

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

RECONNAISSANCE DRILLING IN THE DANFORTH HILLS COAL FIELD,
MOFFAT AND RIO BLANCO COUNTIES, COLORADO,
SEPTEMBER-OCTOBER 1976

By

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INTRODUCTION

The Hayden Farmer Drilling Company, under Contract No. 14-08-0001-15726, awarded by the U.S. Geological Survey, rotary drilled 23 holes in the Danforth Hills coal field for a total footage drilled of 9,246. Geophysical logging of these holes was done by Geo-Dynamics and by the Century Geophysical Corporation. The drilling program was done to collect data on the depths, thicknesses, and correlations of coal beds and coal zones in parts of the Danforth Hills coal field, Moffat and Rio Blanco Counties, Colorado. These data will aid in mapping of quadrangles in the eastern part of the coal field and in the evaluation of subsurface mining possibilities in the Bureau of Land Management's (BLM) tracts 5 and 19 located about 15 mi (24 km) north of Meeker, Colorado. All of the holes drilled are in these two BLM tracts. Geological Survey personnel located the drill sites, arranged permission for access, coordinated the drilling and geophysical logging, performed the lithologic sampling and logging, and analyzed the data. Lithologic logs in this report were compiled from both the sample logs and the geophysical logs and are considered reasonably accurate.

LOCATION AND CORRELATION OF MAJOR COAL BEDS

Using data derived from the lithologic and geophysical logs, thicknesses of the coal beds and overburden were determined and probable correlations between drill holes were made (fig. 6). The thickest and most persistent coal beds are in the Williams Fork Formation of Late Cretaceous age, between the Trout Creek Sandstone Member of the Iles Formation and the Twentymile(?) Sandstone Member of the Williams Fork Formation. Thick coals are also common above the Twentymile(?) Sandstone, but, according to these data, do not appear as persistent as the lower coals. The presence of numerous thick coal beds precludes a detailed discussion of each bed in this report.

In BLM tracts 5 and 19, two zones have the most potential for subsurface mining: Zone one, from about 75 to 250 ft (23 to 76 m) above the Trout Creek Sandstone, contains two to three major coal beds; and zone two, from 300 to 700 ft (91 to 213 m) above the Trout Creek, contains from two to four major coal beds.

Table 1.--Location of drill holes in the Danforth Hills coal field,
Moffat and Rio Blanco Counties, Colorado

[Measurements are in feet; to convert to meters, multiply by 0.3048]

Drill- hole no.	Location	Eleva- tion (approx)	Total depth drilled	Total depth logged
BLM tract 5				
D-19-NG	T. 3 N., R. 93 W., sec. 17, NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	8,100	520	515
D-20-NG	T. 3 N., R. 93 W., sec. 17, NE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$	8,020	520	520
D-23-NG	T. 3 N., R. 93 W., sec. 19, SE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$	8,450	500	497
D-24-NG	T. 3 N., R. 93 W., sec. 18, NE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	8,355	220	220
D-25-NG	T. 3 N., R. 93 W., sec. 17, SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	8,205	540	540
D-26-A	T. 3 N., R. 93 W., sec. 5, SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	7,330	500	498.5
D-27-NG	T. 3 N., R. 93 W., sec. 8, SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$	7,805	500	499.5
D-28-NG	T. 3 N., R. 93 W., sec. 18, SE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$	7,780	280	276
✓ D-29-NG	T. 3 N., R. 93 W., sec. 7, NW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	7,340	381	380
✓ D-30-NG <u>1/</u>	T. 3 N., R. 93 W., sec. 7, NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$	6,985	25	0
✓ D-31-NG	T. 3 N., R. 93 W., sec. 7, C NE $\frac{1}{4}$ NE $\frac{1}{4}$	6,950	200	200
D-33-NG	T. 3 N., R. 93 W., sec. 19, NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	8,280	600	597
D-35-NG	T. 3 N., R. 93 W., sec. 18, SE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$	7,540	380	357
BLM tract 19				
D-13-NG	T. 3 N., R. 93 W., sec. 28, NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	7,855	500	499.5
D-14-NG	T. 3 N., R. 93 W., sec. 29, SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$	7,815	500	394.5
D-15-NG <u>1/</u>	T. 3 N., R. 93 W., sec. 28, NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	7,040	40	0
D-16-NG	T. 3 N., R. 93 W., sec. 21, NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$	7,520	520	518
D-17-NG	T. 3 N., R. 93 W., sec. 21, NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$	7,770	500	497
D-18-NG	T. 3 N., R. 93 W., sec. 15, SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$	7,480	540	535
D-21-NG	T. 3 N., R. 93 W., sec. 20, NE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	8,010	560	560
D-22-NG	T. 3 N., R. 93 W., sec. 20, SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$	8,250	500	497
D-32-NG	T. 3 N., R. 93 W., sec. 22, NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	6,885	220	214
D-34-NG	T. 3 N., R. 93 W., sec. 11, SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	6,700	200	199.5

1/ Hole abandoned owing to problems of caving in thick alluvium. No geophysical log on this hole.

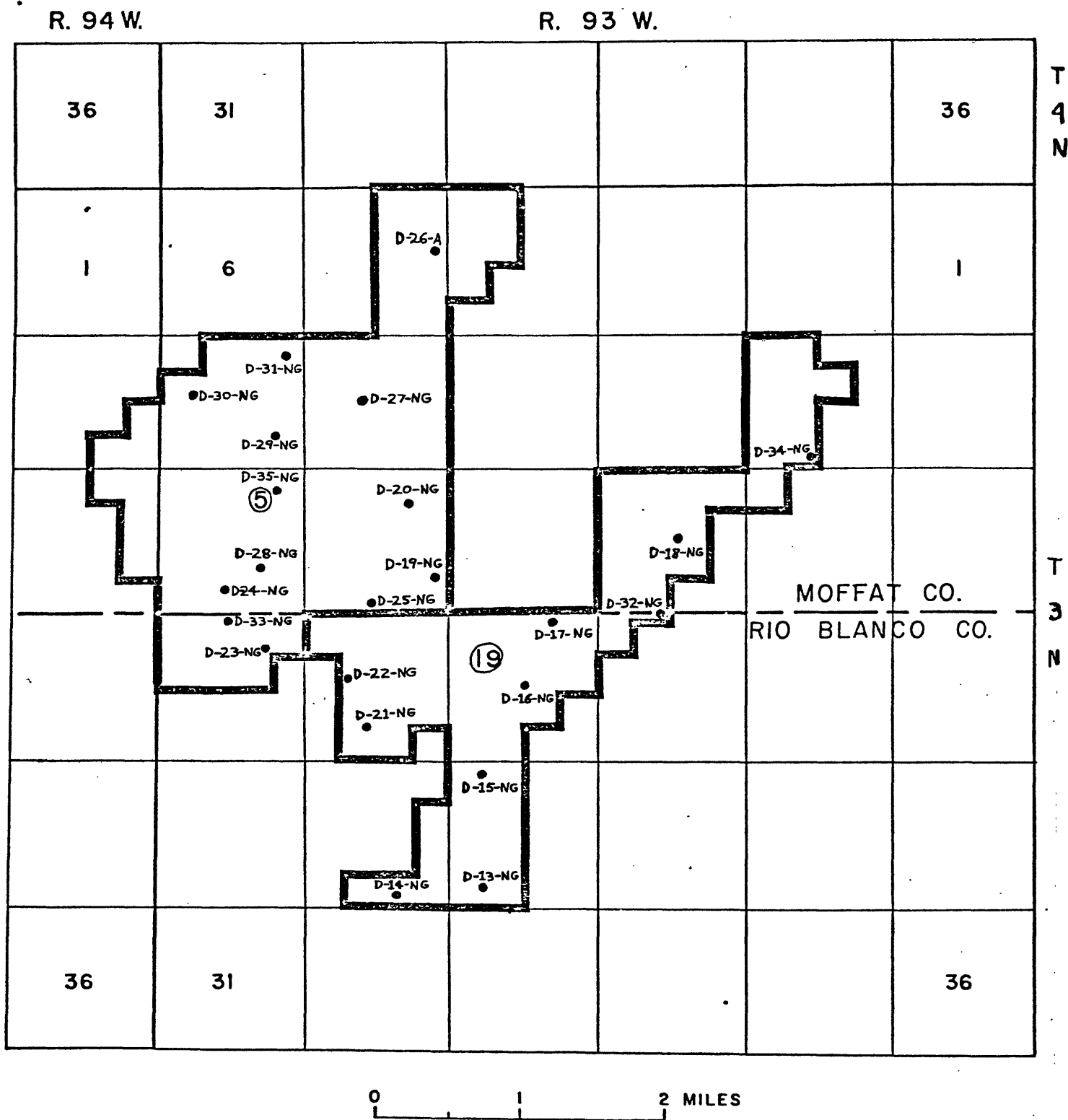


Figure 1. Regional map showing drill-hole locations in BLM tracts 5 and 19.

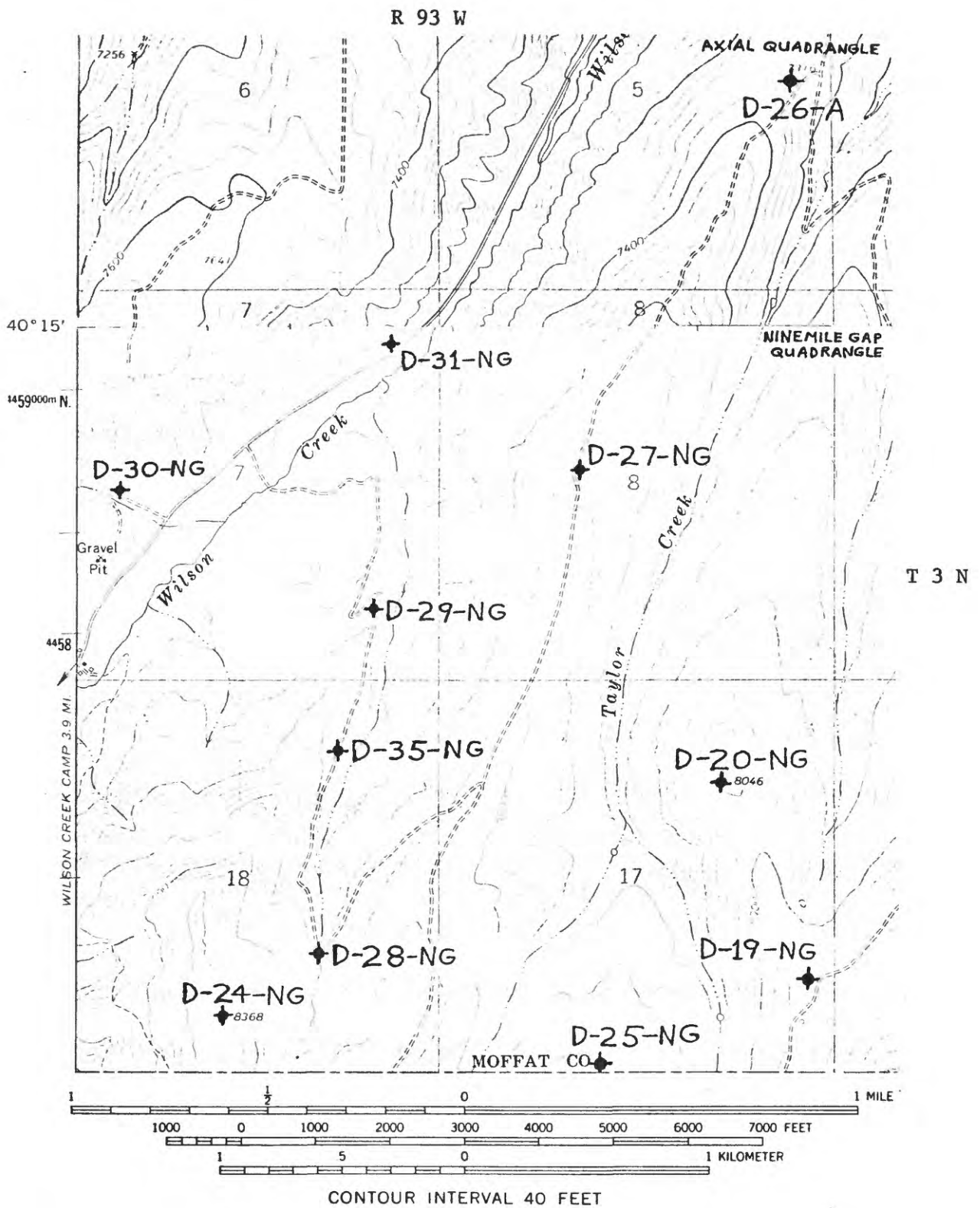


Figure 2. Locations of drill holes, Ninemile Gap and Axial quadrangles, Colorado

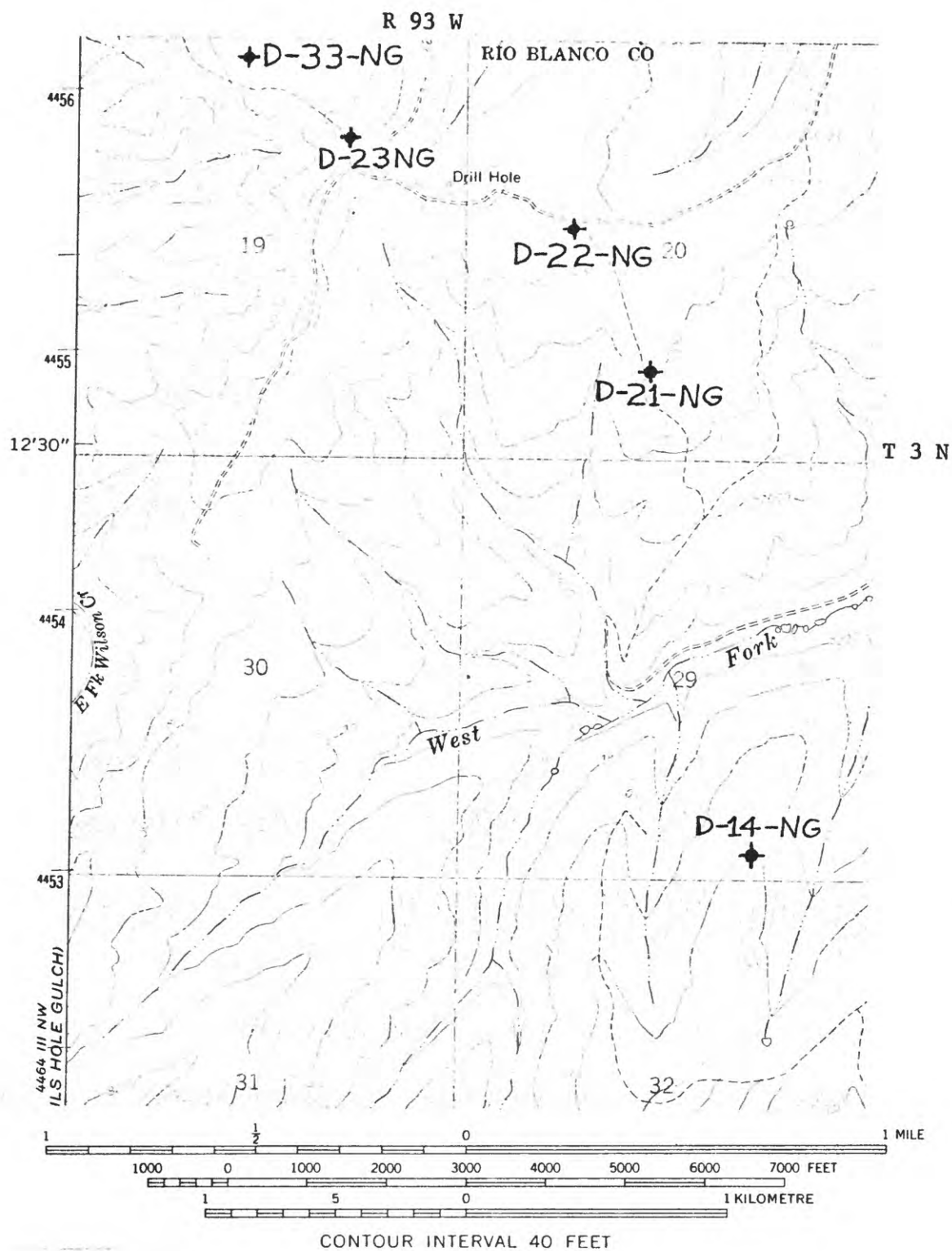


Figure 3. Locations of drill holes, Ninemile Gap quadrangle, Colorado

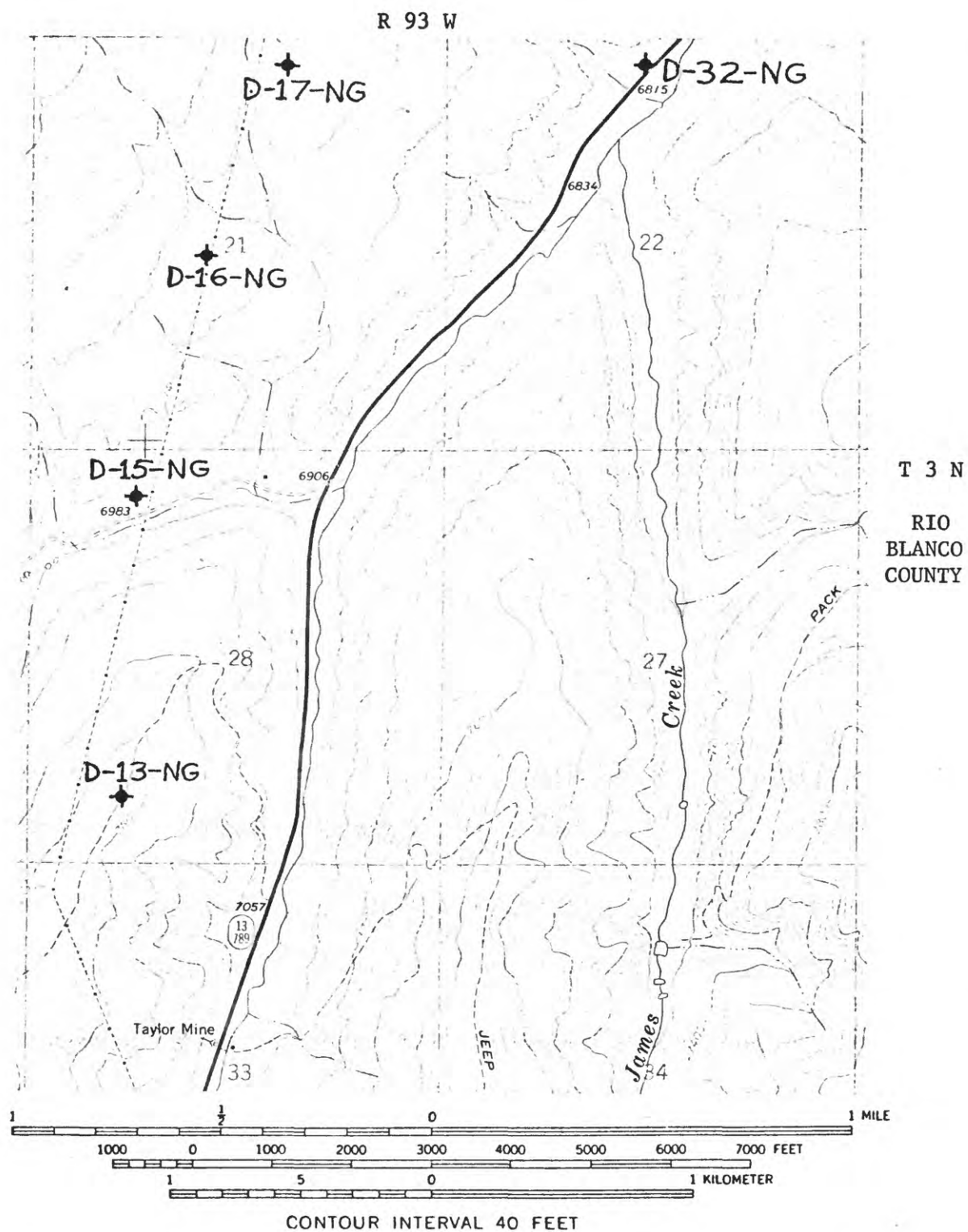


Figure 4. Locations of drill holes, Ninemile Gap quadrangle, Colorado

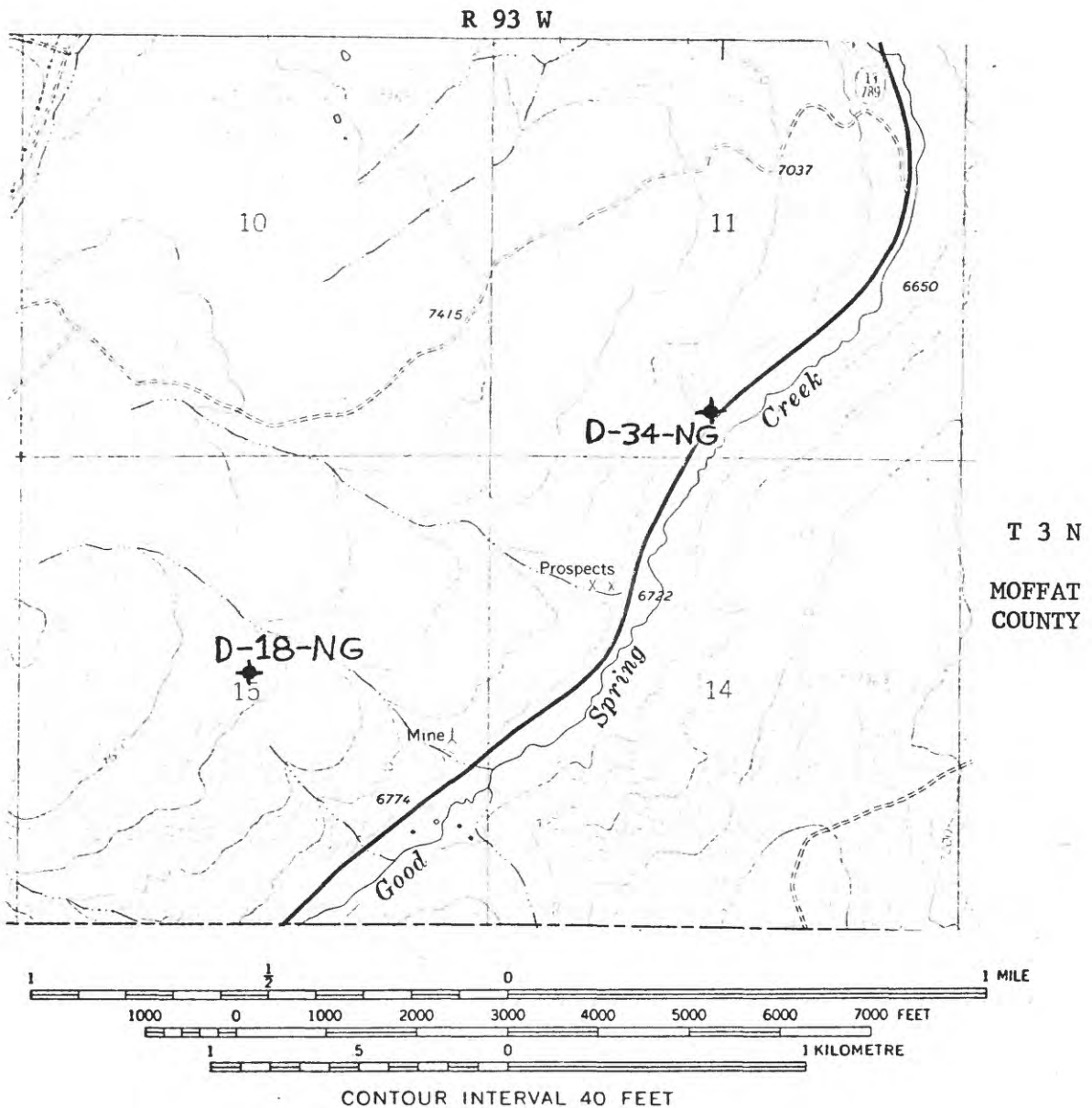


Figure 5. Locations of drill holes, Ninemile Gap quadrangle, Colorado

Depth (ft)	Lithology	Description		Depth (ft)	Lithology	Description
		Tan to gray, fg ss				
10		Gr-br sh + siltst, some tan-or fg ss + black carb sh		90		II
20				100		
30		or vfg carb ss tan-or fg ss		110		II
40		Tan-or vfg ss, some gr + br-gr siltst		120		
50		Coal		130		
		Red-br to gr-br siltst				
		Bony coal				
60		Gr sh		140		
70		Tan-or fg ss, some gr sh		150		
80		Tan-or vfg carb ss, occasional lens gr sh		160		Gr sh Tan-or fg ss

D-13-NG cont.

Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
		Tan-or fg ss			Gr sh
170		Gr sh	260		Gr vfg stp ss
180		Tan-or fg ss	270		Coal
		Gr sh			Dk gr-b carb sh, gr sh
190		Tan-or fg ss	280		Lt-med gr + gr-or vfg stp ss, some gr sh + bl carb sh
		Gr sh			
200		Gr sh + tan-or fg ss	290		
		Gr sh			Lt-med gr vfg stp ss, some gr sh
210		Coal	300		
		Gr sh			
220		Gr-or fg ss	310		Coal
		Gr-or to lt gr vfg stp ss, + dk br-gr carb sh	320		Dk gr carb sh
230					Lt gr vfg stp ss
					Br carb sh
240			330		Gr-br vfg ss, some gr sh
		Gr sh			Coal
250			340		

Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
350		Gr-br vfg ss, some gr sh	440		
360		Gr sh Gr-br vfg ss Gr-or vfg carb ss Gr sh Gr-br vfg carb ss	450		Gr sh Coal Bony coal Coal
370			460		
380		Med br carb sh	470		Lt.-med gr vfg stp ss + gr sh
390		Gr-or vfg carb ss	480		Lt gr to gr-or vfg stp ss
400		Gr sh	490		
410		Br to dk gr carb sh Lt-med gr vfg ss	500		TD hole
420		Gr sh Gr-or vfg stp ss			
430					

Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
0		Topsoil, med gr carb sh, y-br + lt gr vfg stp ss	90		Coal Black carb sh
10		Tan vfg stp carb ss	100		Lt gr-tan vfg stp ss
20		Dk br-bl carb sh Y-br mdst	110		Dk-med gr carb sh
30		Lt gr sh, bl = dk br carb sh Or-tan vfg stp ss, lt gr-Hbr sh	120		Lt tan-gr vfg stp carb ss, occasional lens med dk gr sh
40		Tan vfg stp carb ss, some dk gr carb sh	130		
50			140		
60		Dk gr carb sh Lt y-br vfg stp carb ss + y-wh vfg ss Coal; bony Dk gr sh	150		
70		Lt y-br vfg stp carb ss + y-wh vfg ss Black carb sh	160		Gr to lt br vfg stp ss, black carb sh, + med-dk gray sh
80					



























Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
170			260		
180			270		
190		Med gr. vfg carb ss	280		Med gr-bk vfg stp carb ss, dk gr-bl carb sh
200		Med gr sh, some bl carb sh	290		
210		Lt gr vfg stp carb ss, some dk gr sh	300		Lt gr vfg stp ss
220		Med gr-bl carb sh, med gr vfg stp carb ss	310		
230			320		
240		Y-br bgr vfg stp carb ss	330		Dk gr carb sh
250		Dk gr carb sh	340		Coal
		Lt tan. vfg stp carb ss			Lt gr vfg stp carb ss

Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
		Dk gr carb sh			Lt gr vfg stp carb ss + coal, dk br carb sh
		Med gr vfg carb ss			
350		Bony coal	440		Lt gr - Lt br vfg stp ss, some med gr sh
		Dk gr carb sh			
360		Med gr vfg carb ss, some y-br vfg stp ss	450		Med gr vfg stp carb ss, dk gr carb sh
		Dk gr carb sh			
370		Coal, bony at base?	460		
380			470		
		Geophysical logs end at 394.5'; remainder compiled only from sample log			
390		Med gr vfg stp ss, dk gr-bl carb sh	480		Med gr vfg stp carb ss
		Med gr vfg ss			
400		Coal	490		Med gr vfg stp carb ss, dk gr-bl carb sh
410		Med gr vfg ss	500		J.D. hole
		Lt gr vfg stp carb ss			
420		Lt gr vfg stp carb ss + some med gr carb sh			
430					

D-16-NG

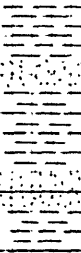
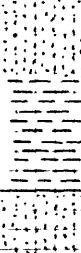
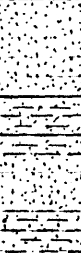

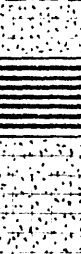
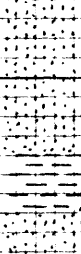
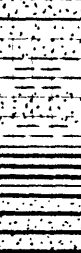
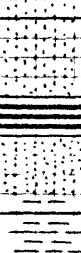
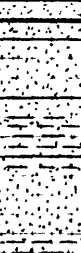
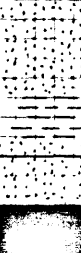

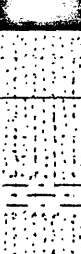
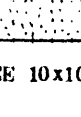
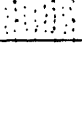
DEPTH (ft.)	LITHOLOGY	Description	DEPTH (ft.)	LITHOLOGY	Description
		Wkd. tan-or to gray-br. fg. ss.			
10			90		DK gray carb. sh.
		Brown siltst.			
20			100		Brick red vfg. ss.
		Lt. orange to gr-white vfg. ss, some gr. sh.			DK gray carb. sh.
30			110		Coal
					DK gray carb. sh.
40		Brick red vfg. ss grading down to gr-orange vfg. ss.	120		
					Med gray vfg. stp carb. ss.
50			130		
60			140		
70			150		Boxy (?) coal.
					Lt. gray vfg. stp. ss.
80			160		Med. gray siltst.

D-16-NG cont.

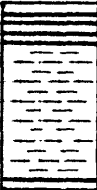
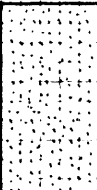




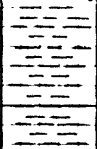








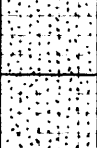
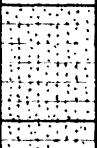
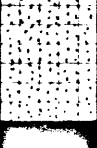
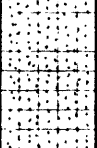
Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
170		Med. gray siltst	260		Med gr. vfg. stp ss
		Lt gray vfg stp ss			
180		Gray siltst	270		Gr-br carb siltst, some med gr. vfg stp ss
190		Lt gray vfg stp ss	280		
200		Lt gray vfg stp ss, some br siltst	290		Lt gr vfg stp ss
210		OK gr carb sh	300		
		OK gr siltst			
220		Lt gray vfg stp ss	310		
230		Coal	320		Coal
		Gr-br carb sh			
240		Coal	330		Br gr vfg stp ss
		Gr sh + br carb sh			
250		Coal	340		OK gr-br carb sh

Depth (ft)	Lithology	Description	Depth (feet)	Lithology	Description
					"
350			440		Gray siltst
		Br-gray to lg rfg. s+p ss			
360			450		
					Lt. gray vfg s+p ss
370			460		
380			470		
390			480		Dk gray carb siltst, br carb sh, lt gray vfg s+p ss
		Coal, some bony?			
400			490		Coal
		Br-bl carb sh			Brown carb sh
					Coal
410		Coal, some bony?	500		Brown carb sh
					Coal
420		Brown carb sh, gr siltst	510		lt gray vfg s+p ss, brown carb sh
430		lt gray vfg s+p ss	520		TD hole

D-17-NG

DEPTH (ft.)	LITHOLOGY	DESCRIPTION	DEPTH (ft.)	LITHOLOGY	DESCRIPTION
10		Lt. gray to or sh, some y-br vfg stp ss	90		Yellowish-gray vfg stp ss grading to red-br at base, some med gr sh
20		Y-br vfg stp ss	100		
30		Lt. gr-br sandy sh + y-br vfg stp ss	110		
40		DK brown carb sh	120		
50		Pale yellow vfg ss	130		Gr-br carb sh
60		Ss as above, some gray to y-br sh	140		Gr-br vfg stp ss, some med gr sh
70		DK gray to black carb sh	150		Coal
80		DK gray sandy carb sh	160		Or-br to brownish-white vfg ss w/ occasional red-br siltst
		Y-br vfg stp ss			
		Med. gray sandy sh + vfg ss			
		Coal			

DEPTH (ft.)	LITHOLOGY	DESCRIPTION	DEPTH (ft.)	LITHOLOGY	DESCRIPTION
170			250	Coal	
				Carb sh	
180			260	Ss	
				Carb ss	
190			270		
				Barry (?) coal	
200			280	Ss	
			290		
210					
		DK brown vfg carb ss	300	Sh	
220				Ss	
		Or-br vfg ss	310		
230				Sh + some carb sh	
			320		
240		Circulation lost at 240' no samples afterward. Remainder interpreted from electric logs			

DEPTH (ft.)	LITHOLOGY	DESCRIPTION	DEPTH (ft.)	LITHOLOGY	DESCRIPTION
330		sh + some carb sh	410		
340		Coal	420		ss
350		sh	430		
360		Coal	440		
		Carb sh			
370		Coal	450		
		sh	460		Coal
380			470		
390		ss	480		sh
400					

DEPTH (ft.)				LITHOLOGY				DESCRIPTION			

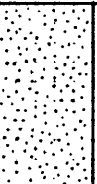

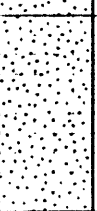




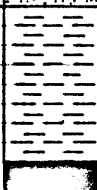
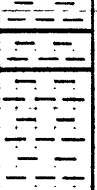
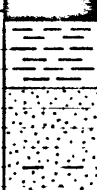
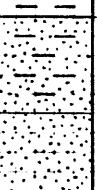

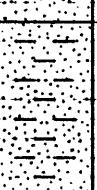
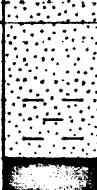
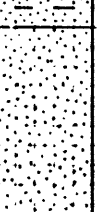
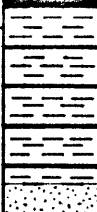

Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
10		Med gr sh + gr. to y-br vfg stp ss	100		Gr vfg carb ss + dk gr carb sh
20		Gr + y-br vfg stp ss	110		
30		Med gr sh	120		Coal
40		Y-br vfg stp ss	130		
50		Med gr sh + y-br vfg stp ss	140		Gr-br to med gr vfg stp ss, some lenses of med- dk gr carb sh
60		Med gr sh + bl carb sh	150		
70		Gr + y-br vfg stp ss, some carb ss	160		
80		Coal	170		
90		DK gray carb sh	180		
		Bony? coal			
		DK gr carb sh			
		Med gr vfg stp ss + med gr to bl carb sh			
		Med to dk gr carb sh			

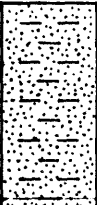




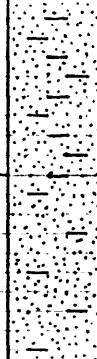
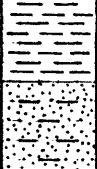
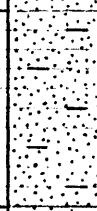


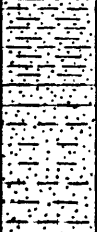
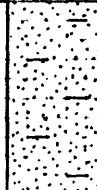
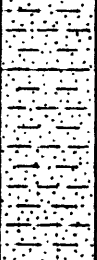

Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
190		Coal	280		Coal
		Dk gr vfg ssp ss, some dk gr carb sh	290		Br to med gr vfg ss, carb at top
200		Coal	300		Coal
		Dk gr to bl carb sh + gr-br vfg ssp ss	310		Dk br vfg carb ss
210		Lt gr to med br vfg ssp ss, becomes carb ss at base	320		Dk gr carb sh
220		Coal, bony in top 2 feet?	330		Med gr to gr-br vfg ssp carb ss
230			340		Dk gr to bl carb sh, some gr-br vfg carb ss
240		Med gr to br vfg ssp ss	350		Dk br to lt gr vfg ss, carb at top
250			360		
260		Coal			Coal
		Br to med gr vfg ss, carb at top			Dk br to med gr vfg ssp ss, carb at top + base
270					

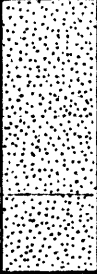
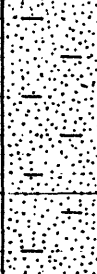


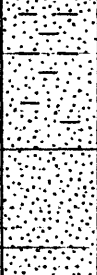







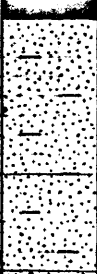

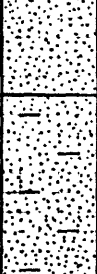

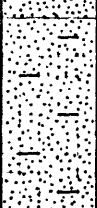


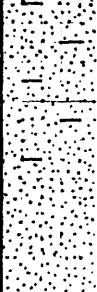
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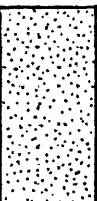





Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
370			450		Med gr-br vfg. stp carb ss
380			470		Lt gr vfg stp ss
390			480		
400		Dk gr to bl carb sh	490		
		Coal	500		
		Med gr-br vfg carb ss, some gr sh	510		Coal
		Coal	520		Dk br vfg stp carb ss + med gr-br vfg stp ss
410			530		Coal
420		Br to lt gr vfg stp ss, carb at top	540		Med-dk br vfg carb ss
430					
440					
450					

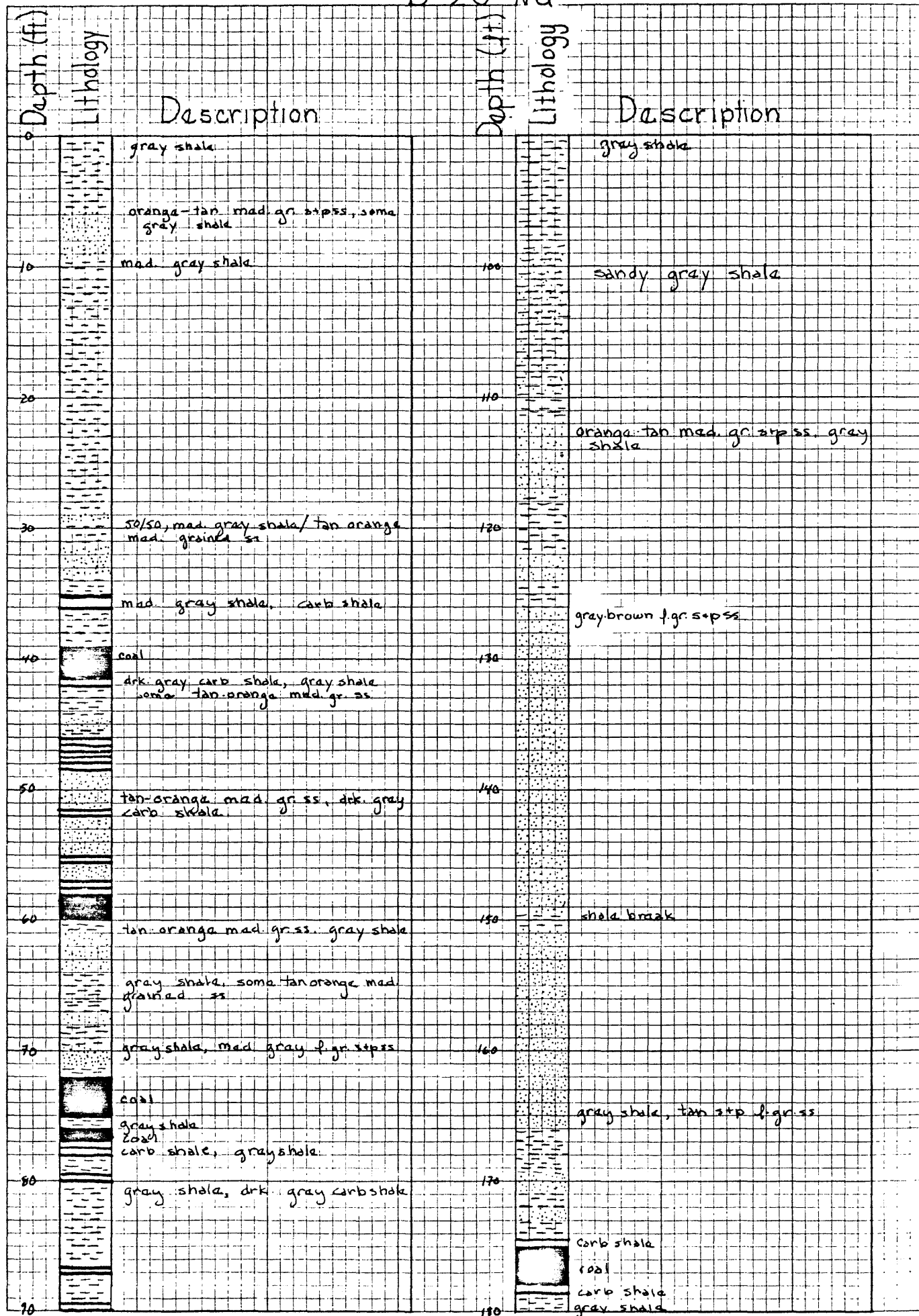
D-19-NG

Depth (ft.)	Lithology	Description	Depth (ft.)	Lithology	Description
10		ORANGE VERY FINE-GRAINED SANDSTONE (SOME WEATHERED AND TANNISH-ORANGE SS)	90		MEDIUM GREY SILTSTONE WITH SOME COAL? AND CARB. SHALE
20		SS. AS ABOVE * SOME LIGHT GREY SHALE	100		LIGHT GREY VERY FINE-GRAINED SALT + PEPPER SANDSTONE WITH SOME MEDIUM GREY SHALE
30		COAL	110		MEDIUM GREY SHALE AND SOME LIGHT GREY SALT + PEPPER SANDSTONE
40		LIGHT TO MEDIUM GREY SHALE WITH SOME GREY CARB. SHALE	120		YELLOWISH + LIGHT GREY S+P CARB. S.S.
50		LIGHT GREY VERY FINE-GRAINED SILTY SANDSTONE AND LIGHT TO MEDIUM GREY SHALE	130		GREY AND MEDIUM GREY SHALE
60		LIGHT GREY VERY FINE-GRAINED SILTY SS.	140		COAL
70		LIGHT GREY VERY FINE-GRAINED SILTY SANDSTONE AND LIGHT TO MEDIUM GREY SHALE	150		MEDIUM GREY SHALE
		ORANGE AND TAN MEDIUM GRAINED SANDSTONE WITH SOME LIGHT GREY VERY FINE-GRAINED SILTY SANDSTONE (TO 86 FT.)			FINE AND VERY FINE GRAINED LIGHT GREY TO GREY SALT AND PEPPER SANDSTONE
					MEDIUM GRAINED FRIABLE SANDSTONE AND SOME MEDIUM GREY SHALE
					COAL
					LIGHT AND MEDIUM GREY SHALE AND CARB. SHALE
					TAN AND ORANGE FINE-GRAINED SANDSTONE

DEPTH (ft.)	LITHOLOGY	DESCRIPTION	DEPTH (ft.)	LITHOLOGY	DESCRIPTION
170		TAN AND ORANGE FINE-GRAINED SANDSTONE AND SOME MEDIUM GREY SHALE	250		COAL
180		MEDIUM GREY SHALE AND SOME FINE-GRAINED TAN-ORANGE SS.	260		MEDIUM GREY SHALE
190		COAL	270		COAL
200		MEDIUM GREY SHALE	280		FINE-GRAINED GREY-BROWN SANDSTONE AND SOME MEDIUM GREY SHALE
210		COAL	290		FINE-GRAINED GREY-BROWN SOMETIMES FRIABLE SANDSTONE AND MINOR MEDIUM GREY SHALE
220		MEDIUM GREY SHALE AND SOME LIGHT GREY FINE-GRAINED SANDSTONE	300		
230		LIGHT GREY FINE-GRAINED SALT + PEPPER SANDSTONE AND SOME MEDIUM GREY SHALE (TO 243 FT.)	310		COAL

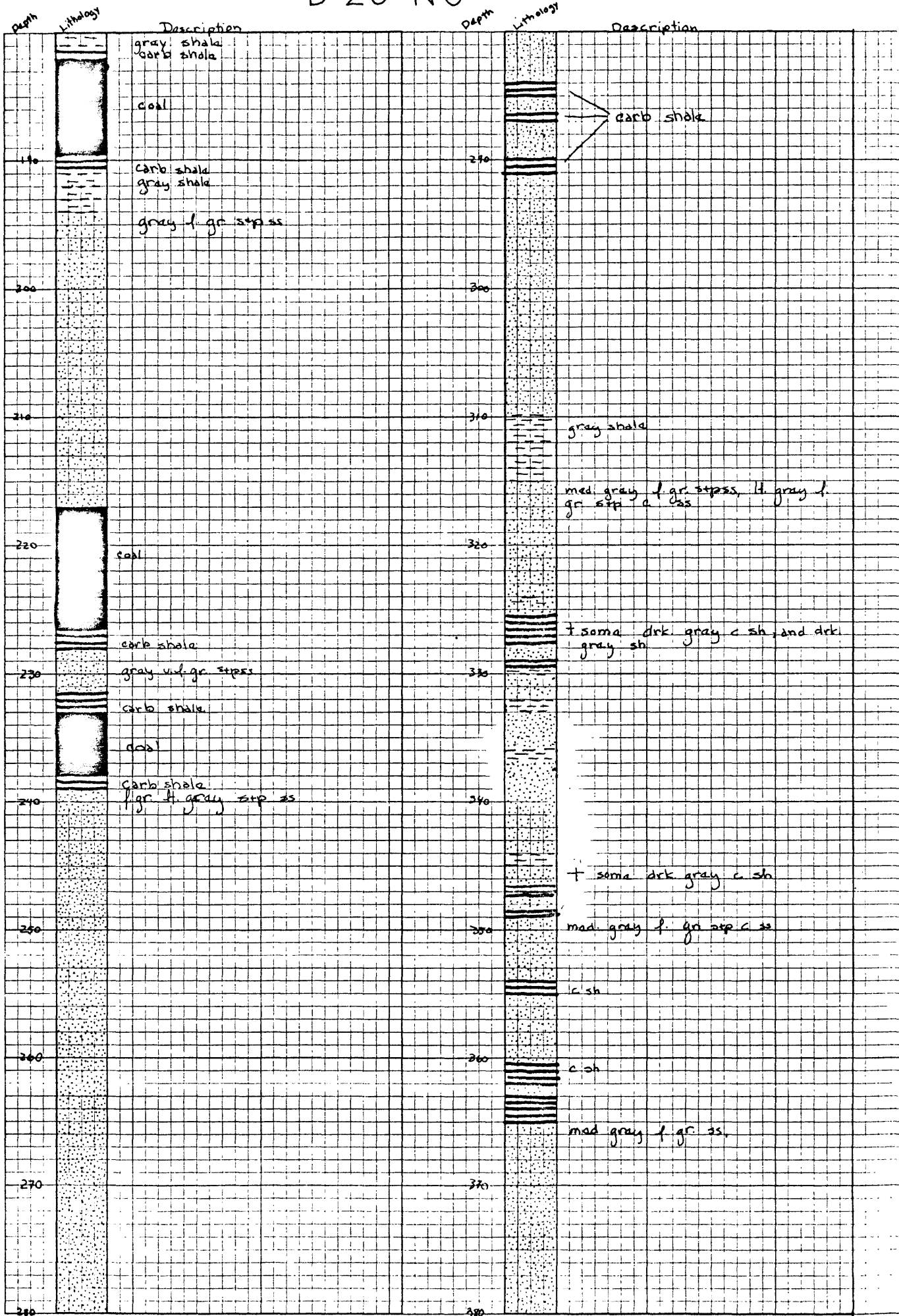
DEPTH (ft.)	LITHOLOGY	DESCRIPTION	DEPTH (ft.)	LITHOLOGY	DESCRIPTION
330		MEDIUM-GREY VERY FINE-GRAINED SANDSTONE	410		GREY BROWN VERY FINE-GRAINED SANDSTONE AND MINOR GREY SHALE
340		COAL	420		COAL
350		MEDIUM GREY VERY FINE-GRAINED SANDSTONE AND SOME GREY SHALE	430		GREY BROWN FINE-GRAINED SS. + GREY SHALE
360		LIGHT GREY AND BROWN VERY FINE GRAINED SALT AND PEPPER SANDSTONE	440		COAL
370		GREY SHALE	450		GREY BROWN FINE-GRAINED SANDSTONE AND MINOR GREY SHALE
380		COAL	460		COAL
390		LIGHT BROWN VERY FINE-GRAINED SANDSTONE + MINOR GREY SHALE	470		GREY BROWN FINE-GRAINED SS. + MINOR GREY SH.
		GREY-BROWN VERY FINE-GRAINED SS.			BONE COAL
		GREY BROWN VERY FINE-GRAINED SANDSTONE AND MINOR GREY SHALE			GRAY SHALE
					SHIT COAL
					GREY BROWN FINE-GRAINED SANDSTONE AND MINOR GRAY SHALE

DEPTH (ft.)	LITHOLOGY	DESCRIPTION							
490		GREY BROWN FINE-GRAINED SANDSTONE							
500		COAL							
510		GREY BROWN FINE-GRAINED SANDSTONE + TRACE GREY SHALE							
		COAL							
		← ELECTRIC LOGGED TO 515'							
520		COAL AND GREY BROWN FINE-GRAINED SANDSTONE							
		TD = 520'							
530									



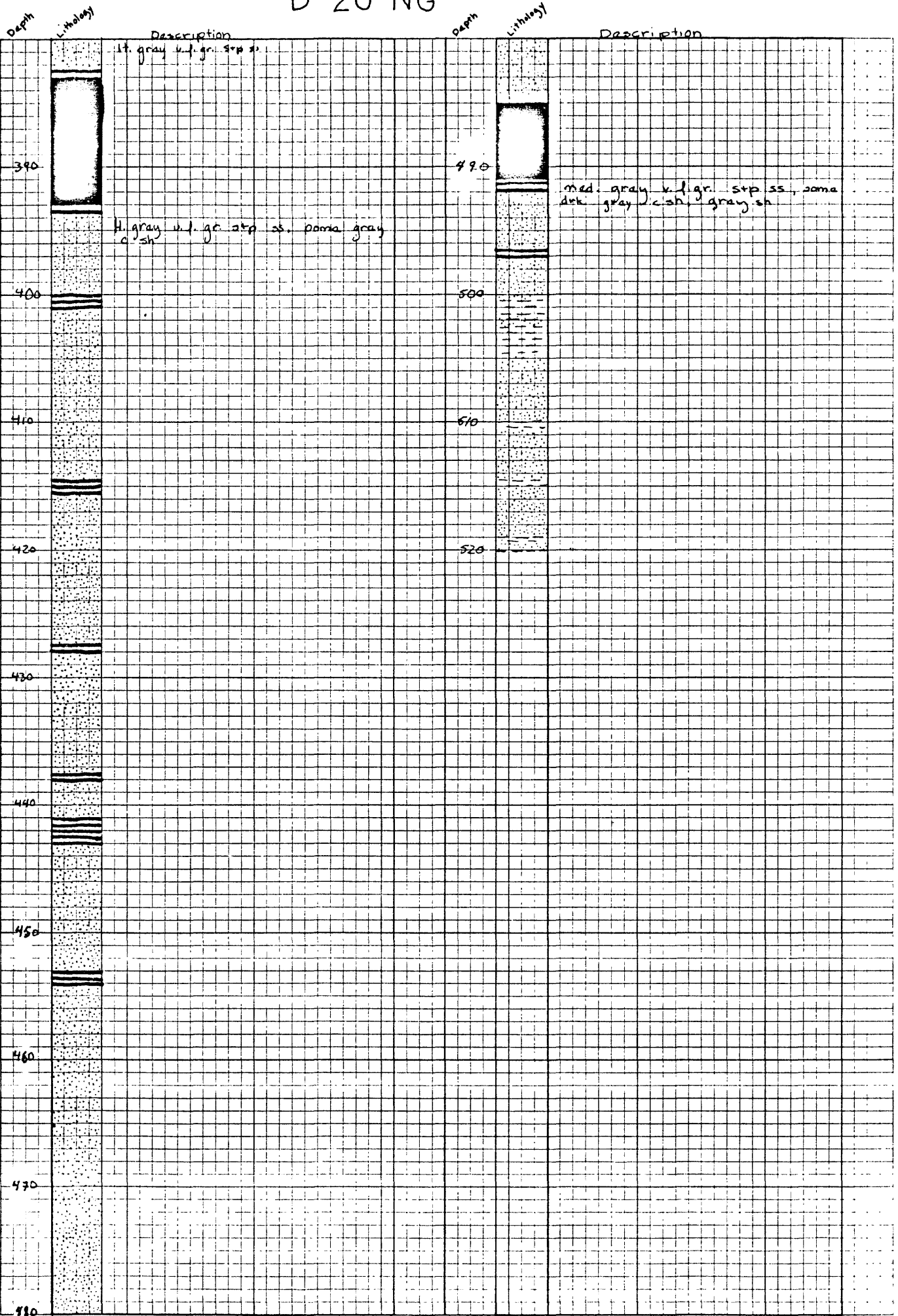
46 0702

 10 X 10 TO THE INCH • 7 X 10 INCHES
 KEUFFEL & ESSER CO. MADE IN U.S.A.



46 0702

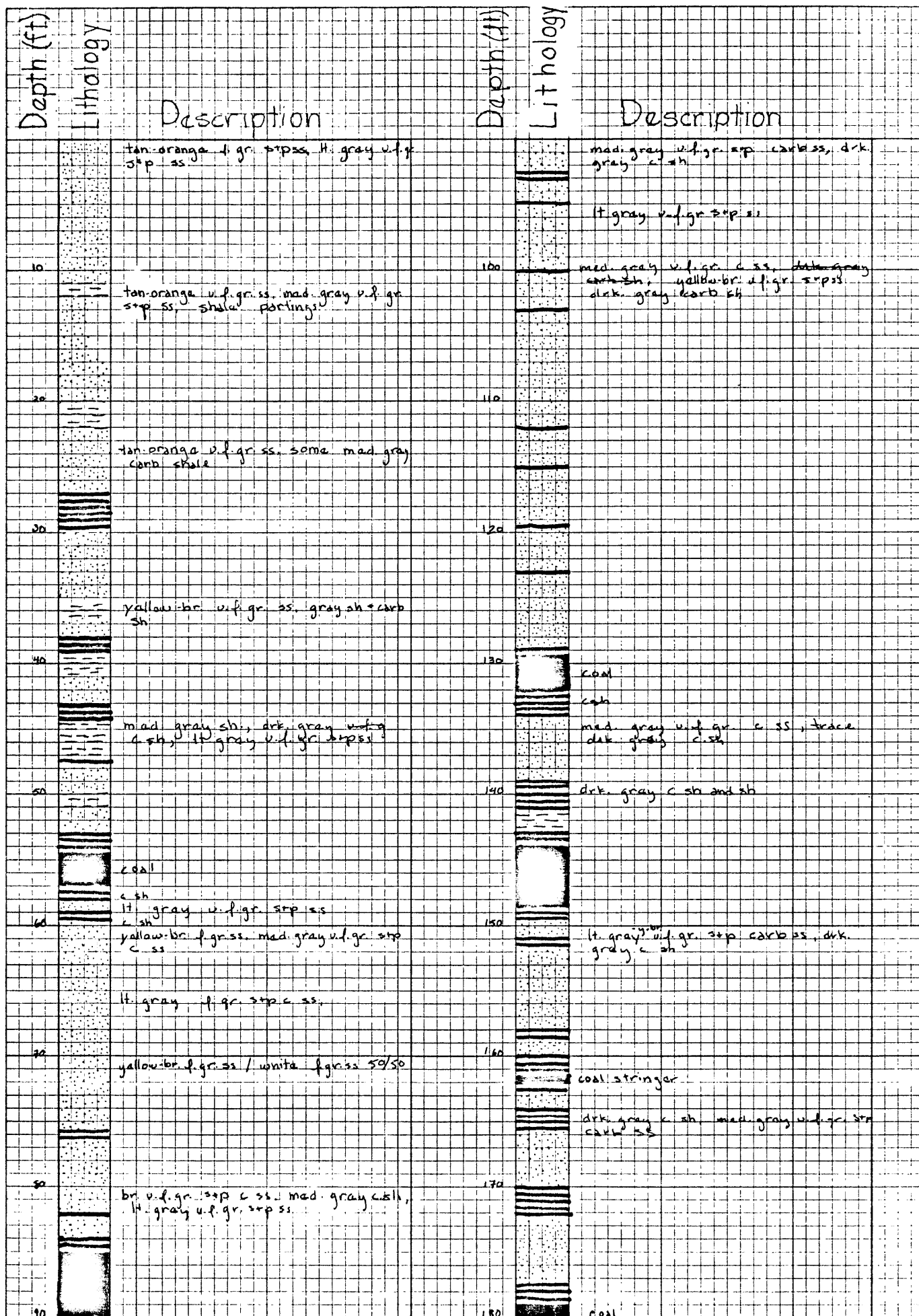
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LITHOLOGIC Log D-21-NG

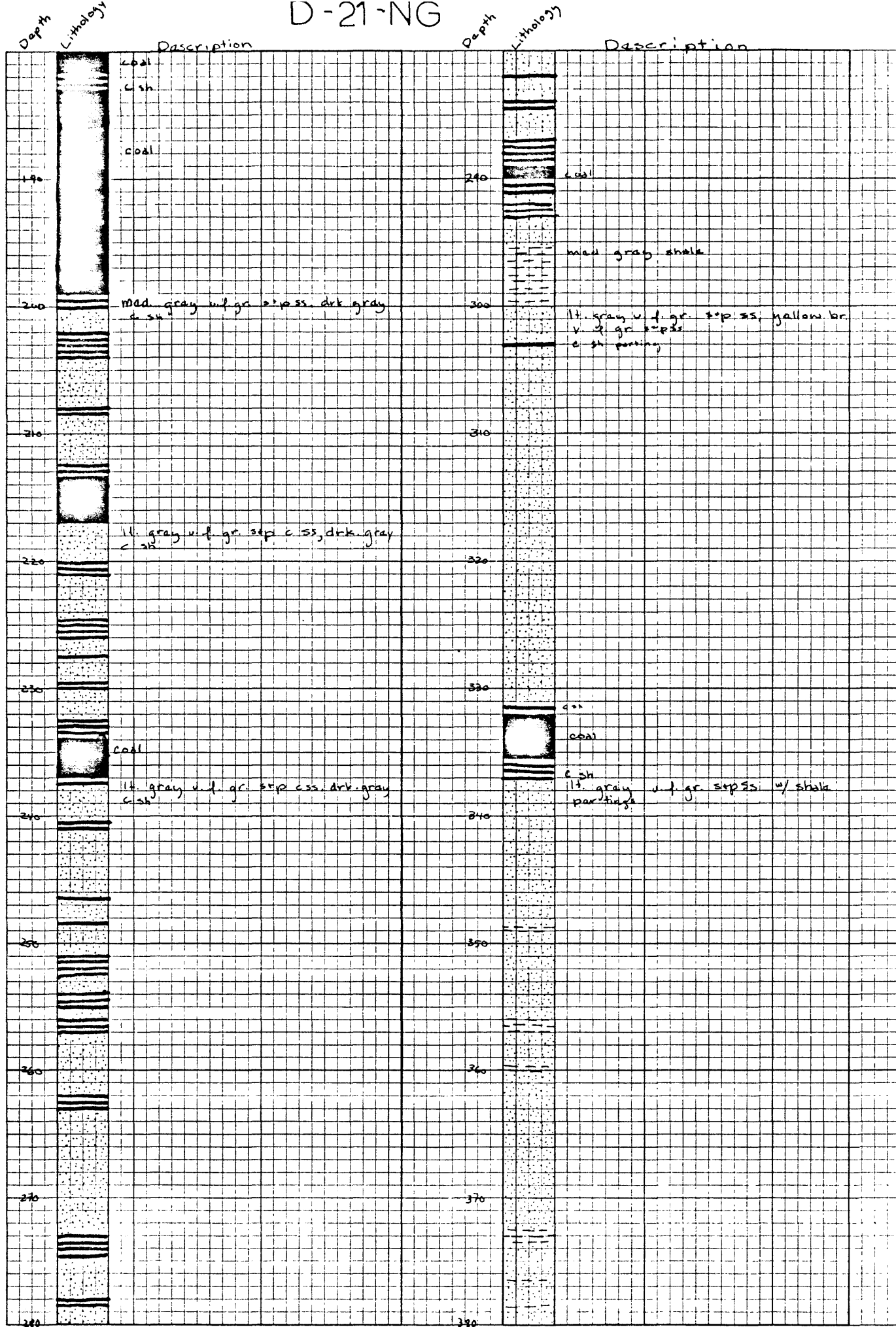


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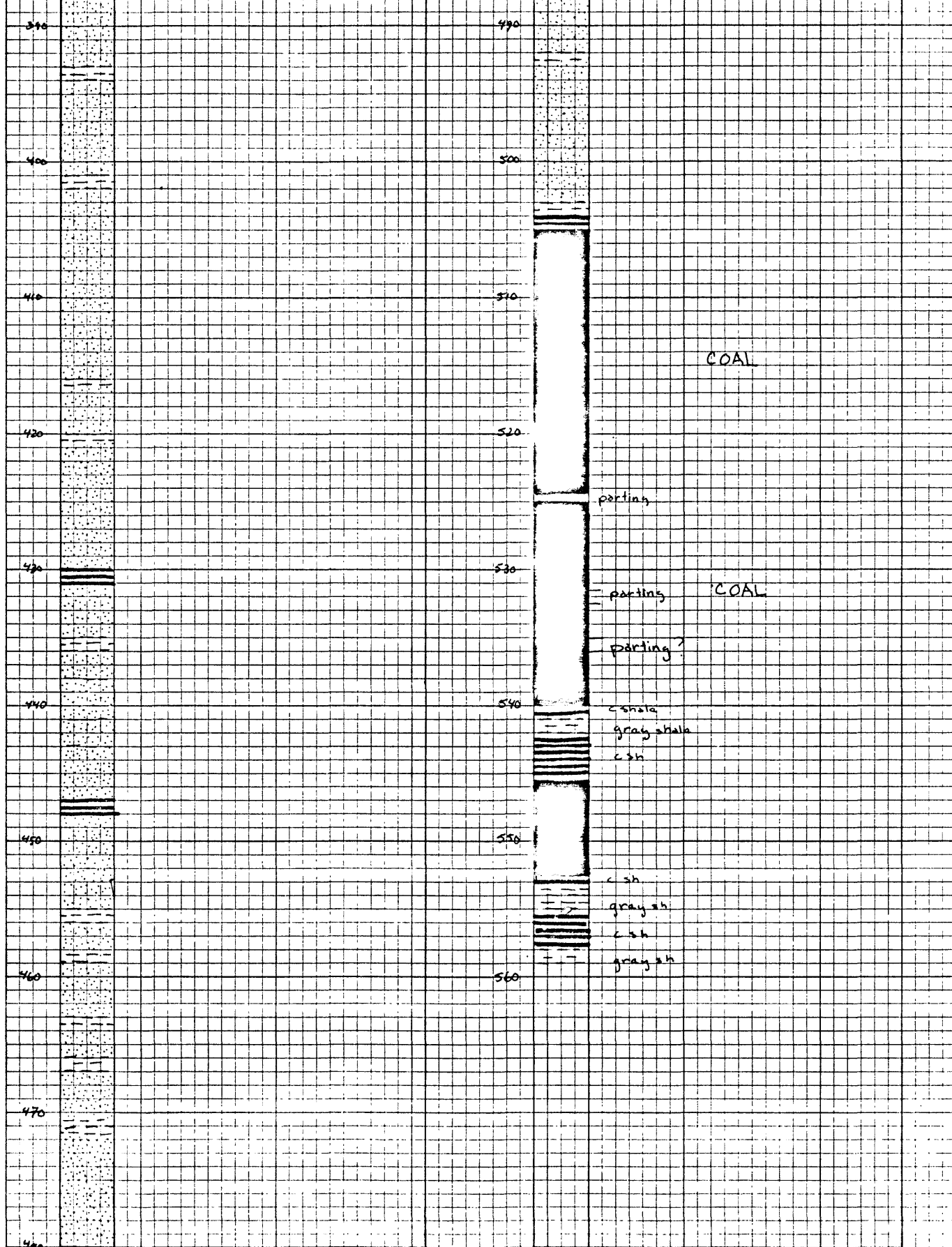
Depth Lithology

D-21-NG

Depth Lithology

Description

lf. gray v. f. gr. dip. ss (some is w. bariticous) with shala partings and c. sh partings (ss is sometimes yellow-br. or med. gray).

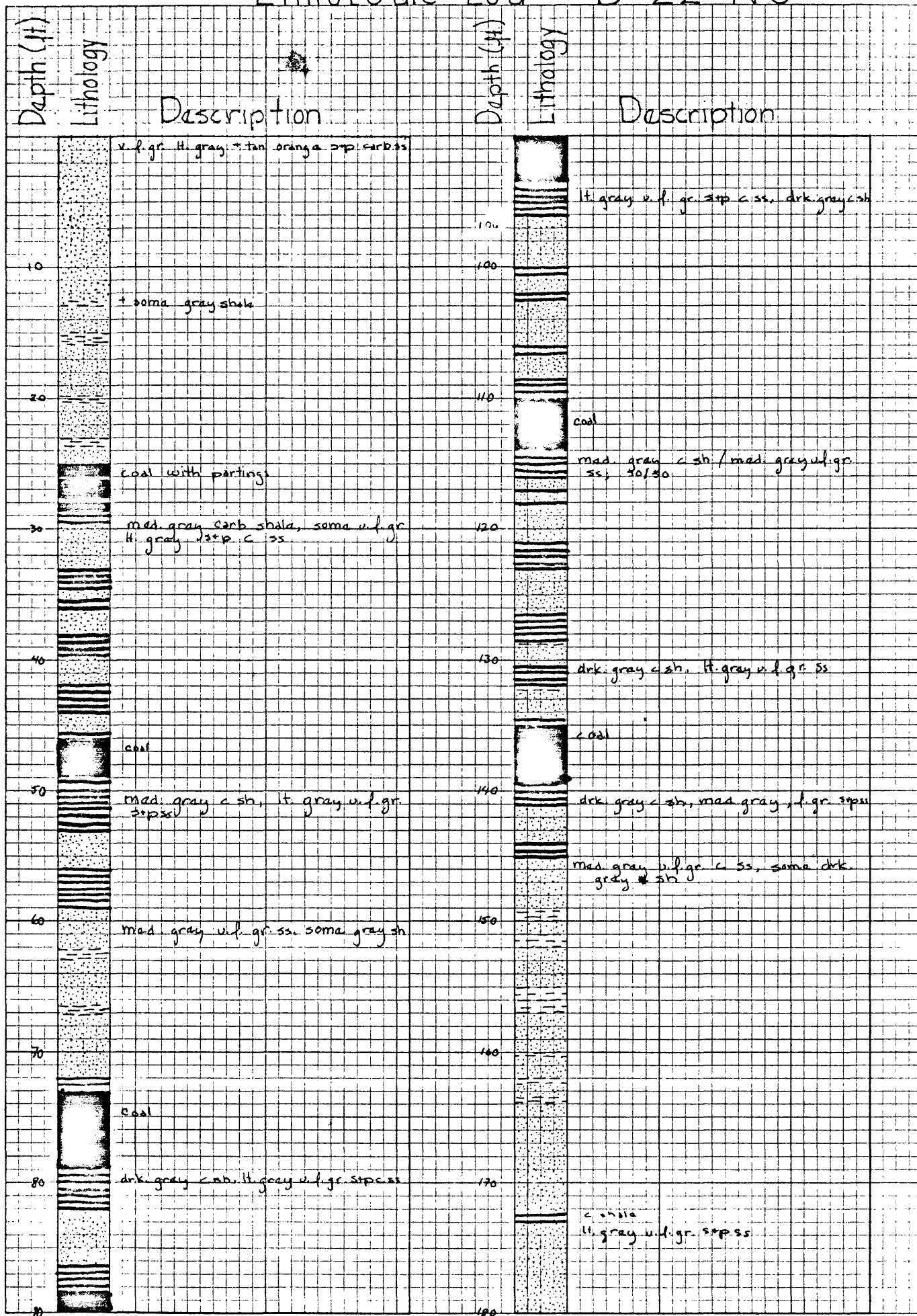


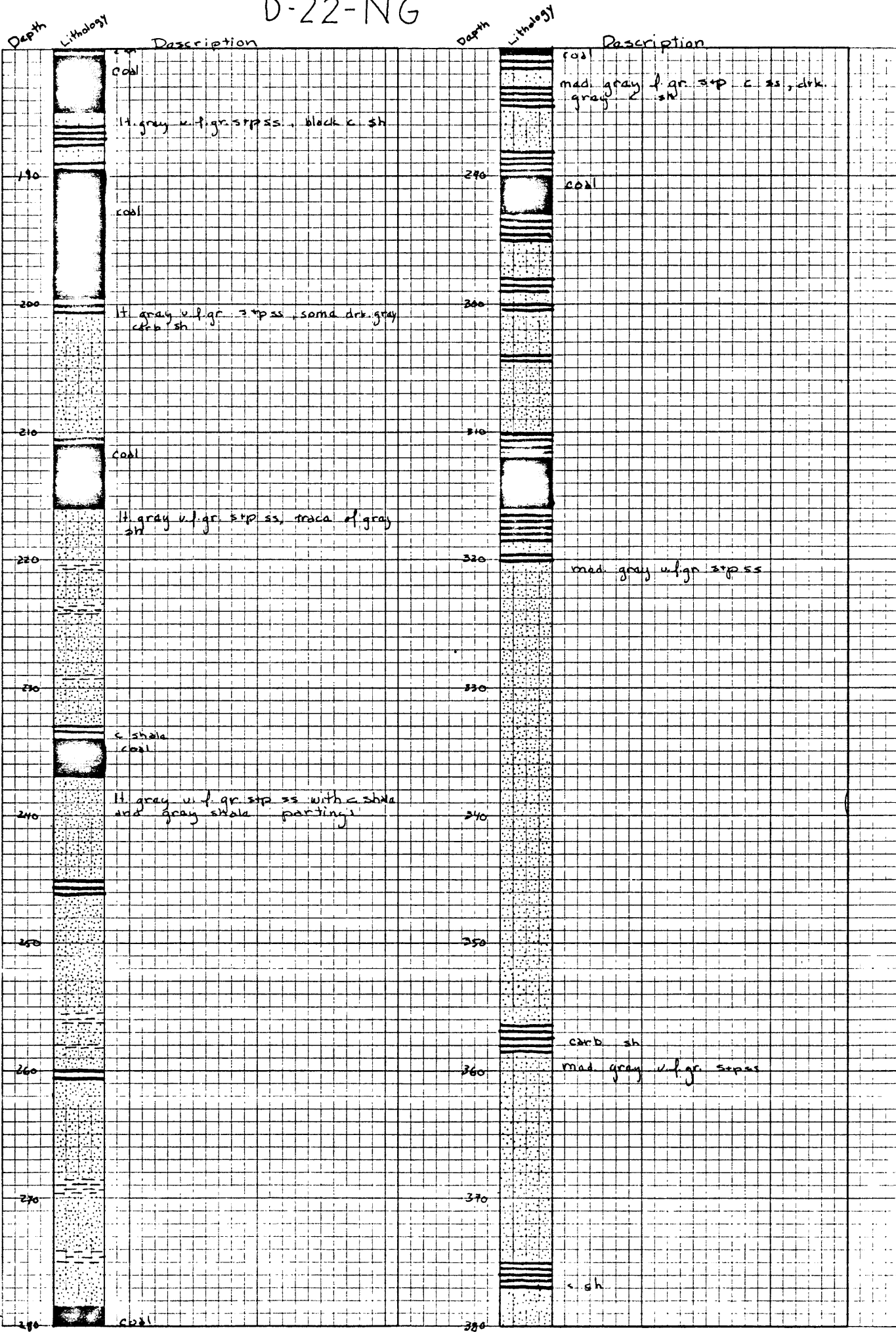
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LITHOLOGIC LOG D-22-NG

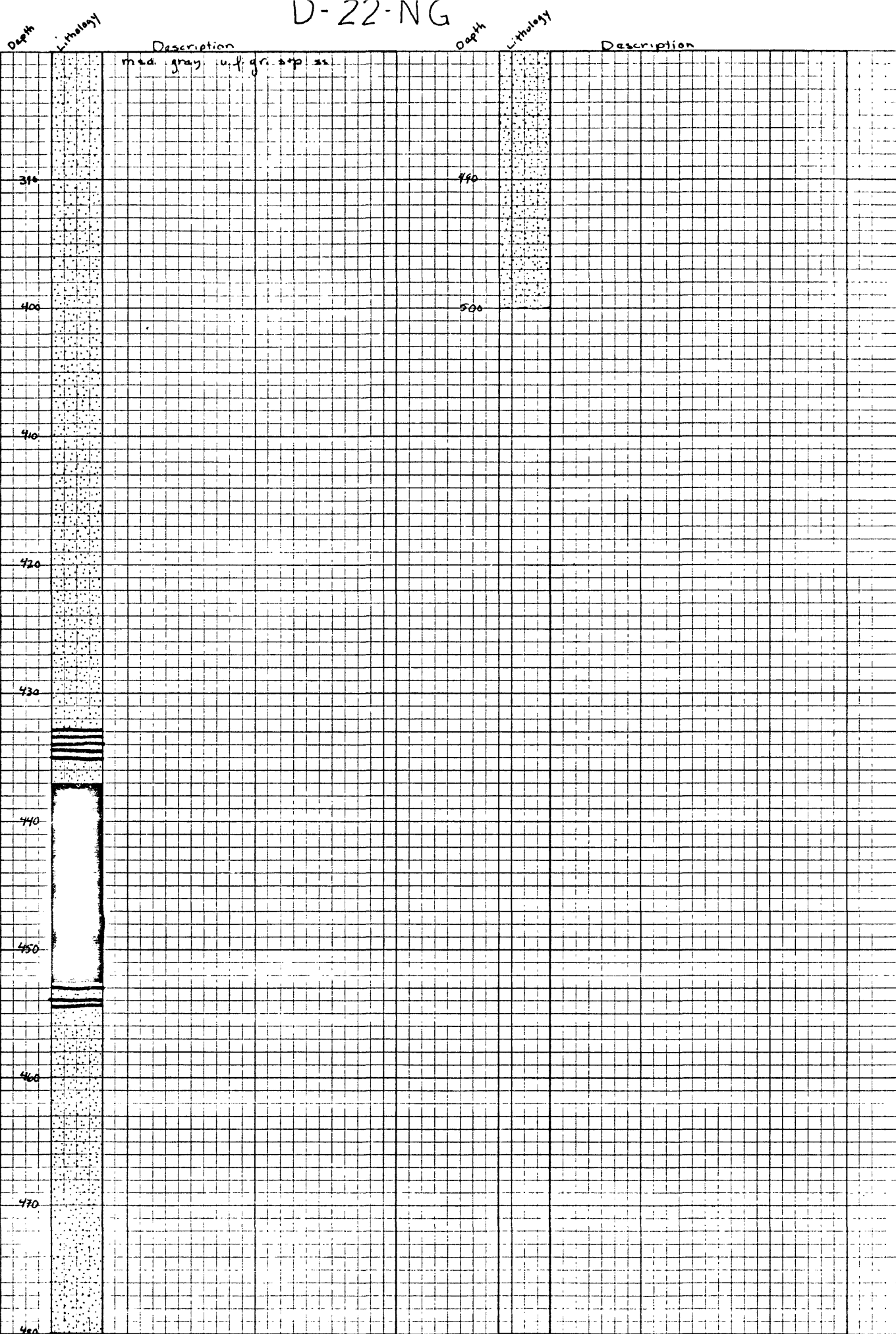




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10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

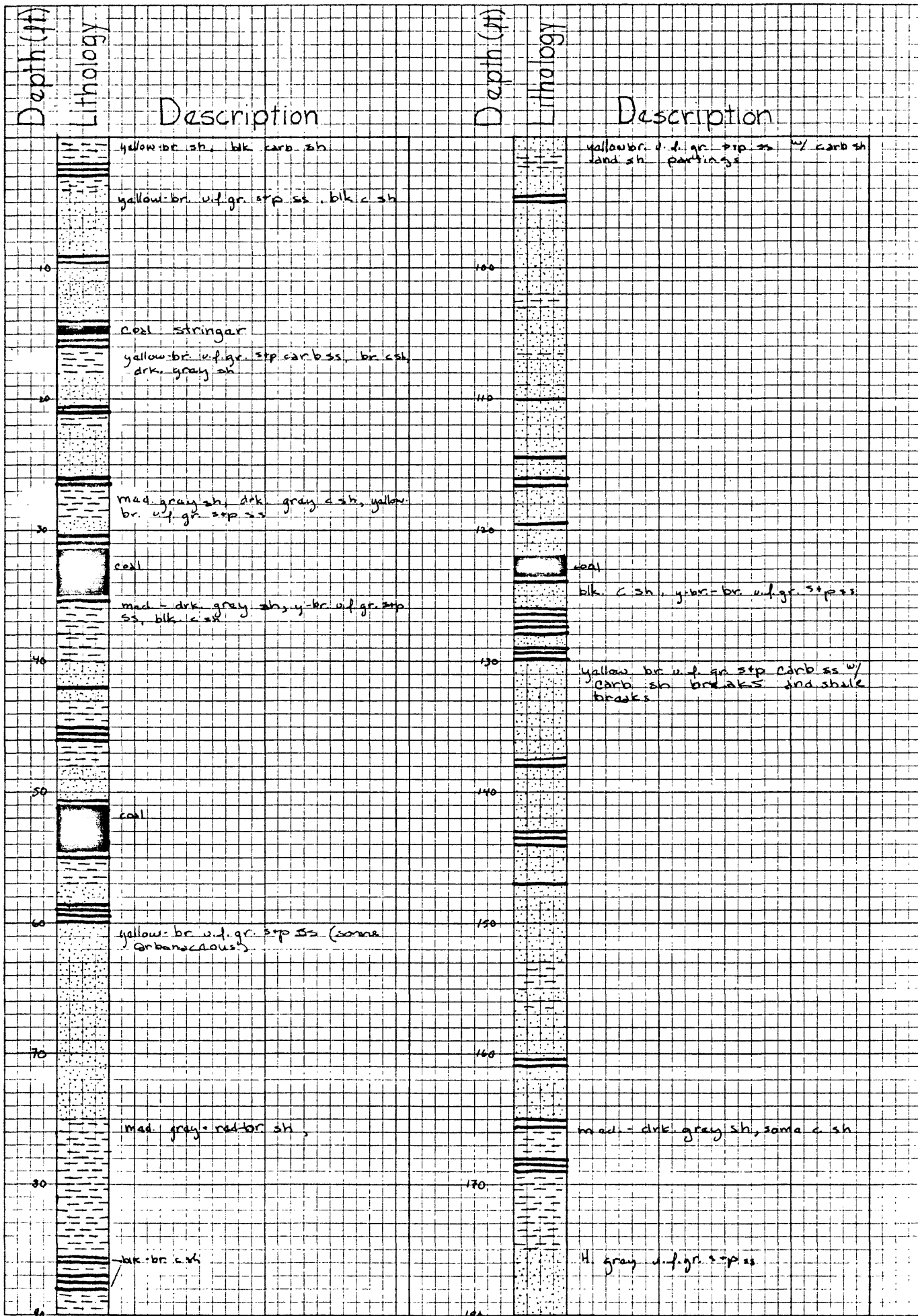
D-22-NG



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10 X 10 TO THE INCH • 7 X 10 INCHES
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LITHOLOGIC LOG D-23-NG

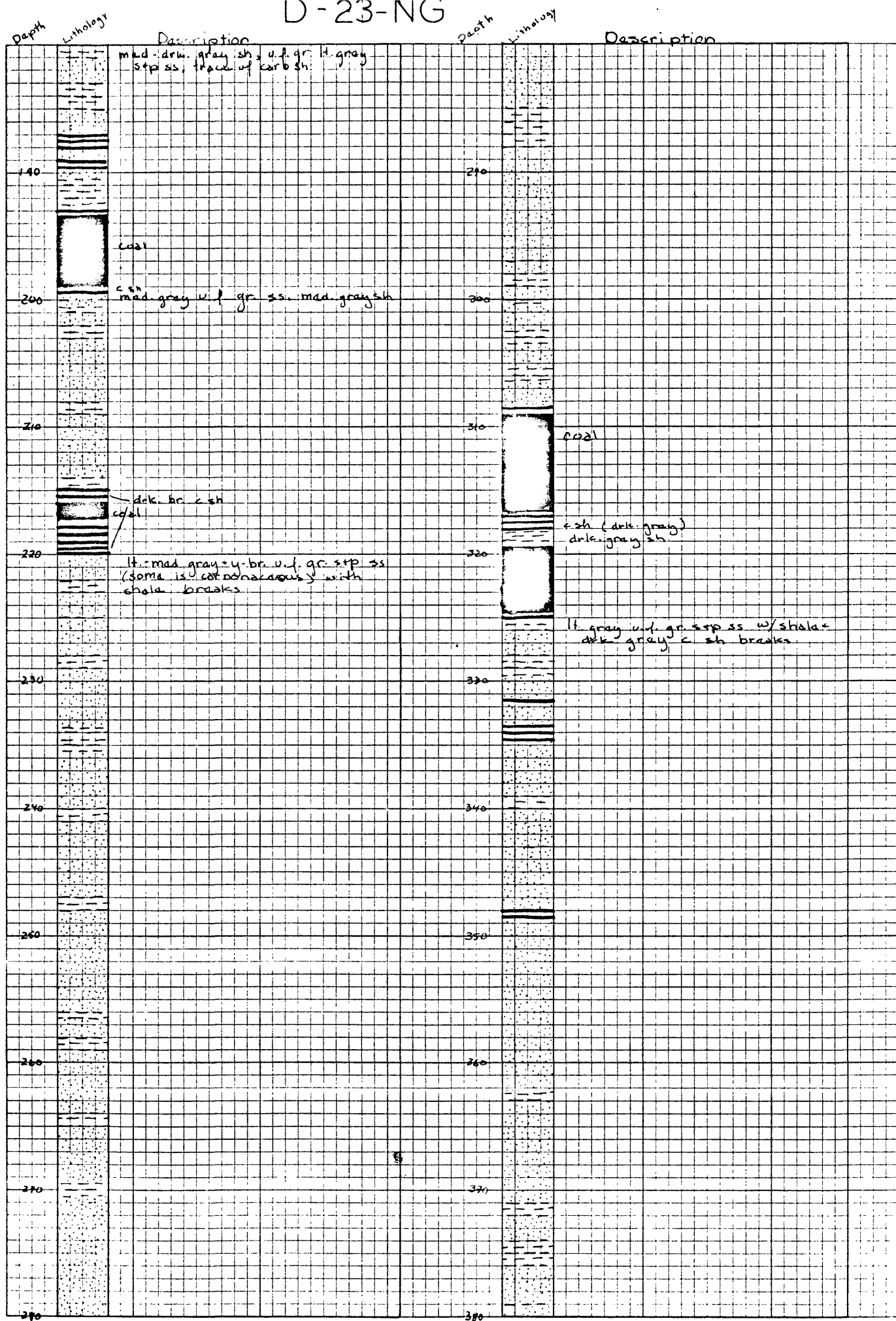


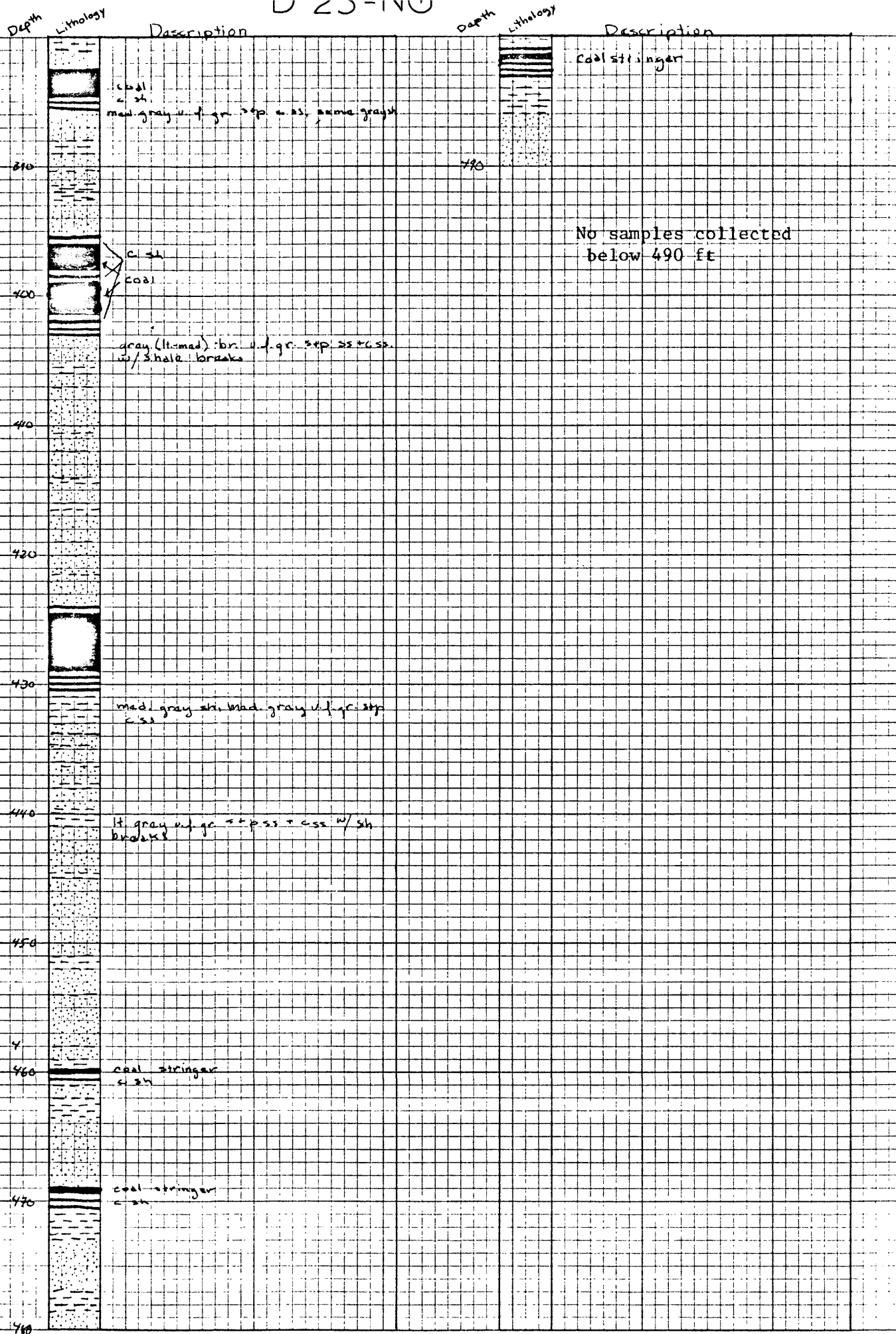
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10 X 10 TO THE INCH • 7 X 10 INCHES
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46 0702

10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.



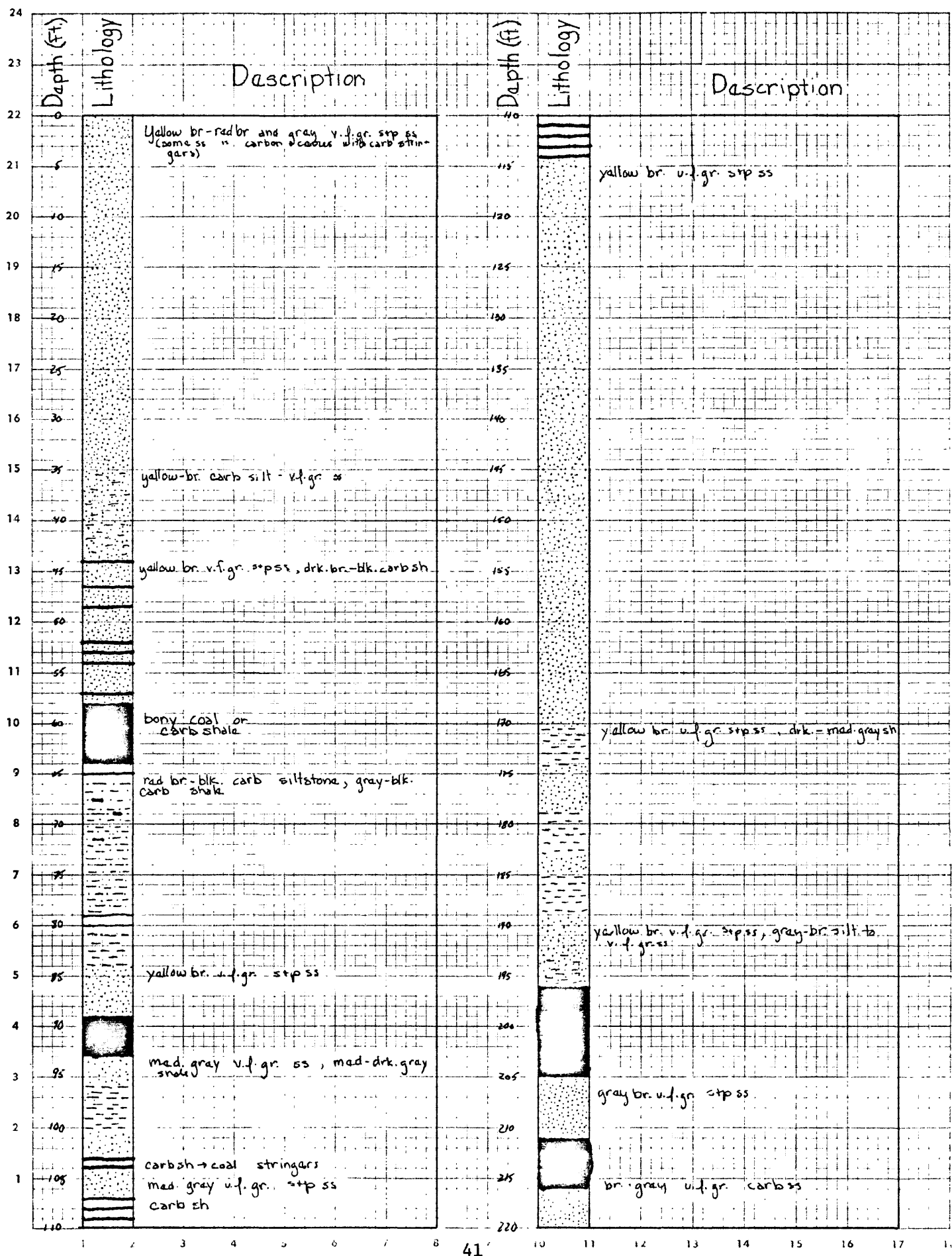


46 0702

10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

LITHOLOGIC LOG

D-24-NG



DEPTH (ft.)	LITHOLOGY	DESCRIPTION	DEPTH (ft.)	LITHOLOGY	DESCRIPTION
10		YELLOW AND LIGHT GREY VERY FINE-GRAINED SANDSTONE AND SOME LIGHT GREY SHALE	90		COAL AND LIGHT GREY VERY FINE-GRAINED SANDSTONE (HIGH DENSITY, LOW NATURAL GAMMA)
20		COAL	100		YELLOW VERY FINE-GRAINED S&P SS AND SOME MEDIUM GREY SHALE
30		GREY VERY FINE-GRAINED SANDSTONE AND SOME YELLOW-BROWN SHALE	110		MEDIUM GREY SHALE SOME YELLOW-BROWN VERY FINE-GRAINED S&P SANDSTONE
40		LIGHT AND MEDIUM GREY SHALE SOME GREY VERY FINE-GRAINED SANDSTONE	120		YELLOW AND BROWN VERY FINE-GRAINED S&P SANDSTONE AND MINOR MEDIUM GREY SHALE
50		COAL AND BONE COAL	130		LIGHT GREY AND GREY SHALE
60		MEDIUM GREY VERY FINE-GRAINED SS, MINOR GREY SHALE	140		MEDIUM TO DARK GREY SHALE, MINOR SS
70		MULTI-COLORED VERY FINE-GRAINED SANDSTONE, MINOR GREY SHALE	150		SANDSTONE AND MINOR SHALE
					NO DESCRIBED SAMPLES BELOW 130' LITHOLOGY INTERPRETED FROM ELECTRIC LOG ONLY.

D-25-NG, CONT.

DEPTH (ft.)				LITHOLOGY				DESCRIPTION			
330				340				350			
360				370				380			
390				400				410			
420				430				440			
450				460				470			

DEPTH (ft.)		LITHOLOGY		DESCRIPTION	
490					
500					
510					
520					
530					
540					

Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
		DRILLING MUD, ORANGE MUD			WHITE FINE GRAINED SANDSTONE
10		DARK YELLOW-BROWN, VERY FINE GRAINED SALT + PEPPER SANDSTONE	90		LIGHT GRAY SHALE
		DARK GRAY-DARK BROWN CARB SHALE			DARK GRAY CARB SHALE
		YELLOW-BROWN, VERY FINE GRAINED SALT + PEPPER SANDSTONE			MED GRAY VERY FINE GRAINED SALT + PEPPER SANDSTONE
20		COAL	100		LIGHT GRAY SHALE
		MED-DARK GRAY SHALE			MED GRAY VERY FINE GRAINED SALT + PEPPER SANDSTONE
30		GRAY VERY FINE GRAINED SANDSTONE	110		MED GRAY SHALE
		BLACK CARB SHALE			MED GRAY VERY FINE GRAINED SANDSTONE
		MED. GRAY SANDY SHALE			COAL
		LIGHT GRAY + YELLOW BROWN VERY FINE GRAINED SALT + PEPPER SANDSTONE	120		MED GRAY TO DARK BROWN CARB SHALE
40		DARK GRAY SHALE SANDSTONE			GRAY VERY FINE GRAINED SALT + PEPPER SANDSTONE
		DARK GRAY CARB SHALE			MED GRAY TO DARK BROWN CARB SHALE
		LIGHT GRAY VERY FINE GRAINED SALT + PEPPER SANDSTONE	130		LIGHT GRAY VERY FINE GRAINED SALT + PEPPER SANDSTONE
50		GRAY BROWN CARB SHALE			MED GRAY SHALE
		LIGHT GRAY VERY FINE GRAINED SALT + PEPPER SANDSTONE	140		LIGHT GRAY VERY FINE GRAINED SALT + PEPPER SANDSTONE
60		DARK GRAY SHALE			MED GRAY SHALE
		MED GRAY VERY FINE GRAINED SALT + PEPPER SANDSTONE	150		LIGHT TO MED GRAY VERY FINE GRAINED CARB SS
70		COAL			DK BROWN TO BLACK CARB SHALE
		BAN VERY FINE GRAINED CARB SANDSTONE	160		

DEPTH (ft.)	LITHOLOGY	DESCRIPTION				DESCRIPTION			
170		MEDIUM GRAY VERY FINE-GRAINED SANDSTONE, SOME MEDIUM TO DARK GRAY & BROWN SHALE				250			
180		MEDIUM GRAY SHALE, SOME MEDIUM GRAY VERY FINE-GRAINED SANDSTONE				260	GRAY BROWN + MEDIUM GRAY VERY FINE-GRAINED SANDSTONE, MEDIUM GRAY SHALE, POSSIBLE STRINGERS OF CARB. SH + SS AND BONE COAL		
190		LIGHT GRAY VERY FINE-GRAINED SANDSTONE, & SOME LIGHT GRAY SHALE				270			
200		COAL				280			
210		BROWN VERY FINE-GRAINED CARB. SANDSTONE				290			
220		LIGHT YELLOW BROWN TO DARK YELLOW BROWN VERY FINE-GRAINED SALT & PEPPER SANDSTONE				300			
230		GRAY BROWN VERY FINE-GRAINED SALT & PEPPER SANDSTONE, MEDIUM TO DARK GRAY SHALE, POSSIBLE CARB. SHALE AND/OR BONE COAL STRINGERS				310			
							COAL + BONE COAL		
							MEDIUM TO DARK GRAY & BROWN VERY FINE-GRAINED SANDSTONE, MEDIUM GRAY SHALE		

DEPTH (ft.)	LITHOLOGY	DESCRIPTION	DEPTH (ft.)	LITHOLOGY	DESCRIPTION
330		MEDIUM GRAY VERY FINE-GRAINED SANDSTONE SOME DARK GRAY CARB SHALE, POSSIBLY MINOR CARB SANDSTONE	410		MEDIUM GRAY VERY FINE-GRAINED SALT & PEPPER SANDSTONE
340			420		
350		COAL	430		COAL
		MEDIUM GRAY VERY FINE-GRAINED SALT & PEPPER SANDSTONE			LIGHT GRAY VERY FINE-GRAINED S+P SANDSTONE, POSSIBLY MINOR CARB SS
360		COAL	440		COAL
					MEDIUM GRAY VERY FINE-GRAINED S+P SANDSTONE, SOME GRAY SHALE
370			450		MEDIUM GRAY VERY FINE-GRAINED SALT & PEPPER SANDSTONE
380		MEDIUM GRAY VERY FINE-GRAINED SALT & PEPPER SANDSTONE	460		
390			470		LIGHT TO MEDIUM GRAY FINE-GRAINED SANDSTONE SOME MEDIUM GRAY SHALE

LITHOLOGIC LOG D-27-NG

Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
		y-br. v.f. gr. ssp ss, some y-br. sh			y-br. - lt. gray v.f. gr. ss
10			100		med. gray sh
20			110		H. gray v.f. gr. ssp ss
30			120		dk. gray c. sh
40		coal	130		coal
50		ssh med. gray sh	140		y-br. v.f. gr. ss, br-med gray sh
60		y-br. - lt. gray v.f. gr. ssp ss gray - blk. c. sh.	150		y-br. v.f. gr. ssp ss
70		H. med. gray sh	160		
80		H. gray v.f. gr. ssp ss	170		med-dk. gr. sh
90		c. sh gray v.f. gr. ssp ss gray-br. sh - med. gray sh	180		coal
100		H. gray v.f. gr. ssp ss	190		H. gray sh. dk. gray c. sh
110		c. sh med. - dk. gray sh	200		y-br. v.f. gr. ssp ss
120		gray - y-br. v.f. gr. ssp ss	210		coal
130		br. c. sh	220		lt. gray sh
140		y-br. v.f. gr. ssp ss	230		y-br. v.f. gr. ss
150		H. med. gr. sh			
160		y-br. v.f. gr. ssp ss			

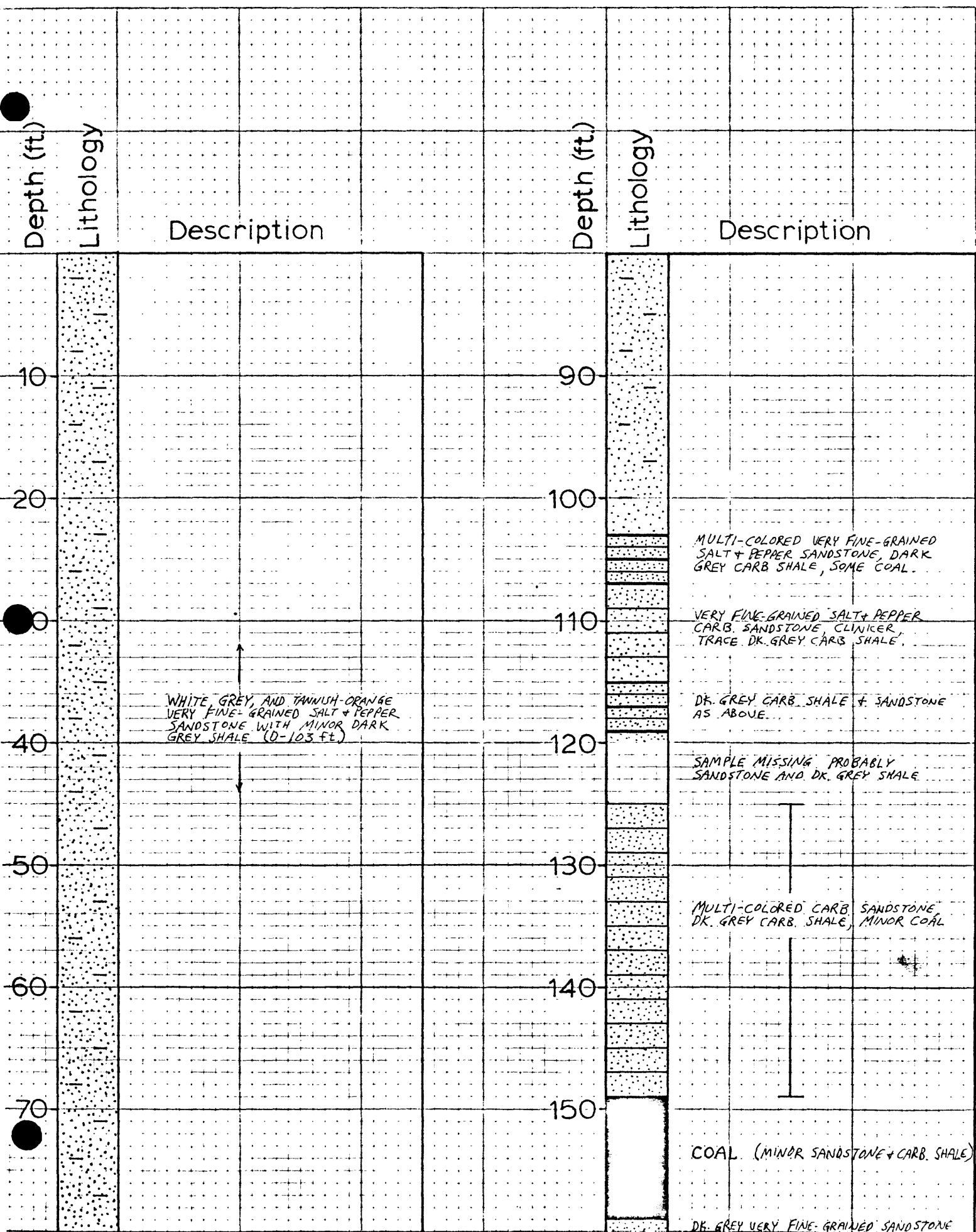
D-27-NG

Depth	Lithology	Description	Depth	Lithology	Description
180		y-br. v.f. gr. sp ss w/ gray sh breaks	290		gray v.f. gr. sp ss w/ sh breaks
200			300		y-br. v.f. gr. sp ss
210			310		lt. gray v.f. gr. sp ss, some c sh, trace d, sh
220			320		y-br. v.f. gr. sp ss w/ shaly or thin bedded breaks
230			330		
240			340		
250			350		
260			360		
270			370		
280			380		
			390		
			400		
			410		
			420		
			430		
			440		
			450		
			460		
			470		
			480		
			490		
			500		
			510		
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			870		
			880		
			890		
			900		
			910		
			920		
			930		
			940		
			950		
			960		
			970		
			980		
			990		
			1000		

Depth	Lithology	Description	Depth	Lithology	Description
		gray v.f. gr. carb ss w/ some shaly breaks			y-br. v.f. gr. spss w/ sh breaks
		y-br. v.f. gr. spss			carb stringer (coal?)
390			490		
400		Coal	500		
		lt gray + y-br. v.f. gr. sp ss, dark gray sh, drk. gray c sh			
		lt. gray v.f. gr. sp ss			
410					
420					
		gray-br. v.f. gr. spss, some gray sh			
430					
		lt gray v.f. gr. spss med-drk. gray sh			
440					
450					
		coal, drk br c sh			
460					
470		br. v.f. gr. spss			
		med.-lt. gray sh			
		yellow br. + gray v.f. gr. spss			
		carb stringers (coal?)			
480					

DEPTH (ft.)	LITHOLOGY	DESCRIPTION	DEPTH	LITHOLOGY	DESCRIPTION
10		LIGHT GRAY AND YELLOW-BROWN VERY FINE-GRAINED SALT + PEPPER SANDSTONE AND LIGHT BROWN AND TAN HARD SHALE	90		DARK GRAY CARB SHALE, MEDIUM GRAY VERY FINE-GRAINED SANDSTONE, SOME DARK GRAY SHALE
20		BROWNISH BLACK CARB SHALE SOME LIGHT GRAY VERY FINE-GRAINED SALT + PEPPER SANDSTONE	100		COAL
30		DARK BROWN CARB SHALE + CLAY	110		DARK GREY SHALE, MEDIUM GRAY VERY FINE-GRAINED SANDSTONE
40		MEDIUM GRAY VERY FINE-GRAINED SALT + PEPPER SANDSTONE	120		COAL
50		COAL	130		COAL
60		LIGHT GRAY VERY FINE-GRAINED SALT + PEPPER CARB. SANDSTONE, MINOR MEDIUM GRAY VERY FINE-GRAINED SANDSTONE + GREY SHALE (POSSIBLY CARB. SHALE)	140		SANDSTONE + SHALE
70		COAL	150		COAL
		MEDIUM GRAY VERY FINE-GRAINED SANDSTONE AND DARK GRAY CARB. SHALE			MEDIUM GRAY VERY FINE-GRAINED SANDSTONE AND DARK GRAY CARB. SHALE
		MEDIUM GRAY VERY FINE-GRAINED SALT + PEPPER CARB. SS, MINOR DARK GRAY CARB. SHALE			MEDIUM GRAY VERY FINE-GRAINED SALT + PEPPER CARB. SS, MINOR DARK GRAY CARB. SHALE

DEPTH (ft.)	LITHOLOGY	DESCRIPTION	DEPTH (ft.)	LITHOLOGY	DESCRIPTION
170		MEDIUM GRAY VERY FINE-GRAINED SANDSTONE + SALT + PEPPER SS. (POSSIBLY MINOR CARB. SS)	250		COAL
180			250		SANDSTONE + SHALE
190		MEDIUM GRAY + BROWN VERY FINE-GRAINED SANDSTONE + SALT + PEPPER SANDSTONE, MINOR DARK GRAY CARB. SHALE	250		BONE COAL (?) (HIGH NATURAL GAMMA, BUT LOWER DENSITY THAN MOST COALS)
200			250		DARK GREY SHALE
210			260		MEDIUM GRAY + BROWN VERY FINE-GRAINED SANDSTONE
220			260		DARK GREY SHALE
230			270		COAL
			270		DARK GREY SHALE (POSSIBLY CARB. SHALE)
			280		LIGHT GRAY VERY FINE-GRAINED SALT + PEPPER SANDSTONE.
			280		TD = 280 ft
			290		
			300		
			310		



Depth (ft.)	Lithology	Description	Depth (ft.)	Lithology	Description
170		DARK GREY VERY FINE-GRAINED SANDSTONE	250		DARK GREY CARB. SHALE AND DARK GREY VERY FINE-GRAINED CARB. SANDSTONE
180		DARK GREY CARB. SHALE WITH SOME S+P CARB. SANDSTONE	260		COAL
190		COAL	270		DARK GREY CARB. SHALE AND DARK GREY VERY FINE-GRAINED CARB. SANDSTONE
200		DARK GREY CARB. SHALE	280		COAL
210		COAL	290		DK GREY VERY FINE-GRAINED CARB. SS, DK GREY CARB. SHALE, AND DARK GREY SHALE
220		DARK GREY VERY FINE-GRAINED CARB. SS.	300		DARK GREY VERY FINE-GRAINED CARB. SALT + PEPPER SANDSTONE
230		COAL	310		DARK GREY CARB. SHALE
		DARK GREY VERY FINE-GRAINED SALT + PEPPER SANDSTONE			COAL AND BONE COAL
		COAL			DARK GREY VERY FINE-GRAINED S+P CARB. SS
		SAMPLE MISSING (PROBABLY CARB. SANDSTONE)			COAL AND BONE COAL
					DARK GREY SANDY CARB. SHALE (POSSIBLY MINOR COAL)

DEPTH (ft.)	LITHOLOGY	DESCRIPTION	DEPTH (ft.)	LITHOLOGY	DESCRIPTION
		TOPSOIL, GREY-BROWN FINE-GRAINED SANDSTONE, BROWN SILT.			
10	V V V	GREY BROWN FINE-GRAINED SANDSTONE; VERY HARD RED-BROWN BAKED (?) VERY FINE-GRAINED SANDSTONE	90		
20		YELLOW-BROWN VERY FINE-GRAINED SANDSTONE, GREY SHALE	100		
30		YELLOW-BROWN VERY FINE-GRAINED SALT + PEPPER SANDSTONE AND SANDY COAL	110		DARK GREY TO BLACK FINE AND VERY FINE-GRAINED CARB. SANDSTONE
40		YELLOW-BROWN VERY FINE-GRAINED S.P. SANDSTONE	120		
		DARK GREY AND BLACK CARB. SHALE			
		COAL			
50			130		
		DARK GREY FINE-GRAINED CARB. SANDSTONE, SOME GREY SHALE			
60			140		
					SAMPLES NOT DESCRIBED FROM 140 FE. TO 160 FE. PROBABLY CARB. SANDSTONE WITH SOME SHALE TO 155 FE.
70			150		
		DARK GREY TO BLACK FINE AND VERY FINE-GRAINED CARB. SANDSTONE			BONE (?) COAL. PROBABLY MINOR GREY VERY FINE-GRAINED SANDSTONE

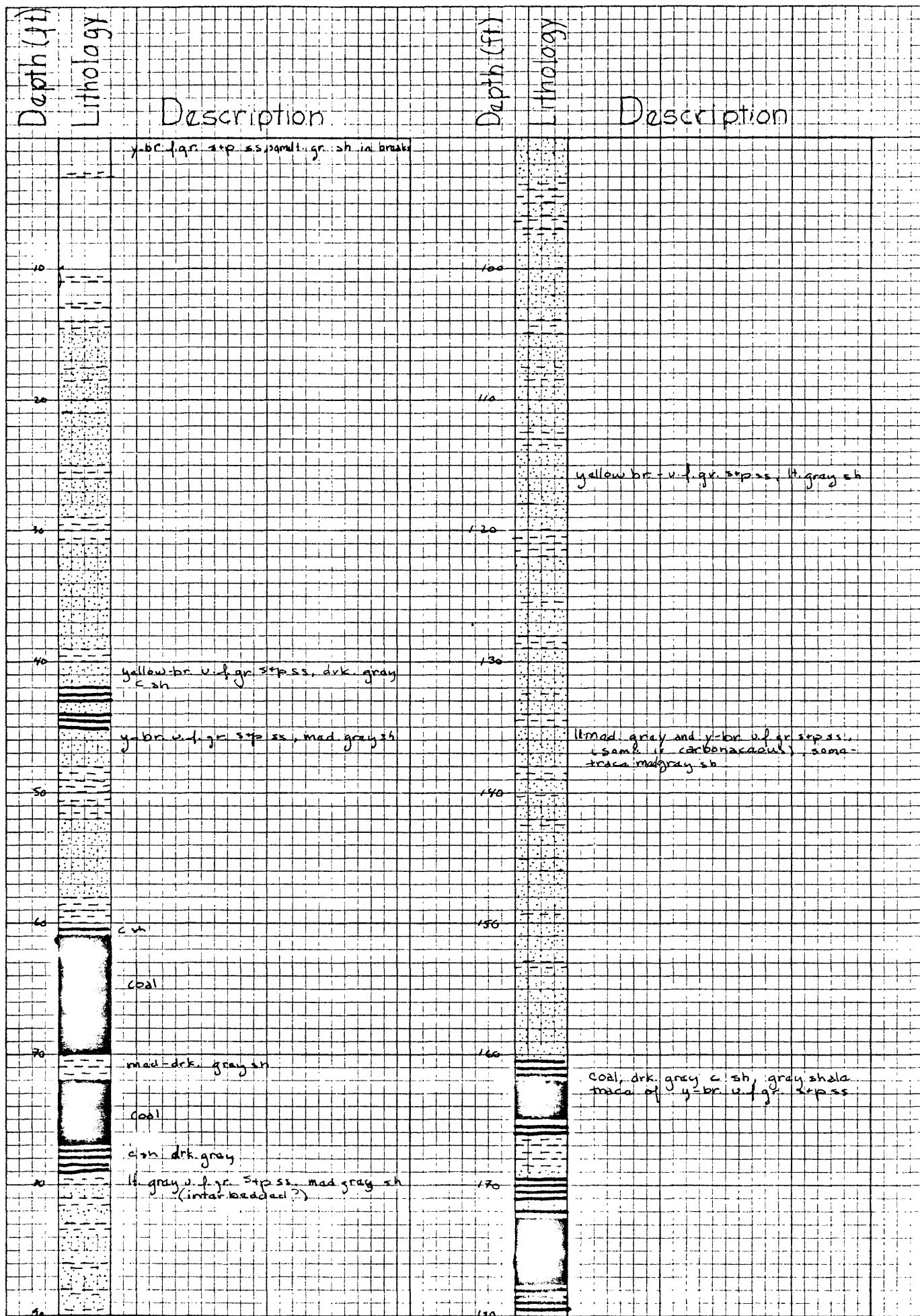
Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
10		Topsoil; red, yellow, white, + gray vfg stp ss, some red + gray-brown carb sh; probably clinkered	90		Coal
20			100		Br-black carb sh
30			110		Lt gr vfg stp ss and gr-br sandy sh
40		Y-br vfg stp ss, gr to y-br sh	120		Gr-br sandy sh
50			130		Dk br-black carb sh
60		Gr-br sh, y-br vfg stp ss, some dk br carb sh	140		Med gr sh, some dk gr carb sh
70		Y-br vfg stp ss, some gr sh, + dk br carb sh	150		Coal, some bony?
80		coal	160		Lt gr-yellow vfg stp ss

Depth (ft)	Lithology	Description							
170		ll							
180									
190		Coal							
200		Black carb sh							
		Coal							
210		Dk gr. black carb sh + y to tlt gr vfg stp ss							
220		Med. gr sh + black carb sh							
		TD hole							

LITHOLOGIC LOG D-33-NG

46 0702

10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.



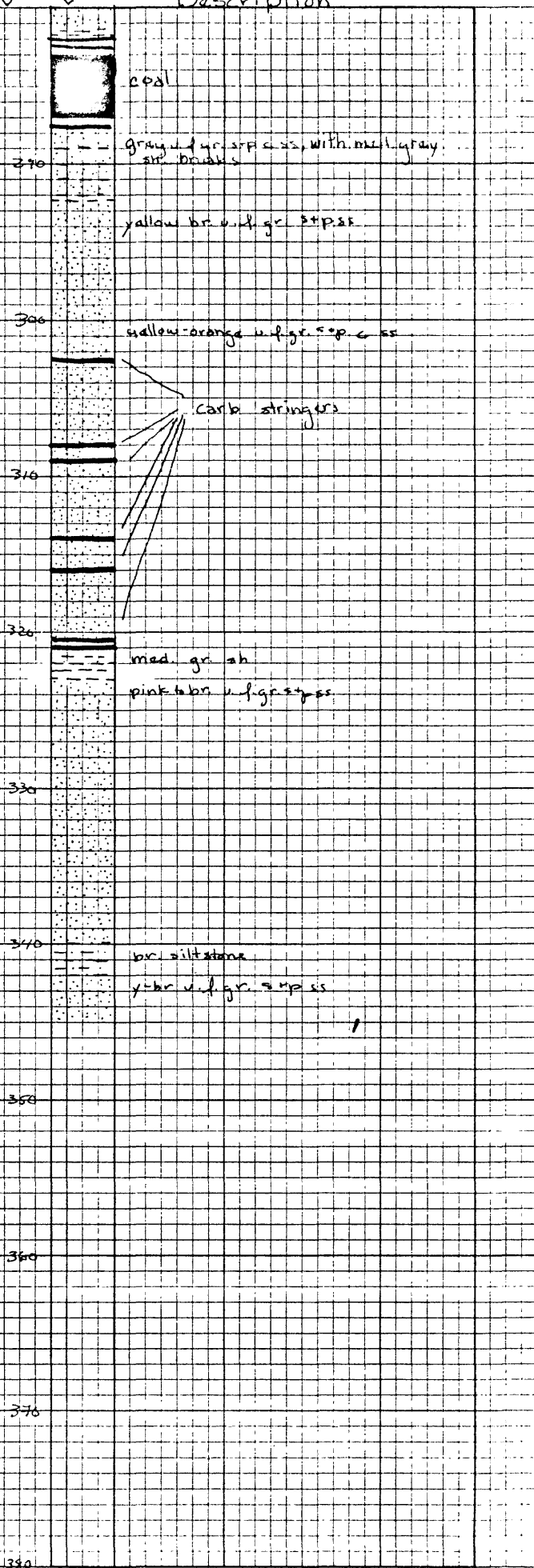
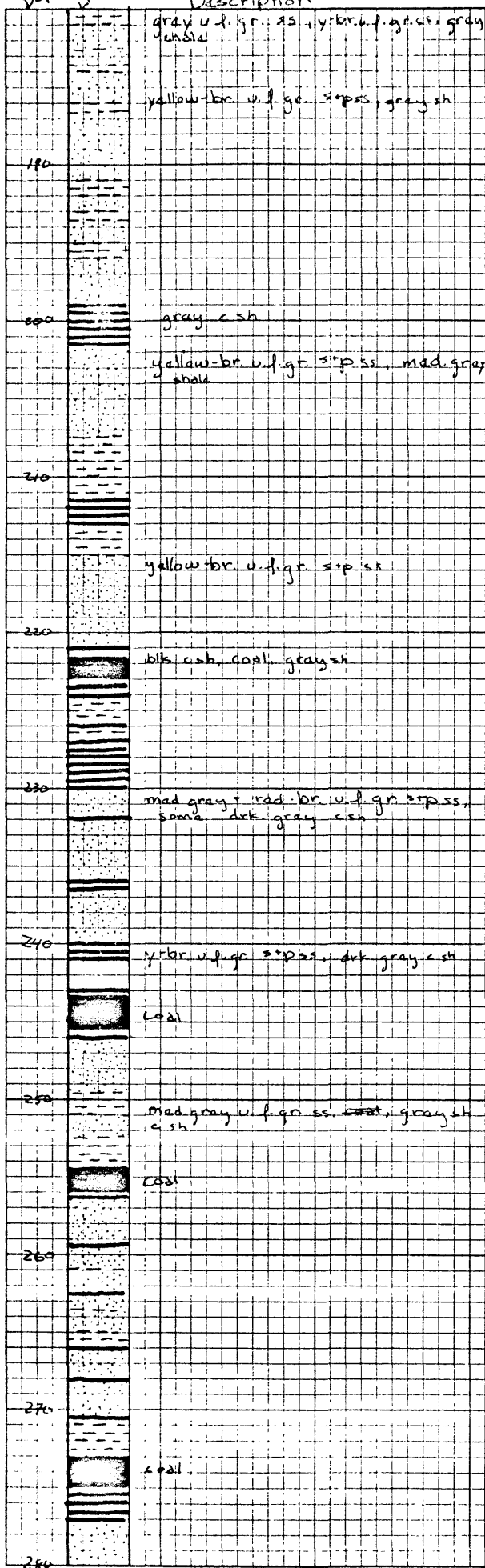
Depth Lithology

Description

Depth Lithology

Description

D-33-NG



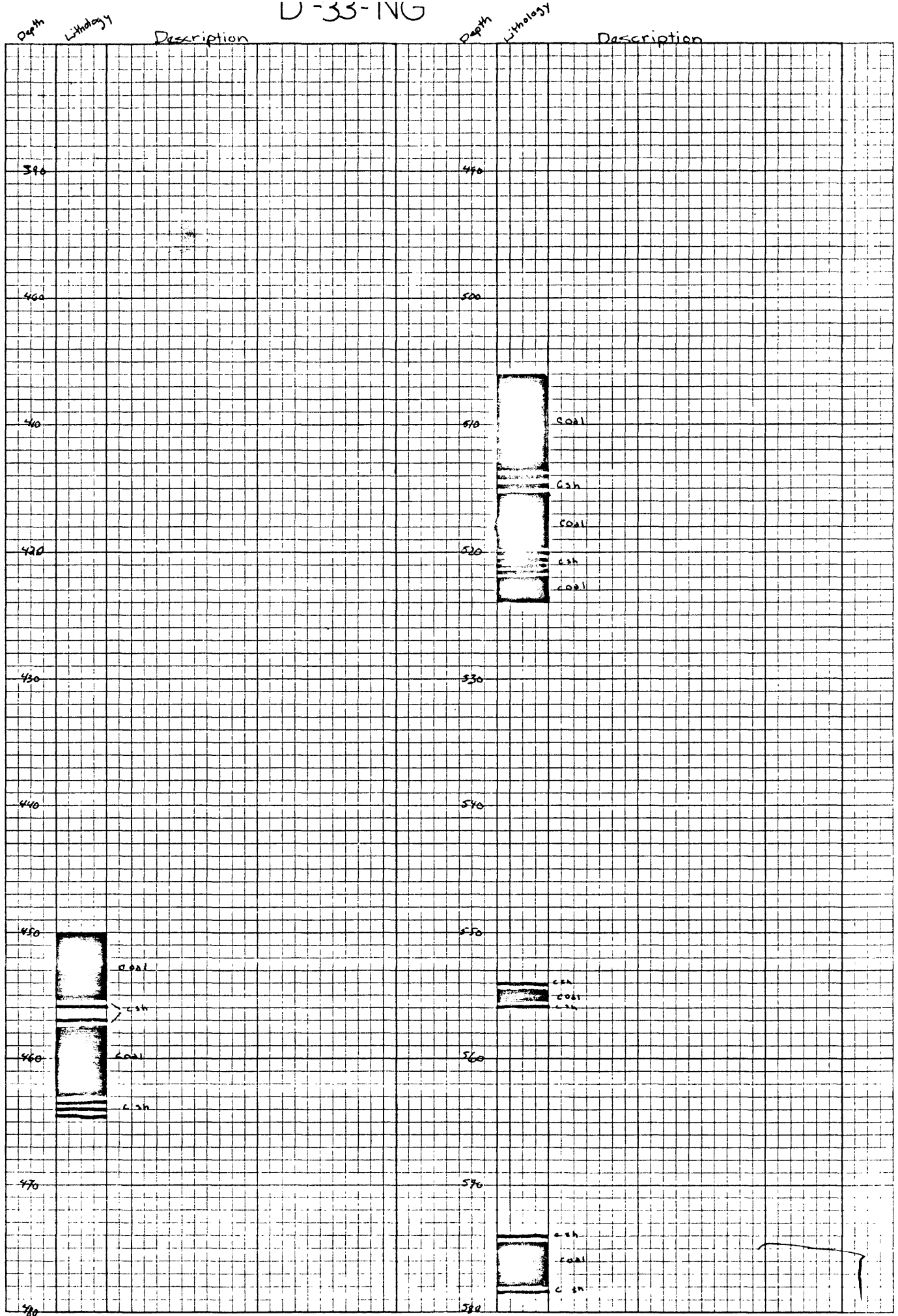
46 0702


10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 0702

10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

D-33-ING



Depth	Lithology	Description
590		<p>No samples collected below 590 ft</p>
600		

46 0702

10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

DEPTH (ft.)	LITHOLOGY	DESCRIPTION	DEPTH (ft.)	LITHOLOGY	DESCRIPTION
		GREY SHALE AND YELLOW-BROWN VERY FINE GRAINED SALT + PEPPER SANDSTONE			GRAY VERY FINE-GRAINED CARB SANDSTONE
10		DARK BROWN TO BLACK CARB SHALE AND SOME COAL	90		DARK BROWN TO BLACK CARB SHALE AND GRAY FINE-GRAINED CARB SS
20		LIGHT GRAY AND YELLOW-BROWN VERY FINE GRAINED SSP SANDSTONE	100		LIGHT GRAY FINE-GRAINED CARB SANDSTONE AND BLACK CARB SHALE
30		MEDIUM YELLOW-BROWN FINE-GRAINED SALT + PEPPER SANDSTONE AND MINOR DARK GREY SHALE AND CARB SHALE	110		GRAY FINE-GRAINED SALT + PEPPER CARB SANDSTONE
40		VERY HARD ORANGE + BROWN BAKED SHALE, MEDIUM GRAY SHALE, GRAY VERY FINE-GRAINED SSP SANDSTONE	120		COAL
50		MEDIUM GRAY FINE GRAINED CARB SANDSTONE, SOME DARK YELLOW AND GREY BROWN CARB SHALE	130		GRAY VERY FINE-GRAINED SS + SOME GRAY SHALE
60		YELLOW BROWN FINE-GRAINED SSP SANDSTONE, SOME DARK GRAY TO BLACK CARB SHALE (TO 81')	140		COAL
70			150		GRAY VERY FINE-GRAINED CARB(?) SS, ORANGE BAKED SHALE, SOME GRAY SH.

[illegible]

Depth (feet)	Lithology	Description				Description
		Topsoil, y-br vfg ss				Circulation lost, no samples from 80-160'. Lithology estimated from geophysical logs
10		y-br vfg stpss			90	
20		dk br-gr carb sh			100	Ss + sh
30		coal, bony?			110	
		lt gr to y-br vfg stp carb ss			120	
40		Bony coal				
		lt gr to y-br to or vfg stp carb ss, some lt gr sh + dk gr carb sh			130	ss, some sa sh?
50		lt gr to red vfg stp carb ss, some lt gr vfg ss - clinker?			140	
60		Red to lt gr carb sh - clinker?			150	
70		lt gr + red vfg stp carb ss, dk gr, r-br, lt gr + red carb sh - clinker?			160	ss
80						

D-35-NG cont.

Depth (ft)	Lithology	Description	Depth (ft)	Lithology	Description
170		ss.	260		Coal
					ss, some carb sh
180		carb sh	270		Coal
		coal			
190		carb sh	280		Med gr vfg ss, dk gray carb sh
		Coal			
200		Bony? coal	290		Dk gr carb sh, med gr vfg stp carb ss
		carb sh			Coal
210		Coal	300		Dk gr carb sh
		ss + sh			Dk gr vfg stp ss
220		coal	310		Dk gr carb sh
					Med gr vfg stp ss
230		ss	320		Dk gr carb sh
					TOP OF TROUT CREEK SS
240		Bony coal	330		Med-dk gr vfg stp ss
		ss, some sh			Lt gr vfg stp ss
250			340		Lith as above, Trout Creek ss to bottom of hole, TD=380'