Quaternary

Qal — **Alluvium**

Poorly sorted, unconsolidated, tan to dark-gray mud, silt, sand, and pebbles, deposited within the channel of streams and on the flood plain adjacent to the streams. Thickness estimated at 3 to 10 feet (1 to 3 m).

Qc — **Colluvium**

Unconsolidated and unsorted sand, cobbles, and boulders that accumulate on the slopes below outcrops of the sandstone and quartzite units, and move slowly downslope under the influence of gravity. Two types were recognized in the Keedysville quadrangle, but not mapped separately. The first type is composed predominately of boulders, largely subangular to angular that overlie outcroppings of quartzites or are present downslope from the quartzite outcrop of the Weverton Formation on South Mountain. This type of colluvium appears to be the direct result of the mechanical breakdown of the quartzite ledges. The thickness was not determined. The second type of colluvium is composed of sand-supported, rounded pebbles and cobbles of quartzite. This type of colluvium is present overlying limestone bedrock in the Hagerstown Valley and is relatively far removed from the slopes of South Mountain. Such colluvium covers much of the eastern portion of the Tomstown outcrop belt. The thickness of this type of colluvium ranges from a thin veneer less 3 feet to more than 300 feet (1 to 100 m).

Qr — **Weathering residuum**

Brownish red to reddish brown soil containing rounded to angular, pebble- to cobble-size white to very light gray quartz. Thickness ranges from a thin veneer to 3 feet (1 m).

Qt — **Terrace deposits**

Reddish brown to brown, sandy and clayey mixture of rounded pebbles to cobbles of sandstone, vein quartz and quartzite. Present along elevated areas above the current Potomac River and Antietam Creek. Thickness ranges from a thin veneer to more than 10 feet thick (0 to 3 m).

Jurassic

Jd — **Diabase dike(s)**

Dark-gray to dark green-gray, medium- to fine-grained diabase. Within thicker dikes the diabase is coarser grained and may take on a salt and pepper appearance. Typically occurs as weathered, large, spheroidal boulders that exhibit a reddish brown patina. Dikes range in thickness from 3 to 15 feet (1 to 3 m).

Conococheague Formation

Interbedded and cyclic, gray limestone, tan dolostone, and laminated and biohermal limestone. Subdivided and mapped as three members, two of which are informal. Only the lower two members are present on this map. Total thickness is from 2,000 to 2,500 feet (600 to 750 m).

Ccm — **Middle member**

Predominantly cyclically bedded, medium- to dark-gray, thrombolitic limestone and gray, ribbony and laminated limestone and tan laminated dolomite. Thrombolites range in thickness from 3 to 6 feet (1 to 2 m) within thrombolitic intervals to less than 1 foot (0.3 m) within the ribbony intervals. Several dark-gray, oolitic intervals present in the upper part of this member. Thickness ranges from 1,500 to 1,800 feet (450 to 600 m).

Ccb — **Big Spring Station Member**

Tan massive dolomite interbedded with tan to light-gray laminated dolomite; unit characterized by dark-brown weathering. At the type section on the western side of the Hagerstown Valley, this member is characterized by interbeds of light-gray, cross-bedded, calcareous, intraclastic, quartzarenitic sandstone approximately 3 feet (1 m) in thickness. Member becomes interbedded with gray dolomitic thrombolite beds near the top. Thickness ranges from 200 to 300 feet (70 to 100 m).

Ce — **Elbrook Formation**

Lower part of the formation is very poorly exposed and contains interbedded tan, thin- to thick-bedded limestone and dolomite, which frequently weather shaly, that are intercalated with medium-bedded, dark-gray limestone. Middle part of the formation contains cyclic, dark-gray limestone and dolomitic limestone. The upper part of the formation, and making up its greatest thickness, is cyclically bedded, gray thrombolitic limestone and ribbony to laminated limestone and dolomite. Thickness ranges from 2,200 to 2,500 feet (700 to 800 m).

Waynesboro Formation

Interbedded and cyclically bedded carbonates and clastics. Specifically, gray limestone and tan dolostone interbedded with a variety of clastic rocks including: red and green siltstone; shale; and red-brown, green-gray, white, and tan, fine-grained sandstone at the top and bottom. Divided into three members by Brezinski (1992).

Cwac — **Chewsville Member**

Reddish brown to chocolate-brown, silty shale, siltstone, and silty fine-grained sandstone, interbedded with white, calcareous, *Skolithus* -burrowed sandstone beds (2 to 6 cm thick) and tan to buff, medium-bedded, sandy dolostone. This unit usually is the most diagnostic of the Waynesboro lithologies and typically forms a ridge, which makes it easily traceable. Thickness estimated at 90 to125 feet (30 to 45 m).

Cwak — **Cavetown Member**

Medium- to thick-bedded, medium-to coarse-grained, intraclastic grainstone; tan, laminated dolostone and dolomitic limestone; and medium-gray, oolitic, lime grainstone, ribbony carbonates, and burrow-mottled dolomitic limestone. This unit is typically poorly exposed, but makes up the greatest thickness of the formation. Thickness estimated at 600 to 750 feet (200 to 250 m).

Cwar — **Red Run Member**

Interbedded, tan-weathering, punky, fine-grained sandstones; green-gray shale; gray sandy limestone; and laminated dolostone. Locally thin (0.6 to 5 cm) layers of red siltstone and sandstone are present. Typically, this unit forms a low ridge somewhat lower in height than the Chewsville Member. Thickness estimated at 150 to 225 feet (60 to 75 m).

Tomstown Formation

Predominately buff-weathering, medium- to dark-gray, dolomite, dolomitic limestone, and limestone. The Tomstown Formation was divided into four members by Brezinski (1992). These are, in ascending order, the Bolivar Heights, Fort Duncan, Benevola, and Dargan Members. The total thickness of the formation is 1,200 to 1,300 feet (366 to 396 m).

Ctd — **Dargan Member**

Interbedded and cyclical dolomite and limestone. Cycles consist of alternations of dark gray, bioturbated dolomite and medium- to dark gray, laminated dolomite, or dark gray dolomite or limestone and tan, laminated, silty dolomite. Thickness is approximately 700 feet (215 m).

Ctb — **Benevola Member**

Light-gray to white, massive to poorly bedded, highly fractured, sugary dolomite. The Benevola Member varies from white to very light gray, both on fresh and weathered surfaces and has a sugary appearance. Bedding is rarely evident within the Benevola Member, except within polished slabs where faint ghosts of crossbedding are common. Thickness is 100 to 150 feet (33 to 50 m).

Ctf — **Fort Duncan Member**

Medium- to dark-gray, thick-bedded, mottled dolomite with white, void-filling, sparry dolomite. Weathered surface characterized by irregular anastamosing network of clotted algae. Layers of the white, sparry dolomite, 1 to 4 cm wide, fill voids that are continuous in beds for up to several yards (several meters). The white, void-filling dolomite contrasts the darker mottled dolomite. Thickness ranges from 200 to 250 feet (60 to 75 m).

Ctbh — **Bolivar Heights Member**

The Bolivar Heights Member is characterized by three stratigraphically stacked lithologies. The basal lithology is a tan, vuggy dolomite that is in contact with the underlying Antietam Formation. This dolomite ranges from 10 to 40 feet (9 to 12 m) in thickness, and is rarely exposed. Overlying the tan basal dolomite is an interval 40 to 50 feet (12 to 15 m) thick, comprised of very light gray, sheared, laminated, dolomitic marble (Keedysville marble bed). Above the Keedysville marble bed, the Bolivar Heights Member consists of about 200 feet (60 m) of thin- to medium-bedded, dark-gray, ribbony, burrow mottled, lime mudstone that weathers light gray. The number and density of burrows vary among beds, with very little burrowing in some layers and an anastomosing network of burrows in others. Thickness is 200 to 250 feet (60 to 75 m).

CHILHOWEE GROUP

Ca — **Antietam Formation**

Dark green-gray, highly cleaved, silty, phyllitic shale and siltstone interbedded with white, *Skolithus* -burrowed, fine-grained sandstone in the lower part of the formation. These lower strata grade upsection into medium-bedded, white, bioturbated and crossbedded, fine- to medium-grained sandstone in the middle of the formation. The uppermost strata of the formation consist of light- to medium-gray, crossbedded, granular conglomerate. Although exposures of the formation are very rare, mapping of the Antietam Formation is facilitated by the upper sandstone-conglomerate interval, which forms a ridge somewhat lower in altitude than the Weverton Formation, but considerably higher than the Waynesboro ridges. Thickness ranges from 500 to 800 feet (150 to 245 m).

Chm / Ch / Chq — **Harpers Formation**

Predominately dark green-gray, highly cleaved, phyllitic shale and siltstone with lesser amounts of metasandstones and impure gray quartzites. Shale and siltstone are dark green-gray, dark brown-gray to medium gray in color and weather tan. Cleavage typically obscures bedding. Metasandstones are commonly thin (1 inch to 16 feet; 3 cm to 5 m), dark green-gray, fine to medium grained, highly argillaceous, and contain *Skolithus* burrows, especially near top of formation. Quartzites are light to medium gray, coarse grained to conglomeratic, crossbedded and commonly less than 30 feet (10 m) in thickness. Where thick enough to be traceable, the metasandstone [Chm] and quartzite [Chq] are mapped separately. Owing to intense intraformational folding, determining the thickness of the formation was impossible. Estimates range from 1,500 to 3,000 feet (450 to 1,000 m).

Weverton Formation

Primarily light-gray to gray quartzite, conglomerate, and metagraywacke with interbeds of dark-gray to black phyllite. Three members are recognized and mapped in the Keedysville quadrangle (Brezinski, 1992).

Cwo — **Owens Creek Member**

Dark to very dark gray, very coarse grained to conglomeratic, crossbedded graywacke. Although commonly crossbedded, the very coarse grained nature of this unit makes recognition of crossbedding difficult. Large (1 to 3 cm) white and pink quartz pebbles are characteristic of this member, although they are only locally common. Thickness ranges from 150 to 180 feet (50 to 60 m).

Cwm — **Maryland Heights Member**

Thin (less than 33 feet; 10 m), medium- to dark-gray quartzite and graywacke interbedded with very dark gray, highly cleaved siltstone and phyllitic shale. Shales and siltstones are very poorly exposed and individual quartzites and graywackes are only locally traceable. Thickness ranges from 150 to 350 feet (50 to 115 m).

Cwb — **Buzzard Knob Member**

The lowest member of the formation consists of two ledge-forming quartzites, which are often difficult to discern. The lower ledge consists of light- to medium-gray, medium-bedded quartzite with dark-gray argillaceous layers up to 4 cm thick, separating the quartzite beds. Crossbedding within individual quartzite strata is pervasive and is commonly accentuated by purplish or yellow-gold bands demarcating the individual crossbed foresets. The upper ledge-forming quartzite is composed of medium- to thick-bedded, very light green-gray, shaly quartzite. Crossbedding is much less common than in the lower ledge. This member is the main ridge-forming unit of the Maryland Blue Ridge. Thickness ranges from 125 to 175 feet (40 to 50 m).

Cambrian or Late Proterozoic

CZl — **Loudoun Formation**

Medium- to dark-gray, medium-bedded conglomerate and black, tuffaceous phyllite. Lithology is very variable, ranging from a crossbedded quartz-pebble conglomerate to a highly cleaved polymictic conglomerate with a matrix of flattened phyllite pebbles. The localized distribution and rapid thickness variations of this formation may be the result of the original deposition patterns. The Loudoun Formation ranges in thickness from 20 to 150 feet (6 to 45 m) in the Keedysville quadrangle.

Late Proterozoic

Catoctin Formation

The Catoctin Formation is a suite of volcanigenic rocks that consists principally of metabasalt, metarhyolite, and tuffaceous phyllites. Although these major rock types are mappable lithologic units, their stratigraphic relationships are not known.

Zcm — **Metabasalt**

Characteristically a green, greenish gray, bluish green, or gray, medium-grained, non-porphyritic, massive to highly cleaved rock. Commonly amygdaloidal with quartz, epidote, plagioclase feldspar, or chlorite filling oval-shaped vesicles; or porphyroblastic with flattened and elongated grains or aggregates of chlorite, actinolite(?), or epidote, ranging between 10 and 25 mm in length. May exhibit medium to broad bands that differ in color or texture. Locally brecciated. Prominent veins and nodular masses of epidote and quartz are widely distributed throughout the unit. Thickness of the entire metabasalt unit ranges from approximately 200 feet to greater than 1,000 feet (60 to 305 m).

Zcr — **Metarhyolite**

Predominantly light-gray to grayish blue, highly sheared metarhyolite. Weathers very light gray to white. Two belts of this lithology are mapped in Pleasant Valley south of Rohersville. Estimated thickness 50 to 100 feet (15 to 30 m).

Zcd — **Mafic dikes**

Typically dark greenish gray to grayish olive-green, fine- to medium-grained metabasalt occurring as dikes intruding rocks of Middletown Complex. Crosscutting relationship with older, gneissic foliation is discernible. Dikes range in width from several inches up to several tens of feet (approximately 7 cm to 10 m). Individual dikes may be traceable and mapped.

Swift Run Formation

Zsrp — **Phyllite**

Very light gray, dusky yellow-green and very light greenish gray, lustrous quartz-sericite(?) phyllite that weathers grayish orange to very light gray. Quartz occurs as medium to coarse detrital grains, either uniformly disseminated throughout the rock or concentrated in thin bands or lenses. Estimated thickness 0 to 75 feet (0 to 23 m).

Zsrq — **Quartzite**

Very light gray, thin-bedded, laminated and cross-laminated sericitic quartzite that weathers light greenish gray to light gray; and medium light gray, thick-bedded, coarse-grained, laminated quartzite, weathering light gray. Locally, a white to very light gray, graded fine- to coarse-grained, friable feldspathic sandstone that weathers yellowish gray and grayish orange. Estimated thickness 0 to 90 feet (0 to 27 m).

Basement gneiss complex

The Basement gneiss complex is a suite of high-grade metamorphic rocks that form the core of the Blue Ridge Anticlinorium in Maryland as well as underlying Pleasant Valley south of Rohersville. These rocks were created during the Grenville Orogeny approximately 1.1 bya and no stratigraphy is inferred.

Ygl — **Leucocratic gneiss**

Fine- to medium-grained, tan to very light gray, massive, finely banded to indistinctly foliated chlorite-quartz-microcline-plagioclase gneiss.

Ygt — **Garnet gneiss**

Fine- to medium-grained, very light gray, finely banded to indistinctly foliated quartz-microcline-plagioclase gneiss. Similar to leucocratic gneiss, but with scattered garnets. Weathers light gray to yellowish.

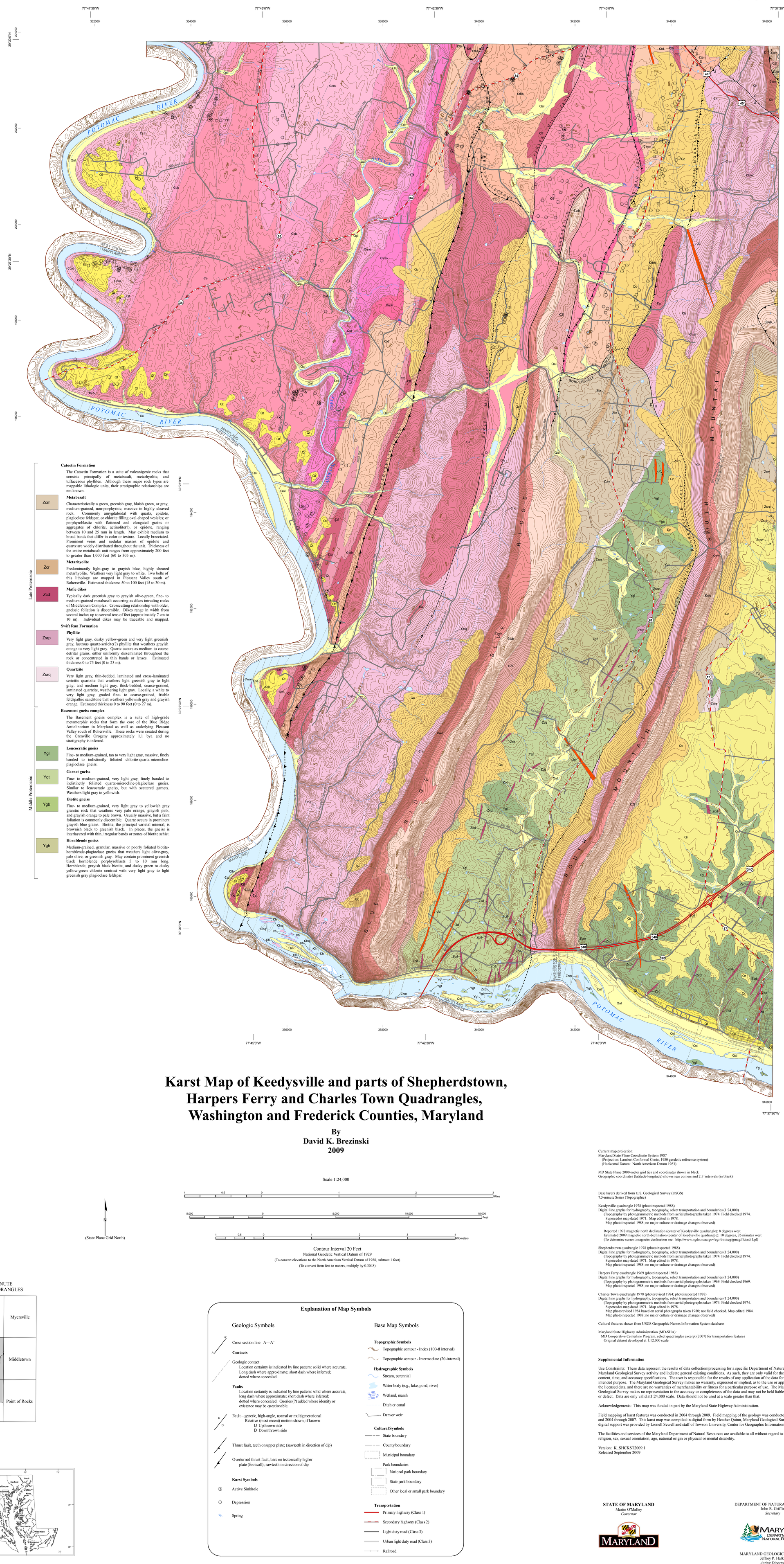
Ygb — **Biotite gneiss**

Fine- to medium-grained, very light gray to yellowish gray granitic rock that weathers very pale orange, grayish pink, and grayish orange to pale brown. Usually massive, but a faint foliation is commonly discernible. Quartz occurs in prominent grayish blue grains. Biotite, the principal varietal mineral, is brownish black to greenish black. In places, the gneiss is interlayered with thin, irregular bands or zones of biotite schist.

Ygh — **Hornblende gneiss**

Medium-grained, granular, massive or poorly foliated biotite-hornblende-plagioclase gneiss that weathers light olive-gray, pale olive, or greenish gray. May contain prominent greenish black hornblende porphyroblasts 5 to 10 mm long. Hornblende, grayish black biotite, and dusky green to dusky yellow-green chlorite contrast with very light gray to light greenish gray plagioclase feldspar.

Middle Proterozoic



Karst Map of Keedysville and parts of Shepherdstown, Harpers Ferry and Charles Town Quadrangles, Washington and Frederick Counties, Maryland

By
David K. Brezinski
2009

Scale 1:24,000

1 0 0.5 0 1 2 3 Miles

5,000 0 5,000 10,000 15,000 Feet

1 0.5 0 1 2 3 4 Kilometers

N (State Plane Grid North)

Contour Interval 20 Feet
National Geodetic Vertical Datum of 1929
(To convert elevations to the North American Vertical Datum of 1988, subtract 1 foot)
(To convert from feet to meters, multiply by 0.3048)

Current map projection:
Maryland State Plane Coordinate System 1987
(Projection: Lambert Conformal Conic, 1980 geodetic reference system)
(Horizontal Datum: North American Datum 1983)

MD State Plane 2000-meter grid tics and coordinates shown in black
Geographic coordinates (latitude-longitude) shown near corners and 2.5' intervals (in black)

Base layers derived from U.S. Geological Survey (USGS)
7.5-minute Series (Topographic)

Keedysville quadrangle 1978 (photoinspected 1988)
Digital line graphs for hydrography, topography, select transportation and boundaries (1:24,000)
(Topography by photogrammetric methods from aerial photographs taken 1974. Field checked 1974.
Supercedes map dated 1971. Map edited in 1978.
Map photoinspected 1988; no major culture or drainage changes observed)

Reported 1978 magnetic north declination (center of Keedysville quadrangle): 8 degrees west
Estimated 2009 magnetic north declination (center of Keedysville quadrangle): 10 degrees, 26 minutes west
(To determine current magnetic declination see: http://www.ngdc.noaa.gov/cgi-bin/seg/gmag/fldsmth1.pl)

Shepherdstown quadrangle 1978 (photoinspected 1988)
Digital line graphs for hydrography, topography, select transportation and boundaries (1:24,000)
(Topography by photogrammetric methods from aerial photographs taken 1974. Field checked 1974.
Supercedes map dated 1971. Map edited in 1978.
Map photoinspected 1988; no major culture or drainage changes observed)

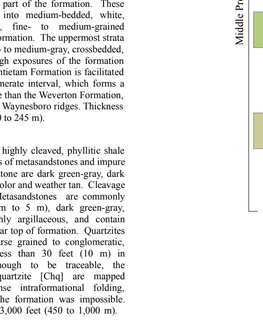
Harpers Ferry quadrangle 1969 (photoinspected 1988)
Digital line graphs for hydrography, topography, select transportation and boundaries (1:24,000)
(Topography by photogrammetric methods from aerial photographs taken 1969. Field checked 1969.
Map photoinspected 1988; no major culture or drainage changes observed)

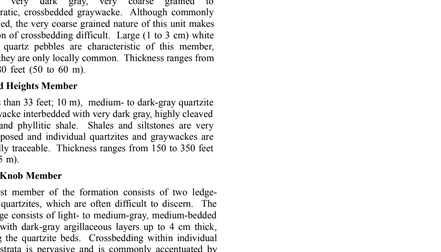
Charles Town quadrangle 1978 (photorevised 1984; photoinspected 1988)
Digital line graphs for hydrography, topography, select transportation and boundaries (1:24,000)
(Topography by photogrammetric methods from aerial photographs taken 1974. Field checked 1974.
Supercedes map dated 1971. Map edited in 1978.
Map photorevised 1984 based on aerial photographs taken 1980; not field checked. Map edited 1984.
Map photoinspected 1988; no major culture or drainage changes observed)

Cultural features shown from USGS Geographic Names Information System database

Maryland State Highway Administration (MD-SHA):
MD Cooperative Centerline Program, select quadrangles excerpt (2007) for transportation features
Original dataset developed at 1:12,000 scale

INDEX TO 7.5-MINUTE
TOPOGRAPHIC QUADRANGLES





Explanation of Map Symbols

Geologic Symbols

Cross section line A—A'

Contacts

Geologic contact
Location certainty is indicated by line pattern: solid where accurate, Long dash where approximate; short dash where inferred; dotted where concealed.

Faults

Location certainty is indicated by line pattern: solid where accurate, long dash where approximate; short dash where inferred; dotted where concealed. Queries (?) added where identity or existence may be questionable.

Fault – generic, high-angle, normal or multigenerational
Relative (most recent) motion shown, if known
U Upthrown side
D Downthrown side

Thrust fault, teeth on upper plate; (sawteeth in direction of dip)

Overturned thrust fault, bars on tectonically higher plate (footwall); sawteeth in direction of dip

Karst Symbols

Active Sinkhole

Depression

Spring

Base Map Symbols

Topographic Symbols
Topographic contour - Index (100-ft interval)
Topographic contour - Intermediate (20-interval)

Hydrographic Symbols
Stream, perennial
Water body (e.g., lake, pond, river)
Wetland, marsh
Ditch or canal
Dam or weir

Cultural Symbols
State boundary
County boundary
Municipal boundary
Park boundaries
National park boundary
State park boundary
Other local or small park boundary

Transportation
Primary highway (Class 1)
Secondary highway (Class 2)
Light duty road (Class 3)
Urban light duty road (Class 3)
Railroad

REFERENCES CITED

Brezinski, D.K., 1992, Lithostratigraphy of the western Blue Ridge cover rocks in Maryland, Maryland Geological Survey Reports of Investigation 55, 69 p.

Supplemental Information

Use Constraints: These data represent the results of data collection/processing for a specific Department of Natural Resources, Maryland Geological Survey activity and indicate general existing conditions. As such, they are only valid for the intended use, content, time, and accuracy specifications. The user is responsible for the results of any application of the data for other than their intended purpose. The Maryland Geological Survey makes no warranty, expressed or implied, as to the use or appropriateness of the licensed data, and there are no warranties of merchantability or fitness for a particular purpose of use. The Maryland Geological Survey makes no representation to the accuracy or completeness of the data and may not be held liable for human error or defect. Data are only valid at1:24,000 scale. Data should not be used at a scale greater than that.

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Field mapping of karst features was conducted in 2004 through 2009. Field mapping of the geology was conducted in 1990, 1991, and 2004 through 2007. This karst map was compiled in digital form by Heather Quinn, Maryland Geological Survey. Additional digital support was provided by Lionell Sewell and staff of Towson University, Center for Geographic Information Sciences.

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