



GEOLOGY OF THE COAL-BEARING PORTION OF THE RICHLANDS QUADRANGLE, VIRGINIA

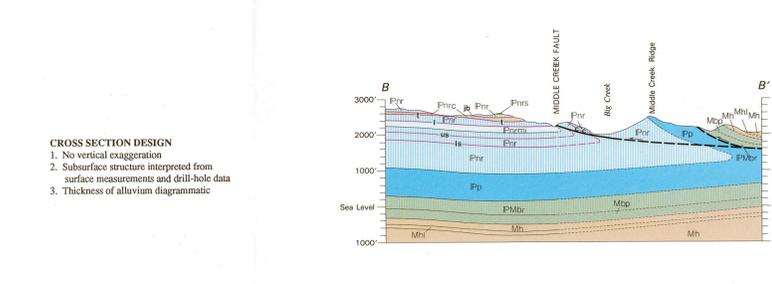
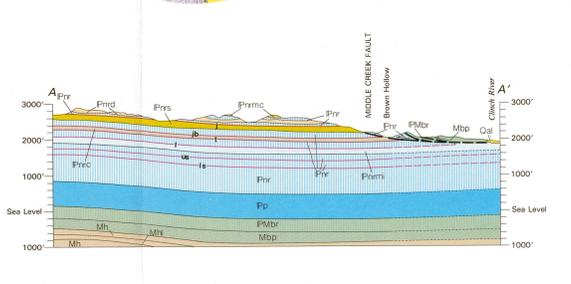
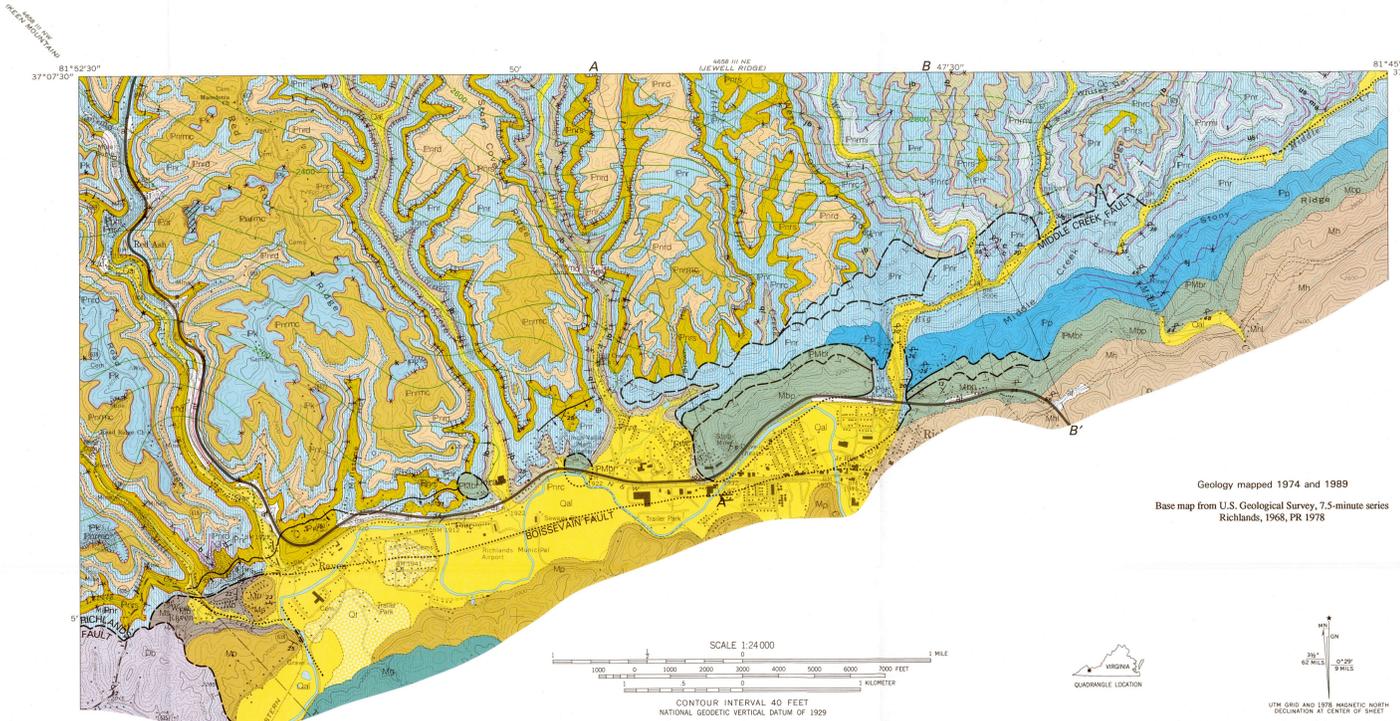
Kenneth J. Englund and Brent A. Couzens
U.S. Geological Survey*

* Published with permission of the Director, U.S. Geological Survey
Printed by the Commonwealth of Virginia



EXPLANATION

- QUATERNARY**
- af Artificial fill
 - Qc Colluvium
 - Qt Terrace deposit
 - Qal Alluvium
- PENNSYLVANIAN**
- Kn Kanawha Formation
 - Knmc, Kennedy coal bed
 - Knrd
 - Knrs
 - Knrc, Council Sandstone Member
 - Knrm, upper tongue of Middleboro Sandstone Member
 - b, laeger B coal bed
 - a, laeger A coal bed
 - j, Jewell coal bed
 - jb, Jawbone coal bed
 - t, Tiller coal bed
 - l, Lee coal bed
 - us, Upper Seaboard coal bed
 - ms, Middle Seaboard coal bed
 - ls, Lower Seaboard coal bed
- MISSISSIPPIAN**
- Pocahontas Formation
 - Pc3, Squire Jim coal bed
 - Pc2
 - Pc1
 - Bluestone Formation
 - Mbr, red member; Mbp, Pride Shale Member
 - Mh
 - Hinton Formation
 - Ml, Little Stone Gap Member
 - Bluefield Formation
 - Mg
 - Greenbrier Limestone
 - Mm
 - Maccrady Shale
 - Mp
 - Price Formation
 - Ms
 - Sunbury Shale
 - Md
 - Berea Sandstone
 - Db
 - Brallier Shale
 - Br
- DEVONIAN**
- Structure contours—Drawn on the base of Jewell coal bed; dashed where concealed; arrows indicate relative horizontal movement
 - Monocline—Dashed where approximately located
 - Strike and dip of overturned beds
 - Strike and dip of horizontal beds
 - Caved adit
 - Prospect or outcrop
 - Contour strip mine
 - Area completely stripped
 - Mine dump



GEOLOGY OF THE COAL-BEARING PORTION OF THE RICHLANDS QUADRANGLE, VIRGINIA

Kenneth J. Englund and Brent A. Couzens

INTRODUCTION

The Richlands quadrangle, which is located in eastern Russell County and western Tazewell County, includes an area of approximately 14 square miles in the southwestern Virginia coalfield. It is a highly dissected area that is characterized by narrow ridges and deep valleys eroded into relatively flat-lying Lower and Middle Pennsylvanian coal-bearing rocks of the Appalachian Plateaus physiographic province. The remainder of the quadrangle is in the Valley and Ridge physiographic province and is underlain by older faulted and folded Paleozoic-age strata that are mostly of marine origin and rarely contain terrestrial coal-bearing rocks.

The geology of the northern part of the Richlands quadrangle was mapped by the U.S. Geological Survey as part of a program to assess the quantity and the quality of low-sulfur coal resources in Tazewell County. This study was supplemented by the mapping of faulted and folded strata in an area adjacent to the coalfield in 1989.

STRATIGRAPHY

The coal deposits of the Richlands quadrangle are in a terrestrial sequence that prograded northwestward across the central Appalachian basin in late Paleozoic time. Within the quadrangle, the principal coal-bearing strata are of Early and Middle Pennsylvanian age and consist of about 2500 feet of mostly interbedded sandstone, siltstone, and shale that are assigned to three formations: the Pocahontas, the New River, and the Kanawha. Most of this sequence was recognized as being the Lee Formation on early geologic maps (Hansberger, 1919; Calver and Hobbs, 1963). However, because the quartzose, conglomeratic sandstone typical of the Lee has wedged out (Englund, 1962; Englund and DeLaney, 1966), the name is no longer applicable to strata dominated by the subgraywacke sandstone of the report area.

The Pocahontas Formation, which is at the base of the coal-bearing sequence, is mostly at depths of about 1400 to 1500 feet below the principal streams. It consists of light-gray, fine- to coarse-grained subgraywacke sandstone, medium- to dark-gray shale and siltstone, and coal and associated underclay. Outcrops of the Pocahontas Formation are limited to a fault slice of overturned beds in the northeastern part of the Richlands quadrangle.

The overlying New River Formation is also a coal-bearing sequence of sandstone, siltstone, shale, and underclay that is similar lithologically to the Pocahontas except for the presence of thick widespread beds of conglomerate, subgraywacke sandstone. The most prominent of these is the Dismal Sandstone Member, which includes the Richlands channel at its base (Englund and Thomas, 1985). This feature follows a meandering course from near Richlands, Virginia, in the north-central part of the Richlands quadrangle, N25°W across the southwestern Virginia coalfield. The channel is as much as 6 miles wide and truncates as much as 130 feet of underlying strata. It contains polygenic conglomerate that consists mostly of well-rounded white quartz pebbles and cobbles as much as 5 inches in diameter. The size of the clasts decreases southwestward, which, together with the northwesterly channel orientations, indicates that these Pennsylvanian-age clastics originated from the southeast and were transported northwestward. The New River Formation crops out in the northern part of the quadrangle and contains the principal mined coal beds of the area.

The Kanawha Formation of Middle Pennsylvanian age conformably overlies the New River and contains the youngest coal-bearing rocks of the Richlands quadrangle. About 140 feet of beds in the lower part of the formation crop out on the highest mountain tops in the northwestern part of the area. Dark-gray shale and fine- to medium-grained feldspathic and micaceous sandstone are the dominant rock types.

STRUCTURE

Formations cropping out in the mapped area occupy two structurally diverse areas: the Appalachian Plateaus province, where the strata are relatively flat lying, and the Valley and Ridge province, where the strata are intensely faulted and folded. In the Appalachian Plateaus, the structure is dominated by the southwestward-plunging Dry Fork anticline, the crest of which is located 1 to 2 miles to the north of the adjacent Jewell Ridge quadrangle (Englund, 1981). Beds on the southeastern limb of this feature dip from 1° to 2° to the south. Locally, these beds exhibit a sharp monoclinical fold at the southeastern edge of the adjacent.

Three low-angle thrust faults (Middle Creek, Boissevain, and Richlands) of an undetermined amount of movement strike southwestward across the mapped area. The Middle Creek fault is a fault slice of overturned Upper Mississippian and Lower Pennsylvanian formations that dip 6° to 50° to the southeast. These strata also are displaced by local imbricate thrust faults. The Middle Creek fault merges southwestward with the Richlands fault, which overlies by upright Lower Mississippian formations that dip as much as 25° to the south. The Richlands fault at the western edge of the mapped area is overlain by overturned Upper Devonian strata that dip about 22° to the southeast.

ECONOMIC GEOLOGY

COAL

Coal is the principal mineral resource in the northern portion of the Richlands quadrangle. It occurs in about 50 beds; 25 are of sufficient thickness and extent to be significant resources. Most of the coal beds are 24 to 48 inches thick, but locally, they range from a few inches to about 60 inches thick. The coal is of low- to medium-volatile bituminous rank, that generally increases with depth. Most of the coal contains thin vitrain bands in a bright attrital matrix. Dull attritus, fusin, and sparsely disseminated pyrite also occur in some beds. On an as-received basis, most of the coal is low in ash (less than 9 percent), low in sulfur (less than 1 percent), and high in heat value (about 14,000 Btu). Analysis for trace elements and major and minor oxide compositions of 22 coal beds in Tazewell County and adjoining areas indicate that none of the samples contain significant amounts of potentially toxic or economically valuable elements (Englund and Teaford, 1980; Trent and others, 1982; Windolph, 1986).

COAL BEDS IN THE POCAHONTAS FORMATION

The Squire Jim coal bed, which is about 150 feet above the base of the Pocahontas Formation, is stratigraphically the lowest coal bed of economic interest in the quadrangle. It occurs in the Appalachian Plateaus at a depth of as much as 2000 feet and increases in thickness eastward from about 14 to 42 inches. Outcrops are limited to the area of overturned beds above the Middle Creek fault. Several abandoned adits along Middle Creek remain from early small-scale mining.

The Pocahontas No. 1, 2, and 2A coal beds are too thin and discontinuous in the mapped area to be of economic interest.

The Pocahontas No. 3 coal bed occurs about 300 feet above the base of the Pocahontas Formation at depths that range from about 1400 to 1700 feet below the principal streams. It is more than 28 inches thick in an area of 3 square miles in the northwestern corner of the quadrangle.

The Pocahontas No. 4 coal bed is absent in most of the mapped area. A small pocket of 14- to 44-inch-thick coal occupies the extreme northeastern corner of the quadrangle.

The upper split of the Pocahontas No. 4 is from 50 to 120 feet above the Pocahontas No. 3 and ranges from 28 to 44 inches in thickness in most of the mapped area. Resources are entirely in the subsurface at depths of as much as 1000 feet.

Other coal beds of the Pocahontas Formation, including the Pocahontas No. 6 and 7, and the Goodwill, are relatively thin and are of little economic interest. A coal tentatively identified as the Pocahontas No. 6, may have been thick enough to mine along Middle Creek as indicated by a few abandoned adits. The Pocahontas No. 7 contains a maximum thickness of 36 inches in the northwestern part of the quadrangle.

COAL BEDS IN THE NEW RIVER FORMATION

The Pocahontas No. 8 is a persistent coal bed at the base of the New River Formation. It is generally less than 12 inches thick.

The Little Fire Creek coal zone consists of one to three coal beds, including the Lower Horsepen, that are from about 100 to 150 feet above the base of the New River Formation. These beds attain a maximum thickness of about 24 inches locally.

The Fire Creek and the Fire Creek rider coal beds, which are also in the lower part of the New River, are thin and moderately persistent. Most of the measured thicknesses are less than 24 inches.

The War Creek coal bed is distributed in a belt across the northern part of the quadrangle. It commonly exceeds 28 inches in thickness.

The Middle and the Upper Horsepen coal beds and associated spurs or riders occur in a 100-foot-thick sequence of sandstone and shale. This sequence contains up to four coal beds, of which the Upper split of the Upper Horsepen is the thickest and most persistent. It averages about 35 inches in thickness in the northern part of the quadrangle.

A coal bed tentatively identified as the Welch(?) is widespread and is about 50 feet above the upper split of the Upper Horsepen coal bed. In the northern part of the quadrangle it averages about 24 inches in thickness, excluding a shale parting as much as 5 inches thick.

The Sewell(?) coal bed is about 80 feet above the Welch(?) in a thick sequence of dark-gray shale and silt shale. It is widely distributed and averages about 22 inches in thickness.

The Sewell(?) coal is a thin bed that locally is from 30 to 50 feet above the Sewell(?) coal bed, it averages about 18 inches in thickness in the mapped area.

The Dirty Six coal bed underlies a small area in the extreme northeastern corner of the quadrangle where it is as much as 37 inches thick. It is absent elsewhere in the mapped area.

The Middle Seaboard coal bed ranges from 60 to 70 feet above the Lower Seaboard and has a similar distribution across the northern part of the area. Outcrops of the bed extend discontinuously from the northeastern corner of the quadrangle northward into the Jewell Ridge quadrangle where it has been mined on a small scale. The average thickness is about 20 inches.

REFERENCES CITED

- Calver, J.L., and Hobbs, C.R.B., Jr., 1963, Geologic map of Virginia: Virginia Division of Mineral Resources, scale 1:500,000.
- Englund, K.J., 1962, Regional relation of the Lee Formation to overlying formations in southeastern Kentucky and adjacent areas of Tennessee: Geological Society of America, Special Paper 68, p. 69-70.
- Englund, K.J., 1981, Geologic map of the Jewell Ridge quadrangle, Buchanan and Tazewell Counties, Virginia: U.S. Geological Survey Quadrangle Map GQ-1550, scale 1:24,000.
- Englund, K.J., and DeLaney, A.O., 1966, Interfingering relations of the Lee Formation in southwestern Virginia: U.S. Geological Survey Professional Paper 350-D, p. D47-D52.
- Englund, K.J., and Teaford, N.K., 1980, Maps showing coal resources of the Jewell Ridge quadrangle, Buchanan and Tazewell Counties, Virginia: U.S. Geological Survey Miscellaneous Field Studies Map MF-1211.
- Englund, K.J., and Thomas, R.E., 1985, The Richlands Channel—Part of an Early Pennsylvanian depositor in east-central Appalachian basin: Bulletin American Association Petroleum Geologists, v. 69, no. 9, p. 1436.
- Hansberger, T.K., 1919, The geology and coal resources of the coal-bearing portion of Tazewell County, Virginia: U.S. Geological Survey Bulletin 19, 195 p.
- Trent, V.A., Medlin, J.H., Coleman, S.L., and Stanton, R.W., 1982, Chemical analyses and physical properties of 12 coal samples from the Pocahontas field, Tazewell County, Virginia, and McDowell County, West Virginia: U.S. Geological Survey Bulletin 1528, 37 p.
- Windolph, J.F., Jr., 1986, Maps showing coal resources of the Amonate quadrangle, Buchanan and Tazewell Counties, Virginia and McDowell County, West Virginia: U.S. Geological Survey Miscellaneous Field Studies Map MF-1730.

SYSTEM	SERIES	FORMATION	MEMBER AND BED	LITHOLOGY	THICKNESS OF COALS IN INCHES	THICKNESS IN FEET	DESCRIPTION						
QUATERNARY	PENNSYLVANIAN	KANAWHA	Colluvium		0-50	0-50	Boulders, sand, silt, and clay in unsorted slope deposits.						
			Aluvium and terrace deposits		0-30	0-30	Gravel, sand, silt, and clay.						
			Kennedy rider coal bed		20-80	100+	Sandstone, shale, coal, and underclay. Sandstone, mostly fine- to medium-grained, light-gray, thick-bedded to massive, cross-bedded; contains from 50 to 65 percent quartz grains and minor amounts of white-weathering feldspar, mica, and dark-mineral grains. Shale, medium- to dark-gray, evenly bedded, locally silty. Coal, mostly bright attritus with minor amounts of vitrain and dull attritus, finely cleated, brittle, occurs principally in the Kennedy coal bed. Underclay, medium-gray, clayey to silty, fossiliferous.						
			McClure Sandstone Member		0-6								
			Dismal Sandstone Member		0-24								
			Jewell coal bed		27-64	650-700							
			Unnamed sandstone member		0-6								
			Jawbone rider coal bed		0-25								
			Jawbone coal bed		0-50								
			Tiller coal bed		0-6								
QUATERNARY	MIDDLE PENNSYLVANIAN	NEW RIVER	Lee coal bed		3-6								
			Middleboro Sandstone Member (upper tongue)		0-6								
			Castle (?) coal bed		0-54								
			Upper Seaboard coal bed		0-28								
			Middle Seaboard coal bed		0-37								
			Dirty Six coal bed		0-38								
			Lower Seaboard coal bed		0-34								
			Upper Seaboard coal bed		0-18								
			Sewell B (?) coal bed		10-39	1800-1900							
			Sewell A (?) coal bed		4-27	1250							
PENNSYLVANIAN	LOWER PENNSYLVANIAN	POCAHONTAS	Welch (?) coal bed		13-33								
			Upper Horsepen coal bed		27-41								
			Middle Seaboard coal bed		0-36								
			War Creek coal bed		0-38								
			Fire Creek rider coal bed		0-26								
			Little Fire Creek coal bed		0-23								
			Lower Horsepen coal zone		0-24								
			Lower Horsepen coal bed		0-6								
			Pocahontas No. 4 coal bed		0-16								
			Pocahontas No. 3 coal bed		0-56								
PENNSYLVANIAN	LOWER PENNSYLVANIAN	POCAHONTAS	Pocahontas No. 2 coal bed		0-6								
			Pocahontas No. 1 coal bed		0-12								
			Squire Jim coal bed		0-35	700-750	Sandstone, siltstone, shale, coal, and underclay. Sandstone, light- to medium-gray, very fine- to coarse-grained, thin- to thick-bedded, cross-bedded; contains from 50 to 65 percent quartz grains and minor amounts of feldspar, mica, and dark-mineral grains; big deposits of ironstone, shale, and coal fragments locally at base of beds; well-rounded quartz pebbles as much as 1 inch in diameter in basal bed. Siltstone, medium-light-gray, thin to irregularly bedded. Shale, medium- to dark-gray, evenly bedded, ironstone concretions or well-preserved plant fossils in some beds. Coal, mostly bright attritus and vitrain, finely cleated. Underclay, medium-gray, clayey to silty, fossiliferous.						
			Red Member		250-300								
			Pride Shale Member		250-325								
			MISSISSIPPIAN	UPPER MISSISSIPPIAN	BLUESTONE	Tiller Sandstone		10-50					
						Little Stone Gap Member		50-80					
						HINTON		850					
							Stony Gap Sandstone Member		200-230				
						MISSISSIPPIAN	UPPER MISSISSIPPIAN	BLUEFIELD			0-12		
GREENBRIER LIMESTONE		700-800											
		550-650											
DEVONIAN	UPPER DEVONIAN	BRALLIER SHALE									50±		Shale, bright red, thin to poorly bedded.
									BEREA SANDSTONE		650±		
											50±		
			DEVONIAN	LOWER DEVONIAN	BRALLIER SHALE						50±		Shale, black, fissile.
											50±		
											1000±		