EXPLANATION

UNCONSOLIDATED TO SEMI-CONSOLIDATED

QUATERNARY

Qa

Alluvium

Qa *Alluvial deposits in stream valleys; thickness ranges from 0.5 meters to more than 5 meters; commonly consists of a lower gravel unit and an upper micaceous sand-silt-clay unit. Gravel unit consists of fragments of local country rock and vein quartz. Clasts locally exceed one meter in diameter. Swamp areas and bogs are common. In urbanized areas, stream deposits have been extensively disrupted. The deposits cannot be accurately shown in many areas because of channelization, suburban development, or other land modifications. Structural symbols on alluvium represent bedrock exposures in stream valleys. These are typically either along the margins of the flood plain or close to the main channel of the drainage.*

Qac

Colluvium and Alluvium

Qac *Unsorted clay to gravel-size clasts of colluvial origin; well to poorly sorted, intercalated gravel, sand, silt, and clay of fluvial origin. Drill data indicate thicknesses exceed 6 meters in places.*

CRETACEOUS

unconformity

Kxs | Kxc

Potomac Group
Patuxent Formation

Two lithofacies have been mapped; areas in which sand and gravel predominate are shown as Kxs; areas shown as Kxc are predominately clay and sandy clay. Iron cemented layers and lenses of sand and gravel with thicknesses ranging from less than 1 centimeter to more than 0.75 meters occur sporadically. Layers more than 0.25 meters thick are shown by a heavy dashed line (----).

Kxs *Sand and gravel facies; gray to white, some beds red, orange-brown, or yellowish brown. Characterized by abrupt horizontal and vertical changes in lithology between the sand and gravel facies and the clay facies. Maximum size of gravel clasts is 20 centimeter in longest axis, but most average less than 2 centimeters. Clasts are mainly vein quartz and quartzite, with minor quartz-feldspar gneiss and iron cemented conglomerate and sandstone. Sand beds are mainly fine to medium grained quartz. In places, the sand is very micaceous. In excavations, sediments of this lithofacies commonly show a color change from white or gray upward to orange-brown or yellowish brown, sand grains and gravel clasts are clay coated, and gravel clasts are friable. These changes are observed in the uppermost 1.5 to 2.5 meters.*

Kxc *Clay and sandy clay facies, gray to white, locally mottled brown, yellow, and maroon. Texture varies from clay, to silty, sandy, and gravelly clay. Predominant clay mineral is kaolinite; illite is less common. Characterized by abrupt horizontal and vertical variations from clay to sand and gravel.*

CRETACEOUS(?)

ps | pc | pu

Potomac Group (?)

Similar in color, lithology, and sedimentological features to the Patuxent Formation in the southeastern part of the Quadrangle, but of uncertain age because of their separation from the Patuxent Formation and lack of dateable paleontological material. Where the gravel, sand and clay overlie marble, chemical weathering of the marble has apparently resulted in significant lowering of the sediments.

ps *Areas in which sand and gravel predominate.*

pc *Areas in which clay predominates*

pu *Undivided Potomac Group (?)*

INTRUSIVE ROCKS

SILURIAN(?)*

unconformity

p

Pegmatite

p *Massive, coarse-grained to very coarse-grained, light colored rock consisting chiefly of mica (mostly muscovite), quartz, and feldspar; contains minor garnet locally (as tiny grains about 2 mm in diameter).*

over print *Areas in which the rock formations commonly include interlayered pegmatite (identical to that described above) as concordant sills as much as several meters thick. Commonly associated with, or replaced by a finer-grained gneissic rock of the same mineralogy.*

CAMBRIAN(?)*

gg

Gunpowder Gneiss†

gg *Fine-, medium-, and coarse-grained, very uniform plagioclase quartz-microcline gneiss, generally with both biotite and muscovite, locally with small feldspar megacrysts. (Previously designated Gunpowder Granite.)*

over print *Areas in which the mapped rock formations include interlayered Gunpowder Gneiss, identical to that described above, as concordant sills, and rarely as cross-cutting dikes, as much as ten meters thick.*

Top of Crystalline Stratigraphic Section

CAMBRIAN(?)

COMPLEX

p

Perry Hall Gneiss

p *Perry Hall Gneiss. Fine- to medium-grained biotite-quartz-plagioclase gneiss with rare muscovite, and hornblende-quartz-plagioclase gneiss, commonly garnetiferous; subordinate amphibolite; all interlayered generally on a scale of meters.*

f | um

Raspeburg Amphibolite

f *Raspeburg Amphibolite. Fine- to medium-grained, uniform amphibolite, locally laminated.*

um *undivided mafic-ultramafic rock.*

thrust fault

CAMBRO-ORDOVICIAN(?)

GLENARM SUPERGROUP

WISSAHICKON GROUP

o

Oella Formation

o *Oella Formation. Medium-grained biotite-plagioclase-muscovite quartz schist, commonly garnetiferous, locally with tourmaline, interlayered on a centimeter to decimeter scale with fine-grained biotite-plagioclase-quartz gneiss or felt (metagraywacke).*

l | ea | lr | lh | m

Loch Raven Schist

l *Loch Raven Schist. Uniform, medium- to coarse-grained biotite-plagioclase-muscovite-quartz schist with lenses and pods of coarse-grained vein quartz. Locally rich in biotite and feldspar. Includes minor quartzite.*

(g) *garnet facies. Garnet common; staurolite and kyanite rare or absent.*

(g-s) *garnet-staurolite facies. Garnet and staurolite common; kyanite rare or absent.*

(g-k) *garnet-kyanite facies. Garnet and kyanite common; staurolite rare or absent.*

(g-s-k) *garnet-staurolite-kyanite facies. Garnet, staurolite, and kyanite all common.*

lh *Hydes Marble Member. Very poorly exposed, sparse outcrops of fine-, medium-, and coarse-grained calcite marble, locally phlogopitic. The Hydes Marble is either younger than Cockeysville Marble or is Cockeysville emplaced by early thrust faulting, based upon location of the Hydes astride a synclinal axis and the absence of Rush Brook in contact with the Hydes.*

lr *Rush Brook Member. Fine-grained, quartz-rich schist and gneiss with subordinate medium-grained quartzite, interlayered generally on a scale of decimeters to meters; tourmaline common in outcrops that include quartzite. Quartz pebble metaconglomerate very rare. Finely disseminated pyrite locally abundant.*

ea *epidote amphibolite. Fine-grained to coarse-grained, finely laminated to uniform amphibolite with epidote, generally accompanied by quartz, either in pods or in thin laminae; locally garnetiferous; calcite very rare.*

a *amphibolite. Similar to above but largely devoid of epidote.*

m *marble. A single lens of fine-grained, phlogopite-rich calcite marble with tremolite, at least 8 meters thick.*

cld | cpl | cml | cmd | cmlc

Cockeysville Marble

cpl *Phlogopitic metalimestone member. Fine- to medium-grained, white to bluish-white calcite marble interlayered on a millimeter- to centimeter-scale with fine- to medium-grained, purplish, phlogopitic calcite marble or calc-schist with feldspar, scapolite, muscovite, quartz, and very minor diopside and tremolite. Locally, uniformly silicate-rich or silicate-poor.*

cmd *Massive metadolostone member. Medium-grained, white, generally massive metadolostone consisting of over 95% dolomite plus minor diopside, tremolite, phlogopite, and quartz. Includes a few occurrences of phlogopitic metalimestone and, northwest of Glen Ellen, a single occurrence of quartz-tremolite rock. Commonly weathers to dolomite sand.*

cld *Layered metadolostone member. Fine-grained, light and dark dolomite marble interlayered generally on a scale of several decimeters. Dark metadolostone contains diopside, tremolite, and phlogopite, and has quartz in thin, concordant layers (5 to 8 cm or less in thickness) and discontinuous zones of nodules; light dolomite marble is largely silicate-free.*

cml *Massive metalimestone member. Foliated to massive, medium- and coarse-grained, quite pure calcite marble, commonly blue streaked, and subordinate fine-grained, brown weathering dolomite generally bearing calcite and silicates (phlogopite, muscovite, tremolite, diopside, quartz) interlayered on a scale of several meters to more than a decameter, though locally on the order of a few decimeters. Includes rare, brown -weathering, massive quartz-tremolite-diopside rock in layers on the order of one meter thick.*

cmlc *Calc-gneiss lens. Fine-grained, bluish-gray, warty-weathering calcite marble or calc-gneiss with scapolite, diopside, tremolite, and quartz; generally pyritic; rarely phlogopitic. Locally includes layers of relatively pure calcite marble a few decimeters thick.*

PRECAMBRIAN*

s | sgs | sg | sq | sqs

Setters Formation

s *Setters Formation undivided*

sgs *Garnet schist member. Fine- to medium-grained biotite-plagioclase-muscovite-quartz schist, generally with abundant, small garnets (2-3 mm in diameter), and locally kyanite. Very subordinate quartzite in zones a few meters thick.*

sg *Gneiss member. Fine-grained microcline-quartz gneiss with biotite or biotite and muscovite and conspicuous tourmaline. Commonly thin-layered. Includes subordinate quartzite and schist in layers ranging from a few decimeters to more than a meter in thickness. Locally the basal 15 to 30 meters in the southern outcrop belt consists almost exclusively of schist, commonly tourmaline-rich, and locally garnetiferous. Gneiss of the northern outcrop belt locally has a "wormy" texture due to the break-up of thin, light-colored laminae.*

sgq *Quartzite lens. Well foliated to massive, medium-grained, unlayered muscovite-feldspar quartzite.*

sq *Quartzite member. Fine- to medium-grained, well layered, slabby weathering; varies from nearly pure quartzite to schistose quartzite rich in muscovite and microcline, commonly bearing tourmaline and locally magnetite. Layering thickness generally a few centimeters to a few decimeters. Locally the quartzite is uniform and lacks layering. Quartzite of northern outcrop belt is locally biotitic and includes schist in layers a few centimeters to a few decimeters in thickness.*

sqs *Schist lens. Medium-grained biotite-microcline-quartz-muscovite schist, locally coarse-grained and more feldspathic, rarely fine-grained and biotitic. Very subordinate muscovite-feldspar quartzite in layers a few decimeters thick.*

unconformity

pCbl | pCbh | pCba | pCbs

Baltimore Gneiss

pCbl *Layered gneiss member. Dark and light biotite-microcline-quartz-plagioclase gneiss varying from biotite schist to massive quartzo-feldspathic granofels interlayered on a scale of centimeters to decameters. Hornblende very rare and confined to outcrops close to the contact of the augen gneiss member.*

pCbh *Hornblende gneiss member. Similar to the layered gneiss member but with hornblende-bearing dark gneiss constituting about 50% of the total outcrop area. Garnet very rare.*

pCba *Augen gneiss member. Crops out in two belts characterized by fine- to medium-grained biotite-microcline-quartz-plagioclase gneiss containing abundant, large (1-3 cm), light-colored ovoids (augen) consisting of microcline or of microcline and quartz. Augen gneiss of the northeastern belt is pinkish and includes subordinate fine- to medium-grained, uniform biotite-quartz-feldspar gneiss, and pinkish biotite-quartz-feldspar granofels in layers generally a decimeter to a meter in thickness. Includes rare layers of Gunpowder Gneiss† in addition to the larger mass near Nolch Cliff. Augen gneiss of the southwestern belt is similar to the layered gneiss member but includes augen in about half of the outcrops.*

pCbs *Streaked-augen gneiss member. Uniform, commonly pinkish, medium-grained biotite-microcline-quartz-plagioclase gneiss generally with augen that have a "stretched" or "streaked" appearance. Magnetite abundant in places; minor garnet and hornblende locally. Includes subordinate, fine-grained, dark biotite-quartz-feldspar gneiss in layers ranging from a few decimeters to a meter in thickness.*

For the crystalline rocks primary minerals are listed in order of increasing abundance. Grain size definitions are: fine = less than 1 mm; medium = 1-5 mm; course = 5 mm - 3 cm; very course = greater than 3 cm.

Contact
Generally approximate or inferred. Distribution and concentration of structural symbols indicates degree of reliability of any contact

boundary between mineral facies of the Loch Raven Schist

Normal Fault
u - upthrown side
d - downthrown side

Thrust Fault
teeth on upper plate

overturned — upright
Anticline or Dome

overturned — upright
Syncline

vertical — inclined — horizontal
Foliation or Schistosity
(everywhere virtually parallel to compositional layering)

inclined
Crumpled Schistosity

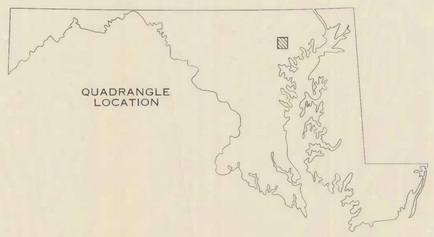
symmetric — dextrally asymmetric — sinistrally asymmetric — symmetric — asymmetric
inclined — horizontal
Axis and Symmetry of Minor Fold

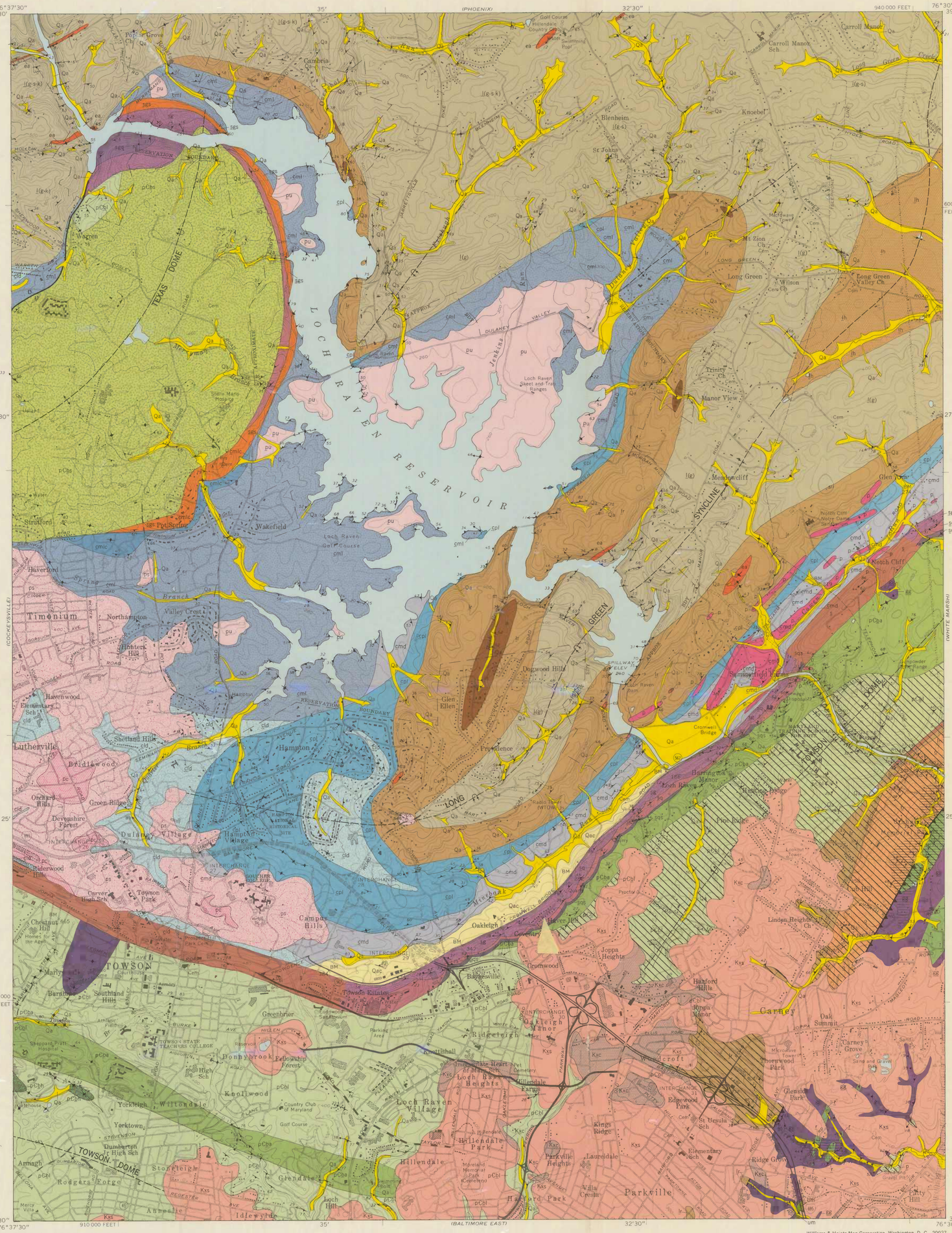
inclined — horizontal
Mineral Lineation

*age designations based on radiometric dates on *Geologic Map of Maryland* (1968)

†Note added in proof: The two, small, finger-shaped bodies of Gunpowder Gneiss, one at Notch Cliff, the other at Towson, are no longer considered to be Gunpowder Gneiss, but rather pre-Glenarm granitic gneiss of probable intrusive origin.

THE JOHNS HOPKINS UNIVERSITY
DEPOSIT
JUN 29 2005
MAP COLLECTION





Base map from U.S. Geological Survey, 1957
Towson Quadrangle, 7½ Minute Series

Crystalline rocks mapped by William P. Crowley and sediments by Emery T. Cleaves.

Field mapping done, 1969 to 1971.

GEOLOGIC MAP OF THE TOWSON QUADRANGLE, MARYLAND

By
William P. Crowley and Emery T. Cleaves
1974

MN | GN
8° 142 MILS | 1° 18 MILS
UTM GRID AND 1966 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000
1 ½ 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

Williams & Heintz Map Corporation, Washington, D. C. 20027

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G3841
.C5
s24
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Towson