



Legend and Scale

Planar Features

- S₀: bedding/volcanic layering
- S₁: orientation of mafic dikes
- S₂: pervasive schistosity or gneissosity (D₁)
- S₃: spaced, axial planar schistosity (D₂)
- S₄: sinistral sense strike-slip SC fabric (D₃)
- S₅: dextral sense strike-slip SC fabric (D₄)
- S₆: discrete dextral strike-slip shear zone (D₅)
- S₇: discrete sinistral strike-slip shear zone (D₆)
- S₈: strike-slip shear zone plays (D₇)
- S₉: reverse sense shear zone (D₈)
- S₁₀: normal sense shear zone (D₉)

Linear Features

- preferred orientation of amphiboles
- mineral streaking lineation
- slickensides (D₁ and later)
- crenulation (D₂ and D₃), undivided
- fold axis (F₁ associated with S₁ fabric)

Other Symbols

- o - outcrop, no measurements
- f - float of unit observed
- geologic contact
- thrust fault

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Geologic Map of the Lower Susquehanna River Gorge: Conowingo to Havre de Grace, Cecil and Harford Counties, Maryland

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Description of Units

(mineral abbreviations after Kretz, 1983, except for AfS - alkali feldspar, Opxs - unidentified opaque phases)

Qal - Quaternary Alluvium and Fill Material (only large deposits shown)

KT - Cretaceous and Tertiary Sands and Gravels - weakly to unconsolidated, deposited nonconformably upon older, crystalline bedrock, crop out in uplands and in extreme southeast portion of the map distribution from Southwick and Owens, 1968, and Higgins and Conant, 1986.

O_{BR} - Juranite Batholith - diabasic dikes, undeformed, age based on similarity to Jurassic dikes throughout the Central Appalachian Piedmont

Conowingo Block

State Line Complex - top part

Basin Run Tonalite (4713.38 Ma, Rb-Sr whole rock; Leser, 1982) - coarse-grained idiomorphic to hypidiomorphic, weakly to non-foliated tonalite and granodiorite; intrudes CO₂ and O₂; C₂ thrust on O₂; scapolite rich, Pl + Al₂SiO₅ + Bt + Ms + Qtz + Ttn + Ilm + Opxs + Zrn + Ap + Grt primary assemblage; Pl or Qtz as phenocryst phase; Grt with Qtz and Pl in thin, sheared pegmatite veins; alignment of Bt defines a weak, dispersive cleavage; northeast-southwest dextral strike-slip SC fabric developed near and along southeast contact, locally cross-cut by northeast-southwest, steeply dipping dip, strike-, and oblique-slip shear zones up to 50m thick. [type section: along Basin Run from Rowlandsville to Liberty Grove, Cecil County, Maryland]

Quartz Diorite (490±20 Ma, Sm-Nd; Shaw and Wasserburg, 1984) - coarse-grained, idiomorphic to hypidiomorphic, weakly to non-foliated quartz diorite with minor quartz gabbro; intrudes CO₂, intruded by O₂; Pl + Cpx (reluctant) + Opx (reluctant) + Qtz + Opxs + Hbl primary assemblage; Pl highly associated by Ep indicating primary high An content. Secondary assemblage is Hbl + Ab + Cld + Tlc + Sps, northeast-southwest subvertical shear zones are common.

Conowingo Dam Formation - weakly to non-foliated, medium-grained Qtz + Pl + AfS granodites with abundant oligoclase of amphibolous quartz, bi-ch schist, greenschist, amphibolite, calcalkaline gneiss, and ultramafic schist, soft sediment deformation structures common; inclusions exhibit mostly oriented internal layering; locally cut by northeast-southwest subvertical shear zones; interpreted as weakly metamorphosed sedimentary melange deposited in a subduction zone trench

Elbow Branch Thrust

Havre de Grace Block

Port Deposit Intrusive Suite

Mafic Dikes (Cambrian or Ordovician) - thin, branching dikes of variably tonon-foliated amphibolite. 1 to 3 or more meters thick; intrudes C₂, C₃, and C₄; Hbl + Pl + Qtz + Opxs + AfS + Ep primary igneous or first metamorphic assemblage; gabbroic to dioritic in composition; chilled margins locally; late Cld and Act in more sheared parts [type section: along RR tracks from US222 to Happy Valley Creek, Cecil County, Maryland]

Tom's Creek Tonalite - coarse-grained, hypidiomorphic, foliated tonalite; intrudes C₂ and C₃; and possibly C₄; sheared boundary with C₂; primary Pl + Qtz + Cn + Bt + Al₂SiO₅ + Ttn + Zrn + Ap; steeply southeast dipping dispersive cleavage is defined by alignment of secondary Bt; discrete northeast-southwest, subvertical dip-slip shear zones exhibit Cld mineralization; cb - intrusion breccia (i.e. unmineralized creek just south of 195 from Susquehanna River to 195, Cecil City, MD)

Port Deposit Gneiss (515 Ma, U-Pb; Sinha, 1989) - medium and coarse-grained, foliated tonalite and granodiorite; all contacts with older rock are intrusive; intruded by C₂ and possibly C₃; igneous textures preserved locally indicate a medium to coarse-grained, hypidiomorphic, granular protolith with primary Pl + Qtz + Bt + Ms + Al₂SiO₅ + Ilm + Opxs + Zrn + Ap + Cn; unit is variably and multiply sheared; northwest part characterized by subvertical, E-W striking dextral strike-slip SC fabric; rest of unit characterized by a pervasive, steeply southeast-dipping foliation. Thin, subvertical dip-slip shear zones cut the entire unit; secondary minerals are Bt + Ms + Grt + Cld + Mag; cb - scapolite rich intrusion breccia along contacts with country rock with Hbl as a primary phase [type section: Port Deposit Quarry to Happy Valley through town of Port Deposit, Cecil County, Maryland]

Coarse Amphibolite - coarse-grained, weakly to strongly lineated amphibolite; intrudes C₂ as a lower parallel subvertical sills with chilled margin; Cum + Ep + Pl + Qtz + Opxs + Hbl assemblage; secondary Act and Cld; may be related to Aberdeen Metagabbro

Aberdeen Metagabbro - coarse-grained, weakly to strongly lineated amphibolite; intrudes C₂ and C₃; Hbl + Ep + Pl + Opxs + Qtz assemblage; metamorphic with relict plagioclase texture; distribution from Southwick and Owens (1968)

Old Mill Tectonite - quartz-feldspathic blutonylonite characterized by rounded to locally euhedral Pl, rounded Qtz, radial Ttn on Ilm, ± AfS millimeter scale porphyroclasts in a fine-grained matrix of Qtz + Pl + Bt + Ep + Ap + Opxs; small aluminous inclusions lie parallel to C₂ planes; porphyroclasts lie in trails at low angles to C₂; small leucocratic bodies lie parallel to C₂; protolith unknown - based on appearance and contact relations it is most likely either C₂ or C₃

James Run Formation Metavolcanics

Felsic James Run (516 Ma, U-Pb; Leser (82)) - thinly interlayered to massive volcanic and subvolcanic diacidic gneiss; depositional contact with C₂; intruded by C₂, C₃, C₄, and mafic dikes; characterized by a very fine-grained Qtz + Ep + Pl + Bt + Hbl matrix, a phenocryst assemblage of Pl + Qtz + Hbl + Pl and accessory Zrn + Ap; small amounts of interlayered rhyolitic and andesitic gneiss and amphibolite; undeformed to strongly sheared; strong dip-slip lineation in high strain zones; this felsic layer typically boudinaged; layering and foliation both dip steeply to SE and are generally parallel; primary volcanic structures in less deformed parts include amygdaloids, volcanic layering, and lava breccia; and devolatilization textures

Mafic James Run - thinly interlayered to massive amphibolite and gneissolite; depositional contact with C₂; intruded by C₂, C₃, C₄, and mafic dikes; fine- to coarse-grained equidimensional amphibolite with a phenocryst assemblage of Pl + Hbl; amygdaloids filled with Ep + Pl + Cc; small amounts of interlayered diacidic, andesitic, and rhyolitic gneiss; undeformed to strongly sheared; strong dip-slip lineation in high strain zones; this felsic layer typically boudinaged; layering and foliation both dip steeply to SE and are generally parallel; primary volcanic structures in less deformed parts include amygdaloids, volcanic layering, and lava breccia; corresponds to Galpin Falls Member of Higgins (1986)

fine amphibolite - fine-grained amphibolite; assemblage is Hbl + Pl + Ep + Qtz + Opxs + Act + Cld; no primary features observed; strongly foliated; locally associated with ultramafic rock described below

ultramafic rock - well-foliated, fine-grained serpentinite intensely veined with asbestos; metamorphic assemblage Sps + Cpx + Opxs + Cld + Hbl (relict) + Tlc; the foliation is vertical and strikes E-W; occurs as a small fragment along CZ₂-C₃ contact within the Rock Run Shear Zone which crops out at a quarry near the entrance to Susquehanna State Park Campground, Harford County, MD; may represent ultramafic dike in C₂; inclusion in C₂, or fragment of ultramafic body along shear zone strike

Canal Road Formation - complexly deformed, interleaved argillaceous feldspathic quartzite (Qtz + Bt + Pl + Grt + Cld + Ms + Opxs) and pelitic schist (Grt + Hbl + Ms + Cld + Sps + Opxs) + Qtz + Pl + Opxs with scattered meter scale amphibolite layers (Hbl + Pl + Qtz + Ep + Bt + Cld + Act + Opxs); intruded by C₂ and thrust upon O₂; characterized by steeply E-W plunging neosynclinal folds and crenulations; highly sheared east-northeast striking vertical fabric along southeastern margin associated with strong retrograde metamorphism [type section: unnamed stream along Canal Road and Control Track, upstream of Canal Road to contact with C₂, Cecil County, MD]

Interpretive Cross-sections - Projected from outcrops into line of section

