STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This map presents an analysis of the oil and gas resources of the Cheat Mountain Further Planning Area in the Monongahela National Forest, Randolph County, W. Va. The area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

INTRODUCTION

The Cheat Mountain Further Planning Area comprises about 7,720 acres in the Monongahela National Forest in east-central West Virginia, southeast of Elkins (fig. 1). The study area lies on a northeast-trending linear ridge bordered on the west by the Right Fork of Tygart River and on the east by Shavers Fork. It averages about 2 mi in length and 1 1/2 mi in width. Altitudes on Cheat Mountain range from about 2,550 to 3,900 ft.

STRATIGRAPHY

Paleozoic rocks of Late Devonian, Mississippian, and Pennsylvanian age crop out in the area and are overlain locally by Quaternary alluvium (Englund and others, 1981). The subsurface stratigraphy (fig. 2) in the vicinity of the Cheat Mountain Further Planning Area is interpreted from nearby deep wells (fig. 3, table 1) to include rocks of Ordovician, Silurian, and Early and Middle Devonian age. The oldest rocks penetrated by deep wells in Randolph County belong to the Trenton Group of Middle Ordovician age (Cardwell, 1974). East of Randolph County, crystalline basement has been identified from seismic data (Jacobeen and Kanes, 1975) and, in eastern West Virginia, is thought to be overlain by limestones and dolomites of Cambrian and Early Ordovician age (Perry, 1964).

Principal stratigraphic units chosen for oil and gas exploration in the vicinity of the Cheat Mountain Further Planning Area are the Ordovician carbonate rocks, the Tuscarora Sandstone of Early Silurian age, the Lower Devonian Helderberg Group and overlying Oriskany Sandstone, and the Middle Devonian Huntersville Chert. Younger rocks in the vicinity of the Cheat Mountain Further Planning Area (see fig. 2) have not produced oil and gas.

STRUCTURE

The Cheat Mountain Further Planning Area lies in the North Potomac syncline, west of the Allegheny Front in the east-central part of the Appalachian basin. The syncline extends more than 100 mi from north of Hyndman, Bedford County, Pa., across western Maryland into Pocahontas County, W. Va. (Berryhill and others, 1956; Flint, 1965; Reger, 1931; Reger and others, 1923). It trends approximately N. 25° E. and, in West Virginia, plunges gently northeast. Dips of beds in the syncline range from almost flat in the trough to as much as 17° on the limbs (Englund and others, 1981). The study area is bordered by the Elkins Valley anticline on the west and the Glady anticline on the east (fig. 3). Locally the mountains and valleys reflect the anticlines and synclines.

Rodgers (1963) suggested that when these folds were formed Devonian and Carboniferous strata slipped along a zone of décollement (a large, nearly flat-lying thrust fault) in the Silurian evaporite deposits, leaving the subjacent Paleozoic rocks and the Proterozoic basement beneath undisturbed. Gwinn (1964) and Rodgers (1970) noted that the anticlines in the vicinity of Cheat Mountain are unfaulted on the surface and highly faulted at intermediate depths. Harris and Milici (1977) showed that the décollement is controlled by contrasts in rock competency and is accompanied by ramping, splay faulting, and shattering of the more brittle rocks, which generate zones of fracture porosity.

Milici (1980) showed that the relationship of the regional structure to oil and gas producing areas is different in different regions of the Appalachian basin. Cheat Mountain is in the Foreland Fold structural province (Milici, 1980), where production is from wells in fractured anticlines. Subsurface information indicates that at Elkins Valley anticline the primary Paleozoic décollement rises along tectonic ramps from Upper Ordovician shale to Middle Silurian shale. Folds in the area are generally related to ramping of the décollement and associated splay thrusting, which thicken beds within the anticline. Faulting and fracturing associated with these structures may form traps and secondary fracture porosity.

OIL AND GAS POTENTIAL

The thermal maturity of the rocks, the rock permeability and porosity, and the production history of the vicinity were considered in determining the oil and gas potential for the Cheat Mountain Further Planning Area.

The thermal maturity of the rocks, the extent to which rocks have been heated by burial since deposition, is a factor controlling the volume of gas available from source beds and is considered an indicator of hydrocarbon potential. Results of two methods for determining thermal maturity are available for northeastern West Virginia, the fixed carbon ratio (White, 1915) and the conodont color alteration index (CAI) (Harris, Harris, and Epstein, 1978). White (1915) showed that oil and gas had not been found in the northern part of the Appalachian basin in rocks closely associated with coals having more than 65 percent fixed carbon (as do the coals of that specific part of the basin). Harris and others (1978), using conodont coloration as an indicator of the thermal maturity, determined isograds for the Appalachian basin. Their maps indicate that oil production is not anticipated in Cheat Mountain Further Planning Area because the rocks are too thermally altered; however, the thermal maturity of Ordovician and younger rocks in the area is appropriate for the occurrence of natural gas.

The presence of gas in reservoir rocks depends on adequate porosity and permeability. All production in the vicinity has required stimulation of the wells by hydraulic fracturing to increase permeability. Compaction, which may be concommitant with thermal maturation, may have reduced the original porosity and permeability in the clastic rocks thus decreasing their reservoir capacity for gas. Cheat Mountain Further Planning Area is near the southern part of the North Potomac syncline where the syncline is narrow and subsurface folding appears to be tighter. Faulting and fracturing associated with the décollement and the formation of the syncline may have created structural traps having fracture porosity with potential for containing gas derived from local source beds. Furthermore, tectonically induced fractures may have increased permeability and become pathways for migration of gas into fracture reservoirs. Fractures may also, however, allow gas to escape from poorly sealed traps. Existing data are insufficient to determine the presence or absence of reservoirs in the Cheat Mountain Further Planning Area.

Oil and gas occurrence and production from a representative sample of wells in the vicinity of Cheat Mountain Further Planning Area are shown by the well records in table 1. About 2,000 ft of Upper Devonian and younger sandstone, shale, and siltstone are exposed in and near Cheat Mountain Further Planning Area. Because most of these beds crop out on the flanks of the nearby anticlines, any gas they might have originally contained probably has migrated to the atmosphere. Oil has not been produced, and gas production has been limited chiefly to anticlines in rocks of Middle and Lower Devonian and Silurian age mostly from depths of 4,500–6,000 ft (Cardwell, 1974). Devonian formations that have yielded gas (table 1, fig. 2) include the Huntersville Chert, the Helderberg Group, and the Oriskany Sandstone. Gas has also been produced locally from the Tuscarora Sandstone of Silurian age (table 1, fig. 2). Some gas discoveries have been made recently in synclinal areas to the north in the Appalachian basin (Moser and Piotrowski, 1979). Several nearby fields are used for gas storage. In 1964 the first storage wells were drilled in Glady Field, most to the depth to encounter the Helderberg Group, to reach the greatest thickness of highly permeable rocks in order to achieve optimum deliverability of the stored gas.

Data from the post-Devonian rocks indicate no potential for oil production and little possibility of gas production in the Cheat Mountain Further Planning Area (de Witt, 1975). Data from about 6,000 ft of Devonian rocks, including about 1,000 ft of black shale, in the vicinity of Cheat Mountain indicate gas shows and gas production in anticlines (de Witt and others, 1975). Data from a 2,000-ft thickness of Silurian rocks in the area show small gas production from the Tuscarora and indicate limited potential (de Witt and others, 1975). Data from the Upper and Middle Ordovician rocks, about 1,500 ft of carbonate rock and 3,000 ft of clastic rock in the vicinity, show no production and limited potential (Miller, 1975). Regional data suggest that the Lower Ordovician and Cambrian rocks may be about 6,000 ft thick in the vicinity of Cheat Mountain, and crystalline basement may occur about 20,000 ft below sea level (Harris, 1975). No production is indicated for these rocks and their potential is unknown.

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Table 1.--*Representative wells near the Cheat Mountain Further Planning Area*

[Based on data from Cardwell (1974,1977), Martens (1939), and from the Geological Sample Log Company and the West Virginia Geological and Economic Survey well records]

County and permit number	Operator-leasee and completion date	Altitude in feet (gl=ground level, kb=Kelly bushing)	Total depth in feet	Formations or lithologic zones (depths in feet)		Remarks (depths in feet, cf = cubic feet, M = thousand, MM = million)
Pendleton-6	United Fuel Gas Co.; Ray Sponaugle No. 1. Completed 7/31/60.	2,999 kb	13,001	Trenton	0-80	Dry.
				Nealmont	80-790	Wills Mountain
				Black River	790-1,295	anticline:
				New Market	1,295-1,690	Fault at
				Beekmantown	1,690-4,265	10,035 ft;
				Copper Ridge	4,265-6,810	overturned fold
				Elbrook	6,810-10,035	(Perry, 1964).
				Fold zone	10,035-11,050	
				Martinsburg	11,050-11,472	
				Nealmont	11,472-12,165	
				Black River	12,165-12,564	
				New Market	12,564-13,001	
Pocahontas-17	Columbian Carbon Co.; M. P. Frisbie No. 1. Completed 3/12/60.	3,344 gl	6,574	Harrell	4,785-5,025	Gas well.
				Mahantango	5,025-5,578	Glady field.
				Marcellus	5,578-6,128	Fractured.
				Huntersville	6,128-6,278	Gas flow from
				Oriskany	6,278-6,478	Oriskany at
				Helderberg	6,478-6,574	90 Mcf/day.
Pocahontas-18	Columbian Carbon Co.; United States of America No. L-1 Completed 6/16/61.	3,780 gl	10,805	Tully	4,983-?	Gas well.
				Tioga	5,228-5,230	Thornwood field
				Huntersville	5,230-5,455	(Browns Mountian
				Oriskany	5,455-5,658	anticline)
				Helderberg	5,658-6,110	Fractured.
				Fault	6,110	Gas flow from
				Oriskany	6,110-6,327	Oriskany at
				Helderberg	6,327-6,998	1.0 MMcf/day.
				Tonoloway	6,998-7,595	
				Wills Creek	7,595-7,837	
				Williamsport	7,837-7,851	
				McKenzie	7,851-8,042	
				Keefer	8,042-8,058	
				Rose Hill	8,058-8,310	
				Tuscarora	8,310-8,710	
				Juniata	8,710-9,410	
				Oswego	9,410-9,520	
				Reedsville	9,520-10,805	
Pocahontas-38	Atlantic Seaboard Corp.; U.S.A.-Tr. 52. Completed 6/15/66.	3,486 gl	6,090	Tully	5,375-5,400	Gas storage well.
				Marcellus	5,400-5,700	Glady field.
				Onondaga	5,700-5,725	Acidized.
				Huntersville	5,725-5,882	Gas test
				Oriskany	5,882-6,085	9.1 MMcf/day.
				Helderberg	6,085-6,090	Shut in 6/21/66.
Randolph-1	Potter Development Co. and others; Endress Hartman No. 1. Completed 9/1/32.	1,960 gl	4,480	Tully(?)	1,037-1,088	Dry.
				Mahantango	1,088-1,200	Elkins Valley
				Marcellus(?)	1,200-1,510	anticline.
				Huntersville	1,510-1,743	Gas show from
				Oriskany	1,743-1,868	Oriskany.
				Helderberg	1,868-2,491	
				Tonoloway	2,491-3,175	
				Wills Creek	3,175-3,496	
				Williamsport	3,496-3,511	
				McKenzie	3,511-3,736	
				Keefer	3,736-3,750	
				Rose Hill	3,750-4,166	
				Tuscarora	4,166-4,480	
Randolph-2	Cumberland and Allegheny Gas Co.; Elva Simmons No. 1. Completed 12/31/40.	2,030 gl	1,816	Huntersville	1,388-1,169	Dry.
				Oriskany	1,169-1,016	Elkins Valley
				Helderberg	1,016-1,816	anticline.
Randolph-90	J. B. Ward, Jr.; J. B. Ward, Heirs, No. 1. Completed 1/20/50.	1,992 gl	1,281	Tully	303-339	Gas flow from
				Mahantango	339-954	Huntersville.
				Marcellus	954-1,270	Elkins Valley
				Huntersville	1,270-1,281	anticline.
Randolph-101	Columbian Carbon Co.; D. H. Hill-Arnold Consolidated No. 2. Completed 10/7/58.	2,920 gl		Onondaga	4,561-4,630	Gas well.
				Huntersville	4,630-4,770	Glady field.
				Oriskany	4,770-4,954	Fractured.
				Helderberg	4,954	Gas flow from Huntersville at 553 Mcf/day and Oriskany at 11,818 Mcf/day.
-101D	Deepened; Completed 1/19/60.		9,815	Helderberg	-5,540	Gas flow from
				Tonoloway	5,540-6,238	Tuscarora at
				Wills Creek	6,238-6,534	1.6 MMcf/day.
				Williamsport	6,534-6,557	Acidized.
				McKenzie	6,557-6,727	Huntersville and
				Rose Hill	6,727-7,077	Oriskany, final
				Tuscarora	7,077-7,815	flow 2.1 MMcf/day
				Juniata	7,815- ?	Shut in 7/12/60.
				Fault	8,715	
				Tuscarora	9,035-9,815	
Randolph-102	Hope Natural Gas Co.; West Virginia Board of Control No. 1. Completed 2/27/59.	2,485 gl	6,173	Huntersville	2,590-2,785	Dry.
				Oriskany	2,785-2,935	Elkins Valley
				Helderberg	2,935- ?	anticline.
				McKenzie	? -6,173	
Randolph-103	Hope Natural Gas Co.; West Virginia Board of Control No. 10228. Completed 3/9/61.	2,036 gl	13,121	Tully	2,280-2,310	Dry.
				Marcellus	? -2,475	Elkins Valley
				Tioga	2,475-2,480	anticline.
				Onondaga	2,480-2,510	Acidized.
				Huntersville	2,510-2,695	Gas shows in
				Oriskany	2,695-2,830	Lower Silurian
				Helderberg	2,830-3,460	and Ordovician;
				Rose Hill	4,906-5,703	estimated
				Tuscarora	5,703-5,917	3.0 MMcf/day.
				Juniata	5,917-7,310	
				Reedsville	7,310-10,118	
				Trenton	10,118-13,121	
Randolph-106	Holly Oil & Gas Corp.; U.S.A. Department of Interior No. BW-1. Completed 6/21/59.	2,258 gl	7,053	Marcellus	6,385-6,570	Dry.
				Huntersville	6,570-6,838	
				Oriskany	6,838-7,046	
				Helderberg	7,046-7,053	
Randolph-107	Columbian Carbon Co.; United States of America. No. G-9. Completed 8/20/59.	3,486 gl	6,386	Marcellus	5,330-5,925	Gas well.
				Onondaga	5,925-5,982	Glady field.
				Huntersville	5,982-6,142	Fractured.
				Oriskany	6,142-6,341	Gas flow from
				Helderberg	6,341-6,386	Huntersville and Oriskany at 189 Mcf/day.
Randolph-110	Columbian Carbon Co.; Julius Haddix No. 1. Completed 1/19/60.	3,025 gl	6,260	Tully(?)	5,540-5,550	Gas well.
				Onondaga	5,830-5,868	Glady field.
				Huntersville	5,868-6,015	Fractured.
				Oriskany	6,015-6,095	Final gas flow
				Helderberg	6,095-6,260	from Huntersville and Oriskany at 569 Mcf/day.
Randolph-113	Barron Kidd (Hope Natural Gas Co.); C. C. & L. E. Riggleman No. 1. Completed 1/18/62.	1,990 gl	3,225	Marcellus	1,945-2,302	Dry.
				Onondaga	2,302-2,336	
				Huntersville	2,336-2,530	
				Oriskany	2,530-2,648	
				Helderberg	2,648-3,225	
Randolph-156	Consolidated Gas Supply Corp.; Cleva McLaughlin No. 1. Completed 5/7/71.	2,070 kb	4,968	Onondaga	3,230-3,265	Dry.
				Huntersville	3,265-3,474	Elkins Valley
				Oriskany	3,474-3,665	anticline.
				Helderberg	3,665- ?	
				Wills Creek	? -4,968	
Randolph-229	Hampshire Gas Co.; 28 Bolyard Farm. Completed 8/15/80.	3,696 kb	9,300	Mauch Chunk	-762	Dry.
				Greenbrier	762-1,210	Job syncline.
				Hampshire	1,210-3,300	Nearby dry well
				Chemung	3,300-7,434	(Randolph-257;
				Brallier	7,434-8,390	altitude
				Harrell	8,390-8,437	3,784 kb ft,
				Mahantango	8,437-8,740	total depth
				Marcellus	8,740-8,806	9,365 ft;
				Tioga	8,806-8,807	completed
				Onondaga	8,807-8,907	8/11/79; drilled
				Huntersville	8,907-9,008	through similar
				Oriskany	9,008-9,265	succession.)
				Helderberg	9,265-9,300	Both wells dry and abandoned.
Tucker-A	Parsons Pulp and Lumber Co. No. 1. Completed 1912.	1,650 gl	4,250	Huntersville	3,825-3,980	Dry.
				Oriskany	3,980-4,060	
				Helderberg	4,060-4,250	
Tucker-1	Ohio Oil Co.; West Virginia Power and Transmission No. 1. Completed 7/3/44.	3,358 gl	8,036	Pocono	top- ?	Gas discovery
				Hampshire	? -1,975	well. Canaan
				Chemung	1,975- ?	Valley field
				Tully	7,320-7,340	(Blackwater
				Mahantango	7,340- ?	anticline).
				Marcellus	? -7,820	Gas flow from
				Huntersville	7,820-7,968	Oriskany at
				Oriskany	7,968-8,036	1.5 MMcf/day.
Tucker-38	Cities Service Oil Co.; L. E. Mullenax No. A-1. Completed 12/29/71.	1,767 kb	6,708	Tioga	3,541-3,571	Gas discovery
				Onondaga	3,571-3,594	well. Leadmine
				Huntersville	3,594-3,740	field (Deer Park
				Oriskany	3,740-3,860	anticline).
				Helderberg	3,860-4,455	Acidized.
				Tonoloway	4,455-4,710	Gas flow from
				Wills Creek	4,710-5,040	Tuscarora at
				Williamsport	5,040-5,210	24.8 MMcf/day.
				McKenzie	5,210-5,472	
				Rose Hill	5,472-6,455	
				Tuscarora	6,455-6,708	
Tucker-41	Traverse Corp.; W. H. Wolford No. 1. Completed 2/7/74.	3,671 kb	8,770	Tully	7,972- ?	Dry.
				Onondaga	8,466-8,512	Red Creek field
				Huntersville	8,512-8,617	(Blackwater
				Oriskany	8,617-8,770	anticline).
						Gas and salt water in Oriskany at 8,750 ft; gas estimated at 100 Mcf/day. Plugged.

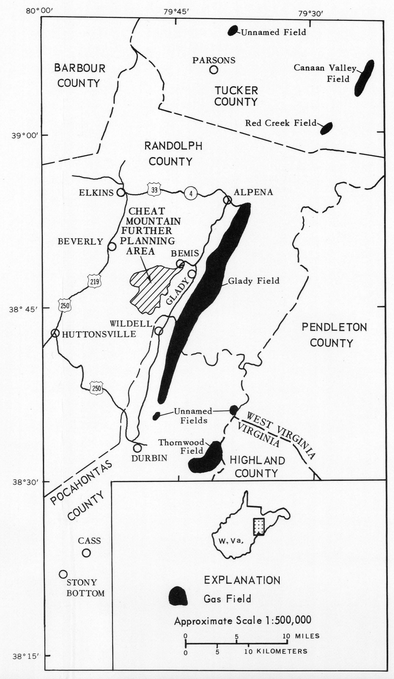

Figure 1.—Location of the Cheat Mountain Further Planning Area and nearby gas fields. Modified from Cardwell and others (1970).

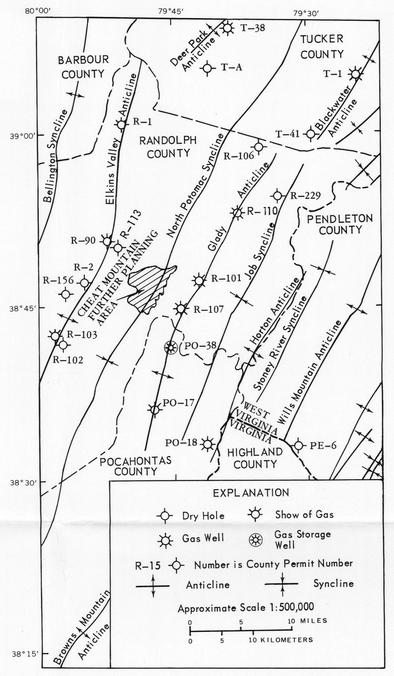

Figure 3.—Location of representative wells and anticlines and synclines near the Cheat Mountain Further Planning Area. Modified from Cardwell and others (1970) and Cardwell (1974).

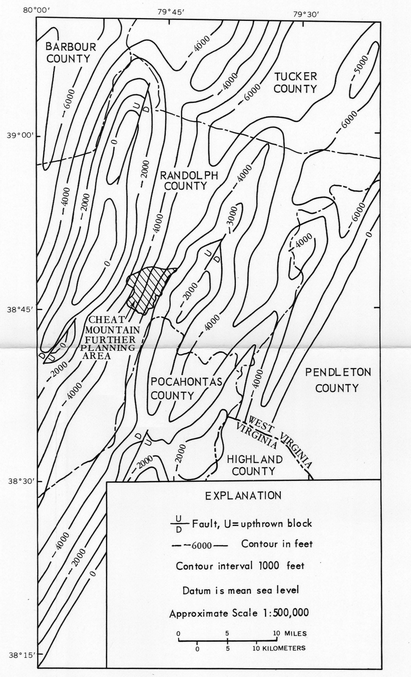

Figure 4.—Structure contour map on top of the Onondaga Limestone or its equivalents. Modified from Cardwell (1974).

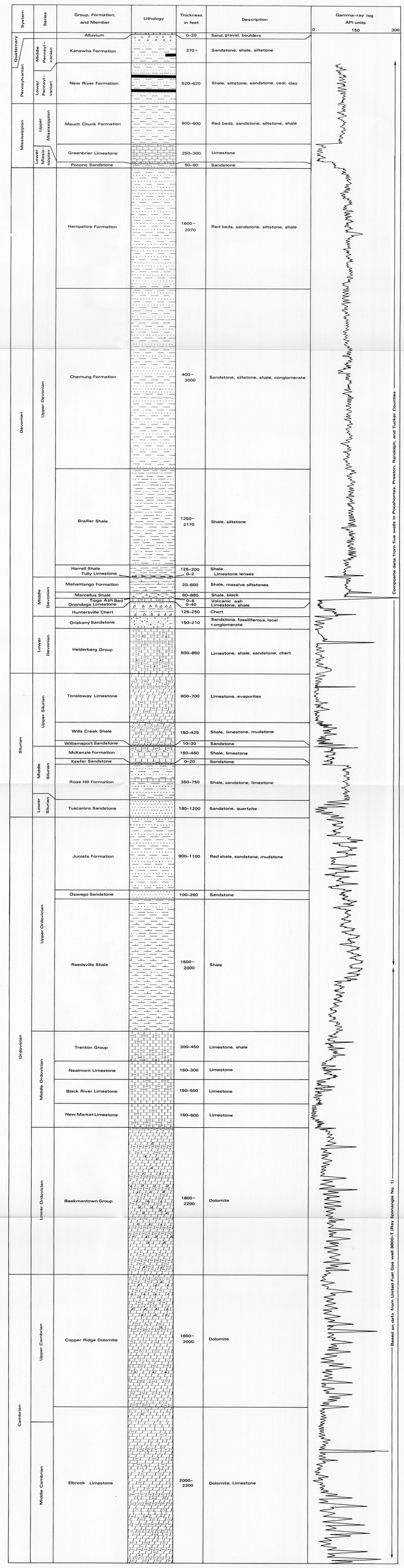

Figure 2.—Generalized geologic column of rocks in the vicinity of the Cheat Mountain Further Planning Area. The thicknesses given are for the general vicinity; the lithology is shown using average thickness estimated to underlie the North Potomac syncline in Randolph County based on data from Avary (1979), Cardwell and others (1968), Martens (1939, 1945), Patchen (1968), Perry (1964), Englund and others (1981), and Geological Sample Log Company and West Virginia Geological and Economic Survey well records.

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By
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1981

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