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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE H S SCHOOL QUADRANGLE, CUSTER COUNTY, MONTANA

[Report includes 7 plates]

By

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

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Conversion table

To convert	Multiply by	To obtain
feet	0.3048	meters (m)
miles	1.609	kilometers (km)
acres	0.40469	hectares (ha)
tons (short)	0.907	metric tons (t)
short tons/acre-ft	7.36	metric tons/hectare-meter (t/ha-m)
Btu/lb	2.326	kilojoules/kilogram (kJ/kg)

INTRODUCTION

Purpose

This text is for use in conjunction with the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) maps of the H S School quadrangle, Custer County, Montana, (7 plates; U.S. Geological Survey Open-File Report 78-638). This set of maps was compiled to support the land planning work of the Bureau of Land Management in response to the Federal Coal Leasing Amendments Act of 1975, and to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRAs) in the western United States. Coal beds considered in the resource inventory are only those beds 5 feet (1.5 m) or more thick and under less than 3,000 feet (914 m) of overburden.

Location

The H S School 7 1/2-minute quadrangle is in southwestern Custer County, Montana, about 30 miles (48 km) south of Miles City, Montana.

Accessibility

The quadrangle is accessible from Miles City, Montana, south by way of U.S. Highway 312 and Montana State Highway 332, a distance of 36 miles (57.6 km). Highway 332, also known as the Tongue River Road, crosses the quadrangle northeast to southwest. The northwest quarter of the quadrangle may be reached from Highway 332 by the Moon Creek Road which bridges the Tongue River. A number of unimproved roads give access to the rest of the quadrangle.

Physiography

The H S School quadrangle is within the Missouri Plateau division of the Great Plains physiographic province. The upland plateau surface, however, has been almost totally dissected by tributaries of the Tongue River. Several small ridges remain as remnants of the old plateau surface near the southeast corner of the quadrangle. These have elevations of about 3,150 feet (960 m) and are the highest points in the quadrangle.

The topography of the H S School quadrangle is dominated by the Tongue River which flows northeastward across the north half of the quadrangle. The lowest elevation, about 2,620 feet (798 m) is on the north border where the Tongue River leaves the quadrangle. Topographic relief is about 530 feet (161 m).

Climate

The climate of Custer County is characterized by pronounced variations in seasonal precipitation and temperature. Annual precipitation in the region varies from less than 12 inches (30 cm) to 16 inches (41 cm) a year. The heaviest precipitation is from April to August. The largest average monthly precipitation is during June. Temperatures in eastern Montana range from as low as -50 °F (-46 °C) to as high as 110 °F (43 °C). The highest temperatures occur in July and the lowest in January; the mean annual temperature is about 45 °F (7 °C) (Matson and Blumer, 1973, p. 6).

Land status

The Northern Powder River Basin Known Recoverable Coal Resource Area (KRCRA) includes a few small tracts in the southern part of the quadrangle.

The Boundary and Coal Data Map (pl. 2) shows the location of the KRCRA tracts and the land ownership status. Approximately 70 percent of the land underlain by coal of Reserve Base thickness is federally owned. There were no outstanding Federal coal leases or prospecting permits as of 1977.

GENERAL GEOLOGY

Previous work

N. W. Bass (1932) mapped that part of the H S School quadrangle which lies south and east of the Tongue River, as part of the Ashland coal field, Rosebud, Powder River, and Custer Counties, Montana. W. G. Pierce (1936) mapped the remainder of the quadrangle as part of the Rosebud coal field, Rosebud and Custer Counties, Montana.

Stratigraphy

A generalized columnar section of the coal-bearing rocks is shown on the Coal Data Sheet (pl. 3) of the CRO maps. The exposed bedrock units belong to the Fort Union Formation (Paleocene). The Fort Union Formation is composed of three members: the upper Tongue River Member, the middle Lebo Shale Member, and the lower Tullock Member. Pierce (1936) considered the Tullock to be a member of the Lance Formation, but since 1949 the U.S. Geological Survey has considered the Tullock to be the lower member of the Fort Union Formation in Montana.

The Tullock Member forms the lowest outcrops in the quadrangle, occurring as the lowermost beds exposed along the Tongue River and its tributaries in the north half of the quadrangle. The Tullock Member is approximately 300 feet (91 m) thick and is made up of alternating beds of

sandstone and shale, and contains several unimportant local coal beds (Pierce, 1936).

The overlying Lebo Shale Member is 160 to 200 feet (49 to 61 m) thick and consists of shale and a few thin, lenticular sandstones, but no mappable coal beds. The Lebo Shale occupies most of the broad stream bottoms and sides in the northern two-thirds of the quadrangle.

The Tongue River Member caps the plateaus and ridges in the south third of the quadrangle, and contains the coal beds of economic interest. The unit is made up mainly of yellow sandstone, sandy shale, carbonaceous shale, and coal. Much coal has burned along outcrops, fracturing and baking the overlying sandstone and shale, forming thick clinker beds. Originally more than 1,000 feet (305 m) thick in this vicinity, most of the Tongue River Member has been removed by erosion so that only about the lower 400 feet (122 m) remains (Pierce, 1936, p. 61).

Coal and other rocks comprising the Tongue River Member were deposited in a continental environment at elevations of perhaps a few tens of feet above sea level in a vast area of shifting flood plains, sloughs, swamps, and lakes that occupied the Northern Great Plains in Paleocene (early Tertiary) time.

Representative samples of the sedimentary rocks overlying and interbedded with minable coal beds in the eastern and northern Powder River Basin have been analyzed for their trace element content by the U.S. Geological Survey and the results summarized by the U.S. Department of Agriculture and others (1974) and by Swanson (in Mapel and others, 1977,

pt. A, p. 42-44). The rocks contain no greater amounts of trace elements of environmental concern than do similar rock types found throughout other parts of the western United States.

Structure

The H S School quadrangle is in the north-central part of the Powder River structural basin. The strata are nearly flat, or in places dip southward or eastward at an angle less than 1 degree. Structure contours on the Terret coal bed in the south third of the H S School quadrangle show minor structural trends with less than 40 feet (12.2 m) of relief (pl. 4).

COAL GEOLOGY

Four coal beds, all in the Tongue River Member of the Fort Union Formation, were mapped on the surface (pl. 1) and are shown in section (pl. 3) in this quadrangle. The Terret coal bed is underlain by three insignificant local coal beds, respectively 30 feet (9.1 m), 90 feet (27.4 m), and 130 feet (39.6 m) below it. The local coal beds range from 1.9 feet (0.58 m) to 4.8 feet (1.46 m) in thickness. Because of their thinness and restricted extent, no economic resources have been attributed to them.

The trace element content of coals in the H S School quadrangle has not been determined; however, coals in the Northern Great Plains, including those in the Fort Union Formation in Montana, have been found to contain, in general, appreciably lesser amounts of most elements of environmental concern than coals in other areas of the United States (Hatch and Swanson, 1977, p. 147).

Terret coal bed

The Terret coal bed was described by Bass (1932, p. 51) from a small mine on the Terret Ranch (Cook Creek Reservoir quadrangle) in the Ashland coal field about 12 miles (19 km) to the southwest of this quadrangle. The Terret bed crops out around the tops of plateaus and ridges in the south third of the H S School quadrangle. Along most of the outcrops much coal has been burned, leaving broad areas of clinker. In a number of places, the clinker has been removed by surface erosion exposing the coal bed. Based on these outcrops the Terret coal bed is seen to range from 1.6 feet (0.49 m) to 6 feet (1.8 m) in thickness (pl. 4). The overburden on the Terret coal bed ranges from zero to 120 feet (37 m) in thickness.

No coal analyses are available for the Terret coal bed in the quadrangle; however, the Montana Bureau of Mines and Geology drilled, cored, and analyzed the Terret coal bed in State Hole SS-5C in the Miller Creek SW quadrangle, about 6 miles (9.6 km) northwest of the H S School quadrangle. The coal is subbituminous C in rank. At depths of 109 to 127 feet (33.2 to 38.7 m) the analysis shows a heating value of 8,020 Btu per pound, ash 9.43 percent, and sulfur 1.18 percent, as received (Matson and Blumer, 1973, p. 102).

COAL RESOURCES

All publicly available surface mapping by others (see list of references) was used to construct the outcrop, isopach, and structure contour maps of the Terret coal bed in the H S School quadrangle.

Coal resource tonnages derived in this report are the Reserve Base part of the Identified Resources found within 3 miles (4.8 km) of a point of coal-bed measurement, as discussed in U.S. Geological Survey Bulletin 1450-B.

The Reserve Base for subbituminous coal is coal that is 5 feet (1.5 m) or more thick, under 3,000 feet (914 m) or less of overburden, and located within 3 miles (4.8 km) of a point of coal bed measurement. Reserve Base is further subdivided into reliability categories according to their nearness to a measurement of the coal bed. Measured coal is coal within 0.25 mile (0.4 km) of a measurement, Indicated coal extends 0.5 mile (0.8 km) beyond Measured coal to a distance of 0.75 mile (1.2 km) from the measurement point, and Inferred coal extends 2.25 miles (3.6 km) beyond Indicated coal to a distance of 3 miles (4.8 km) from the measurement point.

Reserves are the recoverable part of the Reserve Base coal. For surface minable coal in this quadrangle, the coal reserves are considered to be 85 percent (the recovery factor for this area) of that part of the Reserve Base that is beneath 200 feet (61 m) or less of overburden. This depth of overburden is the stripping limit for single, relatively thin (5 to 40 feet or 1.5 to 12 m thick) beds of subbituminous coal in this area.

Estimated coal resources in this quadrangle were calculated using data obtained from the coal isopach map (pl. 4). 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 (13,028 metric tons per hectare-meter) for subbituminous coal yields the coal resources in short tons of coal for each isopached coal bed. Reserve Base and Reserve tonnage values for the Terret coal bed are shown on plate 6 and are rounded to the nearest one-hundredth of a million short tons.

The total Reserve Base tonnage of federally owned coal in this quadrangle is calculated to be 1.90 million short tons (1.72 million metric t). The Reserve Base tonnage totals per section are shown in the northwest corner of each section on CRO plate 2 and by development potential category in table 1. All numbers are rounded to the nearest one-hundredth of a million short tons. About 56 percent of the Reserve Base tonnage is classed as Measured, 30 percent as Indicated, and 14 percent as Inferred.

COAL DEVELOPMENT POTENTIAL

Areas where coal beds are 5 feet (1.5 m) or more thick and are overlain by 200 feet (61 m) or less of overburden in this quadrangle 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 is as follows:

$$MR = \frac{t_o\ (0.911)}{t_c\ (rf)}$$

where MR = mining ratio

t_o = thickness of overburden

t_c = thickness of coal

rf = recovery factor = 0.85

0.911 = conversion factor (cu. yds./ton)

Areas of high, moderate, and low development potential are here defined as areas underlain by coal beds having respective mining-ratio values of 0 to 10, 10 to 15, and greater than 15, as shown on CRO plate 5. These mining-ratio values for each development-potential category are based on current economic and technological criteria and were provided by the U.S. Geological Survey. Calculated tonnages in each development potential category (high, moderate, and low) for surface mining are shown in table 1.

Development potential for surface-mining methods

The Coal Development Potential (CDP) map, plate 7, in this series of maps depicts the highest coal development potential category which occurs within each smallest legal subdivision of Federal coal land (normally about 40 acres or 16.2 ha). If such a 40-acre (16.2 ha) tract of land contains areas of high, moderate, and low development potential, the entire tract is assigned to the high development potential category for CDP mapping purposes, etc.

The coal development potential for surface mining methods (less than 200 feet or 61 m of overburden) is shown on the Coal Development Potential map (pl. 7). The Terret coal has a high development potential over its entire area of occurrence in the southern part of this quadrangle. The rest of the quadrangle has no coal development potential for surface mining.

Development potential for underground mining and in situ gasification

All known economically minable coal in the H S School quadrangle is contained in the Terret coal bed within surface minable depths. Because there is no known Reserve Base coal at depths beneath the Terret coal bed, the development potential for underground mining in the H S School quadrangle is rated as unknown or none. No table of coal resource tonnage by development potential category for underground mining methods was made, nor was a Coal Development Potential map for underground mining methods made.

In situ gasification of coal on a commercial scale has not been done in the United States. Therefore, the development potential for in situ gasification of coal found below the stripping limit in this area is rated as low.

Table 1.--Surface-minable coal resource tonnage by development potential category for Federal coal lands (in short tons) in the H S School quadrangle, Custer County, Montana

[Development potentials are based on mining ratios (cubic yards of overburden/short ton of recoverable coal). To convert short tons to metric tons, multiply by 0.9072]

Coal bed	High development potential (0-10 mining ratio)	Moderate development potential (10-15 mining ratio)	Low development potential (>15 mining ratio)	Total
Terret	1,800,000	100,000	0	1,900,000
Total	1,800,000	100,000	0	1,900,000

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