GJBX-31(80)

National Uranium Resource Evaluation

BRUSHY BASIN DRILLING PROJECT, CEDAR MOUNTAIN, EMERY COUNTY, UTAH

MASTER

Bendix Field Engineering Corporation
Grand Junction Operations
Grand Junction, CO 81502

March 1980

PREPARED FOR U.S. DEPARTMENT OF ENERGY
Assistant Secretary for Resource Applications
Grand Junction Office, Colorado

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ABSTRACT

A 12-hole drilling program was conducted on the northwestern flank of the San Rafael swell of eastern Utah to obtain subsurface geologic data to evaluate the uranium resource potential of the Brushy Basin Member of the Morrison Formation (Jurassic). In the Cedar Mountain-Castle Valley area, the Brushy Basin Member consists primarily of tuffaceous and carbonaceous mudstones. Known uranium mineralization is thin, spotty, very low grade, and occurs in small lenticular pods. Four of the 12 drill holes penetrated thin intervals of intermediate-grade uranium mineralization in the Brushy Basin. The study confirmed that the unit does not contain significant deposits of intermediate-grade uranium.

INTRODUCTION

The Brushy Basin drilling project was conducted in the northwest Cedar Mountain-Castle Valley area on the northwestern flank of the San Rafael swell in Emery County, Utah. A drill-hole location map is shown in figure 1 and table 1 presents information on formation tops and unit thicknesses. The study area extends from Clawson, Utah, northeastward to the Grassy Trails gas field southeast of Wellington, Utah (fig. 1). It encompasses approximately 170 square miles and lies within Tps. 16 through 19 S., and Rs. 8 through 12 E. Access to the study area is by improved dirt roads and jeep trails. The drilling was conducted during June and July 1979 by Bendix Field Engineering Corporation (BFEC), prime contractors for the U.S. Department of Energy (DOE), Grand Junction, Colorado, and was part of a larger drilling program for quadrangle assessment.

In recent years private industry has successfully conducted subsurface investigations in the Brushy Basin Member in sec. 36, T. 18 S., R. 10 E. The results of their work indicated thin, continuous, intermediate-grade uranium mineralization in carbonaceous mudstones and siltstones. In the same region some Brushy Basin outcrops are "buckskin" color. Mickle and others (1977) suggested that the yellowish-tan or yellowish-brown buckskin color indicates higher than average amounts of uranium in the mudstones and sandstones. More probably the color indicates weathered organic material in the carbonaceous mudstones and sandstones.

Purpose

The purpose of the project was to obtain subsurface data to verify the intermediate-grade potential of the Brushy Basin Member of the Morrison Formation (Jurassic) as a part of the National Uranium Resource Evaluation (NURE) program for identifying areas containing large deposits of intermediate grade (0.01 to 0.05 percent U_3O_8) uranium.

Procedure

The 12 holes of this project, totaling 6,867.5 feet, were drilled with a Failing-1500 rotary rig. Himes Drilling Company of Grand Junction, Colorado, was the drilling contractor. An 8.75-inch hole was drilled to set 15 to 20

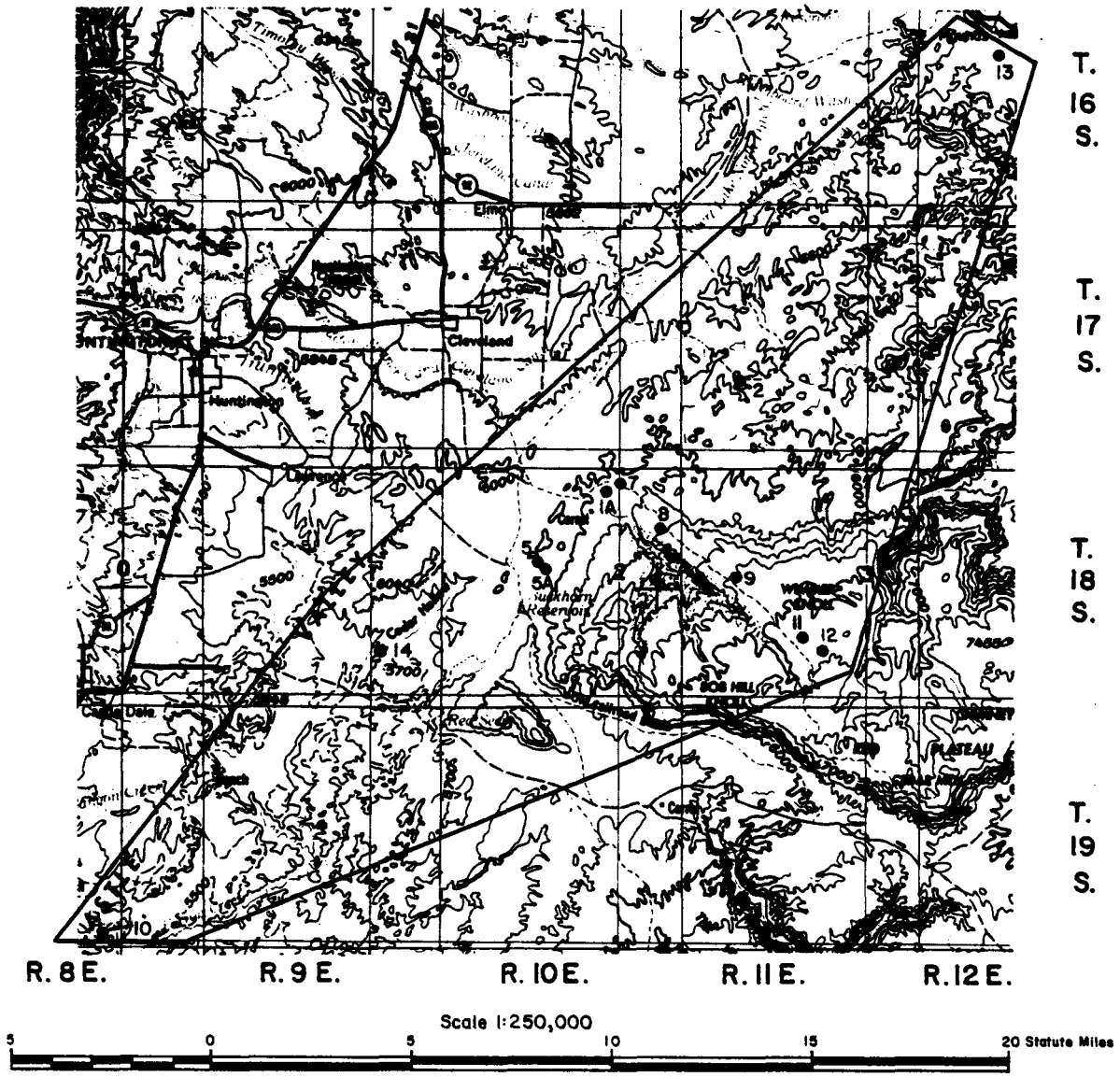


Figure 1. Index map of Brushy Basin drilling project and drill-hole locations, Emery County, Utah.

Table 1. - Approximate tops and thicknesses (in feet) of units penetrated by drilling.

[Km=Mancos Shale, Kd=Dakota Sandstone, Kcm=Cedar Mountain Formation (shale member), Kcb=Cedar Mountain Formation (Buckhorn Conglomerate Member), Jmbb=Morrison Formation (Brushy Basin Member), Jmsw=Morrison Formation (Salt Wash Member), Jsu=Summerville Formation, and Jc=Curtis Formation. Not applicable, ---; uncertain, ?. Total depth and unit thickness reported in feet.]

Hole no.	Location Qtr.	T.S.	R.E.	Sec.	Total depth	Formation	Top	Thickness	Remarks on Brushy Basin Member
5	SENE	18	10	16	101.0	Kcb	10	30	---
						Jmbb	40	61	Barren.
5a	SENE	18	10	16	635.5	Kcb	15	25	---
						Jmbb	40	422	Barren.
						Jmsw	462	115	---
						Jsu	577	58.5	---
7	SWNE	18	10	02	520.0	Kcb	40	69	---
						Jmbb	109	236	2.5 ft/0.015 percent eU_3O_8 at 146 ft and 1.0 ft/0.012 percent at 152 ft.
						Jmsw	345	95	---
1a	NESW	18	10	02	540.0	Kcb	59	33	---
						Jmbb	90	305	Barren.
						Jmsw	395	73	---
						Jsu	468	72	---
8	SESE	18	10	12	618.0	Kcb	5	39	---
						Jmbb	44	326	0.5 ft/0.012 percent eU_3O_8 at 122 ft and 0.5 ft/0.012 percent at 123 ft.
						Jmsw	370	202	---
						Jsu	572	46	---
9	SWSW	18	11	17	530.0	Kcb	10	45	---
						Jmbb	55	307	Barren.
						Jmsw	365	78	---
						Jsu	440	90	---

Table 1. - Approximate tops and thicknesses (in feet) of units penetrated by drilling, continued.

Hole no.	Location Qtr.	T.S.	R.E.	Sec.	Total depth	Formation	Top	Thickness	Remarks on Brushy Basin Member
11	SWSW	18	11	27	430.0	Kcb	10	58	---
						Jmbb	68	300	0.5 ft/0.011 percent eU_3O_8 at 138 ft.
						Jmsw	338	72	---
						Jsu	410	20	---
12	SWNE	18	11	34	410.0	Kcb	8	80	---
						Jmbb	88	247	Barren.
						Jmsw	335	43	---
						Jsu	378	32	---
2	NENW	17	11	29	703.0	Kd	0	103	---
						Kcm	103	105	---
						Kcb	208	18	---
						Jmbb	226?	242?	1.0 ft/0.013 percent eU_3O_8 at 231 ft.
						Jmsw	464?	235?	---
10	NESW	19	08	34	920.0	Km	20	82	---
						Kd	102	43	---
						Kcm	145	509	---
						Kcb	654	38	---
						Jmbb	692	228	Barren.
14	NWSW	18	09	26	600.0	Kcm	10	70	---
						Kcb	80	30	---
						Jmbb	110?	175?	Barren.
						Jmsw	285?	77	---
						Jsu	362?	238?	---
13	NWSE	16	12	08	860.0	Kcm-Kcb	0	72	---
						Jmbb	72?	388?	Barren.
						Jmsw	460?	155?	---
						Jsu	615?	147?	---
						Jc	762?	98?	---

feet of 7-inch interior diameter (ID) steel casing when necessary. Four 4.5-inch drill collars were used in all holes.

Bit sizes ranged from 6.25 inches to 5 inches for rock, mill-tooth and button bits. All holes were drilled with air until water was encountered, after which a mixture of Sta-Foam 202 and water was utilized. Because unusual amounts of ground water and washout problems occurred in hole BB-10, soda ash, gel, cement, starch, and caustic soda were introduced. Most of the holes were drilled to the contact between the Salt Wash Member of the Morrison Formation and the underlying Summerville Formation.

Total depth gamma-ray, self-potential, resistivity, and neutron logs were obtained for all holes by the geophysical logging department of BFEC Advanced Technology Division. KUT (potassium, uranium and thorium) logs were obtained for anomalous zones detected by the gamma-ray probe. These logs are included in Appendices A and B, respectively. Ore calculations using a 0.01 percent eU_3O_8 cutoff were made on mineralized intervals. Fluorometric uranium analyses of drill cuttings were not performed because of time limitations, but all samples are stored for future reference.

GENERAL GEOLOGIC SUMMARY

The San Rafael swell, a large northeast-trending anticline, is located almost entirely in Emery County, Utah, and is 30 by 80 miles in extent. The rocks of the San Rafael swell are sedimentary, consisting of marine and continental sandstones, mudstones, siltstones, and shales with minor limestones.

Exposed rocks range in age from Pennsylvanian(?) through Cretaceous, although rocks of Cambrian, Devonian, and Mississippian age are known from drill-hole data (fig. 2). A generalized geologic map modified from Hintze and Stokes (1964) shows the outcrop pattern of these rocks (pl. 1, in pocket). The kidney-shaped, asymmetric anticline is cut by a great number of small west- to northwest-trending faults and subordinate northeast-trending faults.

Brushy Basin Member

The Brushy Basin Member of the Morrison Formation (Jurassic) was the major target for this drilling project. The Brushy Basin is of continental origin and consists of sediments formed in lacustrine and floodplain environments; the latter being the dominate lithofacies.

In the project area, the Brushy Basin is from 175 to 328 feet thick and consists of slope-forming variegated mudstones with minor amounts of siltstone, sandstone, and limestone. The mudstones and siltstones are white, green, red, purple, pink, grey, and bluish-gray. Abundant montmorillonite, derived from volcanic ash (Craig and others, 1955; Brookins, 1975) that produces a popcornlike texture on weathered surfaces, is present in the Brushy Basin. Carbonaceous mudstones in the Brushy Basin occur as fill in abandoned channels and as paludal deposits. Keller (1962) described the presence of euhedral zircons, books of unaltered biotite, and zoned feldspars as evidence of frequent ash falls during deposition. Poorly sorted and medium- to dark-colored sandstone lenses are found in the member. The sandstone lenses

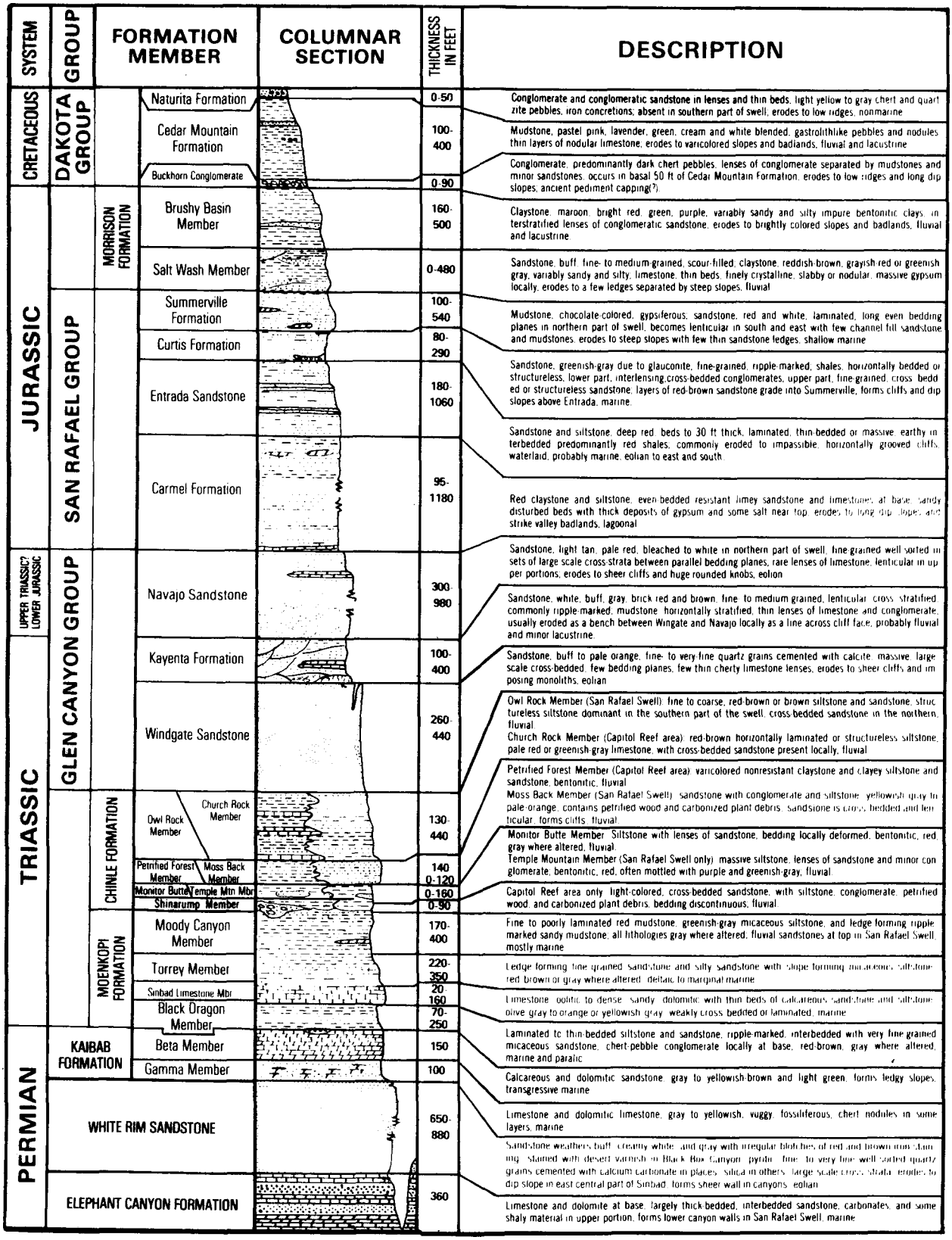


Figure 2. Generalized stratigraphic column, San Rafael swell area.

attain a thickness of as much as 30 feet, but thin rapidly and have little lateral continuity. Some of the sandstone lenses contain conglomerate layers or scattered pebbles.

GAMMA-RAY, ELECTRIC, AND KUT LOG INTERPRETATION

Four of the 12 holes penetrated mineralized zones in the Brushy Basin Member. Ore-grade calculations of these zones show that the grade ranges from 0.01 to 0.015 percent eU_3O_8. Correlation of the mineralized zones was difficult due to discontinuous lithofacies and poor quality self-potential and resistivity logs resulting from tool malfunction and gas in the holes. A 100-foot repeat section was run to determine if the instrumentation was functioning properly. The mineralized holes are discussed in the following text. Barren holes are not discussed although their logs are included in Appendix A. In addition to the 12 holes drilled in this project, five gamma-ray logs from gas wells in the Grassy Trails gas field were examined and evaluated. Equivalent uranium calculations based on these logs suggest that uranium content does not exceed 0.0066 percent eU_3O_8.

The compulogger software program(s) used to produce the KUT raw-data analog mislabels the zero reference points, log scales, and units per division. Listed below are the corrected log scales, zero reference points, and units per division which should be used in log interpretation.

1. The scales shown should be multiplied by:

Thorium	10^{-2}
Potassium	1
Total Gamma	10
Uranium	10^{-2}

2. The zero reference points should be located:

Thorium	0	
Potassium	2	divisions from the left
Total Gamma	4	
Uranium	6	

3. The units per division should be changed to:

CpI	-	Cps/division.
Counts per inch	-	Counts/second/division

Drill hole BB-7, located in the NE/4, sec. 2, T. 18 S., R. 10 E., penetrated two mineralized zones in the upper half of the member, one at 146 feet and the other at 152 feet. The unit top in this hole is at 109 feet and the total thickness is 236 feet. Uranium-grade/thickness calculations utilizing a 0.01 percent eU_3O_8 cutoff are 2.5 feet/0.015 percent eU_3O_8 for the 146-foot intercept and 1.0 foot/0.01 percent eU_3O_8 for the 152-foot intercept. Both mineralized zones are in a gray-green mudstone and siltstone bed. Hole BB-7 was drilled to 520 feet.

Drill hole BB-11, located in the SW/4, sec. 27, T. 18 S., R. 11 E., penetrated a mineralized zone at 138 feet. The top of the member in this hole is at 68 feet and the total thickness is 300 feet. Uranium-grade/thickness calculations for this mineralized zone indicate 0.5 foot/0.011 percent eU_3O_8. The KUT log indicates that in this zone uranium predominates over thorium and potassium. Self-potential and resistivity logs, as well as drill cuttings, indicate the mineralized zone consists of gray-green mudstones and siltstones with subordinate gray sandstone. BB-11 was drilled to a depth of 430 feet.

Drill hole BB-2, located in the NW/4, sec. 29, T. 17 S., R. 11 E., penetrated a mineralized zone at 231 feet, 5 feet below the contact of the Brushy Basin Member with the overlying Buckhorn Conglomerate Member of the Cedar Mountain Formation (Early Cretaceous). The top of the Brushy Basin in this hole is at 226 feet, and total thickness is approximately 242 feet. The mineralized zone consists of red and green mudstone and a trace of very light gray sandstone and chert. Grade/thickness calculations for the mineralized zone indicate 1.0 foot/0.013 percent eU_3O_8. The KUT log indicates that uranium is the major contributor of radioactivity and that the thorium content is low. BB-2 was drilled to a depth of 703 feet.

Drill hole BB-8, located in the SE/4, sec. 12, T. 18 S., R. 10 E., penetrated mineralized zones at 122 feet and 123.5 feet. These two intercepts contain 0.5 foot/0.012 percent eU_3O_8 each, and both consist of gray claystone. The KUT log indicates only a trace amount of thorium. The top of the member is at 44 feet and the unit has a total thickness of 326 feet. BB-8 was drilled to a depth of 618 feet.

CONCLUSIONS

The evidence accumulated during this drilling project indicates that earlier, private industry reports of continuous mineralization in part of the study area may be overly optimistic. Our data indicate the Brushy Basin Member does not contain economic intermediate-grade uranium resources; uranium-bearing zones are lenticular, thin, low grade and discontinuous. The intercepts range from 0.5 ft/0.011 percent eU_3O_8 to 2.5 ft/0.015 percent eU_3O_8. "Buckskin" color is not a valid indicator for uranium mineralization.

It is conceivable that the Brushy Basin was more consistently uraniferous prior to the Laramide orogeny. Subsequent upwarping created steeper hydrologic gradients and permitted leaching groundwaters to deplete uranium. The uranium-bearing groundwaters passing through the Brushy Basin may have descended stratigraphically into the underlying Salt Wash Member and other formations where the uranium was concentrated in more favorable hosts.

Apparently, only residual uranium remains. This residual uranium may be due to concentration in carbonaceous mudstones or adsorption by the volcanic ash-derived bentonite layers or by other associated clays. The spotty mineralization, low uranium concentration, and the possibilities of thorough leaching suggest this relationship.

APPENDIX A

GAMMA-RAY, SELF-POTENTIAL, RESISTIVITY, AND NEUTRON LOGS

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-1A Date: June 25, 1979

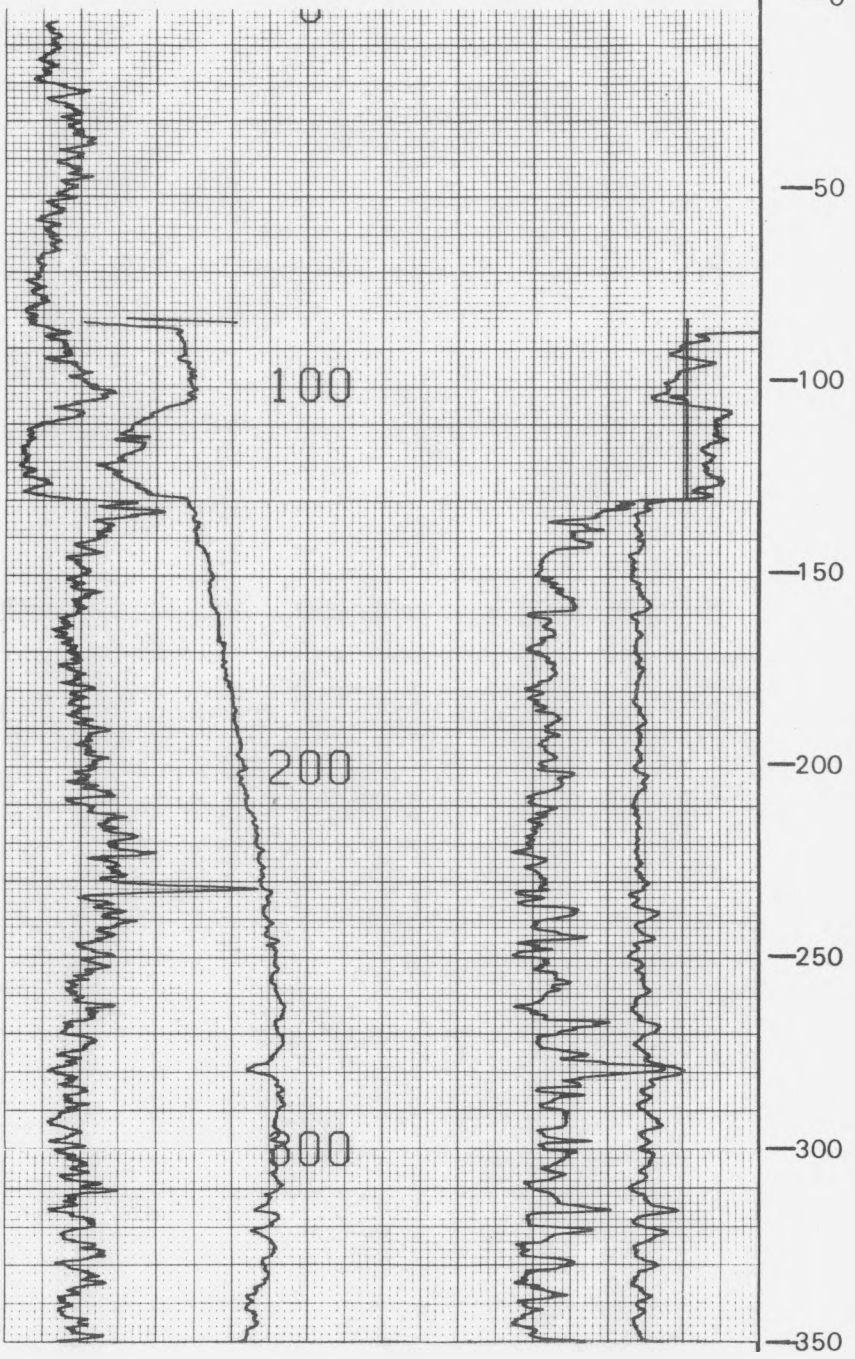
Location: State Utah County Emery T. 18 S., R. 10 E., Sec. 02

Elev: 5975 Drilled depth: 540 ft Logged depth: 513 ft Fluid: Sta-Foam 202

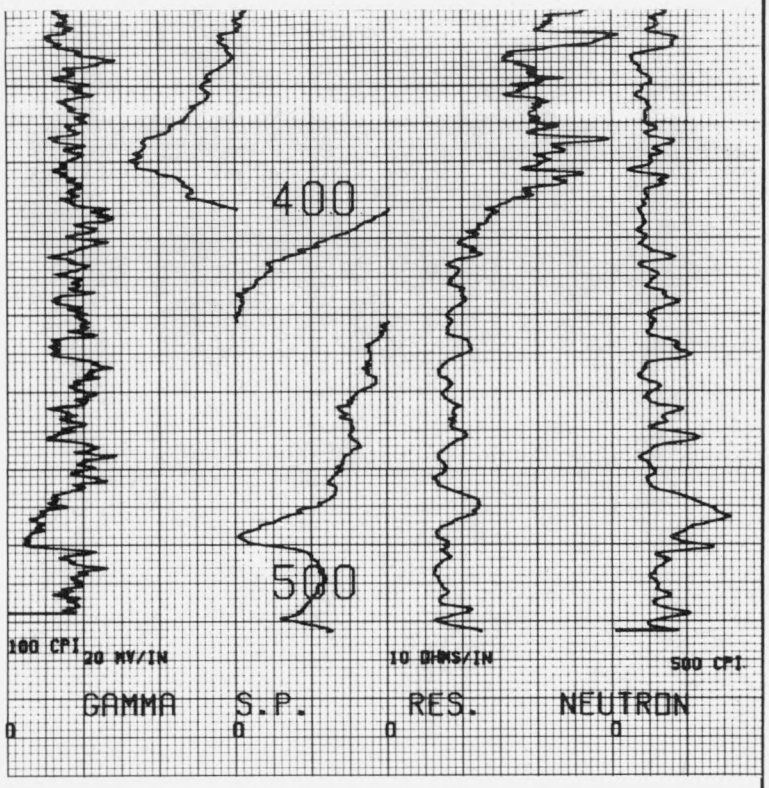
K-Factor: Gamma 5.44×10^{-6} Neutron

Deadtime: Gamma 0.94 µsec. Neutron 0.91 µsec.

Remarks: Gamma, self-potential, resistivity and neutron logs.



Hole No. BB-1A (Continued)



Depth in feet

350
400
450
500
550
600
650
700
750

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-2 Date: July 11, 1979

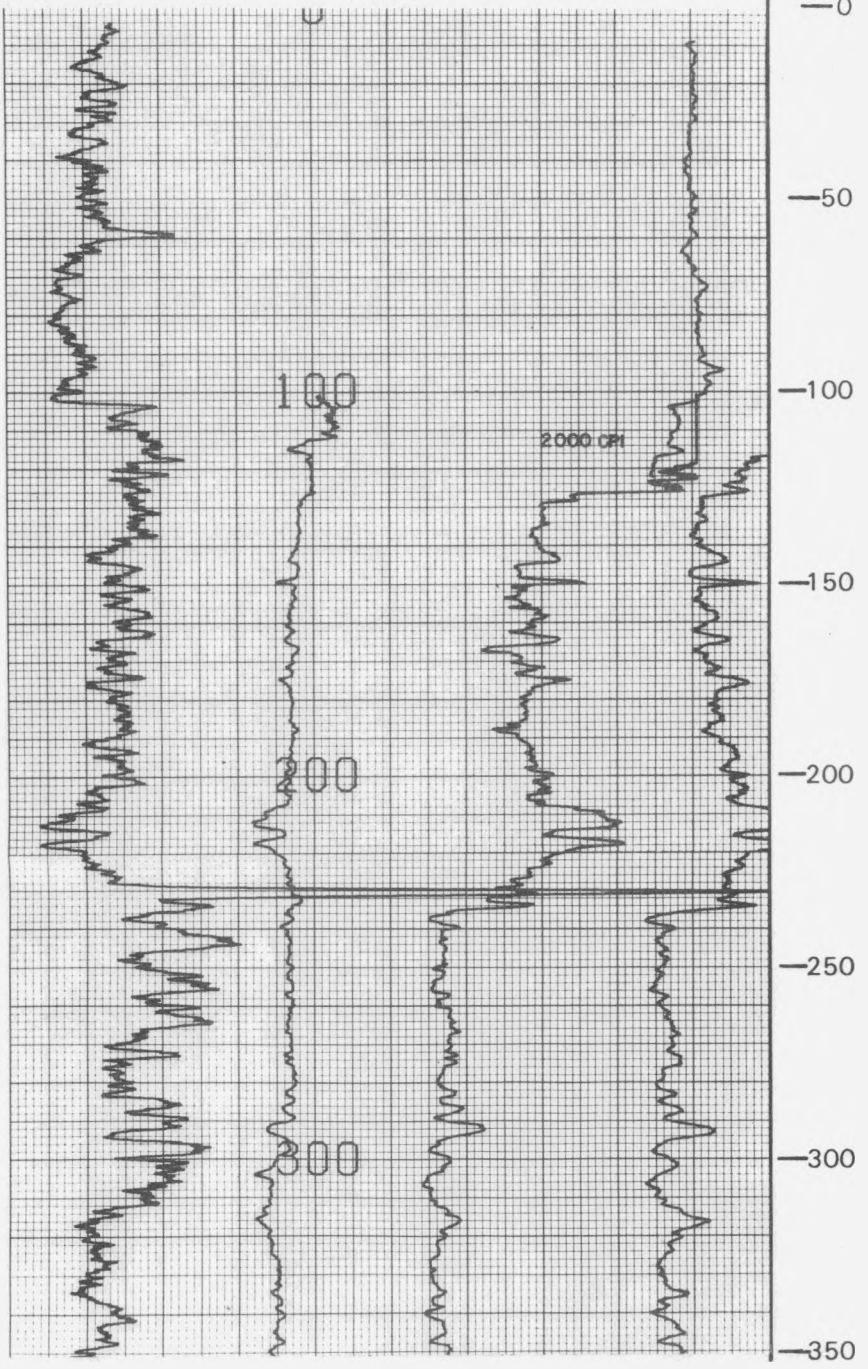
Location: State Utah County Emery T. 17 S., R. 11 E., Sec. 29

Elev: 5760 Drilled depth: 702 ft Logged depth: 682 ft Fluid: Water and foam.

K-Factor: Gamma 5.44×10^{-6} Neutron 5.44×10^{-6}

Deadtime: Gamma 0.94 usec. Neutron 0.91 usec.

Remarks: Gamma, self-potential, resistivity, and neutron logs.



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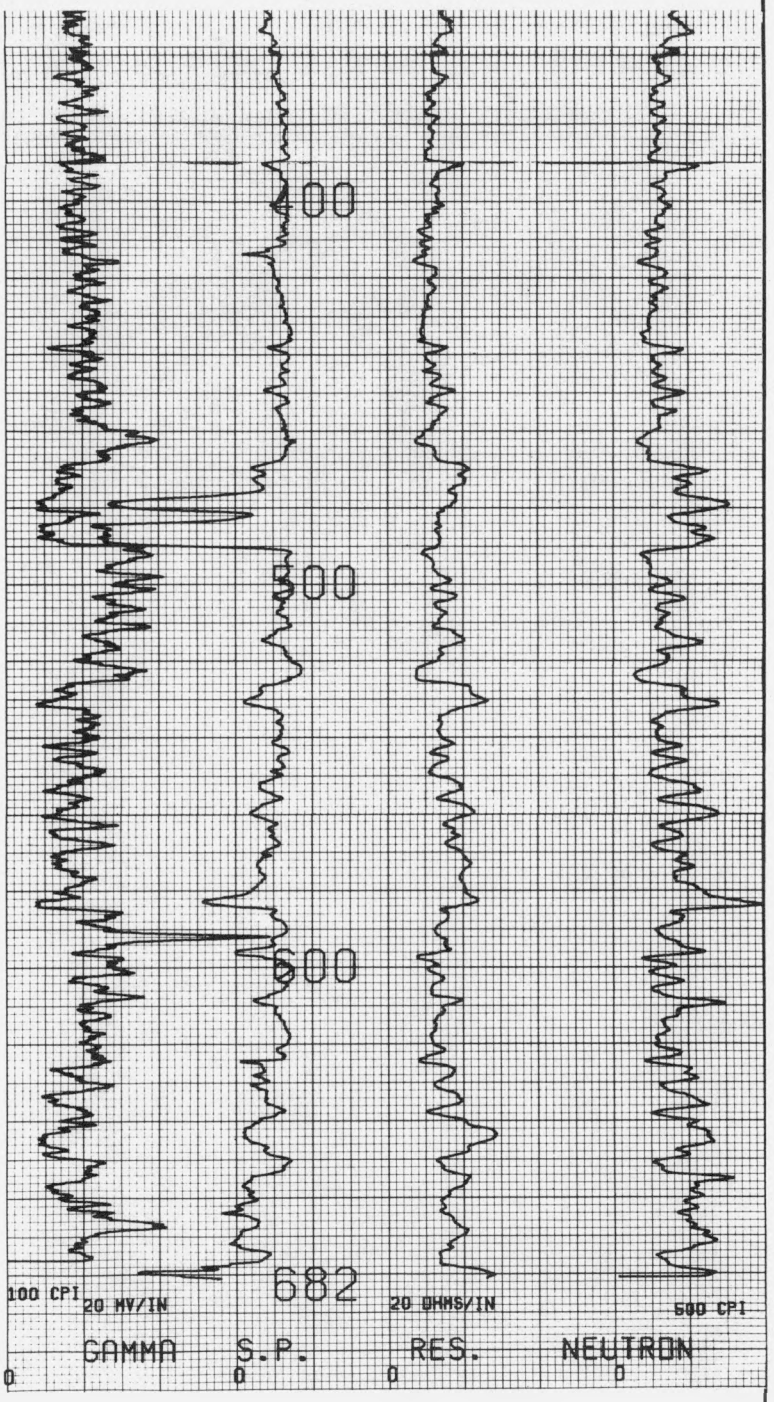


Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-5 Date: June 19, 1979

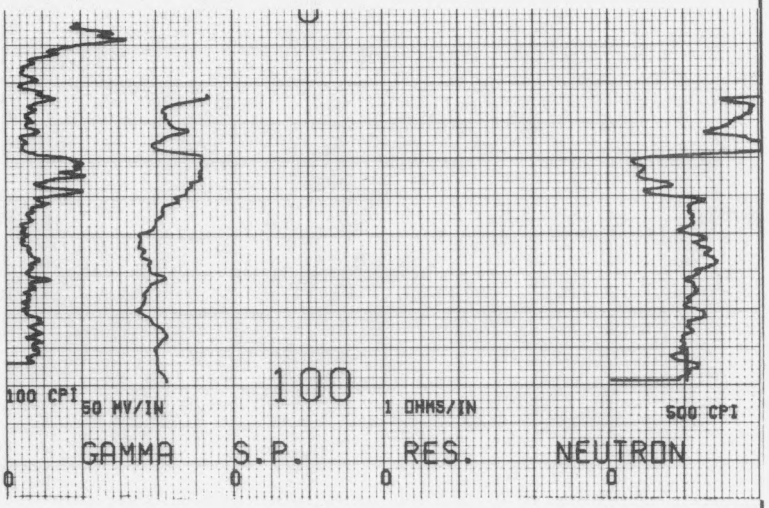
Location: State Utah County Emery T. 18 S., R. 10 E., Sec. 16

Elev: 5840 Drilled depth: 101 ft Logged depth: 100 ft Fluid: Foam

K-Factor: Gamma 5.44×10^{-6} Neutron 5.44×10^{-6}

Deadtime: Gamma 0.94 μsec. Neutron 0.91 μsec.

Remarks: Gamma, self-potential and neutron logs.



Depth in feet

0
50
100
150
200
250
300
350

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Hole No.: BB-5A Date: June 22, 1979

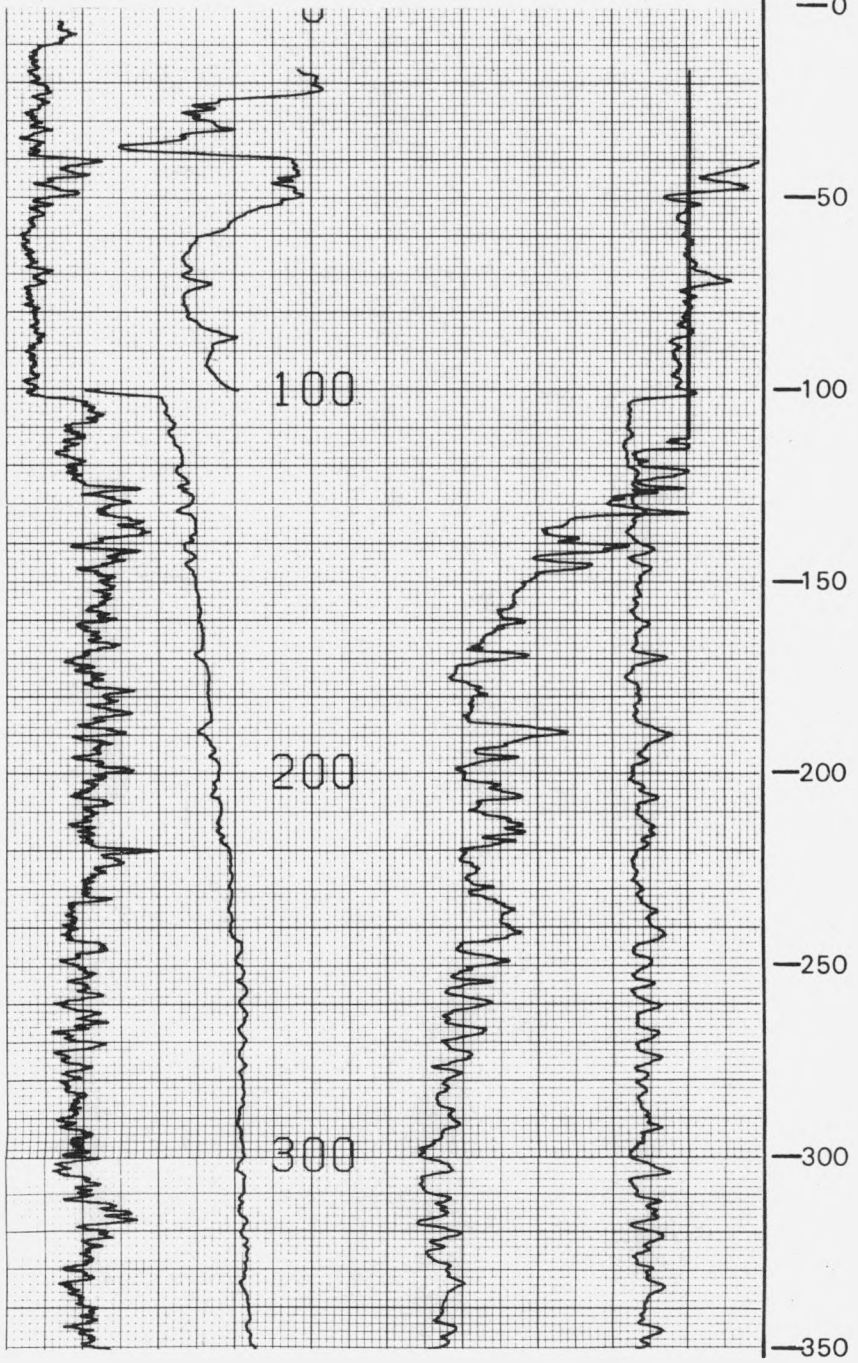
Location: State Utah County Emery T. 18 S., R. 10 E., Sec. 16

Elev: 5840 Drilled depth: 635 ft Logged depth: 634 ft Fluid: Sta-Foam 202

K-Factor: Gamma 5.44×10^{-6} Neutron

Deadtime: Gamma 0.94 µsec. Neutron 0.91 µsec.

Remarks: Gamma, self-potential, and neutron logs.



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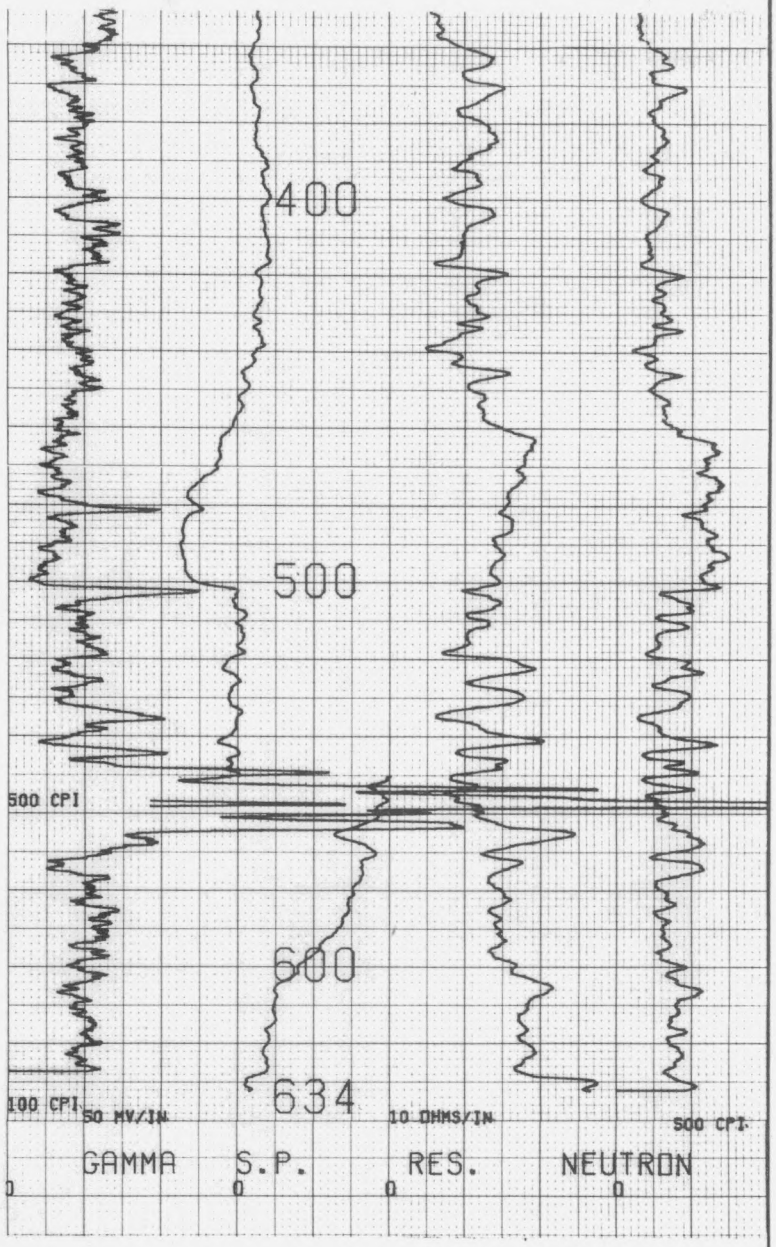


Depth in feet

350
400
450
500
550
600
650
700
750

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-7 Date: June 21, 1979

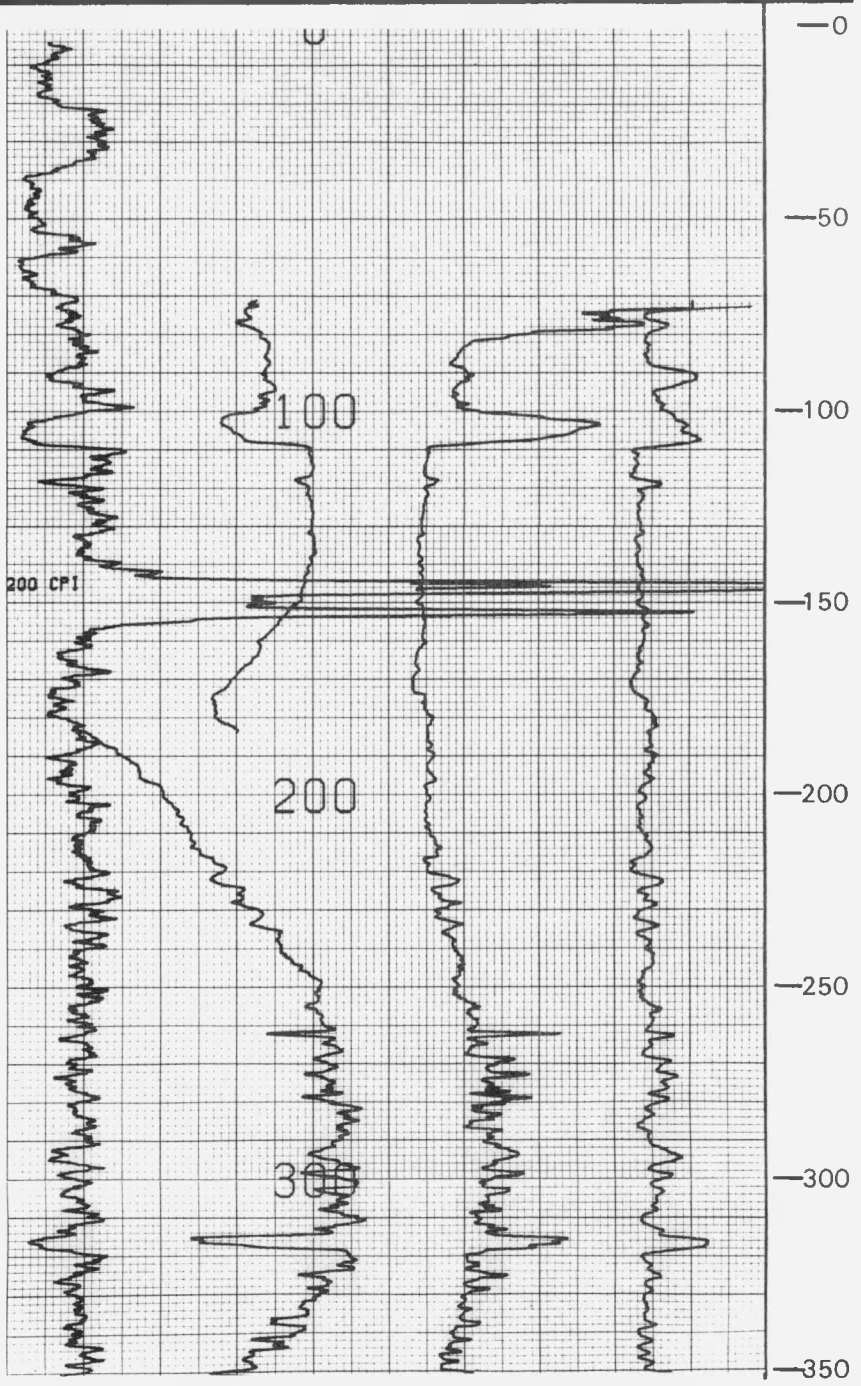
Location: State Utah County Emery T. 18 S., R. 10 E., Sec. 02

Elev: 5990 Drilled depth: 520 ft Logged depth: 518 ft Fluid: Sta-Foam 202

K-Factor: Gamma _____ Neutron 5.44×10^{-6}

Deadtime: Gamma _____ Neutron ≥ 1 μsec.

Remarks: Gamma, self-potential, resistivity and neutron logs.



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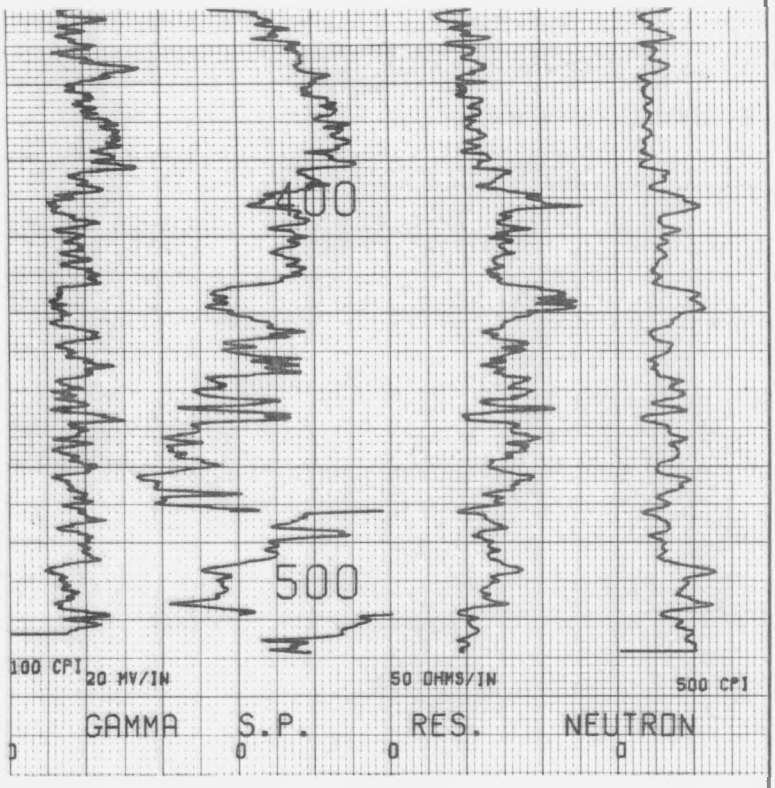


Depth in feet

350
400
450
500
550
600
650
700
750

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-8 Date: June 23, 1979

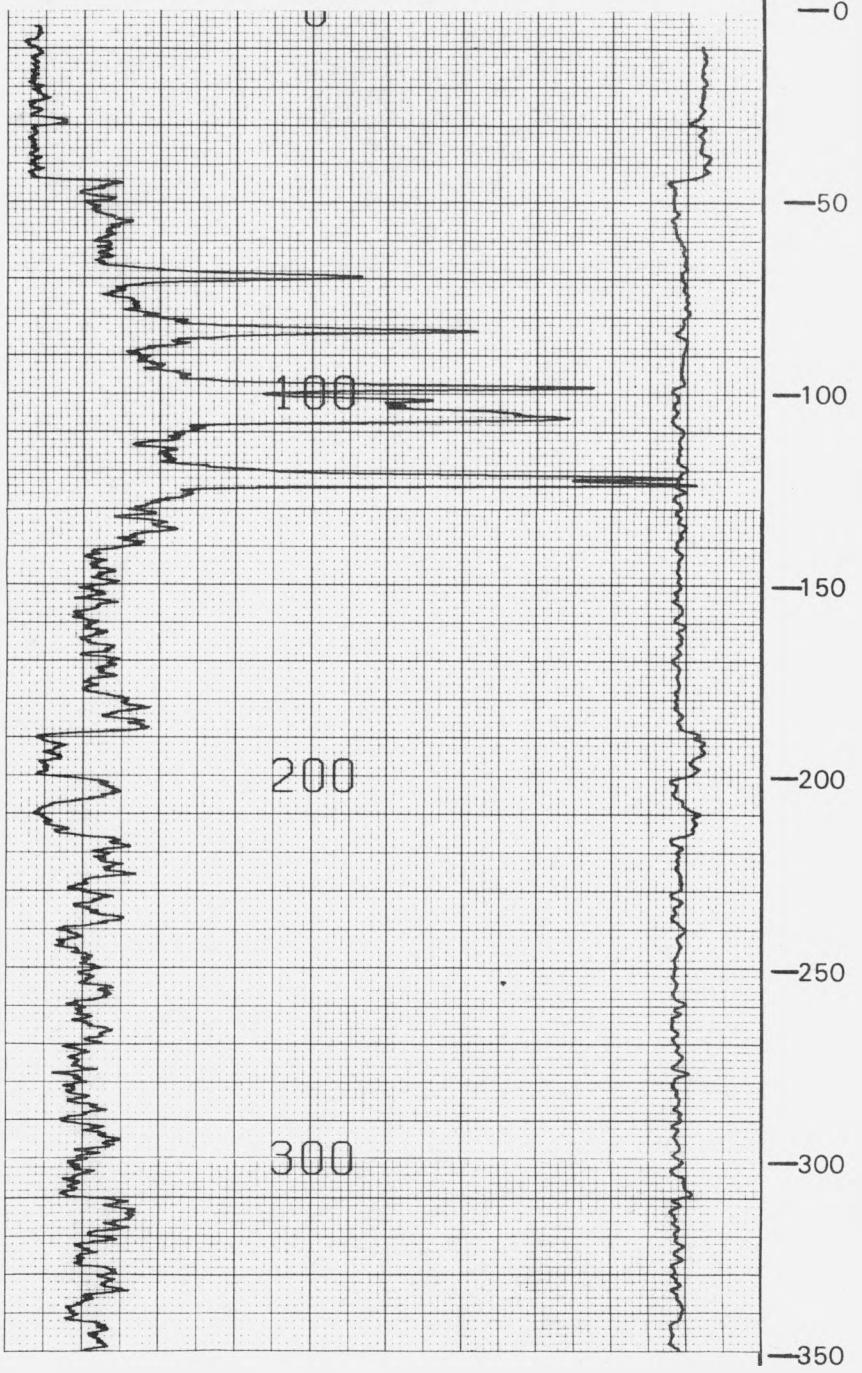
Location: State Utah County Emery T. 18 S., R. 10 E., Sec. 12

Elev: 6360 Drilled depth: 618 ft Logged depth: 612 ft Fluid: Sta-Foam 202

K-Factor: Gamma 5.44×10^{-6} Neutron

Deadtime: Gamma 0.94 usec. Neutron

Remarks: First run, Gamma, self-potential, resistivity, and neutron logs.



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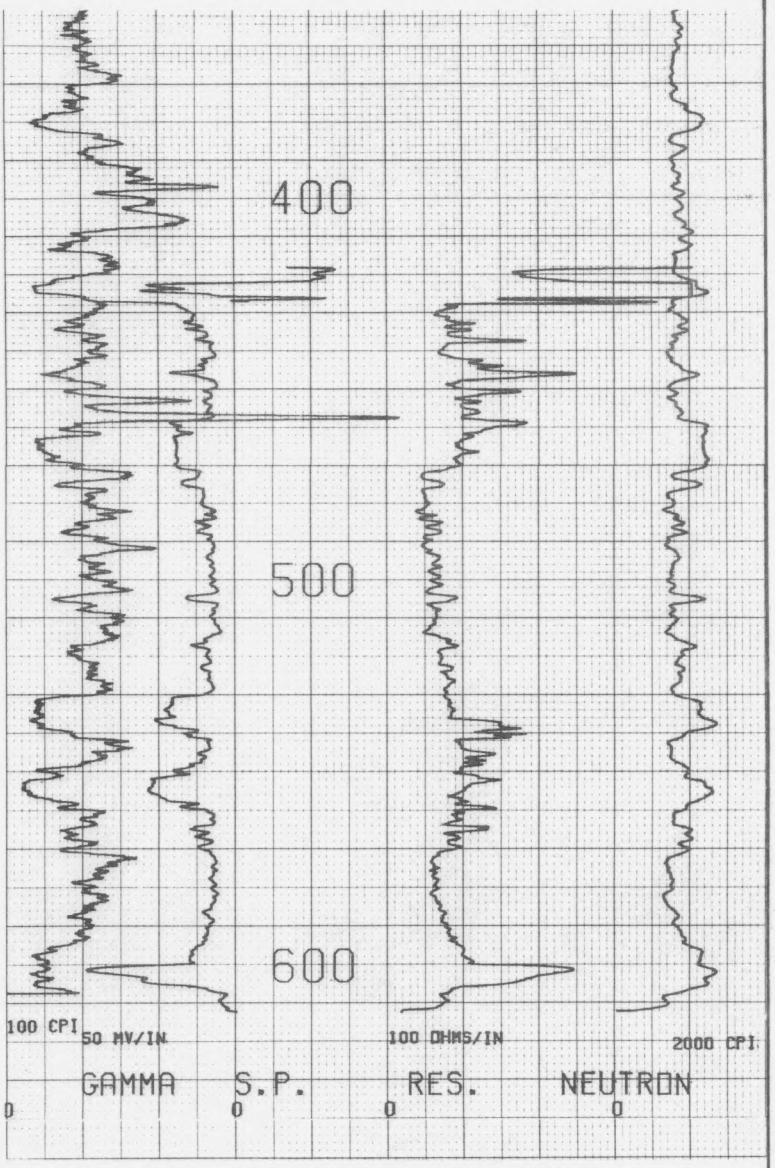


Depth in feet

350
400
450
500
550
600
650
700
750

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-8 Date: June 25, 1979

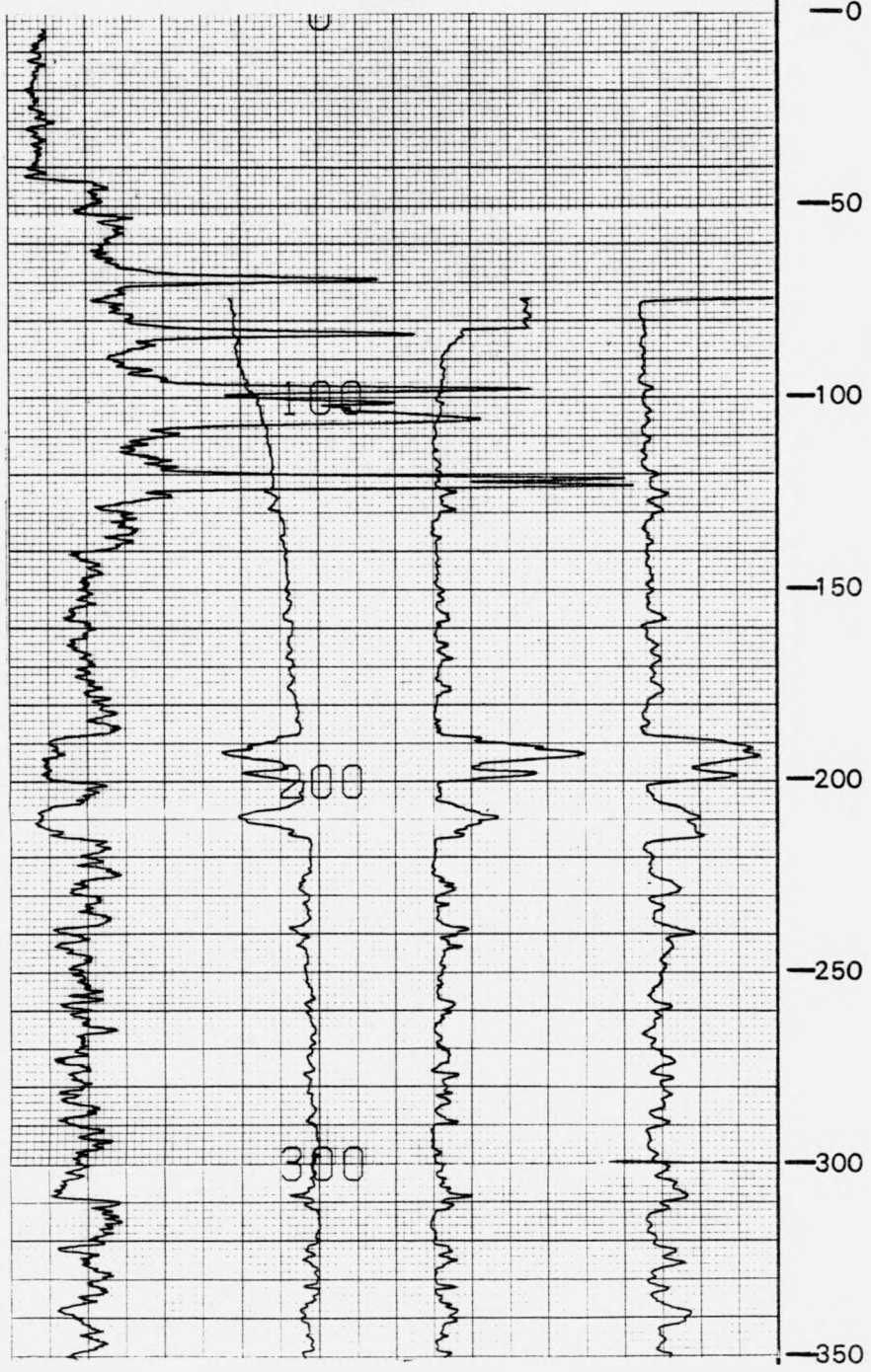
Location: State Utah County Emery T. 18 S., R. 10 E., Sec. 12

Elev: 6360 Drilled depth: 618 ft Logged depth: 584 ft Fluid: Sta-Foam 202

K-Factor: Gamma 5.44×10^{-6} Neutron

Deadtime: Gamma 0.94 μsec. Neutron

Remarks: Second run. Gamma, self-potential, resistivity, and neutron logs.



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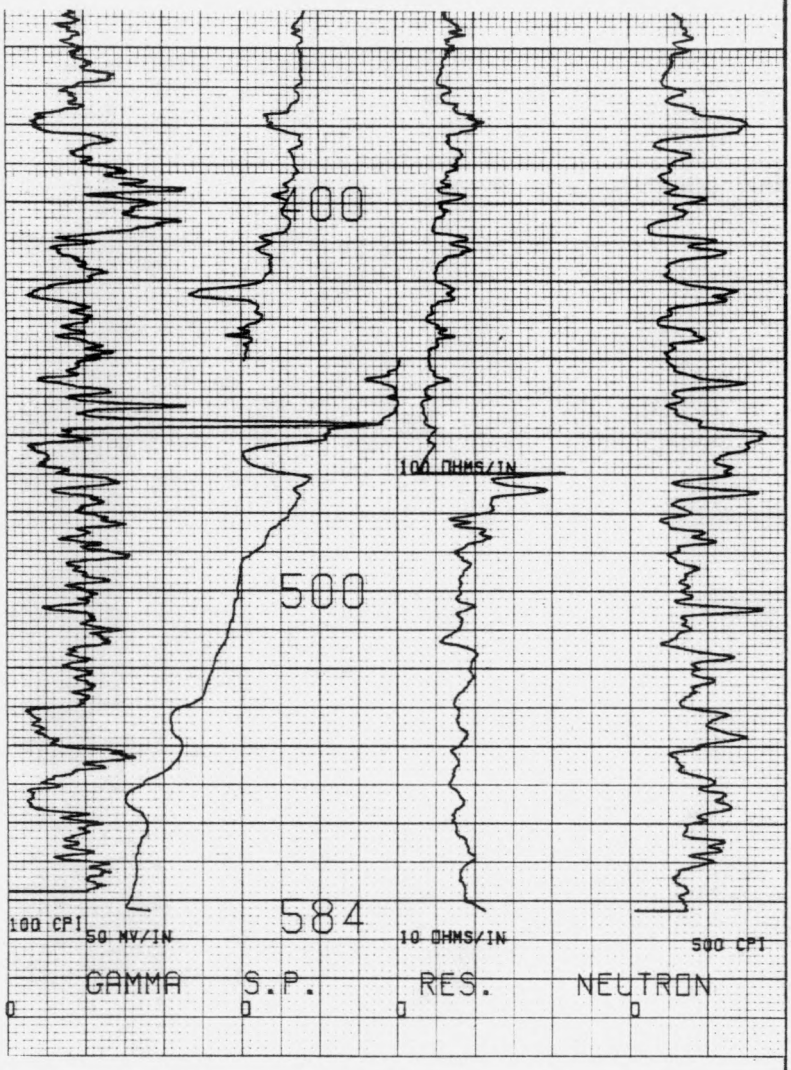


Depth in feet

350
400
450
500
550
600
650
700
750

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-9 Date: June 28, 1979

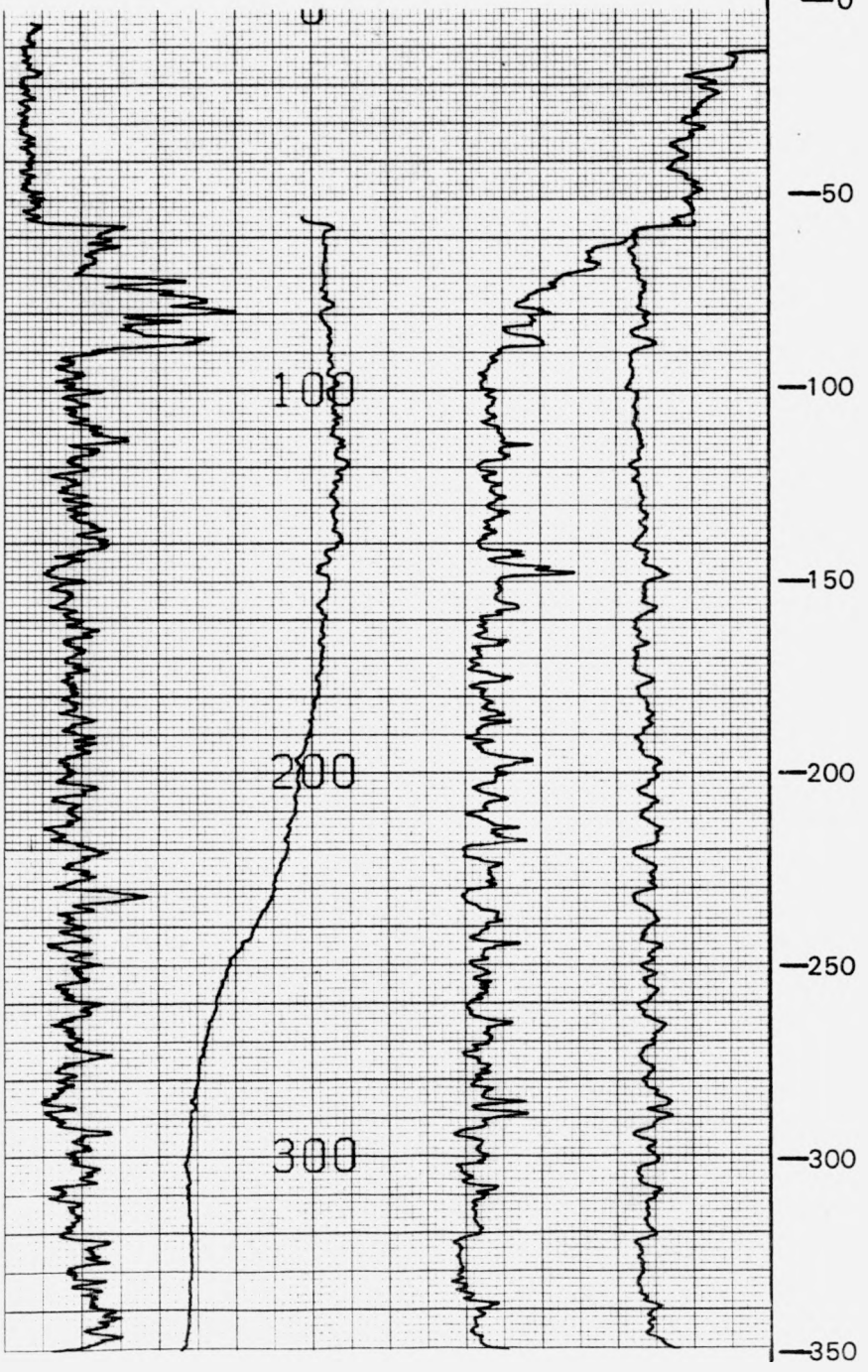
Location: State Utah County Emery T. 18 S., R. 11 E., Sec. 17

Elev: 6750 Drilled depth: 530 ft Logged depth: 478 ft Fluid: Water and foam.

K-Factor: Gamma 5.44×10^{-6} Neutron 5.44×10^{-6}

Deadtime: Gamma 0.94 usec. Neutron 0.91 usec.

Remarks: Gamma, self-potential, resistivity and neutron logs.



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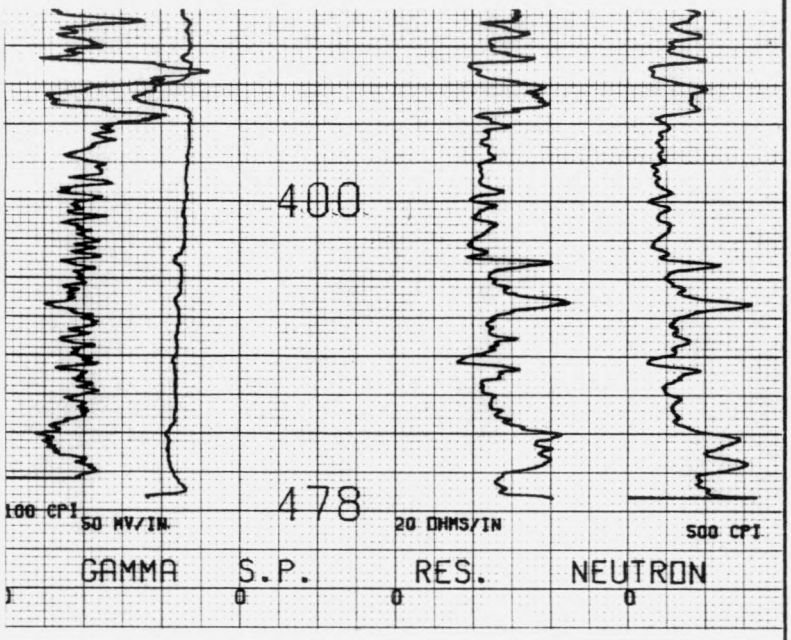


Depth in feet

350
400
450
500
550
600
650
700
750

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-10 Date: July 18, 1979

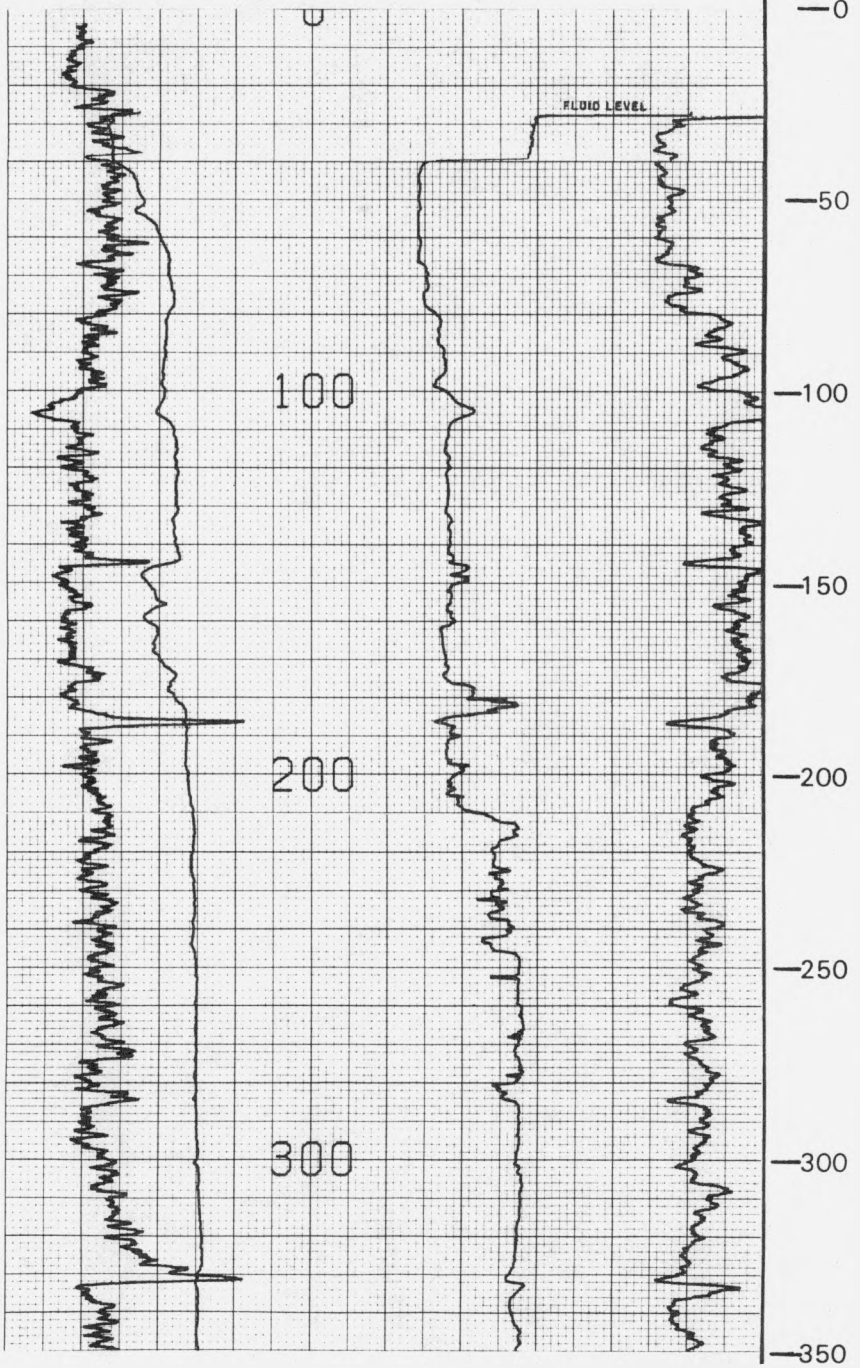
Location: State Utah County Emery T. 19 S., R. 08 E., Sec. 34

Elev: not given Drilled depth: 920 ft Logged depth: 885 ft Fluid: Gel, caustic soda and water.

K-Factor: Gamma 5.59×10^{-6} Neutron

Deadtime: Gamma 1.01 μsec Neutron 0.99 μsec

Remarks: Gamma, self-potential, resistivity and neutron logs.



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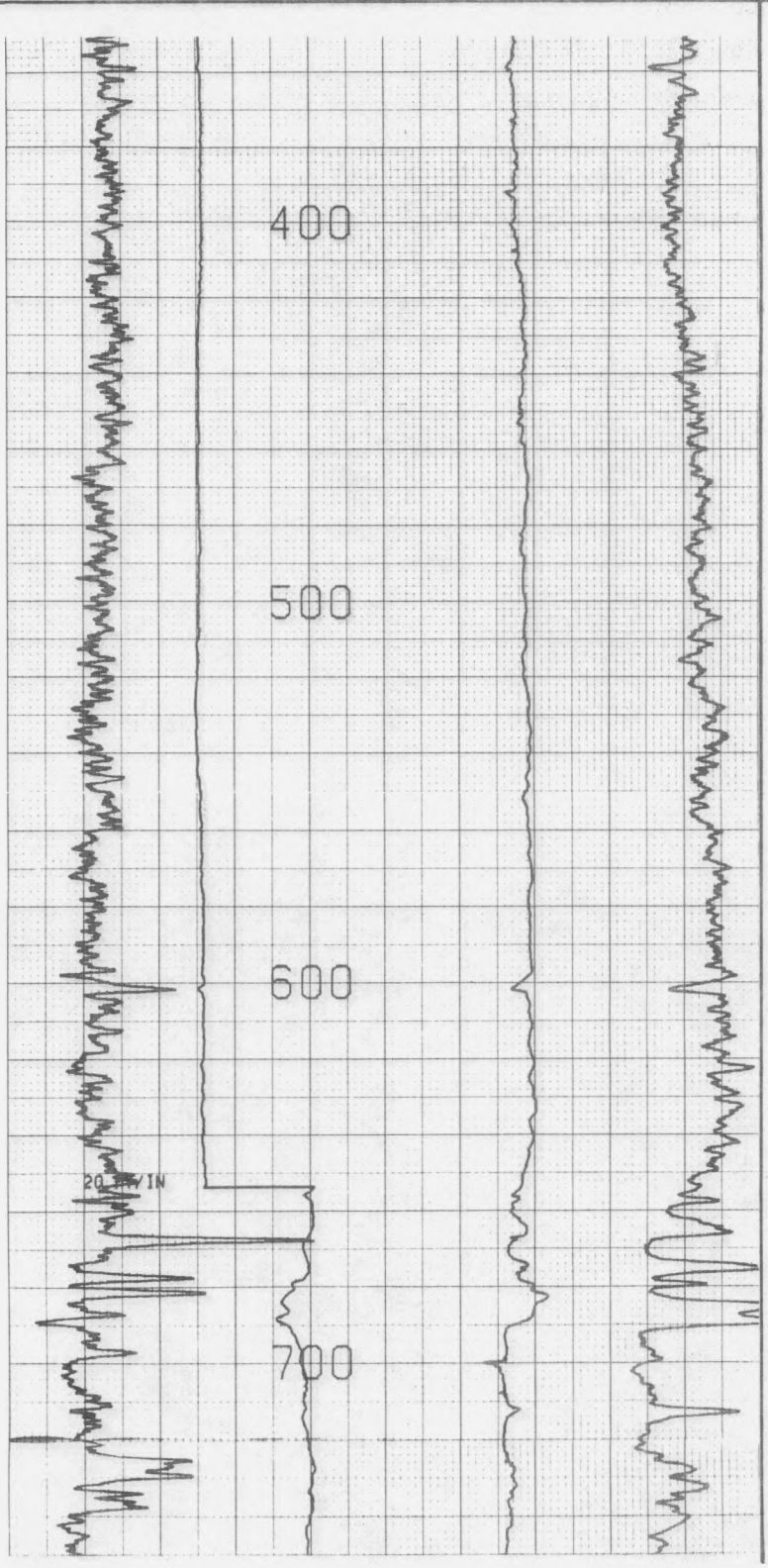

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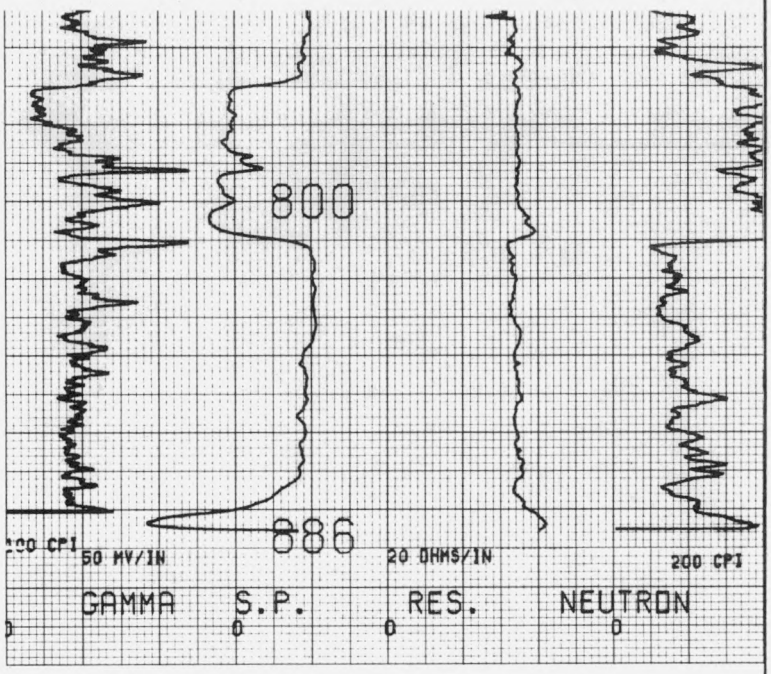


Depth in feet

750
800
850
900
950
1,000
1,050
1,100
1,150

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-11 Date: June 29, 1979

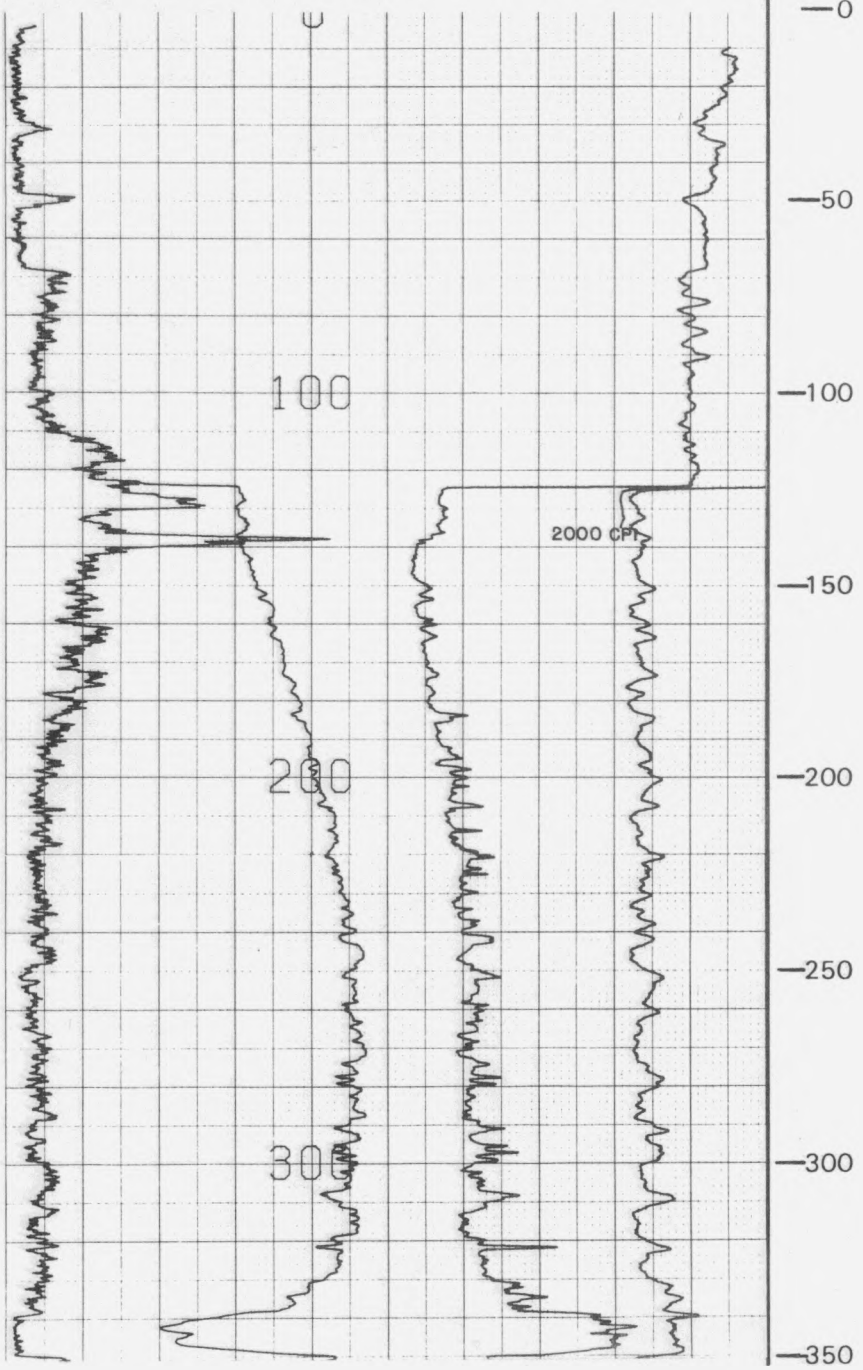
Location: State Utah County Emery T. 18 S., R. 11 E., Sec. 27

Elev: 7090 Drilled depth: 433 ft Logged depth: 430 ft Fluid: Water and foam.

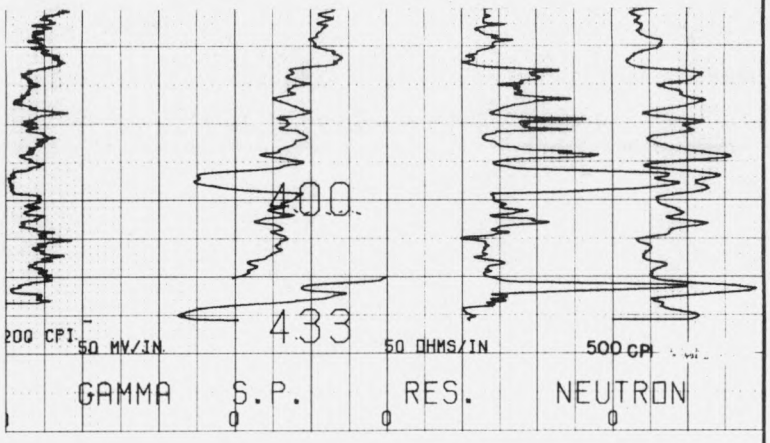
K-Factor: Gamma 5.44×10^{-6} Neutron 5.44×10^{-6}

Deadtime: Gamma 0.94 μsec. Neutron 0.91 μsec.

Remarks: Gamma, self-potential, resistivity and neutron logs.



Hole No. BB-11 (Continued)



Depth in feet

350
400
450
500
550
600
650
700
750

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-12 Date: June 30, 1979

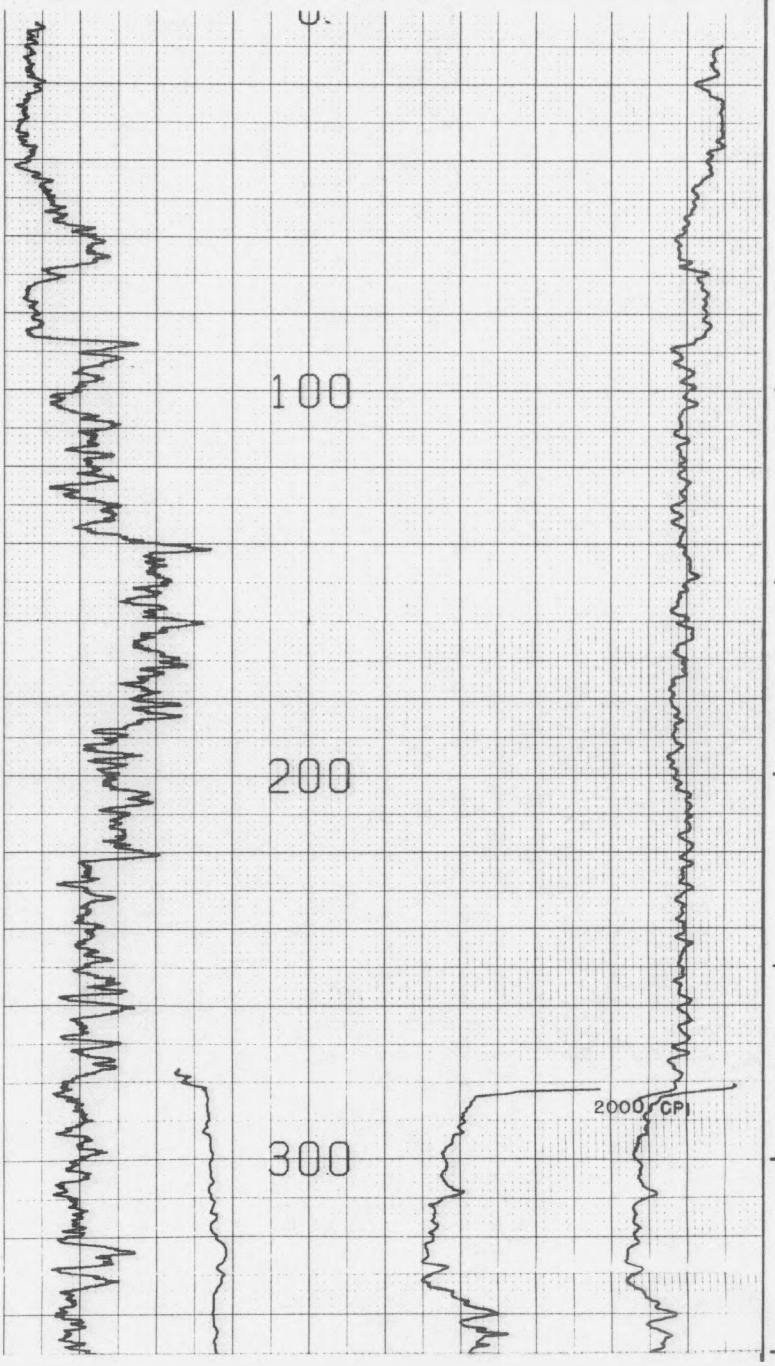
Location: State Utah County Emery T. 18 S., R. 11 E., Sec. 35

Elev: 7205 Drilled depth: 410 ft Logged depth: 406 ft Fluid: Water and foam.

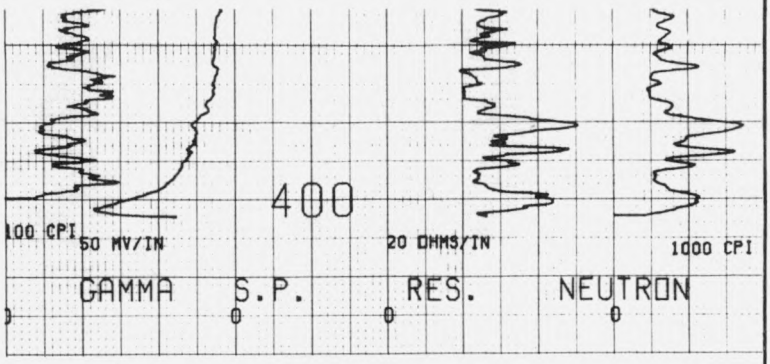
K-Factor: Gamma 5.44×10^{-6} Neutron 5.44×10^{-6}

Deadtime: Gamma 0.94 μsec. Neutron 0.91 μsec.

Remarks: Gamma, self-potential, resistivity and neutron logs.



Hole No. BB-12 (Continued)



Depth in feet

350
400
450
500
550
600
650
700
750

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-13 Date: July 28, 1979

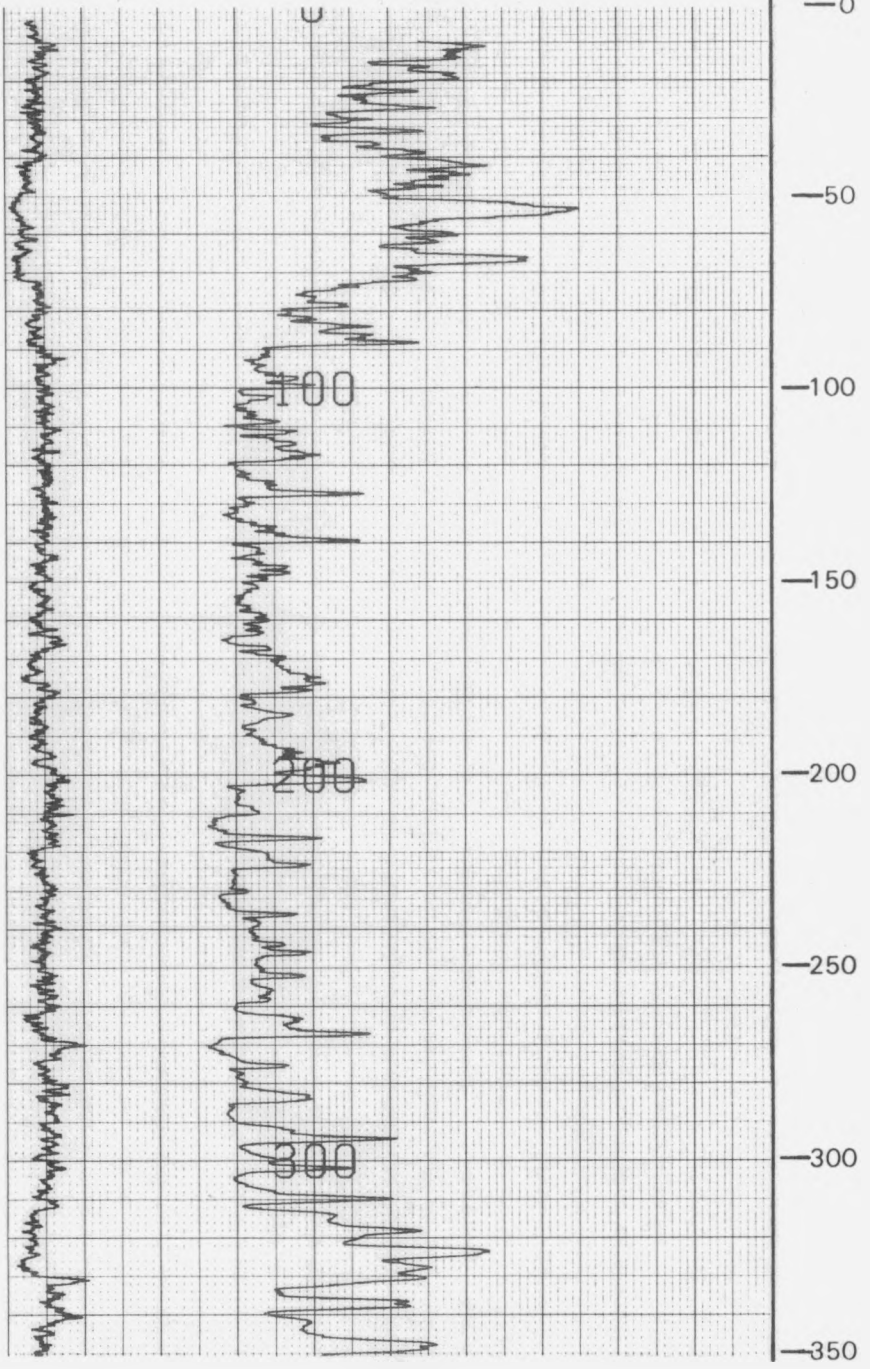
Location: State Utah County Emery T. 16 S., R. 12 E., Sec. 08

Elev: not given Drilled depth: 860 ft Logged depth: 847 ft Fluid: Foam

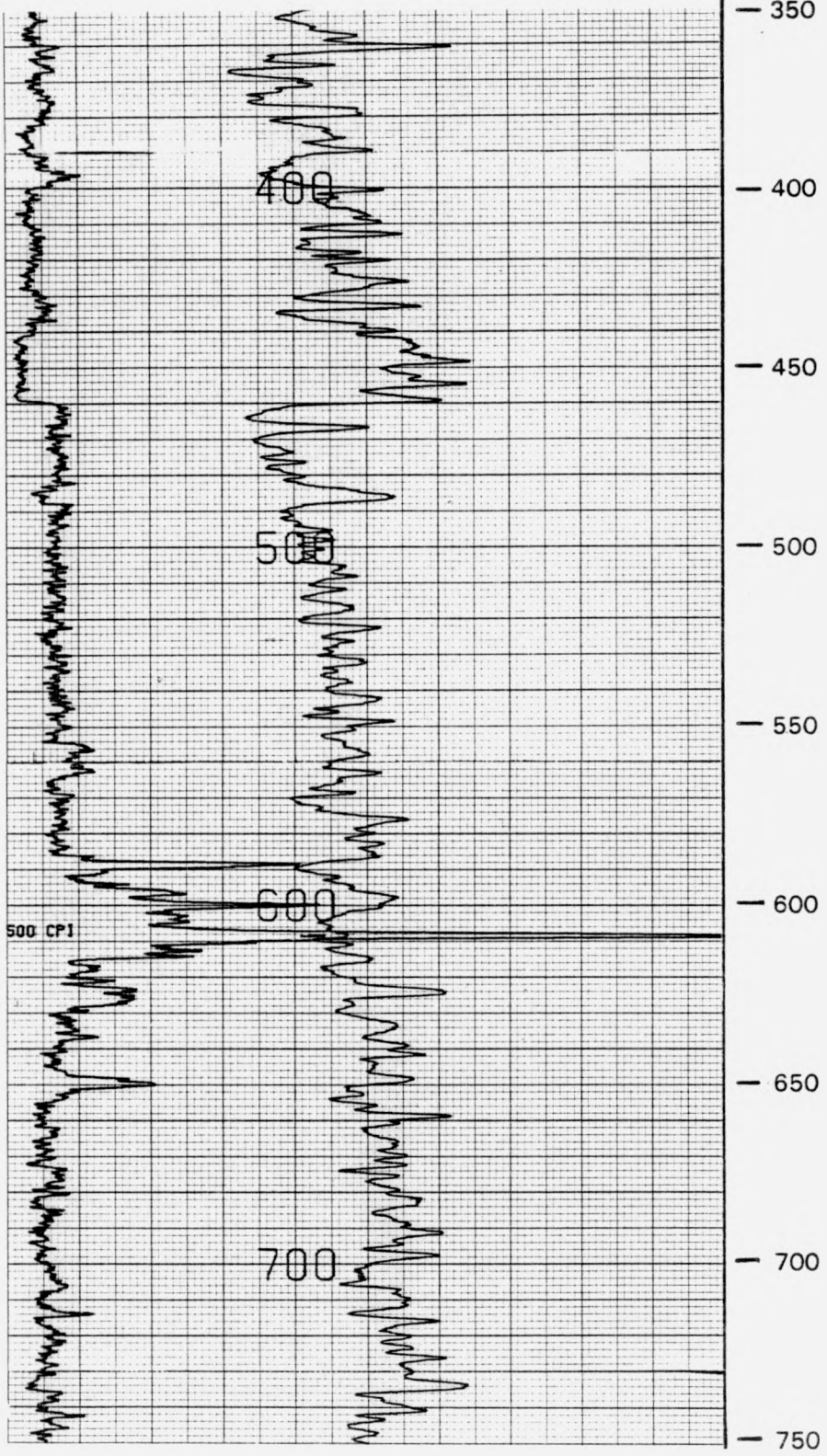
K-Factor: Gamma 5.44×10^{-6} Neutron 5.44×10^{-6}

Deadtime: Gamma 0.94 μsec. Neutron 0.91 μsec.

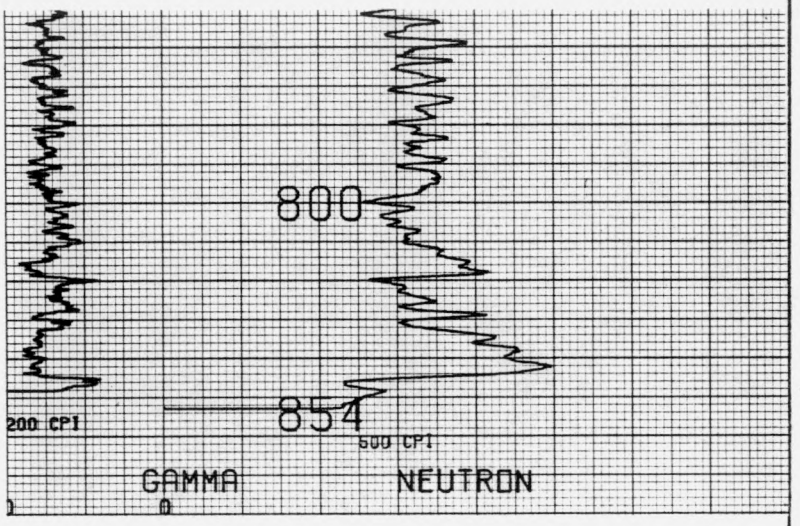
Remarks: Gamma and neutron logs.



Hole No. BB-13 (Continued)



Hole No. BB-13 (Continued)



Depth in feet

750
800
850
900
950
1,000
1,050
1,100
1,150

APPENDIX B

POTASSIUM/URANIUM/THORIUM (KUT) LOGS

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-2 Date: July 11, 1979

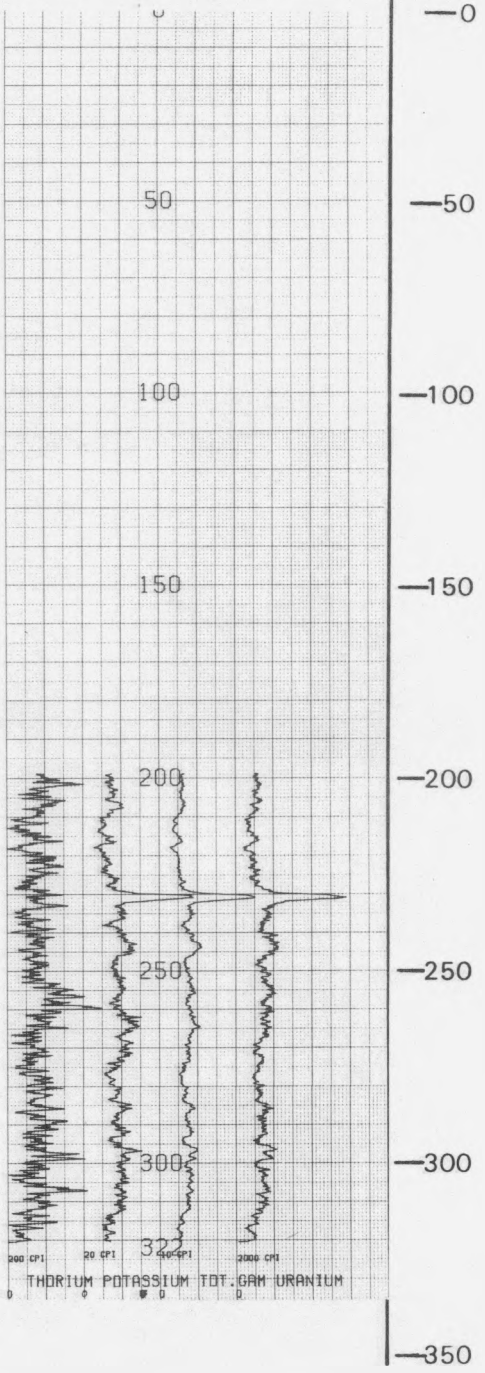
Location: State Utah County Emery T. 17 S., R. 11 E., Sec. 29

Elev: 5760 Drilled depth: 702 ft Logged depth: 682 ft Fluid: Water and foam.

K-Factor: Gamma _____ Neutron _____

Deadtime: Gamma _____ Neutron _____

Remarks: KUT log.



Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-7 Date: June 21, 1979

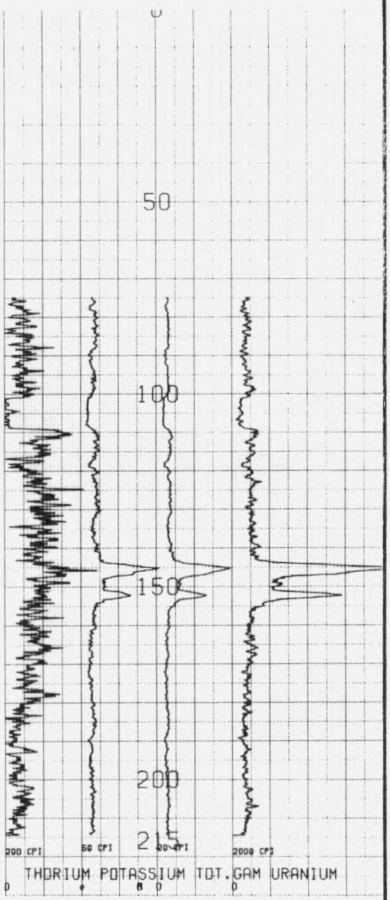
Location: State Utah County Emery T. 18 S., R. 10 E., Sec. 02

Elev: 5990 Drilled depth: 520 ft Logged depth: 518 ft Fluid: Foam

K-Factor: Gamma _____ Neutron _____

Deadtime: Gamma _____ Neutron _____

Remarks: KUT log.



Depth in feet

0
50
100
150
200
250
300
350

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-8 Date: June 23, 1979

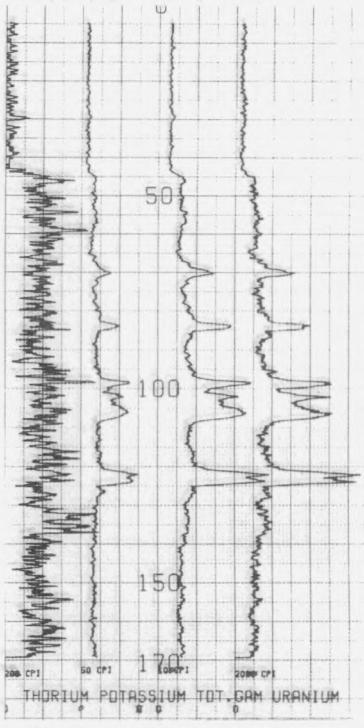
Location: State Utah County Emery T. 18 S., R. 10 E., Sec. 12

Elev: 6360 Drilled depth: 618 ft Logged depth: 612 ft Fluid: Foam

K-Factor: Gamma _____ Neutron _____

Deadtime: Gamma _____ Neutron _____

Remarks: KUT log.



Depth in feet

0
50
100
150
200
250
300
350

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-9 Date: June 28, 1979

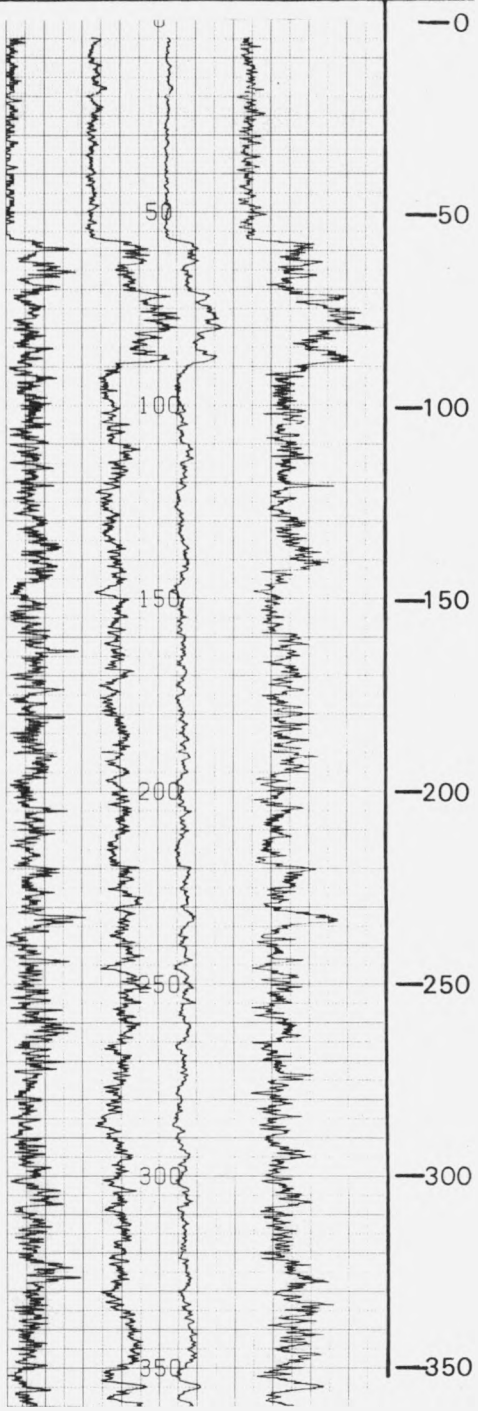
Location: State Utah County Emery T. 18 S., R. 11 E., Sec. 17

Elev: 6750 Drilled depth: 530 ft Logged depth: 478 ft Fluid: Water and foam

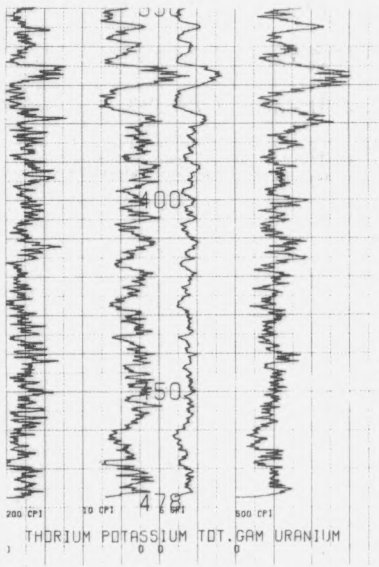
K-Factor: Gamma _____ Neutron _____

Deadtime: Gamma _____ Neutron _____

Remarks: KUT log.



Hole No. BB-9 (Continued)



Depth in feet

— 350
— 400
— 450
— 500
— 550
— 600
— 650
— 700
— 750

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-11 Date: June 29, 1979

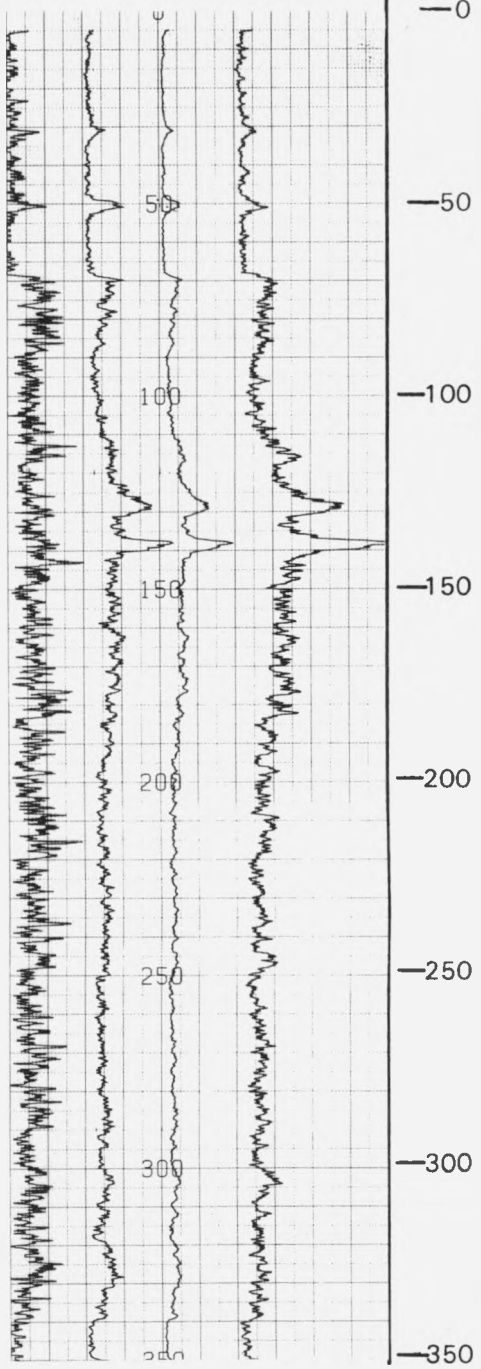
Location: State Utah County Emery T. 18 S., R. 11 E., Sec. 27

Elev: 7090 Drilled depth: 430 ft Logged depth: 429 ft Fluid: Water and foam.

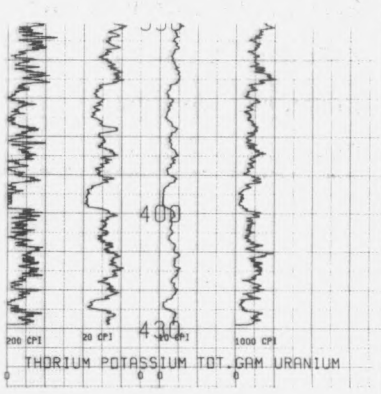
K-Factor: Gamma _____ Neutron _____

Deadtime: Gamma _____ Neutron _____

Remarks: KUT log.



Hole No. BB-11 (Continued)



Depth in feet

350
400
450
500
550
600
650
700
750

Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-12 Date: June 30, 1979

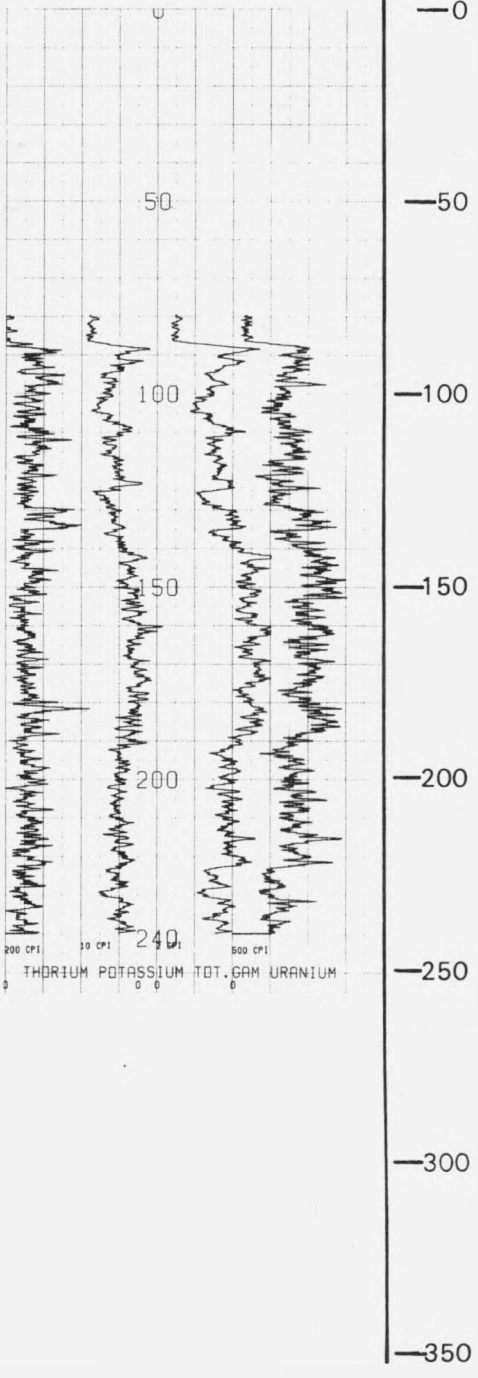
Location: State Utah County Emery T. 18 S., R. 11 E., Sec. 35

Elev: 7205 Drilled depth: 410 ft Logged depth: 406 ft Fluid: Water and foam.

K-Factor: Gamma _____ Neutron _____

Deadtime: Gamma _____ Neutron _____

Remarks: KUT log.



Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-13 Date: July 28, 1979

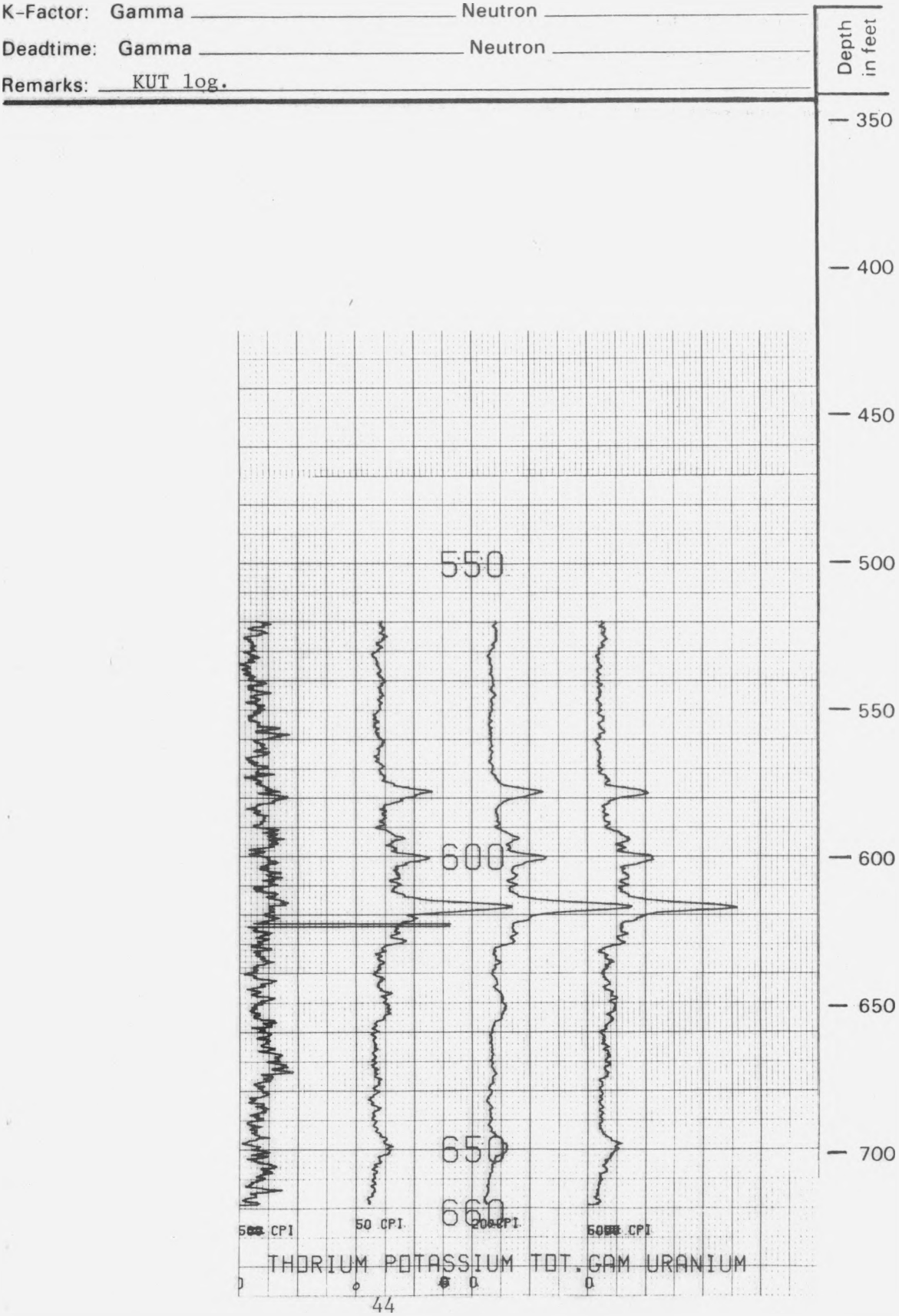
Location: State Utah County Emery T. 16 S., R. 12 E., Sec. 08

Elev: not given Drilled depth: 860 ft Logged depth: 847 ft Fluid: Foam

K-Factor: Gamma _____ Neutron _____

Deadtime: Gamma _____ Neutron _____

Remarks: KUT log.



Bendix Field Engineering Corporation
Grand Junction Operations

Hole No.: BB-14 Date: July 25, 1979

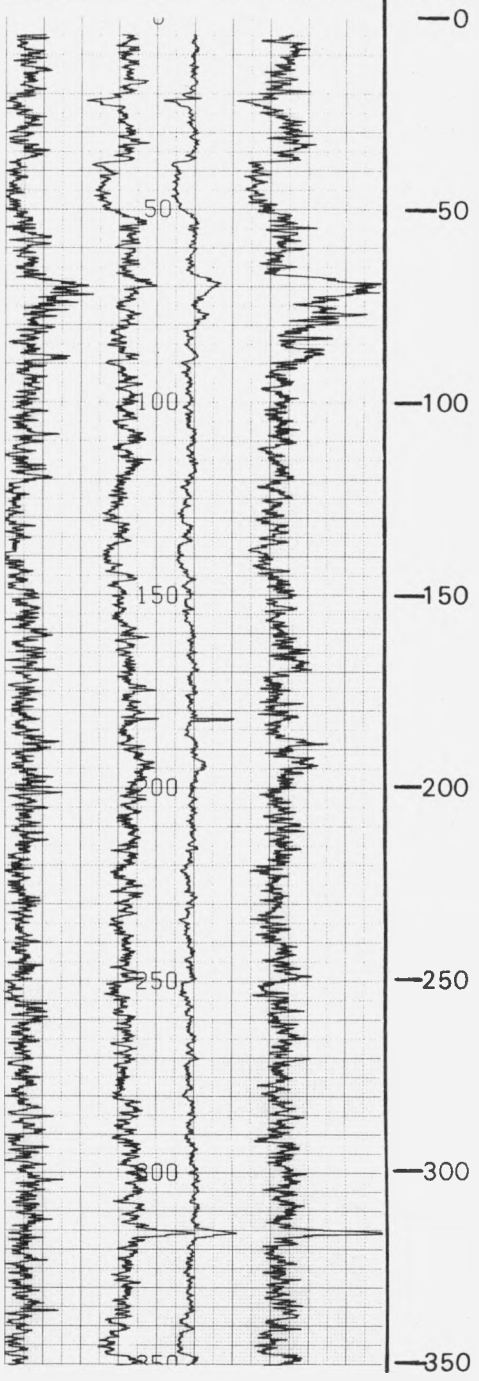
Location: State Utah County Emery T. 18 S., R. 09 E., Sec. 18

Elev: not given Drilled depth: 600 ft Logged depth: 545 ft Fluid: Water and foam.

K-Factor: Gamma _____ Neutron _____

Deadtime: Gamma _____ Neutron _____

Remarks: KUT log.



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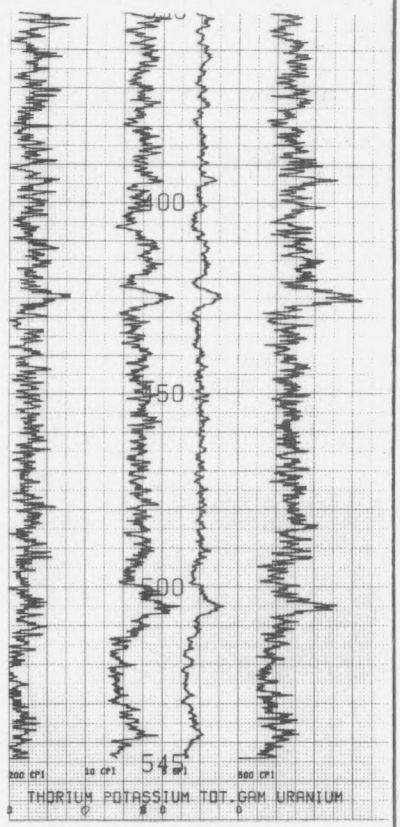

Depth in feet

350
400
450
500
550
600
650
700
750

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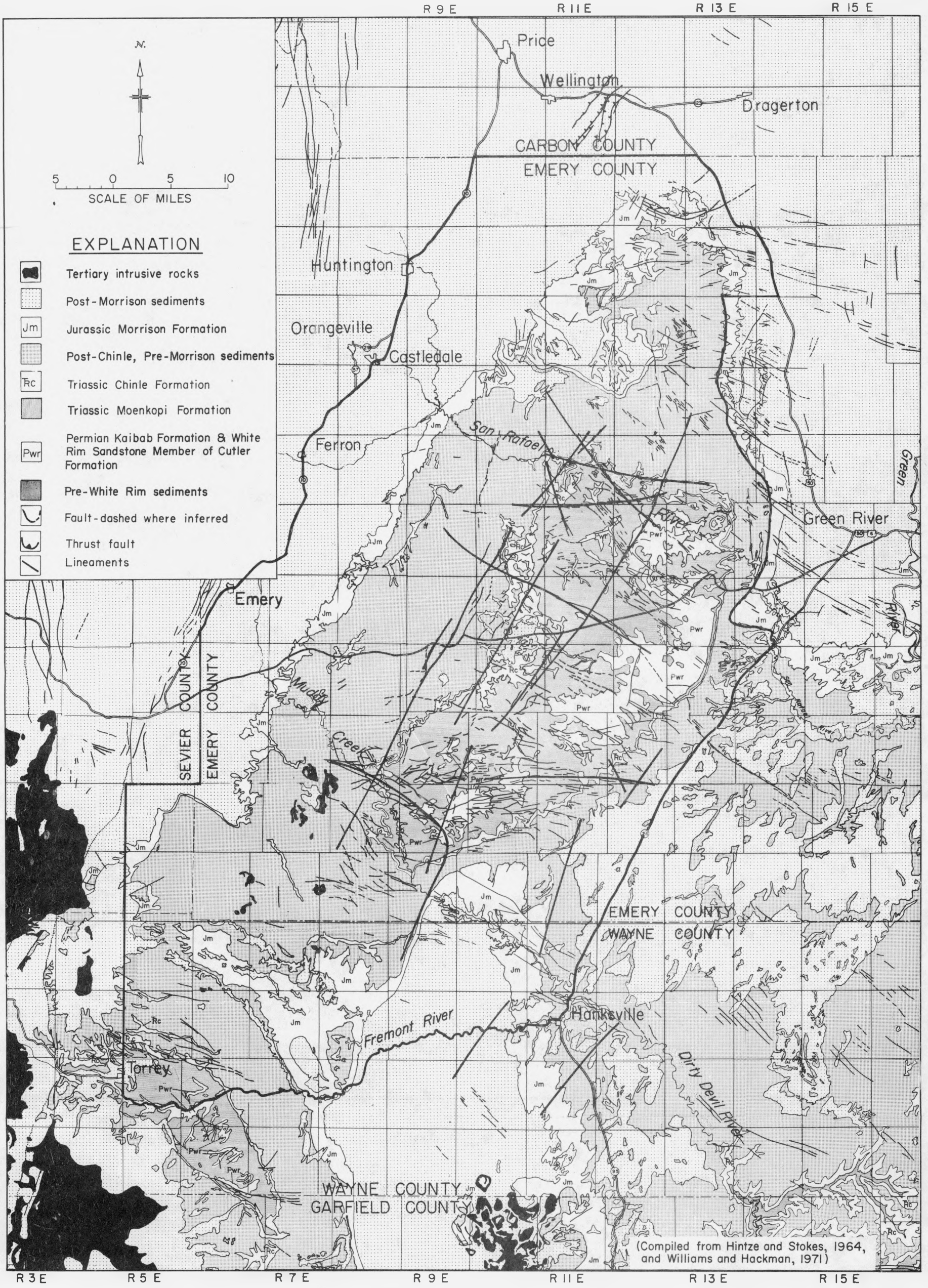

PLATE 1. GENERALIZED GEOLOGIC MAP, SAN RAFAEL SWELL AREA, UTAH.