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ECONOMIC MINERALS
FILE REPORT No.
S-AF-003 (3)

1970005

GEOLOGICAL AND ENGINEERING REPORT
ON THE
INITIAL EXPLORATION PROGRAM
FOR
ANKERTON SULPHUR PROJECT, ALBERTA
DEVIL'S ELBOW MINES LTD.
Permit 1
and the

D.E.M. ANKERTON SULPHUR 15-4
LOCATED
LSD 15 SECT. 4, TWP. 44, RGE. 16W4, ALBERTA

and the

D.E.M. ANKERTON SULPHUR 10-4
LOCATED
LSD 10, SECT. 4, TWP. 44, RGE. 16W4, ALBERTA

BY

A. C. A. HOWE INTERNATIONAL LIMITED

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REPORT No. 87
TORONTO, ONTARIO.

SEPTEMBER 12, 1967

A. C. A. HOWE INTERNATIONAL LIMITED
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SUMMARY

Devil's Elbow Mines Ltd. presently holds a Crown Permit containing 20,000 acres and Freehold leases containing approximately 3,360 acres for the purpose of exploration for sulphur.

The property is located approximately 7 miles south of the village of Daysland, Alberta, and is accessible by gravel roads. Rail transportation is readily available to all points in Canada and the U. S. A.

The Company drilled the D.E.M. Ankerton Sulphur 15-4 and 10-4 wells during May and June 1967, to test the Basal Wabamun Formation for elemental sulphur. Zones of 30.7 feet grading 7.8% sulphur and 6.5 feet grading 5.7% sulphur were intersected in the wells.

The sulphur was apparently deposited in a complex lagoonal environment and other sulphur deposits may be developed nearby.

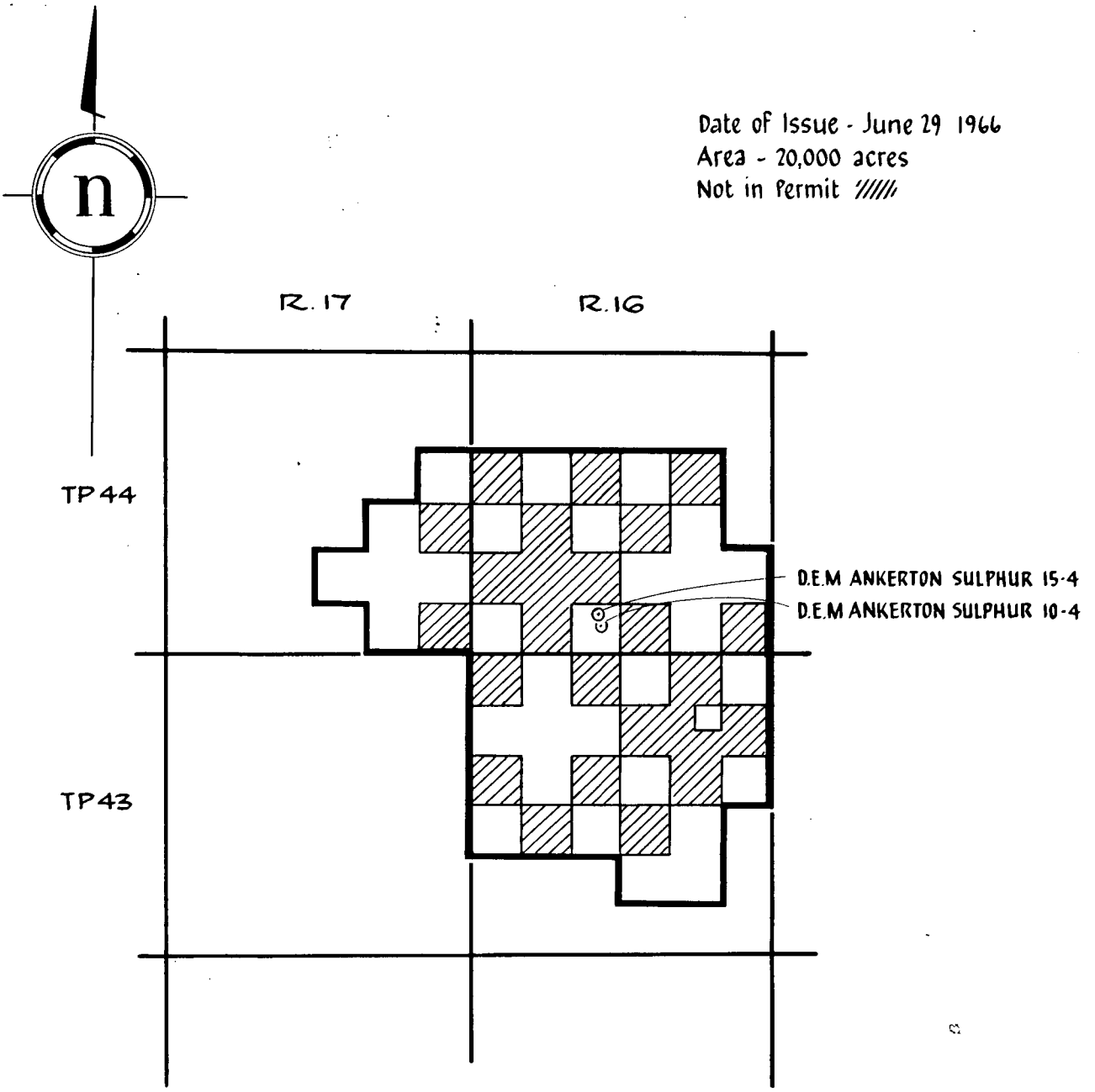
Subsurface control in the area is very limited except in the area between the Banff Ankerton 15-4 well and the D.E.M. Ankerton Sulphur 10-4 well where a tonnage of 216,000 short tons of 20% sulphur has been inferred assuming the deposit is 300 feet wide and consistent between the three wells.

Extraction tests on the cores obtained from the wells indicate that adequate porosities and permeabilities will be developed in the main sulphur zone to enable Frasch mining provided the deposit is economic. More exploratory drilling is required before the potential of the deposit will be known.

An initial exploratory drilling programme consisting of three step-out wells has been recommended to further evaluate the deposit.

The total estimated cost of this programme is $33,925.00 per well.

FIGURE 4



Date of Issue - June 29 1966
Area - 20,000 acres
Not in Permit ////

DEVIL'S ELBOW MINES LTD
SULPHUR PROSPECTING PERMIT No 3

PROPERTY MAP

by

A.C.A. HOWE INTERNATIONAL LTD

JULY '67

PURPOSE AND SCOPE

The purpose of this report is to evaluate the results of D.E.M. Ankerton Sulphur 15-4 and D.E.M. Ankerton Sulphur 10-4, two explorative wells drilled to test a sulphur bearing horizon in the Upper Devonian Wabamun Formation in the Ankerton Area of Alberta.

An interpretation of the geology and structure of the deposit based on the results of the initial exploration program has been made in order to recommend a suitable program for further exploration and evaluation of the deposit.

Some preliminary information regarding the supply and disposal of fresh water is presented in this report.

PROPERTY

The property presently held by the Company consists of a Crown Permit containing 20,000 acres and Freehold leases containing approximately 3,360 acres with title to an additional 960 acres under negotiation.

Crown Permit - The Crown Sulphur Permit contains 20,000 acres granted for one year commencing on June 29, 1966, and renewable for a second and third term upon payment of rentals at the rate of ten cents per acre per year. The Permit Holder has the right to acquire a lease of sulphur rights in the areas within the permit upon consultation with the Minister. The lease includes a provision that, within

one year from date of lease the lessee must commence construction of a plant and the same must be in operation within four years from the date of the notice. Term of the lease is 21 years, renewable for further terms of twenty-one years each, as long as sulphur is being produced.

Rentals - Leases of Sulphur Rights

(a) 25 cents per acre/per year for the first five years

(b) one dollar per acre/per year for the balance of the term of the lease and any renewal of the lease.

Freehold Leases

3,360 acres acquired

960 acres under negotiation

The Freehold Leases are for 25 years with rentals of one dollar per acre per year. If the lease is producing, no rental will be required.

LOCATION AND ACCESS

The property is located in Central Alberta about 4 miles from Ankerton and 7 miles south of the village of Daysland.

Approximate co-ordinates: 112° 33' W, 52° 46' N

The property is accessible by means of gravel roads from Provincial Highway No. 13 which runs through Daysland from the town of Westaskiwin which is located approximately 42 miles south of Edmonton, Alberta.

TOPOGRAPHY, HYDRO ELECTRIC POWER

The topography is generally flat.

Hydro electric power is supplied to the town of Daysland by the Calgary Power Company and to surrounding rural areas by Canadian Utilities Ltd.

TRANSPORTATION

The property lies approximately 50 miles southeast by road from Edmonton. Main lines of the Canadian National and Canadian Pacific Railways pass through Edmonton and connect with all western and eastern points in Canada. An East-West branch line of the Canadian National Railway passes through Daysland 6 miles north of the property.

Rail transportation to the Western United States is readily available.

HISTORY OF THE DEPOSIT

The presence of elemental sulphur in the Basal Wabamun Formation was first noted by the wellsite geologist on the Banff Ankerton Well Lsd 15-4-44-16 W4. F. J. Halkow and E. A. Brownless subsequently wrote a preliminary report on the prospect in November, 1966.(1)

Devil's Elbow Mines Ltd. optioned the property in February 1967 and drilled two exploration wells in May and June, 1967 (See Appendices A & B).

FIGURE 1

GEOLOGY

STRATIGRAPHY

TABLE 1 CORRELATION OF FORMATIONS

AGE	FORMATIONS Members	ELEVATIONS--(ABOVE MEAN SEA LEVEL A.M.S.L.) BANFF ANKERTON 15-4	D.E.M. ANKERTON SULPHUR 15-4	D.E.M. ANKERTON SULPHUR 10-4
Upper Cretaceous	LEA PARK FM.	+1084	+1090	+1076
	COLORADO FM.	+503	+487	+503
	Sec. White Speck	-135	-132	-138
	B. Fish Scale	-323	-329	-341
	Viking S.S.	-494	-492	-497
	Joli Fou	----	-562	-567
Lower Cretaceous	BLAIRMORE FM.	-632	-638	-645
	Ostracod Zone	-1015	-1009	-1004
	Basal Qtz. Sand	-1032	-1023	-1017
Upper Devonian	WABAMUN FM.	-1242	-1248	-1222
	Graminia Silt	-----	-1285	-1276
	Sec. Calcite Zone	-----	-1291	-1308
	Sulphur Zone-top	-1326*	-1325	-1314
	Calmar Silt	-1332	-1344	-1340
	Sulphur Zone-base	-1333*	-1347.5	-1316
	NISKU FM.	-1352	-1355	-1345

*Information taken from sidewall cores

Adequate detailed descriptions of the lithologies in D.E.M. Ankerton Sulphur 15-4 and D.E.M. Ankerton Sulphur 10-4 are presented in the sections on Geology in Appendices A and B respectively.

MODE OF OCCURRENCE OF THE SULPHUR

The Sulphur Zone is developed in the limestone breccia of the Upper Devonian Basal Wabamun Formation and extends through the evaporite unit into the underlying Calmar Silt (See Figures 8 and 9).

A zone of secondary calcite within the lower portion of the Wabamun Formation extending above and through the sulphur zone, appears to be directly associated with the mineralization.

(i) Mineralization and Texture

The elemental sulphur occurs both as bituminous and pure sulphur associated with secondary white calcite. The crystalline calcite occurs as infillings in long, irregular, vertical fractures and also as small blebs in the matrix and fragments of the limestone breccia.

Bituminous sulphur intrudes and appears to replace the limestone breccia matrix first, but complete replacement of limestone fragments by sulphur was noted in some of the higher grade sections.

Bright yellow, crystalline sulphur appears regularly within the bituminous sections and occurs primarily as blebs and drusy masses infilling infrequent small vugs.

Assays of the sulphur extracted during the steam-melting tests (see Appendix A) show that the sulphur contains low values in silica and organic solids and no selenium, tellurium or arsenic.

The underlying shaly portions of the Calmar Silt, when well developed exert a structural control on the deposit, providing a base for the mineralization. This was especially evident in the D.E.M. Ankerton Sulphur 10-4 well.

No limiting structure appears to control the mineralization in the upper portions of the sulphur zone and sulphur values tended to decrease gradually upwards. A well developed zone of secondary calcite, without visible sulphur extended above the sulphur zone for considerable distance into the overlying limestone breccia. The close association of the sulphur with this Secondary Calcite Zone, and the apparent lack of lithological change from the host limestone breccia to the overlying breccia indicates that the sulphur mineralization could extend over greater thicknesses of the Basal Wabumun in other areas of the deposit.

Irregular, long, steeply-dipping fractures (see Core Description) through portions of the limestone breccia do not appear to have acted as channelways for the sulphur. Most of these fractures are completely infilled with shale.

The Calmar Silt, which underlies the deposit is in turn underlain by the upper anhydritic section of the Nisku Formation. This section consisted of anhydritic dolomite in D.E.M. Ankerton Sulphur 15-4 and bedded anhydrites in the second well. The dolomites in the first well were fairly well oil stained and had a much higher effective porosity than the massive bedded anhydrites in the D.E.M. Ankerton Sulphur 10-4 well.

Reference can be made to the 35 mm. colour films (available on request) of the cores for a detailed visual examination of the section through the sulphur zone.

(ii) Electric Log Configuration through the Basal Wabamun Evaporitic Unit

A correlation of the Basal Wabamun evaporitic unit has been made using the resistivity-self potential configuration of the induction electric logs of wells in the area (see Figure 7).

The Basal evaporitic unit of the Wabamun consists mainly of anhydrites or anhydritic dolomites but is significant because of the development of a sulphur bearing zone in the Ankerton well area.

The electric log configuration of the low-porosity, massive anhydrites, dolomites and sulphur-bearing limestones is similar, however, the three lithologies can be readily differentiated by the examination of drilling samples.

The self potential curve characteristically remains very uniform and low (see diagram Figure 7) and the resistivity rapidly increases to a relative high with the maximum usually between 50 to 300 ohm-m^2/m.

This configuration is developed best in units having very low porosities such as massive dense anhydrites, or dolomites (or limestones) in which the pores are almost entirely infilled with calcite, anhydrite or sulphur; however economically significant sulphur zones could be developed in units having higher porosities due to only partial secondary infilling.

(iii) Size and Shape of the Deposit

Reference should be made to the generalized geological cross sections of the area (Figures 8 and 9).

Very sparse subsurface information, except in the area between the two wells, seriously limits the interpretation of the size and shape of the deposit.

In order to understand the controlling structures, a preliminary interpretation of the paleo-environments in the Basal Wabamun unit has been made (see Figure 7).

The most important environmental control was the development of a complex barrier reef up to twenty feet high, trending northwest-southeast and restricting the circulation of sea water over a large area. Lagoonal sediments accumulated within the structure.

The land mass lay to the southeast of the Texaco Heisler 2-13-43-16 well and thick beds of anhydrite were deposited in the back lagoonal area near the land mass and in the mid-lagoonal area near D.E.M. Ankerton Sulphur 10-4.

The Basal Wabamun consists of anhydritic dolomite in the back reef area around Winter et al Daysland 10-12-44-17 and Camak Kodiak Ankerton 5-1-44-17.

In the complex reef and interfringe reef area to the north of D.E.M. Ankerton Sulphur 15-4, the section consists of porous reefoid dolomites and limestones. Open sea probably lay just to the north of wells R.O. Corp Daysland 6-16-44-16 and Cal. Std. Daysland 11-19-44-16 in which these reef structures are exposed.

Another back lagoonal area in which bedded anhydrites were developed existed in the area around Imp. Rosalind 9-9-44-17 several miles to the west of the sulphur deposit. This area may be part of a smaller lagoon within the larger lagoon complex described.

It is important to note that smaller reef-lagoonal environments do exist within the larger area described here and outlined in Figure 7. The sulphur deposit, if compared with other sedimentary sulphur deposits in Poland, could be developed in a portion of one environmental area and there might be several separate sulphur bodies developed in other similar local environments nearby.

The sulphur deposit is underlain by the Calmar Silt which uniformily rises approximately 1 in 300 from west to east (see Figure 9).

The Nisku rises approximately 1 in 150 from D.E.M. Ankerton Sulphur 15-4 to D.E.M. Ankerton Sulphur 10-4 (see Figure 8) and the structure contours to the south indicate that it continues to rise slightly (see Figure 5). The rise to the south of the first well is accompanied by a thinning of the high grade portion of the sulphur bearing zone from over 8 feet to 2 feet. The D.E.M.Ankerton Sulphur 10-4 well therefore intersected the southern edge of the sulphur deposit.

The R.O. Corp Banff Daysland 13-10 well, approximately 6,000 feet northeast of the first sulphur well, intersected a section of anhydritic dolomite in the Basal Wabamun. This is a different environment and lithology from that intersected in D.E.M. Ankerton Sulphur 15-4 and since the 13-10 well is close to the interfringe reef complex in well R.O. Corp Daysland 6-16, it can be assumed that the sulphur deposit does not extend into this area.

Very little control is available to the west and northwest of the deposit. The nearest well to the west is Comak Kodiak Ankerton 5-1 a distance of more than 3.5 miles; therefore the sulphur deposit can not be accurately delimited in this direction. The correlation of the Basal Wabamun unit from well to well is very good

provided the three different characteristic lithologies are taken into account and correlated as one unit.

The sulphur deposit extends approximately 1800 feet to the south of Banff Ankerton 15-4 and is assumed to extend a minimum of 300 feet to the north of that well. This gives a total north-south section of 2100 feet (see Figure 8).

Since the sulphur deposit appears to be controlled by the paleo-environment of the Basal Wabamun section, it is probable that the sulphur mineralization extends for a relatively short distance towards the R.O. Corp. Banff Daysland 13-10 well 6,000 feet to the northeast. The depositional environment in well 13-10 appears to be back reef rather than entirely lagoonal. In addition, there is no evidence of sulphur or the related intensely brecciated limestone in the drilling samples from that well.

The extension of the sulphur zone therefore appears to be limited to the northeast and is assumed to be developed only 1600 feet in that direction (see Figure 9). It should be remembered that the sulphur zone could be found to extend further to the east or northeast.

The western portion of the sulphur deposit is open due to the lack of information.

The D.E.M. Ankerton Sulphur 15-4 well was drilled 300 feet south and almost 100 feet west of the Banff Ankerton 15-4 well. Since a thicker sulphur zone was encountered in the D.E.M. Ankerton Sulphur 15-4 well slightly to the west, we can assume that the section extends in that direction at least for the same distance as it is inferred to be developed to the north east (i.e. 1600 feet).

Not enough information has been obtained from the drilling done to date to calculate proven or indicated reserves.

The following is a calculation of the inferred tonnages in the area between Banff Ankerton 15-4 and D.E.M. Ankerton Sulphur 10-4, using a length of 1700 feet between these wells and assuming a width of 300 feet. A cutoff grade of 20 per cent sulphur will be used to obtain the thicknesses of the sulphur zone in the D.E.M. Ankerton Sulphur 15-4, D.E.M. Ankerton Sulphur 10-4 and Banff Ankerton 15-4 wells.

Banff Ankerton 15-4

note - information obtained from sidewall cores
Interval: 3660 to 3663 feet K.B. (3.0 feet)
Sulphur estimated: 20% by weight

D.E.M. Ankerton Sulphur 15-4

note - information obtained from core assay (see Appendix A)
Interval: 3659.0 to 3667.6 feet K.B. (8.6 feet)
Sulphur calculated: 20.3% by weight

D.E.M. Ankerton Sulphur 10-4

note: information obtained from core assay (see Appendix B)
Interval: 3650.0 to 3651.8 feet K.B. (1.8 feet)
Sulphur calculated: 20.4% by weight

INFERRED TONNAGE BETWEEN BANFF ANKERTON 15-4 and D.E.M. ANKERTON SULPHUR 15-4 IN THE SULPHUR ZONE

Length: 300 feet
Width : 300 feet
Average thickness: $\frac{8.6 + 3.0}{2}$ = 5.8 feet

(arithmetical calculation possible with a consistent grade.)
Average grade: 20%

rock factor (assuming 20% Sulphur (sp.gr.2.0) and 80% limestone (sp.gr.2.7) = 12.5

Tonnage

$\frac{300 \times 300 \times 5.8}{12.5}$ = 41,760 short tons

INFERRED TONNAGE BETWEEN D.E.M. ANKERTON SULPHUR 15-4 AND D.E.M. ANKERTON SULPHUR 10-4 IN THE SULPHUR ZONE

Length: 1400 feet
Width : 300 feet
Average thickness: $\frac{1.8 + 8.6}{2}$ = 5.2 feet

(arithmetical calculation possible with consistent grade)

Average grade: 20% sulphur by weight

Rock factor: assuming 20% Sulphur (sp.gr.2.0) and 80% limestone (sp.gr.2.7) = 12.5

Tonnage

$\frac{1400 \times 300 \times 5.2}{12.5}$ = 174,700 short tons

Assuming the width of the deposit is 300 feet and that the sulphur zone is consistent between the wells, a total inferred tonnage of 216,000 short tons of sulphur bearing limestone grading 20% Sulphur has been outlined in the area of the three wells drilled to date.

(iv) Porosity and Permeability through the Sulphur Zone

Complete porosity and permeability statistics are presented in the Core Analysis Reports at the rear of Appendices A and B. Colour photographs of the core are available on request. Two intervals have been chosen from the results in the D.E.M. Ankerton Sulphur 15-4 well. The following table gives the weighted average permeabilities and porosities before and after the sample was run for extraction tests.

D.E.M. ANKERTON SULPHUR 15-4

K.B. ELEVATION / INTERVAL feet	feet	WEIGHTED ASSAY % Sulphur	SAMPLE TYPE	WEIGHTED PERMEABILITY TO AIR K max	K 90°	WEIGHTED POROSITY %
3663.1-3665.4	2.3	5.7	dried only	0.04	0.04	0.4
" "	"	"	sulphur melted out	6.3	1.0	3.3
" "	"	"	sulphur dissolved out	410	257	12.2
3661.8-3663.1	1.3	26.1	dried only	no data	no data	0.2
" "	"	"	sulphur melted out	"	"	16.5
" "	"	"	sulphur dissolved out	"	"	19.6

The first interval from 3663.1 to 3665.4 feet K.B. was chosen to illustrate the marked increase in permeabilities and porosities after extraction of the sulphur by steam-melting and subsequently by toluene vapour. Extremely low porosities and permeabilities were obtained before the extraction of sulphur. This indicates that this section, which is characteristic of the main sulphur zone has almost all the pores infilled with sulphur and that the permeability increases rapidly as the sulphur is removed.

The steam-melting extraction technique was designed to obtain laboratory results which might indicate the amount of sulphur recoverable by a Frasch Process. Somewhat low values for permeability after steam-melting extraction probably are the result of incomplete recovery due to the relatively short times (24 hours) which the cores were subjected to heat and pressure. It is likely that permeabilities after steam-melting would be consistently higher and closer to the values after solvent extraction if the samples had been exposed to heat over longer periods of time.

The results in the interval from 3661.8 to 3663.1 feet K.B. show clearly the sharp increase in porosity after extraction of the sulphur.

The porosity and permeability results from the main sulphur horizon in D.E.M. Ankerton Sulphur 10-4 well are given in the following table.

D.E.M. ANKERTON SULPHUR 10-4

K.B. ELEVATION feet	INTERVAL feet	WEIGHTED ASSAY % Sulphur	SAMPLE TYPE	WEIGHTED PERMEABILITY TO AIR K max	K 90°	WEIGHTED POROSITY %
3650.0-3652.1	2.1	18.7	dried only	4.8	4.0	1.8
" "	"	"	after solvent extraction	2684	1808	14.2

The results from this hole are similar to those obtained in D.E.M. Ankerton Sulphur 15-4. The porosity and permeability show the same marked increase after solvent extraction of the sulphur. The steam-melting technique for the extraction of sulphur was not applied to the cores of this well.

Extraction tests indicate that adequate porosities and permeabilities will be developed in the main sulphur zone to enable Frasch mining of the sulphur provided that the grade and tonnages are economic and that the technical problems in mining a deposit at this depth can be overcome.

ORIGIN OF THE SULPHUR AND CLASSIFICATION OF THE DEPOSIT

The Ankerton Sulphur Deposit is probably a syngenetic deposit of sedimentary origin. There is no evidence available to date to suggest that it might be related to salt dome structures similar to those found along the Gulf of Mexico or to volcanic structures similar to the Italian deposits.

Most syngenetic bedded deposits are closely associated with limestones and anhydrite [7]. Fugarty [12] and Murzaiev [7] are among those who favour the production of sulphur by reduction of sulphates (in this case anhydrites) and subsequent oxidation of sulphurated hydrogen to elemental sulphur.

There are two widely known theories to explain the initial reduction of sulphates to hydrogen sulphide. Bischof suggests that the sulphates are reduced by Carbon or Methane by the reactions outlined below [1].

$$CaSO_4 + 2C \longrightarrow CaS + 2CO_2$$

$$CaS + CO_2 + H_2O \longrightarrow CaCO_3 + H_2S$$

OR

$$CaSO_4 + CH_4 \longrightarrow CaS + CO_2 + 2H_2O$$

$$CaS + CO_2 + H_2O \longrightarrow CaCO_3 + H_2S$$

The main problem with this theory is the high heat requirement to precipitate the reactions.

A second theory explaining the reduction of sulphates to H_2S has been put forward by Murzaiev [7] and others. In order to explain the conformable sulphur zones within limestone beds, Murzaiev suggests that the reduction of sulphates is precipitated by anaerobic bacterial action simultaneous with the deposition of the limestones hosting the sulphur. Subsequent oxidation of the hydrogen sulphide by reaction with the anhydrite produced the elemental sulphur.

as: $CaSO_4 + 3H_2S + CO_2 \longrightarrow CaCO_3 + 3H_2O + 4S\downarrow$

Ahlfeld [6] suggests that the reaction of percolating hydrogen sulphide with anhydrite would produce elemental sulphur. I am in agreement with Murzaiev [7] that this reaction would not produce widespread syngenetic bedded deposits of the Ankerton type.

There is some evidence of minor secondary sulphur (bright yellow, crystalline) in portions of the Ankerton deposit. In situ recrystallization of bituminous sulphur and subsequent short migration may have produced the apparent epigenetic replacement and fissure filling structures seen in the cores. Murzaiev cites several examples of these anomalous structures in the Polish bedded sulphur deposits.

The development of syngenetic sulphur beds occurs only in special environments. According to Sloss [8] and Krumbein [9], bedded anhydrites and anhydritic limestones are developed in saline environments, while carbonate-dolomite rocks, similar to those of the Basal Wabamun in the Ankerton area, are developed in penesaline areas. During Early Chautauquan time, the Ankerton area was covered by a large lagoonal structure restricted from the open sea to the north and west by a complex barrier reef [8]. Correlation of the evaporitic Basal Wabaman Unit in the Ankerton Area is difficult because of the complexity of this nearby reef structure. Rapid lateral facies changes were developed as a result of the continuously changing nature of the confining structures. It is most likely that the sulphur zone is related to one of the smaller structures within the main lagoonal area, and that it was developed in a penesaline environment.

The Ankerton sulphur deposit was probably produced by the reduction of anhydrite by biochemical action simultaneously with the deposition of the limestones in a lagoonal environment (see figure 2, page 22).

METHODS OF SULPHUR EXTRACTION

The Frasch Process or an adaptation of this process would most likely be used to recover the sulphur from the Ankerton Deposit if it should prove economic.

Conventional underground mining techniques are employed in many of the Italian deposits but all efforts to use this technique in the United States Gulf Coast Deposits have failed because of the presence of hydrogen sulphide in the overlying formations or the nature of the ground. Since the Ankerton Deposit is much deeper than the Gulf Coast Deposits and since there is a producing gas horizon above the sulphur zone, it is very unlikely that conventional methods could be adapted to mine the deposit should it prove economic.

Sulphur Mining by the Frasch Process is one of the most important methods of sulphur production.

The Process involves melting the native sulphur in place by introduction of super-heated water into the host formation and recovering the resultant liquid sulphur.

FIGURE 2 - INFERRED ENVIRONMENTS IN BASAL WABAMUN EVAPORITE UNIT

WELL	LITHOLOGY Basal Wabamun Evaporite Unit		LITHOLOGY Upper Portion Wabamun		COMMENT ON BASAL ENVIRONMENT
		Inferred Environment		Inferred Environment	
Banff Ankerton 15-4-44-16-W4	Dolomite Brecciated in silty pt. marly	Middle Lagoon	Limestone	Lagoon	Near Anhydrite contact
R. O. Corp Daysland 13-10-44-16-W4	Limestone-siltstone anhydrite at Base	Back Reef	Marly-silty L.S.	Lagoon	Possibly marginal lagoon end well
Cal. Std. Daysland 11-19-44-16-W4	Siltstone-Calcareous basal 20' reefy dolomite-porous	Fringe Reef	Siltstone calcareous	Marine ?	Lagoonal barrier
R. O. Corp Daysland 6-16-44-16-W4	Dense Dolomite & Limestone brecciated	Interfringe Reef or Back Reef	Limestone silty argillaceous dense	Marine	Near circulation Barrier
Brink B. A. Heisler 6-9-43-16-W4	Limestone & Dolomite rose & green dense interbed anhydrite	Lagoon near edge	Bedded Anhydrite	Back Lagoon	---------
Redco LSHO Globe 13-11 43-16-W4	Anhydrite bedded	Back Lagoon	bedded Anhydrite	Back Lagoon	---------

FIGURE 2

FIGURE 2 continued

WELL	LITHOLOGY Basal Wabamun Evaporite Unit		LITHOLOGY Upper Portion Wabamun		COMMENT ON BASAL ENVIRONMENT
		Inferred Environment		Inferred Environment	
Camak Kodiak Ankerton 5-1-44-17-W4	Dolomite-Reefoid vuggy oil stained sec. anhydrite Brecciated	Fringe Reef Lagoon Side	Brecciated limestone-marly-silty porous	Lagoon near evaporites	Anomalous Breccia and Secondary Calcite
Winter et al Daysland 10-12-44-17	Dolomite anhydrite dense	Lagoon near back reef	Limestone anhydritic dense	Back Lagoon	---------
Anerada Crown 13-11-44-17	Anhydrite bedded	Back Lagoon	Anhydrite grading to silty limestone	Lagoon	---------
Imperial Rosalind 9-9-44-17	Anhydrite with red & green shales	Back Lagoon	Limestone Breccia-silty	Marine ? inter-lagoon	---------

** Research by N. C. Lenard

The typical sulphur section, presently mineable in the U.S.A., varies in thickness from a few feet to a few hundred feet and grades between 20 and 30 percent sulphur weight. Porositites average about 20% (see section on Porosity and Permeability through the sulphur zone). The sulphur-bearing salt dome structures along the Gulf Coast usually vary considerably over short distances, but sedimentary deposits similar to the Ankerton prospect could be expected to be more consistent. The immediately overlying dense limestones and underlying anhydrite provide permeability barriers to the flow of heated water.

A description of the typical drilling and completion procedure for a Frasch Process is given by Rayne, Craft et al in a paper on the Reservoir Mechanism of Sulphur Recovery [13] and is quoted here:

"Sulfur wells are drilled with conventional oilfield drilling rigs. The cap rock sections are drilled with core bits and continuous core logs are recorded. After coring, the cap rock section is underreamed to a diameter of 9 7/8 in. The bottom of the 8-in. casing is welded closed and rests on the bottom of the drill hole, which extends through the cap rock to a few feet above the bottom of the sulfur-bearing formation. The 8-inch pipe contains five feet of a 3/4 inch perforations on six inch centres and 15 feet of one inch perforations on 1 ft. centres. The perforated section is set opposite the lower 20 ft. of the sulfur-bearing formation. The 4-in. sulfur pipe is set inside the 8-inch water line on a seat ring at the top of the 5 ft. section of 3/4 inch

perforations. The mining water, heated to about 330°F under a pressure of 250 psi, is forced down the annulus between the 8-inch and 4-inch pipes and through the 1-inch perforations to the sulfur-bearing formation. Compressed air, at 400 psi pressure, is supplied through a 1-inch air line near the bottom of the well to provide air-lift of the liquid sulfur. Molten sulfur flows through the 3/4 inch perforations and into the 4-inch pipe, where it is air-lifted. Produced sulfur flows through insulated, steam-jacketed, 4-inch flowlines to a relay station for metering and pumping to storage, shipping, or filtering.

"Water bleedwells are drilled to relieve the reservoir pressure by removing the excess mining water from the cap rock. They are preferably located where the temperature of the bleedwater will be lowest in order to minimize heat loss through bleedwater extraction. Bleedwells are generally located from 500 to 3,000 ft. away from producing wells and extract the water from the lower cap rock sections.

"Bleedwater is highly corrosive and a stream pollutant, and must be treated before disposal. Reclamation and re-use of bleedwater as a mining fluid is possible, as done at Hoskins Mound dome in Texas, if the water temperature is high enough to warrant an economical system of treating and re-heating.

"Upon entry into the sulfur formation, the hot water meets the colder formation water, rises due to the density difference between the two fluids, and transfers heat to the formation and the sulfur.

The molten sulfur flows countercurrently downward through the formation and collects in a pool around the bottom of the wellbore. In well completion operations hot water is usually injected for about 48 hours to provide an effective sulfur seal to prevent water production.

"It is generally believed that the hot water rises to the top of the barren cap rock with very little lateral movement; thus the sulfur melting zone takes the shape of an inverted cone. Temperature surveys and cores from new wells give evidence of hot water caps which may extend over wide areas. These cores frequently show leaching and heating within the upper part of the sulfur horizons, sometimes as much as 1,500 ft. from the closest streaming wells and on the opposite side of the streaming wells from the bleedwells.

"Sulfur extraction forms additional cavities and voids which weaken the formation. Subsidence of the overburden frequently occurs and closes the voids and cavities. This generally improves recovery by diverting the heated water to unleached portions of the reservoir."

The ultimate recovery from a sedimentary deposit may be as high as 75 percent, but is dependent on the porosity and permeability configuration of the deposit.(7)

"Probably the most important problem encountered in sulfur mining is the pattern of sulfur melting, which depends on the injection well spacing, the bleedwell location, the nature of the injected fluid, the design of the injection pipe, and the characteristics of the sulfur-

bearing formation. The almost vertical rise of the injected hot water severly limits the gravitational drainage radius and in addition creates a hot water cap, which reduces the thermal efficiency through enormous heat losses to the overlying sediments. The drainage radius or cone is extended laterally by injecting water at the lowest possible level. The use of a concentrated salt brine solution as a high density mining fluid has given marked increases in both the lateral extraction of sulfur and the production rates, and also at higher thermal efficiencies. Hot brine was initially injected through the annular space between the 8-inch and 4-inch pipes and fresh water was injected through the 4-inch pipe until sulfur production commenced. This is an expensive method and corrosion rates are high; therefore, this system is only used when warranted by absolute necessity.

"Sulfur-bearing limestone is typically very heterogeneous in nature and has effects on the sulfur melting pattern that may vary widely. Large cavities and solution channels exist at random in the limestone. These voids and channels alter the flow of the hot water and in most cases, reduce the effectiveness of the hot water movement. Injection of large volumes of mud into these voids has served to aid the uniformity of hot water flow through the formations.

"Bleedwell spacing is necessarily governed by the structure of the dome and the location of the commercial sulfur deposits and the bleedwater disposal pits. The spacing of bleedwells appears to have

little effect on the overall sulfur recovery, except where it may effect pre-heating of a unit prior to a well completion. Thus it would appear better to develop the reservoir successively toward, rather than away from, the bleedwell locations.

"The economic recovery in tons per well (not tons per acre-foot) appears to be independent of well spacing as long as the sulfur melting patterns, or inverted cones, do not overlap between wells. For example, one well in 40 acres would recover the same quantity of sulfur as one well on 20 acres, if the patterns did not overlap; therefore, the recovery per acre-foot on the 40-acre unit is only half that on the 20-acre unit. For a well to be economic, it must be completed in a deposit of sufficient richness and/or have a melting cone of sufficient lateral extent. Where patterns overlap, the ultimate economic well spacing will be least for the richer deposit and for the steeper cones of depletion. Close well spacing increases the ultimate recovery of the deposit by combining the inverted cone patterns to produce the same effect as lateral extraction."

The Ankerton Deposit is deeper than any of the deposits presently being mined by the Frasch Process. Research will have to be carried out to solve the special problems in extraction which might be encountered if the deposit is found to be economic.

The Frasch Process uses water as a heating medium. The use of electric heaters in high viscosity oil recovery does not appear to be feasible because the amount of heat required to melt the sulphur requires an electrical output far beyond the maximum capacity of bottom hole heaters presently in use [13].

Another heating technique used in oil recovery is in situ combustion sustained by the combustible materials in the deposit. Approximately 1.25 percent of the sulphur is required to melt one ton of sulphur[13]. Difficulty in controlling combustion and combustion gases appears to be appreciable [14].

The problems of sulphur recovery can be researched as exploration proceeds; more exploratory drilling is required before the deposit will be fully evaluated.

AVAILABILITY OF FRESH WATER AND NATURAL GAS

(i) Fresh Water Supply and Disposal

The Frasch Process requires approximately 5 million gallons of water per day for the average well [13]. Bleedwater is highly corrosive and a stream pollutant and must be treated for surface disposal [13].

Preliminary investigations have indicated that a water supply may be available from Red Deer Lake (1 million gallons per day) and Buffalo Lake (5 million gallons per day) which are approximately 20 miles from the Ankerton Deposit.

The fresh water source in the 218 foot section of unconsolidated surface sands intersected in D.E.M. Ankerton Sulphur 15-4 will not be available as it is presently the primary domestic supply of the area.

There is a possibility that bleedwater can be recovered and treated to provide the necessary mining water (13).

The Basal Quartz Sands of the Lower Blairmore Formation may possibly be utilized for disposal of bleedwater if it is not recycled. This would also help to maintain gas pressure in the area.

Disposal on surface would necessitate treatment of the bleedwater.

Further research is necessary before more definite water supply and disposal plans can be made.

(ii) Natural Gas

Very little research has been made into the availability of natural gas. The nearest gas transmission line lies about 28 miles to the northwest. Natural gas is being produced from the Richfield Oil Corp. Daysland 6-16-44-16-W4 well approximately 1 mile northwest of the D.E.M. Ankerton Sulphur 15-4 well.

CONCLUSIONS

A sulphur deposit has been developed in the limestone breccia of the Basal Wabamun Formation in the Ankerton Area of Alberta. Two wells were drilled during May and June 1967 by Devil's Elbow Mines Ltd. to explore the deposit.

Sulphur zones of 30.7 feet grading 7.8% sulphur and 6.5 feet grading 5.7% sulphur were cored in the D.E.M. Ankerton Sulphur 15-4 and D.E.M. Ankerton Sulphur 10-4 wells respectively.

The elemental sulphur occurs both as bituminous and bright yellow varieties associated with secondary calcite. Tests showed that the sulphur contains low values in organic solids and no selenium, tellurium, or arsenic.

The deposit is controlled by the underlying Calmar Silt but the apparently similar lithology of the overlying limestone breccia to the host breccia indicates that the sulphur mineralization could extend over greater thicknesses of the Basal Wabamun in other areas of the deposit.

The sulphur was apparently deposited in local lagoonal environments within a complex lagoonal structure, and there may be separate sulphur bodies developed in other similar local environments nearby.

Very sparse subsurface data, except in the area between the two wells, seriously limits the interpretation of the size and shape of the deposit.

The D.E.M. Ankerton Sulphur 10-4 well intersected the southern edge of the deposit. An extension of 300 feet north of the Banff Ankerton 15-4 well is assumed, giving a total north-south section of 2100 feet.

Environmental similarities between the sulphur section and the Basal Wabumun of the R. O. Corp. Banff Daysland 13-10 well 6,000 feet to the northeast suggest that it is reasonable to assume a development of the deposit at least 1,600 feet in that direction. The western portion of the deposit is difficult to delimit due to lack of information but the geological cross sections (Figures 8 and 9) indicate that the deposit is trough-shaped and elongated along the east-west axis. The deposit is assumed to extend approximately 1,600 feet to the west.

Not enough information has been obtained to calculate proven or indicated tonnages. Inferred tonnages can be calculated using a cut off grade of 20% sulphur to obtain the thicknesses of the deposit in each of the D.E.M. Ankerton Sulphur 10-4 and 15-4 wells and in the Banff Ankerton 15-4 well.

Assuming that the width of the deposit is 300 feet and that the zone is consistent between the three wells, a total of 216,000 short tons grading 20% sulphur by weight can be inferred.

Extraction tests on cores from the deposit indicate that adequate porosities and permeabilities will be developed in the main sulphur zone to enable Frasch mining, provided that the deposit is economic and that the technical problems in mining deposit at this depth can be overcome.

The Frasch Process involves the melting of native sulphur in place by the introduction of super-heated water into the host Formation and recovering the resultant liquid sulphur. Another melting technique used in oil recovery is in situ combustion sustained by the combustible materials in the deposit. Difficulty in controlling combustion and combustion gases in this technique appears to be appreciable.

The problems of sulphur recovery, water and gas supply, and water disposal can be researched as exploration proceeds; more exploratory drilling is required before the potential of the deposit will be known.

RECOMMENDATIONS

A continued exploration drilling program on a step-out basis is recommended to evaluate the deposit. At least three holes should be drilled in the initial program; two to the west of D.E.M. Ankerton Sulphur 15-4 at 400 and 800 foot step-outs and one to the northeast at a 400 feet step-out.

The wells should be drilled employing rotary equipment into the Wabamun Formation and diamond coring equipment with a 60 foot conventional barrel through the basal 70 feet of the Wabamun Formation and 10 feet into the top of the Nisku Formation. Consideration should be given to whipstocking wells to gain additional information.

The sulphur bearing horizon in each well should be evaluated by Induction Electric Logging. Sidewall Neutron Porosity and Formation Density Logging techniques should only be used through the sulphur horizon if core recovery is poor.

A re-evaluation of the deposit must be made in the field after each well. Special attention should be given to the extent of development of the Secondary Calcite Zone in the logging of cores. The cores obtained through the sulphur zone should be assayed and extraction and porosity and permeability tests should be run.

Research into extraction techniques, water supply and disposal, and natural gas supply should continue concurrently with the drilling program.

Special research into the possibility of employing gravity techniques to explore for sulphur-bearing structures could be made before the initiation of a drilling programme.

ESTIMATED COSTS

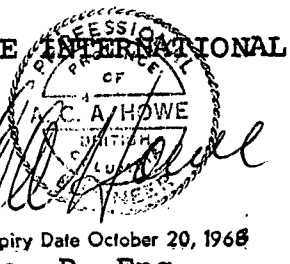
The Initial Exploration Program

Three wells are recommended. If a contract is taken on that basis the cost of each well including diamond coring and logging $26,000.00

Assaying and testing of cores per well	$1,000.00
Engineering and supervision per well, estimate	2,500.00
Contingency at 15%	4,425.00
TOTAL ESTIMATED COST PER WELL	$33,925.00

Respectfully submitted,

A. C. A. HOWE INTERNATIONAL LIMITED,



Expiry Date October 20, 1968

A. C. A. Howe, P. Eng.

[redacted]

J. C. Rowntree, B. Sc.

DATED AT TORONTO, ONTARIO THIS 12th DAY OF SEPTEMBER, 1967.

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(14) Parrent, K. G. - Petroleum Engr. 1955, No. 5, Vol. 27.

CERTIFICATE

I, J. C. Rowntree, of [redacted] of the City of Vancouver, Province of British Columbia, hereby certify that:

1. I am employed as a geologist by A. C. A. Howe International Limited, Geological and Mining Consultants with offices at 826-159 Bay Street, Toronto 1, Ontario and at 401-543 Granville Street, Vancouver, British Columbia.

2. I am an associate member of the Geological Association of Canada.

3. I am a graduate of the University of Toronto, Ontario, Hon. B.Sc. in Geology.

4. I have no interest, direct or indirect, in either the property or securities of Devil's Elbow Mines Ltd., nor do I expect to receive any such interest.

5. My report is based upon personal knowledge of the property gained from acting as wellsite geologist between May 3rd and June 30th, 1967 and upon previous reports on the property, and government publications on the area.

[redacted]

J. C. Rowntree, B.Sc.

DATED AT TORONTO, ONTARIO THIS 12th DAY OF SEPTEMBER, 1967.

CERTIFICATE

I, A. C. A. Howe, of the City of Toronto, in the County of York, Province of Ontario, hereby certify that:

1. I am a Mining Engineer with offices at 826-159 Bay Street, Toronto, Ontario and at 401-543 Granville Street, Vancouver, British Columbia.

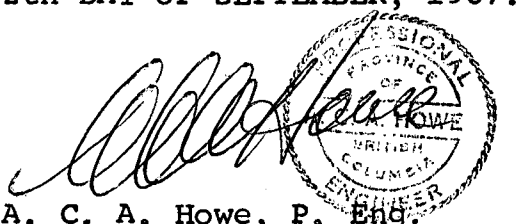
2. I am a graduate of London University, England, B.Sc. in 1949.

3. I am a member of the Associations of Professional Engineers of Ontario and British Columbia.

4. I have no interest, direct or indirect, in either the property or securities of Devil's Elbow Mines Ltd. nor do I expect to receive any such interest.

5. Mr. J. C. Rowntree is a geologist employed by A. C. A. Howe International Limited, of which I am President, and this report is based on his work on the project described which was carried out under my supervision. Mr. Rowntree's work is well known to me.

DATED AT TORONTO, ONTARIO THIS 12th DAY OF SEPTEMBER, 1967.



A. C. A. Howe, P. Eng.
Expiry Date October 20, 1968

Figures 3--9

Maps and Sections

46 pgs

FIGURE 3

Location Map

(39 -- 40)

TWP 44

TWP 43

R17

R16

R15

ZAP et AL HOLMB
7-31

3-32

6-33

TEXACO HOLMBERG
11-30

DERNICK GUY
7-27

Creek

FORUM SND DOM LEASE DAYSLAND
1-34

GRAVEL ROAD
TO PAYSLAND 1 MILE

CANADIAN NATIONAL RAILWAY

HWY 13

Strome

11-19
CAL STD. DAYSLAND

R.O. CORP STROME
6-20

Rosalind

R.O. CORP. DAYSLAND
6-16

B

R.O. CORP BANFF DAYSLAND

13-10

C.P.O.G. DAYSLAND
10-11

LLOYD SOHIO STROME
1-14

9-9
IMP. ROSALINO

8-9
IMP. ROSALINO

15-11
AMERADA CROWN

10-12
WINTER et AL DAYSLAND

2-7
BRINK BANFF ANKERTON

BANFF ANKERTON 15-4

D.E.M. ANKERTON SULPHUR 15-4

D.E.M. ANKERTON SULPHUR 10-4

11-3
BANFF et AL ROSALINO

A

5-1
CAMAK KODIAK ANKERTON

13			16
12			9
5			8
4	3	2	1

A'

1-28
TRIAD DAYSLAND

1-26 ANKERTON
CEG FARGO DUB NEWCLARE

Battle

River

B'

6-9
BRINK B.A HEISLER

TEXACO HEISLER
2-13

15-11
RED'W LSHO
GLOBE M'ST'S

Heisler

4-8

8-13

7-11

n

DEVIL'S ELBOW MINES LTD.

ANKERTON SULPHUR PROJECT

LOCATION MAP

SHOWING SECTIONS AA'BB'

by

A.C.A HOWE INTERNATIONAL LTD.

0 1 2 3
MILES

Figure 3

J.C. ROWNTREE JULY '67

19670005

F I G U R E 4

Property Map

(39 -- 40)

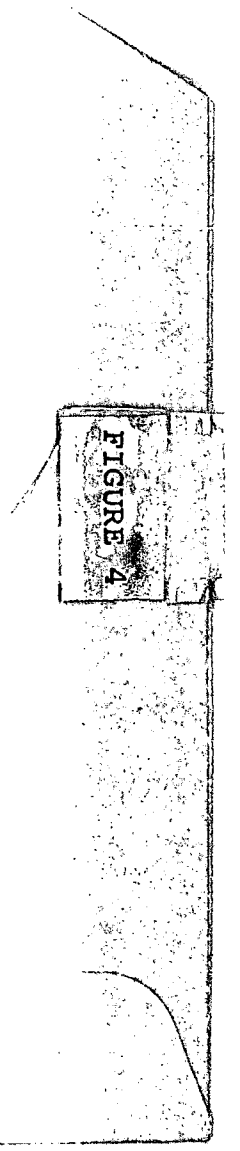
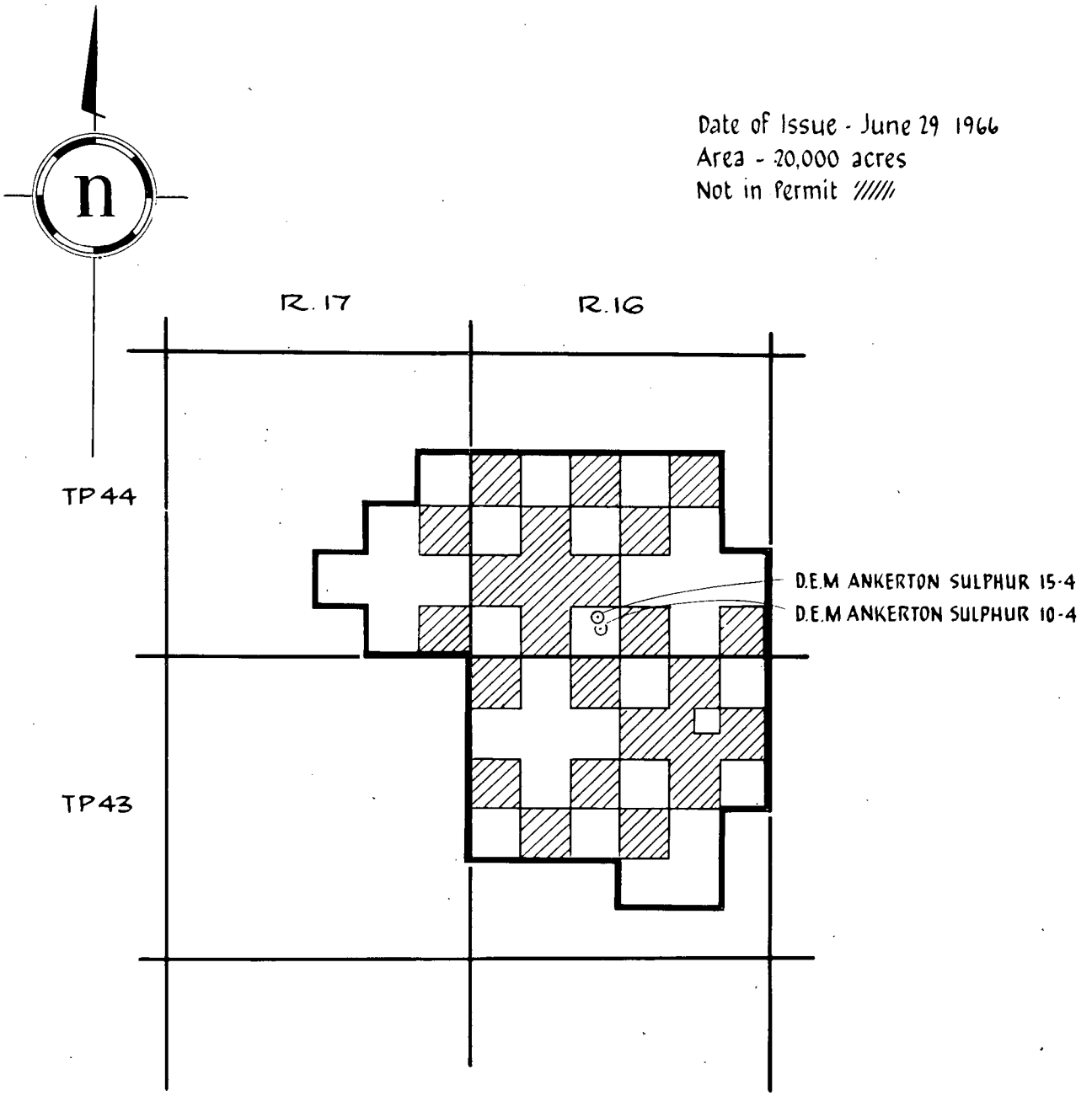


FIGURE 4



Date of Issue - June 29 1966
Area - 20,000 acres
Not in Permit ////////

DEVIL'S ELBOW MINES LTD
SULPHUR PROSPECTING PERMIT No 3

PROPERTY MAP

by

A.C.A. HOWE INTERNATIONAL LTD

[redacted]

19670005

JULY '67

F I G U R E 5

Structure Contour on top of Nisku Formation

(39 -- 40)

FIGURE 5

TWP 44

TWP 43

ZAP et AL HOLMB
NR
7-31

(-1486)
3-32

NR
6-33

TEXACO HOLMBERG
11-30
(-1499)

DERNICK GUY
7-27
(-1480)

creek

Rosalind

(-1379)
11-19
CAL STD. DAYSLAND

FORUM SND DOM LEASE DAYSLAND
1-34

GRAVEL ROAD
TO DAYSLAND 1 MILE

CANADIAN NATIONAL RAILWAY
HWY 13

Strome

R.O.CORP STROME
6-20
NR

(-1362)
R.O. CORP. DAYSLAND
6-16

R.O.CORP BANFF DAYSLAND

LLOYD SOHIO STROME
1-14
NR

(-1443)
13-11
AMERADA CROWN

9-9
(-1498)
IMP. ROSALIND

8-9
NR
IMP ROSALIND

(-1411)
10-12
WINTER et AL DAYSLAND

13-10
(-1337)
NR

C.P.O.G DAYSLAND
NR
10-11

AXIS OF STRUCTURAL HIGH ON TOP OF CALMAR

2-7
NR
BRINK BANFF ANKERTON

(-1354)

BANFF ANKERTON 15-4
D.E.M. ANKERTON SULPHUR 15-4
D.E.M. ANKERTON SULPHUR 10-4

13			16
12			9
5			8
4	3	2	1

11-3
BANFF et AL ROSALIND

(-1456)
5-1
CAMAK KODIAK ANKERTON

AXIS OF STRUCTURAL LOW ON TOP OF CALMAR FORMATION

1500

1-26
ANKERTON
NR
CEG FARGO DUB NEWCLARE

(-1214)
1-28
TRIAD DAYSLAND

1250

1200

R17

R16

R15

Battle

River

1450

1400

1350

(-1365)
15-11
RED'W LSHO
GLOBE M'ST'S

TEXACO HEISLER
2-13
NR

(-1425)
6-9
BRINK B.A HEISLER

Heisler

-1280

1300

NR

NR

NR

n

LEGEND

1250 (-1440) — Structural contour of elevation below sea level

Wells ; elevation of top of Calmar Formation

DEVIL'S ELBOW MINES LTD.

ANKERTON SULPHUR PROJECT

STRUCTURE CONTOURS OF TOP OF NISKU FORMATION

by

A.C.A HOWE INTERNATIONAL LTD.

0 1 2 3
MILES

J.C. ROWNTREE JULY '67

FIGURE 5

19670005

F I G U R E 6

Structure Contour on top of Calmar

(39 -- 40)

FIGURE 6

TWP 44

TWP 43

ZAP et AL HOLMB
7-31
NR
(-1474)
3-32

NR
6-33

TEXACO HOLMBERG
11-30
(-1488)

DERNICK GUY
7-27
(-1474)

Creek

Rosalind

11-19
CAL STD. DAYSLAND

FORUM SND DOM LEASE DAYSLAND
1-34
NR

GRAVEL ROAD
TO DAYSLAND 1 MILE

CANADIAN NATIONAL RAILWAY
HWY 13

Strome

R.O.CORP STROME
6-20 NR

LLOYD SOHIO STROME
1-14
NR

R.O. CORP. DAYSLAND
5-16
(-1346)

R.O. CORP BANFF DAYSLAND
13-10 (-1324)
NO info

C.P.O.G DAYSLAND
10-11
NR

(-1482)
9-9
IMP. ROSALINO
8-9
IMP ROSALINO
NR

15-11
AMERADA CROWN
(-1435)

10-12
WINTER et AL DAYSLAND
(-1406)

2-7
BRINK BANFF ANKERTON
NR

(-1343)
BANFF ANKERTON 15-4
D.E.M. ANKERTON SULPHUR 15-4
D.E.M. ANKERTON SULPHUR 10-4

13			16
12			9
5			8
4	3	2	1

11-3
NR
BANFF et AL. ROSALINO

5-1
(-1449)
CAMAK KODIAK ANKERTON

1-26
CEG FARGO DUB NEWCLARE
NR

ANKERTON

-1200

1-28
(-1200)
TRIAD DAYSLAND

-1400

-1300

-1500

R17

R16

R15

Battle

River

NR
TEXACO HEISLER
2-13

15-11
RED'W LSHO
GLOBE MST'S
(-1357)

6-9
BRINK B.A HEISLER
(-1419)

4-8
(-1278)

Heisler

8-13
NR

7-11
NR

n

LEGEND

1-26 WELL, NUMBER.

-1400- DEPTH OF CALMAR BELOW SEA LEVEL.

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ANKERTON SULPHUR PROJECT

STRUCTURE CONTOUR OF TOP OF THE CALMAR FORMATION

by

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0 1 2 3
MILES

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FIGURE 6

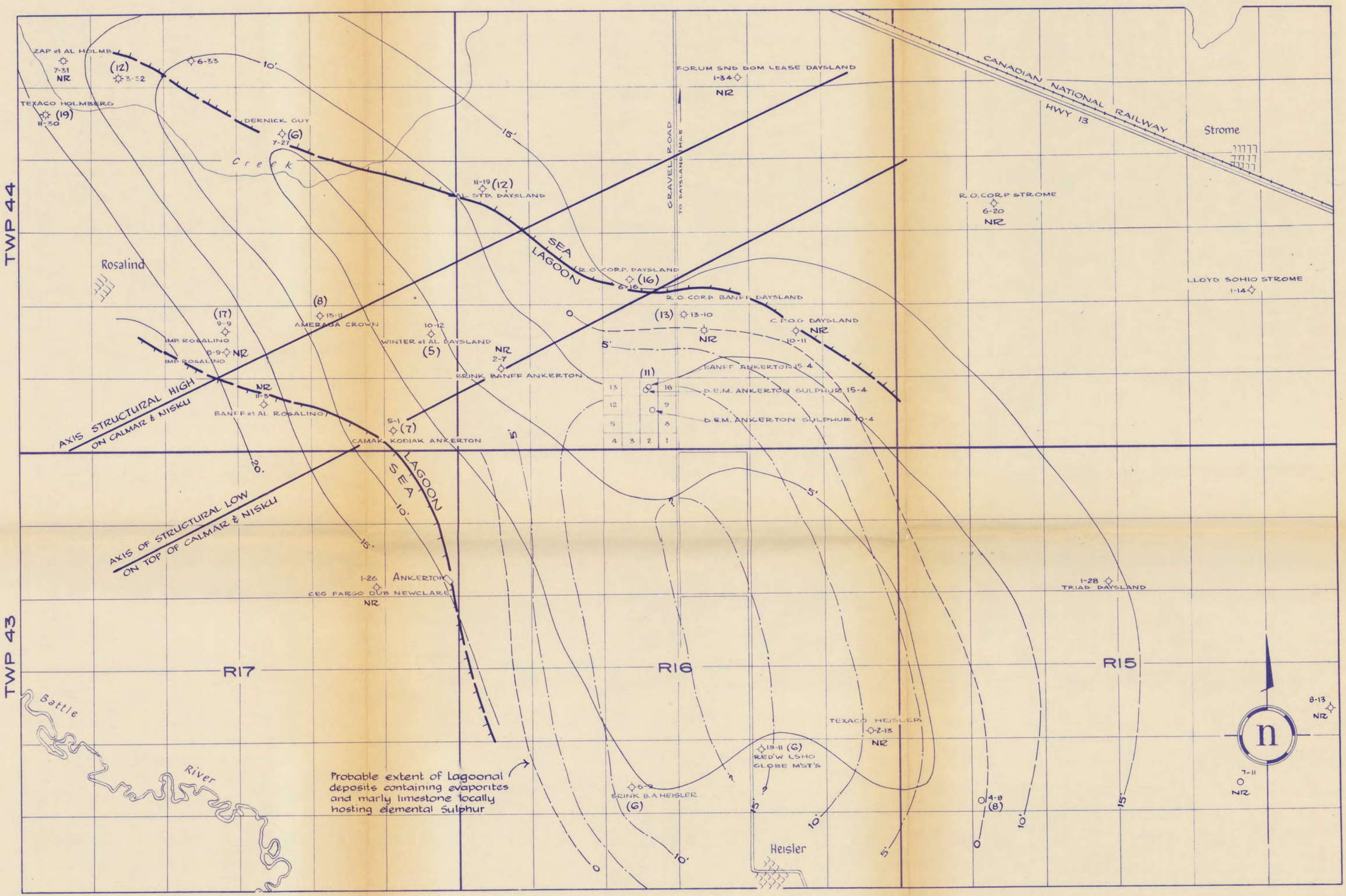
19670005

F I G U R E 7

Isopach of Calmar Silt Showing
Outline of Lagoonal Deposits in Basal Wabamun Formation

(39 -- 40)

FIGURE 7



LEGEND

- OUTLINE OF LAGOONAL DEPOSITS IN BASAL WABAMUN
- ISOPACHS OF CALMAR FORMATION (5' INTERVAL)
- PROBABLE EXTENT OF HIGH RESISTANCE EVAPORITIC UNITS IN BASAL WABAMUN LAGOONAL AREAS.
- ISOPACHS OF HIGH RESISTANCE SECTIONS IN BASAL WABUMUN.
- (4) ISOPACH - CALMAR
- NR CALMAR NOT REACHED IN HOLE

DEVIL'S ELBOW MINES LTD.

ANKERTON SULPHUR PROJECT

ISOPACH OF CALMAR FORMATION

FROM TOP OF CALMAR FORMATION TO TOP OF NISKU FORMATION
SHOWING OUTLINE OF LAGOONAL DEPOSITS IN
THE BASAL WABAMUN UNITS

by

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0 1 2 3
MILES

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FIGURE 7

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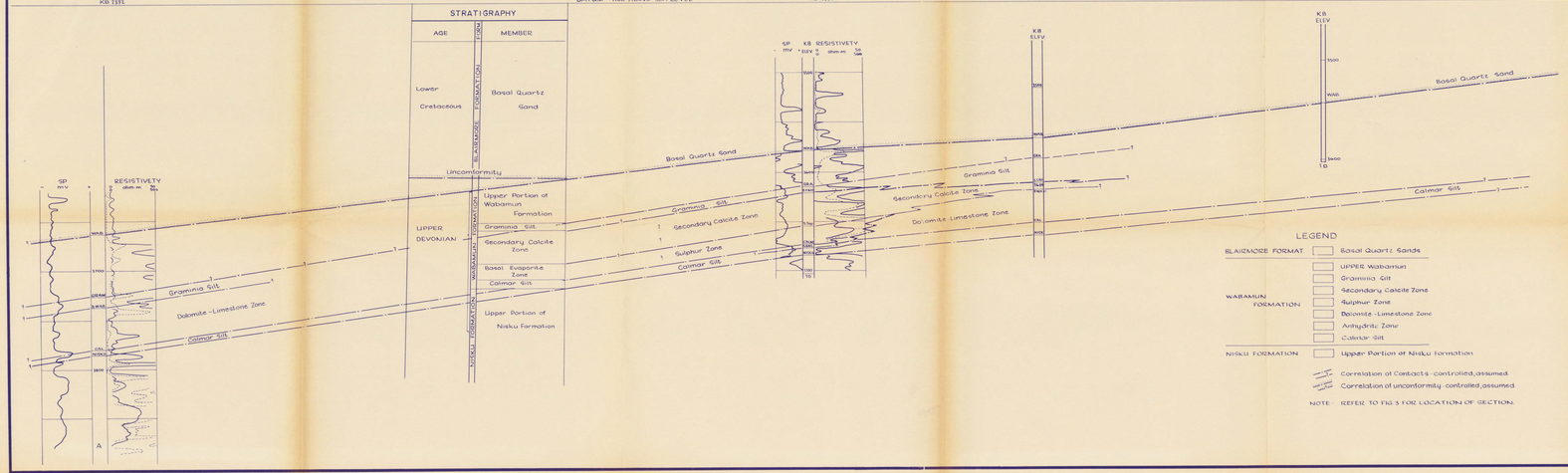
F I G U R E 8

Geological Cross Section AA'
Looking East Through
D.E.M. Ankerton Sulphur 10-4
and
D.E.M. Ankerton Sulphur 15-4

(39 -- 40)

FIGURE 8


CAMAC KODIAC ANKERTON N°5-1-44-17W4
KB 7391
STRATIGRAPHY
AGE
MEMBER
DATUM -1100' ABOVE SEA LEVEL
D.E.M. ANKERTON SULPHUR 15-4-44-16 W4
KB 5330
RO CORP BANFF DAYSLAND N° 13-10-44-16 W4
KB 7325
C.P.O.G. DAYSLAND N° 10-11-44-16 W4
KB 7341
DATUM -1100' ABOVE SEA LEVEL
SP
RESISTIVITY
KB ELEV
Lower Cretaceous
Basal Quartz Sand
Unconformity
UPPER DEVONIAN
Upper Portion of Wabamun Formation
Graminia Silt
Secondary Calcite Zone
Basal Evaporite Zone
Calmar Silt
Upper Portion of Nisku Formation
BLAIRMORE FORMATION
WABAMUN FORMATION
NISKU FORMATION
Dolomite-Limestone Zone
Sulphur Zone
Basal Quartz Sand
Graminia Silt
Secondary Calcite Zone
Dolomite-Limestone Zone
Calmar Silt
LEGEND
BLAIRMORE FORMAT.
Basal Quartz Sands
WABAMUN FORMATION
UPPER Wabamun
Graminia Silt
Secondary Calcite Zone
Sulphur Zone
Dolomite-Limestone Zone
Anhydrite Zone
Calmar Silt
NISKU FORMATION
Upper Portion of Nisku Formation
Correlation of Contacts - controlled, assumed
Correlation of uncontormity - controlled, assumed
NOTE - REFER TO FIG 3 FOR LOCATION OF SECTION
Basal Quartz Sand
Wabamun Formation
Calmar Silt
Nisku Formation
TRIAD DAYSLAND N°1-28-43-11W4
KB 3334
DEVIL'S ELBOW MINES LTD.
ANKERTON SULPHUR PROJECT
GENERALIZED GEOLOGICAL CROSS SECTION A-A'
by
A.C.A. HOWE INTERNATIONAL LTD.
MILE
VERTICAL SCALE : 1 in to 40 ft.
J.C. ROWNTREE
Figure 8
JULY 19, 1967
AG70005

F I G U R E 9

Geological Cross Section BB'
Looking North Through
D.E.M. Ankerton Sulphur 15-4

(39 -- 40)

FIGURE 9

INTERPRETED PALEO-ENVIRONMENT IN BASAL WABAMUN FORMATION

SEAWARD-REEF | BACK REEF | LAGOONAL | BACK LAGOON | LANDWARD

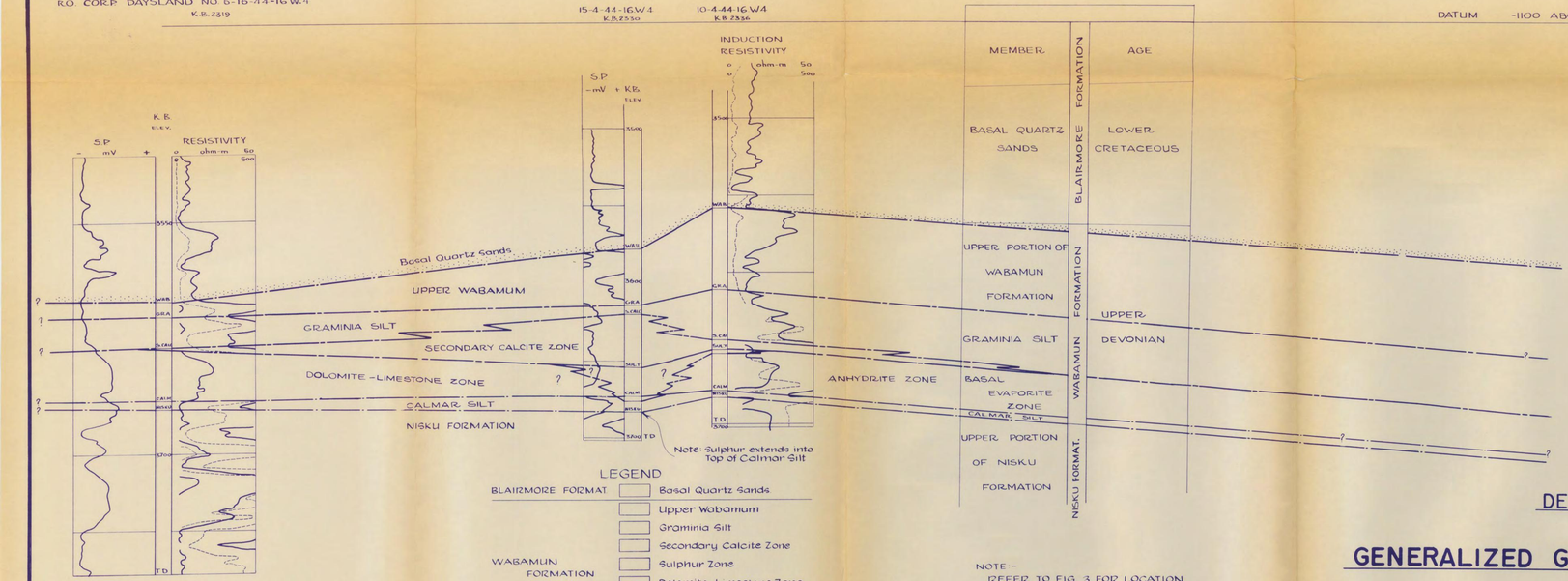
R.O. CORP. DAYSLAND NO. 6-16-44-16W.4
K.B. 2319

DEM. ANKERTON SULPHUR 15-4-44-16W.4 K.B. 2350

DEM. ANKERTON SULPHUR 10-4-44-16W.4 K.B. 2356

DATUM -1100 ABOVE SEA LEVEL

BRINKERHOFF B.A. HEISLER
NO. 6-9-43-16W.4
K.B. 2352



LEGEND

BLAIRMORE FORMAT	Basal Quartz Sands
WABAMUN FORMATION	Upper Wabamum
	Graminia Silt
	Secondary Calcite Zone
	Sulphur Zone
	Dolomite-Limestone Zone
	Anhydrite Zone
	Calmar Silt
NISKU FORMATION	Upper Portion of Nisku Formation
	Correlation of Contacts - controlled, assumed
	Correlation of unconformity - controlled, assumed

NOTE -
REFER TO FIG. 3 FOR LOCATION OF SECTION.

DEVIL'S ELBOW MINES LTD.
ANKERTON SULPHUR PROJECT

GENERALIZED GEOLOGICAL CROSS SECTION B-B'

by

A.C.A. HOWE INTERNATIONAL LTD.

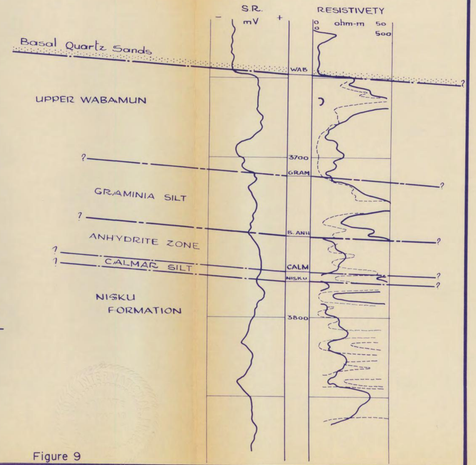
1/5 0 1/5 2/5 3/5 4/5
MILE

VERTICAL SCALE: 1 in to 40 ft.

J.C. ROWNTREE

JULY 19, 1967

Figure 9



AG70005

APPENDICES A and B
TO ACCOMPANY
GEOLOGICAL AND ENGINEERING REPORT
ON THE

INITIAL EXPLORATION PROGRAM
FOR
ANKERTON SULPHUR PROJECT, ALBERTA
DEVIL'S ELBOW MINES LTD.

A P P E N D I X A

APPENDIX A

WELL INFORMATION

ON

D.E.M. ANKERTON SULPHUR 15-4

TO BE APPENDED TO A

GEOLOGICAL AND ENGINEERING REPORT ON THE INITIAL EXPLORATION

OF THE ANKERTON SULPHUR DEPOSIT

DEVIL'S ELBOW MINES LTD.

SEPTEMBER 12, 1967 TORONTO, ONTARIO

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APPENDIX A

INTRODUCTION

D.E.M. Ankerton Sulphur 15-4 is located on Lsd 15 Section 4 Twp. 44 Rge. 16 West of 4th Meridian and is a 300 foot step-out to the south of Banff Ankerton 15-4-44-16-W4 in the Province of Alberta.

The main objective of the well was to test the Basal Wabamun Formation which is sulphur bearing in the Banff Ankerton well immediately to the north. Secondary objectives were to test for fresh water bearing sands in the upper portion of the hole and to determine the nature of the formations overlying and underlying the sulphur zone. The deep objectives were tested by diamond coring.

Excellent sub-surface control was obtained from the electric logs of the Banff Ankerton 15-4 well. The surface hole was tested for water sands by sampling at 10 foot intervals and by induction electric logging before the surface casing was set. Ten foot samples were taken from 2800 feet to the core point at 3554 feet and diamond core was obtained to a depth of 3694 feet. A rubber lined core barrel was used through the sulphur zone in order to ensure full recovery.

The sulphur zone and the overlying and underlying formations were fully evaluated by core examination, assay and testing; and induction electric, sidewall neutron and formation density logs.

The well was completed at a total depth of 3707 feet K.B. in the upper anhydritic section of the Nisku Formation and has been abandoned.

GENERAL DATA SUMMARY

NAME: D.E.M. Ankerton Sulphur 15-4

LOCATION: 15-4-44-16 W4M - Alberta

ELEVATION: Ground: 2319 K.B.: 2330 Interval: 11 ft.

CO-ORDINATES: 2080.0', N 89° 33' 30" W; 977.75', S of NE corner Sect.4

OBJECTIVE: Upper Devonian Nisku Formation

SPUDDED: 11:00 a.m. May 25, 67 RIG RELEASE: 12:00 p.m. June 4, 1967

STATUS: Dry and Abandoned T.D.: 3707 Logged 3710 Drilled

SURFACE CSG.: 8 5/8" X 610 ft. 100 sax cement + 4% $CaCl_2$

PROD'N. CSG.: None

PERFORATIONS: None

OTHER: No drillstem formation tests run; considerable mud-gassifying and lost circulation in Basal Blairmore.

CORING: Devonian Wabamun Formation:

	DEPTH K.B. Ft.	LENGTH Ft.	RE-COVERY
Core 1 Diamond 7 13/16" O.D. Conventional	3565-3600	35	94%
Core 2 " " " "	3600-3644	44	100%
Core 3 " " " "	3644-3654	10	100%
Core 4 " 7 3/4" " Rubber Sleeve	3654-3674	20	100%
Core 5 " " " " "	3674-3694	20	100%

The Conventional core barrel produces a 4" diameter core.
The rubber lined core barrel produces a 3" diameter core.

D.E.M. ANKERTON SULPHUR 15-4

GEOLOGICAL FORMATION SUMMARY

AGE	FORMATION UNIT	TOPS K.B. DEPTH ft.	ELEVATION A.S.L.	INTERVAL ft.
	Lea Park Formation	1240	+1090	603
	Colorado Formation	1843	+ 487	619
Upper	Second White Specks	2462	- 132	197
Cretaceous	Base Fish Scales	2659	- 329	163
	Viking Sand	2822	- 492	70
	Joli Fou	2892	- 562	76
Lower	Blairmore	2968	- 638	371
Cretaceous	Ostracod Equivalent	3339	-1009	14
	Basal Quartz Sand	3353	-1023	225
Upper	Wabamun: Stettler Member	3578	-1248	37
Devonian	Winterburn Grp: Graminia Silt	3615	-1285	6
	Secondary Calcite Zone	3621	-1291	34
	Sulphur Zone, Top	3655	-1325	19
	Calmar	3674	-1344	3.5
	Sulphur Zone, Base (visible)	3677.5	-1347.5	7.5
	Nisku Formation	3685	-1355	22
	Total Depth - Logs	3707	-1377	Used 3
	Total Depth - Drilled	3710	-1380	

N.B.: Drift/bedrock contact at 220'; thick drift sands overlie

DAILY PROGRESS REPORT

D.E.M. ANKERTON SULPHUR 15-4

DATE 1967	DEPTH FROM	DEPTH TO	FOOT-AGE	HOURS ON BOTTOM	BIT NOS.	DEVIATION SURVEY DEPTH	DEVIATION SURVEY R.D.G.	REMARKS
May 25	0	319	319	3-1/4	1Ax12-1/4	60	3/4	Tight surface hole
May 26	319	610	291	5-3/4	1A "	159	1/2	Ran IES Log on Surface hole
				4-1/4	2A	409	1/4	
				5-3/4	2B	501	1/2	
May 27	610					590	1/2	Cementing surface csg.
May 28	610	1487	877	9	1 7-7/8	1100	1/2	
May 29	877	3064	2187	7-3/4	1 7-7/8	1550	1/2	
				12	2 7-7/8	2034	1/8	
May 30	2187	3462	1275	6	2 7-7/8	2613	1/8	
				5	3 7-7/8	3235	1-1/2	Pipe stuck in hole
May 31	3462	3597	135	3-3/4	3 7-7/8	3565	2-1/2	Start Dia. Core @ 3565'
				4-3/4	D.1:7-13/16			
June 1	3597	3644	47	9-1/2	D.2 "			Diamond coring
June 2	3644	3684	40	11-3/4	D.2,3"			" "
June 3	3684	3710	26	4-1/4	D.4 "			Finish D.C. 3694;
					7; 7-7/8			Drill to total depth
June 4								Ran Logs; Plugged and
								Abandoned

DAILY MUD RECORD

D.E.M. ANKERTON SULPHUR 15-4

DATE	DEPTH	Wt. No./gal.	Vis. Sec.	W. Loss 15 min. c.c.	F.C. 32nds	pH	ADDITIVES and REMARKS
May 25	0 - 319	---------	Water	---------			
May 26	610						4300 No.Gel; 50 lb.
							Lime
May 27	610						
May 28	1487	---------	Water	---------			
May 29	3064	9	28	9.5			
May 30	3462	9.5	45				3000 No.Gel;
							200 Caustic
May 31	3597	9.2	70	6.5	2	9.5	2000 No.Gel; 55 gals.
							Pipelax; 90 bbl.Crude
June 1	3644	9.3	60	6.5	1	10	1000 No.Gel; 12 Sac
							Sawdust
June 2		9.2	58	6.4	2	9	
		9.0	75	6.4	2	9.5	

WELL SURVEYS RECORD

D.E.M. ANKERTON SULPHUR 15-4

Well surveyed by: Schlumberger of Canada Ltd.,
1030 Guiness House,
Calgary, Alberta.

Recorded by: F. Pickerel,
Red Deer Branch.

Date: June 3, 1967.

Services provided:

1. Induction Electric Log

   Interval: Surface to Total Depth
   Scale: 2" = 100' and 5" = 100'
   N.B.: Surface (0') to 610' run before casing set.
   Detail Interval: Top of Wabamun to T.D.
   Scale: 25" = 100'

2. Formation Density - Gamma Ray Log

   Interval: 2206 to 3706 K.B.
   Scale: 2" = 100' and 5" = 100'
   Detail Interval: Top of Wabamun to T.D.
   Scale: 25" = 100'

3. Sidewall Neutron Porosity Log

   Interval: 2206 to 3706 K.B.
   Scale: 2" = 100' and 5" = 100'
   Detail Interval: Top of Wabamun to T.D.
   Scale: 25" = 100'

ABANDONMENT PROCEDURE

Well: D.E.M. Ankerton Sulphur 15-4

Location: Lsd. 15 Section 4 Township 44 Range 16 W4, Alberta

Date: June 4, 1967

Plugs set:

Plug No. 1

Set at: 3710 feet to 3310 feet K.B.
Composition: 125 sax cement = 4% Gel
Felt at: -----

Plug No. 2

Set at: 3000 feet to 2775 feet K.B.
Composition: 95 sax cement + 3% $CaCl_2$
Felt at: 2740 feet

Plug No. 3

Set at: 660 feet to 560 feet K.B.
Composition: 50 sax cement + 6% $CaCl_2$
Felt at: 580 feet

Surface casing: Standing and capped

RIG INFORMATION

Contractor: Gustavson Drilling Ltd.,
Elveden House, Calgary.

Rig:

Rig No. 9

Drawworks: National T-20
Engines: 2 G.M. 12-103
Slush pumps: National C 250 7-¼ X 15
Derrick: Lee C. Moore 97' - 300,000 lbs.
Substructure: 9'
Drill Pipe: 4½" F.H. 4000'
Drill Collars: 12 - 6¼" X 2-3/16 X 30
Blow out Pre: 10" 900 API hydril GK
10" 900 API shaffer Manual double gate

Wellsite Supervision: A. C. A. Howe International Limited,
Toronto, Ontario.

Wellsite Geologist: J. C. Rowntree, B. Sc.

Operator: Devil's Elbow Mines Ltd.,
Toronto, Ontario.

GEOLOGY

D.E.M. Ankerton Sulphur 15-4 penetrated a normal section of sediments found in the Camrose-Ankerton area of Alberta.

The Belly River Formation comprises bedrock in the area and consists of grey shales, shaly partly unconsolidated sandstones and thin coal horizons.

The Upper Cretaceous Lea Park Formation occurs at a depth of 1240 feet (K.B.) and consists mainly of grey fissile shales. The Colorado Formation starts at a depth of 1843 feet (K.B.) and consists of grey marine shales. The sampling started at the Viking Sandstone within the Colorado which in this area is a medium-grained fair sorted sandstone with some silty sections.

The Blairmore Formation, from 2968 feet to 3578 feet K.B. is a sequence of interbedded medium to dark grey shales and sideritic shales.

The Basal Quartz Sand at 3353 feet is a friable grey to whitish, fine to medium grained sandstone. This unit is mainly salt water bearing but some oil staining of samples was encountered in the top 15 feet of the zone. Gas was encountered when drilling through the upper portion. Sour gas is produced from this horizon farther to the northeast (Banff Daysland 13-10).

Diamond Coring started at 3565 feet in the Basal Quartz Sands.

The Wabamun Formation was encountered at 3578 feet and consists of a brown to buff limestone breccia with some shaly inclusions. The breccia is very well developed throughout the Wabamun and is probably the result of slumping due to solution of the underlying evaporites.

The Calmar horizon is developed in the lower portion of the Wabamun but the contact is gradational from limestone breccia to a limy siltstone.

The Nisku Formation was encountered at 3685 feet but only 22 feet were drilled before stopping the drilling due to mud flocculation. The upper portion of the Nisku has fair oil stain and consists of silty, light grey dolomites with increasing thicknesses of buff anhydrites near the bottom of the section.

For a detailed description of the lithology in the cored interval from 3565 feet K.B. to T.D., please refer to the Core Descriptions following in this Appendix.

SAMPLING PROGRAM

Samples were obtained from surface (0') to 1300 feet at 10 foot intervals and from 2800 feet to 3550 feet at 10 foot intervals. Controlled samples were circulated at 3555 feet, 3560 feet, and 3565 feet. Two additional samples were obtained from 3700 feet and 3710 feet (T.D.).

Samples have been washed and dried and a portion has been placed in labelled plastic vials for microscopic determinations. Descriptions of the samples are given at the rear of Appendix A.

DISPOSITION OF SAMPLES AND CORE

Drilling Samples

All the samples as outlined above have been bottled and delivered to the operator, Devil's Elbow Mines, Toronto, Ontario, with this report.

Washed and bagged samples from 2800' to T.D. have been delivered to the sample storage center of the Oil and Gas Conservation Board in Calgary.

Washed and bagged samples from surface to 1300' have been delivered to the Water Research Council, 10302 - 107 Street, Edmonton, Alberta.

Core

The split half of the core from 3653 feet to 3683.5 feet has been delivered to the sample storage center of the Oil and Gas Conservation Board in Calgary. The whole diameter core from 3554 to 3653 and from 3683.5 to 3692.0 feet has been delivered to the same Center for storage.

CORE INFORMATION

Core Description

Core No. 1

3565' - 3600'(35') Conventional Barrel

Recovery: 94%

Coring Time: 7, 6, 7, 9, 8, (3670) 3, 3, 2, 2, 2, 3, 2, 2, 2, 3, (3680) 15, 30, 32, 21, 9, 8, 9, 11, 11, 9, (3590) 10, 8, 13, 9, 7, 7, 16, N.A., N.A., N.A. minutes per ft.

Interval:	Description
0 - 3.3 3565 - 3568.3 (K.B.)	Sandstone - fine to medium grained sub-rounded quartz sand friable, well sorted in part, some shale inclusions in blebs.
3.3 - 4.3 3568.3 - 3569.3(K.B.)	Shale - fine-grained, dark very dense
4.3 - 5.6 5369.3 - 3570.6(K.B.)	Sandstone - coarse grained well sorted sub-rounded very porous, non-shaly.
5.6 - 11.5 3570.6 - 3576.5(K.B.)	Sandstone - medium to fine grained, friable, quartzose well bedded with cross bedding and some shaly bands; grades to conglomerate at base, very porous.

Interval:		Descriptions
11.5 - 13.0 3576.5 - 3578.0 (K.B.)		Sandstone - with calcite cement. Very low porosity; medium to coarse grained subangular.

Top of Wabamun 3578.0 K.B. - 1248.0 A.S.L.

13.0 - 35.0 3578.0 - 3600.0 (K.B.)		Limestone - buff colour marly, brecciated. Vertical to oblique flow banding; rubbly with numerous dark gray slickenside shale interbeds, and blebs. No visible effective porosity, no oil staining, no anhydrite. Core loss of 5 feet inferred at 3 rubbly shale sections in this interval.

Core No. 2

3600' to 3644' (44) Conventional

Recovery: 100%

Coring time: 9, 7, 5, 5, 6, 5, 6, 6, 7, 7, (3610) 6, 8, 11 8, 7, 8, 7, 7, 7, 8, (3620) 8, 8, 9, 8, 7, 8, 8, 10, 9, 9, (3630) 5, 7, 8, 8, 9, 9, 10, 8, 10, 10, (3640) 10, 10, 12, 33, (jammed) minutes per foot.

Interval:		Descriptions
35.0 - 38.0 3600.0 - 3603.0 (K.B.)		Limestone breccia - as above

Interval:		Descriptions
38.0 - 41.0 3603.0 - 3606.0 (K.B.)		Limestone - Massive buff marly with occasional steep fractures slickensided and tight.
41.0 - 64.5 3606.0 - 3629.5 (K.B.)		Limestone breccia - as above from (35.0 - 38.0)
64.5 - 79.0 3629.5 - 3644.0 (K.B.)		Limestone breccia - massive tight dark brown, dark grey crypto crystalline to micro crystalline, dense shale as blebs. Angular to sub-angular, randomly oriented fragments to 2" in a matrix of dark grey-brown, very argillaceous, limestone. Secondary white calcite occupies breccia fractures and pores increasing to base of interval.

Core No. 3

3644.0'- 3654.0' (10') Conventional

Recovery: 100%

Coring time: 17, 10, 10, 10, 10, 10, 10, 10, 9, 8 minutes per foot.

Interval:		Descriptions
79.0 - 87.5 3644.0 - 3652.5 (K.B.)		Limestone - as above

Interval:		Descriptions
87.5 - 89.0 3652.5 - 3654.0(K.B.)		Limestone breccia - as above but no shale inclusions. Secondary calcite veinlets as above with crystalline sulphur estimated 2% S.

Core No. 4

3654.0 - 3674.0 (20') rubber lined

Recovery: 100% 3" core

Coring time: 20, 35, 45, 42, 47, 61, 48, 37, 28, 27 minutes per 2 foot interval.

Interval:		Descriptions
89.0 - 94.0 3654.0 - 3659.0(K.B.)		Limestone - as above
94.0 - 99.0 3659.0 - 3664.0(K.B.)		Limestone breccia - as above except light brown crypto crystalline dense calcite and sulphur replaces matrix and breccia fragments to estimated 40% sulphur.
99.0 - 102.0 3664.0 - 3667.0(K.B.)		Limestone breccia - as above with slightly more argillaceous material. Sulphur estimated 5%.

Interval:		Descriptions
102.0 - 106.0 3667.0 - 3671.0(K.B.)		Dolomite - brecciated, buff with silty sections and limy matrix. Calcite and sulphur filling breccia spaces and matrix estimated 10% Sulphur.
106.0 - 108.0 3671.0 - 3673.0(K.B.)		Siltstone - grey, massive quartzose with limy matrix, dark green shale films on fractures. Sulphur disseminated in patches and fractures to estimated 5%.
108.0 - 109.0 3673.0 - 3674.0(K.B.)		Dolomite breccia - brown with limestone matrix containing secondary calcite and sulphur to estimated 5% Sulphur.

Core No. 5

3674.0 - 3694.0 (20') rubber sheeve (3" core)

Recovery: 100%

Coring time: 27, 27, 30, 30, 32, 50, 41, 42, 42, 34, 41

interval 2 ft.

Top of Calmar 3674.0 K.B. - 1344 O.A.S.C.

Interval:		Descriptions
109.0 - 111.5 3674.0 - 3676.5(K.B.)		Dolomite - as above
111.5 - 117.0 3676.5 - 3682.0(K.B.)		Dolomite breccia - with shale fragments and limy matrix. Some silty zones, sulphur disseminated in matrix estimated 1% Sulphur. Trace of pyrite in blebs.

Interval:	Descriptions
117.0 - 122.5 3682.0 - 3687.5 (K.B.)	Siltstone - grey calcareous with dark grey shale bands, pyritic with some sulphur 1%.

Top of Nisku 3687.5 K.B. - 1357.5 A.S.C.

Interval:	Descriptions
122.5 - 127.0 3687.5 - 3692.5 (K.B.)	Dolomite - grey, buff with pinpoint porosity, reefoid with anhydrite blebs, no visible sulphur. Grades to buff, grey anhydrite with marly dolomite. Zones at base have fair oil stain.

End coring at 3692.5 feet

T.D. 3707.0 (K.B.) logs - 1377.0 A.S.L.

T.D. 3710.0 (K.B.) drilling - 1380.0 A.S.L.

CORE TESTING

Procedure

The core obtained was delivered to Core Laboratories Ltd. of Calgary, for assay and porosity and permeability measurements. The final report has been issued and is at the rear of Appendix A.

The cored section from 3552.7 to 3583.4 K.B. was analysed for sulphur content and porosity and permeability were measured both before and after sulphur extraction.

CORING LOG

FROM

CHRISTENSEN DIAMOND PRODUCTS LTD.

14730 - 118th Avenue EDMONTON, ALBERTA

58
300

Date: May 31/67 Service Engineer Vern Abel

Company Devil's Elbow Mines Contractor Custavson #9

Well Name DEM Ankerton No. Sulphur 15-4-44-16 Field — Province Alberta

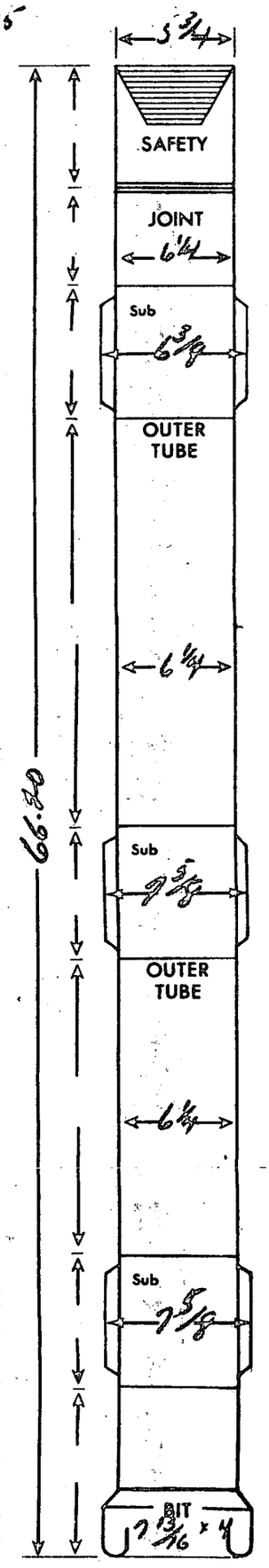
Hole Size 7 7/8 Diamond Bit Size 7 13/16 x 4 Diamond Bit Type 100,131 Bit No. EC-5710

Core Barrel: Size 6 1/4 x 4 Length + Sub. 66.20 Number 50

Core No. 1 Depth: From 3565 To 3597 Total Footage Cored 32 Recovered 30

Formation Cored Description

START	DEPTH	TIME	MIN./FOOT Actual	MIN./FOOT Lost	Mud Report & Remarks	WEIGHT	R. P. M.	PUMP SIZE 5 1/2 x 15 Pressure	PUMP SIZE 5 1/2 x 15 Stroke
	3565	527							
1	66	534	7			8 00	80	1100	58
2	67	540	6		WT 9.2				
3	68	547	7		Vis 70	"	"	"	"
4	69	556	9		WL 6.5				
5	35 70	604	8		PH 9.5				
6	71	607	3		GPm. 300	10 000	95	1100	58
7	72	610	3						
8	73	612	2			12 000	1000	1100	58
9	74	614	2						
10	35 75	616	2						
11	76	619	3						
12	77	621	2						
13	78	623	2			12 000	100	1100	58
14	79	625	2		WT 9.2				
15	35 80	628	3		Vis 100				
16	81	643	15		WL 6.5				
17	82	713	30		PH. 9.5				
18	83	745	32		GPm. 300				
19	84	815	21	9	Time Corr.	12 000	100	1100	58.
20	35 85	824	9						
21	86	832	8						
22	87	841	9						
23	88	852	11						
24	89	903	11						
25	35 90	912	9						
26	91	922	10						
27	92	930	8		WT 9.0				
28	93	943	13		Vis 54				
29	94	922	9		WL 6.5	12 000	100	1100	58
30	35 95	959	7		PH 9.5				
31	96	1006	7		GPm. 300				
32	97	1114	16	32	Lost Mud & Con. @				
33	98				Jammed.				
34	99								
35	3600								
36					Run in w/ Bit To Clean Out				
37									
38					Drill 3 Feet.				
39									
40									
41									
42									



CORING LOG

FROM

CHRISTENSEN DIAMOND PRODUCTS LTD.

14730 - 118th Avenue EDMONTON, ALBERTA

Date: June 1/67 Service Engineer Vern Obel

Company Devils Elbow Mines Contractor Gustavson #9

Well Name D.E.M. Anderson Silver No. 15-4-44-16WA Field — Province Alberta

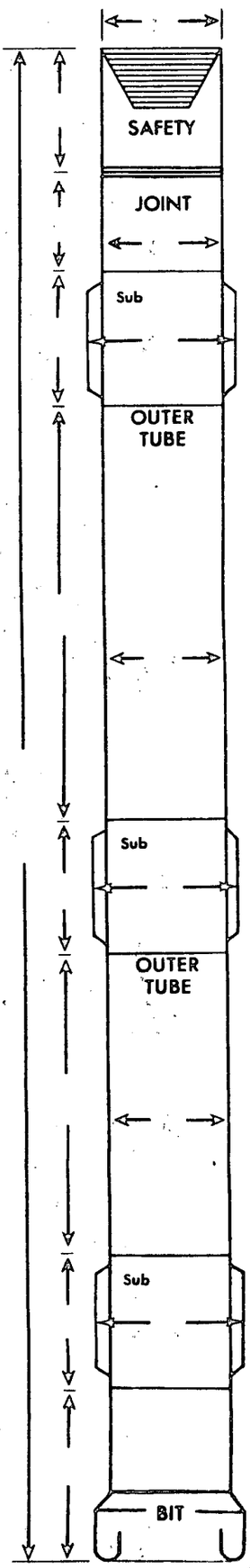
Hole Size 9 7/8 Diamond Bit Size 7 13/16 x 4 Diamond Bit Type ~~Ee 5712~~ 100139 Bit No. Ee-5712

Core Barrel: Size 6 1/4 x 4 Length 1 Sub 6630 Number 50

Core No. 7 Depth: From 3600 To 3644 Total Footage Cored 44 Recovered 44

Formation Cored Description

START	DEPTH	TIME	MIN./FOOT Actual	MIN./FOOT Lost	Mud Report & Remarks	WEIGHT	R. P. M.	PUMP SIZE 5 1/2 x 15 Pressure	PUMP SIZE 5 1/2 x 15 Stroke
	3600	1237							
1	01	1246	9			8000	80	1050	58
2	02	1253	7		Vis 48				
3	03	1258	5		WT. 9.6	10000	90	1050	58
4	04	1103	5		WL. 6.8				
5	36 05	1109	6		PH 9.0				
6	06	1114	5			12000	95	1050	58
7	07	1120	6						
8	08	1126	6						
9	09	1133	7						
10	36 10	1140	7						
11	11	1146	6			12000	95	1050	58
12	12	1154	8						
13	13	2005	11						
14	14	2013	8						
15	36 15	2020	7		Vis 48				
16	16	2028	8		WT. 9.6				
17	17	2035	7		WL. 6.8				
18	18	2042	7		PH. 9.0				
19	19	2049	7						
20	36 20	2057	8			12000	95	1050	58
21	21	3005	8						
22	22	3013	8						
23	23	3022	9						
24	24	3030	8						
25	36 25	3037	7						
26	26	3045	8						
27	27	3053	8						
28	28	4003	10						
29	29	4012	9						
30	36 30	4020	9		V	12000	95	1050	58
31	31	4025	5						
32	32	4045	7	13	Conn				
33	33	4053	8						
34	34	5001	8		Vis 46				
35	36 35	5010	9		WT 9.5				
36	36	5019	9		WL 6.7				
37	37	5029	10		PH. 9.0				
38	38	5037	8						
39	39	5047	10			12000	95	1050	58
40	36 40	5057	10						
41	41	6007	10						
42	42	6017	10						
	43	6029	12						
	44	9002	33		Jammed.				
	36 45								
	46								
	47								
	48								
	49								
	36 50								
	51								
	52								



CORING LOG

FROM

CHRISTENSEN DIAMOND PRODUCTS LTD.

14730 - 118th Avenue EDMONTON, ALBERTA

Date: June 2/67 Service Engineer Vern Abel

Company Devils Elbow Mines Contractor Custowson #9

Well Name DEM Ankerton Surface No. 15-4-14-16-W4 Field — Province Alberta

Hole Size 7 7/8 Diamond Bit Size 2 13/16 Diamond Bit Type 100,139 Bit No. EC-5712

Core Barrel: Size 6 1/4 x 4 Length 1 Sub 6620 Number 50

Core No. 10 Depth: From 3644 To 3654 Total Footage Cored 10 Recovered 10

Formation Cored Description

START	DEPTH	TIME	MIN./FOOT Actual	MIN./FOOT Lost	Mud Report & Remarks	WEIGHT	R. P. M.	PUMP SIZE 5 1/2 x 15 Pressure	PUMP SIZE 5 1/2 x 15 Stroke
	3644	12 40							
1	45	12 57	17			9000	85	1100	58
2	46	1 07	10		Vis 47	10000	90	1100	58
3	47	1 17	10		WT 9.0	12000	100	1100	58
4	48	1 27	10		WL 6.5				
5	3649	1 37	10		PH. 9.0				
6	50	1 47	10			"	"	"	"
7	51	1 57	10						
8	3652	2 07	10						
9	53	2 16	9						
10	3654	2 24	8			"	"	"	"
11									
12					Pull To Rubber Sleeve.				
13									
14									
15									
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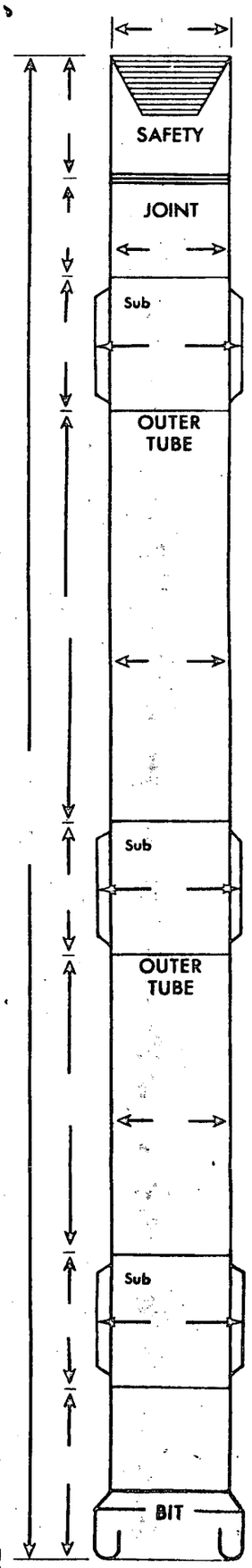
42									



CORING LOG

FROM

CHRISTENSEN DIAMOND PRODUCTS LTD.

14730 - 118th Avenue EDMONTON, ALBERTA

Date: June 2/62 Service Engineer Wally + Jean

Company Devils Elbow Mines Contractor Christensen #9

Well Name DEM Dakota #1 No. 15-4-44-16-W4 Field — Province Alberta

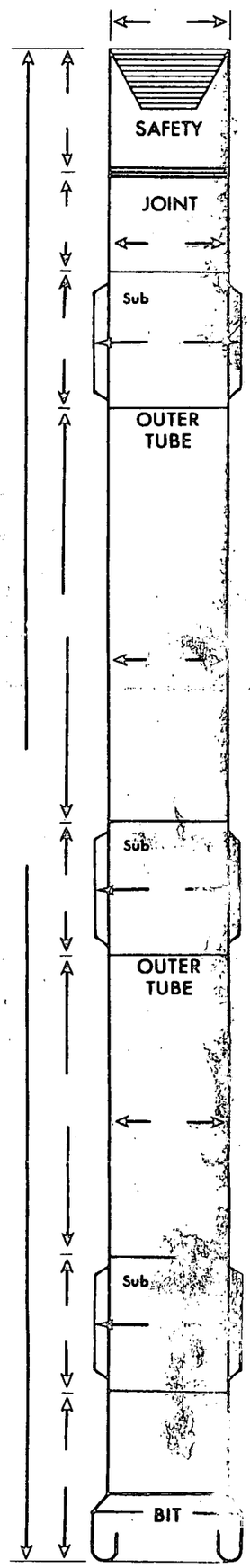
Hole Size 7 7/8 Diamond Bit Size 7 7/8 x 3 Diamond Bit Type Bit No. EC-10602

Core Barrel: Size 6 3/4 x 3 Length 40.0 Number 1

Core No. ~~1~~ II Depth: From 3654 To 3694 Total Footage Cored 40 Recovered 40

Formation Cored R.S Description

START	DEPTH	TIME	MIN./FOOT Actual	MIN./FOOT Lost	Mud Report & Remarks	WEIGHT	R. P. M.	PUMP SIZE: 7 1/2 x 6 Pressure	PUMP SIZE: 7 1/2 x 6 Stroke
	3654	8 35			Core # 1	8 000	60	550	28
2	56	9 15	30						
3									
4	58	9 50	35			8 000	60	550	28
5									
6	60	10 35	45						
7									
8	62	11 17	42						
9									
10	3664	12 04	47			8 000	60	550	28
11									
12	66	1 05	61						
13									
14	68	1 53	48						
15									
16	70	2 30	37						
17									
18	72	2 58	28			8 000	60	550	28
19					Cut 20' Recovered 20'				
20	3674	3 35	37						
21	3674	9 28			Core # 2				
22	76	9 55	27			8 000	60	550	28
23									
24	78	10 25	30						
25									
26	80	10 55	30						
27									
28	82	11 27	32			8 000	60	550	28
29									
30	3684	12 09	60						
31									
32	86	12 48	41						
33									
34	88	1 30	42			8 000	60	550	28
35									
36	90	2 13	43						
37									
38	92	2 47	34						
39						8 000	60	550	28
40	3694	3 28	41						
41					Cut 20' Recovered 20'				
42									



One half of the sample interval was slabbed for laboratory work. One slabbed half was cut into halfs for sulphur assay and descripitive analysis. The remaining slab was delivered as a permanent record to the Core Storage Center of the Oil and Gas Conservation Board of Calgary. Porosity and permeability test and sulphur extraction tests were done using the other half interval, whole diameter core (see figure 10 for sketch of procddure).

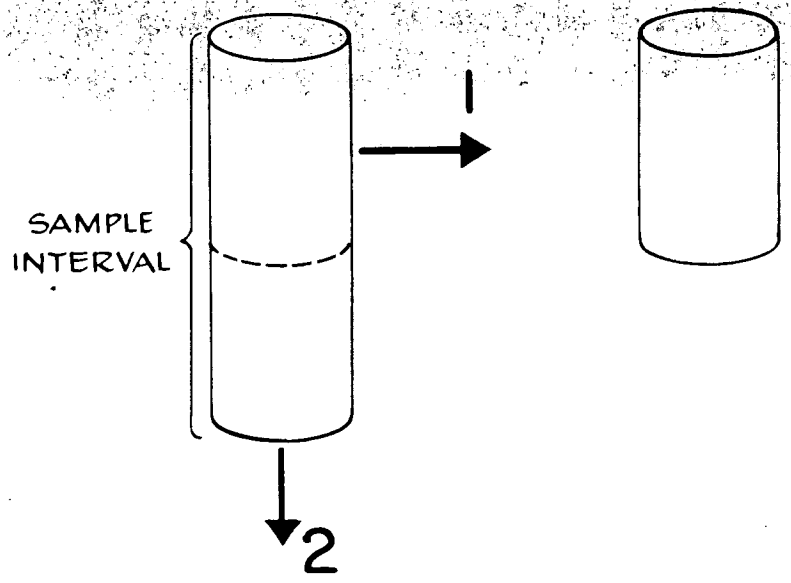
Testing Results

The complete testing results are given in the Core Laboratories Report on the Core Analysis on D.E.M. Ankerton Sulphur 15-4 at the rear of this Appendix.

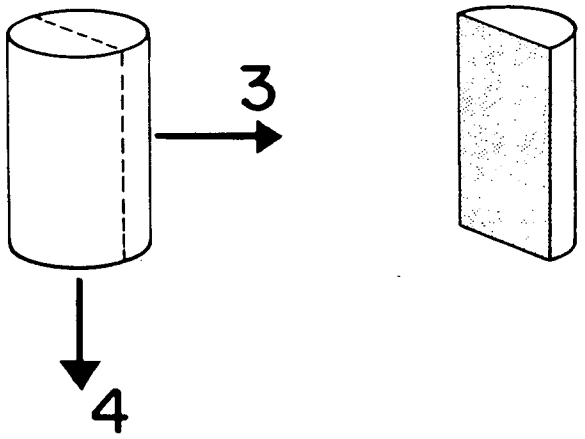
The selected interval from 3652.7' to 3691.7' was assayed in sections for weight percentage sulphur and tested when dried for porosity and permeability with the sulphur in place. The sulphur was then extracted from the whole diameter core by melting using steam under pressure. The weight percentage of recovered sulphur was again calculated. This extraction technique gives an indication of the percentage of sulphur which might be recovered using a Frasch Process. Porosity and permeability measurements were made after steam extractions.

Solvent extraction on whole diameter core recovered the remaining sulphur and the final weight percentage sulphur and porosity and permeability were measured.

FIGURE 10

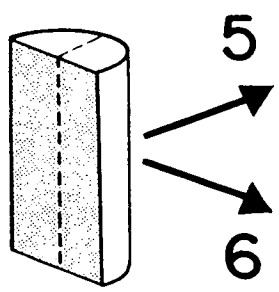


HALF SAMPLE INTERVAL FOR EXTRACTION, POROSITY AND PERMIABILITY TESTS SUBSEQUENTLY STORED AT O&G CONSERVATION BOARD



SLABBED HALF INTERVAL FOR O&G CONSERVATION BOARD STORAGE

SLABBED QUARTER INTERVAL FOR DESTRUCTIVE ANALYSIS OF WEIGHT PERCENT SULPHUR



SLABBED QUARTER INTERVAL FOR RETENTION BY OPERATOR FOR DESCRIPTIVE ANALYSIS

SLABBING PROCEDURE

Four sample intervals in the more heavily mineralized sections were selected for chemical analysis of the water used to extract the sulphur. A chemical analysis determined the weight percentages of sulphur, silica, selenium, tellurium, and arsenic in the solids extracted by the steam technique.

The weighted averages of weight percentage sulphur over several intervals are given elow.

Well: D.E.M. Ankerton Sulphur 15-4

INTERVAL	ACTUAL LENGTH	WEIGHT PERCENTAGE SULPHUR
3659.0 - 3667.6 K.B.	8.6 ft.	20.3
3659.4 - 3664.8 K.B.	5.4 ft.	28.0
3673.3 - 3677.3 K.B.	4.0 ft.	7.5
3652.7 - 3683.4	30.7 ft.	7.8

ESTIMATION OF SULPHUR CONTENT FROM LOGS

Schlumberger of Canada Ltd. employs a log evaluation technique for estimating the sulphur content of Rock. A paper by M. P. Tixier and R. P. Alger (5) developed the technique as outlined very briefly below.

Density, Sonic and Neutron logs are linearly scaled in terms of porosity. This permits direct comparison of various types of logs to correlate lithologies between holes using different logging systems. In order to scale these logs in porosity, it is necessary to assume certain lithological and fluid characteristics. In the porosity determination from a formation density log, the rock is assumed to be a limestone of density 2.71 with pore spaces entirely filled with water of density 1.00. In the calculation of porosity from a formation density log, pore spaces which are filled with sulphur are assumed to be water filled pores. In a sidewall neutron log, however, the porosity is calculated assuming the percentage porosity is a direct function of the absorption of neutrons by hydrogen atoms in either water or hydrocarbons. Elemental Sulphur in this logging technique is therefore measured as rock.

It can be shown mathematically that the porosity determined by the density log (ϕ_d) minus the porosity determined by the neutron log (ϕ_n) represents a measure of the percentage by bulk volume of sulphur in the rock.

That is $$\frac{\phi_d - \phi_n}{0.40} = \% \text{ Sulphur Bulk Volume}$$

The following table shows the results of these calculations taken at different depths (K.B.) in the D.E.M. Ankerton Sulphur 15-4 well. The graph showing porosity determined by neutron and density techniques illustrates the calculations in the table.

FIGURE 11

SULPHUR PERCENTAGE BULK VOLUME - D.E.M. ANKERTON SULPHUR 15-4

Log Depth K.B. feet	ϕ_n LS	ϕ_d LS	$\phi_d - \phi_n$	$\frac{\phi_d - \phi_n}{.40}$ or % Sulphur Bulk Volume
3654	3	3	0	0
3655	2	3	0	0
3656	1.75	5	3.24	8
3657	1.0	10	9.0	22.5
3658	0	18	18	45
3659	.5	15.5	15.0	37.5
3660	1.0	8	7	17.5
3661	2	5	3	7.5
3662	4	3		N.A.
3663	4	4		----
3664	4	6		----
3665	7	5		----
3666	9	5		----
3667	8	3		N.A.
3668	4	6	2	5
3669	5	5		N.A.
3670	4	8	4	10
3671	3.5	9	5.5	14

FIGURE 11

FIGURE 11 - Cont.

SULPHUR PERCENTAGE BULK VOLUME - D.E.M. ANKERTON SULPHUR 15-4

Log Depth K.B. feet	ϕ_n LS	ϕ_d LS	$\phi_d - \phi_n$	$\frac{\phi_d - \phi_n}{.40}$	or % Sulphur Bulk Volume
3672	4	4			N.A.
3673	4	4			N.A.
3674	5	7	2		5
3675	4	4			N.A.
3676	4	4			N.A.

N.A. - Technique not accurate enough to make calculation

FIGURE 12

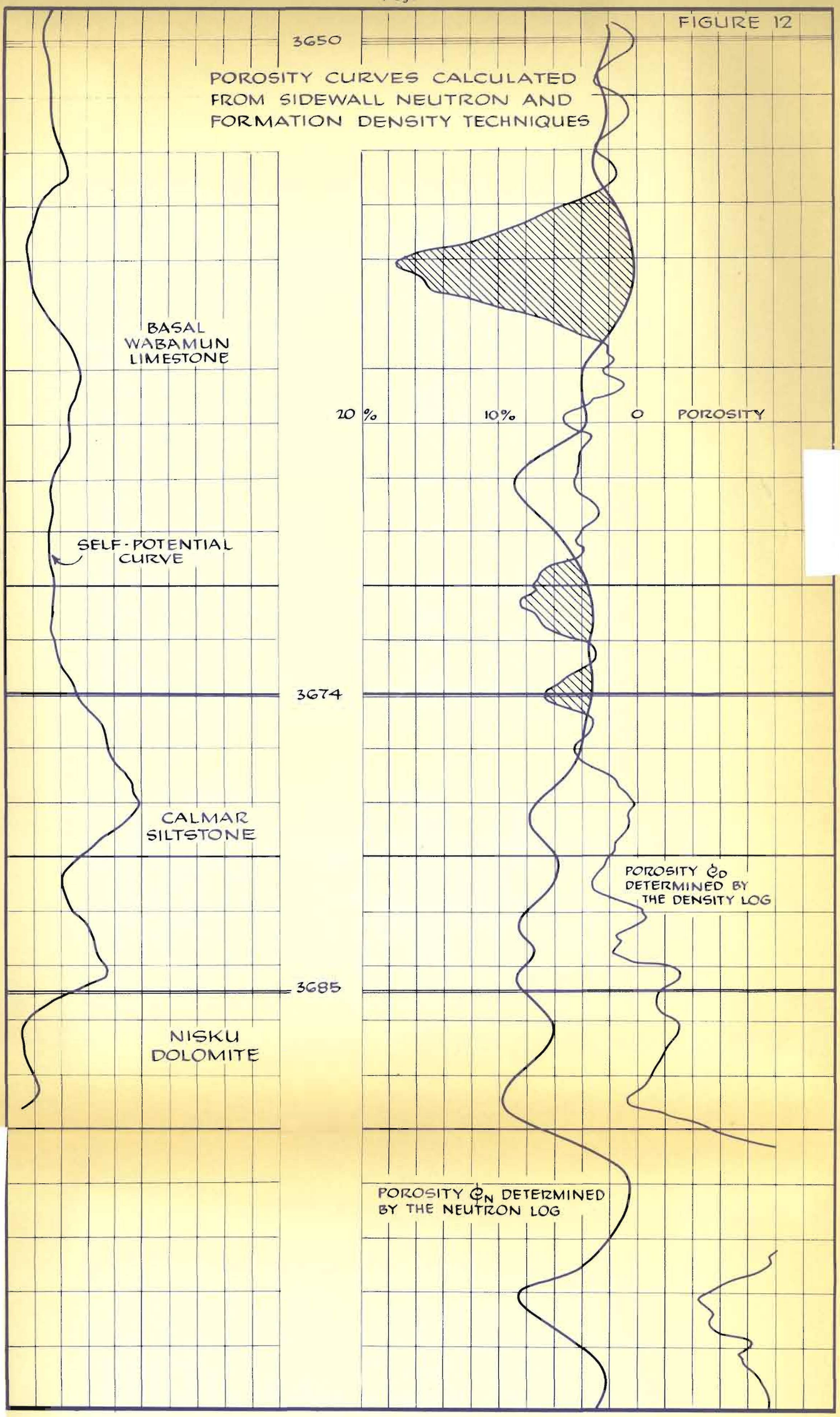


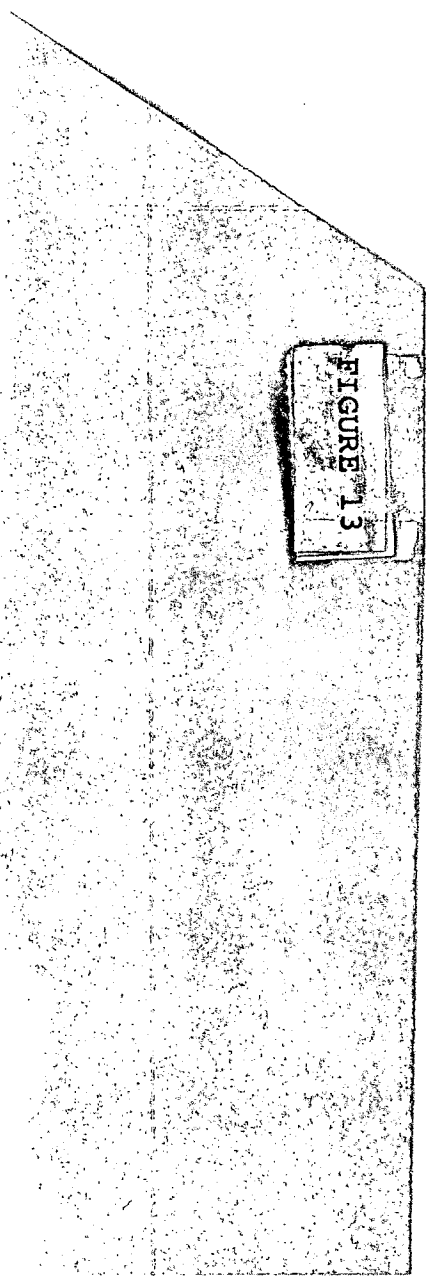
FIGURE 12

F I G U R E 1 3

SAMPLE DESCRIPTIONS AND LITHOLOGY LOG

D. E. M. ANKERTON SULPHUR 15-4

(71 -- 72)



1967000S FIGURE 13

N. C. LENARD - P. GEOL. CALGARY, ALBERTA.

— WELL HISTORY LOG —

COMPANY NAME: DEVILS ELBOW MINES LTD. TORONTO, ONTARIO

WELL NAME: DEM ANKERTON SULPHUR 1574

LOCATION: L.S.D. 15 SEC. 4 TWP. 44 RGE. 16 W. 4 M. IN THE PROVINCE OF ALBERTA

COORDS: 2080' O, N 89° 53' 30" W; 977.75' S. of the N.E. corner of Section 4

GROUND ELEVATION: 2319 KELLY BUSHING: +2330 TOTAL DEPTH: 3707 STATUS: WILDCAT

SPUDDED: MAY 25th 1967 SUSPENDED: COMPLETED: JUNE 4th 1967 ABANDONED: JUNE 4th 1967

CASING: SURF: 0' - 610' KB. — 8 3/8" NEW 24lb — ABANDONNED

PROD'N.:

CORES LOGGED BY: J.C. ROWNTREE FROM 3565 KB TO 3694 KB. DATE JUNE 1967

FROM TO DATE 19

SAMPLES LOGGED BY: J.C. ROWNTREE FROM 2800 KB TO 3565 KB DATE JUNE 1967

VERTICAL SCALE 1" = 100' AND 2" = 100'

OBJECTIVES: ZONE(S) BASAL WABAMUN FORMATION DEPTH(S) 3578 - 3685' K.B.

MAIN ROCK TYPES

CONGLOMERATE, LIGHT & DARK PEBBLES
SANDSTONE
SILTSTONE
SHALE
COAL
SIDERITE OR IRONSTONE
BENTONITE
LIMESTONE
DOLOMITE
ANHYDRITE
SALT
CHERT, LIGHT, DARK, PRIMARY
CHERT, LIGHT, DARK, ANGULAR OR DETRITAL
BASEMENT ROCK
ALGAL LS.
REEF LS.
BIOCLASTIC, FRAGMENTAL LS.

SUPPLEMENTARY SYMBOLS

SANDY
ARILLACEOUS
CARBONACEOUS OR BITUMINOUS
SIDERITIC
CALCAREOUS, LIMY
DOLOMITIC
GLAUCONITIC
OOLITIC, PELLETED
STYLOLITES
PYRITE
SAMPLES MISSING
NOT LOGGED
POOR SAMPLES
CHALKY
MARLY
EARTHY
RESTRICTED BY EVAP'S

POROSITY TYPES

X - FRACTURE POROSITY
G - GRANULAR
V - VUGGY
X - CRYSTALLINE

SAND TYPES

VAR	CLAR	PELOSM	COLOR
QTZ	< 1	< 1	WHITE
SUB-ARKOSE	< 1	> 1	GREY
GRYPHAEOS	LS	> 1	GREEN
ARKOSE	> 25	< 1	PINK

ROUNDNESS

R	ROUND
r	SUBROUND
A	ANGULAR
a'	SUBANGULAR

SORTING

G	GOOD
F	FAIR
P	POOR

POROSITY

POOR 0-10 %
FAIR 10-20 %
GOOD > 20 %

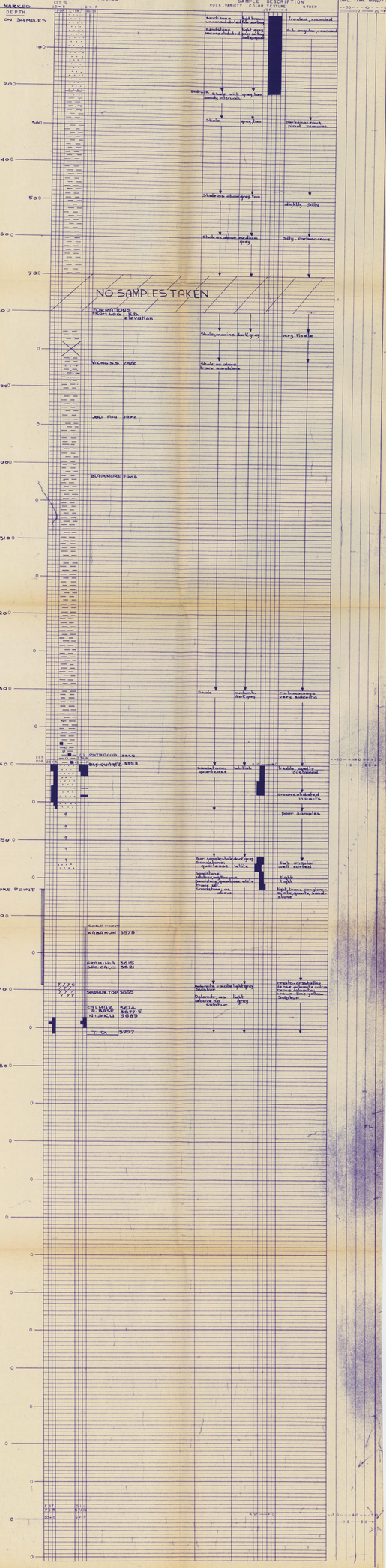
OIL STAINING

POOR
FAIR
GOOD
T: TARRY, ASPHALTIC

ENGINEERING SYMBOLS

PERFORATIONS
CASING SHOE
DRILL STEM TEST
CORED INTERVAL
SAND FRAC'D.

REMARKS:



F I G U R E 1 4

Induction Electric Log of Surface Hole - Annotated

D.E.M. Ankerton Sulphur 15-4

(71 -- 72)

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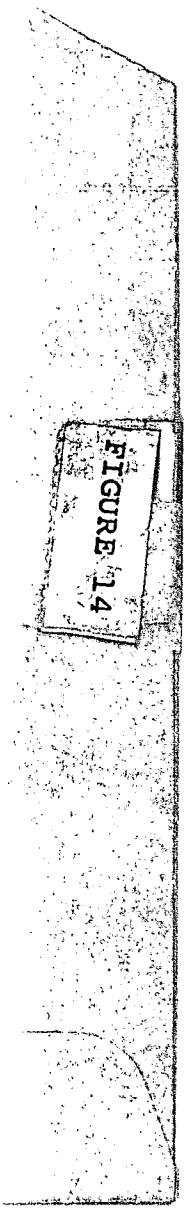


Alberta Government

Disclaimer

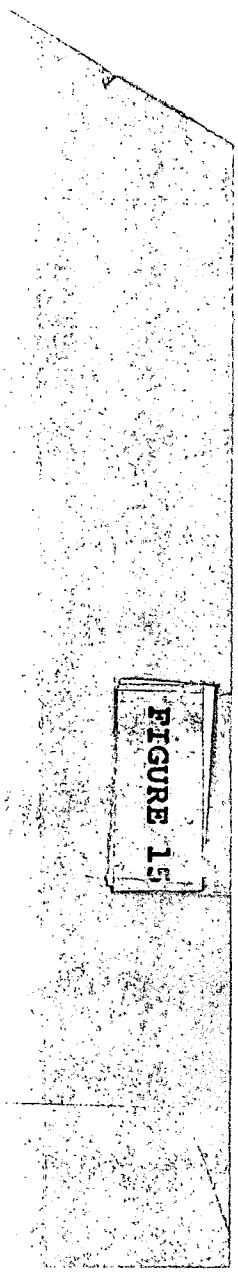
This page was inserted by the Coal and Minerals Development Branch, to provide a reference that Figure 14 associated with this report is not contained in the assessment report on file.

F I G U R E 1 5

Induction Electric Log - Annotated

D.E.M. Ankerton Sulphur 15-4

(71 -- 72)



SCHLUMBERGER

INDUCTION ELECTRICAL LOG

SCHLUMBERGER OF CANADA Calgary, Alberta

PROVINCE ALBERTA
FIELD WILDCAT
WELL DEM ANKERTON SULPHUR
15-4-44-16
COMPANY DEVIL'S ELBOW MINES LIMITED

FIGURE 15

19670005

COMPANY DEVIL'S ELBOW MINES LIMITED

WELL DEM ANKERTON SULPHUR
15-4-44-16

FIELD WILDCAT

PROVINCE ALBERTA

LOCATION LSD 15 Sec. 4 Twp. 44 Rge. 16W4

Other Services: SNP-GR, FDC-GR

Permanent Datum GL Elev. 2319
Log Measured From KB, 11 Ft. Above Perm. Datum

ELEV: KB 2330
GL 2319
CBF

Date	26 MAY 67	3 JUNE 67	
Run No.	ONE	ONE	
First Reading	594	3706	
Last Reading	100	610	
Feet Measured	494	3096	
Depth Reached	595	3707	
Bottom Driller	609	3710	
Csg. SOC	-	610	
Csg. Driller	-	610	
Mud Nature	-	GEL	
Dens. | Visc.	- | -	9.0 | 85	|
Mud pH	-	8.5	
" Water Loss	-	15.0	
" Res.	RMKS @ °F	3.74 @ 59 °F	@ °F
" " @ BHT	- @ - °F	2.25 @ 102 °F	@ °F
" Rmf	- @ - °F	1.90 @ 68 °F	@ °F
" Rmc	- @ - °F	1.30 @ 102 °F	@ °F
Bit Size	12 3/4"	RMKS	
Spacing - AM	16"	16"	16"
" - MN	34'-6"	34'-6"	34'-6"
Ind. Type	6FF40	6FF40	6FF40
Opr. Rig Time	1/2 HR.	2 HRS	
Truck No.	4508 RD	7014 STETT	
Recorded By	PORTH	PICKERL	
Witness	ROWNTREE	ROWNTREE	

7 JUNE 67 CAL PL

REMARKS

1st Run Service Order # 35526

Drilling Stopped 1615 / 26th : Circulation Stopped 1645 / 26th : Tool on Bottom 1800 / 26th : B.H.T. 102 °F
RUN 2 1030 3rd 1315 3rd 1545 3rd

Stand Off = Inches	1.5	1.5
Cartridge No.	F119	F 41
Panel No.	F281	F286
Sonde No.	M139	M 53
IAP-D No. MMP-	B109	D110
SBR	4	2

RUN 1
MUD SAMPLES: MOSTLY WATER Rm #1 = 10.0 @ 75°F

RUN 2 BIT SIZE:
7 7/8" - 3654
7 5/8" - 3710

SPONTANEOUS-POTENTIAL
millivolts

10
− |←→| +

SCALE CHANGE @ 610'

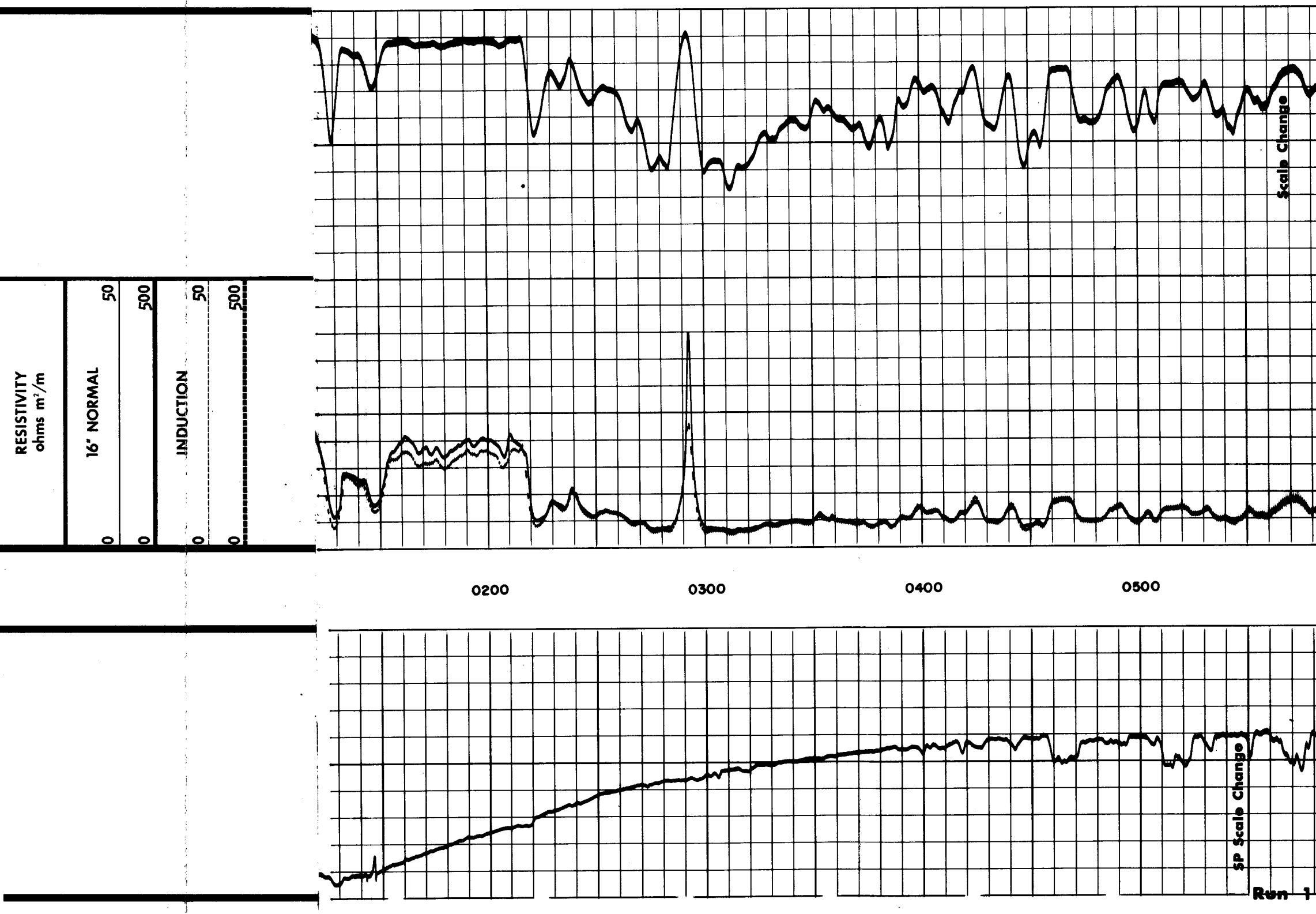
DEPTHS

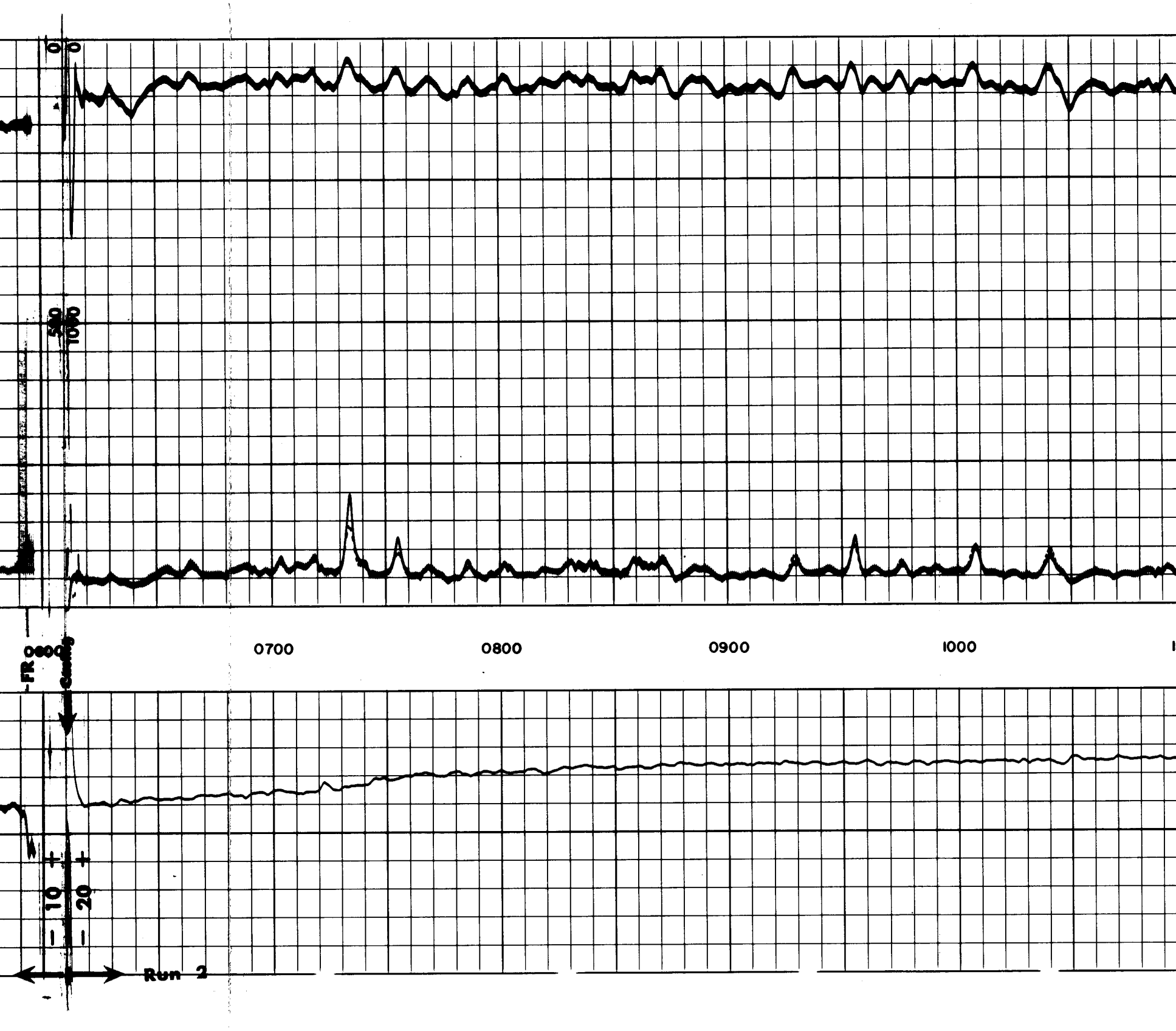
CONDUCTIVITY
$\text{millimhos/m} = \frac{1000}{\text{ohms m}^2/\text{m}}$

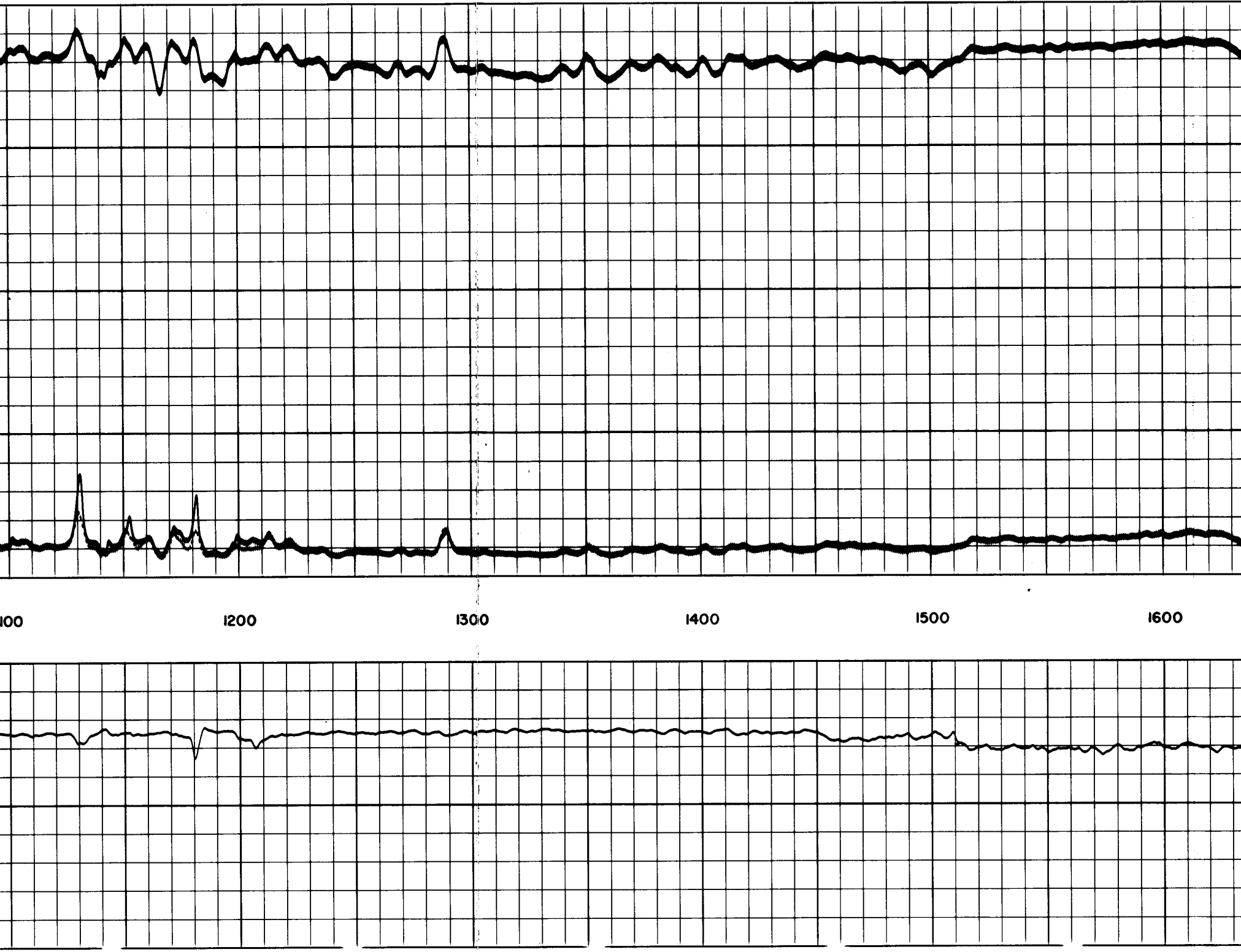
INDUCTION
1000 500 0
1500 1000

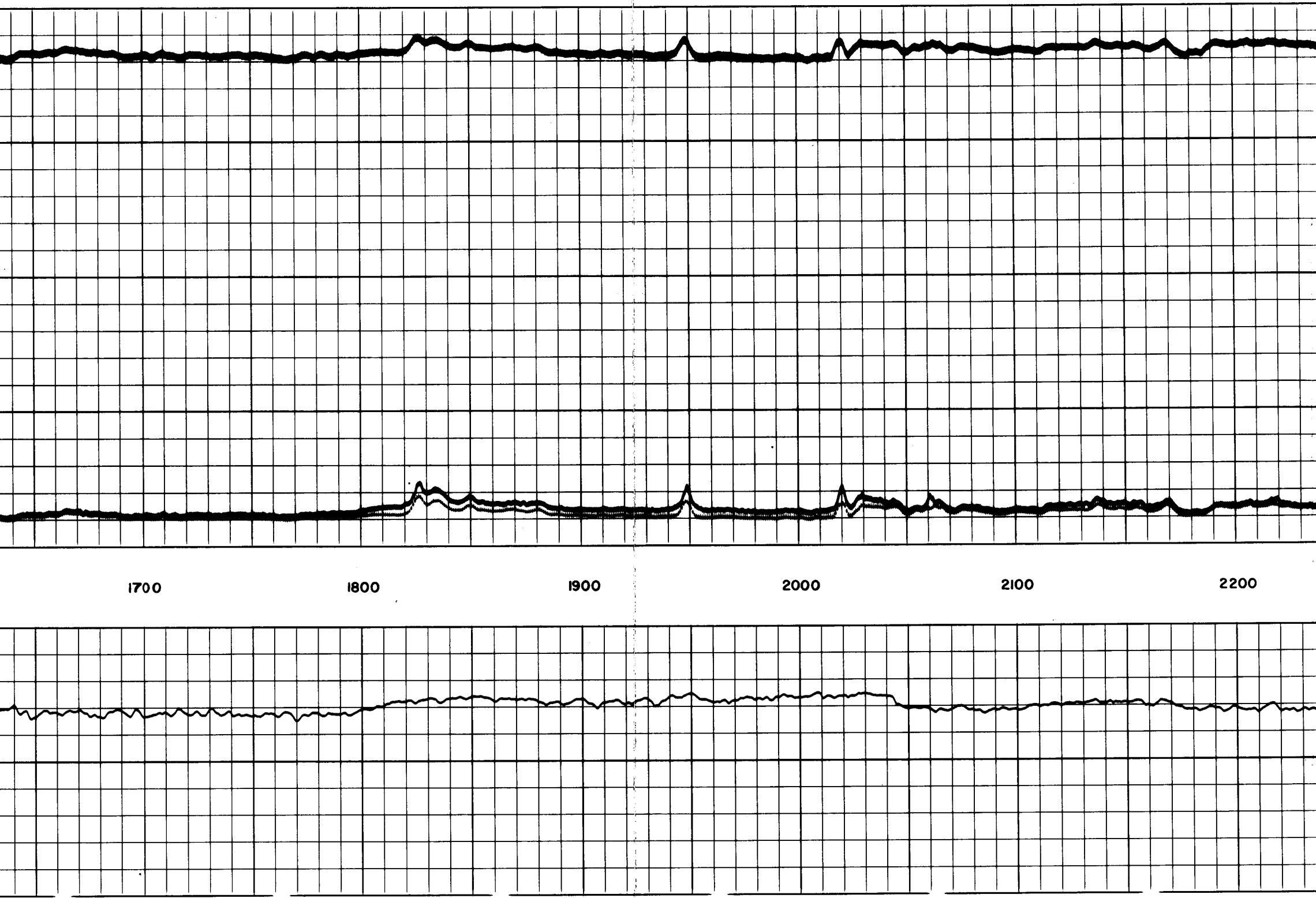
SCALE CHANGE @ 610'

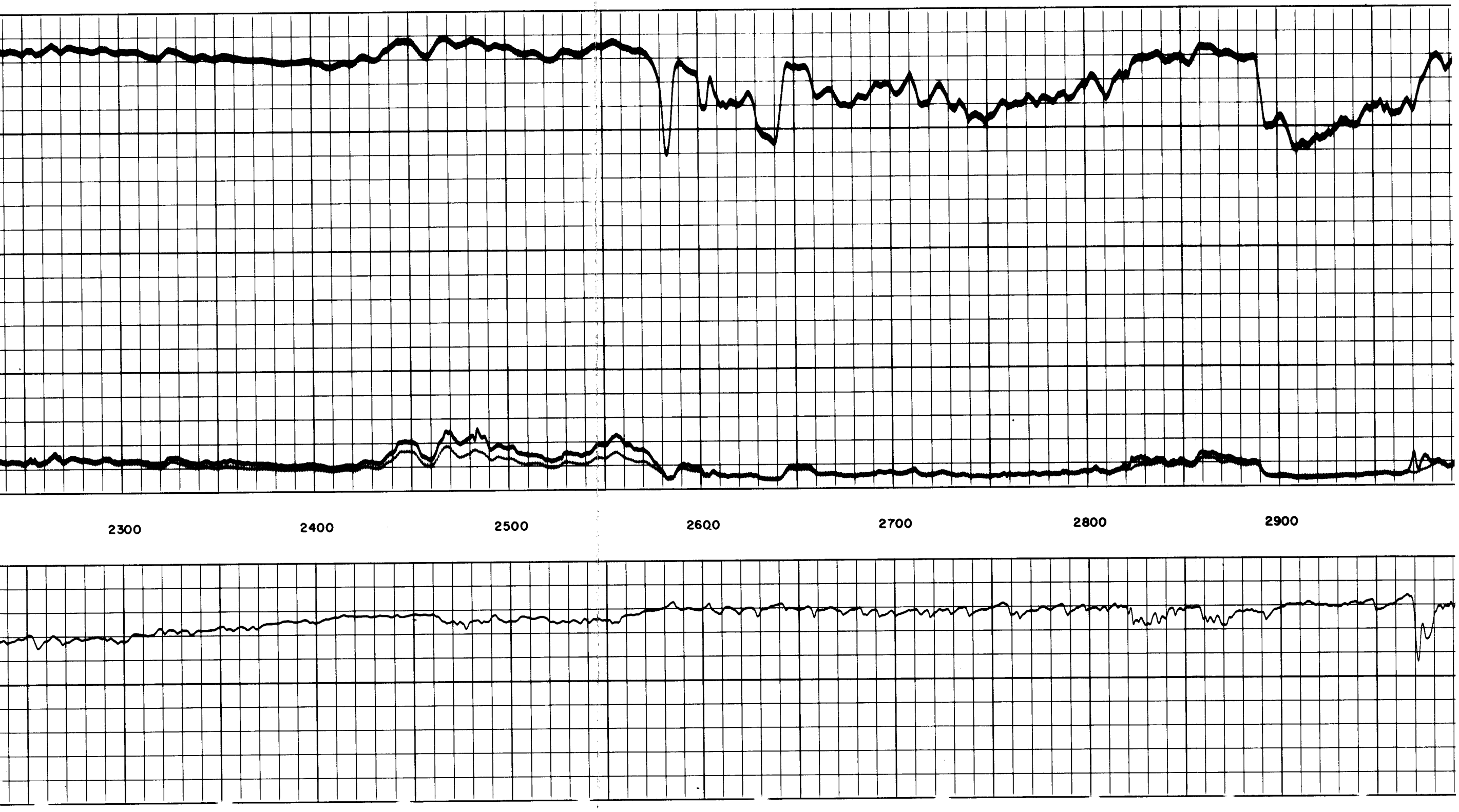
←Speed in FPM→

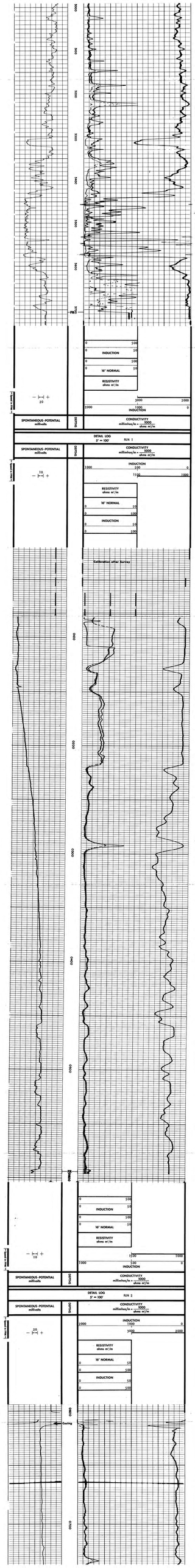




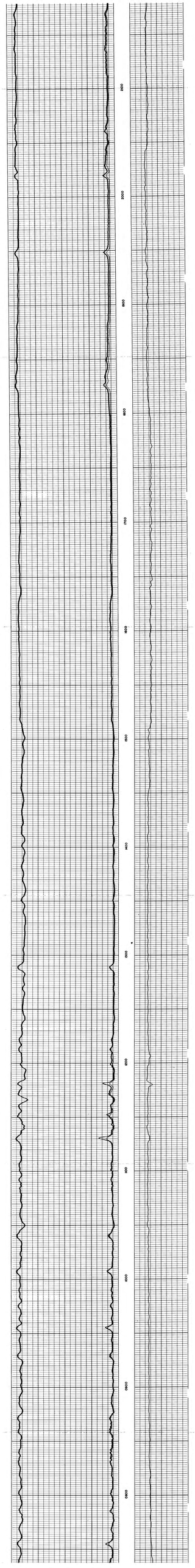


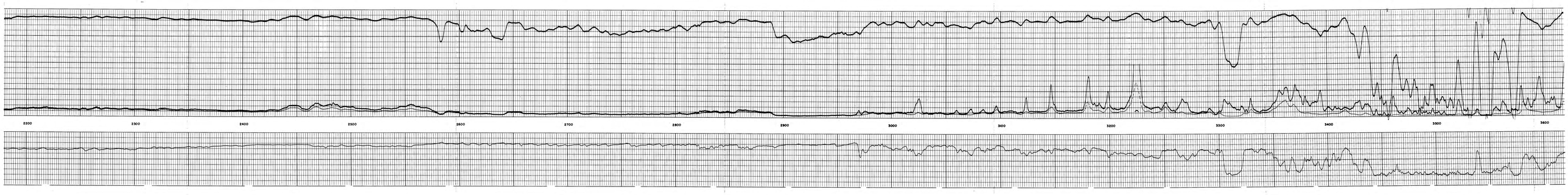


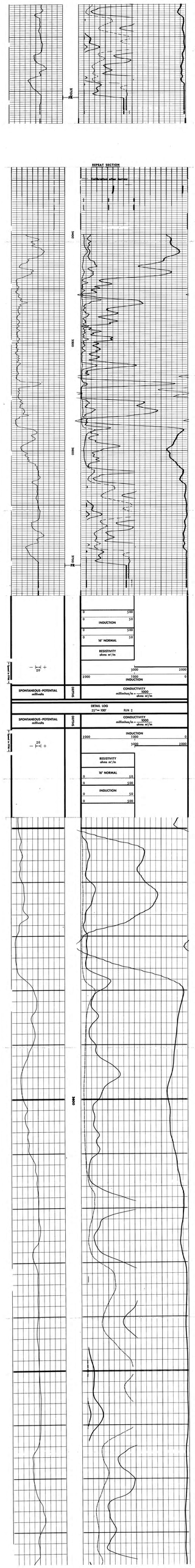




3000
3100
3200
3300
3400
3500
3600
3700
FROM
0 500
0 50
INDUCTION
0 500
0 50
16" NORMAL
RESISTIVITY
ohms m²/m
3000 2000
2000 1000 0
INDUCTION
20
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
DETAIL LOG
5" = 100'
RUN 1
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
INDUCTION
1000 500 0
1500 1000
RESISTIVITY
ohms m²/m
16" NORMAL
0 50
0 500
INDUCTION
0 50
0 500
10
Calibration after Survey
0000
0200
0400
0600
0800
0900
0 500
0 50
INDUCTION
0 500
0 50
16" NORMAL
RESISTIVITY
ohms m²/m
1500 1000
1000 500 0
INDUCTION
10
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
DETAIL LOG
5" = 100'
RUN 2
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
INDUCTION
2000 1000 0
3000 2000
RESISTIVITY
ohms m²/m
16" NORMAL
0 50
0 500
INDUCTION
0 50
0 500
20
Casing
0000
0100




2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
3600



REPEAT SECTION
Calibration after survey
3400
3300
3200
3100
FR
0 500
0 50
INDUCTION
0 500
0 50
16" NORMAL
RESISTIVITY
ohms m²/m
3000 2000
2000 1000 0
INDUCTION
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
DETAIL LOG
25"= 100'
RUN 2
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
INDUCTION
2000 1000 0
3000 2000
RESISTIVITY
ohms m²/m
16" NORMAL
0 50
0 500
INDUCTION
0 50
0 500

3700

FR

0 500

0 INDUCTION 50

0 500

0 16" NORMAL 50

RESISTIVITY
ohms m²/m

3000 2000

2000 1000 0
INDUCTION

Speed in FPM

— +
20

SPONTANEOUS-POTENTIAL
millivolts

DEPTHS

CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m

COMPANY DEVIL'S ELBOW MINES LIMITED

WELL DEM ANKERTON SULPHUR 15-4-44-16

FIELD WILDCAT PROVINCE ALBERTA

SCHLUMBERGER

F I G U R E 1 6

Sidewall Neutron Porosity Log - Annotated

D.E.M. Ankerton Sulphur 15-4

(71 -- 72)

FIGURE 16

SCHLUMBERGER

SIDEWALL NEUTRON POROSITY LOG

SCHLUMBERGER OF CANADA Calgary, Alberta

PROVINCE ALBERTA
FIELD WILDCAT
WELL DEM ANKERTON SULPHUR
15-4-44-16
COMPANY DEVIL'S ELBOW MINES LIMITED

FIGURE 16
19670005

COMPANY DEVIL'S ELBOW MINES LIMITED

WELL DEM ANKERTON SULPHUR
15-4-44-16

FIELD WILDCAT

PROVINCE ALBERTA

LOCATION
LSD 15 Sec. 4 Twp. 44 Rge. 16W4

Other Services:
I-ES, FDC-GR

Permanent Datum GL Elev. 2319
Log Measured From KB , 11 Ft. Above Perm. Datum

ELEV: KB 2330
GL 2319
CBF

Date	3 JUNE 67		
Run No.	ONE		
First Reading	3706		
Last Reading	2206		
Feet Measured	1500		
Depth Reached	3707		
Bottom Driller	3710		
Csg. SOC	610		
Csg. Driller	610		
Mud Nature	GEL		
Dens. | Visc.	9.0 | 85	|	|
Mud pH	8.5		
" Water Loss	15.0		
" Res.	3.74 @ 59 °F	@ °F	@ °F
" Rmf	1.90 @ 68 °F	@ °F	@ °F
" " @ BHT	1.30 @ 102 °F	@ °F	@ °F
" Rmc	— @ — °F	@ °F	@ °F
" ppm-Cl.			
Bit Size	RMKS		
Equipment Type	PNT-A		
Opr. Rig Time	4 HRS		
Truck No.	7014 STETT		
Recorded By	PICKERL		
Witness	ROWNTREE		

7 JUNE 67 CAL PL

REMARKS

Drilling Stopped 1030 / 3rd : Circulation Stopped 1315 / 3rd : Tool on Bottom 2130 / 3rd : 1st Run Service Order # 35526 B.H.T. 102 °F

Panel No. D199
Cartridge No. A 43
Sonde No. D 49
Detector No.

BIT SIZE:
7 7/8" - 3654
7 5/8" - 3710

CALIBRATION: Gamma Ray			Neutron Environmental Cal.	
Background CPS	Test Source CPS	Galv. Deflection	Drawer In-CPS	Drawer Out-CPS
60	420	100	Before	
Panel Settings: Function Former LS	Mud Wt./Salinity 9.0	Temp. Comp. Setting 100	After	
from to	from to	from to	Neutron Auxiliary Cal.-CPS	
from to	from to	from to	Before	
from to	from to	from to	After	

This interpretation represents our best judgment. Nevertheless since all interpretations are opinions based solely on inferences from electrical or other measurements, we cannot and do not guarantee the accuracy or correctness of any interpretation and shall not be liable or responsible for any loss, cost, damages, or expenses that may be incurred or sustained resulting from this or any other interpretation.

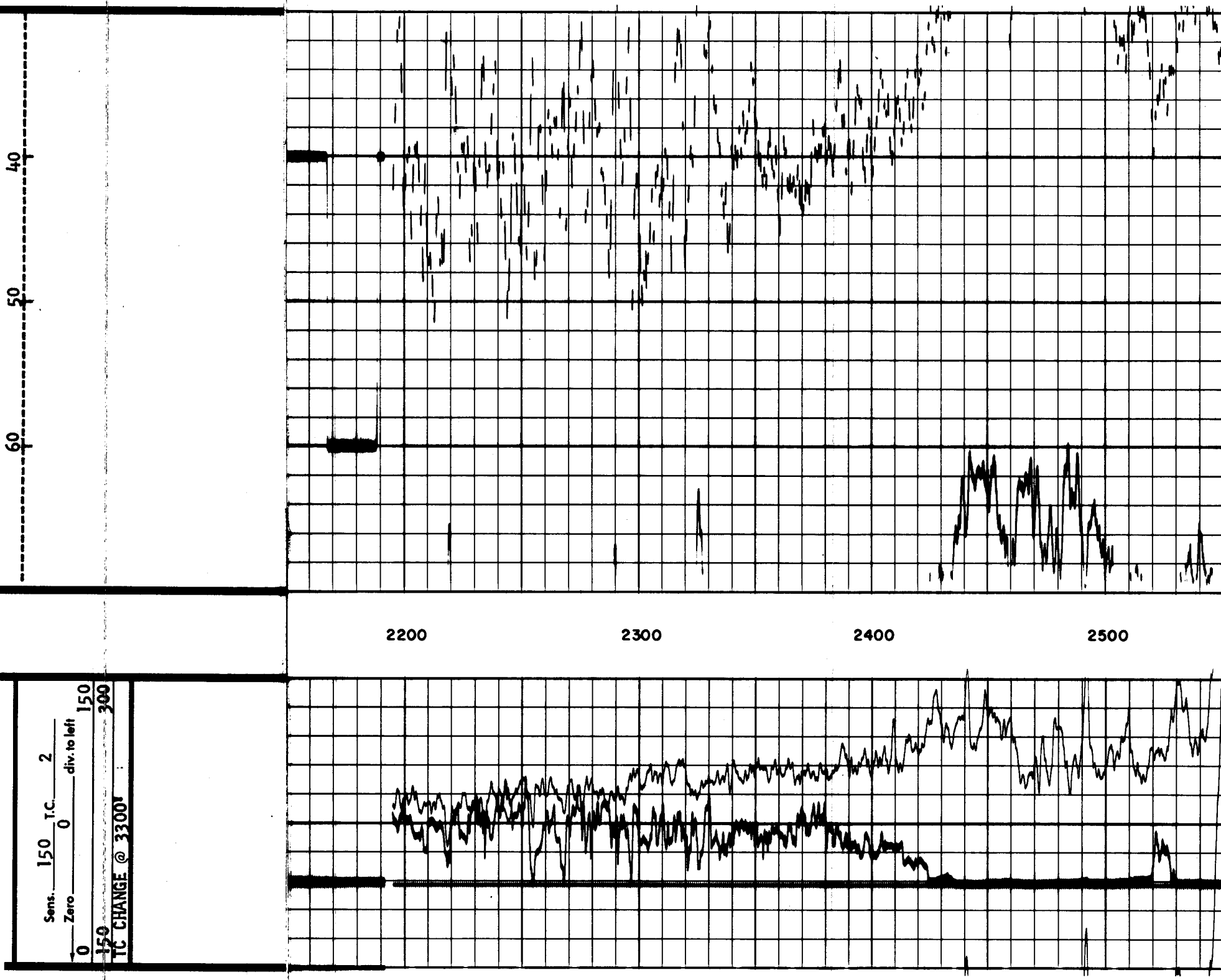
POROSITY (%)
LIMESTONE
-10 0 10 20 30

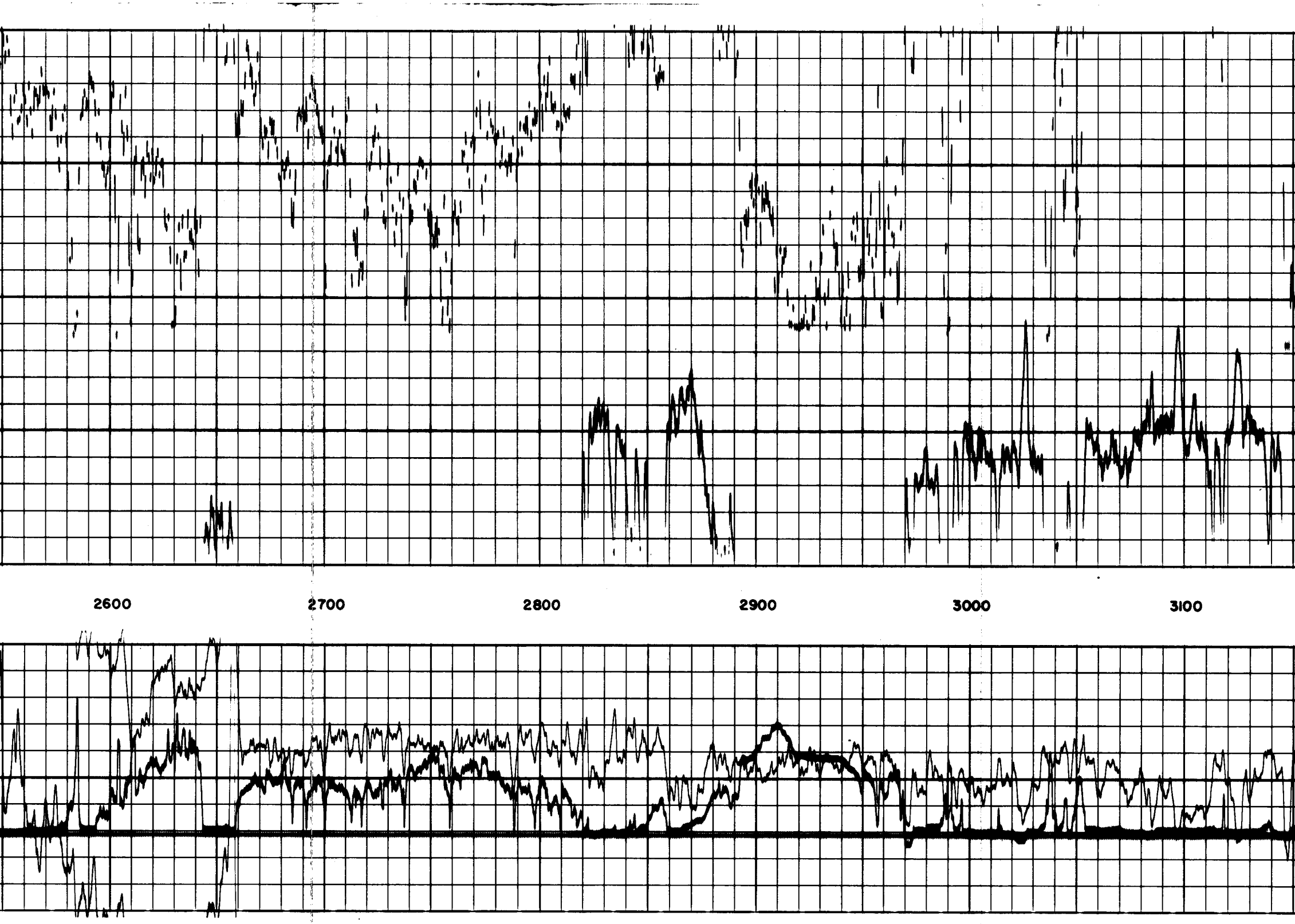
DEPTHS

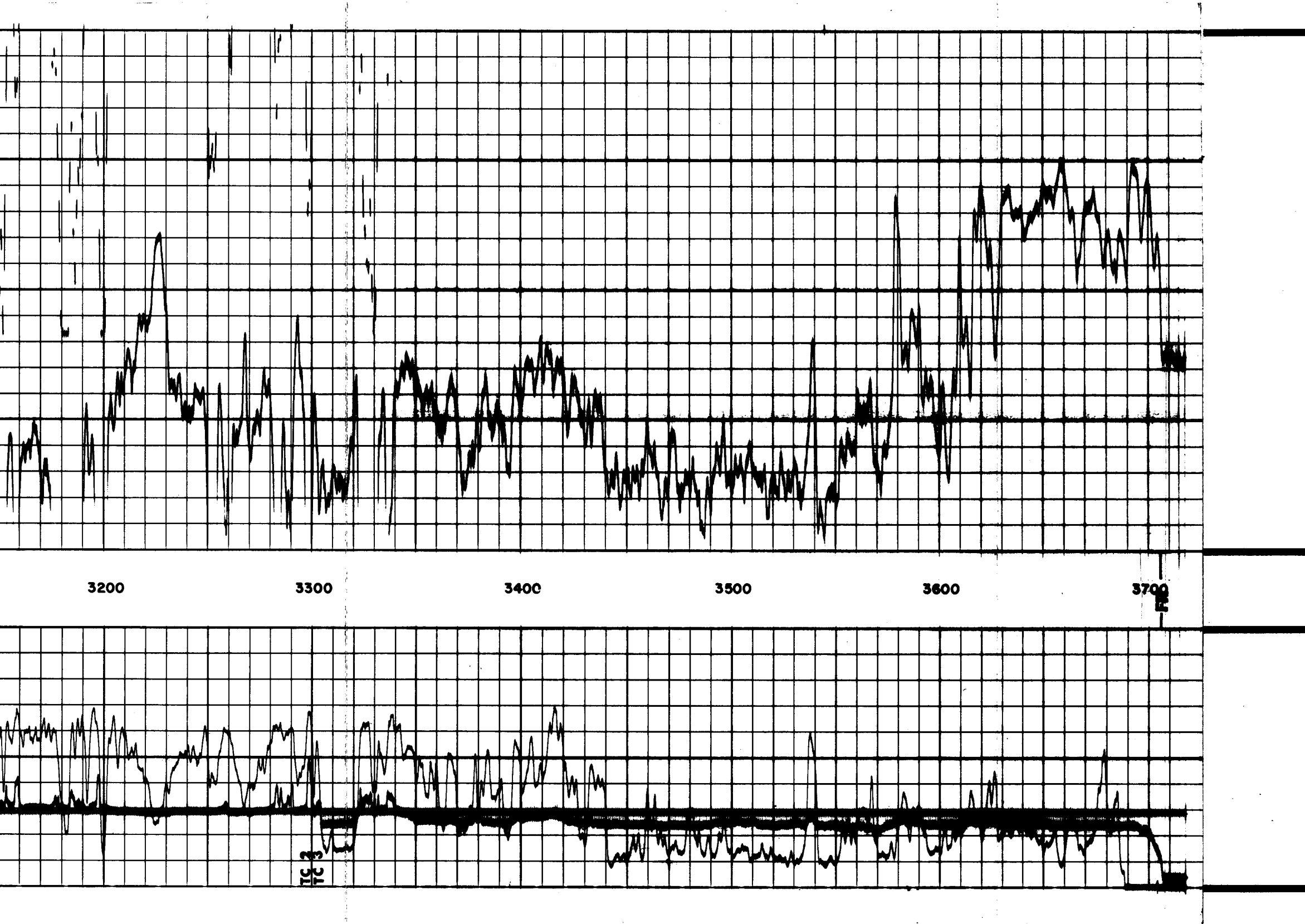
CALIPER
hole diameter in inches
6 7 8 9 10 11 12 13 14

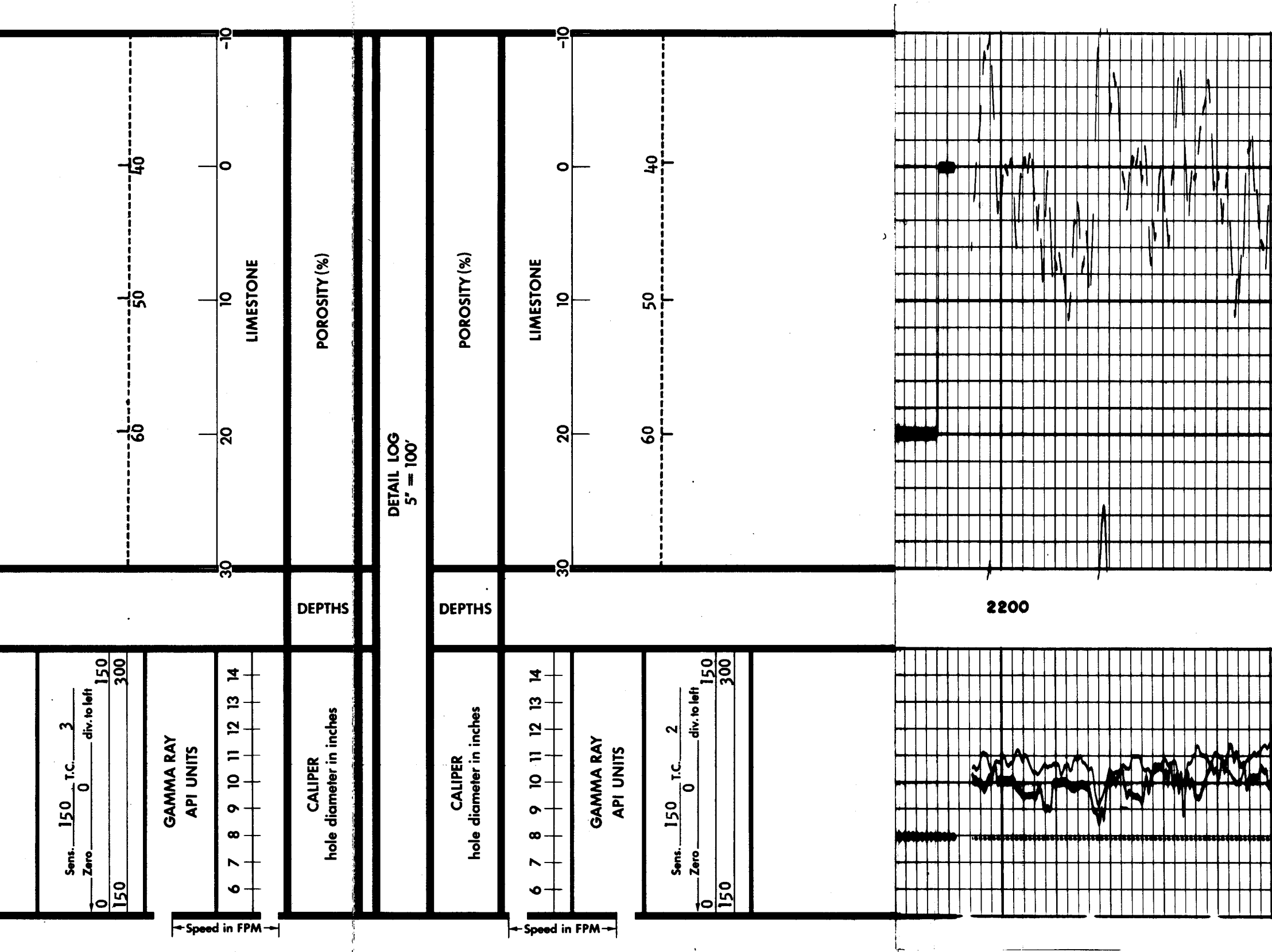
GAMMA RAY
API UNITS

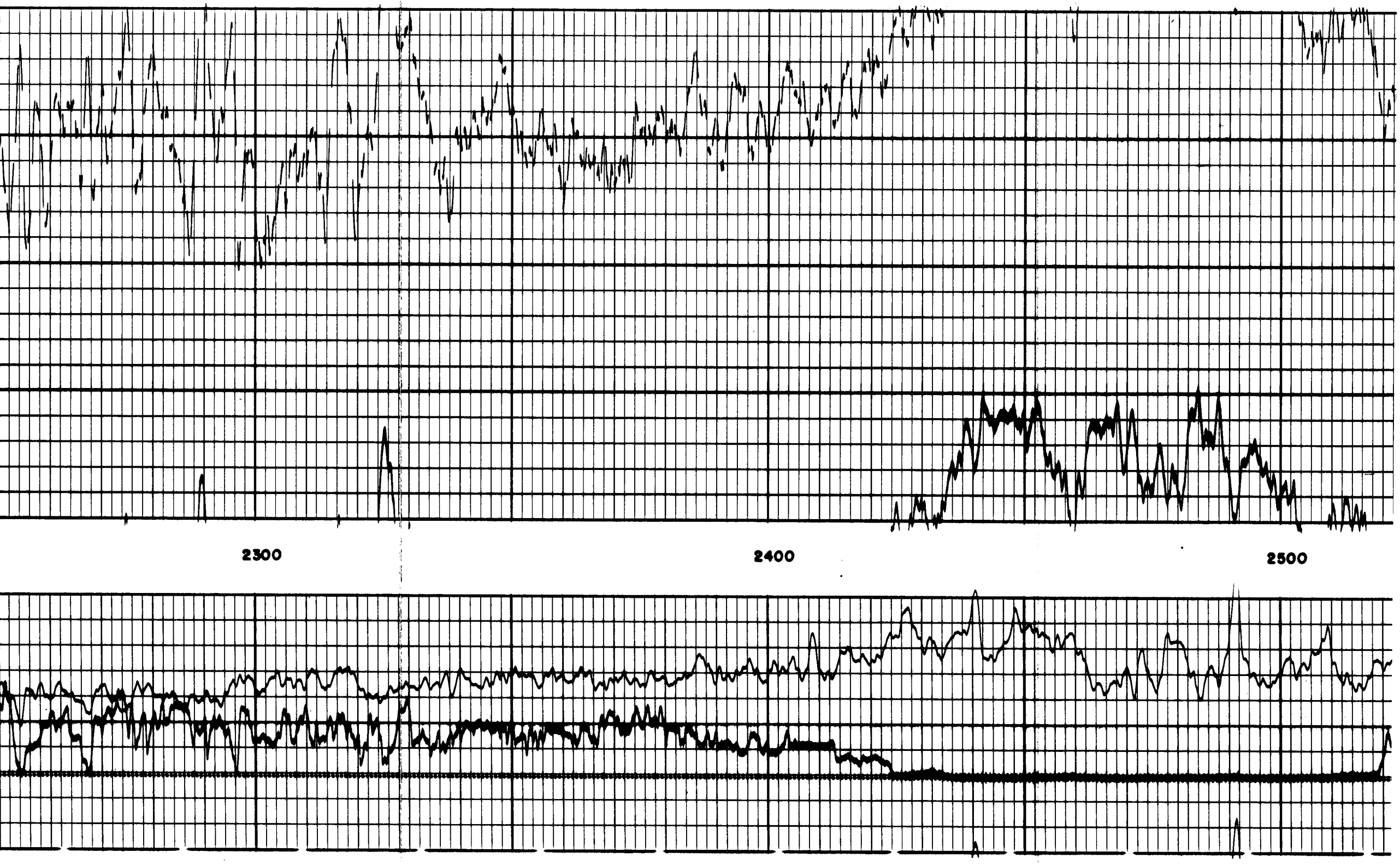
Speed in FPM

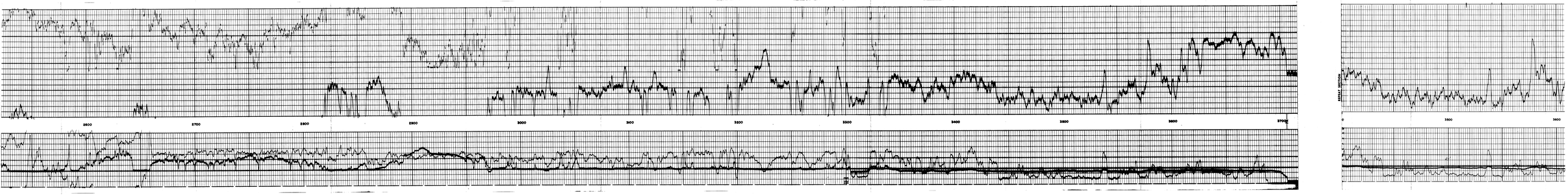


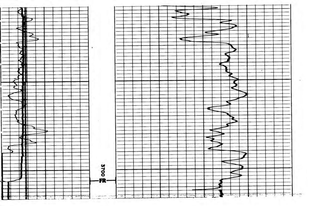




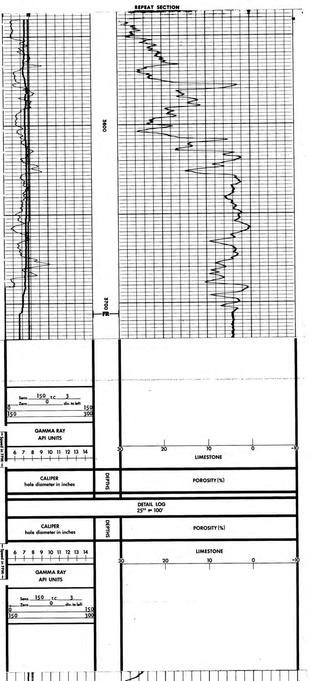




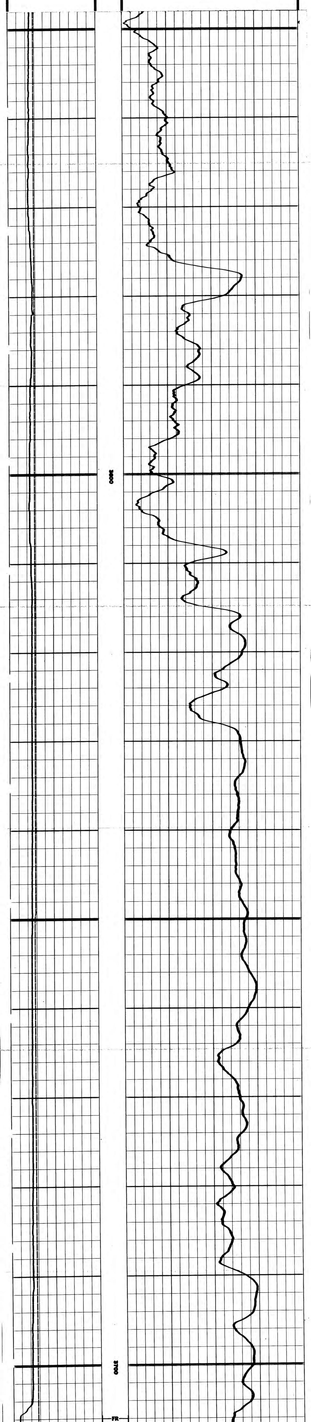

2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
3700
0
3500
3600



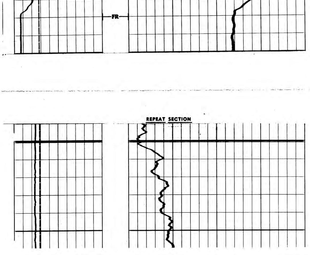
GOLE
FR



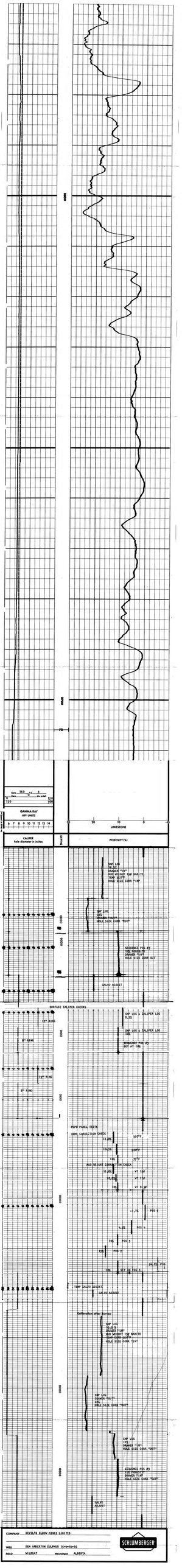
REPEAT SECTION
GOLE
FR
Zero 150 r.c. 3
Zero 0 dis. to left
150
300
GAMMA RAY
API UNITS
6 7 8 9 10 11 12 13 14
CALIPER
hole diameter in inches
DETAIL
POROSITY (%)
DETAIL LOG
25" = 100'
LIMESTONE
20 10 0 -10



GOLE
FR



REPEAT SECTION

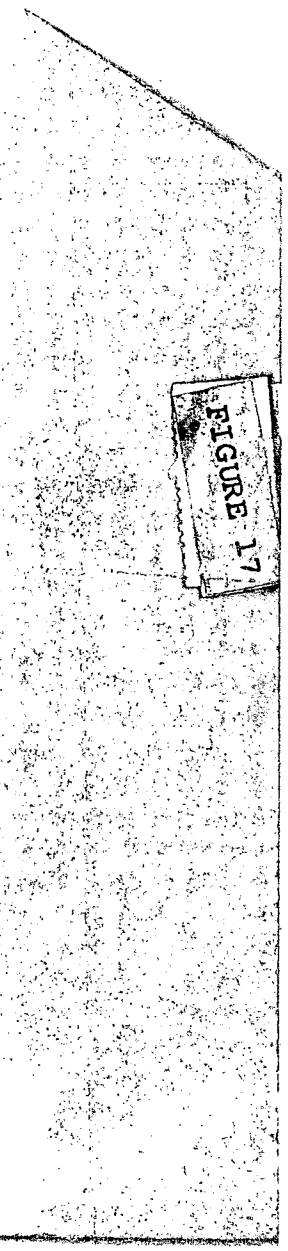

CORE
CORE
CORE

F I G U R E 1 7

Formation Density - Gamma Ray - Annotated

D.E.M. Ankerton Sulphur 15-4

(71 -- 72)



PROVINCE ALBERTA
FIELD WILDCAT
WELL DEM ANKERTON SULPHUR 15-4-44-16
COMPANY DEVIL'S ELBOW MINES LIMITED

SCHLUMBERGER

COMPENSATED
FORMATION DENSITY LOG
SCHLUMBERGER OF CANADA Calgary, Alberta

FIGURE 17
19630005

COMPANY DEVIL'S ELBOW MINES LIMITED

WELL DEM ANKERTON SULPHUR
15-4-44-16

FIELD WILDCAT

PROVINCE ALBERTA

LOCATION
LSD 15 Sec. 4 Twp. 44 Rge. 16W4

Other Services:
I-ES, SNP-GR

Permanent Datum GL Elev. 2319
Log Measured From KB, 11 Ft. Above Perm. Datum

ELEV: KB 2330
GL 2319
CBF

Date	3 JUNE 67		
Run No.	ONE		
First Reading	3706		
Last Reading	2206		
Feet Measured	1500		
Depth Reached	3707		
Bottom Driller	3710		
Csg. SOC	610		
Csg. Driller	610		
Mud Nature	GEL		
Dens. | Visc.	9.0 | 85	|	|
Mud pH	8.5		
" Water Loss	15.0		
" Res.	3.74 @ 59 °F	@ °F	@ °F
" Rmf	1.90 @ 68 °F	@ °F	@ °F
" " @ BHT	1.30 @ 102 °F	@ °F	@ °F
" Rmc	— @ — °F	@ °F	@ °F
" ppm-Cl.			
Bit Size	RMKS		
Source to Detector Spacing	16"		
Equipment Type	PGT-D		
Opr. Rig Time			
Truck No.	7014 STETT		
Recorded By	PICKERL		
Witness	ROWNTREE		

7 JUNE 67 CAL PL

REMARKS

Drilling Stopped 1030 / 3rd : Circulation Stopped 1315 / 3rd : Tool on Bottom 1715 / 3rd : 1st Run Service Order # 35526 B.H.T. 102 °F

BIT SIZE:
7 7/8" - 3654
7 5/8" - 3710

Panel No. D199
Cartridge No. A 43
Sonde No. D 49
Detector No. D186

CALIBRATION:

	Background CPS	Test Source CPS	Galvanometer Deflection Div.	Panel Sens. Tap for Cal.
Gamma Ray	60	420	100	500

GAMMA RAY
API UNITS

Sens. 150 T.C. 2
Zero 0 div. to left
0 150
150 300
TC CHANGE @ 3400'

← Speed in FPM →

CALIPER
hole diameter in inches
6 7 8 9 10 11 12 13 14

DEPTHS

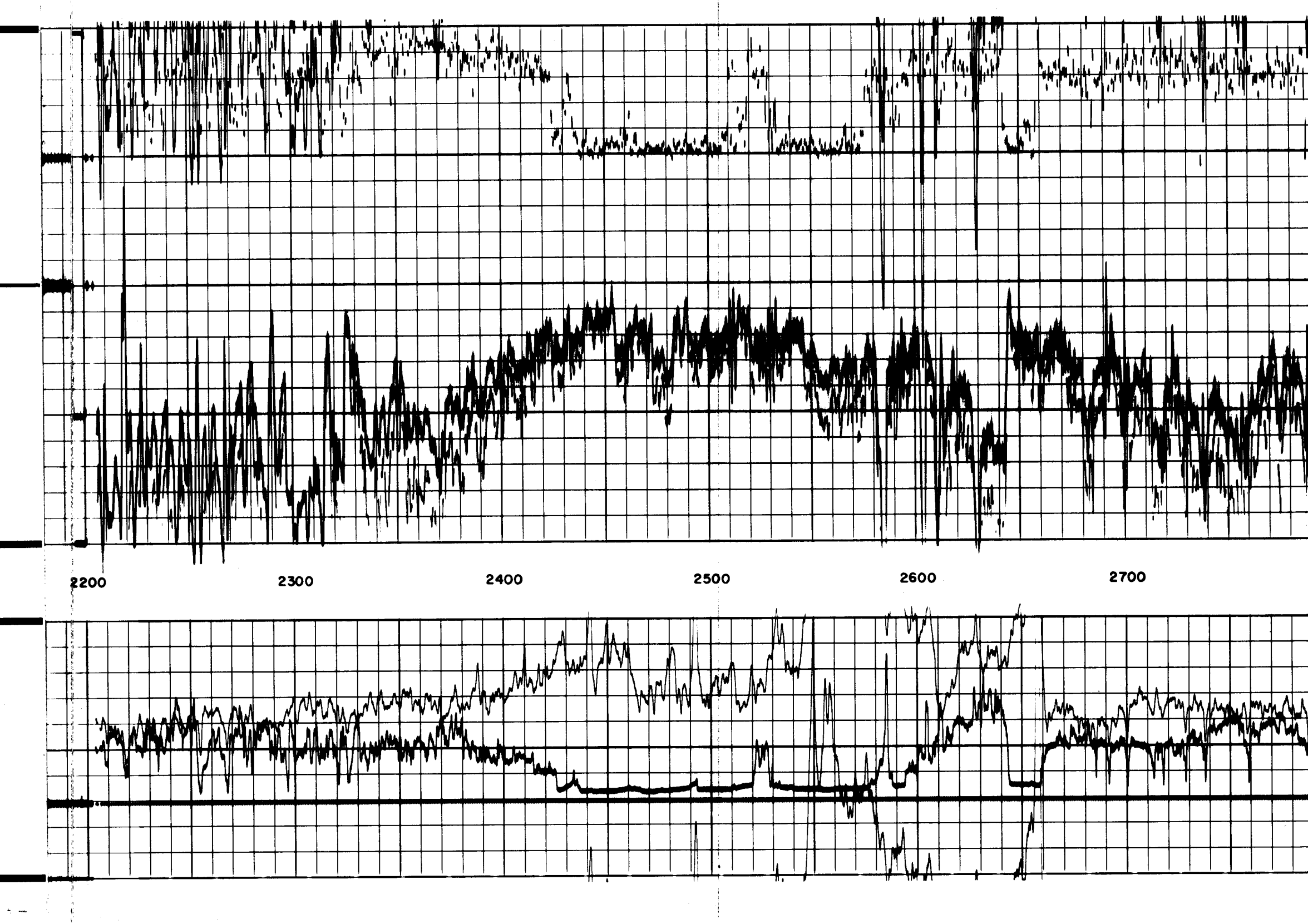
BULK DENSITY
ρ_b - gm/cc
2.0 2.5 3.0

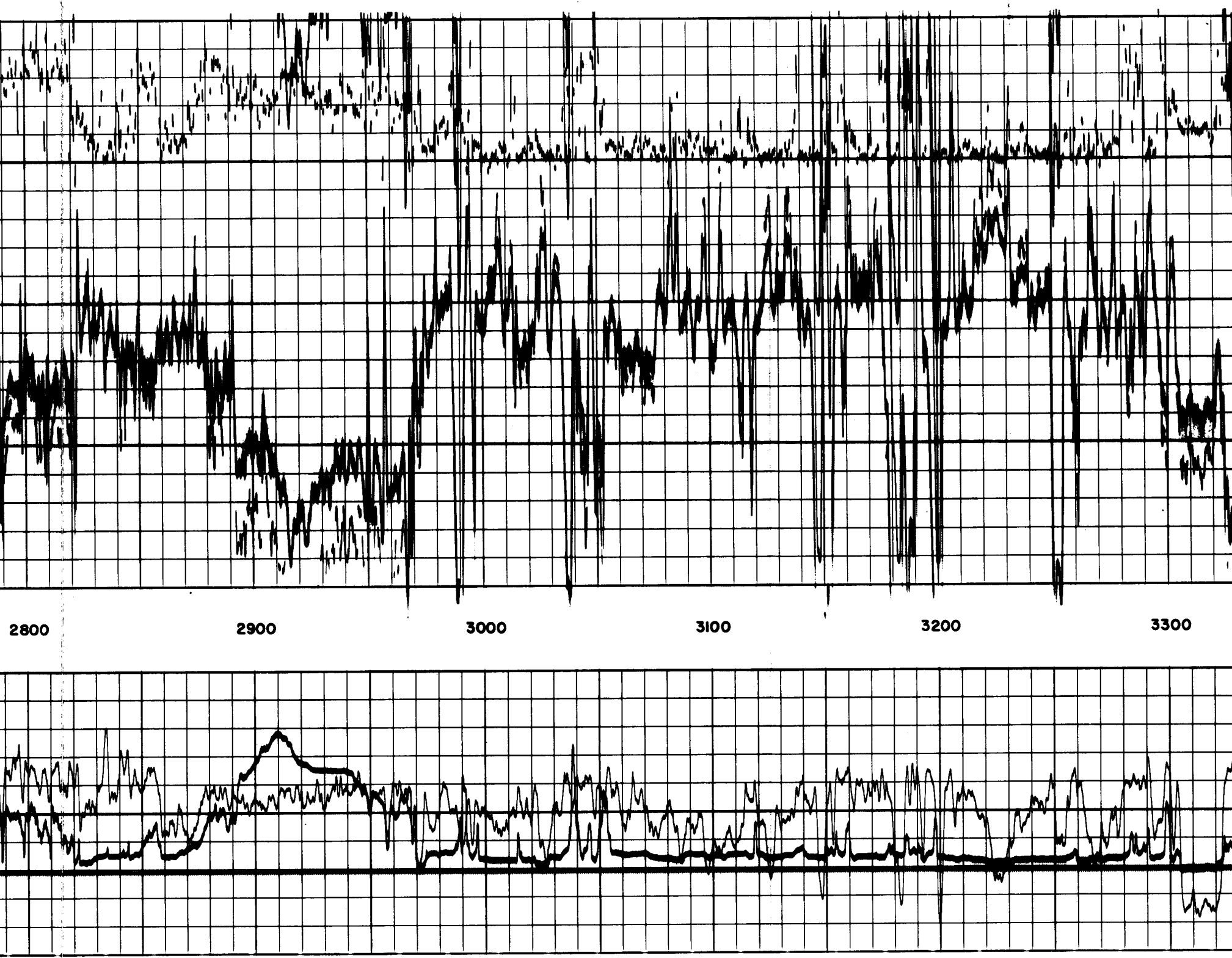
POROSITY %
30 10 -10

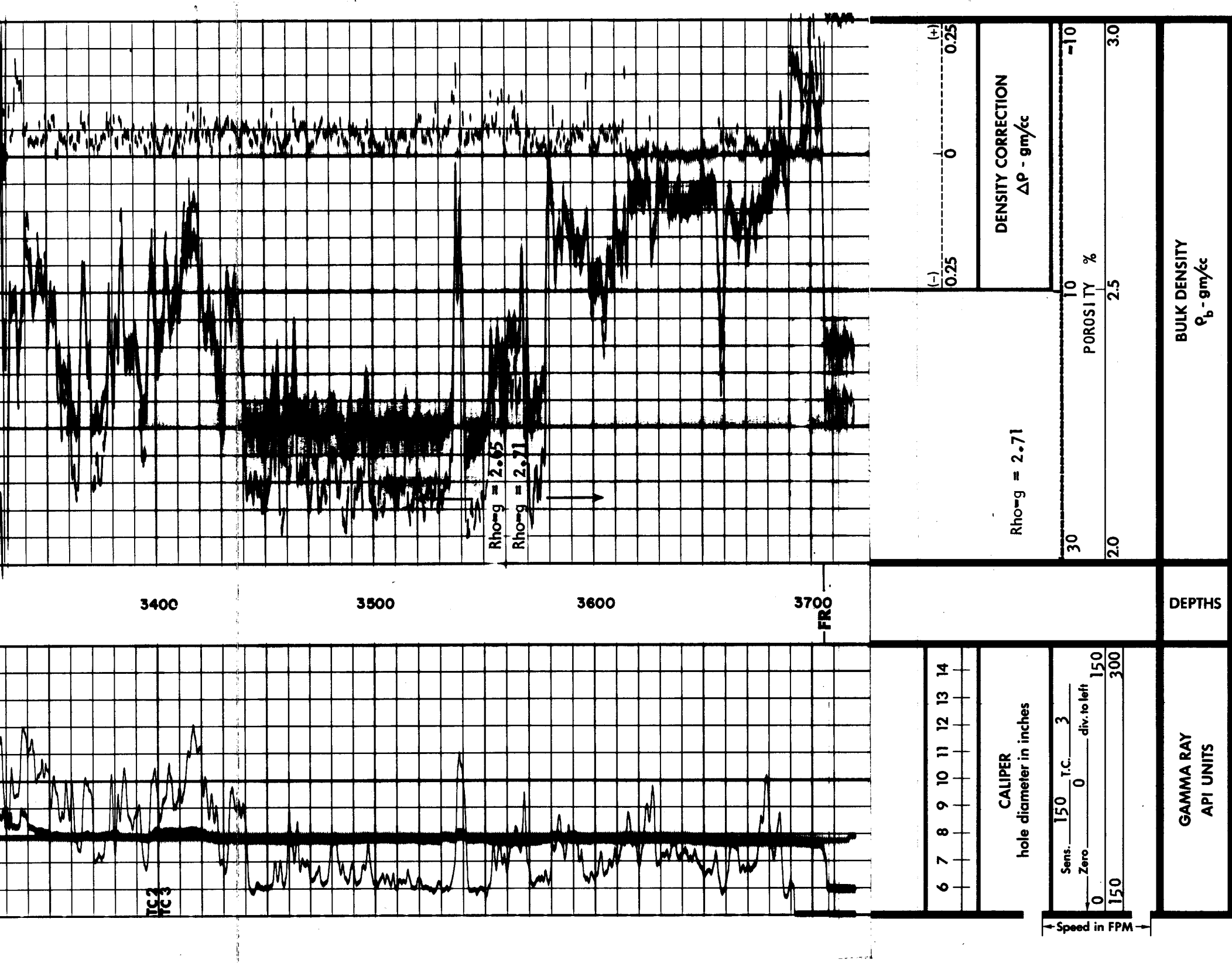
Rho-g = 2.65

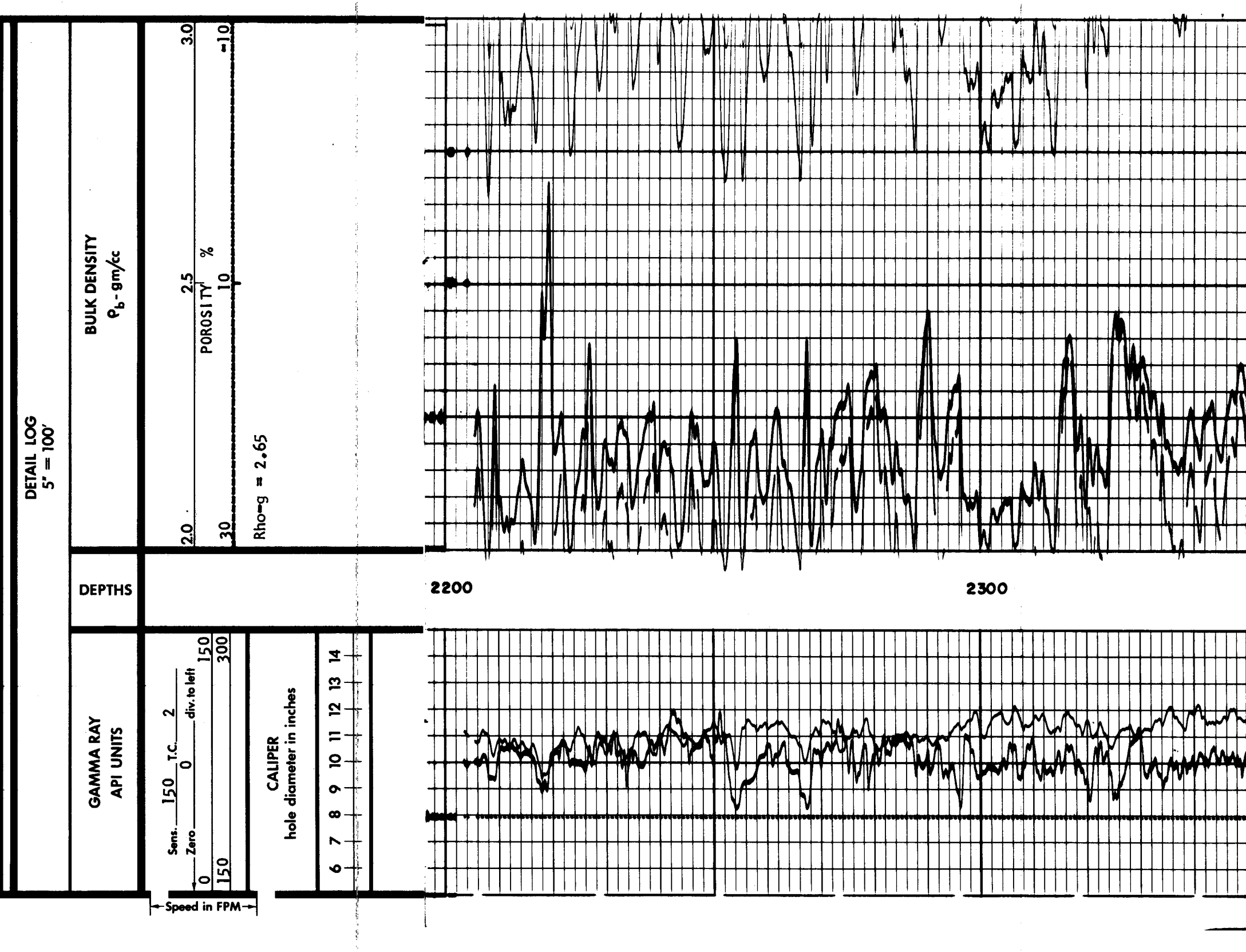
GRAIN DENSITY CHANGE
@ 3560'

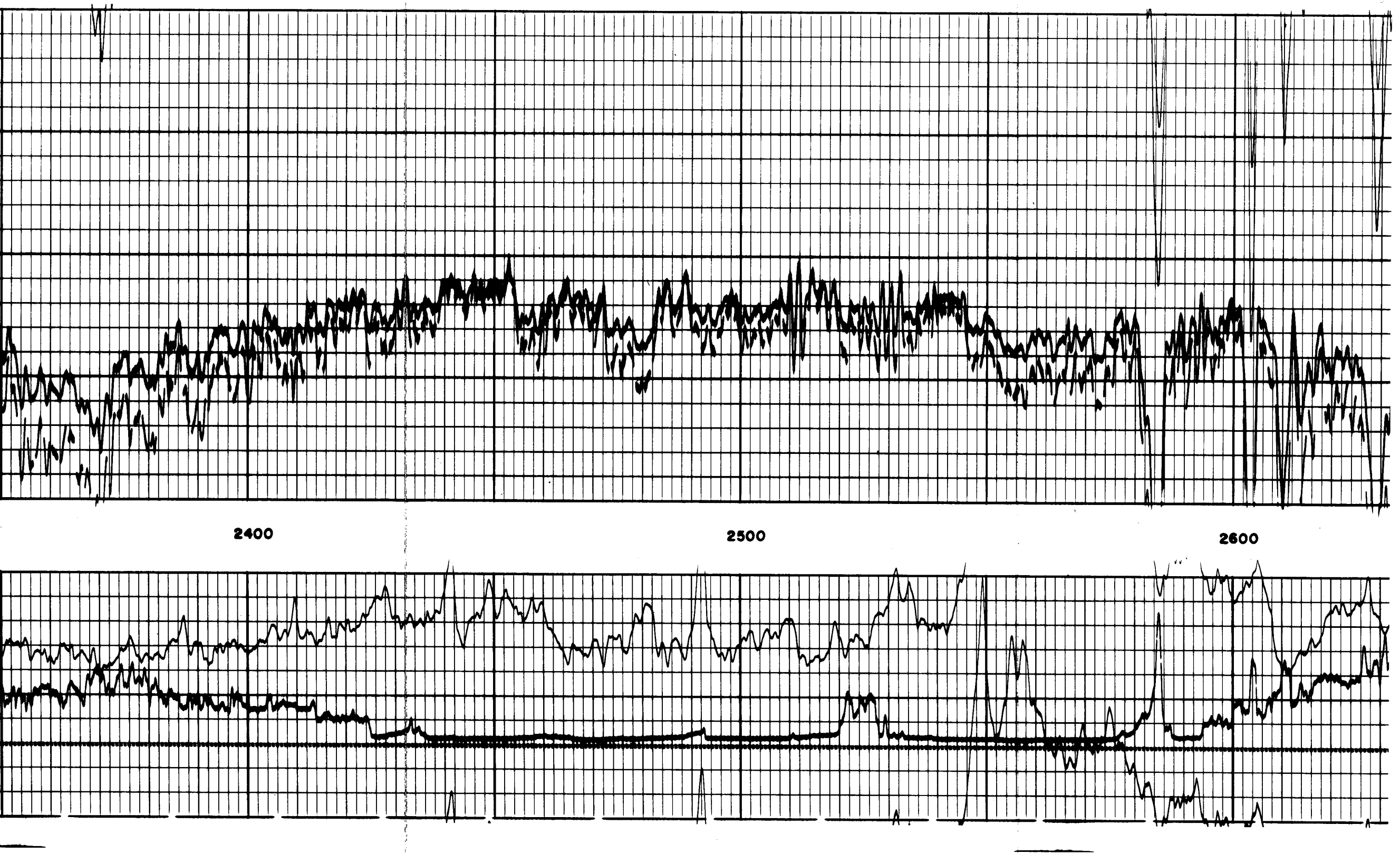
DENSITY CORRECTION
$\Delta\rho$ - gm/cc
0.25 (-) 0 0.25 (+)

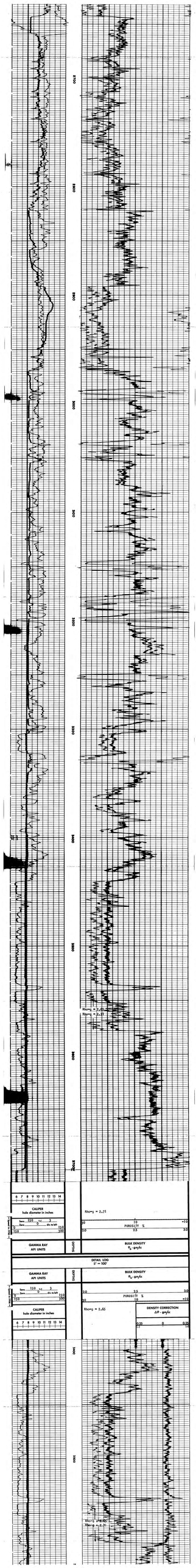











2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
3700
3800
3900
4000
4100
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4300
4400
4500
4600
4700
4800
4900
5000
5100
5200
5300
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5900
6000
6100
6200
6300
6400
6500
6600
6700

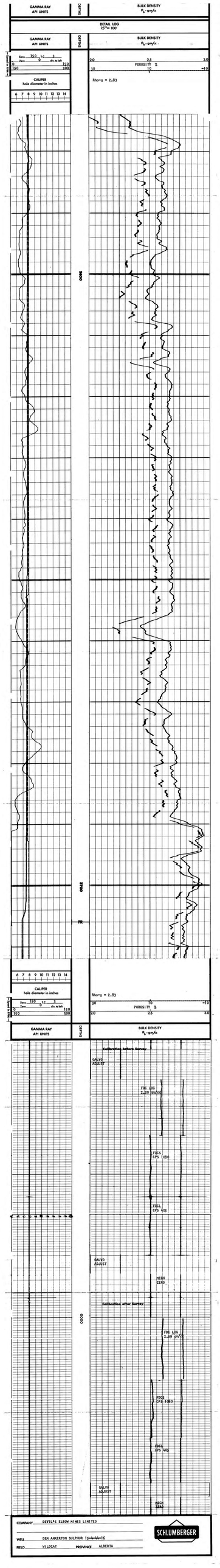
GAMMA RAY
API UNITS
DEPTHS
BULK DENSITY
ρ_b - gm/cc
DETAIL LOG
25" = 100'
GAMMA RAY
API UNITS
DEPTHS
BULK DENSITY
ρ_b - gm/cc
Scale in Feet
Sens 150 t.c. 3
Zero 0 div. to left
0 150
150 300
CALIPER
hole diameter in inches
6 7 8 9 10 11 12 13 14
2.0 2.5 3.0
POROSITY %
30 10 -10
Rho-g = 2.83
3800
3700
FR
6 7 8 9 10 11 12 13 14
Scale in Feet
Sens 150 t.c. 3
Zero 0 div. to left
0 150
150 300
Rho-g = 2.83
30 10 -10
POROSITY %
2.0 2.5 3.0
GAMMA RAY
API UNITS
DEPTHS
BULK DENSITY
ρ_b - gm/cc
Calibration before Survey
GALVO ADJUST
FDC LOG 2.59 gm/cc
FDCS CPS 1080
FDCL CPS 405
GALVO ADJUST
MECH ZERO
Calibration after Survey
FDC LOG 2.59 gm/cc
FDCS CPS 1080
FDCL CPS 405
GALVO ADJUST
MECH ZERO
0000
COMPANY DEVIL'S ELBOW MINES LIMITED
WELL DEN ANKERTON SULPHUR 15-4-W-16
FIELD WILDCAT PROVINCE ALBERTA
SCHLUMBERGER

FIGURE 18

CORE ANALYSIS REPORT

FOR

DEVIL'S ELBOW MINES LIMITED

DEM ANKERTON SULFUR 15-4-44-16

ANKERTON AREA

ALBERTA

FIGURE 18

CORE LABORATORIES - Canada Ltd.

Petroleum Reservoir Engineering

CALGARY - EDMONTON - REGINA

CORE LABORATORIES-CANADA LTD.
CALGARY ALBERTA

Company - DEVIL'S ELBOW MINES LIMITED
Well - DEM ANKERTON SULFUR 15-4-44-16
Field - ANKERTON AREA, ALBERTA
Location - LSD 15-4-44-16 W4M

Date Report - JUNE 29, 1967
Formation - DEVONIAN
D. Fluid - -
Analysis - *

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File - CNP-4-3725, CBH-2-1560, CBH-2-1586
Analysts - MM BK WV

SAMPLE NUMBER	DEPTH REPRESENTED FEET	FOOT. REPR.	PERMEABILITY TO AIR (HORIZONTAL) K MAX	K 90°	VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
CORE NO. 1 3565' - 3600' (Rec. 28.6') (8 boxes)												
-	3565.0-3568.4	3.4	-	-	-	-	-	-	-	-	-	Brecciated sand
-	3568.4-3569.4	1.0	-	-	-	-	-	-	-	-	-	Shale
-	3569.4-3576.5	7.1	-	-	-	-	-	-	-	-	-	Medium to coarse sand
-	3576.5-3580.4	3.9	-	-	-	-	-	-	-	-	-	Mainly limestone Brecciated in part
-	3580.4-3581.6	1.2	-	-	-	-	-	-	-	-	-	Rubble
-	3581.6-3584.6	3.0	-	-	-	-	-	-	-	-	-	Mainly limestone Brecciated in part
-	3584.6-3585.6	1.0	-	-	-	-	-	-	-	-	-	Rubble
-	3585.6-3591.6	6.0	-	-	-	-	-	-	-	-	-	Mainly limestone Brecciated in part
-	3591.6-3593.6	2.0	-	-	-	-	-	-	-	-	-	Rubble and broken core
-	3593.6-3600.0	6.4	-	-	-	-	-	-	-	-	-	Lost core
CORE NO. 2 3600' - 3644' (Rec. 44.0') (13 boxes)												
-	3600.0-3644.0	44.0	-	-	-	-	-	-	-	-	-	Mainly brecciated

SAMPLE NUMBER	DEPTH REPRESENTED FEET	FOOT. REPR.	PERMEABILITY TO AIR (HORIZONTAL) K MAX	K 90°	VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	DENSITY GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
CORE NO. 3 3644' - 3654' (Rec. 9.5') (3 boxes)												
-	3644.0-3652.7	8.7	-	-	-	-	-	-	-	-	-	Not analyzed by request
SS1	3652.7-3653.5	0.8	3.4	-	-	2.7	-	-	-	-	3.06	Dried only
-	3653.5-3654.0	0.5	-	-	-	-	-	-	-	-	-	Lost core
CORE NO. 4 3654' - 3674' (Rec. 19.6') (5 boxes)												
2)	3654.0-3654.7	0.7	0.02	<0.01	<0.01	0.8	2633.	2.68	2.70	-	-	Dried only
2)			-	-	-	-	-	-	-	-	-	-
2)			0.03	0.03	<0.01	1.3	2624.	2.67	2.71	0.34	-	After solvent extraction
2AS	3654.7-3655.5	0.8	-	-	-	-	-	-	-	-	0.82	-
3AS	3655.5-3655.8	0.3	-	-	-	-	-	-	-	-	1.18	-
3)	3655.8-3656.2	0.4	0.89	0.04	<0.01	1.1	1211.5	2.66	2.69	-	-	Dried only
3)			0.30	0.23	0.04	1.5	1207.5	2.65	2.69	0.33	-	After steam extraction
3)		-	0.91	0.91	<0.01	2.4	1202.	2.64	2.70	0.78	-	After solvent extraction
3AS	3656.2-3656.5	0.3	-	-	-	-	-	-	-	-	1.18	-
4)	3656.5-3656.8	0.3	5.2	0.08	<0.01	1.9	815.	2.64	2.69	-	-	Dried only
4)			0.10	0.10	0.05	2.6	813.	2.62	2.69	0.24	-	After steam extraction
4)		-	0.16	0.16	<0.01	4.8	808.	2.60	2.73	2.86	-	After solvent extraction
4AS	3656.8-3657.2	0.4	-	-	-	-	-	-	-	-	0.36	-

SAMPLE NUMBER	DEPTH REPRESENTED FEET	FOOT. REPR.	PERMEABILITY TO AIR (HORIZONTAL) K MAX	(HORIZONTAL) K 90°	VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	DENSITY GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
Core No. 4 (cont'd)												
5)	3657.2-3657.5	0.3	7.3	5.1	<0.01	0.7	760.	2.70	2.72	-	-	Dried only
5)			**	1.2	**	2.8	753.	2.66	2.74	0.92	-	After steam extraction
5)			-	-	-	4.6	740.	2.62	2.74	2.63	-	After solvent extraction
5AS	3657.5-3657.8	0.3	-	-	-	-	-	-	-	-	0.69	-
SS6	3657.8-3658.1	0.3	0.8	-	-	-	2.4	-	-	-	5.43	Dried only
7AS	3658.1-3658.6	0.5	-	-	-	-	-	-	-	-	2.36	-
7)	3658.6-3659.0	0.4	0.19	<0.01	<0.01	0.9	1140.	2.69	2.71	-	-	Dried only
7)			3.9	0.12	0.07	1.9	1135.	2.67	2.72	0.44	-	After steam extraction
7)			5.8	0.09	0.04	2.6	1127.	2.65	2.72	1.14	-	After solvent extraction
SS8	3659.0-3659.4	0.4	0.3	-	-	1.8	-	-	-	-	6.12	Dried only
9AS	3659.4-3659.8	0.4	-	-	-	-	-	-	-	-	26.88	-
9)	3659.8-3660.1	0.3	26.	2.5	0.73	0.9	1103.	2.45	2.47	-	-	Dried only
9)		-	-	-	-	-	-	-	-	-	-	-
9)		-	-	-	-	-	744.	-	-	32.55	-	After solvent extraction
10AS	3660.1-3660.5	0.4	-	-	-	-	-	-	-	-	76.65	-

SAMPLE NUMBER	DEPTH REPRESENTED FEET	FOOT. REPR.	PERMEABILITY TO AIR HORIZONTAL) K MAX	K 90) VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
Core No. 4 (cont'd)											
11)	3660.5-3660.9	0.4	3.6	3.2 0.32	0.5	1533.	2.51	2.52	-	-	Dried only
11)			-	- -	-	-	-	-	-	-	-
11)			-	- -	-	1101.	-	-	28.18	-	After solvent extraction
11AS	3660.9-3661.4	0.5	-	- -	-	-	-	-	-	54.46	-
12)	3661.4-3661.6	0.2	14.	3.8 0.47	0.3	746.5	2.56	2.57	-	-	Dried only
12)			-	- -	20.9	618.5	2.12	2.68	17.15	-	After steam extraction
12)			-	- -	-	565.	--	-	24.31	-	After solvent extraction
12AS	3661.6-3661.8	0.2	-	- -	-	-	-	-	-	17.83	-
13AS	3661.8-3662.1	0.3	-	- -	-	-	-	-	-	35.48	-
13)	3662.1-3662.3	0.2	8.8	3.3 0.17	0.3	746.5	2.54	2.55	-	-	Dried only
13)			1470.	100. 230.	18.9	637.	2.14	2.64	14.67	-	After steam extraction
13)			-	- -	23.8	562.	2.04	2.67	24.72	-	After solvent extraction
14)	3662.3-3662.7	0.4	0.14	0.07 <0.01	0.2	1424.	2.59	2.60	-	-	Dried only
14)			6950.	6000. 2540.	15.0	1263.	2.29	2.69	11.31	-	After steam extraction
14)		-	-	- -	17.0	1170.	2.26	2.73	17.84	-	After solvent extraction
14AS	3662.7-3663.1	0.4	-	- -	-	-	-	-	-	16.53	-

SAMPLE NUMBER	DEPTH REPRESENTED FEET	FOOT. REPR.	PERMEABILITY TO AIR (HORIZONTAL) K MAX	K 90°)	VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
Core No. 4 (cont'd)												
15)	3663.1-3663.5	0.4	0.03	0.03	<0.01	0.4	1425.5	2.66	2.67	-	-	Dried only
15)			0.13	0.09	<0.01	0.6	1424.	2.64	2.66	0.12	-	After steam extraction
15)			725.	513.	-	11.6	1285.	2.42	2.74	9.86	-	After solvent extraction
15AS	3663.5-3664.0	0.5	-	-	-	-	-	-	-	-	6.83	-
16)	3664.0-3664.4	0.4	0.07	0.07	<0.01	0.4	1489.	2.65	2.66	-	-	Dried only
16)			3.9	1.2	0.24	6.2	1432.	2.53	2.70	3.83	-	Aftersteam extraction
16)			205.	78.	-	9.0	1359.	2.48	2.72	8.73	-	After solvent extraction
16AS	3664.4-3664.8	0.4	-	-	-	-	-	-	-	-	5.84	-
17AS	3664.8-3665.1	0.3	-	-	-	-	-	-	-	-	4.10	-
17)	3665.1-3665.4	0.3	<0.01	<0.01	<0.01	0.2	1068.	2.66	2.67	-	-	Dried only
17)			19.	1.9	0.07	3.5	1036.	2.60	2.70	3.00	-	After steam extraction
17)			14.	0.29	-	7.4	1006.	2.53	2.73	5.81	-	After solvent extraction
18AS	3665.4-3665.9	0.5	-	-	-	-	-	-	-	-	10.85	-
18)	3665.9-3666.5	0.6	<0.01	<0.01	<0.01	0.5	2106.	2.63	2.64	-	-	Dried only
18)			-	-	-	-	-	-	-	-		-
18)			83.	31.	0.48	10.1	1900.	2.43	2.71	9.78	-	After solvent extraction

SAMPLE NUMBER	DEPTH REPRESENTED FEET	FOOT. REPR.	PERMEABILITY TO AIR (HORIZONTAL) K MAX	K 90°)	VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
Core No. 4 (cont'd)												
19)	3666.5-3667.1	0.6	0.02	0.01	<0.01	1.0	1819.	2.64	2.67	-	-	Dried only
19)			-	-	-	-	-	-	-	-	-	-
19)			235.	138.	30.	7.7	1644.	2.51	2.71	9.62	-	After solvent extraction
19AS	3667.1-3667.6	0.5	-	-	-	-	-	-	-	-	5.92	-
20AS	3667.6-3668.0	0.4	-	-	-	-	-	-	-	-	6.61	-
20)	3668.0-3668.3	0.3	2.7	2.4	1.7	10.6	1074.5	2.48	2.78	-	-	Dried only
20			4.6	4.5	3.0	13.3	1053.	2.42	2.79	2.00	-	After steam extraction
20)			7.9	7.3	4.5	13.5	1030.	2.40	2.79	4.14	-	After solvent extraction
21AS	3668.3-3668.7	0.4	-	-	-	-	-	-	-	-	3.86	-
21)	3668.7-3669.0	0.3	1.2	0.34	<0.01	1.3	1061.5	2.70	2.73	-	-	Dried only
21)			278.	16.	0.95	4.3	1041.	2.64	2.76	1.93	-	After steam extraction
21)			88.	26.	2.2	6.3	1027.	2.58	2.76	3.25	-	After solvent extraction
22AS	3669.0-3669.7	0.7	-	-	-	-	-	-	-	-	1.68	-
22)	3669.7-3670.3	0.6	0.48	0.43	<0.01	7.6	2193.5	2.55	2.76	-	-	Dried only
22)			-	-	-	-	-	-	-	-	-	-
22)			0.84	0.68	<0.01	9.3	2171.	2.52	2.78	1.03	-	After solvent extraction
23AS	3670.3-3671.1	0.8	-	-	-	-	-	-	-	-	2.83	-

SAMPLE NUMBER	DEPTH REPRESENTED FEET	FOOT. REPR.	PERMEABILITY TO AIR (HORIZONTAL) K MAX	K 90°	VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
Core No. 4 (cont'd)												
23)	3671.1-3671.9	0.8	0.05	0.03	<0.01	2.1	2073.	2.66	2.71	-	-	Dried only
23)			-	-	-	-	-	-	-	-	-	-
23)			304.	51.	3.4	5.6	1989.	2.59	2.74	4.05	-	After solvent extraction
24AS	3671.9-3672.9	1.0	-	-	-	-	-	-	-	-	2.71	-
24)	3672.9-3673.3	0.4	1.1	0.79	0.13	6.6	1387.	2.47	2.65	-	-	Dried only
24)	"		4.0	1.5	1.7	7.7	1375.	2.45	2.65	0.87	-	After steam extraction
24)			8.9	2.4	5.9	8.4	1360.	2.44	2.66	1.95	-	After solvent extraction
25AS	3673.3-3673.6	0.3	-	-	-	-	-	-	-	-	10.46	-
CORE NO. 5 3674' - 3694' (Rec. 20.4') (5 boxes)												
25	3673.6-3674.0	0.4	0.28	0.05	<0.01	1.5	1738.5	2.65	2.69	-	-	Dried only
25			-	-	-	-	-	-	-	-	-	-
25			213.	208.	-	12.4	1560.	2.43	2.77	10.27	-	After solvent extaction
25AS	3674.0-3674.3	0.3	-	-	-	-	-	-	-	-	10.46	-
26)	3674.3-3674.6	0.3	0.02	0.02	<0.01	2.5	1083.	2.66	2.72	-	-	Dried only
26)			0.18	0.18	0.03	5.4	1063.	2.59	2.73	0.96	-	After steam extraction
26)			0.18	0.12	0.67	6.6	1049.	2.57	2.75	3.14	-	After solvent extraction
26AS	3674.6-3674.9	0.3	-	-	-	-	-	-	-	-	2.83	-

SAMPLE NUMBER	DEPTH REPRESENTED FEET	FOOT. REPR.	PERMEABILITY TO AIR (HORIZONTAL) K MAX	K 90	VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
Core No. 5 (cont'd)												
27)	3674.9-3675.5	0.6	0.45	0.26	<0.01	2.1	1855.5	2.63	2.69	-	-	Dried only
27)			-	-	-	-	-	-	-	-	-	-
27)			14660.	229.	-	9.4	1739.	2.49	2.74	6.28	-	After solvent extraction
27AS	3675.5-3676.1	0.6	-	-	-	-	-	-	-	-	4.78	-
28	3676.1-3676.6	0.5	0.12	0.01	<0.01	2.3	1419.	2.67	2.73	-	-	Dried only
28			47.	64.	5.0	9.2	1353.	2.49	2.75	4.65	-	After steam extraction
28			222.	15.	21.	10.3	132.4	2.46	2.75	6.69	-	After solvent extraction
28AS	3676.6-3677.3	0.7	-	-	-	-	-	-	-	-	9.10	-
-	3677.3-3677.5	0.2	-	-	-	-	-	-	-	-	-	Shale
29AS	3677.5-3678.4	0.9	-	-	-	-	-	-	-	-	0.40	-
29)	3678.4-3679.0	0.6	3.7	0.46	<0.01	2.9	2285.	2.63	2.71	-	-	Dried only
29)			-	-	-	-	-	-	-	-	-	-
29)			3.4	0.63	0.15	3.8	2264.	2.61	2.71	0.92	-	After solvent extraction
-	3679.0-3679.7	0.7	-	-	-	-	-	-	-	-	-	Shale
30)	3679.7-3680.2	0.5	3.8	1.6	0.17	1.6	1006.	2.68	2.72	-	-	Dried only
30)			-	-	-	3.7	994.	2.64	2.74	1.19	-	After steam extraction
30)			-	-	-	-	987.	-	-	1.89	-	After solvent extraction

SAMPLE NUMBER	DEPTH REPRESENTED FEET	FOOT. REPR.	PERMEABILITY TO AIR (HORIZONTAL) K MAX	K 90°)	VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
Core No. 5 (cont'd)												
30AS	3680.2-3680.7	0.5	-	-	-	-	-	-	-	-	0.98	-
31)	3680.7-3681.0	0.3	0.04	0.04	<0.01	1.3	1066.	2.69	2.72	-	-	Dried only
31)			0.87	0.22	<0.01	2.3	1056.5	2.68	2.74	0.89	-	After steam extraction
31)			-	-	-	5.6	1037.	2.64	2.79	2.72	-	After solvent extraction
31AS	3681.0-3681.7	0.7	-	-	-	-	-	-	-	-	2.11	-
32)	3681.7-3681.9	0.2	<0.0.1	<0.01	<0.01	1.3	839.	2.70	2.73	-	-	Dried only
32)			0.55	0.30	<0.01	3.2	827.5	2.66	2.75	1.37	-	After steam extraction
32)			0.62	0.39	0.52	5.4	816.	2.62	2.77	2.74	-	After solvent extraction
32AS	3681.9-3682.2	0.3	-	-	-	-	-	-	-	-	3.47	-
33)	3682.2-3682.5	0.3	<0.01	<0.01	<0.01	1.5	1093.5	2.66	2.69	-	-	Dried only
33)			0.18	0.15	<0.01	3.1	1086.5	2.62	2.71	0.64	-	After steam extraction
33)			0.52	0.28	0.07	5.5	1069.	2.59	2.74	2.24	-	After solvent extraction
33AS	3682.5-3682.8	0.3	-	-	-	-	-	-	-	-	2.16	-
34AS	3682.8-3683.1	0.3	-	-	-	-	-	-	-	-	1.61	-

SAMPLE NUMBER	DEPTH REPRESENTED FEET	FOOT. REPR.	PERMEABILITY TO AIR (HORIZONTAL) K MAX	K 90°	VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
Core No. 5 (cont'd)												
34)	3683.1-3683.4	0.3	2.7	0.10	<0.01	3.4	909.	2.58	2.67	-	-	Dried only
34)			0.23	0.20	<0.01	3.4	906.	2.59	2.68	0.33	-	After steam extraction
34)			0.26	0.21	0.09	4.8	895.	2.55	2.68	1.54	-	After solvent extraction
-	3683.4-3685.9	2.5	-	-	-	-	-	-	-	-	-	Not analyzed
35AS	3685.9-3686.5	0.6	-	-	-	-	-	-	-	-	0.09	-
-	3686.5-3686.9	0.4	-	-	-	-	-	-	-	-	-	Not analyzed
36AS	3686.9-3687.9	1.0	-	-	-	-	-	-	-	-	0.15	-
37	3687.9-3688.7	0.8	-	-	-	-	-	-	-	-	0.08	-
38	3688.7-3689.9	1.2	-	-	-	-	-	-	-	-	0.21	-
39	3689.9-3690.6	0.7	-	-	-	-	-	-	-	-	0.05	-
40	3690.6-3691.7	1.1	-	-	-	-	-	-	-	-	0.08	-
-	3691.7-3694.0	2.3	-	-	-	-	-	-	-	-	-	Not analyzed

** - Broken or fractured core

SS - Small sample

* - For Samples 1 - 36 approximately half of each represented interval was used for Full Diameter core analysis. The remaining half of each interval was split in half and half of the resultant slab was used for assay purposes.

Steam extraction was performed in a pressure vessel.
Solvent extraction was performed in a toluene vapor-phase extractor.

CORE LABORATORIES-CANADA LTD.

PETROLEUM RESERVOIR ENGINEERING

EDMONTON CALGARY REGINA

WATER ANALYSIS

File CNP-4-3725, CBH-2-1560, CBH-2-1586

Company Devil's Elbow Mines Limited

Well Name DEM Ankerton Sulfur 15-4-44-6 Sample No. 9

Formation Devonian Depth 3659.8' - 3660.1'

Location LSD 15-4-44-6 W4M Field Ankerton Area Province Alberta

Date Sampled _____ Date Analyzed June 5, 1967 Analyst HP

Analysis of ~~Sampled From~~ Extraction water, after steam extraction of 100 gms core with 1000 mls water By _____

Recovery _____ Elevation _____

Constituents:

1. Total Solids 202 mg/liter 2. pH 6.34 3. Sp.Gr. - @60°F.

4. Resistivity - Ohm-meters @ - °F 5. H_2S Absent

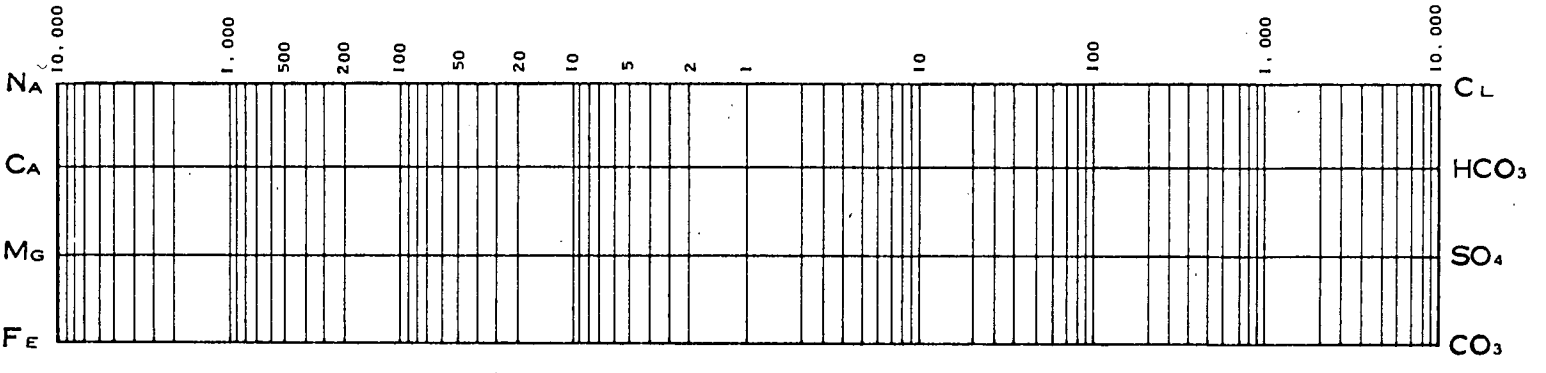
MILLIGRAMS PER LITER

Na & K	Ca	Mg	Fe	Ba		Cl	HCO_3	SO_4	CO_3	OH	
46	23	1	Trace	Absent		68	3	61	-	-	

MEQ PER LITER

2.0	1.1	0.1				1.9	-	1.3	-	-	

LOGARITHMIC PATTERN MEQ PER LITER



CORE LABORATORIES-CANADA LTD.
PETROLEUM RESERVOIR ENGINEERING
EDMONTON CALGARY REGINA

WATER ANALYSIS

File CNP-4-3725, CBH-2-1560, CBH-2-1586

Company Devil's Elbow Mines Limited

Well Name DEM Ankerton Sulphur 15-4-44-6 Sample No. 12

Formation Devonian Depth 3661.4' - 3661.6'

Location LSD 15-4-44-6 W4M Field Ankerton Area Province Alberta

Date Sampled ____ Date Analyzed June 5, 1967 Analyst HP

Analysis of ~~Sample Taken From~~ Extraction water, after steam extraction of 1000 gms core with 1000 mls water By ____

Recovery ____ Elevation ____

Constituents:

1. Total Solids 194 mg/liter 2. pH 6.25 3. Sp.Gr. - @60°F.

4. Resistivity - Ohm-meters @ - °F 5. H_2S Absent

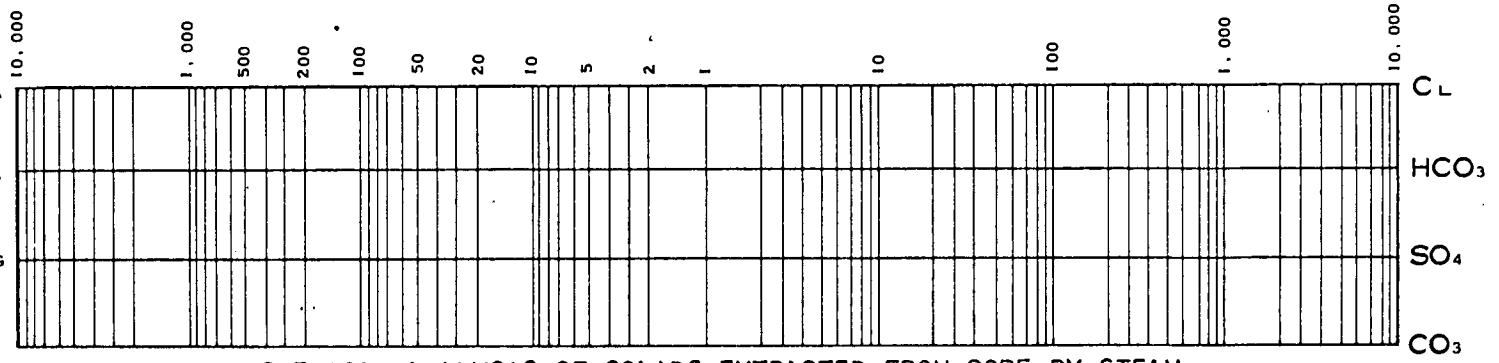
MILLIGRAMS PER LITER

N_A & K	C_A	M_G	F_E	B_A		C_L	HCO_3	SO_4	CO_3	OH	
26	33	2	Trace	Absent		29	10	94	-	-	

MEQ PER LITER

1.1	1.6	0.2				0.8	0.2	2.0	-	-	

LOGARITHMIC PATTERN MEQ PER LITER



CHEMICAL ANALYSIS OF SOLIDS EXTRACTED FROM CORE BY STEAM EXTRACTION

	Wt %
Sulphur	99.04
Silica	0.96
Selenium	Nil
Tellurium	Nil
Arsenic	Nil

CORE LABORATORIES-CANADA LTD.
PETROLEUM RESERVOIR ENGINEERING
EDMONTON CALGARY REGINA

WATER ANALYSIS

File CNP-4-3725, CBH-2-1760 CBH-2-1586

Company Devil's Elbow Mines Limited

Well Name DEM Ankerton Sulphur 15-4-44-6 Sample No. 13

Formation Devonian Depth 3662.1' - 3662.3'

Location LSD 15-4-44-6 W4M Field Ankerton Area Province Alberta

Date Sampled _____ Date Analyzed June 9, 1967 Analyst HP

Analysis of ~~Sampled From~~ Extraction water, after extraction 1000 gms core with 1000 mls water By _____

Recovery _____ Elevation _____

Constituents:

1. Total Solids 499 mg/liter 2. pH 7.43 3. Sp.Gr. - @60°F.

4. Resistivity - Ohm-meters @ - °F 5. H_2S Absent

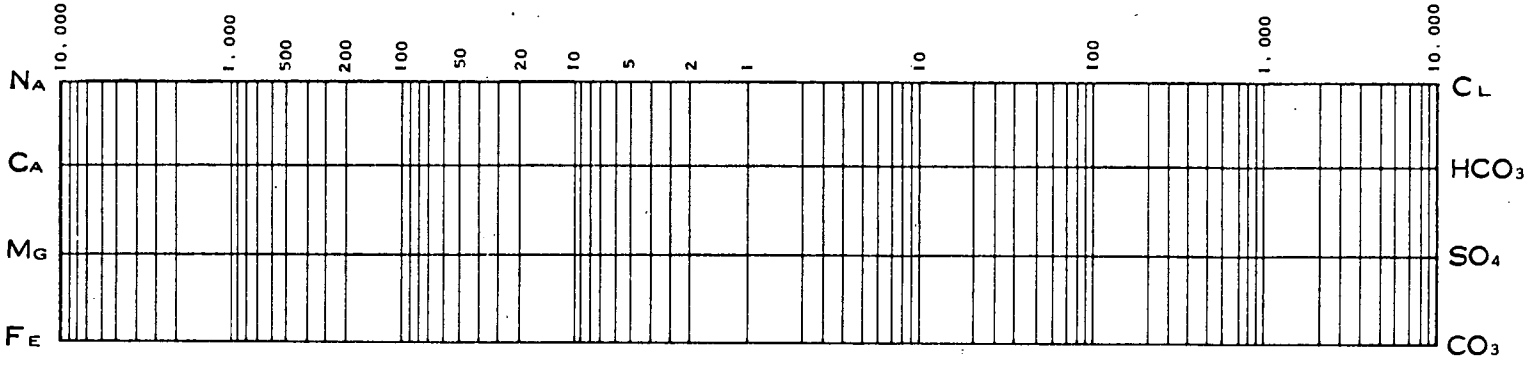
MILLIGRAMS PER LITER

Na & K	Ca	Mg	Fe	Ba		Cl	HCO_3	SO_4	CO_3	OH	
56	100	1	Trace	Absent		63	10	269	-	-	

MEQ PER LITER

2.7	5.0	0.1				1.8	0.2	5.6	-	-	

LOGARITHMIC PATTERN MEQ PER LITER



CHEMICAL ANALYSIS OF SOLIDS EXTRACTED FROM CORE BY STEAM EXTRACTION

	Wt %
Sulphur	95.62
Silica	4.38
Selenium	Nil
Tellurium	Nil
Arsenic	Nil

CORE LABORATORIES-CANADA LTD.
PETROLEUM RESERVOIR ENGINEERING
EDMONTON CALGARY REGINA

WATER ANALYSIS

File CNP-4-3725, CBH-2-1560, CBH-2-1586

Company Devil's Elbow Mines Limited

Well Name DEM Ankerton Sulfur 15-4-44-6 Sample No. 24

Formation Devonian Depth 3672.9' - 3773.3

Location LSD 15-4-44-6 W4M Field Ankerton Area Province Alberta

Date Sampled ____ Date Analyzed June 5, 1967 Analyst HP

Analysis of ~~Sampled From~~ Extract on water, after steam extraction of 1000 gms core with 1000 mls water By ____

Recovery ____ Elevation ____

Constituents:

1. Total Solids 537 mg/liter 2. pH 7.82 3. Sp.Gr. - @60°F.

4. Resistivity - Ohm-meters @ - °F 5. H_2S Absent

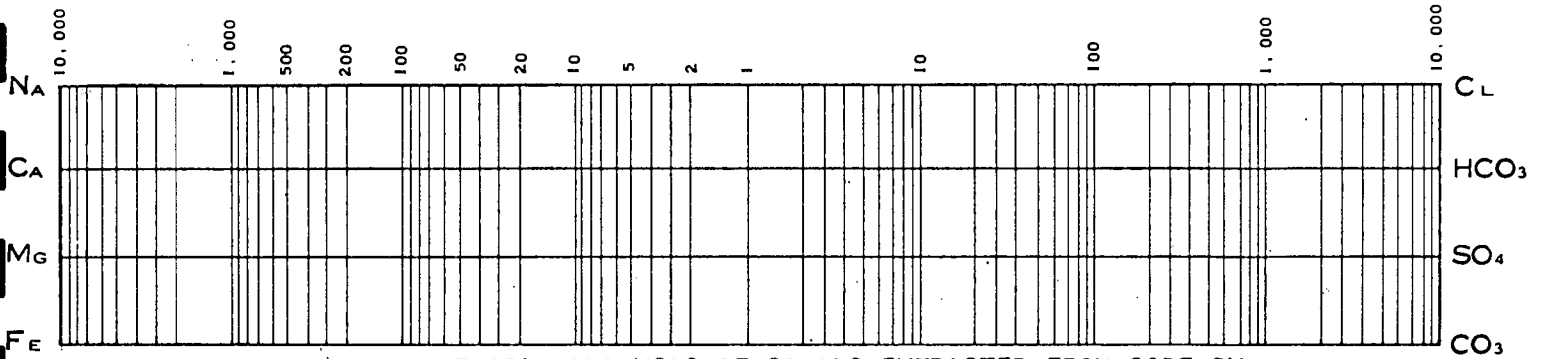
MILLIGRAMS PER LITER

Na & K	Ca	Mg	Fe	Ba		Cl	HCO_3	SO_4	CO_3	OH	
104	79	Trace	Trace	absent		163	11	180	-	-	

MEQ PER LITER

4.5	3.9	Trace				4.6	0.2	3.7	-	-	

LOGARITHMIC PATTERN MEQ PER LITER



CHEMICAL ANALYSIS OF SOLIDS EXTRACTED FROM CORE BY STEAM EXTRACTION

	Wt %
Sulphur	98.89
Silica	0.70
Organic	0.41
Selenium	Nil
Tellurium	Nil

Arsenic Nil



A P P E N D I X "B"

A P P E N D I X B

WELL INFORMATION

ON

D. E. M. ANKERTON SULPHUR 10-4

TO BE APPENDED TO A

GEOLOGICAL AND ENGINEERING REPORT ON THE INITIAL EXPLORATION

OF THE ANKERTON SULPHUR DEPOSIT

DEVIL'S ELBOW MINES LTD.

A. C. A. HOWE INTERNATIONAL LIMITED

SEPTEMBER 12, 1967

TORONTO, ONTARIO.

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APPENDIX B

INTRODUCTION

D.E.M. Ankerton Sulphur 10-4 well is located on L.S.D. 10 Section 4 Township 44 Range 16 West of the 4th Meridian in the Province of Alberta, and is a 1400 foot step out to the south of D.E.M. Ankerton Sulphur 15-4.

The main objective of this second well was to test by diamond coring the Basal Wabamun Formation in order to extend the sulphur bearing zone south from D.E.M. Ankerton Sulphur 15-4. Secondary objectives were to test for fresh water sands in the upper portion of the hole and to determine the nature of the Formations overlying the sulphur zone.

Good sub-surface control was provided by the logs of the D.E.M. Ankerton Sulphur 15-4 well. Ten foot samples were taken from surface to 350 feet and from 2800 feet to core point at 3611 feet. Diamond core was obtained from 3611 feet to total depth at 3696 feet K.B. A rubber lined core barrel was used through the sulphur zone to ensure full recovery.

The sulphur zone and other cored Formations were fully evaluated by core examination, assay and testing and by induction electric, sidewall neutron and formation density - gamma ray logs.

The well was completed at 3696 feet K.B. in the upper anhydrite of the Nisku Formation and has been abandoned.

GENERAL DATA SUMMARY

NAME: D.E.M. Ankerton Sulphur 10-4

LOCATION: 10-4-44-16 W4M Province of Alberta

ELEVATION: Ground: 2325 K.B.: 2336 Interval: 11 feet

CO-ORDINATES: 330.0' N true 330.0' W true of SE corner Lsd 10

OBJECTIVE: Upper Devonian Nisku Formation

SPUDDED: 1:30 A.M. June 16, 67 RIG RELEASE: 9:30 P.M. June 24, 67

STATUS: Dry and Abandoned T.D.: 3694 Driller 3696 Logged

SURFACE CSG.: 8 5/8" X 612 ft. K.B.

100 sox cement + 3% $CaCl_2$

PROD'N CSG.:

None

PERFORATIONS:

None

OTHER: No drill stem formation tests run; some slight lost circulation in Basal Blairmore

Coring:

Formation: Devonian Wabamun Formation

Core Pt.: 3611

Core No. 1: Diamond 7 13/16 O.D. 3611 - 3637 ft. K.B.
Conventional Barrel; Recovery 100%

Core No. 2: Diamond 7 3/4 O.D. 3637 - 3657 ft. K.B.
Rubber sleeve Barrel; Recovery 100%

Core No. 3: Diamond 7 3/4 O.D. 3657 - 3677 ft. K.B.
Rubber sleeve Barrel; Recovery 100%

Core No. 4: Diamond 7 13/16 3677 - 3697 ft. K.B.
Conventional Barrel; Recovery 17' of 20'

N.B.: lost 3 ft. from 3694-3697 down hole

Conventional Barrel produces a 4" I.D. Core
Rubber Sleeve Barrel produces a 3" I.D. Core

D.E.M. ANKERTON SULPHUR 10-4

GEOLOGICAL FORMATION SUMMARY

AGE	FORMATION UNIT	K.B. DEPTH ft.	ELEVATION A.S.L.	INTERVAL ft.
Upper	Lea Park Formation	1250	+1076	573
Cretaceous	Colorado Formation	1833	+ 503	641
	Second White Specks	2474	- 138	203
	Base Fish Scales	2677	- 341	156
	Viking Sand	2833	- 497	70
	Joli Fou	2903	- 567	78
Lower	Blairmore Formation	2981	- 645	359
Cretaceous	Ostracod Equivalent	3340	-1004	13
	Basal Quartz Sand	3353	-1017	205
Upper	Wabamun: Stettler Member	3558	-1222	54
Devonian	Winterburn Grp: Graminia Silt	3612	-1276	32
	Secondary Calcite Zone	3644	-1308	6
	Sulphur Zone Top	3650	-1314	2
	Sulphur Zone Base	3652	-1316	24
	Calmar	3676	-1340	5
	Nisku Formation	3681	-1345	15
	Total Depth - Logs	3696	-1360	2
	Total Depth - Drilled	3694	-1358	
N.B. Cored interval top		3611	-1275	84
	base	3695	-1359	

DAILY PROGRESS REPORT

D.E.M. ANKERTON SULPHUR 10-4

DATE 1967	DEPTH FROM	DEPTH TO	FOOTAGE	HOURS ON BOTTOM	BIT NOS.	DEVIATION DEPTH	DEVIATION R.D.G.	REMARKS
June 12	--	--	--	---	---	--	--	Rig Up
June 16	0	595	595	11 1/2	1A 12 1/4	300	1/2	
	595	612	17	1/2	2A 12 1/4	410	1/3	
						559	1/4	Run 24 lb. casing
June 17	580	616	36	1/2	10SC 7 7/8			
June 18	616	2058	1442	8	" "	916	3/4	
				5 1/2	" "	1425	3/4	
				6 1/4	" "	1936	1/2	
June 19	2058	3207	1149	4 1/2	2DTJ "	2058	1/8'	
				7 1/4	"" "	2575	1/8	
				5 1/4	" "	3050	1	
June 20	3207	3608	401	1 3/4	30SC "	3207	1 1/4	
				7 1/2	" "	--	--	Mud up
				4 1/2	" "	--	--	Core pt. 3608
June 21	3608	3642	34	2 1/4	D.I.7 13/16	3608	1	Diamond coring
				2 3/4	D.2 7 3/4	--	--	" "
June 22	3642	3674	32	14 1/2	" "	--	--	" "
June 23	3674	3696	22	3 1/2	D.I.7 13/16	--	--	" "
	--	--	--	---	-----	--	--	Logging
June 24	--	--	--	---	-----	--	--	Plugged and abandoned

DAILY MUD RECORD

D.E.M. ANKERTON SULPHUR 10-4

DATE 1967	DEPTH	WT. NO./GAL.	VIS. SEC.	W. LOSS 15 MIN. c.c.	F.C. 32nds	pH.	ADDITIVES and REMARKS
June 16	612	--	40	- Water	-	--	2000 No. Gel; 75 lb. Lime
17	616			"			
18	2058	8.6	30	"			
19	3207	8.7	28	"			
20	3495	9.0	28	"			
	3608	9.9	42	- - - -	-	--	Mud up 6200 No. Gel 100 No. Caustic
21	3642	9.8	38	12	--	9.0	Added water 1"
22	3654	9.9	39	--	--	--	
	3664	9.7	40	--	--	--	100 No. Soda ash
	3674	9.8	47	--	--	--	100 No. Soda ash
23	3694	9.7	43	--	--	--	100 No. Soda ash;
							50 No. Caustic;
							700 No. Gel.

WELL SURVEYS RECORD

D.E.M. ANKERTON SULPHUR 10-4

Well Surveyed by: Schlumberger of Canada Ltd.,
1030 Guiness House,
Calgary, Alberta.

Recorded by: J. Porth,
Red Deer Branch.

Date: June 23, 1967

Services Provided:

1. Induction Electric Log

   Interval: Surface casing to T.D. 3696'
   Scale: 2" = 100' and 5" = 100'
   Detail Interval: 3584'to 3696'(T.D.)
   Scale: 25" = 100'

2. Formation Density - Gamma Ray Log

   Interval: 2200'to 3696'(T.D.)
   Scale: 2" = 100' and 5" = 100'
   Detail Interval: 3560'to 3696'(T.D.)
   Scale: 25" = 100'

3. Sidewall Neutron Porosity Log

   Interval: 2200' to 3696'(T.D.)
   Scale: 2" = 100' and 5" = 100'
   Detail Interval: 3500' to 3696' (T.D.)
   Scale: 25" = 100'

N.B.: Bottom 100' section checked for duplication on SNP and F.D.S. logs at 5" = 100' scale.

ABANDONMENT PROCEDURE

Well: D.E.M. Ankerton Sulphur 10-4

Location: L.S.D. 10 Section 4 Township 4, Range 16 W4, Alberta.

Date: June 23, 1967

Plugs set:

Plug No. 1

Set at: 3694' to 3360' K.B.
Composition: 103 sax cement + 4% Gel
Felt at: ----

Plug No. 2

Set at: 2010' to 2750' K.B.
Composition: 120 sax cement + 2% $CaCl_2$
Felt at: 2732'

Plug No. 3

Set at: 660' to 560' K.B.
Composition: 40 sax cement + 2% $CaCl_2$
Felt at: 535'

Surface Casing: Standing and capped

RIG INFORMATION

Contractor: Gustavson Drilling Ltd.
Elveden House, Calgary.

Rig:

Rig No. 9

Drawworks: National T-20
Engines: 2 G.M. 12-103
Slush Pumps: National C 250 7-¼ X 1S
Derrick: Lee C. Moore 97' - 300,000 lbs.
Substructure: 9'
Drill Pipe: 4½" F.H. 4000'
Drill Collars: 12 - 6¼" X 2-3/16"X 30'
Blow Out Pre: 10" 900 API Hydril G.K.
10" 900 API Shaffer Manual Double Gate

Wellsite Supervision: A. C. A. Howe International Limited,
Toronto 1, Ontario.

Wellsite Geologist: J. C. Rowntree, B. Sc.

Operator: Devil's Elbow Mines Ltd.,
Toronto, Ontario.

GEOLOGY

D.E.M. Ankerton Sulphur 10-4 penetrated the same section of sediments intersected in D.E.M. Ankerton Sulphur 15-4.

Bedrock was intersected at 218 feet K.B. and consists of grey to black bentonitic shales, thin sandstones and coal horizons of the Belly River Formation.

The Upper Cretaceous Lea Park Formation was intersected at 1250' K.B. and consisted of tan to grey shales.

The Colorado Formation was penetrated at 1843' K.B. and consists of grey to black marine shales with some silty sections.

Sampling started just above the Viking Sandstone which is poorly developed; very little sandstone was evident in the samples throughout this section.

The Blairmore Formation at 2981' K.B. is a sequence of grey, pyritic shales which are fossiliferized in the lower sections.

The Basal Blairmore Sands, intersected at 3353' K.B., consist of partly unconsolidated, friable, whitish, medium grained, sandstone cemented in part with lime. There was no evidence of gas or oil stain in the upper portion of this zone.

The Wabamun Formation was intersected at a much shallower elevation (3558') in this well. The upper portion of the Wabamun consisted of grey to buff limestone breccia with shaly sections.

Diamond coring started at 3611' K.B. in the Wabamun Formation. The Calmar and Graminia silts were poorly developed in the core. The Graminia silt, intersected at 3612' K.B. was only evident as a silty, marly section in the limestone breccia of the Wabamun. The Calmar consisted of grey to tan shales intersected at 3676' K.B.

The Nisku anhydrites, which were intersected at 3681' K.B., consisted of uniform, brown anhydrite grading downards to dense, buff to brown anhydritic dolomite.

For a detailed description of the lithology in the cored interval from 3611' to 3694' K.B., please refer to core descriptions following in this appendix.

SAMPLING PROGRAM

Samples were obtained from surface (0') to 350 feet and from 2800' to 3600 feet at 10 foot intervals. Controlled samples were circulated at 3560, 3570, 3590 and 3600 feet.

Samples have been washed and dried and a portion has been placed in labelled plastic vials for microscopic examination. Descriptions and a log of the lithologies are given at the rear of Appendix B.

DISPOSITION OF SAMPLES AND CORE

Drilling Samples

All the samples as outlined above have been bottled and delivered to the operator, Devil's Elbow Mines Ltd., Toronto, Ontario with this report.

Washed and tagged samples from 2800' to T.D. have been delivered to the Sample Storage Center of the Oil and Gas Conservation Board in Calgary.

Washed and tagged samples from surface to 350' have been delivered to the Water Research Council, 10302 - 107th St., Edmonton, Alberta.

Core

The split half of the core from 3648 to 3655 feet K.B. will be delivered to the Sample Storage Center of the Oil and Gas Conservation Board in Calgary. The whole diameter core from 3611' to 3648' and from 3655' to 3696' K.B. will be delivered to the same center for storage.

CORE INFORMATION

Core Description

Core No. 1

3611' to 3637' (26')

Recovery 100%

Coring Time: 6, 6, 9, 7, 6, 8, 5, 5, 5, (3620') 5, 5, 5, 6, 6, 7, 6, 6, 6, (3630') 6, 5, 7, 6, 7, 7, 5, 7 minutes per foot.

Conventional Barrel: 7' 3/16" O.D. 4" I.D.

Interval:	Description
1 - 13' 3611 - 3624'K.B.	Limestone breccia - dark brown, very bituminous, breccia fragments of marly L.S. up to 1" size; sinuous long fractures frequent.
13 - 23' 3624 - 3634'K.B.	Limestone breccia - rounded, non-bituminous fragments of grey-buff L.S. and shale. L.S. matrix very shaly and marly. Fragments up to 4 inches in size.
23 - 26' 3634 - 3637'K.B.	Limestone breccia - as above except with frequent calcareous claystone masses and sections. Long irregular vertical fractures.

Core No. 2

3637' to 3657' K.B. (20')

Recovery: 100%

Coring Times: 31, 37, (3641') 37, 40, 40, 37, 40, (3651') 40, 45, 46, minutes per 2 feet

Rubber sleeve barrel: 7-3/4" O.D. 3" I.D.

Interval:	Description
26 - 33' 3637'- 3644'K.B.	Limestone breccia - fragments brown to grey dense crypto to micro crystalline L.S. Matrix shaly L.S. with minor black bitumen films on irregular fractures.

Top of Secondary Calcite Zone - 3644 K.B. - 1308 A.S.L.

33 - 37' 3644 - 3648'K.B.	Limestone breccia - as above except more regular remnant bedding and infillings of white secondary calcite in irregular fractures in matrix.
37 - 39' 3648 - 3650'K.B.	Limestone breccia - as above except secondary calcite veinlets and blebs appear more frequently. Slight sulphur evident on combustion of fragments.

39 - 41' 3650 - 3652'K.B.	Limestone - dark brown, very fine grained fairly banded or bedded. Low porosity. Estimate up to 5% secondary calcite in veinlets and blebs. Estimate 25% bituminous Sulphur infilling with secondary calcite veinlets and blebs. Some massive sulphur blebs up to 1" in size. Shaly.
41 - 44' 3652 - 3655'K.B.	Limestone - finely banded with shaly zones. Otherwise as above. No visible sulphur but evidence of sulphur on combustion. Two inch shale break at top of interval delimits the visible sulphur zone.
44 - 46' 3655 - 3657'K.B.	Anhydrite - brown, bedded grading downwards to grey, finely banded zones. Bituminous films at top of interval.

Core No. 3

3657 to 3677' K.B. (20')

Recovery: 100%

Coring times: 50, 47, (3661') 53, 48, 50, 44, 56, (3671') 49, 45, 55, minutes per 2 feet.

Rubber s eeve core barrel: 7-3/4 O D. 3" I.D.

Interval:	Description
46 - 65' 3657 - 3676'K.B.	Anhydrite - brown to grey, bedded as above with minor lenticles of pale green shale.

Top of Calmar Formation 3676' K.B. - 1340' A.S.L.

Interval:	Description
65 - 66' 3676 - 3677' K.B.	Shale - dark greenish grey, silty, non-calcareous.

Core No. 4

3677 to 3697' (K.B.)) 20')

Recovery: 100%

Coring times: 9, 8, 6, (3680') 9, 8, 9, 7, 7, 10, 12, 13, 12, 11, (3690) 13, 11, 13, 11, 11, 12, 13, minutes per foot.

Conventional barrel: 7-13/16 O.D., 4" I.D.

Interval:	Description
66 - 70' 3677 - 3681'K.B.	Shale - as above, very minor anhydrite inclusions, Calmar Sh.

Top of Nisku Formation - 3681' K.B. -- 1345' A.S.L.

70 - 73' 3681 - 3684'K.B.	Anhydrite - brown bedded, dense extremely uniform.

Interval:	Descriptions
73 - 79' 3684 - 3690' K.B.	Dolomite - Buff, marly, dense with green shale lenticles increasing in frequency towards base. Bedding dips 5° - 7° to C.A.
79 - 84' 3690 - 3695' K.B.	Dolomite - dense, brown micro crystalline with minor vuggy porosity mostly infilled with anhydrite. Slightly brecciated near top of interval.
84 - 86' 3695 - 3697' K.B.	Core lost down hole.

End of Coring

T.D. 3697' (less 2 feet lost core)

CORE TESTING

Procedure

The core was delivered to Core Laboratories Ltd. of Calgary, for assay and porosity and permeability measurements on selected portions. The final report of this testing has been issued and is at the rear of Appendix B.

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CORING LOG

FROM

CHRISTENSEN DIAMOND PRODUCTS LTD.

14730 - 118th Avenue EDMONTON, ALBERTA

Date: June 21st /67. Service Engineer Werchola.

Company Devil's Elbow Mines Ltd Contractor Gustafson #9.

Well Name Dick Atherton Sulphur No. 10-9-44-16 Field ..... Province Alberta

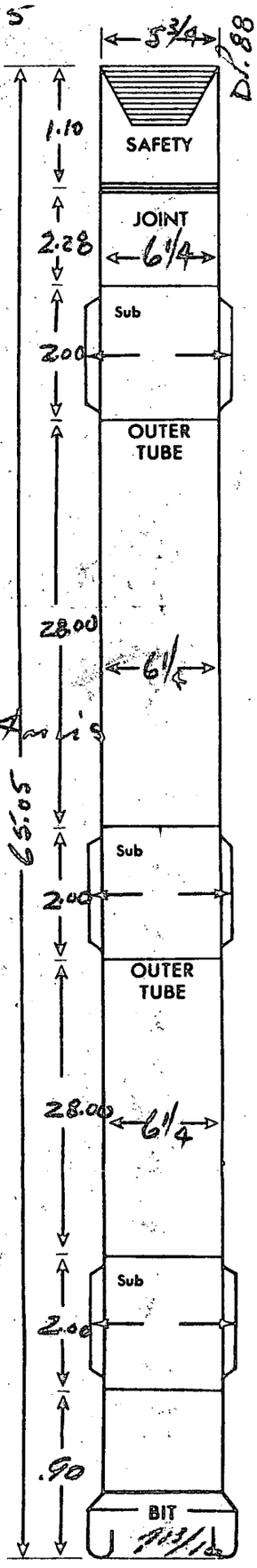
Hole Size 9 7/8 Diamond Bit Size 7 13/16 Diamond Bit Type Double-Core Bit No. E.C.5712

Core Barrel: Size 6 1/4 X 4 Length 60 Number 1257

Core No. 1 Depth: From 3608 To 3634 Total Footage Cored 26 Recovered 26

Formation Cored Dick Mine Description Ran-Slip Knife Sidoe

ART	DEPTH	TIME	MIN./FOOT Actual	MIN./FOOT Lost	Mud Report & Remarks	WEIGHT	R. P. M.	PUMP SIZE 3½ X 15 Pressure	PUMP SIZE 3½ X 15 Stroke
1	3608	7:40							
2	09	46	6		9.5 Full	E	65	900	58
3	3610	52	6			"			
4	11	57	5				63	"	"
5	12	8:04	7			14			
6	13	8:10	6						
7	14	10:10	8		112 mud/oil used				
8	3615	15	5						
9	16	20	5		Wt. 9.5 at 10.				
10	17	25	5						
11	18	30	5						
12	19	35	5						
13	3620	40	5						
14	21	46	6						
15	22	52	6						
16	23	59	7						
17	24	11:05	6						
18	3625	11	6						
19	26	17	6						
20	27	23	6						
21	28	28	5						
22	29	35	7						
23	3630	41	6						
24	31	48	7						
25	32	55	7			"	"	"	"
26	33	12:00	5						
27	34	12:07	7		Cut - 26' Rec. 26' - 2 hrs - 24 min's				



CORING LOG

FROM

CHRISTENSEN DIAMOND PRODUCTS LTD.

14730 - 118th Avenue EDMONTON, ALBERTA

Date: JUNE 21ST / 67. Service Engineer WERCHOLUK

Company DEVIL'S ELBOW MINES LTD Contractor CUSTAWSON #9.

Well Name DEM. ANKERTAN SULPHUR No. 10-4-44-16 Field ..... Province ALBERTA

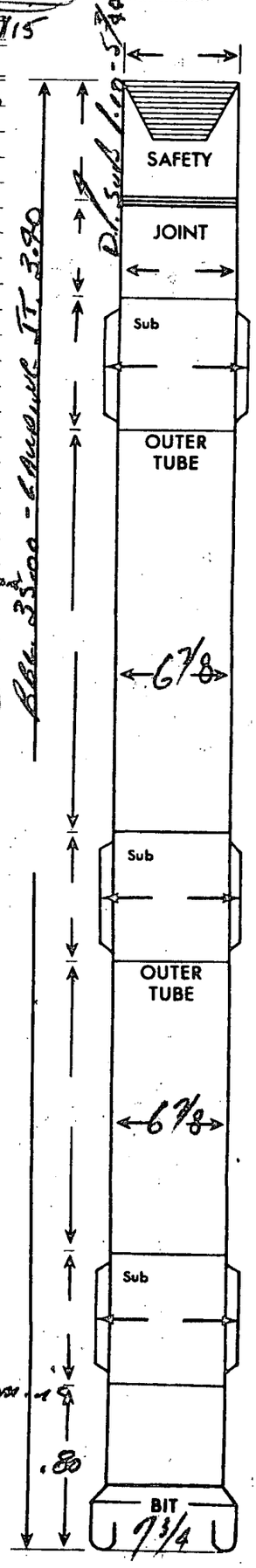
Hole Size 7 7/8 Diamond Bit Size 7 3/4 Diamond Bit Type R/S. Bit No. L.C. 10602

Core Barrel: Size 6 3/8 X 3 Length 20 Number 1

Core No. 2-R/S. #1 Depth: From 3634 To 3674 Total Footage Cored 40 Recovered 40

Formation Cored TIGHT HOLE Description 1/2" X 3/8" JETS. RUBBER SLEEVE

START	DEPTH	TIME	MIN./FOOT Actual	MIN./FOOT Lost	Mud Report & Remarks	WEIGHT	R. P. M.	PUMP SIZE 5 1/2 X 15 Pressure	PUMP SIZE 5 1/2 X 15 Stroke
	3634	9:15							
1									
2	36	46	31		CLEAN 45' FILL TUBE	12	75	700	33
3									
4	38	10:23	37						
5					Hrs. 38. WT. 60				
6	3640	11:00	37						
7									
8	42	.40	40						
9									
10	44	12:20	40						
11									
12	46	.57	37						
13									
14	48	1:37	40						
15									
16	3650	2:17	40						
17							"	"	"
18	52	3:02	45						
19									
20	3654	3:48	46		CUT 20' - REC. 20' - 6 HRS. 30 MIN.				
21									
22									
23									
24									
25									
26					R/S. #2				
27					CORE #3. JUNE 22ND / 67.				
28									
29									
30		3654 START	10:55 A.M.						
31									
32	3656	11:45	50		CLEAN 15' FILL	12	75	750	33
33	58	12:32	47						
34									
35	3660	1.29	53		Hrs. 56. WT. 58				
36									
37	62	2:13	48		HRS. 60				
38									
39					SODA ASH. 100 LBS				
40	64	3:03	50						
41									
42	66	3:47	44						
43									
44	68	4:43	56						
45									
46	3670	5:37	49	5	W/OUT PUMP				
47									
48	72	6:25	48						
49									
50	74	9:30	55	10	TIGHT CORE		"	"	"
51									
52					CUT 20' - REC. 20' - 8 HRS. 20 MIN.				
53									
54									
55									
56									
57									
58									
59									
60									



CORING LOG

FROM

CHRISTENSEN DIAMOND PRODUCTS LTD.

14730 - 118th Avenue EDMONTON, ALBERTA

Date: June 23rd/67 Service Engineer Wercholuk

Company Devils Elbow Mines Ltd Contractor Gustavson #9

Well Name Dem Ankerton Sulphur No. 10-4-44-16 Field — Province Alberta

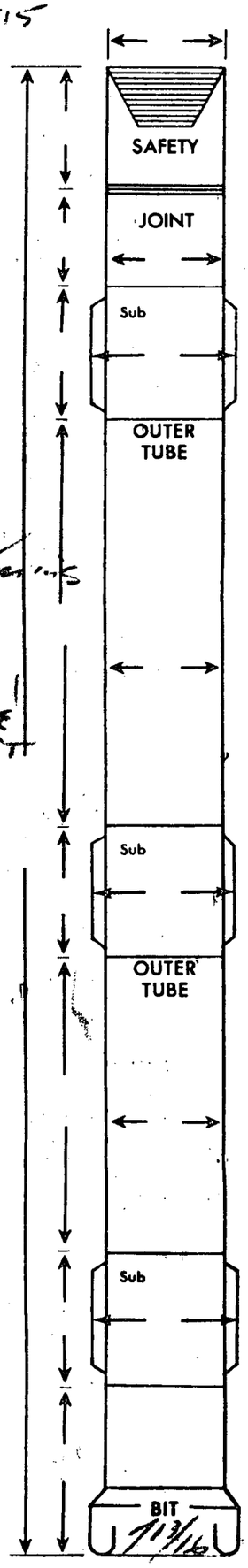
Hole Size 7 7/8 Diamond Bit Size 7 13/16 Diamond Bit Type Double Cone Bit No. E.C. 5712

Core Barrel: Size 6 1/4 x 4 Length 60 Number 1257

Core No. 4 Cone #2 Depth: From 3674 To 3694 Total Footage Cored 20 Recovered 17

Formation Cored Light Hole Description —

START	DEPTH	TIME	MIN./FOOT Actual	MIN./FOOT Lost	Mud Report & Remarks	WEIGHT	R. P. M.	PUMP SIZE 5 1/2 x 15 Pressure	PUMP SIZE 5 1/2 x 15 Stroke
	3674	4:25	A.M.						
1	75	34	9		Ream 45'	8	65	950	60
2	76	42	8		Clean 20'		85	"	"
3	77	48	6		Fill	12			
4	78	57	9						
5	79	5:05	8		Addit.				
6	3680	14	9		400# Soda Ash				
7	81	21	7		50# Caustic				
8	82	30	7						
9	83	40	10						
10	84	52	12						
11	3685	6:05	13						
12	86	17	12						
13	87	28	11		Vis. 43				
14	88	39	13		wt. 9.7				
15	89	50	11						
16	3690	7:03	13						
17	91	14	11			"	"	"	"
18	92	25	11						
19	93	37	12						
20	94	7:50	13		Cut 20' Rec. 17 - 3 Hrs. 25 mins				
21	3695								
22	96				Core - Mix Gel - 1 Hrs				
23	97								
24	98				Note Lost 3' Core,				
25	99								
26	3700				when working Pipe, Circ. &				
27	01				Mixing Gel, Could Not Get				
28	02				over with BBL.				
29	03								
30	3604								
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									



One half of the sample interval was slabbed for laboratory work. One slabbed half was cut into halfs for sulphur assay and descriptive analysis. The remaining slab was delivered as a permanent record to the Core Storage Center of the Oil and Gas Conservation Board, Calgary. Porosity and permeability tests and sulphur extraction tests were completed using the other half interval, whole diameter core. See Figure 10 for sketch of procedure.

Testing Results

The complete testing results are given in the Core Laboratories Report on the Core Analysis on D.E.M. Ankerton Sulphur 10-4 at the rear of this Appendix.

The selected interval from 3648 to 3655 was assayed in sections for weight percentage sulphur and tested when dried for porosity and permeability to air with the sulphur in place.

The sulphur was then extracted from the whole diameter core by melting in a pressurized steam system. The weight percentage of recovered sulphur was calculated. This extraction technique gives an indication of the percentage sulphur which might be recoverable using a Frasch Process. Porosity and permeability measurements were made after steam extraction.

Toluene vapour phase extraction on the whole diameter core recovered the remaining sulphur. Then final weight percentage sulphur and porosity and permeability measurements were made.

No chemical analysis of the water used to extract the sulphur or of the solids extracted were made. The analyses of these two fractions from the cores of the first well (D.E.M. Ankerton Sulphur 15-4) should provide sufficiently reliable data.

The weighted averages of weight percentage sulphur over two intervals are given below.

WELL: D.E.M. ANKERTON SULPHUR 10-4

INTERVAL	ACTUAL LENGTH	WEIGHT % SULPHUR
3650.0' - 3651.8'K.B.	1.8 feet	20.4
3650.0' - 3652.1' K.B.	2.1 feet	18.7
3648.1' - 3654.6'K.B.	6.5 feet	5.7

ESTIMATION OF SULPHUR CONTENT FROM LOGS

A resume of the log evaluation technique for estimating the sulphur content as developed by M.P. Tixier and R.P. Alger (5) is given in Appendix A and need not be repeated here.

It can be shown mathematically that the porosity determined by the density log (ϕ D) minus the porosity from the neutron log (ϕ N) represents a measure of the percentage bulk volume of sulphur in the rock.



That is: -

$$\frac{\phi D - \phi N}{0.40} = \% \text{ Sulphur Bulk Volume}$$

This technique requires the assumption that the host rock is a limestone. The presence of dolomite and/or anhydrite can modify the results.

Only two 1 foot intervals from 3650 to 3652 K.B. in the D.E.M. Ankerton Sulphur 10-4 showed a sufficient difference in porosities ϕ N and ϕ D to obtain positive results.

FIGURE 19

PERCENTAGE SULPHUR BULK VOLUME

Log Depth K.B.	ϕ_n L.S.	ϕ_d L.S.	$\phi_d - \phi_n$	$\frac{\phi_d - \phi_n}{0.40}$ or % S. Bulk Vol.
3650-3651	1.7	2.6	+ .9	2.3
3651-3652	2.8	4.9	+2.1	5.3
3652-3653	5.2	3.1	-2.1	0

The graph showing porosity curves from Sidewall Neutron and Formation Density techniques (Figure 15) illustrates the calculations in Figure 14.

The assays obtained in the Sulphur Zone from 3650' to 3652' K.B. averaged 18.7 percent sulphur. There is a considerable discrepancy between that assay figure and the value of 3.8 percent calculated from the logs. At least a portion of the discrepancy could be the result of assuming that the sulphur host is entirely limestone. The visual log of the Sulphur Zone indicates shaly inclusions within the zone. The presence of shale would cause the Formation Density Porosity curve to increase slightly and the S. Neutron Porosity curve to increase even more. This would decrease the value $\phi_d - \phi_n$ and result in too low values for sulphur content using the log technique.

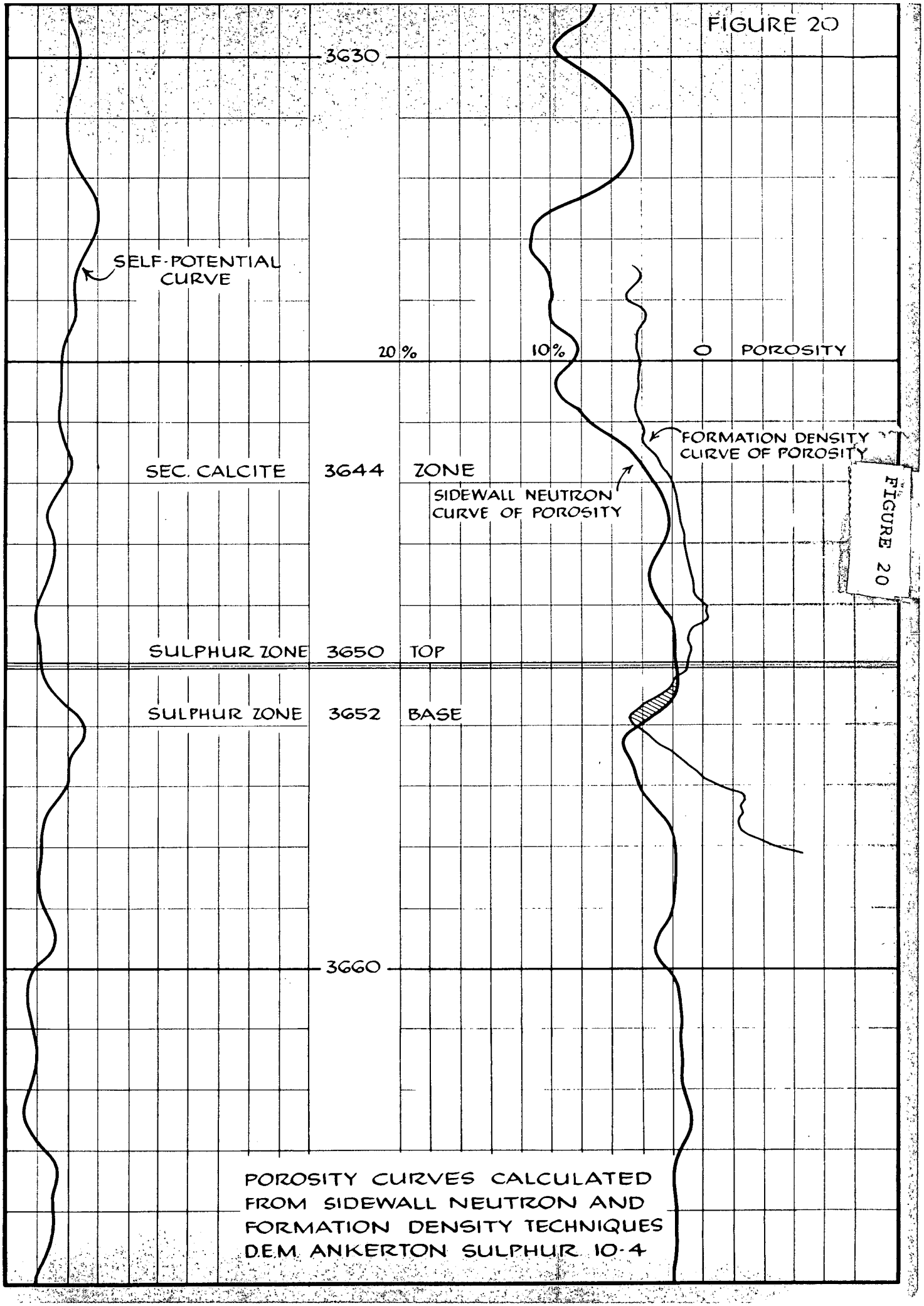


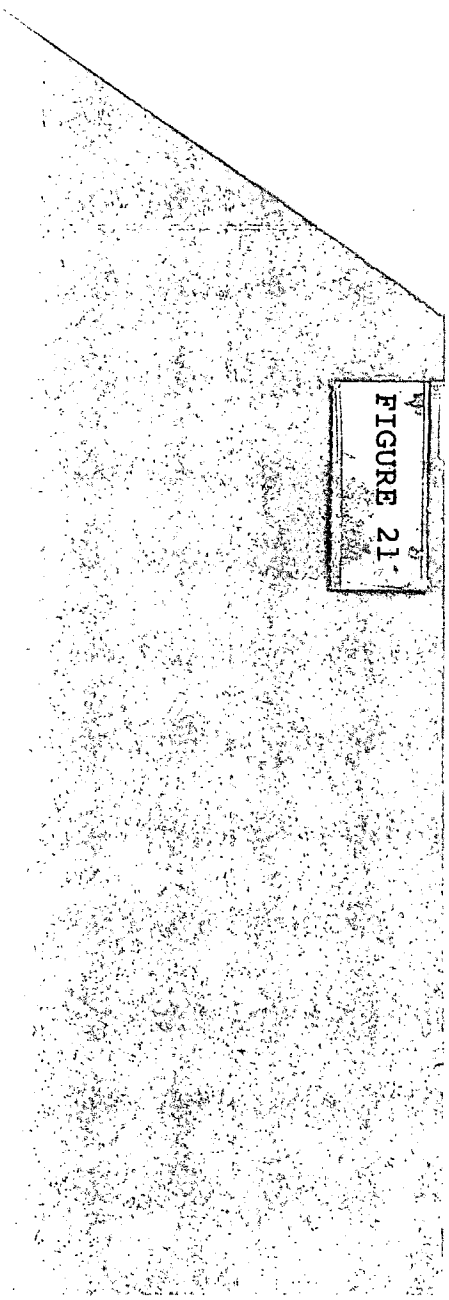
FIGURE 20
3630
SELF-POTENTIAL CURVE
20 %
10%
0 POROSITY
FORMATION DENSITY CURVE OF POROSITY
SEC. CALCITE 3644 ZONE
SIDEWALL NEUTRON CURVE OF POROSITY
FIGURE 20
SULPHUR ZONE 3650 TOP
SULPHUR ZONE 3652 BASE
3660
POROSITY CURVES CALCULATED FROM SIDEWALL NEUTRON AND FORMATION DENSITY TECHNIQUES
D.E.M. ANKERTON SULPHUR 10-4

F I G U R E 2 1

Sample Descriptions and Lithology Log

D.E.M. Ankerton Sulphur 10-4

(99 -- 100)



1967008 FIGURE 21

LITHOLOGY LOG AND WELL HISTORY LOG

N. C. LENARD - P. GEOL. CALGARY, ALBERTA

COMPANY NAME: DEVILS ELBOW MINES LTD. TORONTO, ONTARIO
WELL NAME: D.E.M. ANKERTON SULPHUR 10-4
LOCATION: LSD 10 SEC 4 TWP 44 RGE 10 W 4th IN THE PROVINCE OF ALBERTA
CO-ORDS: 350' W 350' N OF SE CORNER OF LSD 10 LOGS
GROUND ELEVATION: 2325 KELLY BUSHING: 2331 TOTAL DEPTH: 3696 STATUS: WILDCAT
SPUDDED: 1:30PM JUNE 16/67 SUSPENDED — COMPLETED 9:30PM JUNE 22 ABANDONED JUNE 24/67
CASING: SURF 0-612' K.B. — 8⅝" new 24lb — ABANDONED
PROD'N. / /
CORES LOGGED BY: J.C. KNUTSEN FROM 3611 K.B. TO 3697 K.B. DATE: JULY 19 67
SAMPLES LOGGED BY: J.C. KNUTSEN FROM 2800 K.B. TO 3500 K.B. DATE: JULY 19 67

VERTICAL SCALE: 1" = 100'

OBJECTIVES: ZONE(S) BASAL WABAMUN FORMATION DEPTH(S) 3598 — 3681 'K.B.

MAIN ROCK TYPES

- CONGLOMERATE LIGHT & DARK PEBBLES
- SANDSTONE
- SILTSTONE
- SHALE
- COAL
- SIDERITE OR IRONSTONE
- BENTONITE
- LIMESTONE
- DOLOMITE
- ANHYDRITE
- SALT
- CHERT, LIGHT, DARK, PRIMARY
- CHERT, LIGHT, DARK, ANGULAR OR DETRITAL
- BASEMENT ROCK
- ALGAL LS
- REEF LS
- BIOCLASTIC, FRAGMENTAL LS

SUPPLEMENTARY SYMBOLS

- SANDY
- ARGILLACEOUS
- CARBONACEOUS OR BITUMINOUS
- SIDERITIC
- CALCAREOUS, LIMY
- DOLOMITIC
- GLAUCONITIC
- OOLITIC, PELLETED
- STYLOLITED
- PYRITIC
- SAMPLES MISSING
- NOT LOGGED
- POOR SAMPLES
- CHALKY
- MARLY
- EARTHY
- RESTRICTED BY CASING

POROSITY TYPES

- F FRACTURE POROSITY
- G GRANULAR
- V VUGGY
- X CRYSTALLINE

SAND TYPES

VAN	CLAY FELDSPAR		
STE	<	BIO	
SUB GREYWACKE	<	>	GRAVEL
GREYWACKE	>	<	GRAVEL
RAGGED	>	<	PYRITE

ROUNDNESS

R	ROUND
V	SUBROUND
A	ANGULAR
U	SUBANGULAR

SORTING

G	GOOD
F	FAIR
P	POOR

POROSITY: POOR 0-10 %, FAIR 10-20 %, GOOD 20-25 %

OIL STAINING: POOR, FAIR, GOOD, FLUORESCENT, ASPHALTIC

ENGINEERING SYMBOLS: PERFORATIONS, CASING SHOE, DRILL STEM TEST, CORED INTERVAL, SAND FRAC'D

REMARKS:

LOG FACIES | SAMPLE DESCRIPTION (ROCK VARIETY, COLOUR, TEXTURE, OTHER) | DRL. TIME MIN/FT

MARKED DEPTH ON SAMPLES

NO SAMPLES TAKEN

	FORMATIONS FROM K.B. LOGS	ELEV.	
580			Shales, waxy grey. Inorganic fossils rare fossils, patchy pyrite, calcite to 2%
	VIKING SS	2855	
590			Sandstone, grey. rounded quartz, fair porosity, fine to medium grained
			Sandstone as above.
	Joli Fou	2903	Shale, marine. grey to brown. Fossiliferous with up to 1% pyrite, silty
500			
			Shale, grey to black. as above
	BLAIRMORE	2981	
510			
520			
530			
			Shale, grey to black. as above
540	ORTRACOD		
	KNEE HILL CRYSTAL TUFF	3353	Sandstone, whitish to grey. Friable, poorly consolidated, well rounded quartz, medium grained, loosely well sorted
550			
	WABAMUN	3598	Limestone, buff to brown. Silty. CALCAREOUS / CALCISILTITE / CALCISILTITE, FOSSILIFEROUS
560			
	CORE POINT		
	SECRETION	3644	SEE DESCRIPTIONS OF CORES FOR DETAIL
	SASKATOON	3650 3658	
	CALMAR MEMBER	3678 3681	
570		3696	TD

FIGURE 22

F I G U R E 2 2

Induction Electric Log - Annotated

D.E.M. Ankerton Sulphur 10-4

(99 -- 100)

SCHLUMBERGER

INDUCTION ELECTRICAL LOG

SCHLUMBERGER OF CANADA Calgary, Alberta

FIGURE 22

COMPANY DEVIL'S ELBOW MINES LIMITED 19670005

WELL DEM ANKERTON SULPHUR
10-4-44-16

FIELD WILDCAT

PROVINCE ALBERTA

LOCATION LSD 10 Sec. 4 Twp. 44 Rge. 16W4

Other Services: SNP, FDC-GR

Permanent Datum GL Elev. 2325.5
Log Measured From KB, 10.5 Ft. Above Perm. Datum

ELEV: KB 2336.0
GL 2325.5
CBF

Date	23 JUNE 67		
Run No.	ONE		
First Reading	3694		
Last Reading	606		
Feet Measured	3088		
Depth Reached	3695		
Bottom Driller	3694		
Csg. SOC	606		
Csg. Driller	612		
Mud Nature	GEL		
Dens. | Visc.	9.7 | 43	|	|
Mud pH	9.0		
" Water Loss	17.0		
" Res.	1.21 @ 78 °F	@ °F	@ °F
" " @ BHT	0.96 @ 100 °F	@ °F	@ °F
" Rmf	1.14 @ 70 °F	@ °F	@ °F
" Rmc	1.85 @ 72 °F	@ °F	@ °F
Bit Size	7 7/8"		
Spacing - AM	16"	16"	16"
" - MN	34'-6"	34'-6"	34'-6"
Ind. Type	6FF40	6FF40	6FF40
Opr. Rig Time	1.5 HRS		
Truck No.	4508 RD		
Recorded By	PORTH		
Witness	ROWNTREE		

PROVINCE ALBERTA
FIELD WILDCAT
WELL DEM ANKERTON SULPHUR 10-4-44-16
COMPANY DEVIL'S ELBOW MINES LIMITED

1st Run Service Order # 37283

Drilling Stopped 0700 / 23rd : Circulation Stopped 0800 / 23rd : Tool on Bottom 1230 / 23rd : B.H.T. 100 °F

REMARKS

29 JUNE 67 CAL PL

Stand Off – Inches 1.5
Cartridge No. F119
Panel No. F281
Sonde No. M139
IAP-D No. MMP-B109
SBR 4

CONDUCTIVITY
millimhos/m = $\frac{1000}{\text{ohms m}^2/\text{m}}$

INDUCTION
0 1000 2000
2000 3000

RESISTIVITY
ohms m²/m

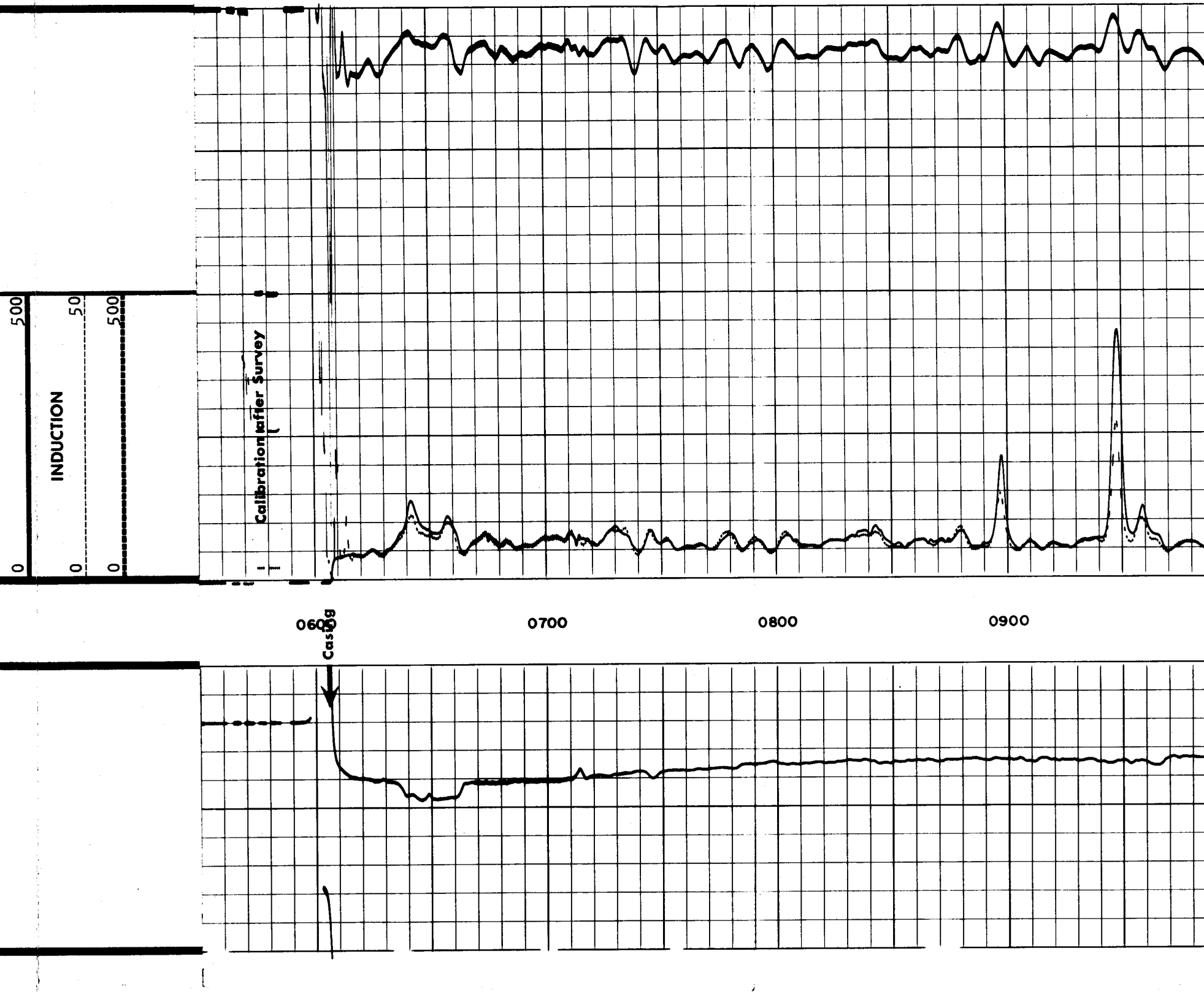
16" NORMAL
0 50

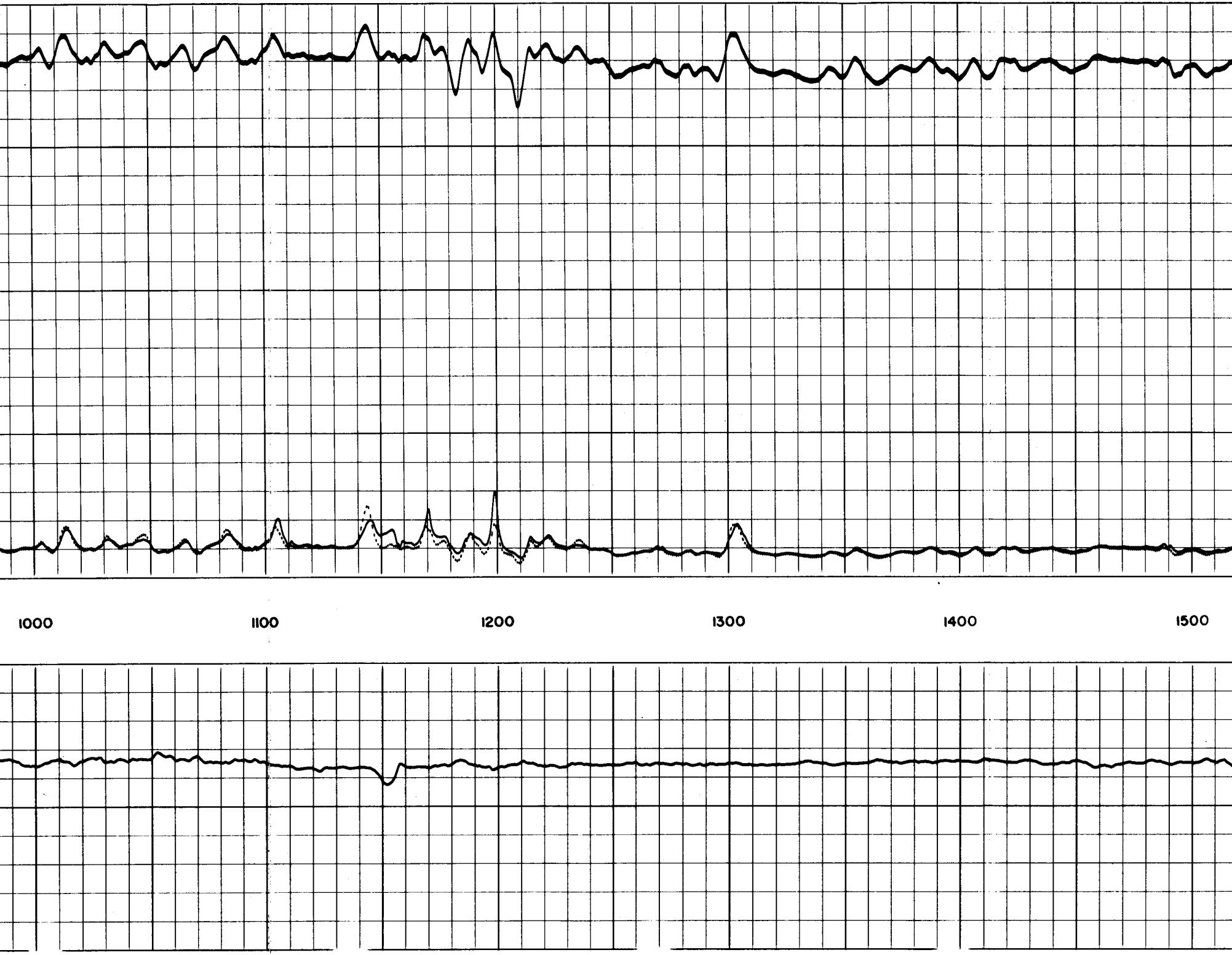
DEPTHS

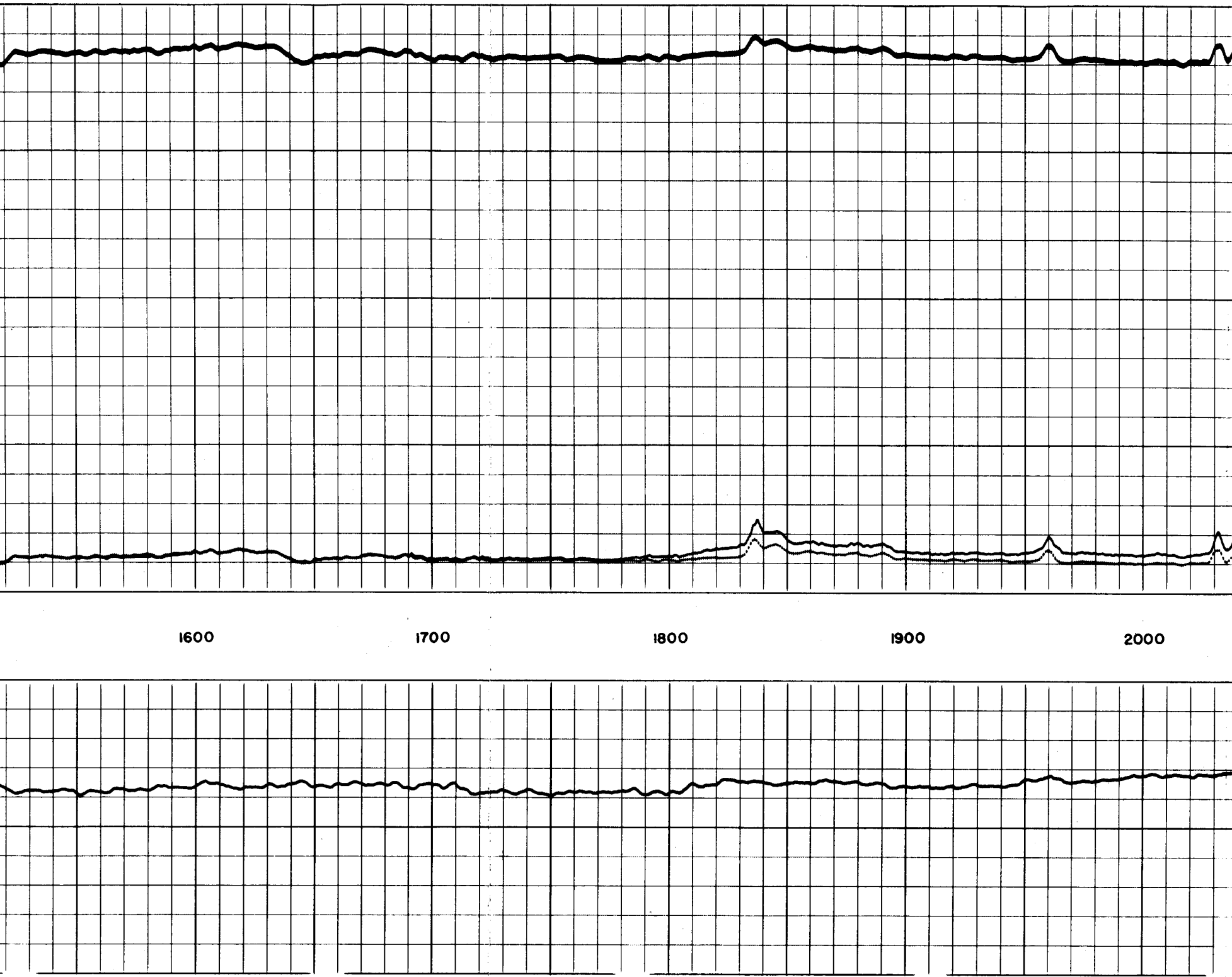
SPONTANEOUS-POTENTIAL
millivolts

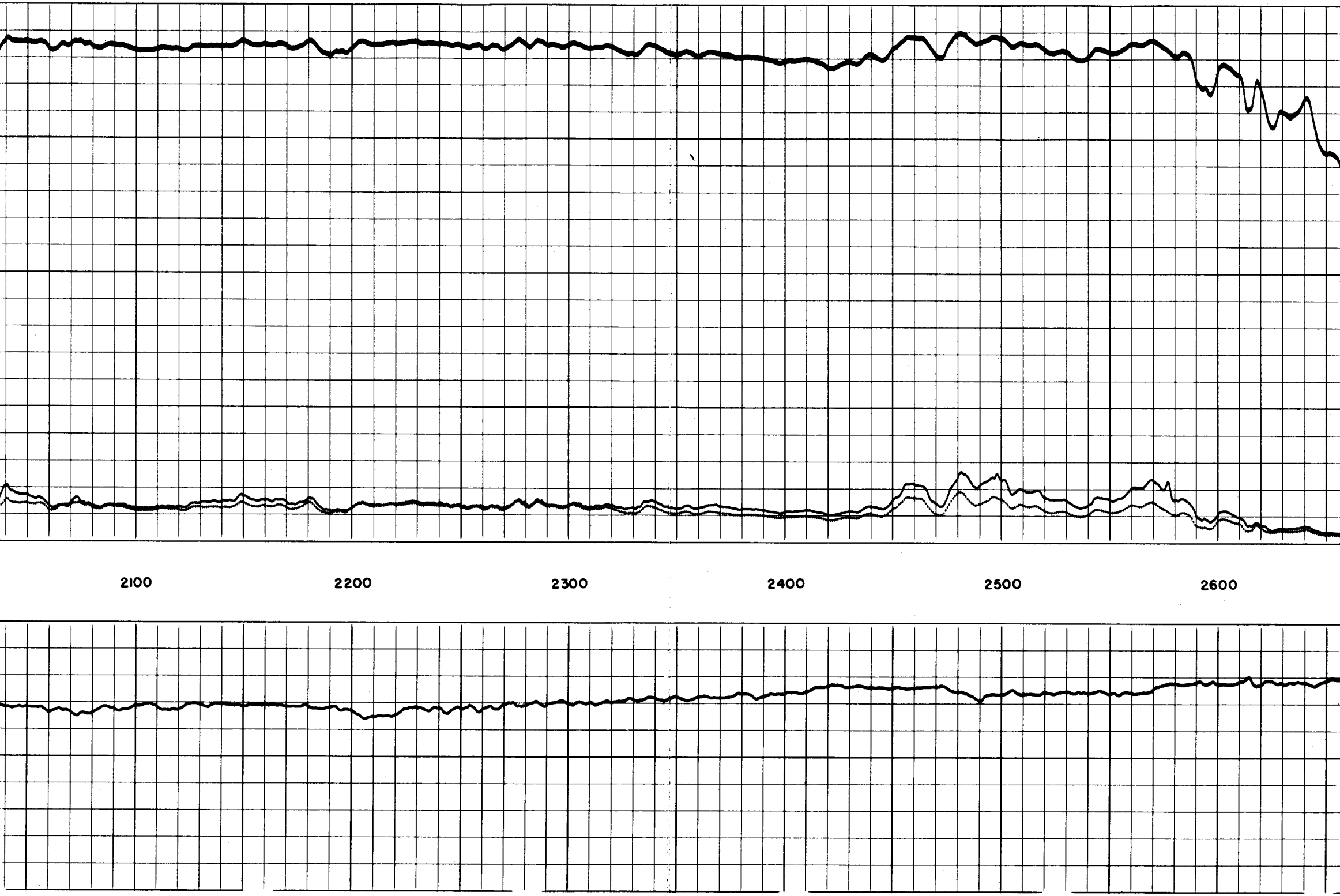
− 20 +

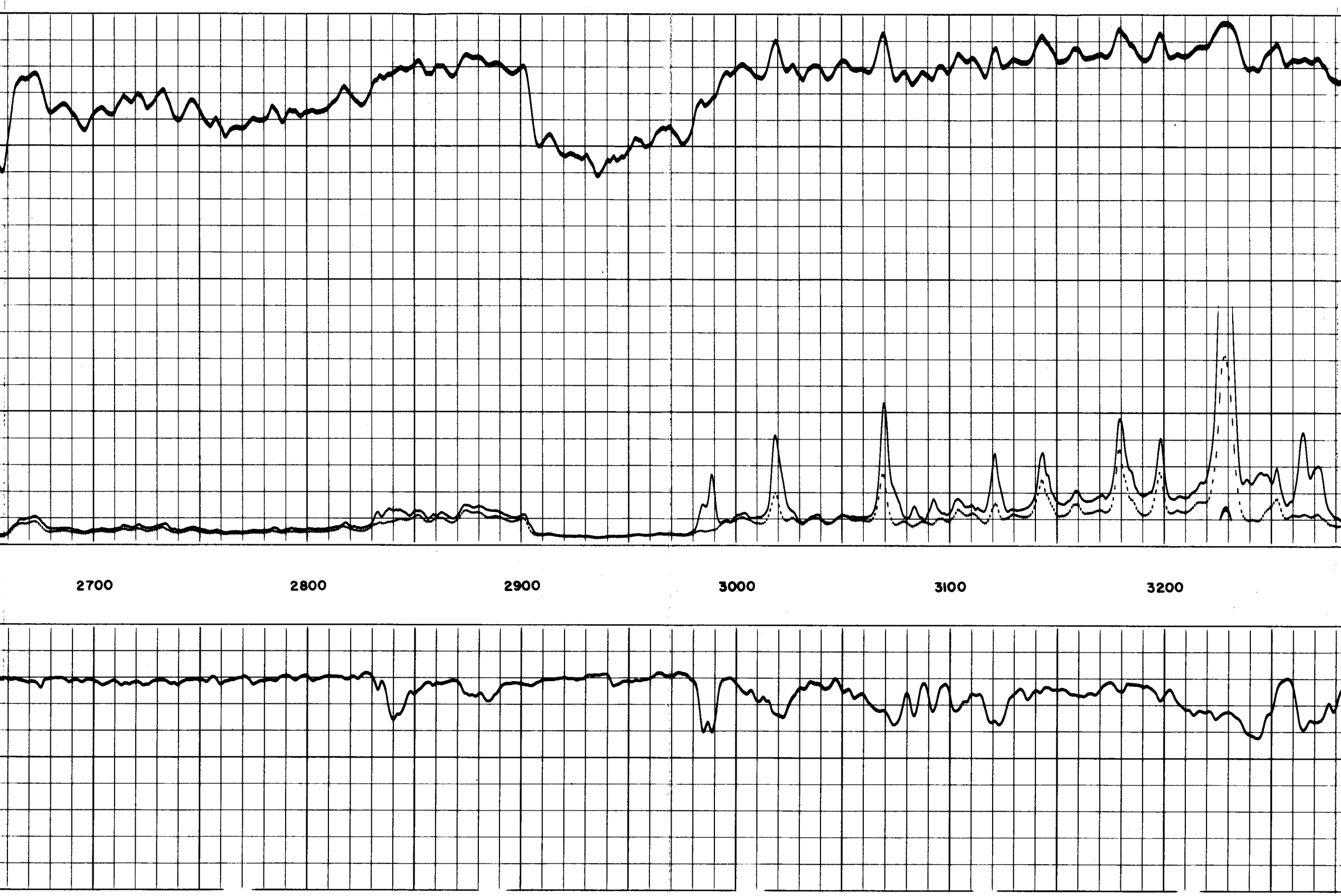
Speed in FPM

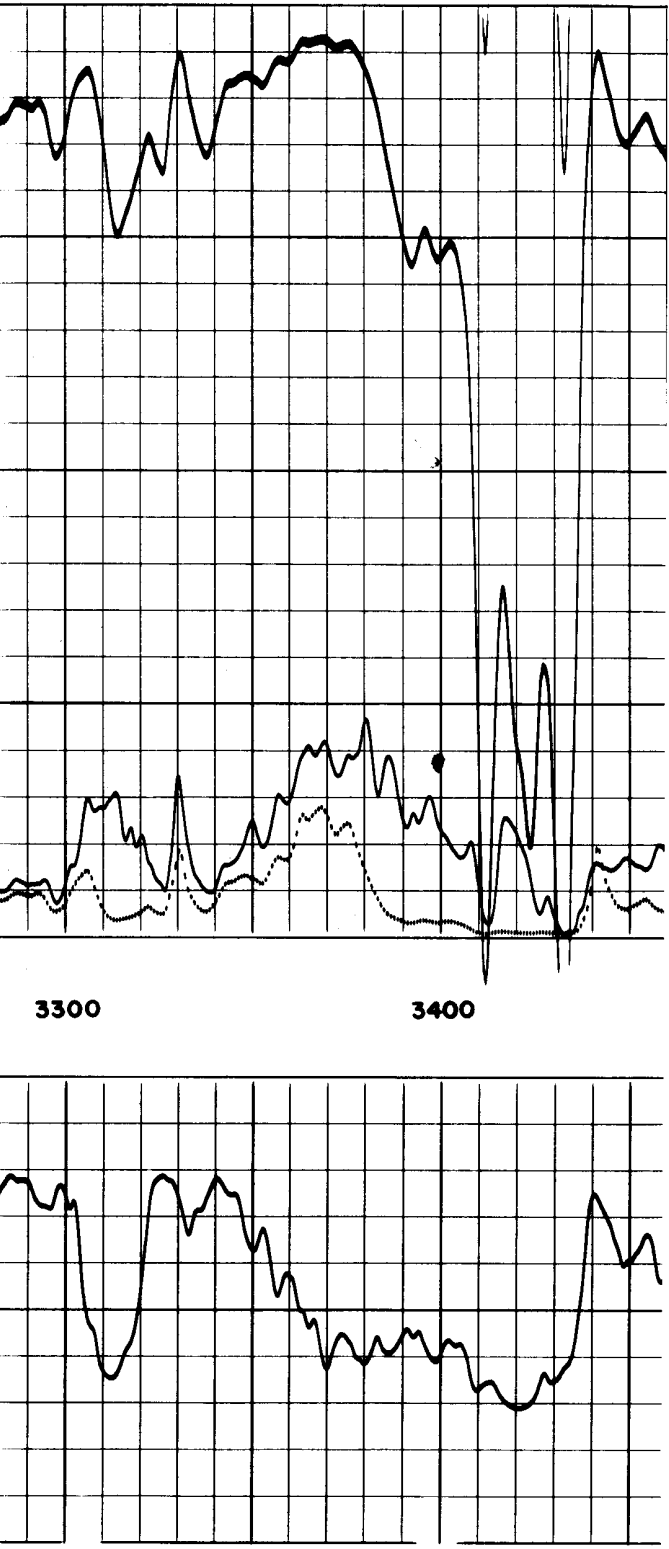


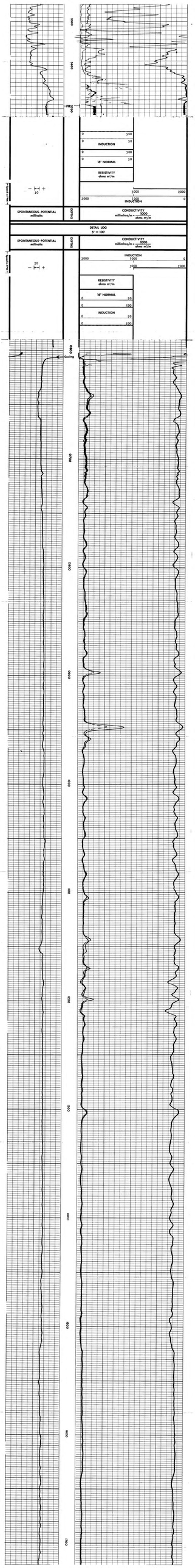




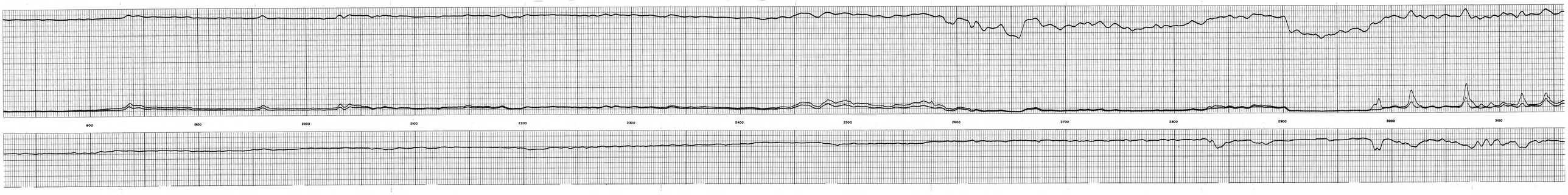


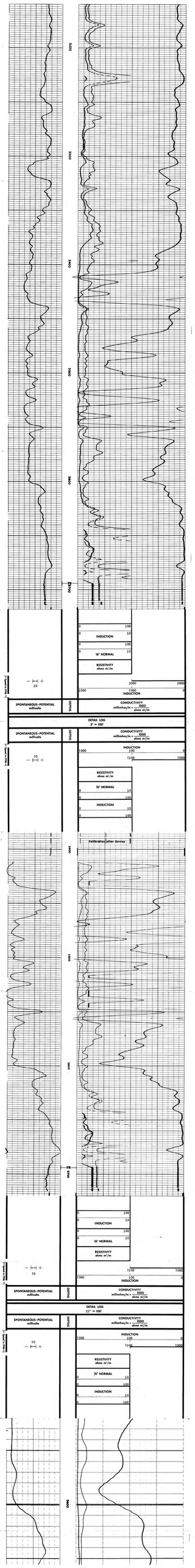






3000
3400
FR
3700
0
500
INDUCTION
0
50
0
500
16" NORMAL
0
50
RESISTIVITY
ohms m²/m
20
3000
2000
2000
INDUCTION
0
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
DETAIL LOG
5" = 100'
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
INDUCTION
2000
1000
0
3000
2000
20
RESISTIVITY
ohms m²/m
16" NORMAL
0
50
0
500
INDUCTION
0
50
0
500
Casing
0700
0800
0900
1000
1100
1200
1300
1400
1500
1600
1700


1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100


3100
3200
3400
3600
3800
3900
INDUCTION
16" NORMAL
RESISTIVITY
ohms m²/m
3000
2000
2000
1000
0
INDUCTION
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
DETAIL LOG
5" = 100'
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
INDUCTION
1000
500
0
1500
1000
RESISTIVITY
ohms m²/m
16" NORMAL
INDUCTION
Calibration after Survey
3400
3600
3800
3900
INDUCTION
16" NORMAL
RESISTIVITY
ohms m²/m
1500
1000
1000
500
0
INDUCTION
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
DETAIL LOG
25" = 100'
SPONTANEOUS-POTENTIAL
millivolts
DEPTHS
CONDUCTIVITY
millimhos/m = 1000 / ohms m²/m
INDUCTION
1000
500
0
1500
1000
RESISTIVITY
ohms m²/m
16" NORMAL
INDUCTION
3600

FR

8700

0 500

0 50
INDUCTION

0 500

0 50
16" NORMAL

RESISTIVITY
ohms m^2/m

Speed in FPM

− 10 +

1500 1000

1000 500 0
INDUCTION

SPONTANEOUS-POTENTIAL
millivolts

DEPTHS

CONDUCTIVITY
millimhos/m = $\frac{1000}{\text{ohms } m^2/m}$

COMPANY DEVIL'S ELBOW MINES LIMITED

WELL DEM ANKERTON SULPHUR 10-4-44-16

FIELD WILDCAT PROVINCE ALBERTA

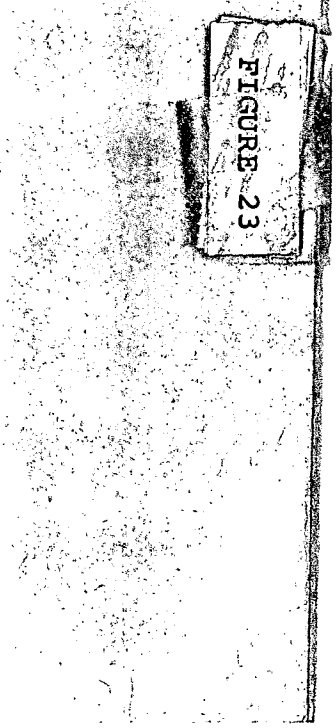
SCHLUMBERGER

F I G U R E 2 3

Sidewall Neutron Porosity Log - Annotated

D.E.M. Ankerton Sulphur 10-4

(99 -- 100)



SCHLUMBERGER

SIDEWALL NEUTRON POROSITY LOG

SCHLUMBERGER OF CANADA Calgary Alberta

FIGURE 23
19670005

COMPANY DEVIL'S ELBOW MINES LIMITED

WELL DEM ANKERTON SULPHUR
10-4-44-16

FIELD WILDCAT

PROVINCE ALBERTA

LOCATION LSD 10 Sec. 4 Twp. 44 Rge. 16W4

Other Services: I-ES, FDC-GR

Permanent Datum GL Elev. 2325.5
Log Measured From KB, 10.5 Ft. Above Perm. Datum

ELEV: KB 2336.0
GL 2325.5
CBF

PROVINCE ALBERTA
FIELD WILDCAT
WELL DEM ANKERTON SULPHUR 10-4-44-16
COMPANY DEVIL'S ELBOW MINES LIMITED

Date	23 JUNE 67		
Run No.	ONE		
First Reading	3695		
Last Reading	50		
Feet Measured	2100		
Depth Reached	3696		
Bottom Driller	3692		
Csg. SOC	606		
Csg. Driller	612		
Mud Nature	GEL		
Dens. / Visc.	9.7 / 43	/	/
Mud pH	9.0		
• Water Loss	17.0		
• Res.	1.21 @ 78 °F	@ °F	@ °F
• Rmf	1.14 @ 70 °F	@ °F	@ °F
• Rmf @ BHT	0.79 @ 102 °F	@ °F	@ °F
• Rmc	1.85 @ 72 °F	@ °F	@ °F
• ppm-Cl.			
Bit Size	7 7/8"		
Equipment Type	PNT-A		
Opr. Rig Time	2.5 HRS		
Truck No.	4508 RD		
Recorded By	PORTH		
Witness	ROWNTREE		

1st Run Service Order # 37283
Drilling Stopped 0700 / 23rd : Tool on Bottom 1800 / 23rd : Circulation Stopped 0800 / 23rd : B.H.T. 102 °F

29 JUNE 67 CAL PL

REMARKS

Panel No. D199
Cartridge No.
Sonde No. D 48
Detector No.

CALIBRATION: Gamma Ray
Background CPS Test Source CPS Galv. Deflection

Panel Settings: Function Former LIME Mud Wt./Salinity Temp. Comp. Setting 100

	from	to
	from	to
	from	to

Neutron Environmental Cal.

	Drawer In-CPS	Drawer Out-CPS
Before	460	270
After	460	265

Neutron Auxiliary Cal.-CPS

	from	to
Before		
After		

This interpretation represents our best judgment. Nevertheless since all interpretations are opinions based solely on inferences from electrical or other measurements, we cannot and do not guarantee the accuracy or correctness of any interpretation and shall not be liable or responsible for any loss, cost, damages, or expenses that may be incurred or sustained resulting from this or any other interpretation.

POROSITY (%)

LIMESTONE

-10 0 10 20 30

40 50

DEPTHS

22

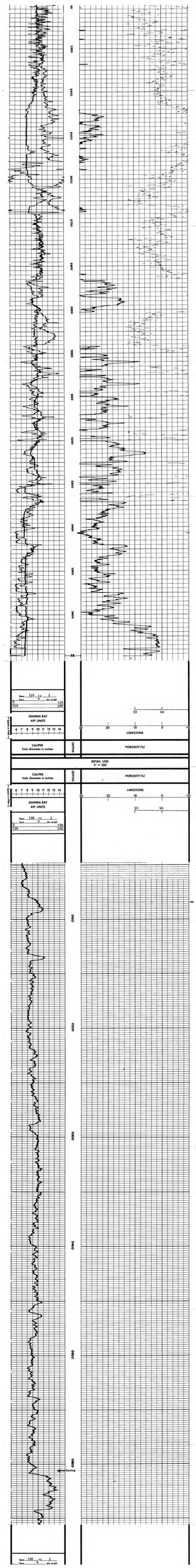
CALIPER
hole diameter in inches

6 7 8 9 10 11 12 13 14

Speed in FPM

GAMMA RAY
API UNITS

Sens. 150 T.C. 2
Zero 0 div. to left
0 150
150 300


00
3200
3400
3600
3800
3700
3800
3900
4000
4100
4200
4300
4400
4500
4600
4700
4800
4900
5000
5100
5200
5300
5400
5500
5600
5700
5800
5900
6000
6100
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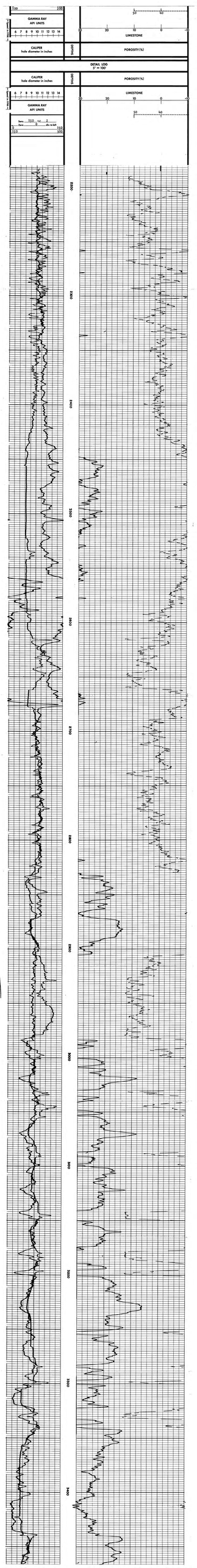
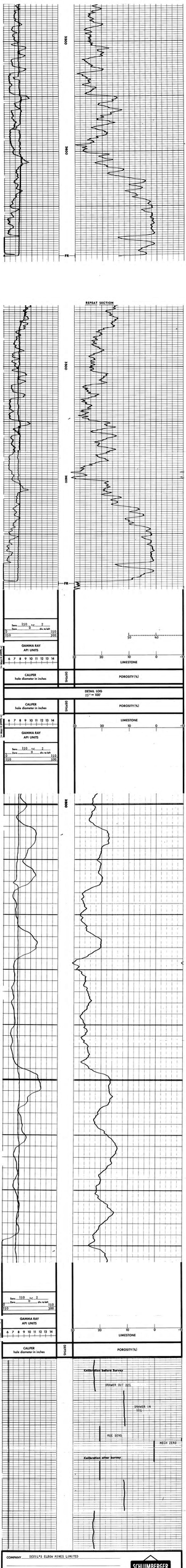
7300
7400
7500
7600



100
200
GAMMA RAY
API UNITS
6 7 8 9 10 11 12 13 14
CALIPER
hole diameter in inches
DEPTHS
50
40
LIMESTONE
0 20 10 0
POROSITY (%)
DETAIL LOG
5" = 100'
CALIPER
hole diameter in inches
DEPTHS
POROSITY (%)
6 7 8 9 10 11 12 13 14
GAMMA RAY
API UNITS
Sens. 150 t.c. 2
Sens. 0 dia. to left
0 150
150 300
LIMESTONE
0 20 10 0
50 40
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
3400



COMPANY DEVILS ELBOW MINES LIMITED

WELL DEN ANKERTON SULPHUR 10-6-16-16

FIELD WILDCAT PROVINCE ALBERTA

SCHLUMBERGER

F I G U R E 2 4

Formation Density - Gamma Ray Log - Annotated

D.E.M. Ankerton Sulphur 10-4

(99 -- 100)

FIGURE 24

SCHLUMBERGER

COMPENSATED FORMATION DENSITY LOG

SCHLUMBERGER OF CANADA Calgary, Alberta

FIGURE 24
19670005

PROVINCE ALBERTA
FIELD WILDCAT
WELL DEM ANKERTON SULPHUR 10-4-44-16
COMPANY DEVIL'S ELBOW MINES LIMITED

COMPANY DEVIL'S ELBOW MINES LIMITED

WELL DEM ANKERTON SULPHUR
10-4-44-16

FIELD WILDCAT

PROVINCE ALBERTA

LOCATION LSD 10 Sec. 4 Twp. 44 Rge. 16W4

Other Services: I-ES, SNP

Permanent Datum GL **Elev.** 2325.5
Log Measured From KB, 10.5 **Ft. Above Perm. Datum**

ELEV: KB 2336.0
GL 2325.5
CBF

Date	23 JUNE 67		
Run No.	ONE		
First Reading	3695		
Last Reading	2195		
Feet Measured	1500		
Depth Reached	3696		
Bottom Driller	3694		
Csg. SOC	606		
Csg. Driller	612		
Mud Nature	GEL		
Dens. | Visc.	9.7 | 43	|	|
Mud pH	9.0		
· Water Loss	17.0		
· Res.	1.21 @ 78 °F	@ °F	@ °F
· Rmf	1.14 @ 70 °F	@ °F	@ °F
· · @ BHT	0.79 @ 102 °F	@ °F	@ °F
· Rmc	1.85 @ 72 °F	@ °F	@ °F
· ppm-Cl.			
Bit Size	7 7/8"		
Source to Detector Spacing	16"		
Equipment Type	PGT-D		
Opr. Rig Time	4 HRS		
Truck No.	4508 RD		
Recorded By	PORTH		
Witness	ROWNTREE		

29 JUNE 67 CAL PL

REMARKS

1st Run Service Order # 37283

Drilling Stopped 0700 / 23rd : Circulation Stopped 0800 / 23rd : Tool on Bottom 0130 / 23rd : B.H.T. 102 °F

Panel No. D199
Cartridge No.
Sonde No. D 48
Detector No.

CALIBRATION: Background CPS Test Source CPS Galvanometer Deflection Div. Panel Sens. Tap for Cal.
Gamma Ray

BULK DENSITY
ρ_b - gm/cc

2.0 2.5 3.0

30 POROSITY % 10 -10

Rho-g = 2.65
Rho-f = 1.00

DENSITY CORRECTION
$\Delta\rho$ - gm/cc

0.25 (-) 0 0.25 (+)

GRAIN DENSITY CHANGE
@ 3500'

DEPTHS

GAMMA RAY
API UNITS

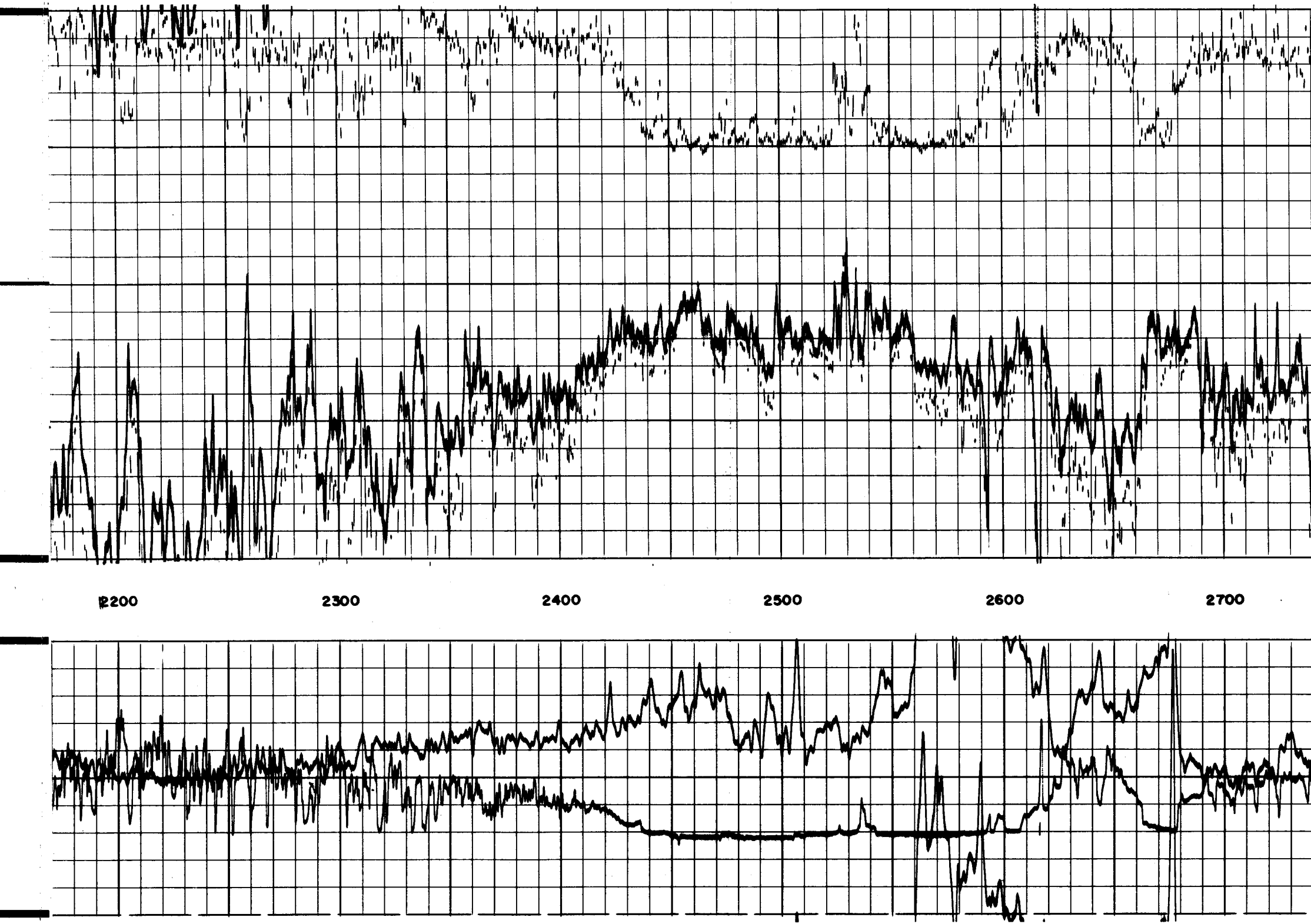
Sens. 150 T.C. 2
Zero 0 div. to left

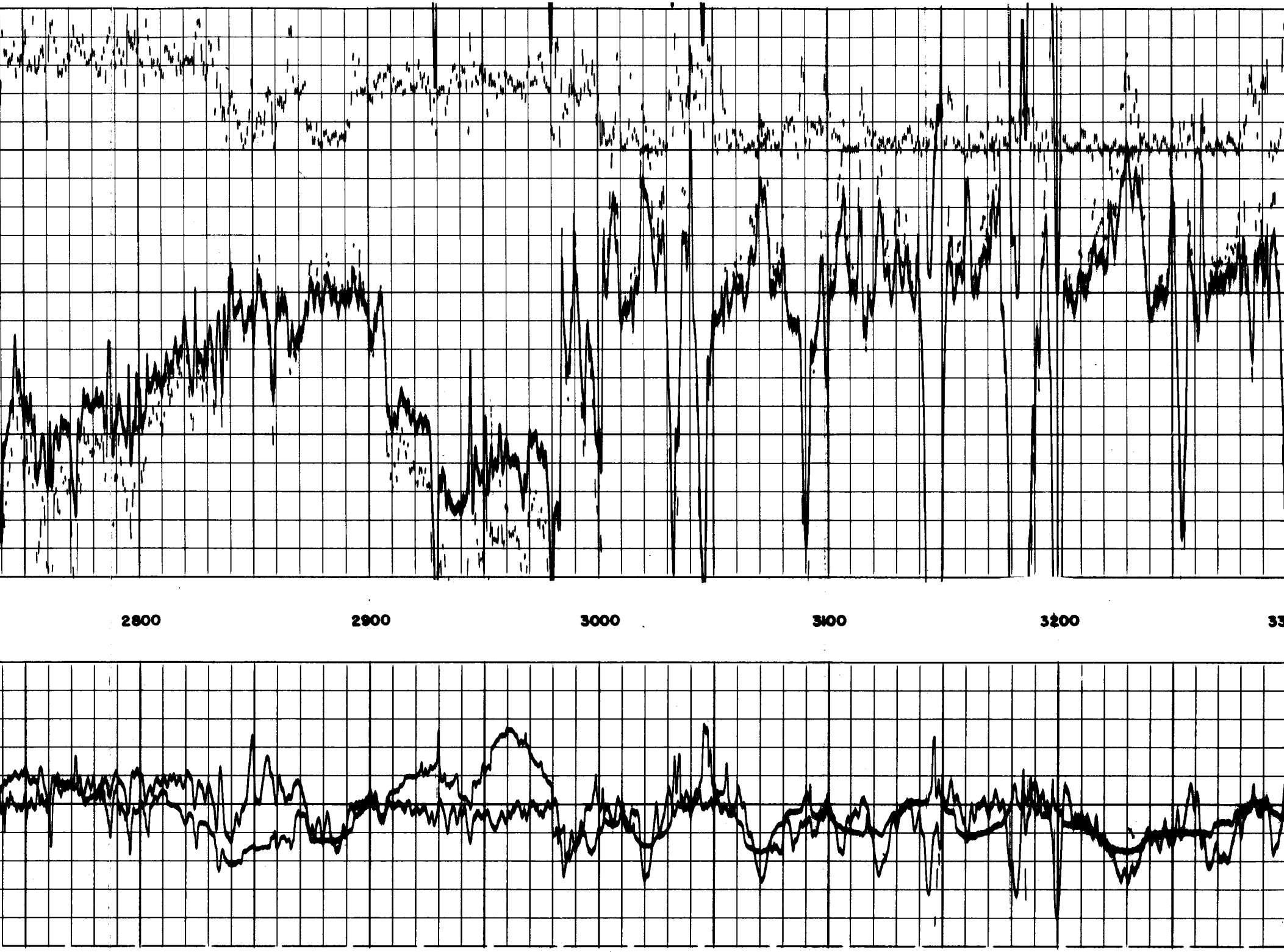
0 150
150 300

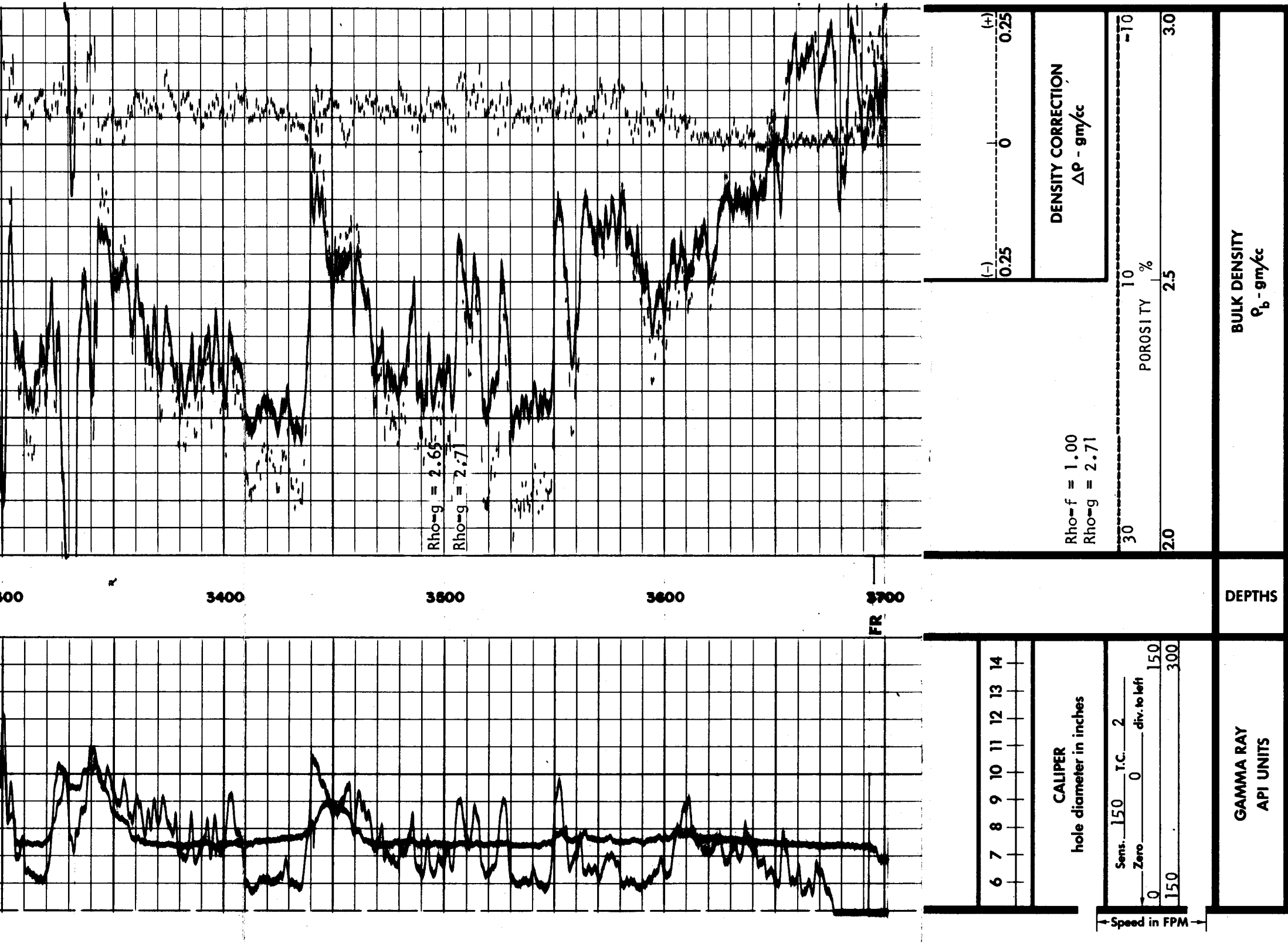
← Speed in FPM →

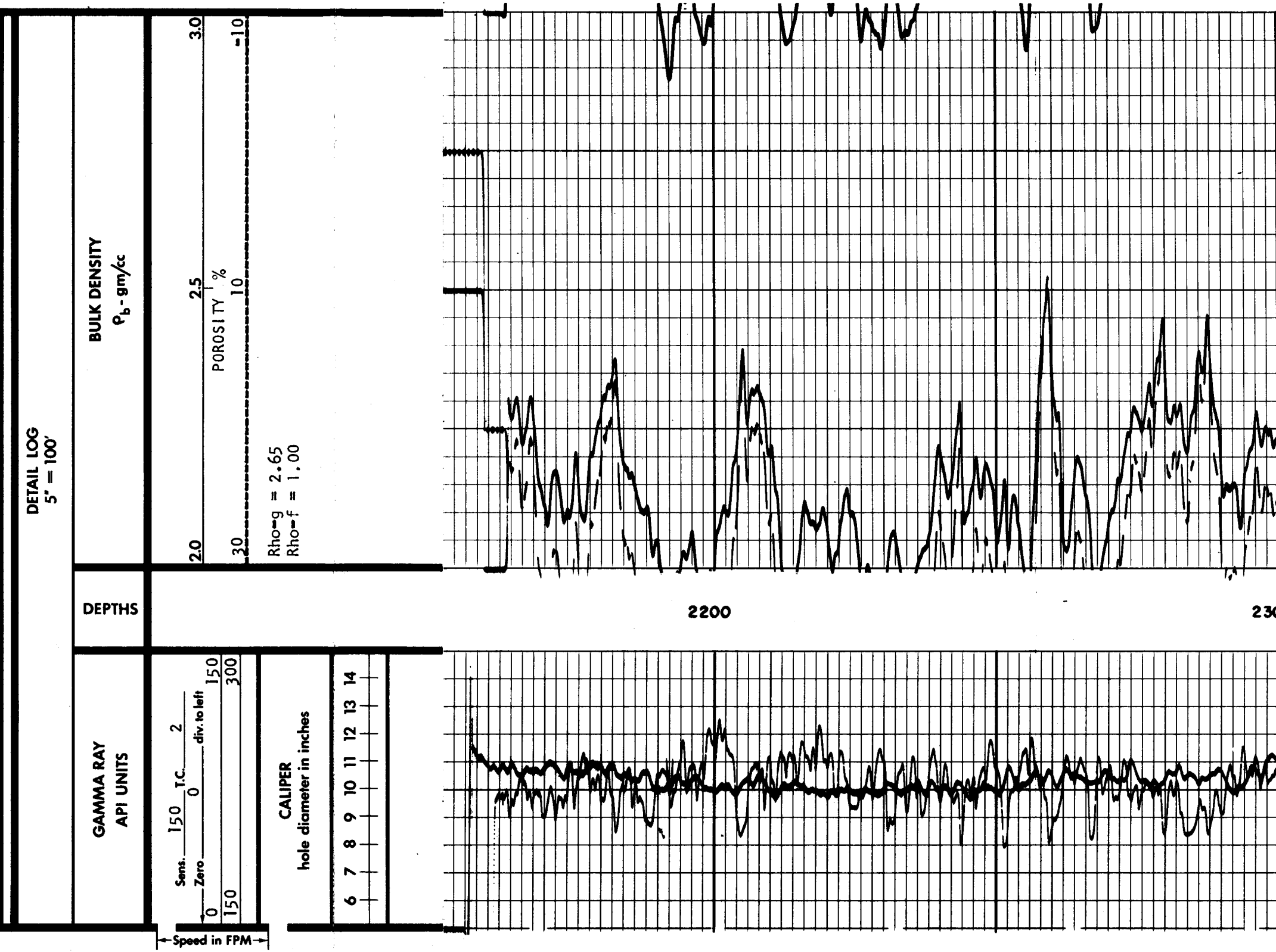
CALIPER
hole diameter in inches

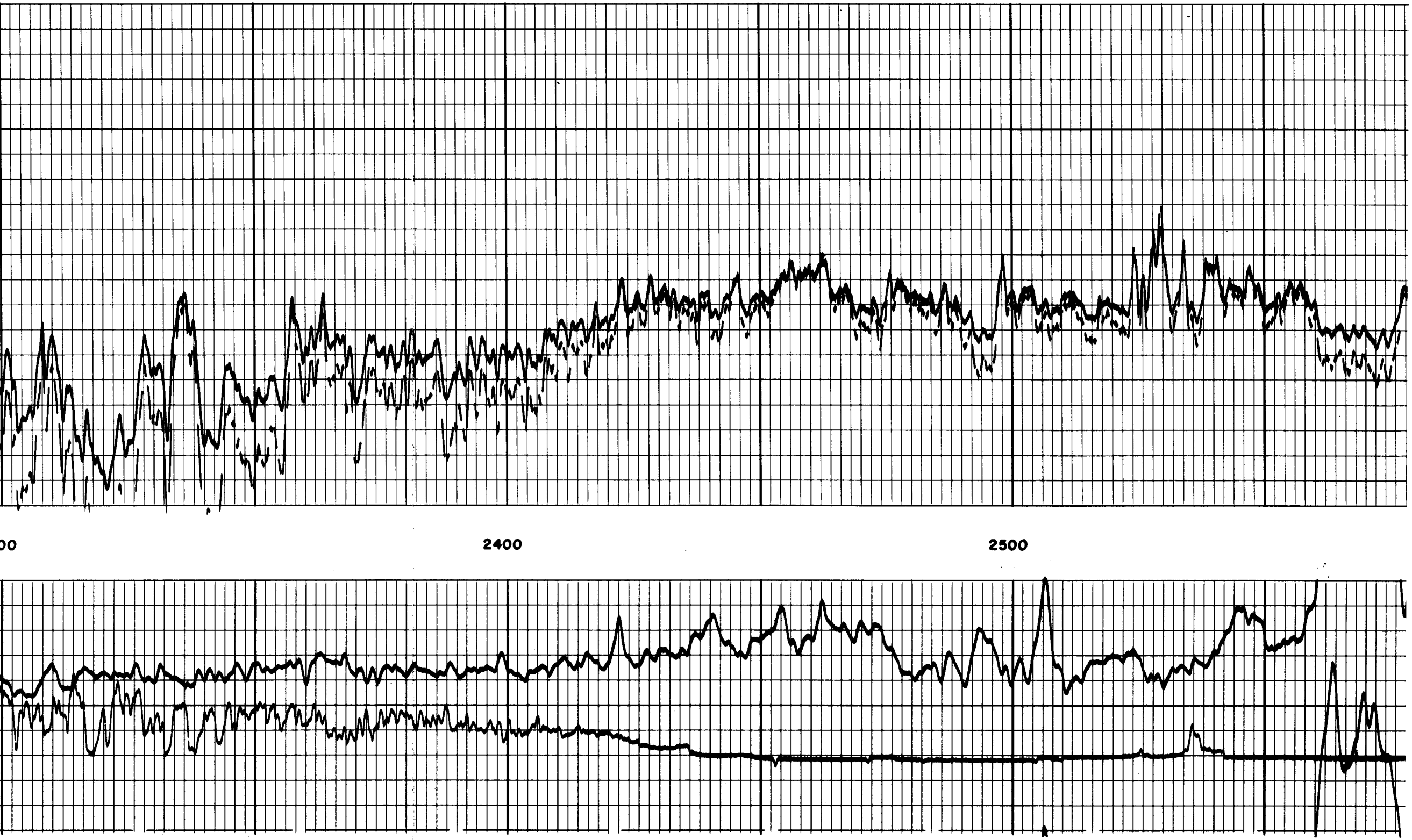
6 7 8 9 10 11 12 13 14

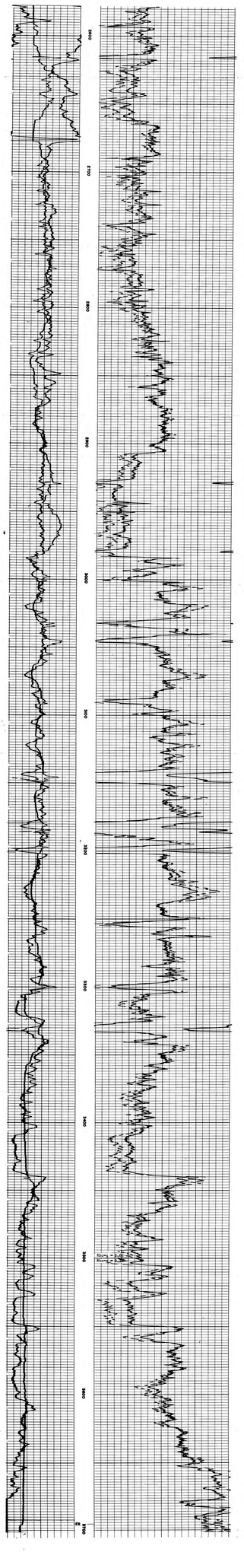




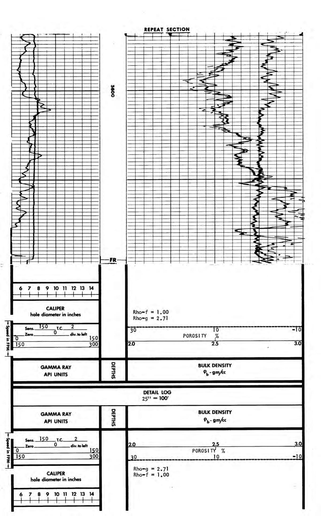




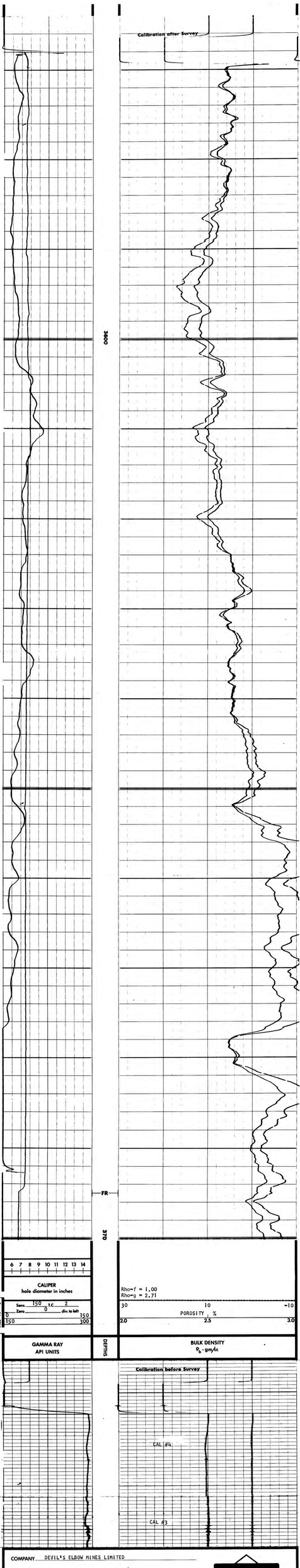




2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
3700
FR
Rhomg = 2.00
Rhomg = 2.70



REPEAT SECTION
3600
FR
6 7 8 9 10 11 12 13 14
CALIPER
hole diameter in inches
Sens 150 t.c. 2
Sens 0 dis. to left
150
150
300
GAMMA RAY
API UNITS
DEPTH
Rhomf = 1.00
Rhomg = 2.71
30
10
-10
POROSITY %
2.0
2.5
3.0
BULK DENSITY
ρ_b - gm/cc
DETAIL LOG
25" = 100'
GAMMA RAY
API UNITS
DEPTH
BULK DENSITY
ρ_b - gm/cc
Sens 150 t.c. 2
Sens 0 dis. to left
150
150
300
CALIPER
hole diameter in inches
6 7 8 9 10 11 12 13 14
2.0
2.5
3.0
POROSITY %
30
10
-10
Rhomg = 2.71
Rhomf = 1.00



COMPANY DEVIL'S ELBOW MINES LIMITED

WELL DEM ANKERTON SULPHUR 10-4-44-16

FIELD WILDCAT PROVINCE ALBERTA

SCHLUMBERGER

FIGURE 25

FIGURE 25

ADDENDUM TO CORE ANALYSIS REPORT
CORE LABORATORIES - CANADA LTD.

for

D.E.M. ANKERTON SULPHUR 10-4-44-16-W-4

by

J. C. Rowntree, B.Sc. (Wellsite Geologist)

A. C. A. HOWE INTERNATIONAL LIMITED

Samples for analysis were selected visually by the wellsite geologist. At the time of analysis, Core Laboratories-Canada Ltd., did not have the depths represented by the various sampling intervals. The following table relates the sample numbers with the depths K.B. in the well.

SAMPLE NUMBER	K.B. DEPTH REPRESENTED FEET	FOOTAGE REPRESENTED
1	3648.1 - 3648.6	0.5
1 AS	3648.6 - 3649.2	0.6
2 AS	3649.2 - 3649.4	0.2
2	3649.4 - 3649.6	0.2
3 AS	3649.6 - 3649.8	0.2
3	3649.8 - 3650.0	0.2
3	3650.0 - 3650.2	0.2
3 AS	3650.2 - 3650.3	0.1
4	3650.3 - 3651.0	0.7
4 AS	3651.0 - 3651.7	0.7
5 AS	3651.7 - 3651.9	0.2
5	3651.9 - 3652.1	0.2
6 AS	3652.1 - 3652.4	0.3
6	3652.4 - 3652.7	0.3
7 AS	3652.7 - 3653.0	0.3
7	3653.0 - 3653.4	0.4
8 AS	3653.4 - 3653.6	0.2
8	3653.6 - 3653.8	0.2
8 AS	3653.8 - 3654.0	0.2
9 AS	3654.0 - 3654.3	0.3
9	3654.3 - 3654.4	0.1
9 AS	3654.4 - 3654.6	0.2

FIGURE 26

CORE ANALYSIS REPORT

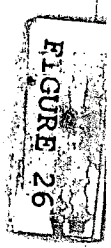
FOR

DEVIL'S ELBOW MINES LIMITED

DEM ANKERTON SULFUR 10-4-44-16

ANKERTON AREA

ALBERTA



CORE LABORATORIES - Canada Ltd.

Petroleum Reservoir Engineering

CALGARY - EDMONTON - REGINA

CORE LABORATORIES-CANADA LTD.
CALGARY ALBERTA

Company - DEVIL'S ELBOW MINES LIMITED
Well - DEM ANKERTON SULFUR 10-4-44-16
Field - ANKERTON AREA, ALBERTA
Location - LSD 10-4-44-16 W4M

Date Report - JULY 17, 1967
Formation - DEVONIAN
D. Fluid -
Analysis -

Page - 1 of 3
File - CNP-4-3753, CBH-2-1639
Analysts - MM RT RM CS
Remarks -

SAMPLE NUMBER	FOOTAGE REPRESENTED	PERMEABILITY TO AIR (HORIZONTAL) K MAX	K 90°	VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	DENSITY GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
CORE NO. 1 (not analyzed by request)											
CORE NO. 2 (Rec. 20.0') (6 boxes)											
-	11.3										Not analyzed by request
1	0.5	0.18	0.04	<0.01	1.4	1369.	2.69	2.73			Dried only
1		0.17	0.07	<0.01	1.8	1367.	2.68	2.73	0.15		After solvent extraction
1AS	0.6									0.19	
2AS	0.2									1.09	
2	0.2	0.12	0.12	<0.01	1.7	630.	2.67	2.72			Dried only
2		0.71	0.09	0.02	1.7	630.	2.68	2.73	0.00		After solvent extraction
3AS	0.2									0.3	
3	0.2	0.16	<0.01	<0.01	0.8	710.	2.59	2.62			Dried only
3	0.2	0.18	<0.01	<0.01	1.1	709.	2.70	2.73	0.14		After solvent extraction
3AS	0.1									3.03	

SAMPLE NUMBER	FOOTAGE REPRESENTED	PERMEABILITY TO AIR (HORIZONTAL) K MAX	K 90	VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	DENSITY GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
Core No. 2 (cont'd)											
4	0.7	7.1	5.9	<0.01	2.3	2116.	2.53	2.59			Dried only, shale brk. fracture
4		3890.	2650.	0.14	18.6	1830.	2.21	2.71	13.52		After solvent extraction
4AS	0.7									24.11	
5AS	0.2									7.79	
5	0.2	0.21	0.10	<0.01	0.7	748.	2.65	2.67			Dried only
5		480.	217.	0.02	9.3	701.	2.50	2.75	6.28		After solvent extraction
6AS	0.3									0.21	
6	0.3	14.	4.0	<0.01	3.3	571.	2.65	2.74			Dried only, shale brk. fracture
6		-	-	-	4.2	569.	2.66	2.78	0.35		After solvent extraction
7AS	0.3									0.11	
7	0.4	0.16	0.06	<0.01	2.9	1031.	2.72	2.80			Dried only
7		0.15	<0.01	<0.01	2.9	1029.	2.72	2.80	0.19		After solvent extraction
8AS	0.2									0.08	
8	0.2	0.12	0.06	<0.01	2.6	628.	2.67	2.74			Dried only
8		0.09	<0.01	<0.01	5.1	624.	2.66	2.80	0.64		After solvent extraction
8AS	0.2									0.08	

SAMPLE NUMBER	FOOTAGE REPRESENTED	PERMEABILITY TO AIR HORIZONTAL) K MAX	K 90) VERTICAL	POROSITY PER CENT	SAMPLE WEIGHT GRAMS	DENSITY BULK	DENSITY GRAIN	WEIGHT % SULPHUR BY CORE ANALYSIS	WEIGHT % SULPHUR BY ASSAY	VISUAL EXAMINATION
Core No. 2 (cont'd)										
9AS	0.3								0.09	
9 Small Plug	0.1	<0.01	<0.01	4.0	21.387	-	-			Dried only
9		0.1	-	4.5	21.376	-	-	0.05		After solvent extraction
9AS	0.2								0.09	

Excepting Sample 9, Full Diameter analysis was performed on approximately half of the represented sample interval before and after toluene vapor-phase extraction.

Remaining half of the represented interval was split vertically, and half of the resultant slab was used for assay purposes.