river terrace deposits as much as 30 feet thick (9 m) at various topographic levels below the upland gravel plateau surface. As the deposits are not deeply weathered, they have been extensively utilized as a source of sand and gravel. Lenticular deposits of fine-grained silt, clay and peat beds as much as 16 feet thick (5 m) are locally interbedded with sand and gravel.

Alluvial gravel, sand, silt and clay occupies the stream bottoms, only the larger deposits of which are shown on the map. The thickness ranges from a veneer to 25 feet or more (8 m). Alluvium is intermixed with many extensive areas of artificial fill, mainly river dredgings, especially along the Anacostia River and the Potomac River below Memorial Bridge. Alluvial sand and gravel has been extensively dredged from the Potomac River.

Artificial fill consists of extensive man-made or man-modified areas that are covered by locally derived unconsolidated material. Small areas of fill are present where roads and railroads cross streams and low points and at reservoirs and filtration plants; such areas commonly adjoin sites of cut and disturbed ground. Fill also includes reclaimed areas covered by spoil from excavations as well as sanitary landfills.

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EXPLANATION

UNCONSOLIDATED MATERIALS
(Mainly Coastal Plain sediments)

QUATERNARY — RECENT

af

Artificial fill

Local unconsolidated material from nearby cuts and river dredgings; includes sanitary landfills.

Qal

Alluvium and artificial fill

Gravel, sand, silt, and clay of lowest stream terraces and bottoms; only larger deposits shown. Thickness a few inches to 25 feet or more. Many large areas of fill, especially along Potomac River and Anacostia River.

QUATERNARY — PLIOCENE(?) & PLEISTOCENE

Unconformity

Qt

River terrace deposits

Gravel, sand, and loam; basal part generally unsorted boulders, pebbles and sand; locally contains plant fossils and peat beds. Average thickness 30 feet; occurs at various levels.

TERTIARY — MIOCENE(?) & PLIOCENE(?)

Unconformity

Tug

Upland gravel and sand

Gravel and sand in orange loam matrix, capping remnants of former plateau. Coarse material at base. Gravel largely quartzite; some vein quartz, crystalline rock fragments and chert. Average thickness 30 feet. Deposited by ancestral Potomac River.

TERTIARY — MIOCENE

Unconformity

Tc

Calvert Formation

Very fine sand mixed with clay. Compact, dark gray to green where fresh; weathered outcrops are soft gray or buff sands. Thickness 20 to 80 feet. In places contains shells and impressions, bone fragments, shark's teeth, fish scales and remains and impressions of plants.

TERTIARY — PALEOCENE

Unconformity

Ta

Aquia Formation

Where fresh, bluish- or greenish-black, moderately fine sand mixed with clay, greensand (glauconite), organic matter, and chalky white marine fossil shells. Weathered material is gray, buff, or reddish-brown sand, with ironstone concretions in places. Thickness less than 50 feet.

MESOZOIC — UPPER CRETACEOUS

Unconformity

Km

Monmouth Formation

Dark micaceous sand with considerable greensand (glauconite). Weathers to brown sand with limonite cemented crusts and concretions. In places contains marine shells or impressions, mostly mollusks. Thickness as much as 50 feet.

MESOZOIC — LOWER & UPPER CRETACEOUS

Unconformity

Kpc / Kps

Potomac Group

Kpc, clay and silt facies — Kps, sand and gravel facies

Kpc-beds in eastern part of area chiefly pink, red, and gray silty clay with interbedded irregular sand and gravel lenses that in places grade into clay. Contains fossil bones, plant remains and lignite. Kps-basal part in western part of District is gravel, sand, and arkose with occasional sandy clay lenses, generally light gray in color. This unit overlies crystalline rocks. Thickness of total Potomac Group increases to the east, where it exceeds 700 feet.

CONSOLIDATED ROCKS AND WEATHERED RESIDUUM
(Mainly Piedmont crystalline rocks and saprolite)

PRECAMBRIAN AND/OR LOWER PALEOZOIC

Unconformity

q

Quartz bodies

A very hard brittle mineral which occurs as veins, veinlets and pods filling fractures in schist and gneiss. Some quartz bodies are massive, others are shattered by fractures; does not weather readily and occurs as fresh angular blocks and fragments at the surfece.

Kg

Kensington gneiss

Medium to coarse crystalline, light gray, layered to nearly massive, jointed quartz diorite gneiss consisting of quartz, feldspar and mica; overlain on valley slopes and uplands by gray-brown, soft, weathered, sandy and silty, well-drained saprolite residuum as much as 120 feet thick.

Gm / U

Georgetown mafic complex

Mixed group of meta-igneous and meta-volcanic rocks consisting of fine- to coarse-crystalline, dark gray-green to black foliated to massive, jointed gabbro, tonalite, diorite, amphibolite, and chloritic schist. The predominant minerals are amphibole, chlorite, plagioclase feldspars and mica; overlain by 10 to 50 feet by red brown, ferruginous, poorly drained, clay-rich saprolite.

U - Ultramafic rocks, chiefly serpentinite, talc schist and chlorite schist with little or no saprolite on weathered dark green rock.

TERTIARY — GLENARM SERIES

Wp | Wd

Wissahickon Formation

Wp - pelitic schist facies — Wd - diamictite gneiss facies

Wp - Fine to coarse crystalline, foliated, quartz-mica schist, chlorite quartz schist with fine garnets; overlain on uplands by reddish brown, soft micaceous, silty, well-drained saprolite residuum as much as 160 feet thick.

Wd - Medium to coarse crystalline, layered to massive, jointed quartz-feldspar-biotite gneiss with scattered quartz pods and schist and amphibolite cobbles; overlain by sandy red-brown well-drained saprolite as much as 120 feet thick on uplends but less than 25 feet thick where overlain by Coastal Plain strata.

Fault, high angle reverse; sawteeth on upthrown side

Contact, approximately located; dotted where concealed

200

Contours on base of sedimentary deposits

Sound metamorphic rock as much as 25 feet below this surface under saprolite. Contour interval 50 and 100 feet; datum is mean sea level.

Slump, mudflow or landslide scar; sawteeth indicate mobile block, arrow indicates direction of displacement.

60 inclined — vertical

Strike and dip of foliation

70 inclined — vertical

Strike and dip of joint or fracture

Abandoned Quarry (Rock) — Abandoned Clay Pit