UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

LITHOLOGIC AND GEOPHYSICAL LOGS AND COAL ANALYSES FROM TEST HOLES DRILLED DURING 1977 IN CONVERSE AND CAMPBELL COUNTIES, WYOMING

By

Frank B. Kistner, Gregg A. Hollomon, and David G. Coppock

Open-File Report 79-1173

1979

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CONVERSTION TABLE

To convert ENGLISH UNITS	Multiply by	To obtain METRIC UNITS
Inches	2.54	Centimeters
Feet	0.3048	Meters
Btu/lb	2.324	Joule/kilogram
Fahrenheit	-32 and ÷ by 1.8	Celsius

LIST OF ABBREVIATIONS

amts - amounts
appx - approximate
avg - average
blk - black
brn - brown
brnish - brownish
carb - carbonaceous
conch - conchoidal
dk - dark
f - fine
frac - fracture
frag - fragment
fragal - fragmental
G.L. - ground level
grnd - grained
gry - gray
L.S. - land surface
lt - light
L.T.D. - logged total depth
m - medium
or - orange
pos - possible
prtcls - particles
sdy - sandy
sh - shale
sltst - siltstone
ss - sandstone
v - very
vf - very fine
vit - vitreous

LITHOLOGIC AND GEOPHYSICAL LOGS AND COAL ANALYSES FROM TEST HOLES DRILLED DURING 1977 IN CONVERSE AND CAMPBELL COUNTIES, WYOMING

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INTRODUCTION

Between August 11 and November 16, 1977, 28 coal test holes were drilled in Converse and Campbell Counties, Wyo. (fig. 1). This drilling was done as part of an ongoing U.S. Geological Survey (USGS) program to evaluate and classify mineral lands in the public domain. The overall purpose of the program is to gather data on the thickness, quality, extent, correlation, and recoverability of coal beds, and the thickness and lithologic characteristics of the associated rocks in the Tertiary Fort Union and Wasatch Formations of the Powder River Basin.

This report presents geophysical logs and lithologic descriptions, lagged or corrected in depth intervals to match the geophysical logs of each test hole, and analyses of coal samples obtained from three offset core holes. Similar information from 343 test holes and approximately 149 coal samples from 53 core tests in Campbell and Converse Counties, Wyo., was presented in earlier reports (U.S. Geological Survey and Montana Bureau of Mines and Geology, 1973, 1974, 1976a, 1976b, 1977, 1978; Kistner, 1977). Figure 1 shows the locations and test-hole numbers of all holes drilled during the 1977 field season.

Specific 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 indicated as distances, in feet, scaled from section lines as they appear on topographic quadrangle sheets. Elevations are approximate for all test holes except CD-77001 which was surveyed. Upon completion of drilling, test-hole CD-77001 was cased and converted to a water-observation well.

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 and then 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, Wyo. Field logs were completed for each test hole, and are also on file in Casper.

The geophysical logging procedure was to run the gamma ray probe followed by the resistance-spontaneous potential (SP) probe, unless there were problems with drill-hole stability. In these instances, the drill pipe was used to temporarily case the hole, and the gamma ray log was run through the drill pipe. Contract loggers geophysically logged the following test holes: CD-77018, CD-77024, CD-77027, and CD-77028. The logs were photographically reduced to 1 inch to 50 feet for convenience in reproducing this report and the originals are on file at the Casper office.

Eight core samples (table 1) were obtained from the following coal test holes: CD-77006, CD-77008, and CD-77017. A core hole was drilled adjacent to a logged test hole to obtain a sample of the coal interval (or intervals) indicated on the logs of the test hole. The core was measured, described, packaged, and sent for analysis to the USGS laboratory, Lakewood, Colo. The results of the analyses for these core samples are presented in tables 2-5 of this report. Analytical procedures used by the Survey are described in Swanson and Huffman (1976).

Discretion is urged in the use and interpretation of the coal analysis data. Although great care was exercised in obtaining and preserving the coal cores, changes in moisture content and some contamination from the drilling-fluid additives should be anticipated. Each core sample is approximately 2-1/8 in. in diameter and as much as 14.7 ft in length and the analysis of a sample this small may not be typical of the coal beds in the surrounding area.

ACKNOWLEDGMENTS

Fieldwork was carried out by the following USGS personnel: Frank B. Kistner, Linda G. Riglin, Edmund L. Fivas, geologists; Gregg A. Hollomon, technician; and Harry R. Cureton, driller. Lithologic detail was added to the field descriptions by Gregg A. Hollomon and David G. Coppock. Supervision and technical guidance were provided by Frank B. Kistner and Elmer M. Schell. Joseph R. Hatch, geologist, coordinated and compiled the various coal analyses.

REFERENCES

Kistner, F. B., 1977, Preliminary report of coal drill-hole data in the southern Powder River Basin, Converse County, Wyoming: U.S. Geological Survey Open-File Report 77-774, 25 p.

Swanson, V. E., and Huffman, Claude, Jr., 1976, Guidelines for sample collecting and analytical methods used in the U.S. Geological Survey for determining chemical composition of coal: U.S. Geological Survey Circular 735, 11 p.

U.S. Geological Survey and Montana Bureau of Mines and Geology, 1973, Preliminary report of coal drill-hole data and chemical analyses of coal beds in Sheridan and Campbell Counties, Wyoming; and Big Horn County, Montana: U.S. Geological Survey open-file report, 57 p.

_____ 1974, Preliminary report of coal drill-hole data and chemical analyses of coal beds in Campbell County, Wyoming: U.S. Geological Survey Open-File Report 74-97, 241 p., 1 fig., 3 tables.

_____ 1976a, Preliminary report of coal drill-hole data and chemical analyses of coal beds in Campbell and Sheridan Counties, Wyoming; Custer, Prairie, and Garfield Counties, Montana; and Mercer County, North Dakota: U.S. Geological Survey Open-File Report 76-319, 377 p., 4 figs., 3 tables.

_____ 1976b, Preliminary report of coal drill-hole data and chemical analyses of coal beds in Campbell, Converse, and Sheridan Counties, Wyoming; and Big Horn, Richland, and Dawson Counties, Montana: U.S. Geological Survey Open-File Report 76-450, 382 p., 4 figs.

U.S. Geological Survey and Montana Bureau of Mines and Geology, 1977, Preliminary report of 1976 drilling of coals in Campbell and Sheridan Counties, Wyoming; and Big Horn, Dawson, McCone, Richland, Roosevelt, Rosebud, Sheridan, and Wibaux Counties, Montana: U.S. Geological Survey Open-File Report 77-283, 403 p., 6 figs.

_____ 1978, Geophysical logs for Campbell and Converse Counties, Wyoming, chapter E of Preliminary report of 1977 coal drilling in eastern Montana and northeastern Wyoming: U.S. Geological Survey Open-File Report 77-721-E, 202 p.

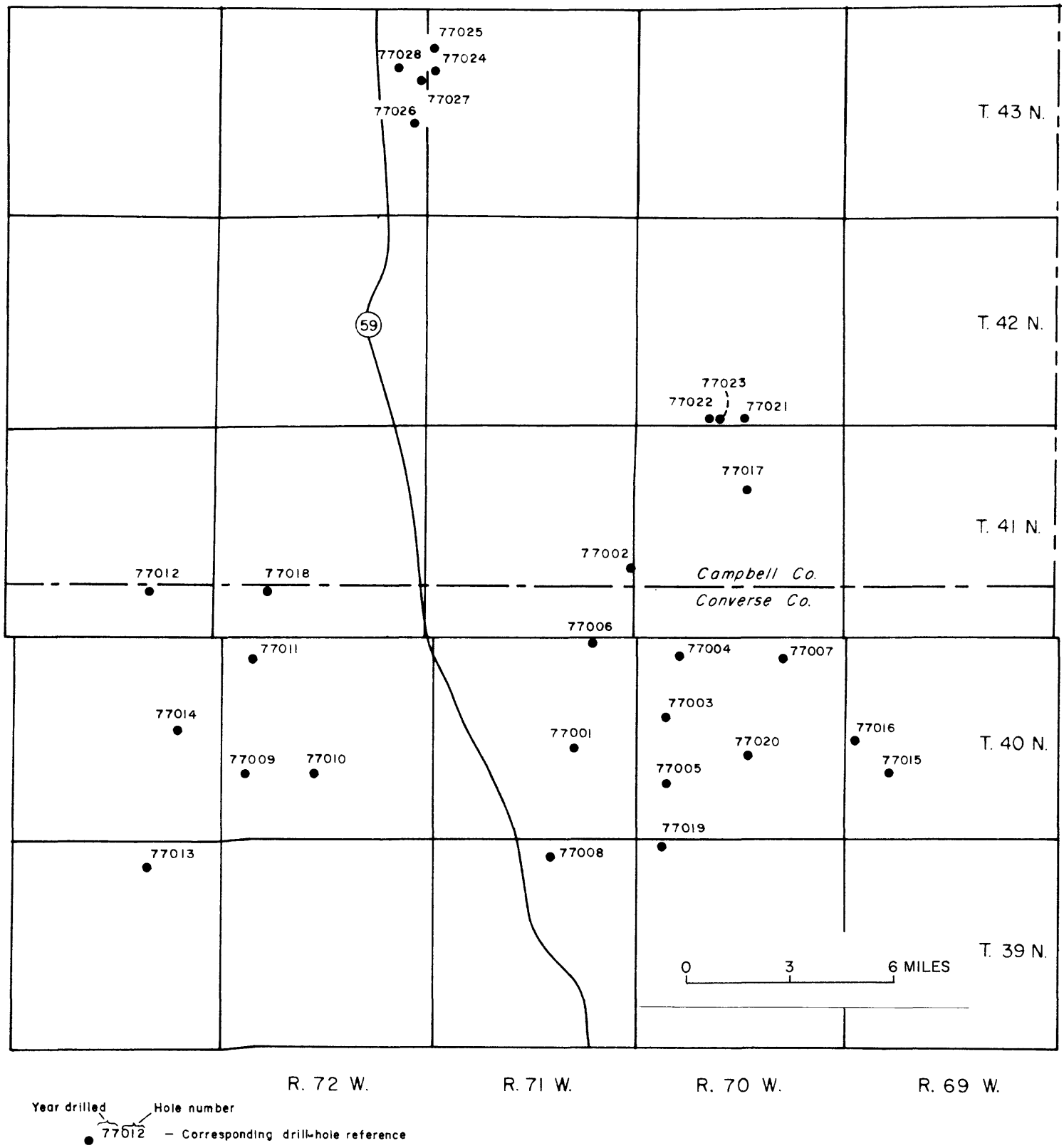


Figure 1.--Location of holes drilled during 1977 in Campbell and Converse Counties, Wyo.

Table 1.--Summary of information for eight coal samples from the Tertiary Fort Union Formation, Converse and Campbell Counties, Wyo.

Sample No.	Hole No.	Location	Sec.	T.N.	R.W.	Depth interval (feet)	Coal bed Name
D196189	CD-77008	SW¼NW¼	3	39	71	117.0-130.5	Wyodak W1
D196190	CD-77006	NE¼NE¼	2	40	71	74.0- 85.5	Do.
D196191	----------do----------					87.0- 97.0	Do.
D196192	----------do----------					97.0-108.5	Do.
D196193	----------do----------					186.0-198.5	Wyodak W2
D196194	----------do----------					203.4-204.3	Do.
D196195	----------do----------					206.5-221.2	Do.
D197320	CD-77017	SW¼SW¼	10	41	70	144.0-153.7	Wyodak

Table 2.--Coal analyses for eight coal samples from the Wyodak beds, Tongue River Member, Fort Union Formation, Converse and Campbell Counties, Wyoming.

[Analyses by U.S. Department of Energy, Coal Analysis Section, Pittsburgh, Pa., Forrest E. Walker, chemist in charge. Type of analysis: A, as received; B, moisture free; and C, moisture and ash free. ---, no data]

Sample No.	Type of analysis	Proximate analysis (percent)				Ultimate analysis (percent)					Heating value (Btu/lb)	Air-dried loss (%)	Forms of sulfur (percent)			Free-swelling index	Ash-fusion temp. (°C)		
		Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur			Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D196189	A	25.1	31.3	36.2	7.4	6.4	49.3	1.0	35.5	0.4	8,430	6.9	0.01	0.07	0.33	0.0	1,165	1,180	1,200
	B	----	41.8	48.3	9.9	4.8	65.8	1.3	17.6	.5	11,260	---	.01	.09	.44				
	C	----	46.4	53.6	---	5.3	73.0	1.5	19.5	.6	12,490	---	.01	.10	.49				
D196190	A	25.4	31.4	38.3	4.9	6.4	51.0	.8	36.6	.4	8,630	10.3	.03	.04	.31	.0	1,215	1,230	1,250
	B	----	42.1	51.3	6.6	4.8	68.4	1.1	18.8	.5	11,570	---	.04	.05	.42				
	C	----	45.1	54.9	---	5.1	73.2	1.1	20.1	.6	12,380	---	.04	.06	.44				
D196191	A	24.5	32.7	38.6	4.2	6.4	52.4	.8	36.0	.2	8,980	7.0	.01	.02	.20	.0	1,245	1,265	1,280
	B	----	43.3	51.1	5.6	4.9	69.4	1.1	18.8	.3	11,890	---	.01	.03	.26				
	C	----	45.9	54.1	---	5.2	73.5	1.1	19.9	.3	12,590	---	.01	.03	.28				
D196192	A	24.8	31.2	37.4	6.6	6.3	50.5	.8	35.5	.2	8,550	9.1	.03	.04	.17	.0	1,190	1,215	1,245
	B	----	41.5	49.7	8.8	4.7	67.2	1.1	17.9	.3	11,370	---	.04	.05	.23				
	C	----	45.5	54.5	---	5.2	73.6	1.2	19.6	.3	12,470	---	.04	.06	.25				
D196193	A	26.7	28.8	39.3	5.2	6.2	50.5	.7	37.2	.2	8,510	11.9	.01	.01	.15	.0	1,210	1,225	1,245
	B	----	39.3	53.6	7.1	4.4	68.9	1.0	18.4	.3	11,610	---	.01	.01	.20				
	C	----	42.3	57.7	---	4.7	74.2	1.0	19.8	.3	12,490	---	.01	.01	.22				
D196194	A	26.8	29.0	37.5	6.7	6.3	48.8	.7	37.3	.2	8,270	12.2	<.01	<.01	.18	.0	1,215	1,230	1,250
	B	----	39.6	51.2	9.2	4.5	66.7	1.0	18.4	.3	11,300	---	<.01	<.01	.25				
	C	----	43.6	56.4	---	5.0	73.4	1.1	20.3	.3	12,440	---	<.01	<.01	.27				
D196195	A	25.7	30.6	39.0	4.7	6.3	52.0	.8	36.0	.2	8,800	9.8	.01	.01	.16	.0	1,100	1,115	1,130
	B	----	41.2	52.5	6.3	4.6	70.0	1.1	17.7	.3	11,840	---	.01	.01	.22				
	C	----	44.0	56.0	---	4.9	74.7	1.1	18.9	.3	12,640	---	.01	.01	.23				
D197320	A	29.8	30.4	34.7	5.1	6.8	47.5	.8	39.5	.3	8,190	15.0	.01	.04	.27	.0	1,210	1,225	1,245
	B	----	43.3	49.4	7.3	4.9	67.7	1.1	18.5	.5	11,670	---	.02	.06	.39				
	C	----	46.7	53.3	---	5.3	73.1	1.2	19.9	.5	12,580	---	.02	.07	.42				

Table 3.--Ash content and major- and minor-oxide and trace-element composition of eight coal samples from the Wyodak beds, Tongue River Member, Fort Union Formation, Converse and Campbell Counties, Wyoming.

[Analyses by U.S. Geological Survey laboratories, Denver, Colo. Analysts: J. H. Christie, J. W. Baker, A. J. Bartel, Candice Bliss, J. C. Hamilton, R. J. Knight, Cindy McFee, V. M. Merritt, H. T. Millard, Jr., H. G. Neiman, G. D. Shipley, J. A. Thomas, M. L. Tuttle, and J. W. Wahlberg. Coal ashed at 525°C. <, less than; --, not detected; N, not determined. Results of semiquantitative emission spectrographic analyses are based on their identity with geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, and so forth, and are reported arbitrarily as midpoints of these brackets, 1.0, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1, respectively. The precision of a reported value is approximately plus-or-minus one bracket at 68-percent, or two brackets at 95-percent confidence level]

Sample No.	A. Percent ash, major- and minor-oxide, and trace-element compositions of ash (percent)											(ppm)				
	Ash	SiO_2	Al_2O_3	CaO	MgO	Na_2O	K_2O	Fe_2O_3	TiO_2	P_2O_5	SO_3	Cu	Li	Mn	Pb	Zn
D196189	9.1	36	11	18	2.76	2.60	0.50	5.2	0.90	2.0	12	80	26	950	35	170
D196190	6.1	30	12	22	4.70	1.17	.50	5.5	.90	2.0	14	89	14	190	35	214
D196191	5.1	24	11	24	6.40	.80	.30	4.3	1.4	<1.0	14	156	24	170	35	113
D196192	8.5	44	17	14	4.20	.55	.90	3.0	1.4	2.0	8.8	136	29	115	35	418
D196193	6.2	37	15	15	4.80	1.63	.40	2.9	1.4	2.0	8.0	125	28	40	40	470
D196194	8.4	40	17	14	3.40	1.20	.30	2.5	1.7	8.5	3.8	61	16	34	90	65
D196195	5.6	32	14	19	5.10	1.84	.20	3.6	1.3	4.0	8.2	96	24	80	50	495
D197320	7.2	31	14	21	4.90	.27	.60	3.2	.96	3.0	12	91	14	110	45	196

	B. Semiquantitative emission spectrographic analyses (ppm) for trace elements															
	B	Ba	Be	Ce	Ga	Ge	La	Mo	Nb	Nd	Ni	Sc	Sr	V	Y	Yb	Zr
D196189	500	3,000	--	--	30	--	70	7	--	--	30	15	2,000	100	50	5	150
D196190	700	3,000	3	--	30	--	70	7	--	--	50	15	2,000	100	50	5	150
D196191	1,000	3,000	--	--	30	--	--	--	20	N	30	15	1,500	100	20	2	150
D196192	700	5,000	3	--	70	--	70	7	30	--	100	30	2,000	200	30	3	200
D196193	500	5,000	7	--	50	--	70	10	30	--	150	20	2,000	150	50	5	200
D196194	300	10,000	20	500	300	70	300	7	30	300	70	70	5,000	300	200	15	150
D196195	500	7,000	3	--	30	--	100	7	30	--	70	15	3,000	100	50	5	300
D197320	1,500	3,000	3	--	30	--	--	50	--	--	30	15	1,500	100	30	2	150

Table 4.--Major, minor, and trace-element composition of eight coal samples from the Wyodak beds, Tongue River Member, Fort Union Formation, Converse and Campbell Counties, Wyoming.

[<, less than; --, not detected; N, not determined]

Sample No.	A. Values calculated from analysis of ash														B. Direct determinations on air-dried (32°C) coal (ppm)								
	(Percent)								(Ppm)														
	Si	Al	Ca	Mg	Na	K	Fe	Ti	Cu	Li	Mn	P	Pb	Zn	As	Co	Cr	F	Hg	Sb	Se	Th	U
D196189	1.5	0.53	1.2	0.15	0.18	0.038	0.33	0.049	7.3	2.4	86	800	3.2	15	0.6	2.0	5.4	30	0.05	0.2	0.5	1.4	<0.2
D196190	.85	.39	.96	.17	.053	.025	.23	.033	5.4	.9	12	530	2.1	13	.8	1.8	2.7	30	.09	.2	.6	.8	< .2
D196191	.57	.30	.87	.20	.030	.013	.15	.043	8.0	1.2	8.7	<220	1.8	5.8	.3	.7	1.7	30	.05	.1	< .1	.6	< .2
D196192	1.7	.76	.85	.21	.035	.064	.18	.071	12	2.5	9.8	740	3.0	36	.6	3.6	6.2	60	.06	.3	.5	1.9	.3
D196193	1.1	.49	.66	.18	.075	.021	.13	.052	7.8	1.7	2.5	540	2.5	29	.7	3.1	2.8	40	.06	.1	.4	1.2	< .2
D196194	1.6	.76	.84	.17	.075	.021	.15	.086	5.1	1.3	2.9	3,100	7.6	5.5	.5	5.3	12	105	.02	1.0	.2	1.4	.4
D196195	.84	.41	.76	.17	.076	.009	.14	.044	5.4	1.3	4.5	980	2.8	28	.5	1.4	2.4	50	.04	.2	< .1	1.2	< .2
D197320	1.04	.53	1.08	.21	.014	.036	.16	.041	6.5	1.0	7.9	940	3.0	14	.6	1.1	2.7	50	.05	< .1	2.9	1.9	1.0

	C. Values calculated from analysis (ppm) of ash by emission spectrography															
	B	Ba	Be	Ce	Ga	Ge	La	Mo	Nb	Nd	Ni	Sc	Sr	V	Y	Yb	Zr
D196189	50	300	--	--	3	--	7	0.7	--	--	3	1.5	200	10	5	0.5	15
D196190	50	200	0.2	--	2	--	5	.5	--	--	3	1	150	7	3	.3	10
D196191	50	150	--	--	1.5	--	--	--	1	N	1.5	.7	70	5	1	.1	7
D196192	70	500	.2	--	7	--	7	.7	2	--	10	2	150	15	2	.2	15
D196193	30	300	.5	--	3	--	5	.7	2	--	10	1.5	150	10	3	.3	15
D196194	20	1,000	1.5	50	20	7	20	.7	2	20	7	7	500	20	15	1.5	15
D196195	30	500	.15	--	1.5	--	5	.5	1.5	--	5	1	150	5	3	.3	15
D197320	100	200	.2	--	2	--	--	3	--	N	2	1	100	7	2	.15	10

Table 5.--Elements looked for, but not detected, in coal samples from the Wyodak beds, Converse and Campbell Counties, Wyoming.

[Approximate lower detection limits in coal ash, as determined by the six-step spectrographic method of the U.S. Geological Survey, are included for all elements except Cd. The reported Cd lower detection limit is for the atomic absorption spectroscopic method]

Element	Lower limit of detection in coal ash (ppm)	Element	Lower limit of detection in coal ash (ppm)
Ag	1	Pd	5
Au	50	Pr	200
Bi	20	Pt	100
Cd	1	Re	100
Ce	500	Sm	200
Dy	100	Sn	20
Er	100	Ta	1,000
Eu	200	Tb	700
Gd	100	Te	5,000
Hf	200	Tl	100
Ho	50	Tm	50
In	20	W	200
Lu	70		

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77001
SHEET 1 OF 2

AREA Southern Powder River Basin		QUAD NAME Betty Reservoir	
DATE STARTED 8/16/77	DATE COMP. 8/16/77	COUNTY Converse	STATE Wyoming
LOCATION: SEC. 23 T. 40N , R. 71W , FOOTAGE LOC. 1600 FNL 550 FWL			GROUND ELEV 4818
SIZE AND BIT TYPE: 4 3/4 Drag	FOOTAGE ROTARY 280 CORING 0		TOTAL DEPTH 280
DRILLING AGENCY: U.S. Geological Survey	DRILL TYPE: Portadrill 524		DEPTH TO WATER 4 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Kistner	GEOPHYSICAL LOGS RECORDED BY F.B. Kistner & G.A. Hollomon		

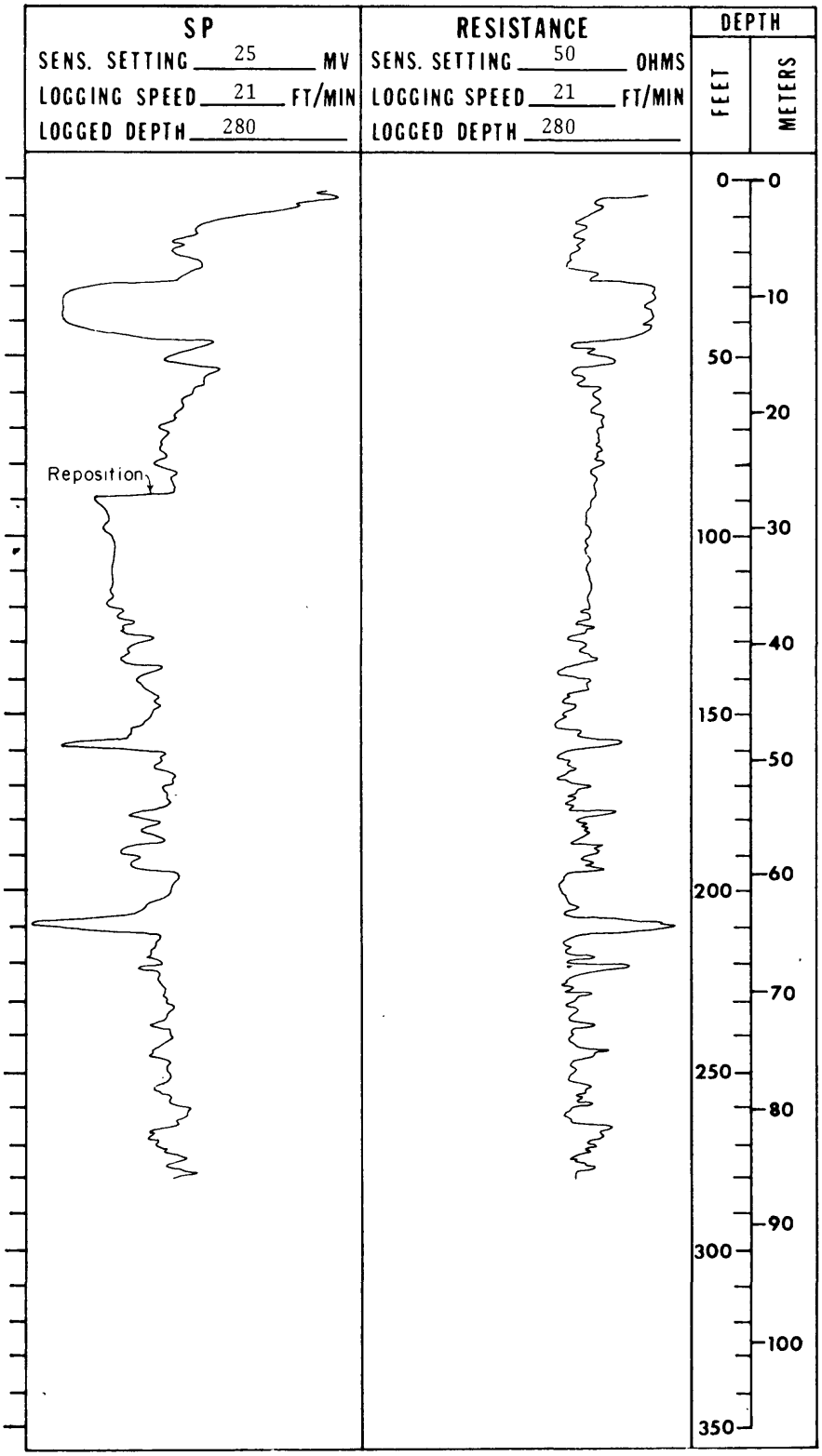
REMARKS:
2-inch observation well installed to 105 ft on 8/17/77

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 10 FT/MIN LOGGED DEPTH 258 ft	T.C. — SEC. RANGE — CPS LOGGING SPEED — FT/MIN LOGGED DEPTH —		
0 Siltstone and sandstone, light-gray, fine-grained sand				0	0
28 Coal, brownish-black to black, vit luster, conchoidal fracture, frag				10	
44 weathered to 40 ft Sandstone, light-gray, to light-brnish-gray, fine-grained sand, well-sorted				50	20
63 Sandstone, light-brownish-gray to brownish-gray, fine-grained to very fine grained, slightly micaceous				100	30
119				150	40
Siltstone and sandstone, light-gray to light-brownish-gray, fine-grained to very fine grained sand; 3 ft coal at 157 ft; 5 ft coal at 207 ft				200	50
				250	60
258 L.T.D.				300	70
				350	80
					90
					100

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77001
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77002
SHEET 1 OF 3

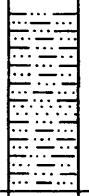
AREA Southern Powder River Basin		QUAD NAME Betty Reservoir NE	
DATE STARTED 8/31/77	DATE COMP. 8/31/77	COUNTY Campbell	STATE Wyoming
LOCATION: SEC. 25 T. 41N , R. 71W , FOOTAGE LOC. 1980 FNL ~~FSL~~ 1200 FEL ~~FWL~~			GROUND ELEV 4730
SIZE AND BIT TYPE: 4 3/4 Drag	FOOTAGE ROTARY 396	CORING 0	TOTAL DEPTH 396
DRILLING AGENCY: U.S. Geological Survey	DRILL TYPE: Portadrill 524		DEPTH TO WATER —
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	GEOPHYSICAL LOGS RECORDED BY Kistner, Hollomon, Riglin		
REMARKS:			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 15 FT/MIN LOGGED DEPTH 396	T.C. ___ SEC. RANGE ___ CPS LOGGING SPEED ___ FT/MIN LOGGED DEPTH ___		
0				0	0
Siltstone and sandstone with possible carbonaceous shale at 85 ft		Reposition		10	
				50	20
				100	30
133 Sandstone					40
143				150	
Siltstone					50
195				200	60
Coal					
236					70
Siltstone				250	
277					80
Coal					
316 Siltstone and sandstone				300	90
					100
				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77002
SHEET 2 OF 3

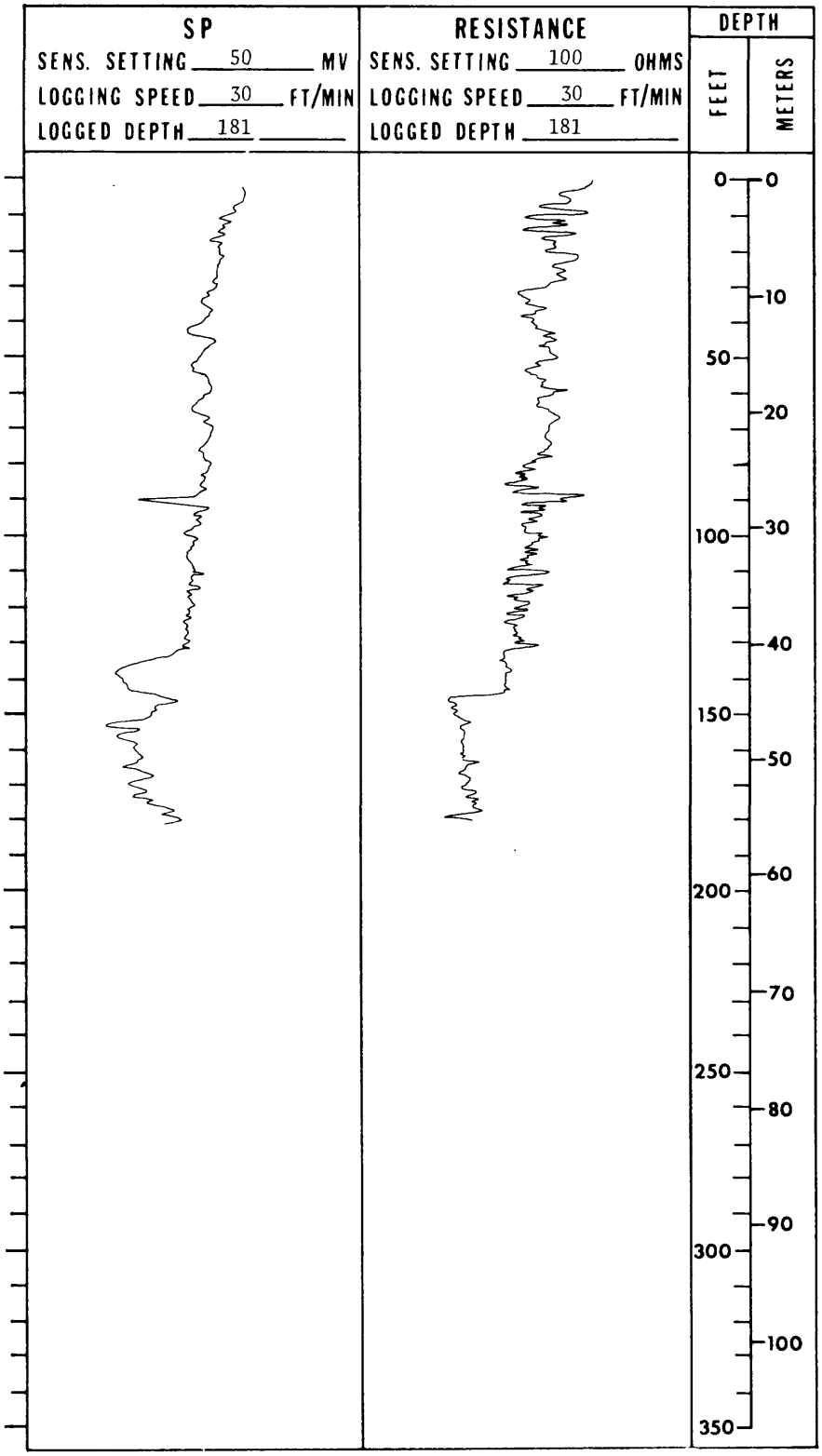
REMARKS:

LITHOLOGY	STRIP LOG	GAMMA T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 15 FT/MIN LOGGED DEPTH 396	DENSITY T.C. ___ SEC. RANGE ___ CPS LOGGING SPEED ___ FT/MIN LOGGED DEPTH ___	DEPTH FEET	DEPTH METERS
Siltstone and sandstone				350	110
396 L.T.D.				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. CD77002
SHEET 3 OF 3

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77003
SHEET 1 OF 2

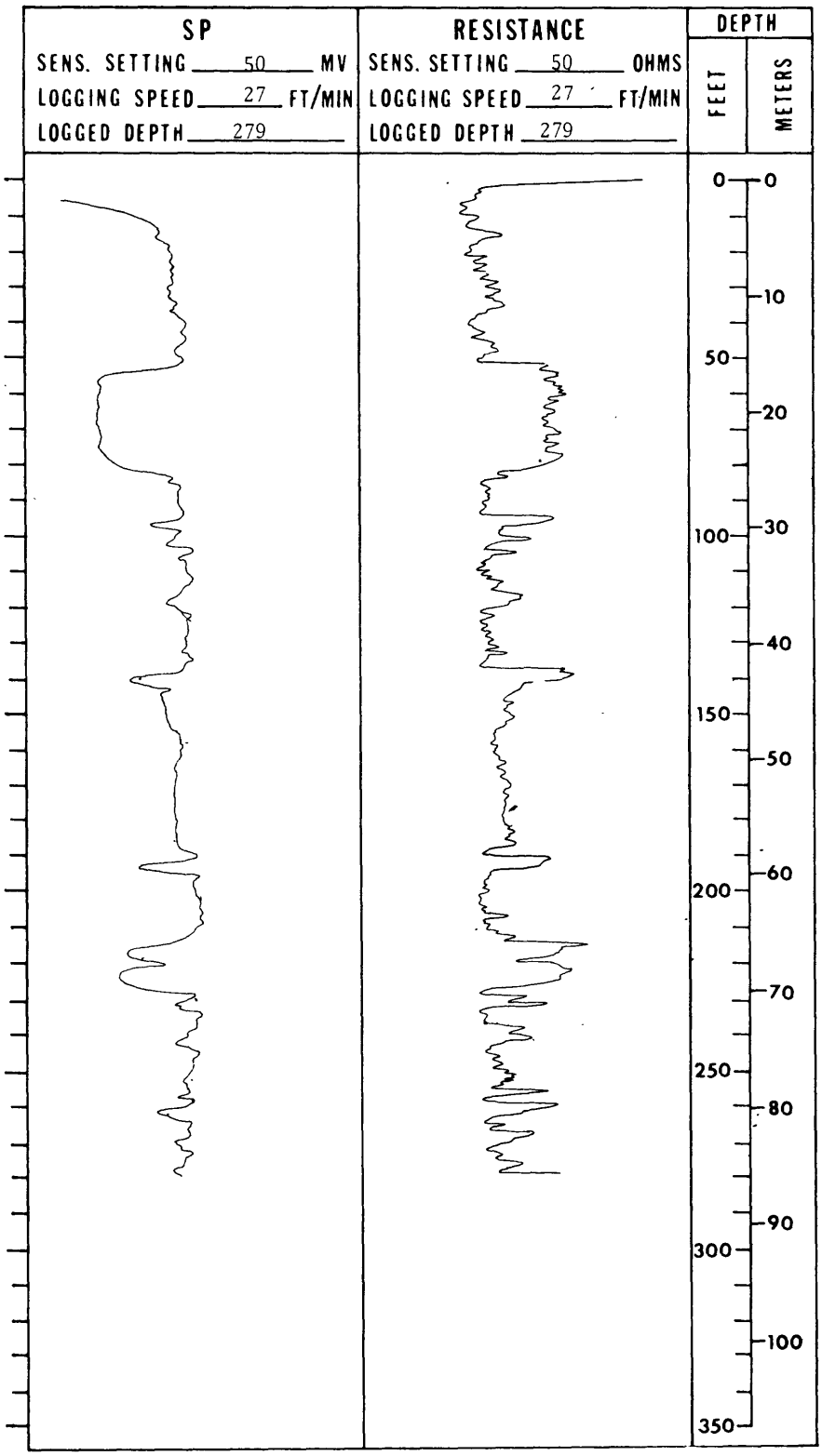
AREA Southern Powder River Basin		QUAD NAME Betty Reservoir	
DATE STARTED 9/1/77	DATE COMP. 9/1/77	COUNTY Converse	STATE Wyoming
LOCATION: SEC. 18 T. 40N , R. 70W , FOOTAGE LOC. 1450 FSL 50 FEL			GROUND ELEV 4845
SIZE AND BIT TYPE: 4 3/4 Drag	FOOTAGE ROTARY 280 CORING 0		TOTAL DEPTH 280
DRILLING AGENCY: U.S. Geological Survey	DRILL TYPE: Portadrill 524		DEPTH TO WATER ———
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	GEOPHYSICAL LOGS RECORDED BY G.A. Hollomon		
REMARKS:			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 18 FT/MIN LOGGED DEPTH 278 ft	T.C. — SEC. RANGE ——— CPS LOGGING SPEED ——— FT/MIN LOGGED DEPTH ———		
0 Siltstone, light-olive-gray, laminated, trace of limonite alteration, weathered to 30 ft				0	0
35 Claystone, dusky-yellowish-brown, carbonaceous .				50	20
49 Coal, black, high luster, fragment size; 0.2 cm to 1.0 cm					
79 Claystone, dusky-yellowish-brown, carbonaceous					
91-94 Coal, black				100	30
Siltstone and claystone, light-gray. Sandy zones at 98 ft and 116 ft					
135-139 Coal, black				150	50
Siltstone, gray, some carbonaceous shale					
188-191 Coal, black Claystone, gray				200	60
212 Coal, black, dull luster, fragmented; with stringers of siltstone at 217 ft					
225 Siltstone and claystone, gray with thin interbeds of poorly sorted fine sandstone				250	80
278 L.T..D.				300	90
					100
				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77003
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77004
SHEET 1 OF 2

AREA Southern Powder River Basin		**QUAD NAME** Betty Reservoir	
DATE STARTED 9/2/77	**DATE COMP.** 9/3/77	**COUNTY** Converse	**STATE** Wyoming
LOCATION: SEC. 5 **T.** 40N **, R.** 70W **, FOOTAGE LOC.** 1250 FSL 500 FWL			**GROUND ELEV** 4730
SIZE AND BIT TYPE: 4 3/4 Drag	**FOOTAGE** ROTARY 300 CORING 0		**TOTAL DEPTH** 300
DRILLING AGENCY: US Geological Survey	**DRILL TYPE:** Portadrill 524		**DEPTH TO WATER** 40 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	**GEOPHYSICAL LOGS RECORDED BY** L. Riglin		
REMARKS:			

LITHOLOGY

0

Siltstone and claystone, gray, weathered to 25 ft

41

Coal, dark-brown to black, dull luster, conchoidal fracture, with poorly defined cleat pattern

71

Claystone, brownish-gray, with thin carbonaceous interbeds. Possible coals; 1 ft coal at 84 ft, 1 ft at 136 ft

166

Coal, black, fractured, slightly visible cleat pattern, appx. fragment size; 0.2 to .06 cm

196

Siltstone and claystone, light-olive-gray, poorly sorted with trace of carbonaceous material. Possible 2 ft coal at 228 ft

299 L.T.D.

STRIP LOG

GAMMA
T.C. 4 SEC. · RANGE 100 CPS
LOGGING SPEED 18 FT/MIN
LOGGED DEPTH 299 ft

DENSITY
T.C. — SEC. · RANGE — CPS
LOGGING SPEED — FT/MIN
LOGGED DEPTH —

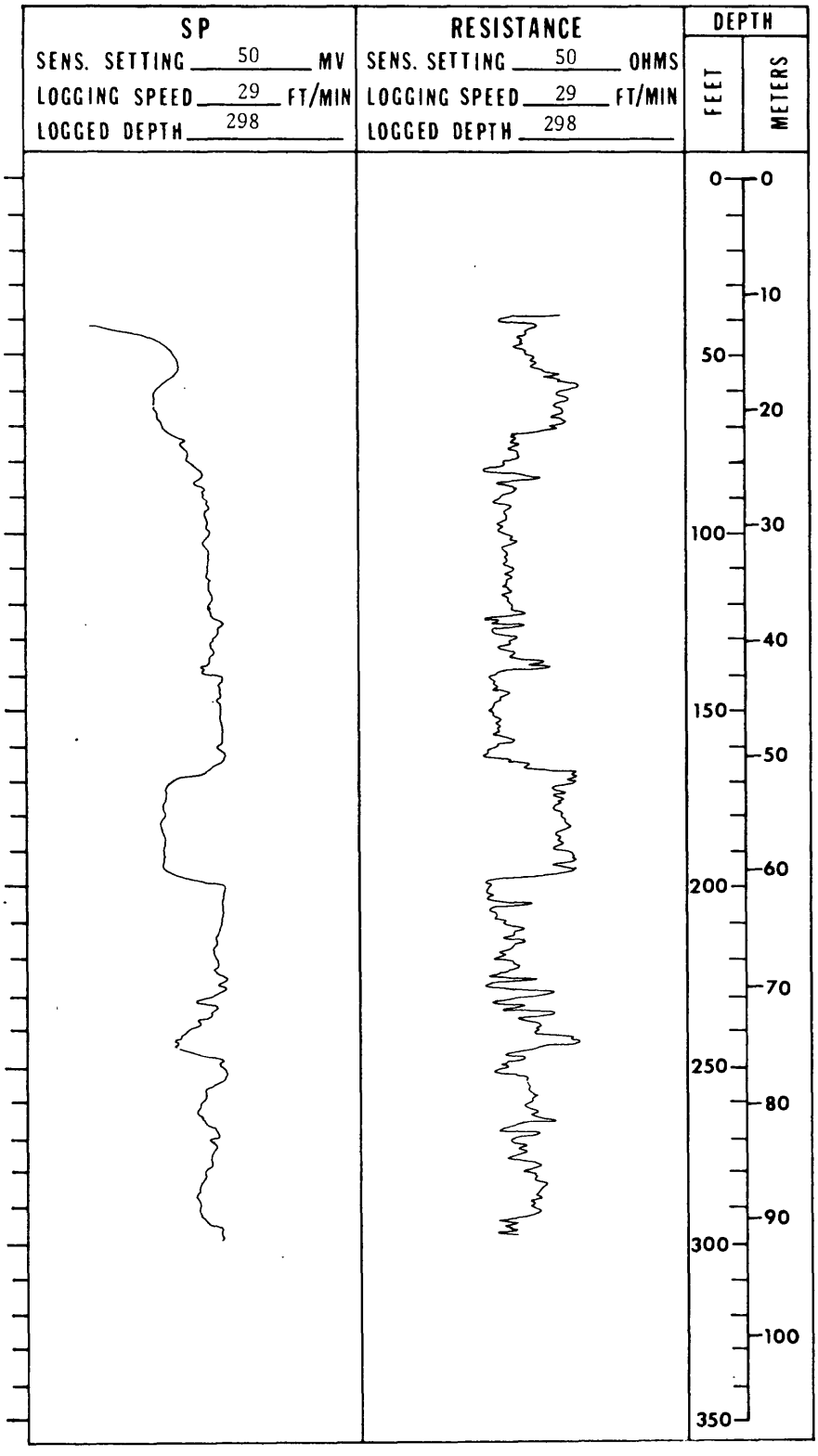
DEPTH

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

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77004
SHEET 2 OF 2

REMARKS



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77005
SHEET 1 OF 2

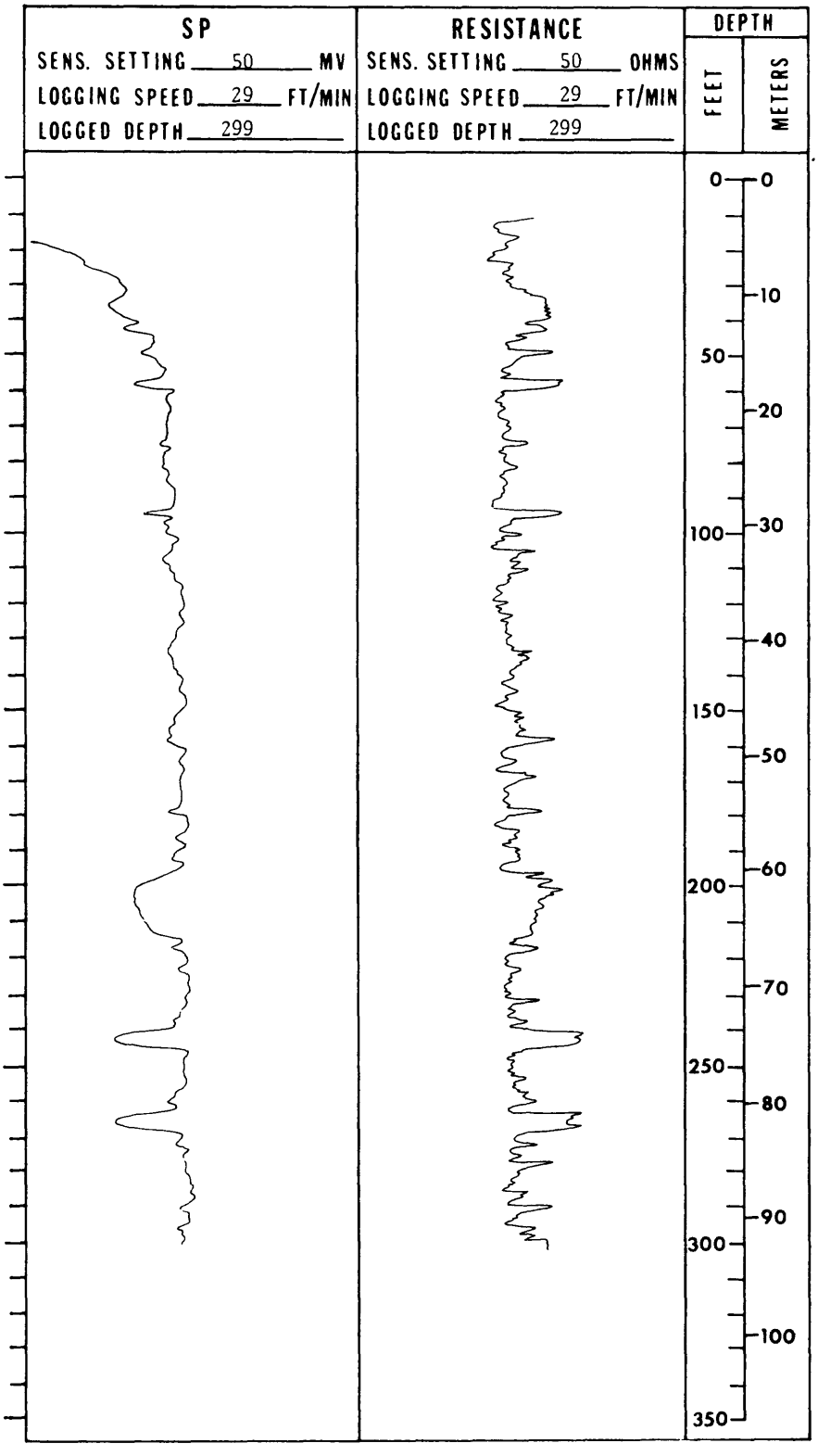
AREA Southern Powder River Basin		**QUAD NAME** Betty Reservoir	
DATE STARTED 9/4/77	**DATE COMP.** 9/4/77	**COUNTY** Converse	**STATE** Wyoming
LOCATION: SEC. 30 **T.** 40N , **R.** 70W , **FOOTAGE LOC.** 2600 FNL 300 FEL			**GROUND ELEV** 4925
SIZE AND BIT TYPE: 4 3/4 Drag	**FOOTAGE** ROTARY 300 CORING 0		**TOTAL DEPTH** 300
DRILLING AGENCY: U.S. Geological Survey	**DRILL TYPE:** Portadrill 524		**DEPTH TO WATER** 11 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	**GEOPHYSICAL LOGS RECORDED BY** G. A. Hollomon		
REMARKS:			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 18 FT/MIN LOGGED DEPTH 299 ft	T.C. — SEC. RANGE — CPS LOGGING SPEED — FT/MIN LOGGED DEPTH —		
0 Siltstone and claystone, brown to gray, minor carbonaceous shale				0	0
24 Coal, black, weathered to 30 ft with siltstone split from 40 to 41 ft					10
43				50	
					20
Siltstone and claystone, gray, minor carbonaceous siltstone, 4 ft coal at 48 ft, 5 ft coal at 56 ft, 2 ft coal at 94 ft; possible thin coals at 158 ft and 177 ft				100	30
					40
				150	
					50
196 Sandstone, gray, very fine grained sand, sorted, sub-angular					60
214 Siltstone and claystone, gray, with minor carbonaceous siltstone				200	
					70
240-45 Coal, black					
Claystone and siltstone, gray to brown, carbonaceous				250	
264-69 Coal, black					80
Claystone and siltstone, gray to brown, carbonaceous					90
299 L.T.D.				300	
					100
				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77005
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77006
SHEET 1 OF 2

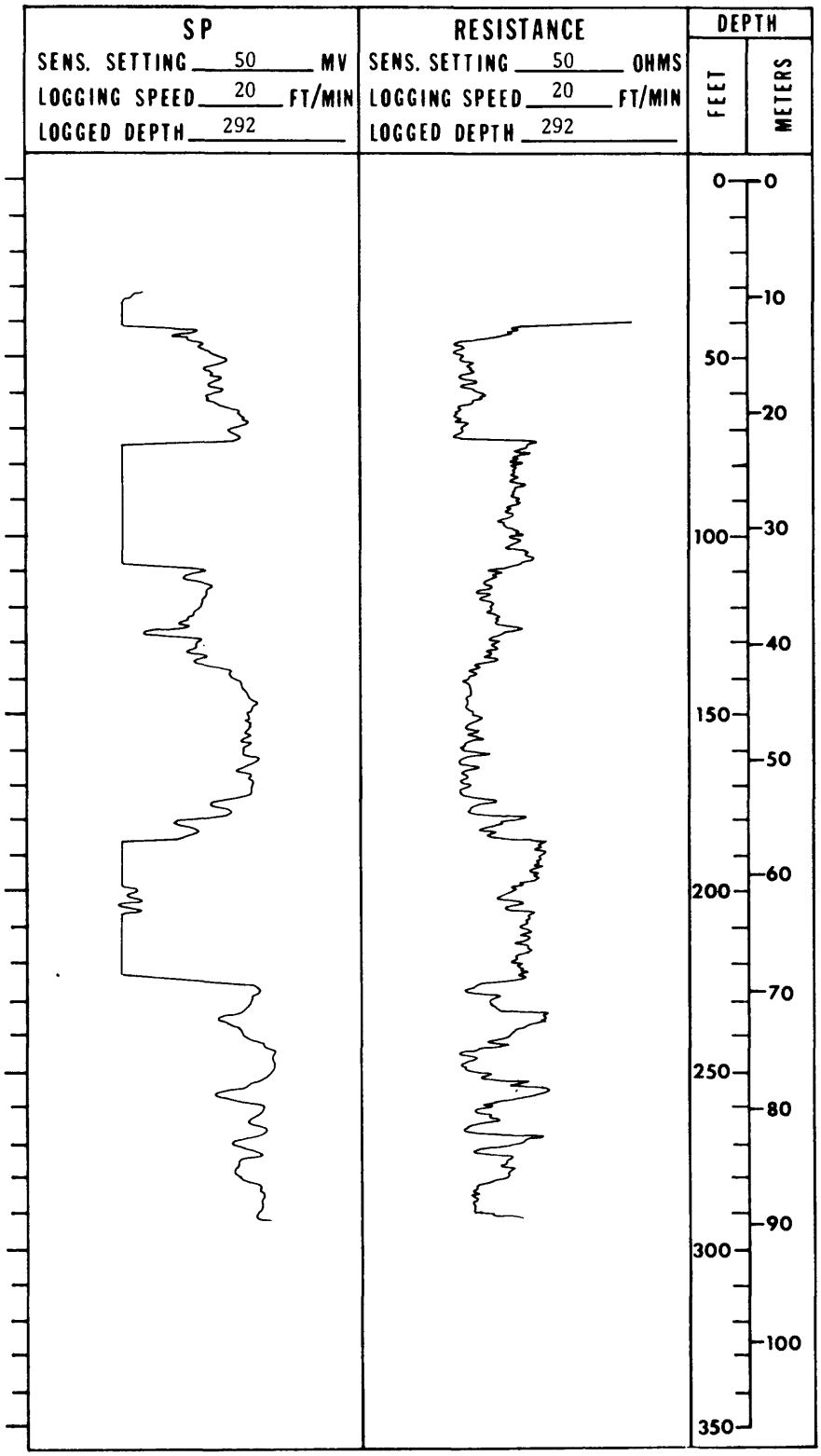
AREA Southern Powder River Basin		**QUAD NAME** Betty Reservoir	
DATE STARTED 9/5/77	**DATE COMP.** 9/5/77	**COUNTY** Converse	**STATE** Wyoming
LOCATION: SEC. 2 **T.** 40N , **R.** 71W , **FOOTAGE LOC.** 1000 FNL ~~FSL~~ 950 FEL ~~FWL~~			**GROUND ELEV** 4650
SIZE AND BIT TYPE: 4 3/4 Drag	**FOOTAGE** ROTARY 223	CORING 77	**TOTAL DEPTH** 300
DRILLING AGENCY: U.S. Geological Survey	**DRILL TYPE:** Portadrill 524		**DEPTH TO WATER** 41 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	**GEOPHYSICAL LOGS RECORDED BY** L. Riglin		
REMARKS:			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 17 FT/MIN LOGGED DEPTH 297	T.C. — SEC. RANGE ——— CPS LOGGING SPEED ——— FT/MIN LOGGED DEPTH ———		
0				0	0
Siltstone, grayish-orange to light-gray				50	10
73				100	20
Coal, black, vitreous luster, sub-conchoidal fracture				150	30
108				200	40
Siltstone and claystone, light-gray to grayish-brown				250	50
186 Coal, black, vitreous luster, sub-conchoidal fracture				300	60
198 Carb sh, grayish-brn to brnish-blk					70
207 Coal, brownish-black, dull to vitreous luster, fragmental					80
226					90
Siltstone and carbonaceous shale, light-gray to brownish-black, pos 3 ft coal at 256 ft and 3 ft coal at 269					100
297 L.T.D.				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77006
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77007
SHEET 1 OF 2

AREA Southern Powder River Basin		**QUAD NAME** Coal Bank Draw	
DATE STARTED 9/6/77	**DATE COMP.** 9/7/77	**COUNTY** Converse	**STATE** Wyoming
LOCATION: SEC. 2 **T.** 40N , **R.** 70W , **FOOTAGE LOC.** 650 FSL 450 FWL			**GROUND ELEV** 4825
SIZE AND BIT TYPE: 4 3/4 Drag	**FOOTAGE** ROTARY 260 CORING 0		**TOTAL DEPTH** 260
DRILLING AGENCY: U.S. Geological Survey	**DRILL TYPE:** Portadrill 524		**DEPTH TO WATER** 78 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	**GEOPHYSICAL LOGS RECORDED BY** L.D. Riglin		

REMARKS:
Lost circulation at 120 ft

LITHOLOGY

0

Clinker, red to light-grays and blues, fine sandstone to siltstone, poorly sorted, sub-angular to angular prtcls, traces of chert and ash. Weathered to 30 ft

97

Sandstone and siltstone, light-gray, siltstones with traces of carbonaceous material at 104 ft and 120 ft

146

Sandstone and siltstone with possible coals at these intervals, 2 ft at 176 ft, 2 ft at 199 ft and 1 ft at 246 ft

247
255 L.T.D.

STRIP LOG

GAMMA
T.C. 4 SEC. · RANGE 100 CPS
LOGGING SPEED 17 FT/MIN
LOGGED DEPTH 255

DENSITY
T.C. — SEC. · RANGE — CPS
LOGGING SPEED — FT/MIN
LOGGED DEPTH —

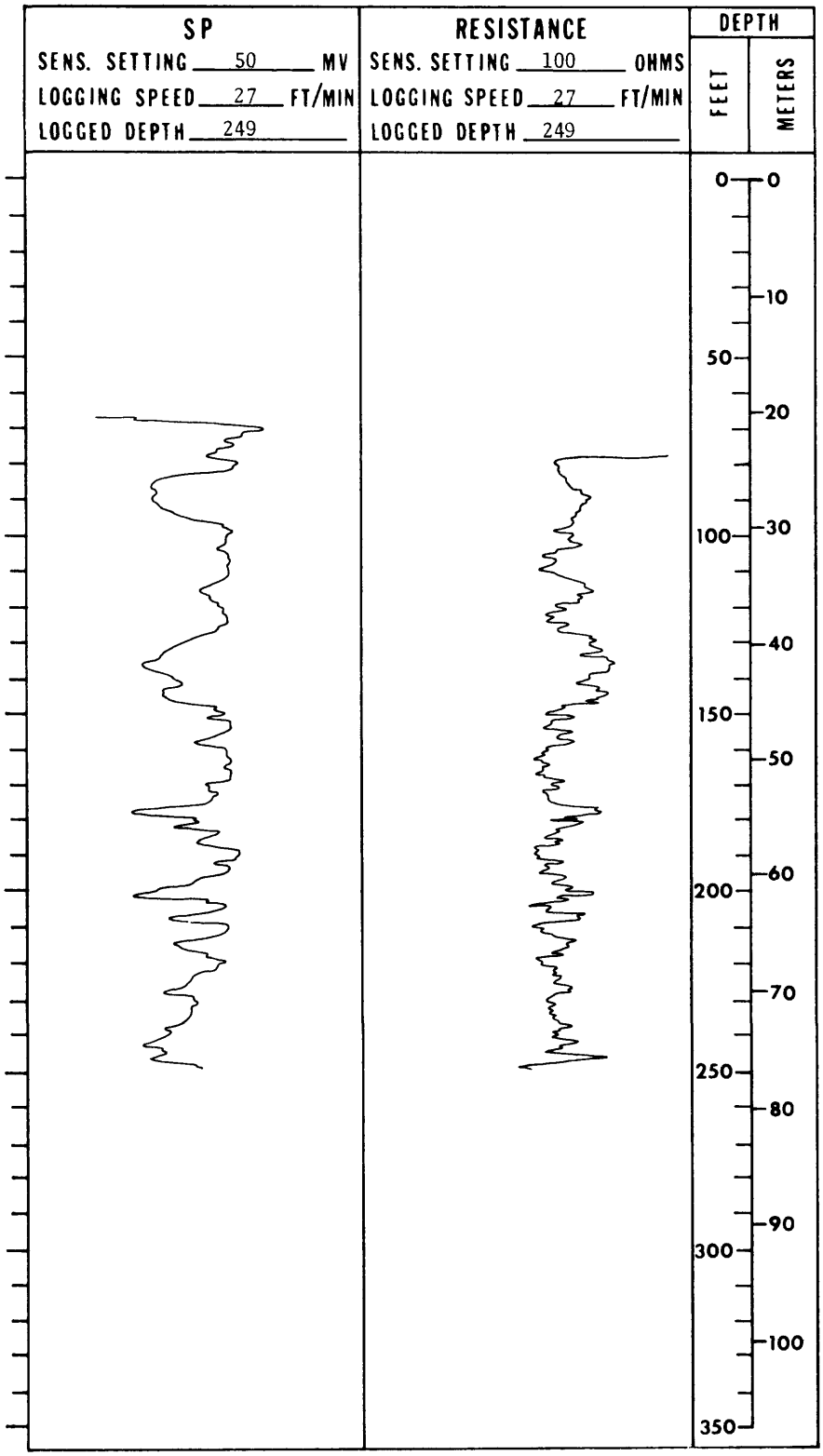
DEPTH

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

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77007
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77008
SHEET 1 OF 2

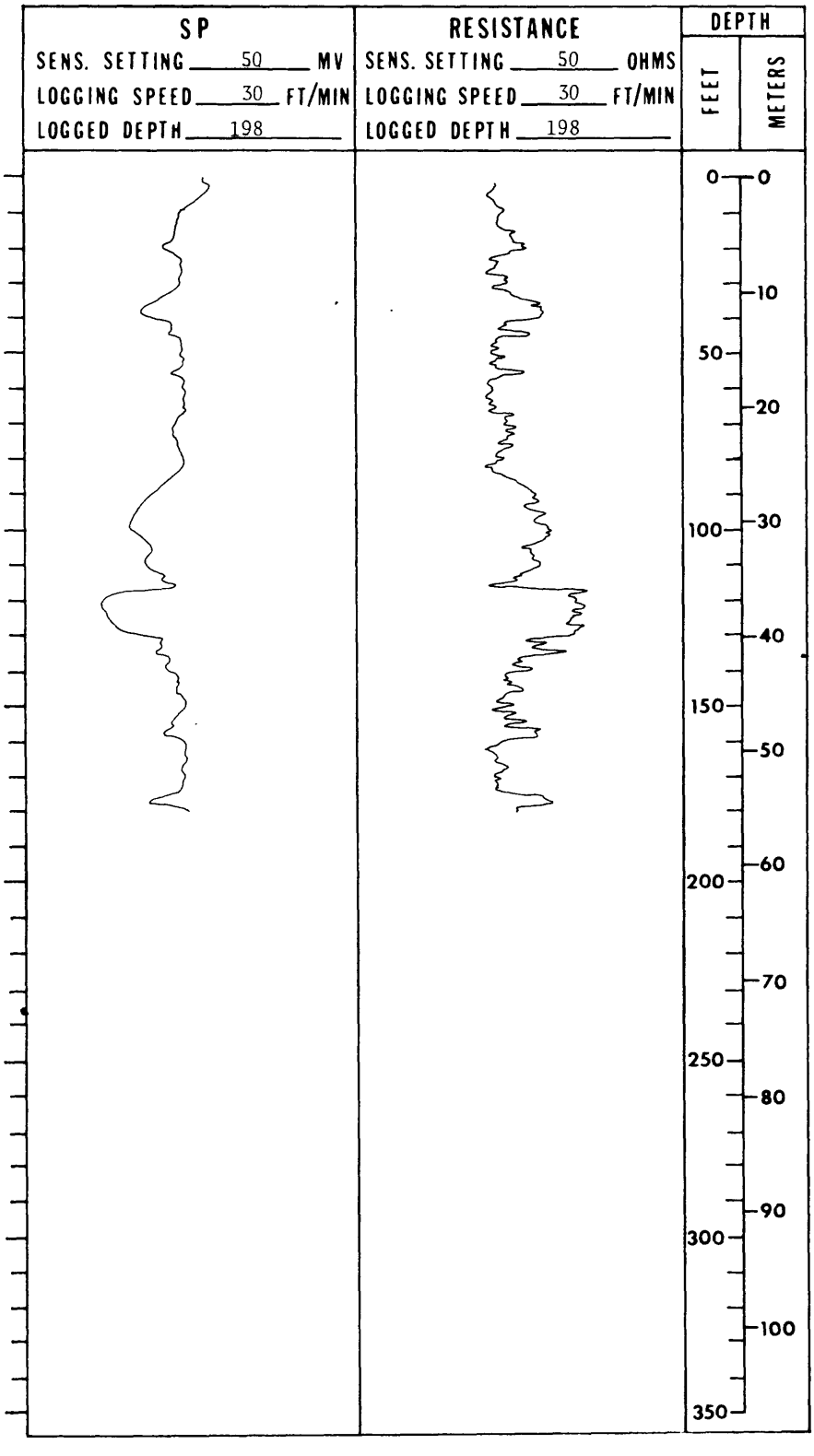
AREA Southern Powder River Basin		QUAD NAME Betty Reservoir	
DATE STARTED 9/8/77	DATE COMP. 9/8/77	COUNTY Converse	STATE Wyoming
LOCATION: SEC. 3 T. 39N , R. 71W , FOOTAGE LOC.		2350 FNL 1450 FWL	GROUND ELEV 4965
SIZE AND BIT TYPE: 4 3/4 Drag		FOOTAGE ROTARY 164 CORING 16	TOTAL DEPTH 180
DRILLING AGENCY: U.S. Geological Survey		DRILL TYPE: Portadrill 524	DEPTH TO WATER LS
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin		GEOPHYSICAL LOGS RECORDED BY L. Riglin	
REMARKS:			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 18 FT/MIN LOGGED DEPTH 179 ft	T.C. — SEC. RANGE — CPS LOGGING SPEED — FT/MIN LOGGED DEPTH —		
0				0	0
Siltstone and sandstone, yellowish-gray to medium-light-gray, fine-grained to very fine grained sand, sub-angular weathered to 50 ft with trace of limonite alteration				50	10 20
84				100	30
Sandstone, light-gray to medium-light-gray, medium-to fine-grained sand, angular to sub-angular grains					
117 Coal, brownish-black, moderate luster conchoidal fracture					
130				150	40 50
Siltstone, light-gray to medium-light-gray, 3 ft coal at 156 ft, 1.5 ft coal at 175 ft				200	60
179 L.T.D.				250	70 80
				300	90 100
				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77008
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77009
SHEET 1 OF 4

AREA Southern Powder River Basin		QUAD NAME Coal Draw	
DATE STARTED 9/18/77	DATE COMP. 9/18/77	COUNTY Converse	STATE Wyoming
LOCATION: SEC. 30 T. 40N , R. 72W , FOOTAGE LOC. 900 FNL 2350 FEL			GROUND ELEV 5010
SIZE AND BIT TYPE: 4 3/4 Drag		FOOTAGE ROTARY 440 CORING 0	TOTAL DEPTH 440
DRILLING AGENCY: U.S. Geological Survey	DRILL TYPE: Portadrill 524		DEPTH TO WATER 92ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	GEOPHYSICAL LOGS RECORDED BY L. Riglin		
REMARKS:			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 11 FT/MIN LOGGED DEPTH 437	T.C. — SEC. RANGE ——— CPS LOGGING SPEED ——— FT/MIN LOGGED DEPTH ———		
0				0	0
Sandstone, light-gray to grayish-orange, very coarse grained to m-grained sand, sub-angular, weathered to 90 ft				50	10
				100	20
					30
127					
Siltstone, light-brownish-gray					40
150				150	
Sandstone, light-gray, very coarse grained to medium-grained sand, sub-rounded grains					50
185					
Sandstone and graded siltstones, light-brownish-gray, grades from silt size particles to very fine grained sands				200	60
					70
250				250	
Siltstone, light-brownish-gray, with very fine grained sands, carb shale zones					80
					90
				300	
Coal, brownish-black to black, dull					100
319 to vitreous luster, fragmental					
325 Siltstone and carbonaceous shale, light-gray to brownish-gray					
342				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77009
SHEET 2 OF 4

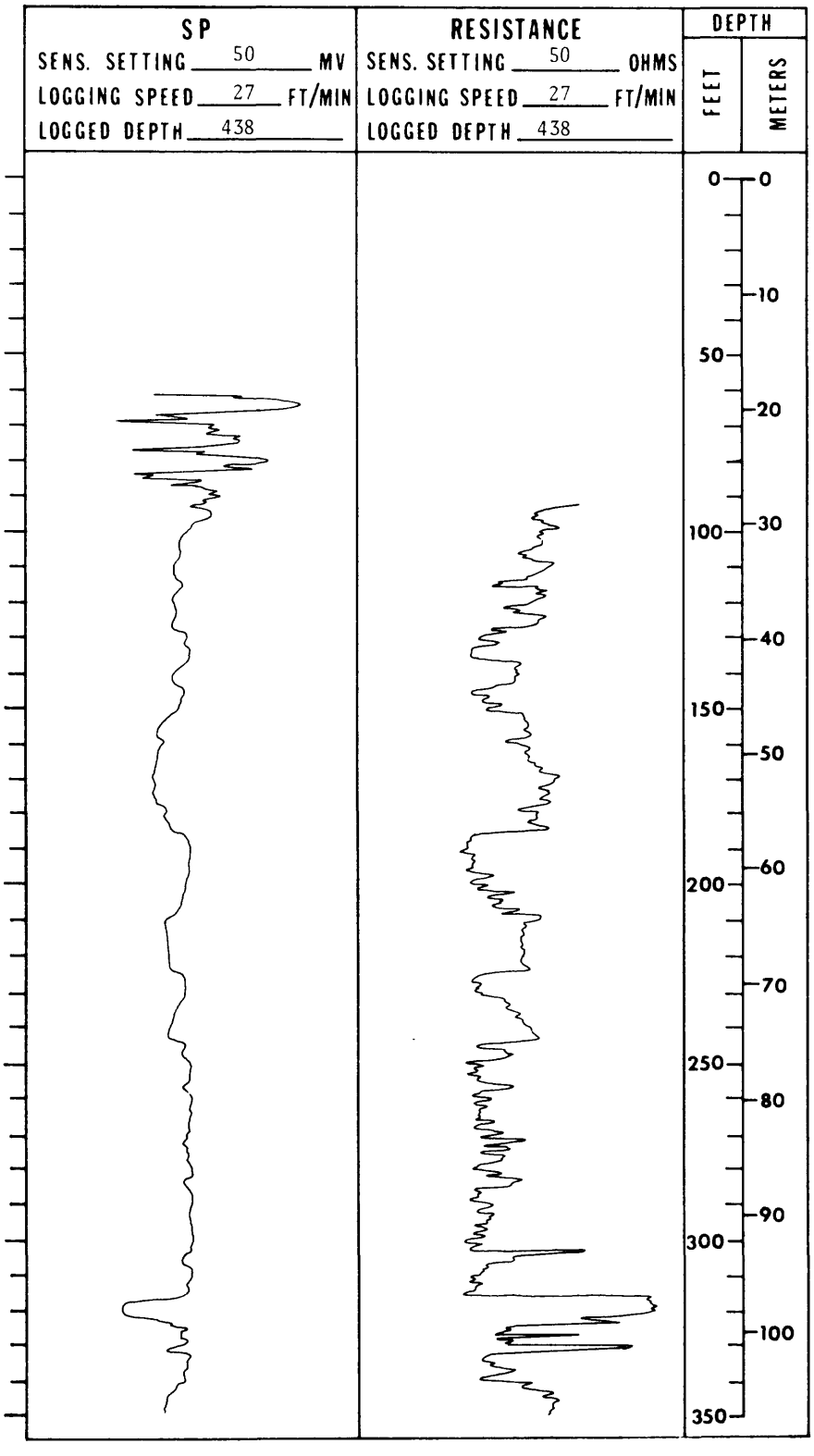
REMARKS:

LITHOLOGY	STRIP LOG	GAMMA T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 11 FT/MIN LOGGED DEPTH 437	DENSITY T.C. — SEC. RANGE — CPS LOGGING SPEED — FT/MIN LOGGED DEPTH —	DEPTH FEET	DEPTH METERS
Sandstone, medium-light-gray to light-brownish-gray, very coarse grained to fine-grained sand, sub-rounded grains				350	110
401				400	120
Sandstone, medium-light-gray, fine-grained to very fine grained sand					130
437 L.T.D.				450	140
				500	150
				550	160
				600	170
				650	180
				700	190
				750	200
					210
					220

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77009
SHEET 3 OF 4

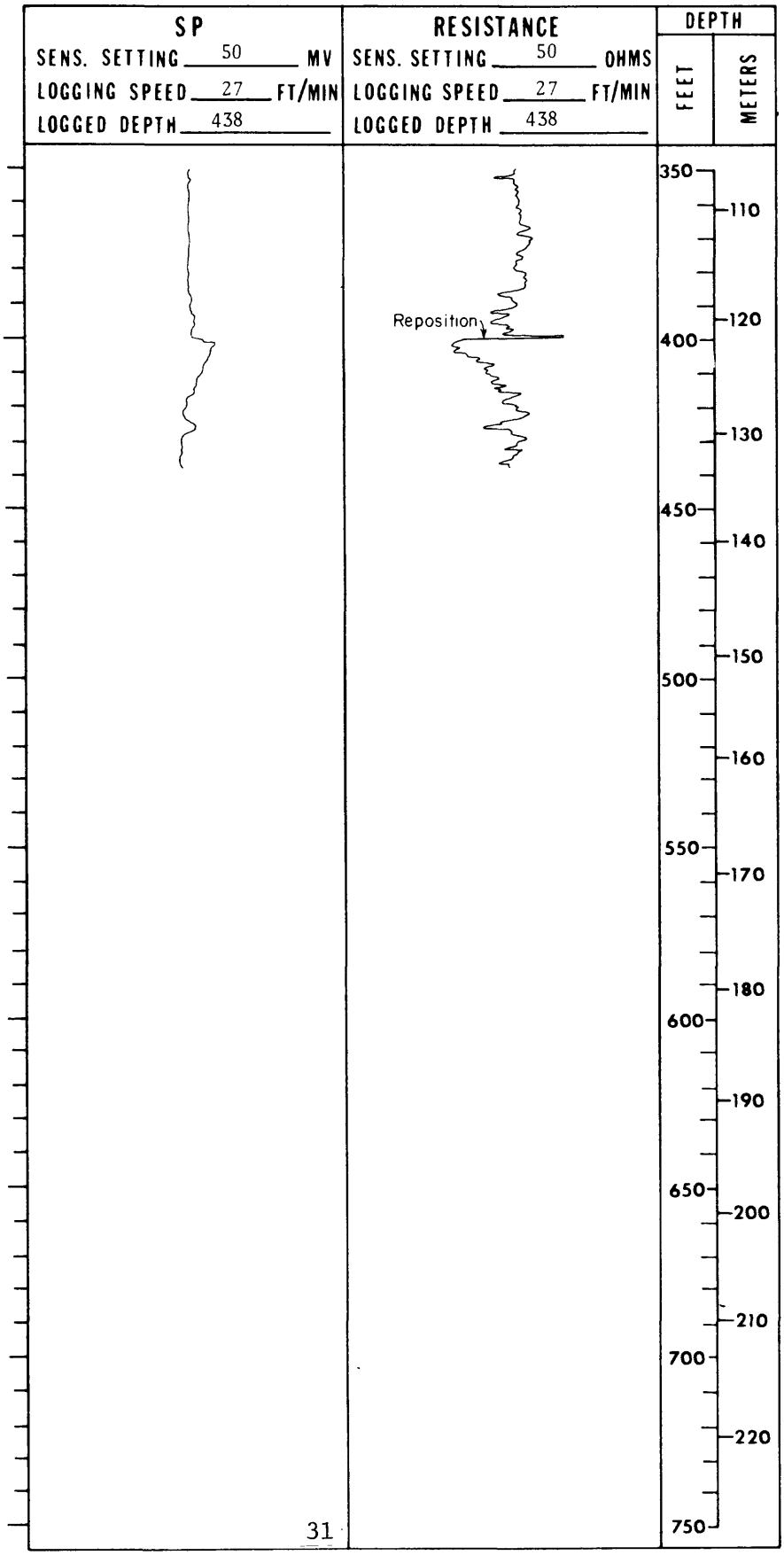
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77009
SHEET 4 OF 4

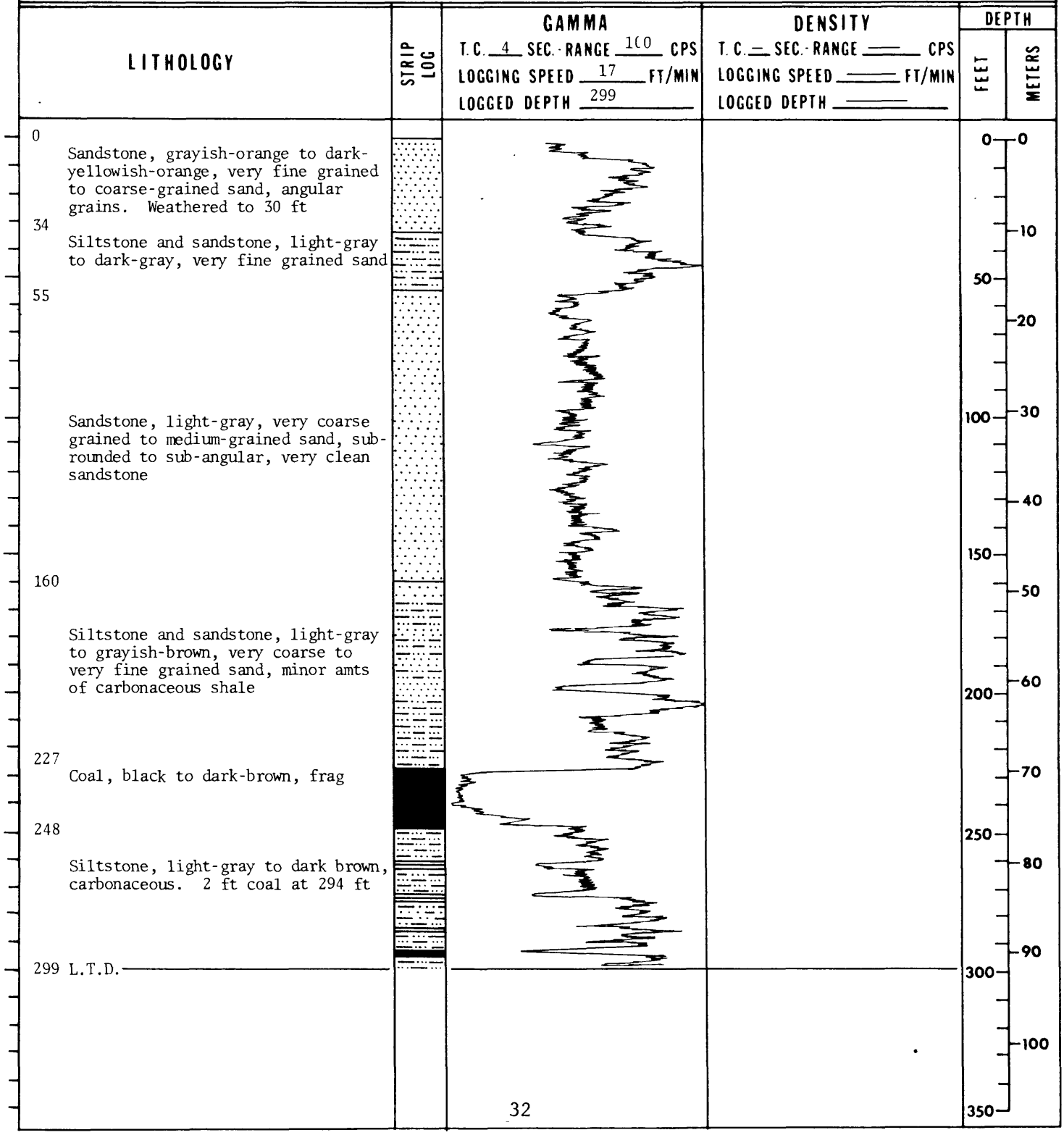
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77010
SHEET 1 OF 2

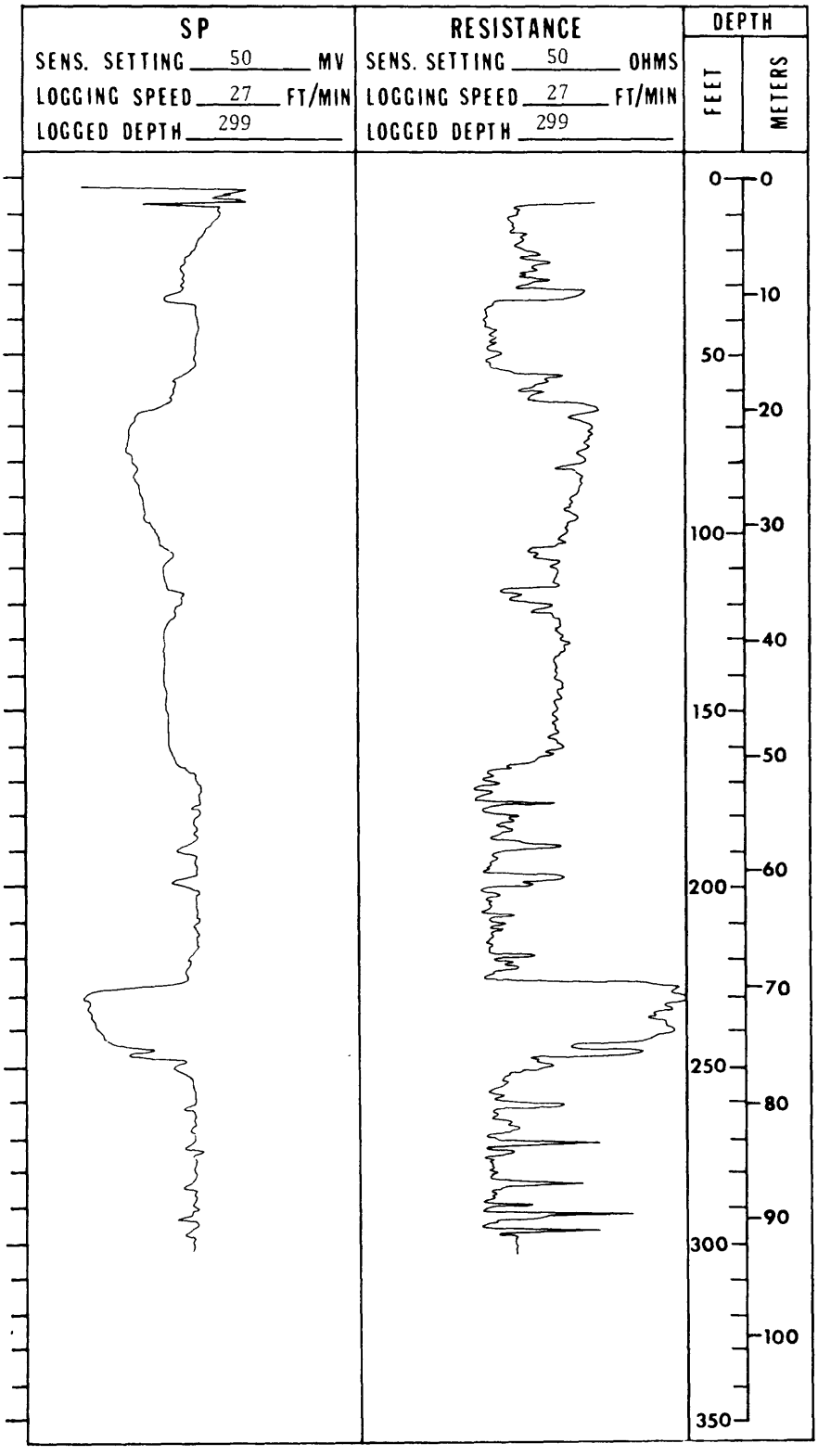
AREA Southern Powder River Basin		**QUAD NAME** Coal Draw	
DATE STARTED 9/19/77	**DATE COMP.** 9/19/77	**COUNTY** Converse	**STATE** Wyoming
LOCATION: SEC. 28 **T.** 40N , **R.** 72W , **FOOTAGE LOC.** 1500 FNL ~~FSL~~ 1000 FEL ~~FWL~~			**GROUND ELEV** 4825
SIZE AND BIT TYPE: 4 3/4 Drag	**FOOTAGE** ROTARY 300 CORING 0		**TOTAL DEPTH** 300
DRILLING AGENCY: U.S. Geological Survey	**DRILL TYPE:** Portadrill 524		**DEPTH TO WATER** 7 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	**GEOPHYSICAL LOGS RECORDED BY** L. Riglin		
REMARKS:			



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD7701
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77011
SHEET 1 OF 4

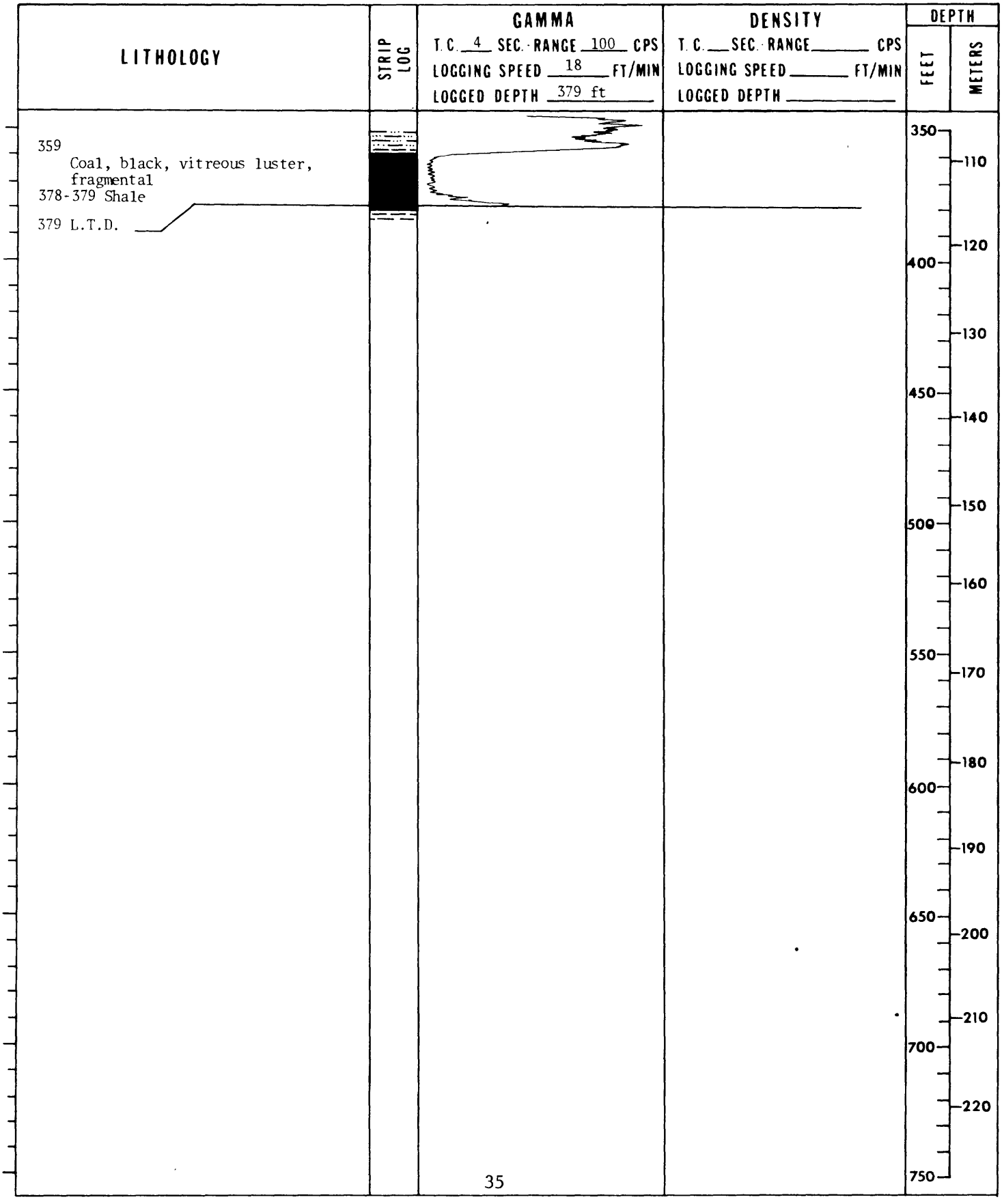
AREA Southern Powder River Basin		QUAD NAME Coal Draw	
DATE STARTED 9/20/77	DATE COMP. 9/20/77	COUNTY Converse	STATE Wyoming
LOCATION: SEC. 6 T. 40N , R. 72W , FOOTAGE LOC. 700 ~~FNL~~ FSL 450 ~~FWL~~ FEL			GROUND ELEV 4890
SIZE AND BIT TYPE: 4 3/4 Drag	FOOTAGE ROTARY 380	CORING 0	TOTAL DEPTH 380
DRILLING AGENCY: U.S. Geological Survey	DRILL TYPE: Portadrill 524		DEPTH TO WATER LS
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	GEOPHYSICAL LOGS RECORDED BY L. Riglin		
REMARKS:			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 18 FT/MIN LOGGED DEPTH 379 ft	T.C. ___ SEC. RANGE ___ CPS LOGGING SPEED ___ FT/MIN LOGGED DEPTH ___		
0 Claystone and sandstone, dark-yellowish-orange to light-gray, very coarse to very fine grained sand, weathered to 35 ft, limonite alteration				0 50 100 150 200 250 300 350	0 10 20 30 40 50 60 70 80 90 100
54 Sandstone, light-gray to medium-gray, very coarse grained to med-grained sands, sub-rounded					
102 Siltstone, light-gray. Possible 2 ft coal at 152 ft, 3 ft coal at 199 ft					
203 Claystone and siltstone, dark-gray to dark-brown, carbonaceous					
307 Siltstone and sandstone, very light gray					
346 Siltstone and claystone, light-gray to dark-gray					

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77011
SHEET 2 OF 4

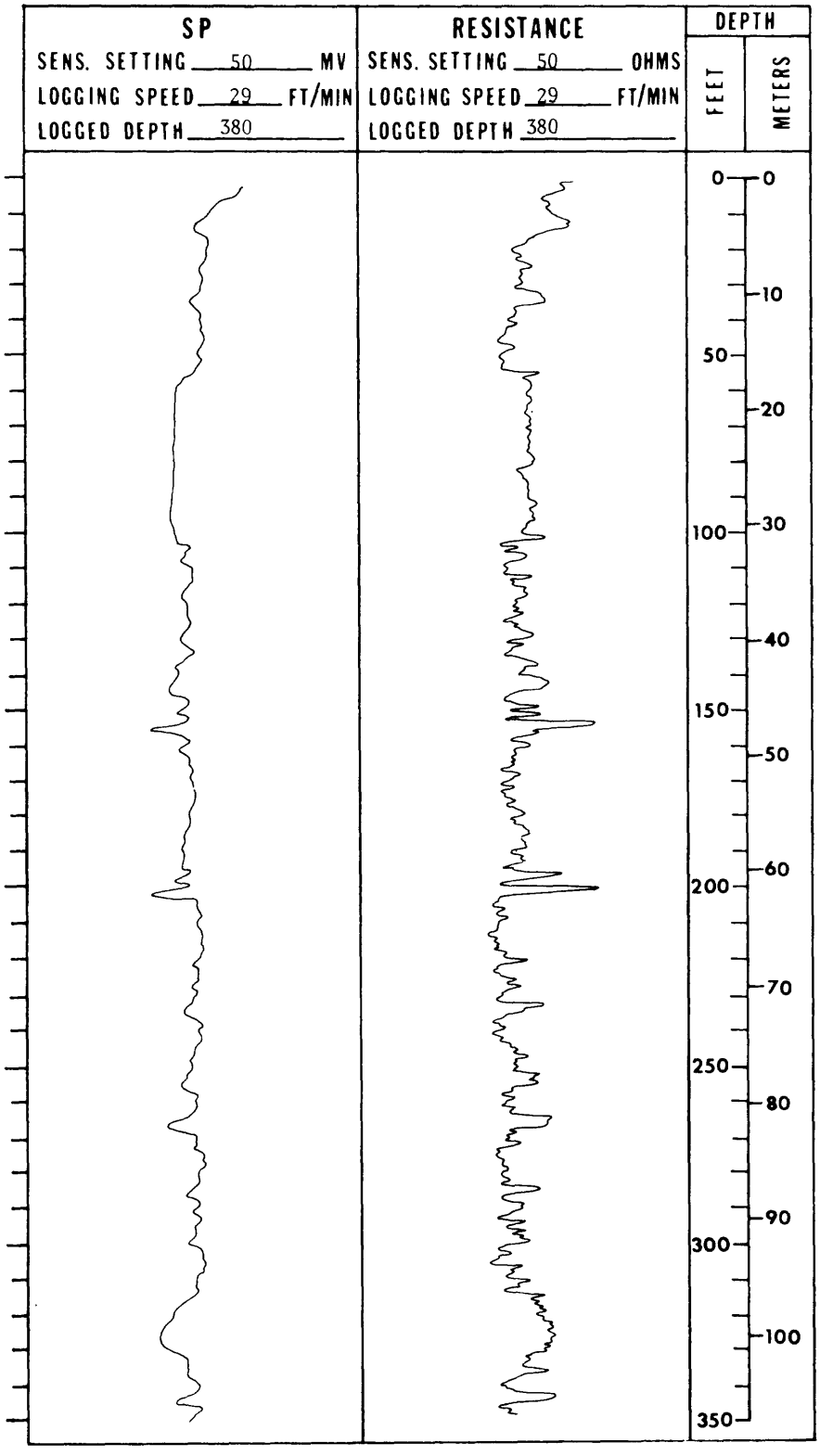
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77011
SHEET 3 OF 4

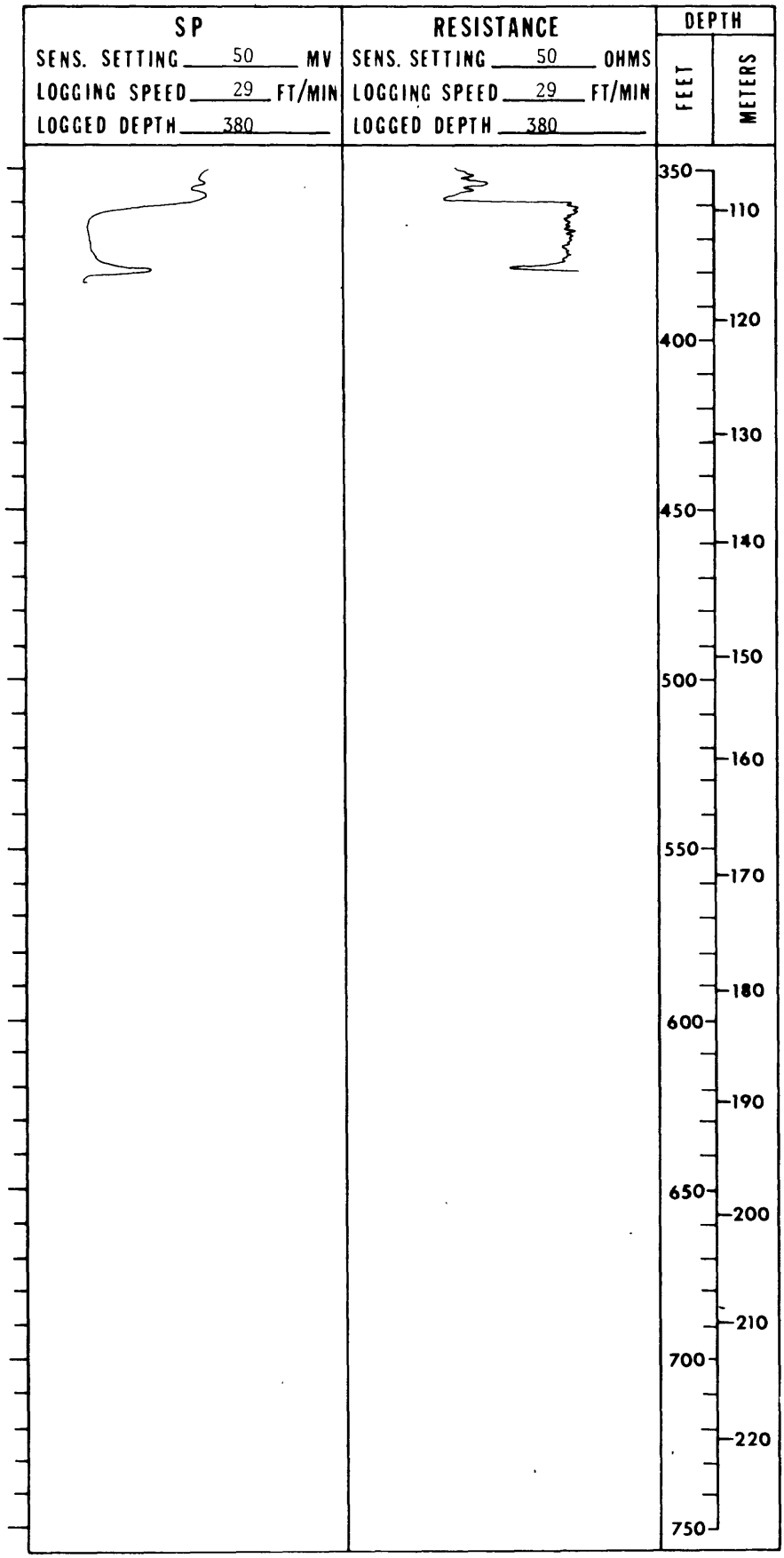
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77011
SHEET 4 OF 4

REMARKS:

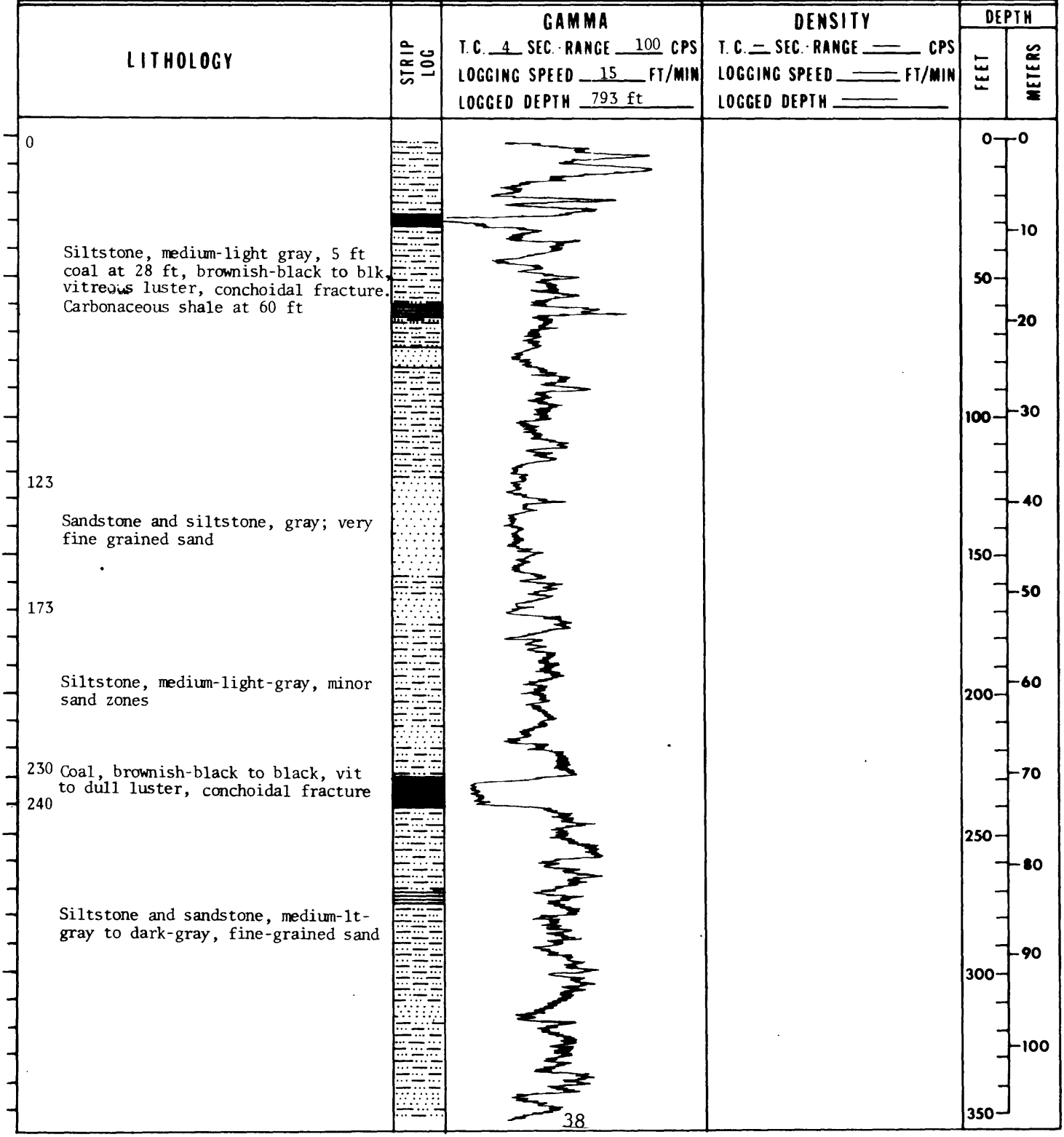


UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77012
SHEET 1 OF 5

AREA Southern Powder River Basin		QUAD NAME Coal Draw	
DATE STARTED 9/21/77	DATE COMP. 9/27/77	COUNTY Converse	STATE Wyoming
LOCATION: SEC. 26 T. 41N , R. 73W , FOOTAGE LOC.		1800 FSL 200 FWL	GROUND ELEV 4910 ft
SIZE AND BIT TYPE: 4 3/4 Drag		FOOTAGE ROTARY 820 CORING 0	TOTAL DEPTH 820
DRILLING AGENCY: U.S. Geological Survey		DRILL TYPE: Portadrill 524	DEPTH TO WATER 5 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin		GEOPHYSICAL LOGS RECORDED BY G. Hollomon	

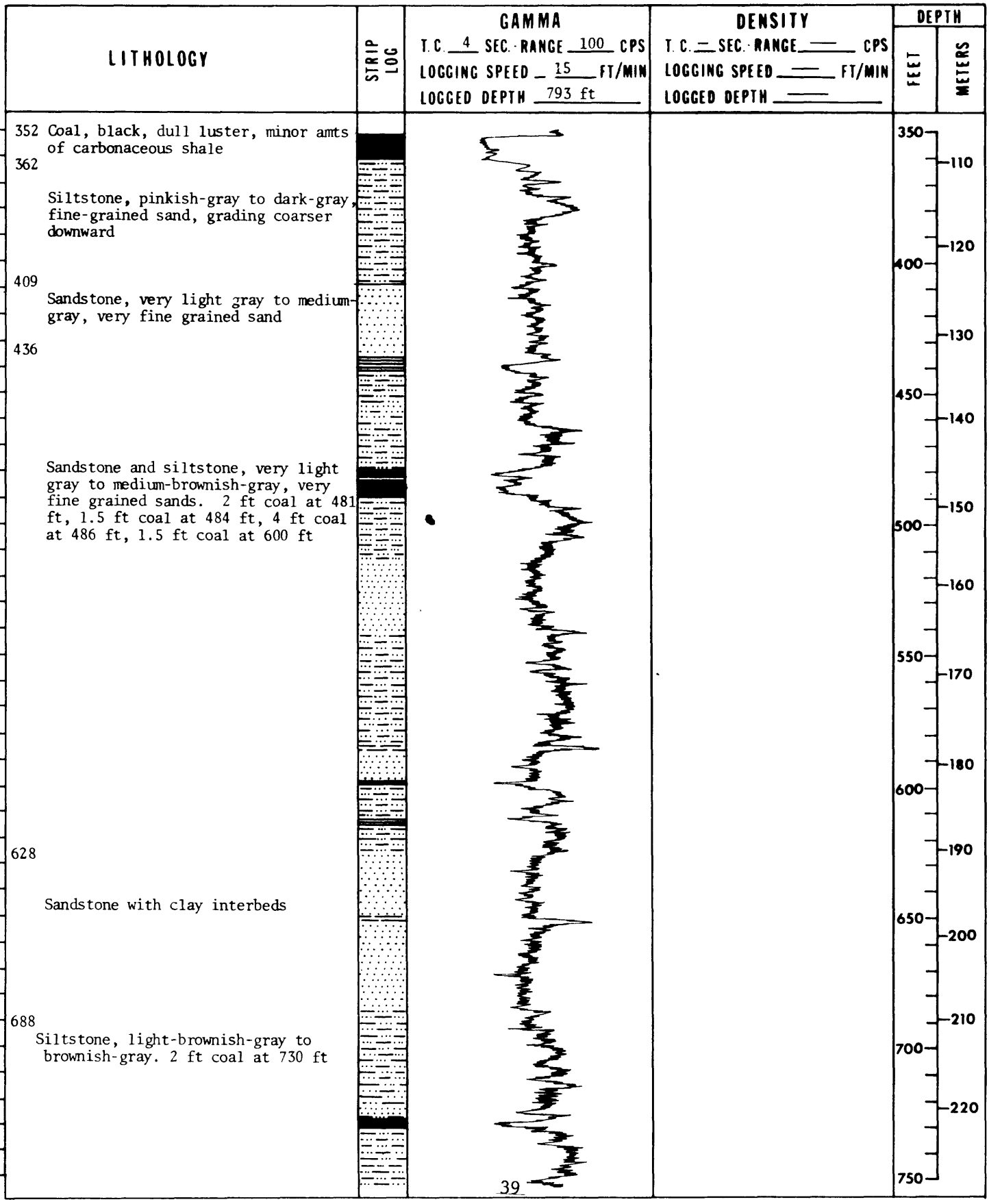
REMARKS: Drilled and logged footage composite of drill holes CDNE-2 and CDNE-2A (40 ft + 780 ft)
Composite log logged through drill rods below 30 ft.



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77012
SHEET 2 OF 5

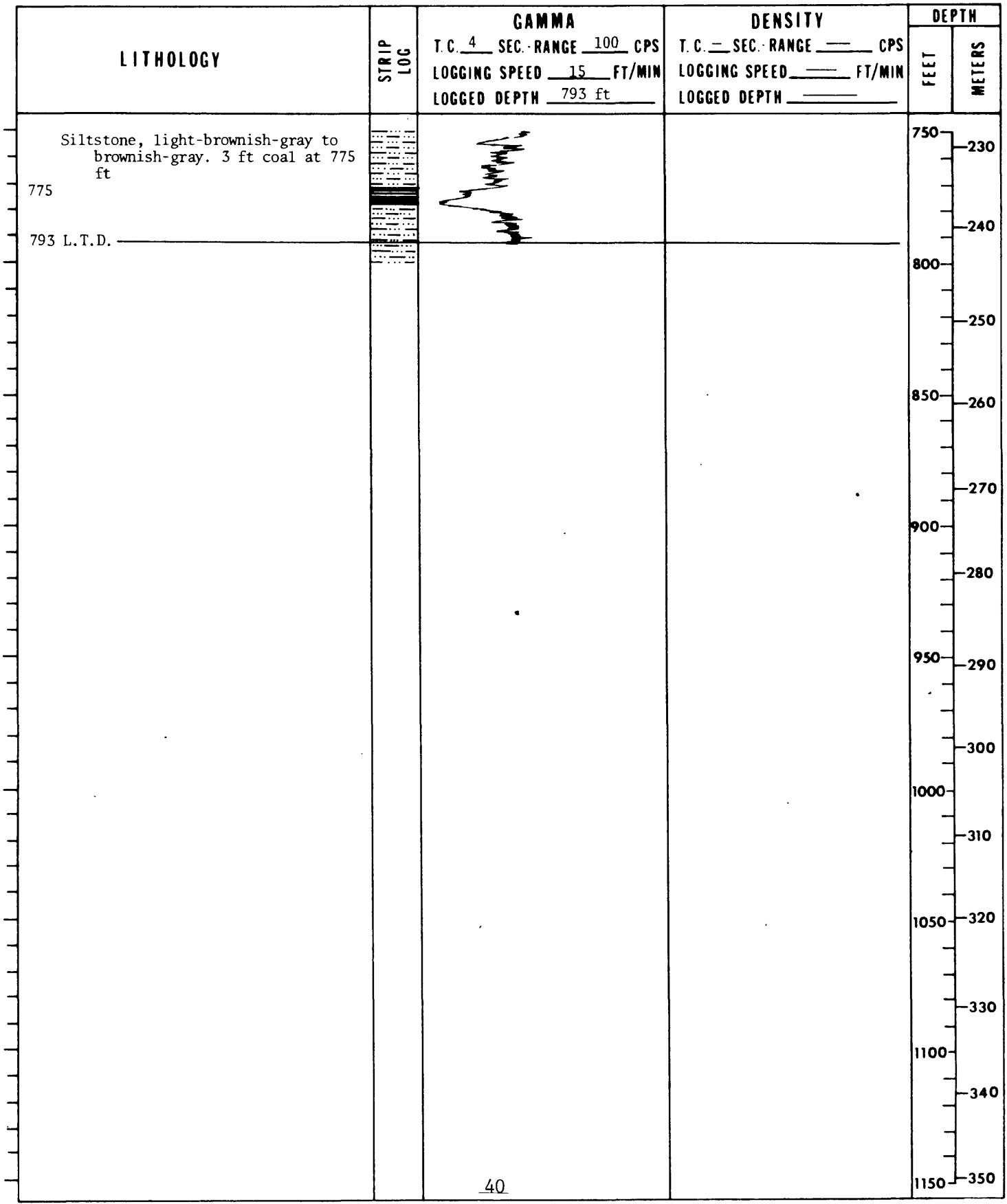
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77012
SHEET 3 OF 5

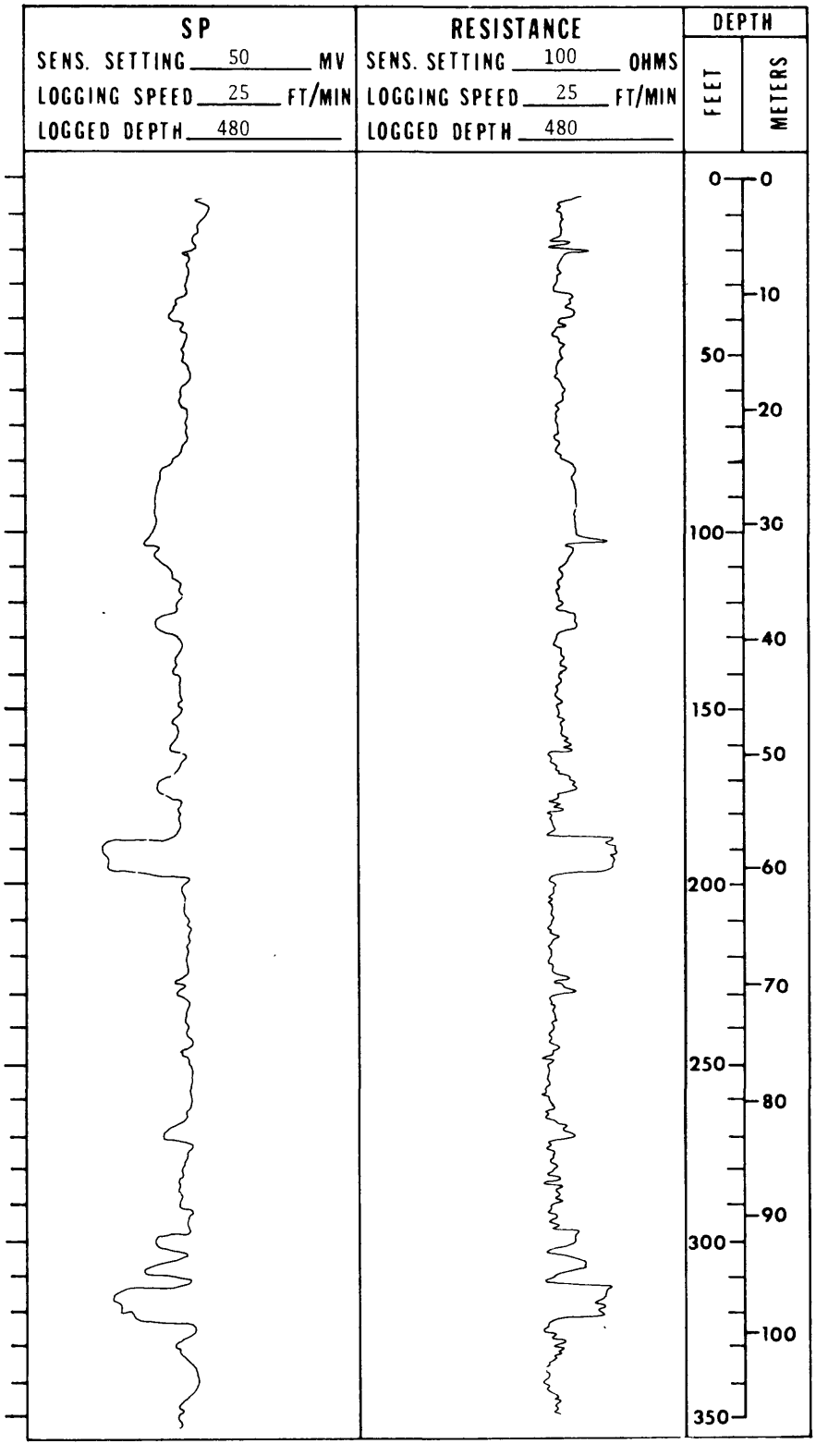
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77012
SHEET 4 OF 5

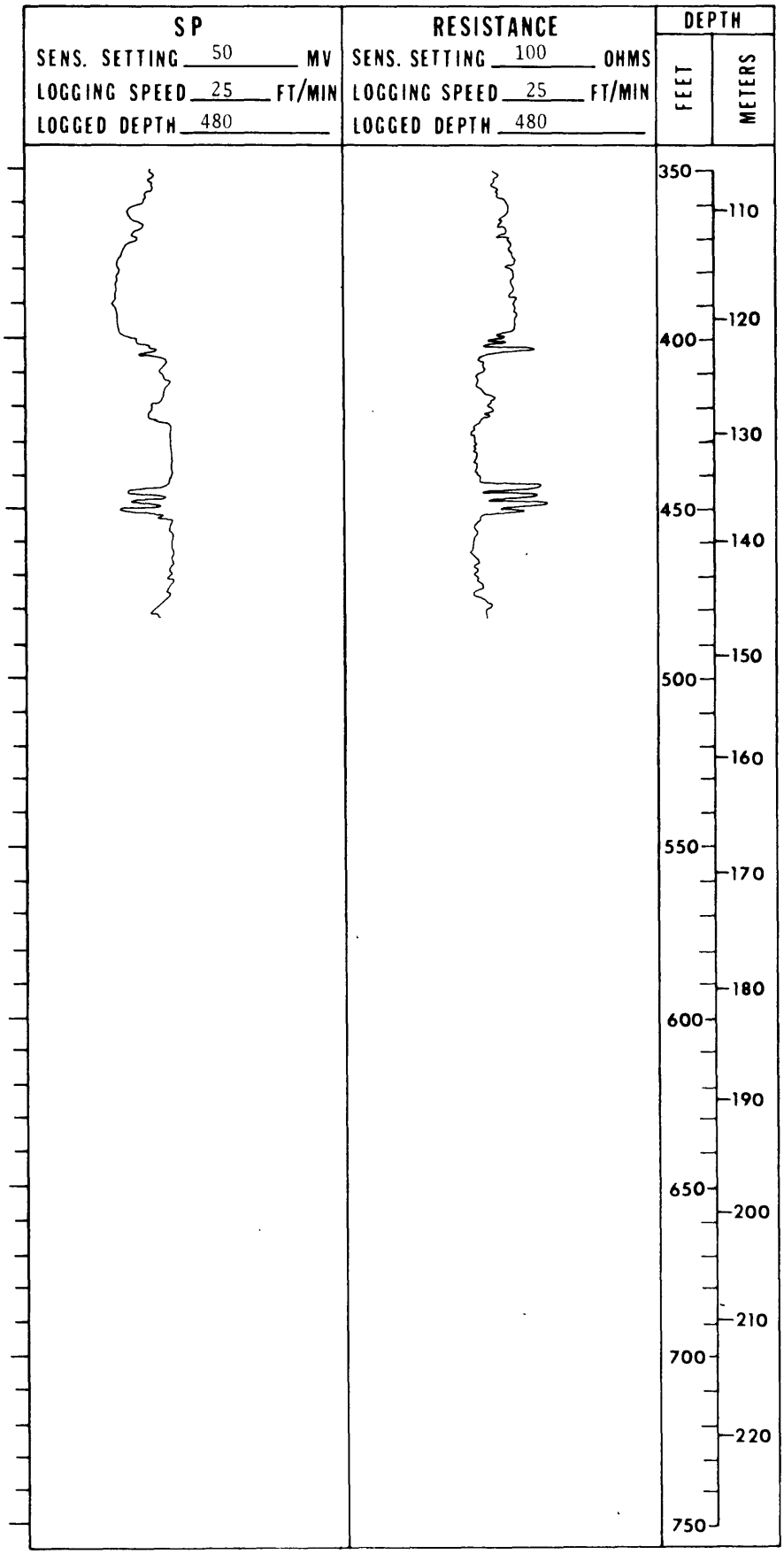
REMARKS: Log recorded 30 ft shallow



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77012
SHEET 5 OF 5

REMARKS: Log recorded 30 ft. shallow



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77013
SHEET 1 OF 2

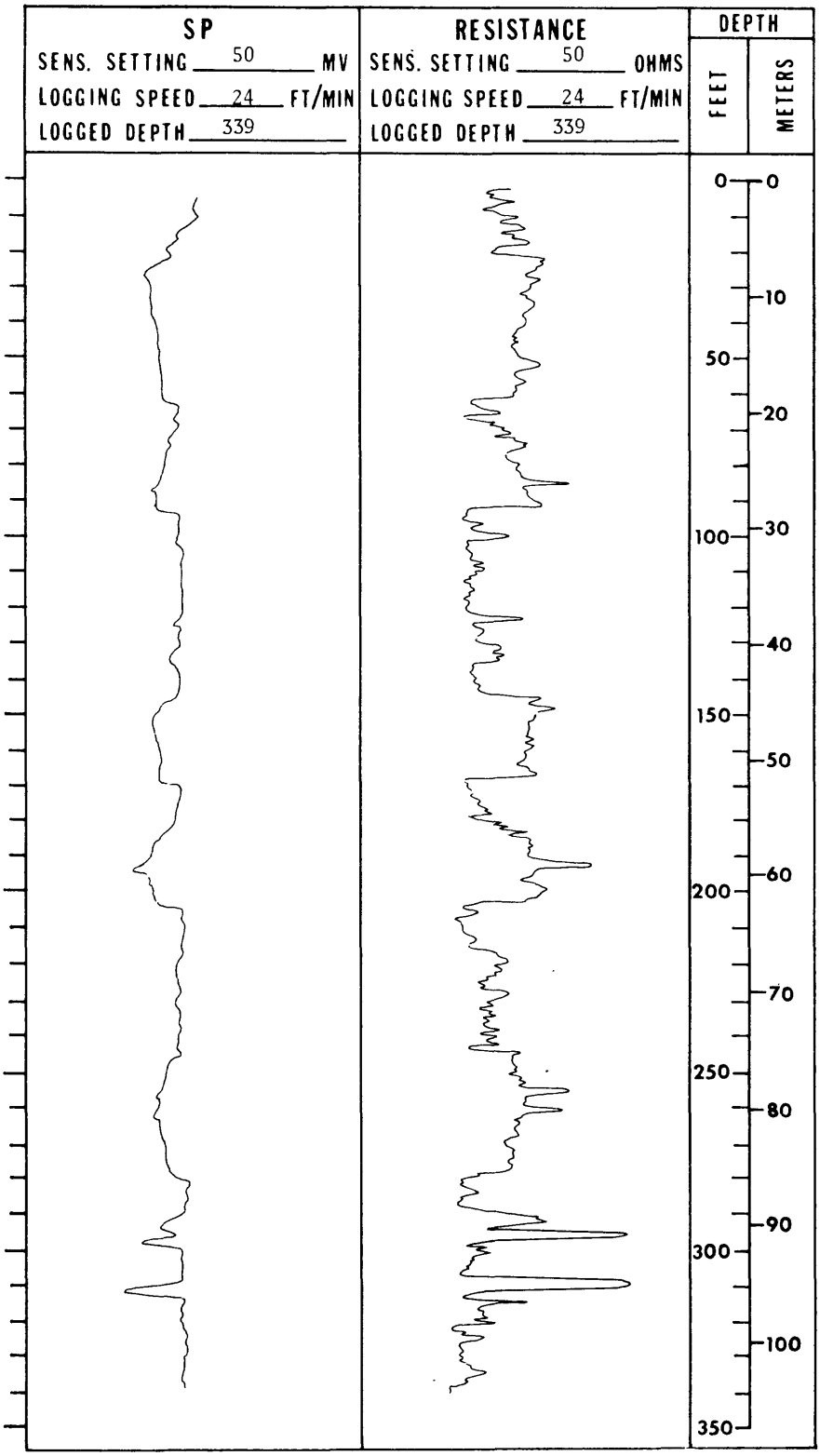
AREA Southern Powder River Basin		QUAD NAME Coal Draw (15 Minute)	
DATE STARTED 9/29/77	DATE COMP. 9/29/77	COUNTY Converse	STATE Wyoming
LOCATION: SEC. 3 T. 39N , R. 73W , FOOTAGE LOC. 1900 FSL 400 FEL			GROUND ELEV 4920
SIZE AND BIT TYPE: 4 3/4 inch Drag		FOOTAGE ROTARY 340 CORING 0	TOTAL DEPTH 340 ft
DRILLING AGENCY: USGS - CD - NRMA	DRILL TYPE: Portadrill 524		DEPTH TO WATER 1.4 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	GEOPHYSICAL LOGS RECORDED BY L.D. Riglin		
REMARKS:			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 15 FT/MIN LOGGED DEPTH 339 ft	T.C. — SEC. RANGE —— CPS LOGGING SPEED —— FT/MIN LOGGED DEPTH ——		
0 Sandstone, grayish-or to medium-gray, poorly sorted, very coarse to very fine grained sand, sub-angular to sub-rounded quartz grains weathered to 60 ft				0	0
				50	10
					20
90 Claystone and sandstone, light-gray to brownish-gray, medium-grained to very fine grained sand, sub-rounded, carbonaceous				100	30
					40
144 Sandstone, lt-gray, poorly sorted, very coarse to very fine grained, sub-angular to rounded quartz sand				150	50
166 Sandstone and siltstone, light-gray to light-brownish-gray, poorly sorted, coarse- to fine-grained sand, sub-angular					60
202 Sandstone and siltstone, light-gray, coarse-grained sand, angular				200	70
					80
244 Sandstone, light-gray to brnish-gray, poorly sorted, coarse- to fine-grained sand, sub-rounded				250	90
279 Sandstone and siltstone, light-gray to brownish-gray, poorly sorted, very coarse to very fine-grained sand, sub-angular. Possible 2 ft coal at 295 ft and 4 ft coal at 308 ft				300	100
339 L.T.D.				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77013
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD 77014
SHEET 1 OF 2

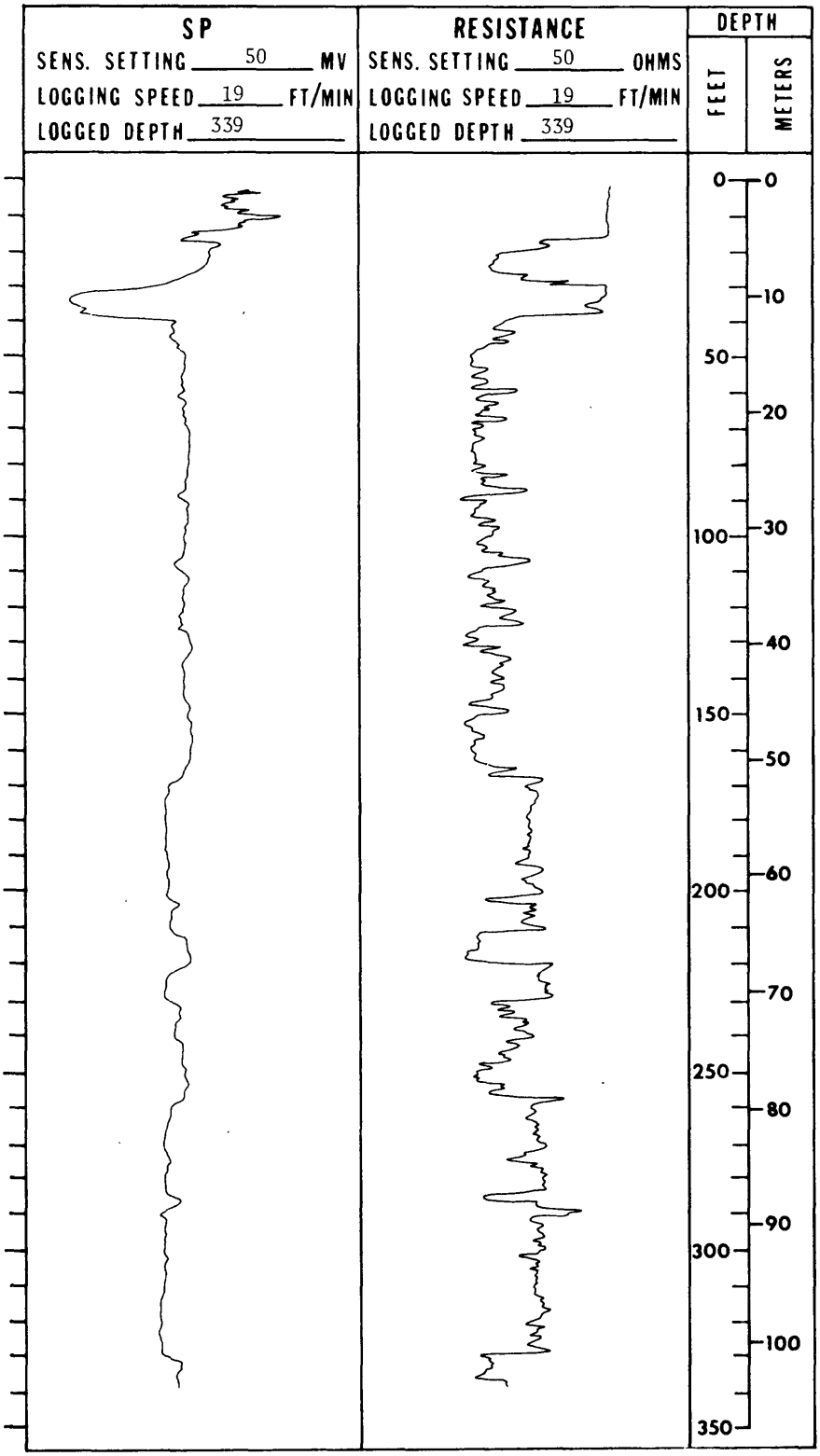
AREA Southern Powder River Basin		**QUAD NAME** Coal Draw	
DATE STARTED 9/30/77	**DATE COMP.** 9/30/77	**COUNTY** Converse	**STATE** Wyoming
LOCATION: SEC. 14 **T.** 40N , **R.** 73W , **FOOTAGE LOC.** 925 FSL 150 FWL			**GROUND ELEV** 4910
SIZE AND BIT TYPE: 4 3/4 Drag	**FOOTAGE** ROTARY 340 CORING 0		**TOTAL DEPTH** 340
DRILLING AGENCY: U.S. Geological Survey	**DRILL TYPE:** Portadrill 524		**DEPTH TO WATER** 16 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	**GEOPHYSICAL LOGS RECORDED BY** L. Riglin		
REMARKS:			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 17 FT/MIN LOGGED DEPTH 339 ft	T.C. — SEC. RANGE — CPS LOGGING SPEED — FT/MIN LOGGED DEPTH —		
0 Siltstone, grayish-orange to light-gray, weathered to 30 ft				0	0
30 38 Coal, brownish-black to black, vitreous luster, conchoidal fracture				50	10 20
Siltstone, pale-yellowish-brown to light-gray, minor fine-grained sands				100	30 40
168 Sandstone, light-gray, coarse-to-fine-grained sand, sub-rounded grains				150 200	50 60
212 Siltstone and sandstone, light-gray to medium-gray, coarse-to medium-grained sand, sub-rounded				250	70 80
258 Sandstone and minor siltstones, light-gray to medium-gray, fine-grained to very fine grained sand				300	90 100
339 L.T.D.				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77014
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77015
SHEET 1 OF 2

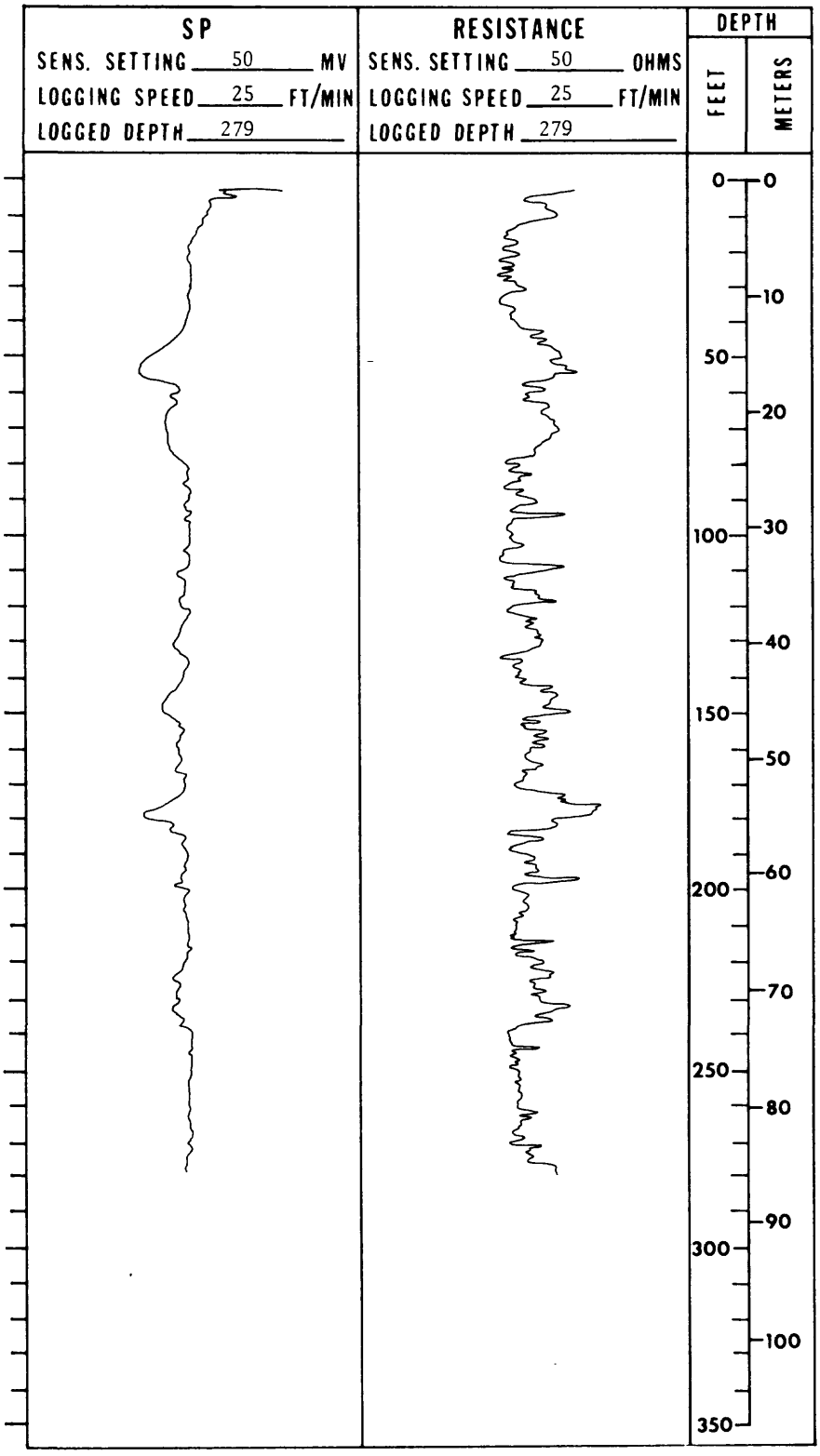
AREA Southern Powder River Basin		QUAD NAME Coal Bank Draw 7½'	
DATE STARTED 10/3/77	DATE COMP. 10/3/77	COUNTY Converse	STATE Wyoming
LOCATION: SEC. 29 T. 40N , R. 69W , FOOTAGE LOC. 300 FNL 750 FWL			GROUND ELEV 4640±
SIZE AND BIT TYPE: 4 3/4 inch Drag	FOOTAGE ROTARY 280	CORING 0	TOTAL DEPTH 280
DRILLING AGENCY: U.S.G.S./ CD/NRMA	DRILL TYPE: Portadrill 524		DEPTH TO WATER 3.5
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin	GEOPHYSICAL LOGS RECORDED BY L.D. Riglin		
REMARKS:			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 17 FT/MIN LOGGED DEPTH 277	T.C. — SEC. RANGE — CPS LOGGING SPEED — FT/MIN LOGGED DEPTH —		
0 Siltstone and sandstone, pinkish-gray to light-brownish-gray, fine-grained sand, carbonaceous shale, weathered to 25 ft				0	0
46 Sandstone, pinkish-gray to light-brownish-gray, medium-to fine-grained sand, sub-rounded				50	10 20
79 Siltstone, sandy to claystone, pinkish-gray to brownish-gray, carbonaceous shale				100	30 40
176-80 Coal, brownish-black				150	50
Siltstone and claystone, pinkish-gray to brownish-gray, carbonaceous shale				200	60 70
238 Siltstone and claystone, light-gray to brownish-gray, carbonaceous shale				250	80 90
277 L.T.D.				300	100
				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77015
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77016
SHEET 1 OF 4

AREA Southern Powder River Basin		QUAD NAME Coal Bank Draw 7½'	
DATE STARTED 10/3/77	DATE COMP. 10/4/77	COUNTY Converse	STATE Wyoming
LOCATION: SEC. 19 T. 40N , R. 69W , FOOTAGE LOC.		100 FNL 150 FWL	GROUND ELEV 4705
SIZE AND BIT TYPE: 4 3/4 Drag		FOOTAGE ROTARY 600 CORING 0	TOTAL DEPTH 600
DRILLING AGENCY: U.S. Geological Survey		DRILL TYPE: Portadrill 524	DEPTH TO WATER surface
LITHOLOGY RECORDED BY Hollomon, Coppock, Riglin		GEOPHYSICAL LOGS RECORDED BY L.D. Riglin	

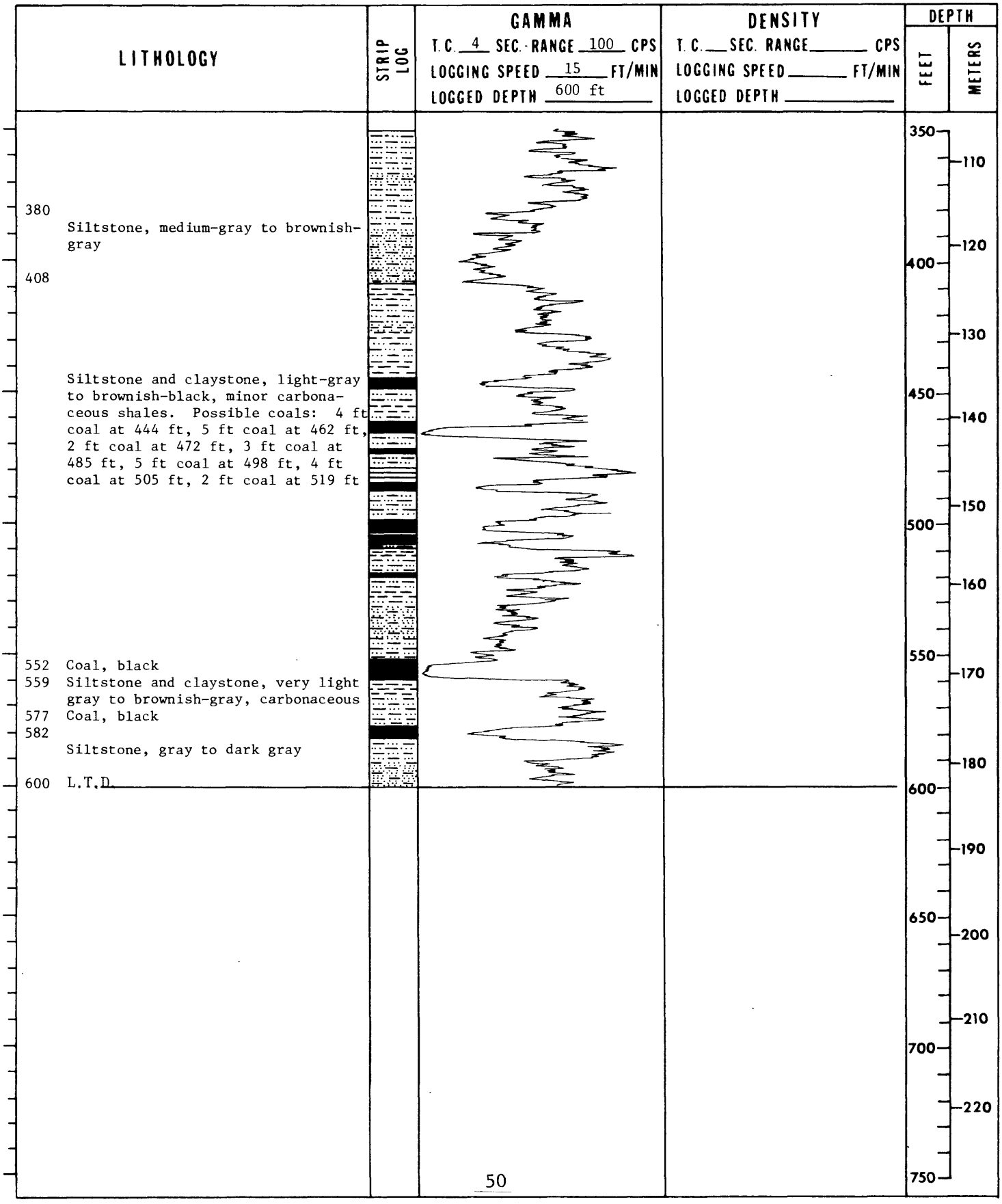
REMARKS:

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 15 FT/MIN LOGGED DEPTH 600 ft	T.C. — SEC. RANGE — CPS LOGGING SPEED — FT/MIN LOGGED DEPTH —	FEET / METERS
0 Sandstone, yellowish-brown, very fine grained to very coarse grained sand, sub-angular, poorly sorted, weathered to 25 ft				0–0
25				10
Siltstone and sandstone, light-gray to brownish-gray, very fine grained sand, trace of carbonaceous shale. Possible 2 ft coal at 56 ft				50–20
				100–30
150				40
Sandstone, lt-gray to medium-gray, very fine grained to medium-grained sand, sub-angular particles				150–50
190				60
Siltstone, light-gray to light-brownish-gray				200–70
232				
Sandstone, light-gray to medium-gray, very fine grained sand				250–80
268 Siltstone, medium-gray to brownish-gray, carbonaceous; claystone near top				
290				90
Sandstone, light-gray to light-brownish-gray, very fine grained sand, fining upward				300–100
316				
Siltstone, light-gray to medium-gray, carbonaceous				350

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77016
SHEET 2 OF 4

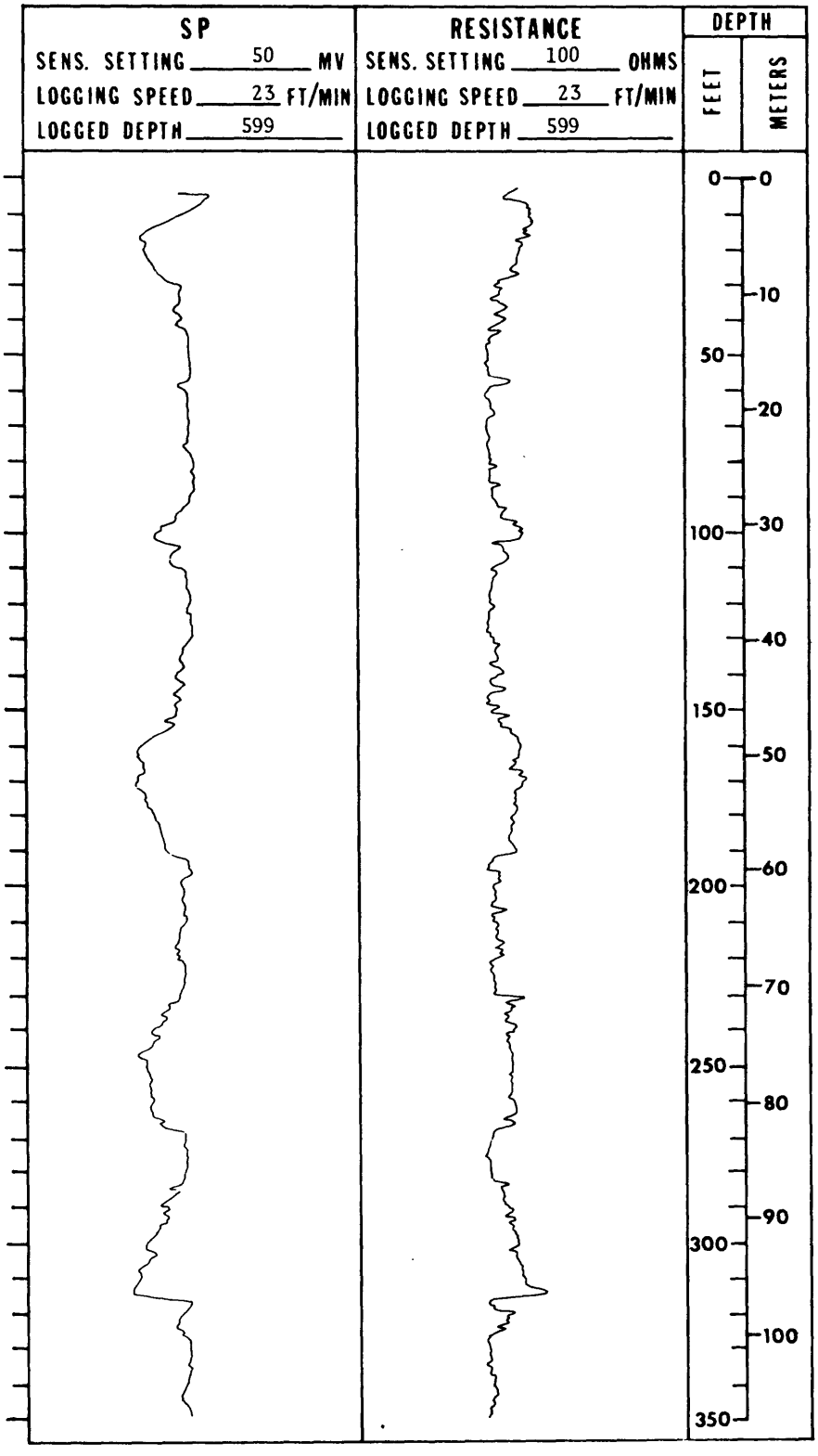
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77016
SHEET 3 OF 4

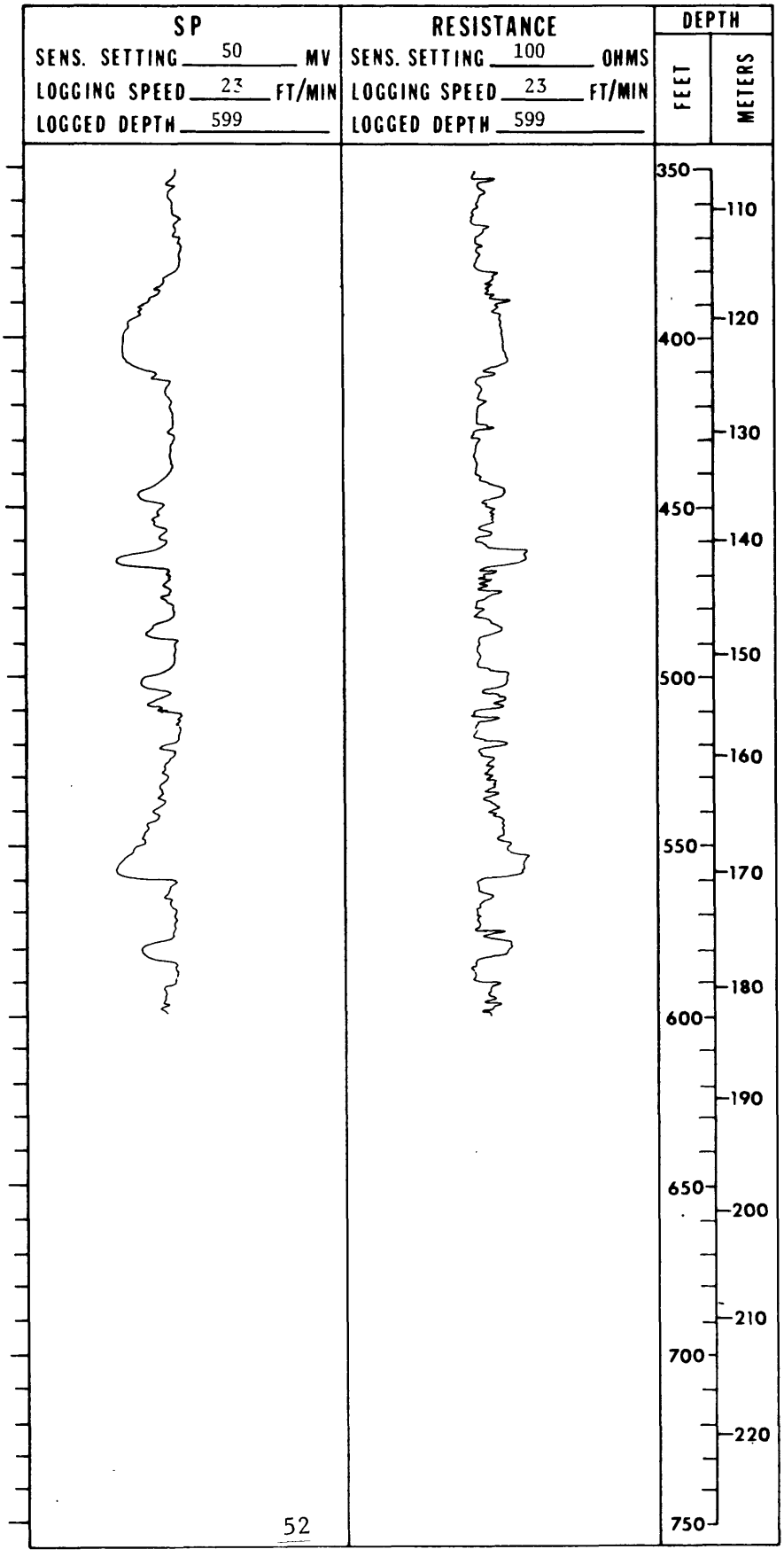
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77016
SHEET 4 OF 4

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77017
SHEET 1 OF 1

AREA Southern Powder River Basin		**QUAD NAME** Teckla	
DATE STARTED 10/12/77	**DATE COMP.** 10/16/77	**COUNTY** Campbell	**STATE** Wyoming
LOCATION: SEC. 10 **T.** 41N , **R.** 70 W , **FOOTAGE LOC.**		1000 ### FSL 950 ### FWL	**GROUND ELEV** 4725 ft
SIZE AND BIT TYPE: NX Diamond 4 3/4 Drag		**FOOTAGE** ROTARY 80 CORING 140	**TOTAL DEPTH** 220
DRILLING AGENCY: U.S. Geological Survey	**DRILL TYPE:** Portadrill 524		**DEPTH TO WATER**
LITHOLOGY RECORDED BY Hollomon, Coppock, Fivas	**GEOPHYSICAL LOGS RECORDED BY** G. Hollomon		

REMARKS: Cored interval from 21 ft to 161 ft. Lost circulation @ 130 ft

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 100 CPS LOGGING SPEED 15 FT/MIN LOGGED DEPTH 213 ft.	T.C. ___ SEC. RANGE ___ CPS LOGGING SPEED ___ FT/MIN LOGGED DEPTH ___		
0 Sandstone, brown, medium to fine-grained, weathered				0	0
25					
Siltstone, brown to red-brown, possibly baked; claystone from 25 ft to 35 ft and from 73 ft to 82 ft				50	10 20
				100	30
143 Coal, black					40
156				150	
Siltstone, gray, with thin claystone and carbonaceous shale interbeds. Thin coal from 169 ft to 172 ft					50
213 L.T.D.				200	60
				250	70 80
				300	90 100
				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77018
SHEET 1 OF 3

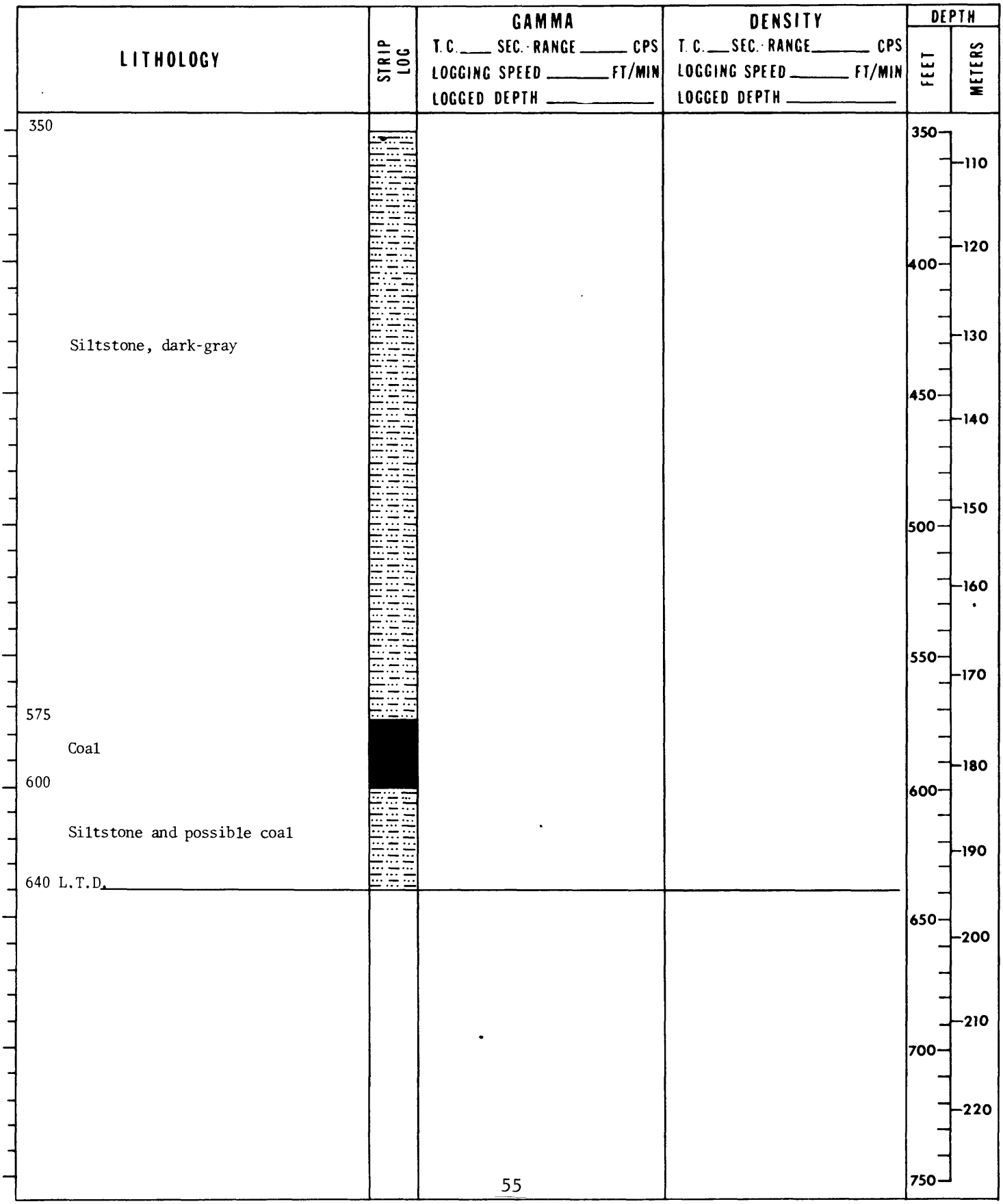
AREA Southern Powder River Basin		**QUAD NAME** Coal Draw	
DATE STARTED 10/18/77	**DATE COMP.** 10/18/77	**COUNTY** Converse	**STATE** Wyoming
LOCATION: SEC. 29 **T.** 41N, **R.** 72W, **FOOTAGE LOC.** 1700 ~~FNL~~ FSL 2100 ~~FWL~~ FEL			**GROUND ELEV** 4765
SIZE AND BIT TYPE: 4 3/4 Drag	**FOOTAGE** ROTARY 640 CORING 0		**TOTAL DEPTH** 640
DRILLING AGENCY: U.S. Geological Survey	**DRILL TYPE:** Portadrill 524		**DEPTH TO WATER** GL
LITHOLOGY RECORDED BY Ed Fivas	**GEOPHYSICAL LOGS RECORDED BY** Rocky Mountain Logging		
REMARKS: Not logged below 334 ft. Lithology based on unlagged samples only.			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 1 SEC. RANGE 25 CPS LOGGING SPEED —— FT/MIN LOGGED DEPTH 334	T.C. - SEC. RANGE 1 K CPS LOGGING SPEED ____ FT/MIN LOGGED DEPTH 334 ft		
0 Sandstone, yellowish-brown, medium-grained, angular to sub-angular grains				0	0
64 Sandy siltstone, gray				50	10 20
88 Coal 92 Siltstone, gray 108				100	30
Sandstone, gray, medium-grained, sub-angular 148				150	40 50
Sandy siltstone, gray, with 3 ft coal at 171 ft, possible 1 ft coal at 227 ft				200	60
				250	70 80
315 Coal				300	90 100
350				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77018
SHEET 2 OF 3

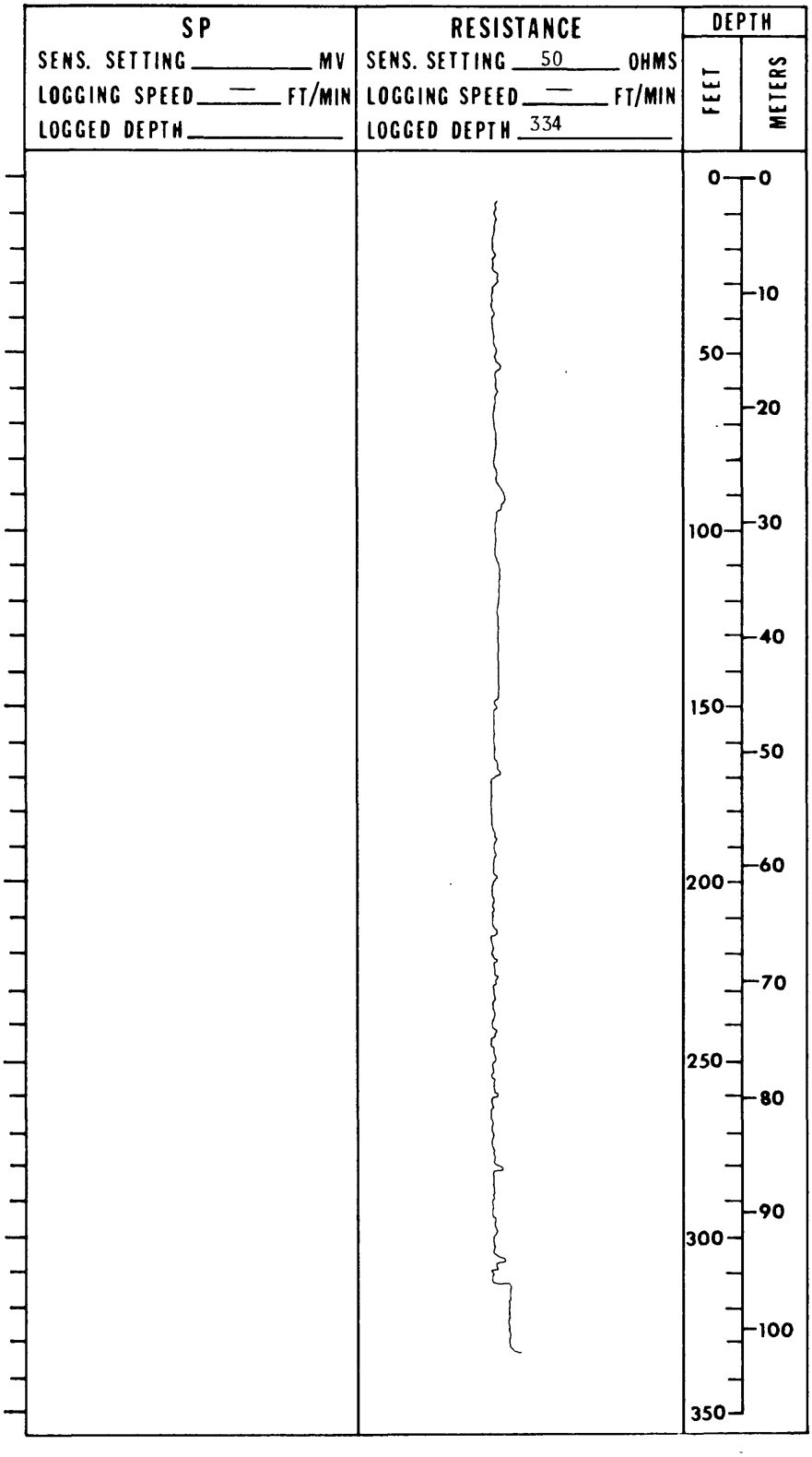
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77018
SHEET 3 OF 3

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77019
SHEET 1 OF 4

AREA Southern Powder River Basin		QUAD NAME Betty Reservoir	
DATE STARTED 10/19/77	DATE COMP. 10/19/77	COUNTY Converse	STATE Wyoming
LOCATION: SEC. 6 T. 39N , R. 70W , FOOTAGE LOC.		950 FNL 1200 FEL	GROUND ELEV 4840
SIZE AND BIT TYPE: 4 3/4 Drag		FOOTAGE ROTARY 500 CORING 0	TOTAL DEPTH 500
DRILLING AGENCY: USGS - CD - NRMA		DRILL TYPE: Portadrill 524	DEPTH TO WATER Land Surface
LITHOLOGY RECORDED BY Hollomon, Coppock, Fivas		GEOPHYSICAL LOGS RECORDED BY F.B. Kistner	

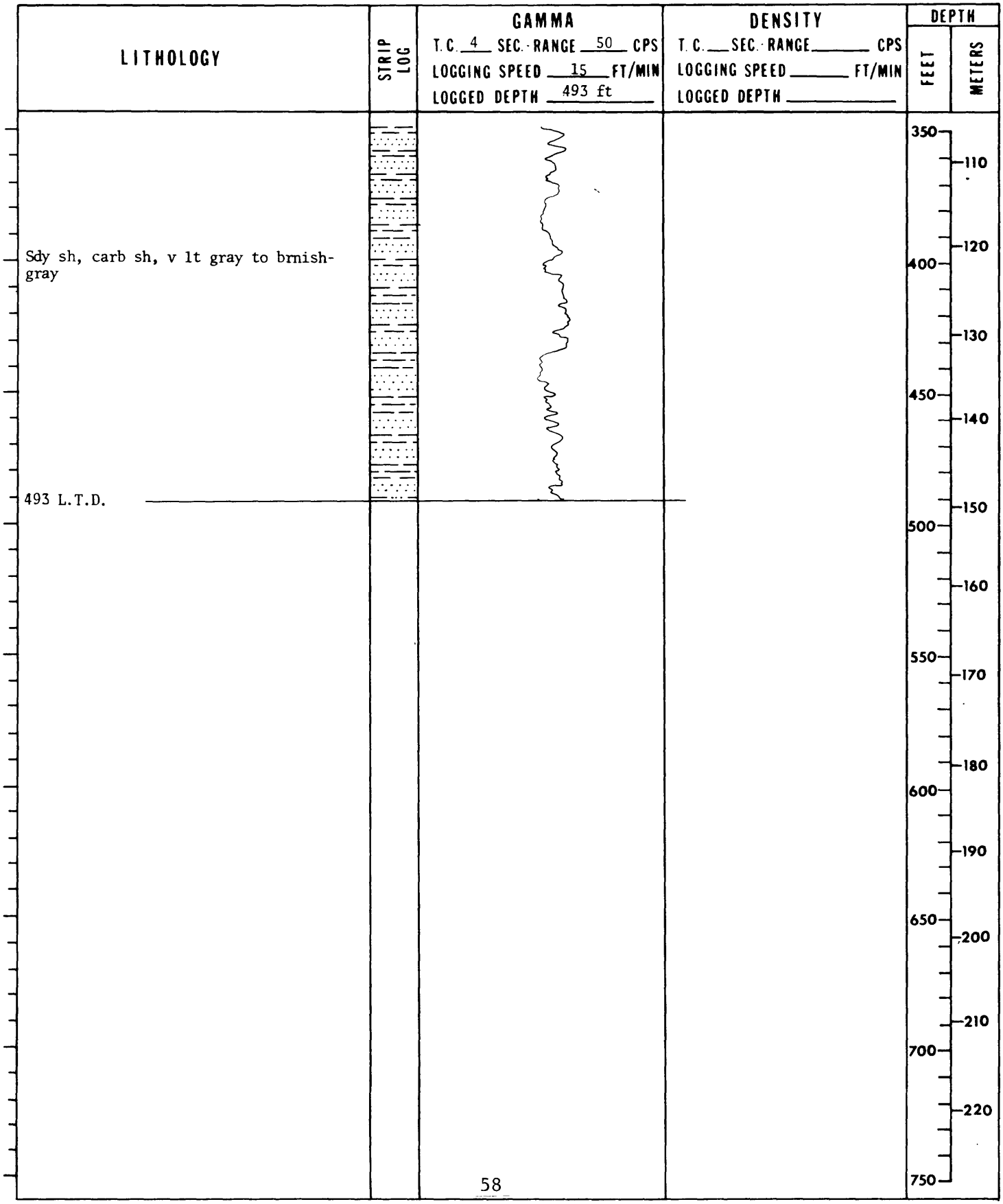
REMARKS:
Geophysical logs poor. Lithology from field logs and samples.

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 50(?) CPS LOGGING SPEED 15 FT/MIN LOGGED DEPTH 493 ft	T.C. — SEC. RANGE — CPS LOGGING SPEED — FT/MIN LOGGED DEPTH —		
0 Sltst and Claystone, grayish-or to grayish brn, weathered to 30 ft				0	0
31 Sandstone, lt-gray, vf grained				50	10
Coal and carb sh, brnish-black, conch frac, dull to vit luster				85	20
90 Sdy sltst and claystone, v lt gray to lt brnish gray				100	30
Coal and carb sh, blk to brnish-blk, conch frac, dull to vit lus-				132	40
136 ter				136	
Sdy slst and claystone, lt-gray to brnish-gray				150	50
180 Ss, lt-gry, v f grained, sub-angular				180	
200 Carb sh and sdy sh, lt gray to brnish gray				200	60
220 Sdy sh, lt-gray to brnish-gray				250	70
					80
280 Carb sh and sdy sh, lt-gray to brnish-gray				300	90
300 Sdy sh, carb sh, v lt gray to brnish-gray					100
				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77019
SHEET 2 OF 4

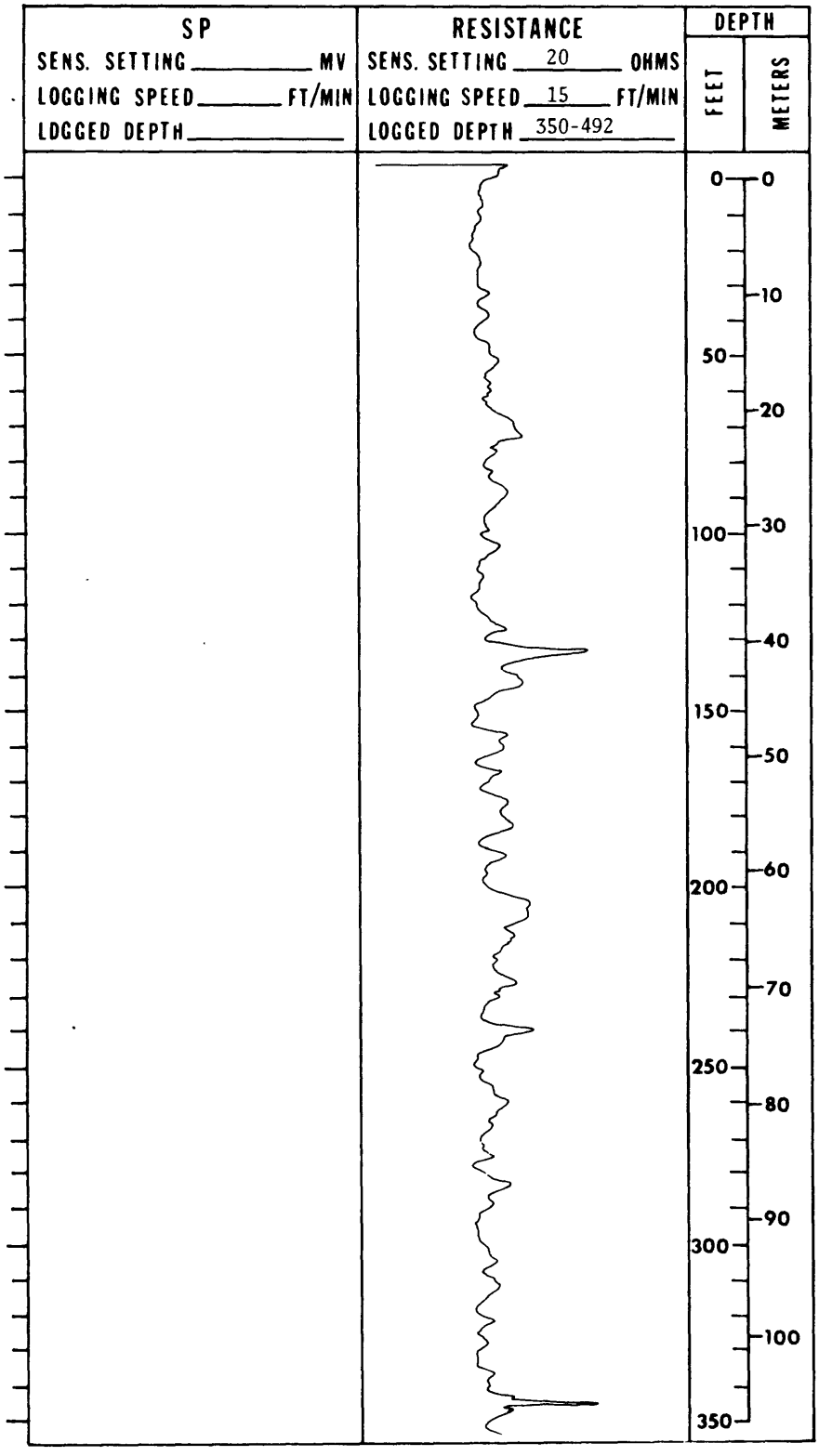
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77019
SHEET 3 OF 4

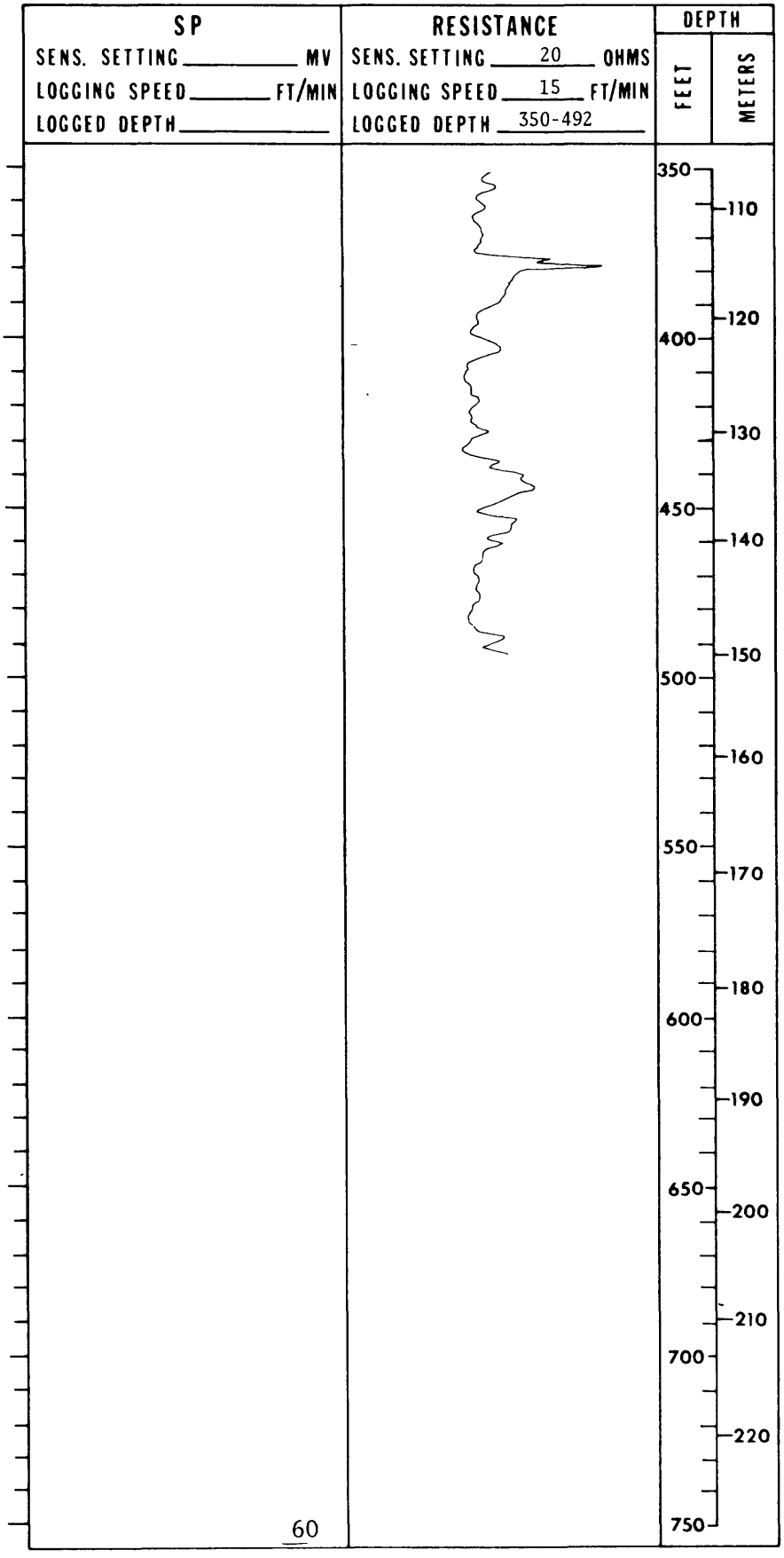
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77019
SHEET 4 OF 4

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77020
SHEET 1 OF 2

AREA Southern Powder River Basin		**QUAD NAME** Betty Reservoir	
DATE STARTED 10/20/77	**DATE COMP.** 10/20/77	**COUNTY** Converse	**STATE** Wyoming
LOCATION: SEC. 22 **T.** 40N , **R.** 70W , **FOOTAGE LOC.** 2250 FSL 1150 FWL			**GROUND ELEV** 4870
SIZE AND BIT TYPE: 4 3/4 Drag	**FOOTAGE** ROTARY 280 CORING 0		**TOTAL DEPTH** 280
DRILLING AGENCY: U.S. Geological Survey	**DRILL TYPE:** Portadrill 524		**DEPTH TO WATER** LS
LITHOLOGY RECORDED BY Hollomon, Coppock, Fivas	**GEOPHYSICAL LOGS RECORDED BY** F.B. Kistner		

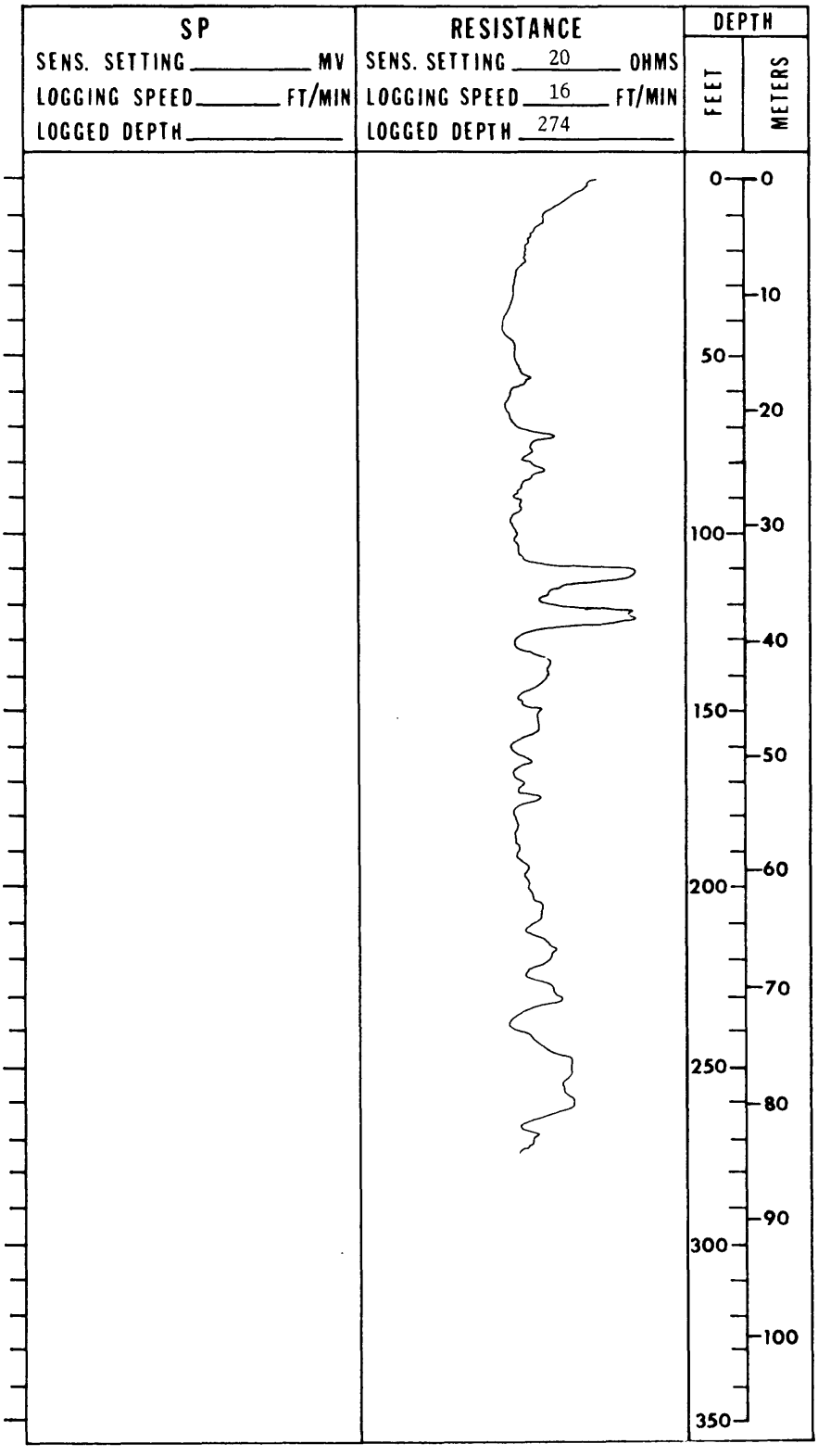
REMARKS: Ground level at base of burn

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 10(?) CPS LOGGING SPEED 18 FT/MIN LOGGED DEPTH 275	T.C. SEC. RANGE CPS LOGGING SPEED FT/MIN LOGGED DEPTH		
0 Siltstone, dk-gy to dk-yellowisn brown, sandy, very fine, sub-angular sand, minor amounts of black shale. Possible 2 ft coal at 19 ft and 1.5 ft coal at 59 ft				0 50 100 150 200 250 300 350	0 10 20 30 40 50 60 70 80 90 100
73 Claystone and sdy sltst, m-lt-gray, approx. 20% carb sh, thin coal at 74 ft					
111 Coal, dk-brn to black, dull luster, avg frag size of 0.4 cm; with dark gray siltstone parting from 117-122 ft					
Siltstone, dark-gray, with less than 5 percent fine-grained sand, minor amounts of carbonaceous shale. Possible 3 ft coal at 176 ft					
275 L.T.D.					

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77020
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77021
SHEET 1 OF 2

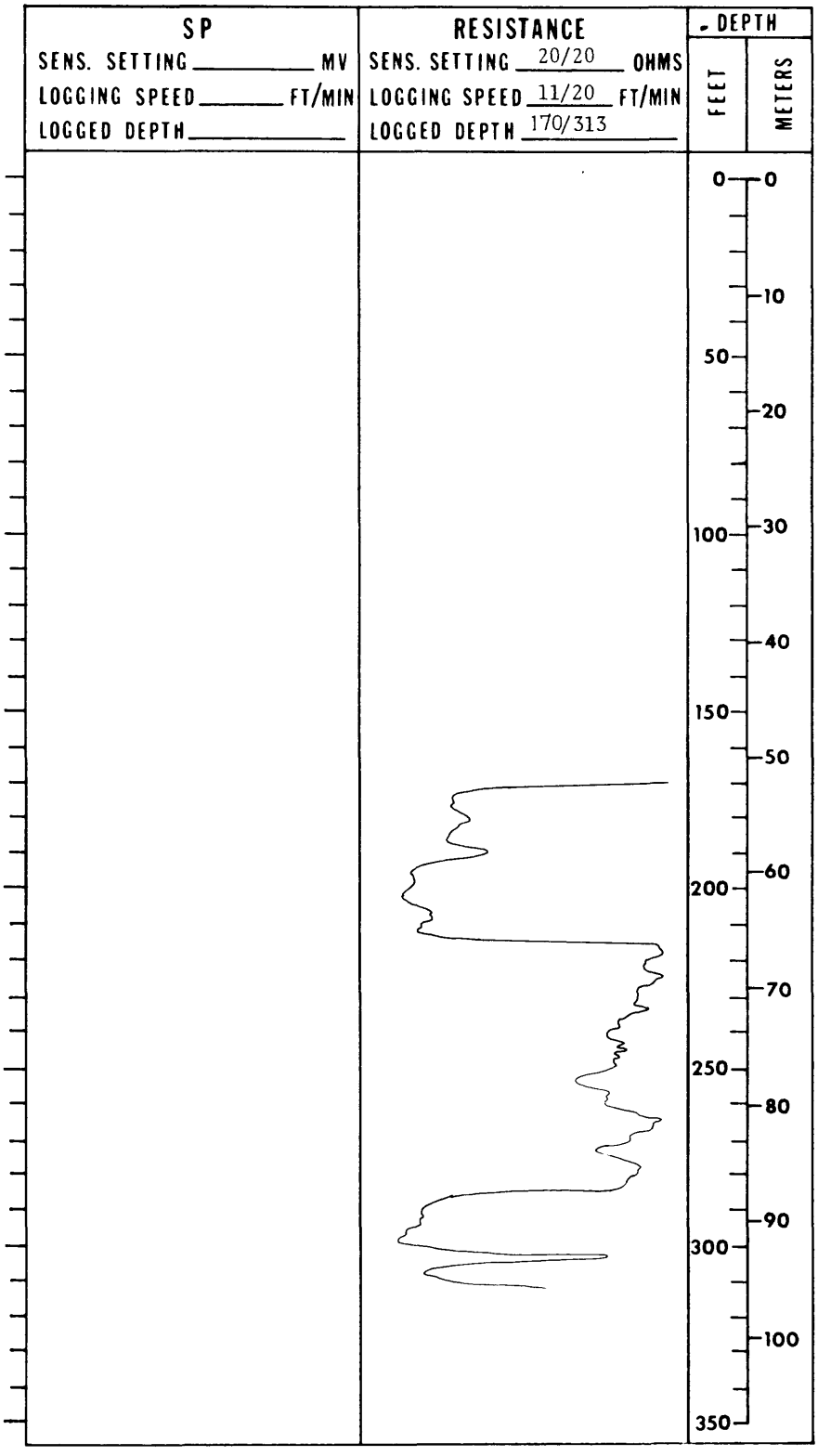
AREA Southern Powder River Basin		QUAD NAME Teckla	
DATE STARTED 10/29/77	DATE COMP. 10/29/77	COUNTY Campbell	STATE Wyoming
LOCATION: SEC. 34 T. 42N , R. 70W , FOOTAGE LOC. 26 FSL 50 FWL			GROUND ELEV 4850
SIZE AND BIT TYPE: 4 3/4 Drag	FOOTAGE ROTARY 318	CORING 0	TOTAL DEPTH 318
DRILLING AGENCY: U.S. Geological Survey	DRILL TYPE: Portadrill 524		DEPTH TO WATER 169'
LITHOLOGY RECORDED BY Hollomon, Coppock, Fivas	GEOPHYSICAL LOGS RECORDED BY G. Hollomon		
REMARKS: USFS SEAM 9A			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 10(?) CPS LOGGING SPEED 13 FT/MIN LOGGED DEPTH 313 ft	T.C. — SEC. RANGE —— CPS LOGGING SPEED —— FT/MIN LOGGED DEPTH ——		
0 Siltstone and sandstone, yellow, weathered to 15 ft				0	0
11 Sandstone, grayish-brown, medium-to fine-grained sand, poorly sorted				10	
48 Sandstone and claystone, yellowish-brown to light-gray, medium-grained to very fine grained sand, carbonaceous				50	20
100 Sandstone, pale-yellowish-brown to medium-gray; siltstone, light-gray to light-brownish-gray, siderite concretions at 160 ft and 190 ft				100	30
				150	40
					50
213 Coal, brownish-black, dull to vitreous luster, fragmental				200	60
					70
				250	80
286 Siltstone and claystone, light-brownish-gray to brownish-black, carbonaceous, possible 4 ft coal at 302 ft				300	90
313 L.T.D.					100
				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77021
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77022
SHEET 1 OF 2

AREA Southern Powder River Basin		QUAD NAME Teckla	
DATE STARTED 10/30/77	DATE COMP. 10/30/77	COUNTY Campbell	STATE Wyoming
LOCATION: SEC. 33 T. 42N , R. 70W , FOOTAGE LOC. 27 FSL 37 FWL			GROUND ELEV 4805
SIZE AND BIT TYPE: 4 3/4 Drag.	FOOTAGE ROTARY 360	CORING 0	TOTAL DEPTH 360
DRILLING AGENCY: U.S. Geological Survey	DRILL TYPE: Portadrill 524		DEPTH TO WATER LS
LITHOLOGY RECORDED BY Hollomon, Coppock, Fivas	GEOPHYSICAL LOGS RECORDED BY G. Hollomon		

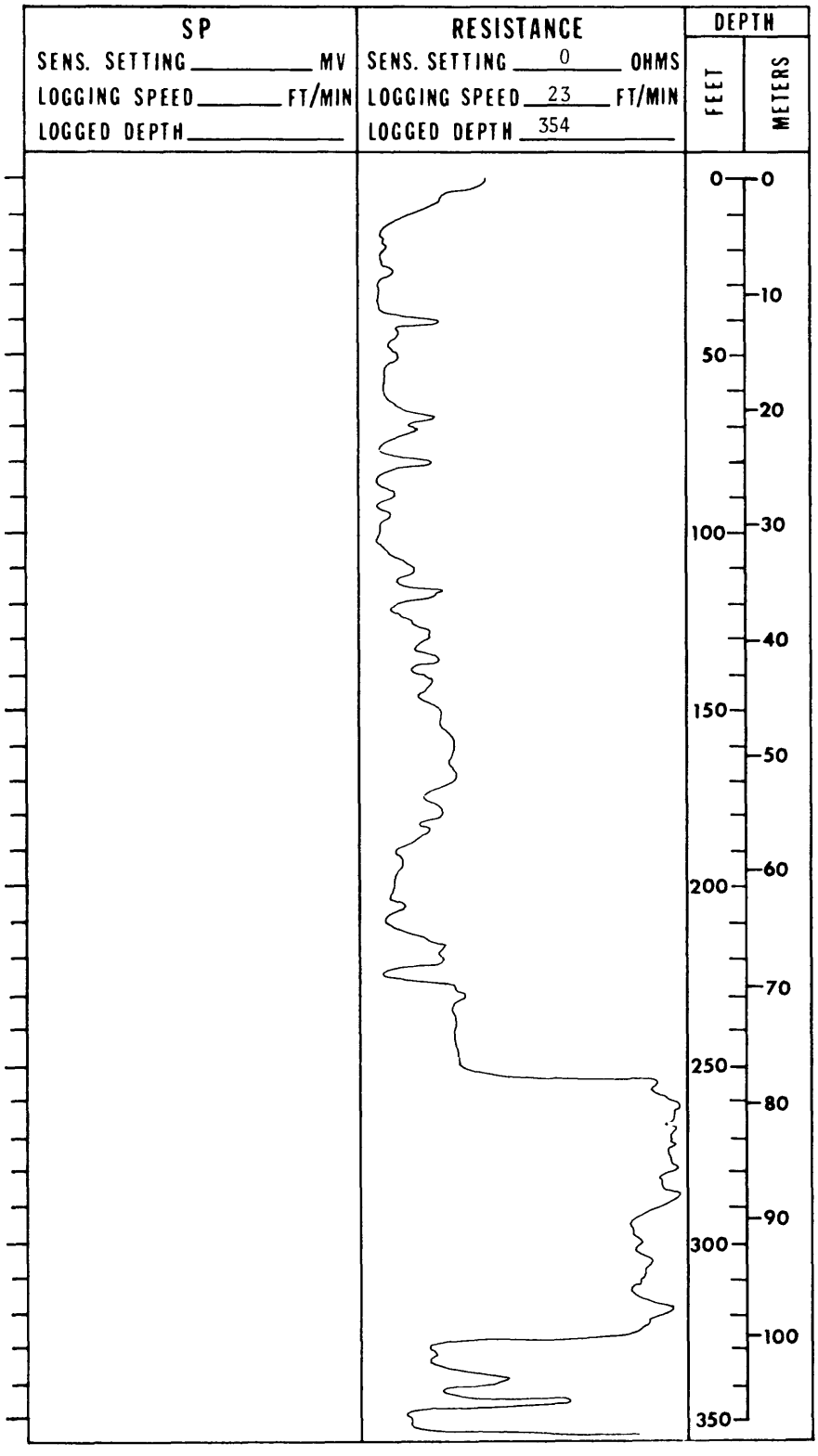
REMARKS:
Technically poor gamma log due to recorder drive malfunction.
Lithology from samples lagged to resistance log. USFS SEAM 11A;

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C.___ SEC.·RANGE ___ CPS LOGGING SPEED ___ FT/MIN LOGGED DEPTH ___	T.C.___ SEC.·RANGE ___ CPS LOGGING SPEED ___ FT/MIN LOGGED DEPTH ___		
0				0	0
Sandstone, moderate-yellowish-brown to light-brownish-gray, weathered to 34 ft; siltstone and claystone, light-gray to brownish-black, medium-grained to very fine grained sand, sub-angular to sub-rounded grains, carbonaceous zones				50	10 20
				100	30
				150	40 50
259				200	60
Coal, dark-brown to black, dull to vitreous luster, fragmental				250	70 80
327				300	90 100
Siltstone and sandstone, medium-light-gray to brownish-black, fine-grained sand, carbonaceous					
353 T.D.				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77022
SHEET 2 OF 2

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77023
SHEET 1 OF 2

AREA Southern Powder River Basin		QUAD NAME Teckla	
DATE STARTED 10/31/77	DATE COMP. 10/31/77	COUNTY Campbell	STATE Wyoming
LOCATION: SEC. 33 T. 42N , R. 70W , FOOTAGE LOC.		200 FSL 2000 FWL	GROUND ELEV 4740
SIZE AND BIT TYPE: 4 3/4 Drag		FOOTAGE ROTARY 240 CORING 0	TOTAL DEPTH 240
DRILLING AGENCY: U.S. Geological Survey		DRILL TYPE: Portadrill 524	DEPTH TO WATER L.S.
LITHOLOGY RECORDED BY Hollomon, Coppock, Fivas		GEOPHYSICAL LOGS RECORDED BY G. A. Hollomon	

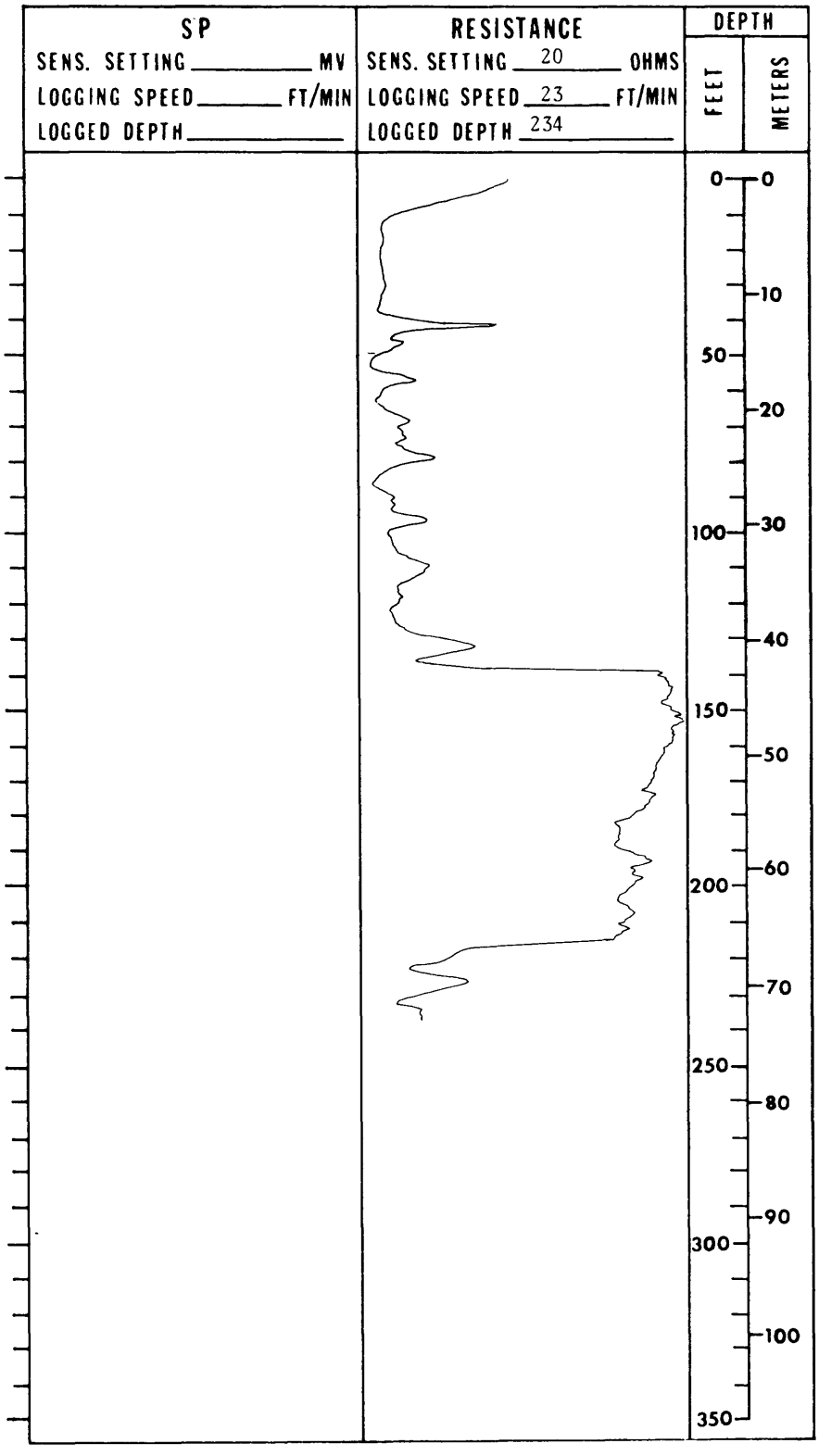
REMARKS: USFS SEAM 3N

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 10 CPS LOGGING SPEED 17 FT/MIN LOGGED DEPTH 234	T.C. ___ SEC. RANGE ___ CPS LOGGING SPEED ___ FT/MIN LOGGED DEPTH ___		
0 Siltstone and sandstone, yellowish-brown to greenish-gray. Surface weathered to 25 ft. Possible 3 ft coal at 42 ft				0 50 100 150 200 250 300 350	0 10 20 30 40 50 60 70 80 90 100
138 Coal, black					
218 Silty sandstone					
234 L.T.D.					

UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77023
SHEET 2 OF 2

REMARKS:



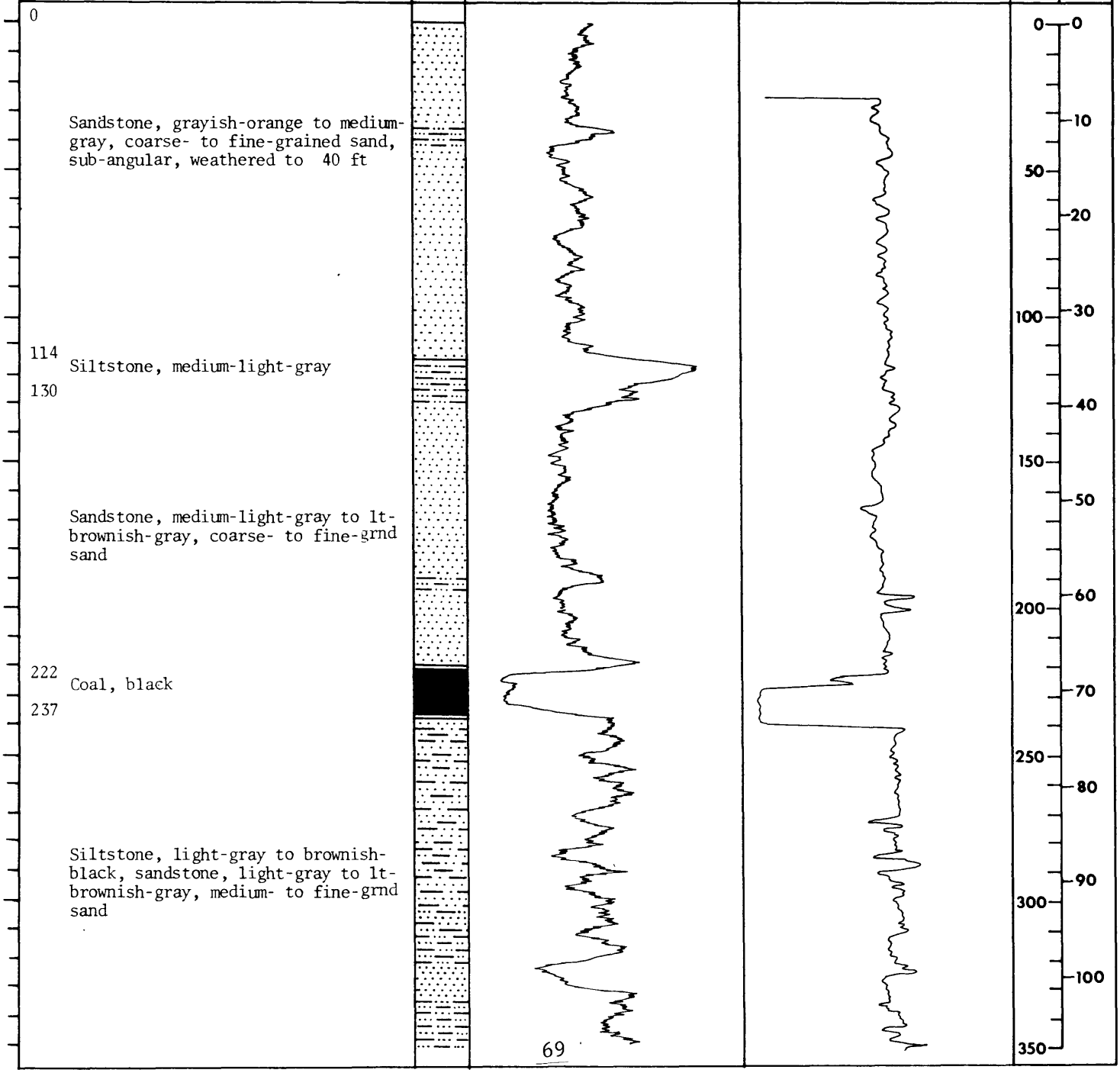
UNITED STATES GEOLOGICAL SURVEY

HOLE NO 77024
SHEET 1 OF 4

AREA Southern Powder River Basin		**QUAD NAME** Little Thunder Reservoir	
DATE STARTED 11/2/77	**DATE COMP.** 11/2/77	**COUNTY** Campbell	**STATE** Wyoming
LOCATION: SEC. 7 **T.** 43N , **R.** 71W , **FOOTAGE LOC.** 100 FSL 100 FWL			**GROUND ELEV** 4850
SIZE AND BIT TYPE: 4 3/4 Drag	**FOOTAGE** ROTARY 700 CORING 0		**TOTAL DEPTH** 700
DRILLING AGENCY: U.S. Geological Survey	**DRILL TYPE:** Portadrill 524		**DEPTH TO WATER** 25 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Fivas	**GEOPHYSICAL LOGS RECORDED BY** G.A. Hollomon		

REMARKS: Gamma logged through drill rods.

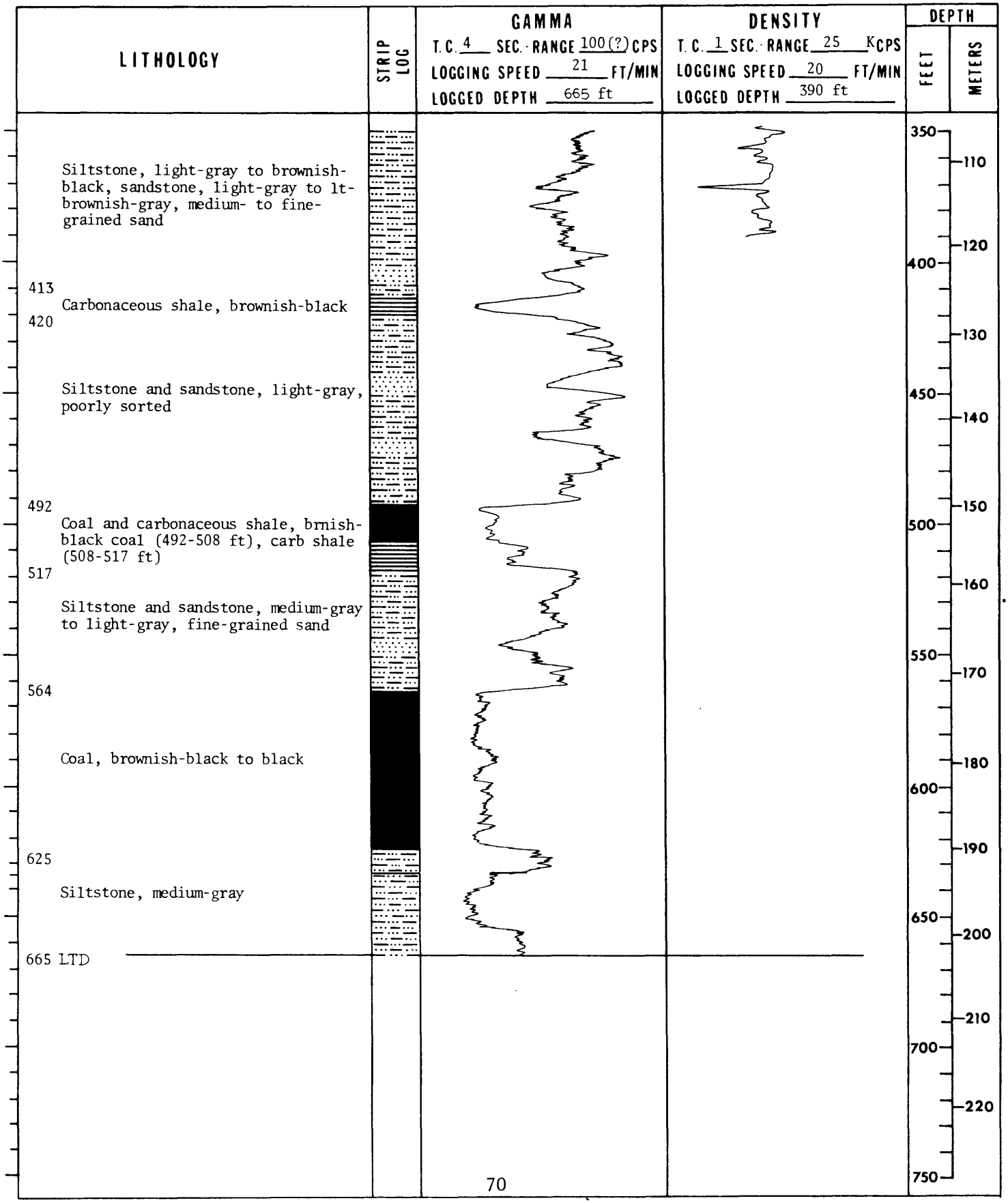
LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. · RANGE 100(?) CPS LOGGING SPEED 21 FT/MIN LOGGED DEPTH 665 ft.	T.C. 1 SEC. · RANGE 25 K CPS LOGGING SPEED 20 FT/MIN LOGGED DEPTH 390 ft		
0 Sandstone, grayish-orange to medium-gray, coarse- to fine-grained sand, sub-angular, weathered to 40 ft				0 50 100 150 200 250 300 350	0 10 20 30 40 50 60 70 80 90 100
114 Siltstone, medium-light-gray					
130 Sandstone, medium-light-gray to lt-brownish-gray, coarse- to fine-grnd sand					
222 Coal, black					
237 Siltstone, light-gray to brownish-black, sandstone, light-gray to lt-brownish-gray, medium- to fine-grnd sand					



UNITED STATES GEOLOGICAL SURVEY

HOLE NO 77024
SHEET 2 OF 4

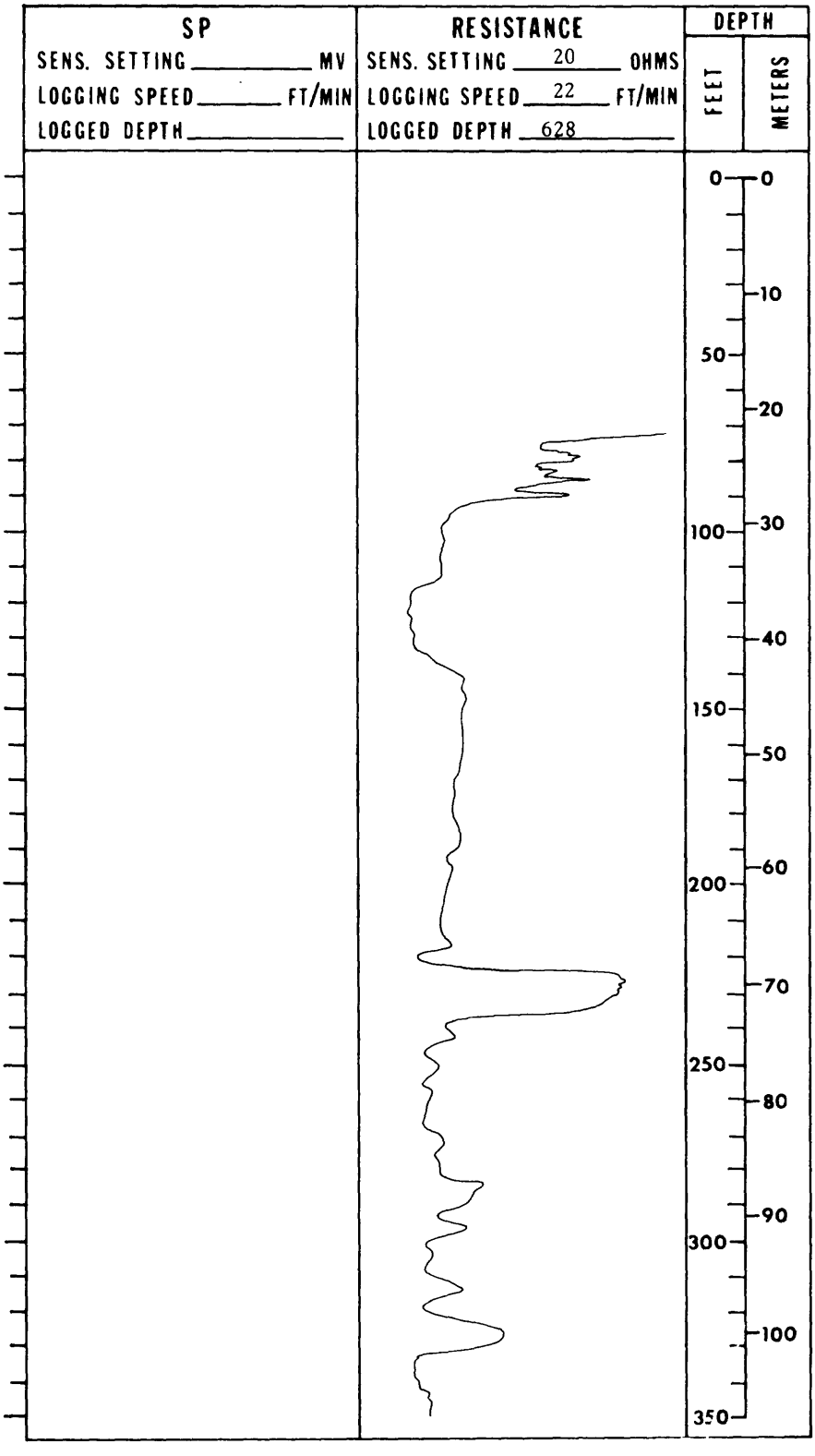
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. 77024
SHEET 3 OF 4

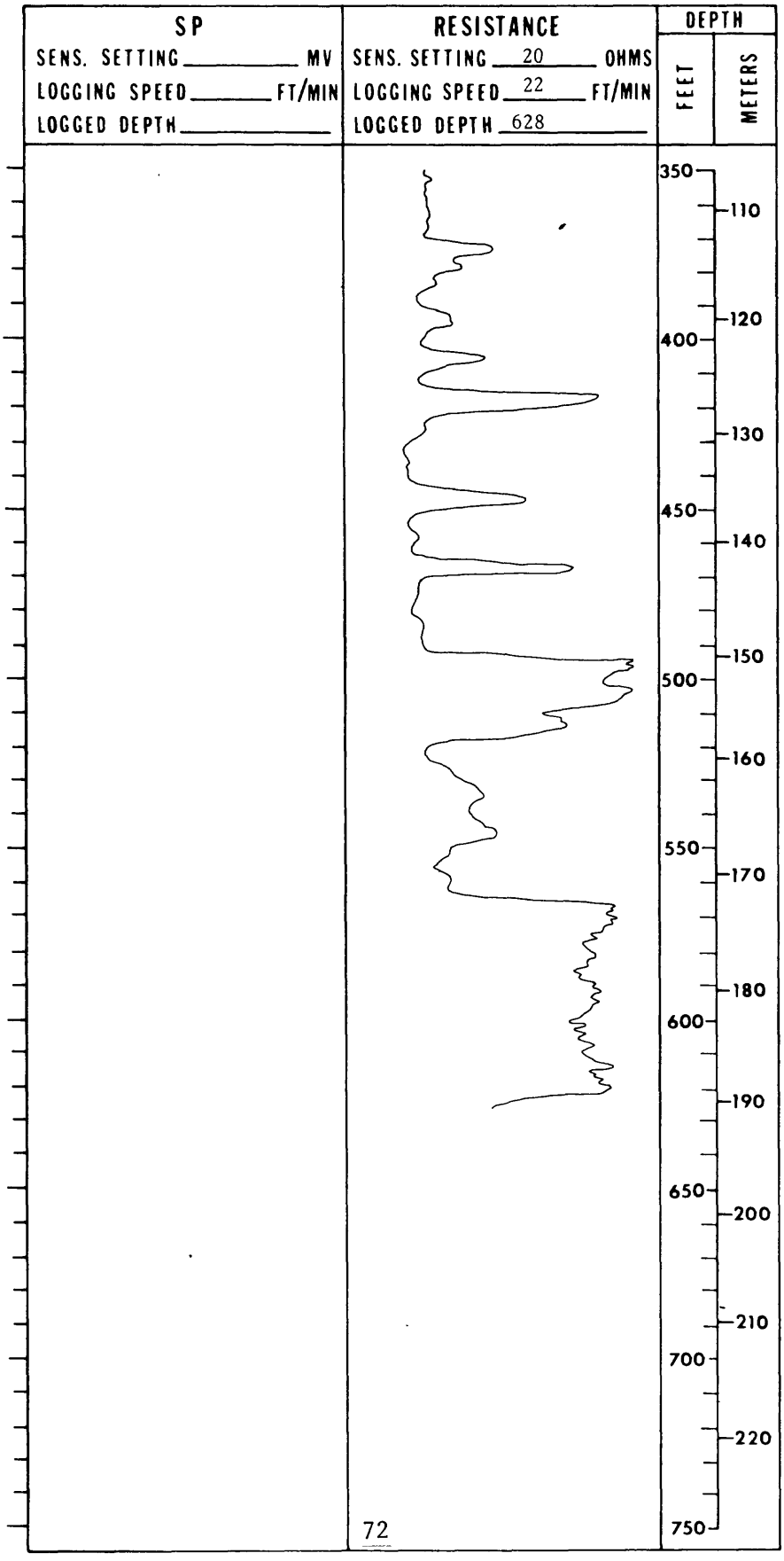
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. 77024
SHEET 4 OF 4

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77025
SHEET 1 OF 4

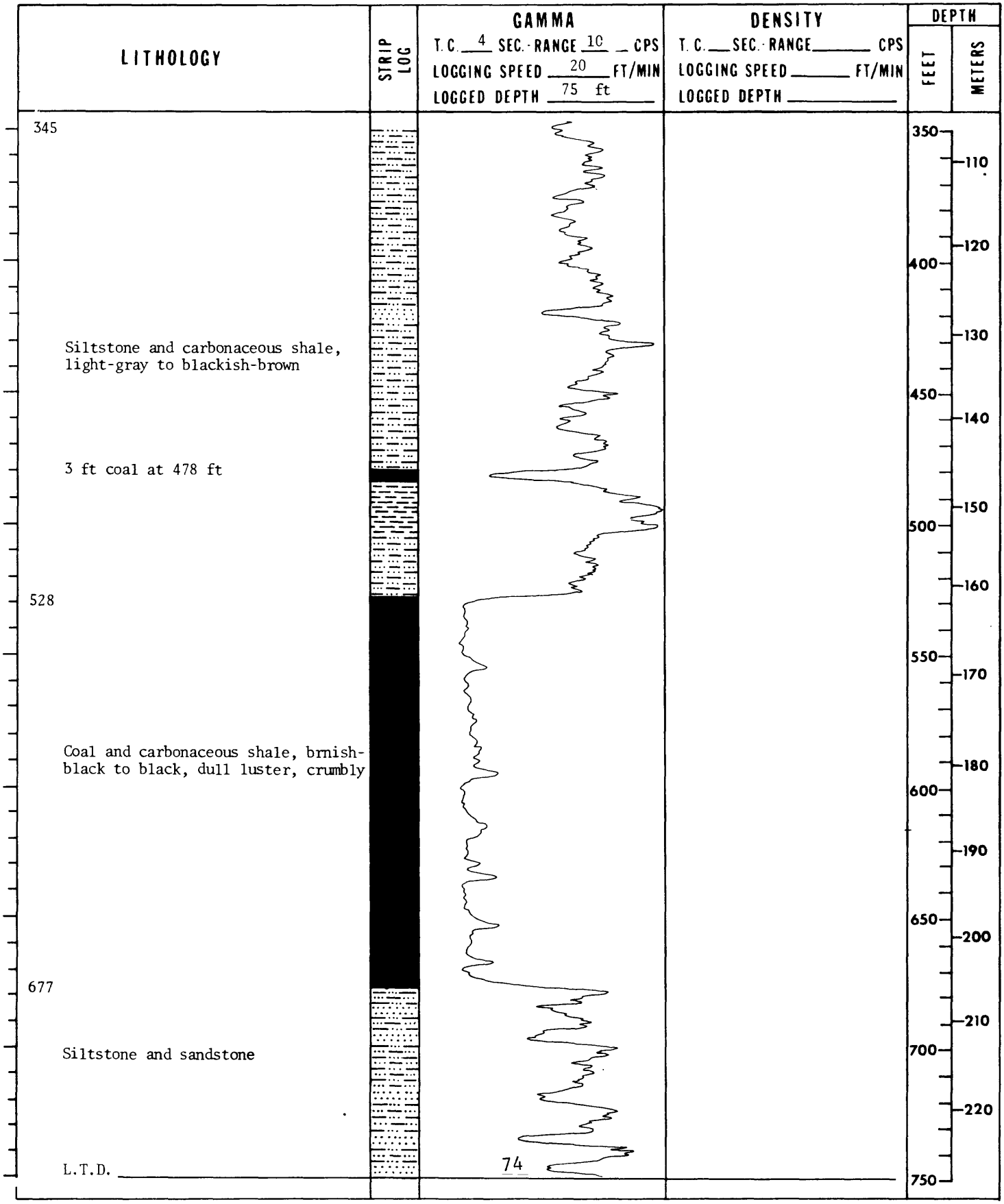
AREA Southern Powder River Basin		QUAD NAME Little Thunder Reservoir	
DATE STARTED 11/11/77	DATE COMP. 11/11/77	COUNTY Campbell	STATE Wyoming
LOCATION: SEC. 7 T. 43N , R. 71W , FOOTAGE LOC. 100 FNL 100 FWL			GROUND ELEV 4900
SIZE AND BIT TYPE: 4 3/4 Ken-claw	FOOTAGE ROTARY 800	CORING 0	TOTAL DEPTH 800
DRILLING AGENCY: U.S. Geological Survey	DRILL TYPE: Portadrill 524		DEPTH TO WATER 27 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Kistner	GEOPHYSICAL LOGS RECORDED BY F.B. Kistner		
REMARKS:			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 10 CPS LOGGING SPEED 20 FT/MIN LOGGED DEPTH 75 ft	T.C. — SEC. RANGE — CPS LOGGING SPEED — FT/MIN LOGGED DEPTH —		
0 Sandstone, dark-yellowish-orange to light-gray, very coarse grained to fine-grained sand, sub-rounded to angular, weathered to 35 ft				0	0
85 Siltstone, light-brownish-gray to m-light-gray, fine sand below 140 ft				100	30
174 Sandstone, light-gray to medium-light-gray, very coarse grained to fine-grained sand, sub-rounded to angular				200	60
253 Siltstone, medium-gray to light-brownish-gray, possible 4 ft coal at 279 ft				250	80
330 Coal, black, vitreous luster, conch fracture, carb shale, brnish-gray to brownish-black				300	90
345		73		350	100

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77025
SHEET 2 OF 4

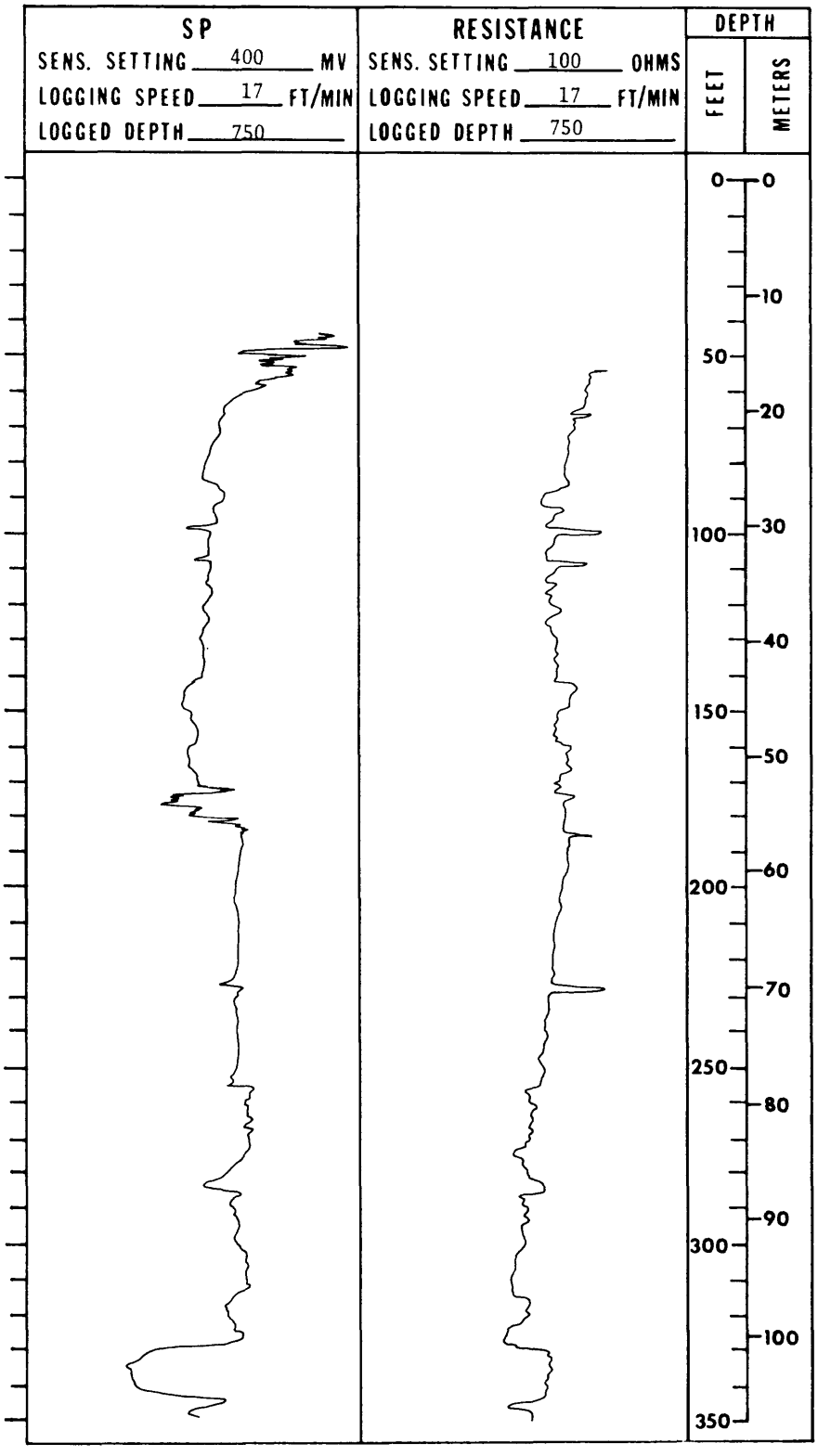
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77025
SHEET 3 OF 4

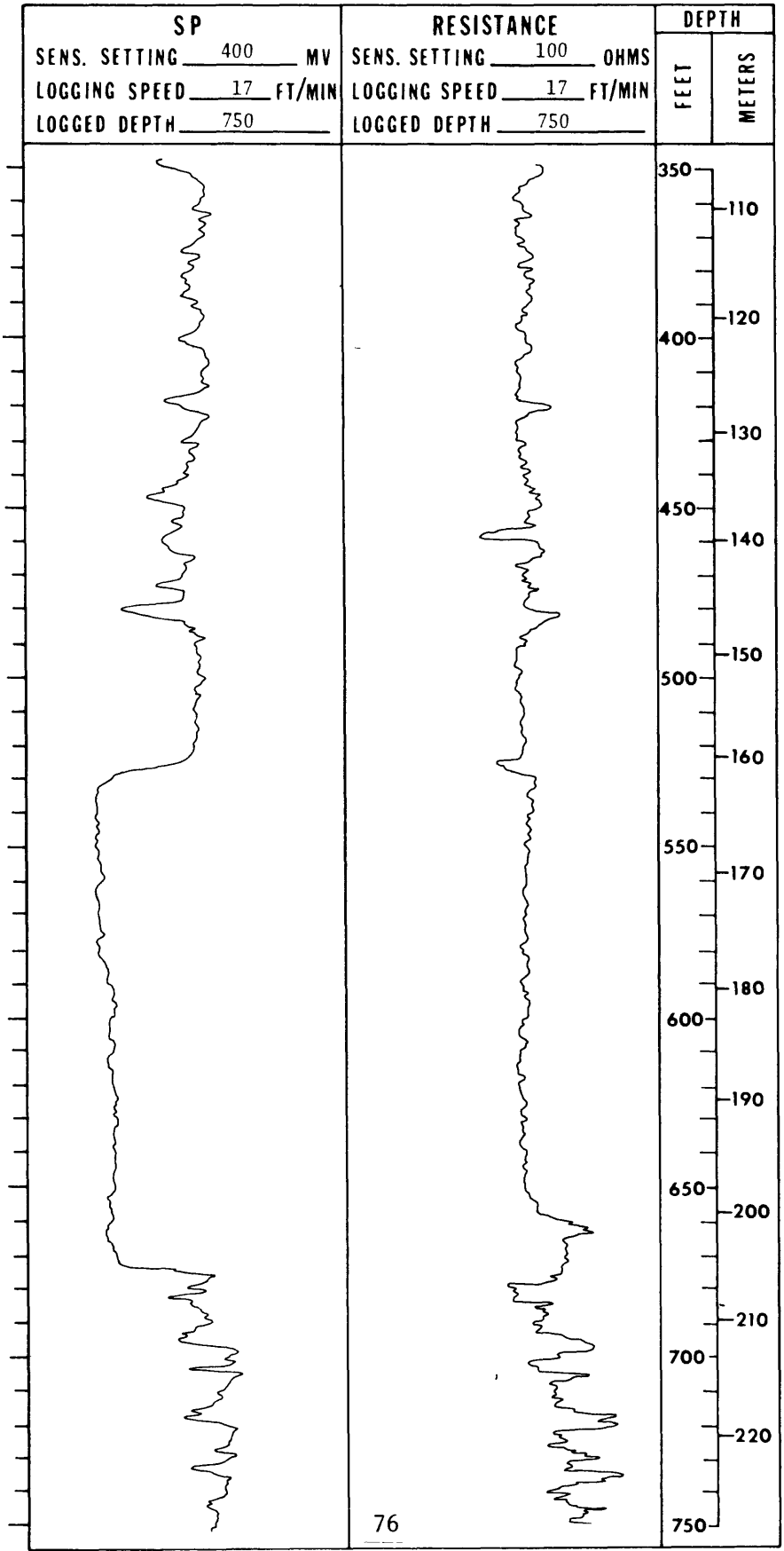
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77025
SHEET 4 OF 4

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77026
SHEET 1 OF 4

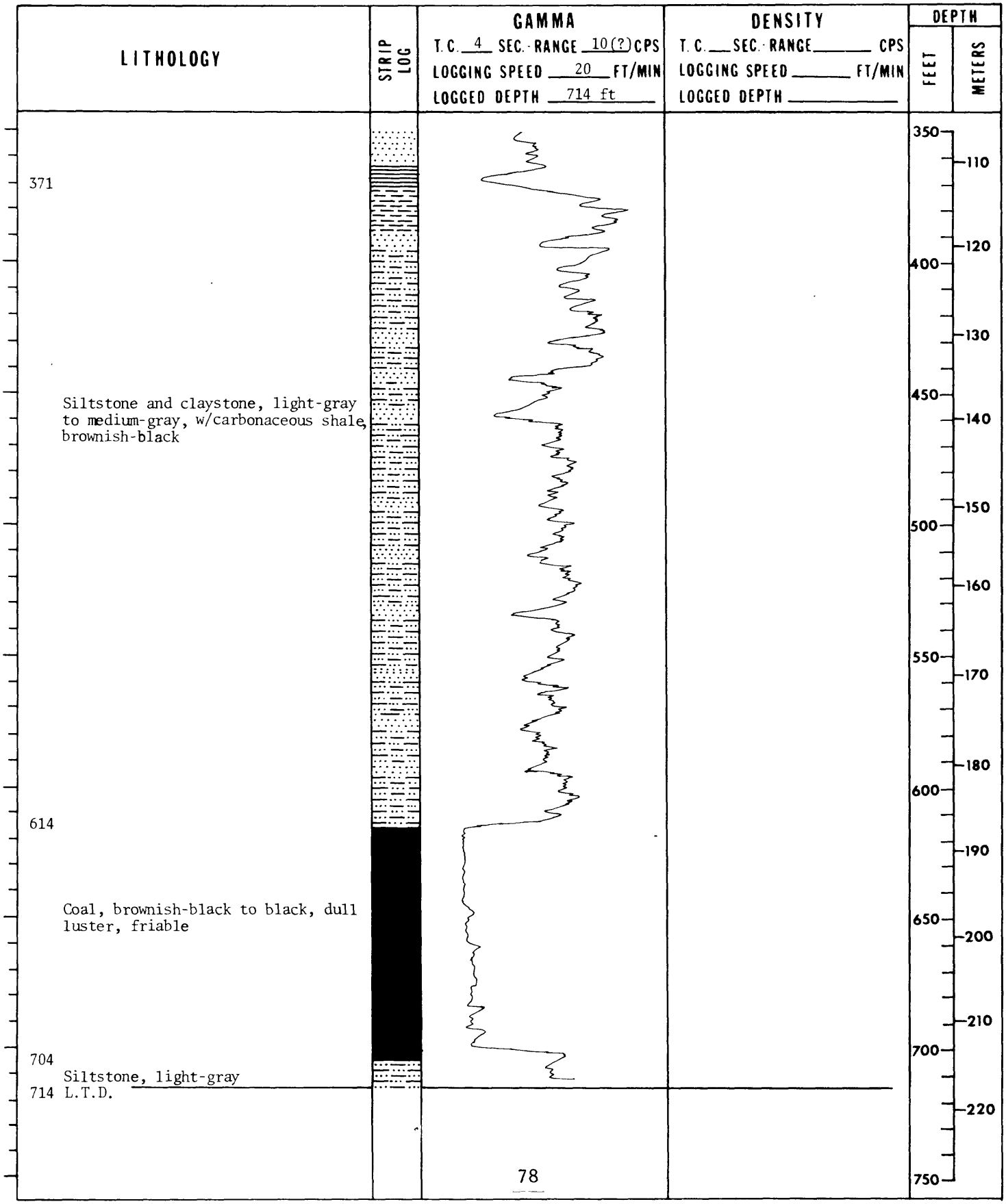
AREA Southern Powder River Basin		QUAD NAME Little Thunder Reservoir	
DATE STARTED 11/13/77	DATE COMP. 11/13/77	COUNTY Campbell	STATE Wyoming
LOCATION: SEC. 24 T. 43N , R. 72W , FOOTAGE LOC. 2550 FNL 2550 FEL			GROUND ELEV 4870
SIZE AND BIT TYPE: 4 3/4 Drag	FOOTAGE ROTARY 725	CORING 0	TOTAL DEPTH 725
DRILLING AGENCY: U. S. Geological Survey	DRILL TYPE: Portadrill 524		DEPTH TO WATER 43 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Fivas	GEOPHYSICAL LOGS RECORDED BY F.B. Kistner		
REMARKS: Gamma logged through drill rods.			

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. · RANGE 10 CPS LOGGING SPEED 20 FT/MIN LOGGED DEPTH 714 ft	T.C. — SEC. · RANGE ——— CPS LOGGING SPEED ——— FT/MIN LOGGED DEPTH ———		
0 Sandstone, dark-yellowish-orange to medium-gray, coarse- to medium-grained sand, sub-rounded, weathered to 60 ft				0	0
65 Siltstone and claystone, light-gray to dark-gray				50	10 20
130 Sandstone, light-gray to medium-dark-gray, very coarse grained to medium-grained sand, sub-rounded				100	30 40
187 Coal, brownish-black to black, vit luster, conchoidal fracture				150	50
199 Siltstone, light-gray to medium-dark-gray				200	60 70
285 Sandstone, light-gray to medium-dark-gray, coarse- to fine-grained sand				250 300	80 90 100
				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77026
SHEET 2 OF 4

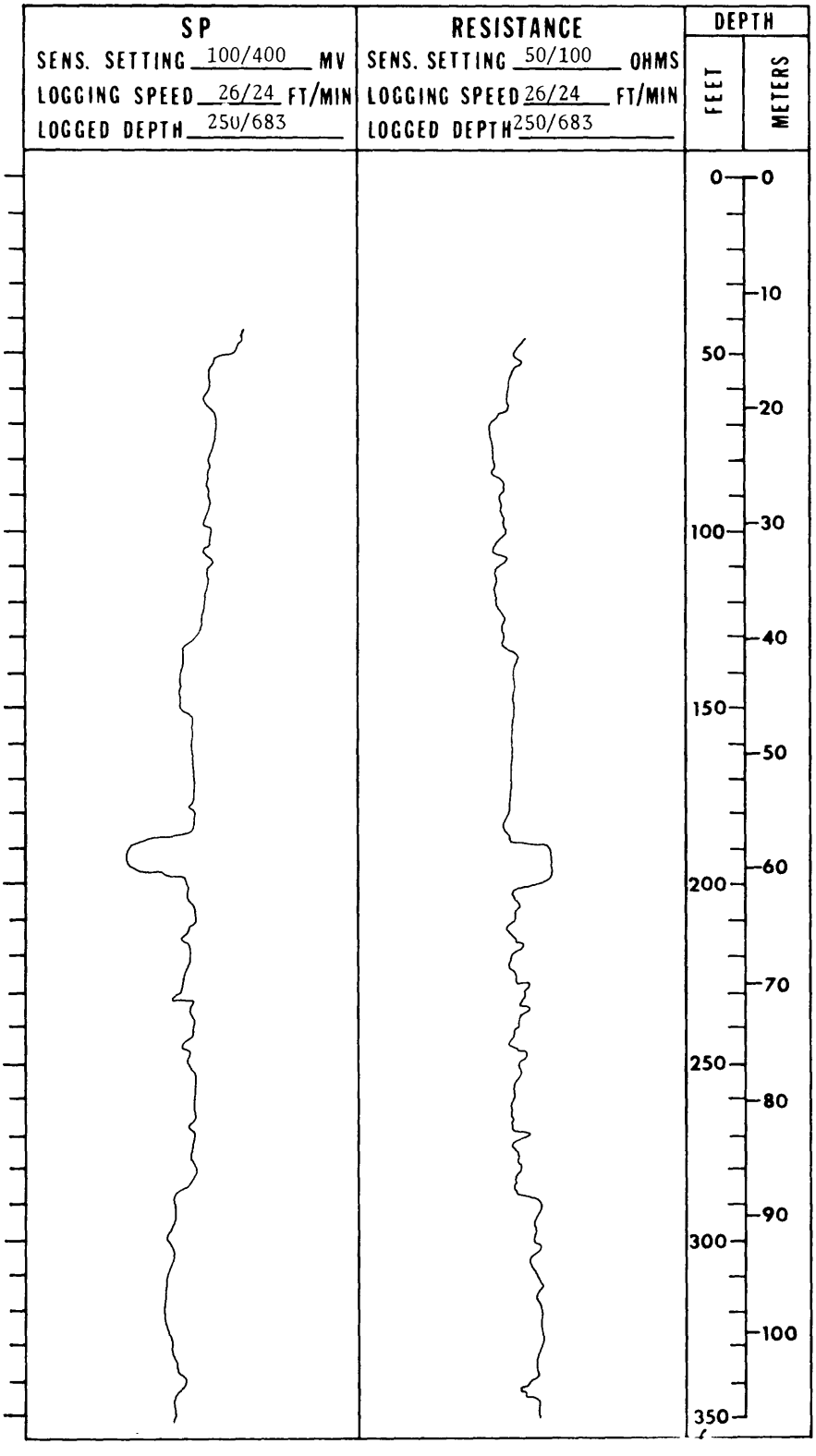
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77026
SHEET 3 OF 4

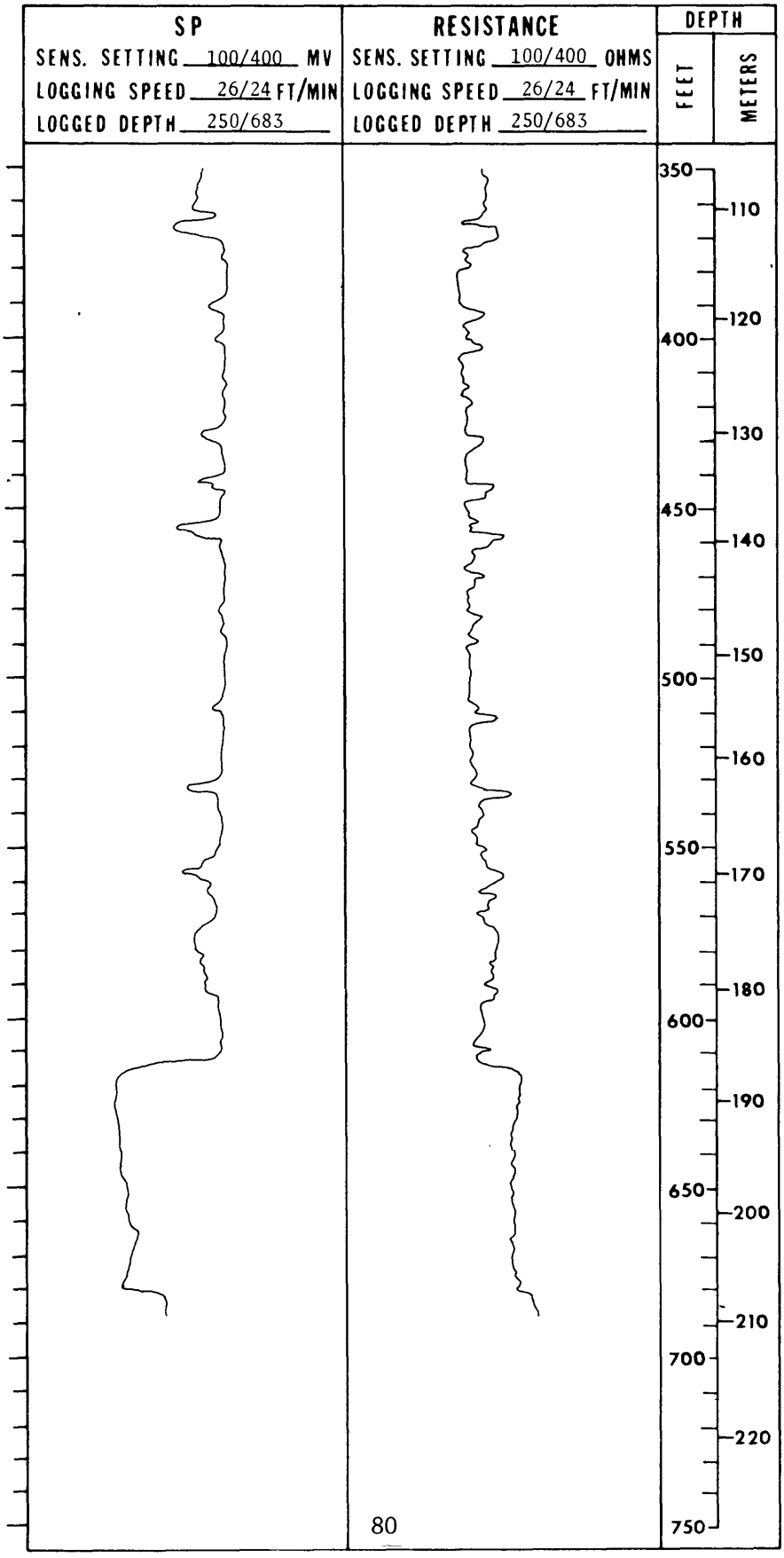
REMARKS: Log is composite of two runs



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77026
SHEET 4 OF 4

REMARKS: Log is composite of two runs



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77027
SHEET 1 OF 4

AREA Southern Powder River Basin		QUAD NAME Little Thunder Reservoir	
DATE STARTED 11/14/77	DATE COMP. 11/14/77	COUNTY Campbell	STATE Wyoming
LOCATION: SEC. 13 T. 43N , R. 72W , FOOTAGE LOC. 600 ~~FSL~~ FNL 300 ~~FWL~~ FEL			GROUND ELEV 4835
SIZE AND BIT TYPE: 4 3/4 Drag	FOOTAGE ROTARY 600	CORING 0	TOTAL DEPTH 600
DRILLING AGENCY: U. S. Geological Survey	DRILL TYPE: Portadrill 524		DEPTH TO WATER 18 ft
LITHOLOGY RECORDED BY Hollomon, Coppock, Fivas	GEOPHYSICAL LOGS RECORDED BY F.B. Kistner		

REMARKS:

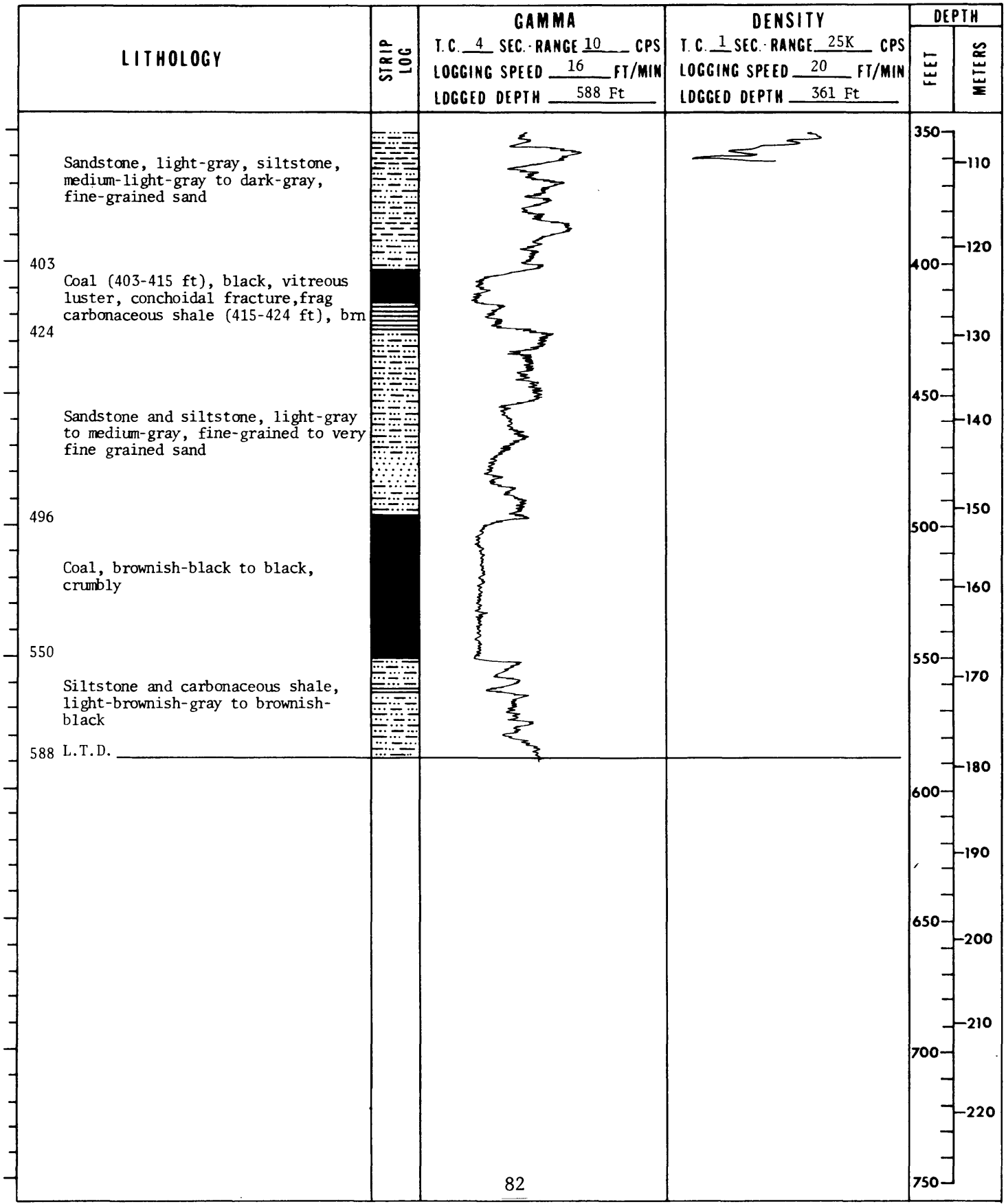
Gamma logged thru drill rods

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH FEET	DEPTH METERS
		T.C. 4 SEC. RANGE 10 CPS LOGGING SPEED 16 FT/MIN LOGGED DEPTH 588 ft	T.C. 1 SEC. RANGE 25K CPS LOGGING SPEED 20 FT/MIN LOGGED DEPTH 361 Ft		
0				0	0
12 Sandy, silty, brown, med					
Sandstone, dark-yellowish-orange to light-gray, coarse- to fine-grained sand, sub-angular to sub-rounded, weathered to 35 ft				50	10 20
95				100	30
Siltstone and claystone, light-gray to brownish-gray					
123				150	40 50
Sandstone, light-gray, very coarse grained to medium-grained sand, sub-angular					
197 Coal, brnish-blk to blk, vit luster, conch frac, fragal, carb sh, brnish-				200	60
210 gray					
				250	70 80
Sandstone, light-gray; siltstone, medium-light-gray to dark-gray, f-grained sand				300	90 100
				350	

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77027
SHEET 2 OF 4

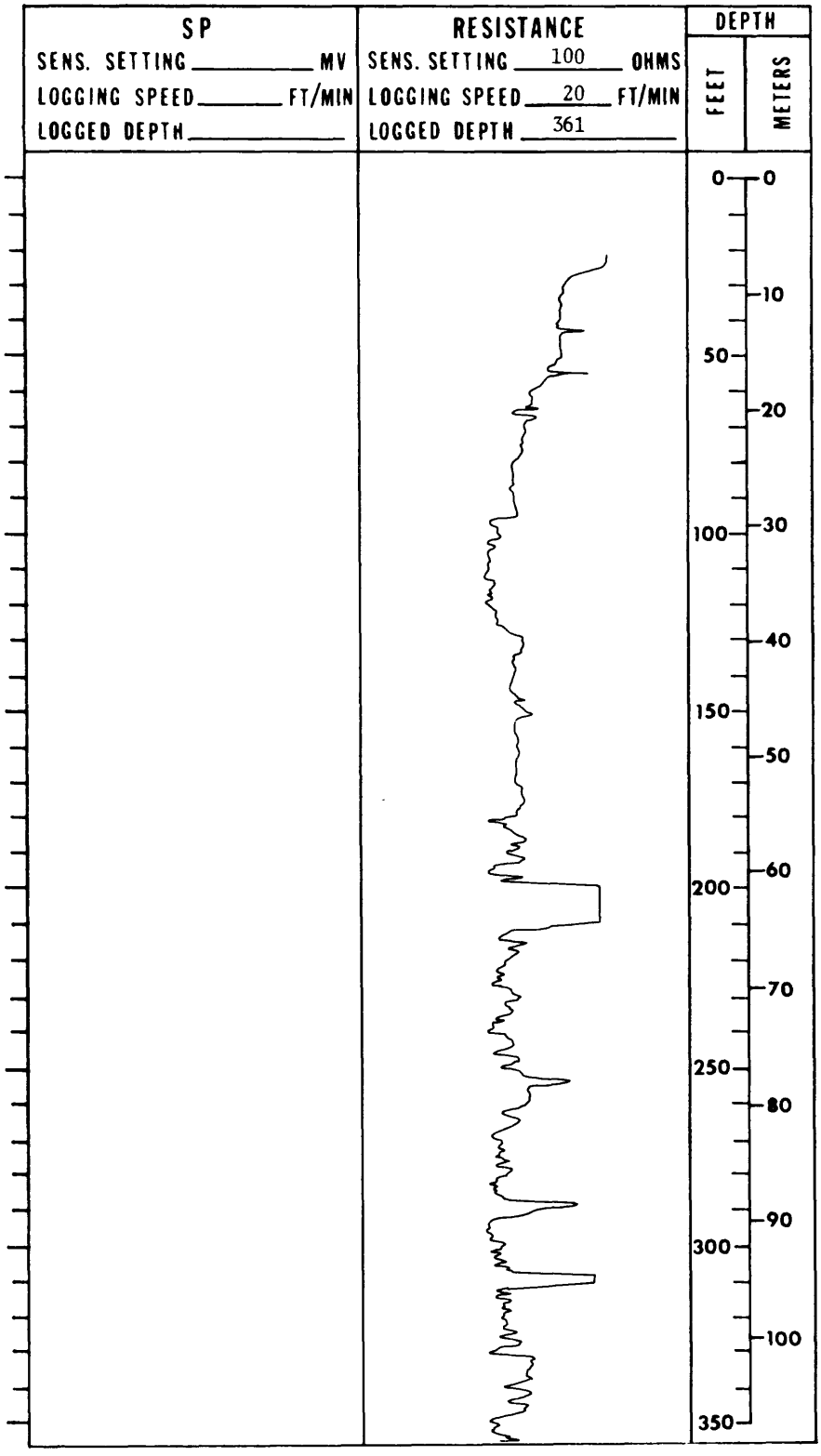
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77027
SHEET 3 OF 4

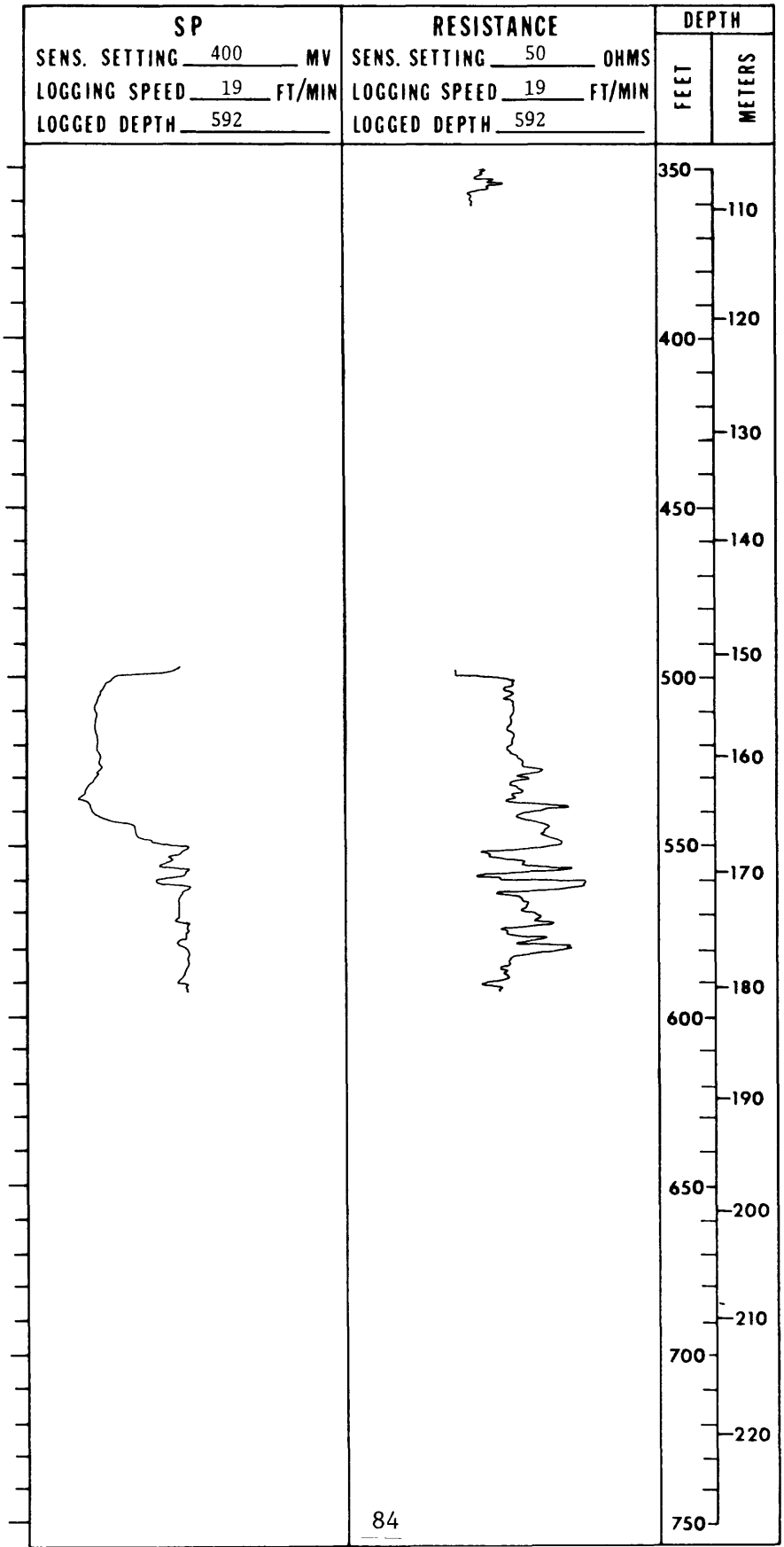
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77027
SHEET 4 OF 4

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77028
SHEET 1 OF 4

AREA Southern Powder River Basin		QUAD NAME Little Thunder Reservoir	
DATE STARTED 11/15/77	DATE COMP. 11/16/77	COUNTY Campbell	STATE Wyoming
LOCATION: SEC. 12 T. 43N. , R. 72W. , FOOTAGE LOC. 1300 FSL 1400 FWL			GROUND ELEV 4860 ft
SIZE AND BIT TYPE: 4 3/4 Ken-claw & drag	FOOTAGE ROTARY 670	CORING 0	TOTAL DEPTH 670 ft
DRILLING AGENCY: U.S.G.S.	DRILL TYPE: Portadrill 524		DEPTH TO WATER 148 ft
LITHOLOGY RECORDED BY Fivas	GEOPHYSICAL LOGS RECORDED BY Century Geophysical		

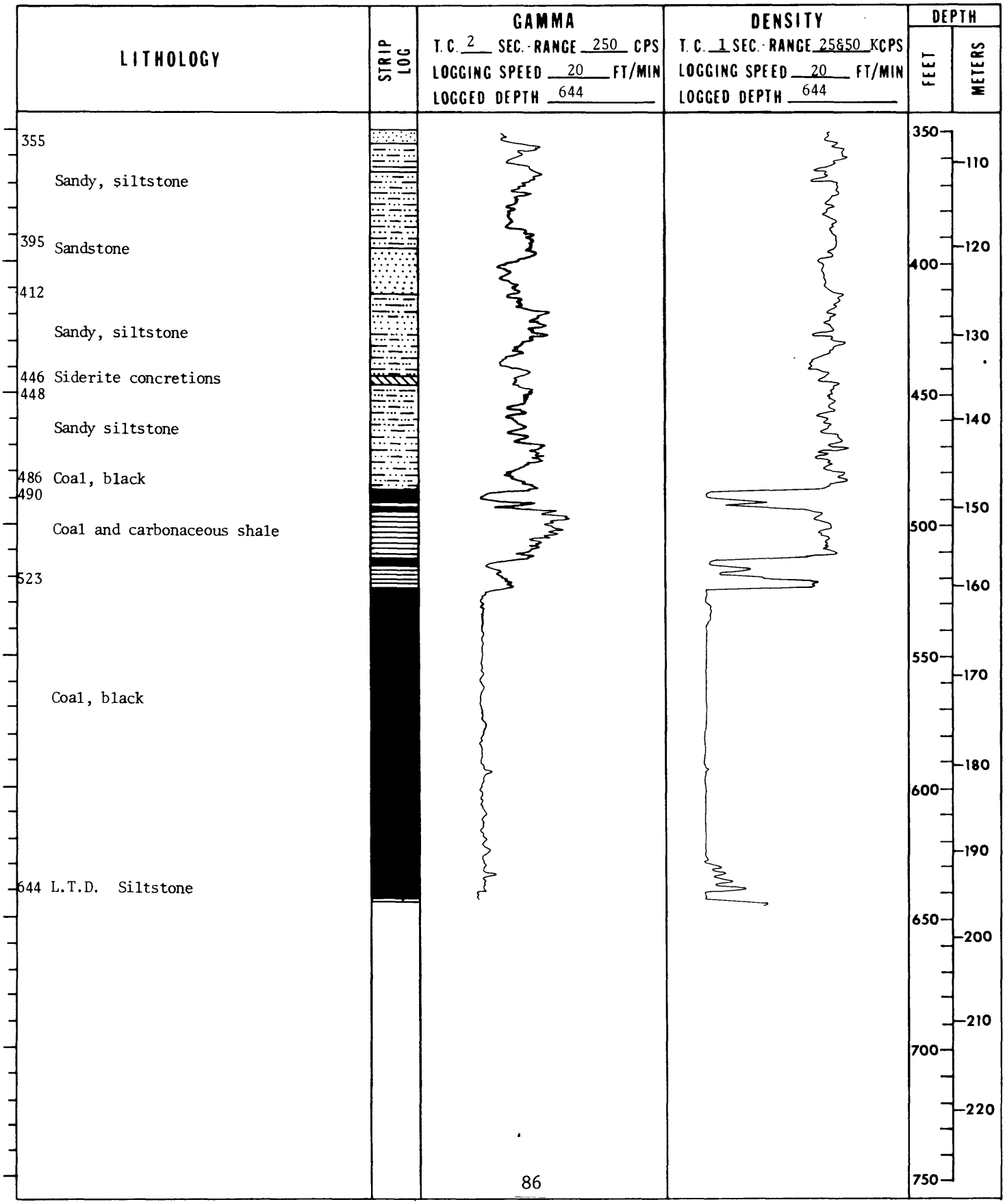
REMARKS: Density log scale changed from 25 to 50 KCPS @ 148 ft
Lost circulation @ 557 ft

LITHOLOGY	STRIP LOG	GAMMA	DENSITY	DEPTH
		T.C. 2 SEC. · RANGE 250 CPS LOGGING SPEED 20 FT/MIN LOGGED DEPTH 644	T.C. 1 SEC. · RANGE 25 & 50 KCPS LOGGING SPEED 20 FT/MIN LOGGED DEPTH 644	FEET / METERS
0 Sandy siltstone with possible coals at 27-30 ft and 35-37 ft, weathered to 20 ft				0 / 0
60 Sandstone, greenish-gray				50 / 20
116 Siltstone 122 Sandstone				100 / 30
160 Silty sandstone 174 Siderite concretions 176 Silty sandstone 192 Siderite concretions 195 Carb shale, black to brown 206 Sandstone, siltstone				150 / 50 200 / 60
228 Sandstone				250 / 80
272 Siltstone 282 Sandstone 289 Siltstone				300 / 90
307 Coal, black				
328 Sandy siltstone				350 / 100
345 Sandstone				

UNITED STATES GEOLOGICAL SURVEY

HOLE NO CD77028
SHEET 2 OF 4

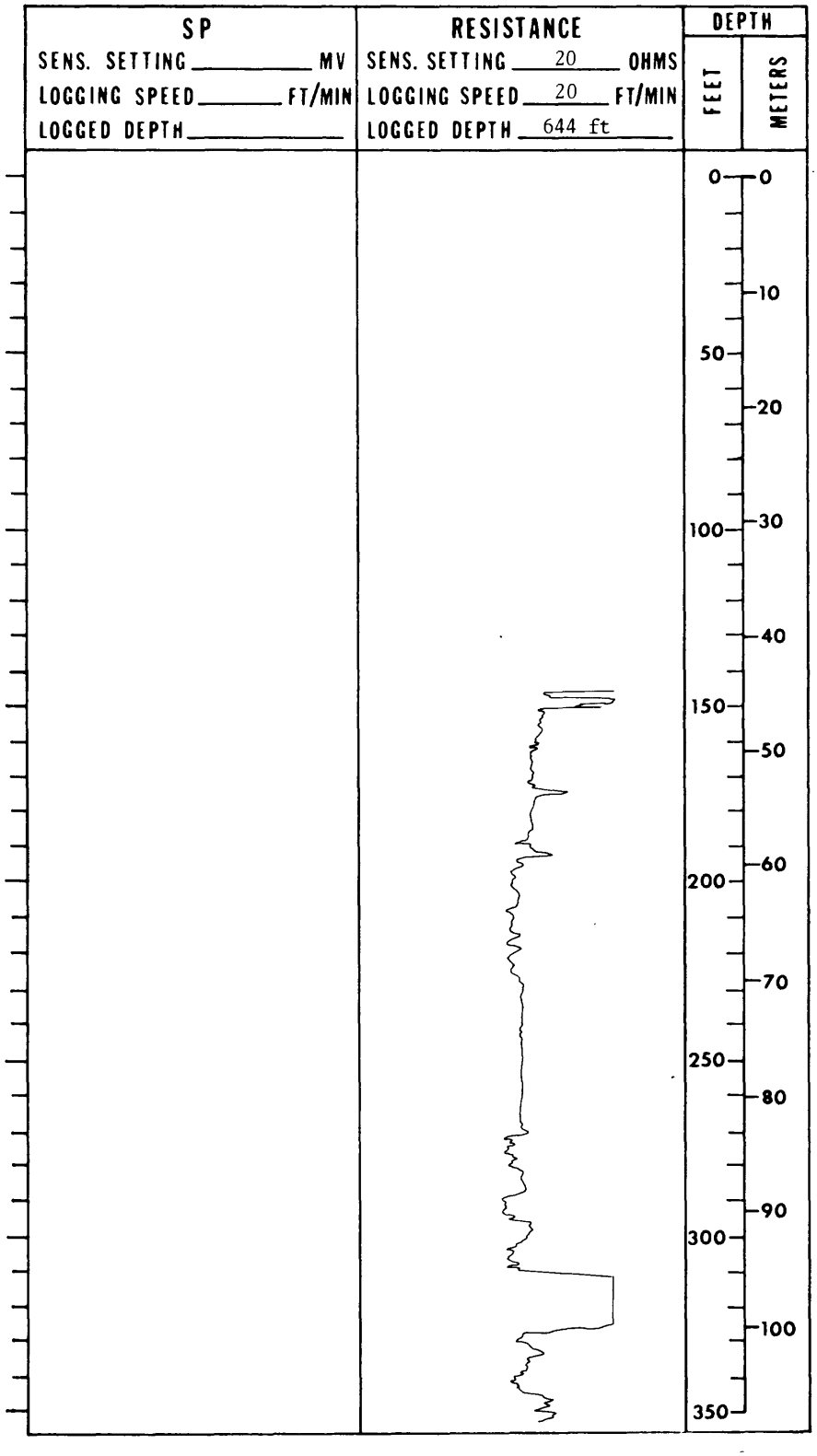
REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NC.CD77028
SHEET 3 OF 4

REMARKS:



UNITED STATES GEOLOGICAL SURVEY

HOLE NO. CD77028
SHEET 4 OF 4

REMARKS: