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COAL RESOURCES OF THE HELIOTROPE MTN. QUADRANGLE SANPETE AND SEVIER COUNTIES, UTAH

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 parepared 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."

Published and unpublished public information were used as data sources for this study. No new drilling or field mapping was done to supplement this study. No confidential or proprietary data were used.

Location

The Heliotrope Mtn. 7½-minute quadrangle is located on the west side of the south central part of the Wasatch Plateau coal field in central Utah. The quadrangle covers parts of Sanpete and Sevier Counties. The city of Manti, the county seat of Sanpete County, is 12 miles (19 km) northwest of the quadrangle. The city of Richfield is the county seat of Sevier County and lies 32 miles (51 km) west and 16 miles (26 km) south of the Heliotrope Mtn. quadrangle. The town of Ferron is 13 miles (21 km) east, and the town of Emery is 8 miles (13 km) southeast of the quadrangle.

Accessibility

The Heliotrope Mtn. quadrangle is in a rugged, mountainous area and no paved roads enter the quadrangle. An unimproved dirt road crosses the quadrangle from the southeast corner to the northwest corner. This road connects the town of Emery on the east side of the Wasatch Plateau with the town of Mayfield 11 miles (18 km) west of the quadrangle on the other side of the Wasatch Plateau.

Another unimproved dirt road crosses the north quarter of the quadrangle area from the town of Ferron. The road intersects the Emery-Mayfield road in the northwest corner of the quadrangle. Several jeep trails provide accessibility into some of the less-rugged areas of the quadrangle.

The nearest railroad is a branch line of the Denver and Rio Grande Western Railroad that runs in a north-south direction in Sanpete Valley at the base of the western side of the Wasatch Plateau. The railroad passes through or near most of the towns on the west side of the plateau and provides rail connections to Salt Lake City, Utah and Denver, Colorado.

Physiography

The eastern margin of the Wasatch Plateau is approximately 80 miles (129 km) long and consists of sparsely vegetated sandstone cliffs and steep shale slopes cut by numerous steep-walled canyons. The rocks are gently dipping, generally less than 10 degrees.

Heliotrope Mtn. quadrangle lies in the high, mountainous central part of the Wasatch Plateau approximately 10 miles (3.5 km) from the east and west sides. Approximately two-thirds of the surface area of the quadrangle is over 9,000 ft (2,743 m) above sea level. Many of the mountains on the south, west, and north sides of the quadrangle are over 10,000 ft (3,048 m) high and a point on Heliotrope Mtn. reaches an elevation of 11,130 ft

(3,392 m). The lowest surface elevation is 7,560 ft (2,304 m) where Muddy Creek leaves the east side of the quadrangle. The relief in the quadrangle is 3,570 ft (1,088 m). Much of the upland area is forested and there are more than 15 small lakes and reservoirs.

Runoff in the quadrangle drains into Muddy Creek which flows eastward through the central part of the quadrangle. The area is in the Colorado River drainage system.

Climate

The climate of the Wasatch Plateau varies with altitude from semi-arid in the lowest elevations to alpine in the highest. The normal annual precipitation in the Heliotrope Mtn. quadrangle ranges from 19 inches (46 cm) in the canyon of Muddy Creek on the eastern edge of the quadrangle to over 40 inches (102 cm) in the high northwest quarter (U.S. Department of Commerce (1964)). Much of the precipitation falls as snow during winter. Cloudburst storms sometimes occur in late summer.

Temperatures in the quadrangle range from an approximate summer high of 85 degrees F (29 degrees C) to a winter low of -30 degrees F (-34 degrees C).

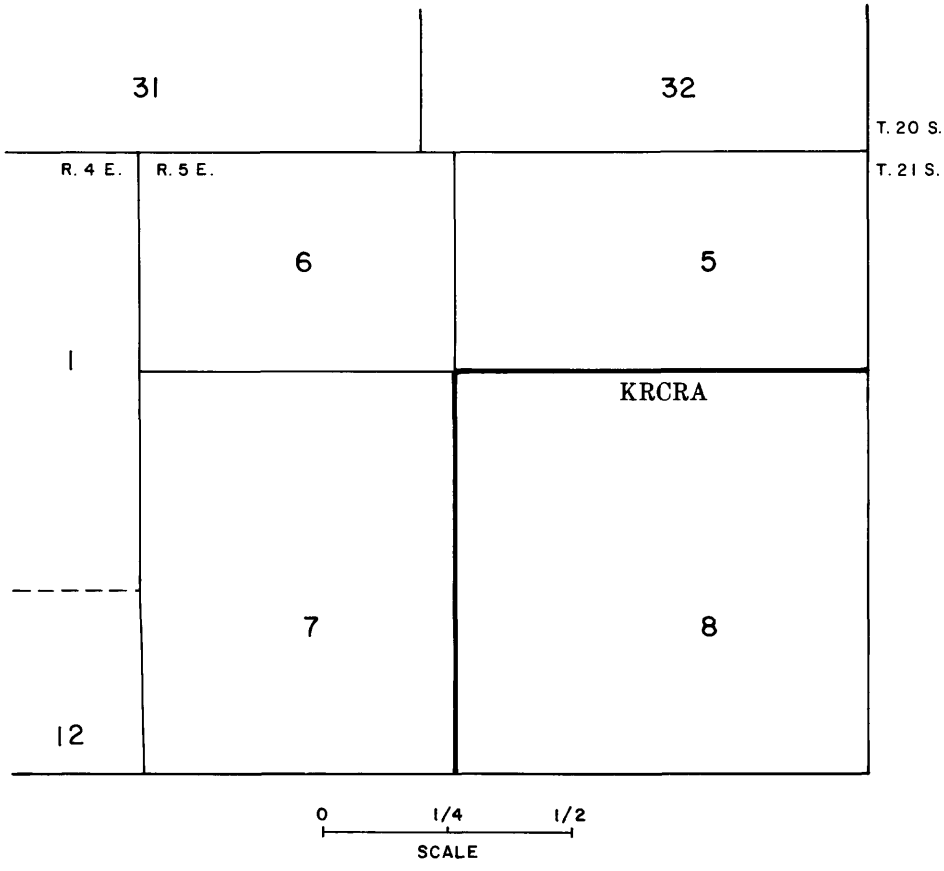
Land Status

The only part of the Wasatch Plateau Recoverable Coal Resource Area (KRCRA) within the Heliotrope Mtn. quadrangle is Section 8, T. 21 S., R. 5 E. in the southeast corner of the quadrangle. The land within the quadrangle KRCRA consists of approximately 410 acres (166 ha) of unleased Federal coal land (1979) (see figure 1).

GENERAL GEOLOGY

Previous Work

Spieker (1931) mapped and described the geology and coal occurrences of the Wasatch Plateau. The stratigraphy of the area has been described



EXPLANATION

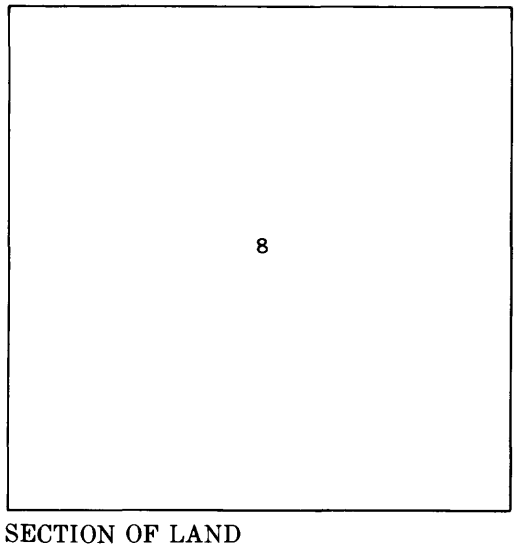
KRCRA

KNOWN RECOVERABLE COAL RESOURCES AREA BOUNDARY – Label within KRCRA boundary.

NOTE: BLM Coal Ownership Data current as of September 22, 1977.

REFERENCE

U.S. Bureau of Mines and U.S. Geological Survey, 1976, Coal resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey: U.S. Geol. Survey Bull. 1450-B, 7p.



SECTION OF LAND

Figure 1. Boundary map, Heliotrope Mountain Quadrangle, Sanpete and Sevier Counties, Utah.

by Spieker and Reeside (1925), Spieker (1949), Katich (1954), and Hayes and others (1977). In 1972 Doelling compiled the geology and available coal data for the coal field. The geology of the adjoining quadrangle to the east, Flagstaff Peak, was recently mapped by Sanchez and Hayes (1977) who also mapped the adjoining Emery West quadrangle (Hayes and Sanchez, 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 were made by Marley and Flores (1977). Marley, Flores, and Cavaroc (1978) presented in preliminary form a discussion of despositional environments and origin of rocks within the Blackhawk Formation and the Star Point Sandstone in the Wasatch Plateau. A detailed description of the lithostratigraphy of portions of these two formations was presented by Marley (1978).

AAA Engineering and Drafting, Inc. (1979a, 1979b, and 1979c) prepared coal resource occurrence and coal development potential maps for the adjoining Flagstaff Peak, Acord Lakes, and Emery West quadrangles.

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. This group includes, in ascending order: Star Point Sandstone, Blackhawk Formation, Castlegate Sandstone, and Price River Formation. The Upper Cretaceous Mancos Shale underlies the Star Point Sandstone, and the North Horn Formation (Upper Cretaceous and Paleocene) overlies the Price River Formation. The North Horn Formation is overlain by the Flagstaff Limestone of Paleocene age.

The oldest unit exposed in the quadrangle is the Blackhawk Formation, the top part of which crops out in the bottom of Muddy Creek canyon on

the eastern edge of the quadrangle (Hintze and Stokes, 1964). The Star Point Sandstone underlies the Blackhawk Formation and is exposed in the lower part of Muddy Creek canyon in the adjoining quadrangle to the east. The Star Point is from 350 to 450 ft (107 to 137 m) thick (Doelling, 1972) and is composed of very fine- to medium-grained sandstone with lesser amounts of siltstone and shale (Marley and Flores, 1977).

The Blackhawk Formation overlies the Star Point Sandstone and consists of very fine- to medium-grained sandstone, siltstone, shale, coal, and minor limestone. The formation is approximately 700 ft (213 m) thick along Muddy Creek (Doelling, 1972, p. 175). 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 overlies the Blackhawk Formation and is a massive, cliff-forming, yellow to gray sandstone unit 150 to 200 ft (46 to 61 m) thick. The overlying Price River Formation is composed of fine- to medium-grained sandstone interbedded with shale and ranges from 250 to 700 ft (76 to 213 m) in thickness (Doelling, 1972). The Price River Formation is less resistant to erosion than the Castlegate Sandstone and forms step-like ledges in its outcrop pattern.

The North Horn Formation overlies the Price River Formation and is Upper Cretaceous and Paleocene in age. It consists of nearly 1,500 ft (457 m) of variegated shale and subordinate conglomerate, sandstone, and limestone. The Flagstaff Limestone overlies the North Horn Formation

and forms the cliffs capping Ferron Mountain, Heliotrope Mountain, Block Mountain, and White Mountain in the quadrangle area. The formation is composed of light-colored resistant limestone with subordinate amounts of interbedded sandstone and shale.

Structure

Most of the quadrangle is not faulted. Three normal faults of small displacement cross the southwest corner of the quadrangle (Hintze and Stokes, 1964) and a normal fault passes into the north central part of the quadrangle from the adjoining quadrangle on the north. There are no faults in the quadrangle KRCRA. The rocks in the quadrangle have a gentle westward dip of less than 5 degrees.

COAL GEOLOGY

The major coal beds in the southern part of the Wasatch Plateau coal field occur in the lower part 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 in the area east of the quadrangle. The Hiawatha bed was recognized as the one immediately above the Star Point Sandstone which was mapped as a continuous ledge-forming unit.

Sanchez and Hayes (1977) mapped the geology of the Flagstaff Peak quadrangle and 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. 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 to near the town of Emery (figure 1). "As a result of this intertonguing,

the contact between the two formations ia bout 20 m (66 ft) 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 result of the recognition of the intertonguing, a revision of the correlations of the lower Blackhawk Formation coal beds between the two sides of the intertonguing zone was suggested by Flores and others (1978). They point 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 and the correlated coal beds for the adjoining quadrangles to the south and southeast are listed in table 1.

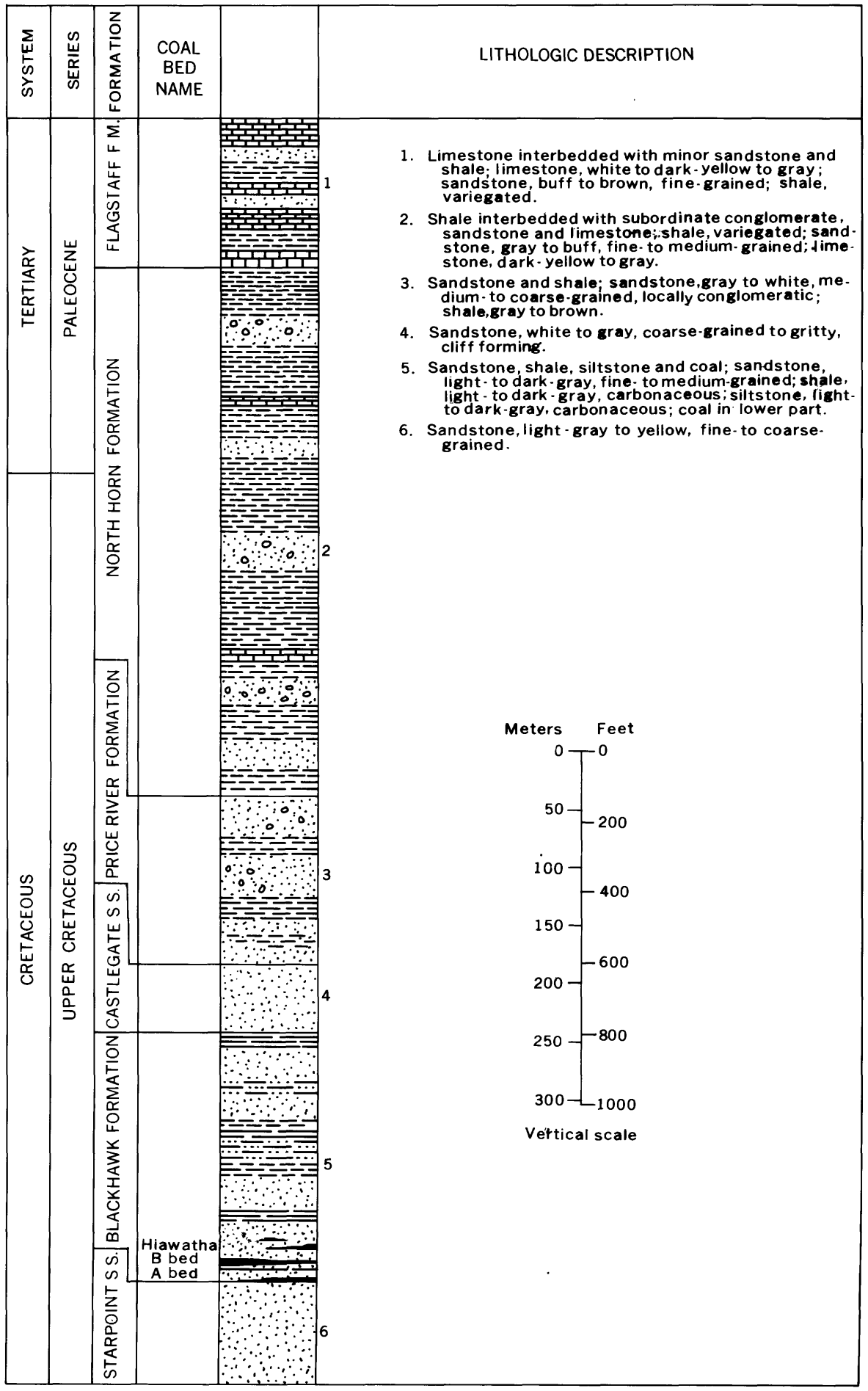


FIGURE 2. Composite columnar section, Heliotrope Mtn. Quadrangle, Sanpete and Sevier Counties, Utah.

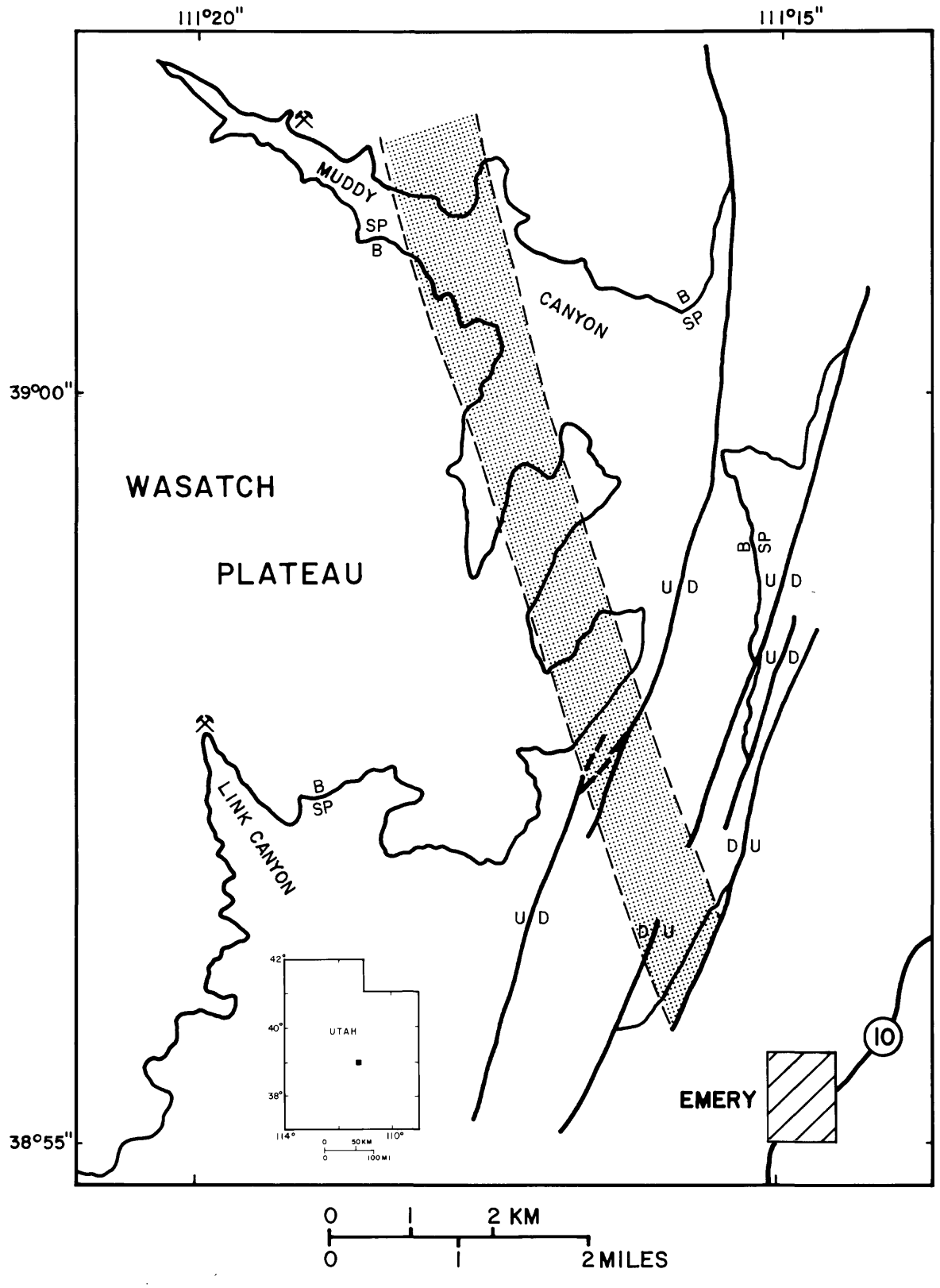
Table 1. Correlations of coal beds between the east and west sides of the zone of intertonguing, Acord Lakes and Emery West quadrangles, Sevier and Emery Counties, Utah.

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

"A" Coal Bed

The "A" coal bed occurs on the west side of the zone of intertonguing (figure 3). The bed in this area was formerly called the "Hiawatha" coal bed by Spieker (1931) and Doelling (1972). Based on work by Flores and others (1978) and bed merges laterally into the Star Point Sandstone in the zone of intertonguing and is approximately 65 ft (20 m) stratigraphically below the Hiawatha coal bed on the east side of the zone.

In the Flagstaff Peak quadrangle to the east the "A" bed crops out in the central part of Muddy Canyon and is generally split into two or more beds. Spieker (1931) called some of the beds Upper Hiawatha but because of the closeness of the beds Doelling (1972) included all them in the Hiawatha. The beds are generally less than 5 ft (1.5 m) in thickness. Two measurements of 5.0 and 5.8 ft (1.5 and 1.8 m) for the main



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

bed suggest a slight thickening of the bed northward in that quadrangle (AAA Engineering and Drafting, Inc., 1979a).

"B" Coal Bed

The "B" bed, formerly called the Upper Hiawatha bed by Spieker (1931) and Doelling (1972) has not been observed in the western part of the adjoining quadrangle to the east (Flagstaff Peak). A hole drilled about 1.5 miles (2.5 km) south of the Heliotrope Mtn. quadrangle KRCRA in the NW¼ Section 20, T. 21 S., R. 5 E. (Acord Lakes quadrangle) encountered a 13.0 ft (4.0 m) thick coal bed identified by Blanchard, Ellis, and Roberts (1977) as the Upper Hiawatha bed, now called the "B" coal bed in this report. Another hole drilled 1.5 miles (2.5 km) southeast of the Heliotrope Mtn. quadrangle KRCRA in the SE¼ Section 16, T. 21 S., R. 5 E. (Emery West quadrangle) encountered a 16.0-ft (4.9-m) thick coal bed also identified by Blanchard, Ellis, and Roberts (1977) as the Upper Hiawatha bed (herein called the "B" bed).

Based on the presence of the "B" bed in the two drill holes noted above and the coal isopach maps for that bed in two adjoining quadrangles (AAA Engineering and Drafting, Inc., 1979a and 1979b), it is inferred by the present authors that the "B" coal bed underlies the Heliotrope Mtn. KRCRA in thicknesses greater than 5 ft (1.5 m).

"C" Coal Bed

The "C" coal bed occurs on the west side of the zone of intertonguing and was formerly called the Muddy No. 1 bed by Spieker (1931) and Doelling (1972). Based on the work of Flores and others (1978) the "C" bed merges laterally into the Star Point Sandstone in the zone of intertonguing. In the Flagstaff Peak quadrangle the "C" bed generally is lenticular and split into several thin beds less than 5 ft (1.5 m) thick. However, in the Muddy Canyon area an individual bed ranges up to 8.5 ft (2.6 m) thick

in a localized area. In the Link Canyon area of the Emery West quadrangle the "C" bed ranges from 1.1 to 10.0 ft (0.3 to 3.0 m) in thickness. Because of a lack of non-proprietary drilling the extent and thickness trends of the "C" bed toward the Heliotrope Mtn. quadrangle are not known. The "C" bed is apparently absent in the Acord Lakes quadrangle area. The "C" bed is expected to be thin or absent in the Heliotrope Mtn. KRCRA.

Hiawatha Coal Bed

Based on field work 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 by Spieker (1931) and Doelling (1972) on the west side of the zone.

The Hiawatha bed in the Muddy Canyon area is generally less than 5 ft (1.5 m) thick on the west side of the zone of intertonguing except for one small area where the bed thickness ranges from 5.2 to 5.5 ft (1.6 to 1.7 m) (AAA Engineering and Drafting, Inc., 1979a). In the northwest part of the Emery West quadrangle, the Hiawatha bed apparently thins from 7.0 ft (2.1 m) thick in Link Canyon to 4.0 ft (1.2 m) in a hole drilled 2.5 miles (4.0 km) southeast of the Heliotrope Mtn. KRCRA.

Muddy No. 1 Coal Bed

The Muddy No. 1 coal bed in the Flagstaff Peak quadrangle occurs 30 to 35 ft (9 to 11 m) above the Hiawatha bed. The Muddy No. 1 was identified by Spieker (1931) in outcrop measured sections in the southeast corner of that quadrangle where the bed is less than 3 ft (1 m) thick. The Muddy No. 1 bed occurs in the northern part of the Emery West quadrangle where is generally less than 5.0 ft (1.5 m) thick except at one point where it is 8.0 ft (2.4 m) thick. The Muddy No. 1 bed has not been reported in measured sections in the Acord Lakes quadrangle.

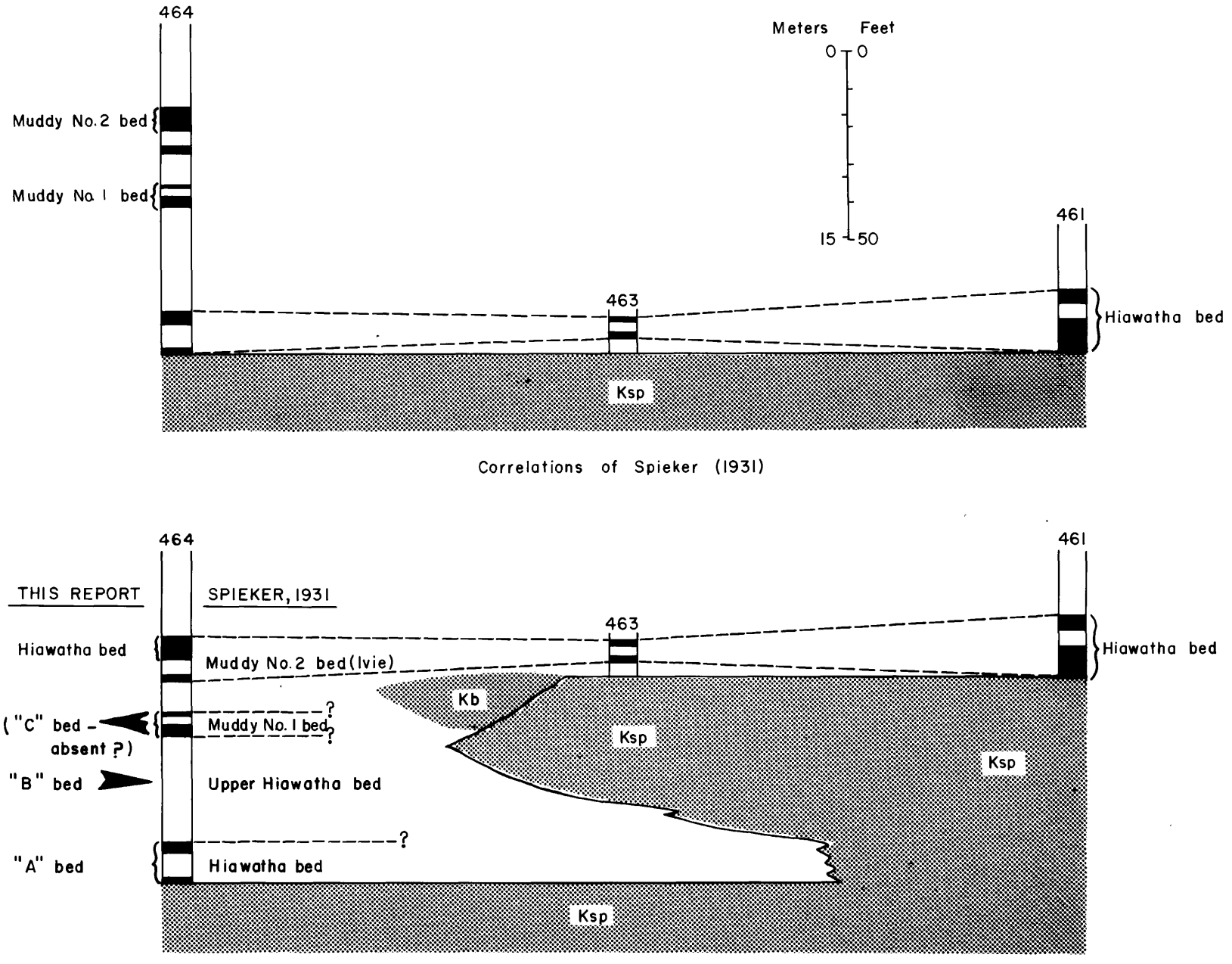


FIGURE 4. Generalized cross sections showing former and revised coal-bed correlations (after Flores and others, 1978).

Chemical Analyses of the Coal

As indicated in the discussion of the coal beds above, the "B" bed may possibly occur under the Heliotrope Mtn. KRCRA in thicknesses greater than 5 ft (1.5 m). Doelling (1972) lists 7 coal analyses of the "B" coal bed from the Link Canyon mine in the adjoining Emery West quadrangle. The proximate analyses of these samples are summarized in the following table.

Table 2. Average proximate analysis of coal from the "B" coal bed (formerly the Upper Hiawatha bed of Spieker, (1931)), Emery West quadrangle, Sevier and Emery Counties, Utah.*

	No. Analyses	As received (percent) Average	Range
Moisture	7	8.3	7.0-12.9
Volatile matter	5	38.1	37.5-38.6
Fixed carbon	5	46.0	45.3-46.4
Ash	7	8.0	5.4-10.0
Sulfur	7	0.42	0.4-0.5
Btu/lb**	5	11,674	11,570-11,770

*Doelling, 1972, p. 133
**To convert Btu/lb to Kj/kg multiply by 2.326

Based on the ASTM system of classification, coal with the average analysis shown in table 1 is ranked as high volatile C bituminous (American Society for Testing and Materials, 1977).

Mining Operations

The nearest mining operation to the Heliotrope Mtn. quadrangle KRCRA took place in the Flagstaff Peak quadrangle. The Ricci mine (also known as the Muddy Creek mine) is located near the mouth of Last Water Canyon on the north side of Muddy Canyon. Doelling (1972, p. 179) reports that the mine "has two mineable seams, the Muddy No. 1 and No. 2. The lower

is at least 12 feet thick and the upper 4 feet thick with 12 to 18 feet between them." However, information from the U.S. Geological Survey inactive lease file of the mine reports a 10.0+ ft (3.0+ m) thickness for Muddy No. 1 bed that was mined and no mention was made of the upper bed. The Muddy No. 1 bed in the mine is now correlated with the "C" bed discussed above. This mine operated from 1941 to 1953 when a mine fire ended the operation after producing a little over 31,000 short tons (28,123 metric tons) of coal.

COAL RESOURCES AND COAL DEVELOPMENT POTENTIAL

There are no coal bed measurements in the Heliotrope Mtn. quadrangle KRCRA and no coal beds of Reserve Base thickness have been projected into the area from adjoining quadrangles. Therefore, no coal resources are shown.

Development Potential for Surface Mining Methods

No development potential for surface mining methods exists in the KRCRA of this quadrangle because of the thick overburden. Based on the depth and dip of the coal beds in the adjoining quadrangles to the east and south (AAA Engineering and Drafting, Inc., 1979a and 1979b), depths to the lower Blackhawk Formation coal beds are estimated to range from 1,700 to 2,000 ft (518 to 610 m) in the Heliotrope Mtn. quadrangle KRCRA.

Development Potential for Subsurface Mining and In Situ Coal Gasification Methods

The coal development potential for subsurface mining of coal is based on coal thickness and thickness of overburden for beds dipping less than 15 degrees. 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 classified as

having 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 classified as having moderate and low development potentials, 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 known coal bed measurements in the Heliotrope Mtn. quadrangle KRCRA. Projections of coal bed thicknesses into the quadrangle from adjoining quadrangles indicate that several coal beds probably occur in the lower part of the Blackhawk Formation in the southeast corner of the quadrangle and that these beds may be more or less than 5 ft (1.5 m) in thickness. These coal beds are overlain by more than 1,000 ft (348 m) of overburden. Even though this area may contain coal thicker than 5 ft (1.5 m) the limited knowledge of the areal distribution of the coal prevents an accurate evaluation of development potential and therefore, the entire KRCRA area in the Heliotrope Mtn. quadrangle is classified as having an unknown development potential.

Classification of development potential for in situ coal gasification was not done because dips are less than 15 degrees within the quadrangle KRCRA. The criteria for selection of areas suitable for in situ coal gasification are a minimum coal thickness of 5 ft (1.5 m), dips of 15 to 90 degrees, and overburden greater than 200 ft (61 m) and less than 3,000 ft (914 m).

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

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