

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Correlated Lithologic Logs and Analyses of 1982 Coal Drilling
in Big Horn, Prairie, Rosebud, and Treasure Counties, Montana

By

William B. Hansen¹ and William C. Culbertson²

In cooperation with the U.S. Bureau of Land Management

Open File Report 85-738

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

¹BLM, Billings, Mont.

²USGS, Denver, Colo.

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INTRODUCTION

In the summer and fall of 1982, the U.S. Bureau of Land Management (BLM) sponsored a drilling program for the purpose of evaluating the coal resources of the Paleocene Fort Union Formation in three areas of southeastern Montana. The site proposals and on-site geologists were provided by the U.S. Minerals Management Service (MMS), but the actual locating and drilling of the holes was done by the U.S. Geological Survey (USGS).

Forty-one holes were drilled in the Birney-Decker area in Big Horn and Rosebud Counties, four holes were drilled in an area west of Colstrip in Rosebud and Treasure Counties, and four holes were drilled in an area west of Terry in Prairie County (see figs. 1-3). The holes ranged in depth from 115 to 1,075 ft (35 to 328 m).

Samples of cuttings that were taken at 5-ft intervals during rotary drilling were examined by the on-site geologists who then prepared a preliminary lithologic log. A suite of geophysical logs, consisting of gamma-ray, gamma-gamma density, and resistivity, plus a caliper log, was run in each hole. The preliminary sample logs were modified by interpretation of the geophysical logs to produce the final lithologic logs which are presented in this report. Where caving in the hole or malfunction of the equipment prevented the geophysical logging of the entire hole, the lithologic description of the unlogged part is based solely on the original sample log (e.g. B82-13 and R82-5). In two holes, B82-8C and CW-1-82, core samples of coal were taken for analysis.

In the Birney-Decker area, five previously drilled water wells were also logged and a lithologic log was created by interpreting the geophysical logs (PDC-13, PDC-14, R82-7WW, R82-19WW, and R82-20WW).

The original geophysical logs have been filed with the BLM Branch of Records, Montana State Office, Billings, Mont. They may be inspected and (or) purchased by contacting Jackie Samsal, Supervisor, Records Assistance Section, Division of Mineral Resources, BLM-MSO, P.O. Box 36800, Billings, MT 59107 (406-657-6564). All logs were recorded at a scale of 1 in. = 10 ft except for the log of core hole B-82-8C which was recorded at an expanded scale of 1 in. = 5 ft for the cored interval.

Jim Gruber, Ed Burks, Hal Owen, John McKay, Scott Haight, and Myra Funkhouser were the MMS on-site geologists for the drilling. The modification of the sample logs by interpretation of the geophysical logs was done primarily by W. B. Hansen of the MMS, and the correlation and nomenclature of the coal beds in the Birney-Decker area were done principally by W. C. Culbertson of the USGS. Special acknowledgment is given to Art Clark and

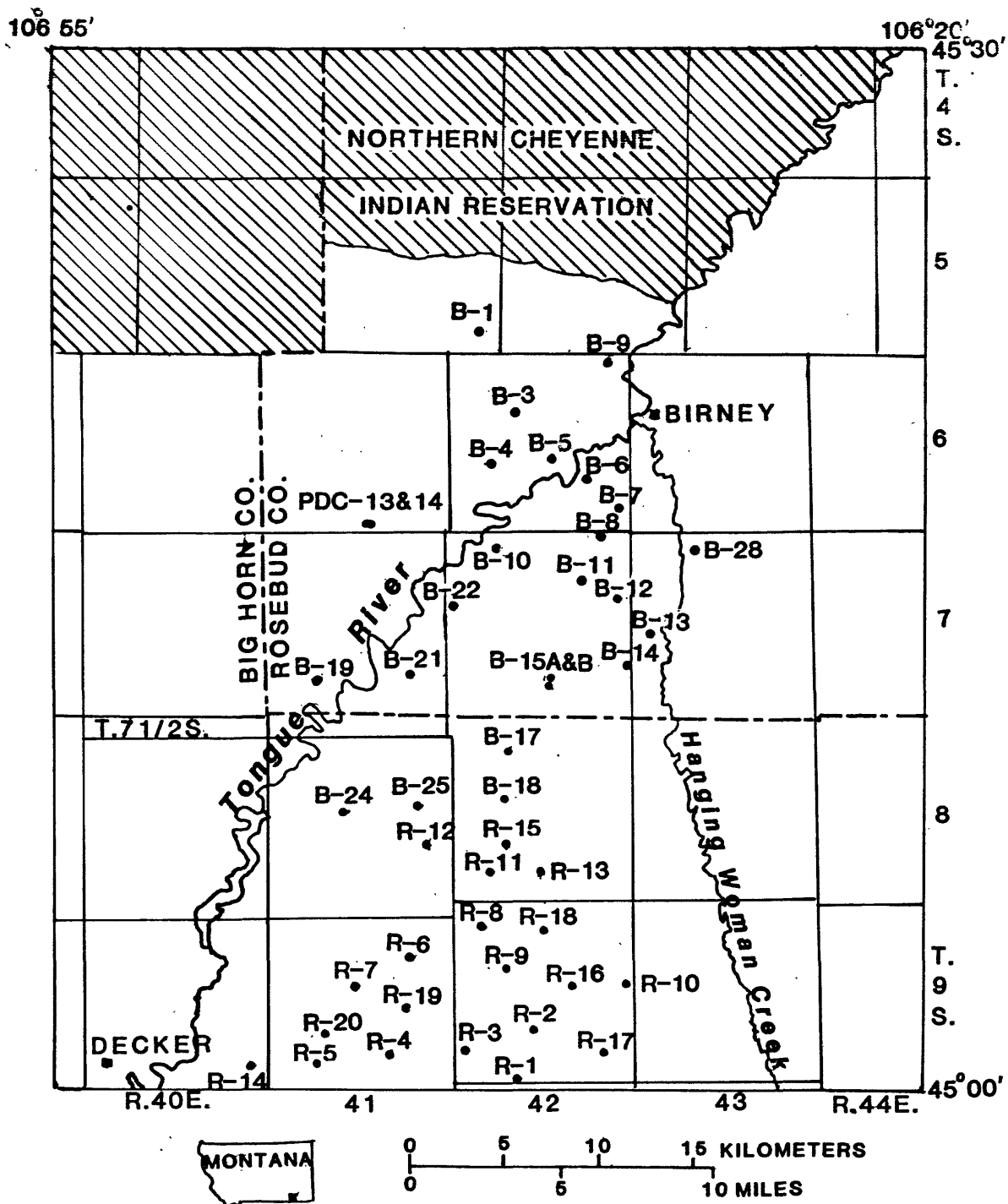


Figure 1: Index map of Birney-Decker area showing location of holes drilled by U.S. Geological Survey in cooperation with the U.S. Bureau of Land Management in 1982, Big Horn and Rosebud Counties, Montana.

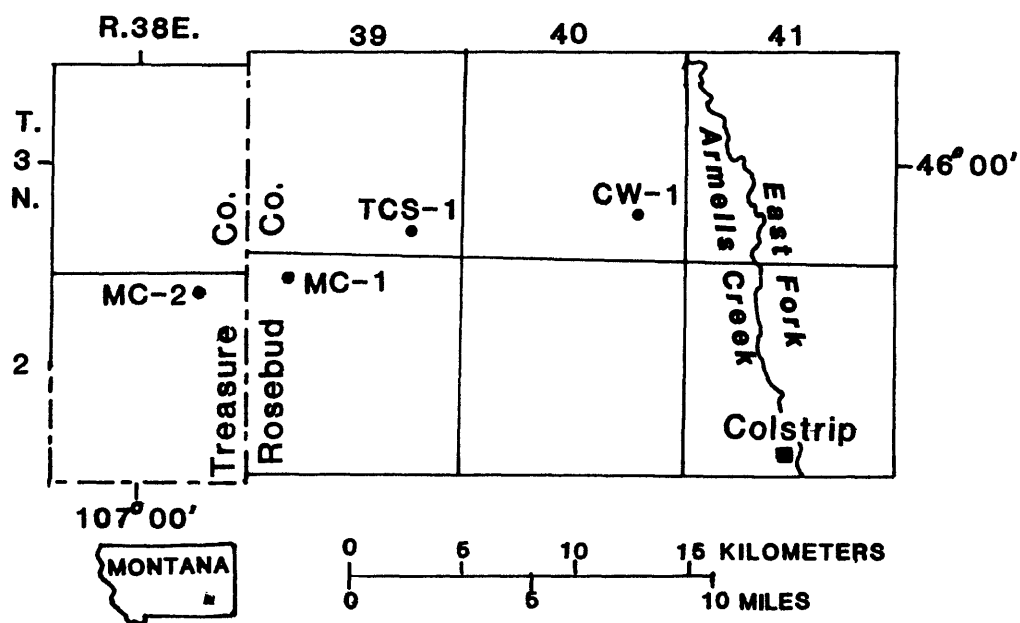


Figure 2: Index map of area west of Colstrip, Montana showing location of holes drilled by U.S. Geological Survey in cooperation with the U.S. Bureau of Land Management, in 1982, Rosebud and Treasure Counties, Montana.

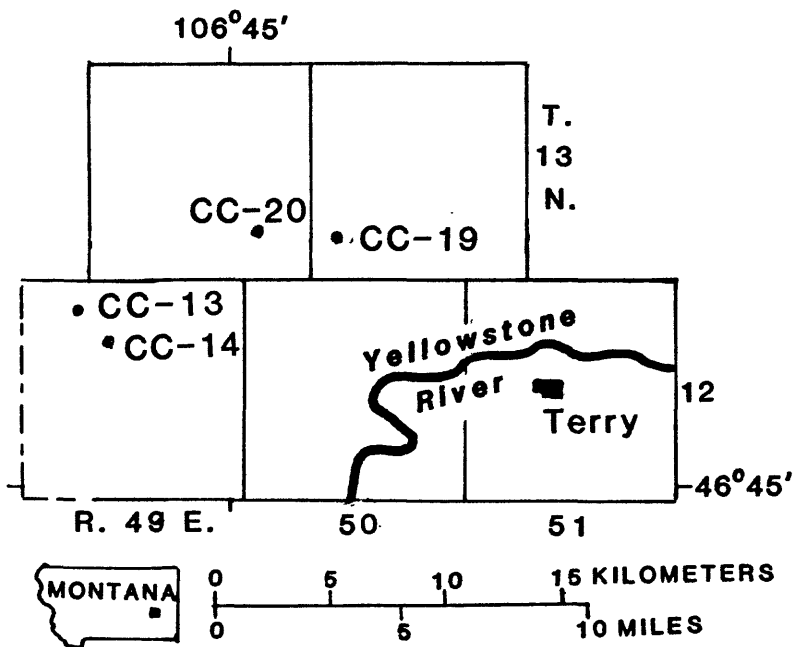


FIGURE 3: Drill hole location map of area west of Terry, showing holes drilled by the U.S. Geological Survey in cooperation with the U.S. Bureau of Land Management in 1982, Prairie County, Montana.

Steve Roberts of the USGS for their cooperation in the field during location and drilling of the holes. Two previous coal exploratory drilling programs in the Birney-Decker area have been reported by Culbertson and others (1980), and Culbertson (1981).

GEOLOGIC SETTING

The coal beds occur primarily in the Tongue River Member of the Paleocene Fort Union Formation but also include the Big Dirty bed in the Lebo Shale Member of the Fort Union Formation and the Badger bed in the lower part of the Eocene Wasatch Formation. The Tongue River Member consists of interbedded sandstone, siltstone, shale, coal, and many thin lenticular beds of silty or sandy limestone. Most of these rocks are poorly consolidated and do not form prominent outcrops, but the beds of limestone or limy sandstone locally form resistant ledges. Where the thick coal beds have burned back from the outcrop, the overlying rocks have been baked or fused into a reddish resistant rock called clinker, or locally "scoria" or "red shale." Thick masses of clinker cap many of the peaks and upland surfaces in the Birney-Decker area.

The lower part of the Wasatch is similar in lithology to the Tongue River Member but contains more carbonaceous shale. The Lebo Shale Member is mainly dark clay shale and mudstone with a few beds of sandstone and lenticular beds of coal.

The regional dip in these areas is generally low, about 30-50 ft to the mile (5.7-9.3 m/km) in a southerly direction. This regional dip is modified by a few low amplitude flexures, and is locally disrupted by normal faults as much as 6 miles (9.7 km) long, with vertical displacements of as much as 300 ft (91 m).

COAL BEDS

In the Birney-Decker area the drilling program penetrated the coal beds of the entire Tongue River Member, which locally may contain as many as 20 beds. However, in many places the coal beds split, coalesce, or pinch out laterally in short distances which complicates the correlation and nomenclature of these beds. The coal bed nomenclature used in these lithologic logs is taken from a correlation diagram by Culbertson (in press), which is a modification of a previous correlation diagram by Culbertson (1980). The principal named beds, in descending order, are: Roland, Smith, Anderson, Dietz 2, Dietz 3, Canyon, Carney, Cook, Otter, Wall, Carlson, Poker Jim, Brewster-Arnold, Odell, King, Knobloch, Nance, and Flowers-Goodale. Where these beds have split, the name of the split bed is derived from the named bed by adding a prefix such as "upper" or "lower," if the split is otherwise unnamed. A few beds of local extent are unnamed.

The Roland and Smith beds are persistent in the area directly east of the Tongue River in T. 8 S. and T. 9 S. (fig. 1), ranging in thickness from 7 to 12 ft (2.4 to 3.7 m) for the Roland, and 8 to 20 ft (2.4 to 6.1 m) for the Smith. The Anderson and Canyon beds are the most persistent beds throughout the Birney-Decker area, attaining thicknesses of 19-37 and 10-24 ft (5.8-11.3 and 3.1-7.3 m), respectively.

The Dietz beds in the Anderson-Canyon interval are difficult to correlate. Hole R82-5 (fig. 1) encountered 25 ft (7.6 m) of coal in the Dietz 2 bed and 18 ft (5.5 m) of coal in the underlying Dietz 3 bed. Yet in other holes there are one to five beds in this interval ranging in thickness from 2 to 14 ft (0.6 to 4.3 m).

The Wall bed, which is the thickest coal penetrated by the drilling, is 51 ft (15.6 m) thick in B82-19 but thins abruptly eastward and splits into as many as five beds.

In the Colstrip area, three coal beds of the Tongue River Member were drilled: the Rosebud, McKay, and Robinson; and one named bed in the Lebo Shale Member, the Big Dirty.

In the area west of Terry, most of the coal beds of the Tongue River penetrated by the drilling are uncorrelated, but the coal bed in the Lebo Shale Member was identified as the Big Dirty.

RANK AND QUALITY OF THE COAL

Coal from the five beds that were cored in B82-8C and the one bed cored in CW-1 (table 1) were analyzed by Geochemical Testing of Somerset, Pa. On the basis of the chemical analyses received (see analyses listed with lithologic logs), the coal beds in B82-8C are subbituminous C in rank. The heating value on an "as-received" basis ranges from 7118 to 8776 Btu/lb, the sulfur content from 0.4 to 0.95 percent, the ash content from 3.7 to 16.9 percent, and the moisture content from 28.2 to 30.1 percent. Other analyses of coal in the Birney-Decker area are reported by Affolter and others (1979). According to the analysis from CW-1, the Big Dirty bed is subbituminous B in rank. The heating value on an "as-received" basis is 7278 Btu/lb, the sulfur content is 0.7 percent, the ash content is 22.9 percent, and the moisture content is 15.1 percent.

REFERENCES CITED

- Affolter, R. H., Hatch, J. R., and Culbertson, W. C., 1979, Chemical analyses of coal from the Tongue River Member, Fort Union Formation, Moorhead and southeastern part of the Northward Extension of the Sheridan coal fields, Powder River and Big Horn Counties, Montana: U.S. Geological Survey Open-File Report 79-538, 68 p.
- Culbertson, W. C., 1980, Diagrams showing correlation of Paleocene coal beds underlying the Birney 1° x 1/2° quadrangle, Big Horn, Rosebud, and Powder River Counties, Montana: U.S. Geological Survey Open-File Report 80-666, 6 p., 2 sheets.
- _____, 1981, Coal exploratory holes drilled in 1980 in the Birney 1° x 1/2° quadrangle, Powder River and Big Horn Counties, Montana: U.S. Geological Survey Open-File Report 81-1329.
- _____, Diagrams showing proposed correlation and nomenclature of Eocene and Paleocene coal beds underlying the Birney 30' x 60' quadrangle, Big Horn, Rosebud, and Powder River Counties, Montana: U.S. Geological Survey Coal Investigation Series (in press).
- Culbertson, W. C., Gaffke, T. M., and Correia, George, 1980, Coal exploratory holes drilled in 1978-79 in the Birney 1° x 1/2° quadrangle, Big Horn and Rosebud Counties, Montana, for coal beds in the Tongue River Member of the Paleocene Fort Union Formation: U.S. Geological Survey Open-File Report 80-55, 68 p.

Table 1.--Identification of samples of coal from two cores in the Tongue River and Lebo Shale Members of the Fort Union Formation in Big Horn and Prairie Counties, Montana

[Coal analyses follow lithologic logs of each hole. To convert feet to meters, multiply by 0.305. Leaders (---) indicate no data]

Hole name	Location	Sample number	Depth interval (in feet)	Bed name	Remarks
B82-8C	T. 7 S., R. 42 E., sec. 2 1100FNL, 100FEL	U10894	70-78	Lower Dietz 3	Includes 0.2 ft of siltstone at 74.8 ft
		U10896	187.7-204.4	Canyon	Includes 0.4 ft of shale at 197.5 ft
		U10895	360-366.5	Lower Otter	---
		U10940	401.5-407.4	Middle Wall	---
		U10941	443-455	Lower Wall	Includes 1.0 ft of shale at 447 ft
CW-1	T. 3 N., R. 40 E., sec. 26	U11085	175-184.2	Big Dirty	---

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-1 Elev. 4024 feet Total Depth 1075 feet
 Location 196' FNL & 118' FWL Sec. 36, T. 5 S., R. 41 E.
 County Rosebud State Montana Quadrangle Birney SW
 Drilled by USGS-GD Driller L. Kozak Hole Size 5-1/8 inches
 Date Started 5-15-82 Date Completed 8-15-82 Geologist H. Owen
 Remarks The base of the Anderson-Dietz bed lies just north of this site at
4061'. Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	32	32	Siltstone, yellow, light brown, light tan
32	36	4	Shale, carbonaceous
36	40	4	Coal - DIETZ 3 BED
40	41	1	Siltstone, light gray
41	44	3	Coal - DIETZ 3 BED
44	59	15	Siltstone, light gray
59	67	8	Siltstone and shale, gray
67	69	2	Sandstone, gray
69	74	5	Claystone, gray
74	79	5	Shale, gray
79	84	5	Siltstone, gray
84	86	2	Shale, carbonaceous
86	88	2	Siltstone, light gray
88	92	4	Shale, carbonaceous
92	95	3	Siltstone, gray
95	101	6	Shale, carbonaceous
101	110	9	Siltstone, light gray
110	113	3	Claystone, light gray
113	126	13	Siltstone, light gray
126	145	19	Sandstone, gray
145	150	5	Siltstone, gray
150	163	13	Shale, carbonaceous
163	174	11	Siltstone, gray
174	177	3	Sandstone, gray
177	182	5	Siltstone, gray
182	191	9	Shale, carbonaceous
191	204	13	Coal - CANYON BED
204	206	2	Clay, gray
206	210	4	Siltstone, light gray
210	215	5	Claystone, light gray
215	217	2	Sandstone, gray
217	226	9	Claystone, light gray
226	229	3	Siltstone, light gray
229	231	2	Shale, gray
231	242	11	Siltstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
242	260	18	Shale and siltstone, gray
260	263	3	Clay, light gray
263	266	3	Coal - COOK BED
266	271	5	Siltstone, light gray
271	276	5	Coal COOK BED
276	298	22	Siltstone and shale, gray, interbedded
298	303	5	Shale, gray
303	305	2	Siltstone, gray
305	312	7	Sandstone, gray
312	316	4	Shale, carbonaceous
316	319	3	Coal - OTTER BED
319	323	4	Clay, light gray
323	335	12	Sandstone, gray
335	346	11	Shale, carbonaceous
346	350	4	Siltstone, gray
350	353	3	Sandstone, gray
353	364	11	Siltstone, light gray
364	372	8	Sandstone, gray, fine
372	376	4	Sandstone, gray
376	388	12	Shale and siltstone, gray, interbedded
394	402	8	Shale, carbonaceous
402	408	6	Siltstone, light gray
408	416	8	Shale, carbonaceous
416	444	28	Coal - WALL BED
444	453	9	Shale, carbonaceous and gray clay
453	459	6	Coal - LOWER WALL BED
459	460	1	Clay, gray
460	462	2	Coal - LOWER WALL BED
462	467	5	Shale, carbonaceous
467	529	62	Sandstone, light gray, fine
529	531	2	Shale, carbonaceous
531	535	4	Coal - CARLSON BED
535	538	3	Clay, gray
538	548	10	Siltstone, light gray
548	559	11	Shale, carbonaceous
559	566	7	Siltstone, light gray
466	568	2	Claystone, gray
568	571	3	Siltstone, gray
571	641	70	Sandstone, light gray, well cemented
641	648	7	Coal - POKER JIM BED
648	650	2	Shale, carbonaceous
650	653	3	Siltstone, dark gray, cemented
653	655	2	Claystone, gray
655	664	9	Shale, carbonaceous
664	676	12	Coal - BREWSTER - ARNOLD BED
676	679	3	Shale, carbonaceous

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
679	688	9	Sandstone, gray
688	696	8	Sandstone, gray
696	713	17	Siltstone, gray
713	717	4	Coal - ODELL BED
717	718	1	Siltstone, gray
718	720	2	Coal - ODELL BED
720	726	6	Shale, carbonaceous
726	730	4	Sandstone, gray
730	758	28	Siltstone & shale, gray, interbedded
758	765	7	Coal - KING BED
765	773	8	Siltstone, gray
773	777	4	Shale, gray
777	780	3	Sandstone, gray
780	798	18	Shale and siltstone, gray
798	802	4	Sandstone, gray
802	838	36	Sandstone & siltstone, gray, interbedded
838	840	2	Coal
840	846	6	Shale, carbonaceous
846	851	5	Siltstone, gray
851	856	5	Claystone, gray
856	864	8	Siltstone, gray
864	879	15	Sandstone, gray
879	883	4	Siltstone, gray
883	890	7	Coal - KNOBLOCH BED
890	891	1	Shale, carbonaceous
891	893	2	Coal - KNOBLOCH BED
893	899	6	Shale, carbonaceous
899	901	2	Sandstone, gray, very fine
901	904	3	Shale, carbonaceous
904	907	3	Sandstone, gray, very fine
907	908	1	Siltstone, gray
908	911	3	Shale, carbonaceous
911	922	11	Siltstone, gray
922	925	3	Sandstone, gray, very fine
925	928	3	Shale, gray
928	939	11	Sandstone & shale, gray, interbedded
939	950	11	Sandstone, gray, well cemented
950	953	3	Siltstone, gray
953	959	6	Sandstone, gray, well cemented
959	962	3	Shale, gray
962	965	3	Sandstone, gray
965	970	5	Shale, gray
970	972	2	Sandstone, gray
972	975	3	Siltstone, gray
975	978	3	Sandstone, gray
978	980	2	Shale, gray
980	988	8	Siltstone, gray
988	995	7	Sandstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
995	998	3	Shale, carbonaceous
998	1004	6	Sandstone, gray
1004	1006	2	Siltstone, gray
1006	1010	4	Coal - NANCE BED
1010	1012	2	Clay
1012	1017	5	Siltstone & sandstone, gray
1017	1022	5	Shale, gray
1022	1075	53	Sandstone, gray

Sample Log

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U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-3 Elev. 3420 feet Total Depth 695 feet
 Location 750' FSL & 375' FWL Sec. 9, T. 6 S., R. 42 E.
 County Rosebud State Montana Quadrangle Birney
 Drilled by USGS-GD Driller L. Kozak Hole Size 5-1/8 inches
 Date Started 8-24-82 Date Completed 8-24-82 Geologist E. Burks
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	17	17	Shale, gray
17	22	5	Siltstone, gray
22	26	4	Coal - CARLSON BED
26	34	8	Shale, gray
34	39	5	Siltstone, gray
39	42	3	Shale, gray
42	81	39	Siltstone, gray
81	84	3	Coal - POKER JIM BED
84	85	1	Shale, gray
85	87	2	Coal - POKER JIM BED
87	96	9	Shale, carbonaceous
96	112	16	Siltstone, gray
112	125	13	Shale and siltstone, gray
125	139	14	Shale, gray
139	150	11	Coal - BREWSTER-ARNOLD BED
150	156	6	Shale, carbonaceous
156	160	4	Coal - ODELL BED
160	170	10	Siltstone, gray
170	172	2	Coal - LOCAL BED
172	185	13	Siltstone, gray
185	196	11	Shale, gray
196	206	10	Siltstone, gray
206	212	6	Sandstone, gray
212	218	6	Siltstone, gray
218	225	7	Shale, carbonaceous
225	232	7	Siltstone, gray
232	239	7	Sandstone, gray
239	250	11	Shale, carbonaceous, with coal fragments
250	255	5	Siltstone, gray
255	261	6	Shale, carbonaceous
261	272	11	Siltstone, gray
272	277	5	Shale, gray
277	278	1	Coal - KING BED
278	280	2	Clay, gray
280	294	14	Siltstone, gray
294	359	65	Sandstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
359	362	3	Siltstone, gray
362	370	8	Coal - KNOBLOCH BED
370	376	6	Shale
376	391	15	Sandstone, gray, with some interbedded siltstone & shale
391	397	6	Shale, gray
397	415	18	Siltstone, gray
415	417	2	Shale, gray
417	421	4	Sandstone, gray
421	435	14	Shale and siltstone, gray
435	446	11	Sandstone, gray
446	452	6	Shale and siltstone, gray
452	455	3	Sandstone, gray
455	457	2	Shale, gray
457	493	36	Sandstone, gray
493	496	3	Coal - NANCE BED
496	502	6	Shale, gray
502	507	5	Siltstone and shale, gray
507	513	6	Shale, carbonaceous
513	528	15	Shale, gray
528	532	4	Siltstone, gray
532	592	60	Sandstone, gray
592	597	5	Shale, gray
597	600	3	Siltstone, gray
600	602	2	Shale, gray
602	605	3	Siltstone, gray
605	613	8	Shale, gray
613	622	9	Coal - FLOWERS-GOODALE BED
622	631	9	Shale, gray
631	639	8	Siltstone, gray, with pyrite
639	695	56	Sandstone, gray

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-4 Elev. 3275 feet Total Depth 415 feet
 Location 2425' FSL & 1625' FWL Sec. 20, T. 6 S., R. 42 E.
 County Rosebud State Montana Quadrangle Birney
 Drilled by USGS-GD Driller L. Kozak Hole Size 5-1/8 inches
 Date Started 8-17-82 Date Completed 8-17-82 Geologist Jim Gruber
 Remarks Wall bed is clinkered roughly 60' above drill site on surrounding
ridges. Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	10	10	Topsoil, brown
10	20	10	Alluvium, yellow, chalky
20	34	14	Siltstone, light brown
34	44	10	Coal - BREWSTER-ARNOLD BED, oxidized near top
44	46	2	Siltstone, light brown
46	52	6	Coal - BREWSTER-ARNOLD BED
52	64	12	Clay, gray
64	72	8	Sandstone, silty, brown
72	80	8	Clay, gray
80	87	7	Siltstone, brown
87	93	6	Sandstone, brown
93	117	24	Clay, brown, silty
117	118	1	Coal - KING BED
118	122	4	Shale, carbonaceous
122	123	1	Coal
123	128	5	Clay, carbonaceous
128	172	4	Sandstone, gray
172	193	21	Clay, brown, carbonaceous, with coal chips
193	202	9	Shale, carbonaceous
202	288	86	Sandstone, gray
288	296	8	Shale, carbonaceous
296	297	1	Coal - KNOBLOCH BED
297	304	7	Siltstone, gray
304	307	3	Shale, carbonaceous
307	318	11	Siltstone, gray
318	322	4	Shale, gray
322	327	5	Sandstone, gray
327	332	5	Shale, carbonaceous
322	337	5	Siltstone, gray
337	350	13	Shale, gray
350	354	4	Sandstone, gray
354	357	3	Siltstone, gray
357	363	6	Sandstone, gray
363	366	3	shale, carbonaceous
366	378	12	Siltstone, gray
378	404	26	Sandstone, gray
404	409	5	Shale, carbonaceous
409	415	6	Sandstone, gray

Sample Log

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U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-5 Elev. 3310 feet Total Depth 655 feet
 Location 1800' FNL & 2350' FWL Sec. 22, T. 6 S., R. 42 E.
 County Rosebud State Montana Quadrangle Birney
 Drilled by USGS-GD Driller L. Kozak Hole Size 5-1/8 inches
 Date Started 8-26-82 Date Completed 8-26-82 Geologist E. Burks
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thickness	
0	22	22	Sandstone, brown to gray
22	31	9	Shale and sandstone, gray
31	47	16	Sandstone, brown
47	60	13	Shale, gray
60	69	9	Sandstone, gray
69	83	14	Shale, gray
83	86	3	Sandstone, gray
86	88	2	Siltstone, gray
88	95	7	Shale, carbonaceous
95	101	6	Siltstone, gray
101	112	11	Coal - BREWSTER-ARNOLD BED
112	113	1	Shale, gray
113	118	5	Coal - BREWSTER-ARNOLD BED
117	121	4	Shale, gray
121	125	4	Siltstone, gray
125	130	5	Sandstone, gray
130	132	2	Siltstone, gray
132	134	2	Coal - LOCAL BED
134	139	5	Shale, gray
139	148	9	Siltstone and shale, gray
148	154	6	Shale, gray
154	172	18	Siltstone, gray
172	189	17	Shale, gray
189	191	2	Siltstone, gray
191	202	11	Sandstone, gray
202	205	3	Shale, gray
205	206	1	Coal - KING BED
206	207	1	Siltstone, gray
207	208	1	Coal - KING BED
208	210	2	Siltstone, gray
210	211	1	Coal
211	214	3	Shale, carbonaceous
214	259	45	Siltstone and shale, gray
259	260	1	Coal
260	299	39	Siltstone and shale, gray
299	311	12	Siltstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
311	316	5	Coal - UPPER KNOBLOCH BED
316	323	7	Shale, gray
323	326	3	Coal - LOWER KNOBLOCH BED
326	329	3	Clay, gray
329	335	6	Sandstone, gray
335	337	2	Shale, gray
337	351	14	Siltstone, gray
351	364	13	Shale, gray
364	367	3	Shale, carbonaceous
367	370	3	Siltstone, gray
370	376	6	Shale, gray
376	385	9	Siltstone, gray
385	388	3	Shale, gray
388	392	4	Siltstone, gray
392	395	3	Shale, gray
395	397	2	Siltstone, gray
397	461	64	Sandstone, gray
461	464	3	Coal - NANCE BED
464	468	4	Siltstone, gray
468	577	109	Sandstone, gray
577	613	36	Shale and siltstone, gray
613	623	10	Coal - FLOWERS-GOODALE BED
623	627	4	Shale, carbonaceous
627	639	12	Siltstone and shale, gray
639	655	16	Sandstone, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-6 Elev. 3322 feet Total Depth 635 feet
Location 300FNL, 2150FEL Sec. 26, T. 6S., R. 42 E.
County Rosebud State Montana Quadrangle Birney
Drilled by USGS-GD Driller L. Kozak Hole Size 5 1/8 inches
Date Started 8-13-82 Date Completed 8-13-82 Geologist Hal Owen
Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)

From To Thick-
ness

Lithologic Description

0	5	5	Claystone, light tan
5	18	13	Siltstone, light brown to gray, limonitic cement
18	21	3	Shale, gray
21	30	9	Siltstone, light gray
30	34	4	Shale, gray
34	37	3	Coal - CARLSON BED
37	40	3	Clay, gray
40	44	4	Siltstone, gray
44	46	2	Shale, gray
46	53	7	Siltstone, gray
53	63	10	Shale, gray
63	74	11	Siltstone, light gray
74	78	4	Coal - POKER JIM BED
78	80	2	Shale, carbonaceous
80	81	1	Coal - POKER JIM BED
81	88	7	Shale, carbonaceous
88	92	4	Siltstone, gray
92	105	13	Shale, carbonaceous
105	123	18	Siltstone and clay, gray
123	127	4	Sandstone, gray
127	130	3	Shale, gray
130	135	5	Siltstone, gray
135	142	7	Claystone, gray
142	153	11	Coal - BREWSTER-ARNOLD BED
153	155	2	Siltstone, gray
155	160	5	Coal - BREWSTER-ARNOLD BED
160	171	11	Siltstone, gray
171	172	1	Coal - Local
172	208	36	Siltstone and shale, gray
208	213	5	Sandstone, gray
213	215	2	Shale, gray
215	221	6	Sandstone, gray
221	225	4	Siltstone, gray
225	230	5	Sandstone, gray
230	233	3	Siltstone, gray
233	256	23	Shale, gray
256	264	8	Siltstone and shale, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
264	265	1	Coal
265	268	3	Shale, carbonaceous
268	271	3	Coal - KING BED
271	279	8	Shale, carbonaceous
279	284	5	Siltstone, gray
284	288	4	Shale, carbonaceous
288	306	18	Siltstone, gray
306	311	5	Shale, carbonaceous
311	313	2	Coal
313	314	1	Shale, carbonaceous
314	317	3	Siltstone, gray
317	320	3	Shale, carbonaceous
320	329	9	Sandstone, gray
329	334	5	Shale, carbonaceous
334	337	3	Sandstone, gray
337	341	4	Siltstone, gray
341	347	6	Clay, green
347	352	5	Sandstone, gray
352	355	3	Shale, carbonaceous
355	365	10	Siltstone, gray
365	371	6	Coal - UPPER KNOBLOCH BED
371	376	5	Siltstone, gray
376	379	3	Coal - LOWER KNOBLOCH BED
379	382	3	Shale, carbonaceous
382	413	31	Siltstone and shale, gray, interbedded
413	424	11	Shale, gray
424	461	37	Siltstone and shale, brown, interbedded
461	505	44	Sandstone, gray, fine, highly cemented
505	509	4	Shale, carbonaceous
509	512	3	Siltstone, gray, highly cemented
512	515	3	Coal - NANCE BED
515	521	6	Siltstone, gray
521	582	61	Sandstone, gray
582	586	4	Shale, carbonaceous
586	590	4	Siltstone, light gray
590	593	3	Shale, carbonaceous
593	612	19	Sandstone, gray
612	617	5	Shale, gray
617	622	5	Siltstone, light gray
622	625	3	Sandstone, gray
625	635	10	Siltstone and shale, light gray

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-7A&B Elev. 3836 feet Total Depth 1015 feet
 Location 330' FNL 7 750' FEL Sec. 36, T. 6 S., R. 42 E.
 County Rosebud State Montana Quadrangle Birney
 Drilled by USGS-GD Driller D. Brown Hole Size 5-1/8 inches
 Date Started 7-29-82 Date Completed 7-31-82 Geologist Myra Funkhouser
 Remarks Hole logged twice due to power loss on first run. Sample log modified
by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	5	5	Colluvium with clinker pebbles
5	10	5	Sandstone, weathered
10	21	11	Shale, weathered
21	29	8	Sandstone, gray
29	33	4	Shale, dark gray
33	41	8	Siltstone, brown, with concretions
41	51	10	Sandstone, gray, siliceous
51	55	4	Siltstone, gray
55	62	7	Shale, gray
62	67	5	Siltstone, gray
67	75	8	Coal - LOWER DIETZ 3 BED
75	80	5	Shale, drak gray, carbonaceous
80	82	2	Siltstone, gray
82	86	4	Shale, gray
86	94	8	Siltstone, gray
94	102	8	Shale, gray
102	141	39	Siltstone, gray, sandy
141	153	12	Sandstone, gray
153	158	5	Siltstone, gray
158	163	5	Shale, carbonaceous, and clay
163	170	7	Siltstone, brown
170	175	5	Clay, brown
175	178	3	Siltstone, brown
178	184	6	Shale, brown, carbonaceous
184	205	21	Siltstone, brown
205	218	13	Sandstone, gray, fine grained
218	223	5	Clay, brown-gray, carbonaceous
223	227	4	Siltstone, brown
227	232	5	Shale, brown, carbonaceous
232	241	9	Coal - CANYON BED
241	243	2	Shale, brown, carbonaceous
243	248	5	Coal - CANYON BED
248	256	8	Siltstone, gray, sandy
256	262	6	Shale, gray
262	267	5	Siltstone, gray
267	272	5	Sandstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
272	275	3	Shale, gray
275	278	3	Coal - CARNEY BED
278	304	26	Siltstone and shale, gray
304	321	17	Shale, brown, carbonaceous
320	325	5	Coal - COOK BED
325	329	4	Shale, brown, carbonaceous
329	331	2	Coal - COOK BED
331	340	9	Shale, brown
340	345	5	Siltstone, gray
345	349	4	Sandstone, gray, calcite cement, siliceous
349	369	20	Shale, brown & gray
369	372	3	Coal - UPPER OTTER BED
372	385	13	Shale, brown to gray
385	392	7	Coal - LOWER OTTER BED
391	398	7	Shale, gray
398	405	7	Siltstone, gray
405	421	16	Shale, gray
421	427	6	Siltstone, gray
427	435	8	Shale, gray
435	441	6	coal - MIDDLE WALL BED
441	447	6	Shale, gray
447	460	13	Siltstone, gray
460	464	4	Shale, carbonaceous
464	468	4	Siltstone, gray
468	471	3	Clay, gray
471	475	4	Coal - LOWER WALL A BED
474	479	5	Clay, gray
479	487	8	Siltstone, gray
487	490	3	Shale, carbonaceous
490	505	15	Siltstone, gray
505	512	7	Coal - LOWER WALL B BED
512	514	2	Shale, gray
514	515	1	Coal
515	519	4	Shale, carbonaceous
519	526	7	Sandstone, gray
526	536	10	Shale, carbonaceous
536	546	10	Sandstone & siltstone, gray
546	549	3	Shale, gray
549	569	20	Siltstone & shale, gray, interbedded
569	572	3	Coal - CARLSON BED
572	577	5	Shale, gray
577	591	14	Siltstone & shale, gray, interbedded
591	596	5	Shale, gray
596	609	13	Siltstone, gray
609	612	3	Coal - POKER JIM BED
612	614	2	Shale, gray
614	616	2	Coal - POKER JIM BED

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
616	619	3	Shale, gray
619	621	2	Sandstone, gray
621	651	30	Siltstone & shale, gray
651	653	2	Sandstone, gray
653	656	3	Siltstone, gray
656	662	6	Shale, gray
662	672	10	Coal - BREWSTER-ARNOLD BED
672	675	3	Shale, gray
675	680	5	Siltstone, gray
680	682	2	Shale, gray
682	685	3	Siltstone, gray
685	690	5	Coal - ODELL BED
690	695	5	Sandstone, gray
695	706	11	Siltstone, gray
706	708	2	Shale, carbonaceous
708	714	6	Siltstone, gray
714	763	49	Sandstone, gray
763	765	2	Siltstone, gray
765	770	5	Shale, gray
770	776	6	Sandstone, gray
776	780	4	Shale, gray
780	787	7	Sandstone, gray
787	789	2	Siltstone, gray
789	792	3	Shale, gray
792	794	2	Coal - KING BED
794	796	2	Shale, gray, carbonaceous
796	799	3	Coal - KING BED
799	802	3	Shale, gray carbonaceous
802	822	20	Siltstone, gray
822	858	36	Sandstone, gray
858	858	1	Coal
859	861	2	Siltstone, gray
861	890	29	Siltstone & sandstone, gray, interbedded
890	922	32	Sandstone, gray
922	930	8	Shale, carbonaceous
930	935	5	Coal - UPPER KNOBLOCH BED
935	940	5	Clay, gray
940	950	10	Sandstone, gray, fining upward
950	956	6	Shale, gray
956	959	3	Coal - LOWER KNOBLOCH BED
959	964	5	Shale & siltstone, gray
964	976	12	Sandstone, gray, fining upward
976	980	4	Siltstone, gray
980	993	13	Shale & siltstone, gray, interbedded
993	997	4	Shale, carbonaceous, brown
997	1005	8	Siltstone, gray
1005	1007	2	Shale, gray
1007	1010	3	Siltstone, gray
1010	1015	5	Sandstone, gray, coarsening upward

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-8A & B Elev. 3770 feet Total Depth 940 feet
 Location 1100FNL, 100FEL Sec. 2, T. 7S., R. 42 E.
 County Rosebud State Montana Quadrangle Birney
 Drilled by USGS-GD Driller D. Brown Hole Size 5 1/8 inches
 Date Started 8-1-82 Date Completed 8-3-82 Geologist Myra Funkhouser & Hal Owen
 Remarks B-82-8B was run to record resistivity log. However, the pen setting was incorrect
on B-82-8B, so the numbers have been corrected upward by four feet. Sample log
modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	5	5	Sandstone, light brown, weathered
5	19	14	Siltstone, yellow-brown, weathered
19	27	8	Siltstone, light brown
27	31	4	Shale, gray
31	41	10	Siltstone, gray, sandy
41	44	3	Shale, gray
44	56	12	Sandstone, gray, calcareous, silty, highly cemented
56	66	10	Shale, gray
66	72	6	Siltstone, dark gray
72	77	5	Coal - LOWER DIETZ 3 BED
77	78	1	Siltstone, gray
78	81	3	Coal - LOWER DIETZ 3 BED
81	83	2	Shale, brown, carbonaceous
83	89	6	Sandstone, gray
89	93	4	Shale, gray
93	97	4	Siltstone, gray, with coal fragments
97	104	7	Shale, brown, carbonaceous
104	107	3	Siltstone, gray
107	113	6	Shale, brown, carbonaceous
113	116	3	Siltstone, gray
116	127	11	Shale and siltstone, gray, interbedded
127	134	7	Shale, gray, silty
134	140	6	Siltstone, gray, sandy
140	143	3	Shale, gray
143	182	39	Siltstone and shale, gray, interbedded
182	190	8	Shale, brown, carbonaceous
190	200	10	Coal - CANYON BED
200	201	1	Shale, brown, carbonaceous
201	206	5	Coal - CANYON BED
206	212	6	Shale, brown, carbonaceous
212	219	7	Siltstone, gray, sandstone
219	229	10	Shale, gray
229	232	3	Coal - CARNEY BED
232	235	3	Shale, brown, carbonaceous
235	240	5	Shale, gray
240	245	5	Shale, brown, carbonaceous, with coal fragments

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
245	248	3	Siltstone, gray, sandy
248	253	5	Shale, gray
253	263	10	Sandstone, gray
263	265	2	Coal - COOK BED
265	266	1	Clay, gray
266	299	33	Sandstone, siltstone, & shale, gray, interbedded
299	315	16	Siltstone, gray
315	323	8	Shale, gray, carbonaceous
323	338	15	Siltstone, gray
338	340	2	Coal - UPPER OTTER BED
340	345	5	Shale, brown, carbonaceous
345	347	2	Coal - UPPER OTTER BED
347	352	5	Shale, brown, carbonaceous
352	356	4	Siltstone, gray, sandy
356	361	5	Shale, gray
361	367	6	Coal - LOWER OTTER BED
367	369	2	Clay, gray
369	375	6	Siltstone, gray
375	385	10	Shale, gray
385	389	4	Sandstone, gray
389	403	14	Shale, gray
403	408	5	Coal - MIDDLE WALL BED
408	410	2	Clay, gray
410	424	14	Siltstone, gray, sandy
424	439	15	Sandstone, gray, with some clay
439	443	4	Shale, carbonaceous
443	447	4	Coal - LOWER WALL BED
447	448	1	Shale, gray, carbonaceous
448	455	7	Coal - LOWER WALL BED
455	465	10	Shale, gray
465	466	1	Coal
466	473	7	Shale, gray
473	480	7	Sandstone, gray
480	490	10	Shale, gray
490	494	4	Siltstone, gray
494	500	6	Shale, gray
500	518	18	Siltstone, gray
518	521	3	Shale, gray, carbonaceous, and clay
521	525	4	Coal - CARLSON BED
525	531	6	Shale, carbonaceous
531	542	11	Sandstone, gray
542	560	18	Shale and siltstone, gray
560	562	2	Sandstone, gray
562	568	6	Shale, gray
568	598	30	Sandstone, gray, silty
598	609	11	Shale, gray
609	634	25	Siltstone and shale, gray, sandy
634	638	4	Sandstone, gray
638	648	10	Siltstone, gray
648	650	2	Shale, carbonaceous

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
650	651	1	Siltstone, gray
651	653	2	Clay, gray
653	663	10	Coal - BREWSTER-ARNOLD BED
663	667	4	Clay, gray
667	673	6	Coal - BREWSTER-ARNOLD BED
673	676	3	Clay, gray
676	686	10	Siltstone, gray
686	689	3	Shale, gray
689	691	2	Coal - Local
691	693	2	Clay, gray
693	704	11	Sandstone and siltstone, gray, interbedded
704	713	9	Shale, gray
713	730	17	Sandstone, gray, fining upward
730	733	3	Shale, gray
733	735	2	Siltstone, gray
735	742	7	Shale, gray
742	778	36	Siltstone and shale, gray, carbonaceous, interbedded
778	781	3	Coal - KING BED
781	787	6	Shale, carbonaceous
787	798	11	Sandstone, gray
798	804	6	Shale, carbonaceous
804	810	6	Sandstone, gray
810	815	5	Siltstone, gray
815	818	3	Shale, gray
818	820	2	Coal - Local
820	823	3	Shale, gray
823	826	3	Siltstone, gray
826	828	2	Shale, gray
828	835	7	Siltstone, gray
835	925	90	Sandstone, gray
925	940	15	Shale, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-8C Elev. 3770 feet Total Depth 480 feet
Location 1100 FNL, 100FEL Sec. 2, T. 7S., R. 42 E.
County Rosebud State Montana Quadrangle Birney
Drilled by USGS-GD Driller D. Brown Hole Size 5 5/8 inches
Date Started 8-10-82 Date Completed 8-10-82 Geologist Hal Owen
Remarks Geophysical log of this hole is at expanded scale of five feet per inch.

Cored intervals (in feet)

Core No.	From	To	Length of Core Recovered	Core No.	From	To	Length of Core Recovered
1	70.0	75.0	5.0	8	365.0	375.0	10.0
2	75.0	85.0	10.0	9	395.0	405.0	10.0
3	180.0	190.0	10.0	10	405.0	415.0	10.0
4	190.0	200.0	10.0	11	435.0	445.0	10.0
5	200.0	210.0	10.0	12	445.0	455.0	10.0
6	210.0	215.0	5.0	13	455.0	460.0	5.0
7	355.0	365.0	10.0				

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
70.0	74.8	4.8	Coal - LOWER DIETZ 3 BED
74.8	75.0	0.2	Shale
75.0	78.3	3.3	Coal - LOWER DIETZ 3 BED
78.3	85.0	6.7	Sandstone, silty
182.2	187.7	5.5	Shale, gray
187.7	197.5	9.8	Coal - CANYON BED
197.5	197.9	0.4	Shale, carbonaceous
197.9	204.2	6.3	Coal - CANYON BED
204.2	209.0	4.8	Shale, gray
209.0	212.4	3.4	Sandstone, silty
356.9	357.7	0.8	Sandstone and shale, laminated
357.7	358.2	0.5	Sandstone
358.2	360.5	2.3	Shale, gray, with carbonaceous stringers
360.5	366.5	6.0	Coal - LOWER OTTER BED
366.5	371.6	5.1	Shale, sandy, with carbonaceous stringers

NO CORE DESCRIPTION AVAILABLE FOR FOLLOWING TWO CORES. LITHOLOGY BASED ON GEOPHYSICAL LOG INTERPRETATION.

397.5	401.5	4.0	Shale
401.5	407.5	6.0	Coal - MIDDLE WALL BED
407.5	411.0	3.5	Clay, gray

Depth interval (feet)

<u>From</u>	<u>To</u>	<u>Thick-</u> <u>ness</u>	<u>Lithologic Description</u>
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439.5	443.0	3.5	Shale, carbonaceous
443.0	447.0	4.0	Coal - LOWER WALL BED
447.0	448.0	1.0	Shale, gray, carbonaceous
448.0	455.5	7.5	Coal - LOWER WALL BED
455.5	458.0	2.5	Shale, gray

USGS-MMS-BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole <u>B-82-8C</u>	Sample No. <u>U10894</u>	Interval <u>70'-78'</u>
Bed Sampled <u>Lower Dietz 3</u>	Remarks <u>Includes 0.2' shale at 74.8'</u>	
Elevation <u>3770'</u>	Location <u>1100FNL, 100FEL,</u>	Sec. <u>2</u> , T. <u>7S.</u> , R. <u>42 E.</u>
County <u>Rosebud</u>	State <u>Montana</u>	Quadrangle <u>Birney</u>
Date Of Report <u>8-12-82</u>	Analyzed By <u>Geochemical Testing, Somerset, PA</u>	

AIR DRY LOSS	20.45	RESIDUAL MOISTURE	12.08
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	As-received	Dry	Dry ash-free
Moisture	30.06		
Ash	8.22	11.75	
Volatile Matter	25.62	36.63	41.51
Fixed Carbon	36.10	51.62	58.49
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

ULTIMATE ANALYSIS

Hydrogen	6.54	4.54	5.14
Carbon	46.10	65.92	74.70
Nitrogen	0.89	1.27	1.44
Sulfur	0.95	1.36	1.54
Oxygen	37.30	15.16	17.18
Ash	8.22	11.75	
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Heating Value (BTU/lb)	7883	11271	12771
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FORMS OF SULFUR

Sulfate sulfur	0.03	0.04	0.05
Pyritic sulfur	0.24	0.34	0.39
Organic sulfur	0.68	0.98	1.10

FREE SWELLING INDEX	0.0
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ASH FUSION TEMPERATURES (reducing Atmosphere)

Initial Deformation	2150 F
Softening Temp.	2220 F
Fluid Temp.	2440 F

USGS-MMS-BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole <u>B-82-8C</u>	Sample No. <u>U10896</u>	Interval <u>187.7'-204.4'</u>
Bed Sampled <u>Canyon</u>	Remarks <u>Includes 0.4' shale at 197.5'</u>	
Elevation <u>3770'</u>	Location <u>1100FNL, 100FEL,</u>	<u>Sec. 2, T. 7S., R. 42 E.</u>
County <u>Rosebud</u>	State <u>Montana</u>	Quadrangle <u>Birney</u>
Date Of Report <u>8-12-82</u>	Analyzed By <u>Geochemical Testing, Somerset, PA</u>	

AIR DRY LOSS 18.94 RESIDUAL MOISTURE 11.46

	As-received	Dry	Dry ash-free
Moisture	28.23		
Ash	12.57	17.51	
Volatile Matter	25.24	35.17	42.64
Fixed Carbon	33.96	47.32	57.36
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

ULTIMATE ANALYSIS

Hydrogen	6.27	4.33	5.25
Carbon	44.17	61.55	74.62
Nitrogen	0.90	1.26	1.53
Sulfur	0.77	1.07	1.30
Oxygen	35.32	14.28	17.30
Ash	12.57	17.51	
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Heating Value (BTU/lb)	7664	10679	12946
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FORMS OF SULFUR

Sulfate sulfur	0.02	0.03	0.04
Pyritic sulfur	0.31	0.44	0.53
Organic sulfur	0.44	0.60	0.73

FREE SWELLING INDEX 0.0

ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation	2080F
Softening Temp.	2440 F
Fluid Temp.	2520 F

USGS-MMS-BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-8C Sample No. U10895 Interval 360.0'-366.5'
 Bed Sampled Lower Otter Remarks -----
 Elevation 3770' Location 1100FNL, 100FEL, Sec. 2, T. 7S., R. 42 E.
 County Rosebud State Montana Quadrangle Birney
 Date Of Report 8-12-82 Analyzed By Geochemical Testing, Somerset, PA

AIR DRY LOSS 19.95 RESIDUAL MOISTURE 11.20

	As-received	Dry	Dry ash-free
Moisture	28.92		
Ash	12.88	18.13	
Volatile Matter	25.15	35.38	43.21
Fixed Carbon	33.05	46.49	56.79
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

ULTIMATE ANALYSIS

Hydrogen	6.16	4.11	5.02
Carbon	43.87	61.72	75.38
Nitrogen	0.95	1.33	1.62
Sulfur	0.73	1.02	1.25
Oxygen	35.41	13.69	16.73
Ash	12.88	18.13	
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Heating Value (BTU/lb)	7468	10506	12832
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FORMS OF SULFUR

Sulfate sulfur	0.02	0.03	0.04
Pyritic sulfur	0.19	0.27	0.33
Organic sulfur	0.52	0.73	0.90

FREE SWELLING INDEX 0.0

ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation	2070F
Softening Temp.	2260 F
Fluid Temp.	2440 F

USGS-MMS-BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole <u>B-82-8C</u>	Sample No. <u>U10940</u>	Interval <u>401.5'-407.4'</u>
Bed Sampled <u>Middle Wall</u>	Remarks <u>-----</u>	
Elevation <u>3770'</u>	Location <u>1100FNL, 100FEL,</u>	Sec. <u>2</u> , T. <u>7S.</u> , R. <u>42 E.</u>
County <u>Rosebud</u>	State <u>Montana</u>	Quadrangle <u>Birney</u>
Date Of Report <u>8-12-82</u>	Analyzed By <u>Geochemical Testing, Somerset, PA</u>	

AIR DRY LOSS	16.90	RESIDUAL MOISTURE	15.32
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	As-received	Dry	Dry ash-free
Moisture	29.63		
Ash	3.66	5.21	
Volatile Matter	34.79	49.43	52.15
Fixed Carbon	31.92	45.36	47.85
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

ULTIMATE ANALYSIS

Hydrogen	6.70	4.81	5.07
Carbon	50.98	72.44	76.42
Nitrogen	1.01	1.44	1.52
Sulfur	0.37	0.52	0.55
Oxygen	37.28	15.58	16.44
Ash	3.66	5.21	
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Heating Value (BTU/lb)	8776	12471	13156
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FORMS OF SULFUR

Sulfate sulfur	0.01	0.01	0.01
Pyritic sulfur	0.03	0.04	0.04
Organic sulfur	0.33	0.47	0.50

FREE SWELLING INDEX	0.0
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ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation	2020F
Softening Temp.	2090 F
Fluid Temp.	2160 F

USGS-MMS-BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-8C Sample No. U10941 Interval 443.0'-455.0'
 Bed Sampled Lower Wall Remarks Includes 1.0' shale at 447'
 Elevation 3770' Location 1100FNL, 100FEL, Sec. 2, T. 7S., R. 42 E.
 County Rosebud State Montana Quadrangle Birney
 Date Of Report 8-12-82 Analyzed By Geochemical Testing, Somerset, PA

AIR DRY LOSS 18.41 RESIDUAL MOISTURE 11.25

	As-received	Dry	Dry ash-free
Moisture	27.59		
Ash	16.88	23.31	
Volatile Matter	23.20	32.05	41.79
Fixed Carbon	32.33	44.64	58.21
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

ULTIMATE ANALYSIS

Hydrogen	5.87	3.84	5.01
Carbon	41.24	56.95	74.26
Nitrogen	0.87	1.20	1.56
Sulfur	0.40	0.56	0.73
Oxygen	34.74	14.14	18.44
Ash	16.88	23.31	
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Heating Value (BTU/lb)	7118	9831	12820
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FORMS OF SULFUR

Sulfate sulfur	0.02	0.02	0.03
Pyritic sulfur	0.10	0.14	0.18
Organic sulfur	0.28	0.40	0.52

FREE SWELLING INDEX 0.0

ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation	2140 F
Softening Temp.	2200 F
Fluid Temp.	2280 F

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-9 Elev. 3245 feet Total Depth 414 feet
 Location 1475FNL, 875FWL Sec. 1, T. 6S., R. 42 E.
 County Rosebud State Montana Quadrangle Birney
 Drilled by USGS-GD Driller L. Kozak Hole Size 5 5/8 inches
 Date Started 8-27-82 Date Completed 8-27-82 Geologist Ed Burks
 Remarks Hole spudded below Brewster-Arnold burn. Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	11	11	Colluvium
11	17	6	Shale, brown
17	27	10	Shale, gray, and siltstone
27	31	4	Sandstone, brown
31	38	7	Sandstone and siltstone, fining upward
38	40	2	Siltstone, gray
40	45	5	Shale, gray
45	63	18	Siltstone and shale, coarsening upward
63	68	5	Shale, carbonaceous
68	73	5	Coal - KING BED
73	75	2	Clay, gray
75	80	5	Shale, gray
80	85	5	Shale, carbonaceous
85	90	5	Siltstone, gray
90	95	5	Sandstone, gray
95	96	1	Siltstone, gray
96	98	2	Shale, gray
98	100	2	Shale, carbonaceous
100	102	2	Shale, gray
102	116	14	Siltstone and shale, gray, interbedded
116	118	2	Sandstone, gray
118	124	6	Shale, gray
124	140	16	Coal - KNOBLOCH BED
140	143	3	Clay, gray
143	150	7	Shale, carbonaceous
150	161	11	Siltstone and shale, gray, interbedded
161	168	7	Shale, gray
168	189	21	Sandstone, gray, with interbedded siltstone
189	215	26	Sandstone, gray
215	220	5	Siltstone, gray
220	233	13	Sandstone, gray
233	235	2	Shale, gray
235	241	6	Sandstone and siltstone, interbedded
241	250	9	Siltstone, gray
250	255	5	Sandstone and siltstone, gray, interbedded
255	269	14	Sandstone, gray
269	274	5	Coal - NANCE BED

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
274	281	7	Shale, carbonaceous
281	291	10	Siltstone and sandstone, gray, fining upward
291	296	5	Shale, carbonaceous
296	301	5	Siltstone, gray
301	305	4	Sandstone, gray
305	307	2	Siltstone, gray
307	308	1	Shale, gray
308	312	4	Siltstone, gray
312	363	51	Sandstone, gray, with some interbedded siltstone near bottom
363	366	3	Siltstone, gray
366	384	18	Coal - FLOWERS-GOODALE BED
384	390	6	Shale, carbonaceous
390	395	5	Siltstone, gray
395	414	19	Sandstone, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-10 Elev. 3302 feet Total Depth 615 feet
 Location 1200FSL, 825FEL Sec. 5, T. 7S, R. 42 E.
 County Rosebud State Montana Quadrangle Birney
 Drilled by USGS-GD Driller L.Kozak Hole Size 5 1/8 inches
 Date Started 8-12-82 Date Completed 8-13-82 Geologist Hal Owen
 Remarks H₂S odor from top of hole. Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	5	5	Sandstone, light yellow-brown, weathered
5	12	7	Sandstone, light gray, cemented, limonitic
12	16	4	Shale, carbonaceous
16	21	5	Siltstone, light gray
21	25	4	Sandstone, light gray
25	30	5	Siltstone, gray
30	32	2	Shale, carbonaceous
32	38	6	Sandstone, light gray, wet (water level)
38	42	4	Shale, carbonaceous
42	44	2	Coal - CARLSON BED
44	57	13	Siltstone, light gray
57	59	2	Limestone, gray
59	71	12	Siltstone, light gray, sandy
71	80	9	Shale, gray
80	86	6	Siltstone, dark gray
86	91	5	Sandstone, coarse, well cemented
91	100	9	Siltstone, dark gray
100	102	2	Shale, carbonaceous
102	136	34	Siltstone and shale, gray, interbedded
136	162	26	Siltstone, sandstone, and shale, gray, interbedded
162	178	16	Siltstone and shale, gray, interbedded
178	183	5	Shale, gray
183	192	9	Siltstone and sandstone, gray
192	207	15	Coal - BREWSTER-ARNOLD BED
207	214	7	Clay, gray
214	216	2	Coal - Local
216	218	2	Clay, gray
218	224	6	Sandstone, light gray, very fine, cemented
224	229	5	Siltstone, light gray
229	235	6	Shale, gray
235	236	1	Sandstone, light gray
236	239	3	Siltstone, light gray
239	241	2	Sandstone, gray
241	248	7	Siltstone, light gray
248	256	8	Shale, gray
256	259	3	Sandstone, gray
259	262	3	Siltstone, gray
262	263	1	Sandstone, gray
263	284	21	Siltstone and shale, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
284	286	2	Shale, carbonaceous
286	289	3	Siltstone, gray
289	291	2	Coal - KING BED
291	292	1	Shale, carbonaceous
292	297	5	Siltstone, gray
297	302	5	Shale, carbonaceous
302	308	6	Sandstone, gray
308	316	8	Siltstone and shale, light gray, interbedded
316	319	3	Shale, carbonaceous
319	322	3	Siltstone, gray
322	354	32	Sandstone, gray, with some interbedded siltstone
354	367	13	Shale, siltstone, and sandstone, gray, fining upward
367	425	58	Sandstone, medium gray, fine, well cemented near bottom
425	428	3	Shale, carbonaceous
428	440	12	Siltstone, light gray
440	447	7	Shale, carbonaceous
447	453	6	Siltstone, light gray
453	458	5	Sandstone, light gray, fine
458	463	5	Shale, carbonaceous
463	465	2	Sandstone, gray
465	482	17	Siltstone, light gray
482	483	1	Sandstone, gray
483	488	5	Shale, carbonaceous
488	496	8	Sandstone, siltstone, and shale, gray, coarsening upward
496	501	5	Siltstone, gray
501	509	8	Sandstone, gray
509	515	6	Shale, carbonaceous
515	520	5	Siltstone, gray
520	538	18	Sandstone, gray, with some interbedded siltstone
538	543	5	Shale, carbonaceous
543	573	30	Siltstone and shale, gray, interbedded
573	581	8	Shale, carbonaceous
581	589	8	Siltstone, gray, coarsening upward into sandstone
589	593	4	Shale, carbonaceous
593	597	4	Siltstone, gray
597	604	7	Shale, carbonaceous
604	606	2	Siltstone, gray
606	611	5	Shale, carbonaceous
611	613	2	Siltstone, gray
613	615	2	Shale, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-11 Elev. 3903 feet Total Depth 915 feet
 Location 400FSL, 700FWL Sec. 11, T. 7S, R. 42 E.
 County Rosebud State Montana Quadrangle Lacey Gulch
 Drilled by USGS-GD Driller D.Brown Hole Size 5 1/8 inches
 Date Started 8-11-82 Date Completed 8-12-82 Geologist Scott Haight
 Remarks Hole drilled to 350' with air then started injecting water. Sample log modified
by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	10	10	Sandstone, light brown, weathered
10	14	4	Limestone, light gray, hard
14	25	11	Siltstone, light brown, calcareous
25	32	7	Shale, gray
32	42	10	Coal - DIETZ 2 BED
42	48	6	Clay, gray
48	51	3	Sandstone, gray
51	52	1	Siltstone, gray
52	60	8	Shale and siltstone, gray, interbedded
60	63	3	Sandstone, gray
63	65	2	Shale, gray
65	79	14	Coal - UPPER DIETZ 3 BED
79	86	7	Shale, carbonaceous
86	97	11	Sandstone and siltstone, orange to gray, interbedded
97	102	5	Shale, light gray
102	106	4	Sandstone, brown to rust colored, fining upward to siltstone
106	146	40	Sandstone, light brown to gray, fining upward
146	151	5	Siltstone, brown
151	158	7	Sandstone, brown, coarse
158	160	2	Siltstone, light gray
160	164	4	Shale, gray
164	174	10	Sandstone and siltstone, gray
174	178	4	Shale, light gray
178	180	2	Sandstone, gray
180	186	6	Shale, gray
186	191	5	Sandstone and siltstone, gray, interbedded
191	202	11	Siltstone and shale, gray, coarsening upward
202	206	4	Siltstone, gray
206	210	4	Shale, black, carbonaceous
210	218	8	Sandstone, gray, fining upward to siltstone
218	223	5	Siltstone, gray
223	237	14	Sandstone, gray, with some interbedded siltstone
237	239	2	Limestone, gray
239	242	3	Siltstone, gray
242	247	5	Coal - LOWER DIETZ 3 BED
247	248	1	Shale, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
248	252	4	Coal - LOWER DIETZ 3 BED
252	253	1	Clay, gray
253	256	3	Sandstone, gray
256	260	4	Shale, carbonaceous
260	270	10	Sandstone, gray
270	272	2	Shale, gray
272	275	3	Coal - UPPER CANYON BED
275	277	2	Shale, gray
277	280	3	Coal - UPPER CANYON BED
280	282	2	Clay, gray
282	284	2	Siltstone, gray
284	287	3	Sandstone, gray
287	289	2	Shale, carbonaceous
289	293	4	Sandstone, gray
293	302	11	Shale and siltstone, gray, fining upward
302	305	3	Shale, carbonaceous
305	310	5	Sandstone, gray, coarse
310	329	19	Sandstone, gray, fining upward
329	341	12	Siltstone, gray
341	351	10	Sandstone, gray
351	353	2	Shale, gray
353	363	10	Coal - CANYON BED
363	365	2	Shale, gray
365	369	4	Coal - CANYON BED
369	373	4	Shale, carbonaceous
373	375	2	Sandstone, gray
375	378	3	Siltstone, gray
378	399	21	Sandstone, gray, coarsening upward, with some siltstone near bottom
399	409	10	Sandstone and siltstone, gray
409	410	1	Coal - CARNEY BED
410	411	1	Shale, black, carbonaceous
411	413	4	Coal - CARNEY BED
413	417	4	Shale, black, carbonaceous
417	425	8	Shale, brown, carbonaceous, with some interbedded siltstone
425	429	4	Sandstone, gray
429	431	3	Coal - COOK BED
431	435	4	Clay, gray
435	457	22	Sandstone, gray, calcareous
457	461	4	Shale, gray
461	503	42	Sandstone, gray, fining downward into siltstone
503	508	5	Shale, carbonaceous
508	512	4	Coal - UPPER OTTER BED
512	517	5	Shale, carbonaceous
517	519	2	Coal - UPPER OTTER BED
519	522	3	Shale, carbonaceous
522	525	3	Sandstone, gray
525	527	2	Siltstone, gray
527	531	4	Shale, carbonaceous
531	536	5	Coal - LOWER OTTER BED
536	548	12	Sandstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
548	551	3	Shale, carbonaceous
551	566	15	Sandstone, gray
566	572	6	Shale, gray
572	577	5	Coal - MIDDLE WALL BED
577	579	2	Clay, gray
579	605	26	Sandstone, gray
605	618	13	Sandstone, gray, fining upward into siltstone and shale
618	622	4	Siltstone, gray
622	629	7	Shale, dark gray, carbonaceous
629	641	12	Coal - LOWER WALL BED
641	642	1	Clay, gray
642	651	9	Siltstone, gray to brown
651	656	5	Shale, gray
656	668	12	Sandstone and siltstone, dark brown
668	672	4	Shale, black, carbonaceous
672	673	1	Coal - Local
673	680	7	Shale, carbonaceous
680	684	4	Sandstone, gray
684	686	2	Siltstone, gray
686	693	7	Shale, carbonaceous
693	708	15	Siltstone, gray, sandy, fining upward
708	710	2	Siltstone, gray, very fine
710	721	11	Shale, carbonaceous
721	723	2	Coal - CARLSON BED
723	726	3	Shale, carbonaceous
726	739	13	Siltstone, gray
739	742	3	Shale, carbonaceous
742	752	10	Siltstone, gray-brown, with interbedded shale
752	786	34	Shale, gray, silty
786	794	8	Siltstone, gray
794	800	6	Shale, gray, silty
800	818	18	Siltstone and shale, gray, interbedded
818	822	4	Shale, carbonaceous
822	826	4	Siltstone, gray
826	837	11	Coal - BREWSTER-ARNOLD BED
837	839	2	Clay, gray
839	844	5	Siltstone, gray
844	857	13	Sandstone, gray
857	862	5	Coal - ODELL BED
862	865	3	Clay, gray
865	872	7	Siltstone, gray, coarsening upward
872	877	5	Shale, gray, silty
877	884	7	Siltstone, gray, fining upward
884	895	11	Sandstone, gray, fining upward
895	897	2	Siltstone, gray
897	899	2	Shale, carbonaceous
899	902	3	Siltstone, gray
902	905	3	Sandstone, gray
905	907	2	Siltstone, gray
907	915	8	Sandstone and siltstone, gray, interbedded

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-12 Elev. 3846 feet Total Depth 855 feet
 Location 1700 FNL, 1700 FEL Sec. 13, T. 7S, R. 42 E.
 County Rosebud State Montana Quadrangle Lacey Gulch
 Drilled by USGS-GD Driller D. Brown Hole Size 5 1/8 inches
 Date Started 8-12-82 Date Completed 8-14-82 Geologist Scott Haight
 Remarks Spudded in a clinker wash. Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	19	19	Clinker
19	25	6	Sandstone, brown
25	29	4	Shale, dark brown
29	34	5	Shale, black, carbonaceous
34	37	3	Sandstone, light gray, fine grained, calcareous
37	41	4	Shale, light brown
41	55	14	Siltstone and shale, gray, interbedded
55	60	5	Siltstone, gray
60	63	3	Shale, black, carbonaceous, with coal fragments
63	71	8	Shale, black, carbonaceous
71	78	7	Sandstone, gray, calcareous
78	81	3	Shale, gray
81	83	2	Sandstone, gray
83	87	4	Siltstone, gray
87	91	4	Shale, carbonaceous
91	117	26	Siltstone, gray, coarsening upward into sandstone
117	120	3	Clay, gray
120	130	10	Siltstone, gray, fining upward
130	132	2	Shale, black, carbonaceous
132	152	20	Siltstone and shale, gray, interbedded
152	154	2	Shale, black, carbonaceous
154	161	7	Siltstone, gray
161	166	5	Coal - LOWER DIETZ 3 BED
166	167	1	Shale, gray
167	169	2	Coal - LOWER DIETZ 3 BED
169	171	2	Shale, carbonaceous
171	182	11	Siltstone, gray
182	194	12	Sandstone, gray, silty
194	200	6	Siltstone, gray
200	206	6	Shale and claystone, gray
206	208	2	Coal - UPPER CANYON BED
208	213	5	Shale, dark gray, carbonaceous
213	215	2	Siltstone, gray
215	227	12	Shale, gray, silty
227	231	4	Sandstone, gray, fine
231	257	26	Siltstone and shale, gray, interbedded
257	260	3	Shale, carbonaceous

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
260	278	18	Siltstone and shale, gray, interbedded
278	288	10	Coal - CANYON BED
288	291	3	Shale, black, carbonaceous
291	295	4	Siltstone, gray
295	319	24	Sandstone, gray, silty
319	323	4	Shale, black, carbonaceous
323	327	4	Coal - SUB-CANYON BED
327	335	8	Shale, black, carbonaceous
335	339	4	Siltstone, gray
339	342	3	Shale, carbonaceous
342	351	9	Siltstone, gray
351	354	3	Shale, carbonaceous
354	357	3	Coal - CARNEY BED
357	361	4	Shale, gray and brown, some carbonaceous
361	367	6	Siltstone, gray, medium grained
367	376	9	Shale, brown, carbonaceous
376	378	2	Siltstone, gray
378	380	2	Shale, brown, carbonaceous
380	385	5	Coal - COOK BED
385	393	8	Shale, gray
393	396	3	Sandstone, gray
396	421	25	Siltstone and shale, gray, interbedded
421	425	4	Shale, brown, carbonaceous with some gray clay
425	428	3	Coal - UPPER OTTER BED
428	431	3	Shale, dark gray
431	433	2	Coal - UPPER OTTER BED
433	435	2	Shale, carbonaceous
435	443	8	Shale, dark gray
443	451	8	Siltstone, gray
451	453	2	Shale, dark gray
453	458	5	Coal - LOWER OTTER BED
458	464	6	Shale, carbonaceous
464	490	26	Siltstone, gray, with some interbedded shale
490	501	11	Shale, dark brown, carbonaceous
501	505	4	Coal - MIDDLE WALL BED
505	509	4	Clay, gray
509	532	23	Siltstone and shale, gray, interbedded
532	550	18	Sandstone, gray, coarsening upward
550	559	9	Shale, brown, carbonaceous
559	562	3	Coal - LOWER WALL BED
562	563	1	Shale, gray
563	571	8	Coal - LOWER WALL BED
571	575	4	Shale, brown, carbonaceous
575	589	14	Sandstone, gray, fining upward into siltstone
589	592	3	Shale, carbonaceous
592	599	7	Sandstone, gray
599	615	16	Shale, gray, with some interbedded siltstone

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
615	638	23	Siltstone, gray, with some interbedded shale
638	642	4	Shale, carbonaceous
642	647	5	Siltstone, gray
647	657	10	Shale, carbonaceous
657	659	2	Coal - CARLSON BED
659	662	3	Clay, gray
662	669	7	Siltstone, gray
669	678	9	Shale, gray, silty
678	684	6	Siltstone, gray
684	708	24	Shale, gray
708	711	3	Siltstone, gray
711	714	3	Shale, gray
714	718	4	Sandstone, gray
718	726	8	Siltstone, gray, fining upward
726	728	2	Shale, gray
728	734	6	Sandstone, gray
734	737	3	Shale, carbonaceous
737	763	26	Sandstone, gray, fining upward into siltstone
763	777	14	Siltstone, gray
777	787	10	Coal - BREWSTER-ARNOLD BED
787	797	10	Shale, gray
797	802	5	Coal - ODELL BED
802	810	8	Sandstone, gray, very fine
810	812	2	Shale, carbonaceous
812	817	5	Siltstone, gray
817	819	2	Sandstone, gray
819	821	2	Siltstone, gray
821	828	7	Sandstone, gray
828	831	3	Siltstone, gray
831	833	2	Shale, carbonaceous
833	855	22	Sandstone, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-13 Elev. 3340 feet Total Depth 835 feet
 Location 2400 FNL, 550 FEL Sec. 19, T. 7 S, R. 43 E.
 County Rosebud State Montana Quadrangle Lacey Gulch
 Drilled by USGS-GD Driller L. Kozak Hole Size 5 5/8 inches
 Date Started 8/29/82 Date Completed 8/30/82 Geologist Scott Haight
 Remarks Sample log modified by geophysical log interpretation. Geophysical log run to
600 feet due to caving in hole.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	11	11	Clay, brown-orange, and silt
11	14	3	Sandstone, tan, fine
14	28	14	Siltstone, tan
28	39	11	Shale, black, carbonaceous, with some clay
39	44	5	Coal - MIDDLE WALL BED
44	46	2	Clay, light gray, hard
46	48	2	Limestone, light gray
48	50	2	Shale, gray
50	51	1	Sandstone, gray
51	57	6	Shale, gray to brown, with coal fragments
57	59	2	Sandstone, gray
59	64	5	Sandstone, gray, fining upward into siltstone
64	79	15	Sandstone, gray, very fine
79	80	1	Shale, black, carbonaceous
80	83	3	Coal - LOWER WALL BED
83	90	7	Shale, black, carbonaceous
90	98	8	Coal - LOWER WALL BED
98	100	2	Clay, gray
100	104	4	Sandstone, gray
104	109	5	Shale, gray
109	119	10	Siltstone, gray
119	124	5	Sandstone, gray
124	128	4	Siltstone, gray
128	134	6	Shale, dark gray, carbonaceous
134	141	7	Sandstone, gray
141	144	3	Shale, gray
144	145	1	Sandstone, gray
145	151	6	Shale, dark gray
151	160	9	Sandstone, gray
160	163	3	Siltstone, gray
163	167	4	Claystone, gray
167	172	5	Shale, carbonaceous
172	176	4	Coal - CARLSON BED
176	180	4	Clay, gray
180	191	11	Sandstone, gray
191	197	6	Siltstone, gray
197	201	4	Shale, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
201	207	6	Siltstone, gray
207	214	7	Shale, brown
214	221	7	Shale, brown to black
221	226	5	Siltstone, gray
226	231	5	Shale, dark brown to black, carbonaceous
231	241	10	Siltstone, gray
241	247	6	Shale, gray, silty
247	261	14	Sandstone, gray
261	265	4	Shale, brown and black, carbonaceous
265	274	9	Siltstone, gray
274	278	4	Sandstone, gray
278	284	6	Clay, gray
284	294	10	Coal - BREWSTER-ARNOLD BED
294	297	3	Siltstone, gray
297	320	23	Sandstone, gray
320	325	5	Coal - ODELL BED
325	328	3	Shale, brown to black, carbonaceous
328	330	2	Limestone, gray
330	333	3	Siltstone, gray
333	335	2	Sandstone, gray
335	339	4	Shale, dark brown, carbonaceous
339	354	15	Sandstone, gray
354	368	14	Sandstone, gray, with interbedded siltstone and shale
368	385	17	Sandstone, gray
385	388	3	Shale, brown, carbonaceous
388	397	9	Siltstone, gray
397	400	3	Shale, brown, carbonaceous
400	407	7	Siltstone, gray
407	410	3	Shale, gray
410	413	3	Siltstone, gray
413	506	93	Sandstone, siltstone, shale, and coal, thinly interbedded (?) (poor geophysical log)
506	510	4	Shale, carbonaceous
510	585	75	Sandstone, gray
585	592	7	Siltstone, gray
592	597	5	Sandstone, gray
597	600	3	Shale, gray (End of geophysical log)
600	605	5	Clay, gray, consolidated
605	610	5	Coal - KNOBLOCH BED
610	630	20	Shale, gray
630	640	10	Claystone, gray, soft
640	645	5	Shale, gray
645	650	5	Shale, black, carbonaceous
650	655	5	Siltstone, gray
655	675	20	Shale, brown to black, carbonaceous
675	685	10	Clay, gray
685	690	5	Shale, gray, sandy
690	695	5	Clay, gray
695	700	5	Shale, brown, carbonaceous

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
700	710	10	Clay, gray
710	720	10	Siltstone, gray, tan
720	735	15	Siltstone, gray with orange clay
735	750	15	Claystone, gray
750	755	5	Shale, brown and gray
755	795	40	Siltstone, gray to dark gray
795	800	5	Clay, brown, with some coal
800	815	15	Sandstone, gray
815	820	5	Shale, brown to black, carbonaceous
820	830	10	Claystone, gray
830	835	5	Shale, brown, carbonaceous

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-14 Elev. 3451 feet Total Depth 495 feet
 Location 1450 FNL, 350 FEL Sec. 25, T. 7 S., R. 42 E.
 County Rosebud State Montana Quadrangle Lacey Gulch
 Drilled by USGS-GD Driller A. Clark Hole Size 5 1/8 inches
 Date Started 9/8/82 Date Completed 9/8/82 Geologist Scott Haight
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	27	27	Alluvium, with some clinker fragments
27	48	21	Sandstone, brown and gray, slightly clayey
48	50	2	Siltstone, gray
50	54	4	Clay, dark gray and black
54	63	9	Coal - COOK BED
63	77	14	Shale, black, carbonaceous
77	83	6	Sandstone, gray
83	86	3	Shale, black, carbonaceous
86	92	6	Coal - UPPER OTTER BED
92	95	3	Shale, black, carbonaceous
95	99	4	Coal - UPPER OTTER BED
99	102	3	Siltstone, gray
102	103	1	Coal, with brown carbonaceous shale
103	107	4	Shale, carbonaceous
107	126	19	Sandstone, gray, medium grained
126	131	5	Coal - LOWER OTTER BED
131	145	14	Siltstone, gray
145	150	5	Siltstone, light gray
150	163	13	Sandstone, light gray
163	168	5	Shale, gray
168	175	7	Siltstone, gray, coarsening upward
175	183	8	Clay, carbonaceous
183	187	4	Coal - MIDDLE WALL BED
187	190	3	Clay, gray
190	211	21	Siltstone, gray, with some interbedded shale
211	218	7	Shale, carbonaceous
218	222	4	Coal - LOWER WALL A BED
222	231	9	Clay, gray
231	238	7	Coal - LOWER WALL B BED
238	255	17	Sandstone, gray, fining upward into siltstone
255	260	5	Shale, carbonaceous
260	270	10	Siltstone, gray
270	272	2	Sandstone, gray
272	277	5	Shale, gray
277	284	7	Siltstone, gray
284	291	7	Shale, gray, carbonaceous
291	298	7	Siltstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
298	300	2	Clay, dark gray
300	303	3	Coal - UPPER CARLSON BED
303	310	7	Siltstone, brown
310	312	2	Coal - LOWER CARLSON BED
312	314	2	Clay, brown
314	323	9	Siltstone, brown
323	342	19	Sandstone, light gray
342	350	8	Siltstone, gray
350	372	22	Shale, dark gray
372	392	20	Siltstone, gray-brown
392	395	3	Sandstone, gray
395	400	5	Siltstone, dark gray
400	402	2	Shale, carbonaceous
402	406	4	Sandstone, gray, medium grained
406	409	3	Siltstone, gray
409	416	7	Sandstone, gray, medium to fine grained
416	437	21	Siltstone, gray
437	439	2	Shale, carbonaceous
439	448	9	Coal - BREWSTER-ARNOLD BED
448	450	2	Siltstone, gray
450	466	16	Sandstone, light gray
466	470	4	Coal - ODELL BED
470	480	10	Siltstone, gray
480	484	4	Shale, carbonaceous
484	490	6	Siltstone, gray
490	495	5	Sandstone, gray, coarse grained

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-15A Elev. 3893 feet Total Depth 115 feet
 Location 400 FSL, 2450 FEL Sec. 27, T. 7 S., R. 42 E.
 County Rosebud State Montana Quadrangle Lacey Gulch
 Drilled by USGS-GD Driller D. Brown Hole Size 5 1/8 inches
 Date Started 8/14/82 Date Completed 8/14/82 Geologist Scott Haight
 Remarks Hole stopped at 115 feet due to lost air pressure. No geophysical log run.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	12	12	Sand, brown, coarsening upward
12	25	13	Shale, gray, sandy
25	30	5	Shale, dark brown to orange, sandy
30	35	5	Shale, brown
35	40	5	Shale, dark brown, with light colored sand
40	55	15	Sandstone, brown, medium grained
55	60	5	Limestone, gray
60	85	25	Sandstone, brown, with interbedded siltstone
85	100	15	Shale, brown to black, carbonaceous
100	115	15	Coal - ANDERSON BED

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-15B Elev. 3900 feet Total Depth 825 feet
 Location 1850 FSL, 2470 FEL Sec. 27, T. 7 S., R. 42 E.
 County Rosebud State Montana Quadrangle Lacey Gulch
 Drilled by USGS-GD Driller D. Brown Hole Size 5 1/8 inches
 Date Started 8/15/82 Date Completed 8/24/82 Geologist Myra Funkhouser
 Remarks Sample log modified by geophysical log interpretation. Hole drilled to 915
feet but caved, allowing geophysical log to go to only 825 feet. Cuttings
poor between 825 feet and 915 feet, no sample.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	13	13	Sand, tan
13	16	3	Clay, gray
16	22	6	Shale, brown, with some sand, gypsum crystals
22	33	11	Sandstone, brown
33	37	4	Shale, black, carbonaceous
37	83	46	Sandstone, brown, with some interbedded siltstone
83	90	7	Clay, gray
90	116	26	Coal - ANDERSON BED
116	118	2	Clay, brown
118	121	3	Siltstone, gray
121	130	9	Shale, gray, carbonaceous
130	133	3	Siltstone, gray, hard
133	137	4	Shale, dark gray, carbonaceous
137	142	5	Clay, dark gray
142	152	10	Coal - DIETZ 2 BED
152	159	7	Clay and brown, carbonaceous shale
159	163	4	Siltstone, dark gray
163	167	4	Shale, black, carbonaceous
167	192	25	Siltstone, gray, with some interbedded shale and sandstone
192	195	3	Shale, black, carbonaceous
195	210	15	Coal - UPPER DIETZ 3 BED
210	211	1	Clay, gray
211	213	2	Siltstone, gray
213	218	5	Shale, carbonaceous
218	224	6	Siltstone, gray
224	240	16	Sandstone, gray, hard, with some interbedded siltstone
240	250	10	Shale, gray, coarsening upward
250	258	8	Siltstone, gray
258	287	29	Shale and siltstone, gray, interbedded
287	289	2	Sandstone, gray
289	291	2	Coal - LOWER DIETZ 3
291	298	7	Shale, brown to black, carbonaceous
298	309	11	Siltstone, gray, with interbedded shale
309	316	7	Shale, dark brown, carbonaceous
316	323	7	Siltstone, gray
323	332	9	Sandstone, gray, coarsening upward
332	356	24	Siltstone, gray, fining upward
356	361	5	Coal - UPPER CANYON BED

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
361	372	11	Siltstone, gray
372	376	4	Limestone, gray
376	389	13	Shale, black and gray, carbonaceous
389	397	8	Sandstone, gray
397	403	6	Shale, gray
403	413	10	Siltstone, gray
413	416	3	Sandstone, gray
416	421	5	Siltstone, gray
421	422	1	Limestone, gray
422	427	5	Siltstone, gray
427	440	13	Coal - CANYON BED
440	446	6	Shale, carbonaceous
446	465	19	Siltstone and shale, gray, interbedded
465	478	13	Shale, brown, carbonaceous
478	504	26	Siltstone and sandstone, gray, coarsening upward
504	510	6	Coal - CARNEY BED
510	512	2	Clay, gray
512	513	1	Coal - CARNEY BED
513	516	3	Shale, carbonaceous
516	522	6	Shale, gray
522	524	2	Shale, carbonaceous
524	529	5	Siltstone, gray
529	532	3	Coal - COOK BED
532	535	3	Shale, brown, carbonaceous
535	553	18	Siltstone, gray
553	558	5	Shale, carbonaceous
558	560	2	Coal - UPPER OTTER BED
560	563	3	Clay, gray
563	567	4	Siltstone, gray
567	576	9	Shale, carbonaceous
576	577	1	Limestone, gray
577	586	9	Shale, carbonaceous
586	588	2	Coal - Local
588	592	4	Clay, gray
592	601	9	Siltstone, gray
601	607	6	Coal - LOWER OTTER BED
607	616	9	Siltstone, gray
616	618	2	Sandstone, gray
618	626	8	Siltstone, gray, fining upward
626	631	5	Shale, carbonaceous
631	637	6	Siltstone, gray
637	639	2	Shale, gray
639	642	3	Siltstone, tan
642	645	3	Shale, gray
645	648	3	Clay, gray
648	654	6	Coal - MIDDLE WALL BED
654	657	3	Clay, gray
657	662	5	Siltstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
662	726	64	Sandstone, gray, fining upward
726	740	14	Coal - LOWER WALL BED
740	750	10	Siltstone, gray
750	756	6	Sandstone, gray
756	763	7	Shale, carbonaceous
763	768	5	Sandstone, gray, coarsening upward
768	778	10	Shale and siltstone, gray, interbedded
778	781	3	Sandstone, gray
781	783	2	Shale, carbonaceous
783	792	9	Sandstone, gray, with some interbedded shale
792	797	5	Shale, gray
797	803	6	Sandstone, gray
803	807	4	Siltstone, gray
807	809	2	Sandstone, gray
809	813	4	Shale, gray
813	816	3	Sandstone, gray
816	820	4	Siltstone, gray
820	825	5	Sandstone and siltstone, gray, interbedded

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-17 Elev. 3732 feet Total Depth 615 feet
 Location 400 FNL, 1600 FEL Sec. 8, T. 8 S., R. 42 E.
 County Big Horn State Montana Quadrangle Lacey Gulch
 Drilled by USGS-GD Driller A. Clark Hole Size 5 1/8 inches
 Date Started 9/10/82 Date Completed 9/10/82 Geologist Scott Haight
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	14	14	Sand, brown
14	26	12	Siltstone, brown, with interbedded shale
26	30	4	Shale, brown
30	34	4	Sandstone, reddish brown
34	38	4	Siltstone, dark gray
38	42	4	Shale, dark gray
42	48	6	Siltstone, gray
48	55	7	Shale, gray
55	80	25	Coal - ANDERSON BED
80	90	10	Shale, black, carbonaceous
90	94	4	Siltstone, gray
94	96	2	Shale, gray
96	99	3	Siltstone, gray
99	104	5	Shale, gray
104	121	17	Siltstone, gray and chocolate brown with interbedded shale
121	125	4	Shale, brown
125	130	5	Siltstone, gray
130	148	18	Sandstone, gray with interbedded siltstone
148	161	13	Siltstone, gray
161	168	7	Sandstone, gray
168	192	24	Siltstone and shale, dark gray and gray
192	227	35	Sandstone, gray with interbedded siltstone
227	254	27	Siltstone, gray, with interbedded shale
254	274	20	Sandstone, dark gray, coarse-grained, with interbedded siltstone
274	293	19	Siltstone, gray
293	298	5	Sandstone, gray
298	305	7	Siltstone, gray
305	309	4	Sandstone, gray
309	324	15	Siltstone, gray, with interbedded brown, carbonaceous shale
324	331	7	Coal - CANYON BED
331	332	1	Shale, gray
332	342	10	Coal - CANYON BED
342	345	3	Clay, gray
345	401	56	Siltstone, gray, with interbedded sandstone and shales
401	425	24	Shale, carbonaceous, with interbedded siltstone
425	433	8	Coal - CARNEY BED
433	442	9	Shale, gray, with interbedded siltstone

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
442	444	2	Shale, carbonaceous
444	451	7	Siltstone, gray
451	453	2	Shale, gray
453	475	22	Sandstone, gray
475	504	29	Siltstone, gray
504	508	4	Shale, gray
508	511	3	Siltstone, gray, sandy
511	521	10	Shale, carbonaceous
521	523	2	Sandstone, gray
523	526	3	Shale, gray
526	530	4	Siltstone, gray
530	560	30	Shale, carbonaceous
560	564	4	Coal - LOWER OTTER BED
564	591	27	Shale, carbonaceous
591	595	4	Siltstone, gray
595	604	9	Coal - MIDDLE WALL BED
604	611	7	Clay, gray
611	615	4	Sandstone, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-18 Elev. 3955 feet Total Depth 594 feet
 Location 1850 FSL, 2500 FWL Sec. 17, T. 8 S., R. 42 E.
 County Big Horn State Montana Quadrangle Lacey Gulch
 Drilled by USGS-GD Driller A. Clark Hole Size 5 5/8 inches
 Date Started 9/8/82 Date Completed 9/9/82 Geologist Scott Haight
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	14	14	Sand, brown
14	25	11	Siltstone, tan to gray
25	27	2	Clay, brown, carbonaceous
27	43	16	Siltstone and shale, brown to gray, interbedded
43	45	2	Shale, black, carbonaceous
45	62	17	Siltstone, gray, sandy in places
62	69	7	Shale, gray
69	71	2	Siltstone, gray
71	74	3	Sandstone, gray, fine
74	77	3	Siltstone, gray
77	81	4	Sandstone, gray
81	84	3	Siltstone, gray
84	110	26	Sandstone, gray, with some interbedded siltstone
110	138	28	Siltstone and sandstone, gray, interbedded
138	150	12	Sandstone, gray
150	177	27	Siltstone, gray, coarsening upward
177	179	2	Shale, brown, carbonaceous
179	190	11	Siltstone, gray, fining upward
190	193	3	Sandstone, gray
193	196	3	Shale, black, carbonaceous
196	222	26	Coal - ANDERSON BED
222	226	4	Clay, gray
226	230	4	Shale, gray
230	232	2	Shale, carbonaceous
232	235	3	Coal - LOWER DIETZ 2 BED
235	239	4	Shale, carbonaceous
239	242	3	Coal - LOWER DIETZ 2 BED
242	249	7	Clay, gray
249	254	5	Sandstone, gray, fining upward
254	294	40	Siltstone and shale, gray, interbedded
294	298	4	Coal - UPPER DIETZ 3 BED
298	301	3	Clay, gray
301	307	6	Siltstone, gray
307	311	4	Shale, carbonaceous
311	314	3	Siltstone, gray
314	320	6	Shale, carbonaceous
320	325	5	Siltstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
325	329	4	Shale, dark gray to black, carbonaceous
329	337	8	Siltstone, gray, fining upward
337	342	5	Shale, gray, coarsening upward
342	344	2	Siltstone, gray
344	348	4	Shale, black, carbonaceous
348	351	3	Clay, gray
351	355	4	Coal - LOWER DIETZ 3 BED
355	358	3	Clay, gray
358	366	8	Siltstone, gray, coarsening upward
366	369	3	Shale, brown to black, carbonaceous
369	373	4	Sandstone, gray, medium grained
373	377	4	Siltstone, gray
377	382	5	Sandstone, gray, coarse
382	384	2	Siltstone, gray
384	389	5	Shale, gray
389	391	2	Shale, black, carbonaceous
391	399	8	Shale, gray
399	414	15	Siltstone, gray
414	425	11	Shale, gray
425	441	16	Siltstone, gray
441	443	2	Coal - UPPER CANYON
443	448	5	Clay, brown, carbonaceous
448	452	4	Siltstone, gray
452	455	3	Sandstone, gray, coarsening upward
455	462	7	Shale, gray
462	498	36	Siltstone, gray
498	512	14	Coal - CANYON BED
512	517	5	Clay, gray
517	520	3	Siltstone, gray
520	526	6	Shale, carbonaceous
526	528	2	Siltstone, gray
528	532	4	Shale, gray
532	541	9	Shale, brown to black, carbonaceous
541	544	3	Siltstone, gray
544	546	2	Shale, gray
546	569	23	Siltstone, gray, coarsening upward
569	578	9	Sandstone, gray, coarse
578	580	2	Siltstone, gray
580	594	14	Sandstone and siltstone, gray, interbedded

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-19 Elev. 3640 feet Total Depth 535 feet
 Location 3050 FNL, 500 FEL Sec. 29, T. 7 S., R. 41 E.
 County Rosebud State Montana Quadrangle Spring Gulch
 Drilled by USGS-GD Driller L. Kozak Hole Size 5 1/8 inches
 Date Started 8/10/82 Date Completed 8/11/82 Geologist Hal Owen
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	17	17	Sandstone, light yellow, weathered, fine grained
17	27	10	Sandstone, light brown, limonitic, fine grained
27	34	7	Shale, light brown, carbonaceous
34	52	18	Shale and siltstone, light gray, interbedded
52	54	2	Shale, light gray, carbonaceous
54	59	5	Siltstone, light gray
59	62	3	Sandstone, light gray
62	65	3	Siltstone, light gray
65	67	2	Shale, carbonaceous
67	85	18	Siltstone, light gray, fining upward
85	87	2	Sandstone, light gray
87	90	3	Shale, light gray
90	95	5	Coal - DIETZ 3 BED
95	111	16	Shale, light gray
111	140	29	Siltstone, light gray
140	142	2	Sandstone, medium brown, very fine grained
142	144	2	Siltstone, light gray
144	155	11	Sandstone, light brown, coarsening upward
155	166	11	Siltstone, light gray, coarsening upward
166	178	12	Shale, light gray, coarsening upward
178	179	1	Coal - CANYON BED
179	180	1	Siltstone, light gray
180	201	21	Coal - CANYON BED
201	202	1	Siltstone, light gray
202	203	1	Coal - CANYON BED
203	206	3	Shale, carbonaceous
206	208	2	Siltstone, light gray
208	210	2	Shale, light gray
210	218	8	Siltstone, light gray
218	221	3	Sandstone, gray
221	232	11	Shale, carbonaceous
232	237	5	Siltstone, light gray, sandy
237	244	7	Shale, carbonaceous
244	247	3	Coal - CARNEY BED
247	251	4	Shale, light gray
251	259	8	Siltstone, light gray
259	261	2	Shale, carbonaceous

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
261	264	3	Coal - COOK BED
264	273	9	Shale, carbonaceous
273	275	2	Coal - COOK BED
275	284	9	Shale, carbonaceous
284	288	4	Sandstone, light gray
288	291	3	Siltstone, light gray
291	295	4	Sandstone, light gray
295	297	2	Siltstone, light gray
297	300	3	Shale, light gray
300	385	85	Sandstone and siltstone, light gray, interbedded
385	394	9	Siltstone and shale, light gray, interbedded
394	403	9	Shale, carbonaceous
403	454	51	Coal - WALL BED
454	457	3	Shale, carbonaceous
457	461	4	Siltstone, gray
461	462	1	Coal - Local
462	465	3	Shale, gray
465	476	11	Siltstone, medium gray
476	478	2	Sandstone, medium gray
478	482	4	Siltstone, medium gray
482	489	7	Shale, carbonaceous
489	494	5	Coal - CARLSON BED
494	498	4	Shale, medium gray
498	503	5	Siltstone, medium gray
503	535	32	Sandstone, medium gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-21 Elev. 3395 feet Total Depth 380 feet
 Location 2250 FSL, 2000 FEL Sec. 26, T. 7 S., R. 41 E.
 County Rosebud State Montana Quadrangle Spring Gulch
 Drilled by USGS-GD Driller D. Brown Hole Size 5 1/8 inches
 Date Started 8/26/82 Date Completed 8/27/82 Geologist M. Funkhouser, J. McKay
 Remarks Hit methane at 395', well blew out. Sample log modified by geophysical log interpretation.

Depth interval (feet)

From To Thick-
ness

Lithologic Description

0	16	16	Sand, light brown
16	20	4	Shale, brown
20	24	4	Sandstone, light brown
24	43	19	Siltstone, tan to gray, fining upward
43	49	6	Coal - UPPER OTTER BED
49	51	2	Shale, carbonaceous
51	80	29	Siltstone, gray
80	106	26	Sandstone, gray
106	115	9	Siltstone, gray
115	145	30	Shale, gray, carbonaceous near bottom
145	178	33	Coal - WALL BED
178	180	2	Clay, gray
180	182	2	Siltstone, gray
182	187	5	Sandstone, gray
187	189	2	Siltstone, gray
189	191	2	Shale, carbonaceous
191	193	2	Siltstone, gray
193	195	2	Shale, carbonaceous
195	199	4	Siltstone, gray
199	203	4	Sandstone, gray
203	220	17	Siltstone, gray, coarsening upward
220	224	4	Coal - CARLSON BED
224	233	9	Shale, brown, carbonaceous
233	239	6	Siltstone, gray
239	241	2	Coal - Local
241	245	4	Shale, carbonaceous
245	268	23	Siltstone, gray, fining upward
268	271	3	Sandstone, gray
271	282	11	Siltstone, gray
282	288	6	Shale, gray
288	293	5	Shale, brown, carbonaceous
293	304	11	Shale, gray
304	311	7	Siltstone, gray
311	319	8	Sandstone, gray
319	323	4	Shale, gray
323	351	28	Siltstone, gray, coarsening upward
351	353	2	Shale, gray

Depth interval (feet)

From	To	Thick- ness
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Lithologic Description

353	363	10	Coal - BREWSTER-ARNOLD BED
363	366	3	Shale, carbonaceous
366	373	7	Sandstone, gray
373	380	7	Siltstone, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-22 Elev. 3355 feet Total Depth 375 feet
 Location 1500FNL, 1500FWL Sec. 18, T. 7S., R. 42 E.
 County Rosebud State Montana Quadrangle Spring Gulch
 Drilled by USGS-GD Driller D. Brown Hole Size 5 1/8 inches
 Date Started 8-25-82 Date Completed 8-25-82 Geologist Myra Funkhouser
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	18	18	Sandstone, tan, fine, friable
18	20	2	Siltstone, gray
20	23	3	Shale, gray
23	39	16	Siltstone and shale, gray, interbedded
39	42	3	Sandstone, gray, hard
42	60	18	Siltstone and shale, gray, interbedded
60	93	33	Coal - WALL BED
93	95	2	Siltstone, gray
95	96	1	Sandstone, gray
96	109	13	Siltstone, gray
109	110	1	Sandstone, gray
110	115	5	Siltstone, gray
115	121	6	Sandstone, gray
121	129	8	Siltstone, gray
129	131	2	Sandstone, gray
131	136	5	Shale, gray
136	143	7	Siltstone, coarsening upward
143	146	3	Shale, carbonaceous
146	150	4	Coal - CARLSON BED
150	154	4	Shale, carbonaceous
154	165	11	Sandstone, gray, fining upward into siltstone and shale
165	167	2	Coal - Local
167	171	4	Sandstone, gray
171	176	5	Siltstone, gray
176	183	7	Shale, carbonaceous
183	189	6	Siltstone, gray
189	193	4	Shale, gray
193	200	7	Siltstone, gray
200	224	24	Shale, carbonaceous
224	230	6	Siltstone, gray
230	233	3	Shale, carbonaceous
233	267	34	Sandstone, gray
267	295	28	Siltstone, gray
295	300	5	Sandstone, gray
300	307	7	Siltstone, gray
307	318	11	Coal - BREWSTER-ARNOLD BED
318	321	3	Shale, carbonaceous

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
321	328	7	Siltstone, gray
328	334	6	Coal - ODELL BED
334	336	2	Shale, carbonaceous
336	350	14	Siltstone, gray, coarsening upward into sandstone
350	352	2	Coal - Local
352	361	9	Siltstone, gray
361	364	3	Shale, gray
364	366	2	Siltstone, gray
366	370	4	Sandstone, gray, hard
370	375	5	Siltstone, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-24 Elev. 3515 feet Total Depth 520 feet
 Location 1500 FNL, 2650 FWL Sec. 16, T. 8 S., R. 41 E.
 County Big Horn State Montana Quadrangle Spring Gulch
 Drilled by USGS-GD Driller D. Brown Hole Size 5 1/8 inches
 Date Started 8/29/82 Date Completed 8/29/82 Geologist John McKay
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	5	5	Sand, yellowish-brown, silty
5	11	6	Clay, light gray
11	16	5	Siltstone, brown to yellow
16	18	2	Sandstone, orange
18	30	12	Siltstone and shale, gray, interbedded
30	38	8	Shale, carbonaceous
38	41	3	Coal - LOWER DIETZ 3 BED
41	43	2	Shale, gray
43	46	3	Siltstone, gray
46	51	5	Shale, gray
51	66	15	Siltstone, gray
66	72	6	Shale, carbonaceous
72	76	4	Siltstone, gray
76	79	3	Shale, carbonaceous
79	80	1	Siltstone, gray
80	85	5	Sandstone, gray
85	88	3	Siltstone, gray
88	93	5	Shale, carbonaceous
93	103	10	Siltstone, gray, fine
103	105	2	Shale, carbonaceous
105	140	35	Siltstone, gray
140	146	6	Shale, carbonaceous
146	165	19	Coal - CANYON BED
165	166	1	Clay, gray
166	188	22	Siltstone, gray, sandy near top
188	191	3	Shale, carbonaceous
191	194	3	Siltstone, gray
194	197	3	Shale, carbonaceous
197	208	11	Siltstone, gray
208	220	12	Shale and siltstone, gray, interbedded
220	228	8	Sandstone, gray, coarsening upward
228	265	37	Siltstone, gray
265	276	11	Coal - CARNEY BED
276	282	6	Siltstone, gray
282	293	11	Shale, carbonaceous
293	296	3	Siltstone, gray
296	299	3	Sandstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
299	302	3	Siltstone, gray
302	309	7	Coal - COOK BED
309	312	3	Shale, carbonaceous
312	317	5	Shale, gray
317	319	2	Sandstone, gray
319	323	4	Shale, carbonaceous
323	329	6	Siltstone, gray, coarsening upward
329	331	2	Shale, carbonaceous
331	336	5	Siltstone, gray
336	346	10	Sandstone, gray
346	348	2	Siltstone, gray
348	350	2	Shale, carbonaceous
350	359	9	Siltstone, gray
359	460	101	Sandstone, gray, clean
460	465	5	Siltstone, gray
465	470	5	Shale, carbonaceous
470	516	46	Coal - WALL BED
516	520	4	Clay, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-25 Elev. 3720 feet Total Depth 535 feet
 Location 1000 FNL, 650 FEL Sec. 14, T. 8 S., R. 41 E.
 County Big Horn State Montana Quadrangle Spring Gulch
 Drilled by USGS-GD Driller D. Brown Hole Size 5 1/8 inches
 Date Started 8/27/82 Date Completed 8/28/82 Geologist John McKay
 Remarks Gas in hole prevented drilling below 534'. Sample log modified by geophysical
log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	10	10	Topsoil, light brown, silty
10	31	21	Sandstone, yellow-brown, silty
31	44	13	Siltstone, light gray, soft
44	52	8	Shale, dark gray to black, carbonaceous
52	57	5	Coal - LOWER DIETZ 2 BED
57	61	4	Shale, carbonaceous
61	81	20	Siltstone, gray, coarser near top
81	86	5	Shale, carbonaceous
86	92	6	Coal - UPPER DIETZ 3 BED
92	96	4	Shale, dark gray, carbonaceous
96	98	2	Siltstone, gray
98	100	2	Sandstone, gray
100	103	3	Siltstone, gray
103	113	10	Sandstone, greenish-gray, silty
113	129	16	Siltstone, gray, coarsening upward
129	132	3	Shale, gray
132	136	4	Siltstone, gray
136	141	5	Shale, dark gray to black, carbonaceous
141	145	4	Coal - LOWER DIETZ 3
145	150	5	Shale, carbonaceous
150	194	44	Siltstone and shale, gray, interbedded, sandy in spots
194	197	3	Shale, gray
197	207	10	Sandstone, gray, fining upward into siltstone
207	214	7	Siltstone, gray
214	254	40	Sandstone, gray, silty in places
254	259	5	Siltstone, gray
259	261	2	Shale, carbonaceous
261	281	20	Coal - CANYON BED
281	283	2	Siltstone, gray
283	284	1	Coal
284	291	7	Siltstone, gray
291	298	7	Shale, gray
298	300	2	Siltstone, gray
300	312	12	Shale, carbonaceous
312	317	5	Siltstone, gray
317	324	7	Sandstone, gray
324	339	15	Siltstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
339	386	47	Sandstone, gray, silty in places
386	396	10	Siltstone, gray
396	407	11	Coal - CARNEY BED
407	410	3	Shale, carbonaceous
410	420	10	Siltstone, gray
420	424	4	Sandstone, gray
424	442	18	Siltstone, gray with some interbedded shale
442	447	5	Sandstone, gray
447	449	2	Coal - UPPER COOK BED
449	456	7	Shale, gray
456	458	2	Coal - LOWER COOK BED
458	466	8	Shale, carbonaceous
466	468	2	Sandstone, gray
468	471	3	Siltstone, gray
471	475	4	Shale, carbonaceous
475	479	4	Shale, gray
479	486	7	Siltstone, gray
486	489	3	Shale, gray
489	493	4	Shale, carbonaceous
493	495	2	Coal - OTTER BED
495	496	1	Siltstone, gray
496	497	1	Coal - Local
497	502	5	Shale, gray
502	521	19	Siltstone, gray, fining upward from 502' - 506'
521	535	14	Sandstone, gray, fining upward

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole B-82-28 Elev. 3310 feet Total Depth 472 feet
 Location 4475 FNL, 2530 FWL Sec. 4, T. 7 S., R. 43 E.
 County Rosebud State Montana Quadrangle Browns Mountain
 Drilled by USGS-GD Driller D. Brown Hole Size 5 5/8 inches
 Date Started 7/27/82 Date Completed 7/28/82 Geologist Myra Funkhouser
 Remarks Shut down at 518' due to methane. Sample log modified by geophysical log
interpretation.

Depth interval (feet)

From To Thick-
ness

Lithologic Description

0	20	20	Silt, light brown, weathered
20	21	1	Shale, gray
21	40	19	Siltstone, brown
40	60	20	Sandstone, brown
60	67	7	Siltstone, gray
67	79	12	Shale, gray
79	83	4	Shale, carbonaceous
83	86	3	Coal - CARLSON BED
86	89	3	Shale, carbonaceous
89	104	15	Shale, gray
104	106	2	Siltstone, gray
106	112	6	Shale, gray
112	113	1	Siltstone, gray
113	118	5	Shale, brown, carbonaceous
118	120	2	Coal - POKER JIM BED
120	121	1	Siltstone
121	123	2	Coal
123	128	5	Shale, carbonaceous
128	129	1	Shale, brown, carbonaceous
129	135	6	Siltstone, gray
135	137	2	Shale, gray
137	140	3	Siltstone, gray
140	145	5	Shale, gray
145	158	13	Siltstone, gray
158	166	8	Shale, gray
166	168	2	Limestone, gray
168	174	6	Clay, gray
174	184	10	Coal - BREWSTER-ARNOLD BED
184	185	1	Clay, gray
185	188	3	Siltstone, gray
188	194	6	Shale, gray
194	203	9	Siltstone, gray
203	208	5	Coal - ODELL BED
208	213	5	Siltstone, gray
213	250	37	Sandstone, gray
250	265	15	Siltstone and shale, gray, interbedded

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
265	285	20	Siltstone, gray, coarsening upward
285	288	3	Shale, brown, carbonaceous
288	293	5	Siltstone, gray
293	324	31	Sandstone, gray, silty in places
324	333	9	Siltstone and shale, gray, interbedded
333	336	3	Coal - UPPER KING BED
336	347	11	Shale, brown, carbonaceous
347	349	2	Coal - LOWER KING BED
349	352	3	Sandstone, gray
352	357	5	Shale, carbonaceous
357	361	4	Siltstone, gray
361	366	5	Shale, gray
366	369	3	Siltstone, gray
369	371	2	Shale, gray
371	374	3	Siltstone, gray
374	380	6	Shale, gray
380	382	2	Coal
382	387	5	Siltstone, gray
387	389	2	Sandstone, gray
389	402	13	Siltstone, gray, coarsening upward
402	406	4	Shale, carbonaceous
406	419	13	Siltstone, gray, fining upward
419	425	6	Siltstone, gray, shaly
425	440	15	Sandstone, gray
440	443	3	Coal - KNOBLOCH BED
443	452	9	Siltstone, gray
452	454	2	Sandstone, gray
454	458	4	Shale, carbonaceous
458	465	7	Siltstone, gray
465	472	7	Sandstone, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole PDC-13 Elev. 3465 feet Total Depth 362 feet
 Location 1000 FSL, 2200 FWL Sec. 34, T. 6 S., R. 41 E.
 County Rosebud State Montana Quadrangle Birney SW
 Drilled by USGS-WRD Driller D. Delaney Hole Size 4 inches
 Date Started 8/13/82 Date Completed 8/13/82 Geologist Hal Owen
 Remarks Log of water well drilled by USGS-WRD, 1978. WRD sample log modified by
geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	33	33	Siltstone and shale, gray
33	35	2	Shale, gray
35	71	36	Siltstone and shale, gray, interbedded
71	84	13	Sandstone, gray, with some interbedded siltstone
84	88	4	Shale, gray
88	95	7	Siltstone, gray
95	100	5	Shale, dark gray, carbonaceous
100	150	50	Coal - WALL BED
150	161	11	Siltstone and sandstone, gray
161	165	4	Shale, gray, carbonaceous
165	180	15	Siltstone, gray, sandy in places
180	184	4	Shale, dark gray, carbonaceous
184	187	3	Sandstone, gray
187	195	8	Siltstone, gray, sandy
195	199	4	Sandstone, gray
199	212	13	Shale, gray
212	217	5	Sandstone, gray
217	219	2	Coal - Local
219	224	5	Siltstone, gray
224	231	7	Sandstone, gray
231	247	16	Siltstone and shale, gray
247	249	2	Sandstone, gray
249	260	11	Siltstone, gray, sandy
260	271	11	Shale, gray
271	273	2	Coal - Local
273	276	3	Shale, gray
276	280	4	Siltstone, gray, sandy
280	362	82	Sandstone and siltstone, gray, and some interbedded shale

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole PDC-14 Elev. 3465 feet Total Depth 150 feet
 Location 1000 FSL, 2200 FWL Sec. 34, T. 6 S., R. 41 E.
 County Rosebud State Montana Quadrangle Birney SW
 Drilled by USGS-WRD Driller D. Delaney Hole Size 4 inches
 Date Started 8/13/82 Date Completed 8/13/82 Geologist Hal Owen
 Remarks Log of water well drilled by USGS-WRD, 1978. WRD sample log modified by
geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	33	33	Siltstone and shale, gray
33	35	2	Shale, gray
35	71	36	Siltstone and shale, gray, interbedded
71	84	13	Sandstone, gray, with some interbedded siltstone
84	88	4	Shale, gray
88	95	7	Siltstone, gray
95	100	5	Shale, dark gray, carbonaceous
100	150	50	Coal - WALL BED

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-1 Elev. 4110 feet Total Depth 730 feet
 Location 600 FSL, 1100 FWL Sec. 33, T. 9S, R. 42 E.
 County Big Horn State Montana Quadrangle Pine Butte School
 Drilled by USGS-GD Driller L. Kozack Hole Size 5 5/8 inches
 Date Started 9-25-82 Date Completed 9-25-82 Geologist M. Funkhouser
 Remarks Sample log modified by interpretation of geological log. Water injected
at 235'. TD only 730' because lost hydraulic fluid in hard rock on bottom.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	3	3	Sandstone, weathered, brown, coarse
3	20	17	Sandstone, gray, coarse
30	42	12	Shale, gray
42	44	2	Shale, Black, carbonaceous
44	48	4	Shale, gray, mollusc fossils
48	64	16	Shale, gray
64	75	11	Sandstone
75	84	9	Coal - BADGER - BED
84	96	12	Sandstone, gray, fine
96	101	5	Sandstone, gray, fine, with organic layers
101	103	2	Sandstone, gray
103	106	3	Shale, black, carbonaceous
106	110	4	Shale, gray
110	120	10	Shale, brown, carbonaceous
120	125	5	Shale, gray
125	132	7	Shale, light brown
132	136	4	Coal - LOCAL BED
136	143	7	Shale, gray
143	154	11	Shale, brown, carbonaceous
154	166	12	Shale, gray
166	171	5	Sandstone and shale, brown, carbonaceous
171	189	18	Shale, gray
189	193	4	Shale, brown, carbonaceous
193	206	13	Shale, gray
206	208	2	Shale, brown, carbonaceous
208	214	6	Sandstone, gray
214	227	13	Shale, black, carbonaceous
227	236	9	Sandstone, gray
236	237	1	Shale, black, carbonaceous
237	241	4	Shale, gray
241	249	8	Shale, brown, carbonaceous
249	259	10	Shale, gray
259	263	4	Limestone, gray, hard
263	269	6	Shale, gray
269	272	3	Shale, black, carbonaceous
272	287	15	Shale, brown & black, carbonaceous

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
287	292	5	Shale, gray & brown, carbonaceous
292	299	7	Shale, gray
299	309	10	Sandstone, gray, & gray shale
309	316	7	Shale, brown, carbonaceous
316	323	7	Sandstone, black, carbonaceous
323	329	6	Siltstone, gray
329	343	14	Shale, black, carbonaceous
343	353	10	Shale, gray, & sandstone
353	361	8	Shale, gray, & black carbonaceous shale
361	366	5	Shale, black & brown, carbonaceous
371	373	2	Shale & silt, gray
373	375	2	Shale, black, carbonaceous, & gray shale
375	384	9	Shale, gray
384	387	3	Sandstone, fine, black, carbonaceous
387	390	3	Shale, gray & black, carbonaceous with gray sand
390	406	16	Siltstone, gray, with gray sandstone and shale
406	410	4	Shale, gray, & sandstone
410	414	4	Siltstone, gray, with coal fragments
414	424	10	Coal - ROLAND BED
424	427	3	Siltstone, and shale, gray
427	429	2	Shale, brown, carbonaceous
429	432	3	Shale, black, carbonaceous
432	435	3	Shale, gray
435	443	8	Siltstone, gray
443	458	15	Shale, gray
458	466	8	Shale, black, carbonaceous
466	474	8	Siltstone, gray
474	481	7	Shale, gray
481	484	3	Coal
484	498	14	Shale, gray
498	502	4	Shale, brown, carbonaceous
502	531	29	Shale, gray
531	535	4	Shale, black, carbonaceous
535	538	3	Coal
538	546	8	Shale, brown, carbonaceous with coal fragments
546	554	8	Shale, blue-gray
554	560	6	Shale, dark gray
560	565	5	Shale, gray
565	586	21	Shale, black & gray, carbonaceous
586	590	4	Coal fragments & black, carbonaceous shale
590	592	2	Shale, black, carbonaceous
592	597	5	Shale, gray
597	603	6	Shale, black, carbonaceous
603	612	9	Sandstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
612	630	18	Sandstone, gray, hard
630	649	19	Shale, black & brown, carbonaceous
649	666	17	Gray shale
666	683	17	Shale, gray
683	689	6	Shale, brown & black, carbonaceous
689	699	10	Coal - SMITH BED
699	715	16	Shale, gray
715	721	6	Shale, black, carbonaceous
721	730	9	Sandstone, hard drilling

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-2 Elev. 4098 feet Total Depth 795 feet
 Location 1000 ft FNL, 900 ft FEL Sec. 28, T. 9S., R. 42 E.
 County Big Horn State Montana Quadrangle Pine Butte School
 Drilled by USGS-GD Driller L. Kozak Hole Size 5 1/8 inches
 Date Started 9-22-82 Date Completed 9-23-82 Geologist M. Funkhouser
 Remarks Sample log modified by interpretation of geophysical log.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	5	5	Clay, tan
5	10	5	Shale, brown, weathered
10	15	5	Shale, gray
15	21	6	Shale, black, carbonaceous
21	25	4	Coal, - LOCAL BED
25	64	39	Shale, gray
64	82	18	Sandstone, gray, coarse
82	86	4	Shale, gray
86	88	2	Sandstone, gray
88	89	1	Shale, black, carbonaceous
89	102	13	Shale, gray
102	105	3	Shale, black, carbonaceous
105	113	8	Sandstone, gray
113	123	10	Shale, brown, carbonaceous
123	143	20	Sandstone, gray
143	148	5	Shale, gray
148	158	10	Shale, brown, carbonaceous
158	163	5	Shale, gray
163	173	10	Shale, black, carbonaceous
173	190	17	Sandstone, gray (wash-out shown on caliper)
190	200	10	Shale, gray
200	210	10	Shale, brown, carbonaceous
210	215	5	Shale, gray
215	220	5	Shale, brown, carbonaceous
220	229	9	Siltstone, gray, sandy
229	236	7	Siltstone, gray
236	246	10	Shale, brown, carbonaceous
246	252	6	Shale, gray
252	263	11	Shale, black, carbonaceous
263	265	2	Sandstone, gray
265	281	16	Shale, gray, & brown carbonaceous
281	293	12	Shale, gray
293	300	7	Sandstone, gray, hard
300	310	10	Shale, gray
310	319	9	Siltstone, gray
319	328	9	Coal - ROLAND BED
328	333	5	Clay, gray

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
333	362	29	Shale, gray
362	369	7	Shale, black, carbonaceous
369	377	8	Siltstone, gray
377	379	2	Coal & black carbonaceous shale
379	387	8	Shale, gray, & coal fragments
387	389	2	Sandstone, gray
389	408	19	Shale, gray
408	412	4	Sandstone, gray
412	417	5	Shale, brown, carbonaceous
417	422	5	Shale gray
422	432	10	Shale, brown, carbonaceous
432	437	5	Siltstone, gray
437	443	6	Shale, gray
443	448	5	Shale, brown, carbonaceous
448	469	21	Shale, gray
469	478	9	Sandstone, gray
478	487	9	Shale, black, carbonaceous
487	492	5	Sandstone, gray
492	497	5	Sandstone with organic material and coal fragments
497	517	20	Sandstone, gray
517	538	21	Sandstone, gray, with organic material & brown carbonaceous shale
538	543	5	Shale, brown, carbonaceous
543	568	25	Shale, black, carbonaceous
568	581	13	Shale, gray
581	588	7	Sandstone, hard, gray & gray shale
588	593	5	Coal fragments & gray shale
593	603	10	Sandstone, gray, with shale and coal fragments
603	611	8	Shale, brown, carbonaceous
611	621	10	Coal - SMITH BED
621	628	7	Clay, gray
628	635	7	Shale, gray
635	640	5	Sandstone, gray, with coal & shale fragments
640	650	10	Shale, gray, & very hard limestone
650	655	5	Clay, gray
655	660	5	Shale, gray, & coal fragments
660	666	6	Sandstone, gray
666	676	10	Sandstone, & clay
676	681	5	Shale, gray
681	686	5	Sandstone, hard
686	718	32	Sandstone & shale, gray
718	725	7	Shale, gray & black, carbonaceous
725	734	9	Sandstone, gray
734	739	5	Shale, gray
739	744	5	Shale, brown & black, carbonaceous
744	766	22	Coal - ANDERSON BED
766	767	1	Shale, gray
767	771	4	Coal - ANDERSON BED
771	776	5	Shale, gray
776	795	19	Sandstone, gray, hard

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-3 Elev. 3990 feet Total Depth 715 feet
 Location 700' FSL & 950' FWL Sec. 30, T. 9S, R. 42 E.
 County Big Horn State Montana Quadrangle Holmes Ranch
 Drilled by USGS-GD Driller Art Clark Hole Size 5-5/8 inches
 Date Started 9-25-82 Date Completed 9-26-82 Geologist E. Burks
 Remarks Sample log modified from geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	15	15	Sandstone, tan, weathered
15	26	11	Sandstone, brown
26	31	5	Shale, gray
31	34	3	Shale, carbonaceous
34	39	5	Sandstone, brown
39	43	4	Shale, gray
43	46	3	Shale, carbonaceous
46	52	6	Sandstone, gray & carbonaceous shale
52	57	5	Shale, gray
57	67	10	Sandstone, gray
67	72	5	Sandstone & shale, gray
72	77	5	Sandstone, gray
77	82	5	Sandstone, gray, & carbonaceous shale
82	88	6	Sandstone & shale, gray
88	96	8	Sandstone, gray
96	100	4	Sandstone, gray, & carbonaceous shale
100	105	5	Shale, gray
105	109	4	Sandstone, gray
109	127	18	Shale, gray
127	137	10	Sandstone, gray
137	142	5	Shale, carbonaceous
142	157	15	Sandstone & shale, gray
157	168	11	Shale, gray
168	174	6	Sandstone, gray
174	200	26	Sandstone & shale, gray
200	210	10	Sandstone, gray
210	215	5	Shale, carbonaceous
215	222	7	Sandstone, gray
222	227	5	Shale, gray
227	234	7	Sandstone, gray
234	240	6	Shale, gray
240	244	4	Sandstone, gray
244	266	22	Sandstone & shale, gray
266	276	10	Coal - ROLAND BED
276	294	18	Sandstone, gray, hard drilling
294	308	14	Sandstone & shale, gray
308	329	21	Shale, gray
329	333	4	Coal
333	341	8	Shale, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
341	348	7	Sandstone, gray, very hard
348	411	63	Sandstone & shale, gray
411	417	6	Sandstone, gray
417	433	16	Shale, gray
433	442	9	Shale, carbonaceous
442	457	15	Shale, gray
457	459	2	Shale, carbonaceous
459	471	12	Shale, gray
471	480	9	Sandstone, gray
480	500	20	Shale, gray
500	515	15	Shale, carbonaceous
515	556	41	Shale, gray
556	562	6	Sandstone, gray
562	567	5	Shale, gray
567	580	13	Coal - SMITH BED
580	590	10	Sandstone & shale, gray
590	595	5	Shale, carbonaceous, & coal
595	607	12	Shale, carbonaceous
607	625	18	Sandstone, gray
625	640	15	Sandstone & shale, gray
640	650	10	Sandstone, gray
650	669	19	Shale, gray
669	692	23	Coal - ANDERSON BED
692	694	2	Shale, gray
694	715	21	Shale & sandstone, gray

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-4 Elev. 3920 feet Total Depth 695 feet
 Location 1325' FNL & 1450' FEL Sec. 27, T. 9 S, R. 41 E.
 County Big Horn State Montana Quadrangle Holmes Ranch
 Drilled by GD-USGS Driller D. Brown Hole Size 5-1/8 inches
 Date Started 9-26-82 Date Completed 10-2-82 Geologist E. Burks
 Remarks Hole caved - logged only to 655'. Sample log modified by geophysical
log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	5	5	Weathered sandstone & shale
5	10	5	Shale, gray
10	24	14	Sandstone, gray
24	28	4	Shale, tan
28	33	5	Sandstone, tan
33	41	8	Shale, gray, carbonaceous
41	51	10	Sandstone & shale, gray
51	57	6	Sandstone, gray
57	93	36	Sandstone & shale, gray
93	103	10	Sandstone, gray
103	115	12	Sandstone & shale, gray
115	119	4	Sandstone, gray, & coal
119	145	26	Sandstone & shale, gray
145	155	10	Sandstone, gray
155	172	17	Sandstone & shale, gray
172	190	18	Sandstone, gray
190	201	11	Coal - ROLAND BED
201	209	8	Shale, gray
209	259	50	Sandstone & shale, gray
259	267	8	Shale, carbonaceous
267	276	9	Sandstone, gray
276	281	5	Shale, gray
281	287	6	Sandstone, gray
287	292	5	Shale, gray
292	307	15	Sandstone, gray
307	314	7	Shale, gray
314	318	4	Shale, gray, & coal
318	349	31	Shale, gray, thin coal at 340-345
349	359	10	Shale, gray
359	371	12	Sandstone & shale, gray
371	384	13	Shale, gray
384	398	14	Sandstone & shale, gray
398	413	15	Sandstone, gray
413	427	14	Sandstone & shale, gray
427	453	26	Shale, gray
453	461	8	Shale, gray, & coal
461	472	11	Shale, carbonaceous

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
472	481	9	Shale, gray
481	496	15	Shale, carbonaceous
496	509	13	Coal - SMITH BED
509	512	3	Shale, gray
512	518	6	Sandstone, gray
518	548	30	Sandstone & shale, gray
548	560	12	Shale, gray
560	564	4	Shale, carbonaceous with coal
564	569	5	Shale, gray
569	593	24	Coal - ANDERSON BED
593	613	20	Shale, gray
613	617	4	Coal - UPPER DIETZ 2 BED
617	621	4	Shale, gray
621	628	7	Sandstone, gray
628	634	6	Shale, gray, and sandstone
634	641	7	Shale, gray & coal
641	666	25	Shale, gray (Geophysical log stops at 655')
666	675	9	No sample
675	680	5	Coal & sandstone, gray
680	685	5	Coal & shale, gray LOWER DIETZ 2 BED
685	690	5	Shale, carbonaceous
690	695	5	Sandstone & shale, gray

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-5 Elev. 3930 feet Total Depth 1075 feet
 Location 2900' FNL & 2650' FW; Sec. 29, T. 9 S, R. 41 E.
 County Big Horn State Montana Quadrangle Holmes Ranch
 Drilled by USGS-GD Driller D. Delaney Hole Size 5-5/8 inches
 Date Started 10-5-82 Date Completed 10-6-82 Geologist J. McKay
 Remarks Sample log modified by geophysical log interpretation to 440'. Hole
caved - logged only to 440'.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	10	10	Clay, dark brown, with brown sandy loam
10	21	11	Sandstone, fine, silty, yellowish pale orange
21	38	17	Sandstone, yellowish brown, silty
38	43	5	Sandstone, light gray to gray, fine, silty
43	61	18	Shale, carbonaceous, dark gray to black, and lignite
61	68	7	Sandstone, gray
68	78	10	Shale, carbonaceous, greenish gray
78	97	19	Sandstone, light gray to gray, silty
97	99	2	Coal
99	175	76	Sandstone, gray, with siltstone
175	185	10	Coal - ROLAND BED
185	189	4	Shale
189	233	44	Sandstone, light gray to gray, with siltstone
233	253	20	Shale, carbonaceous, gray to dark greenish gray
253	256	3	Coal - LOCAL BED
256	268	12	Sandstone, gray to black
268	286	18	Sandstone, silty, gray
286	292	6	Coal (?) dark greenish gray to black
292	339	47	Sandstone, greenish gray with siltstone & clay
339	343	4	Coal - LOCAL BED
343	348	5	Shale
348	356	8	Sandstone
356	402	46	Sandstone, dark greenish gray, with clay and sandstone
402	440	38	Sandstone & siltstone, dark greenish gray (End of geophysical log. Hard drilling at 435')
440	450	10	Sandstone & siltstone, dark greenish gray
450	470	20	Coal - SMITH BED
470	540	70	Sandstone, gray, silty
540	560	20	Coal - ANDERSON BED
560	655	95	Sandstone, gray, silty
655	680	25	Coal - DIETZ 2 BED
680	735	55	Sandstone, gray, silty
735	765	30	Sandstone, gray, silty with coal stringers

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
765	783	18	Coal - DIETZ 3 BED
783	835	52	Sandstone, gray, silty
835	838	3	Coal - LOCAL BED
838	890	52	Sandstone, gray, silty
890	914	24	Coal - CANYON BED
914	925	11	Sandstone, gray, silty
925	950	25	Sandstone, dark greenish gray, clayey, silty
950	955	5	Clay, dark greenish gray to black
955	1030	75	Sandstone, silty
1030	1040	10	Coal - COOK BED
1040	1045	5	Shale, carbonaceous
1045	1075	30	Sandstone, dark greenish gray, clayey silty

Sample Log

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U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-6 Elev. 3916 feet Total Depth 535 feet
 Location 1200' FNL & 400' FEL Sec. 11, T. 9S, R. 41 E.
 County Big Horn State Montana Quadrangle Holmes Ranch
 Drilled by USGS-GD Driller L. Kozak Hole Size 5-5/8 inches
 Date Started 9-26-82 Date Completed 9-26-82 Geologist M. Funkhouser
 Remarks Sample log modified by geophysical log interpretation. First log run
at 40'/minute due to power loss. Second run logged only to 425 due to cave-in

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	5	5	Sand, fine, light brown
5	15	10	Shale, light brown to brown, weathered
15	31	16	Sandstone, brown, fine
31	38	7	Shale, gray
38	40	2	Sandstone
40	42	2	Shale, gray
42	51	9	Coal - ROLAND BED
51	90	39	Shale, gray
90	95	5	Sandstone, gray
95	107	12	Shale, gray
107	110	3	Shale, brown, carbonaceous
110	114	4	Sandstone, gray, very fine grained
114	119	5	Shale, gray
119	129	10	Limestone, gray, with gray shale
129	148	19	Shale, gray
148	164	16	Shale, gray & brown, carbonaceous, with a coal stringer
164	177	13	Shale, gray
177	188	11	Sandstone, gray, coarse, with gray shale
188	192	4	Coal - LOCAL BED
192	198	6	Shale, gray
198	201	3	Coal - LOCAL BED
201	208	7	Shale, gray
208	217	9	Sandstone, gray
217	224	7	Shale, gray & brown, carbonaceous
224	235	11	Sandstone, gray
235	241	6	Shale, gray
241	278	37	Sandstone, gray, fine to medium grained
278	288	10	Shale, gray
288	300	12	Coal - SMITH BED
300	302	2	Shale, black, carbonaceous
302	359	57	Shale, gray to dark gray
359	382	23	Sandstone, gray, fine
382	384	2	Limestone (hard drilling)
384	400	16	Sandstone, gray, with shale
400	405	5	Shale, gray

Depth interval (feet)

From	To	Thick- ness
------	----	----------------

Lithologic Description

405	427	22	Coal - ANDERSON BED (switch to geophysical log run #2)
427	448	21	Shale, gray
448	451	3	Coal - UPPER DIETZ 2 BED
451	460	9	Shale, gray
460	483	23	Sandstone & shale, gray
483	522	39	Sandstone, gray
522	531	9	Shale, gray
531	535	4	Sandstone, gray

Sample Log

Page 1 of 1

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-7WW Elev. 3765 feet Total Depth 345 feet
 Location 2100' FSL & 1600 FEL Sec. 16 , T. 9 S , R. 41 E.
 County Big Horn State Montana Quadrangle Holmes Ranch
 Drilled by N.A. Driller N.A. Hole Size 5 inches
 Date Started N.A. Date Completed N.A. Geologist E. Burks
 Remarks Log of cased water well. Sample log below based entirely on
geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	15	15	Sandstone
15	37	22	Shale
37	39	2	Sandstone
39	46	7	Shale
46	50	4	Sandstone
50	125	75	Sandstone, interbedded with shale
125	128	3	Sandstone
128	131	3	Shale
131	197	66	Sandstone
197	215	18	Shale
215	227	12	Coal - SMITH BED
227	248	21	Shale
248	263	15	Sandstone
263	305	42	Shale
305	310	5	Sandstone
310	317	7	Shale
317	336	19	Coal - ANDERSON BED
336	342	6	Shale
342	345	3	Sandstone

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-8 Elev. 4098 feet Total Depth 608 feet
 Location 750' FSL & 4450' FWL Sec. 6, T. 9 S, R. 42 E.
 County Big Horn State Montana Quadrangle Holmes Ranch
 Drilled by USGS-GD Driller D. Brown Hole Size 5-1/8 inches
 Date Started 9-21-82 Date Completed 9-21-82 Geologist E. Burks
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	5	5	Sandstone, weathered
5	15	10	Siltstone, gray
15	25	10	Sandstone, light brown
25	41	16	Shale, gray
41	49	8	Siltstone, gray with sandstone
49	61	12	Shale, gray
61	75	14	Sandstone, gray
75	93	18	Shale, carbonaceous, gray, with siltstone
93	104	11	Sandstone, gray
104	108	4	Shale, carbonaceous
108	113	5	Coal, boney - LOCAL BED
113	114	1	Shale, gray
114	121	7	Sandstone, gray
121	127	6	Shale, gray
127	137	10	Sandstone, gray
137	144	7	Shale, gray
144	157	13	Sandstone, gray with some interbedded shale
157	171	14	Shale, gray
171	173	2	Shale, carbonaceous
173	182	9	Coal - ROLAND BED
182	185	3	Shale, carbonaceous
185	207	22	Shale, gray, intermixed with siltstone
207	210	3	Sandstone, gray
210	222	12	Shale, gray
222	232	10	Sandstone, gray
232	242	10	Shale, gray
242	251	9	Shale, carbonaceous & gray
251	297	46	Sandstone & shale, gray
297	300	3	Shale, carbonaceous
300	325	25	Sandstone & shale, gray
325	328	3	Coal - LOCAL BED
328	338	10	Shale, gray
338	353	15	Sandstone & shale, gray
353	365	12	Sandstone, gray
365	374	9	shale, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
374	390	16	Sandstone, gray, with some shale
390	404	14	Shale, gray
404	410	6	Siltstone, gray
410	412	2	Shale, gray
412	416	4	Sandstone, gray
416	423	7	Shale, gray
423	426	3	Coal - SMITH BED
426	427	1	Shale, carbonaceous
427	441	14	Coal - SMITH BED
441	447	6	Shale, carbonaceous
447	479	32	Shale, gray, with some sandstone
479	483	4	Sandstone, gray
483	552	69	Shale, siltstone, gray, & some sandstone
552	572	20	Coal - ANDERSON BED
572	576	4	Shale, carbonaceous
576	583	7	Sandstone, tan
583	585	2	Coal - UPPER DIETZ 2 BED
585	589	4	Shale, carbonaceous
589	594	5	Sandstone, gray
594	602	8	Shale, gray
602	604	2	Sandstone, gray
604	608	4	Shale, gray

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-9 Elev. 4025 feet Total Depth 835 feet
 Location 1700 ft FNL, 1900 ft FEL Sec. 17, T. 9 S, R. 42 E.
 County Big Horn State Montana Quadrangle Pine Butte School
 Drilled by USGS-GD Driller Art Clark Hole Size 5 7/8 inches
 Date Started 9-21-82 Date Completed 9-23-82 Geologist E. Burks
 Remarks Sample Log modified by interpretation of geophysical log

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	18	18	Sandstone, gray, weathered & unweathered
18	27	9	Shale, gray
27	30	3	Shale, carbonaceous
30	44	14	Sandstone, gray
44	46	2	Shale, gray
46	73	27	Sandstone, gray, with some shale
73	79	6	Shale, carbonaceous
79	98	19	sandstone, gray, with gray shale
98	132	34	Sandstone, gray, with some gray shale, hard sandstone 98-104
132	140	8	Coal - ROLAND BED
140	155	16	Shale, gray
155	206	51	Sandstone, gray, clean, fine grained, well sorted, fining upward
206	215	9	Sandstone with some organic debris, medium grained, coarsening downward
215	217	2	Shale, carbonaceous
217	220	3	Coal
220	267	47	Sandstone & shale, gray to light gray, hard drilling at 260-265
267	293	26	Shale, gray
293	302	9	Shale & siltstone, gray
302	309	7	Shale with coal
309	334	25	Shale, gray
334	339	5	Shale & sandstone, gray
339	354	15	Shale, gray
354	399	45	Shale & silt, gray
399	404	5	Shale, carbonaceous
404	440	36	Shale, gray
440	449	9	Coal - SMITH BED
449	469	20	Shale, gray
469	494	25	Shale & silt, gray
494	514	20	Shale, gray
514	544	30	Shale & silt, gray
544	575	31	Shale, gray
575	597	22	Coal - ANDERSON BED
597	598	1	Shale, gray
598	601	3	Coal - ANDERSON BED

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
600	615	15	Sandstone, brown & gray
615	630	15	Sandstone & shale, gray, hard drilling
			625-630
630	666	36	Shale, gray
666	669	3	Coal with interbedded brown clay
669	675	6	Clay, brown
675	679	4	Coal - LOWER DIETZ 2 BED
679	681	2	Clay, brown
681	696	15	Shale, gray
696	700	4	Shale
700	714	14	Sandstone
714	735	21	Shale
735	740	5	Coal - UPPER DIETZ 3 BED
740	765	25	Shale & sandstone
765	789	24	Sandstone
789	797	8	Shale
797	806	9	Coal - LOWER DIETZ 3 BED
806	807	1	Shale, gray
807	809	2	Coal - LOWER DIETZ 3 BED
809	835	26	Sandstone, gray, hard

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-10 Elev. 3908 feet Total Depth 815 feet
 Location 30' FNL & 1500' FEL Sec. 24, T. 9 S, R. 42 E.
 County Big Horn State Montana Quadrangle Pine Butte School
 Drilled by USGS-GD Driller D. Brown Hole Size 5-5/8 inches
 Date Started 9-24-82 Date Completed 9-25-82 Geologist E. Burks
 Remarks Hole spudded just below fossiliferous sandstone (gastropods & clams).
Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	5	5	Sandstone, weathered, mollusc fossils
5	11	6	Shale, gray
11	16	5	Sandstone, gray
16	23	7	Shale, gray
23	29	6	Sandstone
29	33	4	Coal - ROLAND BED
33	34	1	Shale, gray
34	37	3	Coal - ROLAND BED
37	50	13	Shale, gray
50	57	7	Sandstone, gray
57	102	45	Sandstone & shale, gray
102	117	15	Sandstone, gray
117	124	7	Shale, gray
124	171	47	Sandstone & shale, gray
171	177	6	Shale, gray
177	183	6	Sandstone, gray
183	188	5	Sandstone & shale, gray
188	192	4	Shale, carbonaceous
192	207	15	Sandstone, gray
207	220	13	Shale, gray
220	243	23	Sandstone, gray
243	252	9	Shale, gray
252	256	4	Sandstone, gray
256	278	22	Sandstone & shale, gray
278	281	3	Shale, carbonaceous
281	327	46	Shale, gray
327	336	9	Coal - SMITH BED
336	339	3	Shale, gray
339	342	3	Sandstone, gray
342	359	17	Shale, gray
359	373	14	Sandstone & shale, gray
373	375	2	Shale, gray
375	378	3	Sandstone, gray
378	384	6	Shale, gray
384	388	4	Sandstone, gray
388	392	4	Shale, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
392	398	6	Sandstone, gray
398	440	42	Shale, gray, with some sandstone
440	472	32	Coal - ANDERSON BED
472	482	10	Shale, gray
482	484	2	Shale, carbonaceous
484	530	46	Shale & sandstone, gray
530	547	17	Shale, gray
547	550	3	Coal - LOWER DIETZ 2 BED
550	566	16	Shale & siltstone, gray
566	571	5	Coal - UPPER DIETZ 3 BED
571	581	10	Shale, gray
581	599	18	Sandstone, gray
599	607	8	Shale, gray
607	611	4	Sandstone, gray
611	616	5	Shale, carbonaceous
616	652	36	Sandstone & shale, gray
652	655	3	Coal
655	658	3	Shale, gray
658	666	8	Sandstone, gray, with some shale
666	672	6	Shale, gray
672	676	4	Sandstone, gray
676	681	5	Shale, gray
681	688	7	Sandstone, gray
688	693	5	Shale, gray
693	712	19	Sandstone & shale, gray
712	715	3	Coal LOWER DIETZ 3 BED
715	716	1	Clay, brown
716	720	4	Coal LOWER DIETZ 3 BED
720	764	44	Sandstone & shale, gray
764	778	14	Sandstone, gray
778	783	5	Shale, gray
783	800	17	Coal - CANYON BED
800	805	5	Shale, gray
805	812	7	Sandstone, gray
812	815	3	Shale, gray

Sample Log

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U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-11 Elev. 4138 feet Total Depth 875 feet
 Location 550' FNL & 2525' FEL Sec. 32, T. 8 S, R. 42 E.
 County Big Horn State Montana Quadrangle Pine Butte School
 Drilled by USGS-GD Driller L. Kozak Hole Size 5-1/8 inches
 Date Started 9-13-82 Date Completed 9-14-82 Geologist S. Haight
 Remarks Sample Log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	5	5	Clay, brown
5	15	10	Clay, gray
15	28	13	Shale, brown & black
28	33	5	Shale, black, carbonaceous
33	41	8	Sandstone, light brown
41	53	12	Sandstone, gray
53	62	9	Shale, gray, to black
62	66	4	Sandstone, gray
66	78	12	Shale, gray
78	83	5	Sandstone, gray
83	98	15	Shale, gray to black, carbonaceous
98	105	7	Coal - ROLAND BED
105	108	3	Shale, gray
108	113	5	Siltstone, gray
113	150	37	Sandstone, gray, medium grained
150	162	12	Shale, dark gray, carbonaceous with some sandstone
162	183	21	Sandstone, gray, with some interbedded shale
183	186	13	Shale, brown
186	195	9	Sandstone, gray & brown
195	208	13	Shale, gray
208	220	12	Sandstone gray, dense, hard drilling
220	225	5	Shale, gray
225	229	4	Sandstone, dark brown
229	234	5	Shale, gray
234	240	6	Sandstone, brown
240	248	8	Shale, gray
248	250	2	Shale, black, carbonaceous with coal fragments
250	260	10	Siltstone, gray
260	264	4	Sandstone
264	273	9	Shale, brown to black, carbonaceous, with coal fragments
273	276	3	Sandstone, gray
276	283	7	Shale, gray to brown
283	291	8	Sandstone, gray
291	299	8	Shale, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
299	313	14	Sandstone, dark brown to gray
313	351	38	Shale, brown to gray
351	368	17	Coal - SMITH BED
368	379	11	Shale, gray
379	387	8	Clay, carbonaceous, gray
387	409	22	Sandstone, gray
409	425	16	Shale, gray to brown
425	486	61	Sandstone, gray to brown, not well consolidated in places
486	500	14	Siltstone, gray
500	515	15	Clay, brown to black, carbonaceous, silty
515	530	15	Shale, brown to black, silty
530	556	26	Coal - ANDERSON BED
556	560	4	Shale, brown
560	563	3	Coal - ANDERSON BED
563	568	5	Siltstone, brown
568	572	4	Coal - UPPER DIETZ 2 (?) BED
572	578	6	Shale, dark gray
578	586	8	Clay - siltstone, gray
586	588	2	Sandstone, gray
588	603	15	Siltstone, light gray with some clay
603	612	9	Shale, black to brown, carbonaceous
612	616	4	Coal - LOWER DIETZ 2 (?) BED
616	619	3	Shale, gray
619	623	4	Siltstone, gray
623	624	1	Sandstone, light gray
624	634	10	Siltstone, gray
634	638	4	Shale, gray
638	644	6	Sandstone, light gray
644	651	7	Shale, dark gray
651	653	2	Sandstone, gray
653	660	7	Shale, gray
660	673	13	Sandstone, gray, silty
673	683	10	Siltstone, gray
683	686	3	Sandstone, gray
686	691	5	Siltstone, brown
691	700	9	Sandstone, gray
700	712	12	Siltstone, gray
712	726	14	Shale, gray
726	728	2	Sandstone, gray
728	735	7	Shale, gray
735	741	6	Sandstone, gray
741	749	8	Shale, gray
749	796	47	Sandstone, siltstone & shale, gray
796	806	10	Shale, gray
806	809	3	Coal - CANYON BED
809	811	2	Shale, gray
811	825	14	Coal - CANYON BED

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
825	827	2	Shale, gray
827	828	1	Coal
828	829	1	Shale, gray
829	830	1	Coal
830	833	3	Shale, gray
833	838	5	Siltstone, gray
838	841	3	Shale, gray
841	875	34	Sandstone, gray

Sample Log

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U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-12 Elev. 4080 feet Total Depth 472 feet
 Location 1850' FSL & 1850' FWL Sec. 24, T. 8 S, R. 41 E.
 County Big Horn State Montana Quadrangle Holmes Ranch
 Drilled by USGS-GD Driller L. Kozak Hole Size 5-1/8 inches
 Date Started 9-21-82 Date Completed 9-21-82 Geologist M. Funkhouser
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	5	5	Sandstone, gray, highly cemented
5	14	9	Sandstone & shale, brown, weathered
14	20	6	Shale, brown, carbonaceous
20	47	27	Sandstone, gray, white, & brown with interbedded gypsum-bearing shale
47	52	5	Shale, black, carbonaceous
52	61	9	Coal - ROLAND BED
61	71	10	Shale, gray
71	77	6	Sandstone, gray
77	89	12	Siltstone, gray
89	92	3	Limestone, gray, highly cemented
92	105	13	Shale, gray
105	107	2	Shale, brown, carbonaceous
107	110	3	Shale, gray
110	121	11	Siltstone, gray
121	131	10	Sandstone & siltstone, interbedded
131	151	20	Shale, gray
151	156	5	Sandstone, gray
156	160	4	Shale, gray
160	169	9	Sandstone, very fine grained
169	173	4	Shale, brown, carbonaceous
173	179	6	Sandstone, gray
179	196	17	Shale, gray to brown, carbonaceous
196	202	6	Coal - LOCAL BED
202	208	6	Shale, carbonaceous
208	210	2	Coal - LOCAL BED
210	213	3	Clay, gray
213	222	9	Shale, gray
222	230	8	Sandstone, gray
230	239	9	Shale, gray
239	252	13	Sandstone, gray with interbedded clay
252	258	6	Shale, brown, carbonaceous
258	264	6	Sandstone, gray, fine grained
264	269	5	Shale, gray
269	278	9	Sandstone, gray
278	285	7	Shale, brown, carbonaceous
285	290	5	Siltstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
290	308	18	Coal - SMITH BED
308	312	4	Clay, gray
312	321	9	Shale, gray
321	326	5	Shale, gray to brown, carbonaceous
326	345	19	Shale & siltstone, gray
345	352	7	Sandstone, gray
352	360	8	Siltstone, gray
360	363	3	Sandstone, gray
363	365	2	Siltstone, gray
365	386	21	Sandstone & clay, gray
386	408	22	Shale, gray with interbedded thin sandstone
408	412	4	Shale, brown, carbonaceous
412	434	22	Coal - ANDERSON BED
434	441	7	Shale, gray
441	444	3	Coal - UPPER DIETZ 2 BED
444	448	4	Shale, gray
448	455	7	Sandstone, gray
455	458	3	Clay, gray
458	472	14	Shale and sandstone, gray

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-13 Elev. 4059 feet Total Depth 775 feet
 Location 33' FNL & 261' FEL Sec. 33, T. 8 S, R. 42 E.
 County Big Horn State Quadrangle Quadrangle Pine Butte School
 Drilled by USGS-GD Driller D. Brown Hole Size 5-1/8 inches
 Date Started 9-12-82 Date Completed 9-13-82 Geologist M. Funkhouser
 Remarks Hole caved slightly, logged only to 750'. Sample log modified by
geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	5	5	Clay, brown, weathered
5	10	5	Clay, with white gastropod-bearing rock
10	23	13	Sandstone, gray & brown
23	32	9	Siltstone, brown
32	37	5	Clay, brown & gray
37	44	7	Shale, gray
44	51	7	Shale, brown, carbonaceous
51	58	7	Coal - ROLAND BED
58	65	7	Shale, black, carbonaceous
65	80	15	Sandstone, gray
80	85	5	Siltstone, gray
85	93	8	Shale, gray
93	98	5	Sandstone, gray
98	100	2	Shale, brown, carbonaceous
100	102	2	Coal
102	108	6	Shale, gray
108	118	10	Sandstone, gray
118	128	10	Siltstone, gray
128	133	5	Shale, gray
133	138	5	Siltstone, gray
138	152	14	Sandstone, gray
152	158	6	Shale, gray
158	167	9	Siltstone, gray
167	172	5	Shale, gray
172	180	8	Sandstone, gray
180	182	2	Shale, black, carbonaceous
182	193	11	Sandstone, gray
193	196	3	Shale, black, carbonaceous
196	199	3	Coal - LOCAL BED
199	202	3	Shale, black, carbonaceous
202	204	2	Coal - LOCAL BED
204	206	2	Shale, brown, carbonaceous
206	221	15	Shale, gray
221	233	12	Sandstone, gray
233	239	6	Shale, brown, carbonaceous

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
239	250	11	Shale, gray
250	255	5	Siltstone, tan
255	261	6	Shale, gray
261	265	4	Sandstone, brown & gray
265	282	17	Sandstone & shale, gray
282	292	10	Sandstone, gray
292	301	9	Siltstone, gray
301	304	3	Shale, gray
304	320	16	Coal - SMITH BED
320	321	1	Shale, carbonaceous
321	322	1	Coal - SMITH BED
322	334	12	Shale, carbonaceous
334	336	2	Limestone, gray, dense, hard
336	353	17	Shale, gray
353	358	5	Sandstone, gray
358	367	9	Siltstone, gray
367	376	9	Shale, brown & black, carbonaceous
376	381	5	Siltstone, gray
381	392	11	Sandstone, gray
392	428	36	Shale, gray
428	436	8	Sandstone, gray
436	441	5	Shale, brown, carbonaceous
441	467	26	Coal - ANDERSON BED
467	472	5	Shale, brown, carbonaceous
472	477	5	Coal - ANDERSON BED
477	480	3	Clay, gray
480	484	4	Sandstone, gray
484	488	4	Shale, gray
488	518	30	Sandstone, gray, with interbedded shale
518	526	8	Shale, gray
526	549	23	Sandstone, gray, with interbedded shale
549	570	21	Shale, brown & black, carbonaceous
570	574	4	Coal - LOWER DIETZ 2 BED
574	577	3	Shale, carbonaceous
577	579	2	Coal
579	586	7	Clay & gray shale
586	590	4	Coal - UPPER DIETZ 3 BED
590	597	7	Shale, gray
597	604	7	Sandstone, gray
604	611	7	Shale, gray
611	619	8	Siltstone, gray
619	626	7	Sandstone, gray
626	645	19	Shale, gray, with siltstone
645	648	3	Coal mixed with carbonaceous shale
648	651	3	Shale, carbonaceous
651	653	2	Coal
653	655	2	Shale, carbonaceous

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
655	663	8	Sandstone, gray
663	668	5	Shale, gray to carbonaceous
668	671	3	Coal - LOWER DIETZ 3 BED
671	674	3	Shale, carbonaceous
674	699	25	Siltstone, gray interbedded with shale
699	715	16	Sandstone, gray
715	737	22	Sandstone & siltstone, gray
737	740	3	Shale, gray
740	754	14	Coal - Canyon BED (geophysical log stops at 750')
754	760	6	Shale, brown, carbonaceous
760	765	5	Shale, gray
765	775	10	Sandstone & shale, gray

Sample Log

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U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-14 Elev. 3750 feet Total Depth 875 feet
 Location 1650' FSL & FWL Sec. 25, T. 9 S., R. 40 E.
 County Big Horn State Montana Quadrangle Decker
 Drilled by USGS-GD Driller D. Brown Hole Size 5-1/8 inches
 Date Started 10-5-82 Date Completed 10-6-82 Geologist E. Burks
 Remarks Hole left open at lessee's request. Sample log modified by
geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	5	5	Sandstone, weathered
5	22	17	Sandstone, tan
22	25	3	Shale, gray
25	33	8	Sandstone, gray
33	38	5	Shale, gray
38	63	25	Sandstone, gray
63	68	5	Shale, gray
68	80	12	Coal - ROLAND BED
80	86	6	Shale, gray
86	104	18	Sandstone, gray
104	125	21	Sandstone and shale, gray
125	130	5	Sandstone, gray
130	148	18	Sandstone and shale, gray
148	163	15	Shale, gray
163	171	8	Siltstone, gray
171	174	3	Coal - LOCAL BED
174	184	10	Shale, carbonaceous to gray
184	205	21	Sandstone and shale, gray
205	210	5	Sandstone, gray
210	223	13	Shale and sandstone
223	231	8	Sandstone, gray
231	237	6	Shale, gray
237	250	13	Sandstone, gray
250	254	4	Siltstone, gray
254	258	4	Shale, gray
258	261	3	Sandstone, gray
261	264	3	Siltstone, gray
264	266	2	Coal
266	274	8	Shale, gray
274	282	8	Sandstone, gray
282	295	13	Sandstone and shale, gray
295	319	24	Sandstone, gray
319	327	8	Siltstone, gray
327	345	18	Shale, carbonaceous, and gray
345	351	6	Siltstone, gray
351	354	3	Sandstone, gray
354	360	6	Shale, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
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360	365	5	Sandstone, gray
365	375	10	Shale, gray
375	379	4	Sandstone, gray
379	389	10	Shale, gray
389	403	14	Coal, SMITH BED
403	407	4	Shale, carbonaceous
407	445	38	Shale and sandstone, gray
445	465	20	Siltstone, gray
465	480	15	Sandstone, gray
480	485	5	Shale, gray
485	509	24	Coal - ANDERSON BED
509	517	8	Shale, gray
517	523	6	Sandstone, gray
523	533	10	Shale, gray
533	537	4	Sandstone, gray
537	547	10	Shale, carbonaceous
547	592	45	Siltstone and shale, gray
592	608	16	Coal - DIETZ 2 BED
608	614	6	Shale, gray
614	623	9	Sandstone, gray
623	636	13	Shale, carbonaceous to gray
636	649	13	Sandstone, gray
649	654	5	Siltstone, gray
654	667	13	Shale, gray
667	668	1	Coal
668	670	2	Shale, gray
670	671	1	Coal
671	673	2	Shale, gray
673	688	15	Coal - DIETZ 3 BED
688	691	3	Shale, gray
691	697	6	Sandstone, gray
697	700	3	Shale, gray
700	746	46	Sandstone, gray, with interbedded shale
746	750	4	Shale, gray
750	757	7	Coal carbonaceous shale
757	762	5	Shale, gray
762	778	16	Siltstone, gray
778	784	6	Sandstone, gray
784	790	6	Shale, gray
790	792	2	Coal - CANYON BED
792	793	1	Shale, gray
793	814	21	Coal - CANYON BED
814	824	10	Shale, gray
824	830	6	Sandstone, gray
830	833	3	Shale, gray
833	875	42	Sandstone, gray

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-15 Elev. 4194 feet Total Depth 895 feet
 Location 225' FNL & 300' FEL Sec. 29, T. 8S, R. 42 E.
 County Big Horn State Montana Quadrangle Pine Butte School
 Drilled by USGS-GD Driller A. Clark Hole Size 5-1/8 inches
 Date Started 9-12-82 Date Completed 9-12-82 Geologist S. Haight
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	22	22	Clay, tan
22	24	2	Shale, brown, carbonaceous
24	35	11	Sandstone, light brown, coarsening downward
35	40	5	Siltstone, gray
40	43	3	Clay, blue-gray
43	52	9	Siltstone, gray
52	55	3	Sandstone, brown, coarse
55	65	10	Siltstone, gray
65	75	10	Sandstone, brown
75	80	5	Shale, gray & sand with white mollusc shell fragments
80	85	5	Shale, gray
85	94	9	Sandstone, dark gray, silty
94	101	7	Shale, gray
101	104	3	Sandstone, gray, fine
104	108	4	Shale, gray
108	116	8	Sandstone, gray, fine
116	123	7	Shale, gray
123	127	4	Sandstone, gray, coarse
127	137	10	Sandstone, gray, with mollusc shell fragments
137	150	13	Siltstone, gray
150	160	10	Shale, dark gray, slightly carbonaceous
160	166	6	Shale, black, carbonaceous
166	169	3	Coal - ROLAND BED
169	171	2	Shale, gray, carbonaceous
171	176	5	Coal - ROLAND BED
176	183	7	Shale, gray to black, carbonaceous
183	189	6	Sandstone, gray, fine
189	197	8	Shale, gray
197	203	6	Sandstone, gray
203	220	17	Shale, gray
220	224	4	Clay, gray
224	226	2	Coal with dark gray carbonaceous shale
226	242	16	Shale, gray to black, carbonaceous
242	257	15	Sandstone, fining upward
257	263	6	Shale, gray, silty

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
263	268	5	Sandstone, gray fine
268	273	5	Shale, gray
273	278	5	Sandstone, gray, fine
278	293	15	Shale, gray
293	309	16	Sandstone, gray
309	316	7	Shale, black, carbonaceous
316	320	4	Sandstone, gray
320	326	6	Shale, gray
326	330	4	Siltstone, gray
330	339	9	Siltstone & shale, gray
339	346	7	Sandstone, gray
346	353	7	Shale, gray
353	356	3	Siltstone, gray
356	362	6	Sandstone, gray
362	384	22	Sandstone & siltstone, gray
384	387	3	Shale, gray
387	408	21	Siltstone, gray
408	425	17	Coal - SMITH BED
425	429	4	Clay, gray
429	451	22	Shale & clay, gray
451	455	4	Shale, black, carbonaceous
455	459	4	Sandstone, gray
459	466	7	Shale, black, carbonaceous
466	475	9	Siltstone, gray
475	534	59	Sandstone, gray
534	540	6	Siltstone, gray
540	544	4	Shale, carbonaceous
544	578	34	Siltstone, gray
578	585	7	Shale, dark brown
585	600	15	Shale, brown, carbonaceous
600	629	29	Coal - ANDERSON BED
629	633	4	Shale, gray
633	637	4	Coal - ANDERSON BED
637	640	3	Shale, gray
640	644	4	Coal - ANDERSON BED
644	655	11	Shale, gray
655	659	4	Sandstone, gray
659	661	2	Siltstone, gray
661	666	5	Shale, dark brown to black
666	675	9	Sandstone, gray
675	690	15	Shale & siltstone, gray
690	697	7	Coal - LOWER DIETZ 2 BED
697	711	14	Shale & clay, gray
711	715	4	Coal - UPPER DIETZ 3 BED
715	725	10	Shale, brown
725	728	3	Coal -Local

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
728	743	15	Siltstone, gray
743	756	13	Shale, brown to black
756	761	5	Sandstone, gray
761	765	4	Siltstone, gray
765	768	3	Shale, gray
768	772	4	Siltstone, gray
772	780	8	Sandstone, brown
780	782	2	Clay, carbonaceous
782	784	2	Coal - Local
784	790	6	Shale, gray
790	809	19	Sandstone, light gray
809	811	2	Coal - LOWER DIETZ 3 BED
811	814	3	Shale, brown to black, carbonaceous
814	820	6	Siltstone, gray
820	828	8	Sandstone, gray
828	833	5	Shale, brown
833	842	9	Sandstone, gray
842	845	3	Shale, gray
845	849	4	Siltstone, gray
849	863	14	Coal - CANYON BED
863	864	1	Clay, gray
864	869	5	Siltstone, gray
869	871	2	Shale, gray
871	895	24	Siltstone, gray

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-16 Elev. 3941 feet Total Depth 855 feet
 Location 200' FSL & 150' FWL Sec. 14, T. 9 S., R. 42 E.
 County Big Horn State Montana Quadrangle Pine Butte School
 Drilled by USGS-GD Driller D. Brown Hole Size 5-5/8 inches
 Date Started 9-23-92 Date Completed 9-24-82 Geologist E. Burks
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	10	10	Shale, weathered
10	17	7	Sandstone, brown
17	26	9	Shale, carbonaceous
26	33	7	Sandstone, brown, with some siltstone
33	42	9	Siltstone, gray
42	45	3	Sandstone, gray with gastropod & mollusc fossils
45	51	6	Siltstone, gray
51	64	13	Shale, gray
64	73	9	Shale, carbonaceous
73	81	8	Coal - ROLAND BED
81	85	4	Clay, gray
85	89	4	Shale, carbonaceous
89	106	17	Siltstone, gray
106	112	6	Shale, gray
112	119	7	Siltstone, gray
119	137	18	Shale, gray
137	140	3	Coal - LOCAL BED
140	143	3	Shale, carbonaceous
143	154	11	Sandstone, gray, clean, fine grained
154	158	4	Siltstone, gray
158	166	8	Shale, gray
166	170	4	Siltstone, gray
170	217	47	Sandstone, gray, clean, coarsening downward
217	231	14	Shale, gray
231	241	10	Sandstone, gray
241	247	6	Shale, carbonaceous
247	249	2	Coal - LOCAL BED
249	251	2	Shale, carbonaceous
251	263	12	Siltstone, gray
263	278	15	Sandstone, gray
278	290	12	Siltstone, gray
290	295	5	Shale, gray
295	308	13	Siltstone, gray
308	312	4	Clay, brown
312	322	10	Shale, gray, with some coal fragments
322	344	22	Siltstone, gray
344	350	6	Sandstone, gray
350	357	7	Shale, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
357	365	8	Coal - SMITH BED
365	375	10	Shale, gray
375	377	2	Siltstone, gray
377	385	8	Sandstone, gray
385	389	4	Siltstone, gray
389	391	2	Shale, gray
391	400	9	Sandstone, gray with some interbedded shale
400	414	14	Siltstone, gray
414	416	2	Shale, gray
416	423	7	Siltstone, gray
423	428	5	Sandstone, gray
428	442	14	Siltstone, gray
442	456	14	Sandstone, gray
456	476	20	Siltstone, gray
476	480	4	Shale, carbonaceous
480	488	8	Siltstone, gray
488	513	25	Coal - ANDERSON BED
513	514	1	Shale, gray
514	519	5	Coal - ANDERSON BED
519	524	5	Shale, carbonaceous
524	535	11	Shale & siltstone, gray
535	540	5	Sandstone, gray
540	570	30	Siltstone & shale, gray, interbedded
570	594	24	Sandstone, gray
594	600	6	Shale, gray
600	623	23	Siltstone, gray
623	639	16	Shale, gray, with black clay & carbonaceous shale below
639	643	4	Coal - LOWER DIETZ 2 BED
643	652	9	Shale, gray
652	660	8	Sandstone, gray
660	676	16	Sandstone & shale, gray
676	682	6	Shale, gray with interbedded siltstone
682	688	6	Coal - UPPER DIETZ 3 BED
688	698	10	Shale, gray
698	700	2	Coal - LOCAL BED
700	701	1	Shale, carbonaceous
701	703	2	Coal - LOCAL BED
703	708	5	Shale, gray
708	712	4	Sandstone, gray
712	721	9	Siltstone, gray
721	729	8	Shale, gray
729	737	8	Sandstone, gray
737	740	3	Shale, gray
740	750	10	Sandstone, gray
750	753	3	Shale, gray
753	760	7	Sandstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
760	762	2	Siltstone, gray
762	768	6	Coal - LOWER DIETZ 3 BED
768	783	15	Sandstone & shale, gray
783	791	8	Sandstone, gray
791	794	3	Shale, gray
794	803	9	Sandstone, gray
803	808	5	Shale, gray
808	810	2	Siltstone, gray
810	812	2	Shale, gray
812	825	13	Coal - CANYON BED
825	827	2	Shale, carbonaceous
827	837	10	Siltstone, gray
837	839	2	Shale, gray
839	841	2	Coal
841	855	14	Shale, gray

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-17 Elev. 3766 feet Total Depth 435 feet
 Location 317' FNL & 92' FEL Sec. 35, T. 9 S, R. 42 E.
 County Big Horn State Montana Quadrangle Pine Butte School
 Drilled by USGS-GD Driller L. Kozak Hole Size 5-1/8 inches
 Date Started 9-24-82 Date Completed 9-24-82 Geologist M. Funkhouser
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	10	10	Clay, white to light brown, weathered
10	15	5	Sandstone, white, fine
15	24	9	Clay, brown, weathered
24	36	12	Sandstone, brown, coarsening downward
36	43	7	Siltstone, brown
43	52	9	Shale, gray & black, carbonaceous
52	56	4	Shale, gray
56	62	6	Shale, black, carbonaceous
62	66	4	Sandstone, gray
66	68	2	Shale, black, carbonaceous
68	78	10	Sandstone, gray & black
78	82	4	Shale, black, carbonaceous
82	98	16	Shale, gray & black, carbonaceous
98	104	6	Sandstone, gray
104	114	10	Shale, brown, carbonaceous
114	121	7	Sandstone, gray
121	131	10	Shale, gray, black, brown, carbonaceous
131	151	20	Sandstone, gray
151	173	22	Shale, brown, carbonaceous
173	195	22	Sandstone & shale, gray
195	205	10	Shale & clay, black, carbonaceous
205	215	10	Shale & siltstone, gray
215	222	7	Siltstone, gray
222	231	9	Coal - SMITH BED
231	247	16	Shale, brown, carbonaceous
247	259	12	Sandstone, gray
259	262	3	Shale, gray
262	282	20	Siltstone & sandstone, gray
282	289	7	Sandstone, gray
289	295	6	Shale, gray & black, carbonaceous
295	344	49	Siltstone & sandstone, gray
344	348	4	Shale, brown, carbonaceous
348	357	9	Sandstone, gray
357	368	11	Shale, brown, carbonaceous
368	400	32	Coal - ANDERSON BED

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
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400	405	5	Shale, brown, carbonaceous
405	419	14	Shale, gray
419	421	2	Limestone, gray
421	435	14	Shale, gray

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole	R-82-18	Elev.	3963	feet	Total Depth	635	feet
Location	28' FNL & 55' FEL			Sec. 9	, T. 9 S, R. 42 E.		
County	Big Horn	State	Montana	Quadrangle	Pine Butte School		
Drilled by	USGS-GD	Driller	L. Kozk	Hole Size	5-1/8 inches		
Date Started	9-22-82	Date Completed	9-22-82	Geologist	M. Funkhouser		
Remarks	Hole stopped in very hard sandstone. Sample log modified by geophysical log interpretation.						

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	11	11	Sand, tan, fine
11	18	7	Shale, brown, carbonaceous, weathered
18	26	8	Sandstone, tan, fine
26	38	12	Sandstone & shale, gray
38	57	19	Shale, brown & black, carbonaceous
57	61	4	Sandstone, gray
61	69	8	Coal - ROLAND BED
69	74	5	Shale, black, carbonaceous
74	79	5	Sandstone, gray
79	84	5	Shale, gray
84	89	5	Sandstone, gray, fine
89	96	7	Shale, gray, brown, black, some carbonaceous
96	106	10	Sandstone, gray
106	120	14	Shale, black, carbonaceous
120	122	2	Coal
122	123	1	Shale, black, carbonaceous
123	124	1	Coal
124	129	5	Shale, black, carbonaceous
129	142	13	Shale, gray
142	167	25	Sandstone, gray with interbedded shale
167	176	9	Shale, black, carbonaceous
176	196	20	Shale, gray
196	197	1	Sandstone, gray
197	205	8	Siltstone, gray
205	215	10	Sandstone, gray
215	223	8	Shale, black, carbonaceous
223	234	11	Sandstone & shale, gray
234	238	4	Shale, gray
238	239	1	Coal
239	241	2	Clay, gray
241	250	9	Shale, gray
250	255	5	Coal - LOCAL BED
255	296	41	Shale & interbedded sandstone, gray
296	304	8	Shale, brown, carbonaceous

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
304	311	7	Sandstone, gray
311	313	2	Shale, gray
313	317	4	Sandstone, gray
317	330	13	Siltstone, gray
330	337	7	Sandstone, gray
337	344	7	Shale, dark gray
344	346	2	Coal
346	352	6	Shale, gray
352	378	26	Sandstone, gray
378	385	7	Shale, carbonaceous
385	387	2	Siltstone, brown
387	390	3	Shale, brown, carbonaceous
390	401	11	Coal - SMITH BED
401	404	3	Clay, gray
404	413	9	Shale, gray, black, carbonaceous
413	434	21	Siltstone & sandstone, gray
434	450	16	Shale, brown, carbonaceous
450	460	10	Sandstone, gray
460	468	8	Shale, brown, carbonaceous
468	480	12	Siltstone, gray
480	490	10	Shale, gray
490	494	4	Sandstone, gray
494	497	3	Shale, gray
497	499	2	Sandstone, gray
499	512	13	Shale, gray, brown, carbonaceous
512	539	27	Coal - ANDERSON BED
539	541	2	Shale, carbonaceous
541	546	5	Coal - ANDERSON BED
546	550	4	Shale, gray
550	556	6	Sandstone, gray, fine
556	564	8	Siltstone & shale, gray
564	578	14	Sandstone, gray
578	584	6	Shale, brown & black, carbonaceous
584	590	6	Sandstone, gray
590	600	10	Siltstone, gray
600	613	13	Shale, brown, carbonaceous
613	617	4	Coal - LOWER DIETZ 2 BED
617	619	2	Clay, gray
619	621	2	Sandstone, gray
621	632	11	Shale, gray
632	635	3	Sandstone, gray

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-19WW Elev. 3630 feet Total Depth 400 feet
 Location 700' FSL & 2200' FEL Sec. 14, T. 9 S., R. 41 E.
 County Big Horn State Montana Quadrangle Holmes Ranch
 Drilled by N.A. Driller N.A. Hole Size 5 inches
 Date Started N.A. Date Completed 10-4-82 Geologist E. Burks
 Remarks Log of cased water well. Sample log below based entirely on
geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	18	18	Weathered sandstone & shale
18	53	35	Sandstone
53	75	22	Shale
75	80	5	Siltstone
80	89	9	Coal - SMITH BED
89	98	9	Shale
98	108	10	Sandstone
108	131	23	Siltstone & shale
131	160	29	Siltstone & sandstone
160	171	11	Sandstone
171	173	2	Shale
173	182	9	Sandstone
182	186	4	Siltstone
186	190	4	Shale
190	212	22	Coal - ANDERSON BED
212	215	3	Shale
215	223	8	siltstone & shale, interbedded
223	229	6	Shale
229	231	2	Coal - UPPER DIETZ 2 BED
231	236	5	Clay
236	241	5	Sandstone
241	255	14	Siltstone
255	259	4	Shale
259	268	9	Siltstone & shale
268	280	12	Shale
280	283	3	Siltstone
283	287	4	Shale
287	294	7	Siltstone
294	298	4	Coal - LOWER DIETZ 2 BED
298	299	1	Clay
299	307	8	Shale
307	315	8	Sandstone
315	328	13	Sandstone & shale, interbedded
328	346	18	Sandstone
346	369	23	Shale
369	373	4	Coal - UPPER DIETZ 3 BED

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
373	379	6	Clay and shale
379	384	5	Siltstone
384	387	3	Shale
387	392	5	Siltstone
392	398	6	Sandstone
398	400	2	Shale

U.S.G.S. - M.M.S.
1982 Drilling Program
Northern Powder River Basin, Montana

Hole R-82-20WW Elev. 3680 feet Total Depth 227 feet
 Location 3300' FNL & 1050' FEL Sec. 20, T. 9S, R. 41 E.
 County Big Horn State Montana Quadrangle Holmes Ranch
 Drilled by N.A. Driller 10-6-82 Hole Size J. McKay
 Date Started N.A. Date Completed 10-6-82 Geologist J. McKay
 Remarks Log of cased water well. Sample log below based entirely on
geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	12	12	Weathered sandstone
12	20	8	Shale and siltstone
20	22	2	Sandstone
22	29	7	Shale
29	39	10	Sandstone
39	42	3	Shale
42	47	5	Siltstone
47	50	3	Shale
50	55	5	Sandstone
55	64	9	Shale
64	72	8	Siltstone
72	78	6	Sandstone
78	99	21	Siltstone & sandstone
99	104	5	Sandstone
104	111	7	Shale
111	114	3	Sandstone
114	117	3	Shale
117	125	8	Sandstone
125	128	3	Shale
128	131	3	Sandstone
131	137	6	Shale
137	148	11	Sandstone & shale
148	176	28	Shale
176	194	18	Sandstone & shale, interbedded
194	204	10	Shale & siltstone
204	206	2	Sandstone
206	209	3	Siltstone
209	219	10	Coal - SMITH BED
219	222	3	Clay
222	224	2	Siltstone
224	227	3	Shale

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole MC-1-82 Elev. 3245 feet Total Depth 305 feet
 Location 750 FSL, 1500 FEL Sec. 5, T. 2 N., R. 39 E.
 County Rosebud State Montana Quadrangle McClure Creek
 Drilled by USGS-GD Driller L. Kozak Hole Size 5 5/8 inches
 Date Started 10/10/82 Date Completed 10/10/82 Geologist Scott Haight
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	5	5	Sandstone, weathered
5	13	8	Sandstone, brown
13	16	3	Siltstone, brown
16	19	3	Sandstone, brown
19	21	2	Siltstone, brown
21	26	5	Sandstone, brown
26	32	6	Shale, brown, carbonaceous
32	36	4	Siltstone, gray
36	38	2	Clay, gray
38	52	14	Shale and siltstone, gray, interbedded
52	75	23	Sandstone, siltstone, and shale, gray, interbedded
75	83	8	Shale, carbonaceous
83	87	4	Siltstone, gray
87	90	3	Shale, gray
90	93	3	Siltstone, gray
93	101	8	Sandstone, gray
101	107	6	Shale, black, carbonaceous
107	111	4	Siltstone, gray
111	120	9	Clay, gray
120	138	18	Siltstone and shale, gray, interbedded
138	145	7	Siltstone, gray
145	149	4	Shale, dark gray
149	163	14	Siltstone, gray
163	166	3	Coal - LOCAL BED
166	170	4	Shale, brown, carbonaceous
170	175	5	Siltstone, gray
175	222	47	Sandstone, gray, silty in places
222	229	7	Siltstone, gray
229	231	2	Coal - LOCAL BED
231	235	4	Siltstone, gray
235	237	2	Sandstone, gray
237	246	9	Siltstone, gray
246	248	2	Limestone, gray
248	260	12	Sandstone, gray
260	272	12	Siltstone and shale, gray, interbedded
272	274	2	Coal, dirty BIG DIRTY BED (?)
274	275	1	Siltstone, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole TCS-1-82 Elev. 3117 feet Total Depth 215 feet
 Location 1550 FSL, 1750 FWL Sec. 35, T. 3 N., R. 39 E.
 County Rosebud State Montana Quadrangle Trail Creek School
 Drilled by USGS-GD Driller L. Kozak Hole Size 5 5/8 inches
 Date Started 10/8/82 Date Completed 10/8/82 Geologist Scott Haight
 Remarks Hole completed as a water well. Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	10	10	Sand, light brown
10	19	9	Siltstone, brown
19	77	58	Sandstone, brown to orange
77	79	2	Clay, gray
79	98	19	Sandstone, gray, with some interbedded siltstone
98	109	11	Siltstone, dark gray, with some shale
109	111	2	Coal, dirty
111	116	5	Shale, black, carbonaceous
116	127	11	Coal - BIG DIRTY BED
127	132	5	Shale, carbonaceous
132	133	1	Coal, dirty
133	138	5	Shale, carbonaceous
138	140	2	Coal - LOCAL BED
140	150	10	Siltstone, light gray
150	155	5	Shale, gray, carbonaceous
155	160	5	Siltstone, gray
160	169	9	Sandstone and siltstone, gray, interbedded
169	171	2	Coal - LOCAL BED
171	172	1	Siltstone, gray
172	173	1	Coal - LOCAL BED
173	188	15	Siltstone and sandstone, gray, interbedded
188	195	7	Shale, carbonaceous
195	205	10	Siltstone and sandstone, gray, interbedded
205	207	2	Coal - LOCAL BED
207	215	8	Siltstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
275	277	2	Coal, dirty BIG DIRTY BED (?)
277	282	5	Shale, carbonaceous
282	286	4	Coal, dirty BIG DIRTY BED (?)
286	287	1	Siltstone, gray
287	291	4	Sandstone, gray
291	293	2	Siltstone, gray
293	299	6	Sandstone, gray
299	305	6	Shale, brown-black, carbonaceous, and white clay

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole MC-2-82 Elev. 3640 feet Total Depth 735 feet
 Location 1900 FSL, 450 FEL Sec. 2, T. 2 N., R. 38 E.
 County Treasure State Montana Quadrangle McClure Creek
 Drilled by USGS-GD Driller L. Kozak Hole Size 5 1/8 inches
 Date Started 10/9/82 Date Completed 10/9/82 Geologist Scott Haight
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	16	16	Siltstone, brown
16	48	32	Sandstone, brown to gray, coarse, silty in spots
48	50	2	Siltstone, gray
50	51	1	Coal, dirty
51	52	1	Siltstone, gray
52	53	1	Coal, dirty
53	56	3	Clay, gray
56	57	1	Coal, dirty
57	64	7	Shale, brown, carbonaceous
64	67	3	Coal, dirty
67	78	11	Shale, brown and gray, with interbedded siltstone
78	83	5	Siltstone, gray
83	86	3	Shale, gray
86	92	6	Siltstone, gray
92	98	6	Clay, gray
98	111	13	Coal - ROSEBUD BED
111	113	2	Clay, gray
113	122	9	Siltstone, gray
122	126	4	Shale, carbonaceous
126	128	2	Coal - Local
128	143	15	Shale, brown, carbonaceous
143	146	3	Coal - UPPER MCKAY BED
146	147	1	Clay, gray
147	155	8	Siltstone, gray
155	163	8	Shale, dark gray, carbonaceous, silty
163	175	12	Sandstone, gray
175	181	6	Coal - LOWER MCKAY BED
181	183	2	Clay, gray
183	186	3	Siltstone, gray
186	189	3	Shale, brown, carbonaceous
189	195	6	Coal, dirty
195	227	32	Siltstone, gray, sandy in spots
227	277	50	Sandstone, gray, coarsest near 240'
277	279	2	Siltstone, gray
279	288	9	Sandstone, gray
288	295	7	Siltstone, gray
295	300	5	Shale and siltstone, blue-gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
300	304	4	Shale, carbonaceous sand
304	310	6	Shale, gray
310	326	16	Siltstone, gray, sandy
326	330	4	Shale, carbonaceous
330	338	8	Coal - ROBINSON BED
338	342	4	Siltstone, gray
342	346	4	Shale, carbonaceous
346	353	7	Coal - ROBINSON BED
353	374	21	Shale, brown, carbonaceous
374	381	7	Siltstone, gray
381	446	65	Sandstone, gray
446	452	6	Shale, gray
452	466	14	Sandstone, gray
466	471	5	Shale, gray
471	475	4	Siltstone, gray
475	485	10	Sandstone, gray
485	491	6	Shale, dark gray, carbonaceous
491	495	4	Sandstone, gray
495	499	4	Siltstone, gray
499	505	6	Sandstone, gray
505	525	20	Siltstone and shale, gray, interbedded
525	580	55	Sandstone and siltstone, gray, interbedded
580	594	14	Siltstone, gray
594	612	18	Sandstone and siltstone, gray, interbedded
612	616	4	Coal - Local
616	618	2	Shale, carbonaceous
618	640	22	Sandstone, gray, coarse
640	663	23	Siltstone and sandstone, gray, interbedded
663	684	21	Sandstone, gray
684	703	19	Siltstone and sandstone, gray, interbedded
703	705	2	Shale, black, carbonaceous
705	708	3	Siltstone, gray
708	711	3	Shale, gray
711	718	7	Sandstone, gray
718	720	2	Shale, carbonaceous
720	735	15	Sandstone, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole CW-1-82 Elev. 3278 feet Total Depth 200 feet
Location 650 FSL, 2000 FWL Sec. 26, T. 3 N., R. 40 E.
County Rosebud State Montana Quadrangle Colstrip West
Drilled by USGS-GD Driller L. Kozak Hole Size 5 5/8 inches
Date Started 10/10/82 Date Completed 10/10/82 Geologist Scott Haight
Remarks Log run at expanded scale from 170'-200'. Sample log modified by geophysical
log interpretation. Big Dirty Bed cored here.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	5	5	Sand, brown
5	15	10	Siltstone, brown
15	21	6	Sandstone, brown
21	25	4	Coal, dirty
25	32	7	Shale, black, carbonaceous
32	41	9	Siltstone, gray and brown
41	50	9	Shale, black, carbonaceous
50	60	10	Siltstone, gray, fining upward
60	120	60	Siltstone and shale, gray, interbedded
120	138	18	Sandstone, gray, fining upward into siltstone
138	160	22	Siltstone and sandstone, gray, interbedded
160	175	15	Shale and siltstone, gray, interbedded
175	184	9	Coal - BIG DIRTY BED
184	196	12	Sandstone, gray
196	200	4	Shale and siltstone, gray

Cored intervals (in feet)

Core No.	From	To	Length of Core Recovered
1	175.0	180.0	5.0
2	180.0	189.3	9.3

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
175	184.2	9.2	Coal - BIG DIRTY BED
184.2	189.3	5.1	Sandstone, gray

Coal Analysis

Page 1 of 1

USGS-MMS-BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole CW-1-82 Sample No. U11085 Interval 175.0'-184.2'
 Bed Sampled Big Dirty Remarks _____
 Elevation 3278' Location 650FSL, 2000FWL, Sec. 26, T. 3N., R. 40 E.
 County Rosebud State Montana Quadrangle Colstrip West
 Date of Report 12-30-82 Analysed by Geochemical Testing, Somerset, PA

AIR DRY LOSS 11.54 RESIDUAL MOISTURE 4.02

	As-received	Dry	Dry ash-free
Moisture	15.10		
Ash	22.85	26.91	
Volatile Matter	26.93	31.73	43.41
Fixed Carbon	35.12	41.36	56.59
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

ULTIMATE ANALYSIS

Hydrogen	4.89	3.77	5.16
Carbon	43.55	51.30	70.19
Nitrogen	0.70	0.83	1.14
Sulfur	0.71	0.84	1.15
Oxygen	27.30	16.35	22.36
Ash	22.85	26.91	
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Heating Value (BTU/lb)	7278	8572	11728
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FORMS OF SULFUR

Sulfate sulfur	0.02	0.02	0.03
Pyritic sulfur	0.52	0.61	0.83
Organic sulfur	0.17	0.21	0.29

FREE SWELLING INDEX 0.0

ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation	2440F
Softening Temp.	2530 F
Fluid Temp.	2660 F

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole CC-13-82 Elev. 2875 feet Total Depth 715 feet
Location 125 FNL, 2500 FEL Sec. 5, T. 12 N, R. 49 E.
County Prairie State Montana Quadrangle McClure Reservoir
Drilled by USGS-GD Driller L. Kozak Hole Size 5 1/8 inches
Date Started 10/12/82 Date Completed 10/18/82 Geologist Scott Haight
Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	10	10	Silt and clay, brown
10	13	3	Clay, gray
13	15	2	Coal - UPPER H BED
15	41	26	Sandstone and siltstone, brown, interbedded
41	48	7	Siltstone, gray
48	55	7	Coal - LOWER H BED
55	58	3	Clay, gray
58	62	4	Coal - LOWER H BED
62	66	4	Siltstone, gray
66	71	5	Sandstone, gray
71	75	4	Clay, gray
75	79	4	Sandstone, gray
79	86	7	Shale, blue-gray
86	88	2	Siltstone, gray
88	92	4	Shale, gray
92	99	7	Siltstone, gray
99	115	16	Shale, dark gray, carbonaceous, coarsening upward into siltstone
115	127	12	Shale, gray
127	131	4	Sandstone, gray
131	132	1	Shale, gray
132	146	14	Siltstone, gray, sandy
146	151	5	Shale, dark gray, carbonaceous
151	173	22	Siltstone and shale, gray, interbedded
173	175	2	Coal, dirty
175	177	2	Siltstone, gray
177	197	20	Shale, brown to gray, carbonaceous
197	216	19	Sandstone, gray, silty
216	241	25	Siltstone and shale, gray
241	257	16	Sandstone, gray, silty
257	267	10	Siltstone, gray
267	387	120	Sandstone, gray, silty in places
387	390	3	Siltstone, gray
390	437	47	Sandstone, gray, silty in places
437	442	5	Siltstone, gray
442	460	18	Sandstone, gray, silty
460	464	4	Coal
464	480	16	Siltstone, gray, sandy

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
480	483	3	Coal
483	500	17	Siltstone, gray, sandy
500	502	2	Coal
502	528	26	Siltstone, gray, sandy
528	532	4	Coal, dirty
532	579	47	Siltstone and sandstone, gray, interbedded
579	585	6	Coal - Local
585	590	5	Shale, brown to black, carbonaceous
590	602	12	Siltstone, gray
602	613	11	Sandstone, gray
613	617	4	Shale, gray
617	631	14	Siltstone, gray, sandy
631	633	2	Shale, carbonaceous
633	666	33	Siltstone and shale, gray
666	669	3	Sandstone, gray
669	677	8	Shale, gray
677	679	2	Siltstone, gray
679	681	2	Sandstone, gray
681	688	7	Siltstone, gray
688	691	3	Shale, brown, carbonaceous
691	715	24	Siltstone, gray to green

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole CC-14-82 Elev. 2731 feet Total Depth 495 feet
 Location 10 FNL, 900 FWL Sec. 9, T. 12 N., R. 49 E.
 County Prairie State Montana Quadrangle McClure Reservoir
 Drilled by USGS-GD Driller L. Kozak Hole Size 5 1/8 inches
 Date Started 10/19/82 Date Completed 10/19/82 Geologist Scott Haight
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	15	15	Sand, brown
15	30	15	Shale, brown and dark gray, carbonaceous
30	33	3	Siltstone, gray
33	38	5	Shale, gray
38	43	5	Sandstone, gray
43	49	6	Clay, gray to green
49	65	16	Sandstone, gray
65	82	17	Siltstone, gray
82	103	21	Sandstone, dark gray
103	110	7	Siltstone, gray
110	134	24	Sandstone, blue-gray, well-rounded quartz grains
134	153	19	Siltstone, blue-gray
153	177	24	Sandstone and siltstone, gray, interbedded
177	193	16	Siltstone, gray
193	195	2	Coal
195	201	6	Shale, black, carbonaceous
201	220	19	Sandstone, gray
220	247	27	Siltstone and shale, gray, interbedded
247	252	5	Shale, brown, carbonaceous
252	266	14	Siltstone, gray, coarsening upward
266	268	2	Coal
268	273	5	Shale, dark gray to black, carbonaceous
273	328	55	Sandstone, blue-gray
328	348	20	Siltstone, gray
348	361	13	Sandstone and siltstone, gray, interbedded
361	376	15	Siltstone, gray
376	404	28	Sandstone and siltstone, gray, interbedded
404	418	14	Siltstone and shale, gray, interbedded
418	456	38	Sandstone and siltstone, gray, interbedded
456	460	4	Coal
460	462	2	Shale, black, carbonaceous
462	465	3	Coal
465	495	30	Siltstone and shale, gray, interbedded

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole CC-19-82 Elev. 2650 feet Total Depth 550 feet
 Location 2500 FSL, 1600 FWL Sec. 30, T. 13 N, R. 50 E.
 County Prairie State Montana Quadrangle Calypso
 Drilled by USGS-GD Driller L. Kozak Hole Size 5 1/8 inches
 Date Started 10/21/82 Date Completed 10/21/82 Geologist Scott Haight
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
0	5	5	Clay, light brown to gray
5	9	4	Sand, gray
9	11	2	Shale, black, carbonaceous
11	16	5	Sandstone, gray
16	24	8	Siltstone, gray
24	29	5	Sandstone, gray
29	33	4	Shale, gray
33	38	5	Sandstone, gray
38	42	4	Shale, gray
42	48	6	Siltstone, gray
48	55	7	Shale, dark gray
55	70	15	Siltstone, blue-gray
70	73	3	Shale, brown, carbonaceous
73	75	2	Coal, dirty
75	77	2	Siltstone, gray
77	86	9	Sandstone, dark gray, fine
86	100	14	Siltstone, gray, fine
100	142	42	Sandstone, gray
142	158	16	Siltstone, gray
158	172	14	Sandstone, gray
172	177	5	Shale, brown, carbonaceous, silty
177	183	6	Coal, dirty
183	246	63	Siltstone, blue-gray, sandy in places
246	251	5	Sandstone, gray
251	264	13	Siltstone, gray to brown
264	267	3	Sandstone
267	272	5	Shale, brown, carbonaceous
272	282	10	Siltstone, gray
282	289	7	Shale, dark gray to brown, carbonaceous
289	293	4	Coal, dirty
293	297	4	Shale, black, carbonaceous
297	305	8	Siltstone, blue-gray
305	314	9	Sandstone, gray
314	361	47	Siltstone, gray, sandy in places
361	363	2	Coal
363	389	26	Siltstone, gray
389	392	3	Coal

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
392	425	33	Siltstone, gray, interbedded with shale
425	431	6	Sandstone, tan, hard
431	443	12	Siltstone, gray
443	477	34	Sandstone, gray
477	488	11	Siltstone, gray, coarsening upward
488	511	23	Sandstone and siltstone, gray
511	520	9	Shale, carbonaceous
520	524	4	Coal - BIG DIRTY BED
524	526	2	Siltstone, gray
526	530	4	Coal - BIG DIRTY BED
530	533	3	Shale, dark gray, carbonaceous
533	550	17	Siltstone, gray

U.S.G.S. - M.M.S - BLM
1982 Drilling Program
Northern Powder River Basin, Montana

Hole CC-20-82 Elev. 2630 feet Total Depth 535 feet
 Location 725 FNL, 1400 FWL Sec. 26, T. 13 N, R. 49 E.
 County Prairie State Montana Quadrangle Calypso
 Drilled by USGS-GD Driller L. Kozak Hole Size 5 1/8 inches
 Date Started 10/21/82 Date Completed 10/21/82 Geologist Scott Haight
 Remarks Sample log modified by geophysical log interpretation.

Depth interval (feet)			Lithologic Description
From	To	Thick- ness	
0	5	5	Shale, brown
5	17	12	Siltstone, light brown
17	20	3	Shale, black, carbonaceous
20	25	5	Siltstone and shale, gray, interbedded
25	31	6	Shale, brown, carbonaceous
31	34	3	Coal
34	41	7	Shale, carbonaceous
41	53	12	Sandstone, gray, coarse
53	58	5	Siltstone, gray
58	60	2	Shale, brown, carbonaceous
60	63	3	Siltstone, gray
63	66	3	Shale, carbonaceous
66	84	18	Sandstone, gray, silty
84	87	3	Shale, gray
87	102	15	Siltstone, gray
102	115	13	Sandstone, gray, coarse
115	122	7	Siltstone, gray
122	123	1	Coal
123	168	45	Siltstone and shale, gray to dark gray, interbedded
168	217	49	Sandstone and siltstone
217	220	3	Shale, brown, carbonaceous
220	232	12	Sandstone, gray
232	258	26	Siltstone, gray
258	289	31	Sandstone, blue-gray, coarse at 269'-274'
289	318	29	Siltstone, gray, sandy
318	321	3	Coal
321	325	4	Siltstone, gray
325	329	4	Shale, carbonaceous
329	332	3	Coal
332	347	15	Siltstone, gray
347	349	2	Coal
349	353	4	Shale, gray
353	383	30	Siltstone and shale
383	407	24	Sandstone, gray
407	448	41	Siltstone and sandstone, gray, interbedded
448	462	14	Siltstone, gray
462	482	20	Sandstone, gray

Depth interval (feet)

From	To	Thick- ness	Lithologic Description
482	485	3	Coal - BIG DIRTY BED
485	497	12	Siltstone, gray
497	500	3	Coal - BIG DIRTY BED
500	502	2	Siltstone, gray
502	507	5	Coal - BIG DIRTY BED
507	510	3	Siltstone, gray
510	512	2	Coal - BIG DIRTY BED
512	535	23	Sandstone, siltstone, shale, gray, interbedded