Triassic - Jurassic Geology of the Southern Part of the Culpeper Basin and the Barboursville Basin, Virginia

by

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TRIASSIC-JURASSIC GEOLOGY OF THE SOUTHERN PART OF THE CULPEPER BASIN AND THE BARBOURSVILLE BASIN, VIRGINIA

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Regional setting and previous investigations

The Culpeper and Barboursville basins are north-northeast trending faulted Mesozoic troughs bordering the east front of the Appalachian Mountains in Maryland and Virginia. These basins were initially evolved during the early Mesozoic period of continental fragmentation that preceded continental drifting and the development of the modern Atlantic continental margin (Van Houten, 1977, p. 83 and 89-96). The basins are part of a belt of similar faulted Triassic-Jurassic troughs in the Piedmont Province of eastern North America. The Culpeper basin, the larger of the two troughs (fig. 1), is about 20 km wide and extends for 140 km, whereas the Barboursville basin to the south (herein named after the town of Barboursville, Va.) is a detached outlier (Conley and Johnson, 1975) about 4 km wide and 16 km long. The 18 partial geologic maps (1:24,000) presented here cover about 1,690 km^2 (fig. 1).

Figure 1 near here

Redfield (1856, p. 357) first designated W. B. Rogers' "New Red Sandstone of the Atlantic slope" in Virginia as the Newark Group: subsequently these rocks were redefined by I. C. Russel in 1879.

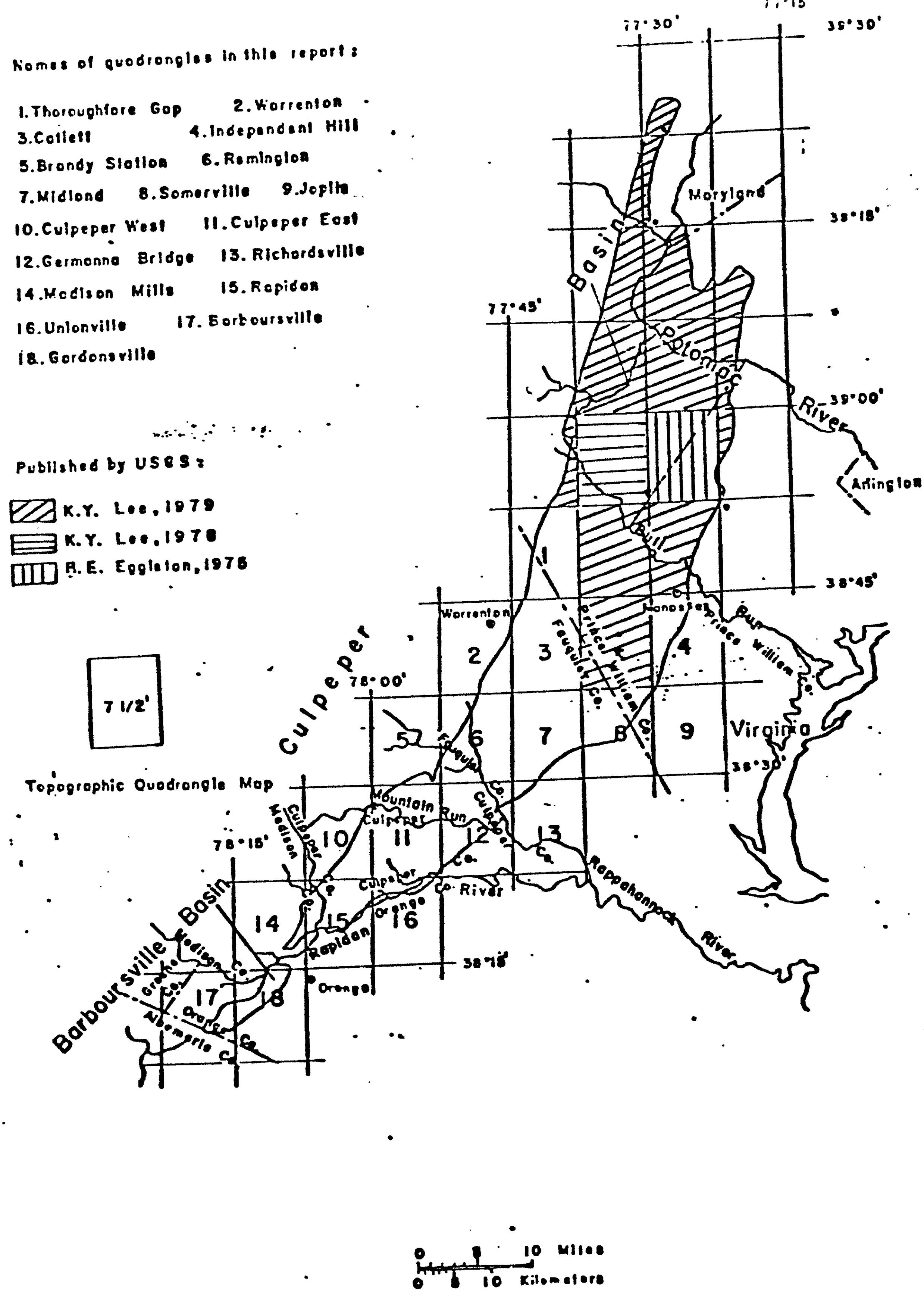

Figure 1. Index Map Showing Geologic Maps, 1 : 24,000, in the Southern Part of Culpeper Basin and Barboursville Basin, Virginia

Roberts (1922, 1923, 1928) carried out the first detailed study of the Triassic geology of Virginia and subdivided the Triassic rocks of the basins into the Manassas Sandstone and the Bull Run Shale. Cornet (1977) established the presence of Lower Jurassic rocks in these basins and the position of the Triassic-Jurassic boundary based upon a detailed palynostratigraphic study. Lee (1977) presented a revised stratigraphy for the northern part of the Culpeper basin on the basis of lithologic sequences and depositional environments. Lee (1979) utilized an informal stratigraphic nomenclature for the rocks of the Culpeper basin to present the 16 partial geologic quadrangle maps in the northern part of the Culpeper basin.

Stratigraphy and structure

Triassic and Jurassic siltstone, sandstone, conglomerate, and shale comprise the Culpeper and Barboursville basins. Jurassic basalt and diabase are exposed in the Culpeper basin only. The sedimentary rocks constitute a distinctive sequence of continental red beds consisting of clastic fluvial and lacustrine deposits.

The informal stratigraphic nomenclature of Lee (1979) is also used in this report. The Culpeper Group is used herein for the Upper Triassic and Lower Jurassic sedimentary and basaltic rocks within the Culpeper and Barboursville basins. The sequence is subdivided, in ascending order, into the Manassas Formation, the Balls Bluff Siltstone, and the Bull Run Formation. The Upper Triassic Manassas Formation contains the Reston Member and the Rapidan Member at its base which both grade upward into and intertongue with the Poolesville Member.

The fine-grained deposits of the Upper Triassic Balls Siltstone locally are gradational or intertongue with the coarser-grained deposits of the Manassas below and the Bull Run above. The Lower Jurassic Bull Run Formation consists of the Catharpin Creek Member, which is conformably overlain by and intertongues with the Mountain Run Member. The Catharpin Creek Member contains the Mt. Zion Church basalt, the Hickory Grove basalt, and the Sander basalt. The rocks of the Culpeper Group in these basins are locally mantled by unconsolidated upper Tertiary (?) and Quaternary terrace deposits and colluvial mountain-wash deposits, and Holocene alluvial deposits.

During the latest stage of Bull Run sedimentation, the sedimentary rocks and basaltic flows within the basins were tilted toward the west and northwest. The tilting was accomplished by renewed movement along the border faults, particularly the western border faults of the Culpeper basin, that was synkinematic with the development of minor folds and shallow faults in rocks within the basins and with extensive intrusion of tholeiitic diabase sills, stocks, and dikes that caused thermal metamorphism of the country rocks. This metamorphism was accompanied locally by sulfide and iron mineralization, hydrothermal alteration, and zeolite mineralization in fissures of the contact aureoles, the diabase, and host rocks outside the aureoles.

Economic Geology

The southern part of the Culpeper basin and the Barboursville basin contain significant groundwater reserves and extensive deposits of rock materials suitable for crushed stone, aggregate, road metal, and riprap, as well as deposits used for dimension stone and monumental stone. Raw materials suitable for manufacture of brick and tile are also abundant. Metallic and non-metallic material deposits have been extensively prospected in the past, but were mined only on a small scale.

Supplies of groundwater adequate for domestic purposes are available in most areas underlain by the sedimentary rocks, and potential supplies sufficient for commercial uses are likely in some of these areas. Water from the Balls Bluff Siltstone is more likely to have high concentrations of calcium, magnesium, and sulfate than water from other sedimentary units (A.J. Froelich, 1979, Pers. commun.).

Basalt is locally quarried for crushed stone, aggregate, road metal, fill, subbase, and riprap at the Sander quarry in the Catlett quadrangle and at the Silver Lake quarry in the Thoroughfare Gap quadrangle. Diabase has been quarried for dimension stone at the Virginia Granite Company quarry and for monumental stone at the Aston quarry in the Rapidan quadrangle. The diabase in these areas is generally easily quarried due to its equigranular texture and an intersecting network of widely spaced joints which facilitate splitting.

The Balls Bluff Siltstone is quarried for crushed stone, aggregate, road metal, fill, and subbase at the Culpeper Crushed Stone quarry in the Culpeper East quadrangle. It has also been quarried for the manufacture of red brick and tile at the Webster Brick Company quarry in the Gordonsville quadrangle. Resistant sandstone of the Catharpin Creek Member was formerly quarried for dimension stone south of U.S. Route 29/211 in the Thoroughfare Gap quadrangle.

Metallic copper and iron mineral deposits in the Culpeper basin were prospected and locally mined on a small scale during the past. These deposits generally occur in granulite and hornfels of the inner zone of contact aureoles, within fractures in diabase, and as fissure fillings in sandstone and siltstone outside the contact aureoles. Principal minerals are chalcopyrite, magnetite, specularite, bornite, and malachite. Non-metallic barite deposits occur typically as fissure fillings locally in siltstone and shale near diabase intrusives.

Potential environmental problems within the basins are related to waste disposal and to contamination of groundwater by septic tank effluent or landfill leachate. Other problems relate to foundation instability caused by highly expandable clays in soils developed on diabase and basalt or within fault gouge, and by the settlement or failure of unconsolidated colluvial deposits along the basin borders.

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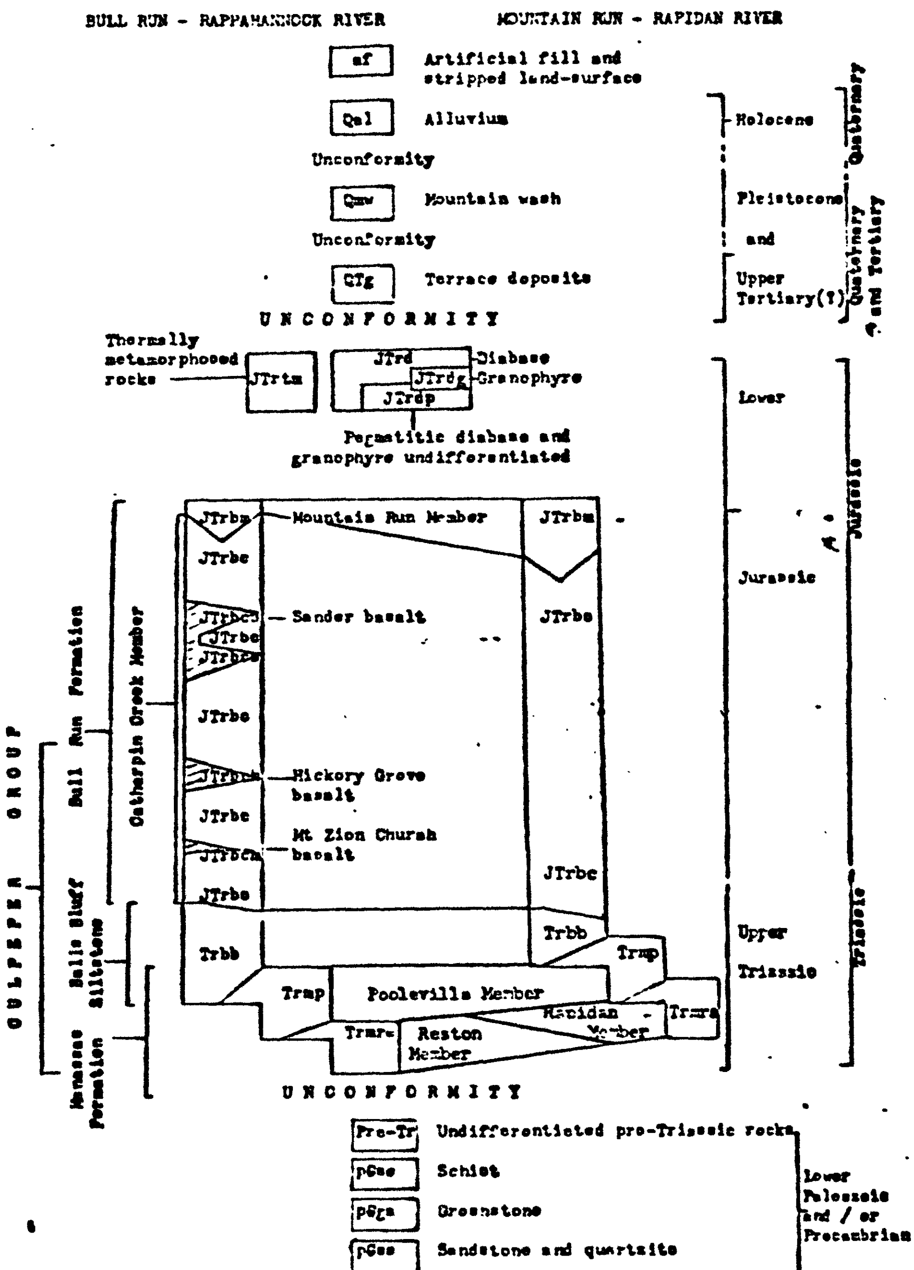
EXPLANATION

CORRELATION OF MAP UNITS 1/



1/ Thicknesses of stratigraphic units are not implied.

Contact, approximately located; short dashed where inferred; dotted where concealed.

Fault, approximately located; bar and ball on downthrown side; short dashed where inferred; dotted where concealed.

24° Strike and dip of beds

Horizontal beds

50° Strike and dip of overturned beds

61° Strike and dip of principal metamorphic foliation

Strike of vertical metamorphic foliation

Minor fold-showing plunge

Anticline

Syncline

Strike and dip of joints. In case of multiple joints, point of observation is at intersection of symbols.

70° Inclined

Vertical

Direction of paleocurrent; measurement at apex based on cross lamination of sandstone and imbricate structure of rock fragments in conglomerate.

Quarry, Mine or Prospect

Active

Abandoned. Cu-Copper, Ba-Barite

Fossil locality

DESCRIPTION OF MAP UNITS

af — Artificial fill and stripped land surface. Manmade features in construction areas.

Unconsolidated Sediments

Qal — Alluvium - Silt, sand, clay, and gravel; generally moderately well-sorted. Commonly, sand layers contain gravel lenses chiefly composed of pebbles of rounded to subrounded rock fragments. Locally contains residual manganese and iron nodules in the Thoroughfare Gap and Rapidan quadrangles. Estimated to be 0.5 to more than 8 m thick.

Qmw — Mountain Wash - Gravel, silt, and sand; gray and moderate-reddish-brown to pale-yellowish-orange; chiefly rounded to angular quartzite and vein-quartz clasts with locally abundant greenstone, sandstone, and schist fragments, and light-gray to gray and moderate-reddish-brown quartz and feldspar sand in a silt matrix. Estimated to be 0.4 to more than 30 m thick. Not mapped where underlain by pre-Triassic rocks.

QTg — Terrace Deposits - Sand, gravel, and clay; gray, grayish-orange, and moderate-reddish-brown; chiefly rounded to subrounded quartzite, vein-quartz, schist, and greenstone fragments with locally abundant quartz and feldspar sand in a clayey silt matrix. Estimated to be 1 to about 10 m thick. Not mapped where underlain by pre-Triassic rocks.

Thermally Metamorphosed Rocks

JTrtm

Hornfels, granulite, and quartzite - Gray to dark-gray, medium-bluish-gray, and olive-black; chiefly metamorphosed, feldspathic, micaceous, argillaceous, ferruginous, and calcareous sandstone, siltstone, and shale; includes slightly thermally altered basalt. Hornfels is the dominant type of metamorphosed argillaceous rock. Granulite and quartzite form fused lenses, bands, and irregular masses. Principal metamorphic mineral assemblages are cordierite, andalusite, quartz, plagioclase, epidote, biotite, and chlorite.

Intrusive Rocks

JTrd JTdg JTrdp

Diabase - Medium- and medium-dark-gray; chiefly equigranular and medium-grained, but locally very coarse-grained, aphanitic near chilled margins; consists chiefly of dark-grayish-green to black discrete crystals of augite and pigeonite, light-gray labradorite and ilmenite. Pegmatitic diabase and granophyre (JTrdp) occur as locally mapped irregular pods and bands within the diabase. Granophyre (JTrdg) - Pale-pink to pink, medium- to coarse-grained; consists chiefly of sodic plagioclase with a turbid appearance, micropegmatitic quartz, and potassium feldspar associated with discrete crystals of hornblende and clinopyroxene and minor biotite, actinolite, magnetite, ilmenite, chlorite, and apatite.

Sedimentary Rocks and Basalt of the Culpeper Group

BULL RUN FORMATION

JTrbm

MOUNTAIN RUN MEMBER - Conglomerate, dusky-yellowish, dusky-grayish-, and moderate-yellowish-green; chiefly angular to subrounded clasts of greenstone with subordinate rounded to subrounded clasts of quartzite and feldspathic sandstone and locally abundant sandstone, vein-quartz and minor schist in a clayey sand and silt matrix, firmly cemented by silica. Estimated to be 150 to 635 m thick.

JTrbc

CATHARPIN CREEK MEMBER - Sandstone, siltstone, and minor conglomerate and shale, grayish-red and dusky-red mostly in the lower part of the sequence; light-brown, pale-yellowish-brown, and moderate-yellowish-brown in the upper part. Interlayered, in part, with basalt flows; locally contains fossiliferous (fish fossils) impure limestone, carbonaceous shale and siltstone, and sandy siltstone containing dinosaur tracks. Estimated to be 40 to about 5,150 m thick.

JTrbcs

SANDER BASALT - Basalt, dark-gray to blackish- or bluish-gray; mostly holocrystalline and equigranular, in part microcrystalline or glassy and porphyritic; consists of augite and plagioclase, chiefly labradorite and andesine, in part exhibiting ophitic texture. Zeolite-filled vescles are common in the upper part of the unit. Hydrothermally altered and locally mineralized with copper sulfide minerals. Interlayered with sandstone and siltstone of the Catharpin Creek Member. This basalt is truncated by western border faults but part of the unit apparently thins and pinches out near the southwestern border of the Remington quadrangle and the eastern border of the Brandy Station quadrangle. Estimated to be as much as 545 m thick.

JTrbch HICKORY GROVE BASALT - Basalt, medium-gray to medium-dark-gray; very fine to very coarse-grained; mostly equigranular and holocrystalline; euhedral or subhedral crystals of plagioclase, chiefly labradorite and andesine, occur in a groundmass of augite. Vesicles mainly in the upper part of the unit. This basalt apparently pinches out near the southwestern border of the Remington quadrangle. Estimated to be as much as 210 m thick.

JTrbcm MOUNT ZION CHURCH BASALT - Basalt, medium-gray and dark-gray; very fine- to medium-grained, porphyritic in part; mostly equigranular and holocrystalline; augite and plagioclase, chiefly labradorite and andesine, display ophitic or subophitic texture. Vesicles generally occur in the upper part of the unit. Columnar joints are well developed. Exposed only as isolated, narrow outcrops in the Catlett and Remington quadrangles. Estimated to be as much as 100 m thick.

BALLS BLUFF SILTSTONE

Trbb

SILTSTONE - Dusky-red, dark-red, grayish-red, and in part, light-greenish-gray, light-bluish-gray, greenish-gray, and medium-dary-gray to dark-gray; feldspathic, micaceous, highly calcareous, ferruginous, and argillaceous; thin- to thick-bedded or massive; ripple-bedded and laminated. Locally contains thin to thick lenses of gray limestone and dolomite, layers and lenses of carbonate oöids, aggregates of carbonate concretions, and dinosaur tracks. Layers of sandstone and silty shale are scattered throughout the sequence. Estimated to be 10 to 1,690 m thick.

MANASSAS FORMATION

Trmp

POOLESVILLE MEMBER - Sandstone, dusky-red to grayish-red and very dark-red; very fine- to medium-grained, mostly medium-grained; micaceous, feldspathic, ferruginous, silty, clayey, and in part calcareous; consists chiefly of quartz and feldspar grains in silt matrix, cemented by clay, silica, and locally calcite. Thick- to very thick-bedded or massive; planar- to cross-bedded. In the lower part of the sequence, contains lenses and layers of light-gray to gray, medium to very coarse-grained, feldspathic sandstone and conglomerate composed of quartzite and vein-quartz fragments. Estimated to be 50 to 460 m thick.

Trmra

RAPIDAN MEMBER - Conglomerate, grayish-green, dusky-green, and grayish-olive-green; angular to subrounded clasts of greenstone and minor amounts of gray quartzite, vein-quartz, and feldspathic sandstone. These clasts are in a clayey sand and silt matrix, firmly cemented by silica. Estimated to be 70 to 140 m thick.

Trmre

RESTON MEMBER - Conglomerate and sandstone, generally loosely coherent near the surface; consists of abundant to sparse, angular to subangular, pebble- to cobble-sized clasts of greenish-gray mica schist, light-gray to gray rounded to subrounded quartzite, vein-quartz, and feldspathic sandstone in a dusky-red, dark-red, very dusky-red-purple, and moderate-brown matrix of clay and silt- and sand-sized quartz and feldspar. Sandstone, dusky-red, dark-red, and very dusky-red-purple; medium- to very coarse-grained; generally loose to semi-compact near the surface; micaceous, ferruginous, silty, and clayey; consists chiefly of feldspar and quartz grains in a silt matrix; locally massive and cross-laminated. Estimated to be 3 to about 100 m thick.

Pre-Triassic Crystalline Rocks */

Pre-Tr	Undifferentiated pre-Triassic crystalline rocks.
pCsc	SCHIST - Medium- to dark-gray and grayish-green; medium- to coarse-grained; consists chiefly of mica, quartz, chlorite, and plagioclase. Intensely foliated with alternating quartz- and mica-rich laminae that are crossed by strain-slip foliation. Locally cut by quartz veins.
pCgs	GREENSTONE - Dusky-yellowish-, dusky-grayish-, and moderate-yellowish-green, and grayish-olive-green, metamorphosed igneous and sedimentary rocks; epidotization and chloritization common; generally intensely foliated.
PCss	SANDSTONE AND QUARTZITE - Light-gray, light-brown, grayish-red, and dusky-red; fine- to very coarse-grained; feldspathic, micaceous, and ferruginous; thick- to very thick-bedded and very compact; generally intensely foliated. Locally cut by intersecting networks of quartz veins.

*/ Contacts between pre-Triassic and Triassic or Jurassic rocks are inferred where covered by Qmw or QTg.