

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Open-File Report 79-1017
1979

COAL RESOURCES OF THE SOUTHEAST QUARTER
OF THE RANGE CREEK 15-MINUTE QUADRANGLE
EMERY AND GRAND COUNTIES, UTAH

By

AAA Engineering and Drafting, Inc.

This report has not been edited for conformity
with U.S. Geological Survey editorial standards
or stratigraphic nomenclature.

CONTENTS

	Page
Introduction-----	1
Purpose-----	1
Location-----	1
Accessibility-----	2
Physiography-----	2
Climate-----	3
Land status-----	4
General geology-----	4
Previous work-----	4
Stratigraphy-----	5
Structure-----	8
Coal geology-----	9
Beckwith coal zone-----	9
Sunnyside coal zone-----	10
Chemical analyses of the coal-----	11
Mining operations-----	12
Coal resources and coal development potential-----	12
Development potential for surface mining methods-----	12
Development potential for subsurface mining and in situ coal gasification methods-----	13
References-----	14

FIGURE

Page

Figure 1. Composite columnar section, southwest quarter of the Range Creek 15-minute quadrangle, Emery County, Utah-----	7
--	---

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."

Published and unpublished public information were used as data sources for this study.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 Range Creek 15-minute quadrangle is located at the southeastern end of the Book Cliffs coal field in east-central Utah. The Green River crosses the quadrangle from the north side to the south and is the boundary between Emery County on the west and Grand County on the east. The county seat of Emery County is Castle Dale approximately 48 miles (77 km) west of the quadrangle. The county seat of Grand County is the city of Moab about 53 miles (85 km) southeast of the quadrangle. The town of Green River is 18 miles (28 km) south and the town of Sunnyside and East Carbon City are 20 miles (32 km) northwest of the quadrangle.

Accessibility

No highways nor improved gravel roads occur in the quadrangle area. The quadrangle is reached by unimproved dirt roads and jeep trails in the canyon along the Green River and in some of the larger tributary canyons. The roads are used mostly by the local ranchers who maintain livestock herds in the area.

U.S. Highway 6 connects the town of Green River, Utah to the city of Price. U.S. Interstate Highway 70 runs eastward from the town of Green River into the state of Colorado, and westward across the San Rafael Swell to Salina, Utah. A main line of the Denver and Rio Grande Western Railroad passes through the town of Green River and provides rail connections to Salt Lake City, Utah and Denver, Colorado.

Physiography

The southeast quarter of the Range Creek 15-minute quadrangle lies in the south central part of the physiographic feature called the Book Cliffs. This is a rugged mountainous area that forms a large S-shaped band extending from central Utah near the city of Price eastward beyond the Utah-Colorado state line. The quadrangle is located at the southeast end of the Book Cliffs coal field and at the west end of the Sego coal field of eastern Utah. The Book Cliffs form a bold southward-facing escarpment of barren sandstone cliffs from 1,000 to 2,000 ft (305 to 610 m) high indented by re-entrant canyons cut into the mountainous area on the north side of the cliff-front. The main escarpment trends north-south approximately 10 miles (16 km) west of the quadrangle. The escarpment swings eastward just north of the town of Green River and is about 10 miles (16 km) from the quadrangle on the south.

The strata are gently-dipping in the quadrangle and the topography is characterized by steep-sided mesas, benches, and ridges.

The Green River crosses the quadrangle from north to south and is the major drainage system in the area. The Green River is one of the major streams in Utah and drains into the Colorado River. Range Creek is a perennial stream which drains the area west and northwest of the quadrangle. Its confluence with the Green River is near the center of the quadrangle.

Relief in the quadrangle area is over 3,760 ft (1,146 m). Elevations range from 7,956 ft (2,425 m) on a peak on the north edge of the quadrangle to 4,190 ft (1,277 m) where the Green River leaves the south side of the quadrangle.

Climate

The Book Cliffs coal field is located in the mid-latitude steppe climate and semi-arid conditions prevail over much of the area. The normal annual precipitation in the quadrangle ranges from 8 inches (20 cm) in the south central area along the Green River to approximately 15 inches (38 cm) in the mountains in the northwest quarter of the quadrangle (U.S. Department of Commerce, (1964)).

The nearest weather recording station is at the town of Green River Utah approximately 18 miles (29 km) south of the quadrangle. The elevation of Green River is approximately 4,000 ft (1,219 m) and the maximum summertime temperature recorded there is 112° F (44° C) (U.S. Department of Commerce, 1975). The minimum recorded winter temperature is -42° F (-41° C). It is expected that the summertime temperature at the higher elevations in the quadrangle will be approximately 15° F (8° C) lower than those in the town of Green River.

Land Status

The Book Cliffs Recoverable Coal Resource Area (KRCRA) does not cover any part of the quadrangle, but is designated in the southeast quarter of the Woodside 15-minute quadrangle, approximately 8 miles (13 km) to the west.

Approximately 41 percent or 15,000 acres (6,071 ha) of the southeast quarter of the Range Creek 15-minute quadrangle area is non-Federal land. This includes nearly all of the area east of the Green River in the quadrangle, except for two small areas south of Coal Creek on the south side, which lies within the Uintah and Ouray Indian Reservation. A little over 1,200 acres (486 ha) of non-Federal land are on the west side of the Green River. There are no Federal coal leases in the quadrangle (1978).

GENERAL GEOLOGY

Previous Work

Clark (1928) mapped and described the geology of the western part of the Book Cliffs coal field from the Standardville 7½-minute quadrangle on the west to the Patmos Head quadrangle on the east. Fisher (1936) mapped the Book Cliffs south and east of Clark's area to the Utah-Colorado State line. The geology and coal deposits in the area have also been described by Abbot and Liscomb (1956), Fisher, Erdmann, and Reeside (1960), Hayes and others (1977), and Young (1955, 1957, and 1966). Doelling (1972) compiled the geology and coal data for the coal field. Osterwald and Mayberry (1974) closely examined the faults and developed an engineering geologic map for the Woodside quadrangle which joins the west side of the Range Creek 15-minute quadrangle. AAA Engineering and Drafting, Inc.

(1979a and 1979b) prepared coal resource occurrence and coal development potential maps for the northeast and southeast quarters of Woodside 15-minute quadrangle.

Stratigraphy

The coal beds of economic importance in the Book Cliffs coal field are Upper Cretaceous in age, and are confined to the Blackhawk Formation of the Mesaverde Group. In the area of the Range Creek quadrangle the Mesaverde Group includes the following formations in ascending order: Blackhawk Formation, Castlegate Sandstone, and Price River Formation. The Upper Cretaceous Mancos Shale underlies and intertongues with the Blackhawk Formation. The Mancos Shale was deposited in an offshore marine environment and the Blackhawk Formation in a mixed marine and continental environment. The Castlegate Sandstone and the Price River Formation were formed in a continental environment.

The bluish-gray shale of the Mancos Shale crops out on the west half of the southeast quarter of the Woodside 15-minute quadrangle and several hundred feet are exposed in the slope above the base of the Book Cliffs. Sandstone beds of the Blackhawk Formation crop out in steep and precipitous cliffs and ledges above the Mancos Shale.

Fisher (1936, p. 22) divided the Blackhawk Formation into the following four members in ascending order: the Lower Sandstone Member, 221 ft (67 m) thick; the Middle Shale Member, 121 ft (37 m) thick; the Middle Sandstone Member, 165 \pm ft (51 \pm m) thick; and the Upper Member which Fisher (1936, p. 14) estimated to range from 70 to 230 ft (21 to 70 m) in thickness. This member is dominantly shale but contains an upper sandstone bed in areas south and east of the quadrangle.

The Lower Sandstone Member is correlated with the Kenilworth sandstone to the west (Doelling, 1972) but thins eastward and cannot be traced

east of Green River. The Middle Shale Member is apparently a tongue of the Mancos Shale and cannot be distinguished from the Mancos east of the Green River. The Sunnyside coal zone lies in the upper part of the Middle Sandstone Member. Young (1955) delineates the Grassy and Desert members of the Blackhawk Formation above the Middle Sandstone Member. These two members are probably equivalent to the Upper Member of Fisher (1936) and consist of sandstone, shale, and lenticular coal beds.

The Castlegate Sandstone thins eastward from 500 ft (152 m) of conglomeratic sandstone in the northern part of the Wasatch Plateau to a feather edge of siltstone near the Utah-Colorado State line (Fisher, 1936). In the Woodside quadrangle to the west the Castlegate is approximately 100 ft (30 m) thick. Fisher (1936) referred to the Castlegate as a member of the Price River Formation, but it is now generally ranked as a formation. The Castlegate is overlain by the Buck Tongue of the Mancos Shale which is poorly developed in the quadrangle area, but it thickens eastward toward the Utah-Colorado state line where it is 350 ft (107 m) thick. The Price River Formation lies on the Castlegate Sandstone where the Buck Tongue is not present. Fisher (1936) described three members of the Price River Formation above the Buck Tongue in the eastern part of the Book Cliffs, but which are not recognized northwest of the Beckwith Plateau. In this quadrangle the Price River Formation consists of interbedded sandstone, shale, carbonaceous shale, and coal streaks.

The oldest formation exposed in the quadrangle area is the Castlegate Sandstone which crops out in Green River canyon on the south edge of the quadrangle (Hintze and Stokes, 1964).

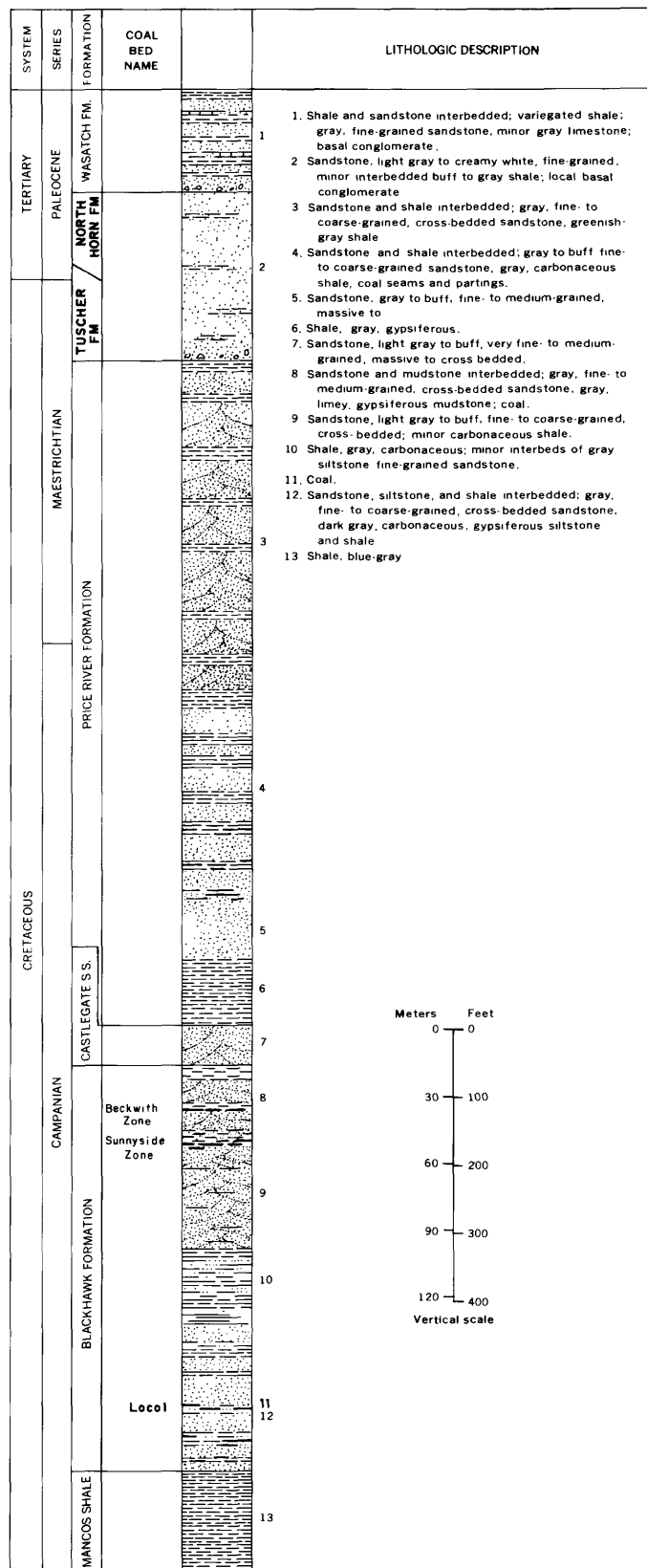


FIGURE 1. Composite columnar section, southeast quarter of the Range Creek 15-minute quadrangle, Emery County, Utah.

The Tertiary strata successively overlying the Price River Formation include the Tuscher, North Horn, Wasatch, and Green River Formations. The basal part of the Green River Formation caps the high ridge that crosses the north edge of the quadrangle. The Tuscher Formation consists of light-gray to cream-white friable massive sandstone, subordinate buff to gray shale, and minor conglomerate (Doelling, 1972). The North Horn Formation is composed of gray to grayish-green calcareous and silty shale, tan to yellowish-gray fine-grained sandstone, and minor conglomerate. The Tuscher Formation thins westward and the North Horn Formation thins eastward. The combined thickness of these two formations in this quadrangle is unknown, but is probably greater than shown in figure 1. The Wasatch Formation is predominantly sandstone with interbedded variegated shales. The Green River Formation consists of greenish-gray and white claystone and shale, fine-grained thin-bedded sandstone, and dark-brown shale.

Structure

Based on the projection of the structure in the Woodside quadrangle (AAA Engineering and Drafting, Inc., 1979a, 1979b) the rocks in the Range Creek quadrangle are estimated by the present authors to dip eastward to northeastward from 4° to 10° . No faults are known to occur in the southeast quarter of the Range Creek 15-minute quadrangle except a short east-west trending fault at the west central boundary of the quadrangle. The state geologic map (Hintze and Stokes, 1964) shows practically no offset of the formation contact lines at the fault trace which suggests that the fault displacement is very small.

COAL GEOLOGY

Fisher (1936, p. 45) reports that "On the basis of age of coal, as well as other features, the Book Cliffs coal field of Utah may be divided conveniently into two subfields. The Sunnyside subfield includes the part west of the Green River; it carries no Price River coals but contains essentially all the coals in the Blackhawk Formation. The Thompsons subfield lies east of the river; it carries all the Price River coals but only very minor amounts of the older Blackhawk coals." The Green River runs through the central part of the southeast quarter of the Range Creek 15-minute quadrangle which lies on the boundary of Clark's subfields.

In this area the Blackhawk coals are thinner and more lenticular than in the quadrangles to the north and west. Two coal zones, the Beckwith and the Sunnyside, occur in the Blackhawk Formation in the quadrangle area. There is no evidence that the Price River Formation coals in the Thompsons subfield are developed in this quadrangle.

Beckwith Coal Zone

In the Woodside quadrangle, the Beckwith coal zone is at least 70 ft (21 m) thick and contains several lenticular coal beds. In that area the measured coal bed thicknesses range from less than 1 ft (0.3 m) to 7.0 ft (2.1 m) (AAA Engineering and Drafting, Inc, 1979b).

Albee (1979) reported the drilling of seven coal test holes (one was abandoned) in the adjoining southwest quarter of the Range Creek 15-minute quadrangle. The holes were drilled well into the Blackhawk Formation and encountered carbonaceous shale and thin coal beds in the Beckwith and Sunnyside zones. The coal beds encountered in the drill holes ranged from 0.2 to 2.0 ft (0.1 to 0.6 m) in thickness (AAA Engineering and Drafting, Inc., 1979c).

A coal test well drilled by J. B. McKean and others in the adjoining quadrangle at the junction of Turtle Canyon and Range Creek canyon in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 27, T. 17 S., R. 16 E. The well encountered three thin coal beds 1.3, 0.5, and 1.3 ft (0.4, 0.2, and 0.4 m) thick. These beds are close in elevation to the coal beds encountered in the nearby BC-9-RC hole drilled by Albee (1979) and are tentatively called the Beckwith zone.

Sunnyside Coal Zone

The Sunnyside coal zone is approximately 60 ft (18 m) below the Beckwith coal zone in the Woodside quadrangle. The Sunnyside coal beds, although somewhat lenticular, are more persistent than the Beckwith beds in that quadrangle (AAA Engineering and Drafting, Inc. 1979b). The Sunnyside coal zone occurs in the Middle Sandstone Member of the Blackhawk Formation. In the adjoining Woodside quadrangle the zone consists of one or more beds which range in thickness from 0.3 to 8.0 ft (0.1 to 2.4 m) or more. These beds apparently thin eastward and become more widely separated from the Beckwith zone based on the drilling results discussed above.

Gulf Oil Corporation drilled the Norris Federal No. 1 oil test well in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T. 18 S., R. 15 E. in the adjoining quadrangle and encountered two thin coal beds 1.2 ft (0.4 m) and 2.5 ft (0.8 m) thick at depths of 2,060 and 2,070.5 ft (628 and 631 m). These beds occur approximately 300 ft (91 m) above the Mancos Shale and may be correlated with the Sunnyside zone.

The only known hole drilled in the southeast quarter of the Range Creek 15-minute quadrangle is an oil-gas test well drilled by Pacific

Natural Gas Exploration Company in 1962. The well, called the Range Creek Unit No. 1, was drilled on the west central edge of the quadrangle in the SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 27, T. 17 S., R. 16 E. in Range Creek canyon. Based on the authors' interpretation of the sonic log of the well, three thin coal beds were encountered at the following depths:

<u>Depth</u> <u>(ft)</u>	<u>Coal Bed thickness</u> <u>(ft)</u>
960.0	1.6
964.1	0.5
968.0	1.8

(To convert feet to meters, multiply by 0.3048)

These thin coal beds are approximately 330 ft above the Mancos Shale and are tentatively correlated by the present authors with the Sunnyside coal zone. The beds are similar in position and thickness to the coal beds encountered in Gulf Oil Corporation Norris Federal No. 1 well discussed above.

Chemical Analyses of the Coal

Doelling (1972, p. 323) reports one coal analysis from the Woodside quadrangle area. The sample was taken from the Beckwith coal zone exposed in the Peterson prospect on the south side of that quadrangle. The results of the as-received proximate analysis are:

	Percent
Moisture	4.7
Volatile matter	33.58
Fixed carbon	50.24
Ash	11.43
Sulfur	1.15

No calorific value was reported. Without additional analyses of the Beckwith coal, the above analysis cannot be regarded as typical for the zone.

Analyses of coal samples from the Lower Sunnyside coal bed in the northeast quarter of the Woodside 15-minute quadrangle show the coal is ranked as high volatile B bituminous (AAA Engineering and Drafting, Inc., 1979). The Lower Sunnyside coal bed is probably equivalent to the Sunnyside coal zone of this quadrangle (Fisher, 1936).

Mining Operations

Inasmuch as no coal beds are known to crop out in the quadrangle area and few holes have been drilled, no effort has been made to prospect for coal by underground mining methods. Doelling (1972) reports that the only known effort to mine coal in the Woodside quadrangle was at Peterson's prospect high on the cliff on the north side of Price River Canyon. A coal bed in the Beckwith zone was prospected through two adits located approximately at the location of the Beckwith zone. The prospect was active before 1905 and little coal was produced.

COAL RESOURCES AND COAL DEVELOPMENT POTENTIAL

The only known hole drilled in this quadrangle is the Pacific Natural Gas Exploration Company Range Creek Unit No. 1 well. The coal beds encountered in that hole were less than 5 ft (1.5 m) thick which is the minimum thickness used to calculate Reserve Base tonnages. Therefore, no coal resources are shown for this quadrangle.

Development Potential for Surface Mining Methods

No development potential for surface mining methods exists in this quadrangle because of the thick overburden which is more than 400 ft (122 m) above the Beckwith zone.

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.

Because there are no known coal beds in this quadrangle more than 5 ft (1.5 m) thick and the knowledge of the coal deposits is very limited, the unleased Federal coal land in the southeast quarter of the Range Creek 15-minute quadrangle is classified as having an unknown development potential for subsurface mining methods.

Classification of development potential for in situ coal gasification was not done because dips are less than 15 degrees within the quadrangle. 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.

REFERENCES

- AAA Engineering and Drafting, Inc., 1979a, Coal resource occurrence and coal development potential maps of the northeast quarter of the Woodside 15-minute quadrangle, Emery and Carbon Counties, Utah: U.S. Geol. Survey Open-File Report 79-897.
- _____, 1979b, Coal resource occurrence and coal development potential maps of the southeast quarter of the Woodside 15-minute quadrangle, Emery County, Utah: U.S. Geol. Survey Open-File Report 79-898.
- _____, 1979c, Coal resources of the southwest quarter of the Range Creek 15-minute quadrangle, Emery County, Utah: U.S. Geol. Survey Open-File Report 79-1016.
- Abbott, W. I., and Liscomb, R. L., 1956, Stratigraphy of Book Cliffs in east central Utah: Intermtn. Assoc. Petroleum Geologists Guidebook, 7th Ann. Field Conf.
- Albee, H. F., 1979, Geophysical and lithologic logs for thirteen holes drilled in the Book Cliffs coal field, Range Creek and Woodside quadrangles, Emery County, Utah: U.S. Geol. Survey Open-File Report 79-727.
- American Society of Testing and Materials, 1977, Standard specifications for classification of coals by rank, in Gaseous fuels, coal, and coke; atmospheric analysis: ASTM Publication D 388-77.
- Clark, F. R., 1928, Economic Geology of the Castlegate, Wellington, and Sunnyside Quadrangles, Carbon County, Utah: U.S. Geol. Survey Bull. 793.
- Doelling, H. H., 1972, Book Cliffs coal field, in Doelling, H. H., Central Utah coal fields: Utah Geol. and Min. Survey Mon. Ser. no. 3.
- Fisher, D. J., 1936, The Book Cliffs coal field in Emery and Grand Counties, Utah: U.S. Geol. Survey Bull. 852.
- Fisher, D. J., Erdmann, C. E., and Reeside, J. B., 1960, Cretaceous and Tertiary formations of the Book Cliffs, Carbon, Emery, and Grand Counties, Utah, and Garfield and Meas Counties, Colorado: U.S. Geol. Survey Prof. Paper 332.
- Gray, R. J., Patalski, R. M., and Schapiro, N., 1966, Correlation of coal deposits from central Utah, in Central Utah coals: Utah Geol. and Minerlog. Survey Bull. 80.
- Gross, L. T., 1961, Stratigraphic analysis of the Mesaverde Group, Uinta Basin, Utah: Unpubl. M.S. thesis, Univ. of Utah.

- Hayes, P. T., and others, 1977, Summary of the geology, mineral resources, engineering geology characteristics, and environmental geochemistry of east-central Utah: U.S. Geol. Survey Open-File Report 77-513.
- Hintze, L. F., and Stokes, W. L., 1964, Geologic map of Utah, southeast quarter: Utah Geol. and Mineral Survey.
- Lewis, R. S., 1914, 1915, The Book Cliffs coal field, Utah: Am. Inst. Mining Eng. Bull. 91; Am. Inst. Mining Eng. Trans., 50.
- Osterwald, F. W., and Mayberry, J. O., 1974, Engineering geologic maps of the Woodside quadrangle, Emery and Carbon Counties, Utah: U.S. Geol. Survey Map I-798.
- Spieker, E. M., 1925, Geology of coal fields in Utah: U.S. Bur. Mines Tech. Paper 345.
- Taff, J. A., 1906, Book Cliffs coal field, Utah, west of Green River: U.S. Geol. Survey Bull. 285.
- Thiessen, R., and Sprunk, G. C., 1937, Origin and petrographic composition of the lower Sunnyside coal of Utah: U.S. Bur. Mines Tech. Paper 473.
- 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.
- U.S. Department of Commerce, (1964), Normal annual precipitation in inches, 1931-1960, State of Utah: U.S. Dept. of Commerce Weather Bureau Map WR-1210-A.
- Young, R. G., 1955, Sedimentary facies and intertonguing in the upper Cretaceous of Book Cliffs, Utah, Colorado: Geol. Soc. Am. Bull., v. 66, p. 177-202.
- _____, 1957, Late Cretaceous cyclic deposits, Book Cliffs, eastern Utah: Am. Assoc. Petroleum Geologists Bull., v. 41, p. 1760-1774.
- _____, 1966, Stratigraphy of coal-bearing rocks of Book Cliffs, Utah, Colorado, in Central Utah coals: Utah Geol. and Mineralog. Survey Bull. 80, p. 7-21.