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UNITED STATES DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

PRELIMINARY REPORT ON THE  
COAL RESOURCES OF THE DICKINSON AREA,  
BILLINGS, DUNN, AND STARK COUNTIES, NORTH DAKOTA

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This report has not been edited  
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Survey editorial standards or  
stratigraphic nomenclature.

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Abstract

The Dickinson area is underlain by the coal-bearing Fort Union Formation (Paleocene). The Fort Union in this area contains nine potentially economic coal beds. Five of these beds are, either all or in part, shallow enough to be economically extracted by conventional strip-mining methods, while the remaining four deeper beds represent future possible strip-mining, in situ, or shaft-mining coal resources. The Fort Union coal beds in the Dickinson area are relatively flat lying (dips are less than  $1\frac{1}{2}^{\circ}$ ) and only slightly influenced by faulting and both depositional and post-depositional channeling.

Topography, coal thickness, and minimum overburden all combine to give the Dickinson area an excellent future coal resource development potential.

## Introduction

This investigation primarily deals with the coal beds underlying a 620-mi<sup>2</sup> (1606-km<sup>2</sup>) area around the town of Dickinson, North Dakota. Particular emphasis is placed on the potentially strippable beds of this area. Dickinson is located adjacent to Interstate 94 in the southwestern part of the State (fig. 1). The lands discussed in this report lie entirely within Billings, Dunn, and Stark Counties, North Dakota.

## Previous Work

Early investigations into the geology of the Dickinson area consist of studies on clay and coal. Clapp (1906) measured sections and discussed Tertiary clay deposits; Leonard, Babcock, and Dove (1925) reported on the outcropping coal beds and mining operations of the area. Further coal investigations in the region resulted in a report by Brant (1953). His work included a survey of the potentially economic outcropping coal beds, mining operations, and past production for the area, and an estimate of the remaining coal resources for the Dickinson area. The first detailed geologic investigation of the area was completed by Caldwell (1954). This report dealt with the general stratigraphy and structure of a 200-mi<sup>2</sup> (518-km<sup>2</sup>) area just south of Dickinson. Reconnaissance mapping and fairly detailed evaluation of two coal beds underlying a 107-mi<sup>2</sup> (277-km<sup>2</sup>) tract west of Dickinson was completed in 1963 by the Geologic Division of the Northern Pacific Railway Company

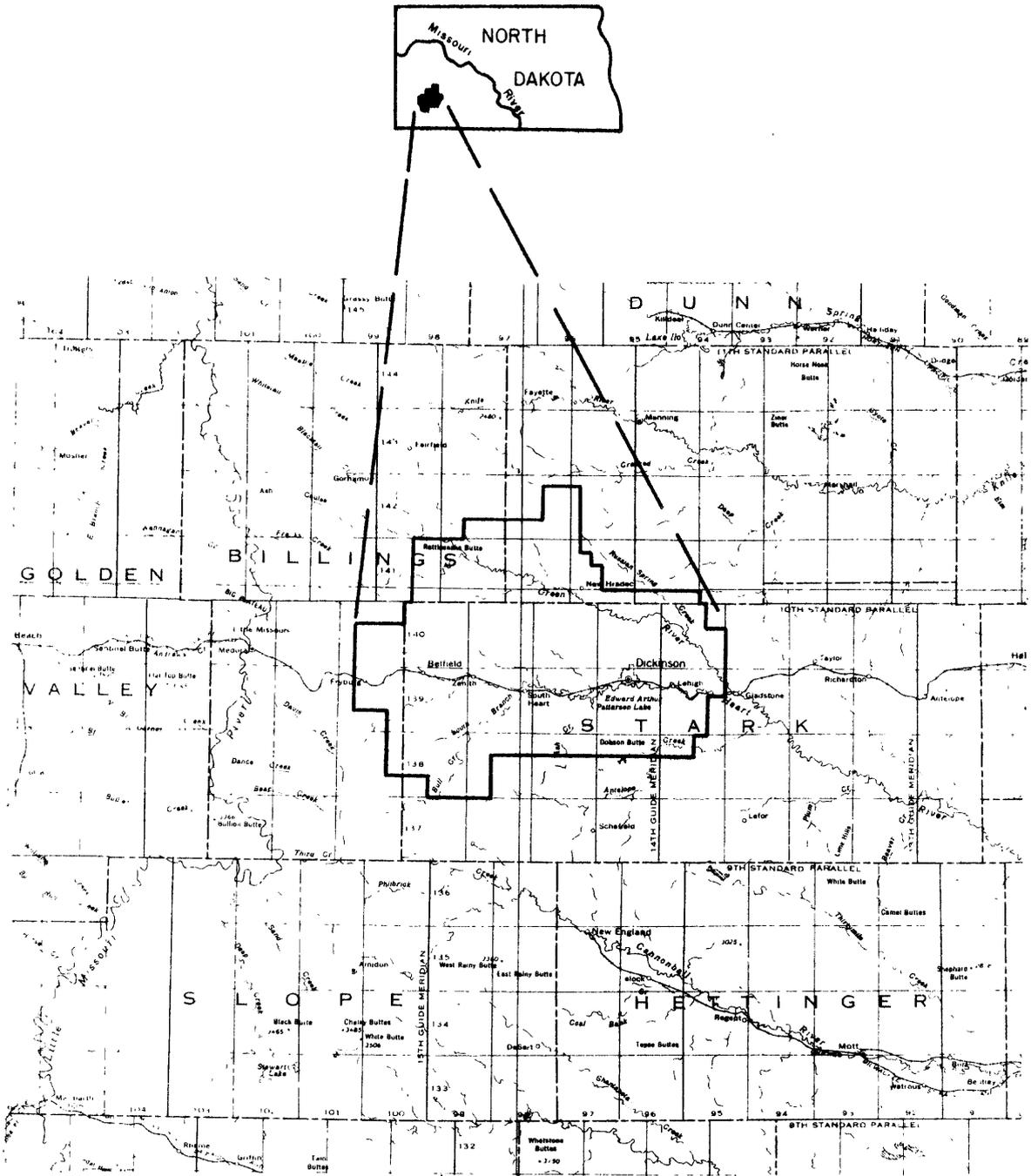


Figure 1.--Index Map of the Dickinson Area,  
Billings, Stark, and Dunn Counties, North Dakota

(now Burlington Northern, Inc.). Portions of the report and another brief coal bed survey of the area were published by Pollard, Smith, and Knox (1972).

#### Methods of Study

Coals of the Dickinson area were evaluated on the basis of drill-hole data and reconnaissance field mapping. Drill-hole information was obtained from water wells (Trapp, 1971), commercial oil and gas wells, and coal exploration drill holes (Northern Pacific Railway Company, 1963). Reconnaissance field mapping was done by Northern Pacific Railway Company personnel (Northern Pacific Railway Company, 1963) and geologists from the U.S. Geological Survey.

#### Physiography

The area discussed in this report is situated on the glaciated Missouri Plateau section of the Great Plains physiographic province. The topography is generally characterized by gently rolling grass-covered hills, accented by widely spaced buttes capped by resistant rocks. The eastward-flowing Heart and Green Rivers dissect the area, forming moderately narrow flood plains along their courses. Local relief in these lands seldom exceeds 300 ft (91.4 m). The topographic character of the area rapidly changes into rugged badlands along the Little Missouri River to the west and the Knife River to the north. Local relief within the Little Missouri badlands is as much as 800 ft (244 m) and within the Knife River badlands as much as 600 ft (183 m).

## Stratigraphy

Three coal-bearing formations underlie part or all of the Dickinson area (pl. 1). From oldest to youngest, these units are the Hell Creek, Fort Union, and Golden Valley Formations.

The Hell Creek Formation (Late Cretaceous) consists of siltstone, shale, bentonitic claystone, ironstone concretions, and lenticular sandstone beds. Coal beds in the Hell Creek are few in number, thin, and lenticular.

The Hell Creek Formation is conformably overlain by the Fort Union Formation. The Fort Union contains four members: the Cannonball, Ludlow, Tongue River, and Sentinel Butte Members. The marine Cannonball is composed of sandstone and shale and interfingers with the nonmarine Ludlow, which consists of siltstone, shale, sandstone, and thin lenticular coal beds. These units are overlain by the Tongue River Member, consisting of sandstone, siltstone, shale, ironstone concretions, and coal beds. Tongue River coal beds are relatively thick (as much as 20 ft; 6.1 m) and laterally continuous. The Tongue River is overlain by the Sentinel Butte Member, which is composed of shale, sandstone, bentonitic claystone, siltstone, and several thick (as much as 44 ft; 13.4 m) continuous coal beds.

The Fort Union Formation is conformably overlain by the Golden Valley Formation (Paleocene and Eocene), composed of sandstone, kaolinitic clay, siltstone, shale, and numerous thin lenticular coal beds.

## Structure

The area discussed in this report is situated on the southwestern flank of the Williston basin and approximately 80 mi (129 km) northeast of the Cedar Creek anticline. The Dickinson area is structurally influenced by two features. The first feature, a synclinal trough (pl. 2), influences the eastern portion of the area. The syncline is asymmetrical with the steeper limb on the northwestern flank. Maximum dips in this area reach  $1^{\circ}$  SE. The second feature, the Williston basin structure, influences the remainder of the area. Dips under this basinal influence are very slight, averaging less than  $1/2^{\circ}$  NE. Faulting in the area is minimal with only one normal fault documented (Northern Pacific Railway Company report, 1963). The fault, located northeast of the town of South Heart (pl. 2), has a trace of about 6 mi (10 km) and a vertical displacement of no more than 15 ft (4.6 m).

## Coal

Coal beds are present throughout the Hell Creek, Fort Union (nonmarine members), and Golden Valley Formations. Those beds within the Hell Creek Formation, the Golden Valley Formation, and Ludlow Member of the Fort Union Formation are too thin and lenticular to be of any significant economic importance in the Dickinson area. Coal beds with sufficient thickness and lateral continuity to be considered commercial prospects are restricted to the Tongue River and Sentinel Butte Members of the Fort Union Formation.

The Tongue River contains four major lignite beds. From deepest to shallowest, these beds are the Hansen (Hn), Harmon (Hr), HT Butte 2 (HT 2), and the HT Butte 1 (HT 1) (pl. 1). Numerous thinner and less continuous coal beds are located between the principal beds. The Tongue River coals in this area are considered too deep (more than 200 ft; 61 m) for economic removal at this time. The Sentinel Butte Member in the Dickinson area contains four potentially economic coal beds and one coal zone. These units, from oldest to youngest, are the C coal zone (CZ), the Fryburg bed (D), the Heart River bed (E), the Lehigh bed, and the Dickinson bed (DK). All of these beds are considered to have potential as economically recoverable resources inasmuch as they have sufficient thickness (greater than 5 ft; 1.5 m), in at least one area, and a lateral continuity with a minimum of overburden (less than 200 ft; 61 m).

#### COAL BEDS OF THE SENTINEL BUTTE MEMBER

C Coal Zone.--The C zone is composed of at least two beds. The maximum coal thickness for the C zone coincides with the two-bed occurrence (44 ft; 13.4 m) (pl. 4). The beds split and thin rapidly toward the south, east, and west and thin gradually to the north. No C zone coal beds crop out within the study area. Maximum overburden on the top bed of the zone is approximately 350 ft (107 m) (pl. 6). (See table 2 for resource summary.)

Fryburg Bed.--The Fryburg bed ranges in thickness from a maximum of 20 ft (6.1 m) (pl. 7) to a pinch-out toward the east and has an average thickness of 10 ft (3 m). Overburden ranges from 0 to

approximately 450 ft (137 m) (pl. 9). The Fryburg coal bed has significant recoverable resources. (See tables 1 and 2 for chemical analyses and resource summary.)

Heart River Bed.--The Heart River bed ranges in thickness from a maximum of 29 ft (8.8 m) (pl. 10) to a pinch-out toward the northwest and has an average thickness of 8 ft (2.4 m). Overburden ranges from 0 to approximately 400 ft (122 m) (pl. 12). The Heart River bed is also important for its recoverable resources. (See tables 1 and 2 for chemical analyses and resource summary.)

Lehigh Bed.--The Lehigh bed is relatively thin and is, therefore, briefly mentioned in this report. The bed does not have a sufficiently minable thickness (at least 5 ft; 1.5 m) over an area large enough to warrant detailed consideration. (See table 1 for chemical analyses.)

Dickinson Bed.--The Dickinson bed is a pod-shaped deposit ranging in thickness from a maximum of 10 ft (3 m) (pl. 4) to a pinch-out toward the north, south, and west. The bed crops out toward the southeast. Interpretation of drill holes in the area indicates the presence of a post-depositional channel through the middle of the deposits. Overburden on the Dickinson bed ranges from 0 to approximately 220 ft (67 m). (See table 2 for resource summary.)

Table 1.--Chemical analyses (in percent) of lignite samples, as received, Dickinson area,

North Dakota

[Leonard, Babcock, and Dove, 1925]

Coal Bed Name	Location	Proximate			Ultimate		
		Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	Btu/lb
Fryburg <sup>1</sup>	T. 139 N., R. 98 W., --- sec. 6, SW $\frac{1}{4}$ ;	40.95	24.30	27.05	7.70	1.35	5,926
	T. 139 N., R. 99 W., sec. 1, SE $\frac{1}{4}$ .						
Fryburg	T. 139 N., R. 98 W., --- sec. 6.	40.86	25.01	29.14	4.99	.60	6,120
Heart River	T. 140 N., R. 99 W., --- sec. 28.	42.91	24.12	26.24	6.73	1.01	5,458
Lehigh	T. 139 N., R. 95 W., --- sec. 8.	38.72	25.55	29.14	6.59	1.10	6,240

<sup>1</sup> Average analysis from two sample locations.

Table 2.--Coal resource summary\*

[Resources in thousands of short tons; to convert to metric tonnes, multiply by 0.90718. Resource figures reported only on beds 5 ft (1.5 m) or greater in thickness]

Township and Range	C Coal Zone	Fryburg Bed	Heart River Bed	Dickinson Bed
T. 138 N., R. 95 W.	---	---	53,200	---
T. 138 N., R. 96 W.	---	---	120,960	6,860
T. 138 N., R. 97 W.	---	206,789	68,320	---
T. 138 N., R. 98 W.	---	290,168	64,656	---
T. 138 N., R. 99 W.	---	455,902	106,051	---
T. 138 N., R. 100 W.	---	62,033	25,424	---
T. 139 N., R. 95 W.	---	---	344,670	16,520
T. 139 N., R. 96 W.	---	---	507,848	65,491
T. 139 N., R. 97 W.	---	438,873	228,346	2,669
T. 139 N., R. 98 W.	---	569,336	31,673	---
T. 139 N., R. 99 W.	---	534,072	93,489	---
T. 139 N., R. 100 W.	---	261,820	41,021	---
T. 140 N., R. 95 W.	---	---	595,694	---
T. 140 N., R. 96 W.	---	---	824,260	27,485
T. 140 N., R. 97 W.	36,433	263,159	376,835	---
T. 140 N., R. 98 W.	8,497	568,314	209,298	---
T. 140 N., R. 99 W.	---	470,816	86,508	---
T. 140 N., R. 100 W.	---	157,279	---	---
T. 141 N., R. 95 W.	---	---	185,819	---
T. 141 N., R. 96 W.	177,488	122,979	108,585	---
T. 141 N., R. 97 W.	1,065,684	269,687	4,926	---
T. 141 N., R. 98 W.	488,760	406,046	---	---
T. 141 N., R. 99 W.	---	122,424	---	---
T. 142 N., R. 96 W.	131,181	18,913	---	---
T. 142 N., R. 97 W.	796,657	66,745	---	---
T. 142 N., R. 98 W.	159,520	98,559	---	---
Bed totals	2,864,220	5,383,914	4,077,583	119,025

Total coal resources----12,444,742

\*Owing to the preliminary nature of this report, the resources reported above have not yet been classified as measured, indicated, or inferred as specified in U.S. Bur. of Mines and U.S. Geol. Survey, 1976, Coal resource classification system of the U.S. Bur. of Mines and U.S. Geological Survey; U.S. Geol. Survey Bull. 1450-B.

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