United States Department of the Interior

U.S. Geological Survey

Report of 1978-1979 Field Investigations of Coal Resources in the Wind River Indian Reservation, Fremont County, Wyoming

By

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Open-file Report 80-674

1980

U. S. Geological Survey
OPEN FILE REPORT
This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature.

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SUMMARY

This report summarizes the results of coal-resource investigations made by the U.S. Geological Survey on the Wind River Indian Reservation during the 1978-1979 field seasons and includes recommendations for the 1980 field season. Table 1 lists some of the work done in 1978 and 1979.

Table 1.--Summary of drilling, sampling, mapping and measured sections

Number of holes drilled and footage	
1. Pilot holes	35
2. Coreholes	21
3. Rockbit footage	16,239 feet
4. Core footage	578 feet
Coal samples	26
Geologic mapping (1:24,000 scale)	
1. Quadrangles	5
2. Square miles mapped	200
Measured sections	
1. 1978	23 sections — 28,000 feet
2. 1979	78 sections — 12,700 feet

INTRODUCTION

The Wind River Indian Reservation is in the western end of the Wind River Basin, in Fremont County, Wyoming. The total area of the reservation is approximately 3,544 square miles, and most of the reservation is above an altitutde of 5,000 feet.

Coal-bearing rocks in the basin have been asymmetrically folded. The northeastern limbs of folds dip gently, whereas the southwestern limbs tend to be steep, inclined, or overturned. Coal beds of resource thickness (>14 inches) occur in the Frontier, Mesaverde, Meeteetse, and Lance Formations of Cretaceous age, and in the Fort Union Formation of Tertiary age. Coal has also been reported in drill holes penetrating the Wind River Formation of the Tertiary. At the request of the U.S. Bureau of Indian Affairs, the U.S. Geological Survey initiated a coal-exploratory drilling program during the fall of 1978 to obtain fresh coal samples, core samples, and electric logs. Data from these drill holes, together with data from geologic field mapping and measured sections, will be used to evaluate the coal resources of the reservation.

ACKNOWLEDGMENTS

Many individuals have assisted in this study, which is being funded primarily by The U.S. Bureau of Indian Affairs. Permission to conduct investigations on the reservation was granted by the Joint Tribal Council of the Shoshone-Arapahoe Nation. Appreciation is extended to Indian field assistants, Lewis Headley, Robert Headley, Benjamin Ridgely, Eugene Ridgely, David Echohawk, and John Yellowplume, who aided in describing stratigraphic sections, and logging drill cuttings and core samples; to U.S. Geological Survey field assistants, Jamie Beitzel, Fredrick Frasse, George Mattingly, and Pamela Clark, who helped implement geologic mapping and coal drilling programs; to personnel of the B & B Drilling Company, William Lake, David Iliff, James Cummings, and Martin Ring; and personnel of Strata Surveys, Inc., Ronald Hicks and Mark Spitzer.

GEOLOGIC MAPPING PROGRAM

Geologic mapping

We have studied the geology and coal deposits of the Maverick Spring, Jenkins Mountain, Alkali Butte, Hudson, and Lander NW 7 1/2-minute quadrangles on the Wind River Indian Reservation (fig. 1). Approximately 200 square miles have been mapped in detail as of 1979. Final compilation will be at a scale of 1:100,000. The geologic setting of the coal-bearing strata in these five quadrangles is described below.

1. Coal-bearing strata in the Maverick Spring quadrangle lie mostly in a northwest-trending syncline whose northeast limb has dips ranging from vertical to 70° overturned to the northeast. The southwest limb is upright and dips 15° - 40° NE. Subbituminous coal beds ranging from 0 to 104 inches in thickness and having variable extent are common in the Frontier and Mesaverde Formations.

2. The geology and structure of the Jenkins Mountain quadrangle have been complicated by folding and faulting. Coal beds as much as 84 inches thick are characteristic of the Mesaverde, Meeteetse, and Fort Union Formations.

3. Alkali Butte quadrangle is astride the northwest end of an elongate domal structure. Coal beds as much as 144 inches thick occur in the Mesaverde and Wind River Formations. The Signor coal bed of the Mesaverde Formation, the thickest and most extensive coal bed on the reservation, may extend more than 22 miles westward in the subsurface towards the town of Hudson. This coal bed has been burned at some surface exposures.

4. In the Hudson quadrangle, four or more coal beds crop out in a narrow northwest-trending belt of Mesaverde and Fort Union rocks. A coal bed measuring 84 inches thick has been tentatively correlated by the authors with the Signor bed of the Mesaverde Formation. This coal bed was mined extensively from 1870 to the early 1900s (Woodruff and Winchester, 1910). Where measured, this bed is overlain unconformably by either the Fort Union(?) or the Wind River(?) Formation. An unconformity also separates a thin wedge of more steeply dipping grayish-red calcareous sandstone and shale beds of the Fort Union(?) Formation from the overlying tuffaceous basal conglomerate of the Wind River(?) Formation.

5. The Lander NW quadrangle is west of the adjoining quadrangle. Outcrops of coal-bearing strata of the Mesaverde Formation in the northwest part of the Lander NW quadrangle are progressively overlapped unconformably by rocks of the Wind River Formation. A coal bed 13 inches thick crops out in rocks of the Frontier Formation on the northeast dip slope of the Hudson-Lander Dome (pl. 1).

Stratigraphic sections

During the 1978 field season, 23 long stratigraphic sections, totaling 28,000 feet, were measured and described from outcrops almost 100 percent exposed. The stratigraphic succession was measured and described along lines

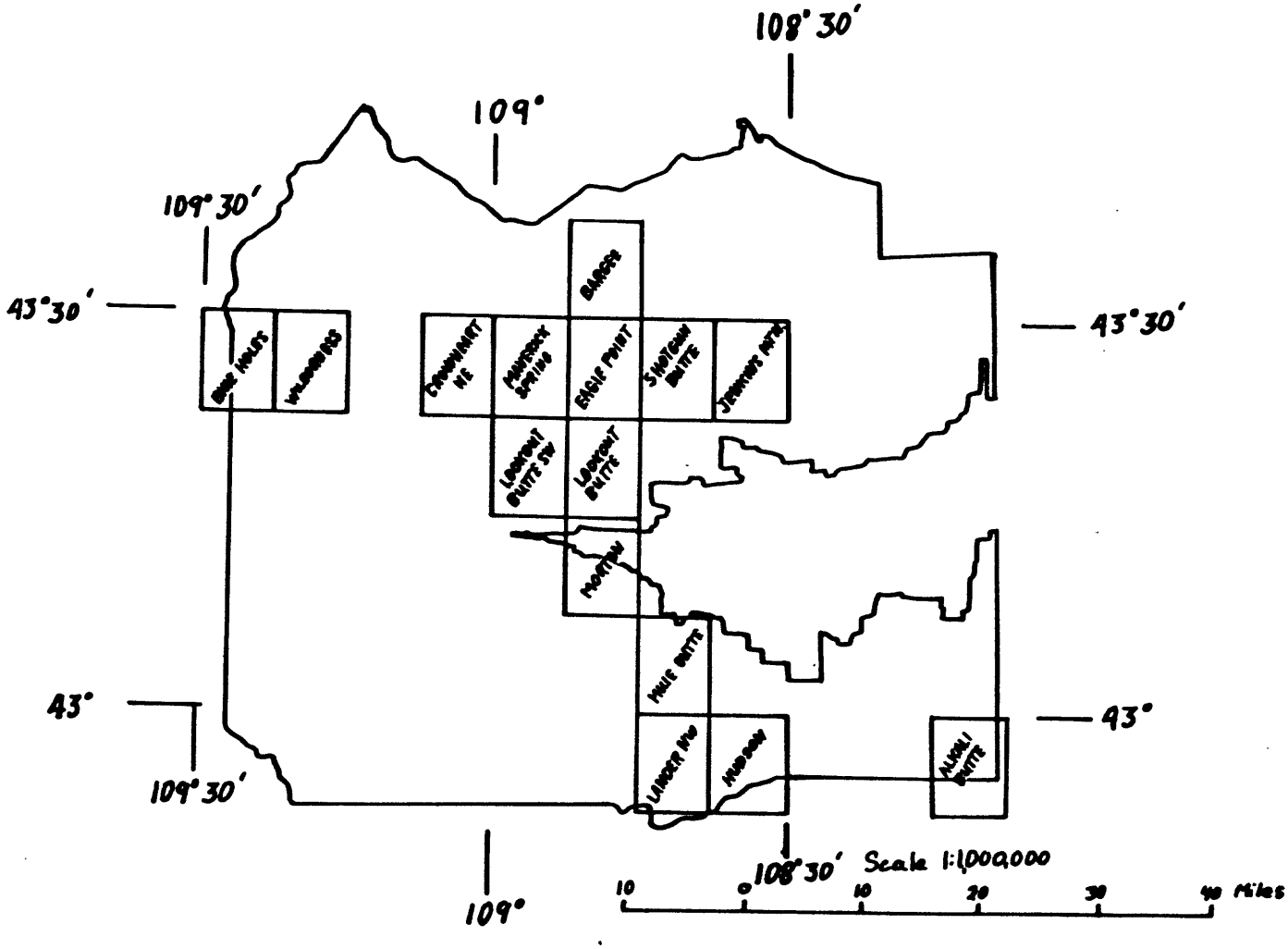

FIGURE 1. Index map of the Wind River Indian Reservation (WRIR), Fremont County, Wyoming, showing locations of U.S. Geological Survey 7½-min. quadrangles where geologic mapping is in progress

perpendicular to strike. These sections were spaced approximately 5 miles apart, began generally in the upper part of the Cody Formation, and extended upward through the Mesaverde, Meeteetse, Lance, and Fort Union Formations and into the lower part of the Wind River Formation. Locations of these stratigraphic sections are shown on plate 1.

Seventy-eight short sections totaling 12,700 feet were measured and described during the 1979 field season; emphasis was placed on coal-bed measurements.

SOME RESULTS OF GEOLOGIC INVESTIGATIONS

Rhyodacite(?) lapilli tuff beds

Three resistant beds of hard, medium-gray siliceous tuff were found in the Alkali Butte quadrangle. These beds are near the base of the Wind River Formation and thin to the northwest into the Hudson, Lander NW, and Mule Butte quadrangles. Beds more than 5 feet thick containing flattened white agglomeratic ash bodies as much as 1 inch in circumference were observed southwest of Alkali Butte. These tuff beds are interbedded with sandstone, siltstone, and bentonitic shale. Grayish-red and greenish-gray shale beds of the Wind River Formation(?) lie immediately above and below the tuff sequence. The tuff beds commonly contain impressions of roots and in places are overlain by thin, dark-gray carbonaceous shale. Further investigations of the tuff beds may result in their recognition as a time-stratigraphic rock unit near the base of the Wind River Formation. Numerous other tonsteins and ash beds were also noted in coal beds and rocks of Cretaceous and Tertiary age.

Vertebrate fossils

Fossilized bone fragments were found in a narrow channel approximately 30 feet wide and 200 feet long above tuff beds in the Wind River(?) Formation southwest of Alkali Butte. This channel trends northeast and contains at its base 2 feet of thin coal and carbonaceous shale, overlain by gray bentonitic shale, siltstone, and sandstone. Turtle shell fragments, fish vertebrae, and crocodile bones have been tentatively identified.

Another fossil bone locality in flat-lying red beds of the Wind River(?) Formation is near an abandoned coal mine in the Frontier Formation. A thrust fault separates rocks of the overlying Frontier Formation from the fossil-bearing beds. The locality is near the east-central border of the Blue Holes quadrangle. These bone fragments have not been identified. Paleontological investigations at both localities may result in vertebrate faunal dating of the basal part of the Wind River Formation.

Coal beds in the Frontier Formation

Several steeply dipping coal beds in the Frontier Formation crop out in the east-central part of the Blue Holes quadrangle and in the west-central part of the Wilderness quadrangle. Two brightly banded coal beds, one 37 inches thick and the other 28 inches thick, are exposed near several caved coal adits. The coal beds and associated rocks of the Frontier Formation have been transported by a high-angle thrust over flat-lying rocks of the Wind River Formation. The southeastern outcrop of both units is overlapped unconformably by sand, gravel, and granitic boulders of Pleistocene age. Several shallow angled drill holes would provide fresh coal samples and data on the areal extent of the coal beds.

Red shale in the Mesaverde Formation

A large, northeast-trending channel, filled with a thick sequence of Mesaverde rock, is exposed in the Maverick Spring quadrangle. The basal third of the channel fill consists of lenses of conglomerate containing rounded pebbles as much as 3 inches in diameter. The pebbles are quartzite, chert, sandstone, and clasts of unknown origin. The upper two-thirds of the fill consists of grayish-red shale that intertongues with gray sandstone and shale. The grayish-red shale beds thin rapidly to the northeast and southwest. Drill hole WR-9, which is 1 mile southeast of the outcrop of the channel fill, penetrated the conglomeratic units. Coal beds in and near the channel are thin and impure.

Several thin beds of red shale along the same trend are stratigraphically younger; they are present at the base of the Meeteetse Formation and at the top of the Fort Union Formation in northeastern Lookout Butte quadrangle. Detailed studies of these three sequences of red beds may allow a better understanding of repetitive depositional environments in the northwest part of the Wind River basin.

Depositional environments of the Mesaverde Formation

During the 1979 summer field season, Romeo Flores of the U.S. Geological Survey joined our group to study the depositional environments. Examination of outcrops near the top of the Cody Shale showed a coarsening upward of grain sizes and intertonguing with the basal sandy units of the Mesaverde Formation. The coarsening upward and intertonguing may indicate a regression of the Cretaceous sea. Sedimentary structures characteristic of mouth bars, point bars, and distributary channel fillings were observed in the lower part of the Mesaverde Formation. These sedimentary structures also indicate regression of the sea and an emerging environment. During the emergence, protective barriers and widespread swampy platforms formed; vegetation accumulated on these platforms and was preserved to form coal. Most coal beds formed in this zonal sequence are thin, lenticular, and of irregular distribution and are probably related to crevasse splay and distributary channels. A thicker and more widespread sheetlike coal bed overlies this zone and may have been deposited under the more stable conditions found in the back-bay swamp environment.

An upper delta-plain environment is suggested by the next higher sedimentary sequence. This sequence consists of approximately 1,000 feet of interbedded lenticular sandstone, siltstone, gray shale, carbonaceous shale, thin coal beds, and thin freshwater limestone beds.

The uppermost unit of the Mesaverde Formation is a white, coarse- to medium-grained blanket sandstone containing several thin carbonaceous shale beds. It appears to be in unconformable contact with the underlying sequence and is interpreted as having been deposited on an alluvial plain. The basal shale units of the overlying Meeteetse Formation record a transgression of the Cretaceous sea.

COAL EXPLORATORY DRILLING PROGRAM

Drilling progam and electric logging

Drilling operations by B & B Drilling Company and logging by Strata Surveys, Inc., began October 27, 1978, and ended November 10, 1978, because

of heavy snow. Drilling resumed on July 6, 1979, and was completed on September 12, 1979. Thirty-five pilot holes (WR-1 to WR-24, table 2, and plate 1) 4 1/4 inches in diameter were drilled by using Tri-cone rollerbits and compressed air to return cuttings.

Electric logs were run on each pilot hole to record the natural gamma radiation, density, resistivity, and borehole diameter and to determine the approximate thickness and depth of penetrated coal beds.

After examination of the electric logs, a second 4 1/4-inch-diameter hole was drilled, approximately 10 feet from each pilot hole, to a depth just above the uppermost coal bed, and a 2 3/8-inch-diameter core of the coal was taken by using a diamond core bit. The core samples included roof and floor rock. This procedure was repeated for each underlying coal bed.

Drilling was done on a 24-hour schedule. Locations of holes drilled in 1978 and 1979 are shown in plate 1. Data for each drill hole are given in table 2 and include uncorrected dip thicknesses. Each drill site was reclaimed after completion of drilling, logging, and sampling. Reclamation consisted of plugging each hole with bentonite, capping it with cement, leveling the surface, and reseeding with native grasses.

Recommendations for the 1980 drilling program

A coal exploratory drilling program has been planned for 1980 to provide data from 31 proposed drill sites (A to EE, table 3, plate 1). Drill sites were selected to provide information from greater depths, from vertical and overturned coal beds in the northern part of the Wind River Indian Reservation, and from potential coal-bearing strata in the Frontier Formation. Deeper drilling, as much as 1,500 feet, on the reservation will penetrate unknown thicknesses of rocks of the Wind River Formation, which overlies targeted coal beds. Shallow drilling in vertical and overturned beds will consist of a series of angle holes no greater than 45° from vertical, ranging from 100 to 200 feet in depth. Holes A–CC will be drilled on the reservation and will be funded by the U.S. Bureau of Indian Affairs.

Two proposed drill sites (DD and EE, table 2, plate 1) are off the reservation near the southeastern boundary; one hole should be 2,000 feet deep in the Beaver Creek coal field, and the other should be 200 feet deep in the Sand Draw coal field. This drilling will be funded by the U.S. Geological Survey. These tests should provide information on coal beds projecting northwestward from south of the reservation boundary. Data from the Stanolind oil and gas well (Johnson No. 1) (Thompson and White, 1952) in the Beaver Creek coal field indicate that 27 coal beds ranging in thickness from 3 to 15 feet are between 750 and 2,888 feet below the surface. The oldest of these coal beds is in the Mesaverde Formation and the youngest is in the Fort Union Formation. A coal bed 22 to 28 feet thick is reported at the Downey mine (Thompson and White, 1952) which is 6 miles east of the Beaver Creek coal field, in the Sand Draw coal field (pl. 1).

Table 2.--Summary of 35 pilot holes drilled on the Wind River Indian Reservation, 1978-1979

Pilot drill holes	Quadrangle	Pilot hole footage	Rockbit footage	Total core footage	Coal thickness (in inches)	Depth to base of coal
WR-1	Alkali Butte	462	724	60	49	105'-10"
					57	379'-0"
					107	402'-9"
WR-1A	Alkali Butte	502	1,026	40	43	265'-6"
				Repeat core	45	263'-2"
WR-1B (corehole only)	Alkali Butte	---	133	60	52 3/4	159'-1"
					99	197'-5"
WR-2	Alkali Butte	602	850	35	72 1/4	96'-8"
					35 3/4	183'-1"
WR-2A	Alkali Butte	142	167	20	Coal not recovered	
WR-3	Hudson	502	716	40	78	214'-1"
					23 1/2	248'-9"
WR-4	Lander NW	562	562	0	---	---
WR-4A	Lander NW	82	82	0	---	---
WR-5	Hudson	262	406	20	33 1/2	148'-4"
WR-6	Mule Butte	542	542	0	---	---
WR-7	Morton	240	240	0	---	---
WR-7A	Morton	342	598	40	18	168'-4"
					15	174'-2"
					49	251'-6"
					36	288'-8"
WR-8	Lookout Butte SW	502	502	0	---	---
WR-8A	Lookout Butte SW	502	910	18	---	---

Table 2.--Summary of 35 pilot holes drilled on the Wind River Indian Reservation, 1978-1979--Continued

Pilot drill holes	Quadrangle	Pilot hole footage	Rockbit footage	Total core footage	Coal thickness (in inches)	Depth to base of coal
WR-9	Maverick Spring	660	660	0	---	---
WR-10	Crowheart NE	320	490	32	62	180'-0"
WR-11	Lookout Butte	40	40	0	---	---
WR-11A	Lookout Butte	280	280	0	---	---
WR-11B	Lookout Butte	340	642	28	42	191'-0"
WR-12	Lookout Butte	200	200	0	---	---
WR-12A	Lookout Butte	542	542	0	---	---
WR-13	Eagle Point	402	402	0	---	---
WR-13A	Eagle Point	280	280	10	51	80'-6"
WR-14	Eagle Point	185	340	20	122	159'-7"
WR-14A (corehole only)	Eagle Point	185	50	22	129 1/2	46'-11"
WR-15	Bargee	333	517	18	104 1/2	31'-7"
WR-16	Shotgun Butte	556	556	18	No significant coal	
WR-17	Eagle Point	302	413	15	30	117'-0"
WR-17A	Eagle Point	402	402	0	---	---
WR-18	Jenkins Mtn.	465	465	0	---	---
WR-19	Jenkins Mtn.	602	687	17	19 1/2 19	93'-8" 95'-4"
WR-20	Jenkins Mtn.	402	513	20	51	121'-10"
WR-21	Jenkins Mtn.	415	415	0	---	---
WR-21A	Jenkins Mtn.	25	25	23	67 3/4	40'-0"
WR-22	Jenkins Mtn.	280	420	22	Coal bed predicted but not found	---
WR-23	Jenkins Mtn.	402	402	0	---	---
WR-24	Wilderness	40	40	0	Hole abandoned	
Total		12,902	16,239	578		

Table 3.--Thirty-one drill sites proposed for the 1980 program

[Proposed drill sites are shown on plate 1; B.I.A., U.S. Bureau of Indian Affairs; USGS, U.S. Geological Survey]

Drill Hole	Approximate Location	Depth (feet)	Target Formation (abbreviations shown on plate 2)
Sites on the reservation — drilling to be funded by B.I.A.			
A	2 miles north of Alkali Butte	1,500	Kmv
B	5 miles west of Alkali Butte	1,500	Kmv
C	2 miles east of Hudson	1,000	Kmv
D	2 miles north of Hudson	1,000	Kmv
E	2 miles south of Ethete	200	Kf
F	4 miles northeast of Ethete	1,000	Kmv
G	7 miles north of Ethete	1,000	Kmv
H	5 miles southwest of Ethete	200	Kf
I	1 mile east of Winkleman Dome	1,000	Kmv
J	5 miles west of Winkleman Dome	200	Kf
K	1 mile south of Bull Lake dam	200	Kf
L	5 miles southwest of Bull Lake dam	200	Kf
M	3 miles north of Bull Lake dam	1,000	Kmv
N	5 miles southwest of Crowheart Butte	200	Kf
O	7 miles west of Crowheart Butte	200	Kf
P	5 miles northwest of Crowheart Butte	1,000	Kmv
Q	0.5 miles north of Wilderness	200	Kf
R	6 miles northwest of Wilderness	200	Kf
S	1 mile west of Rolff Lake	200	Kf
T	2 miles north of Sheldon Dome	200	Kmv

Table 3.--Thirty-one drill sites proposed for the 1980 program -- Continued

Drill Hole	Approximate Location	Depth (feet)	Target Formation (Abbreviations shown on plate 2)
U	1 mile southwest of Little Dome	200	Kmv
V	5 miles southeast of Eagle Point	200	Kmv
W	5 miles east of Eagle Point	200	Kmv
X	5 miles northwest of Shotgun Butte	200	Km
Y	1 mile north of Shotgun Butte	200	Km
Z	2 miles northeast of Shotgun Butte	200	Kmv
AA	2 miles east of Shotgun Butte	200	Km
BB	5 miles southeast of Jenkins Mtn.	1,500	Kmv
CC	6 miles south of Mexican Pass	1,500	Kmv
	Sites off the reservation -- drilling to be funded by USGS		
DD	5 miles south of Alkali Butte	200	Kmv
EE	In Beaver Creek oil field	2,000	Kmv

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