UNITED STATES DEPARTMENT OF THE INTERIOR

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Core Descriptions, Photographs, and Core and X-ray Analyses of Portions of the Upper Cretaceous Mesaverde Group, Washakie Basin, Wyoming

by

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Introduction

Eleven cores from the Upper Cretaceous Mesaverde Group in the Washakie basin, Wyoming (fig. 1, table 1), were described, photographed, and sampled at the U.S. Geological Survey core library, Denver, Colorado. Core-analysis data and bulk-sample X-ray data are included to supplement the core descriptions (tables 2, 3).

In the United States the petroleum industry reports all data such as drilling depths, core depth intervals, intervals for which porosity and permeability tests were conducted, bottom hole temperatures, pressure measurements, and fluid or gas flow rates in English units. The author chose to use metric units when describing specific aspects of the cored intervals such as the size of the burrows in bioturbated zones, lamination thicknesses, and lithologic changes within the total described core intervals. Therefore, a mixture of English and metric units will be found within this report. Conversion factors for English to metric units follow:

1 ft = 0.30 m

1 psi = 7.03×10^{-2} kg/cm^2

1 BOPD = 159 liters of oil/day

1 MCFD = $28.32 m^3$ of gas/day

1 BWPD = 159 liters of water/day

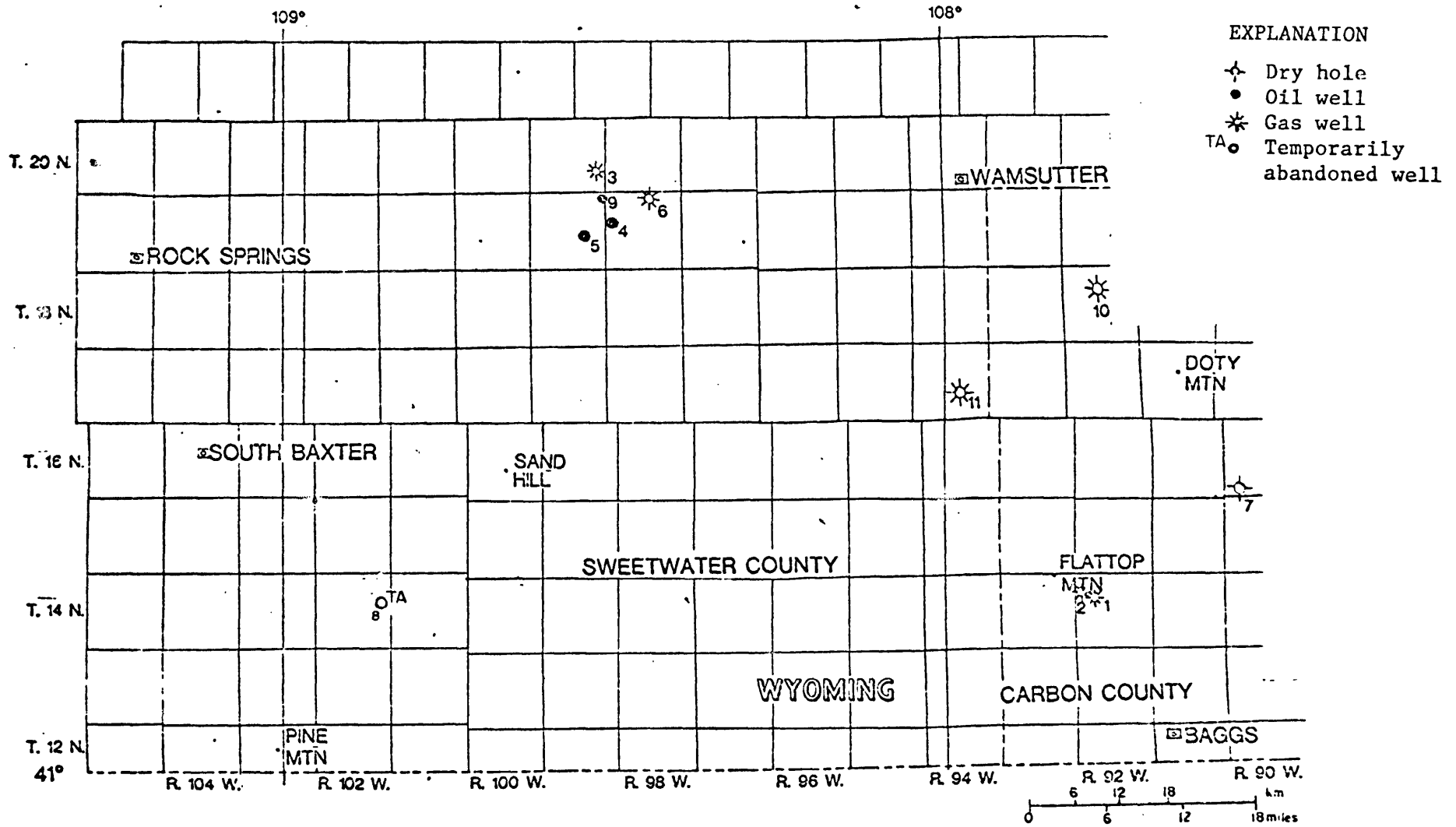


Figure 1.-- Map showing location and reference numbers of drill holes listed in table 1.

Table 1.--List of drill hole locations for described core intervals, and other reference information.

Drill hole reference number[1]	Company name and drill hole location	U.S. Geol. Survey core library reference number	API Well number	Production data	Cored interval[2] (in feet)	Core Analysis	Page this report
1	Colorado Interstate Gas Expl., Inc. SW¼SW¼ sec. 8, T. 14 N., R. 92 W. 2-8-14-92 Blue Gap II Unit	A 221	49-007-20206	Gas Gross pay zone 8970-9652 ft IPF 440 MCFD 84 BWPD	9051.5-9298 Mesaverde Group, undivided	Yes	22
2	Colorado Interstate Gas Expl., Inc. SE¼NW¼ sec. 7, T. 14 N., R. 92 W. 7-14-92 Blue Gap II Unit	A 222	49-007-20186	Gas Gross pay zone 9126-9602 ft IPF 4800 MCFD	9138-9159 Mesaverde Group, undivided	Yes	26
3	Mesa Petroleum Co. NW¼NW¼ sec. 25, T. 20 N., R. 99 W. 1-25 Playa UPRR	A 230	49-037-20653	Gas Gross pay zone 4668-4674 ft IPF 1020 MCFD	4638-4694 Almond Fm of Mesaverde Group	Yes	28
4	Forest Oil Corp. NW¼NW¼ sec. 18, T. 19 N., R. 98 W. 9-18-2 Arch Unit	A 394	49-037-05617	Oil Gross pay zone 4884-4899 ft IPF 232 BOPD	4879-4904 Almond Fm of Mesaverde Group	Yes	32
5	Forest Oil Corp. NW¼NE¼ sec. 23, T. 19 N., R. 99 W. 20-23-4 Arch Unit	A 395	49-037-05578	Oil Gross pay zone 4493-4518 ft. IPF 1578 BOPD	4497-4547 Almond Fm of Mesaverde Group	Yes	34
6	Forest Oil Corp. SW¼NE¼ sec. 3, T. 19 N., R. 98 W. 3-1 UPRR Arch 77	A 415	49-037-05687	Gas Gross pay zone 6054-61 ft 6070-88 ft IPF 1964 MCFD	6020-6069 Almond Fm of Mesaverde Group	Yes	36
7	Amerada Hess Corp. SW¼NW¼ sec. 32, T. 16 N., R. 90 W. Deep Creek 2 Unit	A 416	49-007-05071	Dry & abandoned	2407-2453 Mesaverde Group, undivided	No	38
8	Jerry Chambers, Oil Producer C NW¼ sec. 13, T. 14 N., R. 102 W. 1-13 Kemmer Creek Federal	A 483	49-037-20615	Temporarily abandoned	3705-3751 Mesaverde Group, undivided	Yes	41
9	Forest Oil Corp. SE¼NE¼ sec. 1, T. 19 N., R. 99 W. 1-8 Arch Unit 70	A 579	49-037-05689	Oil Gross pay zone 4790-4810 ft IPF 20 BOPD 468 BWPD	4790-4815 Almond Fm of Mesaverde Group	Yes	43
10	Michigan Wisconsin Pipeline Co. E½SE¼ sec. 9, T. 18 N., R. 92 W. 1-9 Creston	A 716	49-007-20281	Gas Gross pay zone 8591-10195 ft IPF 335 MCFD	8801-10224 Mesaverde Group, undivided	Yes	45
11	Ladd Petroleum Corp. SE¼SE¼ sec. 22, T. 17 N., R. 94 W. 1-22-74 Federal	A 846	49-037-20713	Gas Gross pay zone 11465-12058 ft IPF 840 MCFD	10139-10292 Almond Fm of Mesaverde Group	Yes	54

[1]Shown in figure 1.

[2]Core depths not adjusted to log depths.

Table 2.--Core analysis information, drill holes 1 through 11

[*Oil derived from kerogen in shale]

Depth (feet)	Permeability (millidarcys)	Porosity (percent)	Residual saturation (percent pore) Oil	Residual saturation (percent pore) Total water
	Ref. No. 1 (A 221) Colorado Interstate Gas Expl., Inc. 2-8-14-92 Blue Gap II Unit SW¼SW¼ sec. 8, T. 14 N., R. 92 W.			
9,059-60	0.03	3.2	6.3	75.9
9,060-61	0.04	4.6	13.4	80.3
9,061-63	Shale, no analysis			
9,063-64	0.02	1.7	12.6	75.3
9,064-65	0.13	6.8	2.8	61.9
9,065-66	0.03	6.3	3.1	65.0
9,066-67	5.9	5.4	9.2	81.0
9,067-68	0.03	4.6	4.4	91.9
9,068-69	0.01	4.6	4.4	92.1
9,069-69.5	0.01	3.5	34.9	58.1
9,069.5-73	Lost recovery			
9,073-74	0.29	4.4	13.7	82.2
9,074-75	0.01	4.7	14.8	80.2
9,075-76	1.1	5.0	15.8	82.9
9,076-77	0.01	3.0	17.5	76.8
9,077-80	Lost recovery			
9,080-81	0.31	6.2	3.2	83.1
9,081-82	0.02	4.3	4.6	92.8
9,082-83	0.10	7.1	9.6	60.5
9,083-84	0.10	8.5	2.2	62.6
9,084-85	0.03	10.0	1.9	48.1
9,085-86	0.01	6.4	3.1	67.3
9,086-87	0.02	4.9	4.1	89.9
9,087-88	0.03	4.1	4.9	92.3
9,088-89	0.19	3.0	7.0	90.8
9,089-90	13	3.2	6.5	91.1
9,090-91	5.7	2.0	10.5	84.2
9,091-94	Shale, no analysis			
9,094-95	0.01	0.7	29.2	58.4
9,285-86	1.1	1.5	*33.3	53.2
9,292-93	0.08	3.4	*26.5	70.6
9,296-97	0.05	2.5	* 8.8	88.1
	Ref. No. 2 (A 222) Colorado Interstate Gas Expl., Inc. 7-14-92 Blue Gap II Unit SE¼NW¼ sec. 7, T. 14 N., R. 92 W.			
9,138-39	0.01	5.8	3.4	82.8
9,139-40	0.01	4.1	4.9	48.7
9,140-41	0.01	3.7	1.4	59.6
9,141-42	0.01	2.5	8.0	87.9
9,144-45	0.01	2.4	8.3	79.3
9,145-46	0.01	2.0	5.0	75.0
9,148-49	0.01	4.2	4.8	83.5
9,152-53	0.01	4.4	20.4	77.4
9,156-57	0.01	2.9	17.2	79.5
9,158-59	0.01	6.7	10.4	88.0

Table 2.--Core analysis information, drill holes 1 through 11--Continued

Depth (feet)	Permeability (millidarcys)	Porosity (percent)	Residual saturation (Percent pore) Oil	Residual saturation (Percent pore) Total water
	Ref. No. 3 (A 230) Mesa Petroleum Company 1-25 Playa UPRR NW¼NW¼ sec. 25, T. 20 N., R. 99 W.			
4,635-36	50	21.4	0	93.2
4,636-37	63	20.6	0	81.9
4,637-38	24	19.1	Trace	72.3
4,638-38.5	0.13	8.5	Trace	67.7
4,638.5-47	Shale, no analysis			
4,647-48	0.01	2.0	Trace	66.2
4,648-51	Shale, no analysis			
4,651-52	0.01	10.0	Trace	75.3
4,652-53	0.18	6.2	Trace	75.0
4,653-54	0.01	4.0	Trace	99.1
4,654-55	0.11	6.4	Trace	58.6
4,655-61	Shale, no analysis			
4,661-61.5	0.08	10.9	Trace	71.5
4,661.5-62	Coal, no analysis			
4,662-63	9.50	18.8	Trace	69.6
4,663-64	36	19.1	1.3	58.1
4,664-65	85	19.9	Trace	57.1
4,665-66	2.45	18.2	Trace	63.4
4,666-67	68	19.8	Trace	52.8
4,667-68	7.12	12.3	Trace	48.7
4,668-69	107	19.3	Trace	50.7
4,669-70	78	18.6	Trace	53.8
4,670-71	56	18.9	3.9	67.2
4,671-72	5.32	12.8	7.6	88.4
4,672-73	1.13	9.9	4.9	56.2
4,673-74	1.57	8.9	2.8	45.1
4,674-75	8.20	16.8	Trace	52.9
4,675-80	Shale, no analysis			
4,680-80.5	0.05	12.8	9.2	88.8
4,680.5-81.5	Shale, no analysis			
4,681.5-82	20	19.9	Trace	83.9
4,682-83	20	20.7	Trace	80.7
4,683-84	28	21.0	Trace	72.0
4,684-85	4.36	16.0	0	80.8
4,685-86	11	15.9	Trace	76.8
4,686-87	9.15	16.7	Trace	79.8
4,687-88	14	18.2	Trace	81.9
4,688-89	18	18.6	0	81.3
4,689-90	14	17.8	Trace	76.2
4,690-91	16	17.9	Trace	66.0
4,691-92	0.01	4.5	Trace	90.9
4,692-93	0.15	8.0	Trace	72.0
4,693-94	0.70	13.7	Trace	61.6

Table 2.--Core analysis information, drill holes 1 through 11--Continued

Depth (feet)	Permeability (millidarcys)	Porosity (percent)	Residual saturation (percent pore) Oil	Residual saturation (percent pore) Total water
	Ref. No. 4 (A 394) Forest Oil Corp. 9-18-2 Arch Unit NW¼NW¼ sec. 18, T. 19 N., R. 98 W.			
4,879-80	1.2	9.2	0.0	70.6
4,882-83	15	20.9	13.9	54.5
4,883-84	0.18	6.6	0.0	53.1
4,884-85	0.82	10.7	14.9	38.3
4,885-86	0.11	4.0	0.0	72.5
4,886-87	0.03	2.4	0.0	62.5
4,887-88	42	22.0	14.5	49.5
4,888-89	41	21.3	13.6	50.2
4,889-90	50	21.4	14.0	51.8
4,890-91	112	22.7	14.5	48.8
4,891-92	72	21.9	13.7	47.9
4,892-93	53	20.9	14.4	50.2
4,893-94	115	18.8	14.9	52.1
4,894-95	22	21.8	14.7	51.9
4,895-96	59	22.1	14.5	52.5
4,896-97	179	23.5	13.6	50.6
4,897-98	38	20.7	14.5	53.6
4,898-99	30	18.1	14.9	47.5
4,899-4,900	71	21.6	13.4	50.8
4,900-01	101	24.5	14.3	50.7
4,901-02	87	22.9	14.0	49.7
	Ref. No. 5 (A 395) Forest Oil Corp. 20-23-4 Arch Unit NW¼NE¼ sec. 23, T. 19 N., R. 99 W.			
4,497-98	21	20.7	19.3	41.6
4,498-99	19	21.3	20.6	44.5
4,499-4,500	7.3	18.8	20.2	46.3
4,500-01	15	20.0	20.0	47.5
4,501-02	41	21.5	20.9	41.4
4,502-03	34	23.3	21.4	43.7
4,503-04	33	23.2	21.9	44.8
4,504-05	74	23.3	22.7	39.0
4,505-06	86	23.6	19.9	41.5
4,506-07	10	20.4	21.6	47.1
4,507-08	42	23.0	23.0	38.3
4,508-09	27	22.3	22.9	40.3
4,509-10	47	23.3	21.0	41.6
4,510-11	59	23.1	2.16	40.2
4,511-12	21	22.5	23.5	39.6
4,512-13	22	21.6	22.2	41.2
4,513-14	19	21.4	21.5	44.4
4,514-15	14	19.9	21.6	46.7
4,515-16	41	21.6	17.2	44.1
4,516-17	88	22.4	17.9	48.6
4,517-18	116	25.6	17.6	47.7
4,518-19	135	24.1	17.0	49.3
4,519-20	40	20.5	18.1	49.7
4,524-25	0.21	16.8	15.5	51.8
4,525-26	0.53	12.0	17.5	42.3
4,526-27	0.70	14.7	19.7	45.6
4,527-28	0.53	17.4	16.1	54.0

Table 2.--Core analysis information, drill holes 1 through 11--Continued

Depth (feet)	Permeability (millidarcys)	Porosity (percent)	Residual saturation (percent pore) Oil	Residual saturation (percent pore) Total water
	Ref. No. 6 (A 415) Forest Oil Corp. 3-1 UPRR Arch 77 SW¼NE¼ sec. 3, T. 19 N., R. 98 W.			
6,029-30	1.9	15.6	4.5	73.8
6,030-31	0.08	14.5	3.5	71.7
6,031-32	-0.08	11.7	6.0	78.5
6,032-33	-0.08	8.1	8.7	81.5
6,033-34	-0.08	8.3	19.3	77.4
6,034-35	0.08	12.3	10.6	74.6
6,035-36	0.16	13.8	44.2	48.5
6,039-40	0.16	17.3	7.5	65.4
6,056-57	2.8	19.3	1.0	45.5
6,057-58	5.2	22.2	2.7	46.0
6,058-59	4.6	21.1	1.9	49.7
6,059-60	1.2	18.5	3.8	50.2
6,060-61	4.2	21.2	2.4	49.1
6,061-62	3.3	18.1	1.1	49.5
6,062-63	12	19.9	2.5	44.7
6,063-64	10	19.0	3.2	44.2
6,064-65	11	20.9	1.9	48.8
6,065-66	41	20.8	5.3	50.0
6,066-67	4.7	22.7	2.6	43.1
6,067-68	0.33	19.4	4.1	46.9
	Ref. No. 7 (A 416)			
Data not available				
	Ref. No. 8 (A 483) Jerry Chambers, Oil Producer 1-13 Kemmer Creek Federal CNW sec. 13, T. 14 N., R. 102 W.			
3,705-06	0.14	11.6	1.7	63.2
3,706-07	1.1	11.4	1.7	64.9
3,707-08	0.67	9.2	5.4	76.3
3,708-09	0.67	9.9	5.0	76.3
3,709-10	2.0	10.8	4.6	69.7
3,710-11	0.52	9.6	1.0	61.5
3,711-12	0.76	12.4	7.0	49.7
3,712-13	0.20	10.2	1.9	67.8
3,713-14	8.4	11.0	0.9	67.4
3,714-15	63	9.1	3.7	76.4
3,715-16	9.1	7.8	9.1	77.9
3,716-17	0.04	7.1	4.9	83.0
3,718-19	0.27	8.1	6.2	74.9
3,721-22	1.6	6.2	11.7	83.3
3,724-25	0.69	8.2	6.1	75.9
3,729-30	0.44	8.1	6.2	84.1
3,734-35	2.8	7.4	6.8	81.8
3,742-43	0.38	6.0	8.6	82.6
3,745-46	0.71	7.0	7.1	74.3
3,750-51	29	6.5	7.9	82.3

Table 2.--Core analysis information, drill holes 1 through 11--Continued

Depth (feet)	Permeability (millidarcys)	Porosity (percent)	Residual saturation (percent pore) Oil	Residual saturation (percent pore) Total water
	Ref. No. 9 (A 579) Forest Oil Corp. 1-8 Arch Unit 70 SE¼NE¼ sec. 1, T. 19 N., R. 99 W.			
4,794-95	3.1	17.9	16.8	55.9
4,795-96	16	20.6	15.5	48.5
4,796-97	8.5	18.6	19.4	45.2
4,797-98	24	20.8	18.8	50.5
4,798-99	5.2	17.6	18.8	47.1
4,799-4,800	11.3	21.2	19.3	48.1
4,800-01	22	19.1	18.9	49.8
4,801-02	17	20.0	19.0	50.0
4,802-03	20	21.0	18.6	48.6
4,803-04	7.8	11.5	15.7	29.5
4,804-05	9.3	19.6	19.4	49.4
4,805-06	21	21.2	21.7	46.2
4,806-07	44	18.8	17.0	46.8
4,807-08	27	23.9	27.7	39.0
4,808-09	4.1	17.7	15.2	50.9
4,809-10	75	23.7	23.2	43.9
4,810-11	7.0	20.5	19.5	50.8
4,811-12	102	23.1	21.7	44.1
	Ref. No. 10 (A 716) Michigan Wisconsin Pipeline Company 1-9 Creston E½SE¼ sec. 9, T. 18 N., R. 92 W.			
8,801-02	0.03	12.5	5.2	31.5
8,802-03	0.60	13.5	4.2	31.9
8,803-04	0.28	13.4	3.5	39.3
8,804-05	0.10	12.6	3.7	37.3
8,805-06	0.19	13.3	4.9	30.6
8,825-26	0.01	4.8	18.3	56.9
8,826-27	0.02	5.7	15.2	50.5
8,827-28	0.01	4.3	20.5	54.8
8,842-43	0.18	13.4	1.4	35.1
8,843-44	0.15	13.9	1.4	45.0
8,844-45	0.29	12.7	0.7	43.3
8,845-46	0.25	12.9	0.7	42.4
8,846-47	0.04	13.3	1.4	38.8
8,847-48	0.45	14.1	1.3	48.3
8,848-49	0.52	15.4	1.2	38.9
8,849-50	0.11	12.3	0.8	46.5
8,850-51	0.09	12.3	0.8	48.3
8,851-52	0.06	13.5	0.0	32.1
8,852-53	0.17	13.6	0.0	40.3
8,853-54	0.13	13.7	0.0	37.6
8,854-55	0.30	13.2	1.4	39.8
8,855-56	0.29	14.6	0.6	37.3
8,856-57	0.40	12.3	0.8	38.5
8,857-58	6.0	8.9	5.8	58.2
8,858-59	0.03	7.9	1.2	73.3
8,859-60	0.42	6.3	11.0	62.8
8,860-61	0.33	7.3	28.3	51.1
8,864-65	0.02	5.4	9.2	66.2
8,865-66	0.05	5.8	3.4	74.7
8,866-67	0.02	7.2	2.7	43.2
8,868-69	0.37	3.5	14.7	52.8
8,881-82	0.12	4.7	14.5	58.2

Table 2.--Core analysis information, drill holes 1 through 11--Continued

Depth (feet)	Permeability (millidarcys)	Porosity (percent)	Residual saturation (percent pore) Oil	Residual saturation (percent pore) Total water
	Ref. No. 10 (A 716) Michigan Wisconsin Pipeline Company 1-9 Creston E½SE¼ sec. 9, T. 18 N., R. 92 W. --Continued			
8,882-83	0.07	4.9	9.9	55.7
8,883-84	0.35	4.4	11.3	67.7
8,884-85	0.44	10.8	0.9	33.7
8,885-86	0.08	11.2	4.2	33.2
8,895-96	0.09	6.2	7.8	62.7
8,896-97	0.39	5.6	3.5	74.3
8,897-98	0.09	4.5	2.2	62.4
8,898-99	0.04	4.4	4.6	69.0
8,899-8,900	0.94	4.4	16.2	65.0
10,185-86	0.07	6.0	11.4	26.1
10,186-87	0.01	10.4	6.4	29.1
10,187-88	0.60	10.8	1.8	28.8
10,188-89	0.22	10.5	1.8	25.6
10,189-90	0.20	11.7	1.6	24.1
10,190-91	0.14	12.2	5.3	33.6
10,191-92	0.09	12.2	5.4	30.6
10,192-93	0.04	10.3	8.5	28.3
10,193-94	0.34	10.1	1.9	26.1
10,194-95	0.26	10.7	4.5	27.2
10,213-14	0.14	3.8	19.4	77.5
10,214-15	0.02	3.5	20.9	71.6
10,215-16	0.09	4.0	18.0	77.0
10,218-19	0.01	2.1	5.1	81.8
10,221-22	0.02	3.8	13.5	80.9
10,223-24	0.02	4.9	16.5	66.1
	Ref. No. 11 (A 846) Ladd Petroleum Corp. 1-22-74 Federal SE¼SE¼ sec. 22, T. 17 N., R. 94 W.			
10,139-40	0.01	2.1	5.0	90.3
10,140-41	0.01	2.4	8.8	87.7
10,141-42	0.01	3.2	6.9	89.7
10,143-44	0.01	3.1	10.6	79.2
10,144-45	0.07	4.5	11.2	49.3
10,145-46	0.01	3.7	15.8	63.4
10,146-47	0.01	6.9	5.4	31.3
10,147-48	0.01	3.8	15.8	73.5
10,148-49	0.01	3.7	15.9	74.2
10,149-50	0.30	3.5	11.0	81.3
10,162-63	0.01	0.6	17.3	60.2
10,163-64	0.01	0.7	29.6	59.2
10,164-65	0.02	3.4	11.8	80.5
10,182-83	0.01	3.2	19.3	70.8
10,183-84	0.01	4.5	15.3	70.2
10,184-85	0.11	5.0	17.9	39.8
10,185-86	0.01	4.7	25.2	50.3
10,186-87	0.01	3.9	25.2	60.6
10,187-88	0.01	3.4	21.2	66.7
10,188-89	0.01	5.3	18.7	56.1
10,189-90	0.15	4.5	21.9	61.3
10,201-02	0.01	3.1	6.5	90.4
10,202-03	0.01	3.2	0.0	82.5

Table 2.--Core analysis information, drill holes 1 through 11--Continued

Depth (feet)	Permeability (millidarcys)	Porosity (percent)	Residual saturation (percent pore)	
			Oil	Total water
Ref. No. 11 (A 846) Ladd Petroleum Corp. 1-22-74 Federal SE¼SE¼ sec. 22,, T. 17 N., R. 94 W. --Continued				
10,203-04	0.01	3.6	5.6	89.7
10,204-05	0.01	4.3	2.3	78.8
10,205-06	0.01	4.4	4.5	89.8
10,206-07	0.01	3.7	5.3	85.6
10,207-08	0.01	3.5	5.8	92.1
10,208-09	0.01	4.2	4.9	92.4
10,209-10	0.01	3.9	2.6	92.3
10,210-11	0.08	4.2	4.9	92.8
10,211-12	0.01	4.3	4.7	90.2
10,212-13	0.01	3.4	6.1	91.1
10,213-14	0.01	4.4	8.9	88.6
10,214-15	0.01	3.4	5.9	88.2
10,226-27	0.01	2.9	25.1	71.6
10,227-28	0.01	4.7	16.8	33.6
10,228-29	0.01	4.5	17.5	39.4
10,229-30	0.01	3.1	22.5	70.8
10,233-34	0.01	3.4	11.6	85.5
10,234-35	0.01	3.2	12.3	84.4
10,236-37	0.01	3.0	13.3	84.0
10,237-38	0.01	2.6	7.9	87.1
10,248-49	0.01	1.9	5.6	90.2
10,249-50	0.01	2.4	8.8	88.2
10,252-53	0.01	3.9	16.2	80.8
10,253-54	0.01	4.7	4.2	71.4
10,254-55	0.01	4.0	5.0	75.4
10,255-56	0.01	2.5	4.2	91.9
10,259-60	0.70	5.0	6.9	81.1
10,260-61	0.24	4.6	11.1	80.0
10,261-62	0.15	4.4	11.8	80.2
10,262-63	5.8	4.2	14.7	78.2
10,263-64	0.06	3.8	13.5	81.0
10,264-65	1.5	4.7	11.2	80.5
10,270-71	0.07	4.5	11.3	72.2
10,271-72	0.01	3.6	9.5	78.0
10,272-73	0.18	1.3	40.9	49.0
10,273-74	0.11	3 4	15.1	78.6
10,274-75	0.11	4.0	13.1	83.8
10,288-89	0.42	4.1	22.4	69.6
10,289-90	0.60	4.5	22.4	76.0
10,290-91	0.01	4.3	12.5	80.0
10,291-92	0.18	3.8	13.3	79.8
10,292-93	0.08	4.0	12.5	75.1

Table 5.--Bulk X-ray mineral assemblage, common minerals

[Pm - minor constituent within mineral group; PM - major constituent within mineral group; P - mineral present approximately equal amounts; D - dominant rock constituents; leaders (---) indicate mineral not present.]

Sample footage	Quartz	Feldspars: Albite	Feldspars: Orthoclase	Carbonates: Calcite	Carbonates: Dolomite	Clays: Illite	Clays: Kaolinite	Clays: Montmorillonite	Clays: Mixed-layer clays
Ref. Well No. 1 (A 221) Colorado Interstate Gas Expl., Inc. 2-8-14-92 Blue Gap II Unit SW¼SW¼, sec. 8, T. 14 N., R. 92 W.									
9,064	DPM	Pm	Pm?	Pm	PM	Pm	---	---	Pm?
9,084	DPM	Pm	---	Pm	PM	Pm	---	---	Pm?
9,289	DPM	Pm	---	---	PM	Pm	PM	---	Pm
Ref. Well No. 2 (A 222) Colorado Interstate Gas Expl., Inc. 7-14-92 Blue Gap II Unit SE¼NW¼ sec. 7, T. 14 N., R. 92 W.									
9,138	DPM	DPM	DPm	Pm	PM	PM	Pm	Pm	Pm
9,142	DPM	PM	---	Pm	PM	PM	---	---	Pm
Ref. Well No. 3 (A 230) Mesa Petroleum 1-25 Playa UPRR NW¼NW¼ sec. 25, T. 20 N., R. 99 W									
4,643	DPM	Pm	PM	Pm	PM	Pm	PM	---	Pm
4,651	DPM	Pm	PM	PM	---	Pm	PM	Pm	Pm
4,666	DPM	Pm	PM	DPm	DPM	Pm	PM	Pm	-
4,672	DPM	Pm	PM	Pm	DPM	Pm	PM	Pm	Pm
4,686	DPM	--	PM	Pm	PM	Pm	PM	Pm	Pm?
4,691	DPM	--	PM	PM	Pm	Pm	PM	Pm	Pm
Ref. Well No. 4 (A 394) Forest Oil Corp. 9-18-2 Arch Unit NW¼NW¼ sec. 18, T. 19 N., R. 98 W.									
4,882	DPM	Pm	DPM	Pm	DPM	Pm	PM	---	---
4,894	DPM	Pm	PM	--	Dm	Pm	PM	---	---
4,903	DPM	Pm	PM	Pm	PM	PM	Pm	Pm	Pm
Ref. Well No. 5 (A 395) Forest Oil Corp. 20-23-4 Arch Unit NW¼NW¼ sec. 23, T. 19 N., R. 99 W.									
4,497	DPM	Pm	PM	Pm	DPM	Pm	DPM	---	Pm?
4,510	DPM	PM	Pm	Pm	DM	Pm	PM	Pm	Pm
4,513-19	DPM	PM	Pm	Pm?	PM?	Pm	PM	---	---
4,529	DPM	Pm	PM	Pm	PM	Pm	PM	---	---
4,536	DPM	Pm	PM	Pm	PM	PM	Pm	---	Pm
Ref. Well No. 6 (A 415) Forest Oil Corp. 3-1 UPRR Arch Unit 77 SW¼NE¼ sec. 13, T. 19 N., R. 98 W.									
6,042	DPM	PM	Pm	PM	Pm	PM	Pm?	Pm?	Pm?
6,053	PM	---	---	DPM	---	Pm	PM	---	Pm?
6,062	DPM	DPM	DPm	Pm	PM	Pm	PM	Pm?	Pm
6,068	DPM	Pm	DPM	---	---	Pm	PM	Pm?	Pm

Table 3.--Bulk X-ray mineral assemblage, common minerals--Continued

Sample footage	Quartz	Feldspars		Carbonates		Clays			
		Albite	Orthoclase	Calcite	Dolomite	Illite	Kaolinite	Montmorillonite	Mixed-layer clays
Ref. Well No. 7 (A 416) Amerada Hess Corp. Deep Creek 2 Unit SW¼NW¼ sec. 32, T. 16 N., R. 90 W.									
2,408	DPM	DPM	Pm	Pm	PM	PM	Pm	---	Pm
2,415	DPM	PM	Pm	Pm	DPM	Pm	PM	---	Pm?
2,428-30	DPM	P	P	---	---	PM	Pm	---	Pm?
2,432	DPM	PM	Pm	Pm?	DPM	P	P	Pm?	Pm
2,447-48	DPM	DPM	Pm	Pm	PM	Pm	PM	Pm?	---
2,452	DPM	Pm	PM	Pm	PM	Pm	PM	---	Pm?
Ref. Well No. 8 (A 483) Jerry Chambers, Oil Producer 1-13 Kemmerer Creek Federal CNW¼ sec. 13, T. 14 N., R. 102 W.									
3,707-08	DPM	PM	---	Pm?	PM	PM	Pm	---	Pm
3,724	DPM	PM	Pm	Pm	PM	PM	Pm	---	Pm?
Ref. Well No. 9 (A 579) Forest Oil Corp. 1-8 Arch Unit 70 SE¼NE¼ sec. 1, T. 19 N., R. 99 W.									
4,794	DPM	PM	Pm	PM	Pm	Pm	PM	---	Pm?
4,799	DPM	Pm	PM	Pm	PM	Pm	PM	---	Pm?
4,808	DPM	Pm	PM	P	P	Pm	PM	---	---
Ref. Well No. 10 (A 716) Michigan Wisconsin Pipeline Co. 1-9 Creston E½SE¼ sec. 9, T. 18 N., R. 92 W.									
8,805	DPM	---	Pm?	---	---	PM	Pm	Pm?	---
8,815	DPM	---	---	---	---	Pm	Pm	Pm?	Pm
8,854	DPM	---	---	---	PM	PM	Pm	Pm?	Pm?
8,836	DPM	---	---	---	---	P	P	Pm?	Pm
10,189	DPM	Pm?	---	---	PM	P	P	---	Pm
10,204	DPM	PM	---	---	PM	Pm	PM	Pm?	Pm
10,222	DPM	PM	---	Pm?	PM	PM	Pm	---	Pm?
Ref. Well No. 11 (A 846) Ladd Petroleum Corp. 1-22 Federal SE¼SE¼ sec. 22, T. 17N., R. 94 W.									
10,145	DPM	PM	---	---	DPM	PM	---	---	Pm?
10,167	DPM	PM	---	DPM	Pm	PM	---	---	Pm?
10,185	DPM	PM	---	---	PM	PM	---	---	Pm?
10,194	DPM	PM	Pm	---	PM	PM	---	---	Pm
10,204	DPM	PM	---	Pm	PM	PM	---	---	Pm?
10,207	DPM	PM	Pm	Pm	DPM	PM	---	---	Pm?
10,214	DPM	PM	---	Pm	PM	PM	---	---	Pm
10,228	DPM	PM	---	---	PM	PM	---	---	Pm
10,254	DPM	PM	Pm?	---	PM	PM	---	---	Pm
10,272	DPM	PM	---	---	DPM	PM	Pm?	---	Pm?
10,280	DPM	Pm	---	Pm?	PM	PM	Pm	---	Pm

The author would like to thank the companies listed in table 1 for allowing core analysis data to be released. Samples were prepared by J. R. Peterson, U.S. Geological Survey.

This report is part of a study being conducted by the U.S. Geological Survey in cooperation with the U.S. Department of Energy, to evaluate resources of natural gas trapped in low-permeability reservoirs in the Rocky Mountain region.

General lithology

Mesaverde Group

The described core intervals of the Upper Cretaceous Mesaverde Group consist of very fine to fine-grained, light-gray to gray (N5-N7) sandstone and siltstone, mudstone, black calcareous and carbonaceous shale, and thin coal stringers.

Most of the sandstone and siltstones described have a "salt and pepper" appearance resulting from the presence of dark organic-rich material and dark chert grains. The sandstone and siltstones are homogeneous to thinly laminated, and disruption of laminae is due to high-energy and/or bioturbation. Small-scale rippling and/or scour-fill sedimentary structures are visible and are usually highlighted by organic-rich laminae (fig. 2).

Black shale is frequently interbedded with the sandstones and siltstones, organic-rich mudstones, and coals. These shales are dense to brittle, silty, and at times calcareous and coaly.

Coal intervals vary considerably in thickness, ranging from less than 1 cm to greater than 1 m. The coals and black shales tend to alternate frequently in the described core intervals.

LADD PETROLEUM CORP.
1-22 FEDERAL
SE ¼ SE ¼ sec. 22, T. 17 N.,R. 94 W.
SWEETWATER COUNTY, WYO.
10261-10261.7'

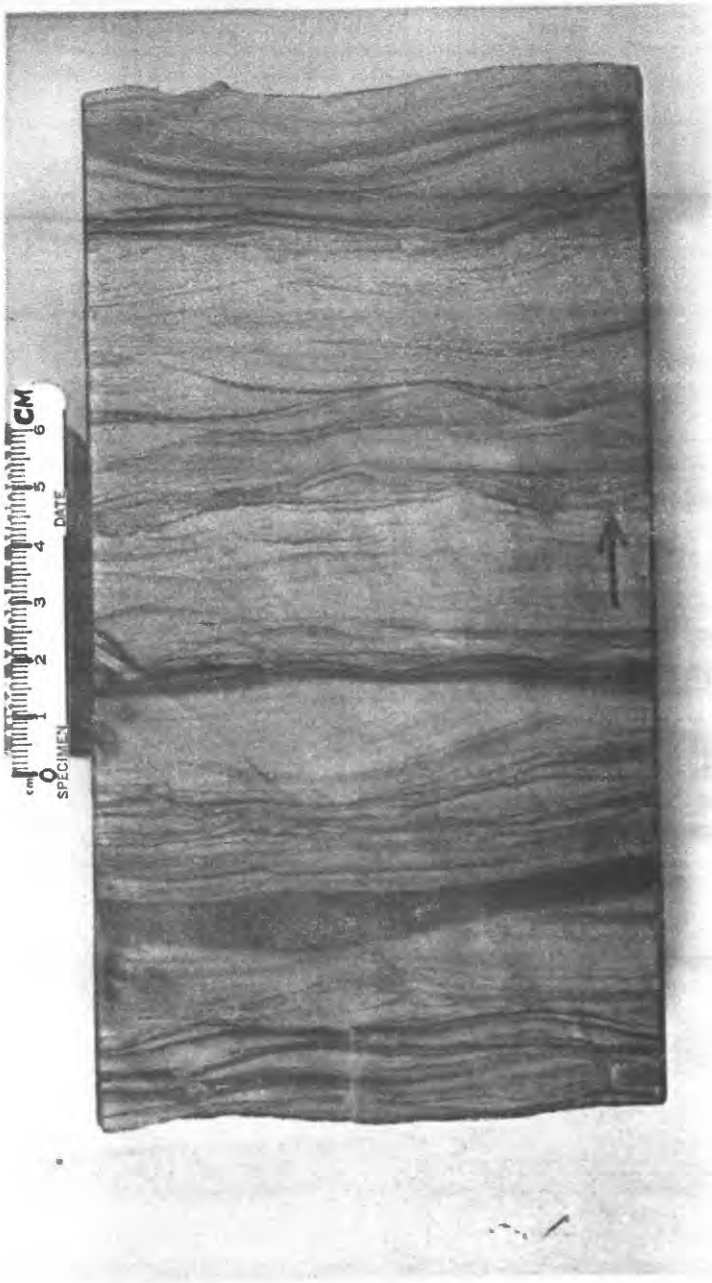


Figure 2 -- Siltstone with small-scale sedimentary structures. (10261 ft)

Abundant shell material occurs in a number of the cores, specifically wells numbered 3, 4, 6, and 9. This shell material is in a matrix of silty mudstone to shale for wells numbered 4, 6, and 9. In well number 3, a thin, 2- to 5-cm shell bed occurs within a thin coal stringer.

Many of the sandstone, siltstone, and shale intervals are bioturbated, and at times this bioturbation gives the core a mottled appearance. Horizontal, vertical, and inclined burrows show the disruptive nature of burrowing organisms. In some of the core areas that are inferred to be burrowed are as large as 2 by 3 cm, and in other core the burrowing is quite dense and a single horizontal burrow could be less than 0.1 cm in diameter (figs. 3, 4).

Environments of deposition

The environments of deposition for the described core intervals can be interpreted from a combination of three factors: (1) the different lithologies present, (2) the sedimentary structures present, and (3) the degree and type of bioturbation (trace fossils). C. W. Spencer (written commun., 1977) has interpreted environments of deposition for the Western Interior Cretaceous marine and coastal deposits using the above three factors.

The environments of deposition for the described intervals range from submarine shoreface-shoreface toe to offshore transition, and possibly include a barrier to lagoonal environment in a landward direction. No specific environments of deposition will be shown on the core descriptions at this time. After more cores have been described and subsurface cross sections completed to help demonstrate the geometry of the various lithologies of the Mesaverde Group, specific environments of deposition will be applied to the described cores.

LADD PETROLEUM CORP.
1-22 FEDERAL
SE ¼ SE ¼ sec. 22, T. 17 N., R. 94 W.
SWEETWATER COUNTY, WYO.
10,290'

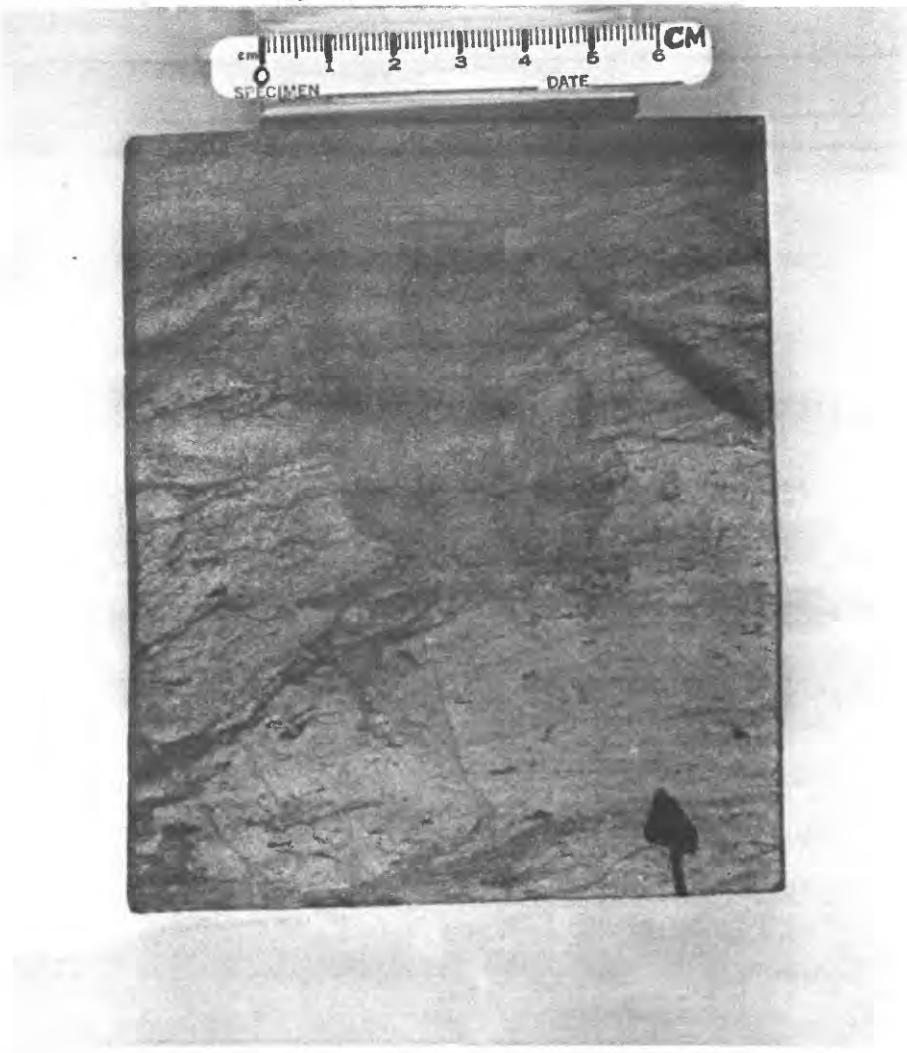


Figure 3 -- Very fine grained sandstone with area of bioturbation (center of photograph). Arrow points to homogenous area which could also be bioturbated. (10290 ft)

AMERADA HESS CORP.
DEEP CREEK 2 UNIT
SW ¼ SW ¼ sec. 32, T. 16 N., R. 90 W.
CARBON COUNTY, WYO.
2414'

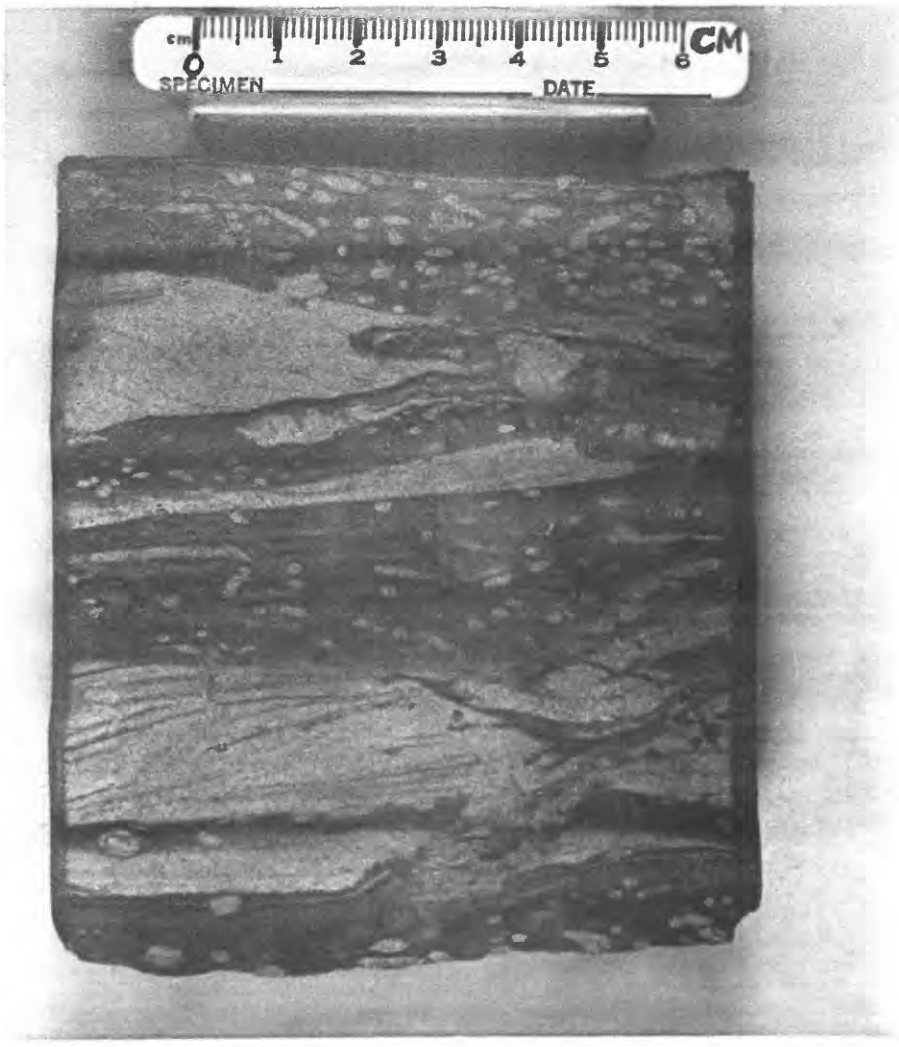
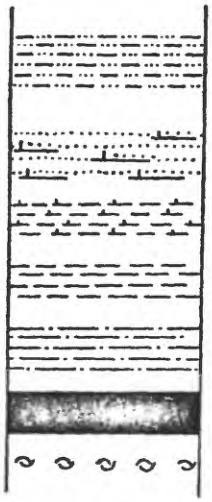


Figure 4 -- Vertical, horizontal, and inclined burrows (Chondrites) in organic-rich shale. Burrows filled with very fine grained sandstone. (2414 ft)

Core descriptions and photographs

The core descriptions and core photographs for the eleven described cores follow in numerical order by drill-hole reference number and core library reference number (table 1). The core descriptions include much of the reference material, as shown in table 1, and the core photographs are referenced by the U.S. Geol. Survey core-library reference number shown in the middle of each photograph. The core box in each photograph is one meter in length, and footages are marked on the core for reference purposes. An explanation is given for the range of estimated visual porosity for the core, the symbols used to describe the major lithologies present, the observed bedding characteristics, and the sedimentary structures. A list is also given to explain the abbreviations used in the core descriptions. Major lithologic rock types are abbreviated and capitalized; within the general description, lower case abbreviations are used when referring to lithologies. Color symbols (N5-N7) are from The Geological Society of America Rock Color Chart.

Estimated visual porosity	(percent)
None	0-1
Poor	1-10
Good	10-20
Excellent	>20



Symbols used to represent rock type

Sandstone or siltstone interbedded with shale

Sandstone or siltstone, calcareous

Shale, calcareous

Shale, noncalcareous

Mudstone

Coal

Shell fragments

Combinations of the general rock types shown above are used in the core descriptions.

Symbols used to represent type of bioturbation

Nondescript horizontal tracks, trails, and burrows

Nondescript vertical burrows

Nondescript inclined burrows

Burrow (mottled or churned sediment)

Contorted bedding, generally due to bioturbation

Sorting of grain size

W - well sorted

M - moderately sorted

P - Poorly sorted

Color

gy - grey

blk - black

brn - brown

grn - green

Abbreviation of lithologies

SS - sandstone
SLTSS - siltstone
SH - shale
LS - limestone

Type of fracture

VF - vertical fracture

HF - horizontal fracture

Type of porosity

VUG - vuggy porosity

FRAC - fracture porosity

IG - intergranular porosity

Type of laminations

ell - even parallel

wll - wavy parallel

dell - discontinuous even parallel

dwll - discontinuous wavy parallel

dwnll - discontinuous wavy nonparallel

tl - thinly laminated

h - homogeneous (no distinct laminations)

Type of ripple

 general

Graded bedding

 normal (becoming finer upward)

 reverse (coarsening upward)

General abbreviations used in core descriptions

k - permeability

ϕ - porosity

subang - subangular

subrd - subrounded

appear - appearance

frag - fragments

sl - slightly

fg - fine grained

sdy - sandy

v - very

calc - calcareous

vert - vertical

hori - horizontal

inclin - inclined

lamin - laminated

tr - trace

lt - light

alt - alternating

anhy - anhydrite

pyr - pyrite or pyritic

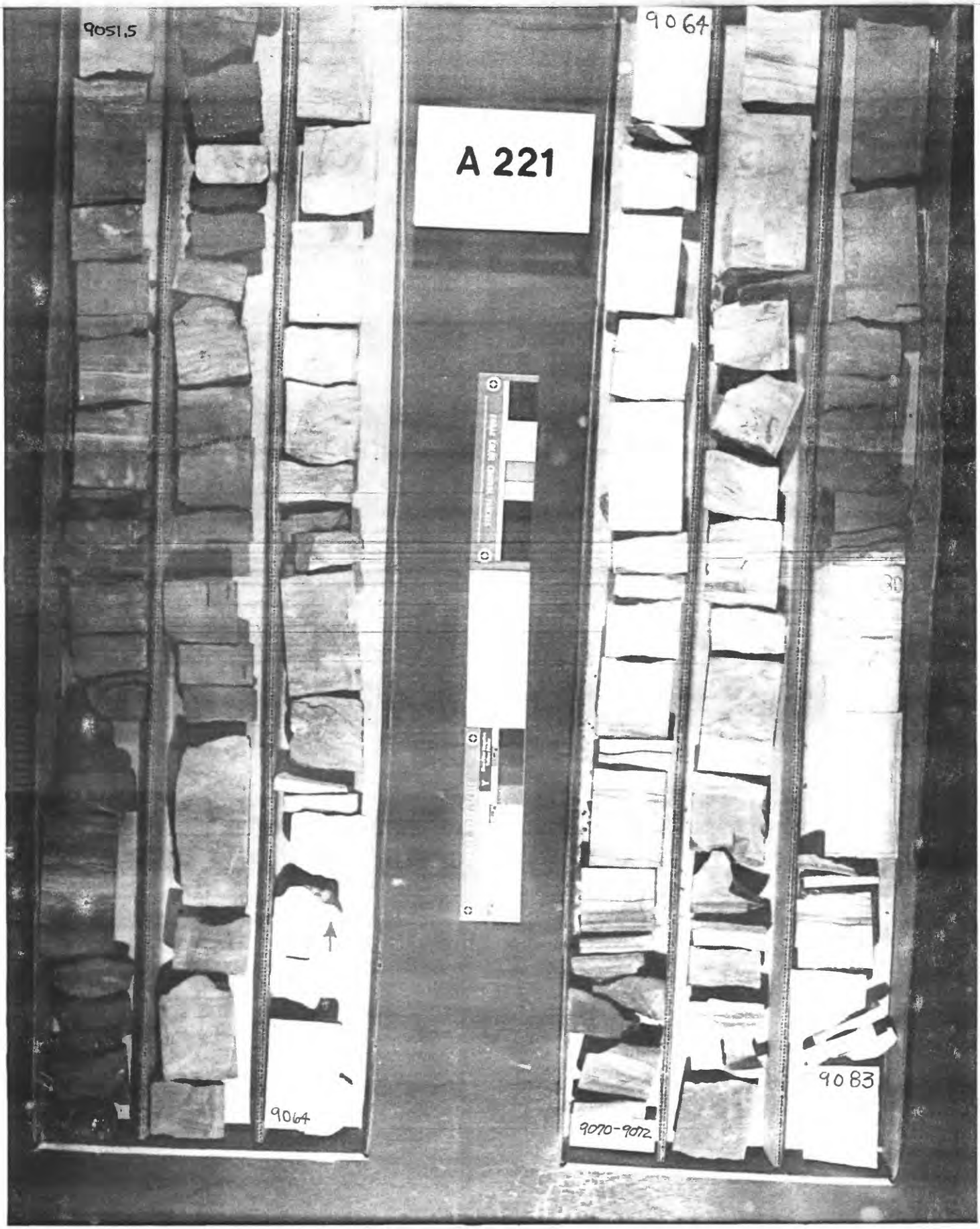
COLORADO INTERSTATE GAS EXPL., INC. 2-8-14-92 Blue Gap II Unit

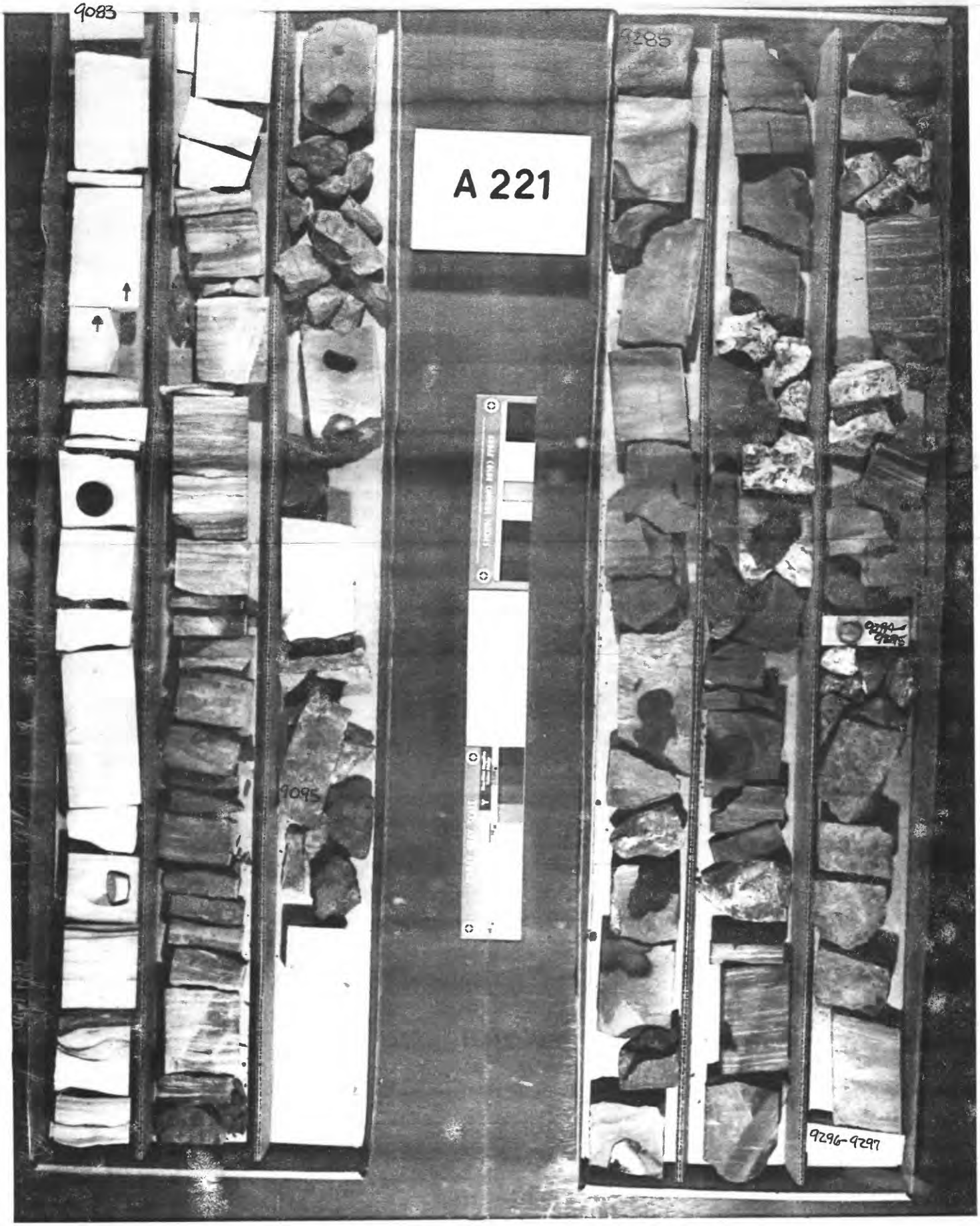
LOCATION SW¼SW¼ Sec. 8 T. 14 N. R. 92 W.

STATE Wyoming COUNTY Carbon

U.S.G.S. CORE LIBRARY NUMBER A.221 5/5 API WELL NUMBER 49-007-20206

Drill hole reference number 1


9051.5
9064
A 221
9064
9083
9070-9072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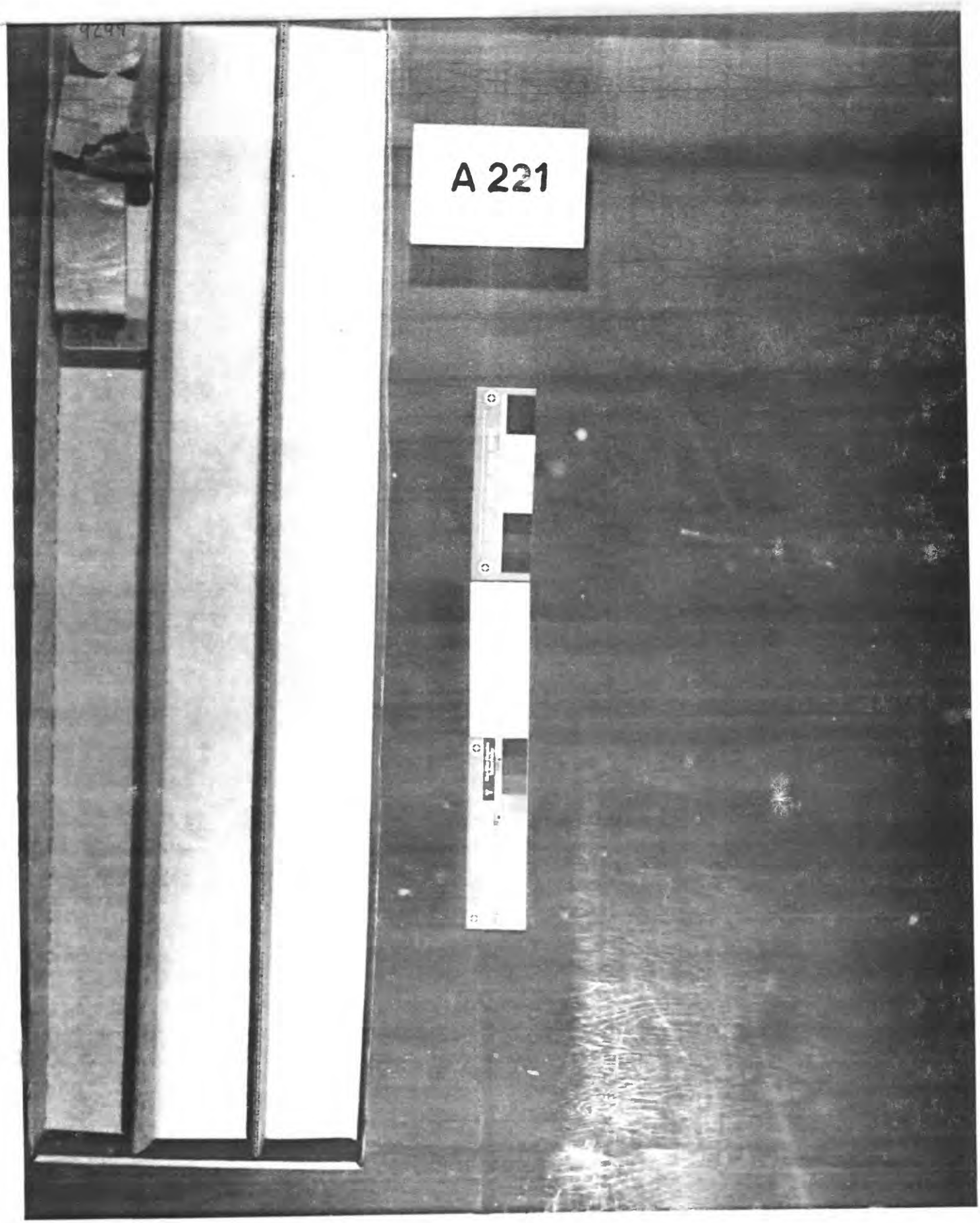
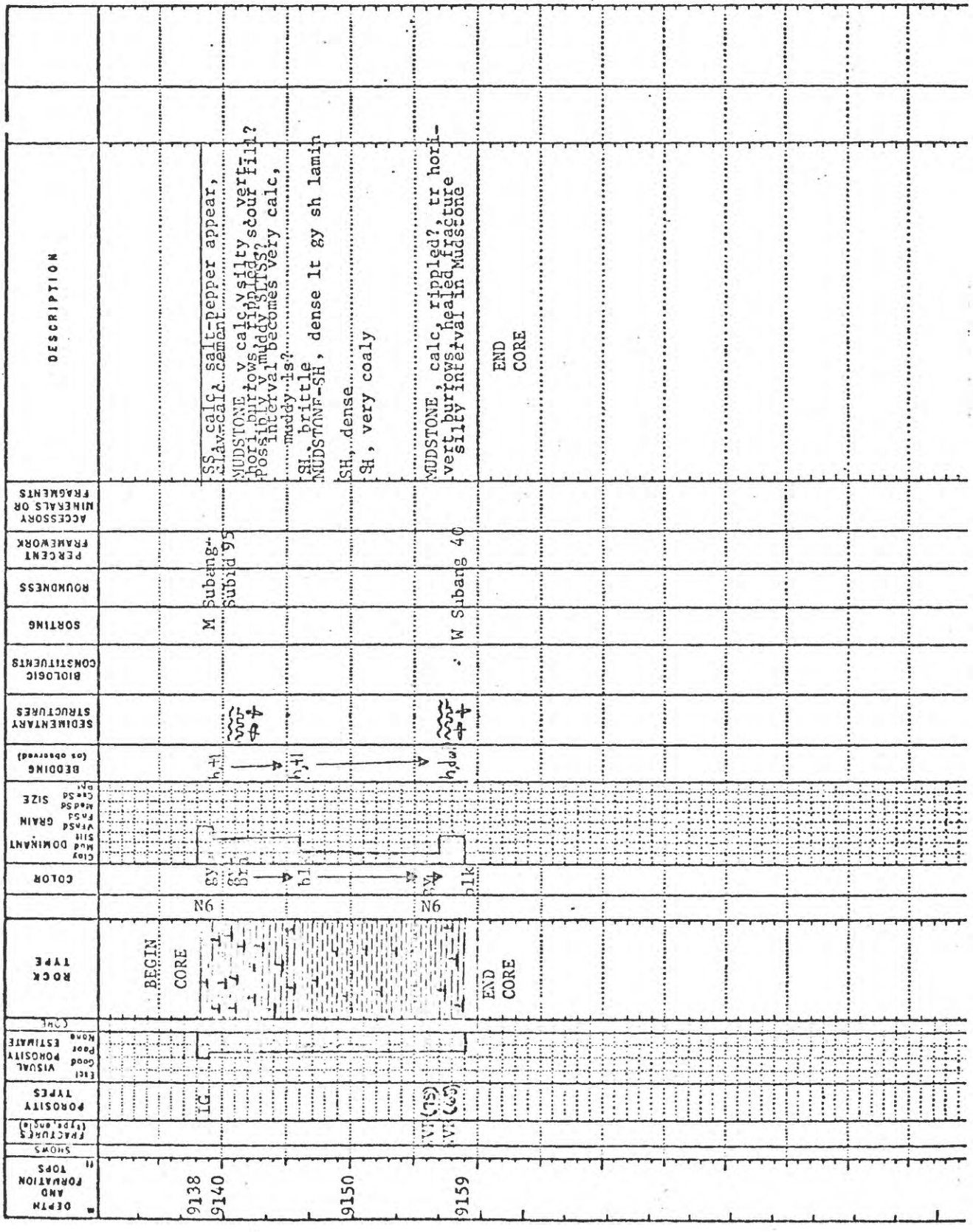
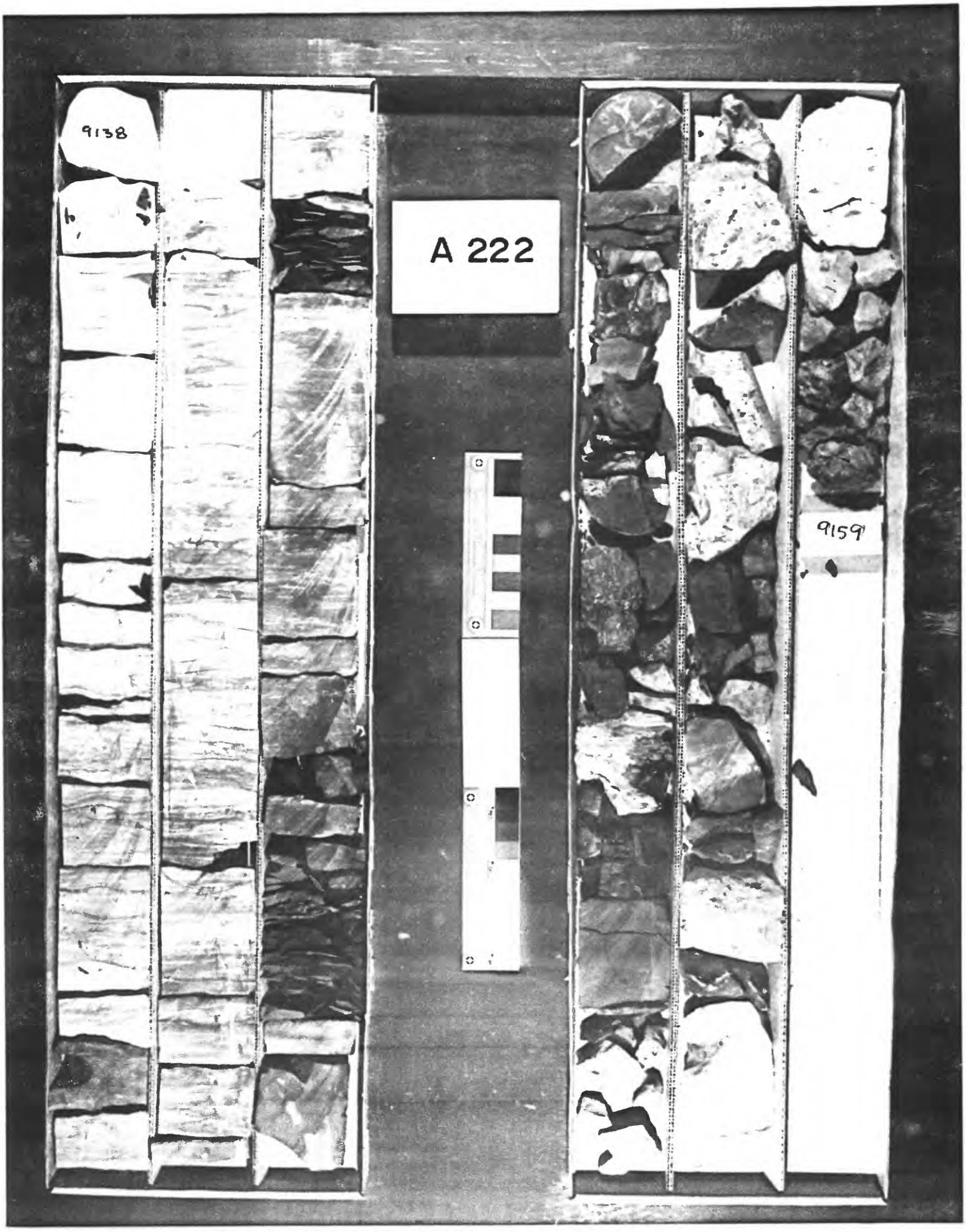
A 221
9285
9095
9296-9297


A 221

COLORADO INTERSTATE GAS EXPL., INC. 7-14-92 Blue Gap II Unit
LOCATION SE NW¼ Sec. 7 T. 14N. R. 92W.
STATE Wyoming COUNTY Carbon
U.S.G.S. CORE LIBRARY NUMBER A 222 2/2 API WELL NUMBER 49-007-20186



Drill hole reference number 2


9138
A 222
9159

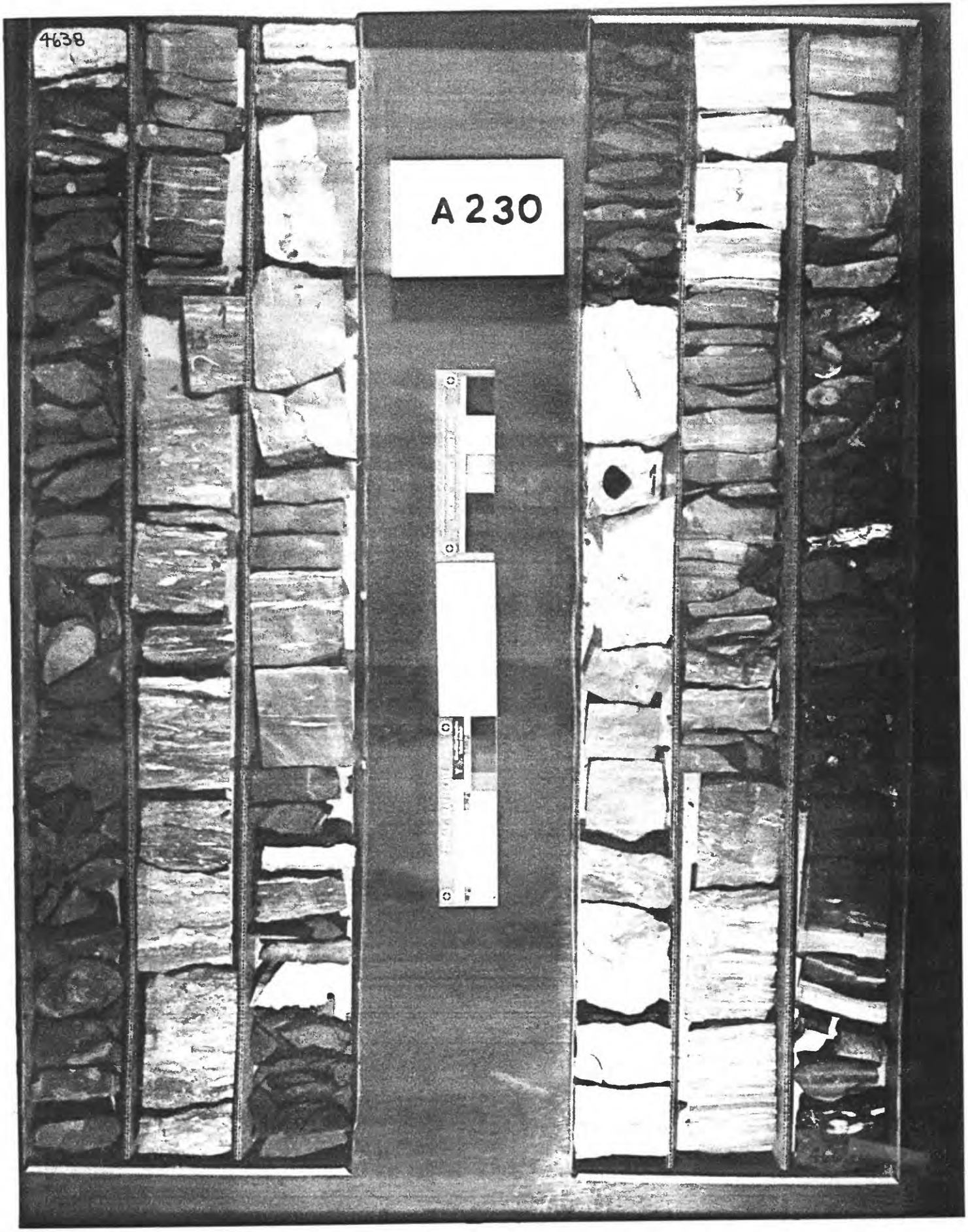
MESA PETROLEUM CO. 1-25 Playa UPRR

LOCATION NW¼NW¼ Sec. 25 T. 20N R. 99W

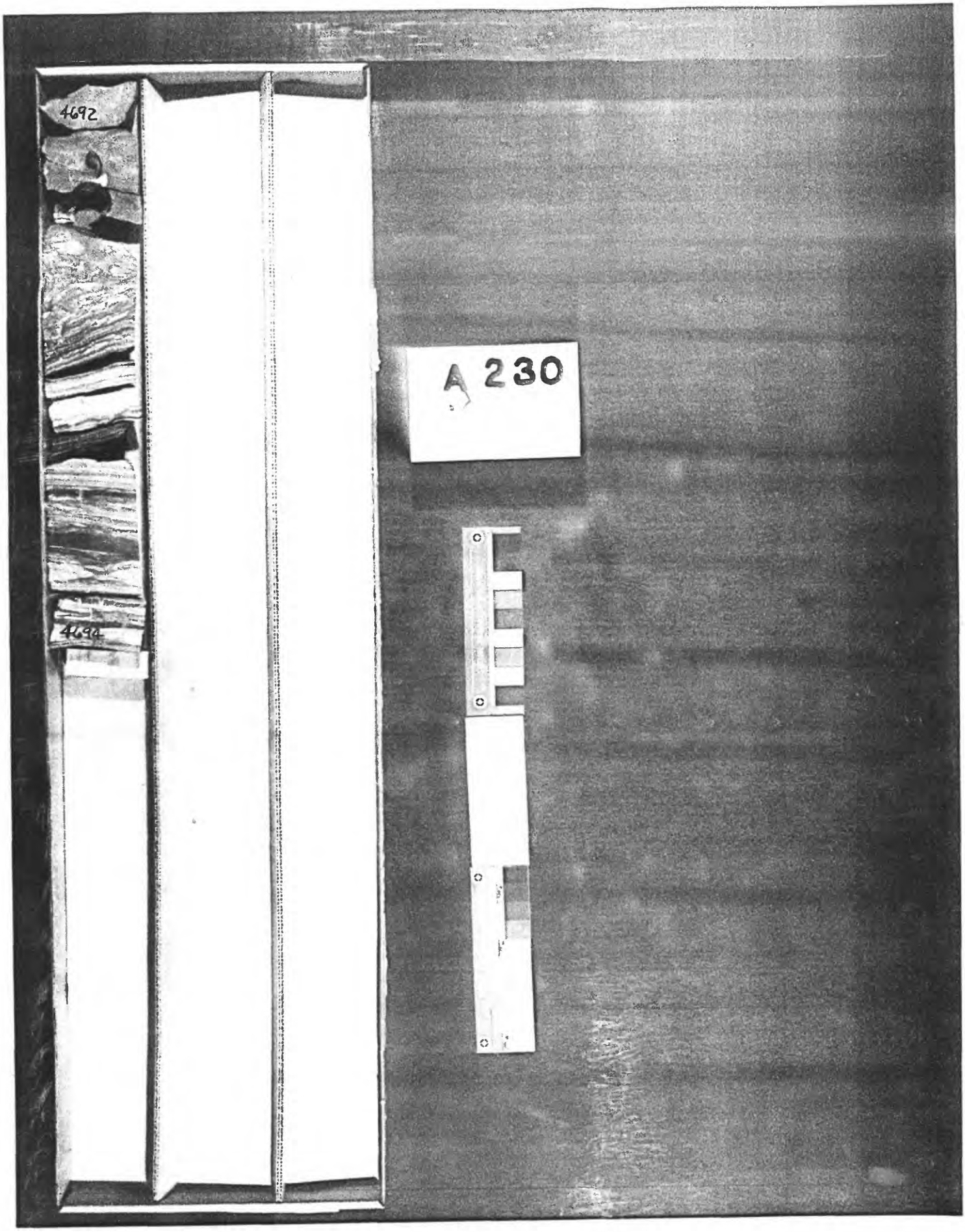
STATE Wyoming COUNTY Sweetwater

U.S.G.S. CORE LIBRARY NUMBER A 230 5/5 API WELL NUMBER 49-037-20653

Drill hole reference number 3


4638
A 230


A230
4677
1
91
1 A692

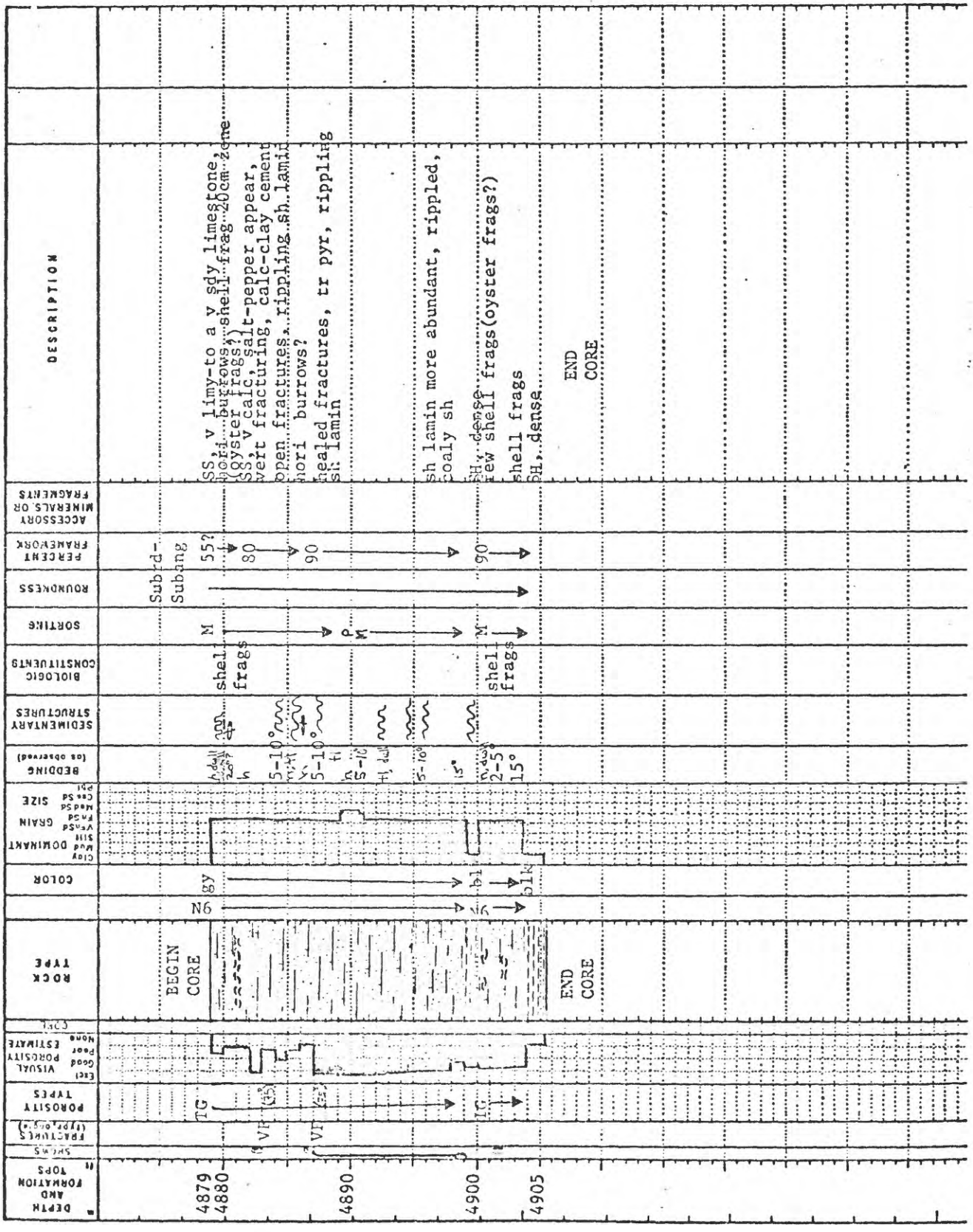

4692
A 230

FOREST OIL CORP. 9-18-2 Arch Unit

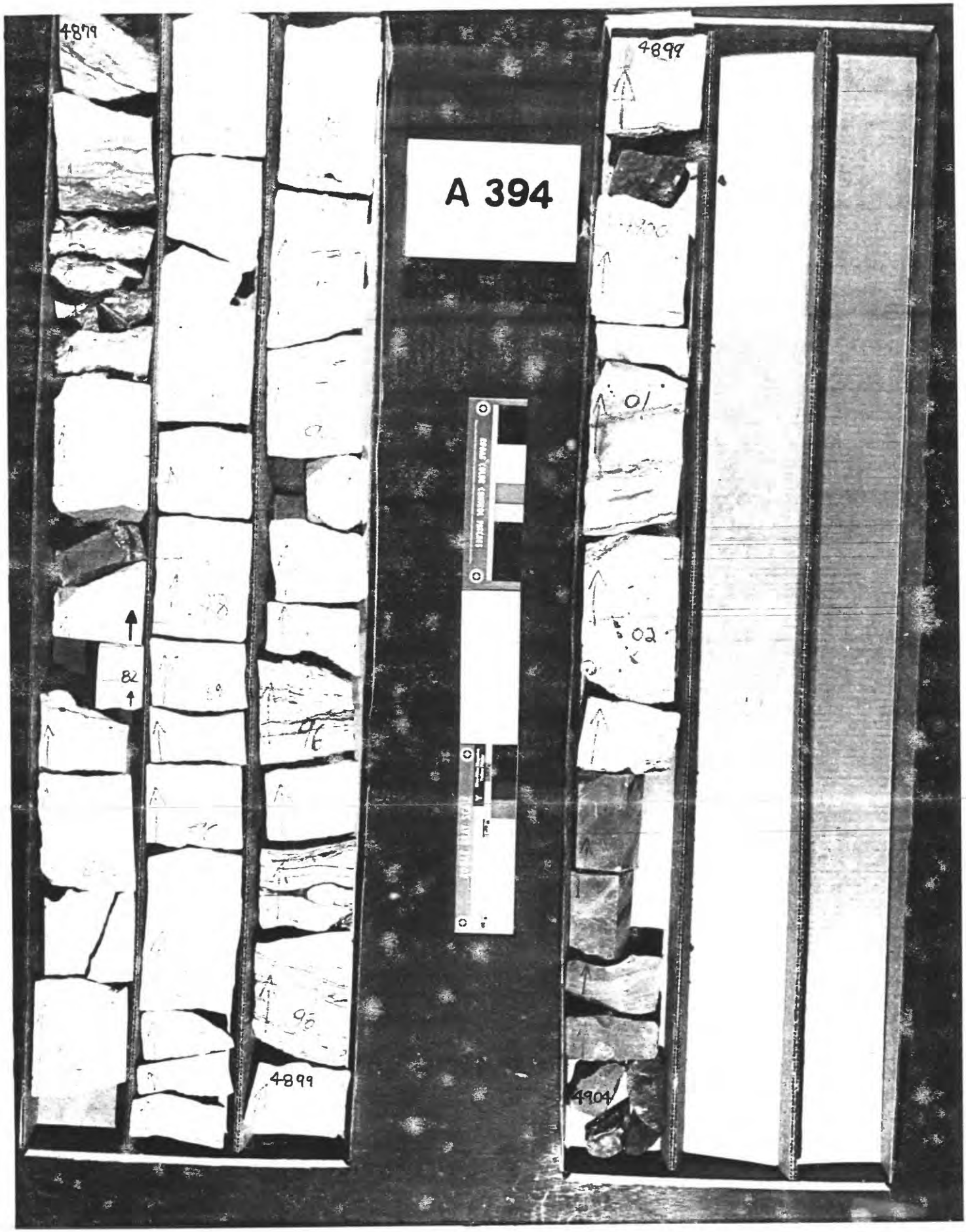
LOCATION NW¼NW¼ Sec. 18 T. 19 N. R. 98 W.

STATE Wyoming COUNTY Sweetwater

U.S.G.S. CORE LIBRARY NUMBER A 394 2/2 API WELL NUMBER 49-037-05617



Drill hole reference number 4

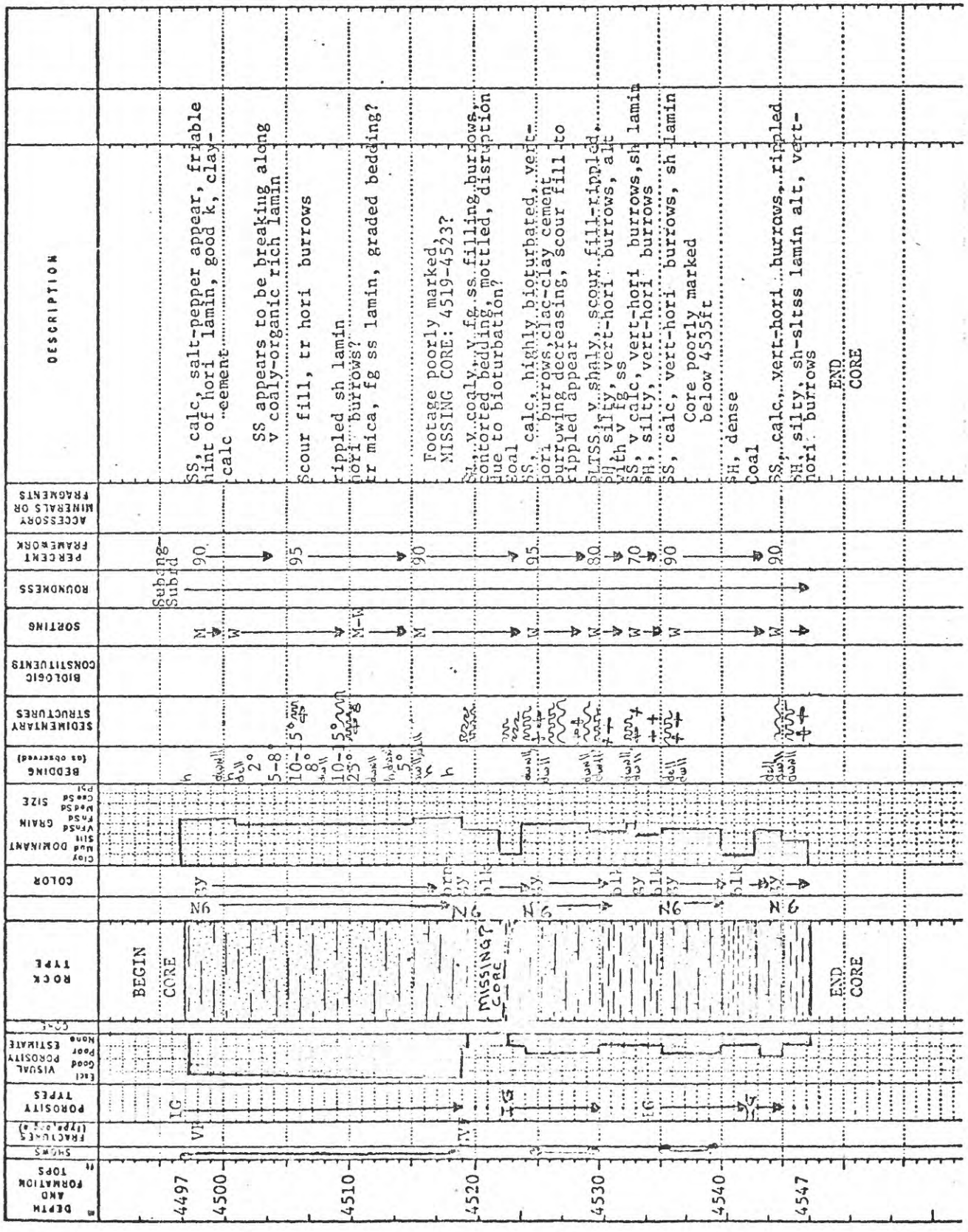

A 394
4879
4899
4899
4904
01
02
82

FOREST OIL CORP. 20-23-4 Arch Unit

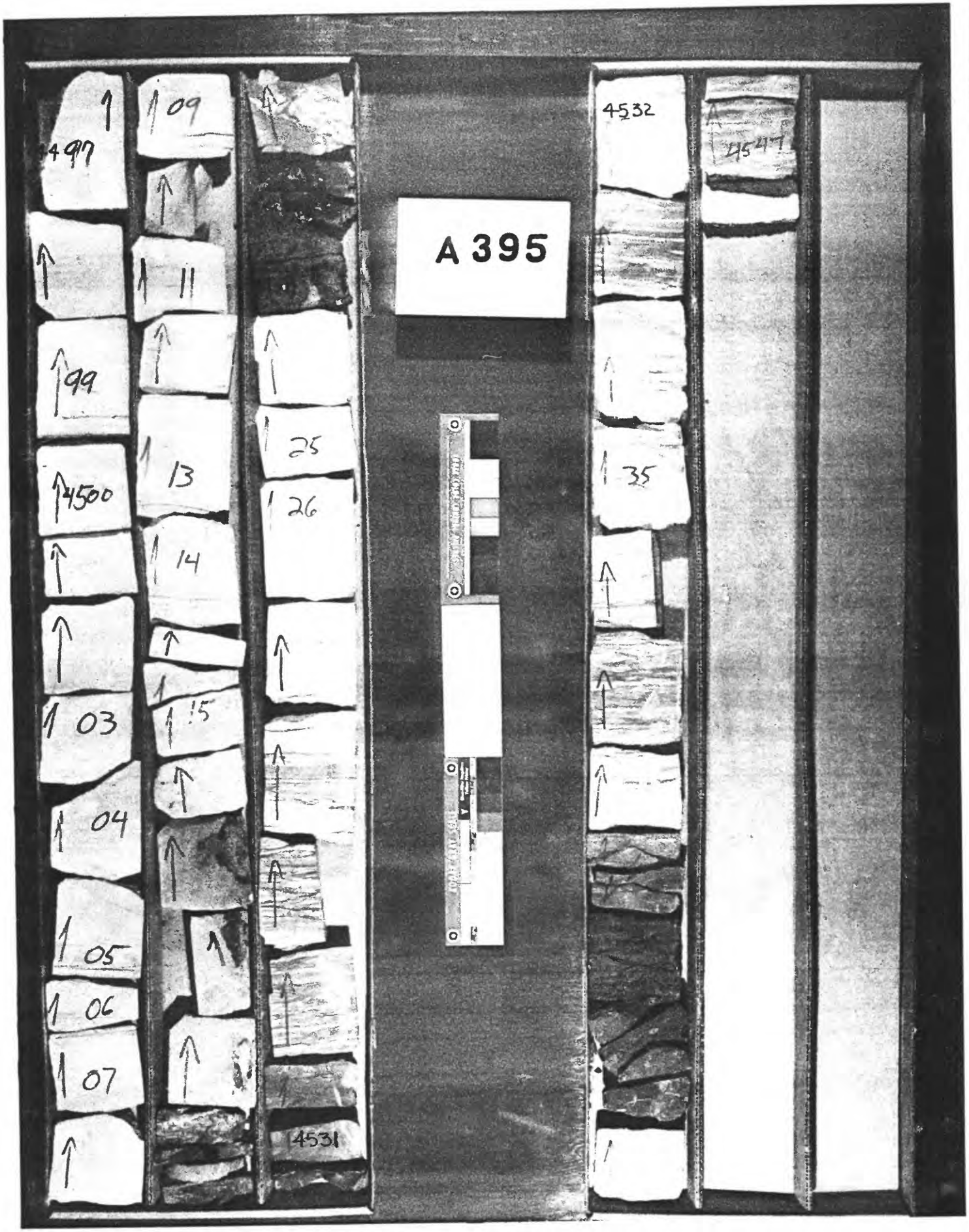
LOCATION NW¼NE¼ Sec. 23 T. 19 N. R. 99 W.

STATE Wyoming COUNTY Sweetwater

U.S.G.S. CORE LIBRARY NUMBER A 395 2/2 API WELL NUMBER 49-037-05578



Drill hole reference number 5


A 395
4532
4531

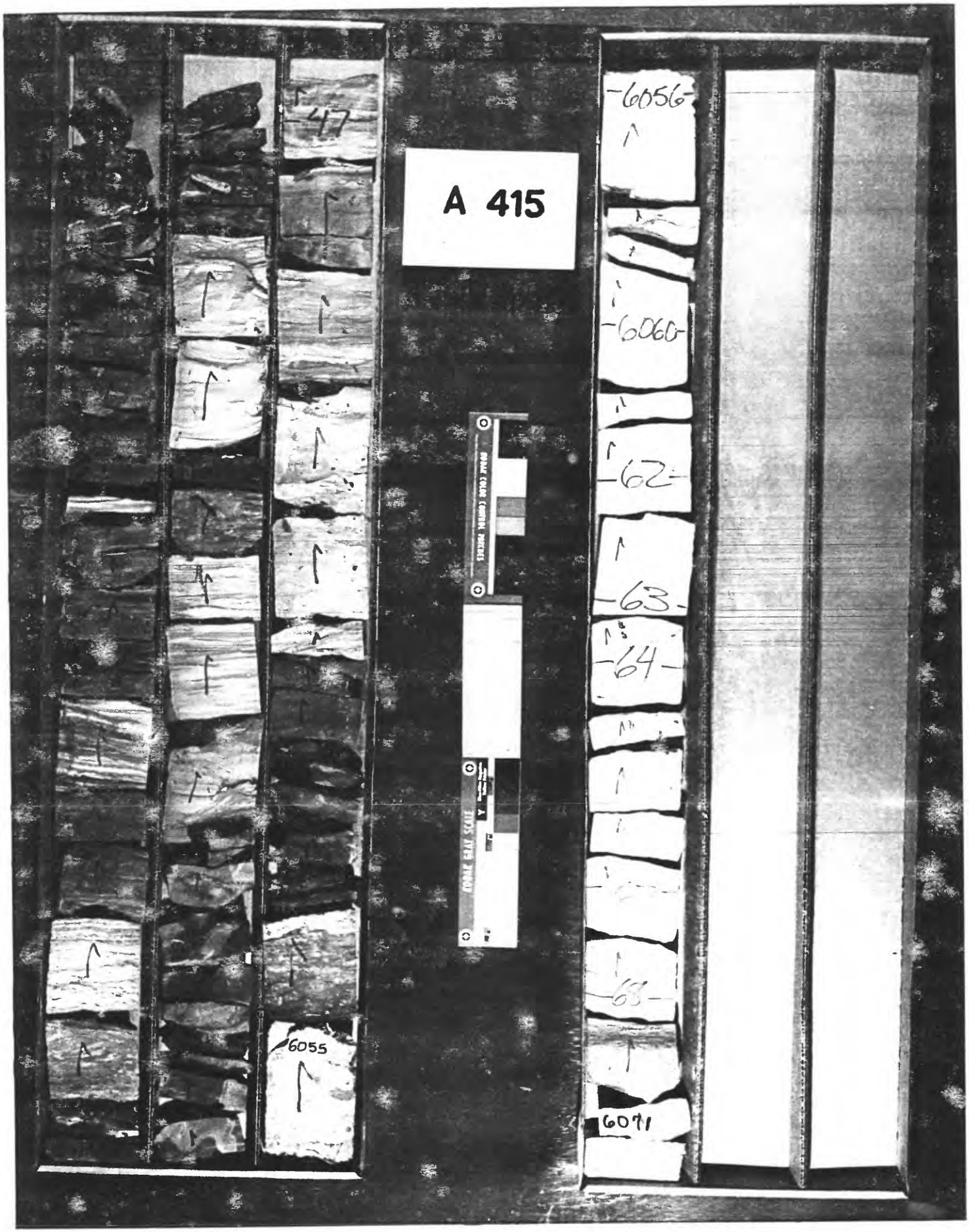
FOREST OIL CORP. 3-1 Arch Unit 77

LOCATION SW¼NW¼ Sec. 3 T. 19 N. R. 98 W.

STATE Wyoming COUNTY Sweetwater

U.S.G.S. CORE LIBRARY NUMBER A.415...2/2 API WELL NUMBER 49-037-05687

Drill hole reference number 6


A 415
6056
6060
62
63
64
68
6071
6055
47

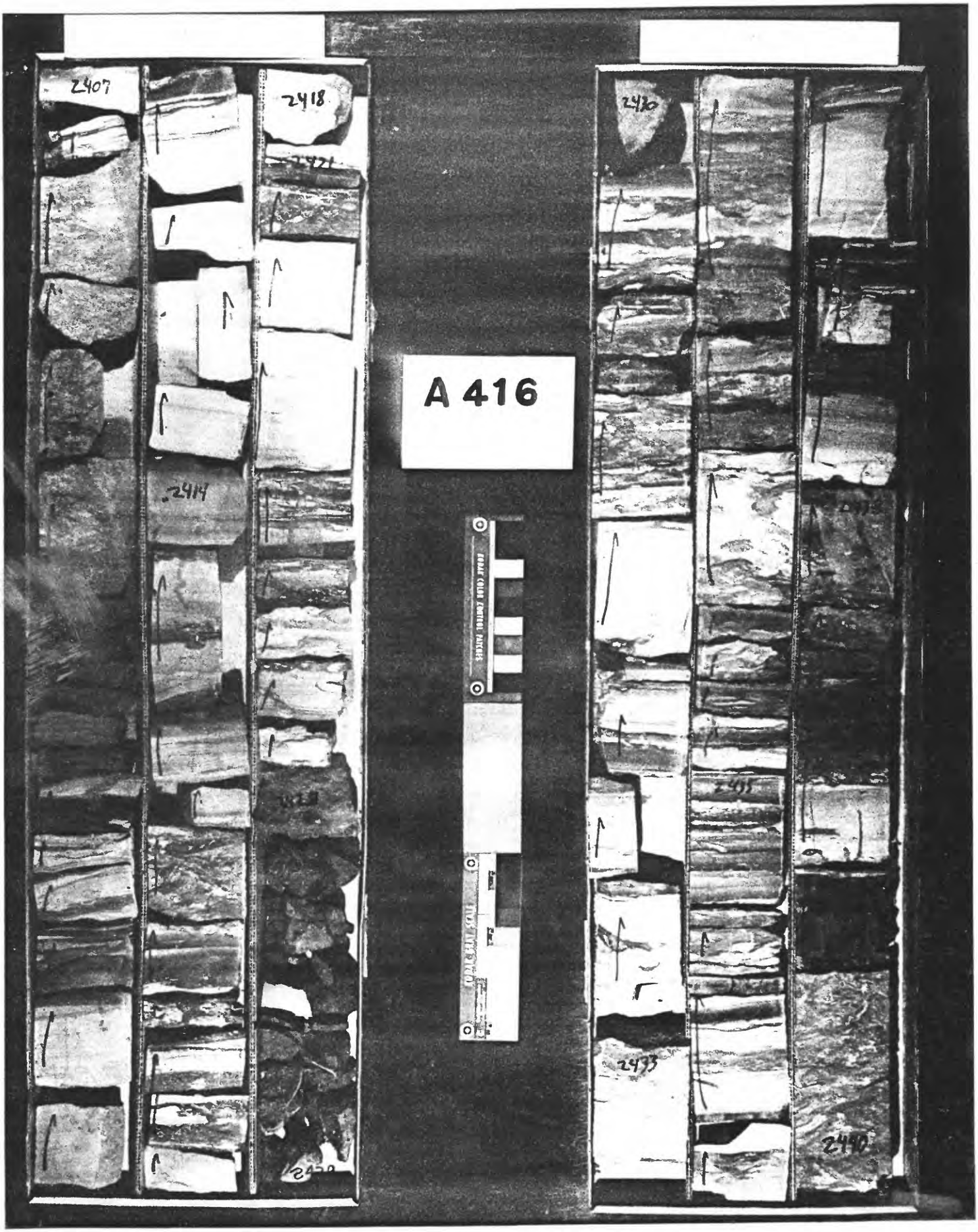
AMERADA HESS CORP.

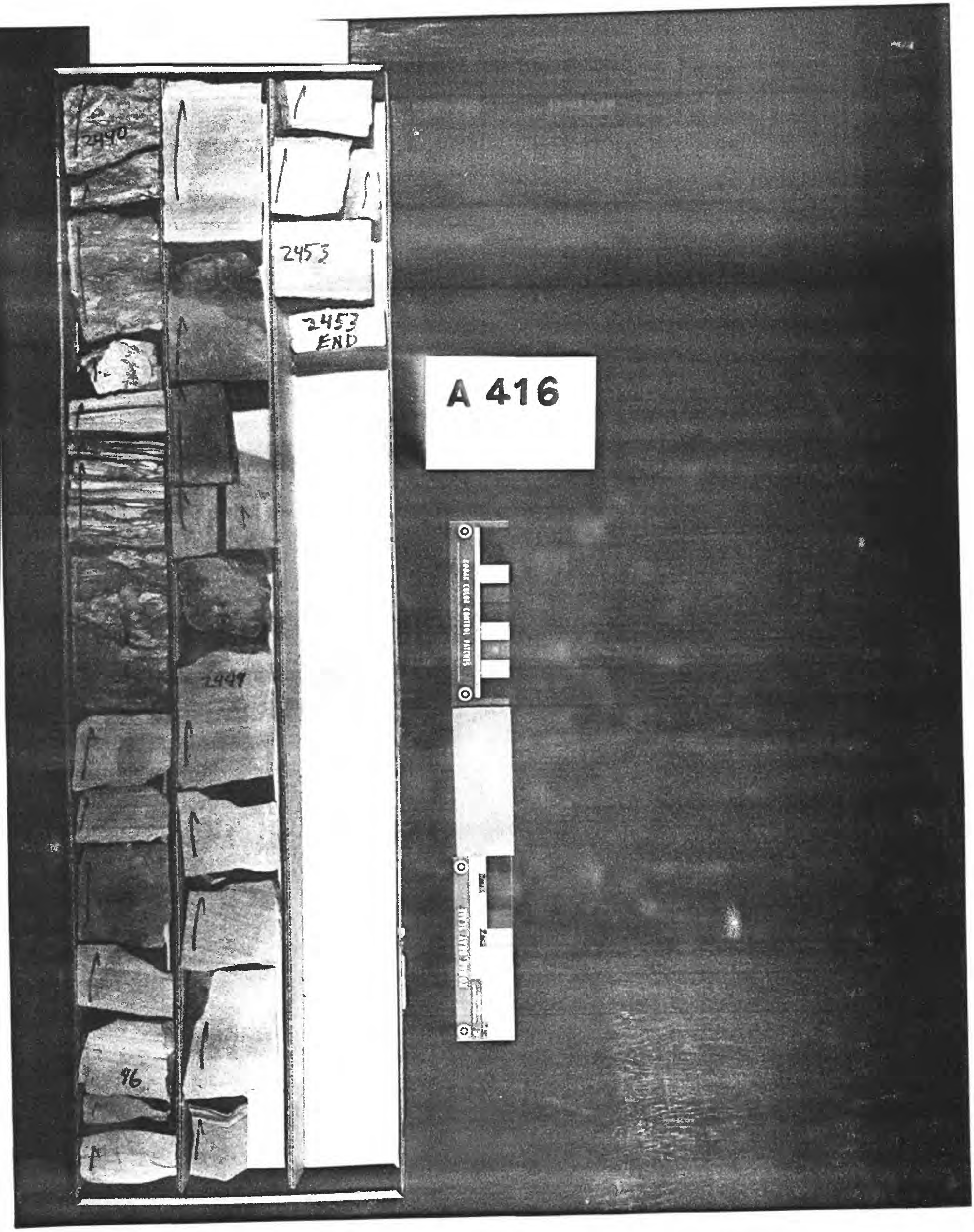
LOCATION SW¼NW¼ Sec. 32 T. 16N R. 90W Deep Creek 2 Unit

STATE Wyoming COUNTY Carbon

U.S.G.S. CORE LIBRARY NUMBER A 416 3/3 API WELL NUMBER 49-007-05071

Drill hole reference number 7


A 416
2407
2418
2414
2430
2433
2440
KODAK COLOR CONTROL PATCHES


2440
2453
2453
END
A 416
2449
46
KODAK COLOR CONTROL PATCHES

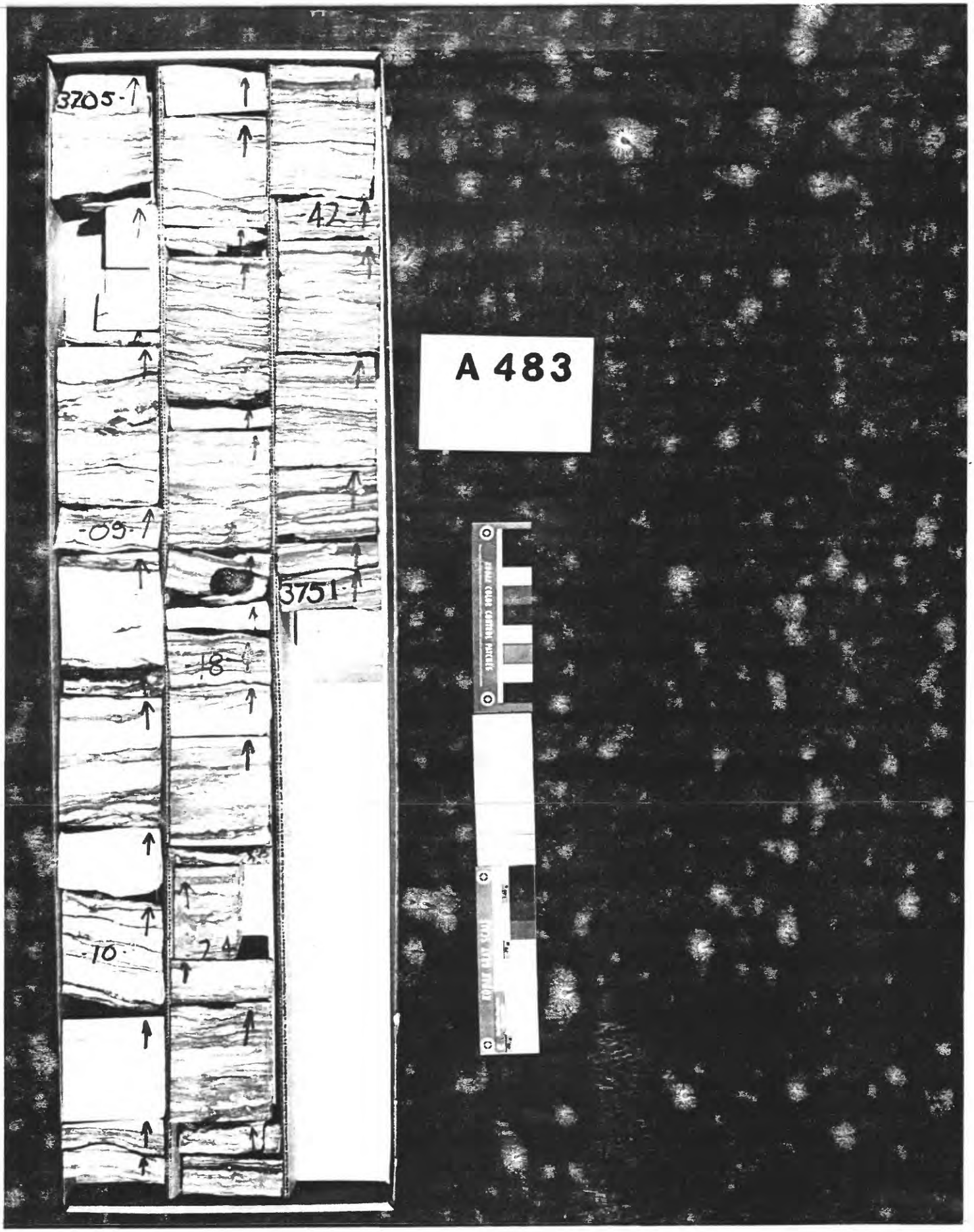
Jerry Chambers, Oil Producer 1-13 Kemmer Creek Federal

LOCATION C NW Sec. 13 T. 14 N. R. 102 W.

STATE Wyoming COUNTY Sweetwater

U.S.G.S. CORE LIBRARY NUMBER A 483 1/1 API WELL NUMBER 49-037-20615

Drill hole reference number 8

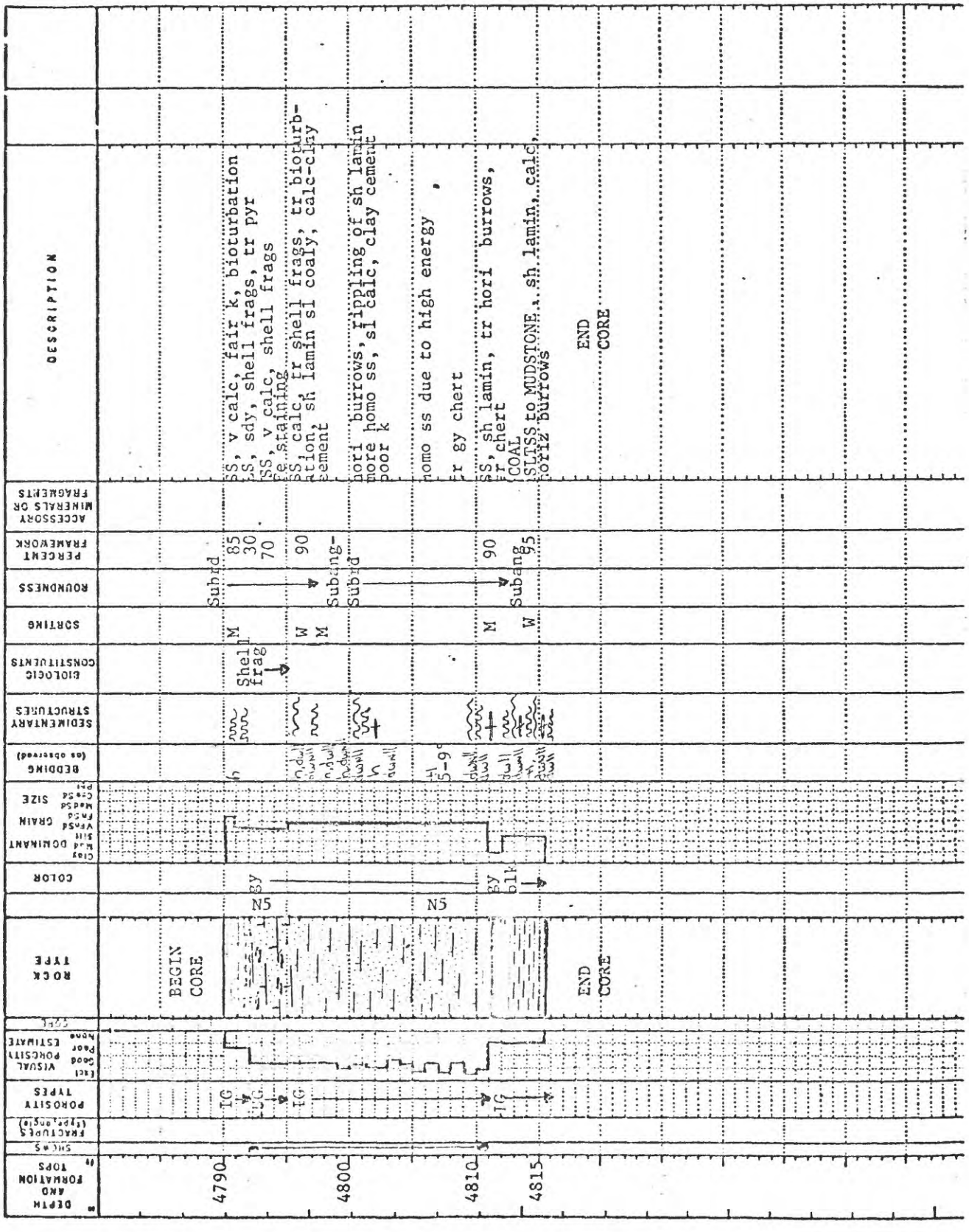

3705
42
A 483
09
3751
18
10
24

FOREST OIL 1-8 Arch Unit 70

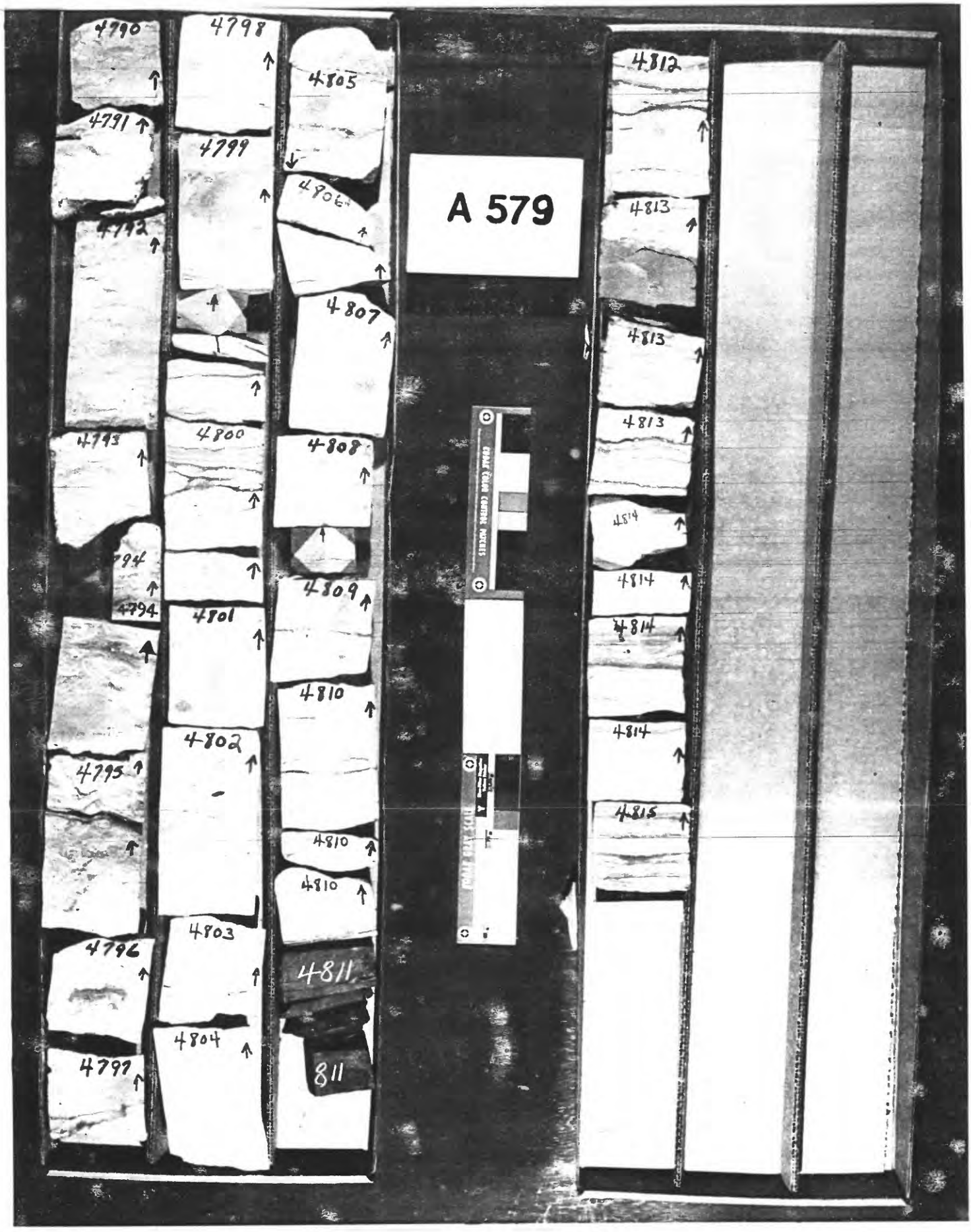
LOCATION SE¼NE¼ Sec. 1 T. 19 N. R. 99 W.

STATE Wyoming COUNTY Sweetwater

U.S.G.S. CORE LIBRARY NUMBER A 579 2/2 API WELL NUMBER 49-037-05689



Drill hole reference number 9


A 579
4790
4798
4805
4791
4799
4806
4792
4807
4793
4800
4808
4794
4809
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4810
4802
4795
4810
4810
4803
4796
4811
4804
4797
811
4812
4813
4813
4813
4814
4814
4814
4814
4815

MICHIGAN WISCONSIN PIPELINE CO. 1-9 Creston

LOCATION E/2 SE Sec. 9 T. 18N R. 92W

STATE Wyoming COUNTY Carbon

U.S.G.S. CORE LIBRARY NUMBER A 716 12/12 API WELL NUMBER 49-007-20231-00

1 of 3

Drill hole reference number 10

LOCATION .... Sec. .... T. .... R. ....
STATE .... COUNTY ....
U.S.G.S. CORE LIBRARY NUMBER .... API WELL NUMBER ....

DEPTH AND FORMATION TOPS ft	SHOWS	FRACTURES (type, origin)	POROSITY TYPES	VISUAL POROSITY ESTIMATE	ROCK TYPE		COLOR	DOMINANT GRAIN SIZE	BEDDING (as observed)	SEDIMENTARY STRUCTURES	BIOLOGIC CONSTITUENTS	SORTING	ROUNDNESS	PERCENT FRAMEWORK	ACCESSORY MINERALS OR FRAGMENTS	DESCRIPTION
8860			IG			N6-N7	gy		15° dwll 20°, 10-15°			W	Subang	95		SS, v sl calc, salt-pepper appear, sh lamin increasing such that interval shaly ss, horiz burrows in organic rich lamin, disrupted lamin
									5° dwll, dwll 2°					95		ss alt with silty sh
8870							blk, gy-Brn		dwll, dwll					50?		SH, dense, lamin of v fg ss gives mottled appear to lamin, few horiz burrows
							blk-brn		dwll			W				
8880			IG				gy-blk		3°					50? 90		SH, v silty to shaly ss, v fg ss filling burrows,
																SS, organic rich lamin, clay-silica cement, few horiz burrows
							blk		5-10° dwll							SH, dense, sl silty
8890			IG			N6	gy		dwll 10°			W		95		SS, vert-horiz burrows, clay-silica cement, v sl calc, mottled
8900					MISSING CORE											MISSING CORE
10174							blk					W	Subang-Subrd	70		SH, dense, v coaly and silty SLTSS to a v shaly SS, mottled, horiz burrows
10180			IG			N6	blk-gy		dwll, dwll, 5-10° dwll					90		SS, calc-silica cement, rootlets?, vert burrows?, salt-pepper appear
10190							gy-blk		dwll, dwll			W				SLTSS to v silty SH, dense, mottled, horiz burrows, clay-silica cement
			IG			N6			dwll, dwll							SS, calc, bioturbated

Drill hole reference number 10

LOCATION..... Sec..... T..... R.....

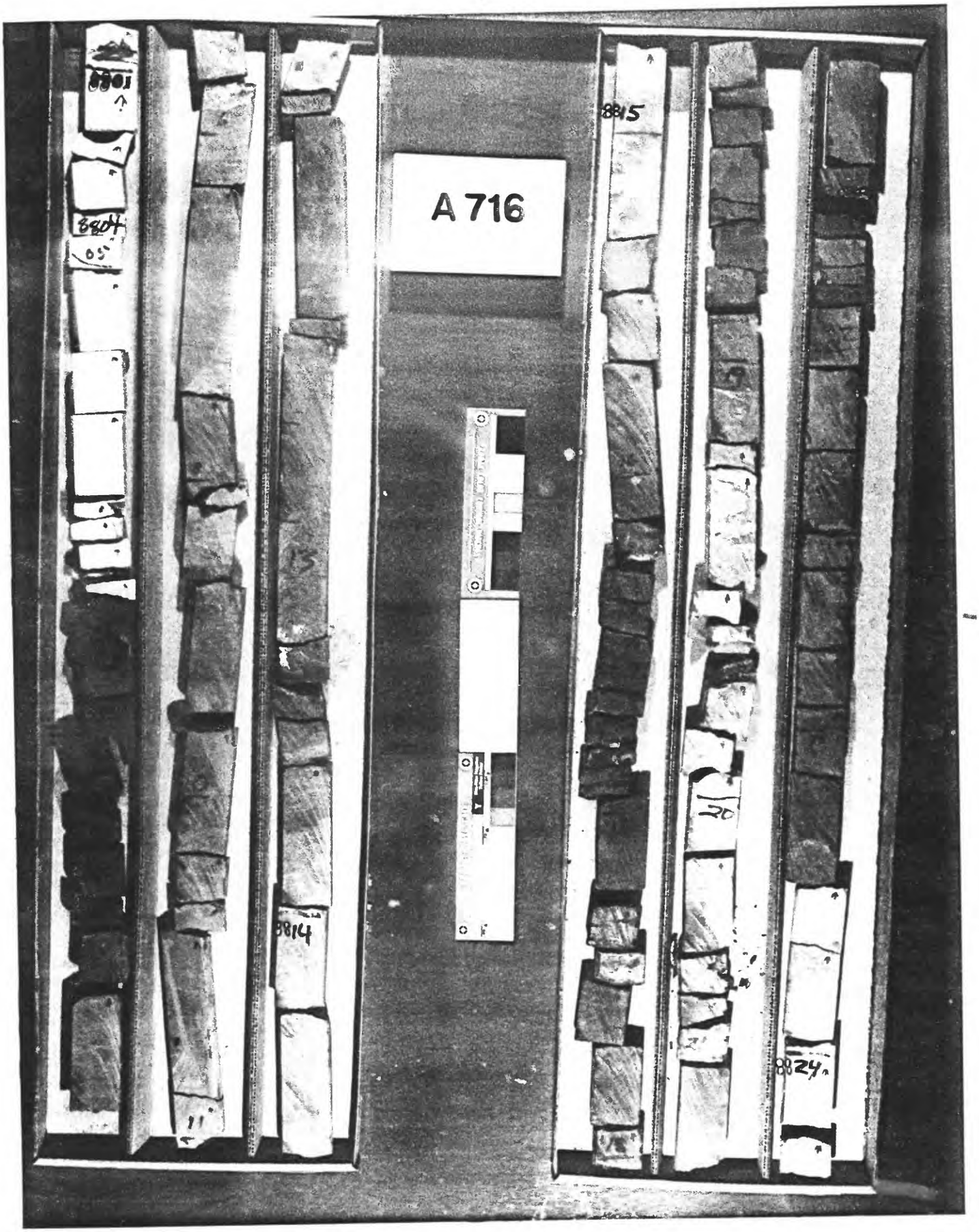
STATE..... COUNTY.....

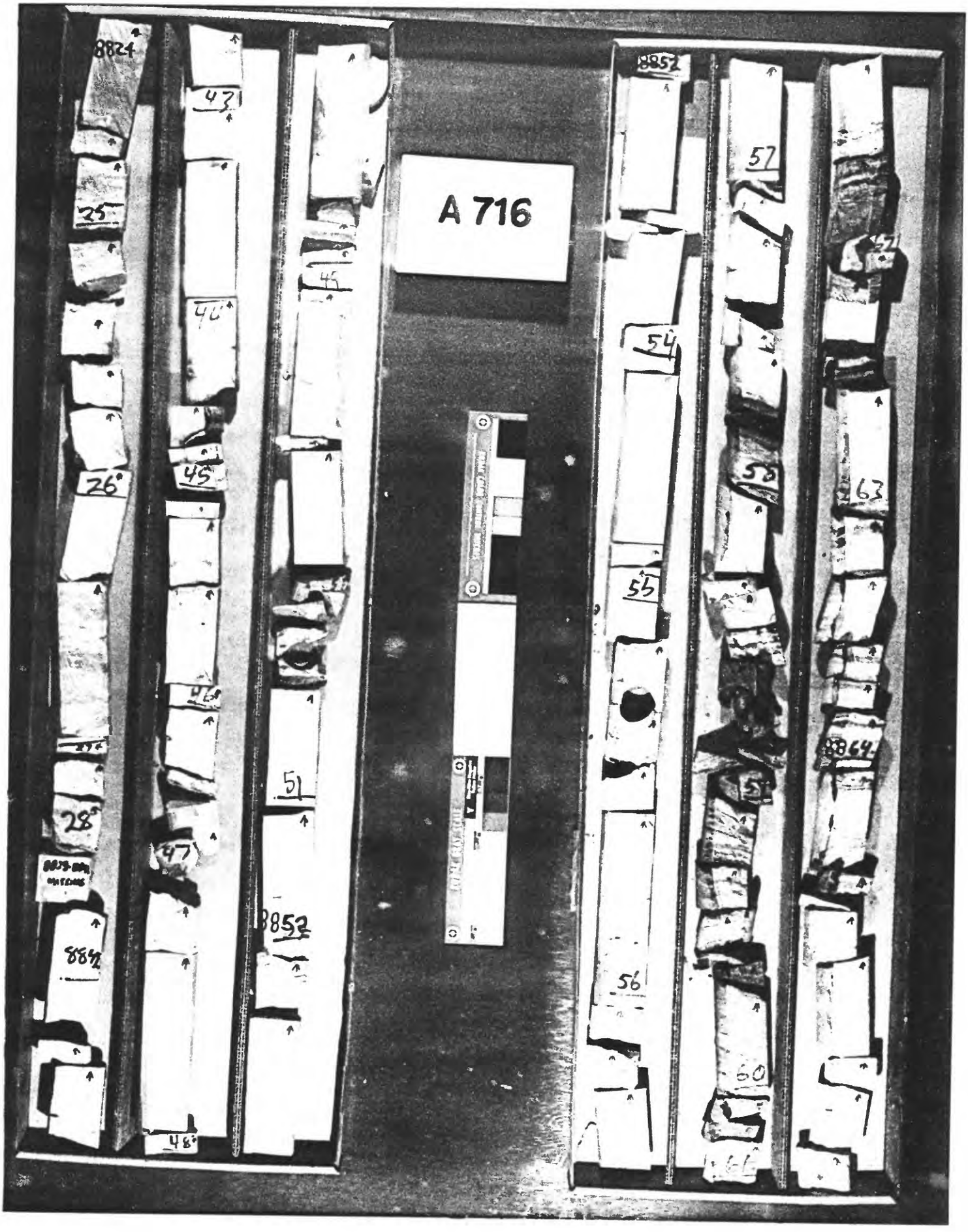
U.S.G.S. CORE LIBRARY NUMBER..... API WELL NUMBER.....

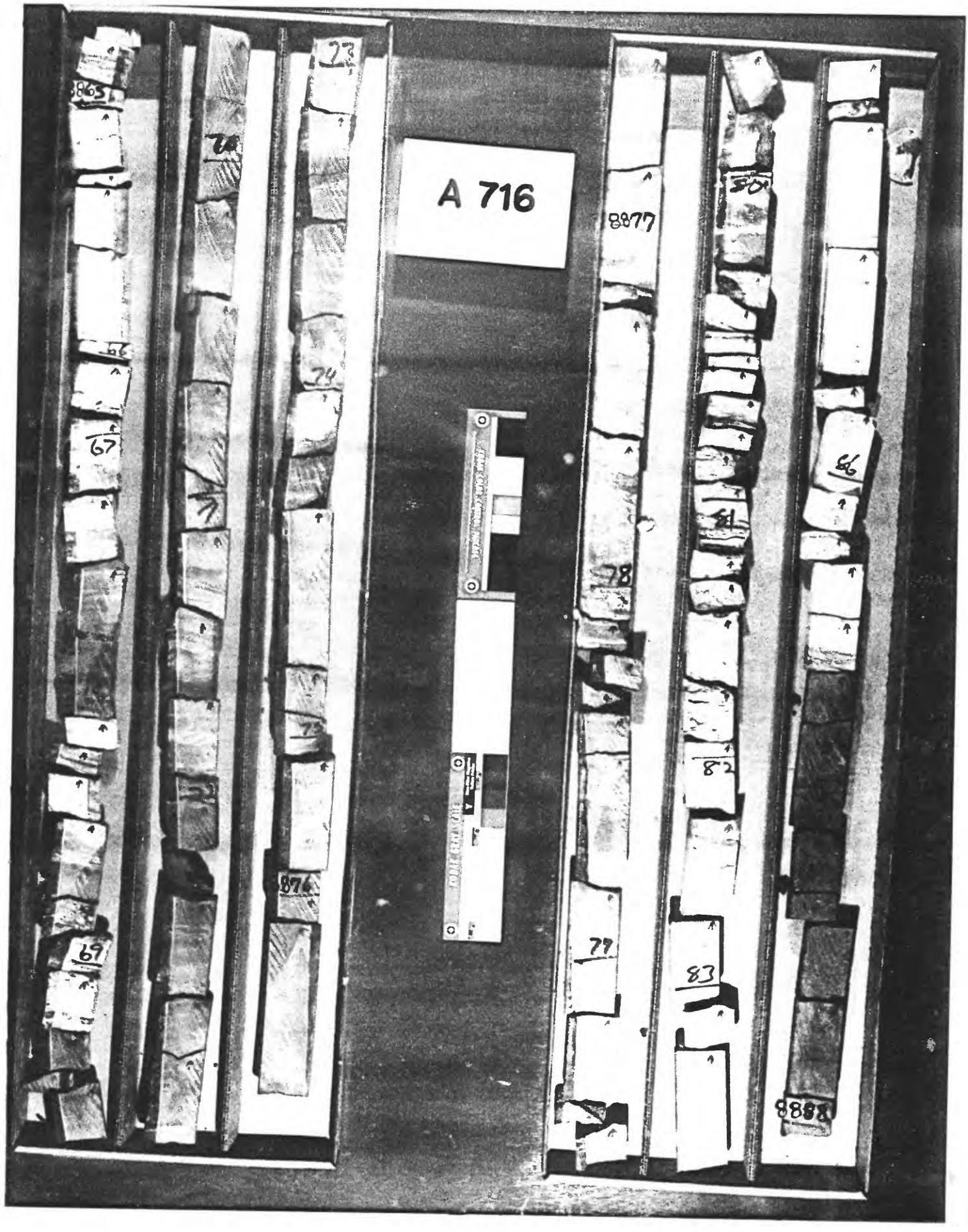
3 of 3

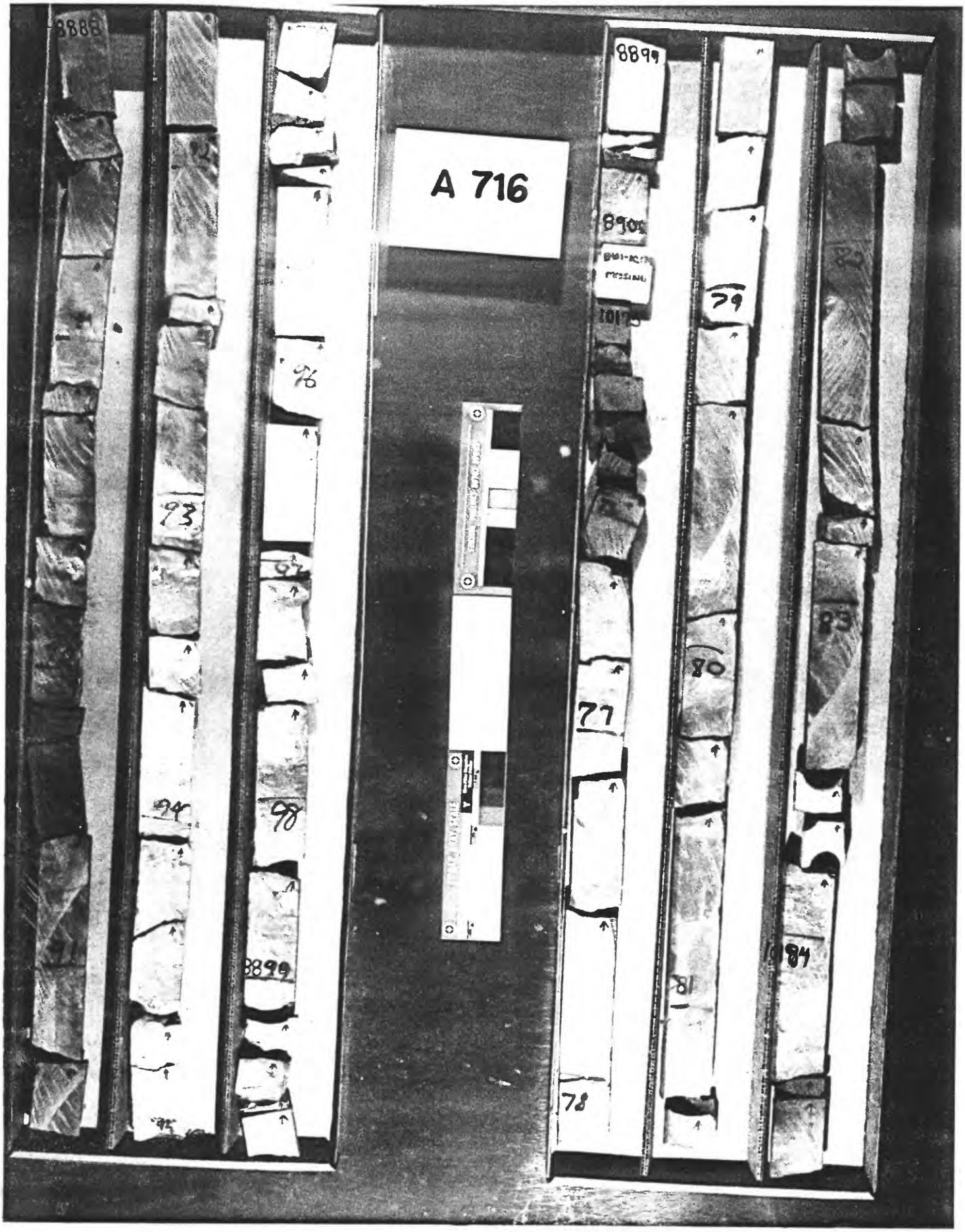
Drill hole reference number 10

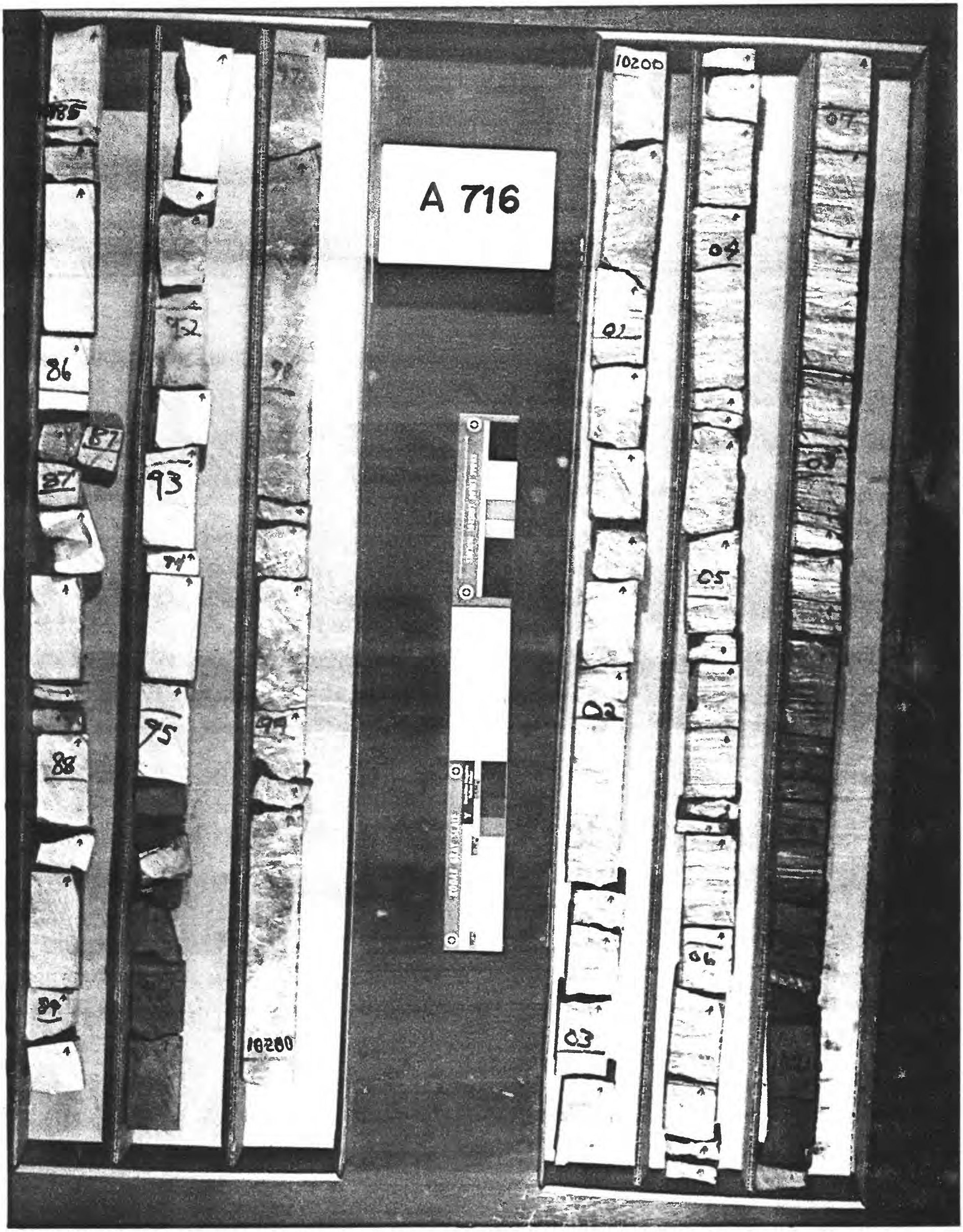
DEPTH AND FORMATION TOPS	ROCK TYPE	COLOR	DOMINANT GRAIN SIZE	BEDDING (as observed)	SEDIMENTARY STRUCTURES	BIOLOGIC CONSTITUENTS	SORTING	ROUNDNESS	PERCENT FRAMEWORK	ACCESSORY MINERALS OR FRAGMENTS	DESCRIPTION
10200											SS, shaly, calc, silty
									80		SS alt with SH or v silty SH
10210							Subrd+ Suban+				SH, dense, v coaly
							W		85		SH, v silty
									40?		SS, mottled, hori burrows, few vert burrows?, clay-silica cement
10220											SH, v silty
									85		SS, sl calc
									40?		SH, v silty
10225	END CORE	N6					W		85		SS, clay-silica cement

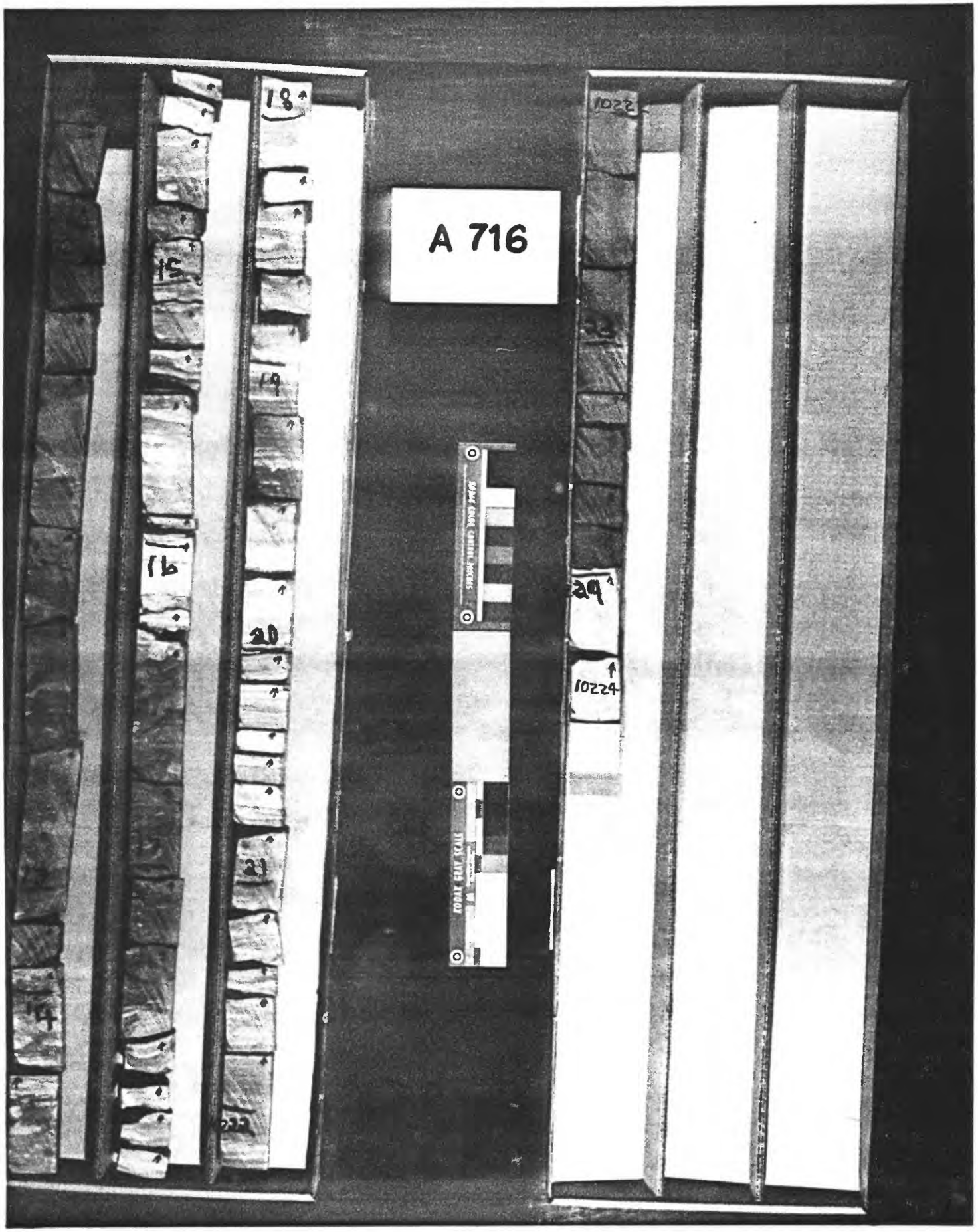

A 716
8801
8804
8815
8814
8824


A 716


A 716


A 716


A 716
10200
10280


A 716
18
19
20
21
1022
29
10224

LADD PETROLEUM CORP. 1-22-74 Federal

LOCATION SE¼ SE¼ Sec. 22 T. 17 N. R. 94 W.

STATE Wyoming COUNTY Sweetwater

U.S.G.S. CORE LIBRARY NUMBER A 846 12/12 API WELL NUMBER 49-037-20713-00

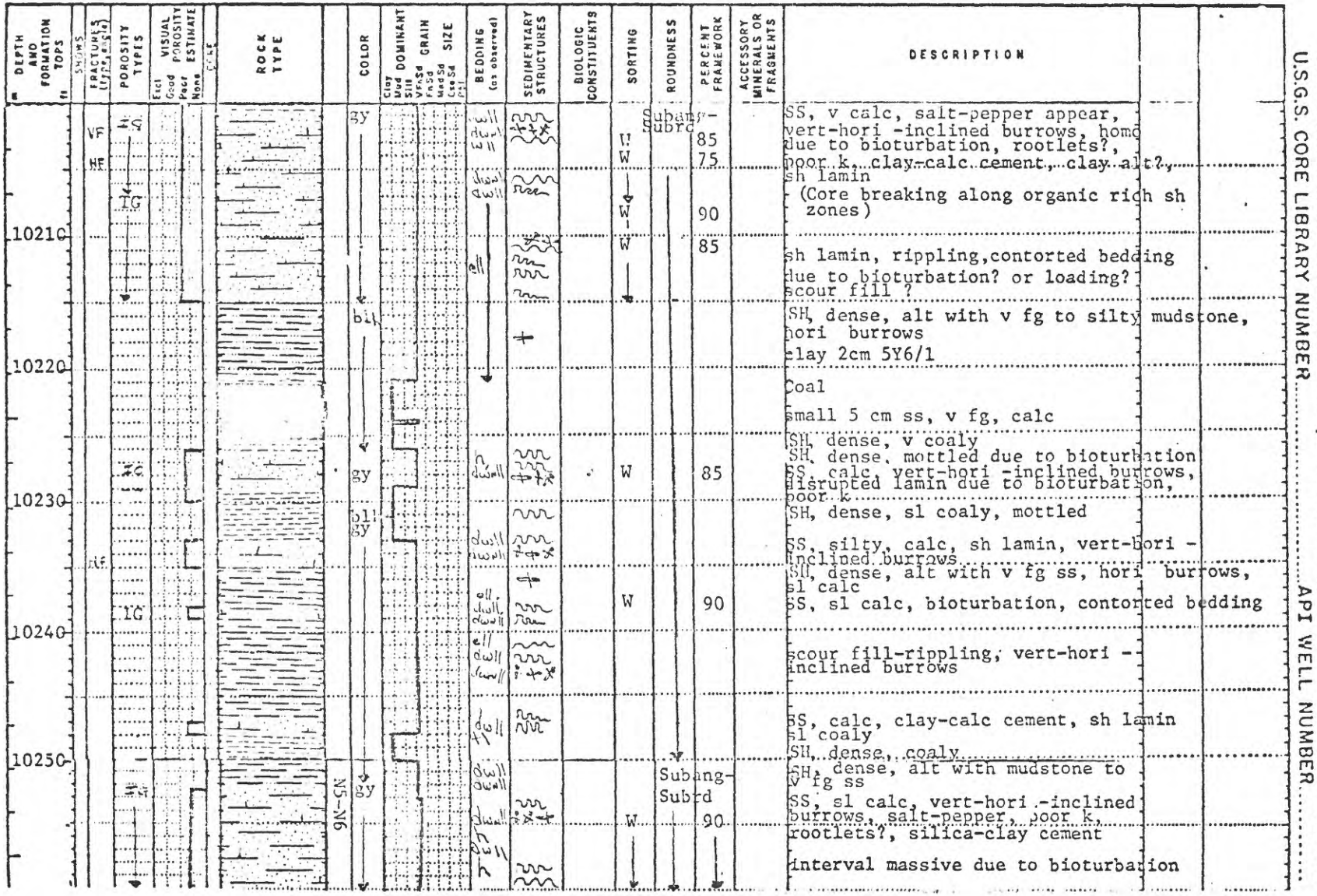
1 of 3

Drill hole reference number 11

LOCATION ..... Sec ..... T ..... R .....

STATE ..... COUNTY .....

U.S.G.S. CORE LIBRARY NUMBER ..... API WELL NUMBER .....



Drill hole reference number 11

LOCATION..... Sec..... T..... R.....

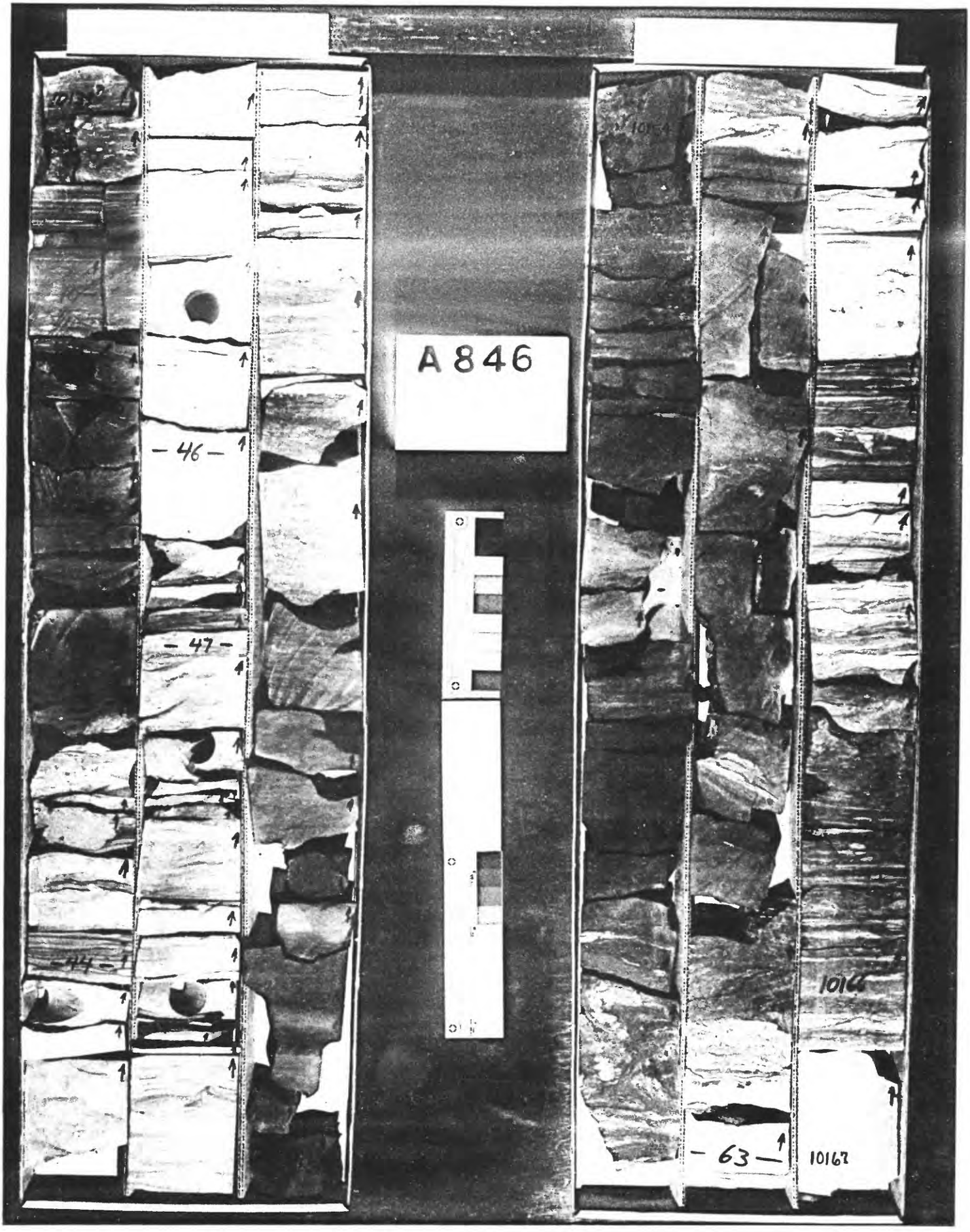
STATE..... COUNTY.....

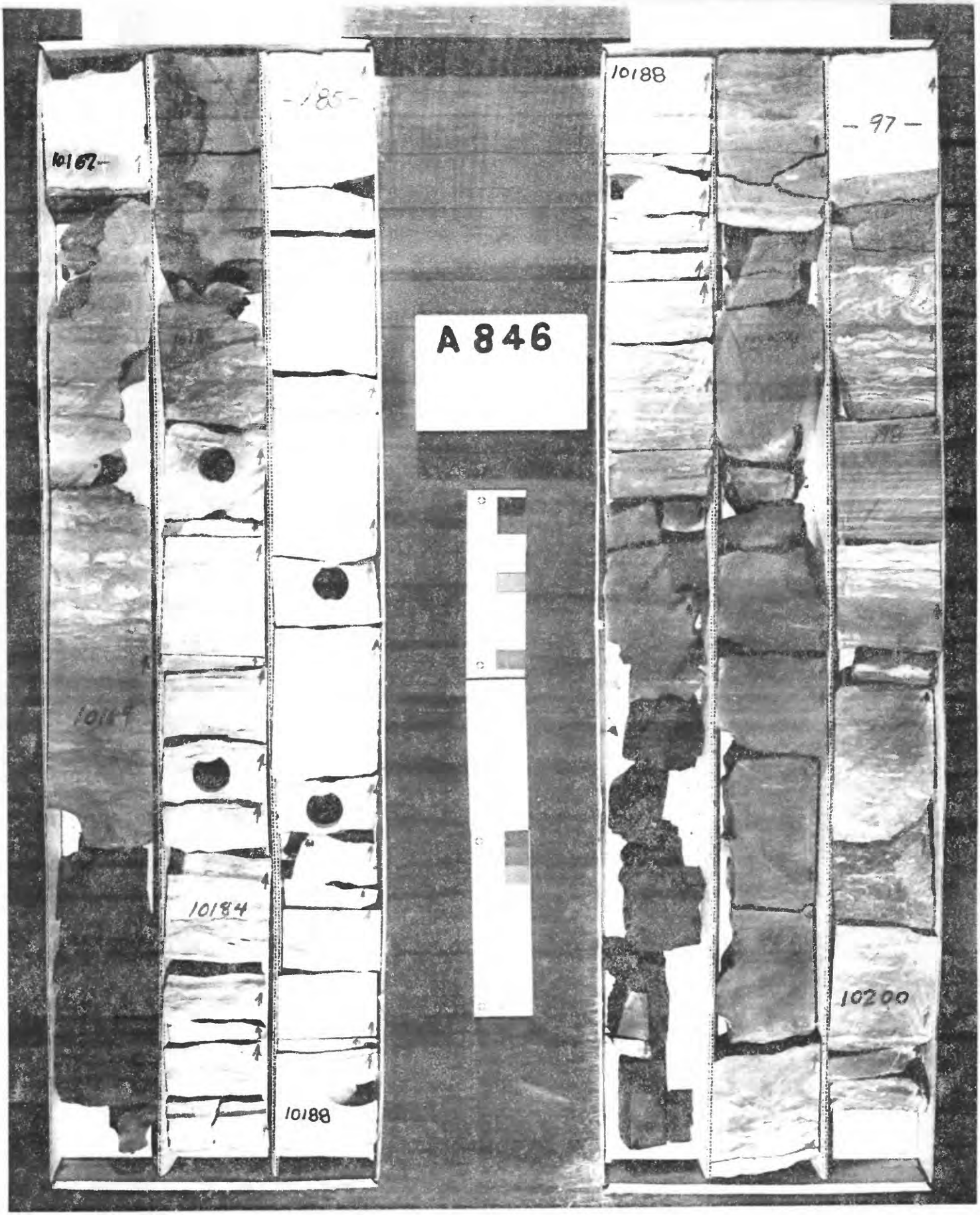
U.S.G.S. CORE LIBRARY NUMBER..... API WELL NUMBER.....

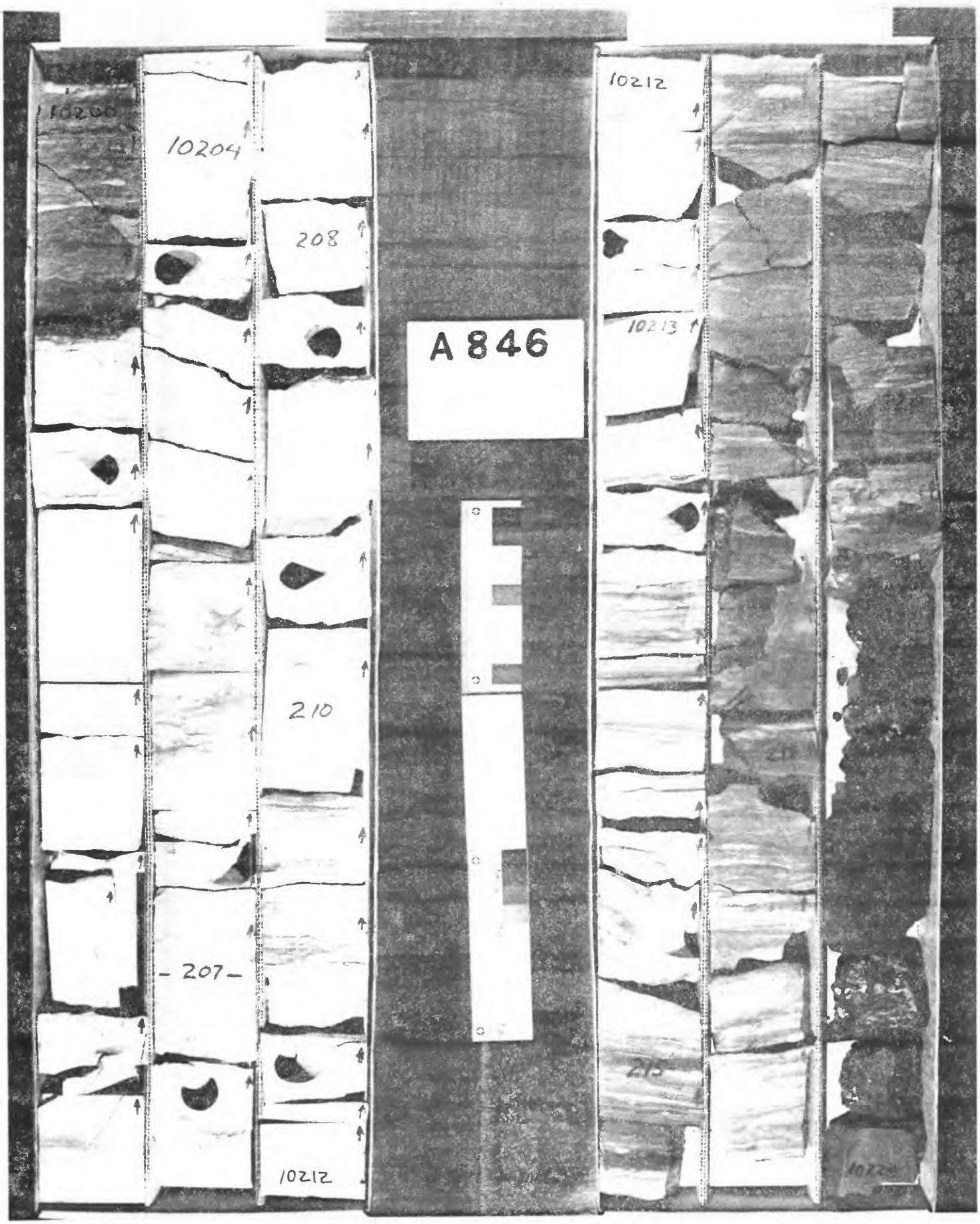
DEPTH AND FORMATION TOPS (ft)	SHOWS	FRACTURES (type, angle)	POROSITY TYPES	VISUAL POROSITY ESTIMATE (Excl Good Poor None)	CORE	ROCK TYPE	COLOR	BEDDING (as observed)	SEDIMENTARY STRUCTURES	BIOLOGIC CONSTITUENTS	SORTING	ROUNDNESS	PERCENT FRAMEWORK	ACCESSORY MINERALS OR FRAGMENTS	DESCRIPTION
10260		VF	IG				bl gy					Subang-Subrd			SS, sl calc, tr vert-hori burrows, scour fill-rippling of sh lamin SH, dense, alt with v fg ss
10270		VF	IG				N5-N6								SI, dense, alt with v fg ss to silty mudstone
		VF	IG				gy				W		85		SS, sl calc, v bioturbated, vert-hori -inclined burrows, poor k some burrows fill with clay 5Y6/1
							bl gy						75		SLTSS to silty MUDSTONE, pyr
10280							bl gy								MUDSTONE, silty, bioturbated, pyr SH, dense, mottled, sl silty
							N5-N6								SS, sl calc, bioturbated, clay-silica cement, coaly sh lamin
10290		VF	IG				gy				W		75		SS, alt with sh lamin, highly bioturbated, vert-hori and inclined burrows, poor k
10292						END									END
					CORE	CORE									CORE

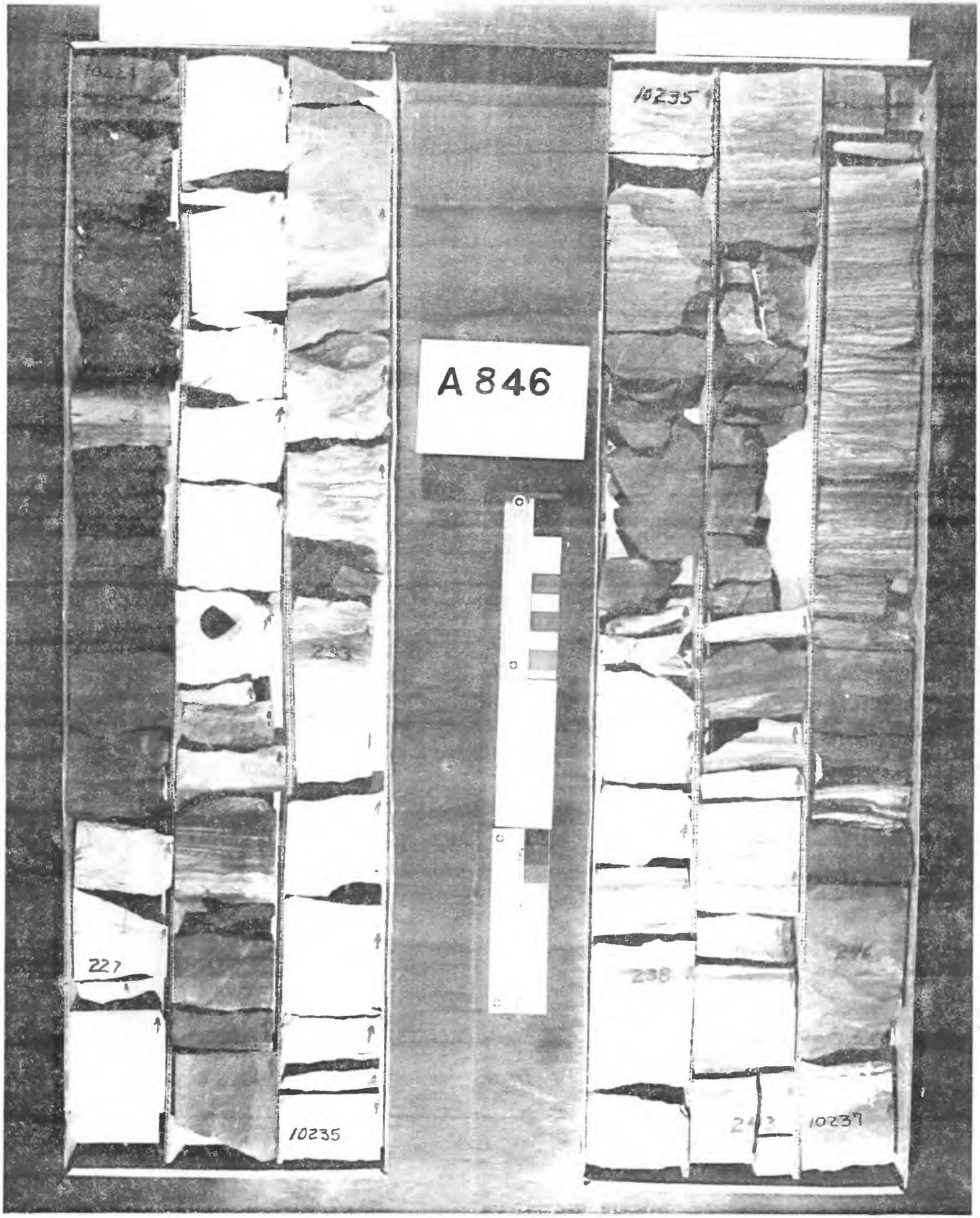
Drill hole reference number 11

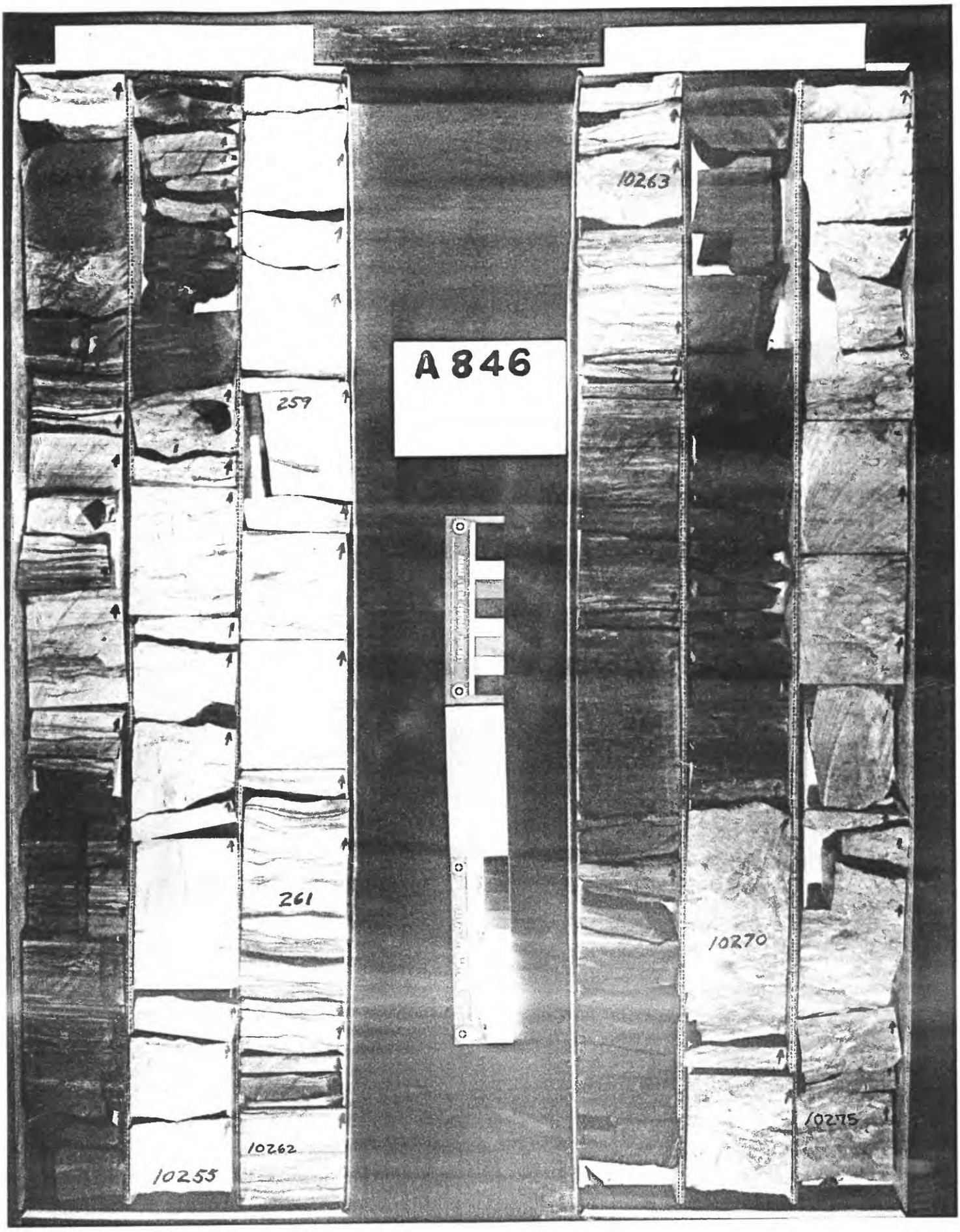
3 of 3


A 846
- 46 -
- 47 -
- 63 -
10167


-185-
10162
10169
10184
10188
A 846
10188
-97-
10200


10200
10204
208
A 846
10212
10213
210
- 207 -
10212


A 846
10235
227
10235
238
10237


A 846
10263
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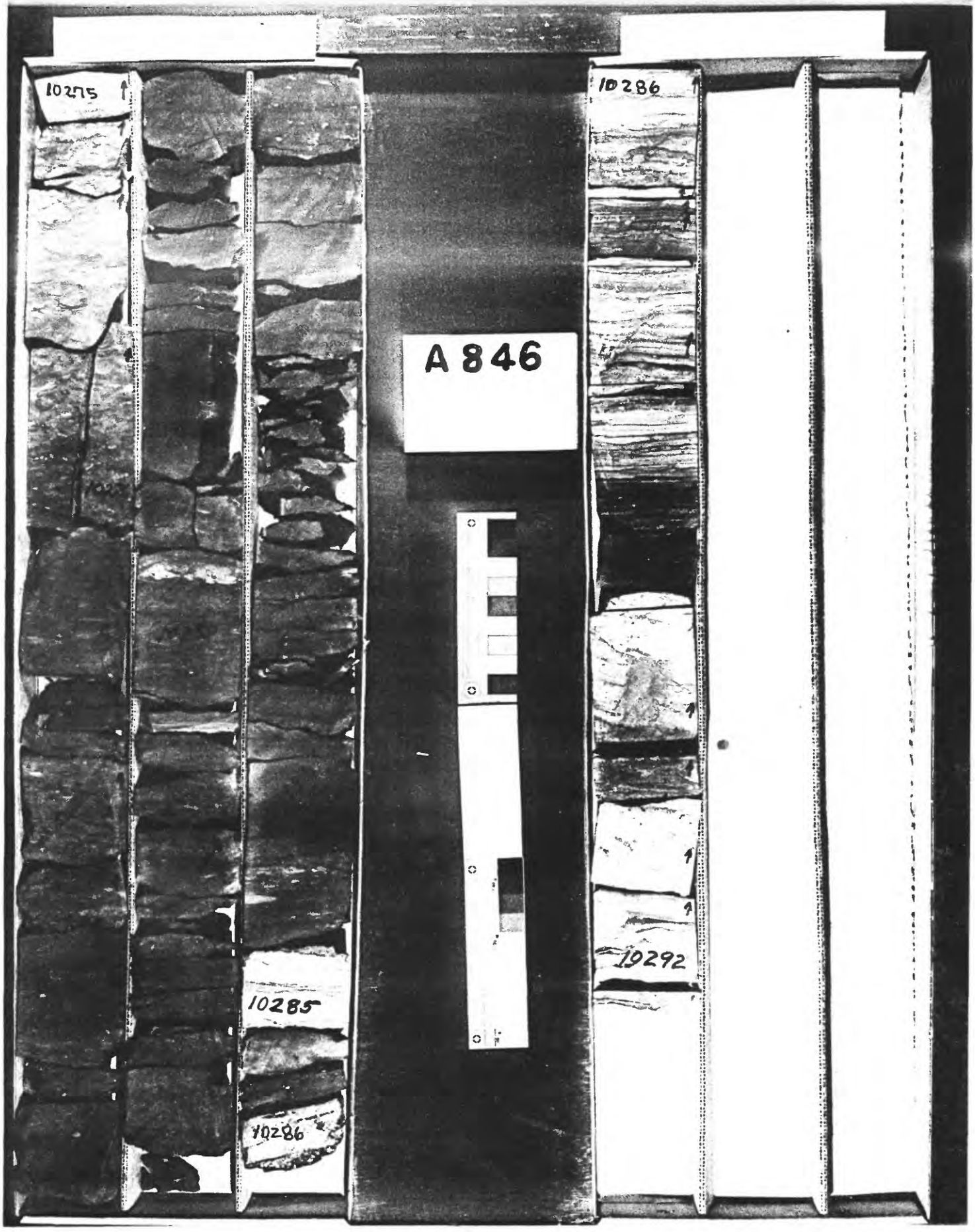
261
10270
10275
10262
10255


10275
A 846
10286
10285
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10292