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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE SOUTHEAST QUARTER OF THE HIAWATHA 15-MINUTE QUADRANGLE EMERY COUNTY, UTAH

(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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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 the 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 deep mining operations and 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 (11 plates) and the Coal Development Potential (CDP) Map (1 plate) of the Southeast Quarter of the Hiawatha 15-minute quadrangle, Emery County, Utah (U.S. Geological Survey Open-File Report 79-1001).

Published and unpublished public information were used as data sources for this study.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 Southeast Quarter of the Hiawatha 15-minute quadrangle is located on the east side of the central part of the Wasatch Plateau coal field in central Utah. The city of Huntington is less than 2 miles (3 km) east of the quadrangle. The town of Orangeville is 1.5 miles (2.4 km) south, and the city of Castle Dale, the county seat of Emery County, is approximately 2.5 miles (4.0 km) south of the quadrangle. The city of Price is 18 miles (29 km) northeast of the quadrangle.

Accessibility

Utah Highway 31 passes through the northeast quarter of the quadrangle in Huntington Canyon. This highway provides access from Huntington on the east side of the Wasatch Plateau to the town of Fairview and Sanpete Valley on the west side. Utah Highway 10 extends from the city of Price southward through Huntington, Castle Dale, and other cities and towns along the base of the east side of the Wasatch Plateau.

Utah Highway 29 passes through the southwest corner of the quadrangle in Cottonwood Canyon and extends from Utah Highway 10 on the north side of Castle Dale to Joes Valley Reservoir at the head of Straight Canyon. Several unimproved dirt roads traverse the bench area in the south half of the quadrangle.

The nearest railhead is at the terminus of the Utah Railway Company line in the coal mining town of Mohrland approximately 4.5 miles (7.2 km) north of the quadrangle. The Utah Railway line makes connection with a main line of the Denver and Rio Grande Western Railroad at the city of Helper 23 miles (37 km) northeast of the quadrangle. There are also rail loading facilities on the Denver and Rio Grande Western Railroad at the city of Price.

Physiography

The Wasatch Plateau is a high and deeply dissected tableland, the eastern margin of which forms a sweeping stretch of barren sandstone cliffs about 80 miles (129 km) in length. The cliffs rise sharply above the flat, dry land of Castle Valley below. Elevations in the quadrangle range from about 5,900 ft (1,798 m) where Huntington and Cottonwood creeks leave the quadrangle to 9,277 ft (2,828 m) on a small peak on the west side of the quadrangle.

The gently sloping low areas below the steep cliffs in the quadrangle consist of dissected pediments locally referred to as "benches." The pediments have developed on the Mancos Shale and are generally capped with a layer of gravel. Shallow washes and gulleys divide the sloping pediments into long narrow benches.

The coal beds in the quadrangle crop out in the irregular line of steep sandstone cliffs at elevations ranging from about 7,500 ft (2,286 m) to 8,300 ft (2,530 m).

Climate

The climate in the quadrangle ranges with altitude from semi-arid in the lower elevations to alpine in the highest. The normal annual precipitation ranges from 8 inches (20 cm) in the southeast corner of the quadrangle to 20 inches (51 cm) on the highest elevations at the west side of the quadrangle (U.S. Department of Commerce, 1964).

Temperatures in the high mountainous country are generally cold in winter with warm days and cool nights during the summer. On the high west side of the quadrangle the summer temperatures may reach 90 degrees F (32 degrees C) while the minimum winter temperatures could drop to -30 degrees F (-34 degrees C). At the lower elevations below the mountain front summer temperatures may reach 100 degrees F (38 degrees C) and the winter temperatures may drop as low as -20 degrees F (-29 degrees C).

Land Status

The Southeast Quarter of the Hiawatha 15-minute quadrangle is located along the east-central side of the Wasatch Plateau Known Recoverable Coal Resource Area (KRCRA). The KRCRA covers approximately 5,700 acres of the quadrangle. The Federal coal lands within the KRCRA boundary include about 1,500 acres of unleased Federal coal land and 2,400 acres of Federal coal leases. Approximately 1,800 acres in the KRCRA boundary of the quadrangle are non-Federal lands. The areas of Federal coal lands, coal leases, non-Federal lands, and the KRCRA boundaries are shown on plate 2.

GENERAL GEOLOGY

Previous Work

Spieker (1931) mapped the geology and coal occurrences in the Wasatch Plateau and his work is the most detailed presently available. The stratigraphy of the area has also been described by Lupton (1916), Spieker and Reeside (1925), Katich (1954), and Hayes and others (1977). Doelling (1972) has summarized the geology and updated the coal data.

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. The Mesaverde consists of the following four formations in ascending order: the Star Point Sandstone, Blackhawk Formation, Castlegate Sandstone, and Price River Formation. The Upper Cretaceous Mancos Shale underlies the Mesaverde Group and consists of three shale members and two sandstone members. The Tunuk Shale Member at the base is succeeded upward by the Ferron Sandstone Member, Blue Gate Shale Member, Emery Sandstone Member, and the Masuk Shale Member.

The North Horn Formation of Upper Cretaceous and Paleocene ages is the youngest formation in the quadrangle and overlies the Mesaverde Group. The North Horn is the lowest member of the Wasatch Group which is more prevalent on the north end of the Wasatch Plateau.

The oldest stratigraphic unit exposed in the quadrangle is the Blue Gate Shale Member of the Mancos Shale. The Blue Gate consists of bluish-gray, nodular, and irregularly bedded marine mudstone and siltstone. The member weathers into low rolling hills and badland topography on the eastern side of the quadrangle. The Emery Sandstone Member of the Mancos Shale overlies the Blue Gate and is thought to be 250 to 350 ft (76 to 107 m) thick in this area (Doelling, 1972). It consists of yellowish-gray littoral sandstone with some shaly partings. The overlying Masuk Member, a gray marine shale, is about 1,000 ft (305 m) thick and crops out over a large area below the steep sandstone cliffs of the Mesaverde Group. The extensive pediments in the quadrangle are largely developed on the Masuk Shale.

The Star Point Sandstone forms a cliff above the Masuk Shale. It consists of massive yellowish-gray to white sandstone with interbedded subordinate shale and is approximately 500 ft (152 m) thick.

The Blackhawk Formation overlies the Star Point Sandstone and consists of approximately 700 ft (213 m) of alternating shale, sandstone, and coal. The coal beds occur in the lower 200 to 300 ft (61 to 91 m) of the formation. The Blackhawk is successively overlain by the Castlegate Sandstone and the Price River Formation both of which have similar lithologies of gray to white gritty sandstone with subordinate interbeds of shale and conglomerate. The Castlegate Sandstone is cliff-forming and more massive than the Price River Formation which contains more shale beds. The combined thickness of the two formations is approximately 550 ft (168 m).

The North Horn Formation caps the Price River Formation on the mountain near the west edge of the quadrangle and is composed of variegated shale, sandstone, and limestone.

Structure

The principal structural features are the north-south trending normal faults in the northwest part of the quadrangle. These faults are extensions of components of the Pleasant Valley fault zone in the adjoining quadrangle. The faults cut the coal beds and could hinder or limit mining depending on the amount of displacement. The offset on the larger faults could be as much as 200 ft (61 m).

The coal-bearing strata in the northwest part of the quadrangle dip westward to northwestward with local variations caused by faulting or gentle folding. The dips of the beds generally do not exceed 5 degrees except in close proximity to faults.

COAL GEOLOGY

Five named and several unnamed local coal beds occur in the quadrangle. The local beds are generally thin and insignificant. The named coal beds, in ascending order, are the Hiawatha, Blind Canyon, Bear Canyon, Upper Bear Canyon, and Upper Grimes Wash.

Hiawatha Coal Bed

The Hiawatha coal bed is the most persistent and well-developed coal bed in the quadrangle. It ranges in thickness from 0.7 ft (0.2 m) in an erosional or non-depositional channel in the northern part of the coal-bearing area to 14.9 ft (4.5 m) of coal in the south part. The bed thickens northward from the 0.7 ft (0.2 m) measurement near the boundary of Sections 10 and 11, T. 17 S., R. 7 E. and is 6.0 ft (1.8 m) thick at the north edge of the quadrangle (plate 9). The bed thickness may exceed 15 ft (5 m) in the mining areas of the Wilburg Deseret, and Anderson mines. The bed thins to 7.5 ft (2.3 m) in an elongated area in Section 24, T. 17 S., R. 7 E.

The Hiawatha coal bed is being produced in the Wilburg and Deseret mines at the writing of this report (1979). The bed has also been mined or prospected in the Huntington mine, Mapel Creek mine, and possibly in the Stump

Flat mine. The location of the various mines are shown on plate 1 and listed in table 2.

Blind Canyon Coal Bed

The Blind Canyon bed lies from 30 to 60 ft (9 to 18 m) above the Hiawatha coal bed and ranges in thickness from 1.5 to 15.3 ft (0.5 to 4.7 m) in measured sections in the quadrangle. The bed thickens to at least 8 ft (2 m) in the area of the Beehive mine and Doelling (1972) notes that thicknesses of 12 to 18 ft (4 to 5.5 m) have been reported in the Deer Creek mine and two seams 6 ft (2 m) and 12 ft (4 m) thick in the Paramount mine. The isopach map of the Blind Canyon bed (plate 4) shows the two areas of thickening of the coal bed in the northwest quarter of the quadrangle based on available measurements of the bed.

Spieker (1931) reports a measured section in Deer Creek Canyon at index number 2 (plate 1) where 2.5^{+} ft (0.8^{+} m) of coal were measured at the base of 30 ft (9 m) of burned rock. Inasmuch as the 2.5-ft (0.8-m) measurement is a minimum thickness and the true original thickness of the coal before burning is unknown, the measurement was not considered in drawing the isopach map on plate 4. The section measured by Spieker (1931, sec. 267, pl. 22) at index number 3 on plate 1 indicates that the Blind Canyon bed is missing at that point. However, because of the extensive burning of this bed in the area, other geologists (personal communication) believe the bed is present behind the burned surface rocks where the bed is not recognized.

Bear Canyon Coal Bed

The Bear Canyon coal bed lies approximately 50 ft (15 m) above the Blind Canyon bed in areas where both beds occur. The Bear Canyon bed is 5.0 ft (1.5 m) thick in the extreme northwest corner of the quadrangle in Meetinghouse

Canyon. There are no outcrop measurements for the bed in Deer Creek Canyon nor in Maple Gulch, but rocks near the normal position of the bed show the effects of intense burning and the bed may be present (Spieker, 1931). In the Grimes Wash area the bed is over 6 ft (2 m) thick (index no. 19, plate 1). Because of the sparcity of measured sections for this bed, no coal isopach nor structure contour maps were made. Most of the measured sections are located on non-Federal or leased Federal lands.

Upper Bear Canyon Coal Bed

The Upper Bear Canyon bed was measured at index numbers 18 and 19 (plate 1) by Spieker (1931) in Grimes Wash. At these points the bed is 6.8 ft (2.1 m) and 7.3 ft (2.2 m) thick and ranges from 15.0 ft (4.6 m) to 34.0 ft (10.4 m) above the Bear Canyon bed. It is not known if this coal bed has been produced in the area. The measured sections of the bed occur on non-Federal and leased Federal lands and therefore no Reserve Base tonnages were calculated for the bed.

Other Coal Beds

The Upper Grimes Wash coal bed is a thin bed measured in Grimes Wash at index numbers 18 and 19 (plate 1). The bed consists of a 2.5 ft (0.8 m) thick bed at one location and as two splits 0.5 ft (0.2 m) and 0.6 ft (0.2 m) thick at the other location.

Several thin, unnamed, and non-correlatable coal beds were measured at index numbers 3, 4, 5, and 6 (plate 1). These coal beds are 2.5 ft (0.8 m) or less in thickness. At index numbers 3 and 5 the beds occur up to 270 ft (82 m) above the Bear Canyon coal bed horizon. In the measured section at index number 4 the local coal beds occur between the Hiawatha and Blind Canyon beds.

Chemical Analyses of the Coal

Doelling (1972, p. 199) has tabulated the average and the ranges of coal analyses of samples from the Blind Canyon and Hiawatha coal beds in this quadrangle. The summaries of the analyses are shown in the following table.

Table 1. Average coal analyses, Southeast Quarter of the Hiawatha 15-minute quadrangle.*

	No. Analyses	As-received (percent) Average	Range
		Blind Canyon Coal Bed	
Moisture	108	5.1	1.2-8.0
Volatile matter	100	42.5	38.5-45.6
Fixed carbon	100	44.8	37.5-48.4
Ash	104	7.4	4.0-18.3
Sulfur	93	0.52	0.4-1.1
Btu/lb	104	12,803	10,800-13,353
		Hiawatha Coal Bed	
Moisture	46	5.5	2.0-11.4
Volatile matter	40	41.2	37.4-44.7
Fixed carbon	40	44.8	35.1-48.1
Ash	43	8.2	4.4-11.2
Sulfur	43	0.67	0.31-1.50
Btu/lb**	40	12,448	11,660-13,274

*Doelling (1972)
**To convert Btu/lb to Kj/kg multiply by 2.326

Based on the average analyses shown above, the Blind Canyon and Hiawatha coals are both ranked as high volatile B bituminous (American Society of Testing and Materials, 1977).

Mining Operations

Coal has been produced from a number of mines in the quadrangle for many years. At the present time (1979) Emery Mining Corporation is operating the Deer Creek, Deseret, Beehive, Little Dove, and Wilburg mines for Utah Power and Light Company. The coal from these mines supplies power plants at Huntington Canyon, Castle Dale, and other locations. Table 2 lists the active and inactive mines in the quadrangle, their approximate location, coal beds mined, and years during which the mines were active.

Table 2. Mines and their locations, Southeast Quarter of the Hiawatha 15-minute quadrangle, Emery County, Utah*

Mine Name(s)	Location T. 17 S., R. 7 E.	Coal Bed Mined	Period of Activity
Deer Creek mine (American Fuel, McKinnon)	Secs. 10 & 11	Blind Canyon	1937-1966 1971-
Deer Creek (old)	SE¼ NW¼ Sec. 11	Blind Canyon	Intermittent 1896-1916 1937-1956
Anderson mine (Bell)	SW¼ SW¼ Sec. 26	Hiawatha	Early 1900's-1922 1932-1937 1946-1951
Deseret mine	SE¼ NE¼ Sec. 26	Hiawatha	1909-
Beehive mine	SE¼ NE¼ Sec. 26	Blind Canyon	1956-
Little Dove mine	SE¼ NE¼ Sec. 26	Blind Canyon	1977-
Huntington mine (Meetinghouse, Harrison, Leonard, Community)	SE¼ NE¼ Sec. 3	Hiawatha	1921-1952
Mapel Creek mine	SE¼ NE¼ Sec. 14	Hiawatha	May be a prospect
Paramount mine	SE¼ SW¼ Sec. 2	Blind Canyon	1948-1956
Stump Flat mine	SE¼ SW¼ Sec. 24	?	Intermittent 1938-1960
Wilburg mine (Fox, Straight Canyon, Castle Valley, Crow Reed)	NW¼ NE¼ Sec. 27	Hiawatha	Intermittent 1898-1936 1937-

*After Doelling, 1972, p. 200

Little is known about the operation and production of the older mines. The boundaries of mined-out areas were not available nor were total production figures. Doelling (1972) estimated a total production from the quadrangle of 4,040,300 short tons (3,665,360 metric tons) by 1972. Coal production in the quadrangle has increased substantially since 1972 largely because of the construction of coal-steam electric generating plants in the central Utah area.

COAL RESOURCES

The principal sources of data used in the construction of the coal isopach maps, structure contour maps, and the coal-data maps were Doelling (1972) and Spieker (1931).

Coal resource tonnages were calculated for measured, indicated, and inferred categories in unleased areas of Federal coal land within the KRCRA boundary. Data obtained from the coal isopach maps (plates 4 and 7) were used to calculate the Reserve Base values. The coal-bed acreage (measured by planimeter) multiplied by the average isopached thickness of the coal bed times a conversion factor of 1,800 short tons of coal per acre-foot of bituminous coal yields the coal resources in short tons of coal for the isopached coal bed. Reserve Base and Reserve values for the Blind Canyon coal bed are shown on plate 7 and those for the Hiawatha bed on plate 11. The values are rounded to the nearest tenth of a million short tons and the Reserve values are based on a subsurface mining recoverability factor of 50 percent.

Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 10.9 million short tons (9.9 million metric tons) for the unleased Federal coal lands within the KRCRA boundary in the Southeast Quarter of the Hiawatha 15-minute quadrangle. These data are summarized in the following tabulation.

Table 3. Coal Reserve Base data for subsurface mining methods for Federal coal lands (in short tons) in the Southeast Quarter of the Hiawatha 15-minute quadrangle, Emery County, Utah.

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

Coal Bed Name	High development potential	Moderate development potential	Low development potential	Total
Blind Canyon	2,300,000	-0-	-0-	2,300,000
Hiawatha	8,600,000	-0-	-0-	8,600,000
Total	10,900,000	-0-	-0-	10,900,000

AAA Engineering and Drafting, Inc. has not made any determination of economic mineability for any of the coal beds described in this report.

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

The coal development potential for the subsurface mining of coal is shown on plate 12. In this quadrangle the areas where coal beds 5 ft (1.5 m) or more in thickness are overlain by less than 1,000 ft (305 m) of overburden are considered to have a high development potential for subsurface mining.

Areas where such beds are overlain by 1,000 to 2,000 ft (305 to 610 m) and 2,000 to 3,000 ft (610 to 914 m) of overburden are rated as having a moderate and a low development potential respectively. Areas that contain no known coal in beds 5 ft (1.5 m) or more thick, but coal-bearing units are present at depths of less than 3,000 ft (914 m) are classified as areas of unknown coal development potential. Areas where no coal beds are known to occur or where coal beds are present at depths greater than 3,000 ft (914 m) have no coal development potential. There are no areas of unleased Federal coal land within the KRCRA in the quadrangle that are known to fall within the moderate and low development potential classifications.

The designation of a coal development potential classification is based on the occurrence of the highest-rated coal-bearing area that may occur within any fractional part of a 40-acre BLM land grid area or lot area of unleased Federal coal land. For example, a certain 40-acre area is totally underlain by a coal bed with a "moderate" development potential. If a small corner of the same 40-acre area is also underlain by another coal bed with a "high" development potential, the entire 40-acre area is given a "high" development potential rating even though most of the area is rated "moderate" by the lower coal bed. Another possibility is a 40-acre area devoid of any coal except a small corner where a 5-ft (1.5 m) coal bed crops out. In this case the 40-acre area will have a "high" development potential rating.

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 bed depth of 200 to 3,000 ft (61 to 914 m).

Inasmuch as the coal beds dip less than 15 degrees in the Southeast Quarter of the Hiawatha 15-minute quadrangle, the criteria for the classification of in situ coal gasification methods of development potential do not apply.

Table 4. Sources of data used on plate 1.

Source	Plate 1 Index Number	Measured Section	Data Base No.	Page No.
Doelling, 1972	1	3, 10, and 18		198
Spieker, 1931	2	266		pl. 22
	3	267		pl. 22
	4	268		pl. 22
	5	270		pl. 22
	6	271		pl. 22
	7	272		pl. 22
	8	273		pl. 22
	9	274		pl. 22
	10	275		pl. 22
	11	276		pl. 22
	12	277		pl. 22
	13	278		pl. 22
Doelling, 1972	14	28		198
	15	30		198
	16	31		198
	17	5, 16, and 35		198
Spieker, 1931	18	286		pl. 23
	19	288		pl. 23
Doelling, 1972	20	40		198

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