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COAL RESOURCE OCCURRENCE MAPS OF THE SOUTHWEST QUARTER OF THE CASTLE DALE 15-MINUTE QUADRANGLE EMERY COUNTY, UTAH

(Report includes 3 plates)

By

AAA Engineering and Drafting, Inc.

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INTRODUCTION

Purpose

This report was compiled to support the land planning work of the Bureau of Land Management and to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) in the Western United States. It supplements the land planning requirements of the Federal Coal Leasing Amendments Act of 1976 (Public Law 94-377) sec. (3)(B) which states, in part, that "Each land-use plan prepared by the Secretary [of the Interior] (or in case of lands within the National Forest System, the Secretary of Agriculture pursuant to subparagraph (A) (i)) shall include an assessment of the amount of coal deposits in such land, identifying the amount of such coal which is recoverable by surface mining operations."

This text is to be used in conjunction with the Coal Resource Occurrence (CRO) Maps (3 plates) of the Southwest Quarter of the Castle Dale 15-minute quadrangle, Emery County, Utah (U.S. Geological Survey Open-File Report 79-1005).

Published and unpublished public information were used as data sources for this study. No new drilling nor field mapping were done to supplement this study. No confidential nor proprietary data were used.

Location

The Southwest Quarter of the Castle Dale 15-minute quadrangle is located in the south-central part of the Wasatch Plateau coal field in Emery County in central Utah. The town of Ferron lies on the east side of the quadrangle. The town of Castle Dale is the county seat of Emery County and is 8.5 miles (13.7 km) northeast of the quadrangle. The local industrial center is the city of Price, approximately 37 miles (59.5 km) northeast of the quadrangle.

Accessibility

Utah Highway 10 crosses the east side of the quadrangle in a north-south direction through the town of Ferron. This highway connects many of the towns along the east side of the Wasatch Plateau from the city of Price on the north to the town of Emery on the south.

A dirt road runs westward from the town of Ferron up Ferron Canyon. Another dirt road cuts across the southwest corner of the quadrangle connecting Bills Fork to Sage Flat. The mountainous area in the west half of the quadrangle is rugged, steep, and generally inaccessible.

A main line of the Denver and Rio Grande Western Railroad passes through the city of Price and provides rail connections to Salt Lake City, Utah and Denver, Colorado.

Physiography

The Wasatch Plateau is a high and deeply dissected tableland. The eastern margin forms a sweeping stretch of barren sandstone cliffs some 80 miles (129 km) long. The strata have gentle dips, generally less than 10 degrees, and erosion has produced ledges and cliffs along the plateau front and on the steep walls of re-entrant canyons.

The Wasatch Plateau cliffs extend from north to south along the west side of the quadrangle. The area east of the cliffs is occupied by a foothill zone of low hills and shallow washes. The east side of the quadrangle is the flat to gently sloping surface of Castle Valley.

The total relief in the quadrangle area is over 2,980 ft (908 m). The low point of 5,870 ft (1,789 m) is on Ferron Creek where it leaves the eastern edge of the quadrangle. The high point on Sage Flat near the western side of the quadrangle is 8,852 ft (2,698 m) above sea level.

The coal outcrops in the quadrangle generally occur between the elevations of 7,500 and 7,700 ft (2,286 and 2,347 m), but coal beds in fault blocks may be found at other altitudes.

The major drainage in the quadrangle is Ferron Creek which flows eastward from the high plateau area, past the town of Ferron and empties into the San Rafael River approximately 12 miles (19 km) east of the quadrangle.

Climate

The Wasatch Plateau has a mid-latitude steppe climate with semi-arid conditions prevailing in the lower elevations around the mountainous area. The normal annual precipitation in the quadrangle ranges from 8 inches (20 cm) or less in the southeast corner to approximately 17 inches (43 cm) in the southwest corner (U.S. Department of Commerce (1964)). Much of the precipitation falls as snow in the higher areas during the winter months. Occassional late summer cloudburst storms in the mountains may create flash floods in the narrow canyons and washes at the lower elevations.

Recorded temperature extremes at the town of Ferron are 97 degrees F (36 degrees C) and -15 degrees F (-26 degrees C) (U.S. Department of Commerce, 1957). The temperatures in the high mountainous areas to the west are approximately 10 to 15 degrees F (5.6 to 8.3 degrees C) lower than those observed at Ferron.

Land Status

The Southwest Quarter of the Castle Dale 15-minute quadrangle is in the south central part of the Wasatch Plateau Known Recoverable Coal Resource area (KRCRA). The KRCRA only covers a small area in the northwest quarter of the quadrangle (see plate 2) and includes approximately 1,100

acres (445 ha). About 200 acres (81 ha) of the KRCRA are non-Federal land and 900 acres (364 ha) are unleased Federal coal land. There were no Federal coal leases in the KRCRA area of the quadrangle at the date the land source data was obtained (1977).

GENERAL GEOLOGY

Previous Work

Spieker (1931) mapped the geology and coal outcrop traces of the Wasatch Plateau and his maps have been the most detailed original work available until recently when some of the quadrangles in the area were re-studied (Sanchez and Hayes, 1977; Hayes and Sanchez, 1977; Marley and Flores, 1977; Marley, Flores, and Carovac, 1978; and Marley, 1978). Doelling (1972) summarized the geology and assembled the availabe coal data for the coal field. The stratigraphy of the area has also been described by Spieker and Reeside (1925), Katich (1954), and Hayes and others (1977).

Stratigraphy

The coal beds of economic importance in the Wasatch Plateau field are Upper Cretaceous in age, and are confined to the Blackhawk Formation of the Mesaverde Group. This group includes, in ascending order, the Star Point Sandstone, Blackhawk Formation, Castlegate Sandstone, and the Price River Formation. The Upper Cretaceous Mancos Shale underlies the Mesaverde Group and consists of the Tunuk Shale Member at the base succeeded by the Ferron Sandstone Member, Blue Gate Shale Member, Emery Sandstone Member, and the Masuk Shale Member. Only the Blue Gate, Emery, and Masuk members are exposed on the east side of the quadrangle below the cliffs of the Mesaverde Group.

The Tertiary strata in the quadrangle which overlie the Mesaverde Group consist of two formations of the Wasatch Group, the North Horn Formation and the Flagstaff Limestone. The North Horn Formation is Upper

Cretaceous and Paleocene in age and the Flagstaff Limestone is Paleocene.

The oldest stratigraphic unit exposed in the quadrangle is the Blue Gate Shale Member of the Mancos Shale. This member crops out in the eastern third of the quadrangle and consists of bluish-gray marine mudstone and siltstone. Only the upper half of the 1,700 ft (518 m) thick unit is exposed (Doelling, 1972). The overlying Emery Sandstone Member is 450 ft (137 m) thick and consists of two 50 ft (15 m) thick sandstone tongues separated by a thick blue-gray shale interval. The Masuk Shale Member is about 900 ft (274 m) thick and overlies the Emery Sandstone Member.

The Star Point Sandstone is about 400 ft (122 m) thick and in the quadrangle to the north it is a well-defined, massive, cliff-forming, yellowish-gray sandstone. In this quadrangle the unit is less massive than to the north and is well bedded and is less easily distinguished from the overlying Blackhawk Formation. The Blackhawk consists of sandstone interbedded with shale and coal beds. It forms step-like outcrops and is 750 ft (229 m) or more in thickness.

The Castlegate Sandstone is from 150 ft (46 m) thick and consists of massive white to gray coarse-grained and gritty sandstone with some conglomerate. It generally forms a prominent cliff. The overlying Price River Formation has a similar sandstone lithology, but contains some interbedded shale and does not form cliffs. The Price River Formation is 200 ft (61 m) thick and caps Nelson Mountain. The Price River Formation is less resistant and less massive than the Castlegate Sandstone.

In the quadrangle area the North Horn Formation and the Flagstaff Limestone form the top of the plateau on Sage Flat. The North Horn Formation consists of variegated shale with subordinate amounts of sandstone, conglomerate, and freshwater limestone. The Flagstaff consists of yellowish-gray, resistant, ledge-forming limestone.

Structure

The Joes Valley fault system consists of a series of north-south trending faults along the west side of the quadrangle. The faults have cut the coal-bearing Blackhawk Formation into narrow strips. The west side of the fault zone is in the adjoining Flagstaff Peak quadrangle. The rocks between the east and west bounding faults have mostly collapsed to form a series of grabens and horsts. The strata have gentle dips except locally in the narrow fault blocks. The rocks near the faults may be jointed and drag-folded.

COAL GEOLOGY

The chief coal beds in the southern part of the Wasatch Plateau coal field occur in the lower section of the Blackhawk Formation. Spieker (1931) described the Hiawatha and Upper Hiawatha beds in the lower of two groups of coal beds and the Muddy No. 1 and Muddy No. 2 beds in the upper group of coal beds. The Hiawatha bed was recognized as the one immediately above the Star Point Sandstone which was mapped as a continuous ledge-forming unit.

At none of the measured sections within the KRCRA in the quadrangle area were any of the coal beds over 5 ft (1.5 m) thick which is the minimum coal thickness for Reserve Base calculations. Therefore, no derivative maps were made for any of the coal beds occurring in this quadrangle.

Intervals reported as "bony coal," "bone," "shaly coal," or other similar terms in the data sources are shown as "rock" intervals in this report on plates 1 and 3. These intervals were not included in the coal thicknesses used to construct the coal isopach maps.

Muddy No. 1 and Muddy No. 2 Coal Beds

The Muddy No. 1 and Muddy No. 2 have only been measured at index location number 19 on plate 1. The section was measured by Spieker (1931) and at that point the Muddy No. 1 bed was 3.9 ft (1.2 m) thick and the Muddy No. 2 consisted of a 1.2 ft (0.4 m) bed and a 1.0 ft (0.3 m) bed separated by a 0.3 ft (0.1 m) rock interval. Without additional points of measurement for these coal beds it is difficult to describe thickness trends for these bed in the immediate area.

Upper Hiawatha Coal Bed

The Upper Hiawatha coal bed was measured at 12 locations in the northwest quarter of the quadrangle and at one location in the southwest quarter. In 5 of the measured sections the bed is split by rock seams and at all the measured sections within the KRCRA of the quadrangle area the bed is less than Reserve Base thickness 5.0 ft (1.5 m). At index location number 5 on plate 1 the Upper Hiawatha coal bed includes 5.1 ft (m) of coal but the measured point lies outside the KRCRA. Therefore, no coal isopach nor other derivative maps were made for this coal bed.

Hiawatha Coal Bed

The Hiawatha coal bed is the most prominent and widespread coal bed in the quadrangle. The outcrop trace of this bed was mapped by Spieker (1931) and extends from the north boundary to the south part of the quadrangle. No measurements of over 5.0 ft (1.5 m) in thickness for a single bed have been reported in the quadrangle area. In the south part of the quadrangle the Hiawatha is split into two or three separate thin beds. Northward the

bed thickens to 13.3 ft (4.1 m) in the adjoining Northwest Quarter of the Castle Dale 15-minute quadrangle to the north. The bed thickens westward to 12.6 ft (3.8 m) in the adjoining Flagstaff Peak quadrangle on the west.

Chemical Analyses of the Coal

No chemical analyses of coal samples from the quadrangle area are available. Spieker (1931, p. 71) shows two analyses of coal from the Hiawatha bed in the adjoining quadrangle to the north as shown in table 1.

Table 1. Proximate analyses of coal from the Hiawatha coal bed in the Northwest Quarter of the Castle Dale 15-minute quadrangle, Emery County, Utah.

	As Received (percent)	
Laboratory No.*	(86403)	(86404)
Moisture	6.8	6.4
Volatile matter	41.0	41.0
Fixed carbon	47.0	46.3
Ash	5.2	6.3
Sulfur	0.6	0.8
Btu/lb**	12,490	12,270

*Spieker, 1931, p. 71
**To convert Btu/lb to Kj/kg multiply by 2.326

Based on the ASTM classification of coal (American Society for Testing and Materials, 1977) the coal of laboratory sample no. 86403 is ranked as high volatile B bituminous and the coal of laboratory sample no. 86404 is high volatile C bituminous coal.

Mining Operations

No extensive mining has been conducted in the quadrangle area, but Spieker (1931, p. 174) noted two prospects in the northwest corner of the quadrangle which he described as follows:

"In Biddlecome Hollow two mines have been driven on a bed, probably about 25 feet above the Star Point Sandstone, in one of the narrow fault blocks west of the Paradise fault. These mines are about half a mile by road from Ferron Canyon and about 6½ miles from the town of Ferron. . .Both mines are about 50 feet above the bottom of Biddlecome Hollow.

"The southern of the two mines consists merely of an entry which has been driven N. 50° W. about 50 feet to a fault that cuts the coal off completely . . .

"The northern mine, the mouth of which is about 270 feet N. 15° E. of the southern one, has been driven N. 45° W. about 100 feet, and one room has been turned to the south. The entry ends against the same fault as that in the other mine. . ."

Doelling (1972) reports that the coal beds are thin at the localities of the prospects described above. One bed is 3.5 ft (1.1 m) thick, but about 5 ft (1.5 m) of coal are available if two beds are mined. He also reports that the upper bed is resinous and that the amount of coal mined is estimated to be less than 1,000 short tons (907 metric tons).

COAL RESOURCES

Inasmuch as no coal-bed measurements over 5 ft (1.5 m) thick are known within the KRCRA boundary of this quadrangle, no derivative maps (coal isopach, structure contour, overburden isopach, and areal distribution and identified resources map) were made.

COAL DEVELOPMENT POTENTIAL

Development Potential for Surface Mining Methods

No development potential for surface mining methods exists in the area of this quadrangle because of the rugged topography, steep-sided canyons, extreme relief, and thick overburden. There may be very small areas where

some rim stripping could be done, but in general the area is not conducive to surface mining methods.

Development Potential for Subsurface Mining and In Situ Coal Gasification Methods

Development potential maps for subsurface mining methods were not made because the entire quadrangle KRCRA area covered by unleased Federal coal lands is considered to have an unknown development potential where coal beds less than 5 ft (1.5 m) thick and occur at depths of less than 3,000 ft (914 m) below the surface. Therefore no Reserve Base tonnage for coal exists in the KRCRA area of this quadrangle.

The in situ coal gasification methods of development potential classification are based on the dip and depth of coal beds having a minimum thickness of 5 ft (1.5 m). There are only two development potential classifications--moderate and low. The criteria for in situ coal gasification include coal bed dips of 15 to 90 degrees and coal depths of 200 to 3,000 ft (61 to 914 m).

Inasmuch as the coal beds dip less than 15 degrees in the Standardville quadrangle, the in situ coal gasification methods of development potential classification do not apply.

Table 2. Sources of data used on plate 1.

Source Reference	Plate 1 Index Number	Data Base: Measured Section No.	Data Base: Page or Plate No.
Spieker, 1931	1	408-B	pl. 25
	2	407-A,407-B	pl. 25
	3	409	pl. 25
	4	411	pl. 25
	5	410	pl. 25
	6	20 ft. S. of 410	pl. 25
	7	415	pl. 25
	8	412	pl. 25
	9	413	pl. 25
	10	414	pl. 25
	11	440-A,440-B	pl. 25
	12	441-A,441-B	pl. 25
	13	443	pl. 28
	14	444	pl. 28
	15	445	pl. 28
	16	446	pl. 28
	17	447	pl. 28
	18	448	pl. 28
	19	449,449-A	pl. 28, p. 179

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