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COAL RESOURCE OCCURRENCE MAPS AND COAL DEVELOPMENT POTENTIAL MAPS OF THE HUERFANO TRADING POST QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO

[Report includes 12 plates]

by

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

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HUERFANO TRADING POST 7 1/2-MINUTE QUADRANGLE

INTRODUCTION

Purpose

This text is to be used in conjunction with the Coal Resource Occurrence (CRO) Maps and the Coal Development Potential (CDP) Maps of the Huerfano Trading Post quadrangle, San Juan County, New Mexico. These maps were compiled to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) of the western United States. The work was performed under contract with the Conservation Division of the U.S. Geological Survey (Contract No. 14-08-0001-17172).

The resource information gathered in this program is in response to the Federal Coal Leasing Amendments Act of 1976 and is a part of the U.S. Geological Survey's coal program. The information provides basic data on coal resources for land-use planning purposes by the Bureau of Land Management, state and local governments, and the public.

Location

The Huerfano Trading Post 7 1/2-minute quadrangle is located in east-central San Juan County, New Mexico. It is approximately 26 miles (42 km) southeast of Farmington and 72 miles (116 km) northeast of Gallup.

Accessibility

The area is accessible by New Mexico State Route 44 which trends northwest-southeast through the quadrangle. Numerous light-duty and unimproved dirt roads branch out from State Route 44 providing access to the more remote areas. The Atchison, Topeka, and Santa Fe Railway operates a route 72 miles (116 km) to the southwest at Gallup, New Mexico, which services Gallup, Grants, and Albuquerque.

Physiography

This quadrangle is in the central part of the Central Basin area (Kelley, 1950) of the larger structural depression known as the San Juan Basin. Total relief in the area is moderate, ranging from 6,460 ft (1,969 m) in the southeast to 7,474 ft (2,278 m) on Huerfano Mountain. The greatest local relief is about 500 ft (152 m) at Huerfano Mountain. A radial drainage pattern has developed around Huerfano Mountain and, consequently, there is no major drainage direction in the quadrangle area.

Climate

The climate of the San Juan Basin is arid to semi-arid. Annual precipitation is usually less than about 10 inches (25 cm) with slight variations across the basin due to elevational differences. Rainfall is rare in the early summer and winter; most precipitation is received in July and

August as intense afternoon thundershowers. Annual temperatures range from 0°F (-18°C) to over 100° (38°C) in the basin. Snowfall occurs from November to April.

Land Status

The quadrangle is in the central portion of the San Juan Basin Known Recoverable Coal Resource Area, and the Federal Government owns the coal rights to approximately 90 percent of the KRCRA land within the quadrangle as shown on Plate 2 of the Coal Resource Occurrence Maps. No Federal coal leases occur within the quadrangle.

GENERAL GEOLOGY

Previous Work

Reeside (1924) mapped the surficial geology of the area on a scale of 1:250,000 as part of a study of the Upper Cretaceous and Tertiary formations of the San Juan Basin. More recently, Fassett and Hinds (1971) made subsurface interpretations of Fruitland Formation coal occurrences as part of a larger San Juan Basin coal study.

Geologic History

The San Juan Basin, an area of classic transgressive and regressive sedimentation, provided the ideal environment for formation of coals during

Late Cretaceous time. At that time a shallow epeiric sea, which trended northwest-southeast, was northeast of the basin. The sea transgressed southwesterly into the basin area and regressed northeasterly numerous times; consequently, sediments from varying environments were deposited across the basin. Noncarbonaceous terrestrial deposition predominated during Paleocene and Eocene time.

The first depositional evidence of the final retreat of the Late Cretaceous sea is the nearshore regressive Pictured Cliffs Sandstone. Southwest (shoreward) of the beach deposits, swamps, which were dissected by streams, accumulated organic matter which became coals of the Fruitland Formation. Deposition of organic material was influenced by the strandline as shown by both the continuity of the coal beds parallel to the north-south strandline and their discontinuity perpendicular to it to the east. The less continuous Fruitland coals appear to be noncorrelative, but are stratigraphically equivalent in terms of their relative position within the Fruitland Formation.

The brackish-water swamp environment of the Fruitland moved farther to the northeast as the regression continued in that direction. Terrestrial freshwater sediments covered the quadrangle as indicated by the lacustrine, channel, and floodplain deposits of the Kirtland Shale. This sequence of events is evidenced by both an upward decrease in occurrence and thickness of Fruitland coals and a gradational change to noncarbonaceous deposits of the Kirtland. Continuous deposition during Late Cretaceous time ended with the Kirtland. The sea then retreated to the northeast beyond the limits of the quadrangle area, and modern basin structure began to develop. An erosional unconformity developed in a relatively short time as part of the Cretaceous Kirtland Shale was removed.

Terrestrial deposition resumed in the Paleocene as represented by the Ojo Alamo Sandstone and the overlying Nacimiento Formation. Alluvial plain and floodplain deposits of the Ojo Alamo were followed by the thick, lithologically varied deposits of the Nacimiento during continuous nonmarine deposition. The Nacimiento was later exposed to erosion. The Eocene San Jose Formation was subsequently deposited over the Nacimiento erosional surface, reflecting various nonmarine environments which developed across the basin. Deposition and structural deformation of the basin then ceased, and the warped strata of the San Juan Basin have been exposed to the present time.

Stratigraphy

The formations studied in this quadrangle range from Late Cretaceous to Eocene in age. They are, in order from oldest to youngest: Pictured Cliffs Sandstone, Fruitland Formation, Kirtland Shale, Ojo Alamo Sandstone, Nacimiento Formation, and San Jose Formation. A composite columnar section on CRO Plate 3 illustrates the stratigraphic relationships of these formations and is accompanied by lithologic descriptions of the individual formations.

The Pictured Cliffs Sandstone averages 90 ft (27 m) in thickness in this area. Because the unit is persistent throughout most of the San Juan Basin and easily recognized on geophysical logs, the top was used as the datum (CRO Plate 3) for Fruitland coal correlations. The formation consists of a cream to light gray, calcareous, kaolinitic, micaceous sandstone, interbedded with gray to brown shale near the base of the unit. Intertonguing with the overlying Fruitland Formation occurs throughout the entire basin and, consequently, minor Fruitland coal beds are commonly present in the upper portion of the Pictured Cliffs Sandstone.

The major coal-bearing unit in the quadrangle, the Fruitland Formation, conformably overlies the Pictured Cliffs Sandstone. Wide variations in reported thickness are common due to an indistinct upper contact with the Kirtland Shale, but the average thickness is about 250 ft (76 m) in this quadrangle. Many authors have used various criteria for establishing the upper contact but, in general, for this study the uppermost coal in the Fruitland Formation was chosen (after Fassett and Hinds, 1971). The formation consists primarily of gray-green to gray carbonaceous shale interbedded with plant fossils and local siderite nodules, gray, micaceous siltstone, interbedded gray, calcareous, micaceous sandstone, and lenticular coal beds.

The Upper Cretaceous Kirtland Shale conformably overlies the Fruitland Formation and averages 470 ft (143 m) in thickness in this area. It consists of freshwater, gray-green to gray siltstone and thin, interbedded shale and sandstone. The formation has previously been divided into several members by various authors; however, for the purposes of this report it was not necessary to distinguish between the individual members.

The Paleocene Ojo Alamo Sandstone unconformably overlies the Kirtland Shale. It is a white to cream, coarse-grained to conglomeratic sandstone with scattered feldspar pebbles, and interbedded gray to brown siltstone and shale and averages 160 ft (49 m) in thickness in this area.

Approximately 1,200 ft (366 m) of the Paleocene Nacimiento Formation overlie the Ojo Alamo Sandstone. These rocks are exposed across most of the quadrangle where they consist of light gray-green to gray claystone and siltstone and interbedded cream, slightly arkosic, micaceous, locally conglomeratic sandstone.

The San Jose Formation of Eocene age unconformably overlies the Nacimiento Formation and crops out exclusively at the top of Huerfano Mesa. It is predominantly buff to yellow, fine- to coarse-grained, locally conglomeratic, arkosic sandstone, and brown to gray shale, and includes many lithologies gradational between the two.

Structure

The Huerfano Trading Post quadrangle is in the Central Basin area (Kelley, 1950) of the major structural depression, the San Juan Basin. The axis of the basin is about 33 miles (53 km) northeast of the quadrangle area and trends in an arcuate pattern across the northern portion of the Central Basin area (Baltz, 1967). Regional dip within the quadrangle is to the northeast at approximately 1° to 2°.

COAL GEOLOGY

Two coal beds (Fruitland 1, Fruitland 2) and a coal zone (Fruitland) were identified in the subsurface of this quadrangle (CRO Plate 1). The Fruitland 1 (Fr 1) coal bed is defined as the lowermost coal of the Fruitland Formation; it is generally directly above the Pictured Cliffs Sandstone. Above the Fruitland 1 is the Fruitland 2 (Fr 2) coal bed; the two are separated by a rock interval of 4 to 37 ft (1.2-11.3 m). The remaining coals of the Fruitland Formation are grouped together as the Fruitland coal zone (Fr zone). These coals are generally noncorrelative, discontinuous, and less than reserve base thickness (5 ft [1.5 m]); exceptions are a 7-ft (2.1-m) coal bed in drill hole 19 and a 5-ft (1.5-m) coal bed in drill hole 34 (CRO Plate 1). Due to these characteristics, derivative maps were not constructed.

Fruitland Formation coals in the central portion of the San Juan Basin are considered high volatile B to high volatile A bituminous in rank. The rank of the coal has been determined on a moist, mineral-matter-free basis with calorific values averaging 14,696 Btu's per pound (34,183 kj/kg) (Amer. Soc. for Testing and Materials, 1977). The coal is hard, brittle, and black with a bright luster. The coal readily slakes with exposure to weather; however, it stocks fairly well when protected (Bauer and Reeside, 1921; Dane, 1936). The "as-received" analyses indicate moisture content ranging from 1.4 to 4.2 percent, ash content varying from 13.4 to 31.0 percent, sulfur content less than one percent, and heating values on the order of 10,857 Btu's per pound (25,253 kj/kg). Analyses of several Fruitland Formation coals are given in Table 1 (Fassett and Hinds, 1971).

Fruitland 1 Coal Bed

Although the Fruitland 1 coal bed is correlated and mapped as a consistent horizon, as the lowermost coal of the Fruitland Formation it may actually be several different coal beds that are lithostratigraphically equivalent but not laterally continuous.

As illustrated by the structure contour map (CRO Plate 5), the coal bed dips less than 1° to the northeast. As a result of dip and topography, overburden (CRO Plate 6) varies from less than 1,700 ft (518 m) in the south-

TABLE 1

Analyses of coal samples from the Fruitland Formation

(Form of analysis: A, as received; B, moisture free; C, moisture and ash free)

U.S. Bureau Mines Lab No.	Well or Other Source	Location			Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent					Heating Value (Btu)	Remarks
		Section	T.N.	R.W.			Moisture	Volatile matter	Fixed Carbon	Ash	Sulfur		
H-16695	Century Exploration	SW¼ 21	25	9	1,620-1,625	A	4.2	31.5	33.3	31.0	0.9	9,280	
	Mobil-Rudman No. 2					B	---	32.8	34.8	32.4	0.9	9,680	
						C	---	48.6	51.4	----	1.4	14,310	
H-15776	Aztec Oil & Gas	SW¼ 12	27	10	1,900-1,905	A	2.2	40.4	44.0	13.4	0.6	12,520	
	Hanks No. 14-D					B	---	41.3	45.1	13.6	0.6	12,790	
						C	---	47.9	52.1	----	0.7	14,820	
H-13063	Aztec Oil & Gas	NW¼ 29	27	9	2,135-2,145	A	2.7	38.3	40.4	18.6	0.8	11,650	
	Hudson No. 5-D					B	---	39.3	41.6	19.1	0.8	11,970	
						C	---	48.6	51.4	----	1.0	14,800	
H-12705	Aztec Oil & Gas	SW¼ 8	27	9	2,215-2,230	A	2.2	36.7	41.2	19.9	0.8	11,440	
	Whitley No. 6-D					B	---	37.5	42.1	20.4	0.8	11,700	
						C	---	47.1	52.9	----	1.1	14,700	
H-21490	El Paso Nat. Gas	NE¼ 8	27	8	2,800-2,820	A	1.9	29.5	32.9	35.7	0.6	9,170	
	Schwerdtfeger					B	---	30.0	33.6	36.4	0.6	9,350	
	No. 20-A					C	---	47.2	52.8	----	1.0	14,700	
H-13061	Aztec Oil & Gas	SW¼ 17	28	9	1,985-1,990	A	1.4	36.1	42.1	20.4	0.8	11,670	
	Reid No. 23-D					B	---	36.6	42.7	20.7	0.8	11,830	
						C	---	46.2	53.8	----	1.0	14,920	
H-13779	El Paso Nat. Gas	NE¼ 30	28	8	2,185-2,195	A	1.9	33.7	35.1	29.3	0.6	10,270	
	Florence No. 10-C					B	---	34.3	35.8	29.9	0.7	10,460	
						C	---	48.9	51.1	----	0.9	14,920	

To convert Btu's/lb to kj/kg, multiply Btu's/lb by 2.326.
To convert feet to meters, multiply feet by 0.3048.

west to greater than 2,700 ft (823 m) at Huerfano Mountain, which is also located in the southwest quarter of the quadrangle. The isopach map (CRO Plate 4) shows the coal bed is greater than 10 ft (3.0 m) thick in the southwest. It decreases in thickness in all directions, and the coal is absent in the central to southeast, northwest, and north-central portions of the quadrangle.

Chemical Analyses of the Fruitland 1 Coal Bed - Analyses of several Fruitland Formation coals from this quadrangle and the surrounding area are given in Table 1 (Fassett and Hinds, 1971).

Fruitland 2 Coal Bed

The Fruitland 2 coal bed, informally named by the authors, has been correlated and mapped as a consistent horizon although it may actually be several different coal beds that are lithostratigraphically equivalent but not laterally continuous.

The structure contour map (CRO Plate 9) illustrates that the coal bed dips less than 1° to the northeast. Due to dip and topography, overburden (CRO Plate 10) within the coal-bearing area varies from less than 2,000 ft (610 m) throughout most of the eastern half of the quadrangle to greater than 2,400 ft (732 m) at Huerfano Mountain. The isopach map (CRO Plate 8) indicates that the coal bed is present only in the northeastern and north-central parts of the quadrangle. The coal bed is greater than 10 ft (3.0 m) thick in the northeast, and the thickness decreases in all directions.

Chemical Analyses of the Fruitland 2 Coal Bed - Analyses of several Fruitland Formation coals from this quadrangle and the surrounding area are given in Table 1 (Fassett and Hinds, 1971).

COAL RESOURCES

Coal resource data from oil and gas wells and pertinent publications were utilized in the construction of isopach and structure contour maps of coals in this quadrangle. All of the coals studied in the Huerfano Trading Post quadrangle are more than 1,670 ft (509 m) below the ground surface and, thus, have no outcrop or surface development potential.

The U.S. Geological Survey designated the Fruitland 1 and Fruitland 2 coal beds for the determination of coal resources in this quadrangle. Coals of the Fruitland zone were not evaluated because they are discontinuous, noncorrelative, and generally less than the reserve base thickness (5 ft [1.5 m]).

For Reserve Base and Reserve calculations, each coal bed was areally divided into measured, indicated, and inferred resource categories (CRO Plates 7 and 11) according to criteria established in U.S. Geological Survey Bulletin 1450-B. Data for calculation of Reserve Base and Reserves for each category were obtained from the respective coal isopach (CRO Plates 4 and 8) and areal distribution maps (CRO Plates 7 and 11) for each coal bed. The surface area of each isopached bed was measured by planimeter, in acres, for each category, then multiplied by both the average isopached thickness of the coal bed and 1,800 short tons of coal per acre-foot (13,239 tons/hectare-meter), the conversion factor for bituminous coal. This yields the Reserve Base coal, in short tons, for each coal bed.

In order to calculate Reserves, a recovery factor of 50 percent was applied to the Reserve Base tonnages for underground coal. However, in areas of underground coal exceeding 12 ft (3.7 m) in thickness, the Reserves (mineable coal) were calculated on the basis of a maximum coal bed thickness of 12 ft (3.7 m), which represents the maximum economically mineable thickness for a single coal bed in this area by current underground mining technology.

Reserve Base and Reserve values for measured, indicated, and inferred categories of coal for the Fruitland 1 and Fruitland 2 beds are shown on CRO Plates 7 and 11, respectively, and are rounded to the nearest hundredth of a million short tons. The total coal Reserve Base, by section, is shown on CRO Plate 2 and totals approximately 225 million short tons (204 million metric tons).

The coal development potential for each bed was calculated in a manner similar to the Reserve Base, from planimetered measurements, in acres, for areas of high, moderate, and low potential for subsurface mining methods. The Huerfano Trading Post quadrangle has development potential for subsurface mining methods only (CDP Plate 12).

COAL DEVELOPMENT POTENTIAL

Coal beds of 5 ft (1.5 m) or more in thickness which are overlain by 200 to 3,000 ft (61-914 m) of overburden are considered to have potential for underground mining and are designated as having high, moderate, or low development potential according to the overburden thickness: 200 to 1,000 ft (61-305 m), high; 1,000 to 2,000 ft (305-610 m), moderate; and 2,000 to 3,000 ft (610-914 m), low. Table 2 summarizes the coal development potential, in short tons, for underground coal of the Fruitland 1 and Fruitland 2 coal beds.

TABLE 2

COAL RESOURCE DATA FOR UNDERGROUND MINING METHODS FOR FEDERAL COAL LANDS
(in short tons) IN THE HUERFANO TRADING POST QUADRANGLE,
SAN JUAN COUNTY, NEW MEXICO

(To convert short tons to metric tons, multiply by 0.9072)

Coal Bed	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Fruitland 2	--	70,050,000	6,570,000	76,620,000
Fruitland 1	--	83,110,000	65,000,000	148,110,000
TOTAL	--	153,160,000	71,570,000	224,730,000

Development Potential for Surface Mining Methods

All coals studied in the Huerfano Trading Post quadrangle occur more than 1,670 ft (509 m) below the ground surface and, thus, they have no coal development potential for surface mining methods.

Development Potential for Subsurface Mining Methods

Underground coal of the Fruitland 1 coal bed has moderate development potential in the northeast and southwest parts of the quadrangle (CDP Plate 12) where the coal bed thickness varies from 5 to 10 ft (1.5-3.0 m) (CRO Plate 4) and the overburden ranges from 1,700 ft (518 m) to 2,000 ft (610 m) thick (CRO Plate 6). The Fruitland 2 coal bed has moderate development potential in the northeast quadrant where the coal bed thickness varies from 5 to 13 ft (1.5-4.0 m) (CRO Plate 8) and overburden is approximately 1,900 to 2,000 ft (579-610 m) thick (CRO Plate 10).

Coal of the Fruitland 1 has low development potential in the northeast, west-central, and northwest areas where the coal bed is 5 to 10 ft (1.5-3.0 m) thick and the overburden ranges from 2,000 to over 2,200 ft (610-671 m) in thickness. The Fruitland 2 coal bed has low development potential in the northeast part of the quadrangle. The coal bed thickness ranges from 5 to 10 ft (1.5-3.0 m) and overburden is greater than 2,000 ft (610 m) thick. Approximately half of the quadrangle area has unknown development potential (central, northwest, and southeast [CDP Plate 12]), where both coal beds are less than the Reserve Base thickness of 5 ft (1.5 m). Most of the southern part of the quadrangle has no coal development potential and includes areas with no Fruitland 1 or Fruitland 2 coal.

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