Harford County Geology: Tectonic and Orogenic Framework

Map basis. The most recent complete countywide geological map identified by the Maryland Geological Survey remains Southwick and Owens' 1968 Geologic Map of Harford County. Later Maryland Geological Survey work notes that Piedmont nomenclature and tectonic interpretations have changed since that map was published. For that reason, the accompanying spreadsheets retain the 1968 mapped units while giving later correlations and modern tectonic interpretations where possible.

How the Older Map Units Relate to Modern Nomenclature

A later Maryland Geological Survey Harford County study is particularly useful because its correlation table places many of the 1968 names beside later interpretations. It correlates several Wissahickon facies with the Loch Raven Schist, Sykesville Formation, Oella and Piney Run formations, Prettyboy Schist, and the Pleasant Grove Shear Zone. It also places several mafic and ultramafic units within or near the Baltimore Mafic Complex.

Coastal Plain Context

The southern part of Harford County lies in the Atlantic Coastal Plain rather than the Piedmont. Harford County studies recognize the Early Cretaceous Potomac Group, younger upland gravel deposits, Pleistocene lowland or Talbot deposits, and modern alluvium. The Potomac Group may be subdivided into formations such as the Patuxent, Arundel, and Patapsco, but these subdivisions can be difficult to distinguish consistently in Harford County and are often mapped collectively.

Major Tectonic Chapters Recorded in Harford County

1. Grenville Orogeny - roughly 1.3-1.0 billion years ago

The Baltimore Gneiss is the principal Harford County unit representing this ancient history. Modern zircon studies indicate a protolith age near 1.25 billion years, followed by several Mesoproterozoic metamorphic and magmatic events. These rocks were later affected again during Paleozoic Appalachian tectonism.

2. Opening of the Iapetus Ocean - Neoproterozoic into Cambrian

This was not an orogeny, but it created the passive continental-margin setting in which sediment accumulated along Laurentia. Those sediments ultimately became units such as the Setters Formation and Cockeysville Marble.

3. Taconic Orogeny - mainly Ordovician, approximately 490-440 Ma

This is the dominant Paleozoic mountain-building event recorded in Harford County's Piedmont. It encompasses or strongly affects the Baltimore Mafic Complex, James Run volcanic rocks, Port Deposit

plutonic rocks, Wissahickon-related metasedimentary rocks, and associated ultramafic bodies. Much of the county's complex metamorphism, accretion, and tectonic transport is tied to this event.

4. Acadian Orogeny - Devonian

Harford County does not contain a simple group of formations that can be labeled purely Acadian. Instead, the event is better viewed as a later thermal and deformational overprint on older Piedmont rocks. Geochronologic work on Baltimore Gneiss records later Paleozoic thermal events consistent with continued Appalachian tectonism.

5. Alleghanian Orogeny - Pennsylvanian-Permian

The Alleghanian event likewise represents a later deformation and metamorphic overprint in the eastern Piedmont rather than the time when most Harford County rock units originally formed. Baltimore Gneiss records late Paleozoic titanite growth associated with this interval.

6. Atlantic rifting and Coastal Plain deposition - Mesozoic to present

After Appalachian mountain building ended and Pangaea began to break apart, erosion of the Piedmont and Appalachians supplied sediment to the Atlantic Coastal Plain. The Potomac Group and younger Coastal Plain deposits belong to this post-orogenic history rather than to an Appalachian orogeny.

Summary Statement

Harford County preserves evidence of more than a billion years of geologic history, beginning with Mesoproterozoic rocks affected by the Grenville Orogeny, followed by passive-margin sedimentation along the Iapetus Ocean and extensive Ordovician volcanism, plutonism, metamorphism, and accretion associated with the Taconic Orogeny. Later Acadian and Alleghanian events locally overprinted these older rocks, while Cretaceous and younger Coastal Plain sediments accumulated after Appalachian mountain building had ended.

Key Sources

- Maryland Geological Survey, RI 81: https://mgs.md.gov/reports/RI_81.pdf
- Maryland Geological Survey, RI 58: https://www.mgs.md.gov/publications/report_pages/RI_58.html
- USGS Geolex - Setters Formation: https://ngmdb.usgs.gov/Geolex/Units/Setters_3771.html
- USGS Geolex - Cockeysville Marble: https://ngmdb.usgs.gov/Geolex/UnitRefs/CockeysvilleRefs_1139.html
- USGS Geolex - James Run: https://ngmdb.usgs.gov/Geolex/UnitRefs/JamesRunRefs_2221.html
- USGS - Baltimore Gneiss geochronology: https://www.usgs.gov/publications/deciphering-multiple-mesoproterozoic-and-paleozoic-events-recorded-zircon-and-titanite

Reference Table Keys

The following keys explain the meaning of each attribute used in the two companion spreadsheets for the Harford County Geology Reference Project.

Piedmont Geologic Units Spreadsheet

Attribute	Meaning
Mapped Unit	The geologic unit name used on, or derived from, the 1968 Geologic Map of Harford County. This preserves the historical terminology used when the county was mapped.
Approximate Age	The estimated geologic age of the rock or its original protolith based on later MGS, USGS, and published geochronologic research. Ages may be given as a geologic period or an approximate numerical age.
Modern Interpretation / Name	A newer name, correlation, or interpretation applied to the older 1968 map unit by subsequent geological research. Some older units have been subdivided, renamed, or reinterpreted.
Orogeny / Tectonic Association	The major tectonic event or geologic environment associated with the unit. This may refer to formation, emplacement, deformation, metamorphism, or later tectonic overprinting; it does not necessarily mean the rock originally formed during that orogeny.
Source URL	The principal geological reference used to establish or support the age, modern interpretation, or tectonic association of the unit.
1968 Map Symbol / Code	The abbreviated symbol used to identify the geologic unit on the 1968 Harford County geologic map. Some units have more than one symbol because the map distinguishes different lithologies or subunits.
Map Symbol Source	The publication used to verify the map symbol or code, primarily Maryland Geological Survey material reproducing or correlating the 1968 mapping.

Important interpretation note: In the Piedmont table, rock age and orogenic association are not necessarily the same event. A unit may have an older protolith or crystallization age and later have been deformed or metamorphosed during one or more Appalachian orogenies.

Coastal Plain Geologic Units Spreadsheet

Attribute	Meaning
Unit	The name of the sedimentary formation, group, or surficial deposit occurring in the Coastal Plain portion of Harford County.
Age	The geologic time interval during which the sediment was deposited. These units are much younger than most Piedmont rocks and range mainly from Cretaceous to Quaternary age.
Depositional / Geologic Significance	A short description of what the unit consists of and the depositional environment or process responsible for it, such as fluvial sediment, flood-basin clay, terrace deposits, or modern stream alluvium.
Orogeny / Tectonic Association	Indicates whether the unit is directly associated with a mountain-building event. Most Harford County Coastal Plain deposits are post-orogenic sediments deposited after Appalachian mountain building.
Source URL	The principal MGS, USGS, or other geological publication used to support the unit description, age, or interpretation.
1968 Map Symbol / Code	The symbol used on the 1968 map, or the closest map-level designation where individual formations were not separately mapped. For example, several Early Cretaceous formations may be represented collectively as Kp (Potomac Group).
Map Correlation Note	Explains limitations or special circumstances in matching the spreadsheet entry to the 1968 map, especially where the map groups several formations together or later terminology differs.
Map Symbol Source	The reference used to verify or interpret the map symbol shown in the spreadsheet.

Important interpretation note: Coastal Plain ages generally refer to the time of sediment deposition. These deposits are mostly post-orogenic and should not be interpreted as rocks formed during the Appalachian mountain-building events.