Open File Geologic Map of the Woodbine Quadrangle, Howard, Carroll, and Montgomery Counties, Maryland

by Rebecca Kavage Adams, 2024

Description of Map Units

Quaternary

Ordovician

Lower Cambrian and/or Neoproterozoic

Alluvium

Qal

Poorly to well-sorted, stratified mixtures of unconsolidated clay, silt, sand, gravel, and cobbles underlying flood plains of nearly all rivers and tributaries. Channels of tributaries are incised into bedrock with alluvium covering and exposed along the banks. Thickness of alluvium is highly variable, and is a function of bedrock, topography, and land-use practices. Abundant deposits of alluvium are present along Cattail Creek, Little Cattail Creek, Piney Branch, Cabin Branch, the Pautuxent River, and the Patapsco River.

Bear Island Granodiorite

Obg

Pinkish-gray, fine- to coarse-grained, muscovite-biotite granodiorite and related pegmatite composed largely of plagioclase feldspar, with lesser quartz and mica. Forms small- to medium-size, cross-cutting sheets and bodies in rocks of the Mather Gorge Formation. Cross-cutting bodies are 2 inches to 5 feet (3 cm to 2 m) thick, and pegmatite veins contain euhedral hornblende crystals 0.1 to 1 inch long (3 mm to 2 cm) in size. Appears to have been quarried locally. Very susceptible to weathering, and weathers to friable, orange cobbles with visible mica grains. Granodiorite may be a later phase of partial melting during the migmatization of the Mather Gorge Formation. Minimum age is estimated at 469±20 Ma based on Rb-Sr dating (Muth et al., 1979).

Sykesville Formation (Lower Cambrian)

Lineated schist

Cs/Csl

Exposures found adjacent to and within Mather Gorge and Sykesville Formations. Strongly developed foliation and lineation comprised of dark schist and lighter felsic banding from 0.08 to 0.4 inch (2 mm-1 cm) in thickness, often with gneissic appearance, abundant 0.4 to 1.2 inch (1 to 3 cm) quartz clasts with reaction rims that form "eyes" and occasional clasts up to 4 inches (10 cm) that are also stretched. Where visible, these clasts have a sigma shape indicating dextral shear. Locally quarried historically near Cattail Creek, likely due to preferential split along planar surfaces parallel to foliation. The best texture exposures are seen on surfaces of historic stone buildings (Fig. 3).

Sykesville Formation, schist

Cs

Variegated, olive- to pinkish-gray, granitic-looking matrix containing abundant small 0.04- to 2-inch long (1 mm to 5 cm) fragments of quartz and dark-grey schist. Tends to weather into massive, rounded outcrops and boulders. Clast shape and orientation is heterogeneous in some outcrops and aligned in others. Visible 0.2- to 0.4-inch (0.5-1 cm) garnet porphyroblasts become more common in southeastern part of the quadrangle.

Sykesville Formation, coarse fragments

Csf

Similar to schist, but contains coarse fragments of metagraywacke, quartz-rich schist, amphibolite and banded schist ranging from 2 inches to 5 feet (5 cm to 2 m) in size. Granitic veins with sharp to diffuse boundaries intrude Csf and commonly surround and cross-cut dark-gray fragments of schist.

Mather Gorge Formation (Lower Cambrian? and Neoproterozoic?)

Schist with interlayered metagraywacke

Czmg

Quartz-rich schist and quartzitic metagraywacke interbedded in layers and lenses ranging from 0.1 inch to 3 feet thick (2.5 mm to 1 m). Muscovite-chlorite-plagioclase-epidote-magnetite +/- garnet schist is very fine grained and greenish-gray to gray. Metagraywacke is light- to dark-olive-gray, fine- to medium-grained, with quartz pebbles and graded bedding occasionally visible. Stringers and pods of isoclinally folded and boudinaged white quartz veins are abundant.

Metagraywacke (Pleasant Grove shear zone)

Czmgp

Interbedded quartz-mica schist and quartzitic metagraywacke with penetrative S-C metamorphic fabric (illustration below in cross section), formed by the intersection of the dominant foliation (S) and the shear plane (C) near the Pleasant Grove Fault (Krol and Muller, 1995; Muller, 1994). Mapped on distinct appearance of rotated foliation although lithologically is similar to Czmg.

Banded schist with interlayered metagraywacke

Czmgb

Interbedded quartz-mica schist and quartzitic metagraywacke with intermittent zones of banded schist. The banded schist contains mm to cm-scale light-gray to white and dark-gray to black layers interpreted as in-situ leucosome (light layers) and melanosome (dark layers) produced by partial melting of the parent material (Sawyer, 2008). Metagraywacke remains similar in appearance to Czmg but is often surrounded by cm-scale zones of light-gray to white quartz. Weathering form of outcrops with banded schist is more massive and rounded than Czmg, and foliation is less apparent.

Banded schist with metagraywacke fragments

Czmgbf

Banded, light-gray to white and dark-gray to black, commonly contorted, schist. Metagraywacke fragments, similar in appearance to Czmg, 1 to 3 feet (0.3 to 1 m) long, are surrounded by banded schist. Also contains 0.25-to-1-foot (10 to 40 cm) thick, felsic bands containing abundant small schist clasts, similar in appearance to Cs. Interpreted to be produced by partial melting of quartz-mica schist and quartzitic metagraywacke (Sawyer, 2008). Cross-cutting, cm-scale, bands are white to very pale orange and comprised of mm-cm size crystals of plagioclase feldspar, quartz, and muscovite. Occasionally larger (0.2 to 0.4 inches / 5 mm to 1 cm) euhedral crystals of black, bladed hornblende are present. These felsic bands sometimes contain clasts of schist and metagraywacke and are interpreted as in-situ or in-source leucosome (Sawyer, 2008).

Ultramafic Rocks

Czu

Greenish-gray serpentinite, soapstone, and talc-chlorite schist that occur as large bodies or smaller blocks within rocks of the Mather Gorge and Sykesville Formations. The cores of the bodies are comprised of dark-green to black serpentinite with a rounded, fractured weathering surface, while the margins are typically magnesian schist. Serpentine was historically quarried west of Cattail Creek along Daisy Rd, as well as north and south of the Patuxent River west of Howard Chapel Rd. Extent of the ultramafic body just south of Rt 144 was mapped based on float and previous mapping (Cloos and Broedel, 1940).

Magnesian schist

Czs

Soft, very light-gray to dark greenish-gray actinolite-tremolite-chlorite schist with bladed crystals from 0.1 to 0.4 inch (3 mm to 1 cm) in length. 0.1 to 0.2 inch (3 to 5 mm) euhedral magnetite grains occur in abundance within the schist, and were mined west of Rt 97 at small, historic magnetite and limonite prospects (Pearre, 1961).

Metagabbro

Czg

Very light-gray and dark-gray to black, coarse- to very coarse-grained plagioclase feldspar, hornblende, epidote. Presumed to result from metamorphism of gabbroic protolith, but pyroxene has been altered to hornblende and is not visible in thin section (Sample 1a). A massive, equigranular, rusty-weathering body approximately 600 x 1800-foot (180 to 550 m) in size occurs east of Carrs Mill Rd in the Mather Gorge Formation and appears to have been quarried historically.

Marburg Formation

Metasiltstone

Czmb

Greenish-gray to light-olive-gray, phyllitic metasiltstone containing thin, light-gray quartz laminae and ribbons; medium-light-gray to very pale-orange muscovite phyllite. Foliation is dominant observable structure in metasiltstone and typically close to vertical.

Quartzite

Czmbq

Light- to medium-olive gray, coarse-grained, blocky to massive quartzite. Pebbly beds are sometimes present, containing white to bluish-gray quartz pebbles 0.04 to 0.1 inch (1 to 3 mm) in size. A cleavage spaced from 2 to 20 inches (5 to 50 cm) is folded into antiforms and synforms and overturned to the northwest on a 16- to 33-foot (5 to 10 m) scale, is visible in quartzite beds.

Phyllite (Pleasant Grove Shear Zone)

Czmp

Greenish-gray, chlorite-sericite phyllite containing white vein quartz. Many foliation surfaces have abundant euhedral magnetite grains ranging from 0.04 to 0.2 inch (1 to 5 mm) in size. Exposure is generally limited to outcrops where NE-SW trending ridges are cut by creeks and rivers. The ridges appear to be created by erosional resistance of 100- to 300-foot (30 to 90 m) wide zones of highly-strained, strongly foliated and lineated fabric with isoclinally folded, 0.04 to 0.16 inch (1 to 4 mm) thick, quartz ribbons. However, comparison to lithology in intervening valleys is hampered by lack of exposure. S-C shear bands on outcrop and mantled porphyroclasts indicate dextral sense of shear. $^{40}Ar/^{39}Ar$ dating of white mica in this zone yielded ages of 348 and 363 Ma, indicating late Devonian-Mississippian deformation (Krol et al., 1999).

Prettyboy Schist

Mica schist

Czpb

Dark greenish-gray, medium- to coarse-grained muscovite schist with mantled albite and garnet prophyroclasts. One 800 ft (244 m) wide zone is mapped west of Woodbine Road.

MD iMap Maryland LiDAR Statewide Slope RGB, 2019

U.S. Geological Survey (USGS) US Topo TNM Woodbine, MD quadrangle, 2022

Coordinate System: NAD 1983 Maryland State Plane FIPS1900

Geographic coordinates (latitude-longitude) shown near corners

APPROXIMATE MEAN DECLINATION, 2023

SCALE 1:24 000

1 MILE

1 KILOMETER

CONTOUR INTERVAL 20 FEET

(To convert from feet to meters, multiply by 0.3048)

1	2	3
4		5
6	7	8

1. Libertytown
2. Winfield
3. Finksburg
4. Damascus
5. Sykesville
6. Gaithersburg
7. Sandy Spring
8. Clarksville

Adjoining 7.5' quadrangle names (Woodbine quadrangle shaded)

Explanation of Map Symbols

A — A′ Cross section line

Contacts

Geologic contacts, inferred; dotted where concealed by alluvium, dashed where projected in cross section.

Faults

Fault, unknown type, location inferred. Dotted where concealed by alluvium.

Strike-slip fault, location inferred. Arrows show relative motion. Dotted where concealed by alluvium.

Minor fault, showing strike and dip.

Fault, in cross section. Arrows showing relative motion.

Strike-slip movement toward viewer, in cross section

Strike-slip movement away from viewer, in cross section

Folds

Showing axial trace and plunge direction

Inclined small folds (20-100 cm)

Minor antiform, plunging

Minor antiform, horizontal

Other Features

Quarry or mine, inactive

G Garnet, euhedral, 1-5mm, seen in outcrop

M Magnetite, euhedral, 1-5mm, seen in outcrop

S-C metamorphic fabric, formed by intersection of dominant foliation (S) and the shear plane (C) (shown in cross section only)

Planar Features

Showing strike and dip

Inclined bedding

Inclined joint

Vertical or near-vertical joint

Inclined spaced cleavage

Vertical spaced cleavage

Inclined penetrative foliation

Vertical penetrative foliation

Inclined shear band cleavage, dextral sense of shear

Vertical shear band cleavage, dextral sense of shear

Linear Features

Showing trend and plunge

Aligned clasts, pebbles, amygdules; inclined

Aligned deformed/elongate minerals, inclined

Cleavage-cleavage intersection, inclined

Foliation-cleavage intersection, inclined

Other Features

Strongly foliated and lineated rock fabric

Small rock fragments (shown in cross section only)

Large rock fragments (shown in cross section only)

Base Map Symbols

Transportation

Primary highway, divided by median strip

Primary route, class 1 (divided, lanes separated)

Primary route, class 1 (undivided)

Secondary route, class 2

Light duty road or street, class 3

Railroad

Topography

Topographic index contour (100-ft interval)

Topographic intermediate contour (20-ft interval)

Hydrography

Muddy Creek Stream

Spring

Deep Lake Water body (e.g. lakes, ponds, rivers)

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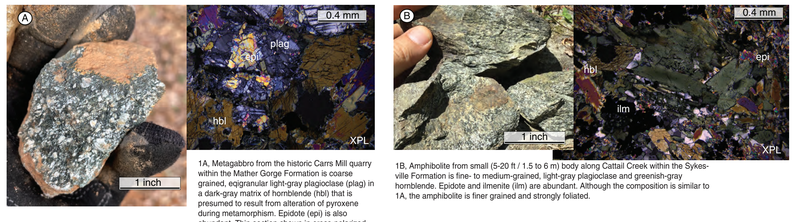
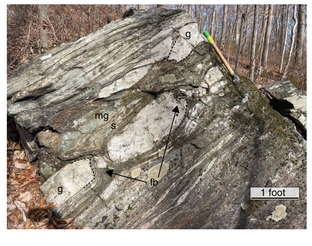
1 Hand samples and thin sections of metagabbro from the Mather Gorge Formation (Czg, left, 1A) and amphibolite in the Sykesville Formation (Csf, right, 1B).



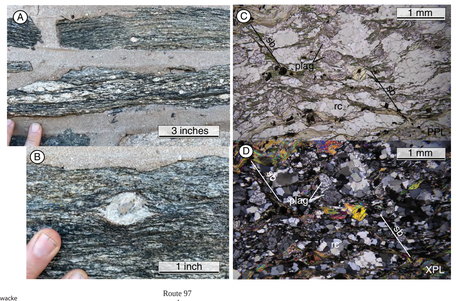
1A, Metagabbro from the historic Carrs Mill quarry within the Mather Gorge Formation is coarse grained, equigranular light-gray plagioclase (plag) in a dark-gray matrix of hornblende (hbl) that is presumed to result from alteration of pyroxene during metamorphism. Epidote (epi) is also abundant. Thin section shown in cross-polarized light (XPL).

1B, Amphibolite from small (5-20 ft / 1.5 to 6 m) body along Cattail Creek within the Sykesville Formation is fine- to medium-grained, light-gray plagioclase and greenish-gray hornblende. Epidote and ilmenite (ilm) are abundant. Although the composition is similar to 1A, the amphibolite is finer grained and strongly foliated.

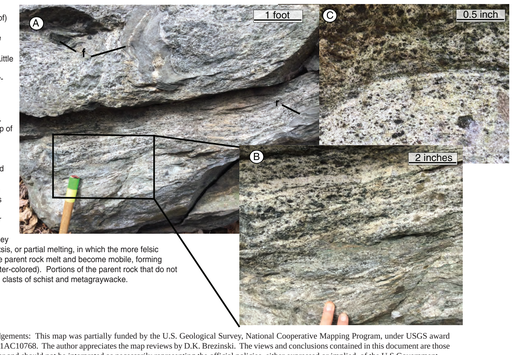
2 Discontinuous beds of granodiorite within banded schist and metagraywacke of the Mather Gorge Formation (Czmgb). Light-gray granodiorite (g) intruded into the schist (s) and metagraywacke (mg) into continuous bands parallel to layering. These bands were later pulled apart into separate boudins (a French word for sausage) during layer-parallel extension, and schist flowed in-between (Fossen, 2016). During extension and formation of boudins, the outer margins of the boudins were pulled more strongly than the center, creating the "fish-mouth" shape (fb, dotted lines).

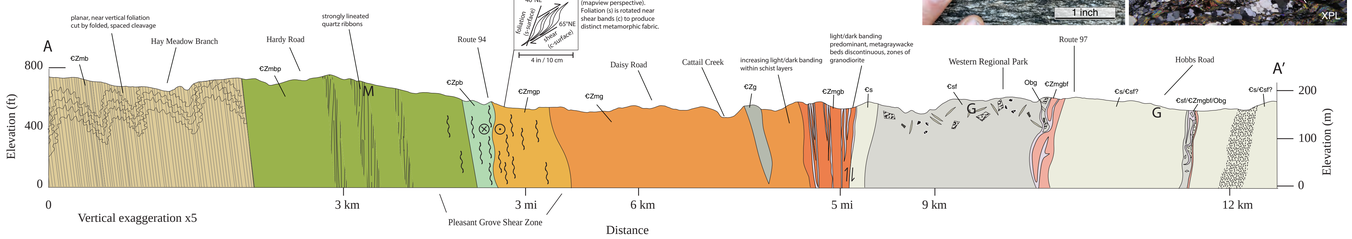


3 Lineated schist (Csl) in hand sample (A and B, right) and thin section (C and D, right), showing strongly foliated texture and quartz "eyes". Dark gray and light gray to white bands form a finely banded matrix that is gneissic in appearance and splits preferentially along foliation planes. Porphyroclasts of plagioclase (plag) mantled with fine-grained wings and recrystallized quartz (rq) form "augen" (the German word for eyes). Foliation is also offset by shear bands (sb). These characteristics are evidence of strong ductile shearing (Passchier and Trouw, 2005).Thin section shown in plane-polarized (PPL) and cross-polarized light (XPL).



4 Banded schist (Mather Gorge Formation, Czmgbf) and coarse fragments in granitic matrix (Sykesville Formation, Csf) in an outcrop (photo A) along Little Cattail Creek. Large fragments (f) of metagraywacke and schist are surrounded by granitic matrix with abundant, mm-cm size schist clasts. Inset photo (B) is close-up of banded schist. Photo C shows texture of granitic matrix with small schist clasts, which was mapped as Sykesville Formation (Cs) if larger clasts were absent. These lithologies are often found in close proximity to each other or within the same outcrop, possibly indicating that they are all products of anatexsis, or partial melting, in which the more felsic (silica-rich) portions of the parent rock melt and become mobile, forming zones of leucosome (lighter-colored). Portions of the parent rock that do not melt become the residual clasts of schist and metagraywacke.





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Wes Moore
Governor
Aruna Miller
Lieutenant Governor

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