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GEOLOGY OF THE
NORTON QUADRANGLE, VIRGINIA

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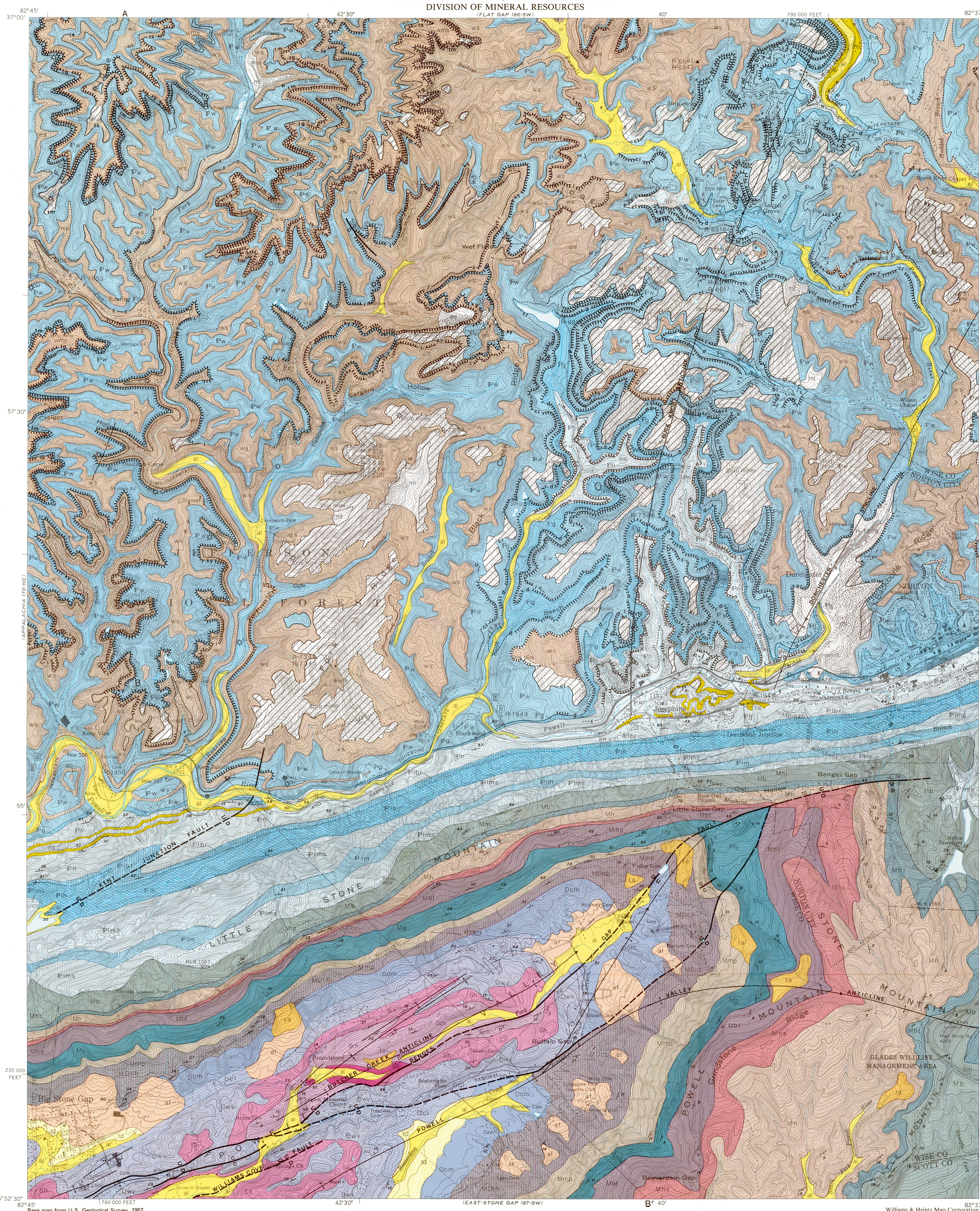
DIVISION OF MINERAL RESOURCES



Base map from U.S. Geological Survey, 1957 (78-PR) Norton Quadrangle, 7½ minute series.

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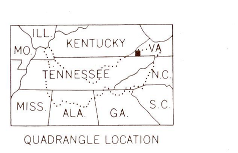
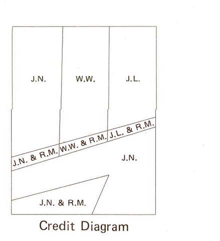
SCALE 1:24 000

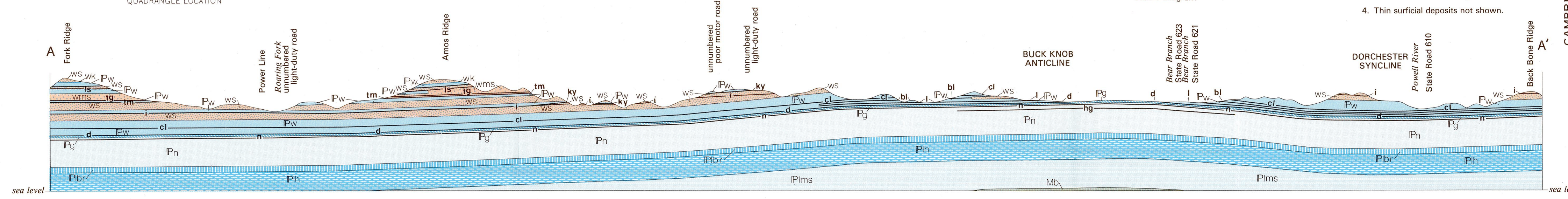
CONTOUR INTERVAL 20 FEET

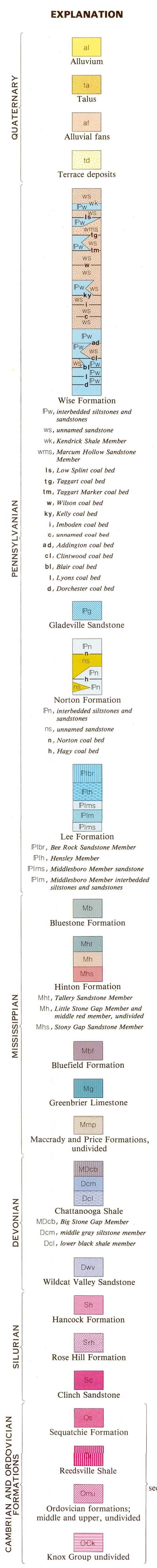


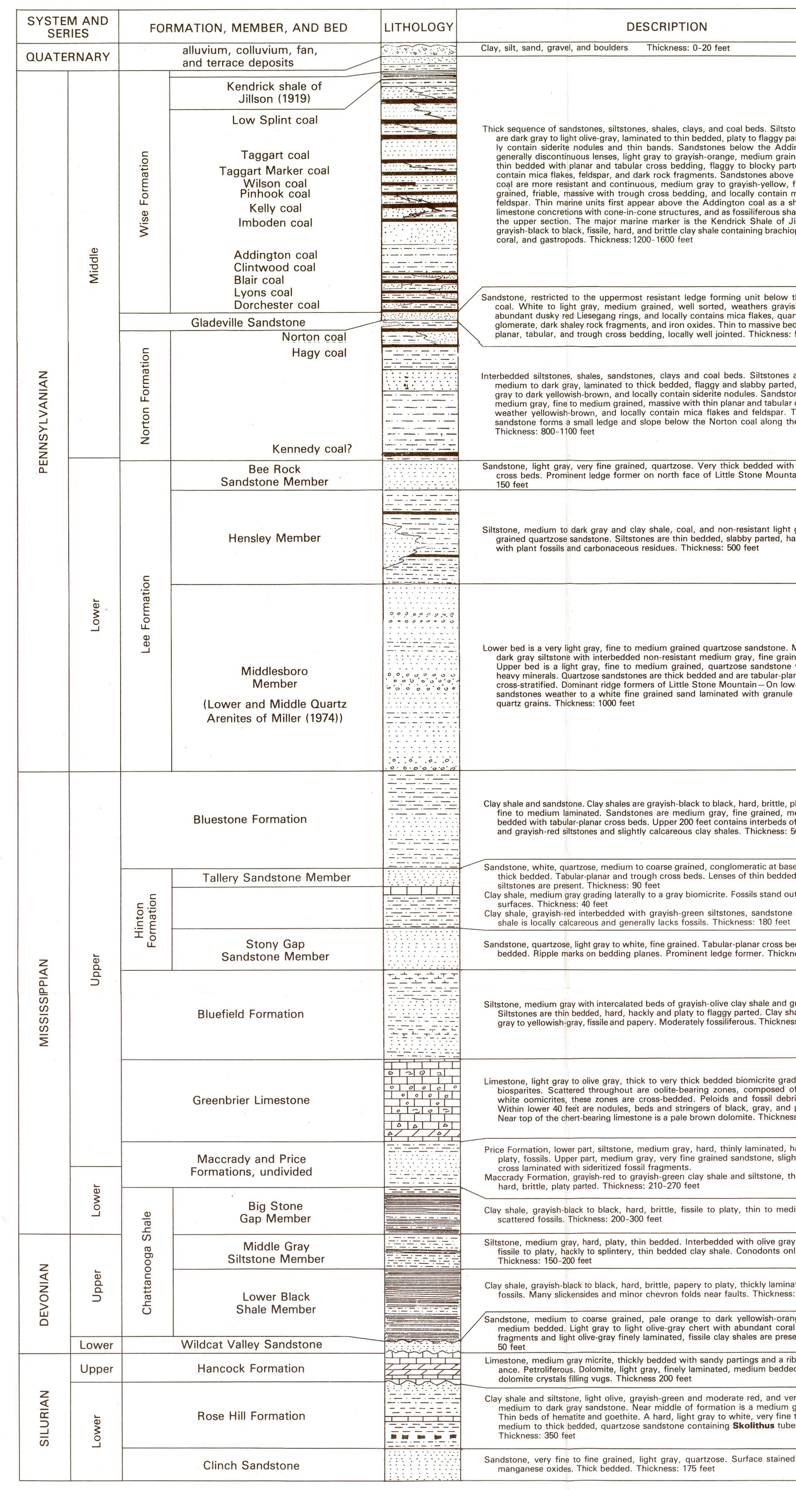


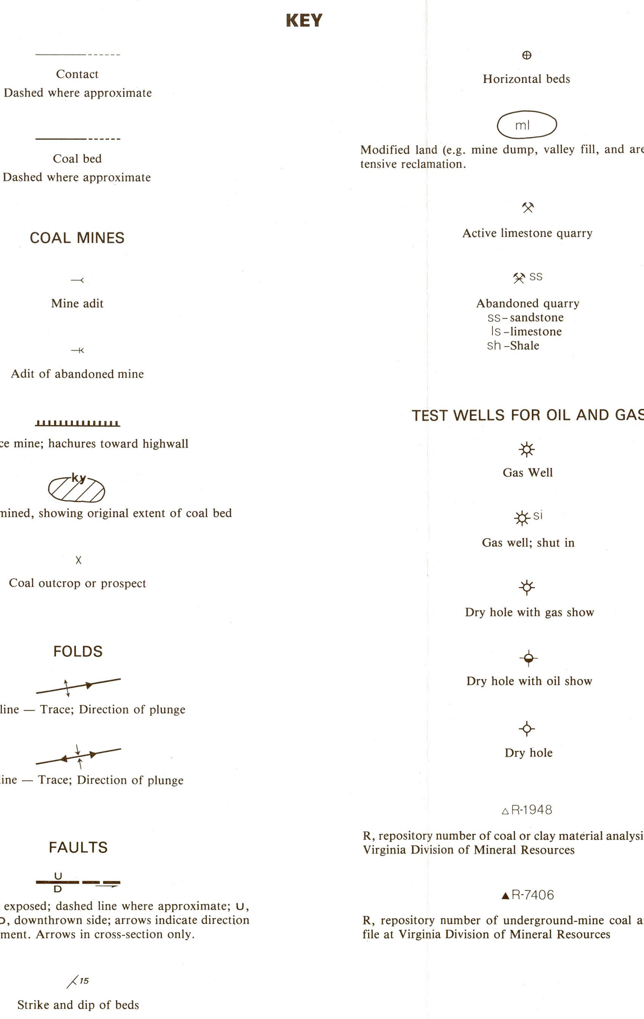
CROSS SECTION DESIGN:

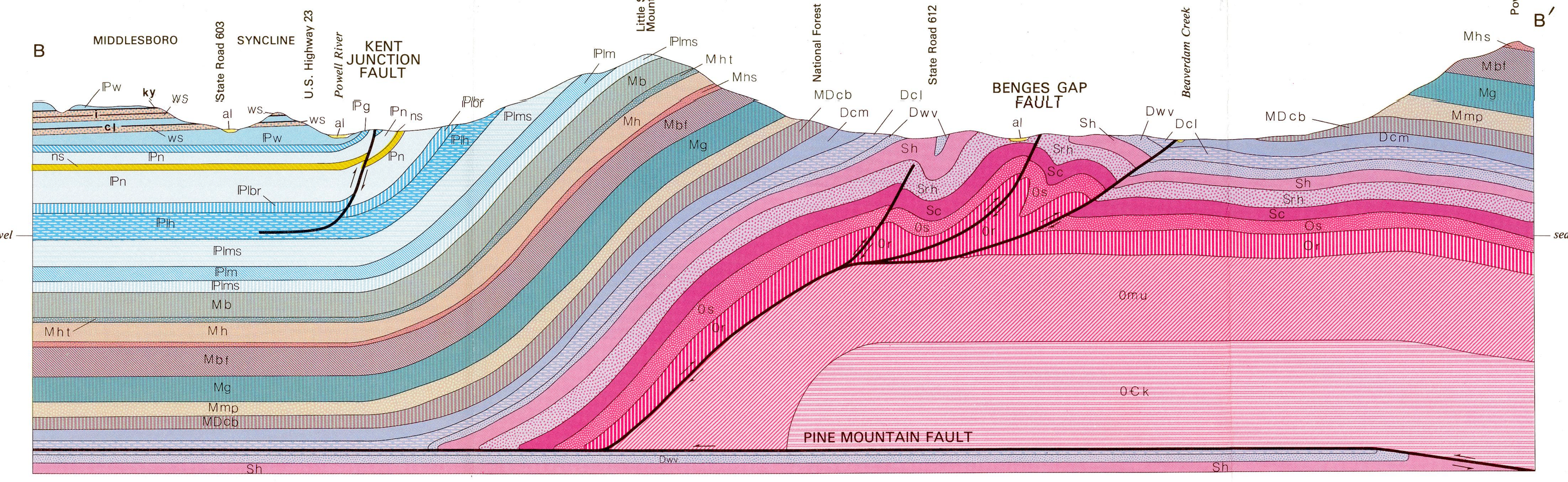
1. No vertical exaggeration.
2. Subsurface unit interpreted from surface and drill-hole data.
3. Coal bed thickness is diagrammatic.
4. Thin surficial deposits not shown.











GEOLOGY OF THE NORTON QUADRANGLE, VIRGINIA

Jack E. Nolde, James A. Lovett,
William W. Whitlock, and Ralph L. Miller[1]

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STRATIGRAPHY

The exposed stratigraphic succession in the Norton quadrangle area consists of a bedrock sequence that ranges in age from the Lower Silurian Clinch Sandstone to the Middle Pennsylvanian Wise Formation (see stratigraphic column). Also present is a thin, unconsolidated, surficial sequence of Quaternary age. These 15 Paleozoic bedrock formations total about 7,600 feet in thickness. Sandstone, siltstone, and limestone predominate in the lower two-thirds of this section (Clinch Sandstone to Bluestone Formation) and conglomerate, sandstone, siltstone, and coal in the upper one-third (Lee Formation to Wise Formation). The Quaternary surficial sediments include numerous unconsolidated deposits of clay, silt, sand, pebbles, and cobbles, with common fragments or lenses of organic material.

STRUCTURE

There are two regional structures in the Norton quadrangle area, the Powell Valley anticline and the Middlesboro syncline. The Powell Valley anticline is in the southern half, and the Middlesboro syncline, consisting of relatively flat-lying beds, is in the remainder of the area. The Pigeon Creek flexure trends eastward and is in the common limb of the two structures. These structures formed during movement on the subhorizontal Pine Mountain thrust fault (Harris and Milici, 1977), which developed during the Alleghanian orogeny in Late Paleozoic time.

The Powell Valley anticline is an elongate, flexural-slip fold that plunges about 6 degrees northeastward to eastward. Near Buffalo Gap, the axis of the fold bifurcates with one branch trending northeasterly and the other easterly. The Powell Valley anticline is asymmetric to the northwest. Many associated folds were developed in the anticline; the largest of these, the Butcher Creek anticline (Eby, 1923), is asymmetric to the southeast.

The Pigeon Creek flexure, which was formerly called the Pigeon Creek fault (Campbell, 1893; Eby, 1923), is a fold hinge line that separates the Powell Valley anticline from the Middlesboro syncline.

The Middlesboro syncline (see cross sections) contains two transverse broad north-trending folds, the Buck Knob anticline, and the Dorchester syncline. The Buck Knob anticline is a prominent feature in the northern part of the area and extends northward into Flat Gap quadrangle. The fold plunges northward at about 1.5 degrees. The axis of the Dorchester syncline trends north to northeast and plunges approximately 1 degree northward.

The Pine Mountain fault, which is present only in the subsurface, is a major upper level decollement. A fault with a northwesterly dip has developed on the Pine Mountain thrust sheet. This fault, herein named the Benges Gap fault, is interpreted as a back-thrust. The fault has a fairly straight trace, indicating a steep fault plane, and shows rotational movement. A subsidiary fault joins the Benges Gap fault just north of the Blue Springs Church and rejoins that fault within Hoot Owl Hollow. This subsidiary fault is interpreted to be a splay off the Benges Gap fault. Silurian through Mississippian age rocks are present on the surface between the Benges Gap fault and the splay.

The Williams Cove fault is nearly parallel to the Benges Gap fault for 1 mile near the southern boundary of the quadrangle. The Williams Cove fault is interpreted to be a back-thrust.

The Kent Junction fault, herein named, has been traced northeasterly to Kent Junction. The fault may be a small antithetic bedding thrust.

ECONOMIC GEOLOGY

COAL

Coal is the most important mineral resource in the area. In general, the coal is high volatile C to high volatile A bituminous. Analyses of 24 coal samples from within the quadrangle are available (Division of Mineral Resources files). Generally, values for fixed carbon range from about 49 to 64 percent, total sulfur about 0.6 to 3.4 percent, ash approximately 3.0 to 20.8 percent, and volatile matter about 28 to 39 percent. Most of the heat values of the coals, on a moisture- and ash-free basis, are between 12,310 to 15,390 Btu per pound.

Underground and surface mines in the area produce from the Norton, Dorchester, Lyons, Blair, Clintwood, Addington, Imboden, Kelly, Taggart Marker, Taggart, and Low Splint coals. Surface mining is performed by contour and hill-top removal methods. At places, as surface mining nears completion, additional coal is removed by horizontal augers at the base of the high wall. The coals are described in ascending stratigraphic order, omitting coals of no present economic value.

Below the Gladeville Sandstone, coal beds of the Norton Formation are separated from each other by about 100 feet of interbedded siltstones and sandstones. Above the Gladeville Sandstone, five coal beds that have been mined economically occur in the lowest 200 feet of the Wise Formation. Discontinuous sandstones, multiple splits, and partings of the coal beds are common. These coal beds in the Wise Formation have generally been surface mined together in groups with multiple bench levels. Most surface workings have been backfilled and reclaimed; therefore, the coal beds are seldom exposed.

The lowest coal bed that was mined is located north of the Powell River, just northwest of Josephine. The small abandoned surface mine is approximately 100 feet below the Norton coal. Although no coal is exposed, this bench level would correlate with the Hagy coal.

The Norton coal bed is mined in the deeply dissected areas along Thacker Branch, Black Creek, and the Guest River. This coal bed lies approximately 40 feet below the base of the Gladeville Sandstone. The coal averages 26 to 30 inches thick in most surface exposures, increasing to 54 inches of coal with 13 inches of interbedded siltstone as observed in a core taken from a well located northwest of the City of Norton. In places it has a thin rider coal 10 to 20 feet above the main coal bed. The Norton coal has been mined at the surface and underground. It is currently being mined underground east of Thacker Branch.

The Dorchester coal bed is above the Gladeville Sandstone and approximately 100 feet above the Norton coal. The Dorchester coal is generally 24 to 48 inches thick and ranges from 14 inches exposed south of the Guest River to more than 5 feet as noted from a drill hole northwest of Dorchester. Drill hole data often reflect two splits of the coal with a separation of less than 10 feet. The Dorchester coal has been mined at the surface and underground and is currently being mined underground south of Laurel Grove along the Powell River.

The Lyons coal bed is 50 feet above the Dorchester coal and averages 24 to 30 inches thick. This coal is poorly exposed because of mine waste that was dumped downslope from the mining of coals above the Lyons coal bed. It appears to have been extracted only by surface mining.

The Blair coal beds lie 40 to 60 feet above the Lyons coal and have the most variation in thickness of any of the coals within the section. Numerous discontinuous coal beds and irregularly distributed sandstones make up the coal-bearing zone. Typically, this zone contains two or more splits of coal within a 20-foot section. South of Laurel Grove, three coal beds, 17, 26, and 12 inches thick, and three minor riders are exposed within a 30-foot section. These pinch out to the west and are absent to the southwest at the head of Bear Branch. The Blair coal beds have been recovered by contour-bench and hilltop-removal surface mining.

The Clintwood coal beds are 30 to 60 feet above the Blair coal. These coal beds occur as two consistent splits of coal, each 20 to 40 inches thick, with a 1.5- to 10-foot shale and siltstone separation. The upper split of the Clintwood is cut out by a channel sandstone locally. The two splits appear to thin and possibly become discontinuous to the northeast along the Guest River. The Clintwood coal beds have been extensively mined at the surface and underground. They are currently being mined underground north of the Powell River, where they are separated by less than 2 feet.

The Addington coal bed is 30 to 50 feet above the Clintwood and averages 10 to 18 inches thick. This coal bed is not mined separately but is recovered with the Clintwood coal beds; it can usually be found in the highwall of the Clintwood benches. Sandstone is present 10 to 20 feet below the Addington coal bed. This sandstone becomes more prominent to the northeast, along the Guest River.

The Imboden coal crops out 300 to 370 feet above the Clintwood coal and as much as 20 feet above a thick sandstone, as a thick coal bed with splits above and below. A maximum thickness of 74 inches of coal was identified from a drill hole near Mill Branch, but the average thickness is 40 inches. The Imboden coal has been extensively surface mined in the western half of the area.

The Kelly coal bed is separated from the Imboden coal by a 75-foot-thick sandstone with a minor amount of shale near the head of Sargent Hollow, but this interval thins to 5 feet along Roaring Fork. The Kelly coal attains a maximum thickness of 40 inches north and south of Sargent Hollow, thins westward and locally grades to carbonaceous shale.

The Pinhook coal bed has a maximum thickness of 18 inches in Fork Ridge and thins laterally and is discontinuous in the northern part of the area. The Kelly and Pinhook coal beds are surface mined in association with the Imboden coal.

The Wilson coal bed is approximately 220 feet above the Kelly coal and 20 feet below a massive sandstone. The coal occurs locally along Roaring Fork where it varies from 14 to 26 inches thick and was surface mined on the west side of Amos Ridge.

The Taggart Marker occurs as 3 to 4 feet of coal approximately 260 feet above the Imboden coal. It is surface mined in association with the overlying Taggart coal bed. An underground mine is active in the Taggart Marker coal on the west side of Amos Ridge.

The Taggart coal crops out in the western part of the area, 30 to 40 feet above the Taggart Marker. It is typically a single coal bed that averages 4 feet thick but locally appears as two splits. Several caved adits were seen in the Taggart coal along the upper part of Roaring Fork.

The Low Splint coal bed is approximately 130 feet above the Taggart coal. The Low Splint has been surface mined along Roaring Fork. There the coal is 30 to 60 inches thick with a six-inch siltstone parting. Several underground mines are present in this coal along Amos Ridge, just east of Pine Branch.

The Low Splint "A" coal, the youngest coal bed exposed in the area, occurs about 60 feet above the Low Splint coal and lies within a few feet above a massive sandstone between the two coals. Locally, the coal, which is 18 inches thick, was surface mined along the west side of Amos Ridge.

COKING OPERATIONS

Coke was produced in the quadrangle by the Wise Coal and Coke Company up until March 1, 1967. The company operated 270 bee-hive ovens near Dorchester supplying chemical and furnace coke (Sweet, 1969). No data are available on the names of the coals that were fired. The Westmoreland Coal Company operated 180 Mitchell-type ovens along Roaring Fork just west of Pine Branch until February 1970. The Taggart coal that formed the principal charge was mined at their Pine Branch mine.

OIL AND GAS

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). Gas shows have been reported in the Hinton Formation and at various intervals within the Pennsylvanian rocks. Natural gas accumulation may be related to the various fold structures, as well as variations in reservoir porosity and permeability. Oil shows were encountered in the upper sandstone of the Hinton Formation (Ravencliff sand) and the Clinch Sandstone of Lower Silurian age.

Since the earliest exploratory well was drilled in southwest Virginia near Ramsey in the early 1890's, a total of 151 gas wells were permitted in Wise County, as of August 31, 1985. Of the 26 gas tests located in the quadrangle, seven are producing, fifteen are shut-in gas wells, two are plugged and abandoned with a gas show, and one is dry, plugged and abandoned. There is also one oil test which is plugged and abandoned with an oil show. Nearly all of the completed wells were hydraulically fractured and then acidized. Wells in the area normally have an initial flow of approximately 185 Mcf per day and after stimulation a flow of about 720 Mcf per day at a pressure of about 800 to 950 pounds per square inch.

During 1984 about 50 miles of gas pipeline were constructed in Wise County by ANR Production Company. Approximately 8 miles of this pipeline are present in the quadrangle. Total gas production from the six wells in this quadrangle connected to this line was 16,772 Mcf in November 1984.

CLAY AND SHALE

A previous report contained analyses of 14 samples of clay, shale, and related material collected in Wise County, including six samples from the Norton quadrangle area (Johnson and others, 1966). These samples are from the Big Stone Gap Member of the Chattanooga Shale (R-1947), the Norton (R-1948, R-1949) and the Wise formations (R-1950, R-1953), and from coal-mine refuse (R-1958) piles. The samples have potential use in the manufacture of common brick, tile, and sintered lightweight aggregate. An abandoned shale quarry is present near the south end of the Norton Reservoir. Shale was taken from the Bluestone Formation at that site for use as raw material for the manufacture of lightweight aggregate.

LIMESTONE

The Greenbrier Limestone is actively quarried at Rim Rock Quarries 0.4 mile southeast of Little Stone Gap off State Road 610. Limestone from the quarry is crushed for use as road stone and railroad ballast and is also used for riprap. The formation averages 500 feet thick in this area.

An abandoned quarry near Big Stone Gap (outside mapped area) was the source for road stone, concrete aggregate, and building stone extracted from the Greenbrier. A chemical analysis of limestone from this quarry reported 82 to 89 percent calcium carbonate (Eby, 1923).

SANDSTONE

Sandstone occurs at frequent intervals in the stratigraphic sequence. The Tallery sandstone of the Hinton Formation was quarried for road stone in the vicinity of Benges Gap. The Lee sandstones, though of good quality, have not been excavated extensively. They occur in the upper slopes of Little Stone Mountain and have steep dips; a small sand pit occurs near the Norton Reservoir. Along U. S. Highway 23, about one-quarter mile east of Kent Junction, is another abandoned quarry. This quarry is in the sandstone just below the Clintwood coal bed. Other sandstones of the Wise Formation are used locally as a base for coal-mine haul roads, railroad ballast and fill, and some have been used for building stone. Most are, however, too irregularly bedded and friable to be a good building stone.

ACKNOWLEDGMENTS

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[1] U.S. Geological Survey