UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

COAL TEST DRILLING FOR THE DE-NA-ZIN BISTI AREA, SAN JUAN COUNTY, NEW MEXICO

By

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Open-File Report 80-1289

1980

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COAL TEST DRILLING IN THE DE-NA-ZIN-BISTI AREA, SAN JUAN COUNTY, NEW MEXICO

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INTRODUCTION

From October 1978 to June 1979, the U. S. Geological Survey (USGS) drilled 51 test holes, and cored 9 holes, in the vicinity of the Bisti Trading Post in the southwestern part of the San Juan Basin, San Juan County, N. Mex. The drilling was done in response to expressions of interest received by the Bureau of Land Management (BLM) concerning coal leasing and, in some places, badlands preservation. The object of the drilling was to determine the depth, thickness, extent, and quality of the coal in the Upper Cretaceous Fruitland Formation in northwest New Mexico.

The drilling was done under contract no. 14-08-0001-17432, awarded by the USGS to Longman Drilling Company of Grants, N. Mex., and was done in two phases. The first phase consisted of rotary drilling and geophysical logging 51 holes from October 1978 to February 1979. The second phase, conducted in May 1979, consisted of coring selected coal intervals in twinned holes at 9 of the 51 previously drilled holes. The drill holes and the 9 that were cored are shown on figures 1-3. These figures also show Western Coal Company leases on Federal and State lands. All drill-hole locations were surveyed with alidade and planetable. The drill hole numbers are preceded by the letter A or B. The two different letters were assigned because the drilling was planned to be done in two stages. Several numbers in the B group are missing because those locations were deleted when it was learned that they were within the proposed Bisti Wilderness Study Area (Bureau of Land Management, 1976). Previous drilling was done in the Bisti area in 1976 by the USGS (Jentgen and Fassett, 1977) and the BLM (Bureau of Land Management, 1976).

DRILLING, SAMPLING AND GEOPHYSICAL LOGGING

Four-inch holes were drilled using mud, water, air or foam as the drilling fluid. Cuttings were sampled and logged by USGS personnel in the field. All holes were drilled through the Fruitland Formation into the underlying

Pictured Cliffs Sandstone (Upper Cretaceous) to assure that all of the Fruitland coal beds had been penetrated. The depth to the Pictured Cliffs ranged from 25 ft in the south to 365 ft in the north. Table 1 gives the total depth and depth logged for each hole.

The holes were geophysically logged immediately after drilling. Resistivity, spontaneous-potential, and natural gamma logs were run in all of the holes. A high-resolution density log was also run in all holes drilled before January 13, when a logging unit from the USGS in Albuquerque was available. After January 13, the holes were logged by a USGS unit from Casper, Wyo. that lacked density logging capabilities. (Depths on the gamma logs run after January 13 are 4 ft too deep.) The geophysical logs in this report are reduced to 20 percent of their original size. The full-size logs may be inspected in the office of the District Geologist in Farmington, N. Mex.

CORING AND COAL QUALITY ANALYSES

At nine locations a second hole was drilled, about 20 ft from the first hole, down to selected coal-bearing intervals and the coal beds were cored. (The drilling and coring depths were chosen from the geophysical logs of the nearby hole.) A detailed description of each of the cores is given on the page(s) following the logs for each hole. From these coal cores, 32 intervals were selected and submitted to the Department of Energy in Pittsburgh, Pa., for analysis (table 2). Some of the intervals overlap because of the desire to analyze individual coal beds as well as thicker, composite coal beds, including partings. After being described, the coals were crushed and run through a splitter so that each interval tested would be accurately represented.

The thickness of each interval sampled and the number of partings in each interval were chosen after careful consideration of the different ways in which the coal might be mined. Because of this, the analyses reflect a wide variation of Btu/lb values. Samples, such as hole A-22 (109.1-113.3-ft interval), being predominantly composed of coal with no partings, showed Btu/lb values of approximately 10,000 to 11,000. Samples with many partings, or those with a few thick partings, such as hole A-15 (193.8-200.0-ft interval), showed Btu/lb values as low as 2,843. The average as-received Btu/lb value for minable coal beds in this area is about 8,954.

USING THE LOGS

The lithologic logs in this report are from the field notes of the geologists at the drill site. The geologists' field determination of the top of the Pictured Cliffs Sandstone is shown in the lithologic log. The strip log shows the coals in solid black and identifies the top of the Pictured Cliffs (PC) by a dashed line. The strip log was based on geophysical log interpretation where there was a difference between the lithology interpreted from well cuttings and from geophysical logs. All of the major coal beds and many of the minor ones are identified on the strip log.

REFERENCES

Bureau of Land Management, 1976, Bisti west study site, Bisti coal field: U. S. Department of the Interior, Bureau of Land Management, Energy Mineral Rehabilitation Inventory and Analysis (EMRIA) Report 5-1976, 108 p., 6 appendices.

Jentgen, R. W., and Fassett, J. E., 1977, Sundance-Bisti-Star Lake 1976 drilling in McKinley and San Juan Counties, northwestern New Mexico: U. S. Geological Survey Open-File Report 77-369, 80 p., 20 oversize sheets.

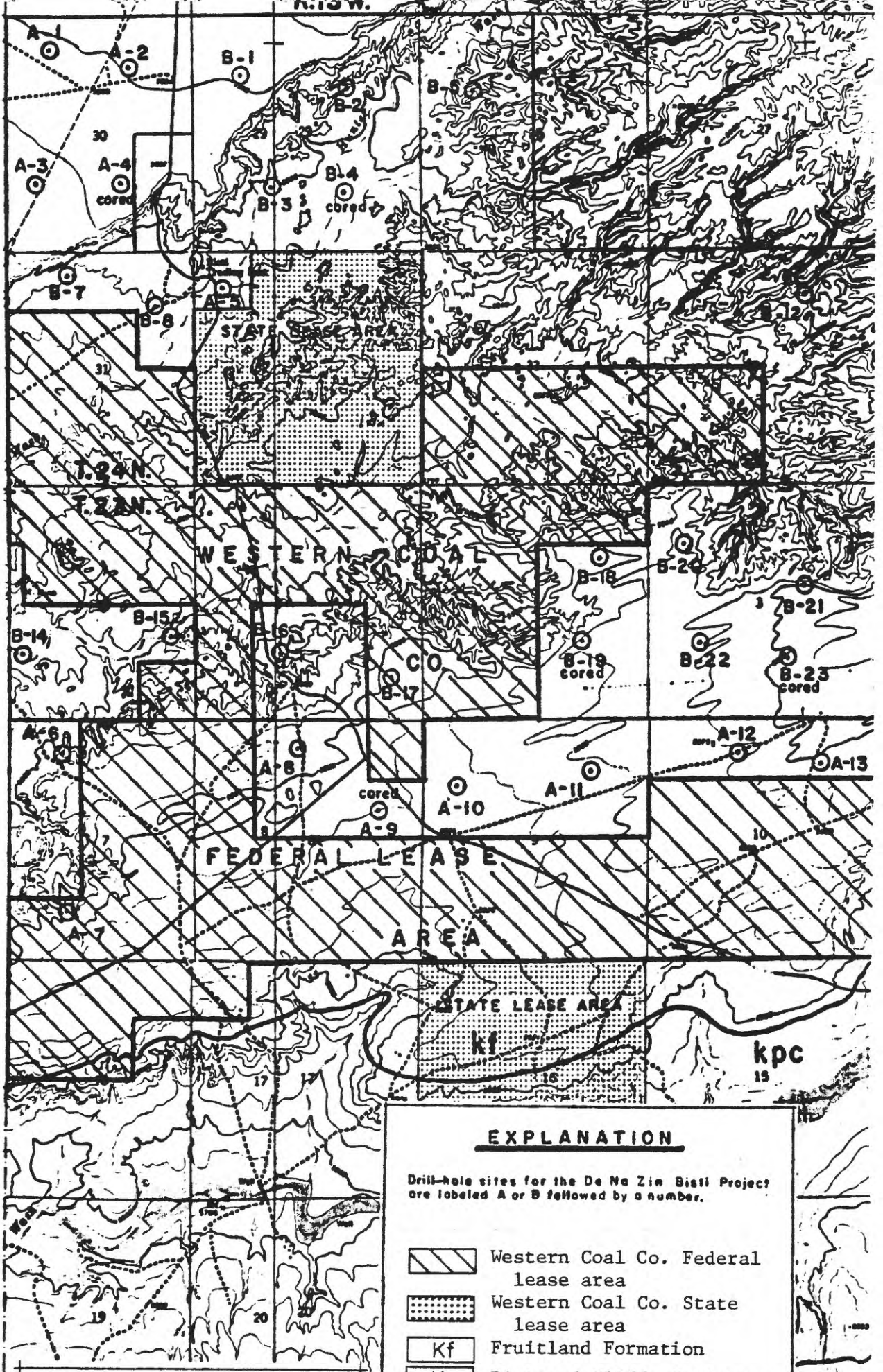


Figure 1.—Drill-hole locations in western part of project area, San Juan County, N. M.

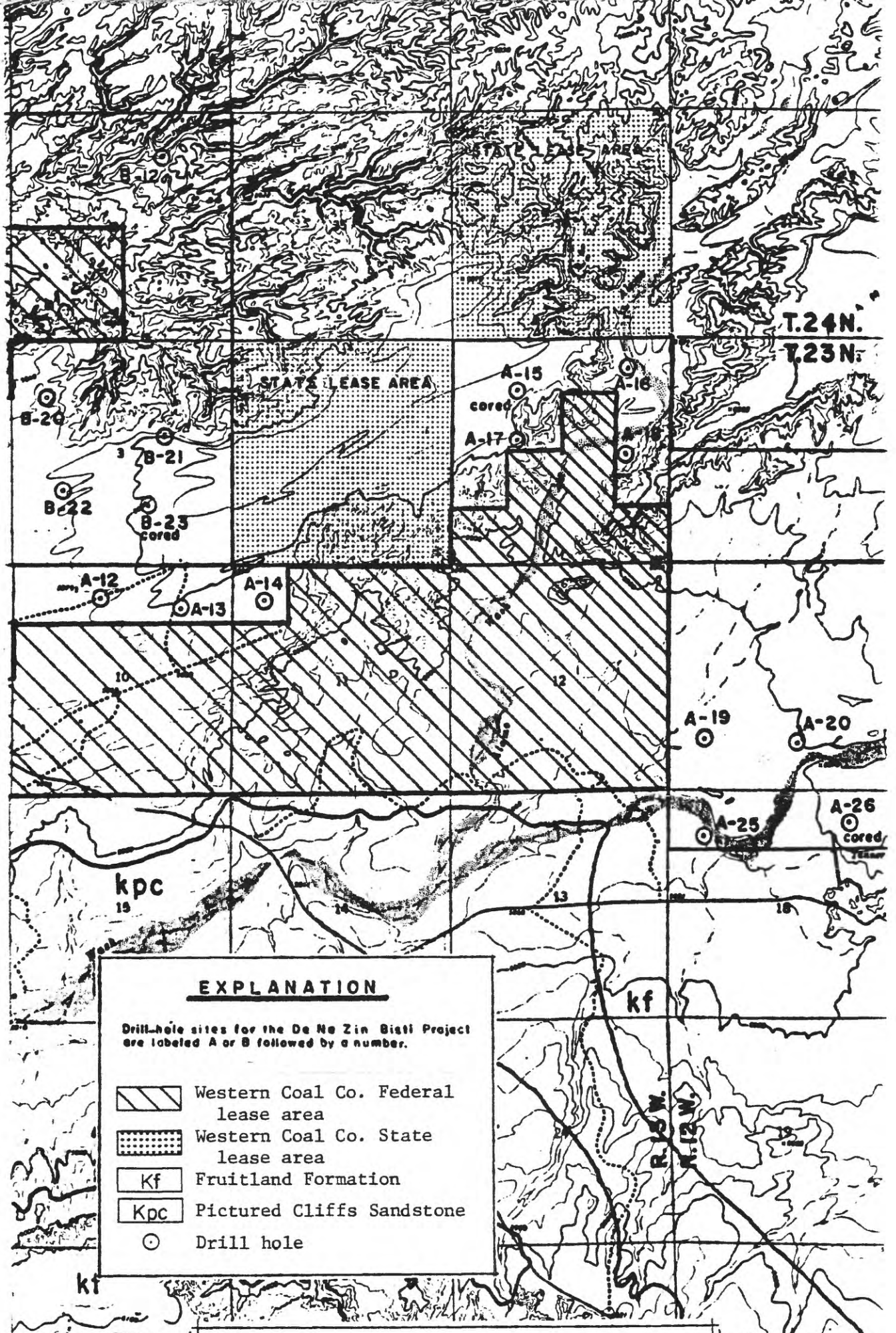


Figure 2— Drill-hole locations, central part of project area, San Juan County, N. M.

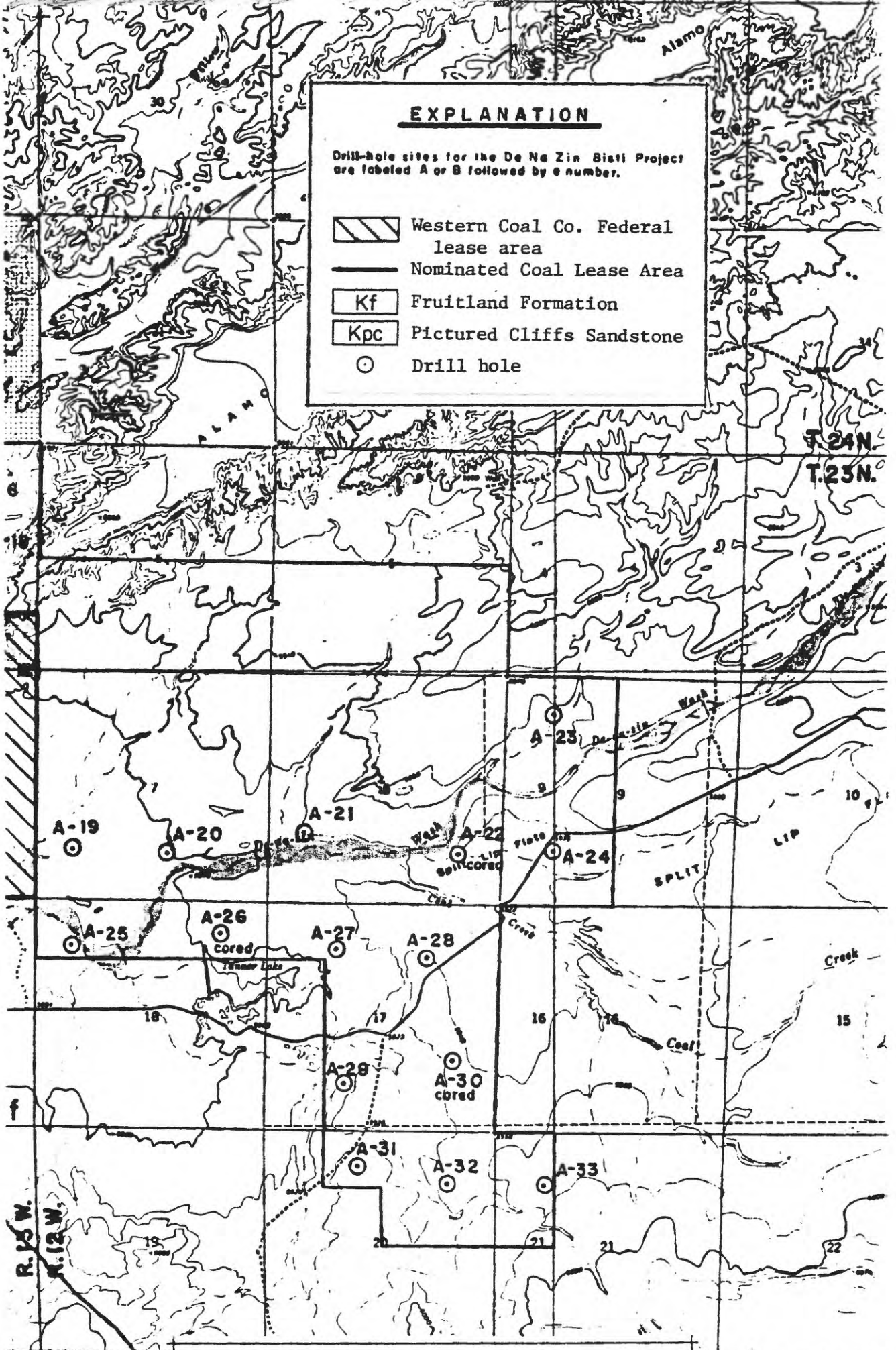


Figure 3.—Drill-hole locations, eastern part of project area, San Juan County, N. M.

Table 1.--Locations, elevations, drilled depths, and total depths for 51 drill holes in the De-Na-Zin Bisti area, San Juan County, N. Mex.

Drill hole No.	Location				Surface elevation (feet)	Date completed	Total depth drilled (feet)	Total depth logged (feet)
		Sec.	T.N.	R.W.				
A-1	NW¼	30	24	13	5,891.1	1-12-79	440	414
A-2	NE¼	30	24	13	5,899.8	1-15-79	420	420
A-3	SW¼	30	24	13	5,872.8	1-18-79	380	380
*A-4	SE¼	30	24	13	5,881.7	1-19-79	380	380
A-5	NW¼	32	24	13	5,771.5	1-11-79	180	178
A-6	NW¼	7	23	13	5,796.4	2-01-79	80	80
A-7	SW¼	7	23	13	5,897.7	2-01-79	120	120
A-8	NW¼	8	23	13	5,887.3	12-22-78	180	180
*A-9	NE¼	8	23	13	5,912.5	12-05-78	178	178
A-10	NW¼	9	23	13	5,931.7	11-14-78	195	190
A-11	NE¼	9	23	13	5,955.3	11-16-78	195	194
A-12	NW¼	10	23	13	5,981.1	11-17-78	205	203
A-13	NE¼	10	23	13	5,993.7	11-27-78	249	249
A-14	NW¼	11	23	13	5,971.9	11-28-78	225	222
*A-15	NW¼	1	23	13	6,029.5	11-28-78	425	414
A-16	NE¼	1	23	13	5,910.4	1-26-79	260	260
A-17	NW¼	1	23	13	6,015.0	11-29-78	400	393
A-18	SE¼	1	23	13	5,904.6	1-26-79	260	260
A-19	SW¼	7	23	12	5,885.3	1-30-79	120	120
A-20	SE¼	7	23	12	5,894.1	1-31-79	140	140
A-21	SW¼	8	23	12	5,917.3	1-31-79	160	160
*A-22	SE¼	8	23	12	5,917.0	10-18-78	195	188
A-23	NW¼	9	23	12	5,881.7	11-06-78	255	253
A-24	SW¼	9	23	12	5,927.5	10-11-78	192	172
A-25	NW¼	18	23	12	5,883.1	11-09-78	90	88
*A-26	NE¼	18	23	12	5,899.9	10-20-78	88	87
A-27	NW¼	17	23	12	5,907.0	10-20-78	103	86
A-28	NE¼	17	23	12	5,934.0	10-11-78	135	133
A-29	SW¼	17	23	12	5,914.2	10-05-78	90	89
*A-30	SE¼	17	23	12	5,942.6	10-04-78	90	88
A-31	NW¼	20	23	12	5,932.2	10-03-78	75	73
A-32	NE¼	20	23	12	5,943.5	10-03-78	75	71
A-33	NW¼	21	23	12	5,976.6	10-03-78	75	73
B-1	NW¼	29	24	13	5,906.1	1-17-79	420	420
B-2	NE¼	29	24	13	5,802.2	1-23-79	320	315
B-3	SW¼	29	24	13	5,784.7	1-23-79	280	280
*B-4	SE¼	29	24	13	5,796.7	1-24-79	280	280
B-5	NW¼	28	24	13	5,819.8	1-25-79	400	400
B-7	NW¼	31	24	13	5,774.3	1-15-79	192	192
B-8	NE¼	31	24	13	5,773.9	1-19-79	180	180
B-12	NE¼	34	24	13	5,837.7	1-11-79	260	256
B-14	SW¼	6	23	13	5,736.1	2-01-79	60	60
B-15	SE¼	6	23	13	5,746.8	1-09-79	74	72
B-16	SW¼	5	23	13	5,820.0	12-27-78	120	118
B-17	SE¼	5	23	13	5,907.6	2-01-79	120	120
B-18	NE¼	4	23	13	5,939.4	12-12-78	260	256
*B-19	SE¼	4	23	13	5,962.7	12-14-78	262	262
B-20	NW¼	3	23	13	5,966.1	12-12-78	341	341
B-21	NE¼	3	23	13	6,007.1	12-05-78	340	340
B-22	SW¼	3	23	13	5,984.4	12-04-78	280	280
*B-23	SE¼	3	23	13	6,009.6	12-05-78	300	300

*Cored

Table 2.--Chemical analyses of 32 coal core samples from drill holes in the De-Na-Zin Bisti area, San Juan County, N. Mex.

[Analyses by Department of Energy, Pittsburgh, Pa. Type of analysis: A, as-received; B, moisture free; C, moisture and ash free. ---, not applicable. Free-swelling index was tested on all samples and found to be 0.0]

Drill hole No.	Sample interval (feet)	Type of analysis	Proximate analysis (percent)				Ultimate analysis (percent)	Heating value (Btu/lb)
			Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	
A-4	126.45-131.45	A	7.0	32.0	36.7	24.3	1.1	9,026
		B	---	34.3	39.5	26.2	1.2	9,701
		C	---	46.5	53.5	---	1.6	13,137
A-4	132.45-134.90	A	8.9	31.2	34.7	25.2	.6	8,650
		B	---	34.2	38.2	27.6	.6	9,493
		C	---	47.2	52.8	---	.9	13,113
A-4	126.45-134.90	A	7.8	31.7	34.0	26.5	.7	8,722
		B	---	34.4	36.9	28.7	.8	9,457
		C	---	48.3	51.7	---	1.1	13,269
A-4	280.35-291.15	A	5.9	34.1	40.3	19.7	.6	9,997
		B	---	36.2	42.9	20.9	.6	10,600
		C	---	45.7	54.3	---	.8	13,397
A-9	76.0-81.7	A	5.5	31.4	34.4	28.7	.5	8,726
		B	---	33.2	36.4	30.4	.5	9,230
		C	---	47.7	52.3	---	.7	13,264
A-15	193.8-200.0	A	4.9	14.7	10.6	69.8	.7	2,843
		B	---	15.4	11.2	73.4	.7	2,989
		C	---	58.0	42.0	---	2.7	11,225
A-15	262.0-265.9	A	8.9	36.4	44.5	10.2	.5	11,010
		B	---	39.9	48.9	11.2	.6	12,086
		C	---	45.0	55.0	---	.6	13,609
A-15	269.1-276.55	A	7.2	30.8	36.6	25.4	.6	8,820
		B	---	33.2	39.4	27.4	.7	9,505
		C	---	45.8	54.2	---	.9	13,095
A-15	278.05-285.8	A	6.7	32.7	34.3	26.3	.6	8,827
		B	---	35.1	36.8	28.1	.6	9,461
		C	---	48.8	51.2	---	.8	13,166
A-15	286.65-292.8	A	5.6	26.7	26.2	41.5	.4	6,678
		B	---	28.3	27.7	44.0	.4	7,077
		C	---	50.5	49.5	---	.8	12,633
A-15	269.1-292.8	A	6.2	27.3	27.6	38.9	.5	7,094
		B	---	29.1	29.4	41.5	.5	7,565
		C	---	49.7	50.3	---	.9	12,929
A-22	96.8-102.7	A	7.2	33.7	44.2	14.9	.5	10,477
		B	---	36.3	47.7	16.0	.5	11,287
		C	---	43.2	56.8	---	.6	13,439
A-22	109.1-113.3	A	8.4	37.2	43.3	11.1	.6	11,046
		B	---	40.6	47.3	12.1	.7	12,065
		C	---	46.2	53.8	---	.7	13,731
A-26	43.6-49.25	A	9.2	35.7	42.8	12.3	.5	10,697
		B	---	39.4	47.0	13.6	.6	11,787
		C	---	45.6	54.4	---	.7	13,642
A-30	34.75-39.55	A	7.2	29.1	34.6	29.1	.5	8,324
		B	---	31.4	37.2	31.4	.5	3,970
		C	---	45.7	54.3	---	.8	13,075

Table 2.--Chemical analyses of 32 coal core samples from drill holes in the De-Na-Zin Bisti area, San Juan County, N. Mex.--Continued

Drill hole No.	Sample interval (feet)	Type of analysis	Proximate analysis (percent)				Ultimate analysis (percent)	Heating value (Btu/lb)
			Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	
A-30	54.55-59.60	A	8.5	35.8	42.6	13.1	0.6	10,698
		B	---	39.1	46.6	14.3	.6	11,687
		C	---	45.7	54.3	---	.7	13,640
B-4	35.9-46.0	A	5.4	30.0	30.9	33.7	.5	7,925
		B	---	31.7	32.7	35.6	.5	8,376
		C	---	49.3	50.7	---	.9	12,998
B-4	96.15-100.6	A	9.8	33.4	42.1	14.7	.7	10,132
		B	---	37.0	46.7	16.3	.7	11,230
		C	---	44.3	55.7	---	.9	13,417
B-4	134.0-137.35	A	8.1	31.6	36.6	23.7	.5	9,018
		B	---	34.4	39.9	25.7	.5	9,808
		C	---	46.3	53.7	---	.7	13,208
B-4	138.4-144.5	A	8.6	29.1	31.0	31.3	.5	7,821
		B	---	31.8	34.0	34.2	.5	8,558
		C	---	48.3	51.7	---	.8	13,009
B-4	134.0-144.5	A	8.4	27.3	28.7	35.6	.4	7,230
		B	---	29.8	31.4	38.8	.5	7,890
		C	---	48.6	51.4	---	.8	12,895
B-4	200.25-205.85	A	6.1	34.8	43.8	15.3	.6	10,565
		B	---	37.1	46.6	16.3	.6	11,252
		C	---	44.3	55.7	---	.7	13,436
B-4	208.45-211.60	A	6.2	35.9	44.0	13.9	.6	10,893
		B	---	38.3	46.9	14.8	.6	11,607
		C	---	44.9	55.1	---	.7	13,623
B-4	200.25-211.60	A	5.6	29.6	35.5	29.3	.5	8,501
		B	---	31.4	37.5	31.1	.5	9,003
		C	---	45.5	54.5	---	.8	13,064
B-19	128.2-138.65	A	5.1	31.6	33.8	29.5	.5	8,495
		B	---	33.3	35.6	31.1	.6	8,956
		C	---	48.4	51.6	---	.8	13,007
B-19	128.2-143.6	A	4.9	26.7	26.7	41.7	.6	6,762
		B	---	28.1	28.1	43.8	.7	7,112
		C	---	50.0	50.0	---	1.2	12,665
B-19	201.1-205.85	A	6.8	35.8	45.3	12.1	.5	10,920
		B	---	38.4	48.6	13.0	.6	11,719
		C	---	44.1	55.9	---	.6	13,475
B-19	207.0-211.35	A	6.3	36.0	42.6	15.1	1.4	10,529
		B	---	38.4	45.5	16.1	1.5	11,236
		C	---	45.8	54.2	---	1.8	13,395
B-19	201.1-211.35	A	6.0	30.6	37.1	26.3	.9	8,981
		B	---	32.6	39.4	28.0	.9	9,549
		C	---	45.2	54.8	---	1.3	13,256
B-23	184.95-195.45	A	8.3	30.2	35.1	26.4	.5	8,564
		B	---	32.9	38.3	28.8	.6	9,335
		C	---	46.2	53.8	---	.8	13,113
B-23	246.7-252.4	A	8.7	34.6	44.9	11.8	.5	10,776
		B	---	37.9	49.2	12.9	.5	11,809
		C	---	43.5	56.5	---	.6	13,556
B-23	246.7-257.0	A	7.8	27.5	31.3	33.4	.6	7,791
		B	---	29.8	34.0	36.2	.7	8,448
		C	---	46.7	53.3	---	1.1	13,245

DRILL HOLE LOGS

Location Number DB A-1 Date Logged 1-12-79 Surface Elevation (ft) 5891.1

County & State San Juan County, N. M. Location NW¼, Sec. 30, T. 24 N., R. 13 W.

Map Bisti Trading Post, N. M. Drilled depth (ft) 440 Logged depth (ft) 414

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

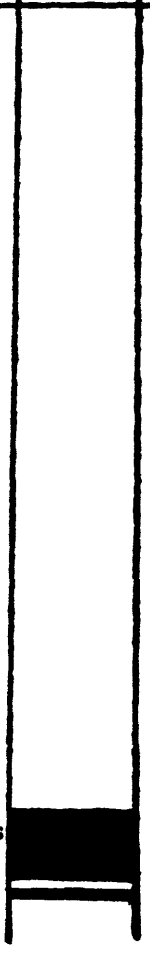
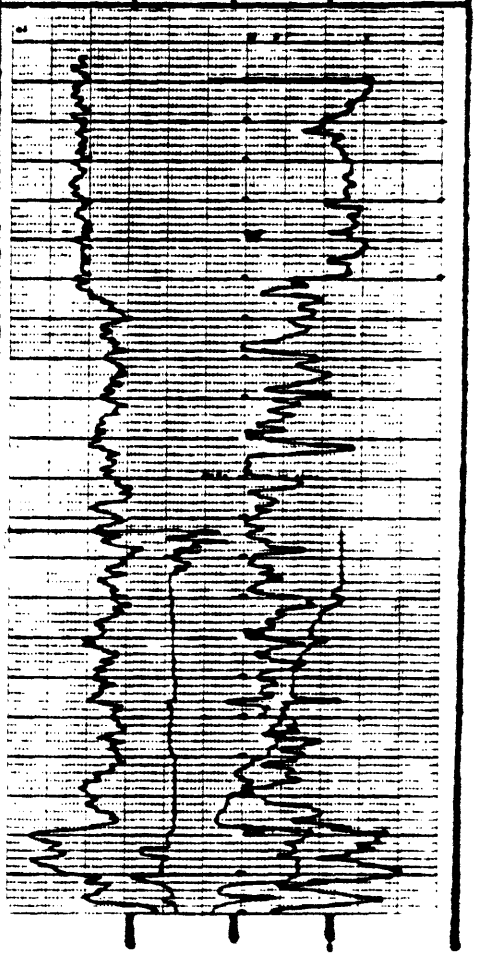
Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-6 ft Sandstone, tan, very coarse grained 6-65 ft Sandstone, tan, fine-grained 65-70 ft Shale, grayish-tan, very sandy 70-95 ft Sandstone, yellowish-tan, fine-grained, silty and shaly 95-100 ft Shale, gray, silty 100-105 ft Sandstone, tan, very fine grained 105-196 ft Sandstone, gray, very fine grained, shaly 196-214 ft Coal 214-217 ft Shale, gray, silty, carbonaceous 217-219 ft Coal 219-234 ft Shale, brownish-gray, silty, sandy		0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB A-1 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs
234-237 ft Coal 237-265 ft Shale, brownish-gray, silty, sandy and carbonaceous 265-273 ft Coal 273-292 ft Shale, gray, silty 292-294 ft Coal, shaly 294-328 ft Shale, gray, silty and sandy 328-338 ft Coal 338-340 ft Shale, dark-gray, silty, carbonaceous 340-380 ft No samples 380-405 ft Sandstone, gray, very fine grained, shaly, hard 405-410 ft Shale, gray, silty, soft 410-440 ft Sandstone, salt-and-pepper gray, fine-grained, soft, shaly (Pictured Cliffs)	PC	250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190	Gamma Sp Res Den

DRILL HOLE LOGS

Location Number DB A-2 Date Logged 1-15-79 Surface Elevation (ft) 5899.8

County & State San Juan County, N. M. Location NE¼ Sec. 30, T. 24 N., R. 13 W.

Map Bisti Trading Post, N. M. Drilled depth (ft) 420 Logged depth (ft) 420

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

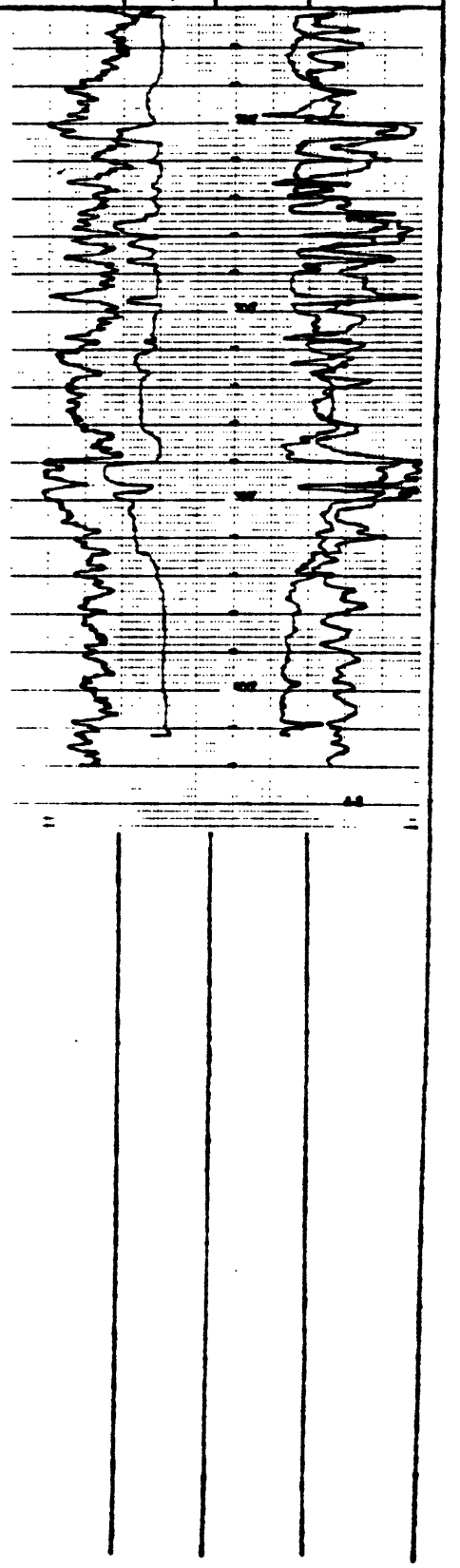
Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-82 ft Sandstone, tan, very fine grained, silty, shaly, eolian		0	0	
			10	
		50		
			20	
82-90 ft Shale, gray, silty				
90-135 ft Siltstone, gray, shaly, sandy		100	30	
			40	
135-145 ft Sandstone, light-gray, very fine grained, shaly, silty				
145-150 ft Sandstone, gray, very fine grained, shaly, silty		150		
			50	
150-190 ft Shale, gray, silty, sandy				
			60	
190-208 ft Siltstone, gray, shaly		200		
208-210 ft Shale, black, carbonaceous				
210-216 ft Coal				
216-222 ft Shale, dark-brown, carbonaceous sandy			70	

Hole No. DB A-2 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
222-240 ft Shale, gray, silty 240-252 ft Siltstone, light-gray, shaly 252-256 ft Coal 256-265 ft Shale, dark-gray, carbonaceous, sandy, silty 265-275 ft Shale, gray, silty 275-295 ft Coal, shaly 295-303 ft Shale, dark-gray, carbonaceous, coaly, silty 303-320 ft Shale, gray, silty 320-344 ft Sandstone, salt-and-pepper gray, very fine grained, silty, shaly 344-348 ft Coal 348-385 ft Shale, gray, silty, sandy (Pictured Cliffs) 385-420 ft Sandstone, gray, shaly	PC	250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190	

DRILL HOLE LOGS

Location Number DB A-3 Date Logged 1-18-79 Surface Elevation (ft) 5872.8

County & State San Juan County, N. M. Location SW¼ Sec. 30, T. 24 N., R. 13 W.

Map Bisti Trading Post, N. M. Drilled depth (ft) 380 Logged depth (ft) 380

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: P. Lambert

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Loggers: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 50 mv/in. Logging speed 16-17 fpm

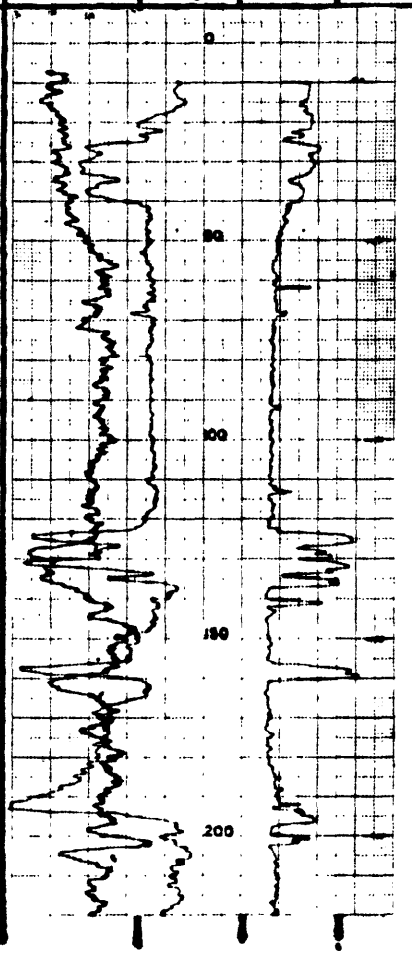
Resistivity (Res): Scale 20 ohms/in. Logging speed 16-17 fpm

Gamma (G): Scale 5 cps/in. * Logging speed 16-17 fpm

Density (Den): Scale _____ Logging speed _____ fpm

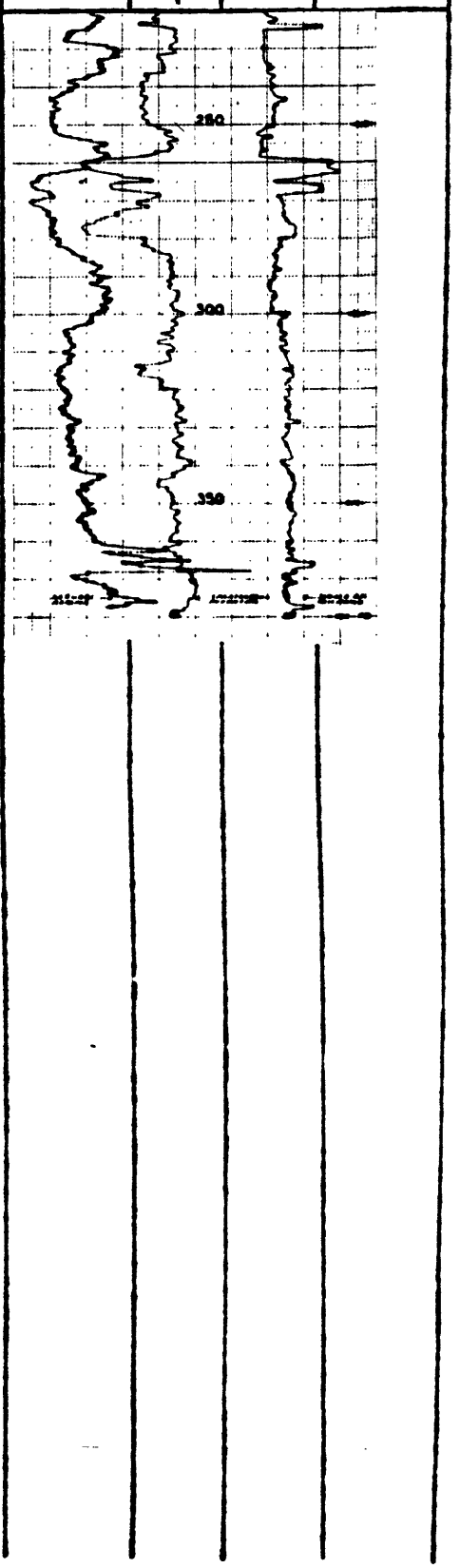
Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma / Sp / Res / Den
0-40 ft Sandstone, yellow, fine-grained 40-45 ft Shale, yellow, weathered 45-50 ft Shale, yellowish-gray 50-65 ft Shale, dark-yellowish-gray 65-70 ft Shale, gray 70-75 ft Shale, dark-yellowish-gray, fissile 75-80 ft Shale, dark-greenish-gray 80-85 ft Shale, dark-greenish-gray, fissile 85-90 ft Shale, gray 90-95 ft Shale, dark-greenish-gray 95-100 ft Shale, gray 100-120 ft Shale, gray, silty 120-125 ft Coal; some gray silty shale 125-135 ft Coal; some black carbonaceous shale 135-140 ft Sandstone, dark-gray, fine-grained; some coal and black carbonaceous shale 140-145 ft Shale, gray 145-150 ft Shale, gray, silty 150-160 ft Coal; some dark-gray silty shale 160-165 ft Shale, dark-gray 165-185 ft Shale, gray, silty 185-190 ft Sandstone, gray, very fine grained, silty; some coal 190-195 ft Coal; some very dark gray sand 195-200 ft Coal 200-205 ft Shale, gray, sandy and silty 205-220 ft Shale, gray, silty		0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB A-3 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
220–225 ft Shale, gray, silty; some black carbonaceous shale				
225–230 ft Shale, gray				
230–235 ft Shale, gray, silty				
235–250 ft Sandstone, gray, very fine grained				
250–255 ft Shale, gray, silty	PC			
255–265 ft Coal; some gray silty shale				
265–270 ft Shale, gray, silty; some black carbonaceous shale				
270–280 ft Shale, dark-gray				
280–285 ft Sandstone, salt-and-pepper light-gray, fine-grained (Pictured Cliffs)				
285–295 ft Sandstone, salt-and-pepper light-gray to light-yellow, fine-grained				
295–310 ft Sandstone, salt-and-pepper gray, fine-grained				
310–380 ft Sandstone, salt-and-pepper light-gray, fine-grained				



DRILL HOLE LOGS

Location Number DB A-4 **Date Logged** 1-19-79 **Surface Elevation (ft)** 5881.7

County & State San Juan County, N. M. **Location** SE¼ **Sec.** 30, T. 24 N., R. 13 W.

Map Bisti Trading Post, N. M. **Drilled depth (ft)** 380 **Logged depth (ft)** 380

Cored depth (ft) 296.2 **Cored:** [x] Yes [ ] No **Geologists:** P. Lambert, R. Jentgen

Drilling medium: [ ] Air [ ] Water [x] Foam [ ] Mud **Loggers:** Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 20 mv/in. Logging speed 16-17 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 16-17 fpm

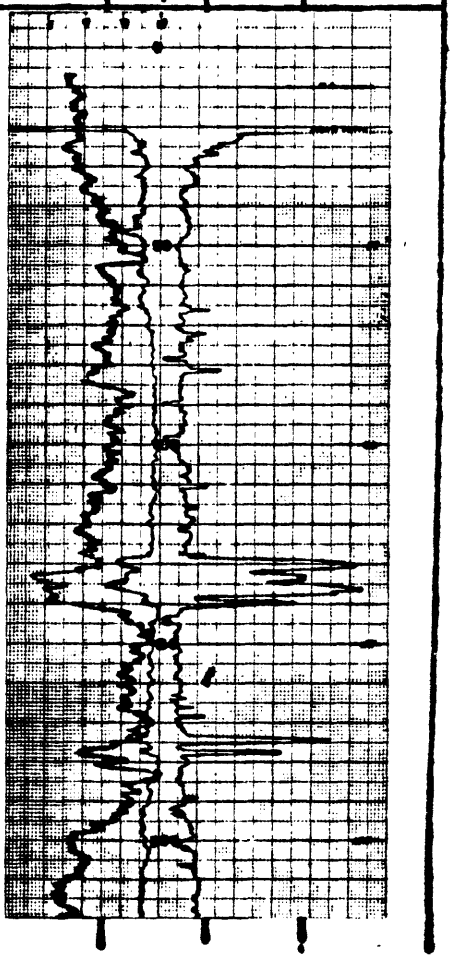
Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

Density (Den): Scale _____ Logging speed _____ fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma, Sp, Res, Den
0-35 ft Sandstone, yellow, fine-grained, unconsolidated		0	0	
35-45 ft Shale, grayish-yellow			10	
45-55 ft Shale, yellowish-gray		50		
55-60 ft Shale, yellow			20	
60-70 ft Shale, gray				
70-125 ft Shale, gray, silty		100	30	
125-130 ft Coal, some gray silty shale				
130-140 ft Coal			40	
140-160 ft Shale, gray		150		
160-170 ft Shale, gray, silty			50	
170-180 ft Shale, black, carbonaceous; some coal				
180-190 ft Shale, dark-gray			60	
190-195 ft Shale, gray		200		
195-205 ft Shale, gray, silty				
205-230 ft Siltstone, gray, clayey			70	



Hole No. DB A-4 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs
230–232 ft Coal 232–238 ft Shale, gray, sandy 238–241 ft Coal 241–245 ft Shale, dark-gray, silty, carbonaceous 245–260 ft Shale, gray, silty 260–275 ft Sandstone, light-gray, very fine grained, soft, shaly 275–285 ft Shale, gray, silty 285–320 ft Sandstone, light-gray, very fine grained, soft, shaly 320–330 ft Shale, gray, silty, sandy 330–345 ft Sandstone, salt-and-pepper gray, very fine grained (Pictured Cliffs) 345–380 ft Shale, gray, very sandy	PC	250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190	Gamma Sp Res Den

Description of core from A-4

Total depth of hole (T.D.): 380.00 ft
Total thickness of coring: 39.55 ft.

Lithologic description	Feet From	Feet To
Interval 1 depth--120.00 - 139.35 ft		
Mixture of mud, clay, and rock fragments, light-brown	120.00	122.65
Sandstone, calcareous, very fine grained, light-gray	122.65	125.40
Sandstone and siltstone, interbedded, calcareous, very fine grained, gray	125.40	125.55
Sandstone, calcareous, very fine grained, light-gray	125.55	125.85
Sandstone and siltstone, interbedded, calcareous, very fine grained, gray; layers of sand and silt as much as 5 mm thick	125.85	126.00
Siltstone, gray; coal fragments as much as 20 mm in diam.	126.00	126.45
Coal, black; shale fragments as much as 35 mm in diam.	126.45	127.95
Siltstone, tan	127.95	128.10
Coal, black; thin layers of silt as much as 2 mm thick	128.10	129.10
Coal, black, laminated; some vitrain	129.10	129.60
Coal, black, laminated; some vitrain	129.60	130.40
Coal, black; shale fragments as much as 30 mm in diam.	130.40	131.45
Shale, carbonaceous, brown, fissile	131.45	131.75
Shale, carbonaceous, light-brown, fissile	131.75	132.15
Shale, carbonaceous, black, fissile; 50 percent coal	132.15	132.45
Coal, black, laminated; shale fragments as much as 35 mm in diam.	132.45	133.65
Siltstone, tan	133.65	133.70

Description of core from A-4 -- continued

Lithologic description	Feet From	Feet To
Coal, black; shale fragments as much as 25 mm in diam.	133.70	133.75
Sandstone, very fine grained, gray; coal fragments as much as 20 mm in diam.	133.75	133.95
Coal, black, laminated; shale fragments as much as 5 mm; some vitrain	133.95	134.90
Shale, carbonaceous, dark-brown	134.90	135.10
Siltstone, gray; coal fragments as much as 25 mm in diam.	135.10	137.90
Coal, black; shale fragments as much as 35 mm in diam.	137.90	139.35

Thickness of interval = 19.35 ft

Thickness of coal in interval - 8.50 ft

Interval 2 depth--276.00 - 296.20 ft

Shale, bentonitic, gray; coal fragments as much as 6 mm in diam.	276.00	280.35
Coal, black; contains less than 5 percent resin particles as much as 6 mm in diam., uniformly dispersed; thin pyrite vein from 286.6 ft to 286.8 ft as much as 1.5 mm thick; thin gypsum vein from 280.8 ft to 281.7 ft as much as 3 mm thick	280.35	287.10
Shale, gray, silty; coal fragments and veins throughout	287.10	287.65
Coal, black; contains less than 5 percent resin	287.65	288.05
Shale, light-gray; possible tonstein	288.05	288.10
Coal, black; contains less than 5 percent resin	288.10	290.50
Coal, dark-gray, silty, very fine grained, sandy	290.50	291.15
Sandstone, very fine grained, light-gray, shaly, bentonitic; coal streaks and veins in upper .35 ft	291.15	296.20

Thickness of interval = 20.20 ft

Thickness of coal in interval = 10.20 ft

DRILL HOLE LOGS

Location Number DB A-5 Date Logged 1-11-79 Surface Elevation (ft) 5771.5

County & State San Juan County, N. M. Location NW¼ Sec. 32, T. 24 N., R. 13 W.

Map Bisti Trading Post, N. M. Drilled depth (ft) 180 Logged depth (ft) 178

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: D. Umshler

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0–15 ft Shale, gray; some dark-brown and black carbonaceous shale mixed with gray shale 15–30 ft Shale, dark-gray 30–39 ft Coal, black 39–41 ft Shale, gray 41–43 ft Coal, black 43–49 ft Shale, gray 49–69 ft Sandstone, light-gray, fine-grained, hard, well-cemented 69–76 ft Shale, dark-gray 76–79 ft Coal, black 79–80 ft Coal, gray 80–82 ft Coal, black 82–94 ft Shale, gray 94–96 ft Coal, black 96–105 ft Shale, gray 105–108 ft Mixture of sandstone, shale and coal, light-gray, gray, and black; fine-grained sandstone 108–135 ft Sandstone, light-gray, medium-grained to fine-grained 135–138 ft Shale, gray 138–140 ft Coal, black 140–145 ft Mixture of shale and coal, gray and black 145–148 ft Coal, black 148–150 ft Shale, gray 150–154 ft Coal, black	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	A-5

Hole No. DB A-5 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
154-180 ft Mixture of sandstone and coal, light-gray and black, fine-grained to very fine grained; very soft shaly coal; probably washed or recirculated (Pictured Cliffs)		250	80				
			90				
		300					
			100				
		350	110				
			120				
		400					
			130				
			140				
		450					
			150				
		500					
			160				
			170				
		550					
			180				
		600					
			190				

DRILL HOLE LOGS

Location Number DB A-6 Date Logged 2-01-79 Surface Elevation (ft) 5796.4

County & State San Juan County, N. M. Location NW¼ Sec. 7, T. 23 N., R. 13 W.

Map The Pillar 3 NE, N. M. Drilled depth (ft) 80 Logged depth (ft) 80

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 20 mv/in. Logging speed 16-17 fpm

Resistivity (Res): Scale 10 ohms/in. Logging speed 16-17 fpm

Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

Density (Den): Scale _____ Logging speed _____ fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs
0-5 ft Shale, red, clinkered 5-16 ft Shale, pink, silty, clinkered 16-30 ft Siltstone, light-brown, shaly 30-40 ft Sandstone, gray, very fine grained, silty, shaly 40-45 ft Shale, gray, silty 45-55 ft Sandstone, gray, fine-grained to very fine grained, silty, shaly (Pictured Cliffs) 55-80 ft Shale, light-gray, very sandy, soft	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	Gamma Sp Res Den

DRILL HOLE LOGS

Location Number DB A-7 Date Logged 2-01-79 Surface Elevation (ft) 5897.7

County & State San Juan County, N. M. Location SW¼ Sec. 7, T. 23 N., R. 13 W.

Map The Pillar 3 NE, N. M. Drilled depth (ft) 120 Logged depth (ft) 120

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Loggers: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 20 mv/in. Logging speed 16-17 fpm

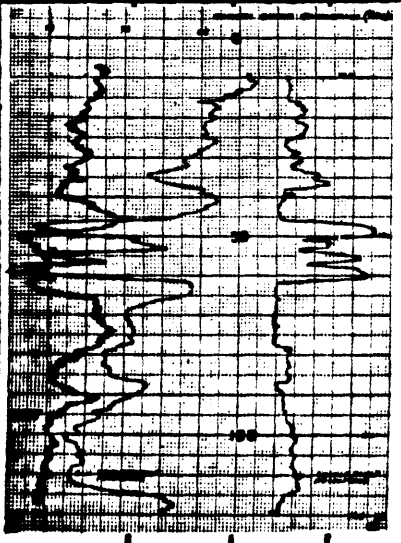
Resistivity (Res): Scale 50 ohms/in. Logging speed 16-17 fpm

Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

Density (Den): Scale _____ Logging speed _____ fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma	Sp	Res	Den
0-5 ft Shale, brownish-gray, silty; yellow streaks 5-10 ft Shale, brown, silty 10-20 ft Shale, brownish-gray, silty; yellow streaks 20-40 ft Siltstone, tan, shaly, hard; red streak at 39.5 ft less than 0.2 foot thick 40-45 ft Shale, gray, silty 45-60 ft Coal 60-78 ft Shale, dark-gray, silty 78-95 ft Sandstone, gray, very fine grained, silty (Pictured Cliffs) 95-120 ft Shale, light-gray, sandy, soft	PC	0 50 100 150 200	0 10 20 30 40 50 60 70				

DRILL HOLE LOGS

Location Number DB A-8 Date Logged 12-22-78 Surface Elevation (ft) 5887.3

County & State San Juan County, N. M. Location NW¼ Sec. 8, T. 23 N., R. 13 W.

Map Tanner Lake, N. M. Drilled depth (ft) 180 Logged depth (ft) 180

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 100 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-4 ft Sand, tan, fine-grained, unconsolidated		0	0	
4-8 ft Shale, brown, silty				
8-19 ft Shale, gray, silty, slightly carbonaceous			10	
19-20 ft Shale, brownish-red, carbonaceous, clinkered		50		
20-20.5 ft Coal, shaly			20	
20.5-23 ft Shale, brown, silty				
23-36 ft Shale, brownish-gray, silty, slightly carbonaceous				
36-44 ft Shale, gray, silty	PC			
44-56 ft Siltstone, white, hard		100	30	
56-61 ft Shale, gray, silty				
61-65 ft Coal				
65-81 ft Shale, gray, silty				
81-83 ft Shale, dark-gray, carbonaceous, coaly			40	
83-86 ft Coal				
86-120 ft Sandstone, salt-and-pepper gray, very fine grained, shaly, soft (Pictured Cliffs)		150	50	
120-180 ft Sandstone and shale mix, gray, silty; very fine grained sandstone			60	
		200		
			70	

DRILL HOLE LOGS

Location Number DB A-9 Date Logged 12-05-78 Surface Elevation (ft) 5912.5

County & State San Juan County, N. M. Location NE¼ Sec. 8, T. 23 N., R. 13 W.

Map Tanner Lake, N. M. Drilled depth (ft) 178 Logged depth (ft) 178

Cored depth (ft) 85 Cored: [x] Yes [ ] No Geologists: J. Fassett

Drilling medium: [ ] Air [ ] Water [x] Foam [ ] Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

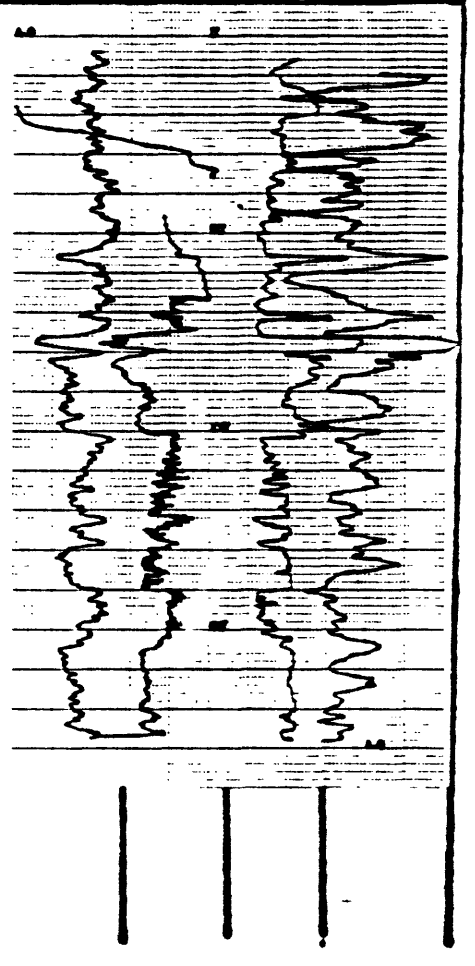
Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 200 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale Logging speed fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0–10 ft Shale, yellowish-gray 10–15 ft Shale, brownish-gray 15–25 ft Sandstone to siltstone, gray, very fine grained 25–30 ft Shale, dark-brown to black 30–35 ft Shale and sandstone, dark-brown to gray, very fine grained sandstone 35–40 ft Shale, green to gray 40–45 ft Siltstone and shale, dark-gray 45–55 ft Shale, dark-gray 55–60 ft Shale and coal, light-gray and black; coal at about 58.0 ft 60–70 ft Shale and siltstone, dark-gray 70–75 ft Coal and carbonaceous siltstone, black 75–80 ft Coal and carbonaceous shale, black 80–85 ft Siltstone and sandstone, black to gray, very fine grained; contains some coal 85–90 ft Sandstone, gray, fine-grained; some coal (Pictured Cliffs) 90–95 ft Sandstone and shale, dark-gray to greenish-gray, fine-grained 95–100 ft Sandstone, gray, medium-grained to fine-grained; some scattered coal 100–120 ft Sandstone and shale, gray to dark-gray, fine-grained to medium-grained	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB A-9 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
120-125 ft Sandstone, gray, very fine grained 125-135 ft Sandstone, dark-gray, fine-grained; contains some shale 135-140 ft Sandstone, gray, fine-grained 140-150 ft Sandstone, dark-gray, fine-grained; some gray shale 150-165 ft Sandstone and shale, gray, very fine grained 165-178 ft No sample returned		250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190				

Description of core from A-9

Total depth of hole (T.D.): 178.00 ft
Total thickness of coring: 25.00 ft

Lithologic description	Feet From	Feet To
Interval 1 depth--25.00 - 30.00 ft		
Siltstone, gray; coal fragments as much as 10 mm in diam.	25.00	25.70
Siltstone, light yellow; oxidation giving yellow appearance	25.70	26.00
Siltstone; coal fragments as much as 2 mm in diam.	26.00	26.35
Siltstone, carbonaceous, dark-gray; coal fragments as much as 15 mm in diam.	26.35	27.70
Siltstone, gray; large coal fragments as much as 40 mm in diam.	27.70	27.95
Siltstone, gray; coal fragments as much as 4 mm in diam.	27.95	28.50
Missing interval	28.50	30.00
Thickness of interval = 5.00 ft		
Thickness of coal in interval = 0.00 ft		
Interval 2 depth--65.00 - 85.00 ft		
Mixture of siltstone, mud, and coal fragments, gray	65.00	65.70
Siltstone, light-gray; gritty feeling	65.70	66.85
Sandstone, very fine grained, gray	66.85	67.15
Siltstone, gray; gritty; coal fragments as much as 15 mm in diam.	67.15	67.30
Sandstone, very fine grained, gray	67.30	67.85
Siltstone, gray, gritty; coal fragments as much as 15 mm in diam.	67.85	68.50
Siltstone, carbonaceous, gray; 5 percent coal	68.50	69.00
Siltstone, carbonaceous, dark-gray; 30 percent coal	69.00	69.25
Siltstone, gray; coal fragments as much as 10 mm in diam.	69.25	70.00

Description of core from A-9 -- continued

Lithologic description	Feet From	Feet To
Siltstone, gray; coal fragments as much as 10 mm in diam.	70.00	70.80
Siltstone, gray; coal fragments as much as 30 mm in diam.	70.80	72.50
Siltstone, calcareous, black to dark-gray; 25 percent coal	72.50	72.55
Coal, black, laminated	72.55	72.70
Siltstone, dark-gray; coal fragments as much as 20 mm in diam.	72.70	73.30
Coal, black, laminated; siltstone fragments as much as 20 mm in diam.	73.30	74.40
Siltstone, carbonaceous, black to dark-gray	74.40	74.90
Siltstone, gray; long coal fragments as much as 30 mm in length	74.90	75.45
Siltstone, carbonaceous, dark-gray to black; 5 percent coal	75.45	76.00
Coal, black, laminated; shale fragments as much as 5 mm in diam.	76.00	79.00
Coal, black, laminated	79.00	79.45
Sandstone, fine-grained, gray to dark-brown; 40 percent coal	79.45	79.75
Coal, black, laminated	79.75	80.75
Siltstone, carbonaceous, dark-gray; 50 percent coal	80.75	80.80
Coal, black, laminated	80.80	81.00
Clay-shale, light-gray, fissile; coal fragments as much as 10 mm in diam.	81.00	81.25
Clay-shale, light-gray, clean, fissile	81.25	81.40
Coal, black; thin clay-shale beds as much as 1 mm thick	81.40	81.50
Coal, black, laminated, clean	81.50	81.70
Sandstone, calcareous, fine-grained, light-tan; coal fragments; thin coal layers as much as 1 mm thick	81.70	82.60
Sandstone, calcareous, fine-grained, light-tan, well-sorted	82.60	85.00

Thickness of interval = 20.00 ft

Thickness of coal in interval = 6.20 ft

DRILL HOLE LOGS

Location Number DB A-10 Date Logged 11-14-78 Surface Elevation (ft) 5931.7

County & State San Juan County, N. M. Location NW¼ Sec. 9, T. 23 N., R. 13 W.

Map Tanner Lake, N. M. Drilled depth (ft) 195 Logged depth (ft) 190

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

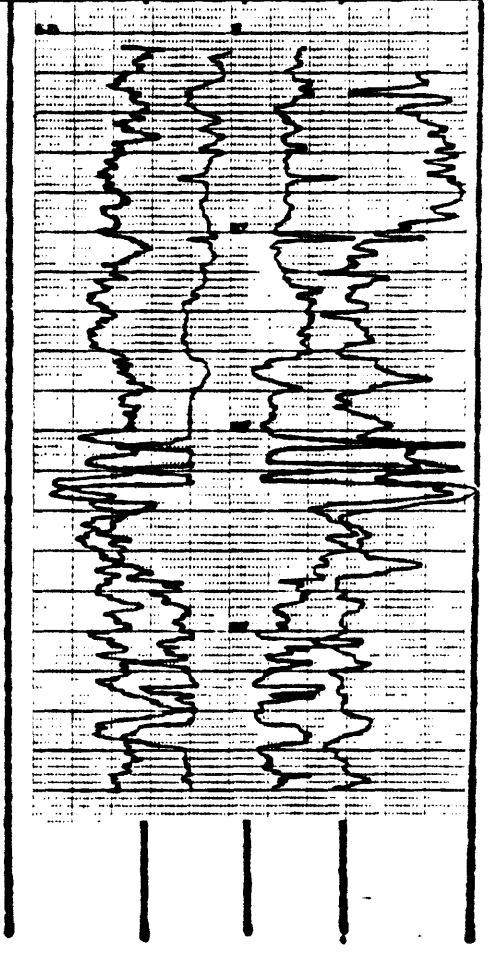
Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-3 ft Sands, tan, medium-grained, unconsolidated		0	0	
3-5 ft Shale, gray, silty				
5-6 ft Shale, black, carbonaceous				
6-7 ft Shale, gray, silty			10	
7-12 ft Siltstone, tan				
12-14 ft Siltstone, gray		50		
14-15 ft Clinker, red, shaly				
15-20 ft Shale, gray, silty			20	
20-25 ft Shale, black, carbonaceous				
25-27 ft Coal, black, shaly and poor quality				
27-30 ft Shale, black to brown, carbonaceous; coal streaks		100	30	
30-36 ft Shale, brownish-gray, silty				
36-51 ft Shale, alternating light-gray and dark-gray, greasy, soft	PC		40	
51-53 ft Coal				
53-60 ft Shale, gray, soft, silty		150		
60-61 ft Siltstone, grayish-brown, hard, siderite-cemented			50	
61-65 ft Shale, gray, silty				
65-83 ft Sandstone, light-gray, fine-grained, silty, shaly; alternating hard and soft			60	
83-104 ft Shale, gray, silty; sand streaks		200		
104-105 ft Coal				
105-135 ft Mixture of sandstone, shale and coal			70	



Hole No. DB A-10 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
135-171 ft Sandstone, salt-and-pepper gray, very fine grained, shaly (Pictured Cliffs) 171-195 ft Mixture of sandstone and shale; gray shale with salt-and-pepper sandstone, very fine-grained, soft		250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190				

DRILL HOLE LOGS

Location Number DB A-11 Date Logged 11-16-78 Surface Elevation (ft) 5955.3

County & State San Juan County, N. M. Location NE¼ Sec. 9, T. 23 N., R. 13 W.

Map Tanner Lake, N. M. Drilled depth (ft) 195 Logged depth (ft) 194

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 100 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-6 ft Sand, light-brown, fine-grained, unconsolidated		0	0	
6-17 ft Shale, brown, silty				
17-22 ft Shale, tan, very sandy				
22-38 ft Sandstone, white, fine-grained to medium-grained, shaly; siderite streaks		50	10	
38-45 ft Shale, gray; hard sandy streaks				
45-51 ft Coal, shaly			20	
51-63 ft Shale, gray; sandy streaks				
63-64 ft Shale, dark-gray, carbonaceous				
64-73 ft Coal; interbedded in carbonaceous shale		100	30	
73-78 ft Shale, gray, silty				
78-80 ft Coal, shaly				
80-83 ft Shale, gray, silty			40	
83-84 ft Coal, shaly				
84-95 ft Shale, gray, silty				
95-96 ft Coal, shaly				
96-136 ft Shale, gray, silty	PC	150	50	
136-143 ft Coal				
143-145 ft Shale, black, carbonaceous				
145-149 ft Coal			60	
149-150 ft Sandstone, reddish-brown, very fine grained to fine-grained, shaly		200		
150-152 ft Shale, gray, silty				
152-195 ft Sandstone, salt-and-pepper gray, medium-grained to fine-grained, soft, shaly (Pictured Cliffs)			70	

DRILL HOLE LOGS

Location Number DB A-12 Date Logged 11-17-78 Surface Elevation (ft) 5981.1

County & State San Juan County, N. M. Location NW¼ Sec. 10, T. 23 N., R. 13 W.

Map Tanner Lake, N. M. Drilled depth (ft) 205 Logged depth (ft) 203

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 400 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 200 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-5 ft Sand, light-brown, fine-grained, unconsolidated		0	0	
5-9 ft Shale, gray, silty				
9-12 ft Shale, black				
12-16 ft Shale, tan, silty			10	
16-21 ft Shale, gray, silty, hard				
21-23 ft Shale, red, sandy; possible burned coal		50		
23-24 ft Shale, gray, silty			20	
24-27 ft Shale, black, coaly				
27-31 ft Shale, tan, silty				
31-33 ft Shale, dark-gray, silty				
33-34 ft Shale, red, sandy; possible burned coal		100	30	
34-36 ft Shale, dark-brown, silty				
36-42 ft Shale, yellowish-brown, silty with hard streaks			40	
42-45 ft Shale, light-gray, silty with hard streaks		150		
45-54 ft Sandstone, gray to white, fine-grained to very fine grained, soft, shaly; yellow streaks			50	
54-59 ft Sandstone, salt-and-pepper gray, bery fine grained, shaly			60	
59-61 ft Coal		200		
61-68 ft Shale, gray, greasy	PC			
68-72 ft Coal				
72-73 ft Shale, gray, greasy				
73-75 ft Coal				
75-102 ft Shale, dark-gray to gray, greasy, silty			70	

Hole No. DB A-12 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
102-106 ft Coal 106-108 ft Shale, gray, greasy, silty 108-113 ft Coal 113-119 ft Shale, gray, greasy, silty 119-122 ft Shale, brown to gray, coaly, carbonaceous 122-130 ft Shale, gray, greasy, silty 130-133 ft Shale, dark-gray, hard, silty 133-136 ft Sandstone, gray, very fine grained, shaly 136-137 ft Shale, brown, carbonaceous 137-148 ft Shale, gray, greasy, silty 148-153 ft Shale, gray to black, carbonaceous, sandy, coaly 153-156 ft Shale, gray, greasy, silty 156-158 ft Shale, brown, carbonaceous, sandy 158-164 ft Sandstone, salt-and-pepper gray, very fine grained, shaly 164-175 ft Shale, gray, silty, hard 175-176 ft Shale, brown, carbonaceous, silty 176-179 ft Siltstone, salt-and-pepper gray, shaly 179-182 ft Shale, gray, greasy, silty; mixed with brown, carbonaceous, sandy shale 182-184 ft Shale, brown, carbonaceous, sandy 184-190 ft Coal 190-192 ft Shale, brown, carbonaceous 192-194 ft Shale, gray, greasy, silty 194-196 ft Coal 196-198 ft Shale, brown, carbonaceous 198-205 ft Sandstone, salt-and-pepper gray, very fine grained, shaly (Pictured Cliffs)		250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190				

DRILL HOLE LOGS

Location Number DB A-13 Date Logged 11-27-78 Surface Elevation (ft) 5993.7

County & State San Juan County, N. M. Location NE¼ Sec. 10, T. 23 N., R. 13 W.

Map Tanner Lake, N. M. Drilled depth (ft) 249 Logged depth (ft) 249

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

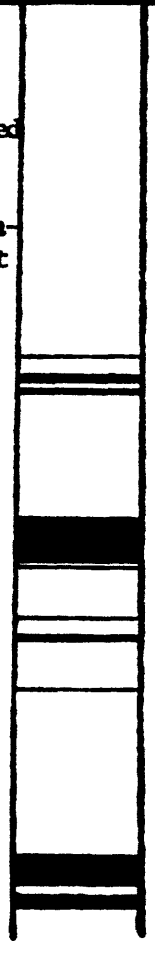
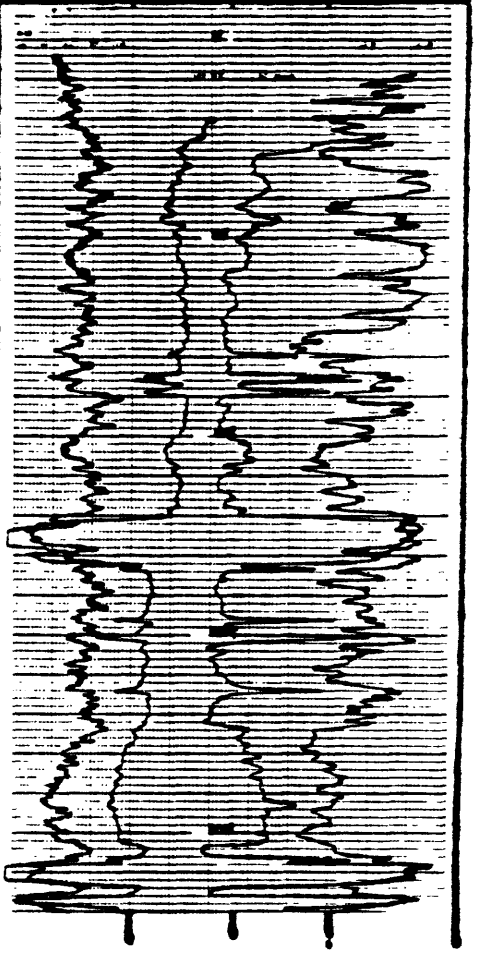
Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0–18 ft Sand, tan, fine-grained, unconsolidated 18–22 ft Shale, tan, silty 22–25 ft Sandstone, tan, very fine grained to fine-grained, shaly, silty 25–49 ft Shale, yellow-gray and yellow-brown, silty; occasional carbona-ceous streaks less than 0.25 ft thick 49–53 ft Coal, brownish-black, soft and weathered 53–55 ft Shale, brownish-gray, soft, silty 55–68 ft Shale, gray, greasy 68–73 ft Shale, blue-gray, hard, brittle 73–79 ft Shale, gray, greasy, sandy, very fine grained 79–81 ft Siltstone, light-gray, hard 81–84 ft Shale, light-gray, very fine grained, sandy, silty, slightly carbonaceous 84–86 ft Coal 86–88 ft Shale, black, coaly 88–90 ft Coal 90–91 ft Shale, dark-brown, carbonaceous 91–100 ft Shale, gray, greasy; silty and hard, brittle alternating 100–101 ft Shale, brown, silty, carbona-ceous		0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB A-13 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma / Sp / Res / Den
101-107 ft Sandstone, salt-and-pepper gray, very fine grained, shaly	PC			
107-120 ft Shale, gray, hard, brittle				
120-133 ft Coal		250	80	
133-150 ft Shale, gray, greasy, silty				
150-152 ft Coal				
152-164 ft Shale, gray, greasy, silty			90	
164-166 ft Coal				
166-175 ft Shale, gray		300		
175-177 ft Siltstone, salt-and-pepper gray, brittle			100	
177-193 ft Sandstone, salt-and-pepper gray, very fine grained, shaly, coaly at top				
193-195 ft Shale, dark-gray, hard				
195-197 ft Shale, yellow-brown, bright yellow stain or jointing		350	110	
197-204 ft Sandstone, salt-and-pepper gray, very fine grained, soft, shaly				
204-219 ft Coal			120	
219-240 ft Shale and sandstone, light-gray shale and salt-and-pepper gray sandstone, very fine grained, soft, shaly (Pictured Cliffs)		400		
			130	
			140	
		450		
			150	
		500		
			160	
			170	
		550		
			180	
		600		
			190	

DRILL HOLE LOGS

Location Number DB A-14 Date Logged 11-28-78 Surface Elevation (ft) 5971.9

County & State San Juan County, N. M. Location NW¼ Sec. 11, T. 23 N., R. 13 W.

Map Tanner Lake, N. M. Drilled depth (ft) 225 Logged depth (ft) 222

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: D. Umshler

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

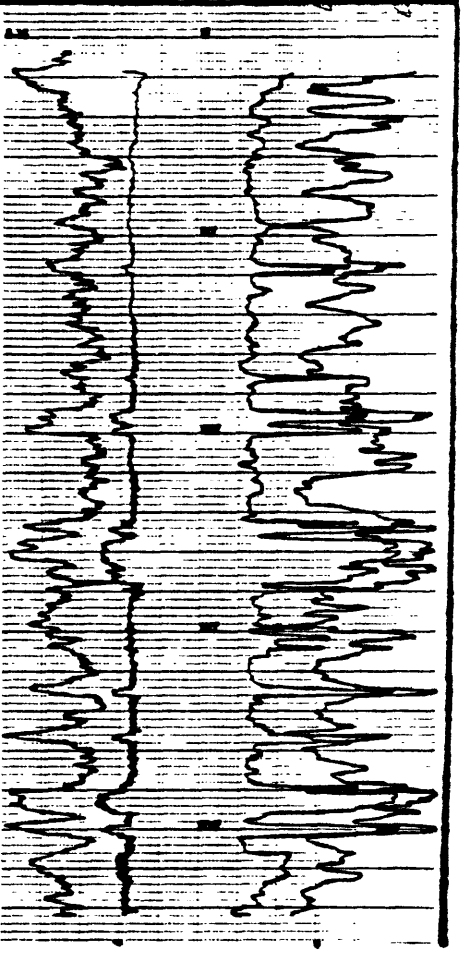
Spontaneous potential (sp): Scale 400 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-3 ft Shale, light-gray 3-15 ft Sandstone, light-gray, fine-grained, shaly, soft 15-35 ft Sandstone, orange-brown, fine-grained 35-60 ft Shale, gray 60-63 ft Coal, black, very hard, silty 63-73 ft Shale, medium-gray to dark-gray 73-76 ft Coal, black, very shaly, soft 76-90 ft Shale, gray, silty 90-97 ft Shale, dark-gray, silty 97-103 ft Coal, black 103-125 ft Shale, gray, soft 125-142 ft Coal, black 142-147 ft Clay, gray; shale, black, carbonaceous, silty 147-160 ft Sandstone, light-gray, fine-grained to medium-grained 160-170 ft Shale, gray 170-182 ft Siderite, light-brown, very fine grained 182-192 ft Shale, gray 192-207 ft Coal, black 207-209 ft Shale, dark-gray 209-225 ft Sandstone, salt-and-pepper gray, medium-grained to coarse-grained (Pictured Cliffs)	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	

DRILL HOLE LOGS

Location Number DB A-15 Date Logged 11-28-78 Surface Elevation (ft) 6029.5

County & State San Juan County, N. M. Location NW¼ Sec. 1, T. 23 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 425 Logged depth (ft) 414

Cored depth (ft) 295 Cored: [x] Yes [ ] No Geologists: R. Jentgen

Drilling medium: [ ] Air [ ] Water [x] Foam [ ] Mud Logger: Water Resources Divisio

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale Logging speed fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs
0-10 ft Sandstone, tan, fine-grained to medium-grained; unconsolidated alluvium		0	0	Gamma Sp Res Den
10-15 ft Sandstone, white, medium-grained; unconsolidated alluvium			10	
15-20 ft Sandstone, tan, coarse-grained; unconsolidated alluvium		50		
20-35 ft Shale, brown, sandy			20	
35-45 ft Shale, brown, silty				
45-55 ft Shale, gray, greasy, silty				
55-60 ft Shale, gray, silty				
60-85 ft Sandstone, light-gray, very fine grained, silty, shaly		100	30	
85-105 ft Sandstone, gray, very fine grained, silty, shaly				
105-106 ft Shale, brown, carbonaceous				
106-115 ft Sandstone, gray, very fine grained, silty, shaly			40	
115-125 ft Shale, gray, silty		150		
125-150 ft Sandstone, white, very fine grained, silty, shaly			50	
150-155 ft Shale, brown, carbonaceous				
155-165 ft Shale, white, silty; very fine grained sand			60	
165-168 ft Shale, brown, carbonaceous		200		
168-190 ft Shale, gray, silty; very fine grained sand				
190-193 ft Coal, black, shaly, dirty			70	

Hole No. DB A-15 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
193–194 ft Shale, brown, carbonaceous 194–198 ft Coal, black, shaly, dirty 198–225 ft Shale, dark-gray, silty, sandy 225–231 ft Mixture of coal and carbonaceous shale 231–235 ft Shale, light-gray, silty, sandy 235–265 ft Sandstone, salt-and-pepper gray, very fine grained, silty, shaly 265–275 ft Coal 275–279 ft Sandstone, brown, very fine grained, shaly 279–280 ft Shale, gray, silty 280–390 ft No returns (Pictured Cliffs-374 ft)		250 300 350	80 90 100 110	
390–410 ft Shale, greenish-gray, silty	PC	400	120 130	
410–425 ft Sandstone, salt-and-pepper gray, very fine grained, shaly		450 500 550 600	140 150 160 170 180 190	

Description of core from A-15

Total depth of hole (T.D.): 425.00 ft
Total thickness of coring: 52.40 ft

Lithologic description	Feet From	Feet To
Interval 1 depth--190.00 - 200.00 ft		
Siltstone, gray; fragments of very fine grained sandstone, coal, clay balls, and carbonaceous shale as much as 30 mm in diam.	190.00	193.80
Coal, black, dull, clean, laminated	193.80	194.60
Coal, black, shaly, laminated	194.60	195.10
Siltstone, dark-gray, carbonaceous	195.10	195.80
Siltstone, dark-gray; coal fragments	195.80	197.70
Coal, black, dull, laminated	197.70	198.20
Coal, black	198.20	199.45
Coal, grayish-black; 45 percent shell fragments	199.45	199.50
Coal, black	199.50	199.70
Siltstone, gray; coal fragments	199.70	199.80
Coal, black	199.80	200.00
Thickness of interval = 10.00 ft		
Thickness of coal in interval = 3.50 ft		
Interval 2 depth--248.00 - 257.40 ft		
Siltstone, gray; coal fragments	248.00	248.85
Sandstone, calcareous, very fine grained, light-gray; gypsum veins; calcareous cement; coal fragments	248.85	249.95
Siderite, light-brown, very hard	249.95	250.15
Sandstone, very fine grained, light-gray; contains some coal fragments; very thin siltstone layers as much as 2 mm thick	250.15	253.50
Siltstone, gray; large coal fragments; lumps of carbonaceous siltstone	253.50	254.80
Sandstone, calcareous, very fine grained, light-gray; some very thin siltstone layers as much as 5 mm thick; coal fragments	254.80	257.20
Siltstone, gray; small coal fragments	257.20	257.40
Thickness of interval = 9.40 ft		
Thickness of coal in interval = 0.00 ft		

Description of core from A-15 — continued

Lithologic description	Feet From	Feet To
Interval 3 depth—262.00 - 295.00 ft		
Coal, black, dull, resinous, laminated	262.00	265.90
Siltstone, carbonaceous, gray; thinly laminated with coal as much as 1 mm thick	265.90	269.10
Coal, grayish-black, thinly laminated with carbonaceous siltstone as much as 1 mm thick	269.10	269.55
Coal, black, dull, laminated, clean	269.55	269.80
Coal, black, dull; large siltstone fragments	269.80	270.30
Coal, black, dull, clean, hard	270.30	270.60
Coal, black, laminated; layer of gypsum at 271.60 ft, 2 mm thick	270.60	272.50
Missing interval	272.50	273.00
Coal, black, laminated	273.00	273.70
Tonsteins, light-brown; layer 15 mm thick	273.70	273.75
Coal, black, laminated, clean	273.75	275.90
Coal, black, laminated, dull, clean	275.90	276.55
Siltstone, gray; coal fragments	276.55	277.70
Siltstone, carbonaceous, dark-gray; as much as 30 percent coal	277.70	278.05
Coal, black, laminated, as much as 5 percent siltstone fragments	278.05	279.40
Tonsteins, light-brown	279.40	279.45
Coal, black, laminated, clean; tonsteins layer at 280.70 ft, 3 mm thick	279.45	282.55
Tonsteins, light-brown; curved stacks of kaolinite vermicules	282.55	282.65
Coal, black, dull, hard	282.65	282.95
Coal, black, laminated, very brittle	282.95	283.45
Missing interval	283.45	284.00
Coal, black, laminated	284.00	284.35
Coal, black; as much as 25 percent siltstone	284.35	284.75
Siltstone, gray; coal layers every 1 mm, 1 mm thick	284.75	284.85
Coal, black; as much as 40 percent siltstone	284.85	284.95
Siltstone, gray; coal layers, 1 mm thick; coal fragments	284.95	285.00

Description of core from A-15 -- continued

Lithologic description	Feet From	Feet To
Coal, black, laminated; siltstone fragments as much as 8 mm in diam.	285.00	285.80
Siltstone, gray; coal fragments as much as 3 mm in diam.	285.80	286.30
Clay-shale, light-gray; as much as 5 percent coal fragments	286.30	286.45
Shale, carbonaceous, gray, fissile; coal fragments as much as 10 mm in diam.	286.45	286.55
Clay-shale, light-gray; as much as 5 percent coal fragments	286.55	286.65
Coal, black, laminated	286.65	286.80
Coal, black, hard; littered with small shale fragments as much as 1 mm in diam.	286.80	286.95
Siltstone, carbonaceous, gray; 10 percent coal fragments	286.95	287.00
Clay-shale, light-gray; as much as 5 percent coal fragments	287.00	287.10
Coal, black, laminated, clean; siltstone layers at 288.35 ft, 288.40 ft, and 288.45 ft as much as 3 mm thick	287.10	288.55
Siltstone, carbonaceous, dark-gray; 30 percent coal	288.55	288.65
Siltstone, gray; 10 percent coal	288.65	288.70
Coal, black, laminated	288.70	289.10
Siltstone, carbonaceous, dark-gray; 40 percent coal	289.10	289.50
Coal, black, laminated; 10 percent siltstone	289.50	290.25
Coal, black, hard; 5 percent siltstone	290.25	290.85
Coal, black, laminated	290.85	292.00
Siltstone, gray; thin coal layers as much as 2 mm thick	292.00	292.40
Siltstone, carbonaceous, blackish-dark gray; 40 percent coal	292.40	292.50
Coal, black, laminated	292.50	292.80
Siltstone, carbonaceous, dark-gray; 30 percent coal	292.80	293.00
Siltstone, dark-gray; 5 percent coal	293.00	294.10
Siltstone, gray; coal fragments	294.10	294.50
Missing interval	294.50	295.00

Thickness of interval = 33.00 ft

Thickness of coal in interval = 22.65 ft

DRILL HOLE LOGS

Location Number DB A-16 Date Logged 1-26-79 Surface Elevation (ft) 5910.4

County & State San Juan County, N. M. Location NE¼ Sec. 1, T. 23 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 260 Logged depth (ft) 260

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 50 mv/in. Logging speed 16-17 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 16-17 fpm

Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

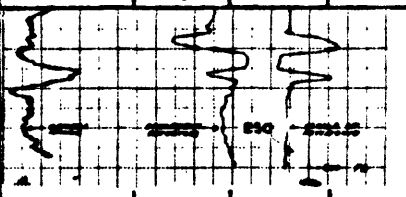
Density (Den): Scale _____ Logging speed _____ fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs
0-15 ft Shale, tan, silty 15-17 ft Siltstone, tan, shaly 17-86 ft Sandstone, light-gray, very fine grained, silty, shaly		0 10 50 20	0 10 20	Gamma Sp Res Den
86-88 ft Coal 88-94 ft Shale, dark-gray, carbonaceous, silty 94-100 ft Shale, gray, silty; carbonaceous streaks less than 13 mm thick 100-150 ft Siltstone, brownish-gray, shaly		100	30 40	
150-170 ft Coal		150	50	
170-175 ft Shale, brownish-gray, silty 175-197 ft Sandstone, salt-and-pepper light gray, very fine grained, shaly 197-200 ft Coal 200-220 ft Sandstone, light-gray to salt-and-pepper gray, very fine grained, shaly, soft		200	60 70	

Hole No. DB A-16 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
220-238 ft Coal 238-240 ft Shale, dark-brown, carbonaceous 240-260 ft Sandstone, white grading to light-gray, very fine grained, soft, shaly (Pictured Cliffs)	PC	250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190				

DRILL HOLE LOGS

Location Number DB A-17 Date Logged 11-29-78 Surface Elevation (ft) 6015.0

County & State San Juan County, N. M. Location NW¼ Sec. 1, T. 23 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 400 Logged depth (ft) 393

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

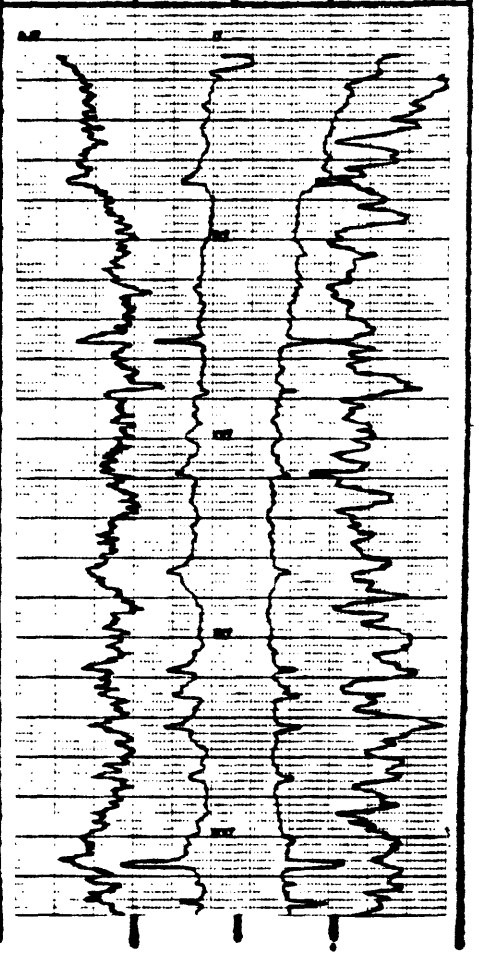
Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs
0-30 ft Sand, tan, fine-grained, unconsolidated		0	0	Gamma Sp Res Den
30-35 ft Sandstone, light-brown, very fine grained, shaly			10	
35-50 ft Shale, light-gray, hard, sandy		50		
50-66 ft Shale, gray, silty			20	
66-68 ft Coal				
68-125 ft Shale, gray, silty		100	30	
125-128 ft Shale, dark-brown, carbonaceous				
128-168 ft Shale, gray, silty			40	
		150		
168-170 ft Shale, dark-brown, carbonaceous			50	
170-180 ft Shale, gray, silty				
180-190 ft Shale, dark-brown, carbonaceous, coaly			60	
190-225 ft Shale, dark-gray, silty		200		
			70	



Hole No. DB A-17 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
225–228 ft Coal				
228–230 ft Shale, dark-gray, carbonaceous				
230–238 ft Coal				
238–260 ft Shale, dark-brown, carbonaceous, sandy, coaly		250	80	
260–295 ft Siltstone, salt-and-pepper gray, shaly, hard			90	
295–315 ft Shale, gray, greasy		300		
315–325 ft Coal			100	
325–340 ft Siltstone, salt-and-pepper gray to brown, hard				
340–350 ft Sandstone, salt-and-pepper gray, very fine grained, shaly (Pictured Cliffs)	PC	350	110	
350–355 ft Coal				
355–370 ft Sandstone, salt-and-pepper gray, very fine grained, very hard			120	
370–372 ft Coal		400		
372–390 ft Sandstone, salt-and-pepper gray, very fine grained, shaly, soft			130	
390–400 ft Shale, dark-gray				
			140	
		450		
			150	
		500		
			160	
			170	
		550		
			180	
		600		
			190	

DRILL HOLE LOGS

Location Number DB A-18 **Date Logged** 1-26-79 **Surface Elevation (ft)** 5904.6

County & State San Juan County, N. M. **Location** SE¼ **Sec.** 1, **T.** 23 N., **R.** 13 W.

Map Alamo Mesa West, N. M. **Drilled depth (ft)** 260 **Logged depth (ft)** 260

Cored depth (ft) _____ **Cored:** ☐ Yes ☒ No **Geologists:** R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud **Logger:** Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): **Scale** 50 mv/in. **Logging speed** 16-17 fpm

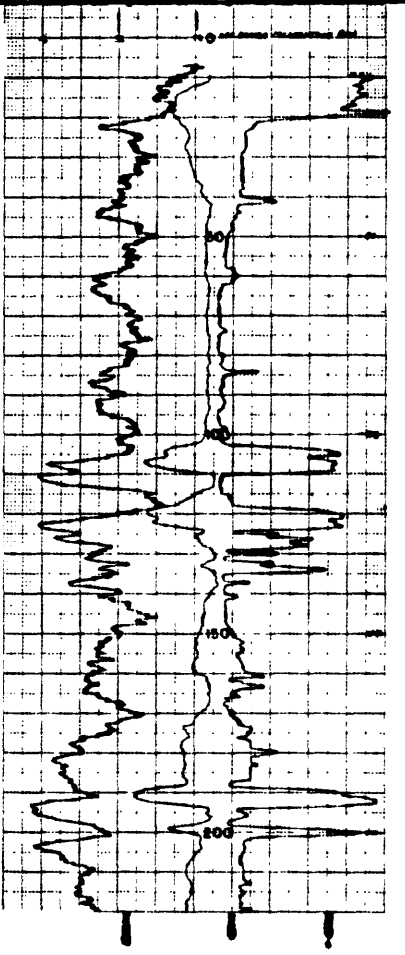
Resistivity (Res): **Scale** 20 ohms/in. **Logging speed** 16-17 fpm

Gamma (G): **Scale** 10 cps/in. * **Logging speed** 16-17 fpm

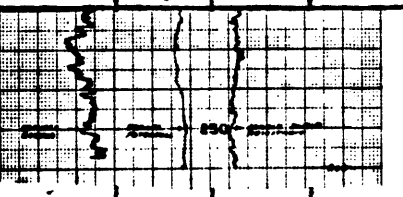
Density (Den): **Scale** _____ **Logging speed** _____ fpm

Neutron (Neu): **Scale** _____ **Logging speed** _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma, Sp, Res, Den
0-15 ft Shale, tan, silty 15-30 ft Shale, dark-brown, silty 30-35 ft Shale, gray, silty 35-60 ft Siltstone, light-gray to gray, shaly 60-65 ft Shale, dark-gray, silty 65-102 ft Siltstone, gray, shaly 102-111 ft Coal 111-115 ft Shale, dark-gray, carbonaceous, sandy 115-120 ft Coal, shaly 120-135 ft Coal 135-140 ft Shale, dark-gray, carbonaceous 140-150 ft Sandstone, salt-and-pepper gray, hard 150-165 ft Shale, gray, silty, sandy 165-195 ft Shale, gray, silty 195-215 ft Sandstone, salt-and-pepper gray to black, shaly, soft (Pictured Cliffs)	PC	0 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB A-18 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
215-250 ft Shale, light-gray, silty, very bentonitic		250	80				
			90				
		300					
			100				
		350	110				
			120				
		400					
			130				
			140				
		450					
			150				
		500					
			160				
			170				
		550					
			180				
		600					
			190				

DRILL HOLE LOGS

Location Number DB A-19 **Date Logged** 1-30-79 **Surface Elevation (ft)** 5885.3

County & State San Juan County, N. M. **Location** SW¼ **Sec.** 7, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. **Drilled depth (ft)** 120 **Logged depth (ft)** 120

Cored depth (ft) _____ **Cored:** ☐ Yes ☒ No **Geologists:** R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud **Logger:** Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 20 mv/in. **Logging speed** 18 fpm

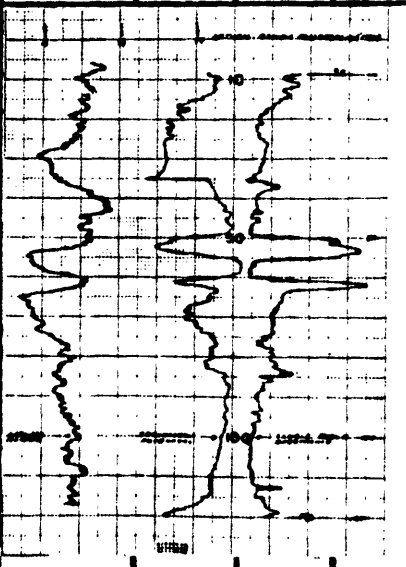
Resistivity (Res): Scale 20 ohms/in. **Logging speed** 18 fpm

Gamma (G): Scale 10 cps/in. * **Logging speed** 18 fpm

Density (Den): Scale _____ **Logging speed** _____ fpm

Neutron (Neu): Scale _____ **Logging speed** _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma	Sp	Res	Den
0-10 ft Sand, tan, very fine grained, unconsolidated 10-25 ft Sand, dark-brown, very fine grained, carbonaceous, shaly 25-40 ft Sand, light-brown, medium-grained to fine-grained 40-45 ft Sand, brown, coarse-grained to medium-grained, poorly consolidated 45-60 ft Sand, brown, very fine grained, very clayey (quicksand) 60-65 ft Shale, gray, silty 65-66 ft Coal 66-85 ft Shale, gray, silty 85-120 ft Sandstone, light-gray, very fine grained, shaly, soft (Pictured Cliffs)	PC	0 50 100 150 200	0 10 20 30 40 50 60 70				

DRILL HOLE LOGS

Location Number DB A-20 Date Logged 1-31-79 Surface Elevation (ft) 5894.1

County & State San Juan County, N. M. Location SE¼ Sec. 7, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 140 Logged depth (ft) 140

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 20 mv/in. Logging speed 16-17 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 16-17 fpm

Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

Density (Den): Scale _____ Logging speed _____ fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma, Sp, Res, Den
0-10 ft Sand, tan, very fine grained, shaly, poorly consolidated		0	0	
10-17 ft Siltstone, white, shaly				
17-35 ft Coal, shaly			10	
35-42 ft Siltstone, gray, shaly				
42-45 ft Shale, dark-gray, carbonaceous				
45-52 ft Siltstone, light-gray, shaly		50		
52-61 ft Coal			20	
61-65 ft Shale, dark-gray, carbonaceous				
65-71 ft Siltstone, gray, shaly				
71-80 ft Coal				
80-105 ft Sandstone, salt-and-pepper gray, very fine grained, shaly, silty, hard (Pictured Cliffs)	PC	100	30	
105-140 ft Sandstone, light-gray, very fine grained, soft, shaly			40	
		150		
			50	
			60	
		200		
			70	

DRILL HOLE LOGS

Location Number DB A-21 Date Logged 1-31-79 Surface Elevation (ft) 5917.3

County & State San Juan County, N. M. Location SW¼ Sec. 8, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 160 Logged depth (ft) 160

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 50 mv/in. Logging speed 16-17 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 16-17 fpm

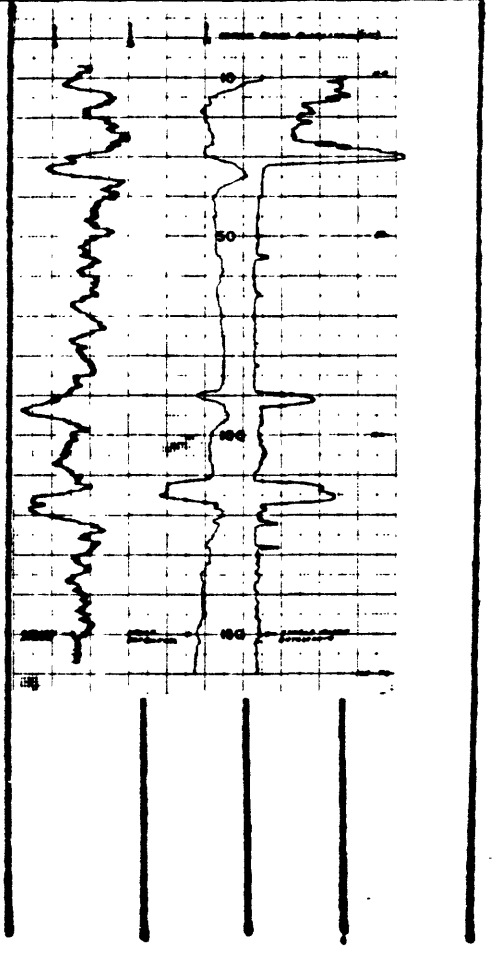
Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

Density (Den): Scale _____ Logging speed _____ fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma Sp Res Den
0-3 ft Sand, tan, fine-grained, unconsolidated, clayey		0	0	
3-12 ft Shale, black, coaly				
12-22 ft Siltstone, gray, shaly				
22-38 ft Coal		50	10	
38-53 ft Shale, gray, silty				
53-55 ft Coal				
55-58 ft Siltstone, gray, shaly, hard				
58-63 ft Siltstone, brown, carbonaceous, shaly		100	20	
63-85 ft Siltstone, gray, shaly				
85-93 ft Coal				
93-96 ft Sandstone, salt-and-pepper gray, very fine grained, hard		150	30	
96-110 ft Sandstone, grayish-white, very fine grained, soft, shaly				
110-115 ft Shale, light-gray, sandy, silty			40	
115-118 ft Coal	PC			
118-145 ft Shale, dark-brownish gray, silty		200	50	
145-155 ft Shale, brownish-gray, very sandy				
155-160 ft Sandstone, light-gray, very fine grained, soft, shaly (Pictured Cliffs)			60	
			70	



DRILL HOLE LOGS

Location Number DB A-22 Date Logged 10-18-78 Surface Elevation (ft) 5917.0

County & State San Juan County, N. M. Location SE¼ Sec. 8, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 195 Logged depth (ft) 188

Cored depth (ft) 115 Cored: [x] Yes [ ] No Geologists: R. Fulton, N. Wingard

Drilling medium: [ ] Air [ ] Water [x] Foam [ ] Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale Logging speed fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs
0–13 ft Sandstone, brown, very fine grained, unconsolidated		0	0	Gamma Sp Res Den
13–20 ft Sandstone, brown, fine-grained to medium-grained, unconsolidated			10	
20–32 ft Sandstone, brown, coarse-grained, unconsolidated		50		
32–70 ft Sandstone, brown, very coarse grained, unconsolidated			20	
70–80 ft Sandstone, brown, very coarse grained, carbonaceous, conglomerate				
80–115 ft Sandstone, brown, very coarse grained		100	30	
115–155 ft Coal (Probable Pictured Cliffs top picked from geophysical log at 126')	PC		40	
155–170 ft Coal and sand, very fine grained to fine-grained, unconsolidated		150	50	
170–195 ft Coal and sandy clay, gray, very fine grained			60	
		200		
			70	

Description of core from A-22

Total depth of hole (T.D.): 195.00 ft
Total thickness of coring: 20.00 ft

Lithologic description	Feet From	Feet To
Interval 1 depth--95.00 - 115.00 ft		
Mixture of mud, silt, and coal, gray	95.00	96.25
Siltstone, carbonaceous, dark-gray; 25 percent coal	96.25	96.80
Coal, black, laminated; siltstone fragments as much as 20 mm in diam.	96.80	102.70
Shale, carbonaceous, dark-gray, fissile; 40 percent coal	102.70	102.90
Siltstone, gray; coal fragments as much as 25 mm in diam.	102.90	105.70
Shale, carbonaceous, dark-gray, fissile	105.70	106.30
Clay-shale, brownish-gray; coal fragments as much as 25 mm in diam.	106.30	109.10
Coal, black; shale fragments as much as 30 mm in diam.	109.10	109.90
Coal, black, shale fragments as much as 10 mm in diam.	109.90	113.30
Missing interval	113.30	114.00
Siltstone, gray	114.00	114.30
Siltstone, dark-gray; coal fragments as much as 30 mm in diam.	114.30	114.55
Siltstone, gray; coal fragments as much as 5 mm in diam.	114.55	115.00

Thickness of interval = 20.00 ft

Thickness of coal in interval = 10.10 ft

DRILL HOLE LOGS

Location Number DB A-23 Date Logged 11-06-78 Surface Elevation (ft) 5881.7

County & State San Juan County, N. M. Location NW¼ Sec. 9, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 255 Logged depth (ft) 253

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: P. Lambert, R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

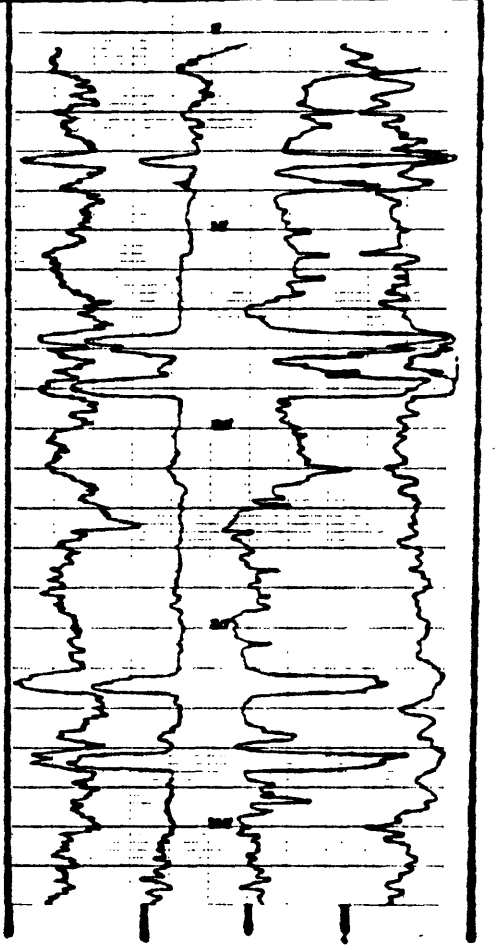
Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-13 ft Sand, tan, medium grained to very coarse grained, unconsolidated 13-19 ft Shale, brown, silty 19-20 ft Shale, dark-brown, sandy, carbonaceous 20-21 ft Sandstone, white, very fine grained, soft, shaly 21-22 ft Sandstone, salt-and-pepper gray, very fine grained, hard 22-24 ft Shale, gray to brown 24-25 ft Sandstone, gray, very fine grained, silty 25-27 ft Shale, gray to yellow, silty 27-31 ft Shale, gray 31-35 ft Coal 35-38 ft Shale, gray 38-39 ft Shale, light-gray, silty 39-41 ft Coal 41-53 ft Shale, alternating brown and gray; brown is carbonaceous, gray is silty 53-56 ft Shale, light-gray, greasy 56-59 ft Shale, light-gray, sandy 59-62 ft Shale, light-gray, silty 62-64 ft Sandstone, light-gray, very fine grained, shaly 64-66 ft Shale, light-gray; some very fine grained sand 66-74 ft Shale, light-gray, silty	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB A-23 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
74-75 ft Shale, gray							
75-76 ft Shale, dark-gray, hard, coaly							
76-83 ft Coal, shaly							
83-85 ft Shale, gray		250	80				
85-87 ft Shale, gray, silty							
87-93 ft Coal, shaly							
93-103 ft Shale, light-gray, very sandy; very fine grained sand			90				
103-104 ft Sandstone, gray, very fine grained, shaly		300					
104-106 ft Shale, gray, sandy							
106-107 ft Sandstone, gray, very fine grained, shaly			100				
107-110 ft Shale, gray; some very fine grained sand; some sandstone streaks		350	110				
110-112 ft Sandstone, light-gray, very fine grained to fine-grained							
112-118 ft Shale, light-gray; some very fine grained to fine-grained sand; some sandstone streaks			120				
118-119 ft Shale, black, hard, coaly		400					
119-125 ft Shale, greenish-gray, silty			130				
125-130 ft Shale, gray							
130-131 ft Sandstone, gray, very fine grained			140				
131-136 ft Shale, greenish-gray		450					
136-137 ft Sandstone, gray, very fine grained; some white shale							
137-140 ft Shale, gray, silty; some sandstone streaks			150				
140-145 ft Shale, light-gray; some streaks of very fine grained sand		500					
145-146 ft Shale, brown, carbonaceous			160				
146-152 ft Shale, light-gray, silty, greasy							
152-157 ft Shale, gray to brown, silty							
157-161 ft Shale, gray, silty, sandy; very fine grained sand			170				
161-163 ft Shale, brown, carbonaceous		550					
163-167 ft Coal							
167-168 ft Shale, brown, carbonaceous							
168-175 ft Shale, light-gray, silty, greasy			180				
175-177 ft Sandstone, very fine grained, salt-and-pepper gray, shaly							
177-180 ft Shale, light-gray, silty, greasy		600					
180-181 ft Shale, brown, carbonaceous			190				
181-187 ft Coal							
187-191 ft Shale, gray, silty, greasy							
191-192 ft Shale, gray, silty; sandy streaks							
192-193 ft Shale, dark-gray, carbonaceous							

Hole No. DB A-23 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
193-194 ft Shale, gray, soft 194-195 ft Shale, black, coaly 195-221 ft Shale, light-gray, very sandy, greasy 221-241 ft Sandstone, light-gray, very fine grained, shaly, soft (Pictured Cliffs) 241-242 ft Siderite concretion 242-244 ft Sandstone, light-gray, very fine grained, shaly, soft 244-255 ft Shale, gray, sandy, soft		250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190				

DRILL HOLE LOGS

Location Number DB A-24 Date Logged 10-11-78 Surface Elevation (ft) 5927.5

County & State San Juan County, N. M. Location SW¼ Sec. 9, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 192 Logged depth (ft) 172

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0–10 ft Sand, tan, fine-grained, unconsolided		0	0	
10–15 ft Shale, dark-brown, soft, silty				
15–19 ft Shale, light-gray, soft, silty				
19–25 ft Sandstone, salt-and-pepper gray, fine-grained to medium-grained; soft with fine clay balls		50	10	
25–26 ft Sandstone, light-gray, very fine grained, shaly			20	
26–40 ft Shale, dark-brown, carbonaceous; possible barite				
40–44 ft Coal				
44–54 ft Shale, gray, carbonaceous, sandy		100	30	
54–55 ft Sandstone, white, very fine grained, very hard, siliceous				
55–58 ft Shale, gray, sandy				
58–60 ft Coal, shaly	PC		40	
60–68 ft Shale, dark-gray, soft				
68–75 ft Shale, light-gray, sandy		150		
75–116 ft No returns			50	
116–118 ft Coal				
118–125 ft Shale, light-gray				
125–130 ft Coal				
130–131 ft Shale, brown, silty, carbonaceous			60	
131–135 ft Shale, light-gray, soft		200		
135–138 ft Shale, light-gray				
138–140 ft Sandstone, light-gray, very fine grained, hard (Pictured Cliffs)			70	

Hole No. DB A-24 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
140-144 ft Shale, light-gray 144-146 ft Sandstone, light-gray, very fine grained to fine-grained 146-155 ft Shale, light-gray 155-157 ft Sandstone, light-brown, very fine grained; siderite cement 157-160 ft Shale, light-gray 160-180 ft Sandstone, light-gray, very fine grained; mixed with gray shale 180-192 ft Sandstone, light-gray, very fine grained to fine-grained		250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190				

DRILL HOLE LOGS

Location Number DB A-25 Date Logged 11-09-78 Surface Elevation (ft) 5883.1

County & State San Juan County, N. M. Location NW¼ Sec. 18, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 90 Logged depth (ft) 88

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: D. Umshler

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Divisio

GEOPHYSICAL LOGS: Albuquerque, N. M.

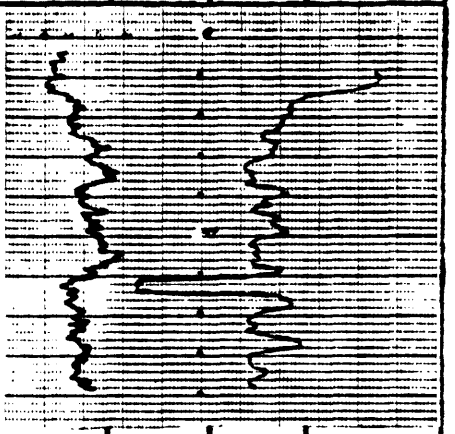
Spontaneous potential (sp): Scale _____ Logging speed _____ fpr

Resistivity (Res): Scale _____ Logging speed _____ fpr

Gamma (G): Scale 100 cps/in. Logging speed 20 fpr

Density (Den): Scale 5000 cps/in. Logging speed 20 fpr

Neutron (Neu): Scale _____ Logging speed _____ fpr

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma Sp Res Den
0-21 ft Alluvium and sand, gray, fine-grained to medium-grained, unconsolidated 21-90 ft Sandstone, light-gray, fine-grained to very fine grained, very shaly, soft (Pictured Cliffs)	PC	0 10 50 20 100 30 40 150 50 60 200 70	0 10 20 30 40 50 60 70	
Remark: Sp and Res logs not run because hole would not hold water.				

DRILL HOLE LOGS

Location Number DB A-26 Date Logged 10-20-78 Surface Elevation (ft) 5899.9

County & State San Juan County, N. M. Location NE¼ Sec. 18, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 88 Logged depth (ft) 87

Cored depth (ft) 53.25 Cored: [x] Yes [ ] No Geologists: R. Jentgen

Drilling medium: [ ] Air [ ] Water [x] Foam [ ] Mud Logger: Water Resources Division Albuquerque, N. M.

GEOPHYSICAL LOGS:

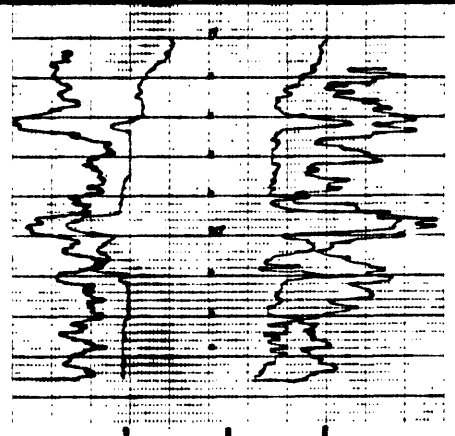
Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale Logging speed fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-8 ft Sand, brown, medium-grained, unconsolidated, clayey 8-19 ft Sand, brown, coarse-grained, unconsolidated, water-saturated 19-27 ft Coal; very badly weathered 27-39 ft Shale, light-gray, silty, soft 39-43 ft Shale, light-gray, sandy, soft 43-45 ft Sandstone, salt-and-pepper light-gray, very fine grained, shaly 45-46 ft Shale, gray, sandy, soft 46-53 ft Coal 53-54 ft Shale, grayish-brown, sandy, soft 54-58 ft Sandstone, salt-and-pepper gray, very fine grained, shaly 58-60 ft Shale, gray-brown, sandy, soft 60-64 ft Coal 64-70 ft Shale, gray-brown, sandy, soft 70-88 ft Sandstone, salt-and-pepper gray, very fine grained, shaly, soft (Pictured Cliffs)	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	

Description of core from A-26

Total depth of hole (T.D.): 88.00 ft
Total thickness of coring: 14.65 ft

Lithologic description	Feet From	Feet To
Interval 1 depth--20.00 - 21.40 ft		
Coal, black, laminated	20.00	21.05
Siltstone, gray	21.05	21.40
Thickness of interval = 1.40 ft		
Thickness of coal in interval = 1.05 ft		
Interval 2 depth--40.00 - 53.25 ft		
Sandstone, calcareous, very fine grained, light-gray; very thin layers of silt	40.00	41.20
Siltstone, gray; coal fragments as much as 10 mm in diam.	41.20	42.60
Siltstone, carbonaceous, dark-gray	42.60	42.75
Shale, coaly, black, fissile	42.75	43.60
Coal, black, laminated; 2 percent shale	43.60	45.40
Siltstone, tan	45.40	45.45
Coal, black, laminated; 5 percent shale	45.45	46.00
Coal, black, laminated; some vitrain	46.00	48.00
Coal, black; shale fragments as much as 35 mm in diam.	48.00	49.25
Siltstone, carbonaceous, dark-gray	49.25	49.75
Siltstone, gray; coal fragments as much as 35 mm in diam.	49.75	50.20
Sandstone and siltstone, interbedded, very fine grained, gray; thin layers of sand and silt as much as 2 mm thick; coal fragments as much as 20 mm in diam.	50.20	50.35
Sandstone, very fine grained, light-gray; coal fragments as much as 10 mm in diam., thin layers of interbedded coal 1-2 mm thick	50.35	53.25
Thickness of interval = 13.25 ft		
Thickness of coal in interval = 5.60 ft		

DRILL HOLE LOGS

Location Number DB A-27 **Date Logged** 10-20-78 **Surface Elevation (ft)** 5907.0

County & State San Juan County, N. M. **Location** NW¼ **Sec.** 17, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. **Drilled depth (ft)** 103 **Logged depth (ft)** 86

Cored depth (ft) _____ **Cored:** ☐ Yes ☒ No **Geologists:** N. Wingard

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud **Logger:** Water Resources Divisio
Albuquerque, N. M.

GEOPHYSICAL LOGS:

Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-9 ft Shale, dark-brown 9-15 ft Shale, light-brown, silty 15-22 ft Coal 22-25 ft Shale, light-brown, silty 25-26 ft Shale, gray, sandy 26-28 ft Sandstone, gray, fine-grained, well-sorted 28-30 ft Sandstone, gray, silty, carbonaceous 30-32 ft Sandstone, gray, fine-grained, well-sorted 32-33 ft Shale and sandstone, brown and gray 33-35 ft Sandstone, gray, medium-grained 35-36 ft Sandstone, gray, fine-grained, friable, silty 36-37 ft Sandstone, gray, medium-grained, hard 37-38 ft Sandstone, gray, fine-grained, silty, friable 38-38.5 ft Sandstone, light-brown, fine-grained, silty, very friable 38.5-41 ft Shale, gray 41-42 ft Sandstone, gray, fine-grained 42-49 ft Coal 49-53 ft Shale, dark-brown, carbonaceous 53-58 ft Shale, gray, silty 58-70 ft Shale, light-gray, silty, sandy, very soft	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB A-27 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
70–80 ft Sandstone, light-gray, fine-grained, silty, shaly (Pictured Cliffs) 80–83 ft Shale, gray, silty 83–87 ft Mixture of sandstone and shale, light-gray, fine-grained, silty 87–90 ft Mixture of sandstone, shale, and coal; shale is carbonaceous 90–102 ft Sandstone, light-gray, fine-grained to very fine grained, soft, shaly 102–103 ft Sandstone, light-gray, fine-grained, hard, shaly; contains some greenish-gray shale		250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190				

DRILL HOLE LOGS

Location Number DB A-28 Date Logged 10-11-78 Surface Elevation (ft) 5934.0

County & State San Juan County, N. M. Location NE¼ Sec. 17, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 135 Logged depth (ft) 133

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: D. Umshler

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Divisio

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0–10 ft Sand, light-brown, fine-grained, unconsolidated		0	0	
10–20 ft Shale, dark-gray				
20–30 ft Shale, black, carbonaceous				
30–40 ft Shale, greenish-brown		50	10	
40–62 ft Sandstone, salt-and-pepper light-gray, fine-grained to very fine grained, wet				
62–72 ft Shale, dark-gray			20	
72–75 ft Coal, black				
75–76 ft Shale, dark-gray, carbonaceous				
76–88 ft Shale, dark-gray				
88–91 ft Coal, black	PC	100	30	
91–100 ft Shale, gray, carbonaceous				
100–105 ft Shale, gray				
105–120 ft Shale, gray, silty			40	
120–135 ft Sandstone, salt-and-pepper gray, fine-grained, soft, shaly (Pictured Cliffs)		150	50	
			60	
		200		
			70	

DRILL HOLE LOGS

Location Number DB A-29 Date Logged 10-05-78 Surface Elevation (ft) 5914.2

County & State San Juan County, N. M. Location SW¼ Sec. 17, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 90 Logged depth (ft) 89

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: D. Umshler

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

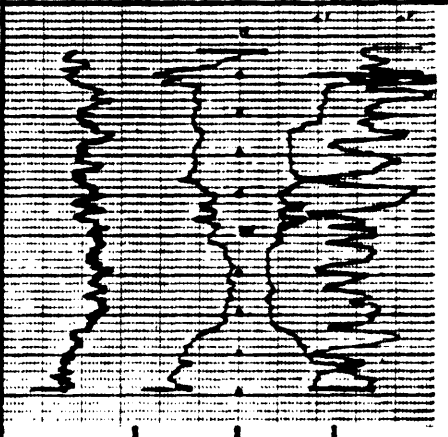
Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-8 ft Shale and sandstone; shale is dark gray; sandstone is light gray and fine grained 8-10 ft Coal, black 10-20 ft Shale, dark-gray 20-25 ft Sandstone, salt-and-pepper light-gray, very fine grained, wet 25-50 ft Sandstone, salt-and-pepper light-gray, fine-grained to very fine grained, wet 50-70 ft Shale, dark-gray 70-90 ft Sandstone, salt-and-pepper light-gray, fine-grained to very fine grained (Pictured Cliffs)		0 50 100 150 200	0 10 20 30 40 50 60 70	

DRILL HOLE LOGS

Location Number DB A-30 Date Logged 10-04-78 Surface Elevation (ft) 5942.6

County & State San Juan County, N. M. Location SE¼ Sec. 17, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 90 Logged depth (ft) 88

Cored depth (ft) 60.1 Cored: [x] Yes [ ] No Geologists: D. Umshler

Drilling medium: [ ] Air [ ] Water [x] Foam [ ] Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale Logging speed fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0–10 ft Shale, grayish-green; mixed with some grayish-green, unconsolidated fine-grained to very fine grained sandstone		0	0	
10–30 ft Shale, grayish-green			10	
30–40 ft Coal, black; some light-gray shale		50		
40–50 ft Shale, dark-gray; some light-gray, fine-grained to very fine grained sandstone			20	
50–60 ft Coal, black				
60–70 ft Shale, gray; some clay		100	30	
70–80 ft Shale, grayish-green; some clay				
80–85 ft Sandstone, light-gray, fine-grained to very fine grained, wet (Pictured Cliffs)			40	
85–90 ft Shale, dark-gray; some light-gray, fine-grained to very fine grained, wet sandstone		150	50	
			60	
		200		
			70	

Description of core from A-30

Total depth of hole (T.D.): 90.00 ft
Total thickness of coring: 21.60 ft

Lithologic description	Feet From	Feet To
Interval 1 depth--28.00 - 40.00 ft		
Missing interval	28.00	30.30
Mixture of mud, coal, and various rock fragments	30.30	30.95
Sandstone, very fine grained, light-gray, well-sorted, clean	30.95	31.55
Missing interval	31.55	33.25
Siltstone, dark-gray; coal fragments as much as 7 mm in diam.	33.25	34.75
Coal, black; siltstone fragments as much as 10 mm in diam.	34.75	35.05
Siltstone, dark-gray; coal fragments as much as 10 mm in diam.	35.05	35.25
Coal, black; 40 percent siltstone	35.25	35.40
Sandstone, black to tan, dirty; thin coal layers as much as 1 mm thick	35.40	35.55
Coal, black, laminated; siltstone fragments as much as 10 mm in diam.	35.55	37.05
Coal, black, clean	37.05	39.55
Siltstone, black and gray; coal fragments as much as 10 mm in diam.	39.55	40.00
Thickness of interval = 12.00 ft		
Thickness of coal in interval = 4.45 ft		
Interval 2 depth--50.50 - 60.10 ft		
Sandstone, very fine grained, light-gray, well sorted; coal fragments as much as 3 mm in diam.	50.50	53.30
Sandstone, very fine grained, light-gray, well-sorted; coal fragments as much as 15 mm in diam.	53.30	54.35
Sandstone, very fine grained, light-gray, well-sorted; thin coal layers as much as 2 mm thick	54.35	54.55
Coal, black	54.55	54.60
Sandstone, very fine grained, light-gray; thin layers of coal as much as 1 mm thick	54.60	54.70
Coal, black; 5 percent siltstone	54.70	54.90

Description of core from A-30 -- continued

Lithologic description	Feet From	Feet To
Coal, black, laminated, clean; some resin	54.90	59.60
Siltstone, carbonaceous, dark-gray; 30 percent coal . . .	59.60	59.90
Siltstone, gray; coal fragments as much as 10 mm in diam.	59.90	60.10

Thickness of interval = 9.60 ft

Thickness of coal in interval = 4.95 ft

DRILL HOLE LOGS

Location Number DB A-31 Date Logged 10-03-78 Surface Elevation (ft) 5932.2

County & State San Juan County, N. M. Location NW¼ Sec. 20, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 75 Logged depth (ft) 73

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: D. Umshler

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

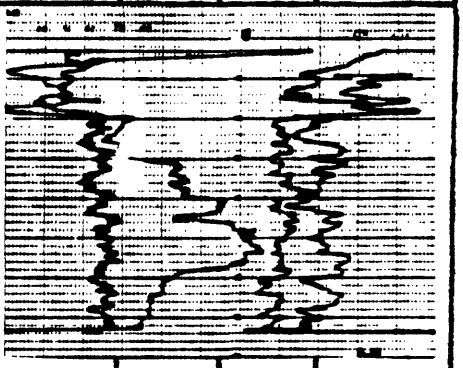
Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-10 ft Sandstone, gray, fine-grained to very fine grained, powdery 10-12 ft Coal, black 12-18 ft Shale, gray, very soft 18-30 ft Shale, carbonaceous, gray 30-35 ft Shale, dark-gray; some clay 35-75 ft Shale, gray; some clay	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	

DRILL HOLE LOGS

Location Number DB A-32 Date Logged 10-03-78 Surface Elevation (ft) 5943.5

County & State San Juan County, N. M. Location NE¼ Sec. 20, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 75 Logged depth (ft) 71

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: D. Umshler

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Divisio

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
0-10 ft Shale, brown; shale, carbonaceous, brown; coal, brown to black, shaly, 1 ft thick; shale, brownish-gray, some clay 10-15 ft Clay, brown 15-30 ft Shale and clay, dark-brown and gray 30-40 ft Sandstone, gray, fine-grained to very fine grained; looks like Pictured Cliffs Ss. 40-45 ft Shale, dark-gray 45-75 ft Sandstone, gray, fine-grained, some clay (Pictured Cliffs)	PC	0 50 100 150 200	0 10 20 30 40 50 60 70				

DRILL HOLE LOGS

Location Number DB A-33 Date Logged 10-03-78 Surface Elevation (ft) 5976.6

County & State San Juan County, N. M. Location NW¼ Sec. 21, T. 23 N., R. 12 W.

Map Tanner Lake, N. M. Drilled depth (ft) 75 Logged depth (ft) 73

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: D. Umshler

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Divisio

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
0-10 ft Sand, light-brown, fine-grained, unconsolidated; wind deposited 10-20 ft Sand, light-brown, fine-grained, unconsolidated 20-33 ft Sand, light-brown and black, fine-grained, unconsolidated 33-43 ft Coal, black to brown, shaly 43-60 ft Clay, gray 60-75 ft Sandstone, light-gray, fine-grained; salt-and-pepper (Pictured Cliffs)	PC	0 50 100 150 200	0 10 20 30 40 50 60 70				

DRILL HOLE LOGS

Location Number DB B-1 Date Logged 1-17-79 Surface Elevation (ft) 5906.1

County & State San Juan County, N. M. Location NW¼ Sec. 29, T. 24 N., R. 13 W.

Map Bisti Trading Post, N. M. Drilled depth (ft) 420 Logged depth (ft) 420

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: P. Lambert, R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 50 mv/in. Logging speed 16-17 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 16-17 fpm

Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

Density (Den): Scale _____ Logging speed _____ fpm

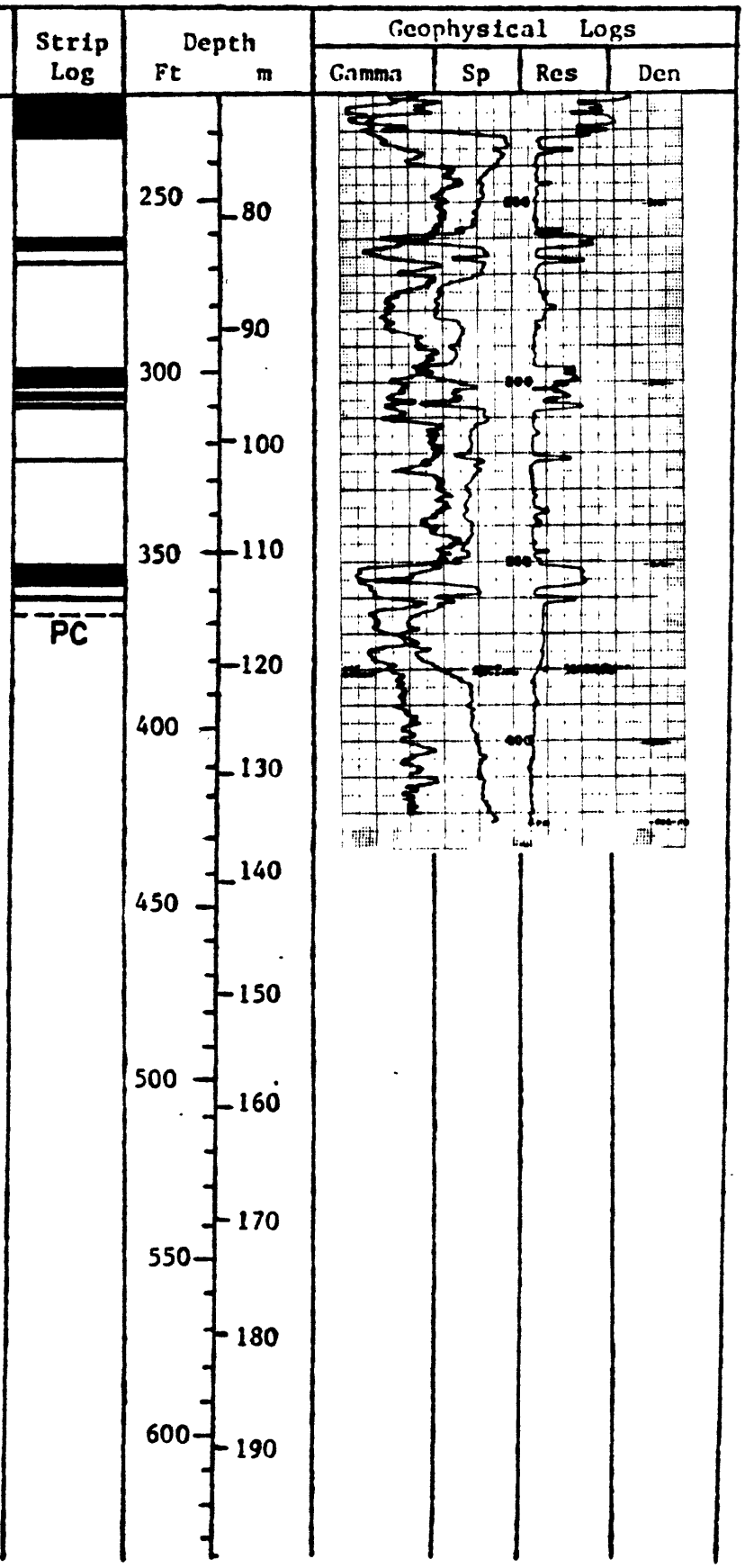
Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs
0-75 ft Sand, yellow, fine-grained, unconsolidated		0	0	Gamma Sp Res Den
			10	
		50	20	
75-90 ft Shale, yellowish-green, some unconsolidated sand				
90-105 ft Sandstone, light-gray, fine-grained to very fine grained				
		100	30	
105-110 ft Sandstone, light-gray, fine-grained; some green shale				
110-115 ft Shale, dark-gray, silty				
115-120 ft Shale, dark-gray			40	
120-135 ft Siltstone, light-gray				
135-150 ft Shale, gray, silty		150		
150-155 ft Shale, gray to dark-gray			50	
155-160 ft Shale, dark-gray				
160-165 ft Shale, light-gray				
165-170 ft Shale, gray			60	
170-175 ft Shale, black		200		
175-180 ft Shale, dark-gray				
180-185 ft Shale, gray; some yellow shale				
185-190 ft Shale, gray				
190-195 ft Shale, black; some gray siltstone			70	
195-200 ft Siltstone, light-gray; some gray to black shale				

Hole No. DB B-1 (continued)

LITHOLOGY
200–205 ft Shale, gray
205–210 ft Shale, black
210–215 ft Shale, gray
215–220 ft Shale and coal, gray
220–225 ft Coal
225–235 ft Coal; some gray shale
235–240 ft Shale, gray and black, carbonaceous
240–250 ft Shale, gray
250–255 ft Shale, dark-gray to black
255–260 ft Coal
260–265 ft Shale, dark-gray, silty
265–270 ft Shale, dark-gray to black, carbonaceous
270–275 ft Shale, dark-gray, silty
275–300 ft No sample returned
300–305 ft Coal, shaly
305–315 ft Shale, dark-gray, carbonaceous
315–330 ft Sandstone, tan, coarse-grained, silty
330–340 ft Shale, gray, silty
340–355 ft Coal
355–360 ft Shale, gray, silty
360–370 ft Coal, shaly
370–400 ft Shale, gray, silty, sandy (Pictured Cliffs)
400–420 ft Shale, light-gray, sandy; sand is very fine grained



DRILL HOLE LOGS

Location Number DB B-2 Date Logged 1-23-79 Surface Elevation (ft) 5802.2

County & State San Juan County, N. M. Location NE¼ Sec. 29, T. 24 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 320 Logged depth (ft) 315

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 20 mv/in. Logging speed 16-17 fpm

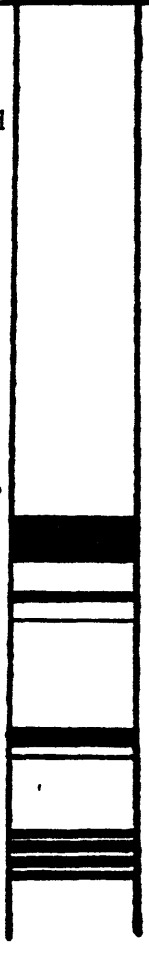
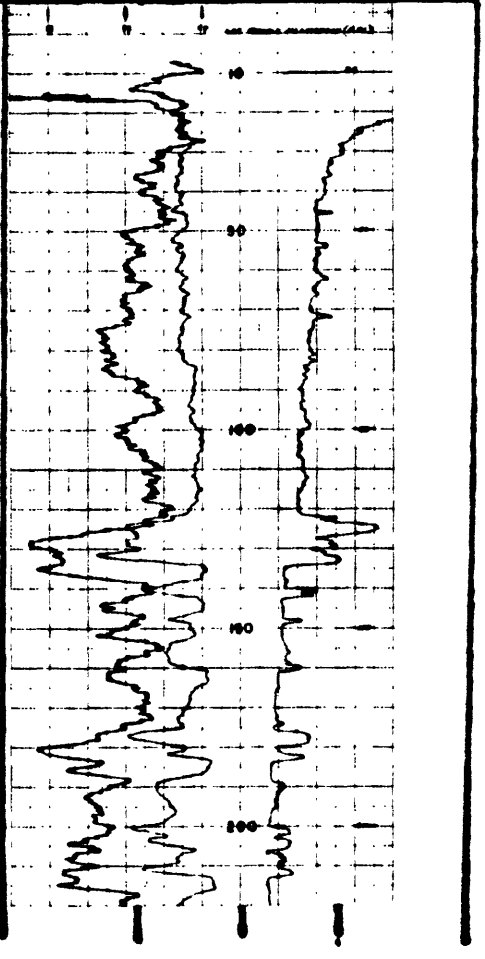
Resistivity (Res): Scale 50 ohms/in. Logging speed 16-17 fpm

Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

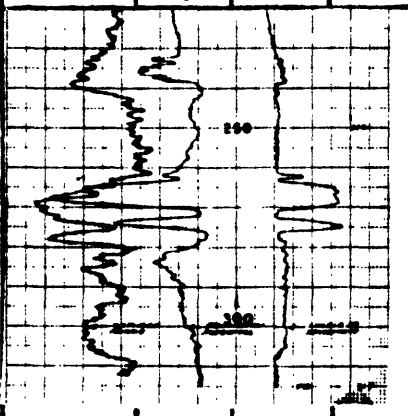
Density (Den): Scale _____ Logging speed _____ fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma / Sp / Res / Den
0-5 ft Shale, tan 5-10 ft Shale, light-gray, silty 10-14 ft Shale, tan, silty 14-20 ft Siltstone, light-gray, very hard 20-26 ft Shale, brown, carbonaceous 26-40 ft Shale, tan, silty 40-42 ft Coal, shaly 42-87 ft Siltstone, gray, sandy, shaly 87-88 ft Shale, dark-gray, carbonaceous 88-112 ft Siltstone, gray, sandy, shaly 112-113 ft Coal 113-121 ft Siltstone, gray, sandy, shaly 121-135 ft Coal; shale partings less than 2 ft thick 135-140 ft Shale, dark-brown, carbonaceous, coaly 140-146 ft Coal, shaly 146-152 ft Shale, dark-gray, carbonaceous 152-155 ft Siltstone, light-gray, sandy, shaly 155-164 ft Shale, gray, silty 164-170 ft Shale, dark-gray, carbonaceous 170-176 ft Shale, gray, silty 176-181 ft Coal 181-187 ft Shale, dark-gray, carbonaceous 187-200 ft Shale, brownish-gray, silty 200-220 ft Coal		0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB B-2 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma / Sp / Res / Den
220-236 ft Shale, gray, silty, sandy 236-238 ft Coal 238-257 ft Shale, gray, silty, sandy 257-265 ft Shale, light-gray, sandy 265-278 ft Coal 278-290 ft Sandstone, salt-and-pepper gray, very fine grained, shaly, soft (Pictured Cliffs) 290-300 ft Shale, gray, sandy 300-320 ft Sandstone, light-gray, very fine grained, shaly	PC	250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190	

DRILL HOLE LOGS

Location Number DB B-3 Date Logged 1-23-79 Surface Elevation (ft) 5784.7

County & State San Juan County, N. M. Location SW¼ Sec. 29, T. 24 N., R. 13 W.

Map Bisti Trading Post, N. M. Drilled depth (ft) 280 Logged depth (ft) 280

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen, J. Fassett

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 20 mv/in. Logging speed 16-17 fpm

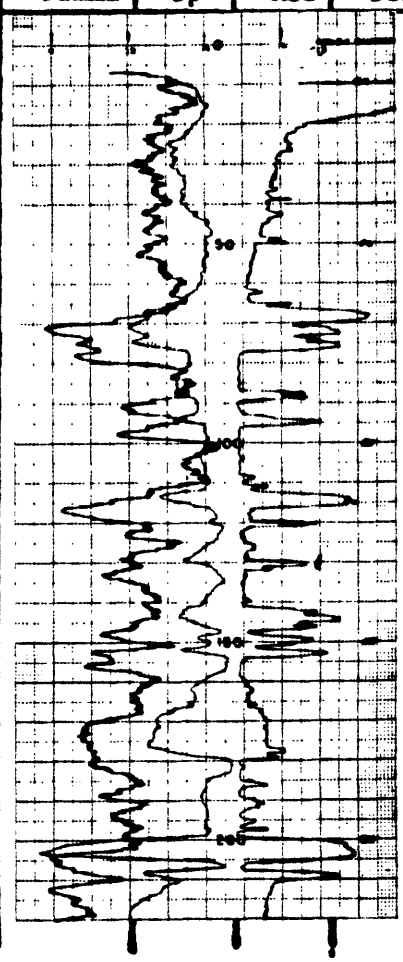
Resistivity (Res): Scale 20 ohms/in. Logging speed 16-17 fpm

Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

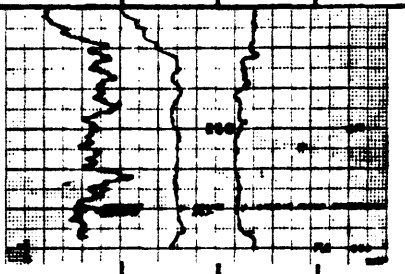
Density (Den): Scale _____ Logging speed _____ fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma, Sp, Res, Den
0-15 ft Siltstone, tan and light-gray, very hard, shaly 15-25 ft Shale, brown, silty 25-45 ft Shale, gray, silty, sandy 45-60 ft Siltstone, light-gray, shaly 60-65 ft Shale, gray, silty 65-80 ft Coal 80-85 ft Shale, dark-gray, carbonaceous 85-87 ft Coal 87-95 ft Siltstone, light-gray, shaly, sandy 95-110 ft Coal 110-150 ft Siltstone and shale, light-gray 150-165 ft Coal 165-170 ft Sandstone, carbonaceous 170-220 ft Sandstone, gray (Pictured Cliffs)	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB B-3 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma / Sp / Res / Den
220–280 ft Sandstone, gray (Pictured Cliffs)		250	80	
			90	
		300		
			100	
		350	110	
			120	
		400		
			130	
			140	
		450		
			150	
		500		
			160	
			170	
		550		
			180	
		600		
			190	

DRILL HOLE LOGS

Location Number DB B-4 Date Logged 1-24-79 Surface Elevation (ft) 5796.7

County & State San Juan County, N. M. Location SE¼ Sec. 29, T. 24 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 280 Logged depth (ft) 280

Cored depth (ft) 215.6 Cored: [x] Yes [ ] No Geologists: R. Jentgen

Drilling medium: [ ] Air [ ] Water [x] Foam [ ] Mud Logger: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 20 mv/in. Logging speed 16-17 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 16-17 fpm

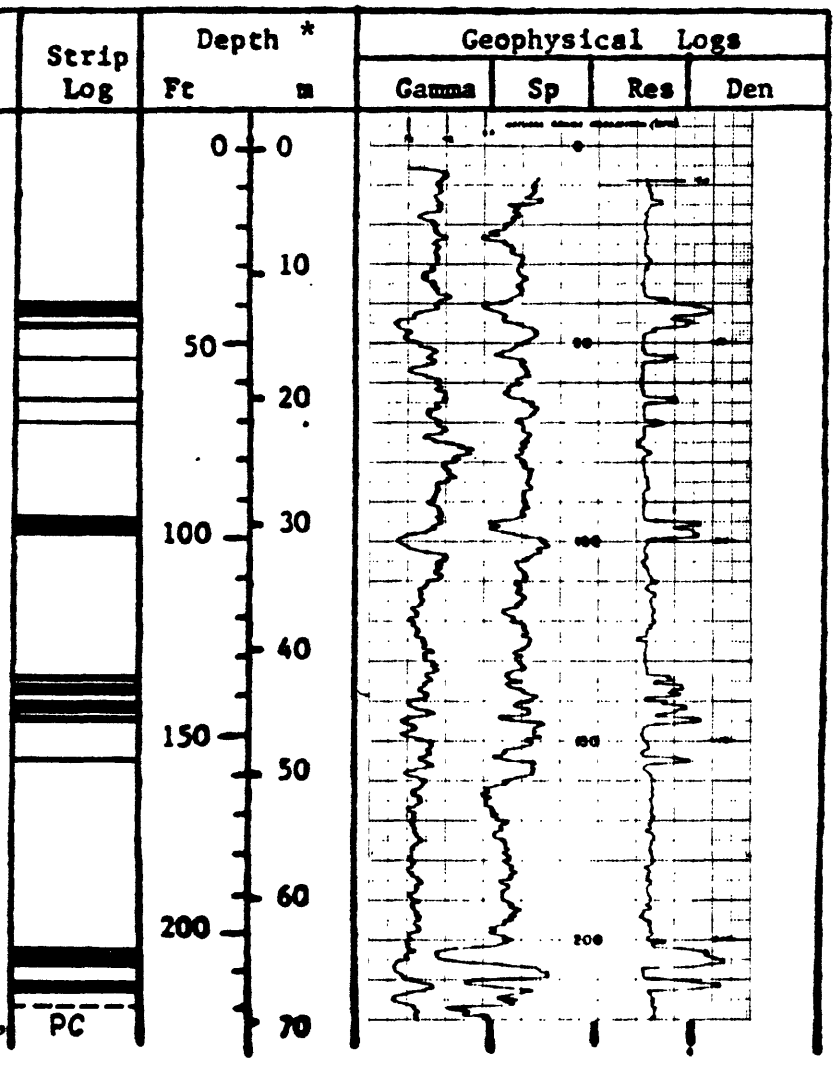
Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

Density (Den): Scale Logging speed fpm

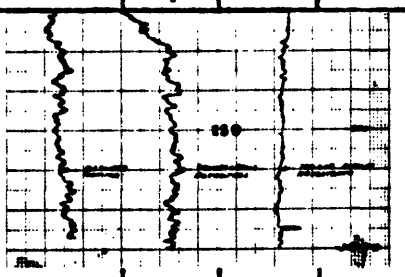
Neutron (Neu): Scale Logging speed fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY
0-5 ft Sand, tan, very fine grained; unconsolidated alluvium
5-25 ft Shale, dark-gray, silty
25-36 ft Siltstone, gray, shaly
36-40 ft Shale, black, carbonaceous
40-48 ft Coal
48-55 ft Sandstone, brown, very fine grained, shaly, carbonaceous, coaly
55-62 ft Sandstone, gray, very fine grained, shaly
62-64 ft Coal
64-67 ft Shale, gray, silty
67-69 ft Coal
69-75 ft Siltstone, dark-gray; shale, carbonaceous
75-95 ft Siltstone, light-gray, shaly; carbonaceous streaks less than 0.25 ft thick
95-100 ft Shale, dark-gray, carbonaceous, coaly
100-105 ft Shale, gray; carbonaceous streaks less than 0.25 ft thick
105-120 ft Siltstone, light-gray, shaly
120-133 ft Shale, gray, silty
133-145 ft Coal, shaly
145-153 ft Shale, gray, silty
153-160 ft Shale, dark-brown, carbonaceous, coaly



Hole No. DB B-4 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs
160-185 ft Sandstone, light-gray, very fine grained, silty, very shaly 185-190 ft Shale, gray, silty 190-202 ft Siltstone, light-gray, shaly, sandy 202-215 ft Coal, shaly 215-225 ft Shale, gray, silty 225-230 ft Shale, gray; some very fine grained sand 230-240 ft Sandstone, salt-and-pepper gray, very fine grained, shaly, brittle (Pictured Cliffs) 240-280 ft Sandstone, light-gray, very fine grained, very shaly, very soft		250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190	

Description of core from B-4

Total depth of hole (T.D.): 280.00 ft
Total thickness of coring: 57.00 ft

Lithologic description	Feet From	Feet To
Interval 1 depth—35.00 - 51.60 ft		
Siltstone, carbonaceous, dark-gray; 30 percent coal	35.00	35.90
Coal, black, laminated; some vitrain	35.90	36.45
Siltstone, gray; 20 percent coal	36.45	36.55
Coal, black, laminated; thin sandstone layers	36.55	36.80
Siltstone, carbonaceous, dark-gray; 35 percent coal	36.80	37.00
Coal, black, laminated; some vitrain; layer of siltstone at 37.80 ft, 8 mm thick	37.00	38.85
Shale, carbonaceous, dark-brown; fissile; 40 percent coal	38.85	39.00
Coal, black, clean, hard	39.00	39.60
Coal, black, clean, laminated	39.60	41.00
Coal, black, clean, laminated	41.00	43.85
Siltstone, tan	43.85	43.90
Coal, black, clean, laminated	43.90	44.00
Coal, black, clean, hard	44.00	44.20
Siltstone, tan	44.20	44.30
Coal, black, laminated; 35 percent siltstone	44.30	44.45
Shale, carbonaceous, dark-brown, fissile	44.45	44.75
Coal, black, laminated	44.75	46.00
Siltstone, gray; coal fragments as much as 15 mm in diam.	46.00	47.00
Siltstone, gray	47.00	47.75
Siltstone, gray; coal fragments as much as 20 mm in diam.	47.75	47.95
Sandstone, calcareous, very fine grained, light-gray; strong HCl reaction	47.95	48.10
Siltstone, gray	48.10	49.00
Siltstone, dark-gray; coal fragments as much as 20 percent coal	49.00	49.55
Sandstone, calcareous, very fine grained, light-gray; strong HCl reaction	49.55	49.65

Description of core from B-4 -- continued

Lithologic description	Feet From	Feet To
Siltstone, gray	49.65	49.80
Coal, black, laminated	49.80	50.90
Siltstone, gray; coal fragments as much as 20 mm in diam.	50.90	51.60
Thickness of interval = 16.60 ft		
Thickness of coal in interval = 10.30 ft		
Interval 2 depth--94.00 - 101.00 ft		
Mixture of siltstone, mud, and coal	94.00	95.65
Shale, carbonaceous, dark-gray, fissile	95.65	96.15
Coal, black, laminated; siltstone fragments as much as 40 mm in diam.	96.15	100.60
Shale, carbonaceous, dark-brown, fissile	100.60	100.70
Siltstone, gray	100.70	101.00
Thickness of interval = 7.00 ft		
Thickness of coal in interval = 4.45 ft		
Interval 3 depth--132.70 - 146.00 ft		
Mixture of siltstone, mud, and coal, gray	132.70	134.00
Coal, black, clean, laminated	134.00	135.70
Siltstone, gray; large coal fragments; about 20 percent coal	135.70	135.75
Coal, black, laminated; some vitrain	135.75	136.20
Siltstone, gray; large coal fragments; about 20 percent coal	136.20	136.25
Coal, black, laminated; some vitrain	136.25	137.35
Shale, carbonaceous, dark-brown, fissile; large coal fragments; about 35 percent coal	137.35	137.80
Shale, brown, fissile; coal fragments as much as 35 mm in diam.	137.80	138.40
Coal, black; shale fragments as much as 10 mm in diam.	138.40	140.25
Siltstone, tan	140.25	140.30
Coal, black, laminated; shale fragments as much as 10 mm in diam.	140.30	141.00
Coal, black, clean, laminated	141.00	141.30

Description of core from B-4 -- continued

Lithologic description	Feet From	Feet To
Coal, black, laminated; large shale fragments; 5 percent coal; layer of siltstone 5 mm thick at 141.75 ft	141.30	142.20
Coal, black, hard; small amounts of shale	142.20	142.30
Siltstone, dark-brown; about 30 percent coal	142.30	142.45
Siltstone, carbonaceous, brown	142.45	142.65
Coal, black, laminated; siltstone fragments as much as 20 mm in diam.	142.65	142.95
Siltstone, light-tan	142.95	143.05
Coal, black, laminated	143.05	144.40
Shale, carbonaceous, dark-brown, fissile	144.40	144.50
Siltstone, dark-gray, fissile; 50 percent carbonaceous shale and coal	144.50	145.00
Siltstone, gray; large coal fragments as much as 20 mm in diam.	145.00	146.00
Thickness of interval = 13.30 ft		
Thickness of coal in interval = 8.75 ft		
Interval 4 depth--195.50 - 215.60 ft		
Sandstone, very fine grained, light-gray, clean; subangular grains; coal layers 5 mm thick at 196.00 ft	195.50	196.70
Sandstone, very fine grained, light-gray; sub-angular grains; very thin coal layers less than 2 mm thick, 15 mm apart	196.70	197.00
Siltstone, gray, large coal fragments as much as 30 mm in diam.	197.00	197.05
Sandstone, very fine grained, light-gray, clean; subangular grains; shale layers as much as 8 mm thick at 199.15 ft, 199.20 ft, 199.35 ft, 199.40 ft, 199.45 ft, 199.95 ft, 200.05 ft and 200.20 ft	197.05	200.25
Coal, black, clean, laminated	200.25	201.00
Coal, black, laminated; small amounts of vitrain; siltstone layer 6 mm thick at 201.15 ft	201.00	205.10
Siltstone, tan	205.10	205.15
Coal, black, laminated; small amounts of vitrain	205.15	205.85
Shale, carbonaceous, dark-brown; 25 percent coal	205.85	206.00
Siltstone, gray; coal fragments as much as 15 mm in diam.	206.00	207.00

Description of core from B-4 -- continued

Lithologic description	Feet From	Feet To
Mixture of mud, siltstone, and coal fragments, gray and black	207.00	207.75
Siltstone, gray; coal fragments as much as 25 mm in diam.	207.75	208.10
Siltstone, dark-gray; coal fragments as much as 25 mm in diam.	208.10	208.45
Coal, black, siltstone fragments as much as 25 mm in diam.	208.45	208.70
Coal, black, clean, hard	208.70	208.75
Siltstone, tan	208.75	208.80
Coal, black, laminated; siltstone fragments as much as 15 mm in diam.	208.80	210.10
Coal, black, laminated; small amounts of vitrain; siltstone fragments as much as 5 mm in diam.	210.10	211.60
Siltstone, carbonaceous, dark-gray	211.60	211.90
Sandstone, coaly, very fine grained, dark-gray; coal fragments as much as 20 mm in diam.; many thin layers of shale	211.90	212.75
Sandstone, very fine grained, light-gray; subangular grains	212.75	213.85
Siltstone, carbonaceous, dark-gray; coal fragments as much as 25 mm in diam.	213.85	213.90
Sandstone, coaly, very fine grained, dark-gray; coal fragments as much as 30 mm in diam.; many thin layers of shale	213.90	214.10
Sandstone, very fine grained, light-gray; sub-angular grains	214.10	215.60

Thickness of interval = 20.10 ft

Thickness of coal in interval = 8.65 ft

DRILL HOLE LOGS

Location Number DB B-5 Date Logged 1-25-79 Surface Elevation (ft) 5819.8

County & State San Juan County, N. M. Location NW¼ Sec. 28, T. 24 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 400 Logged depth (ft) 400

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 50 mv/in. Logging speed 16-17 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 16-17 fpm

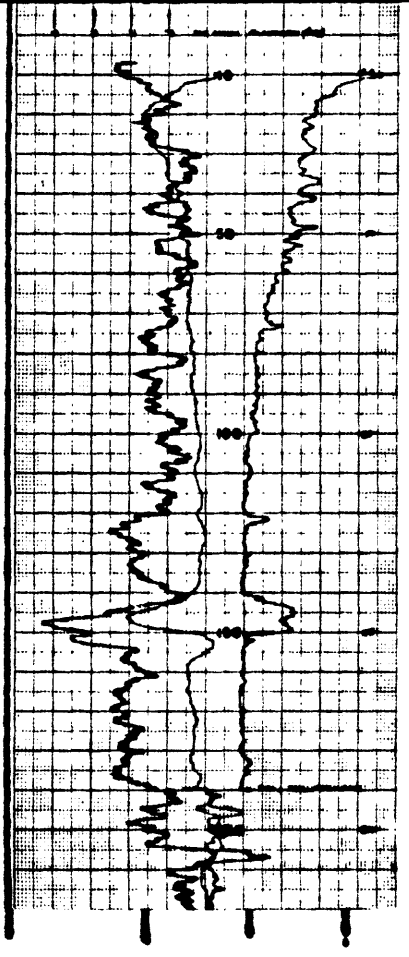
Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

Density (Den): Scale _____ Logging speed _____ fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma, Sp, Res, Den
0-7 ft Siltstone, brown; yellow streaks		0	0	
7-10 ft Shale, tan, silty				
10-17 ft Shale, gray, silty				
17-25 ft Sandstone, light-yellow, very fine grained, silty, shaly		50	10	
25-40 ft Shale, gray, silty				
40-45 ft Shale, dark-brown, silty				
45-50 ft Shale, dark-gray, silty			20	
50-60 ft Siltstone, light-gray, shaly				
60-70 ft Shale, gray, silty				
70-75 ft Siltstone, light-gray, shaly		100	30	
75-78 ft Shale, dark-gray, carbonaceous				
78-115 ft Shale, gray, silty				
115-138 ft Siltstone, gray, shaly				
138-140 ft Shale, dark-gray, carbonaceous			40	
140-151 ft Coal				
151-155 ft Shale, dark-gray, carbonaceous				
155-183 ft Siltstone, dark-gray, sandy		150	50	
183-185 ft Sandstone, salt-and-pepper gray, very fine grained, silty, shaly				
185-193 ft Shale, dark-gray, silty				
193-202 ft Coal, shaly, sandy, poor quality			60	
202-205 ft Shale, light-gray; bentonite				
205-215 ft Shale, gray, silty		200		
215-230 ft Shale, dark-brown, carbonaceous, silty				
			70	



Hole No. DB B-5 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
230-235 ft Coal				
235-240 ft Shale, dark-brown, carbonaceous				
240-260 ft Coal		250	80	
260-275 ft Shale, dark-brown, carbonaceous				
275-295 ft Coal				
295-300 ft Shale, dark-brown, carbonaceous				
300-315 ft Shale, gray, silty			90	
315-320 ft Sandstone, salt-and-pepper gray, very fine grained, shaly	PC	300		
320-330 ft Shale, dark-brown, carbonaceous			100	
330-345 ft Shale, gray, silty				
345-355 ft Sandstone, salt-and-pepper gray, very fine grained, silty, brittle				
355-360 ft Coal				
360-370 ft Shale, dark-brown, carbonaceous, silty		350	110	
370-380 ft Sandstone, salt-and-pepper gray, very fine grained, hard, shaly (Pictured Cliffs)			120	
380-395 ft Shale, gray				
395-400 ft Siltstone, grayish-black, very hard		400	130	
			140	
		450		
			150	
		500		
			160	
			170	
		550		
			180	
		600		
			190	

DRILL HOLE LOGS

Location Number DB B-7 Date Logged 1-15-79 Surface Elevation (ft) 5774.3

County & State San Juan County, N. M. Location NW¼ Sec. 31, T. 24 N., R. 13 W.

Map Bisti Trading Post, N. M. Drilled depth (ft) 192 Logged depth (ft) 192

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division
Albuquerque, N. M.

GEOPHYSICAL LOGS:

Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-3 ft Coal and shale, black, carbonaceous		0	0	
3-6 ft Shale, tan, silty; yellow streaks				
6-22 ft Shale, brownish-gray, silty			10	
22-30 ft Coal				
30-55 ft Shale, gray, silty		50		
55-65 ft Sandstone, gray, very fine grained, shaly			20	
65-72 ft Coal				
72-127 ft Shale, gray, silty, sandy		100	30	
127-136 ft Coal				
136-152 ft Sandstone, salt-and-pepper gray, fine-grained to very fine grained, shaly			40	
152-154 ft Coal		150		
154-180 ft Sandstone, salt-and-pepper gray, very fine grained, shaly (Pictured Cliffs)	PC		50	
180-192 ft No sample returned			60	
		200		
			70	

DRILL HOLE LOGS

Location Number DB B-8 **Date Logged** 1-19-79 **Surface Elevation (ft)** 5773.9

County & State San Juan County, N. M. **Location** NE¼ **Sec.** 31 , T. 24 N., R. 13 W

Map Bisti Trading Post, N. M. **Drilled depth (ft)** 180 **Logged depth (ft)** 180

Cored depth (ft) _____ **Cored:** ☐ Yes ☒ No **Geologists:** D. Umshler

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud **Logger:** Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): **Scale** 20 mv/in. **Logging speed** 16-17 fpm

Resistivity (Res): **Scale** 50 ohms/in. **Logging speed** 16-17 fpm

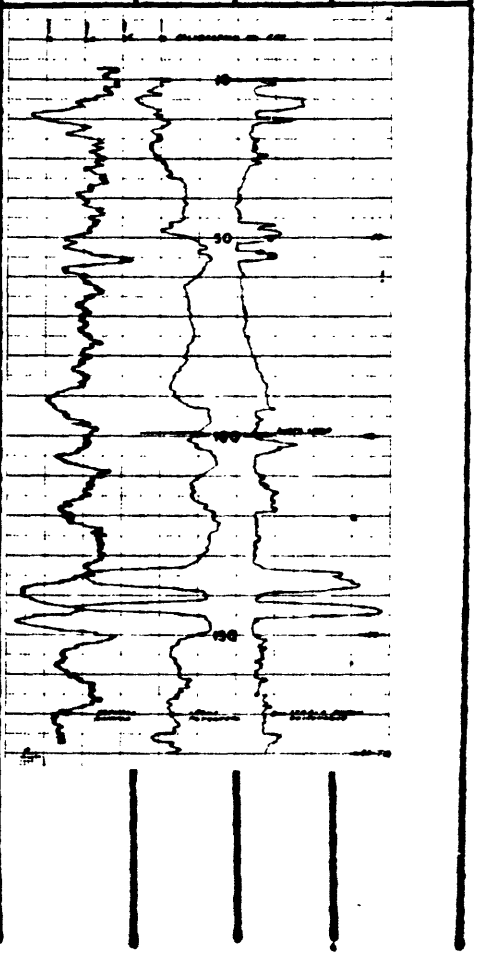
Gamma (G): **Scale** 10 cps/in. * **Logging speed** 16-17 fpm

Density (Den): **Scale** _____ **Logging speed** _____ fpm

Neutron (Neu): **Scale** _____ **Logging speed** _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m
0-25 ft Shale, olive-green; contains some black, carbonaceous shale		0	0
25-28 ft Coal, black			
28-47 ft Shale, gray		50	10
47-56 ft Coal, black			
56-70 ft Mixture of coal and shale, black and gray			20
70-79 ft Shale, gray, clayey		100	30
79-105 ft Sandstone, light-gray, fine-grained, shaly, soft			
105-120 ft Shale, gray			40
120-123 ft Sandstone, light-gray, fine-grained		150	50
123-135 ft Shale, dark-gray to black, carbonaceous			
135-140 ft Coal, black	PC		60
140-142 ft Clay, light-gray		200	
142-146 ft Shale and coal, black; shale is carbonaceous			
146-154 ft Shale, gray, clayey			70
154-160 ft Sandstone, light-gray, soft, shaly			
160-162 ft Coal and shale, black; shale is carbonaceous			
162-180 ft Sandstone, light-gray, soft (Pictured Cliffs)			



DRILL HOLE LOGS

Location Number DB B-12 Date Logged 1-11-79 Surface Elevation (ft) 5837.7

County & State San Juan County, N. M. Location NE¼ Sec. 34, T. 24 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 260 Logged depth (ft) 256

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

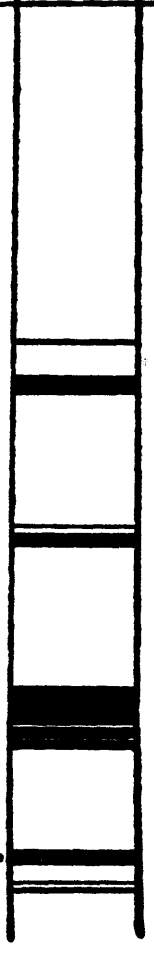
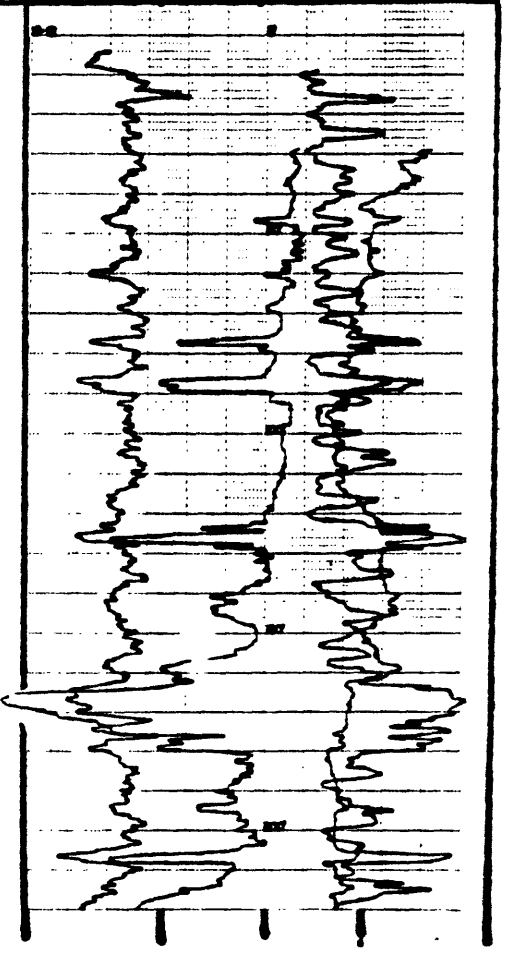
Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-5 ft Shale, light-tan, silty, hard 5-10 ft Sandstone, white, very fine grained, shaly 10-20 ft Shale, gray, silty 20-23 ft Shale, dark-gray, carbonaceous 23-30 ft Shale, light-gray, silty 30-35 ft Shale, dark-gray 35-75 ft Shale, gray, silty 75-77 ft Coal 77-86 ft Shale, gray, silty 86-89 ft Coal 89-95 ft Shale, dark-gray 95-110 ft Shale, gray, silty 110-111 ft Coal 111-125 ft Shale, gray, silty, sandy 125-131 ft Coal 131-150 ft Sandstone, brownish-gray, very fine grained, silty, shaly 150-165 ft Shale, gray, silty 165-185 ft Coal 185-205 ft Shale, black, carbonaceous, sandy 205-215 ft Coal 215-235 ft Sandstone, salt-and-pepper gray, very fine grained, soft, shaly		0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB B-12 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
235-250 ft Coal				
250-260 ft Sandstone, salt-and-pepper gray, fine-grained, very soft; 30 percent shale (Pictured Cliffs)	PC	250	80	
			90	
		300		
			100	
		350	110	
			120	
		400		
			130	
			140	
		450		
			150	
		500		
			160	
			170	
		550		
			180	
		600		
			190	

DRILL HOLE LOGS

Location Number DB B-14 Date Logged 2-01-79 Surface Elevation (ft) 5736.1

County & State San Juan County, N. M. Location SW¼ Sec. 6, T. 23 N., R. 13 W.

Map Bisti Trading Post, N. M. Drilled depth (ft) 60 Logged depth (ft) 60

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 20 mv/in. Logging speed 16-17 fpm

Resistivity (Res): Scale 10 ohms/in. Logging speed 16-17 fpm

Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

Density (Den): Scale _____ Logging speed _____ fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma / Sp / Res / Den
0-5 ft Sandstone, tan, very fine grained, unconsolidated 5-10 ft Sandstone, light-brown, very fine grained, shaly 10-12 ft Siltstone, light-gray, hard 12-18 ft Sand, light-brown, very fine grained, unconsolidated; red streaks less than 2 in. thick 18-20 ft Sand, gray, very fine grained, unconsolidated 20-30 ft Shale, gray, silty; carbonaceous flecks 30-38 ft Sandstone, light-gray, very fine grained; very shaly (Pictured Cliffs) 38-60 ft Shale, light-gray, sandy	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	

DRILL HOLE LOGS

Location Number DB B-15 Date Logged 1-09-79 Surface Elevation (ft) 5746.8

County & State San Juan County, N. M. Location SE¼ Sec. 6, T. 23 N., R. 13 W.

Map Bisti Trading Post, N. M. Drilled depth (ft) 74 Logged depth (ft) 72

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: J. Fassett

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

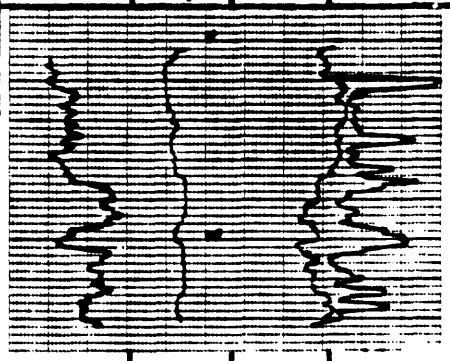
Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0–10 ft Sandstone, white, very fine grained, very well sorted 10–15 ft Sandstone, light-brown, very fine grained, very well sorted 15–20 ft Sandstone, brown, fine-grained to very fine grained; some very thin carbonaceous stringers 20–30 ft Sandstone, brown, fine-grained, less well sorted 30–35 ft No sample returned 35–40 ft Coal 40–48 ft Shale, brown to gray, silty, greasy 48–56 ft Sandstone, light-gray, very fine grained, shaly, soft 56–67 ft Shale, brown, sandy 67–74 ft Sandstone, light-gray, fine-grained to very fine grained, soft, shaly; much more shaly in last 2 ft (Pictured Cliffs)	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	

DRILL HOLE LOGS

Location Number DB B-16 Date Logged 12-27-78 Surface Elevation (ft) 5820.0

County & State San Juan County, N. M. Location SW¼ Sec. 5, T. 23 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 120 Logged depth (ft) 118

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: J. Fassett

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

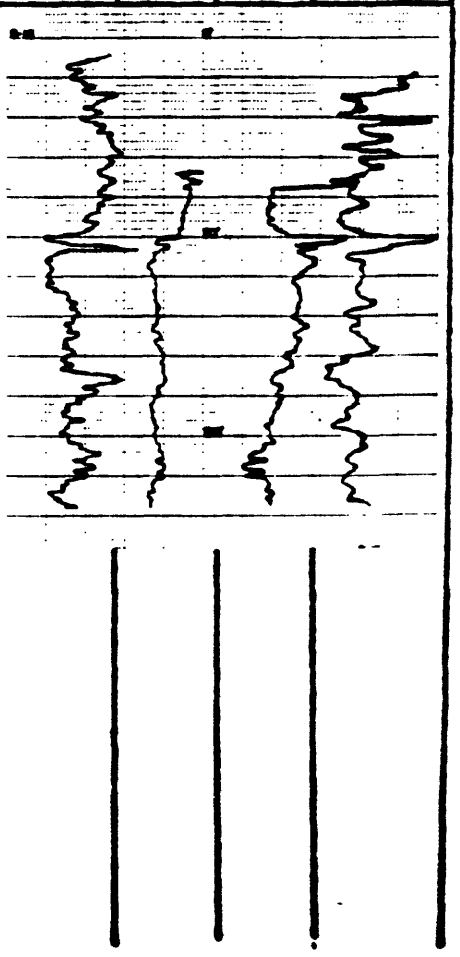
Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
0-5 ft Siltstone and shale, brown 5-15 ft Sandstone, light-gray, very fine grained; some siltstone 15-20 ft Siltstone and carbonaceous shale, very fine grained 20-25 ft Shale, carbonaceous, brownish-black 25-30 ft Shale, gray 30-35 ft Shale and coal, gray 35-40 ft Coal, shale, and siltstone, gray and white 40-50 ft Shale, gray, silty 50-55 ft Shale and coal, gray; shale is silty 55-120 ft Sandstone, white and gray, fine-grained (Pictured Cliffs)	PC	0 50 100 150 200	0 10 20 30 40 50 60 70				

DRILL HOLE LOGS

Location Number DB B-17 Date Logged 2-01-79 Surface Elevation (ft) 5907.6

County & State San Juan County, N. M. Location SE¼ Sec. 5, T. 23 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 120 Logged depth (ft) 120

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Conservation Division

GEOPHYSICAL LOGS: Casper, Wyoming

Spontaneous potential (sp): Scale 20 mv/in. Logging speed 16-17 fpm

Resistivity (Res): Scale 20 ohms/in. Logging speed 16-17 fpm

Gamma (G): Scale 10 cps/in. * Logging speed 16-17 fpm

Density (Den): Scale _____ Logging speed _____ fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

* Subtract four (4) feet from natural gamma reading for correct vertical scale.

LITHOLOGY	Strip Log	Depth * Ft	Depth * m	Geophysical Logs: Gamma / Sp / Res / Den
0-5 ft Sand, tan, fine-grained to very fine grained, unconsolidated		0	0	
5-10 ft Sand, brown, fine-grained to very fine grained, unconsolidated			10	
10-15 ft Sand, tan, very fine grained, shaly		50		
15-19 ft Coal, shaly			20	
19-28 ft Siltstone, light-brown				
28-46 ft Coal, dark-brown to black, dull luster		100	30	
46-50 ft Claystone and siltstone, gray to tan				
50-60 ft Siltstone, dark-gray; intermixed with very fine grained sandstone			40	
60-65 ft Siltstone, carbonaceous, dark-brown, very dirty		150		
65-70 ft Siltstone, light-gray, shaly			50	
70-85 ft Sandstone, light-gray, very fine grained, dirty, well-sorted				
85-90 ft Sandstone, light-gray, very fine grained, slightly carbonaceous; poor sorting			60	
90-120 ft Siltstone and claystone, light-brown to gray, shaly		200		
			70	

DRILL HOLE LOGS

Location Number DB B-18 Date Logged 12-12-78 Surface Elevation (ft) 5939.4

County & State San Juan County, N. M. Location NE¼ Sec. 4, T. 23 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 260 Logged depth (ft) 256

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

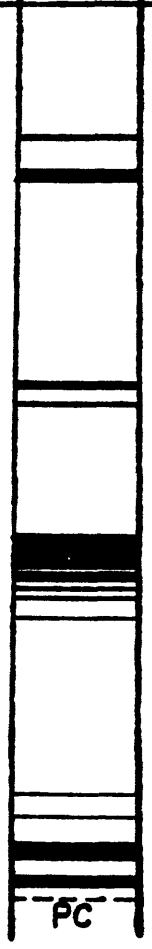
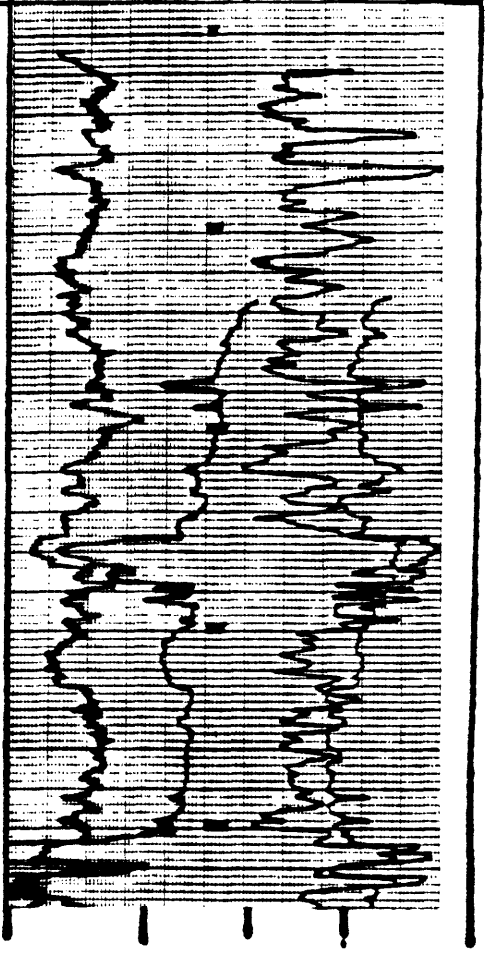
Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

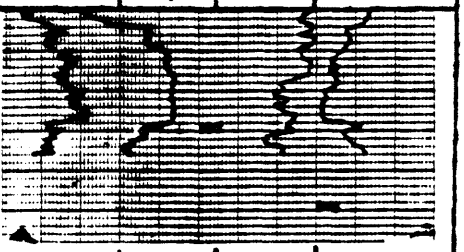
Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0–10 ft Sand, tan, very fine grained; unconsolidated alluvium 10–31 ft Shale, gray, silty 31–32 ft Coal, shaly 32–45 ft Shale, gray, silty 45–75 ft Shale, light-gray, very fine grained, sandy 75–85 ft Shale, gray, silty 85–91 ft Coal, shaly 91–110 ft Shale, gray, silty 110–132 ft Shale, light-gray, very fine grained, sandy 132–147 ft Coal; mixed with shale 147–150 ft Shale, gray, silty, carbonaceous 150–155 ft Shale, light-gray, sandy; sand is very fine grained 155–165 ft Sandstone, light-gray, very fine grained, shaly, soft 165–181 ft Shale, light-gray, silty 181–190 ft Shale, dark-gray, carbonaceous 190–207 ft Shale, gray, silty 207–218 ft Coal 218–230 ft Shale, gray, silty		0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB B-18 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma / Sp / Res / Den
230-245 ft Sandstone, light-gray, very fine grained, shaly 245-260 ft Sandstone, salt-and-pepper gray, very fine grained, shaly (Pictured Cliffs)		250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190	

DRILL HOLE LOGS

Location Number DB B-19 Date Logged 12-14-78 Surface Elevation (ft) 5962.7

County & State San Juan County, N. M. Location SE¼ Sec. 4, T. 23 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 262 Logged depth (ft) 262

Cored depth (ft) 211.35 Cored: [x] Yes [ ] No Geologists: P. Lambert

Drilling medium: [ ] Air [ ] Water [x] Foam [ ] Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

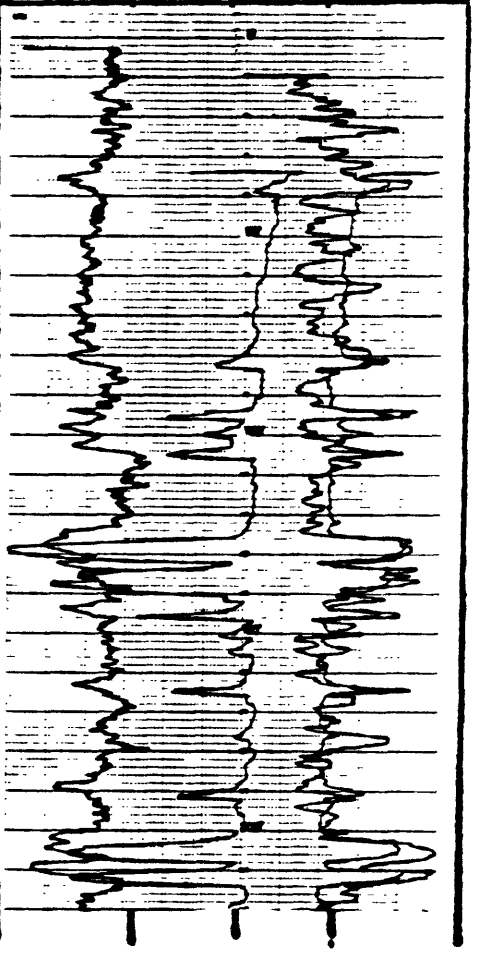
Spontaneous potential (sp): Scale 200 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale Logging speed fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-5 ft Sand, yellow, very fine grained 5-10 ft Shale, yellow-gray, soft 10-15 ft Shale, yellow, silty 15-20 ft Shale, gray 20-25 ft Shale, carbonaceous, black, coaly 25-30 ft Shale, yellow to gray, silty 30-35 ft Shale, dark-gray, soft 35-40 ft Coal; some yellow-green, silty shale 40-45 ft Shale, gray, soft 45-50 ft Shale, yellow-gray, soft 50-60 ft Shale, light-gray, silty, sandy 60-65 ft Siltstone, light-gray 65-75 ft Sandstone, light-gray, fine-grained 75-80 ft Sandstone, light-gray, very fine grained, silty 80-85 ft Coal; some light-gray, very fine grained, silty sandstone 85-90 ft Shale, gray 90-95 ft Shale, gray; some black, carbonaceous, coaly shale 95-100 ft Coal; some dark-gray, carbonaceous shale 100-105 ft Siltstone, light-gray, hard; some black, carbonaceous shale 105-110 ft Coal; some gray, carbonaceous shale	PC	0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB B-19 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma / Sp / Res / Den
110–115 ft Shale, gray to dark-gray 115–120 ft Shale, dark-gray 120–125 ft Shale, carbonaceous, black 125–130 ft Coal; some dark-gray shale 130–135 ft Coal 135–140 ft Coal and shale, carbonaceous, black 140–145 ft Shale, carbonaceous, black; some coal 145–150 ft Coal; some gray shale 150–155 ft Shale, gray, silty 155–160 ft Shale, gray 160–165 ft Coal; some dark-gray, carbonaceous shale 165–170 ft Shale, gray; some coal 170–185 ft Shale, gray 185–190 ft Shale, dark-gray 190–195 ft Shale, gray, silty 195–200 ft Shale, dark-gray 200–205 ft Coal; some black, carbonaceous shale 205–210 ft Coal 210–215 ft Coal; some black, carbonaceous shale, and gray shale 215–225 ft Shale, dark-gray 225–235 ft Sandstone, salt-and-pepper gray, fine-grained; abundant white grains as much as 10 mm; possibly calcite (Pictured Cliffs) 235–260 ft Sandstone, salt-and-pepper gray, fine-grained to very fine grained, clayey		250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190	

Description of core from B-19

Total depth of hole (T.D.): 260.00 ft
Total thickness of coring: 39.35 ft

Lithologic description	Feet From	Feet To
Interval 1 depth--122.00 - 150.00 ft		
Mixture of mud, siltstone, and coal fragments, gray	122.00	126.00
Siltstone, carbonaceous, black, laminated; 10 percent coal	126.00	126.65
Siltstone, dark-gray; 25 percent coal	126.65	128.20
Coal, black, laminated; siltstone fragments as much as 10 mm in diam.	128.20	129.45
Siltstone, light-gray	129.45	129.50
Coal, black, laminated	129.50	129.95
Clay-shale, dark-gray; coal fragments as much as 10 mm in diam.	129.95	130.00
Coal, black; 5 percent siltstone	130.00	130.20
Siltstone, dark-gray; 10 percent coal	130.20	130.65
Coal, black, clean, laminated	130.65	132.40
Siltstone, gray; coal fragments as much as 10 mm in diam.	132.40	132.55
Coal, black, clean, hard	132.55	132.70
Siltstone, gray	132.70	132.80
Coal, black, laminated; layers of siltstone less than 10 mm thick at 133.65 ft, 134.35 ft, 134.45 ft, and 136.65 ft	132.80	136.85
Coal, black; 5 percent siltstone	136.85	137.45
Silt-shale, light-gray, fissile; 15 percent coal in thin layers less than 2 mm thick	137.45	137.60
Coal, black, laminated	137.60	138.00
Coal, black, clean, laminated	138.00	138.65
Siltstone, gray; coal fragments as much as 20 mm in diam.	138.65	141.00
Coal, black, clean, laminated	141.00	141.75
Siltstone, tan; 40 percent coal; clayballs	141.75	141.85
Coal, black, laminated; some vitrain	141.85	143.60
Siltstone, light-gray	143.60	143.65

Description of core from B-19 -- continued

Lithologic description	Feet From	Feet To
Siltstone, carbonaceous, dark-gray; 40 percent coal	143.65	143.70
Siltstone, gray; coal fragments as much as 30 mm in diam.	143.70	144.00
Siltstone, gray; coal fragments as much as 20 mm in diam.	144.00	146.65
Siltstone, carbonaceous, gray; coal fragments as much as 20 mm in diam.	146.65	147.25
Siltstone, gray; coal fragments as much as 20 mm in diam.	147.25	147.60
Sandstone, calcareous, very fine grained, gray; coal fragments as much as 20 mm in diam.	147.60	147.90
Coal, black, laminated	147.90	148.40
Siltstone, carbonaceous, brown; large coal fragments as much as 50 mm in diam.	148.40	149.10
Siltstone, dark-gray; coal fragments as much as 40 mm in diam.	149.10	150.00

Thickness of interval = 28.00 ft

Thickness of coal in interval = 12.50 ft

Interval 2 depth--200.00 - 211.35 ft

Mixture of coal, siltstone, and mud, gray	200.00	200.40
Siltstone, carbonaceous; coal fragments as much as 10 mm in diam.	200.40	201.10
Coal, black, laminated; some vitrain; siltstone fragments as much as 5 mm in diam.	201.10	205.85
Siltstone, gray; coal fragments as much as 5 mm in diam.	205.85	206.45
Shale, carbonceous, dark-gray, fissile; coal fragments	206.45	207.00
Coal, black, laminated; some vitrain	207.00	211.35

Thickness of interval = 11.35 ft

Thickness of coal in interval = 9.10 ft

DRILL HOLE LOGS

Location Number DB B-20 **Date Logged** 12-12-78 **Surface Elevation (ft)** 5966.1

County & State San Juan County, N. M. **Location** NW¼ **Sec.** 3, T. 23 N., R. 13 W.

Map Alamo Mesa West, N. M. **Drilled depth (ft)** 341 **Logged depth (ft)** 341

Cored depth (ft) _____ **Cored:** ☐ Yes ☒ No **Geologists:** R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud **Logger:** Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 100 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 50 ohms/in. Logging speed 20 fpm

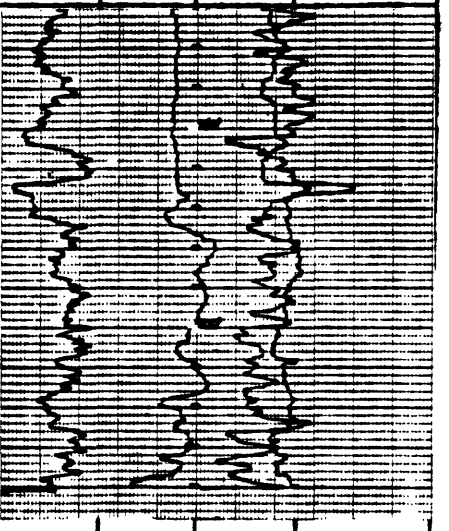
Gamma (G): Scale 100 cps/on. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-3 ft Sand, tan, fine-grained; unconsolidated alluvium		0	0	
3-10 ft Shale, gray, silty				
10-16 ft Sandstone, tan, fine-grained, shaly		50	10	
16-19 ft Shale, brown, carbonaceous				
19-45 ft Shale, brownish-gray, silty			20	
45-54 ft Shale, gray, silty				
54-62 ft Sandstone, tan, very fine grained, shaly				
62-66 ft Shale, gray, silty		100	30	
66-72 ft Shale, dark-gray, carbonaceous				
72-78 ft Shale, gray, silty				
78-80 ft Coal				
80-85 ft Shale, gray, silty			40	
85-95 ft Siltstone, light-gray, sandy, shaly				
95-100 ft Sandstone, light-gray, very fine grained		150	50	
100-105 ft Sandstone, very light gray, very fine grained				
105-115 ft Sandstone, very light gray, very fine grained, silty				
115-120 ft Siltstone, light-gray, sandy			60	
120-125 ft Shale, dark-gray		200		
125-130 ft Shale, gray; some siltstone				
130-135 ft Shale, dark-gray; some siltstone				
135-140 ft Shale, carbonaceous, black			70	

Hole No. DB B-20 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma Sp Res Den
140-145 ft Shale, carbonaceous, dark-gray to black, hard				
145-165 ft Shale, gray, silty				
165-170 ft Shale, light-gray, silty		250	80	
170-175 ft Shale, gray, silty; some carbonaceous material				
175-180 ft Shale, gray; some carbonaceous shale and coal	PC		90	
180-190 ft Coal		300		
190-195 ft Shale, gray, silty			100	
195-205 ft Shale, carbonaceous, black, coaly				
205-210 ft Shale, gray to black; some carbonaceous shale				
210-215 ft Shale, gray		350	110	
215-220 ft Shale, dark-gray				
220-225 ft Shale, dark-gray				
225-230 ft Siltstone, gray				
230-235 ft Siltstone, light-gray, sandy			120	
235-240 ft Shale, gray, silty, sandy				
240-280 ft No sample returned		400		
280-285 ft Shale, gray, sandy			130	
285-305 ft No sample returned				
305-310 ft Shale, gray, silty; poor samples				
310-340 ft Sandstone, salt-and-pepper light-gray, very fine grained, clayey, silty (Pictured Cliffs)			140	
		450		
			150	
		500		
			160	
			170	
		550		
			180	
		600		
			190	

DRILL HOLE LOGS

Location Number DB B-21 Date Logged 12-05-78 Surface Elevation (ft) 6007.1

County & State San Juan County, N. M. Location NE¼ Sec. 3, T. 23 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 340 Logged depth (ft) 340

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Division

GEOPHYSICAL LOGS: Albuquerque, N. M.

Spontaneous potential (sp): Scale 400 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 200 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

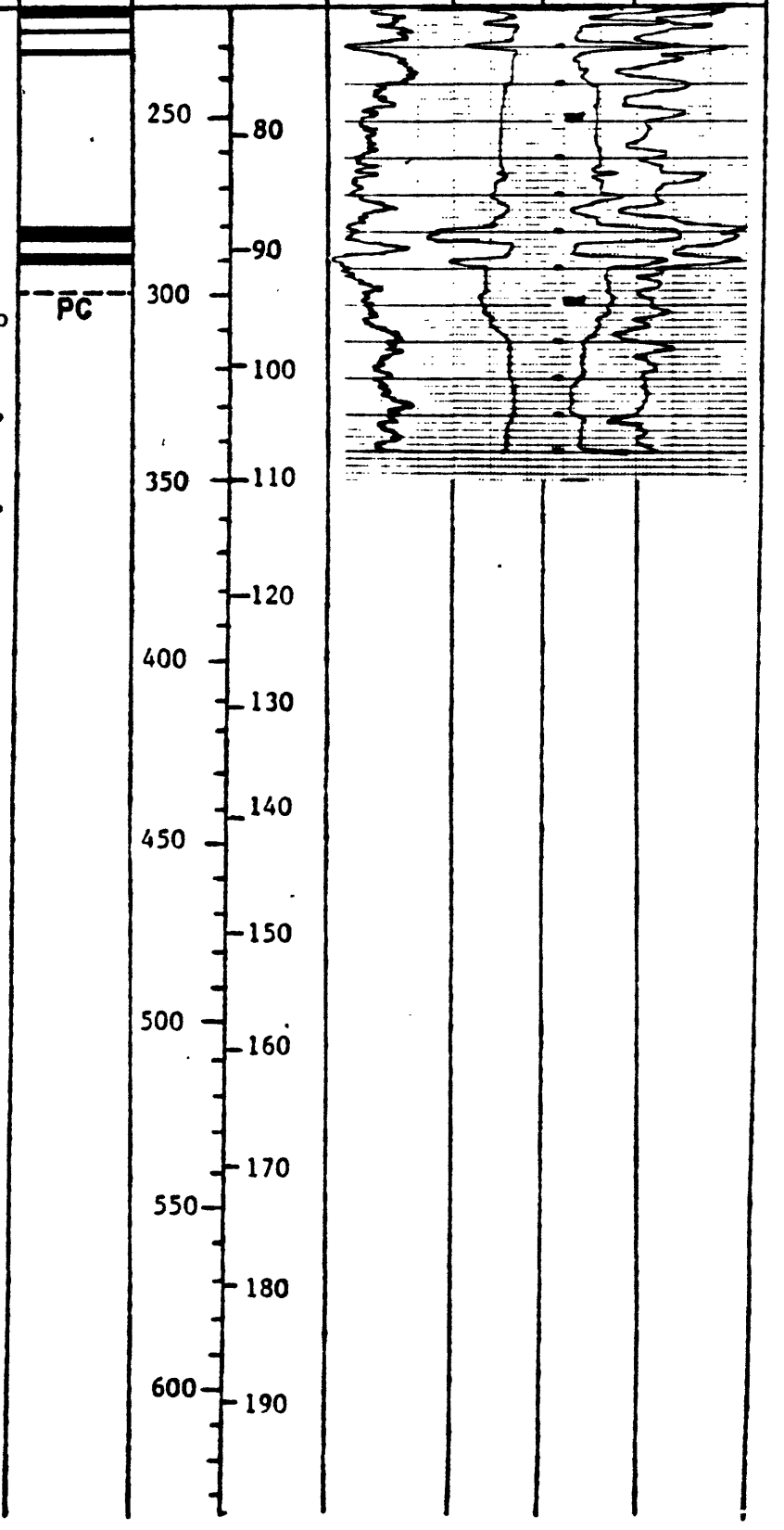
Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-6 ft Sand, tan, fine-grained; unconsolidated alluvium		0	0	
6-21 ft Shale, tan, silty			10	
21-35 ft Shale, grayish-brown, silty		50		
35-45 ft Shale, tan, silty, sandy; sand is very fine grained			20	
45-56 ft Shale, gray, silty				
56-60 ft Shale, dark-gray, silty, carbonaceous				
60-68 ft Sandstone, white, very fine grained, shaly			30	
68-90 ft Sandstone, gray, fine-grained to very fine grained, shaly		100		
90-102 ft Shale, dark-gray, silty, hard				
102-105 ft Shale, dark-gray, carbonaceous				
105-117 ft Sandstone, light-gray, fine-grained to very fine grained, shaly			40	
117-119 ft Coal				
119-130 ft Shale, gray, silty		150		
130-144 ft Siltstone, gray, shaly			50	
144-159 ft Sandstone, white, very fine grained, shaly				
159-166 ft Shale, dark-gray, carbonaceous, coaly			60	
166-187 ft Shale, gray, silty, sandy; very fine grained sand		200		
187-189 ft Coal			70	

Hole No. DB B-21 (continued)

LITHOLOGY
189-197 ft Shale, gray, silty
197-200 ft Coal, shaly, dirty
200-216 ft Coal
216-225 ft Shale, dark-gray, carbonaceous, sandy; very fine grained sand
225-228 ft Coal
228-232 ft Shale, dark-gray, carbonaceous
232-235 ft Coal
235-239 ft Shale, light-gray, silty
239-260 ft Sandstone, gray, fine-grained to very fine grained, shaly, soft
260-275 ft Shale, gray, silty
275-280 ft Sandstone, salt-and-pepper gray, very fine grained, shaly
280-288 ft Coal
288-340 ft Sandstone, salt-and-pepper gray, fine-grained, soft, shaly (Pictured Cliffs)



DRILL HOLE LOGS

Location Number DB B-22 Date Logged 12-04-78 Surface Elevation (ft) 5984.4

County & State San Juan County, N. M. Location SW¼ Sec. 3, T. 23 N., R. 13 W.

Map Alamo Mesa West, N. M. Drilled depth (ft) 280 Logged depth (ft) 280

Cored depth (ft) _____ Cored: ☐ Yes ☒ No Geologists: R. Jentgen

Drilling medium: ☐ Air ☐ Water ☒ Foam ☐ Mud Logger: Water Resources Divisio

GEOPHYSICAL LOGS: Albuquerque, N. M.

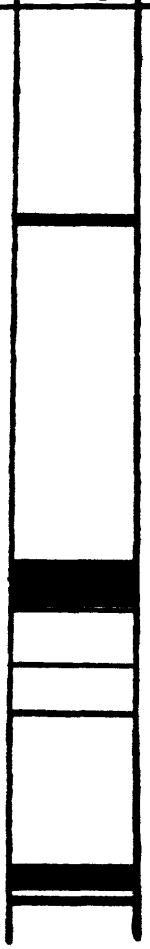
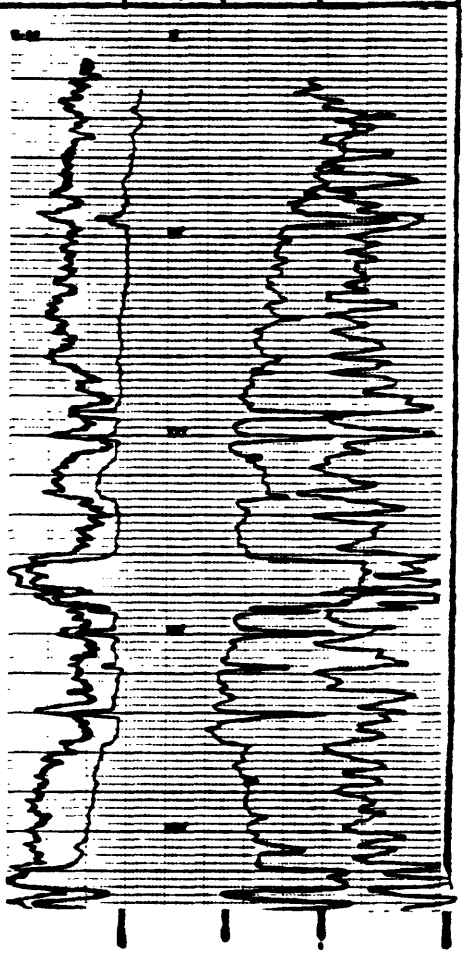
Spontaneous potential (sp): Scale 400 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 100 ohms/in. Logging speed 20 fpm

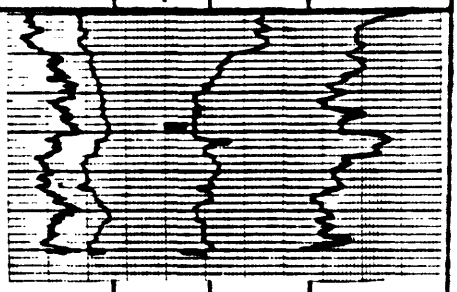
Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0–33 ft Shale, tan, silty 33–45 ft Shale, gray, silty, sandy; very fine grained sand 45–47 ft Coal 47–65 ft Shale, gray, silty 65–70 ft Sandstone, gray, very fine grained, silty 70–81 ft Shale, dark-gray, carbonaceous, coaly 81–110 ft Shale, gray, silty 110–120 ft Sandstone, light-gray, very fine grained, shaly 120–130 ft Shale, dark-gray, silty 130–132 ft Shale, dark-gray, carbonaceous 132–144 ft Coal 144–150 ft Shale, dark-gray, silty 150–156 ft Shale, black, coaly 156–172 ft Shale, gray, silty 172–175 ft Coal 175–180 ft Shale, dark-gray 180–210 ft Sandstone, light-gray, fine-grained, shaly 210–218 ft Coal		0 50 100 150 200	0 10 20 30 40 50 60 70	

Hole No. DB B-22 (continued)

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma	Sp	Res	Den
218-240 ft Sandstone, light-gray, fine-grained, shaly 240-280 ft Sandstone, salt-and-pepper gray, fine-grained to very fine grained, shaly (Pictured Cliffs)	PC	250 300 350 400 450 500 550 600	80 90 100 110 120 130 140 150 160 170 180 190				

DRILL HOLE LOGS

Location Number DB B-23 **Date Logged** 12-05-78 **Surface Elevation (ft)** 6009.6

County & State San Juan County, N. M. **Location** SE¼ **Sec.** 3, T. 23 N., R. 13 W.

Map Alamo Mesa West, N. M. **Drilled depth (ft)** 300 **Logged depth (ft)** 300

Cored depth (ft) 261.0 **Cored:** [x] Yes [ ] No **Geologists:** R. Jentgen

Drilling medium: [ ] Air [ ] Water [x] Foam [ ] Mud **Logger:** Water Resources Division Albuquerque, N. M.

GEOPHYSICAL LOGS:

Spontaneous potential (sp): Scale 400 mv/in. Logging speed 20 fpm

Resistivity (Res): Scale 200 ohms/in. Logging speed 20 fpm

Gamma (G): Scale 100 cps/in. Logging speed 20 fpm

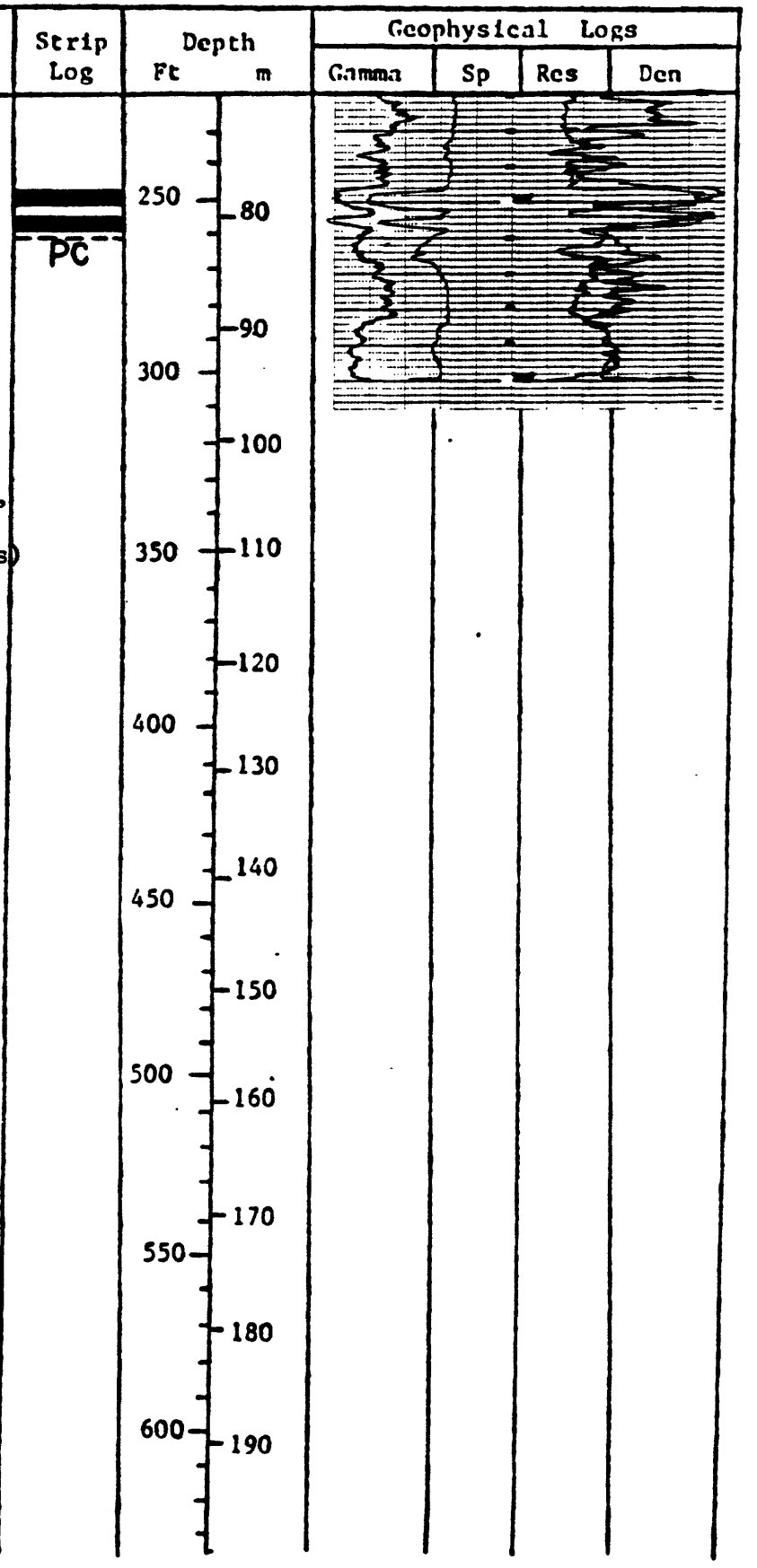
Density (Den): Scale 5000 cps/in. Logging speed 20 fpm

Neutron (Neu): Scale _____ Logging speed _____ fpm

LITHOLOGY	Strip Log	Depth Ft	Depth m	Geophysical Logs: Gamma, Sp, Res, Den
0-18 ft Alluvium; mixture of mud and sand		0	0	
18-43 ft Shale; alternating tan, silty, sandy shale and light-gray, silty shale about every foot			10	
43-44 ft Sandstone, red, very fine grained, shaly; possibly burned coal		50		
44-61 ft Shale, gray, silty			20	
61-62 ft Shale, black, carbonaceous				
62-63 ft Shale, gray, silty				
63-64 ft Shale, black, carbonaceous				
64-80 ft Shale, dark-gray, silty		100	30	
80-84 ft Coal				
84-105 ft Shale, dark-gray, silty				
105-120 ft Sandstone, gray, very fine grained, soft, shaly			40	
120-136 ft Shale, gray, silty				
136-139 ft Coal		150		
139-143 ft Shale, gray, silty			50	
143-144 ft Coal, shaly				
144-155 ft Shale, gray, silty				
155-157 ft Shale, light-gray, very hard; siderite cemented			60	
157-170 ft Shale, yellowish-gray, silty		200		
170-176 ft Shale, gray, silty, sandy; very fine grained sand				
176-185 ft Coal			70	

Hole No. DB B-23 (continued)

LITHOLOGY
185-186 ft Shale, black, carbonaceous
186-191 ft Coal
191-196 ft Shale, gray, silty
196-197 ft Coal
197-212 ft Shale, gray, silty, sandy; very fine grained sand
212-216 ft Coal
216-246 ft Shale, gray, silty, sandy; very fine grained sand
246-251 ft Coal
251-254 ft Shale, dark-gray, carbonaceous
254-257 ft Coal
257-272 ft Shale, dark-gray, silty
272-300 ft Sandstone, salt-and-pepper gray, fine-grained to very fine grained, silty (Pictured Cliffs)



Description of core from B-23

Total depth of hole (T.D.): 300.00 ft
Total thickness of coring: 45.85 ft

Lithologic description	Feet From	Feet To
Interval 1 depth--79.00 - 88.25 ft		
Siltstone, gray; coal fragments as much as 10 mm in diam.	79.00	80.55
Siltstone, gray; coal fragments as much as 25 mm in diam.	80.55	83.30
Shale, carbonaceous, dark-brown, fissile; coal fragments as much as 25 mm in diam.	83.30	83.50
Siltstone, gray; coal fragments as much as 25 mm in diam.	83.50	84.10
Shale, carbonaceous, grayish-black, fissile	84.10	84.30
Coal, black, laminated	84.30	84.75
Siltstone, tan	84.75	84.80
Coal, black, laminated	84.80	85.30
Siltstone, tan	85.30	85.35
Coal, black, laminated	85.35	85.90
Siltstone, tan; coal fragments as much as 35 mm in diam.	85.90	86.00
Coal, black	86.00	86.15
Shale, carbonaceous, black, fissile; 40 percent coal	86.15	86.50
Siltstone, carbonaceous, dark-brown; 30 percent coal	86.50	87.15
Siltstone, gray; coal fragments as much as 20 mm in diam.	87.15	88.25
Thickness of interval = 9.25 ft		
Thickness of coal in interval = 1.65 ft		
Interval 2 depth--182.50 - 199.10 ft		
Siltstone, gray; large coal fragments as much as 30 mm in diam.	182.50	184.00
Shale, carbonaceous, grayish-black, fissile	184.00	184.95
Coal, black, laminated; shale fragments as much as 25 mm in diam.; some vitrain	184.95	187.00

Description of core from B-23 -- continued

Lithologic description	Feet From	Feet To
Siltstone, tan; very thin layers of coal less than 1 mm thick	187.00	187.10
Coal, black, laminated; shale fragments as much as 5 mm in diam.	187.10	188.90
Siltstone and coal, gray and black, thin alternating layers 1 mm thick	188.90	188.95
Coal, black, laminated; shale fragments as much as 5 mm in diam.	188.95	189.00
Coal, black, laminated	189.00	189.05
Siltstone, carbonaceous, black; 40 percent coal	189.05	189.25
Coal, black, laminated; siltstone fragments as much as 15 mm in diam.	189.25	189.50
Siltstone, dark-gray; coal fragments as much as 15 mm in diam.	189.50	189.75
Siltstone, light-gray; coal fragments as much as 10 mm in diam.	189.75	189.90
Siltstone, dark-gray; coal fragments as much as 10 mm in diam.	189.90	190.10
Coal, black; siltstone fragments as much as 30 mm in diam.	190.10	191.10
Coal, black; 40 percent shale	191.10	191.45
Shale, carbonaceous, dark-gray	191.45	191.80
Siltstone, gray; coal fragments as much as 30 mm in diam.	191.80	194.70
Siltstone, carbonaceous, dark-gray	194.70	196.05
Coal, black, laminated; shale fragments as much as 30 mm in diam.	196.05	197.40
Siltstone, gray; coal fragments as much as 35 mm in diam.	197.40	198.00
Sandstone, very fine grained, light-gray; very thin coal layers less than 2 mm thick	198.00	199.10
Thickness of interval = 16.60 ft		
Thickness of coal in interval = 6.90 ft		
Interval 3 depth--241.00 - 261.00 ft		
Siltstone, gray; coal fragments as much as 10 mm in diam.	241.00	242.00
Sandstone, calcareous, very fine grained, gray	242.00	242.30

Description of core from B-23 — continued

Lithologic description	Feet From	Feet To
Siltstone, gray, clean	242.30	245.10
Siltstone, gray; coal fragments as much as 10 mm in diam.	245.10	246.10
Siltstone, carbonaceous, dark-gray	246.10	246.70
Coal, black, laminated, clean	246.70	248.00
Coal, black, laminated; shale fragments as much as 15 mm in diam.	248.00	248.55
Coal, black, laminated, clean	248.55	249.90
Coal, black, laminated; shale fragments as much as 10 mm in diam.	249.90	250.50
Coal, black, laminated, clean	250.50	252.00
Shale, carbonaceous, dark-gray, laminated	252.00	252.75
Siltstone, gray; coal fragments as much as 10 mm in diam.	252.75	253.80
Shale, dark-gray, fissile	253.80	254.15
Coal, black, laminated; small scattered silt particles	254.15	255.05
Coal, black, laminated; some vitrain	255.05	257.00
Shale, carbonaceous, black, laminated; 50 percent coal	257.00	257.50
Siltstone, dark-gray; coal fragments as much as 40 mm in diam.	257.50	259.85
Sandstone, fine-grained, gray; angular grains	259.85	261.00

Thickness of interval = 20.00 ft

Thickness of coal in interval = 8.15 ft