UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE OLD WOMAN PLATEAU QUADRANGLE SEVIER COUNTY, UTAH

(Report includes 8 plates)

By

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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 (7 plates) and the Coal Development Potential (CDP) Map (1 plate) of the Old Woman Plateau quadrangle, Sevier County, Utah (U.S. Geological Survey Open-File Report 79-1012).

Published and unpublished public information were used as data sources for this study.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 Old Woman Plateau 7½ minute quadrangle is located in the southern part of the Wasatch Plateau coal field in central Utah. The quadrangle lies in Sevier County and is approximately 31 miles (50 km) east of the city of Richfield, the county seat. The city of Salina is 6 miles (10 km) north and 20 miles (32 km) west of the quadrangle, and the town of Emery is 3 miles (5 km) north and 6 miles (10 km) east.

Accessibility

U.S. Interstate Highway 70 passes through the south side of the Old Woman Plateau quadrangle in an east-west direction. This is the only paved road in the quadrangle area. A light-duty gravel road, Utah Highway 72, joins U.S. Interstate 70 at Fremont Junction in the southeast corner of the quadrangle. There are numerous unimproved dirt roads and jeep trails in the upland area of the plateau on the west side of the quadrangle. No roads exist in the steep rocky canyons that cut through the rugged sandstone cliffs on the east side of the plateau.

The nearest railhead is at Salina, approximately 6 miles (10 km) north and 20 miles (32 km) west of the quadrangle. A branch line of the Denver and Rio Grande Western Railroad runs north and south from Salina along the western side of the Wasatch Plateau. The railroad makes 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 m) long. The strata have gentle dips generally less than 10 degrees and erosion has produced ledges and cliffs along the plateau front and in steep-walled re-entrant canyons. The cliff line which marks the eastern edge of the plateau crosses the eastern half of the Old Woman Plateau quadrangle in a north-south direction. The upland area above the cliffs in this quadrangle is called the "Old Woman Plateau."

The lowland area on the east side of the cliffs is characterized by low hills and shallow washes. The lowest point in the quadrangle is 6,350 ft (1,935 m) above sea level where the creek in Trough Hollow leaves the

east side of the quadrangle. The upland area of the Old Woman Plateau is hilly, but not excessively rugged. The highest point is 8,775 ft (2,675 m) on the top of a hill near the west central side of the quadrangle.

The main drainage system is that of Ivie Creek on the south side of the quadrangle. Ivie Creek flows eastward and drains into Muddy Creek approximately 10 miles (16 km) east of the quadrangle. The drainage divide between the east and west sides of the plateau crosses the western part of the quadrangle in a north-south direction.

Climate

The climate of the Wasatch Plateau varies with altitude and ranges from semi-arid in the lower elevations to mid-latitude steppe in the higher. The normal annual precipitation in the Old Woman Plateau quadrangle ranges from 8 inches (20 cm) in the southeast corner to approximately 19 inches (48 cm) in the high areas on the west side of the quadrangle. (U.S. Department of Commerce, (1964)).

Temperatures on the high plateau are generally cool in the summer and cold in winter. Summertime temperatures may reach a high of 85 degrees F (29 degrees C) and a low of -20 degrees F (-29 degrees C) in winter. The maximum and minimum temperatures in the lowland area on the east side of the quadrangle are approximately 10 to 15 degrees F (5.6 to 8.3 degrees C) higher than those in the highland area.

Land Status

The Old Woman Plateau quadrangle lies in the south part of the Wasatch Plateau Known Recoverable Coal Resource Area (KRCRA). Approximately 26,300 acres (11,756 ha) of the quadrangle area lies within the KRCRA. Plate 2 shows the distribution, and table 1 lists the acres of Federal, non-Federal, and leased-Federal lands in that area.

Table 1. Approximate distribution of coal lands within the KRCRA in the Old Woman Plateau quadrangle, Sevier County, Utah.

Category	Approximate Area (acres)*	Percent of KRCRA (%)
Non-Federal land	3,300	13
Leased Federal coal land	900	3
Unleased Federal coal land	22,100	84
Total	26,300	100

*To convert arces to hectares, multiply acres by 0.4047

GENERAL GEOLOGY

Previous Work

Spieker (1931) mapped the geology and coal outcrops of the Wasatch Plateau in detail. The stratigraphy of the area has also been described by Spieker and Reeside (1925), Katich (1954), and Hayes and others (1977). Doelling (1972) summarized the geology and assembled the available coal data for the coal field.

The Emery West and Flagstaff Peak quadrangles to the northeast of the Old Woman Plateau quadrangle were recently mapped by Hayes and Sanchez (1977) and Sanchez and Hayes (1977). Detailed measurements and descriptions of closely spaced stratigraphic sections of the upper part of the Star Point Sandstone and the lower part of the Blackhawk Formation in those two quadrangles were made by Marley and Flores (1977). Marley, Flores, and Carovac (1978) presented in preliminary form some lithogenetic variations in the Blackhawk Formation and the Star Point Sandstone in the Wasatch Plateau and a detailed description of the stratigraphic variations in these two formations was made by Marley (1978).

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 the following four formations 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.

The oldest unit exposed in the quadrangle is the Blue Gate Shale Member of the Mancos Shale which crops out in the extreme southeast corner of the quadrangle. The Blue Gate Shale is overlain by the Emery Sandstone Member of the Mancos Shale. The Emery Sandstone is at least 800 ft (244 m) thick. The Emery is overlain by the Masuk Shale Member of the Mancos Shale which consists of 350 to 450 ft (107 to 137 m) of bluish-gray sandy shale (Doelling, 1972).

The Star Point Sandstone overlies the Masuk Shale and crops out as a cliff along the eastern margin of the Wasatch Plateau. The Star Point is from 300 to 450 ft (91 to 137 m) thick (Doelling, 1972) and is composed of an upper massive white sandstone unit which is underlain by an interbedded sandstone and shale unit.

The Blackhawk Formation is approximately 750 ft (229 m) thick (Doelling, 1972) and is exposed in the walls of the main canyons in the quadrangle. The formation consists of interbedded sandstone, shale, and coal beds. Sandstone is the dominant rock type. Marley and Flores (1977, p. ii and iii) report that "the Blackhawk Formation interfingers laterally with and locally unconformably overlies the Star Point Sandstone. . . The characteristics of the rock types of the Blackhawk Formation suggest that they represent delta-plain deposits, which grade (seaward) into the underlying delta-front and prodelta deposits of the Star Point Sandstone."

The Castlegate Sandstone is a massive, cliff-forming, yellow to gray sandstone unit 90 to 200 ft (27 to 61 m) thick. The overlying Price River Formation is composed of fine- to medium-grained sandstone with some interbedded shale and is generally less resistant than the Castlegate Sandstone. However, in the quadrangle area the cliff-forming characteristic of the Castlegate is not well developed and both units appear more like the typical Price River Formation. The combined exposed thickness of both units is 600 to 700 ft (183 to 213 m) in this area (Doelling, 1972).

Structure

The few insignificant faults that cut coal beds in the quadrangle trend northeast. One crosses Tommy Hollow in the southwest; two lie just north of Saleratus Creek; one occurs in the northeast corner of the quadrangle; and one is in the northwest corner. The Saleratus faults have displacements up to 60 ft (18 m) but are unimportant because they are close to and parallel to the edge of the cliff. The Joes Valley fault zone cuts across the southeast corner of the quadrangle but it is located below the cliffs and thus does not affect the Blackhawk coal. Strata in the quadrangle area are gently inclined to the west with dips of less than 3 degrees.

COAL GEOLOGY

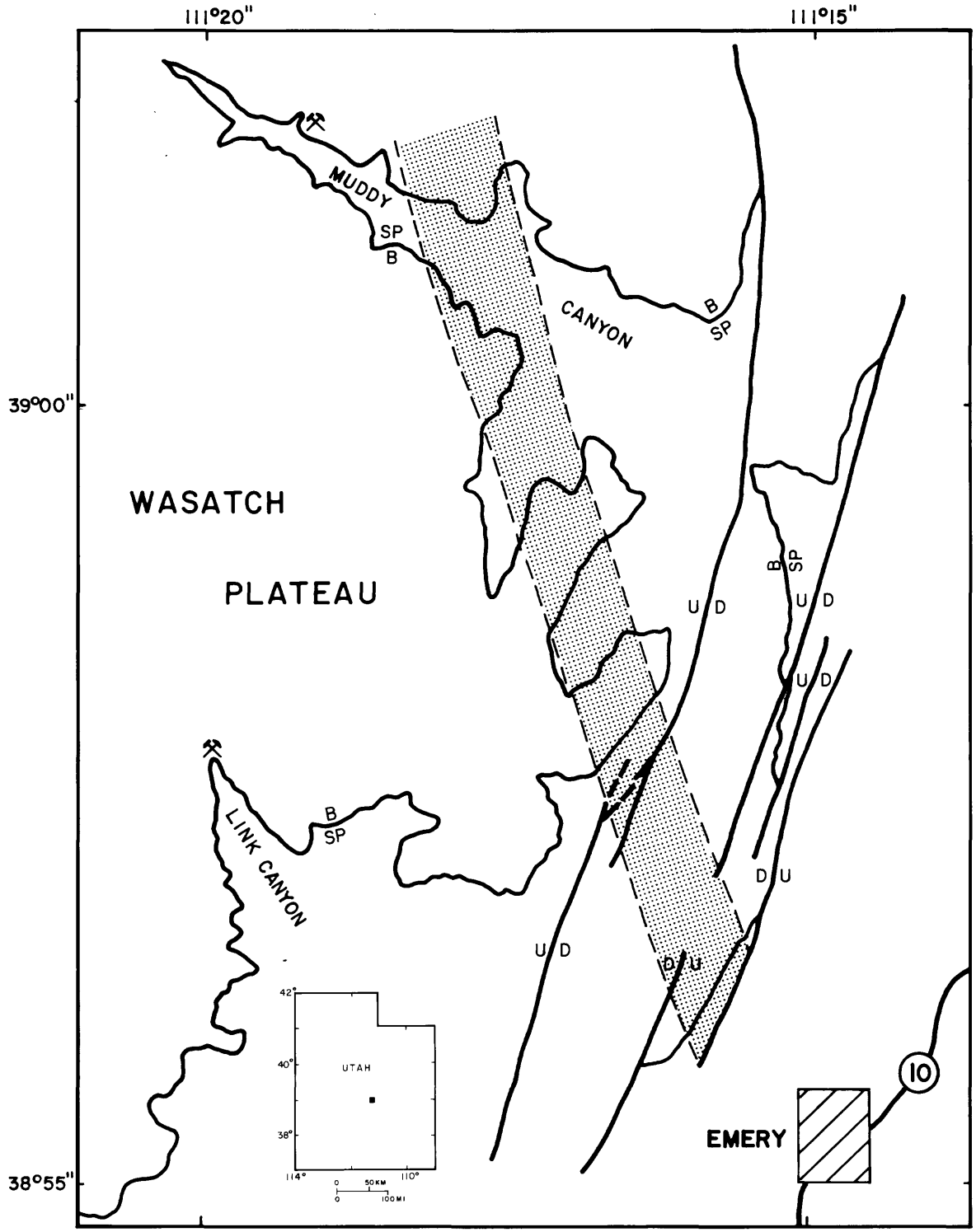
The chief coal beds in the southern part of the Wasatch Plateau coal field occur in the lower section of the Blackhawk Formation. In the area of this quadrangle Spieker (1931) lists the following coal beds in ascending order: the Hiawatha, Upper Hiawatha, Ivie, Upper Ivie, Saleratus, and some thin local beds.

Sanchez and Hayes (1977) mapped the geology of the Flagstaff Peak quadrangle and the geology of the Emery West quadrangle (Hayes and Sanchez, 1977). Marley and Flores (1977) made detailed measurements and descriptions of closely-spaced stratigraphic sections of the upper part of the

Star Point Sandstone and the lower part of the Blackhawk Formation. During the course of this work a zone of intertonguing between these two formations was observed at several localities within a 6 mile (10 km) long and 0.6 mile (1 km) wide belt extending south-southeastward from the north wall of Muddy Creek Canyon in the Flagstaff Peak quadrangle to a point near the town of Emery in the Emery West quadrangle. See figure 1. "As a result of this intertonguing, the contact between the two formations is about (20 m) higher to the east than it is to the west and the coal-bed correlations of Spieker (1931) must be modified." (Flores and others, 1978).

As a consequence of the recognition of the intertonguing, a revision of the correlations of the lower Blackhawk Formation coal beds on the two sides of the zone of intertonguing was suggested by Flores and others (1978). They pointed out, for example, that "the upper bed in the abandoned mine of Muddy Canyon and referred to as Muddy No. 2 coal bed by Spieker (1931) is apparently the Hiawatha coal bed. . .", and that, "The coal bed mined in the abandoned Link Canyon mine. . .and identified by Doelling (1972) as the Upper Hiawatha coal bed merges laterally eastward into the Star Point Sandstone and must be about 20 m below the stratigraphic position of the Upper Hiawatha coal bed of areas to the east of the zone of intertonguing" (Flores and others, 1978). Generalized cross sections through the zone of intertonguing are shown in figure 2.

The Old Woman Plateau quadrangle lies approximately 8 miles (13 km) southwest of the zone of intertonguing and the coal-bed names used here reflect the stratigraphic correlations suggested by Flores and others (1978) in the Emery West and Flagstaff Peak quadrangles. The names "A" Bed and "B" Bed, are used tentatively here by the present authors for the lack of other names. Table 2 below shows the coal bed correlations used in this report and in the Emery West quadrangle.



EXPLANATION

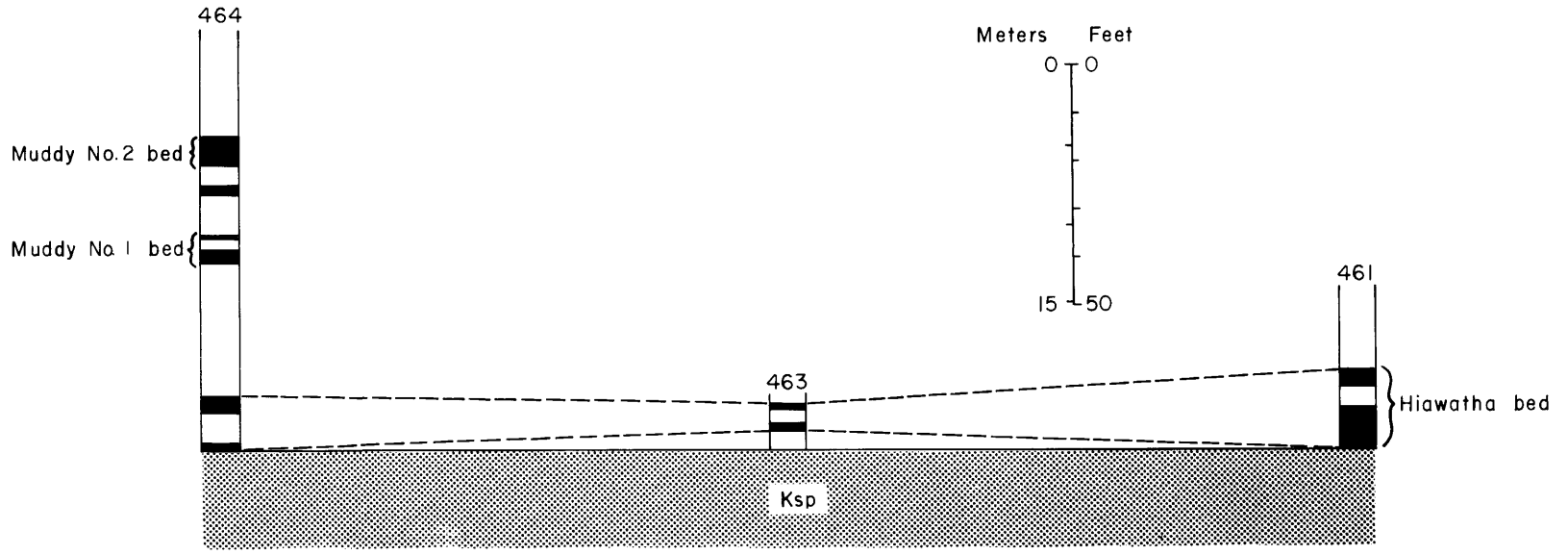
ZONE OF INTERTONGUING

COAL MINE

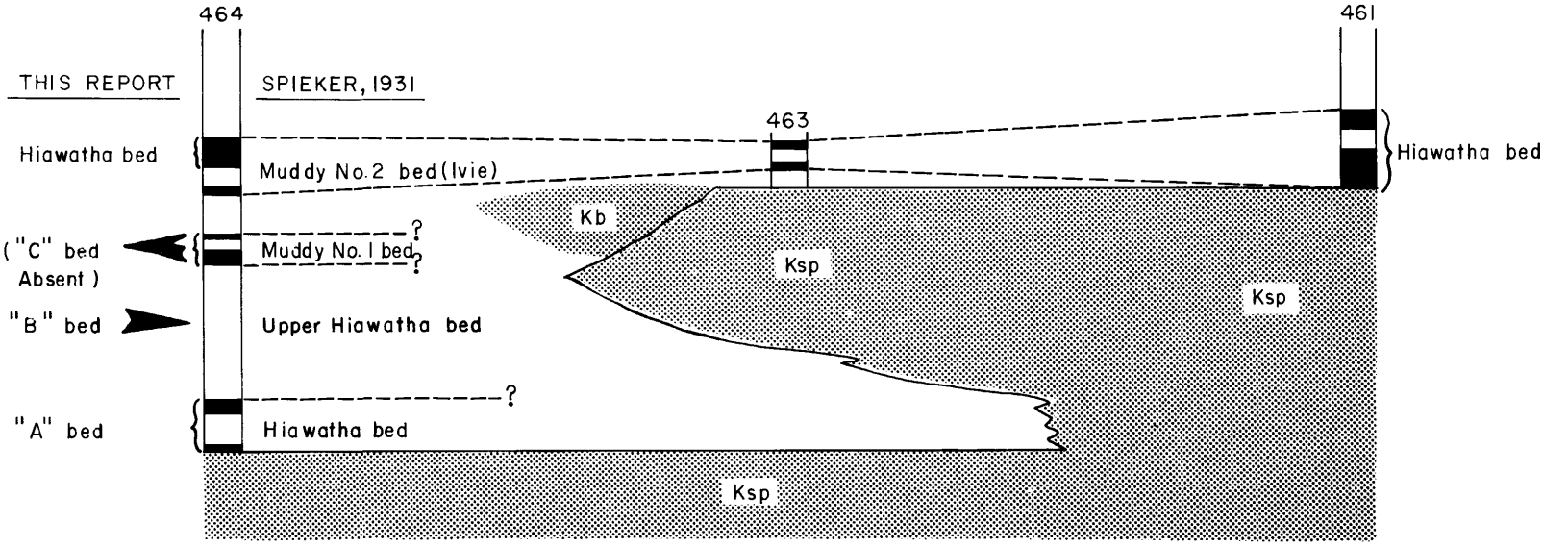
B / SP — CONTACT BETWEEN BLACKHAWK FORMATION (B) AND STAR POINT SANDSTONE (SP)

U / D — FAULT - DASHED WHERE FAULT IS INFERRED U. UPTHROWN SIDE, D. DOWNTHROWN SIDE

FIGURE 1. Map showing zone of intertonguing (after Flores and others, 1978).



Correlations of Spieker (1931)



Revised correlations

FIGURE 2. Generalized cross sections showing former and revised coal-bed correlations (after Flores and others, 1978).

Table 2. Correlations of coal beds on the east and west sides of the zone of intertonguing, Old Woman Plateau and Emery West quadrangles, Sevier and Emery Counties, Utah.

West Side of Zone of Intertonguing			East Side of Zone of Intertonguing
New Correlations Old Woman Plateau Quadrangle	New Correlations Emery West Quadrangle	Spieker (1931) and Doelling (1972)	Spieker (1931) and Doelling (1972)
			Upper Ivie
			Muddy No. 2
			Muddy No. 1
Upper Hiawatha	Upper Hiawatha	Upper Ivie	Upper Hiawatha
Hiawatha	Hiawatha	Muddy No. 2 (Ivie)	Hiawatha
(absent)	"C" Bed	Muddy No. 1	
"B" Bed	"B" Bed	Upper Hiawatha	
"A" Bed	"A" Bed	Hiawatha	

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.

"A" Coal Bed

The "A" coal bed occurs on the west side of the zone of intertonguing and the name is tentatively used here by the present authors because of the lack of another name. The bed in this area is the one formerly called the "Hiawatha" coal bed by Spieker (1931) and Doelling (1972). Based on findings interpreted by Flores and others (1978) the bed merges laterally into the Star Point Sandstone about 5 miles (8 km) east of the quadrangle in the zone of intertonguing and is approximately 65 ft (20 m) stratigraphically below the Hiawathat coal bed on the east side of the zone.

In the Old Woman Plateau quadrangle the "A" bed is lenticular and ranges in thickness up to 3.0 ft (0.9 m). The bed is missing in much of the quadrangle area. (See plates 1 and 3.) An isopach map was not made for this coal bed because it does not reach Reserve Base thickness of over 5 ft (1.5 m).

"B" Coal Bed

The "B" coal bed occurs on the west side of the zone of intertonguing and was formerly called the Upper Hiawatha coal bed by Spieker (1931), Doelling (1972), and others. This bed is also missing in much of the Old Woman Plateau quadrangle. It is lenticular and thin, but reaches a thickness of over 4 ft (1.2 m) in the northeast corner of the quadrangle.

"C" Coal Bed

The "C" coal bed, formerly called the Muddy No. 1 by Spieker (1931) occurs in the Emery West quadrangle but is apparently absent in the Old Woman Plateau quadrangle.

Hiawatha Coal Bed

Based on findings interpreted by Flores and others (1978) the Hiawatha coal bed on the east side of the zone of intertonguing correlates with the coal bed formerly called the Muddy No. 2 coal bed on the west side of the zone by Spieker (1931) and Doelling (1972). In the Ivie Creek area Spieker (1931, p. 180) suggests the equivalency of the Muddy No. 2 and the Ivie coal beds. In this report the coal bed called "Hiawatha" is the one formerly called the Ivie coal bed by Spieker (1931). The points of measurement for this coal bed occur in numerous measured sections and drill holes through the central part of the quadrangle in a north-south direction. See the coal isopach map, plate 4. The coal bed ranges in thickness from 3.0 to 11.7 ft

(0.9 to 3.6 m) in thickness. The bed apparently thins westward and eastward away from the thicker band in the central quadrangle area.

Upper Hiawatha Coal Bed

The coal bed called the Upper Hiawatha in this report was formerly called the Upper Ivie coal bed by Spieker (1931) on the west side of the zone of intertonguing. The bed is generally thin and somewhat lenticular in this quadrangle. It is missing in some of the drill holes and ranges up to 10.3 ft (3.1 m) in thickness. At most of the points where the bed has been measured it is less than 5.0 ft (1.5 m) thick. The three measurements greater than 5.0 ft (1.5 m) thick are points at index numbers 2, 3, and 9 at the north side of the quadrangle. Because of the limited number of points of measurement where the Upper Hiawatha bed is over 5.0 ft (1.5 m) thick an isopach map was not made but an isolated data map has been drawn for this bed on a separate sheet kept in U.S. Geological Survey files. Reserve Base tonnages per Federal section have been calculated for this bed where it is more than 5.0 ft (1.5 m) thick and are shown on plate 2 and in table 5 as non-isopached coal tonnage.

Local Coal Beds

Several thin non-correlatable coal beds occur at various positions in the measured sections and drill holes in the quadrangle. One of these has been called the Saleratus bed in one of the drill holes and at two locations mapped by Spieker (1931). Most of the local beds are less than 5.0 ft (1.5 m) thick except at index number 23 (plate 1) where a coal bed 5.8 ft (1.8 m) thick was measured.

Chemical Analyses of the Coal

No chemical analyses of coal from the Old Woman Plateau quadrangle are available. However, analyses of the Upper Hiawatha coal bed (formerly

the Upper Ivie bed of Spieker, 1931) from the adjoining Acord Lakes quadrangle (Doelling, 1972) on the north indicate that this coal ranges in rank from high volatile C bituminous to high volatile B bituminous. Proximate analyses of coal samples from the Hiawatha coal bed (formerly Ivie bed of Spieker, 1931) from the adjoining Johns Peak quadrangle on the south indicate that this coal is ranked as high volatile C bituminous if it is agglomerating (American Society for Testing and Materials, 1977). The following tables show the range and average proximate analyses of coal samples from the adjoining quadrangles.

Table 3. Average proximate analysis of coal from the Upper Hiawatha coal bed (formerly Upper Ivie bed of Spieker, 1931), Acord Lakes quadrangle, Sevier County, Utah.*

	No. Analyses	As-received (percent) Average	Range
Moisture	12	8.7	5.6-10.4
Volatile matter	11	38.3	36.2-40.6
Fixed carbon	11	46.6	43.3-50.4
Ash	12	6.5	5.9- 7.1
Sulfur	12	0.46	0.3- 0.6
Btu/lb**	11	11,770	11,390-12,260

*Doelling, 1972, p. 141
**To convert Bty/lb to Kj/kg multiply by 2.326

Table 4. Average proximate analysis of coal samples from the Hiawatha coal bed (formerly Ivie bed of Spieker, 1931), Johns Peak quadrangle, Sevier County, Utah.*

	No. Analyses	As-received (percent) Average	Range
Moisture	2	13.4	12.9-13.9
Volatile matter	2	3 .2	35.2-37.2
Fixed carbon	2	43.8	43.6-43.9
Ash	2	6.7	6.0- 7.3
Sulfur	2	.6	.6
Btu/lb**	2	10,570	10,540-10,600

*After Doelling, 1972, p. 96
**To convert Btu/lb to Kj/kg multiply by 2.326

Mining Operations

Doelling (1972) reports that a number of old prospects are present around Ivie Creek, Red Creek, and Clear Creek canyons. The specific locations of these prospects are unknown. The only active mine in the quadrangle (1979), the Knight mine, is located in Ivie Creek Canyon in Section 34, T. 23 S., R. 4 E. This mine is producing from the Hiawatha bed (formerly the Ivie bed of Spieker, 1931). It was opened in 1923 and has been intermittently active with a 20-year period of inactivity preceding its reactivation in 1977. The total coal production from the quadrangle is unknown.

COAL RESOURCES

The principal sources of data used in the construction of the coal isopach, structure contour, and the coal-data maps were Doelling (1972), Spieker (1931), Blanchard, Ellis, and Roberts (1977), and unpublished drill-logs.

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 map (plate 4) 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 (13,238 metric tons per hectare-meter) for bituminous coal yields the coal resources in short tons of coal for each isopached coal bed. Reserve Base and Reserve values for the Hiawatha bed are shown on plate 7 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. Coal beds thicker than 5 ft (1.5 m) that lie less than 3,000 feet (914 m) below the ground surface are included, although this criteria differs somewhat from that used in calculating Reserve Base and Reserve tonnages as stated in U.S. Geological Survey Bulletin 1450-B, which calls for a minimum thickness of 28 inches (70 cm) for bituminous coal and a maximum depth of 1,000 feet (305 m) for both bituminous and subbituminous coal. Reserve Base tonnages only (designated as inferred resources) were calculated for areas in this quadrangle that are influenced by isolated data points.

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 unleased Federal coal lands within the KRCRA boundary in the Old Woman Plateau quadrangle. These data are shown in table 5.

"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 ½ mile (0.8 km) apart. Measured coal is projected to extend as a ¼ 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 ½ (0.8 km) to 1½ miles (2.4 km) apart. Indicated coal is projected to extend as a ½ mile (0.8 km) wide belt that lies more than ¼ 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 a 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 1½ (2.4 km) to 6 miles (9.6 km) apart. Inferred coal is projected to extend as a 2¼ 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).

Table 5. Coal Reserve Base data for subsurface mining methods for Federal coal lands (in short tons) in the Old Woman Plateau quadrangle, Sevier County, Utah.

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

Coal Bed Name	High development potential	Low and Moderate development potential	Unknown development potential	Total
Hiawatha	98,000,000	-0-	-0-	98,000,000
Non-isopached coal bed	-0-	-0-	3,400,000	3,400,000
Total	98,000,000	-0-	3,400,000	101,400,000

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 8. 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. The unleased Federal coal land within the KRCRA in this quadrangle are classified as having a high or an unknown development potential (see plate 8). No areas fall into the moderate or low classifications. A small area has no development potential.

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 (16-ha) BLM land grid area or lot area of unleased Federal coal land. For example, a certain 40-acre (16-ha) area is totally underlain by a coal bed with a "moderate" development potential. If a small corner of the same 40-acre (16-ha) area is also underlain by another coal bed with a "high" development potential, the entire 40-acre (16-ha) 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 (16-ha) 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 (16-ha) 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 depths of 200 to 3,000 ft (61 to 914 m).

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

Table 6. Sources of data used on plate 1.

Source	Plate 1 Index Number	Data Base: Drill Hole or Measured Section No.	Data Base: Page or Plate No.
Spieker, 1931	1	531	pl. 29
	2	532	pl. 29
	3	533	pl. 29
	4	538	pl. 29
	5	539	pl. 29
	6	540	pl. 29
	7	541	pl. 30
	8	542	pl. 30
	9	543	pl. 30
	10	544	pl. 30
	11	545	pl. 30
	12	546	pl. 30
	13	547	pl. 30
	14	548	pl. 30
	15	549	pl. 30
	16	550	pl. 30
	17	551	pl. 30
	18	552	pl. 30
	19	553	pl. 30
	20	554	pl. 30
	21	555	pl. 30
	22	557	pl. 30
	23	558	pl. 30
	24	559	pl. 30
	25	560	pl. 30
	26	561	pl. 30
	27	563	pl. 30
	28	564	pl. 30
	29	565	pl. 30
	30	566	pl. 30
	31	567	pl. 30
	32	568	pl. 30
	33	569	pl. 30
	34	570	pl. 30
	35	571	pl. 30
	36	572	pl. 30
	37	573	pl. 30
	38	574	pl. 30
	39	575	pl. 30

Source	Plate 1 Index Number	Data Base: Drill Hole or Measured Section No.	Data Base: Page or Plate No.
Spieker, 1931	40	576	pl. 30
	41	577	pl. 30
	42	578	pl. 30
	43	579	pl. 30
	44	580	pl. 30
	45	581	pl. 30
	46	582	pl. 30
	47	583	pl. 30
	48	584	pl. 30
	49	590	pl. 30
	50	591	pl. 30
	51	592	pl. 30
	52	593	pl. 30
	53	594	pl. 30
	54	595	pl. 30
U.S. Geol. Survey, 1977, unpublished logs	55	d.h. W-LCC-14-OWP	
	56	d.h. H-4	
	57	d.h. W-LCC-12-OWP	
	58	d.h. W-LCC-27-OWP	
	61	d.h. W-LCC-25-OWP	
	62	d.h. W-LCC-13-OWP	
	63	d.h. W-LCC-23-OWP	
Blanchard, Ellis, and Roberts, 1977	60	d.h. W-OWP-3-OWP	
	64	d.h. W-OWP-1-OWP	
Unpublished drill log	59	J.H. Moore, Old Woman, Fed. No. 1	

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