UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

GEOPHYSICAL LOGS AND COAL SECTIONS OF HOLES DRILLED DURING 1977 AND 1978 IN T. 16 N., Rs. 90 AND 91 W., KETCHUM BUTTES AND DOTY MOUNTAIN QUADRANGLES, CARBON COUNTY, WYOMING

By

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Open-File Report 80-643

1980

This report has not been edited for conformity with U.S. Geological Survey editorial standards or stratigraphic nomenclature.

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CONVERSION TABLE

To convert ENGLISH UNITS	Multiply by	To obtain METRIC UNITS
Inches	2.54	Centimeters
Feet	.3048	Meters

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INTRODUCTION

This report presents data obtained during 1977 and 1978 from the U.S. Geological Survey coal drilling programs in the Little Snake River coal field, southwestern Carbon County, Wyo.

The USGS drilled 31 holes in T. 16 N., Rs. 90 and 91 W., in the northwestern part of the Ketchum Buttes quadrangle and the southeastern part of the Doty Mountain quadrangle, in the southeastern part of the Little Snake River coal field (figs. 1-3), during parts of October-December 1977 and July-August 1978. This drilling was done primarily to obtain information on the depth, thickness, and extent of coal in the Upper Cretaceous Almond Formation and is part of a project to evaluate and classify coal resources on public lands in the Little Snake River coal field and adjacent areas. Previous reports on drilling in the Almond Formation in the area were presented by Barclay and Zimmerman, 1976; Barclay and Shoaff, 1977 and 1978; and Barclay, 1979a, 1979b, and 1980.

Drilling was done with truck-mounted rotary drilling rigs. In 1977, drilling was done by a private contractor; in 1978, two USGS rigs and crews were used. Most drilling was done with 4 3/4- and 5 1/8-in. roller-cone rock bits. Thick intervals of claystone were commonly drilled with drag bits. Drilling fluids used were air, water, and rarely, foam. Compressed air was used to depths where drill cuttings became too sticky from formation water to be blown from the hole. Then water, or water charged with a biodegradable foam, was injected with compressed air to aid in transport of cuttings to the surface. During drilling, cuttings believed to be representative of the rock strata were sampled. Later, each drill hole was logged by geophysical methods. Collection of samples and geophysical logging were done by USGS personnel.

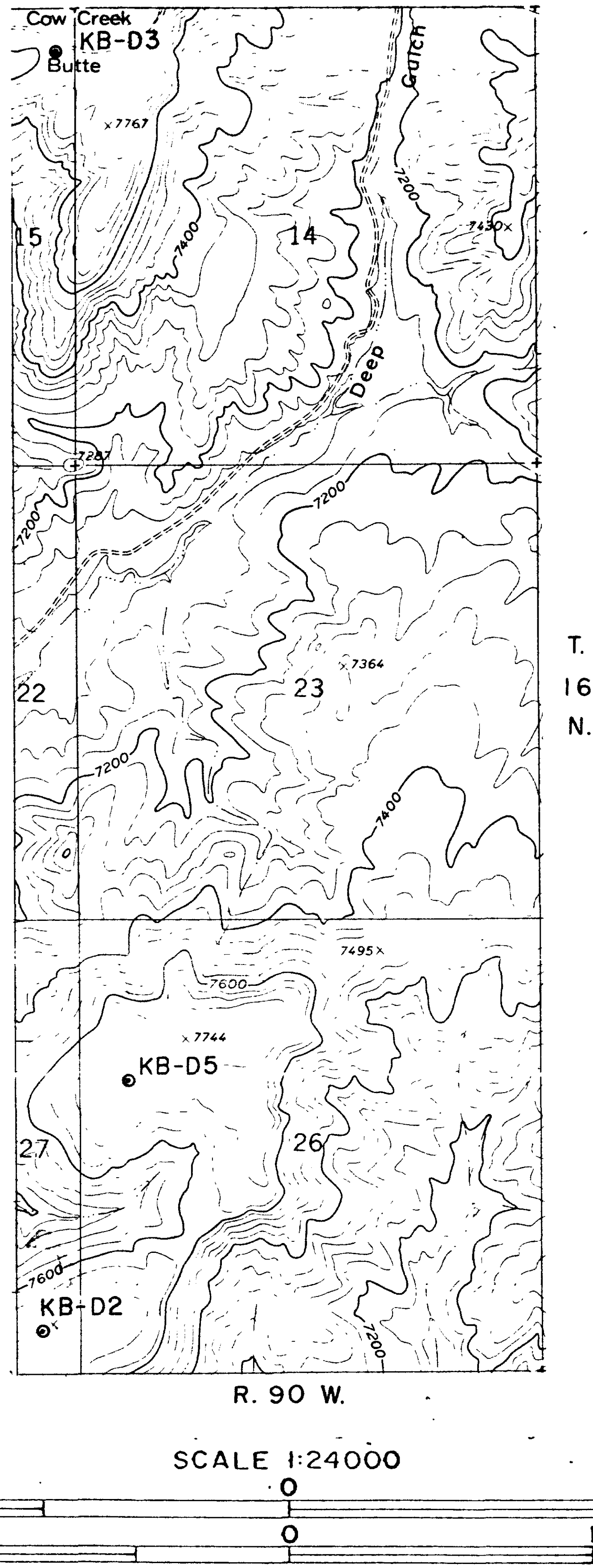

Figure 1.--Location map for holes drilled in 1977 in T. 16 N., R. 90 W., in the northwestern part of the Ketchum Buttes quadrangle, Wyo.

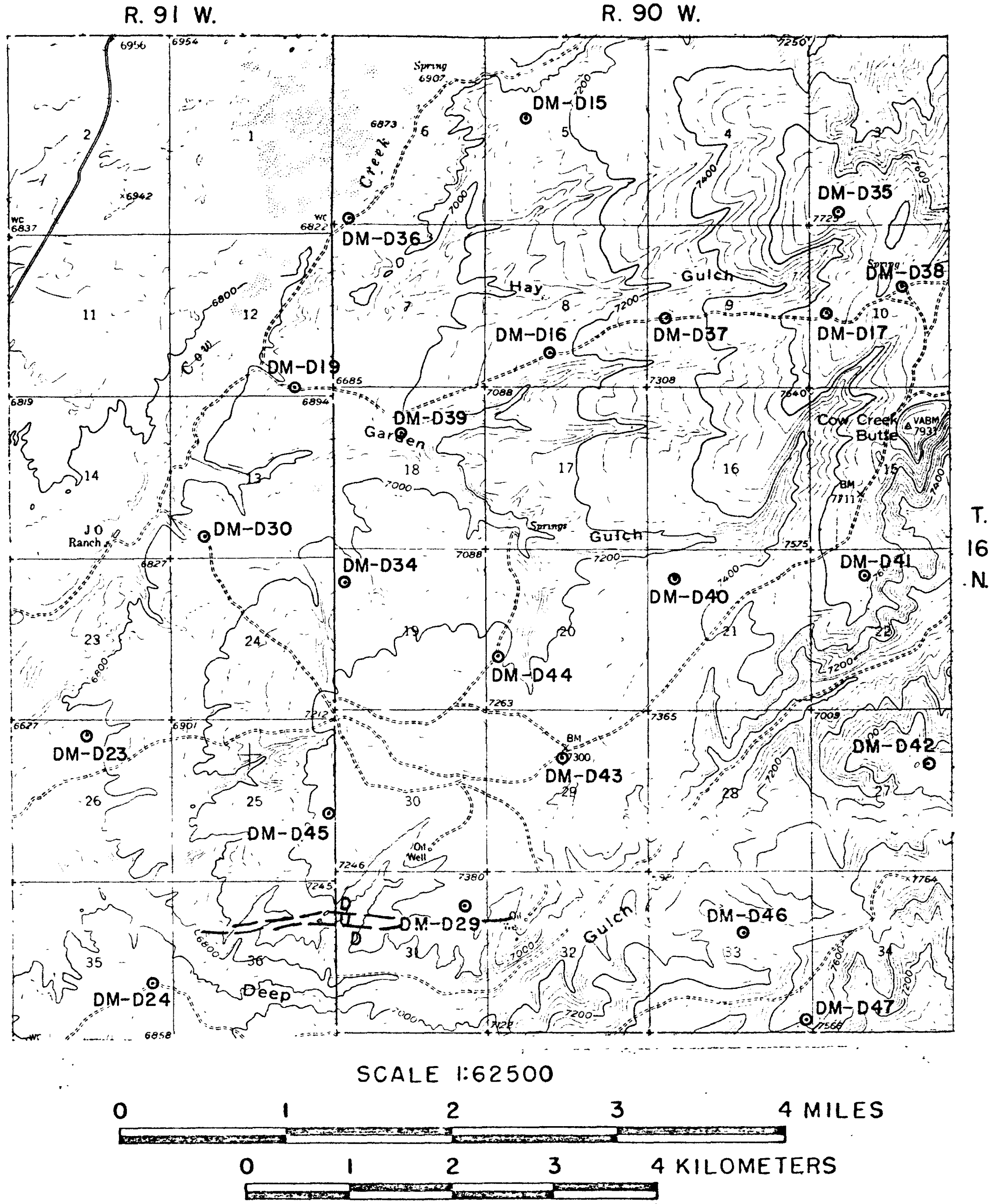

Figure 2.--Location map for holes drilled in 1977 in T. 16 N., Rs. 90-91 W., in the southeastern part of the Doty Mountain quadrangle, Wyo. Two normal faults near drill-hole DM-D29 are shown by dashed lines. Apparent displacement along the faults is noted by D (downthrown side) and U (upthrown side).

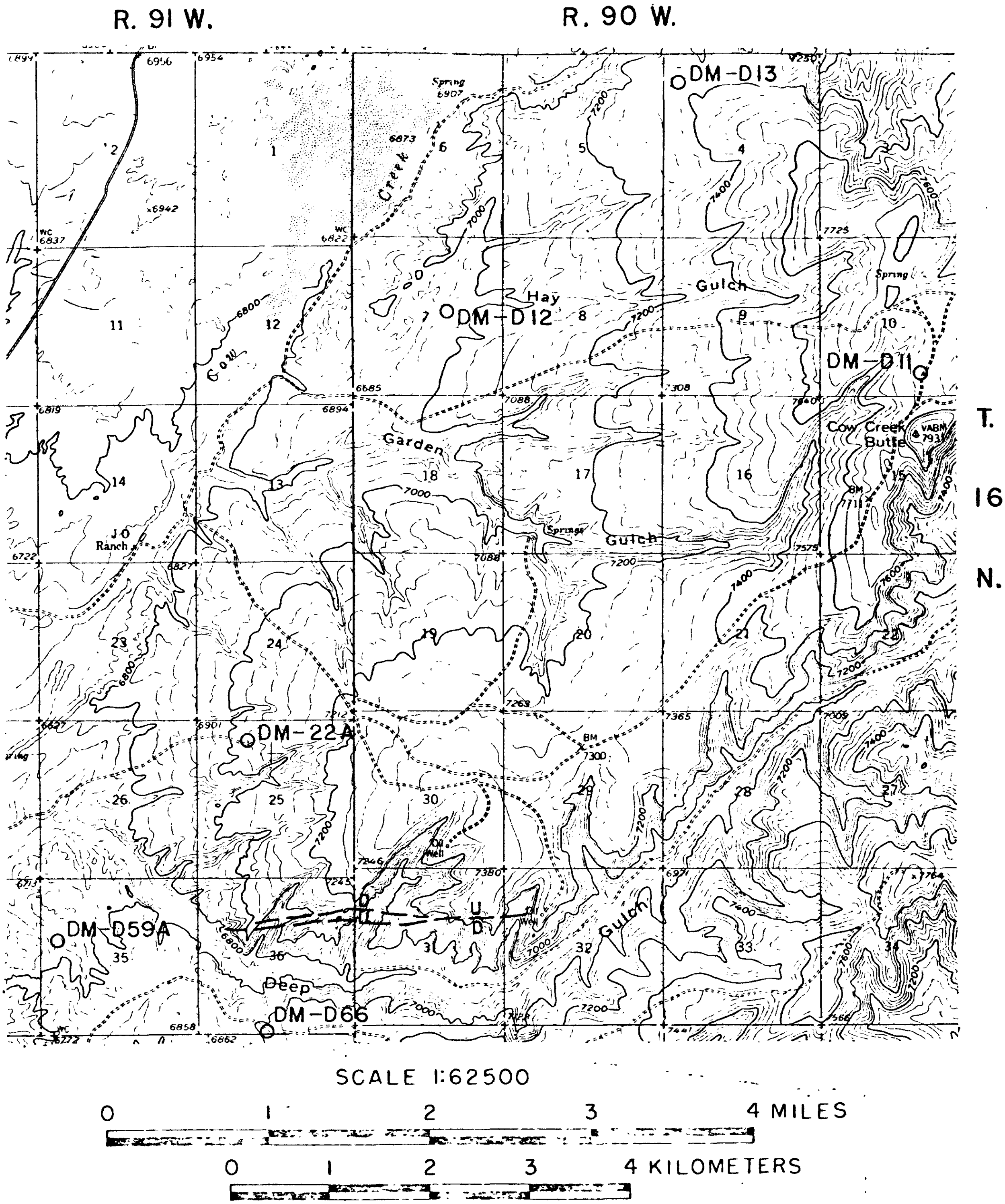

Figure 3.--Location map for holes drilled in 1978 in T. 16 N., Rs. 90-91 W., in the southeastern part of the Doty Mountain quadrangle, Wyo. Two normal faults in the bluffs bordering Deep Gulch on the north are shown by dashed lines. Apparent displacement along the faults is noted by D (downthrown side) and U (upthrouwn side).

STRATIGRAPHY OF THE DRILLED FORMATIONS

Rock strata and sediments intersected by the drill holes belong to the Mesaverde Group and the overlying Lewis Shale, both of Late Cretaceous age, the Browns Park Formation of Miocene age, and unconsolidated deposits of Quaternary age. Correlations of stratigraphic units between drill holes are shown in figure 4.

In south-central Wyoming, the Mesaverde Group consists of, in ascending order, the Haystack Mountains Formation, the Allen Ridge Formation, the Pine Ridge Sandstone, and the Almond Formation (Gill and others, 1970, p. 5). In the Little Snake River coal field, the Haystack Mountains Formation, which was not intersected in any of the drill holes discussed in this report, is 750-950 ft thick. It is a marine and marginal-marine formation of thick, alternating sandstone and shale units, and overlies the Marine Steele Shale of Late Cretaceous age, which crops out in some places in the eastern part of the Ketchum Buttes quadrangle. Single coal beds, 1-3 ft thick, occur above regressive marine sandstone of the Hatfield Sandstone, a member of the Haystack Mountains, in many places in the northern part of the Little Snake River coal field.

In most of the Little Snake River coal field, the Allen Ridge Formation is estimated to be 1,200-1,400 ft thick and consists of two informal members--a thick lower nonmarine member, and a thin, upper unit with marine affinities.

The lower member is estimated to be 1,000-1,200 ft thick and is composed largely of continental fluvial sequences of sandstone, siltstone, mudstone, and thin carbonaceous shale and coal beds. Coal beds, 1-4 ft thick, occur near the base of the formation in the southeastern part of the coal field.

The upper part is believed to range in thickness from 140 to 220 ft in the southern part of the Little Snake River coal field and from 150 to 190 ft in the area covered by this report. It consists of paralic (dominantly lagoonal-paludal?) deposits of thick, bioturbated, organic-rich brown shales, thinly bedded ripple-laminated sandstone, and coal beds. Coal beds are generally 1-3 ft thick but are as thick as 4.5 ft in this area and 6.5 ft in some places to the south and southeast; typically, they grade, both vertically and laterally, to carbonaceous shale.

The Pine Ridge Sandstone is a continental fluvial deposit consisting primarily of trough-crossbedded sandstone and minor amounts of carbonaceous siltstone and mudstone. According to Gill, Merewether, and Cobban (1970, p. 30), the Pine Ridge is probably unconformable on the Allen Ridge in most places in southern Wyoming. Although its contacts with sub- and superjacent formations are not well known, the Pine Ridge is believed to range in thickness from 40 to 120 ft in the Little Snake River coal field and to be between 45 and 90 ft thick in the area covered by this report.

The Almond Formation is 450-550 ft thick in the coal field. It is 455-480 ft thick in the area included in this report, and is composed of marginal marine and paralic deposits. In most places, the lower part is characterized by several 5-20-ft-thick coal beds, and the upper part by shale and sandstone deposited by alternating transgressive and regressive cycles, respectively, of a Late Cretaceous western interior sea.

In some places in the southeastern part of the Little Snake River coal field, the Pine Ridge Sandstone may be absent (Barclay and Shoaff, 1978; Barclay, 1979). In such places, the paralic deposits normally included in the Allen Ridge cannot be separated from similar deposits in the lower part of the Almond and are included in the Almond Formation. In these areas, the Almond may be as much as 930 ft thick and characteristically contains thick, areally persistent, marine sandstone beds.

The Lewis Shale is about 2,500 ft thick and consists of marine shale and, near the top, sandstone. About 92 ft of siltstone and clay-shale at the base of the Lewis were drilled in sec. 35, T. 16 N., R. 91 W. (DM-D59A). Thinner intervals of the basal Lewis Shale were penetrated in drill-holes DM-D23, DM-D24, and DM-D36. The Lewis Shale is overlain by the Fox Hills Sandstone in the western part of the Doty Mountain quadrangle.

The Miocene Browns Park Formation in the Little Snake River coal field overlies all older formations with angular unconformity and typically consists of a basal conglomerate and a much thicker overlying unit of clayey tuffaceous sandstone, numerous thin tuff beds, and, locally, a few thin tuffaceous limestone beds. Near the southern edge of the coal field as much as 2,000 ft of Browns Park may be preserved beneath basalt flows of the Elkhead Mountains volcanics. Erosional remnants, 5-170 ft thick, of the Browns Park cap high tablelands and buttes in the eastern part of the report area and were penetrated in drill-hole KB-D2, KB-D3, KB-D5, DM-D11, and DM-D38. The thickest drilled interval of Browns Park is in KB-D3 and consists of sandy pebble conglomerate and clayey sandstone.

Unconsolidated Quaternary deposits, 10-15 ft thick, and consisting of clay, silt, sand, and minor gravel, were drilled in DM-D36 and DM-D59A.

STRUCTURE NEAR THE DRILL SITES

Geologic structure exposed at the surface of the drill sites is generally subdued. Beds of the Almond Formation dip less than 10° in westerly directions. Drill-hole DM-D29 is near the crest of a small dome or doubly plunging (north, south) anticline in Mesaverde Group formations.

A few normal faults occur in the area. The two most prominent are north of Deep Gulch near drill-hole DM-D29. They trend about east-west and appear to bound a small horst that has a displacement of about 30 ft (figs. 2 and 3).

GEOPHYSICAL LOGS

All drill holes were logged by geophysical methods (figs. 7-128). The logs are natural gamma, gamma-gamma, neutron, single-point resistance, spontaneous-potential, 16- and 64-in. normal resistivity, and caliper. Not all logs were run in each hole. Some holes were logged with each of two different logging units and at each of two different vertical scales, 1 in. = 10 ft and 1 in. = 20 ft.

Calibration curves relating porosity and density to counts per second (cps) on the neutron and gamma-gamma logs, obtained with Well Reconnaissance logger W-236265, are given in figures 5 and 6, respectively. The calibration curves are for water-filled holes and can only be applied to those portions of the logs which were obtained below water level. The calibration curves cannot be used to determine actual porosity or density in coal. The neutron tool measures water-filled porosity by measuring the amount of hydrogen present. Coal, because it is composed largely of hydrocarbons, gives a false porosity value. The calibration curve for the gamma-gamma tool was calibrated in material of densities between 1.65 and 2.65 gm/cc and probably is not accurate for coals of the Mesaverde Group, which presumably have densities in the range of 1.3-1.5 gm/cc.

COAL IN THE DRILLED FORMATIONS

Coal beds occur in the Almond Formation and in the marine member of the Allen Ridge Formation. Depths and thicknesses of the coal beds and correlations of stratigraphic units in these holes are shown in figure 4.

Coal in the Mesaverde Group is subbituminous to bituminous in rank (Ball and Stebinger, 1910, p. 202; Hatch and Barclay, 1979).

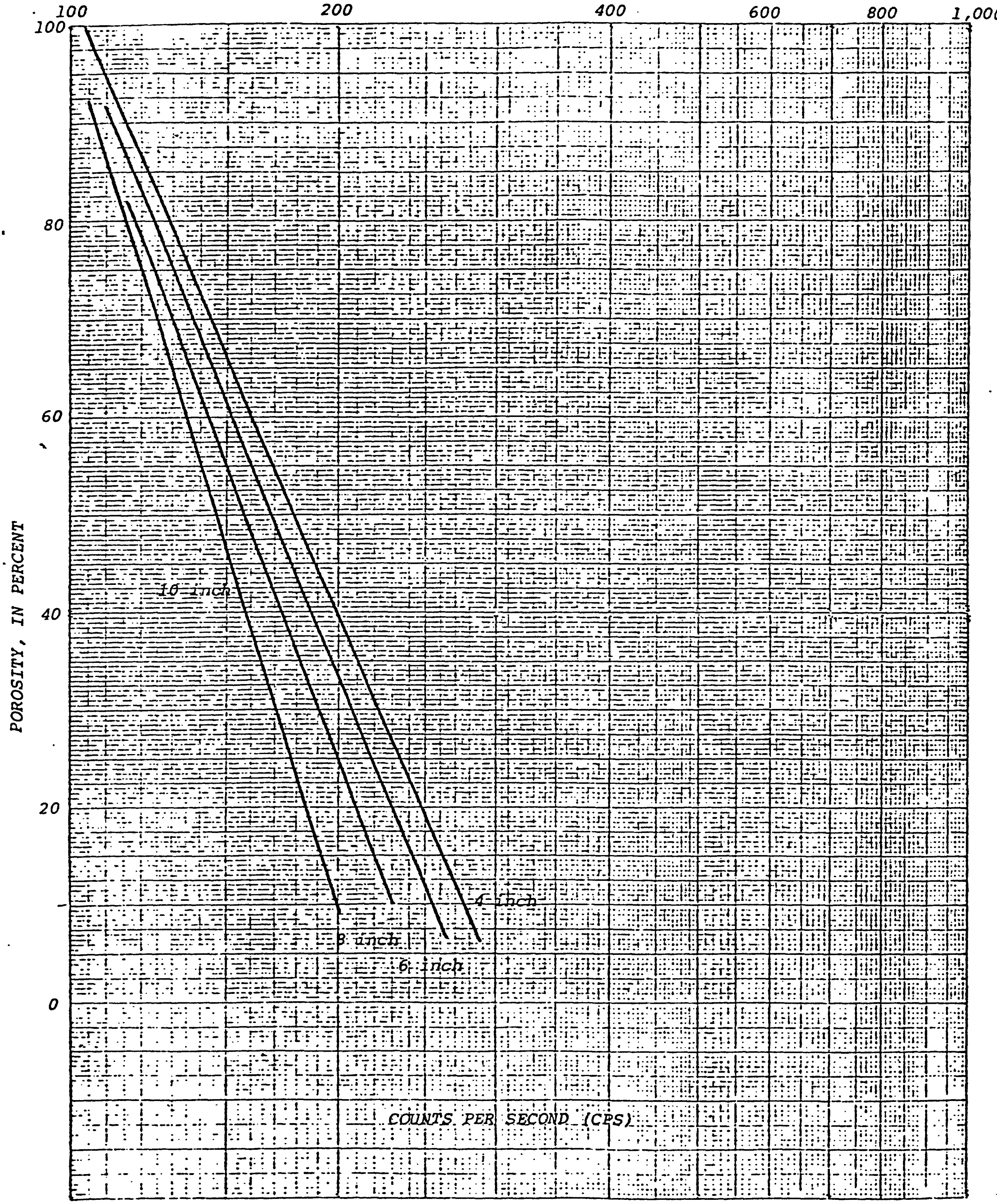

Figure 5.--Calibration curve for neutron log, well reconnaissance logger W-236265: 4-, 6-, 8-, and 10-inch water-filled drill holes.

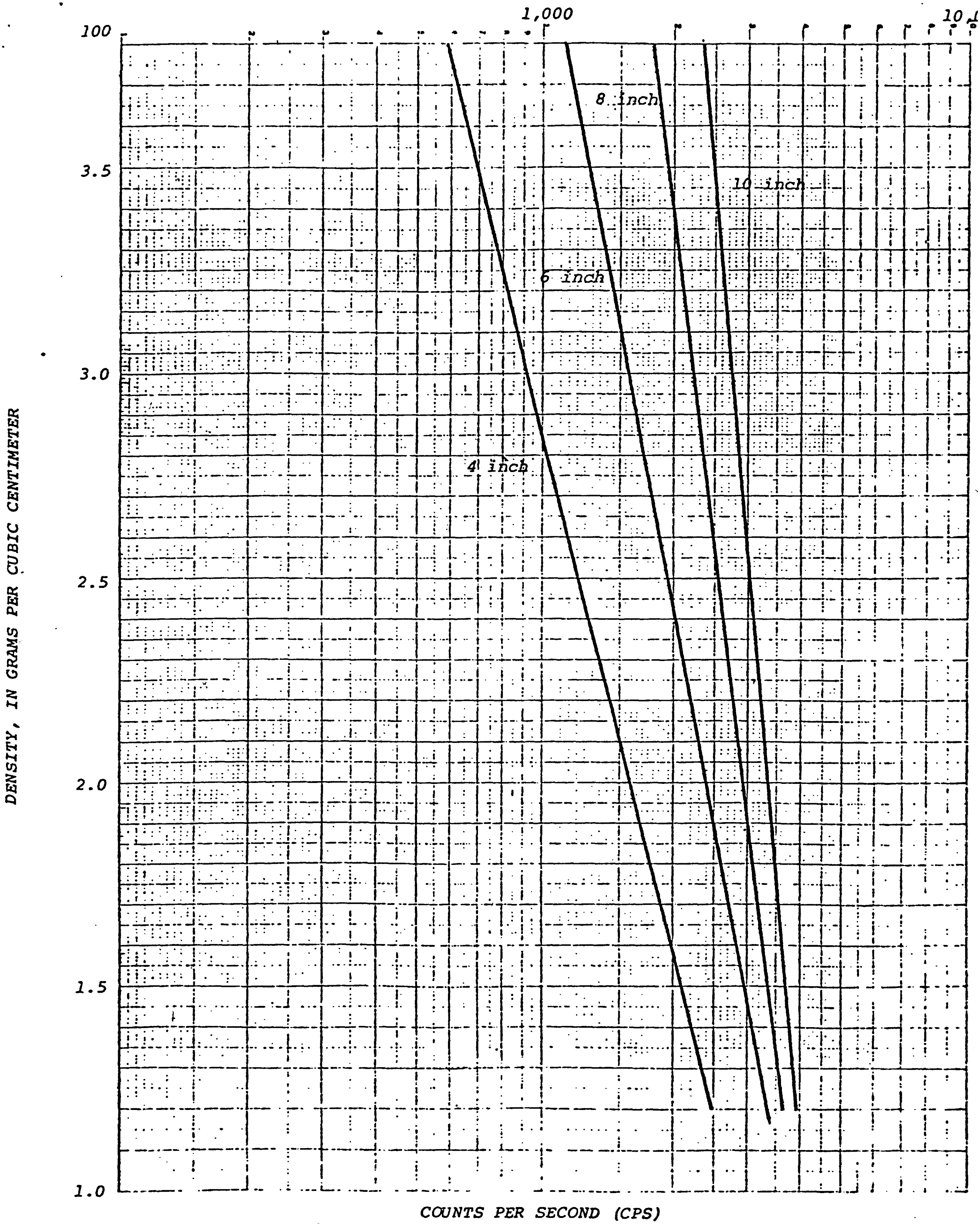

Figure 6.--Calibration curve for gamma-gamma log, well reconnaissance logger W-236265: 4-, 6-, 8-, and 10-inch water-filled drill holes.

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