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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE SOUTHWEST QUARTER OF THE SCOFIELD 15-MINUTE QUADRANGLE EMERY, CARBON, AND SANPETE COUNTIES, UTAH

(Report includes 12 plates)

By

AAA Engineering And Drafting, Inc.

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 Southwest Quarter of the Scofield 15-minute quadrangle, Emery, Carbon, and Sanpete Counties, Utah (U.S. Geological Survey Open-File Report 79-485).

Published and unpublished public information were used as data sources for this study.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 Scofield 15-minute quadrangle is located in the northern third of the Wasatch Plateau coal field in central Utah. The town of Clear Creek lies about 1.5 miles (2.4 km) north of the quadrangle and the town of Scofield is 7 miles (11 km) north. The quadrangle is approximately 17 miles (27 km) west of the city of Price which is the county seat

of Carbon County. The town of Fairview is about 10 miles (16 km) west, and the city of Huntington is 15 miles (24 km) southeast of the quadrangle.

Accessibility

Utah Highway 31 passes through the length of the quadrangle in Huntington Canyon. The highway connects the city of Huntington on the east side of the Wasatch Plateau to Fairview on the west side. Several unimproved dirt roads and jeep trails traverse some of the canyons and ridges in the quadrangle. The nearest railhead is at Clear Creek about 1.5 miles (2.4 km) north of the quadrangle. Clear Creek is at the south end of the Pleasant Valley branch of the Denver and Rio Grande Western Railroad. The branch line joins the main line of the railroad at Colton, approximately 16 miles (26 km) northeast of Clear Creek.

Physiography

The Wasatch Plateau is a high and deeply dissected tableland, the eastern margin of which forms a sweeping stretch of barren sandstone cliffs over 80 miles (129 km) long. The quadrangle lies in the mountainous area near the central part of the plateau.

Surface elevations in the quadrangle range from 7,650 ft (2,332 m) in Huntington Canyon on the south boundary of the quadrangle, to 10,443 ft (3,183 m) at Monument Peak. At least seven prominences have elevations in excess of 10,000 ft (3,048 m). Outcrop elevations of the coal beds range between 7,500 and 9,800 ft (2,286 and 2,987 m). In spite of the rugged high area, the first coal mine in the Wasatch Plateau coal field was developed in this quadrangle.

Climate

The normal annual precipitation in the quadrangle ranges from 20 inches (51 cm) at the lowest elevations in Huntington Canyon on the south side of the quadrangle to approximately 35 inches (89 cm) in the highest areas in the northeast part of the quadrangle (U.S. Department of Commerce, (1964)).

Late summer cloudburst storms which sometimes occur in the area could damage small bridges and dirt roads.

In this relatively high mountainous area the maximum summer temperatures are expected to be near 85 degrees F (29 degrees C) and the minimum winter temperatures near -30 degrees F (-34 degrees C).

Land Status

The Southwest Quarter of the Scofield 15-minute quadrangle is located on the northwest side of the Wasatch Plateau Known Recoverable Coal Resource Area (KRCRA). In the quadrangle there are approximately 2,600 acres of leased- and 21,500 acres of unleased-Federal coal land within the KRCRA boundary. The KRCRA covers about 73 percent of the quadrangle. The Federal and non-Federal lands in the KRCRA are shown on plate 2. Unleased Federal coal lands constitute 80 percent of the KRCRA in the quadrangle, 9 percent are leased Federal lands, and 11 percent are non-Federal lands.

GENERAL GEOLOGY

Previous Work

Spieker (1931) mapped the geology and coal outcrops of the Wasatch Plateau and his report and maps are the most detailed original work presently available. The stratigraphy of the area is further described by Spieker and Reeside (1925), Hayes and others (1977), and Katich (1954). Doelling (1972) has summarized the geology and updated the coal information for the field.

Stratigraphy

The coal beds of economic importance in the Wasatch Plateau coal field are Upper Cretaceous in age and are confined to the Blackhawk Formation of the Mesaverde Group. The Mesaverde includes four formations which are, in ascending order, the Star Point Sandstone, Blackhawk Formation, Castlegate Sandstone, and the Price River Formation. The Mancos Shale of Upper Cretaceous

age underlies the Mesaverde Group, and the North Horn Formation of Upper Cretaceous and Paleocene ages overlies the Mesaverde Group. Several igneous dikes thought to be basic lamprophyres (Spieker, 1931) cut the sedimentary rocks in the northern half of the quadrangle.

The upper part of the Masuk Shale Member of the Mancos Shale is exposed in the bottom of Huntington Canyon above the unconsolidated alluvium. The upper part of the Masuk Member consists of sandy gray shale. The overlying Star point Sandstone is well exposed in Huntington Canyon and in the Left Fork of Huntington Canyon. The Star Point consists of massive cliff-forming yellowish-gray sandstone which is over 1,000 ft (305 m) thick in Pleasant Valley to the north of the quadrangle, but thins to about 600 ft (183 m) at the south side of the quadrangle. The Blackhawk Formation is about 1,200 ft (366 m) thick and crops out over a large area of the quadrangle. It consists of sandstone, shale, and coal, and its outcrops are expressed as a series of alternating ledges and slopes. The major coal seams occur in the lower 400 ft (123 m) of the formation. The Castlegate Sandstone and Price River Formation are composed of gritty to conglomeratic sandstone. Their combined thickness is about 400 ft (123 m) on the east side of the quadrangle, but they thicken westward and at Bald Mountain the Price River Formation alone is 600 ft (183 m). Patches of the North Horn Formation occur in downfaulted blocks and on the top of Bald Mountain. The North Horn consists of variegated shale, sandstone, conglomerate, and freshwater limestone.

Structure

The eastern and western sides of the quadrangle are characterized by north-south trending faults and grabens. The central area between the fault zones is a wide unfaulted block whose strata dip gently southward from a westward plunging anticlinal nose on the north side of the quadrangle (plate 9).

The faults on the east side of the quadrangle are a southward extension of the Pleasant Valley fault zone. The displacement of the western, or

Pleasant Valley fault, near the head of South Hughes Canyon is 750 ft (229 m) with the downthrown side to the east. The displacement of the eastern fault in Woodward Canyon is 350 ft (107 m) and the west side is downthrown.

The north-south trending faults on the west side of the quadrangle are part of the Joes Valley fault zone. The easternmost fault in this zone is called the Valentine fault and at Valentines Gulch it has a displacement of 800 ft (244 m) which probably decreases to the north and south. The downthrown block is to the west. The next major fault west of Valentine fault is Joes Valley fault. It extends from the north side of the quadrangle at Bear Canyon to the south side of the quadrangle and through the adjoining quadrangle. This fault has a displacement of more than 600 ft (183 m).

COAL GEOLOGY

Five coal beds or zones are recognized in the Southwest Quarter of the Scofield 15-minute quadrangle and their positions in the Blackhawk Formation are shown in the composite columnar section on plate 3. Practically all of the localities from which the coal data were obtained are in Upper Huntington Canyon where most of the coal mining in the quadrangle has taken place. The data are all from surface measured sections and mine workings. No nonproprietary drilling data was available for the quadrangle.

The lowest coal bed in the Blackhawk Formation is the Hiawatha bed which lies on the Star Point Sandstone. A 40 to 55 ft (12 to 17 m) noncoal interval lies between the Hiawatha bed and the Blind Canyon coal bed. The Blind Canyon bed is succeeded by a rock interval 90 to 200 ft (27 to 61 m) thick which contains thin local coal beds. This inverval is overlain by the Castlegate "A" coal bed, a noncoal interval 30 to 100 ft (9 to 30 m) thick, the Candland coal bed, a noncoal interval 40 to 80 ft (12 to 24 m) thick, and the Bob Wright coal zone. A few thin lenticular local coal beds may occur in the noncoal intervals and in the stratigraphic section above the Bob Wright zone.

Chemical Analyses of the Coal

Coal analyses of 22 coal samples from the quadrangle are reported by Doelling (1972) and he presumes that they are all from the Castlegate "A" coal bed. A summarization of these analyses is presented in the following table.

Table 1. Average coal analyses, Southwest Quarter of the Scofield 15-minute quadrangle, Emery, Carbon, and Sanpete Counties, Utah.*

	No. Analyses	As received (percent)	
		Average	Range
Moisture	22	7.21	4.9-11.0
Volatile matter	18	41.78	37.7-45.1
Fixed carbon	18	45.93	42.8-48.0
Ash	22	4.95	2.8-11.2
Sulfur	21	0.62	0.31-1.6
Btu/lb**	15	12,459	11,640-13,350

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

On the basis of the above average analysis, the rank of the coal is high volatile B bituminous (American Society of Testing and Materials, 1977).

Bob Wright Coal Zone

The Bob Wright zone is the highest named coal unit in the coal-bearing section of the Blackhawk Formation in the quadrangle area. The coal zone generally consists of two or more thin coal beds which generally do not exceed 2 ft (0.6 m) in thickness separately or 4 ft (1.2 m) combined. The Bob Wright is not economically important in explored areas of this quadrangle but has been mined in the adjoining quadrangle to the east where the coal is up to 10 ft (3 m) thick.

Candland Coal Bed

The Candland bed was named for its exposures around Candland Mountain in the southeast quarter of the quadrangle. The maximum reported measured

thickness of 15.7 ft (4.6 m) for the coal bed occurs in the northern part of the quadrangle on the west side of upper Huntington Canyon. The coal isopach map (plate 4) of the Candland coal bed shows that it thins rapidly northward. The bed thins gradually southward in Candland Mountain to 4.0 ft (1.2 m) at the south side of the quadrangle. Except for the southwest side, a large part of Candland Mountain appears to be underlain with the Candland bed 5 ft (1.5 m) or more in thickness.

Castlegate "A" Coal Bed

The Castlegate "A" is a valuable bed in the quadrangle and is present in Reserve Base thickness in many areas of the quadrangle as shown on plate 8. The maximum measured thickness of 14.5 ft (4.4 m) occurs in the extreme north part of the quadrangle while another thick section of 11.3 ft (3.4 m) occurs in the northwest corner. In the southeast corner of the quadrangle the bed thins southward and pinches out in the next quadrangle to the south.

Blind Canyon Coal Bed

The measured thicknesses of the Blind Canyon coal bed in the quadrangle area (plate 1) are all less than 4 ft (1.2 m). In some of the measured sections the bed is 1 ft (0.6 m) or less thick and is absent in other measured sections.

Hiawatha Coal Bed

The Hiawatha coal bed lies on or close to the top of the Star Point Sandstone. The coal bed is widespread in the Wasatch Plateau and has been mined in several areas. In this quadrangle the bed is thin. The maximum measured thickness is 3.2 ft (1.0 m) and the average is 2 ft (0.6 m).

Intervals reported as "bony coal", "bone", or "shaly coal", 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.

Mining Operations

Some of the first operating coal mines in the Wasatch Plateau occur in the quadrangle area and were opened in 1874. There have been a number of mines and prospects in the quadrangle and the Clear Creek mine with its portal in an adjoining quadrangle has mined into the northeast corner of the Southwest Quarter of the Scofield 15-minute quadrangle. Table 2 lists the main mines with portals in the quadrangle. At the time of this report (1979) there were no active coal mines in the quadrangle although the mine plan of one coal company was approved by the U.S. Geological Survey in 1977 but the mine has not yet been opened.

Table 2. Mines and their locations in the Southwest Quarter of the Scofield 15-minute quadrangle, Emery, Carbon, and Sanpete Counties, Utah.*

Mine	Location	Active Period
Arrowhead mine (Sanders)	NE¼ Sec. 11, T. 14 S., R. 6 E.	1940's (?)
Bentley mine	NE¼ SW¼ Sec. 11, T. 14 S., R. 6 E.	1874 - 1877
Deseret mine	SW¼ SW¼ Sec. 12, T. 14 S., R. 6 E.	1896 - 1910
Huntington mine (Fairview, Bell, Connellsville, New York, Bear Gulch, Christensen, New York and Howell, Tompkins)	SW¼ NE¼ Sec. 11, T. 14 S., R. 6 E.	Active intermittently, 1875 - 1940's
Fireside mine	NW¼ NW¼ Sec. 9, T. 14 S., R. 7 E.	Never produced
Larsen mine	SE¼ SW¼ Sec. 2, T. 15 S., R. 6 E.	1906 - 1915
Larsen and Rigby mine	NE¼ Sec. 25, T. 14 S., R. 6 E.	1937 - 1972
Loucks mine	NE¼ Sec. 11, T. 14 S., R. 6 E.	1874 - 1877

*After Doelling (1972, p. 236)

The earliest mining operations in the upper Huntington canyon area were conducted, in part, to produce coke from the coal. Doelling (1972) reports that although the first attempts to make coke were uneconomical, from 1875 to 1877 eleven coke ovens produced 1,000 short tons (907 metric tons) of coke.

The Huntington mine operated five to six months a year and produced 34,000 short tons (30,845 metric tons) of coal between 1895 and 1921 and another 20,000 short tons (18,144 metric tons) in the late 1930's and early 1940's.

The Larsen and Deseret mines produced a known combined production of 20,000 short tons (18,144 metric tons) of coal between 1895 and 1915 for the use of the communities in Sanpete Valley (Doelling, 1972). The Larsen and Rigby mine supplied Sanpete Valley with coal from 1937 to 1972 in a part-time operation but produced a total of about 150,000 short tons (136,080 metric tons) of coal before becoming inactive.

Doelling (1972) estimated that the total coal production from mines with portals in this quadrangle was 230,000 short tons (208,656 metric tons). Part of the northeast corner of the quadrangle area was mined in the Clear Creek mines through portals in the adjoining quadrangle to the north.

COAL RESOURCES

The principal sources of data for the construction of the coal isopach maps, structure contour maps, and the coal data map 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 8) 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 each isopached coal bed. Reserve Base and Reserve values for the Candland and Castlegate "A" beds are shown on plates 7 and 11, respectively, and are rounded to the nearest tenth of a million short tons. The Reserve values are based on a subsurface mining recoverability factor of 50 percent.

"Measured resources are computed from dimensions revealed in outcrops, trenches, mine workings, and drill holes. The points of observation and measurement are so closely spaced and the thickness and extent of coals are so well defined that the tonnage is judged to be accurate within 20 percent of true tonnage. Although the spacing of the points of observation necessary to demonstrate continuity of the coal differs from region to region according to the character of the coal beds, the points of observation are no greater than 1/2 mile (0.8 km) apart. Measured coal is projected to extend as a 1/4 mile (0.4 km) wide belt from the outcrop or points of observation or measurement.

"Indicated resources are computed partly from specified measurements and partly from projection of visible data for a reasonable distance on the basis of geologic evidence. The points of observation are 1/2 (0.8 km) to 1 1/2 miles (2.4 km) apart. Indicated coal is projected to extend as a 1/2 mile (0.8 km) wide belt that lies more than 1/4 mile (0.4 km) from the outcrop or points of observation or measurement.

"Inferred quantitative estimates are based largely on broad knowledge of the geologic character of the bed or region and where few measurements of bed thickness are available. The estimates are based primarily on an assumed continuation from Demonstrated coal for which there is geologic evidence. The points of observation are 1 1/2 (2.4 km) to 6 miles (9.6 km) apart. Inferred coal is projected to extend as a 2 1/4 mile (3.6 km) wide

belt that lies more than 3/4 mile (1.2 km) from the outcrop or points of observation or measurement." (U.S. Bureau of Mines and U.S. Geological Survey, 1976).

Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 101.4 million short tons (92.0 million metric tons) for the isopached coal beds and 500,000 short tons (453,600 metric tons) for the non-isopached coal beds in the unleased Federal coal lands within the KRCRA boundary. The Reserve Base tonnages are also shown in the following tabulation.

Table 3. Coal Reserve Base data for subsurface mining methods for Federal coal lands (in short tons) in the Southwest Quarter of the Scofield 15-minute quadrangle, Emery, Carbon, and Sanpete Counties, Utah.

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

Coal bed name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Candland	28,000,000	2,700,000	-0-	30,700,000
Castlegate "A"	70,300,000	400,000	-0-	70,700,000
Non-isopached coal beds	500,000	-0-	-0-	500,000
Total	98,800,000	3,100,000	-0-	101,900,000

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 conductive 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 underground 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 Southwest Quarter of the Scofield 15-minute quadrangle that are known to fall within the "low" development potential classification.

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.

In the Southwest Quarter of the Scofield 15-minute quadrangle within the KRCRA boundary approximately 11,180 acres of unleased Federal land have a high development potential rating, 160 acres have a moderate development potential, 9,870 acres have an unknown development potential, and about 290 acres have no development potential.

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 depths of 200 to 3,000 ft (61 to 914 m). Inasmuch as the coal beds dip less than 15 degrees in the quadrangle, the in situ coal gasification methods of development potential classification do not apply.

Table 4. Sources of data used on plate 1.

Source	Plate 1 Index Number	Data Base Measured Section No.	Page or Plate
Doelling, 1972	1	7	237
Spieker, 1931	2	205	pl. 21
	3	204	pl. 21
Doelling, 1972	4	53	237
Spieker, 1931	5	202	pl. 21
	6	201	pl. 21
	7	200	pl. 21
	8	197	pl. 21
Doelling, 1972	9	31, 32, and 67	237 and 238
Spieker, 1931	10	196	pl. 21
	11	195	pl. 21
	12	190	pl. 21
Doelling, 1972	13	21	237
Spieker, 1931	14	189	pl. 21
Doelling, 1972	15	5	237
Spieker, 1931	16	185	pl. 21
	17	184	pl. 21
	18	188	pl. 21
	19	183	pl. 21
Doelling, 1972	20	36	237
Spieker, 1931	21	186	pl. 21
Doelling, 1972	22	45	237
Spieker, 1931	23	181	pl. 21
Doelling, 1972	24	16	237
Spieker, 1931	25	178	pl. 21
	26	176	pl. 21
Doelling, 1972	27	40	237
Spieker, 1931	28	174	pl. 21
	29	173	pl. 21
	30	172	pl. 21

Source	Plate 1 Index Number	Data Base Measured Section No.	Page or Plate
Doelling, 1972	31	3	237
Spieker, 1931	32	52	pl. 14
Doelling, 1972	33	28	237
	34	29	237

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