BIRDWELL

Gamma Ray-Neutron

COMPANY MICHIGAN GEOLOGICAL SURVEY

WELL DRILL HOLE NO. 4

FIELD MIDDLE PRECAMBRIAN TEST

COUNTY MARQUETTE STATE MICHIGAN

LOCATION: NW NW NE

SEC. 2 TWP. 48N RGE. 28W

OTHER SERVICES

■ FDL
CA3

PERMANENT DATUM GROUND LEVEL , ELEV. 1470.0
LOG MEASURED FROM D.F. 1.5 Ft. Above Perm. Datum
DRILLING MEASURED FROM DERRICK FLOOR

ELEV. K.B. NA
D.F. 1471.5
G.L. 1470.0

DATE	5-9-78			
RUN NO.	ONE			
TYPE LOG	GR-NL			
DEPTH – DRILLER	3176			
DEPTH – LOGGER	3174			
BTM. LOG. INTER.	3173			
TOP LOG. INTER.	50			
TYPE FLUID IN HOLE	WATER			
SALINITY PPM CL	NA			
DENSITY LB./GAL.	NA			
LEVEL	30'			
MAX.REC.TEMP.–°F	NA			
OPER. RIG TIME	3 HOURS			
RECORDED BY	J. MOREHEAD			
WITNESSED BY	J. VAN ALSTINE			
LOCATION	MT. PLEASANT, MI.			

RUN NO.	BORE HOLE RECORD			CASING RECORD			
	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	3-7/8"	SURF.	1470	3-5/8	NA	180	1470
1	2-63/64	1470	3176				

EQUIPMENT DATA

GAMMA RAY		NEUTRON	
RUN NO.	ONE	RUN NO.	ONE
TOOL MODEL NO.	LALA8001	LOG TYPE	N-N
TOOL SERIAL NO.	12	TOOL MODEL NO.	LALA8001
DIAMETER	1-11/16"	TOOL SERIAL NO.	12
DETECT. MODEL NO.	E-1050	DIAMETER	1-11/16"
TYPE	SCINT.	DETECT. MODEL NO.	E-1031
LENGTH	2.5"	TYPE	BE3
DIST. TO N. SOURCE	101"	LENGTH	6"
GENERAL		SOURCE MODEL NO.	LABA3001
TRUCK NO.	3086	SERIAL NO.	MRC 280
SERVICE ORDER/INV. NO.	523727	SPACING	15.4"
		TYPE	PU:BE
		STRENGTH-N/SEC	.98X10⁷

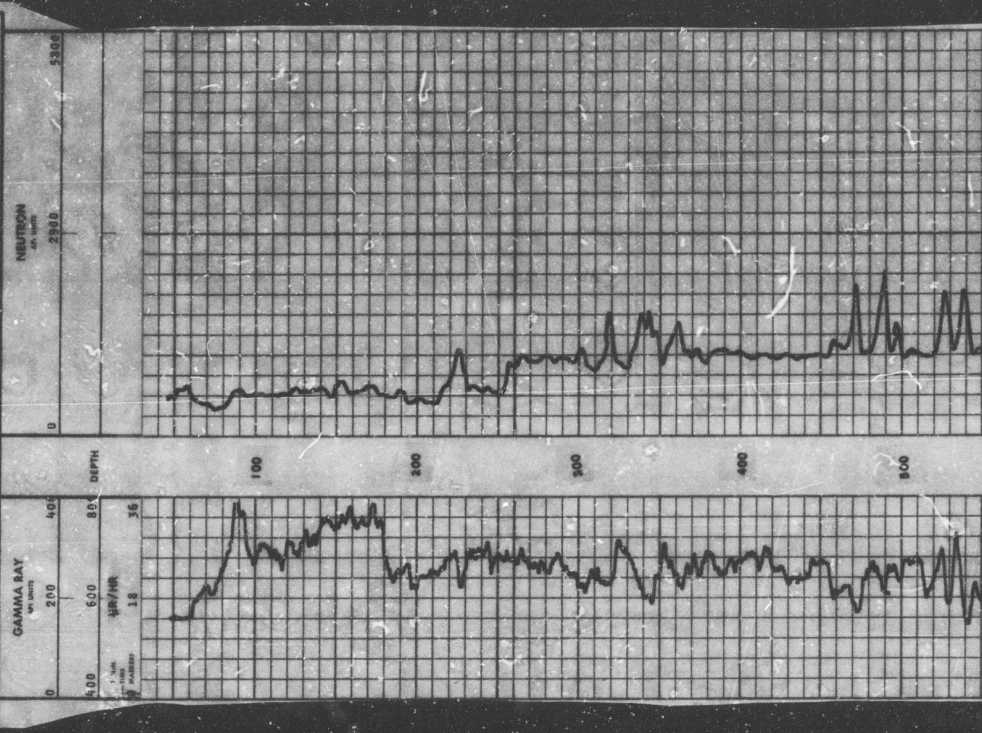
LOGGING DATA

GENERAL				GAMMA RAY				NEUTRON			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED FT/MIN	TC SEC.	CPM FULL SCALE	ZERO DIV. L. OR R.	API G.R. UNITS PER LOG DIV.	TC SEC.	CPM FULL SCALE	ZERO DIV. L. OR R.	API N. UNITS PER LOG DIV.
1	3173	50	30	2	20K	0	40	2	50K	0	290

REFERENCE LITERATURE:

REMARKS: THIS WORK WAS PERFORMED UNDER UNITED STATES NUCLEAR REGULATORY COMMISSION BY-PRODUCT MATERIAL LICENSE NO. 35-05651-01 AND SPECIAL NUCLEAR MATERIALS LICENSE NO. SNM-161

GAMMA RAY SN-12 DEAD TIME 31.154 µS
AIR X FACTOR 2.162 X 10⁵.



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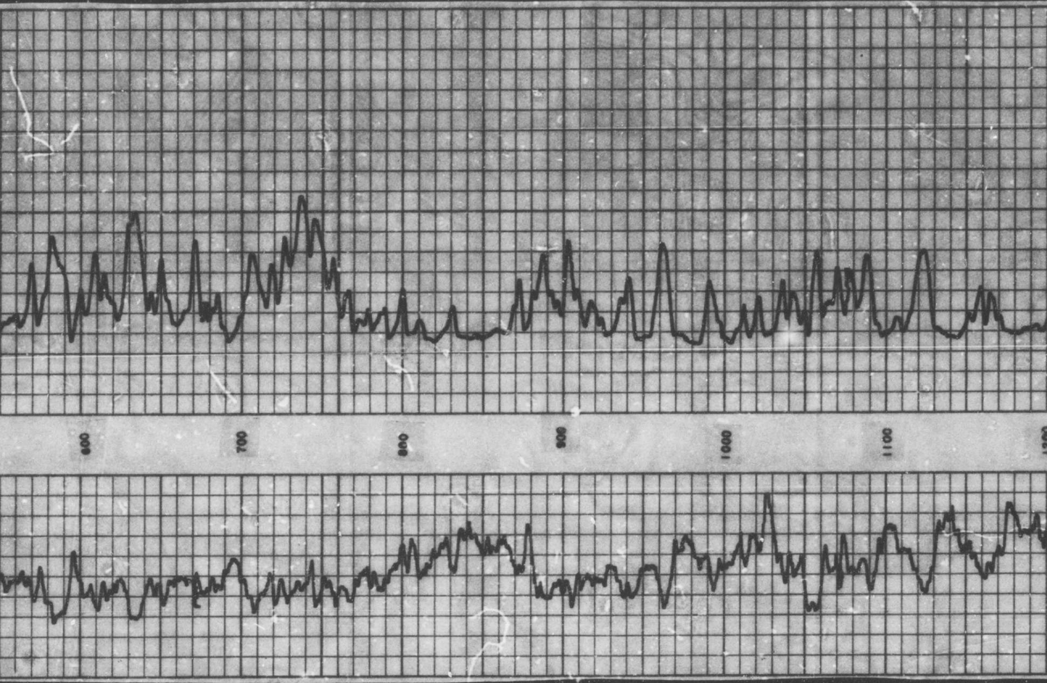

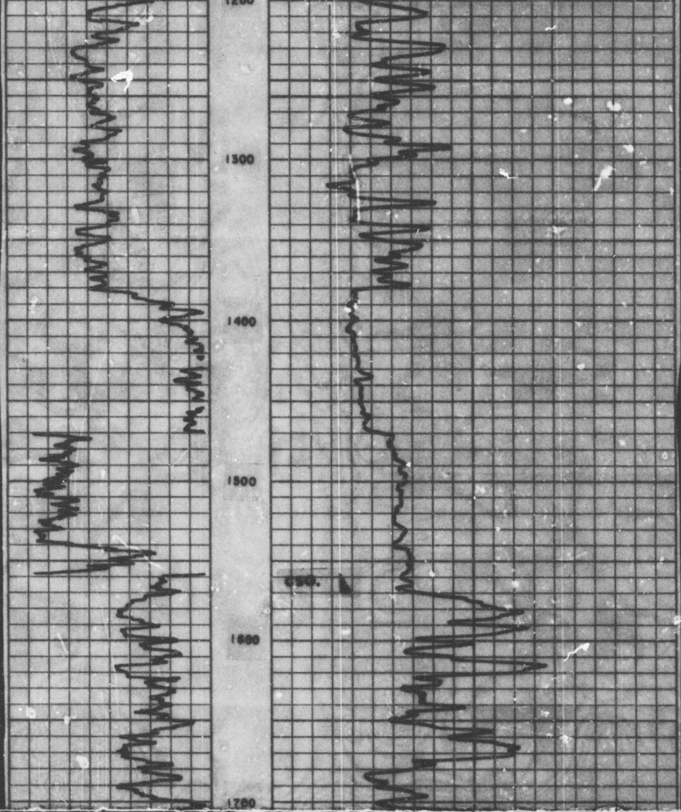

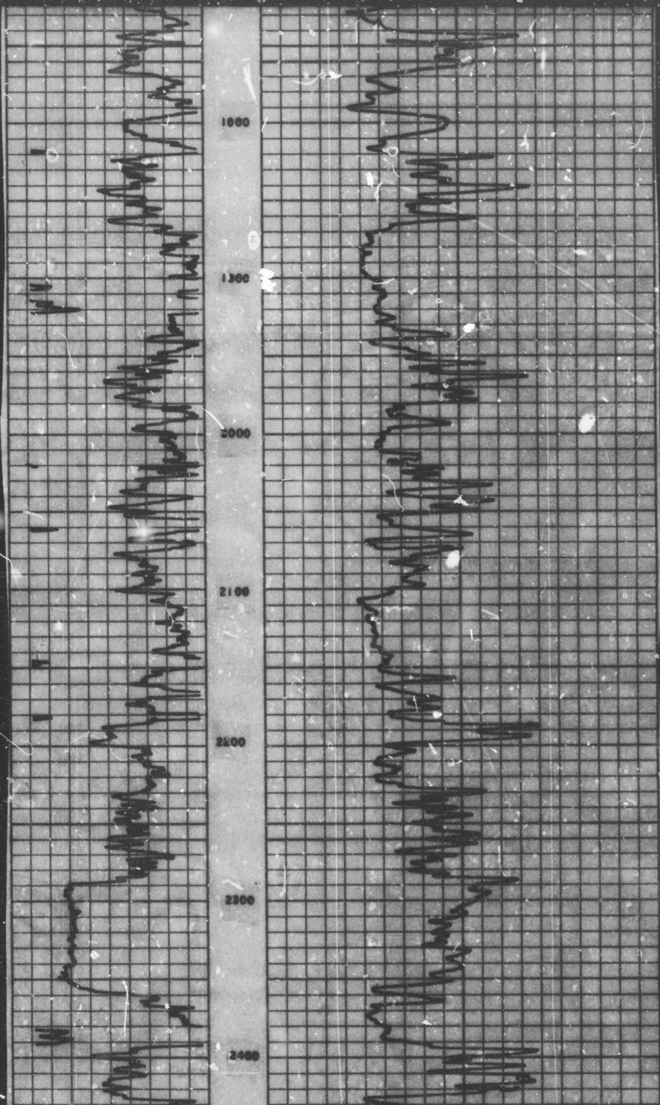
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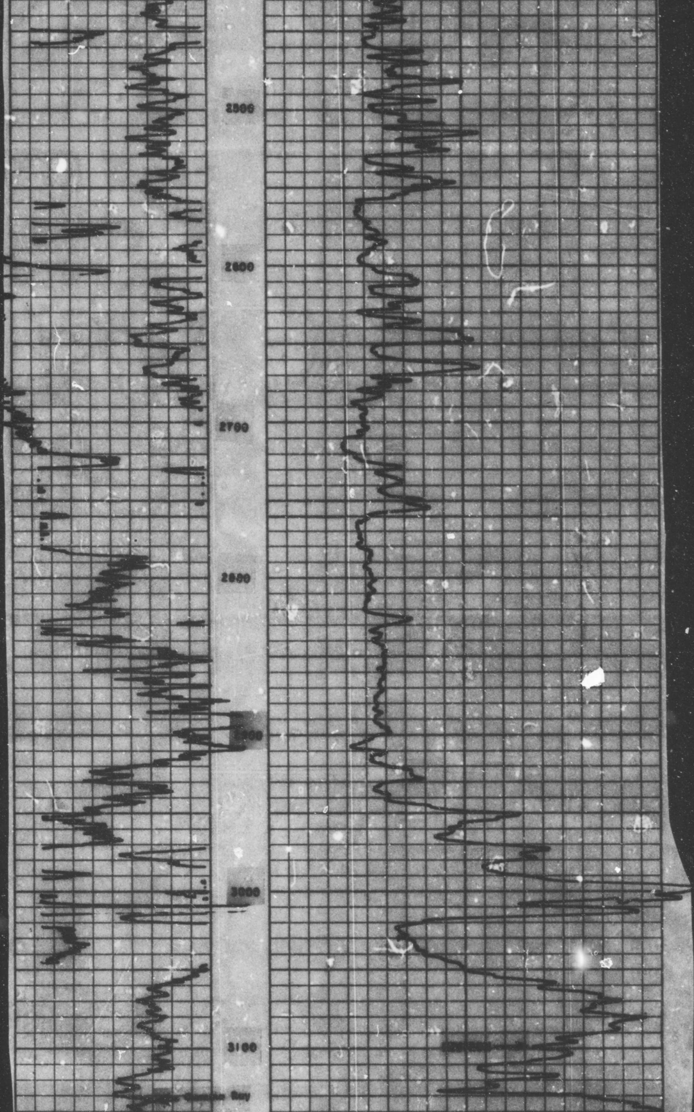
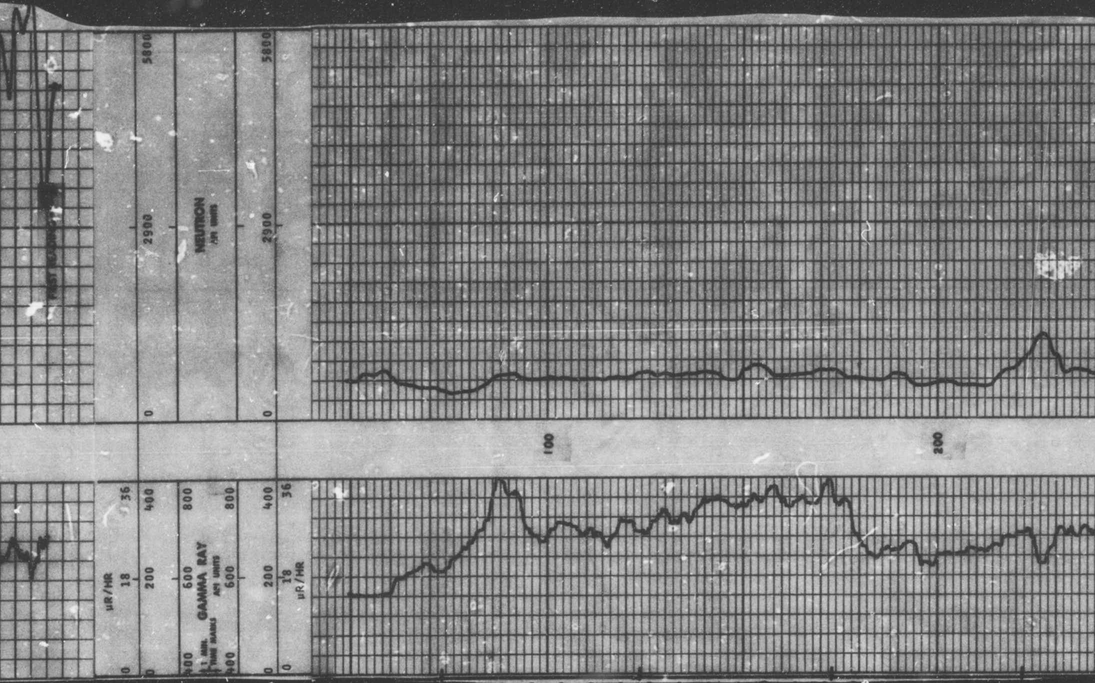
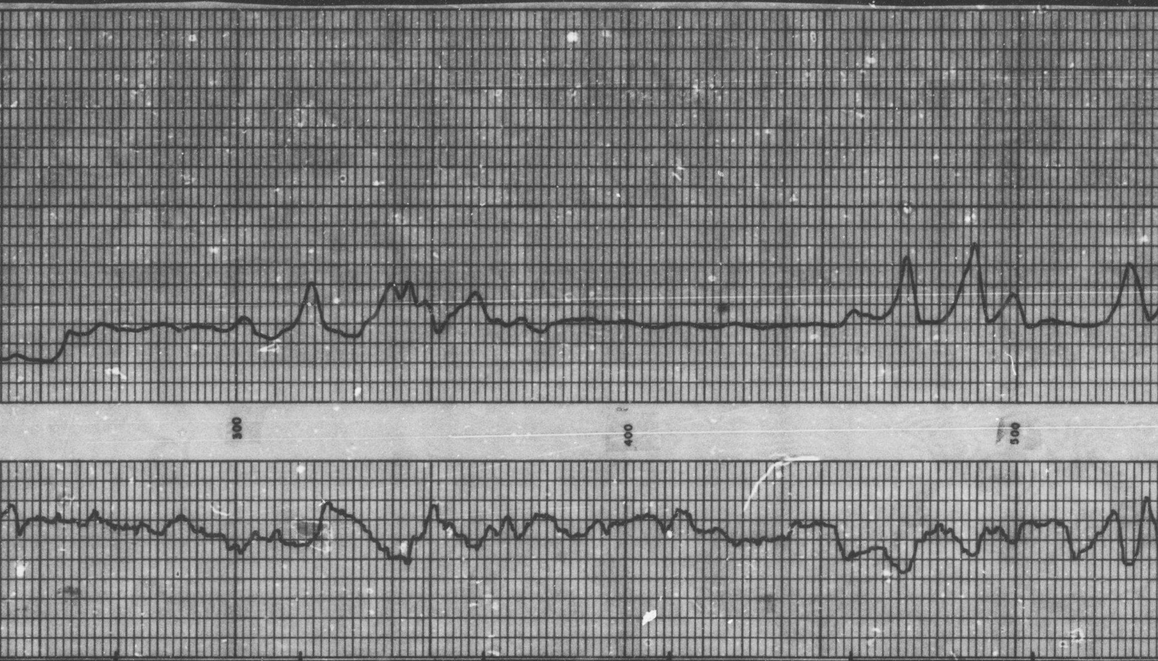
1900
2000
2100
2200
2300
2400



2500
2600
2700
2800
2900
3000
3100
Gamma Ray


FIRST READING
5800
2900
0
NEUTRON
API UNITS
5800
2900
0
100
200
µR/HR
0
18
36
0
200
400
400
600
800
GAMMA RAY
API UNITS
1 MIN.
TIME MARKS
400
600
800
0
200
400
0
18
36
µR/HR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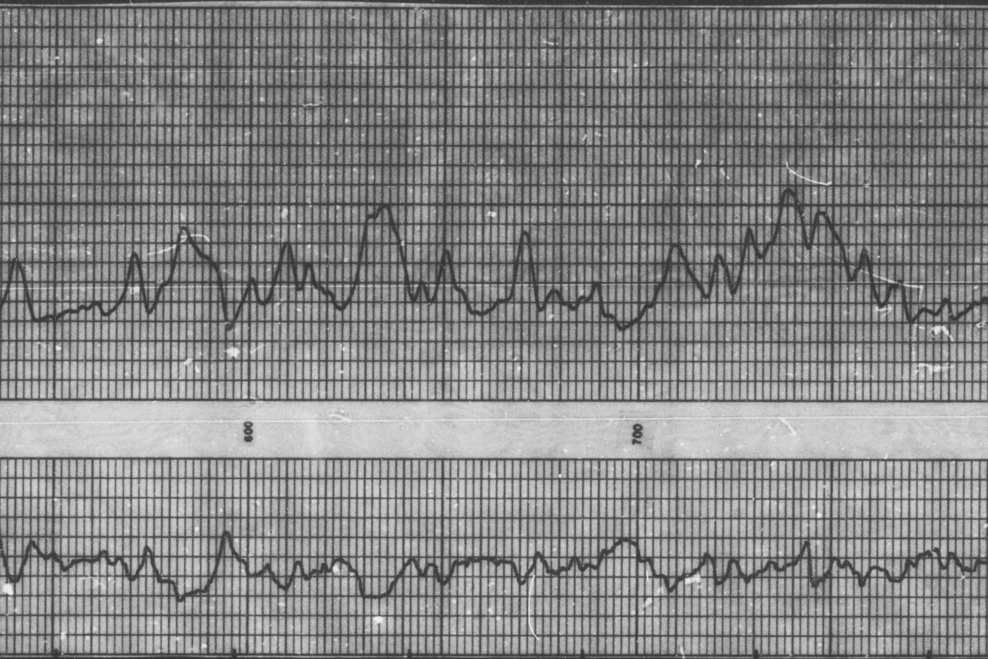
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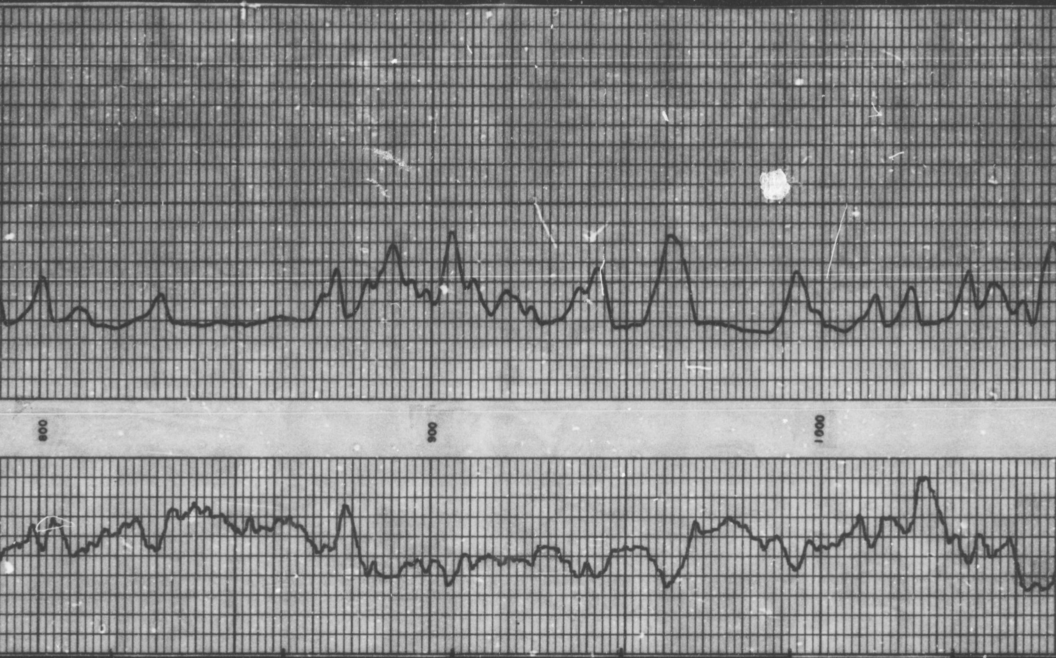
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900
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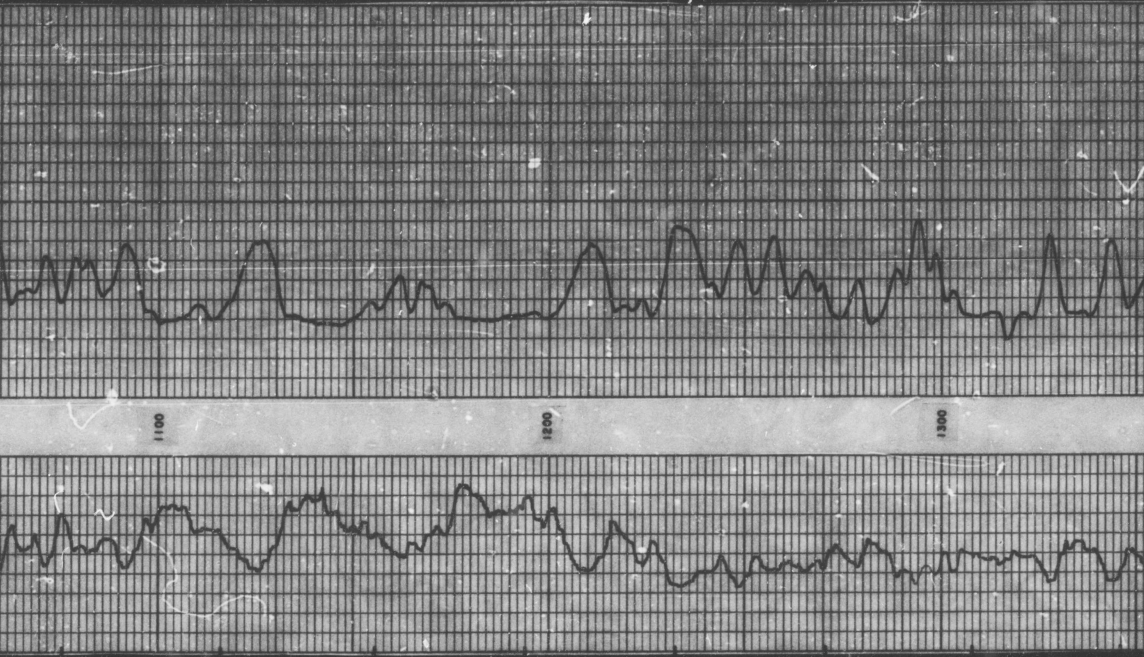
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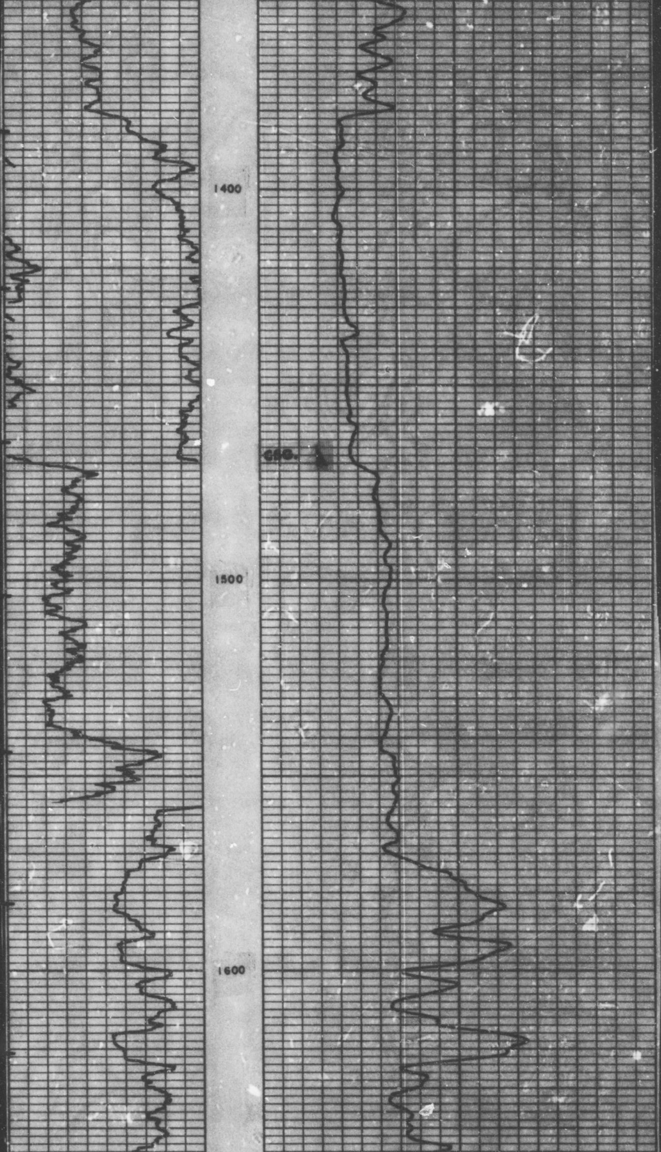
1300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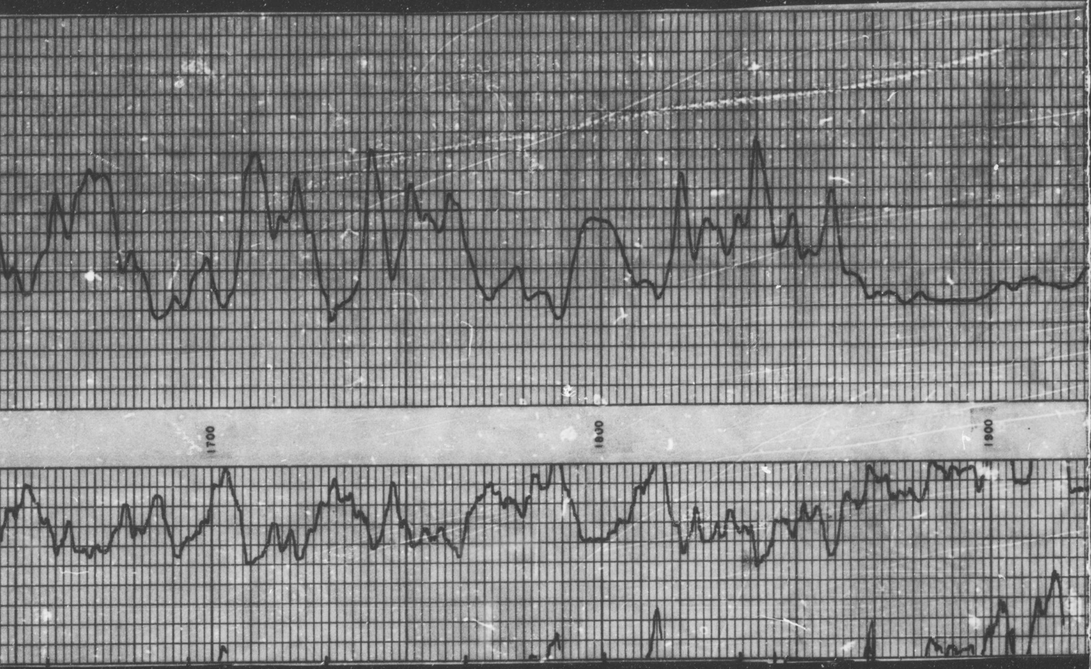
CSG.
1500
1600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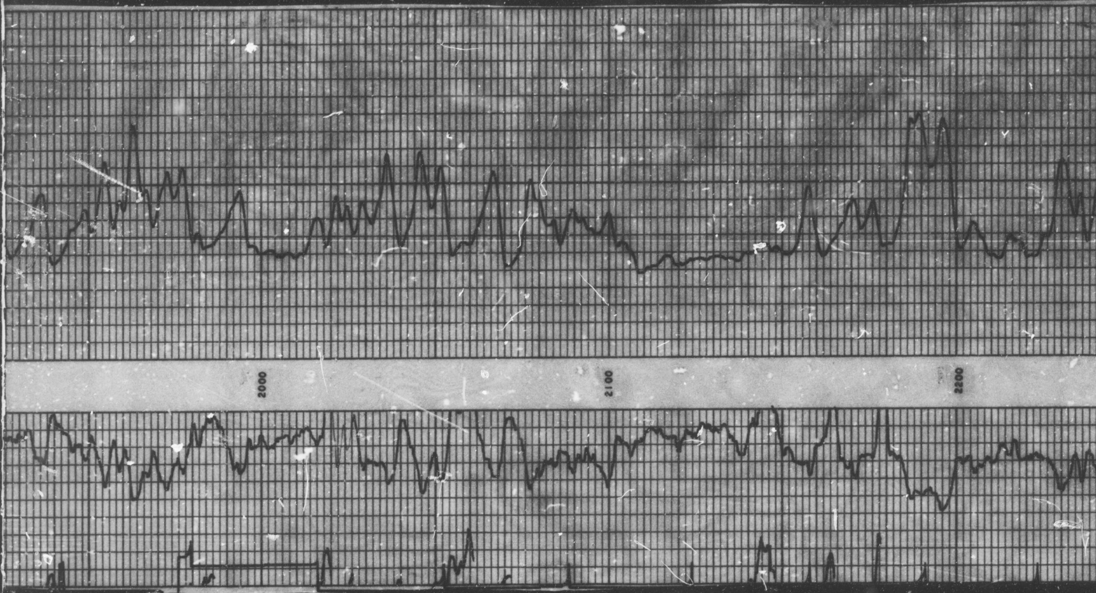
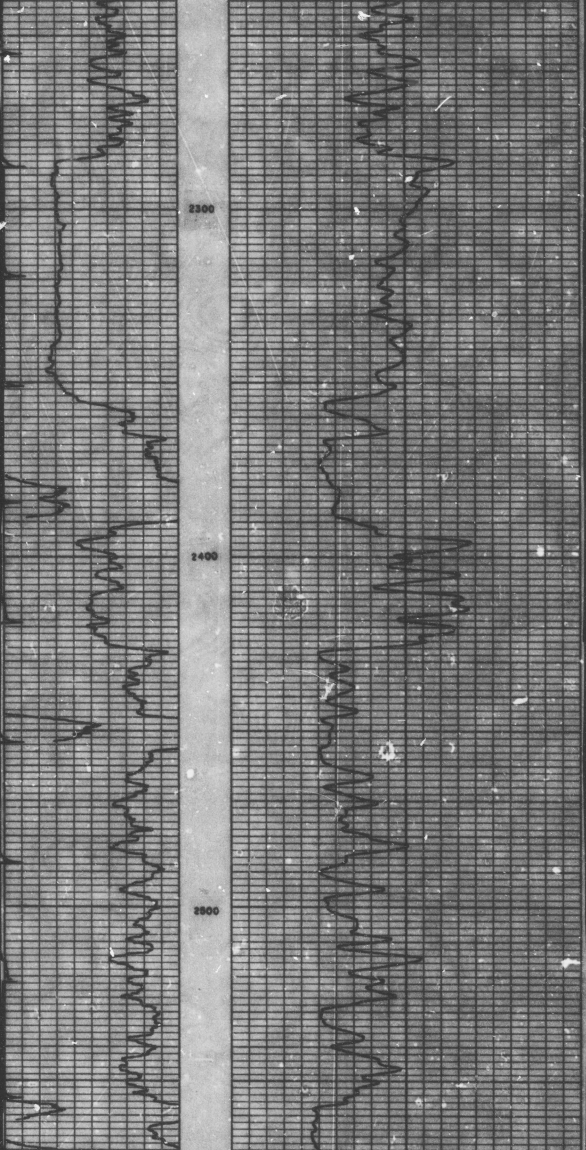
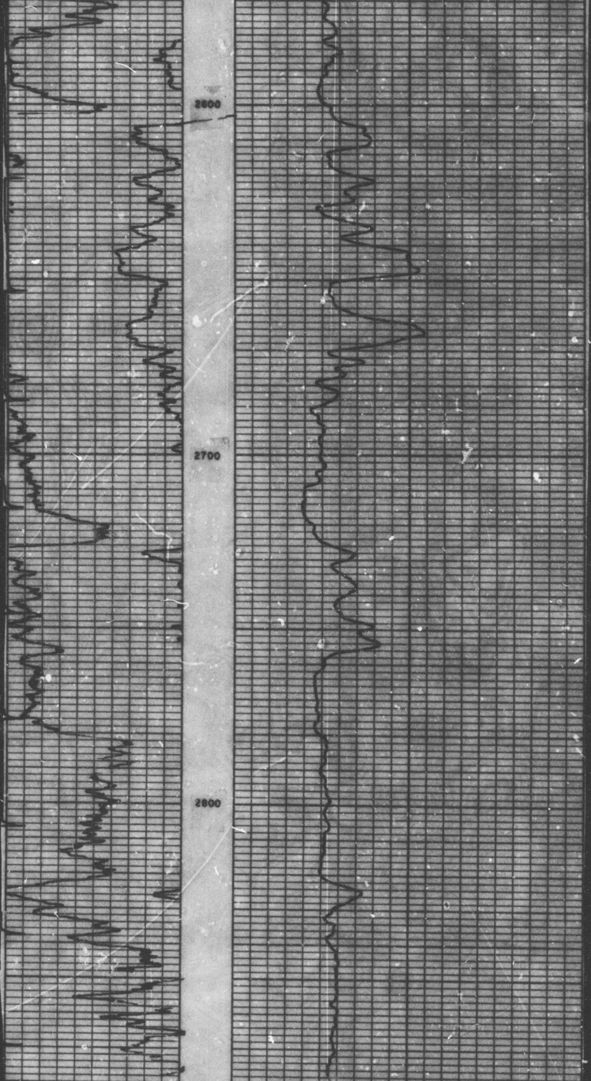
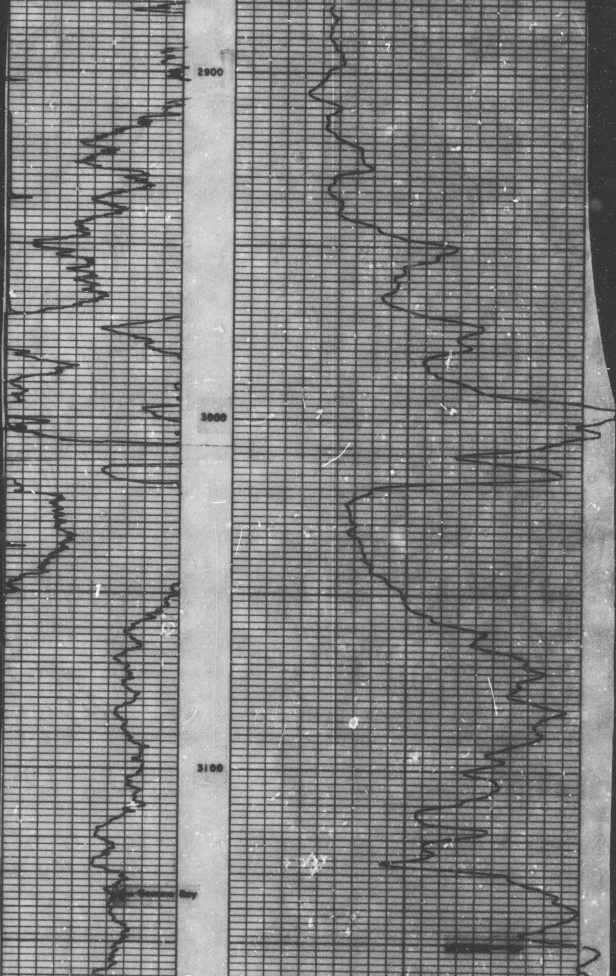
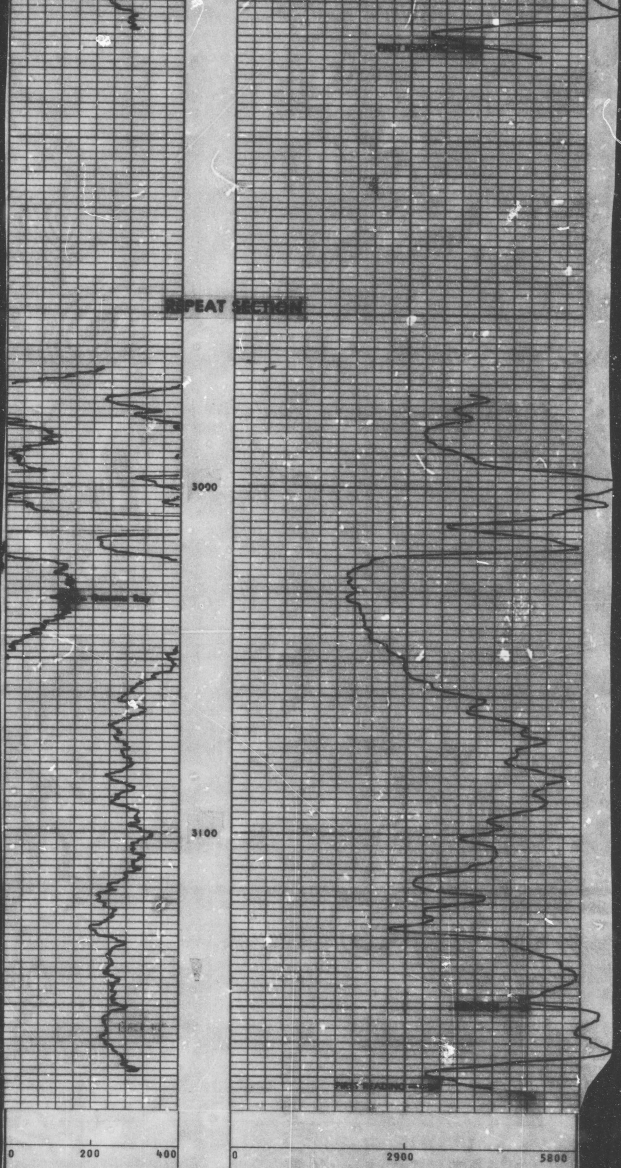
1800
1900











400 600 800

μR/HR 18 36

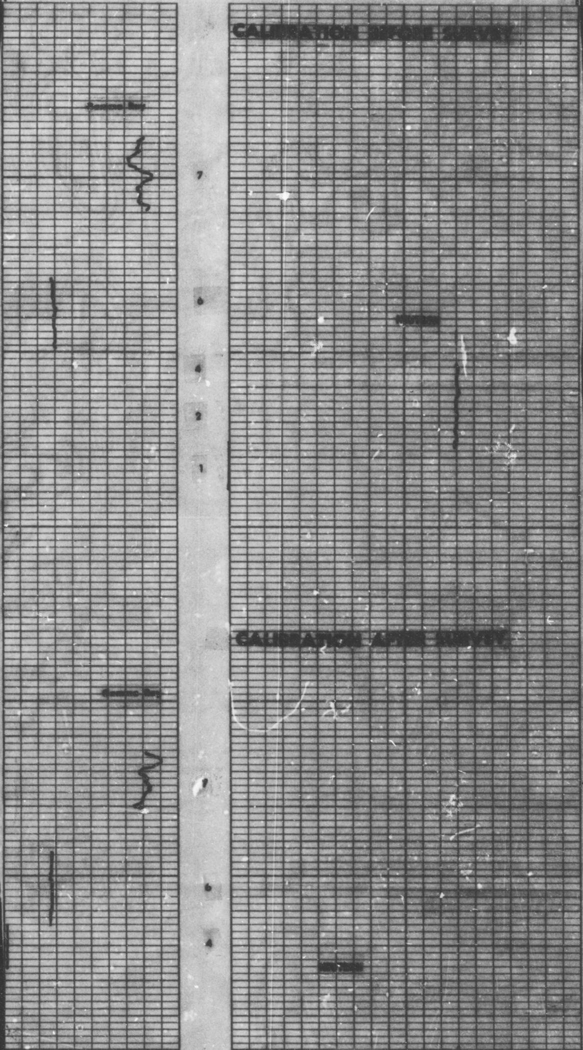
1 MIN. TIME MARKS **GAMMA RAY**

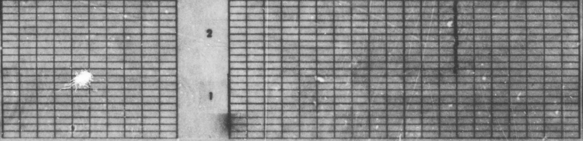
API UNITS

NEUTRON

API UNITS

CALIBRATION DATA





NEUTRON CALIBRATION CODE

1. INSTRUMENT ZERO
2. LOW VALUE = 3760 API UNITS
3. HIGH VALUE = ______ API UNITS

GAMMA RAY CALIBRATION CODE

4. INSTRUMENT ZERO
5. 10K CPM
6. BACKGROUND RADIATION
7. 200 API UNITS ABOVE BACKGROUND

CALIBRATION DATA

COMPANY MICHIGAN GEOLOGICAL SURVEY
WELL DRILL HOLE NO. 4
FIELD MIDDLE PRECAMBRIAN TEST
LOCATION NW NW NE SEC. 2-48N-28W
COUNTY MARQUETTE
STATE MICHIGAN DATE 5-9-78

DRILLER T.D. 3176'
BIRDWELL T.D. 3174'
BIRDWELL F.R. 3173'
ELEV.: K.B. NA
D.F. NA
G.L. 1470'

BIRDWELL DIVISION
Seismograph Service Corporation
A SUBSIDIARY OF RAYTHEON COMPANY

BIRDWELL

Electric Log

[redacted]

COMPANY MICHIGAN GEOLOGICAL SURVEY

WELL DRILL HOLE NO. 4

FIELD MIDDLE PRECAMBRIAN TEST

COUNTY MARQUETTE **STATE** MICHIGAN

LOCATION: NW NW NE

SEC. 2 **TWP.** 48N **RGE.** 28W

OTHER SERVICES:

PERMANENT DATUM GROUND LEVEL **ELEV.** 1470.0
LOG MEASURED FROM DF , 1.5 **FT. ABOVE PERM. DATUM**
DRILLING MEASURED FROM DERRICK FLOOR

ELEV. K.B. NA
D.F. 1471.5
G.L. 1470.0

DATE	5-9-78							
RUN NO.	ONE							
DEPTH—DRILLER	3176							
DEPTH—LOGGER	3174							
BTM. LOG INTER.	3174							
TOP LOG INTER.	1470							
CASING—DRILLER	3-5/8@ 1470		@		@		@	
CASING—LOGGER	1470							
BIT SIZE	2-63/64"							
TYPE FLUID IN HOLE	WATER							
LIQUID LEVEL	30'							
DENS. | **VISC.**	NA	NA						
pH | **FLUID LOSS**	NA	NA ml		ml		ml		ml
SOURCE OF SAMPLE	NA							
R_m @ MEAS. TEMP.	NA	@ °F		@ °F		@ °F		@ °F
R_{mf} @ MEAS. TEMP.	NA	@ °F		@ °F		@ °F		@ °F
R_{mc} @ MEAS. TEMP.	NA	@ °F		@ °F		@ °F		@ °F
SOURCE R_{mf} | **R_{mc}**	NA							
R_m @ B.H.T.	NA	@ °F		@ °F		@ °F		@ °F
TIME SINCE CIRC.	NA							
MAX. REC. TEMP.	NA	°F		°F		°F		°F
EQUIP. | **LOCATION**	3086	MT. PLEASANT, MI.						
RECORDED BY	J. MOREHEAD							
WITNESSED BY	J. VAN ALSTINE							

SSC-603-H

SCALE CHANGES

TYPE LOG	DEPTH	SCALE UP HOLE	SCALE DOWN HOLE

EQUIPMENT DATA

RUN NO.	SONDE MODEL NO.	SERIAL NO.	SONDE POS.	SONDE DIA.	OTHER

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES

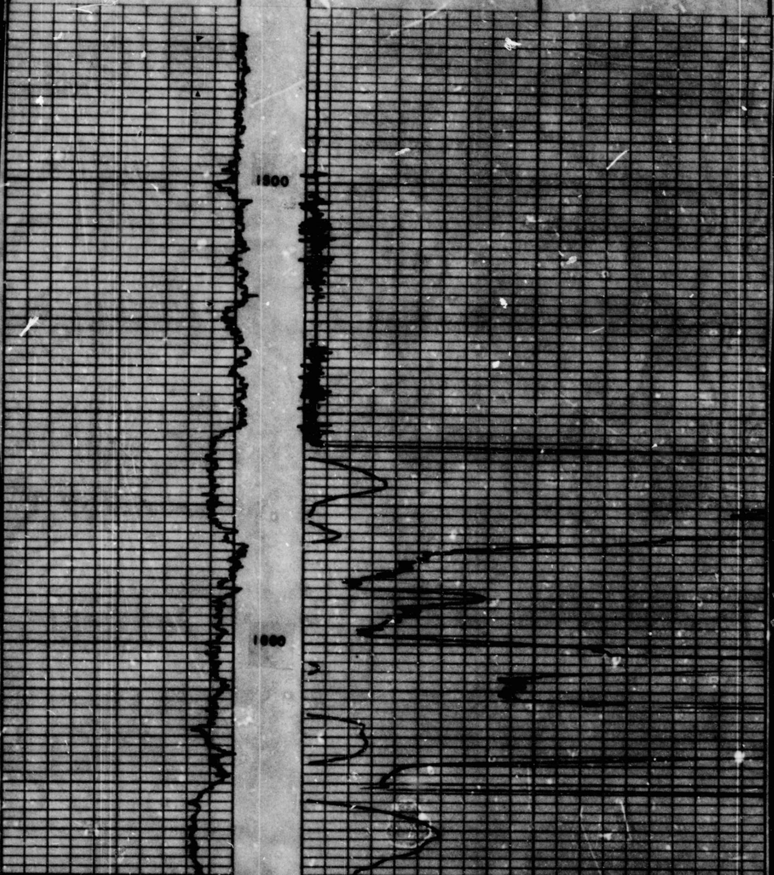
DATE	SAMPLE NO.	
DEPTH—DRILLER		
TYPE FLUID IN HOLE		
LIQUID LEVEL		
DENS. | VISC.		
pH | FLUID LOSS	ml	ml
SOURCE OF SAMPLE		
R_m @ MEAS. TEMP.	@ °F	@ °F
R_{mf} @ MEAS. TEMP.	@ °F	@ °F
R_{mc} @ MEAS. TEMP.	@ °F	@ °F
SOURCE R_{mf} | R_{mc}		
R_m @ B.H.T.	@ °F	@ °F
R_{mf} @ B.H.T.	@ °F	@ °F
R_{mc} @ B.H.T.	@ °F	@ °F

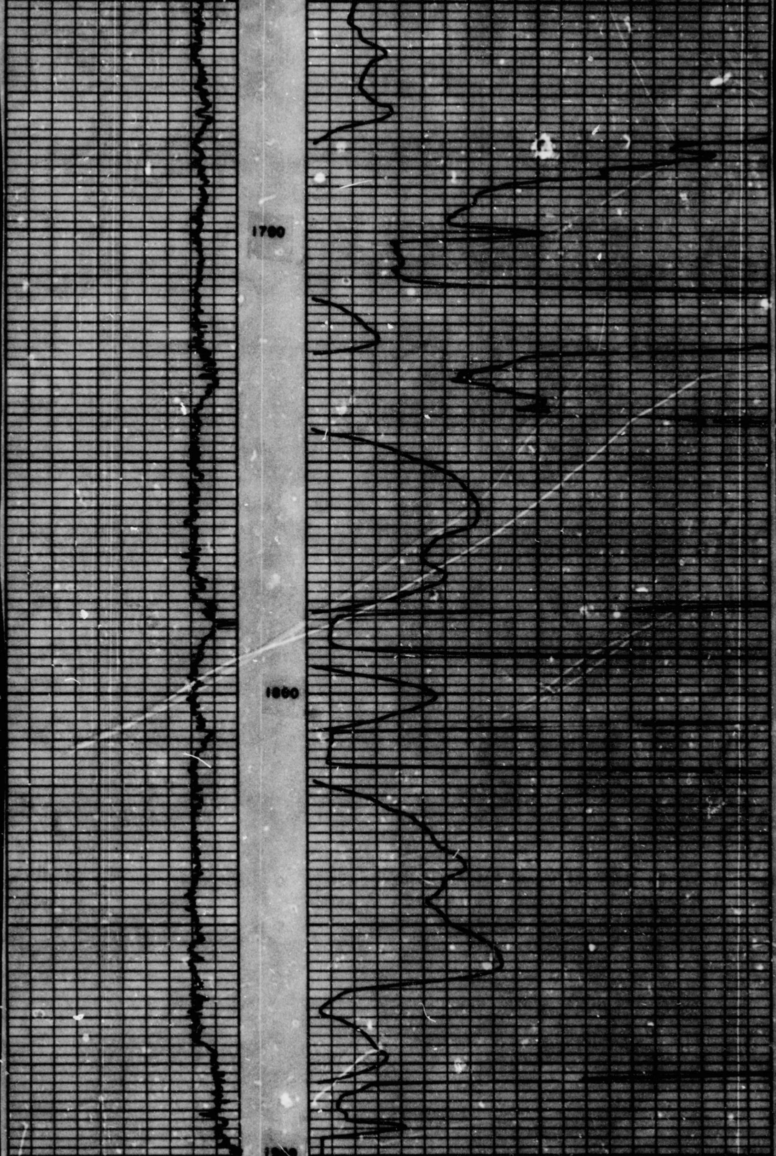
REMARKS:

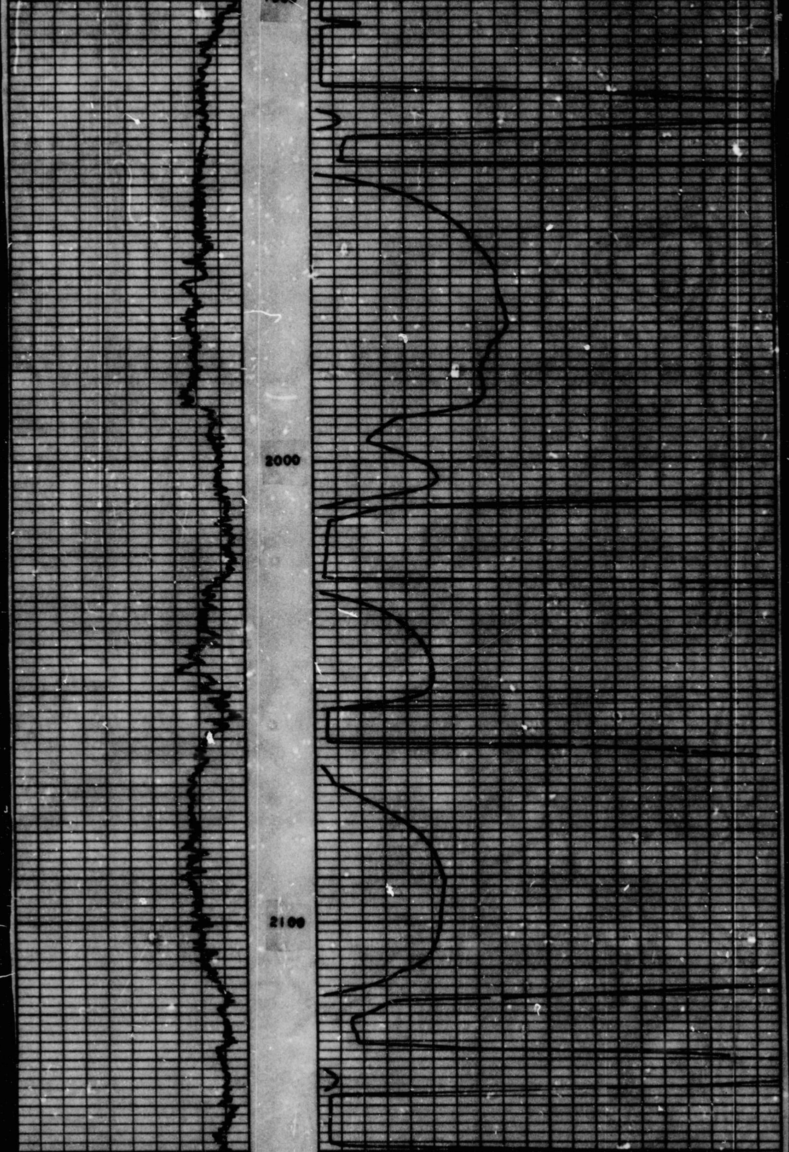
N.A.: INFORMATION NOT AVAILABLE

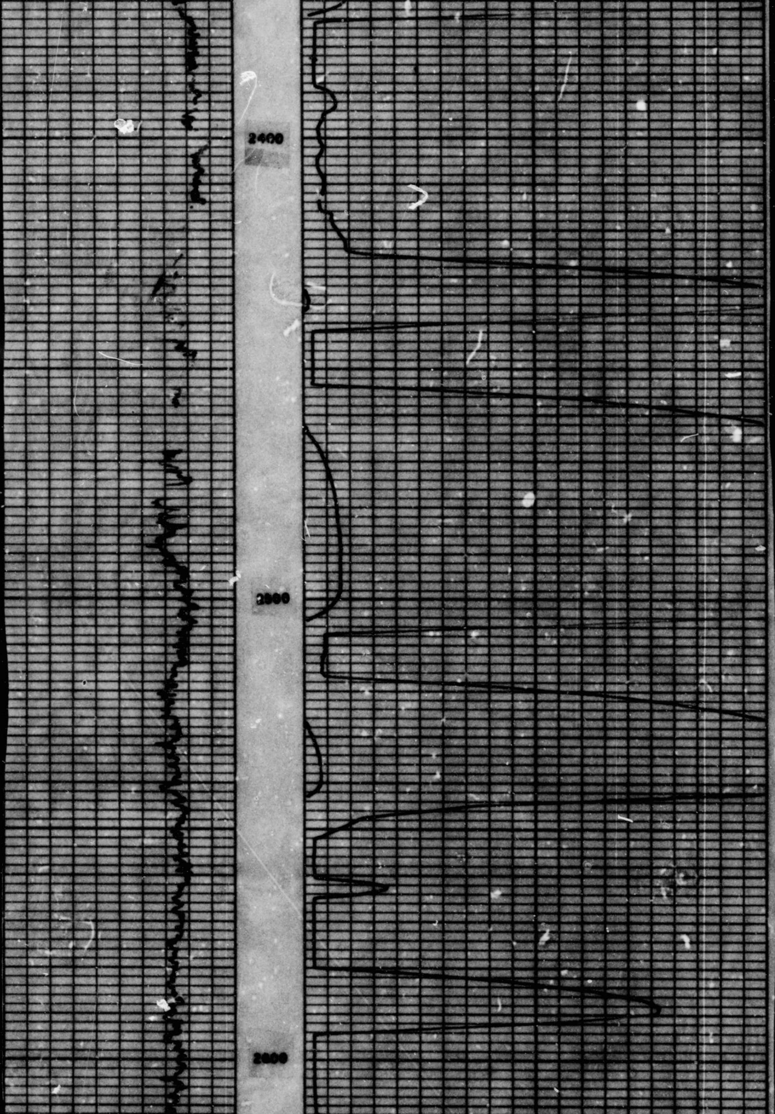
SERVICE ORDER/INVOICE NO.: N/C

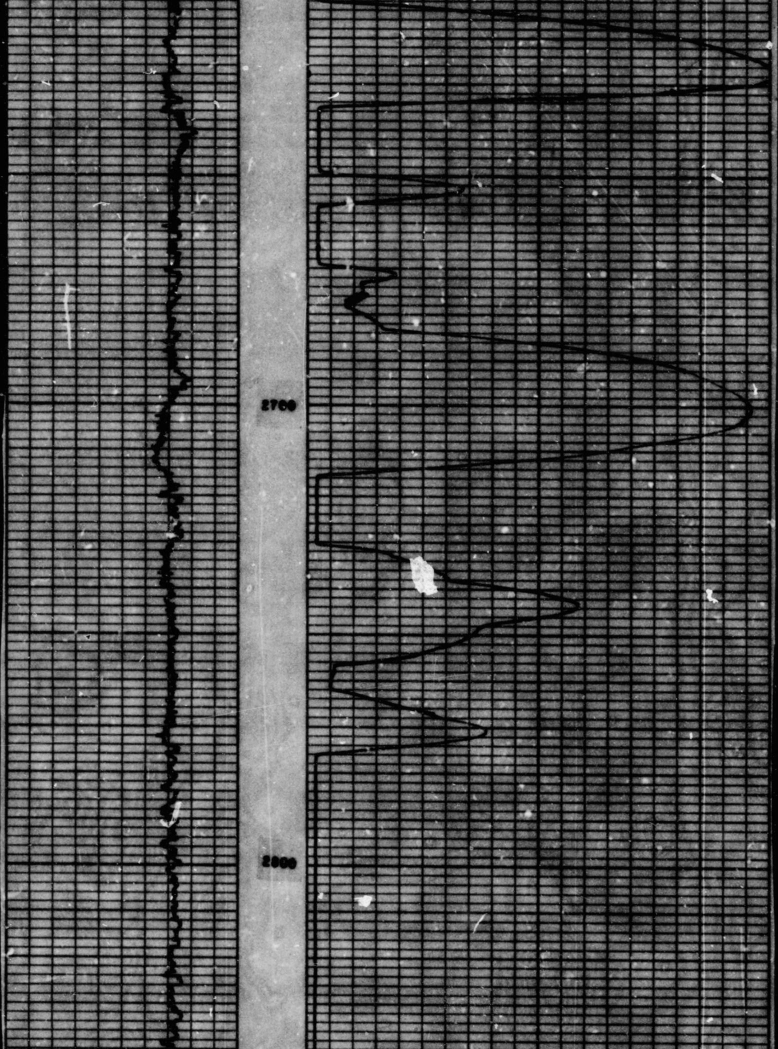
SPONTANEOUS-POTENTIAL MILLIVOLTS	DEPTH	RESISTIVITY OHMS M²/M	RESISTIVITY OHMS M²/M
− 100 +		64" LONG NORMAL 0 50 100 600	 100 1100
		MONO ELECTRIC OHM/M 1.0	

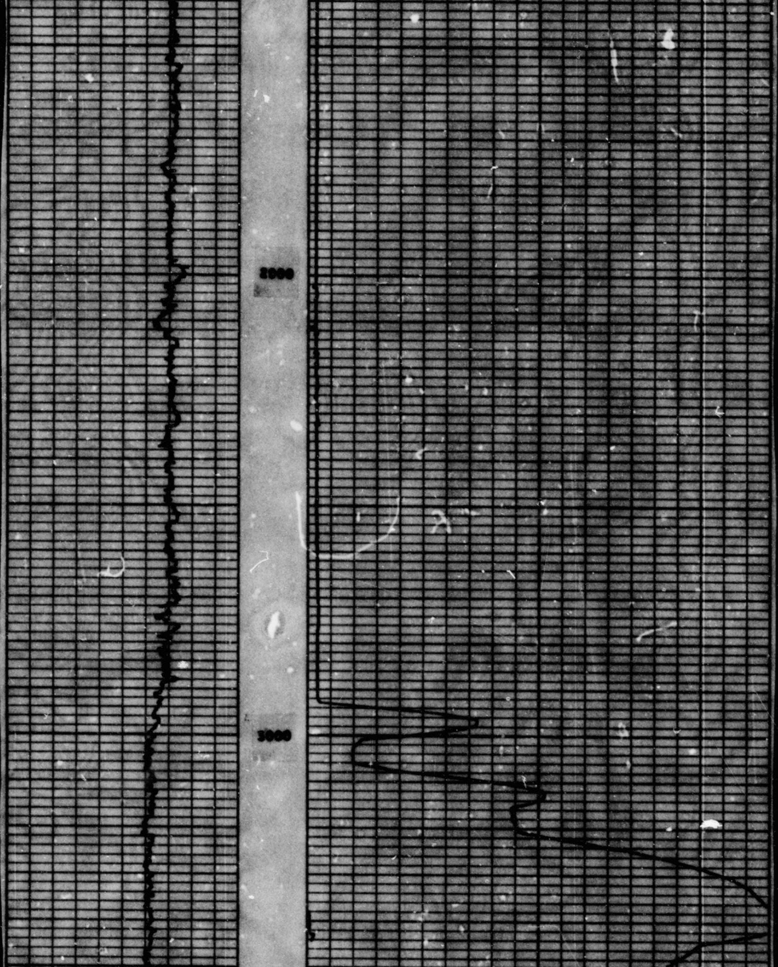


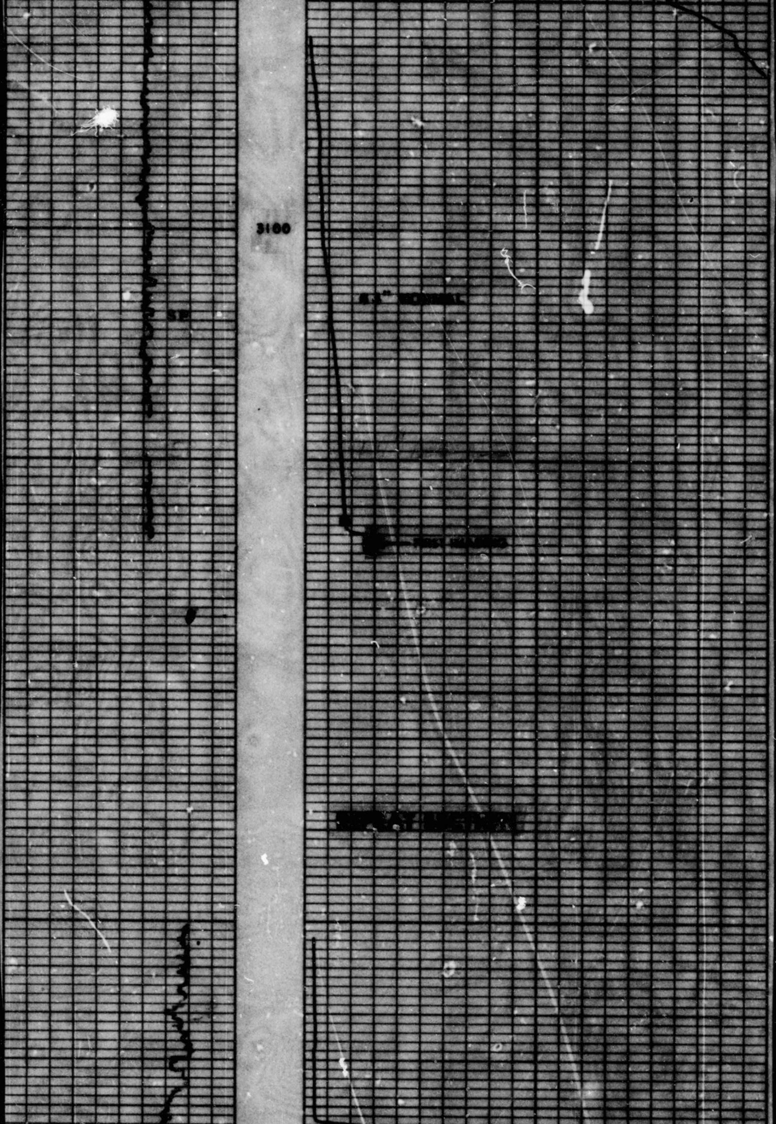


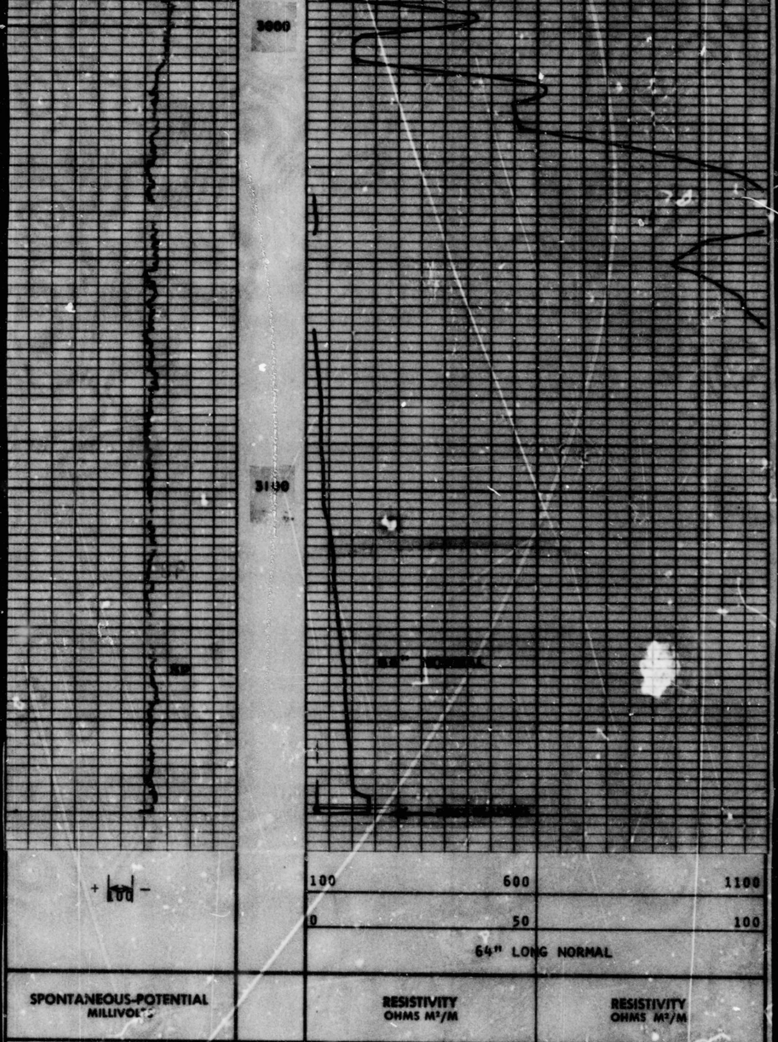


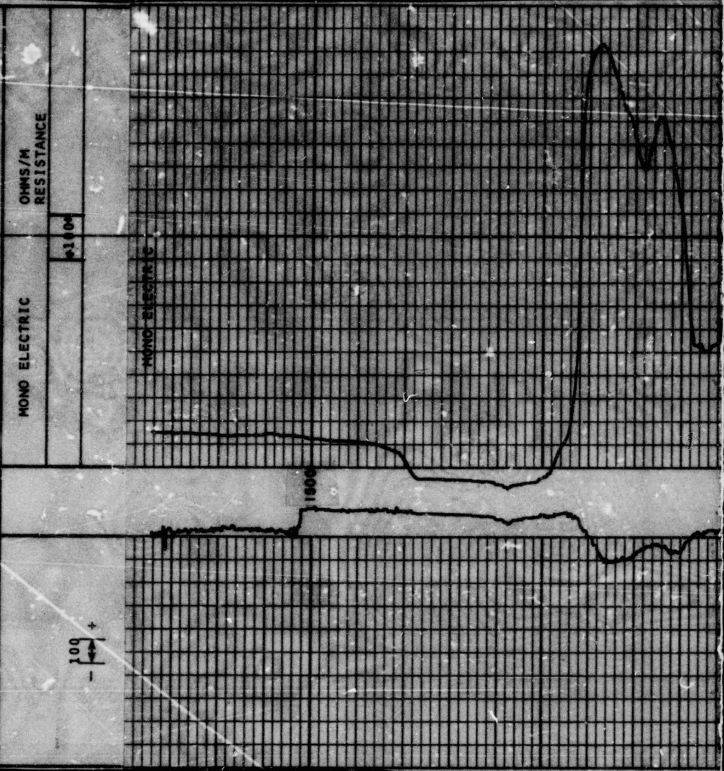


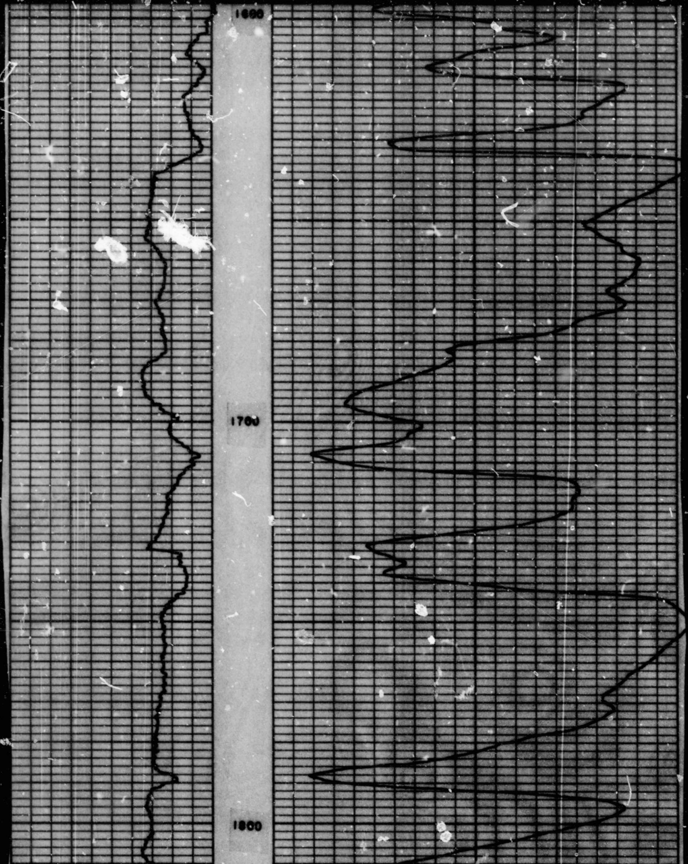


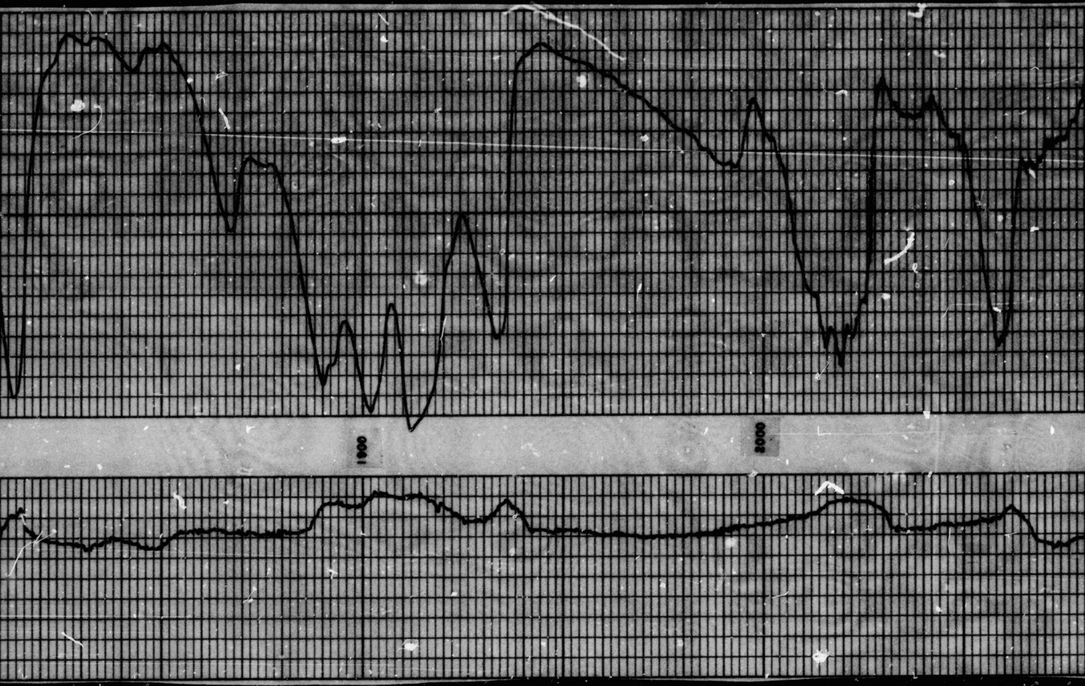


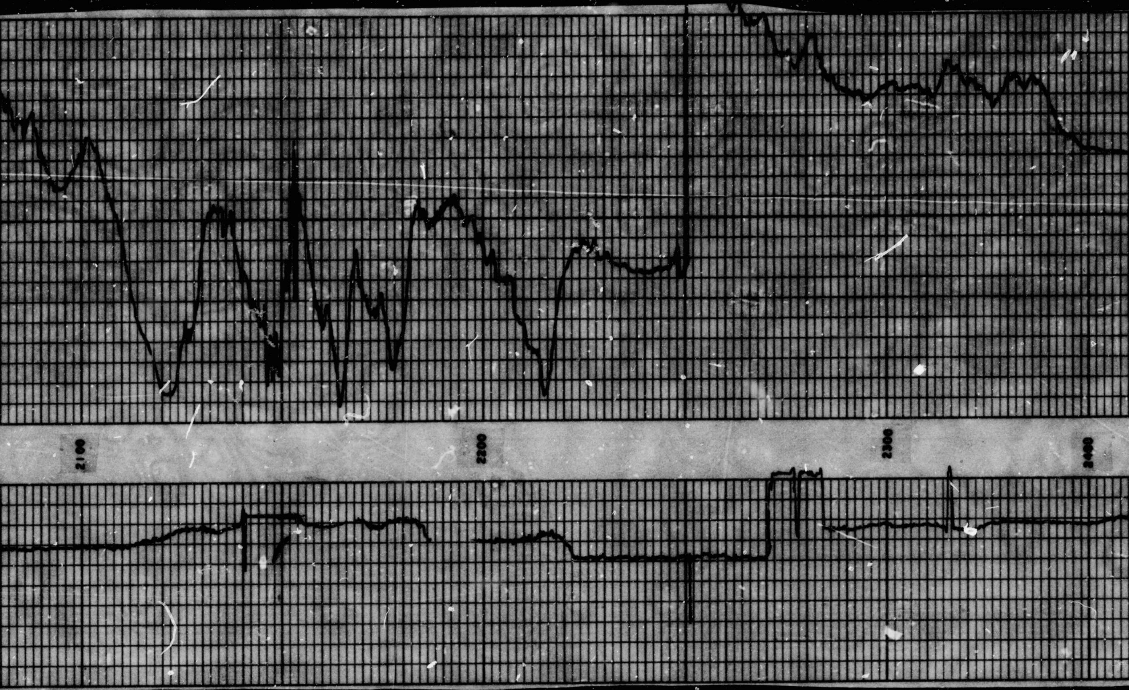


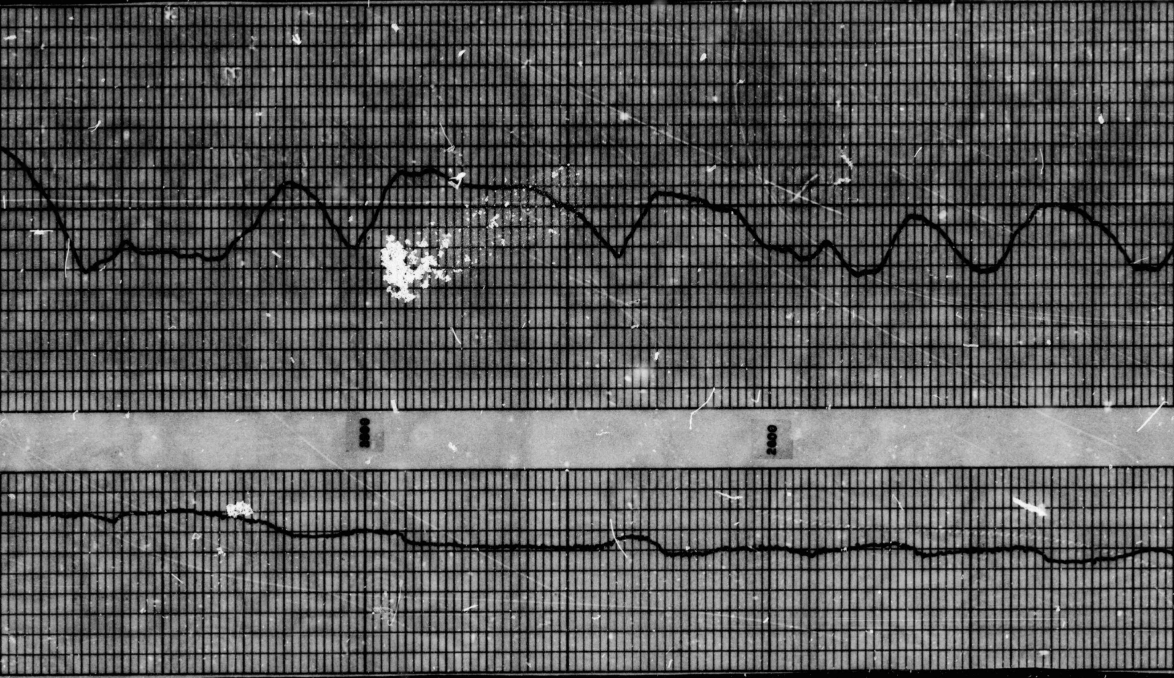


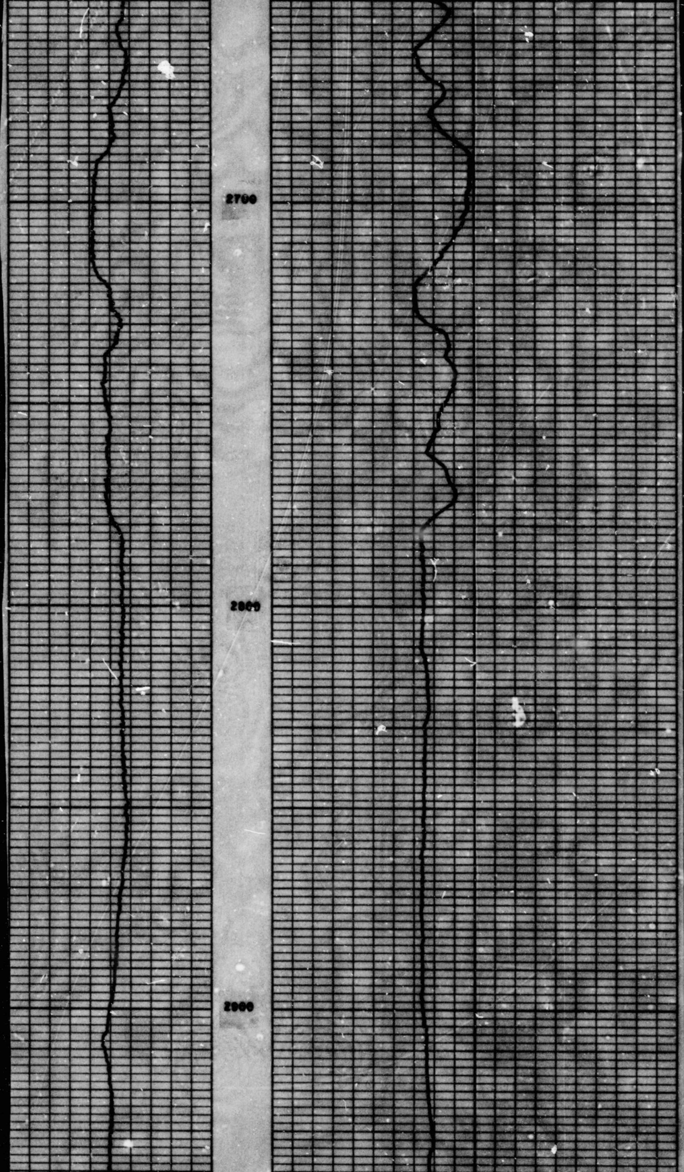


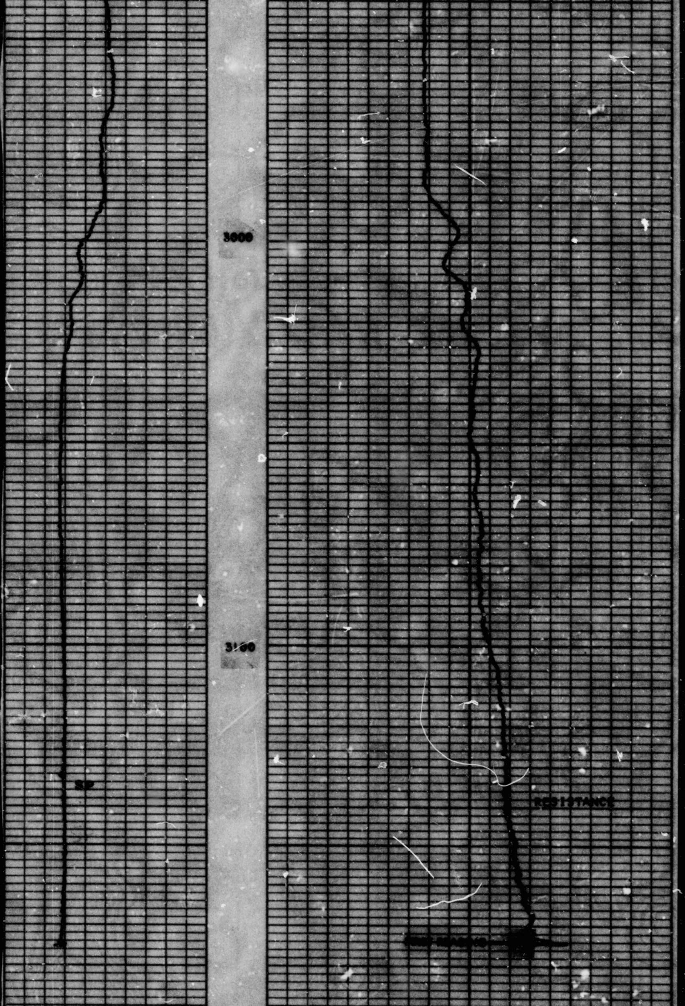


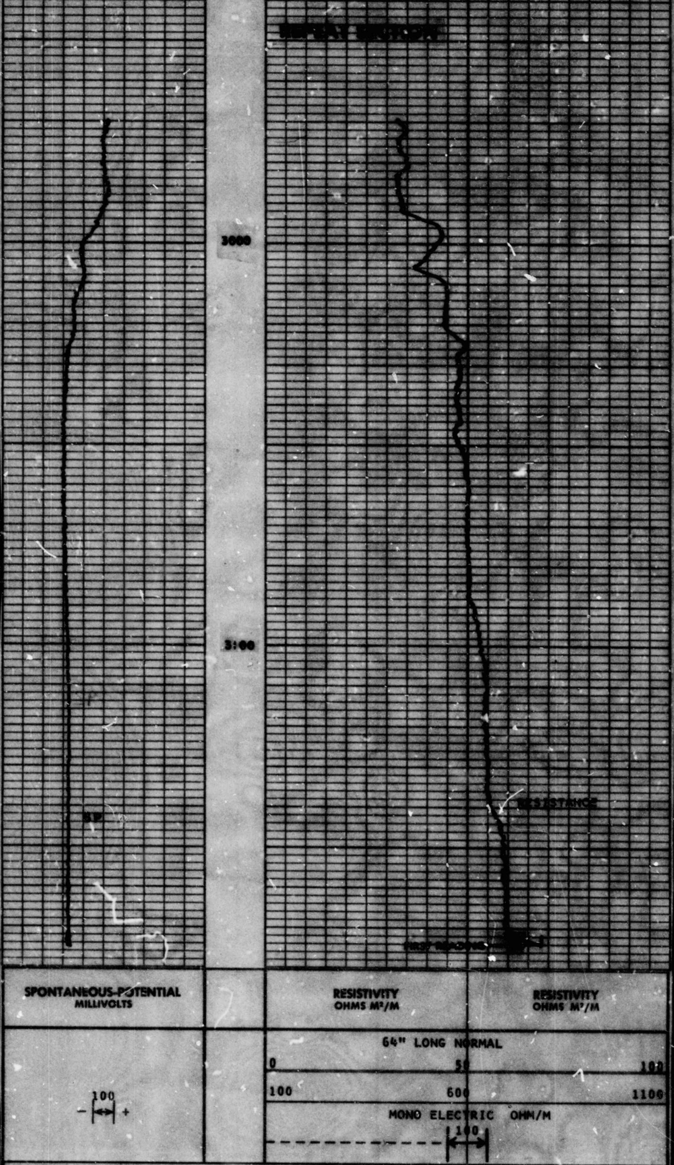












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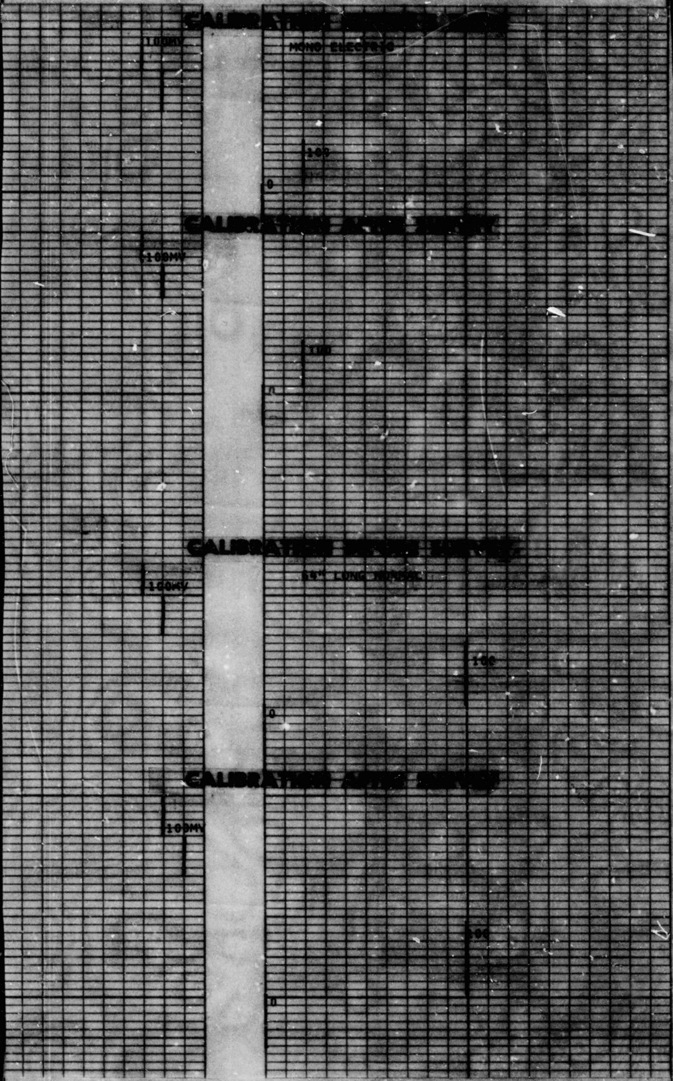


COMPANY	MICHIGAN GEOLOGICAL SURVEY	DRILLER T.D.	3176'
WELL	DRILL HOLE NO. 4	BIRDWELL T.D.	3174'
FIELD	MIDDLE PRECAMBRIAN TEST	BIRDWELL F.R.	3174'
LOCATION	NW NW NE SEC. 2-48N-28W	ELEV.: K.B.	NA
COUNTY	MARQUETTE	D.F.	1471.5'
STATE	MICHIGAN DATE 5-9-78	G.L.	1470.0'

BIRDWELL DIVISION

Seismograph Service Corporation
A SUBSIDIARY OF RAYTHEON COMPANY

SSC-705-C

BIRDWELL

Density Log

COMPANY MICHIGAN GEOLOGICAL SURVEY

WELL DRILL HOLE NO. 4

FIELD MIDDLE PRECAMBRIAN TEST

COUNTY MARQUETTE STATE MICHIGAN

LOCATION: NW NW NE

SEC. 2 TWP. 48N RGE. 28W

OTHER SERVICES

DATUM GROUND LEVEL , ELEV. 1470

MEASURED FROM DF , 1.5 Ft. Above Perm. Datum

MEASURED FROM DERRICK FLOOR

ELEV. K.B. NA

D.F. 1471.5

G.L. 1470.0

	5-9-78
	ONE
	FBL
DRILLER	3176
LOGGER	3174
INTER.	3172
INTER.	1400
IN HOLE	WATER
PPM CL.	NA
GAL.	NA
	30'
-°F	NA
	2 HOURS
	J. MOREHEAD
	J. VAN ALSTINE
	MT. PLEASANT, MI.

BORE HOLE RECORD			CASING RECORD			
BIT	FROM	TO	SIZE	WGT.	FROM	TO
3-7/8"	SURF.	1470	3-5/8	NA	180	1470
2-63/64	1470	3176				

BBC-947-D

DENSITY CALIBRATION DATA

PRIMARY REF.	CR.	
EQUIVALENT DEN. G/CC		
SECONDARY REF.		
EQUIVALENT DEN. G/CC		
RECORDER CAL. REF.	10K	25K
EQUIVALENT DEN. G/CC	2.86	2.38
NOMINAL HOLE DIAM.	3"	3"

EQUIPMENT DATA

RUN NO.	ONE
DEN. SONDE MOD. NO.	LAHC8001
DEN. SONDE SER. NO.	1
DIAMETER	2-1/4"
DEN. SOURCE NO.	A-439

REMARKS:

BENCH MARK 1469.94

GENERAL

TRUCK NO.	3086
SERVICE ORDER INV.	523727

REFERENCE LITERATURE:

N.A.: INFORMATION NOT AVAILABLE

LOGGING DATA

GENERAL				DENSITY	
DEPTHS FROM	DEPTHS TO	SPEED FT/MIN	TC SEC.	CFM FULL SCALE	G./CC/ LOG. DIV.
3172	1400	30			

NOTE: RECORDER BULK DENSITY MUST BE CORRECTED FOR STANDOFF (PROXIMITY INDEX)

1 MIN TIME MARKERS

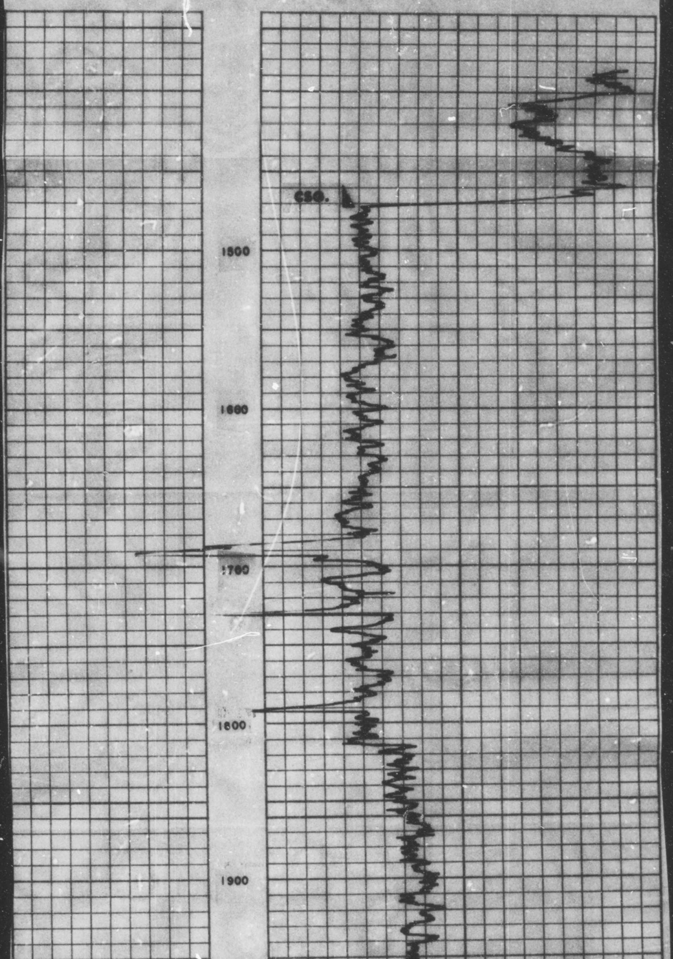
CALIPER CURVE

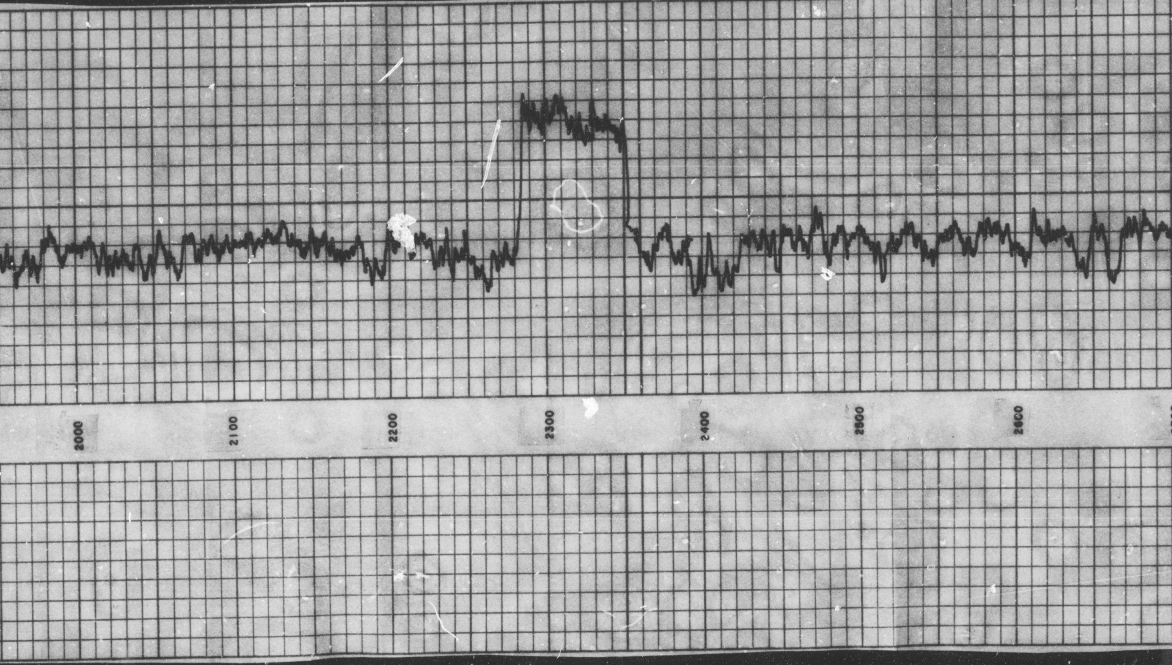
0 5 10

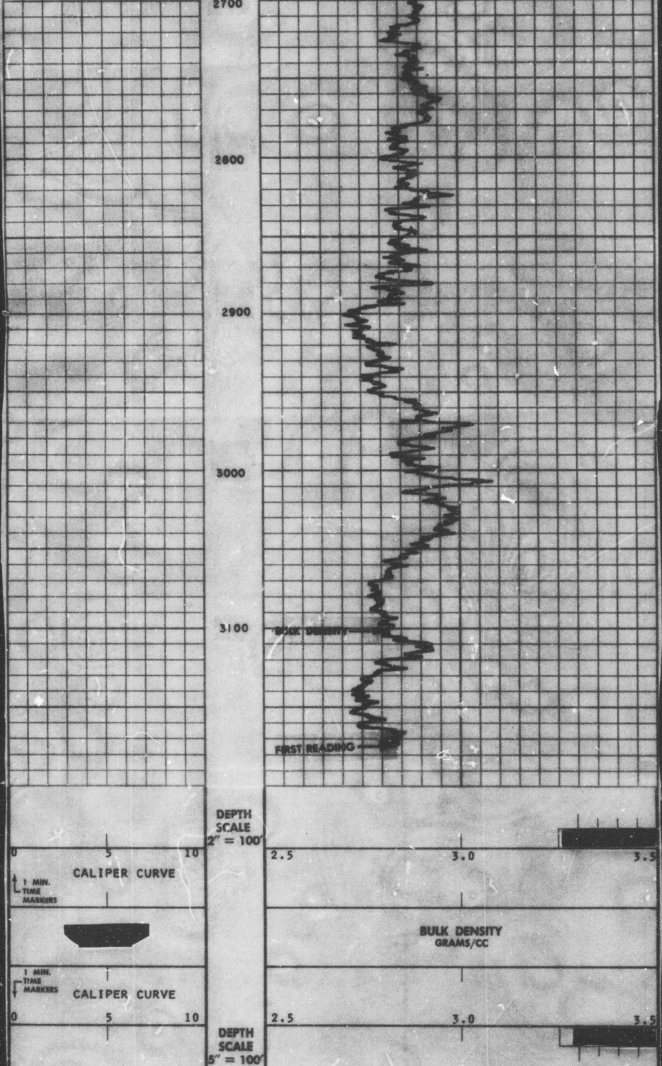
DEPTH

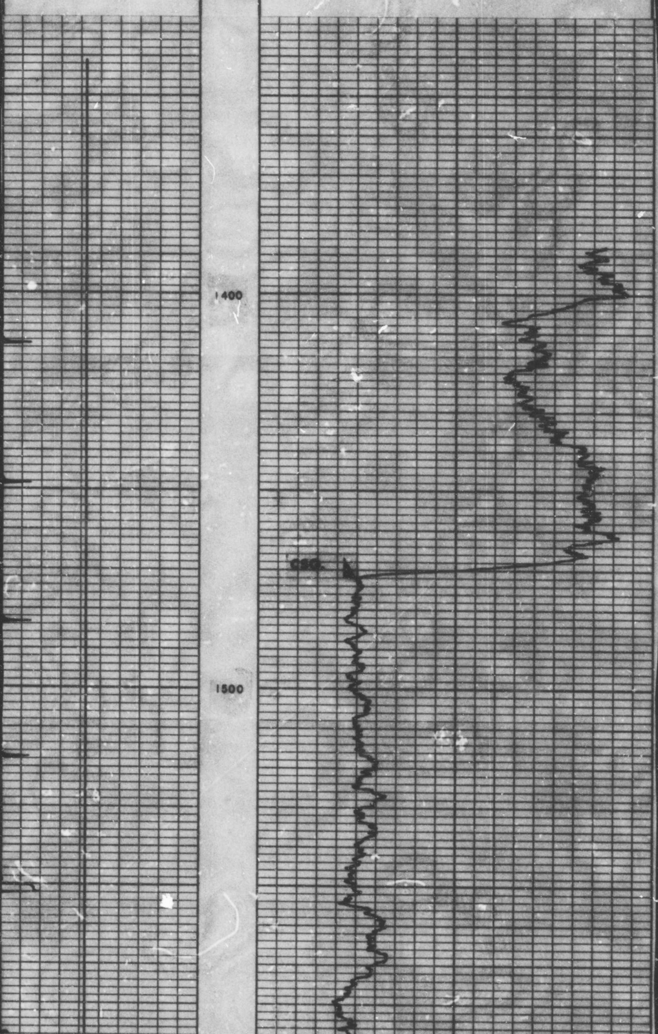
BULK DENSITY
GRAMS CC

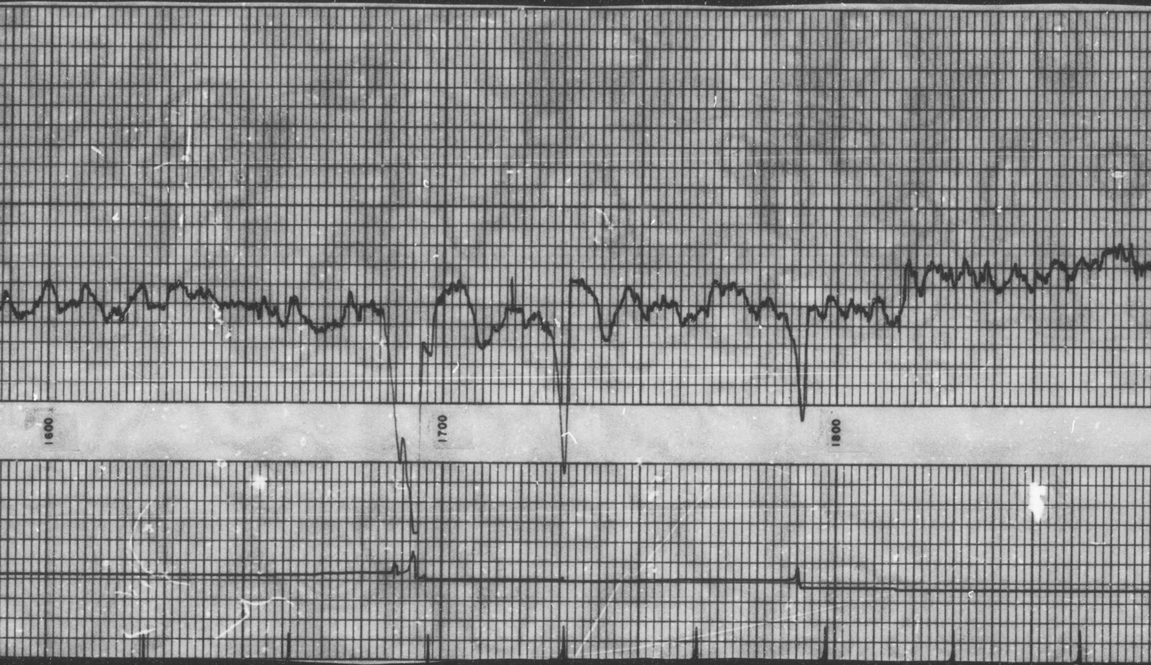
2.5 3.0 3.5

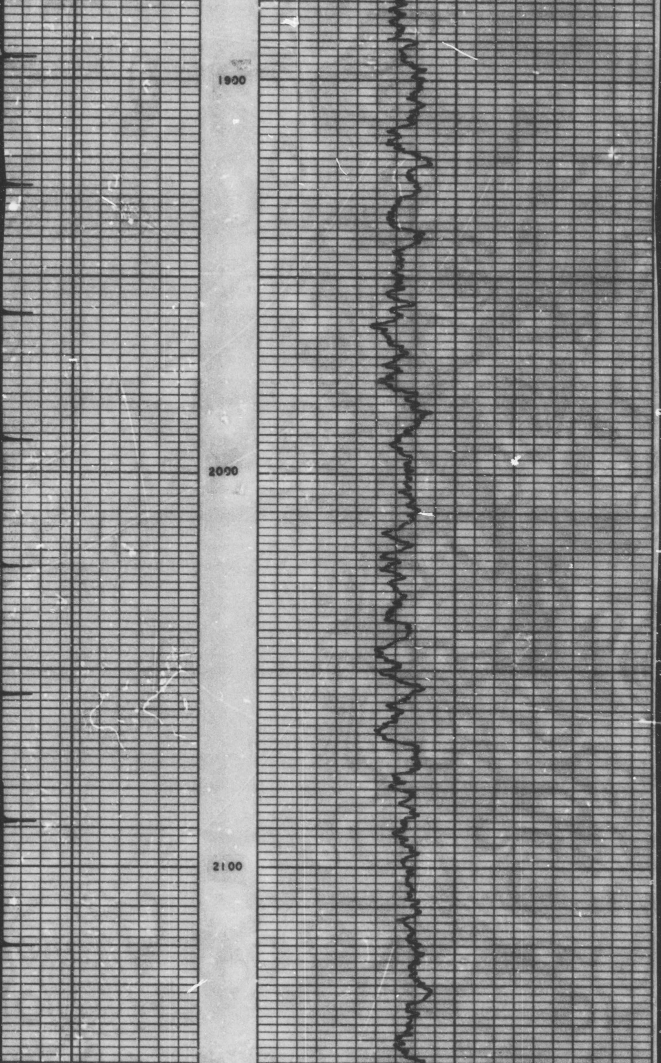


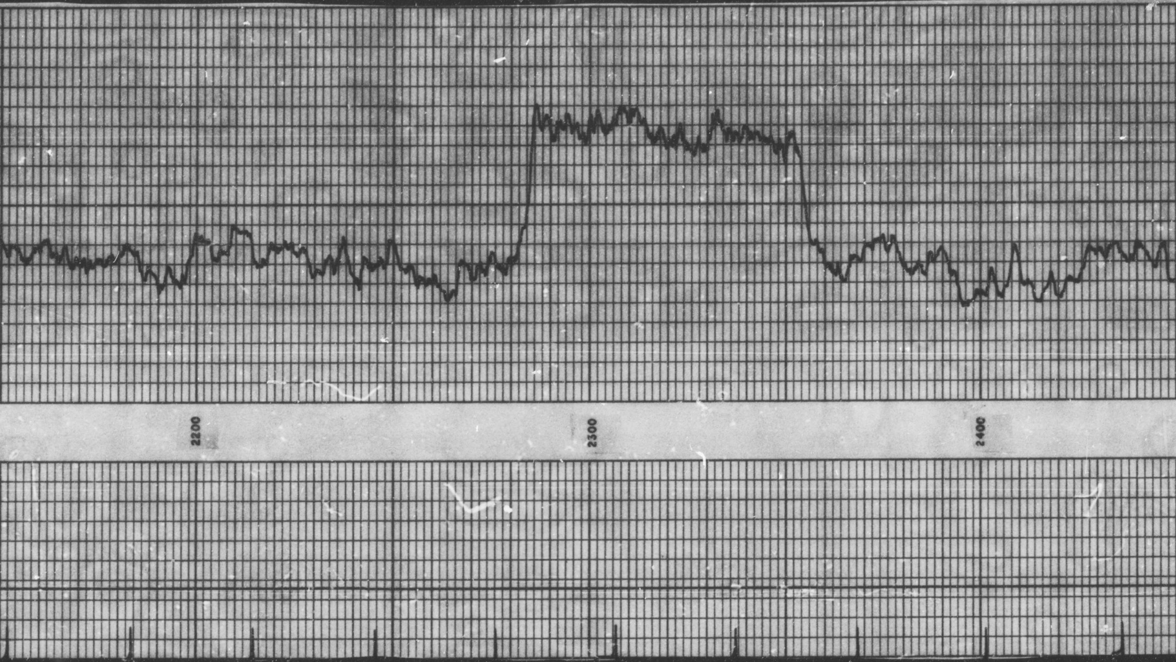


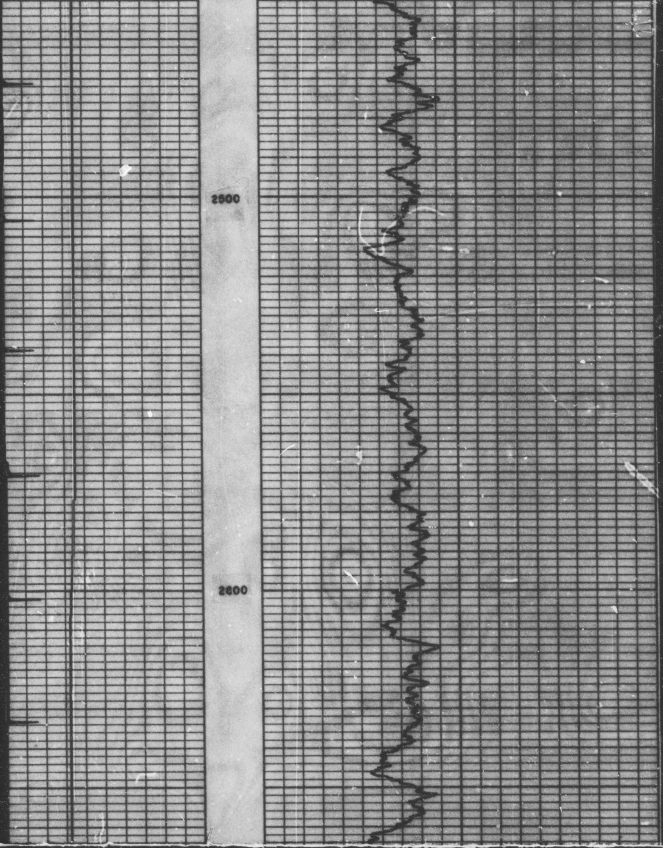


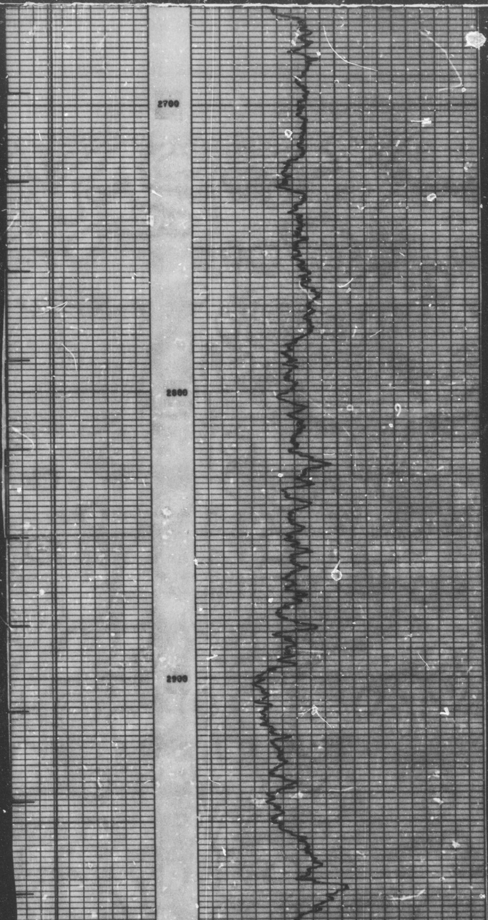


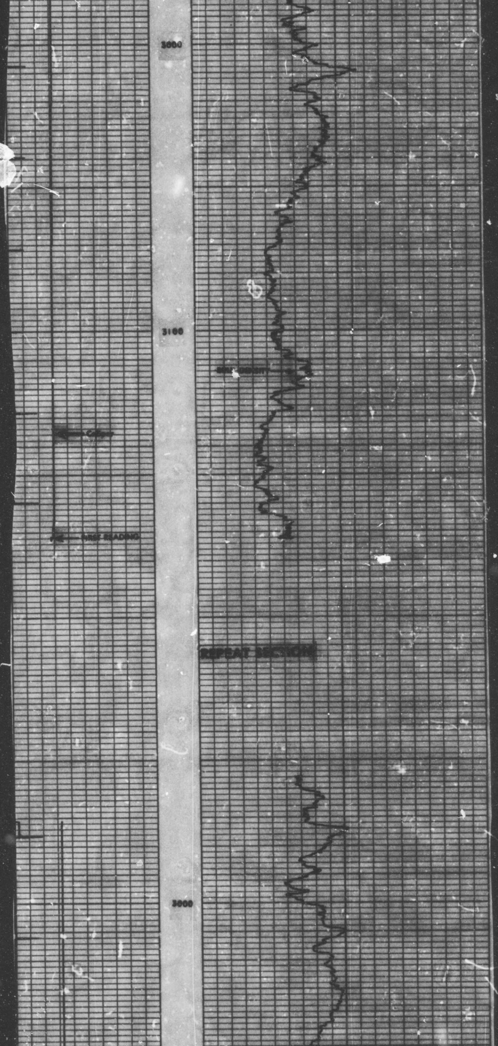


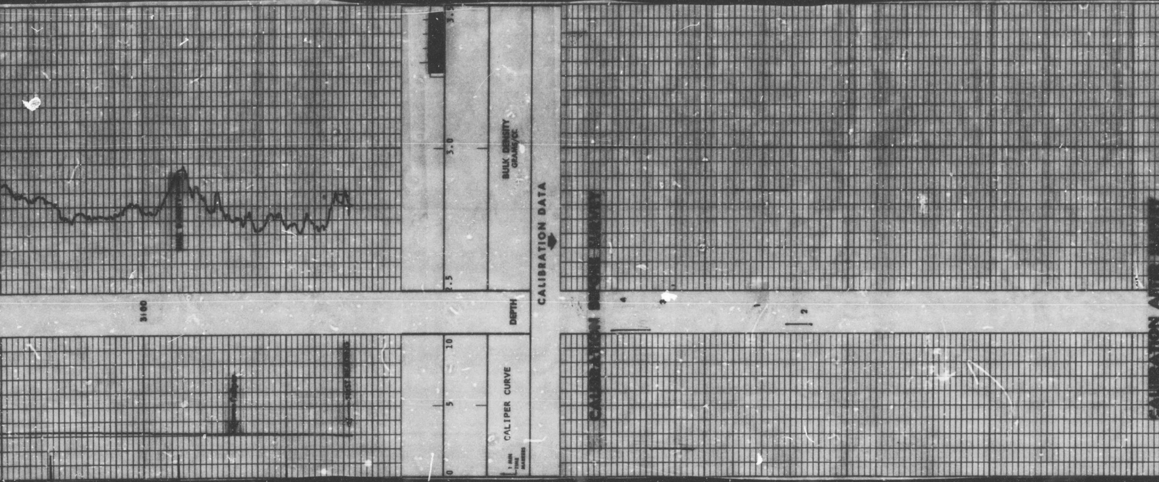


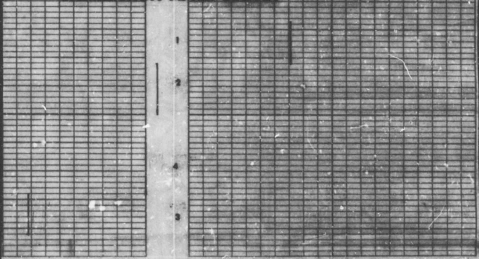












F.D.L. CALIBRATION CODE

1. HIGH DENSITY READING 2.86 gm/cc*
2. LOW DENSITY READING 2.18 gm/cc*
3. 4. CALIPER ☒ OR PROXIMITY INDEX ☐ SMALL VALUE 1-5/8" INCHES
LARGE VALUE 10 INCHES

GAMMA RAY CALIBRATION CODE

5. INSTRUMENT ZERO
6. 10K CPM
7. BACKGROUND RADIATION
8. ________ API UNITS ABOVE BACKGROUND

*Nominal Value: Calibrated for 3 inch diameter hole. See Appropriate correction charts for other hole diameter and (or) Proximity Stand-off Corrections.

CALIBRATION DATA

COMPANY	MICHIGAN GEOLOGICAL SURVEY	DRILLER T.D.	3176'
WELL	DRILL HOLE NO. 4	BIRDWELL T.D.	3174'
FIELD	MIDDLE PRECAMBRIAN TEST	BIRDWELL F.R.	3172'
LOCATION	NW NW NE SEC. 2-48N-28W	ELEV.: K.B.	NA
COUNTY	MARQUETTE	D.F.	NA
STATE	MICHIGAN DATE 5-9-78	G.L.	1470'

BIRDWELL DIVISION
Seismograph Service Corporation
A SUBSIDIARY OF RAYTHEON COMPANY

Birdwell

ELASTIC PROPERTIES LOG

Section No. 1	Section No. 2
Interval Velocities ① Shear Wave ② Compressional Wave Computed Percent Porosity Poisson's Ratio	Elastic Moduli ① Shear ② Bulk ③ Young's Bulk Density

3D LOG RUN NO. 1 NOMINAL TRANSDUCER SPACING 6 FT.

DENSITY TOOL SPACING 2½ IN. TOOL

COMPANY MICHIGAN GEOLOGICAL SURVEY

WELL DRILL HOLE NO. 4

FIELD MIDDLE PRECAMBRIAN TEST

COUNTY MARQUETTE STATE MICHIGAN

LOCATION:

NW NW NE

SEC. 2 TWP. 48N RGE. 28W

ELEVATIONS:

KB. NA

DF. 1475.5'

GL. 1470.0'

DEPTH REF. DF

COMPUTATION DATE 5-24-78

REMARKS:

NA: INFORMATION NOT AVAILABLE

POROSITY - APPARENT LIMESTONE UNITS

DG = 2.71 GM/CC DF = 1.0 GM/CC VM = 21,000 FT/SEC VF = 5300 FT/SEC

Section No. 1

POISSON'S RATIO .3 .2 .1

COMPUTED POROSITY PERCENT 30 0

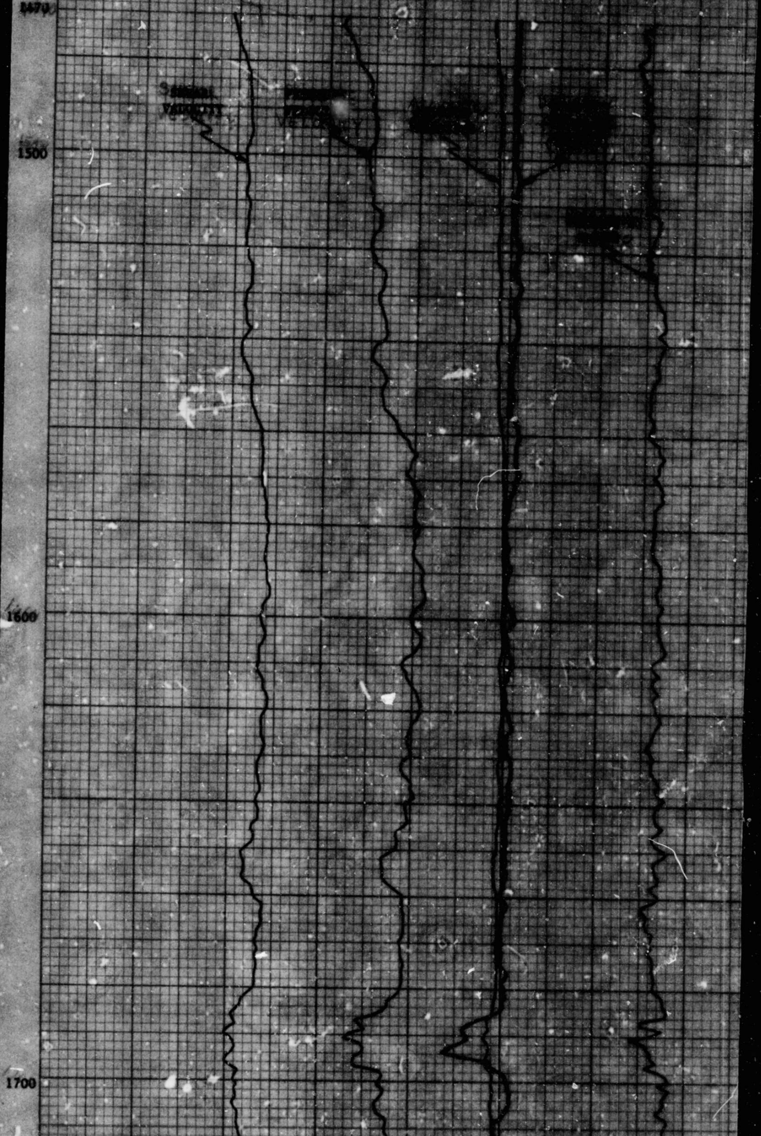
INTERVAL VELOCITY FEET PER SEC. 0 5000 10000 15000 20000

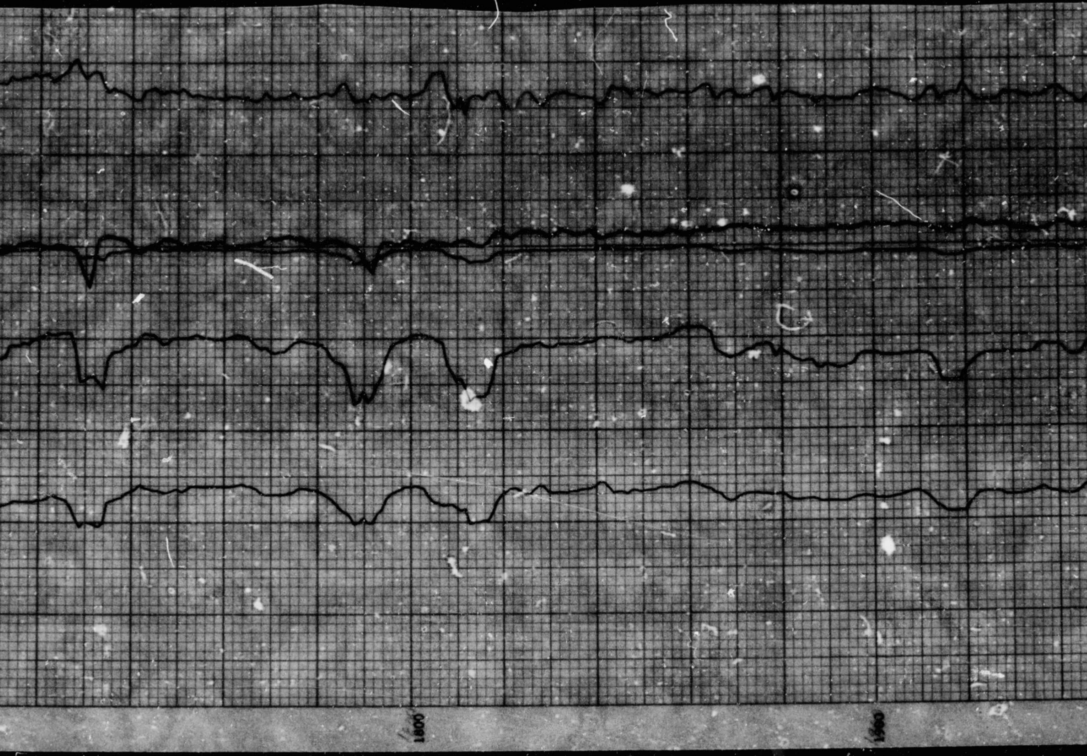
TRAVEL TIME IN MICROSECONDS

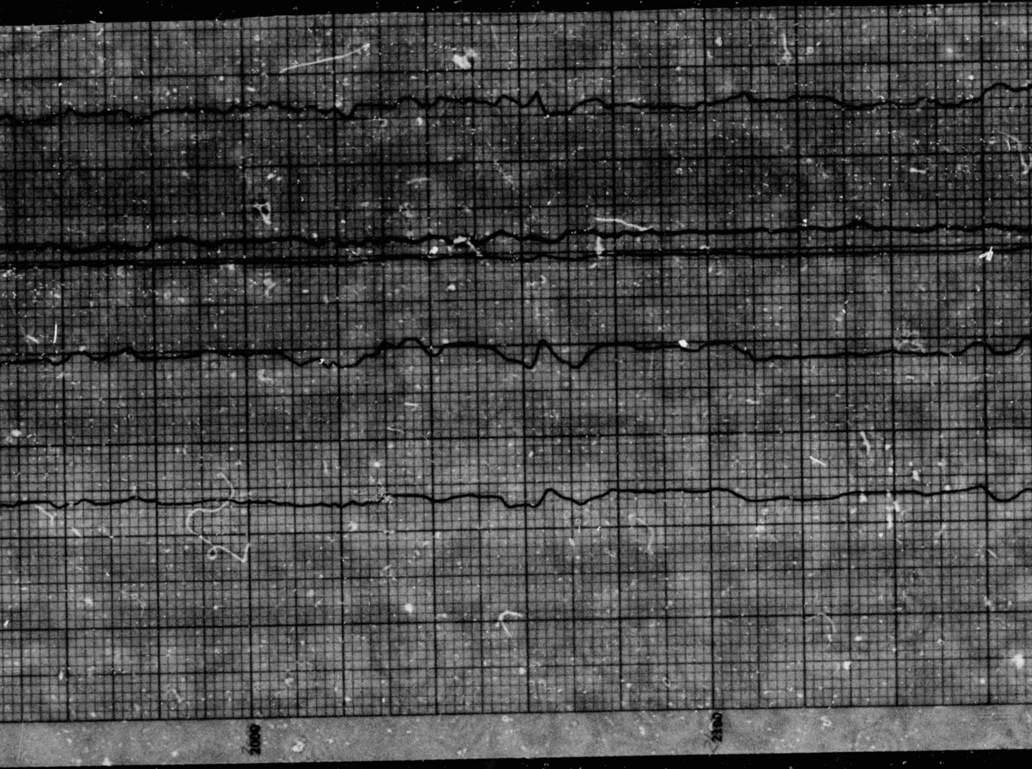
DEPTH

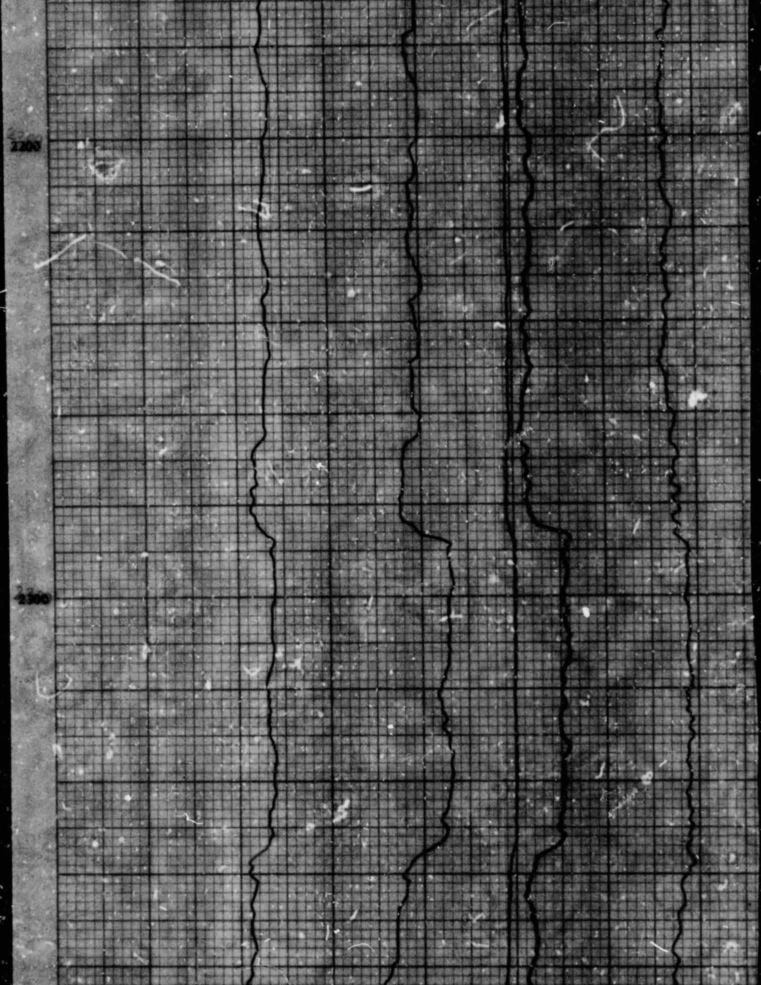
BW-7

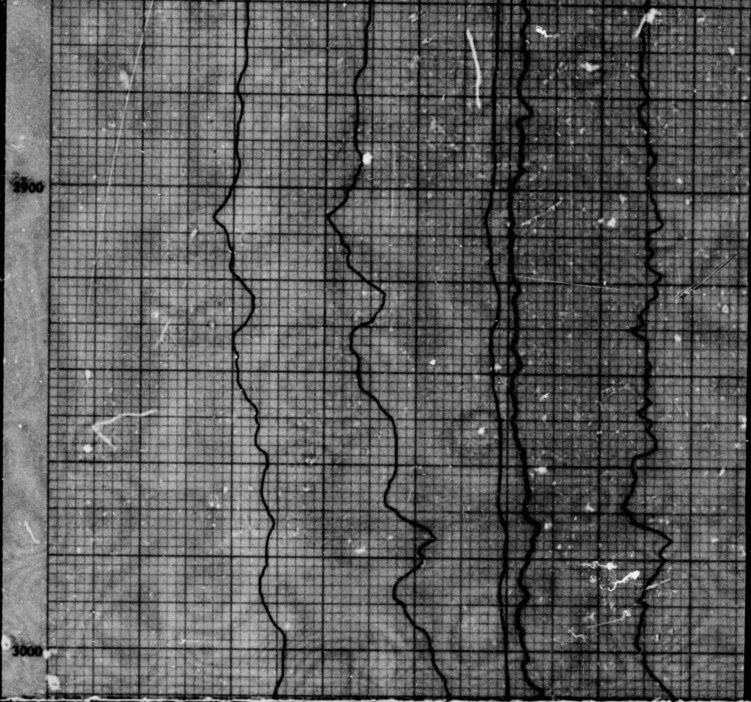
Feb. 4, 1970

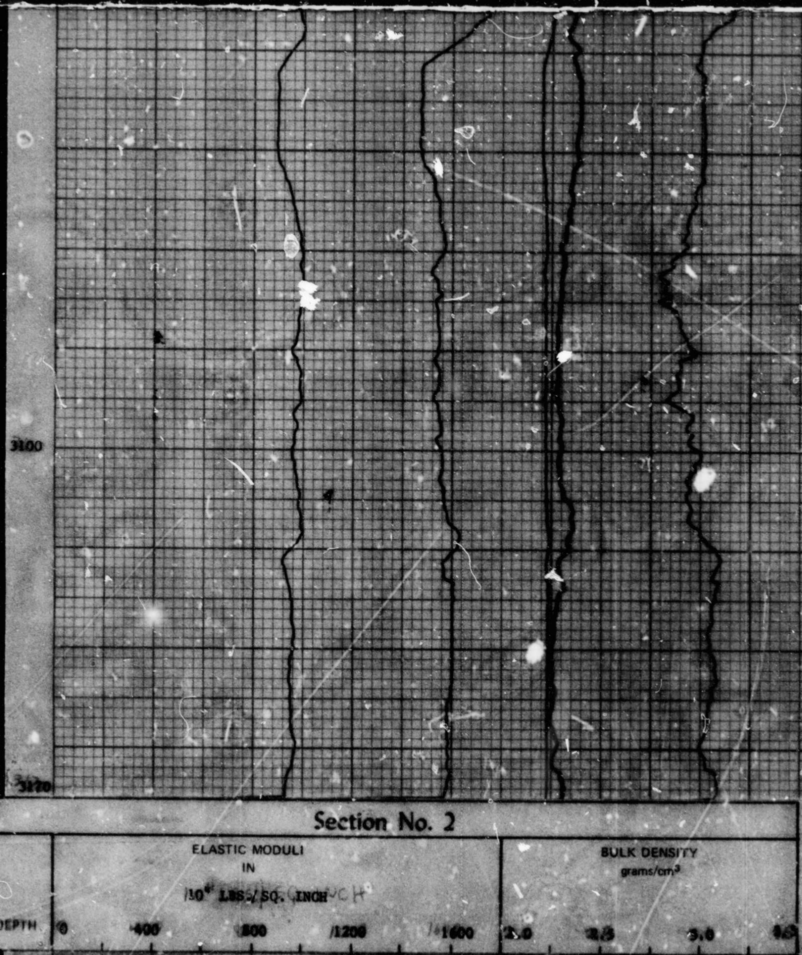


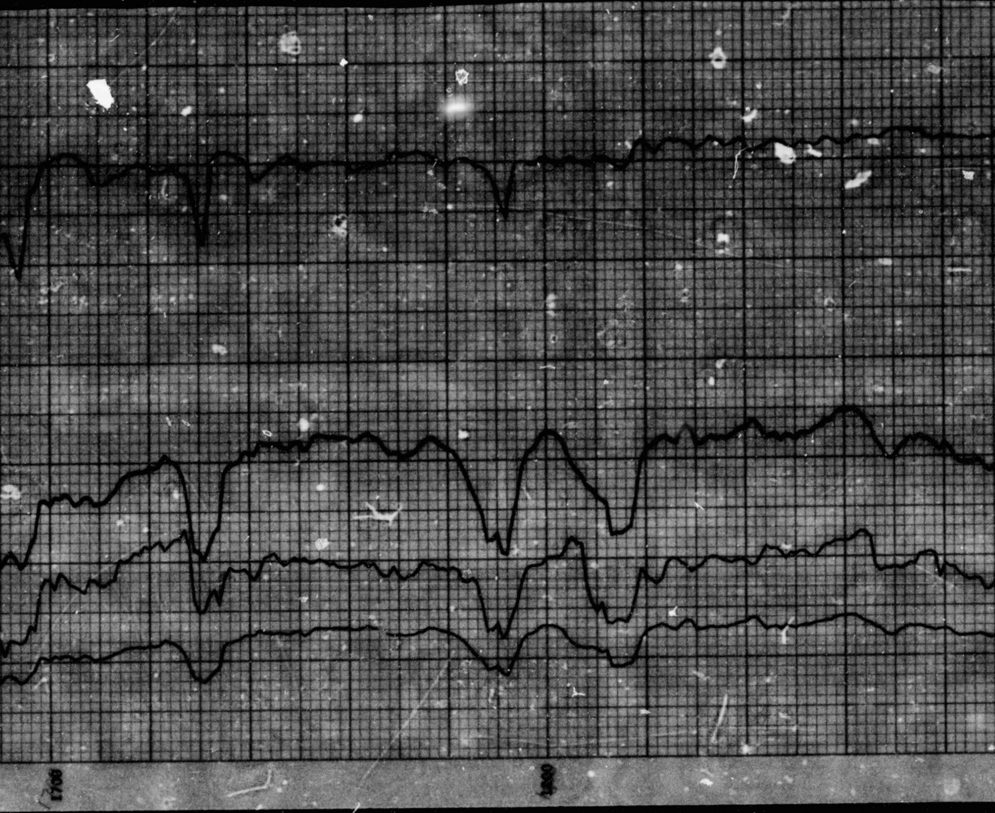


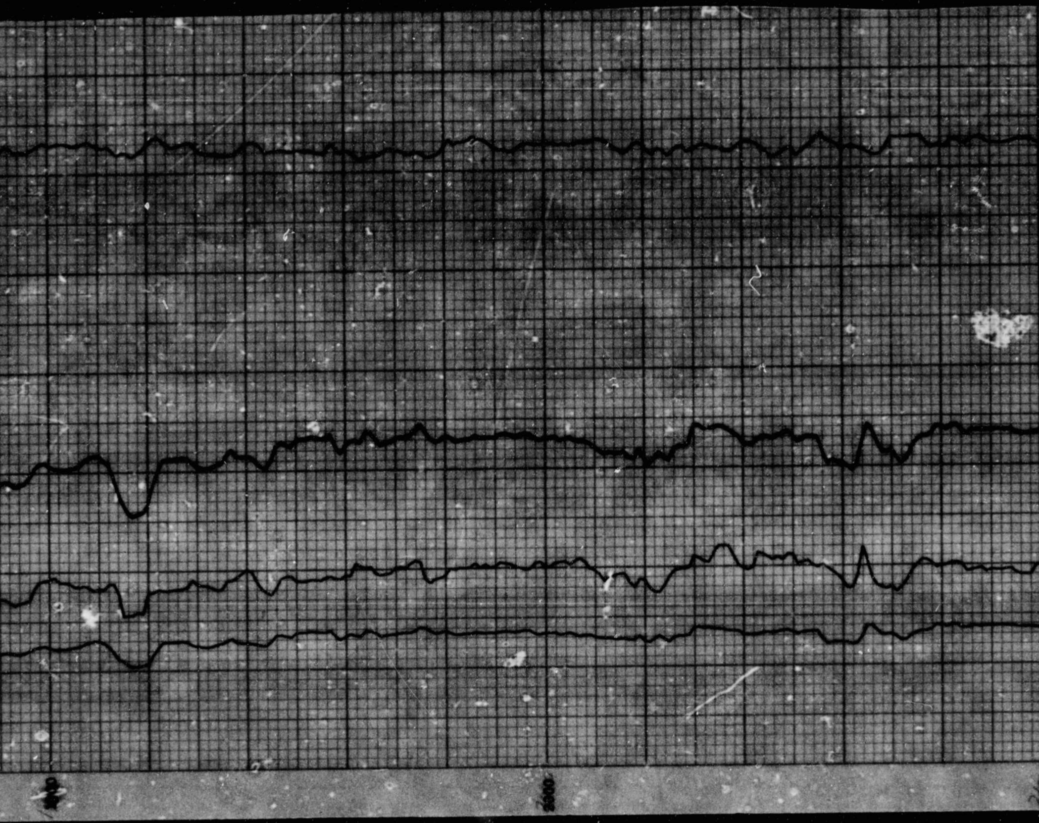




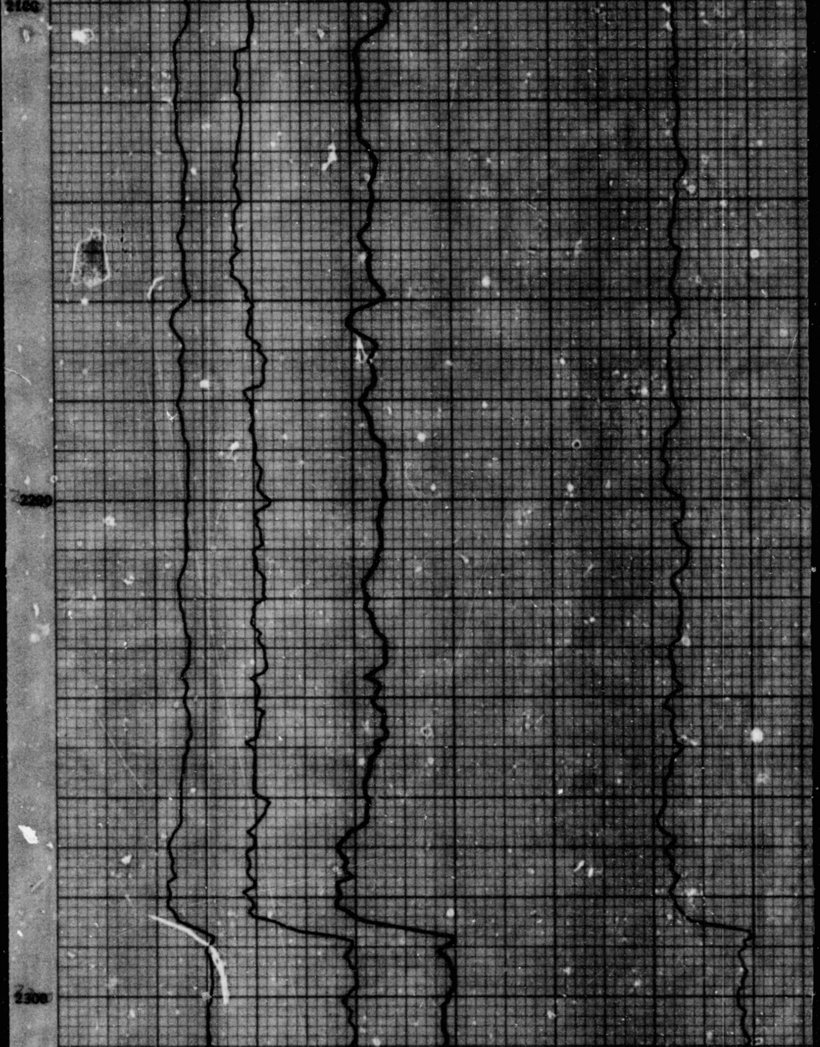



3100
3170
Section No. 2
DEPTH
ELASTIC MODULI
IN
10^4 LBS./SQ. INCH
0
400
800
1200
1600
BULK DENSITY
grams/cm^3
2.0
2.5
3.0
3.5


1700
1800



2000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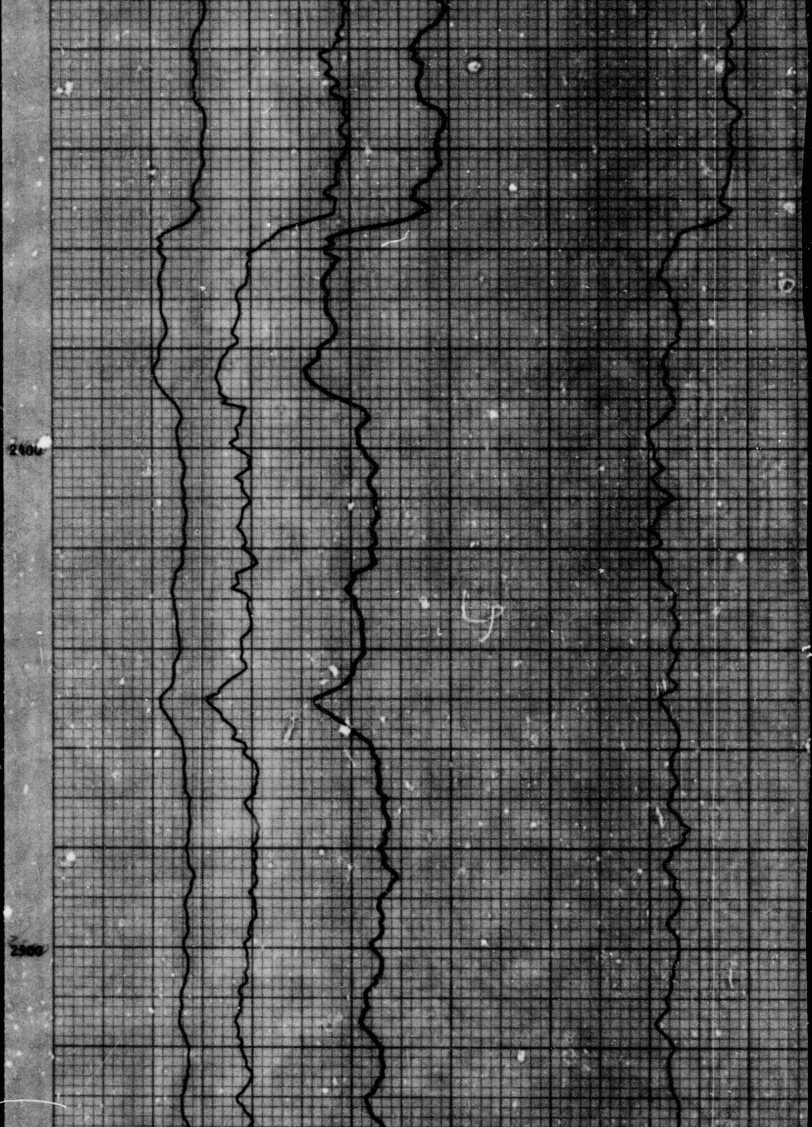
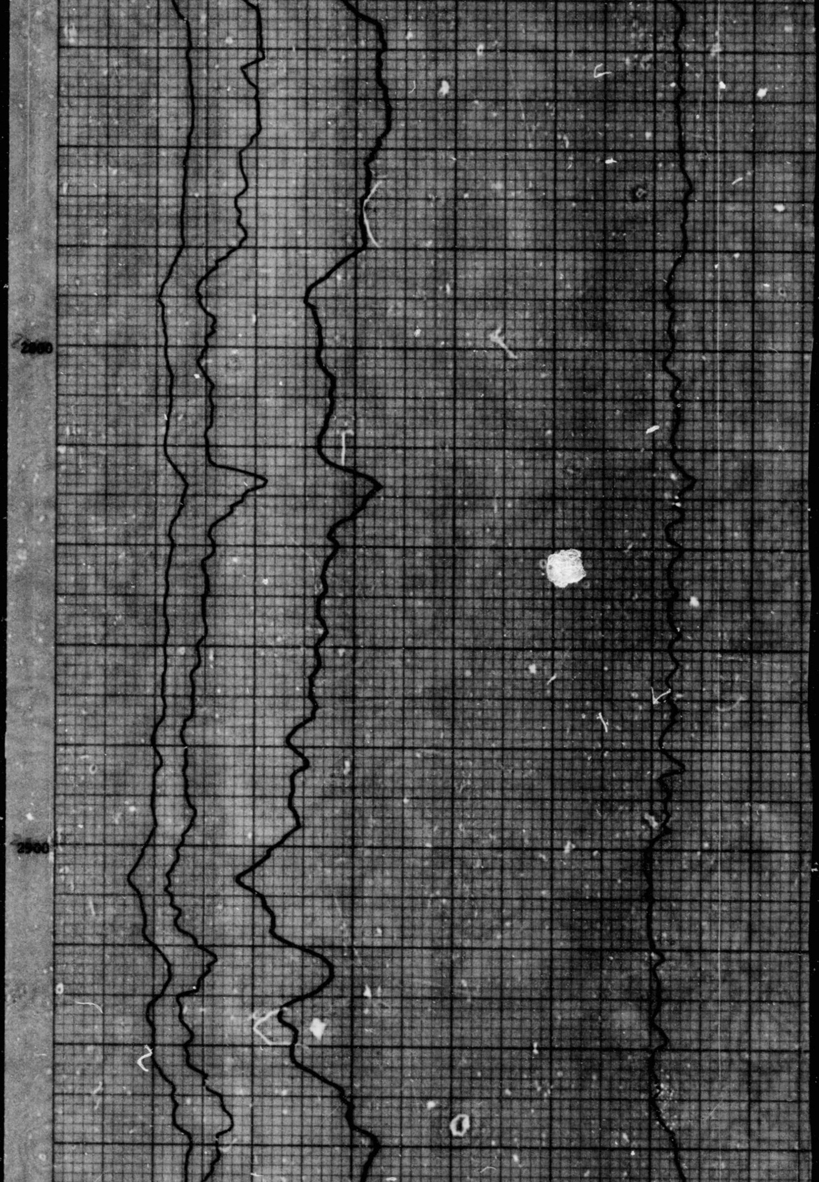
2200
2300


2400
2500

2600
2700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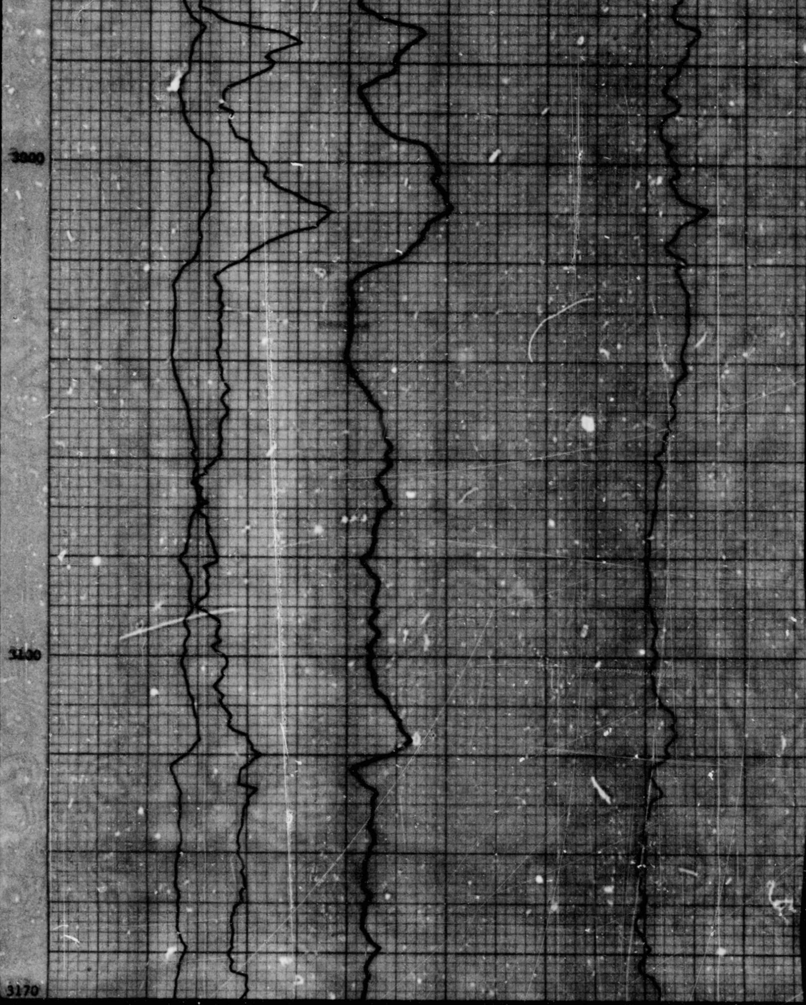
2900


3000
3100
3170

Field Engineering Corporation
Gamma Ray-Neutron Operations

NEUTRON/NEUTRON

Date: 5/25/78
Truck No.: 1275
Operator: BRYAN

COMPANY: BP/Michigan
FIELD: ELA
FACILITY: CLAIM
AREA:
COUNTY: Mecosta STATE: Michigan

Sec. 2 Twsp. 12N Rge. 13W
Elev. Kelly Bushing: 1000
Elev. Ground Level: 1000
Elevation Measured From: KB
Depth Measured From: KB

EQUIPMENT DATA

Probe No.	877	
Probe Type	2"	
RECEIVER		
Run No.		
Hole Type	Open	Cased
Diameter	7"	4½"
Detector Type	LP/CDAT	LP/CDAT
Detector Length	12"	12"
Source Strength	N/A	N/A
Source Type	N/A	N/A
Source Serial No.	1625-25	1625-25
Disc. Level	0.50	0.50
Filter Type	NA	NA
Filter Thickness		
Casing Tension		
ELECTRICAL		
Run No.		
Hole Type		
Cable Length		
GP Reference		
GP Offset		
Drum Length		
CALIPER		
Run No.		
Hole Type		
Calipers Used		
Hole Size		
Minimum Diam.		
Maximum Diam.		

CASING RECORD

Size	Depth	Type
8 5/8"	Surface	32#

Casing Shoe: 2775
Casing Collar: 2741
Bottom Log Int.: 2775
Top Log Int.: 2400
Bottom Log Gal.: 2775
Top Log Gal.: 2400
Casing Fluid: 30#
Remarks: NO Gamma indicates casing shoe in 5/8" Mud from 40-2775'

HOLE RECORD

Size	Depth	Type
12 3/4"	Surface	1420
7 7/8"	1420	2776

Bit No.:
Hole Type:

CEMENT

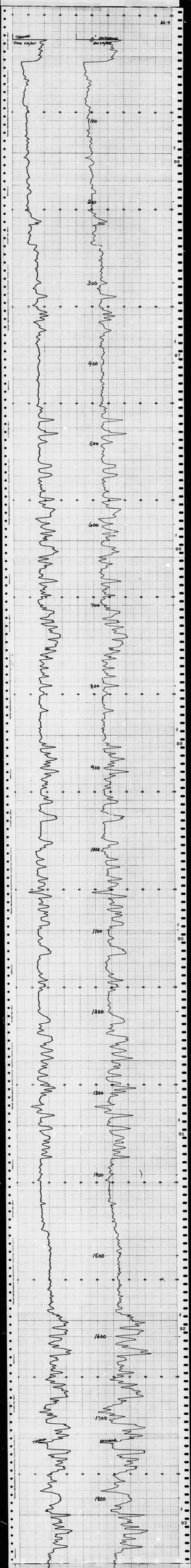
Run No.:
Hole Type:

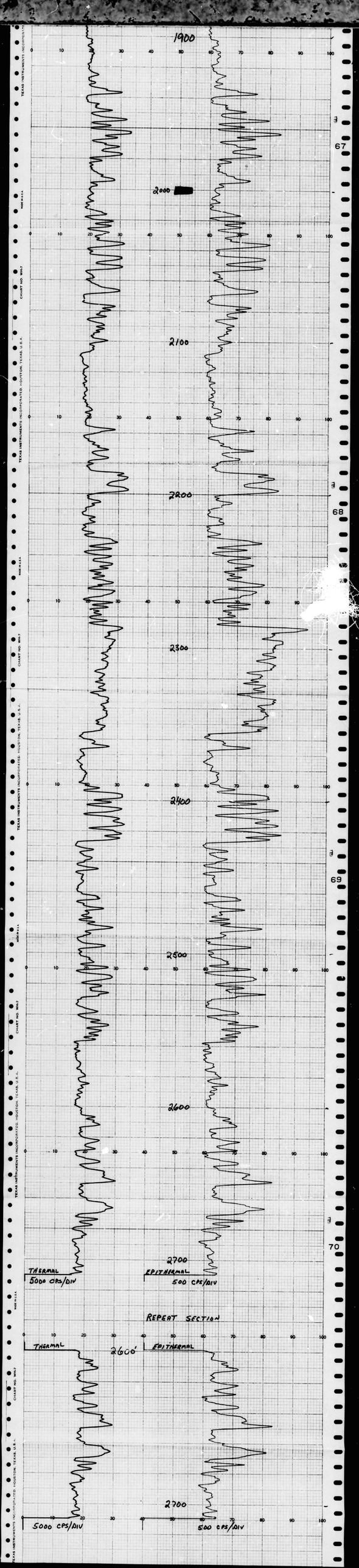
FLUID DATA

Fluid Level:
Fluid Type:
Density:
Viscosity:
Fluid Loss:
Resistivity:
Temperature:
Chlorides:
Calcium:

LOGGING DATA

No.	Run Date	Depth Logged From	Depth Logged To	Speed Ft/Min	Time Constant	Sensitivity Scale	Sensitivity Setting	Gain	Gain Setting	Source Strength	Source Type
1	5/25/78	2775	2400	110	25	17x102	500cps	1		NA	NA
2	5/25/78	2775	0	110	25	17x102	500cps	1	27.single	NA	NA
3	5/25/78	2775	0	110	25	17x102	500cps	1		NA	NA
4	5/25/78	2775	0	2775	25	17x102	500cps	1	27.single	NA	NA




1900
2000
2100
2200
2300
2400
2500
2600
2700
THERMAL
5000 CPS/DIV
EPITHERMAL
500 CPS/DIV
REPEAT SECTION
THERMAL
2600'
EPITHERMAL
2700
5000 CPS/DIV
500 CPS/DIV
67
68
69
70
TEXAS INSTRUMENTS INCORPORATED HOUSTON, TEXAS, U.S.A.
CHART NO. WM-7

Schlumberger — **Field Engineering Corporation**
Formed Jurisdiction Operations

GRPM, RES, SP

Date: 5/26/78
Run No: 1ST
Operator: KRCW

COMPANY: ATLAS Minerals
WELL: CLARK
PROPERTY:
AREA:
COUNTY: Manistee STATE: Michigan

LOCATION:
Sec 14, Twp 18N, Rng 15W
elev. 2000 ft. above sea level
Elevations: KB 2000 ft. Grid Elev. N/A
DF 2000 ft. Base Map N/A
GL 2000 ft.
Date of Measurement of Logs: 5/26/78

CASING RECORD

B.O.T.	Surface	80'	

Type Fluid: Gelled Water
Density: 8.7 lb/gal
Viscosity: 40 sec
Fluid Level: Full
Source of Sample: Pump
Rm @ Meas. Temp: .1@ 70°F
Rmf @ Meas. Temp: .1@ 70°F
Rmc @ Meas. Temp: .1@ 70°F
Source Rmf: Rmc: Mud Flow at Jets
Rm @ BHT: .1@ 150°F
Max. Rec. Temp. Recorded: 150°F @ 1870'

TIME SINCE MADE

Last Circ.	5/26/78
Left Bottom	5/26/78
Arrival	5/26/78

EQUIPMENT DATA

Hole Size	12 1/4"		
Bit Type	Reed		
Bit No.	1		
Jets	Open		
Depth Out	1800'		
Depth In	80'		
Footage	1720'		
Hours	5		
Feet/Hour	344		
Mud Type	Gelled Water		
Mud Wt.	8.7 lb/gal		
Viscosity	40 sec		
Fluid Loss	N/A		
Pump Size	5 x 5		
Liner Size	5"		
Stroke	18"		
Spm	60		
Pressure	1000 psi		
Jet Size	12/32		
Pump Output	0.0		
Hydraulic Horsepower			
Jet Velocity			
Impact Force			
Bottom Hole Assembly	Rock Bit, 6 DC		

CASING DATA

Size	8 5/8"
Wt.	24#
Grade	J-55
Thd.	Buttress
Depth	80'
Cmt.	50 sx
Type Cmt.	Class A
Add.	2% CaCl
Disp.	5 bbl
Bumped	Yes
Plug Down	1:00 AM
Cmt. Circ.	Yes
Top Cmt.	Surface
Hole Size	12 1/4"
Shoe Test	Not Drilled
Stage Tool	
Centralizers	1
Scratchers	
Baskets	
Cmt. Bond Log	

CORING

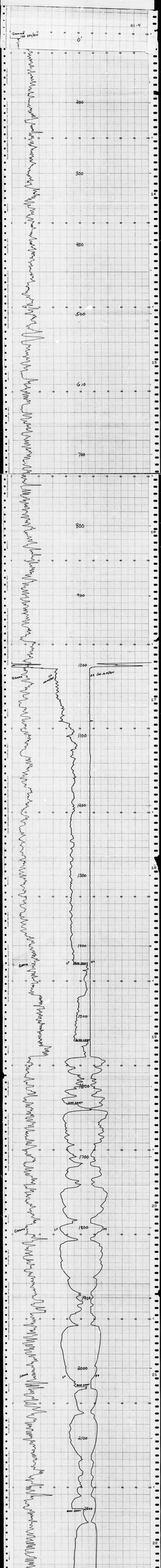
Size	
Type	
Interval	
Recovery	

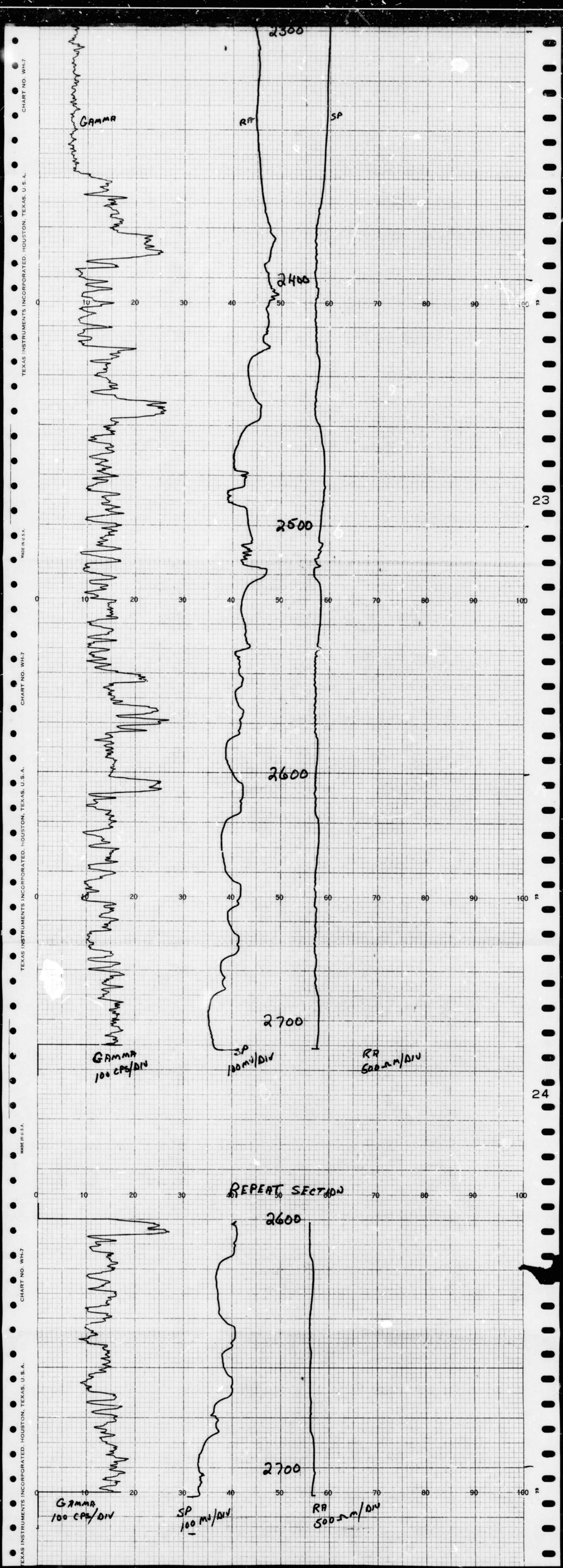
CORE DESCRIPTION

Core No.	Depth		Length Cored	Length Recovered	% Recovered	Lithology	Porosity	Fluid Content	Other Observations

DRILL STEM TEST

Test No.	Interval	Time	Initial Flow	Final Flow	Initial Shut-In	Final Shut-In	Recovery	Pressure	Temp.

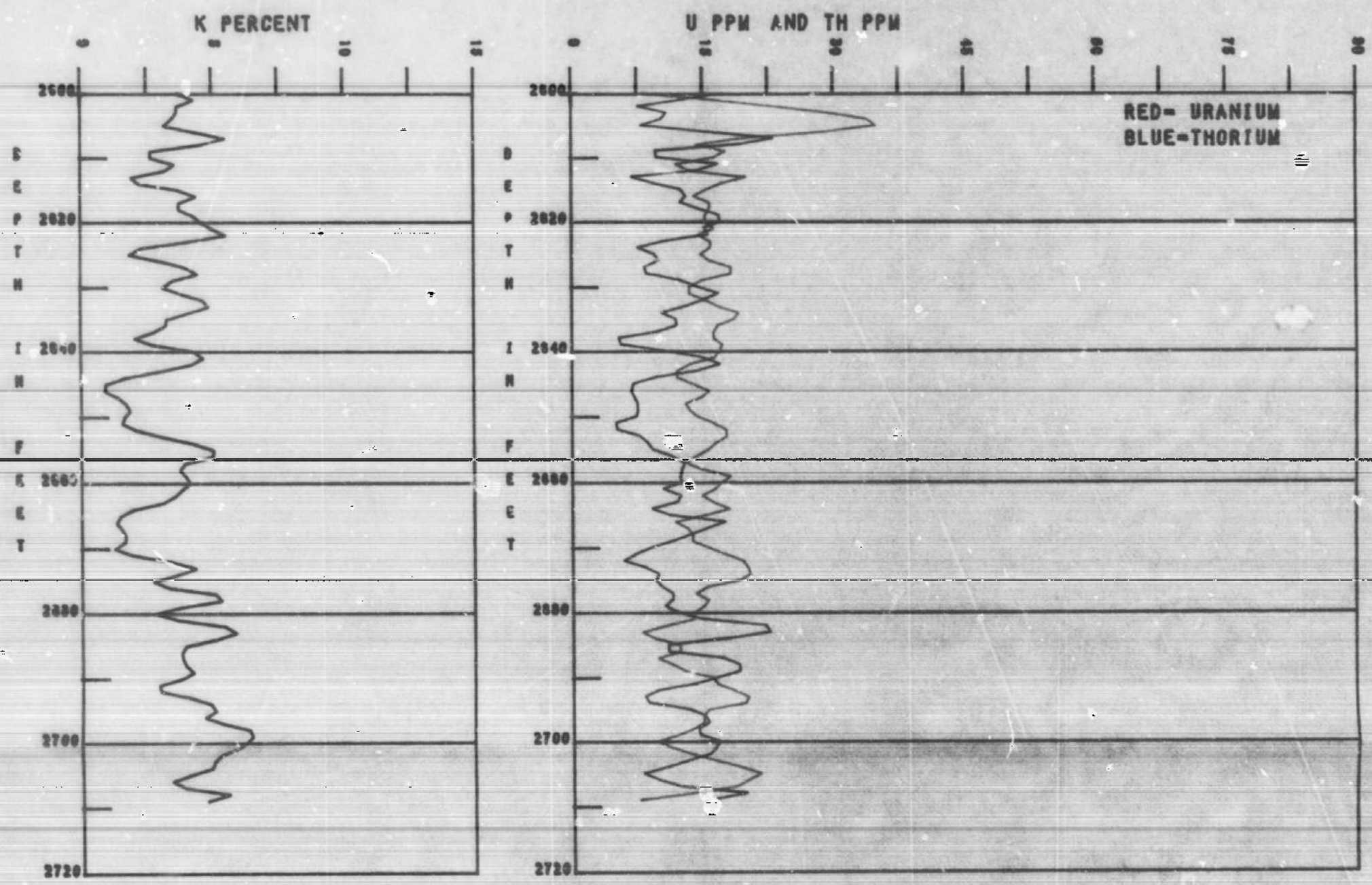



2300
GAMMA
RA
SP
2400
2500
2600
2700
GAMMA
100 CPS/DIV
SP
100 MV/DIV
RA
500 Ω-m/DIV
REPEAT SECTION
2600
2700
GAMMA
100 CPS/DIV
SP
100 MV/DIV
RA
500 Ω-m/DIV
23
24
TEXAS INSTRUMENTS INCORPORATED, HOUSTON, TEXAS, U.S.A.
CHART NO. WH-7
MADE IN U.S.A.

HOLE DL-4 REPEAT

MICHIGAN BASIN (FILTERED)

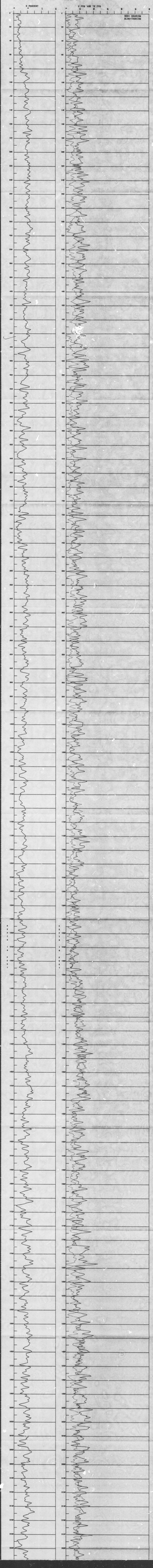
LOGGED- 05/29/78 UNIT 1725 PROBE 253-L 2600' - 2720'

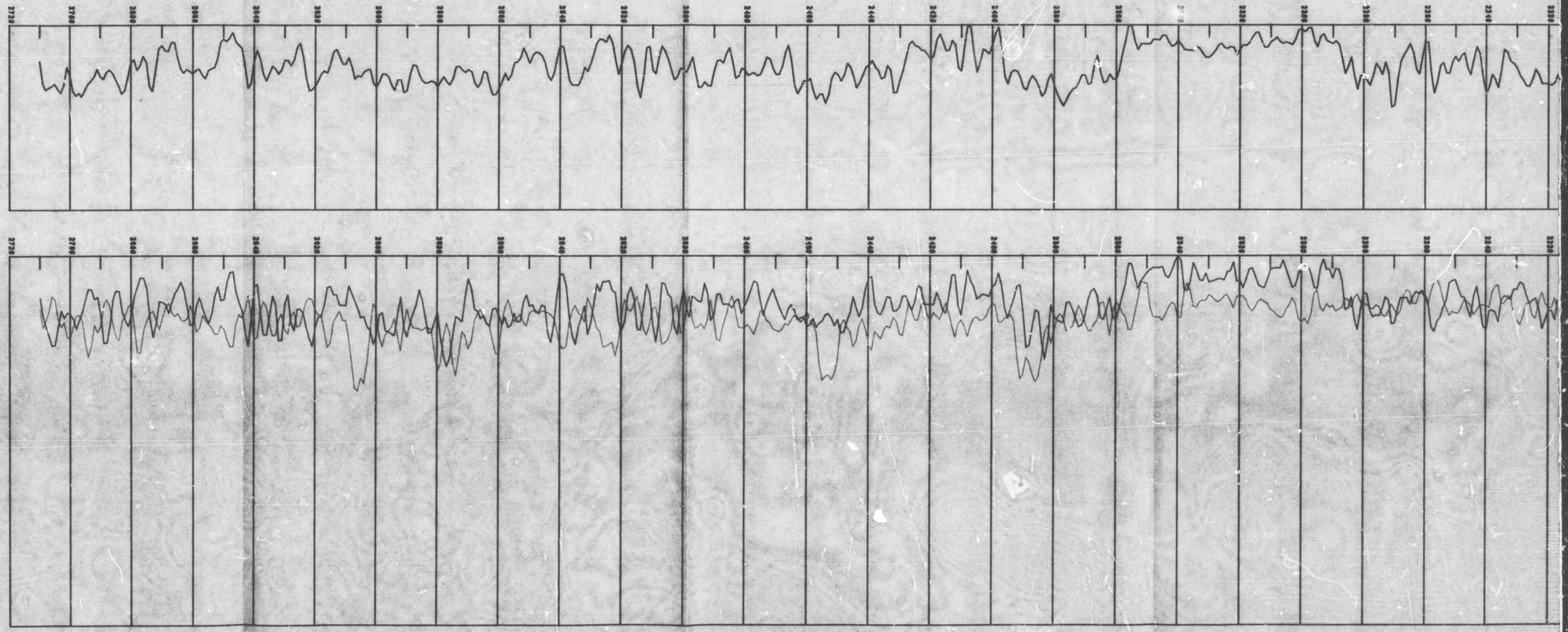


HOLE DL-4

MICHIGAN BASIN (FILTERED)

LOGGED: 05/28/79 SHOT 1733 PROBE 203-L





Bendix Field Engineering Corporation
Grand Junction Operations

CALIPER
MAGNETIC SUSCEPTIBILITY

Date 5/30/78 REV. NO.
Truck No. 1725
Operator Gisler

COMPANY BFEC/Michigan
HOLE DL-4 CLAIM
PROPERTY
AREA
COUNTY Marquette STATE Michigan

LOCATION
NW 1/4, NE 1/4
SEC 2 TWP 48N RGE 28W

Other Services
Gamma RA, SP
NOT N/A

Permanent Datum: Elev.:
Log Measured From: Ft. Above Perm. Datum
Drilling Measured From: Elev.:

EQUIPMENT DATA

PROBE NO. CAL-502, MS-901 PROBE DIAM. CAL-1-7/8", MS-2.5"

NUCLEAR			
Run No.			
Log Type			
Detector			
Detector Size			
Source Type			
Source Strength			
Source Spacing			
Amp. Gain			
Disc. Level			
K Factor			
Deadtime			
Casing Factor			

ELECTRICAL			
Run No.			
Log Type			
Normal Spacing			
Reference			
SP Polarity			
Bridle Length			

CALIPER			
Run No.	1		
Device Type	1 arm		
Tool Position	Side		
Minimum Span	2.25		
Maximum Span	10"		

FOLD HERE

CASING RECORD

Size, Wgt	From	To
4-1/2"	Surface	90'

Depth Driller: 3176
Depth Logger: 2710
Type Fluid in Hole: Water
Salinity ppm: Fresh
LM and Fluid Level:
Density Lb/Gal:
Fluid Level: 30'

Remarks: Mud Plug at 2715'
MS log indicates casing 1000' to 1470'

BORE HOLE RECORD

Bit Size	From	To
3.78"	Surface	1470'
2.98"	1470	3176

OTHER			
Run No.	1		
Log Type	Magnetic Susceptibility		
Bias Polarity	Positive		
Bias Setting	0.10		

LOGGING DATA

Run No.	Log Type	Depths From	Depths To	Fr-ager Logged	Speed Ft./Min.	Depth Scale	Sens. Units/Div.	T.C. Sec.	Zero Div. L or R	Digital Interval	Digital Time
1	Caliper	2710	0	2710	30	1"=20'	1"=1"	--	=0=	0.5'	0.1sec
1	MS	2710	0	2710	30	1"=20'	6.5V	--	=0=	NA	

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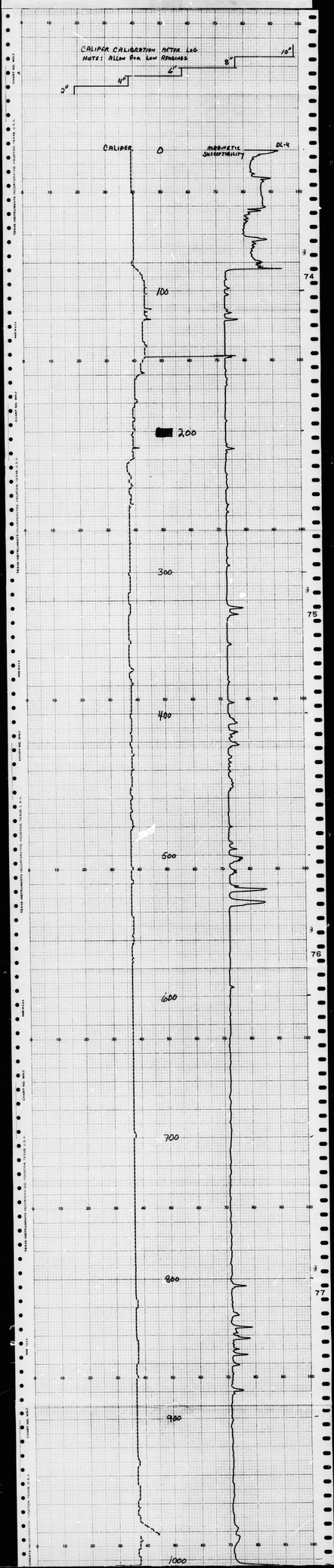

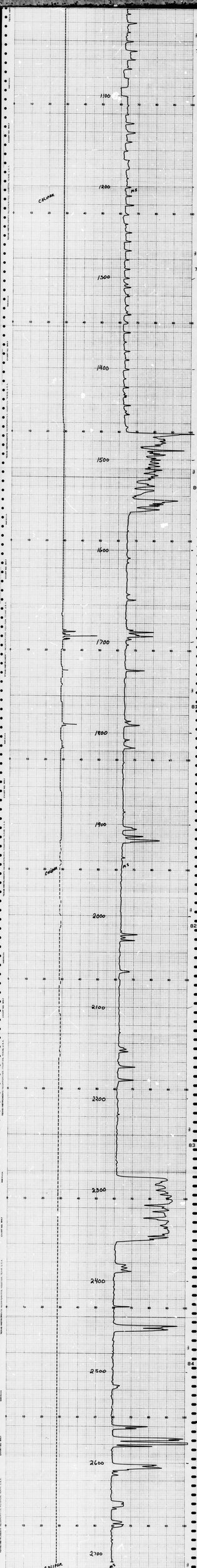
CALIBR
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
CALIBR
79
80
81
82
83
84
85