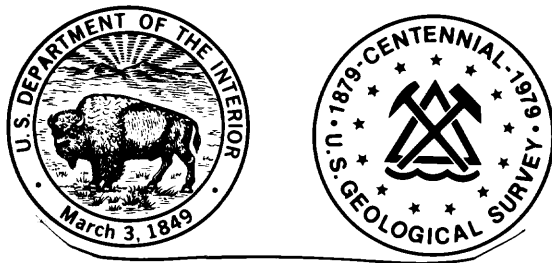


UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY



LIGNITE DRILLING DURING 1978 IN WESTERN NORTH DAKOTA:

ADAMS, BILLINGS, BOWMAN, BURKE, GOLDEN VALLEY,
HETTINGER, MCKENZIE, MCLEAN, AND SLOPE COUNTIES

By

U.S. Geological Survey

and

North Dakota Geological Survey

Open-File Report 79-1051

1979

This report has not been edited for conformity
with U.S. Geological Survey editorial standards
or stratigraphic nomenclature.

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INTRODUCTION AND ACKNOWLEDGMENTS

A drilling program was conducted in western North Dakota by the North Dakota Geological Survey (NDGS) under Grant No. 14-08-0001-G-551 from the U.S. Geological Survey (USGS). The drilling was done as part of the U.S. Geological Survey's program to evaluate and classify mineral lands in the public domain. The overall purpose of the program was to gather data on the thickness, quality, extent, and recoverability of lignite beds and the lithologic characteristics of the Tertiary Fort Union Formation in western North Dakota.

This report includes geophysical logs, descriptions of samples, lists of lignite beds, and locations of the test holes. The lists of lignite beds include most of the beds more than 2 feet thick and were generally made from the density logs, but where there were depth discrepancies between the gamma and density logs, sample depths were consulted to decide which log to use.

Test holes were drilled in five general areas between June 29, 1978, and September 23, 1978, with the first hole in Burke County (Area A) and the last hole in McKenzie County (Area E). For convenience of reference, the areas are designated A through E (fig. 1). Test-hole locations are shown on figures 2-6 and the specific locations are on the log headings using the system of land survey in use by the U.S. Bureau of Land Management. The distances from section lines are approximate. Elevations are also approximations taken from the topographic quadrangle sheets or, where topographic

coverage was lacking, from altimeter surveys.

The total number of test holes and the area in which they were drilled are as follows: Area A, 45 holes; Area B, 42 holes; Area C, 20 holes; Area D, 17 holes; and Area E, 7 holes. A total of 53,594 feet were drilled plus 110 feet of core.

Seven core holes were drilled during the 1978 drilling program. The procedure was to move a few feet from a test hole and core the interval or intervals indicated on the log of the adjacent hole (for example, Bu 31 and Bu 31C). The core holes are: Bu 9C and Bu 31C in Burke County; McL 5C, McL 14C, and McL 37C in McLean County; and Rs 12C and RS 16C in Hettinger County. The core was split and one-half was sent for analysis to the USGS laboratory, Lakewood, Colorado. Selected samples were sent to the USGS office in Billings, Mont., for palynological studies. The remainder of the core is in the NDGS storage facilities in Grand Forks, North Dakota.

Fieldwork was carried out by the following personnel: Clarence G. Carlson, Randall Reichert, Fred O'Toole, Tom Heck, and David Lechner, of the North Dakota Geological Survey, and Susan Cook, of the U.S. Geological Survey. Coordination and technical guidance were provided by Clarence G. Carlson (NDGS) and Elmer M. Schell (USGS).

A forward rotary drill was used with water as the drilling fluid. Continuous 5-ft samples were collected except where circulation was difficult to maintain and sample returns were not satisfactory. In those instances, no samples were collected. Samples were logged by the geologist in the field and then bagged and placed in the storage facilities of the NDGS, Grand Forks, North Dakota. A driller's log for each test hole was obtained and these are on open file at the NDGS office in Grand Forks.

The logging procedure was to run the gamma-ray, spontaneous-potential (SP), and resistivity probes, followed by the density probe. The log printouts were photographically reduced and both the originals and negatives are on open file at the NDGS office in Grand Forks.

Test holes were given letter and number designations prior to the drilling season. A few sites were later deleted, but to avoid the confusion of renumbering subsequent holes, the original designations were retained. This resulted in a few missing numbers (for example, Bu-33 and McK-4) for which no holes were drilled.

All measurements are in feet. To convert to meters, multiply by 0.3048.

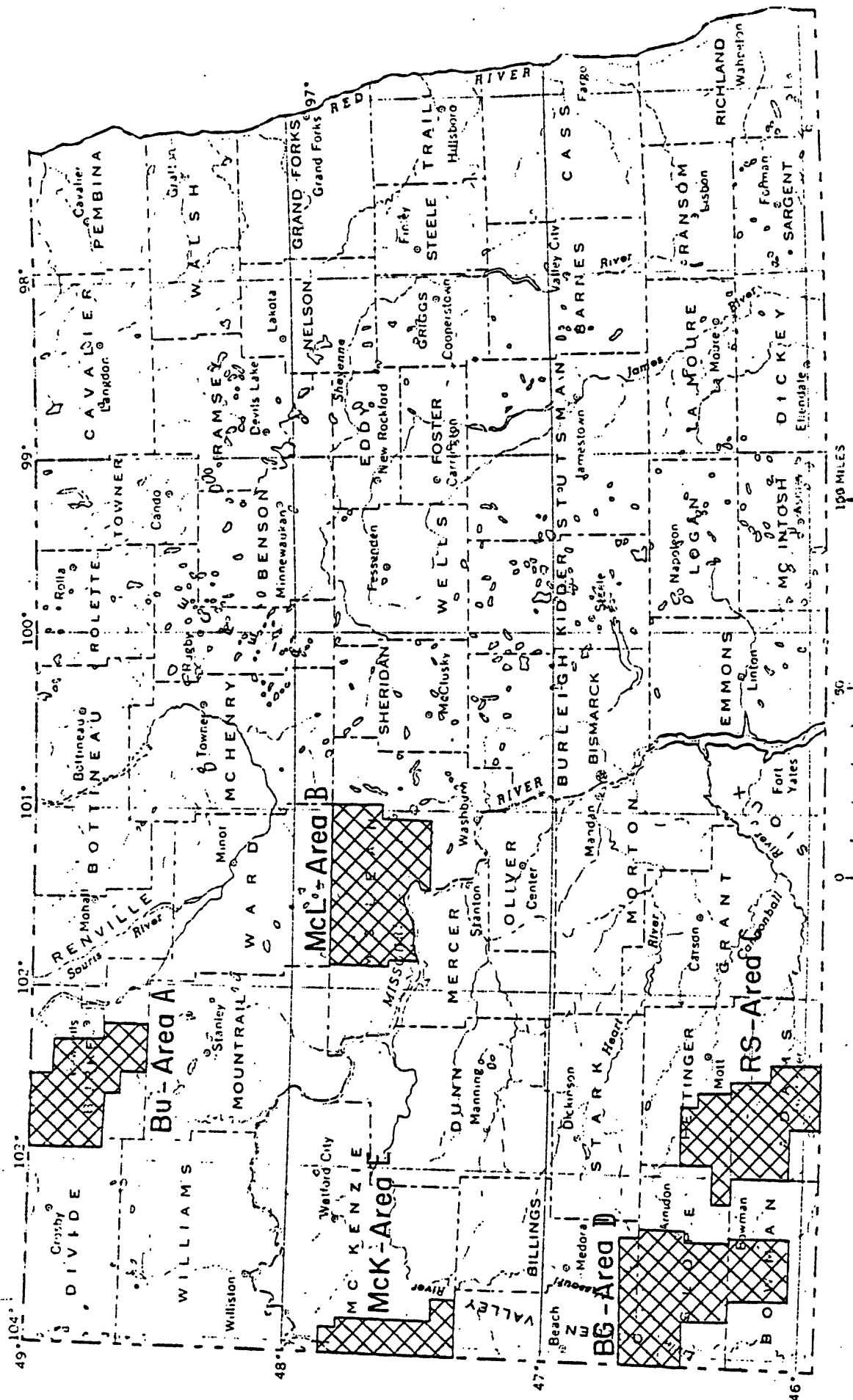


Figure 1.—Index map showing area of drilling activity in western North Dakota: A, Burke County; B, McLean County; C, Hettinger, Slope and Adams Counties; D, Bowman, Billings, Slope and Golden Valley Counties; and E, McKenzie County.

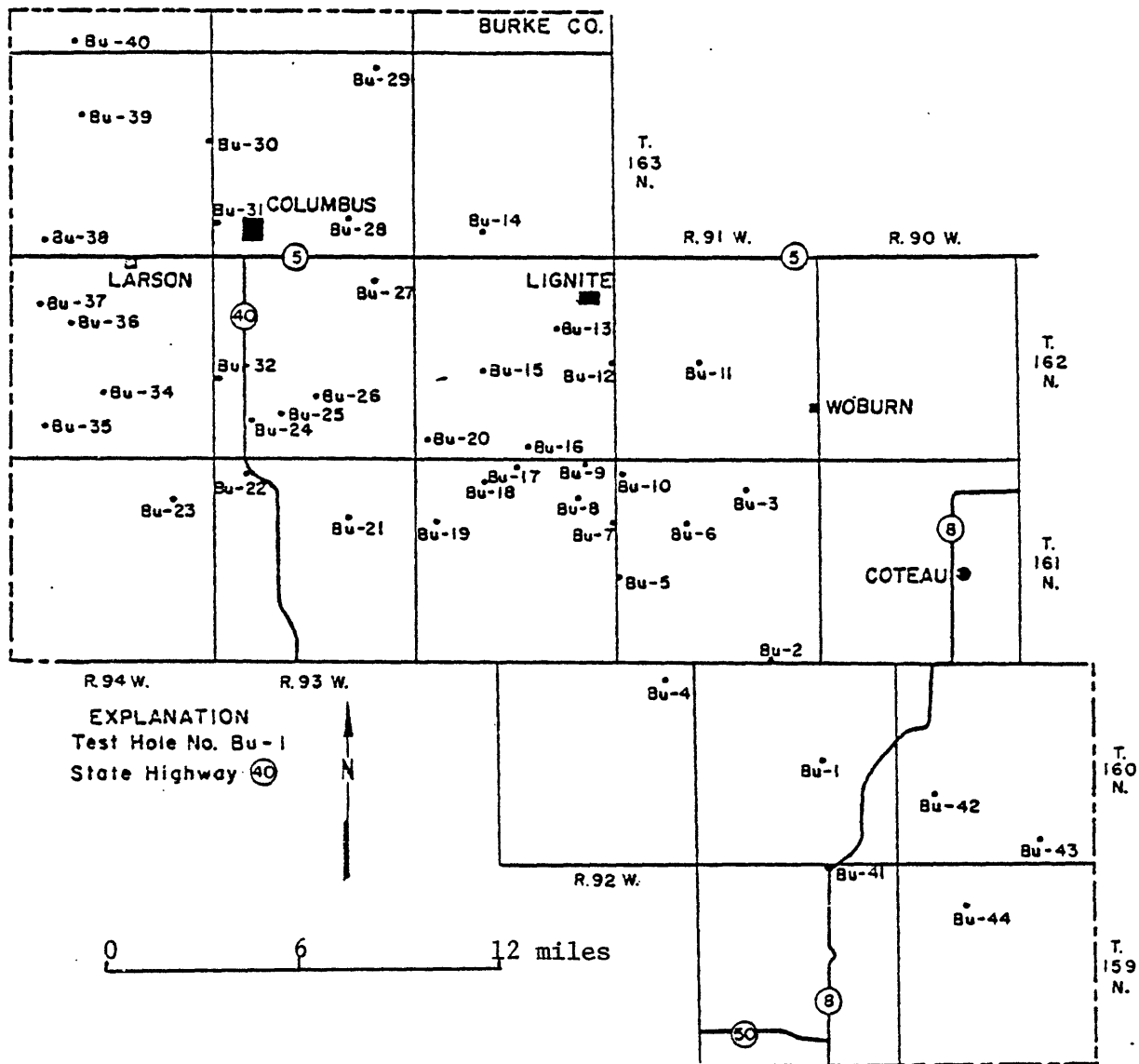


Figure 2.—Drill-hole locations for Area A, Burke County, North Dakota.

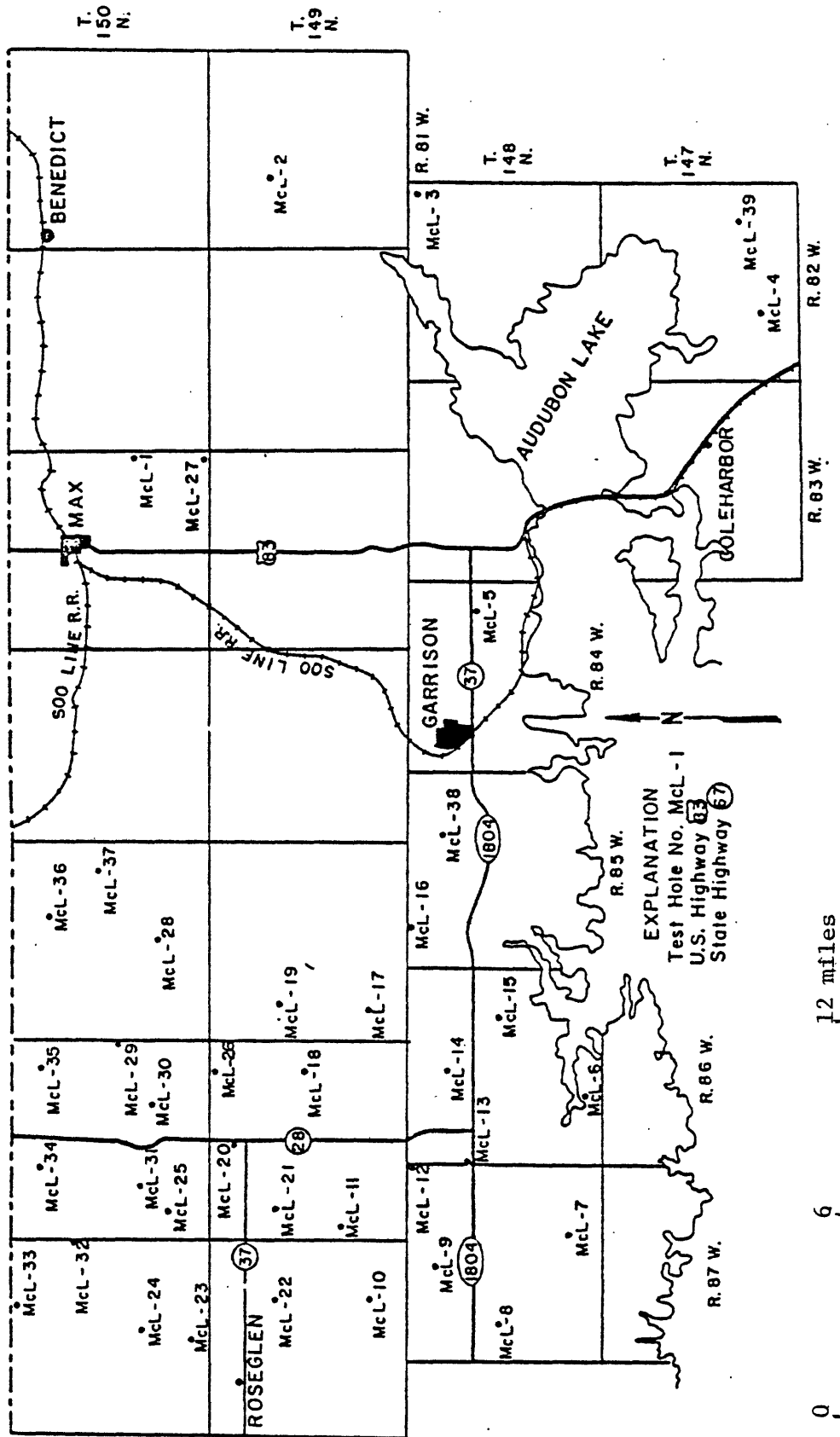


Figure 3. Drill-hole locations for Area B, McLean County, North Dakota.

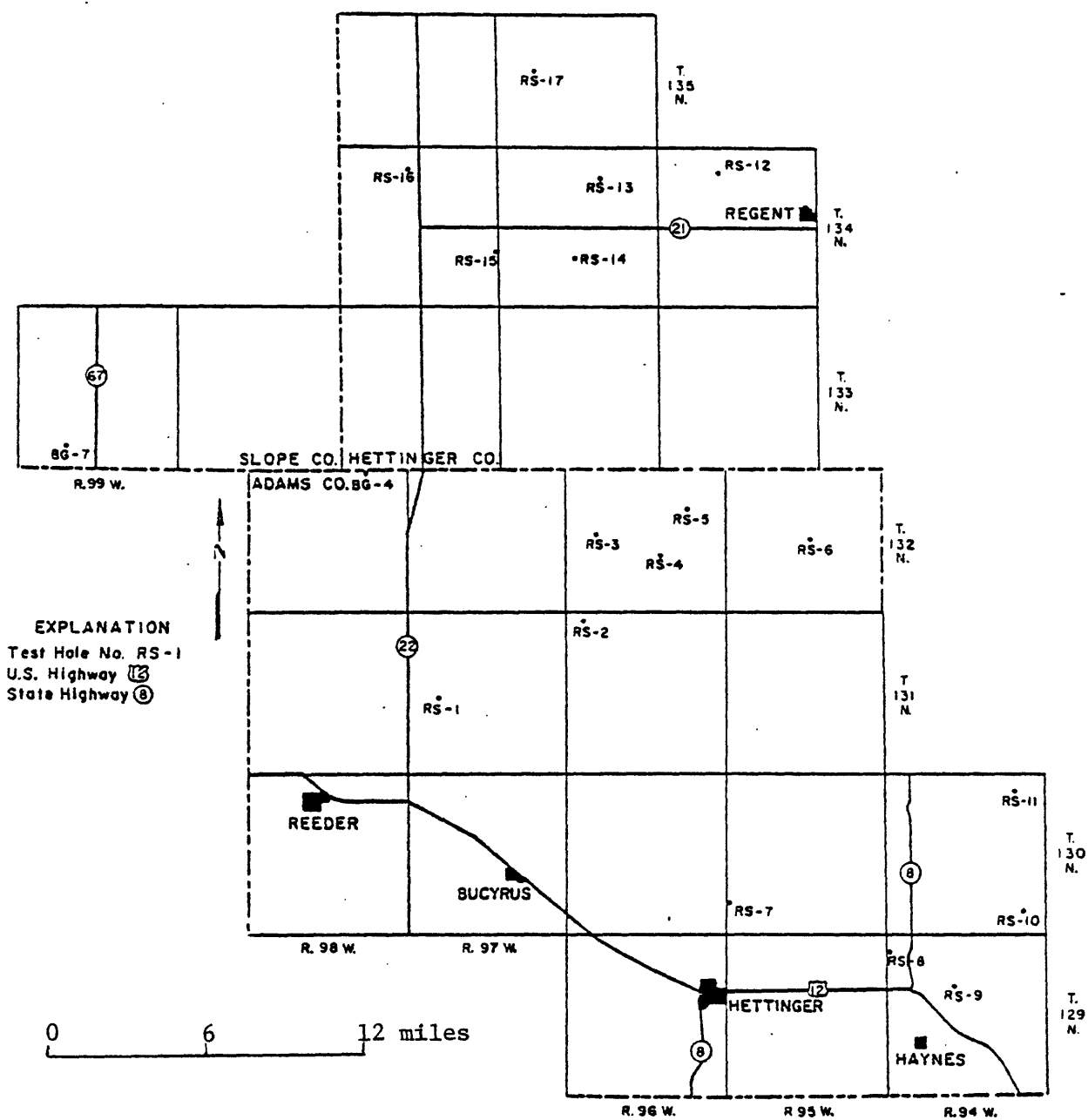


Figure 4.--Drill-hole locations for Area C, Hettinger, Slope, and Adams Counties, North Dakota.

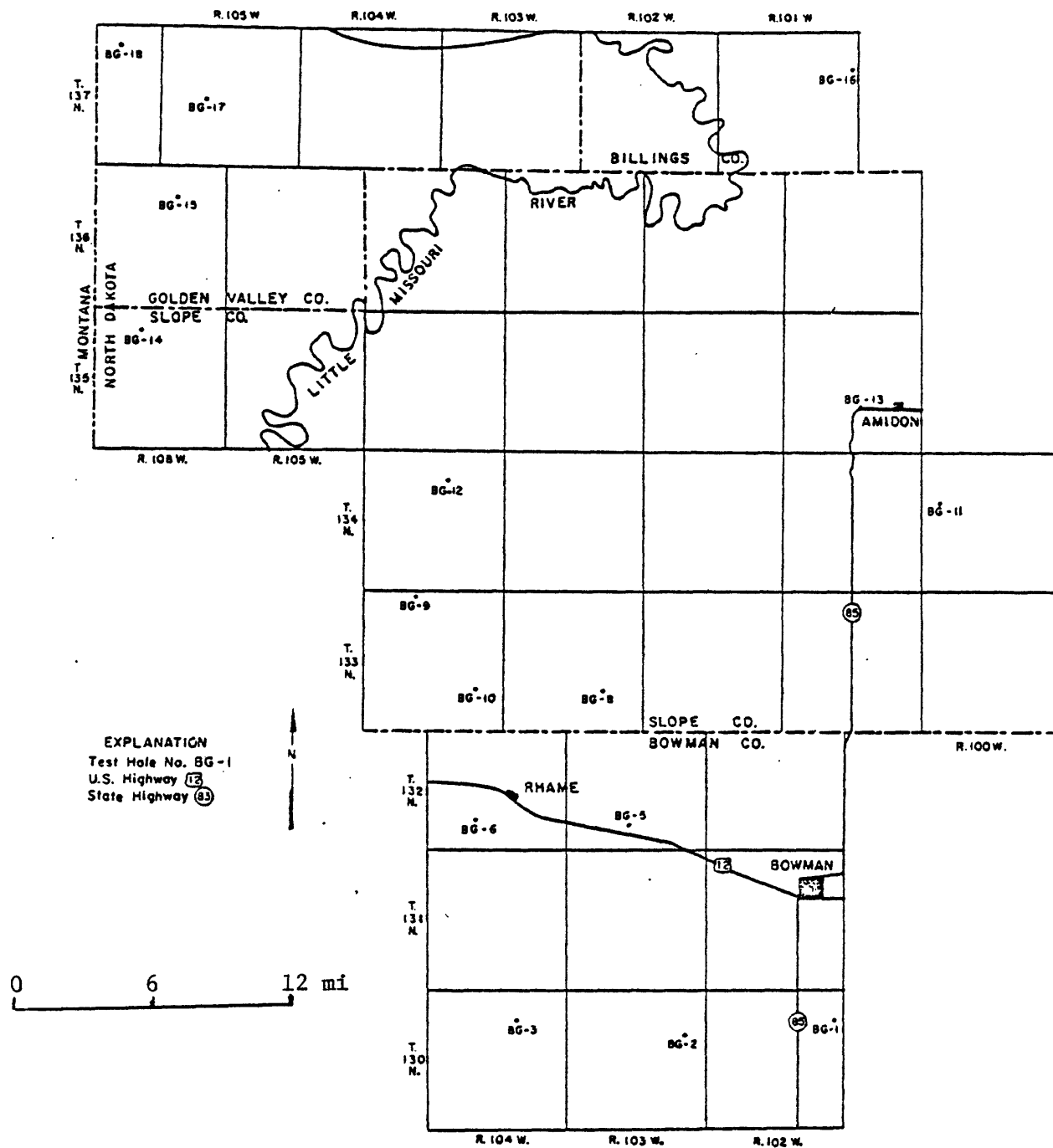


Figure 5.--Drill-hole locations for Area D, Bowman, Billings, Slope, and Golden Valley Counties, North Dakota.

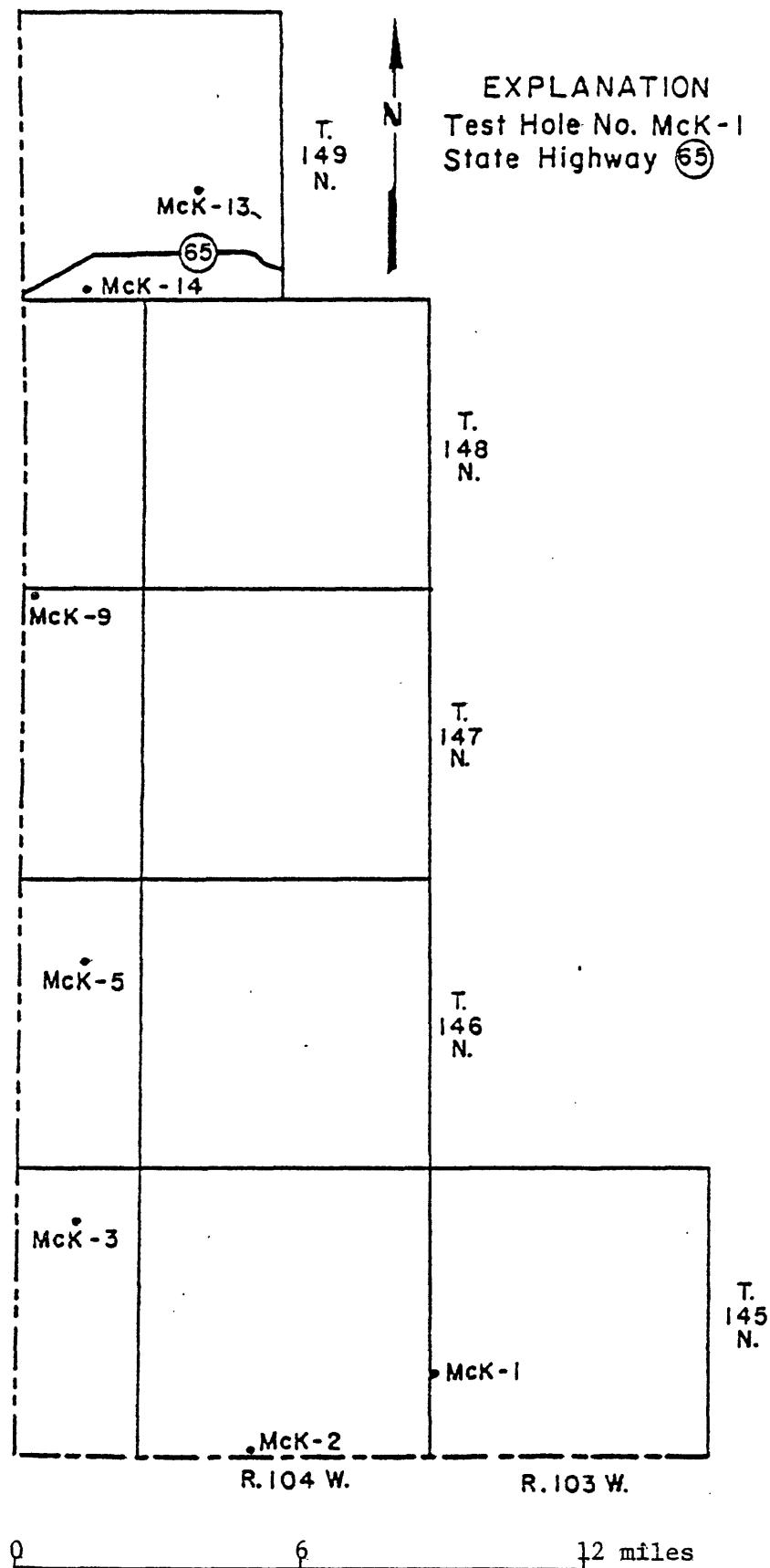


Figure 6.—Drill-hole locations for Area E, McKenzie County, North Dakota.

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-1 Map: Thompson Lake Date: 8-6-78 State: ND County: Burke
 Elev.: 2285 ft Location: T. 160 ^N/_S, R. 91 ^E/_W, Sec. 15, Tract: dc/dc Drilled depth: 700 ft
 Measured: 15 ft ~~PSL~~, 1620 ft ~~FEL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 238-248; 409-414; 447-450; 515-522; 619-625, 5

Remarks: _____

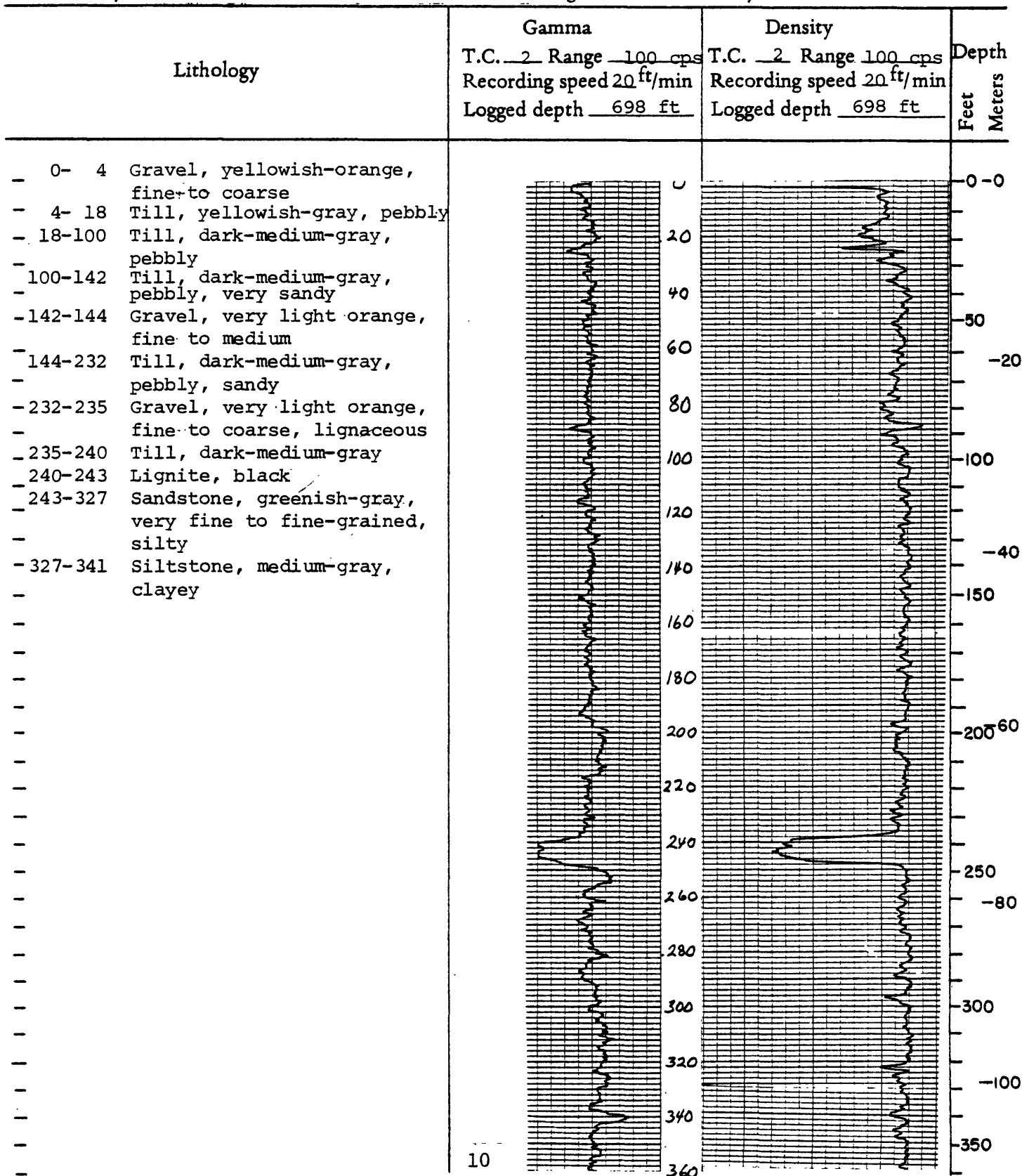
Lithology

Recorded by: Randall Reichert

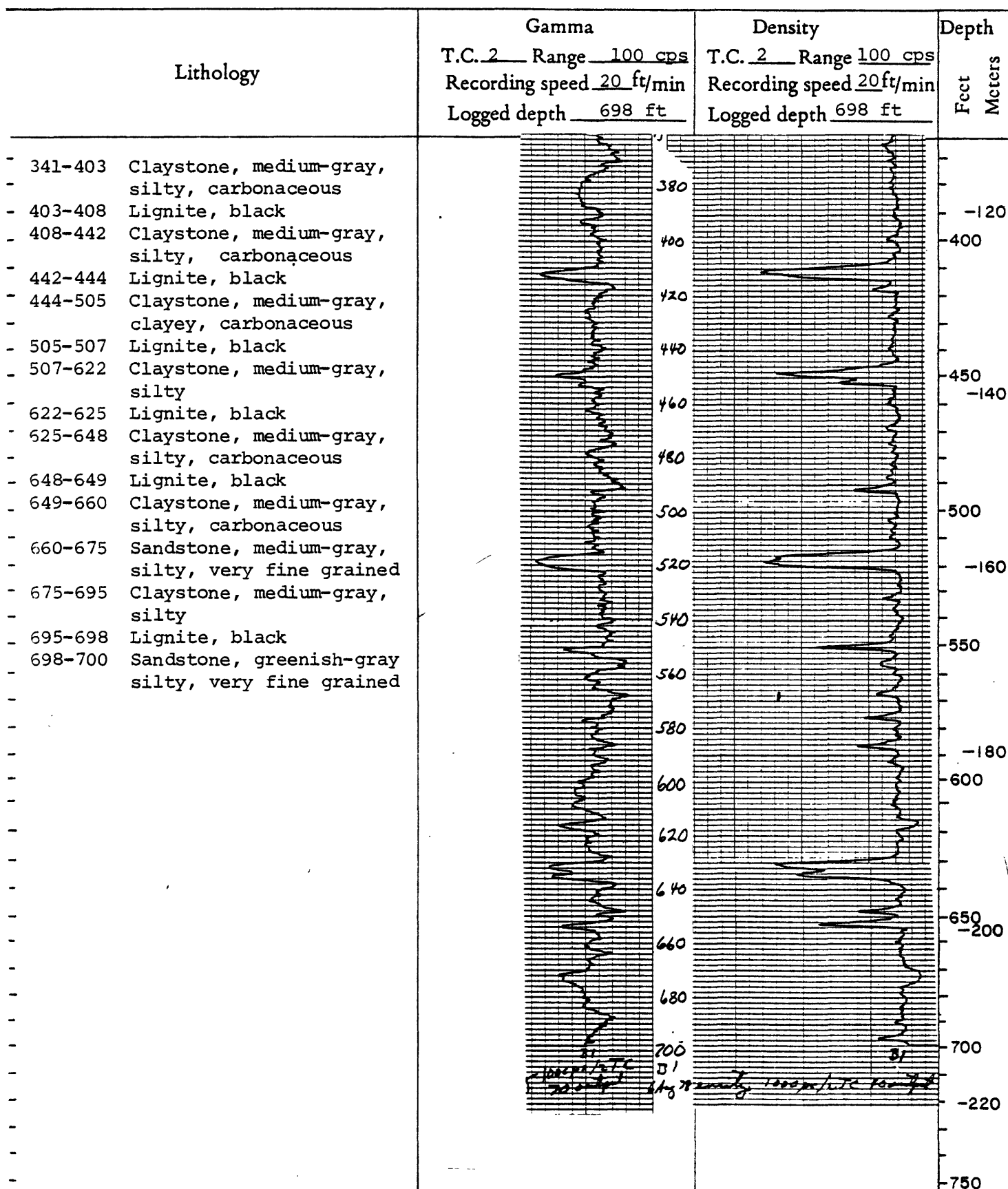
Geologist ^{Yes} ~~No~~

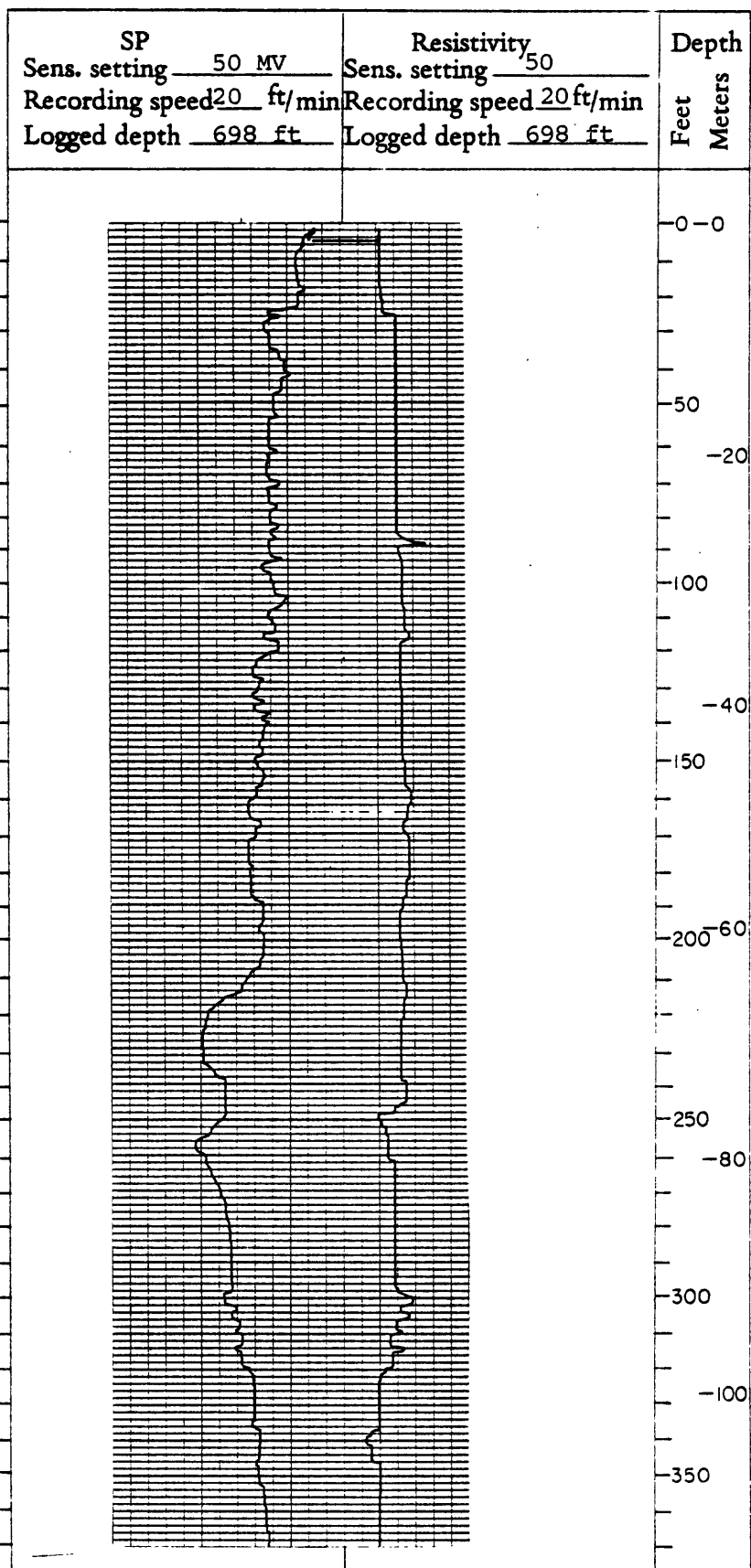
Geophysical logs

recorded by: Lechner

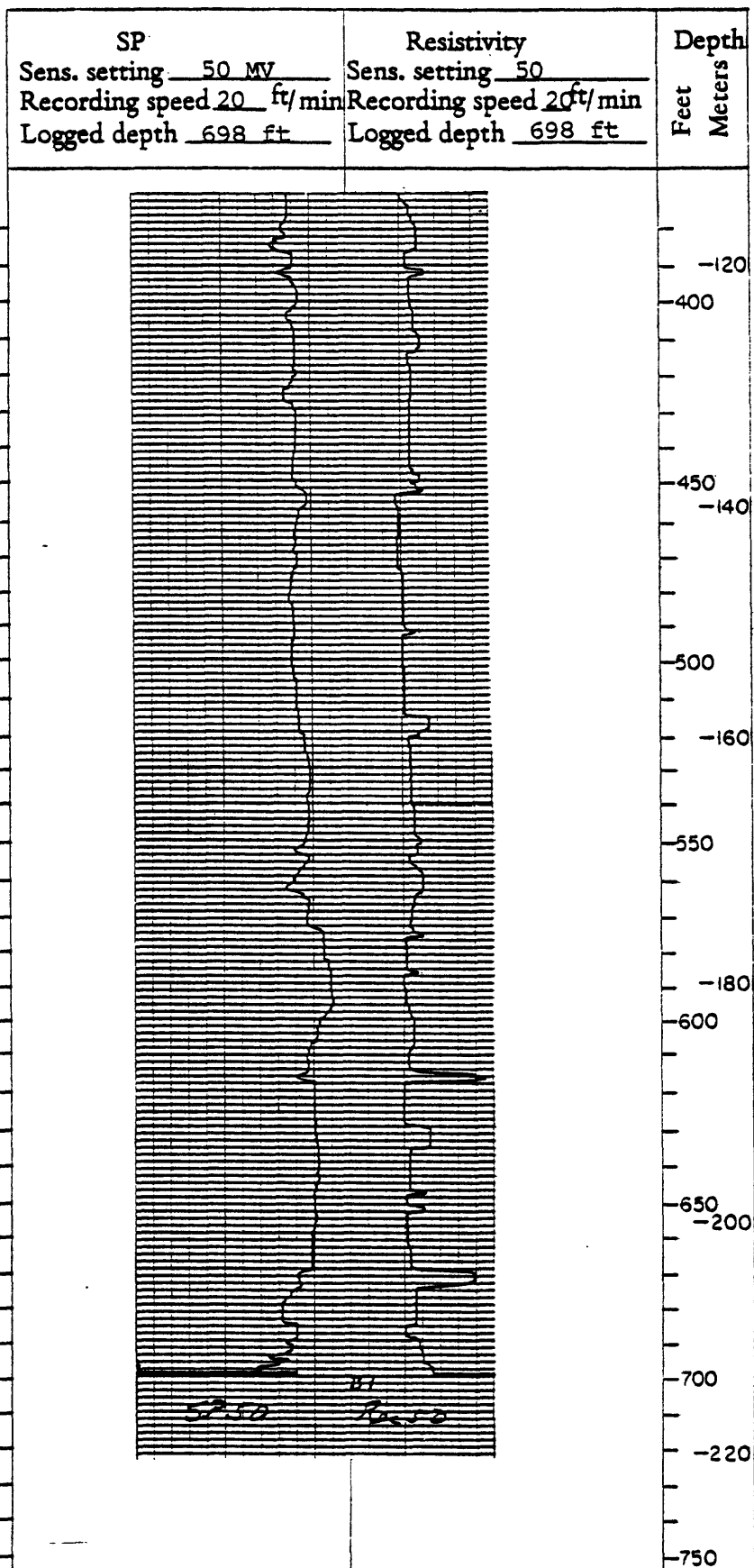


Hole number—continued
BU-1





Hole number—continued
BU-1



Hole No: BU-2 Map: Thompson Lake Date: 7-25-78 State: ND County: Burke
Elev.: 2370 ft Location: T. 161 ^{N.}~~S.~~, R. 91 ^{E.}~~W.~~, Sec. 35, Tract: dccd Drilled depth: 740 ft
Measured: 10 ft ^{FSL}~~FSL~~, 2020 ft ^{FEL}~~FEL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 402-408; 546-552; 692-700; 704-708

Lithology

Recorded by: Fred O'Toole

Geologist ☒ Yes ☒

Geophysical logs

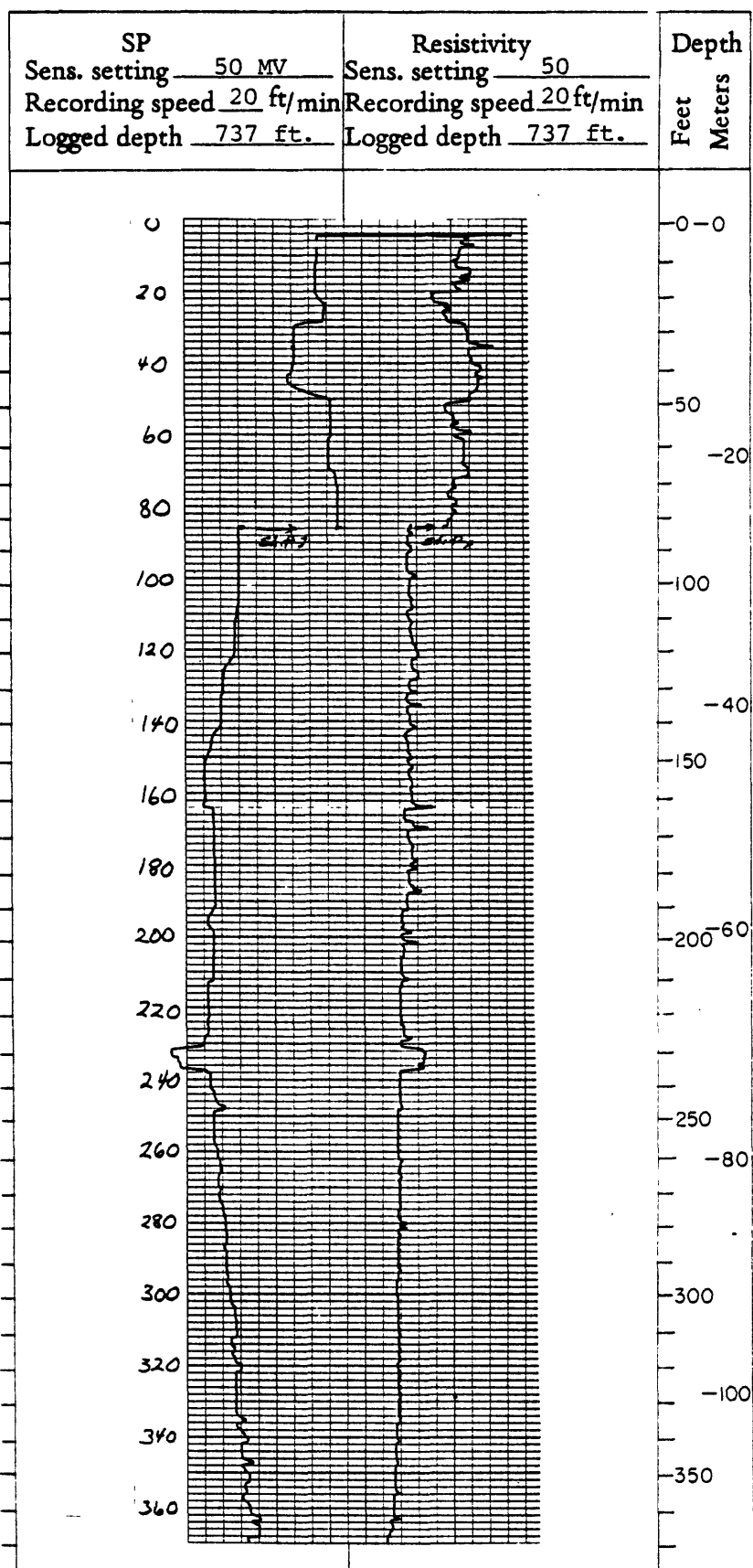
recorded by: Lechner

Lithology	Gamma	Density	Depth Feet Meters
	T.C. 2 Range 100 cps Recording speed 20 ft/min Logged depth 737 ft	T.C. 2 Range 100 cps Recording speed 20 ft/min Logged depth 737 ft	
0- 8 Sand, dark-gray, pebbly, very fine grained 8- 40 Gravel, orangish-brown, medium to coarse 40- 60 No samples			0-0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360

Hole number—continued

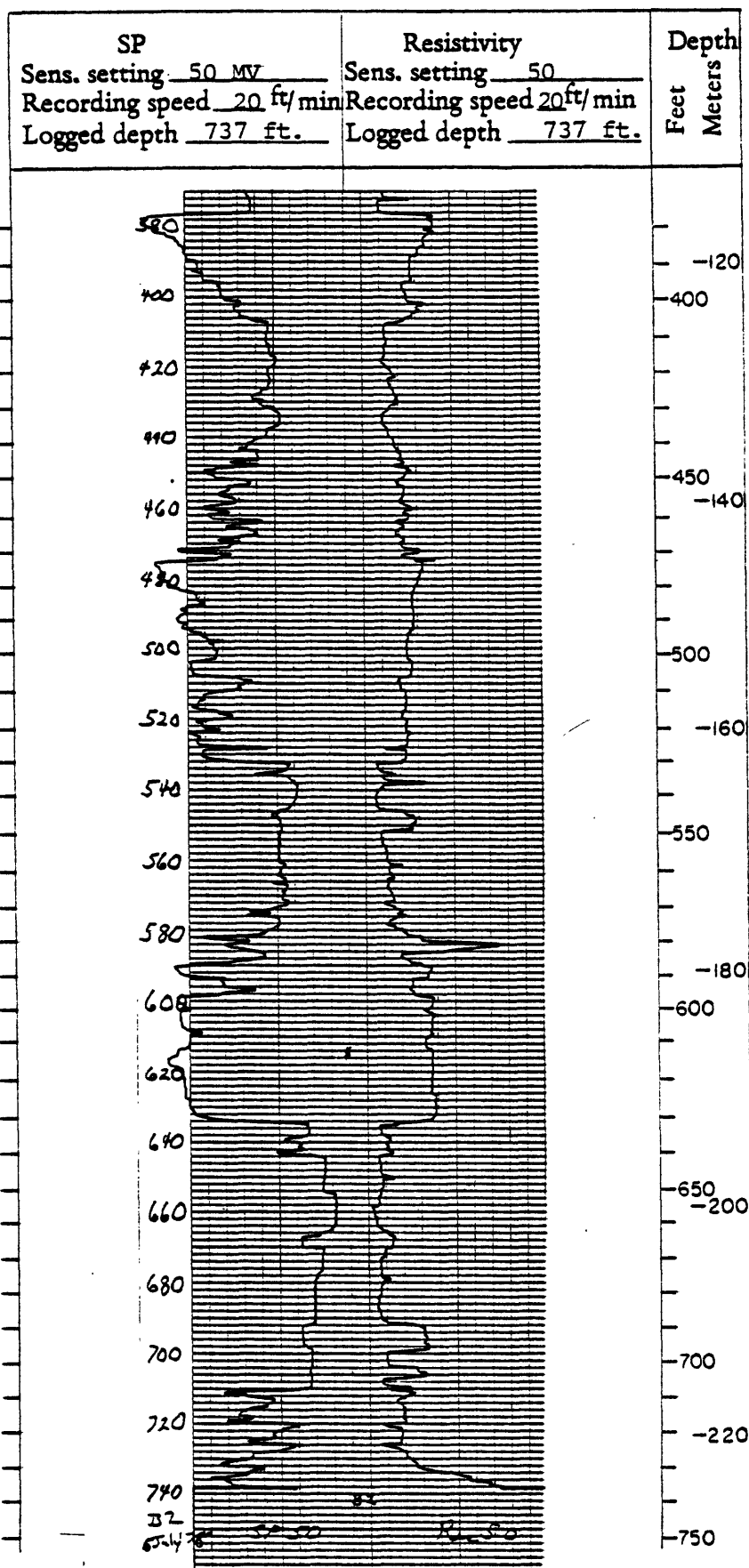
BU-2

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fect	Meters
	Recording speed 20 ft/min		Recording speed 20 ft/min			
	Logged depth 737 ft		Logged depth 737 ft			
60-402 Till, dark-gray, pebbly, sandy		360				
402-410 Claystone, dark-gray, silty		380			-120	
410-414 Lignite, black		400			400	
414-430 Claystone, medium-gray, silty		420				
430-432 Lignite, black		440				
432-457 Siltstone, medium-gray, clayey		460			450	
457-492 Claystone, light-brown silty		480			-140	
492-528 Sandstone, light- to medium-gray, very fine grained		500			500	
528-536 Claystone, medium-gray		520			-160	
536-538 Lignite, black		540				
538-541 Siltstone, medium-gray, sandy		560			550	
541-550 Sandstone, medium-gray		580				
550-554 Lignite, black		600			-180	
554-570 Claystone, medium-gray, silty		620			600	
570-577 Siltstone, medium-gray, clayey		640				
577-585 Claystone, light-gray, silty		660			-200	
585-587 Lignite, black		680			650	
587-590 Claystone, light-gray		700			-220	
590-609 Sandstone, light-gray, very fine grained		720				
609-630 Claystone, medium-gray, silty		740			700	
630-635 Siltstone, medium-brown, clayey, carbonaceous		760				
635-656 Sandstone, medium-gray, very fine grained		780			-220	
656-660 Claystone, medium-gray, silty		800				
660-677 Siltstone, medium-gray; some clay		820			700	
677-707 Claystone, medium-gray, silty		840				
707-711 Lignite, black		860			-220	
711-713 Claystone, medium-gray		880				
713-715 Lignite, black		900			750	
715-740 Claystone, dark-greenish-gray, silty		920				



Hole number—continued

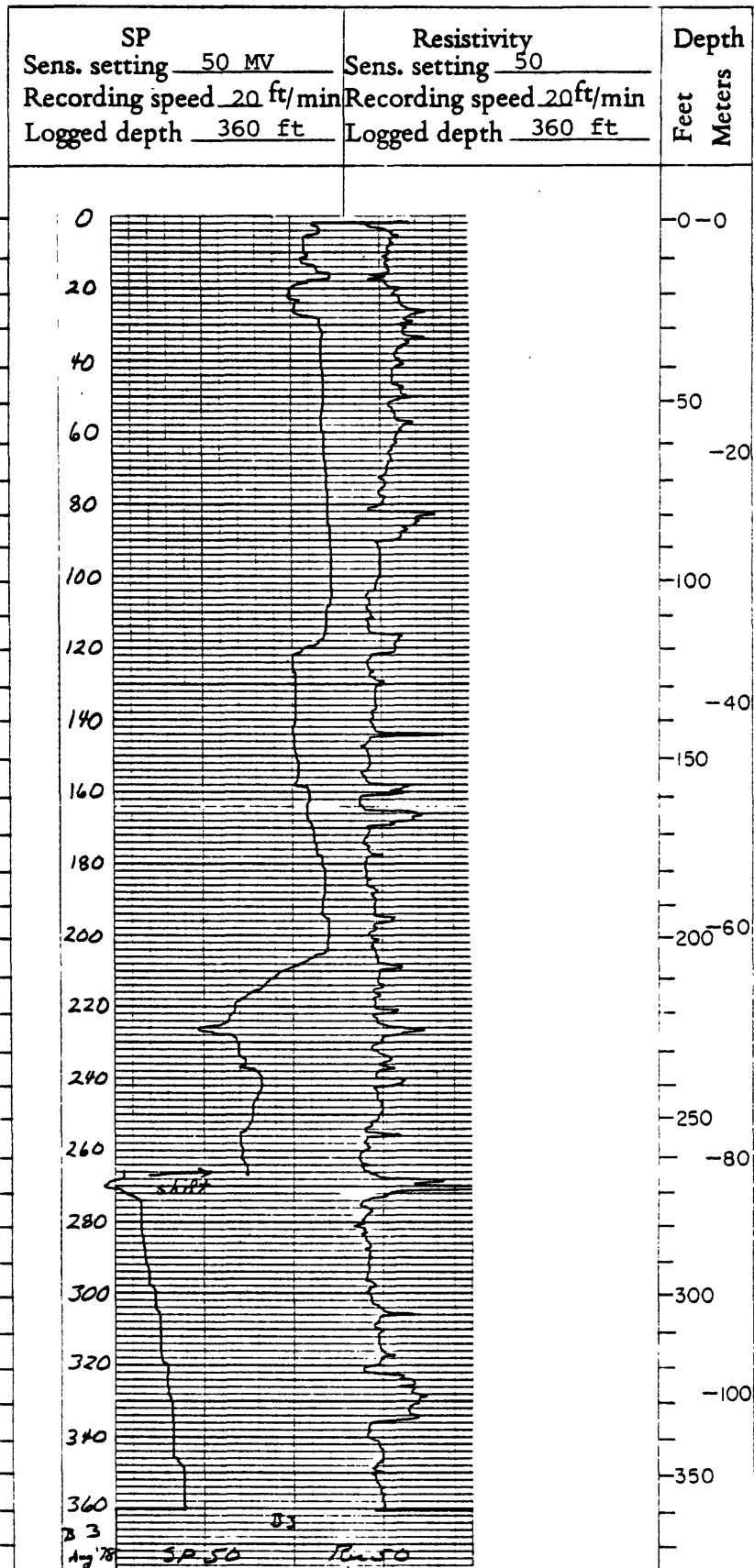
BU-2





Hole number--continued

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>360 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>360 ft</u>	Depth	
			Feet	Meters
300-323 Siltstone, greenish-gray, clayey, sandy, carbon- aceous			-120	
323-327 Lignite, black			-400	
327-344 Claystone, medium-gray, silty, carbonaceous			-450	
344-360 Claystone, light-green, silty			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued

BU-3

SP		Resistivity		Depth	
Sens. setting <u>50 MV</u>		Sens. setting <u>50</u>		Feet	Meters
Recording speed <u>20</u> ft/min		Recording speed <u>20</u> ft/min			
Logged depth <u>360 ft</u>		Logged depth <u>360 ft</u>			
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No.: BU-4 Map: Hilde Lake Date: 7-25-78 State: ND County: Burke
 Elev.: 2400 ft Location: T. 160 ^N_S, R. 92 ^E_W, Sec. 1, Tract: bccc Drilled depth: 760 ft
 Measured: 2110 ft ^{FNL}_{FWL}, 10 ft ^{FNL}_{FWL} Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 376-380; 416-424; 433-435; 562-566; 598-601; 603-606; 654-659

Remarks: _____

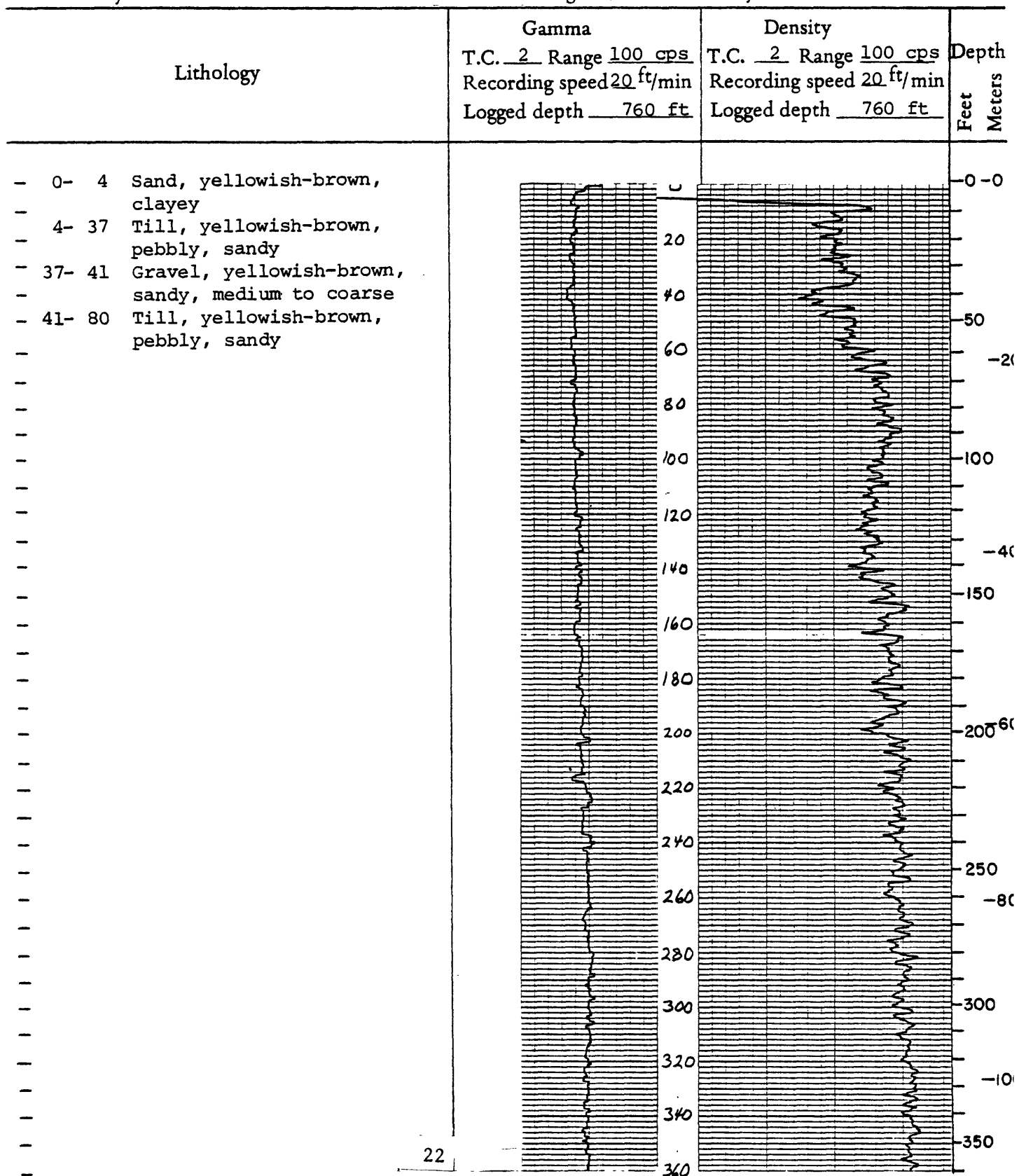
Lithology

Recorded by: Fred O'TooleGeologist ^{Yes}_{No}

Geophysical logs

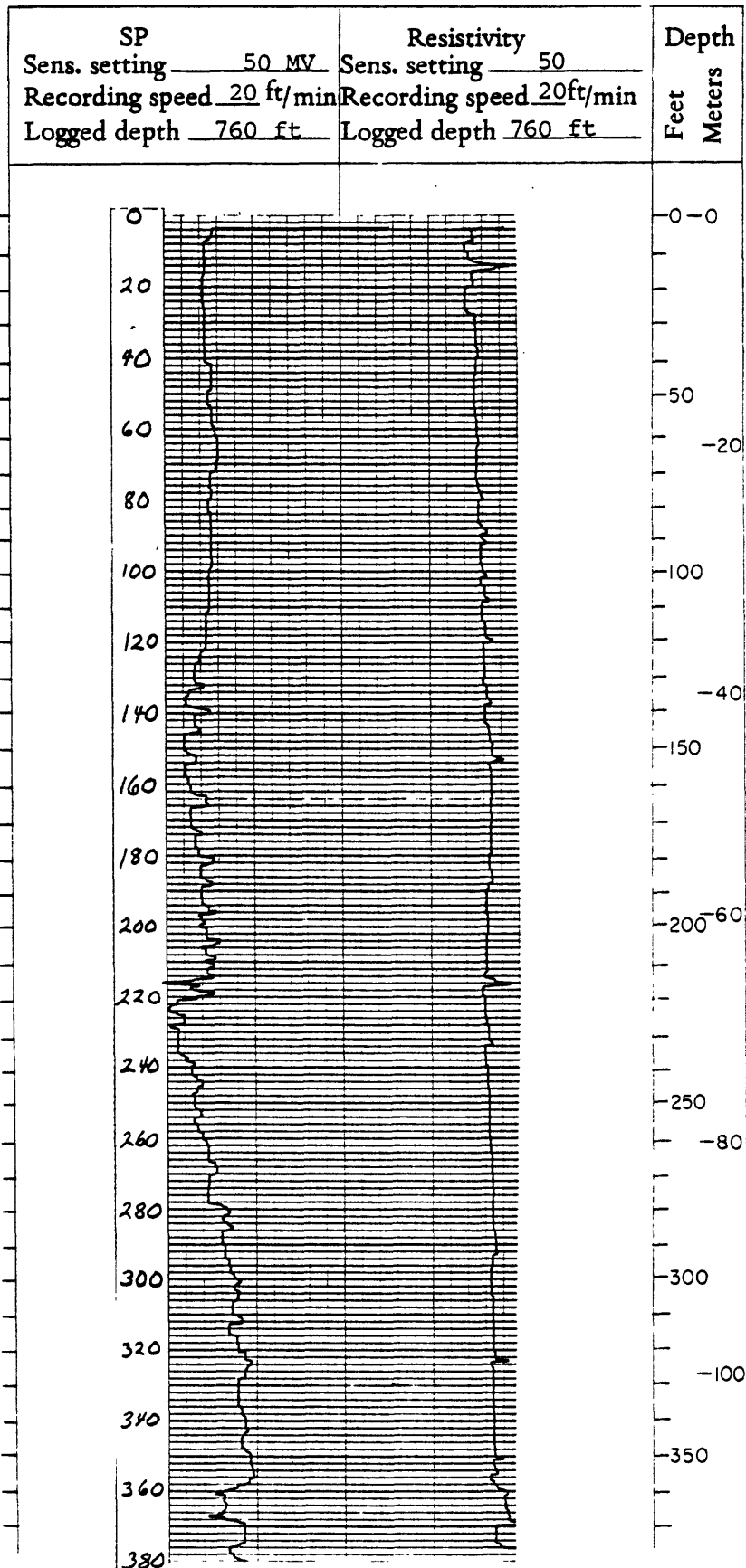
recorded by: _____

Lechner



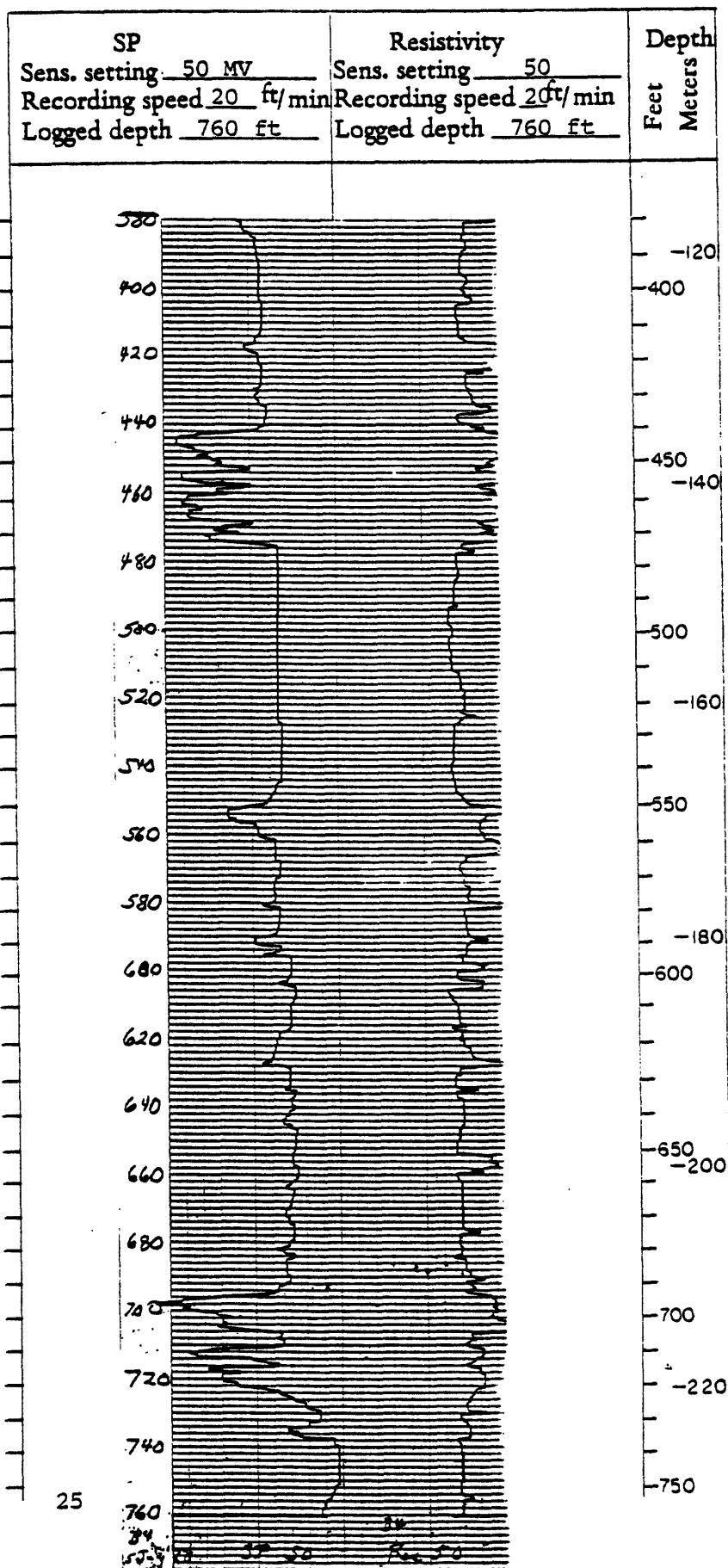
Hole number—continued

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fect	Meters
	Recording speed	20 ft/min	Recording speed	20 ft/min		
	Logged depth	760 ft	Logged depth	760 ft		
80-366 Till, dark-gray, pebbly, sandy						
366-373 Sandstone, light-gray, very fine grained					-120	
373-375 Lignite, black					400	
375-382 Claystone, medium-gray, silty						
382-414 Sandstone, medium-gray, very fine grained						
414-418 Claystone, dark-brown, carbonaceous					450	
418-421 Lignite, black					-140	
421-430 Claystone, medium-gray						
430-431 Lignite, black						
431-443 Claystone, medium-brown silty						
443-464 Sandstone, medium-gray, very fine grained					500	
464-466 Lignite, black					-160	
466-490 Claystone, medium-gray; some siltstone						
490-562 Sandstone, medium-gray, very fine grained, silty					550	
562-570 Claystone, medium-gray						
570-573 Lignite, black						
573-580 Claystone, medium-gray						
580-596 Sandstone, medium-gray, very fine grained, silty					-180	
596-599 Claystone, medium-brown, silty					600	
599-602 Lignite, black						
602-606 Claystone, medium-gray						
606-608 Lignite, black						
608-633 Sandstone, medium-gray, very fine grained					650	
633-650 Claystone, medium-brown, silty, carbonaceous					-200	
650-655 Lignite, black						
655-660 Claystone, medium-brown, silty						
660-684 Sandstone, medium-gray, very fine grained					700	
684-688 Claystone, medium-gray					-220	
688-689 Lignite, black						
689-695 Claystone, medium-brown						
695-718 Sandstone, medium-gray, very fine grained					750	
718-760 Claystone, light-gray, silty						



Hole number—continued

BU-4



NORTH DAKOTA GEOLOGICAL SURVEY

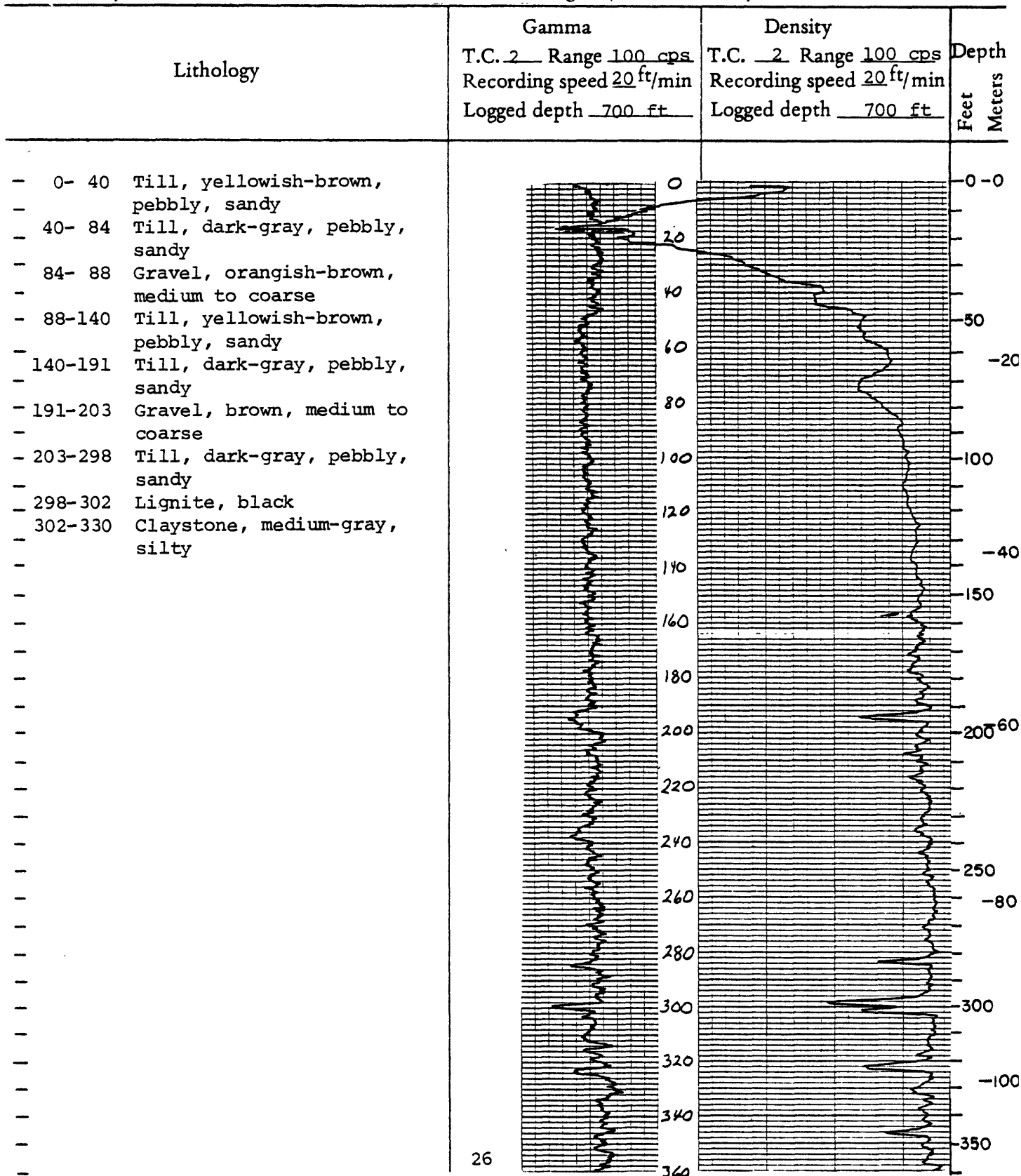
Hole No: BU-5 Map: Rennie Lake Date: 7-23-78 State: ND County: Burke
 Elev.: 2330 ft Location: T. 161^N R. 91^W, Sec. 19, Tract: cbbb Drilled depth: 700 ft
 Measured: 2600 ft ~~FSL~~, 8 ft ~~FWL~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 297-299; 300-302; 320-323; 377-383; 424-426; 520-524; 626-628

Remarks: _____

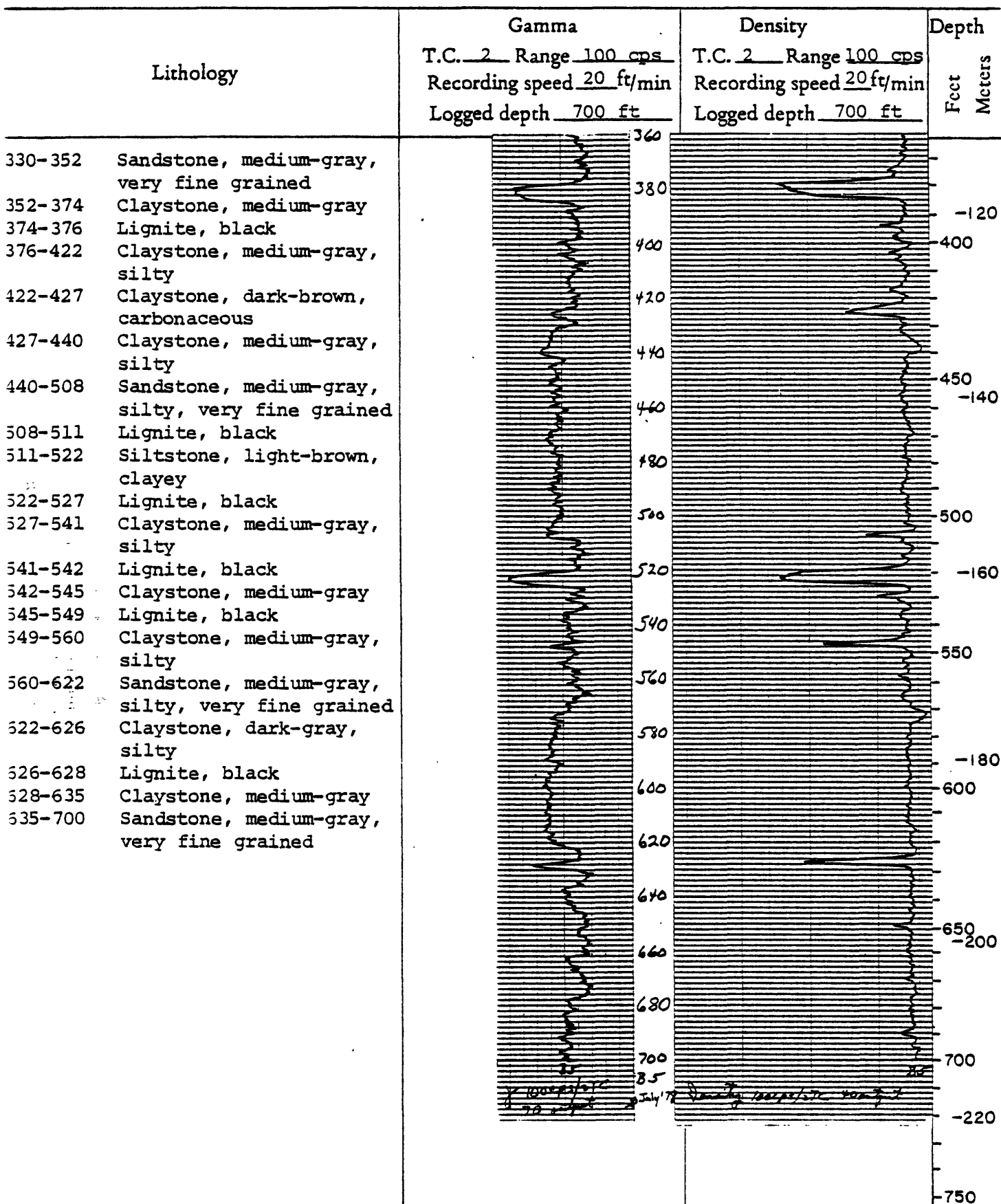
Lithology

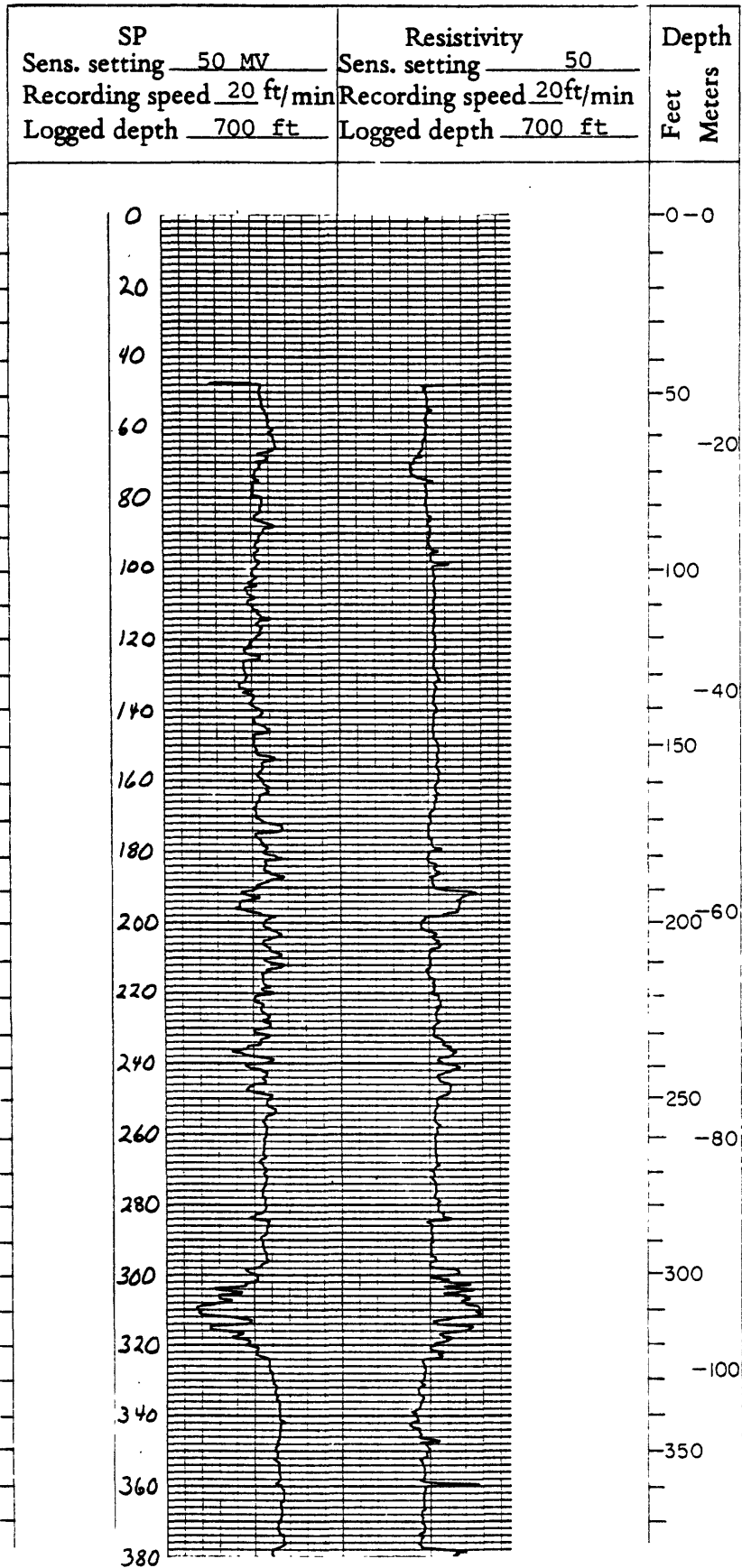
Recorded by: Fred O'TooleGeologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner

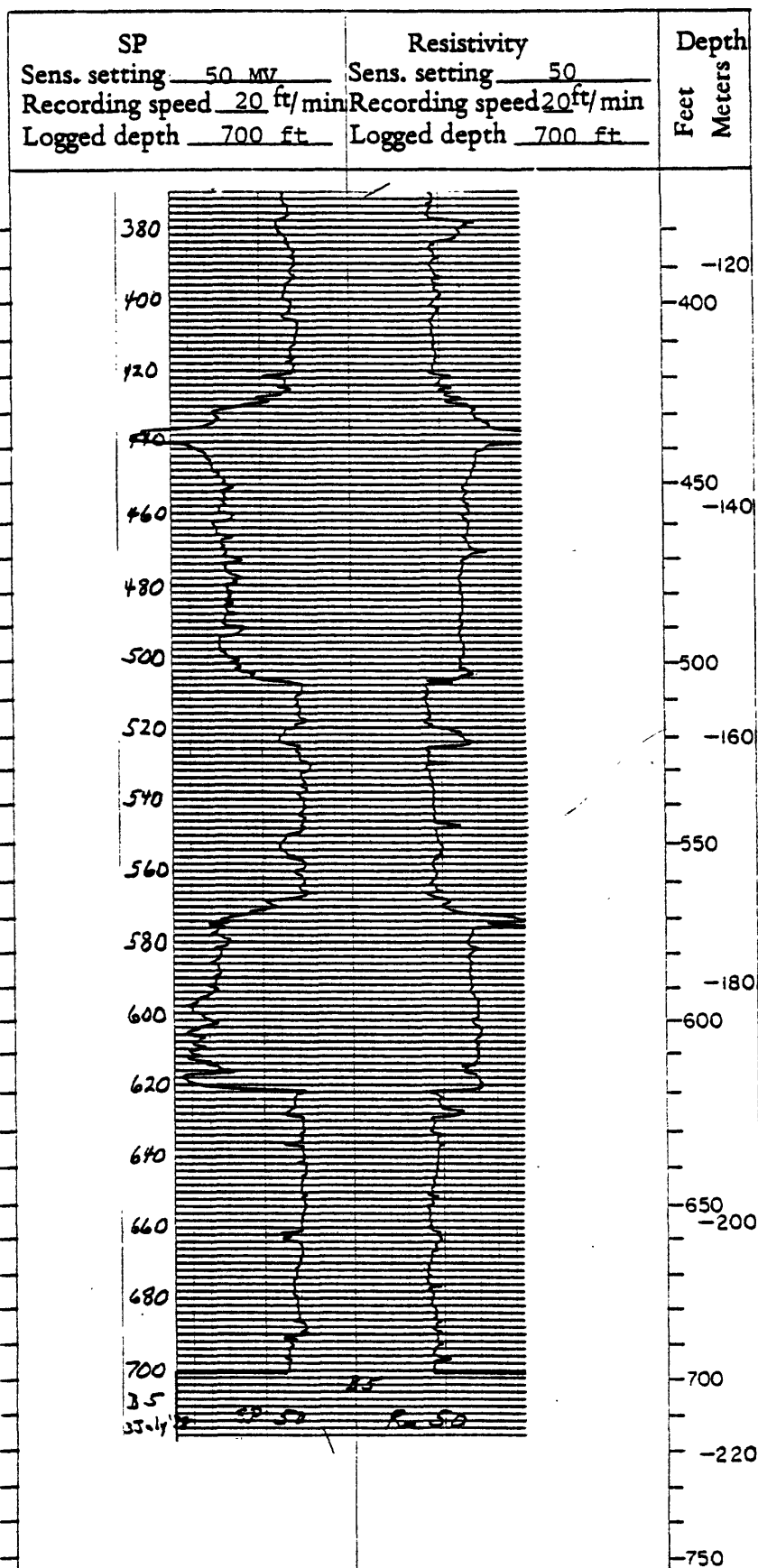
Hole number—continued
BU-5





Hole number—continued

BU-5



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-6 Map: Rennie Lake Date: 8-1-78 State: ND County: Burke
 Elev.: 2065 ft Location: T. 161^N, R. 91^E, Sec. 9, Tract: cccc Drilled depth: 460 ft
 Measured: 75 ft ~~PSL~~ 127 ft ~~FWL~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 74-76; 113-119; 202-208; 218-221; 241-250; 274-276,5; 316-318;
395-407

Remarks: _____

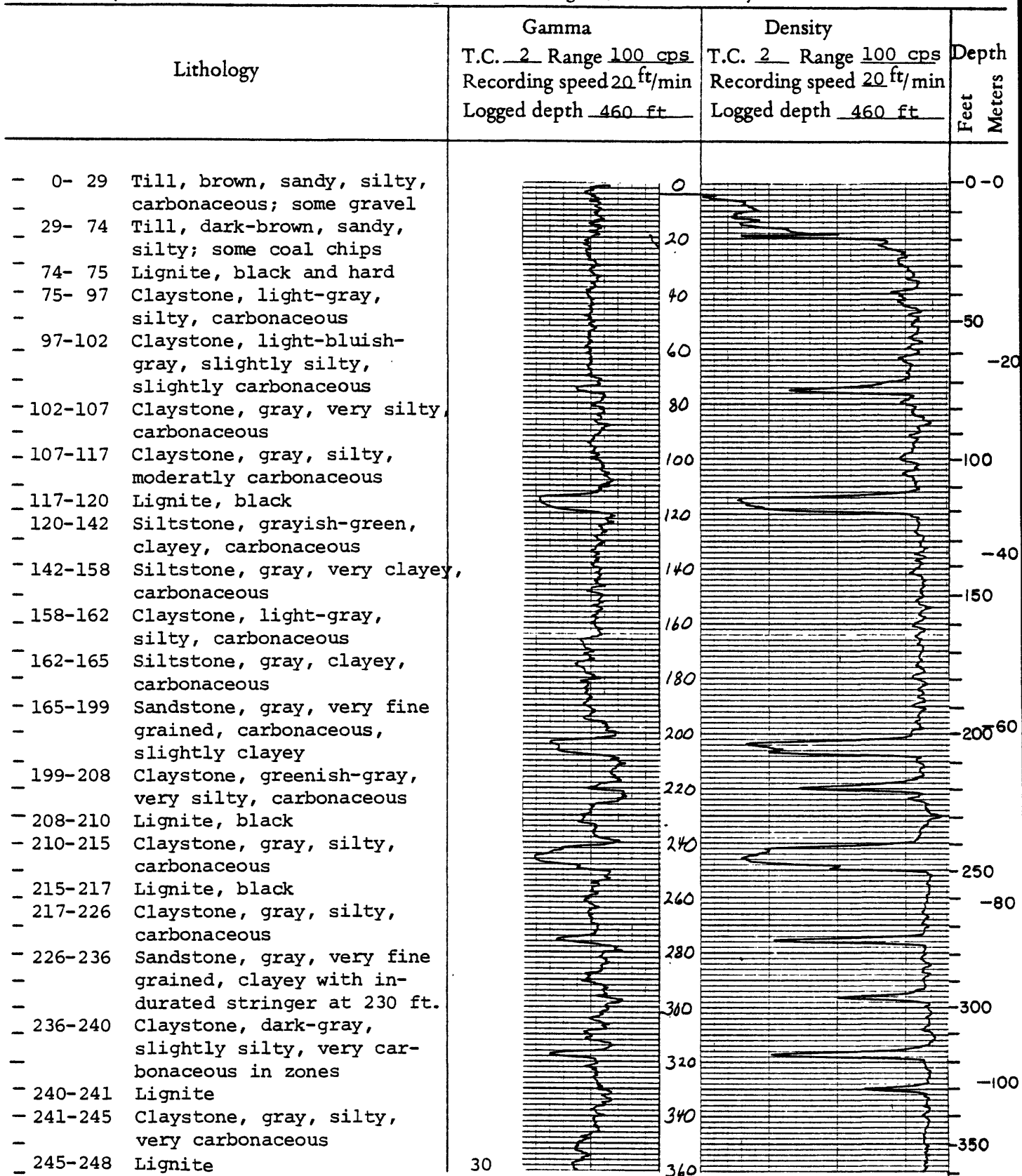
Lithology

Recorded by: Susan Cook

Geologist ^{Yes} ~~No~~

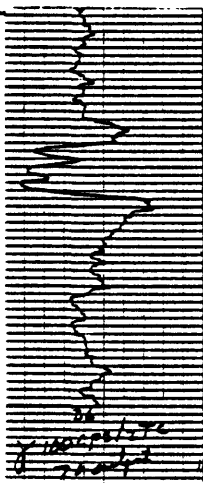
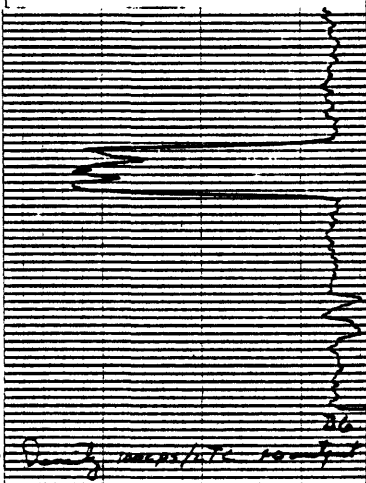
Geophysical logs

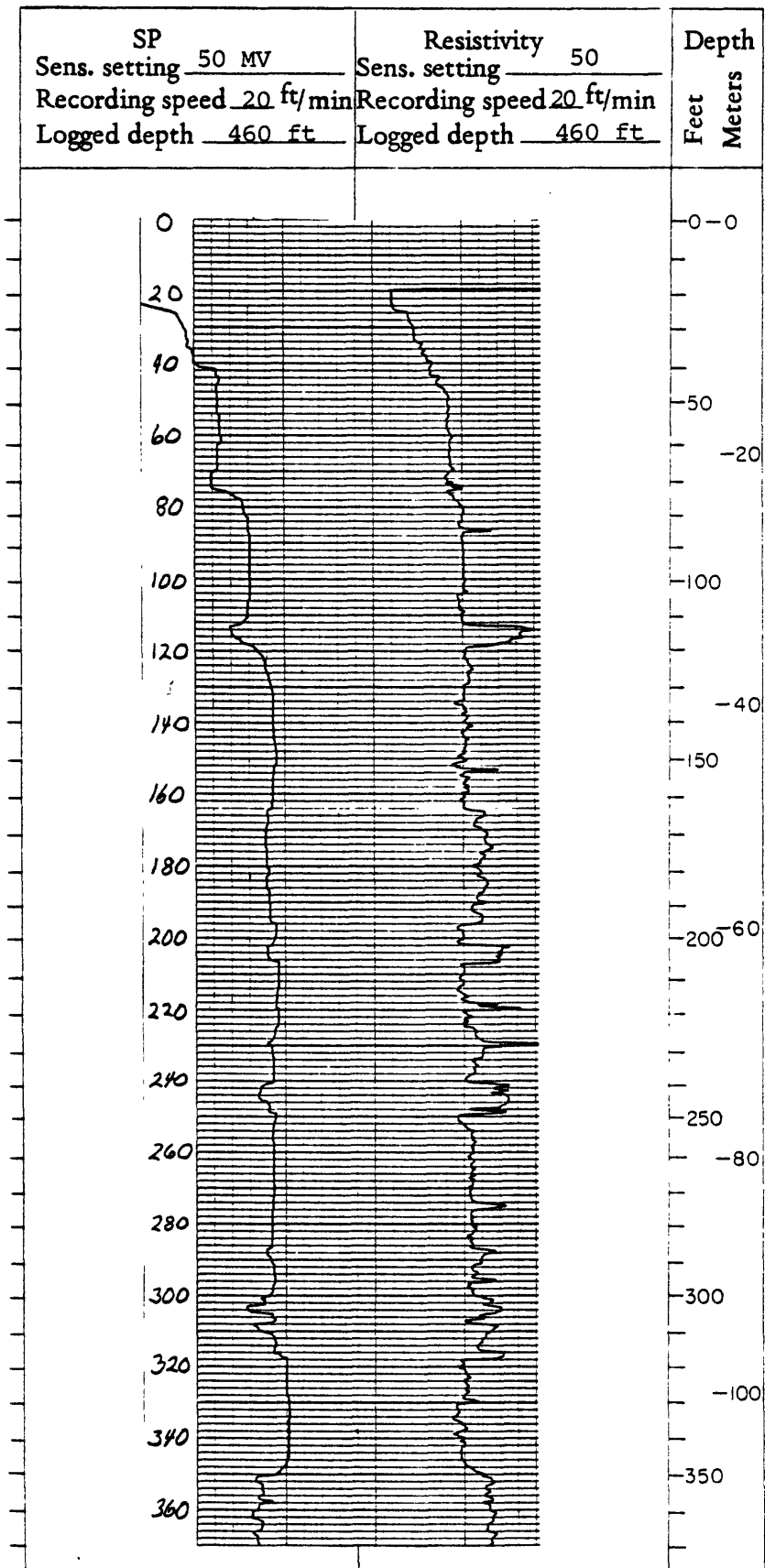
recorded by: Lechner



Hole number—continued

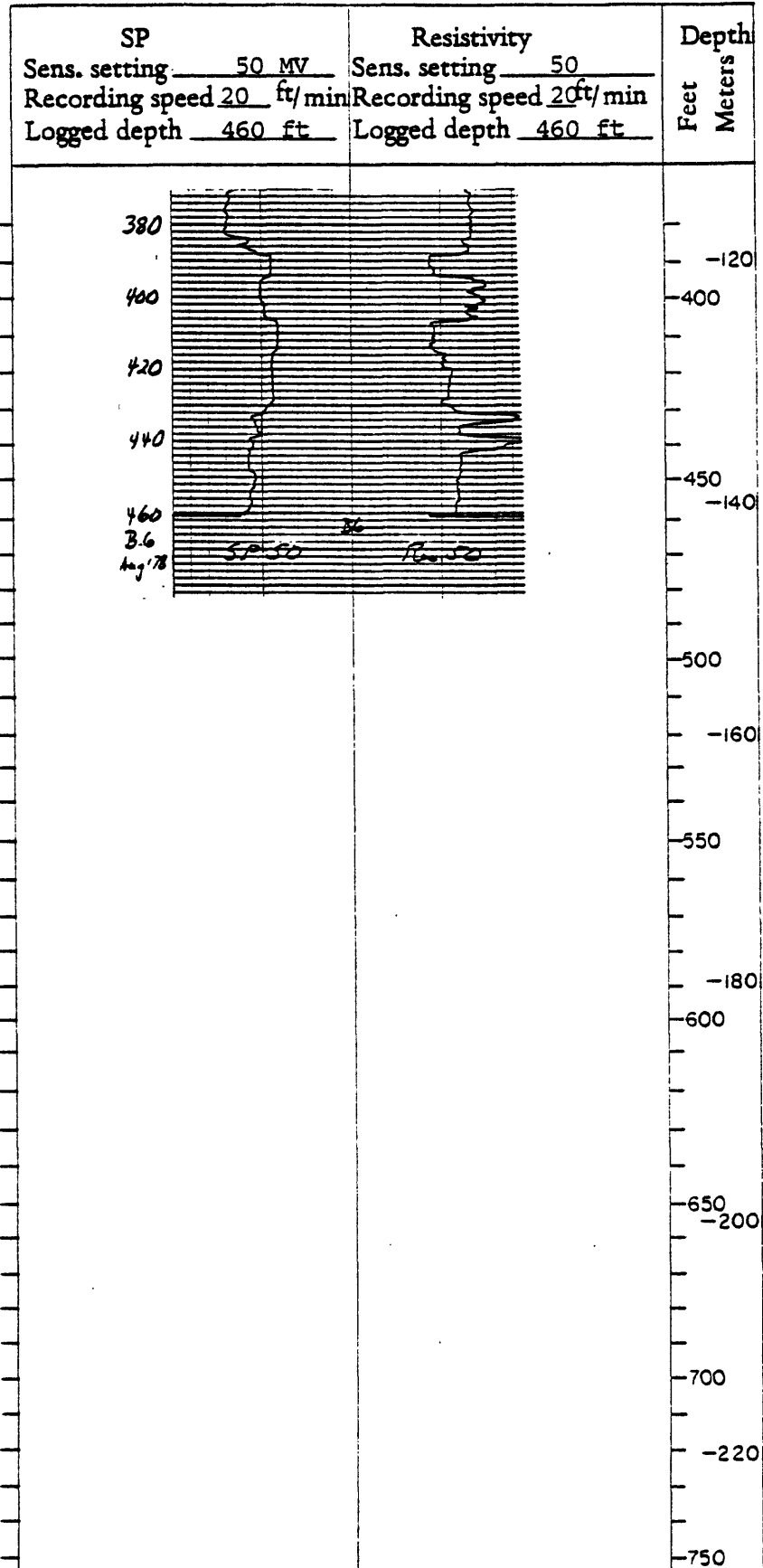
BU-6

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fect	Meters
	Recording speed	20 ft/min	Recording speed	20 ft/min		
	Logged depth	460 ft	Logged depth	460 ft		
248-270 Claystone, greenish-gray, silty, carbonaceous		380				
270-272 Sandstone, very fine grained, very clayey, carbonaceous		400			-120	400
272-284 Claystone, gray, very silty, carbonaceous		420				
284-294 Siltstone, gray, very clayey, carbonaceous		440				
294-295 Lignite, black		460			450	
295-303 Claystone, gray, slightly to moderately silty, carbonaceous		B 6			-140	
303-314 Siltstone, gray, clayey, carbonaceous		Aug 78				
314-321 Claystone, gray, silty, moderately carbonaceous					500	
321-322 Lignite						
322-325 Claystone, brownish-gray silty, carbonaceous					-160	
325-329 Lignite, black						
329-336 Claystone, gray, silty, carbonaceous					550	
336-363 Siltstone, grayish-green, clayey, carbonaceous						
363-374 Claystone, gray, silty, carbonaceous					-180	
374-406 Sandstone, gray, very fine grained, slightly carbonaceous, clayey					600	
406-408 Claystone, brownish-gray, silty, carbonaceous						
408-410 Lignite						
410-413 Sandstone, gray, very fine grained, carbonaceous					650	-200
413-416 Lignite						
416-421 Sandstone, tanish-gray, very fine grained, clayey, carbonaceous					700	
421-431 Claystone, gray, moderately silty, carbonaceous						
431-435 Siltstone, gray, clayey, slightly sandy, carbonaceous					-220	
435-460 Sandstone, gray, very clayey, very fine grained, carbonaceous					750	



Hole number—continued

BU-6



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-7 Map: Rennie Lake Date: 7-23-78 State: ND County: Burke
 Elev.: 2088 ft Location: T. 161 ^N~~S~~, R. 92 ^E~~W~~, Sec. 12, Tract: ddda Drilled depth: 500 ft.
 Measured: 450 ft ^{FSL}~~FSL~~, 6 ft ^{FEL}~~FEL~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 62-64; 88-90; 155-162; 301-308; 313-315; 454-467;

Remarks: _____

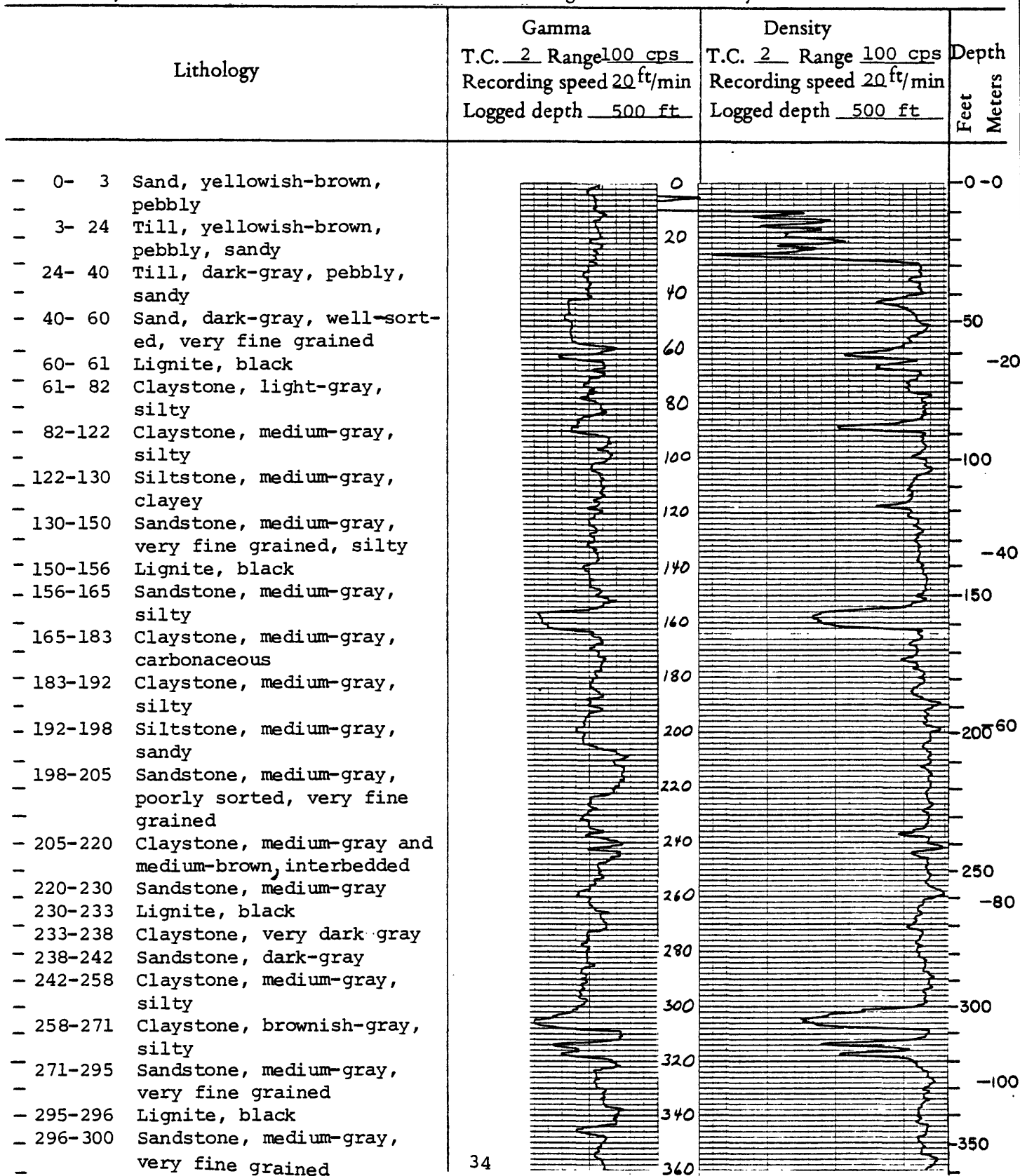
Lithology

Recorded by: Fred O'Toole

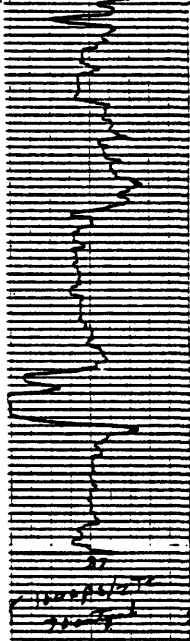
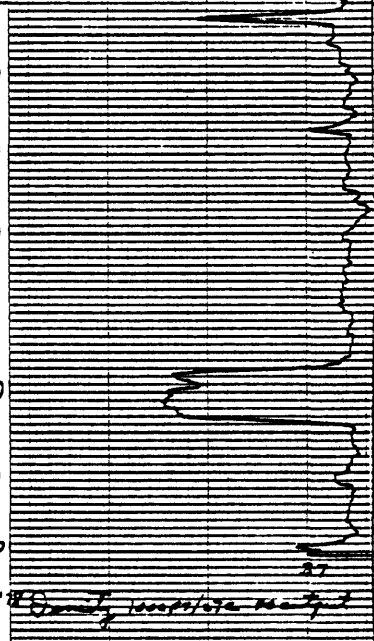
Geologist ^{Yes}~~No~~

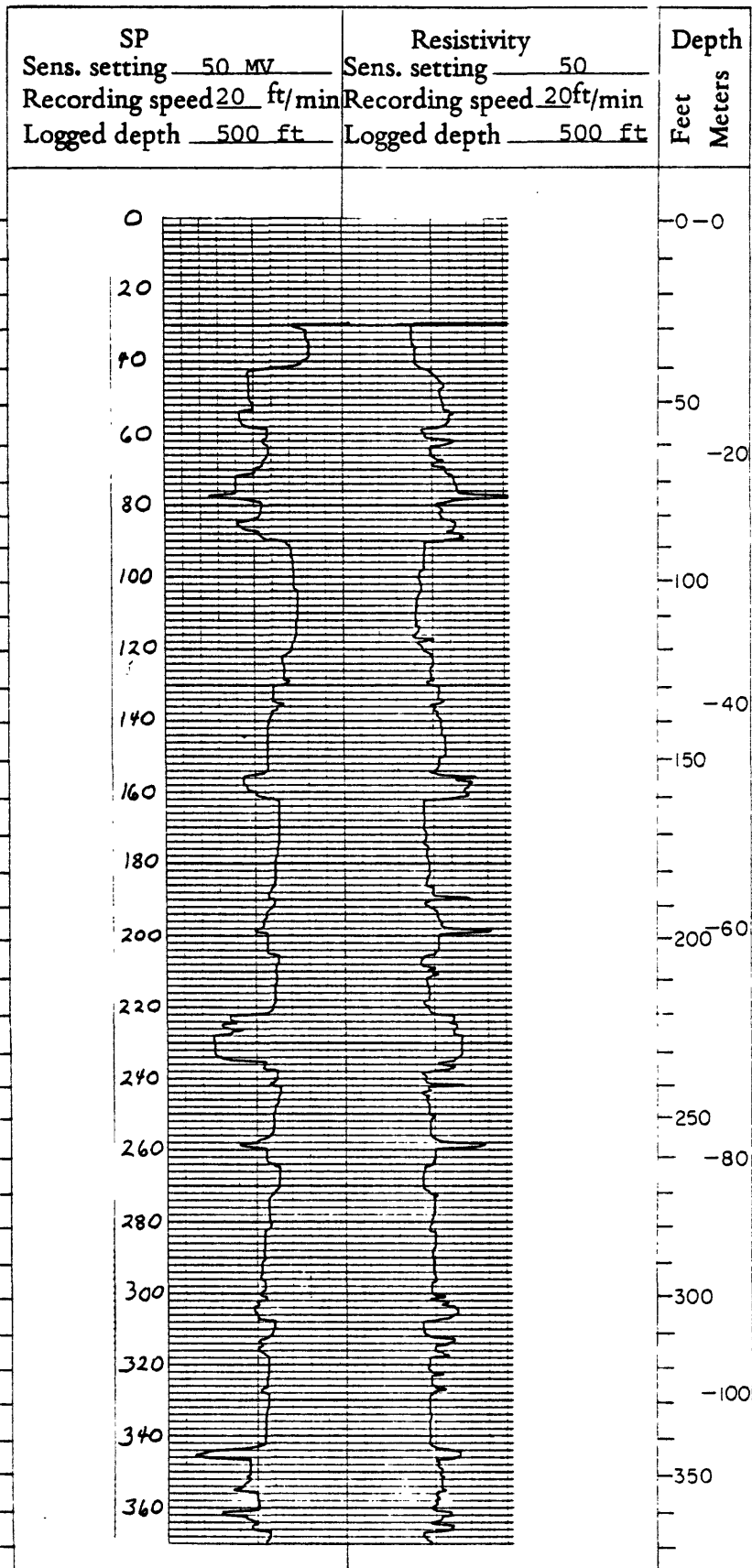
Geophysical logs

recorded by: Lechner

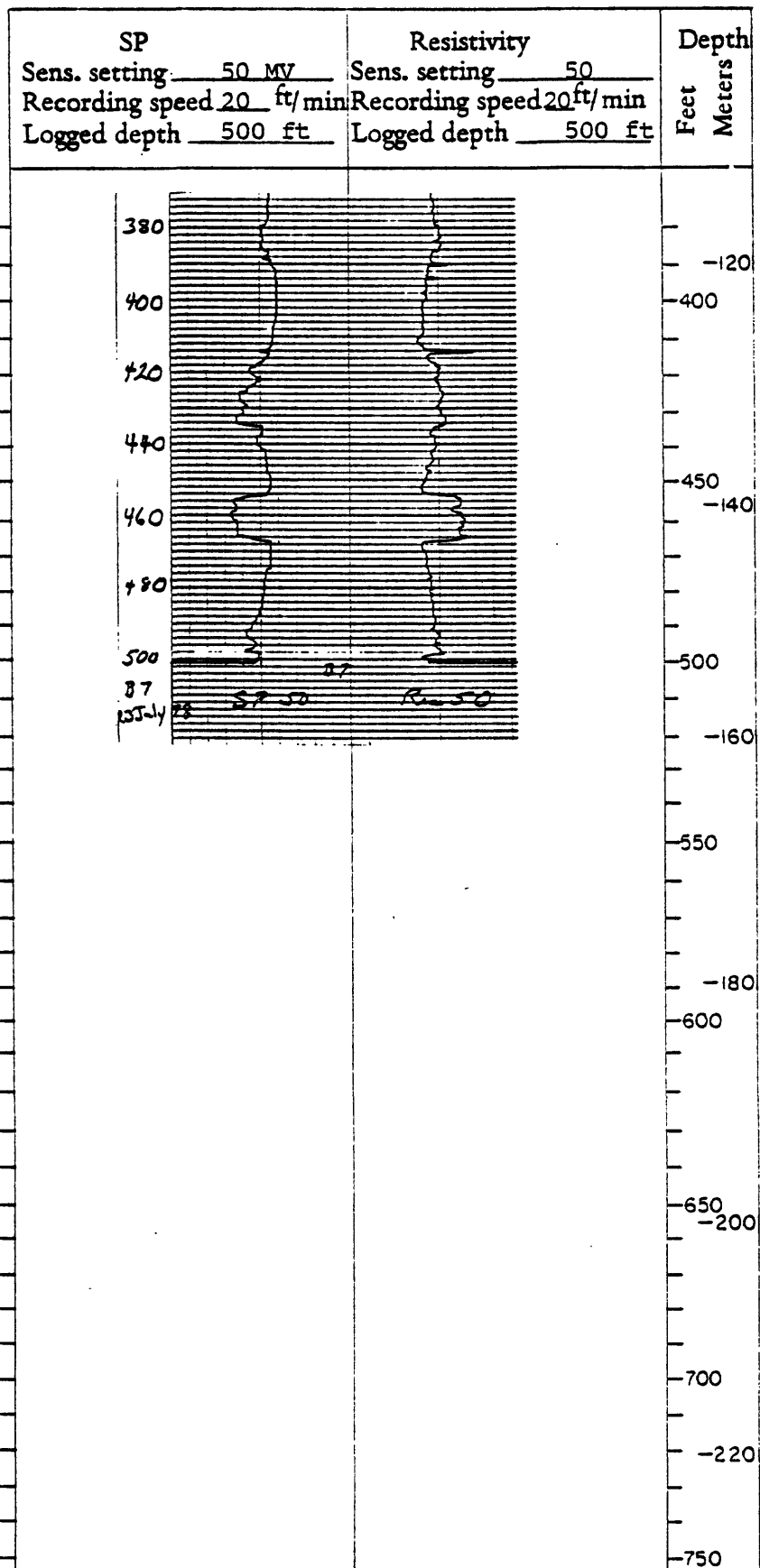


Hole number—continued
BU-7

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fect	Meters
	Recording speed	20 ft/min	Recording speed	20 ft/min		
	Logged depth	500 ft	Logged depth	500 ft		
300-304 Lignite, black						
304-307 Claystone, medium-brown						
307-309 Lignite, black					-120	
309-332 Claystone, dark-gray, carbonaceous					400	
332-340 Claystone, medium-brown, silty						
340-347 Sandstone, medium-gray						
347-355 Claystone, medium-gray, silty						
355-360 Claystone, light-yellowish-gray					450	
360-375 Claystone, medium-gray, silty					-140	
375-379 Claystone, light-brown						
379-390 Sandstone, medium-gray						
390-418 Claystone, medium-gray, silty					500	
418-445 Sandstone, light-gray, very fine grained					-160	
445-447 Lignite, black						
447-455 Claystone, medium-brown, carbonaceous					550	
455-456 Lignite, black						
456-460 Claystone, medium-brown, carbonaceous						
460-466 Lignite, black					-180	
466-478 Claystone, medium-gray, silty					600	
478-500 Siltstone, medium-gray, sandy						
					650	
					-200	
					700	
					-220	
					750	



Hole number—continued
BU-7



NORTH DAKOTA GEOLOGICAL SURVEY

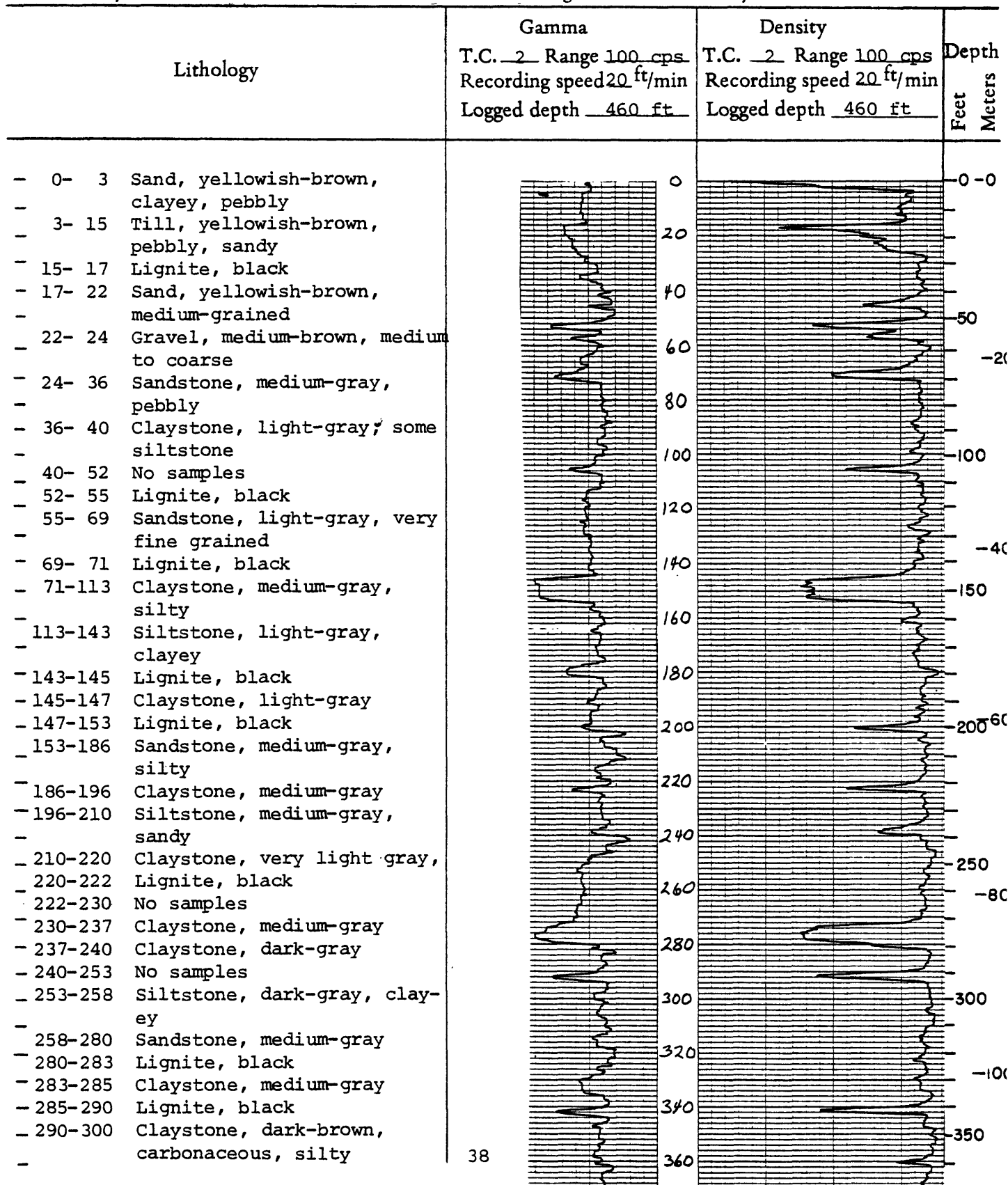
Hole No: BU-8 Map: Rennie Lake Date: 7-21-78 State: ND County: Burke
 Elev.: 2062 ft Location: T. 161^N, R. 92^W, Sec. 11, Tract: aaaa Drilled depth: 460 ft
 Measured: 72 ft ^{FNL} 75 ft ^{FEL} ~~72 ft~~ ~~75 ft~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 52-54; 69-72; 145-154; 272-280; 290-292; 340-342; 414-428

Remarks: _____

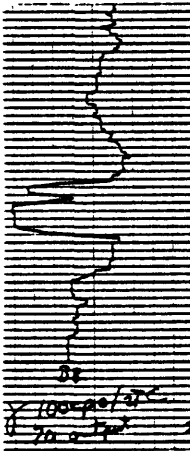
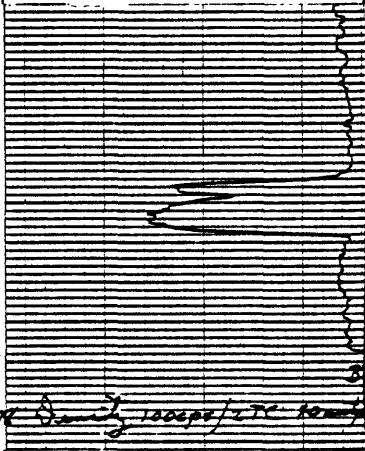
Lithology

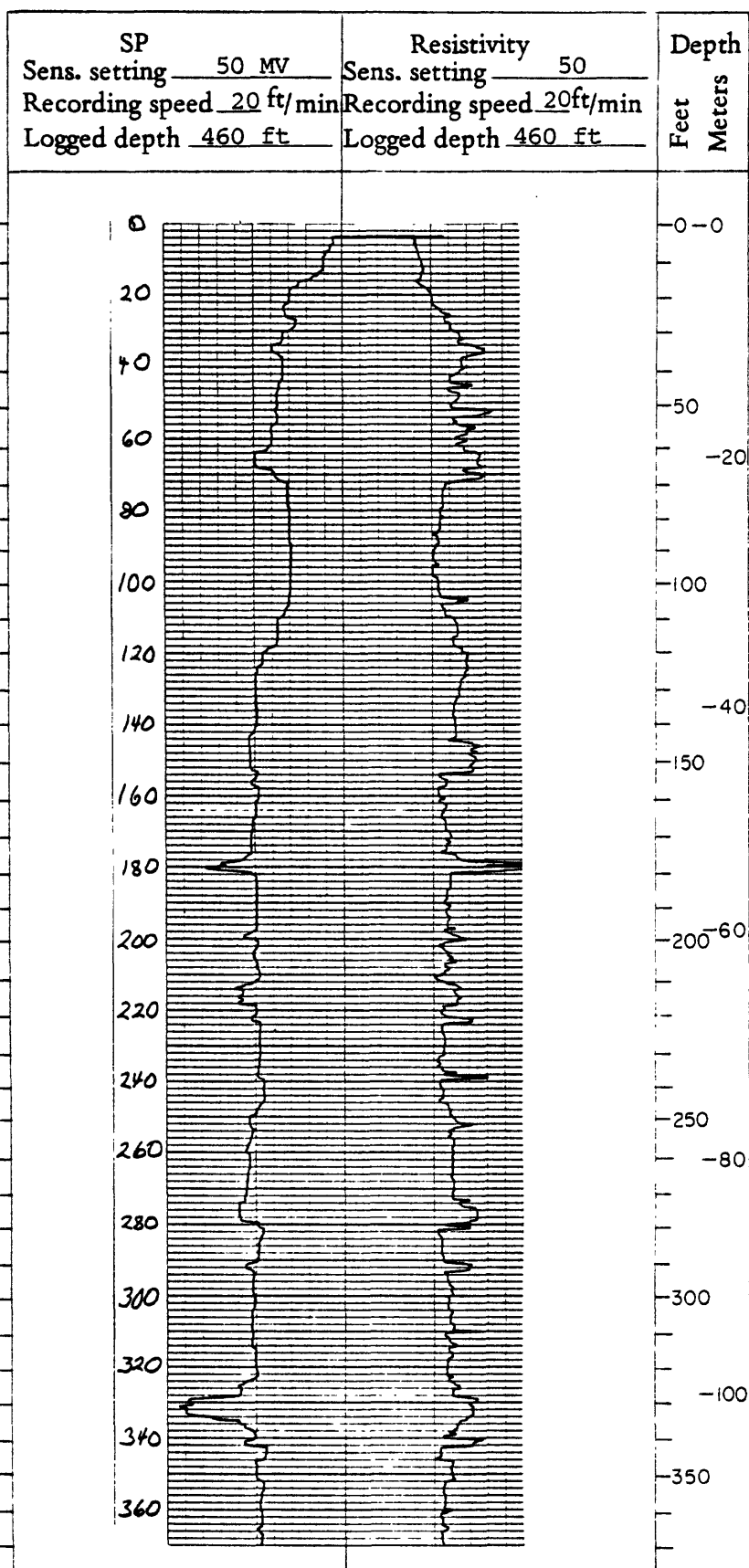
Recorded by: Fred O'TooleGeologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner

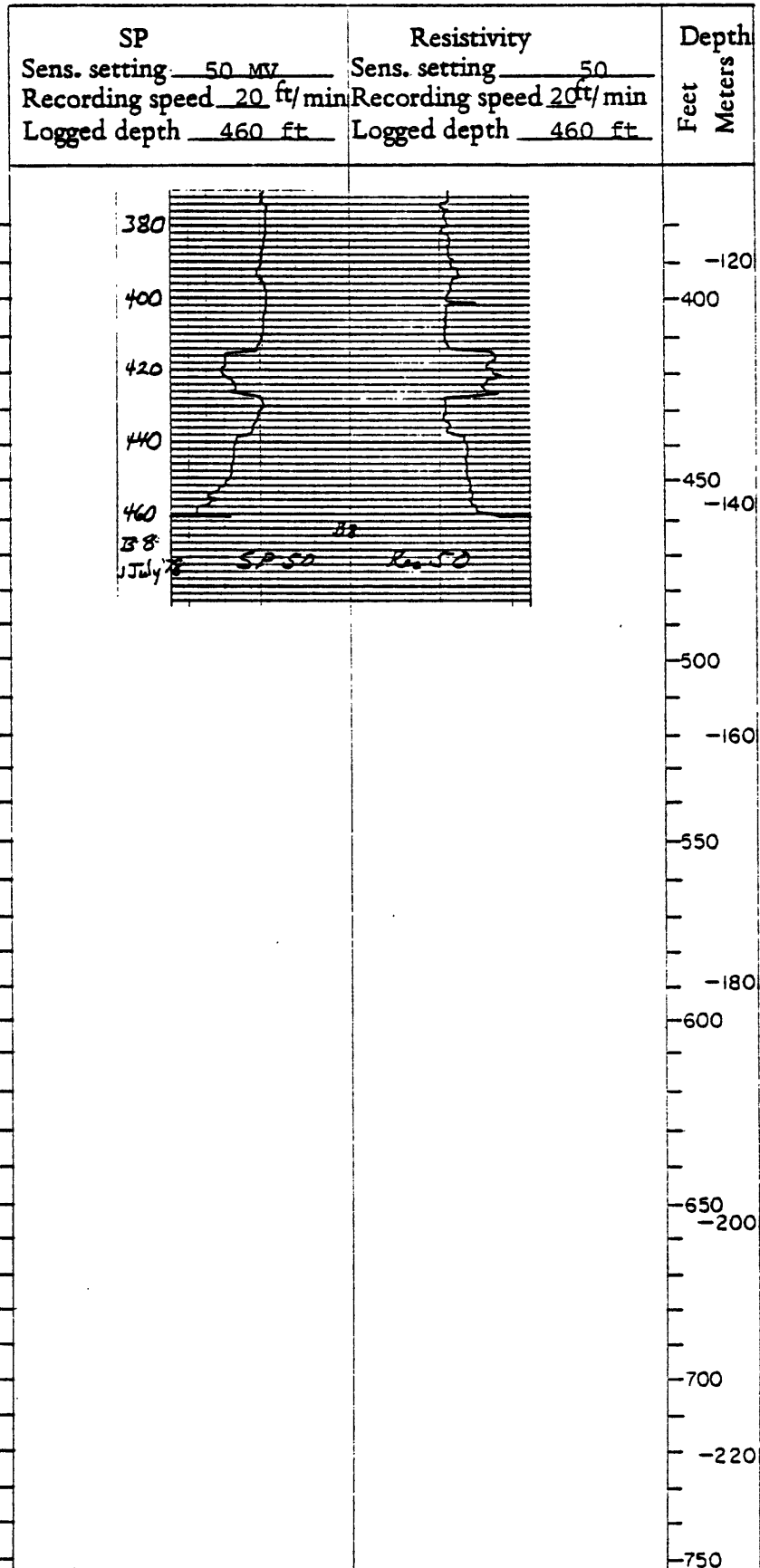
Hole number—continued
BU-8

Lithology	Gamma	Density	Depth	
	T.C. 2 Range 100 cps	T.C. 2 Range 100 cps	Fect	Meters
	Recording speed 20 ft/min	Recording speed 20 ft/min		
	Logged depth 460 ft	Logged depth 460 ft		
300-303 Lignite, black			-120	
303-320 Sandstone, medium-gray			400	
320-460 No samples				
			450	
			-140	
			500	
			-160	
			550	
			-180	
			600	
			-200	
			650	
			-220	
			700	
			-220	
			750	



Hole number—continued

BU-8



NORTH DAKOTA GEOLOGICAL SURVEY

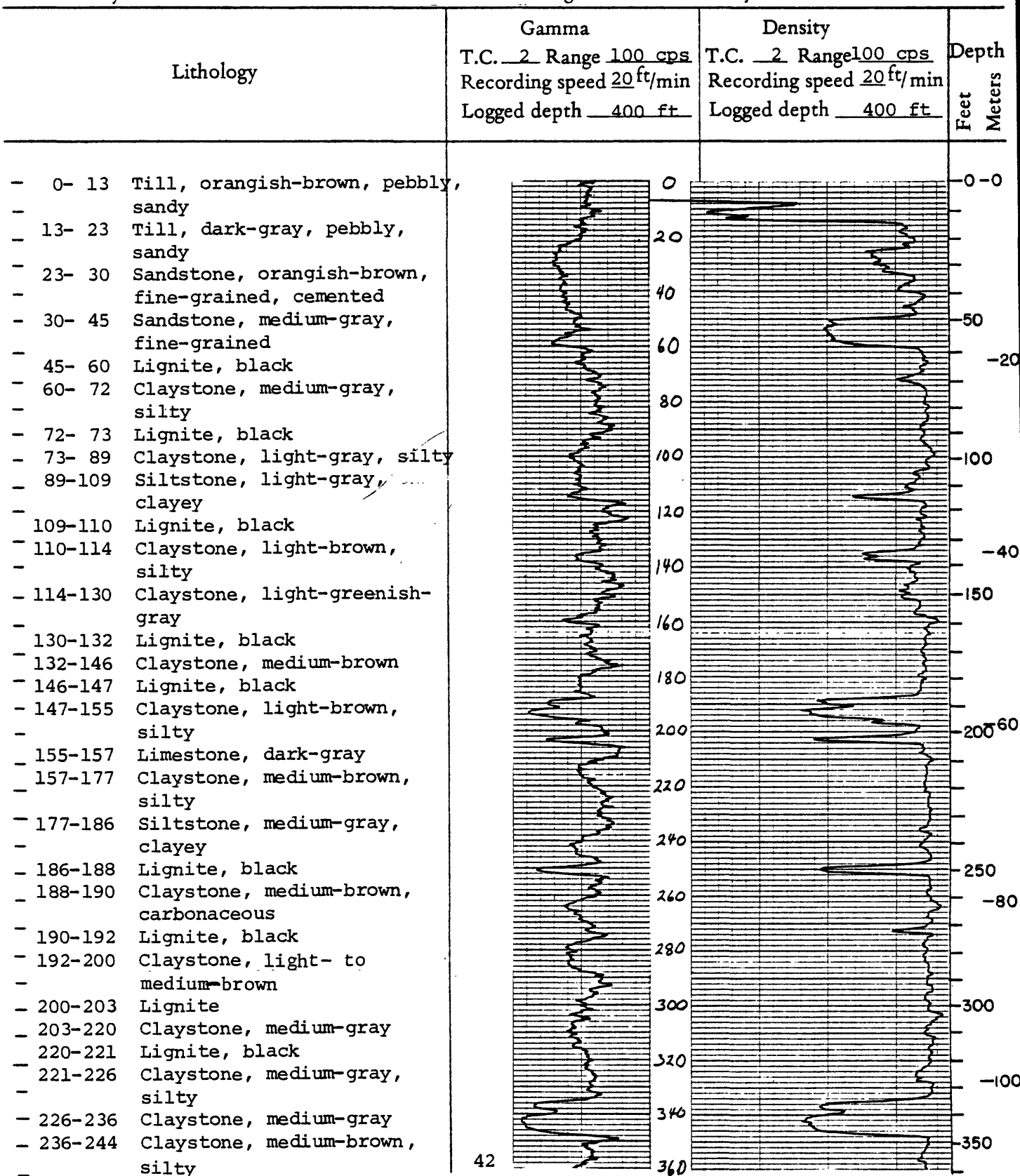
Hole No: BU-9 Map: Rennie Lake Date: 7-18-78 State: ND County: Burke
 Elev.: 2006 ft Location: T. 161 ^N, R. 92 ^W, Sec. 1, Tract: bbbb Drilled depth: 400 ft
 Measured: 48 ft ^{FNL} ~~PSD~~, 63 ft ^{FWL} ~~FWK~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 50-59; 113-115; 135-138; 178-185; 202-204; 249-251; 335-347

Remarks: _____

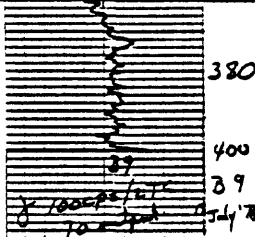
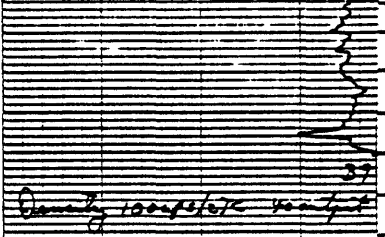

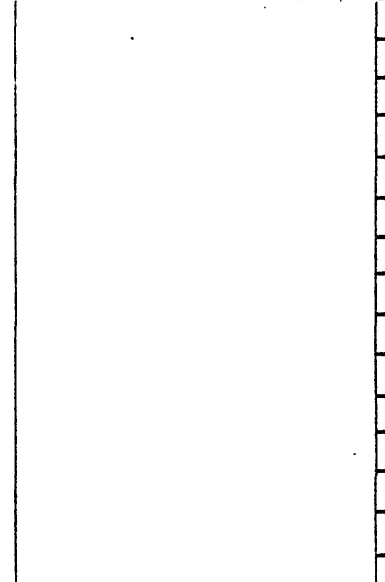
Lithology

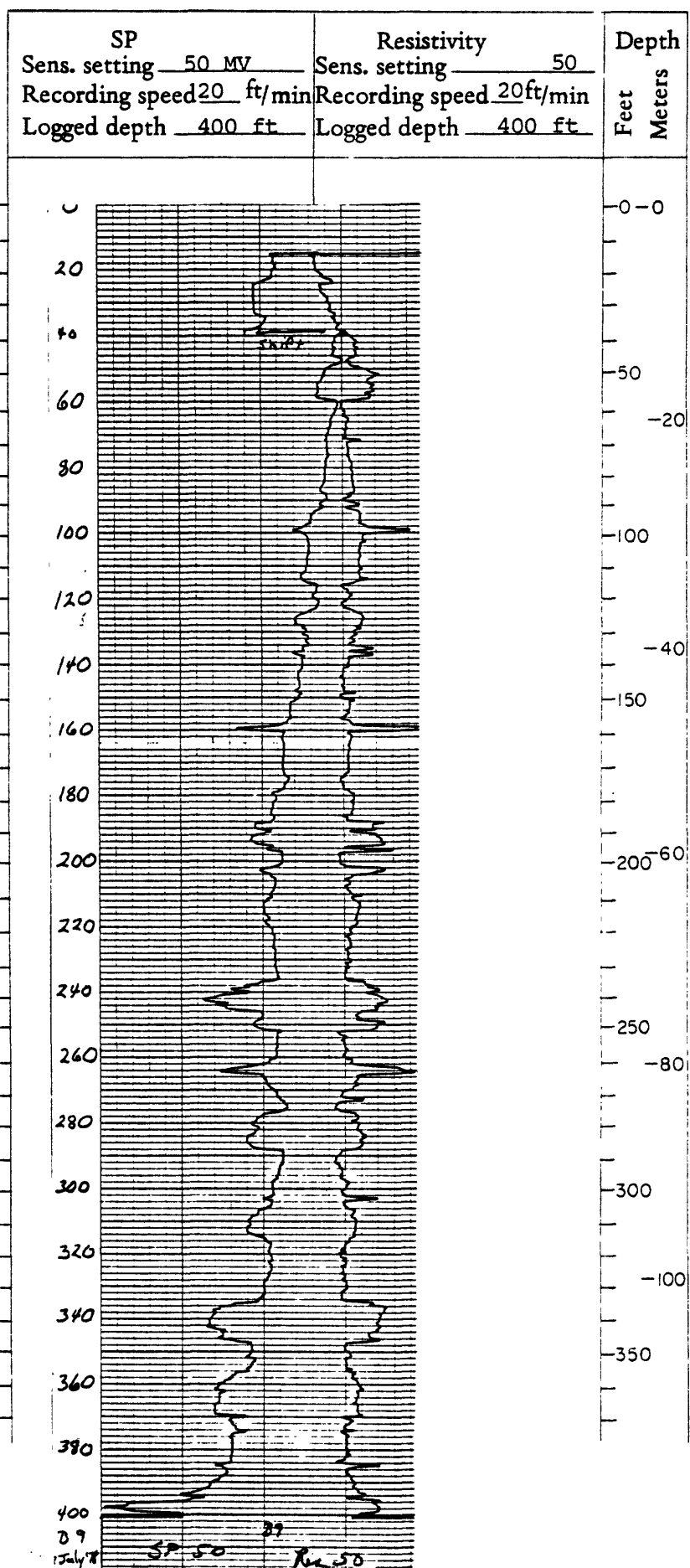
Recorded by: Fred O'TooleGeologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner

Hole number—continued
BU-9

Lithology	Gamma		Density		Depth	
	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>400 ft</u>	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>400 ft</u>	Fect	Meters
244-246 Lignite, black					-120	
246-257 Claystone, medium-brown						
257-265 Siltstone, medium-gray, sandy					400	
265-292 Sandstone, light-gray, clayey						
292-307 Claystone, medium-gray						
307-326 Siltstone, light-gray, clayey						
326-329 Claystone, medium-gray					-450	
329-335 Lignite, black					-140	
335-341 Claystone, medium-gray						
341-343 Lignite, black						
343-350 Claystone, medium-brown, carbonaceous						
350-377 Claystone, medium-gray					-500	
377-381 Claystone, very light gray						
381-387 Claystone, greenish-brown, carbonaceous					-160	
387-395 Siltstone, light-gray, clayey					-550	
395-400 Claystone, very light brown						
					-180	
					600	
					-650	
					-200	
					700	
					-220	
					750	



Hole number—continued
BU-9

SP		Resistivity		Depth	
Sens. setting <u>50 MV</u>		Sens. setting <u>50</u>		Feet	Meters
Recording speed <u>20</u> ft/min		Recording speed <u>20</u> ft/min			
Logged depth <u>400</u> ft		Logged depth <u>400</u> ft			
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

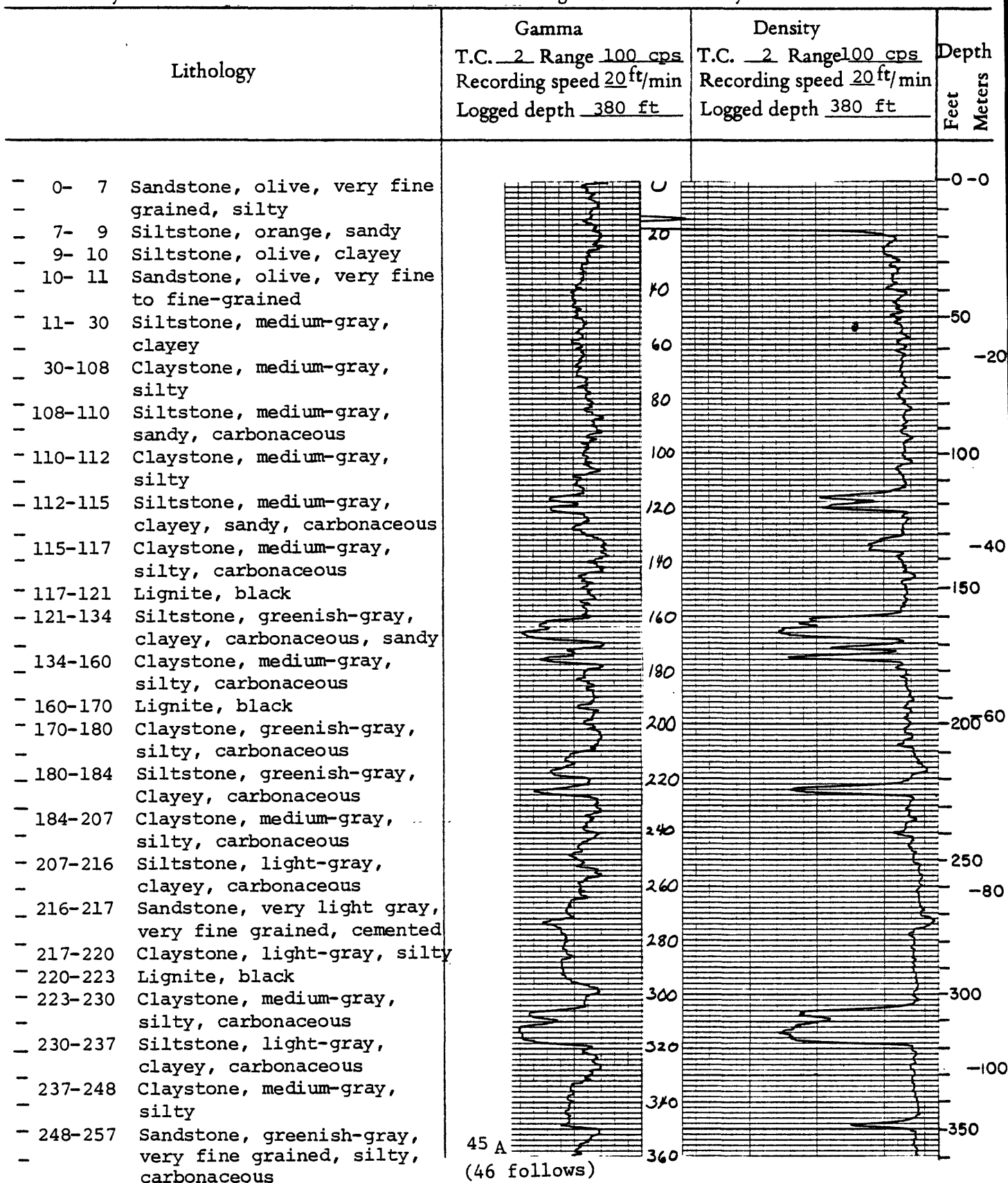
Hole No: BU-10 Map: Rennie Lake Date: 8-6-78 State: ND County: Burke
 Elev.: 1970 ft Location: T. 161^N, R. 91^W, Sec. 6, Tract: bdbb Drilled depth: 380 ft.
 Measured: 1400 ft^{FNL} 1388 ft^{FWL} Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 115-117; 119-121; 160-168; 174-176; 223-226; 305-318

Remarks: _____

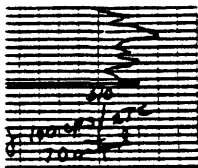
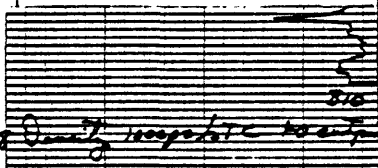
Lithology

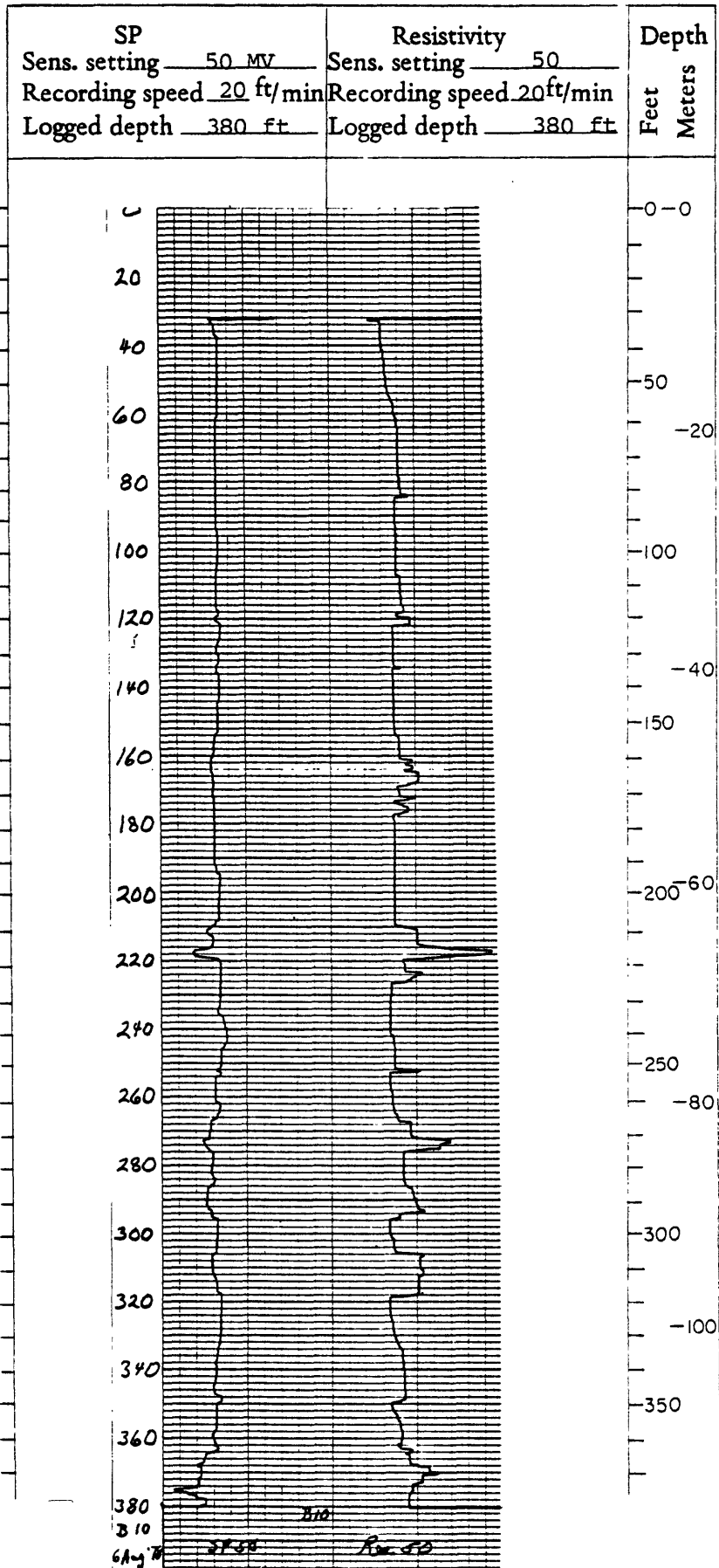
Recorded by: Randall ReichertGeologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner

Hole number—continued
BU-10

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>380</u> ft	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>380</u> ft	Feet	Meters
257-268 Claystone, medium-gray, silty, carbonaceous				
268-298 Sandstone, greenish-gray, very fine to fine-grained silty, carbonaceous			-120	
298-302 Claystone, dark-medium-gray, silty, carbonaceous			400	
302-303 Lignite, black				
303-309 Claystone, medium-gray, carbonaceous				
309-315 Lignite, black			450	
315-320 Claystone, dark-medium-gray, silty, carbonaceous			-140	
320-328 Sandstone, greenish-gray, very fine to fine-grained				
328-360 Claystone, greenish-gray, silty, carbonaceous			500	
360-380 Claystone, light-gray			-160	
			550	
			-180	
			600	
			650	
			-200	
			700	
			-220	
			750	



BU-10

Feet	Meters	Depth
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47A (48 follows)

NORTH DAKOTA GEOLOGICAL SURVEY

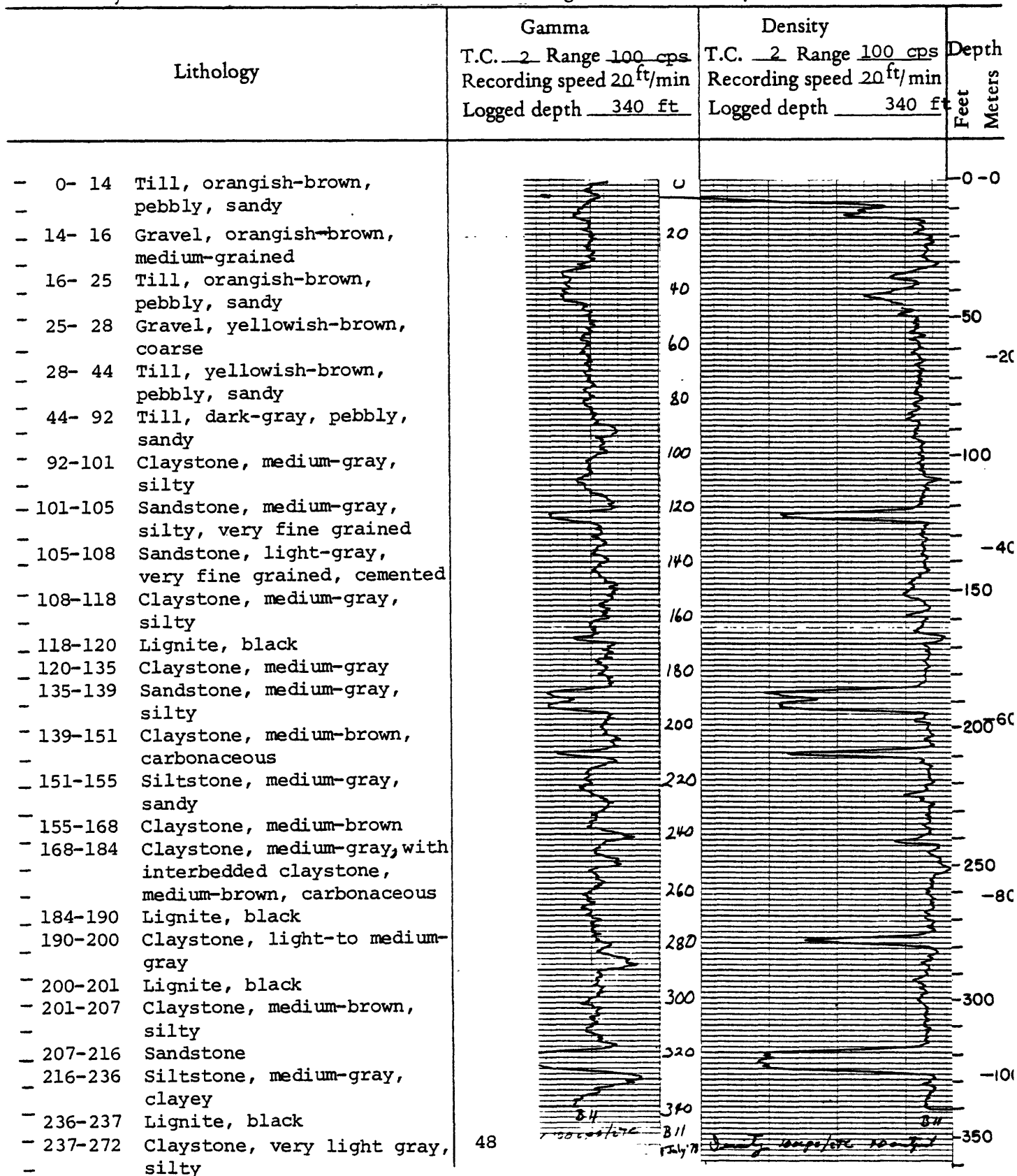
Hole No: BU-11 Map: Woburn Date: 7-18-78 State: ND County: Burke
 Elev.: 1945 ft Location: T. 162 ^N, R. 91 ^E, Sec. 21, Tract: baab Drilled depth: 340 ft
 Measured: 190 ft ^{FNL} ~~FHL~~, 2180 ft ^{FWL} ~~FEL~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 122-125; 187-195; 209-212; 278-280; 319-327

Remarks: _____

Lithology

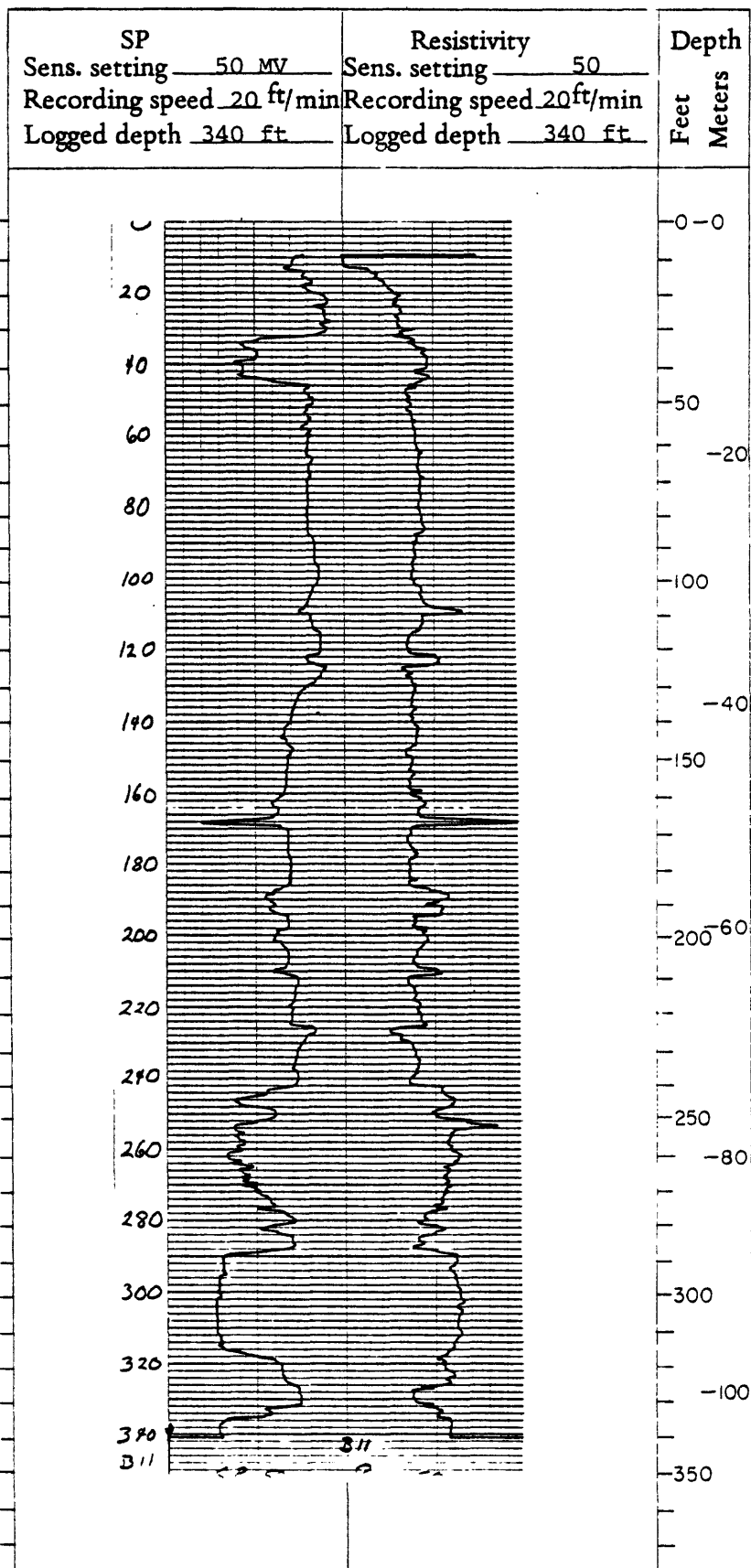
Recorded by: Fred O'TooleGeologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner

Hole number—continued
BU-11

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>340 ft</u>	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>340 ft</u>	Feet	Meters
272-282 Sandstone, medium-gray, silty				
282-285 Claystone, medium-gray, silty			-120	
285-313 Claystone, light-greenish, gray and light-gray, interbedded			-400	
313-316 Lignite, black				
316-321 Claystone, medium-brown				
321-325 Lignite, black				
325-327 Claystone, medium-gray			-450	
327-330 Lignite, black			-140	
330-340 Claystone, medium-brown, silty				
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



BU-11

50A (51 follows)

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-12 Map: Rennie Lake Date: 7-18-78 State: ND County: Burke
 Elev.: 1944 ft Location: T. 162^N, R. 92^W, Sec. 24, Tract: aaaa Drilled depth: 360 ft.
 Measured: 114 ft ^{FNL} 33 ft ^{FEL} ~~FWL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 37-40; 50-54; 59-62; 68-71; 115-118; 190-201; 312-315; 338-348

Remarks: _____

Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes} ~~No~~

Geophysical logs

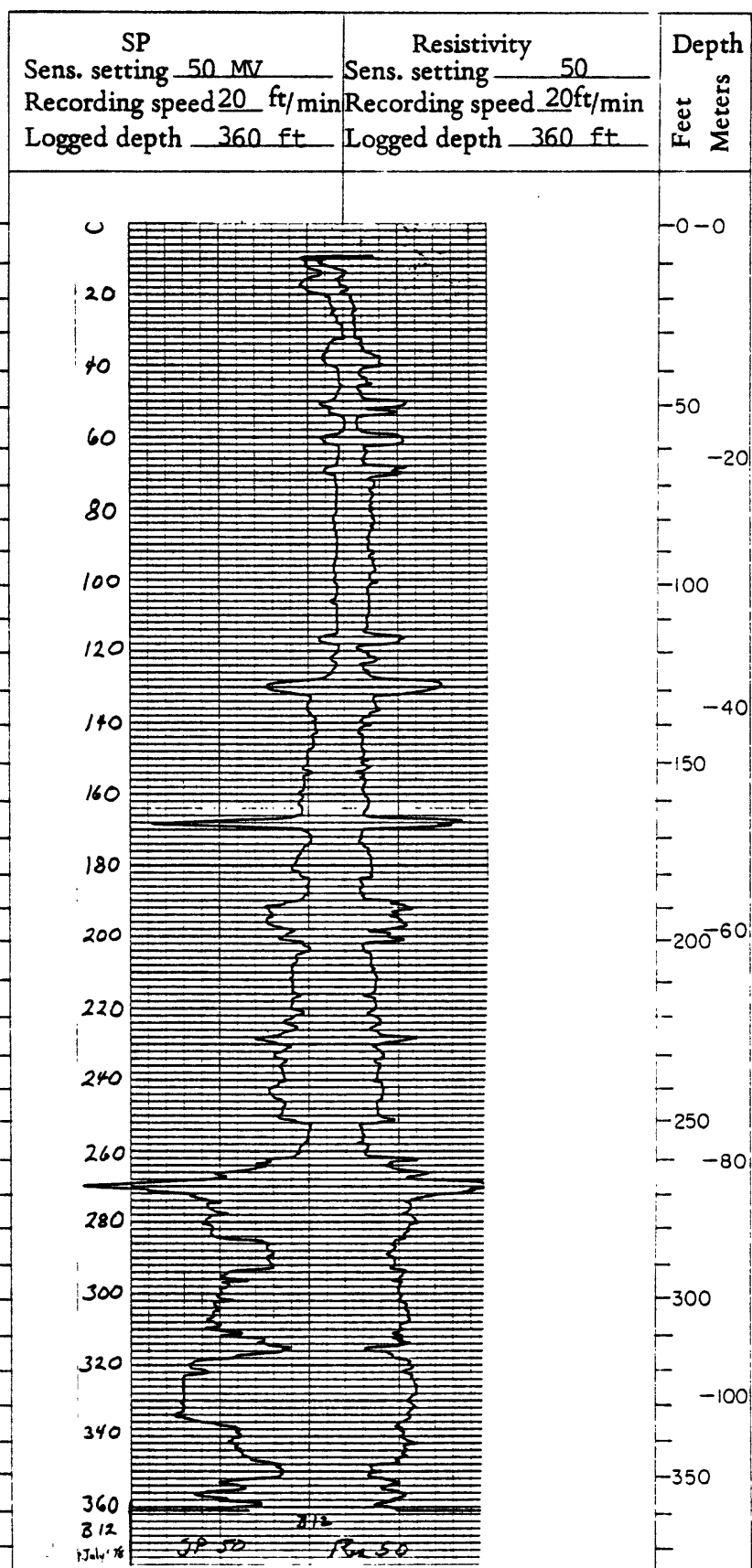
recorded by: Lechner

Lithology	Gamma		Density		Depth Feet Meters
	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>360 ft</u>	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>360 ft.</u>	
0- 6 Sand, grayish-yellow, very fine grained					0-0
6- 25 Till, yellowish-gray, pebbly					20
25- 32 Till, dark-gray, pebbly					40
32- 35 Claystone, medium-gray, silty					50
35- 38 Lignite, black					60
38- 43 Sandstone, greenish-gray, very fine to fine-grained					-20
43- 50 Claystone, medium-gray					80
50- 53 Lignite, black					100
53- 55 Claystone, dark-medium-gray, silty					100
55- 57 Lignite, black					120
57- 62 Claystone, dark-medium-gray, silty					-40
62- 63 Lignite, black					140
63- 68 Claystone, greenish-gray, silty					150
68- 70 Lignite, black					160
70- 80 Siltstone, greenish-gray, clayey					180
80- 95 Claystone, medium-gray, silty					200
95-110 Siltstone, medium-gray, clayey					200 ⁶⁰
110-116 Claystone, medium-gray, silty					220
116-120 Lignite, black					240
120-132 Sandstone, greenish-gray, very fine to fine-grained					250
132-133 Sandstone, greenish-gray, very fine grained, cemented					-80
133-140 Sandstone, greenish-gray, very fine grained					280
140-163 Claystone, medium-gray, silty					300
163-166 Sandstone, greenish-gray, very fine grained					320
166-168 Limestone, dark-gray					-100
168-192 Claystone, medium-gray, silty					340
192-200 Lignite, black					350

Hole number—continued
BU-12

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>360 ft</u>	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>360 ft</u>	Fect	Meters
200-260 Sandstone, greenish-gray, very fine to fine-grained				
260-264 Claystone, dark-gray, silty			-120	
264-293 Sandstone, greenish-gray, very fine grained			-400	
293-310 Claystone, light-gray				
310-312 Lignite, black				
312-338 Claystone, greenish-gray, silty				
338-340 Lignite, black			-450	
340-350 Claystone, medium-gray, silty			-140	
350-355 Lignite, black				
355-360 Claystone, medium-gray, silty			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	

Hole number BU-12



Hole number—continued
BU-12

SP		Resistivity		Depth	
Sens. setting	<u>50 MV</u>	Sens. setting	<u>50</u>	Ft	Meters
Recording speed	<u>20 ft/min</u>	Recording speed	<u>20 ft/min</u>		
Logged depth	<u>360 ft</u>	Logged depth	<u>360 ft</u>		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

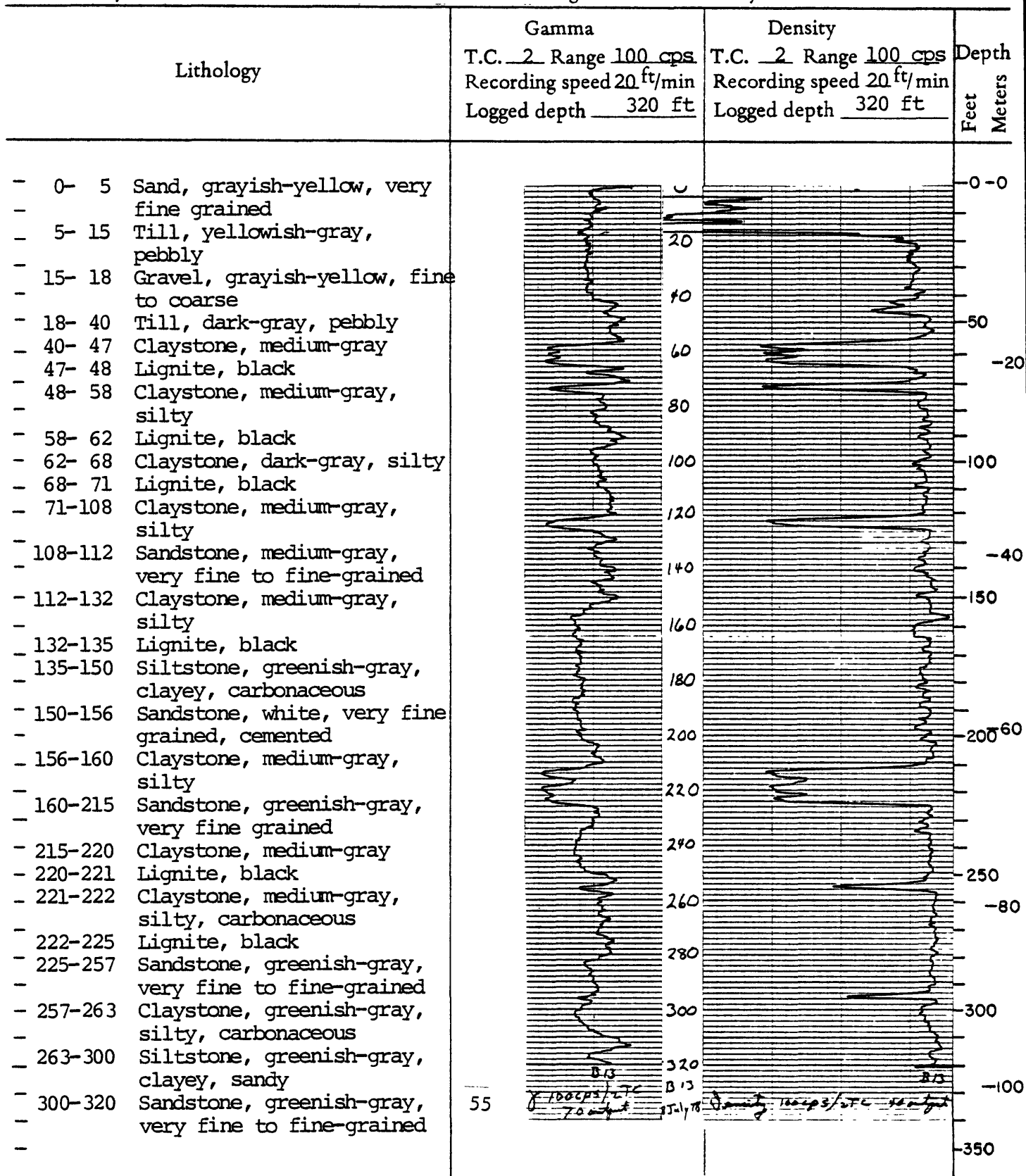
Hole No: BU-13 Map: Rennie Lake Date: 7-18-78 State: ND County: Burke
 Elev.: 1952 ft Location: T. 162^N, R. 92^W, Sec. 14, Tract: baaa Drilled depth: 320 ft.
 Measured: 105 ft^{FNL} 2630 ft^{FNL} FWL Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 57-65; 72-74; 121-124; 212-225; 254-256;

Remarks: _____

Lithology

Recorded by: Randall ReichertGeologist ^{Yes} ~~NO~~

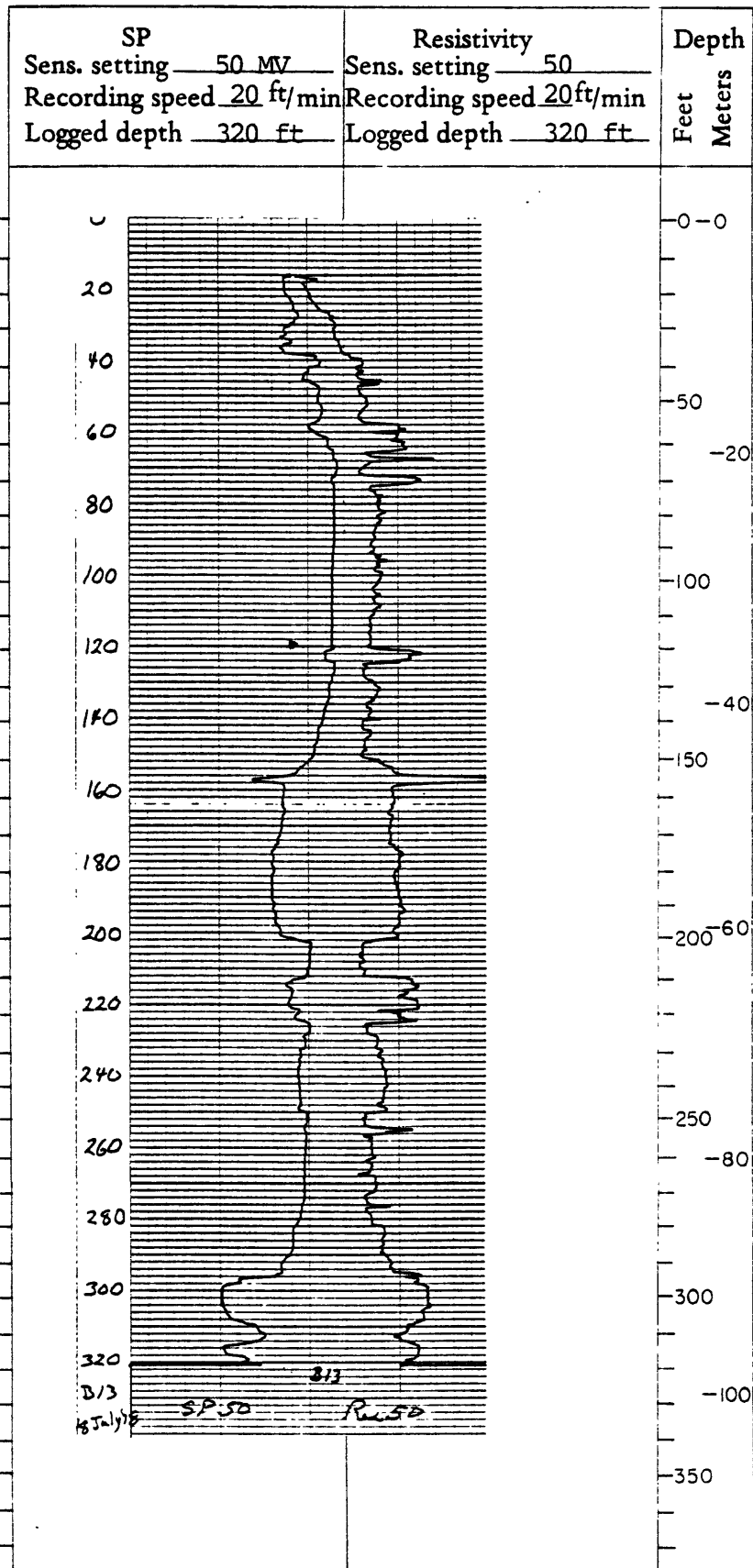
Geophysical logs

recorded by: Lechner

Hole number—continued

BU-13

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>320 ft.</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>320 ft.</u>	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



BU-13

58

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-14 Map: Stamped Date: 7-7-78 State: ND County: Burke
Elev.: 1932 ft. Location: T. 163^N ~~S~~, R. 92^E ~~W~~, Sec. 33, Tract: bbbb Drilled depth: 320 ft.
Measured: 198 ft ~~188~~^{FNL}, 30 ft ~~FWL~~^{REX}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 178-186; 198-200.5; 315-324

Remarks:

Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner

Lithology	Gamma		Density		Depth	
	T.C.	Range 100 cps Recording speed 20 ft/min Logged depth 320 ft	T.C.	Range 100 cps Recording speed 20 ft/min Logged depth 320 ft	Feet	Meters
0- 2 Gravel, orangish-brown, pebbly, sandy, medium-grained					0	0
2- 21 Till, yellowish-brown, pebbly, sandy, gravelly						
21- 40 Till, medium-gray, pebbly, sandy						
40- 58 Till, medium-gray, silty						
58- 80 Till, medium-gray, silty, sandy, pebbly						
80-148 Gravel, medium-gray, coarse grained						
148-160 Siltstone, light-gray, clayey						
160-173 Sandstone, light-gray, silty, very fine grained						
173-176 Claystone, medium-gray, silty						
176-178 Lignite, black						
178-180 Claystone, medium-brown, carbonaceous						
180-186 Lignite, black						
186-198 Claystone, medium-gray and brown, carbonaceous, interbedded						
198-200 Lignite, black						
200-240 Claystone, light-gray, silty						
240-250 Claystone, medium-gray, silty						
250-308 Claystone, light-gray						
308-313 Lignite, black						
313-320 Claystone, light-brown, silty						

γ 100 cps/2" x 100 ft
320 ft

Density 100 cps/2" x 100 ft
320 ft

0-0

20

40

50

60

80

100

120

140

150

160

180

200

220

240

250

260

280

300

320

340

350

59

8/14

200 ft

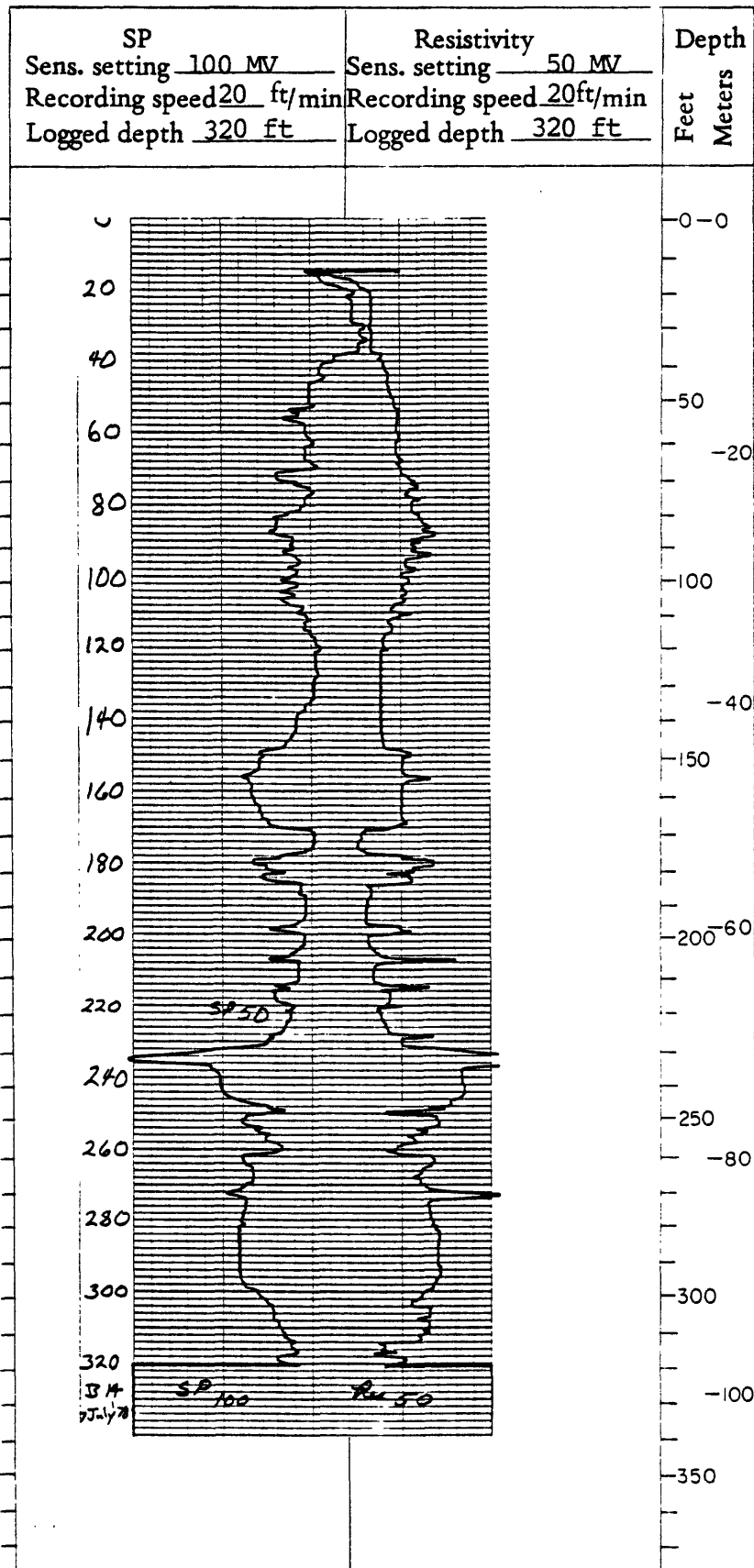
320 ft

200 ft

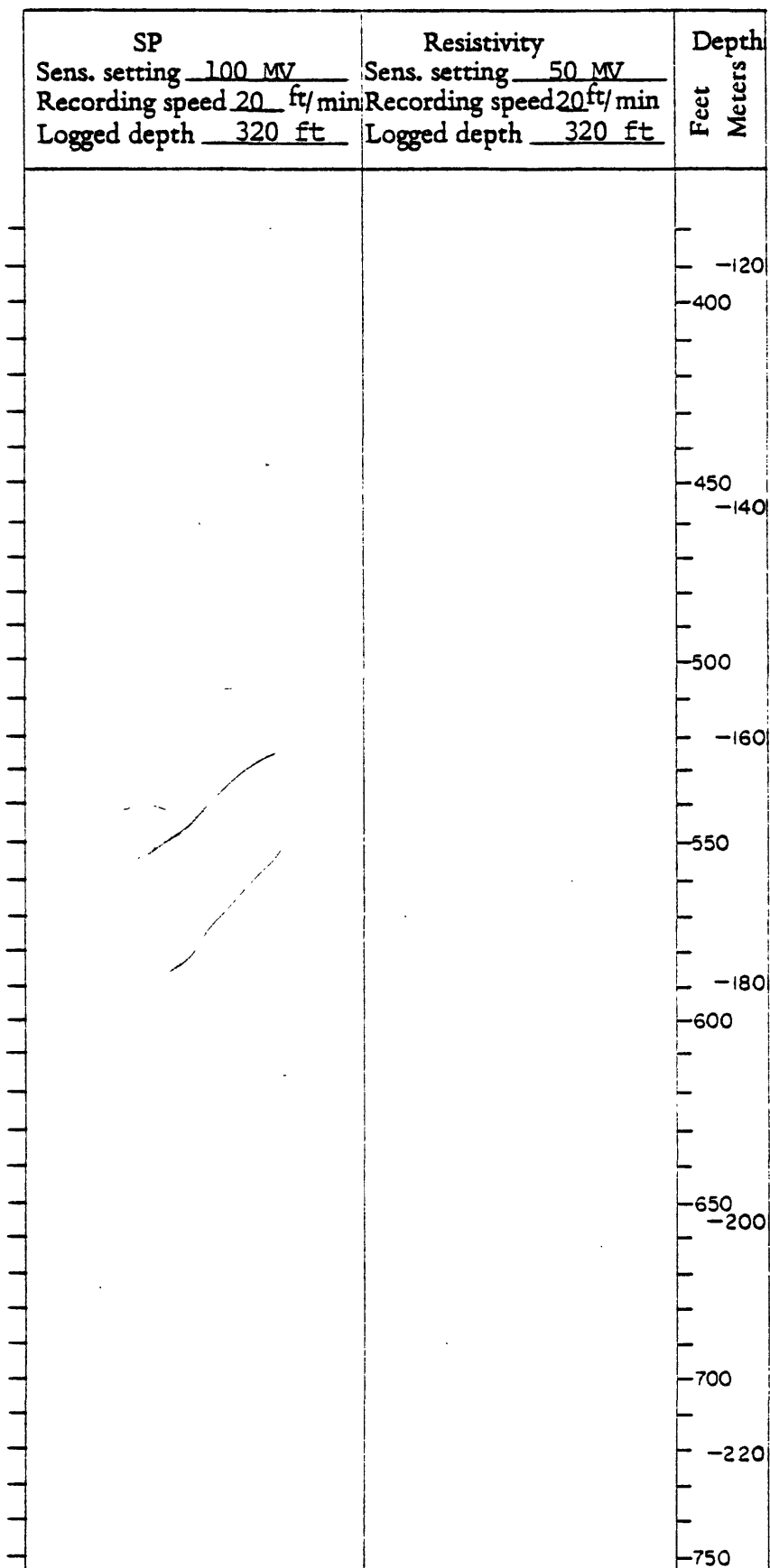
Hole number—continued

BU-14

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>320</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>320</u> ft	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued
BU-14



NORTH DAKOTA GEOLOGICAL SURVEY

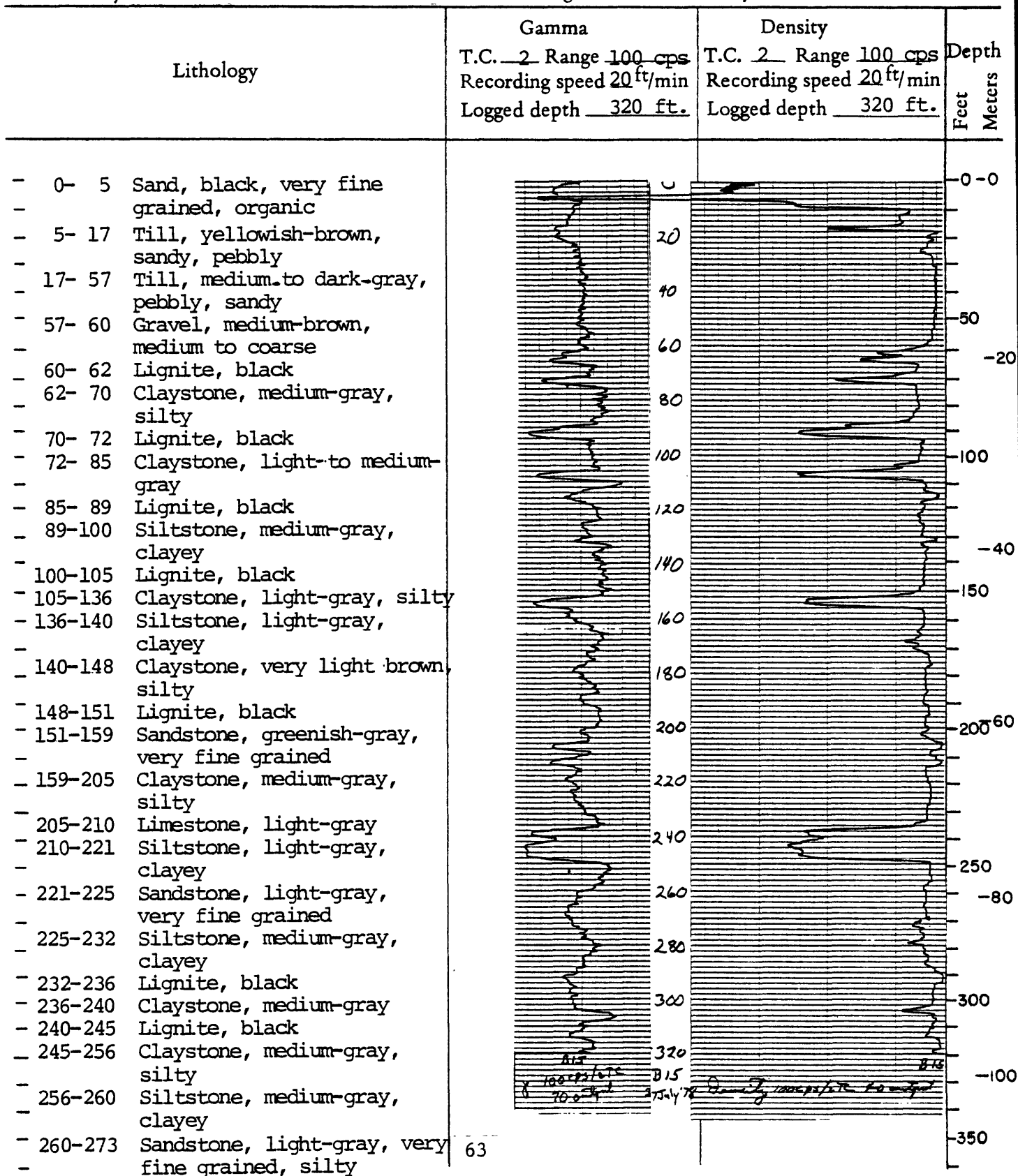
Hole No: BU-15 Map: Beaver Lake Date: 7-27-78 State: ND County: Burke
 Elev.: 1946 ft Location: T. 162 ^N ~~X~~, R. 92 ^W ~~X~~, Sec. 21, Tract: bbbc Drilled depth: 320 ft.
 Measured: 1100 ft ~~FNL~~ ^{FNL} ~~40 ft ~~FWL~~ ^{FWL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 62-66; 72-74; 88-94; 106-108; 152-156; 237-248~~

Remarks:

Lithology

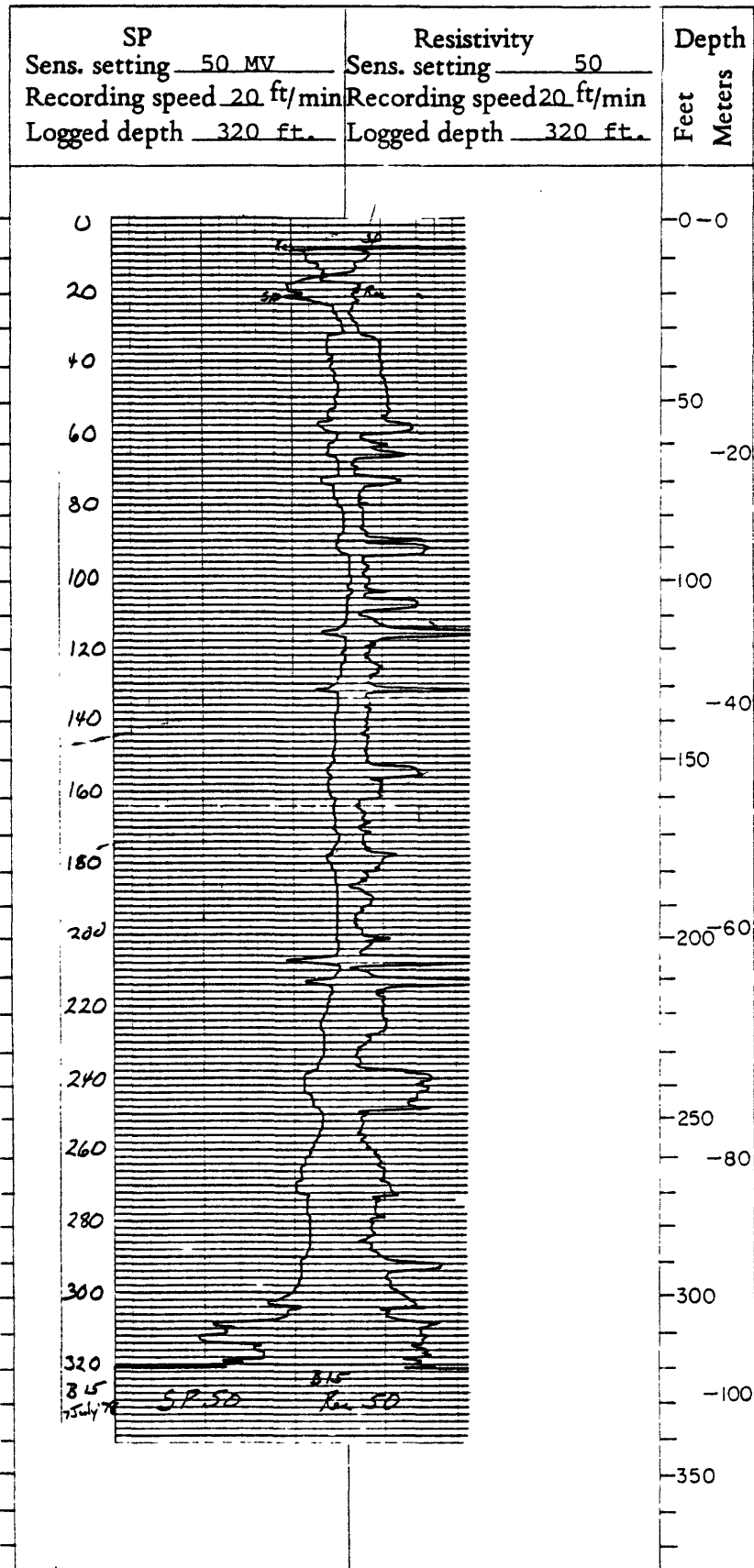
Recorded by: Fred O'TooleGeologist ^{Yes} ~~XX~~

Geophysical logs

recorded by: Lechner

Hole number—continued
BU-15

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>320 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>320 ft</u>	Depth	
			Feet	Meters
273-305 Siltstone, medium-gray, clayey				
305-320 Claystone, very light-gray				
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued

BU-15

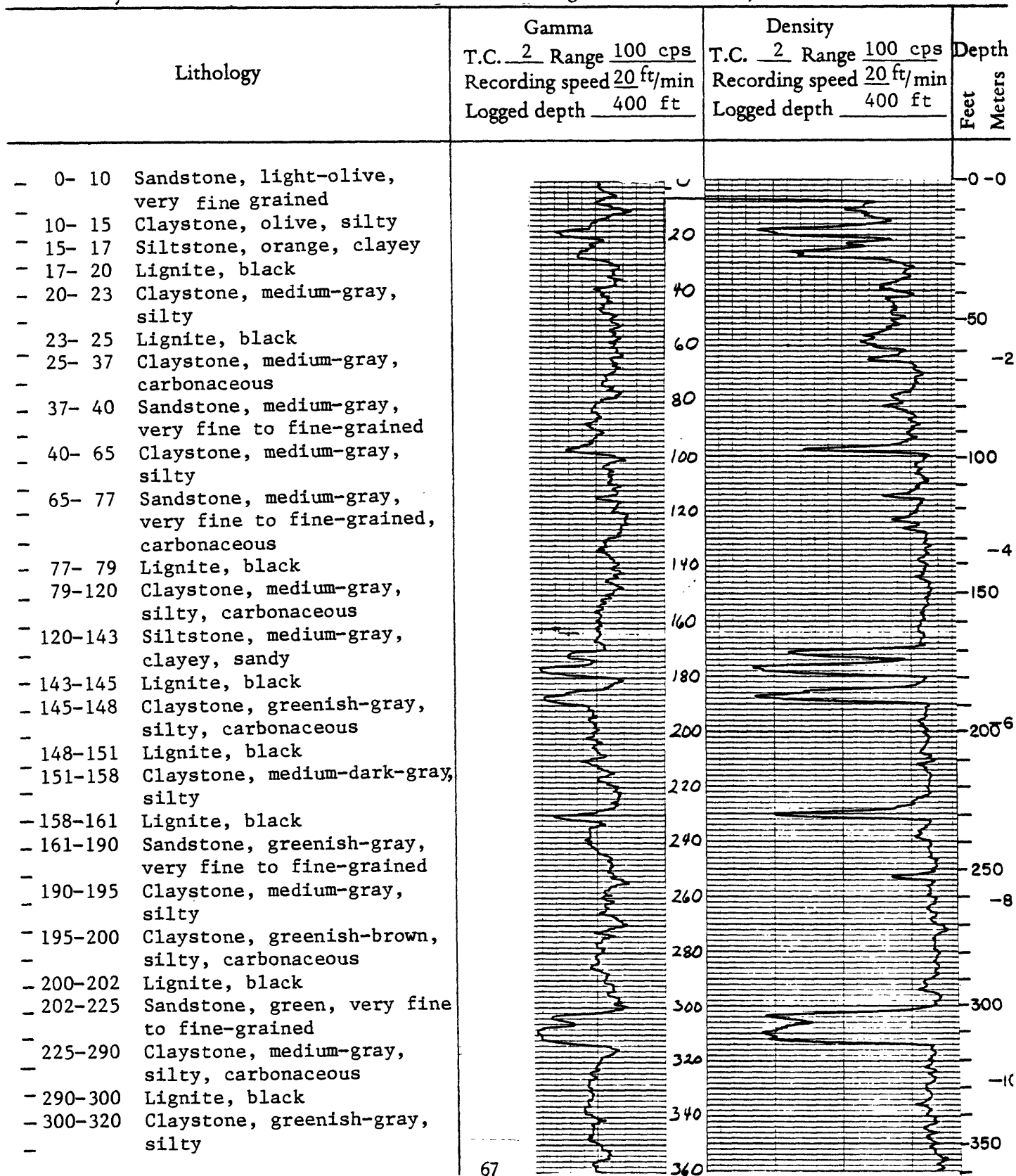
SP		Resistivity		Depth	
Sens. setting <u>50 mv</u>		Sens. setting <u>50</u>		Feet	Meters
Recording speed <u>20</u> ft/min		Recording speed <u>20</u> ft/min			
Logged depth <u>320 ft.</u>		Logged depth <u>320 ft.</u>			
					-120
					-400
					-450
					-140
					-500
					-160
					-550
					-180
					-600
					-650
					-200
					-700
					-220
					-750

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-16 Map: Rennie Lake Date: 7-18-78 State: ND County: Burke
 Elev.: 1999 ft Location: T. 162^N_S, R. 92^W_W, Sec. 34, Tract: Caaa Drilled depth: 400 ft
 Measured: 2620 ft ~~FSL~~ ^{FWL} 2600 ft ~~FWL~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 17-20; 25-28; 96-98; 170-173; 175-179;
184-189; 229-232; 302-319

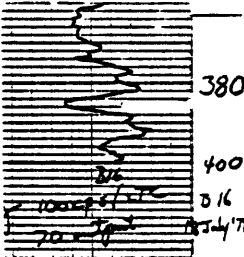
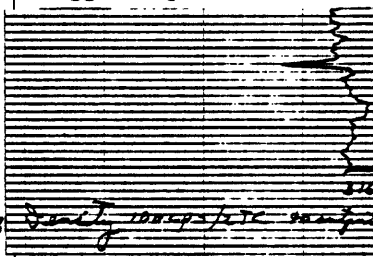
Remarks: _____

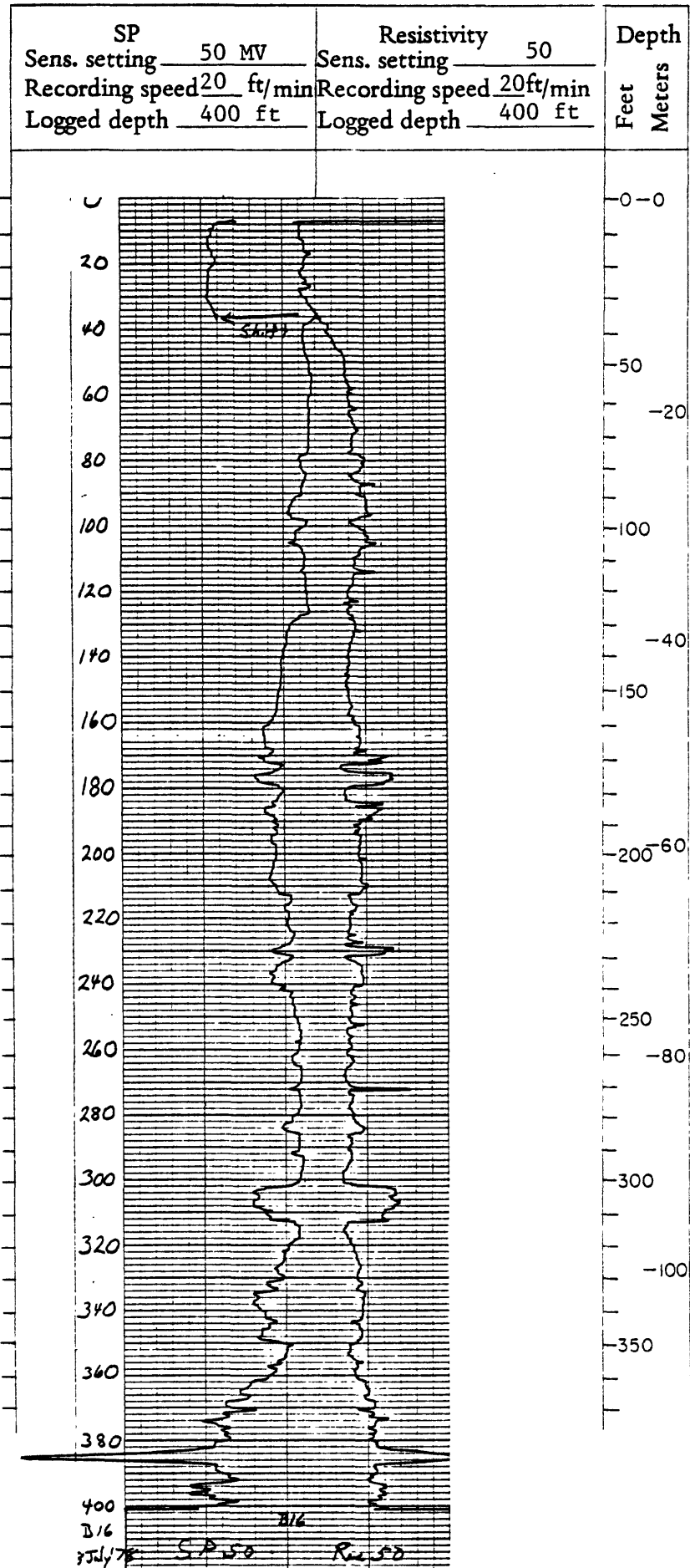
Lithology

Recorded by: Randall ReichertGeophysical logs
 recorded by: Lechner

Hole number—continued

BU-16

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fcct	Meters
	Recording speed 20 ft/min		Recording speed 20 ft/min			
	Logged depth 400 ft		Logged depth 400 ft			
320-335 Sandstone, greenish-gray, very fine to fine-grained					-120	
335-345 Siltstone, green, clayey, sandy					400	
345-360 Sandstone, greenish-gray, very fine to fine-grained, carbonaceous, silty						
360-372 Claystone, medium-gray, silty					450	
372-373 Sandstone, white, very fine grained, cemented					-140	
373-380 Sandstone, medium-gray, very fine grained						
380-400 Siltstone, light-gray, clayey, sandy, carbonaceous					500	
					-160	
					550	
					-180	
					600	
					650	
					-200	
					700	
					-220	
					750	



BU-16

SP		Resistivity		Depth	
Sens. setting	<u>50 MV</u>	Sens. setting	<u>50</u>	Feet	Meters
Recording speed	<u>20 ft/min</u>	Recording speed	<u>20 ft/min</u>		
Logged depth	<u>400 ft</u>	Logged depth	<u>400 ft</u>		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-17 Map: Rennie Lake Date: 7-19-78 State: ND County: Burke
 Elev.: 2050 ft Location: T. 161^N~~SE~~, R. 92^W~~XX~~, Sec. 3, Tract: bbbc Drilled depth: 460 ft
 Measured: 420 ft ^{FNL}~~FWL~~, 54 ft ^{FWL}~~FWL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 24-27; 36-39; 113-122; 142-144; 217-224; 231-234; 281-283; 344-355

Remarks: _____

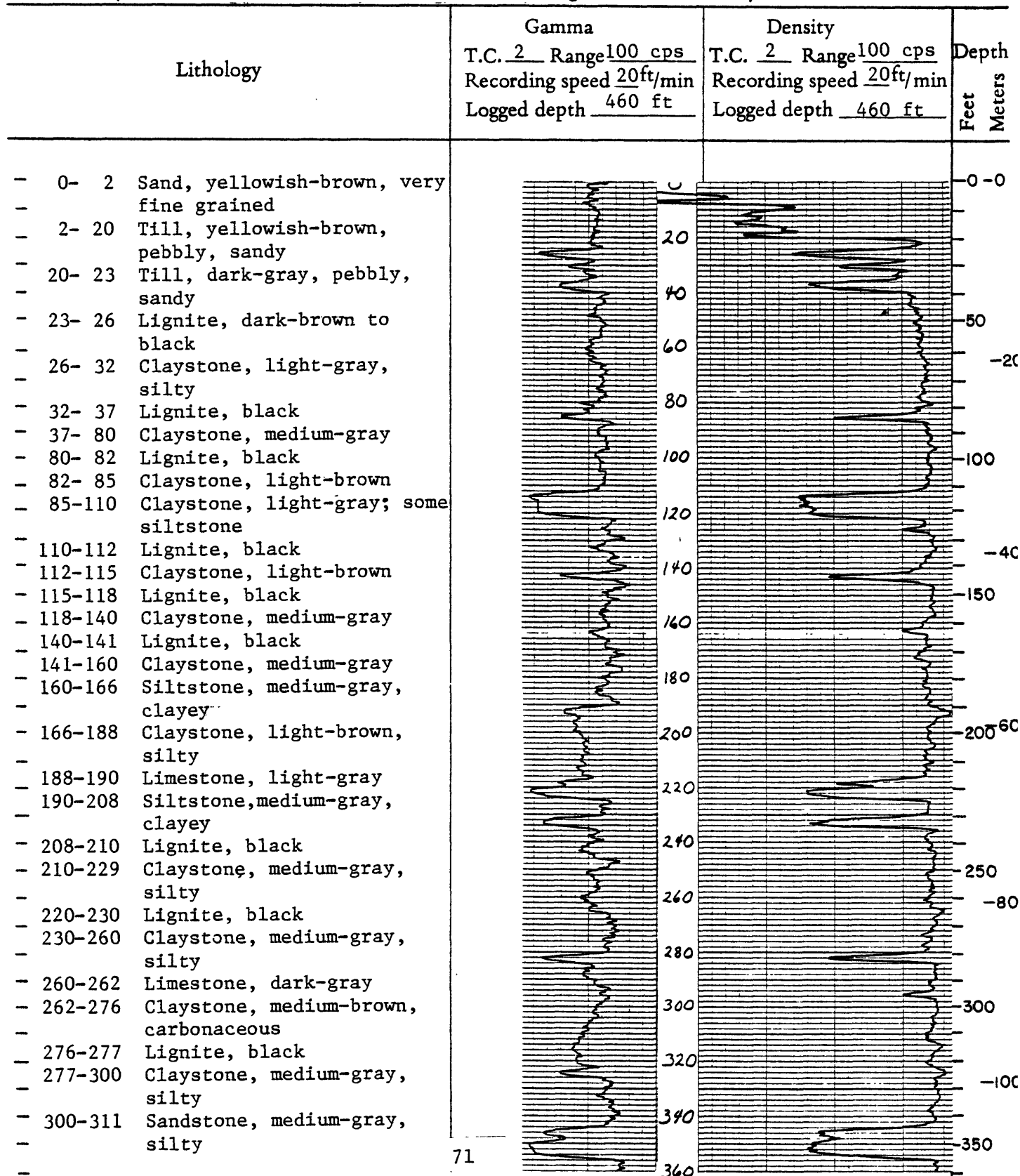
Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes}~~NA~~

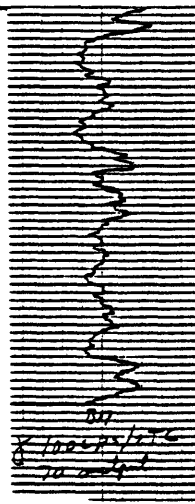
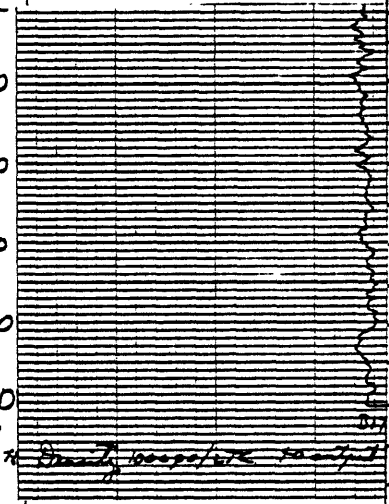
Geophysical logs

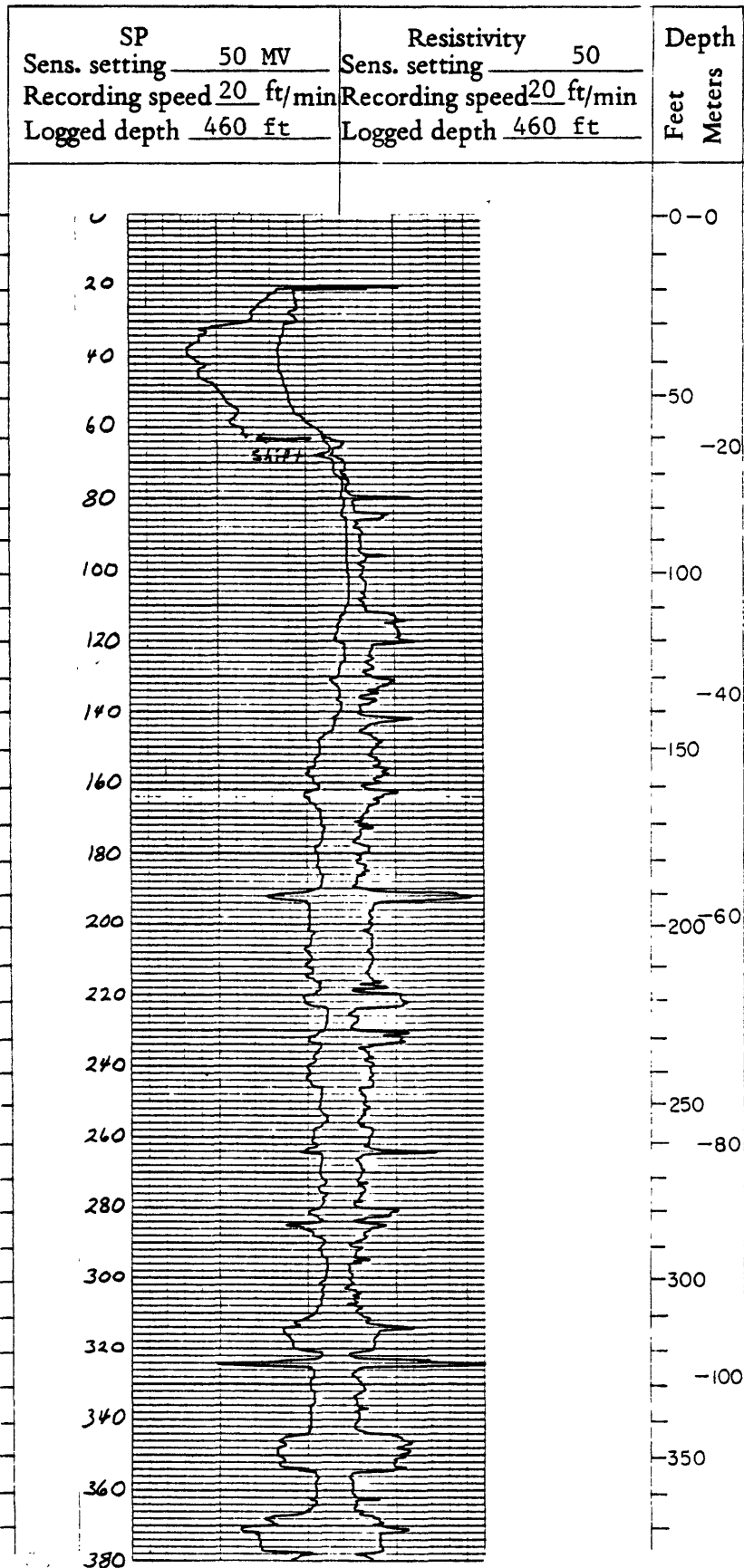
recorded by: Lechner



Hole number—continued

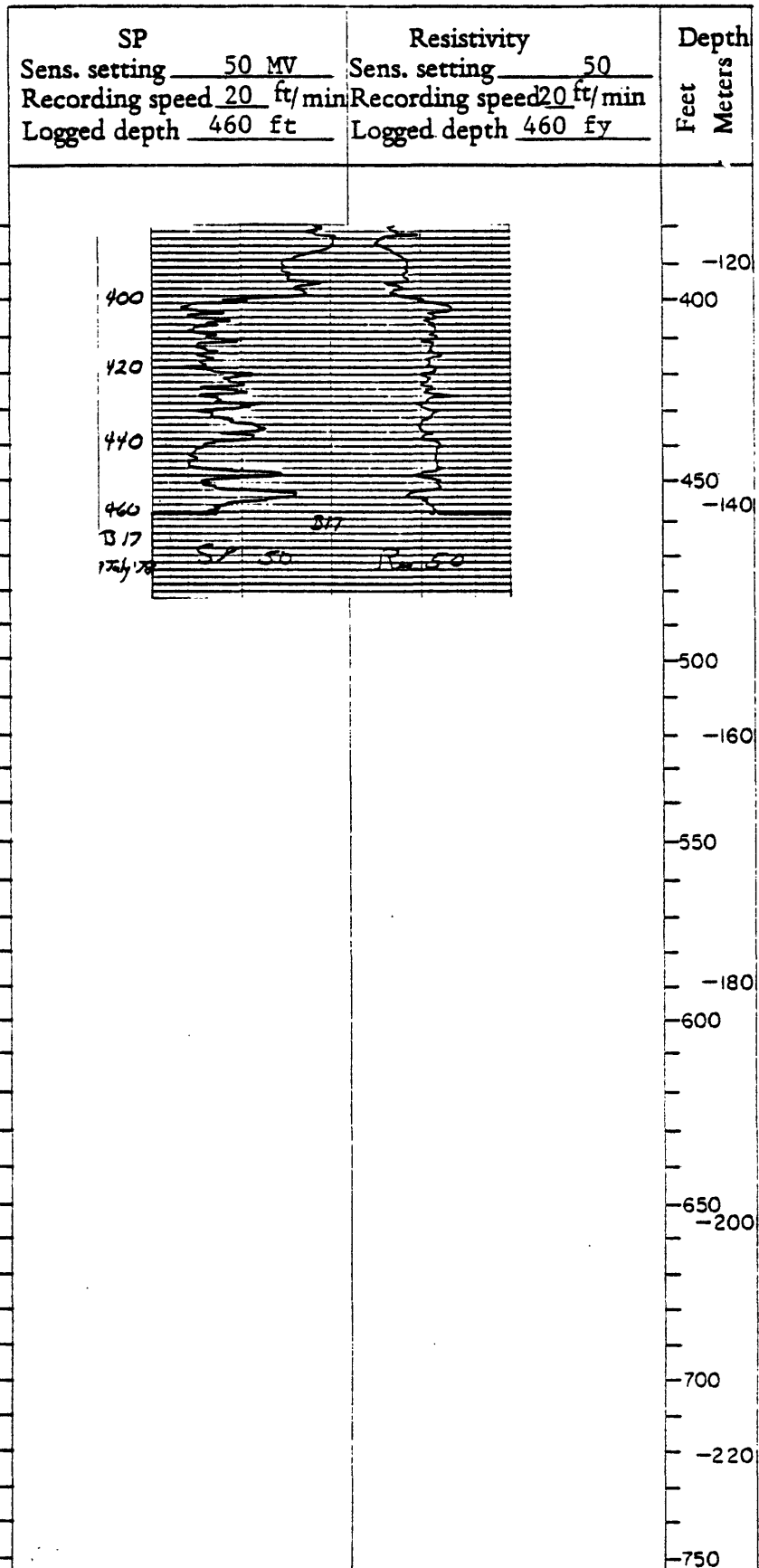
BU-17

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fect	Meters
	Recording speed: 20 ft/min		Recording speed 20 ft/min			
	Logged depth 460 ft		Logged depth 460 ft			
311-340 Claystone, medium-gray, silty					-120	
340-348 Lignite, black					400	
348-360 Claystone, medium-gray						
360-437 Sandstone, medium-gray, silty, very fine grained						
437-452 Claystone, light-brown, silty					450	
452-453 Lignite, black					-140	
453-460 Claystone, light-gray	B17 X 100 cps/ft 10 m/ft		B17 X 100 cps/ft 10 m/ft			
					500	
					-160	
					550	
					-180	
					600	
					650	
					-200	
					700	
					-220	
					750	



Hole number—continued

BU-17



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-18 Map: Beaver Lake Date: 7-20-78 State: ND County: Burke
 Elev.: 2088 ft Location: T. 161 ^N, R. 92 ^W, Sec. 4, Tract: cbbb Drilled depth: 480 ft
 Measured: 2580 ft ~~PSL~~ ^{FWL}, 44 ft ~~FWL~~ ^{FWL} Hole size: 4 1/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 143-150; 254-260; 276-280; 334-336; 398-408

Remarks: _____

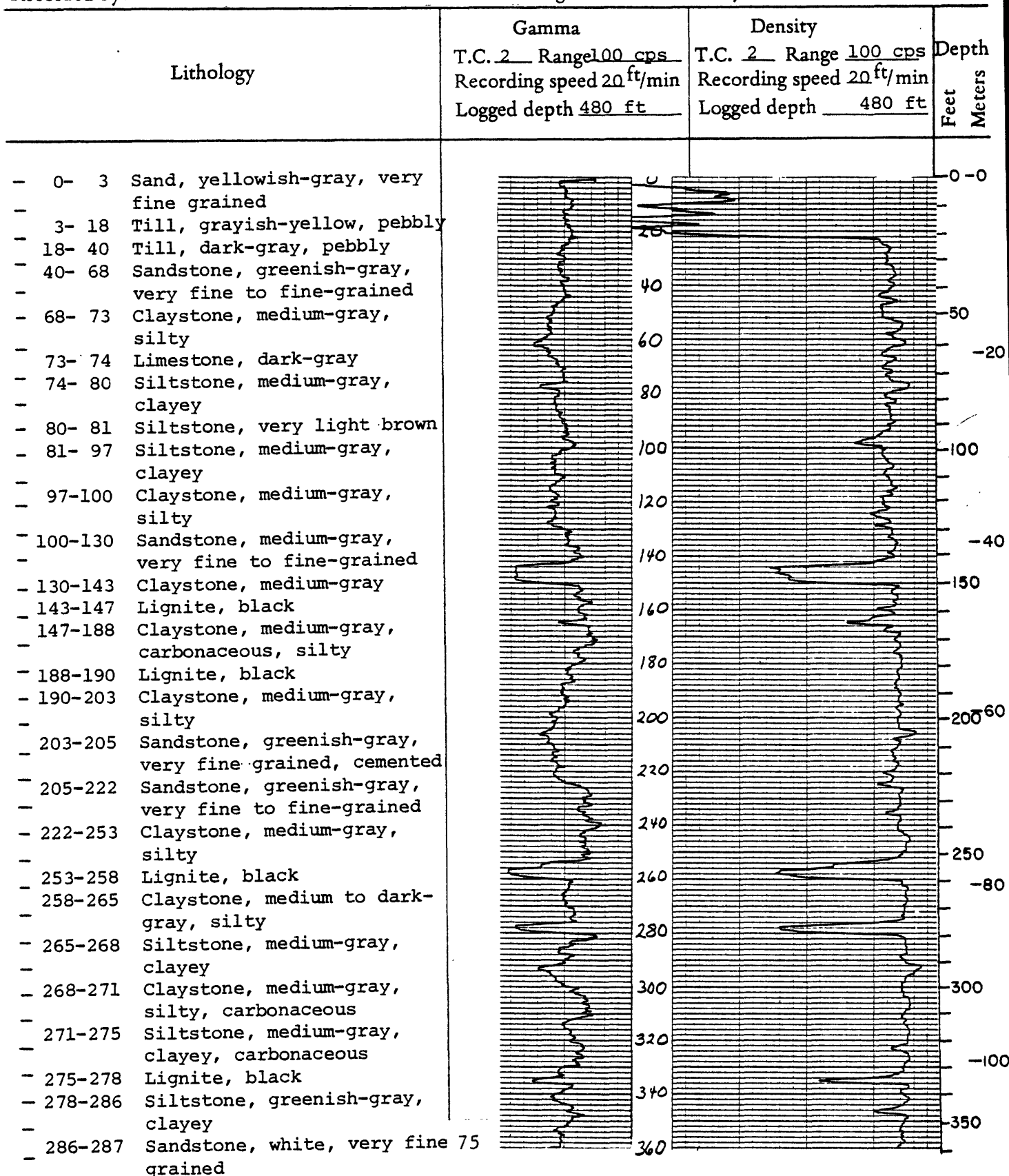
Lithology

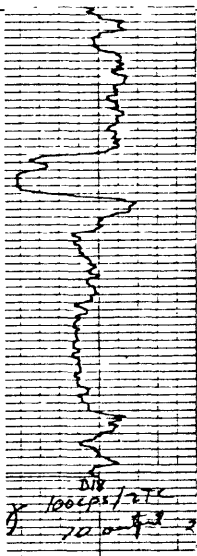
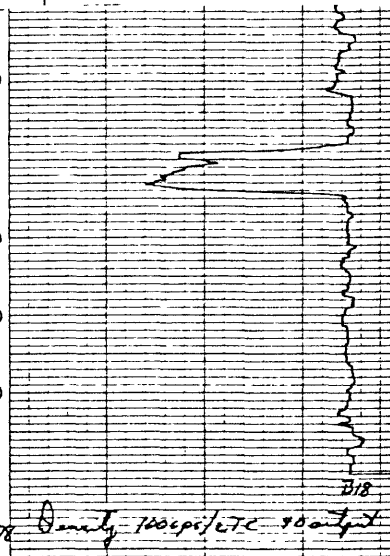
Recorded by: Randall Reichert

Geologist ^{Yes} ~~No~~

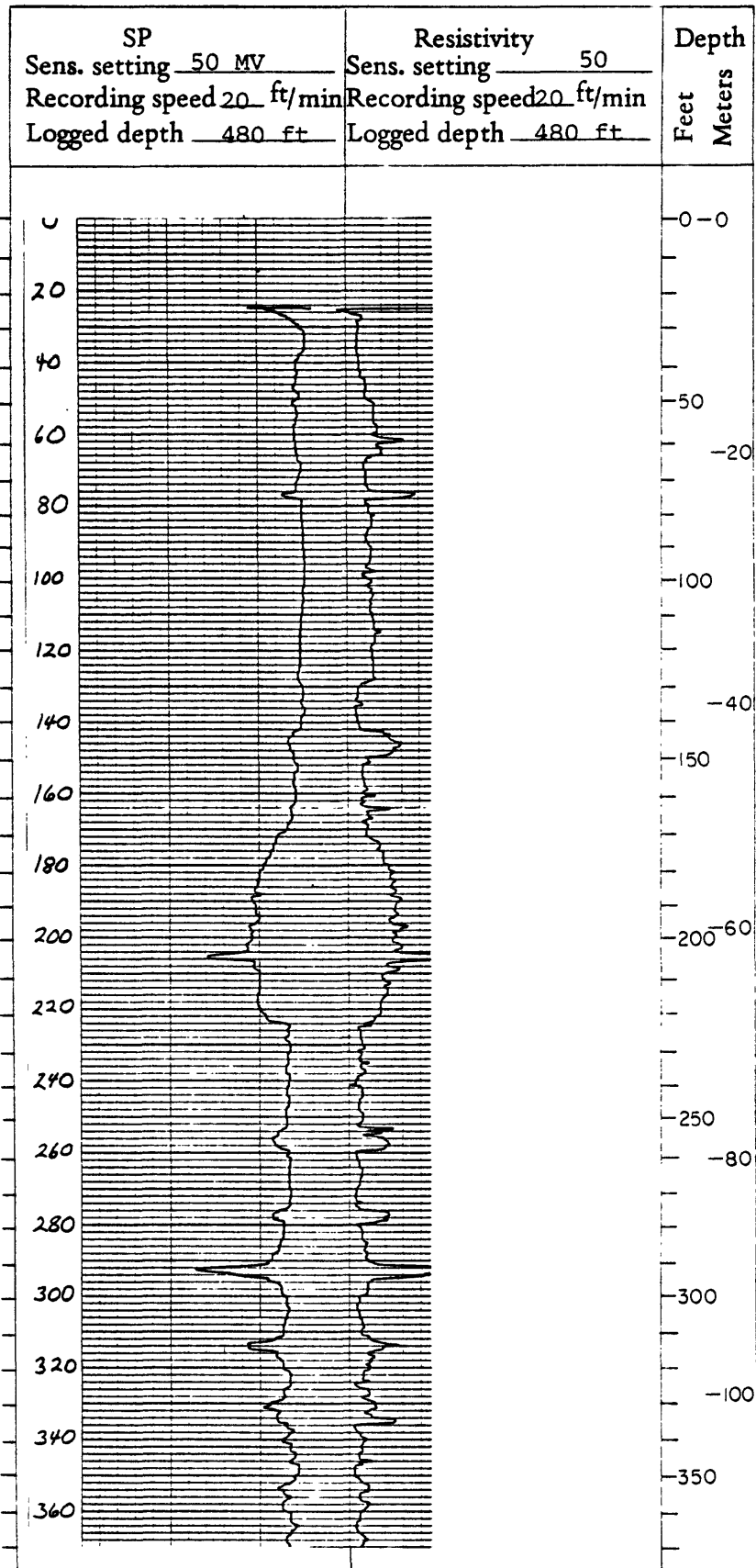
Geophysical logs

recorded by: Lechner



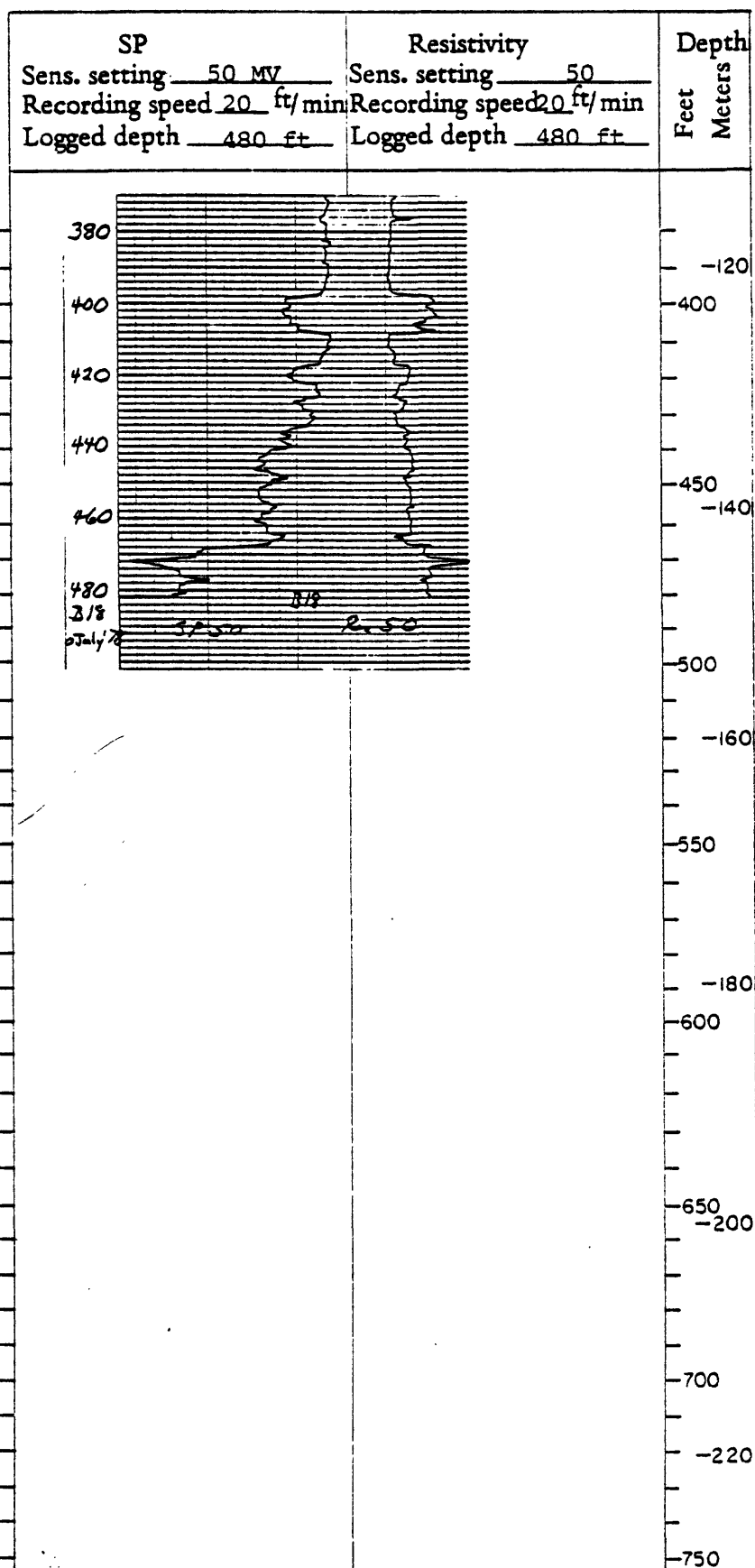
Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100 cps</u>	T.C. <u>2</u> Range <u>100 cps</u>	Fect	
	Recording speed <u>20 ft/min</u>	Recording speed <u>20ft/min</u>	Meters	
	Logged depth <u>480 ft</u>	Logged depth <u>480 ft</u>		
- 287-289 Sandstone, light-gray, very fine grained, cemented				
- 289-300 Sandstone, greenish-gray, very fine grained			380	-120
- 300-320 Claystone, light-gray			400	400
- 320-331 Siltstone, medium-gray, clayey			420	
- 331-334 Claystone, green, silty, carbonaceous			440	
- 334-342 Claystone, greenish-gray, silty			460	450
- 342-392 Claystone, medium-gray, silty, carbonaceous			480	-140
- 392-397 Lignite, black			500	
- 397-400 Claystone, medium-to dark-gray, silty			518	
- 400-407 Lignite, black			538	500
- 407-410 Siltstone, medium-gray, clayey, carbonaceous				-160
- 410-480 Sandstone, greenish-gray, very fine to fine-grained				550
-				-180
-				600
-				650
-		-200		
-		700		
-		-220		
-		750		

Hole number BU-18



Hole number—continued

BU-18



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-19 Map: Beaver Lake Date: 7-20-78 State: ND County: Burke
 Elev.: 2355 ft Location: T. 161^N, R. 92^W, Sec. 7, Tract: dddc Drilled depth: 720 ft.
 Measured: 100 ft ^{FSL} 1060 ft ^{FEL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 266-268; 288-290; 318-320; 326-330; 401-408; 556-565; 698-708

Remarks: _____

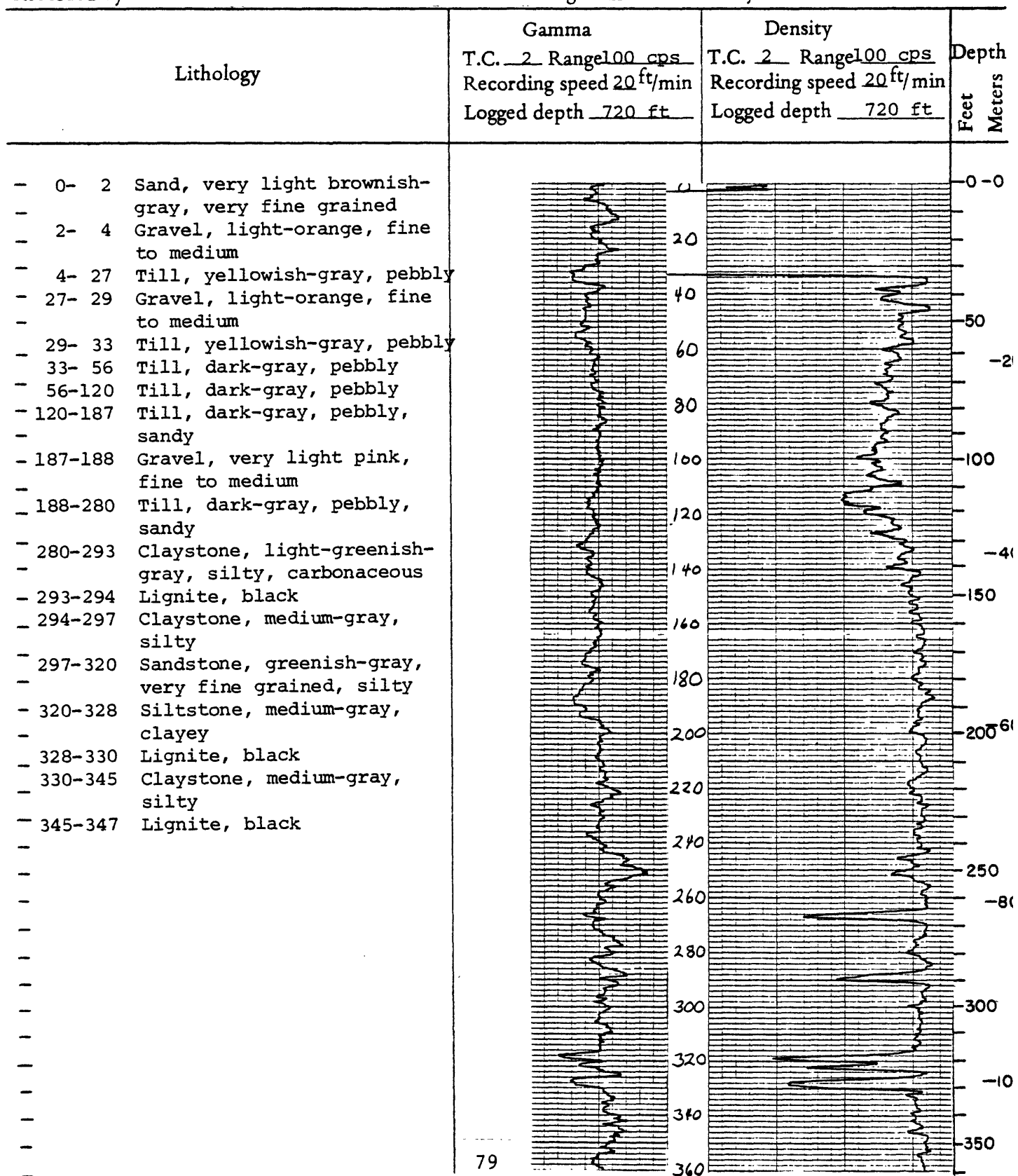
Lithology

Recorded by: Randall Reichert

Geologist ^{Yes} ~~XX~~

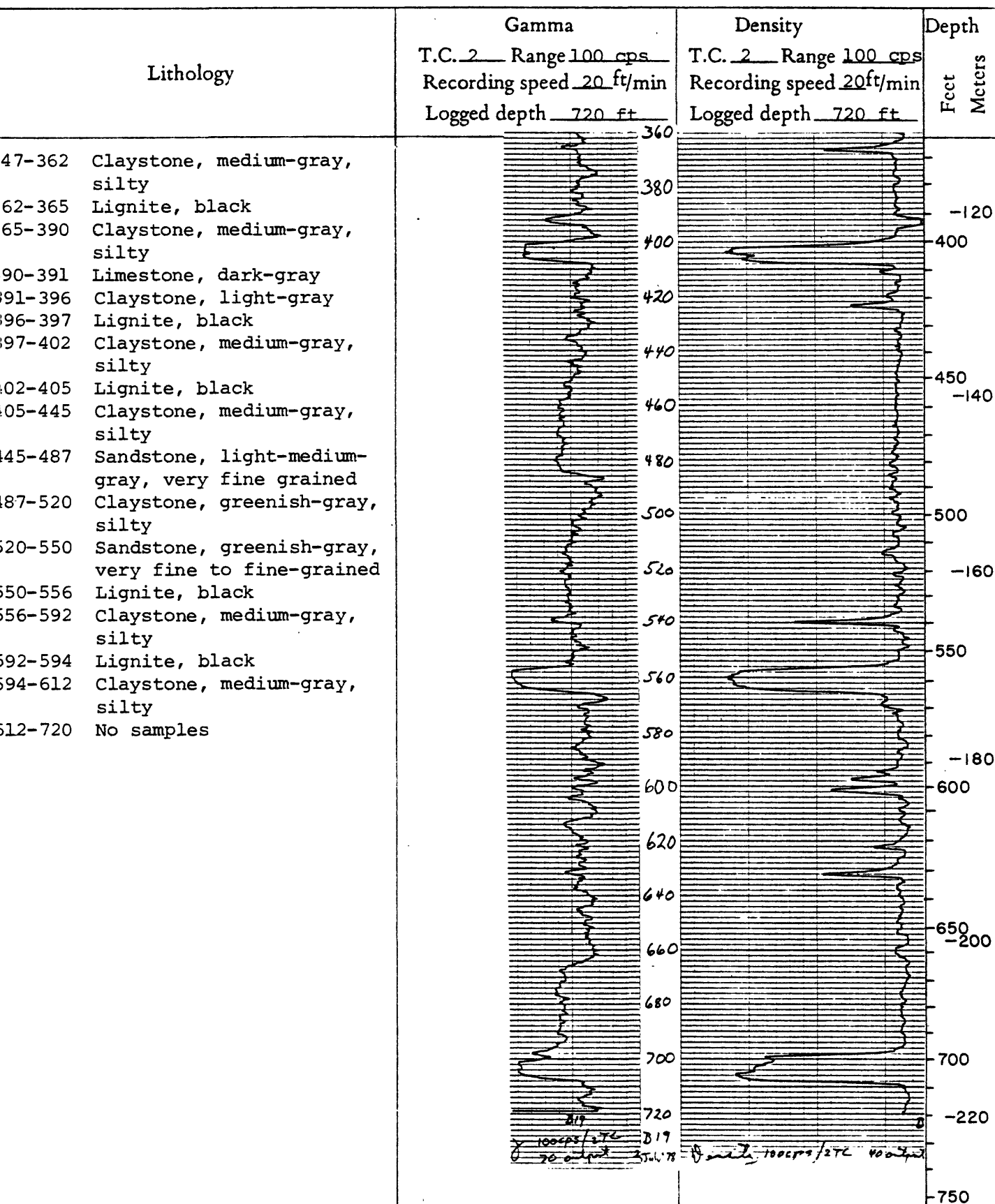
Geophysical logs

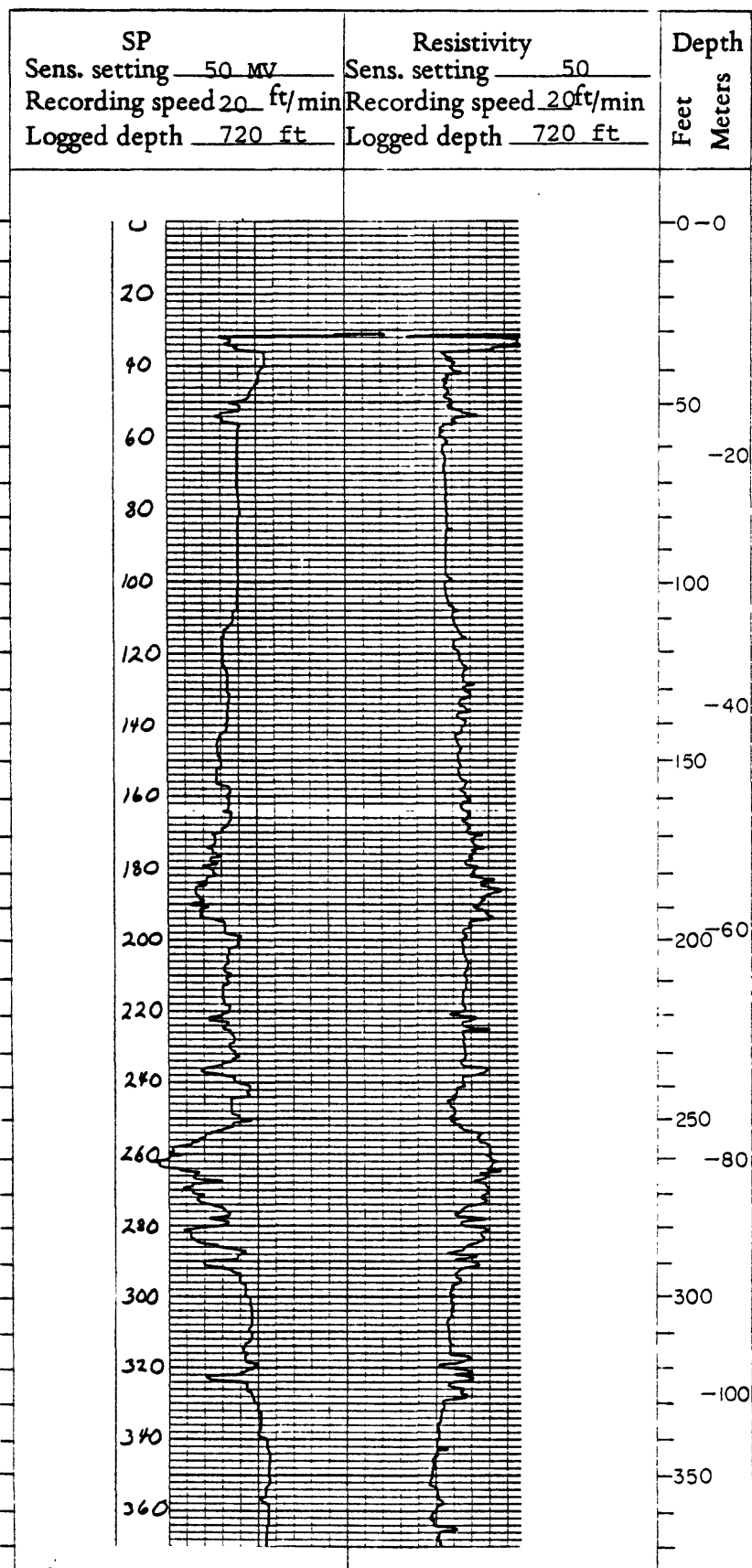
recorded by: Lechner



Hole number—continued

BU-19





BU-19



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-20 Map: Beaver Lake Date: 7-19-78 State: ND County: Burke
 Elev.: 2054 ft Location: T. 162^N, R. 92^W, Sec. 31, Tract: accc Drilled depth: 420 ft
 Measured: 2630 ft^{FNL}, 2390 ft^{FEL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 26-29; 108-116; 145-148; 214-217; 220-224; 228-232; 350-361

Remarks: _____

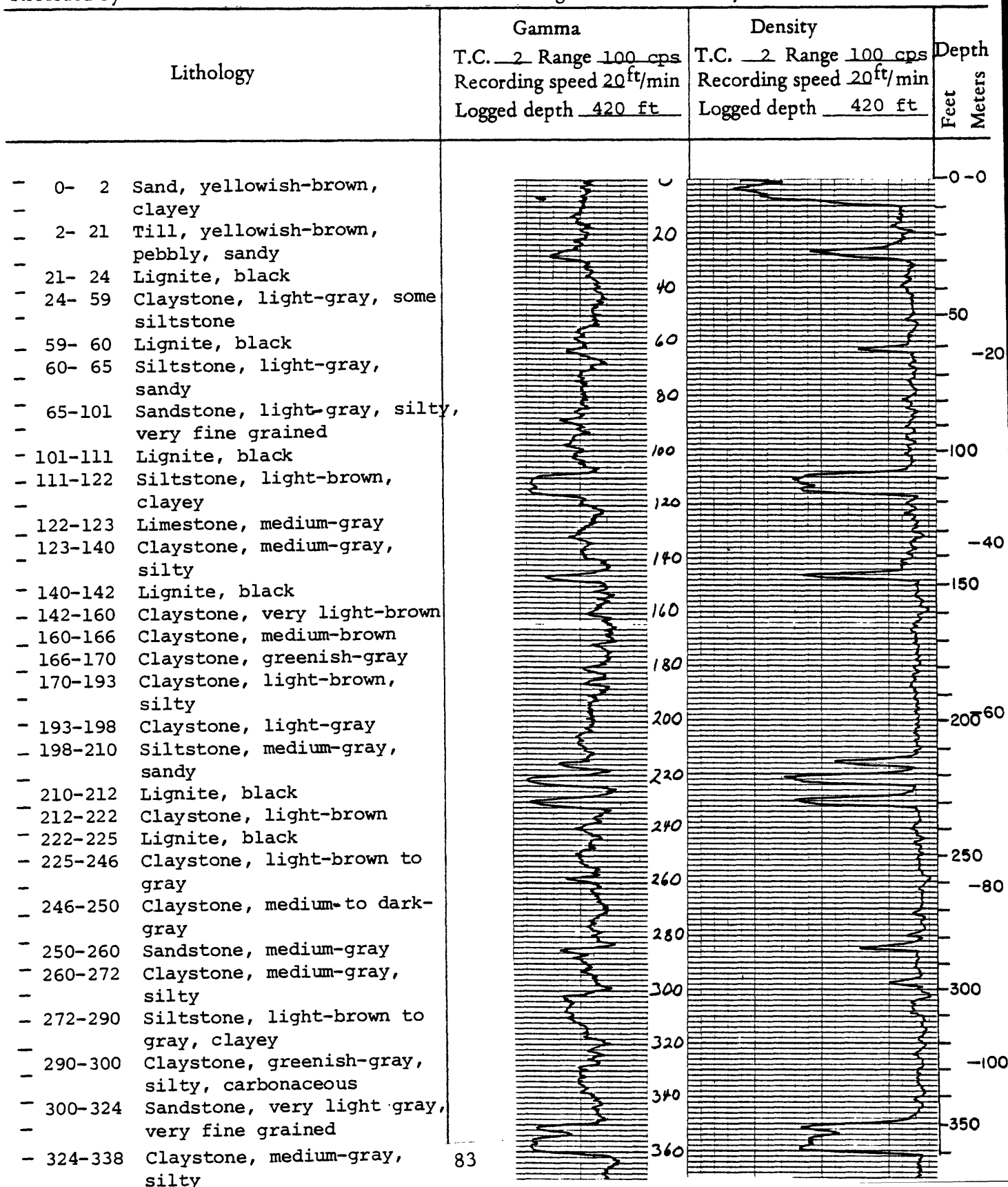
Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes}_{NA}

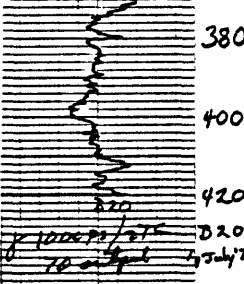
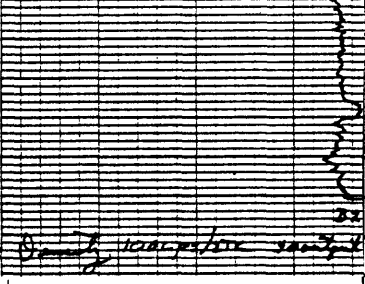
Geophysical logs

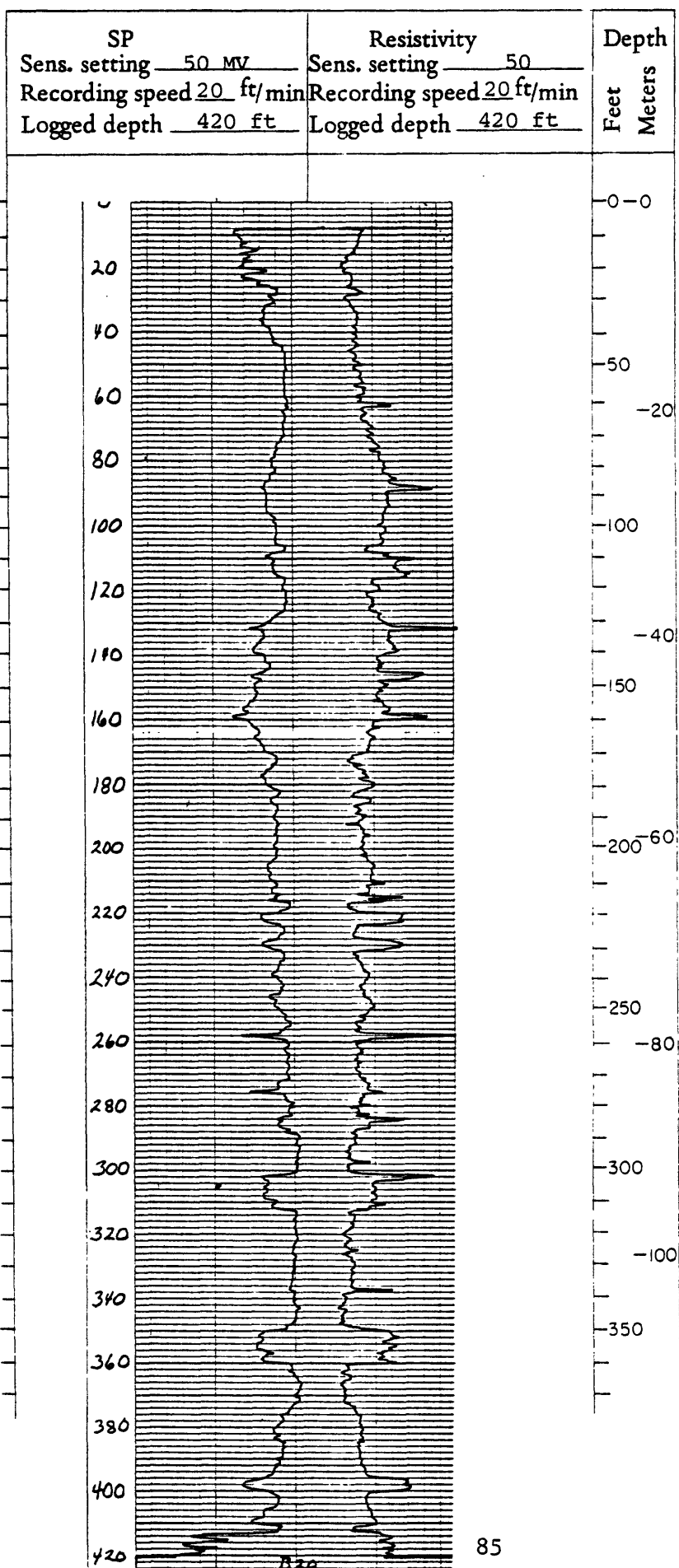
recorded by: Lechner



Hole number—continued

BU-20

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>420 ft.</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>420 ft.</u>	Depth	
			Feet	Meters
38-351 Sandstone, medium-gray, silty, poorly sorted, very fine grained			-120	
51-354 Lignite, black			400	
54-360 Claystone, medium-brown, carbonaceous				
60-390 No samples				
90-400 Sandstone, light-gray, poorly sorted, silty, very fine grained				
00-420 No samples			450	
			-140	
			500	
			-160	
			550	
			-180	
			600	
			650	
			-200	
			700	
			-220	
			750	



BU-20

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NORTH DAKOTA GEOLOGICAL SURVEY

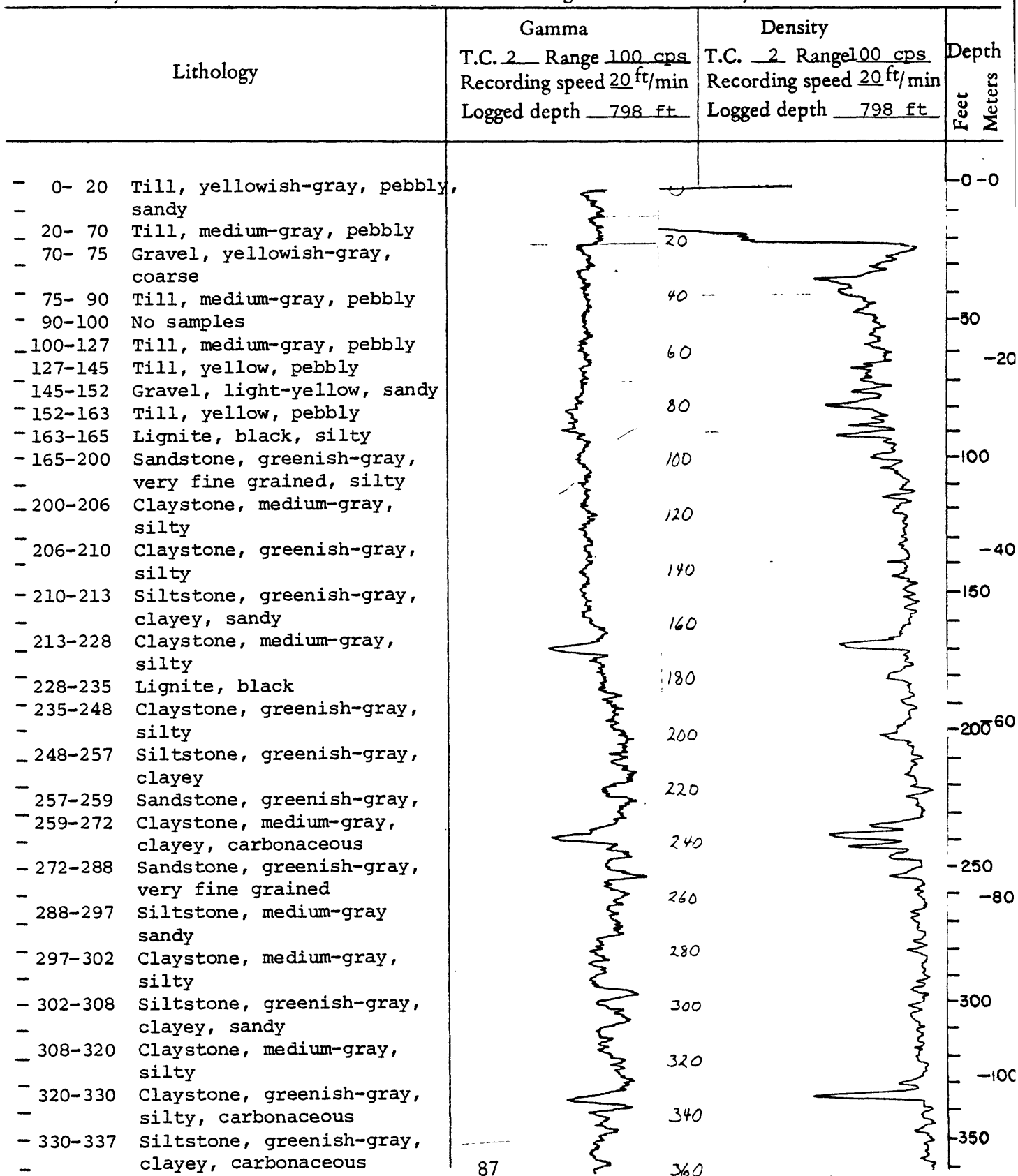
Hole No: BU-21 Map: Beaver Lake Date: 6-29-78 State: ND County: Burke
 Elev.: 2425 ft Location: T. 161 ^N, R. 93 ^W, Sec. 11, Tract: ccch Drilled depth: 800 ft.
 Measured: 396 ft. ~~FSL~~, 9 ft. ~~FWL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 166-169; 236-238; 332-334; 407-414; 497-504; 521-523; 613-621;
760-770

Remarks: _____

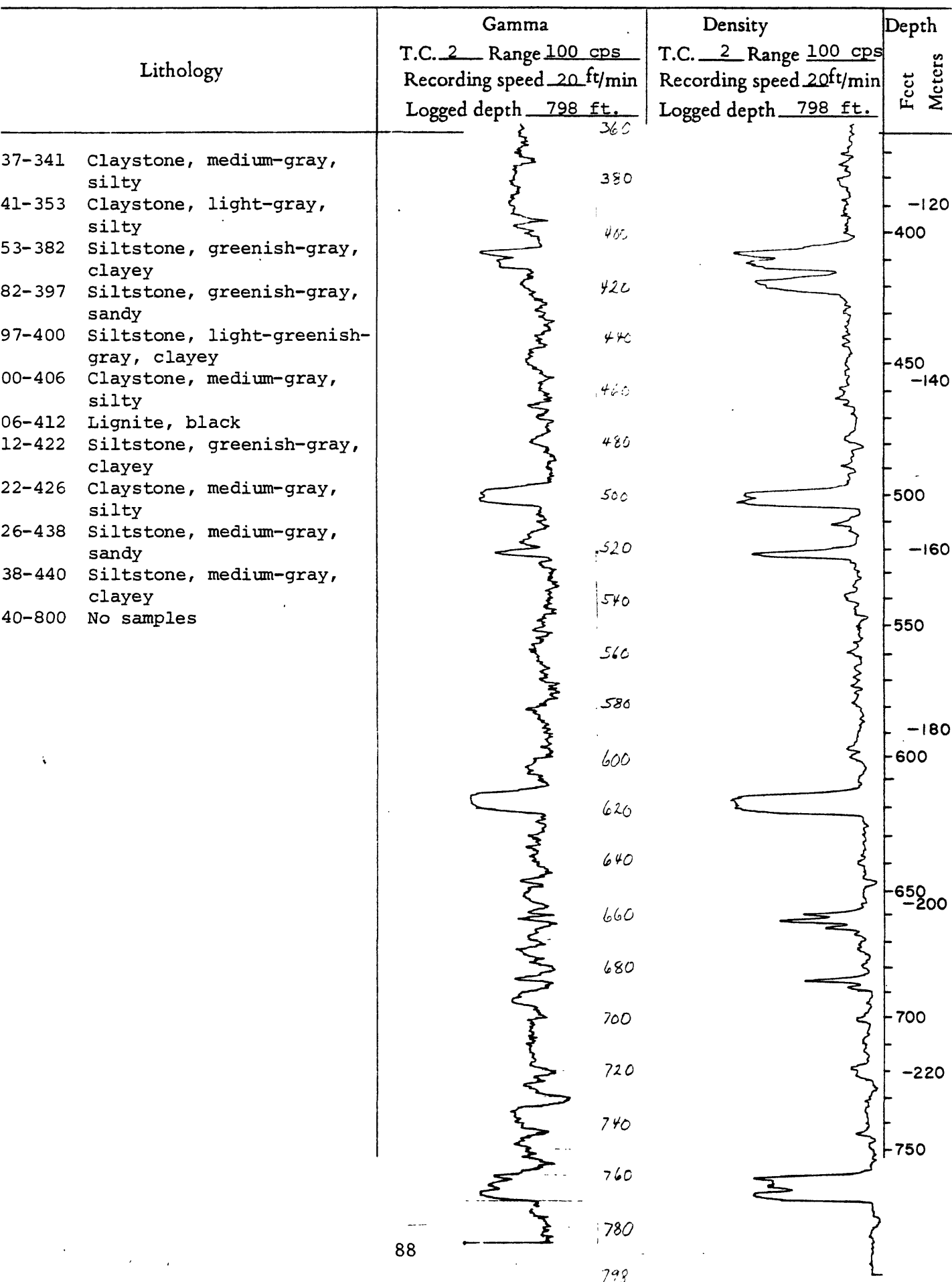
Lithology

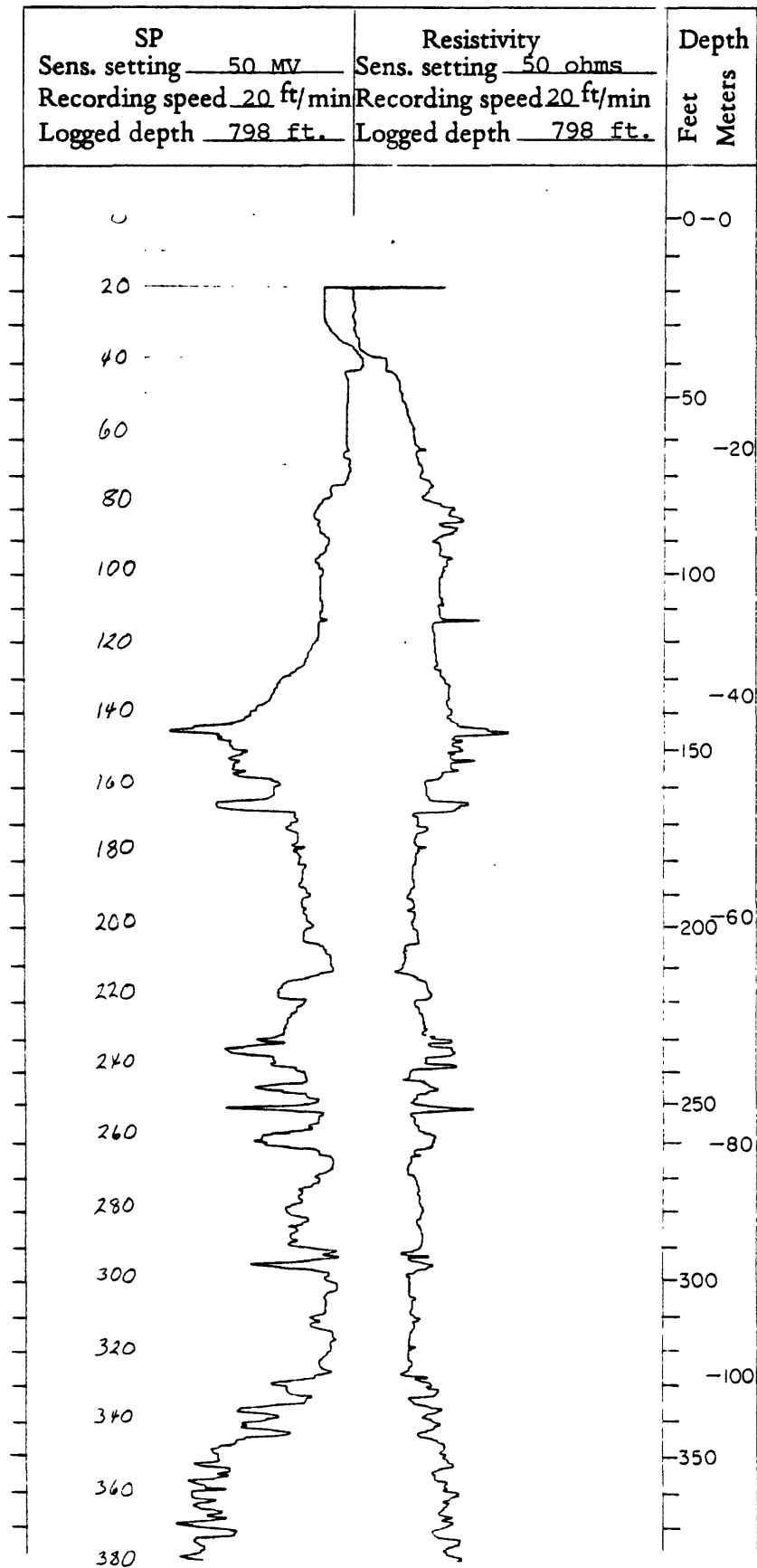
Recorded by: Randall ReichertGeologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner

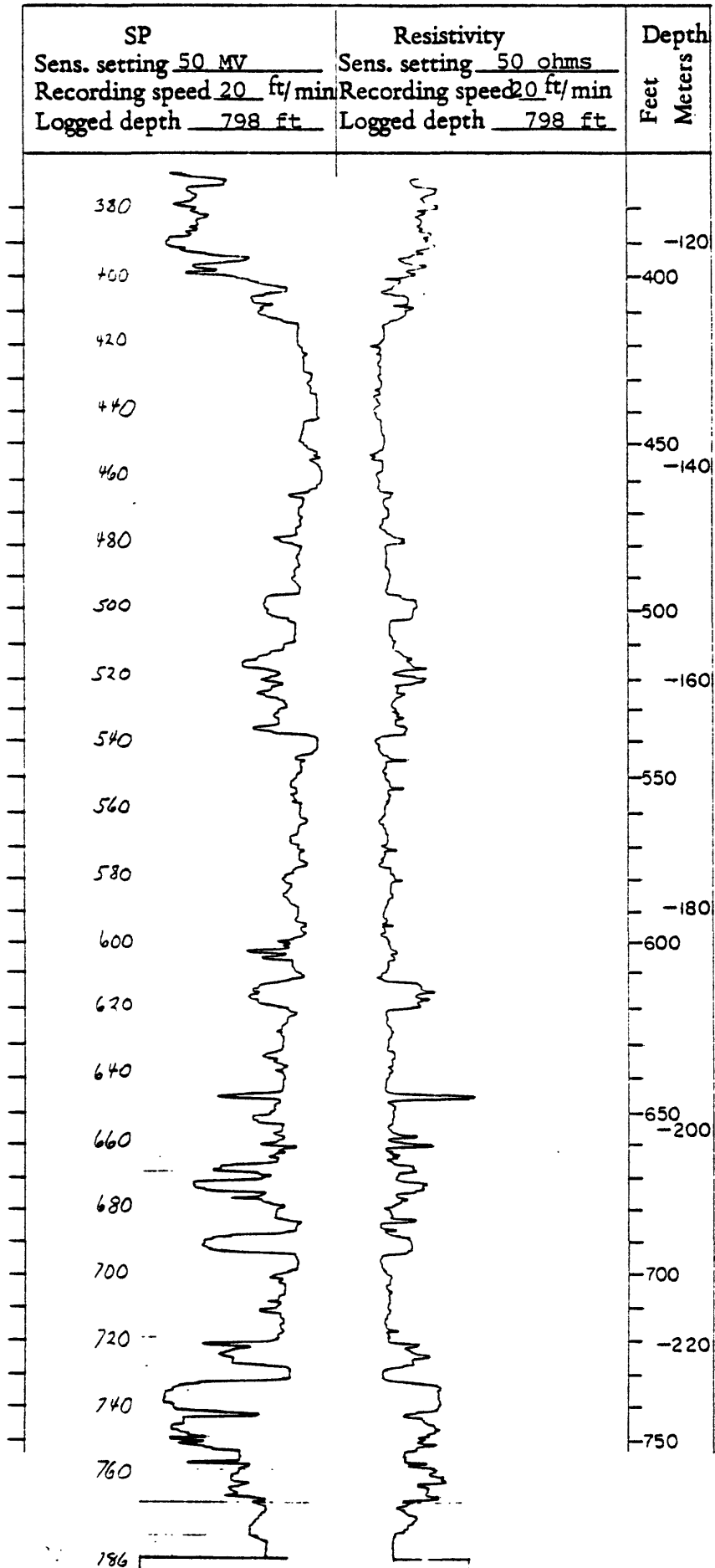
Hole number—continued
BU-21





Hole number—continued

BU-21



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-22 Map: Columbus SE Date: 6-30-78 State: ND County: Burke
 Elev.: 2350 ft Location: T. 161 ^N_S, R. 93 ^E_W, Sec. 5, Tract: cbcb Drilled depth: 720 ft
 Measured: 1740 ft ^{FSL}_{FWL}, 48 ft ^{FSL}_{FWL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 298-306; 381-386; 508-515; 550-553; 625-629; 637-640

Remarks: _____

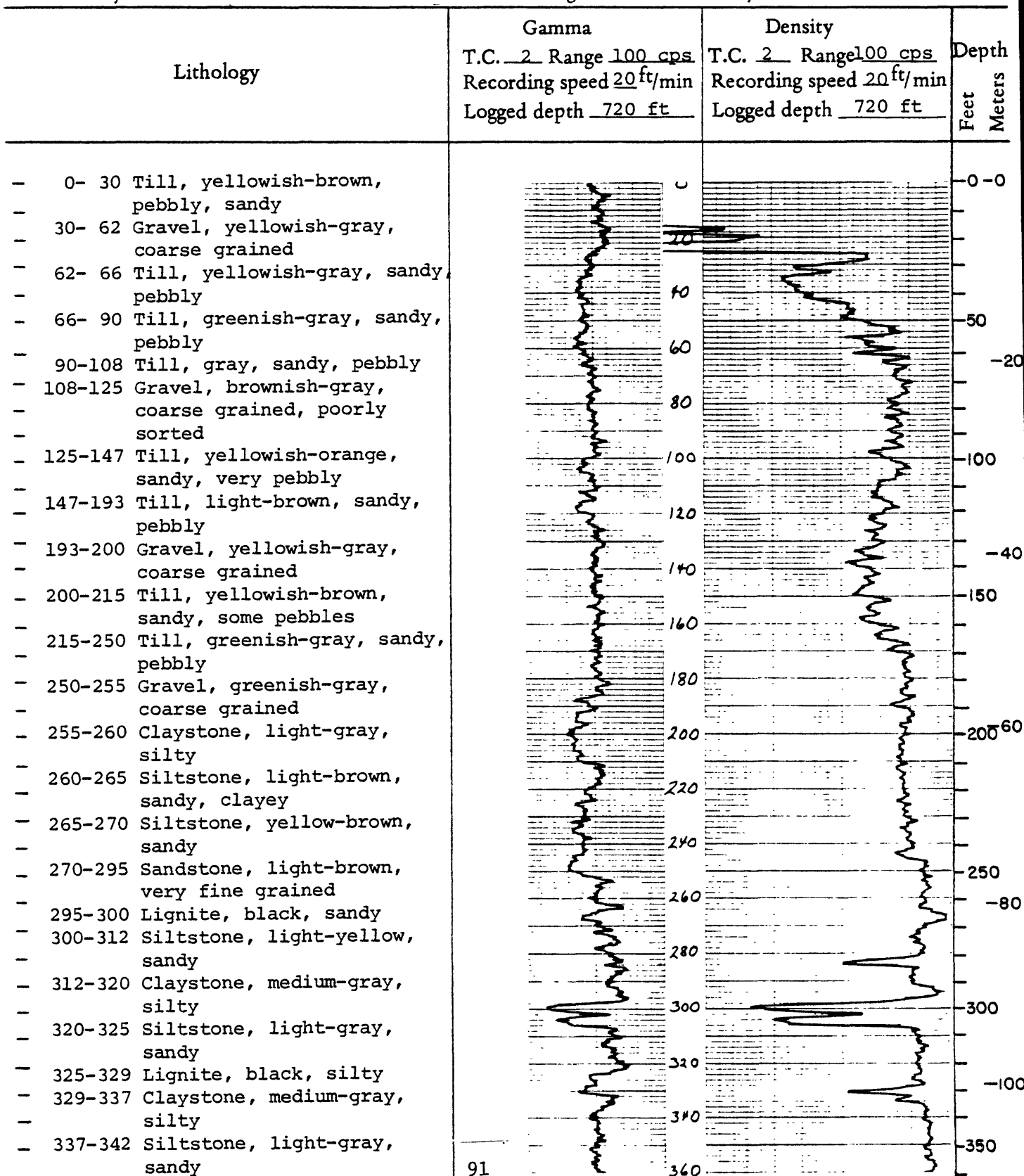
Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes}_{No}

Geophysical logs

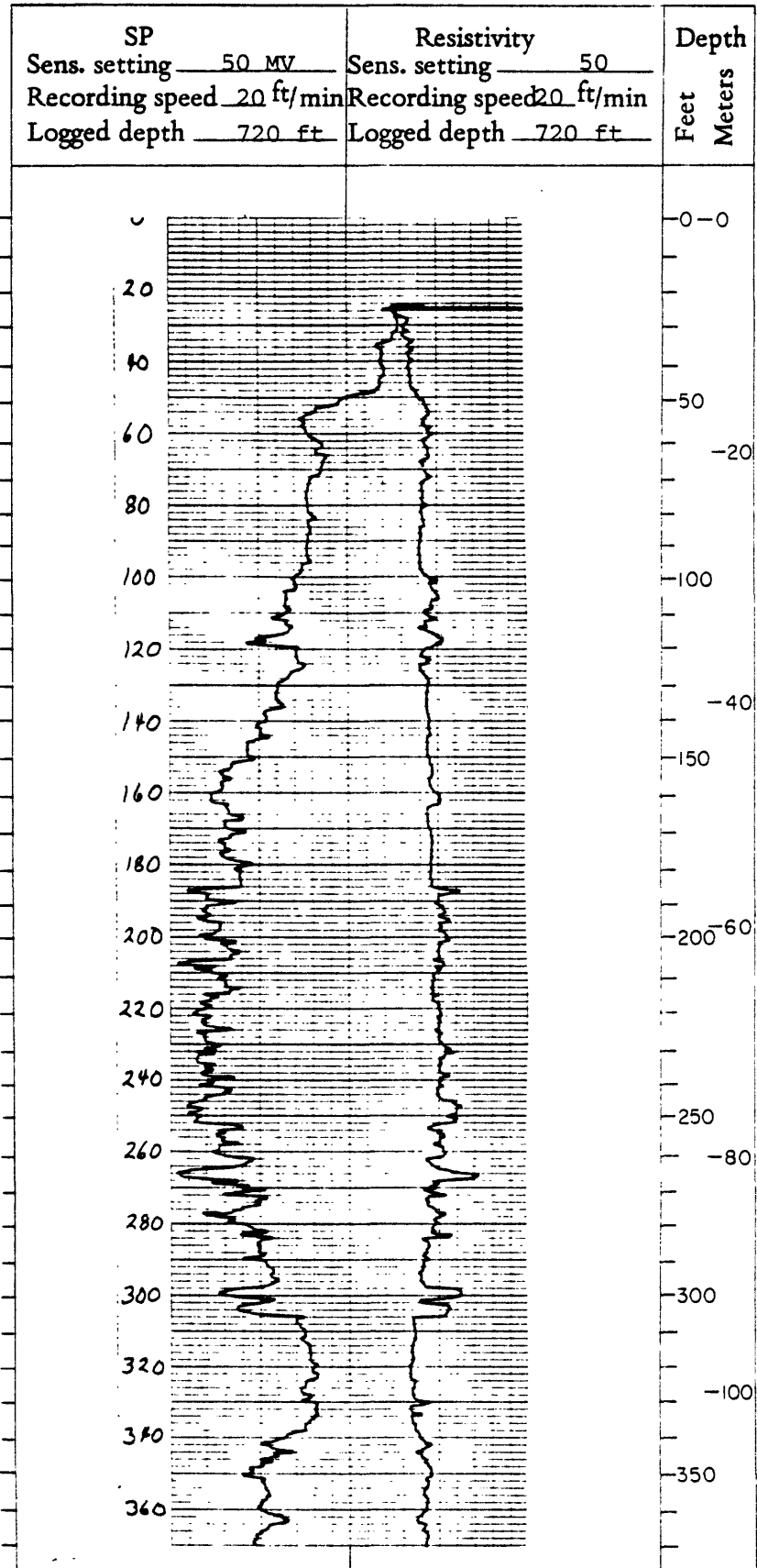
recorded by: Lechner



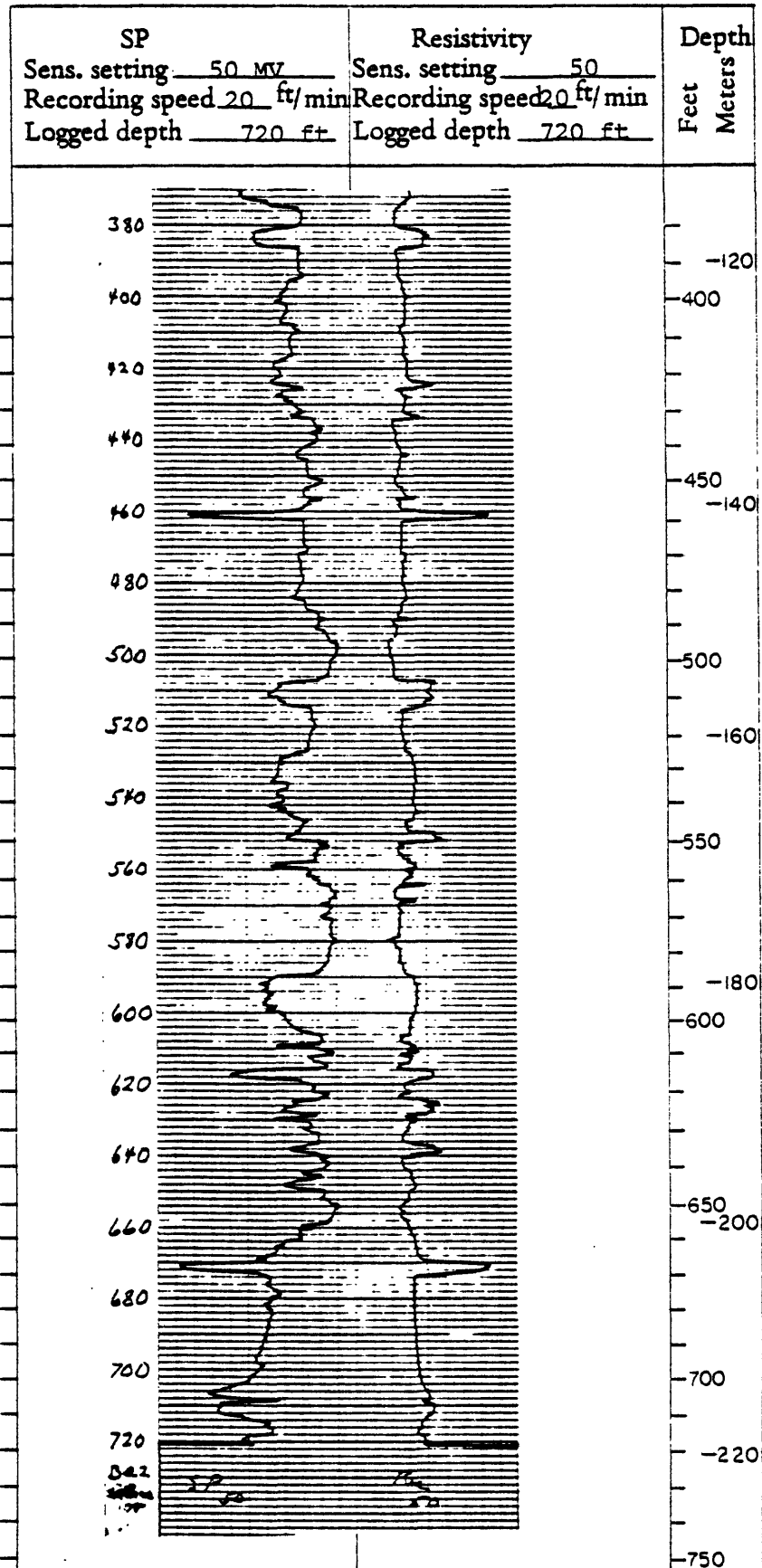
Hole number—continued

BU-22

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fect	Meters
	Recording speed	20 ft/min	Recording speed	20 ft/min		
	Logged depth	720 ft.	Logged depth	720 ft.		
342-355 Sandstone, light-gray, sandy						
355-360 Claystone, medium-gray, sandy					-120	
360-368 Sandstone, medium-gray, very fine grained					400	
368-375 Sandstone, light-gray, fine grained						
375-380 Claystone, light-gray, silty						
380-385 Lignite, black					450	
385-388 Sandstone, yellow-brown, medium-grained					-140	
388-403 Sandstone, light-gray, fine grained						
403-406 Claystone, light-gray, silty					500	
406-420 Sandstone, light-gray, very fine grained					-160	
420-424 Lignite, black, clayey						
424-427 Claystone, medium-gray, silty					550	
427-435 Sandstone, medium-gray, some pebbles, very fine grained						
435-440 Sandstone, bright-green, very fine grained					-180	
440-450 Siltstone, light-brown, sandy					600	
450-453 Sandstone, bright-green, very fine grained						
453-460 Sandstone, light-gray, very fine grained						
460-470 Siltstone, greenish-gray, clayey					650	
470-475 Claystone, light-brown and interbedded green, sandy					-200	
475-480 Siltstone, light-brown, sandy						
480-483 Claystone, light-green, silty					700	
483-490 Siltstone, light-brown, sandy					-220	
490-505 Sandstone, greenish-gray, very fine grained						
505-508 Lignite, black, clayey					-750	
508-510 Claystone, light-gray						
510-515 Lignite, black						



Hole number—continued
BU-22



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-23 Map: Columbus SE Date: 6-30-78 State: ND County: Burke
 Elev.: 2390 ft Location: T. 161 ^N, R. 94 ^E, Sec. 11, Tract: aaab Drilled depth: 760 ft
 Measured: 342 ft ^{FNL} ~~342~~, 4 ft ^{FEL} ~~4~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 337-344; 408-414; 467-470; 539-547; 569-572; 683-686; 703-706

Remarks: _____

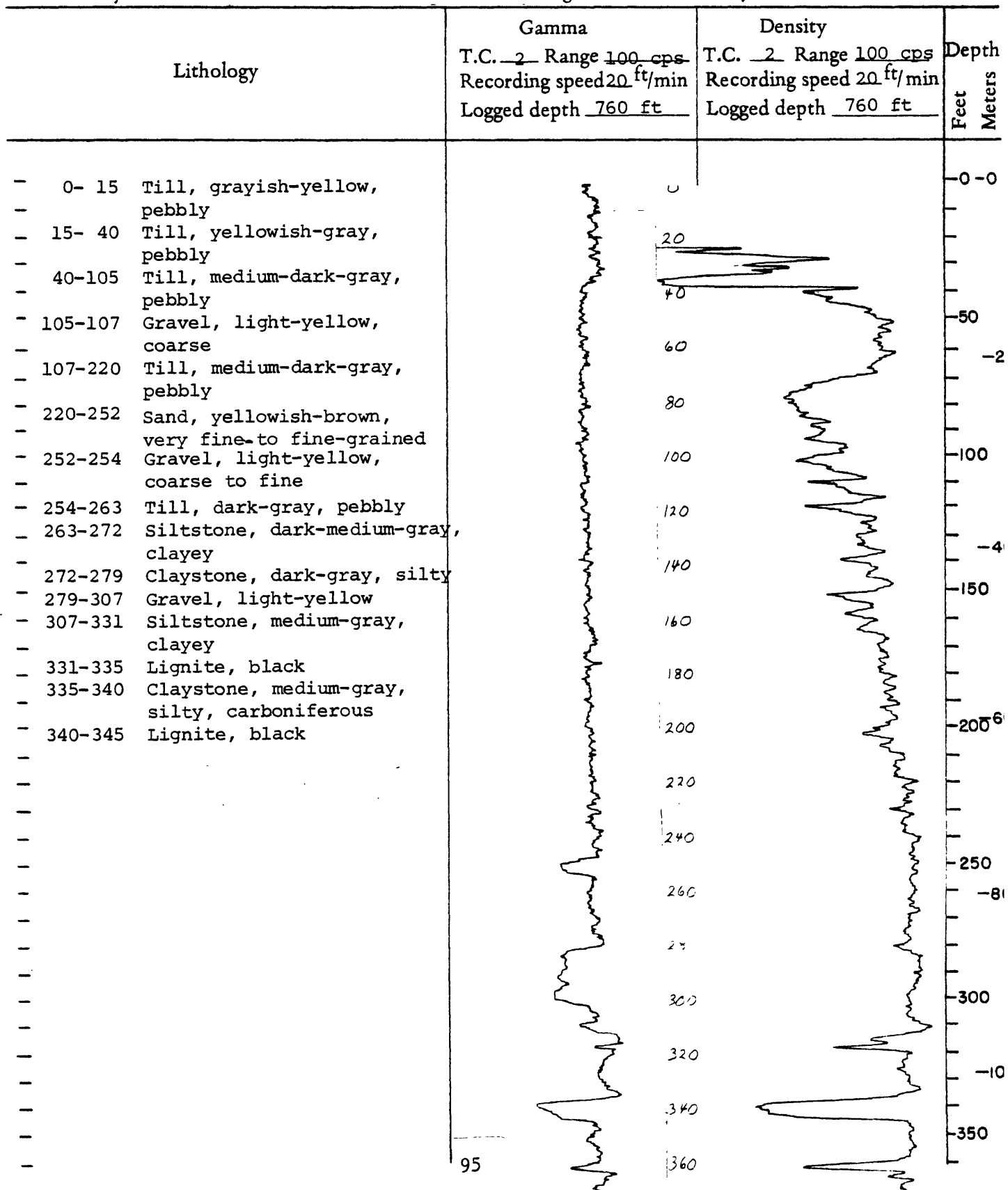
Lithology

Recorded by: Randall Reichert

Geologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner



Hole number—continued

BU-23

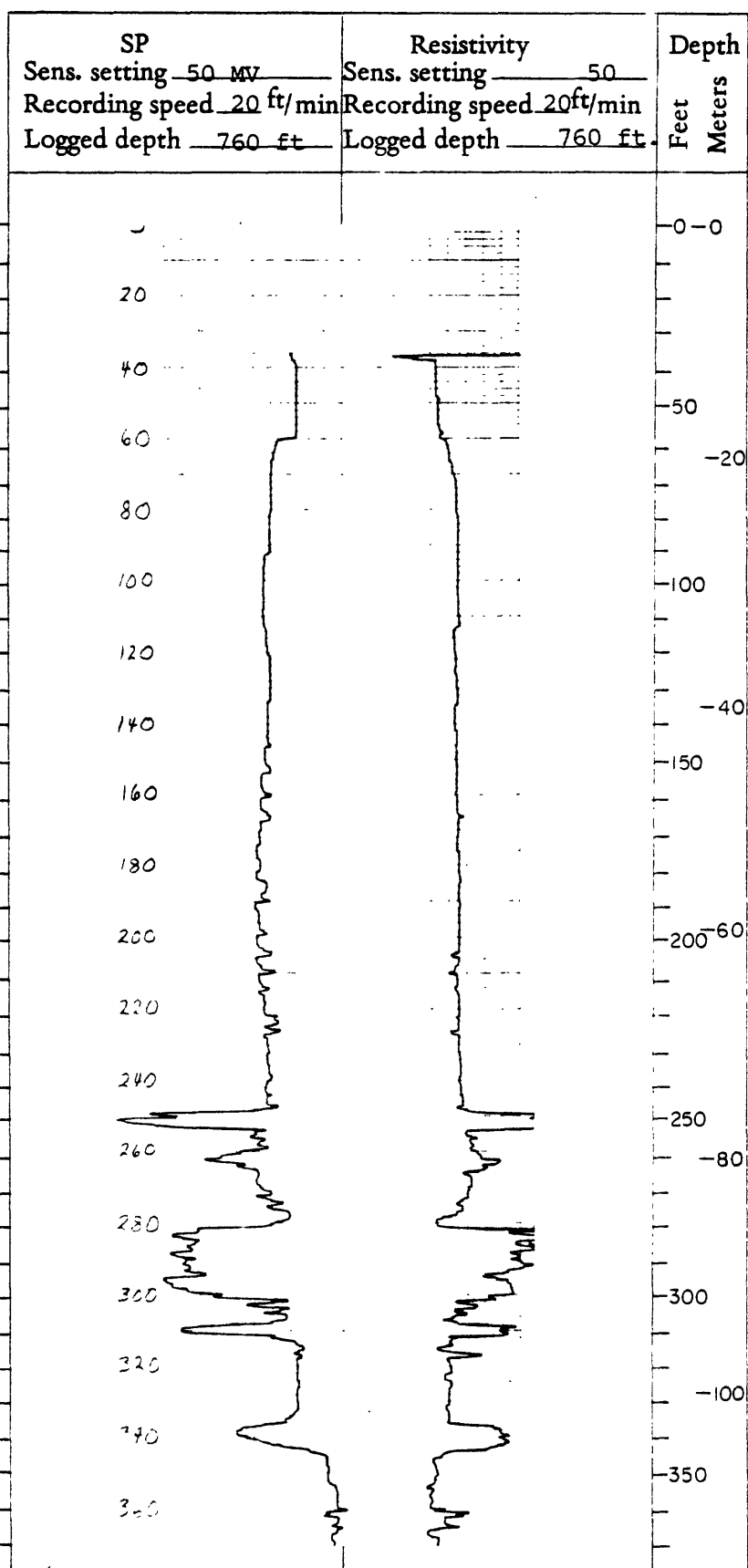
Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Feet	Meters
	Recording speed 20 ft/min		Recording speed 20ft/min			
	Logged depth 760 ft		Logged depth 760 ft			
		360				
345-357 Siltstone, medium-gray, silty, carboniferous		380				
357-370 Sandstone, greenish-gray, very fine grained		400			-120	
370-380 Siltstone, greenish-gray, sandy		420			400	
380-405 Sandstone, greenish-gray, very fine to fine-grained, silty		440				
405-407 Siltstone, medium-gray, clayey		460			450	
407-410 Lignite, black		480			-140	
410-421 Siltstone, greenish-gray, clayey		500				
421-426 Lignite, black		520				
426-432 Siltstone, medium-gray, clayey		540			500	
432-433 Limestone, medium-gray		560				
433-446 Siltstone, greenish-gray, carbonaceous		580			-160	
446-454 Claystone, medium-gray, carbonaceous		600				
454-462 Siltstone, greenish-gray, clayey		620			550	
462-464 Lignite, black		640				
464-484 Siltstone, green, clayey		660				
484-488 Siltstone, olive, sandy		680			-180	
488-496 Siltstone, medium-gray, clayey		700			600	
496-497 Sandstone, greenish-gray, cemented		720				
497-498 Claystone, white		740				
498-500 Siltstone, greenish-gray, clayey		760			-650	
500-516 Claystone, medium-gray, silty, carbonaceous		780			-200	
516-517 Sandstone, greenish-gray, very fine grained		800				
517-520 Siltstone, medium-gray, clayey		820			-700	
520-532 Sandstone, greenish-gray, very fine to fine-grained		840				
532-534 Lignite, black		860			-220	
534-540 Sandstone, greenish-gray, very fine to fine-grained		880				
540-546 Lignite, black		900			-750	
546-564 Claystone, medium, silty carboniferous		920				

BU-23

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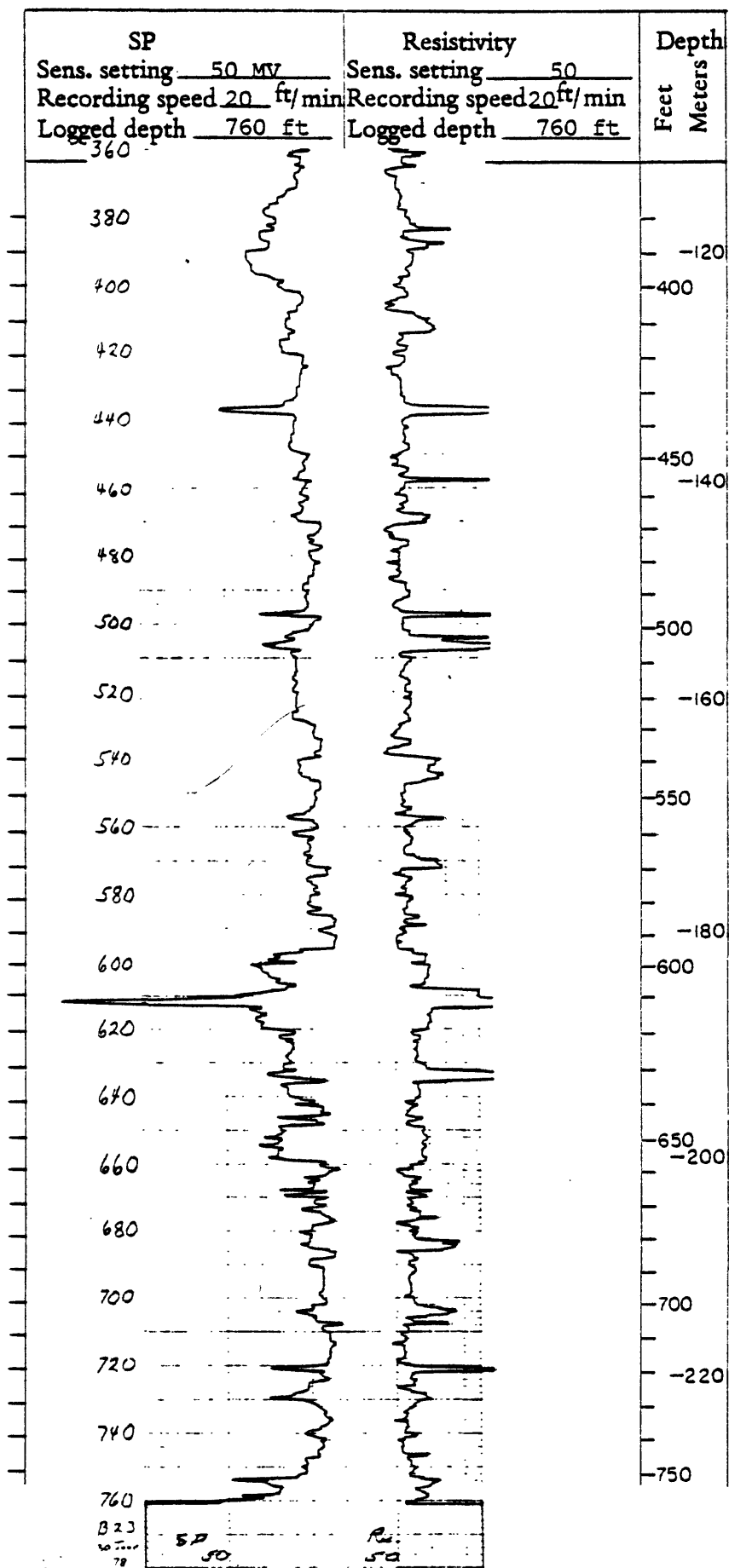
Hole No: _____ Map: _____ Date: _____ State: _____ County: _____
 Elev.: _____ Location: T. _____ N S, R. _____ E W, Sec. _____, Tract: _____ Drilled depth: _____
 Measured: _____ FNL FSL, _____ FEL FWL, Hole size: _____ Air ☐ Water ☐ Cored: Yes ☐ No ☐
 Lignite beds: _____

Lithology
Recorded by: _____ Geologist ^{Yes}_{No} Geophysical logs
recorded by: _____



Hole number—continued

BU-23



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-24 Map: Columbus SE Date: 7-6-78 State: ND County: Burke
 Elev.: 2090 ft Location: T. 162^N R. 93^W, Sec. 29, Tract: ccdd Drilled depth: 460 ft.
 Measured: 102 ft ~~FSL~~ ^{FSL}, 1200 ~~FWL~~ ^{FWL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 73-76; 110-116; 168-170; 251-258; 371-373; 385-388

Remarks: _____

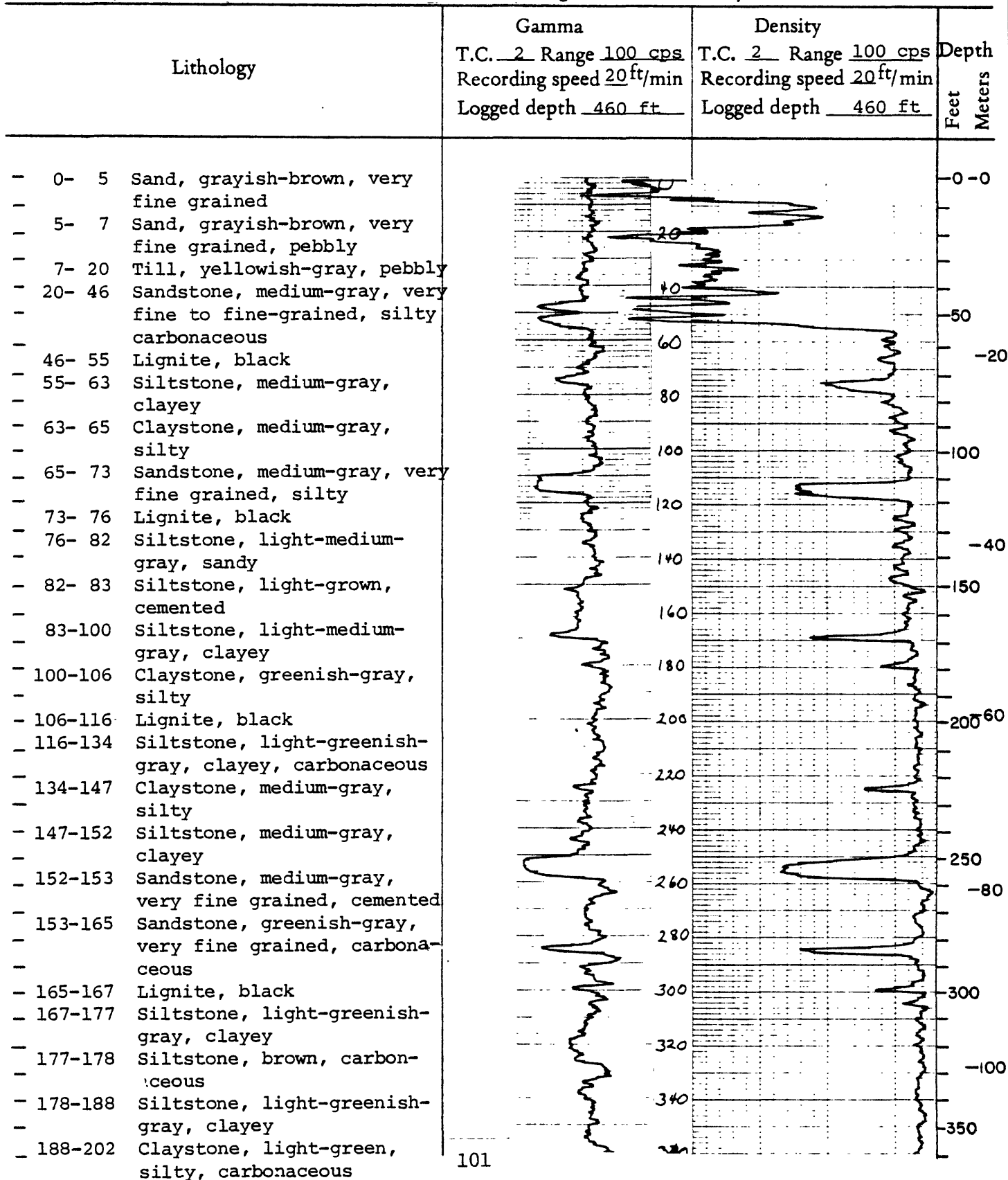
Lithology

Recorded by: Randall Reichert

Geologist ^{Yes} ~~No~~

Geophysical logs

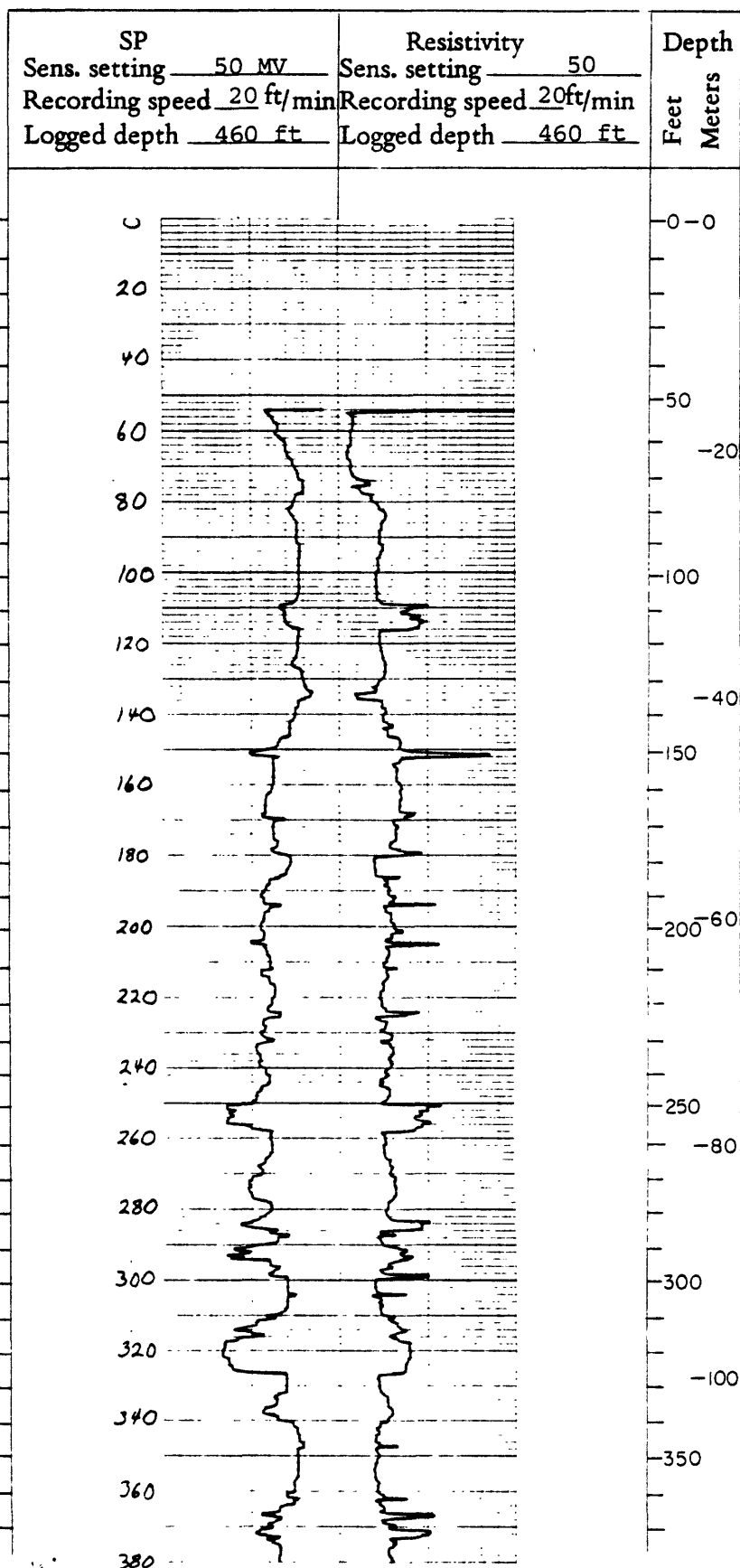
recorded by: Lechner



Hole number—continued

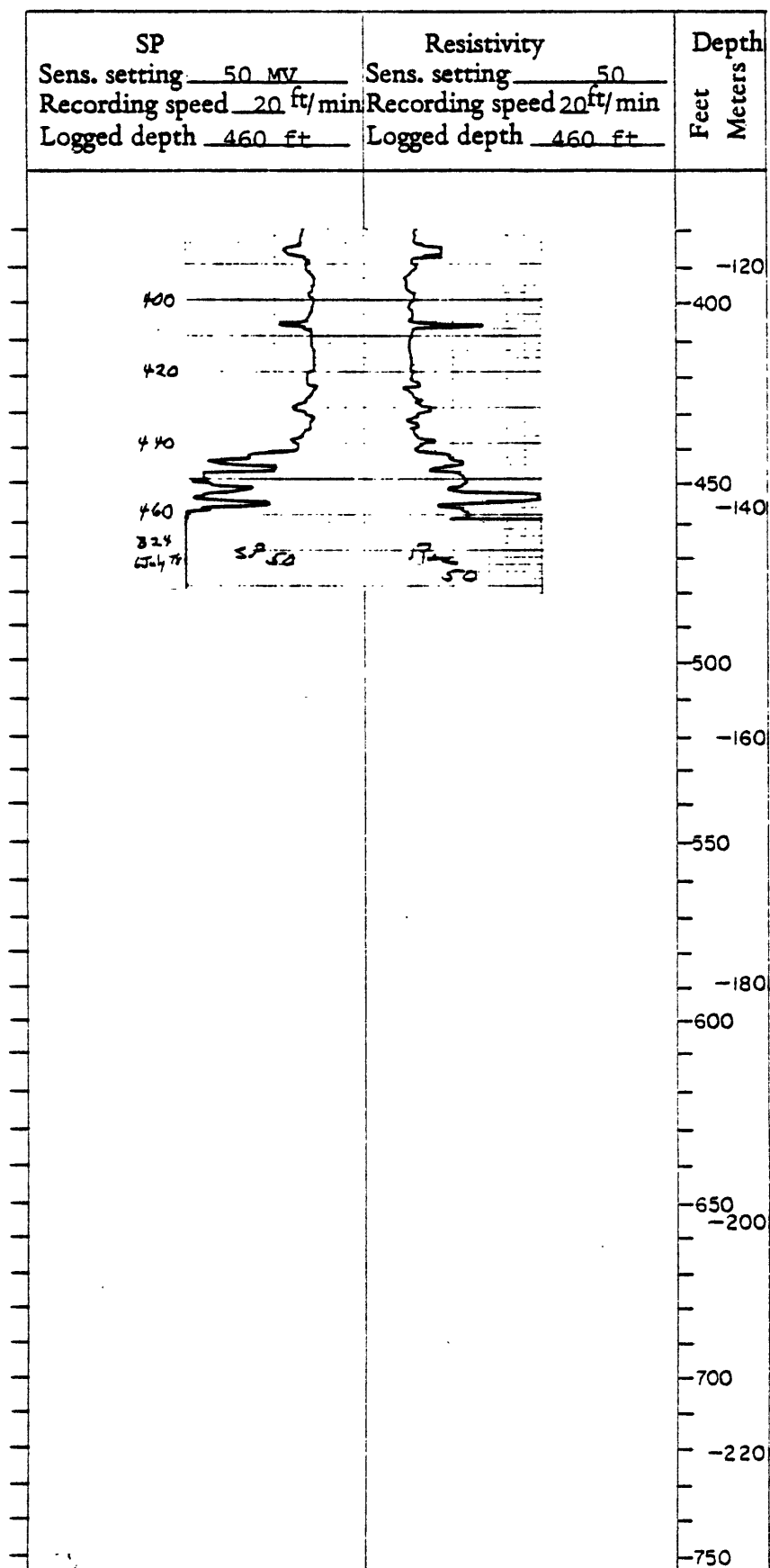
BU-24

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>460 ft.</u>	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>460 ft.</u>	Feet	Meters
202-203 Claystone, white				
203-220 Claystone, medium-gray, silty, carbonaceous			-120	
220-221 Claystone, white			400	
221-223 Lignite, black				
223-225 Siltstone, medium-gray, clayey				
225-240 Sandstone, greenish-gray, very fine grained				
240-241 Siltstone, very light brown; partially cemented			450	
241-248 Sandstone, medium-gray, very fine grained			-140	
248-253 Lignite, black				
253-257 Sandstone, greenish-gray, very fine grained				
257-261 Siltstone, light-greenish-gray, clayey, carbonaceous			500	
261-262 Lignite, black			-160	
262-278 Siltstone, greenish-gray, sandy, clayey, carbonaceous				
278-280 Claystone, medium-greenish-gray, silty, carbonaceous			550	
280-284 Lignite, black				
284-310 Siltstone, medium-gray, clayey, carbonaceous			-180	
310-332 Sandstone, greenish-gray, very fine grained			600	
332-340 Claystone, medium-gray, silty, carbonaceous				
340-341 Lignite, black				
341-360 Claystone, medium-gray, silty, carbonaceous				
360-366 Siltstone, greenish-gray, clayey			650	
366-368 Lignite, black			-200	
368-372 Claystone, olive, silty, carbonaceous				
372-375 Lignite, black				
375-383 Claystone, medium-gray, silty, carbonaceous			700	
383-387 Lignite, black			-220	
387-438 Claystone, greenish-gray, silty, carbonaceous				
438-439 Claystone, white			750	
439-451 Claystone, medium-gray, silty				
451-453 Limestone, dark-gray				
453-460 Siltstone, medium-gray, clayey				



Hole number—continued

BU-24



NORTH DAKOTA GEOLOGICAL SURVEY

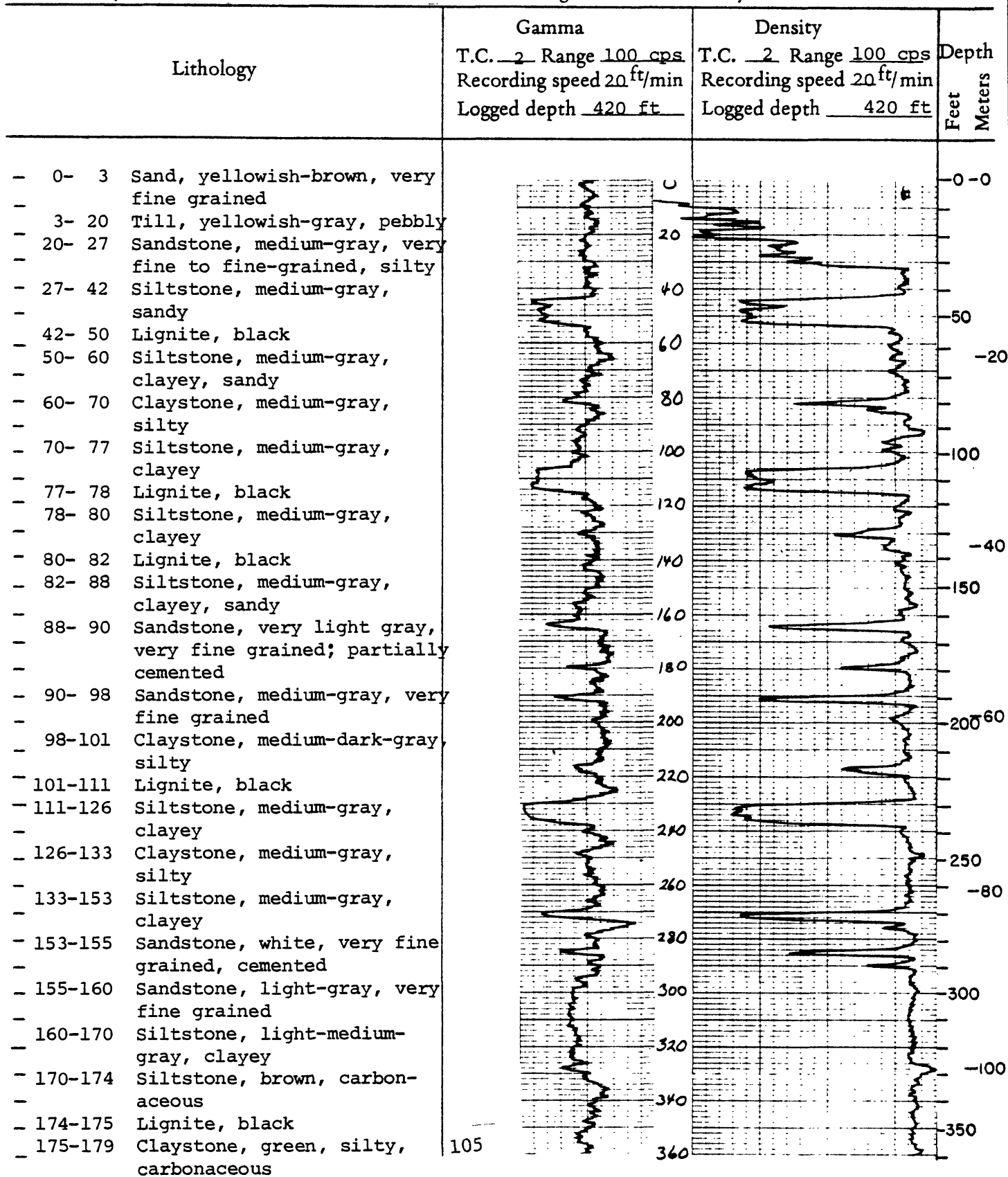
Hole No: BU-25 Map: Columbus SE Date: 7-6-78 State: ND County: Burke
 Elev.: 2075 ft Location: T. 162^N & R. 93^E W, Sec. 28, Tract: chbc Drilled depth: 420 ft
 Measured: 1056 ft ~~FSL~~ ^{FWL}, 6 ft ~~FWL~~ ^{FWL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 44-53; 106-115; 164-166; 190-192.5; 229-237; 270-273; 374-376;
378-380; 383-387

Remarks: _____

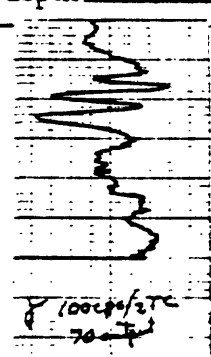
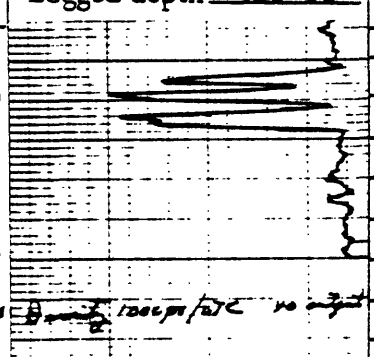
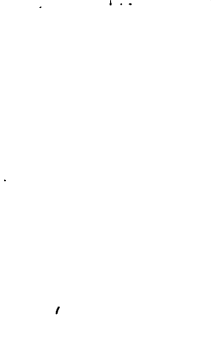

Lithology

Recorded by: Randall ReichertGeologist ^{Yes} ~~No~~

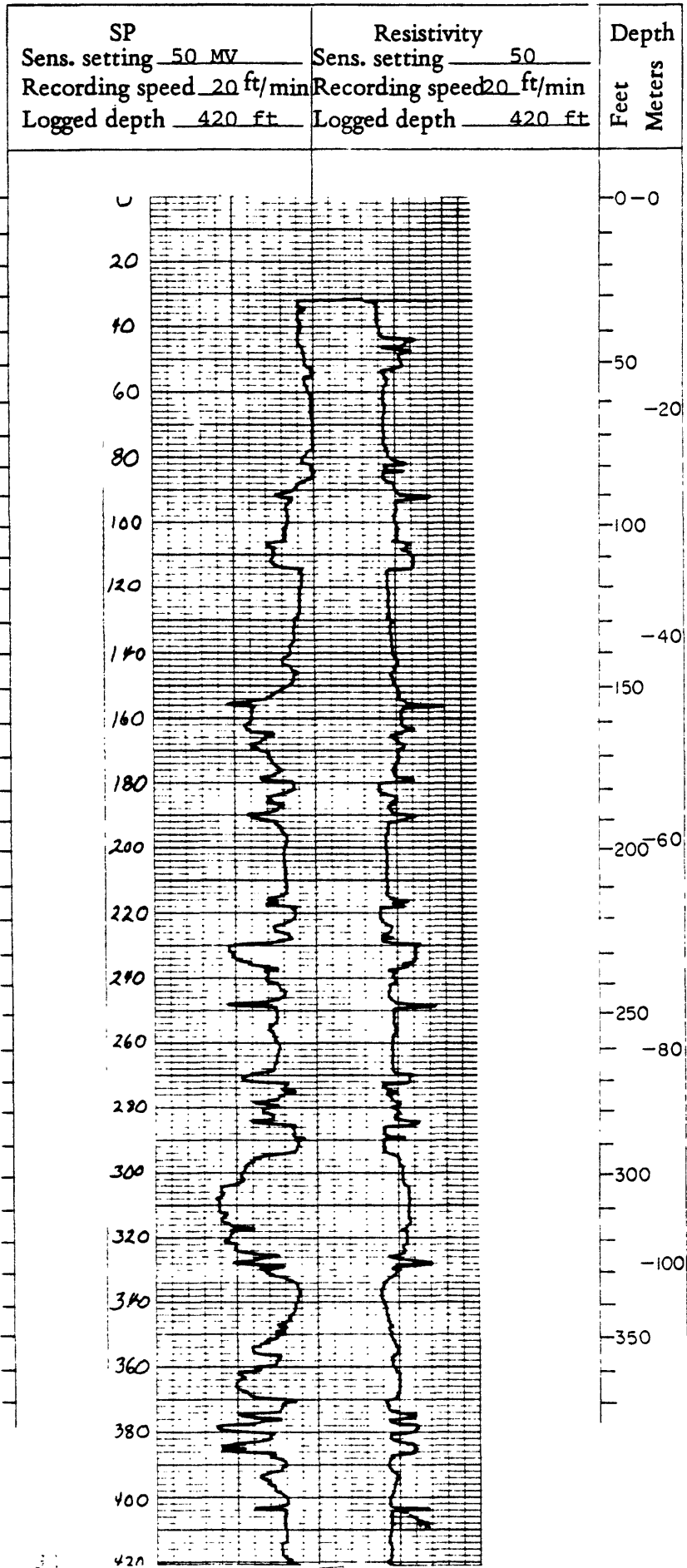
Geophysical logs

recorded by: Lechner

Hole number—continued
BU-25

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fcct	Meters
	Recording speed	20 ft/min	Recording speed	20ft/min		
	Logged depth	420 ft	Logged depth	420 ft		
179-187 Sandstone, greenish-gray, very fine grained						
187-188 Lignite, black					-120	
188-193 Siltstone, olive, carbonaceous, clayey					400	
193-197 Siltstone, brown, carbonaceous						
197-207 Siltstone, olive, clayey, sandy						
207-210 Claystone, olive, silty					450	
210-212 Lignite, black					-140	
212-220 Siltstone, green, clayey, carbonaceous						
220-225 Sandstone, green, very fine grained						
225-229 Lignite, black					500	
229-230 Claystone, green, silty, carbonaceous						
230-234 Lignite, black					-160	
234-240 Siltstone, greenish-gray, clayey, sandy						
240-242 Lignite, black					550	
242-267 Siltstone, greenish-gray, clayey, carbonaceous						
267-269 Lignite, black						
269-290 Siltstone, greenish-gray, clayey, sandy					-180	
290-332 Sandstone, greenish-gray, very fine grained					600	
332-335 Siltstone, greenish-gray, sandy						
335-340 Claystone, medium-gray, silty						
340-348 Sandstone, medium-greenish-gray, very fine grained					650	
348-357 Siltstone, light-green, clayey, sandy					-200	
357-367 Sandstone, medium-gray, very fine grained						
367-371 Lignite, black					700	
371-382 Claystone, medium-gray, silty, carbonaceous						
382-388 Lignite, black					-220	
388-393 Claystone, light-green, silty						
393-414 Siltstone, light-green, clayey					750	
414-420 Claystone, medium-gray, silty, carbonaceous						

Hole number BU-25



Hole number--continued
BU-25

SP		Resistivity		Depth	
Sens. setting	50 MV	Sens. setting	50	Feet	Meters
Recording speed	20 ft/min	Recording speed	20 ft/min		
Logged depth	420 ft	Logged depth	420 ft		
				-120	
				400	
				450	
				-140	
				500	
				-160	
				550	
				-180	
				600	
				650	
				-200	
				700	
				-220	
				750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No.: BU-26 Map: Beaver Lake Date: 7-7-78 State: ND County: Burke
 Elev.: 2018 ft Location: T. 162 ^N/_S, R. 93 ^E/_W, Sec. 27, Tract: bbbb Drilled depth: 400 ft
 Measured: 20 ft ^{FNL}/_{FSL}, 92 ft ^{FRL}/_{FWL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 76-78; 146-153; 197-199; 268-270; 272-275; 285-288

Remarks: _____

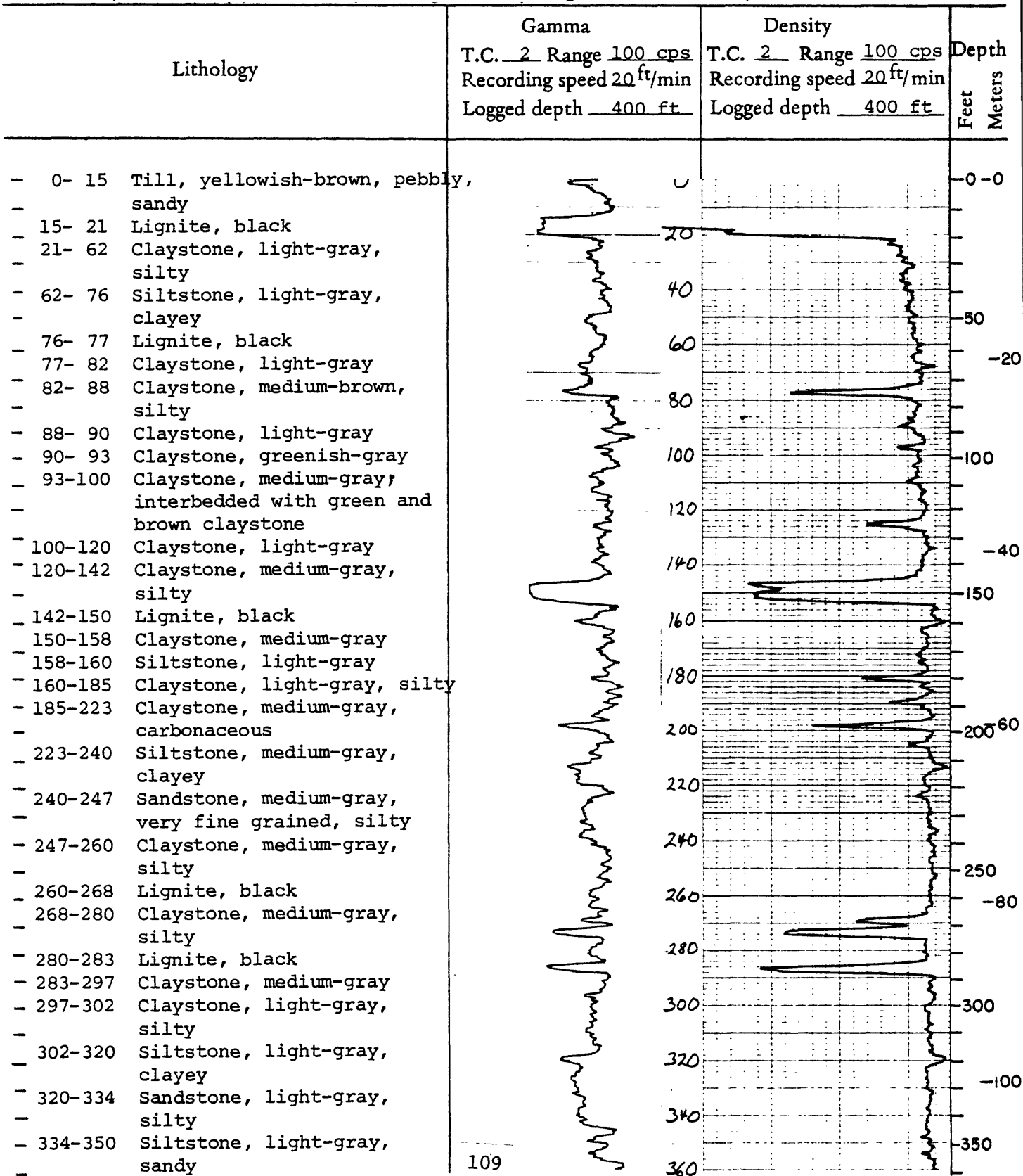
Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes}/_{No}

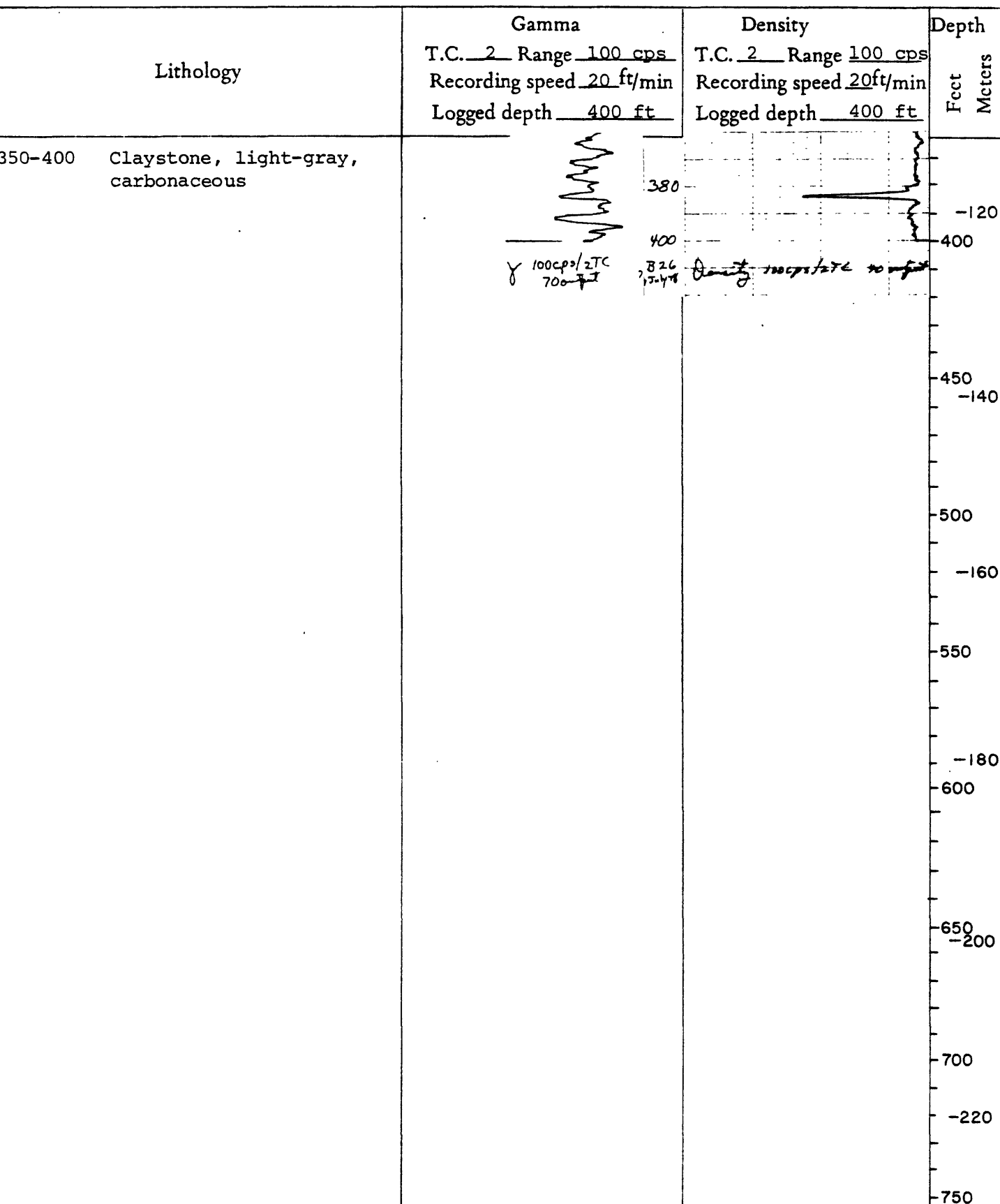
Geophysical logs

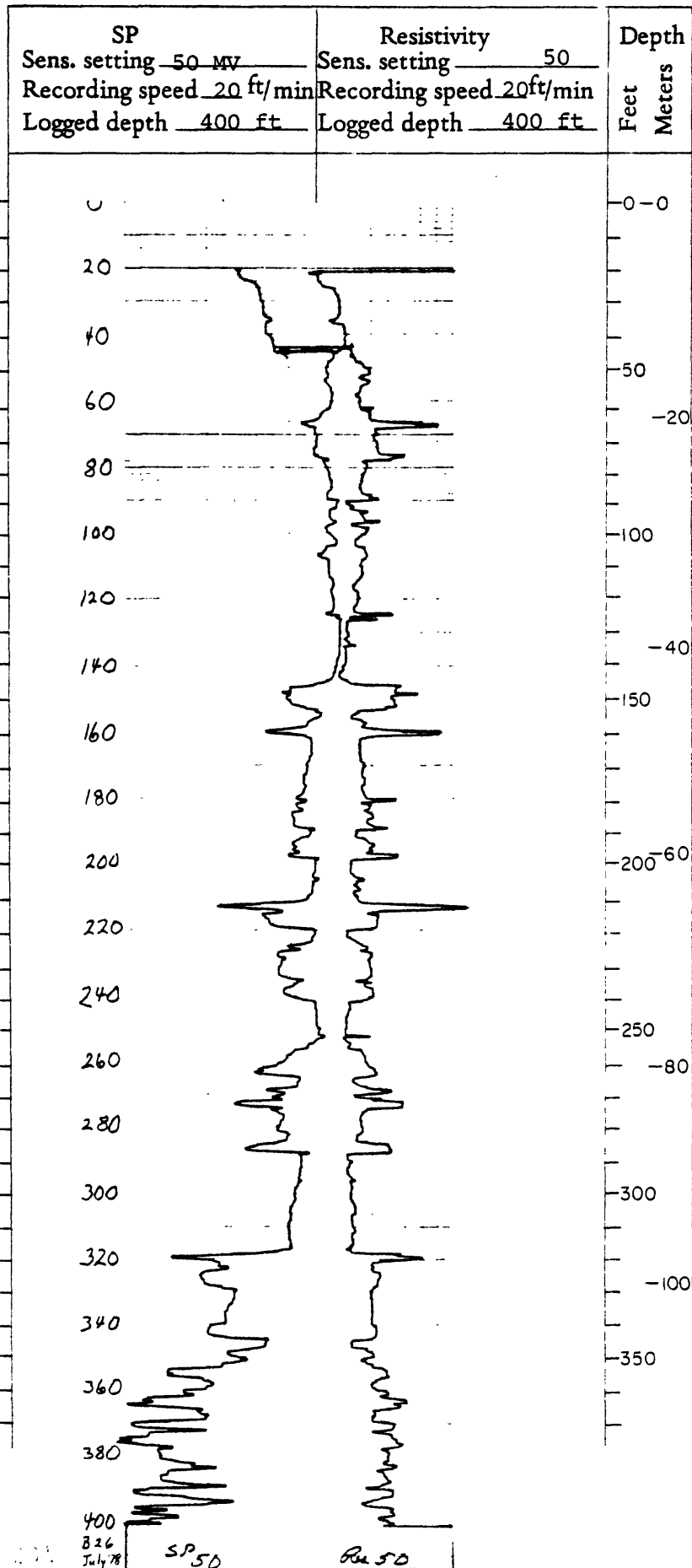
recorded by: Lechner



Hole number—continued

BU-26





BU-26

112

NORTH DAKOTA GEOLOGICAL SURVEY

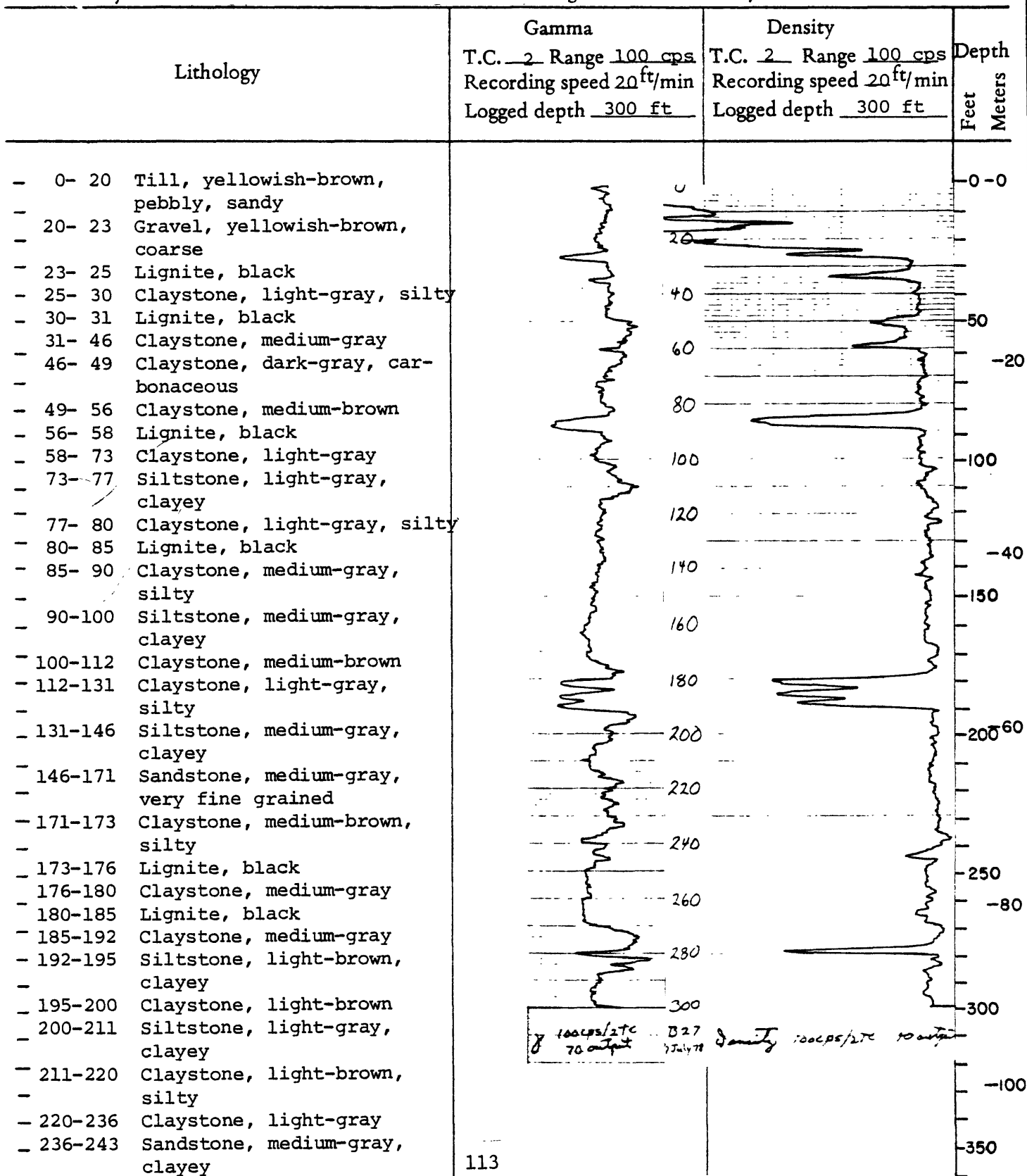
Hole No: BU-27 Map: Stampede Date: 7-7-78 State: ND County: Burke
 Elev.: 1936 ft Location: T. 162 ^N ~~S~~, R. 93 ^R ~~W~~, Sec. 2, Tract: daad Drilled depth: 300 ft
 Measured: 2112 ft ~~FSL~~ ^{FEL} ~~60 ft~~ ^{60 ft} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 85-89; 180-183; 185-187; 189-191; 279-281

Remarks:

Lithology

Recorded by: Fred O'TooleGeologist ^{Yes} ~~No~~

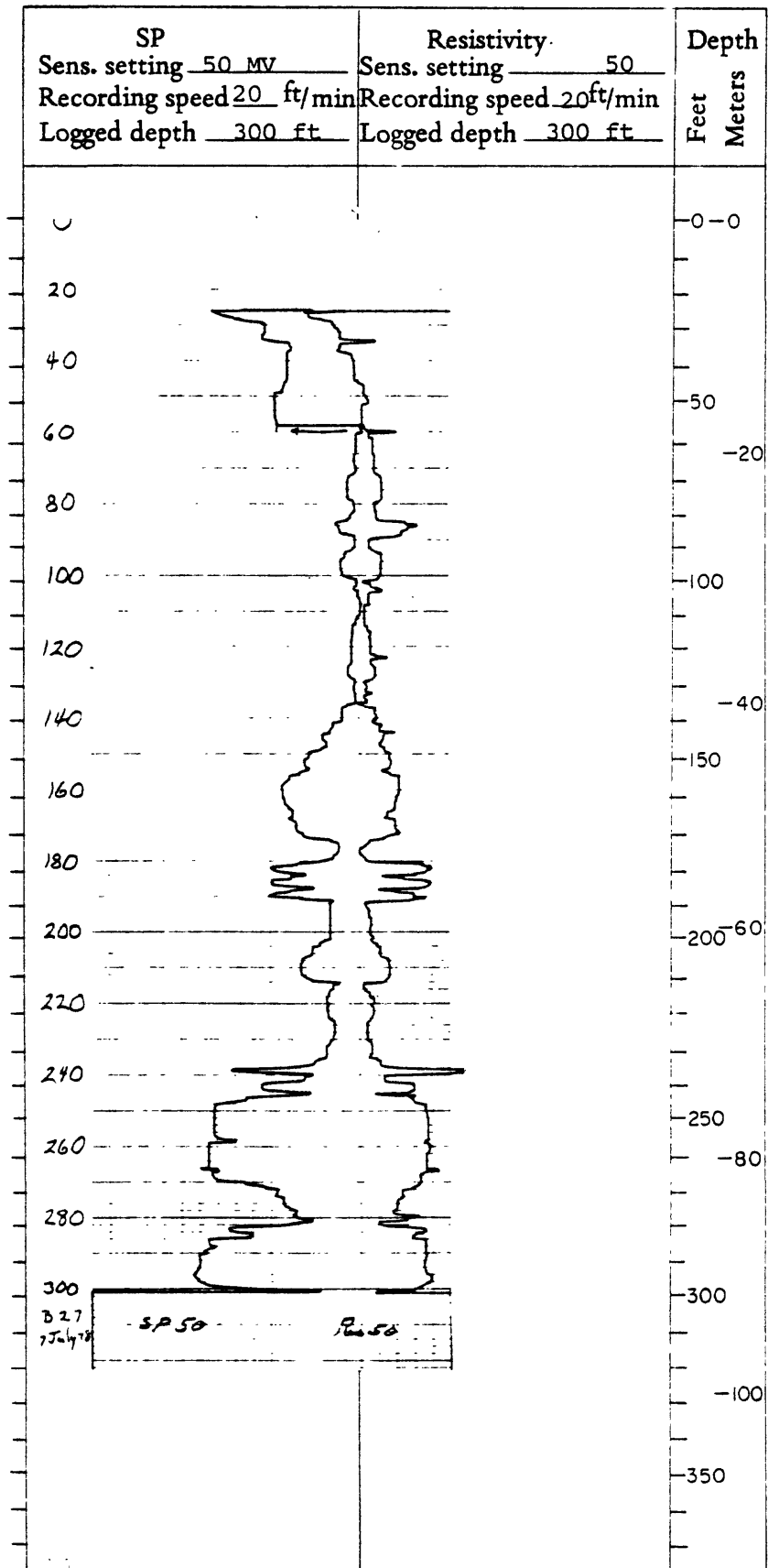
Geophysical logs

recorded by: Lechner

Hole number—continued

BU-27

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>300 ft</u>	Depth	
			Fect	Meters
43-246 Claystone, light-gray, silty				
46-300 Sandstone, light-gray				
				-120
				400
				450
				-140
				500
				-160
				550
				-180
				600
				650
				-200
				700
				-220
				750



Hole number—continued

BU-27

SP Sens. setting <u>50 MV</u> Recording speed <u>20</u> ft/min Logged depth <u>300 ft</u>	Resistivity Sens. setting <u>50</u> Recording speed <u>20</u> ft/min Logged depth <u>300 ft</u>	Depth Feet Meters
		-120 -400 -450 -140 -500 -160 -550 -180 -600 -650 -200 -700 -220 -750

NORTH DAKOTA GEOLOGICAL SURVEY

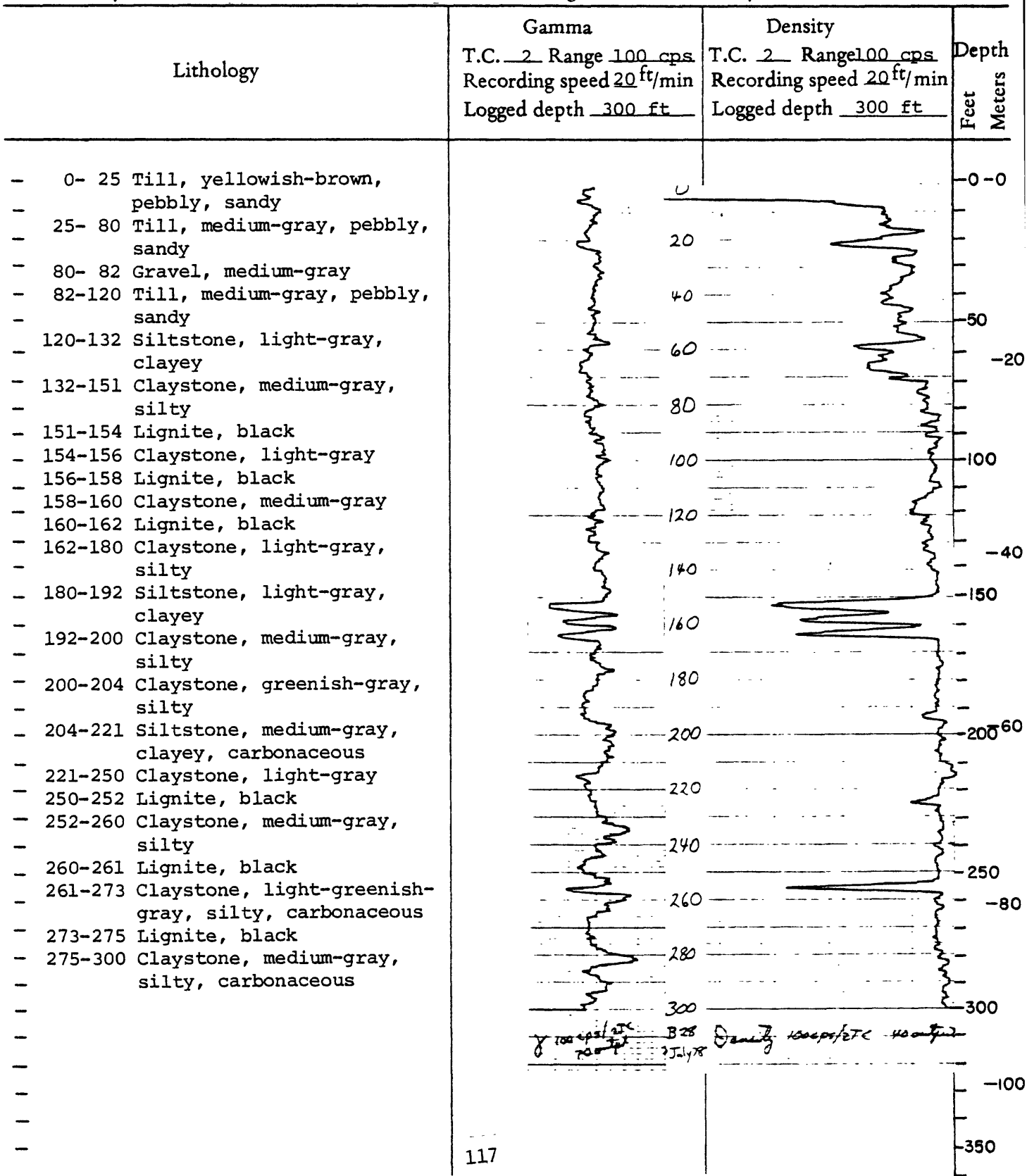
Hole No: BU-28 Map: Stampede Date: 7-7-78 State: ND County: Burke
 Elev.: 1930 ft Location: T. 163^N, R. 93^W, Sec. 26, Tract: cccc Drilled depth: 300 ft.
 Measured: 120 ft ~~FSL~~ ^{FWL}, 30 ft ~~FWL~~ ^{FWL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 142-145; 157-160; 162-165; 253-255

Remarks: _____

Lithology

Recorded by: Fred O'TooleGeologist ^{Yes} ~~No~~

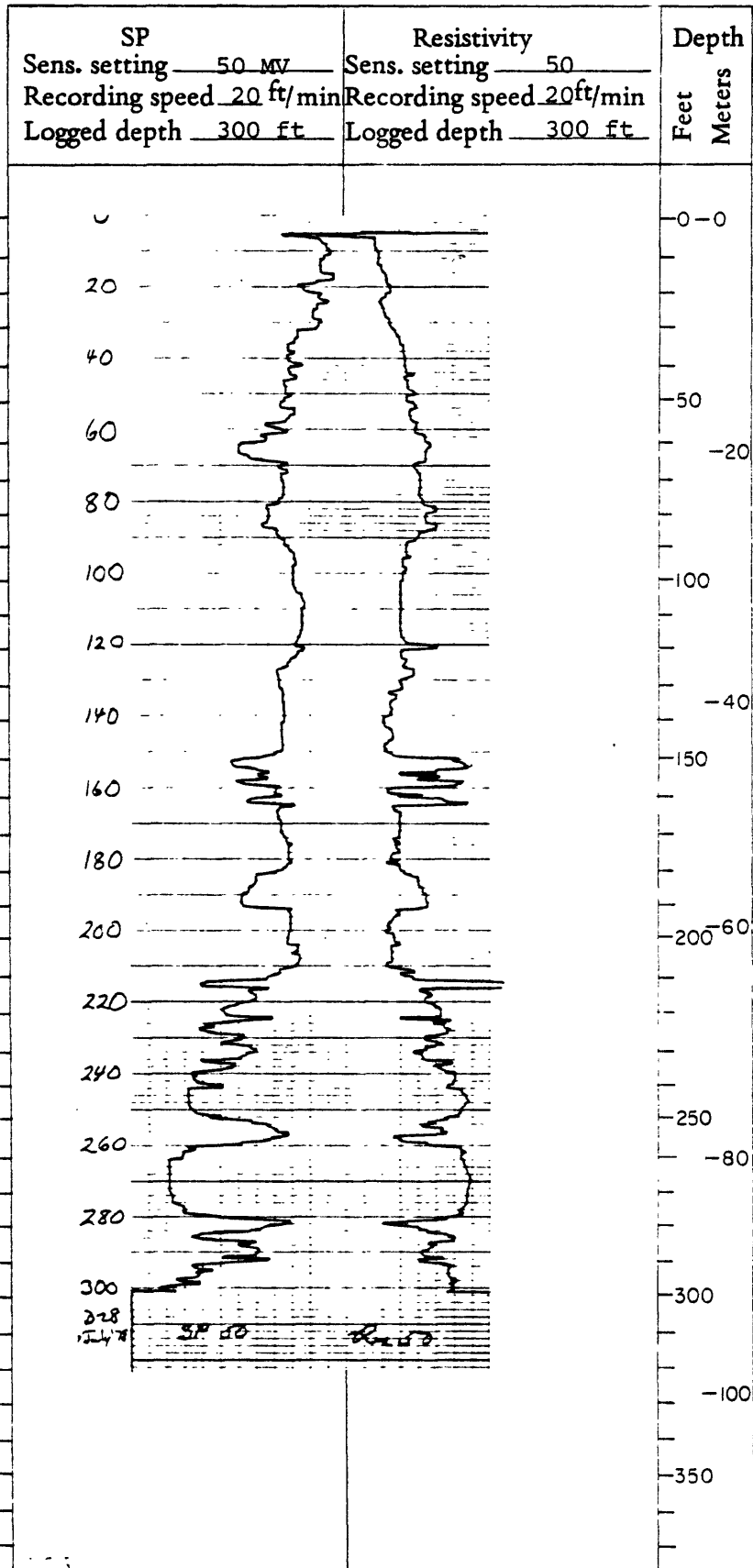
Geophysical logs

recorded by: Lechner

Hole number—continued

BU-28

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft.</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft.</u>	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



BU-28

120

NORTH DAKOTA GEOLOGICAL SURVEY

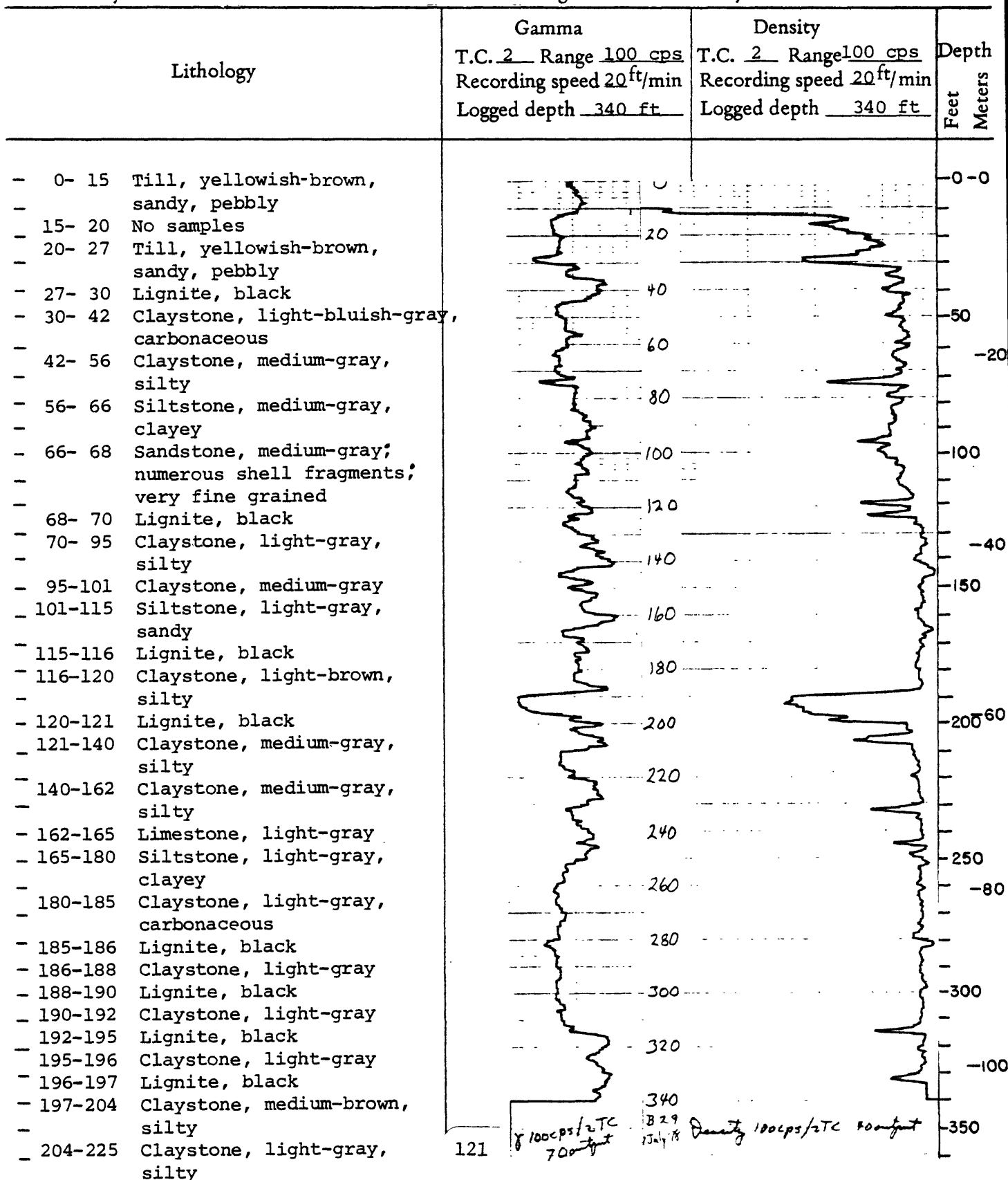
Hole No: BU-29 Map: Stamper Date: 7-7-78 State: ND County: Burke
 Elev.: 1930 ft. Location: T. 163^N, R. 93^E, Sec. 2, Tract: add Drilled depth: 340 ft.
 Measured: 2400 ft ^{FNL} ~~2400~~ ^{FEL} ~~18~~ ²⁴⁰⁰ ~~18~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 73-75; 189-200

Remarks:

Lithology

Recorded by: Fred O'TooleGeologist ^{Yes} ~~No~~

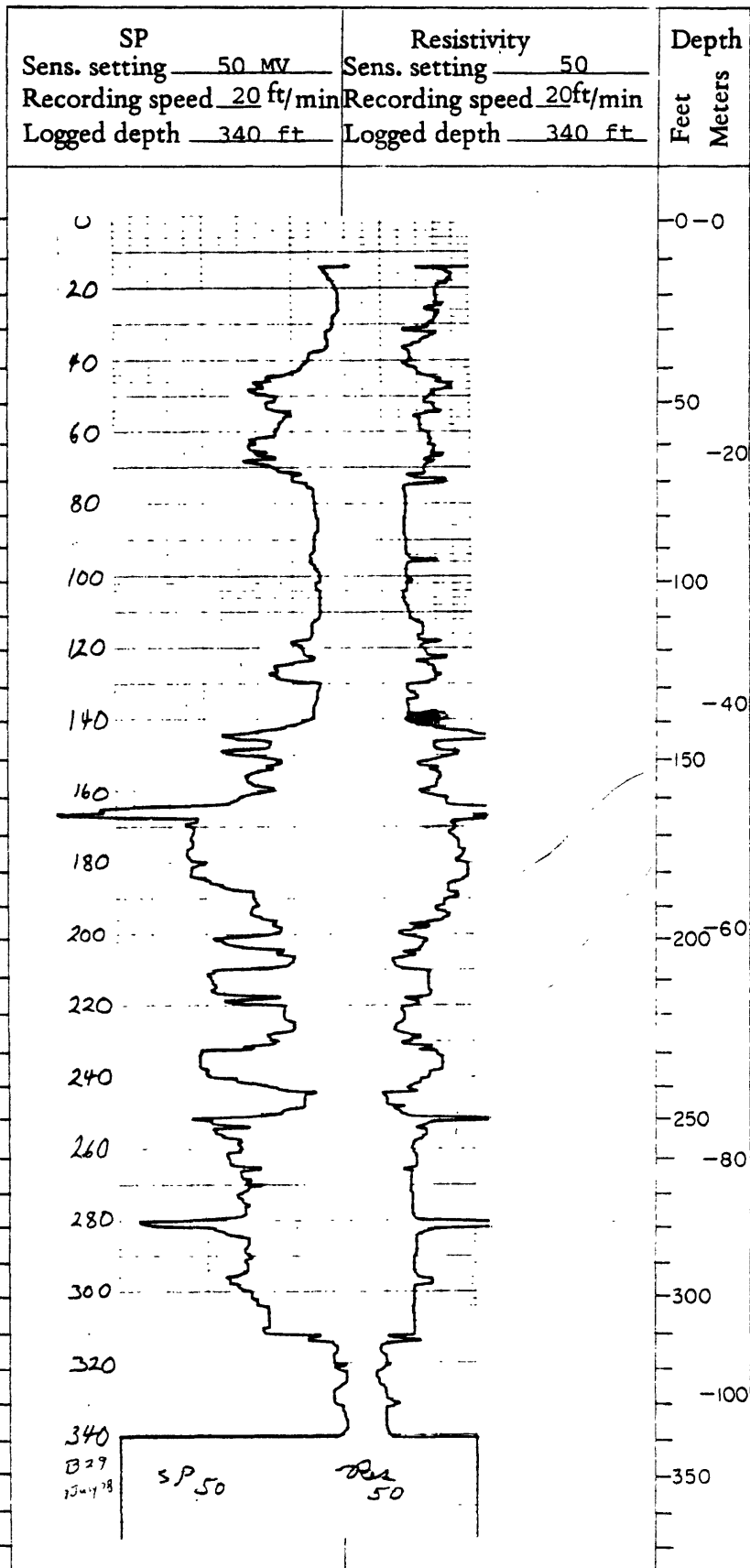
Geophysical logs

recorded by: Lechner

Hole number--continued

BU-29

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>340 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>340 ft</u>	Depth	
			Fect	Meters
25-227 Lignite, black				
27-240 Claystone, light-gray, silty				
40-241 Lignite, black				-120
41-247 Claystone, light-gray, silty			400	
47-250 Claystone, medium-brown, carbonaceous, silty				
50-277 Sandstone, light-gray, very fine grained				
77-282 Sandstone, medium-gray, cemented, very fine grained			450	-140
82-302 Siltstone, light-brown, sandy				
02-308 Claystone, medium-gray, silty			500	
08-311 Lignite, black				
11-320 Claystone, light-brown, silty, carbonaceous				-160
20-340 No samples				
			550	
				-180
			600	
			650	-200
			700	
				-220
			750	



Hole number—continued

BU-29

SP Sens. setting <u>50 mv</u> Recording speed <u>20</u> ft/min Logged depth <u>340 ft</u>	Resistivity Sens. setting <u>50</u> Recording speed <u>20</u> ft/min Logged depth <u>340 ft</u>	Depth Feet Meters
		-120 -400 -450 -140 -500 -160 -550 -180 -600 -650 -200 -700 -220 -750

NORTH DAKOTA GEOLOGICAL SURVEY

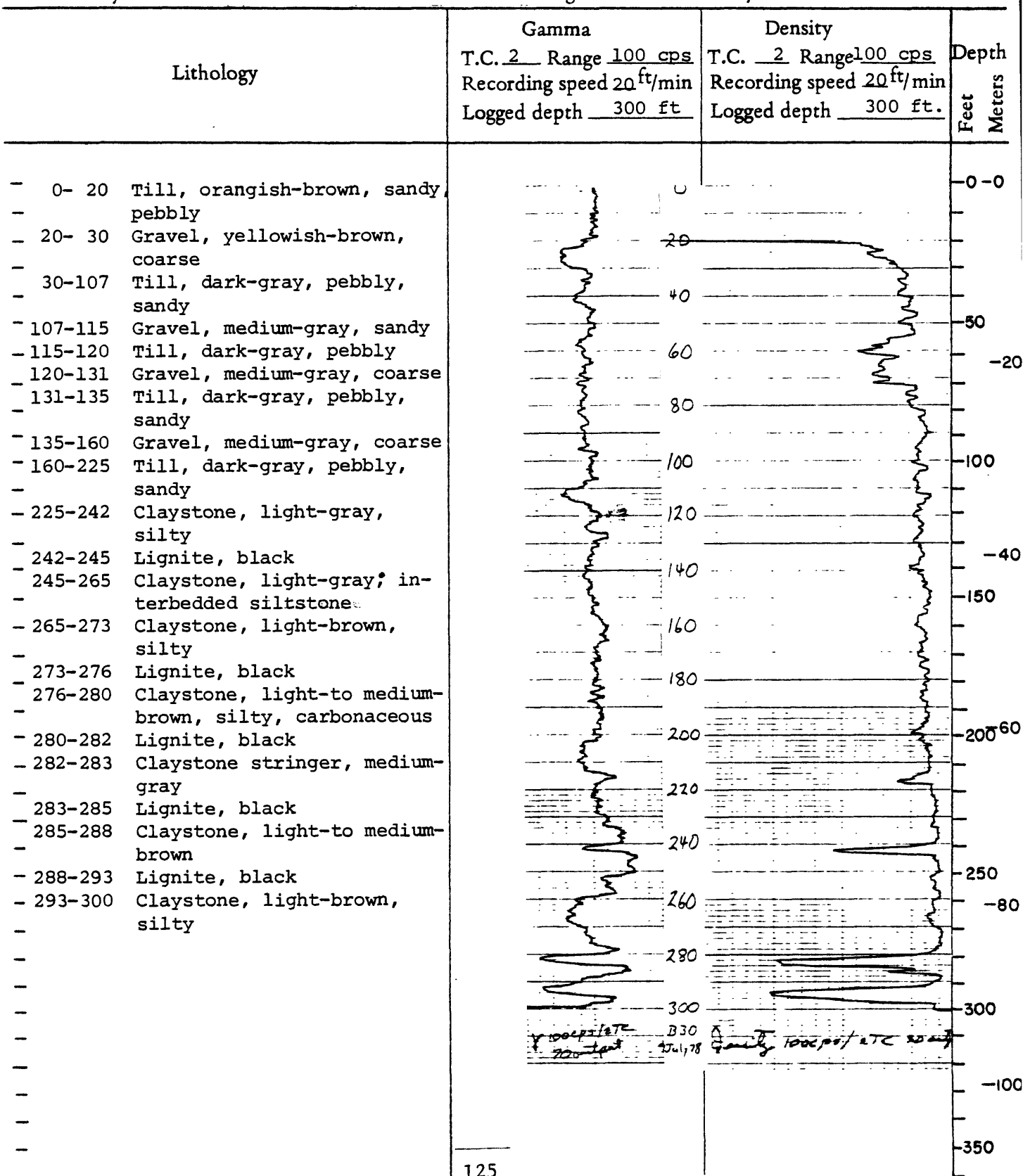
Hole No: BU-30 Map: Columbus Date: 7-9-78 State: ND County: Burke
 Elev.: 1917 ft Location: T. 163 ^N, R. 94 ^E, Sec. 13, Tract: daad Drilled depth: 300 ft.
 Measured: 2006 ft ^{FSL}, 15 ft ^{FEL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 241-243; 281-284; 292-297

Remarks: _____

Lithology

Recorded by: Fred O'TooleGeologist ^{Yes} ~~No~~

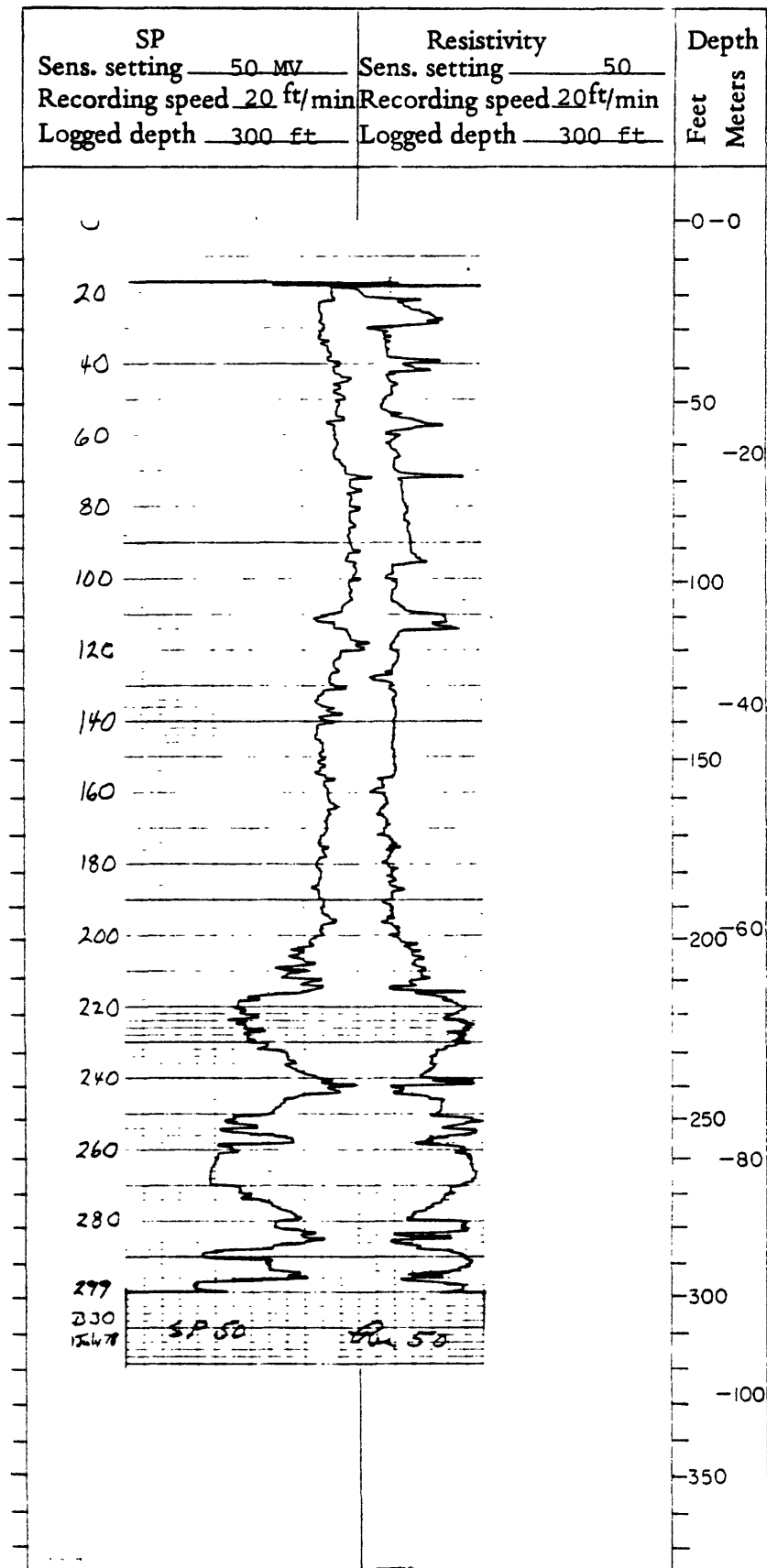
Geophysical logs

recorded by: Lechner

Hole number—continued

BU-30

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>300</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>300</u> ft	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued
BU-30

SP		Resistivity		Depth	
Sens. setting <u>50 mv</u>		Sens. setting <u>50</u>		Fet	
Recording speed <u>20</u> ft/min		Recording speed <u>20</u> ft/min		Meters	
Logged depth <u>300</u> ft		Logged depth <u>300</u> ft			
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

Hole No: BU-31 Map: Columbus Date: 7-9-78 State: ND County: Burke
 Elev.: 1922 ft Location: T. 163 ^N, R. 93 ^W, Sec. 31, Tract: bbbb Drilled depth: 300 ft
 Measured: 75 ft ^{FNL} ~~RSX~~, 24 ft ^{FWL} ~~FWL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 64-68; 93-99; 182-185; 189-194

Remarks: _____

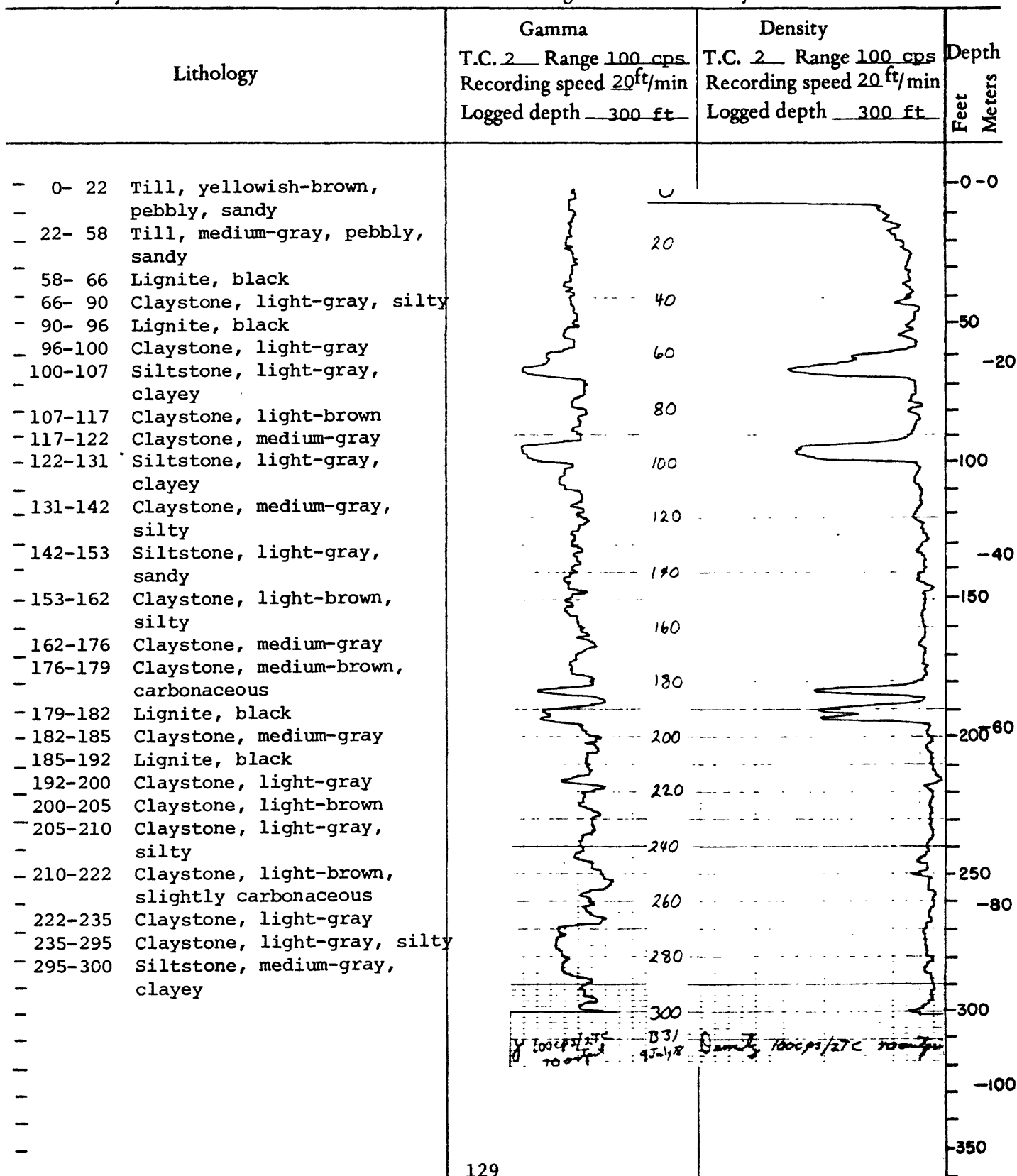
Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes} ~~No~~

Geophysical logs

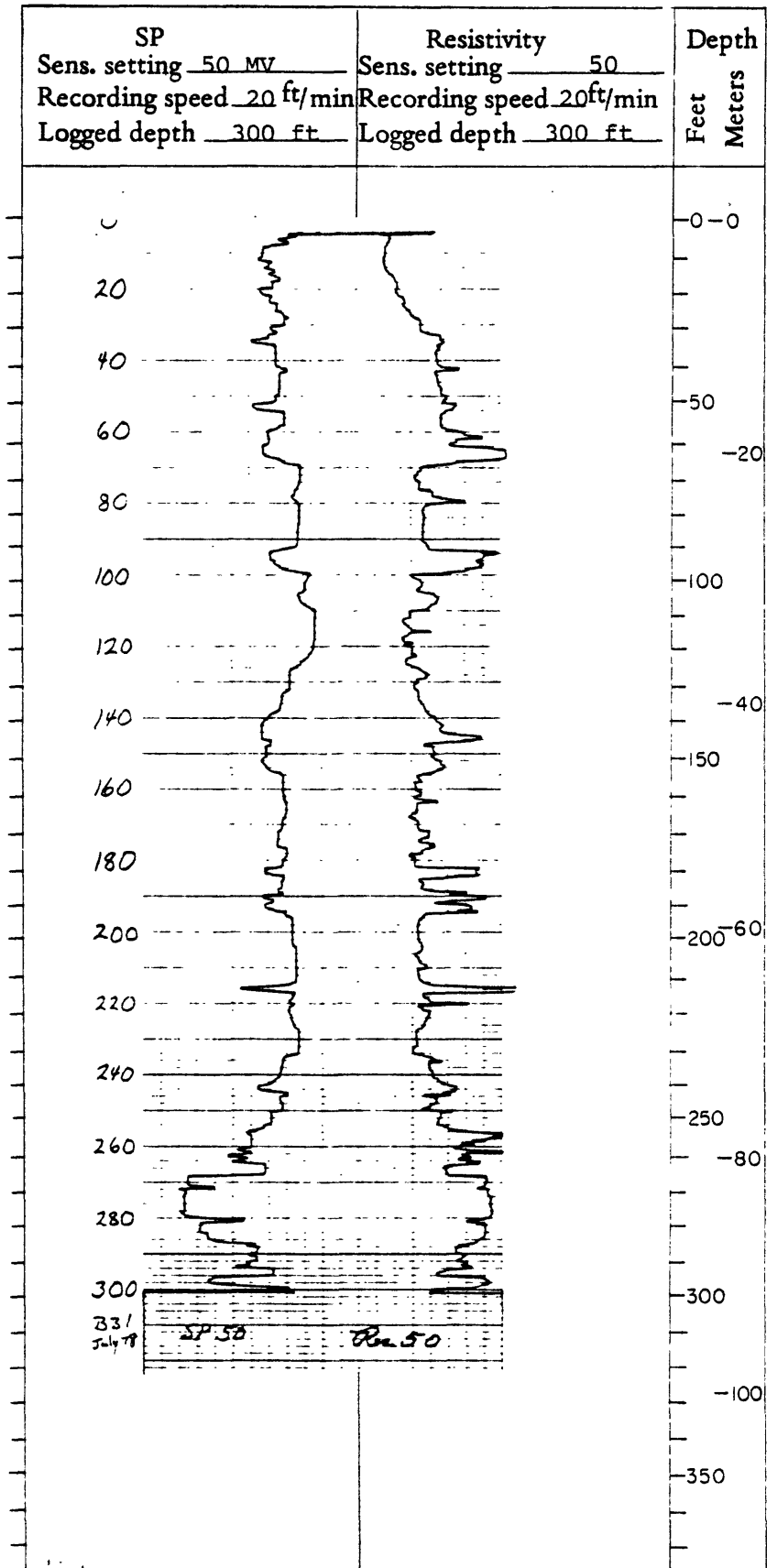
recorded by: Lechner



Hole number—continued

BU-31

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>300 ft</u>	Depth	
			Fect	Meters
				-120
				-400
				-450
				-140
				-500
				-160
				-550
				-180
				-600
				-650
				-200
				-700
				-220
				-750



Hole number—continued

BU-31

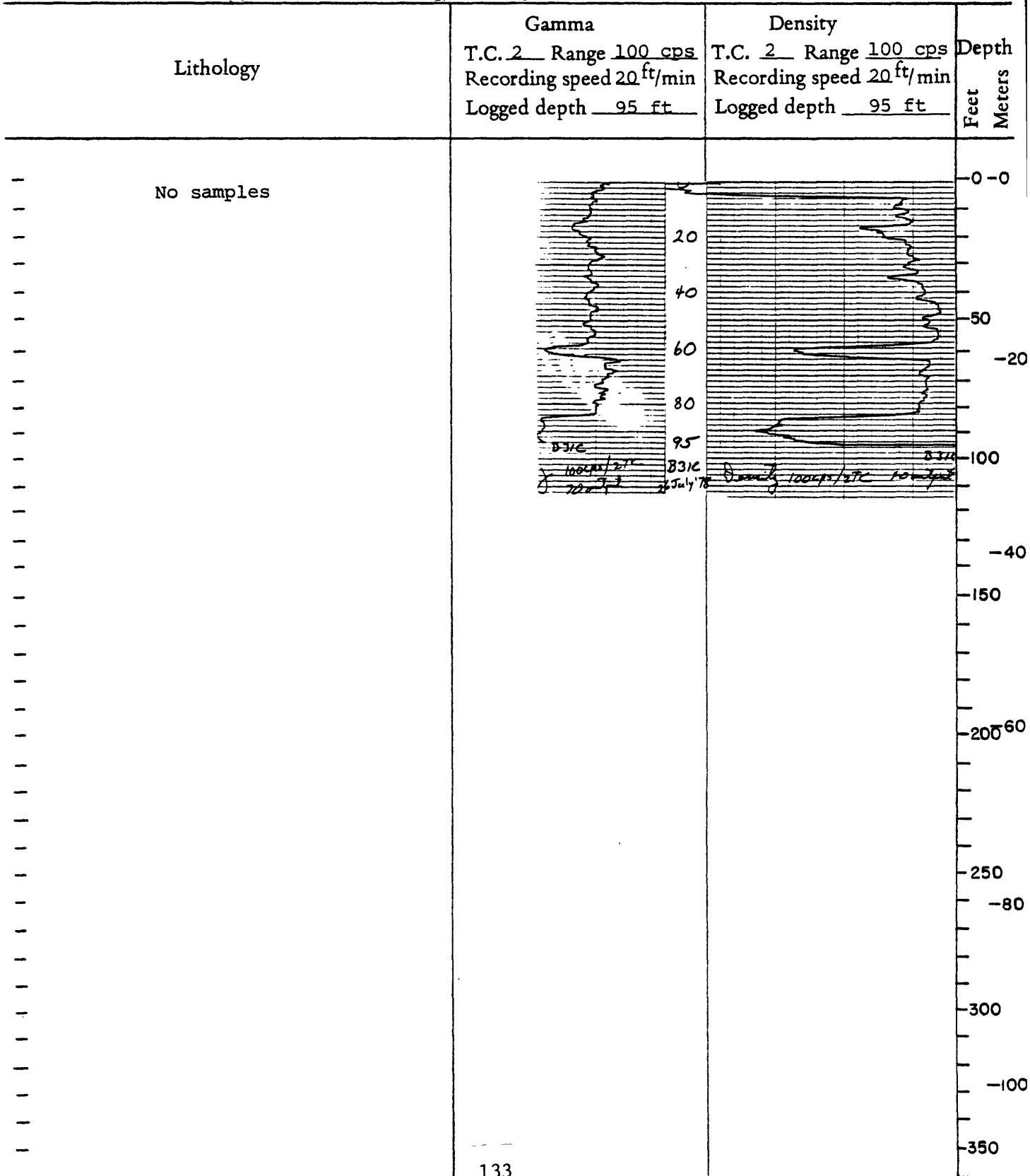
SP		Resistivity	Depth Feet Meters
Sens. setting <u>50 MV</u>		Sens. setting <u>50</u>	
Recording speed <u>20</u> ft/min		Recording speed <u>20</u> ft/min	
Logged depth <u>300</u> ft		Logged depth <u>300</u> ft	
			-120
			-400
			-450
			-140
			-500
			-160
			-550
			-180
			-600
			-650
			-200
			-700
			-220
			-750

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-31 C Map: Columbus Date: 7-26-78 State: ND County: Burke
 Elev.: 1922 ft Location: T. 163 ^N_S, R. 93 ^E_W, Sec. 31, Tract: bbbb Drilled depth: 98 ft.
 Measured: 90 ft ^{FNL}_{FSD}, 24 ft ^{RML}_{FWL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☒ No ☐
 Lignite beds: _____

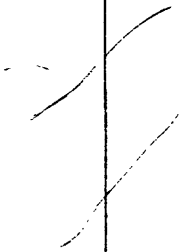
Remarks: _____

Lithology Recorded by: _____ Geologist ^{Yes}_{No} recorded by: _____



Hole number—continued

BU-31C

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>95 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>95 ft</u>	Depth	
			Fect	Meters
No samples			-120	
			400	
			450	
			-140	
			500	
			-160	
			550	
			-180	
			600	
			650	
			-200	
			700	
			-220	
			750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-32 Map: Columbus SE Date: 7-12-78 State: ND County: Burke
 Elev.: 2010 ft Location: T. 162 ^N, R. 93 ^W, Sec. 19, Tract: cbaa Drilled depth: 400 ft
 Measured: 2400 ^{FSL}, 1000ft ^{FWL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 23-31; 91-93; 118-120; 149-156; 202-204; 295-300; 306-308

Remarks: _____

Lithology

Recorded by: Randall Reichert

Geologist ^{Yes} ~~No~~



Geophysical logs

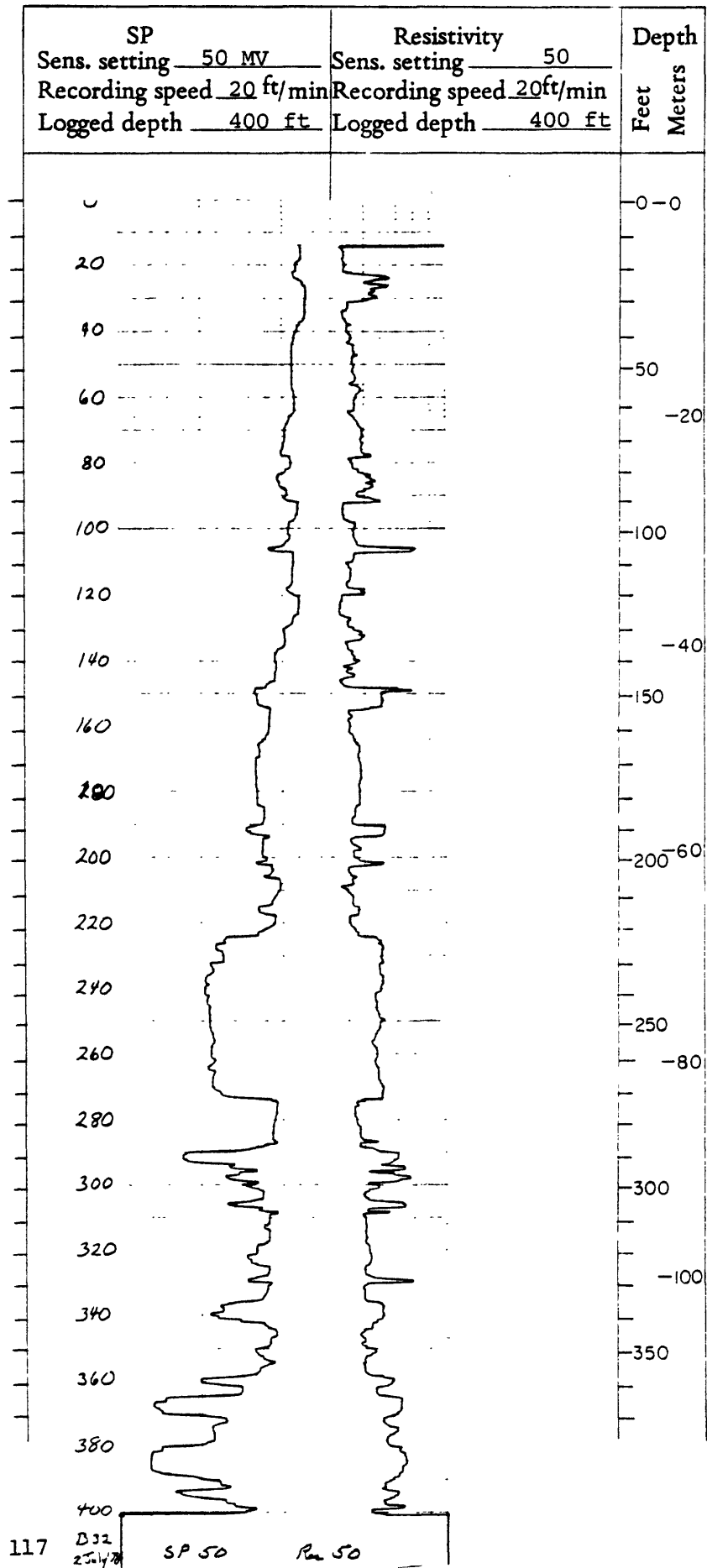
recorded by: Lechner

Lithology	Gamma		Density		Depth Feet Meters
	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>400 ft</u>	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>400 ft</u>	
- 0- 20 Till, yellow, pebbly					0-0
- 20- 26 Lignite, black					
- 26- 30 Sandstone, light-gray, very fine grained					
- 30- 62 Claystone, medium-gray, silty					
- 62- 72 Sandstone, medium-gray, very fine grained					50
- 72- 74 Lignite, black					-2
- 74- 82 Sandstone, greenish-gray, very fine grained					
- 82- 86 Lignite, black					
- 86- 97 Claystone, green, silty, carbonaceous					100
- 97-100 Siltstone, green, clayey					
- 100-118 Claystone, medium-gray, silty					-4
- 118-119 Lignite, black					
- 119-124 Claystone, medium-gray, silty					150
- 124-143 Sandstone, greenish-gray, very fine grained					
- 143-151 Lignite, black					
- 151-157 Siltstone, medium-gray, clayey					200
- 157-183 Sandstone, medium-gray, fine to very fine-grained					200
- 183-185 Siltstone, medium-gray, sandy					
- 185-187 Claystone, dark-gray, silty					
- 187-190 Lignite, black					250
- 190-195 Sandstone, medium-gray, very fine grained					-8
- 195-212 Claystone, medium-gray, silty					
- 212-240 Sandstone, greenish-gray, fine to very fine-grained					300
- 240-260 Sandstone, medium-gray, very fine grained, silty					
- 260-280 No samples					-10
- 280-287 Claystone, medium-gray, silty					
- 287-288 Lignite, black					350
- 288-293 Claystone, medium-gray					

Hole number—continued

BU-32

Lithology	Gamma		Density		Depth	
	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>400 ft</u>	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>400 ft</u>	Feet	Meters
93-296 Lignite, black						
96-301 Claystone, light-gray		380				
01-303 Lignite, black					-120	
03-318 Siltstone, light-brown, clayey		400			400	
18-325 Siltstone, medium-gray, sandy	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <i>γ 100cps/LTC 70 output</i> </div>		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <i>B32 12 July '78 Density 100cps/LTC 40 output</i> </div>			
25-335 Claystone, medium-gray, silty						
35-341 Siltstone, medium-gray, clayey					450	
41-360 Claystone, medium-gray					-140	
60-400 No samples						
					500	
					-160	
					550	
					-180	
					600	
					650	
					-200	
					700	
					-220	
					750	



Hole number—continued

BU-32

SP		Resistivity		Depth	
Sens. setting	<u>50 mV</u>	Sens. setting	<u>50</u>	Feet	Meters
Recording speed	<u>20 ft/min</u>	Recording speed	<u>20 ft/min</u>		
Logged depth	<u>400 ft</u>	Logged depth	<u>400 ft.</u>		
					-120
					-400
					-450
					-140
					-500
					-160
					-550
					-180
					-600
					-650
					-200
					-700
					-220
					-750

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-34 Map: Columbus SE Date: 7-26-78 State: ND County: Burke
 Elev.: 2133 ft Location: T. 162^N R. 94^W, Sec. 28, Tract: aaaa Drilled depth: 500 ft.
 Measured: 100 ft ^{FNL} ~~FSL~~, 45 ft ^{FEL} ~~FSL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 124-130.5; 158-166.5; 210-214; 282-287; 322-325; 432-434.5

Remarks: _____

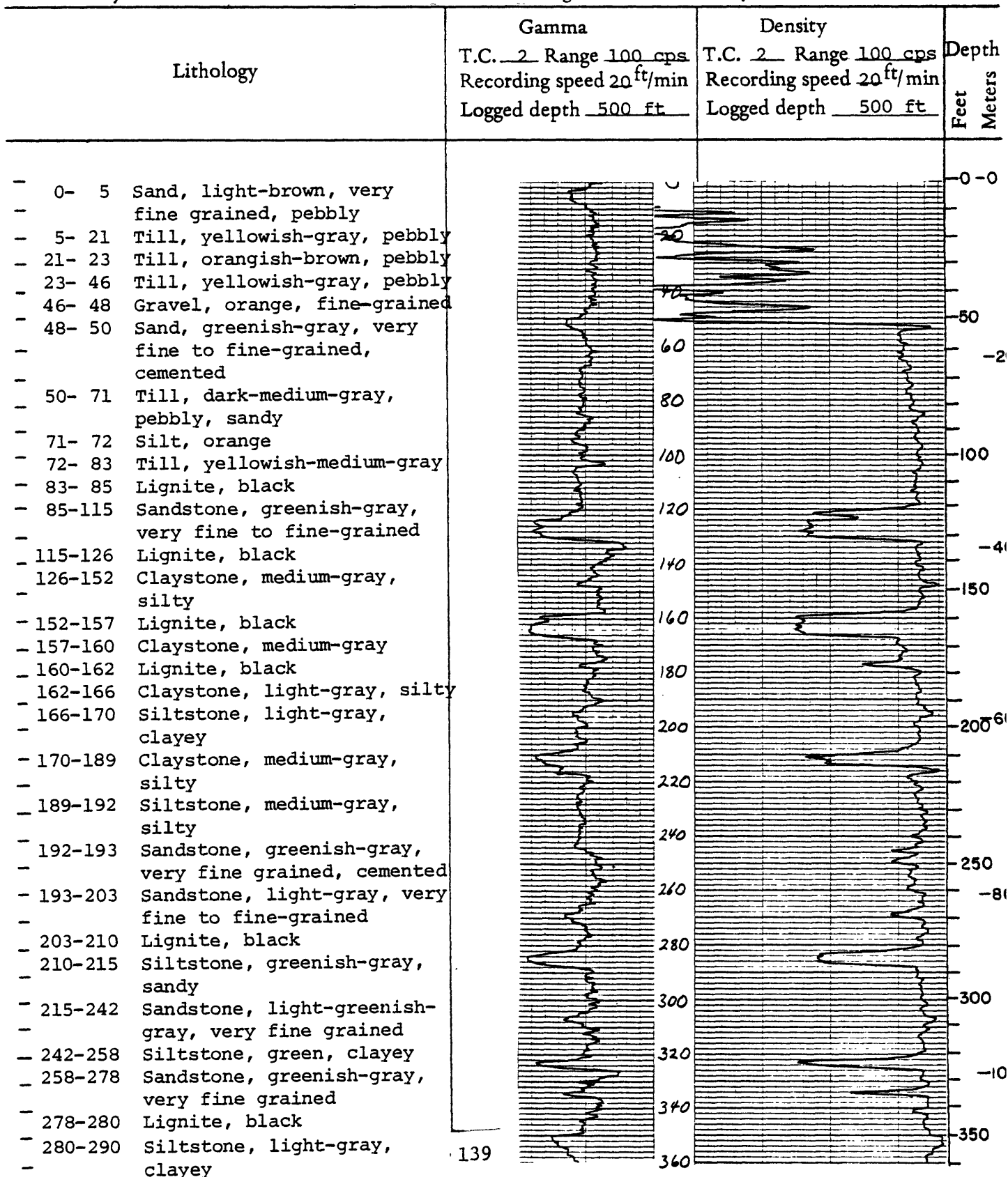
Lithology

Recorded by: Randall Reichert

Geologist ^{Yes} ~~No~~

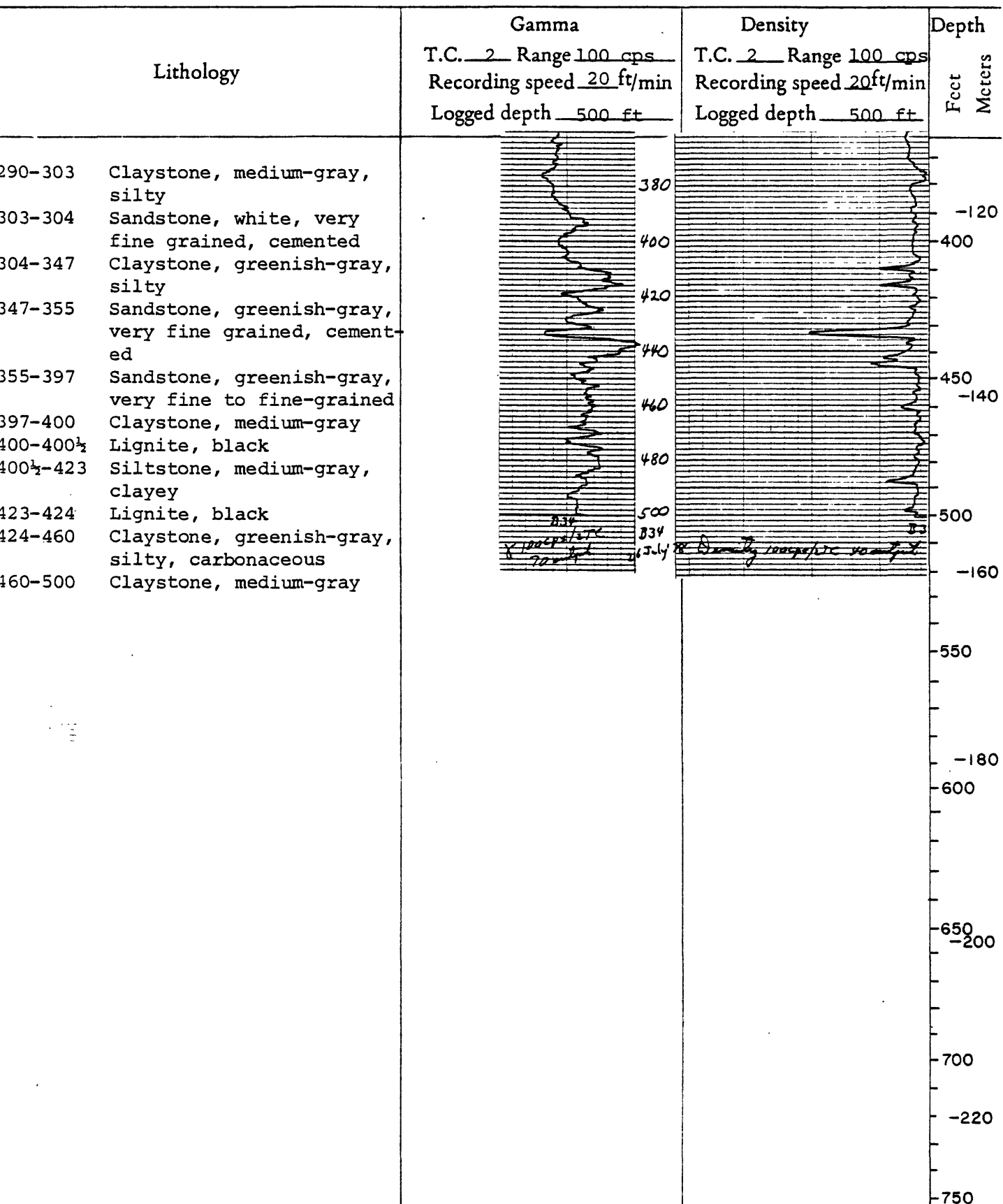
Geophysical logs

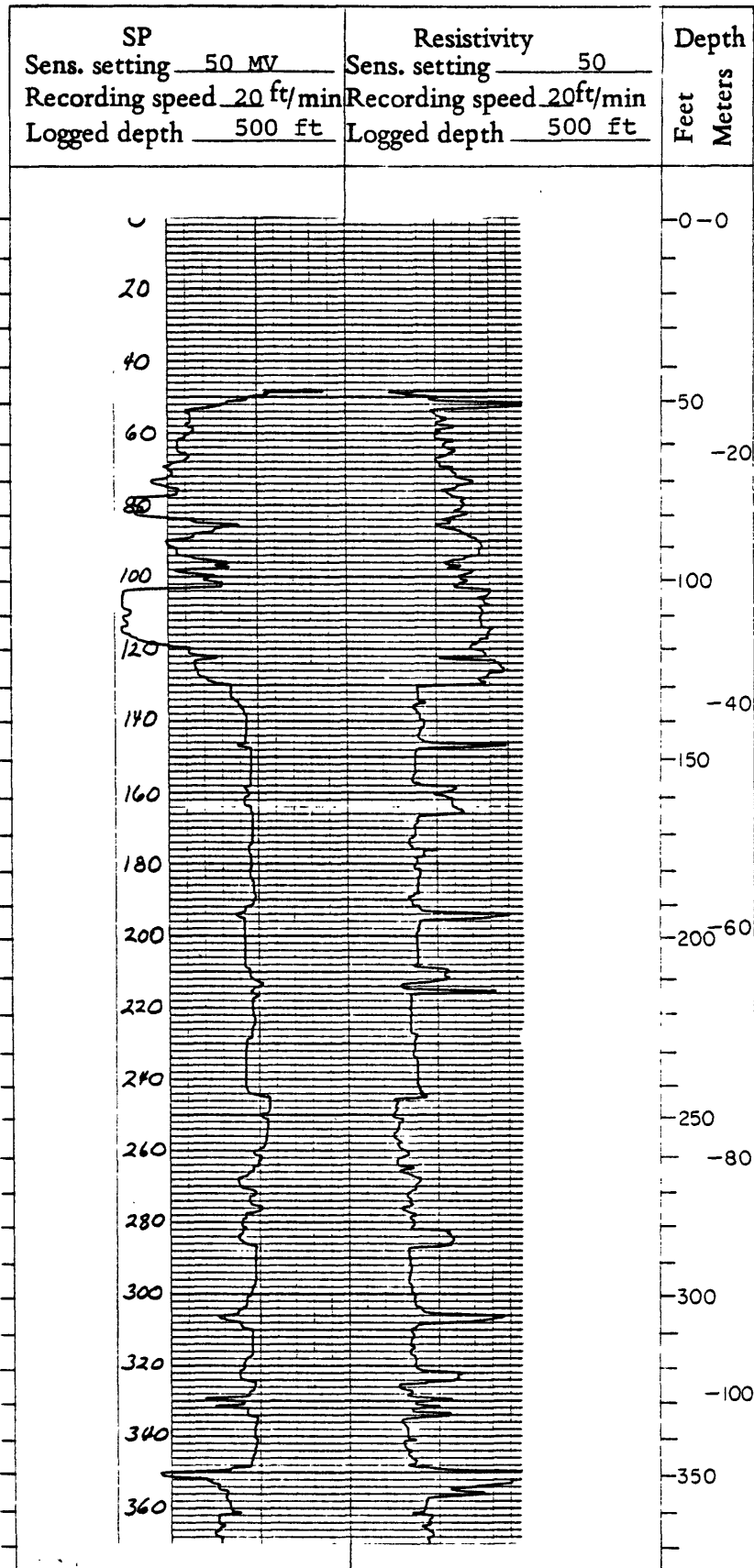
recorded by: Lechner



Hole number—continued

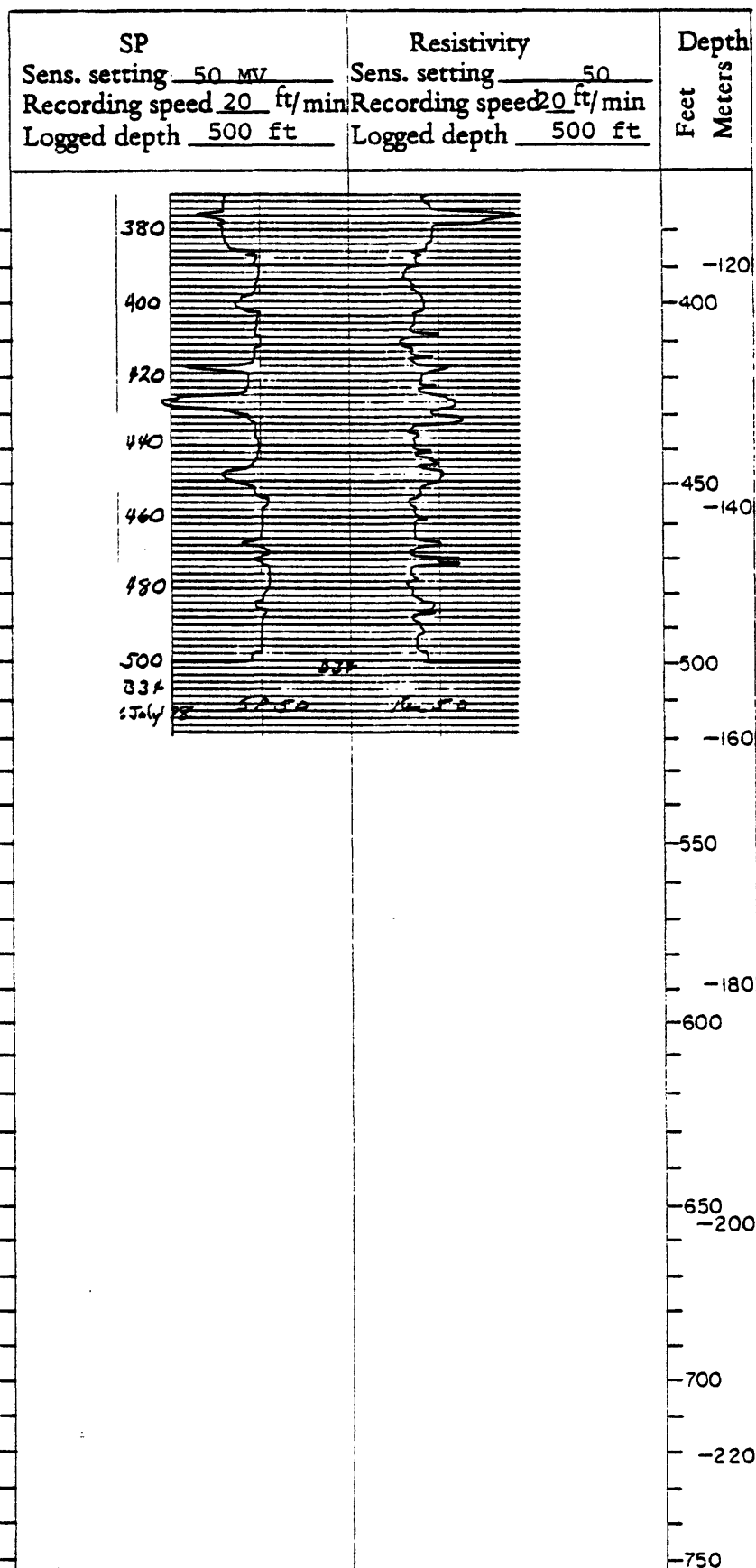
BU-34





Hole number—continued

BU-34



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-35 Map: Columbus SW Date: 7-6-78 State: ND County: Burke
 Elev.: 2280 ft Location: T. 162^N, R. 94^W, Sec. 32, Tract: bbbb Drilled depth: 640 ft
 Measured: 90 ft ^{FNL} 195 ft ^{FNL} FWL Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 207-217; 233-240; 288-292; 359-364; 387-390

Remarks: _____

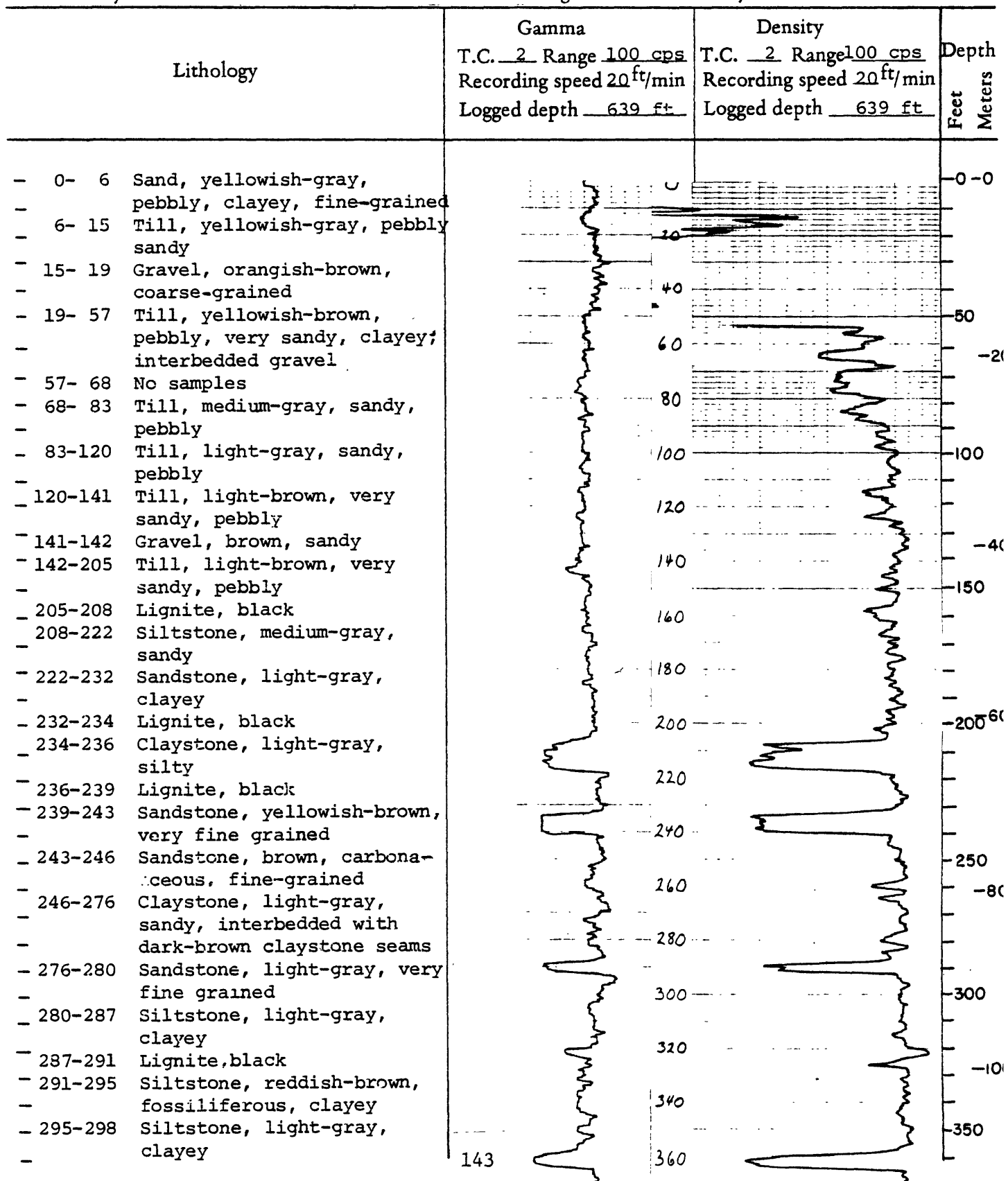
Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner



Hole number—continued
BU-35

Lithology	Gamma T.C. 2 Range 100 cps Recording speed 20 ft/min Logged depth 639 ft	Density T.C. 2 Range 100 cps Recording speed 20 ft/min Logged depth 639 ft	Depth	
			Fcft	Meters
98-300 Claystone, greenish-gray				
00-308 Siltstone, light-gray, sandy, cemented			-120	
08-311 Sandstone, medium-gray, silty, fine-grained	400		400	
11-316 Claystone, medium-gray, silty	420			
16-322 Claystone, light-brown, silty	440			
22-327 Siltstone, medium-gray, clayey	460		450	
27-330 Sandstone, yellowish-brown, carbonaceous, very fine grained	480		-140	
30-332 Sandstone, light-brown, very fine grained	500			
32-345 Sandstone, light-gray, very fine grained, carbonaceous	520		-160	
45-348 Claystone, light-gray, sandy	540			
48-360 Sandstone, light-gray, very fine grained	560		550	
60-362 Lignite, black	580			
62-364 Claystone, light-gray, silty	600		-180	
64-373 Siltstone, light-gray, clayey	620		600	
73-377 Claystone, light-gray, silty	640			
77-378 Lignite, black	650		-200	
78-387 Claystone, medium-gray, silty				
87-389 Lignite, black				
89-390 Claystone, medium-gray, silty				
90-392 Lignite, black				
92-418 Claystone, very-light-gray, silty, interbedded with dark-brown, carbonaceous claystone			700	
18-421 Claystone, light-green, silty			-220	
21-428 Siltstone, light-gray with brown claystone interbedded				
28-433 Siltstone, very-light-gray, clayey			750	
33-442 Claystone, light-gray, silty				

Hole number—continued

BU-35

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>639 ft</u>	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>639 ft</u>	Fect	Meters
442-446 Siltstone, light-gray, clayey				
446-460 Claystone, light-gray, silty			-120	
460-471 Claystone, medium-gray, silty			-400	
471-476 Claystone, greenish-gray, silty				
476-497 Claystone, medium-gray, silty, interbedded with carbonaceous claystones			-450	
497-500 Siltstone, light-gray, clayey			-140	
500-507 Sandstone, light-gray, cemented, very fine grained				
507-517 Claystone, greenish-gray, silty			-500	
517-528 Siltstone, light-gray, sandy			-160	
528-565 Sandstone, medium-gray, very fine grained				
565-585 Sandstone, medium-brown, clayey, very fine grained			-550	
585-600 Siltstone, medium-gray, clayey and sandy				
600-604 Claystone, light-brown, silty			-180	
604-620 Siltstone, light-gray, sandy			-600	
620-621 Lignite, black				
621-637 Siltstone, light-gray, clayey				
637-640 Claystone, light-gray, silty			-650	
			-200	
			-700	
			-220	
			-750	

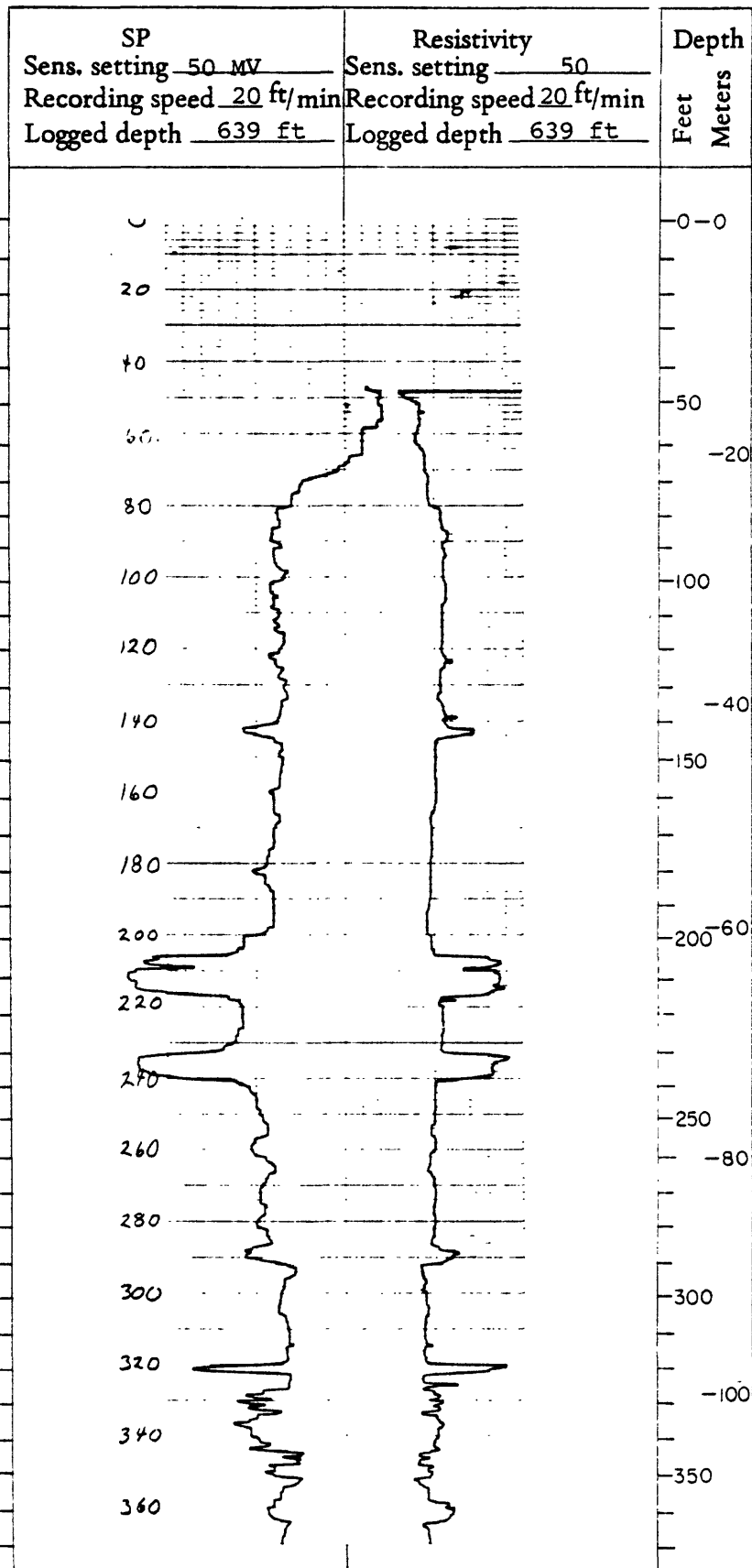
NORTH DAKOTA GEOLOGICAL SURVEY

Hole No.: _____ Map: _____ Date: _____ State: _____ County: _____
 Elev.: _____ Location: T. _____ ^N/_S, R. _____ ^E/_W, Sec. _____, Tract: _____ Drilled depth: _____
 Measured: _____ ^{FNL}/_{FSL}, _____ ^{FEL}/_{FWL}, Hole size: _____ Air ☐ Water ☐ Cored: Yes ☐ No ☐
 Lignite beds: _____

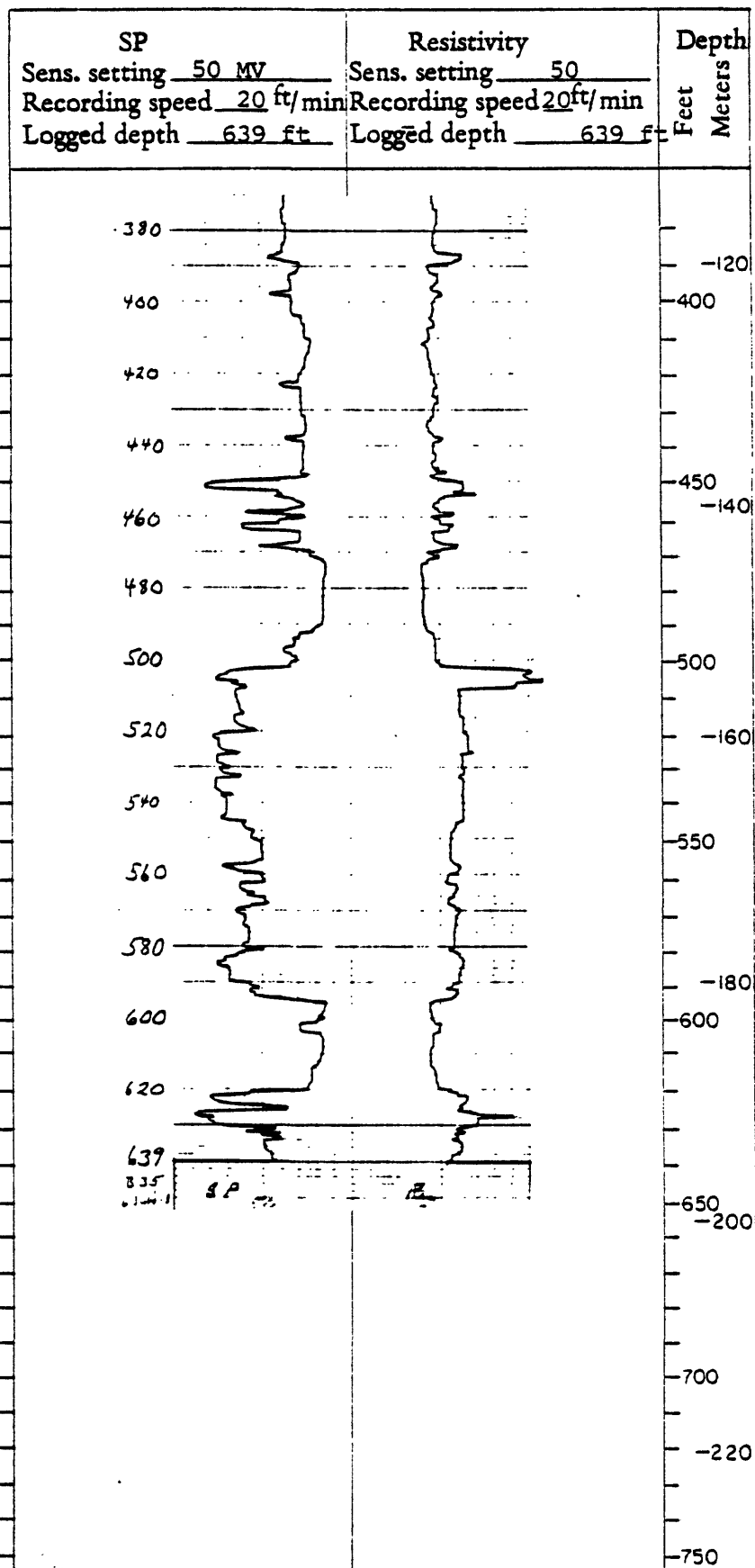
Remarks: _____

Lithology
 Recorded by: _____ Geologist ^{Yes}/_{No} Geophysical logs recorded by: _____

Lithology	Gamma		Density		Depth	
	T.C. _____	Range _____	T.C. _____	Range _____	Feet	Meters
	Recording speed _____	ft/min	Recording speed _____	ft/min		
	Logged depth _____		Logged depth _____			
-					0	0
-						
-						
-						
-						
-					50	
-						
-					-20	
-						
-						
-					100	
-						
-						
-					-40	
-						
-					150	
-						
-						
-					-200	60
-						
-						
-					250	
-					-80	
-						
-					300	
-						
-					-100	
-						
-					350	



Hole number—continued
BU-35



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-36 Map: Columbus SW Date: 7-11-78 State: ND County: Burke
 Elev.: 1990 ft Location: T. 162 ^N_S, R. 94 ^E_W, Sec. 17, Tract: aaaa Drilled depth: 380 ft.
 Measured: 50 ft ^{FNL}_{FSL}, 20 ft ^{FEL}_{FWE}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 57-61; 82-86; 172-174; 341-344;

Remarks: _____

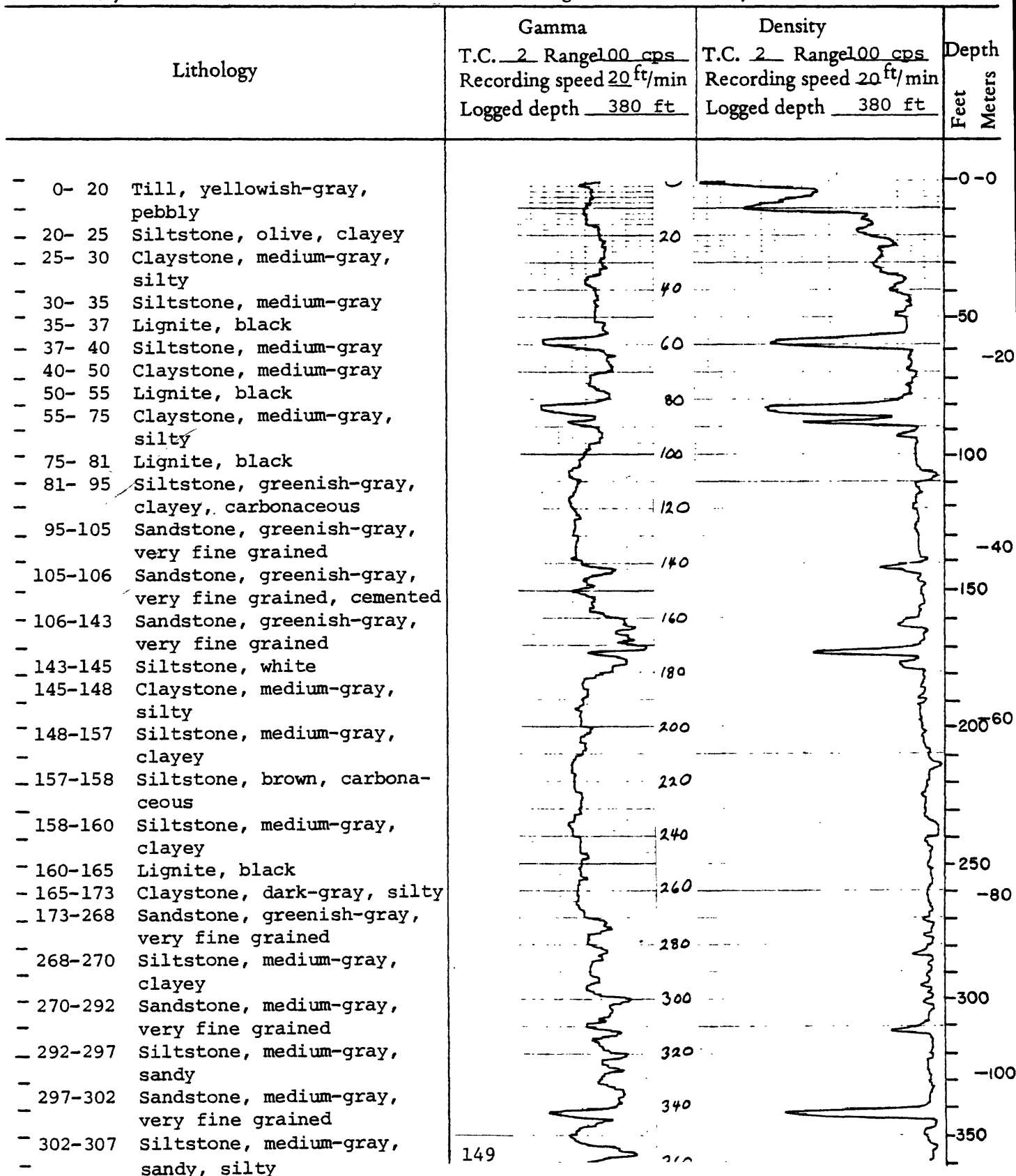
Lithology

Recorded by: Randall Reichert

Geologist ^{Yes}_{No}



Geophysical logs

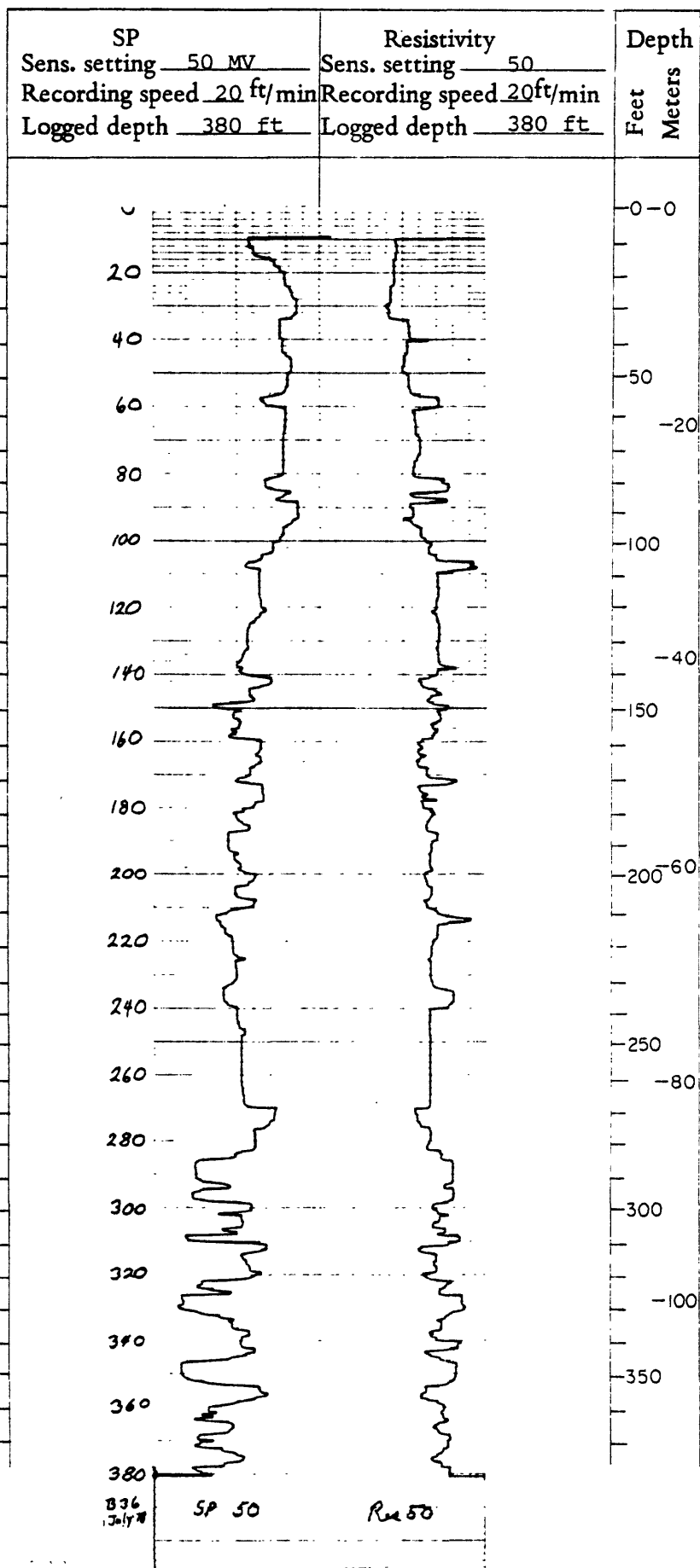
recorded by: Lechner



Hole number—continued

BU-36

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>380 ft</u>	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>380 ft</u>	Fect	Meters
07-344 Claystone, medium-gray, silty				
44-345 Lignite, black			-120	
45-380 Claystone, medium-gray, silty			400	
			450	
			-140	
			500	
			-160	
			550	
			-180	
			600	
			650	
			-200	
			700	
			-220	
			750	



BU-36

SP		Resistivity		Depth	
Sens. setting	<u>50 MV</u>	Sens. setting	<u>50</u>	Feet	Meters
Recording speed	<u>20 ft/min</u>	Recording speed	<u>20 ft/min</u>		
Logged depth	<u>380 ft</u>	Logged depth	<u>380 ft</u>		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-37 Map: Columbus SW Date: 7-11-78 State: ND County: Burke
 Elev.: 1980 ft Location: T. 162^N S, R. 94^E W, Sec. 7, Tract: daaa Drilled depth: 360 ft.
 Measured: 2376 ft ^{FSL} 10 ft ^{FEL} FWL Hole size: 4 3/4 ft. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 54-57; 78-83; 352-355

Remarks: _____

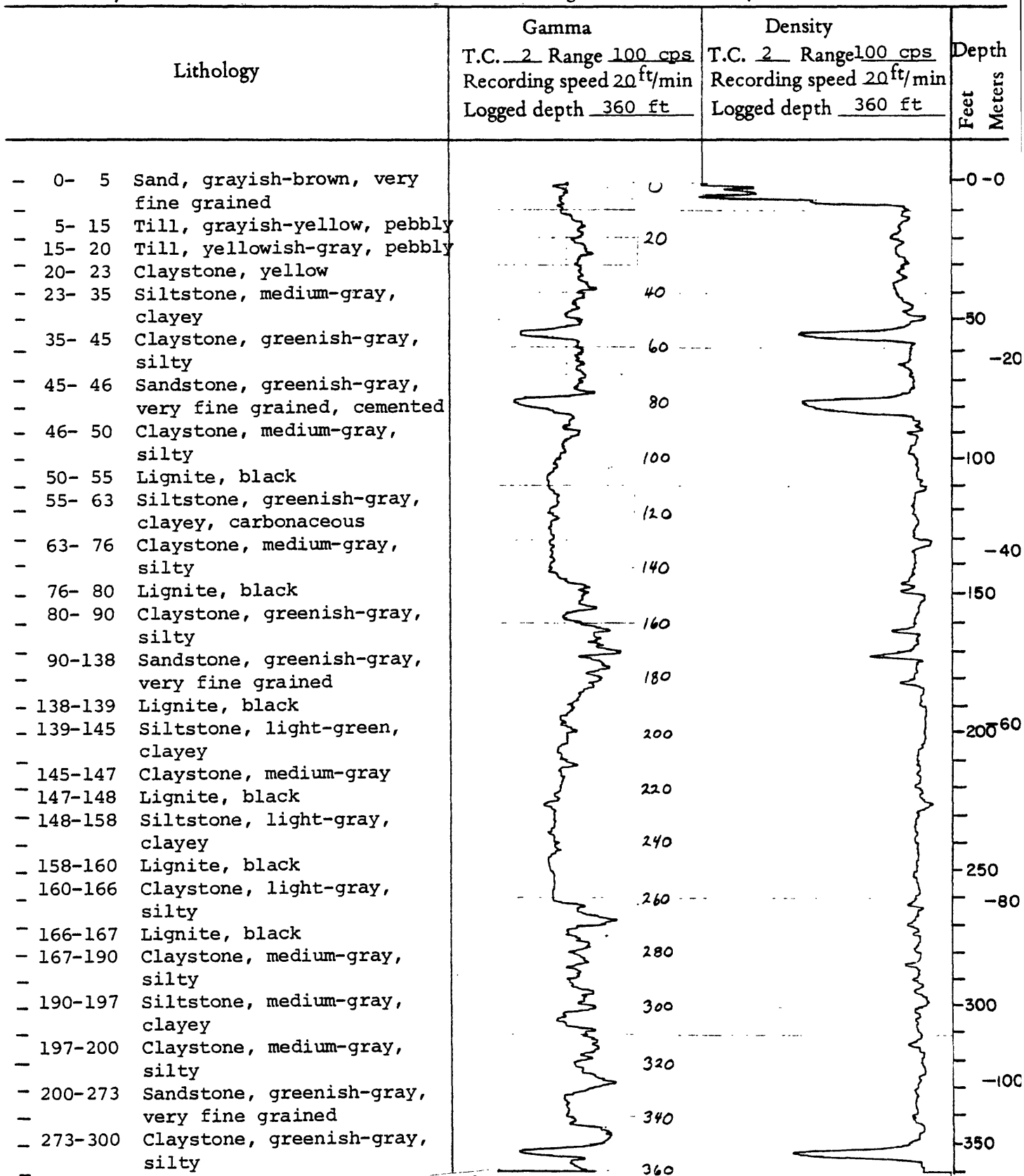
Lithology

Recorded by: Randall Reichert

Geologist ^{Yes} ~~No~~

Geophysical logs

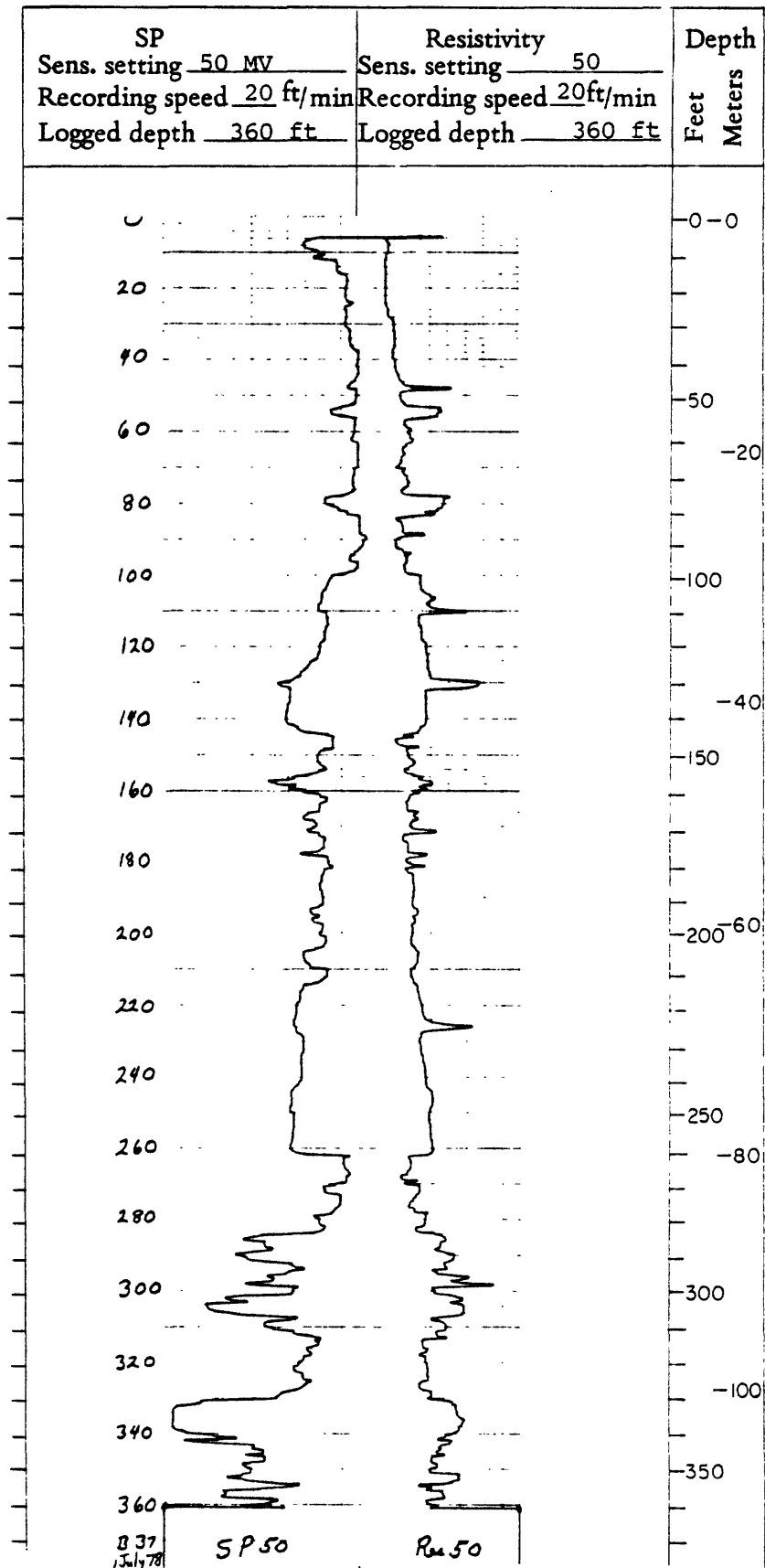
recorded by: Lechner



Hole number—continued

BU-37

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>360 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>360 ft</u>	Depth	
			Fcct	Meters
300-333 Claystone, medium-gray, silty				
333-340 Claystone, green, silty				-120
340-346 Claystone, medium-gray, silty				400
346-352 Lignite, black				
352-360 Claystone, medium-gray, silty				
				450
				-140
				500
				-160
				550
				-180
				600
				650
				-200
				700
				-220
				750



BU-37

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NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-38 Map: Atcoal Date: 7-11-78 State: ND County: Burke
 Elev.: 1912 ft Location: T. 163^N, R. 94^W, Sec. 32, Tract: cbbb Drilled depth: 300 ft
 Measured: 2610 ft ^{FSL} 48 ft ^{FWL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 250-254; 280-282

Remarks: _____

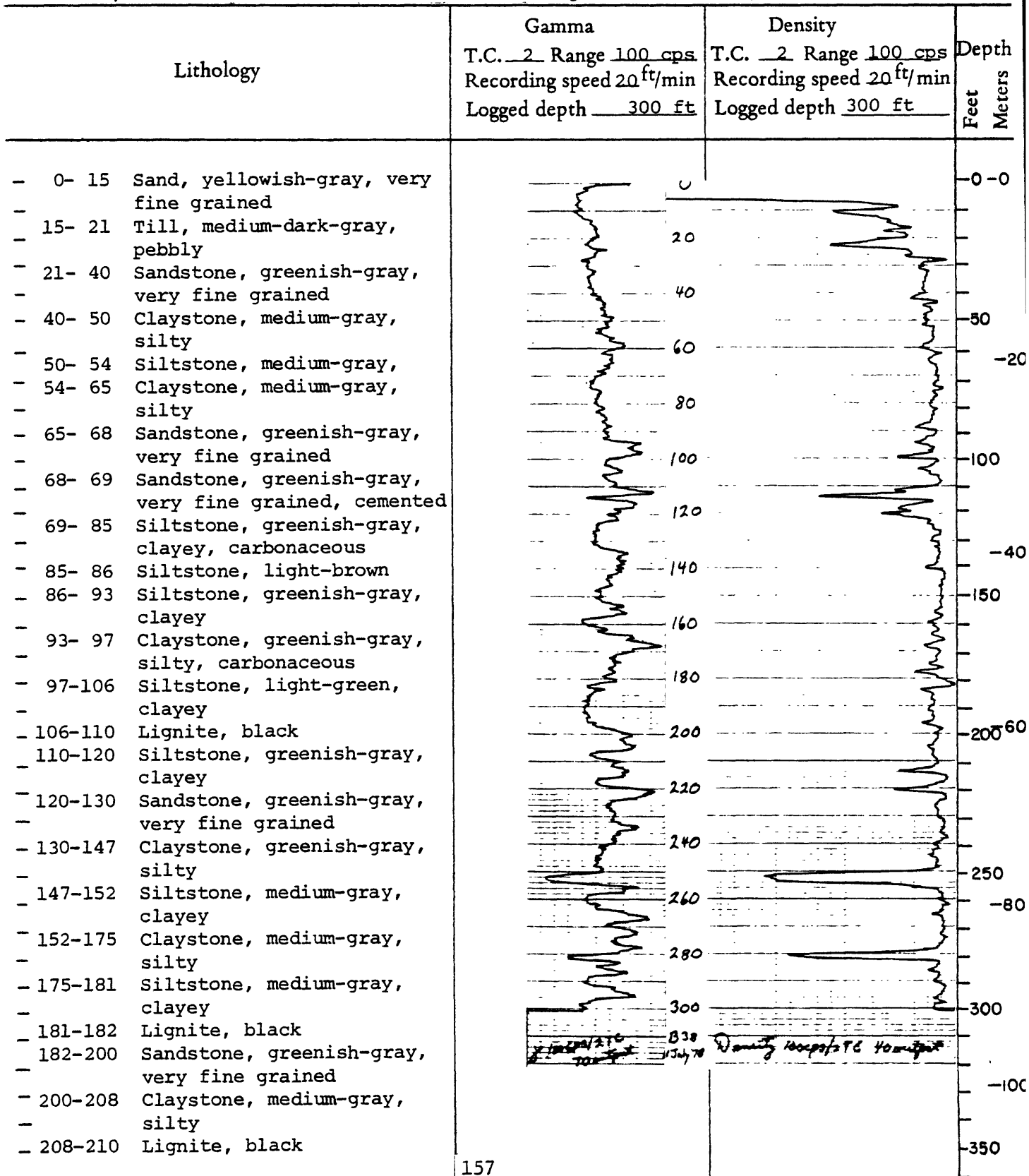
Lithology

Recorded by: Randall Reichert

Geophysicist ^{Yes} ~~No~~

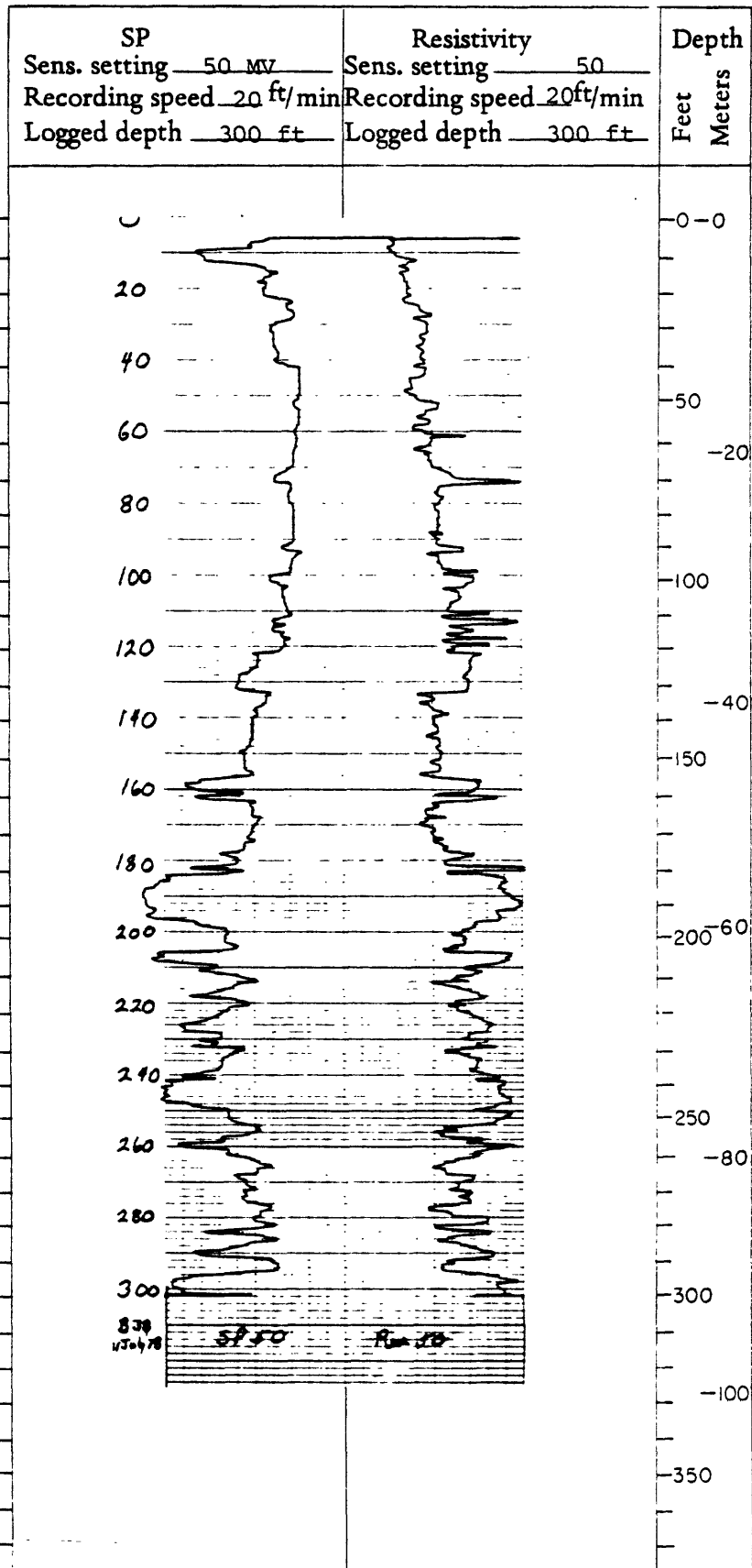
Geophysical logs

recorded by: Lechner



Hole number—continued
BU-38

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft</u>	Depth	
			Fect	Meters
10-245 Siltstone, light-gray, clayey, carbonaceous				
45-251 Lignite, black				-120
51-265 Siltstone, medium-gray, clayey, carbonaceous			400	
65-300 Claystone, medium-gray, silty, carbonaceous				
			450	
			-140	
			500	
				-160
			550	
				-180
			600	
			650	
			-200	
			700	
				-220
			750	



Hole number—continued
BU-38

SP Sens. setting <u>50 mV</u> Recording speed <u>20</u> ft/min Logged depth <u>300 ft</u>	Resistivity Sens. setting <u>50</u> Recording speed <u>20</u> ft/min Logged depth <u>300 ft</u>	Depth Feet Meters
		-120 -400 -450 -140 -500 -160 -550 -180 -600 -650 -200 -700 -220 -750

NORTH DAKOTA GEOLOGICAL SURVEY

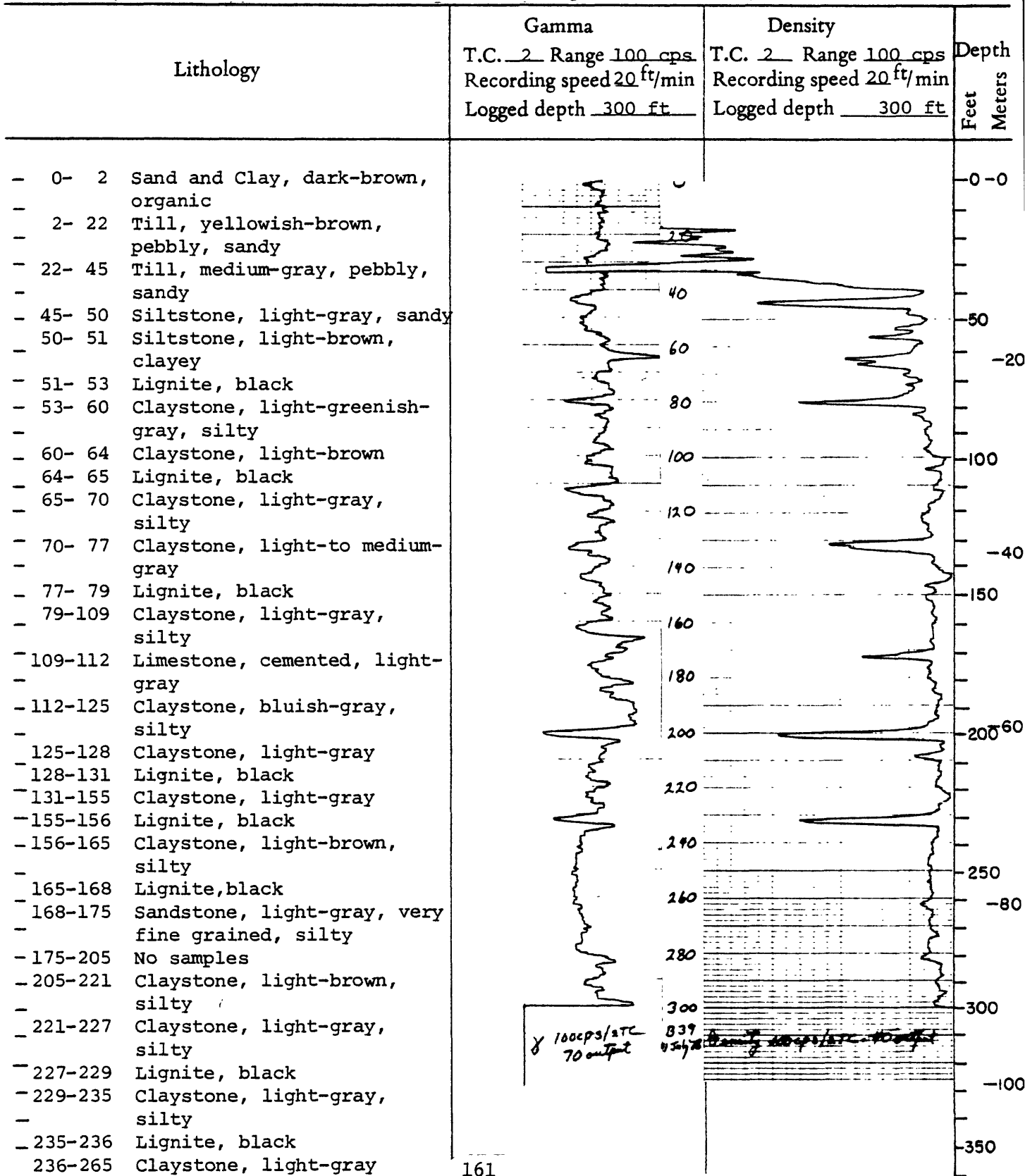
Hole No: BU-39 Map: Atcoal Date: 7-11-78 State: ND County: Burke
 Elev.: 1908 ft Location: T. 163 ^N, R. 94 ^E, Sec. 9, Tract: cccc Drilled depth: 300 ft
 Measured: 15 ft ^{FSL} ~~XXX~~, 54 ft ^{FWL} ~~XXX~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 42-45; 79-81; 199.5-202; 231-233

Remarks: _____

Lithology

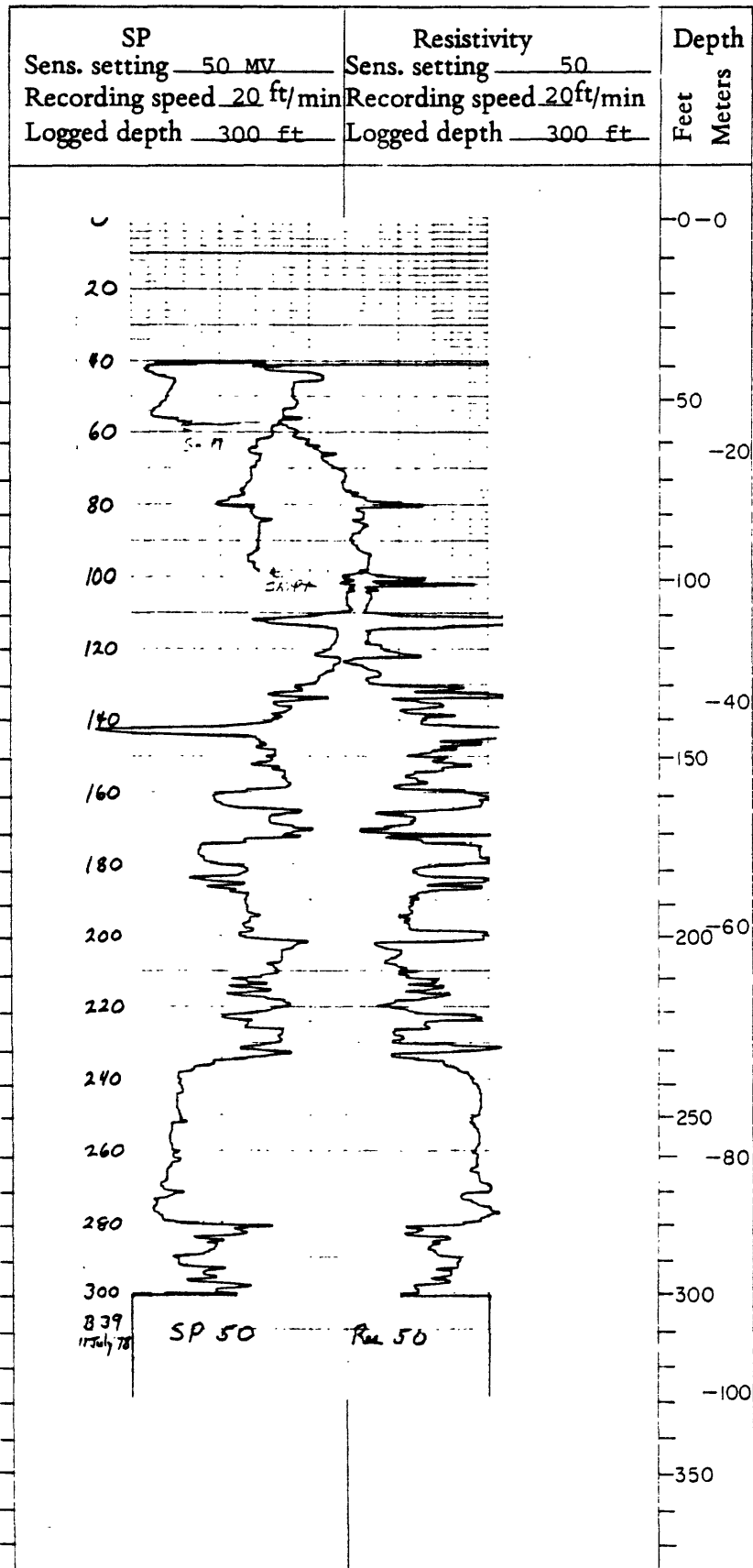
Recorded by: Fred O'TooleGeologist ^{Yes} ~~XXX~~

Geophysical logs

recorded by: Lechner

Hole number—continued
BU-39

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>300 ft</u>	Depth	
			Fect	Meters
265-290 No samples				
290-300 Claystone, medium-gray, silty				
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	
	162			



BU-39

164

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-40 Map: Atcoal Date: 7-9-78 State: ND County: Burke
 Elev.: 1898 ft Location: T. 164 ^N, R. 94 ^W, Sec. 32, Tract: ddda Drilled depth: 280 ft.
 Measured: 342 ft ^{FSL}, 16 ft ^{FEL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 234-237

Remarks: _____

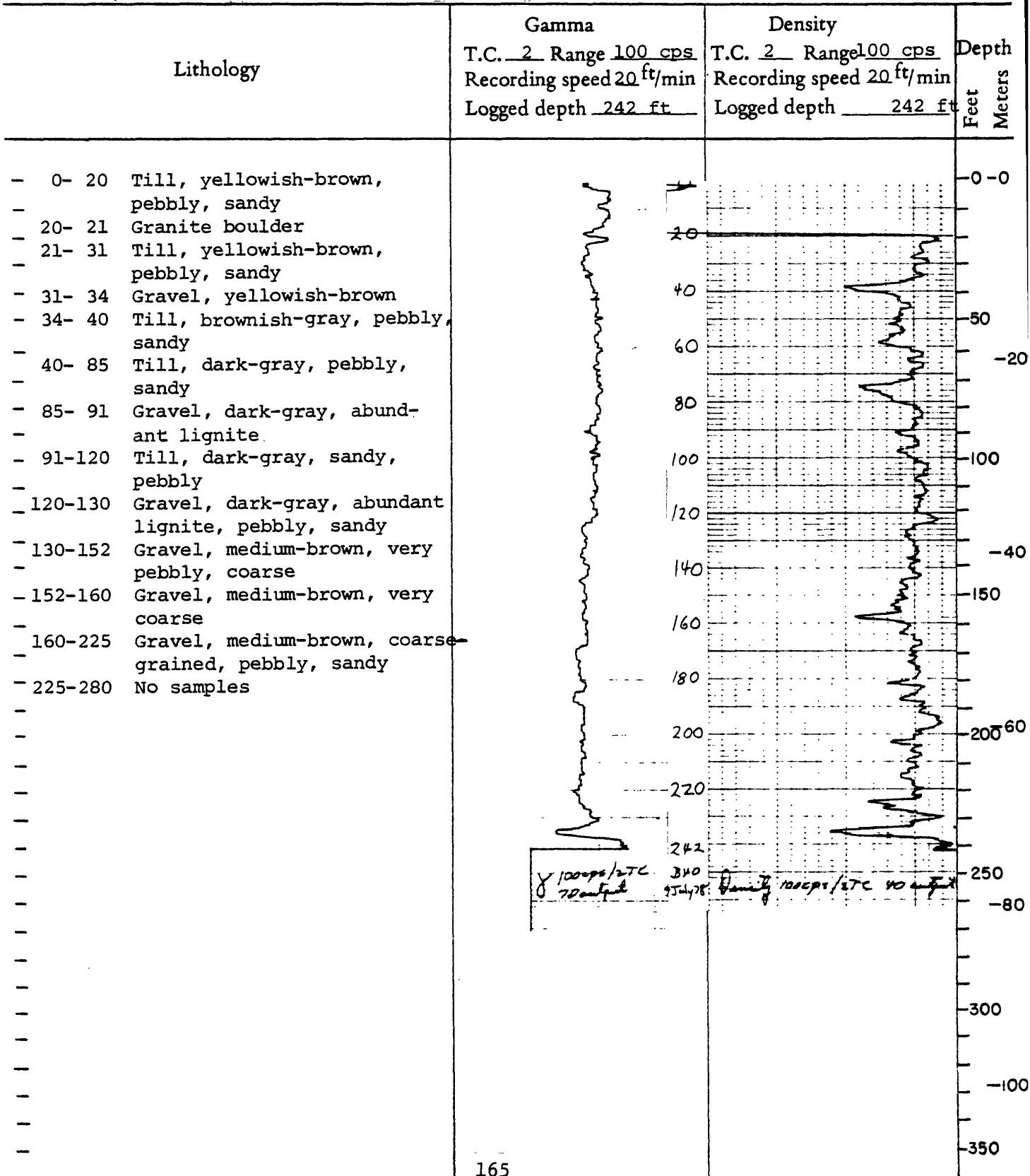
Lithology

Recorded by: Fred O'Toole

Geophysicist ^{Yes} ~~No~~

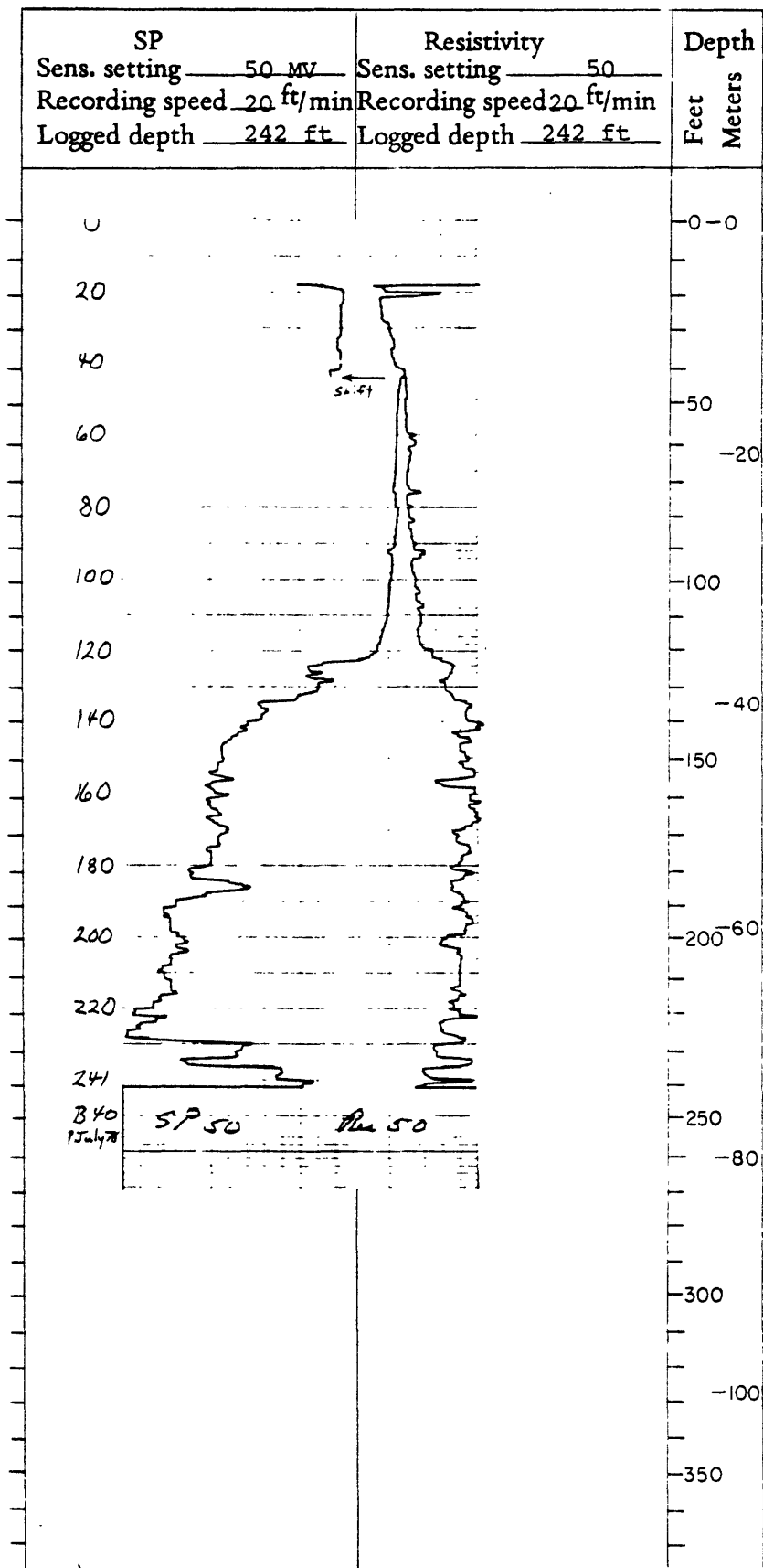
Geophysical logs

recorded by: Lechner



Hole number—continued
BU-40

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>242</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>242</u> ft	Depth	
			Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued

BU-40

SP		Resistivity		Depth	
Sens. setting	50 mV	Sens. setting	50	Feet	Meters
Recording speed	20 ft/min	Recording speed	20 ft/min		
Logged depth	242 ft	Logged depth	242 ft		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-41 Map: Thompson Lake Date: 8-8-78 State: ND County: Burke
 Elev.: 2335 ft Location: T. 159^N, R. 91^W, Sec. 2, Tract: bbba Drilled depth: 740 ft
 Measured: 30 ft ^{FNL} 519 ft ^{FWL} Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 206-209; 286-291; 341-344; 360.5-368; 510-512; 668-670; 727-732

Remarks: _____

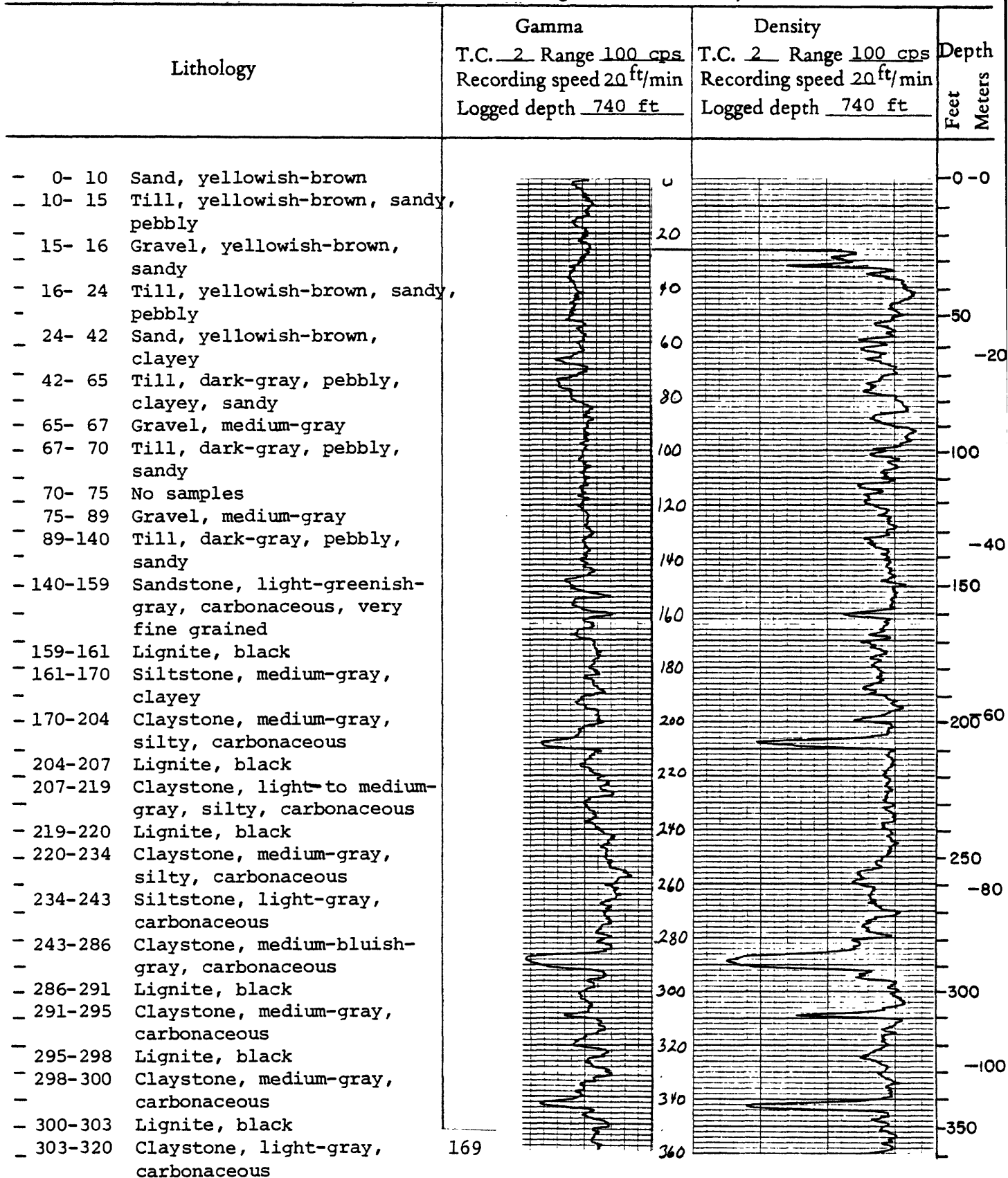
Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes} ~~Yes~~

Geophysical logs

recorded by: Lechner

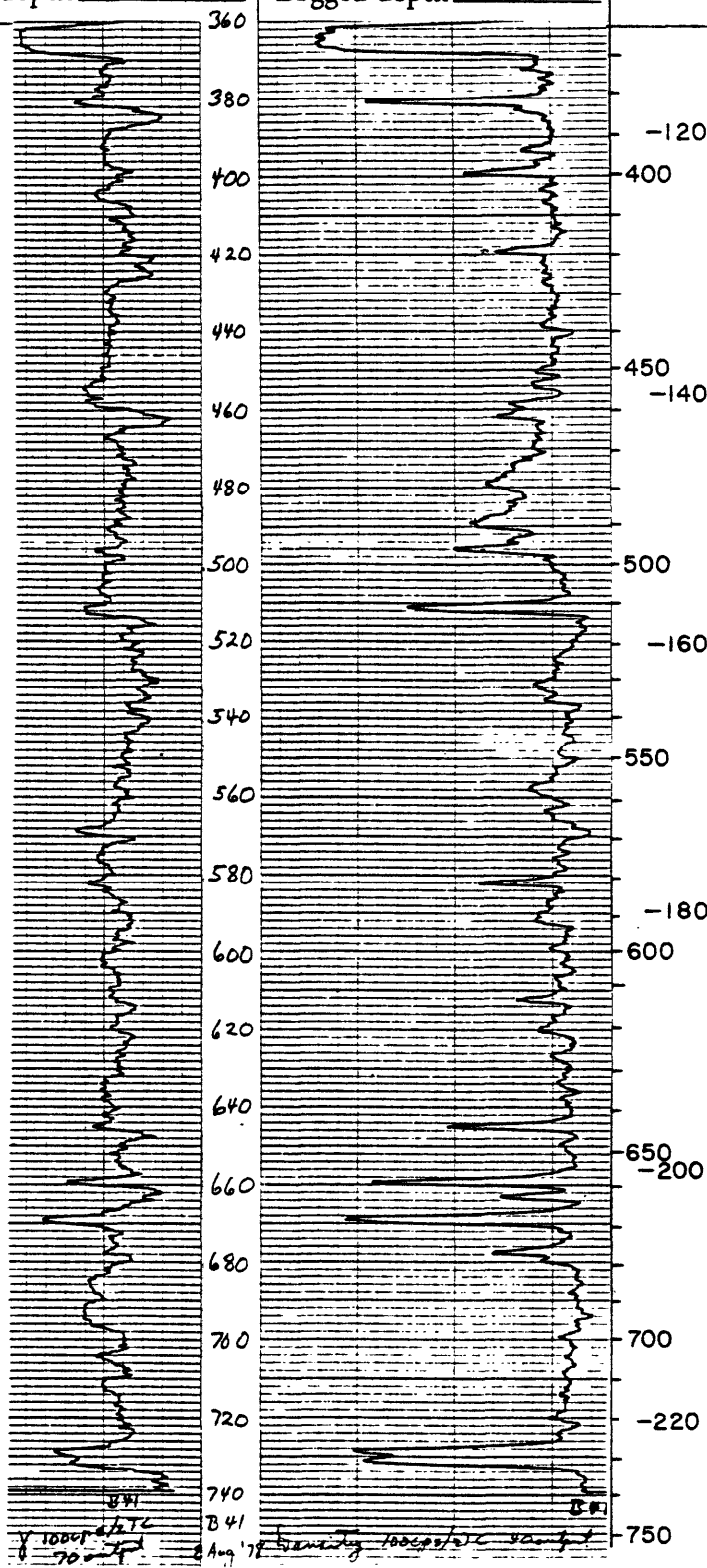


Hole number—continued

BU-41

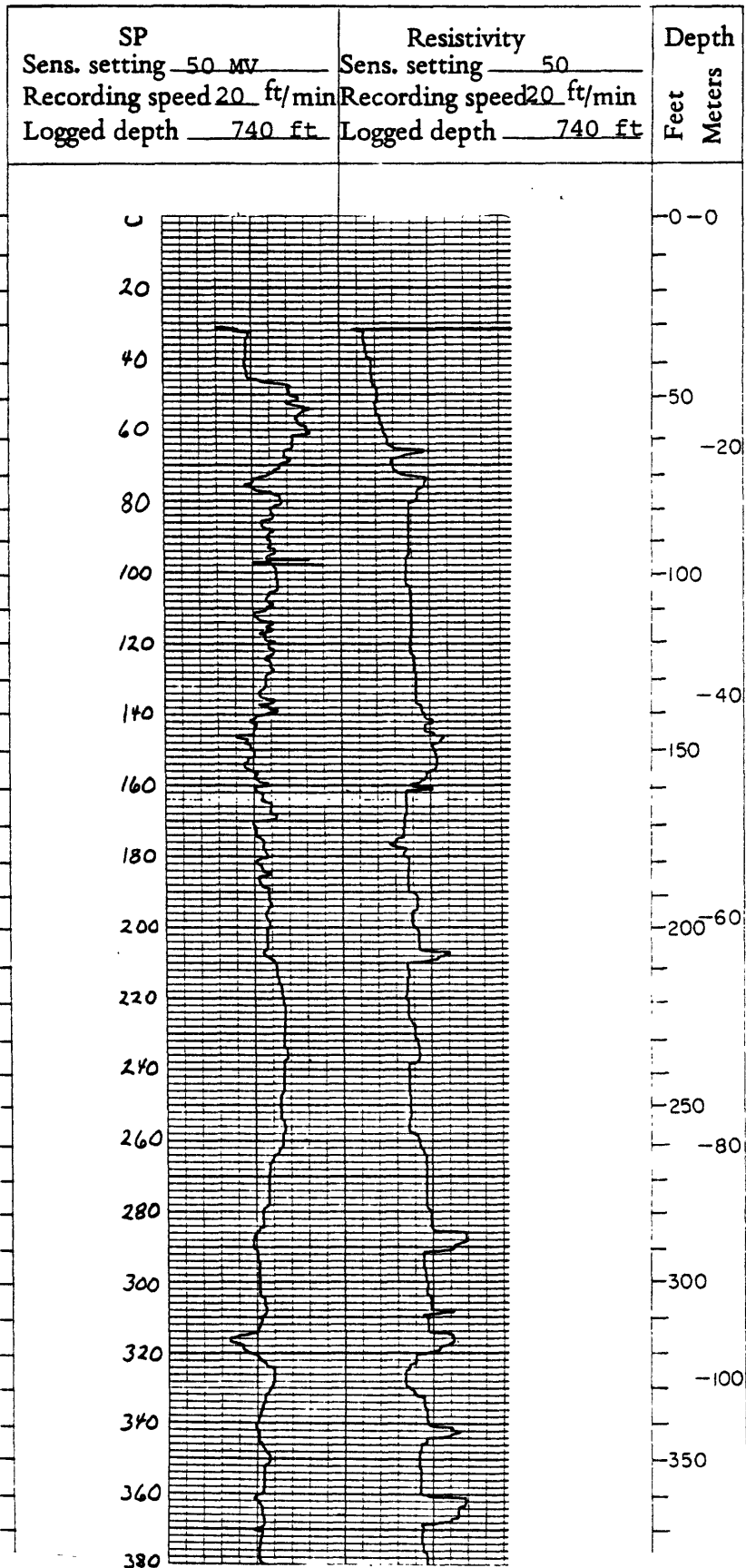
Lithology	Gamma		Density		Depth	
	T.C. 2 Range 100 cps		T.C. 2 Range 100 cps		Fect	Meters
	Recording speed 20 ft/min		Recording speed 20ft/min			
	Logged depth 740 ft		Logged depth 740 ft			
20-335	No samples					
335-344	Claystone, light-gray, silty				-120	
344-350	Siltstone, light-gray, clayey				400	
350-360	Claystone, medium-gray, carbonaceous					
360-367	Lignite, black					
367-371	Siltstone, medium-gray, sandy, carbonaceous				450	
371-385	Sandstone, light-gray, very fine grained, carbonaceous				-140	
385-443	Claystone, light-gray					
443-465	Claystone, medium-gray, silty					
465-485	Claystone, light-gray, carbonaceous				500	
485-502	Claystone, dark-brown, highly carbonaceous				-160	
502-510	Claystone, medium-gray, carbonaceous					
510-511	Lignite stringer, black				550	
511-527	Claystone, medium-gray, carbonaceous					
527-528	Lignite stringer, black					
528-562	Claystone, medium-gray, silty, carbonaceous, interbedded with claystone, light-green				-180	
562-583	Claystone, medium-gray, silty				600	
583-585	Lignite, black					
585-645	Claystone, medium-gray, silty, carbonaceous				650	
645-646	Lignite stringer, black				-200	
646-651	Claystone, medium-gray, silty					
651-653	Lignite, black					
653-665	Claystone, medium-gray, silty, carbonaceous				700	
665-668	Lignite, black					
668-671	Claystone, medium-gray, carbonaceous				-220	
671-675	Lignite, black					
675-692	Claystone, medium-brownish-gray, carbonaceous				750	
692-713	Sandstone, light-gray, very fine grained, silty					

170



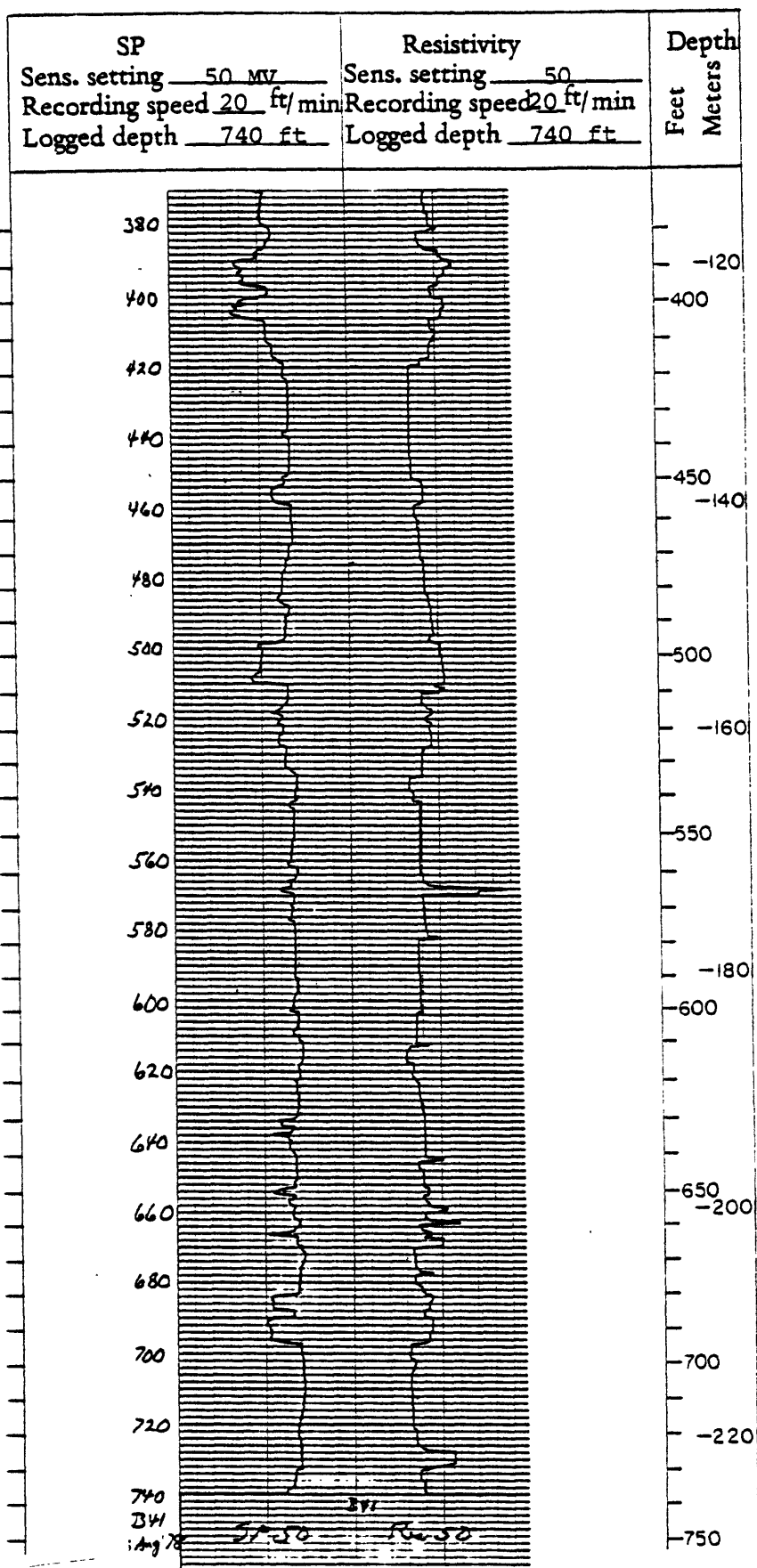
BU-41

Lithology		Gamma	Density	Depth	
		T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>740</u> ft	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>740</u> ft	Fect	Meters
13-728	Claystone, medium-gray, silty				
28-732	Lignite, black			-120	
32-740	Claystone, medium-gray, carbonaceous			400	
				450	
				-140	
				500	
				-160	
				550	
				-180	
				600	
				650	
				-200	
				700	
				-220	
				750	



Hole number—continued

BU-41



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-42 Map: Vanville NE Date: 8-7-78 State: ND County: Burke
 Elev.: 2340 ft Location: T. 160 ^N_S, R. 90 ^E_W, Sec. 20, Tract: cdcd Drilled depth: 740 ft.
 Measured: 8 ft ^{FWL}_{FWL}, 1600 ft ^{FWL}_{FWL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 136-138; 191-194; 249-256; 272-275; 328-335; 460-463; 509-512;
654-657; 736-739

Remarks: _____

Lithology

Recorded by: Fred O'TooleGeologist ^{Yes}_{No}

Geophysical logs

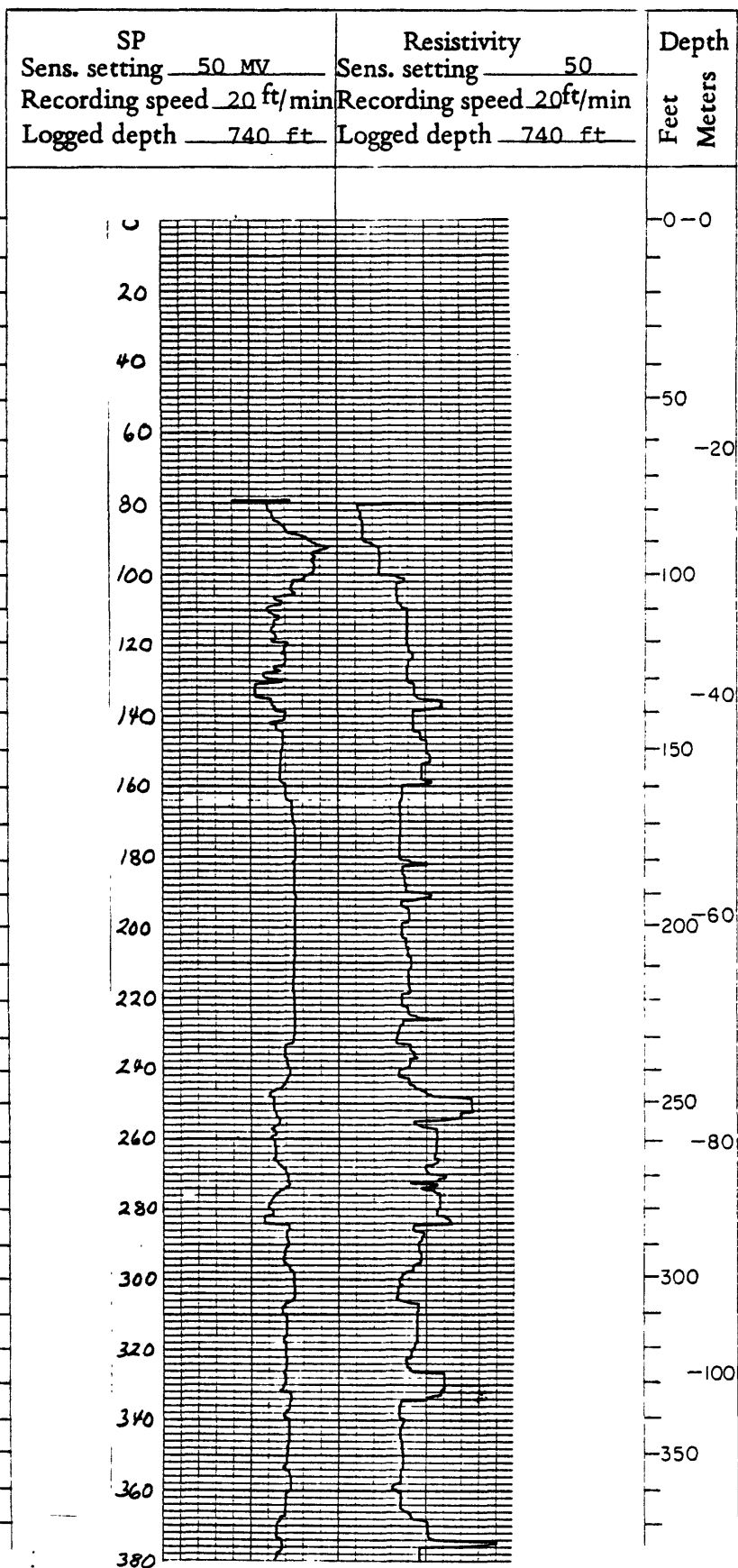
recorded by: Lechner

Lithology	Gamma	Density	Depth Feet Meters
	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>740 ft</u>	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>740 ft</u>	
- 0- 3 Gravel, orangish-brown, medium to coarse			0-0
- 3- 22 Till, yellowish-brown, sandy, pebbly			
- 22- 24 Gravel, yellowish-brown			
- 24-100 Till, dark-gray, sandy, pebbly			50
- 100-127 Till, dark-gray, very sandy			
- 127-133 Claystone, medium-gray, silty, carbonaceous			-20
- 133-135 Lignite, black			
- 135-137 Claystone, medium-gray, silty			100
- 137-150 Siltstone, light-gray, clayey			
- 150-180 No samples			
- 180-181 Lignite, black			-40
- 181-187 Claystone, medium-gray, carbonaceous			150
- 187-189 Lignite, black			
- 189-198 Sandstone, light-gray, very fine grained, carbona- ceous			200 ⁶⁰
- 198-212 Claystone, medium-gray, silty			
- 212-241 Siltstone, medium-gray, carbonaceous, sandy			
- 241-246 Claystone, bluish-gray, carbonaceous			
- 246-251 Lignite, black			250
- 251-255 Claystone, light-greenish- brown, carbonaceous, silty			-80
- 255-260 Claystone, medium-gray, carbonaceous			
- 260-261 Lignite, black			300
- 261-266 Claystone, medium-gray, carbonaceous			
- 266-270 Lignite, black			
- 270-282 Claystone, medium-gray, silty			-100
- 282-297 Siltstone, medium-gray, some clay			
- 297-300 Claystone, light-gray			350
- 300-308 Siltstone, light-gray, sandy	175		

Hole number--continued

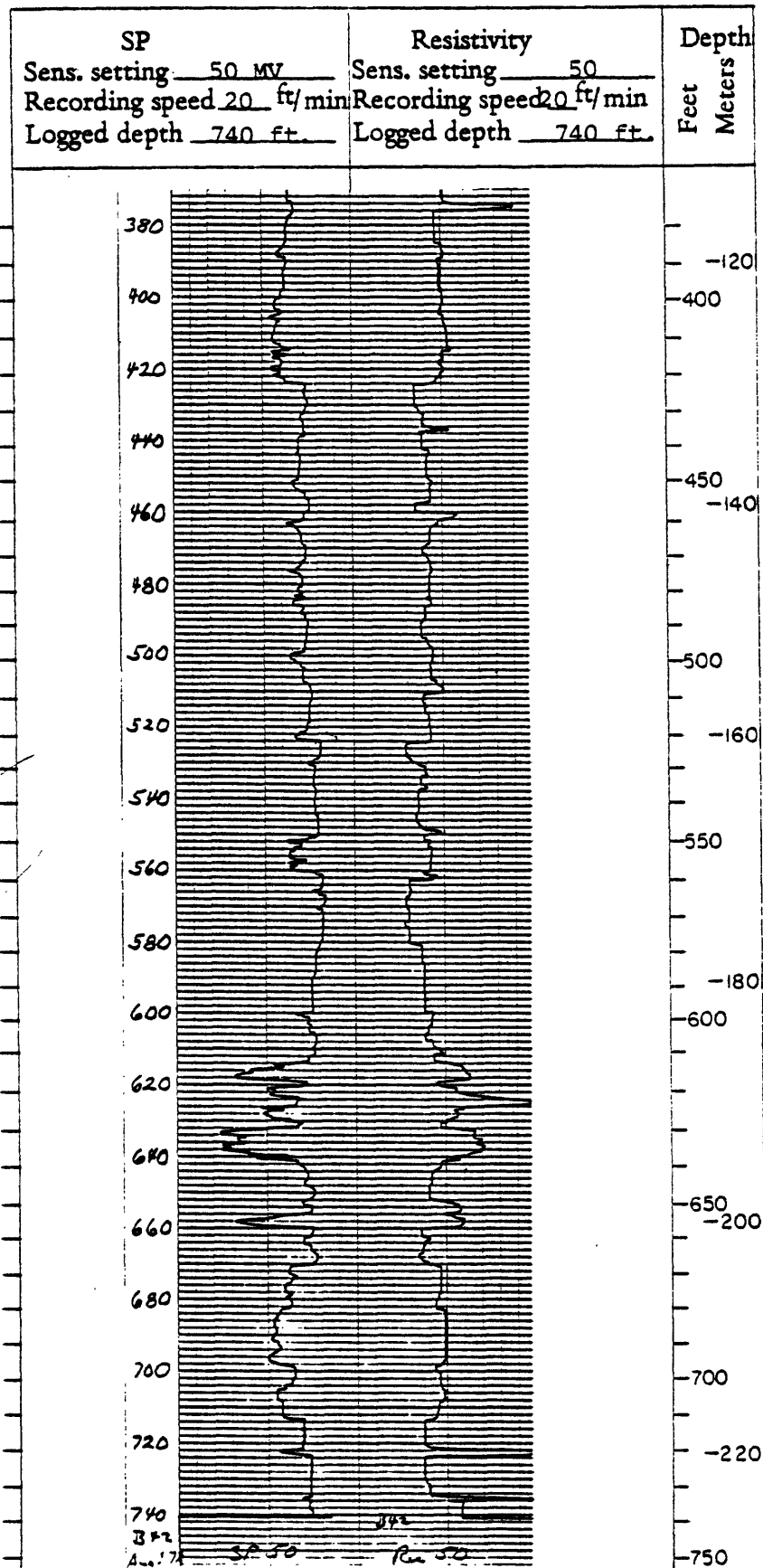
BU-42

Lithology	Gamma		Density		Depth			
	T.C. 2 Range 100 cps		T.C. 2 Range 100 cps		Feet	Meters		
	Recording speed 20 ft/min		Recording speed 20 ft/min					
	Logged depth 740 ft		Logged depth 740 ft					
308-320	Sandstone, light-gray, very fine grained							
320-326	Lignite, black				-120			
326-330	Claystone, medium-brown, carbonaceous, silty				400			
330-360	Claystone, medium-gray, carbonaceous							
360-420	Sandstone, light-gray, very fine grained							
420-451	Claystone, medium-gray, silty				450			
451-455	Claystone, medium-brown, carbonaceous				-140			
455-462	Claystone, medium-gray							
462-468	Claystone, bluish-gray, carbonaceous, silty							
468-510	Claystone, medium-gray, silty				500			
510-530	Claystone, medium-brown, silty, carbonaceous				-160			
530-540	No samples							
540-556	Claystone, medium-gray, silty, carbonaceous				550			
556-560	Claystone, green, carbonaceous							
560-582	Claystone, medium-gray, silty				-180			
582-607	Claystone, light to medium-gray, carbonaceous				600			
607-618	Siltstone, light-gray, carbonaceous, clayey							
618-624	Sandstone, light-gray, very fine grained							
624-625	Sandstone, light-gray, cemented, very fine grained				650			
625-633	Claystone, greenish-gray, carbonaceous, bentonitic				-200			
633-641	Claystone, medium to dark-gray, some siltstone							
641-646	Claystone, light-gray				700			
646-648	Lignite, black							
648-662	Claystone, light-gray							
662-680	Claystone, medium-gray, silty, carbonaceous				-220			
680-716	Sandstone, light-gray, silty, very fine grained							
716-728	Claystone, medium-gray, carbonaceous				750			
728-730	Limestone, dark-gray, some gypsum							
730-740	No samples							



Hole number—continued

BU-42



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BU-43 Map: Vanville NE Date: 8-7-78 State: ND County: Burke
 Elev.: 2225 ft Location: T. 160 ^N~~S~~, R. 90 ^W~~E~~, Sec. 35, Tract: bbba Drilled depth: 640ft.
 Measured: 30 ft ^{FNL}~~FSL~~, 600 ft ^{RSL}~~FWL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 106-116; 125-128; 165-171; 303-305; 559-562; 628-638

Remarks: _____

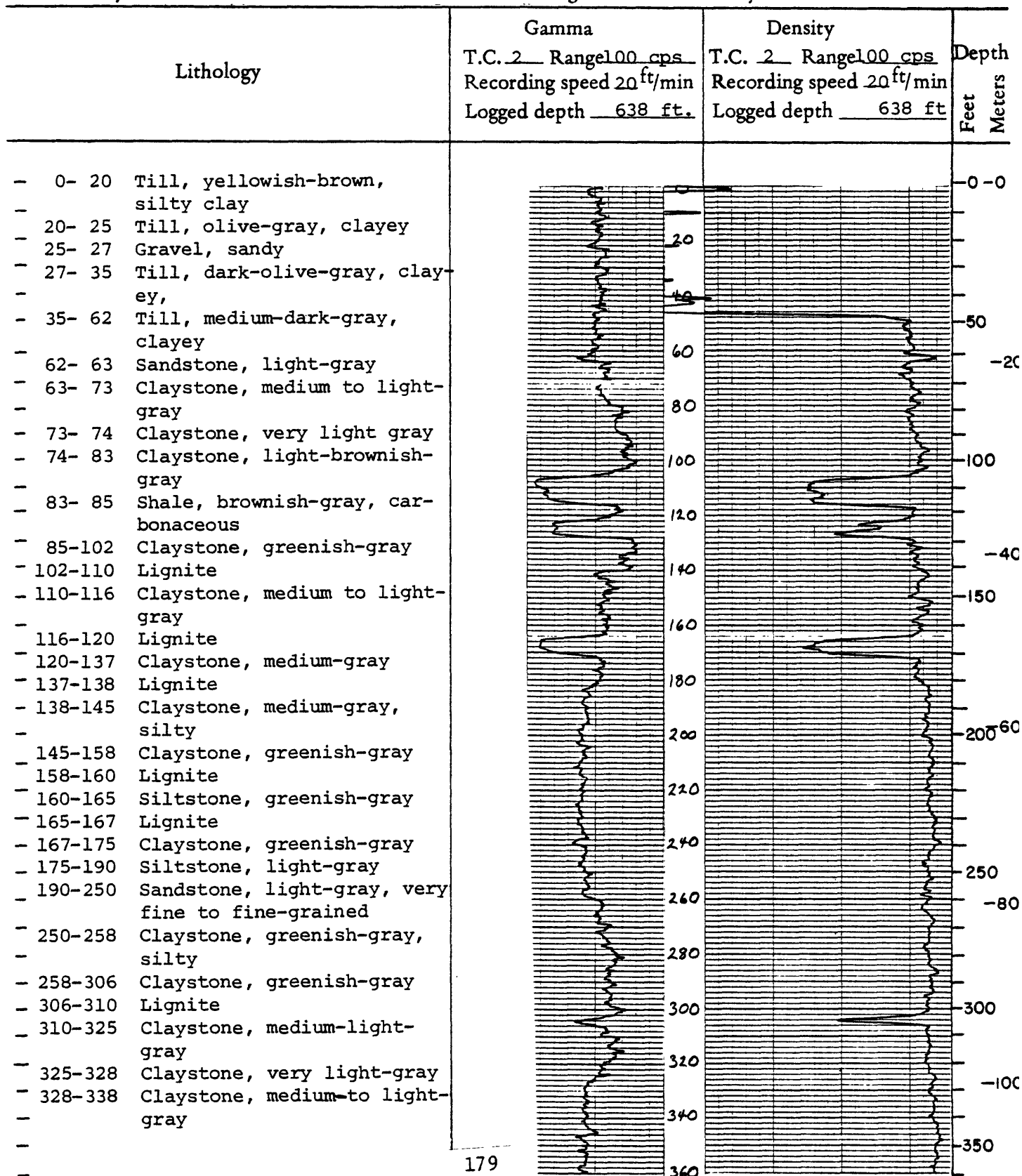
Lithology

Recorded by: Clarence Carlson

Geologist ^{Yes}~~No~~

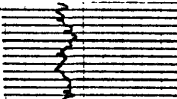
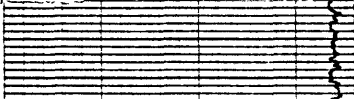


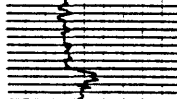
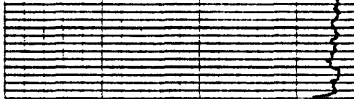

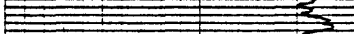

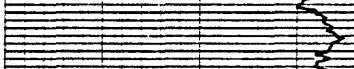

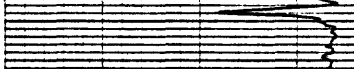
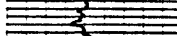
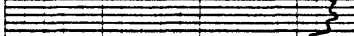








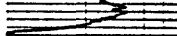




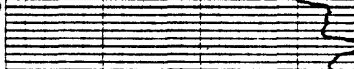

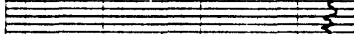

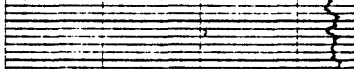


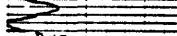

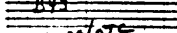
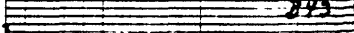

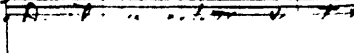
















Geophysical logs

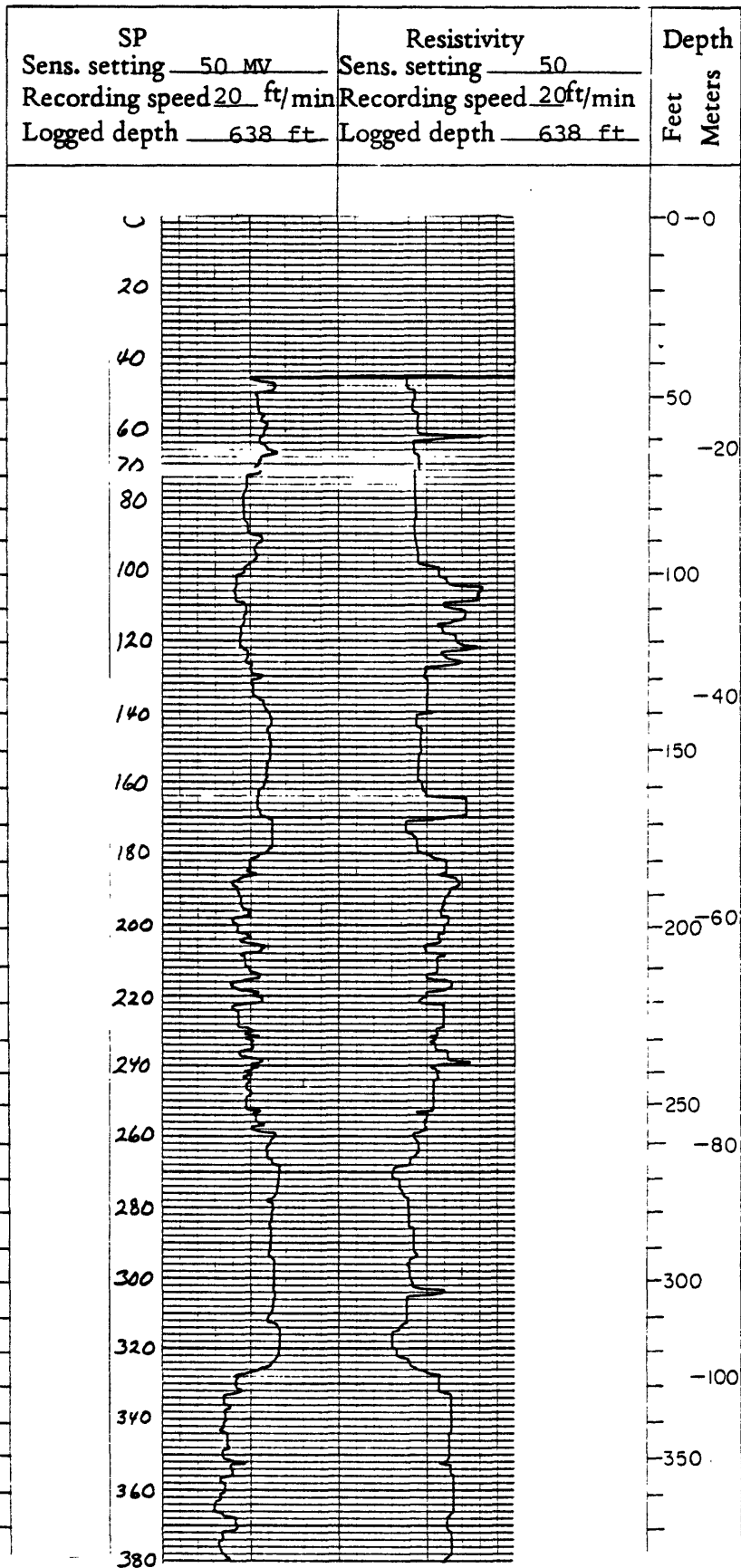
recorded by: Lechner



Hole number—continued

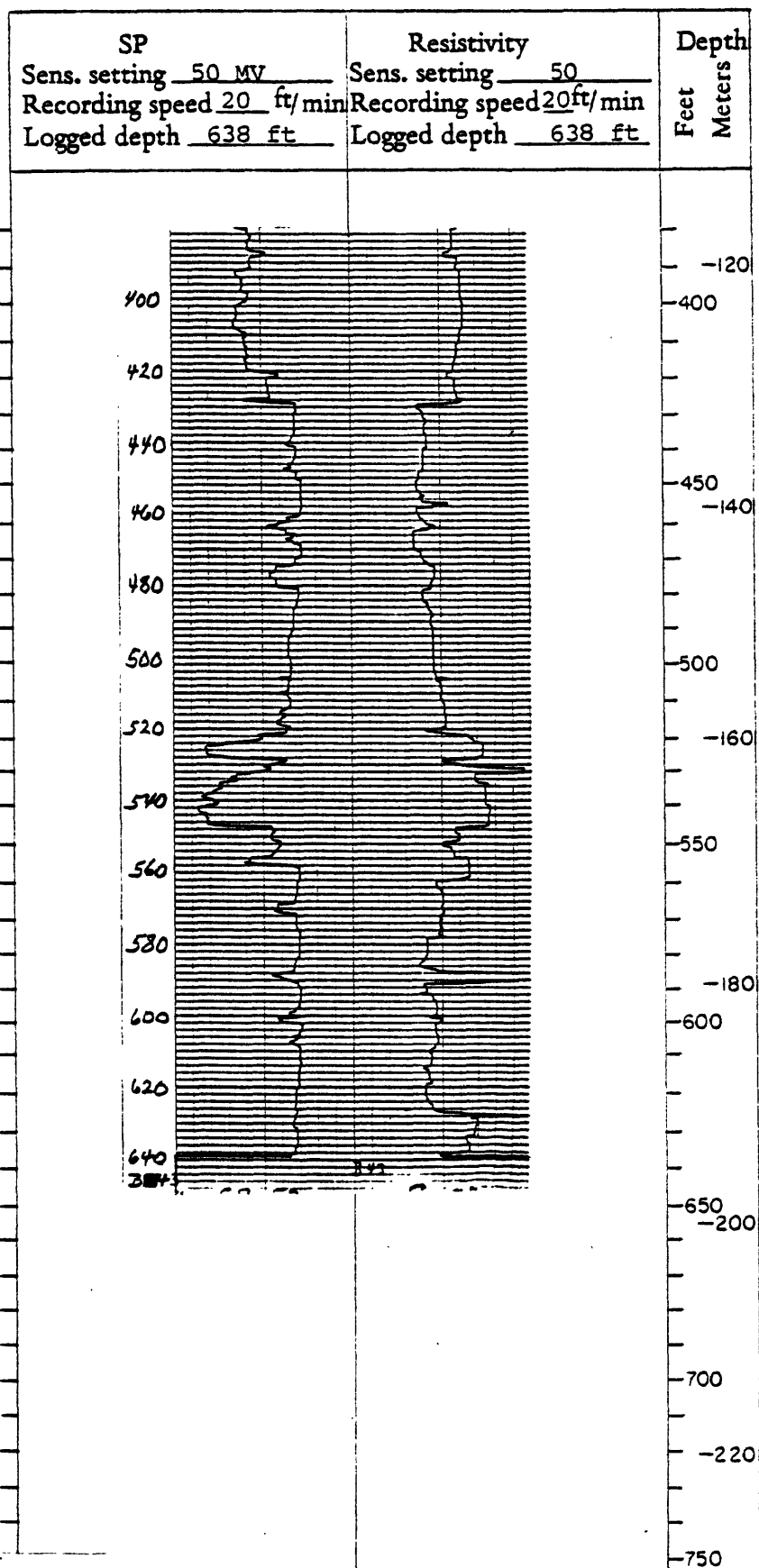
BU-43

Lithology	Gamma		Density		Depth	
	T.C. 2 Range 100 cps		T.C. 2 Range 100 cps		Feet	Meters
	Recording speed 20 ft/min		Recording speed 20ft/min			
	Logged depth 638 ft		Logged depth 638 ft			
338-355 Claystone, medium to light-gray, silty						
355-375 Sandstone, light-gray, very fine grained, silty					-120	400
375-436 Sandstone, light-gray, very fine to fine-grained, silty						
436-438 Lignite						
438-447 Claystone, medium to light-gray					450	
447-449 Claystone, brownish-gray, carbonaceous					-140	
449-460 Claystone, brownish-gray						
460-467 Siltstone, medium to light-gray						
467-469 Claystone, brownish-gray, lignite stringer					500	
469-480 Siltstone, medium to light-gray, sandy					-160	
480-485 Sandstone, medium to light-gray, very fine to fine-grained, silty						
485-492 Claystone, brownish-gray					550	
492-500 Siltstone, light-gray, clayey						
500-520 Claystone, medium to light-gray					-180	
520-540 No samples					600	
540-560 Claystone, medium to light-gray						
560-562 Lignite						
562-568 Claystone, brownish-gray						
568-571 Lignite						
571-582 Claystone, light-brownish-gray					650	
582-588 Claystone, medium to light-gray, silty					-200	
588-590 Limestone, light-gray						
590-605 Claystone, medium to light-gray					700	
605-608 Claystone, brownish-gray						
608-615 Claystone, medium-gray					-220	
615-632 Claystone, medium-gray, silty						
632-638 Lignite						
638-640 Claystone, medium-gray					750	



Hole number—continued

BU-43



NORTH DAKOTA GEOLOGICAL SURVEY

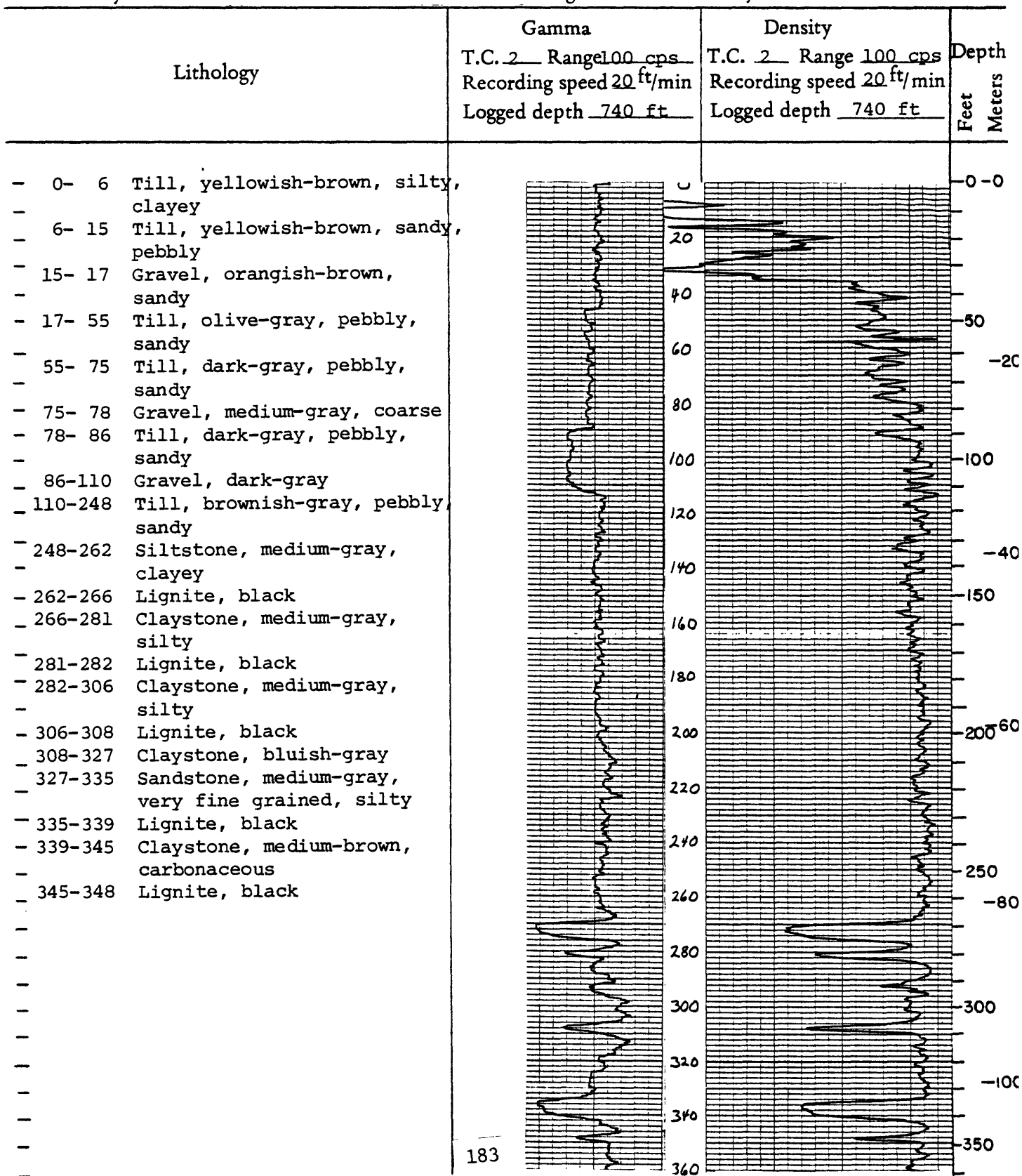
Hole No: BU-44 Map: Westby Lake Date: 8-8-78 State: ND County: Burke
 Elev.: 2330 ft Location: T. 159 ^N~~S~~, R. 90 ^E~~W~~, Sec. 9, Tract: bbbc Drilled depth: 740 ft
 Measured: 600 ft ^{FNL}~~RSL~~, 200 ft ^{FWL}~~RSL~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 270-276; 280-282.5; 307-309; 334-341; 733-739

Remarks: _____

Lithology

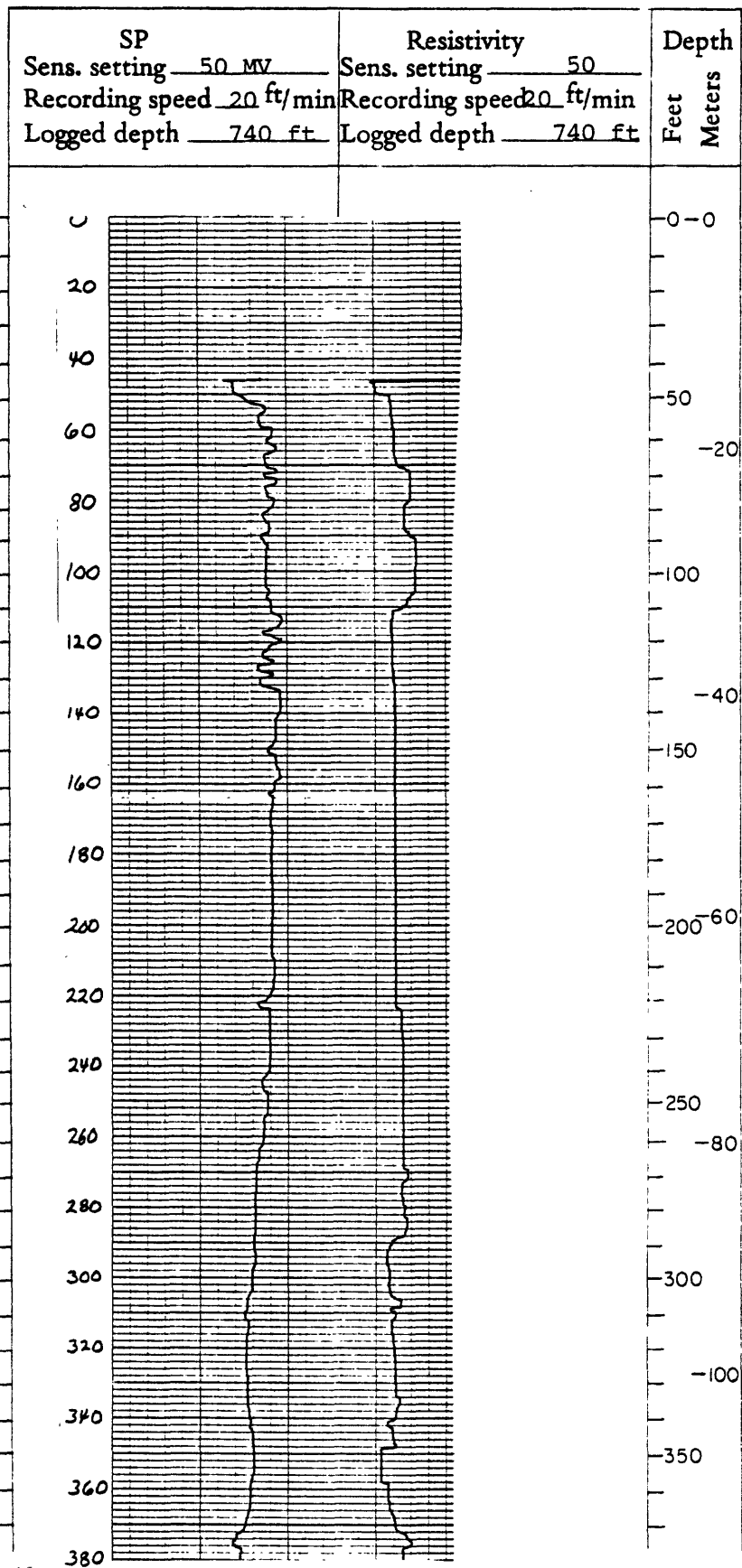
Recorded by: Fred O'Toole

Geophysical logs

Geologist ^{Yes}~~No~~recorded by: Lechner

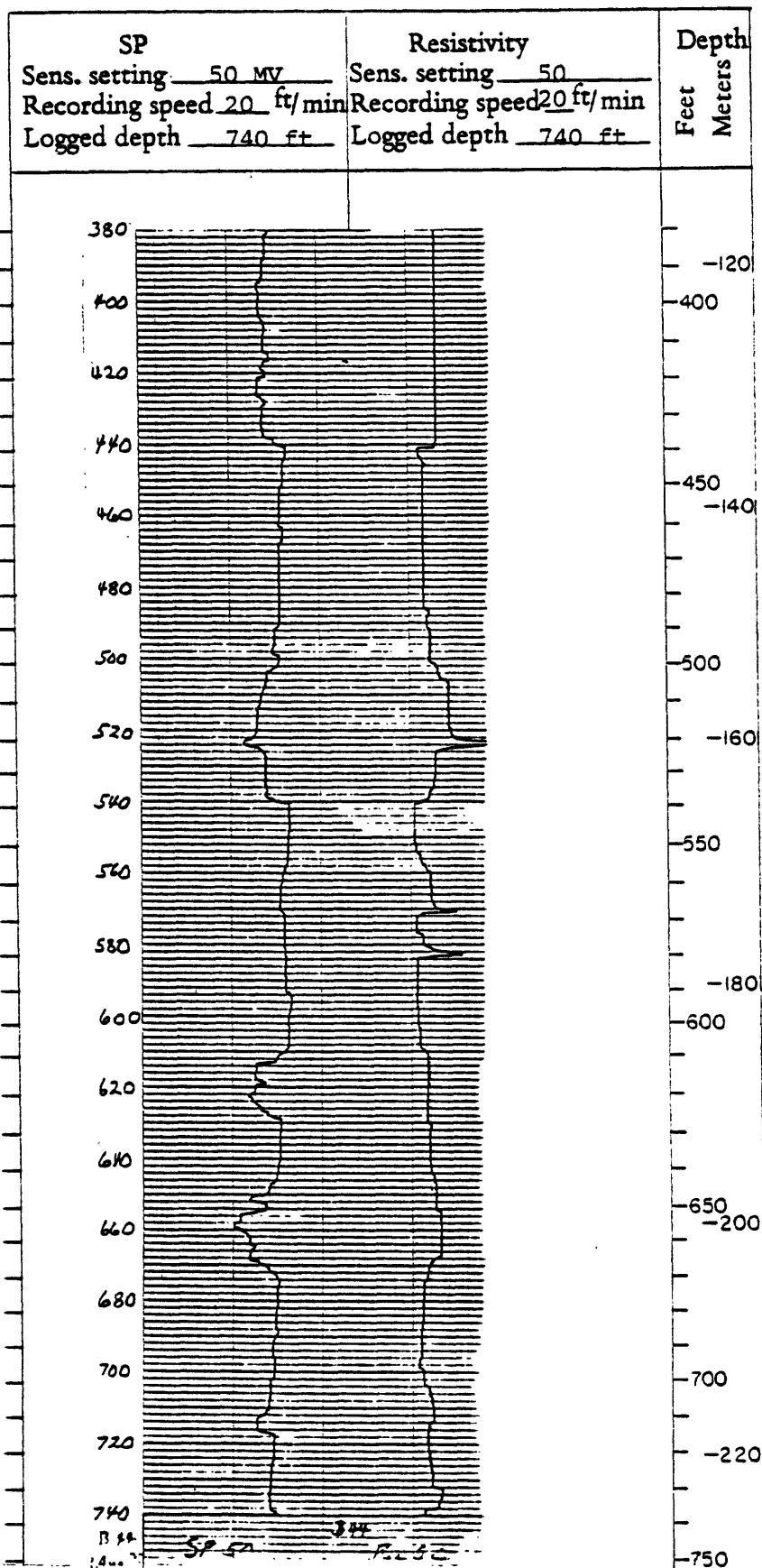
Hole number—continued
BU-44

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fcct	Meters
	Recording speed	20 ft/min	Recording speed	20 ft/min		
	Logged depth	740 ft	Logged depth	740 ft		
348-366 Claystone, medium-gray						
366-378 Claystone, light-gray						
378-387 Claystone, light-brown, silty					-120	
387-441 Sandstone, light-gray, very fine grained					400	
441-450 Claystone, greenish-gray						
450-485 Claystone, medium-gray						
485-488 Lignite, black						
488-490 Claystone, dark-brown, carbonaceous					450	
490-505 Claystone, medium-gray, silty					-140	
505-506 Lignite						
506-509 Claystone, medium-brown, carbonaceous						
509-522 Sandstone, medium-gray, very fine grained					500	
522-584 Claystone, medium-gray						
584-586 Lignite					-160	
586-630 Claystone, medium to dark-gray, silty						
630-633 Lignite					550	
633-635 Claystone, dark-brown, carbonaceous						
635-642 Claystone, light-greenish-gray, carbonaceous					-180	
642-644 Lignite					600	
644-684 Claystone, light-gray, carbonaceous						
684-695 Siltstone, medium-gray with dark-brown claystone stringers, carbonaceous						
695-715 Claystone, medium-gray, silty					650	
715-729 Claystone, light-gray					-200	
729-734 Lignite						
734-740 Claystone, dark-brownish-gray, carbonaceous						
					700	
					-220	
					740	
					750	



Hole number—continued

BU-44



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No.: McL-1 Map: Benedict SW Date: 8-30-78 State: ND County: McLean
 Elev.: 2195 ft Location: T. 150^N, R. 83^W, Sec. 24, Tract: ddad Drilled depth: 540 ft
 Measured: 1256 ft ~~FSL~~ 528 ft ~~FSL~~ ^{FEL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 159-162; 185-187; 214-218; 222-228; 317-321; 336-338;
369-373; 434-438

Remarks: _____

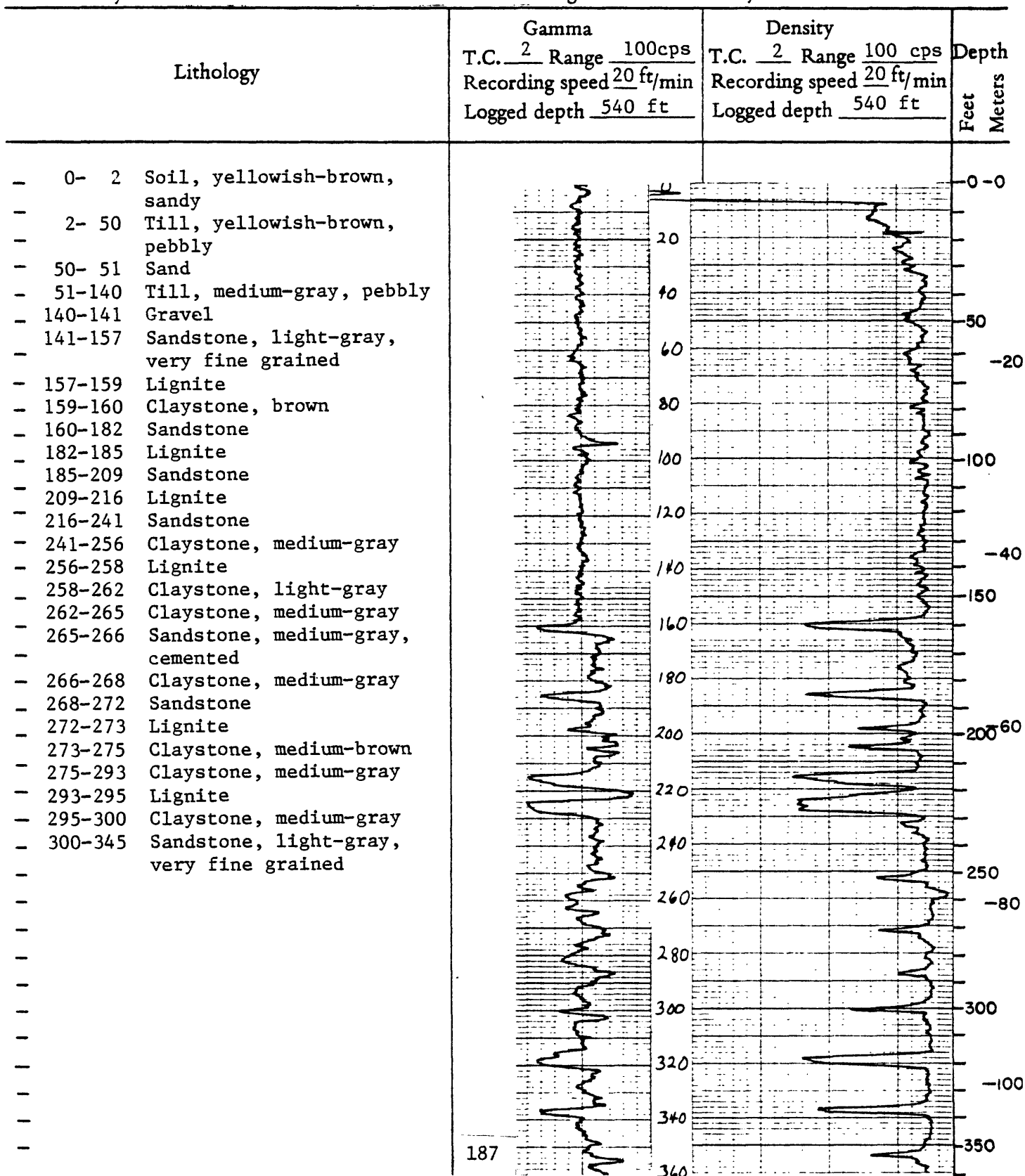
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~No~~

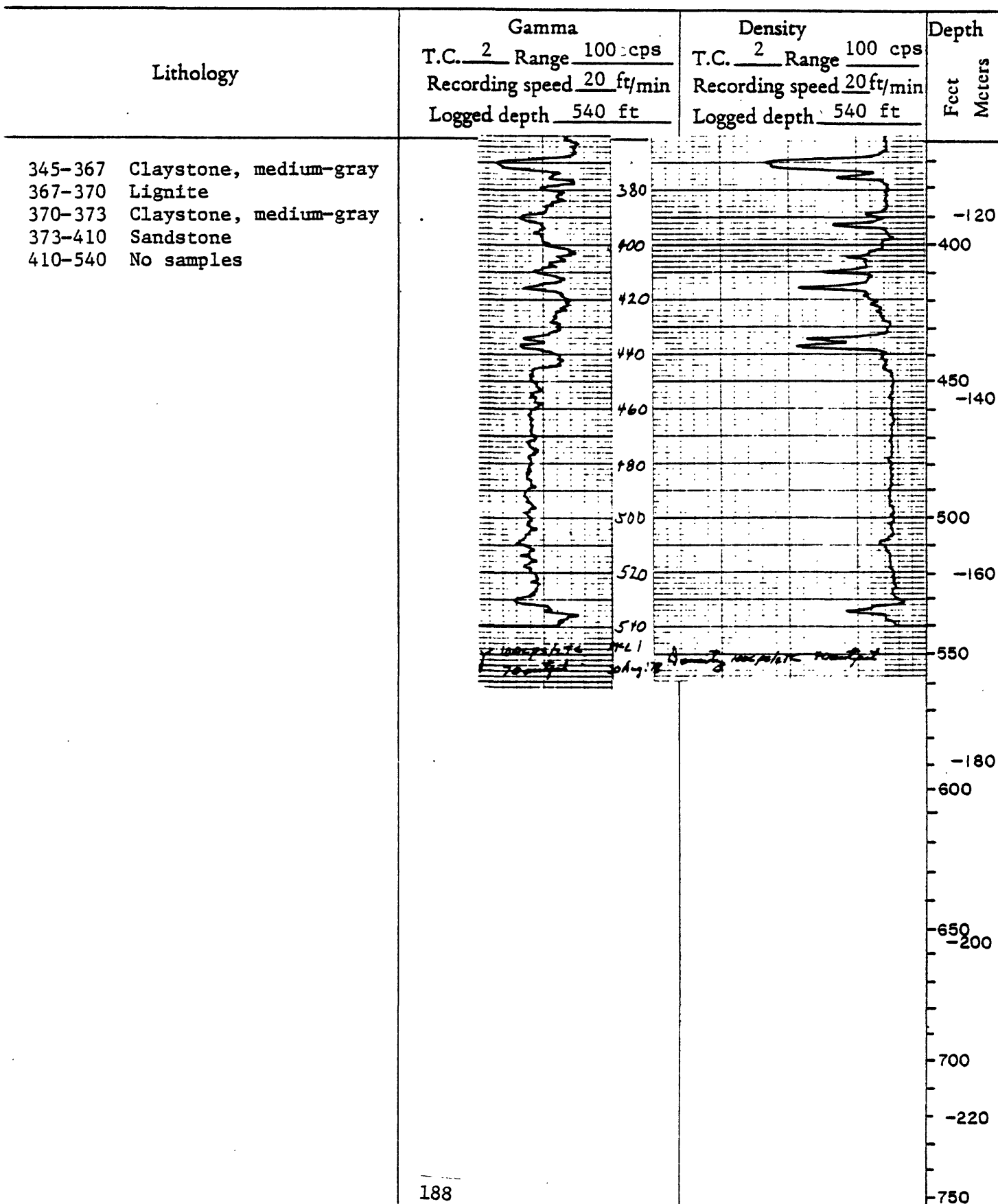
Geophysical logs

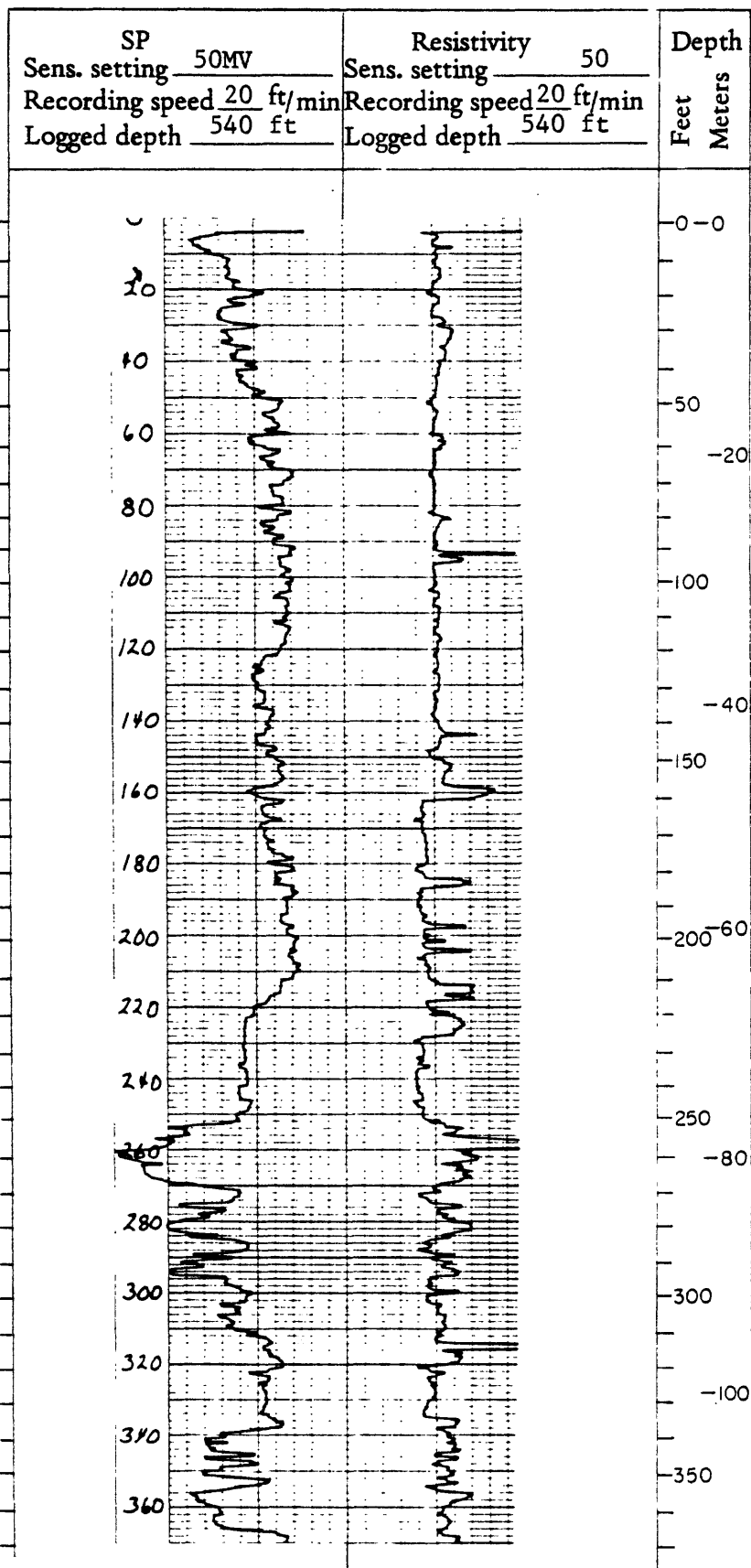
recorded by: Lechner



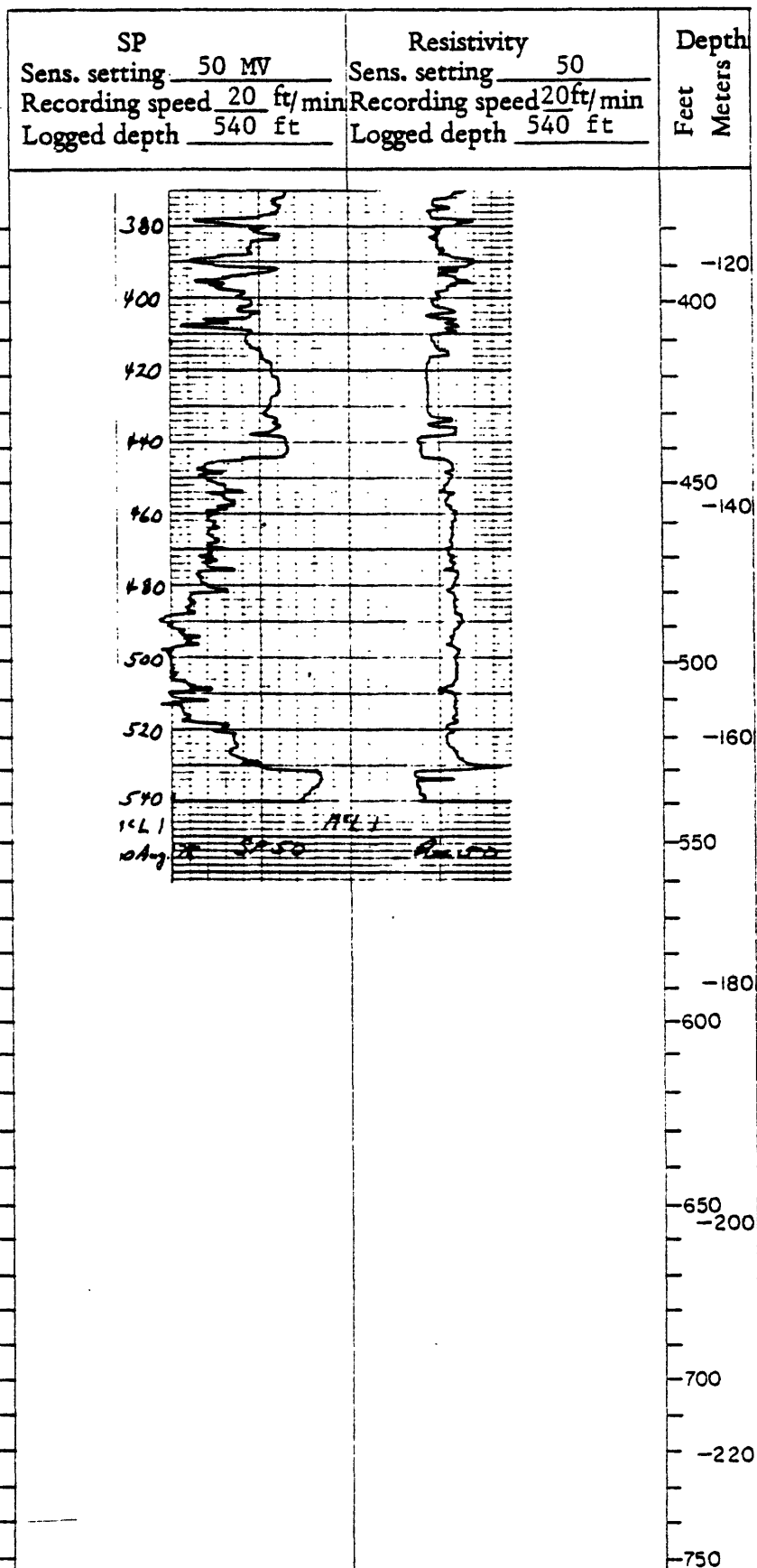
Hole number—continued

McL-1





Hole number—continued
McL-1



NORTH DAKOTA GEOLOGICAL SURVEY

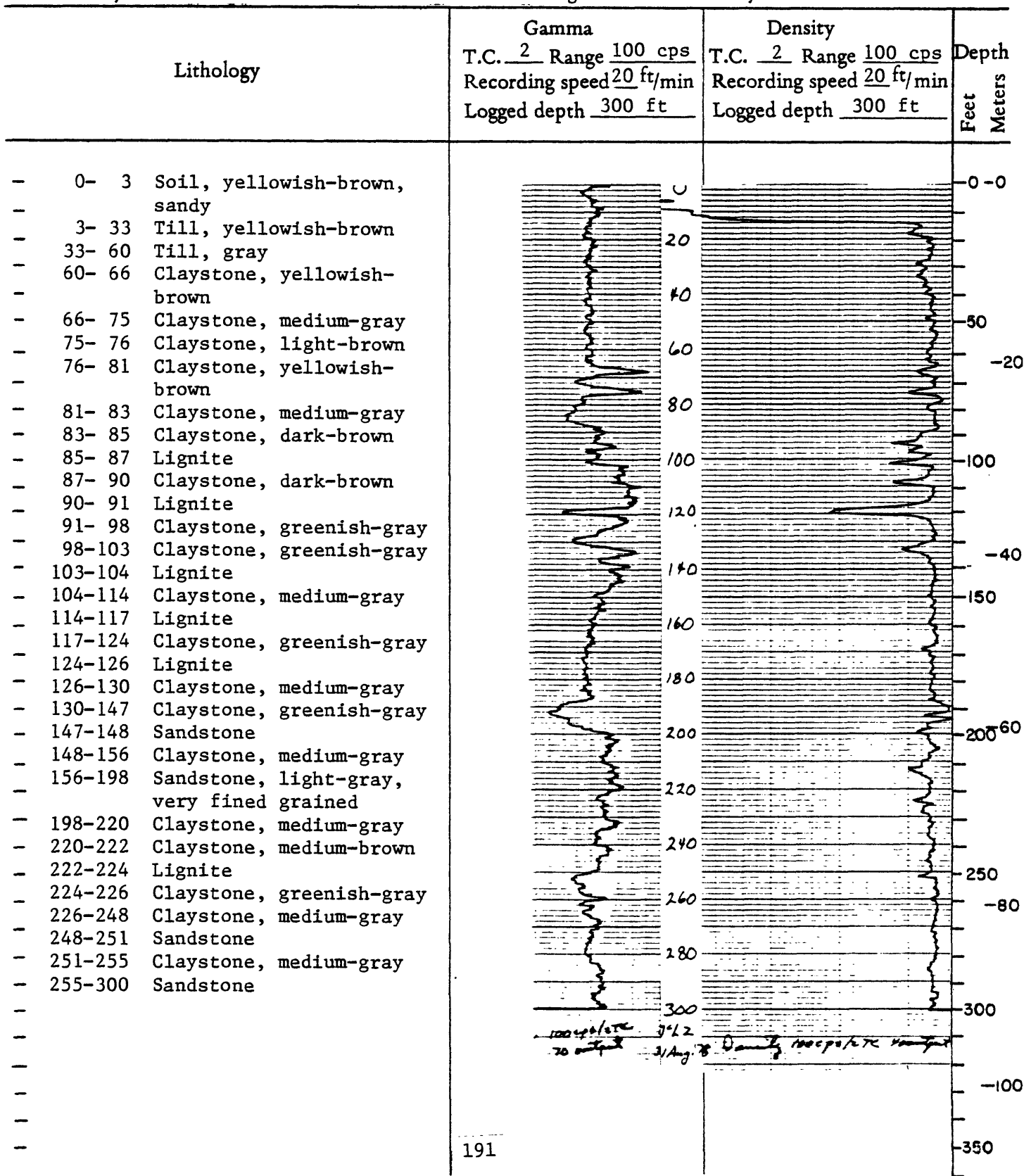
Hole No: McL-2 Map: Cole Harbor Date: 8-31-78 State: ND County: McLean
 Elev.: 1960 ft Location: T. 149^N~~S~~ R. 81^W~~E~~, Sec. 9, Tract: cccc Drilled depth: 300 ft
 Measured: 315 ft^{FSL}~~FSL~~, 10 ft^{FWL}~~FSL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 118-120

Remarks:

Lithology

Recorded by: Tom HeckGeologist ^{Yes}~~No~~

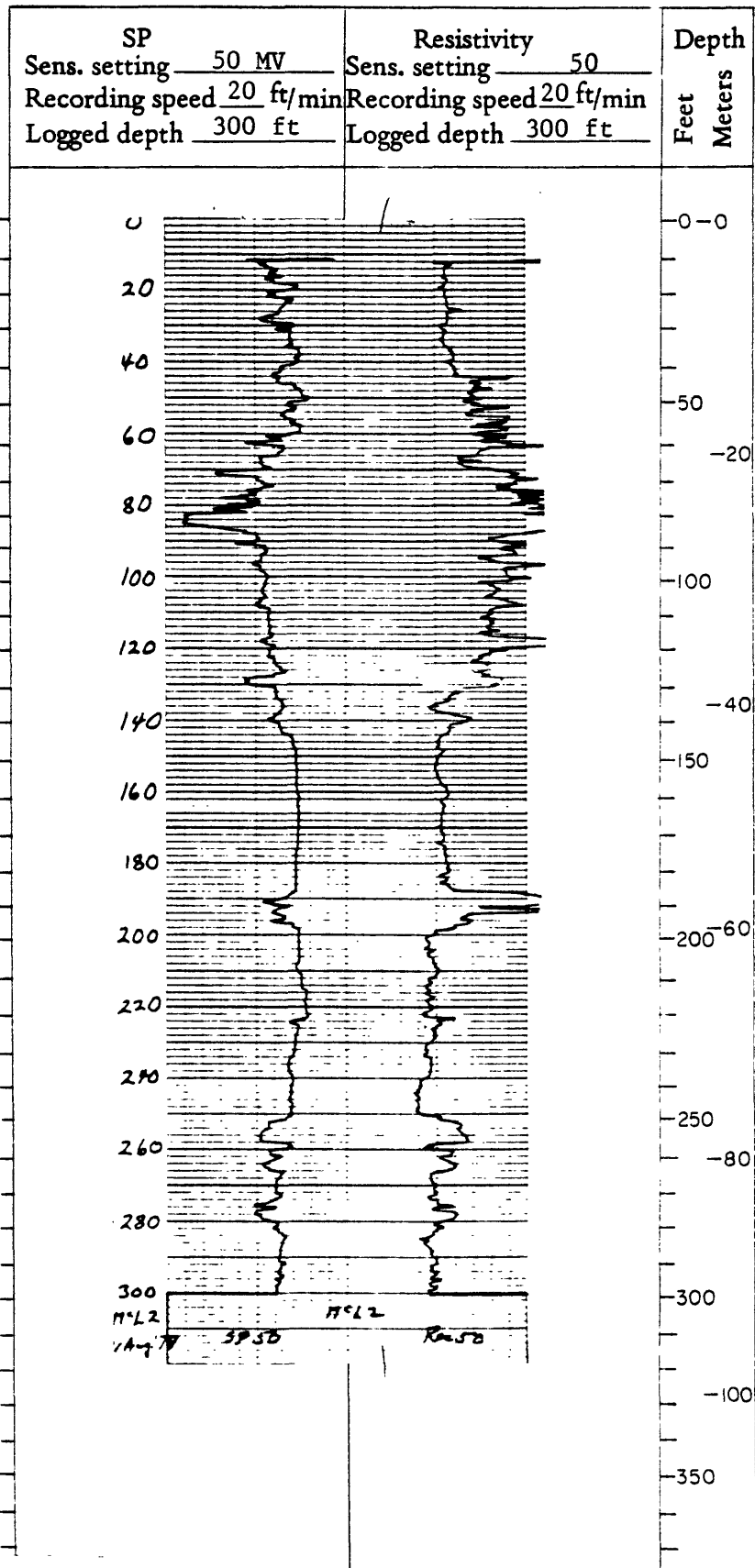
Geophysical logs

recorded by: Lechner

Hole number—continued

McL-2

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>300 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>300 ft</u>	Depth	
			Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued
McL-2

SP		Resistivity		Depth	
Sens. setting <u>50 MV</u>		Sens. setting <u>50</u>		Feet	Meters
Recording speed <u>20</u> ft/min		Recording speed <u>20</u> ft/min			
Logged depth <u>300 ft</u>		Logged depth <u>300 ft</u>			
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
-750					

Hole No: McL-3 Map: Cole Harbor Date: 8-31-78 State: ND County: McLean
Elev.: 1945 ft Location: T. 148^N~~xx~~, R. 82^W~~xx~~, Sec. 1, Tract: abbb Drilled depth: 100 ft
Measured: 25 ft^{FNL}~~xx~~, 2540 ft^{FEL}~~xx~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: none

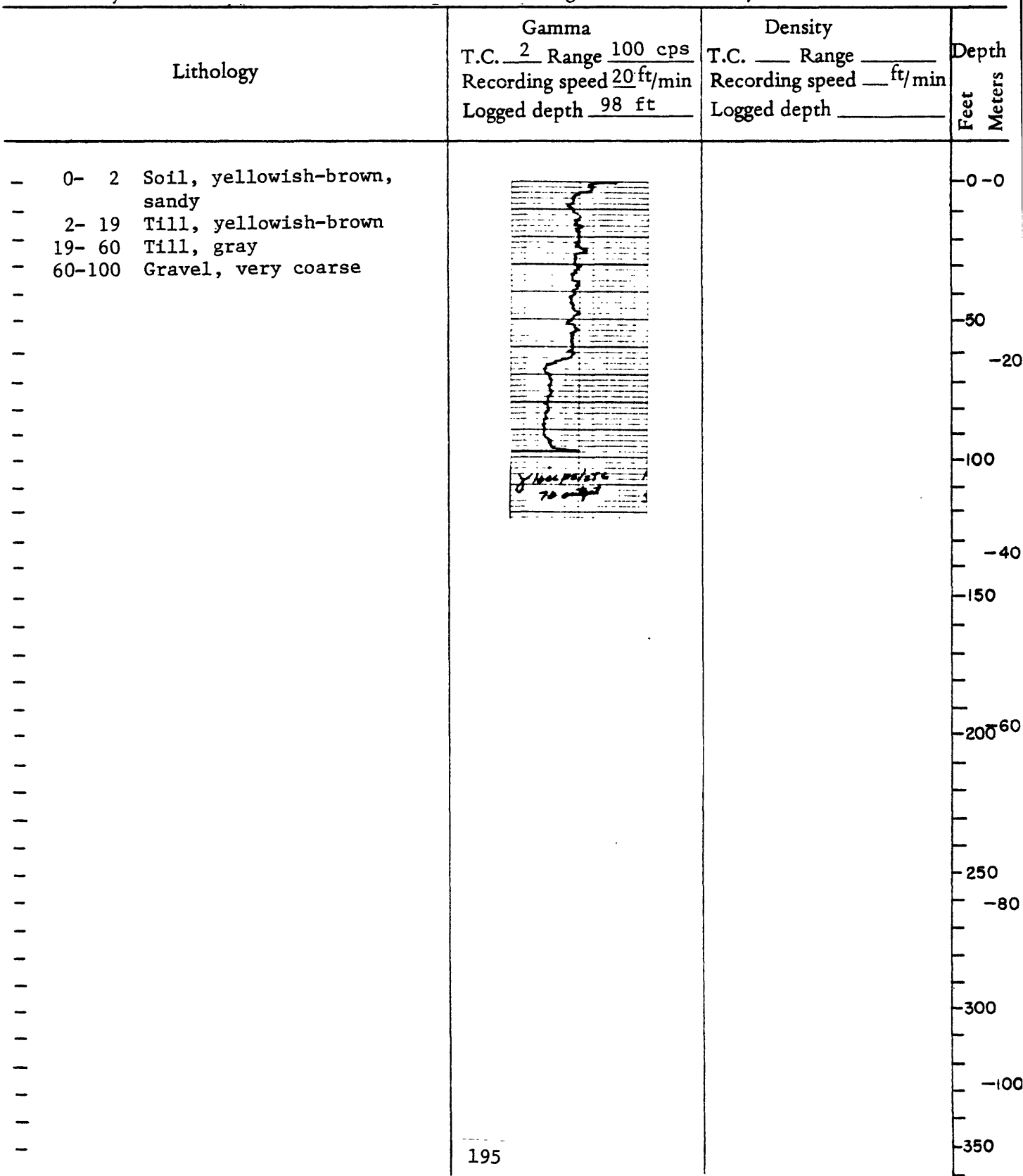
Lithology

Recorded by: Tom Heck

Geologist ^{Year} ~~2005~~

Geophysical logs

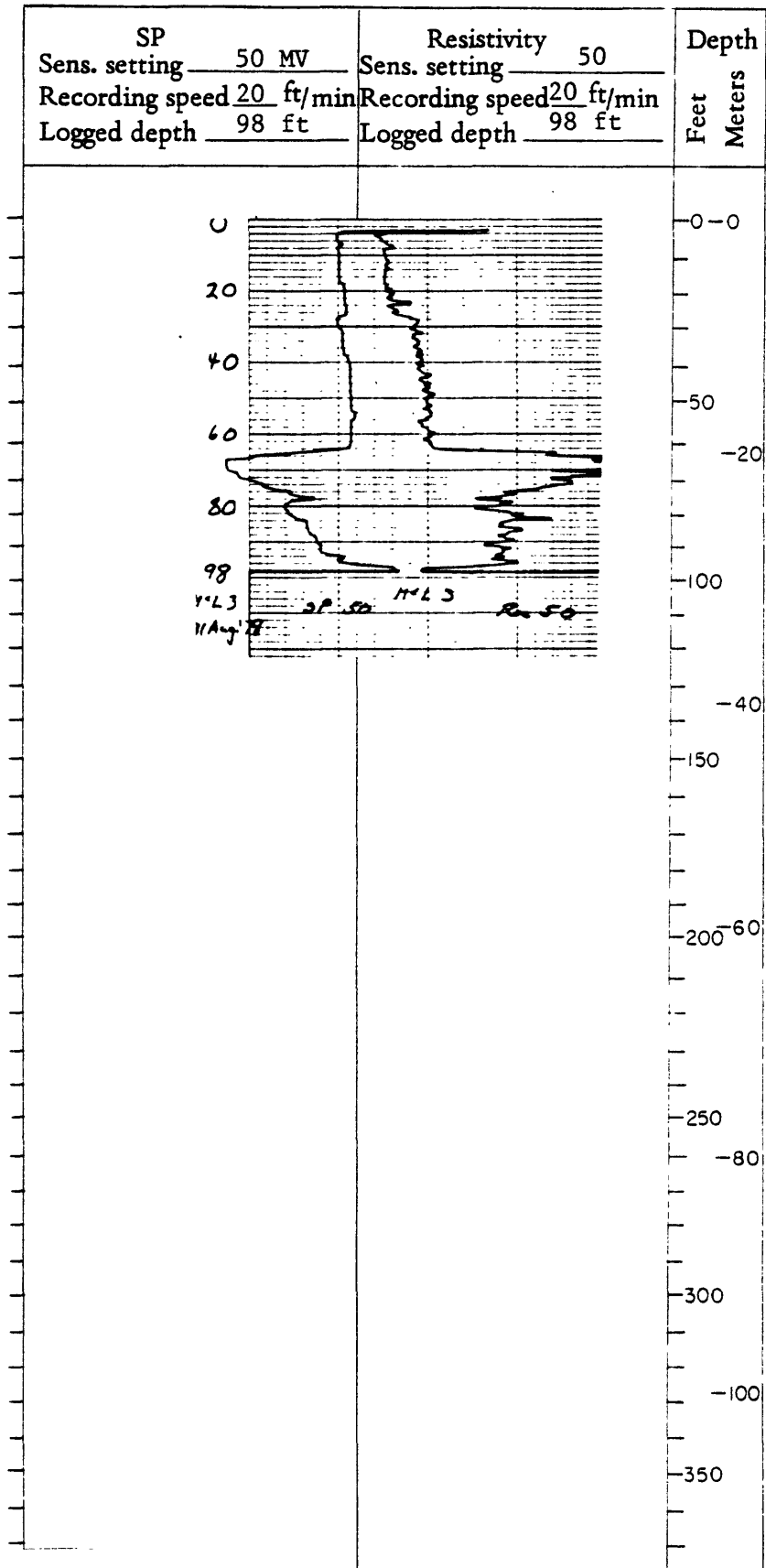
Geophysical logs
recorded by: Lechner



Hole number—continued

McL-3

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>98</u> ft	Density T.C. _____ Range _____ Recording speed _____ ft/min Logged depth _____	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



McL-3

Feet	Meters	Depth
1	0.30	1
2	0.61	2
3	0.91	3
4	1.22	4
5	1.52	5
6	1.83	6
7	2.13	7
8	2.44	8
9	2.74	9
10	3.05	10
11	3.35	11
12	3.66	12
13	3.96	13
14	4.27	14
15	4.57	15
16	4.88	16
17	5.18	17
18	5.49	18
19	5.79	19
20	6.10	20
21	6.40	21
22	6.71	22
23	7.01	23
24	7.32	24
25	7.62	25
26	7.93	26
27	8.23	27
28	8.53	28
29	8.84	29
30	9.14	30
31	9.45	31
32	9.75	32
33	10.06	33
34	10.36	34
35	10.67	35
36	10.97	36
37	11.28	37
38	11.58	38
39	11.89	39
40	12.19	40
41	12.50	41
42	12.80	42
43	13.11	43
44	13.41	44
45	13.72	45
46	14.02	46
47	14.33	47
48	14.63	48
49	14.93	49
50	15.24	50
51	15.54	51
52	15.85	52
53	16.15	53
54	16.46	54
55	16.76	55
56	17.07	56
57	17.37	57
58	17.68	58
59	17.98	59
60	18.29	60
61	18.59	61
62	18.90	62
63	19.20	63
64	19.51	64
65	19.81	65
66	20.12	66
67	20.42	67
68	20.73	68
69	21.03	69
70	21.34	70
71	21.64	71
72	21.95	72
73	22.25	73
74	22.56	74
75	22.86	75
76	23.17	76
77	23.47	77
78	23.78	78
79	24.08	79
80	24.38	80
81	24.69	81
82	24.99	82
83	25.30	83
84	25.60	84
85	25.91	85
86	26.21	86
87	26.52	87
88	26.82	88
89	27.13	89
90	27.43	90
91	27.74	91
92	28.04	92
93	28.35	93
94	28.65	94
95	28.96	95
96	29.26	96
97	29.57	97
98	29.87	98
99	30.18	99
100	30.48	100

Hole No: McL-4 Map: Cole Harbor Date: 8-31-78 State: ND County: McLean
Elev.: 1952 ft Location: T. 147^N~~E~~, R. 82^W~~E~~, Sec. 28, Tract: cccb Drilled depth: 300 ft
Measured: 600 ft ~~FSL~~, 40 ft ~~FSL~~ ^{FWL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 70-72; 94-98; 130-137

Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~No~~

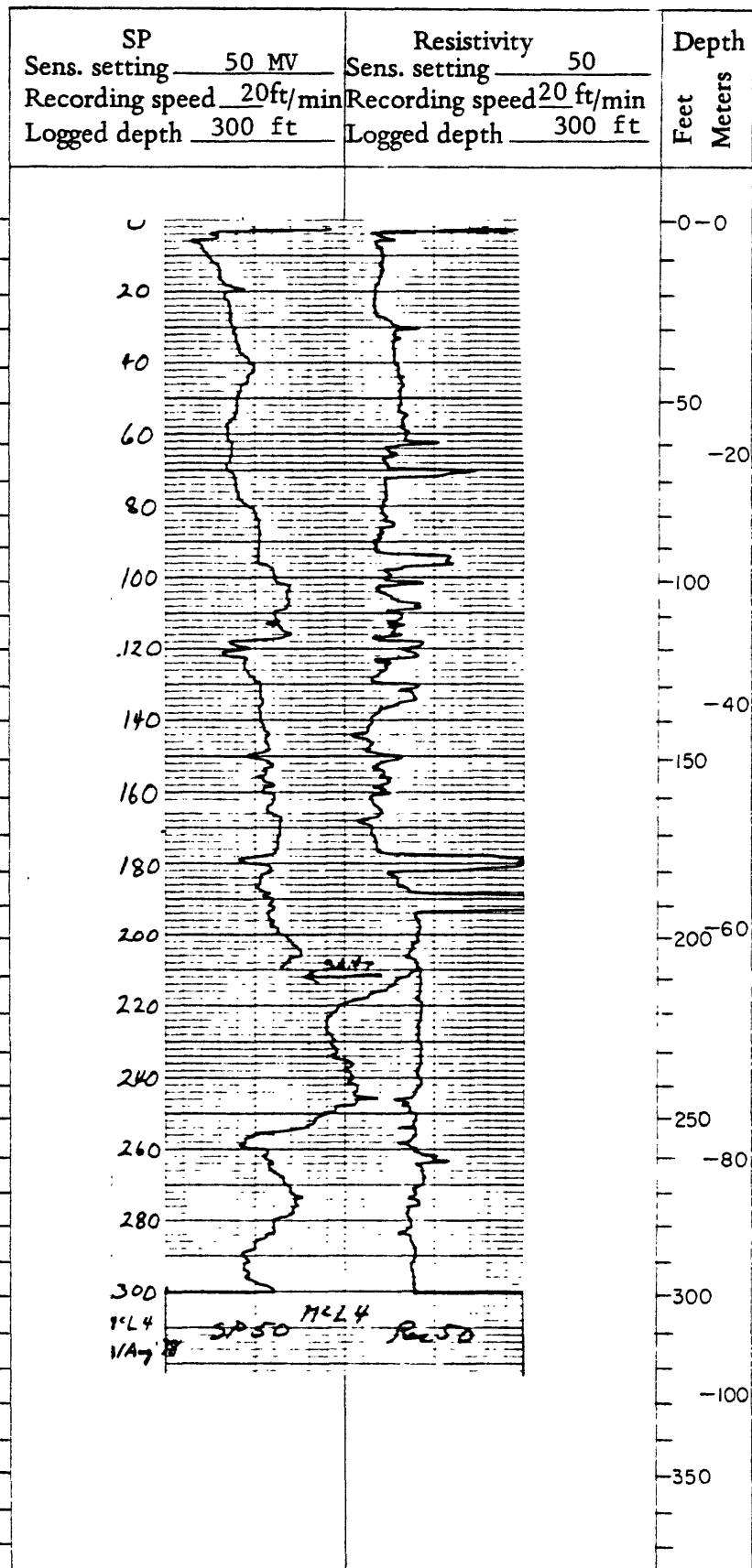
Geophysical logs

recorded by: Lechner

199

McL-4

200



Hole number—continued
McL-4

SP Sens. setting <u>50 MV</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft</u>		Resistivity Sens. setting <u>50</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft</u>		Depth Feet Meters	
					-120
					-400
					-450
					-140
					-500
					-160
					-550
					-180
					-600
					-650
					-200
					-700
					-220
					-750

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-5 Map: Garrison Date: 8-30-78 State: ND County: McLean
 Elev.: 1950 ft Location: T. 148^N S, R. 84^E W, Sec. 13, Tract: bbbb Drilled depth: 300 ft
 Measured: 210 ft ~~FNL~~ 25 ft ~~FWL~~ ~~xxxx~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 50-56; 155-160; 184-188; 226-228

Remarks: _____

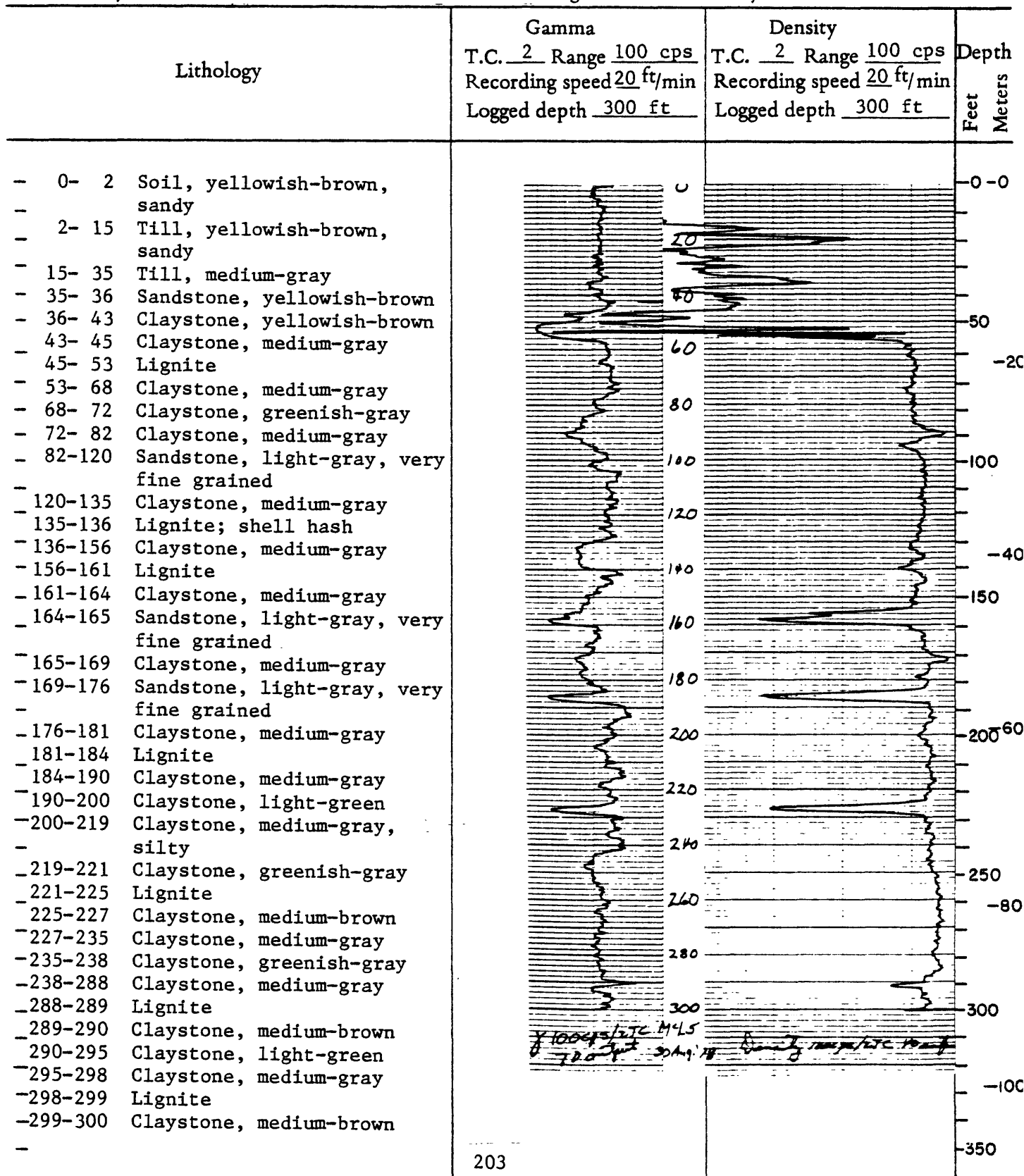
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner

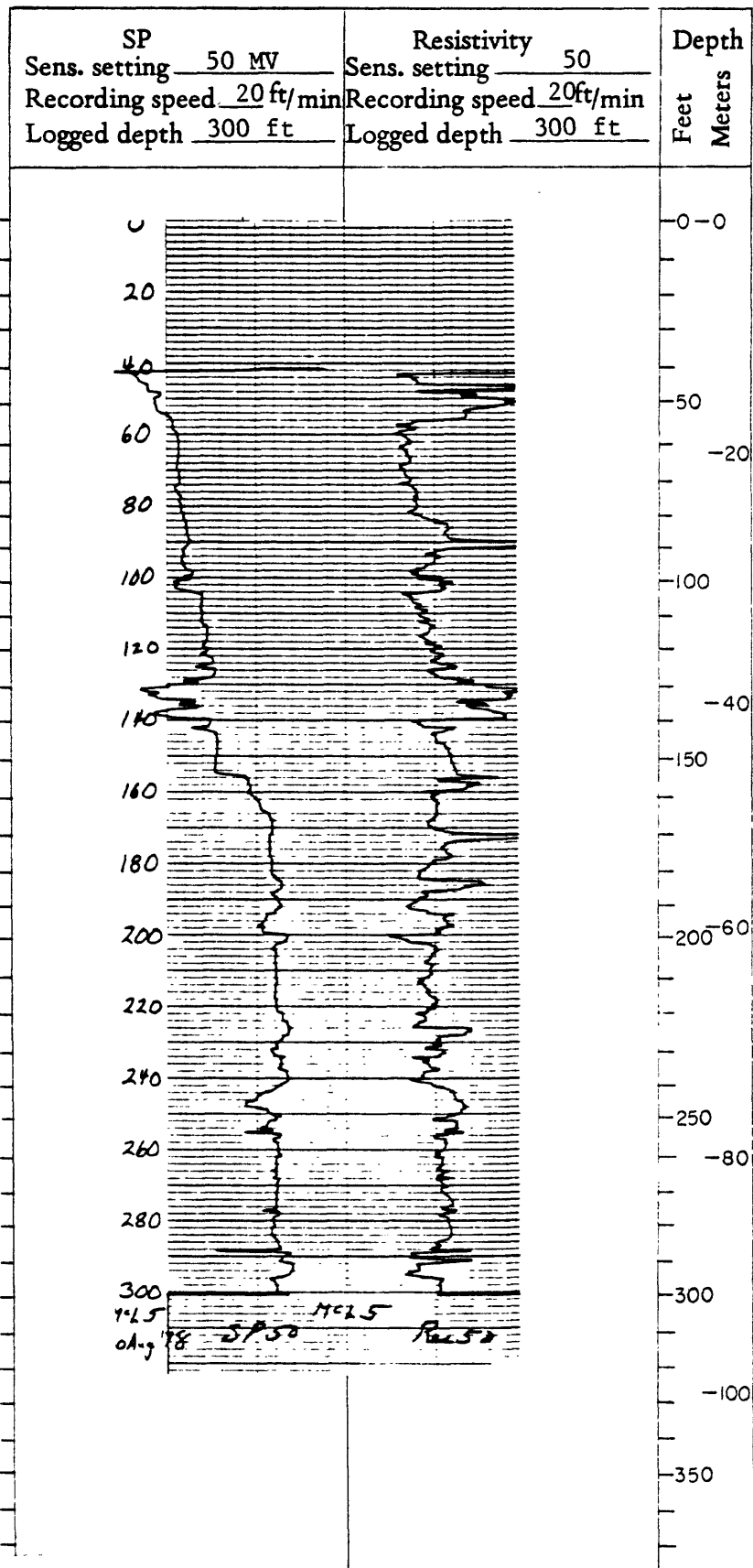


Hole number—continued

McL-5

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>300</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>300</u> ft	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	

Hole number McL-5



McL-5

206

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-5C Map: Garrison Date: 8-30-78 State: ND County: McLean
 Elev.: 1950 ft Location: T.148 ^N8, R. 84 ^EW, Sec. 13, Tract: bbbb Drilled depth: 152 ft
 Measured: 210 ft ^{FNL}~~210~~, 25 ft ^{FWL}~~210~~ FWL, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☒ No ☐
 Lignite beds: _____

Remarks: No gamma, S.P. or Resistivity run.

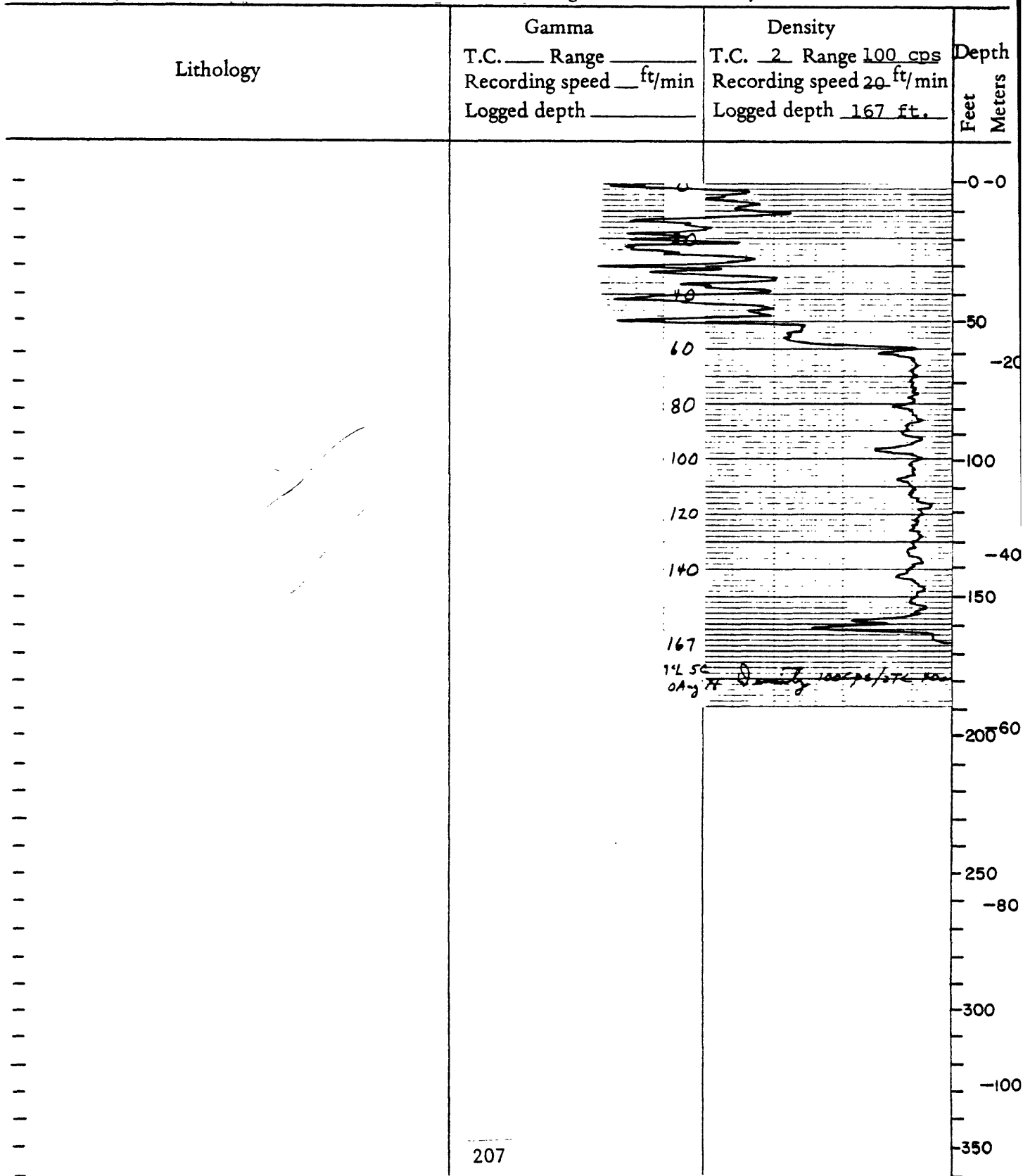
Lithology

Recorded by: _____

Geologist ^{yes}No

Geophysical logs

recorded by: _____



Hole number—continued

McL-5C

Lithology	Gamma T.C. _____ Range _____ Recording speed _____ ft/min Logged depth _____	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>167</u> ft.	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-6 Map: Emmet SW Date: 8-22-78 State: ND County: McLean
 Elev.: 1915 ft Location: T. 148^N R. 86^W Sec. 33, Tract: bccb Drilled depth: 280 ft
 Measured: 2000 ft^{FNL} 25 ft^{FWL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 96-98; 108-112; 153-158; 255-257

Remarks:

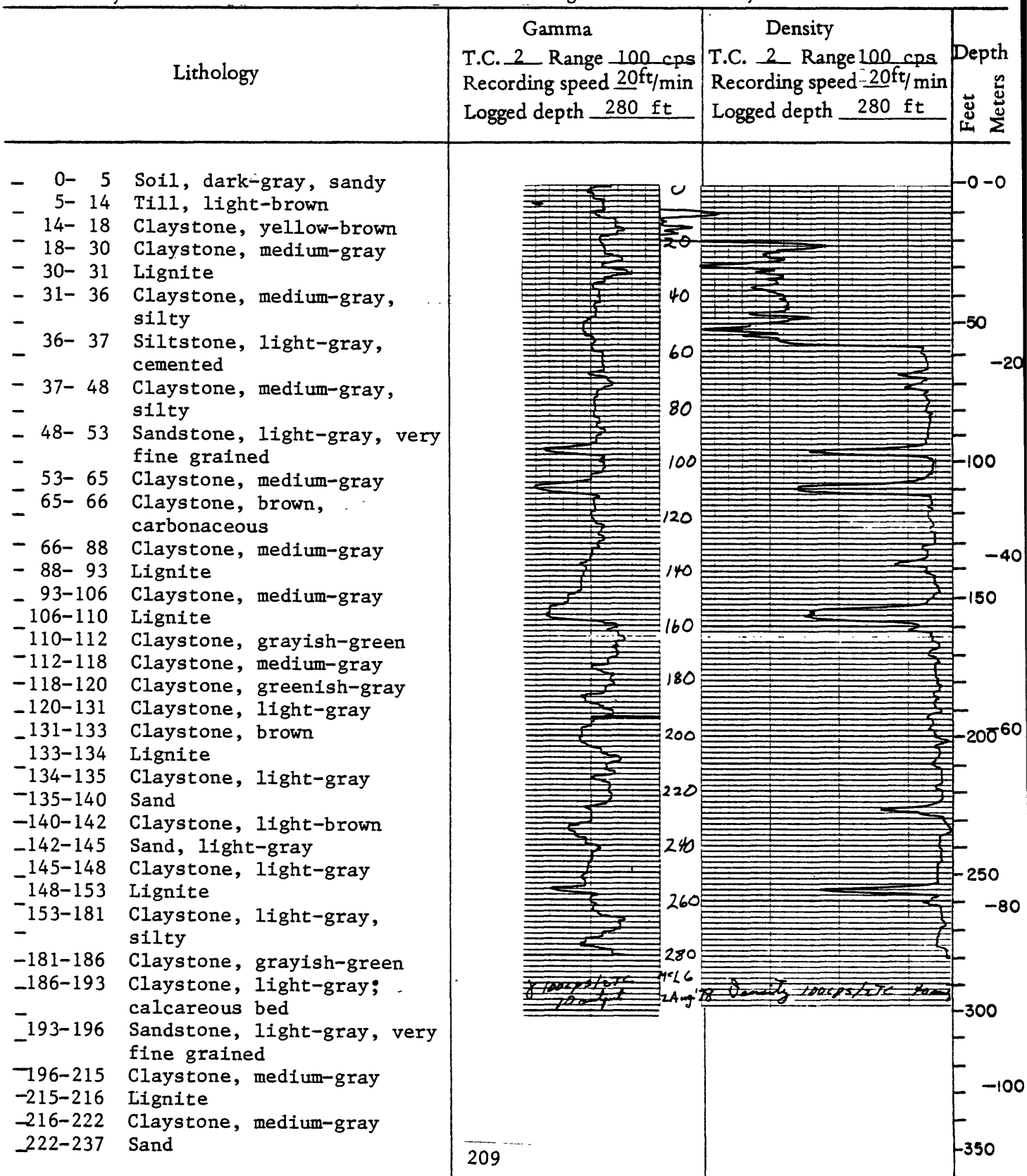
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner

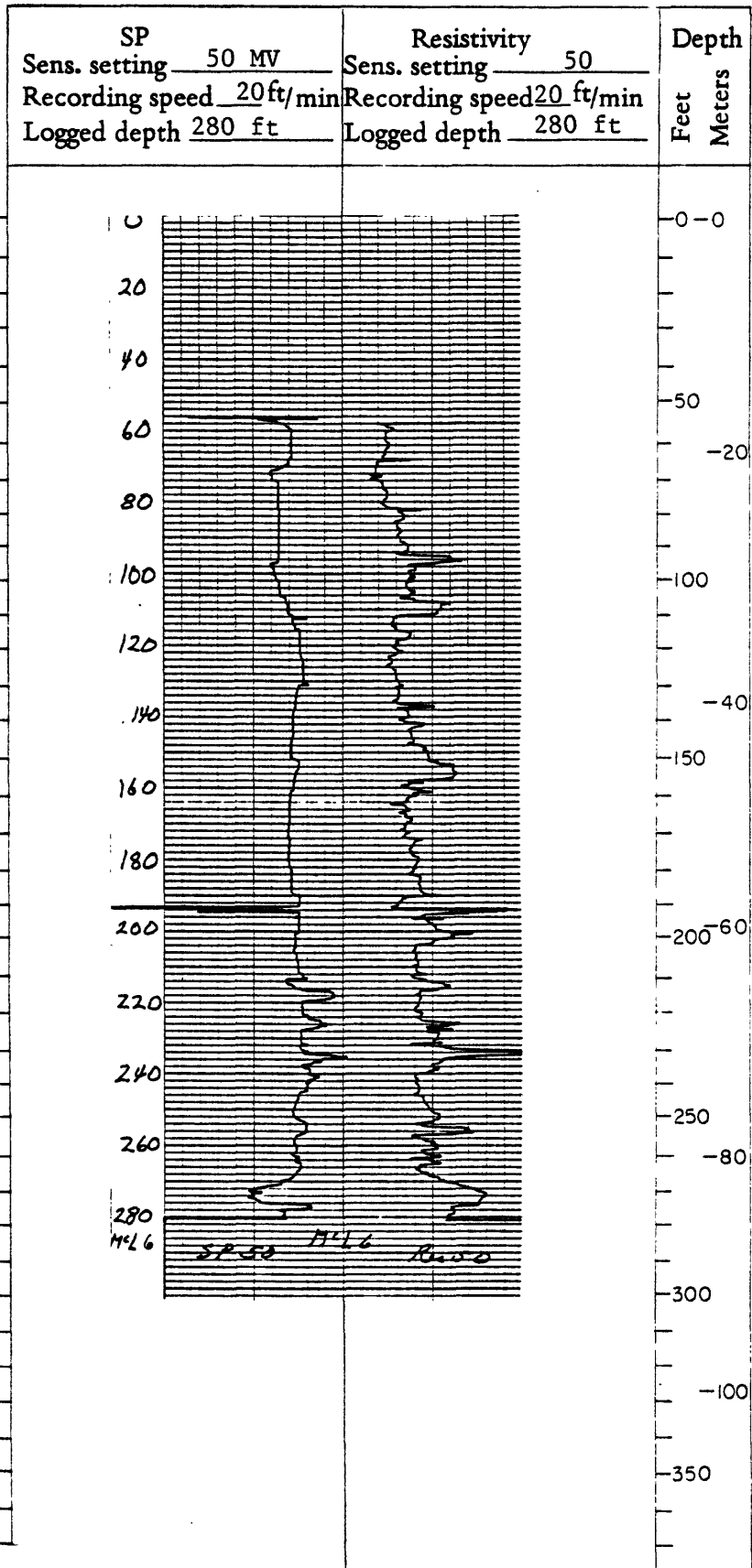


Hole number—continued

McL-6

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>280</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>280</u> ft	Depth	
			Fcct	Meters
237-246 Claystone, light-gray				
246-250 Siltstone, light-gray				-120
250-251 Lignite				-400
251-261 Claystone, greenish-gray				
261-264 Claystone, medium-gray				
264-269 Siltstone, light-green				-450
269-280 Claystone, medium-gray				-140
				-500
				-160
				-550
				-180
				-600
				-650
				-200
				-700
				-220
				-750

Hole number McL-6



McL-6

SP		Resistivity		Depth	
Sens. setting	<u>50 MV</u>	Sens. setting	<u>50</u>	Feet	Meters
Recording speed	<u>20 ft/min</u>	Recording speed	<u>20 ft/min</u>		
Logged depth	<u>280 ft</u>	Logged depth	<u>280 ft</u>		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

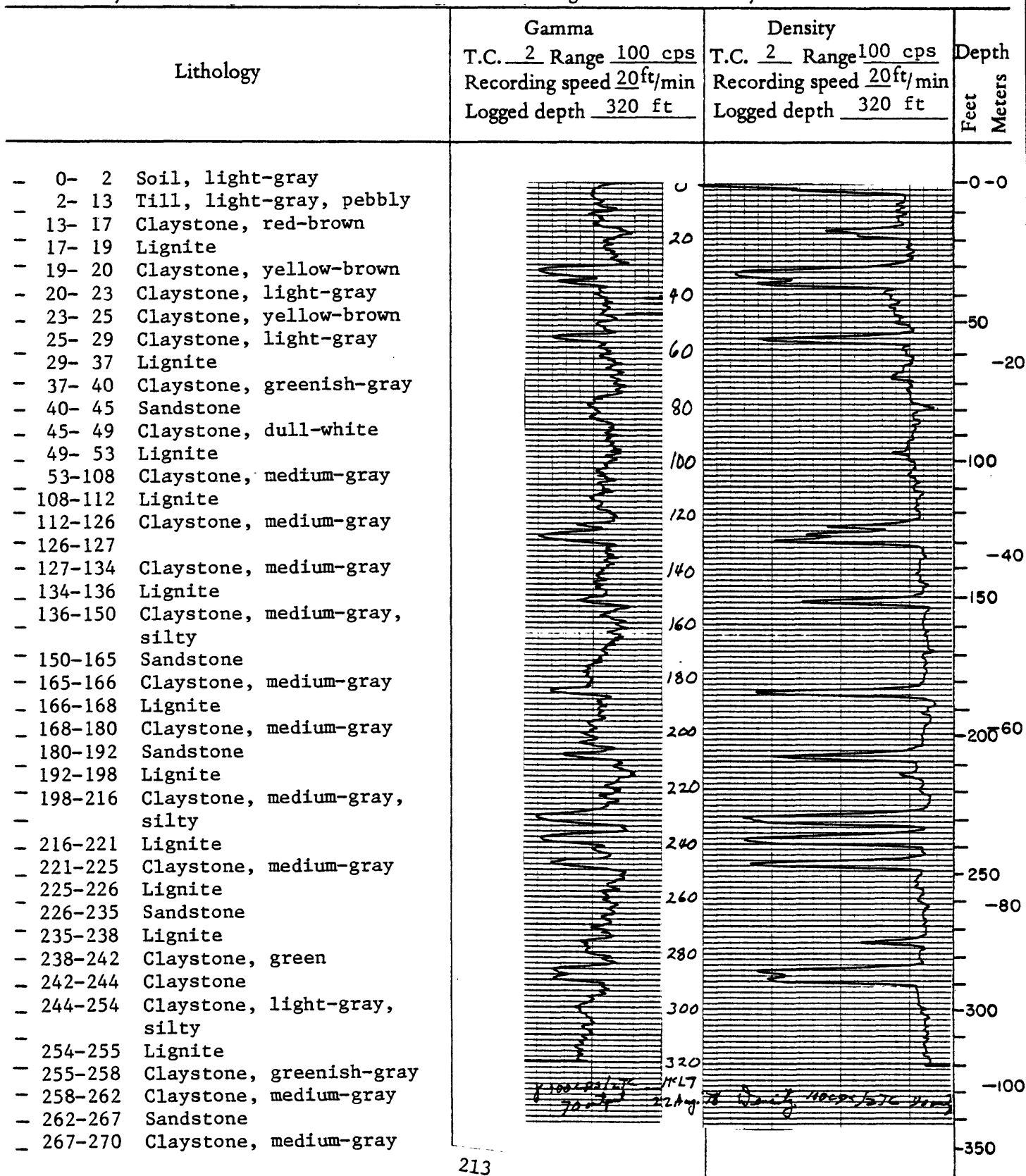
Hole No: McL-7 Map: Emmet SW Date: 8-22-78 State: ND County: McLean
 Elev.: 1984 ft Location: T. 148^N~~SE~~, R. 87^W~~SE~~, Sec. 27, Tract: dddd Drilled depth: 320 ft
 Measured: 10 ft~~FSL~~, 135 ft^{FEL}~~FSL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 30-37; 55-58; 126-130; 150.5-153; 207-209.5; 229-233;
237-240; 246-249; 285-291

Remarks: _____

Lithology

Recorded by: Tom Heck

Geologist ^{Yes}~~XX~~ recorded by: Lechner

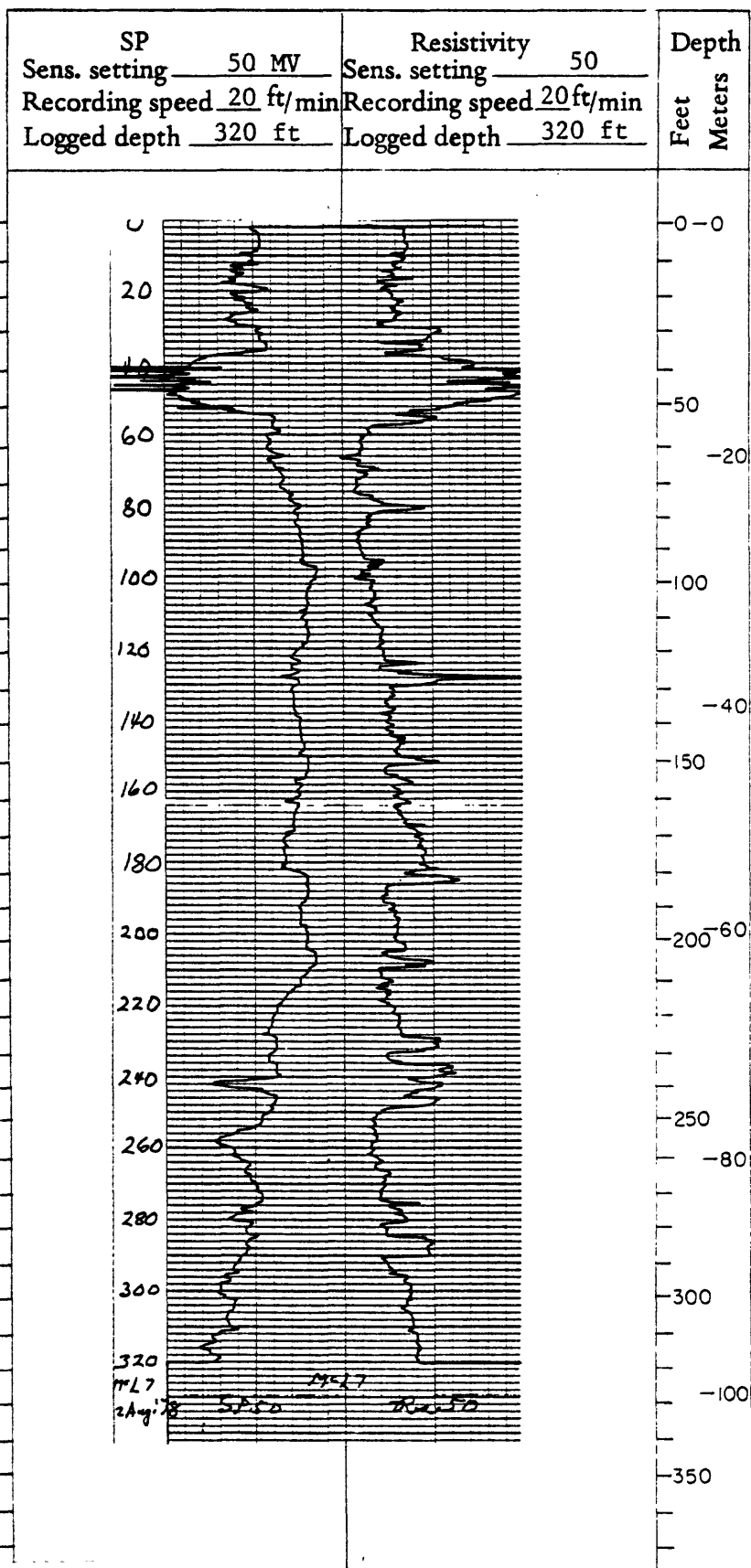


Hole number—continued

McL-7

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>320 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>320 ft</u>	Depth	
			Fect	Meters
270-281 Lignite				
281-283 Claystone, greenish-gray				-120
283-285 Claystone, medium-gray				-400
285-300 Sandstone				
				-450
				-140
				-500
				-160
				-550
				-180
				-600
				-650
				-200
				-700
				-220
				-750

Hole number McL-7



McL-7

SP		Resistivity		Depth	
Sens. setting	<u>50 MV</u>	Sens. setting	<u>50</u>	Feet	Meters
Recording speed	<u>20 ft/min</u>	Recording speed	<u>20ft/min</u>		
Logged depth	<u>320 ft</u>	Logged depth	<u>320 ft</u>		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

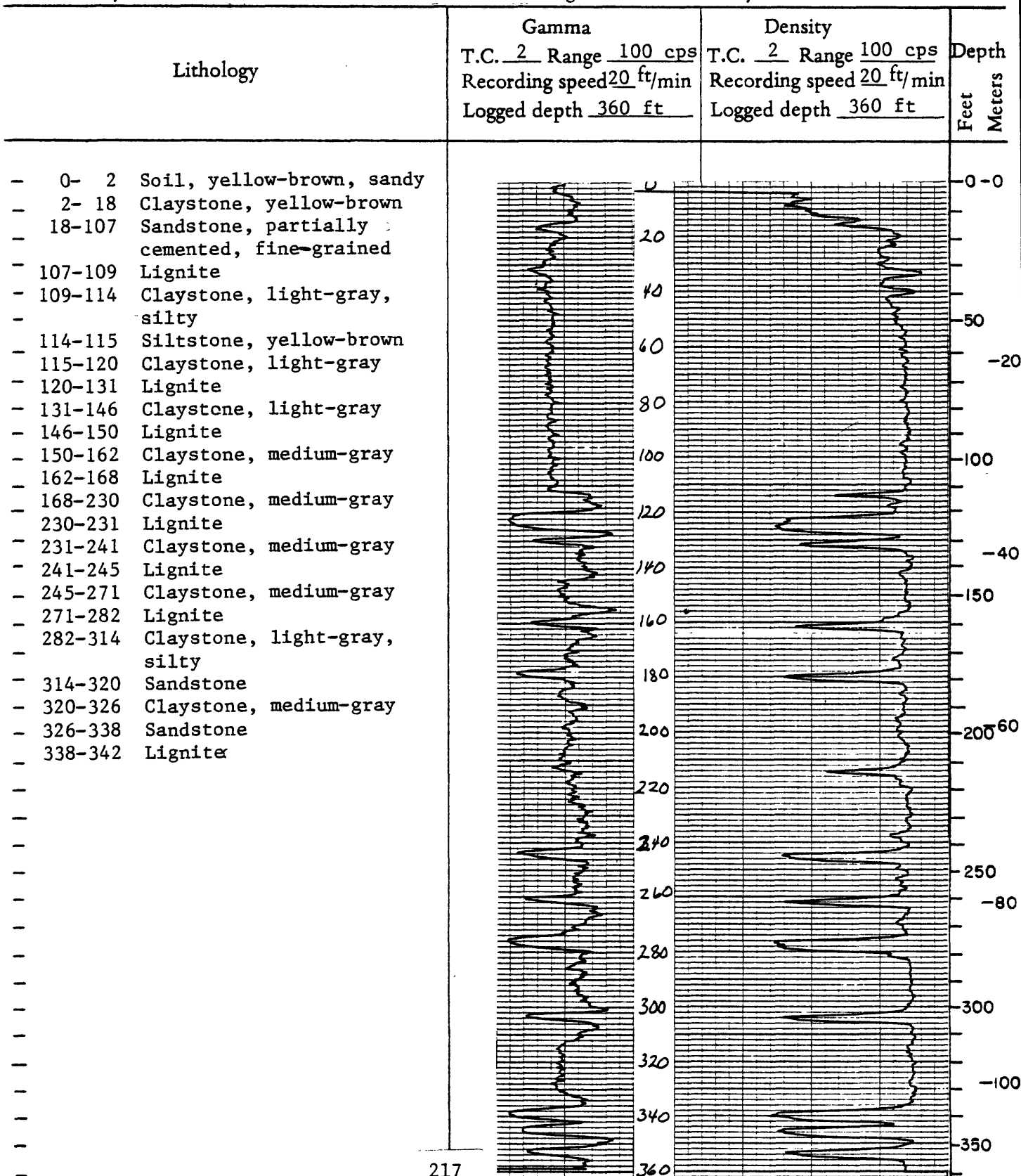
Hole No: McL-8 Map: Blackwater Lake Date: 8-21-78 State: ND County: McLean
 Elev.: 1995 ft Location: T. 148 ^N_S, R. 87 ^E_W, Sec. 17, Tract: ccbb Drilled depth: 360 ft
 Measured: 1080 ft ~~FSL~~, 20 ft ~~FWL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 122-128; 130-132.5; 179-182; 244-247; 261-263.5;
276-280; 303-306; 338-342; 344-348; 352-355.5

Remarks: _____

Lithology

Recorded by: Tom Heck

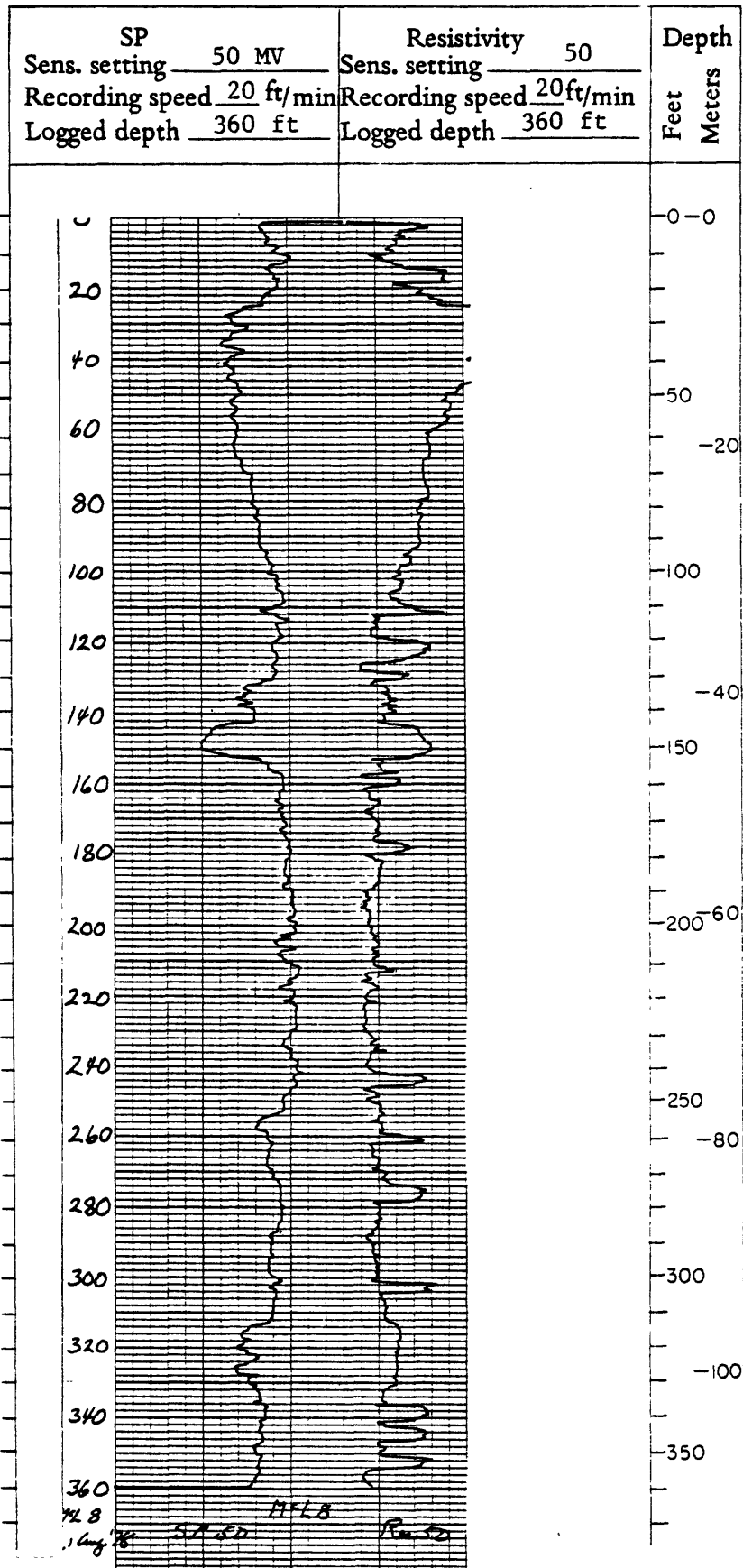
Geophysical logs
 Geologist ^{Yes}~~XXX~~ recorded by: Lechner



Hole number—continued

McL-8

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>360 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>360 ft</u>	Depth	
			Fect	Meters
342-356 Sandstone				
356-360 Claystone, greenish-gray				
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



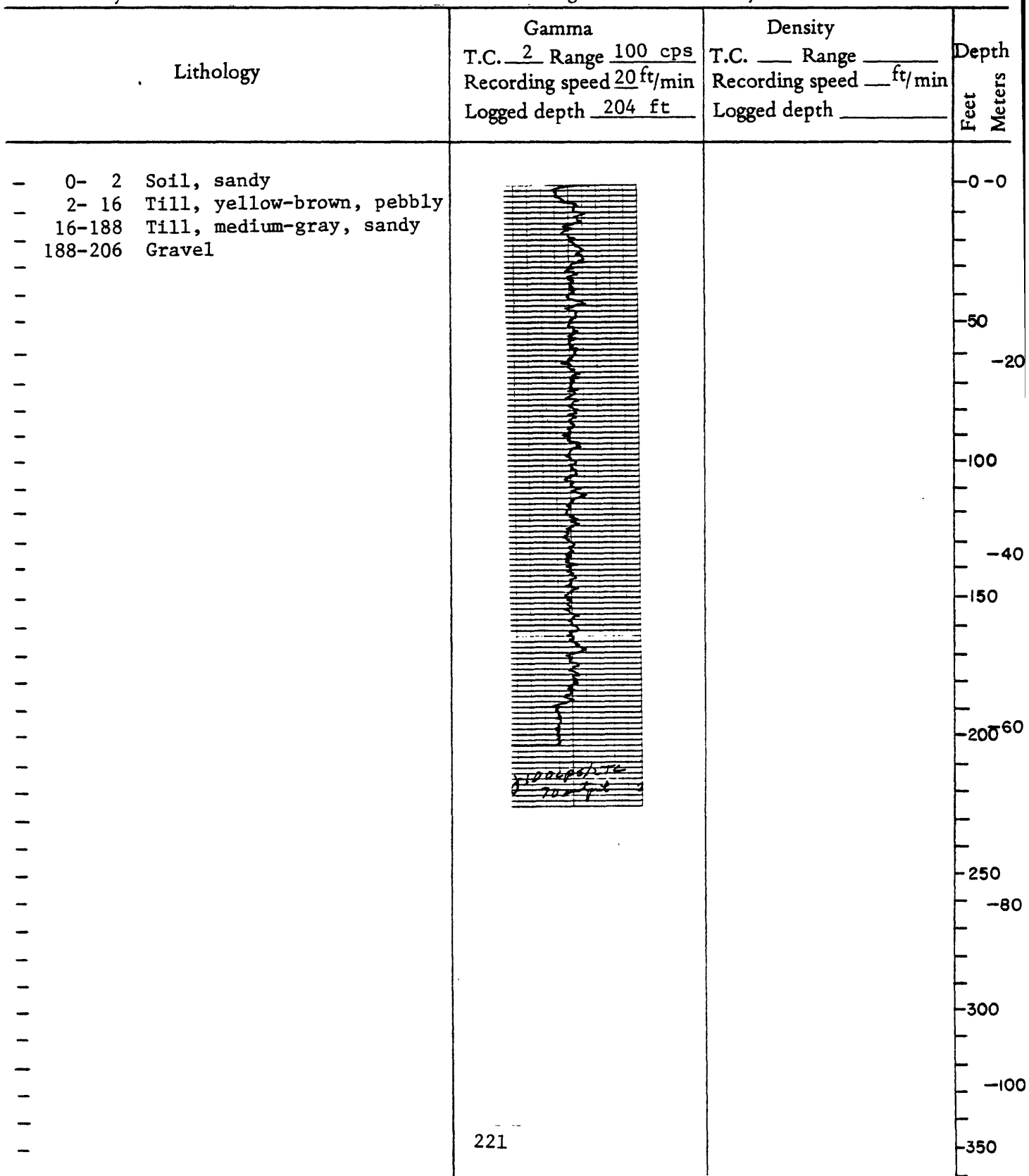
Hole number—continued

McL-8

SP		Resistivity		Depth	
Sens. setting	<u>50 MV</u>	Sens. setting	<u>50</u>	Feet	Meters
Recording speed	<u>20 ft/min</u>	Recording speed	<u>20ft/min</u>		
Logged depth	<u>360 ft</u>	Logged depth	<u>360 ft</u>		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

Hole No: McL-9 Map: Blackwater Lake Date: 8-21-78 State: ND County: McLean
Elev.: 1976 ft Location: T. ^N148^{xxx}, R. ^E87^{xxx} W, Sec. 4, Tract: dddd Drilled depth: 206 ft
Measured: 78 ft ^{xxx}FSL, 10 ft ^{FEL}FSL, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: none

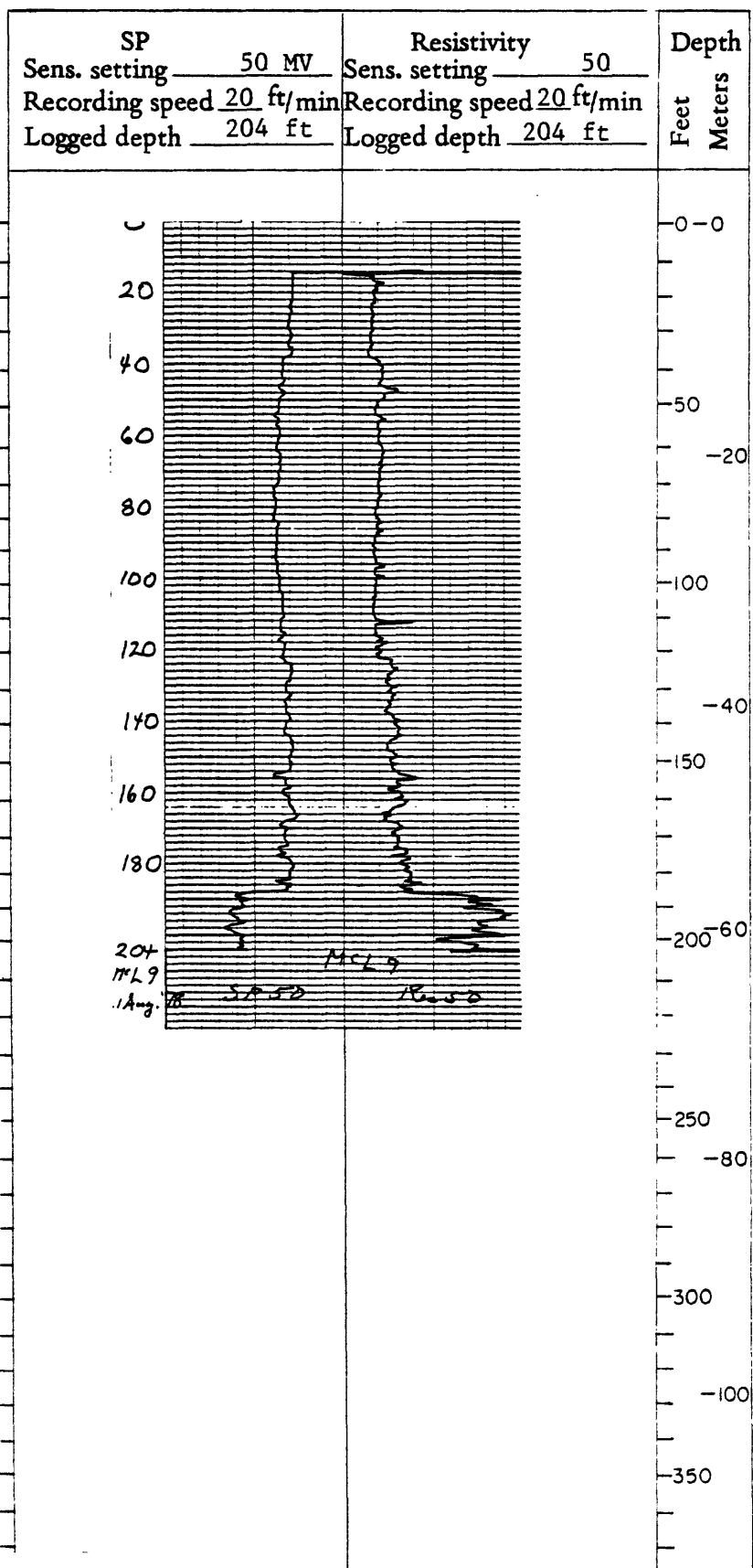
Lithology
Recorded by: Tom Heck Geologist ^{Yes}~~No~~ Geophysical logs
recorded by: Lechner



Hole number—continued

McL-9

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>204 ft</u>	Density T.C. _____ Range _____ Recording speed _____ft/min Logged depth _____	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



McL-9

SP		Resistivity		Depth	
Sens. setting	50 MV	Sens. setting	50	Feet	Meters
Recording speed	20 ft/min	Recording speed	20 ft/min		
Logged depth	204 ft	Logged depth	204 ft		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

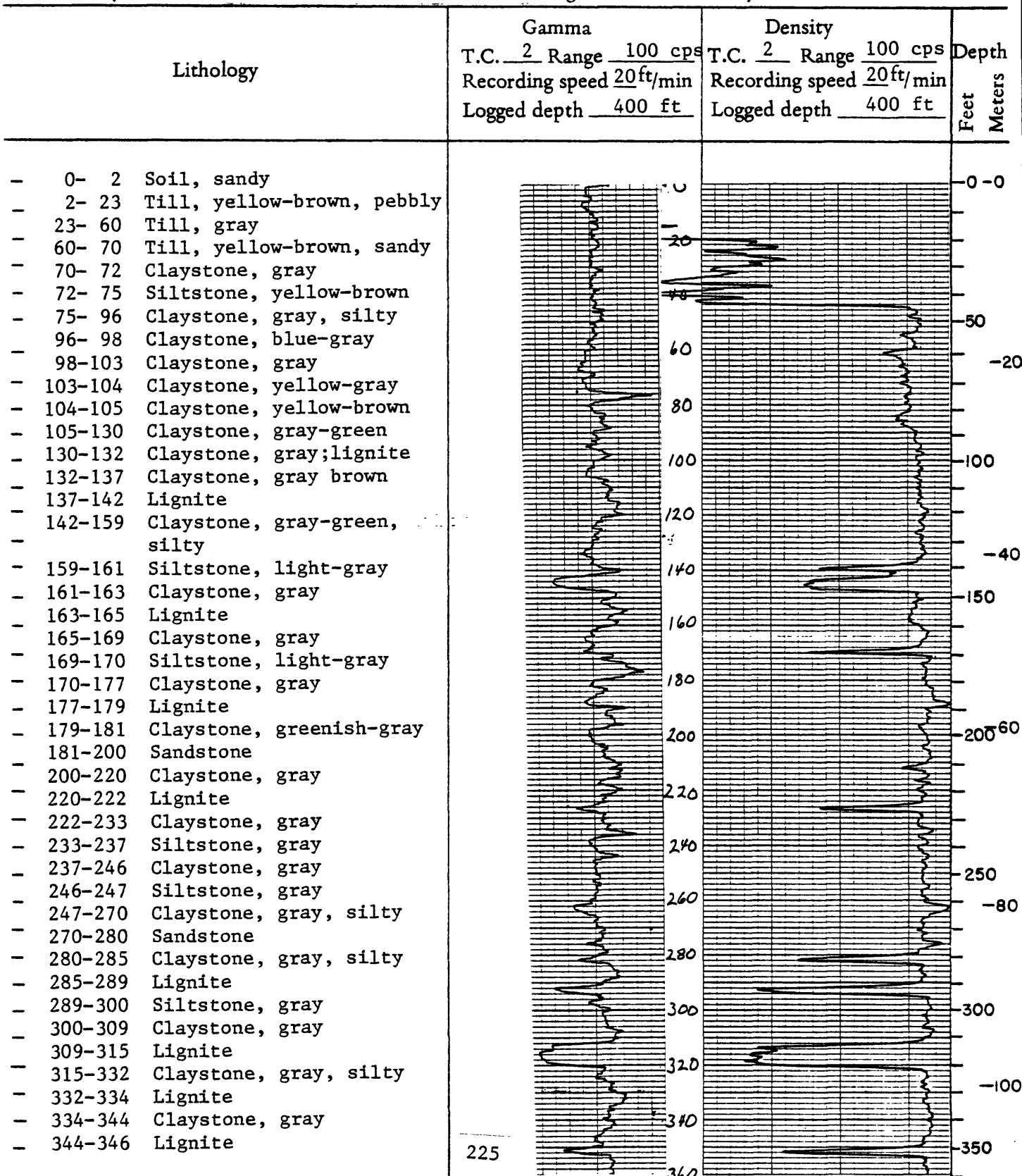
Hole No: McL-10 Map: Blackwater Lake Date: 8-21-78 State: ND County: McLean
 Elev.: 2058 ft Location: T. 149^N, R. 87^W, Sec. 26, Tract: ccbc Drilled depth: 400 ft
 Measured: 872 ft ~~FSL~~, 25 ft ~~FWL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 143-147; 280.5-283; 292-294;
312-320; 351-353; 392-394.5

Remarks: _____

Lithology

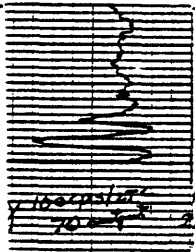
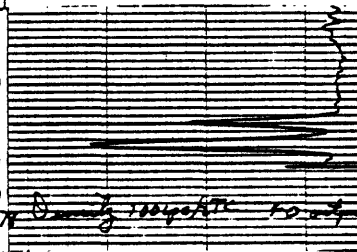
Recorded by: Tom Heck

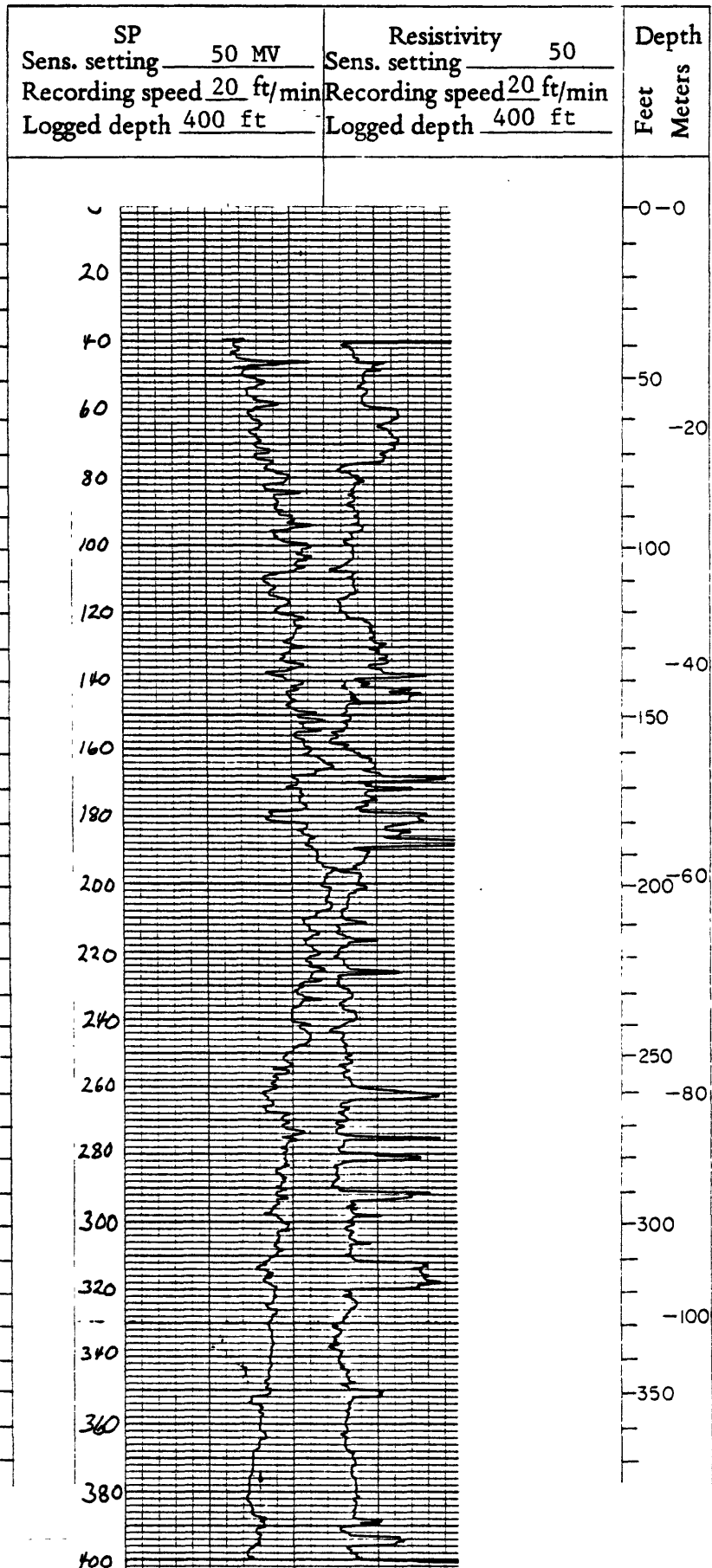
Geologist ^{Yes}~~NA~~ recorded by: Lechner



Hole number—continued

McL-10

Lithology	Gamma		Density		Depth	
	T.C. <u>2</u>	Range <u>100 cps</u>	T.C. <u>2</u>	Range <u>100 cps</u>	Fect	Meters
	Recording speed <u>20 ft/min</u>		Recording speed <u>20 ft/min</u>			
	Logged depth <u>400 ft</u>		Logged depth <u>400 ft</u>			
346-383 Claystone, gray, silty						
383-384 Lignite					-120	
384-386 Claystone, gray					400	
386-390 Lignite						
390-400 Claystone, gray						
					450	
					-140	
					500	
					-160	
					550	
					-180	
					600	
					-200	
					650	
					-220	
					700	
					-220	
					750	



Hole number—continued
McL-10'

SP		Resistivity		Depth	
Sens. setting	<u>50 MV</u>	Sens. setting	<u>50</u>	Feet	Meters
Recording speed	<u>20 ft/min</u>	Recording speed	<u>20 ft/min</u>		
Logged depth	<u>400 ft</u>	Logged depth	<u>400 ft</u>		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-11 Map: Emmet Date: 8-21-78 State: ND County: McLean
Elev.: 2160 ft Location: T. 149 ^N₄, R. 86 ^E_W, Sec. 19, Tract: cdcc Drilled depth: 500 ft
Measured: 25 ft ^{FSL}_{FSL}, 1582 ft ^{FSL}_{FSL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 162.5-165.5; 352-354; 375-381; 461.5-464; 470.5-474

Remarks:

Lithology

Recorded by: Tom Heck

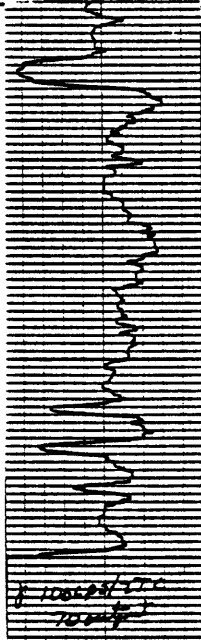
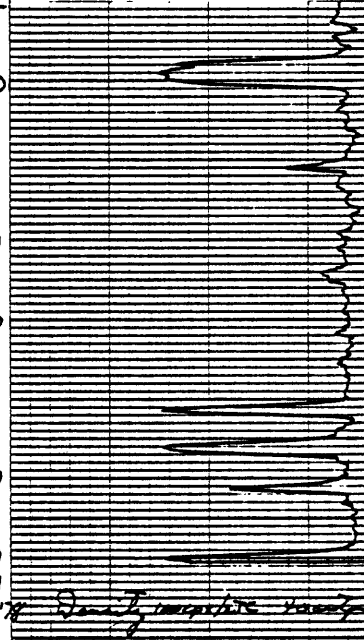
Geologist ☒ Yes ☒ No

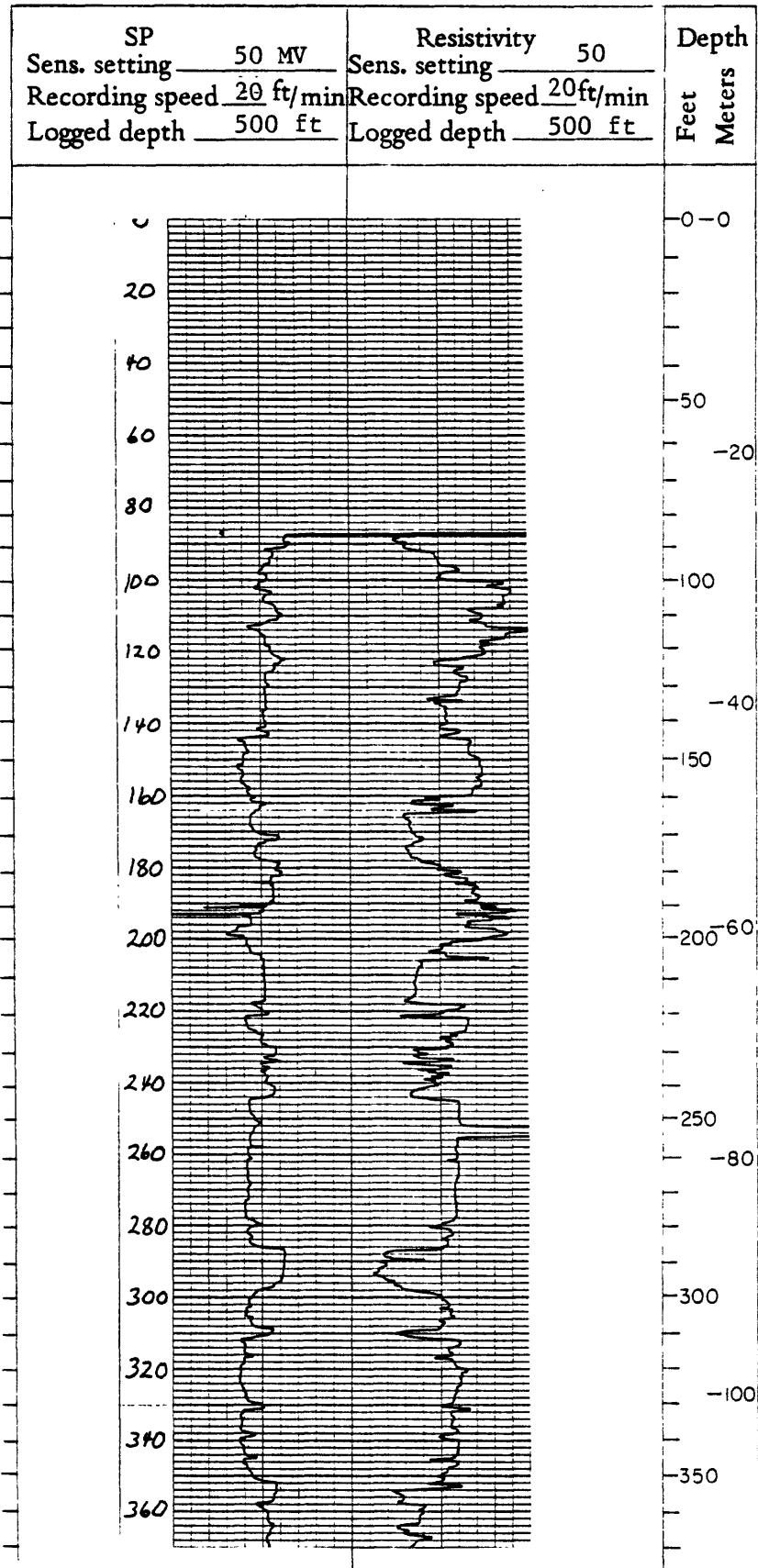
Geophysical logs

recorded by: Lechner

Lithology	Gamma		Density		Depth Feet Meters
	T.C.	Range	T.C.	Range	
	2	100 cps	2	100 cps	
	Recording speed	20ft/min	Recording speed	20 ft/min	
	Logged depth	500 ft	Logged depth	500 ft	
0- 2 Soil, light-brown, sandy					0-0
2- 28 Till, yellow-brown, silty-clay					
28- 89 Till, medium-gray, silty-clay					
89-132 Till, yellow-brown, sandy					
132-160 Sandstone					50
160-161 Lignite					
161-187 Clay					-20
187-190 Lignite					
190-200 Claystone, light-gray					
200-203 Lignite					
203-222 Claystone, light-gray					100
222-237 Sandstone					
237-248 Claystone, light-gray, silty					
248-249 Claystone, white					-40
249-260 Claystone, gray					
260-290 Sandstone					150
290-292 Lignite					
292-321 Claystone, gray, silty					
321-322 Claystone, white					
322-343 Claystone, gray					
343-345 Lignite					200
					220
					240
					260
					-80
					300
					320
					-100
					340
					360

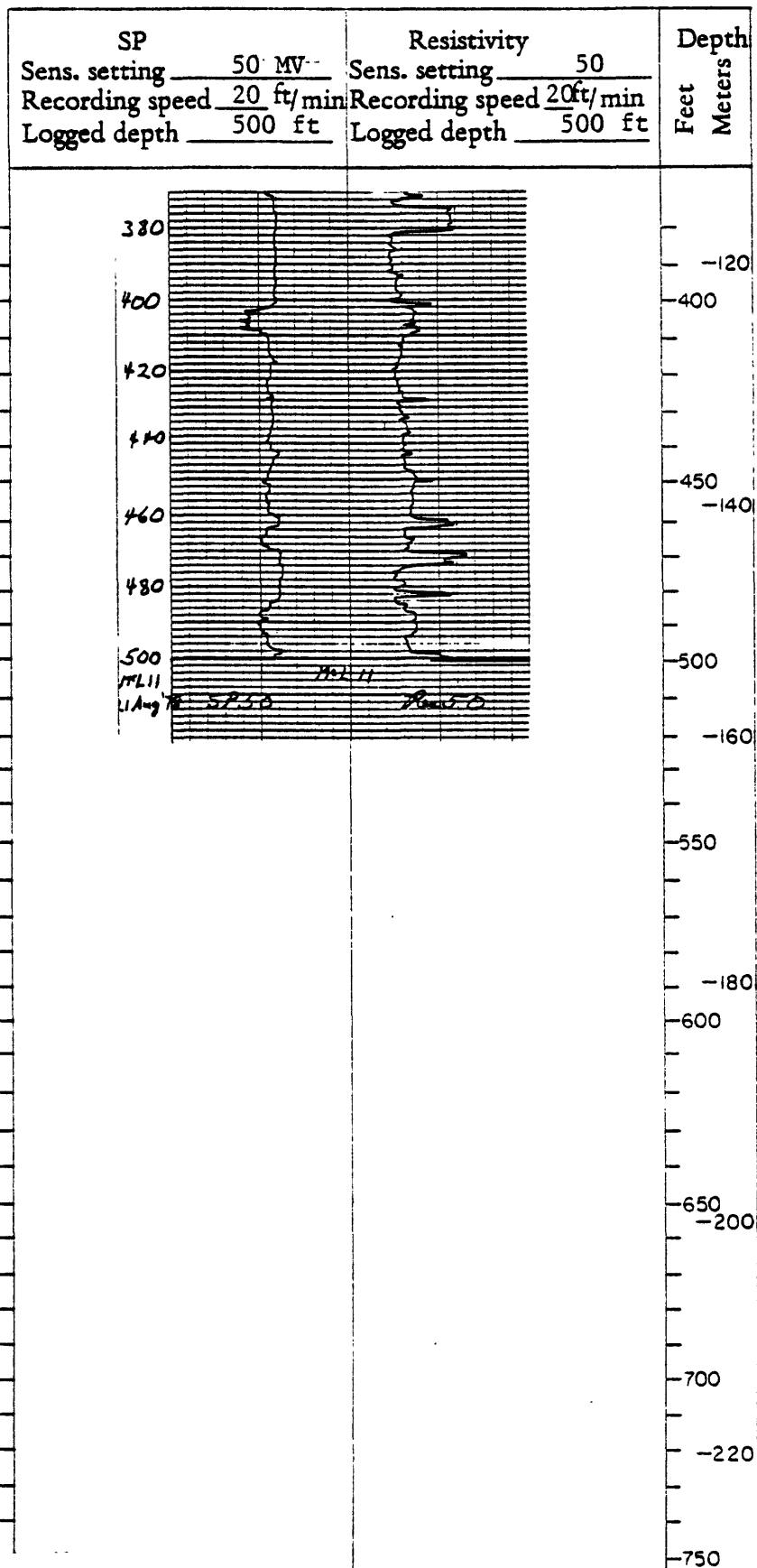
Hole number—continued
McL-11

Lithology	Gamma		Density		Depth	
	T.C.	Range 100 cps	T.C.	Range 100 cps	Feet	Meters
	Recording speed 20 ft/min		Recording speed 20 ft/min			
	Logged depth 500 ft		Logged depth 500 ft			
345-364 Claystone, gray		380				
364-374 Lignite					-120	
374-376 Siltstone, yellow-brown		400			400	
376-453 Claystone, gray						
453-455 Claystone, green		420				
455-462 Claystone, gray						
462-465 Lignite		440			450	
465-467 Siltstone, yellow-brown					-140	
467-481 Claystone, gray		460				
481-483 Lignite						
483-500 Claystone, gray		480			500	
	500					
	100 cps at 500 ft 1 Aug. 1958	McL-11 1 Aug. 1958	Density incomplete range		-160	
					550	
					-180	
					600	
					650	
					-200	
					700	
					-220	
					750	



Hole number—continued

McL-11



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-12 Map: Emmet Date: 8-22-78 State: ND County: McLean
 Elev.: 2061 ft Location: T. 148 ^N, R. 87 ^W, Sec. 1, Tract: aaaa Drilled depth: 400 ft
 Measured: 10 ft ^{FNL} ~~830X~~, 10 ft ^{FEL} ~~830X~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 181-198; 290-295.5; 321-327

Remarks: _____

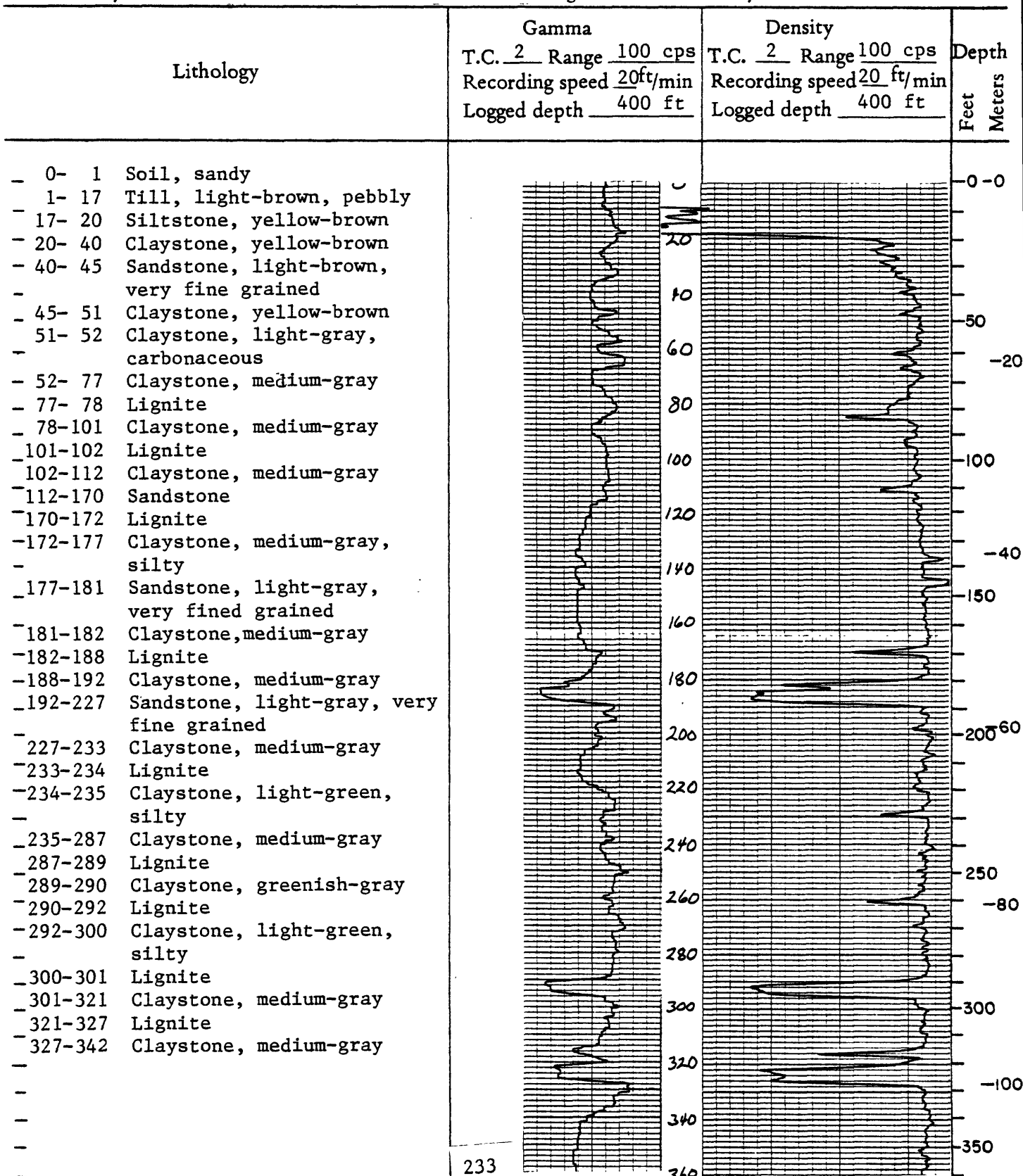
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~XXXX~~


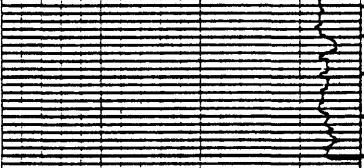
Geophysical logs

recorded by: Lechner

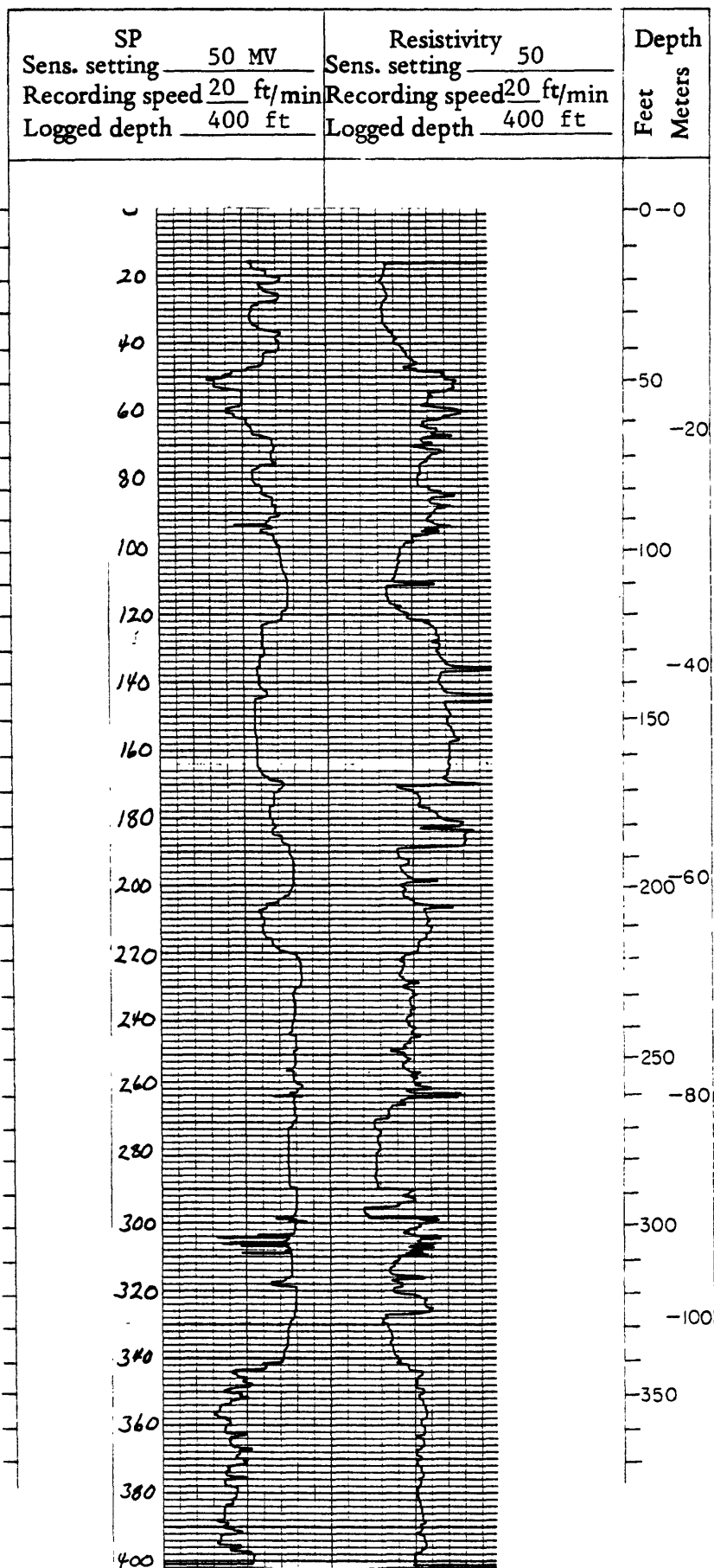


Hole number—continued

McL-12

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fect	Meters
	Recording speed 20 ft/min		Recording speed 20 ft/min			
	Logged depth 400 ft		Logged depth 400 ft			
342-384 Sandstone						
384-386 Lignite					-120	
386-400 Sandstone					400	
	<p> <i>γ 100 cps/2 TC</i> <i>0 70 ft/min</i> <i>McL-12</i> <i>2 Aug '88</i> </p>		<p> <i>Density 100 cps/2 TC</i> <i>0 70 ft/min</i> <i>McL-12</i> <i>2 Aug '88</i> </p>			
					-450	
					-140	
					-500	
					-160	
					-550	
					-180	
					600	
					-650	
					-200	
					-700	
					-220	
					-750	

Hole number McL-12



McL-12

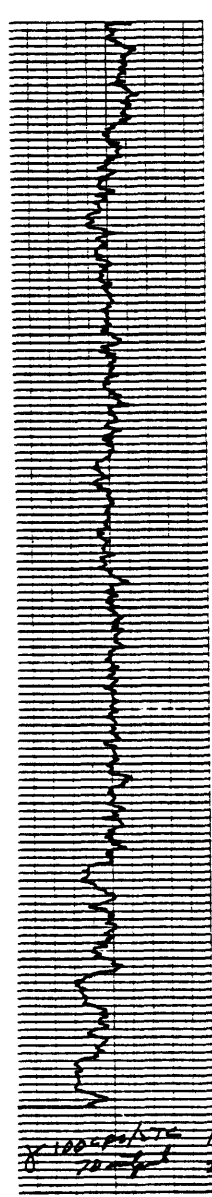
236

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-13 Map: Emmet Date: 8-23-78 State: ND County: McLean
 Elev.: 1990 ft Location: T. 148^N, R. 86^W, Sec. 7, Tract: cccc Drilled depth: 280 ft
 Measured: 153 ft ~~PSL~~, 25 ft ~~FWL~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: _____

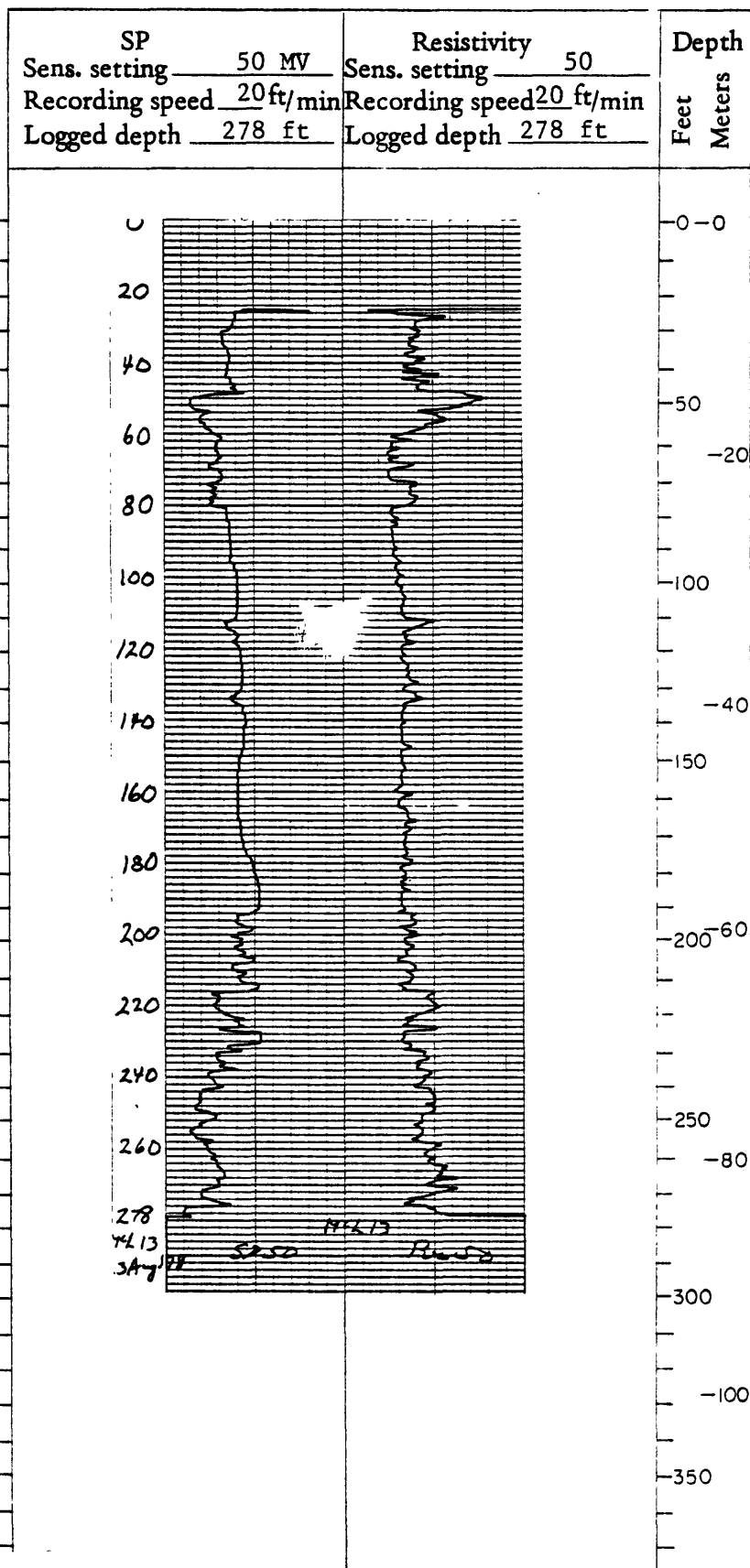
Remarks: No density log run

Lithology
 Recorded by: Tom Heck Geologist ^{Yes} ~~XXX~~ Geophysical logs recorded by: Lechner

Lithology	Gamma	Density	Depth Feet Meters
	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>278 ft</u>	T.C. <u> </u> Range <u> </u> Recording speed <u> ft/min</u> Logged depth <u> </u>	
- 0- 2 Soil, light-brown, sandy			0-0
- 2- 30 Till, yellow-brown, pebbly			
- 30- 50 Sand, very fine grained			
- 50- 51 Clay, yellow-brown, carbonaceous			
- 51- 60 Sand			
- 60- 78 Till, yellow-brown, silty			50
- 78-165 Till, medium-gray; with sand stringers, very fine grained			-20
- 165-210 Till, medium-gray			
- 210-260 Sand			100
- 260-280 Gravel			
-			-40
-			150
-			
-			200
-			60
-			
-			250
-			-80
-			
-			300
-			-100
-			350

Hole number—continued McL-13

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>278</u> ft	Density T.C. _____ Range _____ Recording speed _____ ft/min Logged depth _____	Depth	
			Fcft	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



McL-13

SP		Resistivity		Depth	
Sens. setting	50 Mv	Sens. setting	50	Feet	Meters
Recording speed	20 ft/min	Recording speed	20 ft/min		
Logged depth	278 ft	Logged depth	278 ft		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-14 Map: Emmet Date: 8-22-78 State: ND County: McLean
 Elev.: 2038 ft Location: T. 148^N, R. 86^W, Sec. 9, Tract: add Drilled depth: 380 ft
 Measured: 2540 ft ^{FNL} ~~2540~~, 20 ft ^{FEL} ~~20~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 116-123.5; 216.5-222.5; 261-267; 364-366

Remarks: _____

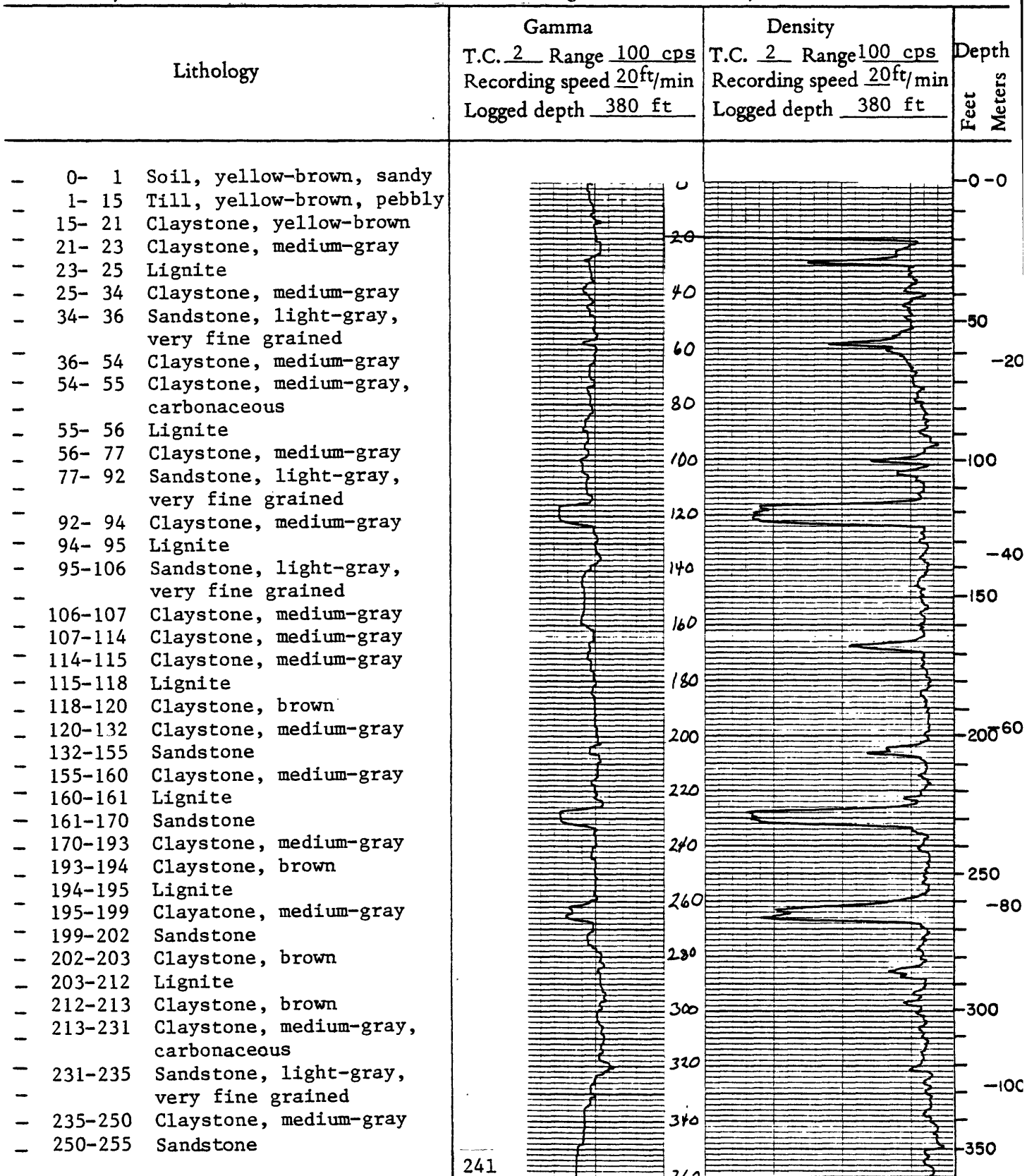
Lithology

Recorded by: Tom Heck

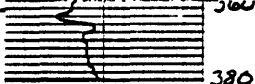

Geologist ^{Yes} ~~XX~~

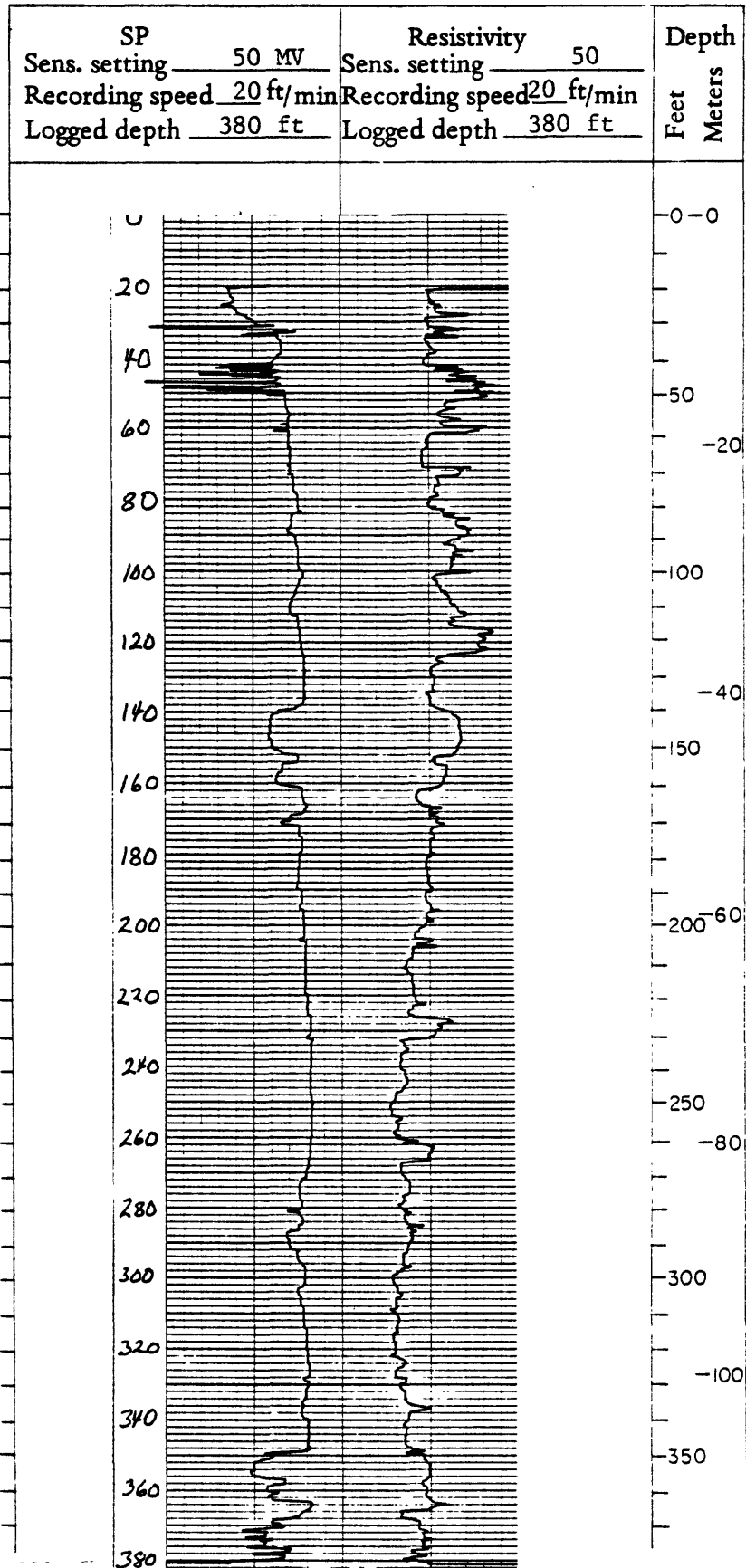
Geophysical logs

recorded by: Lechner



Hole number—continued
McL-14

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>380</u> ft	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>380</u> ft	Fect	Meters
255-261 Lignite				
261-288 Sandstone			-120	
288-307 Claystone, medium-gray			400	
307-308 Claystone, light-gray, carbonaceous				
308-324 Claystone, medium-gray				
324-362 Sandstone				
362-366 Lignite				
366-375 Sandstone			450	
375-380 Claystone, medium-gray			-140	
			500	
			-160	
			550	
			-180	
			600	
			650	
			-200	
			700	
			-220	
			750	
	242			



Hole number—continued

McL-14

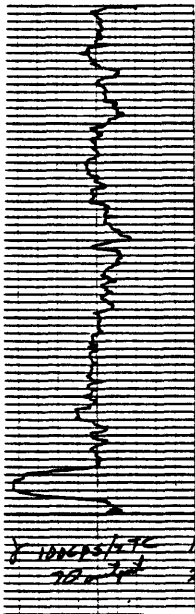
SP		Resistivity		Depth	
Sens. setting <u>50 MV</u>		Sens. setting <u>50</u>		Fet Meters	
Recording speed <u>20 ft/min</u>		Recording speed <u>20 ft/min</u>			
Logged depth <u>380 ft</u>		Logged depth <u>380 ft</u>			
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: MCL-14C Map: Emmet Date: 8-23-78 State: ND County: McLean
 Elev.: 2041 ft. Location: T. 148 ^N_S, R. 86 ^E_W, Sec. 9, Tract: add Drilled depth: 130 ft.
 Measured: 2562 ft ^{FNL}_{FSL}, 48 ft ^{FEL}_{FWL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☒ No ☐
 Lignite beds: _____

Remarks: _____

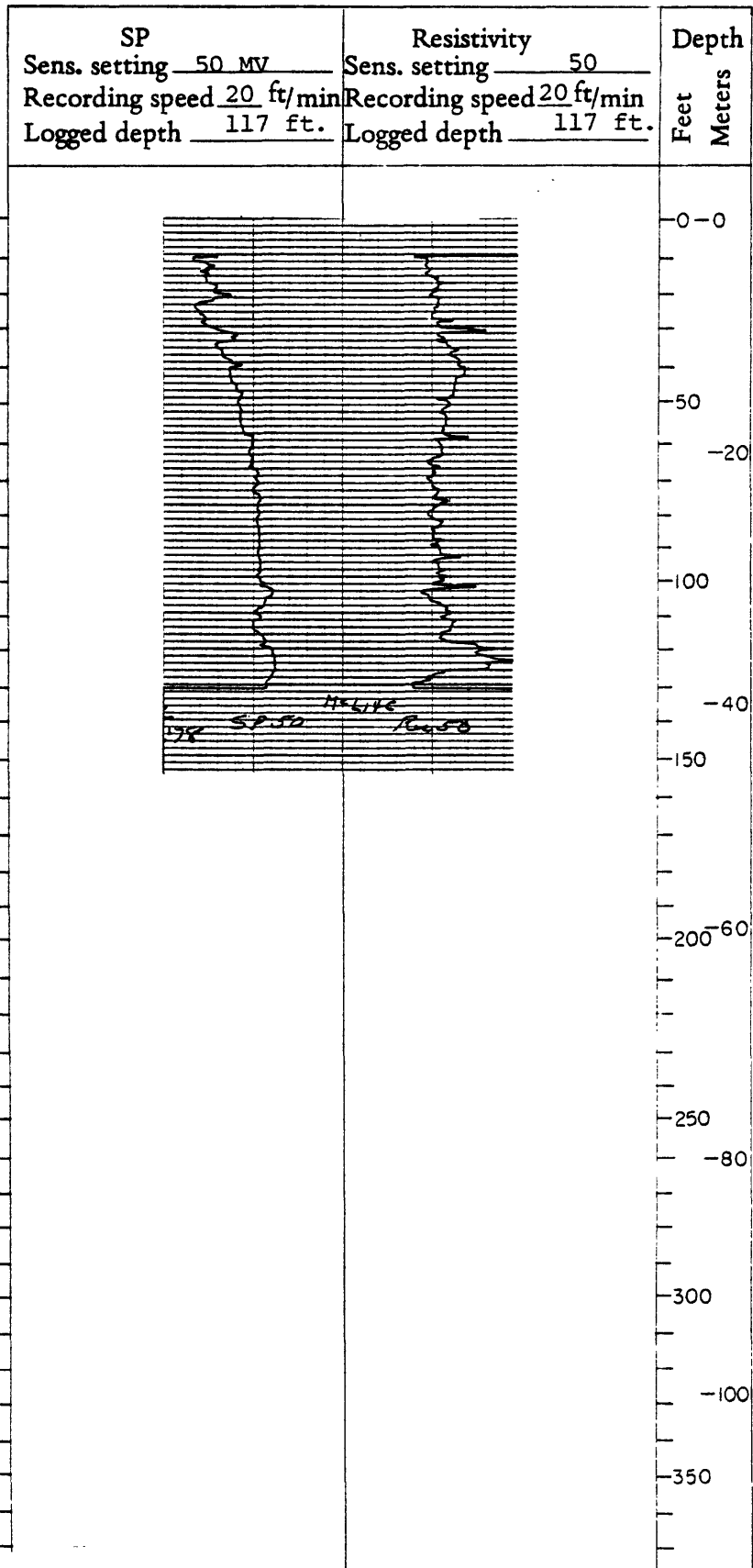
Lithology Recorded by: _____ Geologist ^{Yes}_{No} Geophysical logs recorded by: _____

Lithology	Gamma	Density	Depth Feet Meters
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>117</u> ft.	T.C. <u> </u> Range <u> </u> Recording speed <u> </u> ft/min Logged depth <u> </u>	
<div style="display: flex; flex-direction: column; align-items: center;"> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> <div style="width: 100%; height: 100%; border-left: 1px dashed black; border-right: 1px dashed black;"></div> </div>	<div style="display: flex; flex-direction: column; align-items: center;">  </div>		0-0
			20
			40
			60
			80
			100
			120
			130
			140
			150
			160
			170
			180
			190
			200
			210
			220
			230
			240
			250
			260
			270
			280
			290
			300
			310
			320
			330
			340
			350

Hole number—continued

MCL-14C

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>117</u> ft.	Density T.C. ____ Range ____ Recording speed ____ ft/min Logged depth ____	Depth	
			Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



MCL-14C

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NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-15 Map: Emmet NE Date: 8-22-78 State: ND County: McLean
 Elev.: 1970 ft Location: T. 148^N, R. 86^W, Sec. 14, Tract: dccc Drilled depth: 320 ft
 Measured: 20 ft ~~FSL~~ ^{FEL} 2500 ft ~~FSL~~ ^{FEL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 54-58; 74-76; 108-110; 151-156;
194.5-199; 310-312.5

Remarks: _____

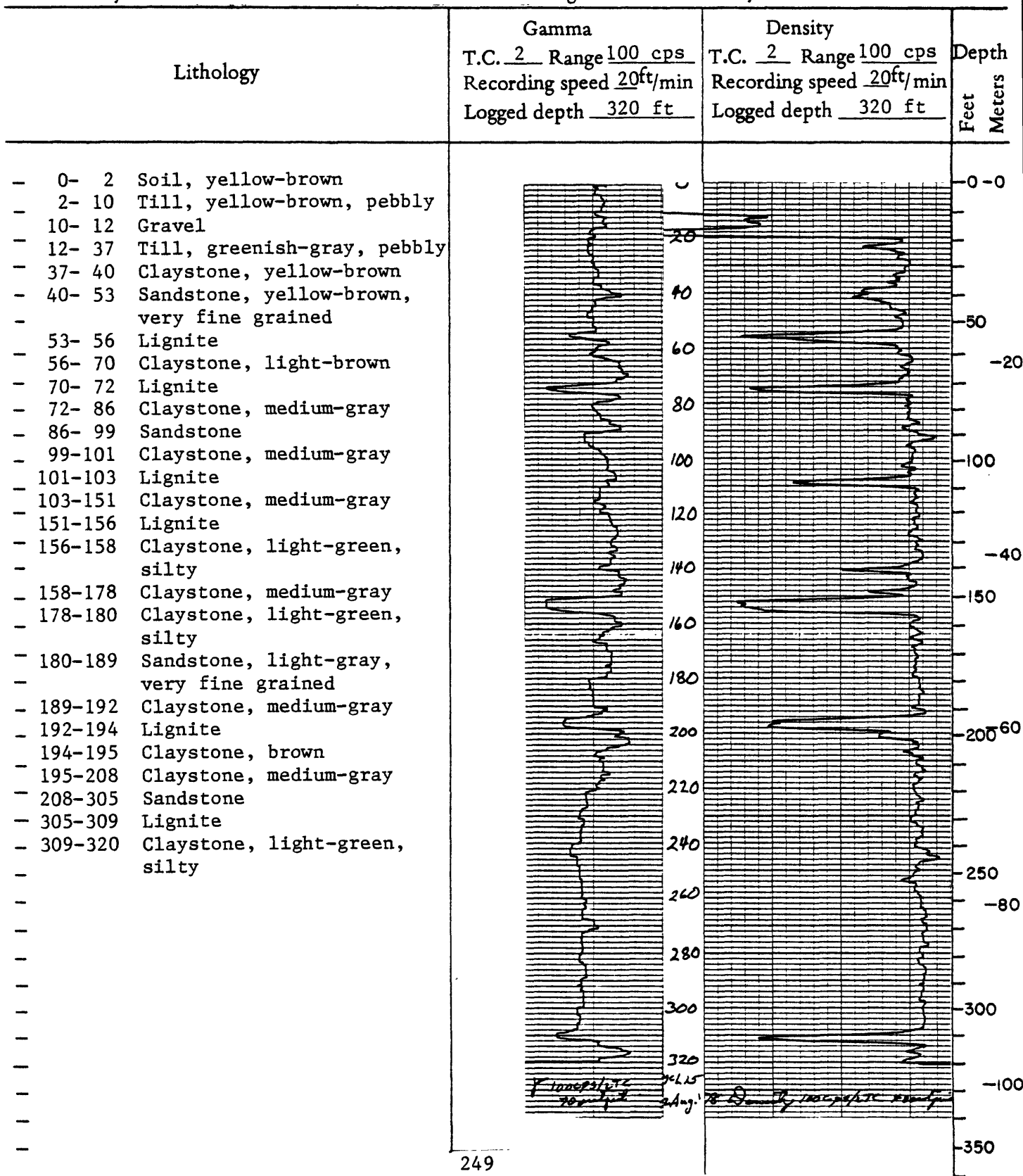
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner



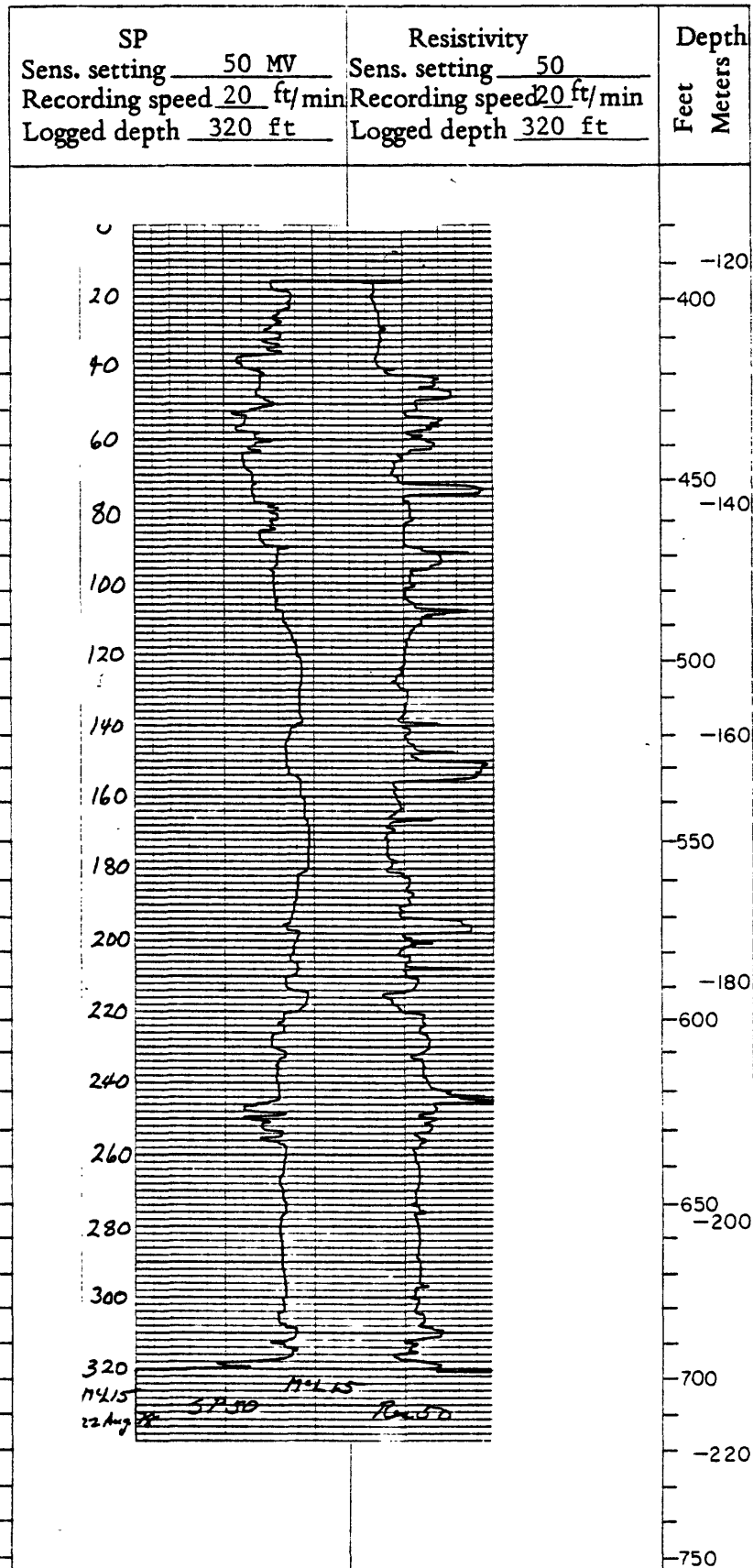
Hole number—continued

McL-15

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>320</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>320</u> ft	Depth	
			Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	

Hole number—continued

McL-15



Hole number McL-15

SP		Resistivity		Depth	
Sens. setting	<u>50 MV</u>	Sens. setting	<u>50</u>	Feet	Meters
Recording speed	<u>20 ft/min</u>	Recording speed	<u>20ft/min</u>		
Logged depth	<u>320 ft</u>	Logged depth	<u>320 ft</u>		
				-0	0
				-50	
					-20
				-100	
					-40
				-150	
				-200	-60
				-250	
					-80
				-300	
					-100
				-350	

NORTH DAKOTA GEOLOGICAL SURVEY

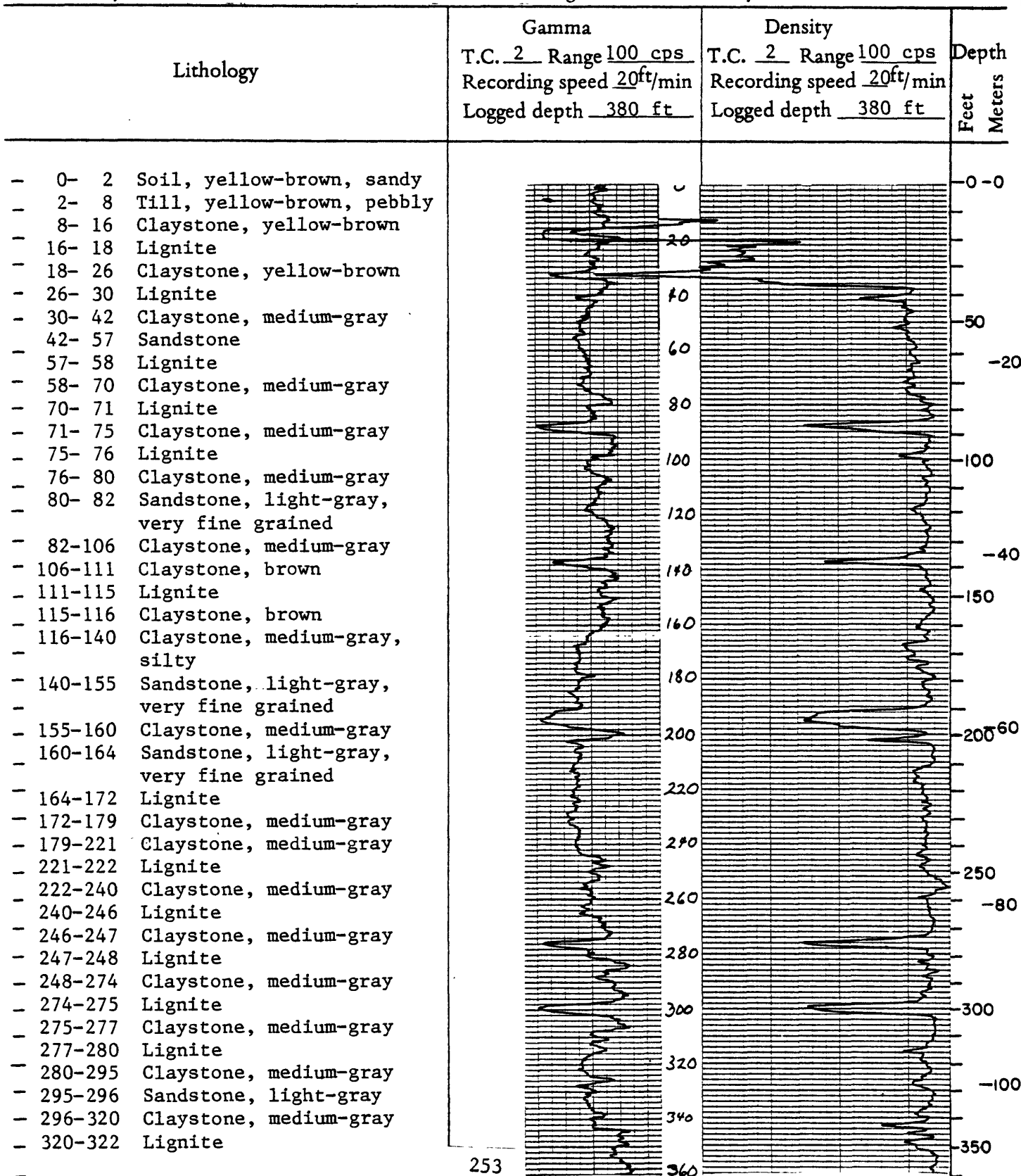
Hole No: McL-16 Map: Emmet NE Date: 8-24-78 State: ND County: McLean
 Elev.: 2023 ft Location: T. 148^N, R. 85^W, Sec. 5, Tract: baaa Drilled depth: 380 ft
 Measured: 40 ft ~~FNL~~ 2615 ft ~~FWL~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: _____

Remarks: _____

Lithology


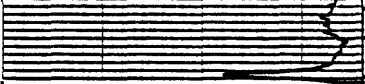
Recorded by: Tom Heck

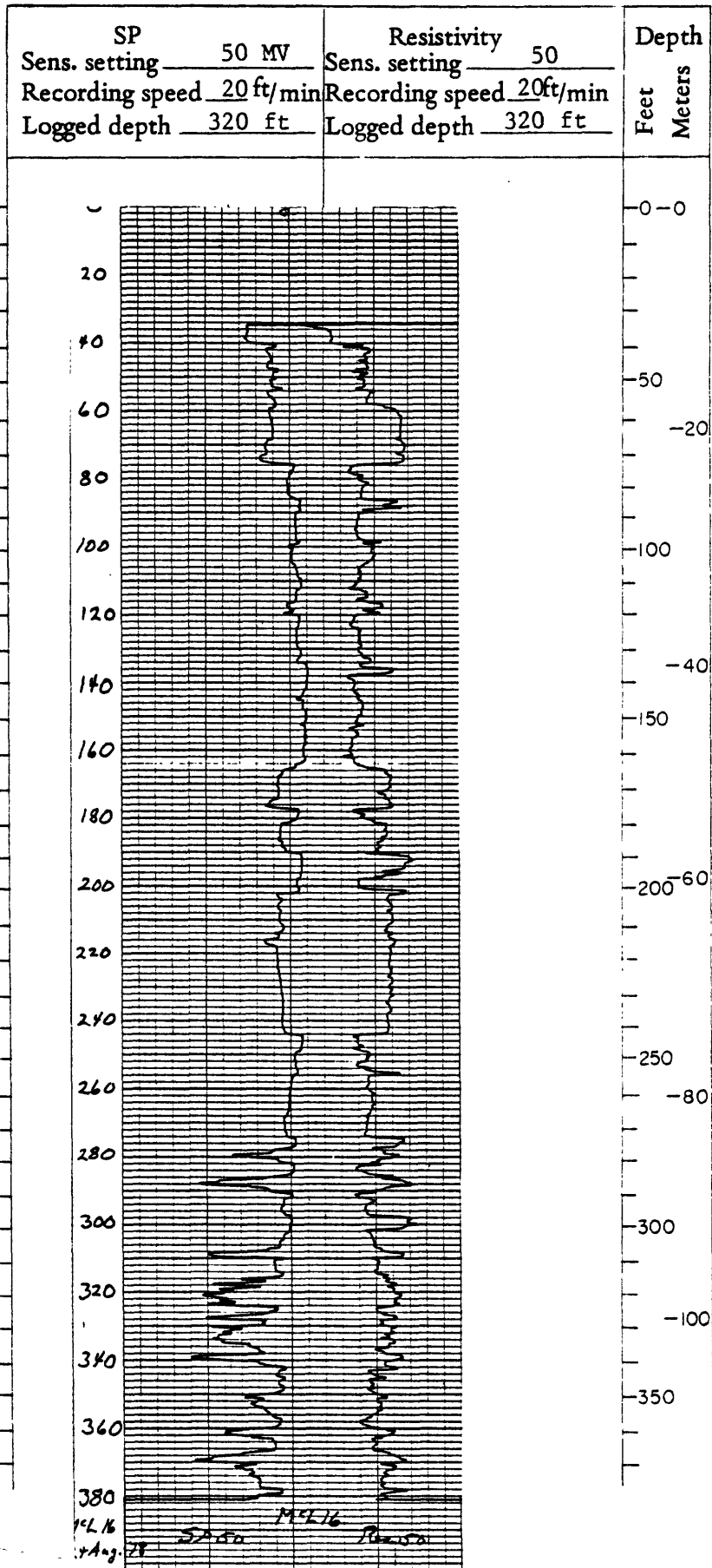
Geologist ^{Yes}~~No~~ recorded by: Lechner



Hole number—continued

McL-16

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>380</u> ft	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>380</u> ft	Fect	Meters
322-325 Claystone, brownish-gray				
325-326 Lignite			-120	
326-352 Claystone, medium-gray			400	
352-353 Lignite				
353-360 Claystone, light-gray				
			450	
			-140	
			500	
			-160	
			550	
			-180	
			600	
			650	
			-200	
			700	
			-220	
			750	



Hole number—continued

McL-16

SP		Resistivity		Depth	
Sens. setting	50 MV	Sens. setting	50	Ft	Meters
Recording speed	20 ft/min	Recording speed	20 ft/min		
Logged depth	380 ft	Logged depth	380 ft		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-17 Map: Emmet NE Date: 8-24-78 State: ND County: McLean
Elev.: 2055 ft Location: T. 149^N, R. 85^W, Sec. 30, Tract: dddd Drilled depth: 420 ft
Measured: 126 ft ~~FSL~~^{FSL}, 20 ft ~~FSL~~^{FEL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: _____

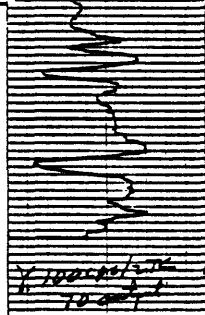
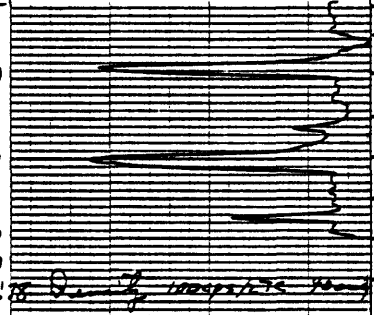
Remarks:

Lithology
Recorded by: Tom Heck _____ Geologist ^{Yes}~~No~~
Geophysical logs
recorded by: Lechner _____

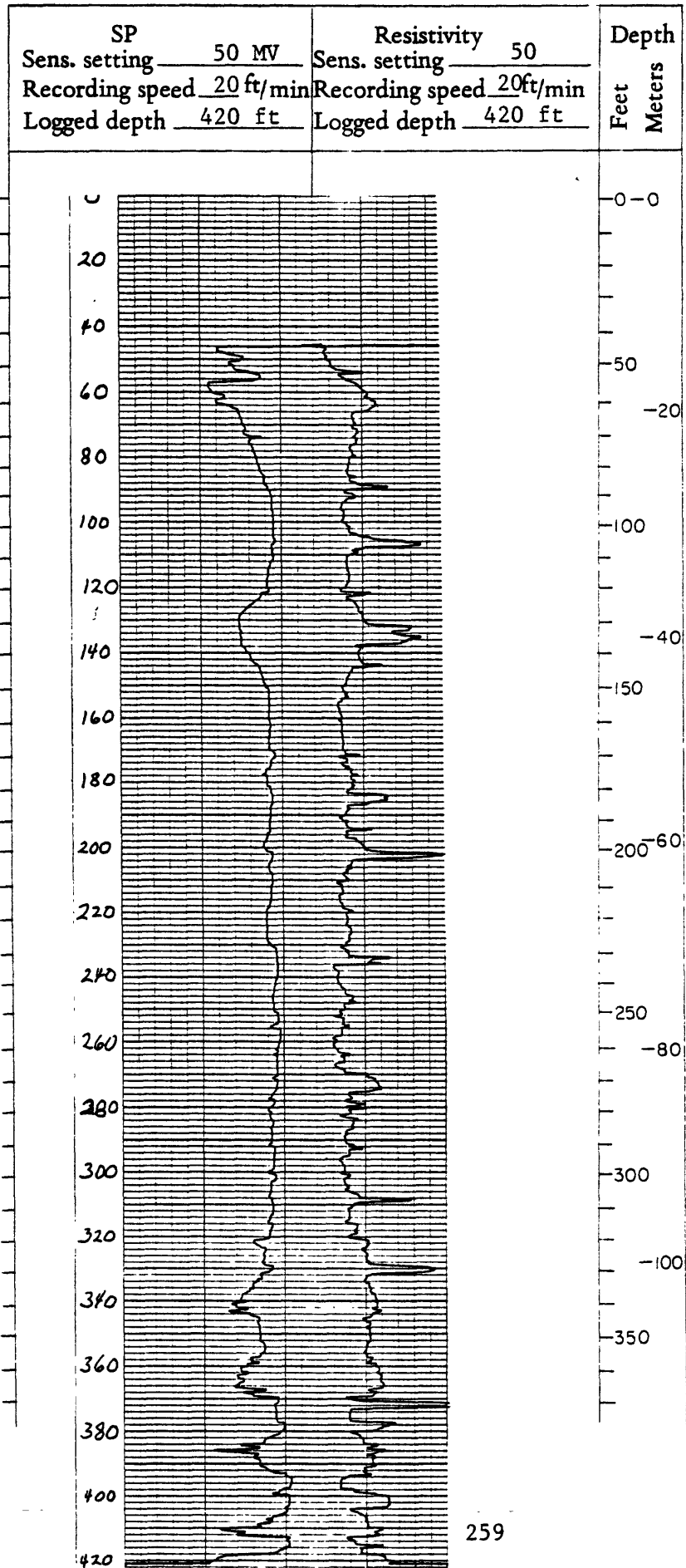
[illegible]

Hole number—continued

McL-17

Lithology	Gamma		Density		Depth	
	T.C. 2 Range 100 cps		T.C. 2 Range 100 cps		Feet	Meters
	Recording speed 20 ft/min		Recording speed 20ft/min			
	Logged depth 420 ft		Logged depth 420 ft			
320-370 Sandstone, light-gray, very fine grained		380		-120		
370-373 Lignite		400		400		
373-399 Claystone, medium-gray						
399-403 Lignite		420				
403-414 Claystone, medium-gray		<i>Y. 100 cps/20 ft</i>		<i>McL-17</i>		
414-415 Ligninte	<i>100 ft</i>	<i>200 ft</i>				
415-420 Claystone, medium-gray						
					-450	
					-140	
					-500	
					-160	
					-550	
					-180	
					600	
					-650	
					-200	
					-700	
					-220	
					-750	

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Hole number—continued

McL-17

SP		Resistivity		Depth	
Sens. setting	50 MV	Sens. setting	50	Feet	Meters
Recording speed	20 ft/min	Recording speed	20 ft/min		
Logged depth	420 ft	Logged depth	420 ft		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-18 Map: Emmet Date: 8-20-78 State: ND County: McLean
 Elev.: 2075 ft Location: T. 149^N, R. 86^W, Sec. 13, Tract: cccc Drilled depth: 380 ft
 Measured: 225 ft ~~FSL~~ ^{FNL}, 35 ft ~~FWL~~ ^{FNL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 194-196; 207-213.5; 257-261; 315.5-318; 352-362

Remarks: _____

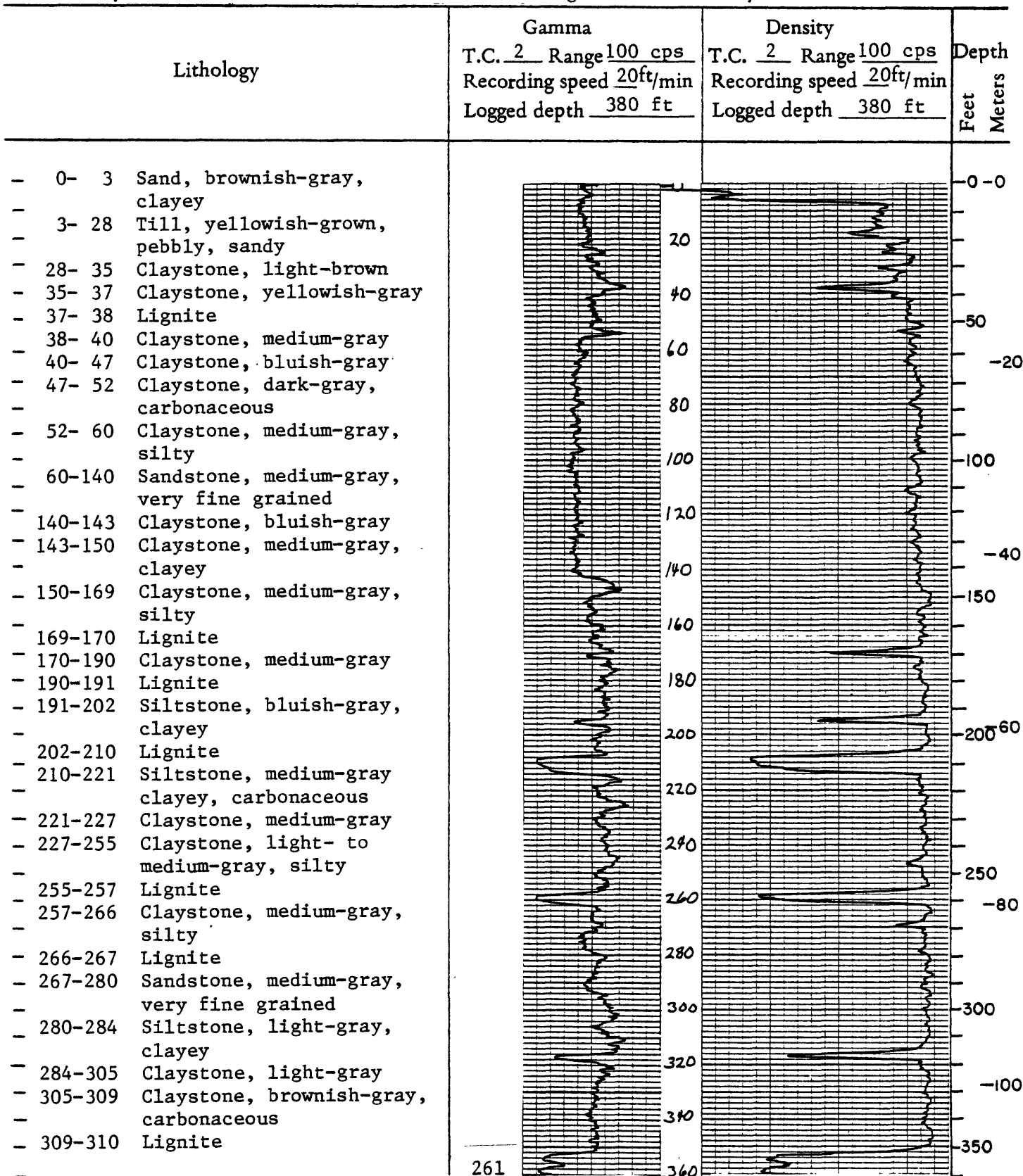
Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes} ~~NA~~



Geophysical logs

recorded by: Lechner



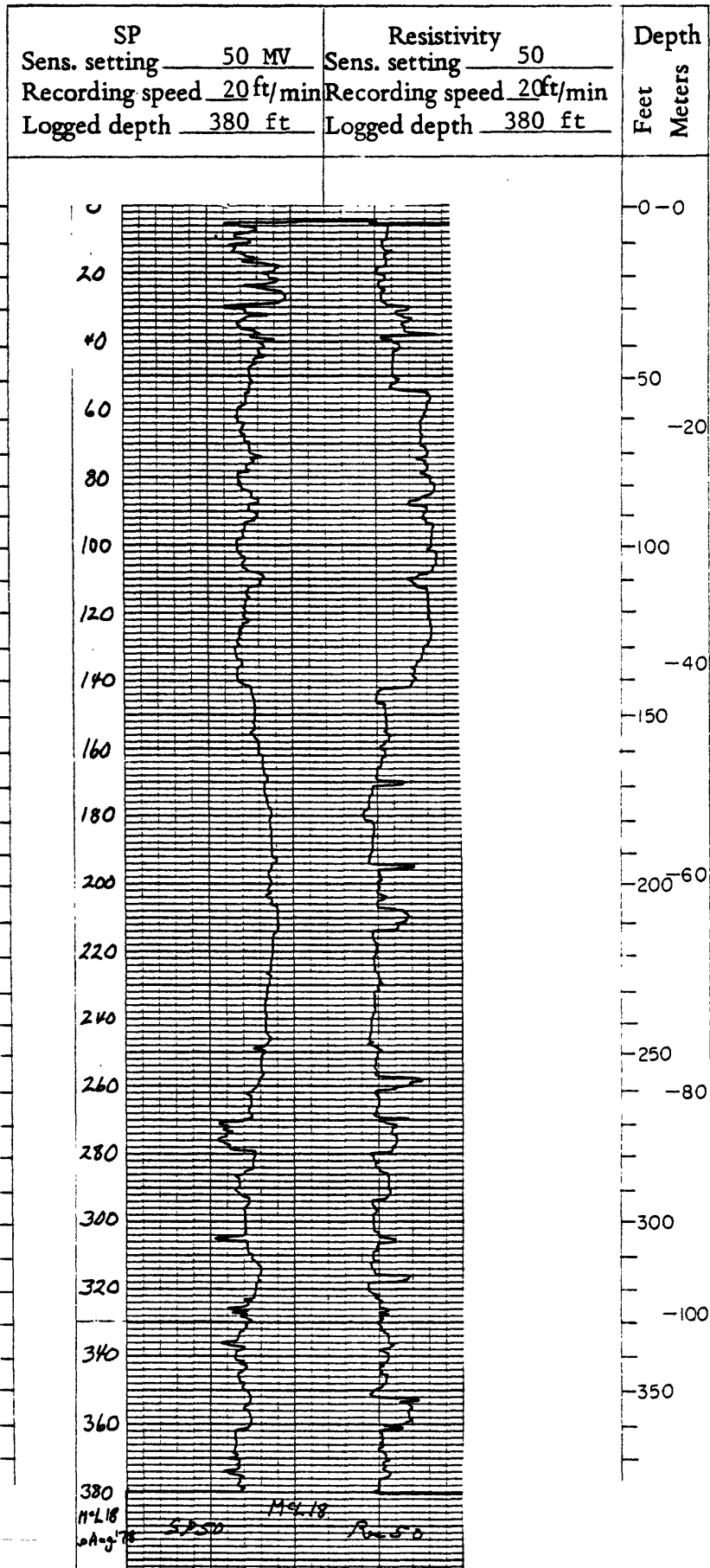
Hole number—continued

McL-18

Lithology	Gamma		Density		Depth	
	T.C. 2 Range 100 cps		T.C. 2 Range 100 cps		Feet	Meters
	Recording speed 20 ft/min		Recording speed 20ft/min			
	Logged depth 380 ft		Logged depth 380 ft			
310-327 Claystone, light- to medium-gray						
327-345 Sandstone, light-gray, very fine grained, bentonitic, silty					-120	
345-346 Claystone, dark-brown, carbonaceous					-400	
346-359 Lignite						
359-380 Claystone, medium-brownish-gray, silty					-450	
					-140	
					-500	
					-160	
					-550	
					-180	
					-600	
					-650	
					-200	
					-700	
					-220	
					-750	

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Hole number McL-18



McL-18:

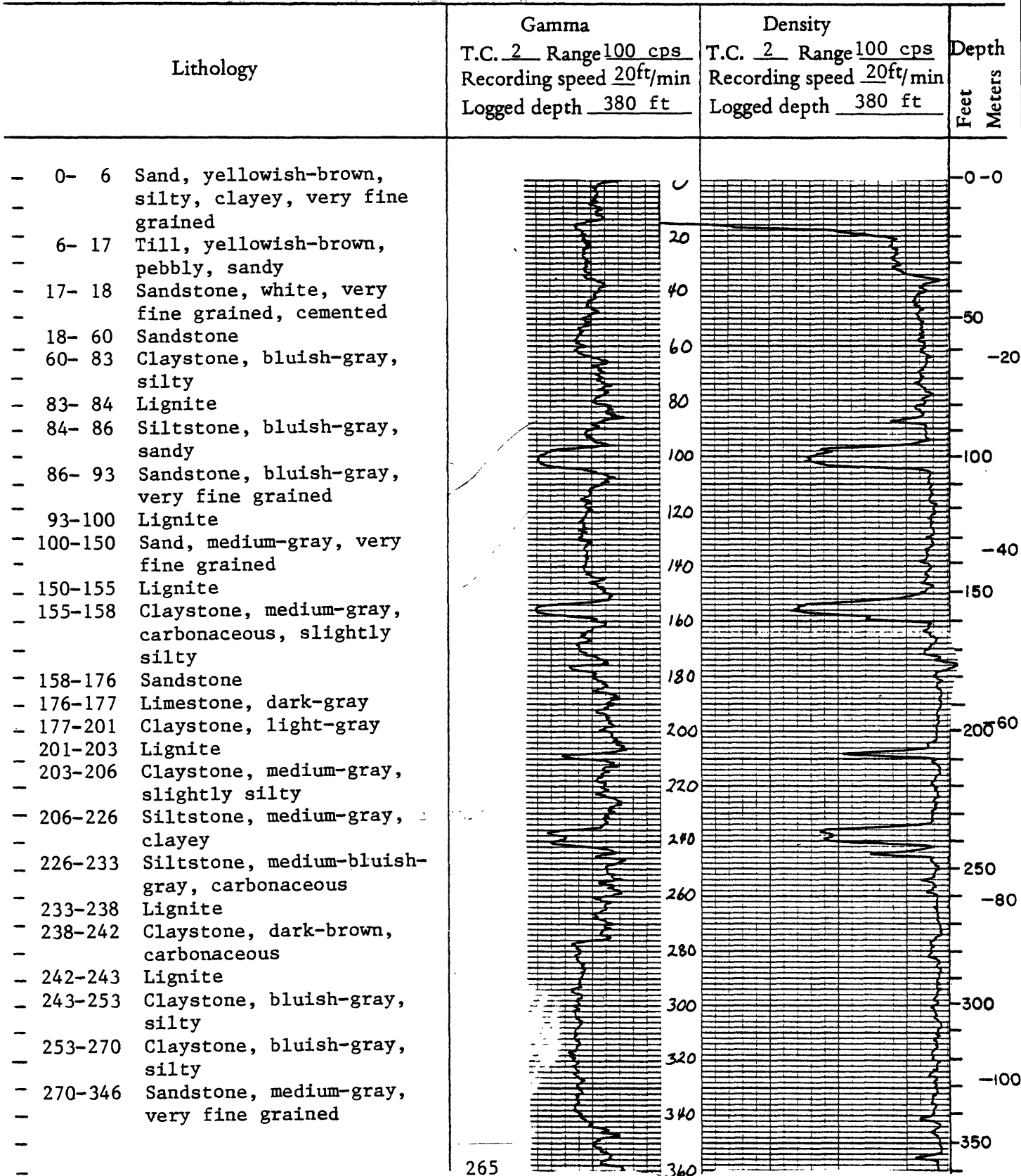
264

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-19 Map: Emmet NE Date: 8-20-78 State: ND County: McLean
 Elev.: 2037 ft Location: T. 149^N, R. 85^W, Sec. 17, Tract: bbbb Drilled depth: 380 ft
 Measured: 84 ft ^{FNL}~~FSK~~, 24 ft ^{FWL}~~FSK~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 96-194; 152.5-160; 235-241



Remarks: _____

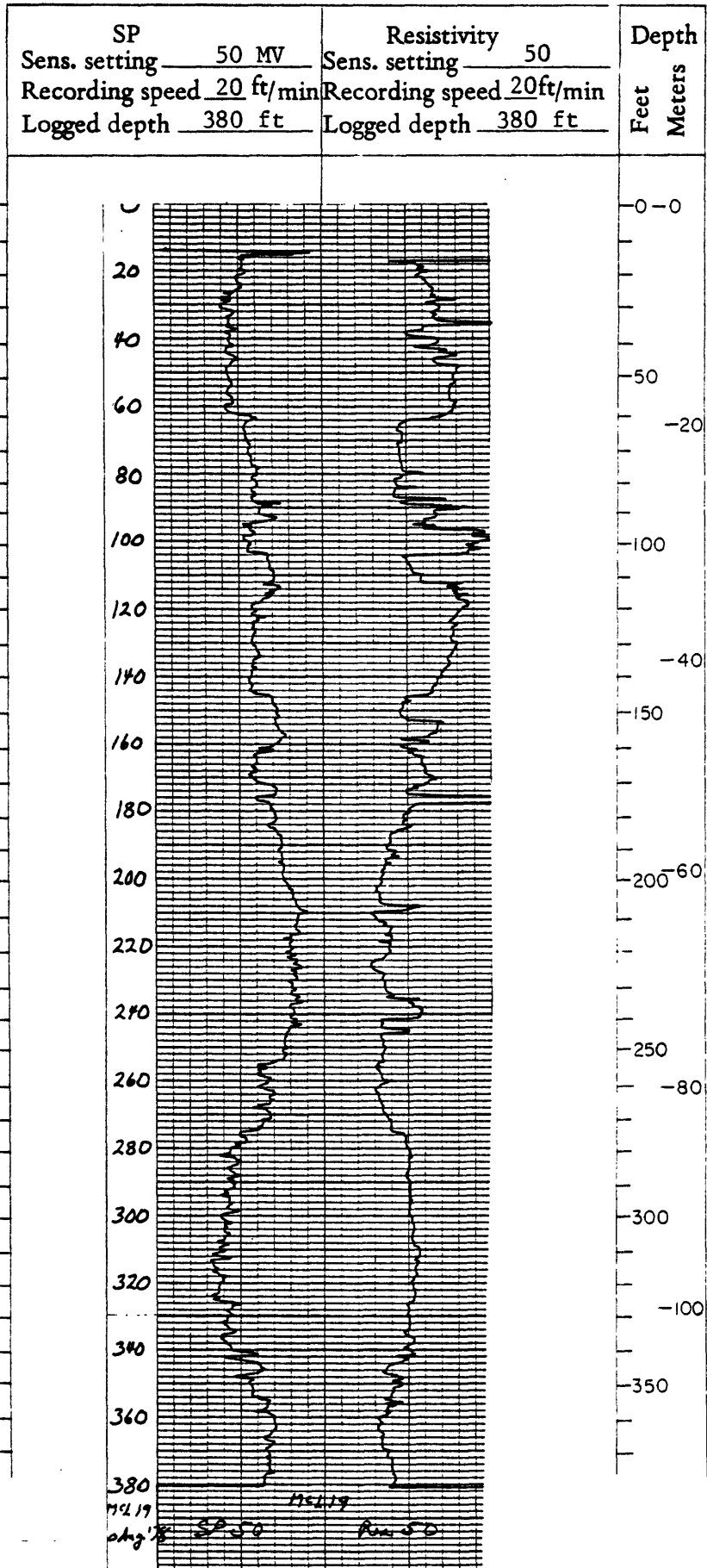
Lithology
 Recorded by: Fred O'Toole Geologist ^{Yes}~~NA~~ Geophysical logs recorded by: Lechner



Hole number—continued

McL-19

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>380</u> ft	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>380</u> ft	Fect	Meters
346-380 Claystone, medium-gray, silty				
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued
McL-19

SP		Resistivity		Depth	
Sens. setting	50 MV	Sens. setting	50	Feet	Meters
Recording speed	20 ft/min	Recording speed	20 ft/min		
Logged depth	380 ft	Logged depth	380 ft		
					-120
					-400
					-450
					-140
					-500
					-160
					-550
					-180
					-600
					-650
					-200
					-700
					-220
					-750

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McL-20 Map: Emmet Date: 8-19-78 State: ND County: McLean
 Elev.: 2125 ft Location: T. 149^N S, R. 86^E W, Sec. 4, Tract: ddaa Drilled depth: 480 ft
 Measured: 1280 ft ~~FSL~~ ^{FEL}, 72 ft ~~FSL~~ ^{FEL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: _____

Remarks: _____

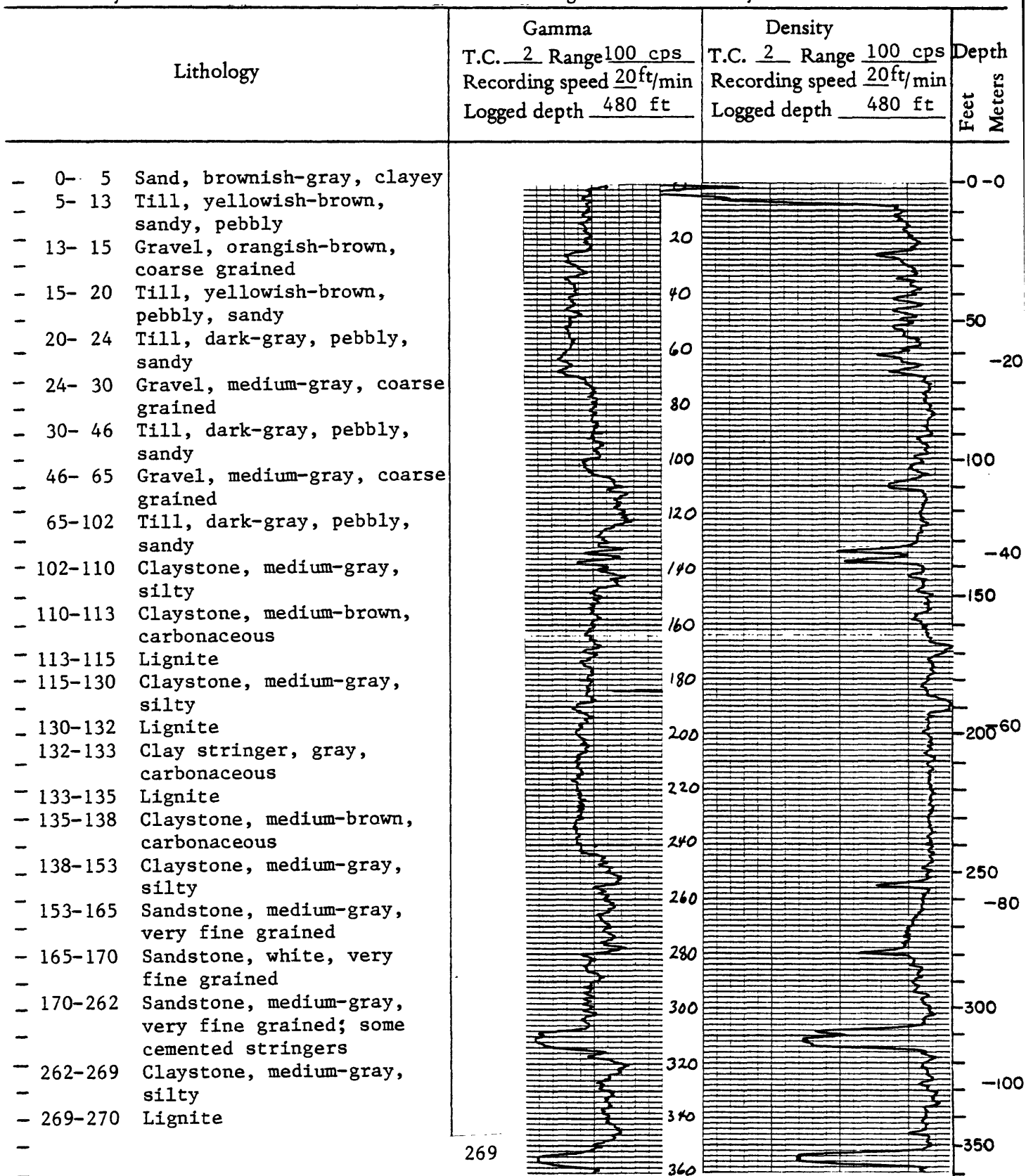
Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes} ~~NA~~

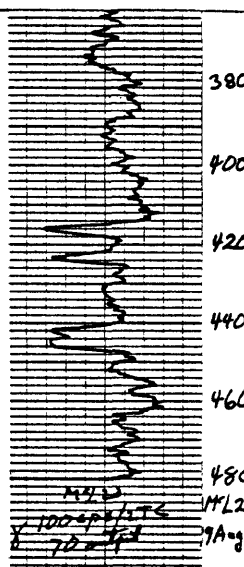
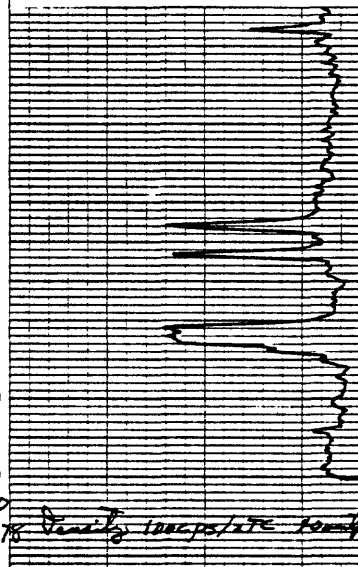
Geophysical logs

recorded by: Lechner

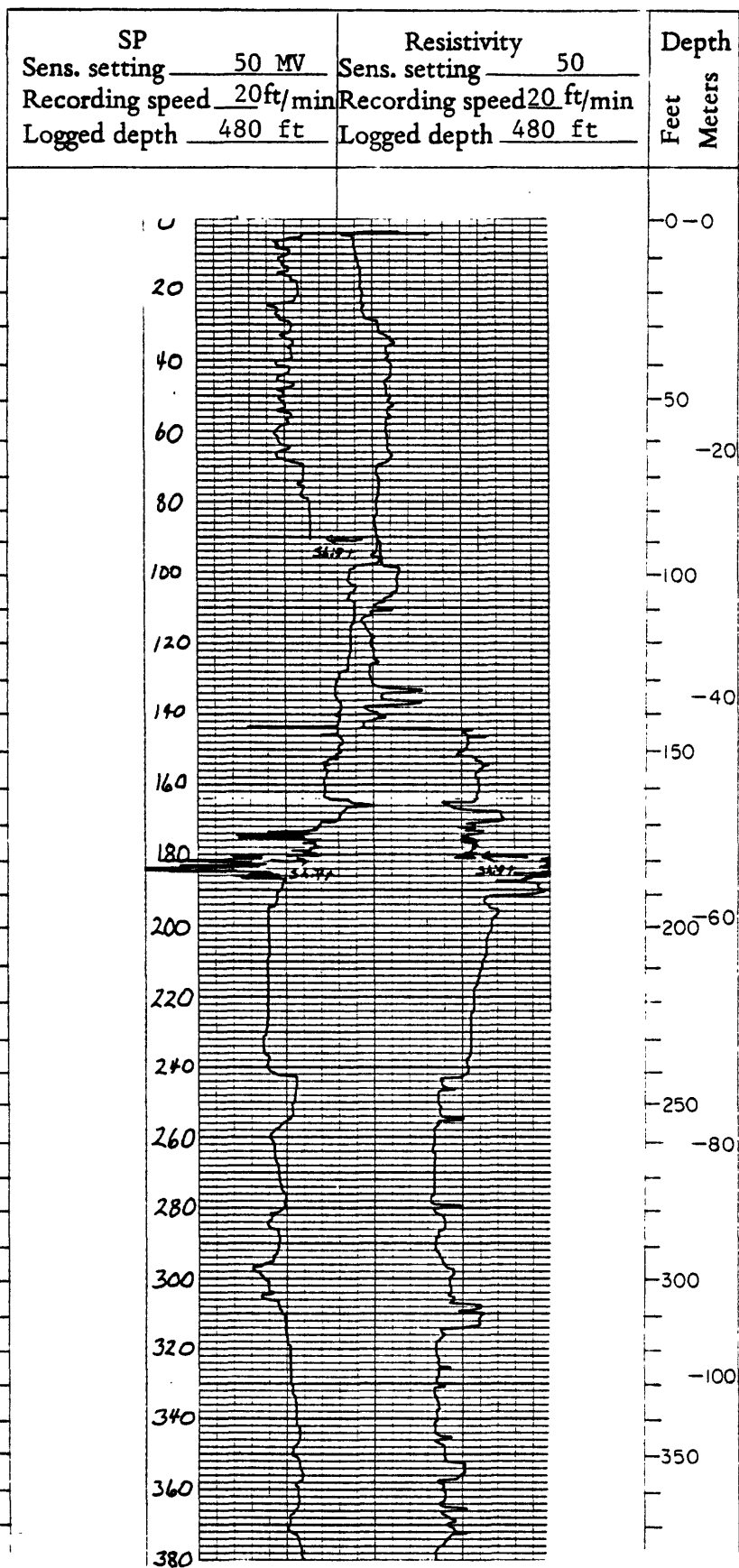


Hole number—continued

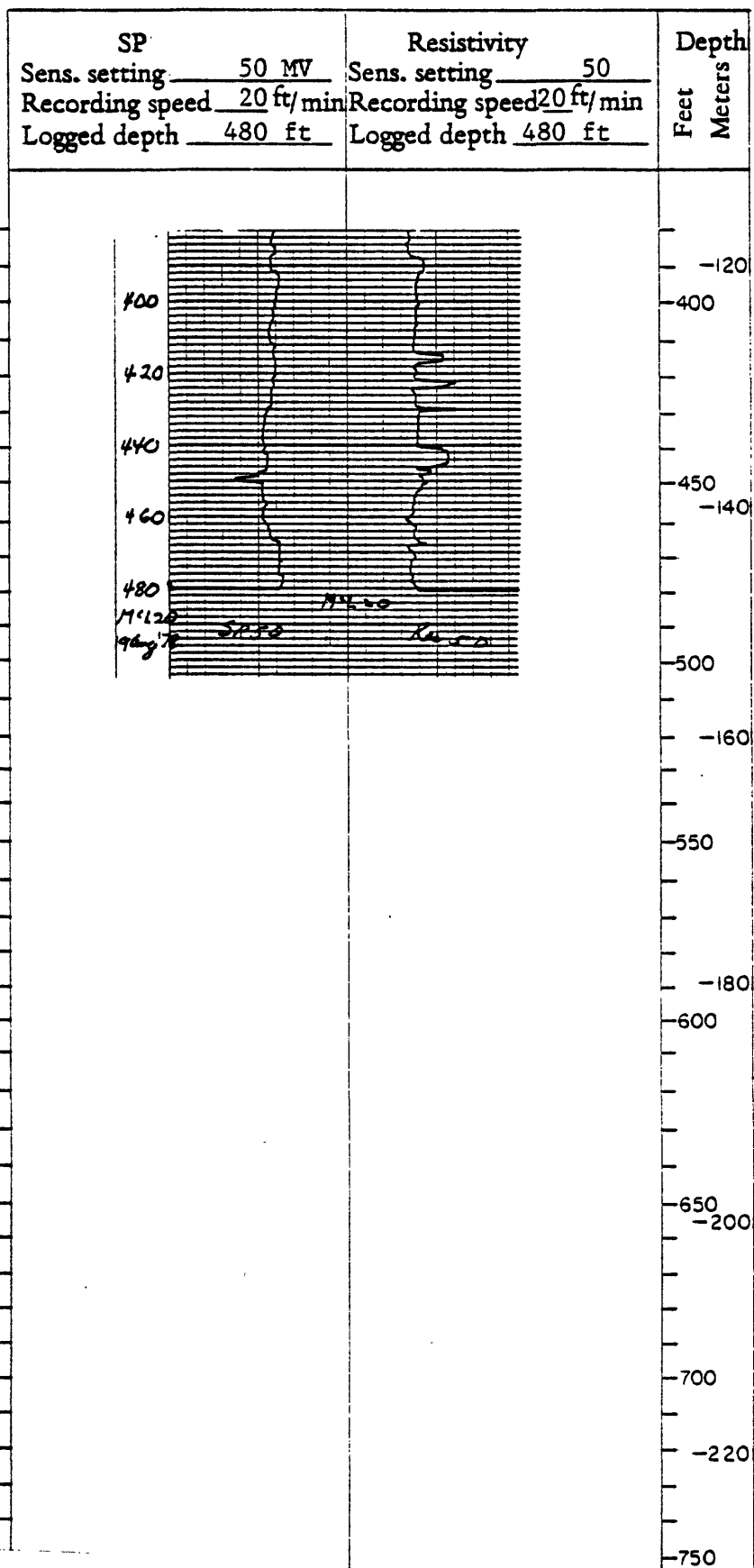
McL-20

Lithology	Gamma	Density	Depth
	T.C. 2 Range 100 cps	T.C. 2 Range 100 cps	Fect
	Recording speed 20 ft/min	Recording speed 20ft/min	Meters
	Logged depth 480 ft	Logged depth 480 ft	
70-283 Siltstone, medium-gray, carbonaceous			
83-300 Claystone, medium-gray, silty			-120
00-304 Sandstone, light-gray, very fine grained			400
04-311 Lignite			
11-316 Sandstone, medium-gray, very fine grained			
16-325 Claystone, medium-gray, silty			450
25-326 Lignite			-140
26-342 Claystone, medium-gray, carbonaceous			
42-344 Lignite			
44-350 Siltstone, medium-gray, clayey, carbonaceous			500
50-355 Lignite			
55-366 Claystone, medium-gray, silty			-160
66-368 Lignite			
68-375 Sandstone, medium-gray, very fine grained			550
75-394 Claystone, bluish-gray, carbonaceous			
94-405 Siltstone, bluish-gray, clayey, carbonaceous			
05-415 Claystone, bluish-gray			-180
15-416 Lignite			600
16-424 Claystone, light-brown, carbonaceous			
24-425 Lignite			650
25-438 Claystone, light-brownish-gray			-200
38-439 Lignite			
39-441 Claystone, medium-brown, carbonaceous			700
41-444 Lignite			
44-455 Claystone, light-brown, silty			-220
55-480 Claystone, medium-gray, silty			750

270



Hole number—continued
McL-20



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: MCL-21 Map: Emmet Date: 8-20-78 State: ND County: McLean
 Elev.: 2195 ft Location: T. 149 ^N_S, R. 86 ^E_W, Sec. 7, Tract: dddd Drilled depth: 540 ft
 Measured: 36 ft ^{FSL}~~FSL~~, 110 ft ^{FEL}~~FEL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 383-391; 432-434; 485-494; 508-514

Remarks: _____

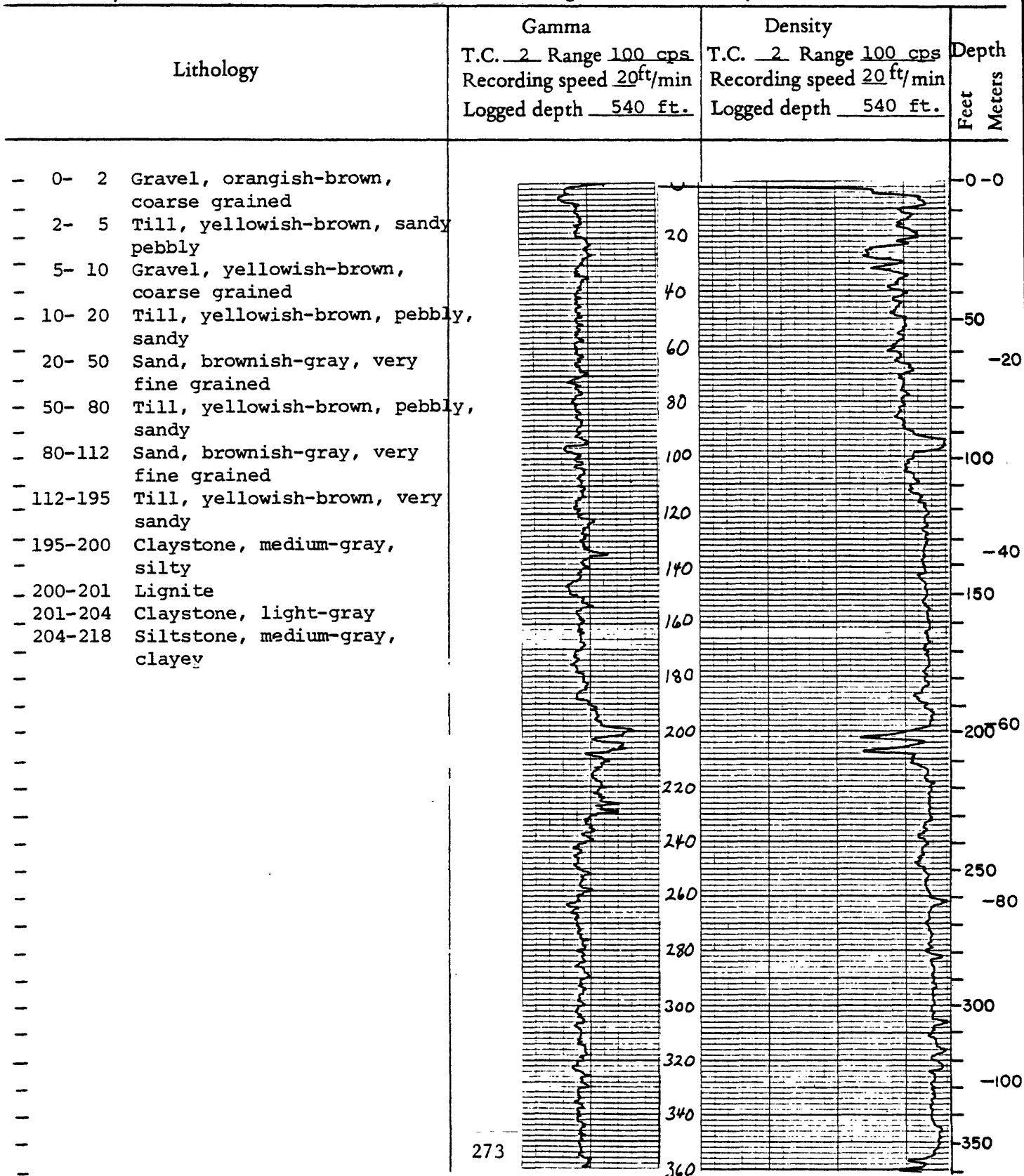
Lithology

Recorded by: Fred O'Toole

Geophysical logs

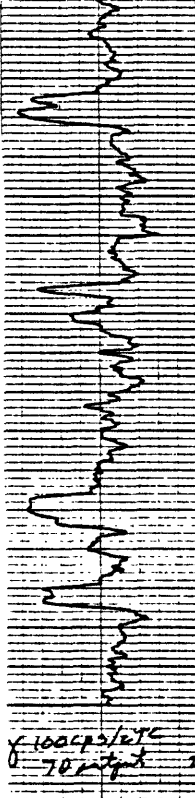
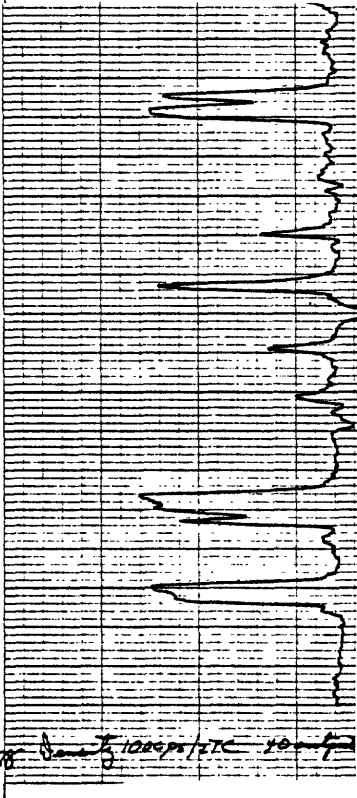
Geologist ^{Yes}~~No~~

recorded by: Lechner



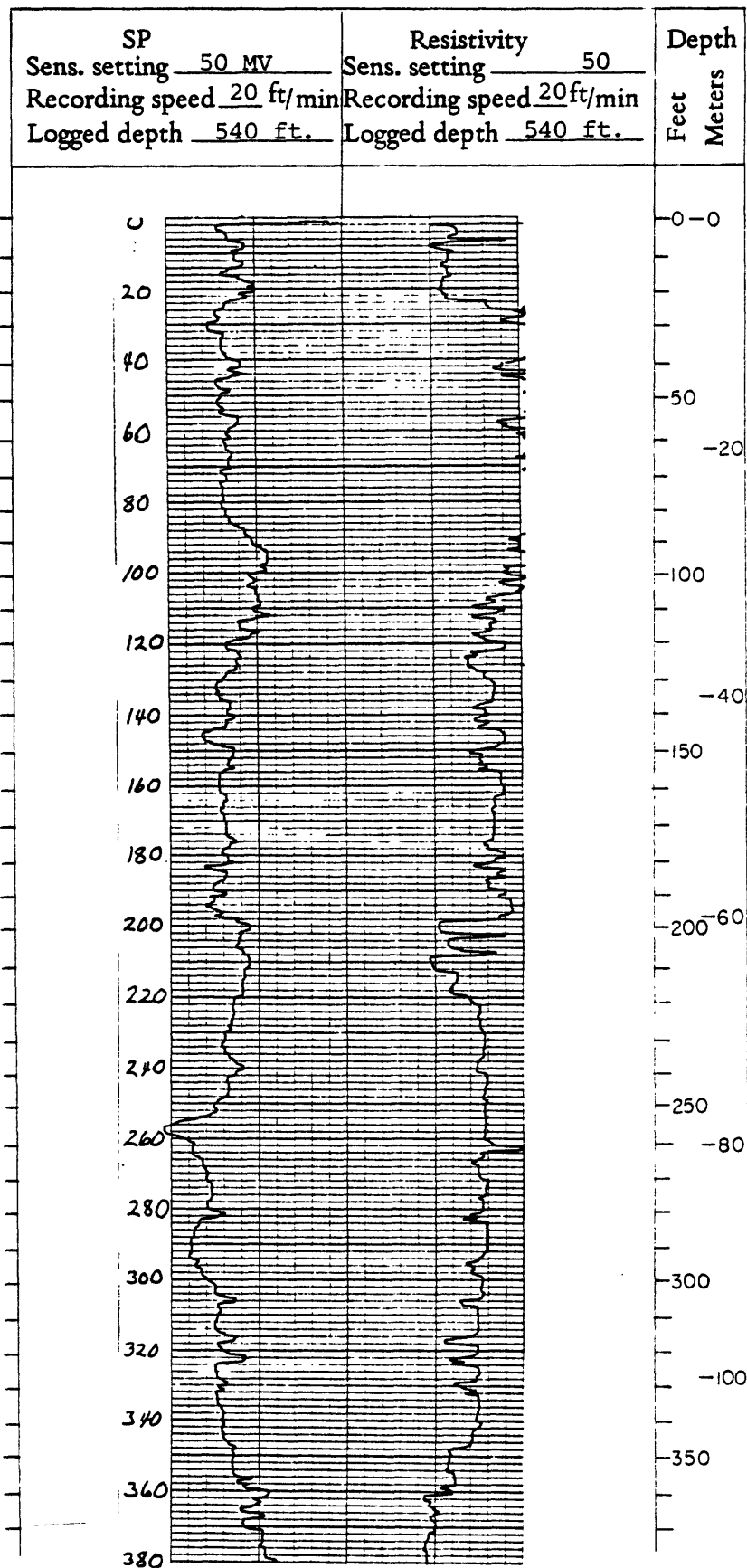
Hole number—continued

MCL-21

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Feet	Meters
	Recording speed	20 ft/min	Recording speed	20 ft/min		
	Logged depth	540 ft.	Logged depth	540 ft.		
218-352 Sandstone, bluish-gray, very fine grained						
352-353 Lignite					-120	
353-368 Sandstone, medium-gray, very fine grained, carbonaceous					400	
368-376 Siltstone, medium-gray, sandy, carbonaceous						
376-380 Claystone, medium-gray, silty, carbonaceous						
380-383 Claystone, light-gray, silty					450	
383-393 Claystone, light-gray, silty					-140	
393-400 Sandstone, light-to medium-gray, very fine grained						
400-426 Claystone, medium-gray, silty						
426-428 Lignite					500	
428-430 Claystone, medium-gray, carbonaceous						
430-431 Lignite					-160	
431-480 Claystone, medium-gray, silty						
480-481 Claystone, light-brown					550	
481-487 Lignite						
487-502 Claystone, brownish-gray, carbonaceous, silty						
502-509 Lignite					-180	
509-511 Claystone, dark-brown, carbonaceous					600	
511-526 Claystone, medium-gray with greenish tint, silty						
526-529 Lignite						
529-532 Claystone, medium-brown, carbonaceous						
532-540 Claystone, medium-gray, silty					650	
					-200	
					700	
					-220	
					750	

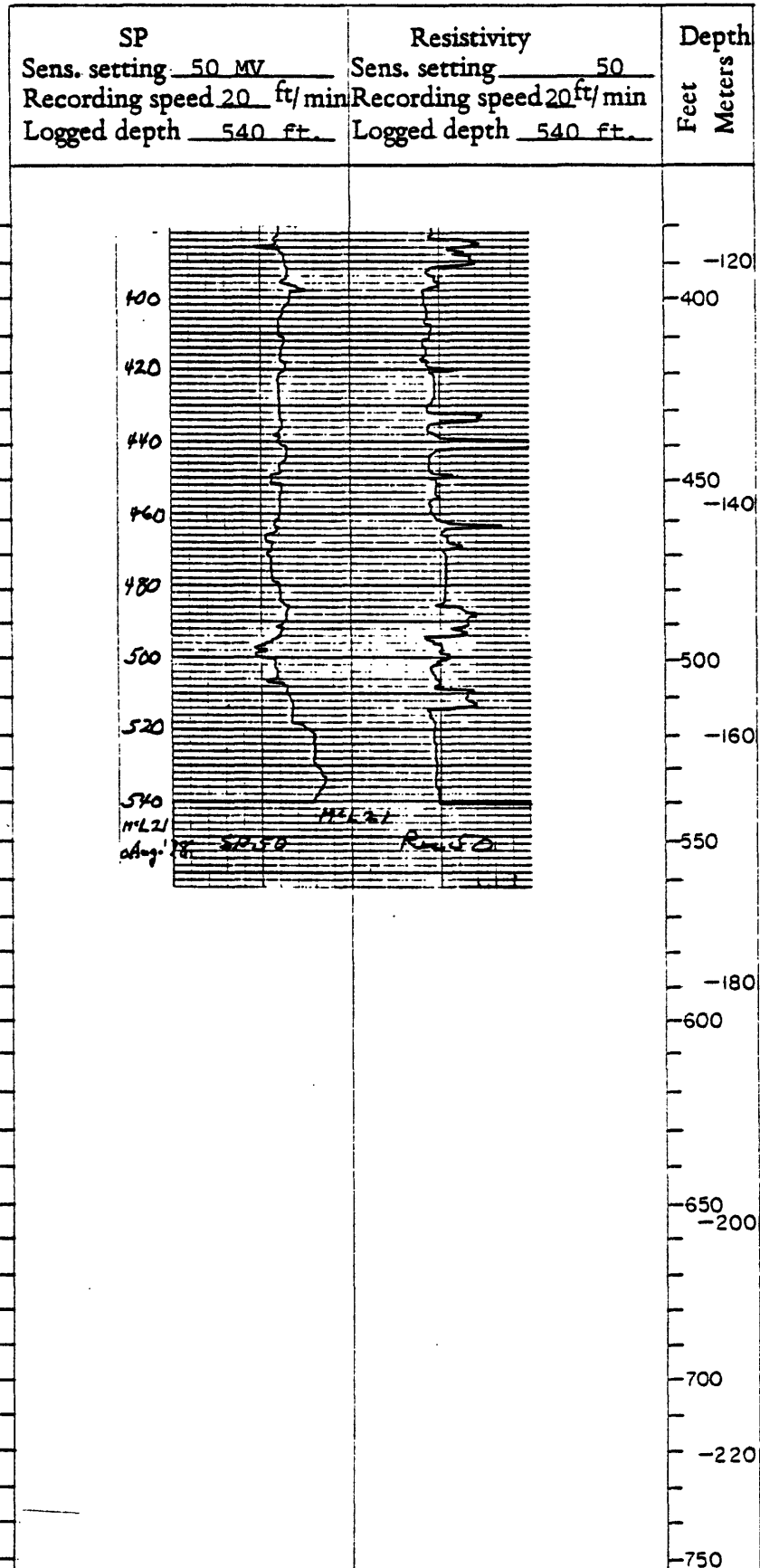
100 cps/ft
 70 ft/min
 11/21/78
 20 ft/min

Density 100 cps/ft
 10 ft/min



Hole number--continued

MCL-21



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: MCL-22 Map: Blackwater Lake Date: 8-20-78 State: ND County: McLean
Elev.: 2093 ft. Location: T. 149 ^N, R. 87 ^E, Sec. 11, Tract: CCCC Drilled depth: 440 ft.
Measured: 36 ft ^{RMK} FSL, 117 ft ^{RMK} FWL, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 330-336; 354-356; 370-374; 402-404; 406-410; 434-438

Remarks:

Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes} ~~No~~

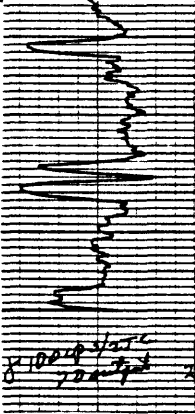
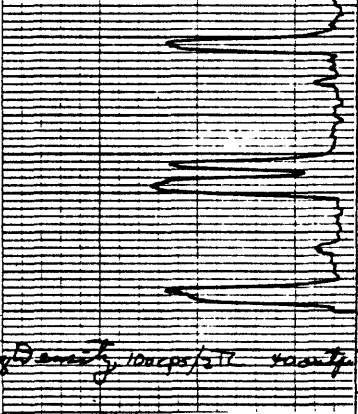

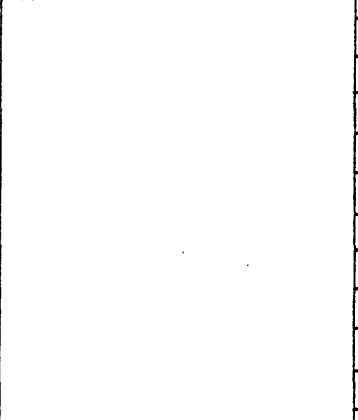
Geophysical logs

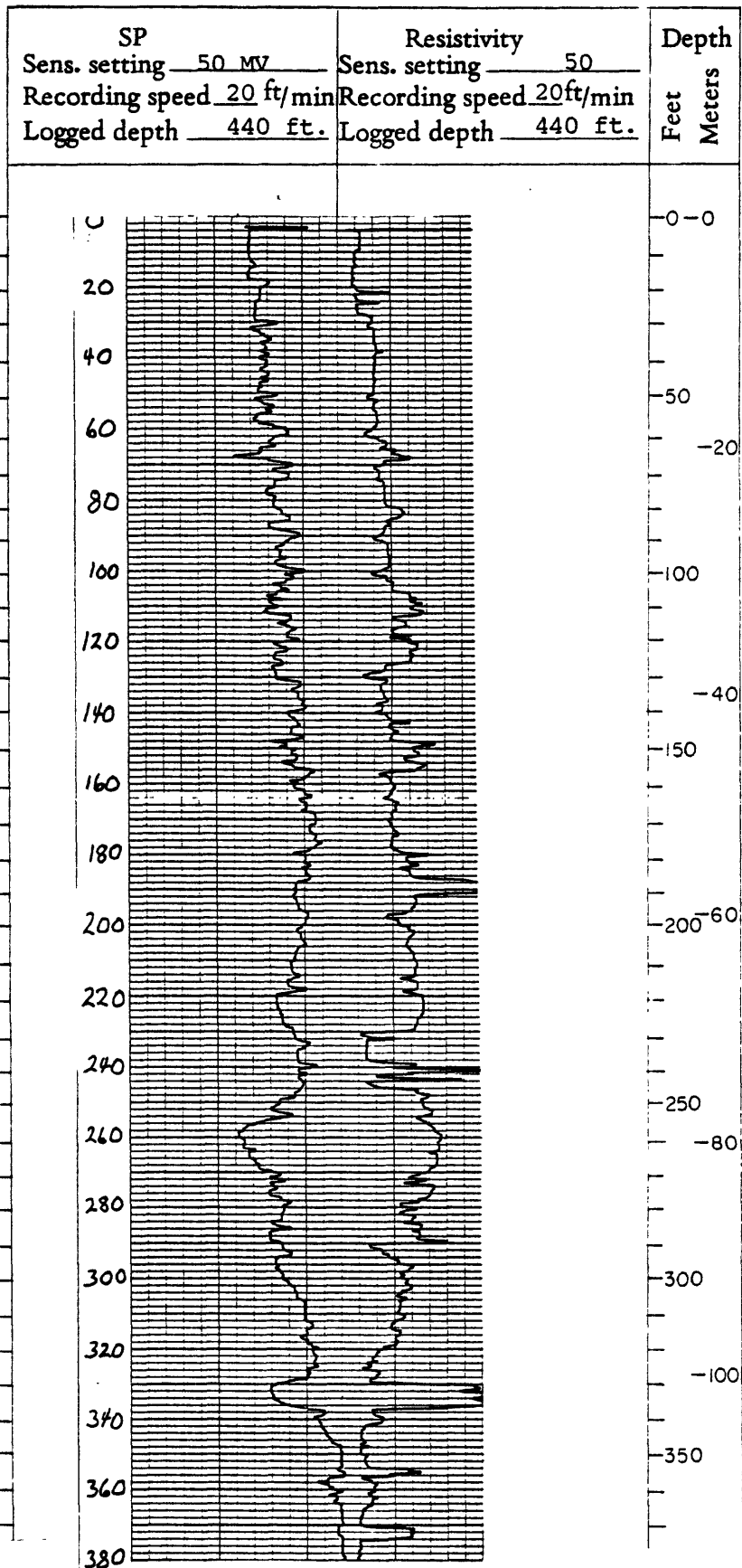
recorded by: Lechner

Lithology	Gamma	Density	Depth Feet Meters
	T.C. 2 Range 100 cps Recording speed 20 ft/min Logged depth 440 ft.	T.C. 2 Range 100 cps Recording speed 20 ft/min Logged depth 440 ft.	
0- 1 Sand, brownish-gray, clayey			0-0
1- 20 Till, yellowish-brown, pebbly, sandy			
20- 60 Till, olive-gray, pebbly, sandy			
60- 62 Gravel, medium-gray			
62-100 Till, dark-gray, pebbly, sandy			50
100-122 Till, dark-gray, very sandy			-20
122-140 Gravel, medium-gray, medium- to coarse-grained			
140-183 No samples			
183-185 Sandstone, white, very fine grained, bentonitic			100
185-285 Sandstone, medium-gray, very fine grained			
285-287 Lignite			-40
287-322 Sandstone, medium-gray, very fine grained			150
322-332 Sandstone, medium-gray, very fine grained			
332-335 Siltstone, medium-gray, sandy, carbonaceous			
335-348 Sandstone, medium-gray, very fine grained			200 60
			200
			220
			240
			260
			-80
			280
			300
			320
			-100
			340
			360

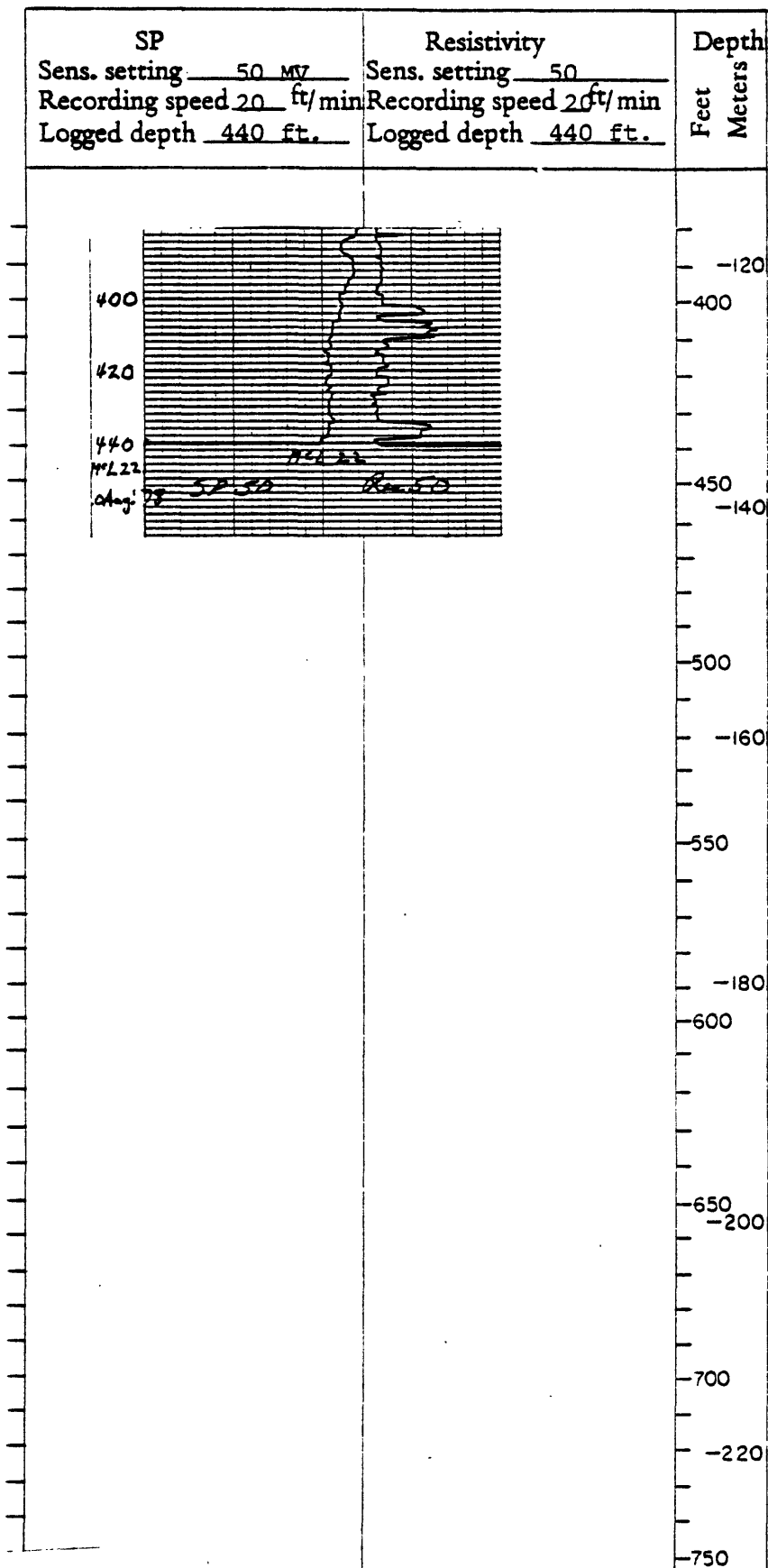
Hole number—continued

MCL-22

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>440</u> ft.	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>440</u> ft.	Feet	Meters
348-353 Lignite				
353-360 Siltstone, medium-gray, sandy				
360-365 Claystone, medium-gray, silty			-120	
365-374 Lignite			400	
374-391 Claystone, medium-gray				
391-400 Claystone, medium-gray, silty				
400-407 Lignite				
407-411 Claystone, medium-brown, carbonaceous			450	-140
411-415 Siltstone, greenish-gray, clayey, carbonaceous				
415-440 Claystone, medium-gray, silty				
			500	
			-160	
			550	
			-180	
			600	
			-200	
			650	
			-220	
			700	
			-220	
			750	



Hole number—continued
MCL-22



NORTH DAKOTA GEOLOGICAL SURVEY

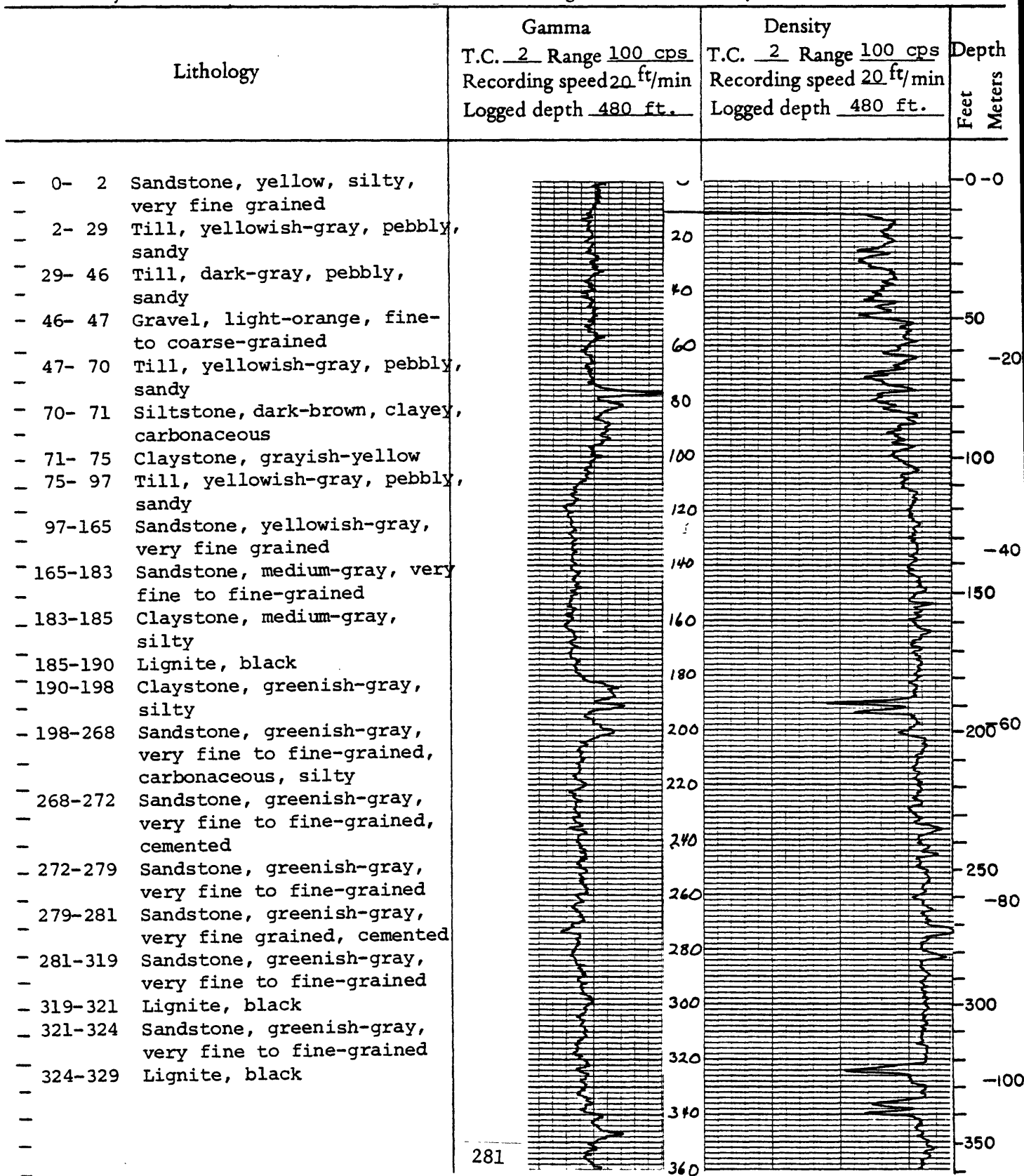
Hole No: MCL-23 Map: Roseglen Date: 8-15-78 State: ND County: McLean
 Elev.: 2135 ft. Location: T. 150 ^N_S, R. 87 ^E_W, Sec. 33, Tract: add Drilled depth: 480 ft.
 Measured: 2460 ft. ^{FNL}_{FWL}, 51 ft. ^{FEL}_{FWL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 401-403; 421-425.5; 432-440; 454-462

Remarks: _____

Lithology

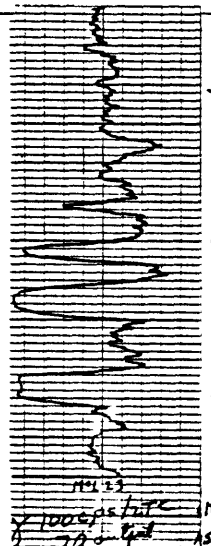
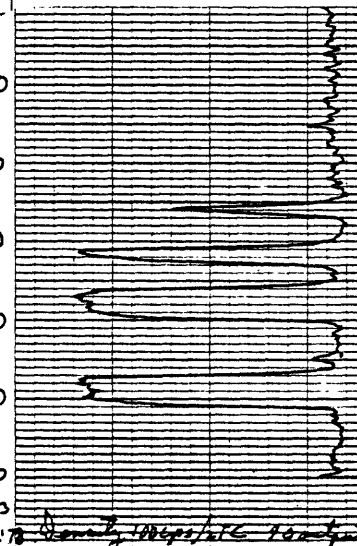

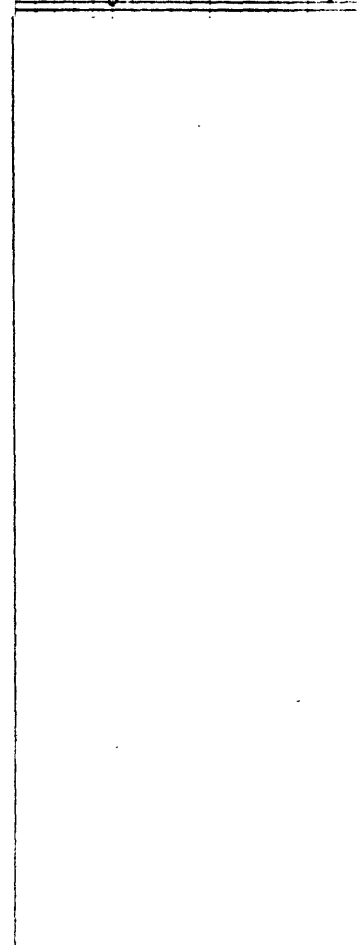
Recorded by: Randall Reichert

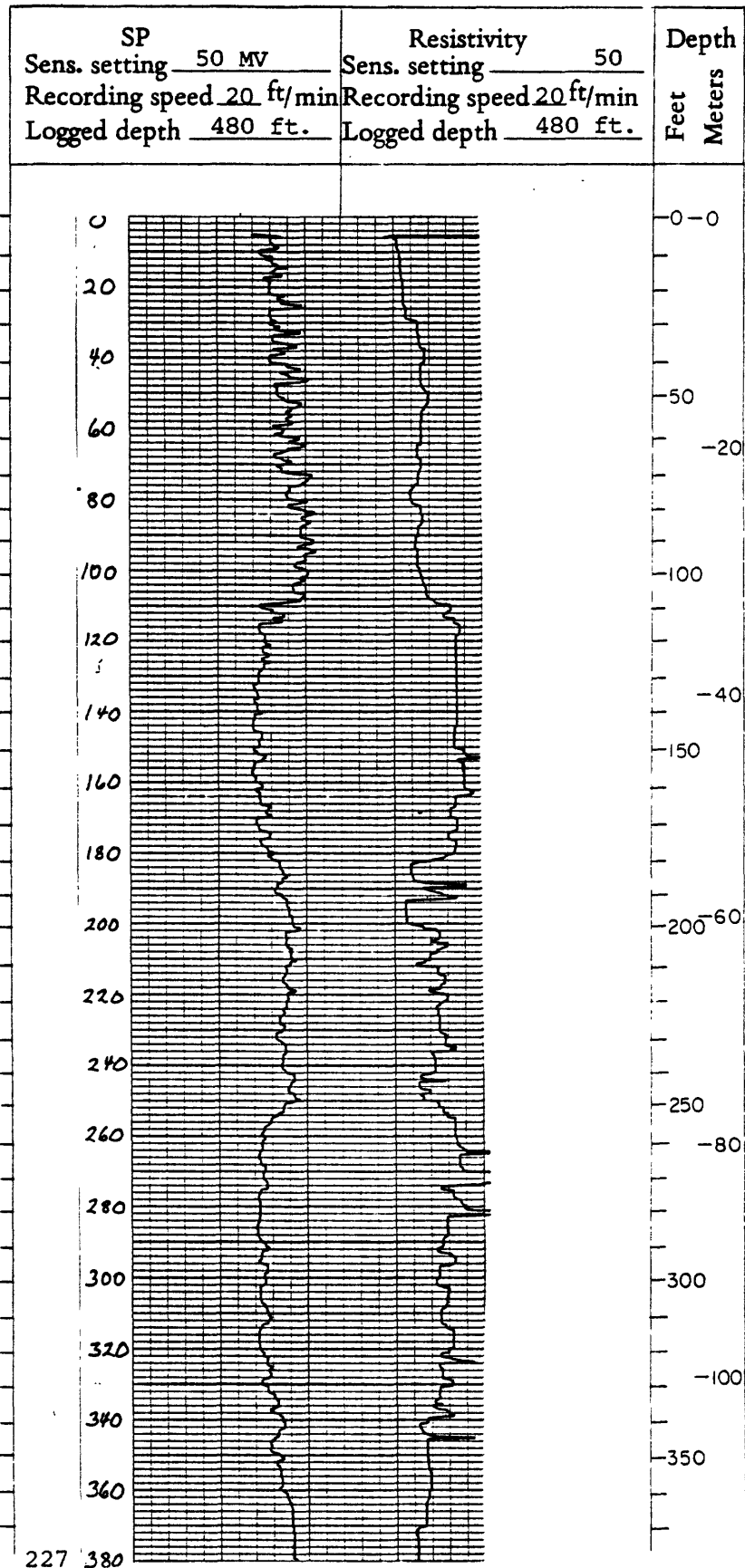
Geophysical logs

Geologist ^{Yes}~~XXX~~ recorded by: Lechner

Hole number—continued

MCL-23

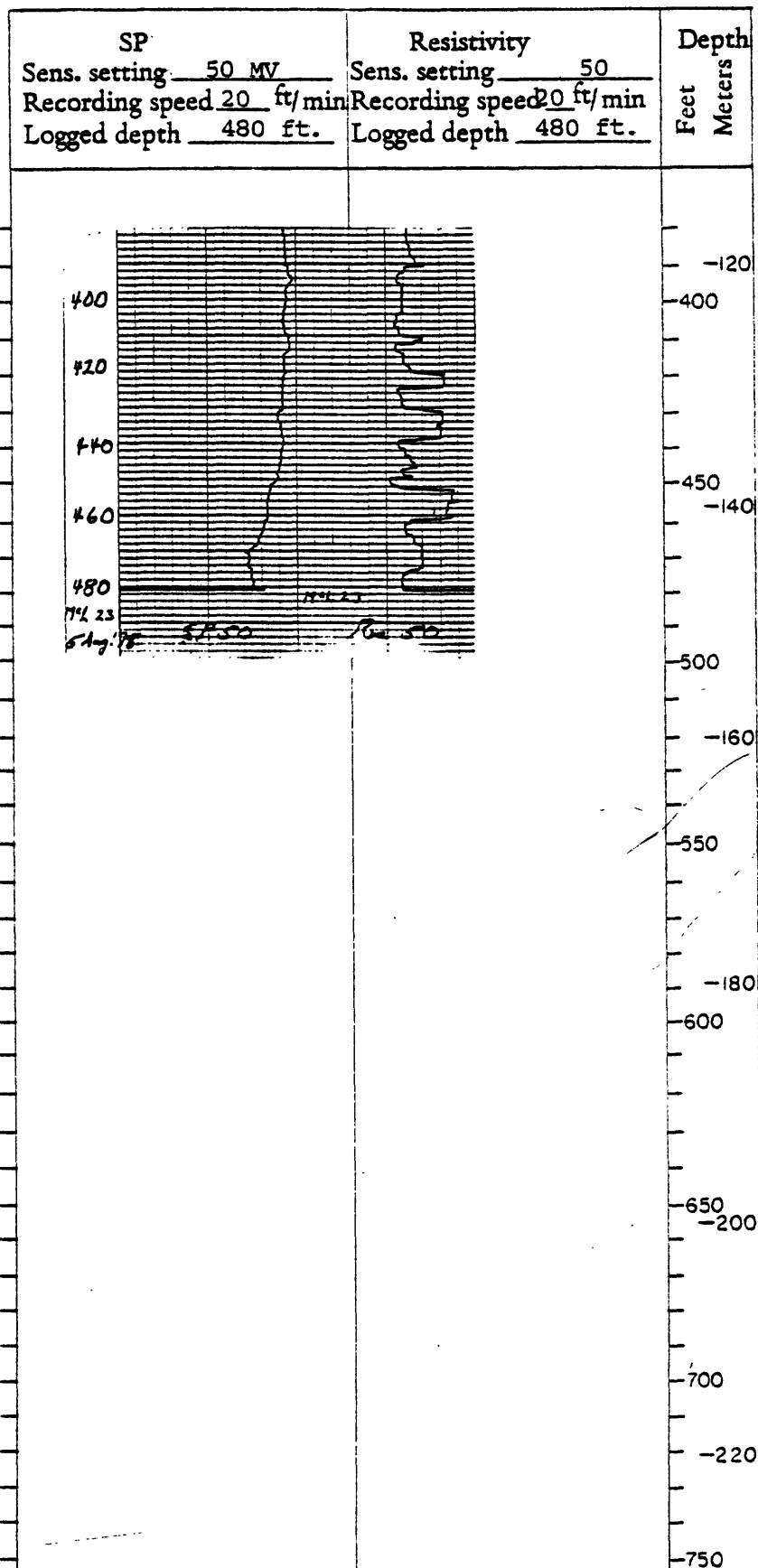
Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fect	Meters
	Recording speed 20 ft/min		Recording speed 20 ft/min			
	Logged depth 480 ft.		Logged depth 480 ft.			
329-378 Sandstone, greenish-gray, very fine to fine-grained, carbonaceous						
378-383 Siltstone, medium-gray					-120	
383-406 Claystone, medium-gray					400	
406-408 Claystone, green, carbonaceous, silty						
408-411 Lignite, black						
411-415 Claystone, medium-gray, silty, carbonaceous						
415-433 Lignite, black					450	
433-441 Claystone, medium-gray, silty					-140	
441-454 Lignite, black						
454-465 Claystone, green, silty, carbonaceous						
465-477 Siltstone, greenish-gray, clayey, carbonaceous					500	
477-480 Claystone, medium-gray, carbonaceous, silty					-160	
					550	
					-180	
					600	
					-200	
					650	
					-220	
					700	
					-220	
					750	



227 380

Hole number—continued

MCL-23



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: MCL-24 Map: Roseglen Date: 8-15-78 State: ND County: McLean
 Elev.: 2140 ft. Location: T. 150 ^N, R. 87 ^W, Sec. 22, Tract: ccdc Drilled depth: 500 ft.
 Measured: 12 ft. ^{FSL}, 661 ft. ^{FSL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 142-144; 146-148; 187-189; 231-233; 461-466; 484-492.5

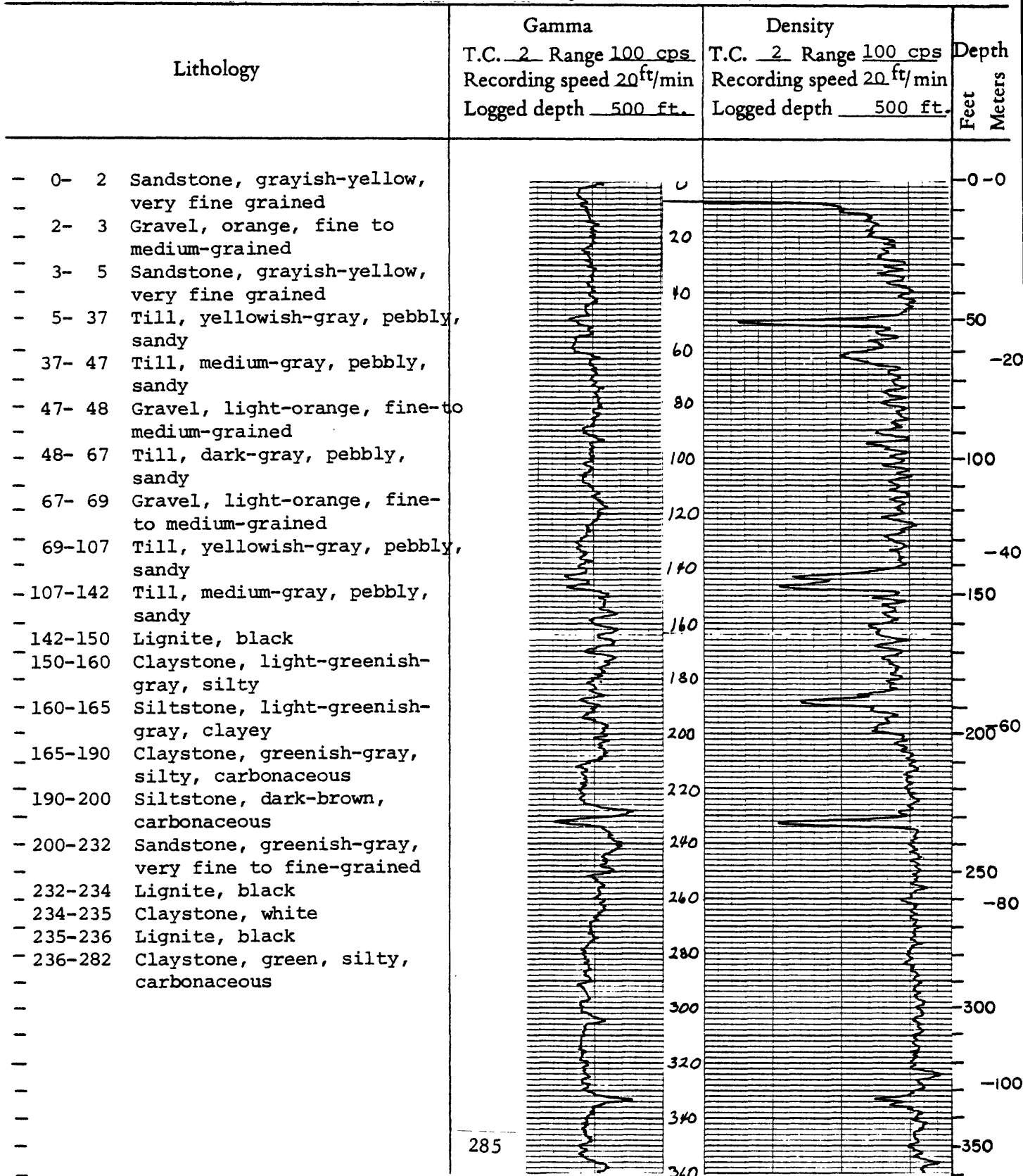
Remarks: _____

Lithology

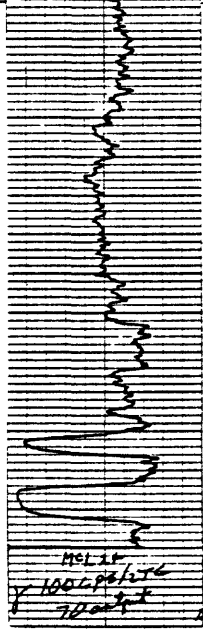
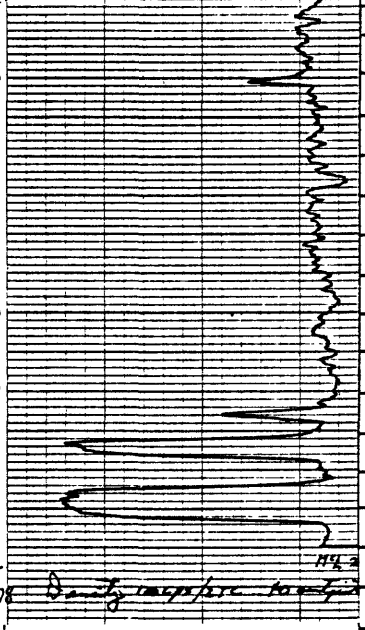

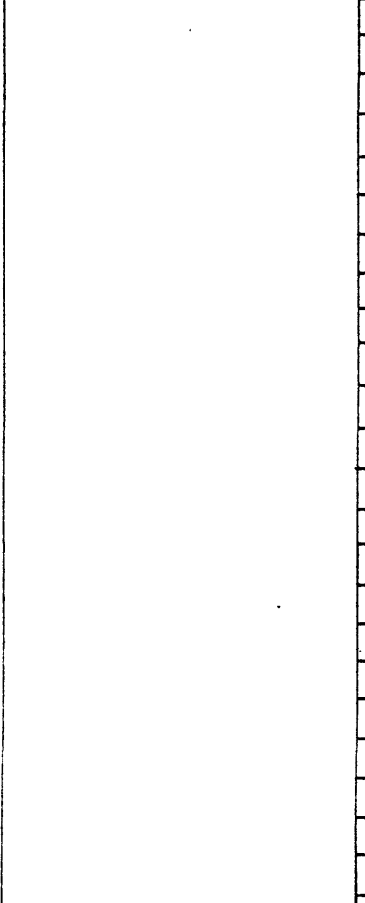
Recorded by: Randall Reichert

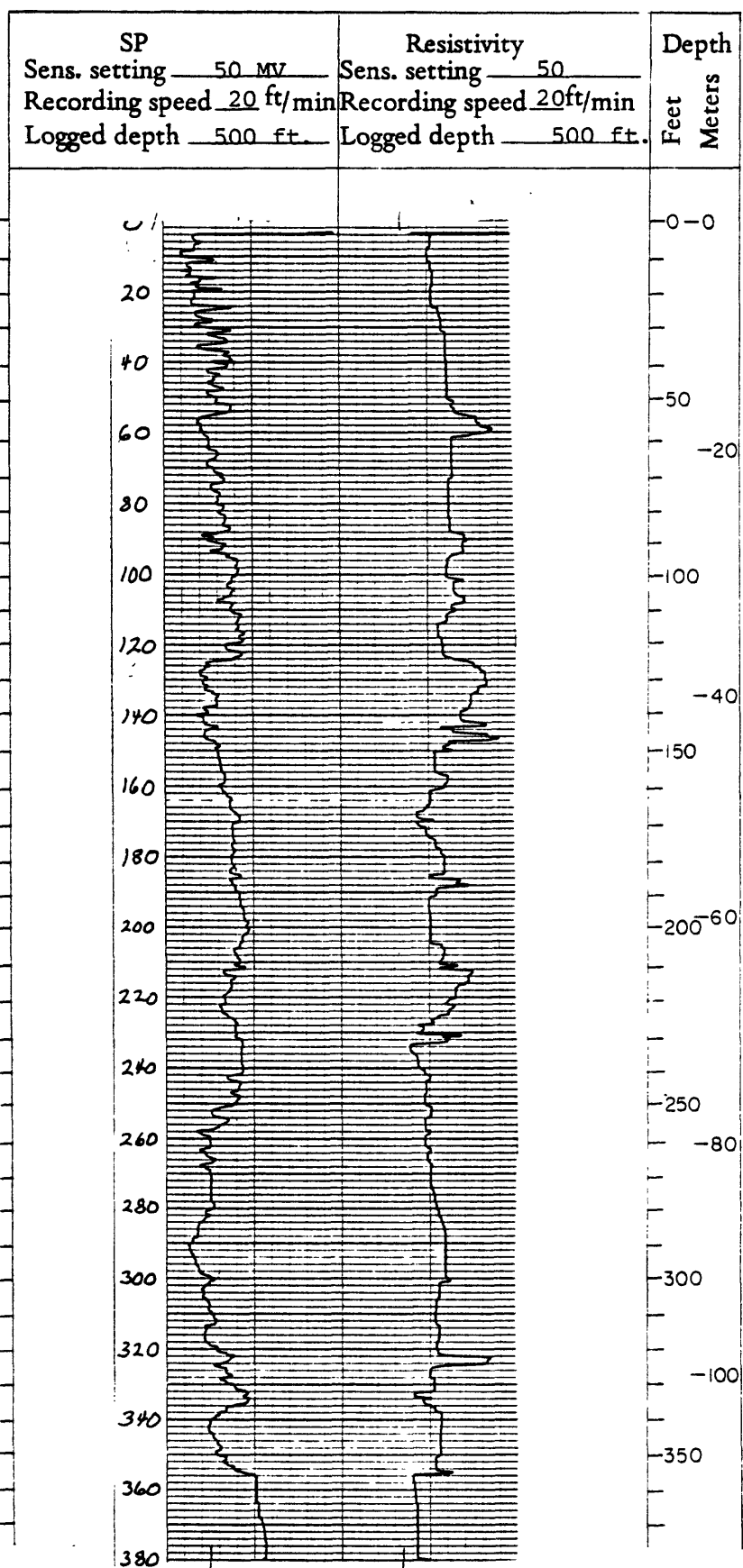
Geophysical logs

Geologist ^{Yes} ~~xxx~~ recorded by: Lechner



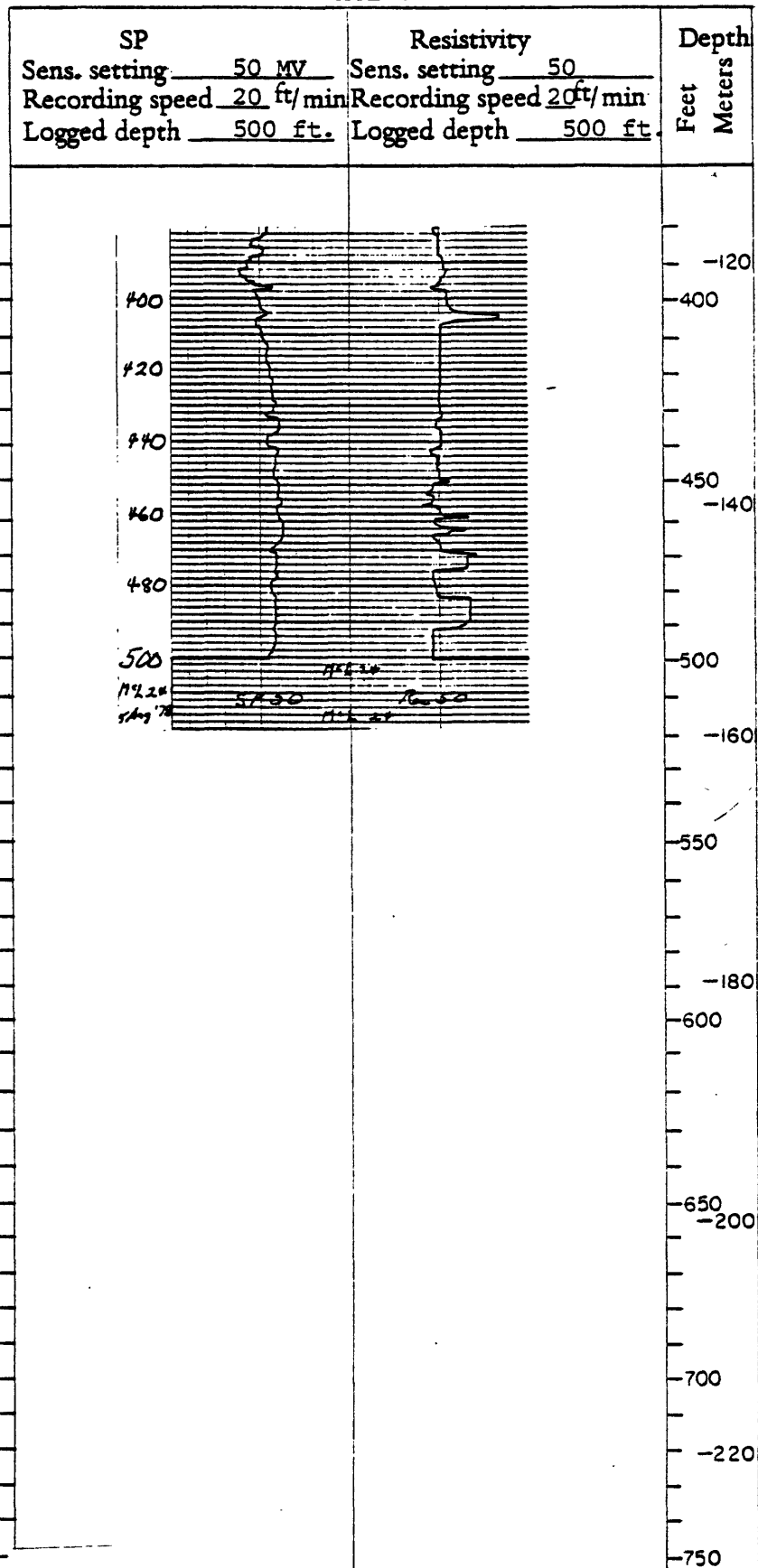
Hole number—continued
MCL-24

Lithology	Gamma		Density		Depth	
	T.C. <u>2</u>	Range <u>100</u> cps	T.C. <u>2</u>	Range <u>100</u> cps	Fcct	Meters
	Recording speed <u>20</u> ft/min		Recording speed <u>20</u> ft/min			
	Logged depth <u>500</u> ft.		Logged depth <u>500</u> ft.			
282-372 Sandstone, greenish-gray, very fine-to fine-grained						
372-380 Claystone, greenish-gray, silty					-120	
380-402 Sandstone, greenish-gray, very fine-to fine-grained					400	
402-403 Sandstone, greenish-gray, very fine grained, cemented						
403-452 Sandstone, greenish-gray, very fine-to fine grained						
452-455 Claystone, medium-gray, silty					450	
455-458 Sandstone, greenish-gray, very fine-to fine-grained					-140	
458-460 Sandstone, greenish-gray, very fine grained, cemented						
460-461 Lignite, black					500	
461-466 Claystone, medium-gray						
466-472 lignite, black	MCL 24 100 cps/ft 70 ft/min		MCL 24 Density range/ft. 100 ft/min			
472-480 Claystone, greenish-gray, silty					-160	
480-487 Lignite, black						
487-500 Claystone, medium-gray					550	
					-180	
					600	
					650	
					-200	
					700	
					-220	
					750	



Hole number—continued

MCL-24



NORTH DAKOTA GEOLOGICAL SURVEY

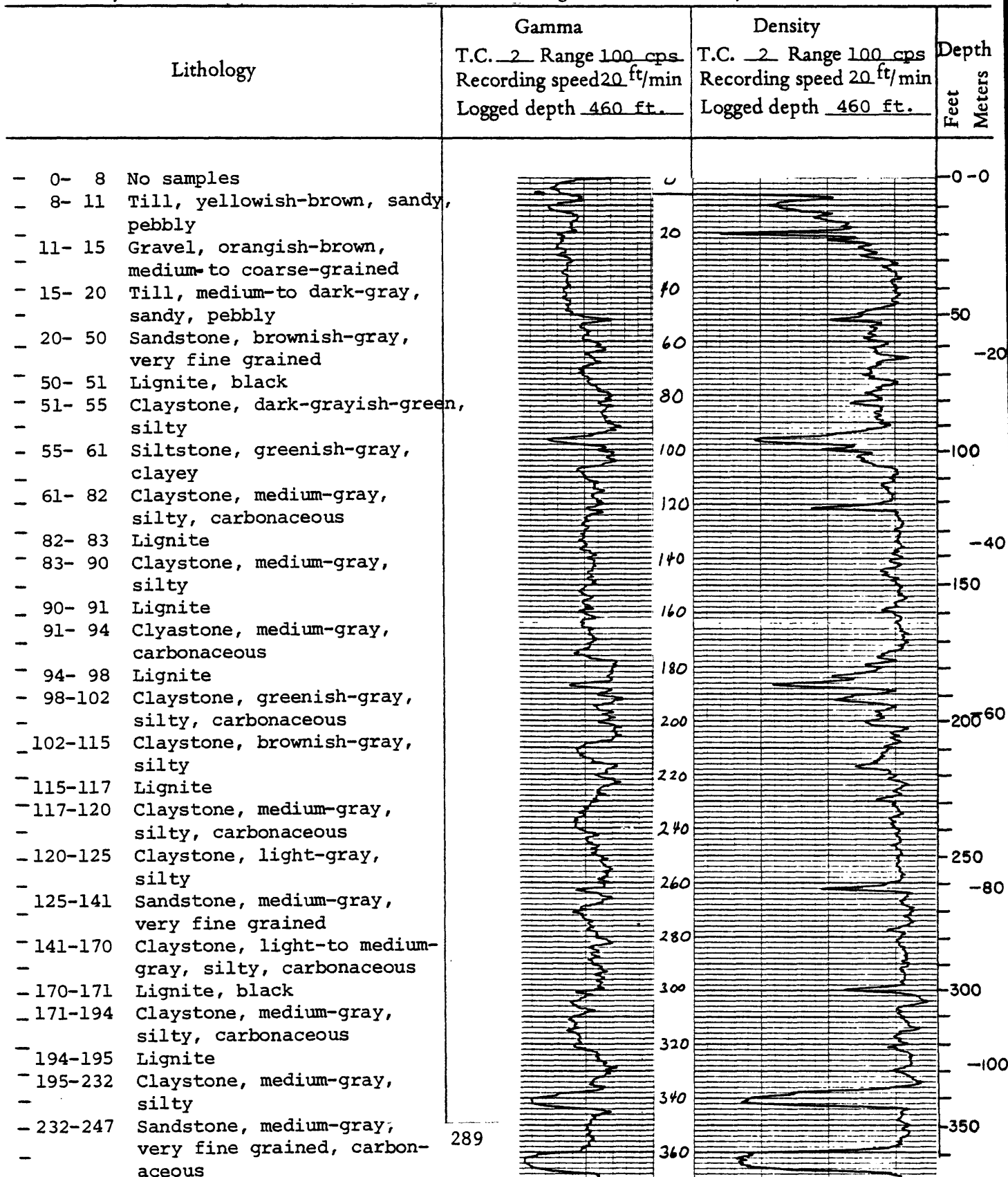
Hole No: MCL-25 Map: Blue Hill Date: 8-17-78 State: ND County: McLean
 Elev.: 2125 ft. Location: T. 150^N, R. 86^R W, Sec. 30, Tract: dadd Drilled depth: 460 ft.
 Measured: 1354 ft. ~~FSL~~ ^{FEL} 78 ft. ~~FSL~~ ^{FEL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 95-98; 337-343; 359-367; 420-426; 457-460

Remarks: _____

Lithology

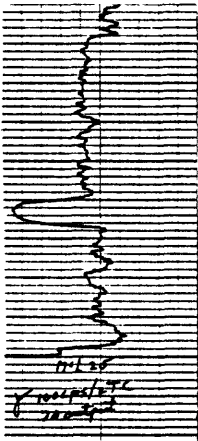
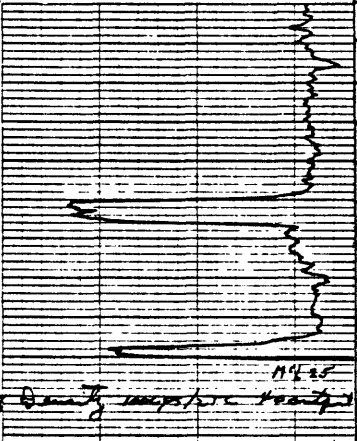
Recorded by: Randall Reichert

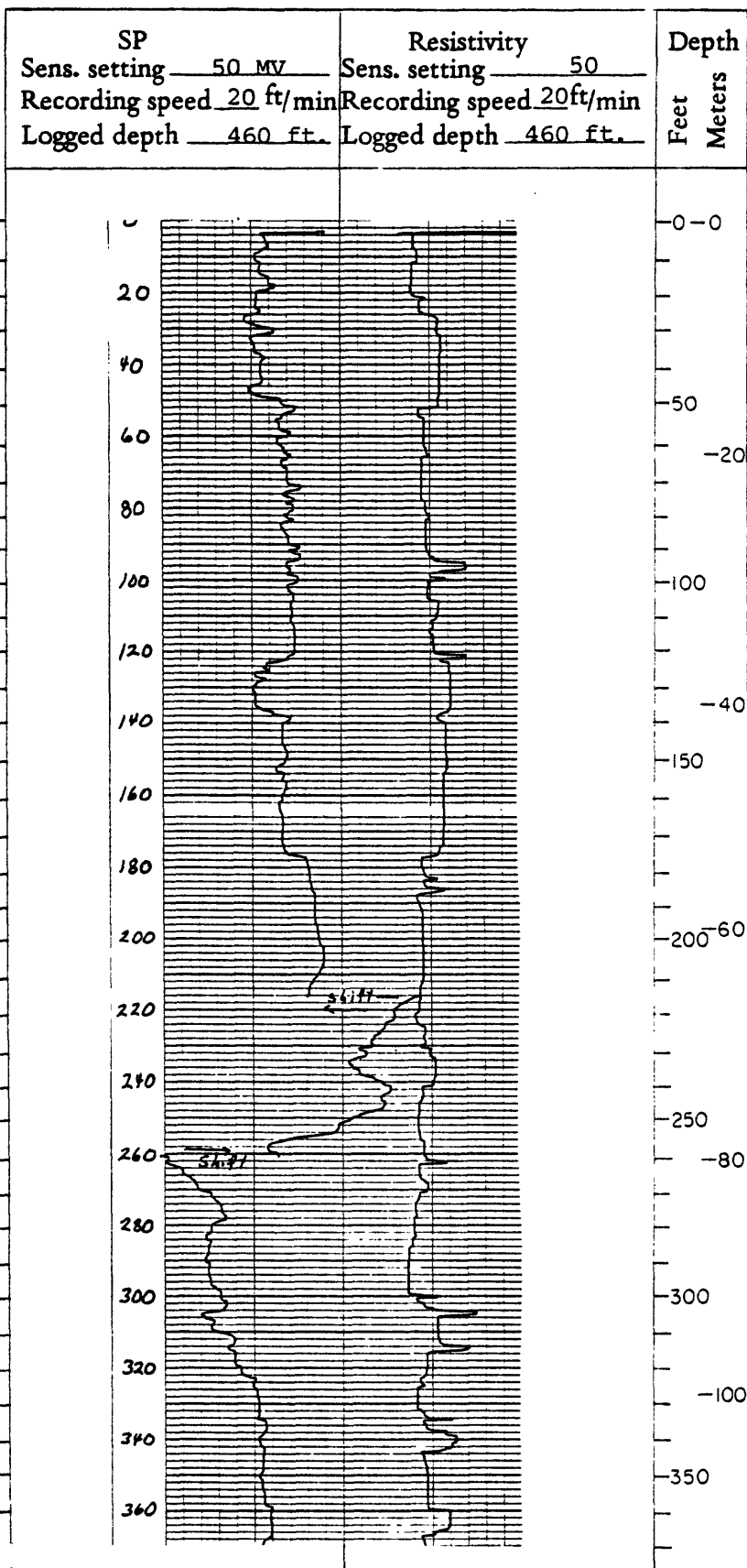
Geophysical logs

Geologist ^{Yes} ~~No~~ recorded by: Lechner

Hole number—continued

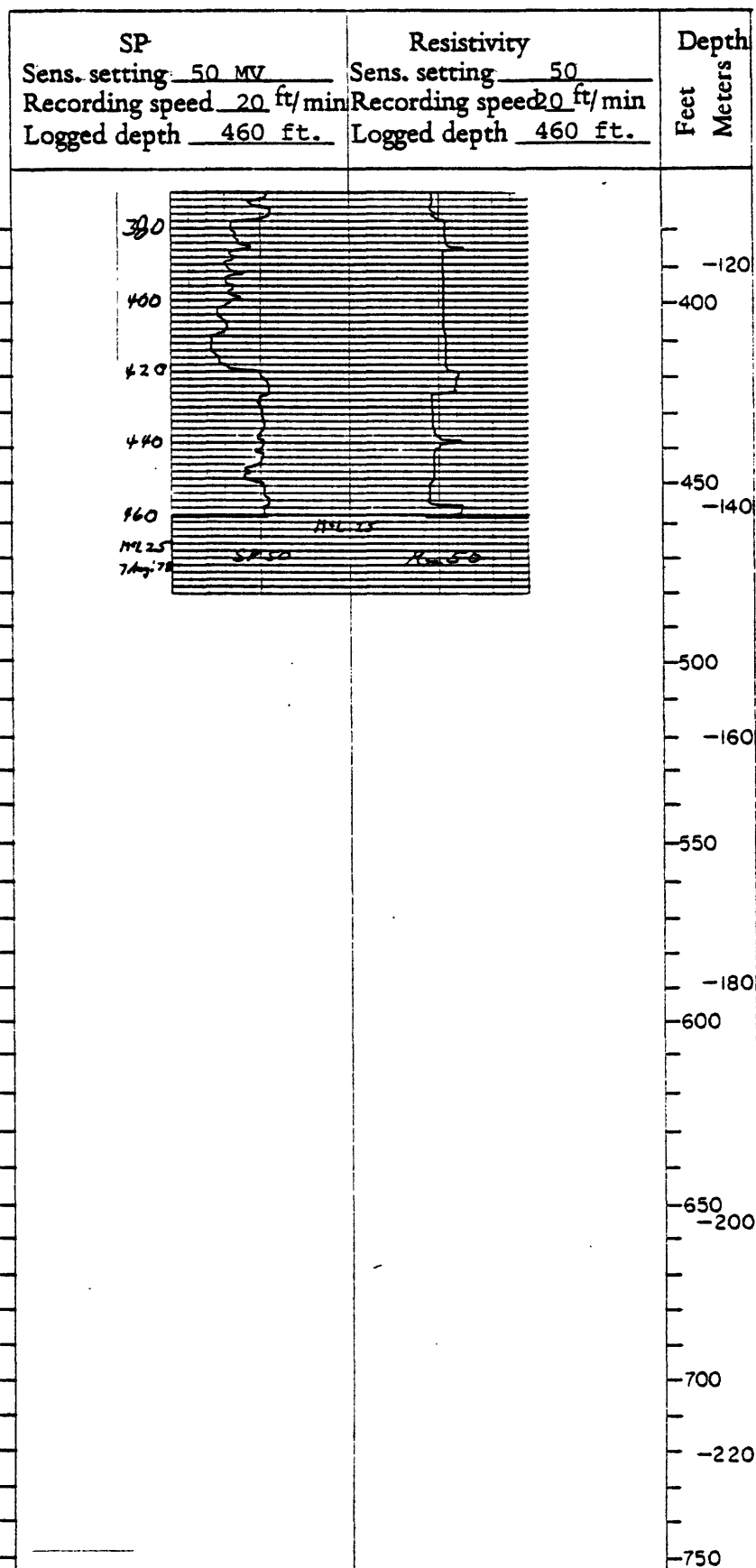
MCL-25

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>460</u> ft.	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>460</u> ft.	Feet	Meters
47-303 Claystone, medium-gray			-120	
03-328 Sandstone, light-gray, very fine grained, some cemented			400	
28-353 Claystone, medium-gray, silty				
53-356 Lignite				
56-362 Siltstone, medium-gray, clayey				
62-368 Lignite			450	
68-408 Sandstone, light-gray, very fine grained			-140	
08-411 Lignite				
11-413 Claystone, medium-gray, carbonaceous				
13-420 Lignite			500	
20-447 Claystone, light-greenish- gray, silty			-160	
47-450 Lignite				
50-460 Claystone, light-to medium- gray, silty			550	
			-180	
			600	
			-200	
			650	
			-220	
			700	
			-220	
			750	



Hole number—continued

MCL-25



NORTH DAKOTA GEOLOGICAL SURVEY

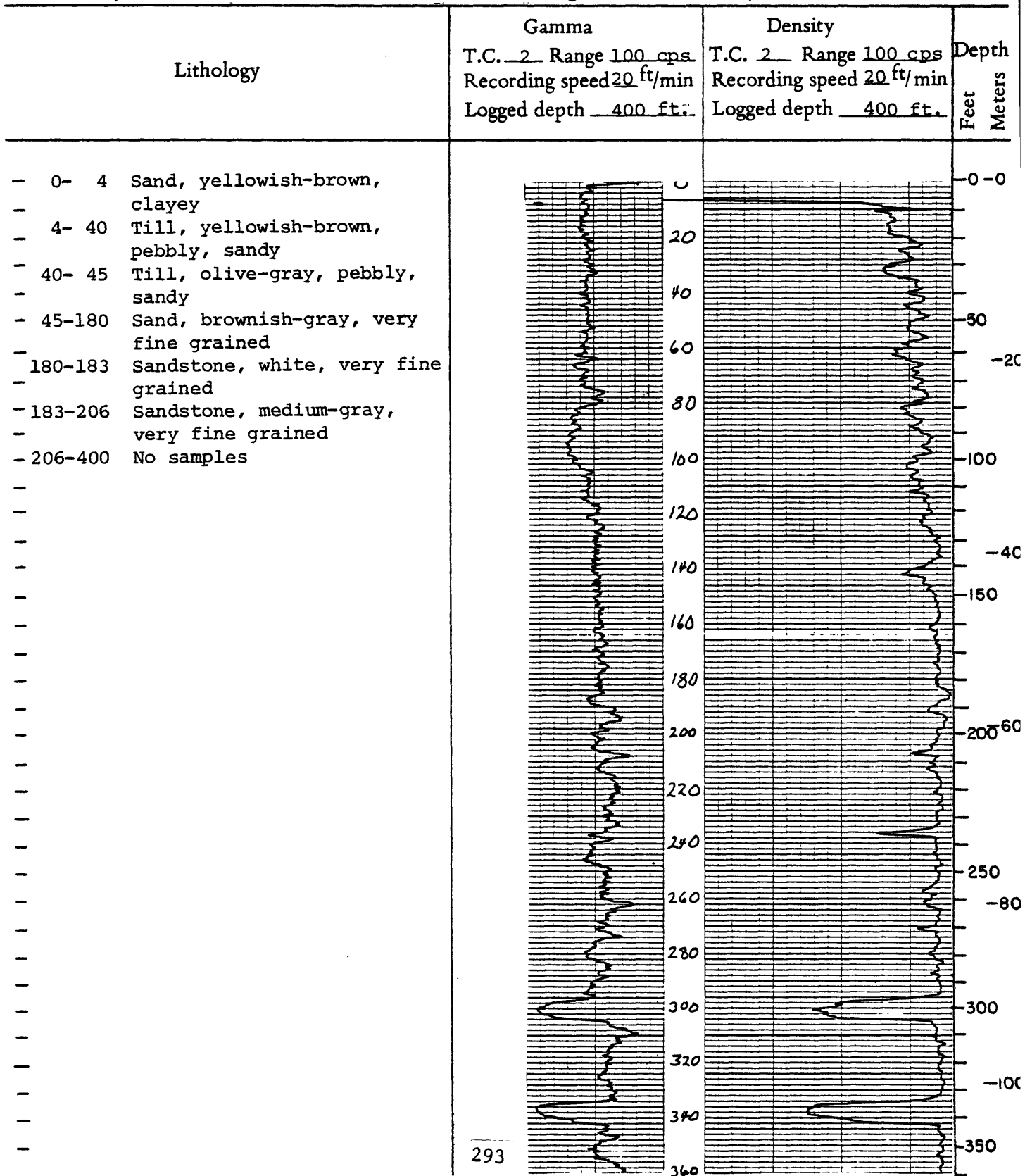
Hole No: MCL-26 Map: Blue Hill Date: 8-19-78 State: ND County: McLean
 Elev.: 2145 ft. Location: T. 149 ^N, R. 86 ^W, Sec. 1, Tract: bbba Drilled depth: 400 ft.
 Measured: 12 ft. ^{FNL} ~~375 ft.~~ ^{FWL} Hole size: 4 3/4 ft. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 297-304; 334-342

Remarks: _____

Lithology

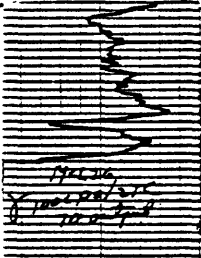
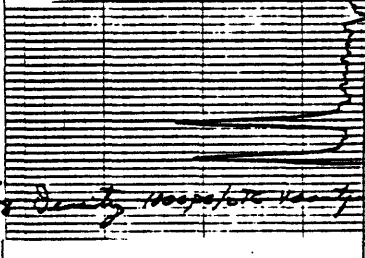
Recorded by: Randall ReichertGeologist ^{Yes} ~~No~~

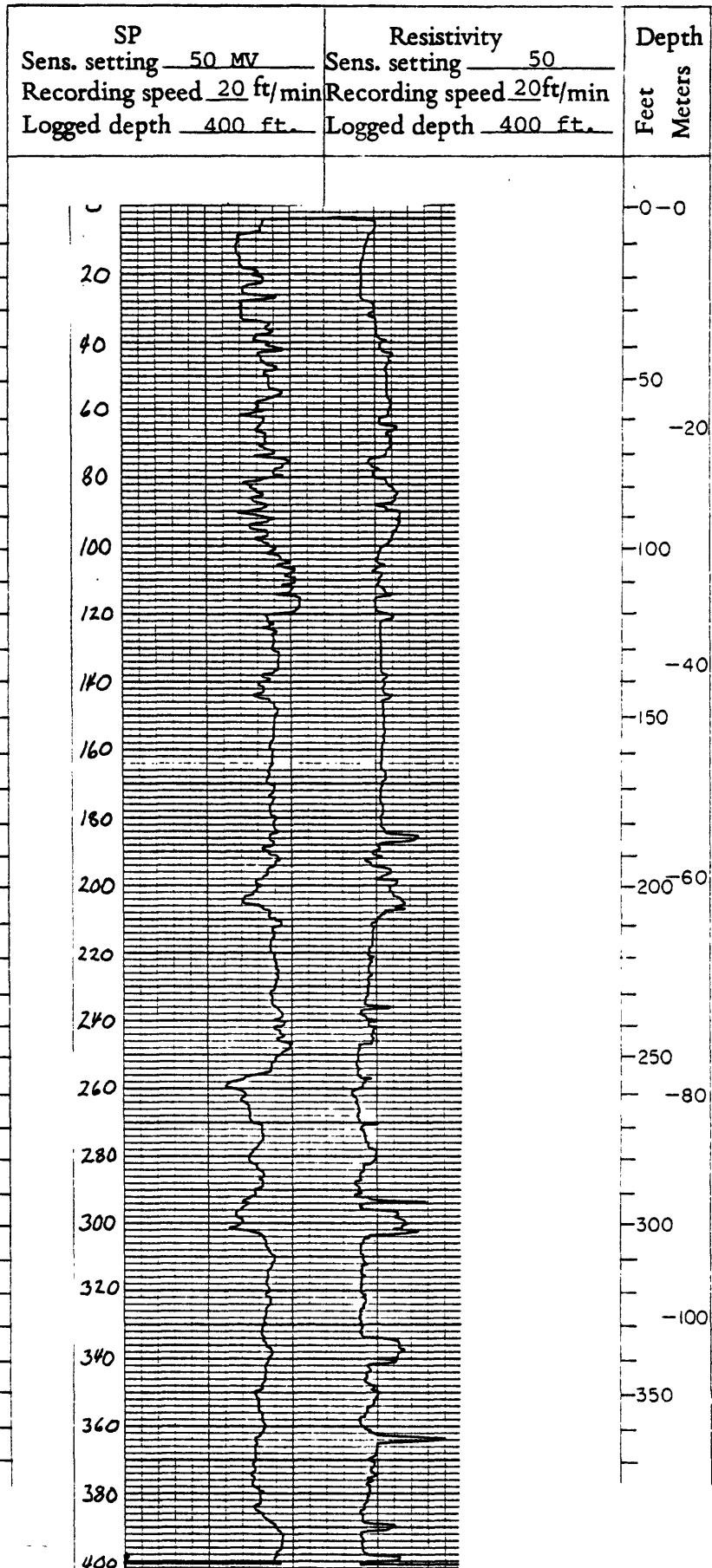
Geophysical logs

recorded by: Lechner

Hole number—continued

MCL-26

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>400</u> ft.	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>400</u> ft.	Depth	
			Feet	Meters
				
			-120	
			400	
			450	
			-140	
			500	
			-160	
			550	
			-180	
			600	
			650	
			-200	
			700	
			-220	
			750	



MCL-26

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NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: MCL-27 Map: Benedict Date: 8-31-78 State: ND County: McLean
Elev.: 2085 ft. Location: T. 150^N, R. 83^E W, Sec. 36, Tract: dddc Drilled depth: 380 ft.
Measured: 8 ft. ~~FSL~~^{FNL}, 550 ft. ~~SW~~^{FEL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 102-107; 160.5-164; 328-331; 333-337

Remarks:

Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~No~~

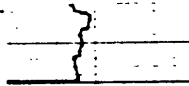
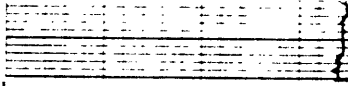
Geophysical logs

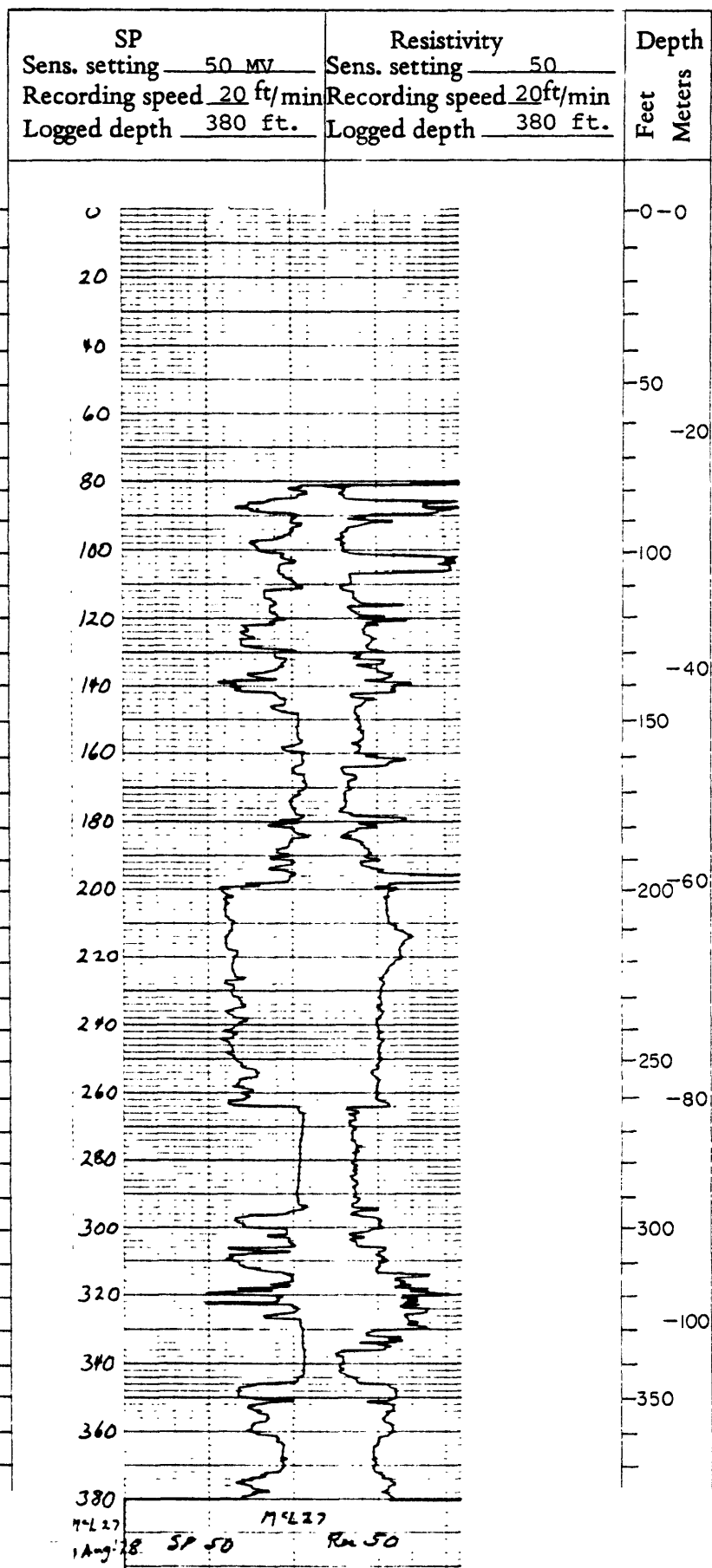
recorded by: Lechner

Lithology	Gamma		Density		Depth	
	T.C.	Range 100 cps Recording speed 20 ft/min Logged depth 380 ft.	T.C.	Range 100 cps Recording speed 20 ft/min Logged depth 380 ft.	Feet	Meters
0- 3 Soil, yellowish-brown, sandy					0-0	
3- 40 Till, yellowish-brown, pebbly						
40- 80 Till, medium-gray, pebbly						
80- 86 Gravel						
86- 99 Claystone, medium-gray					50	
99-104 Lignite						
104-108 Claystone, medium-gray					-20	
108-111 Lignite						
111-118 Claystone, medium-gray						
118-123 Lignite						
123-125 Claystone, medium-gray					100	
125-160 Sandstone,						
160-194 Claystone, light-gray, silty						
194-275 Sandstone					-40	
275-285 Claystone, dark-gray						
285-287 Lignite					150	
287-301 Sandstone						
301-303 Lignite						
303-313 Claystone, medium-brown						
313-322 Claystone, medium-gray						
322-324 Lignite						
324-332 Claystone, medium-brown					200	60
332-334 Claystone, black						
334-350 Claystone, medium-gray						

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Hole number—continued
MCL-27

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>380</u> ft.	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>380</u> ft.	Fcct	Meters
350-380 Sandstone				
			-120	
			400	
			450	
			-140	
			500	
			-160	
			550	
			-180	
			600	
			650	
			-200	
			700	
			-220	
			750	



Hole number—continued

MCL-27

SP		Resistivity		Depth	
Sens. setting <u>50 mv</u>		Sens. setting <u>50</u>		Feet	Meters
Recording speed <u>20 ft/min</u>		Recording speed <u>20 ft/min</u>			
Logged depth <u>380 ft.</u>		Logged depth <u>380 ft.</u>			
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

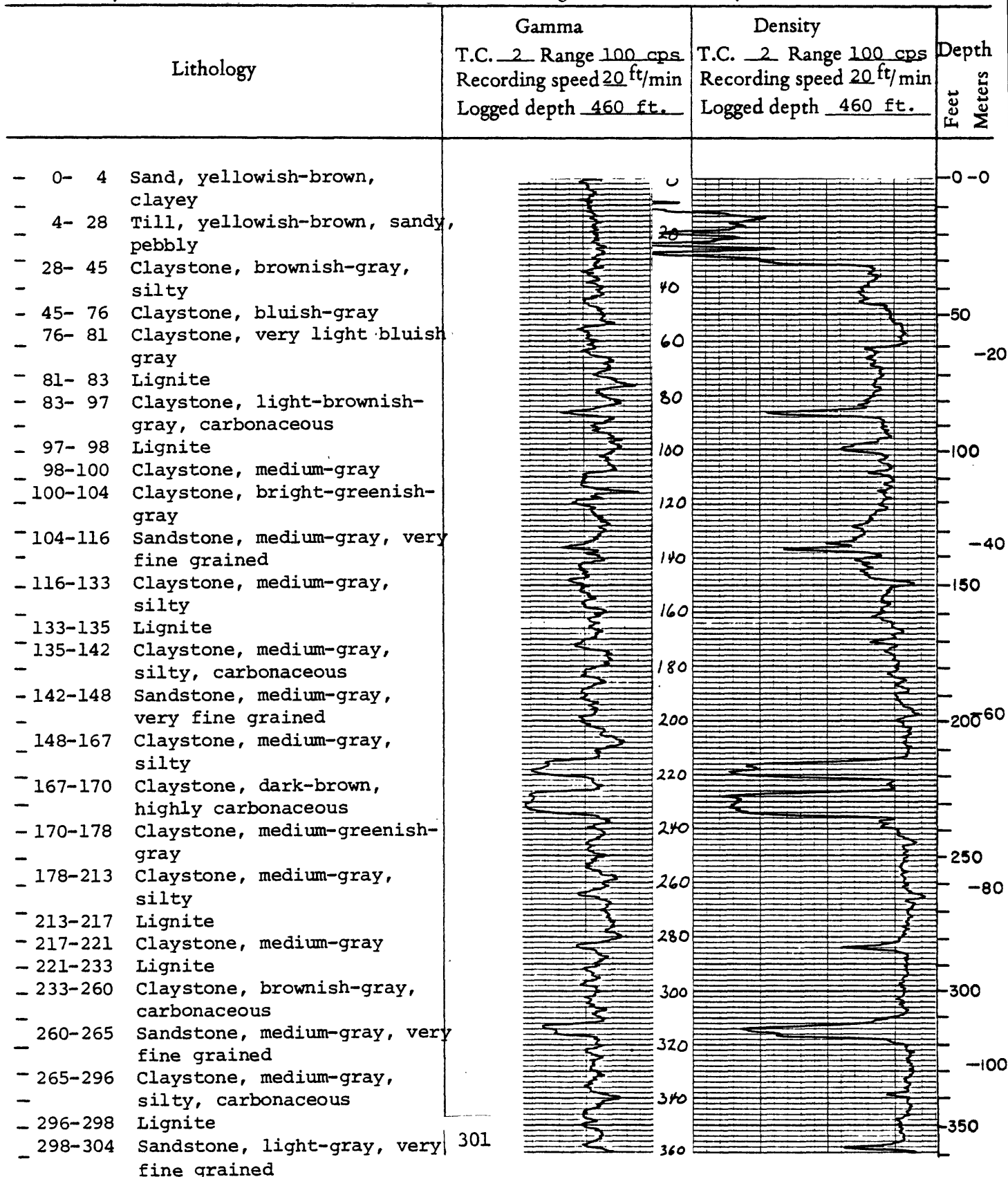
Hole No: MCL-28 Map: Douglas West Date: 8-18-78 State: ND County: McLean
 Elev.: 2110 ft. Location: T. 150^N ~~S~~, R. 85^E ~~W~~, Sec. 27, Tract: bccc Drilled depth: 460 ft.
 Measured: 2430 ft.^{FNL} ~~FWL~~, 20 ft.^{FWL} ~~FWL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 215-221; 226.5-237; 312.5-317; 428.5-431

Remarks: _____

Lithology

Recorded by: Fred O'Toole

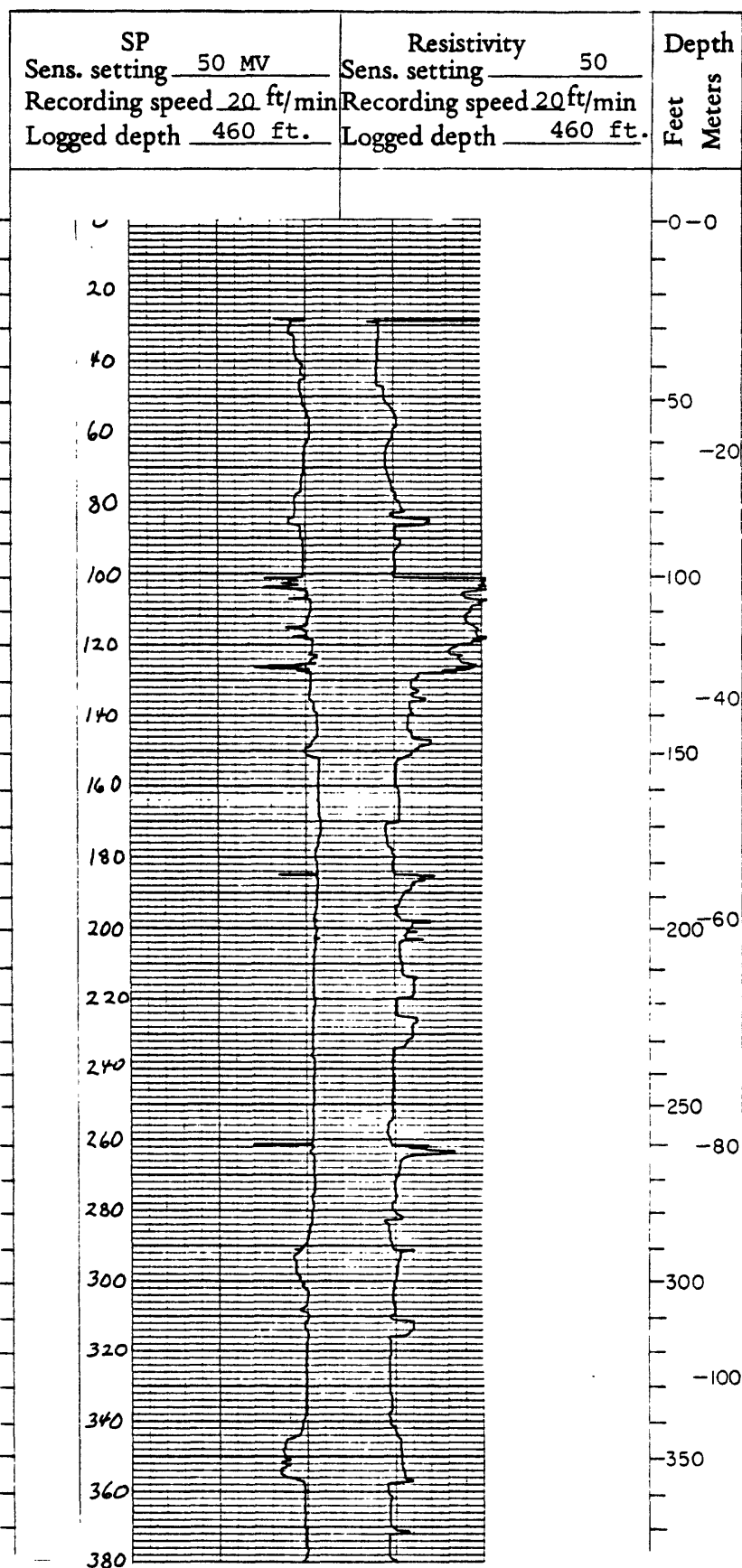
Geophysical logs

Gecologist ^{Yes} ~~XXX~~ recorded by: Lechner

Hole number—continued

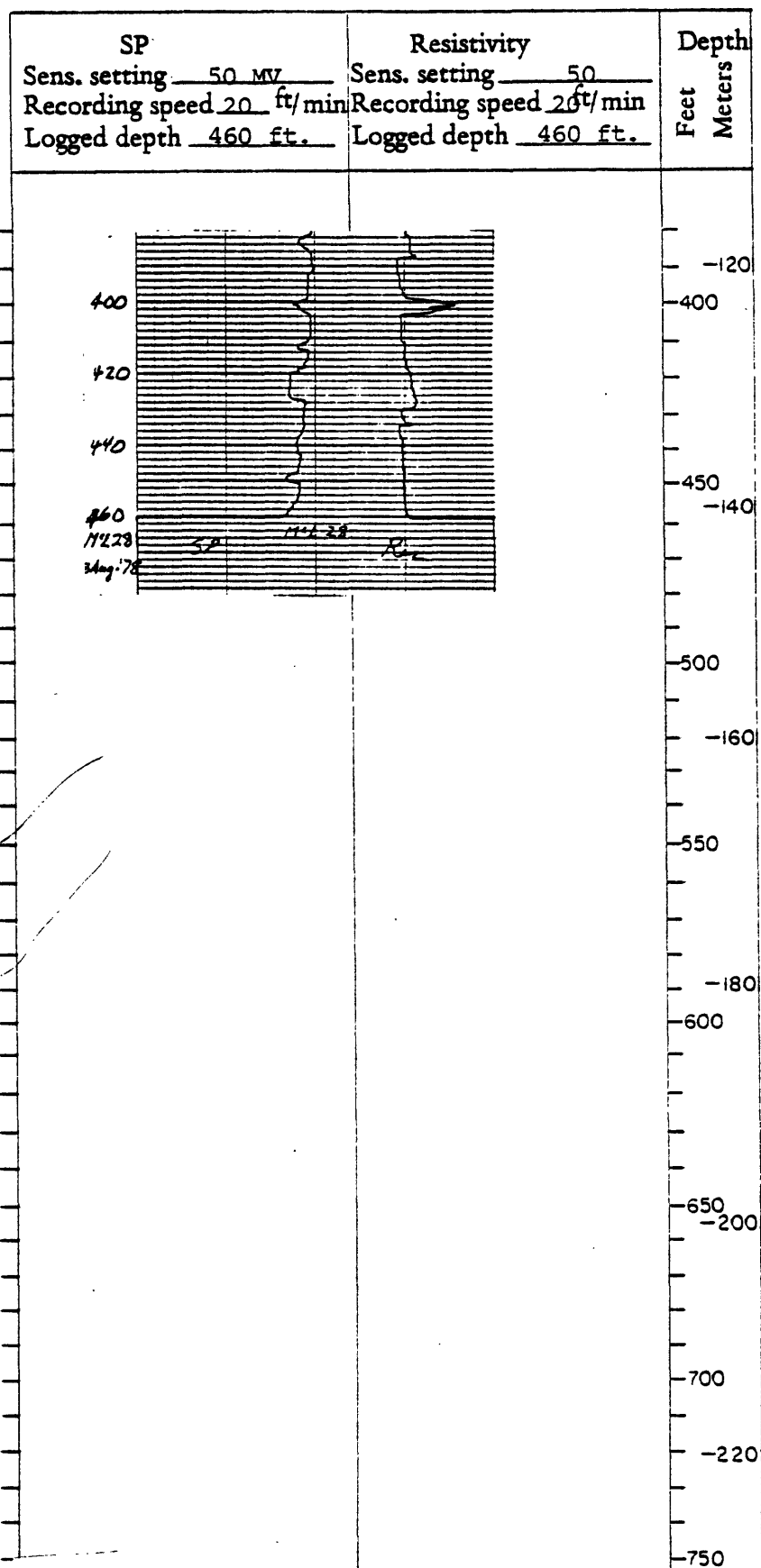
MCL-28

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>460</u> ft.	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>460</u> ft.	Fcct	Meters
304-306 Claystone, brownish-gray, carbonaceous				
306-307 Lignite			-120	
307-326 Claystone, medium-gray, silty			400	
326-349 Siltstone, medium-gray, clayey				
349-350 Lignite, black				
350-377 Claystone, medium-gray				
377-385 Sandstone, light-gray, very fine grained			450	
385-398 Claystone, medium-gray			-140	
398-406 Sandstone, medium-gray, very fine grained, some cemented stringers				
406-418 Claystone, medium-gray, silty, carbonaceous			500	
418-421 Siltstone, light-gray, clayey			-160	
421-422 Lignite				
422-460 Claystone, medium-gray, silty			550	
			-180	
			600	
			-200	
			650	
			-220	
			700	
			-220	
			750	



Hole number—continued

MCL-28



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: MCL-29 Map: Douglas West Date: 8-19-78 State: ND County: McLean
 Elev.: 2150 ft. Location: T. 150^N, R. 86^E, Sec. 24, Tract: aaad Drilled depth: 500 ft.
 Measured: 384 ft. ^{FNL} ~~FWL~~, 20 ft. ^{FEL} ~~FWL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 343-359; 436-440

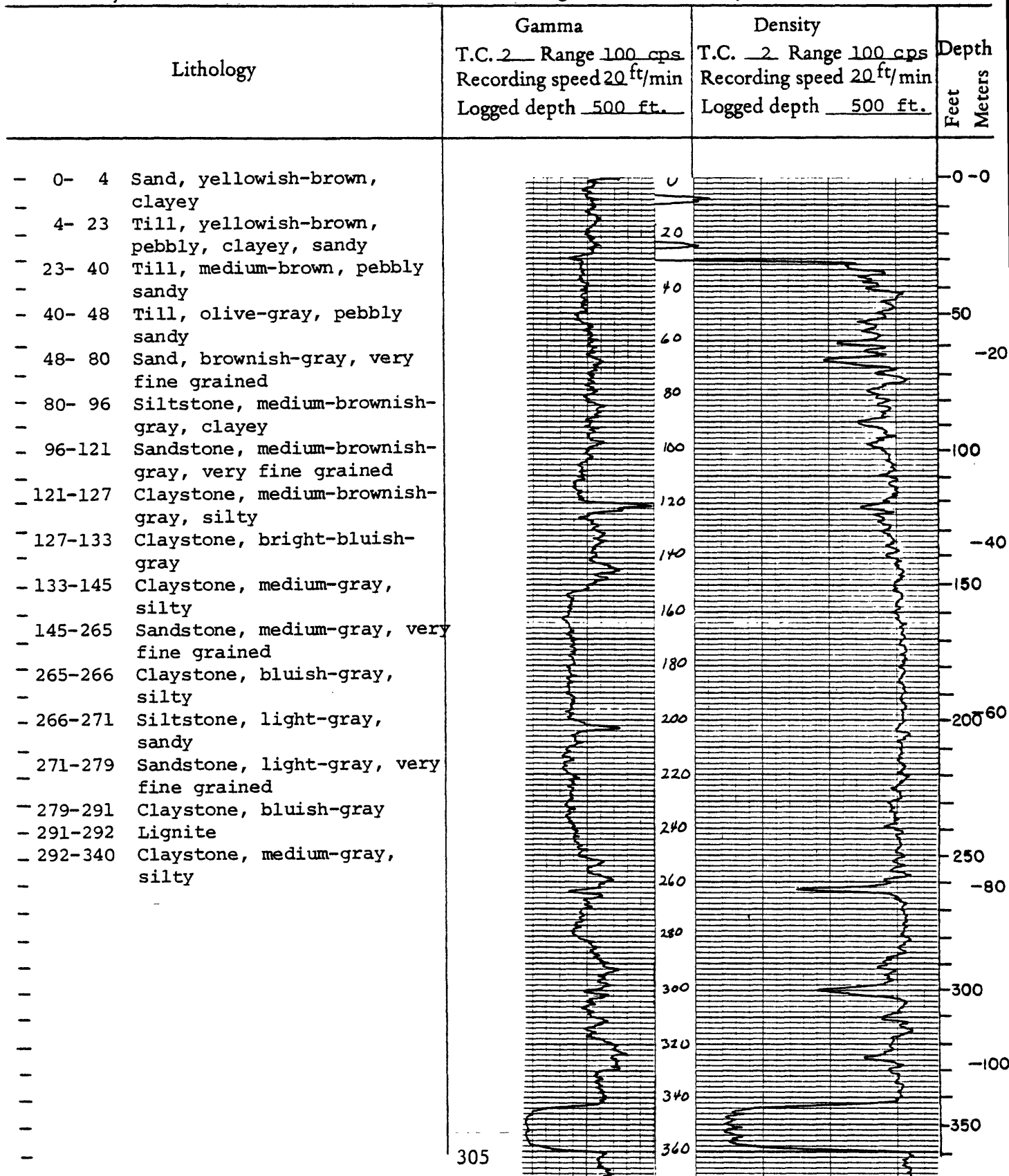
Remarks: _____

Lithology

Recorded by: Fred O'Toole

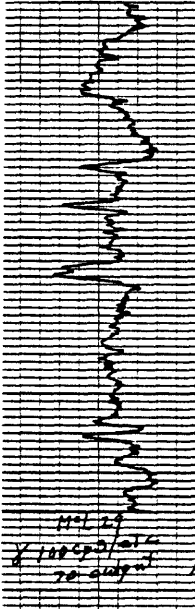
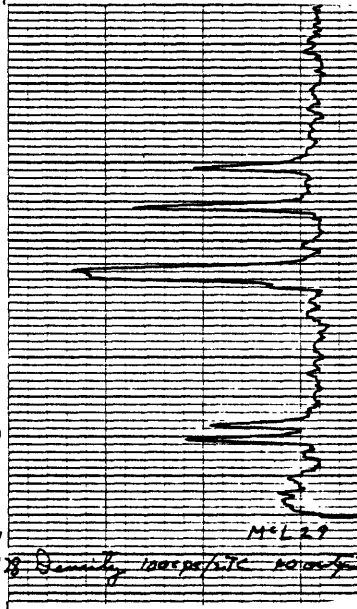
Geophysical logs

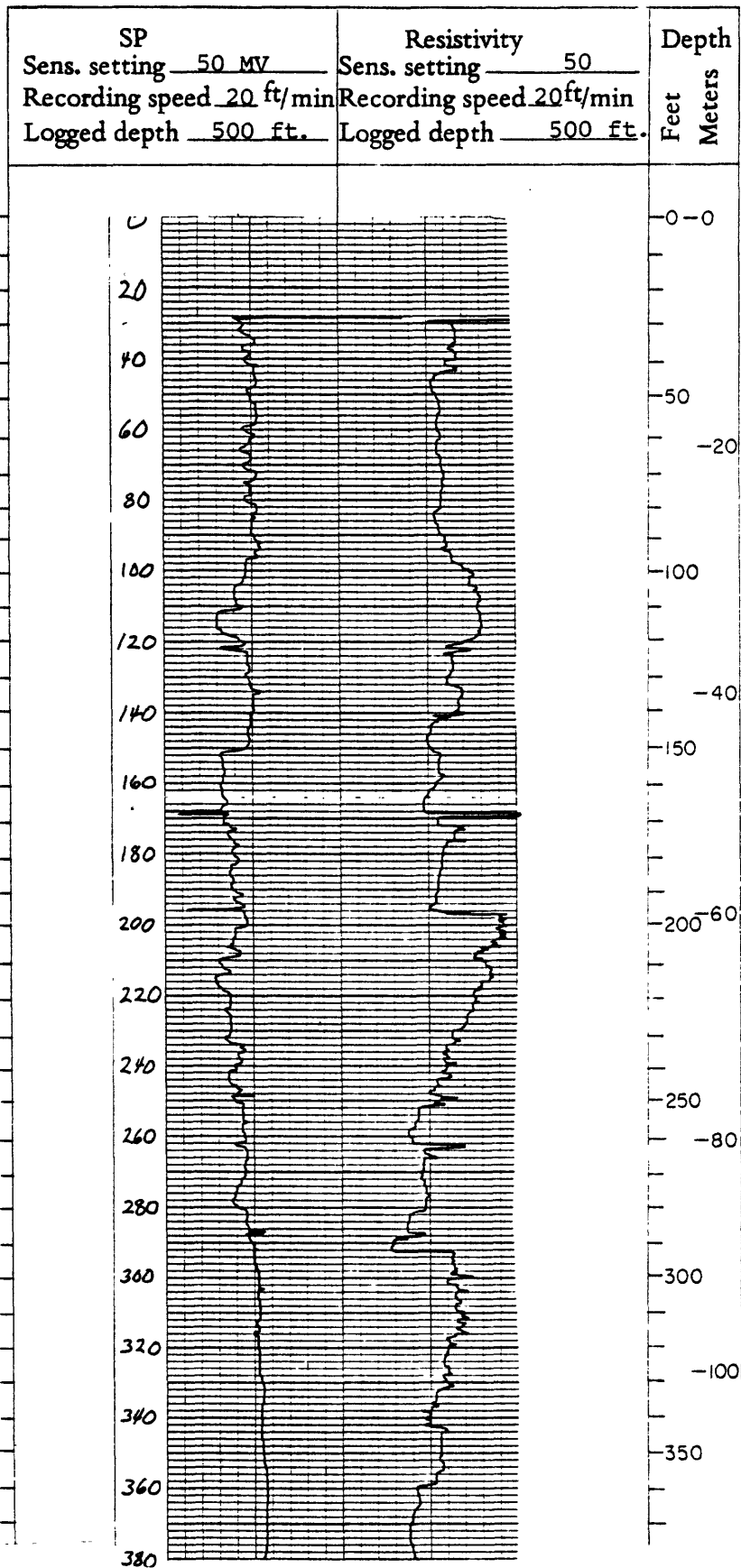
Geologist ^{Yes} ~~XXX~~ recorded by: Lechner



Hole number—continued

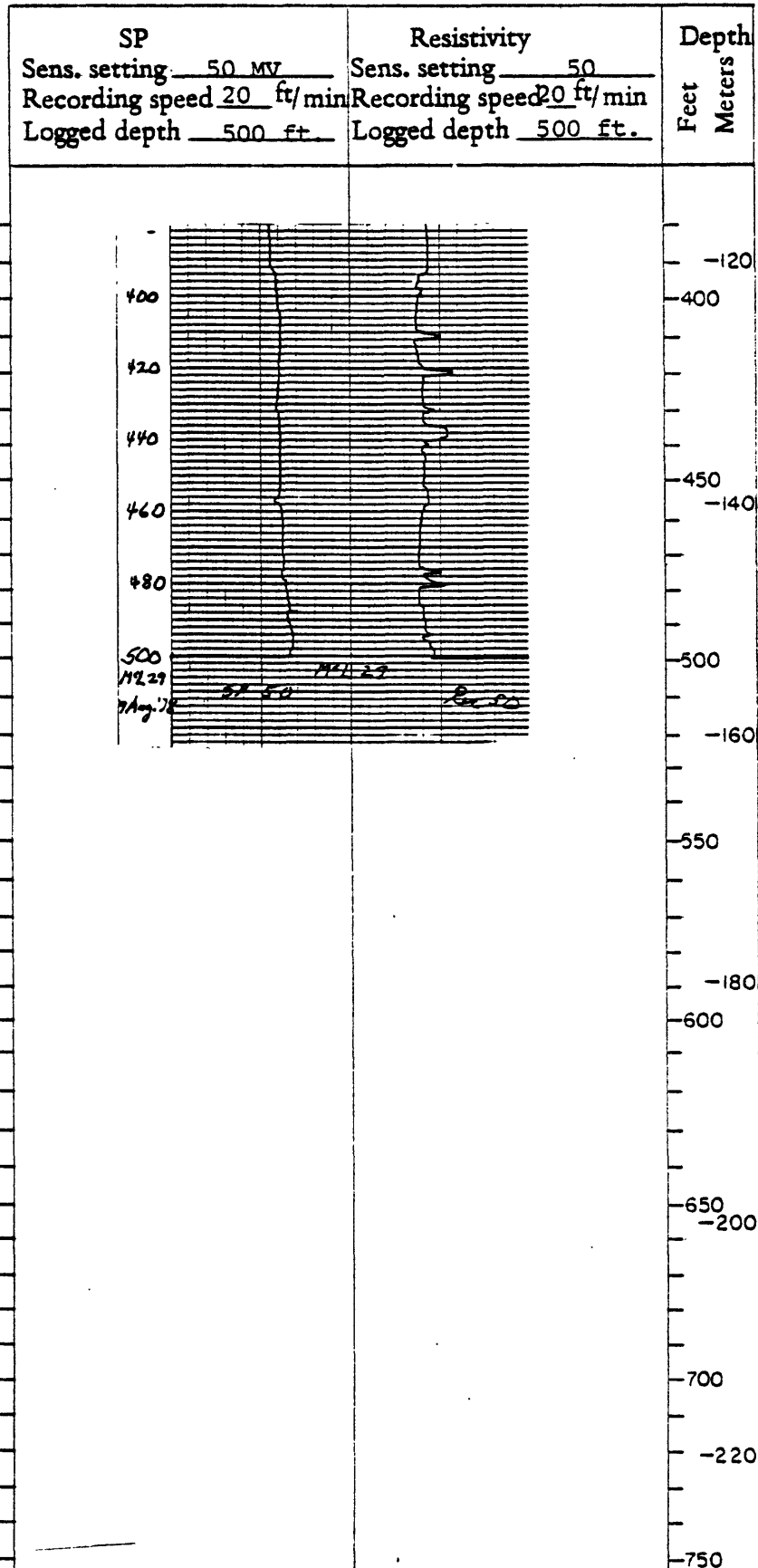
MCL-29

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>500</u> ft.	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>500</u> ft.	Feet	Meters
340-352 Lignite				
352-361 Siltstone, medium-gray, clayey			-120	
361-368 Claystone, medium-gray, silty			400	
368-395 Sandstone, light-gray, very fine grained				
395-405 Claystone, medium-gray				
405-407 Lignite				
407-410 Claystone, medium-brown, carbonaceous			450	
410-435 Claystone, medium-gray, silty			-140	
435-438 Claystone, dark-brown, carbonaceous				
438-440 Lignite			500	
440-500 Claystone, medium-gray, silty			-160	
			550	
			-180	
			600	
			650	
			-200	
			700	
			-220	
	306		750	



Hole number—continued

MCL-29



NORTH DAKOTA GEOLOGICAL SURVEY

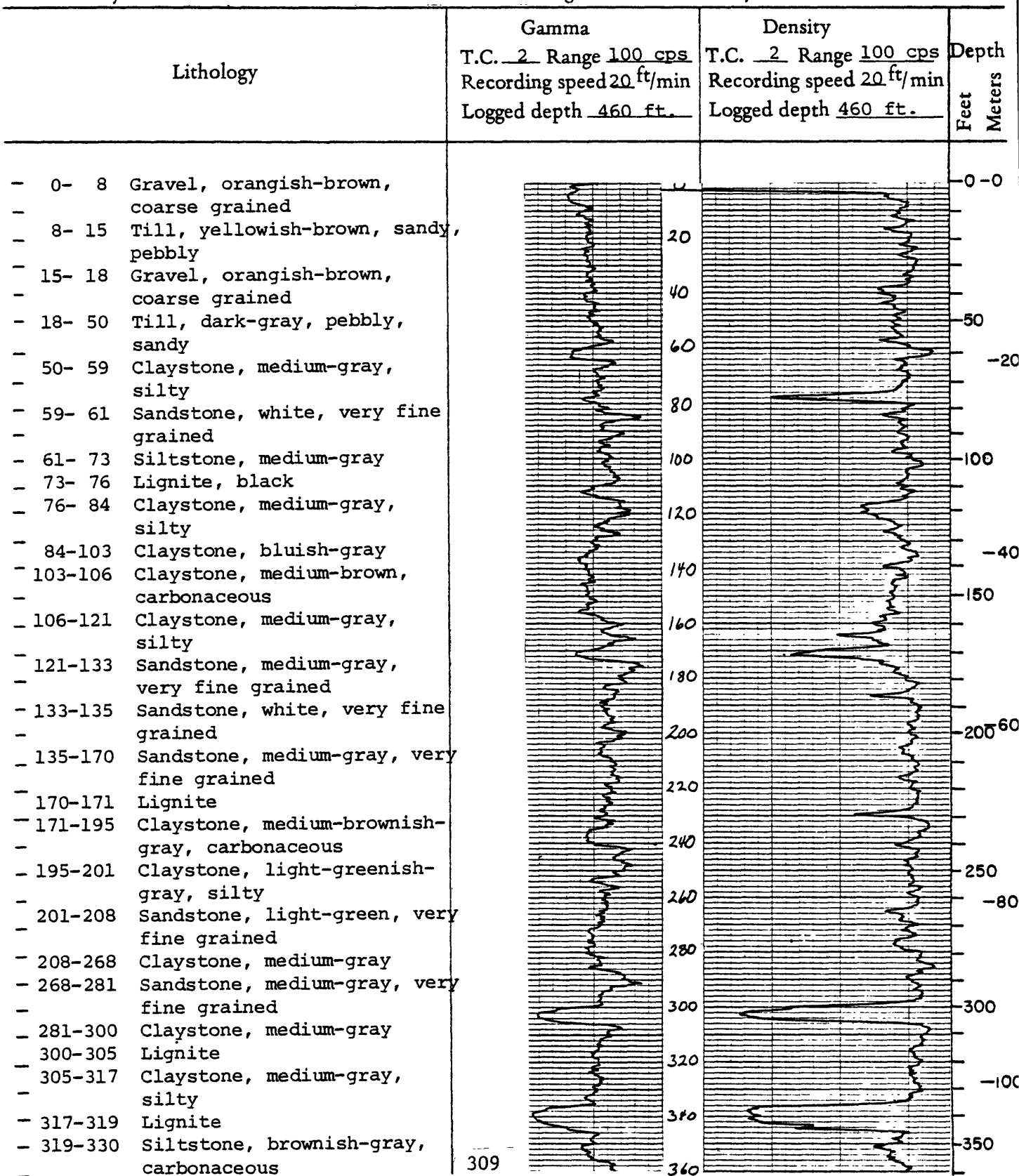
Hole No: MCL-30 Map: Blue Hill Date: 8-19-78 State: ND County: McLean
 Elev.: 2135 ft. Location: T. 150^N, R. 86^E, Sec. 26, Tract: bccb Drilled depth: 460 ft.
 Measured: 2300 ft.^{FNL} 20 ft.^{FWL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 76-79; 169-172; 299-305; 336-345; 401-405.5; 418-422

Remarks: _____

Lithology

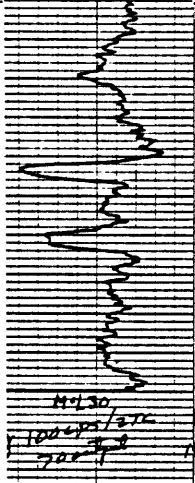
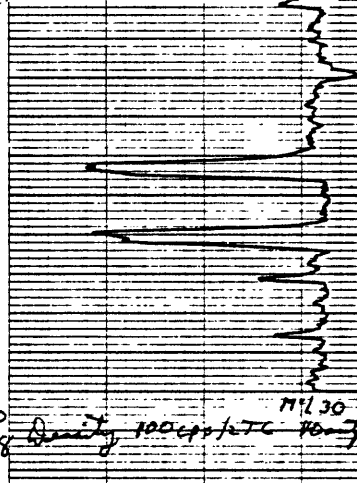
Recorded by: Fred O'Toole

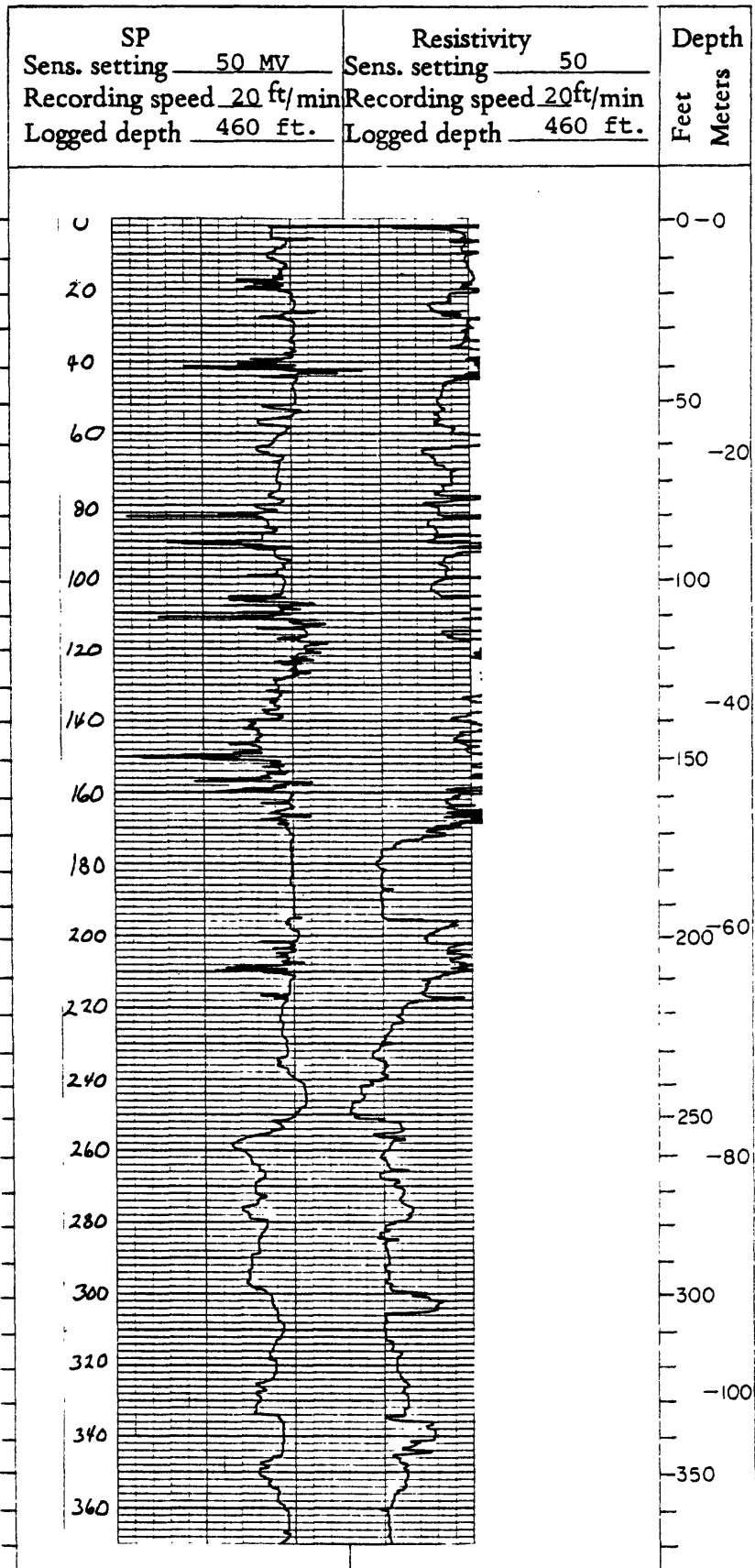
Geophysical logs
 recorded by: Lechner



Hole number—continued

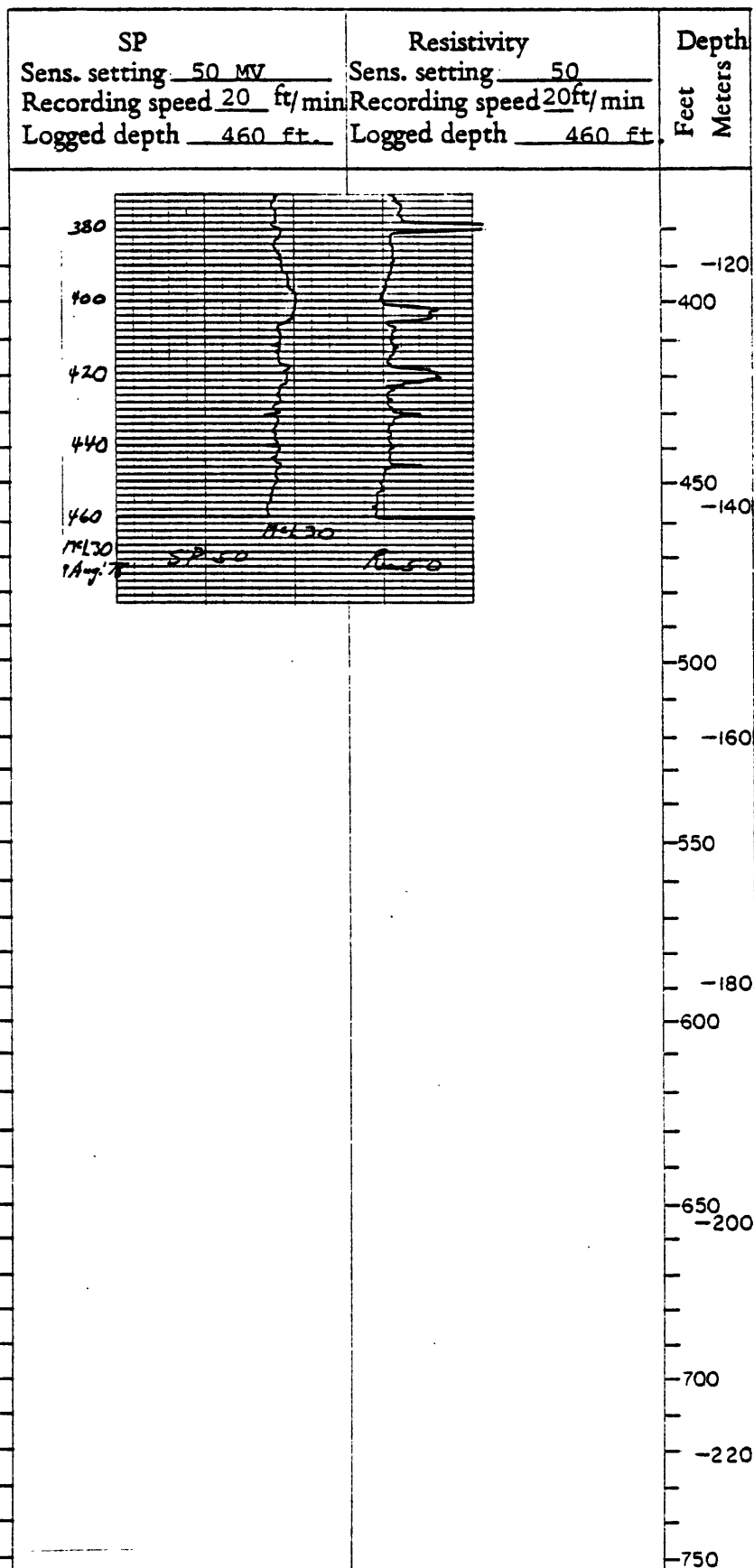
MCL-30

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fcct	Meters
	Recording speed	20 ft/min	Recording speed	20 ft/min		
	Logged depth	460 ft.	Logged depth	460 ft.		
30-337 Sandstone, medium-gray, very fine grained		380		400		
337-344 Lignite					-120	
344-354 Sandstone, medium-gray, very fine grained					400	
354-360 Claystone, medium-gray						
360-366 Sandstone, medium-gray, very fine grained						
366-377 Claystone, brownish-gray, carbonaceous						
377-378 Limestone, dark-gray					450	
378-380 Lignite					-140	
380-400 Claystone, medium-gray, silty						
400-403 Lignite						
403-409 Claystone, medium-gray					500	
409-411 Lignite						
411-415 Claystone, medium-gray, carbonaceous					-160	
415-418 Lignite						
418-460 Claystone, medium-gray, silty, carbonaceous					550	
					-180	
					600	
					-200	
					700	
					-220	
					750	



Hole number—continued

MCL-30



NORTH DAKOTA GEOLOGICAL SURVEY

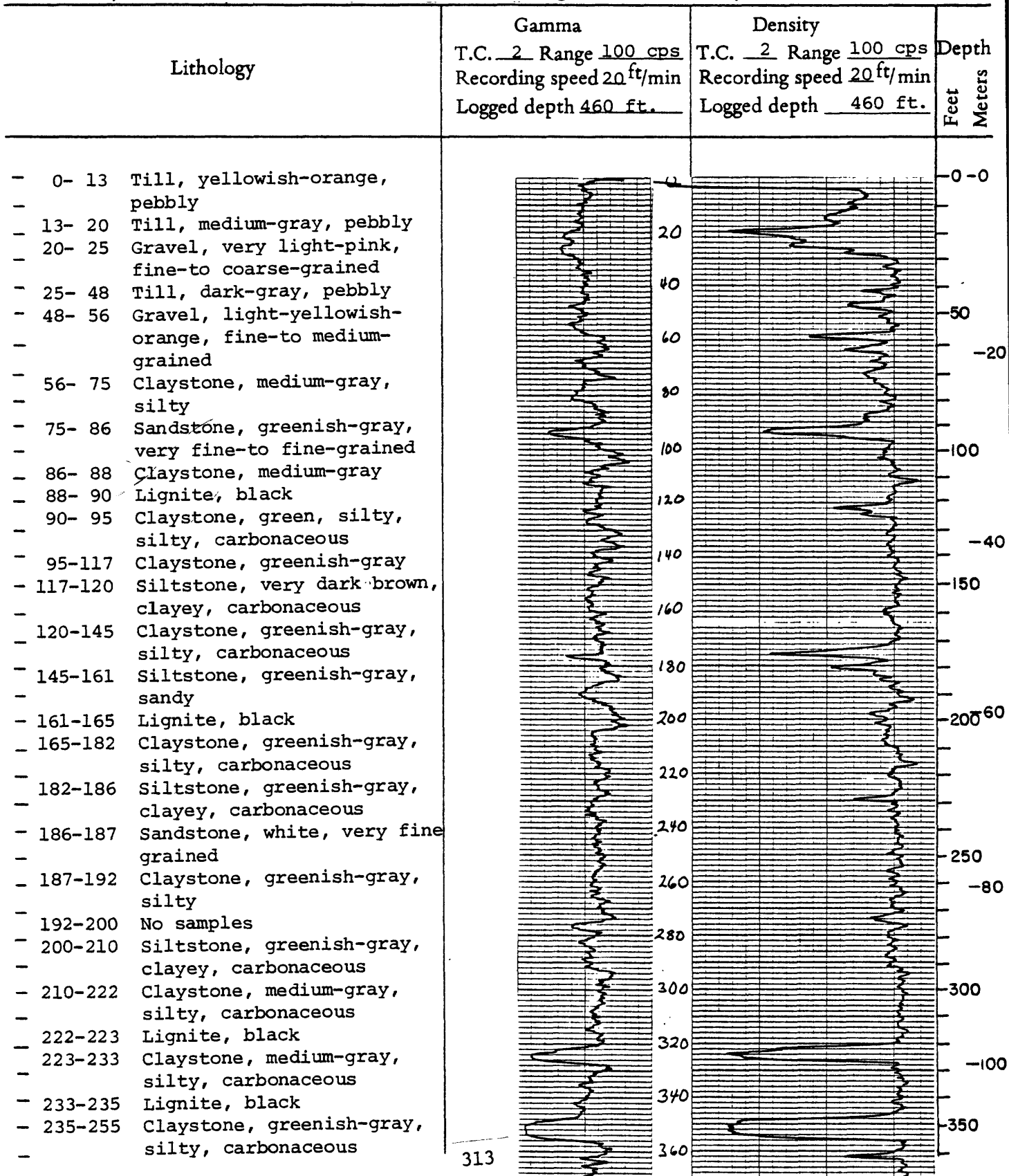
Hole No: MCL-31 Map: Blue Hill Date: 8-17-78 State: ND County: McLean
 Elev.: 2126 ft. Location: T. 150 ^N, R. 86 ^W, Sec. 20, Tract: dccc Drilled depth: 460 ft.
 Measured: 27 ft. ^{FSL} 2584 ft. ^{FEL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 92-95; 321-326; 348-356; 404-420; 439-442

Remarks: _____

Lithology

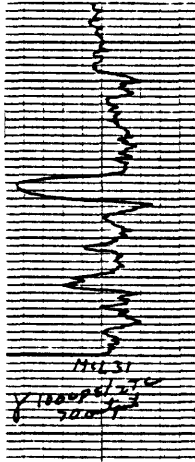
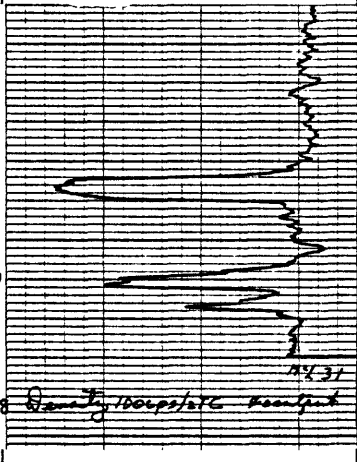
Recorded by: Randall Reichert

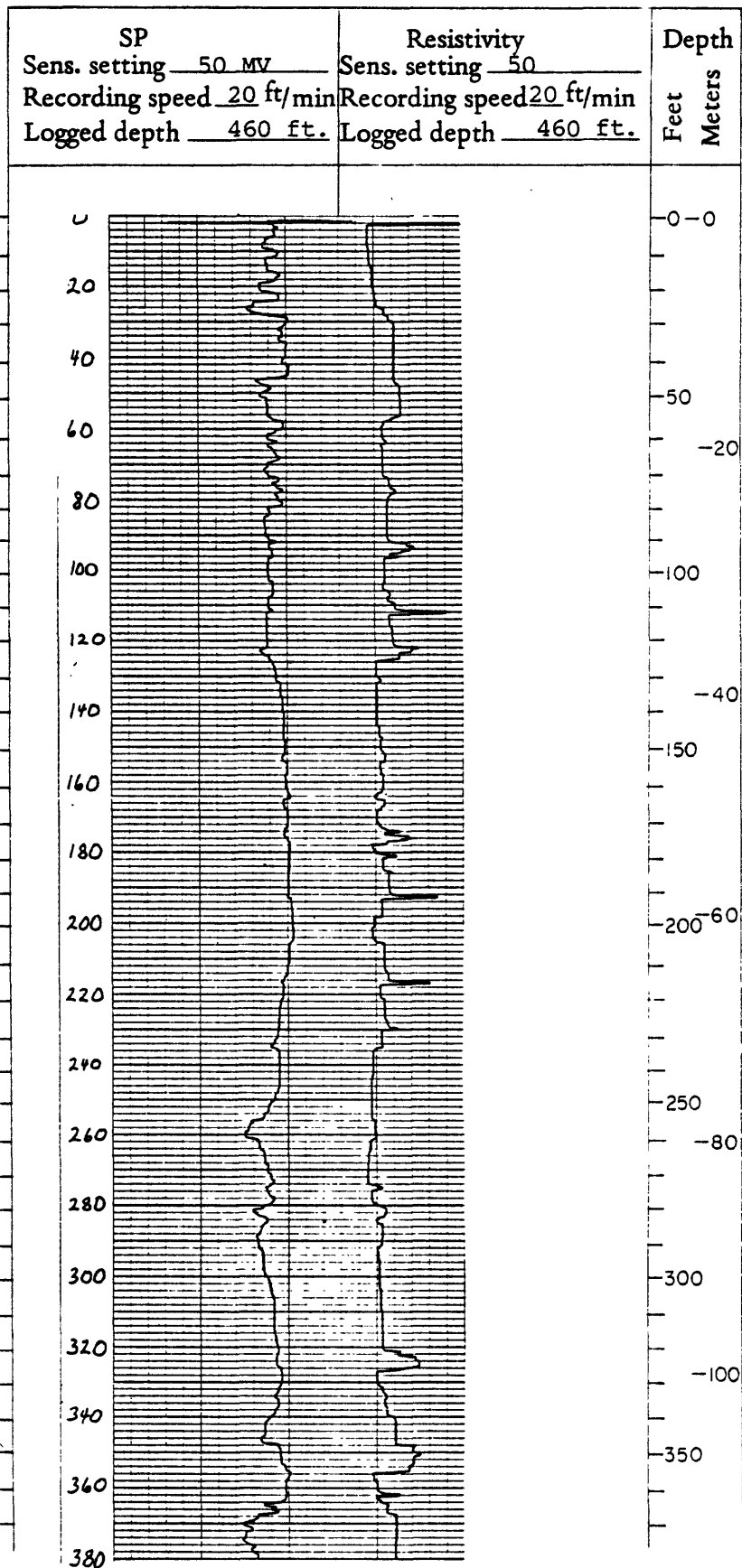
Geophysical logs
 recorded by: Lechner



Hole number—continued

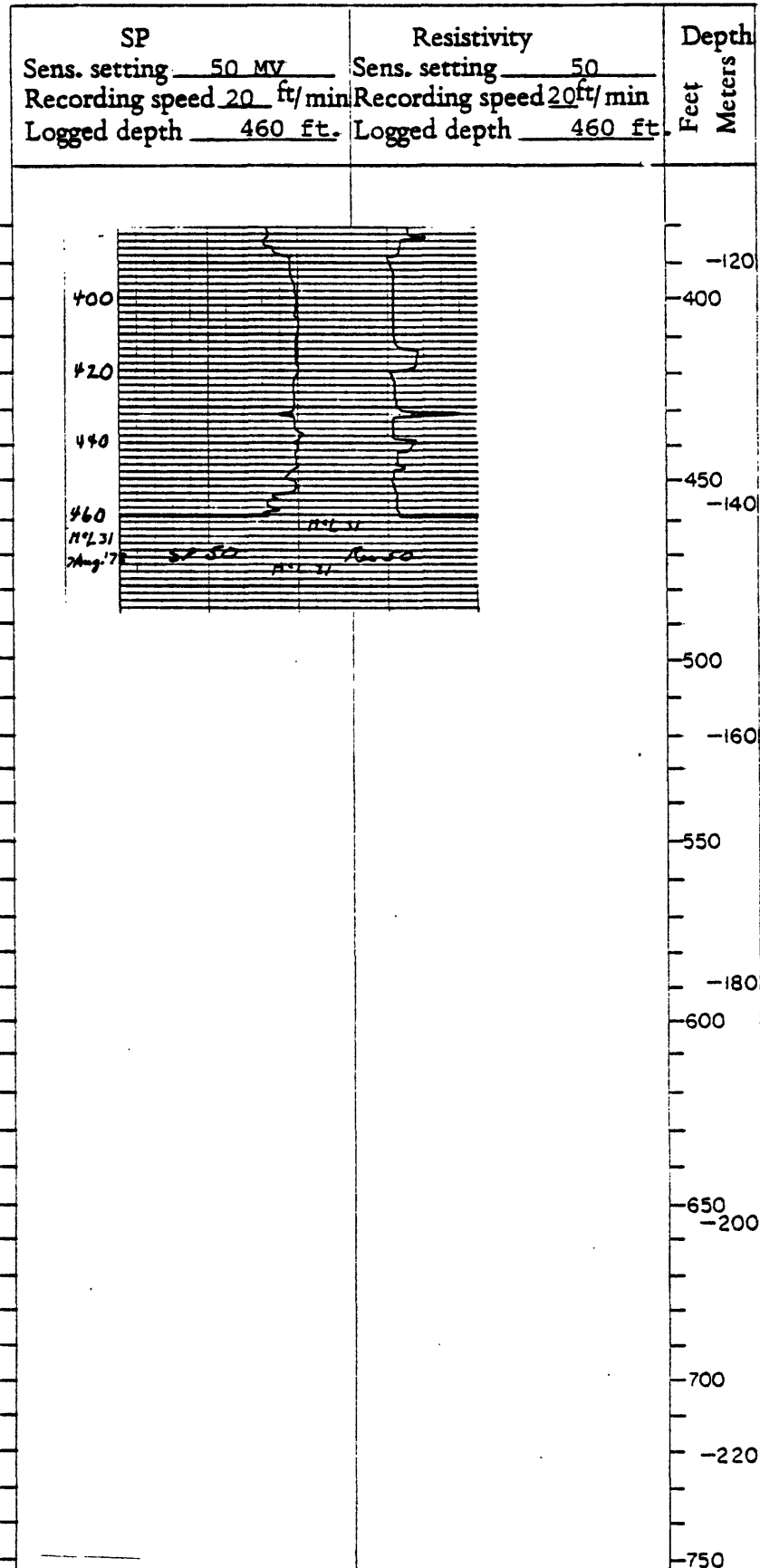
MCL-31

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>460 ft.</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>460 ft.</u>	Depth	
			Feet	Meters
255-270 Sandstone, greenish-gray, very fine to fine-grained				
270-288 Claystone, greenish-gray, silty			-120	
288-289 Siltstone, brown, carbon- aceous			400	
289-326 Claystone, greenish-gray, silty, carbonaceous				
326-327 Lignite, black				
327-330 Claystone, medium-gray, carbonaceous			450	
330-335 Lignite, black			-140	
335-350 Claystone, greenish-gray, silty, carbonaceous				
350-355 Sandstone, greenish-gray, very fine to fine-grained			500	
355-361 Lignite, black				
361-375 Claystone, greenish-gray, silty			-160	
375-383 Lignite, black				
383-390 Claystone, medium-gray, silty, carbonaceous			550	
390-395 Sandstone, greenish-gray, very fine to fine-grained				
395-417 Claystone, light-greenish- gray, silty			-180	
417-423 Lignite, black			600	
423-453 Claystone, medium-gray, carbonaceous				
453-454 Lignite, black			650	
454-460 Claystone, medium-gray, carbonaceous			-200	
			700	
			-220	
			750	



Hole number—continued

MCL-31



Hole No: MCL-32 Map: Blue Hill Date: 8-9-78 State: ND County: McLean
Elev.: 2190 ft. Location: T. 150 ^N ~~S~~, R. 87 ^E ~~W~~, Sec. 12, Tract: ddad Drilled depth: 540 ft.
Measured: 702 ft. ~~FSL~~ ^{FSL}, 6 ft. ~~FSL~~ ^{FEL}, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 190-193; 289-292; 294-296; 440.5-450; 504-510.5

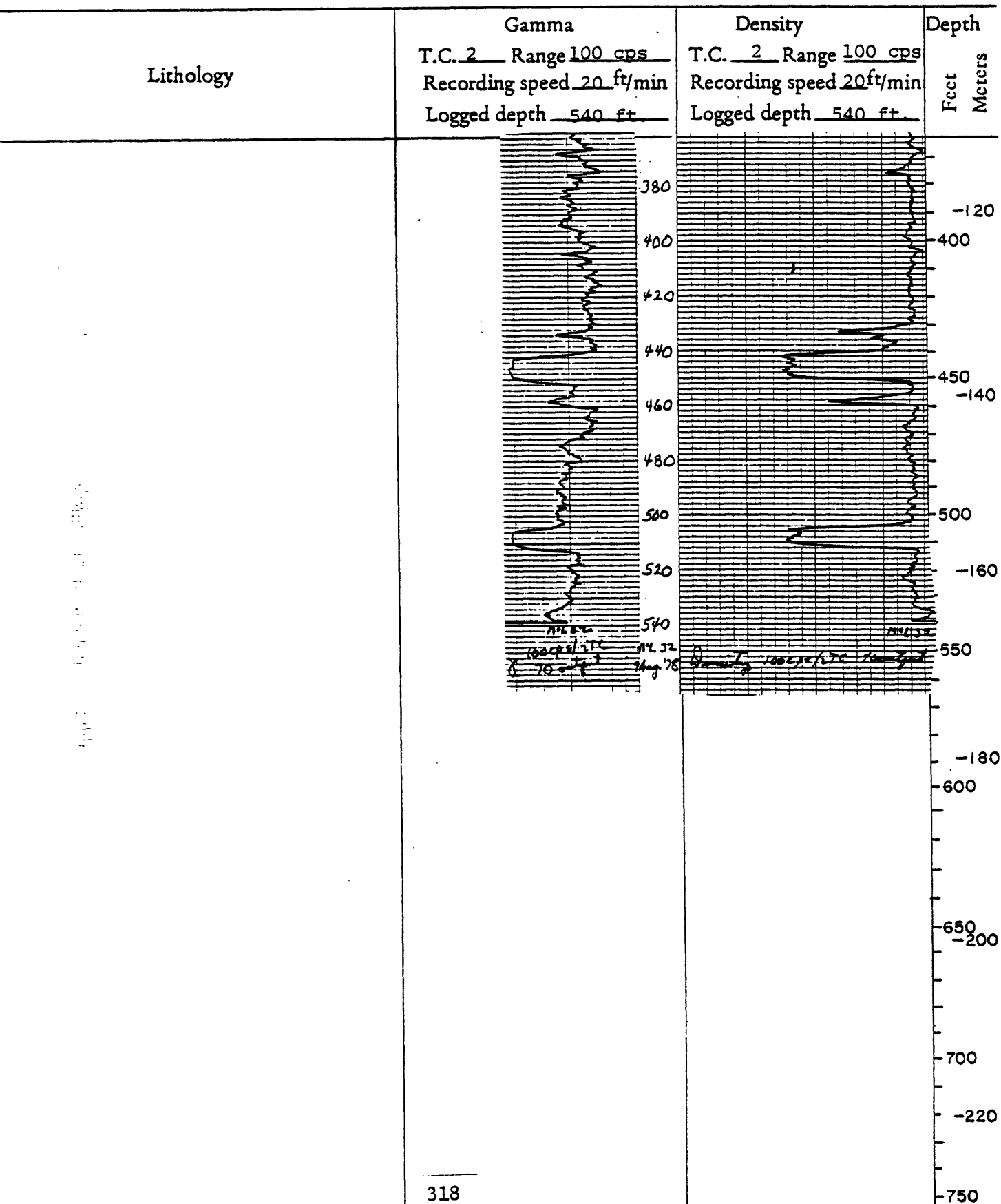
Recorded by:

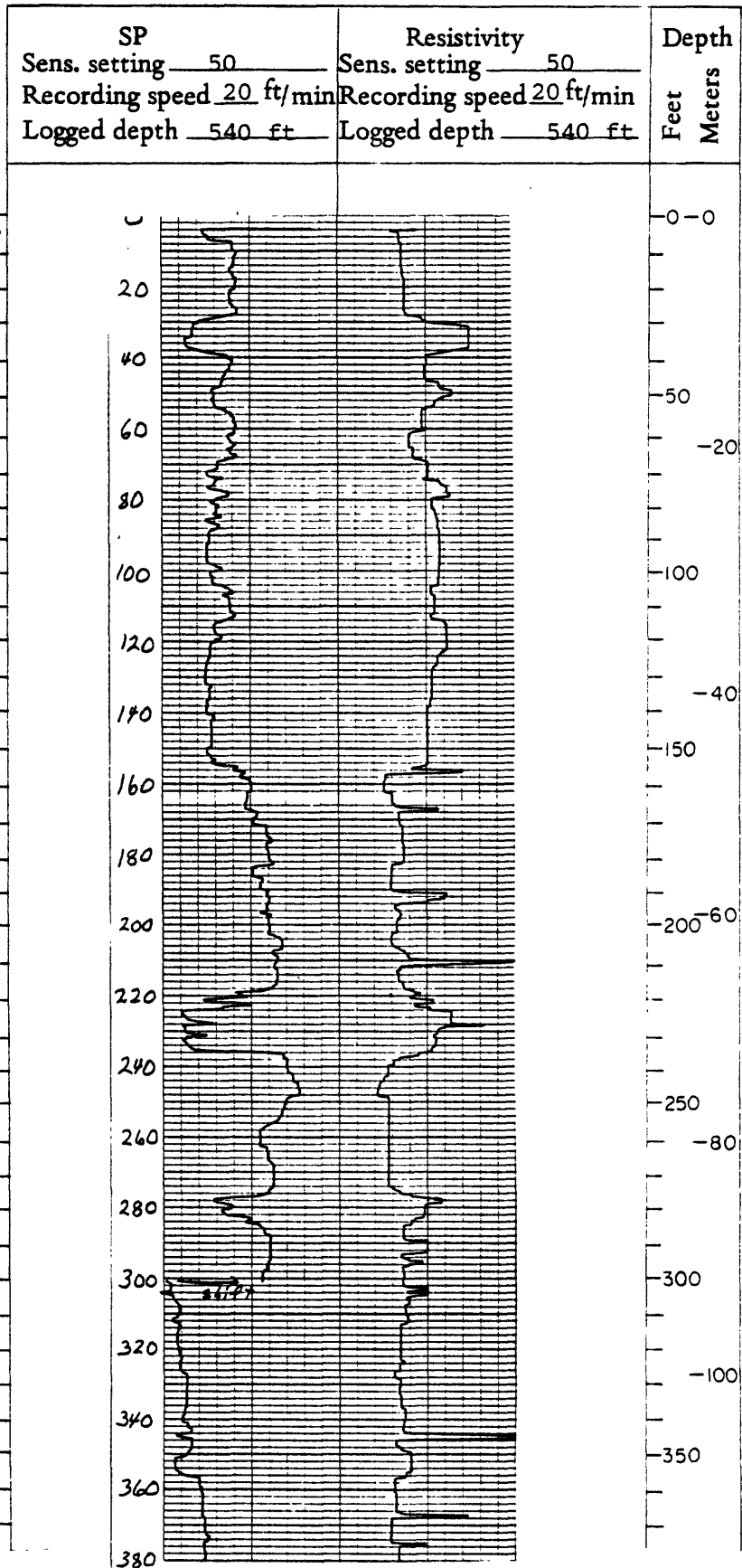
Geologist ^{Yes} _{No} Geophysical logs recorded by: _____

Lithology	Gamma	Density	Depth	
	T.C. 2 Range 100 cps Recording speed 20 ft/min Logged depth 540 ft.	T.C. 2 Range 100 cps Recording speed 20 ft/min Logged depth 540 ft.	Feet	Meters
- No samples			0	0
			20	
			40	
			60	
			80	
			100	
			120	
			140	
			160	
			180	
			200	60
			220	
			240	
			260	80
			280	
			300	100
			320	
			340	
			360	120

Hole number—continued

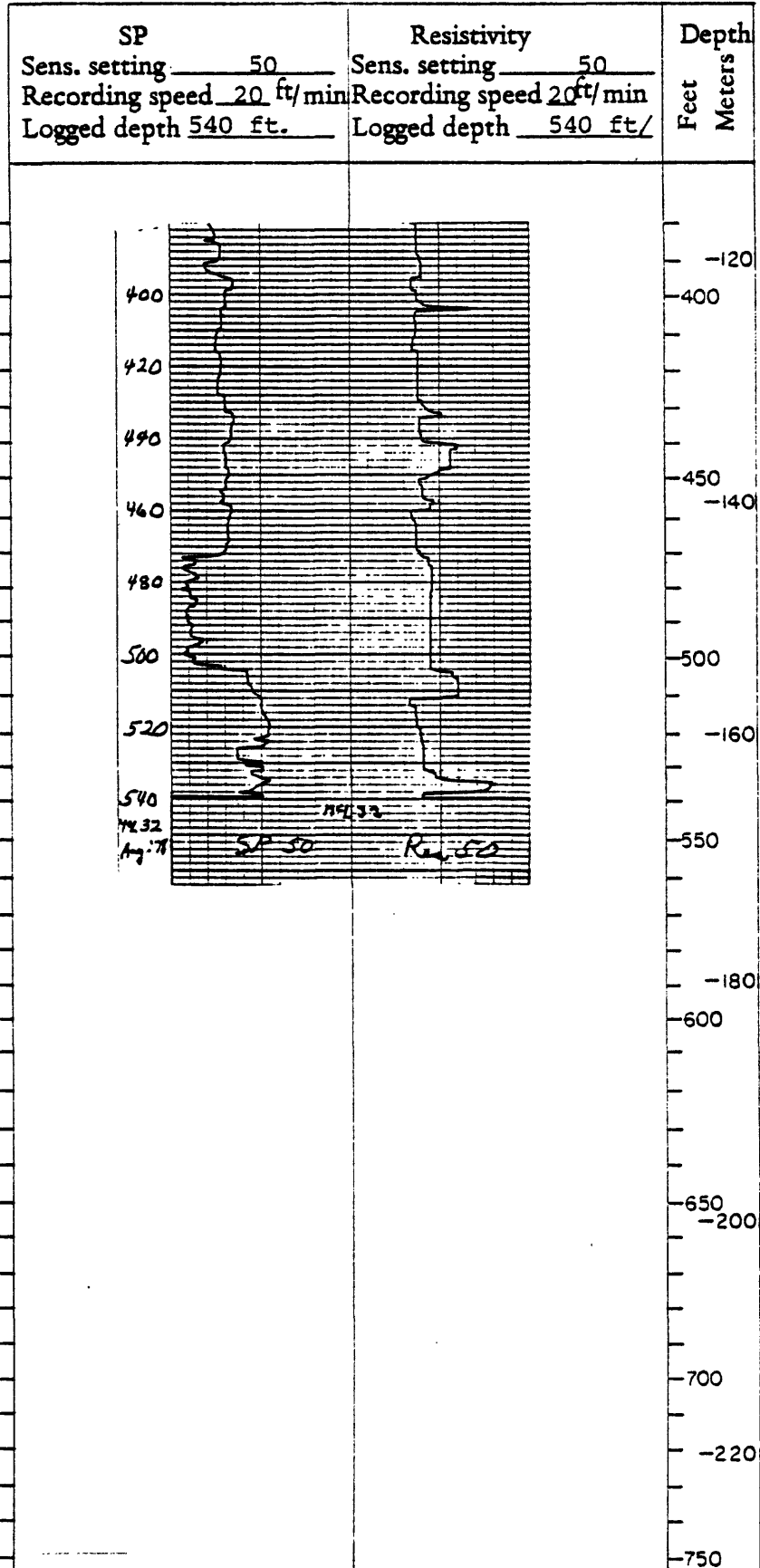
MCL-32





Hole number—continued

MCL-32

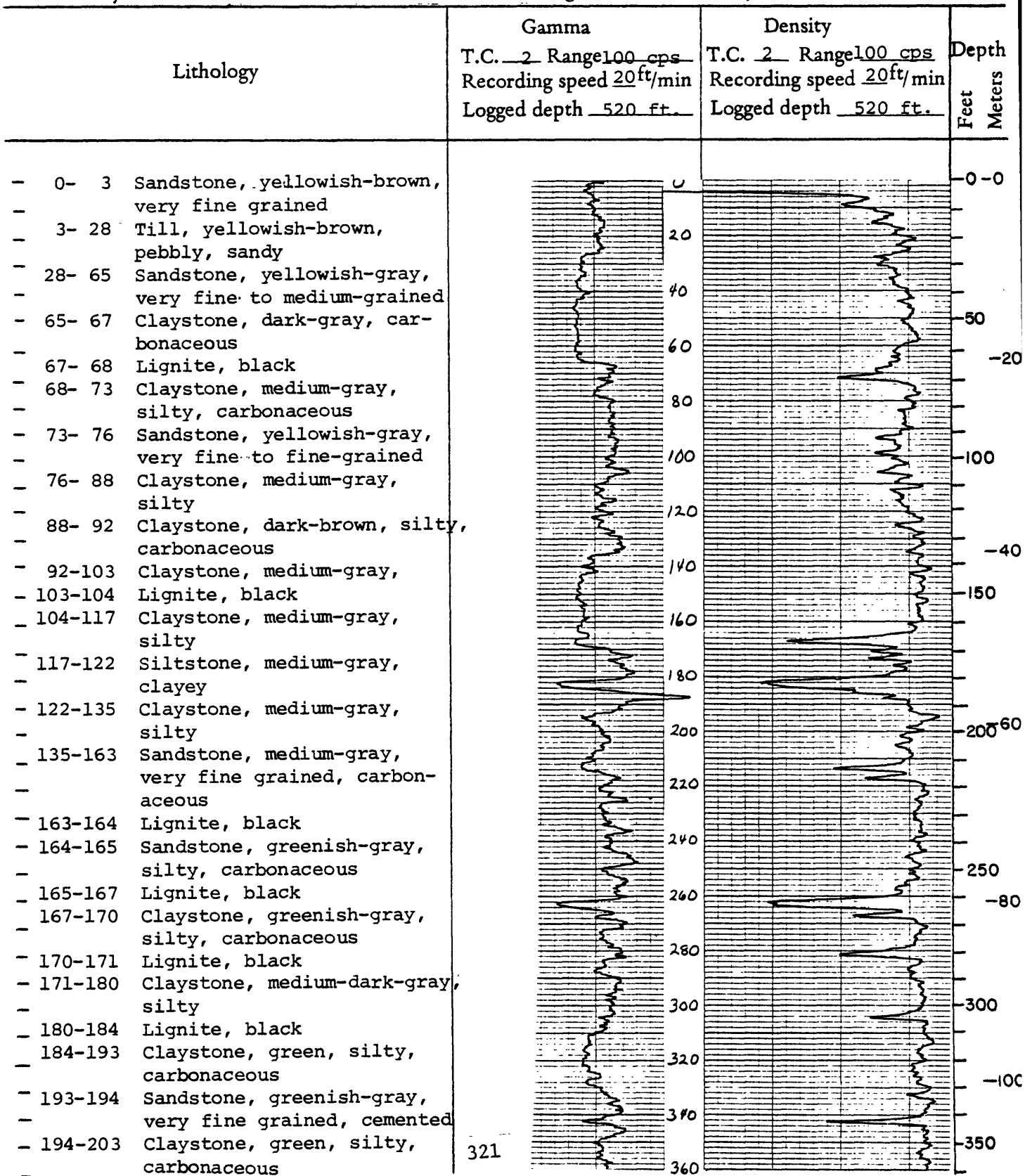


NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: MCL-33 Map: Roseglen Date: 8-10-78 State: ND County: McLean
 Elev.: 2178 ft. Location: T. 150^N, R. 87^E, Sec. 3, Tract: aaaa Drilled depth: 520 ft.
 Measured: 66 ft. ^{FNL} ~~FSL~~, 30 ft. ^{FEL} ~~FSL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 181-184; 261-264; 404-412; 463-470

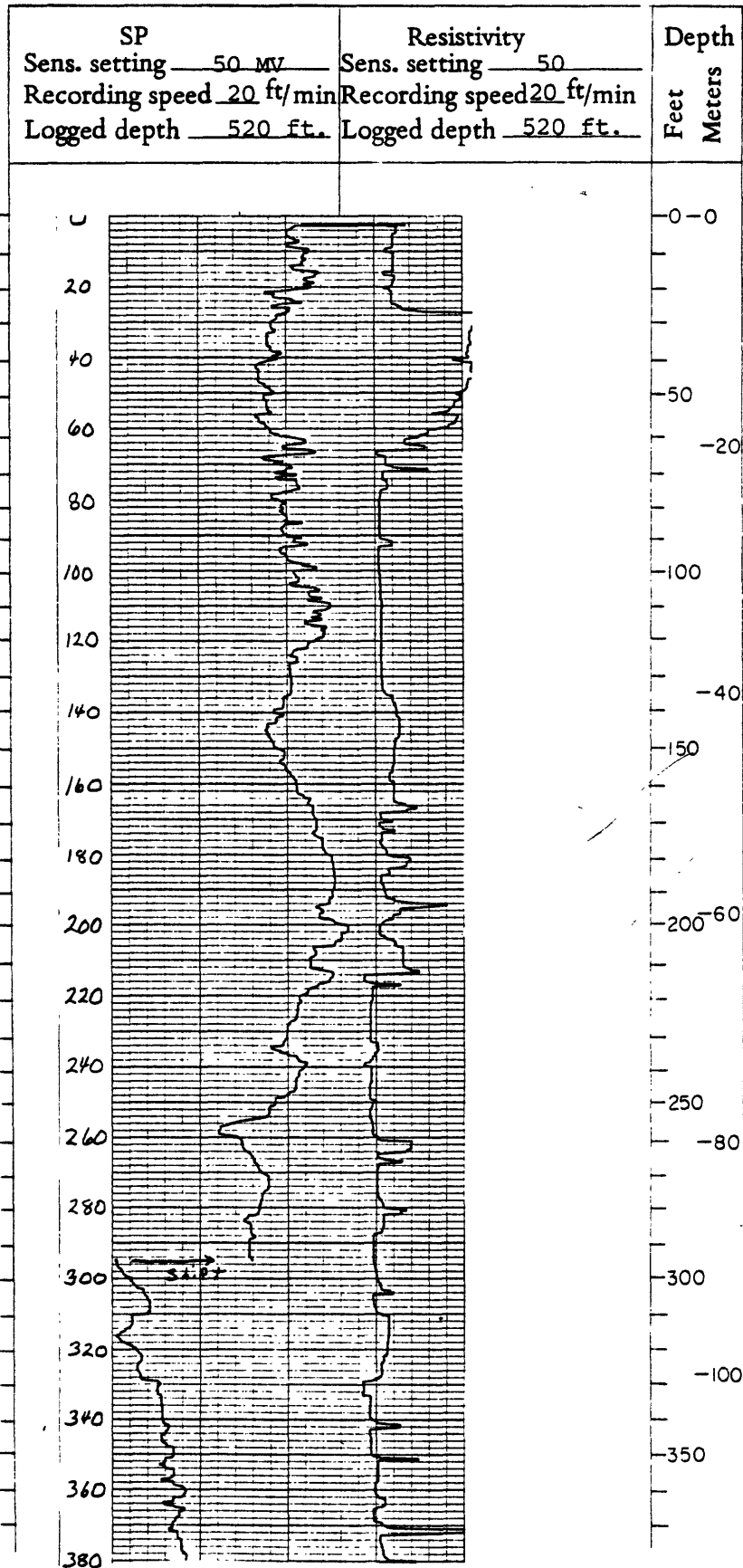
Remarks: _____

Lithology
 Recorded by: Randall Reichert Geologist ^{Yes} ~~No~~ Geophysical logs
 recorded by: Lechner



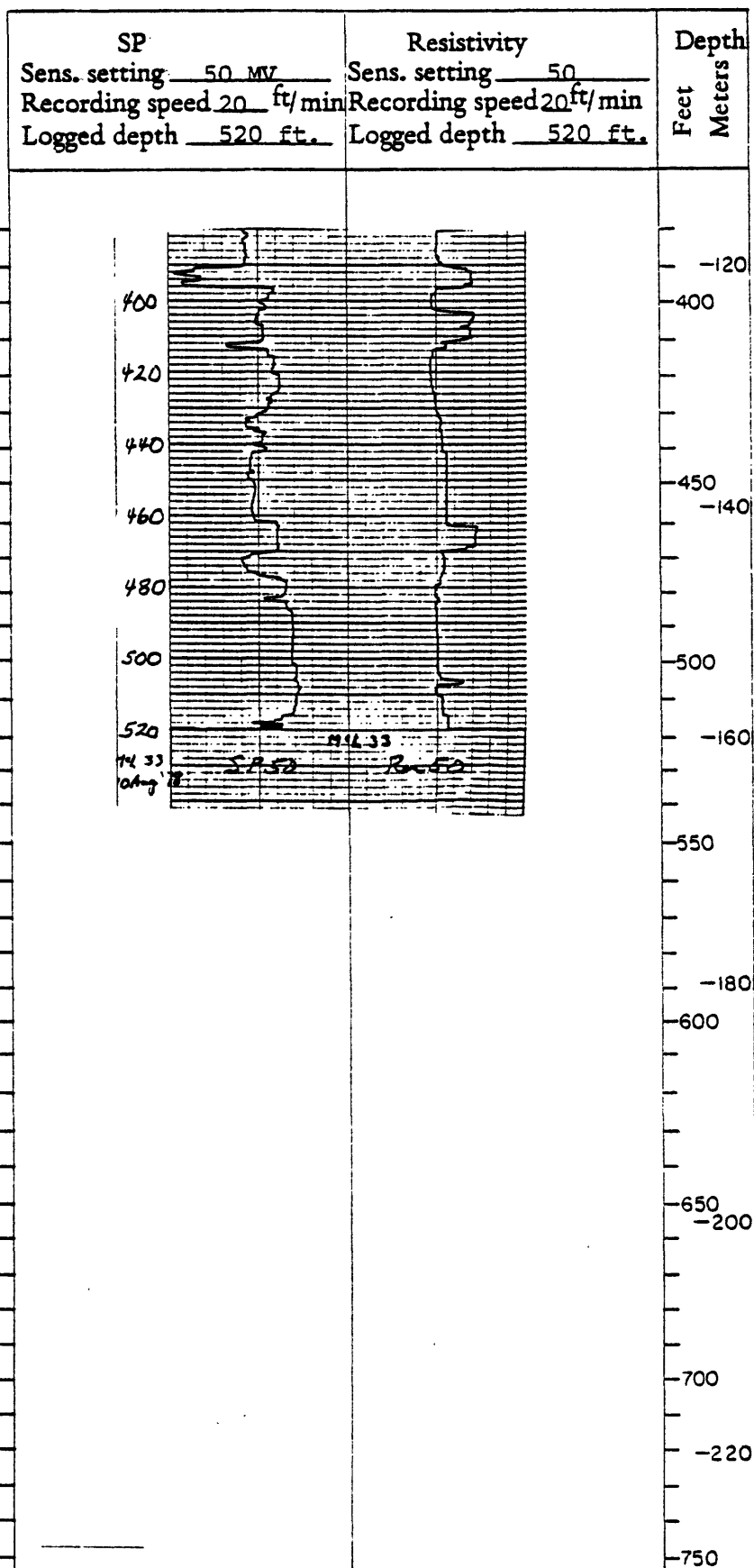
Hole number—continued

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fcft	Meters
	Recording speed	20 ft/min	Recording speed	20 ft/min		
	Logged depth	520 ft.	Logged depth	520 ft.		
203-206 Claystone, medium-gray						
206-210 Lignite, black						
210-215 Claystone, green, carbonaceous					-120	
215-253 Claystone, greenish-gray, silty, carbonaceous					400	
253-260 Claystone, medium-gray, carbonaceous						
260-265 Lignite, black						
265-310 Claystone, medium-gray, silty, carbonaceous					450	
310-325 Sandstone, greenish-gray, very fine to fine-grained					-140	
325-328 Lignite, black						
328-370 Claystone, dark-gray, silty, carbonaceous						
370-371 Sandstone, white, very fine grained, cemented					500	
371-376 Claystone, dark-gray, silty, carbonaceous					-160	
376-377 Siltstone, white, clayey						
377-390 Claystone, dark-gray, silty, carbonaceous						
390-391 Siltstone, dark-brown, clayey, carbonaceous					550	
391-400 Claystone, medium-gray,						
400-410 Lignite, black						
410-415 Siltstone, greenish-gray, clayey, carbonaceous					-180	
415-435 Claystone, greenish-gray, silty, carbonaceous					600	
435-460 Siltstone, greenish-gray, sandy, carbonaceous						
460-464 Sandstone, green, very fine to fine-grained					650	
464-502 Claystone, dark-gray, silty, carbonaceous					-200	
502-503 Lignite, black						
503-510 Claystone, dark-gray, silty, carbonaceous						
510-520 Claystone, green, silty, carbonaceous					700	
					-220	
					750	



Hole number—continued

MCL-33



NORTH DAKOTA GEOLOGICAL SURVEY

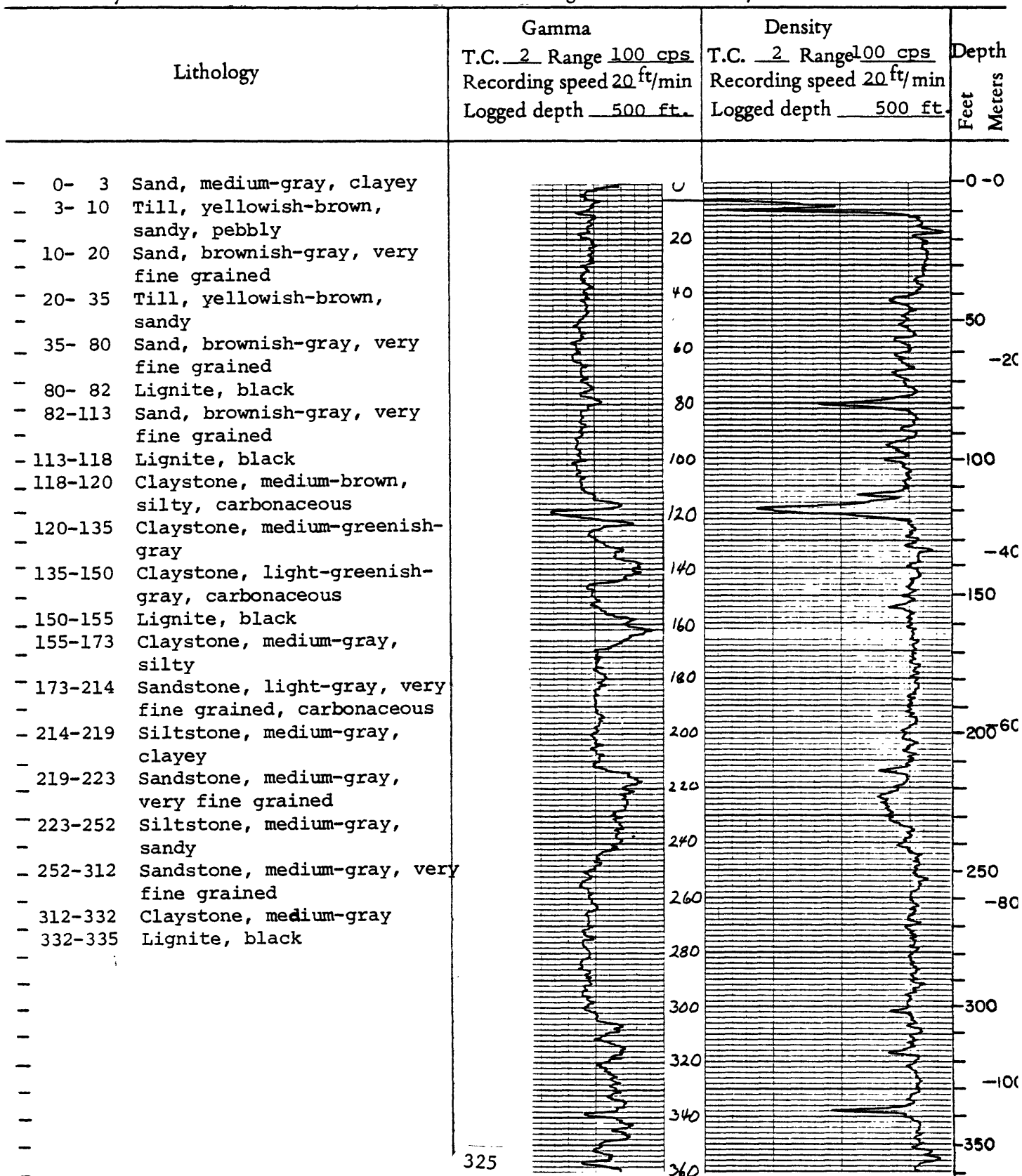
Hole No: MCL-34 Map: Blue Hill Date: 8-9-78 State: ND County: McLean
 Elev.: 2155 ft. Location: T. 150 ^N/₈, R. 86 ^R/_W, Sec. 4, Tract: cabb Drilled depth: 500 ft.
 Measured: 1056 ft. ^{FSL} 72 ft. ^{FWL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 118-121; 417-430; 475-480

Remarks: _____

Lithology

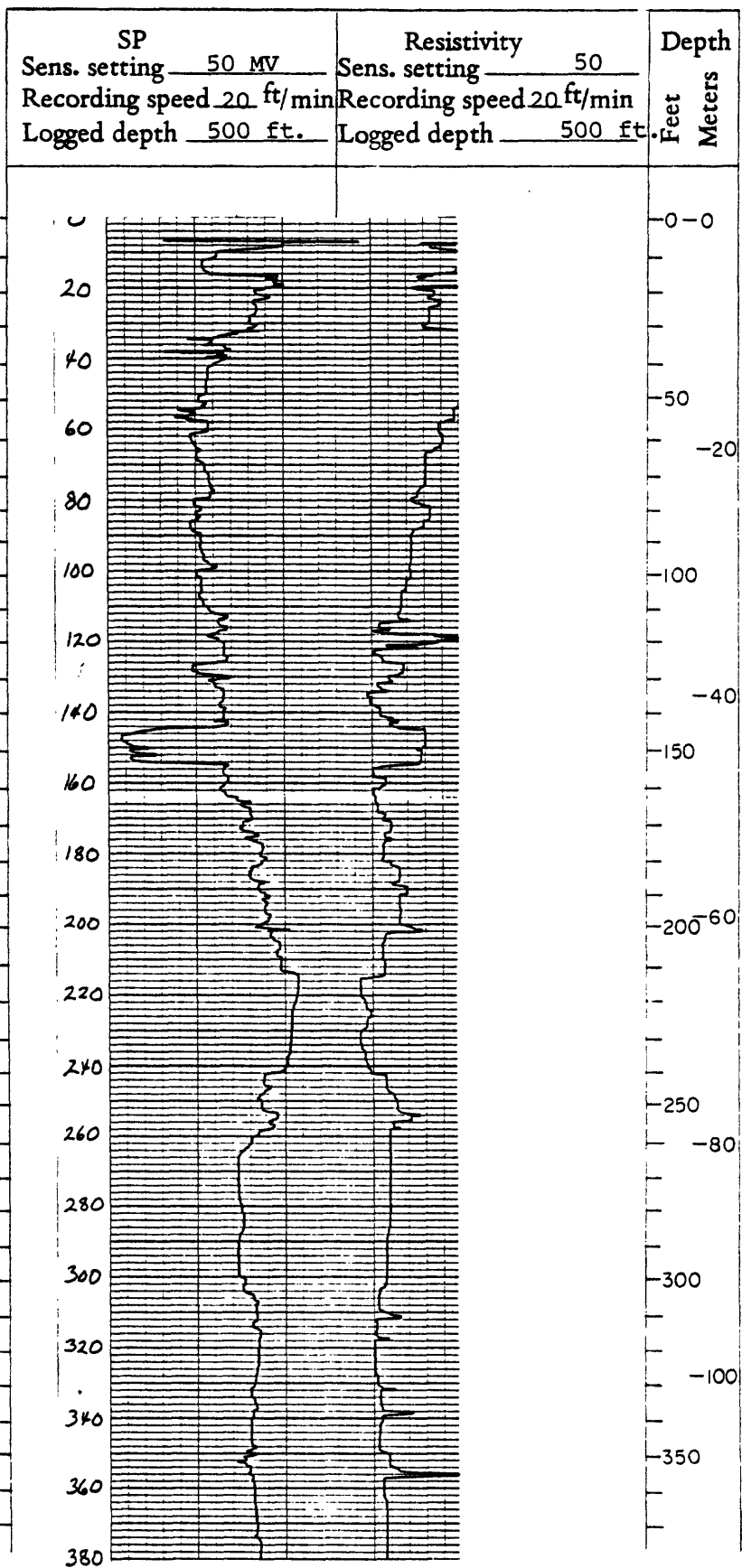
Recorded by: Randall Reichert

Geophysical logs

Geologist ^{Yes} ~~xxxx~~ recorded by: Lechner

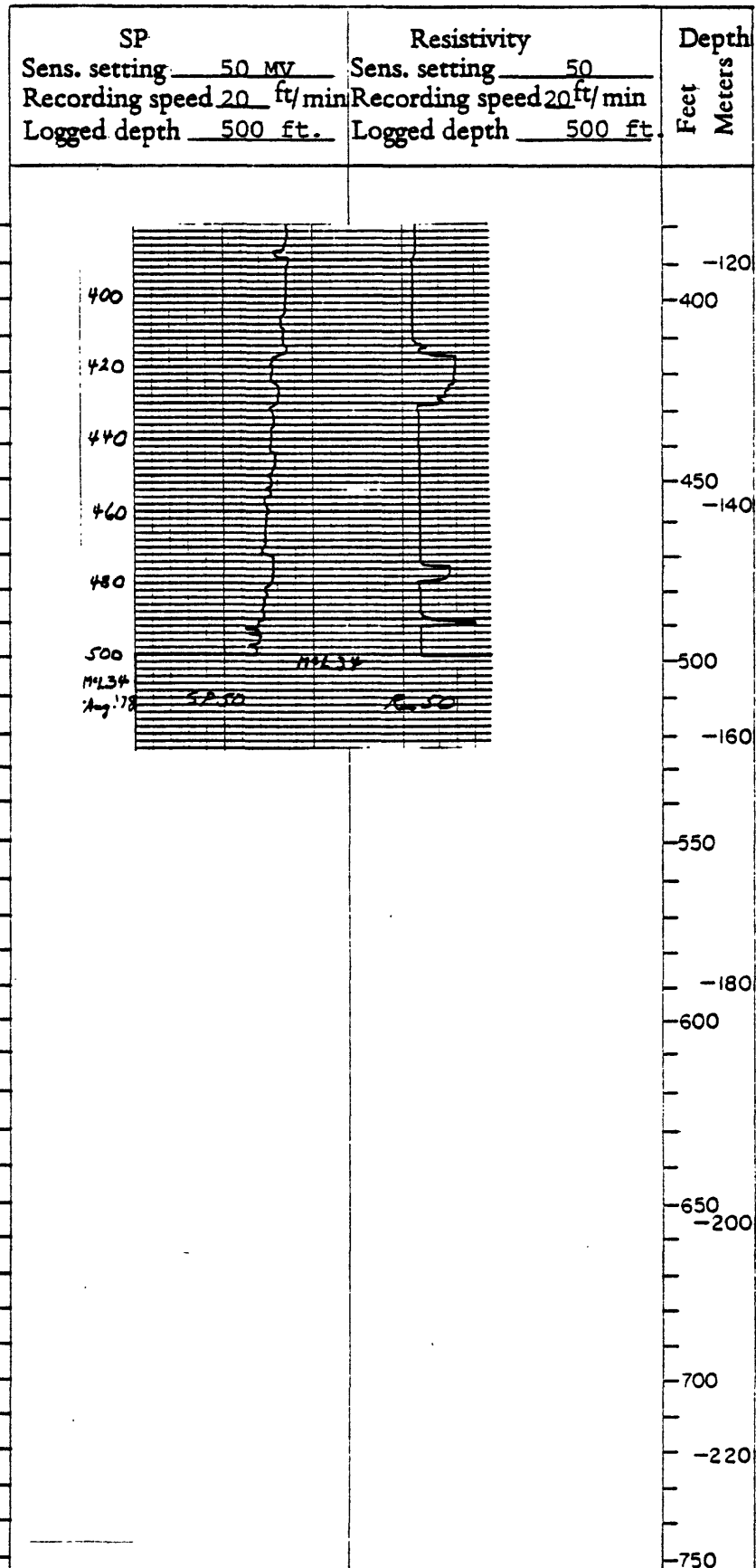
MCL-34

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Hole number—continued.

MCL-34



NORTH DAKOTA GEOLOGICAL SURVEY

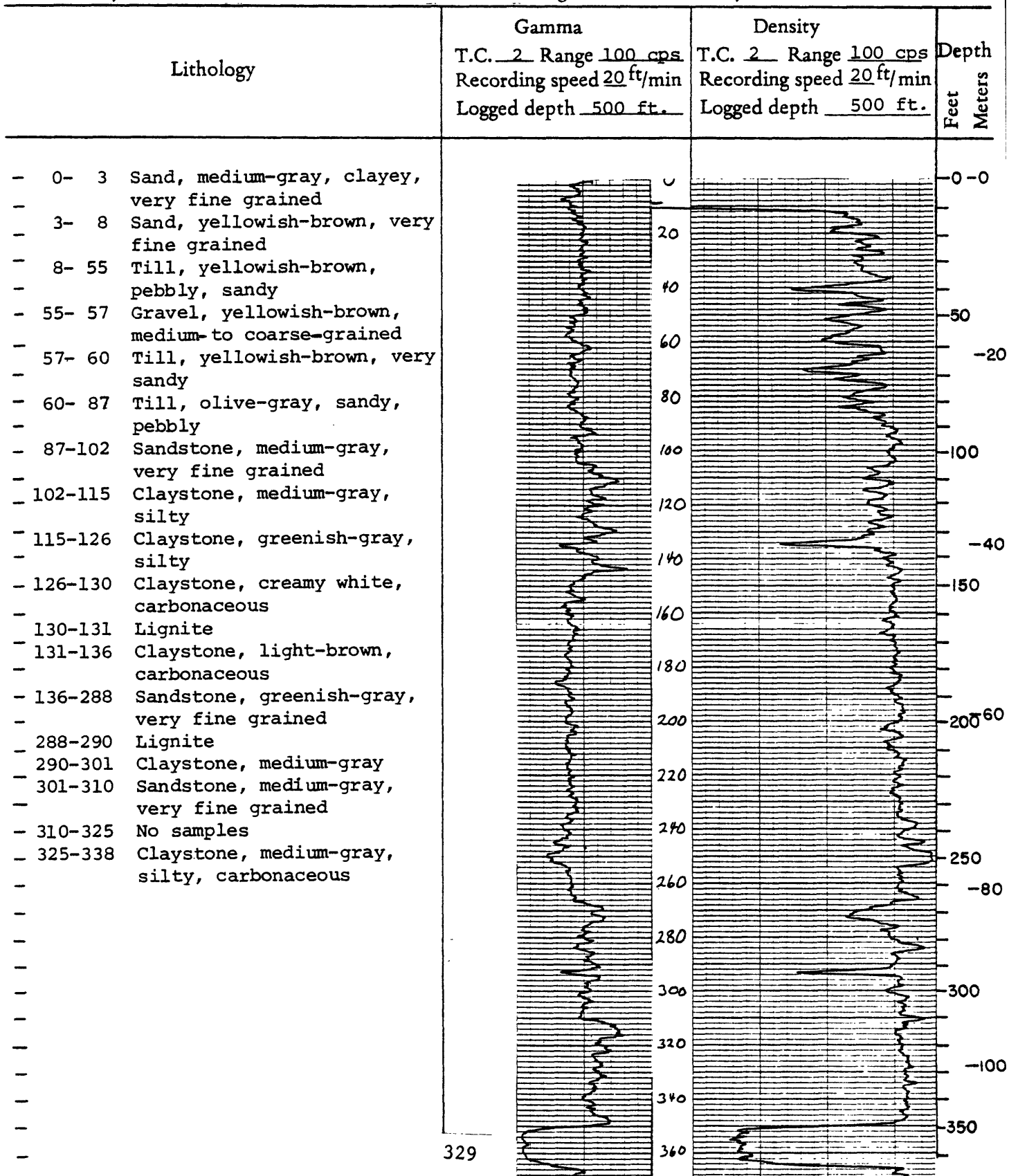
Hole No: MCL-35 Map: Blue Hill Date: 8-17-78 State: ND County: McLean
 Elev.: 2163 ft. Location: T. 150 ^N_S, R. 86 ^E_W, Sec. 1, Tract: cccc Drilled depth: 500 ft.
 Measured: 32 ft. ~~FSL~~ 135 ft. ~~FWL~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 123-125; 350-365; 414-417; 441-444

Remarks: _____

Lithology

Recorded by: _____

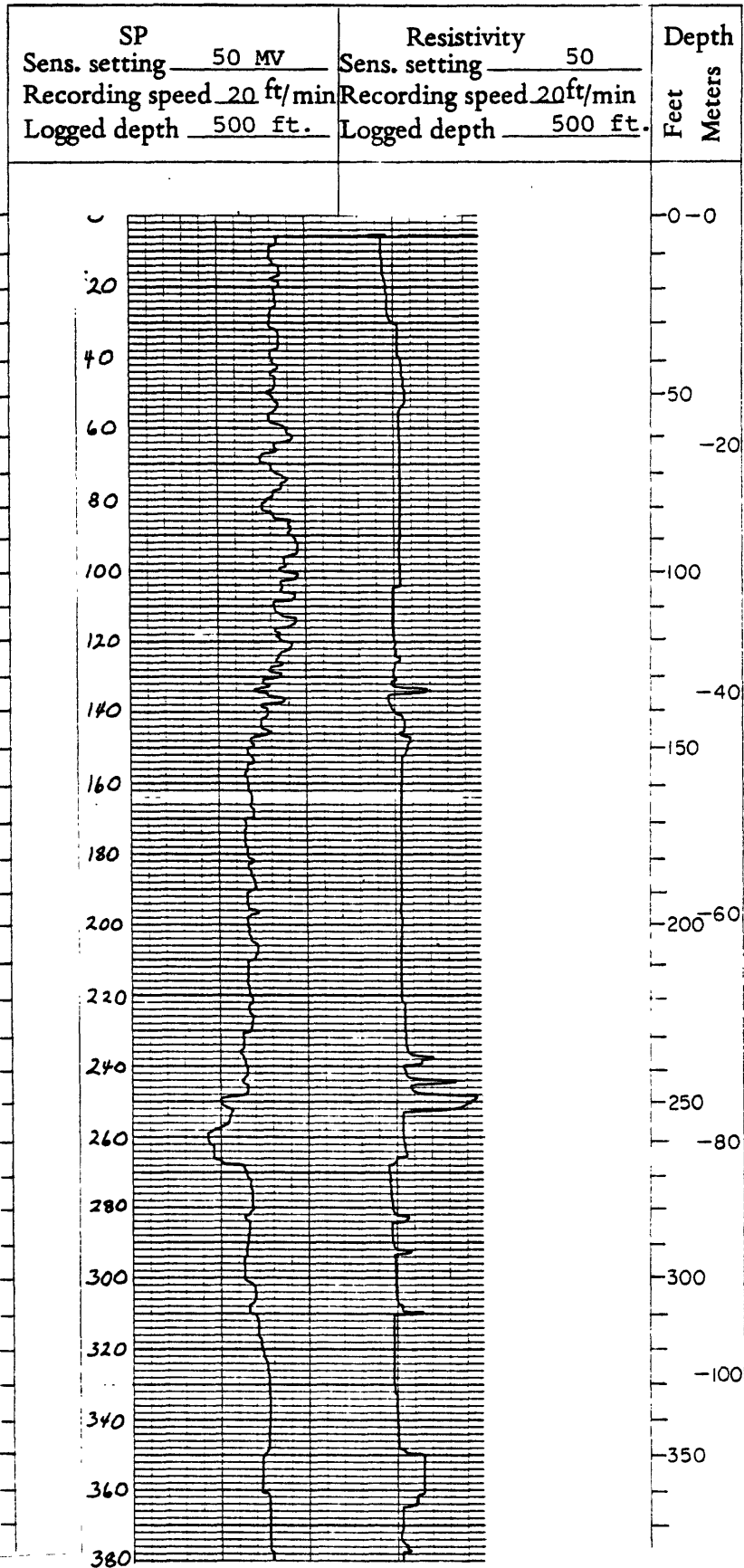
Geophysical logs
 Geologist ^{Yes}No recorded by: Lechner



MCL-35

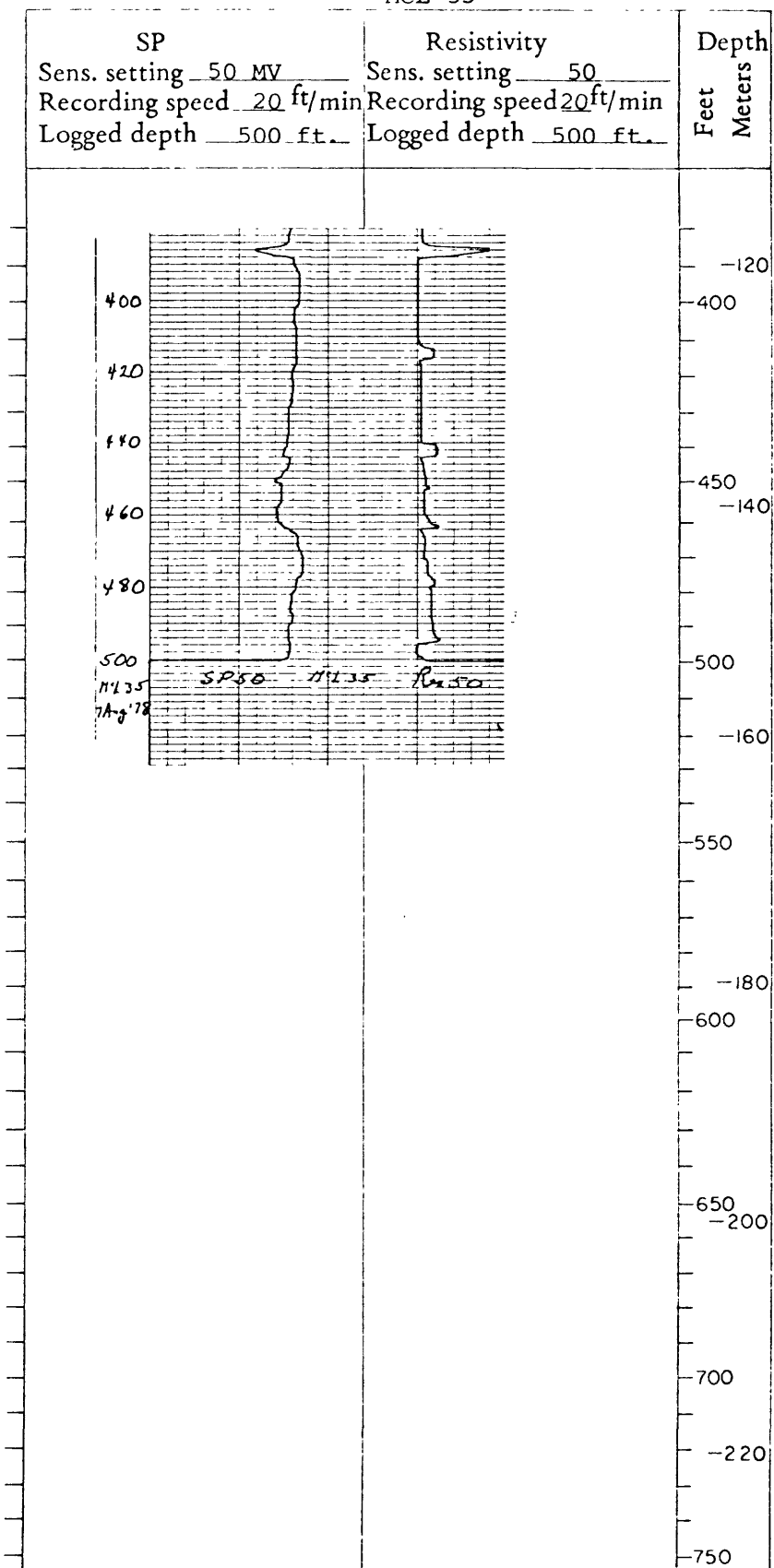
330

Hole number MCL-35



Hole number—continued

MCL-35



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: MCL-36 Map: Douglas West Date: 8-18-78 State: ND County: McLean
 Elev.: 2069 ft. Location: T. 150 ^N_S, R. 85 ^E_W, Sec. 10, Tract: aaaa Drilled depth: 400 ft.
 Measured: 21 ft. ^{FNL}~~FNL~~, 90 ft. ^{FEL}~~FEL~~, Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 151-164; 252-255; 304-306.5

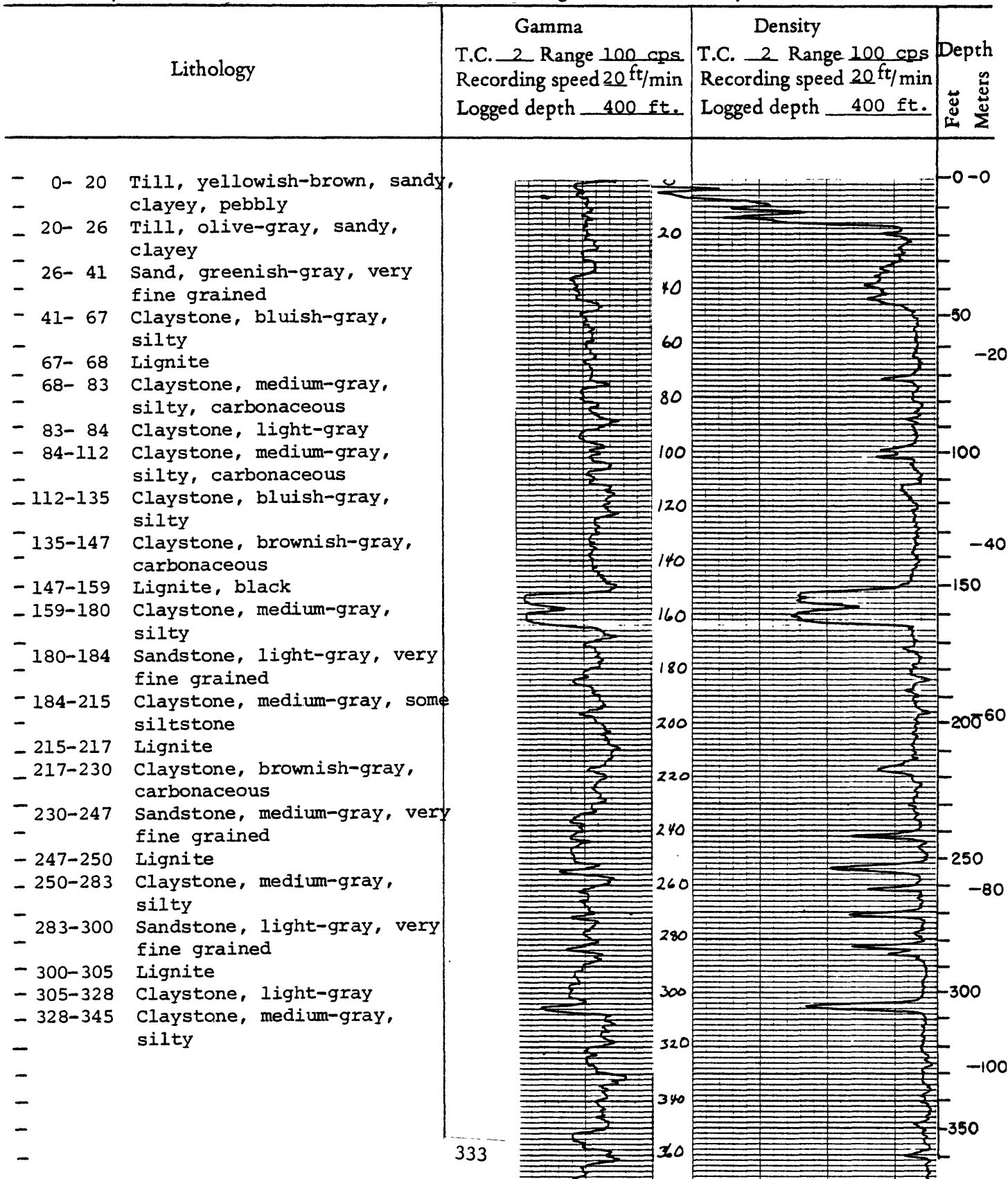
Remarks: _____

Lithology

Recorded by: Fred O'Toole

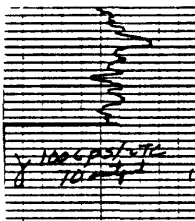
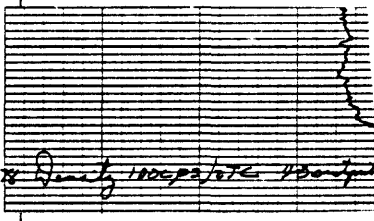
Geophysical logs

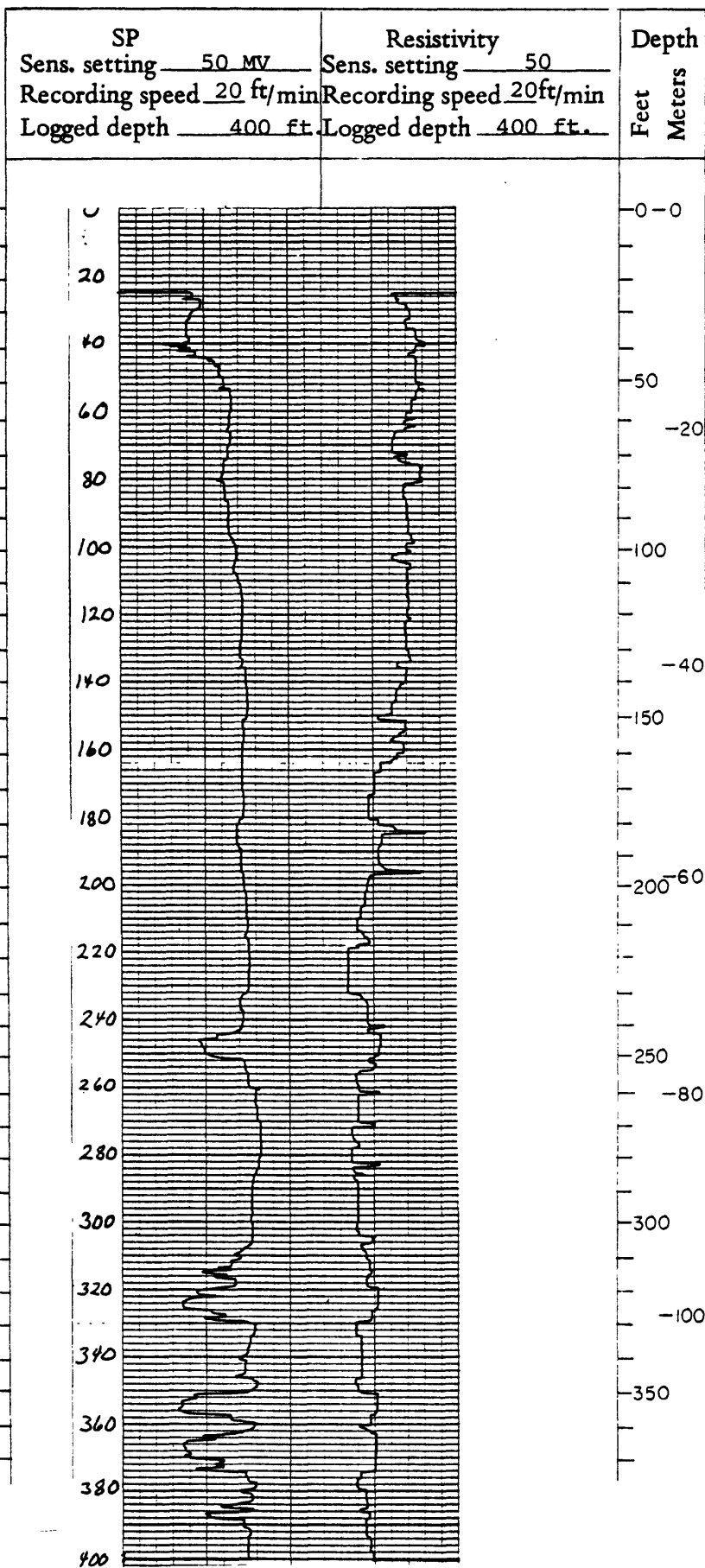
Geologist ^{Yes}~~No~~ recorded by: Lechner



Hole number—continued

MCL-36

Lithology	Gamma	Density	Depth	
	T.C. 2 Range 100 cps Recording speed 20 ft/min Logged depth 400 ft.	T.C. 2 Range 100 cps Recording speed 20 ft/min Logged depth 400 ft.	Feet	Meters
- 345-353 Claystone, medium brownish-gray, carbonaceous				
- 353-358 Sandstone, medium-gray, very fine grained			-120	
- 358-400 Claystone, medium-gray, silty			400	
			450	-140
			500	
			-160	
			550	
			-180	
			600	
			650	-200
			700	
			-220	
			750	



MCL-36

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NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: MCL-37 Map: Douglas West Date: 8-18-78 State: ND County: McLean
 Elev.: 2058 ft. Location: T. 150^N, R. 85^E, Sec. 13, Tract: ccbc Drilled depth: 360 ft.
 Measured: 780 ft. ~~FSL~~ 130 ft. ~~FSL~~ FWL Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 147-160; 232-234; 240-243; 280-282; 305-307

Remarks: _____

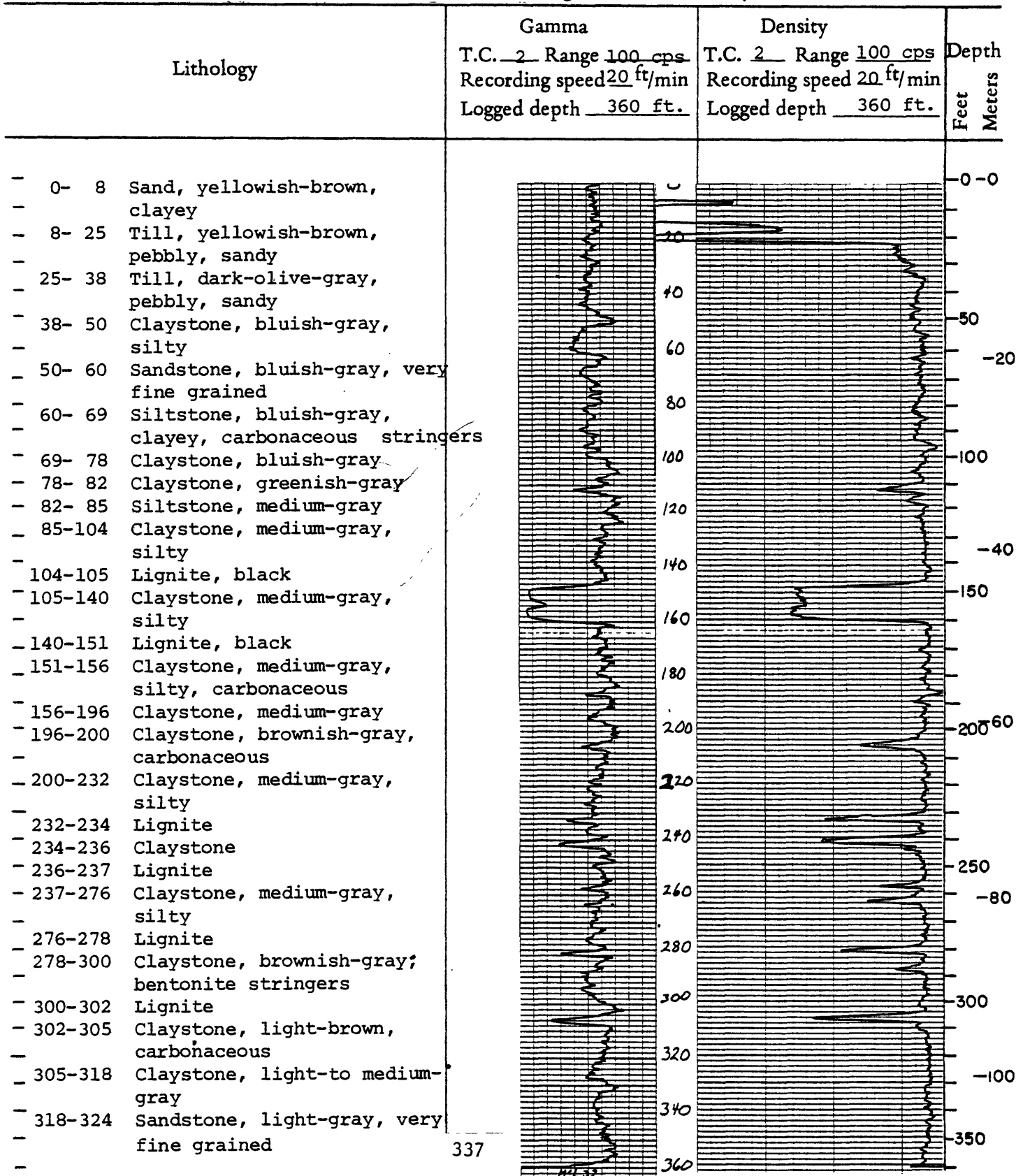
Lithology

Recorded by: Fred O'Toole

Geologist ^{Yes} ~~No~~

Geophysical logs

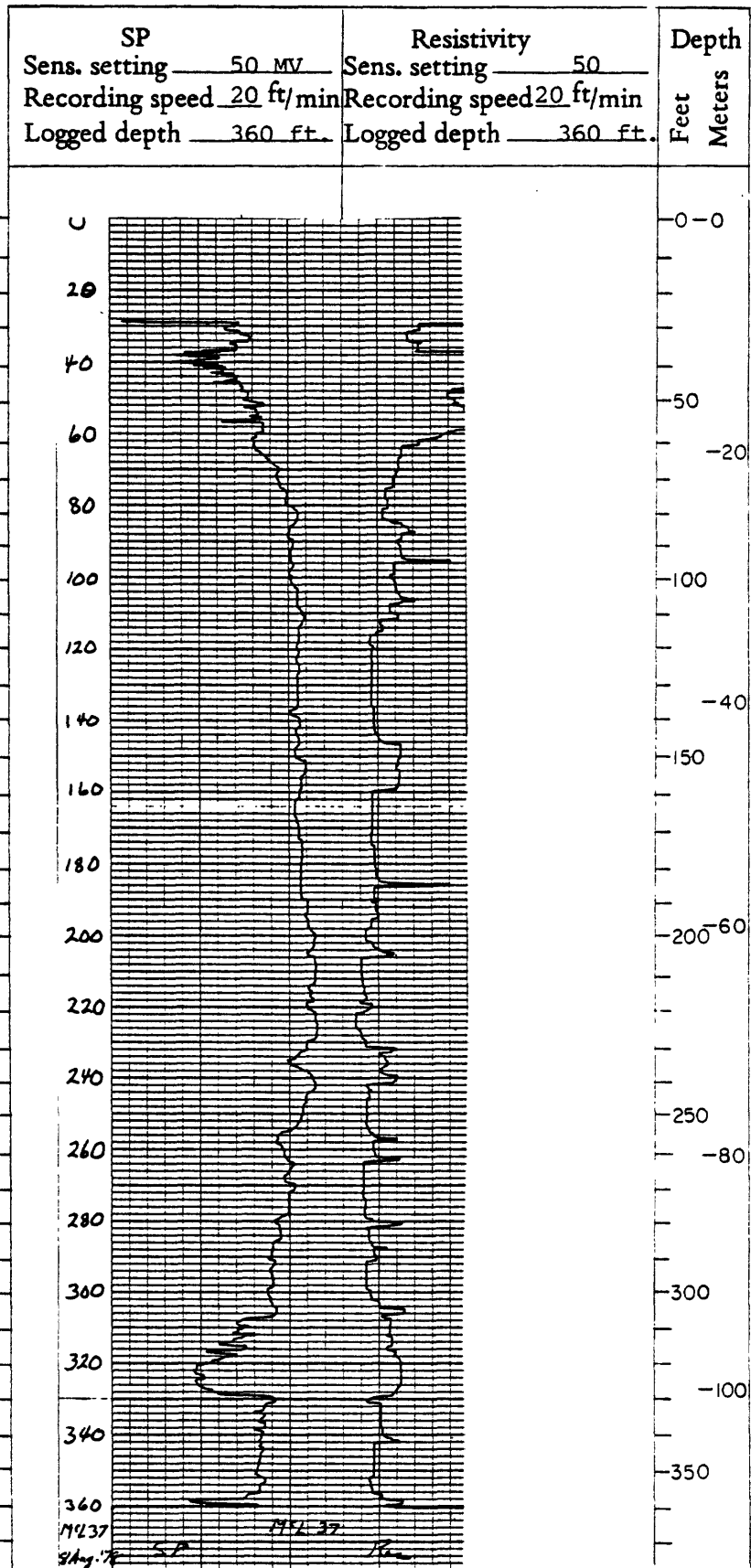
recorded by: Lechner



Hole number--continued

MCL-37

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>360</u> ft.	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>360</u> ft.	Fect	Meters
324-360 Claystone, light-to medium-gray, silty			-120	
			400	
			450	
			-140	
			500	
			-160	
			550	
			-180	
			600	
			650	
			-200	
			700	
			-220	
			750	
	338			



MCL-37

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NORTH DAKOTA GEOLOGICAL SURVEY

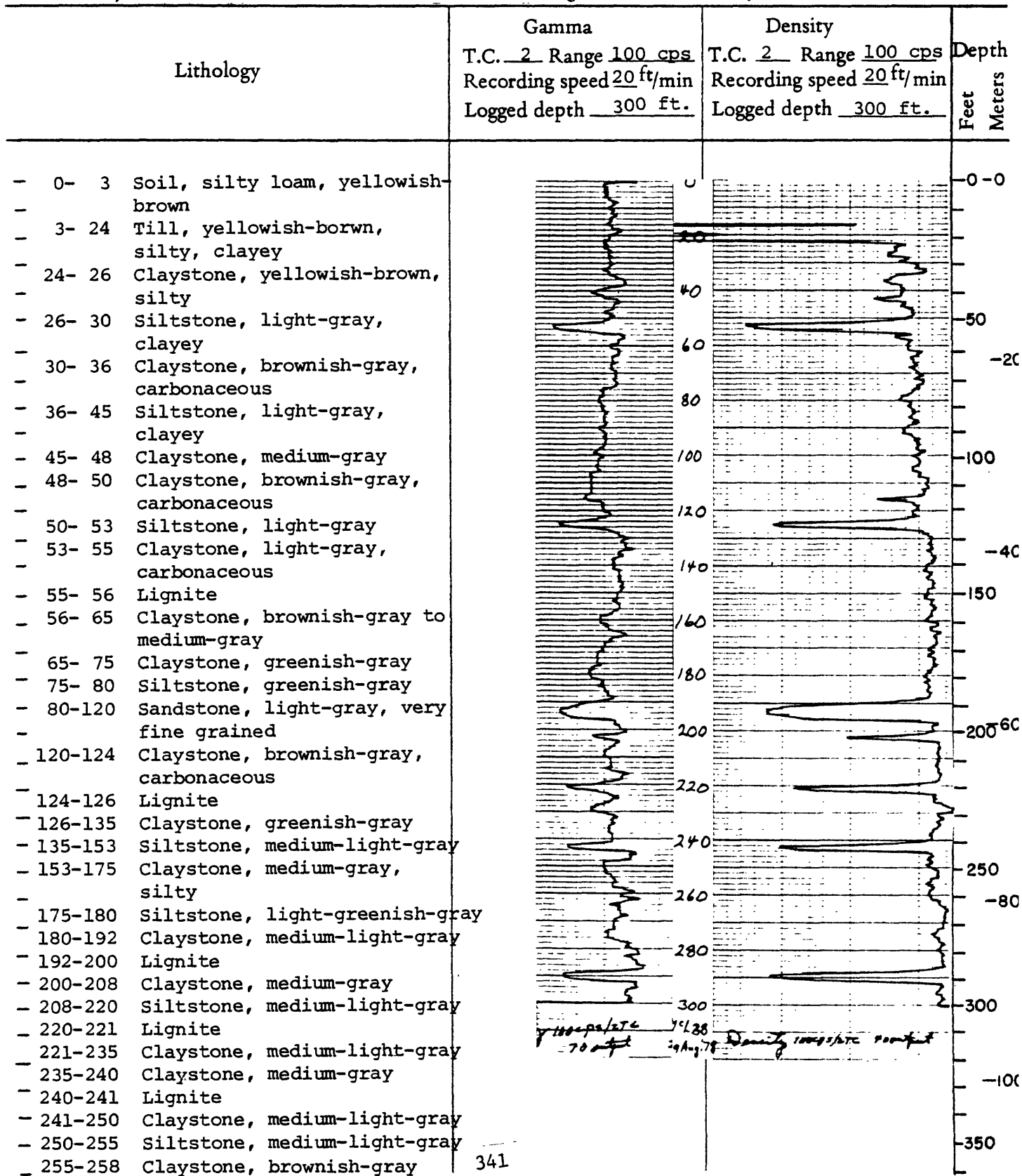
Hole No: MCL-38 Map: Garrison Date: 8-29-78 State: ND County: McLean
 Elev.: 1965 ft. Location: T. 148^N, R. 85^E, Sec. 11, Tract: bbbb Drilled depth: 300 ft.
 Measured: 175 ft. ^{FNL} ~~FWL~~ 25 ft. ^{FWL} ~~FWL~~ Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 52-55; 124-126.5; 190-196; 220-222; 241-244; 288-291

Remarks: _____

Lithology

Recorded by: Clarence Carlson

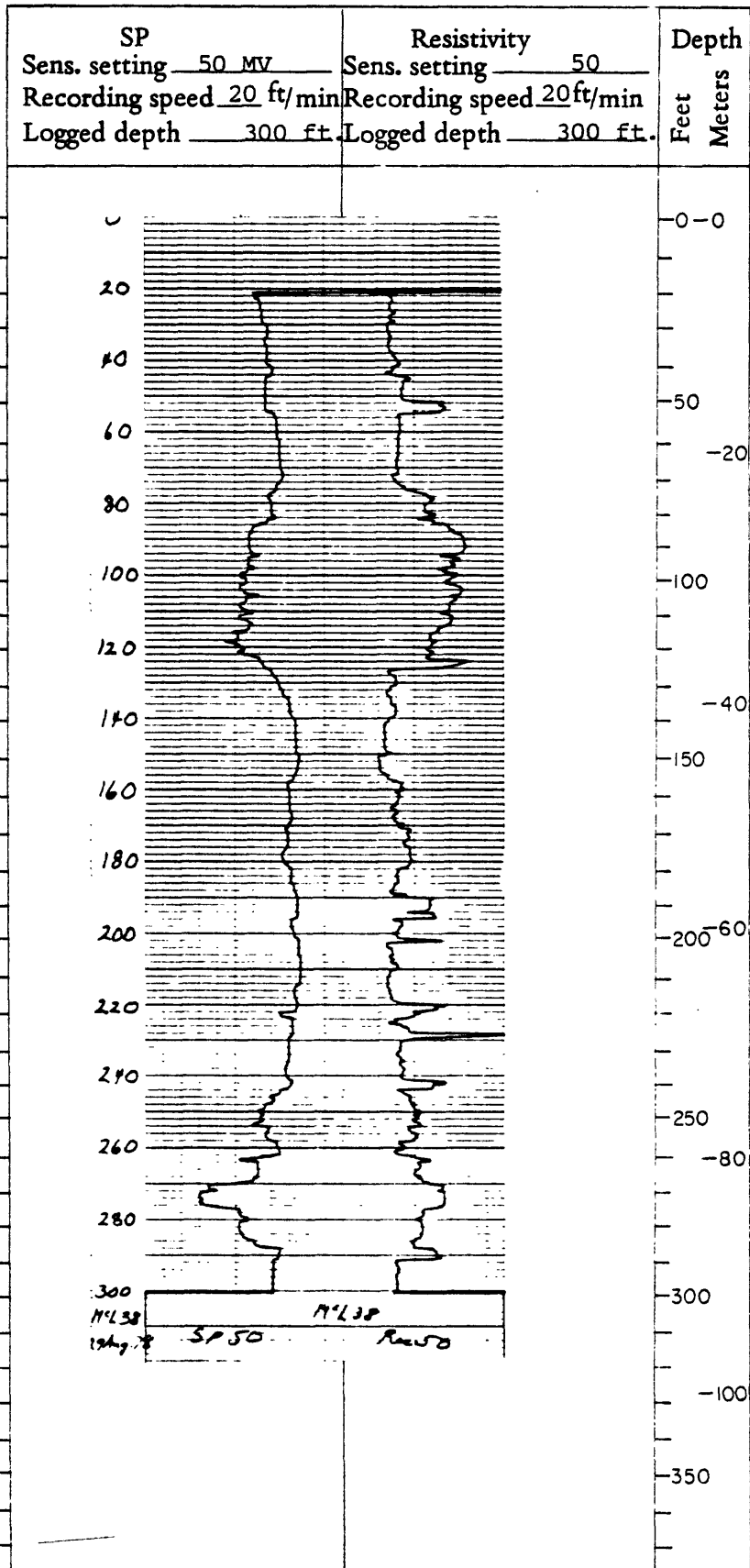
Geophysical logs
 Geologist ^{Yes} ~~No~~ recorded by: Lechner



Hole number—continued

MCL-38

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft.</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft.</u>	Depth	
			Fect	Meters
258-273 Claystone, light-greenish-gray, silty				
273-278 Siltstone, light-greenish-gray			-120	
278-286 Claystone, light-greenish-gray			400	
286-290 Lignite				
290-300 Claystone, brownish-gray				
			450	
			-140	
			500	
			-160	
			550	
			-180	
			600	
			650	
			-200	
			700	
			-220	
			750	



MCL-38

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NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: MCL-39 Map: Lake Nettie Date: 8-31-78 State: ND County: McLean
Elev.: 1951 ft. Location: T. 147^N 3, R. 82^E W, Sec. 26, Tract: aaaa Drilled depth: 200 ft.
Measured: 471 ft. ~~FNL~~ ^{FNL} 25 ft. ~~FWE~~ ^{FEL} Hole size: 4 3/4 in. Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 108-112; 139-141

Remarks:

Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~316~~

Geophysical logs

recorded by: Lechner

Lithology	Gamma		Density		Depth	
	T.C.	Range 100 cps Recording speed 20 ft/min Logged depth 200 ft.	T.C.	Range 100 cps Recording speed 20 ft/min Logged depth 200 ft.	Feet	Meters
0- 1 Soil, yellowish-brown, sandy					0-0	
1- 22 Till, yellowish-brown, pebbly						
22- 60 Till, medium-gray						
60- 67 Sandstone						
67- 70 Lignite						
70- 80 Claystone, medium-gray						
80- 96 Sandstone						
96-104 Claystone, dark-brown, carbonaceous						
104-108 Lignite						
108-118 Claystone, medium-brown						
118-120 Claystone, greenish-brown						
120-128 Claystone, medium-brown						
128-132 Claystone, greenish-gray						
132-133 Lignite						
133-139 Claystone, medium-brown						
139-142 Claystone, dark-gray						
142-172 Claystone, medium-gray						
172-176 Sandstone, light-gray, very fine grained						
176-200 Claystone, medium-gray						

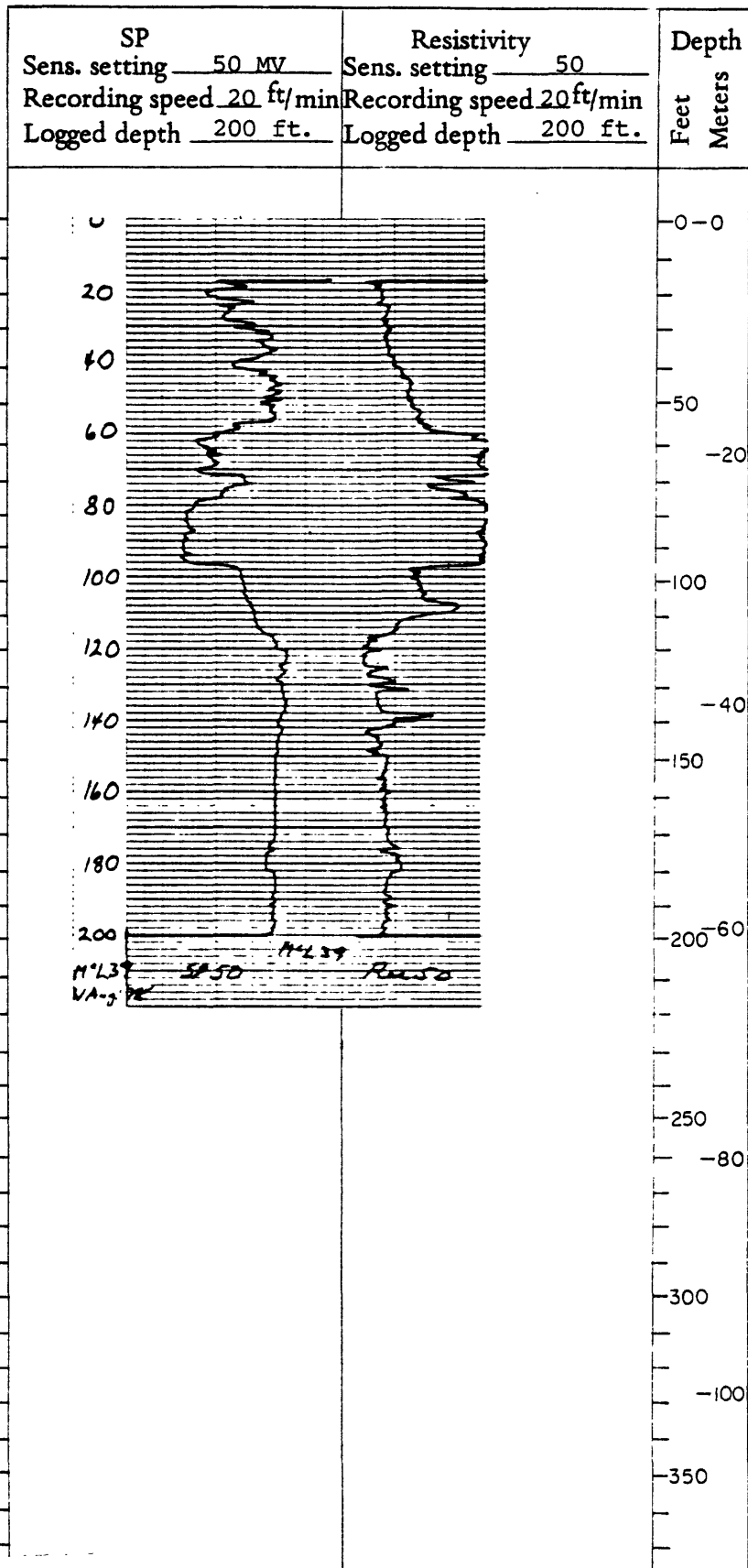
K 139
VA-1

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Hole number—continued

MCL-39i

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>200</u> ft.	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>200</u> ft.	Depth	
			Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued

MCL-39

SP		Resistivity		Depth	
Sens. setting <u>50</u> MV		Sens. setting <u>50</u>		Fet	Meters
Recording speed <u>20</u> ft/min		Recording speed <u>20</u> ft/min			
Logged depth <u>200</u> ft		Logged depth <u>200</u> ft			
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-1 Map: Wolf Butte Date: 9-7-78 State: ND County: Adams
Elev.: 2,845 ft Location: T. 131^N, R. 97^W, Sec. 20, Tract: bbbb Drilled depth: 360 ft
Measured: 68 ft ~~FSL~~^{FNL}, 15 ft ~~FSL~~^{FWL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 185-188; 202-205; 254-257; 280-282.5

Remarks:

Lithology

Recorded by: Tom Heck

Geologist ^{Yes}~~No~~

Geophysical logs

recorded by: Lechner

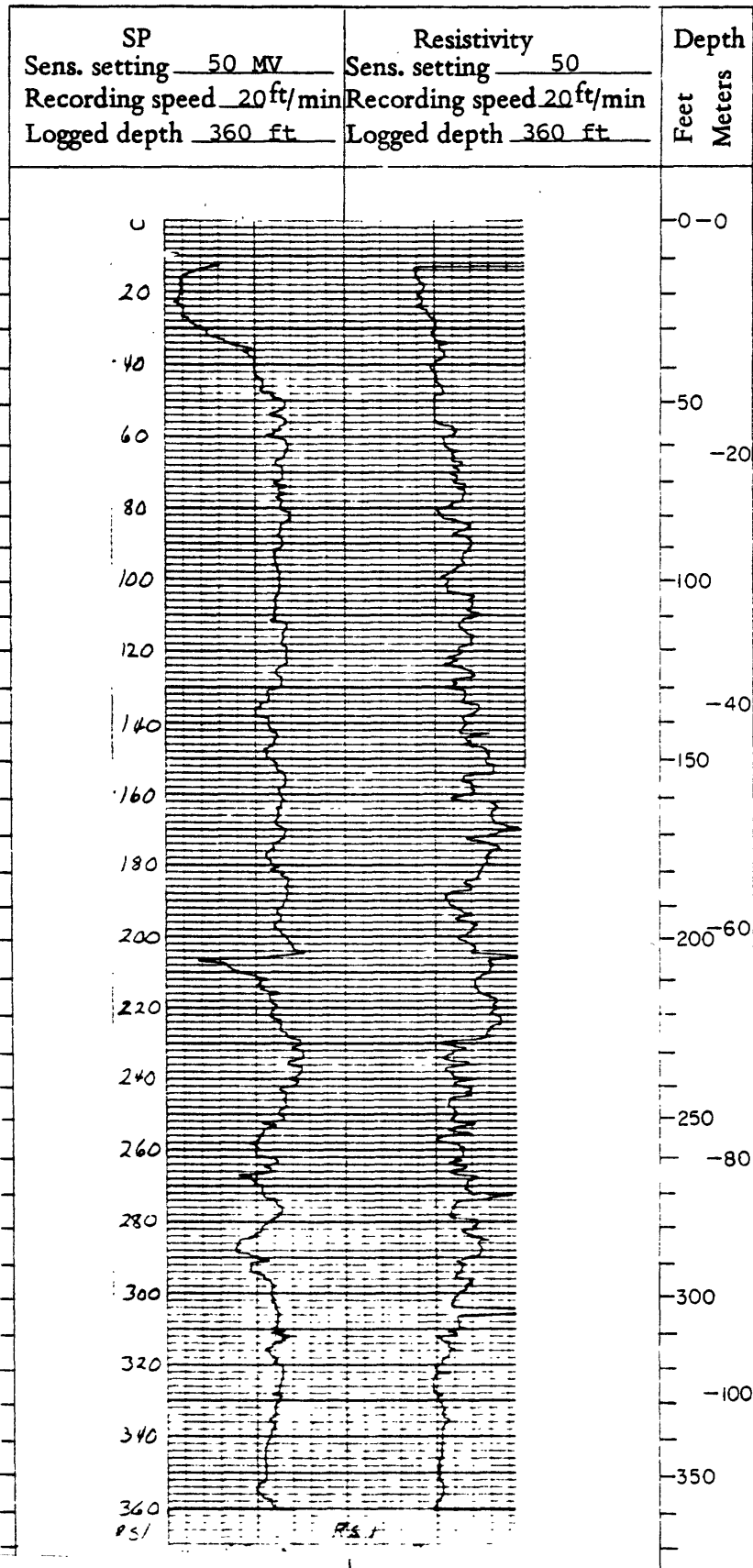
Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps Recording speed 20 ft/min Logged depth 360 ft	T.C. 2	Range 100 cps Recording speed 20 ft/min Logged depth 360 ft	Feet	Meters
0- 3 Sand					0	0
3- 21 Claystone, greenish-gray						
21- 22 Lignite						
22- 25 Claystone, light-green						
25- 27 Claystone, greenish-gray						
27- 28 Claystone, medium-brown						
28- 34 Claystone, greenish-gray						
34- 60 Claystone, medium-gray						
60- 72 Sandstone						
72- 78 Claystone, medium-gray						
78- 79 Lignite						
79- 80 Claystone, brown						
80- 91 Claystone, medium-gray, silty						
91-119 Claystone, greenish-gray						
119-125 Claystone, light-gray						
125-127 Lignite						
127-144 Claystone, light-gray						
144-145 Lignite						
145-151 Sandstone						
151-159 Claystone, greenish-gray						
159-168 Claystone, light-gray						
168-170 Lignite						
170-180 Claystone, light-gray						
180-182 Lignite						
182-186 Claystone, light-brown						
186-203 Claystone, light-gray						
203-235 Sandstone						
235-253 Claystone, dark-gray						
253-256 Lignite						
256-260 Claystone, dark-gray						
260-340 Sandstone						
340-360 Claystone, medium-gray						

349

Hole number—continued

RS-1

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>360</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>360</u> ft	Depth	
			Fect	Meters
340-360 Claystone, medium-gray			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



RS-1

352

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-2 Map: Ehler Lake Date: 9-5-78 State: ND County: Adams
 Elev.: 2,710 ft Location: T. 131 ^N, R. 96 ^W, Sec. 6, Tract: abcc Drilled depth: 220 ft
 Measured: 1282 ft ^{FNL}, 2620 ft ^{FNL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 86.5-89

Remarks: _____

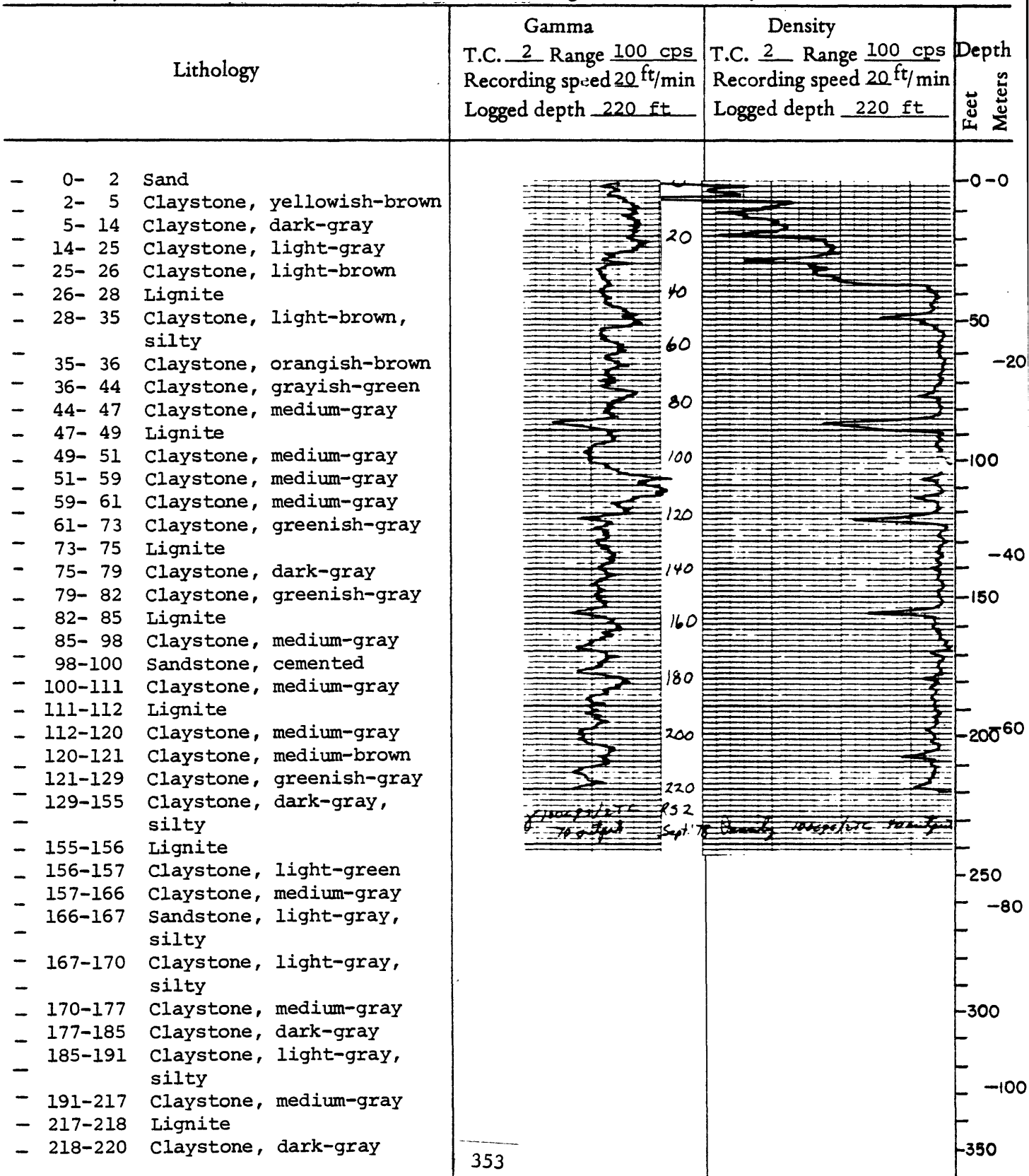
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~XX~~

Geophysical logs

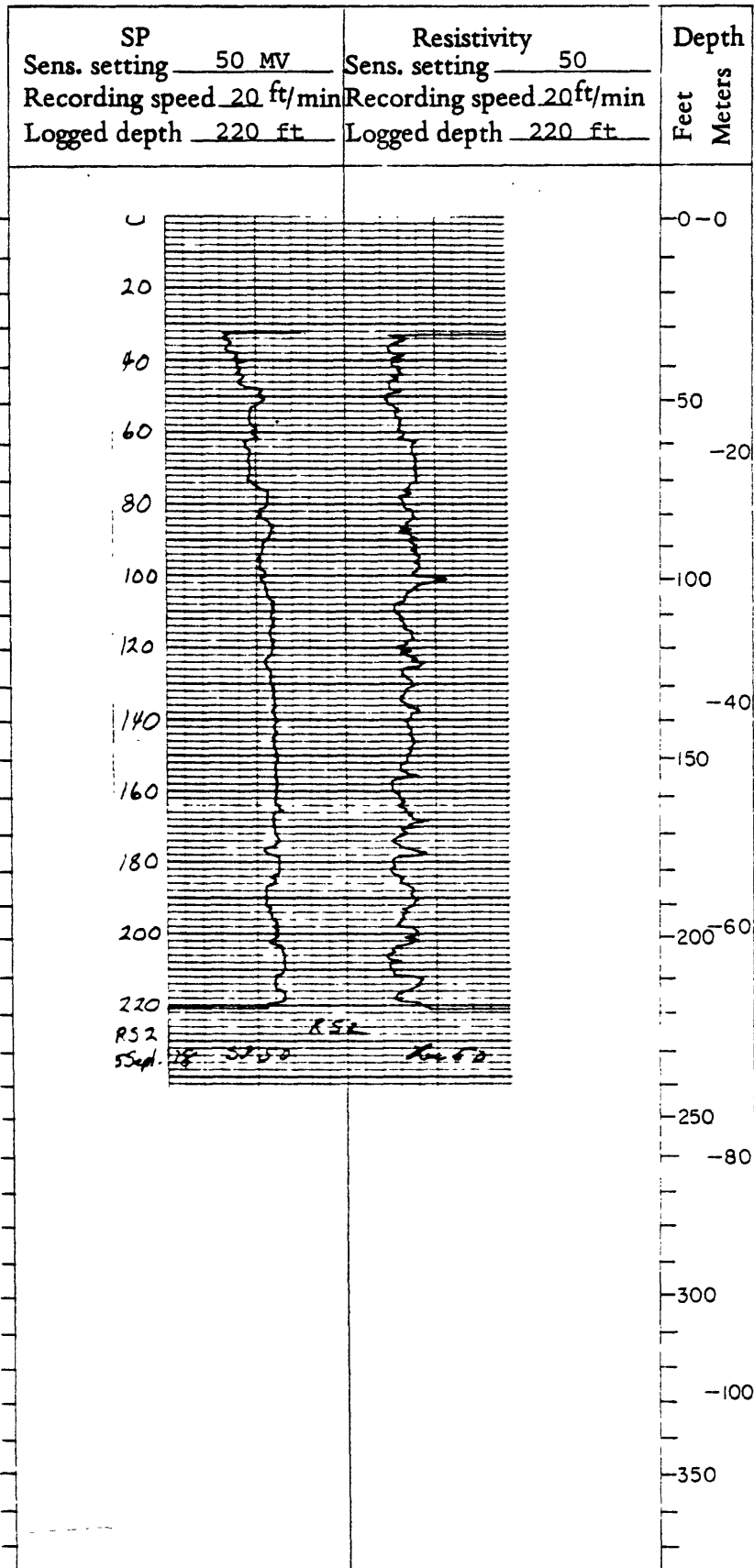
recorded by: Lechner



Hole number—continued

RS-2

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>220</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>220</u> ft	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued

RS-2

SP		Resistivity		Depth	
Sens. setting <u>50 mv</u>		Sens. setting <u>50</u>		Feet	Meters
Recording speed <u>20 ft/min</u>		Recording speed <u>20 ft/min</u>			
Logged depth <u>220 ft</u>		Logged depth <u>220 ft</u>			
					-120
					-400
					-450
					-140
					-500
					-160
					-550
					-180
					-600
					-650
					-200
					-700
					-220
					-750

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-3 Map: Ehler Lake Date: 9-5-78 State: ND County: Adams
 Elev.: 2,678 ft Location: T. 132^N, R. 96^W, Sec. 20, Tract: bbbb Drilled depth: 240 ft
 Measured: 30 ft ~~FNL~~ 285 ft ~~FWL~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 120-122.5

Remarks: _____

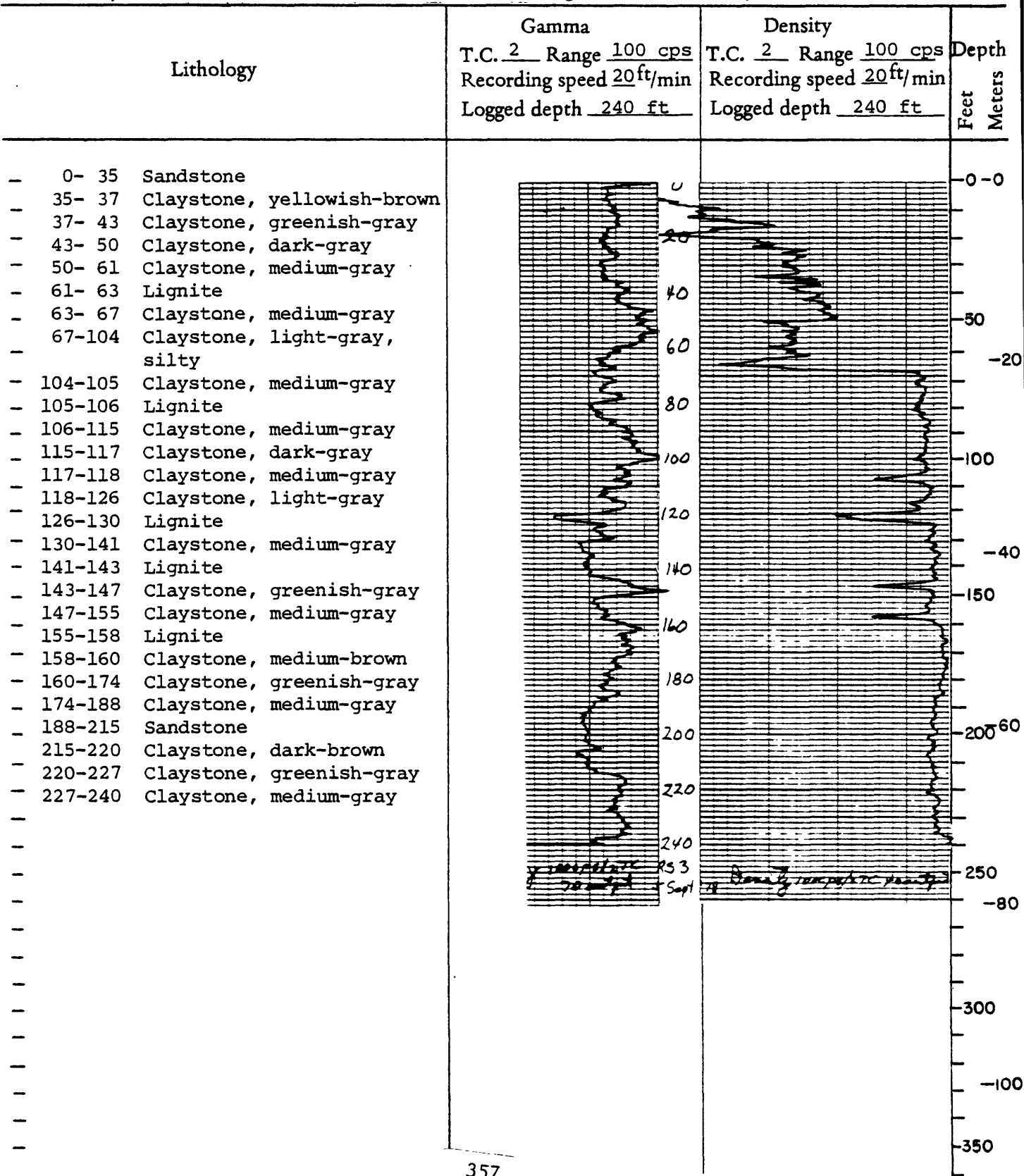
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~XX~~

Geophysical logs

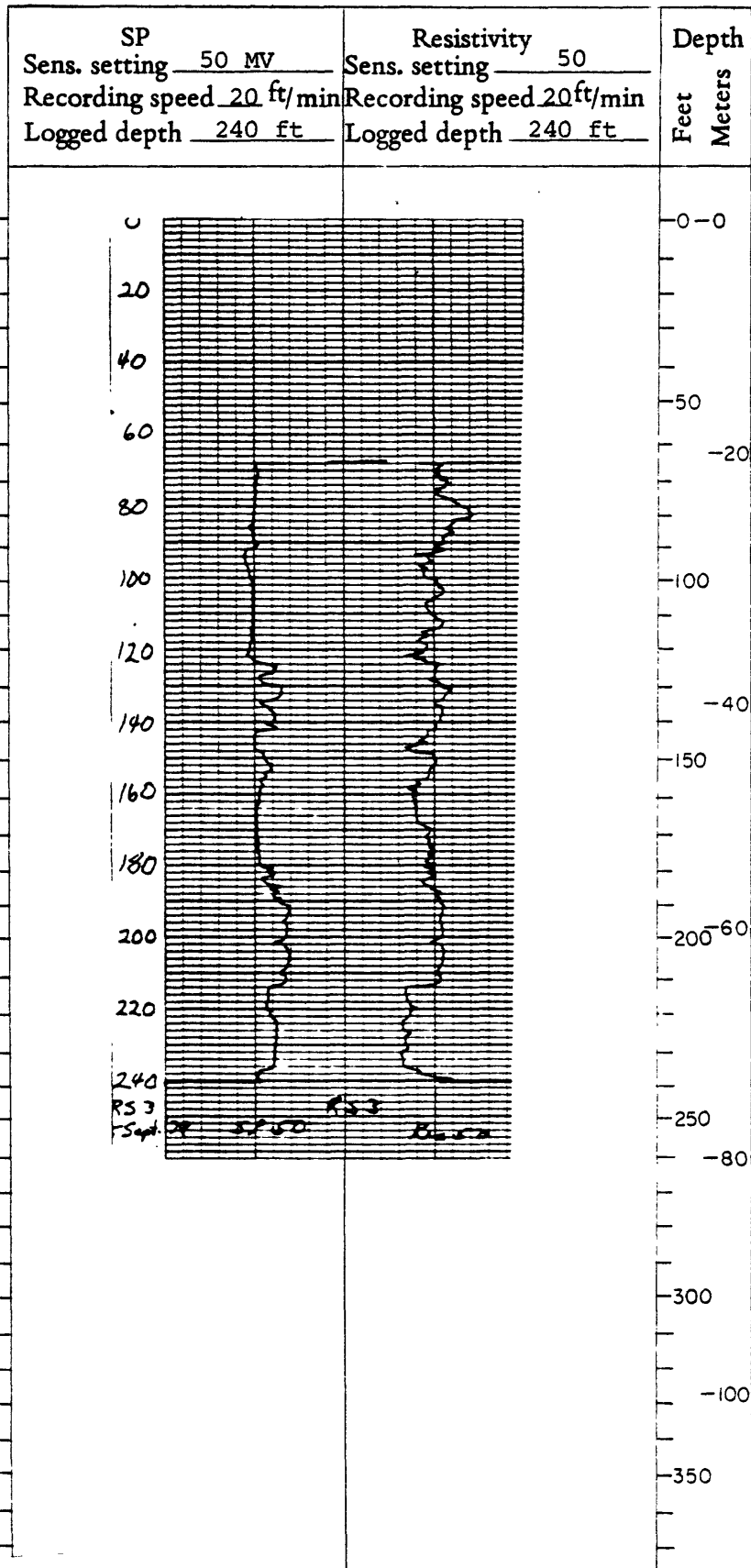
recorded by: Lechner



Hole number—continued

RS-3

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>240</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>240</u> ft	Depth	
			Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued

RS-3

SP		Resistivity		Depth	
Sens. setting	50 MV	Sens. setting	50	Feet	Meters
Recording speed	20 ft/min	Recording speed	20 ft/min		
Logged depth	240 ft	Logged depth	240 ft		
					-120
					-400
					-450
					-140
					-500
					-160
					-550
					-180
					-600
					-650
					-200
					-700
					-220
					-750

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-4 Map: Ehler Lake Date: 9-5-78 State: ND County: Adams
 Elev.: 2,632 ft Location: T. 132^N, R. 96^W, Sec. 22, Tract: dccc Drilled depth: 220 ft
 Measured: 50 ft ^{FSL} 2540 ft ^{FEL} Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 79-81; 158-160

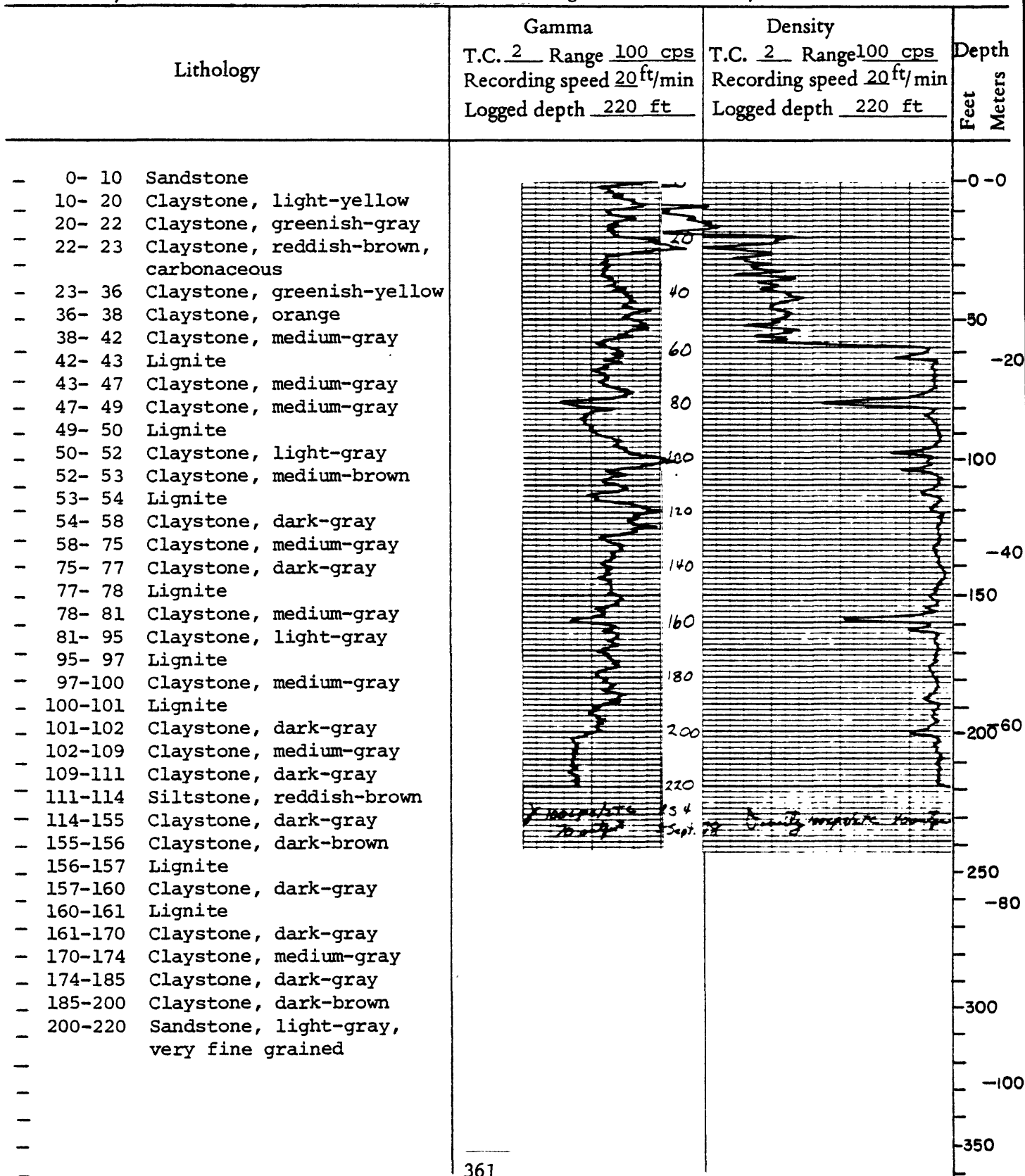
Remarks: _____

Lithology

Recorded by: Tom Heck

Geophysical logs

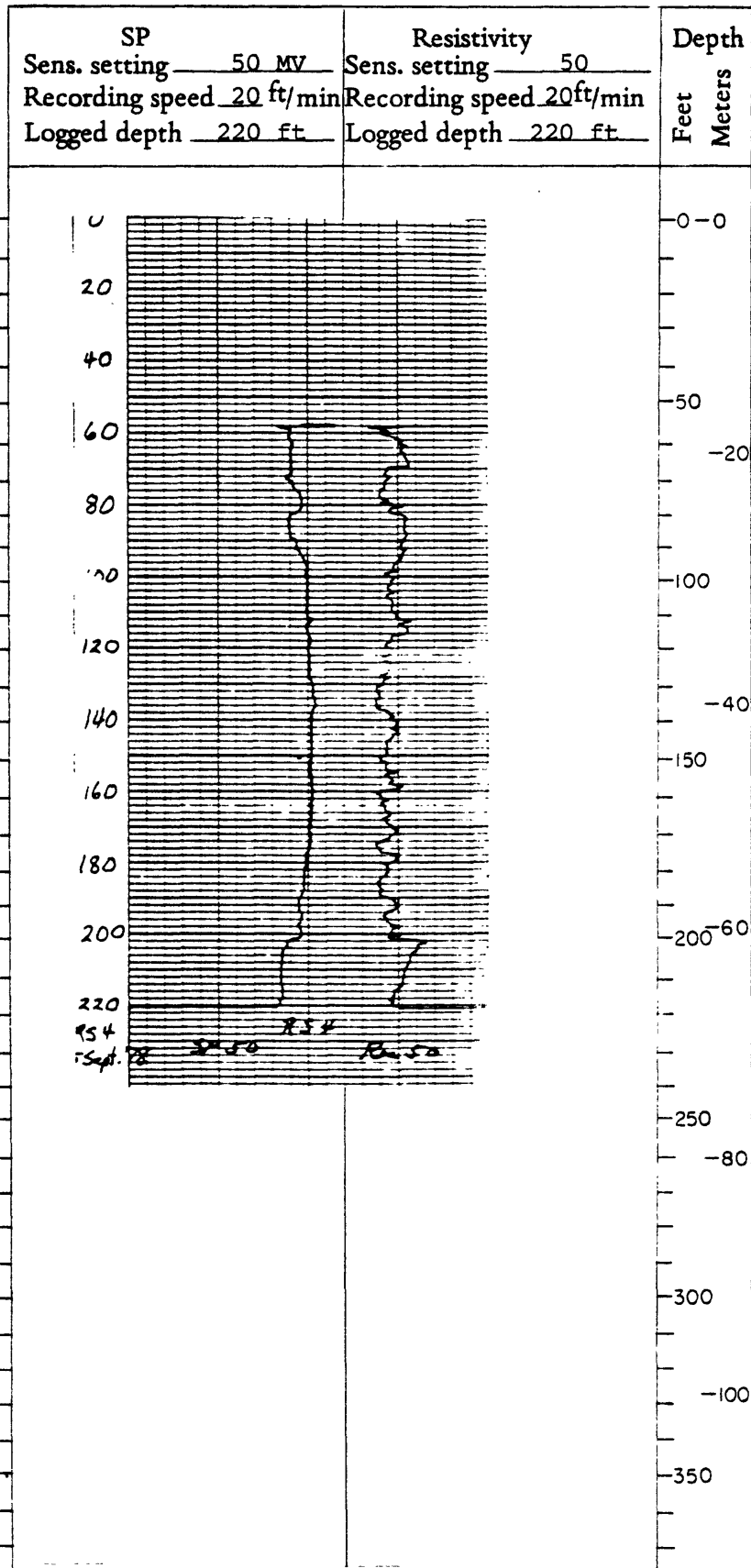
Geologist ^{Yes} ~~XX~~ recorded by: Lechner



Hole number—continued

RS-4

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>220</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>220</u> ft	Depth	
			Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



RS-4

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NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-5 Map: Liens Dam Date: 9-5-78 State: ND County: Adams
 Elev.: 2,695 ft Location: T. 132^N, R. 96^W, Sec. 14, Tract: aabb Drilled depth: 300 ft
 Measured: 15 ft ^{FNL} 1300 ft ^{FEL} Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 26-29; 40-43; 83-87

Remarks: _____

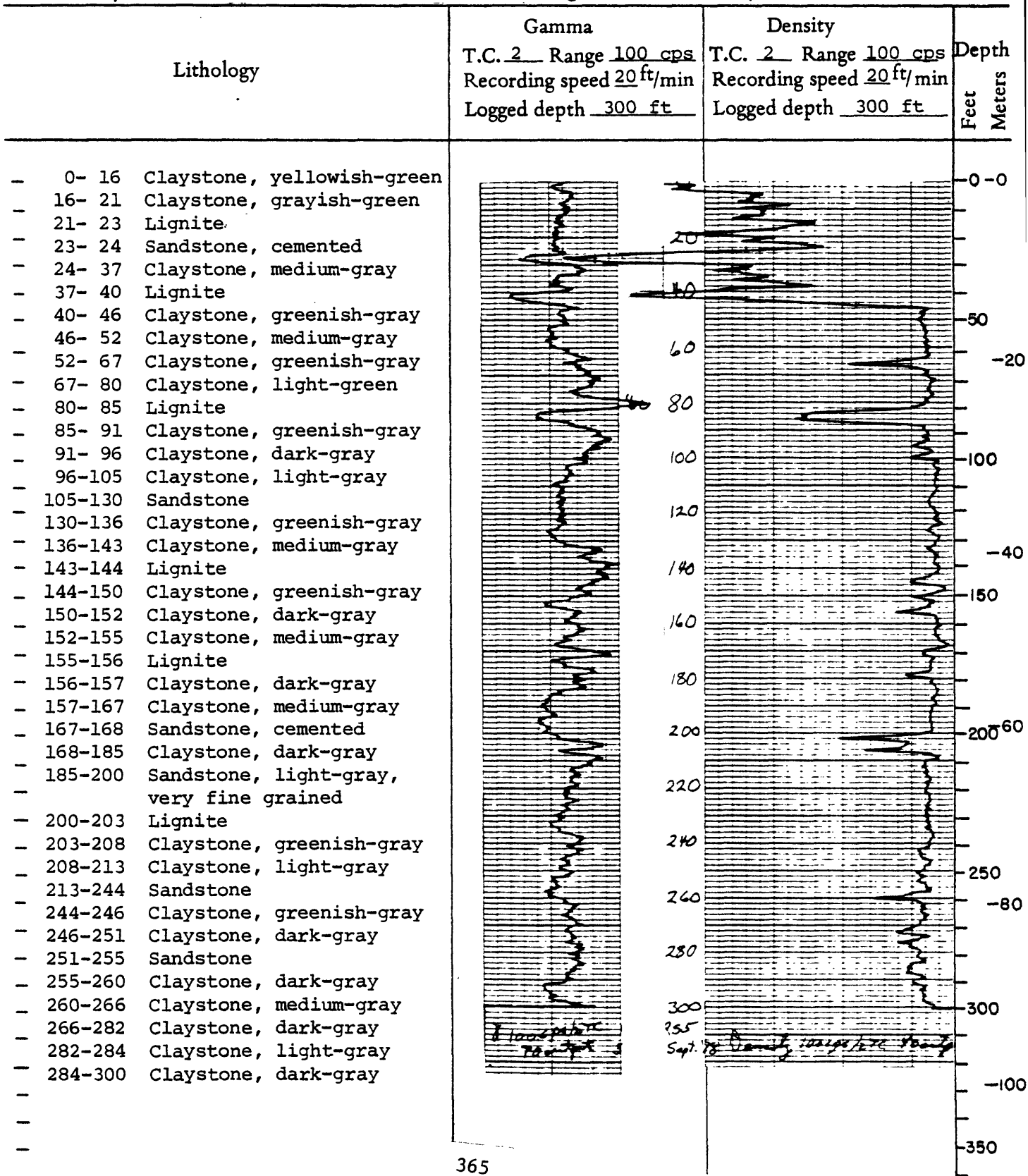
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~No~~

Geophysical logs

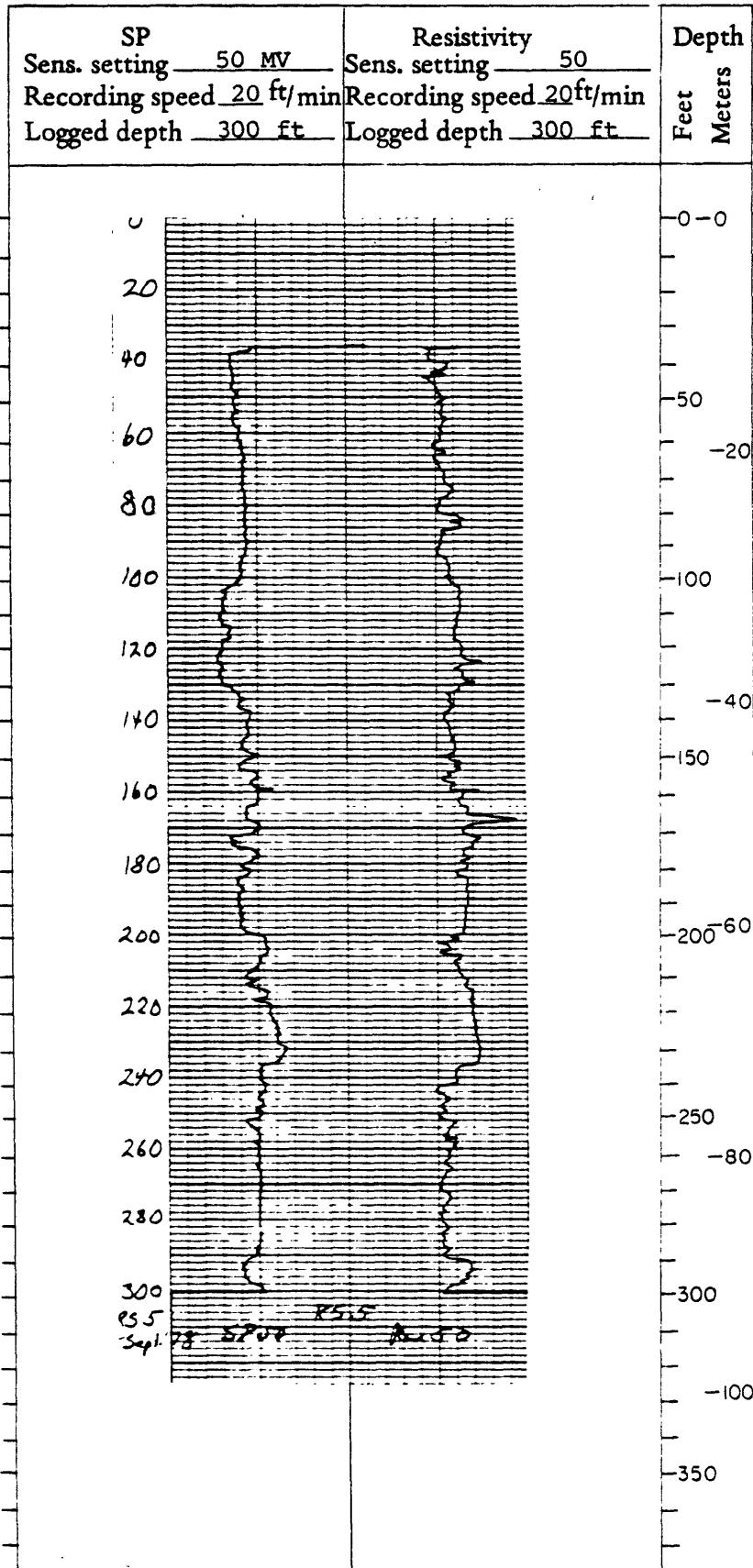
recorded by: Lechner



Hole number—continued

RS-5

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20</u> ft/min Logged depth <u>300 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20</u> ft/min Logged depth <u>300 ft</u>	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued

RS-5

SP		Resistivity		Depth	
Sens. setting	50 MV	Sens. setting	50	Feet	Meters
Recording speed	20 ft/min	Recording speed	20 ft/min		
Logged depth	300 ft	Logged depth	300 ft		
					-120
					-400
					-450
					-140
					-500
					-160
					-550
					-180
					-600
					-650
					-200
					-700
					-220
					-750

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-6 Map: Taylor Butte Date: 9-5-78 State: ND County: Adams
Elev.: 2,832 ft Location: T. 132^N, R. 95^E W, Sec. 22, Tract: bdbb Drilled depth: 400 ft
Measured: 900 ft ~~FSL~~ ^{FNL}, 800 ft ~~FSL~~ ^{FNL} FWL, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 72-78; 106-109; 126-128; 178-180

Remarks:

Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~XX~~

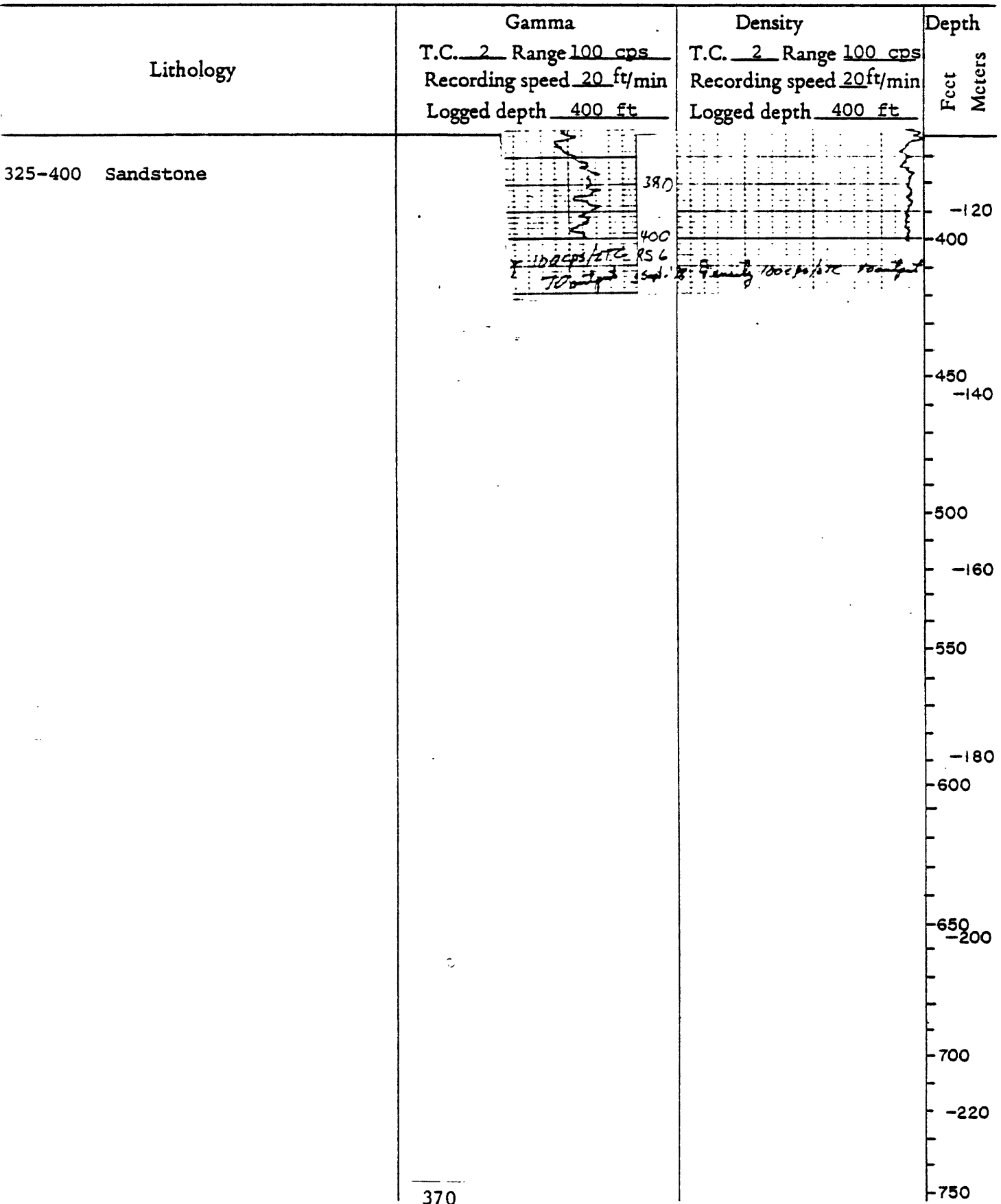
Geophysical logs

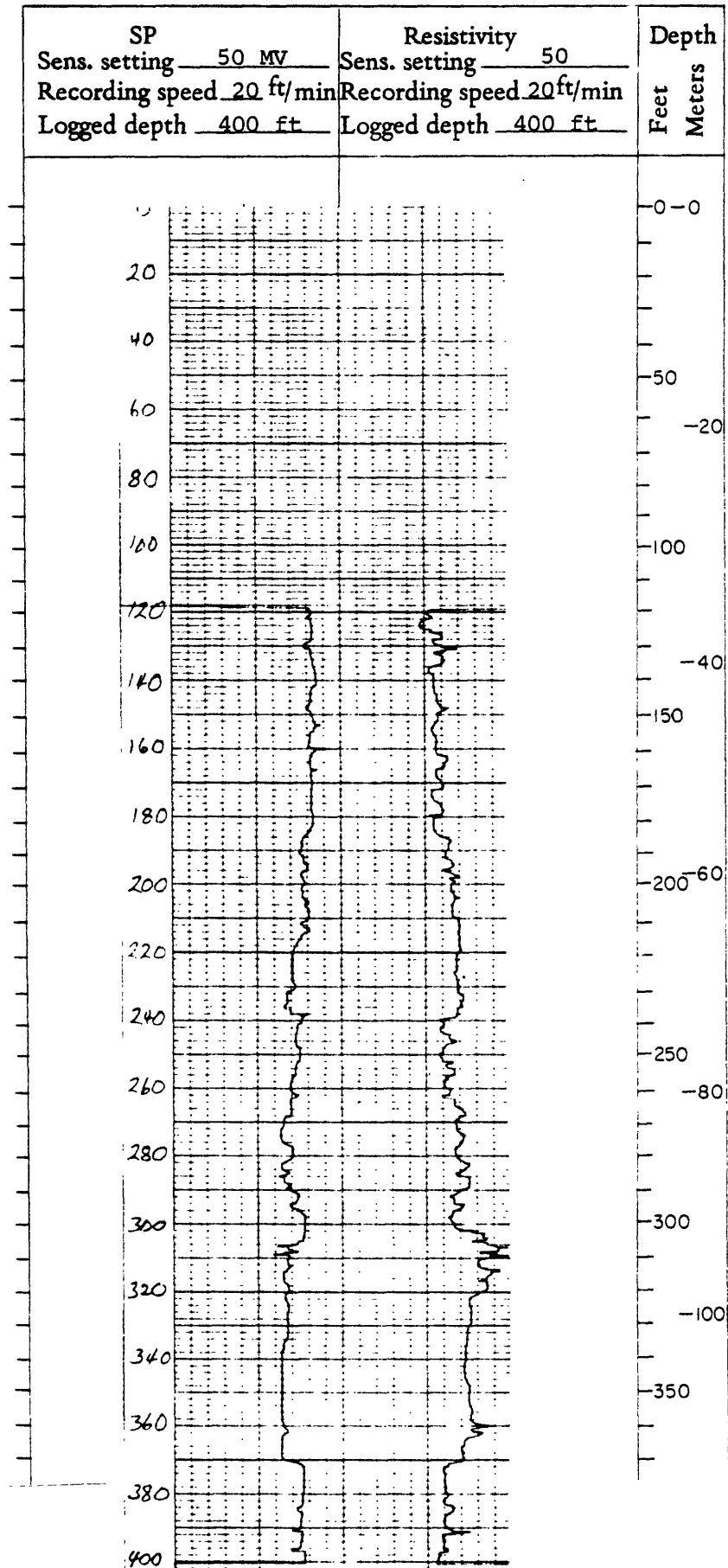
recorded by: Lechner

[illegible]

Hole number—continued

RS-6





RS-6

372

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-7 Map: Taylor Butte SE Date: 9-6-78 State: ND County: Adams
 Elev.: 2,905 ft Location: T. 130^N, R. 95^W, Sec. 19, Tract: cbcc Drilled depth: 300 ft
 Measured: 1500 ft ~~FSL~~ ^{FSL}, 38 ft ~~FWL~~ ^{FWL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 16-22.5

Remarks: _____

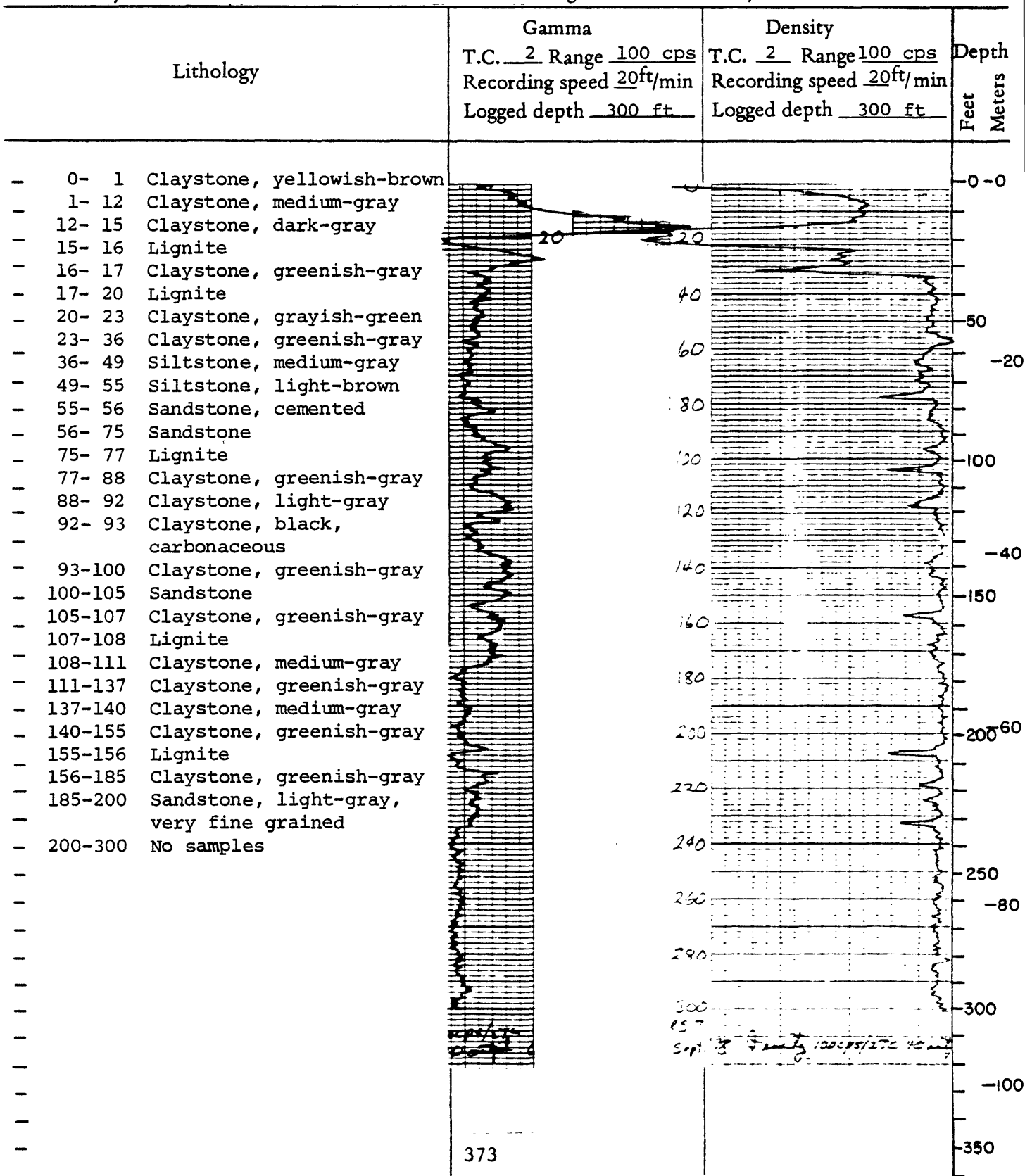
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~No~~

Geophysical logs

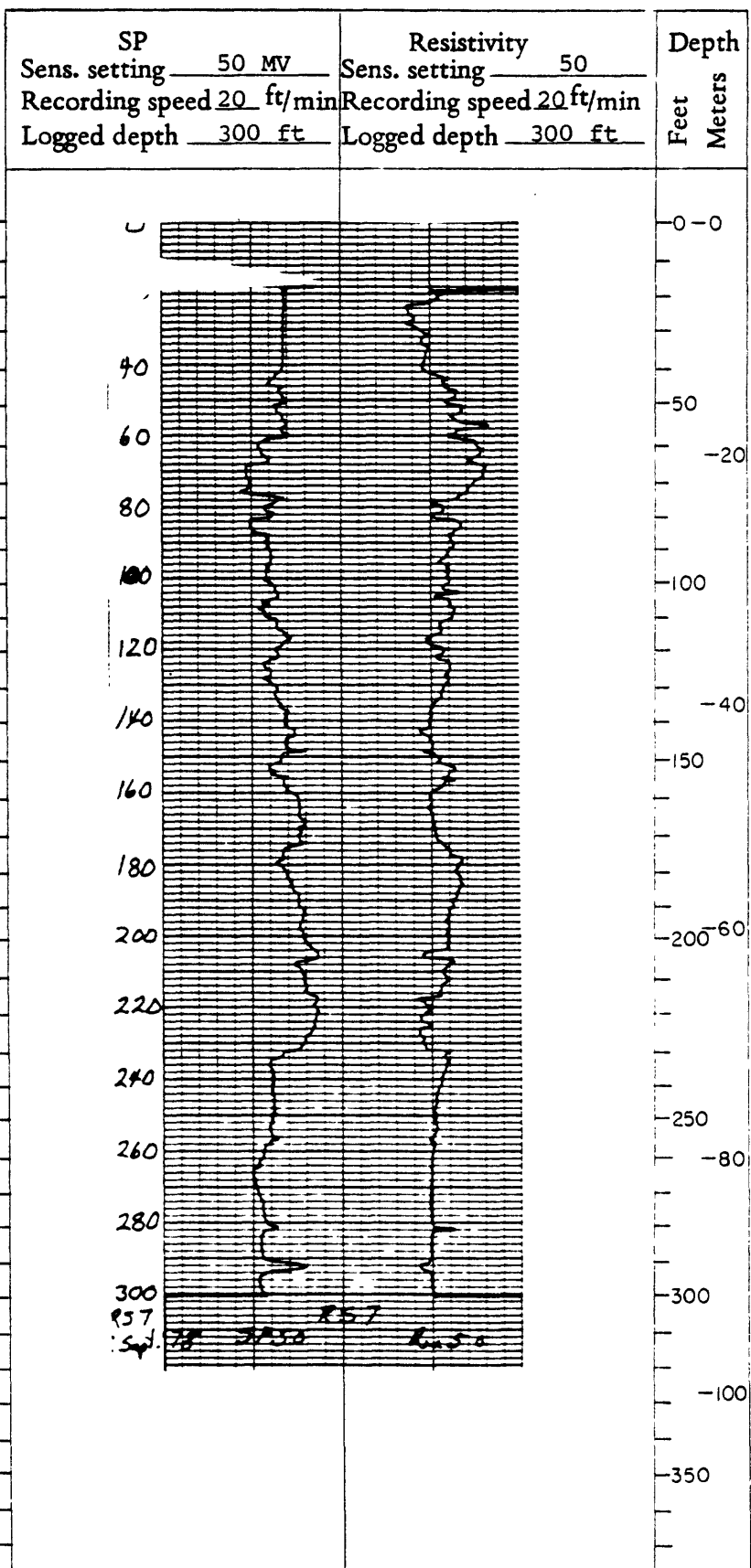
recorded by: Lechner



Hole number—continued

RS-7

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>300</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>300</u> ft	Depth	
			Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued

RS-7

SP		Resistivity		Depth	
Sens. setting	50 MV	Sens. setting	50	Fect	Meters
Recording speed	20 ft/min	Recording speed	20 ft/min		
Logged depth	300 ft	Logged depth	300 ft		
					-120
					400
					450
					-140
					500
					-160
					550
					-180
					600
					650
					-200
					700
					-220
					750

Hole No: RS-8 Map: Pearl Butte Date: 9-6-78 State: ND County: Adams
Elev.: 2,745 ft Location: T. 129^N, R. 94^W, Sec. 6, Tract: cbbc Drilled depth: 140 ft
Measured: 2200 ft ^{FMS} FSL, 70 ft ^{FWS} FWL, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 24-29; 32-45

Lithology

Geologist ☒ Yes ☒ No

recorded by: Lechner

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Hole number—continued

RS-8

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>140</u> ft	T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>140</u> ft	Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	

RS-8

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RS-8

Depth
Feet
Meters

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-9 Map: Pearl Butte Date: 9-6-78 State: ND County: Adams
 Elev.: 2680 ft Location: T. 129^N, R. 94^W, Sec. 16, Tract: abba Drilled depth: 100 ft
 Measured: 27 ft ^{FNL} 2092 ft ^{FEL} FWL Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 2-8

Remarks: _____

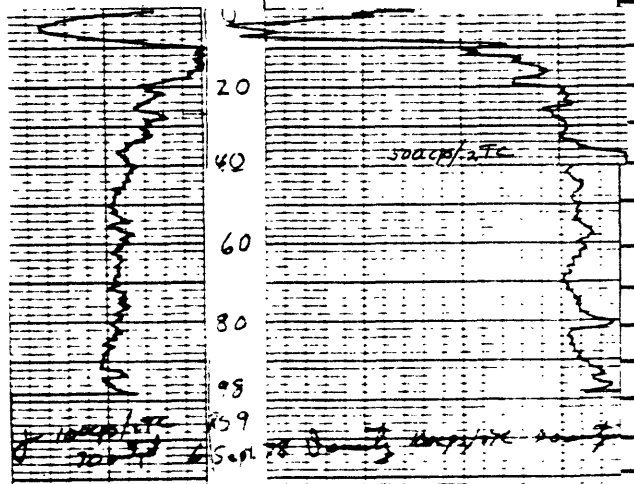
Lithology

Recorded by: Clarence CarlsonGeologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner

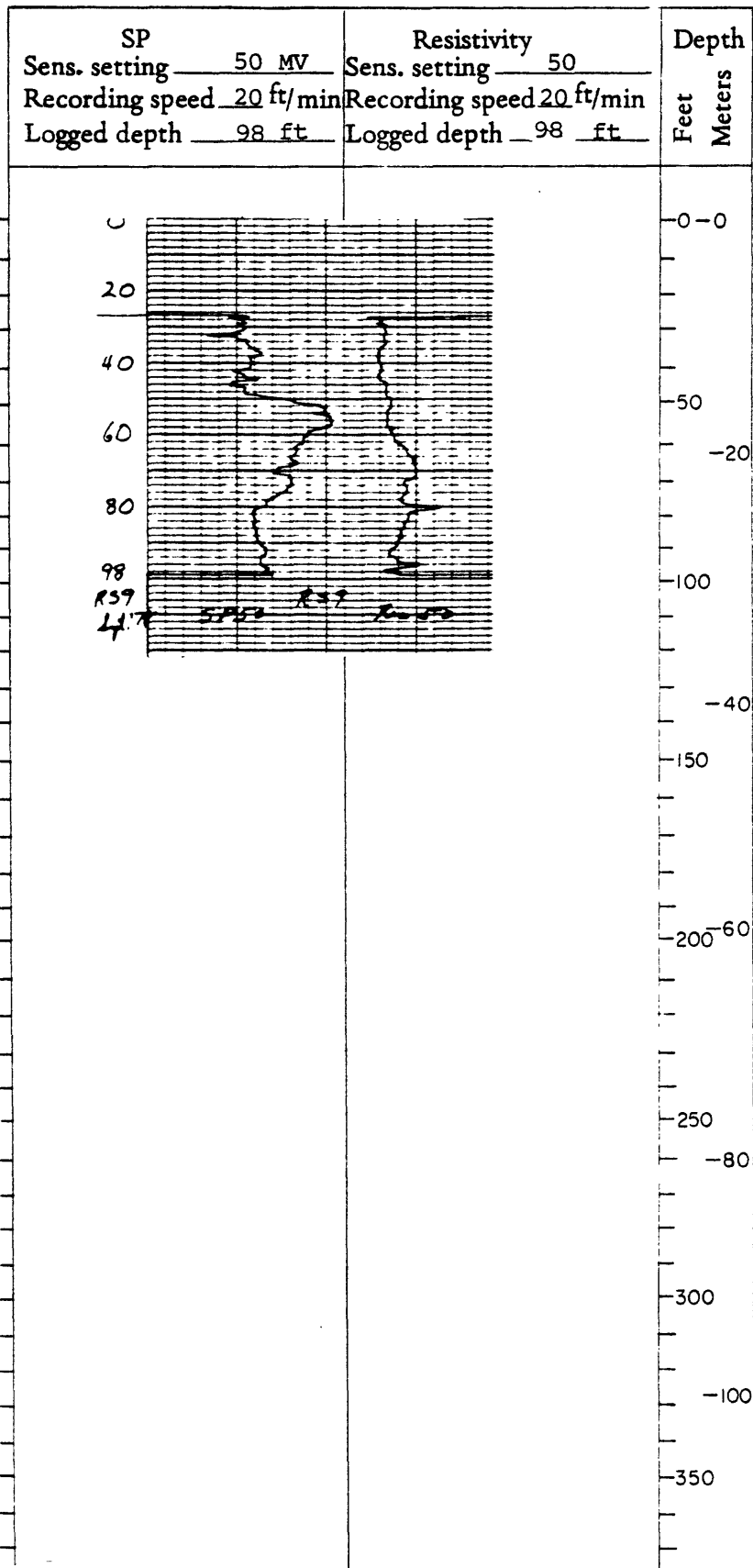
Lithology	Gamma		Density		Depth Feet Meters
	T.C. <u>2</u>	Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>98</u> ft	T.C. <u>2</u>	Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>98</u> ft	
0- 5 Lignite					0-0
5- 8 Claystone, light-gray					
8- 10 Shale, dark-brown, lignitic					
10- 15 Claystone, light-yellowish-brown					
15- 18 Claystone, medium-light-gray					
18- 30 Siltstone, very light gray and light-yellow					
30- 38 Siltstone, light-gray, clayey					
38- 75 Sandstone, very fine grained, silty					
75- 95 Sandstone, fine to very fine grained					
95-100 Claystone, medium-light-gray					
					-40
					-150
					-200
					-250
					-300
					-350



Hole number—continued

RS-9

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>98</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>98</u> ft	Depth	
			Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



RS-9

384

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-10 Map: Pearl Butte Date: 9-6-78 State: ND County: Adams
 Elev.: 2695 ft Location: T. 130^N R. 94^W, Sec. 36, Tract: bbbb Drilled depth: 260 ft
 Measured: 80 ft ~~FNL~~ 250 ft ~~FWL~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 34-36; 39-51

Remarks: _____

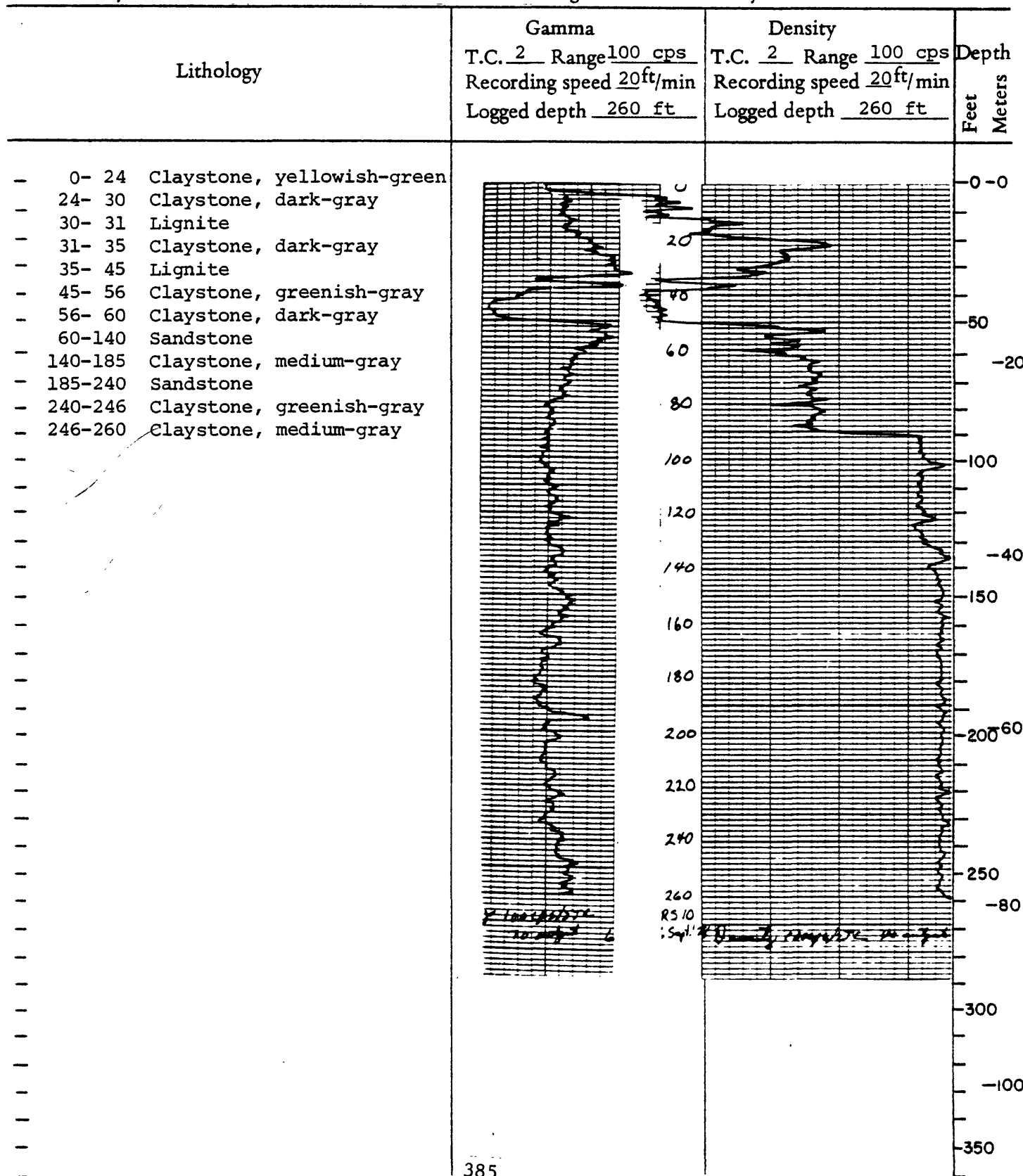
Lithology

Recorded by: Tom Heck

Geologist ^{Yes}
~~Max~~

Geophysical logs

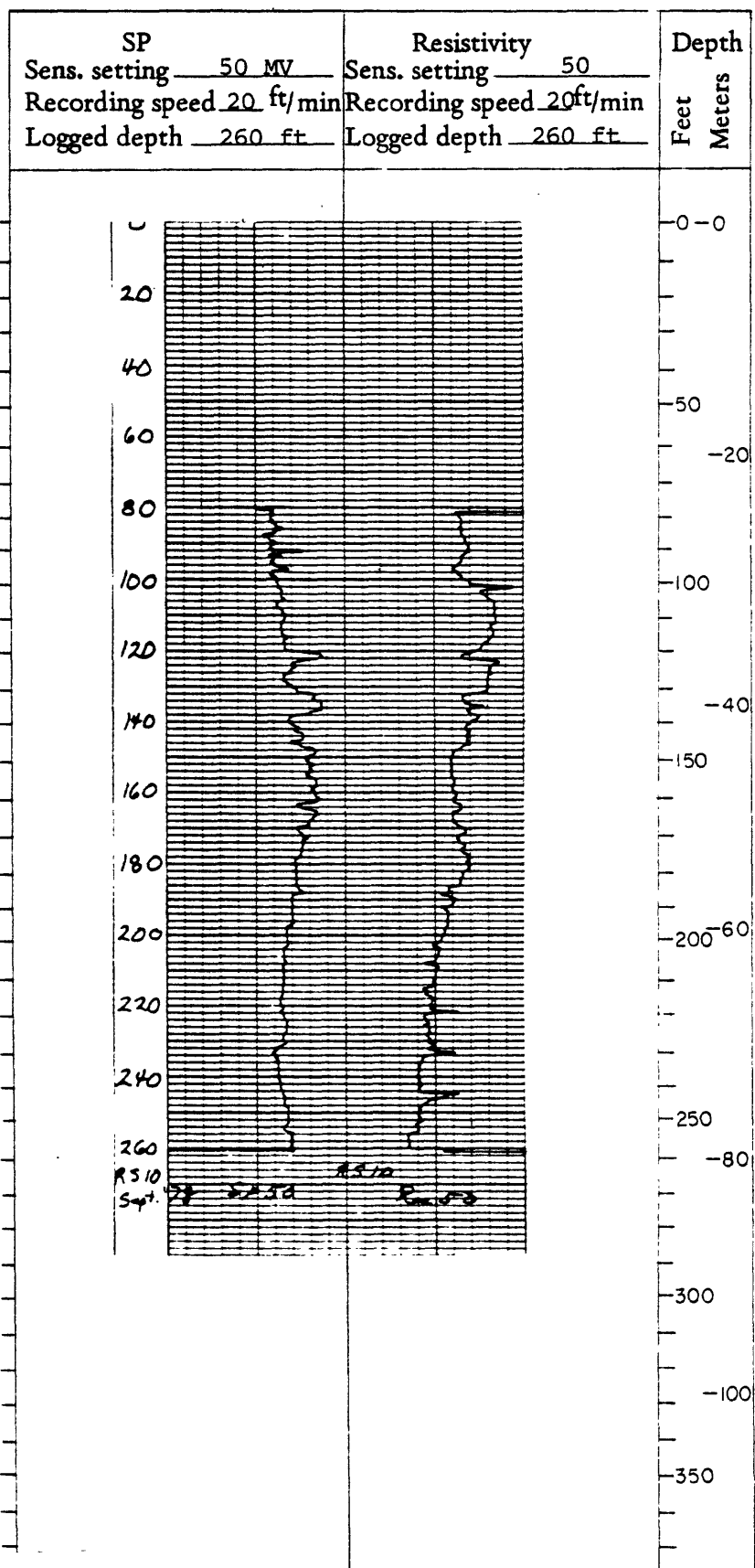
recorded by: Lechner



Hole number—continued

RS-10

Lithology	Gamma		Density		Depth	
	T.C.	Range	T.C.	Range	Fect	Meters
	2	100 cps	2	100 cps		
	Recording speed	20 ft/min	Recording speed	20ft/min		
	Logged depth	260 ft	Logged depth	260 ft		
					-120	
					-400	
					-450	
					-140	
					-500	
					-160	
					-550	
					-180	
					-600	
					-650	
					-200	
					-700	
					-220	
					-750	



Hole number—continued

RS-10

SP		Resistivity	Depth Feet Meters
Sens. setting	50 MV	Sens. setting 50	
Recording speed	20 ft/min	Recording speed 20 ft/min	
Logged depth	260 ft	Logged depth 260 ft	
			-120
			-400
			-450
			-140
			-500
			-160
			-550
			-180
			-600
			-650
			-200
			-700
			-220
			-750

Hole No: RS-11 Map: Pearl Butte Date: 9-6-78 State: ND County: Adams
Elev.: 2,585 ft Location: T. 130^N, R. 94^E W, Sec. 2, Tract: daad Drilled depth: 340 ft
Measured: 2055 ft ~~FSL~~ 10 ft ~~FSL~~ ^{FEL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: none

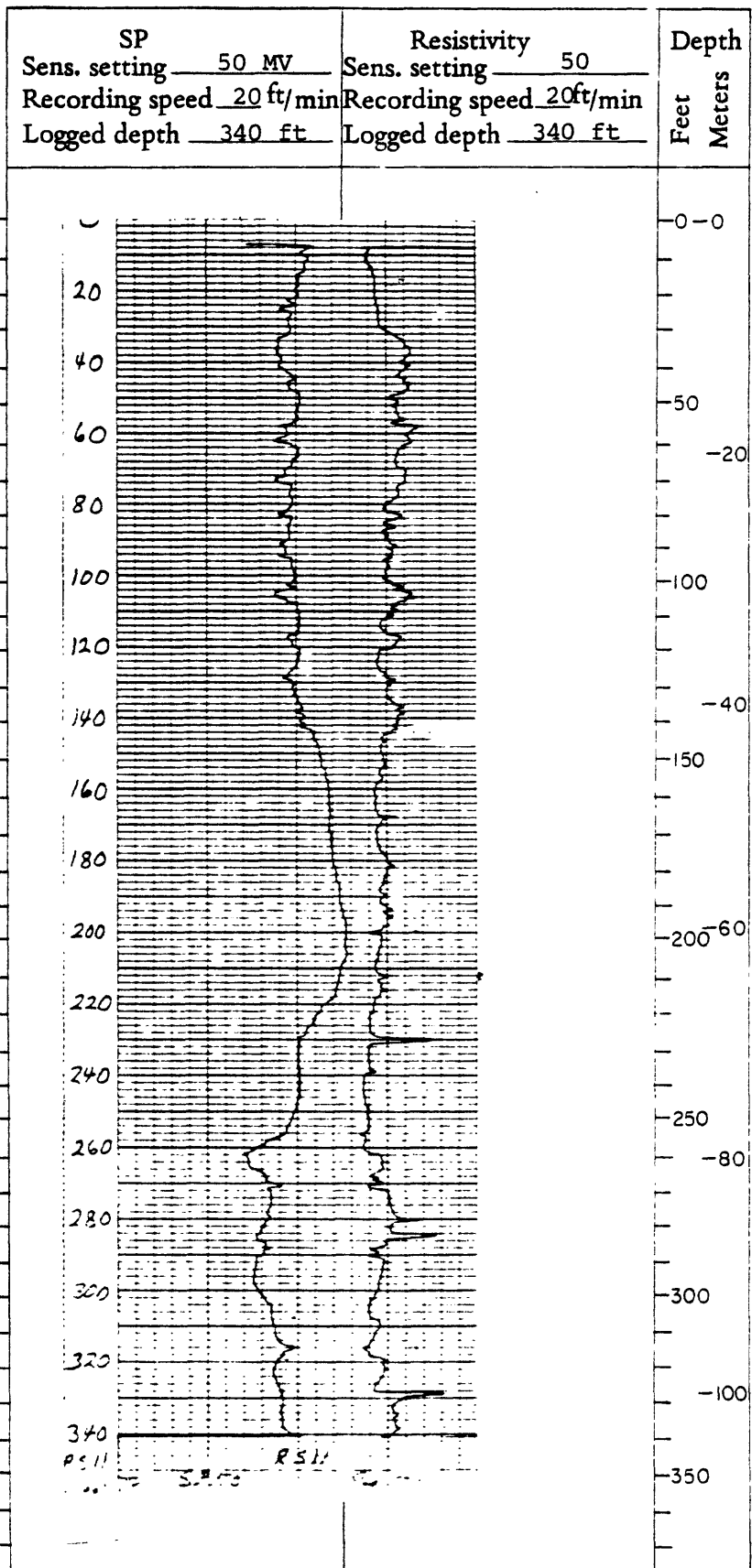
Lithology
Recorded by: Tom Heck Geologist ^{Yes}~~No~~ Geophysical logs
recorded by: Lechner

[illegible]

Hole number—continued

RS-11

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>340</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>340</u> ft	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued

RS-11

SP		Resistivity		Depth	
Sens. setting <u>50 MV</u>		Sens. setting <u>50</u>		Fet Meters	
Recording speed <u>20</u> ft/min		Recording speed <u>20</u> ft/min			
Logged depth <u>340</u> ft		Logged depth <u>340</u> ft			
					-120
					-400
					-450
					-140
					-500
					-160
					-550
					-180
					-600
					-650
					-200
					-700
					-220
					-750

NORTH DAKOTA GEOLOGICAL SURVEY

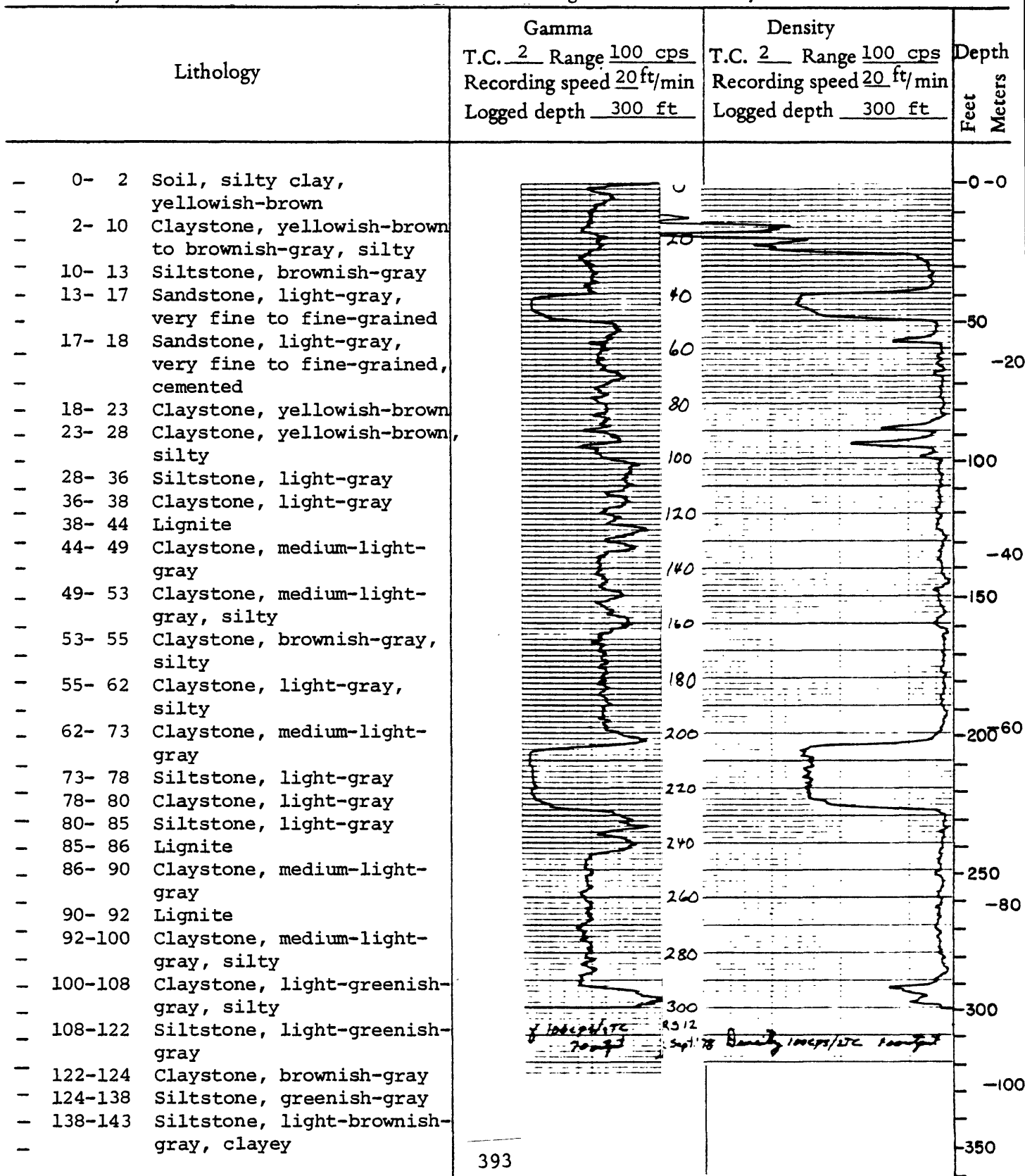
Hole No: RS-12 Map: Havelock Date: 9-2-78 State: ND County: Hettinger
 Elev.: 2,505 ft Location: T. 134^N, R. 95^W, Sec. 4, Tract: cccd Drilled depth: 300 ft
 Measured: 27 ft ~~BSL~~ FSL, 575 ft ~~FWL~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 40-49; 204-227

Remarks: _____

Lithology

Recorded by: Clarence CarlsonGeologist ^{Yes} ~~XX~~

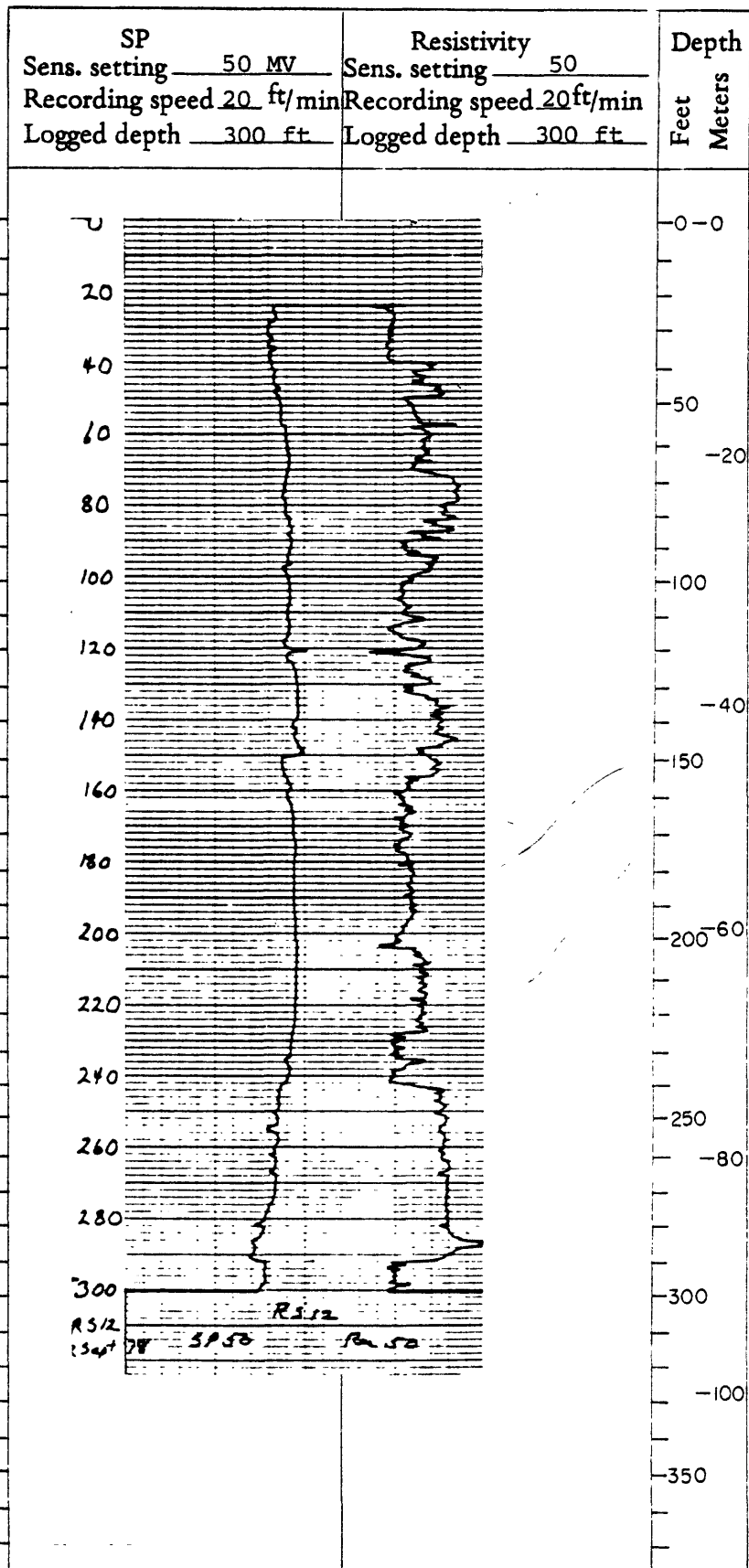
Geophysical logs

recorded by: Lechner

Hole number—continued

RS-12

Lithology	Gamma		Density		Depth	
	T.C. <u>2</u>	Range <u>100 cps</u>	T.C. <u>2</u>	Range <u>100 cps</u>	Fect	Meters
	Recording speed <u>20 ft/min</u>		Recording speed <u>20 ft/min</u>			
	Logged depth <u>300 ft</u>		Logged depth <u>300 ft</u>			
143-144 Claystone, light-brownish-gray						
144-156 Siltstone, greenish-gray					-120	
156-160 Claystone, light-brownish-gray, silty					-400	
160-170 Claystone, greenish-gray, silty						
170-177 Claystone, light-brownish-gray						
177-183 Claystone, greenish-gray					-450	
183-198 Siltstone, greenish-gray, clayey					-140	
198-201 Claystone, light-brownish-gray						
201-224 Lignite						
224-226 Claystone, brownish-gray					-500	
226-284 Sandstone, light-gray, very fine to fine-grained						
284-287 Lignite					-160	
287-300 Claystone, brownish-gray to light-brownish-gray						
					-550	
					-180	
					-600	
					-650	
					-200	
					-700	
					-220	
					-750	

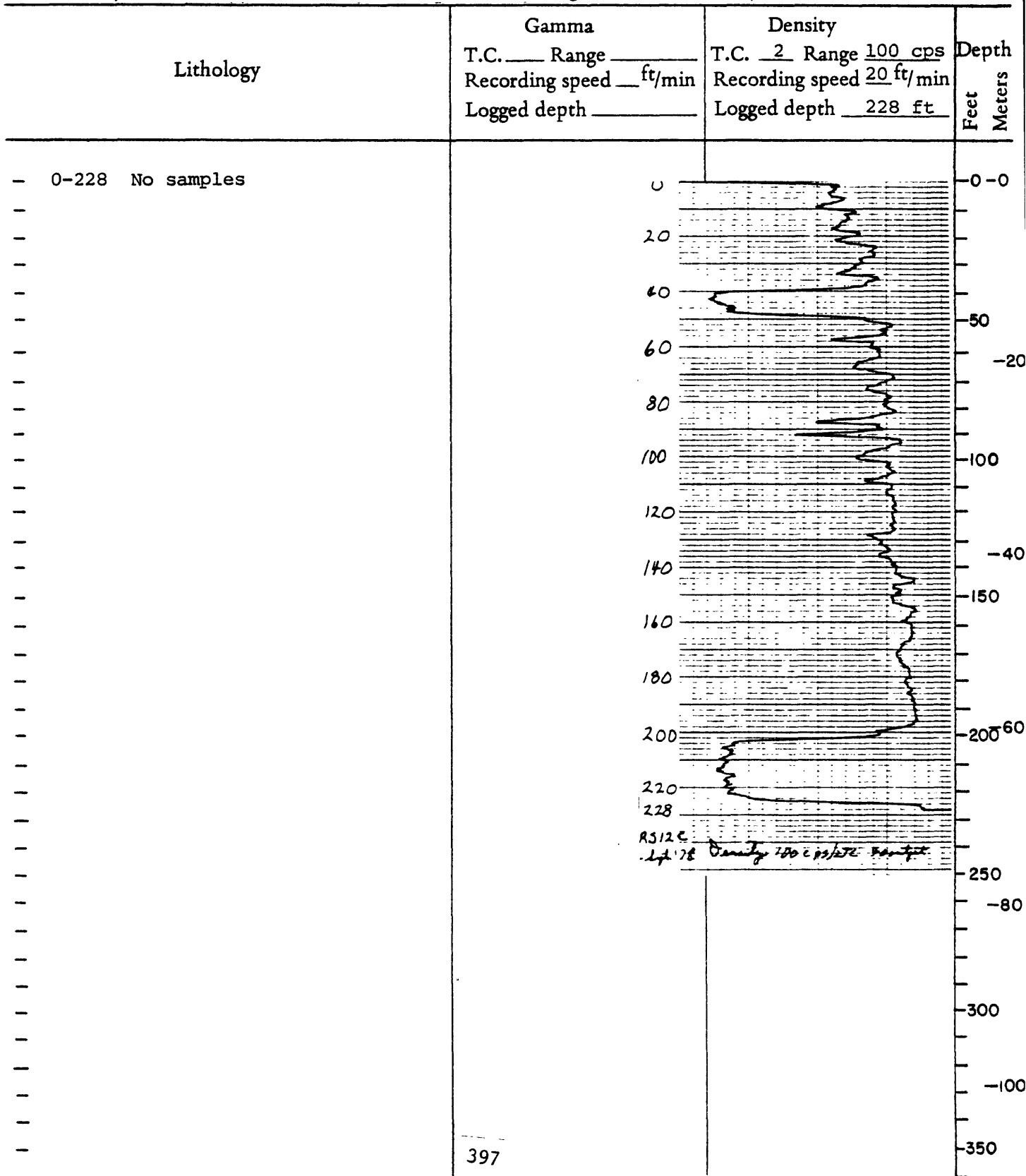


Hole number—continued
RS-12

SP		Resistivity		Depth	
Sens. setting	50 MV	Sens. setting	50	Feet	Meters
Recording speed	20 ft/min	Recording speed	20 ft/min		
Logged depth	300 ft	Logged depth	300 ft		
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

Hole No: RS-12C Map: Havelock Date: 9-2-78 State: ND County: Hettinger
Elev.: 2,505 ft Location: T. 134 ^N, R. 95 ^E W, Sec. 4, Tract: cccd Drilled depth: 228 ft
Measured: 27 ft ^{PNL} FSL, 605 ft ^{PNL} FWL, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☒ No ☐
Lignite beds: 39.5-48.5; 202-225.5

Lithology
Recorded by: _____ Geologist ^{Yes} ~~No~~ Geophysical logs
recorded by: _____ Lechner



Hole number—continued

Lithology	Gamma		Density		Depth	
	T.C. _____	Range _____	T.C. _____	Range _____	Fect	Meters
					-120	
					-400	
					-450	
					-140	
					-500	
					-160	
					-550	
					-180	
					-600	
					-650	
					-200	
					-700	
					-220	
					-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-13 Map: Havelock Date: 9-2-78 State: ND County: Hettinger
 Elev.: 2,595 ft Location: T. 134 ^N, R. 96 ^E, Sec. 10, Tract: aaaa Drilled depth: 400 ft
 Measured: 100 ft ^{FNL} ~~238~~, 35 ft ^{FEL} ~~274~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 82-92; 230-247

Remarks: _____

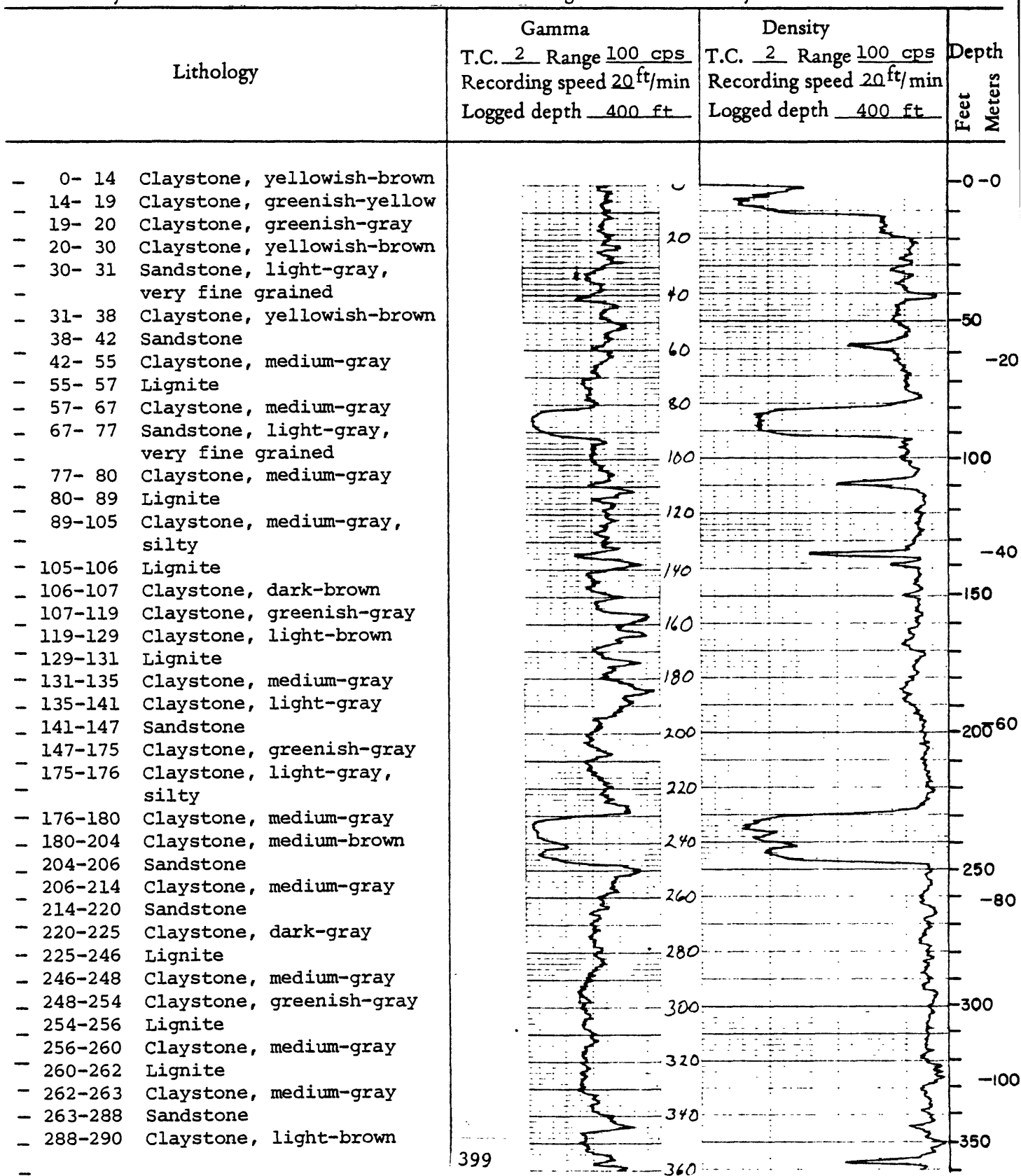
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~XXX~~

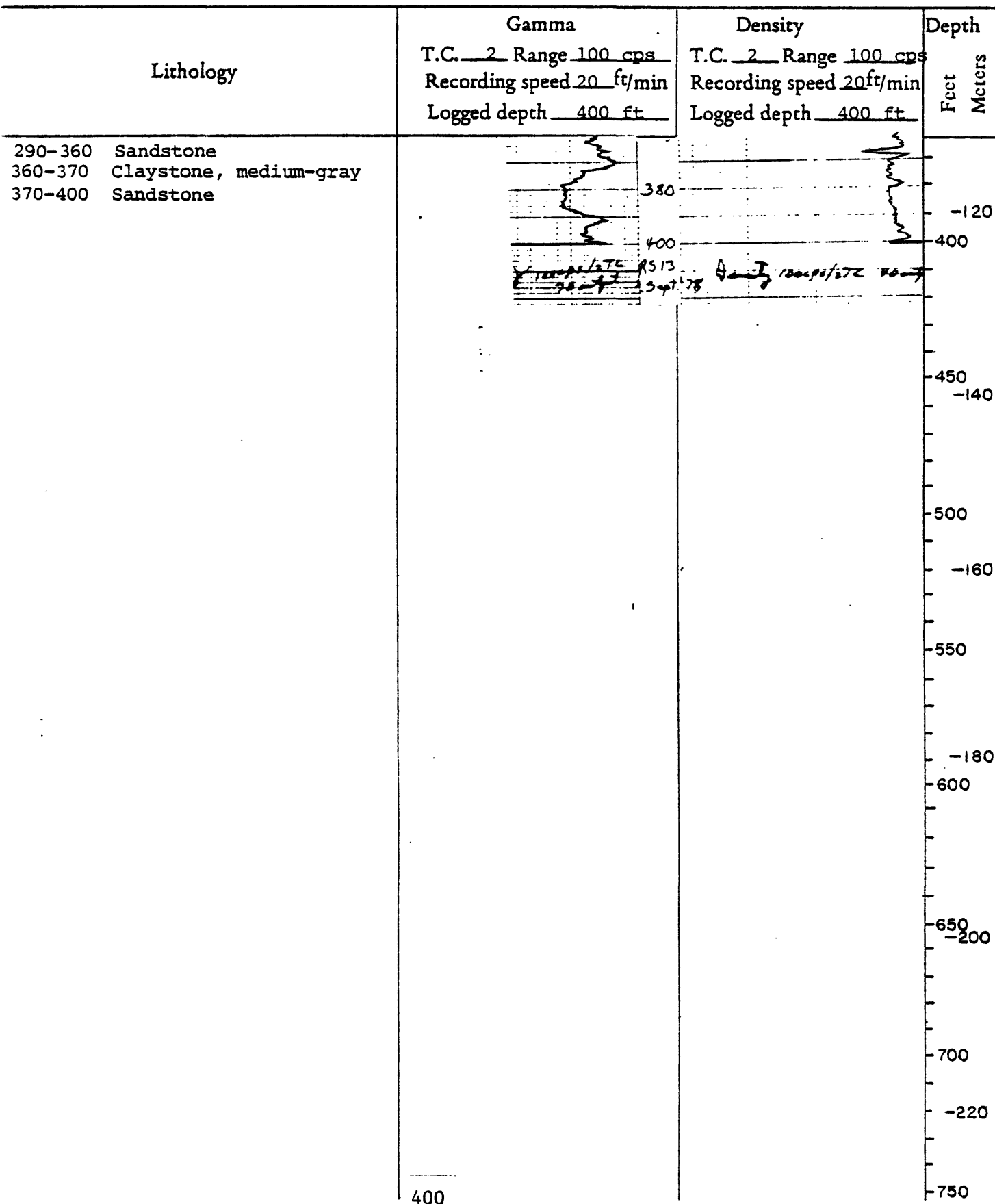
Geophysical logs

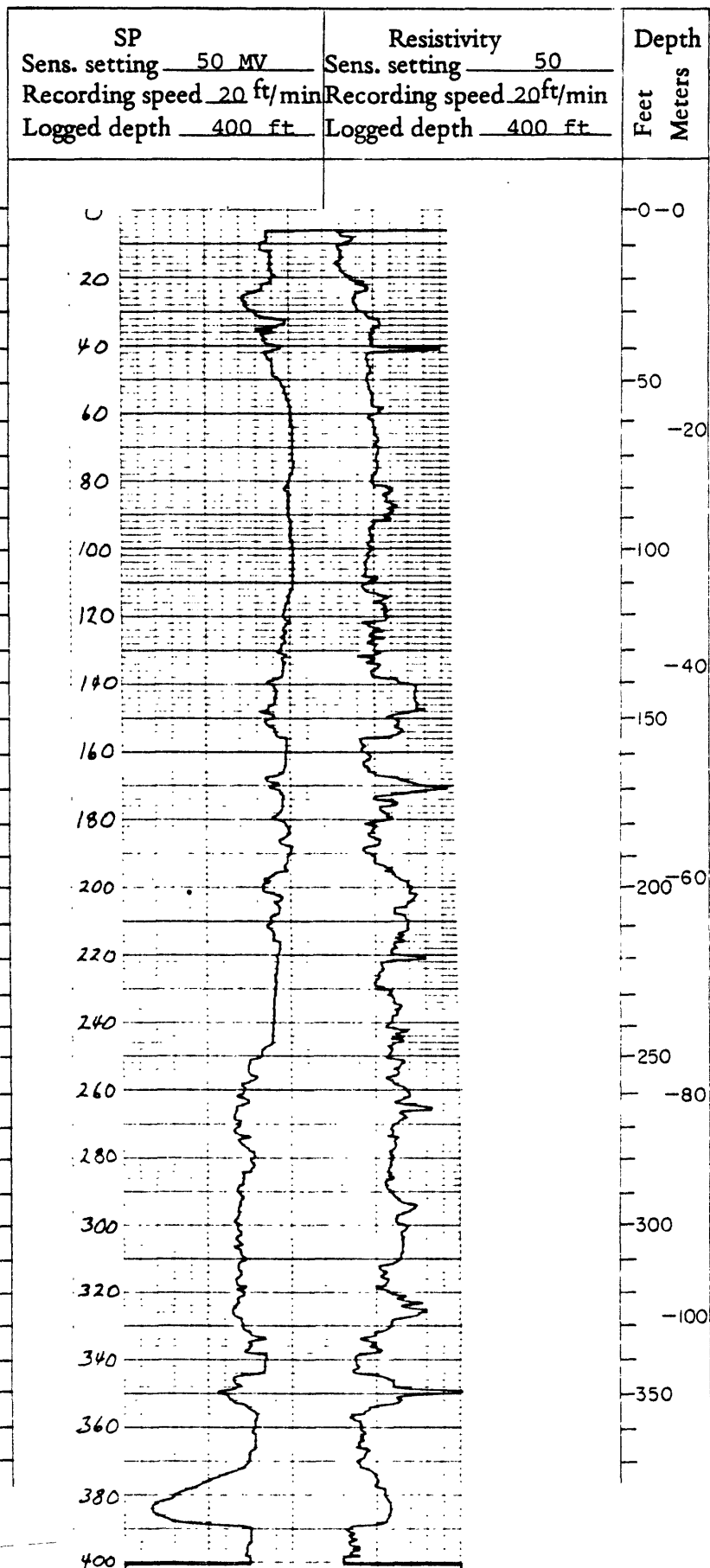
recorded by: Lechner



Hole number—continued

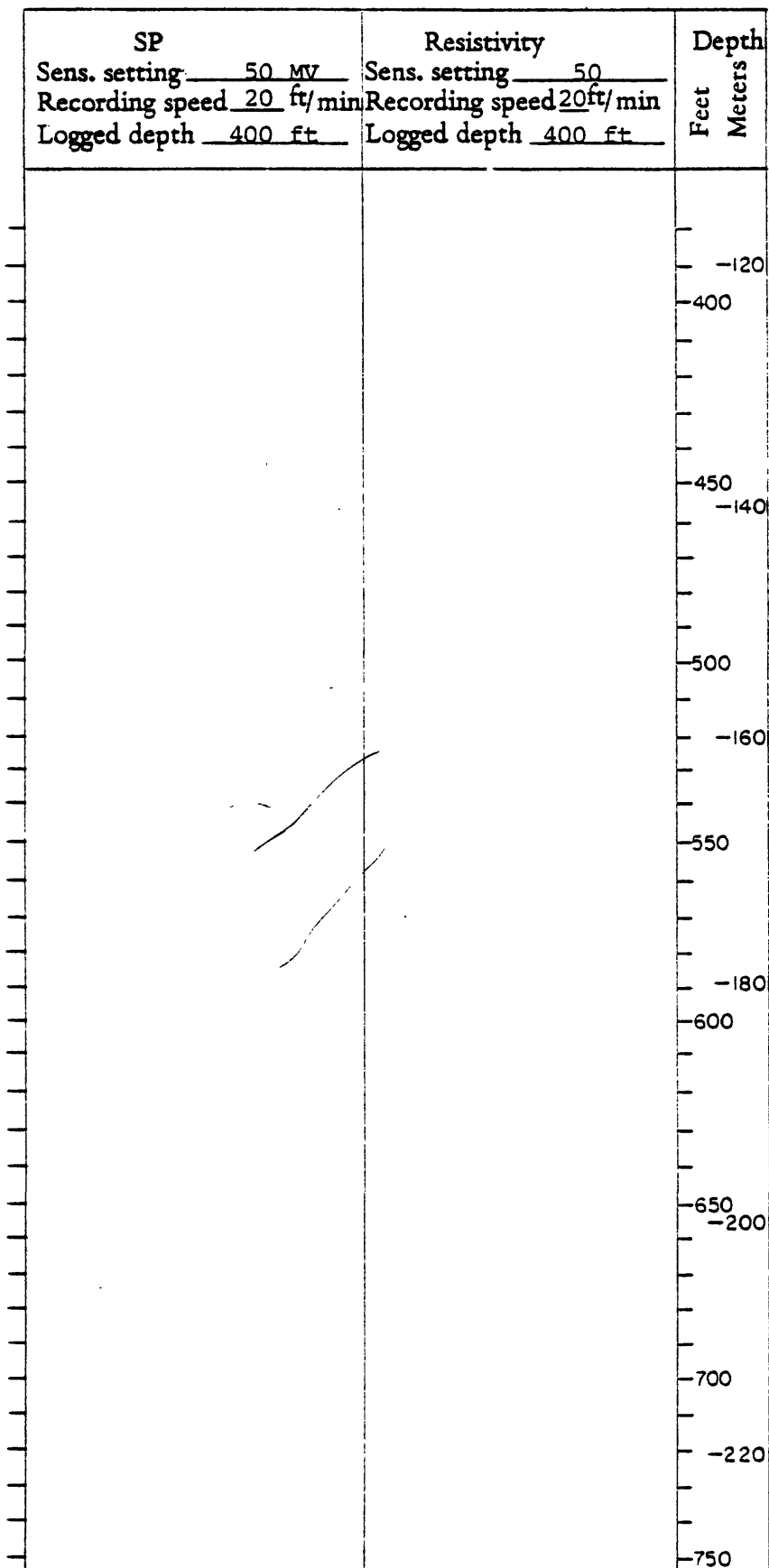
RS-13





Hole number—continued

RS-13



Hole No: RS-14 Map: Havelock Date: 9-4-78 State: ND County: Hettinger
Elev.: 2,670 ft Location: T. 134 ^N, R. 96 ^E W, Sec. 28, Tract: aaab Drilled depth: 460 ft
Measured: 50 ft ~~FNL~~ ^{FNL}, 495 ft ~~FNL~~ ^{FEL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 107-112; 280-284.5; 327-332; 402-404

Lithology

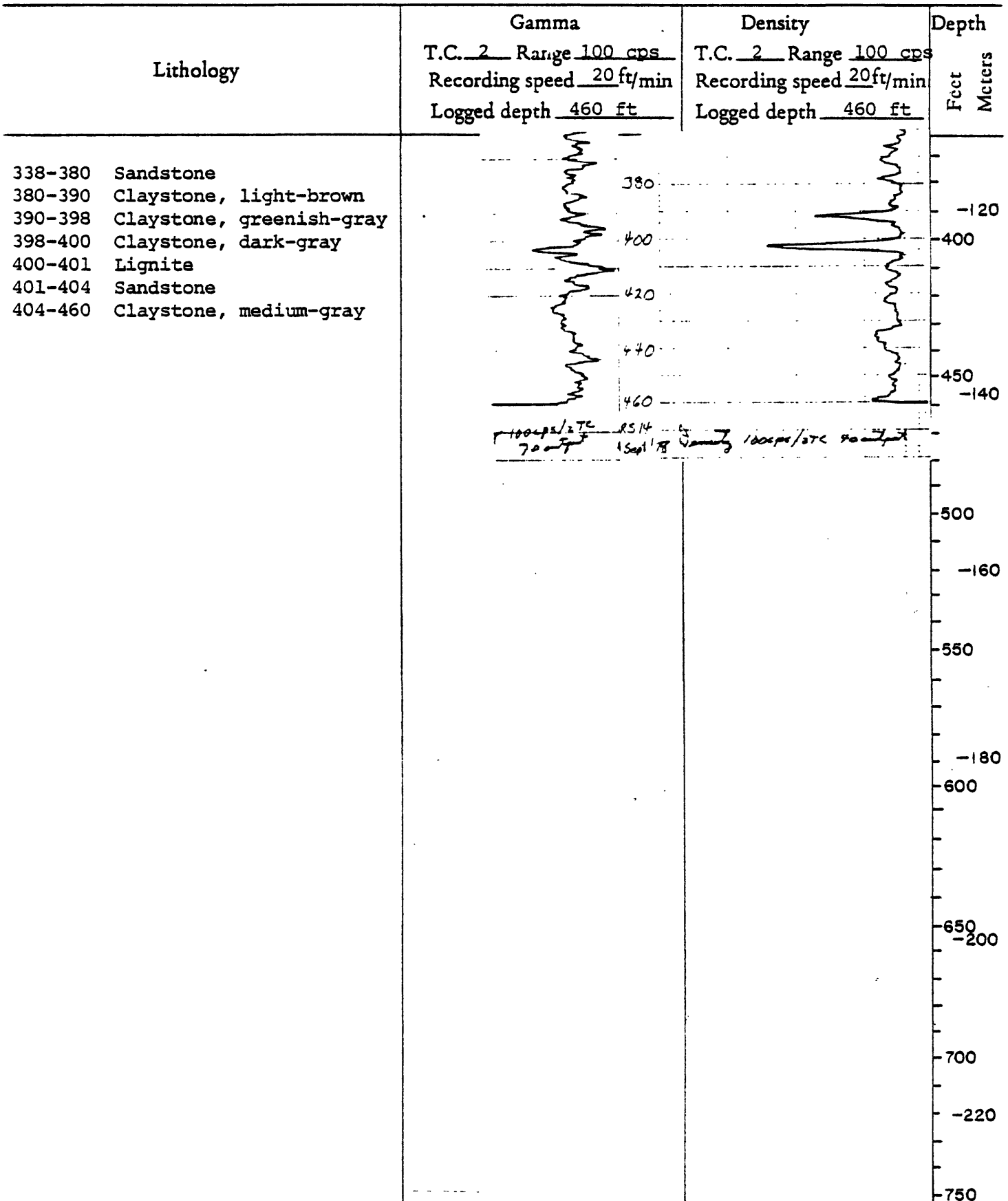
Recorded by: Tom Heck

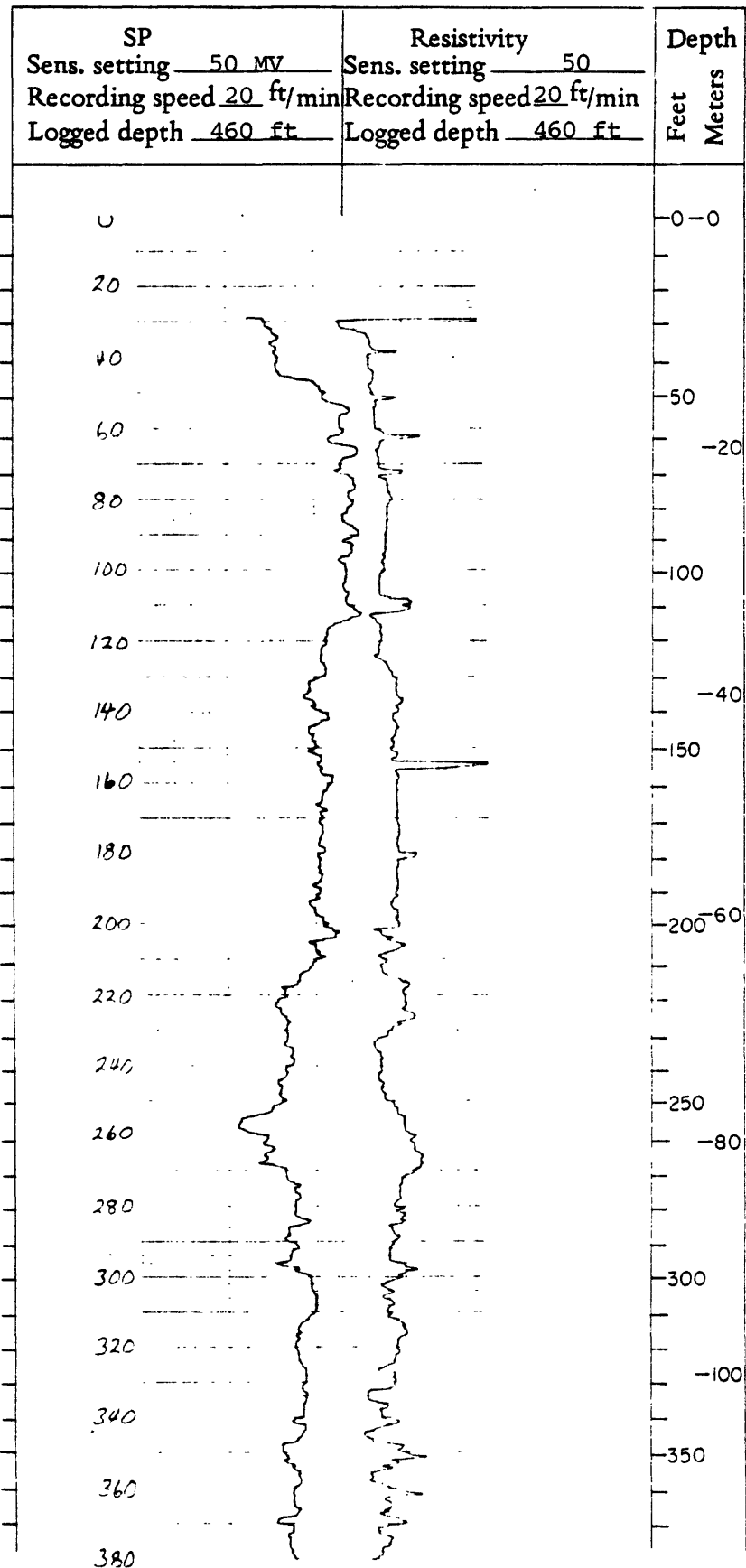
Geologist ^{Yes}~~No~~ Geophysical logs recorded by: Lechner

Lithology	Gamma		Density		Depth Feet Meters
	T.C.	Range 100 cps Recording speed 20 ft/min Logged depth 460 ft	T.C.	Range 100 cps Recording speed 20 ft/min Logged depth 460 ft	
0- 11 Claystone, yellowish-green					0-0
11- 12 Claystone, orange					
12- 20 Claystone, medium-gray					
20- 26 Claystone, light-green					
26- 36 Claystone, medium-gray					
36- 37 Sandstone, light-gray, cemented					50
37- 45 Claystone, medium-gray					
45- 46 Lignite					-20
46- 48 Sandstone, light-gray, very fine grained					
48- 67 Claystone, medium-gray					
67- 68 Lignite					100
68- 69 Claystone, greenish-gray					
69-105 Claystone, medium-gray					
105-111 Lignite					-40
111-112 Claystone, dark-gray					
112-119 Claystone, medium-gray					-150
119-120 Claystone, light-green					
120-130 Claystone, light-gray, silty					
130-148 Siltstone, light-gray					-200
148-208 Sandstone, light-gray, very fine grained					60
208-221 Claystone, light-green, silty					
221-241 Claystone, greenish-gray					
241-246 Claystone, medium-brown					
246-250 Claystone, greenish-gray					
250-280 Claystone, medium-gray					-250
280-283 Lignite					
283-284 Claystone, medium-gray					-80
284-285 Lignite					
285-292 Claystone, medium-gray					
292-298 Claystone, medium-brown					
298-309 Claystone, greenish-gray					300
309-320 Claystone, medium-gray					
320-323 Claystone, light-gray					
323-332 Lignite					-100
332-335 Claystone, light-gray					
335-338 Claystone, light-green					-350

Hole number—continued

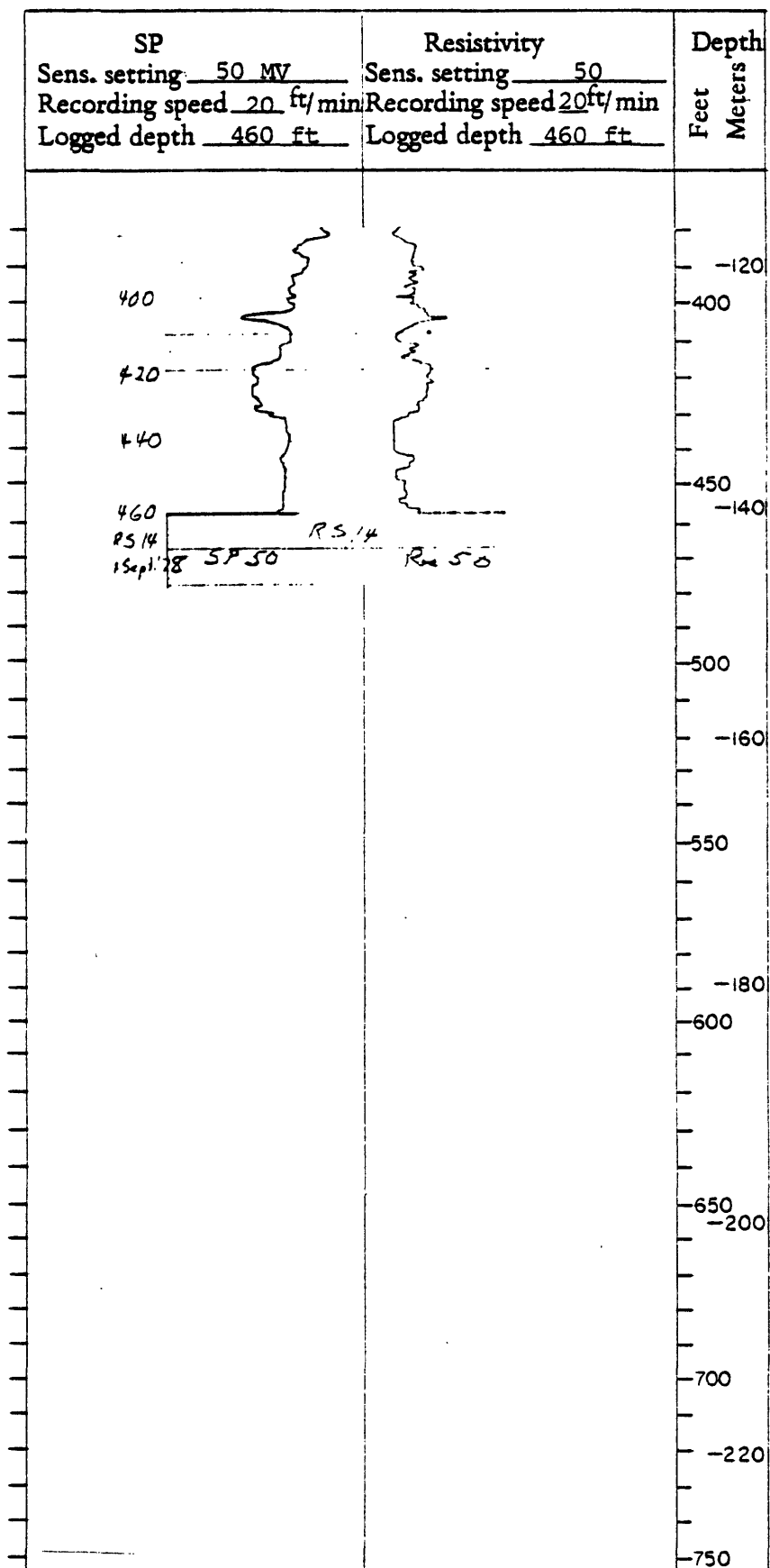
RS-14





Hole number—continued

RS-14



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-15 Map: Jung Lake Date: 9-4-78 State: ND County: Hettinger
 Elev.: 2,728 ft Location: T. 134^N, R. 97^W, Sec. 24, Tract: dddd Drilled depth: 540 ft
 Measured: 55 ft ~~FSL~~, 175 ft ~~FEL~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 70-75; 280-282; 377-379; 482-484

Remarks: _____

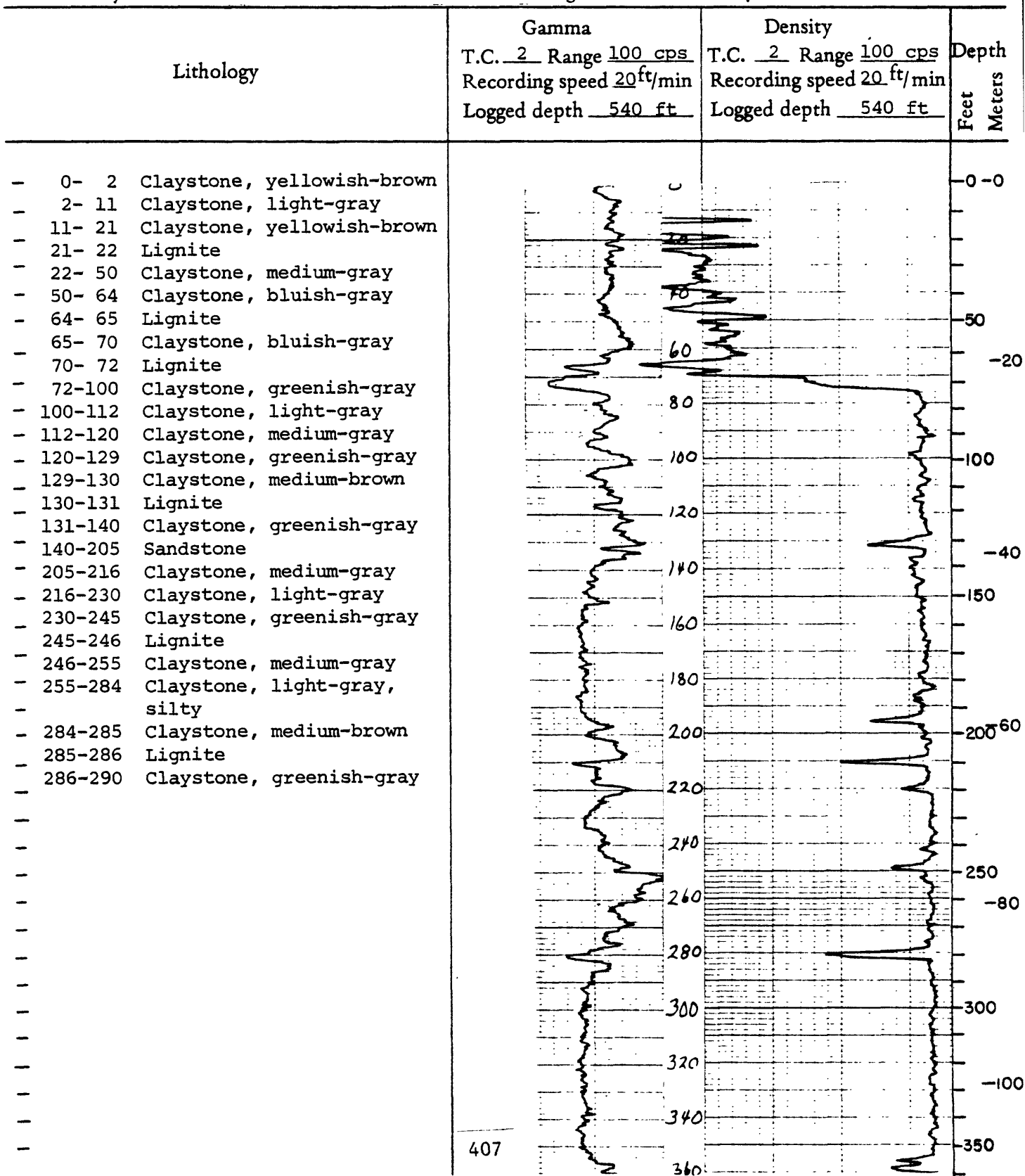
Lithology

Recorded by: Tom Heck

Geologist ^{Yes}
~~XX~~

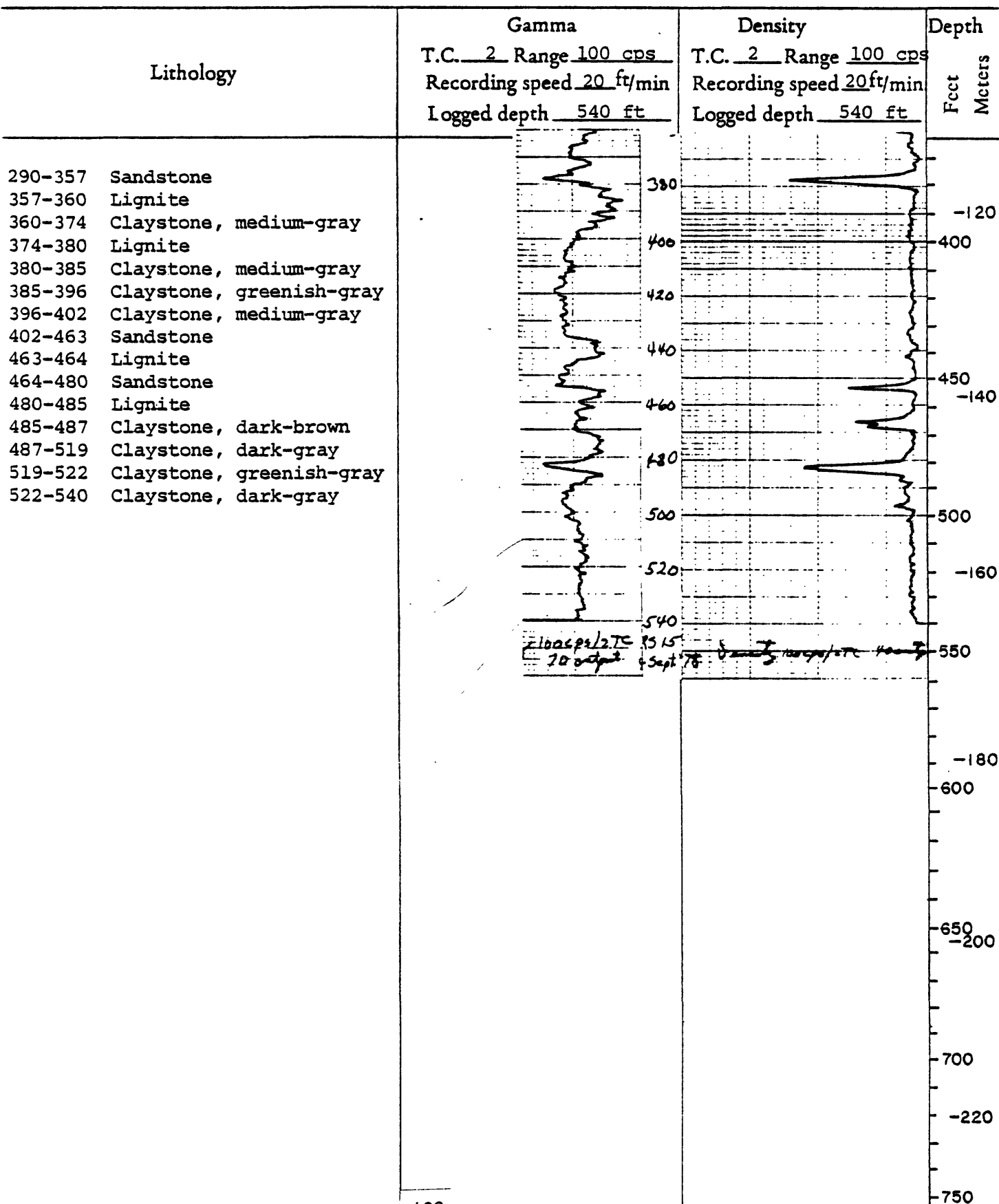
Geophysical logs

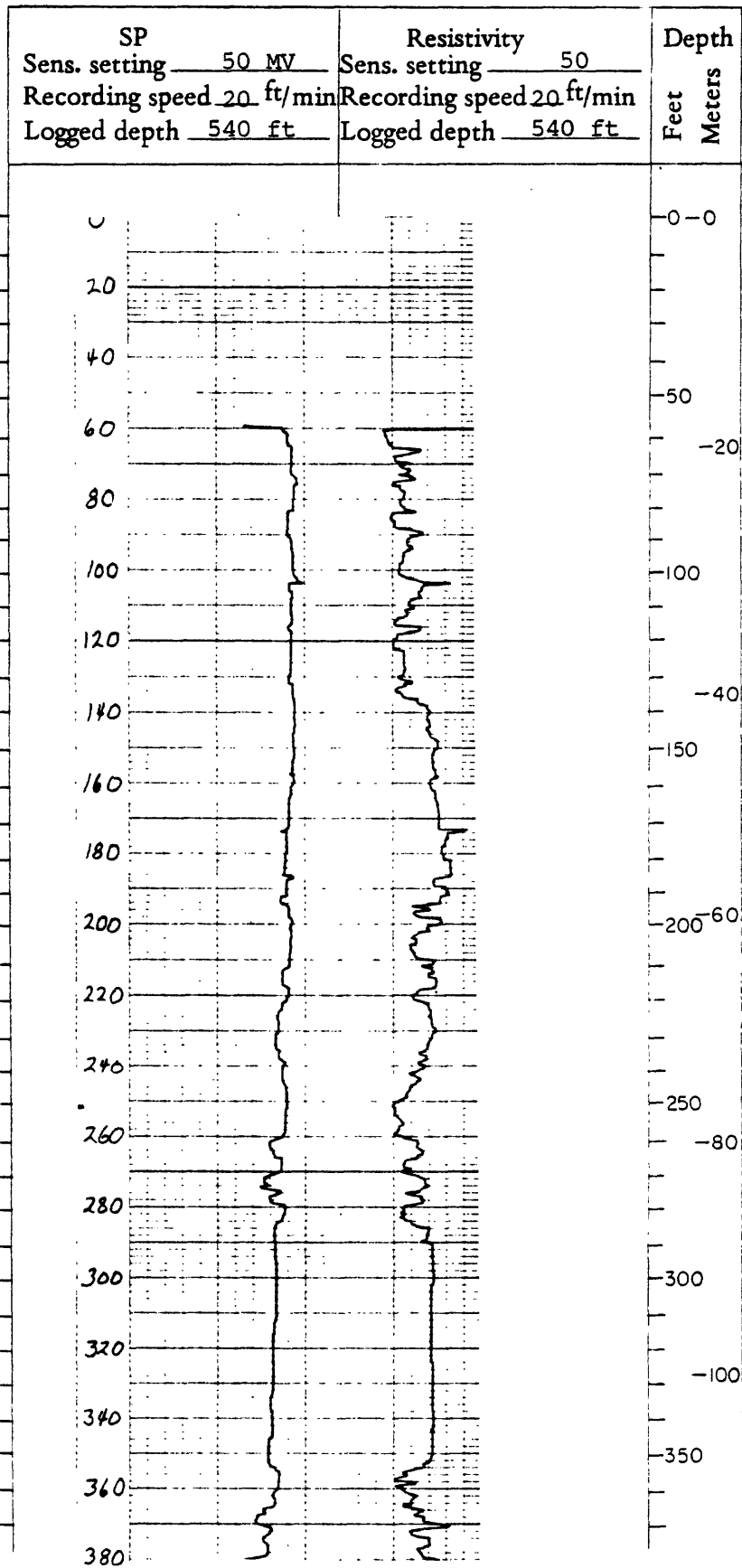
recorded by: Lechner



Hole number—continued

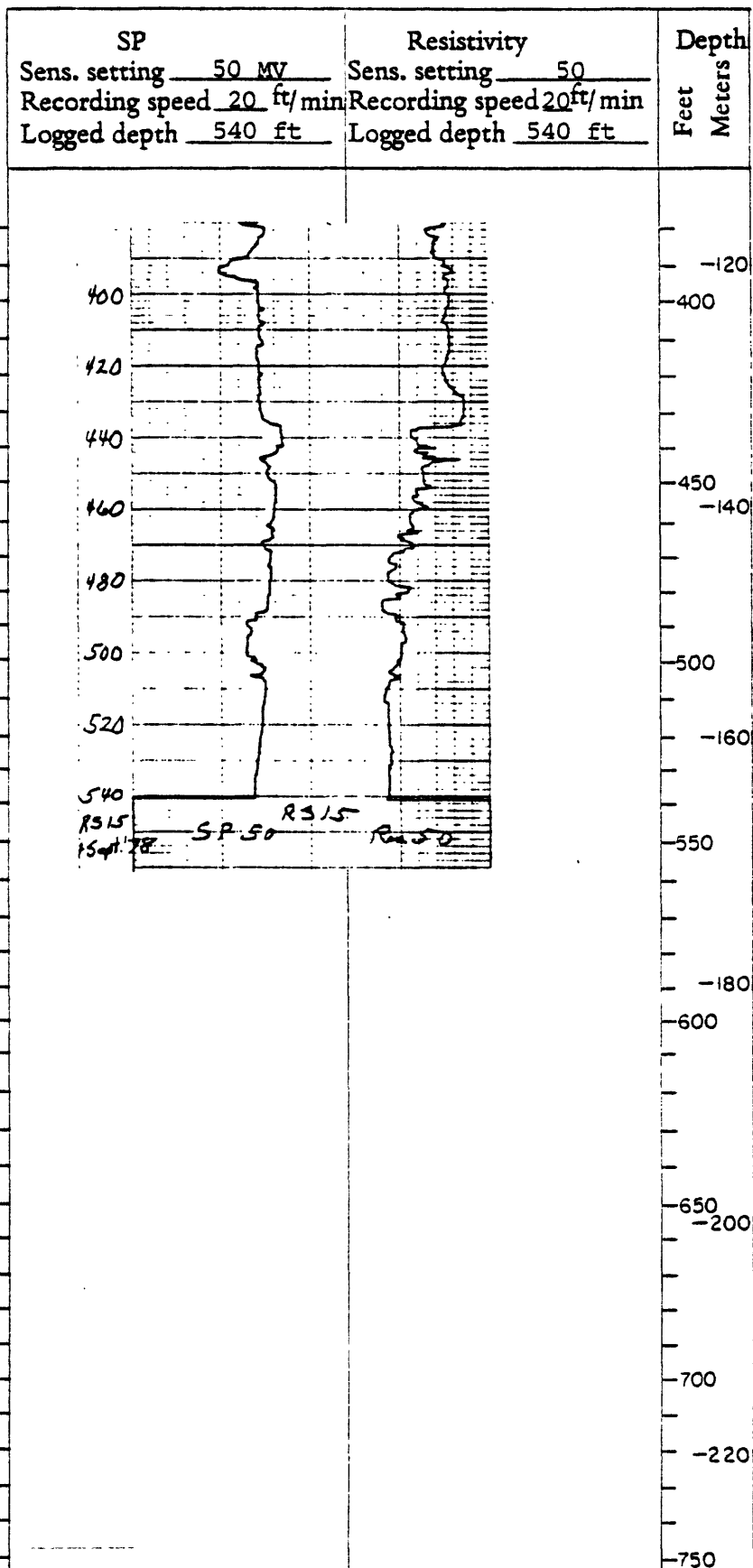
RS-15





Hole number—continued

RS-15



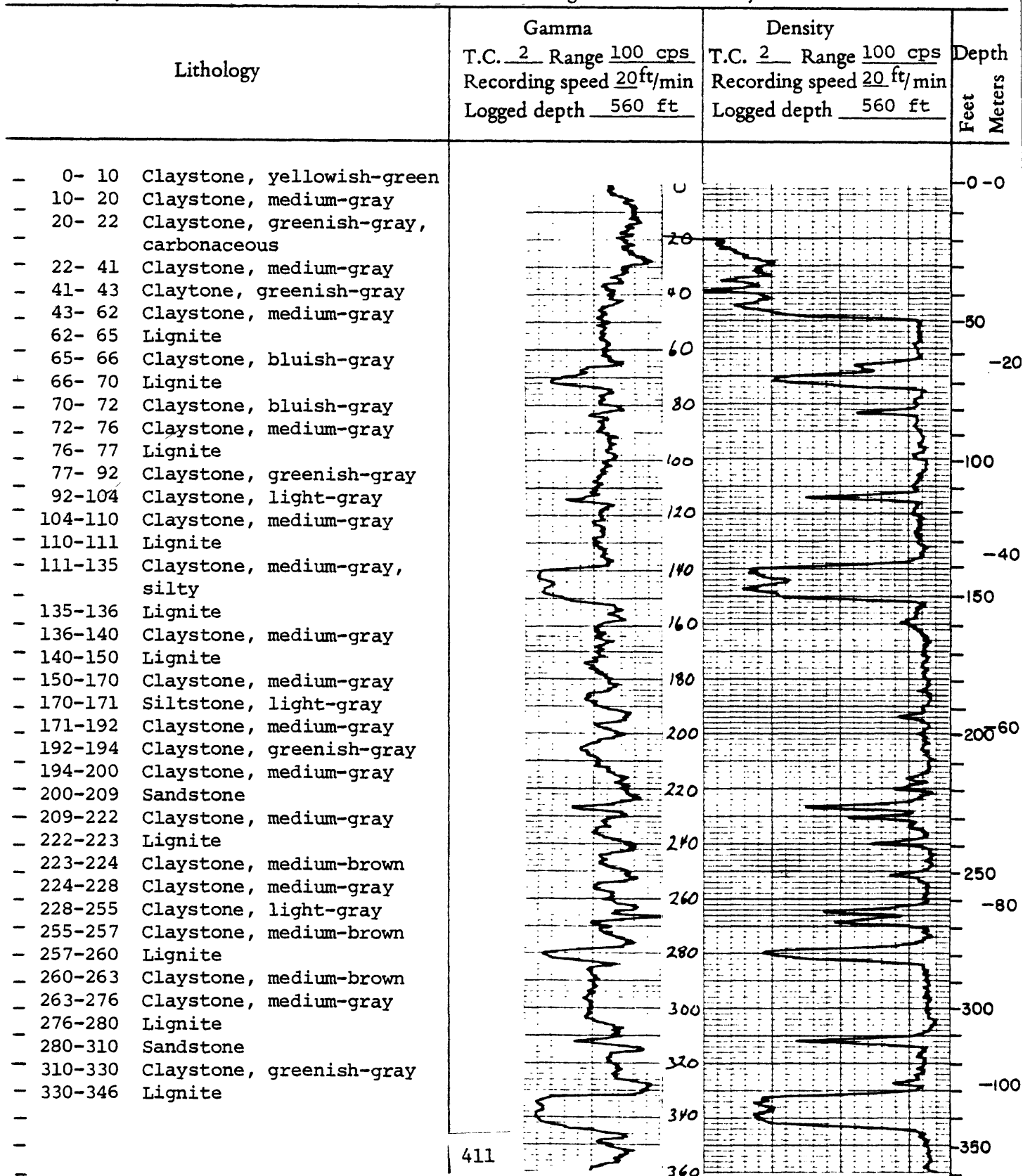
NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-16 Map: Jung Lake Date: 9-3-78 State: ND County: Hettinger
 Elev.: 2,750 ft Location: T. 134^N, R. 97^W, Sec. 4, Tract: dccc Drilled depth: 560 ft
 Measured: 115 ft ~~FSL~~ ^{FEL} 2400 ft ~~FSL~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 69-73; 139-151; 278-283; 311-313; 331-343

Remarks: _____

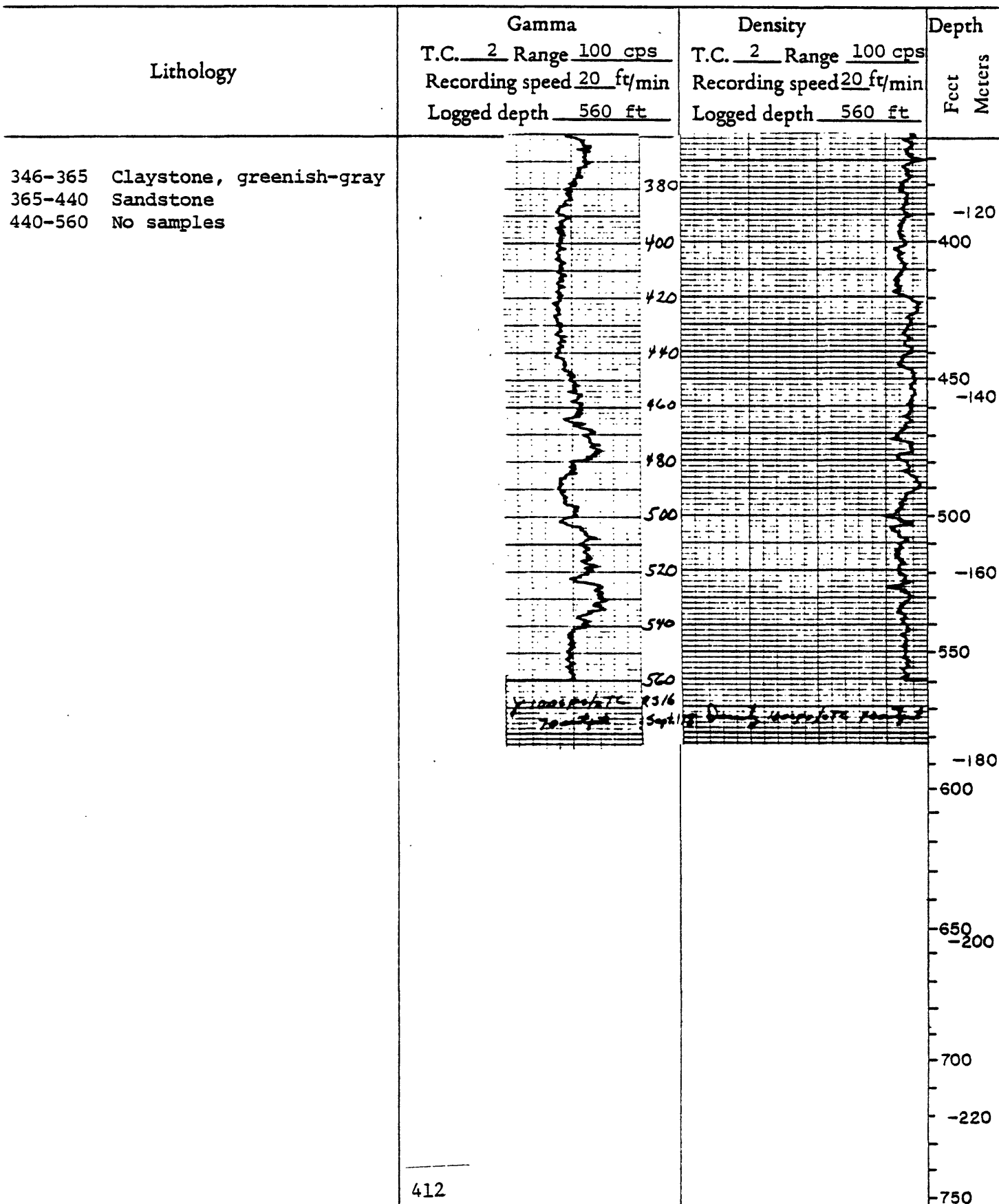
Lithology

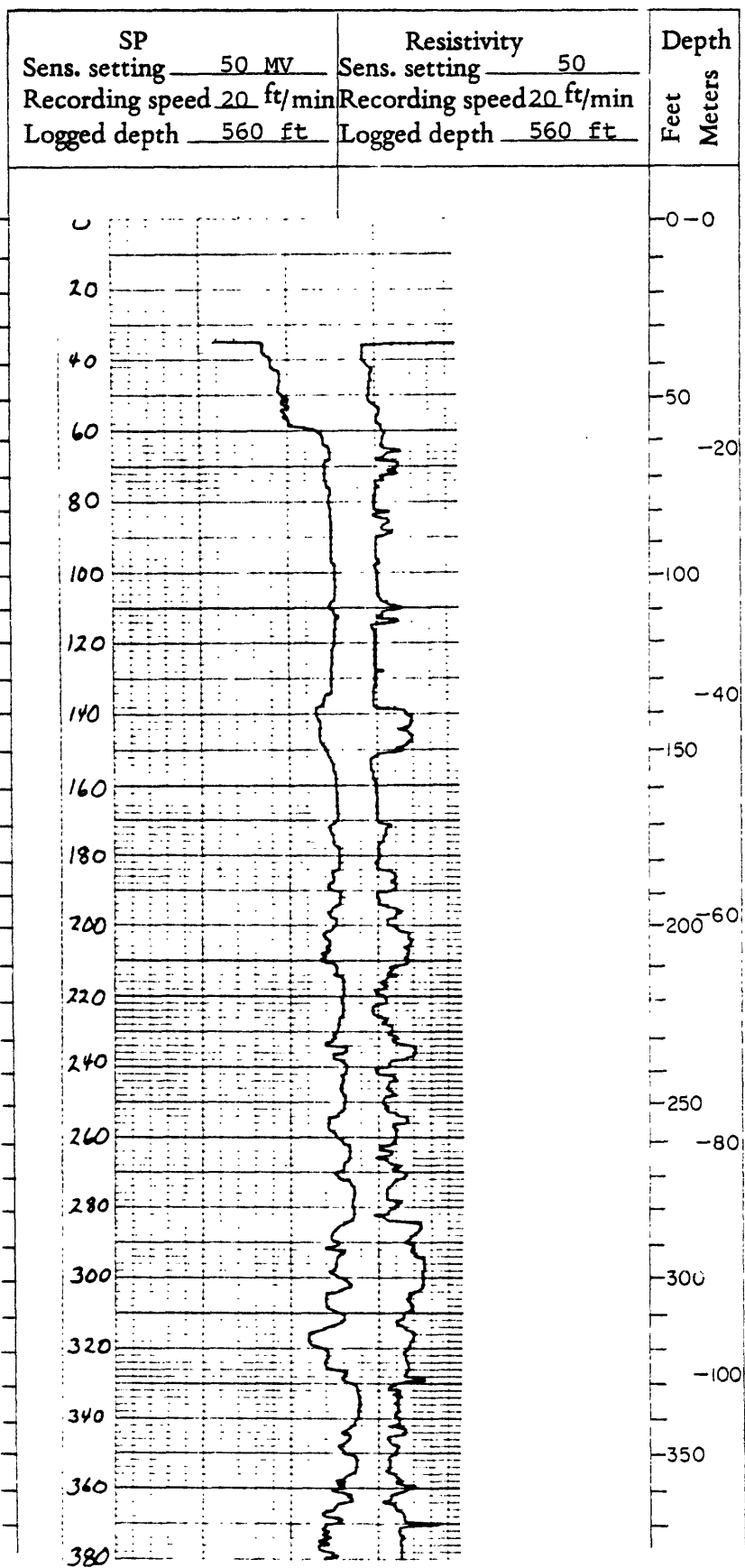
Recorded by: Tom Heck Geologist ~~Y~~^Y recorded by: Lechner Geophysical logs



Hole number—continued

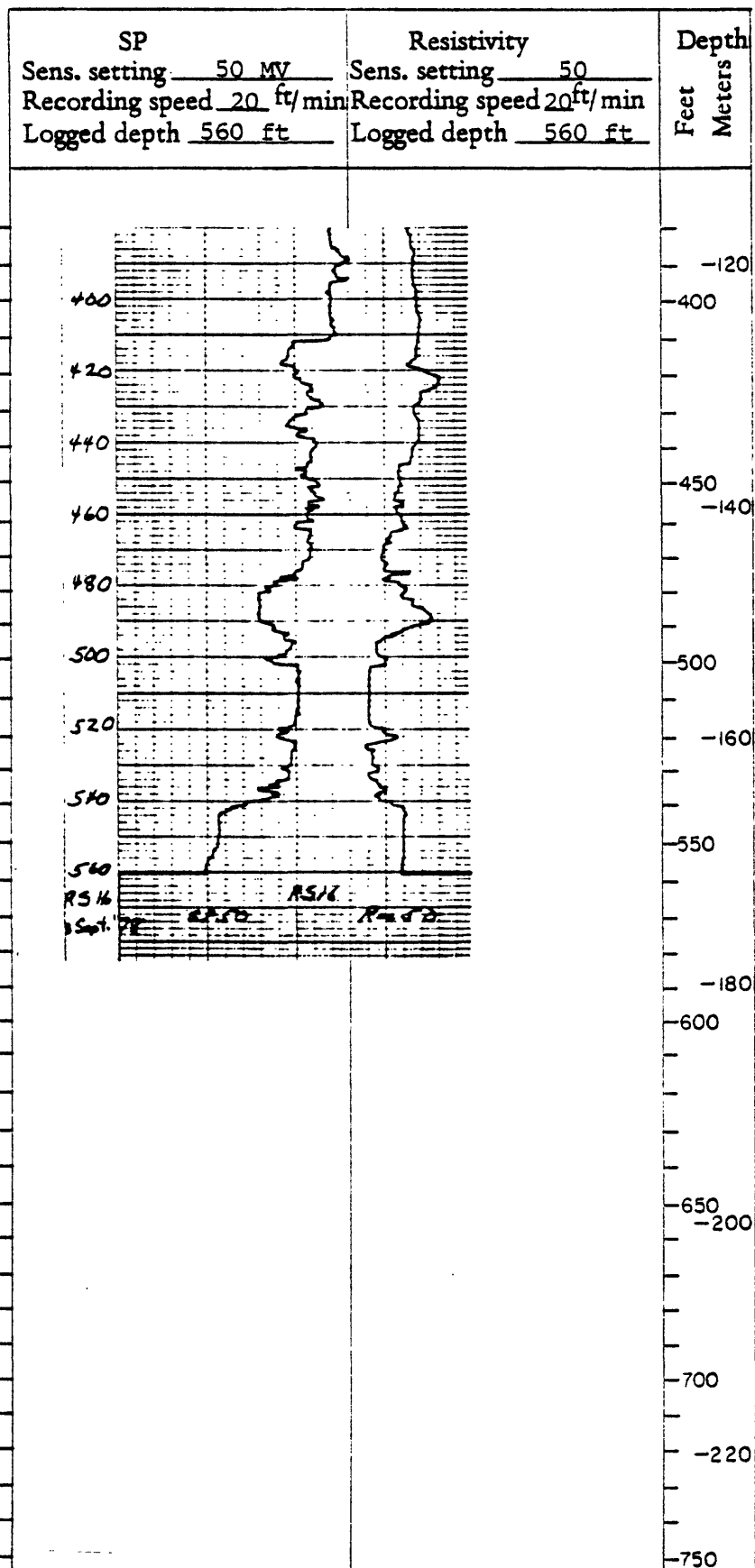
RS-16





Hole number—continued

RS-16



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: RS-16C Map: Jung Lake Date: 9-3-78 State: ND County: Hettinger
 Elev.: 2,748 ft Location: T. 134^N, R. 97^E, Sec. 4, Tract: dccc Drilled depth: 154 ft
 Measured: 105 ft ~~FSL~~ ^{FEL}, 2400 ft ~~FSL~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☒ No ☐
 Lignite beds: _____

Remarks: No G.R., S.P. or Res. run

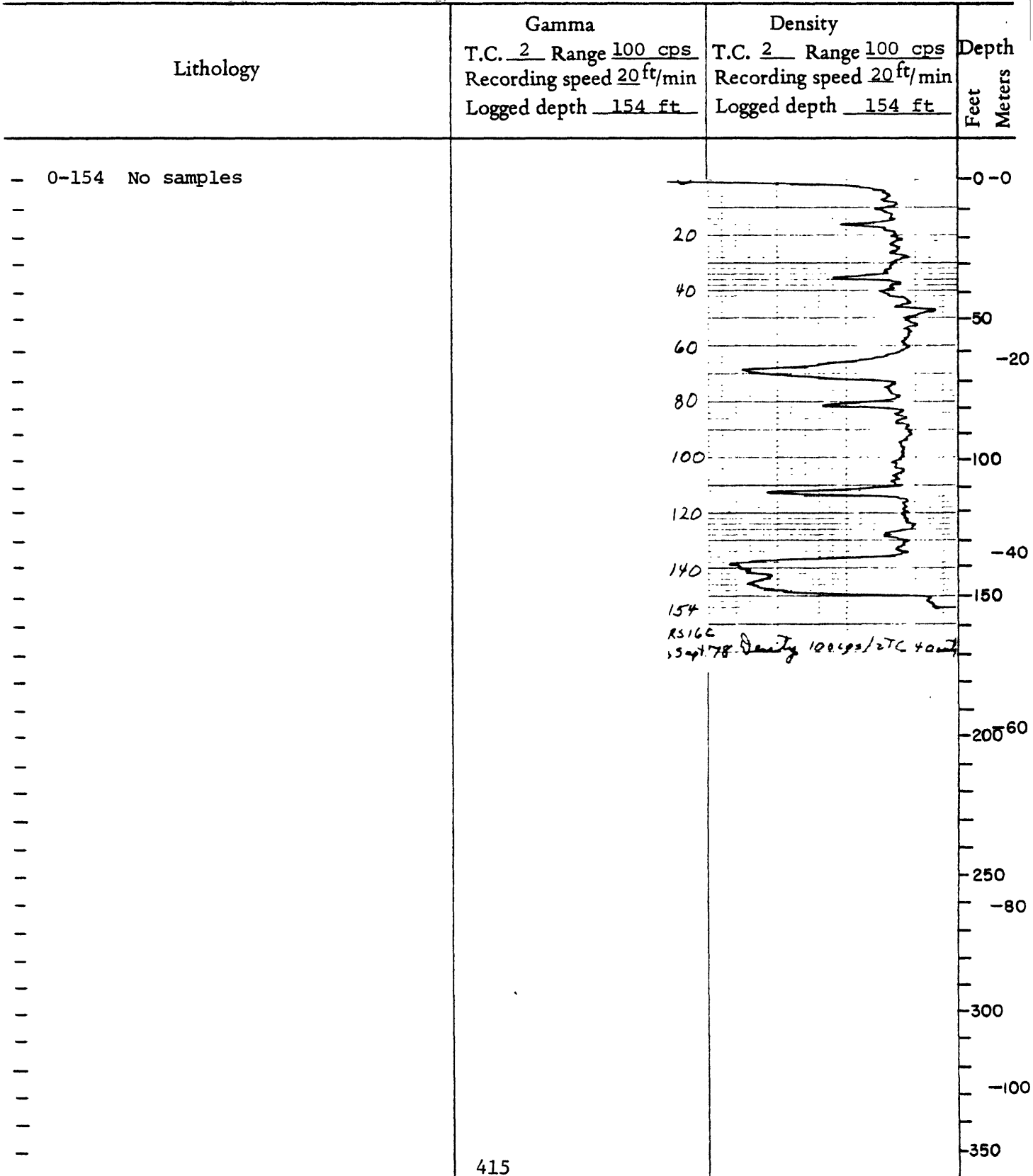
Lithology

Recorded by: _____

Geologist ^{Yes} ~~No~~

Geophysical logs

recorded by: Lechner



Hole number—continued

Lithology	Gamma	Density	Depth	
	T.C. _____ Range _____	T.C. _____ Range _____	Feet	Meters
	Recording speed _____ ft/min	Recording speed _____ ft/min		
	Logged depth _____	Logged depth _____		
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	

NORTH DAKOTA GEOLOGICAL SURVEY

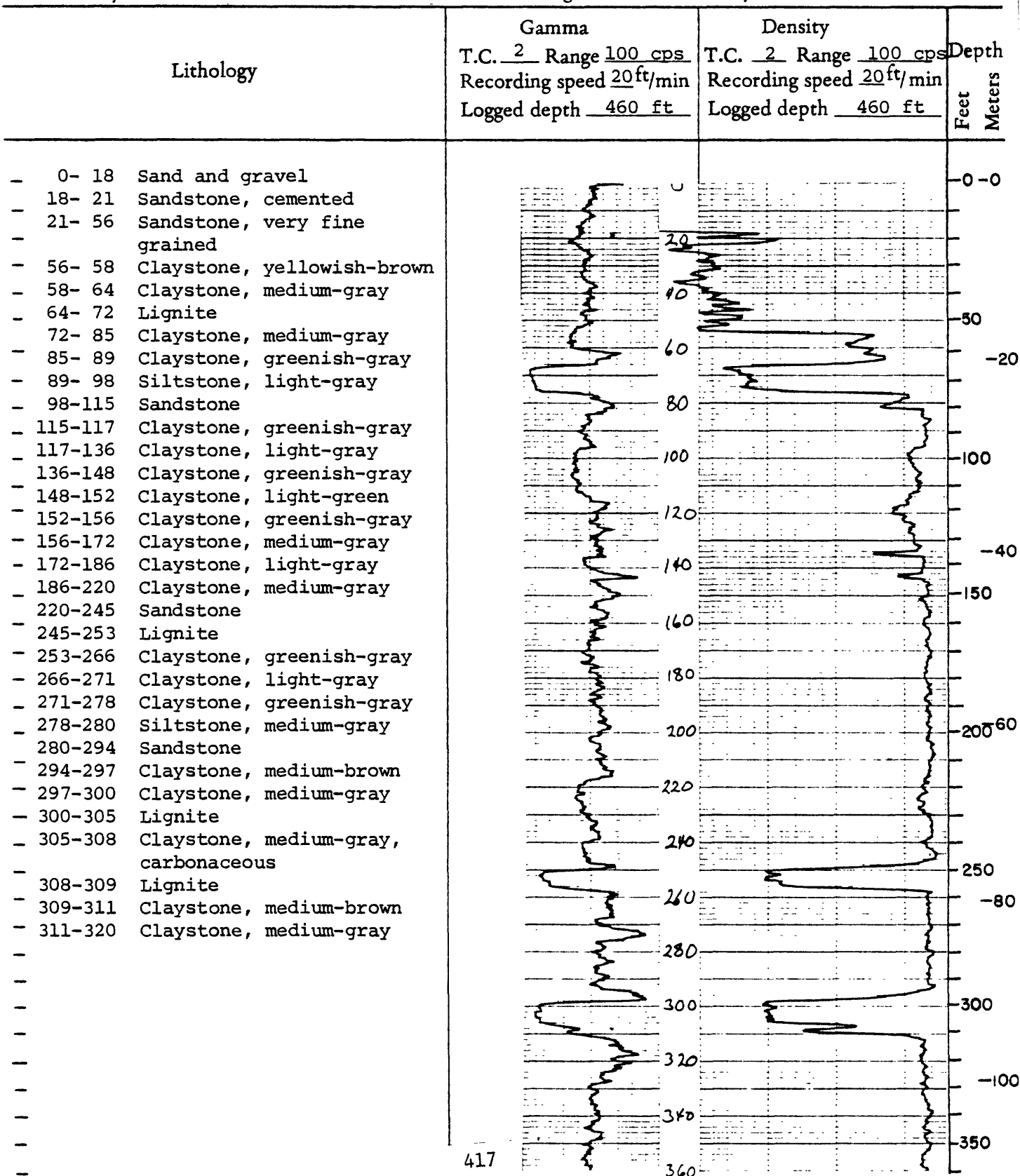
Hole No: RS-17 Map: Jung Lake Date: 9-3-78 State: ND County: Hettinger
 Elev.: 2,592 ft Location: T. 135^N, R. 96^R, Sec. 20, Tract: baaa Drilled depth: 460 ft
 Measured: 60 ft ~~FNL~~ 2557 ft ~~FWL~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 66-76; 249-257; 297-310

Remarks: _____

Lithology

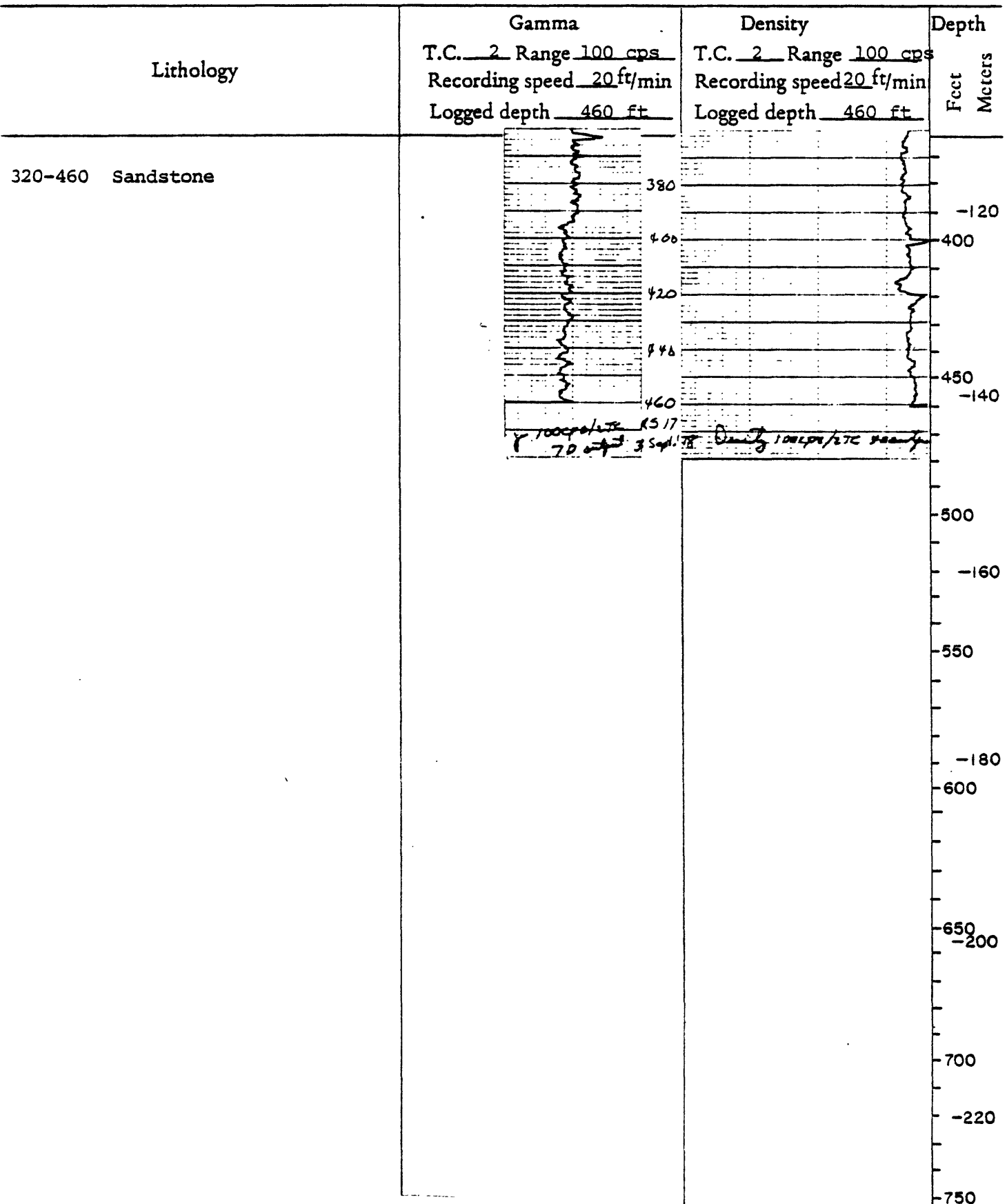
Recorded by: Tom HeckGeologist ^{Yes}
~~XX~~

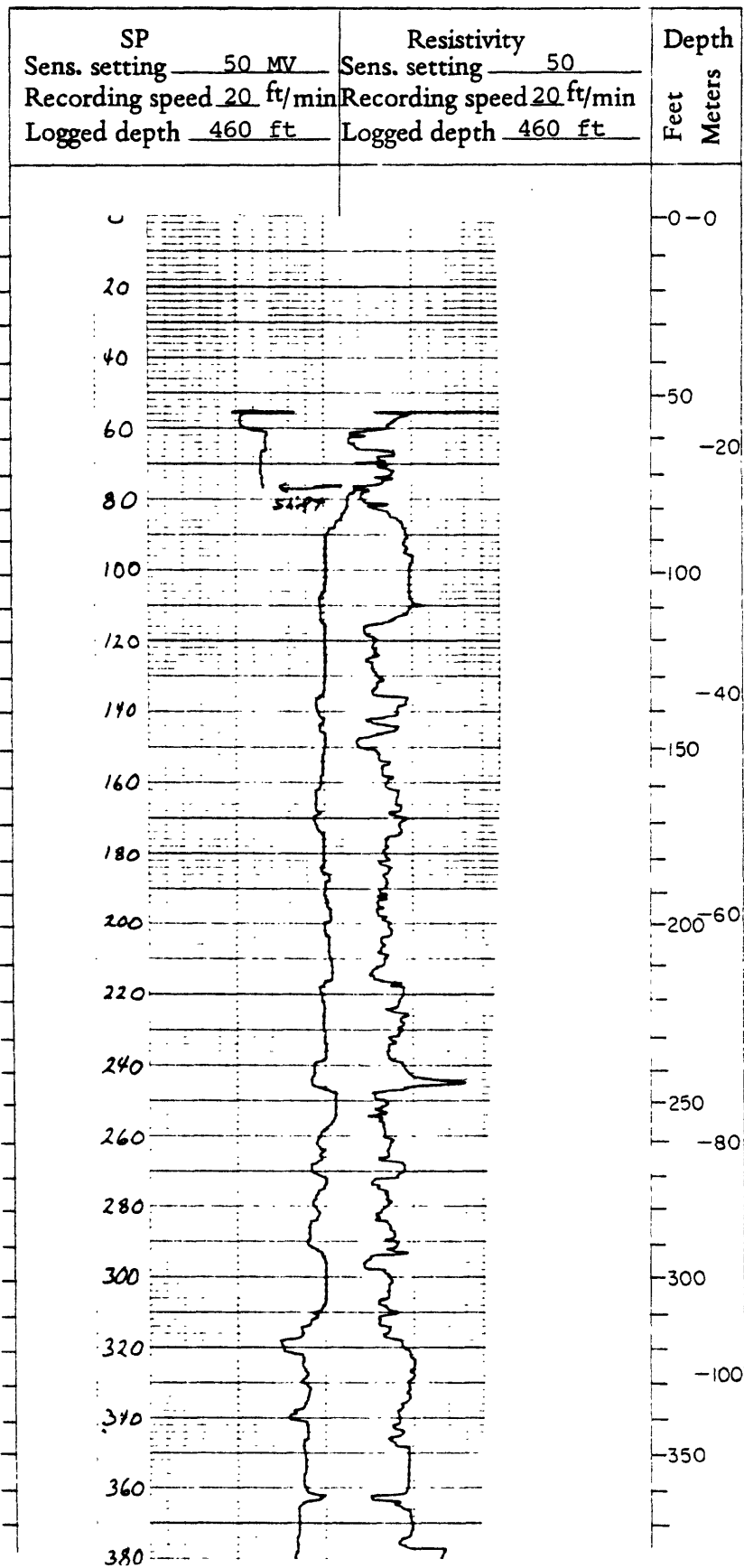
Geophysical logs

recorded by: Lechner

Hole number—continued

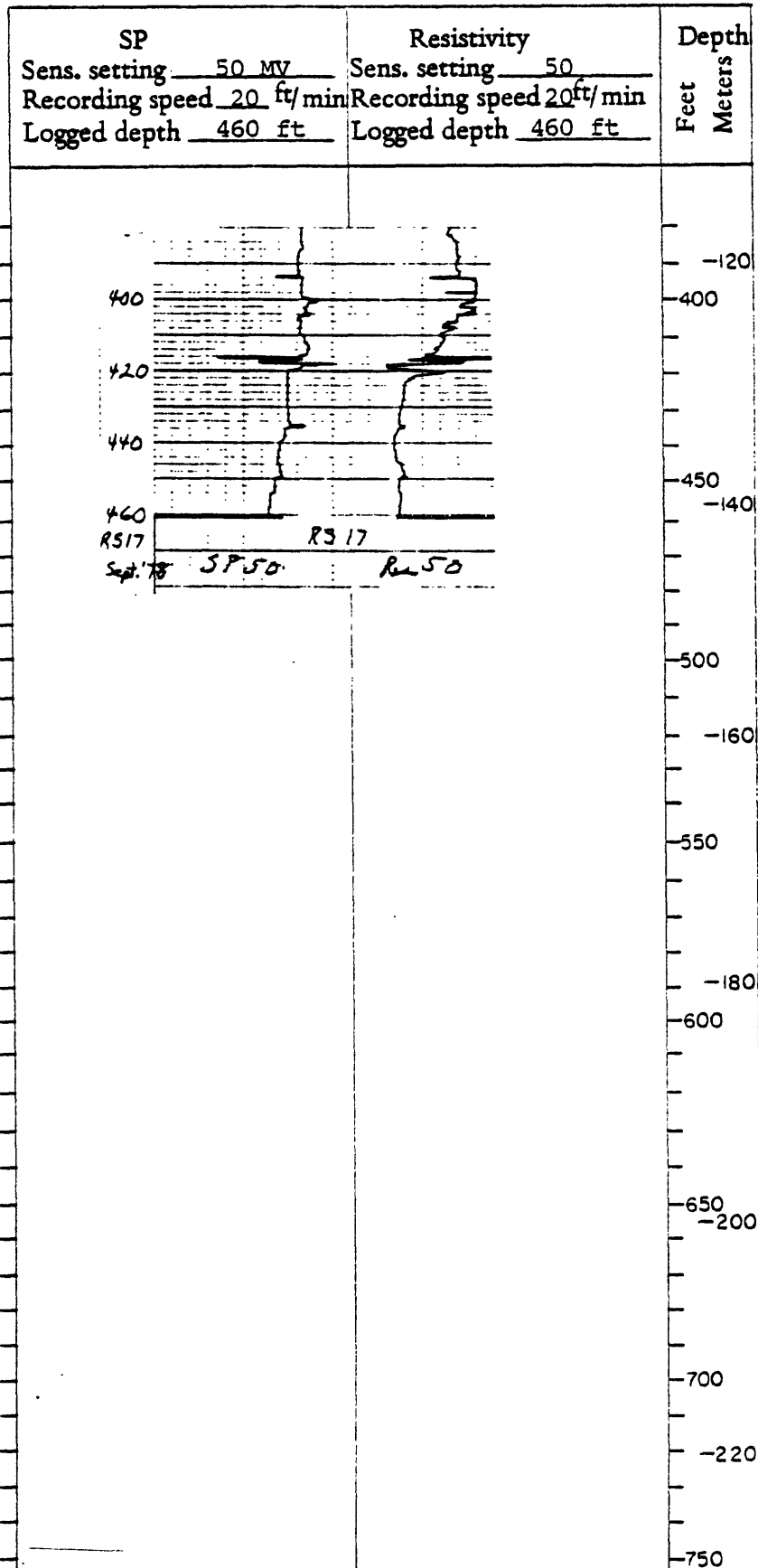
RS-17





Hole number—continued

RS-17



NORTH DAKOTA GEOLOGICAL SURVEY

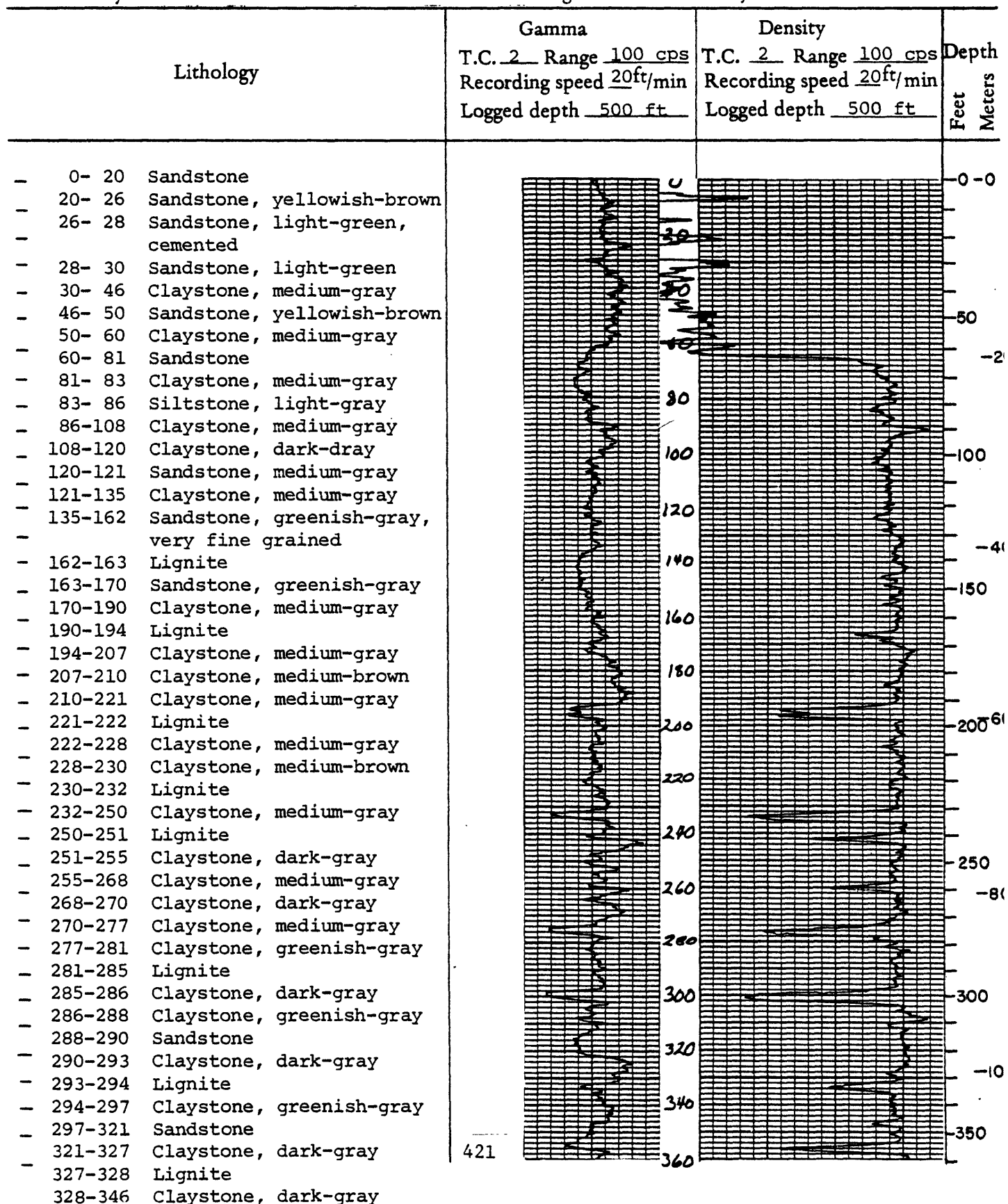
Hole No: BG-1 Map: Bowman SW Date: 9-16-78 State: ND County: Bowman
 Elev.: 2,915 ft Location: T. 130 N, R. 102 W, Sec. 12, Tract: abdc Drilled depth: 500 ft
 Measured: 1225 ft ^{FNL} 1950 ft ^{FEL} 1950 ft Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 194-197.5; 231-234; 275-278; 299-302; 429-432

Remarks: _____

Lithology

Recorded by: Tom HeckGeologist ^{Yes} ~~No~~

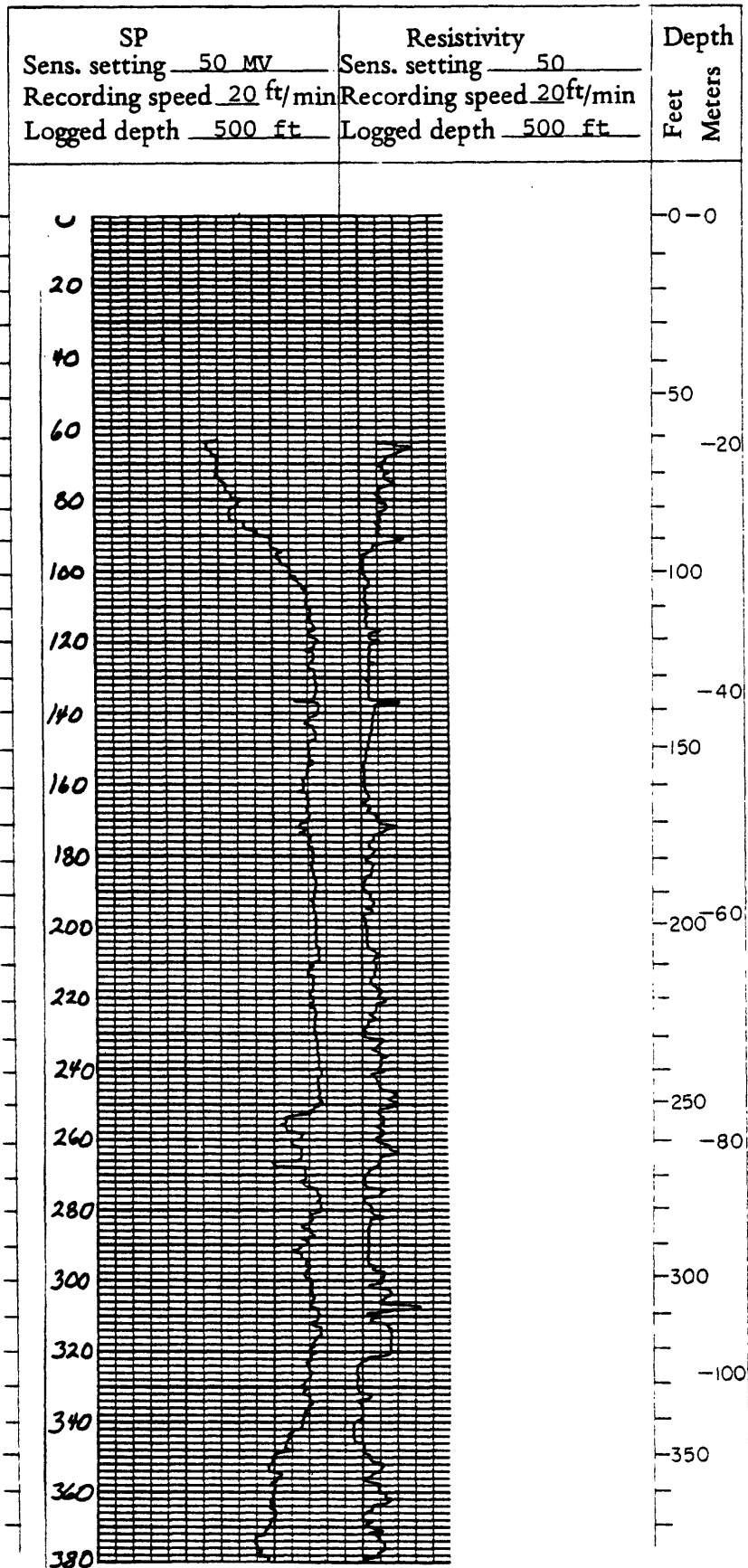
Geophysical logs

recorded by: Lechner

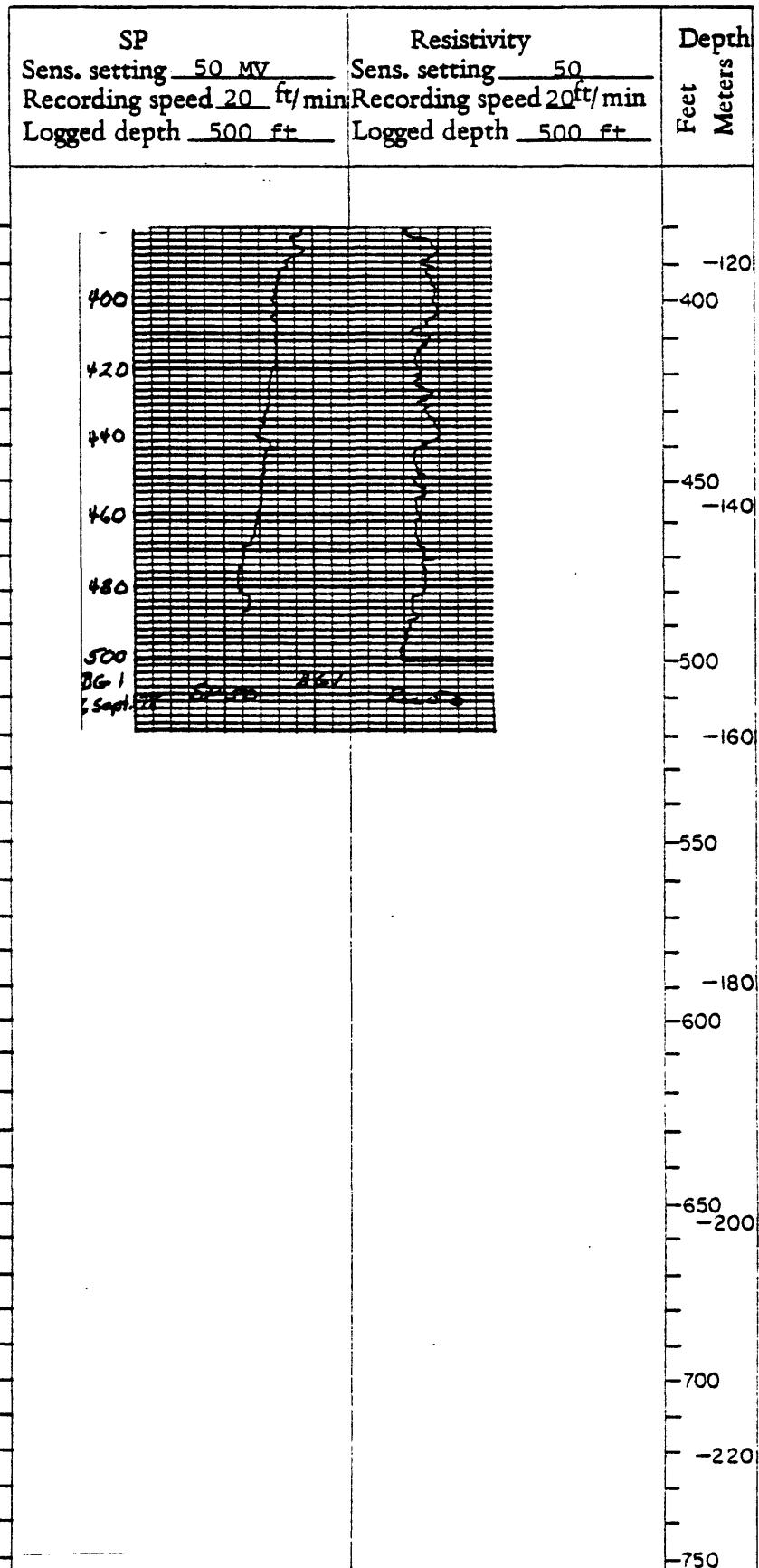
Hole number—continued

BG-1

Lithology	Gamma		Density		Depth	
	T.C.	Range 100 cps	T.C.	Range 100 cps	Feet	Meters
	Recording speed	20 ft/min	Recording speed	20 ft/min		
	Logged depth	500 ft	Logged depth	500 ft		
346-350 Lignite						
350-352 Claystone, dark-gray						
352-360 Sandstone					-120	
360-390 Claystone, medium-gray					400	
390-392 Sandstone						
392-393 Lignite						
393-400 Sandstone						
400-416 Claystone, medium-gray						
416-421 Claystone, greenish-gray						
421-423 Claystone, dark-gray					450	
423-424 Lignite					-140	
424-430 Claystone, medium-gray						
430-441 Sandstone						
441-466 Claystone, medium-gray						
466-482 Sandstone, light-green, very fine grained					500	
482-500 Claystone, greenish-gray						
					-160	
					550	
					-180	
					600	
					650	
					-200	
					700	
					-220	
					750	



Hole number—continued
BG-1



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BG-2 Map: Rhame SE Date: 9-16-78 State: ND County: Bowman
 Elev.: 2,988 ft Location: T. 130^N S. 103^E W, Sec. 12, Tract: cccc Drilled depth: 500 ft
 Measured: 50 ft ~~FSL~~ 110 ft ~~FWL~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 96-98; 201-205; 248-251; 258-260; 285-288

Remarks: _____

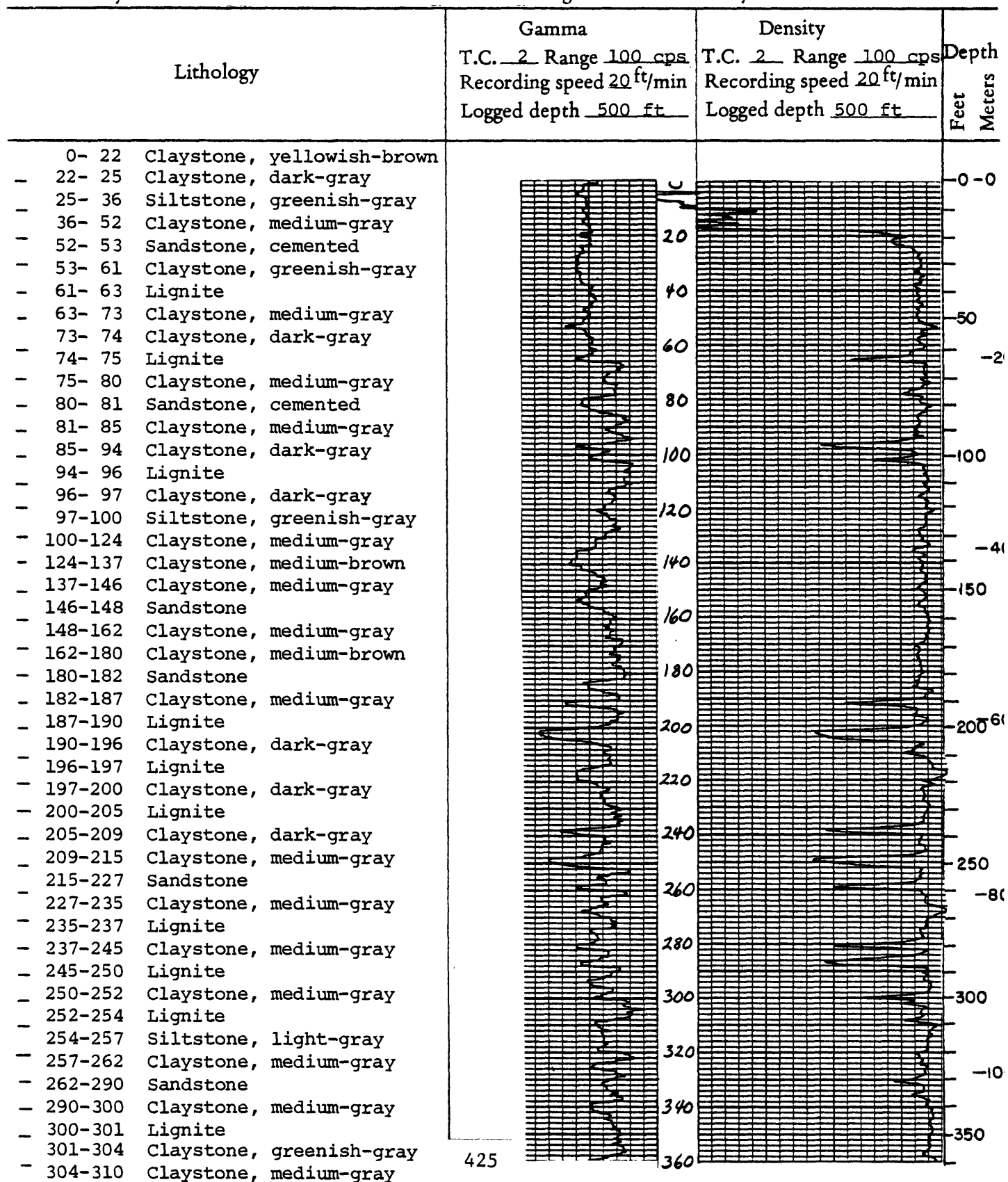
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~XX~~

Geophysical logs

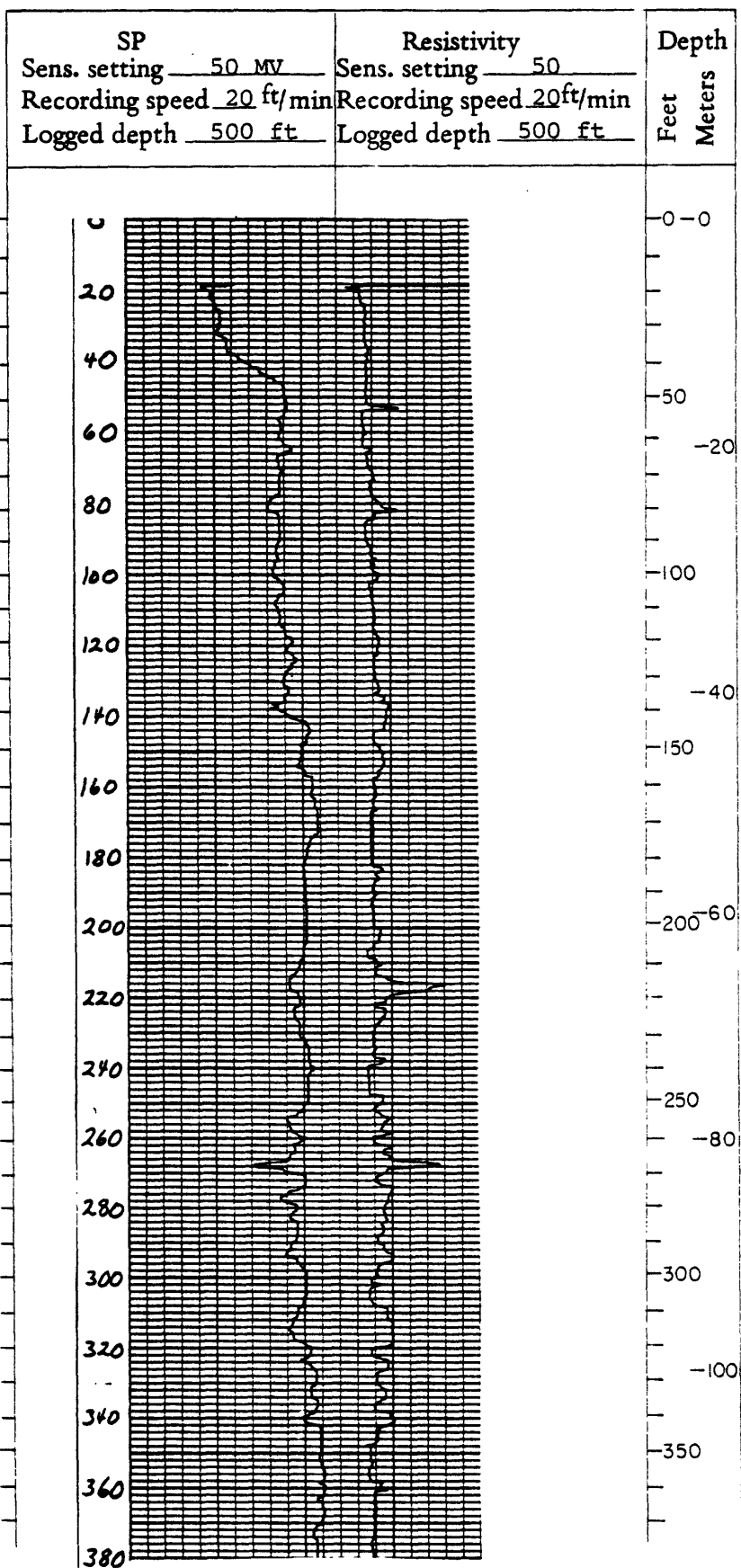
recorded by: Lechner



Hole number—continued

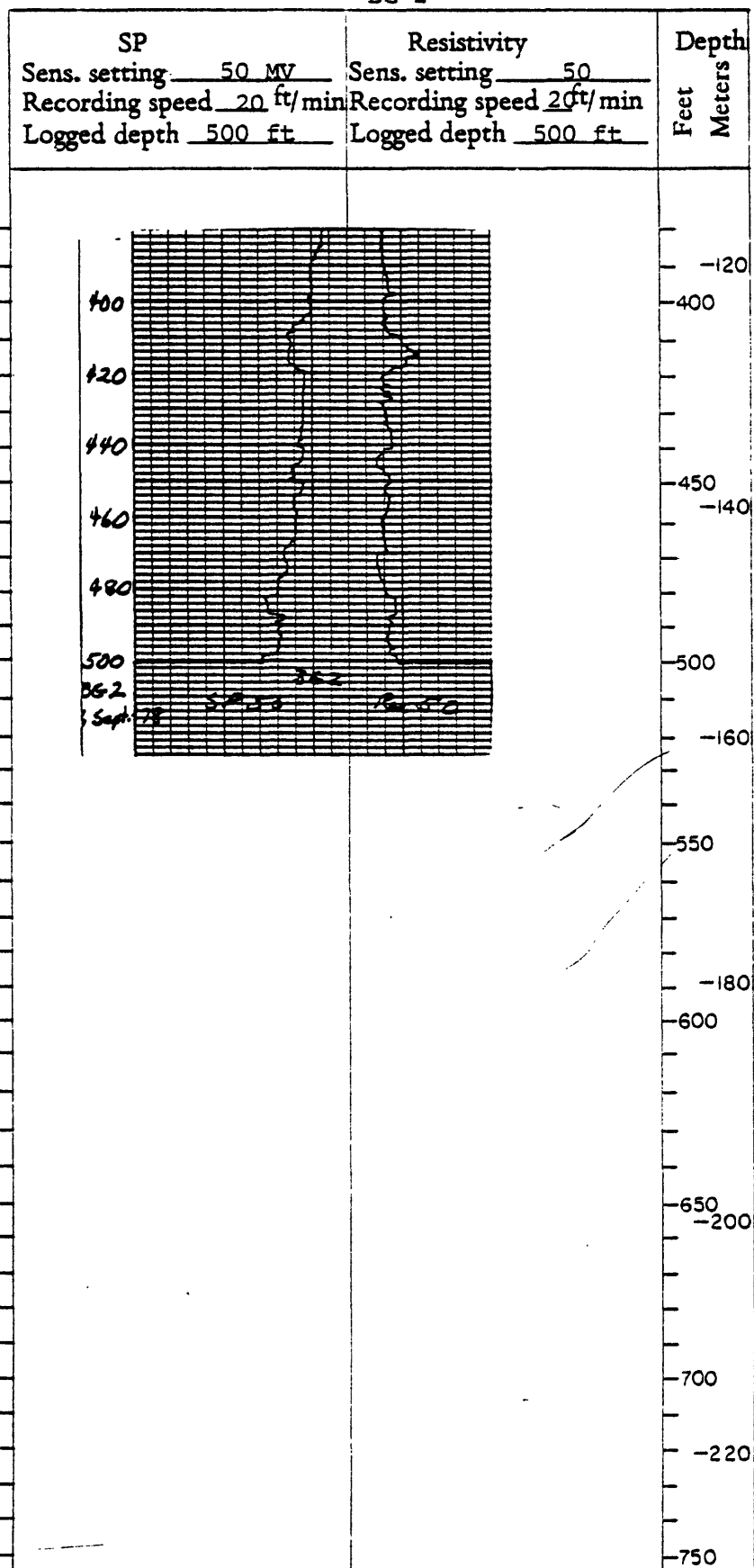
BG-2

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fcct	Meters
	Recording speed 20 ft/min		Recording speed 20ft/min			
	Logged depth 500 ft		Logged depth 500 ft			
310-320 Siltstone, light-gray						
320-332 Claystone, medium-gray		330				
332-336 Claystone, dark-gray						-120
336-360 Claystone, medium-gray		400				400
360-371 Sandstone						
371-383 Claystone, medium-gray		420				
383-402 Sandstone						
402-409 Siltstone, light-gray		440				
409-416 Sandstone						
416-425 Claystone, medium-gray		460			450	
425-427 Sandstone						-140
427-430 Claystone, medium-gray		480				
430-436 Sandstone						
436-437 Siltstone, greenish-gray		500				
437-440 Sandstone						
440-445 Claystone, medium-gray		562			500	
445-451 Sandstone						
451-452 Claystone, medium-gray						-160
452-461 Sandstone						
461-466 Claystone, medium-gray						
466-471 Claystone, greenish-gray						
471-475 Sandstone						550
475-476 Claystone, medium-gray						
476-500 Sandstone						
						-180
						600
						650
						-200
						700
						-220
						750



Hole number—continued

BG-2



Hole No: BG-3 Map: Camel Butte Date: 9-15-78 State: ND County: Bowman
Elev.: 3,215 ft Location: T. 130^N, R. 104^E W, Sec. 10, Tract: aaad Drilled depth: 500 ft
Measured: 425 ft ^{FNL} ~~FSL~~, 80 ft ^{FEL} ~~FSL~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 44-48; 124-128; 138-149; 190-193; 195-206; 252-259; 264-266; 285-288

Lithology

Geologist ☒ Yes ☒ No

Geophysical logs

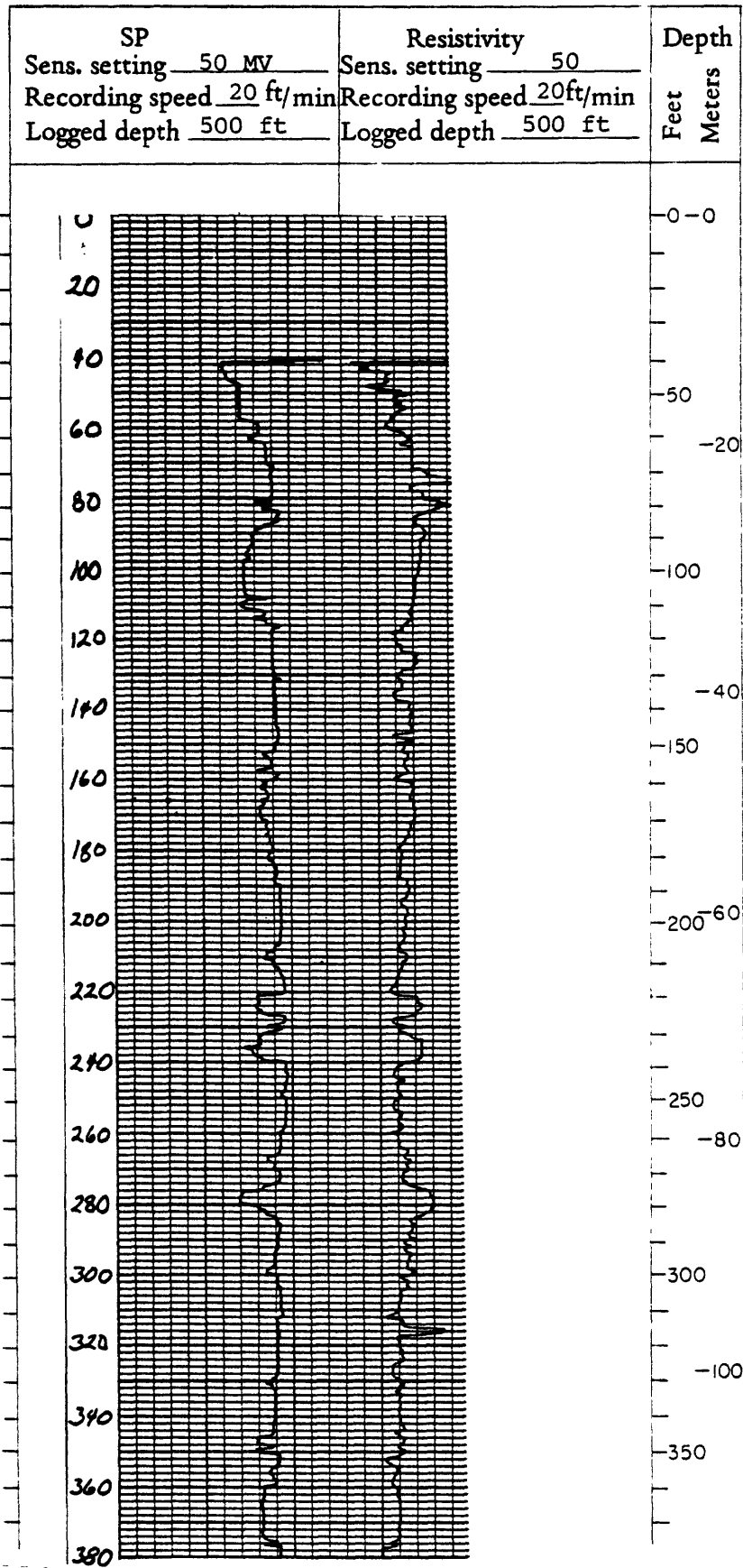
recorded by: Lechner

Lithology	Gamma	Density	Depth Feet Meters
	T.C. $\frac{2}{\text{Range}}$ $\frac{100 \text{ cps}}{\text{Recording speed } 20 \text{ ft/min}}$ Logged depth $\frac{500 \text{ ft}}$	T.C. $\frac{2}{\text{Range}}$ $\frac{100 \text{ cps}}{\text{Recording speed } 20 \text{ ft/min}}$ Logged depth $\frac{500 \text{ ft}}$	
- 0- 25 Sandstone			0 - 0
- 25- 27 Lignite			
- 27- 30 Claystone, light-gray			
- 30- 40 Siltstone, light-red			
- 40- 44 Lignite			
- 44- 45 Claystone, dark-gray			
- 45- 47 Lignite			
- 47- 50 Claystone, dark-gray			50
- 50- 53 Lignite			
- 53- 64 Claystone, medium-gray			-20
- 64- 75 Sandstone			
- 75- 86 Claystone, medium-gray			
- 86-120 Sandstone			
- 120-123 Lignite			100
- 123-130 Claystone, medium-gray			
- 130-134 Claystone, dark-gray			
- 134-135 Lignite			
- 135-144 Claystone, dark-gray			-40
- 144-150 Claystone, light-gray			
- 150-155 Lignite			150
- 155-161 Sandstone			
- 161-170 Claystone, dark-gray			
- 170-176 Claystone, light-gray			
- 176-180 Sandstone			
- 180-184 Claystone, dark-gray			200
- 184-187 Lignite			200 60
- 187-192 Claystone, light-gray			
- 192-202 Lignite			
- 202-205 Claystone, dark-gray			
- 205-220 Claystone, medium-gray			
- 220-225 Claystone, medium-brown			
- 225-240 Sandstone			250
- 240-254 Claystone, medium-brown			-80
- 254-260 Lignite			
- 260-265 Claystone, dark-gray			
- 265-287 Claystone, medium-gray			
- 287-288 Lignite			
- 288-327 Claystone, medium-gray			300
- 327-332 Claystone, medium-brown			
-			-100
-			
-			350

429

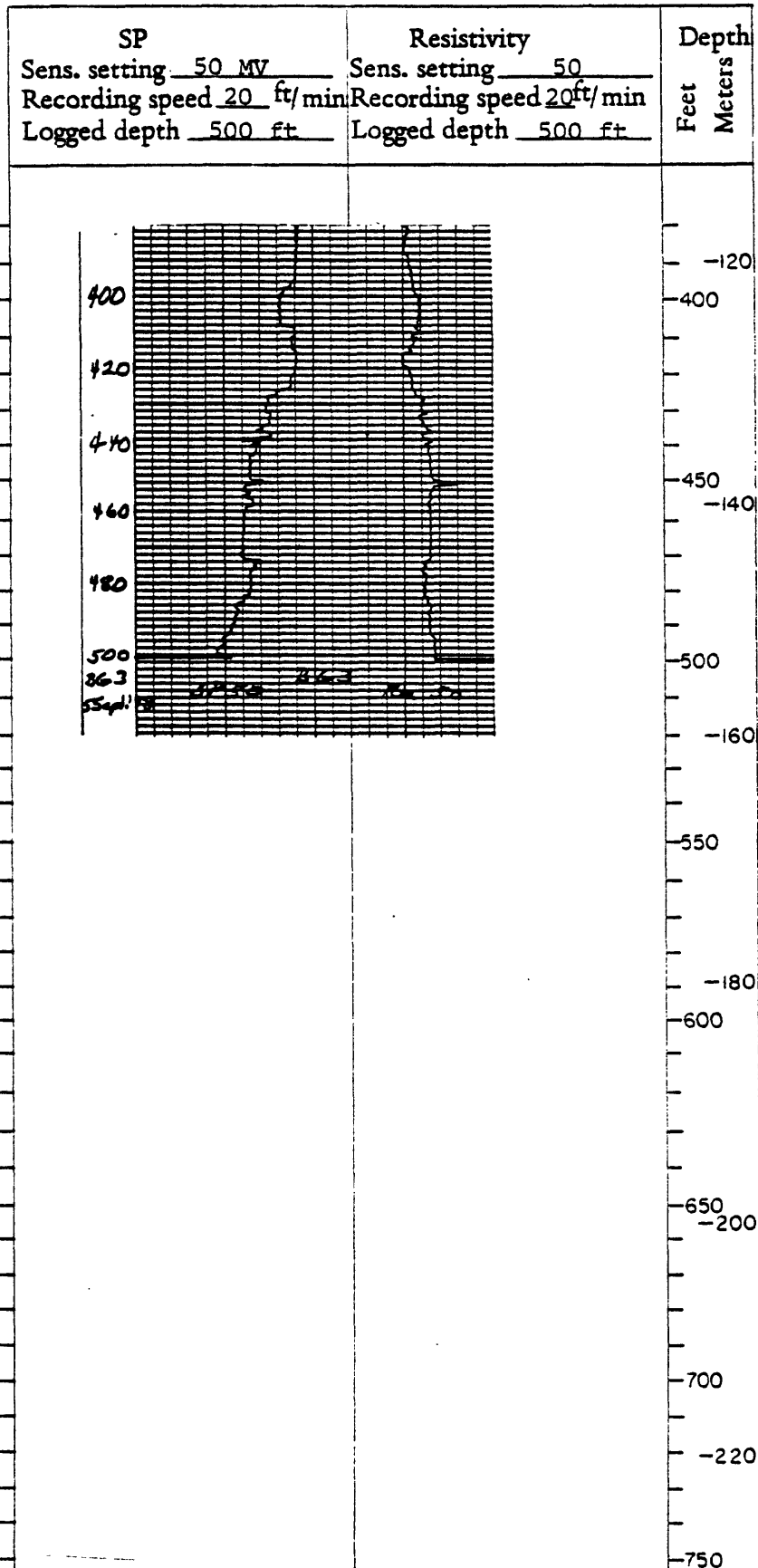
BG-3

Lithology	Gamma		Density		Depth	
	T.C.	Range 100 cps Recording speed 20 ft/min Logged depth 500 ft	T.C.	Range 100 cps Recording speed 20ft/min Logged depth 500 ft	Fect Meters	
332-360 Claystone, greenish-gray		380		-120		
360-370 Sandstone		400		-400		
370-386 Claystone, greenish-gray		420		-450		
386-390 Claystone, medium-brown		440		-140		
390-400 Claystone		460		-500		
400-500 No samples		480		-160		
		500		-550		
		-180				
		-600				
		-650				
		-200				
		-700				
		-220				
		-750				



Hole number—continued

BG-3



NORTH DAKOTA GEOLOGICAL SURVEY

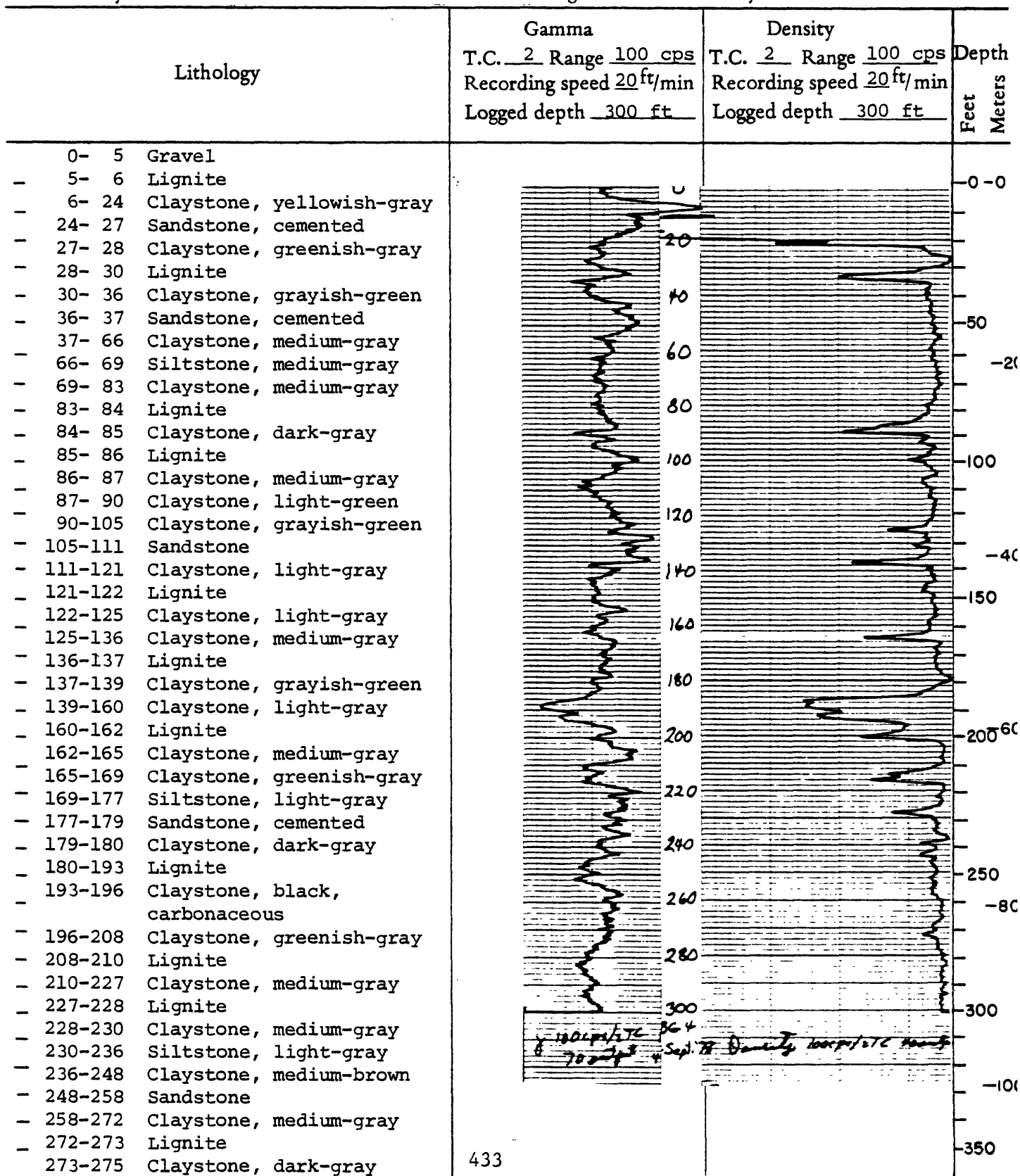
Hole No: BG-4 Map: Cedar Lake Date: 9-4-78 State: ND County: Adams
 Elev.: 2,702 ft Location: T. 132^N, R. 98^E, Sec. 2, Tract: baba Drilled depth: 300 ft
 Measured: 35 ft ^{FNL} ~~1840 ft~~ ^{FWL} ~~1840 ft~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 186-194

Remarks: _____

Lithology

Recorded by: Tom HeckGeologist ^{Yes} ~~XX~~

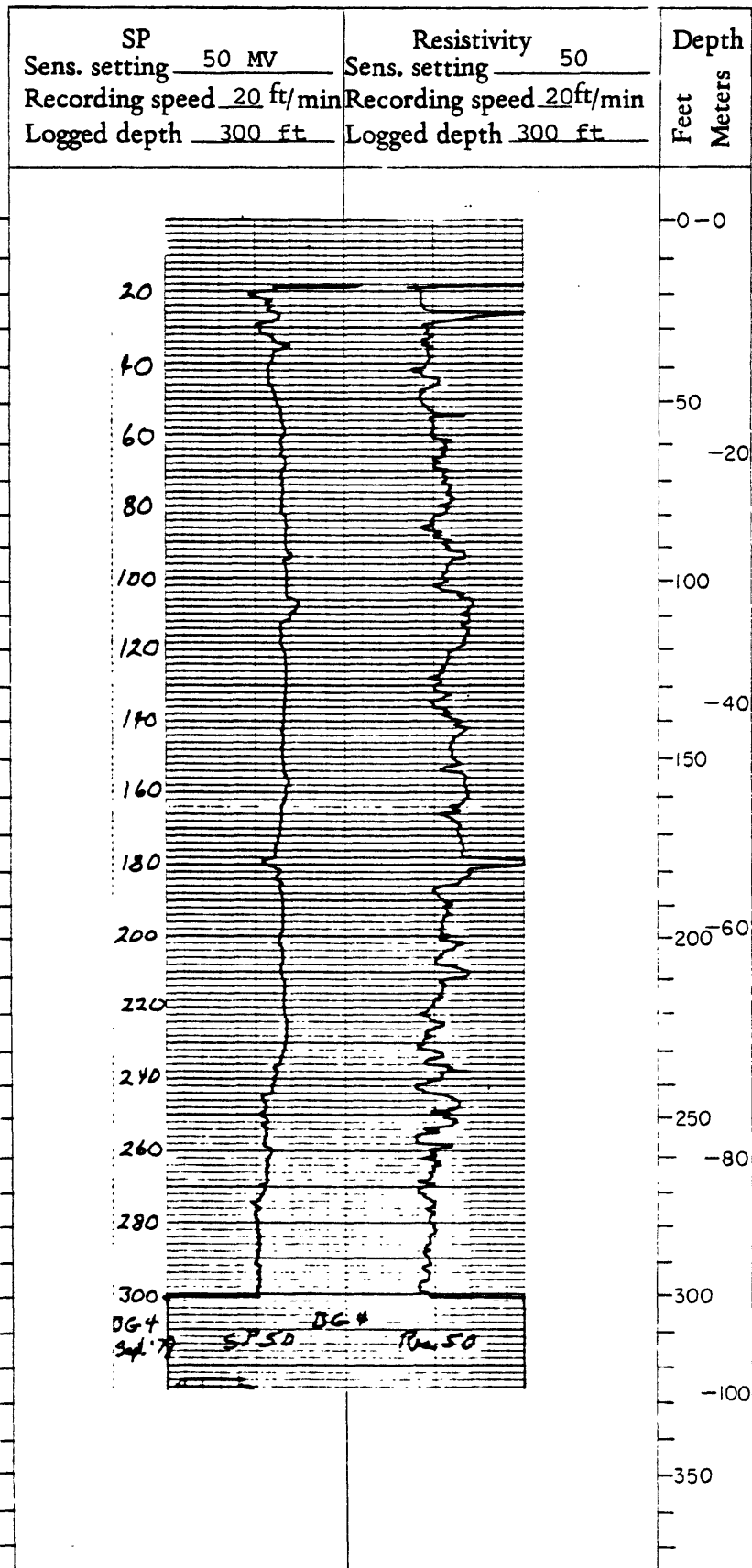
Geophysical logs

recorded by: Lechner

Hole number—continued

BG-4

Lithology	Gamma	Density	Depth	
	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft</u>	T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>300 ft</u>	Fcct	Meters
275-282 Claystone, greenish-gray				
282-285 Sandstone, light-green				
285-300 Claystone, greenish-gray				
				-120
				400
				450
				-140
				500
				-160
				550
				-180
				600
				650
				-200
				700
				-220
				750



BG-4

436

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BG-5 Map: Griffin Date: 9-16-78 State: ND County: Bowman
 Elev.: 3,078 ft Location: T. 132^N, R. 103^E, Sec. 28, Tract: dddc Drilled depth: 600 ft
 Measured: 60 ft ~~FSL~~ ^{FEL}, 360 ft ~~FSL~~ ^{FEL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 30-34; 74-77.5; 102-106; 128-136; 315-335; 482-484; 491-497

Remarks: _____

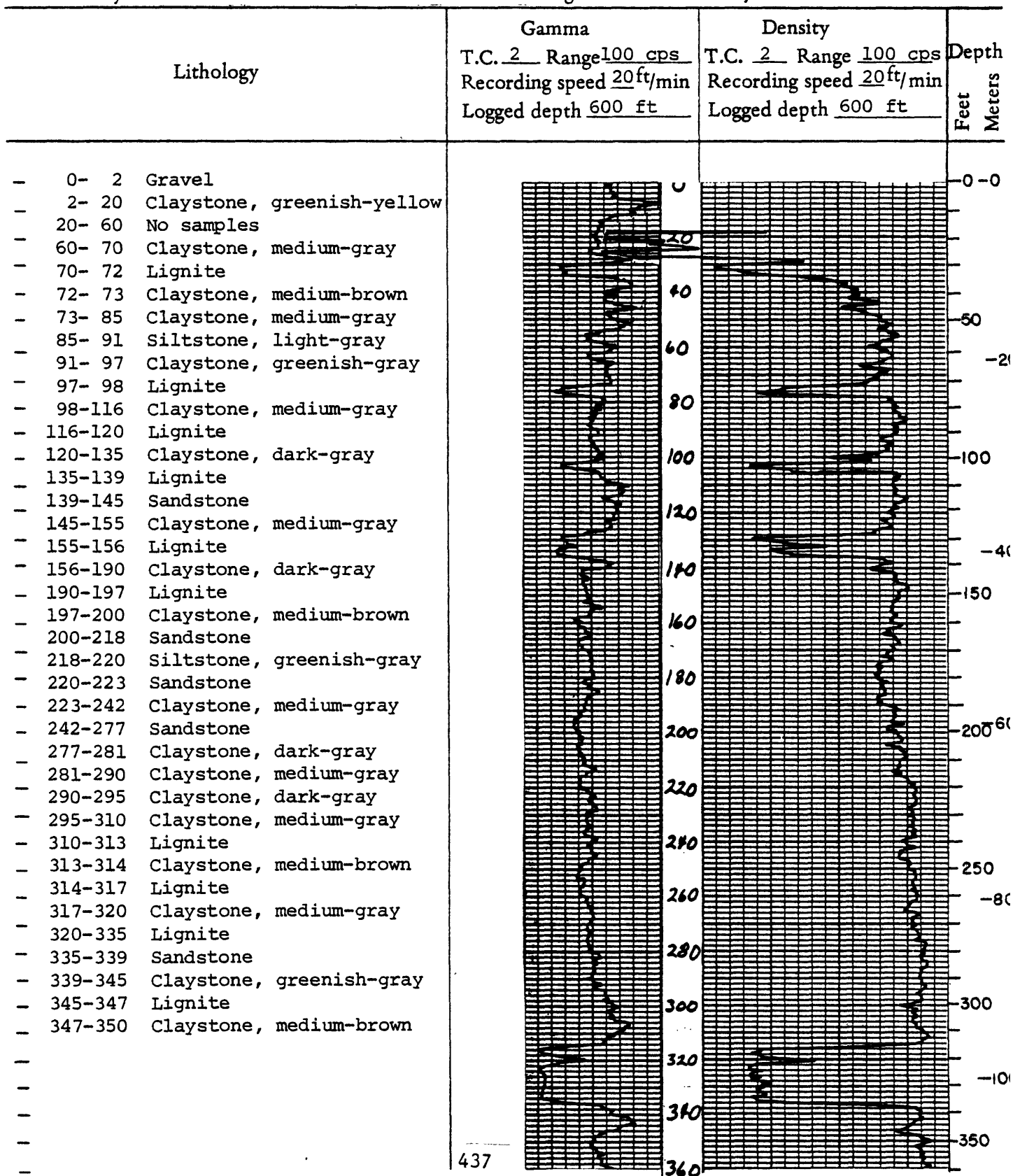
Lithology

Recorded by: Tom Heck

Geologist ^{Yes}
~~XX~~

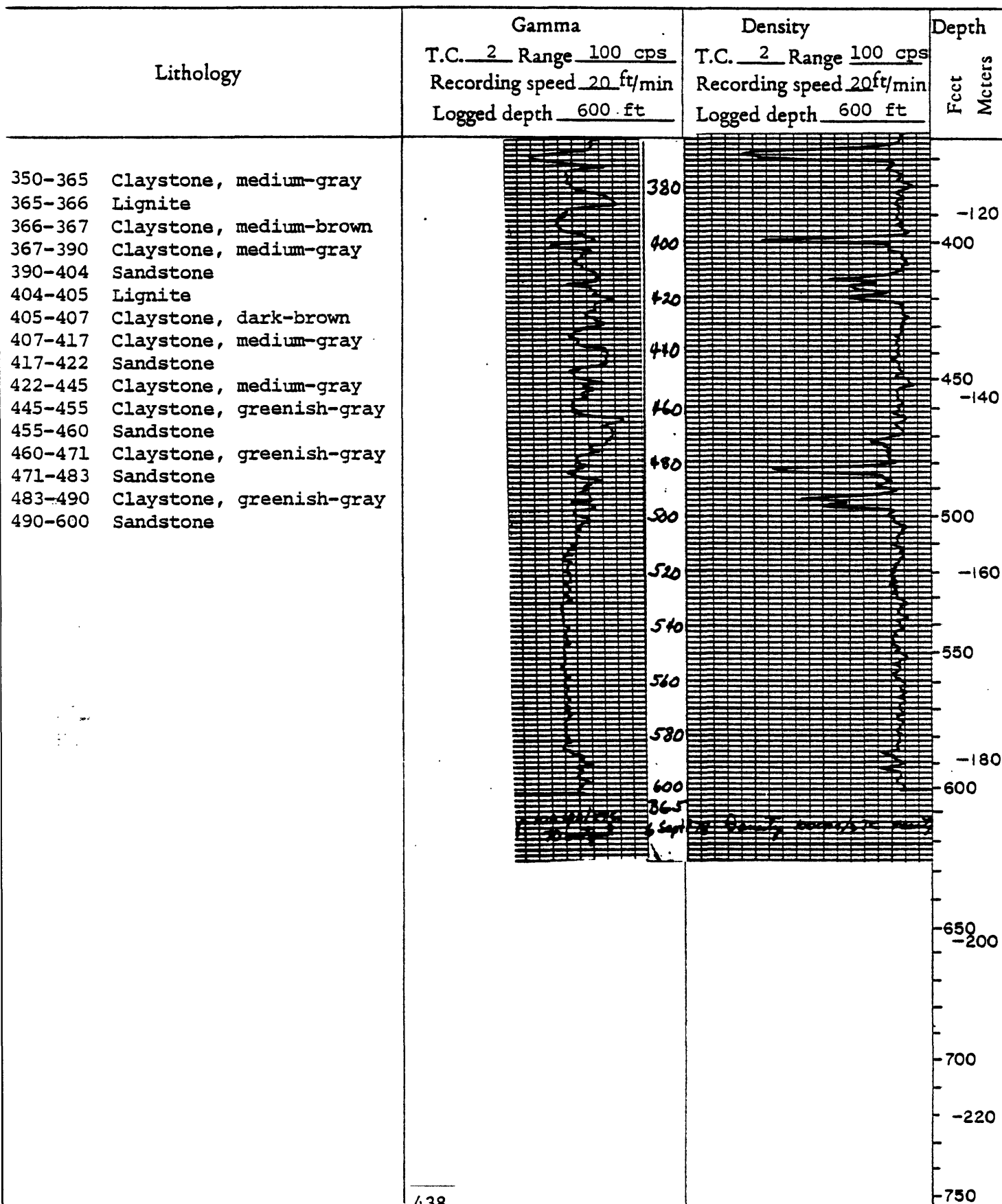
Geophysical logs

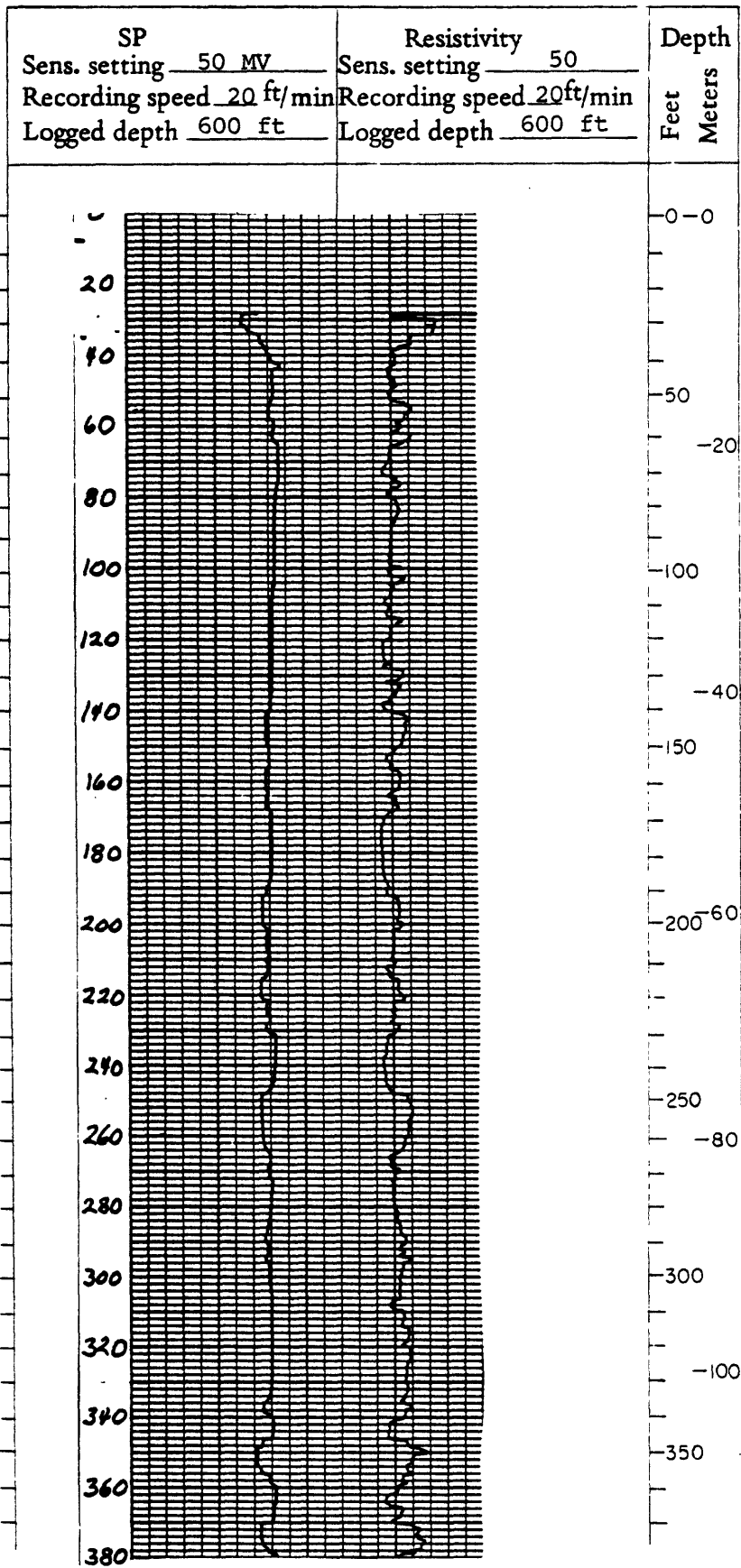
recorded by: Lechner



Hole number—continued

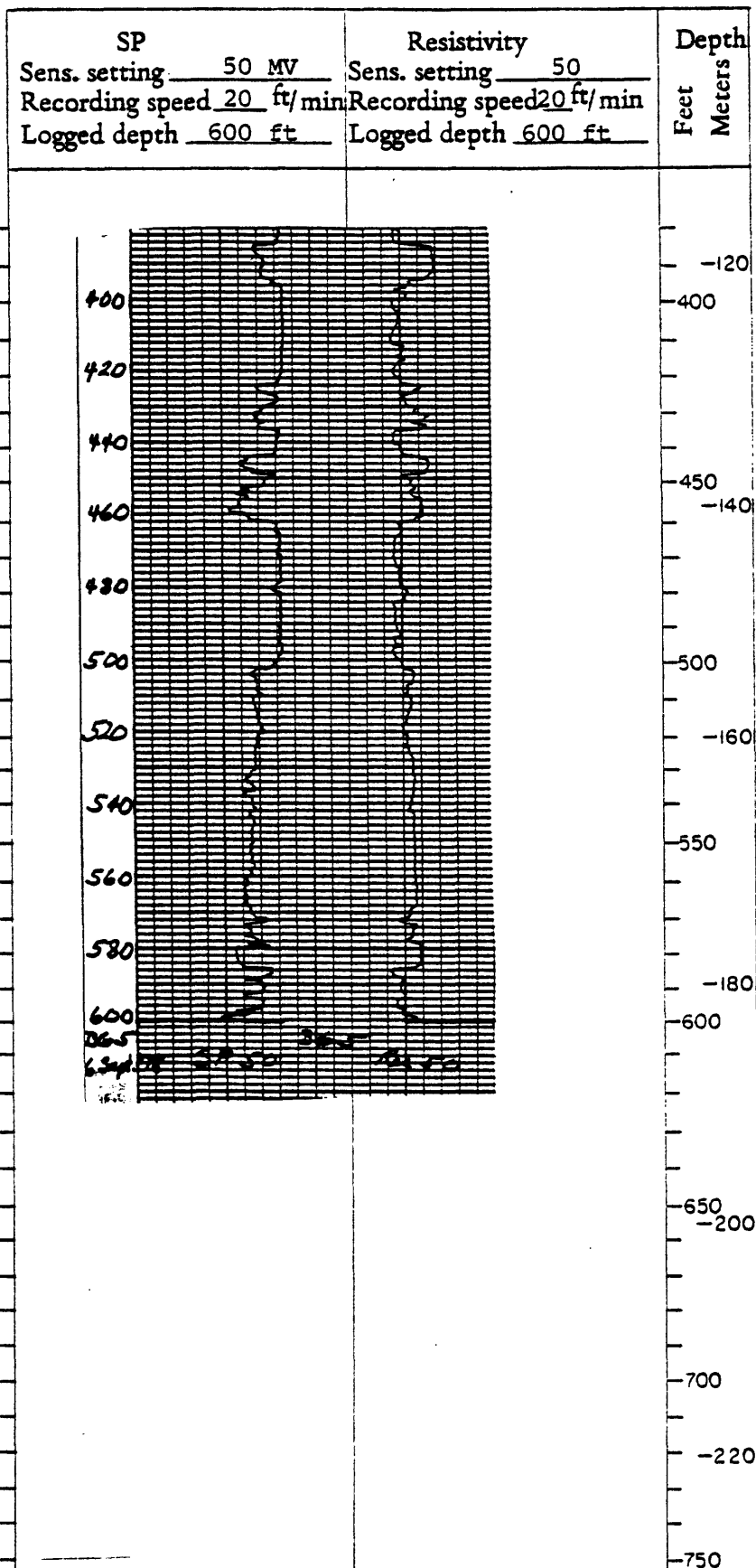
BG-5





Hole number—continued

BG-5



Hole No: BG-6 Map: Rhame Date: 9-15-78 State: ND County: Bowman
Elev.: 3,010 ft Location: T. 132^N~~132~~, R. 104^E~~104~~ W, Sec. 28, Tract: ccbb Drilled depth: 500 ft
Measured: 1050 ft ~~FSL~~ ^{FSL}, 18 ft ~~FWL~~ ^{FWL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 33-36; 124-139; 152-162; 187-192; 212-216; 284-286; 354-358

Lithology

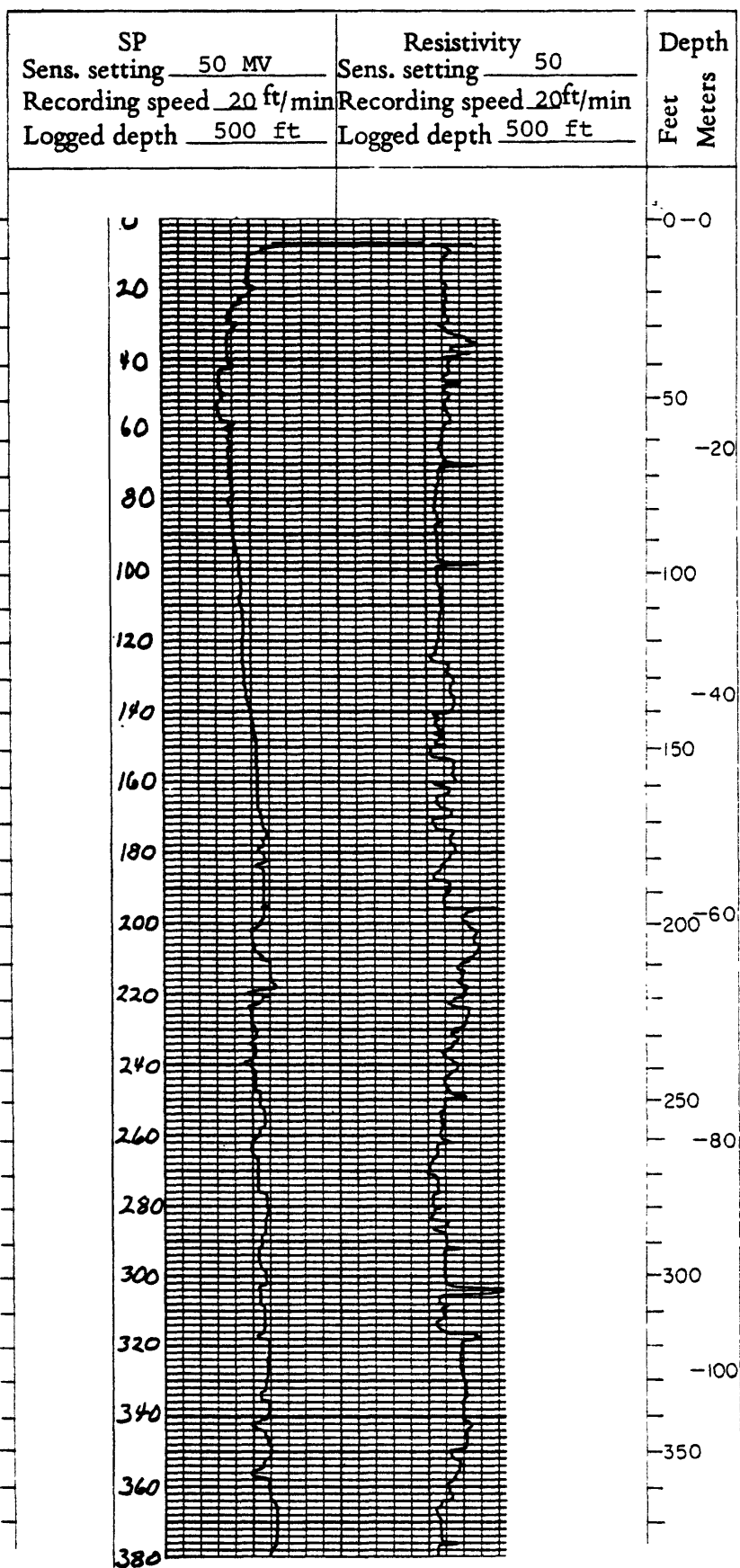
Recorded by: Tom Heck

Geologist ^{Yes}~~No~~ Geophysical logs recorded by: Lechner

[illegible]

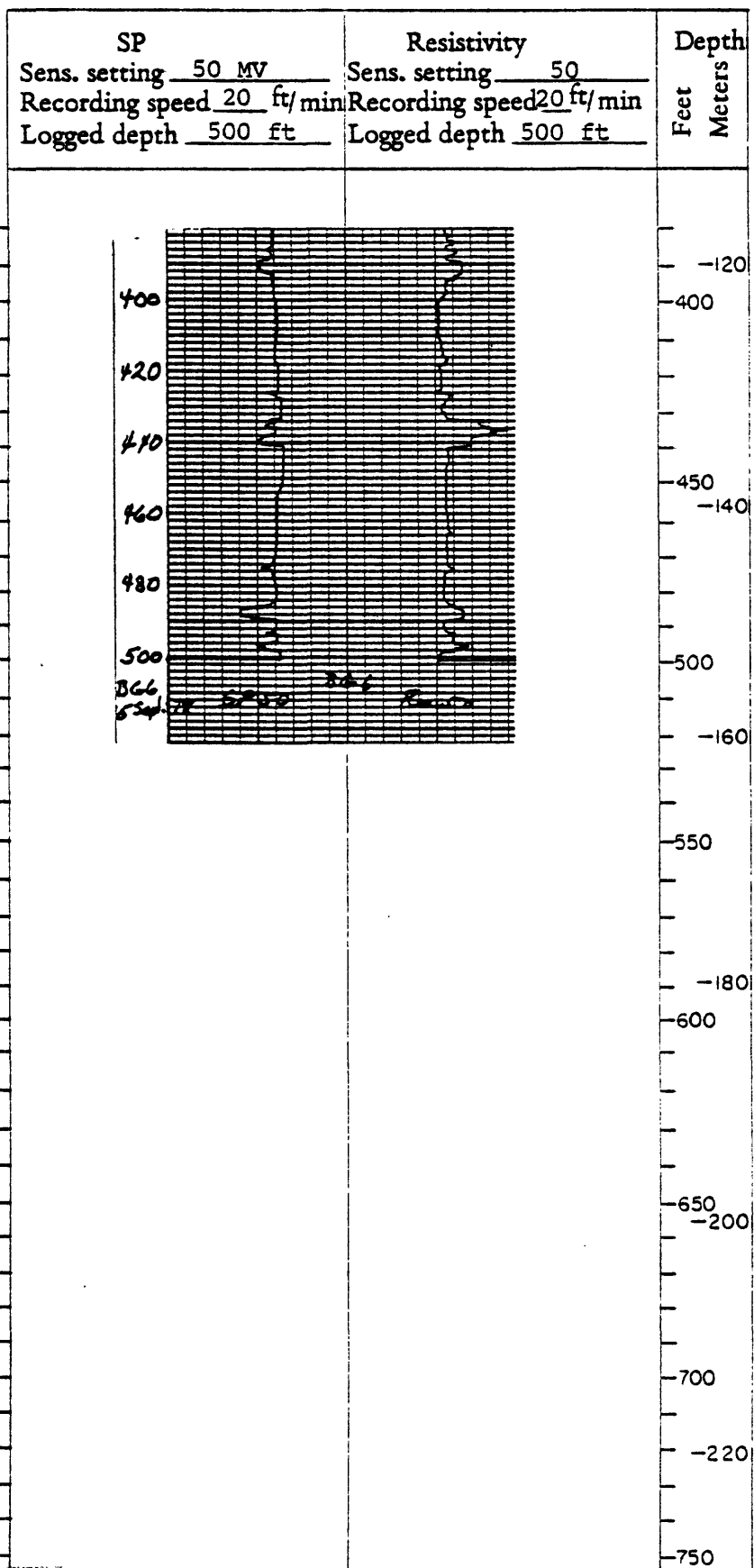
BG-6

442



Hole number—continued

BG-6



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BG-7 Map: Mineral Springs Date: 9-7-78 State: ND County: Slope
 Elev.: 2,798 ft Location: T. 133^N, R. 99^W, Sec. 32, Tract: aaaa Drilled depth: 400 ft
 Measured: 62 ft ^{FNL}~~830~~, 45 ft ^{FEL}~~872~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 23-25; 70-73; 97-100

Remarks: _____

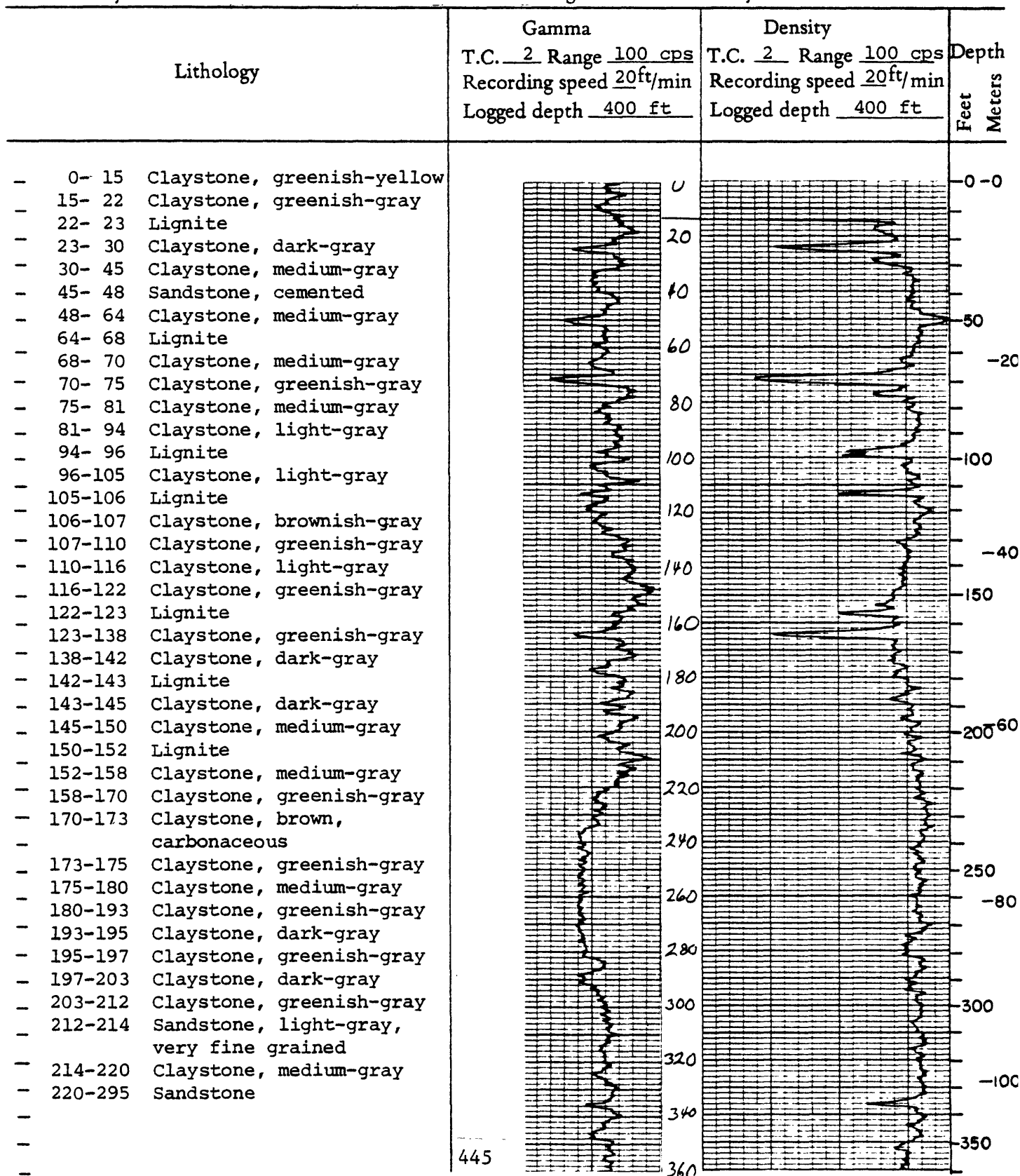
Lithology

Recorded by: Tom Heck

Geologist ^{Yes}~~No~~

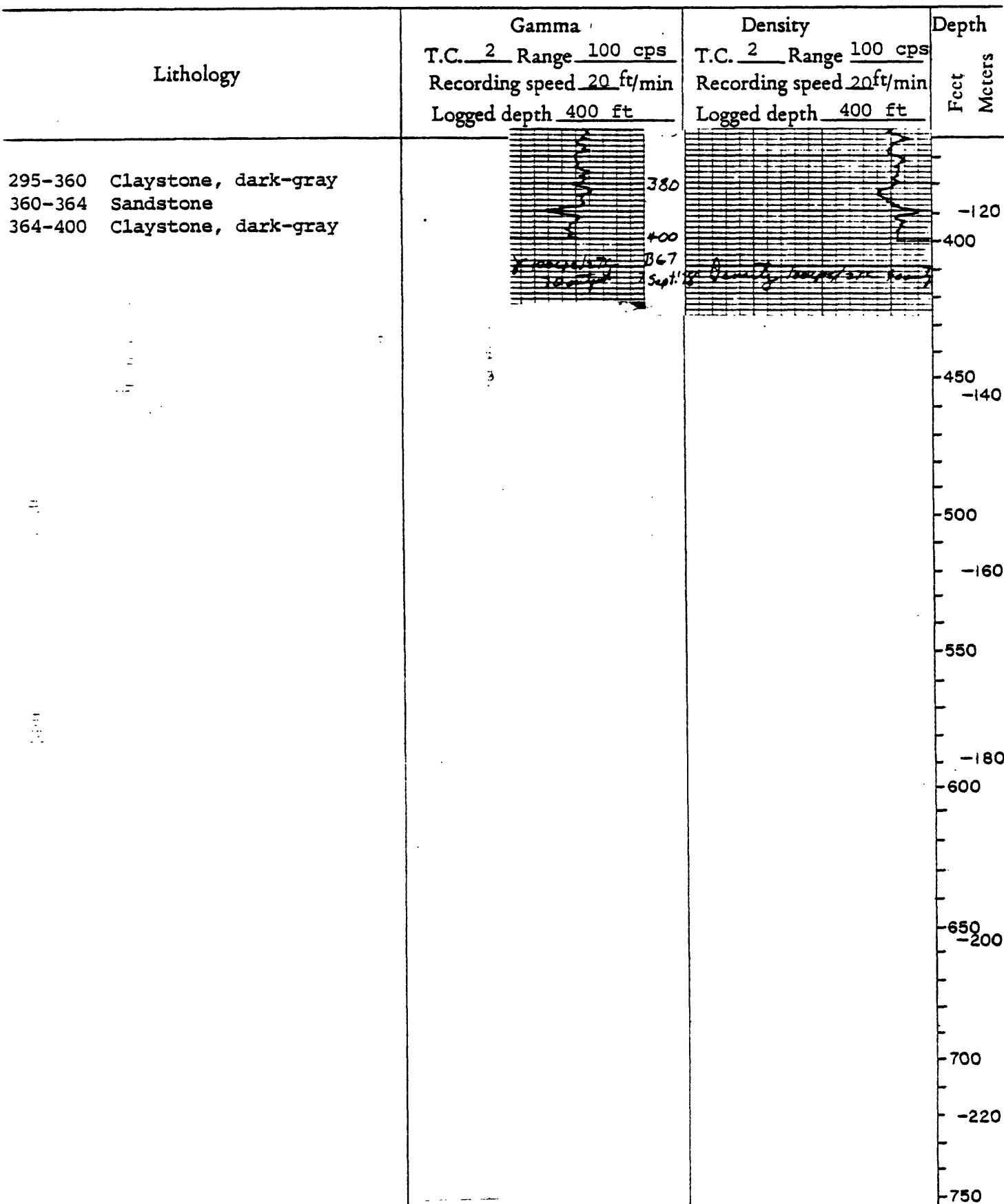
Geophysical logs

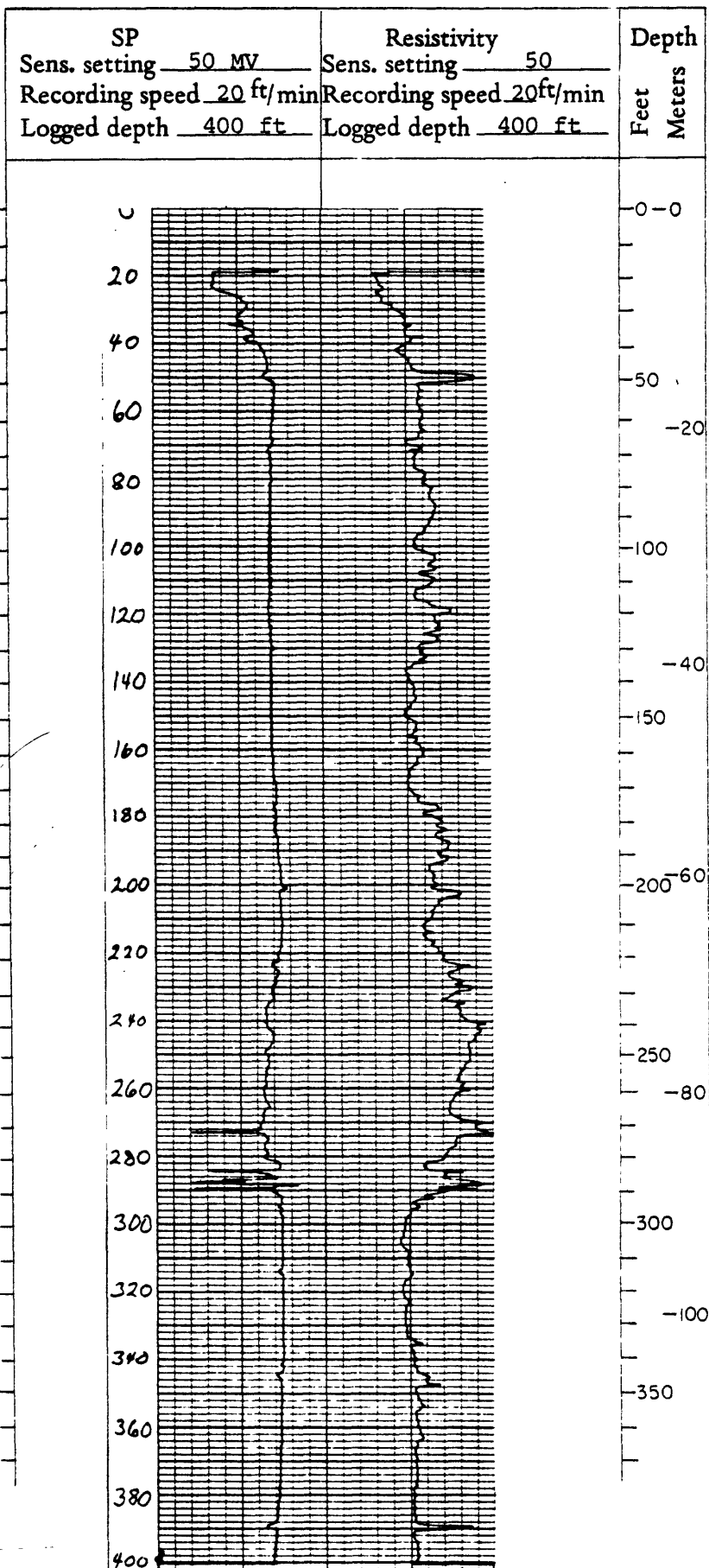
recorded by: Lechner



Hole number—continued

BG-7





Hole number—continued

BG-7

SP		Resistivity		Depth	
Sens. setting <u>50 MV</u>		Sens. setting <u>50</u>		Feet	Meters
Recording speed <u>20 ft/min</u>		Recording speed <u>20ft/min</u>			
Logged depth <u>400 ft</u>		Logged depth <u>400 ft</u>			
				-120	
				-400	
				-450	
				-140	
				-500	
				-160	
				-550	
				-180	
				-600	
				-650	
				-200	
				-700	
				-220	
				-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BG-8 Map: Marmarth 1 SE Date: 9-14-78 State: ND County: Slope
 Elev.: 2,965 ft Location: T. 133^N, R. 103^W, Sec. 26, Tract: bbaa Drilled depth: 600 ft
 Measured: 60 ft ^{FNL} ~~1300 ft~~ ^{FWL} ~~FWL~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 106-113; 292-294; 431-442; 466.5-470

Remarks: _____

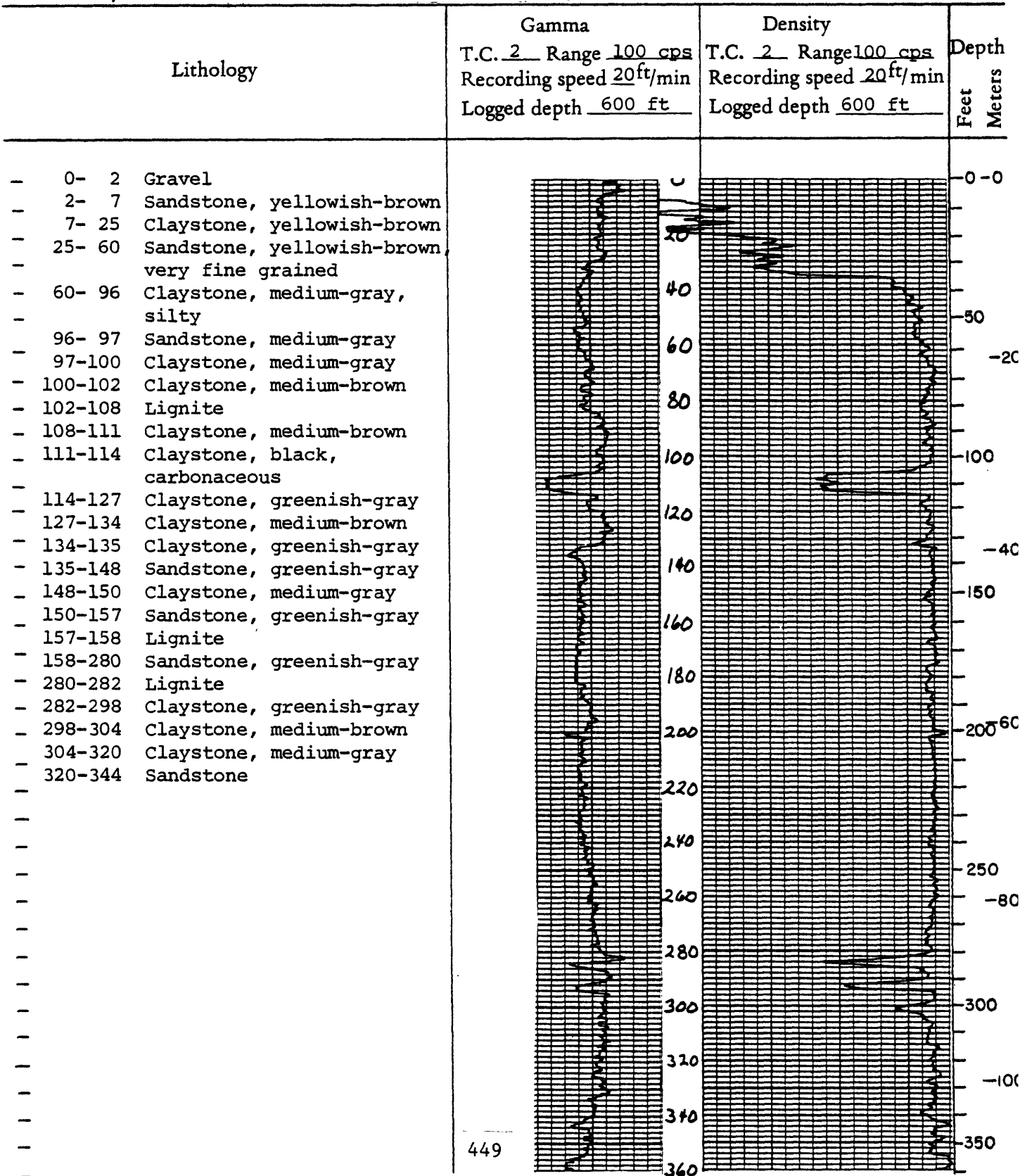
Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~XX~~

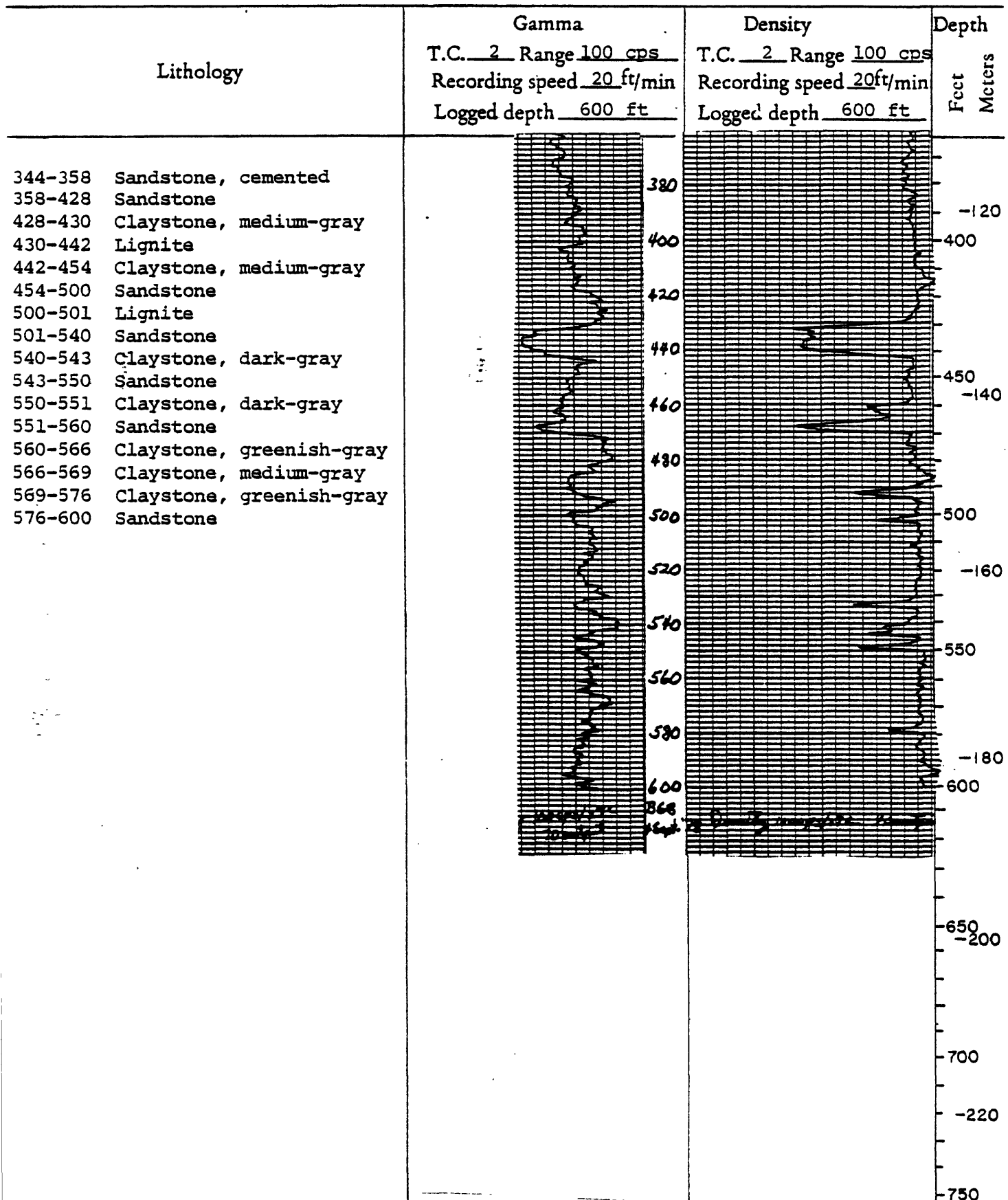
Geophysical logs

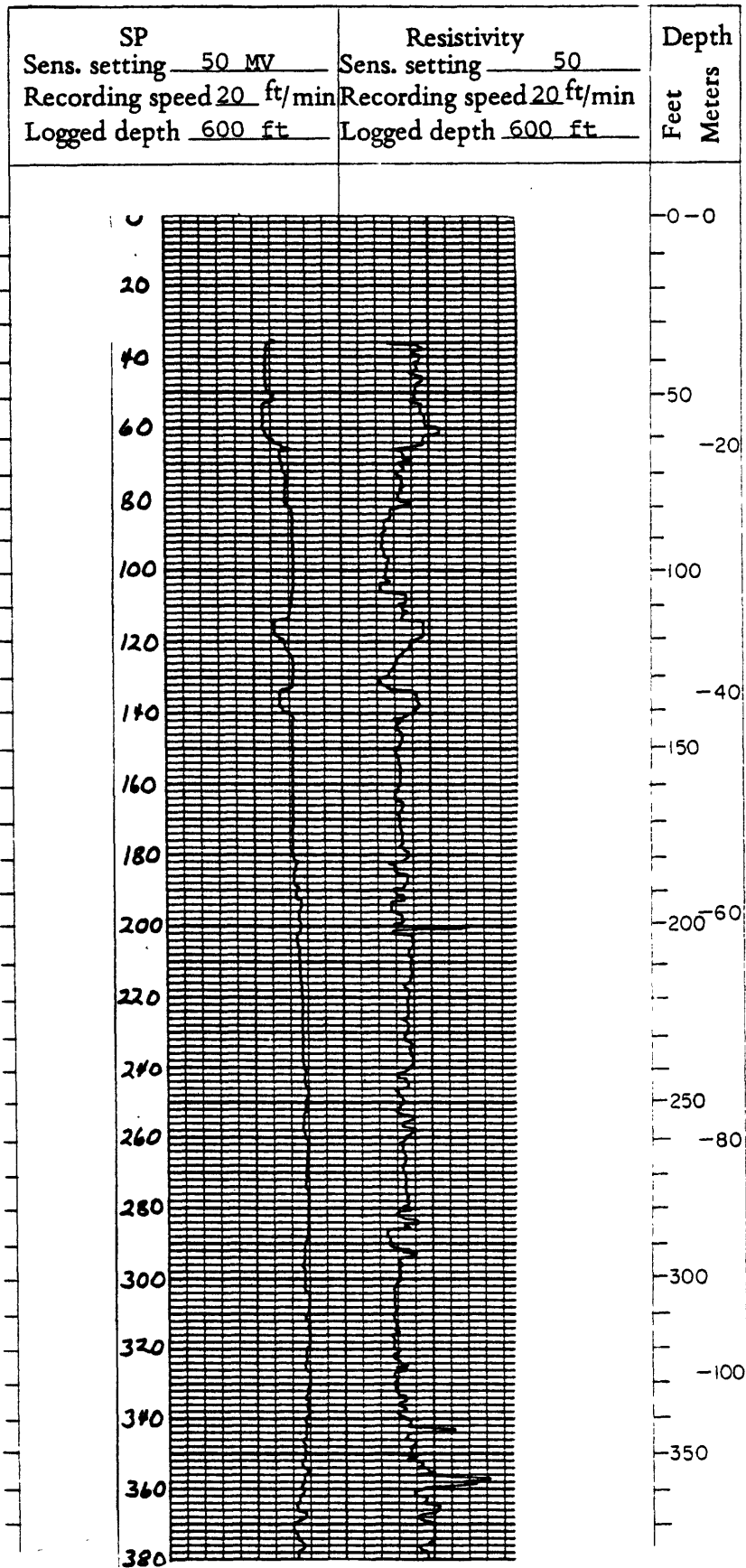
recorded by: Lechner



Hole number—continued

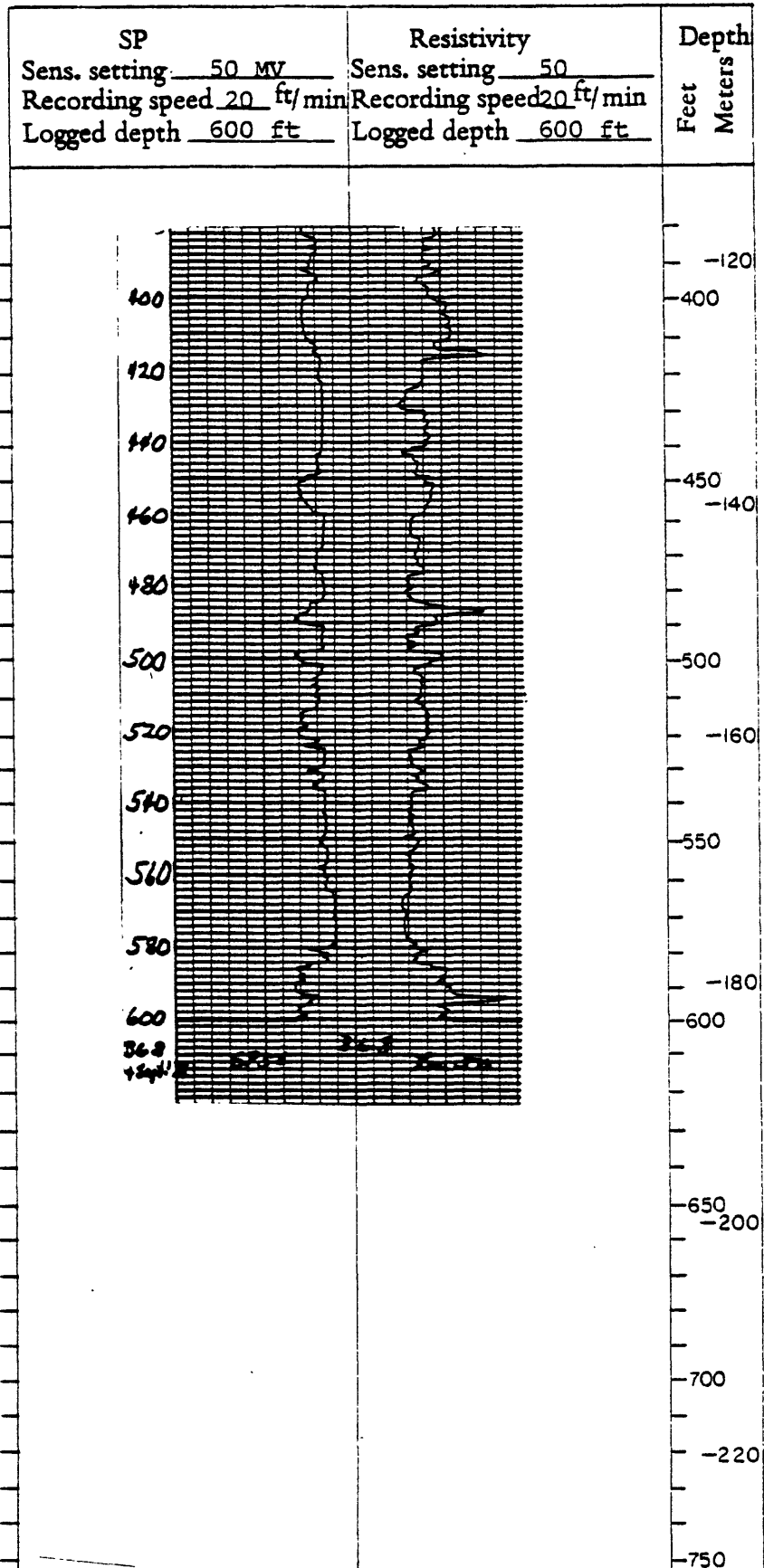
BG-8





Hole number—continued

BG-8



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BG-9 Map: Marmarth 2 SE Date: 9-15-78 State: ND County: Slope
 Elev.: 3,040 ft Location: T. 133^N, R. 104^W, Sec. 4, Tract: bbbb Drilled depth: 500 ft
 Measured: 40 ft ~~FNL~~ 10 ft ~~FWL~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 102-104; 156-165; 172-174; 180-184; 258-260; 262-264

Remarks: _____

Lithology

Recorded by: Tom Heck

Geologist ^{Yes} ~~MM~~

Geophysical logs

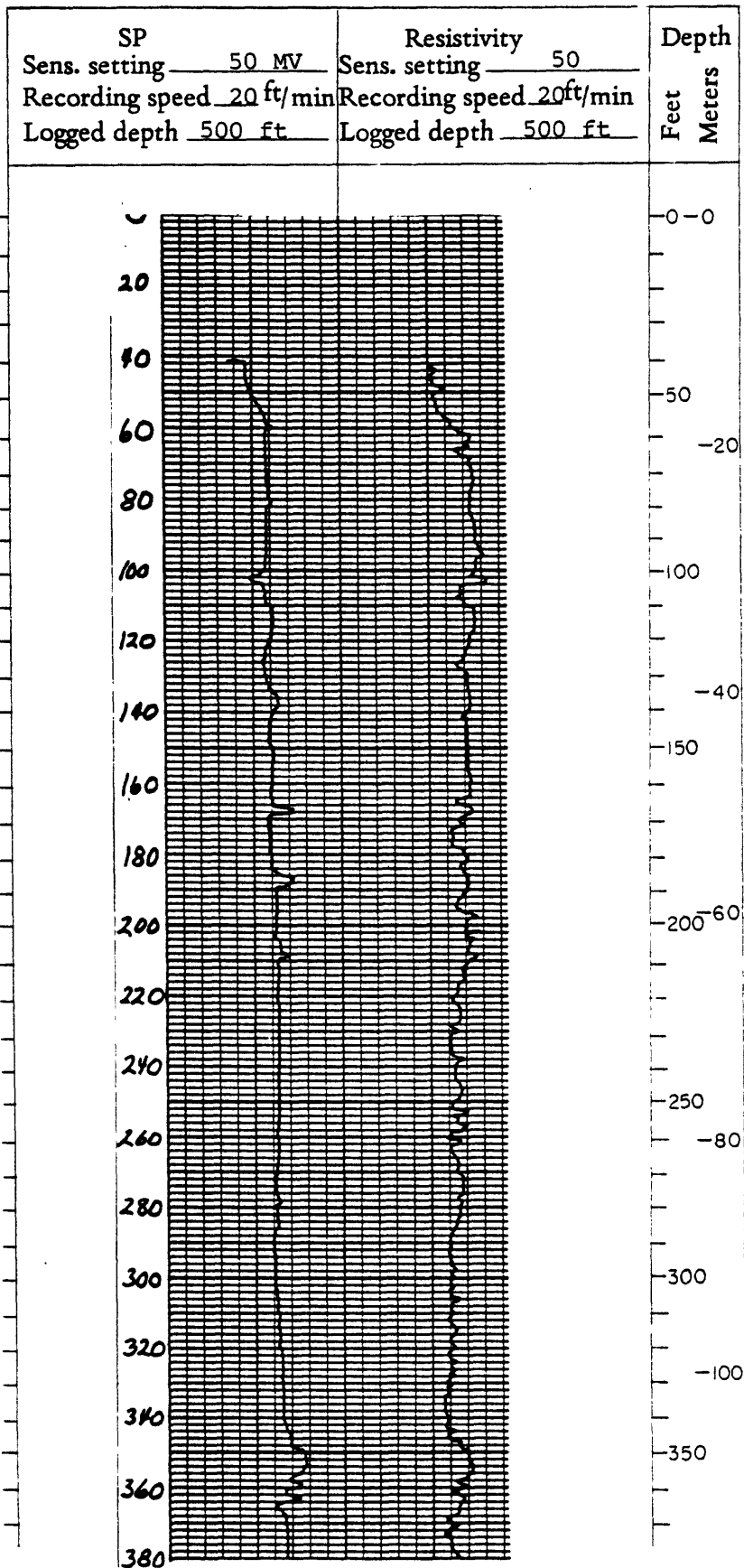
recorded by: Lechner

Lithology	Gamma		Density		Depth Feet Meters
	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>500 ft</u>	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>500 ft</u>	
0- 5 Sandstone					0-0
- 5- 21 Claystone, yellowish-brown					
- 21- 22 Lignite					
- 22- 28 Claystone, greenish-gray					
- 28- 29 Claystone, medium-gray					
- 29- 30 Lignite					
- 30- 39 Claystone, greenish-gray					
- 39- 45 Claystone, medium-gray					50
- 45- 47 Lignite					
- 47- 50 Claystone, greenish-gray					60
- 50- 55 Claystone, medium-gray					-20
- 55- 58 Claystone, greenish-gray					
- 58- 64 Claystone, medium-gray					80
- 64- 67 Lignite					
- 67- 87 Claystone, medium-gray					100
- 87-100 Sandstone					
- 100-102 Lignite					120
- 102-106 Claystone, dark-gray					
- 106-114 Claystone, medium-gray					140
- 114-118 Claystone, dark-gray					150
- 118-121 Claystone, medium-gray					
- 121-132 Claystone, dark-gray					160
- 132-152 Sandstone, greenish-gray					
- 152-163 Lignite					180
- 163-166 Claystone, dark-gray					
- 166-171 Lignite					200
- 171-178 Claystone, dark-gray					200 60
- 178-183 Lignite					
- 183-184 Claystone, dark-gray					220
- 184-192 Claystone, greenish-gray					
- 192-196 Claystone, dark-gray					240
- 196-197 Lignite					
- 197-202 Claystone, light-gray					260
- 202-233 Claystone, medium-gray					-80
- 233-253 Claystone, dark-gray					
- 253-255 Claystone, dark-brown					280
- 255-256 Lignite					
- 256-259 Claystone, dark-brown					300
- 259-264 Claystone, dark-gray					300
- 264-270 Claystone, greenish-gray					
- 270-297 Claystone, medium-gray					320
- 297-300 Claystone, greenish-gray					-100
- 300-320 Claystone, dark-gray					
- 320-330 Sandstone					340
- 330-341 Claystone, dark-gray					360

Hole number—continued

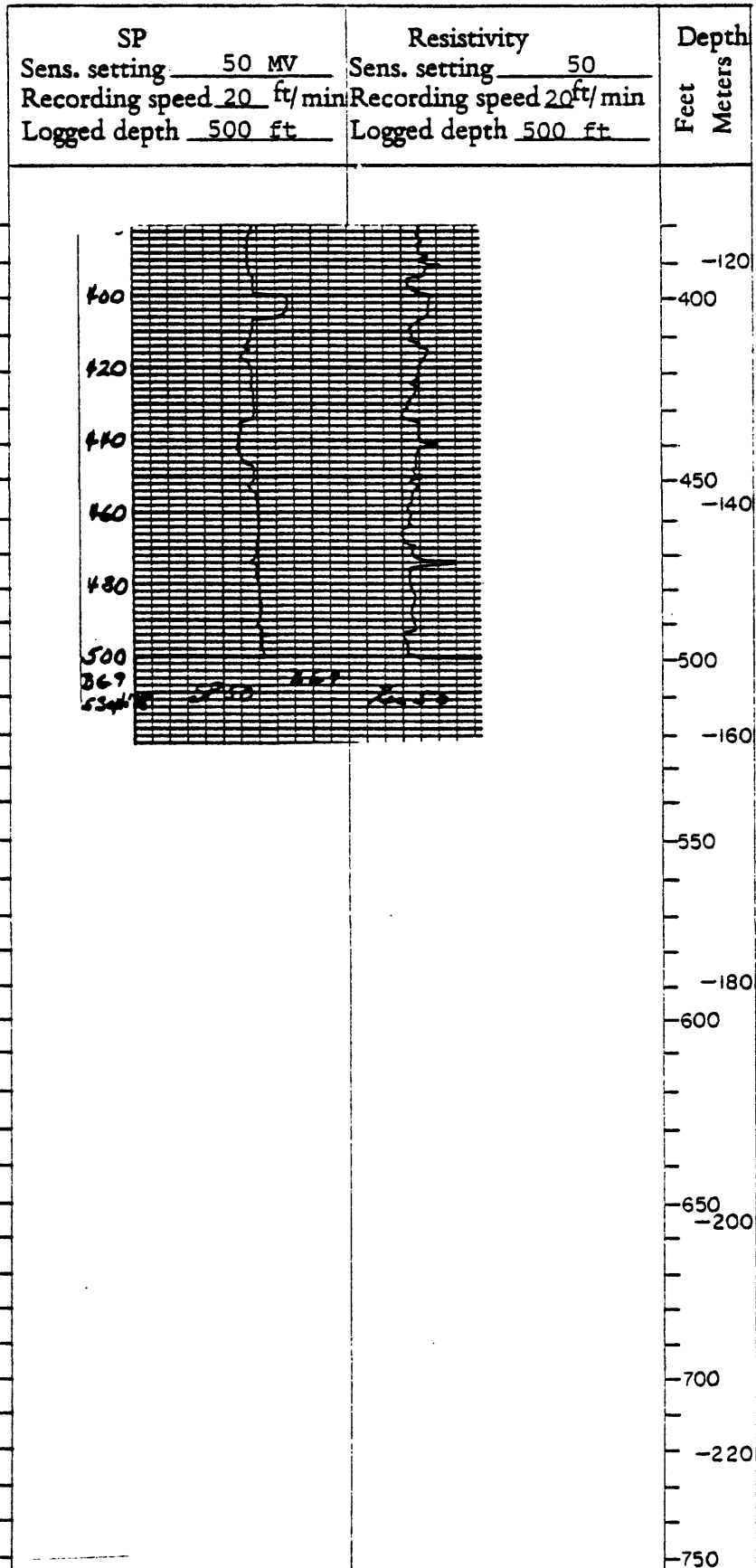
BG-9

Lithology	Gamma		Density		Depth	
	T.C. 2	Range 100 cps	T.C. 2	Range 100 cps	Fcct	Meters
	Recording speed 20 ft/min		Recording speed 20 ft/min			
	Logged depth 500 ft		Logged depth 500 ft			
341-357 Claystone, medium-gray		380				
357-361 Claystone, light-gray					-120	
361-373 Claystone, medium-gray						
373-400 Claystone, greenish-gray		400			400	
400-401 Lignite						
401-404 Claystone, dark-gray		420				
404-409 Claystone, medium-gray						
409-414 Claystone, light-gray						
414-426 Claystone, medium-gray		440				
426-438 Sandstone, greenish-gray					450	
438-440 Claystone, medium-gray		460			-140	
440-446 Sandstone, medium-gray						
446-463 Claystone, medium-gray						
463-470 Sandstone		480				
470-476 Claystone, medium-gray						
476-479 Claystone, greenish-gray		500			500	
479-481 Claystone, medium-gray		500				
481-487 Claystone, greenish-gray						
487-488 Lignite					-160	
488-493 Claystone, medium-gray						
493-499 Claystone, greenish-gray						
499-500 Claystone, medium-gray					550	
					-180	
					600	
					650	
					-200	
					700	
					-220	
					750	



Hole number—continued

BG-9



Hole No: BG-10 Map: Marmarth 1 SW Date: 9-14-78 State: ND County: Slope
Elev.: 3,125 ft Location: T. 133^N, R. 104^W, Sec. 26, Tract: aaaa Drilled depth: 100 ft
Measured: 90 ft ^{FNL}~~RSD~~, 50 ft ^{FEL}~~RWD~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: NONE

Lithology
Recorded by: Tom Heck Geologist ^{Yes} ~~No~~ Geophysical logs
recorded by: Lechner

[illegible]

Hole number—continued

Lithology	Gamma T.C.____ Range____ Recording speed____ft/min Logged depth____	Density T.C.____ Range____ Recording speed____ft/min Logged depth____	Depth	
			Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	

Hole No: BG-11 Map: Amidon Date: 9-19-78 State: ND County: Slope
Elev.: 2,985 ft Location: T. 134 ^N ~~S~~, R. 100 ^E ~~W~~, Sec. 18, Tract: aaaa Drilled depth: 500 ft
Measured: 250 ft ^{FNL} ~~RSD~~, 70 ft ^{FEL} ~~RWK~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 53-58; 104-110; 415-440; 488-493

Lithology

Recorded by: Tom Heck

Geologist ☒ Yes ☒ No

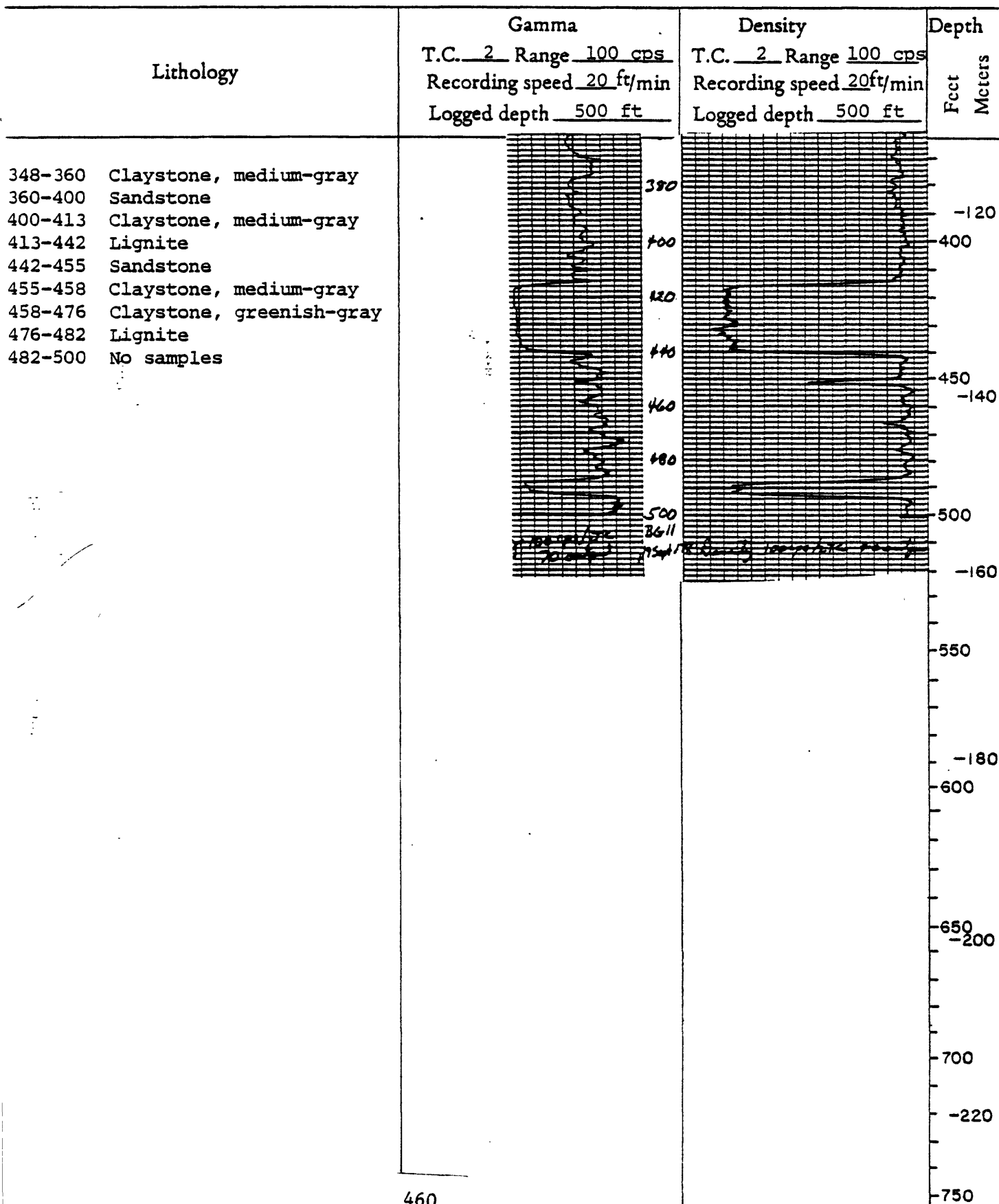
Geophysical logs

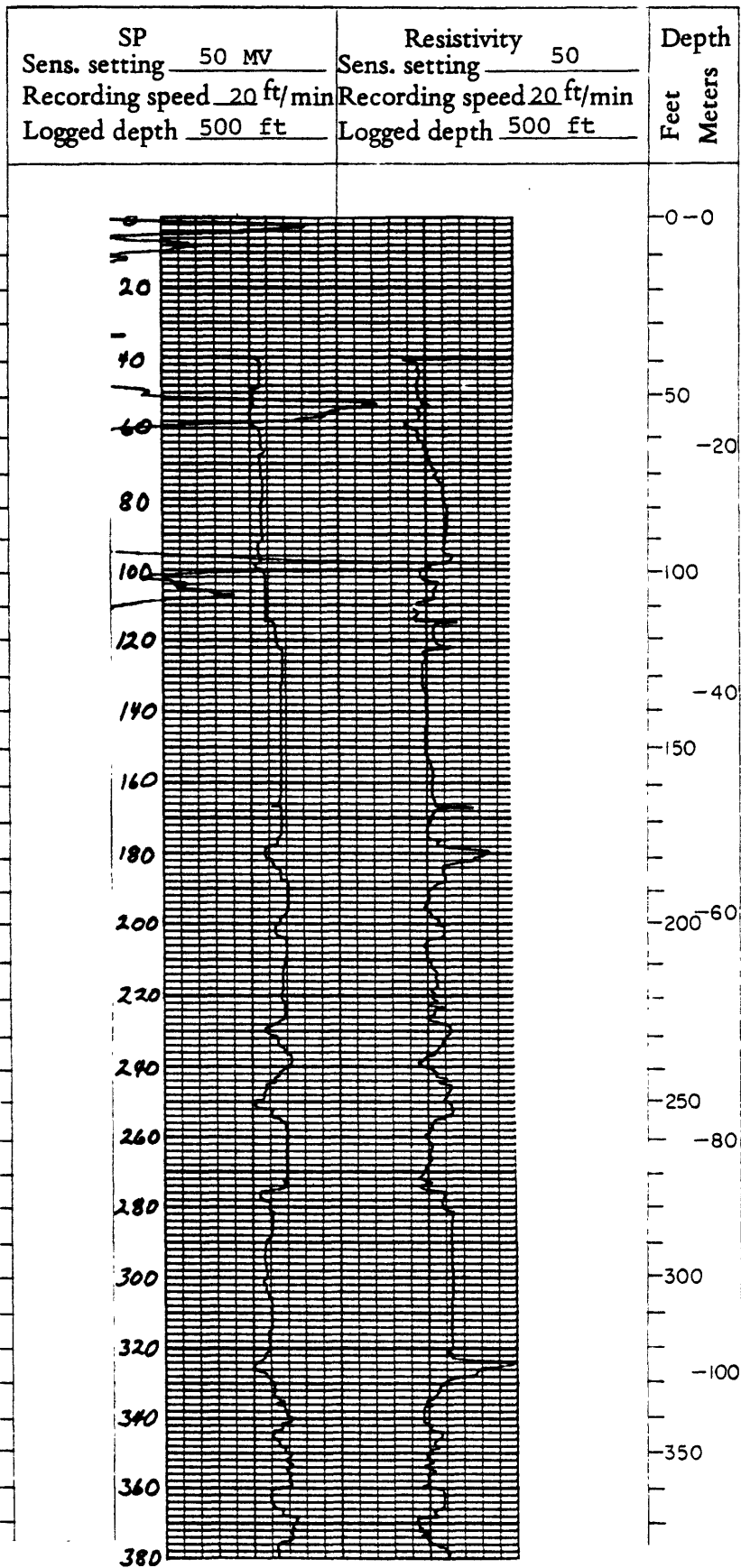
recorded by: Lechner

459

Hole number—continued

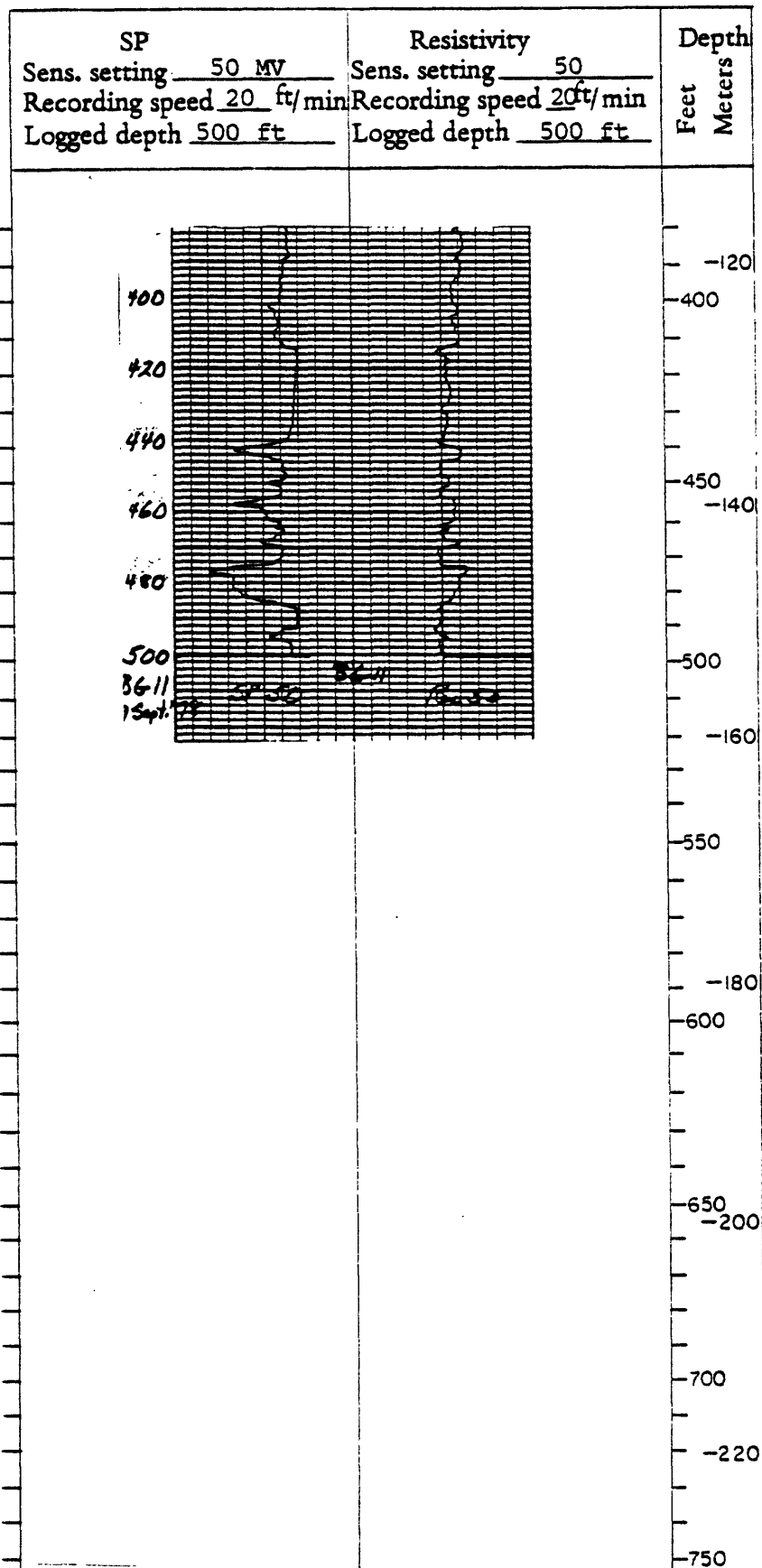
BG-11





Hole number—continued

BG-11



NORTH DAKOTA GEOLOGICAL SURVEY

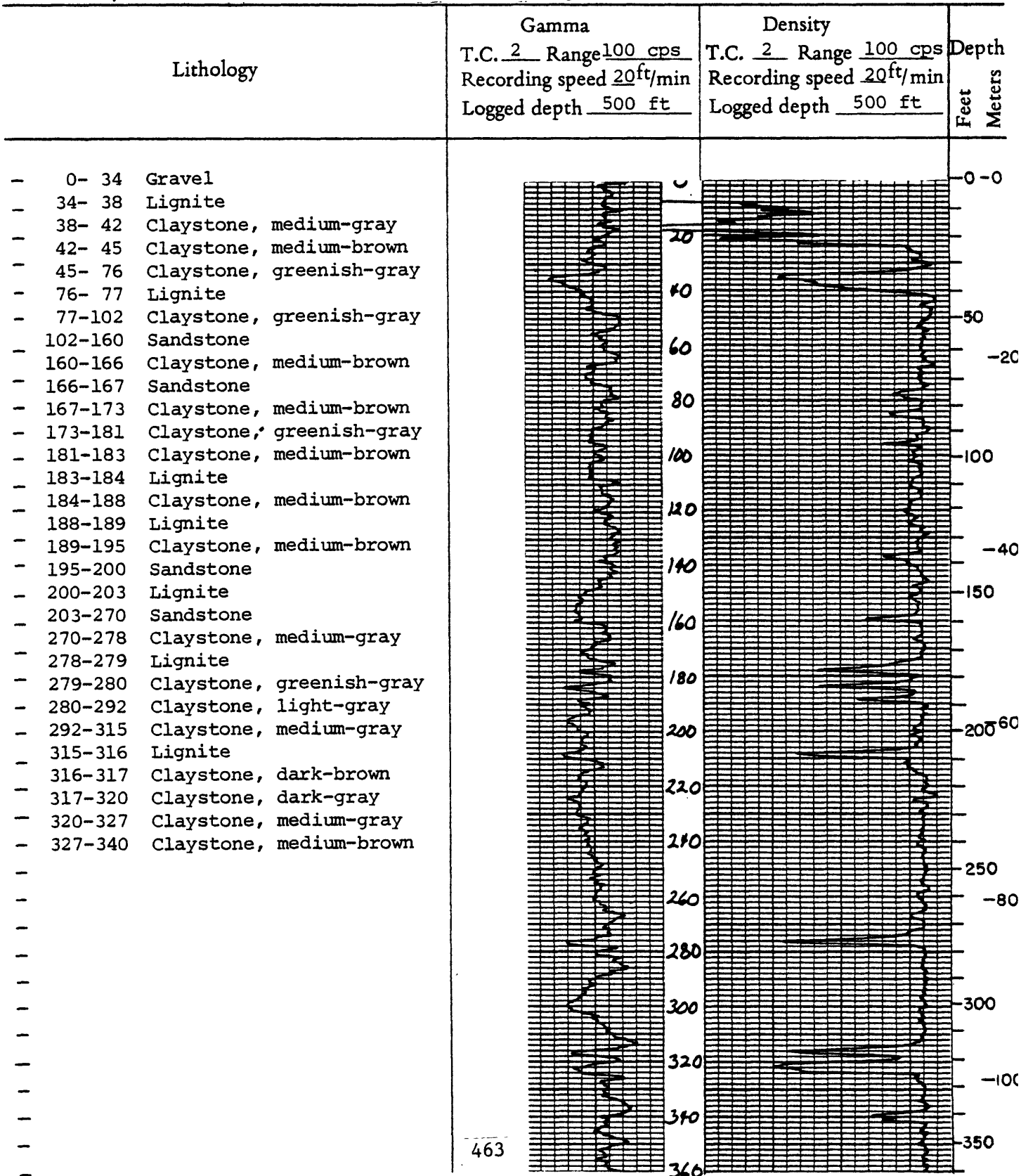
Hole No.: BG-12 Map: Marmarth 1 NW Date: 9-14-78 State: ND County: Slope
 Elev.: 2,945 ft Location: T. 134 ^N_S, R. 104 ^W_E, Sec. 10, Tract: aaaa Drilled depth: 500 ft
 Measured: 25 ft ^{FNL}_{FWL}, 153 ft ^{FEL}_{FWL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 34-36; 207-209; 315-317; 320-324; 405-408; 456-463

Remarks: _____

Lithology

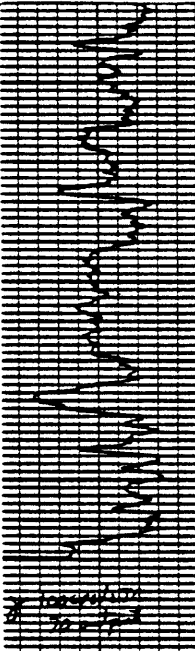
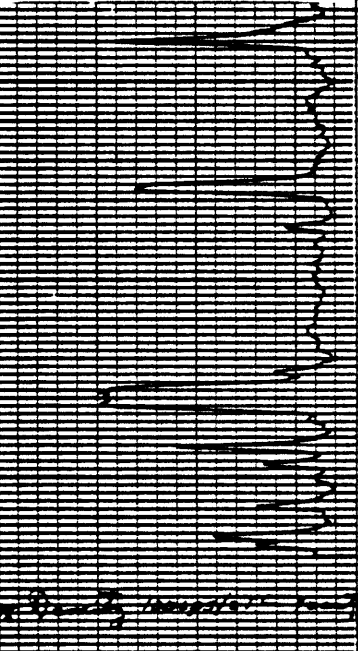
Recorded by: Tom HeckGeologist ^{Yes}_{No}

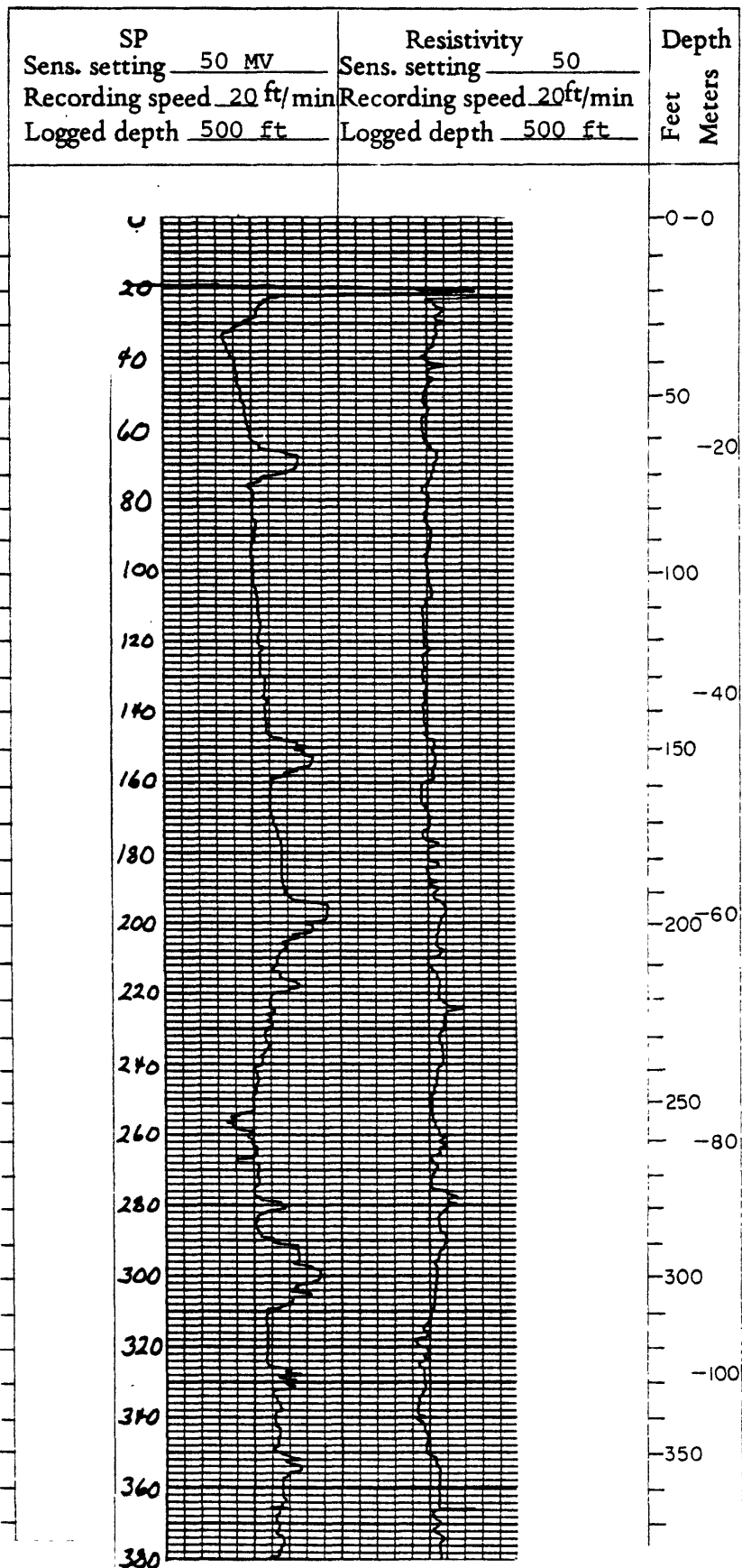
Geophysical logs

recorded by: Lechner

Hole number—continued

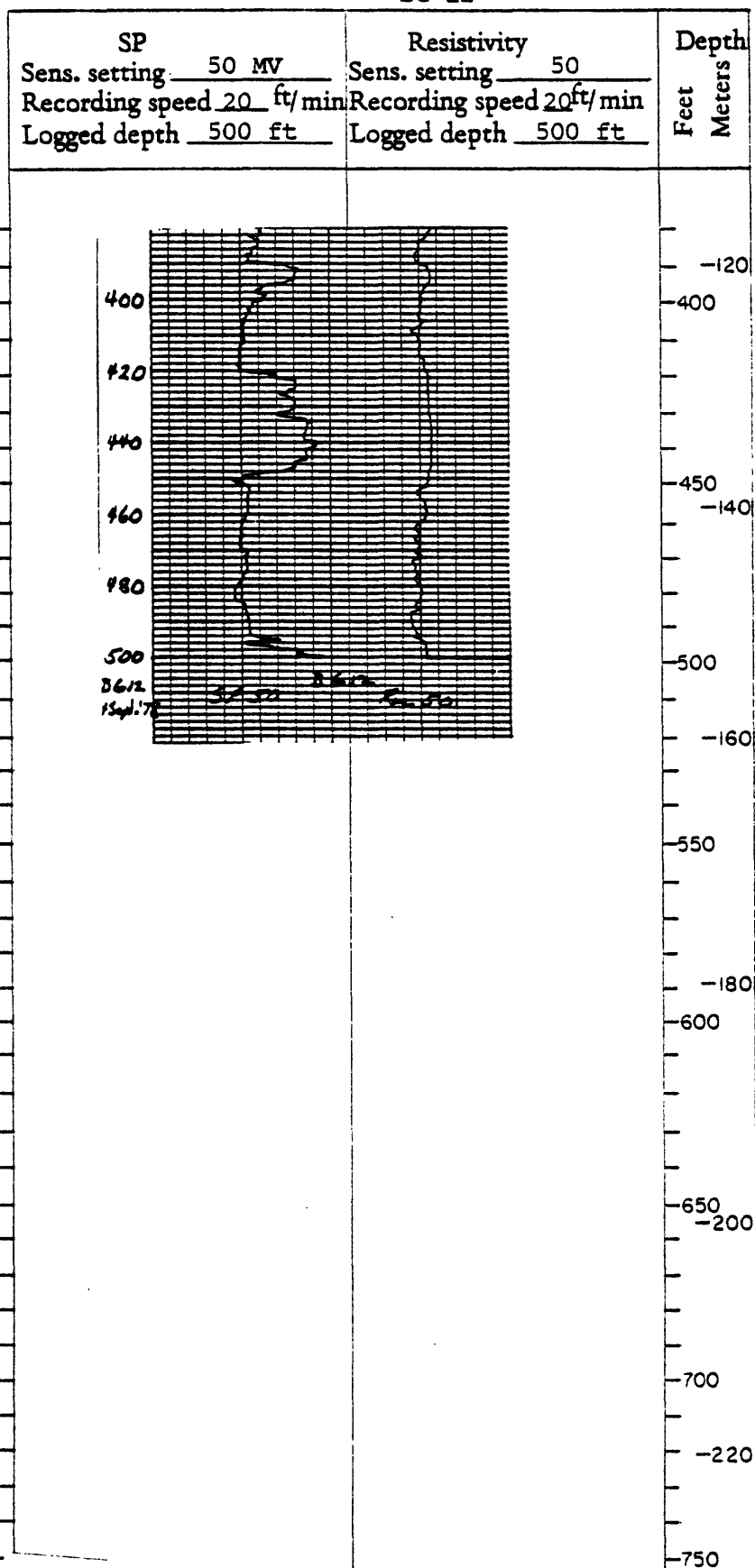
BG-12

Lithology	Gamma		Density		Depth	
	T.C.	Range 100 cps	T.C.	Range 100 cps	Fect	Meters
	Recording speed 20 ft/min		Recording speed 20ft/min			
	Logged depth 500 ft		Logged depth 500 ft			
340-500 No samples						
						-120
						400
						450
						-140
						500
						-160
						550
						-180
						600
						650
						-200
						700
						-220
						750



Hole number—continued

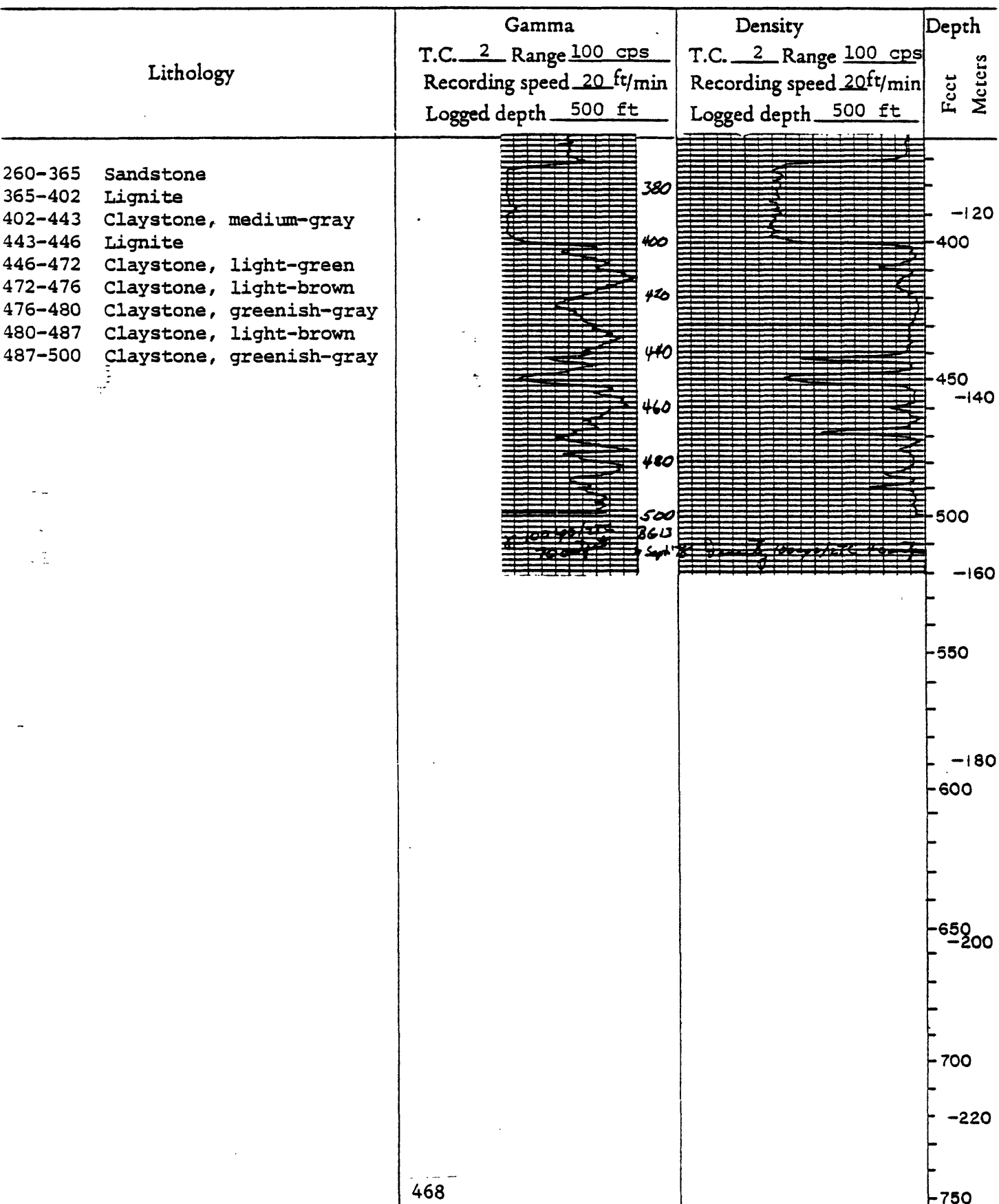
BG-12

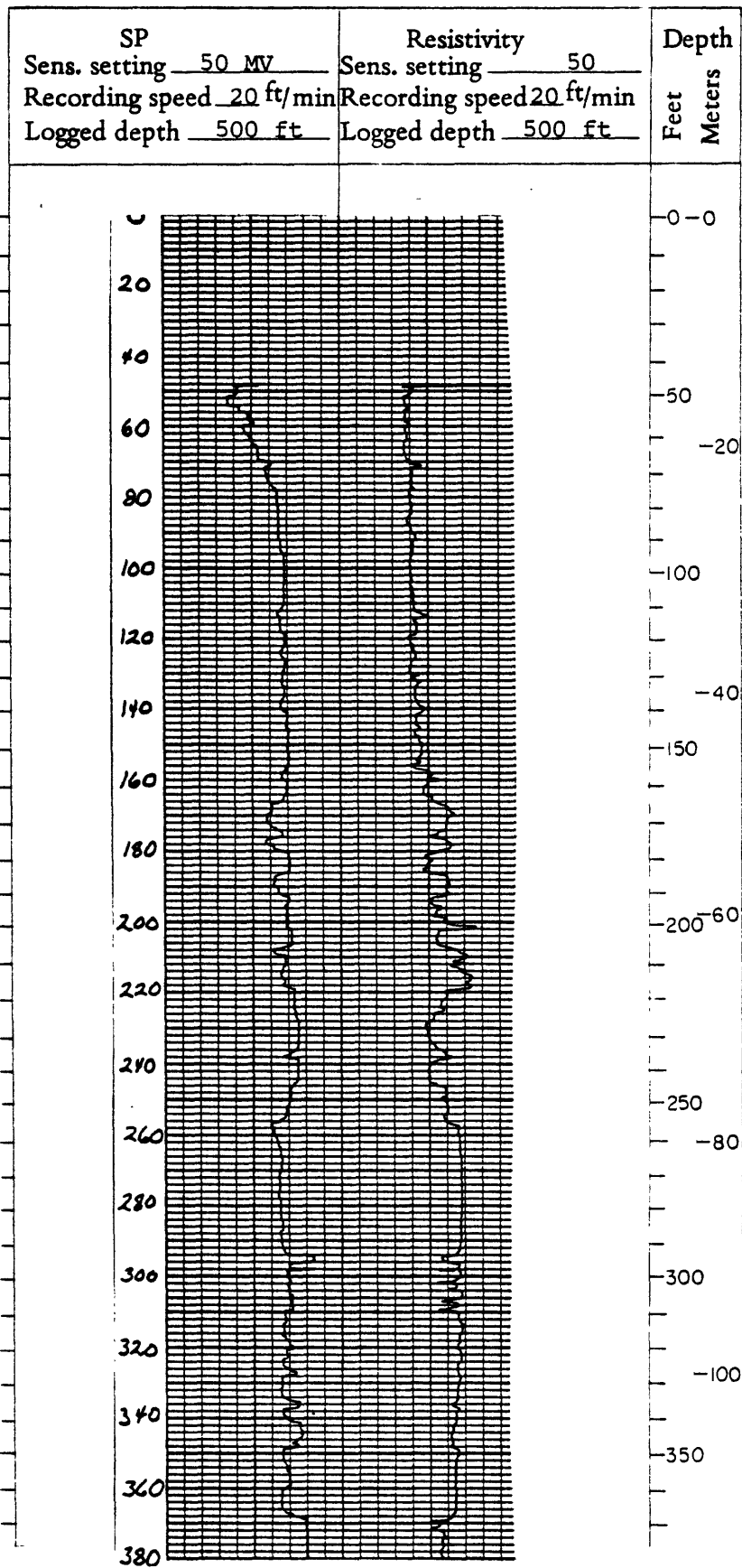




Hole number—continued

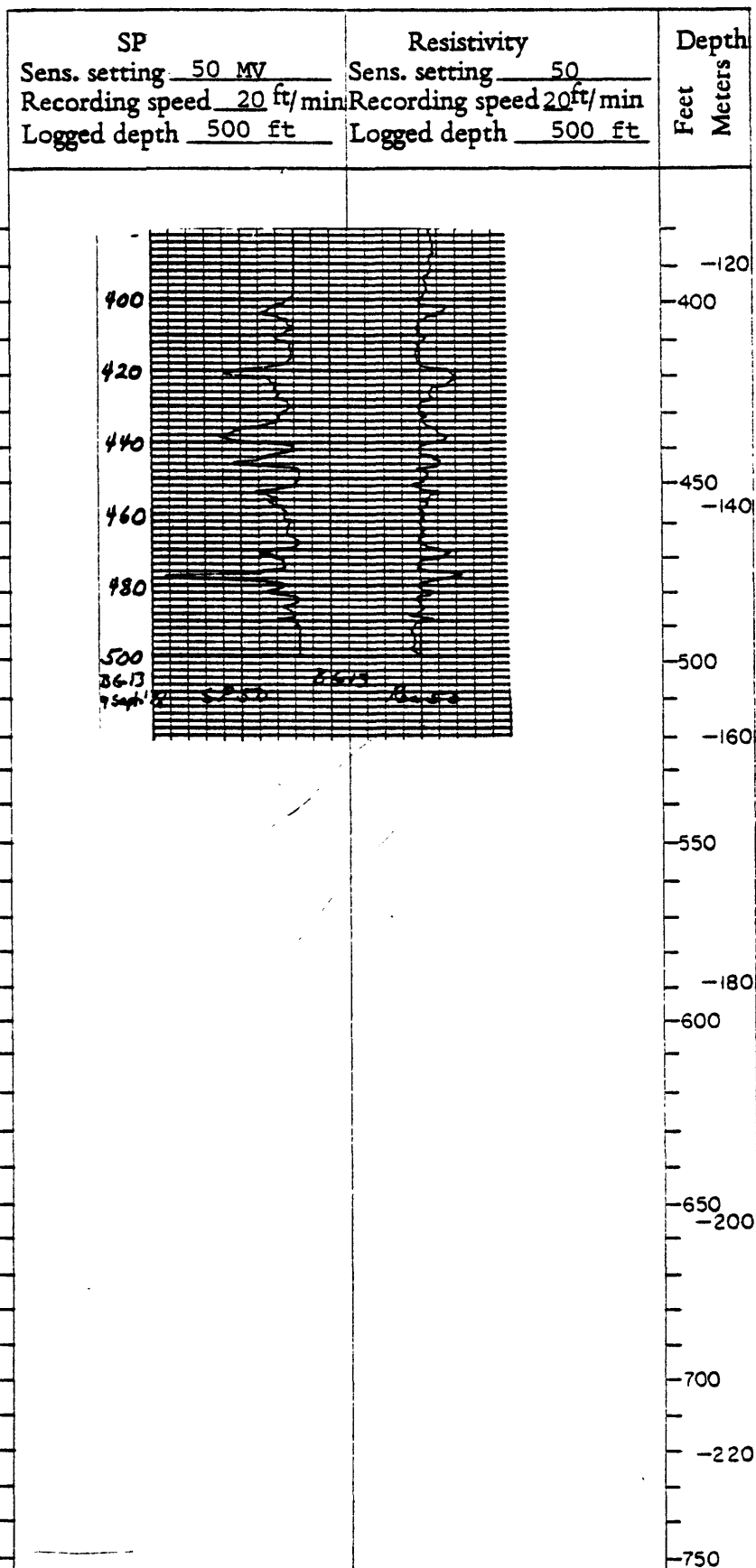
BG-13





Hole number—continued

BG-13



Hole No: BG-14 Map: Medora 3 SW Date: 9-21-78 State: ND County: Slope
Elev.: 2,995 ft Location: T. 135^N, R. 106^W, Sec. 4, Tract: cccd Drilled depth: 80 ft
Measured: 75 ft ~~FSL~~, 500 ft ~~FWL~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: NONE

Lithology

Geologist ^{Yes}~~No~~ Geophysical logs recorded by: Lechner

Lithology	Gamma		Density		Depth	
	T.C. ____	Range ____	T.C. ____	Range ____	Feet	Meters
0- 80 Sandstone, light-brown, very fine grained					0	0
					50	
					100	
					150	
					200	60
					250	
					300	
					350	

471

Hole number—continued

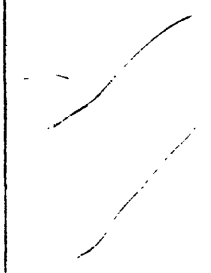
Lithology	Gamma	Density	Depth	
	T.C. _____ Range _____ Recording speed _____ ft/min Logged depth _____	T.C. _____ Range _____ Recording speed _____ ft/min Logged depth _____	Fect	Meters
				-120
				-400
				-450
				-140
				-500
				-160
				-550
				-180
				-600
				-650
				-200
				-700
				-220
				-750

Hole No: BG-14A Map: Medora 3 SW Date: 9-21-78 State: ND County: Slope
Elev.: 2,935 ft Location: T. 135^N, R. 106^EW, Sec. 4, Tract: cdcd Drilled depth: 45 ft
Measured: 75 ft ^{FMSL} 1700 ft ^{FWL} Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: NONE

Lithology

Lithology	Gamma		Density		Depth	
	T.C. _____	Range _____	T.C. _____	Range _____	Feet	Meters
0- 23 Claystone, yellowish-brown					0	0
23- 45 Sandstone						
					50	
					100	
					150	
					200	60
					250	
					300	
					350	

Hole number—continued

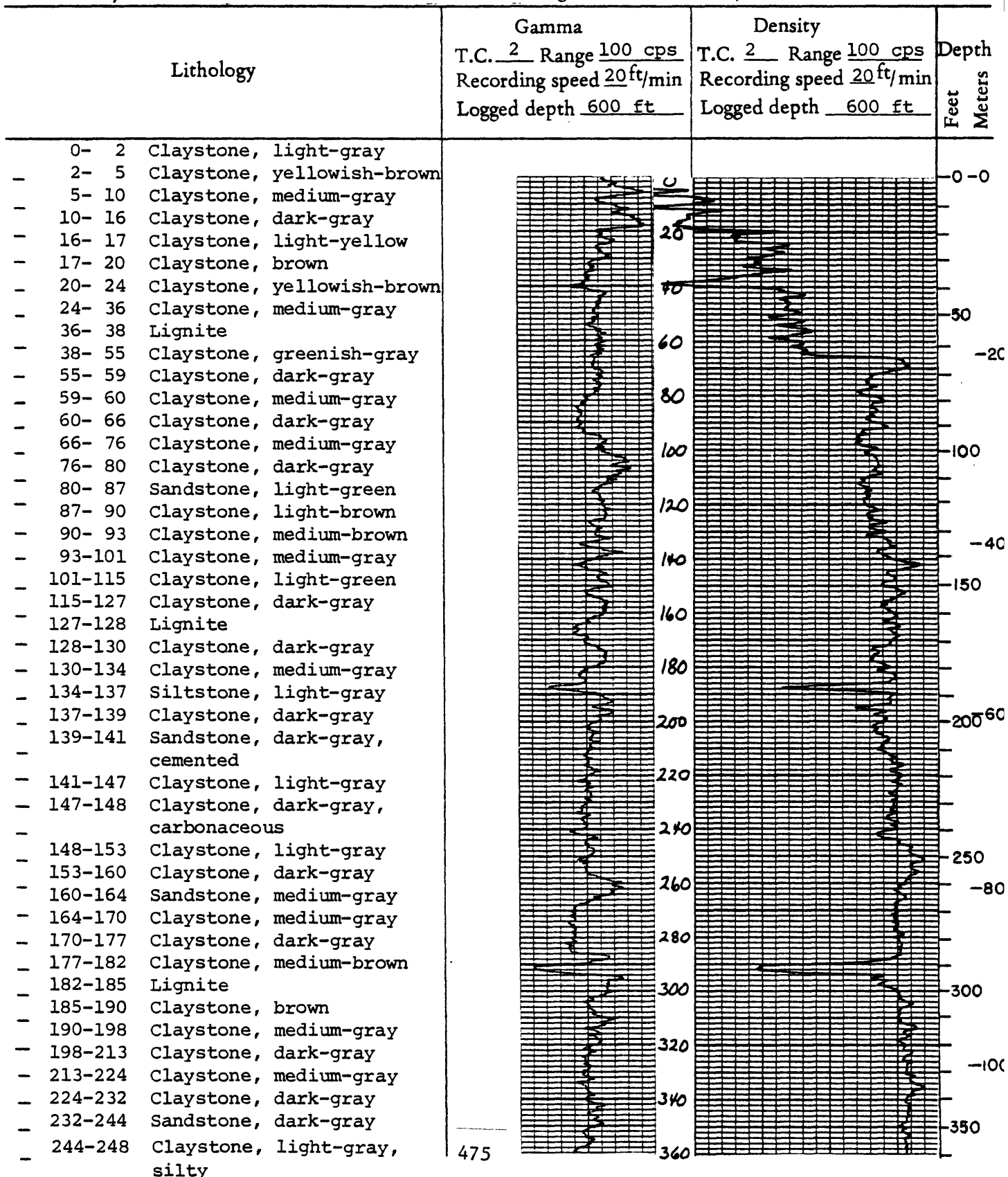
Lithology	Gamma T.C. _____ Range _____ Recording speed _____ ft/min Logged depth _____	Density T.C. _____ Range _____ Recording speed _____ ft/min Logged depth _____	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: BG-15 Map: Medora .3 SW Date: 9-21-78 State: ND County: Golden Valley
 Elev.: 2,992 ft Location: T.136^N, R.106^W, Sec. 10, Tract: aaaa Drilled depth: 600 ft
 Measured: 35 ft ~~FNL~~, 18 ft ~~FEL~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 186-188; 290-293.5; 383-409; 491-493; 580-582

Remarks: _____

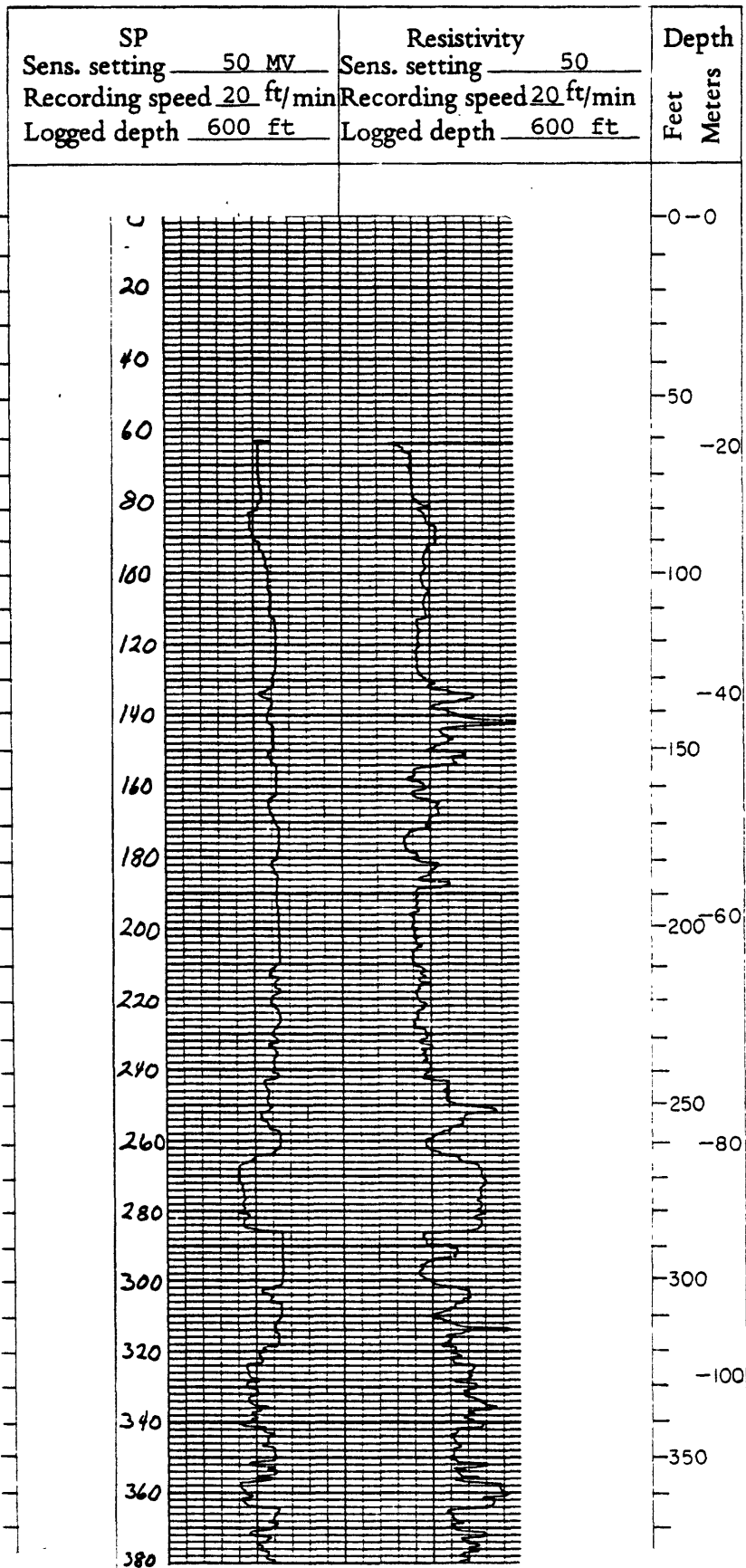
Lithology

Recorded by: Tom HeckGeophysical logs
 recorded by: Lechner

Hole number—continued

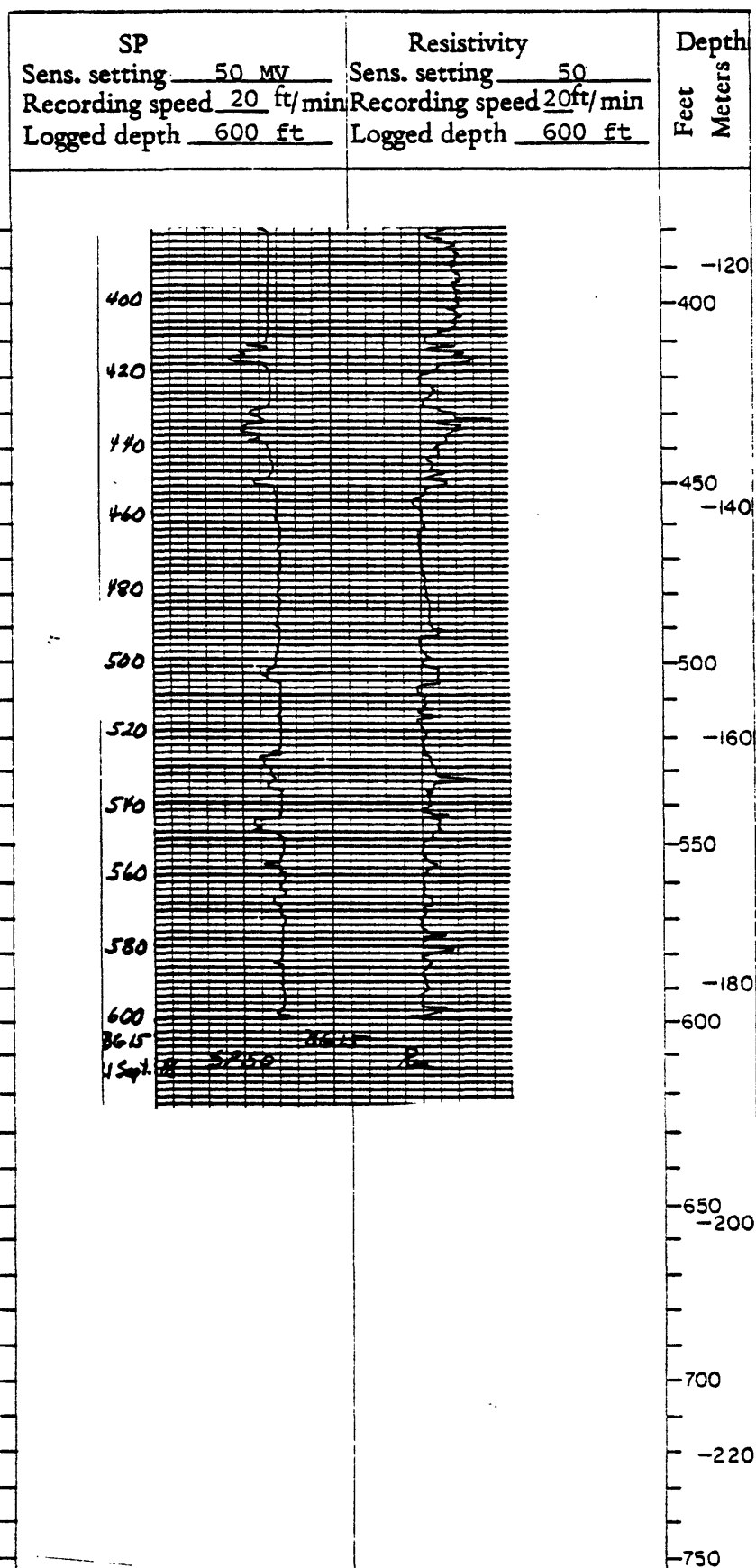
BG-15

Lithology	Gamma		Density		Depth	
	T.C.	Range	T.C.	Range	Fect	Meters
	2	100 cps	2	100 cps		
	Recording speed	20 ft/min	Recording speed	20 ft/min		
	Logged depth	600 ft	Logged depth	600 ft		
248-255 Sandstone, white, cemented						
255-260 Claystone, light-gray					-120	
260-270 Claystone, medium-gray						
270-285 Sandstone					400	
285-290 Lignite						
290-300 Claystone, dark-gray						
300-307 Claystone, light-gray						
307-310 Claystone, medium-brown						
310-313 Sandstone, light-gray, cemented					450	
313-320 Claystone, medium-gray					-140	
320-350 Sandstone, medium-gray						
350-358 Claystone, medium-gray						
358-367 Claystone, light-grayish-brown						
367-378 Lignite					500	
378-380 Claystone, black, carbonaceous						
380-385 Lignite					-160	
385-390 Sandstone						
390-395 Lignite						
395-404 Claystone, medium-gray					550	
404-408 Claystone, light-green						
408-430 Claystone, dark-gray						
430-437 Claystone, greenish-gray						
437-441 Claystone, medium-gray						
441-453 Claystone, dark-gray					-180	
453-462 Claystone, greenish-gray					600	
462-463 Lignite						
463-475 Claystone, dark-gray						
475-480 Sandstone, light-green						
480-486 Claystone, dark-gray						
486-490 Claystone, dark-brown, carbonaceous					650	
490-535 Sandstone					-200	
535-540 Claystone, dark-gray						
540-544 Claystone, greenish-gray						
544-550 Claystone, medium-gray						
550-558 Claystone, dark-gray						
558-560 Claystone, dark-brown					700	
560-600 No samples					-220	
					-750	



Hole number—continued

BG-15



Hole No: BG-16 Map: Medora 3 NW Date: 9-19-78 State: ND County: Billings
Elev.: 2,965 ft Location: T. 137^N, R. 101^W, Sec. 12, Tract: acda Drilled depth: 60 ft
Measured: 2000 ft ^{FNL}~~FSL~~, 1380 ft ^{FEL}~~FWL~~ Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: NONE

Lithology

Recorded by: Tom Heck

Geologist ^{Yes}~~No~~ Geophysical logs recorded by: Lechner

Lithology	Gamma		Density		Depth	
	T.C. _____	Range _____	T.C. _____	Range _____	Feet	Meters
0- 10 Claystone, yellowish-brown					0	0
10- 13 Lignite						
13- 20 Claystone, yellowish-brown						
20- 45 Sandstone, yellowish-brown						
45- 60 No samples						
					50	
					20	
					100	
					40	
					150	
					200	60
					250	
					80	
					300	
					100	
					350	

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Hole number—continued

Lithology	Gamma	Density	Depth	
	T.C. _____ Range _____ Recording speed _____ ft/min Logged depth _____	T.C. _____ Range _____ Recording speed _____ ft/min Logged depth _____	Fect	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	

Hole No: BG-17 Map: Medora 3 NW Date: 9-21-78 State: ND County: Golden Valley
Elev.: 2855 ft Location: T. 137^N, R. 105^W, Sec. 20, Tract: aaaa Drilled depth: 560 ft
Measured: 10 ft ^{FNL}~~FEL~~, 95 ft ^{FEL}~~FEL~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 144-146; 276-278; 319-321; 324-331; 384-386; 445-448; 456-468;
509-516

Lithology

Recorded by:

Tom Heck

Geologist ~~Yes~~

Geophysical logs

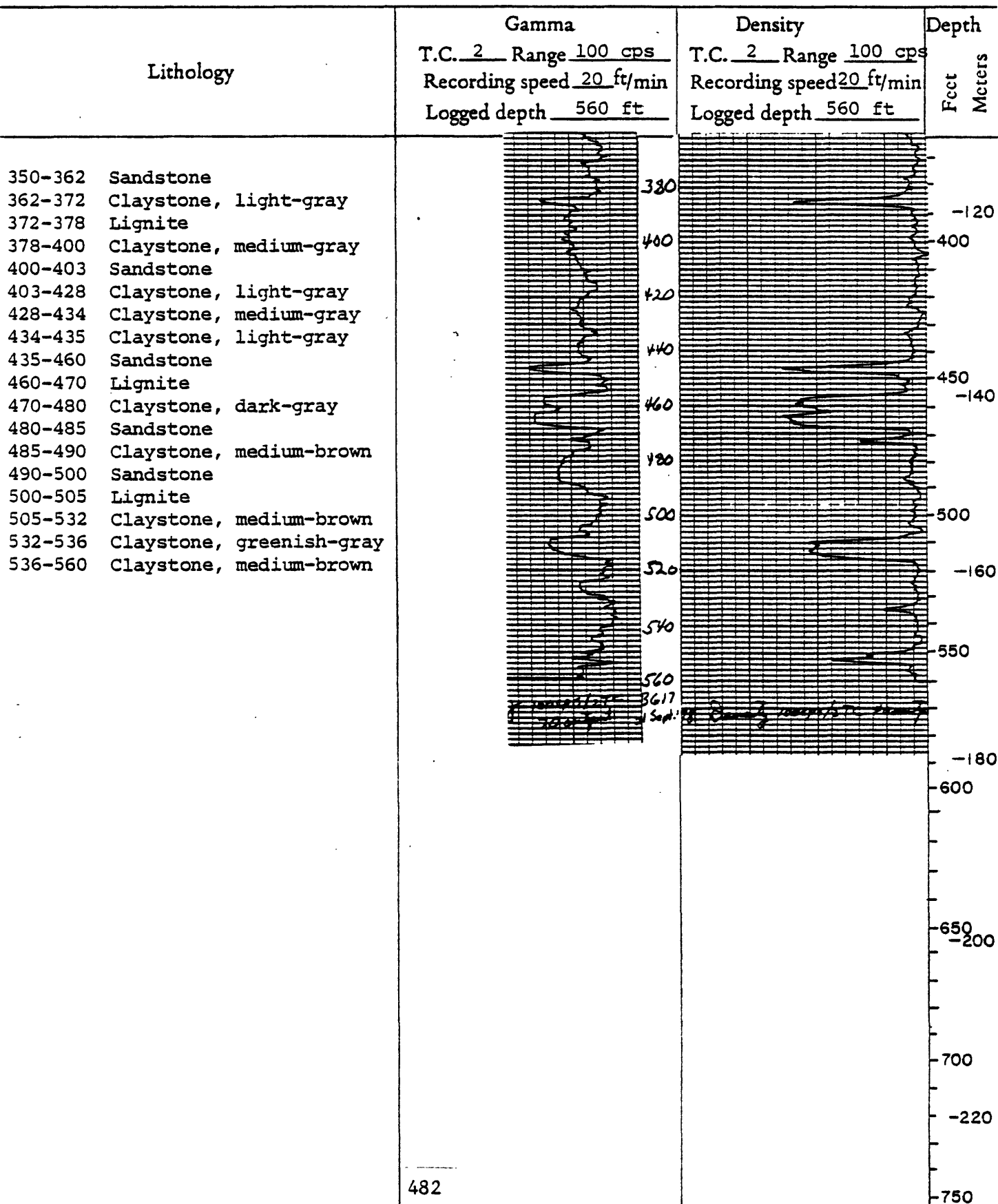
recorded by:

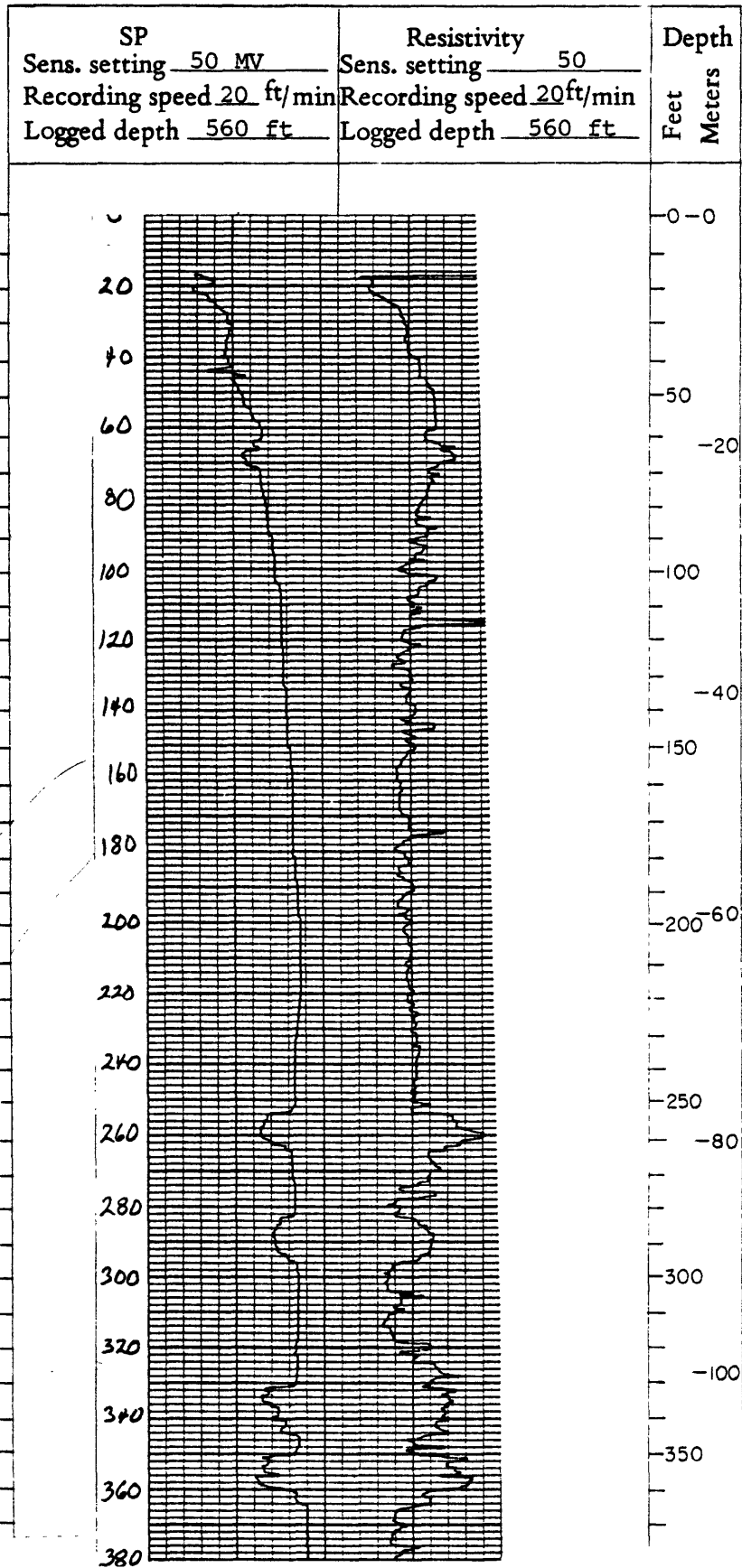
Lechner

Lithology	Gamma		Density		Depth Feet Meters
	T.C.	Range 100 cps Recording speed 20 ft/min Logged depth 560 ft	T.C.	Range 100 cps Recording speed 20 ft/min Logged depth 560 ft	
0- 25 Claystone, yellowish-brown					0-0
25- 31 Claystone, brown					
31- 43 Claystone, greenish-gray					
43- 60 Claystone, dark-brown					
60- 65 Claystone, greenish-gray					
65- 69 Claystone, light-gray					
69- 77 Claystone, dark-gray					50
77- 81 Claystone, greenish-gray					
81- 91 Claystone, light-gray					-20
91- 98 Claystone, dark-gray					
98-113 Claystone, medium-gray					
113-116 Sandstone, medium-gray, cemented					100
116-140 Claystone, medium-gray					
140-142 Lignite					
142-177 Claystone, medium-gray					
177-195 Claystone, dark-gray					-40
195-205 Claystone, light-gray					
205-245 Claystone, medium-gray					150
245-255 Sandstone					
255-261 Claystone, medium-gray					
261-262 Lignite					
262-282 Claystone, dark-gray					
282-300 Sandstone					
300-302 Lignite					200 60
302-303 Claystone, yellowish-gray					
303-308 Claystone, medium-brown					
308-323 Claystone, greenish-gray					
323-330 Lignite					
330-340 Sandstone					
340-346 Claystone, medium-gray					250
346-347 Lignite					-80
347-350 Claystone, dark-gray					
					300
					-100
					350

Hole number—continued

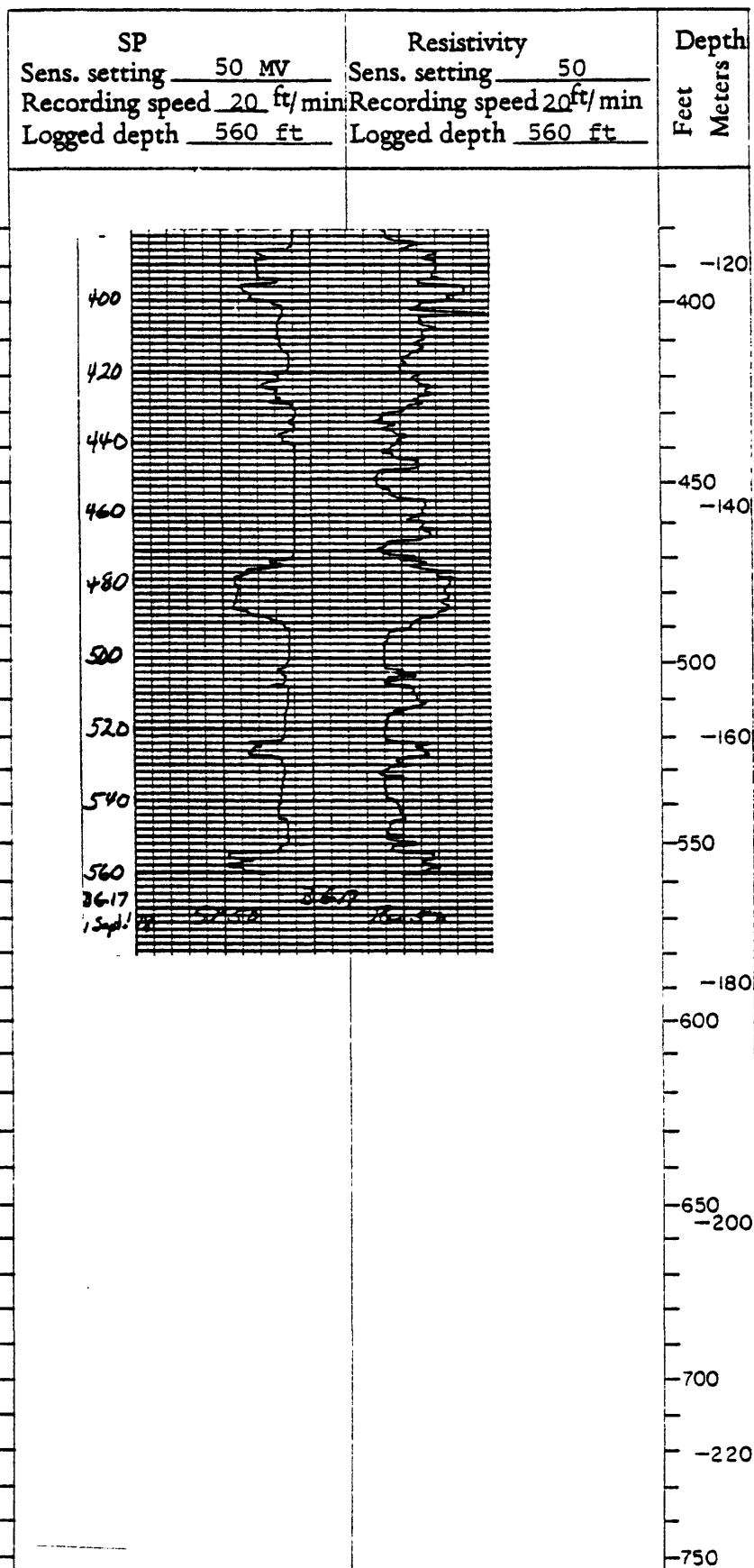
BG-17





Hole number—continued

BG-17



Hole No: BG-18 Map: Wibaux 4 NE Date: 9-21-78 State: ND County: Golden Valley
Elev.: 3000 ft Location: T. 137^N, R. 106^E W, Sec. 10, Tract: ccdd Drilled depth: 660 ft
Measured: 50 ft ~~FSL~~ ^{FNL}, 1050 ft ~~FWL~~ ^{FEL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
Lignite beds: 45-50; 236-240; 324-327; 336-338; 408-413; 484-486

Remarks:

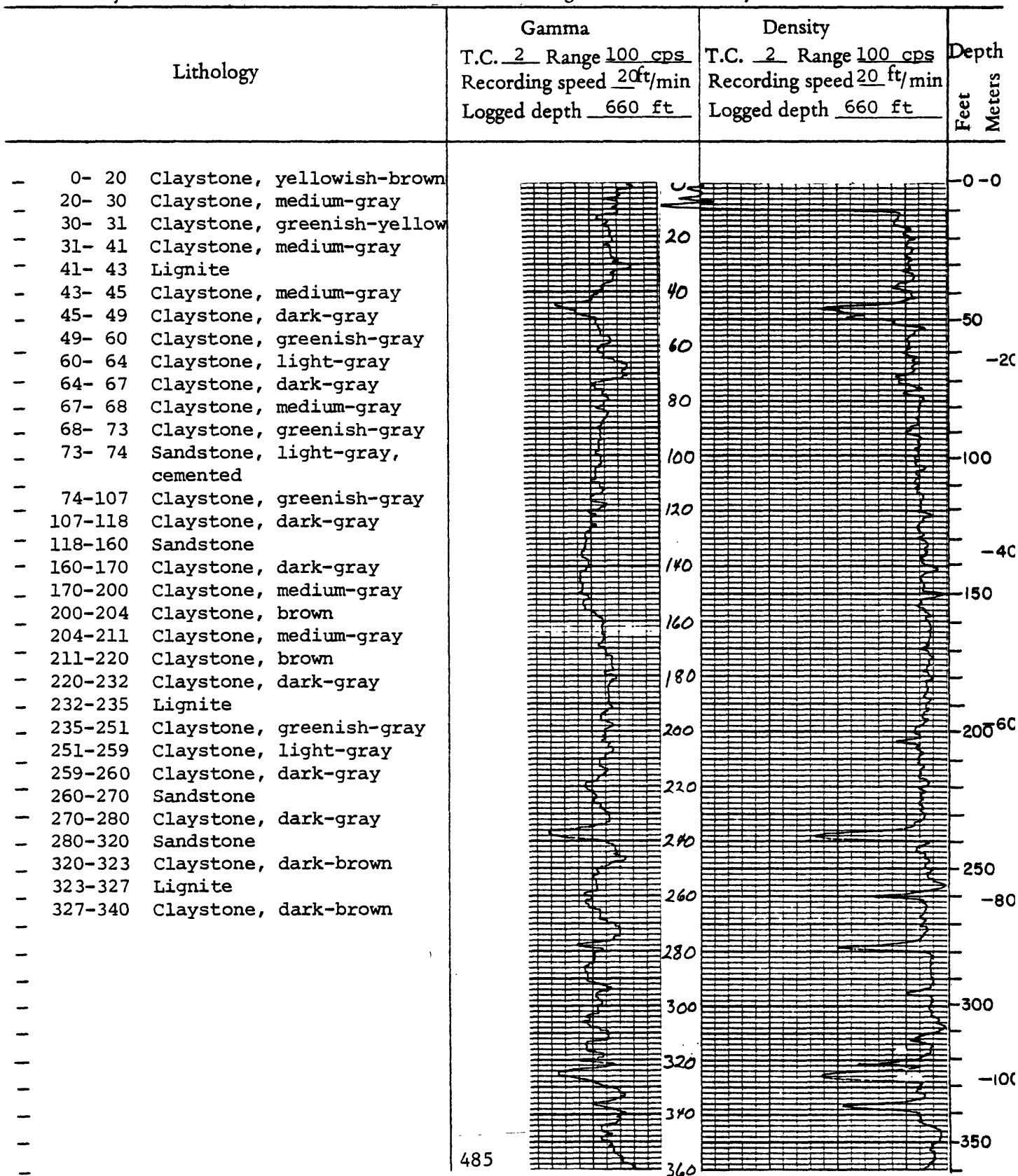
Lithology

Recorded by: Tom Heck

Geologist ~~Yes~~

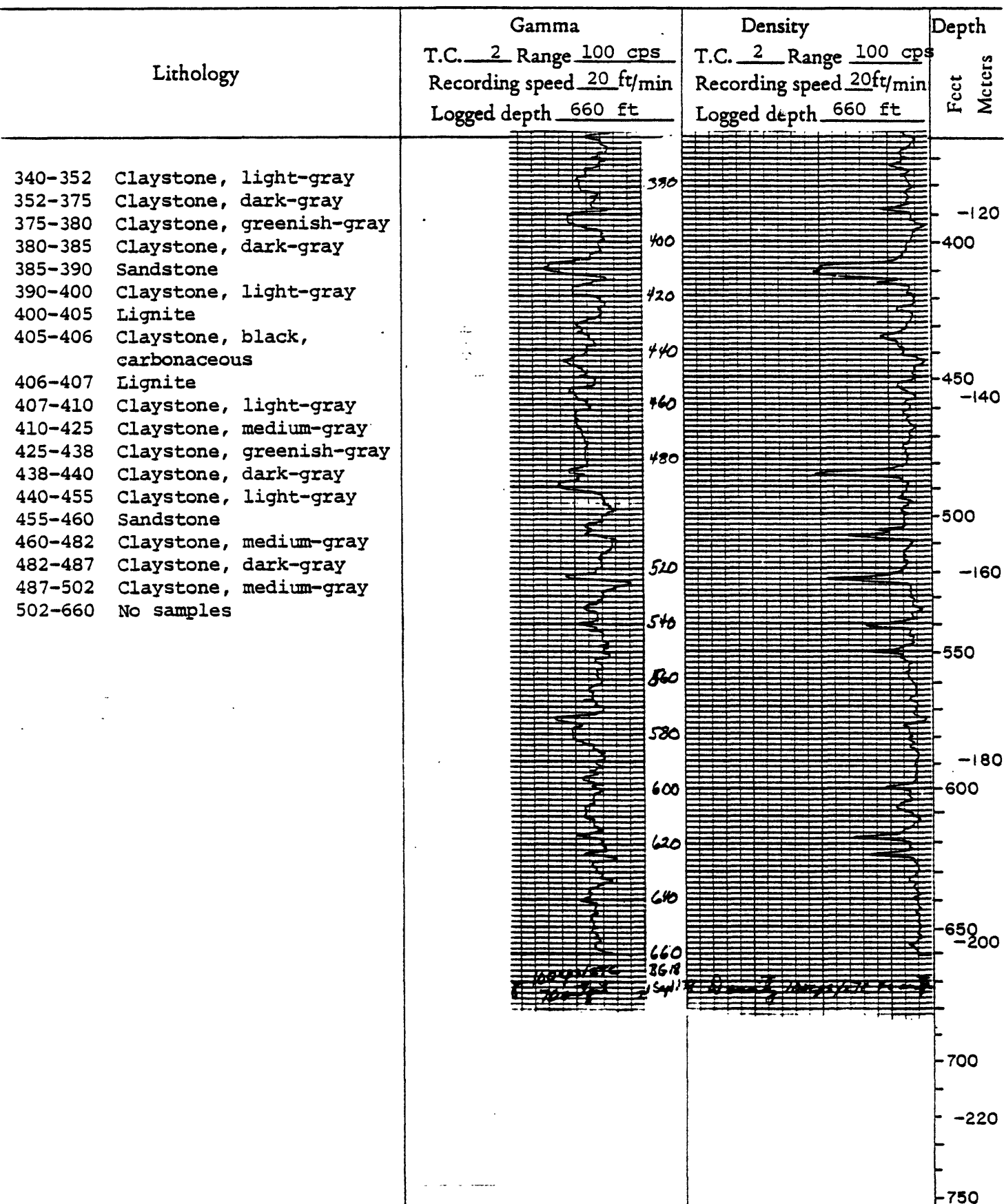
Geophysical logs

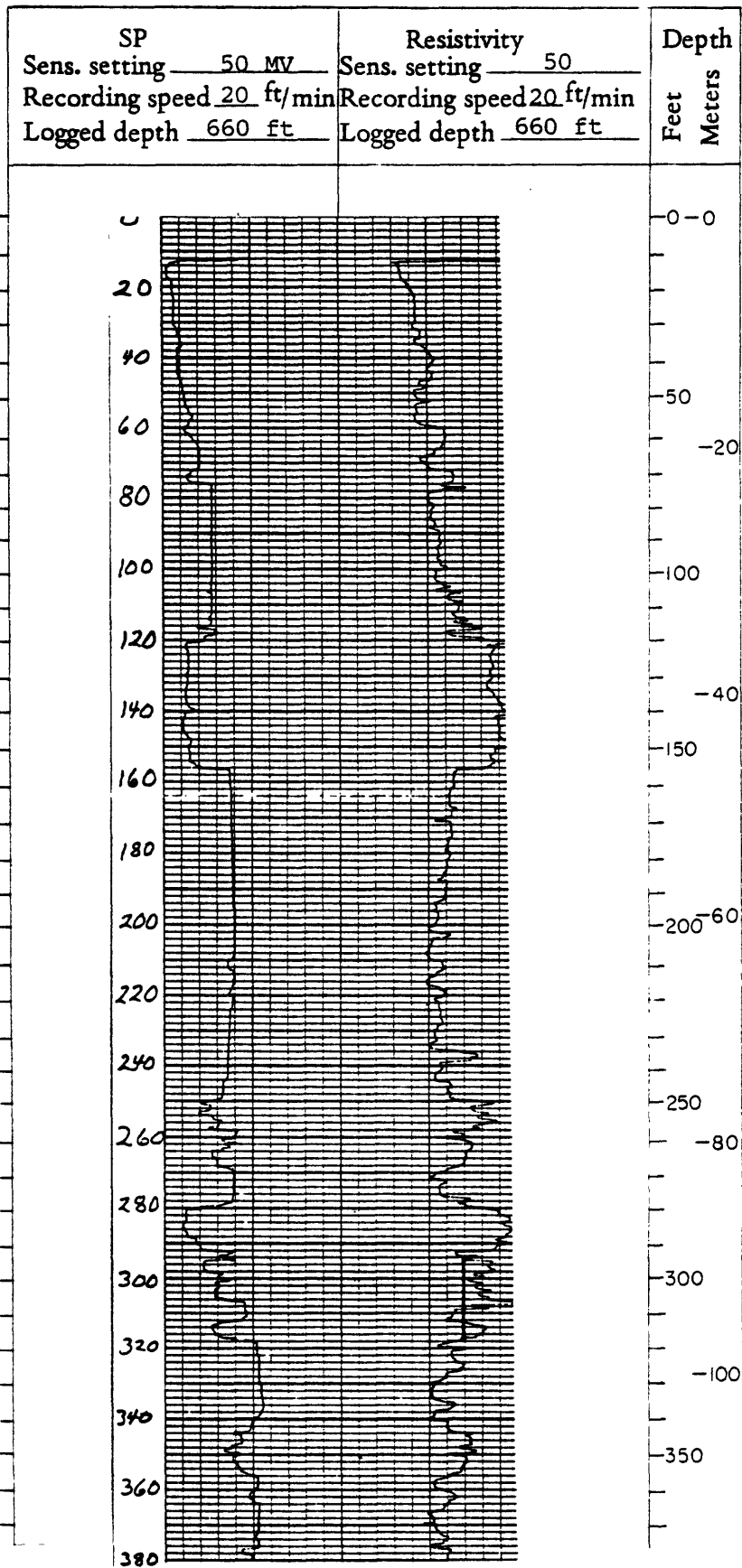
recorded by: Lechner



Hole number—continued

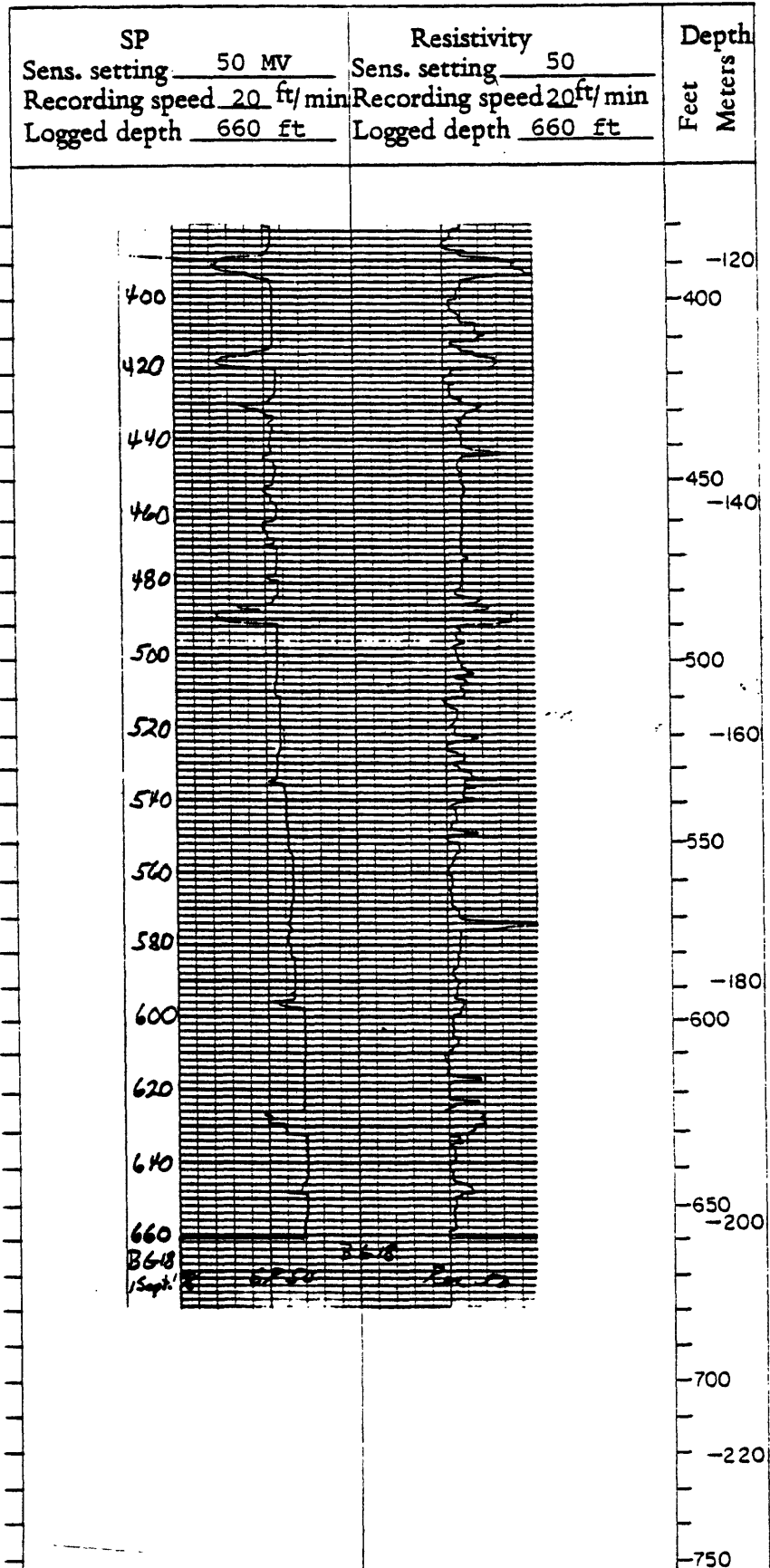
BG-18





Hole number—continued

BG-18



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McK-1 Map: Trotters SE Date: 9-22-78 State: ND County: McKenzie
 Elev.: 2,650 ft Location: T. 145^N R. 103^W, Sec. 30, Tract: bbbd Drilled depth: 640 ft
 Measured: 620 ft ^{FNL} ~~535~~, 425 ft ^{FWL} ~~425~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 77.5-82.5; 119.5-122.5; 186-194; 448-454; 480-482; 566-570; 604-607

Remarks: _____

Lithology

Recorded by: Clarence Carlson

Geologist ^{Yes} ~~4%~~

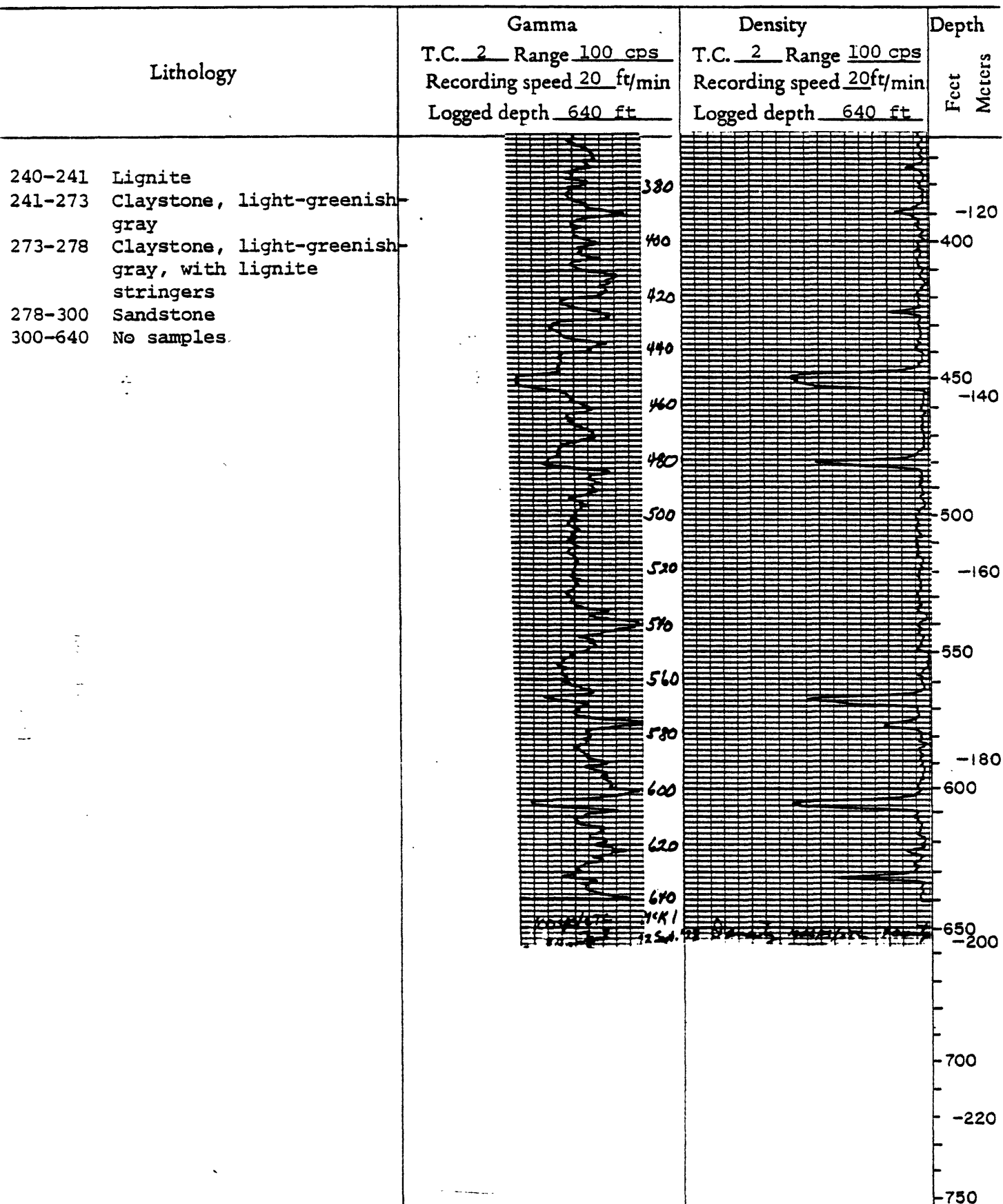
Geophysical logs

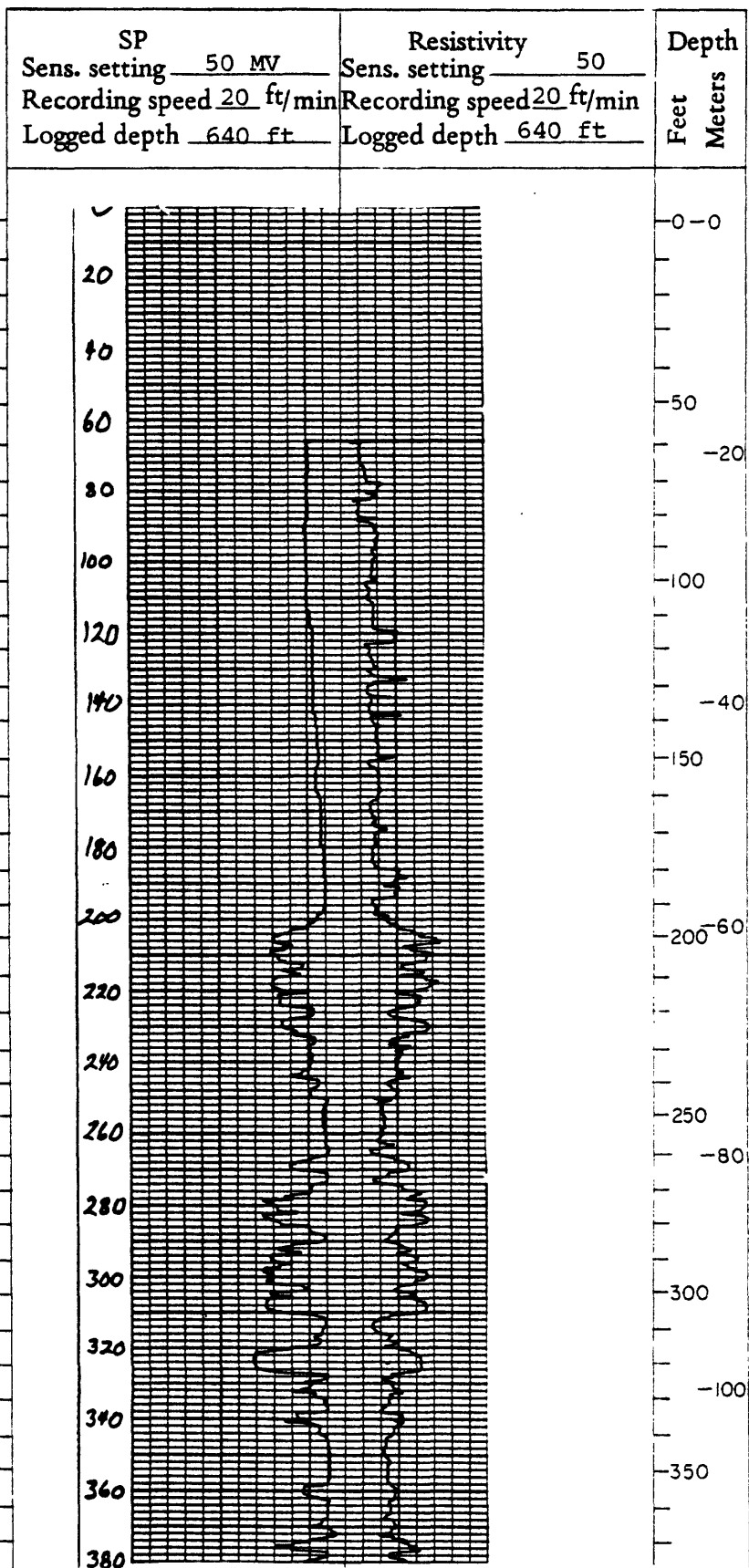
recorded by: Lechner

Lithology	Gamma		Density		Depth Feet Meters
	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>640 ft</u>	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>640 ft</u>	
0- 18 Sandstone, light-yellowish-brown, very fine to fine-grained					0-0
- 18- 20 Claystone, light-yellowish-gray					
- 20- 34 Claystone, greenish-gray, silty					
- 34- 35 Shale, dark-gray; lignite					50
- 35- 40 Sandstone, very fine grained, silty					-20
- 40- 44 Claystone, greenish-gray					
- 44- 45 Lignite					
- 45- 52 Siltstone, greenish-gray					
- 52- 73 Claystone, greenish-gray					100
- 73- 77 Claystone, brownish-gray, carbonaceous					
- 77- 78 Lignite					
- 78- 80 Claystone, brownish-gray, carbonaceous					-40
- 80- 84 Siltstone, greenish-gray					150
- 84- 85 Lignite					
- 85-100 Siltstone, light-brownish-gray					
- 100-105 Claystone, greenish-gray					
- 105-115 Siltstone, greenish-gray					200
- 115-118 Claystone, greenish-gray					60
- 118-121 Lignite					
- 121-133 Claystone, brownish-gray					
- 133-140 Siltstone, greenish-gray					
- 140-142 Limestone, light-gray					
- 142-149 Siltstone, light-greenish-gray					250
- 149-150 Shale, dark-gray; lignite					
- 150-174 Siltstone, light-brownish-gray, sandy					-80
- 174-180 Claystone, light-brownish-gray					
- 180-182 Claystone, brownish-gray					300
- 182-190 Lignite					
- 190-192 Claystone, light-brownish-gray					
- 192-200 Siltstone, light-brownish-gray					-100
- 200-220 Sandstone, light-gray					
- 220-240 Claystone, light-greenish-gray	489				350

Hole number—continued

McK-1





McK-1

492

NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McK-2 Map: Trotters Date: 9-22-78 State: ND County: McKenzie
 Elev.: 2,450 ft Location: T. 145^N, R. 104^W, Sec. 33, Tract: cdcc Drilled depth: 500 ft
 Measured: 250 ft ~~FSL~~ ^{FSL}, 1350 ft ~~FWL~~ ^{FWL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 192-199.5; 356.5-360.5; 474-476

Remarks: _____

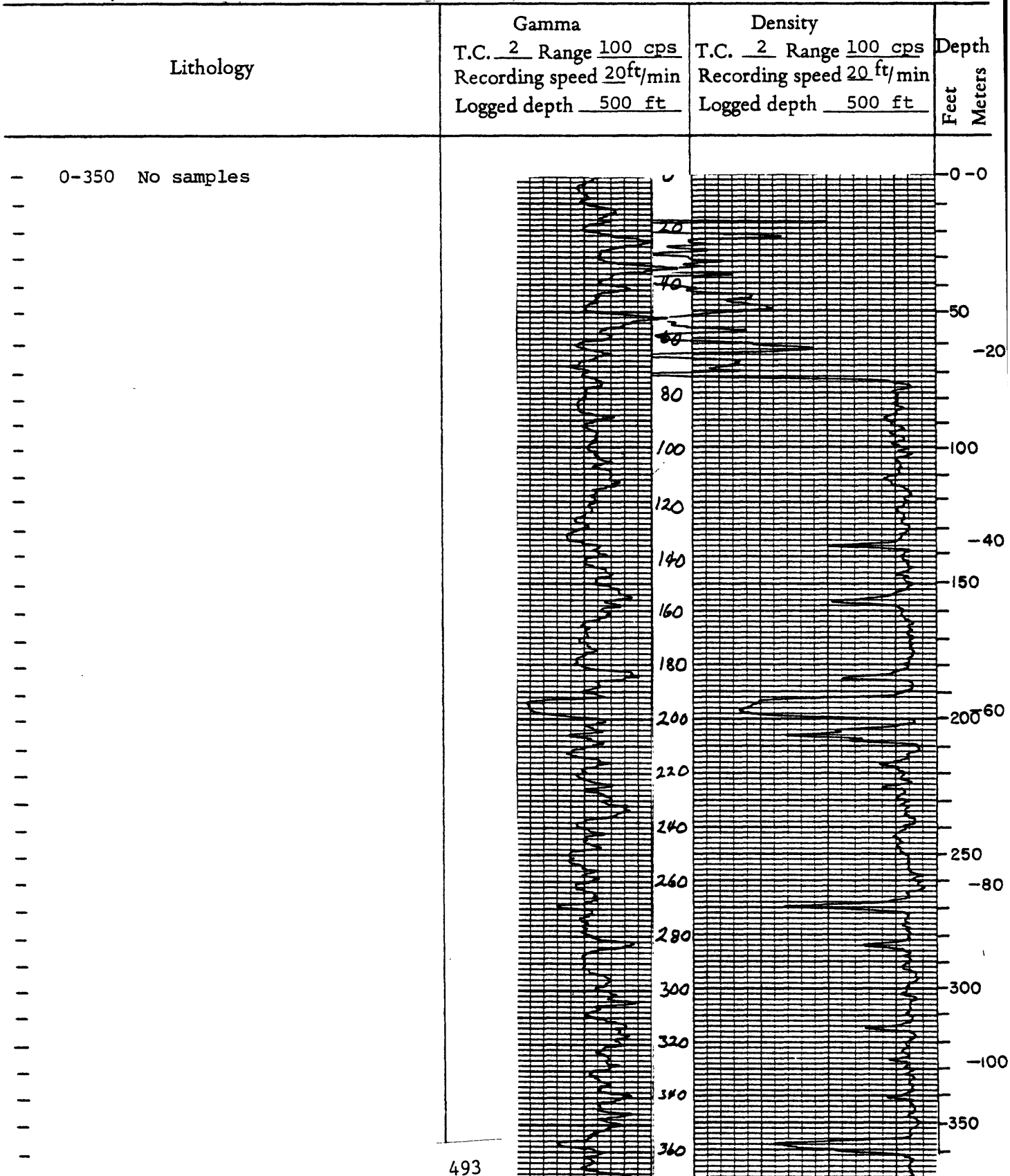
Lithology

Recorded by: Clarence Carlson

Geologist ^{Yes} ~~NA~~

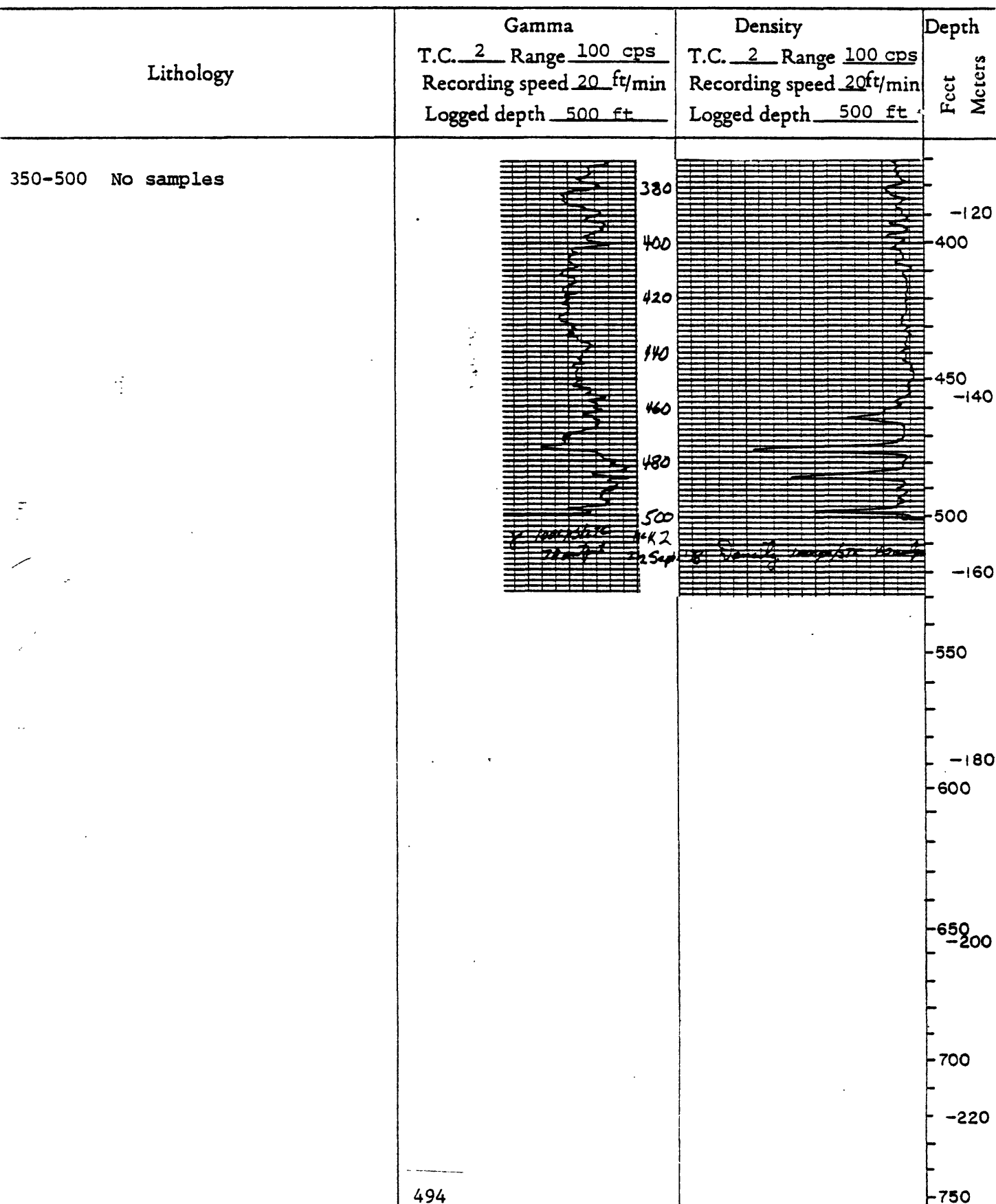
Geophysical logs

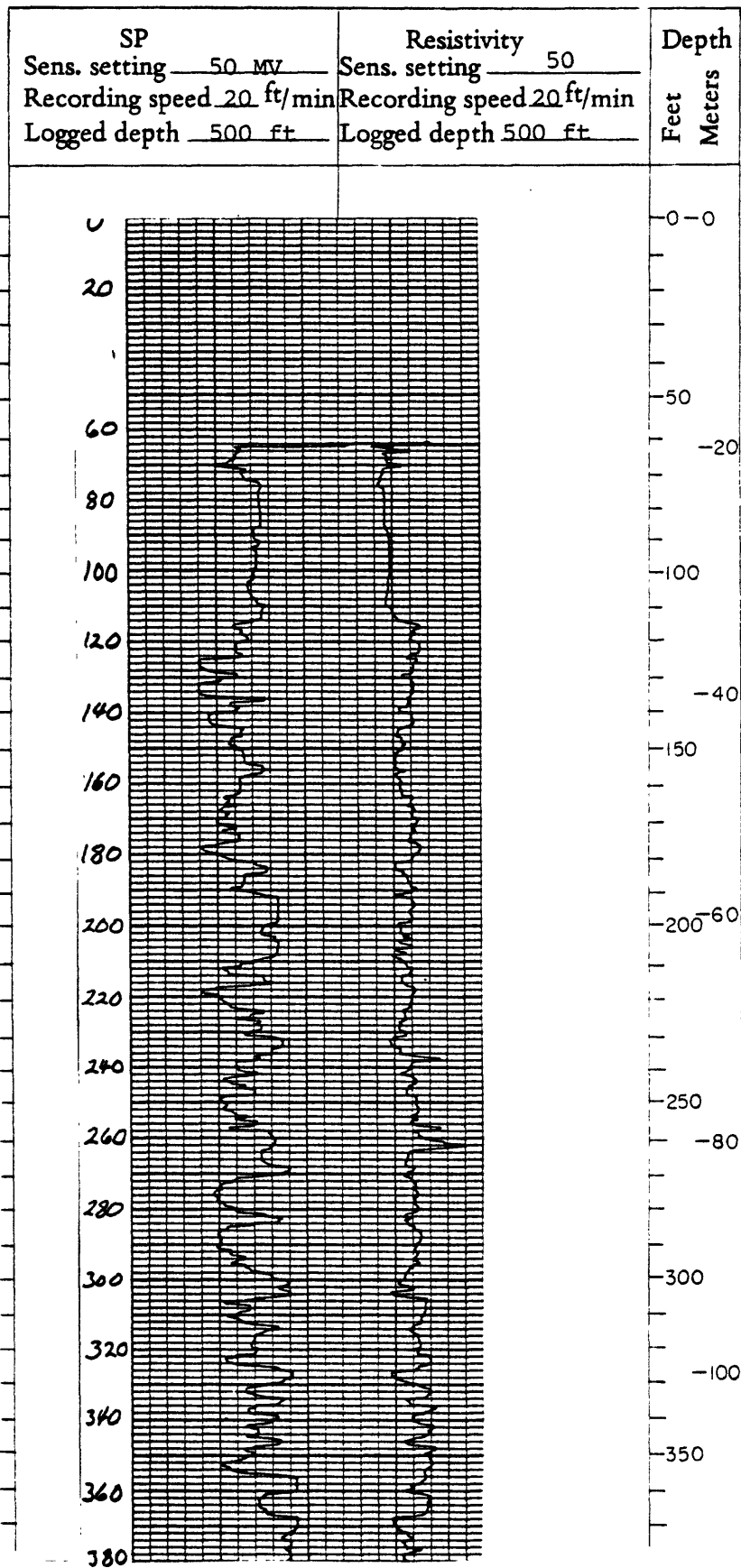
recorded by: Lechner



Hole number—continued

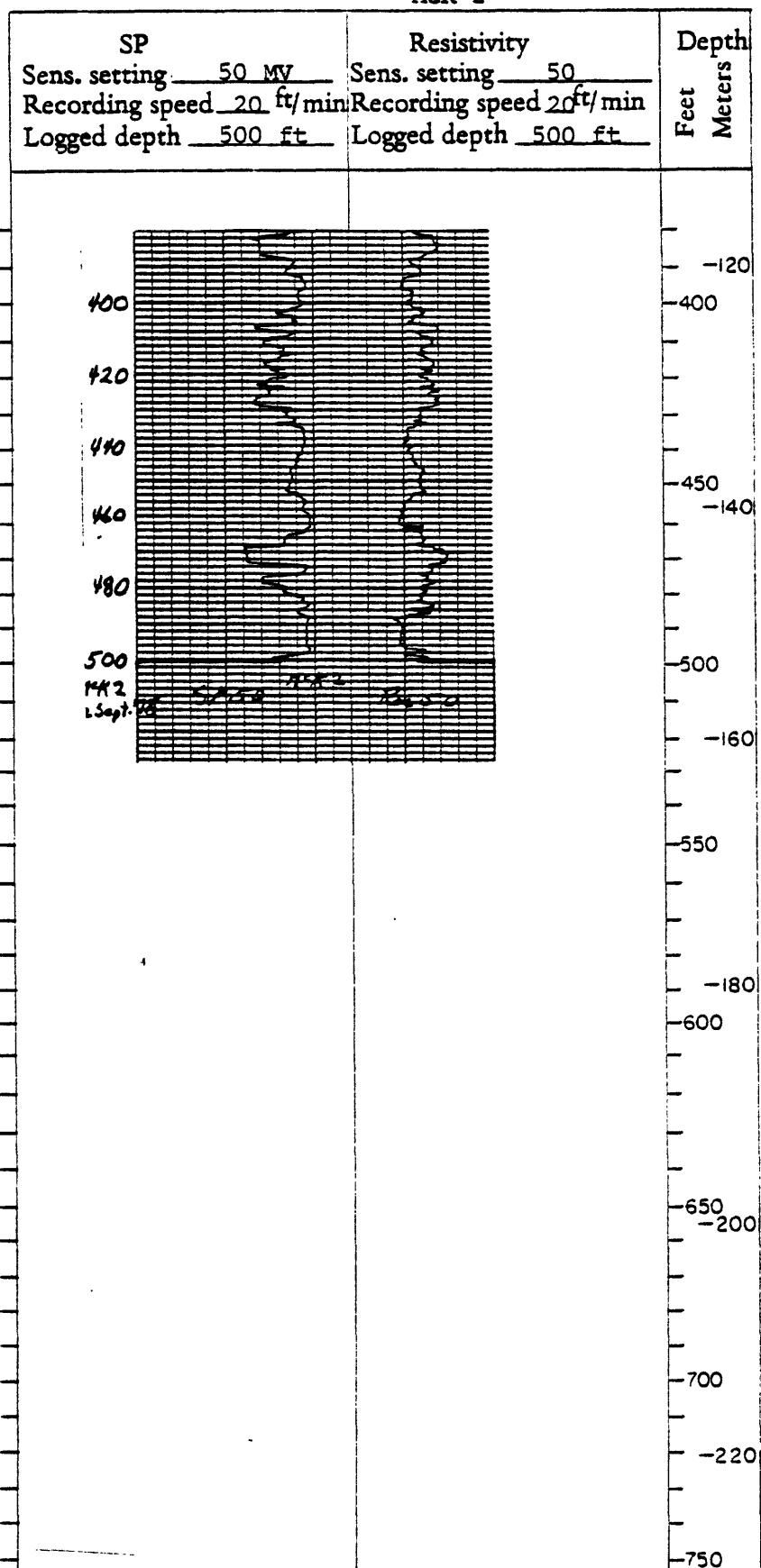
McK-2





Hole number—continued

McK-2



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McK-3 Map: Skaar NE Date: 9-22-78 State: ND County: McKenzie
 Elev.: 2,350 ft Location: T. 145^N, R. 105^R, Sec. 11, Tract: abac Drilled depth: 500 ft
 Measured: 575 ft ^{FNL} ~~225~~, 1500 ft ^{SEL} ~~350~~ ^{FWL} Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 67-73; 266-269; 367-372; 385-387; 430-432

Remarks: _____

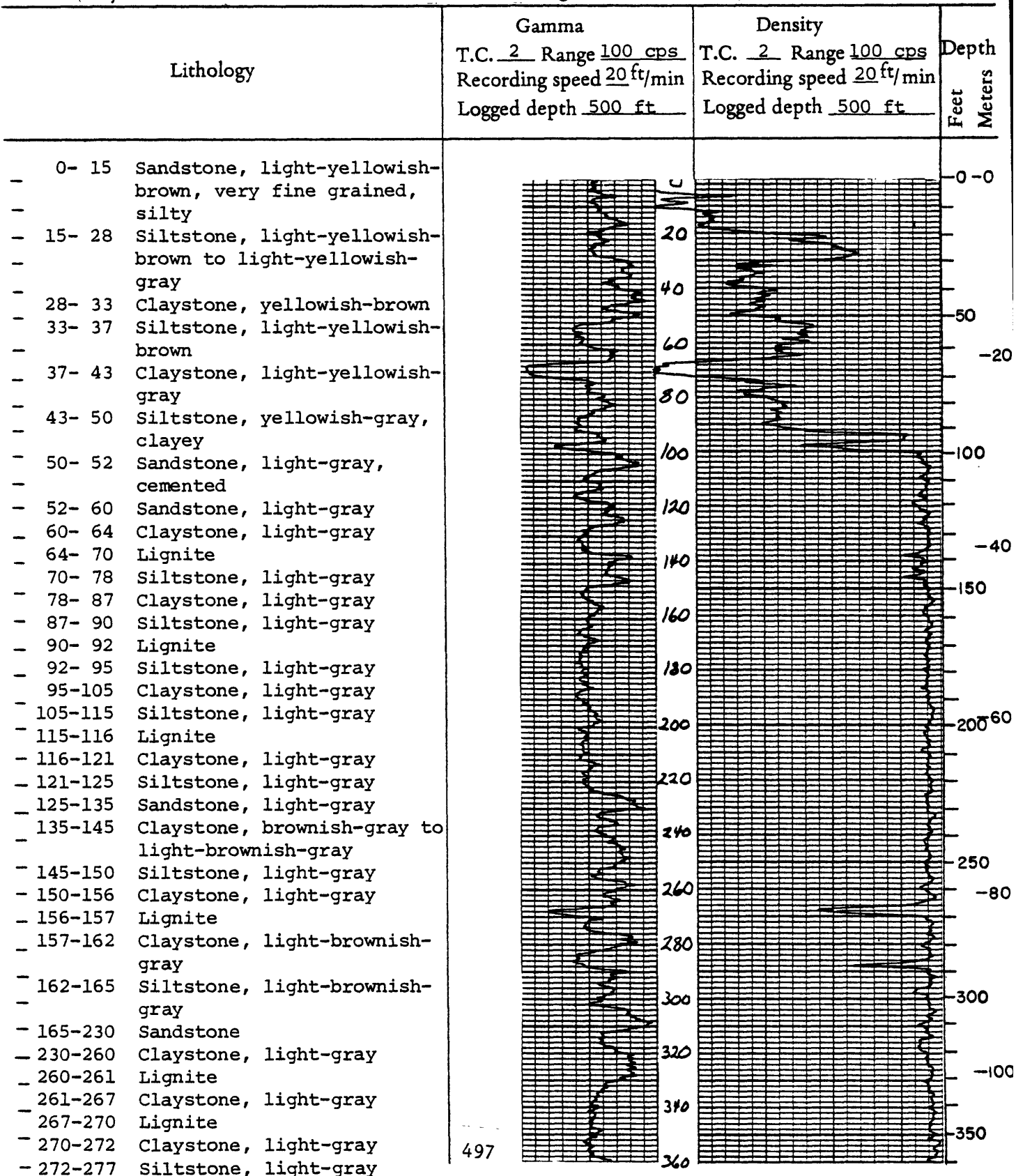
Lithology

Recorded by: Clarence Carlson

Geologist ^{Yes} ~~No~~

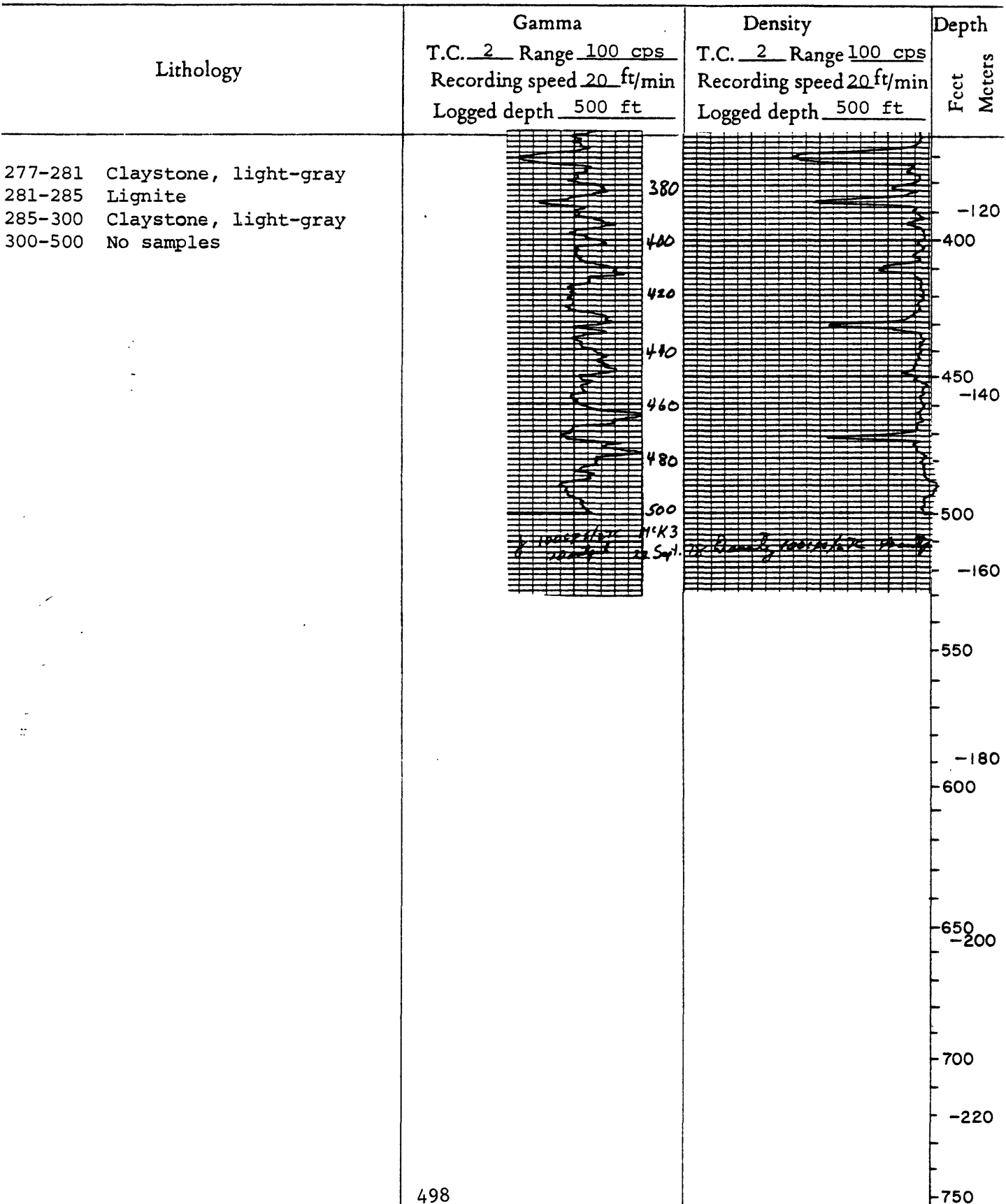
Geophysical logs

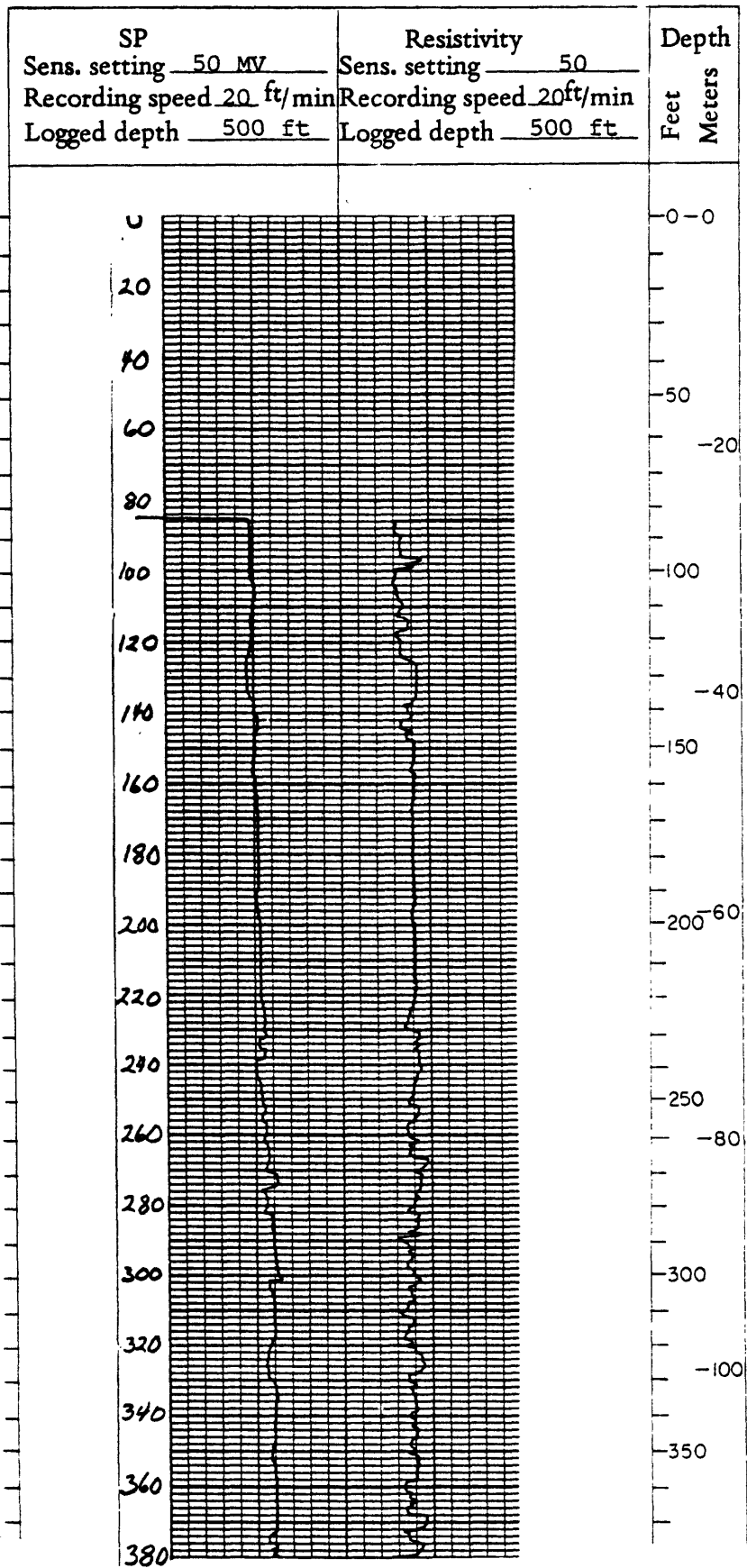
recorded by: Lechner



Hole number—continued

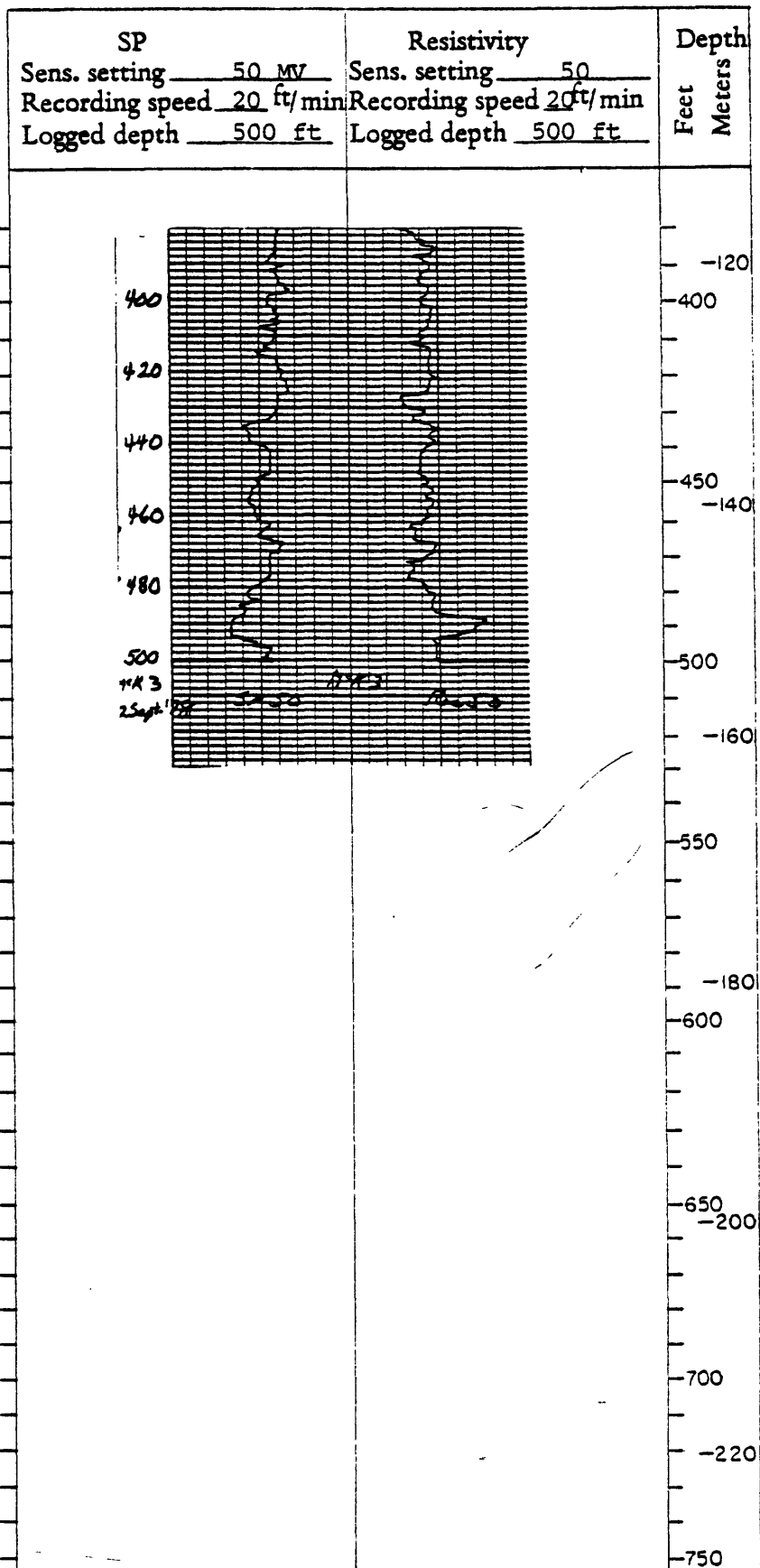
McK-3





Hole number—continued

McK-3



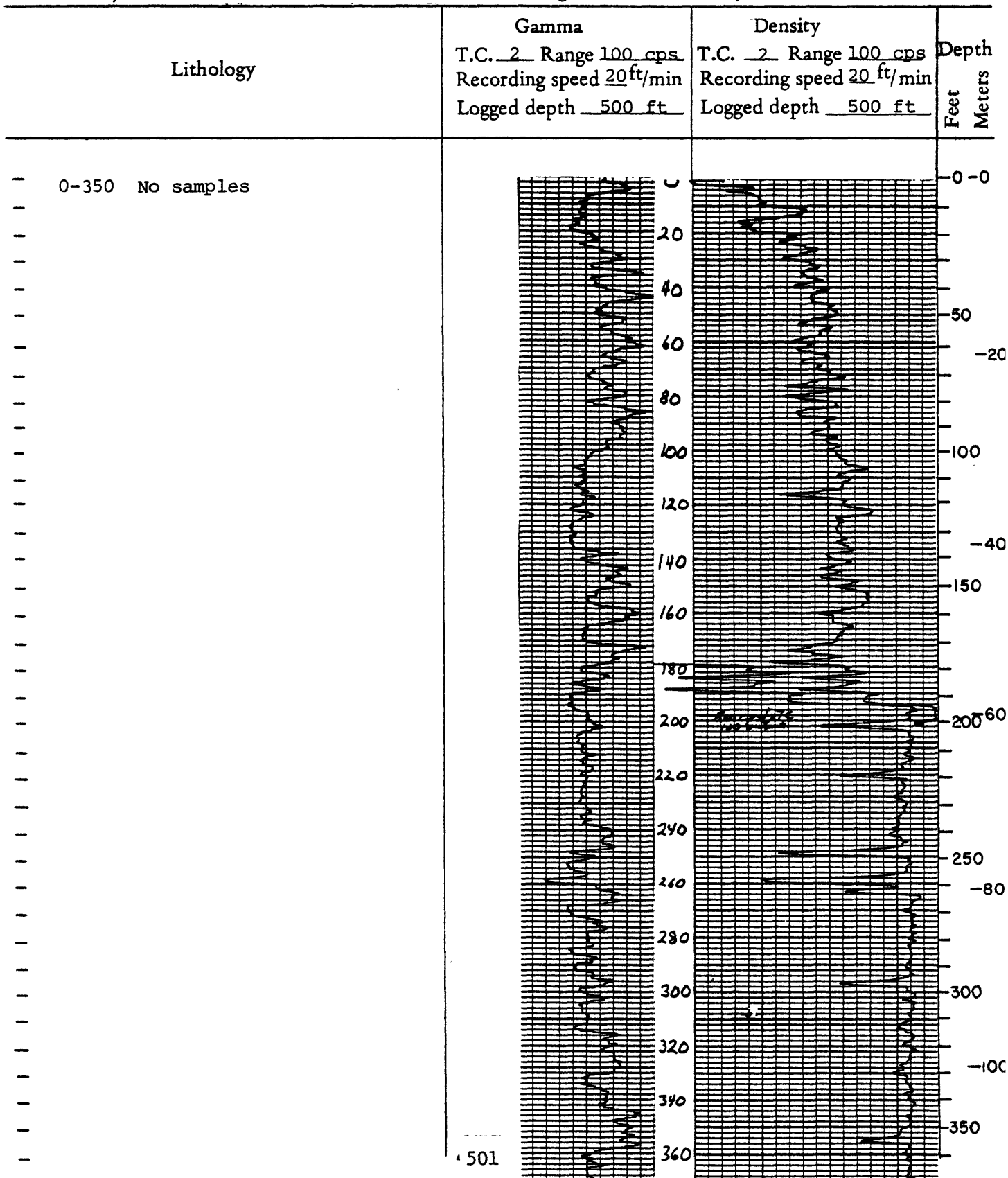
NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: MCK-5 Map: Skaar NE Date: 9-23-78 State: ND County: McKenzie
 Elev.: 2,450 ft Location: T. 146^N, R. 105^W, Sec. 11, Tract: dacb Drilled depth: 500 ft
 Measured: 1950 ft ~~FSL~~^{FEL}, 1100 ft ~~FSL~~^{FEL}, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 248-250; 258-260; 372-375.5; 417-419; 493-500

Remarks: _____

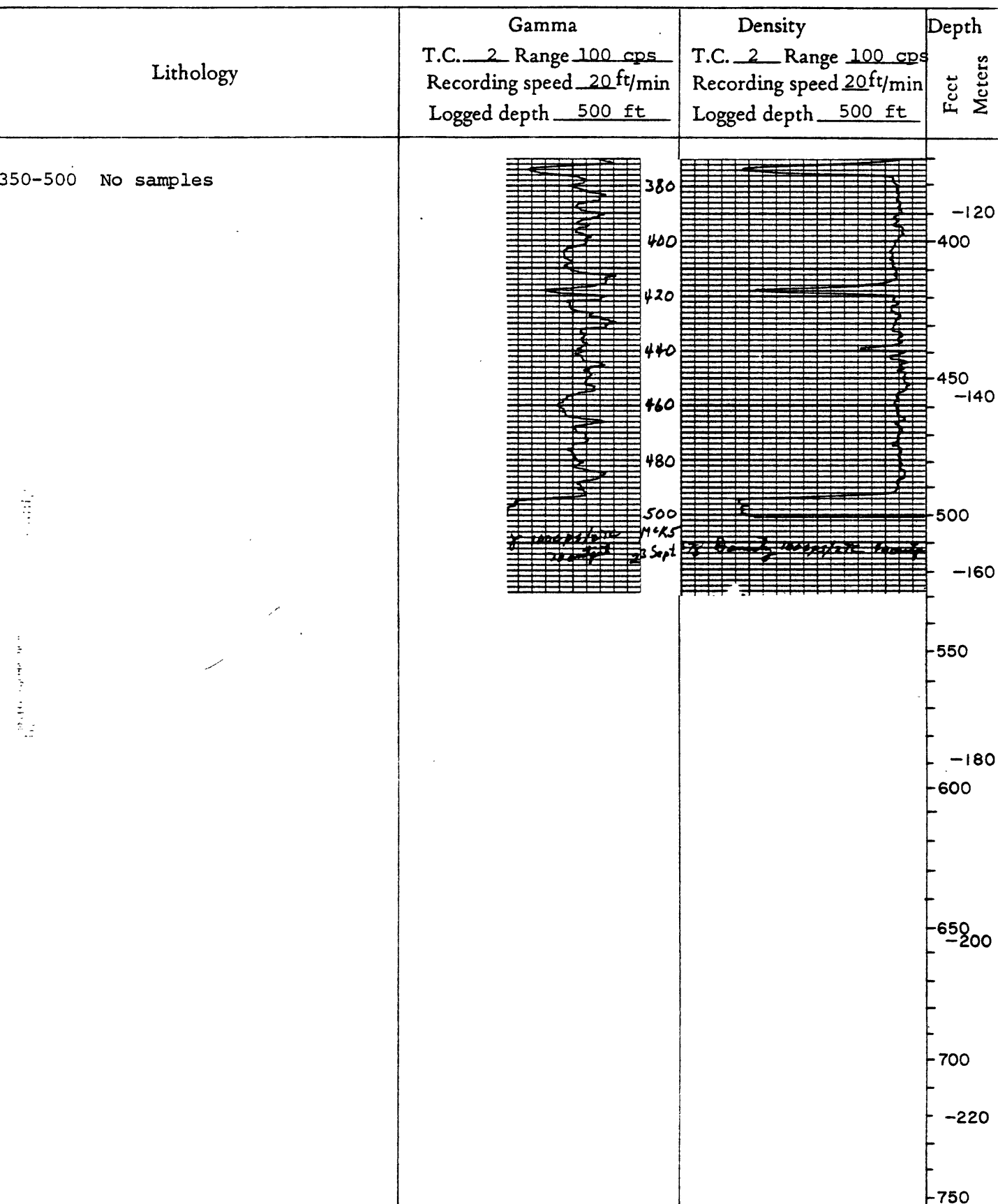
Lithology

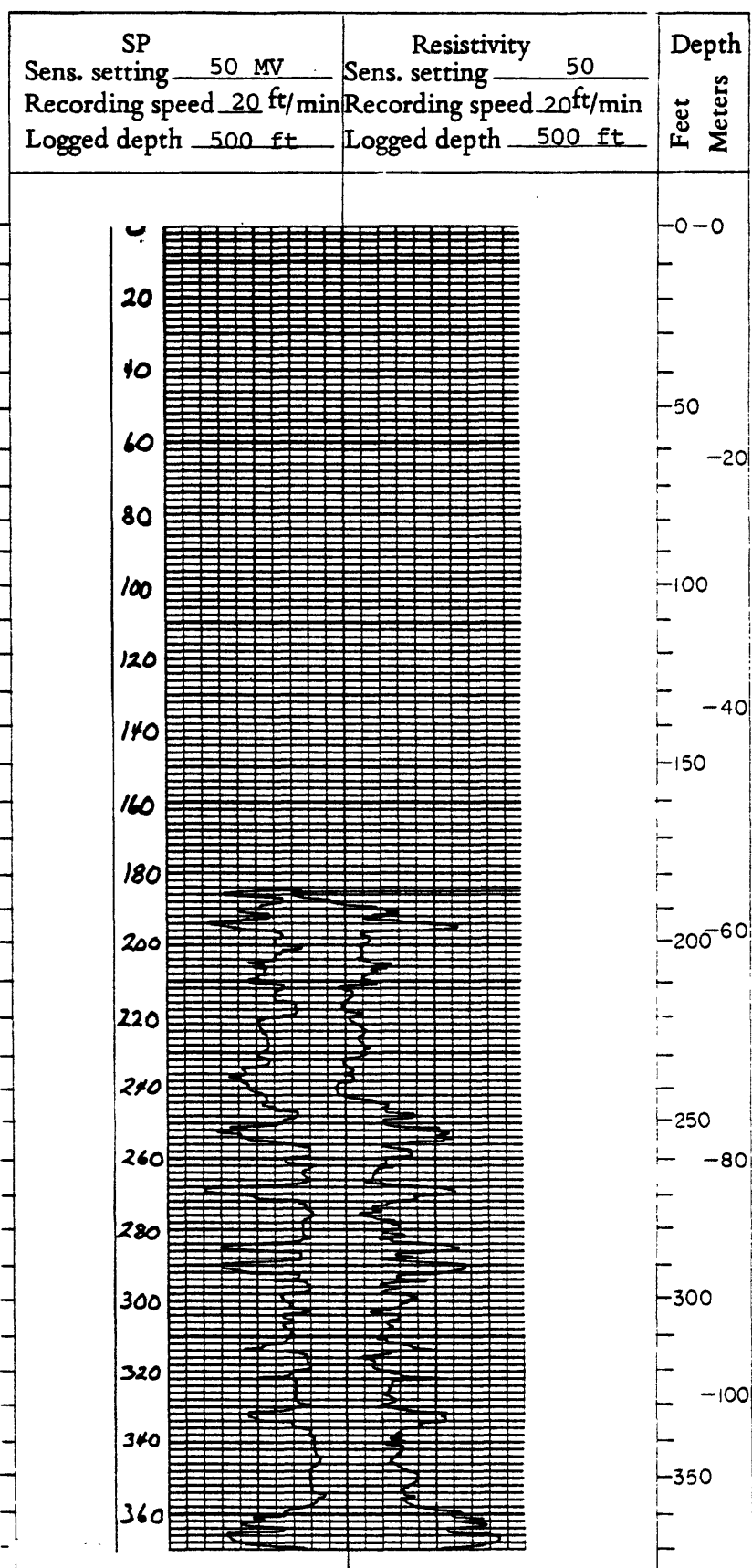
Recorded by: Clarence Carlson Geologist ^{Yes}~~No~~ Geophysical logs recorded by: Lechner



Hole number—continued

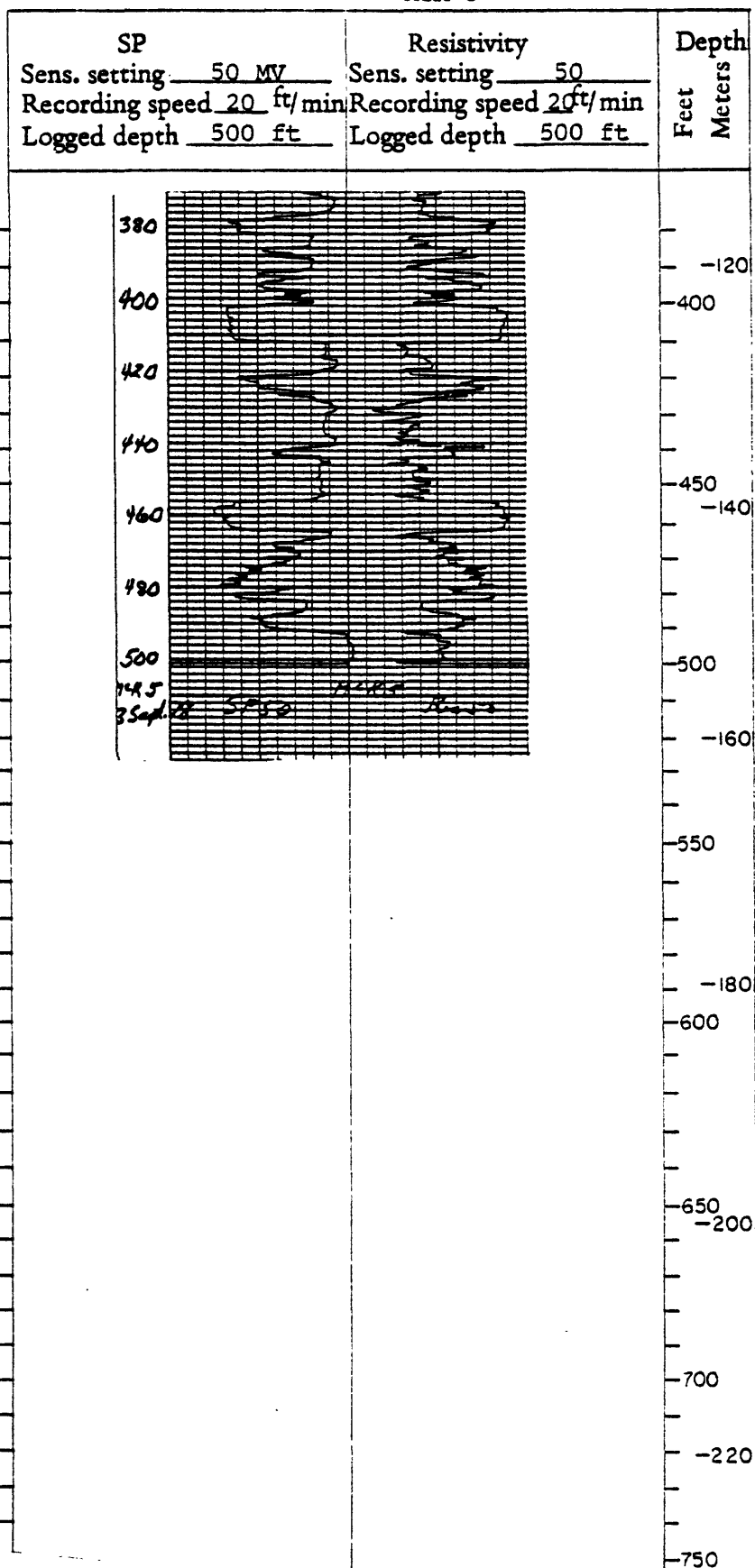
McK-5





Hole number—continued

McK-5



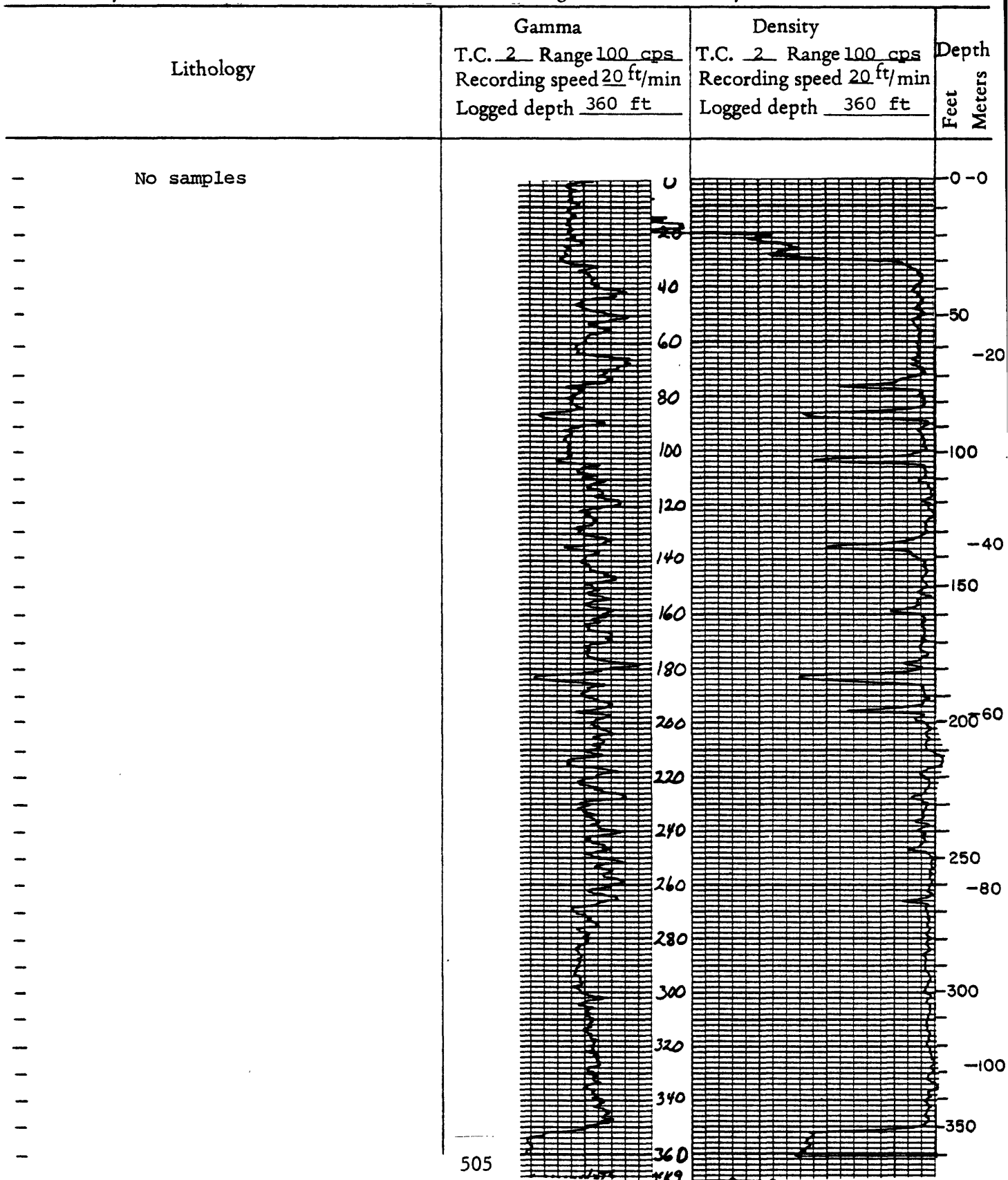
NORTH DAKOTA GEOLOGICAL SURVEY

Hole No.: McK-9 Map: Sidney SE Date: 9-23-78 State: ND County: McKenzie
 Elev.: 2186 ft Location: T. 147^N, R. 105^W, Sec. 3, Tract: abba Drilled depth: 360 ft
 Measured: 70 ft ^{FNL} ~~FSL~~, 2200 ft ^{FEL} ~~FSL~~, Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 85.5-88; 102-104; 134-136; 182-185; 351-360

Remarks: _____

Lithology

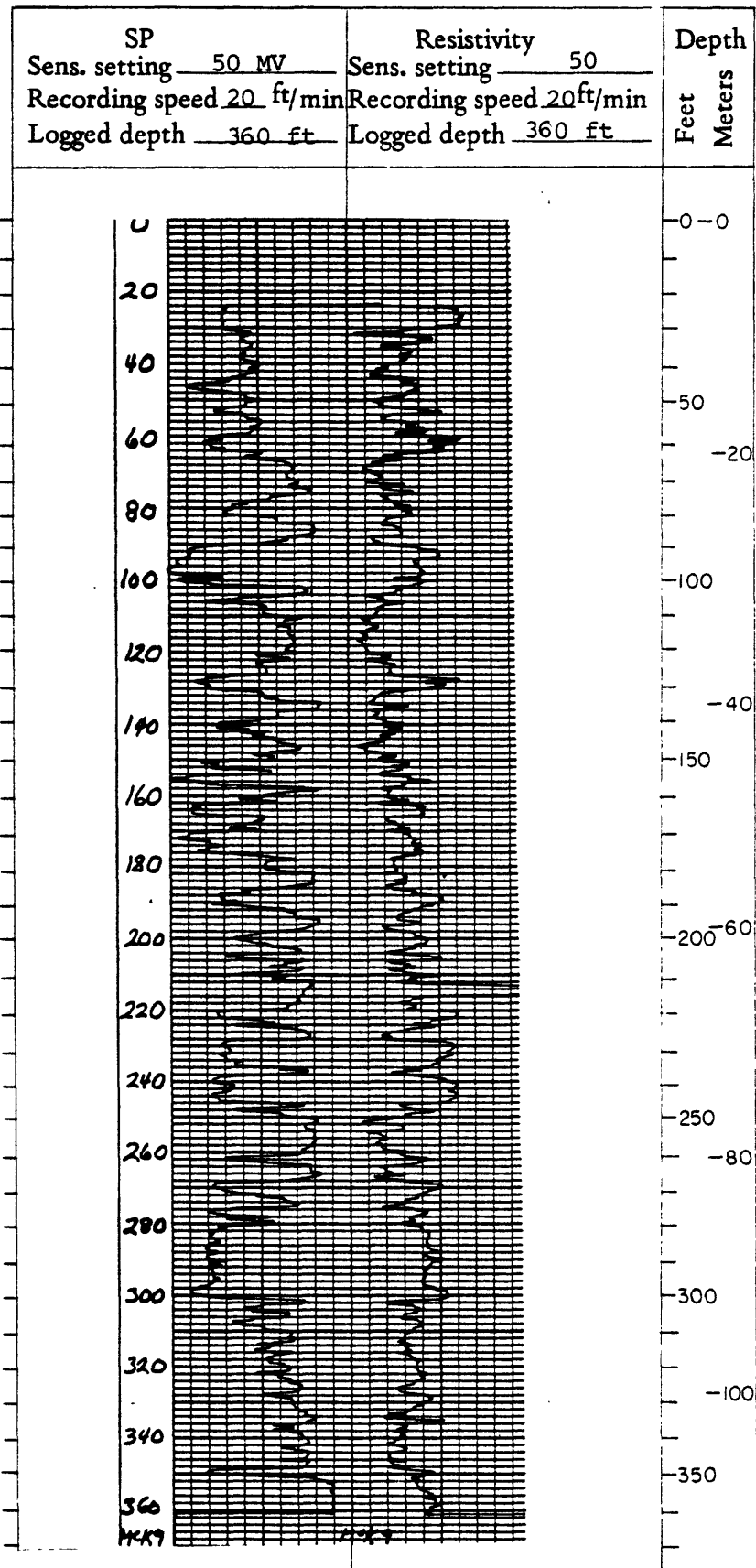
Recorded by: Clarence Carlson Geologist ^{Yes} ~~No~~ Geophysical logs recorded by: Lechner



Hole number—continued

McK-9

Lithology	Gamma T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>360</u> ft	Density T.C. <u>2</u> Range <u>100</u> cps Recording speed <u>20</u> ft/min Logged depth <u>360</u> ft	Depth	
			Feet	Meters
350-360 No samples			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



McK-9

508

Horse

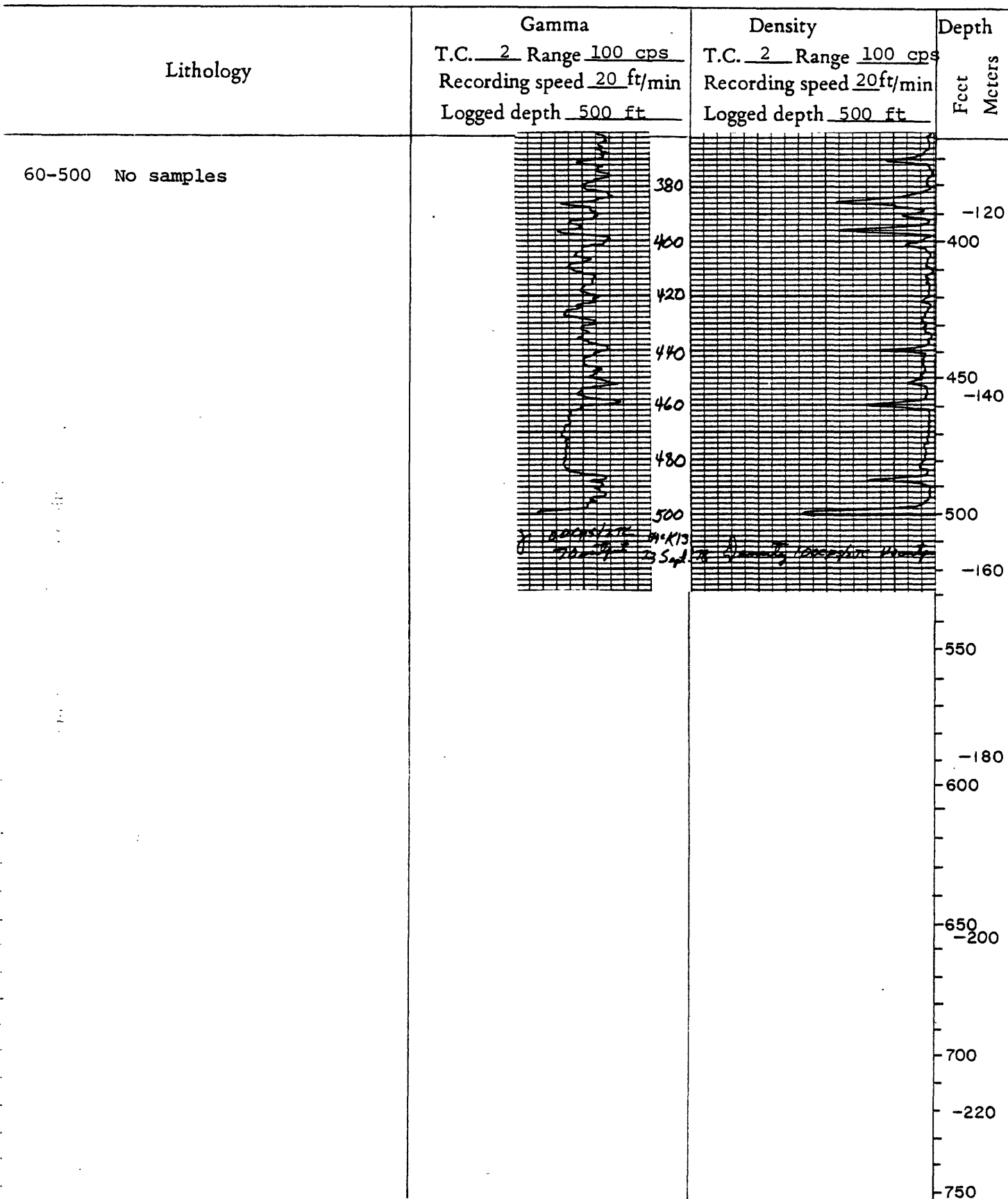
Remarks:

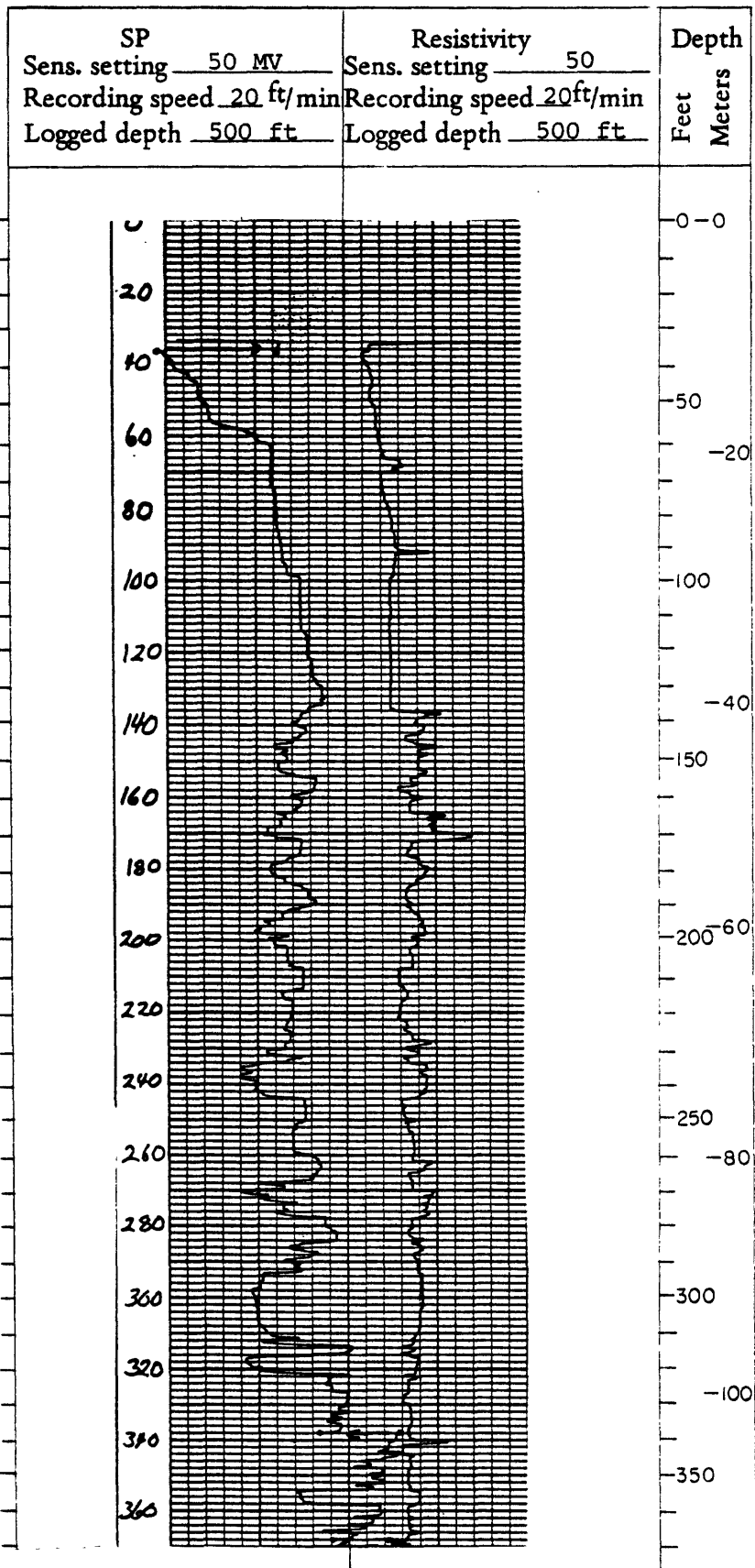
Lithology

Lithology	Gamma		Density		Depth Feet Meters
	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>500 ft</u>	T.C. <u>2</u>	Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>500 ft</u>	
0- 3 Soil, silty loam					0-0
3- 12 Claystone, dark-brownish-gray					
12- 15 Siltstone, olive-gray					
15- 20 Claystone, olive-gray					
20- 22 Lignite					
22- 24 Claystone, light-brownish-gray					50
24- 27 Siltstone, yellowish-brown					
27- 30 Claystone, yellowish-brown					
30- 37 Siltstone, light-yellowish-brown, sandy					
37- 40 Claystone, light-brownish-gray					100
40- 50 Claystone, light-gray					
50- 60 Siltstone, light-gray					
					150
					200
					250
					300
					350
					400
					450
					500

Hole number—continued

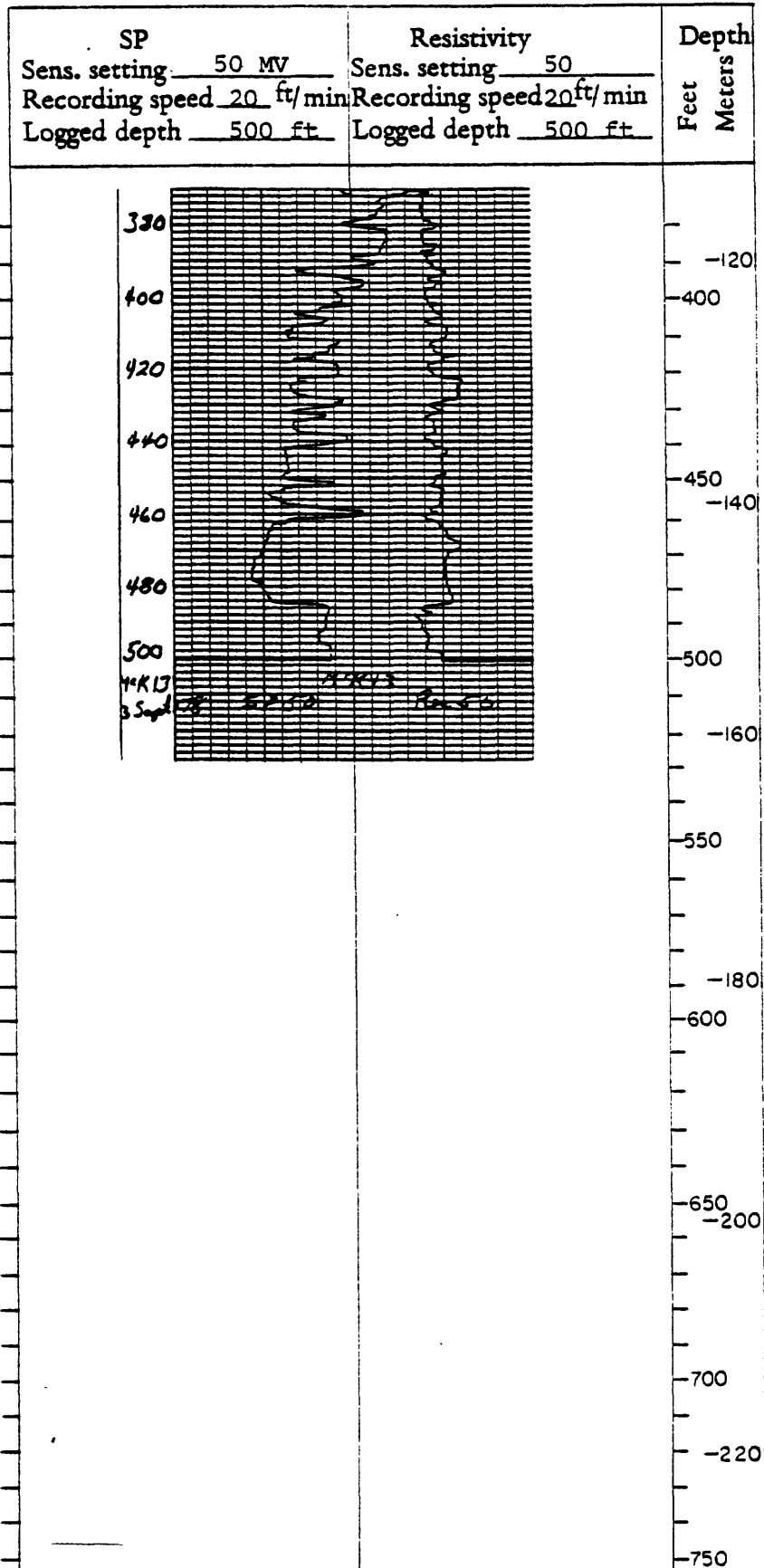
McK-13





Hole number—continued

McK-13



NORTH DAKOTA GEOLOGICAL SURVEY

Hole No: McK-14 Map: Sidney NE Date: 9-23-78 State: ND County: McKenzie
 Elev.: 2,110 ft Location: T. 149^N, R. 104^W, Sec. 32, Tract: dddd Drilled depth: 300 ft
 Measured: 300 ft ~~FSL~~ ^{FSL}, 30 ft ~~FEL~~ ^{FEL} Hole size: 4 3/4 in Air ☐ Water ☒ Cored: Yes ☐ No ☒
 Lignite beds: 173-179; 282-286

Remarks: _____

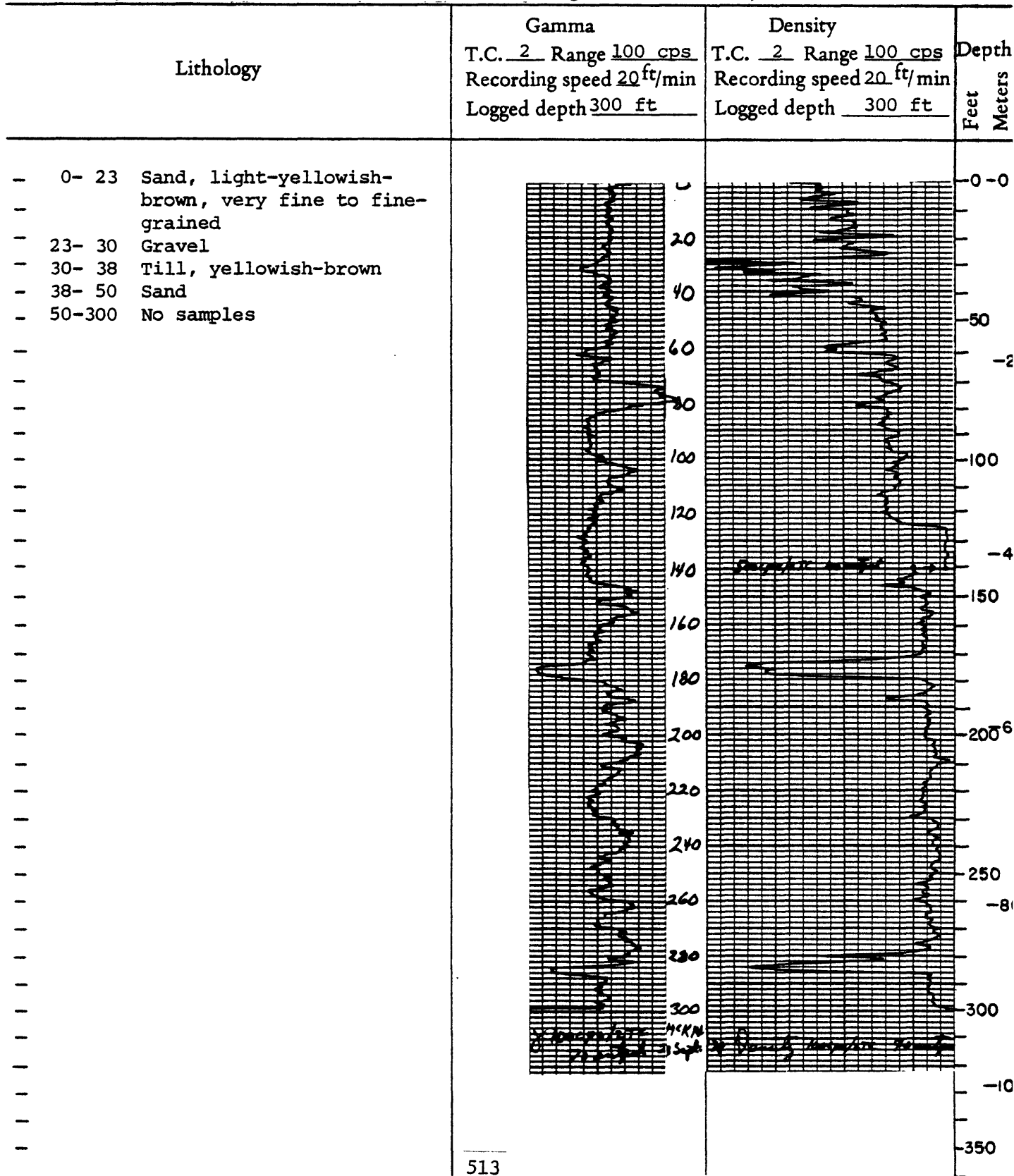
Lithology

Recorded by: Clarence Carlson

Geologist ^{Yes} ~~XX~~

Geophysical logs

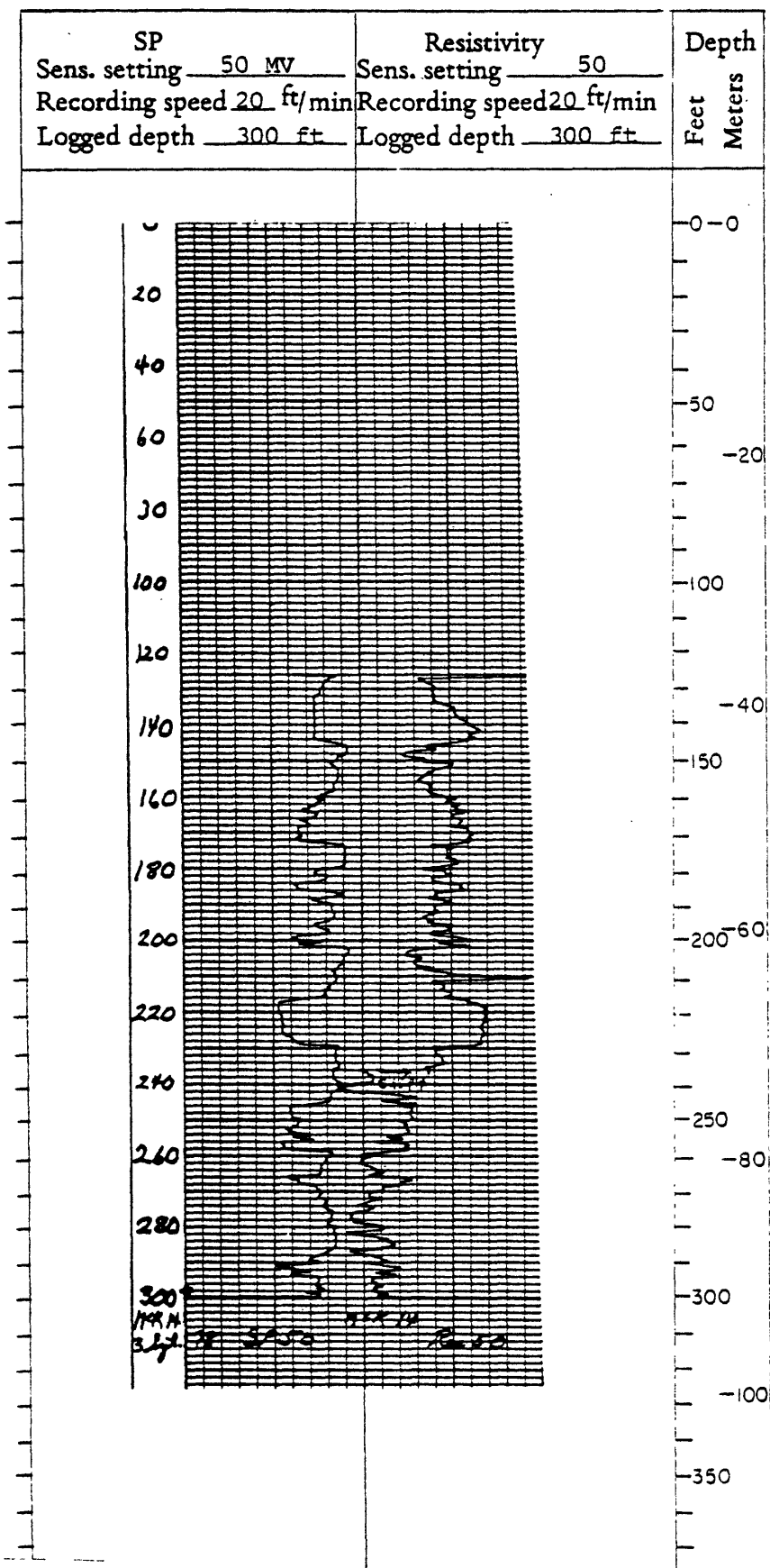
recorded by: Lechner



Hole number—continued

McK-14

Lithology	Gamma T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20 ft/min</u> Logged depth <u>300 ft</u>	Density T.C. <u>2</u> Range <u>100 cps</u> Recording speed <u>20ft/min</u> Logged depth <u>300 ft</u>	Depth	
			Feet	Meters
			-120	
			-400	
			-450	
			-140	
			-500	
			-160	
			-550	
			-180	
			-600	
			-650	
			-200	
			-700	
			-220	
			-750	



Hole number—continued

McK-14

SP		Resistivity	Depth Feet Meters
Sens. setting <u>50 MV</u>		Sens. setting <u>50</u>	
Recording speed <u>20 ft/min</u>		Recording speed <u>20 ft/min</u>	
Logged depth <u>300 ft</u>		Logged depth <u>300 ft</u>	
			-120
			-400
			-450
			-140
			-500
			-160
			-550
			-180
			-600
			-650
			-200
			-700
			-220
			-750