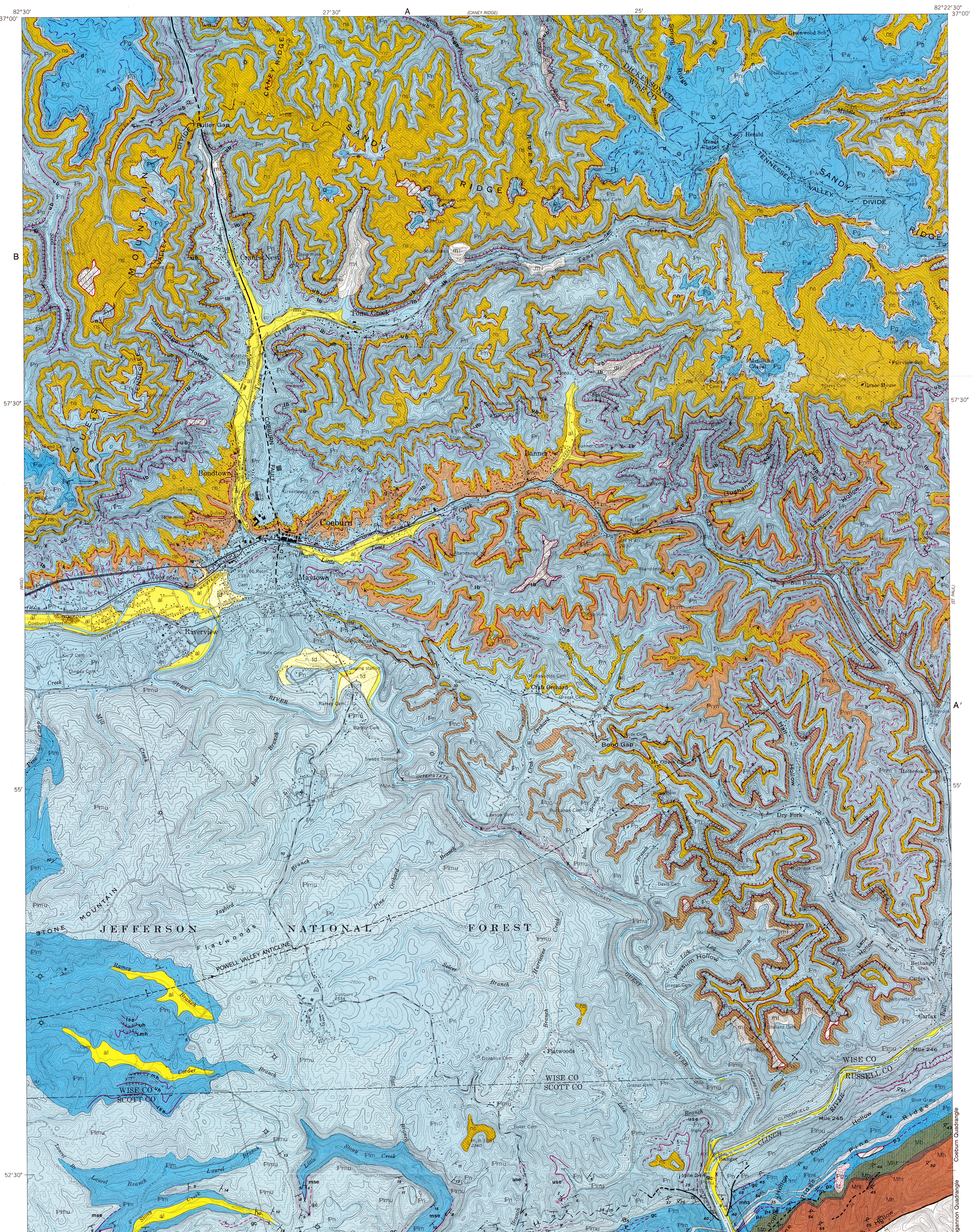
COMMONWEALTH OF VIRGINIA
DEPARTMENT OF MINES, MINERALS AND ENERGY
DIVISION OF MINERAL RESOURCES

PUBLICATION 81
GEOLOGY OF THE COEBURN QUADRANGLE AND THE COAL-BEARING PORTION OF THE DUNGANNON QUADRANGLE, VIRGINIA



Base map from U.S. Geological Survey, 1957, Coeburn and Dungannon quadrangles, 7½ minute series.

GEOLOGY OF THE COEBURN QUADRANGLE AND THE COAL-BEARING PORTION OF THE DUNGANNON QUADRANGLE, VIRGINIA

Jack E. Nolde (Coeburn Quadrangle) and Robert N. Diffenbach (Dungannon Quadrangle)

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.

SCALE 1:24 000
1 ½ 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

MN GN 3° 53 MILS 0°52′ 15 MILS
UTM GRID AND 1978 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

QUADRANGLE LOCATION

EXPLANATION

QUATERNARY
- ld — Landslide-debris deposits
- al — Alluvium
- c — Colluvium
- td — Terrace Deposits

PENNSYLVANIAN
- Pw, d — Wise Formation
  - Pw, interbedded siltstones and sandstones
  - d, Dorchester coal bed
- Pg — Gladeville Sandstone
- Norton Formation (Pn, n, ns, h, sd, ub, lb, k, Pnm, a, r, j, Pnc, use)
  - Pn, interbedded siltstones and sandstones
  - ns, unnamed sandstones
  - Pnm, McClure Sandstone Member
  - Pnc, Council Sandstone Member
  - n, Norton coal bed
  - h, Hagy coal bed
  - sd, Splash Dam coal
  - ub, Upper Banner coal bed
  - lb, Lower Banner coal bed
  - k, Kennedy coal bed
  - a, Aily coal
  - r, Raven coal bed
  - j, Jawbone coal bed
  - use, Upper Seaboard coal bed
- Lee Formation (Plmu, gc, mse, Plm, lse, uh, mh3, mh2, mh1, wc, c, Plml)
  - Plmu, Middlesboro Member, middle quartz arenite, locally contains siltstone
  - Plm, Middlesboro Member, interbedded siltstones and sandstones
  - Plml, Middlesboro Member, lower quartz arenite; locally contains siltstone
  - gc, Greasy Creek coal bed
  - mse, Middle Seaboard coal bed
  - lse, Lower Seaboard coal bed
  - uh, Upper Horsepen coal bed
  - mh3, Middle Horsepen coal bed, upper split
  - mh2, Middle Horsepen coal bed, middle split
  - mh1, Middle Horsepen coal bed, lower split
  - wc, War Creek coal bed
  - c, Carter coal bed
- Pocahontas Formation (p4, Pp, p3r, p3, sj)
  - Pp, interbedded siltstones and sandstones
  - p4, Pocahontas No. 4 coal bed
  - p3r, Pocahontas No. 3 rider coal bed
  - p3, Pocahontas No. 3 coal bed
  - sj, Squire Jim coal bed

MISSISSIPPIAN
- Mb — Bluestone Formation
- Mht, Mh, c — Hinton Formation
  - Mht, Tallery Sandstone Member
  - Mh, Little Stone Gap Member, middle red member, and Stony Gap Sandstone Member, undivided
  - c, unnamed coal
- Mbf — Bluefield Formation
- Mg — Greenbrier Limestone
- Mmp — Maccrady and Price Formations, undivided

DEVONIAN
- MDcb, be, Dcml — Chattanooga Shale
  - MDcb, Big Stone Gap Member
  - be, Berea Sandstone
  - Dcml, middle gray siltstone and lower black shale members, undivided

CAMBRO-ORDOVICIAN
- O€ — In Cross Section Only. Ordovician-Cambrian rocks, undivided

KEY

- Contacts. Dashed where approximate
- Coal Bed. Dashed where approximate

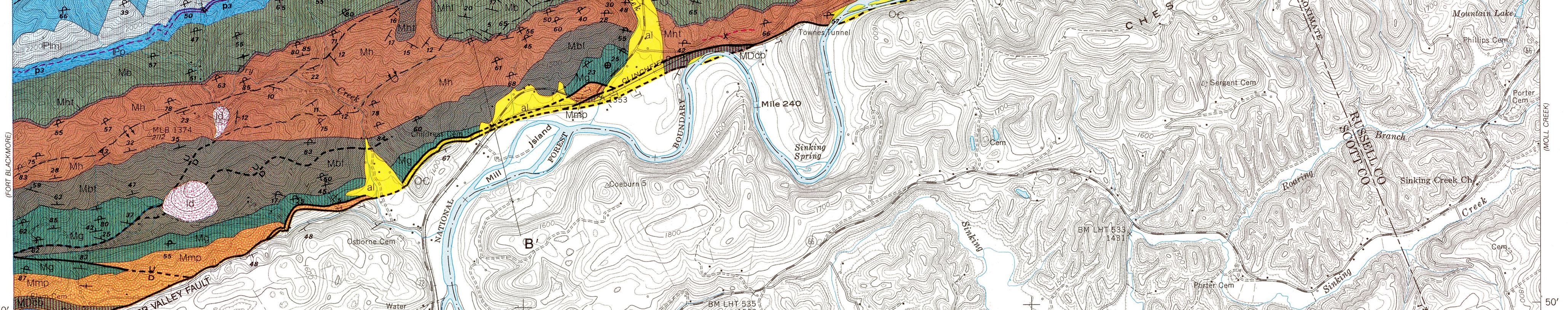
FOLDS
- Anticline trace; direction of plunge
- Syncline: axial trace
- Overturned anticline; axial trace
- Overturned syncline; axial trace

FAULTS
- U / D — Exposed (solid); approximate (dashed); T-on upper plate; U-upthrown side; D-downthrown side

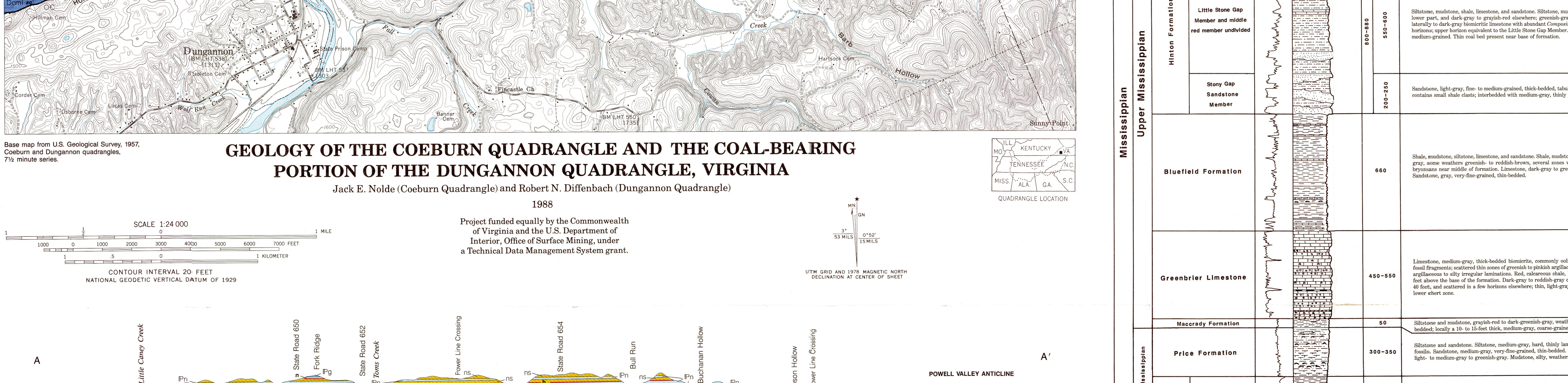
ATTITUDE OF ROCKS
- 35 — Strike and dip of beds
- Strike of vertical bed
- 20 — Strike and dip of overturned bed
- Horizontal bed

MINERAL RESOURCES
- Mine adit
- Adit of abandoned mine
- Surface mine; hachures toward highwall
- lb — Area surface mined, showing original extent of coal beds
- x — Coal outcrop or prospect
- Gas well
- Dry hole with gas show
- Dry hole
- ml — Modified land (e.g. mine dump, valley fill, and areas of extensive reclamation)

SYSTEM AND SERIES	FORMATION, MEMBER, AND BED	GAMMA-RAY LOG	LITHOLOGY	COAL THICKNESS IN INCHES	UNIT THICKNESS IN FEET	DESCRIPTION
Quaternary	Alluvium					Stratified, moderate- to well-sorted accumulations of clay, silt, sand, and pebbles with some cobbles and boulders.
	Colluvium					Nonstratified to crudely stratified, unsorted, mostly angular to subangular rock fragments in a silty clay matrix.
	Terrace Deposits					Stratified, moderate- to well-sorted deposits of rounded pebbles, cobbles, and boulders in a clay or sand matrix along hill slopes and interfluves.
Pennsylvanian, Middle Pennsylvanian	Wise Formation: Dorchester coal					Siltstone and coal. Siltstone, medium-gray to pale-brown, thin- to medium-laminated, platy.
	Gladeville Sandstone				30-40	Sandstone, quartzose to conglomeratic, very-light-gray to white, fine- to coarse-grained, thin- to very-thick-bedded, cross-bedded, friable.
	Norton Formation: Norton coal			20-48	20-40; 40-130 (310-360)	Siltstone and shale, sandstone, and coal. Siltstone; medium-gray to grayish-black, may contain nodules and lenses of siderite and black, laminated and thin-bedded shale, fissile to platy; may contain nodules and lenses of siderite. Eagle Shale Member (White, 1891), medium-gray to grayish-black, even- to ripple-laminated; linguloid shells occur locally, especially near bottom. Sandstone, medium- to light-gray, fine- to medium-grained, thin-bedded, cross-bedded, moderately indurated.
	Eagle Shale of White (1885)				100-190; 40-90; 0-50	
	Hagy coal			13-28	130-160 (300-340)	Siltstone, sandstone, shale, and coal. Siltstone, light- to medium-gray, medium-laminated to medium-bedded, platy, weathers pale-brown. Sandstone, medium-gray, fine- to medium-grained, thick-bedded. Shale, grayish-black, thinly laminated, contains bivalve and brachiopod shells; occurs 40 feet above the Lower Banner coal bed.
	Splash Dam coal			10-35	14-50	
	Upper Banner coal			22-99	30-70; 60-90	
	Lower Banner coal			15-40	220-240 (320-350)	Siltstone, sandstone, and coal. Siltstone, medium-gray, medium-laminated, fissile to platy, soft, weathers pale-brown. Sandstone, medium-gray, fine-grained, thick- to very-thick-bedded, cross-bedded and planar-bedded. McClure Sandstone Member, light- to medium-gray, fine- to coarse-grained, micaceous and feldspathic, cross-bedded.
	Kennedy coal; McClure Sandstone Member			0-33	30-60; 0-20; 60-80	
	Aily coal			17-36	70-110; 105-140 (340-360)	Siltstone, sandstone, shale, and coal. Siltstone, medium- to dark-gray, laminated, platy, nodules and lenses of siderite. Sandstone, quartzose to feldspathic, light- to medium-gray, very-fine- to fine-grained, trough cross-bedded and planar-bedded, plant debris. Shale, dark-gray to grayish-black, thinly laminated, irregular-shaped nodules and laminae of siderite. Shale below Aily coal bed contains *Lingula*.
	Raven coal			0-48	35-75; 80-120	
	Jawbone coal			5-62	50-90; 180-220 (230-310)	Siltstone and sandstone. Siltstone, light-brown and light- to dark-gray, laminated, hackly, resistant, nodules and lenses of siderite. Sandstone, quartzose to feldspathic, light- to medium-gray, fine- to medium-grained, moderately sorted, micaceous, thin- to thick-bedded, trough cross-bedded.
	Upper Seaboard coal					
Lower Pennsylvanian	Lee Formation, Middlesboro Member, middle quartz arenite: Greasy Creek coal (?)			0-33	150-250 (820-1040)	Sandstone, siltstone, and coal. Sandstone, quartzose, very-light- to light-gray, fine- to coarse-grained, moderately sorted, local conglomeratic sandstone lenses a few feet thick contain quartz pebbles as large as 1 inch in diameter. Siltstone, medium- to dark-gray, thinly laminated, 20- to 50-feet thick. Coal beds thin to discontinuous.
	Middle siltstone: Mid-Seabrd-coal (?)			9-20	500-630	Siltstone, sandstone, and coal. Siltstone, medium- to dark-gray, laminated, resistant, hackly, carbonaceous, grades locally into sandstone. Sandstone, medium-light- to light-gray, very-fine- to fine-grained, argillaceous, micaceous; locally contains quartz pebbles. Coal beds are persistent, typically 20-inches thick.
	Low-Seabrd-coal (?)			6-24		
	Up Horsepen coal (?)			6-24		
	Middle Horsepen coal			12-24		
	War Creek coal			11-58		
	Lower quartz arenite: Carter coal			0-11; 0-11	130-300	Sandstone, quartzose and conglomeratic, very-light-gray to white, fine- to coarse-grained with numerous quartz pebbles as large as 1 inch in diameter, thin- to very-thick-bedded, cross-bedded in part.
	Pocahontas Formation: No. 4 coal (?)			0-20	200-400	Siltstone, sandstone, and coal. Siltstone, medium- to dark-gray, medium-laminated, carbonaceous, abundant plant fossils; *Neuropteris pocahontas*. Sandstone, medium- to dark-gray, very-fine- to fine-grained, micaceous and carbonaceous, thin-bedded.
	Pocahontas No. 3 rider coal			8-20		
	Pocahontas No.3 coal			12-84		
? — ?	Squire Jim coal (?)			20-36		
Mississippian, Upper Mississippian	Bluestone Formation				550-650	Shale, siltstone, and sandstone. Shale, grayish-red, greenish-gray and grayish-black to black, medium- to thick-laminae, fissile. Shale in lower part of formation calcareous, fossils rare. Siltstone, medium-gray, thinly-laminated, micaceous. Sandstone, medium- to dark-gray, very-fine-grained, thin- to medium-bedded; quartz and quartzite pebbles and rock clasts at the base of the sandstone.
	Hinton Formation: Tallery Sandstone Member				40-100 (800-880)	Sandstone, light- to medium-gray, fine- to medium-grained, quartzose to argillaceous, often with quartz pebbles; quartzite pebbles and rock clasts near base.
	Little Stone Gap Member and middle red member undivided				550-600	Siltstone, mudstone, shale, limestone, and sandstone. Siltstone, mudstone, and shale, light-gray in lower part, and dark-gray to grayish-red elsewhere; greenish-gray calcareous mudstone grades laterally to dark-gray biomicritic limestone with abundant *Composita* and *Lophophyllidium* at two horizons; upper horizon equivalent to the Little Stone Gap Member. Sandstone, light- to dark-gray, medium-grained. Thin coal bed present near base of formation.
	Stony Gap Sandstone Member				200-250	Sandstone, light-gray, fine- to medium-grained, thick-bedded, tabular-planar cross-bedded; locally contains small shale clasts; interbedded with medium-gray, thinly laminated shale.
	Bluefield Formation				660	Shale, mudstone, siltstone, limestone, and sandstone. Shale, mudstone, and siltstone, light- to dark-gray, some weathers greenish- to reddish-brown, several zones with abundant brachiopods and bryozoans near middle of formation. Limestone, dark-gray to greenish-gray argillaceous micrite. Sandstone, gray, very-fine-grained, thin-bedded.
	Greenbrier Limestone				450-550	Limestone, medium-gray, thick-bedded biomicrite, commonly oolitic and peloidal with abundant fossil fragments; scattered thin zones of greenish to pinkish argillaceous to silty limestone; greenish argillaceous to silty irregular laminations. Red, calcareous shale, 10-feet thick, present about 170 feet above the base of the formation. Dark-gray to reddish-gray chert nodules abundant in lower 40 feet, and scattered in a few horizons elsewhere; thin, light-gray dolomite present at top of the lower chert zone.
	Maccrady Formation				50	Siltstone and mudstone, grayish-red to dark-greenish-gray, weathers reddish-gray, thin- to thick-bedded; locally a 10- to 15-feet thick, medium-gray, coarse-grained sandstone at the top.
Lower Mississippian	Price Formation				300-350	Siltstone and sandstone. Siltstone, medium-gray, hard, thinly laminated, fissile to platy, contains fossils. Sandstone, medium-gray, very-fine-grained, thin-bedded. Siltstones grade downward into light- to medium-gray to greenish-gray. Mudstone, silty, weathers brownish-green.
	Chattanooga Shale: Big Stone Gap Member				150-200	Shale, grayish-black to black, hard, brittle, fissile to platy, thin- to medium-laminated, scattered brachiopods and conodonts. Berea beds present about 20 feet above base; upper part light-gray, thin-bedded siltstone with light-gray, very-fine-grained sandstone; middle part dark-gray shale; lower part light-gray, medium- to thick-bedded siltstone.
	Berea Bed				100	
Upper Devonian	Middle Gray Siltstone Member				350+	Siltstone, light- to dark-gray, hard, platy, thin-bedded; interbedded with olive-gray and dark-gray, fissile to platy, hackly to splintery, thin-bedded, medium-gray shale.



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

Coeburn Quadrangle and the coal-bearing part of Dungannon Quadrangle encompass approximately 70 square miles in parts of Dickenson, Russell, Scott, and Wise counties, Virginia. Bounded on the south by the Hunter Valley thrust fault, this area is in the Appalachian Plateaus physiographic province.

STRATIGRAPHY

Approximately 6000 feet of layered rock, ranging from Early Devonian to Middle Pennsylvanian in age and locally overlain by discontinuous, thin, unconsolidated surficial deposits of Quaternary age, are exposed in the map area. These predominantly clastic strata consist of quartzarenite, feldspathic sandstone, siltstone, mudstone, and limestone in decreasing order of abundance. Quartzarenites form prominent cliffs throughout the area. Pennsylvanian-age strata contain coal beds ranging in thickness from a few inches to a few feet and locally to more than 90 inches where tectonically overthickened (Milici and others, 1982).

The boundary between the Lee and Norton formations is placed at the top of the middle quartzarenite of the Lee Formation (Miller, 1974) as the Bee Rock Member of the Lee Formation or upper quartzarenite member (Miller, 1974), which marks the top of the Lee in the type section, is not present in this area.

Previous workers (Campbell, 1893; Eby, 1923; Miller, 1969) misidentified the prominant sandstone below the Norton coal seam as the Gladeville Sandstone in eastern Wise County. Recent mapping in Wise Quadrangle identified the Gladeville Sandstone as the sandstone occurring 20 feet above the Norton coal (William Whitlock and James Lovett, oral communication, 1986), and this sandstone was traced across Coeburn Quadrangle.

Strip mining for coal has rearranged the topography locally both by removal of rock and soil overburden and by reposition of mixtures of coal, shale, siltstone, and sandstone now mapped as modified land. Current contour mining operations return mined-land surfaces to approximately original configurations.

STRUCTURE

The area mapped lies entirely on the Pine Mountain thrust block. The broad, gently eastward plunging Powell Valley anticline is bounded on the south by the overturned Stone Mountain syncline and on the north by the south flank of the Middlesboro syncline. To the south, rock formations from the Chattanooga Shale through the Norton Formation are overturned to the northwest beneath and north of the Hunter Valley thrust sheet. Structural relief on the Powell Valley anticline is the result of imbrication of lower Paleozoic strata beneath the Pine Mountain thrust fault (Harris and Milici, 1977).

Two overturned antithetic thrust faults extend northeastward from the overturned limb of the Powell Mountain syncline. These faults climb stratigraphically from the Greenbrier Limestone in the southwest to the Hinton Formation where they become kink folds on opposite sides of a rotated block. These folds die out in the Lee Formation to the northeast.

A southeastward inclined thrust fault with about 800 feet of horizontal displacement emerges from the axial portion of the Stone Mountain syncline in the southeast corner of the mapped area. The fault dies out southwestward at a point east of Little Stony Creek.

A prominent transverse flexure offsets the trend of the overturned limb of the Stone Mountain syncline near Little Stony Creek. A northwestward trending lateral thrust ramp from a lower decollement may have arched rocks along its west side prior to Hunter Valley thrusting. Alternatively, a northwestward trending wrench zone with 1200 to 1400 feet of right-lateral strike-slip displacement may explain the origin of the flexure.

Using high-altitude CIR photography and ERTS-1 imagery, Johnston and others (1975) identified a north-trending lineament near Coeburn that subsequently was named the Coeburn fault. Rocks along the Coeburn fault are intensely deformed, folded, tilted, and jointed with slickensides indicating bedding-plane slippage; however, detailed mapping revealed no significant vertical offset of strata across the fault. The exact nature of the deformed zone remains enigmatic pending access to additional core or mining data along it.

Synthetic-antithetic faults (Harris and Milici, 1977) occur in the Kennedy coal bed near Banner and in the Raven coal bed about one mile east of Maytown. Extensional joints and shear fractures with major trends N65°-70°E and N20°-25°W are present both in underground and in surface mines (Milici and others, 1982).

ECONOMIC GEOLOGY

Coal

The Pocahontas coal beds underlie most of the area but are below drainage except where they are exposed along the overturned limb of the Stone Mountain syncline. All four Pocahontas coals, which are inclined at 35 to 90 degrees, have been mined adjacent to both Little Stony Creek and Clinch River. Three exposures, 20- to 34-inches thick, of the Squire Jim coal bed, 350 to 400 feet below the Lee Formation, were measured. The Pocahontas No. 3 (Burtons Ford) coal bed, 100 to 200 feet below the Lee Formation, is 3- to 7-feet thick and mined extensively. A rider coal 9- to 20-inches thick, occurs 5 to 25 feet above the Pocahontas No. 3 at some locations. One outcrop of the Pocahontas No. 3A coal bed is about 50 feet below the lower quartzarenite of the Lee Formation. It consists of two beds, 8- and 10-inches thick, separated by 5 feet of underclay. One exposure of the Pocahontas No. 4 coal bed, directly beneath the lower quartzarenite of the Lee Formation, is 13-inches thick. Core data indicate that the Pocahontas No. 4 coal bed is discontinuous.

Core data reveal twelve coal beds, several with two or more splits, in the Lee Formation; only the seven that could be traced are shown on the map. Since Lee Formation coals rarely exceed 24 inches in thickness, except where tectonically overthickened, and many are below drainage except in the overturned limb of the Stone Mountain syncline, only four coal beds have been mined. The Lower Seaboard and Upper and Middle Horsepen coal beds were surface mined along Corder Branch. The Greasy Creek and Middle Horsepen coal beds were mined underground along Little Stony Creek and the Clinch River.

The Carter coal bed, with two splits of 8 to 11 inches and separated by 20 feet of rock, is within the lower quartzarenite about 100 feet above the base of the Lee Formation. The War Creek coal bed, 11- to 58-inches thick with 10 inches of included shale, is about 550 feet above the base of the Lee Formation. The Middle Horsepen coal bed, 12- to 24-inches thick, is about 150 feet above the War Creek. The Upper Horsepen coal bed, 6- to 24-inches thick, lies about 75 feet above the Middle Horsepen. The Lower Seaboard coal bed, at 3 to 24 inches, the Middle Seaboard at 9 to 20 inches, and the Greasy Creek at 15 to 33 inches, lie 70, 110, and 220 feet, respectively, above the Upper Horsepen. The middle quartzarenite of the Lee Formation (the upper Lee member in this area) thins from west to east, its base rising stratigraphically from the Middle Seaboard to the Greasy Creek across the southern part of the map area.

In the Norton Formation, the Upper Seaboard coal, 3- to 24-inches thick, lies about 30 feet above the middle quartzarenite of the Lee Formation. A coal bed corresponding to the Jawbone and reportedly (personal communication, local resident) 50-inches thick with a 20-inch rider 1 to 20 feet above it is about 250 feet above the middle quartzarenite of the Lee Formation. This bed and rider have been mined between Bull Run Creek and the Guest and Clinch rivers. The Raven coal bed averages 36 inches in thickness and crops out 120 to 160 feet above the Jawbone. It has been mined extensively between Dry Fork and the Guest and Clinch rivers.

The Aily (Hog Wallow) coal bed, rarely more than 24-inches thick, is 120 to 160 feet above the Raven. It was mined underground about 0.5 mile east of Coeburn. The Kennedy coal bed averages 29 inches in thickness and crops out 165 feet above the Aily coal bed. It was mined underground along Bull Run and Little Toms creeks near Banner. Lower Banner coal bed, 24- to 36-inches thick, crops out 260 feet above the Kennedy coal bed. It was mined extensively, both on the surface and underground, between Toms and Little Toms creeks.

The Upper Banner coal bed averages 60 inches in thickness and lies 140 feet above the Lower Banner. The Splash Dam coal bed is 20- to 36-inches thick and is 14 to 50 feet above the Upper Banner. These two beds, the most extensively mined in the mapped area, are generally worked together. The Hagy (Edwards) coal bed is locally 24-inches thick but is probably discontinuous. It crops out 150 to 170 feet above the Splash Dam. Mining of the Hagy coal bed has been limited. The Norton coal bed is 12- to 34-inches thick with one or more shale partings. It crops out 330 feet above the Hagy and has been extensively mined.

The Dorchester coal bed of the Wise Formation is the youngest coal preserved in the area. It ranges between 16 and 26 inches in thickness.

Oil and Gas

As of June 30, 1987, 27 oil and gas test wells had been drilled in the map area with permits granted for an additional 15. Southwestern Oil and Gas Company drilled the first exploratory well, Hagan No. 1, to 3751 feet in 1940. Gas shows were found in the Tallery Sandstone Member of the Hinton Formation ("Ravencliff sand"), in two horizons in the Greenbrier Limestone ("Big Lime"), and in the Big Stone Gap Member of the Chattanooga Shale ("Berea sand"). Initial gas flow was 110 to 250 Mcf per day. Both Hagan No. 1 and Hagan No. 3, completed in 1942 with shows of gas, were plugged and abandoned by April 1, 1942.

In the map area, thirteen wells are producing gas, seven are shut in, and seven are plugged and abandoned. Initial production ranged from shows to 539 Mcf per day, increasing to 353 to 1555 Mcf per day respectively after acidization and hydraulic fracturing. The Powell Valley anticline provides structural traps for gas south of the Guest River; to the North hydrocarbon traps are unrelated to mapped surface structure and are probably fracture or stratigraphic traps. Gas-producing zones include Devonian shales in addition to the zones mentioned above.

ACKNOWLEDGMENTS

We thank Thomas M. Gathright, II, Virginia Division of Mineral Resources, for assistance with field work, and Elizabeth V. Campbell, Virginia Division of Mineral Resources, for data from the U.S. Geological Survey NCRDS files. We appreciate drill-hole data from John C. Lydzinski and Ed Burns, Virginia Iron Coal and Coke Company; T. J. Morris and Thomas G. Boby, Consolidation Coal Company; and Roswell K. Barranco, Coastal Oil and Gas Corporation. Lydzinski, Burns, Morris, and Boby also provided valuable discussion of many coal beds. We thank Diane Davis, Virginia Division of Gas and Oil, for information on gas wells in the map area and Charles Saboites, U.S. Forest Service, for cooperation and support during mapping within the Jefferson National Forest portions of the area.

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