Text to Accompany

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

[Report includes 18 plates]

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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INTRODUCTION

Purpose

This text is to be used in conjunction with Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) Maps of the Southeast Quarter of the Notom 15-minute quadrangle, Garfield County, Utah. These maps and report were 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 the Henry Mountains Known Recoverable Coal Resource Areas (KRCRA's), Utah. Consequently, only those geologic features relevant to coal occurrences are described herein.

This investigation was undertaken by Dames & Moore, Salt Lake City, Utah at the request of the U.S. Geological Survey under contract number 14-08-0001-17489. The resource information gathered for this report is in response to the Federal Coal Leasing Amendments Act of 1976 (P.L. 94-377). Published and unpublished public information available through June 1979 was used as the data base for this study. Neither drilling nor field mapping was performed; nor were any confidential data used.

Location

The Southeast Quarter of the Notom 15-minute quadrangle is located in the north-cenral part of Wayne County, Utah on the east-central side of the Henry Mountains coal field. The northern border of the map area is two miles (3.2 km) from the northern Wayne County border. The town of Notom lies roughly seven miles (11.2 km) north of the map area's northwestern corner. Hanksville is 30 miles (48 km) to the northeast. The area is unpopulated.

Accessibility

Principal access is by an unimproved road which departs Highway 24, extends through the town of Notom and trends, roughly, north-south through the center of the map area. At Gravity Station, just west of the Elbow of the Sandy, an unimproved road branches eastward from the main road to cross Wildcat Mesa. A mile and a half (2.4 km) below Gravity Station, another unimproved road branches from the main road toward the west.

Winter access to the map area is limited by snow and wind.

Physiography

The Southeast Quarter of the Notom 15-minute quadrangle is located on the central west flank of the Henry Mountains structural basin. The northeastern edge of the Waterpocket Fold extends across the southwest corner of the map area.

Relatively low-lying, irregularly benched strata and mesas dominate the map area's topography. Elevations range from 5,120 ft (1,561 m) in the Sandy Creek channel to greater than 7,360 ft (2,243 m) in the southwestern corner of the map area. Bluffs around Wildcat Mesa follow an "S" curve bordering the east side of the map area.

Streams in the area form a dendritic pattern and are generally north-flowing. The perennial Oak Creek flows through the northeast quarter of the map area draining into Sandy Creek. All other streams are intermittent. The principal collector is Sandy Creek which trends north-south through the map area center. Sandy Creek joins the Fremont River near Caineville, 12 miles (19 km) north of the map area. The Fremont joins with Muddy Creek near Hanksville to form the Dirty Devil River which eventually flows into the Colorado.

Climate and Vegetation

Climate in the Southeast Quarter of the Notom 15-minute quadrangle is arid. Average annual precipitation ranges around 10 inches (25 cm) but, typical of desert regions, fluctuates from year to year. Extended drought periods of over three years are common. Most precipitation is in the form of local late summer thundershowers and light winter snows and rain.

Temperatures in the map area range from more than 100°F (38°C) in the late summer months to less than 0°F (-18°C) in the winter. The yearly average for the region is 56°F (13°C) (U.S. Bureau of Land Management, 1978). Typically, temperatures decrease and precipitation increases with increasing elevation.

Winds generally blow from the west and southwest. The highest seasonal wind velocities occur in the spring and early summer.

Water quality and stream flow reflect seasonal climatic changes. Most surface water is saline due to high evaporation rates during the summer; streams typically dry up in late summer.

Principal types of vegetation in the area include grass, sagebrush, pinon, juniper, saltbrush and greasewood (U.S. Bureau of Land Management, 1978).

Land Status

The Southeast Quarter of the Notom 15-minute quadrangle contains the northeastern part of the central Henry Mountains Known Recoverable Coal Resource Area. The Federal government owns the coal rights for lands over most of the map area, as shown on plate 2 of the Coal Resource Occurrence Map. The Bureau of Land Management supervises 66.3 percent of the area, 18.7 percent is a National Park, the state of Utah owns 10.6 percent and the remaining 4.4 percent is privately held. Coal lands are located in the eastern half of the map area, cover 28.6 percent of the total area and are mostly owned by the Bureau of Land Management and the state of Utah. A Preference Right Lease Application (PRLA U6733) is outstanding in sections 15 and 22, and part of sections 10, 11, 14, 15, 22, 23 and 26, T. 31 S., R. 8 E., in the northeast corner of the map area.

GENERAL GEOLOGY

Previous Work

John Wesley Powell named the Henry Mountains in 1869 and made some of the first comments on the geology of the area (Gilbert, 1877). G. K. Gilbert conducted a study of the Henry Mountains in 1875 to 1876. His report (Gilbert, 1877) is considered a classic of geologic literature. Geologic mapping of the Southeast Quarter of the Notom 15-minute quadrangle was completed by Smith and others (1963) as part of their work on the Capitol Reef area for the U.S. Geologic Survey. C. B. Hunt studied coal in the Henry Mountains in 1935 completing field studies in 1939. The results of his effort were published in 1953 as U.S. Geological Survey Professional Paper 228. More recently, coal studies were completed by Doelling (1972) of the Utah Geological and Mineralogical Survey and Law (1977) of the U.S. Geological Survey. The results of these investigations provided most of the data used in this coal resource evaluation. Additional publications which describe geologic features in the region are included in the bibliography.

Stratigraphy

A complete sequence of Jurassic strata, principally sandstones, from Navajo Sandstone through the Morrison Formation, underlies the west half of the map area. A few small outcrops of Triassic red beds appear in the southwest corner of the area. Overlying the Jurassic strata is the Cretaceous Dakota Sandstone, the oldest known coal-bearing unit in the Southeast Quarter of the Notom 15-minute quadrangle. Above the Dakota Sandstone are the Tununk Shale, the Ferron Sandstone, the Blue Gate Shale, the Emery Sandstone and Masuk Shale members of the Mancos Shale, all of Cretaceous age. Lower sandstone beds of the Cretaceous Mesa Verde Formation cap mesas in the southeast corner of the map area. A composite columnar section accompanied by lithologic descriptions on CRO plate 3 illustrates the stratigraphic relationships of these units.

The Dakota Sandstone is a westward transgressive littoral sequence and lies uncomformably atop the varicolored Brushy Basin Shale member of the Jurassic Morrison Formation. The Dakota Sandstone weathers to form a thin series of ledges and slopes at the base of broad slopes developed upon the overlying Tununk Shale member of the Mancos Shale (Peterson and Ryder, 1975). It consists of yellow-gray to brown sandstone, lenticular thin interbeds of gray and carbonaceous shale with subordinate conglomerate and minor coal (Hunt, Averitt, and Miller, 1953). The formation averages 52 ft (16 m) in thickness in the map area; coal beds are less than 1.5 ft (50 cm) thick.

Conglomeratic, crossbedded sandstones which occur at the base of the Dakota Sandstone in this map area may have been derived by reworking of underlying Morrison Formation strata in a fluvial environment (Hunt, Averitt, and Miller, 1953). Minor interbeds of gray and carbonaceous shale and coal reflect local marsh and lagoonal environments. A diagnostic bed of fossils containing Gryphaea, Exogyra and Inoceramus occurs near the top of the formation. Gryphaea are most abundant and commonly form reefs (Hunt, Averitt, and Miller, 1953).

The Mancos Shale lies conformably over the Dakota Sandstone and fills the sedimentary basin in this part of the Henry Mountains. The lowermost, Tununk Shale member of the Mancos Shale is gradational and interfingering with the underlying Dakota Sandstone. It is about 575 ft (175 m) thick in the map area and represents a continuation of the first westward transgression of the late Cretaceous sea in which the Dakota Sandstone was deposited (Peterson and Ryder, 1975).

The Tununk Shale member is a gray, fissile shale with some bentonitic shale and subordinate, mostly thin-bedded, medium-grained sandstones (Doelling, 1972). The lowest few feet of the member everywhere contain oysters (Hunt, Averitt, and Miller, 1953). The sandstones are light gray to brown and become more abundant toward the top of the member, where the Tununk Shale member is transitional with the overlying Ferron Sandstone member (Doelling, 1972). The top of the Tununk Shale member is placed beneath the first thick-bedded or massive sandstone ledge in the transition zone (Peterson and Ryder, 1975). A regressive sequence, partially the result of deltaic progradation, occurs in the upper part of the member (Hunt, Averitt, and Miller, 1953).

The first significant coal-bearing horizon in the map area, the Ferron Sandstone member of the Mancos Shale, is a regressive unit composed of littoral and coastal plain facies

(Doelling, 1972). A lower, littoral unit, transitional with the underlying Tununk Shale member, is characterized by interbedded thin to thick horizons of gray to brown sandstone and gray shale. The upper portion of the member is a coastal plain deposit of interbedded tan to yellowish-gray, massive to thick, medium-grained sandstone and lenticular light gray to tan sandstone, gray sandy shale and coal.

The Ferron Sandstone member typically forms a conspicuous series of low ridges or ledges between broad valleys of flanking shale. It is locally capped by a thin sandstone bed which probably represents a transgressive littoral deposit. In this area the Ferron Sandstone member averages 300 ft (91 m) thick.

The Ferron Sandstone member is unconformably overlain by the Blue Gate Shale member. The contact between the Ferron Sandstone and the Blue Gate Shale members is an erosional hiatus which may represent the removal of 50 to 100 feet (15.2 to 30.5) from the top of the sandstone member (Peterson and Ryder, 1975).

The Blue Gate Shale member of the Mancos Shale, like the Tununk Shale member, represents a transgressive sequence of marine deposition. It is composed of blue-gray, finely laminated shale with thin beds of shaly sandstone and shaly limestone in the upper one-third of the unit. The member weathers easily to form smooth valleys or broad benches (Peterson and Ryder, 1975).

The average thickness of the Blue Gate Shale member in this map area is 1,400 ft (427 m). The upper contact between the Blue Gate Shale member and the overlying Emery Sandstone member is interfingering and gradational.

The Emery Sandstone member of the Mancos Shale, like the Ferron Sandstone member, is a regressive sequence (Peterson and Ryder, 1975) and is the most important coal bearer in the area. It can also be divided into two units.

The lower unit represents littoral deposition and consists of gray to light-brown massive and thick-bedded, medium-to coarse-grained sandstone with a few thin gray shale interbeds. Gypsum seamlets are present in its upper half. The upper unit consists of interbedded gray shale, tan, sandy shale, tan to brown medium-grained, thick-bedded, locally resistant sandstone and coal. The upper unit is thought to be of nearshore fluvial origin by some investigators. The average thickness for the Emery Sandstone member in the map area is 430 ft (131 m). The lower part of the member forms prominent and slightly irregular cliffs, whereas the upper part tends to weather back in a short series of ledges and slopes.

The Emery Sandstone member is conformably overlain by the Masuk Shale member of the Mancos Shale. The contact between the members occurs in a thick gradational zone and is difficult to place (Doelling, 1972). All exposures of Masuk Shale member in the area appear atop or near the rim of Wildcat Mesa along the map area's east border.

The Masuk Shale member, where exposed, consists of sandy and carbonaceous shale with minor lenticular interbeds of shaly limestone (Hunt, Averitt, and Miller, 1953). It is generally continental but locally marine in origin where littoral and lagoonal depositional environments are represented. The Masuk Shale member exhibits an average thickness of 200 ft (61 m) in the map area, is not coal bearing and is locally overlain by erosional remnants of the Cretaceous Mesa Verde Formation.

Structure

Structure in the Southeast Quarter of the Notom 15-minute quadrangle is dominated by eastward dipping monoclinal beds on the east flank of the Waterpocket Fold. The monocline representing the east flank of the fold parallels and separates the Henry Mountains structural basin to the east from the Circle Cliffs upward to the west. Dips across the monocline in the map area range from 4 to 35 degrees, rapidly becoming more gentle eastward. Along the eastern side of the map area, dips in the Ferron Sandstone member average 15 to 20 degrees and range from 7 to 15 degrees in the Emery Sandstone member.

Faults are rare along the Waterpocket Fold, but two appear in the map area. These trend east-west, at right angles to outcrop trends in T. 32 S., R. 8 E. and form a graben in which displacement is small.

Geologic History

Most pre-Cretaceous Mesozoic rocks in this part of the Colorado Plateau are continental in origin. Permian through Jurassic continental deposition was along coastal plains adjacent to principal seaways. The major types of depositional environments that existed during this period were eolian, intertidal mudflats, lacustrine, fluvial and flood plains (Hunt, Averitt, and Miller, 1953).

The Cretaceous history of the Henry Mountains coal field is similar to that of coal fields in central Utah and throughout the Colorado Plateau in general. The region is one in which classic transgressive and regressive sedimentation provided an environment for coal deposition.

During the early Cretaceous, the Henry Mountains region lay on a lowland plain over which neither subsidence nor uplift was occurring. However, sufficient erosion took place to remove lower Cretaceous strata and plane off the top of the Jurassic Morrison Formation.

Subsidence then resumed in the region and a sheet of fluvial sand and clay was deposited to form the Dakota Sandstone. Broad flood plains with swamps and lakes provided an environment in which vegetation flourished. Resulting accumulations of carbonaceous material formed local, thin coal seams.

In the meantime, as subsidence increased, a sea in which the Mancos Shale was to be deposited began its encroachment from the east. The sea eventually covered all the Henry Mountains region and extended westward to the present-day Wasatch Plateau area. The shoreline remained there throughout Mancos Shale deposition except for two dramatic regressions which deposited the Ferron Sandstone and Emery Sandstone members. Orogenic pulses to the west supplied clastics for these sandstone members faster than the area could subside (Doelling, 1972). Marine shale deposition changed to nearshore sand and finally to lagoonal and fluvial sand and shale. Forests flourished, dead vegetation accumulated and, in places, coal was produced. All of the thick coal seams in the Henry Mountains Basin were deposited during these two events.

After deposition of the Mancos Shale the Cretaceous sea retreated permanently eastward. Although sedimentation undoubtedly continued in the Henry Mountains region, continental rather than marine beds were deposited and these were later removed by erosion.

According to Hunt and others (1953) the Waterpocket Fold and presumably the Henry Mountains structural basin were formed between the close of Cretaceous time and the Eocene Epoch. Eocene deposits cover the fold at places in the region.

Emplacement of the Henry Mountains intrusives east of the map area may have occurred anytime after early to mid-Tertiary. Thereafter the Colorado Plateau began its uplift and erosion instead of deposition dominated. This activity has continued to the present day.

COAL GEOLOGY

Significant coal beds appear in the Ferron and Emery Sandstone members in the eastern half of the Southeast Quarter of the Notom 15-minute quadrangle. The Dakota Sandstone bears coal as well. However, Dakota coals, occurring in the northeast quarter of the area, are lenticular, with no exposed seam exceeding 2.4 ft (70 cm) in thickness.

Thin coal beds in the Ferron Sandstone member appear discontinuously through the length of the map area. The beds occupy the lower of two coal zones which occur in the Ferron Sandstone member elsewhere in the Henry Mountains. The maximum known bed thickness in the map area is 2.8 ft (85 cm) in section 10, T. 32 S., R. 8 E. Beds measuring around 2.5 ft (76 cm) in thickness occur for a few thousand feet north and south of that location and near the northern border of the map area. The average Ferron coal bed thickness is 1.7 ft (50 cm).

The best coal in the Southeast Quarter of the Notom 15-minute quadrangle is in the Emery Sandstone member. The Emery coal zone occurs along Wildcat Mesa, near the top of the member, above the cliff rim. The coal beds are very lenticular and pinch in and out but, except for a few local areas, coal is continuous along the outcrop.

Eight distinct beds (Em-1 through Em-8) which at least locally exceed five feet (1.5 m) in thickness were identified in the Emery coal zone in the map area. Thick beds higher in the zone occur in the northern half of the map area where the maximum measured continuous coal section is 6.7 ft (20 cm) in section 23, T. 31 S., R. 8 E. Immediately to the south, in section 26, T. 31 S., R. 8 E., several seams aggregate a thickness of 17 ft (5.2 m) with 1.0 ft (30 cm) of rock partings.

Coal beds appear lower in the Emery coal zone in the southern half of the map area and are generally thinner than those to the north. In the south, a few single beds (Em-1 and Em-2) only locally exceed 5 ft (1.5 m) in thickness, with the average being 1.7 ft (50 cm).

Chemical Analyses of Emery Zone Coal

Six samples of Emery coal from the Southeast Quarter of the Notom 15-minute quadrangle were collected and analyzed by the Bureau of Land Management in connection with EMRIA Report No. 15 (1978). Analytical results are shown in table 1. This coal is subbituminous A in rank (ASTM, 1966).

Table 1 -- Average proximate analyses of coal samples in percent

	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	Btu/lb
D189019	11.5	40.6	46.4	13.8	0.9	11,289
D189020	11.0	41.4	43.2	17.7	0.5	11,019
D189021	9.5	39.4	40.2	25.8	2.4	10,264
D189022	11.6	41.4	48.3	9.7	0.7	12,002
D189023	10.3	42.0	42.3	18.4	0.8	10,947
D189024	10.9	42.8	47.5	9.0	1.1	12,086
Average	10.8	41.3	44.7	15.7	1.1	11,268

U.S Bureau of Land Management (1978).

COAL RESOURCES

Data from three U.S. Geological Survey coal test holes and 56 measured surface sections and surface mapping by Doelling (1972) of the Utah Geological and Mineralogical Survey and Law (1979) of the U.S. Geological Survey were used to construct outcrop, isopach and structure contour maps of coal zones and beds in the Southeast Quarter of the Notom 15-minute quadrangle, (CRO plates 1 through 15).

Coal resources were calculated using data obtained from the coal isopach maps (CRO plates 4,8,12 and 15). The coal-bed acreage (measured by planimeter) multiplied by the average isopached thickness of the coal bed times a conversion factor of 1,770 short tons of coal per acre-foot for subbituminous coal yielded the coal resources in short tons of coal for each isopached coal bed. Reserve Base for the Em-1 and Em-2 coal beds is shown on CRO plates 7 and 11, and is rounded to the nearest tenth of a million short tons. Only that coal equal to or thicker than the 5.0 ft (1.5 m) minimum advocated in U.S. Geological Survey Bulletin 1450-B is included in the Reserve Base. Thinner beds presently being mined or for which there is evidence that they could be mined commercially at this time are not included in the Reserve Base calculation. Total coal Reserve Base for all coal beds thicker than 5.0 ft (1.5 m), as shown on CRO plate 2, is about 10.2 million short tons. Reserve base (in short tons) in the various development-potential categories for surface and underground mining methods is shown on tables 2 and 3.

Dames & Moore has not made any determination of economic recoverability for any of the coal beds in this report.

Isolated Data Points

In instances where isolated measurements of coal beds of Reserve Base thickness (greater than 5 feet or 1.5 meters) are encountered, the standard criteria for construction of isopach, structure contour, mining ratio, and overburden isopach maps are not available. The lack of data concerning these beds limits the extent to which they can be reasonably projected in any direction and usually precludes correlations with other, better known, beds. For this reason, the isolated data points are mapped separately and are shown on figures 2 and 3. The isolated points mapped in this map area are listed below.

Source	Location	Coal Bed	Millions Short Tons	Thickness
USBLM, EMRIA (1978)	Section 23 T.31S., R.8E.	Em 7	0.49	12.7 ft (3.9 m)
DOELLING (1972)	Section 26 T.31S., R.8E.	Em 8	0.65	7.0 ft (2.1 m)

▲ (16)
C 12.7(Em)[7]

POINT OF MEASUREMENT - Showing thickness of coal, in feet. Includes all points of measurement other than drill holes. Index number refers to hole on plate 1 of CRO map. Letters designate name of coal bed as listed below. Bracketed number identifies coal bed named on plates 1 or 3.

Em - Emery coal zone

COAL BED SYMBOL AND NAME - Coal bed identified by bracketed number is not formally named, but is numbered for identification purposes in this quadrangle only.

Em

TRACE OF COAL ZONE OUTCROP - Showing symbol of name of coal zone as listed above. Arrow points toward coal-bearing area. Dashed where inferred.

C

INFERRED LIMIT OF BURNED AND CLINKERED COAL - Arrow points toward area of baked and fused rock.

A

BOUNDARY OF IDENTIFIED RESERVE BASE COAL - Drawn along the coal bed outcrop, an arc (A) drawn 2,640 feet from the nearest point of Reserve Base coal bed measurement, the PRLA boundary (P), the quadrangle boundary (Q), and the non-Federal coal ownership boundary (N). Arrow points toward area of identified Reserve Base coal.

RB

— (Measured)
— (Indicated)
0.49 (Inferred)

IDENTIFIED COAL RESOURCES - Showing totals for Reserve Base (RB), in millions of short tons, for each section or part(s) of section of non-leased Federal coal land, either within or beyond the stripping-limit. Dash indicates no resources in that category.

To convert short tons to metric tons, multiply short tons by 0.9072.

To convert feet to meters, multiply feet by 0.3048.

SCALE - 1:24,000 (1 inch = 2,000 feet)

FIGURE 1. - Explanation for FIGURES 2 and 3.

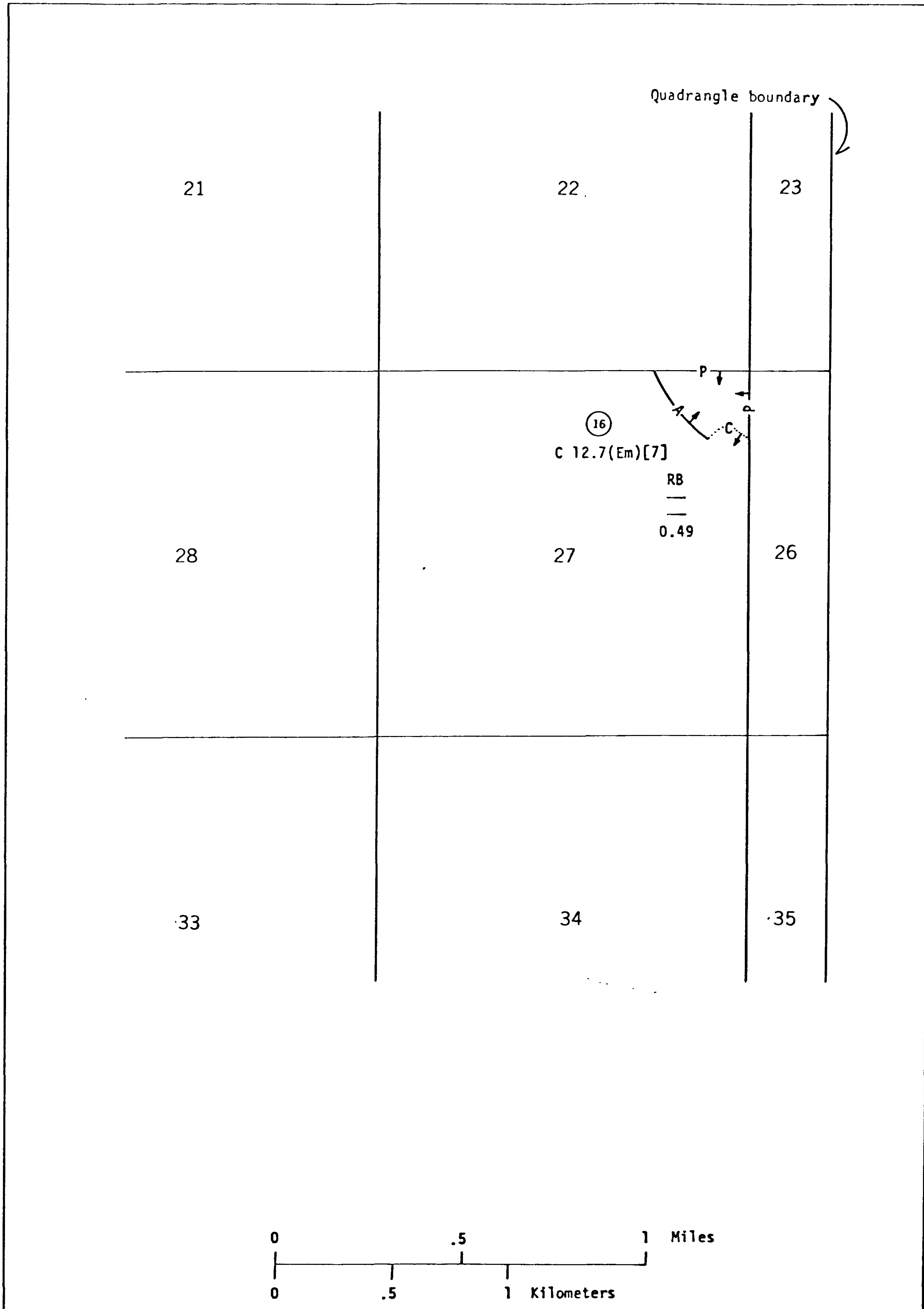

FIGURE 2. - Isolated data point map of the Emery [7] coal bed.

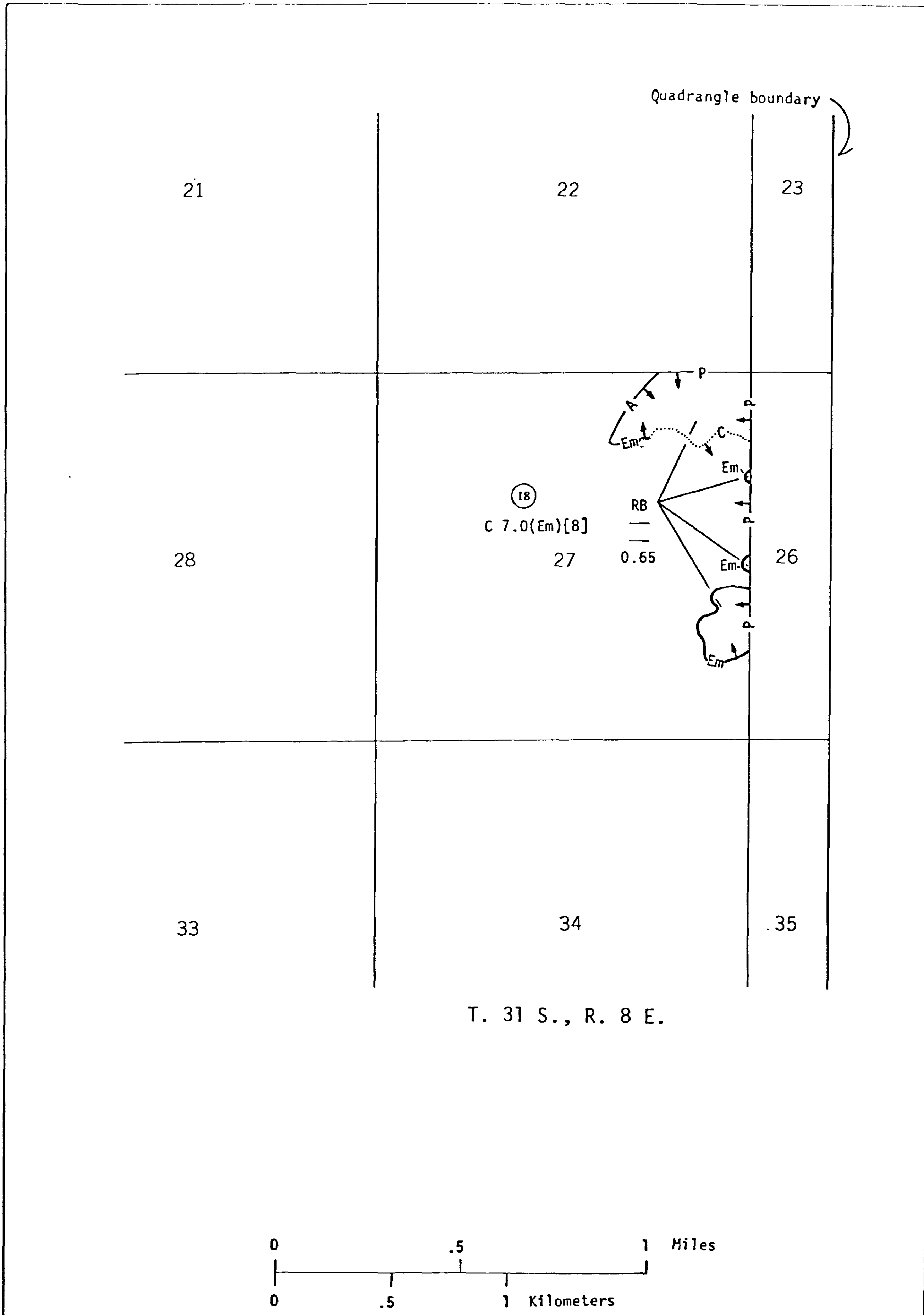

FIGURE 3. - Isolated data point map of the Emery [8] coal bed.

COAL DEVELOPMENT POTENTIAL

Coal development potential areas are drawn so as to coincide with the boundaries of the smallest legal land subdivisions shown on plate 2. In sections or parts of sections where no land subdivisions have been surveyed by the BLM, approximate 40-acre (16-ha) parcels have been used to show the limits of the high, moderate, or low development potentials. A constraint imposed by the BLM specifies that the highest development potential affecting any part of a 40-acre (16-ha) lot, tract, or parcel be applied to that entire lot, tract, or parcel. For example, if 5 acres (2 ha) within a parcel meet criteria for a high development potential, 25 acres (10 ha) a moderate development potential, and 10 acres (4 ha) a low development potential, then the entire 40 acres (16 ha) are assigned a high development potential.

Development Potential for Surface Mining Methods

Areas where the coal beds of Reserve Base thickness are overlain by 100 ft (30 m) or less of overburden are considered to have potential for surface mining and were assigned a high, moderate, or low development potential based on the mining ratio (cubic yards of overburden per ton of recoverable coal). The formula used to calculate mining ratios for surface mining of coal is as follows:

$$MR = \frac{t_o\ (cf)}{t_c\ (rf)}$$

where MR = mining ratio

t_o = thickness of overburden in feet

t_c = thickness of coal in feet

rf = recovery factor (85 percent for this quadrangle)

cf = conversion factor to yield MR value in terms of cubic yards of overburden per short tons of recoverable coal:

0.911 for subbituminous coal

Note: To convert mining ratio to cubic meters of overburden per metric ton of recoverable coal, multiply MR by 0.8428.

Areas of high, moderate and low development potential for surface mining methods are defined as areas underlain by coal beds having respective mining ratio values of 0 to 10, 10 to 15, and greater than 15. These mining ratio values for each development potential category are based on economic and technological criteria and were provided by the U.S. Geological Survey.

Areas where the coal data are absent or extremely limited between the 100-foot (30-m) overburden line and the outcrop are assigned unknown development potentials for surface mining methods. This applies to those areas where no known coal beds 5 feet (1.5 m) or more thick occur or where coal exceeds 5 feet (1.5 m) but data is insufficient to properly evaluate coal development potential. Limited knowledge pertaining to the areal distribution, thickness, depth, and attitude of the coal beds prevents accurate evaluation of the development potential in the high, moderate, or low categories.

The coal development potential for surface mining methods is shown on plate 17. Of the Federal land areas assigned a development potential for surface mining methods, 96 percent are rated high and 4 percent are rated low.

Development Potential for Subsurface Mining Methods

Areas considered to have a development potential for conventional subsurface mining methods include those areas where the coal beds of Reserve Base thickness are between 100 and 3,000 feet (30 and 914 m) below the ground surface and have dips of 15° or less. Coal beds lying between 100 and 3,000 feet (30 and 914 m) below the ground surface, dipping greater than 15°, are considered to have a development potential for in-situ mining methods.

Areas of high, moderate and low development potential for subsurface mining methods are defined as areas underlain by coal beds at depths ranging from 100 to 1,000 feet (30 to 305 m), 1,000 to 2,000 feet (305 to 610 m), and 2,000 to 3,000 feet (610 to 914 m), respectively.

Areas where the coal data are absent or extremely limited between 100 and 3,000 feet (30 and 914 m) below the ground surface are assigned unknown development potentials. This applies to those areas influenced by isolated data points and the areas where no known coal beds of Reserve Base thickness occur.

Limited knowledge pertaining to the areal distribution, thickness, depth, and attitude of the coals in these areas prevents accurate evaluation of the development potential in the high, moderate or low categories. The areas influenced by isolated data points in this map area contain approximately 1.14 million short tons (1.03 million metric tons) of coal available for subsurface mining.

The coal development potential for conventional subsurface mining methods is shown on plate 18. Of those Federal land areas assigned a development potential for conventional subsurface mining methods, 100 percent are rated high.

Table 2 -- Coal Reserve Base Data for surface mining methods for Federal coal lands (in short tons) in the Southeast Quarter of the Notom 15-minute quadrangle, Garfield County, Utah.

[Development potentials are based on mining ratios (cubic yards of overburden/ton of underlying coal). To convert short tons to metric tons, multiply by 0.9072; to convert mining ratios in yd^3/ton coal to m^3/t, multiply by 0.842]

Coal bed	High development potential (0-10 mining ratio)	Moderate development potential (10 - 15 mining ratio)	Low development potential (>15 mining ratio)	Unknown development potential	Total
Em-1	70,000	40,000	50,000	---	160,000
Em-2	240,000	80,000	140,000	---	460,000
Em-3	770,000	210,000	70,000		1,050,000
Em-4	3,810,000	830,000	550,000		5,190,000
Em-5	960,000	360,000	140,000		1,460,000
Em-7	---	---	---	490,000	490,000
Em-8	---	---	---	650,000	650,000
Total	5,850,000	1,520,000	950,000	1,140,000	9,460,000

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

[To convert short tons to metric tons, multiply by 0.9072]

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Em-1	60,000	---	---	60,000
Em-2	350,000	---	---	330,000
Em-3	180,000	---	---	180,000
Em-4	50,000	---	---	50,000
Em-5	80,000	---	---	80,000
Em-7	---	---	---	---
Em-8	---	---	---	---
Total	720,000	---	---	720,000

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