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DEPARTMENT OF MINES, MINERALS AND ENERGY
DIVISION OF MINERAL RESOURCES

PUBLICATION 161
GEOLOGIC MAP OF THE VIRGINIA PORTION OF
THE WINCHESTER 30 X 60 MINUTE QUADRANGLE

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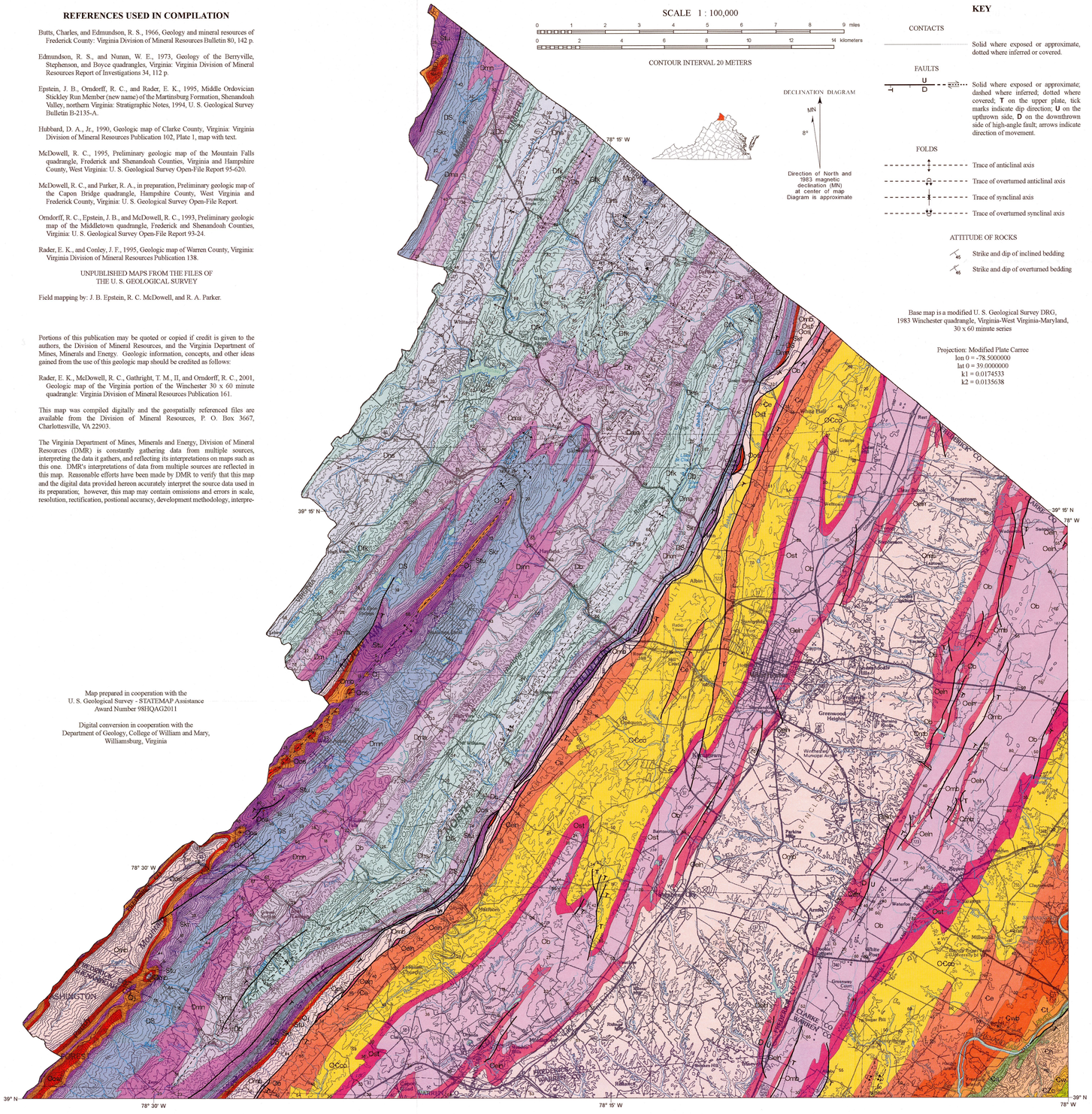

KEY

CONTACTS

Solid where exposed or approximate, dotted where inferred or covered.

FAULTS

Solid where exposed or approximate; dashed where inferred; dotted where covered; **T** on the upper plate, tick marks indicate dip direction; **U** on the upthrown side, **D** on the downthrown side of high-angle fault; arrows indicate direction of movement.

FOLDS

Trace of anticlinal axis

Trace of overturned anticlinal axis

Trace of synclinal axis

Trace of overturned synclinal axis

ATTITUDE OF ROCKS

Strike and dip of inclined bedding

Strike and dip of overturned bedding

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UNPUBLISHED MAPS FROM THE FILES OF
THE U. S. GEOLOGICAL SURVEY

Field mapping by: J. B. Epstein, R. C. McDowell, and R. A. Parker.

This map was compiled digitally and the geospatially referenced files are available from the Division of Mineral Resources, P. O. Box 3667, Charlottesville, VA 22903.

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EXPLANATION

MISSISSIPPIAN

Mpo — **Pocono Formation**

Sandstone, medium- to light-gray, medium- to coarse-grained with thin beds of black, carbonaceous shale. Basal contact mapped at base of the lowest gray sandstone overlying reddish-brown shale or mudstone. Thickness: less than 200 feet preserved on Shockeys Knob.

DEVONIAN

Dhs — **Hampshire Formation**

Shale, mudstone, siltstone, and sandstone. Shale, mudstone, and siltstone, dusky- to grayish-red, in part micaceous. Sandstone, medium- to brownish-gray, thin- to thick-bedded, cross-laminated, in part micaceous and feldspathic; no reported fossils. Basal contact placed above the youngest fossiliferous sandstone and shale of the Foreknobs Formation overlain by redbeds. Thickness: 3600 feet in northern Frederick County (Butts and Edmundson, 1966); in central Frederick County the preserved thickness ranges from 550 to 750 feet.

Dfk — **Foreknobs Formation**

Sandstone, siltstone, and minor shale, interbedded. Sandstone, brownish-gray, medium- to coarse-grained, medium- to thick-bedded, in part cross-laminated, conglomeratic beds common, sandstone most abundant in the upper part of the formation; many beds very fossiliferous. Siltstone, medium- to thick-bedded, dominant in lower part of unit. Shale, interbedded with sandstone and siltstone throughout section. Brownish-red shale common in upper half of section. Basal contact mapped at the base of fossiliferous sandstone underlain by micaceous shale and thin-bedded siltstone. Thickness ranges from 2000 to 2500 feet.

Db — **Brallier Formation**

Shale, siltstone, and minor sandstone, interbedded, dark-gray to greenish-gray, weathers light brownish-gray; grain size increases upward in section; sandstone more abundant in upper part of section, thin- to medium-bedded, sparsely fossiliferous. Base of the formation placed at the top of a thick sandstone unit of the underlying Mahantango Formation. Thickness ranges from 1000 to 1800 feet.

Dma — **Mahantango Formation**

Mudstone, sandstone, and shale. Mudstone, dark- to olive-gray, hackly weathering, locally very fossiliferous, bedding obscure, spheroidal weathering common. Sandstone, medium-gray, fine-grained, medium- to very-thick-bedded, locally fossiliferous. Base gradational, mapped at the base of olive-gray beds overlying black, fissile shale. Thickness: approximately 1100 feet.

Dmn — **Marcellus Shale, Tioga Bentonite, and Needmore Formation, undivided**

Marcellus Shale: shale, dark-gray to black, fissile, with interbeds of dark-gray argillaceous limestone or calcareous shale, locally very fossiliferous, fossils small. Thickness: about 500 feet in northern Frederick County. **Tioga Bentonite:** alternating gray, silty shale and siltstone; brown, biotite-bearing, calcareous tuff; and fissile black shale. Thickness: approximately 10 feet west of Little North Mountain. **Needmore Formation:** dark-greenish-gray, fossiliferous shale and calcareous mudstone with thin (3 to 8 feet) black shale at base. Thickness: about 120 feet. Base of the map unit placed at top of gray sandstone of the Ridgeley Sandstone.

unconformity

DS — **Devonian and Silurian rocks, undivided**

Ridgeley Sandstone: quartz arenite, light- to yellowish-gray, fine- to coarse-grained, locally conglomeratic, thin- to thick-bedded, generally cross-laminated, calcareous cement, friable when weathered; fossiliferous, commonly contains molds of shells; thickness ranges from 0 to 200+ feet near Gore, Frederick County. **Helderberg Group:** limestone, light- to dark-gray, fine- to coarse-grained, laminated to thick-bedded, with black, nodular chert and white to light-gray, blocky chert; upper portion of the unit argillaceous, lower part of the unit sandy (locally a sandstone), base defined by a coarse-grained, gray limestone with large white to pink crinoid stems; locally very fossiliferous, thickness ranges from 50 to 100 feet. **Keyser Limestone:** medium- to dark-gray, fine- to coarse-grained limestone with abundant fossils, sandy near top, argillaceous near base, may contain laminated beds similar to the underlying Tonoloway Limestone in lower portion, sparse, small black chert nodules common; thickness ranges from 75 to 150 feet. **Tonoloway Limestone:** upper and lower members, medium- to dark-gray, fine-grained, laminated, mudcracked limestone with sparse fossils (ostracodes and rare brachiopods); middle member, medium-gray, fine- to medium-grained, abundant algal structures; thickness 400+ feet west of Great North Mountain. **Wills Creek Formation:** light- to medium-gray, fine- to coarse-grained, fossiliferous limestone; gray, calcareous siltstone; greenish-gray, calcareous mudstone; all lithologies weather to a yellowish-gray shaly residue; top generally marked by a 10-foot-thick gray sandstone **(Tavenner Sandstone Member)**; thin beds of reddish shale occur near the base; thickness: about 400 feet west of Great North Mountain. **Bloomsburg Formation:** dusky-red mudstone with interbedded fine- to medium-grained, thick-bedded, cross-laminated, ferruginous sandstone and dusky-red, yellowish-brown weathering shale; several thin (2 to 8 feet thick) quartz arenite beds occur in the Massanutten Synclinorium; thickness ranges from 80 to 150 feet. **McKenzie Formation:** medium-gray, yellowish weathering, calcareous shale, locally very fossiliferous; thickness about 200 feet west of Little North Mountain.

SILURIAN

Skr — **Keefer Sandstone and Rose Hill Formation, undivided**

Keefer Sandstone: sandstone, light-gray, fine- to coarse-grained, locally conglomeratic, cross-laminated, quartz cement or overgrowths, thin green to purple shale beds near base, sparsely fossiliferous (*Skolithos*, *Arthrophycus*); thickness ranges from 30 to 70 feet, thickens in a southwestern direction. **Rose Hill Formation: (Clinton Formation** of earlier reports) sandstone and shale. Sandstone, light-gray to dusky-red, fine- to coarse-grained, cross-laminated; gray sandstone identical to the overlying Keefer and the underlying Tuscarora, very resistant to weathering, makes ledges. Shale, green, yellowish-brown, and dusky-red, commonly contains limonitic lenses from the weathering of thin limestone beds. Fossiliferous. Thickness: about 350 feet.

Stu — **Tuscarora Formation**

Sandstone and quartzite. Sandstone, light-gray, weathers rusty brown, fine- to coarse-grained, commonly conglomeratic, clasts 0.25 to 0.5 inch, thin- to thick-bedded, cross-laminated, quartz cement, matrix less than 1%. Quartzite, light-gray, fine- to medium-grained, cemented by overgrowths, thick-bedded. Thin, red, green, or purple shale near base and top of unit. Sandstone generally overlain by quartzite. Contacts gradational, basal contact mapped at the base of the oldest thick sandstone bed, upper contact mapped at the first thick shale sequence overlying a thick quartzite. Thickness: ranges from 150 to 300 feet.

Oj — **Juniata Formation**

Sandstone, dusky-red, fine- to medium-grained, cross-laminated, in part feldspathic. Sandstone, light-gray to white, fine- to medium-grained, thick-bedded, cross-laminated, base often contains red shale clasts. Shale and mudstone, dusky-red, weathers lumpy. Thickness ranges from 50 to 300 feet.

Oos — **Oswego Formation**

Sandstone, greenish-gray, fine- to coarse-grained, conglomeratic with chert, quartz, and lithic clasts, medium- to thick-bedded; minor interbeds of olive-gray shale. Thickness ranges from 200 to 300 feet.

Omb — **Martinsburg Formation**

Upper 100 to 200 feet: brown, medium- to coarse-grained sandstone, may be fossiliferous. Middle 3000 to 4500 feet: olive-green, silty shale, dark-gray siltstone, and medium- to coarse-grained sandstone, locally contains pebbles. Lower 400 to 900 feet: **Stickley Run Member** (Epstein and others, 1995), medium-gray to grayish-black, very-fine-grained, very-thin- to thin-bedded, argillaceous limestone with interbedded medium- to dark-gray calcareous shale Thickness ranges from an estimated maximum of 5200 feet in the Massanutten Synclinorium to about 2000 feet in the western outcrop areas.

ORDOVICIAN

Oeln — **Edinburg Formation, Lincolnshire Limestone, and New Market Limestone, undivided**

Edinburg Formation: black, fine-grained to aphanic limestone with black shale partings, pyrite common (**Liberty Hall lithofacies** of Cooper and Cooper, 1946), and medium- to light-gray, fine- to coarse-grained, nodular limestone with thin black shale partings (**Lantz Mill lithofacies** of Cooper and Cooper, 1946). Top of the Edinburg marked by a 30- to 60- foot thick very-fine-grained, medium-gray, thick-bedded limestone (**St. Luke Member**). East of Little North Mountain, a greenish-gray siltstone occurs about 15 feet above the base of the Edinburg (**Tumbling Run Siltstone Member**). K-bentonites, some with basal chert or silicified zones, common, particularly near the base and top. Fossiliferous. Thickness ranges from 425 to 500 feet. **Lincolnshire Limestone:** limestone, light- to very-dark-gray, fine- to coarse-grained, medium to very-thick-bedded; dark colored limestone with black chert nodules, generally parallel to bedding; light colored, coarse-grained limestone, generally at the top of the formation, composed of fossil fragments (**Murat Limestone Member**). Upper contact gradational with the overlying Edinburg; lower contact unconformable with the underlying New Market. Thickness ranges from 25 to 250 feet. **Unconformity. New Market Limestone:** lower unit: medium- to dark-gray, fine-grained, thin-bedded, argillaceous, in part dolomitic, bioturbated limestone, carbonate pebble conglomerate common at base; upper unit: medium-gray, aphanic, thick-bedded limestone with scattered, rhomboid-shaped sparry calcite crystals; high-calcium limestone quarried in the area. Contacts unconformable. Thickness ranges from 0 to 200+ feet.

unconformity

Ob — **Pinesburg Station Dolomite and Rockdale Run Formation, undivided**

Pinesburg Station Dolomite: dolostone, medium- to light-gray, weathers very-light-gray, fine-grained, medium- to thick-bedded, weathered surfaces exhibit a "butcher-block" structure, sparse fossils. Limestone, medium-gray, fine-grained, near base of unit. Thickness ranges from 0 to 875 feet. Present in the western outcrop belts and north of central Clarke County in the eastern belt. Absence may be explained by pre-New Market erosion, nondeposition, or lateral facies change. **Rockdale Run Formation:** medium-gray, fine-grained, fossiliferous limestone; light- to medium-gray, fine-grained, laminated dolomitic limestone and dolostone with mottled beds; thin lenses of calcareous sandstone occur in Warren County; thin lenses of gray chert common near the base of the formation. Upper contact unconformable; lower contact placed at the oldest thick-bedded dolomite overlying dark-gray limestone of the Stonehenge Limestone. Thickness ranges from 1500 feet where the Pinesburg Station is present to 2400 feet where the Pinesburg Station is absent.

Ost — **Stonehenge Limestone**

Upper Stonehenge: medium- to dark-gray and black, fine- to medium-grained limestone, thin beds of macerated fossil debris common. Thickness ranges from 400 to 500 feet. **Lower Stonehenge (Stouffterstown Member):** dark-gray to black, fine-grained limestone with thin, sheet-like partings; partings crinkly because of cleavage; and thin beds of coarse-grained, bioclastic limestone. Thickness: 50 to 150 feet.

OCco — **Conococheague Formation**

Upper Conococheague: light- to dark-gray, fine-grained, laminated limestone, dolomitic limestone, and dolostone with flat-pebble conglomerate beds. The following lithologies occur as erosional-surface-bounded packages (from base to top): oolitic, coarse-grained calcarenite; stromatolitic limestone; ribbon-banded limestone and dolostone, interbedded fine-grained limestone and dolostone; dolostone commonly containing mudcracks; sandstone beds in uppermost part of formation, some sandstone beds cross-laminated. **Big Spring Station Member** (lower 200 to 500 feet of Conococheague): light-gray, fine-grained dolostone; medium- to dark-gray, fine-grained laminated limestone and dolomitic limestone; gray, brown-weathering, coarse-grained sandstone and dolomitic sandstone; beds of flat-pebble conglomerate in dolostone. Thickness ranges from 2200 to 2600 feet.

Ce — **Elbrook Formation**

Bulk of formation: dark- to medium-gray, fine- to medium-grained limestone, dolomitic limestone, dolostone, and dolomitic shale. Lithologies commonly occur as erosion-surface-bounded sequences of algal limestone overlain by laminated dolostone. Ground surface frequently covered with decalcified, ocherous, shale-like chips. Thickness ranges from 2000 to 2500 feet. Lower 300 to 400 feet: green to greenish-gray, fine-grained dolostone, dolomitic limestone, and shale; brown-weathering calcareous siltstone marks the top of unit.

Cwb — **Waynesboro Formation**

Upper 300 feet: dusky-red to olive-gray, fine- to medium-grained sandstone and dusky-red to gray shale. Middle 400 feet: medium- to dark-gray, saccharoidal dolostone and fine-grained limestone. Lower 500 feet: dusky-red, olive-gray, and dark-gray shale and dusky-red to brownish-gray, fine- to medium-grained sandstone. Thickness approximately 1200 feet.

CAMBRIAN

Ct — **Tomstown Dolomite**

Upper unit: light- to dark-gray, fine- to coarse-grained, medium- to thick-bedded, locally laminated dolostone; white chert rosettes and nodules in upper 50 feet; thickness about 600 feet. Middle unit: very-light- to medium-gray, medium-grained, very-thick-bedded dolostone and high-magnesium dolostone; thickness about 210 feet. Lower unit: dark-gray to black, very-fine-grained, thin- to very-thin-bedded limestone and dolomitic limestone with argillaceous laminations; thickness about 325 feet. Thickness ranges from 1100 to 1200 feet.

Ca — **Antietam Formation**

White to light-gray, fine- to coarse-grained, silica-cemented, vitreous quartzite and subarkose with phyllite partings; *Skolithos* common. Thickness ranges from 350 to 600 feet.

Ch — **Harpers Formation**

Upper 1100 feet: gray, fine- to medium-grained sandstone and quartzite, in part ferruginous. Lower 900 feet: gray to olive-gray phyllite and sandy phyllite with interbedded lithic sandstone. Thickness ranges from 2000 to 2500 feet.

Cw — **Weverton Formation**

Upper 150 feet: quartz-pebble conglomerate and micaceous sandstone. Middle 300 feet: greenish-gray sandy phyllite and micaceous sandstone. Lower 150 feet: basal conglomerate composed of subangular to rounded quartz and flat shale clasts in a matrix of sand-size quartz and lithic grains (includes sericite and chlorite), quartz cement, overlain by light-gray, conglomeratic quartzite with interbedded greenish-gray sandy phyllite. Thickness ranges from 500 to 600 feet.

unconformity

LATE PROTEROZOIC

CZc — **Catoctin Formation**

Grayish-green to dark-yellowish-green, fine-grained, schistose metabasalt composed of albite, epidote, chlorite, actinolite, magnetite, hematite, sphene, and pyroxene; amygdule fillings of albite, quartz, calcite, epidote, chlorite, and jasper; tops of flows locally autobrecciated. Interbedded lithologies include: purple meta-arkose, phyllite, rhyolitic metatuff, epidosite, and lithic metasandstone. Thickness ranges from 1500 to 3000 feet.