UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

GEOPHYSICAL AND LITHOLOGIC LOGS OF NINE TEST HOLES DRILLED DURING 1978 IN HARDING COUNTY, SOUTH DAKOTA

By

Frank B. Kistner

Open-File Report 80-852

1980

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To convert English units	Multiply by	To obtain metric units
Inches (in)	2.54	Centimeters (cm)
Feet (ft)	0.3048	Meters (m)

Abbreviations

brn	-	brown
carb	-	carbonaceous
lt	-	light
LTD	-	Logged Total Depth
NR	-	No Record
ss	-	sandstone
w/	-	with

GEOPHYSICAL AND LITHOLOGIC LOGS OF NINE TEST HOLES DRILLED DURING 1978 IN HARDING COUNTY, SOUTH DAKOTA

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INTRODUCTION

Between October 25 and November 1, 1978, nine coal test holes were drilled and geophysically logged near Ludlow, in Harding County, South Dakota (fig. 1). Drilling was conducted by personnel (and drilling equipment) of the U.S. Geological Survey (USGS) as part of an ongoing USGS program to evaluate and classify mineral lands in the public domain. The purpose of the program is to gather data on the thickness, extent, correlation, quality, and recoverability of coal beds, and the thickness and lithologic characteristics of the associated rocks in the Tertiary Tongue River and Ludlow-Cannonball Members of the Fort Union Formation in the Williston Basin.

The occurrence of lignite in northwestern South Dakota has been discussed by several writers (Winchester and others, 1916; Searight, 1930; Baker, 1952). Discovery of uranium associated with these lignites has drawn the attention of numerous investigators to this area since the mid-1950's (Curtiss, 1955; Denson and others, 1959; Pipiringos and others, 1965; Dane, 1978). Several authors (Hares, 1928; Kepferle and Culbertson, 1955; Rehbein, 1977) have discussed the general geology, stratigraphy, and depositional environments of the thicker lignite deposits in North Dakota. These discussions apply in a general way to the coal geology of northwestern South Dakota.

Although considerable uranium exploration drilling has been conducted in the Ludlow area, there has been no previous coal drilling to the writer's knowledge. This report presents geophysical logs and field lithologic descriptions lagged (or corrected in depth intervals) to match the geophysical logs. Test holes CD-78001 through CD-78071, inclusive, and test hole CD-78081 were drilled in Wyoming and their logs were presented in a report by Kistner and others (1980). Table 1 lists the locations and test-hole numbers of all holes drilled in Harding County, South Dakota, during the 1978 field season.

Specific drill-site locations, following the system of land survey used by the U.S. Bureau of Land Management, appear on the individual log headings. The locations are expressed as distances, in feet, scaled from section lines as they appear on topographic quadrangle sheets. Elevations are approximate for all test holes.

A conventional rotary drill was used, with circulating water as the usual drilling fluid. Continuous 10-foot samples were collected except where circulation was difficult to maintain. Where circulation could not be maintained an air-mist drilling medium was used and no samples were collected. Samples were logged by a geologist in the field and then bagged and sent to the USGS storage facilities in Casper, Wyoming. Field logs were completed for each test hole and are on file in Casper.

The usual geophysical logging procedure was to run a multiconductor probe equipped with gamma-ray, resistance, and spontaneous potential detectors. Where problems existed with drill-hole instability, the drill pipe was used to temporarily case the hole, and a gamma-ray casing collar locator log was run through the drill pipe. The logs were photographically reduced to a vertical scale of 1 inch to 50 feet for convenience in reproducing this report, and the originals are on file at the Casper office.

The identification of lignites from geophysical logs is discussed at length by Kaiser (1974, p. 32), Kaiser and others (1978, p. 67-68), and Rehbein (1977, p. 3-4). Gamma-ray logs were found to be generally the most useful, followed in order of usefulness by density, neutron, acoustic (sonic), and electrical logs. Induction logs, used alone, were found to be the least reliable for the identification of lignite beds, especially near the outcrop. This experience is supported by the logs presented in this report. The single-point resistance log often does not respond to lignites. Is is thought that the water quality and content of the lignites in relation to their enclosing rocks dictates this lack of electrical response.

ACKNOWLEDGEMENTS

Fieldwork was carried out by the following USGS personnel: Frank B. Kistner, geologist; Gregg A. Hollomon, technician; Harry R. Cureton, driller. Supervision and technical guidance were provided by Frank B. Kistner and Robert C. Lewis.

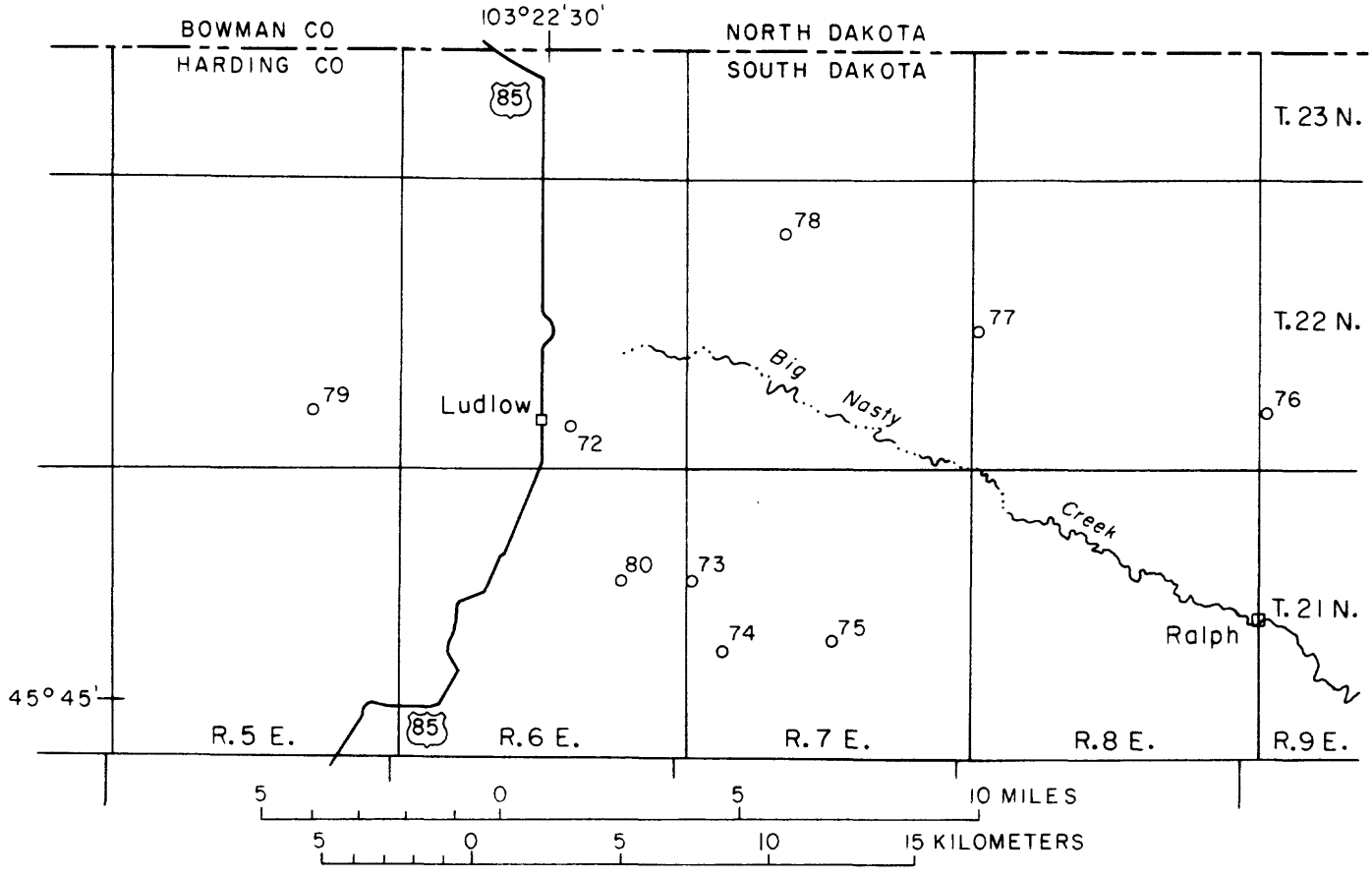

Figure 1. - Coal test holes drilled during 1978 in Harding County, South Dakota, (Hole numbers in Table 1 are preceded by CD-780__.)

Table 1.--Summary of information for nine coal test holes in Harding County, South Dakota

Test-hole Number	Location				Depth (feet)	
	T.N.	R.E.	Sec.	1/4	Drilled	Logged
CD-78072	22	6	34	NE	400	390
CD-78073	21	7	18	NW	200	200
CD-78074	21	7	19	SE	500	490
CD-78075	21	7	22	SW	300	300
CD-78076	22	9	30	SW	540	530
CD-78077	22	8	19	NW	500	490
CD-78078	22	7	9	NW	420	417
CD-78079	22	5	26	SW	620	610
CD-78080	21	6	14	NE	200	190

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UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78072
SHEET 1 OF 2

AREA Southern Williston Basin		QUAD NAME Ludlow SE	
DATE STARTED 10-25-1978	DATE COMP. 10-26-1978	COUNTY Harding	STATE South Dakota
LOCATION: SEC. 34 T. 22 N., R. 6 E., FOOTAGE LOC. 890 FNL 1650 FEL			GROUND ELEV 3090
SIZE AND BIT TYPE: 5-in. wing	FOOTAGE ROTARY 400	CORING 0	TOTAL DEPTH 400
DRILLING AGENCY: USGS/CD/NRMA	DRILL TYPE: Portadrill 524		DEPTH TO WATER NR
LITHOLOGY RECORDED BY F. B. Kistner	GEOPHYSICAL LOGS RECORDED BY G. A. Hollomon		

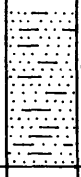
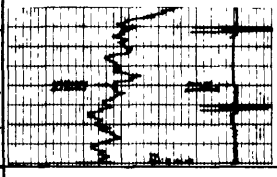
REMARKS: Gamma ray logged through drill pipe
"Noisy" SP curve
SP = 20 MV
RES = 10 OHMS

LITHOLOGY		STRIP LOG	GAMMA		DEPTH	
			T.C. 4 SEC. RANGE 5 CPS LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 390	LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 290	FEET	METERS
Sandstone, lt-brn, silty, w/white quartzite flakes; thin lignite at 5 ft					0	0
11 Claystone, light-gray; 2 ft lignite at 15 ft.					10	
27					50	20
Sandstone, light-brown, fine, moderately well sorted, weakly cemented, micaceous, weathered.						
73 Claystone, with lignite interbeds from 78 to 83 and 86 to 89 ft; weathered to 90 ft.					100	30
93 Sandstone, gray, fine to medium, poorly sorted (clayey) in part, weakly to strongly (125-127 ft) cemented, "salt-and-pepper" appearance.						40
130					150	50
Siltstone, gray to dark-brownish-gray with lignite beds from 157 to 164 and 177 to 179 ft; probable lignite beds from 145 to 148 and from 315 to 316 ft. Numerous thick to very thick interbeds of fine sandstone, and thin cemented streaks below 140 ft.				- MV + SP RES	200	60
					250	70
						80
					300	90
						100
					350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78072
SHEET 2 OF 2

REMARKS:

LITHOLOGY	STRIP LOG	GAMMA T.C. 4 SEC. · RANGE 5 CPS LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 390	LOGGING SPEED _____ FT/MIN LOGGED DEPTH _____	DEPTH FEET	DEPTH METERS
Siltstone, gray-to dark-brownish-gray, with numerous thick to very thick interbeds of fine sandstone.				350	110
390 LTD					120
				400	130
				450	140
					150
				500	160
				550	170
					180
				600	190
				650	200
					210
				700	220
				750	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78073
SHEET 1 OF 1

AREA Southern Williston Basin		QUAD NAME Ludlow SE	
DATE STARTED 10-26-1978	DATE COMP. 10-26-1978	COUNTY Harding	STATE South Dakota
LOCATION: SEC. 18 T. 21 N., R. 7 E., FOOTAGE LOC. 1950 FNL 50 FWL			GROUND ELEV 3090
SIZE AND BIT TYPE: 5-in. wing	FOOTAGE ROTARY 200	CORING 0	TOTAL DEPTH 200
DRILLING AGENCY: USGS/CD/NRMA	DRILL TYPE: Portadrill 524		DEPTH TO WATER NR
LITHOLOGY RECORDED BY F. B. Kistner	GEOPHYSICAL LOGS RECORDED BY G. A. Hollomon		
REMARKS: SP = 20 MV RES = 10 OHMS			

LITHOLOGY	STRIP LOG	GAMMA T.C. 4 SEC. RANGE 5 CPS LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 200	LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 200	DEPTH FEET	DEPTH METERS
Sandstone, very light gray, fine, weakly cemented, weathered.			-MV+ SP RES	0	0
20 Siltstone and claystone, light-brown to gray; with interbeds of lignite from 30 to 45 ft and from 48 to 52 ft. Weathered to 30 ft.				50	20
63 Sandstone, light-gray, fine to medium, moderately to strongly cemented.				100	30
101 Siltstone and claystone, dark-grayish-brown to light-gray, mostly carbonaceous, with a 6-ft lignite interbed at 165 ft. Thick sandstone interbeds to 115 ft.				150	50
184 Ss, locally strongly cemented; probable lignite interbed from 187 to				200	60
200 LTD 189 ft				250	80
				300	90
				350	100

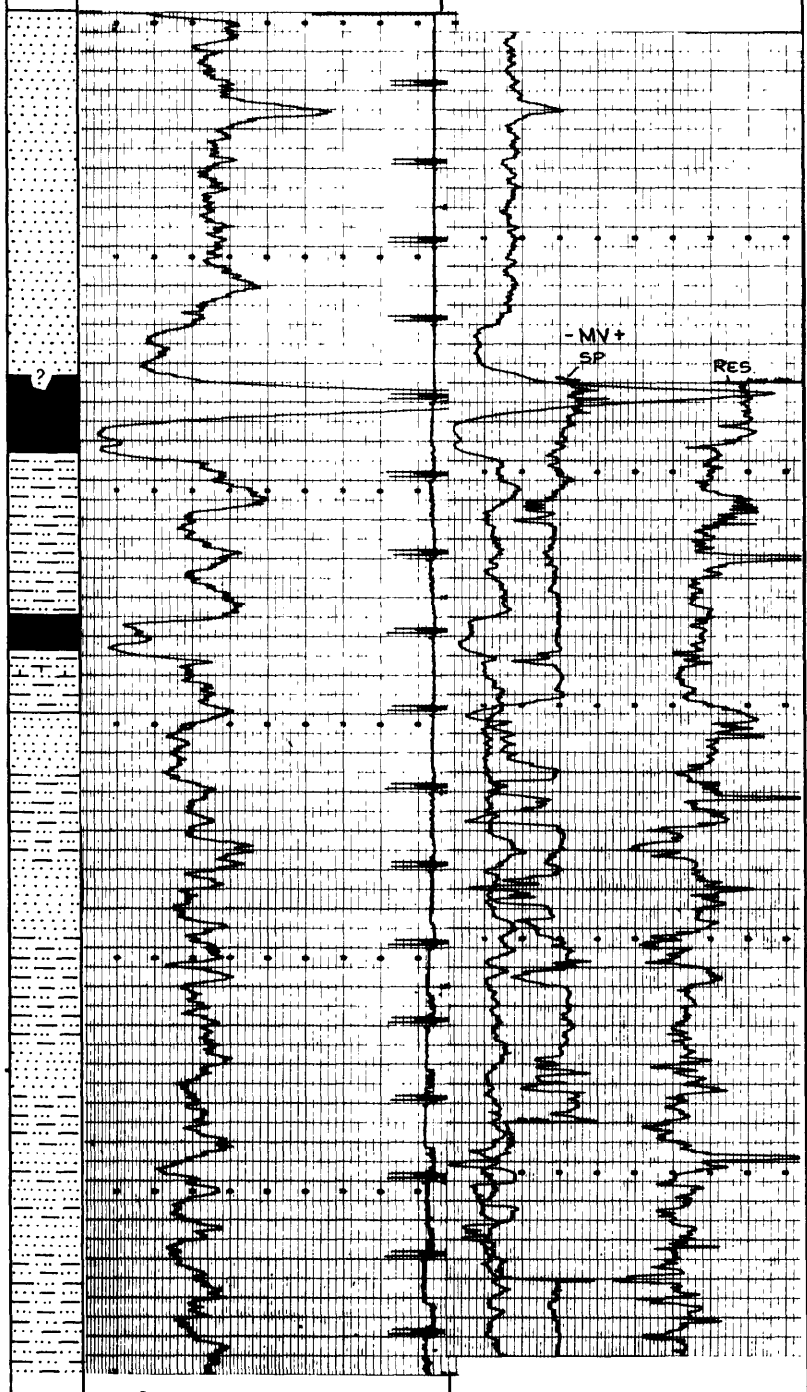
UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78074
SHEET 1 OF 2

AREA Southern Williston Basin		QUAD NAME Ludlow SE	
DATE STARTED 10-27-1978	DATE COMP. 10-27-1978	COUNTY Harding	STATE South Dakota
LOCATION: SEC. 19 T. 21 N., R. 7 E., FOOTAGE LOC. 700 FSL 50 FEL			GROUND ELEV 3090
SIZE AND BIT TYPE: 5-in. wing	FOOTAGE ROTARY 500	CORING 0	TOTAL DEPTH 500
DRILLING AGENCY: USGS/CD/NRMA	DRILL TYPE: Portadrill 524		DEPTH TO WATER 95
LITHOLOGY RECORDED BY F. B. Kistner	GEOPHYSICAL LOGS RECORDED BY G. A. Hollomon		

REMARKS: Gamma ray logged through drill pipe
SP = 10 MV
RES = 10 OHMS

LITHOLOGY	STRIP LOG	GAMMA		DEPTH	
		T.C. 4 SEC. RANGE 5 CPS LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 490	LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 500	FEET	METERS
Sandstone, very light gray to light-brown, fine, moderately well sorted, weakly cemented, "salt-and-pepper" appearance, weathered to 80 ft.				0	0
				50	10
				100	20
96? Lignite, brown-black; radioactive in upper portion.	?				30
114				150	40
Siltstone, medium-gray.					50
156				200	60
165 Lignite, brown-black, cleat pattern developed					70
				250	80
Siltstone, light-gray to dark-brownish-gray, mostly carbonaceous. Numerous fine sandy interbeds, with sand increasing below 300 ft. Occasional thin cemented stringers. Possible thin lignite at about 210 ft.				300	90
					100
				350	



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78074
SHEET 2 OF 2

REMARKS:
SP = 10 MV
RES = 10 OHMS

LITHOLOGY	STRIP LOG	GAMMA T.C. 4 SEC. RANGE 5 CPS LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 490	LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 500	DEPTH FEET	DEPTH METERS
Siltstone, light-gray to dark-brownish-gray, mostly carbonaceous. Fine sandy interbeds increasing downward		GR	SP RES	350	110
415					120
Sandstone, medium-gray, fine, weakly cemented, "salt-and-pepper" appearance, micaceous, occasional thin cemented stringers. Dark-gray-brown clayey siltstone interbed from 458 to 472 ft.				400	130
				450	140
500 LTD				500	150
				550	160
				600	170
				650	180
				700	190
				750	200
					210
					220

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78075
SHEET 1 OF 1

AREA Southern Williston Basin		QUAD NAME Ralph SW	
DATE STARTED 10-28-1978	DATE COMP. 10-28-1978	COUNTY Harding	STATE South Dakota
LOCATION: SEC. 22 T. 21 N., R. 7 E., FOOTAGE LOC. 2150 FSL 1100 FWL			GROUND ELEV 3035
SIZE AND BIT TYPE: 5-in. wing	FOOTAGE ROTARY 300 CORING 0		TOTAL DEPTH 300
DRILLING AGENCY: USGS/CD/NRMA	DRILL TYPE: Portadrill 524		DEPTH TO WATER 70
LITHOLOGY RECORDED BY F. B. Kistner	GEOPHYSICAL LOGS RECORDED BY G. A. Hollomon		

REMARKS: SP = 20 MV
RES = 10 OHMS

LITHOLOGY

Sandstone, very light brownish-gray, fine-to-medium, weakly cemented, slightly micaceous, with occasional light-brown oxidation streaks.

56

Lignite and siltstone, black to brownish-black, some sub-conchoidal fracture and cleat pattern apparent; clayey siltstone, medium-gray to dark-grayish-brown. Weathered to 63 ft. Lignites from 69 to 77 ft; 82 to 89 ft; 93 to 100 ft; 106 to 114 ft.

114

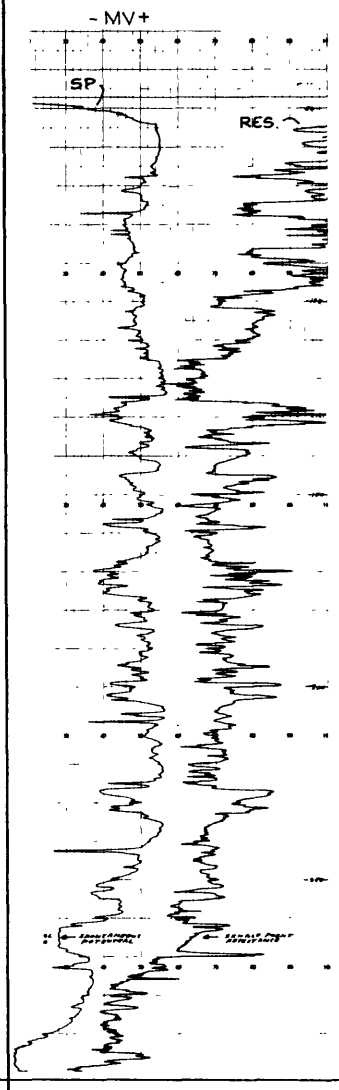
Siltstone, medium-brownish-gray to medium-gray, mostly carbonaceous; numerous thick, fine sandy interbeds and occasional thin cemented zones. Sand content increases below 250 ft, and color becomes medium gray. Possible lignites 211 — 215 ft, and 246 — 247 ft.

300 LTD

STRIP LOG

GAMMA
T.C. 4 SEC. RANGE 2 CPS
LOGGING SPEED 16-17 FT/MIN
LOGGED DEPTH 300

LOGGING SPEED 16-17 FT/MIN
LOGGED DEPTH 300



DEPTH

FEET	METERS
0	0
50	10
100	30
150	50
200	60
250	80
300	90
350	100

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78076
SHEET 1 OF 2

AREA Southern Williston Basin		QUAD NAME Ralph	
DATE STARTED 10-28-1978	DATE COMP. 10-29-1978	COUNTY Harding	STATE South Dakota
LOCATION: SEC. 30 T. 22 N., R. 9 E., FOOTAGE LOC. 500 FSL 100 FWL			GROUND ELEV 3030
SIZE AND BIT TYPE: 5-in. wing	FOOTAGE ROTARY 540	CORING 0	TOTAL DEPTH 540
DRILLING AGENCY: USGS/CD/NRMA	DRILL TYPE: Portadrill 524		DEPTH TO WATER NR
LITHOLOGY RECORDED BY F. B. Kistner	GEOPHYSICAL LOGS RECORDED BY G. A. Hollomon		

REMARKS: Gamma ray logged through drill pipe
SP = 10 MV
RES = 5 OHMS

LITHOLOGY	STRIP LOG	GAMMA		DEPTH	
		T.C. 8 SEC. · RANGE 2 CPS LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 530	LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 535	FEET	METERS
Siltstone, light-olive-gray to medium-grayish-brown, clayey, mostly carbonaceous. Thin fossiliferous limestone at 15 ft. Weathered to 30 ft.			-MV+ SP RES	0	0
62 Siltstone, light-brownish-gray, fine sandy, slightly carbonaceous.				50	10 20
97 Siltstone and claystone, light-brownish-gray, with occasional cemented zones.				100	30 40
150 Siltstone, medium-grayish-brown, fine sandy, carbonaceous.				150	50 60
208 Sandstone, medium-gray, fine, weakly cemented, slightly micaceous, strongly cemented from 217 to 223 ft. Minor dark-grayish-brown carbonaceous siltstone.				200	70
247 Siltstone, medium-gray to dark-grayish-brown, with very thick interbeds of fine sandstone, and occasional cemented zones. Thick lignite interbed occurs at 301-304 ft.				250 300	80 90 100
				350	

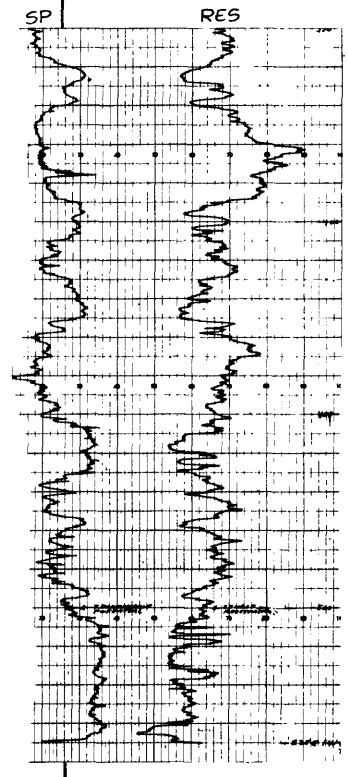
UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78076
SHEET 2 OF 2

REMARKS:

SP = 10 MV
RES = 5 OHMS

LITHOLOGY	STRIP LOG	GAMMA		DEPTH	
		T.C. 8 SEC. - RANGE 2 CPS LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 530	LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 535	FEET	METERS



Siltstone, medium-gray to dark-grayish-brown, with very thick interbeds of fine sandstone, and occasional cemented zones. Sandstone decreases with depth below 400 ft. Thick lignite interbeds occur at 362-366 ft; 397-399 ft; 513-517 ft.

530 LTD

350 110
400 120
450 130
500 140
550 150
600 160
650 170
700 180
750 190
200
210
220

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78077
SHEET 1 OF 2

AREA Southern Williston Basin		QUAD NAME Ralph SW	
DATE STARTED 10-29-1978	DATE COMP. 10-30-1978	COUNTY Harding	STATE South Dakota
LOCATION: SEC. 19 T. 22 N., R. 8 E. , FOOTAGE LOC. 50 FNL 100 FWL			GROUND ELEV 2950
SIZE AND BIT TYPE: 5-in. wing	FOOTAGE ROTARY 500 CORING 0		TOTAL DEPTH 500
DRILLING AGENCY: USGS/CD/NRMA	DRILL TYPE: Portadrill 524		DEPTH TO WATER 38
LITHOLOGY RECORDED BY F. B. Kistner	GEOPHYSICAL LOGS RECORDED BY G. A. Hollomon		

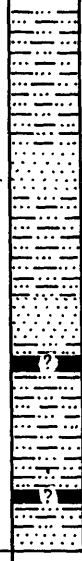
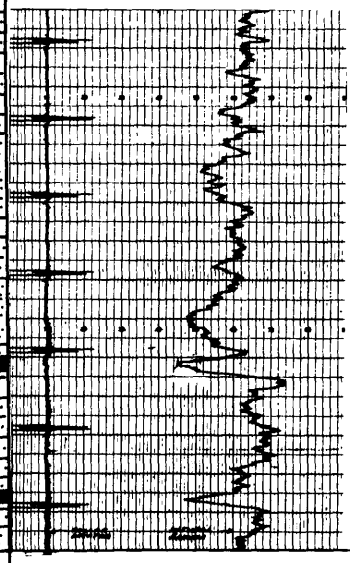
REMARKS: Gamma ray logged through drill pipe
SP = 20 MV
RES. = 10 OHMS
ELECTRIC LOG SPLICE AT 145 FT.

LITHOLOGY	STRIP LOG	GAMMA T.C. 4 SEC. RANGE 5 CPS LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 490	LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 170	DEPTH FEET	DEPTH METERS
Siltstone, light-gray to medium-brownish-gray, clayey, becoming carbonaceous below 40 ft. Thin gray limestone bed at 35 ft. Weathered to 20 ft.			-MV+ SP RES	0	0
60 Sandstone, dark-gray to gray, fine, micaceous, weakly cemented and argillaceous to 70 ft. Strongly cemented calcareous zones below 95 ft.				50	10
98 Siltstone, light-brownish-gray to medium-grayish-brown, carbonaceous; with lignite interbeds from 108 to 112 ft, and from 116 to 121 ft.				100	20
134 Sandstone, gray, fine, poorly sorted, weakly cemented to 155 ft. Strongly cemented calcareous zone below 158 ft				150	30
162 Siltstone, dark-brownish-gray to very dark brown, carbonaceous; lignite interbeds from 165 to 172 ft, from 222 to 227 ft, and from 230 to 234 ft.				200	40
265 Sandstone, medium-gray, fine, moderately to poorly sorted, weakly cemented, micaceous; minor siltstone interbeds.				250	50
311 Siltstone, light-brownish-gray, slightly carbonaceous; occasional very thick interbeds of medium-gray, fine sandstone having a "salt-and-pepper" appearance. Possible lignite interbed from 323 to 326 ft.	?			300	60
				350	70

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78077
SHEET 2 OF 2

REMARKS:

LITHOLOGY	STRIP LOG	GAMMA T.C. 4 SEC. · RANGE 5 CPS LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 490	LOGGING SPEED _____ FT/MIN LOGGED DEPTH _____	DEPTH FEET / METERS
Siltstone, light-brownish-gray, slightly carbonaceous; occasional very thick interbeds of medium-gray, fine sandstone having a "salt-and-pepper" appearance. **Possible lignite interbeds at 441-444 ft, and 476-478 ft.** 490 LTD				350 / 110 400 / 120 450 / 130 500 / 140 550 / 150 600 / 160 650 / 170 700 / 180 750 / 190 200 210 220

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78078
SHEET 1 OF 2

AREA Southern Williston Basin		QUAD NAME Tepee Buttes	
DATE STARTED 10-30-1978	DATE COMP. 10-30-1978	COUNTY Harding	STATE South Dakota
LOCATION: SEC. 9 T. 22 N., R. 7 E., FOOTAGE LOC. 45 FNL 55 FWL			GROUND ELEV 3020
SIZE AND BIT TYPE: 5-in. wing	FOOTAGE ROTARY 420	CORING 0	TOTAL DEPTH 420
DRILLING AGENCY: USGS/CD/NRMA	DRILL TYPE: Portadrill 524		DEPTH TO WATER NR
LITHOLOGY RECORDED BY F. B. Kistner	GEOPHYSICAL LOGS RECORDED BY G. A. Hollomon		
REMARKS:			

LITHOLOGY

Sandstone, light-yellow-brown, silty, weathered.

18

Siltstone, light-grayish-brown to light-gray, weathered to 50 ft; black lignite interbed from 61 to 64 ft.

68

Sandstone, medium-gray, fine, moderately to poorly sorted; gray siltstone interbeds.

113

Siltstone, medium-gray to dark-grayish-brown, carbonaceous in part; black, chippy lignite interbed from 159 to 162 ft.

165

Sandstone, medium-gray, fine, moderately well sorted becoming well-sorted below 185 ft; weakly cemented except near top of unit, "salt-and-pepper" appearance.

208

Siltstone, medium-gray (above lignites) to medium-brownish-gray, carbonaceous; black lignite interbeds from 248 to 256 ft and from 258 to 263 ft.

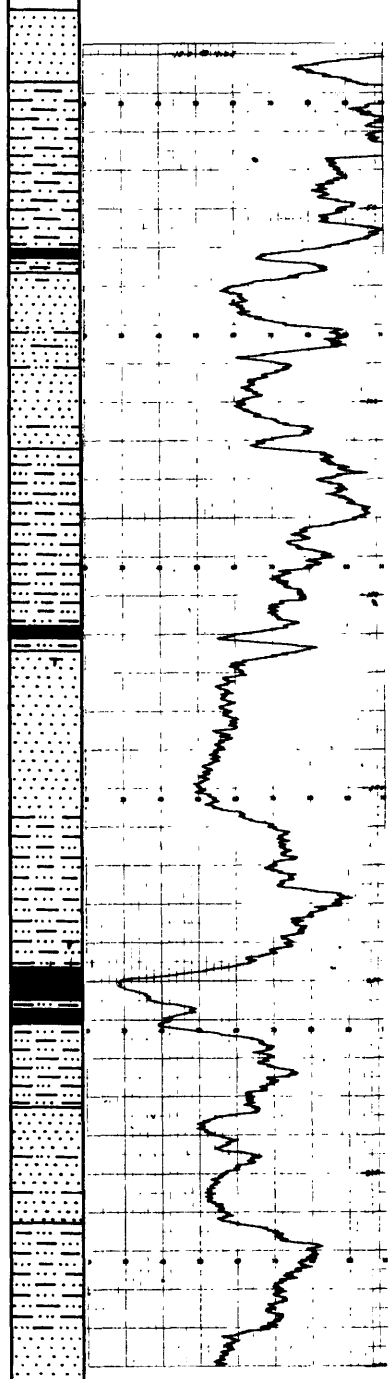
284

Sandstone, light-gray, very fine to fine, "salt-and-pepper" appearance; siltstone interbeds.

314

Siltstone, medium-brownish-gray to light-gray, slighty carbonaceous, mostly very fine sandy; sand content increasing below 340 ft.

STRIP LOG



GAMMA
T.C. 8 SEC. RANGE 2 CPS
LOGGING SPEED 16-17 FT/MIN
LOGGED DEPTH 417

LOGGING SPEED _____ FT/MIN
LOGGED DEPTH _____

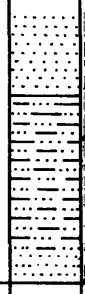
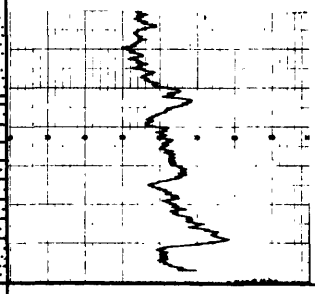
DEPTH

FEET	METERS
0	0
	10
50	
	20
	30
100	
	40
150	
	50
	60
200	
	70
250	
	80
	90
300	
	100
350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78078
SHEET 2 OF 2

REMARKS:

LITHOLOGY	STRIP LOG	GAMMA T.C. 8 SEC. RANGE 2 CPS LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 417	LOGGING SPEED _____ FT/MIN LOGGED DEPTH _____	DEPTH FEET	DEPTH METERS
Siltstone, medium-brownish-gray to light-gray, slightly carbonaceous, mostly very fine sandy; sand content increasing below 340 ft.				350 400 450 500 550 600 650 700 750	110 120 130 140 150 160 170 180 190 200 210 220
417 LTD					

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78079
SHEET 1 OF 2

AREA Southern Williston Basin		QUAD NAME Ludlow	
DATE STARTED 10-31-1978	DATE COMP. 11-1-1978	COUNTY Harding	STATE South Dakota
LOCATION: SEC. 26 T. 22 N., R. 5 E., FOOTAGE LOC. 600 XXX FSL 500 XXX FWL			GROUND ELEV 3300
SIZE AND BIT TYPE: 4-3/4 in. Tricone; 5-in. wing	FOOTAGE ROTARY 620	CORING 0	TOTAL DEPTH 620
DRILLING AGENCY: USGS/CD/NRMA	DRILL TYPE: Portadrill 524		DEPTH TO WATER NR
LITHOLOGY RECORDED BY F. B. Kistner	GEOPHYSICAL LOGS RECORDED BY G. A. Hollomon		

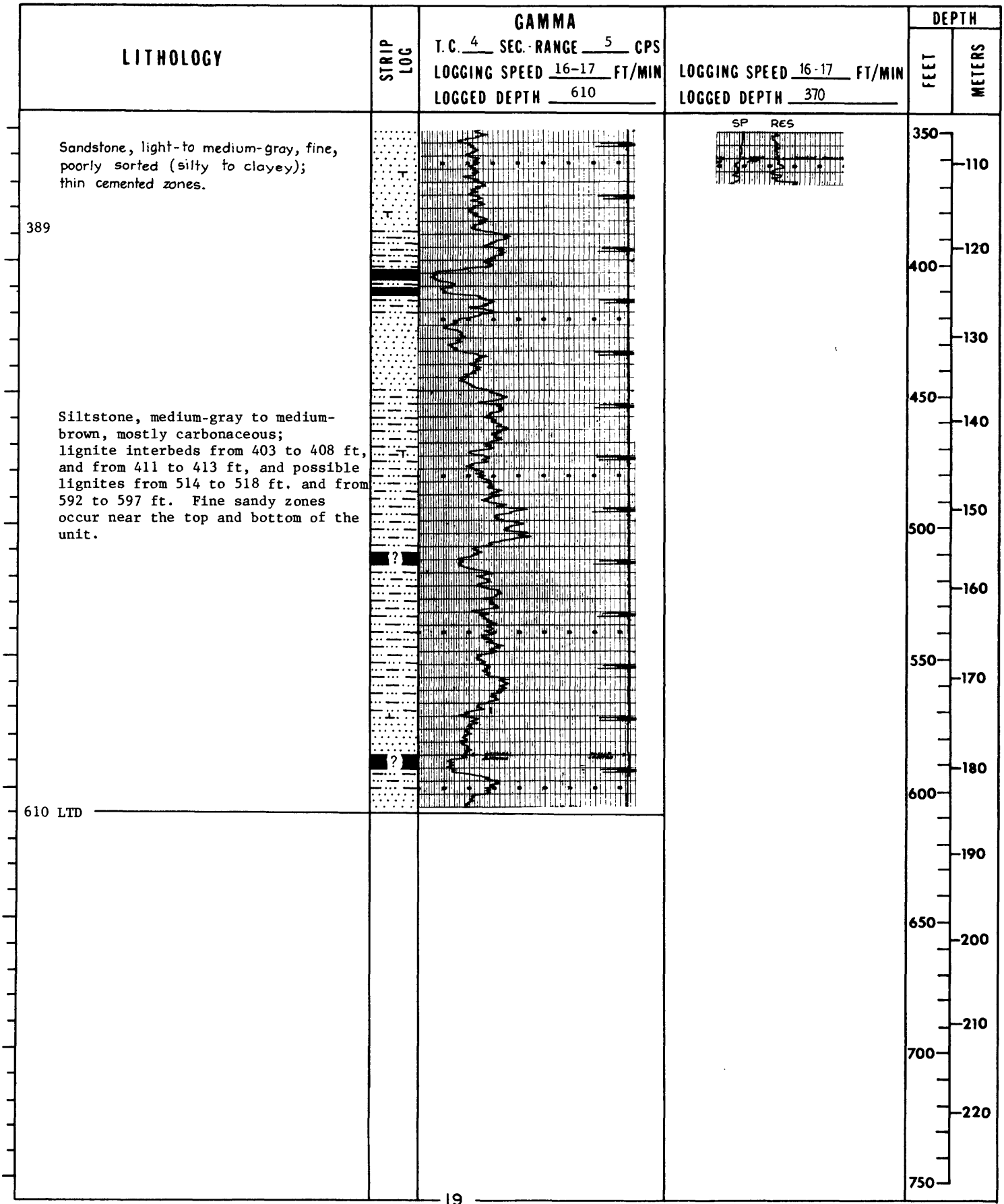
REMARKS: Gamma ray logged through drill pipe. Collared at top of E-Sandstone (Pipiringos, etal, 1965), Tongue River Member, Fort Union Formation.
SP = 20 MV RES = 10 OHMS

LITHOLOGY	STRIP LOG	GAMMA		DEPTH	
		T.C. 4 SEC. · RANGE 5 CPS LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 610	LOGGING SPEED 16-17 FT/MIN LOGGED DEPTH 370	FEET	METERS
Sandstone, light-yellowish-brown to medium-gray, fine to occasionally coarse, poorly sorted, strongly cemented above 7 ft, moderately cemented from 7 to 50 ft, and weakly cemented below 50 ft except near base of unit, "salt-and-pepper" appearance; silt increases below 92 ft; unit includes thick to very thick gray siltstone interbeds; radioactive zones below 92 ft. Weathered to 50 ft.				0 50 100 150 200 250 300 350	0 10 20 30 40 50 60 70 80 90 100
150					
Siltstone, light-gray to dark-grayish-brown, mostly carbonaceous above 280 ft; lignite interbeds from 153 (?) to 155 ft, from 181 to 189 ft, from 194 to 198 ft, from 282 to 286 ft, from 288 to 292 ft, and from 294 to 296 ft. Uppermost lignite may be thicker than indicated by geophysical log.			- MV + SP RES		
333					
Sandstone, light-to medium-gray, fine, poorly sorted (silty to clayey); thin cemented zones.					

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78079
SHEET 2 OF 2

REMARKS:
SP = 20 MV
RES = 10 OHMS



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD-78080
SHEET 1 OF 1

AREA Southern Williston Basin		QUAD NAME Ludlow SE	
DATE STARTED 11-1-1978	DATE COMP. 11-1-1978	COUNTY Harding	STATE South Dakota
LOCATION: SEC. 14 T. 21 N., R. 6 E., FOOTAGE LOC. 2590 FNL 2500 FEL			GROUND ELEV 3110
SIZE AND BIT TYPE: 5-in. wing	FOOTAGE ROTARY 200 CORING 0		TOTAL DEPTH 200
DRILLING AGENCY: USGS/CD/NRMA	DRILL TYPE: Portadrill 524		DEPTH TO WATER NR
LITHOLOGY RECORDED BY F. B. Kistner	GEOPHYSICAL LOGS RECORDED BY G. A. Hollomon		

REMARKS:
Gamma ray logged through drill pipe
SP = 20 MV
RES = 10 OHMS

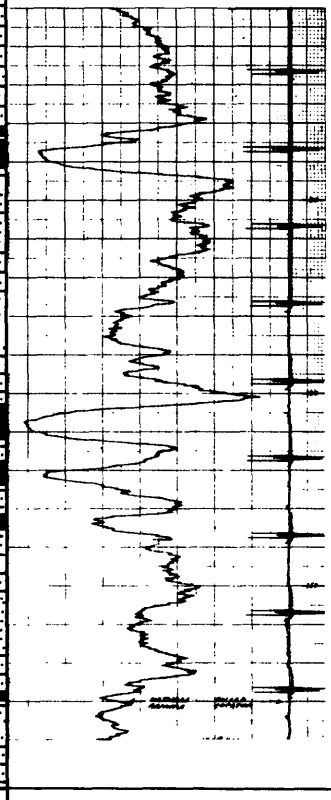
LITHOLOGY

Siltstone, light-gray to grayish-brown, mostly carbonaceous; lignite interbeds from 32 to 34 ft, from 35 to 43 ft, from 104 to 113 ft, from 119 to 124 ft, from 178 to 180 ft; possible lignite interbed from 132 to 136 ft. Very thick fine sandy zones occur throughout the unit. Weathered to 50 ft.

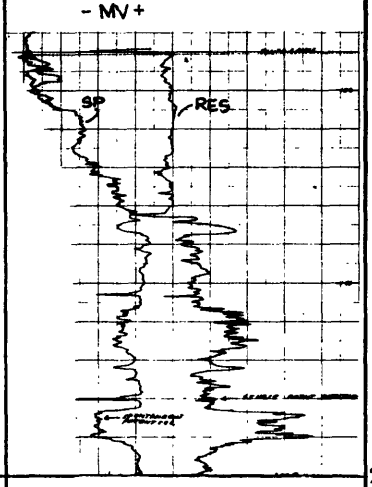
182 Sandstone
190 Siltstone, medium-grayish-brown, carb
200 LTD

STRIP LOG

GAMMA
T.C. 4 SEC. RANGE 5 CPS
LOGGING SPEED 16-17 FT/MIN
LOGGED DEPTH 200



LOGGING SPEED 16-17 FT/MIN
LOGGED DEPTH 200



DEPTH

FEET	METERS
0	0
	10
50	
	20
100	30
	40
150	
	50
200	60
	70
250	
	80
	90
300	
	100
350	