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GEOLOGICAL SURVEY

LIGNITE GEOLOGY OF THE KEENE AREA,
McKENZIE COUNTY, NORTH DAKOTA

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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 English units	Multiply by	To obtain metric units
Feet	0.3048	Meters
Feet/mile	.1894	Meters/kilometer
Mile	1.609	Kilometer

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INTRODUCTION

The Keene area is in eastern McKenzie County, North Dakota (fig. 1 and pl. 1). The area extends from Lake Sakakawea on the north to Dunn County on the south. Its eastern boundary is the Fort Berthold Indian Reservation. To the west, available data on the lignite beds are too sparse for adequate analysis.

The two principal lignite beds of the area are the Keene and Williston beds. These are in the Sentinel Butte Member of the Paleocene Fort Union Formation.

PREVIOUS WORK

Leonard and others (1925) briefly reported on the lignite resources of the area. Their report was part of a statewide survey and was based on reports from small mines at the outcrop and brief reconnaissance mapping. Their beds no. 3 of the Tobacco Garden and North Branch sections (table 1) appear to correlate with the Keene bed. Their no. 2 bed of the Tobacco Garden and no. 1 bed of the North Branch section appear to correlate with the Williston bed.

Nevin (1946) drew a structure-contour map on the E bed which lies about 200 ft below the Williston bed (his H bed). His map covers the eastern half of the county and delineates the Keene Dome.

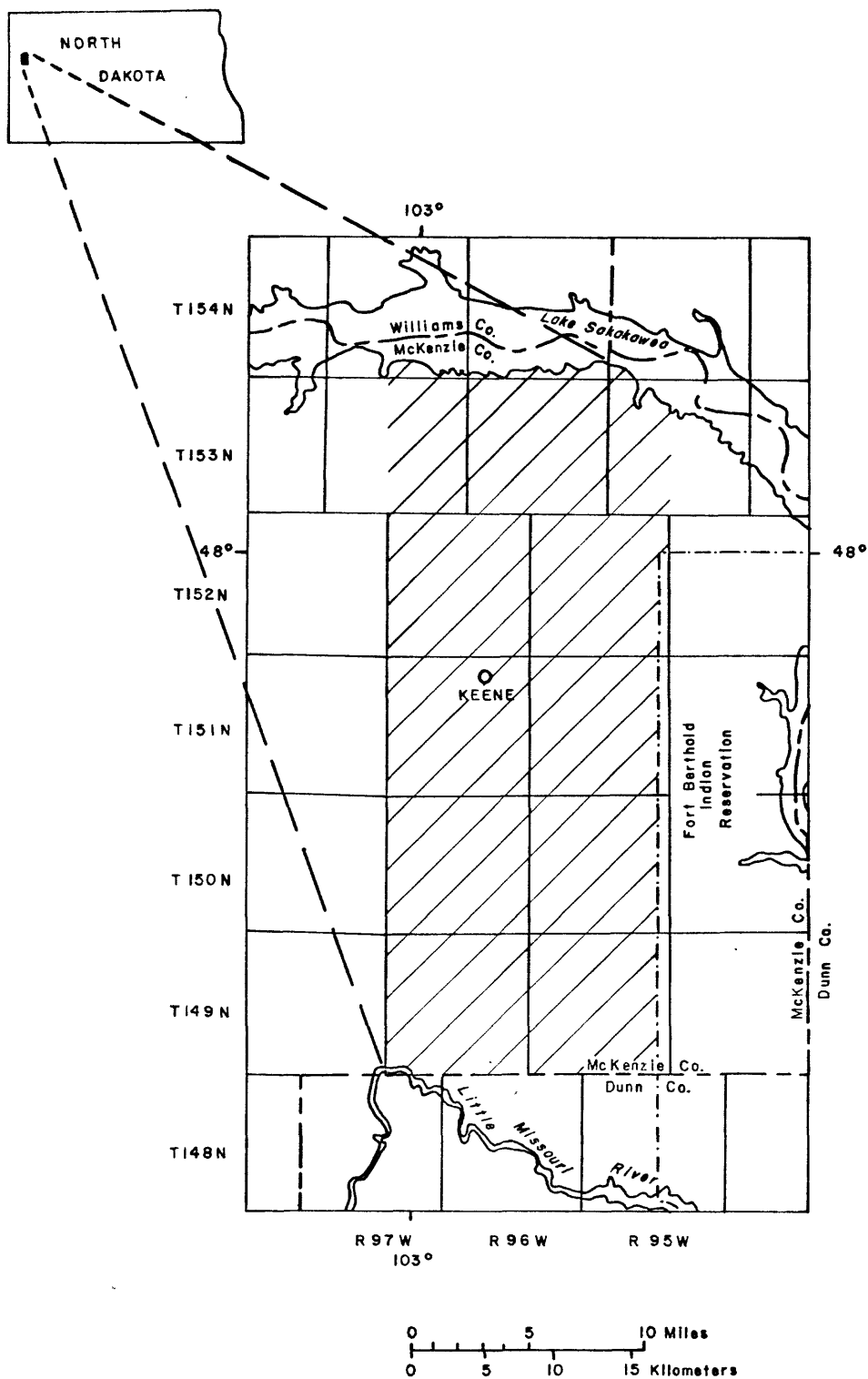


Figure 1.--Location map of Keene area in eastern McKenzie County, North Dakota

Table 1.--Correlation of previous authors' lignite bed names and interburden intervals around the Keene area, McKenzie County, North Dakota

[---, no information]

This report	Collier, 1918		Leonard and others, 1925		Nevin, 1946		Spencer, 1978a	
	Nesson anticline	Tobacco Garden	North Branch	Keene Dome	Williams County			
Keene	no. 7 ?	no. 3	no. 3	I	---			
3-110 ft	50 ft	40 ft	64 ft	50-65 ft				
Williston	Williston	No. 2	No. 1	H	Williston			

The Williston bed was first mapped in Williams County, to the north, by Collier (1918). The Williston bed correlates with further mapping by Spencer (1978a) in Williams County.

Drilling by the U.S. Geological Survey (Spencer, 1978b), data from U.S. Geological Survey files, and oil-well logs provided subsurface information (drill holes labeled MK, K, and OW, respectively, on plate 1). Unpublished outcrop mapping determined the cropline.

GEOGRAPHY

The land in the area is principally used for cattle ranching and grain farming. Approximately 12 percent of the area is part of the National Forest Service Little Missouri River National Grasslands. The grasslands are used for grazing, recreation (mainly hunting), and oil development. There are oil fields throughout the Keene area (fig. 2).

North Dakota state highways 23 and 73 cross the center of the area (pl. 1). The remainder of the area is covered by a network of graded, gravel county roads. The Burlington Northern, Inc., railway track, serving Watford City (the county seat), lies 12 mi to the west. The town of Keene is at the center of the area.

The Missouri-Little Missouri River divide crosses the southern end of the area. Maximum relief in the area is about 800 ft. Blue Buttes, the highest point, lies in T. 151 N., R. 95 W. Drainage from all sides of Blue Buttes is into Lake Sakakawea (on the Missouri River) which lies both north and east of the area. The remainder of the Keene area has a more rolling topography with an average relief of about 100 ft.

STRUCTURE

The Keene area is located near the center of the Williston Basin. The local structure is dominated, however, by the Keene Dome. Nevin

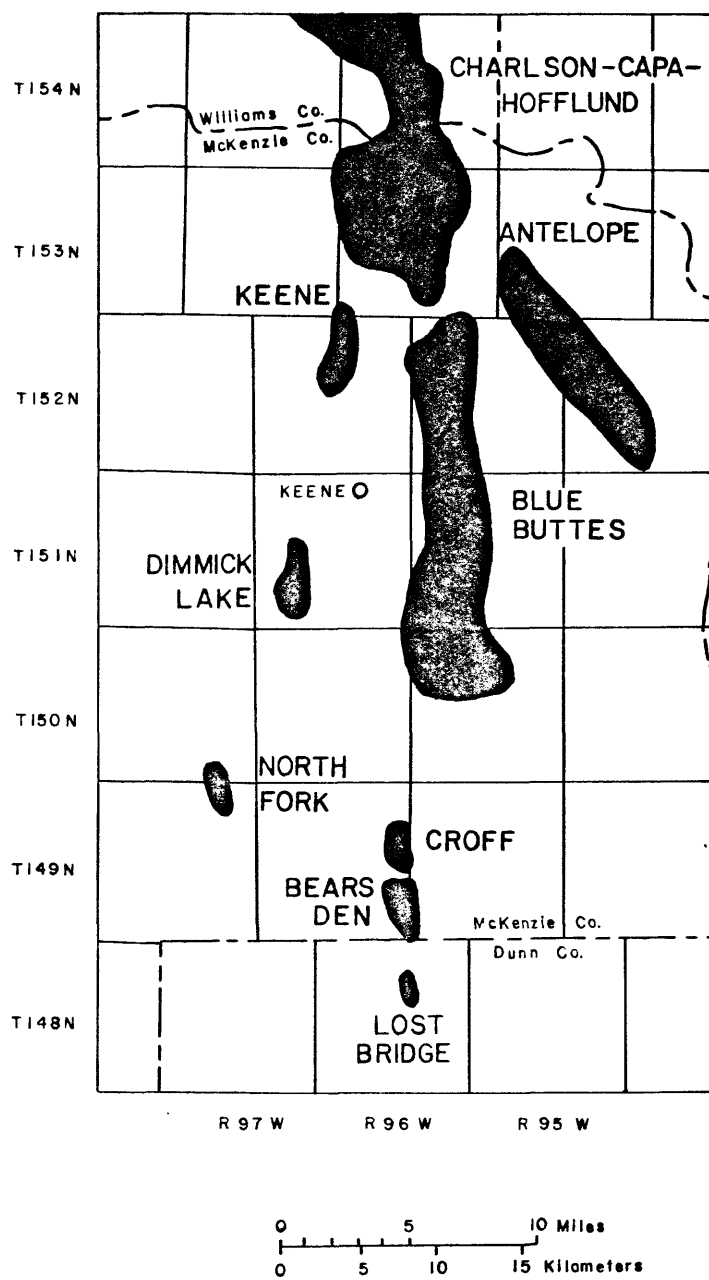


Figure 2.--Location of oil fields in the Keene area,
McKenzie County, North Dakota

(1946) first identified the dome by mapping lignites in the area and speculated that deeper structure might be an oil trap. His speculation proved correct (fig. 2). The dome has a closure of about 170 ft shown by the lignite beds (pls. 2, 3). The lignites dip about 26 ft/mi on the sides of the dome.

STRATIGRAPHY

The bedrock of the area has been identified as the Fort Union Formation of Paleocene age (Royse, 1967). Royse suggested that the exposures in the area are in the Sentinel Butte Member of the Fort Union, which is composed of interbedded siltstone, claystone, sandstone, and lignite.

COAL

There are several lignite beds in the area (pls. 1, 4). Of these, the Williston and Keene beds are the most consistent and traceable. Other beds in the area are too inconsistent, too thin, or too deep for adequate mapping. The HT Butte bed has been identified in oil well logs at depths of 200 ft or more (E. A. Rehbein, 1976, written commun.) and may correlate with the Pittsley bed of southeast Williams County (Spencer, 1978a).

The Keene bed ranges in thickness from 1.2 to 10.0 ft in the area (pl. 5). The bed exceeds 5 ft in thickness through the center of the area, around the town of Keene, reaching its maximum thickness in T. 152 N., R. 96 W. There is a small area north of the town of Keene where the bed is separated by a 1-1.5 ft parting. The upper bench ranges in thickness from 1 to 2 ft and the lower from 6 to 7.6 ft.

The Williston bed is 3.0-110 ft below the Keene bed (pl. 6). It ranges from 3.0 to 13.4 ft in thickness in the area, reaching its maximum thickness in T. 150 N., R. 95 W. (pl. 7).

Overburden on the Keene and Williston beds exceeds 350 ft at Blue Buttes (in T. 151 N., R. 95 W.) and at the south end of the area near the Dunn County line (pls. 6, 8). The former is due to a topographic rise and the latter mostly to the bed structure dipping off to the south. There are broad areas of less than 150 ft overburden in the north part of the area, north of Keene.

Analyses of core samples of lignite in the area are shown in table 2.

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- Royse, C. F., Jr., 1967, The Tongue River-Sentinel Butte contact in western North Dakota: North Dakota Geological Survey Report of Investigations 45, 53 p.
- Spencer, J. M., 1978a, Lignite geology of southeast Williams County, North Dakota: U.S. Geological Survey Open-File Report 78-168, 12 p.
- _____ 1978b, Geophysical and lithologic logs for 1977 coal drilling in McKenzie County, North Dakota: U.S. Geological Survey Open-File Report 78-451, 161 p.

Table 2.--Chemical and physical analyses of lignites in the Keene area, McKenzie County, North Dakota

[Data from U.S. Department of Energy, written commun., 1978. Type of analysis:
A, as received; B, moisture free; C, ash free; --, no data.]

Drill- hole no.	Bed name	Location	Type of analysis	Proximate (percent)			Ultimate (percent) Sulfur	Heating value Btu/lb
				Moisture	Volatile matter	Fixed carbon		
MK 45	Keene	T. 151 N., R. 96 W., sec. 2	A	42.9	24.4	26.0	0.4	5,872
			B	--	42.7	45.6	.7	10,292
			C	--	48.4	51.6	.8	11,660
MK 45	Williston	T. 151 N., R. 96 W., sec. 2	A	41.8	24.8	25.6	1.6	6,038
			B	--	42.6	44.0	2.7	10,381
			C	--	49.2	50.8	3.2	11,990
MK 41	Local 10-ft bed	T. 149 N., R. 96 W., sec. 4	A	41.9	25.1	23.9	1.2	5,890
			B	--	43.2	41.2	2.0	10,138
			C	--	51.2	48.8	2.4	12,012
MK 40	Local 10-ft bed	T. 150 N., R. 96 W., sec. 22	A	41.1	23.2	23.1	1.3	5,343
			B	--	39.4	39.2	2.3	9,069
			C	--	50.1	49.9	2.9	11,544