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

GEOLOGY OF THE VIRGINIA PORTION OF THE CLINTWOOD AND JENKINS EAST QUADRANGLES

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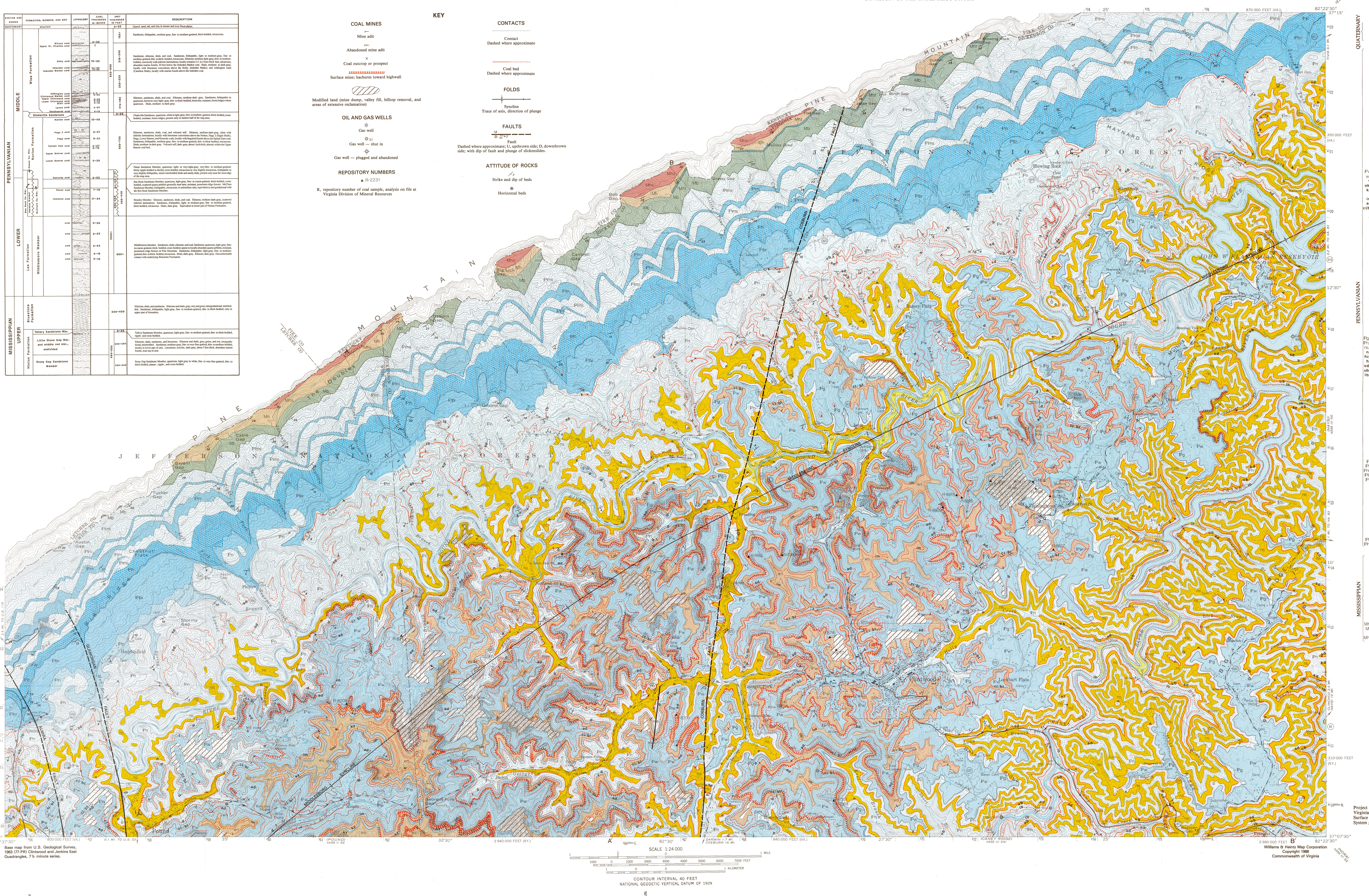
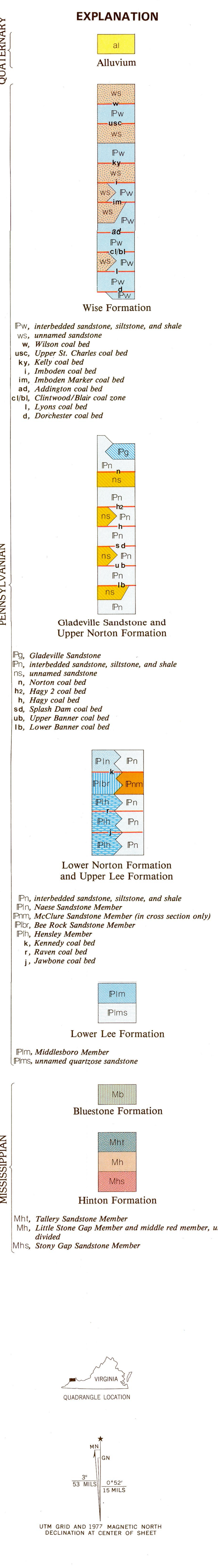
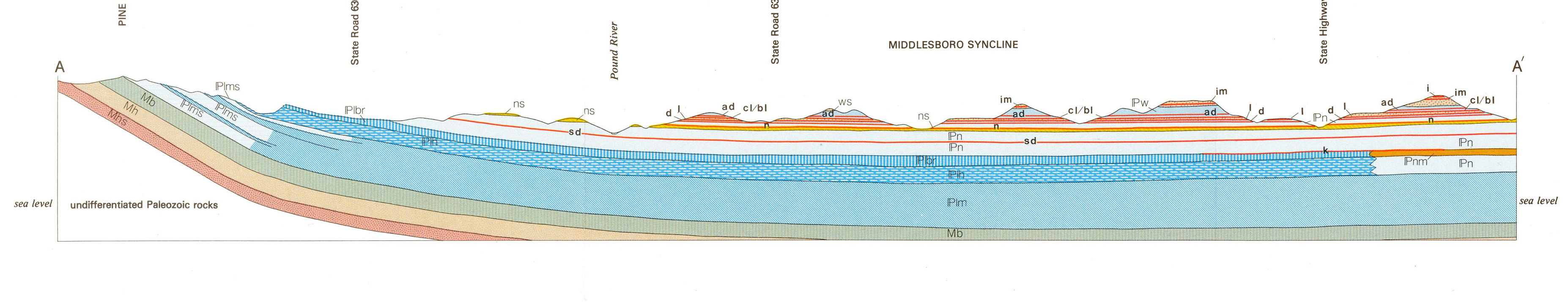
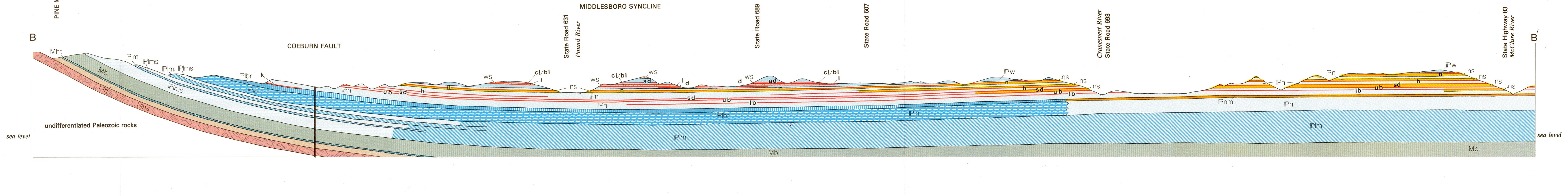
1988





Project funded equally by the Commonwealth of Virginia and the U.S. Department of Interior, Office of Surface Mining, under a Technical Data Management System grant.





CROSS SECTION DESIGN

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

INTRODUCTION

The Virginia portion of the Clintwood and Jenkins East quadrangles comprises approximately 85 square miles of mountainous terrane in northern Wise and western Dickenson counties. The quadrangles are in the Appalachian Plateaus physiographic province and the Appalachian coal basin. Elevations in the quadrangles range from about 1320 feet on Pound River at the eastern edge of Clintwood quadrangle to 3149 feet near Birch Gap on Pine Mountain north of Clintwood.

Geologic mapping was begun in January, 1987 and completed in February, 1988. The primary purpose of the mapping project is to provide an accurate, three-dimensional picture of the geology of the area. The geologic data will become a part of the automated geologic database being assembled by the Department of Mines, Minerals and Energy, Division of Mined Land Reclamation.

STRATIGRAPHY

Rocks exposed in the map area represent a stratigraphic interval of approximately 3500 feet and range in age from Upper Mississippian to Middle Pennsylvanian. They are primarily interbedded sandstones, siltstones, and shales; numerous coal beds are present in the upper half of the sequence. Principal stratigraphic units present are the Lee, Norton, and Wise formations, all of Pennsylvanian age (Giles, 1921).

The boundary between the Lee and Norton formations is defined as the top of the youngest quartzose sandstone (quartzarenite) unit above the base of the Lee. In the map area, the youngest exposed quartzose sandstones are the Naese and the Bee Rock members of the Lee Formation, which crop out along the southeast base of Pine Mountain. As these sandstones extend to the east on the surface or in the subsurface, the Naese pinches out in the Norton Formation and the Bee Rock grades laterally into a feldspathic sandstone. Where these members can not be recognized the following changes take place in the stratigraphic nomenclature: (1) the top of the Lee Formation drops down to the next highest quartzose sandstone, which is the top of the Middlesboro Member, (2) the Hensley Member of the Lee Formation becomes the lower part of the Norton Formation, and (3) the Bee Rock Sandstone is replaced by the feldspathic McClure Sandstone, also considered part of the Norton Formation (Gathright, 1964). Refer to the stratigraphic column and cross sections A-A′ and B-B′ for clarification.

The Norton Formation and the overlying Wise Formation are separated by the Gladeville Sandstone in central Wise County. The Gladeville Sandstone is not present throughout most of the western half of the map area and there the base of the Dorchester coal is defined as the boundary between the Norton and Wise formations.

Although present in the eastern part of the map area, the Gladeville Sandstone is too thin in most places to show on the map as a separate unit. Instead, it is shown as a line marking the boundary between the Norton and Wise formations. Although thin, the Gladeville nevertheless crops out prominently as a hard, light-gray to white, quartzose sandstone that makes a very useful marker bed in the field. It underlies most of the "flats" in the southeastern part of Clintwood quadrangle, including Lockhart Flats, Baker Ridge, and Big Ridge.

Earlier geologic reports misidentified the Gladeville Sandstone in much of Wise County and all of Dickenson County. The first prominent, stratigraphically lower sandstone of the Norton Formation was thought to be Gladeville (Whitlock and others, 1988). This misidentification of sandstones led to the miscorrelation of certain coals. As a result, the coal currently known throughout most of the map area as the Dorchester is actually the Norton coal.

Sandstones similar to the Gladeville also are present between the Clintwood and Addington coals. In the Clintwood quadrangle, these sandstones are very lenticular with no significant lateral extent. In part of Jenkins East quadrangle, however, a quartzose sandstone is present just above the Lower Clintwood coal and has enough lateral extent to serve as a local marker bed.

Most stratigraphic units thin toward the northwest. For example, the interval between the Norton and Kennedy coals is approximately 700 feet at the southeast corner of the map area, but thins to about 600 feet near the Pound River. Also, the interval between the Kennedy coal and the base of the Lee Formation is about 1600 feet thick (in the subsurface) at the southeast corner of the map area, but is only 1300 feet thick on Pine Mountain.

STRUCTURE

The Middlesboro syncline crosses the map area in a generally northeast-southwest direction. In the eastern part of the map area the axis of the syncline generally coincides with the course of the Pound River, but in the western part the axis is as much as 1.5 miles south of the river. This syncline formed as the result of movement on the underlying Pine Mountain thrust fault (Harris and Milici, 1977). The southeast limb of the syncline dips generally 1° to 2° to the northwest, but locally as much as 4° to 5°. The northwest limb dips to the southeast and the amount of dip gradually increases to the northwest, being about 10° at the base of Pine Mountain and reaching generally 28° to 30° at the top of the mountain. The dip of the strata on Pine Mountain, which is parallel to the fault, reflects the slope on the underlying thrust ramp.

Three faults cross the map area in a general northerly direction. The Coeburn fault, first discovered by Johnston and others (1975), is near the center of the area. Although it was originally thought to be upthrown on the west side, current mapping shows it upthrown on the east side. This fault is accompanied by a zone of broken and deformed rocks as much as 400 feet wide. The zone contains minor faulting, rock strata tilted as much as 15°, and coal rolls in the affected coal beds. Vertical displacement on the main fault is as much as 40 feet and across the entire fault zone as much as 80 feet. The amount of vertical displacement and the width of the fault zone varies along the fault.

Near the west edge of the map area are two other north trending faults, the Glamorgan and the Almira faults. The Glamorgan fault was first recognized and mapped in 1986 (Whitlock and others, 1988). This fault passes through the center of Pound, just south of the map area, and continued north as far as Big Ridge, where it appears to die out. It is well exposed in an abandoned railroad cut through a hill 0.7 mile north of State Highway 83 at Pound. There the east side is upthrown 20 to 30 feet and well developed slickensides plunge 2° in a southerly direction.

The Almira fault is located about 3500 feet west of the Glamorgan fault. It is best exposed along U.S. Highway 23 about 0.25 mile north of the settlement of Almira. Here the west side is upthrown about 20 feet and well developed slickensides plunge 8° to 13° in a southerly direction. Where sandstone is present on both sides of the fault an 18-inch wide breccia zone developed. The breccia fragments range from sand- to cobble-size and some fragments are well rounded as a result of the fault movement. The fault can be traced to the north at least as far as the top of Pine Mountain, approximately 2.3 miles from the south edge of the map area. Exposures immediately south of the map area along U.S. Highway 23 Business show a zone about 1800 feet wide which contains minor faulting and in which the rock strata dip toward a centrally located fault creating a syncline. There, fault drag indicates that the east side is upthrown. Farther south, the fault dies out but the syncline is present for a long distance into Pound quadrangle (Whitlock, 1988, personal communication).

The Coeburn, Glamorgan, and Almira faults are all believed to be predominantly strike-slip faults. They probably formed as the result of differential horizontal stress within the Pine Mountain thrust sheet.

ECONOMIC GEOLOGY

COAL

The coal in the map area is generally high-volatile A bituminous. Based on twenty-one samples, analyzed on an as-received basis, the coal has 28.6 to 38.0 percent volatile matter, 52.1 to 61.8 percent fixed carbon, 1.8 to 13.9 percent ash, 0.7 to 2.6 percent sulfur, and 11,942 to 14,659 Btu per ton. Individual analyses for the samples are on file at the Virginia Division of Mineral Resources, Economic Section files.

Coal is produced by surface mining, underground mining, and augering. Current production is limited to the Norton, Lyons, and Clintwood coals. In the past, significant amounts of coal were also mined from the Upper Banner, Haggy, Imboden Marker, Imboden, and Kelly coals. In its current mapping program, the Division of Mineral Resources is attempting to adopt standarized coal names for the coal beds throughout southwest Virginia. As a result, many of the names used in this report are different from those used locally. In the discussion below, the locally used name is in parentheses if it differs from the name used by the Division of Mineral Resources. The lowest coals stratigraphically are those in the Middlesboro Member of the Lee Formation that crops out on Pine Mountain. At least five unidentified coal beds were encountered by widely-spaced core drilling in the Jefferson National Forest (Englund and others, 1983). The drill data show one coal thickness of 54 inches, but the data also suggest that the coals are variable in thickness and discontinuous. None of these were seen in the field during current mapping. Little information is available concerning these coals south of Pine Mountain, where they are almost flat-lying and at depths of 800 feet or more.

Two coals, the Jawbone and the Raven, are present in the Hensley Member of the Lee Formation along Pine Mountain. Drill data suggest reasonable continuity for these coals. The Jawbone is 17 to 34 inches thick and the Raven 7 to 16 inches thick. Both beds crop out along U.S. Highway 23 approximately 0.3 mile and 0.4 mile, respectively, north of Almira.

The Kennedy coal is just above the Bee Rock Sandstone Member of the Lee Formation and crops out at the base of Pine Mountain. At one location along White Oak Creek a 47-inch coal zone is present, but it includes 16 inches of shale. At two exposures near Almira, this coal is intensely deformed, but this is probably a local condition resulting from the proximity to the Almira fault. The Kennedy has been both surface mined and deep mined at several locations, but only on a very small scale.

The Lower Banner coal is 150 to 200 feet above the Kennedy. At most locations a sandstone 40 to 50 feet thick lies just below the coal. The Lower Banner commonly is 20 to 22 inches thick, including a 4- to 6-inch parting, but at one location along Pine Creek 36 inches of coal without partings, is present.

The Upper Banner is 80 to 90 feet above the Lower Banner. It lies below a 40 to 60 foot thick sandstone in most areas. The Upper Banner is especially well developed in the southeastern part of the map area, where it reaches a thickness of 63 inches. Most of the thick coal has been removed by deep mining. Elsewhere, it is generally thin or absent, being truncated by the overlying sandstone. In one area north of Ramey Flats, thicknesses of 21 inches and 22 inches were measured. As noted by Giles (1921), "one of the most marked characteristics of the Upper Banner is the persistent sandstone parting less than 2 inches thick in the upper half of the bed." Current analytical work has determined, however, that this parting is a volcanic tuff bed, which helps explain its remarkable persistence, and provides a valuable, regionally extensive, marker bed for correlation control.

The Splash Dam coal lies 50 to 70 feet above the Upper Banner. It is very persistent and is probably present throughout the map area where the stratigraphic interval is present. Generally it is less than 15 inches thick, but north of the Pound River in the northeastern part of the map thicknesses of 26 inches and 27 inches were measured. The Splash Dam commonly has two splits separated by 15 to 20 feet of rock. A small area of the Splash Dam bed was surface mined adjacent to Flannigan Reservoir on the east edge of the map area.

The Hagy coal is 100 to 110 feet above the Splash Dam. In the southeastern corner of the map area a thick sandstone lies directly above the Hagy, but north of the Pound River there is up to 20 feet of shale between the coal and this overlying sandstone. The Hagy is thin or absent, except like the Splash Dam, it is best developed north of the Pound River in the northeastern part of the map area. There the coal has a thickness of 28 to 30 inches and has been both surface and deep mined at several locations, generally north of Meadow Branch. In the central part of the area north of the Pound River, the thickness is about 21 inches.

The Hagy 2 coal is present 70 to 80 feet above the Hagy, at the top of a thick sandstone and at the base of a thick shale sequence. The Hagy 2 is only locally present and commonly thin but reaches a thickness of 21 inches along State Highway 83 about 0.4 mile east of the intersection with State Road 632.

The Norton (Dorchester) coal is 110 to 120 feet above the Hagy 2. It overlies a 40 to 60 foot thick sandstone that was identified as the Gladeville Sandstone in earlier reports. The Norton coal is actually a coal zone made up of two or three coal beds separated by 5 to 20 feet of rock. Commonly only one, but locally two, of the coal beds have significant thickness. The Norton is a very persistent coal and is thickest in the central part of the map area, thinning to the west, north, and east. In the central section it is generally 35 to 40 inches thick, not counting a shale parting that characteristically occurs near the top of the seam. At present the Norton coal is produced from eight deep mines and one surface mine in the map area.

The Dorchester (Lyons) coal is 40 to 70 feet above the Norton and 10 to 20 feet above the Gladeville Sandstone where the Gladeville is present. The Dorchester typically consists of two splits, each about 8 to 10 inches thick, separated by 5 to 15 feet of rock. Very little mining of the Dorchester has been done. It is well exposed on State Highway 83 in the town of Clintwood approximately 0.1 mile west of the intersection with State Road 631.

The Lyons (Eagle, Blair) coal is 30 to 50 feet above the Dorchester. In the eastern part of the map area it is commonly 26 to 32 inches thick, but in the western part it becomes a split seam separated by about 10 feet of rock with individual splits about 6 inches thick. The Lyons has been surface mined locally and at present is being produced from one underground mine. It is well exposed along State Road 631, 0.9 mile north of its intersection with State Highway 83.

The Clintwood and Blair coal zone starts 40-70 feet above the Lyons. In most of the area a thick sandstone is present between the Lyons and the Clintwood/Blair, but in the western part of the map this sandstone thins and pinches out. The Blair coal does not seem to be present, or cannot be distinguished from the Lower Clintwood, throughout most of the map area. It can be seen as a separate and distinct coal near Pound, about 0.5 mile south of the map area, where it occurs as an 18-inch-thick zone of interbedded coal and shale about 30 feet below the Lower Clintwood bed. The rock interval thickness between the Blair and Lower Clintwood coals, however, decreases to the north and the two coals either merge or the Blair pinches out a short distance into the map area. Near Flemingtown, in the eastern part of the area, a coal zone is present 5-15 feet below the Lower Clintwood. This coal zone could be interpreted as a split of the Lower Clintwood or as the Blair.

The Clintwood zone typically consists of three coals, the Lower Clintwood, the Upper Clintwood (Middle Clintwood), and the Clintwood Marker (Upper Clintwood). Intervals between these three coals vary from 5 to 30 feet. Lenticular sandstones may be present locally between the coals or above the Clintwood Marker. North of Flemingtown these sandstones become extensive and locally either the Lower Clintwood or the Upper Clintwood (Middle Clintwood) may be truncated beneath them. Coal thicknesses have a wide range; the Lower Clintwood is generally 36 to 48 inches thick, the Upper Clintwood 18 to 30 inches, and the Clintwood Marker 12 to 18 inches. South of Clintwood the Upper and Lower Clintwood coals join to provide thicknesses of 9 to 10 feet (local miners' reports). The Clintwood seams have been mined extensively by both surface and underground methods and at present surface mining of the Clintwood still accounts for most coal production from the area.

The Addington coal occurs 60 to 70 feet above the Lower Clintwood. It typically consists of 6 to 12 inches of hard black shale over 2 to 4 inches of coal and marks the change from a sandy, silty sequence below to a thick shale sequence above. It is remarkably persistent and can be seen in the highwall of most Clintwood surface mines. The Addington has no economic importance in the map area, but with the overlying shale and limestone concretions is valuable as a marker bed.

The Imboden Marker (Lower Bolling) coal is 250 to 310 feet above the Lower Clintwood. It ranges in thickness from 11 to 35 inches. The Imboden (Upper Bolling) coal is 15 to 50 feet above the Imboden Marker and is 24 to 59 inches thick. The Imboden commonly has a thick sandstone above it, although as much as 20 feet of shale may separate the coal and the sandstone. The Imboden and Imboden Marker coals were usually surface mined together on a common bench. The Imboden was also deep mined. Both coals are exposed in the road cut through Georges Fork Gap on State Highway 83.

The Kelly (Pinhook) and higher coals are present only at the higher elevations in south central Jenkins East quadrangle. The Kelly is 60 to 80 feet above the Imboden and is 12 to 30 inches thick. It has been surface mined and typically is overlain by a thick shale unit.

The Upper St. Charles (Lower Standiford) coal and the Wilson (Upper Standiford) coal are 150 to 190 feet above the Kelly. The two coals are separated by 25 to 40 feet of rock. They have been surface mined in only one small area near the south edge of the map; both coals were mined from the same bench. The thickness of the Upper St. Charles could not be determined but the Wilson is as much as 36 inches thick. Thick sandstones are present both below the Upper St. Charles and above the Wilson.

GAS

By 1988, 26 gas wells have been drilled in the area. Of these, three are plugged and abandoned, one is shut in and the remaining 22 wells are producers.

Gas is found primarily in the Berea sandstone (at depths of 4000 to 4500 feet) and in the upper part of the Devonian shales a short distance below the Berea. It is also found in the lower part of the Devonian shales and in the Mississippian Greenbrier Limestone (Big Lime). Small amounts of production were reported from the Stony Gap Member of the Hinton Formation (Maxon sands) in two wells and from the Tallery Sandstone Member of the Hinton Formation (Ravencliff sand) in one well.

Initial production rates from these wells range from 0 to 246 Mcfg/d and averaged 112 Mcfg/d. After stimulation by hydraulic fracturing and acidification, production rates were 146 to 3275 Mcfg/d and averaged 1370 Mcfg/d.

SANDSTONE

Sandstone is abundant in the map area; several abandoned sandstone quarries presumably produced road stone. The quartzose sandstones of the Lee Formation, found at the foot of and on Pine Mountain, may have potential as non-polishing aggregate for use in road surfacing materials. The quartzose Gladeville Sandstone may have similar potential if a thick section of it can be located.

ACKNOWLEDGEMENTS

The author thanks Thomas M. Gathright, II, Division of Mineral Resources, for his assistance with this project. I also thank George S. Brady, III, and W. Scott Custer, both with Pyxis Resources Company, and John C. Lydzinski, Virginia Iron, Coal and Coke Company, for generously providing core data for use in this project. Thanks also goes to Charles J. Saboites, U.S. Forest Service, for his cooperation and support of the field work in the National Forest portions of the area.

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