

UNITED STATES DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

TEXT TO ACCOMPANY:

COAL RESOURCE OCCURRENCE

AND

COAL DEVELOPMENT POTENTIAL

MAPS

OF THE

ORPHA QUADRANGLE,

CONVERSE COUNTY, WYOMING

BY

INTRASEARCH INC.

DENVER, COLORADO

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This report is preliminary, and has not been edited or reviewed for conformity with United States Geological Survey standards or stratigraphic nomenclature.

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CONVERSION TABLE

<u>TO CONVERT</u>	<u>MULTIPLY BY</u>	<u>TO OBTAIN</u>
inches	2.54	centimeters (cm)
feet	0.3048	meters (m)
miles	1.609	kilometers (km)
acres	0.40469	hectares (ha)
tons (short)	0.9072	metric tons (t)
cubic yards/ton	0.8428	cubic meters per metric tons
acre feet	0.12335	hectare-meters
Btu/lb	2.326	kilojoules/kilogram (kJ/kg)
Btu/lb	0.55556	kilocalories/kilogram (kcal/kg)
Fahrenheit	5/9 (F-32)	Celsius

I. Introduction

This report and accompanying maps set forth the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) of coal beds within the Orpha Quadrangle, Converse County, Wyoming. This CRO and CDP map series includes 3 plates (U. S. Geological Survey Open-File Report 79-478). The project is compiled by IntraSearch Inc., 1600 Ogden Street, Denver, Colorado, under KRCRA Northeastern Powder River Basin, Wyoming Contract Number 14-08-0001-17180. This contract is a part of a program to provide an inventory of unleased federal coal in Known Recoverable Coal Resource Areas (KRCRAs) in the western United States.

The Orpha Quadrangle is located in Converse County, in northeastern Wyoming. It encompasses all or parts of Townships 32, 33 and 34 North, Ranges 72 and 73 West, and covers the area: 42° 45' to 42° 52' 30" north latitude; 105° 30' to 105° 37' 30" west longitude.

Main access to the Orpha Quadrangle is provided by Interstate 25 which extends east to west across the southern half of the quadrangle. A paved highway (Natural Bridge Road) extends north to south in the southwest quarter of the quadrangle. Another paved highway parallels Interstate 25 across most of the southern half of the quadrangle. Maintained gravel roads provide access throughout most of the remaining area. Minor roads and trails provide additional access to the more remote area. The closest railroads are the Burlington Northern and the Chicago North Western trackage which extends east to west across the northern third of the quadrangle.

Primary drainage is provided by the eastward flowing North Platte River extending east to west across the northern third of the quadrangle. Alkali Gulch and La Prele Creek flow northward into the North Platte River and drain the moderate to rugged terrain of the southern half of the quadrangle. Elevations attain heights of 5672 feet (1729 m) above sea level on the Table Mountain area along the southern boundary of the quadrangle, 750 to 850 feet (229 to 259 m) above the valley floors to the north. The somber grays, yellows, and browns of outcropping shales and siltstones contrast strikingly with the brilliant reds, oranges, and purples of "clinker", and deep greens of the juniper and pine tree growth.

The 10 to 12 inches (25 to 30 cm) of annual precipitation that falls in this semi-arid region accrues principally in the springtime. Summer and fall precipitation usually originates from thunderstorms, and infrequent snowfalls of six inches (15 cm) or less generally characterize winter precipitation. Although temperatures ranging from less than  $-25^{\circ}\text{F}$  ( $-32^{\circ}\text{C}$ ) to more than  $100^{\circ}\text{F}$  ( $38^{\circ}\text{C}$ ) have been recorded near Douglas, Wyoming, average wintertime minimums and summertime maximums approach  $+5^{\circ}$  to  $+15^{\circ}\text{F}$  ( $-15^{\circ}$  to  $-9^{\circ}\text{C}$ ) and  $75^{\circ}$  to  $90^{\circ}\text{F}$  ( $24^{\circ}$  to  $32^{\circ}\text{C}$ ), respectively.

Surface ownership is divided among fee, state, and federal categories with the state and federal surface generally leased to ranchers for grazing purposes. Details of surface ownership are available at the Converse County Courthouse in Douglas, Wyoming. Details of mineral ownership on federal lands are available from the U. S. Bureau of Land Management in Cheyenne, Wyoming. Federal coal ownership is shown on Plate 2 of the Coal Resources Occurrence maps. The non-federal coal

ownership comprises both fee and state coal resources.

The Coal Resource Occurrence and Coal Development Potential program pertains to unleased federal coal and focuses upon: 1) the delineation of lignite, subbituminous coal, bituminous coal, and anthracite at the surface and in the subsurface on federal land; 2) the identification of total tons in place as well as recoverable tons; 3) categorization of these tonnages into measured, indicated, and inferred reserves and resources, and hypothetical resources; and 4) recommendations regarding the potential for surface mining, underground mining, and in-situ gasification of the coal beds. This report evaluates the coal resources of all unleased federal coal beds in the quadrangle which are 5 feet (1.5 m) or greater in thickness and occur at depths down to 3000 feet (914 m). No resources or reserves are computed for leased federal coal, state coal, fee coal, or lands encompassed by coal prospecting permits and preference right lease applications.

## II. Geology

Regional. The thick, economic coal deposits of the Powder River Basin in northeastern Wyoming occur mostly in the Tongue River Member of the Fort Union Formation, and in the lower part of the Wasatch Formation. Approximately 3000 feet (914 m) of the Fort Union Formation, that includes the Tongue River, Lebo, and Tullock Members of Paleocene age, are unconformably overlain by approximately 700 feet (213 m) of the Wasatch Formation of Eocene age. These Tertiary formations lie in a structural basin flanked on the east by the Black Hills uplift, on the south by the Hartville and Casper Mountain uplifts, and on the west by

the Casper Arch and the Big Horn Mountain uplift. The structural configuration of the Powder River Basin originated in Late Cretaceous time, with episodic uplift thereafter. The Cretaceous Cordillera was the dominant positive land form throughout the Rocky Mountain area at the close of Mesozoic time.

Outcrops of the Wasatch Formation and the Tongue River Member of the Fort Union Formation cover most of the areas of major coal resource occurrence in the Powder River Basin. The Lebo Member of the Fort Union Formation is mapped at the surface northeast of Recluse, Wyoming, east of the principal coal outcrops and associated clinkers (McKay, 1974), and presumably projects into the subsurface beneath much of the basin. One of the principal characteristics for separating the Lebo and Tullock Members (collectively referred to as the Ludlow Member east of Miles City, Montana) from the overlying Tongue River Member is the color differential between the lighter-colored upper portion and the somewhat darker lower portion (Brown, 1958). Although geologists working with subsurface data, principally geophysical logs, in the basin are trying to develop criteria for subsurface recognition of the Lebo-Tullock and Tongue River-Lebo contacts, no definitive guidelines are known to have been published. Hence, for subsurface mapping purposes, the Fort Union Formation is not divided into its member subdivisions for this study.

During the Paleocene epoch, the Powder River Basin tropic to subtropic depositional environment included broad, inland flood basins with extensive swamps, marshes, freshwater lakes, and a sluggish but active northeastward discharging drainage system, superimposed on a near base level,

emerging sea floor. Much of the vast areas where organic debris collected was within a reducing depositional environment. Localized uplifts began to disturb the near sea level terrain of northeastern Wyoming, following retreat of the Cretaceous seas. However, the extremely fine-grained characteristics of the Tongue River Member clastics suggest that areas of recurring uplift peripheral to the Powder River Basin were subdued during major coal deposit formation.

The uplift of areas surrounding the Powder River Basin created a structural basin of asymmetric characteristic, with the steep west flank located on the eastern edge of the Big Horn Mountains. The axis of the Powder River Basin is difficult to specifically define, but is thought to be located in the western part of the Basin, and to display a north-south configuration some 15 to 20 miles (24 to 32 km) east of Sheridan, Wyoming. Thus, the sedimentary section described in this report lies on the east flank of the Powder River Basin, with gentle dips of two degrees or less disrupted by surface structure thought to relate to tectonic adjustment and differential compaction.

Some coal beds in the Powder River Basin exceed 200 feet (61 m) in thickness. Deposition of these thick, in-situ coal beds requires a discrete balance between subsidence of the earth's crust and in-filling by tremendous volumes of organic debris. These conditions in concert with a favorable ground water table, non-oxidizing clear water, and a climate amenable to the luxuriant growth of vegetation produce a stabilized swamp critical to the deposition of coal beds.

Deposition of the unusually thick coal beds of the Powder River Basin may be partially attributable to short-distance water transportation of organic, detritus into areas of crustal subsidence. Variations in coal

bed thickness throughout the basin relate to changes in the depositional environment. Drill-hole data that indicate either the complete absence or extreme attenuation of a thick coal bed probably relate to location of the drill-holes within the ancient stream channel system draining this low land area in Early Cenozoic time. Where thick coal beds thin rapidly from the depocenter of a favorable depositional environment, it is not unusual to encounter a synclinal structure over the maximum coal thickness due to the differential compaction between organic debris in the coal depocenter and fine-grained clastics in the adjacent areas.

The Wasatch Formation of Eocene age crops out over most of the central part of the Powder River Basin and exhibits a disconformable contact with the underlying Fort Union Formation. The contact has been placed at various horizons by different workers; however, for the purpose of this report the contact is positioned near the top of the Roland coal bed as mapped by Olive (1957) in northwestern Campbell County, Wyoming and is considered to disconformably descend in the stratigraphic column to the top of the Wyodak-Anderson coal bed (Roland coal bed of Taff, 1909) along the eastern boundary of the coal measures. No attempt is made to differentiate the Wasatch and Fort Union Formations on geophysical logs or in the subsurface mapping program that is a part of this CRO-CDP project.

Although Wasatch and Fort Union lithologies are too similar to allow differentiation in some areas, most of the thicker coal beds occur in the Fort Union section on the east flank of the Powder River Basin. Furthermore, orogenic movements peripheral to the basin apparently increased in magnitude during Wasatch time causing the deposition of friable, coarse-grained to gritty arkosic sandstones, fine-to very fine-grained sandstones,

siltstones, mudstones, claystones, brown-to-black carbonaceous shales and coal beds. These sediments are noticeably to imperceptibly coarser than the underlying Fort Union clastics.

The Orpha Quadrangle is located at the southern extremity of the Powder River Basin and is flanked along the southern boundary by the Casper Mountain uplift. This uplift, creates an abrupt increase in the northward dip of the strata exposing an extensive sedimentary section. Outcrops are classified in descending stratigraphic order, into Ogallala Formation, the White River Formation, the Wasatch Formation, the Fort Union Formation (Denson and Horn, 1975). Precambrian metamorphic and granitic rocks crop out near the crest of Casper Mountain. Geophysical log interpretations indicate that none of the formations present in the quadrangle contain a significant coal-bearing rock sequence, and hence they are not studied in this report.

### III. Data Sources

Publications regarding the areal geology of coal outcrops and associated clinker in the Orpha Quadrangle at a scale appropriate for the CRO-CDP mapping program are unknown at the time of this publication.

The major source of subsurface control is the geophysical logs from oil and gas test bores and producing wells. Some geophysical logs are not applicable to this study, for the logs relate only to the deep potentially productive oil and gas zones. More than eighty percent of the logs include resistivity, conductivity, and self-potential curves. Occasionally the logs include gamma, density, and sonic curves. These logs are available from several commercial sources.

All geophysical logs available in the quadrangle are scanned to select those with data applicable to Coal Resource Occurrence mapping. Paper copies of the logs are obtained and interpreted.

The topographic map of the Orpha Quadrangle is published by the U. S. Geological Survey, compilation date, 1949, photorevised 1974. Land network and mineral ownership data are compiled from land plats available from the U. S. Bureau of Land Management in Cheyenne, Wyoming. This information is current to October 13, 1977.

IV. Coal Bed Occurrence

The Orpha Quadrangle is located southwest of the principal coal deposits of the Powder River Basin. No coal beds averaging 5 feet (1.5 m) thick or greater are known within the Orpha Quadrangle.

The Coal Data Sheet, Plate 3, shows by columnar section the interpretation of geophysical logs. Because no coal beds are identified in the subsurface, mean sea level is designated as datum for the correlation diagram.

V. Coal Development Potential

The current data base indicates that there are no significant coal resources in the Orpha Quadrangle of importance to surface or underground mining, or in-situ gasification. Therefore, no coal development potential maps are compiled for this quadrangle.

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