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COAL RESOURCE OCCURRENCE MAPS OF THE ARROYO CHIJUILLITA QUADRANGLE, SANDOVAL COUNTY, NEW MEXICO

[Report includes 3 plates]

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ARROYO CHIJUILLITA 7 1/2-MINUTE QUADRANGLE

INTRODUCTION

Purpose

This text is to be used in conjunction with the Coal Resource Occurrence (CRO) Maps of the Arroyo Chijuillita quadrangle, Sandoval 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 has been 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 Arroyo Chijuillita 7 1/2-minute quadrangle is located in northeastern Sandoval County, New Mexico, with Rio Arriba County to the north and McKinley County to the west. The area is approximately 81 miles (130 km) southeast of Farmington and 69 miles (111 km) northwest of Santa Fe, New Mexico. The Jicarilla Apache Indian Reservation is located in the northern third of the quadrangle.

Accessibility

The Arroyo Chijuillita quadrangle is accessible by New Mexico State Route 44 which extends east-west through the central part of the area. Unimproved dirt roads provide access to other areas of the quadrangle from Route 44. The Atchison, Topeka, and Santa Fe Railway operates a route approximately 69 miles (111 km) to the southeast of the area at Albuquerque, New Mexico.

Physiography

The quadrangle is located in the southeastern corner of the Central Basin area (Kelley, 1950) of the structural depression known as the San Juan Basin. Elevations range from 6,920 ft (2,109 m) in the southeast to 7,700 ft (2,347 m) in the Badland Hills. Mesa Chijuillita is located in the southwest and Mesa de Cuba in the southeast; smaller mesas are present throughout the area. To the north, on the Jicarilla Apache Indian Reservation, are the Badland Hills and the Continental Divide. The major drainage is Arroyo Chijuillita which drains to the south.

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 in the basin range from below 0°F (-18°C) to above 100°F (38°C). Snowfall occurs from November to April with an average of 18 inches (46 cm) in the southern part of the basin.

Land Status

The quadrangle is in the southeastern portion of the San Juan Basin Known Recoverable Coal Resource Area. The Federal Government owns the coal rights for lands covering approximately 28 percent of the quadrangle as shown on Plate 2 of the Coal Resource Occurrence Maps. No Federal coal leases occur within the area.

GENERAL GEOLOGY

Previous Work

Dane (1936) mapped the Tertiary strata within the southern part of the quadrangle as part of a study of the geology and the fuel resources of the southern San Juan Basin. In 1967, Baltz, in studying the stratigraphy of the east-central San Juan Basin, mapped the surficial geology of the area. More recently, Fassett and Hinds (1971) made subsurface interpretations of Fruitland Formation coal occurrences in the quadrangle 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 later 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 northwest-southeast strandline and their discontinuity perpendicular to it to the northeast. 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 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 erosional processes 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: the Pictured Cliffs Sandstone, Fruitland Formation, Kirtland Shale, Ojo Alamo Sandstone, Nacimiento Formation, and the 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 80 ft (24 m) thick 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 light gray to brown, fine-grained sandstone interbedded with gray shale near the base of the formation. Intertonguing with the Fruitland Formation occurs throughout the entire basin and, consequently, minor coal beds are commonly present in the upper portion of the Pictured Cliffs.

The major coal-bearing unit in the quadrangle is the Fruitland Formation. Wide variations in reported thickness are common due to an indistinct upper contact with the Kirtland Shale, but the Fruitland averages about 80 ft (24 m) thick in this quadrangle. Many authors have utilized various criteria for establishing the upper contact, but, in general, for this study the uppermost coal was chosen (after Fassett and Hinds, 1971). The formation consists primarily of dark gray to brown carbonaceous shale, interbedded white to brown, coarse-grained sandstone, and lenticular coal beds.

The Upper Cretaceous Kirtland Shale conformably overlies the Fruitland Formation and averages 100 ft (30 m) in thickness in this area. It is predominantly gray to brown shale and interbedded gray siltstone. 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 cream to light gray, locally conglomeratic sandstone with interbedded gray shale and averages 100 ft (30 m) in thickness. The upper contact of the Ojo Alamo with the Nacimiento Formation is gradational in places and difficult to determine.

Approximately 1,400 ft (427 m) of the Paleocene Nacimiento Formation overlie the Ojo Alamo Sandstone. These rocks are exposed in the extreme southwestern corner of the quadrangle where they consist of gray to brown to green siltstone and white to buff calcareous sandstone.

The San Jose Formation of Eocene age unconformably overlies the Nacimiento Formation and crops out over most of the quadrangle area. It consists of gray to orange-brown, fine- to coarse-grained, locally conglomeratic sandstone and interbedded shale and siltstone.

Structure

The Arroyo Chijuillita quadrangle is in the Central Basin area (Kelley, 1950) of the major structural depression known as the San Juan Basin. The axis of the basin is about 12 miles (19 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

One coal bed (Fruitland 1) and one coal zone (Fruitland) were identified in the subsurface of this quadrangle. The Fruitland 1 (Fr 1) coal bed is defined by the authors as the lowermost coal of the Fruitland Formation and is generally directly above the Pictured Cliffs Sandstone. Throughout this quadrangle the Fruitland 1 coal bed has a thickness less than the reserve base (5 ft [1.5 m]) as set by the U.S. Geological Survey. The upper

Fruitland Formation coals are grouped together as the Fruitland zone (Fr zone). These coals are generally noncorrelative and less than reserve base thickness.

Fruitland Formation coal beds in the southeastern part of the San Juan Basin are generally considered high volatile C bituminous in rank, although the coals vary from subbituminous A to high volatile A bituminous. The rank of the coal has been determined on a moist, mineral-matter-free basis with calorific values ranging from 11,358 to 14,545 Btu's per pound (26,419-33,832 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. The "as received" analyses indicate moisture content varying from 2.1 to 13.48 percent, ash content ranging from 19.86 to 30.49 percent, sulfur content less than one percent, and heating values on the order of 8,888 Btu's per pound (20,673 kj/kg). Analyses of several undesignated Fruitland Formation coals are given in Table 1 (Dane, 1936; Fassett and Hinds, 1971; Shomaker and Lease, 1971).

Since the Fruitland 1 and Fruitland zone coal beds are less than reserve base thickness (5 ft [1.5 m]) in this quadrangle, derivative maps were not constructed.

COAL RESOURCES

Coal resources were not calculated for the Fruitland 1 and Fruitland zone coal beds, as all of the coal beds are discontinuous and less than the reserve base thickness of 5 ft (1.5 m).

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 Section	T.N.	R.W.	Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent Moisture	Volatile matter	Fixed Carbon	Ash	Sulfur	Heating Value (Btu)	Remarks
+TH-55298	Core Sample	------	19	3	----	A	9.44	27.40	32.67	30.49	0.57	8,161	
						B	-----	30.26	36.07	33.67	0.63	9,012	
+TH-55672	Core Sample	------	19	4	----	A	11.50	36.57	32.07	19.86	0.67	9,473	
						B	-----	41.32	36.24	22.44	0.76	10,704	
+TH-57167	Core Sample	------	19	5	----	A	13.13	32.63	32.46	21.75	0.49	9,003	
						B	-----	37.56	37.37	25.07	0.56	10,364	
+TH-57168	Core Sample	------	19	5	----	A	12.05	30.39	27.96	29.60	0.59	7,870	
						B	-----	34.55	31.79	33.66	0.67	8,948	
+TH-57166	Cuttings Sample	------	19	5	----	A	13.48	29.55	28.05	28.92	0.50	7,829	
						B	-----	34.15	32.42	33.43	0.58	9,049	
H-32405	El Paso Nat. Gas Lindrith No. 42	NE¼ 22	24	3	3,194-3,205	A	2.1	38.7	36.7	22.5	0.7	10,990	
						B	-----	39.5	37.5	23.0	0.7	11,230	
						C	-----	51.3	48.7	-----	1.0	14,580	

+analysis by Commercial Testing and Eng. Co.

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.

COAL DEVELOPMENT POTENTIAL

Coal development potential maps were not developed for this quadrangle because all of the coal beds within the KRCRA are less than the reserve base thickness (5 ft [1.5 m]) and, therefore, have unknown coal development potential.

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