COMMONWEALTH OF VIRGINIA
DEPARTMENT OF MINES, MINERALS AND ENERGY
DIVISION OF MINERAL RESOURCES

GEOLOGY OF THE EAST STONE GAP QUADRANGLE, VIRGINIA

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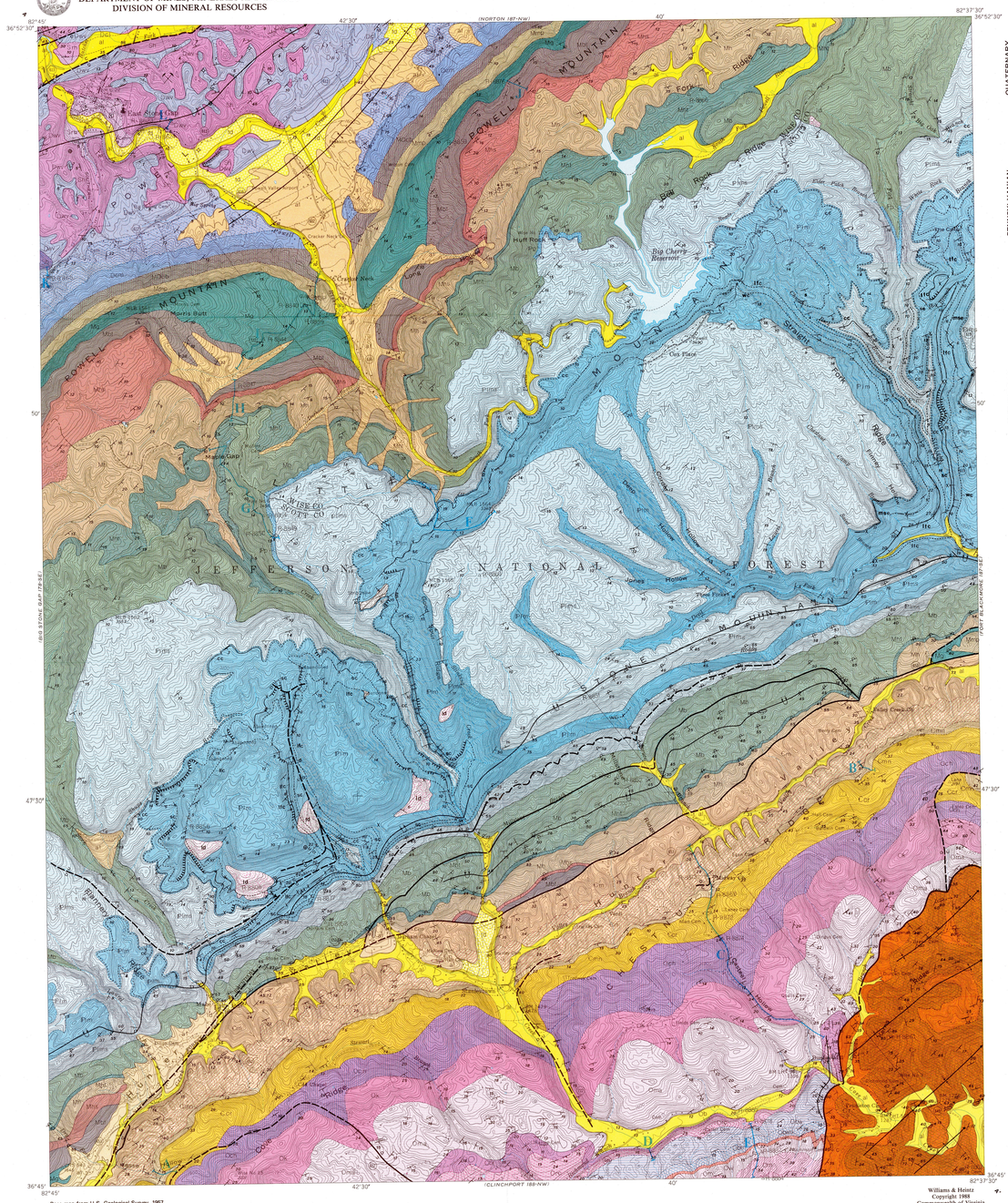

Base map from U.S. Geological Survey, 1967
(189-PR) East Stone Gap Quadrangle, 7½ minute series

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SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

UTM GRID AND 1969 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

QUADRANGLE LOCATION

EXPLANATION

QUATERNARY

- Alluvium
- Alluvial fan
- Terrace deposit
- Landslide-debris deposit

PENNSYLVANIAN

Lee Formation
Plms, *Middlesboro Member sandstone*
Plm, *Middlesboro Member interbedded siltstone and sandstone*
msc, *Middle Seaboard Coal Bed*
wc, *War Creek Coal Bed*
lfc, *Little Fire Creek Coal Bed*
sc, *Stock Creek Coal Bed*
cc, *Cove Creek Coal Bed*
c, *Carter Coal Bed*

- Pocahontas Formation
- Bluestone Formation

MISSISSIPPIAN

Hinton Formation
Mhs, *Tallery Sandstone Member*
Mh, *Little Stone Gap Member and middle red member, undivided*
Mhs, *Stony Gap Sandstone Member*

- Bluefield Formation
- Greenbrier Limestone
- Maccrady and Price Formations, undivided

DEVONIAN

Chattanooga Shale
MDcb, *Big Stone Gap Member*
Dcm, *middle gray siltstone member*
Dcl, *lower black shale member*

- Wildcat Valley Sandstone
- Hancock Formation

SILURIAN

- Rose Hill Formation
- Clinch Sandstone
- Sequatchie Formation
- Reedsville Shale

Cross Section only

ORDOVICIAN

- Trenton Limestone
- Moccasin Formation
- Witten Limestone
- Bowen Limestone
- Benbolt-Wardell Limestones
  Obwu, *upper member in Rye Cove only*
- Rye Cove Limestone
- Blackford Formation
- Mascot Dolomite
- Kingsport Dolomite
- Chepultepec Dolomite
- Copper Ridge Dolomite
- Maynardville Formation
- Nolichucky Formation
- Maryville Limestone
- Rogersville Shale
- Rutledge Limestone
- Pumpkin Valley Shale
- Rome Formation

Cross Section only

CAMBRIAN

- Pumpkin Valley Shale and Rome Formation
  S, *siltstone, shale, and sandstone*
  C, *carbonate (dolomite)*

Omu — Middle Ordovician, undivided

KEY

Contact

Dashed where covered or inferred

Coal bed

Dashed where covered or inferred

COAL MINES

Mine adit

Adit of abandoned mine

Surface mine; hachures toward highwall.

Area surface mined, showing original extent of coal bed.

Coal outcrop or prospect

FOLDS

Anticline: trace; direction of plunge.

Syncline: trace; direction of plunge.

Overturned anticline: trace; direction of plunge.

Overturned syncline: trace; direction of plunge.

Minor anticline: direction and angle of plunge.

Minor syncline: direction and angle of plunge.

Minor fold: strike and dip of axial plane and direction and angle of plunge.

Minor fold: strike and dip of axial plane, direction and angle of plunge and symmetry of fold.

FAULTS

Exposed or approximate (solid); covered or inferred (dashed); U, upthrown side; D, downthrown side; T, upper sheet; arrows indicate direction of relative movement.

Strike and dip of minor fault; U, upthrown side; D, downthrown side.

Strike and dip of minor fault where direction of relative movement is uncertain.

ATTITUDE OF ROCKS

Strike and dip of bed

Strike of vertical bed

Strike and dip of overturned bed

Horizontal bed

Strike and dip of cleavage

Vertical cleavage

Direction and plunge of lineation

QUARRIES AND PROSPECTS

Active limestone quarry

Abandoned quarry

Limonite prospect

TEST WELLS FOR OIL AND GAS

Dry hole

SAMPLE LOCATIONS

R-1948

R, repository number of coal or clay material analysis on file at Virginia Division of Mineral Resources

R-7406

R, repository number of underground-mine coal analysis on file at Virginia Division of Mineral Resources

MEASURED STRATIGRAPHIC SECTIONS

C

Location of measured stratigraphic section and gamma-ray log traverse; measured sections on file at VIRGINIA DIVISION OF MINERAL RESOURCES.

INTRODUCTION

East Stone Gap quadrangle, located in southwestern Wise and northwestern Scott counties, Virginia, has an area of approximately 59 square miles. The central portion of the area is a broad, deeply incised upland underlain by Pennsylvania-age, coal-bearing strata. This area is an extension of the Appalachian Plateaus physiographic province and the Appalachian Coal basin described by Campbell and Woodruff (1909) as the Powell Mountain Coalfield. The northwestern and southeastern portions of the area, including Powell Valley and Hunter Valley respectively, lie within the Valley and Ridge physiographic province and are lowlands with varied southwestward-trending ridge and valley topography. Elevations range from 3620 feet on Bell Rock Ridge near the base of the coal bearing-strata to 1250 feet on Cove Creek in the southeastern part of the area.

Geologic mapping began in the winter of 1985–1986 and was completed in the fall of 1986. Field notes on Powell Valley by Ralph Miller of the U. S. Geological Survey were used as a guide. Detailed mapping, integrated with surface gamma-ray stratigraphic studies, resulted in numerous changes in geologic interpretation. The delineation of the Pocahontas Formation rather than the Tallery Sandstone as the basal Pennsylvanian unit (Englund and others, 1983), in the central part of the area, is one of the most significant changes resulting from this study.

STRUCTURE

Silurian through Early Pennsylvanian strata underlying the area between Powell Valley and Stone Mountain are on the east limb of the Powell Valley anticline, a major structure of the Pine Mountain thrust block. Between Stone Mountain and Hunter Valley, Mississippian and Pennsylvanian rocks are mostly overturned to form the southeastern limb of the Stone Mountain syncline. The Stone Mountain syncline and the Millstone Branch fault are the southeastern-most exposed portions of the Pine Mountain fault block. Strata in Hunter Valley, southeast of the Hunter Valley fault, are stacked in shingle fashion. The rocks were thrust toward the northwest over rocks that formed the Pine Mountain block. The southeastwardly-inclined Hunter Valley block forms the northwestern limb of the Rye Cove syncline (Brent, 1963). The Rye Cove syncline formed as the result of thrusting and arching beneath the Clinchport thrust sheet which is the next shingle block toward the southeast. Cambrian clastic and carbonate rocks that form the Clinchport sheet thus lie above the middle Ordovician rocks in the syncline west of the Clinchport fault in the southeastern corner of the area.

Minor faulting associated with the Hunter Valley thrust has a significant role in the development of surface drainage and groundwater flow in the southern part of the area. Major springs used for domestic water supplies are common along cross-strike structures. Such springs occur in the Lee Formation along a fault northeast of Flannery Ridge, in carbonate rocks near the head of Jesse Hollow, and along a fault southeast of Stanleytown. An oil seep in a spring, reported by local residents appears to be localized by a cross fault in Lick Creek Valley along the Clinchport fault.

Compression as the result of overthrust faulting along Hunter Valley and Millstone Branch was transferred northwestward by bedding-plane slip and imbrication along several coal beds in the Lee Formation. Campbell and Woodruff (1909, p. 155) described imbricate structures in the Powell Mountain Coalfield: "The roof is exceedingly uneven, lying in rolls which give the coal bed a varying thickness . . . it was noted that the laminae of the coal are vertical instead of horizontal as they should be in a flat-lying bed. It was further noted that at the roof and also at the floor the laminae are curved in opposite directions. The curved laminae extend for a distance of 4 to 6 inches into the coal bed. From this feature it was apparent that the great thickness is not normal, but due to differential movement between the roof and floor. Ordinarily when coal beds are subjected to severe stresses the coal is crushed into small flakes that show slickensides on all faces, but in this locality the coal was too hard to be crushed and it broke into blocks, and these blocks through the differential movement of the roof and floor, were turned up on end across the bed."

Resultant strain associated with overthrusting and overturning of the Stone Mountain syncline has complicated mining of Lee Formation coals in the Powell Mountain field because of numerous coal rolls, fault offsets, and pinchouts. Several ancient landslides (Id on geologic map) that developed on steep topography along fault traces represent an additional hazard to mine portals and surface operations in this area.

ECONOMIC GEOLOGY

COAL

Pocahontas Formation Coal Beds

Pocahontas coals are probably not of mineable thickness in this area. Only the uppermost Pocahontas coal that was correlated with the Squire Jim coal bed by Englund and others (1983) can be recognized with certainty. It generally contains a resource thickness of less than a foot measured on outcrop and appears to be absent as the result of erosion below the lower conglomeratic sandstone of the Lee Formation.

Lee Formation Coal Beds

Nine coal beds were recognized in the Lee Formation in this study. Where practical, these beds have been correlated by gamma-ray logs with coal beds recognized in the main coal basin of southwestern Virginia.

In general Lee Formation coal is a high-volatile A bituminous type suitable for manufacture of metalurgical coke. Twenty-four channel samples of Lee Formation coals were analyzed by the U. S. Department of Energy and results were published by the U.S. Geological Survey (Behum, 1984). One additional channel sample (R-8808), collected from a new opening in the Cove Creek coal located approximately one mile north of Mabe, is on file at the Division of Mineral Resources office in Charlottesville.

Carter coal bed. Outcrops of the Carter coal bed along old railway grades in the gorges of Straight Fork and its tributaries, Lane Camp Branch and Church Rock Branch, may indicate a potentially mineable resource. A resource thickness of 4.9 feet was assumed near the mouth of Lane Camp Branch. This coal bed is between two and three feet thick beneath a rock overhang along the northwest bank of Straight Fork where there are three adits driven beneath the massive upper ledge of the lower Lee quartzarenite.

Cove Creek coal bed. The Cove Creek is the most persistent and economically most important coal in this quadrangle. It lies directly above the lower Lee quartzarenite and is described locally both as the Tacus coal bed and as the Starns coal bed in the Stock Creek drainage area (Eby, 1923, p. 474).

Trinity Coal Company was mining a four-foot coal beneath a sandstone roof on the northeast face of the gorge of Cove Creek about 2.5 miles north of Stanleytown in 1986. The coal bed thins gradually northward toward the end of the 3600-foot mine entries.

Core drill and outcrop data indicate that the Cove Creek coal bed splits into two benches and tends to be thinner both to the east and to the west of the Cove Creek drainage basin. Ranging from one to about three feet in thickness in the hills above Stock Creek, this coal is commonly so sheared that its cleat structure is rotated into a slaty cleavage. The Cove Creek is thin and locally may be absent along the top of the outcrop of the lower quartzarenite unit in the gorge of Straight Fork along the eastern edge of the quadrange.

Stock Creek coal bed. The Stock Creek coal bed is the second most persistent and economically important coal bed in this quadrangle. It lies from forty to one-hundred feet above the Cove Creek coal bed and is most extensively mined and prospected in the area between Stone Creek and Cove Creek. This coal, described by Eby (1923) as the Egan coal bed, is deeply weathered or covered throughout the area except in the highwall and several prospects near the Egan Energy mine, about one mile northeast of Mabe. The coal there is banded bright and dull, sheared and slickensided, and has a thick, dark shale and siltstone top. Small folds or coal rolls and minor faults are common in the Stock Creek coal bed, especially near the axis of the Stone Mountain syncline. Such structures also were noted in outcrops and on mine maps up to 0.5 mile northwest of the synclinal axis.

Limited subsurface data, data from abandoned mines, and outcrop measurements indicate that from 3.5 to 4.9 feet of coal was mined in many small adits and surface mines above Shupe Branch, Stock Creek, Dry Creek, and Cove Creek. Core drill data and measured sections northeast of Cove Creek show that the Stock Creek coal bed may thin and split into two benches separated by as much as 25 feet of sandstone and shale in the eastern part of the area (MEASURED SECTION F). The maximum thickness of the Stock Creek coal bed reported from the Straight Fork drainage area was 1.8 feet (Behum, 1984).

Little Fire Creek coal bed. Little Fire Creek coal bed lies between 180 and 200 feet above the top of the lower Lee quartzarenite. Detailed mapping, correlation of local measured sections, gamma-ray logs, and core descriptions show the Little Fire Creek coal to be nearly as persistent as the Stock Creek and Cove Creek beds below. Correlation is based on similarity in stratigraphic position and sequence in locally measured sections, core descriptions, and a regional correlation net (Nolde, in preparation). The Little Fire Creek bed is equivalent to the C-1 coal bed described by Englund and others (1983) and does not correlate with the coal located below the top of the lower Lee quartzarenite that Englund and others (1983) previously described as Little Fire Creek. The latter coal is herein described as the Carter coal bed.

Little Fire Creek coal bed ranges in thickness from about 1.3 feet, measured at the Egan Energy mine one mile northeast of Mabe (ESG-7319), to 6.3 feet, measured at a collapsed adit on the southwest face above the gorge of Cove Creek. Where the bed has been opened, it generally lies at the top of the thick shale-siltstone sequence above the Stock Creek coal. This bed is split by a sandstone along Dry Creek where both benches were prospected. Adits in the coal are still open along Devils Fork and Straight Fork, where the coal is about 2.5 feet thick and overlain by dark-colored fossil-bearing marine shale.

Lower Horsepen coal bed. This discontinuous coal bed is herein recognized primarily from regional core drill data (Nolde, in preparation) and is not considered a mappable unit at 1:24,000 scale. Generally less than 1-foot thick, it is found between 60 and 75 feet above the Little Fire Creek coal bed at the top of a sandstone sequence. This coal is recognized in outcrop in the northeastern part of the quadrangle above Camp Branch and the underclay above Crackers Neck Hollow, is described in MEASURED SECTION F.

War Creek coal bed. War Creek coal bed is found 140 to 160 feet above the Little Fire coal bed at or near the top of a bench-forming sandstone sequence. Above Straight Fork, in prospected outcrops on both the eastern and western sides of the gorge, the War Creek is from less than a foot to 2.25 feet thick and was called "C2" (Behum, 1984). This bed reaches its maximum reported thickness of 3.6 feet along a National Forest road above Big Cherry Reservoir where it shows considerable shear deformation and slaty cleavage with fissile shale laminations constituting up to two-thirds of the measured interval.

Middle Horsepen coal bed. Middle Horsepen coal bed is generally a thin (0.5 foot) marker coal that occurs about 80 feet above the War Creek coal bed and above a prominent bench-forming sandstone. Its underclay, approximately 260 feet above the Little Fire Creek horizon, is described in MEASURED SECTION F. This unit is too thin to be considered a mappable unit within this study area.

Upper Horsepen coal bed. Like the other Horsepen coal beds in the area, the Upper Horsepen bed at 100 feet above the Middle Horsepen, is a 0.5 foot marker that occurs above a prominent sandstone sequence. The underclay, at a horizon about 365 feet above the Little Fire Creek bench, is described in MEASURED SECTION F.

Middle Seaboard coal bed. The coal highest in elevation in the study area underlies a small area along State Road 619 at the eastern quadrangle boundary. There it ranges from 1.5 to 2.3 feet in thickness where it is exposed in small roadside adits. This coal contains considerable evidence of shearing below the massive upper quartzarenite unit of the Lee Formation.

Gas and Oil

Natural gas is found in the Devonian shales, the Big Stone Gap Member of the Chattanooga Shale ("Berea Sand"), the Price Formation ("Weir sand"), and the Greenbrier Limestone ("Big Lime") in the Norton quadrangle to the north (Nolde and others, 1986). If natural gas accumulations are present in East Stone Gap quadrangle, they may be attributed to variation in reservoir porosity and permeability in similar rock units at depths of 2000 to 4500 feet in the central part of the quadrangle. The area is untested at this time.

Silurian sandstone and shale as well as the Cambrian and Ordovician carbonate rocks were tested on the crest of the Powell Valley anticline by the Osborne No. 1 well located near the intersection of State Roads 612 and 613 about 3 miles east-northeast of Little Stone Gap. This early exploration well, drilled between 1948 and 1950, was spudded in the Hancock Formation and reached a total depth of 4861 feet in the Chepultepec Dolomite. No production was reported (Huddle and others, 1956, p. 565).

Roen (1983, quoted in Englund, Sigleo, and Behum, 1983) concluded that there is some potential for oil and a moderate to high potential for gas accumulation where Ordovician, Devonian, and Mississippian rocks have been deformed and fractured near the Hunter Valley fault. Residents reported that an oil seep along the Clinchport fault about 1000 feet northeast of the Chapman cemetery was drilled in the early 1980s. No records of permitted wells have been located nor have traces of the reported wells at the alleged drill site been found.

Limestone and Dolomite

Rim Rock Quarries, Inc. operates a large quarry in the Hancock Formation in the town of East Stone Gap. Approximately 225 feet of Hancock limestone and dolomite was measured, Measured Section L, adjacent to the quarry. Near the top of the quarry section, 5 to 15 feet of the overlying Wildcat Valley Formation has also been quarried.

The following test results released by the Virginia Department of Highways and Transportation on January 27, 1986, apply to material from the Rim Rock East Stone Gap Quarry.

QUALITY TEST ON CONCRETE AGGREGATE

L. A. ABRASION LOSS

SP. GR.	ABS.	A	B	C
2.70	0.4		22.1	

BITUMINOUS CONCRETE FINE AGGREGATE DATA

		SOUNDNESS	SAND
SP. GR.	ABS.	LOSS	EQUIVALENT
2.69	0.6	9.0	57

Dolomite of the Knox group and massively-bedded Rye Cove Limestone located on the Hunter Valley fault block in the southeast part of the area also may represent potential sources of crushed stone.

Sandstone

Sandstone in the lower quartzarenite of the Lee Formation apparently was quarried for use as building stone along the Forest Service road at the northeast end of Bell Rock Ridge, near the boundary between Wise and Scott counties. Sandstone there is highly quartzose but somewhat friable possibly due to deep weathering. The same unit appears to be much more sound where the massive beds are overturned and slightly metamorphosed along the east limb of the Stone Mountain syncline. Accessible exposures of the overturned Lee Formation are found in gorges where Laurel Fork, Stock Creek, Dry Creek, Cove Creek, and Spruce Lick Branch have cut through the overturned limb of the Stone Mountain syncline in the southern part of the quardrangle.

Large sandstone blocks in a blockfield derived from the Stony Gap Member of the Hinton Formation have been blasted and trucked from a site along State Road 722 about 0.5 mile north of Maple Gap. Because of attractive reddish-orange iron staining along prominent cross-bed sets these boulders are used locally as a decorative stone.

Shale and Clay

Material from weathered exposures of the Nolichucky Formation sampled along State Road 653 about 1.35 miles east of Stanleytown is a potential source of common brick clay (R – 2468, Johnson and others, 1966, p. 93). Preliminary ceramic tests of five samples of the Lee Formation from the Devils Fork section of Jefferson National Forest indicate material suitable for manufacture of structural clay products (Englund, Sigleo, and Behum, 1983). An additional analysis of a sample of the roof shale of the Stock Creek coal bed indicates that it may be suitable for the manufacture of lightweight aggregate (Englund, Sigleo, and Behum, 1983).

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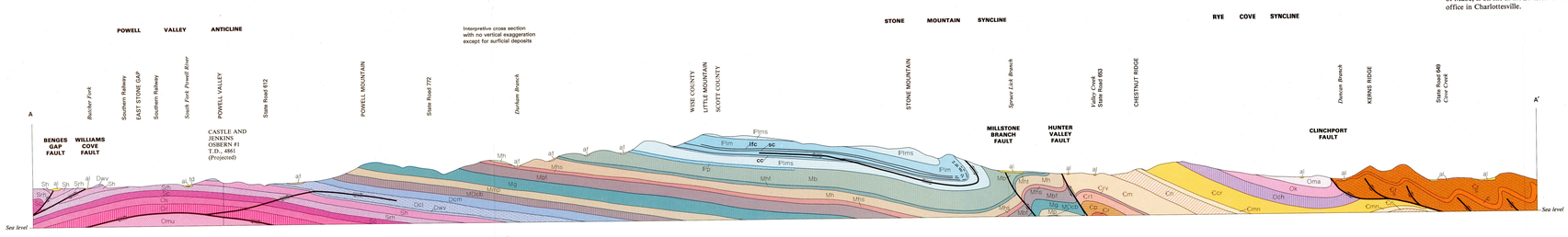
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