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DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT
DIVISION OF MINERAL RESOURCES

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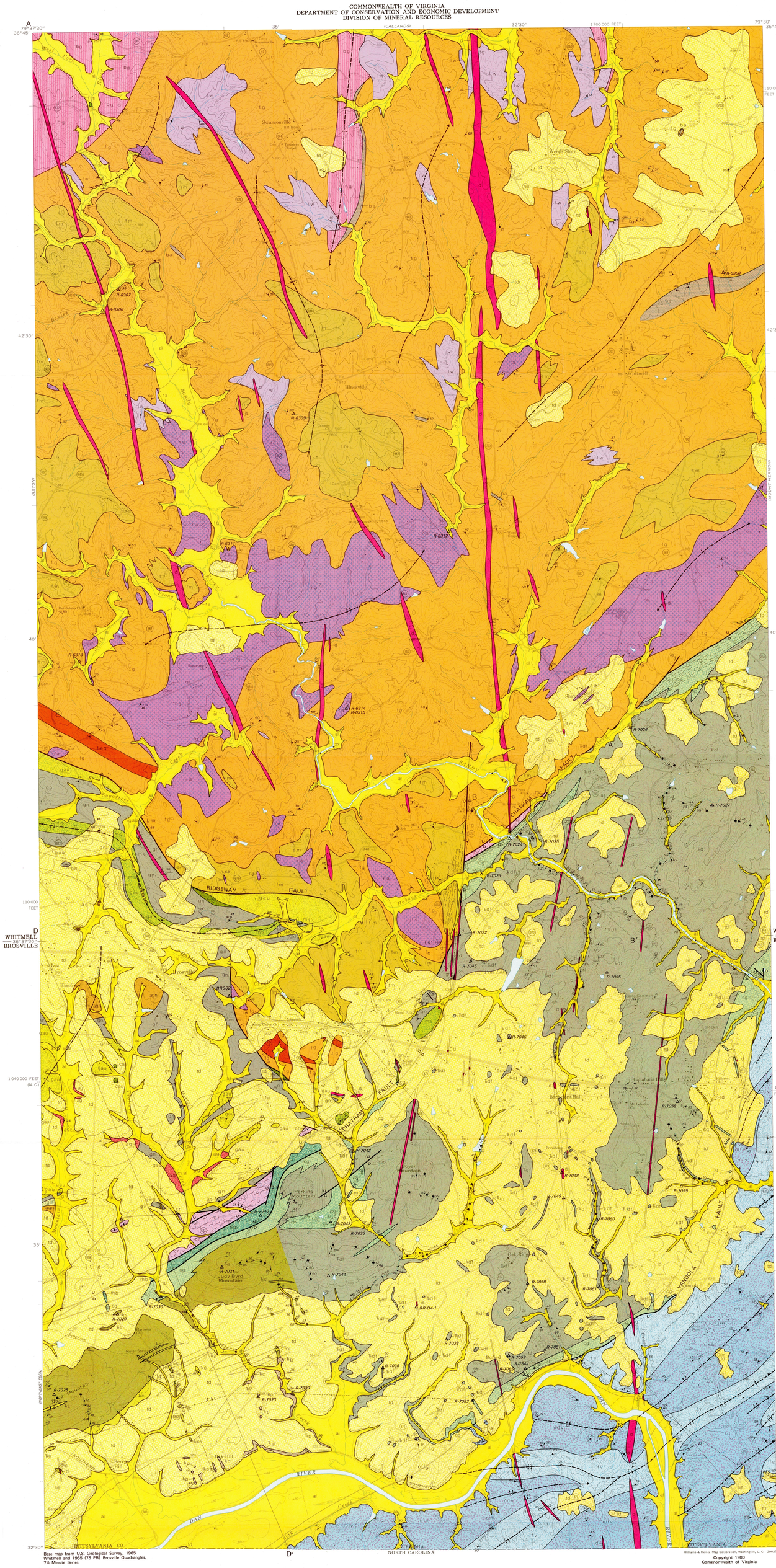
WHITMELL AND BROSVILLE QUADRANGLES

GEOLOGY OF THE WHITMELL AND BROSVILLE QUADRANGLES, VIRGINIA

By Van Price, J. F. Conley, R. G. Piepul, G. R. Robinson; Triassic System
by P. A. Thayer; Rocks Southeast of Danville Basin By Van Price and W. S. Henika



Base map from U.S. Geological Survey, 1965
Whitmell and 1965 (7.8 PR) Brosville Quadrangles,
7½ Minute Series

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UNIT CHARACTERISTICS

QUATERNARY

al — Alluvium: *Unconsolidated floodplain deposits containing interlayers and lenses of light-brown and gray organic clays and light-brown sands and gravels; some gravels in clay matrix; cut-and-fill structures and cross-bedding common.*

td — Terrace deposits: *Unconsolidated stream deposits composed of rounded pebbles, cobbles and boulders in a matrix ranging from clay to sand occur as valley fill or terrace deposits along hill slopes and on interfluves; valley fill and low terrace material composed of white clay with thin, interlayered white sand beds, generally with white cobble layer at the base.*

JURASSIC

d — Diabase dikes: *Dark-greenish-gray to black rock ranging from basalt to gabbro; texture diabasic, plagioclase crystals elongate, augite grains stubby, anhedral.*

LATE PALEOZOIC-TRIASSIC

mb, mc — Microbreccia and cataclasite: mc, microbreccia, *hard, medium-light-gray, composed chiefly of unoriented, angular fragments of intergrowths of strained quartz and microcline, dark-gray to opaque aphanitic material, and silt-sized and angular fragments of quartz and feldspar ranging in size from 0.02 to 2 mm (these angular grains form the mortar between larger fragments), with very light-gray porphyroclasts up to several centimeters long; intensively fractured, many fractures filled with light-green, micro-crystalline chlorite that contains numerous small crystals of pyrite, mostly altered to limonite; Cataclasite, aphanitic, structureless, with angular quartz and feldspar porphyroblasts; forms less than twenty percent of the unit. Unit derived from metamorphic rocks lying west of the Danville basin. (Quartz veins up to several feet long and an inch wide commonly cut the unit.)* (mylonite breccia), *silicified fragmental cataclastic rocks with recognizable domains of conglomerate; derived from Triassic conglomerate lying along western border of Danville basin.*

TRIASSIC

cg, ts, mr, ftdt, kc, kp, cg — Triassic sedimentary rocks: *In the southwestern part of the area, Triassic rocks are divided into three formal units: the Pine Hall (* kp *), the Cow Branch (* kc *), and the Stoneville (* ts *) formations, named from bottom to top. The Cow Branch Formation forms the reference beds for this division of rocks, and where it is absent there is no basis for distinguishing one basin from a single formation. Thus in the northeastern part of the area, only the Dry Fork Formation is recognized. In addition to these four formal formations, there are two intervals of conglomerate beds, one at the base and the other at the top of the rock sequence. These are referred to here informally as the lower conglomerate unit and the upper conglomerate unit.* cg (western conglomerate), *chiefly a thick-bedded, poorly sorted, sandy, cobble and boulder lithic conglomerate with minor amounts of poorly sorted, pebbly, coarse- and very coarse-grained, cross-bedded arkose and lithic arkose; multicolored, subrounded clasts are in a light- and medium-gray, poorly sorted, densely packed lithic arkose matrix; unit intensely sheared, silicified, and cut by quartz veins along and near border fault.* kdf (Dry Fork Formation, sandstone facies), *very well-indurated, dominantly massive, crudely stratified, gray and greenish-gray, poorly sorted, coarse-grained, arkose and lithic arkose interbedded with subordinate mudrock and conglomerate; grayish-red and dark-reddish-brown interbeds are chiefly siltstones and silty mudstones, massive to medium- and thick-bedded and in places with burrow mottles, carbonate concretions and thick laminations.* kmf (mudrock facies), *dominantly uniformly and thinly bedded, medium- to dark-gray, silty, laminated mudrock containing carbonaceous films and pyrite and silt-shale. Sandstone subordinate, poorly sorted, arkosic and subarkosic with minor amounts of granule and pebble lithic arkosic conglomerate. Minor sedimentary structures include ripple marks, small-scale, tabular cross-stratification, burrow casts, and primary current lineations. There are some carbonized wood chips.* ts (Stoneville Formation), *massive to thick-bedded, light-gray, grayish-orange and pale-yellowish-orange, poorly sorted, medium- to very coarse-grained arkose and lithic arkose, containing granules and pebbles of K-feldspar and quartz; thin lenses of poorly sorted pebble and cobble lithic conglomerate; contains some carbonized plant debris. Rhythmic, fining-upward cycles of sandstone and mudrock are common.* kc (Cow Branch Formation), *well-indurated, resistant, chiefly massive to thinly laminated, medium- to dark-gray, siltstone, claystone, and shale, with subordinate poorly sorted, very fine- to medium-grained, arkose and subarkose, and minor amounts of dolomite. Siltstone evenly stratified, uniformly thin- and medium-bedded; sedimentary structures include delicate laminations, small-scale cross-and ripple bedding, mud cracks, oscillation-and current-ripple marks, mottled and disturbed bedding, and irregular sandstone channel lenses. There is some carbonaceous matter.* kp (Pine Hall Formation, sandstone facies) *medium- to thick-bedded or thickly cross-bedded, light-gray and pinkish-gray, poorly sorted, medium- to very coarse-grained arkose, subarkose, and lithic subarkose locally with lenses of sandy, pebble and cobble lithic conglomerate and interbeds of reddish-brown siltstone and mudrock. Sandstones dominantly of quartz, K-feldspar, and plagioclase, with subordinate metamorphic rock fragments, locally with mudrock intraclasts, erosional channels, small-scale trough cross-bedding, and ripple-drift cross-laminations. Silicified fragments and logs of araucarian conifers abundant in lowermost part of unit.* cg (eastern conglomerate), *well-indurated, massive to thick-bedded, poorly sorted, sandy, cobble and boulder lithic conglomerate, interbedded with subordinate pebbly, coarse- and very coarse-grained, arkose and lithic arkose, some cross-bedded; conglomerate along eastern basin margin derived primarily from metamorphosed, volcanic-sedimentary rocks east of the basin; silicified fragments and araucarian conifers locally abundant; along western basin margin, conglomerate typically coarser grained than at eastern margin; extensively sheared, silicified, and cut by numerous quartz veins near border fault.*

PALEOZOIC

cr — Cataclastic gneisses, mylonite and pegmatite: *Fine-grained to coarse-grained, laminated to fragmental, recrystallized mylonite composed chiefly of quartz and feldspar, prograde garnet has grown across fabric; cataclastic gneisses locally intruded by sheared and also undeformed pegmatites.*

STRATIGRAPHIC UNITS ARRANGED BY STRUCTURES

SMITH RIVER ALLOCHTHON

lw — Leatherwood granite: *Light-gray, porphyritic, biotite granite composed of microcline, antiperthitic oligoclase, quartz and biotite with accessory epidote, clinozoisite, apatite, sphene and opaque minerals; in sheet-like masses and dikes. Rapikivi texture and slightly sheared feldspar grain boundaries are common.*

rg — Rich Acres Formation: *Dark-gray, non-foliated to slightly foliated, medium to coarse-grained, porphyritic, pyroxene gabbro, in places noritic; some norites with diorite, generally as granophyre, filling interstices in peripheral agmatite zones. Gabbro generally composed of: bytownite-labradorite, orthopyroxene, clinopyroxene (primarily augite), hornblende (including pargasite), and biotite; accessory epidote, sphene ilmenite, uralite, rutile, zircon, and rare olivine. Contacts normally concordant but some slightly to totally discordant with regard to foliation of country rock. (Unit cut by pegmatites which generally have biotite selvages at contact with gabbro.)*

PRECAMBRIAN-PALEOZOIC

ttls — Talc-tremolite schist: *Altered dark-green, schistose to granular, ultramafic intrusive rock, composed of talc, tremolite, chlorite, and opaque minerals (mostly magnetite). Igneous textures are not apparent, but the unit locally contains relict pyroxene partially altered to tremolite.*

feq, fm, fg — Fork Mountain Formation: fm (schist unit), *medium-gray, fine- to medium-grained, porphyroblastic, schist composed of coalescing garnets, muscovite, sericite, chlorite, quartz and accessory sphene, magnetite and plagioclase. Unit shows polymetamorphism; relict sillimanite formed during first metamorphic event is altered to sericite, and small, unoriented second prograde staurolite and kyanite crystals have grown in these sites of sericite pseudomorphous after sillimanite. Second prograde muscovite porphyroblasts cross foliation and in places obliterate it thereby producing a fels (massive) texture. The schist unit in places has gradational contact with the gneiss unit.* fg (gneiss unit), *dark-gray, segregation-banded, garnet-biotite gneiss; bands composed of quartz-feldspar and generally schistose, biotite-rich layers; layers about 0.5 inch (1.3 cm) thick. Mineral composition is plagioclase, quartz, biotite, garnet, microcline, muscovite, epidote and opaque minerals. Discordant and concordant muscovite-biotite-microcline pegmatites common.* feq (epidote quartzite), *green to greenish-gray, medium-grained, equigranular rock primarily of epidote and quartz with accessory magnetite and garnet; occurs as boudins and layers throughout the Fork Mountain Formation.*

ba, bg — Bassett Formation: ba (amphibolite), *dark-green to black, medium-grained, equigranular, hornblende and plagioclase amphibolite with accessory epidote, garnet, quartz, and sphene. (Amphibolite in the Fork Mountain Formation may be Bassett amphibolite in antiformal folds or may be interbeds in the Fork Mountain Formation.)* bg (biotite gneiss), *equigranular biotite, quartz and plagioclase biotite gneiss with microcline porphyroblasts and accessory sphene, epidote and magnetite; foliation outlined by oriented biotite grains. Pegmatites and migmatites make up as much as 30 percent of the rock; some pegmatites are discordant.*

SAURATOWN MOUNTAINS ANTICLINORIUM

ag — Granite gneiss: *Light- to medium-gray, poorly foliated, fine- to medium-grained, orthogneiss composed of microcline, oligoclase and quartz with accessory hornblende, garnet, sphene and zircon; intrusive into garnetiferous amphibolite.*

ms — Garnet-mica schist: *Silver-gray schist with up to 20 percent muscovite and sericite and varying amounts of staurolite, kyanite, plagioclase and quartz; accessory chlorite, chloritoid, biotite, zircon, rutile, epidote, sphene and opaque minerals. Garnet, kyanite, and staurolite occur as porphyroblasts in quartz-mica matrix. Foliation is wrapped around rotated garnets; deformation followed crystallization. There are thin layers or lenses of garnetiferous quartzite in some places.*

cas — Chlorite-amphibole schist: *Dark-green, schistose to granular rock composed of chlorite and hornblende with variable amounts of carbonate, talc, anthopyllite, cummingtonite, and opaque minerals. The chlorite-amphibole schist has a sporadic distribution within and along the borders of the amphibolite unit.* gau, *and the schist is probably an altered mafic to ultramafic rock.*

gau — Garnetiferous amphibolite: *Dark-green to black, slightly foliated to well-foliated, medium- to coarse-grained garnet-plagioclase-hornblende amphibolite with salt and pepper appearance; accessory sphene, epidote and opaque minerals; occurs at top of mica gneiss unit and contains flattened, lensoidal masses of quartz-feldspar-epidote and feldspar-garnet-quartz that resemble flattened amygdules.*

gn — Mica gneiss and mica schist: *Quartz and plagioclase rock with varying amounts of muscovite and biotite and accessory microcline, sphene, epidote, hornblende, garnet, and opaque minerals. Bands 1.5 to 10 feet (0.5-3 m) thick of medium-grained, layered, light-gray gneiss are interlayered with biotite-rich, mica gneiss and garnet-mica schist; also with mica schist bands and rare amphibolite layers.*

gal — Garnetiferous amphibolite: *Dark-green to black, slightly to well-foliated, medium- to coarse-grained, garnetiferous, hornblende-plagioclase amphibolite with accessory garnet, sphene, epidote and opaque minerals; basal part contains calcite-rich gneiss and quartzitic layers.*

agn — Augen gneiss: *Light- to medium-gray, irregularly layered to massive, augen gneiss composed of microcline, plagioclase, and perthite porphyroblasts up to 1.6 inches (4 cm) across in matrix of plagioclase, quartz, and biotite with accessory sphene, epidote, amphibole and opaque minerals; in places consists of segregation-banded gneiss composed of quartz-feldspar-rich layers and muscovite-biotite-rich layers and muscovite-biotite mica schist interlayers; augen locally partially destroyed by shearing, some attenuated, flattened, and bent by crinkle folds.*

ROCKS EAST OF THE DANVILLE TRIASSIC BASIN

fv, mfv — Metamorphosed volcanic-sedimentary rocks: fv (felsic gneisses), *White to very pale-orange, layered, medium- to coarse-grained muscovite-quartz-feldspar gneiss with locally abundant interlayered coarse quartz-feldspar granite and pegmatitic granite sills; shear-foliation well-developed along the Dan River. Rocks at amphibolite grade; scant evidence of primary textures. To the northeast primary volcanic and sedimentary textures occur in lower metamorphic grade equivalents of these rocks (Henika, 1977).* mfv (interlayered felsic, intermediate and mafic gneisses), *muscovite-quartz-microcline-plagioclase gneiss, hornblende-quartz-plagioclase gneiss and small amounts of amphibole gneiss and amphibolite. Gray biotite gneiss and amphibole-biotite gneiss (probably metagraywacke beds) where in contact with the overlying felsic gneisses; much sheared in the southeastern part of the quadrangle, locally is protomylonite.*

KEY

CONTACTS
- Exposed or approximate
- Covered or inferred

FOLDS
- Antiform—trace and direction of plunge
- Synform—trace and direction of plunge
- Overturned antiform—trace and direction of plunge
- Overturned synform—trace and direction of plunge
- Direction and angle of plunge of hinge line and strike and dip of axial plane of minor fold
- Direction and angle of plunge of hinge line of minor upright antiform

FAULTS
- Black line where exposed or approximate; gray line where covered or inferred; U, upthrown block; D, downthrown block of normal fault; T, on overthrust block. Dip of fault plane denoted by dip symbol.
- Shear zone

ATTITUDE OF ROCKS
- Strike and dip of beds

FOLIATION
- Strike and dip of compositional layering
- Strike and dip of schistosity
- Strike of vertical schistosity

JOINTS
- Strike and dip of joints
- Strike of vertical joints

LINEATIONS
- Direction and angle of plunge of mineral lineation

QUARRIES AND PROSPECTS
- Prospect

SAMPLE LOCATIONS
- R-6288 R, repository number of rock samples on file at Virginia Division of Mineral Resources

Table 1. General features of selected stratigraphic units.

	ROCK CHARACTERISTICS					SAPROLITE CHARACTERISTICS			
Unit	Topographic expression	Joint spacing	Parting	Potential economic value	Groundwater	Approximate thickness	Composition of B soil horizon	Susceptibility to slumping after excavation	Drainage quality
al	flat		bedding	sand and gravel; agriculture		absent[1]			
td	gentle slopes and flat hill tops		bedding	sand and gravel; agriculture		absent[1]			
d	gentle hills and ridges		none, massive	possible crushed stone from wider dikes		0-25'	clay rich	moderate	poor
eg	gently rolling terrain		thick-bedded			thick	clay rich	moderate	good
Ꞧdf	moderate hills and ridges		thick-bedded	crushed stone		variable	sandy, clay-rich loam	moderate	poor
mr	low, gently rolling terrain		thin-bedded		high iron content	thick	sandy, clay-rich loam	high	poor
Ꞧs	moderate hills and ridges		massive to thick-bedded		domestic use	thin	clay rich	moderate; slump on bedding, joint planes	good
Ꞧc	flat and low areas		thin-bedded	brick and ceramic ware from saprolite	high iron content	0-15'	silty clay rich	moderate	poor
Ꞧp	flat, gently rolling topography		medium-to very thick-bedded		domestic use		clay-rich loam		poor
lw	low cliffs	wide	massive to slightly foliated	dimension stone		0-50'	sandy, clay rich	moderate	good
ra	valleys	wide	massive to slightly foliated	quarry stone; magnetite and emery	thin saprolite restricts recharge	0-25'	clay rich	moderate	poor
						0-25'	clay rich		poor
fm	highlands; steep slopes and ridges	moderate	schistose	occurences of magnetite	possible high yield	0-25'	micaceous, clay-rich loams	slight	good
fg	rolling terrain	moderate	schistose to gneissic banding	crushed stone, dimension stone agriculture	possible high yield	0-60'	sandy, clay rich	moderate	excellent
feq	low ridges		massive to slabby		high iron content	0-25'	sandy, clay rich	slight	good
ba	low ridges	moderate	slabby			0-25'	clay rich	slight	good
bg	subdued, rolling terrain	moderate	schistose to gneissic banding		possible high yield	0-50'	sandy, clay rich	moderate	excellent
ag	subdued, rolling terrain		slight to massive			0-30'	sandy	moderate	excellent
ms	low ridges	wide	schistose		thin saprolites restricts recharge	0-10'	micaceous and quartz rich	moderate along foliation planes	poor
cas	moderate ridges		schistose to massive	quarry stone, talc		0-25'	clay rich	moderate	poor
gau	moderate ridges	moderate	slabby		high iron content	0-25'	clay rich	moderate	poor
gn	gently rolling terrain	moderate	schistose to gneissic banding	agriculture		0-50'	micaceous, sandy loams	moderate	excellent
gal	moderate ridges	moderate	slabby		high iron content	0-25'	clay rich	moderate	poor
agn	gently rolling terrain	moderate	irregular gneissic banding	agriculture		0-75'	micaceous; sandy clay	moderate	excellent
fv	low, rolling terrain		gneissic banding sheared		clay in subsoil restricts recharge		sandy, clay rich	high	poor
mfv	subdued terrain		gneissic banding slabby, sheared		clay in subsoil restricts recharge	0-60'	clay-rich loam	moderate	poor

[1]Alluvial and also terrace deposits have high susceptibility to slump; drainage in the units is generally good, but alluvial deposits are commonly saturated.

ECONOMIC GEOLOGY

MINERAL RESOURCES

Kyanite: The garnet-mica schist unit in the area contains kyanite. Representative exposures of the kyanite-bearing rock are north of the intersection of U. S. Highway 58 and State Road 869 (Brosville quadrangle).

Magnetite and Emery: Magnetite and emery occur within the contact aureole developed in the Fork Mountain Formation around the intrusive rocks of the Rock Acres Formation. Magnetite is abundant in float about 0.6 mile (1.0 km) north of Bethel Church and one mile (1.6 km) southeast of Hinesville (both localities are in the Whitmell quadrangle area). Magnetite and emery were mined on the property of Ernest and Joe Blair, 2 miles (3.2) miles west of Sharon (R-6314; R-6315) (Whitmell quadrangle).

Uranium: Uranium-bearing rocks occur in Triassic strata and associated rocks along the boundaries of the Danville basin, an elongate basin partly contained in the mapped quadrangles (Dribus, 1978).

ROCK RESOURCES

Clay Materials: Residual clay, shale and mudstone from the Cow Branch and Dry Fork formations, which here form a portion of the deposits of the Danville basin, have been tested and evaluated as possible sources of raw materials for bricks and ceramic ware (Meyertons, 1963). Samples were from parts of the Danville basin lying outside the study area. Data on raw and fired materials are available for two rock samples from the Danville basin (Sweet, 1973).

Crushed Stone: The biotite gneiss of the Fork Mountain Formation has been quarried for crushed stone in the Martinsville area to the west of the area mapped. The biotite gneiss is present in the Whitmell and Brosville quadrangles, but there has been no known production to date.

Because of considerable hardness, sandstone facies of the Stoneville and Dry Fork formations are potential sources of crushed stone. Similar rocks are quarried by the Vulcan Materials Company just east of the Whitmell quadrangle. Favorable areas for potential quarry sites are along the flanks of Boyd, Judy Byrd, Perkins and Soyar mountains (Brosville quadrangle).

Sand and Gravel: Small amounts of sand and gravel are produced for local use from floodplain deposits near Stony Mill (Whitmell quadrangle).

REFERENCES

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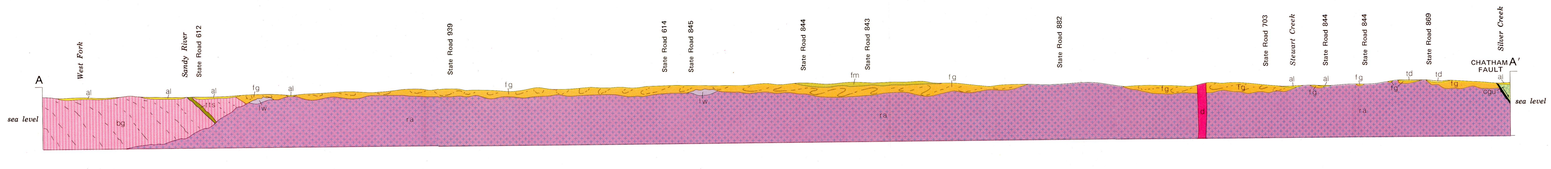
Henika, W. S., 1977, Geology of the Blairs, Mount Hermon, Danville, and Ringgold quadrangles, Virginia *with sections on the* Triassic System by Thayer, P. A.: Virginia Division of Mineral Resources Publication 2, 45p.

Meyertons, C. T., 1963, Triassic formations of the Danville basin: Virginia Division of Mineral Resources Rept. Inv. 6, 65p.

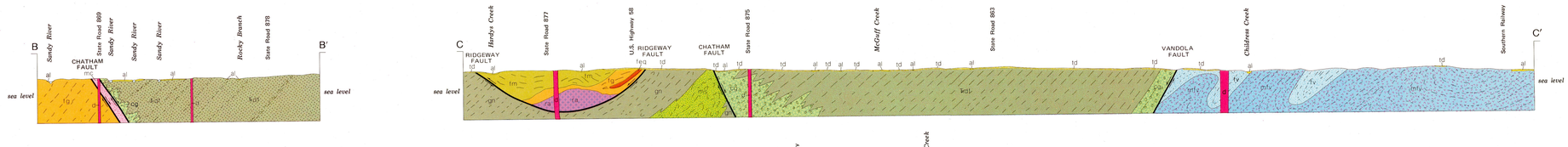
Sweet, P. C., 1973, Analyses of clay, shale, and related materials—southern counties: Virginia Division of Mineral Resources Mineral Resources Report 12, 183p.

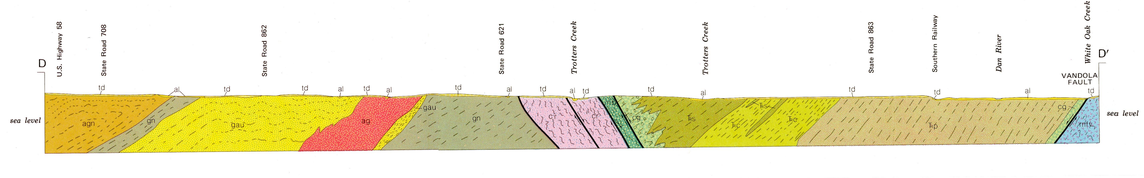
REFERENCE NOTE

Portions of the publication may be quoted if credit is given to the Virginia Division of Mineral Resources. It is recommended that reference to this report be made in the following form:
Price, Van and others, 1980, Geology of the Whitmell and Brosville quadrangles, Virginia: Virginia Division of Mineral Resources Publication 21, text and 1:24,000 scale map.



Interpretive cross sections
with no vertical exaggeration





MN GN
9° 03' 1983
0°53' 15 MILS

UTM GRID AND 1978 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

1980

VIRGINIA
QUADRANGLE LOCATION