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Text to Accompany:

Open-File Report 79-119

1979

COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE ELKOL SW QUADRANGLE, LINCOLN AND UINTA COUNTIES, WYOMING

[Report includes 15 plates]

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

By

DAMES & MOORE

DENVER, COLORADO

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Purpose

This text is to be used in conjunction with Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) Maps of the Elkol SW quadrangle, Lincoln and Uinta Counties, Wyoming. This report was compiled to support the land planning work of the Bureau of Land Management (BLM) to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) in the western United States. This investigation was undertaken by Dames & Moore, Denver, Colorado, at the request of the U.S. Geological Survey under contract number 14-08-0001-17104. The resource information gathered for this report is in response to the Federal Coal Leasing Amendments Act of 1975 (P.L. 94-377). Published and unpublished public information available through March, 1978, was used as the data base for this study. No new drilling or field mapping was performed, nor was any confidential data used.

Location

The Elkol SW quadrangle is located in southwestern Wyoming along the county line between north-central Uinta County and south-central Lincoln County, approximately 12 miles (19 km) southwest of Kemmerer and 20 miles (32 km) northeast of Evanston, Wyoming. The area is unpopulated.

Accessibility

No major roads pass through the Elkol SW quadrangle. Just east of the quadrangle boundary, U.S. Highway 189 runs north-south to join Interstate Highway 80 approximately 15 miles (24 km) to the south with U.S. Highway 30N approximately 14 miles (23 km) to the north.

A branch of the Union Pacific Railroad, the Oregon Shortline Railroad, passes through the town of Kemmerer, connecting Pocatello, Idaho with the Union Pacific Railroad main line at Granger, Wyoming. Approximately 2 miles (3 km) west of Kemmerer, a spur line of the railroad runs south to the town of Elkol and to the northern edge of the adjacent Cumberland Gap quadrangle.

Physiography

The Elkol SW quadrangle is located on the eastern edge of the Wyoming Overthrust Belt. The landscape within the quadrangle is characterized by buttes in the western half and north-south trending hogbacks and the large valley of Cumberland Flats in the eastern half. Altitudes in the quadrangle range from approximately 6,600 feet (2,012 m) along the eastern edge of the quadrangle to 7,500 feet (2,286 m) along the western edge of the quadrangle.

The northern half of the Elkol SW quadrangle is drained by the southeasterly flowing Little Muddy Creek and its tributaries, Sheep and Bell Creeks. Ryckman Creek and a tributary, Hill Creek, flow northeasterly draining the southern half of the quadrangle. Little Muddy Creek, joined by Ryckman Creek in the east-central part of the quadrangle, then flows easterly into the Green River east of the quadrangle. All streams in the quadrangle flow intermittently, mainly in response to snowmelt in the spring.

Climate and Vegetation

Southwest Wyoming's climate is semiarid, characterized by low precipitation, rapid evaporation, and large daily temperature variations. Summers are usually dry and mild, and winters are cold. The annual precipitation in the area averages 9.8 inches (24.9 cm) and is fairly evenly distributed throughout the year.

The average annual temperature of the area is 39° F (4° C). The temperature during January averages 17° F (-8° C) and ranges from 4° F (-16° C) to 30° F (-1° C). During July, the average temperature is 62° F (17° C), and the temperature ranges from 43° F (6° C) to 82° F (28° C) (U.S. Bureau of Land Management, 1978, and Wyoming Natural Resources Board, 1966).

Winds are usually from the west and west-southwest with an average velocity of 15 miles per hour (24 km per hr) (U.S. Bureau of Land Management, 1978).

Principal types of vegetation in the quadrangle include grasses, sagebrush, greasewood, saltbush, rabbitbrush, serviceberry, mountain mahogany, and juniper (U.S. Bureau of Land Management, 1978).

Land Status

The Elkol SW quadrangle lies in the west-central part of the Kemmerer Known Recoverable Coal Resource Area (KRCRA). The eastern three quarters of the quadrangle lies within the KRCRA boundary and the Federal government owns the coal rights for approximately two thirds of this area. One active coal lease is present within the KRCRA boundary, as shown on plate 2.

GENERAL GEOLOGY

Previous Work

The geology and economic resources of a large part of Lincoln and Uinta Counties in southwestern Wyoming were mapped in detail by Veatch in 1907. Schultz (1914) made a detailed investigation of the geology and coal resources of the northern part of the Kemmerer coal field. Walker (1943) mapped the geology of the Cumberland Reservoir area on Little Muddy Creek. Townsend discussed the coal geology and reserves of the Kemmerer coal field in 1960. Oriel and Tracey (1970) described the stratigraphy of the Evanston, Wasatch, and Green River Formations in the Kemmerer area. Rubey, Oriel and Tracey (1975) also mapped the geology and described the stratigraphy of the Kemmerer and Sage 15-minute quadrangles. Glass reported coal analyses and measured sections of Adaville Formation coal in the Kemmerer coal field in 1975, and updated information on the Kemmerer coal field, a part of the Hams Fork coal region, in 1977. Roehler, Swanson and Sanchez (1977) included the Elkol SW quadrangle in a report on the geology and mineral resources of the Sweetwater-Kemmerer area. Schroeder made a detailed investigation of the geology and coal resources of the Elkol SW quadrangle in 1977. Cook (1977) described the stratigraphy and structural geology of the southern part of the Wyoming Overthrust Belt. Unpublished data from Rocky Mountain Energy Company (RMEC) also provided coal thickness information.

Stratigraphy

Formations cropping out in the Elkol SW quadrangle range in age from Pennsylvanian to Recent. The major coal-bearing formations are the Frontier and Adaville Formations of Late Cretaceous age which crop out in the eastern third of the quadrangle. The formations of Pennsylvanian through Upper Jurassic age, cropping out in a small area in the north-central part of the quadrangle (secs. 19 and 30, T. 19 N., R. 117 W.) and occurring in the subsurface west of the Absaroka thrust fault, are non-coal-bearing.

The Gannett Group of Early Cretaceous age, cropping out in the north-central part of the quadrangle, consists of a basal conglomerate, tan to red sandstone, brick-red shale and mudstone in the lower half, and interbedded red sandy mudstone with thin beds of gray to purplish-gray limestone in the upper half. The Gannett Group is approximately 625 feet (191 m) thick and is non-coal-bearing (Rubey and others, 1975, and Schroeder, 1977).

Conformably overlying the Gannett Group, and cropping out in the north-central part of the quadrangle, is the Bear River Formation of Early Cretaceous age. This formation consists of dark-gray to black fissile shale and claystone, tan to greenish-brown fine-grained sandstone, a few thin fossiliferous limestone beds, and may contain a few thin stringers of impure coal (Glass, 1977). The Bear River Formation is approximately 500 to 600 feet (152 to 183 m) thick in the Elkol SW quadrangle (Rubey and others, 1975, Cook, 1977, and Schroeder, 1977).

The Aspen Shale of latest Early Cretaceous age conformably overlies the Bear River Formation and occurs in the subsurface of the quadrangle. It consists of approximately 900 to 1,000 feet (274 to 305 m) of light- to dark-gray siltstone and shale, gray quartzitic sandstone, and thin porcelanite beds (Rubey and others, 1975, and Schroeder, 1977).

The Frontier Formation of early Late Cretaceous age conformably overlies the Aspen Shale and crops out in a north-south trending band in the eastern third of the quadrangle. The lower section of the formation is composed of dark-gray shale, tan siltstone, and thin white and brown sandstone beds which are less resistant to erosion than the rest of the formation. Coals of the Spring Valley Coal Zone, plus other thin coals and lignite beds, occur in the lower part of the this section, which is approximately 1,000 feet (305 m) thick. The upper section of the Frontier Formation consists of a thick interval of dark shaly claystone and tan sandstone (that contains the Willow Creek Coal Zone in the northern part of the Kemmerer area) overlain by the prominent hogback-forming Oyster Ridge Sandstone Member. This member consists of approximately 130 feet (40 m) of white to light-gray thick-bedded resistant sandstone containing abundant large fossil oyster shells, and is overlain by shale, lignitic claystone, thin beds of gray sandstone, and the Kemmerer Coal Zone. The upper section of the Frontier Formation is approximately 1,200 feet (366 m) thick (Rubey and others, 1975, and Schroeder, 1977).

The Hilliard Shale of early Late Cretaceous age, conformably overlies the Frontier Formation and is approximately 6,000 feet (1,829 m) thick. The formation crops out in the eastern third of the quadrangle forming the Cumberland Flats area and is composed of a thick sequence of non-resistant dark-gray to dark-brown marine shale and claystone, light- to medium-gray sandy siltstone, sandy shale, and, in the upper part of the formation, a few conspicuous light-gray to light-tan, fine-grained resistant sandstone beds (Oriel and Tracey, 1970, Rubey and others, 1975, and Schroeder, 1977).

The Adaville Formation of Late Cretaceous age lies conformably over the Hilliard Shale, cropping out in a northwest-trending band in the northeastern part of the quadrangle. At the base of the Adaville Formation is the Lazeart Sandstone Member, which is composed of approximately 200 to 400 feet (61 to 122 m) of light-gray to white fine- to coarse-grained sandstone. The main body of the Adaville Formation consists of interbedded gray sandstone, siltstone, carbonaceous shale, and the Adaville Coal Zone which may contain up to 32 subbituminous coal beds (Glass, 1977). Sandstones in the main body are calcareous, fine- to coarse-grained, thin-bedded to massive and become partially conglomeratic in the upper part of the formation. The thicker coal beds occur in the lower part of the formation immediately above the Lazeart Sandstone Member. The Adaville Formation is approximately 2,300 feet (701 m) thick in the Elkol SW quadrangle (Oriel and Tracey, 1970, Rubey and others, 1975, and Schroeder, 1977).

Unconformably overlying the Adaville Formation is the Evanston Formation which crops out in a north-south band through the center of the quadrangle. At the base of the formation is the Hams Fork Conglomerate Member of latest Cretaceous age which may consist of up to 1,000 feet (305 m) of boulder-conglomerate beds with interbedded white to brown calcareous sandstone, and gray mudstone. The main body of the Evanston Formation, which is Paleocene in age, consists of over 200 feet (61 m) of gray siltstone, red shaly mudstone, carbonaceous claystone, quartzitic siltstone, gray carbonaceous sandstone, and some dark-brown concretionary ironstone. Composition of the Evanston Formation varies both laterally and vertically (Oriel and Tracey, 1970, Rubey and others, 1975, and Schroeder, 1977).

The Wasatch Formation of Eocene age unconformably overlies the Evanston Formation and crops out in the western half of the quadrangle. It is composed of up to 2,000 feet (610 m) of red, maroon, yellow, and gray mudstone, yellow, brown, and gray, fine- to coarse-grained sandstone; and a sequence of stream-channel conglomerate beds containing boulders, cobbles, and pebbles of quartzite, chert, and limestone (Oriel and Tracey, 1970, and Schroeder, 1977).

The Green River Formation of Eocene age conformably intertongues with the Wasatch Formation and crops out on ridge crests in the western half of the quadrangle. It consists of 200 to 400 feet (61 to 122 m) of white-weathering marlstone, calcareous siltstone, and claystone (Oriel and Tracey, 1970, and Schroeder, 1977).

Recent deposits of alluvium cover the stream valleys of Little Muddy Creek and Ryckman Creek. Recent deposits of gravel derived predominately from the Hams Fork Conglomerate Member of the Evanston Formation also cover a large area in the northeastern part of the quadrangle.

The transgression and regressions of a broad, shallow, north-south trending Cretaceous seaway that extended across central North America are indicated by the Upper Cretaceous formations deposited in the Elkol SW quadrangle. Sediments accumulated near the western edge of the Cretaceous sea and reflect the location of the shoreline (Weimer, 1960 and 1961).

Sandstone, mudstone and limestone of the Gannett Group were deposited during a brief transgression of the Cretaceous sea to the west; sandstone, black claystone and fresh-water limestone of the Bear River Formation were deposited in coastal swamps and flood plains during a regression of the Cretaceous sea (Roehler and others, 1977). Deposition of the marine shale, siltstone and sandstone of the Aspen Shale were deposited in water up to 120 feet (37 m) deep and marked a westward or landward movement of the sea (Hale, 1960).

Frontier Formation sediments were deposited during two major transgressions and regressions of the sea. Coal beds in the lower and upper parts of the formation were deposited in coastal swamps during periods when the sea retreated eastward. The Oyster Ridge Sandstone Member is a littoral or beach deposit marking the retreat of the Cretaceous sea from the area (Hale, 1960, Myers, 1977, and Roehler and others, 1977).

The marine shale, claystone and sandstone of the Hilliard Shale indicate another transgression of the Cretaceous sea with minor fluctuations of the shoreline (Roehler and others, 1977).

The Lazeart Sandstone Member, at the base of the Adaville Formation, is a beach deposit marking a transition from the marine deposition of the Hilliard Shale to the continental coastal plain deposition of the Adaville Formation. The sandstone, siltstone, and coals of the Adaville Formation were deposited in flood plains and swamps along the coastal plain (Roehler and others, 1977).

After the final withdrawal of the Cretaceous sea, thick sections of detrital material, eroded from older deposits to the west, were deposited by large streams as the conglomerates of the Hams Fork Conglomerate Member of the Evanston Formation. Environments of deposition for the main body of the Evanston Formation included streams, marshes, and, probably, ponds (Oriel and Tracey, 1970).

The Wasatch Formation is composed of continental sediments. The bright-colored mudstones were probably deposited on a flood plain and then cut by stream channels now filled with well-sorted conglomerate (Oriel and Tracey, 1970).

The Green River Formation was deposited in a lacustrine environment. Fluctuations in lake size are recorded in the intertonguing of Green River Formation beds with Wasatch Formation beds (Oriel and Tracey, 1970).

Structure

The Elkol SW quadrangle lies on the southeastern edge of the structurally complex Wyoming Overthrust Belt. Folded Paleozoic and Mesozoic rocks are thrust eastward over folded Cretaceous-age rocks with younger rocks, Cretaceous and Tertiary in age, resting unconformably on top of the older rocks. Coal-bearing strata crop out in eroded limbs of folds as long narrow belts bounded on the west by major thrust faults (Roehler and others, 1977).

The axial trace of the asymmetric Lazeart syncline trends north-south along the eastern edge of the quadrangle. Cretaceous-age beds dip about 30° on the eastern limb of the syncline and are nearly vertical or overturned on the western limb. Part of the western limb of the syncline is covered by thick Tertiary-age sediments (Rubey and others, 1977).

Two large thrust faults trend north-south to the west of the Lazeart syncline. The trace of the Round Mountain fault, although poorly exposed, is located just east of the Oyster Ridge Sandstone Member of the Frontier Formation. Stratigraphic displacement of the Round Mountain fault may be as much as 7,000 feet (2,134 m) in the Elkol SW quadrangle (Cook, 1977).

The Absaroka fault is located west of the Round Mountain fault, cutting through the center of the quadrangle. It is an extensive thrust fault which has been mapped for a linear distance of 205 miles (330 km) in Wyoming and Idaho. Stratigraphic displacement of the Absaroka fault is approximately 10,000 to 15,000 feet (3,048 to 4,572 m), and its lateral displacement is approximately 3 miles (4.8 km). Major movement along the fault occurred very late in Cretaceous time with probable minor movement in the Paleocene (Rubey and others, 1975).

An unnamed overturned anticline, which lies between the Round Mountain and Absaroka faults, and numerous secondary faults and folds accompany the major structural features of the area. Strata in this quadrangle generally strike north-south, with dips ranging from horizontal to overturned.

COAL GEOLOGY

Coal beds of both the Adaville and Frontier Formations have been identified in this quadrangle. The Kemmerer and Spring Valley Coal Zones of the Frontier Formation occur within the quadrangle although their lateral extent is limited by structural features. The Adaville Formation coal beds are stratigraphically above and separated from the Frontier Formation Coal Zones by the thick shales and siltstones of the Hilliard Shale. All of the coal beds are affected by the Lazeart syncline in the eastern third of the quadrangle.

Chemical analyses of coal.--No coal analyses were available from this quadrangle, but analyses from the adjacent Warfield Creek, Cumberland Gap, and Elkol quadrangles are listed in table 1 (Glass, 1975, and U.S. Bureau of Mines, 1931). In general, the Spring Valley and Kemmerer coals are high-volatile B bituminous in rank while most of the Adaville Formation coals rank as subbituminous B. The coals from these coal zones are ranked on a moist, mineral-matter-free basis according to ASTM Standard Specification D 388-77 (American Society for Testing and Materials, 1977).

Frontier Formation Coal Zones

The Frontier Formation and its associated Spring Valley and Kemmerer Coal Zones are exposed along the western limb of the Lazeart syncline in this quadrangle. The Frontier Formation has been mapped in an area trending north-south, roughly bordered by the Absaroka and Round Mountain faults, as shown on plate 1. The rocks are intensely faulted and folded with steep dips to the east toward the axis of the syncline.

The Spring Valley Coal Zone, lowest of the coal zones identified in the quadrangle, is separated from the overlying Kemmerer Coal Zone by approximately 1,400 feet (427 m) of resistant sandstone, shale, and siltstone. The Willow Creek Coal Zone is sometimes found between the two zones, but it has not been mapped in this quadrangle.

Spring Valley Coal Zone

Coal beds of the Spring Valley Coal Zone crop out along the western limb of the Lazeart syncline, west of the Round Mountain fault and the Oyster Ridge Sandstone Member of the Frontier Formation. The coal zone, named after Spring Valley Station in T. 15 N., R. 118 W. (Glass, 1977), is approximately 200 feet (61 m) thick but appears to be much thicker due to folding (Schroeder, 1977) or high-angle faulting (Veatch, 1907). Dips are toward the east at 30° to 75°.

The Spring Valley coal beds are generally thin and trashy in the Elkol SW quadrangle, and are difficult to correlate. Due to the lack of information pertaining to the areal extent of the coal beds, measurements (corrected for dip) greater than Reserve Base thickness (5 feet or 1.5 meters) have been included in this report as isolated data points. The Spring Valley coals are more important along the eastern limb of the syncline where the coal beds are thicker and dips are less steep.

Kemmerer Coal Zone

The coal beds of the Kemmerer Coal Zone crop out just west of the Round Mountain fault between the prominent Oyster Ridge Sandstone Member and the base of the Hilliard Shale. Schroeder (personal communication, 1978) also identified Kemmerer coals, although less than 5 feet (1.5 m) thick, in an apparent fault block in sec. 32, T. 19 N., R. 117 W. The coals in the Kemmerer Coal Zone were mined extensively around the turn of the century and are named for the town of Kemmerer in T. 21 N., R. 116 W. Along the outcrop the coal beds dip steeply to the east, and are overturned in one area. The Round Mountain fault cuts the zone at depth, effectively limiting the resources of the coal zone.

The coal thicknesses on plate 4 are cumulative and do not include the partings that are usually present. Thin trashy coal beds separated from the main thick beds by several feet of shale are not included in the total thickness of the Kemmerer Coal Zone. Coal thickness increases gradually as the coal zone is traced southward through the Meadow Draw quadrangle. A maximum thickness of 23 feet (7.0 m) was recorded in sec. 29, T. 18 N., R. 117 W., of the Elkol SW quadrangle as shown on plate 4. The Kemmerer Coal Zone thins and is covered by Tertiary deposits in the northern part of the quadrangle (T. 19 N., R. 117 W.).

Adaville Coal Zone

Coal beds in the Adaville Formation crop out in the northeastern corner of the quadrangle where they have been localized by folding associated with the Lazeart syncline. Coals are thickest near the base of the formation, just above the Lazeart Sandstone Member. Isopach, structure contour, and overburden isopach maps have been constructed for the Adaville coal beds present in the quadrangle. All Federal lands containing these coal beds are leased, as shown on plate 2; therefore, Reserve Base tonnages were not calculated and areal distribution and identified resources maps were not prepared.

Isolated Data Points

In instances where isolated measurements of coal beds thicker than 5 feet (1.5 m) 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 which usually precludes correlations with other, better known beds. For this reason, isolated data points are included on a separate sheet (in U.S. Geological Survey files) for non-isopached coal beds. The isolated data points used in this quadrangle are listed below.

Source	Location	Coal Bed or Zone	Thickness
RMEC	secs. 20, 28 T. 19 N., R. 117 W.	Adaville	35.3 ft (10.8 m)
Veatch (1907)	sec. 18, T. 18 N., R. 117 W.	Kemmerer	7.5 ft (2.3 m)
RMEC	sec. 30, T. 18 N., R. 117 W.	Kemmerer	24.0 ft (7.3 m)
Schroeder (1977)	sec. 32, T. 19 N., R. 117 W.	Kemmerer	9.0 ft (2.7 m)
Veatch (1907)	sec. 8, T. 18 N., R. 117 W.	Spring Valley	5.9 ft (1.8 m)
Schroeder (1977)	sec. 8, T. 18 N., R. 117 W.	Spring Valley	5.6 ft (1.7 m)
Schroeder (1977)	sec. 8, T. 18 N., R. 117 W.	Spring Valley	6.5 ft (2.0 m)

Source	Location	Coal Bed or Zone	Thickness
RMEC	sec. 20, T. 18 N., R. 117 W.	Spring Valley	7.0 ft (2.1 m)
Schroeder (1977)	sec. 32, T. 19 N., R. 117 W.	Spring Valley	5.5 ft (1.7 m)

COAL RESOURCES

Information from coal test holes drilled by RMEC, as well as surface mapping by Schroeder (1977) and Veatch (1907) were used to construct outcrop, isopach, and structure contour maps of the coal beds in the quadrangle. At the request of RMEC, coal-rock data for some of their drill holes have not been shown on plate 1 or on the derivative maps. However, data from these holes have been used to construct the derivative maps. These data may be obtained by contacting RMEC. The source of each indexed data point shown on plate 1 is listed in table 3.

Coal resources were calculated using data obtained from the coal isopach map of the Kemmerer Coal Zone (plate 4). The coal bed acreage (measured by planimeter) multiplied by the average isopached thickness of the coal and by 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 for the coal zone. Coal beds of Reserve Base thickness (5.0 feet or 1.5 meters) or greater that lie less than 3,000 feet (914 m) below the ground surface are included. These criteria differs somewhat from that used in calculating Reserve Base 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 ft (305 m) for both bituminous and subbituminous coal.

Reserve Base tonnages for the Kemmerer Coal Zone are shown on plate 6, and are rounded to the nearest 10,000 short tons (9,072 metric tons). Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 16,490,000 short tons (14,960,000 metric tons) for the entire quadrangle. This total includes 10,860,000 short tons (9,852,000 metric tons) from the isolated data points.

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

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 and Subsurface Mining Methods

Areas where the coal beds of Reserve Base thickness are overlain by 200 feet (61 m) or less of overburden are ordinarily considered to have potential for surface mining and are assigned a high, moderate, or low development potential based on the mining ratio -- cubic yards of overburden per ton of recoverable coal (to convert mining ratio to cubic meters of overburden per metric ton of recoverable coal, multiply mining ratio by 0.8428). The areas of high, moderate, and low development potential 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 ordinarily considered to have a development potential for conventional subsurface mining methods include those areas where the coal beds of Reserve Base thickness are between 200 feet (61 m) and 3,000 feet (914 m) below the ground surface and have dips less than 15°. Areas of high, moderate, and low development potential for conventional subsurface mining are defined by the U.S. Geological Survey as areas underlain by coal beds of Reserve Base thickness at depths ranging from 200 to 1,000 feet (61 to 305 m), 1,000 feet to 2,000 feet (305 to 610 m), and 2,000 to 3,000 feet (610 to 914 m), respectively.

Unknown development potentials are assigned to those areas where coal data is absent or extremely limited, including those areas influenced by isolated data points. Even though these areas probably contain coal thicker than 5 feet (1.5 m), limited knowledge pertaining to the areal distribution, thickness, depth, and attitude of the coal beds in this quadrangle prevents accurate evaluation of the development potential in the high, moderate, or low categories.

All Federal lands within the KRCRA boundary in this quadrangle have been classified as having an unknown development potential for surface or conventional subsurface mining methods because of the high dips of the coal beds and the low tonnages available for mining.

Development Potential for In-Situ Mining Methods

Coal beds lying between 200 feet (61 m) and 3,000 feet (914 m) below the ground surface, dipping greater than 15°, are considered to have a development potential for in-situ mining methods. Based on criteria provided by the U.S. Geological Survey, coal beds of Reserve Base thickness dipping between 35° and 90° with a minimum Reserve Base of 50 million short tons (45.4 million metric tons) for bituminous coal and 70 million short tons (63.5 million metric tons) for subbituminous coal have a moderate potential for in-situ development; coal beds dipping from 15° to 35°, regardless of tonnage, and coal beds dipping from 35° to 90° with less than 50 million short tons (45.5 million metric tons) of coal have a low development potential for in-situ mining methods. Coal lying between the 200-foot (61-m) overburden line and the outcrop is not included in the total coal tonnages available as it is needed for cover and containment in the in-situ process.

Since measured and calculated dips range from 45° to 85° and the total Reserve Base tonnage is less than 50 million short tons (45.4 million metric tons), all of the Federal land areas in this quadrangle having a known development potential have been rated low for in-situ mining methods as shown on plate 15. Tonnages in the low development potential category for in-situ mining methods total approximately 5.63 million short tons (5.11 million metric tons) and is listed in table 2.

Unknown development potentials have been assigned to the remaining Federal land areas in the quadrangle which have not been leased. The tonnages in the unknown development potential category from isolated data points are shown in table 2. That part of the total Reserve Base tonnage which was calculated from isolated data points for coals lying between the 200-foot (61-m) overburden line and the outcrop is not included in determining the development potential for in-situ mining methods.

Table 1. -- Chemical analyses of coals in the Elkol SW quadrangle, Lincoln and Uinta Counties, Wyoming

Location	COAL BED NAME	Form of Analysis	Proximate				Ultimate					Heating Value	
			Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Calories	Btu/Lb
NW¼, SW¼, sec. 3, T. 20 N., R. 117 W., Sorensen Mine (Glass, 1975)	Adaville No. 10	A	20.5	33.0	39.6	6.9	0.9	-	-	-	-	-	9,410
		C	0.0	41.5	49.8	8.7	1.2	-	-	-	-	-	11,840
NE¼, SW¼, sec. 31, T. 19 N., R. 116 W., Cumberland No. 1 Mine (U.S.Bureau of Mines, 1931)	Upper Kemmerer	A	6.8	39.8	47.4	6.0	0.4	-	-	-	-	-	12,270
		C	0.0	42.7	50.9	6.4	0.5	-	-	-	-	-	13,160
SW¼, sec. 4, T. 20 N., R. 116 W., Fitzpatrick Mine (U.S. Bureau of Mines, 1931)	Spring Valley	A	7.1	35.2	54.8	6.9	0.4	-	-	-	-	-	12,470
		C	7.0	37.9	54.7	7.4	0.5	-	-	-	-	-	13,420

Form of Analysis: A, as received

C, moisture free

Note: To convert Btu/pound to kilojoules/kilogram, multiply by 2.326

Table 2. -- Coal Reserve Base data for in-situ mining methods for Federal coal lands (in short tons) in the Elkol SW quadrangle, Lincoln and Uinta Counties, Wyoming

Coal Bed or Zone	Moderate Development Potential	Low Development Potential	Unknown Development Potential	Total
Kemmerer Coal Zone	--	5,630,000	9,880,000	15,510,000

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

Table 3. -- Sources of data used on plate 1

Plate 1 Index Number	Source	Data Base
1	Schroeder, 1977, U.S. Geological Survey, unpublished map	Measured section No. 5
2	Veatch, 1907, U.S. Geological Survey Professional Paper 56, p. 125	Measured section No. 71
3	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
4	↓	Drill hole No. 2, line A
5	↓	Drill hole No. 3, line A
6	↓	Drill hole No. 4, line A
7	Veatch, 1907, U.S. Geological Survey Professional Paper 56, p. 125	Measured section No. 72
8	Rocky Mountain Energy Co.., (no date), unpublished data	Drill hole No. 5, line A
9	Schroeder, 1977, U.S. Geological Survey, unpublished map	Measured section No. 15
10	↓	Measured section No. 13
11	↓	Measured section No. 14
12	Rocky Mountain Energy Co., (no date), unpublished data	Measured section
13	Schroeder, 1977, U.S. Geological Survey, unpublished map	Mine section No. 4
14	Rocky Mountain Energy Co., (no date), unpublished data	Measured section

Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
15	Rocky Mountain Energy Co., (no date), unpublished data	Measured section
16	↓	Drill hole No. 1, line A
17	↓	Drill hole No. 2, line A
18	↓	Drill hole No. 4, line A
19	↓	Drill hole No. 2A, line A
20	↓	Measured section
21	↓	Drill hole No. 1, line A
22	Veatch, 1907, U.S. Geological Survey Professional Paper 56, p. 126	Measured section No. 79
23	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 4, line A
24	↓	Drill hole No. 3, line A
25	↓	Drill hole No. 1, line A
26	Schroeder, 1977, U.S. Geological Survey, unpublished map	Measured section No. 3
27	Rocky Mountain Energy Co., (no date), unpublished data	Measured section
28	↓	Drill hole No. 3, line A
29	↓	Drill hole No. 2, line A
30	↓	Drill hole No. 1, line A

Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
31	Schroeder, 1977, U.S. Geological Survey, unpublished map	Measured section No. 2
32	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1-A, line A
33		Measured section
34		Measured section
35		Measured section
36	Schroeder, 1977, U.S. Geological Survey, unpublished map	Measured section No. 1
37	Rocky Mountain Energy Co., (no date),	Drill hole No. 1-A, line B
38		Drill hole No. 1, line A
39		Drill hole No. 2, line A
40		Drill hole No. 3, line A
41	Schroeder, 1977, U.S. Geological Survey, unpublished map	Measured section No. 9
42	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 14, line A
43		Drill hole No. 13, line A
44		Drill hole No. 12, line A
45		Drill hole No. 11, line A
46		Drill hole No. 10, line A
47		Drill hole No. 9, line A

Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
48	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 8, line A
49		Drill hole No. 7, line A
50		Drill hole No. 6, line A
51		Drill hole No. 5, line A
52		Drill hole No. 4, line A
53		Drill hole No. 3, line A
54		Drill hole No. 2, line A
55		Drill hole No. 1, line A
56		Drill hole No. 4, line B
57		Drill hole No. 5, line B
58		Drill hole No. 6, line B
59		Drill hole No. 7, line B
60		Drill hole No. 8, line B
61		Drill hole No. 9, line B
62		Drill hole No. 11, line B
63		Drill hole No. 4, line A
64		Drill hole No. 3, line A
65		Drill hole No. 2, line A
66		Drill hole No. 1, line A

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Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
67	Schroeder, 1977, U.S. Geological Survey, unpublished map	Measured section No. 11
68	↓	Measured section No. 7
69	↓	Measured section No. 8
70	Rocky Mountain Energy Co.. (no date), unpublished data	Drill hole No. 1, line A
71	↓	Drill hole No. 2, line A
72	Schroeder, 1977, U.S. Geological Survey, unpublished map	Measured section No. 20
73	↓	Measured section No. 19
74	↓	Measured section No. 18
75	↓	Measured section No. 17
76	↓	Measured section No. 16
77	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1A, line A
78	↓	Drill hole No. 1, line A
79	Schroeder, 1974, U.S. Geological Survey, unpublished map	Measured section No. 6

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REFERENCES

American Society for Testing and Materials, 1977, Standard specification for classification of coals by rank, _in_ Gaseous fuels; coal and coke; atmospheric analysis: ASTM Standard Specification D 388-77, pt. 26, p. 214-218.

Cook, W. R., III, 1977, The structural geology of the Aspen Tunnel area, Uinta County, Wyoming, _in_ Rocky Mountain and thrust belt geology and resources, Joint Wyoming, Montana and Utah Geological Association Guidebook, 29th Annual Field Conference, 1977: p. 397-405.

Glass, G. B., 1975, Analyses and measured sections of 54 Wyoming coal samples (collected in 1974): Wyoming Geological Survey Report of Investigations No. 11, p. 14-17, 55-102.

______ 1977, Update on the Hams Fork coal region, _in_ Rocky Mountain and thrust belt geology and resources, Joint Wyoming, Montana and Utah Geological Associaton Guidebook, 29th Annual Field Conference, 1977: p. 689-706.

Hale, L. A., 1960, Frontier Formation - Coalville, Utah and nearby areas of Wyoming and Colorado, _in_ Overthrust belt of southwestern Wyoming and adjacent areas, Wyoming Geological Association Guidebook, 15th Annual Field Conference, 1960: p. 137-146.

Myers, R. C., 1977, Stratigraphy of the Frontier Formation (Upper Cretaceous), Kemmerer area, Lincoln County, Wyoming, _in_ Rocky Mountain and thrustbelt geology and resources, Joint Wyoming, Montana and Utah Geological Association Guidebook, 29th Annual Field Conference, 1977: p. 271-311.

Oriel, S. S., and Tracey, J. I., Jr., 1970, Uppermost Cretaceous and Tertiary stratigraphy of Fossil Basin, southwestern Wyoming: U.S. Geological Survey Professional Paper 635, 53 p.

Rocky Mountain Energy Company, (no date), Unpublished drill hole data from the Union Pacific coal inventory of 1968-1969.

Roehler, H. W., Swanson, V. E., and Sanchez, J. D., 1977, Summary report of the geology, mineral resources, engineering geology and environmental geochemistry of the Sweetwater-Kemmerer area, Wyoming, Part A, geology and mineral resources: U.S. Geological Survey Open-File Report 77-360, 80 p.

Rubey, W. W., Oriel, S. S., and Tracey, J. I., Jr., 1975, Geology of the Sage and Kemmerer 15-minute quadrangles, Lincoln County, Wyoming: U.S. Geological Survey Professional Paper 885, 18 p.

References-Continued

Schroeder, M. L., 1977, Preliminary geologic map and coal resources of the Elkol Southwest quadrangle, Lincoln and Uinta Counties, Wyoming: U.S. Geological Survey unpublished map, scale 1:24,000.

Schultz, A. R., 1914, Geology and geography of a portion of Lincoln County, Wyoming: U.S. Geological Survey Bulletin 543, p. 90-115.

Townsend, D. H., 1960, Economic report on the Kemmerer coal field, in Overthrust Belt of southwestern Wyoming and adjacent areas, Wyoming Geological Association Guidebook, 15th Annual Field Conference, 1960: p. 251-255.

U.S. Bureau of Land Management, 1978, Draft environmental statement, proposed development of coal resources in southwestern Wyoming: U.S. Bureau of Land Management, v. 1-3.

U.S. Bureau of Mines, (1931), Analyses of Wyoming coals: U.S. Bureau of Mines Technical Paper 484, pp. 54-56, 115-121.

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

Veatch, A. C., 1907, Geography and geology of a portion of southwestern Wyoming with special reference to coal and oil: U.S. Geological Survey Professional Paper 56, 178 p.

Weimer, R. J., 1960, Upper Cretaceous stratigraphy, Rocky Mountain area: American Association of Petroleum Geologists Bulletin, v. 44, no. 1, p. 1-20.

______ 1961, Uppermost Cretaceous rocks in central and southern Wyoming, and northwest Colorado, in Symposium on the Late Cretaceous rocks in Wyoming and adjacent areas, Wyoming Geological Association Guidebook, 16th Annual Field Conference, 1961: p. 17-28.

Walker, C. L., 1943, Geology of the Cumberland Reservoir, Little Muddy Creek area, Lincoln and Uinta Counties, Wyoming: Masters Thesis, University of Wyoming.

Wyoming Natural Resources Board, 1966, Wyoming weather facts: Cheyenne, p. 30-31.