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PETROPHYSICAL EVALUATION 31/2-6

A complementary study to the 31/2 field

PRELIMINARY REPORT

Den norske stats oljeselskap a.s

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Gradering

Avdeling for Reservoarevaluering
Seksjon for Petroleumsteknologi

Oppdragsgiver

FELT

Undertittel

Petrophysical Evaluation

Tittel

PETROPHYSICAL EVALUATION 31/2-6

A complementary study to the 31/2 field

PRELIMINARY REPORT

Utarbeidet		Godkjent	
MAY 82	Urban Fält	9/82	

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1. INTRODUCTION

This report presents a preliminary evaluation of well 31/2-6 based on Waxman-Smits equation to calculate water saturation, and density log-core porosity correlation to calculate total porosity. As a basic concept the report of R. Dixon, Petrophysical Evaluaton, Quick look evaluation wells 1-5 31/2-block, 11.09.81 (reference 1) has been used to check parameters and zonings of the well. The log correlation for the wells in 31/2 block by Ø. Kirkhus and R. Nylend (foreløpig loggkorrelasjon i brønnene 31/2-1, 2, 3, 4, 5 og 6 Des. 1981) has been consulted for lithostratigraphical zoning and hydrocarbon contacts.

2. SUMMARY

The petrophysic study for the 31/2-6 well presented in this report is based on the log results and core analysis performed. The parameters used have been checked and cho~~o~~sen in accordance to those used in Reference (1). The total depth intervall studied is 1492-1750 m and includes a gas/oil zone with a net pay of 88.0 m in the interval 1492-1572 m. Below this interval the net pay obtained in the order of 4.75 m. The statistics for the whole interval and the main gas/oil zone are presented below. Table I (see also fig. 3-14).

TABLE I SUMMARY OF STATISTICS

	GAS 1492-1571.5	OIL 1571.5-1582	WATER 1582-1750
TOTAL DEPTH			
Thickness	79.5	10.5	168.0
Aver.phif	0.289	0.295	0.230
Sw	0.055	0.123	0.914
NET PAY			
Thickness	77.5	10.5	4.75
Aver.phif	0.295	0.295	0.193
Aver.Sw	0.056	0.123	0.590
NET SAND			
Thickness	77.5	10.5	157.75
Aver.phif	0.295	0.295	0.240
Aver.Sw	0.056	0.123	0.946
NET/GROSS			
Hnpay/HGsand	0.975	1.0	0.028
Hnsand/HGsand	0.975	1.0	0.939
Hnpay/Hnsand	1.0	1.0	0.030

3. GEOLOGY 31/2-6

3.1 General

A lithostratigraphical study has been performed by O. Kirkhus and R. Nylend (reference 2). It is mainly based on ISF/SONIC/GR but also on other logs and coredata.

31/2-6 contains a hydrocarbon reservoir in the Sogn formation which is related to the lithostratigraphical zoning described in fig. 1.

NB!

Den litostratigrafiske inndelingen er senere endret.

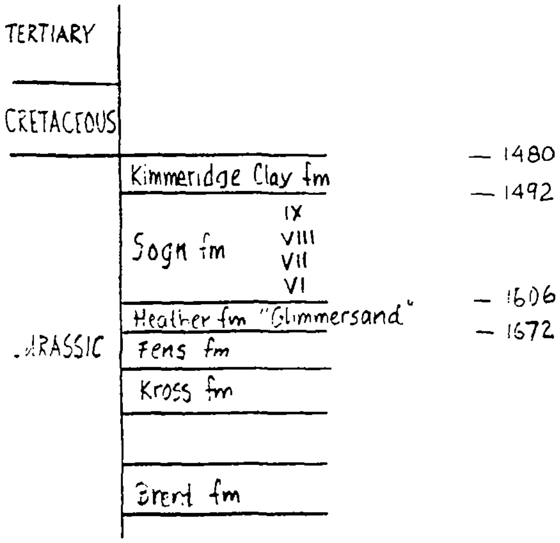


FIG. 1 31/2-6

The Sogn formation can be zoned in five different parts. In well 31/2-6 only four zones are possible to separate (VI, VII, VIII and IX). The zone VI contains a sandstone of fine to medium grain size. (GR 40-50 API). Some coarser beds appear. Mica is present. The upper part of VI is coarser, medium to coarse clean sandstone. The sand is unconsolidated. The thickness of zone VI is max. 110 m. Above zone VI there are at least three more units which are characterized by unconsolidated fine to coarse sand. The formation borders above to the Kimmeridge clay, a dark, organic shale (10-12 m) and in the bottom to the Glimmer sand, a fine grained sandstone (siltstone) with high content of mica with a characteristic GR anomaly of 60-80 API.

3.2 Hydrocarbon contacts

Hydrocarbon shows have been observed on cores:

Gas "shows"	1504 - 1566 m
Oil "shows"	1509 - 1580 m
Oil stain	1569 - 1580 m

Two tests have been performed in two zones.

1571.4 - 1582.2	OIL
1492 - 1571.4	GAS

The FDC/CNL log suggest a gas-oil contact (GOC) at 1571.5 m and the ILD/SFL and FLL/MSFL indicate a oil water contact (OWC) at 1582 m. The lithology is fairly homogen in the reservoir and core data and production tests confirm the hydrocarbon contacts.

3.3 Conclusions

The studied interval contains three different units, the Kimmeridge Clay, the Sogn formation and the Glimmer sand. The hydrocarbon reservoir is situated in the Sogn formation and has an approximate thickness of 90 m (1492 - 1582 m). The lithology is fairly homogen and consists of an unconsolidated sandstone with presence of mica.

4. Petrophysical Evaluation 31/2-6

4.1 General

The method used for evaluation of 31/2-6 is based on the Waxman-Smit's equation for shaly-sand. The presence of clay provides and electrically conductive path in addition to that formed by the brine in the pores of the rock. The resistivity of a sand under these conditions will be lower than if no clays were present. The presence of hydrocarbons in clayey sand will further complicate the conductive phenomenon. If a clean sand approach was to be used under these circumstances this would result in a pessimistic interpretation with too high water saturations.

The Waxman - Smith's equation can be written

$$S_w^{n^*} = \frac{F^* R_w}{R_t (1 + R_w B Q_v / S_w)} \qquad (1)$$

and

$$F^* = a^* \phi^{-m^*} \qquad (2)$$

$$F^* = F (1 + R_w B Q_v) \qquad (3)$$

$$Q_v = \frac{CEC (1-\phi) RHOMA}{\phi \, 100} \qquad (4)$$

The clay activity is measured in laboratory as the cation exchange capacity (CEC). It affects the resistivity to be more suppressed as if no clay was present. With increasing CEC the resistivity will be more suppressed. The type of clay is important i.e. a small quantity of montmorillonite will influence the log response more than a large quantity of kaolinite (low active clay). If CEC is known together with matrix density (RHOMA) and porosity, QV can be calculated according to equation (4). Qv is the cation exchange capacity per unit total pore volume. Qv may also be calculated by using the empirical relationship:

$$Qv = C\ \phi^{-E} \qquad (5)$$

where C and E are obtained by crossplotting Qv vs DPOR.

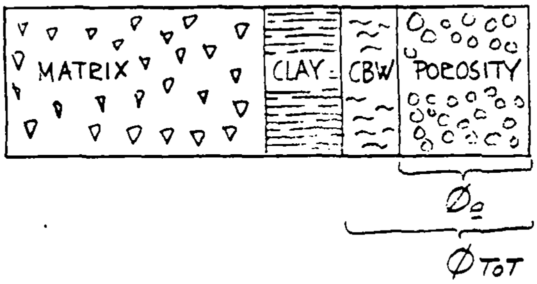
According to ref.1 the constant C is dependent on the nature of the mineral content in the formation. If the mineral content changes, this will affect the cation exchange capacity and a family of curves will be obtained which may be characterized by the constant C.

In the well 31/2-6 no measurement of CEC (cation exchange capacity) were available. The value of Qv has been determined from the relationship established in eqn. (5) based on average determined values of the constants C and E from cross plots of Qv versus porosity in wells 31/2-1, 2, 3 and 5. The equation has the following form:

$$Qv = 0.00317\ \phi^{-3.63} \qquad (6)$$

According to the geologists the Sogn formation, contianing the reservoir, is relatively uniformly developed with rock characterishes fairly constants. There might be changes within the formation but, as a first approximation, it may be assumed that the cation exchange capacity relationship as shown in eqn (6) holds true for 31/2-6. (see reference).

In the Waxman-Smit's equation for water/saturation the total porosity is used. The difference between total porosity and effective porosity is the amount of clay-bound water (CBW) which affects the electric conductivity of the formation but does not contribute to the hydraulic transmissibility or producibility. Fig. 2 shows schematicly the concept of the rock construction.



Total porosity Ø tot, is the pore space available for fluids, including clay bound water.

Effective porosity, Øe, is the pore space avaiable for fluids ie $\emptyset_{tot}$ minus the fraction of the bulk volume occupied by CBW.

$$\emptyset e = \emptyset_{tot} - CBW \qquad (7)$$

where CBW is the water unmobilised by the clay present in the formation. Øe can be calculated according to the equation (8) (see reference 1).

$$\emptyset e = \emptyset_{tot} - CBW = \emptyset_{tot} \left(1-(0.084S^{-0.5}+0.22)Qv \frac{1}{\rho_{CBW}}\right) \qquad (8)$$

where S is the salinity of the formation water in Meq/cm^3 an ρ_{CBW} is the density of CBW which may be assumed to be unity.

The evaluation of 31/2-6 were based on the following selected parameters and applied corrections of the log readings.

Deep laterolog resistivity, RLLD, was used in the hydrocarbon zone corrected to true resistivity, R_t, by the Statoil inhouse program, RES-CORR-I, which corrects the resistivity for invasion using the tornado chart. In the water zone the uncorrected induction resistivity was used.

Neutron porosity, CNL, was corrected for lithology by 0.04 pu.

The parameters used in the evaluation are tabled in section 6. Table VII.

The creteria for Waxman-Smit approach were found to be fullfield according to

a) Salininity of formation water > 30.000 ppm
b) RwBQv > 0.1.

4.2 Estimation of RHOMA RHOFL and POROSITY

The Gamma ray log was used to separate mica sand from clean sand at the GR-value of 55 API. Fig. 14

Calculations of RHOFL for 31/2-6 have been made using cross-plots of depth matched core porosities corrected for overburden vs FDC. Fig. 15 - 19.

The basic equation is

$$\phi = \frac{\rho_{ma} - \rho_b}{\rho_{ma} - \rho_{fl}} \qquad (9)$$

where ρma is taken to 2.65 g/cc in clean sand and 2.67 g/cc in mica sands based on core data. ρ_b is the logreading from the FDC and $\emptyset$ is the core porosity corrected for overburden. Following ρ_{ma} and ρ_{fl} values were used in the evaluation. Table II.

TABLE II

	ρ_{ma}	ρ_{fl}
Mica gas sand	2.67	0.53
Clean gas sand	2.65	0.49
Mica oil sand	2.67	-
Clean oil sand	2.65	0.77
Mica water sand	2.67	0.90
Clean water sand	2.65	0.95

4.3 Porosity

The values above of ρ_{fl} involves overburden correction and the final porosity calculation based on these data will include heavy mineral effect and hydrocarbon effect. The total porosity calculated in this way is assumed to be close to the effective porosity due to the fact that VSH is close to zero. The basic equation used is

$$\emptyset_T = \frac{\rho_{ma} - \rho_b}{\rho_{ma} - \rho_{fl}} \qquad (9)$$

The values of ρfl used in the evaluation according to reference I have not been corrected for overburden effect. This correction is made in a later stage on the phif porosity.

4.4 Core porosity

Measurements of the core porosity ~~was~~ were performed on frozen cores. The usually used helium porosity is not applicable under these circumstances. Instead brine porosity was measured. The relation between helium porosity and brine porosity has been checked in wells from 34/10-field. According to these studies the brine porosity is 1-1.5 porosity units lower than the helium porosity. This should be kept in mind whenever future frozen core analyses is taken. Until same plug core saturation and helium porosity measurements are available, this saturation porosity data cannot be quantified in the analysis.

Core porosity is presented in table III.

4.5 Porosity at overburden conditions

Studies of overburden pressures have been made in the wells 31/2-1, 2, 3 and 5. Porosity has been measured at different pressures in a hydrostatic coreholder.

Net confining pressure was calculated to 2300 psi. A poissons ratio of $\nu = 0.3$ was assumed resulting in a laboratory net confining pressure of 1426 psi or 100 kg/cm^2. The method based on Shells concept has been used. The overburden reduction factor on core porosity was found to be 0.9165.

Average final porosity is presented in table IV and the realtion of log derived porosity to uncorrected and corrected core porosity is shown in table V.

A cross plot of overburden corrected core porosity versus phif showed an acceptable agreement. Se fig. 24.

4.6 Formation water resistivity

A check for formation water resistivity was performed. Due to bad SP-deflection, Rw was checked using porosity log vs a function of true resistivity ($1/\sqrt{R_t}$). True resistivity was taken in the water zone from the uncorrected induction resitivity log. Plots of $1/\sqrt{R_t}$ vs phin and $1/\sqrt{R_t}$ vs rhob were constructed. Fig. 20 - 23.

Following Rw values were obtained

phin vs		Rw = 0.080
phin vs	GR<55	Rw = 0.078
rhob vs		Rw = 0.063
rhob vs	GR<55	Rw = 0.055

The Rw value used in this study corresponds to that found in reference 1 ie 0.06 Ωm (se fig. 33-36).

4.7 FWS, a* and m*

Based on studies in 31/2-1, 2, 3, 5 and 6 the average realtion of formation factor and porosity follows the expression:

$$F^* = 0.94\ \emptyset^{-2.13}$$

at atmospheric conditions

Studies at overburden conditions in the wells 31/2-1, 2, 3 indicates a relation of

$$F^* = 0.97\emptyset^{-2.08}$$

which will be applied in the evaluation of 31/2-6

The equation above is based on the expression

$$FWS = F^* = F\ (1 + RwBQv)$$

where

B is calculated according to equation

$$B = \frac{-1.28 + 0.255T - 0.0004059\,T^2}{1 + R_w^{1.23}\,(0.045T - 0.27)} \quad [mhom^{-1}/meq\,cm^{-3}]$$

with T in $^{\circ}$C and Rw = 0.06

F has been corrected for overburden pressure by a factor of 1.23 ,which was found to correct for the overburden effect in 31/2-1, 2 and 3.

4.8 Qv-Ø relationship

Cation -exchange capacity, CEC, has been measured on cores from wells 31/2-1,2,3 and 5. Calculation of Qv was made by applying the equation

$$Qv = \frac{CEC\,(1-\phi)\,\rho_{ma}}{100 \cdot \phi} \qquad (4)$$

By cross-plotting Qv versus Øcore the empirical equation was solved for the constants C and E

$$Qv = C\ \phi^{-E} \qquad (5)$$

Average values on C and E were

$C = 0.00317$

$E = 3.63$

and are used in the evaluation of 31/2-6

4.9 Permeability

Permeability from logs were derived from a regression (reduced) technique of log determined porosities to measured permeabilities in the cored section of the well. Data has also been studied from other wells in the 31/2-field. The resulting expressions are differentiated between mica sand and clean sand by use of the gamma ray log at 55 API. In this way permeabilities in the uncored interval of the well may be estimated.

In order to differentiate between mica sand and clean sand it was also found practical to study the different geological units. The resulting expressions then will reflect the permeabilities in the different geological zones and on the clean and mica rich sandstone. In table VI the relation obtained can be seen.

The relations are found to fit the core permeability with an acceptable accuracy, and can be used to predict permeability in the uncored intervals. Due to the complexity of the permability relations it will be impossible to obtain a perfect fit based on porosity only.

The bottom interval 1654-1750 m which is the glimmersand and the Fens formation are characterized by a high GR and a lowering in the porosity compared to the Sogn formation and would consequensly have a lower permeability. Studies of core data in 31/2-1, 3 and 4 will give a possibility to perform correlations between log derived permeability and core permeability. From the log data and geological indication it was found that the results from 31/2-3 and 4 could be used in 31/2-6. These wells are close to 31/2-6 (31/2-3 approximately 7,5 km) and as an approximately relation for the Glimmersand and Fens Formation the results from 31/2-4 was choosen.

No simple relation for describing - the permability derived from logs could be found. Instead a number of realtions are performed which describes the complexity of the permability problem.

Log derived permeability is presented in table VI. A comparance of log dervied permeability to core permeability is shown in fig. 25.

5. Water saturation

In the hydrocarbon zone, 1492-1582 m, the dual laterolog (RLLD), corrected for invasion has been used as Rt. In the water zone deep induction (RILD) (uncorrected) has been used.

Water saturation was calculated from Waxman-Smits equation by employing the Statoil inhouse computer system.

$$S_{wt} = \left[\frac{R_t \left(1 + R_w B Q_v / S_{wt}\right)}{a \, \phi_t^{-m^*} R_w} \right]^{-\frac{1}{n^*}} \qquad (11)$$

Average watersaturation is presented in table IV.

6. Parameters and constants used in the evaluation 31/2-6

TABLE VII

Parameters used in 31/2-6

FT	101
ρma, clean	2.65
ρma, mica	2.67
ρfl, gas, clear	0.49
ρfl, gas, mica	0.53
ρfl, oil, clean	0.77
ρfl, water, clean	0.95
ρfl, water,clean	0.90
Rm	0.108
Rmf	0.098
Rmc	0.230
Rw	0.06
Bit Size	12.25
a*	0.97
m*	2.08
n*	2.0
B	6.448
C	0.00317
E	3.63

7. Results

The selected input parameters were checked in 31/2-6 in accordance to the results based on the evaluation of wells 1-5 in the 31/2-block (ref.1). The results of the evaluation consists of the output curves phif, sw, net pay, net sand, net to gross ratios.

The statistics for the total interval and specified intervalls defined by fluid characteristics and lithology are shown in figures . The cut off values used are : phif < 0.12 and Sw > 0.65.

The results are shown in tables III, IV, V and VI. The Statistics for 31/2-6 by units and hydrocarbon zones are presented in figures 4 - 13.

8. Conslusions/Recommendations

The evaluation of 31/2-6 has been performed by use of the Waxman-Smits method, which assumes a sand/shale formation with no or small changes in shale type and distribution and the fact that the measured conductivity is affected by the presence of shale which increases the conductivity. The model is based on a conductance of free electrolyte (formation water) and clay exchange cations (CEC or Qv) in paralell, i.e $Co = \frac{1}{F^*}(Cw + BQv)$ where Co is the electrical conductivity of a shaly sand, Cw = formation water conductivity and BQv = conductivity of the clay exchange cations. If the formation water resistivity is low this means that the electrical conduction is dominated by the term CW in the equation above and the term BQv is less significant. The geologic evaluation indicates that the shale content in the formation is of minor importance. The presence of mica seems to be more important. It is recommended that further studies are made to evaluate the properties involved and the limitation and assumptions of the Waxman-Smits model in the 31/2 field.

Since the salinity of the formation water is high (70.000-80.000 ppm) the Waxman-Smits method could be replaced by a general Water-saturation equation. As some general rule one could say that if the salinity is more than 35.000-40.000 ppm the above statement may hold true.

The cr~~e~~iteria of RwBQv can be used as an indicator of method to be approached. If $RwBQv > 0.1$ the effect of CBW will be significant and Waxman-Smit approach should be used of $RwBQv < 0.1$ a water saturation formula of Archie could be used.

References

1) Dixon, Robert Quick look evaluation wells 1-5 31/2 block Statoil 11.09.81

2) Kirkhus/Nylend Foreløpig loggkorrelasjon i brønnene 31/2-1, 2, 3, 4, 5 og 6. DES 1981 Statoil

3) Waxman M.H. and Smits Electrical conductivities in OIl-Bearing, Shaly Sands, SOC of P.E.J. June 1968

4) Keelan D.K. and Mc Ginley D.C. Application of cation exchange capacity in a study of the shannon sand of Wyoming SPWLA June - 71.

5) Waxman, M.H. and Thomson E.C. Electrical conductivities in shaly sands SPE paper 4094, 1972.

6) Juhasz I. The central role of Qv and formation water salinity in the evaluation of shaly formations SPWLA June 3-6 1979.

7) Geco Conventional core analysis well 31/2-6 core 1-9.

8) van Benten J.A. Investigation of cores from well 31/2-1, Norway part I. Petrophysical properties of core samples. KSEPL, HAAG HOLLAND, july 1980.

TABLE III AVERAGE VALUES OF GRAIN DENSITY, CORE POROSITY AND CORE PERMEABILITY FOR NET PAY INTERVALS BY UNIT

	UNIT 4	5	6	7	8	9
GRAIN DENSITY g/cc			2.568*	2.646	2.627*	
CORE POROSITY			0.308*	0.316	0.302*	
HORISONTAL PERMEABILITY			6562.6* 1073.9* 2.9*	5788.3 1169.0 5.6	3583.1* 302.9* 94.7*	
VERTICAL PERMEABILITY			4226.5* 1522.0* 17.9*	1329.8 124.5 18.5		
VERTICAL TO HORISONTAL PERMEABILITY			0.64* 1.42* 6.17*	0.23 0.11 3.3		

* part of unit

TABLE IV AVERAGE LOG DERIVED POROSITY, PERMEABILITY AND WATER SATURATION FOR NET PAY INTERVALS BY UNIT

	UNIT 4	5	6	7	8	9
AVERAGE LOG POROSITY	0.174	0.198	0.296	0.299	0.273	0.291
LOG DERIVED PERMEABILITY						
Karitm	42,2	2.6	7936.7	7212.8	1749.2	2473.3
Kgeom	7.4	1.3	1025.6	1364.5	148.6	485.3
Kharm	2.0	1.0	13.1	50.2	4.3	26.8
WATER SATURATION	0.5[illegible]4	0.772	0.096	0.051	0.093	0.069

TABELL V

Relationship between log derived porosity and uncorrected core porosity

$PHIF = 0.885\ \phi_{core} + 0.014$	$R^2=0.44$	Reduced regression

Relationship between log derived porosity and corrected core porosity

$PHIF = 0.966\ \phi_{core} + 0.014$	$R^2=0.44$	Reduced regression

TABLE VI LOG DERIVED PERMEABILITY 31/2-6

THE TABLE PRESENTS THE CONSTANTS A AND B
IN THE REALTION

$$\log (\mathrm{KLOGH}) = A\ \mathrm{pHIF} - B$$

		UNIT 4	5	6	7	8	9
clean sand GR < 55 API	A			23.94*[1] 20.57	17.87		
	B			3.55*[1] 2.57	1.75		
Mica sand GR>55 API	A	16.09	15.04	22.04	26.31	24.79	24.79
	B	2.77	3.02	3.84	5.28	4.61	4.61

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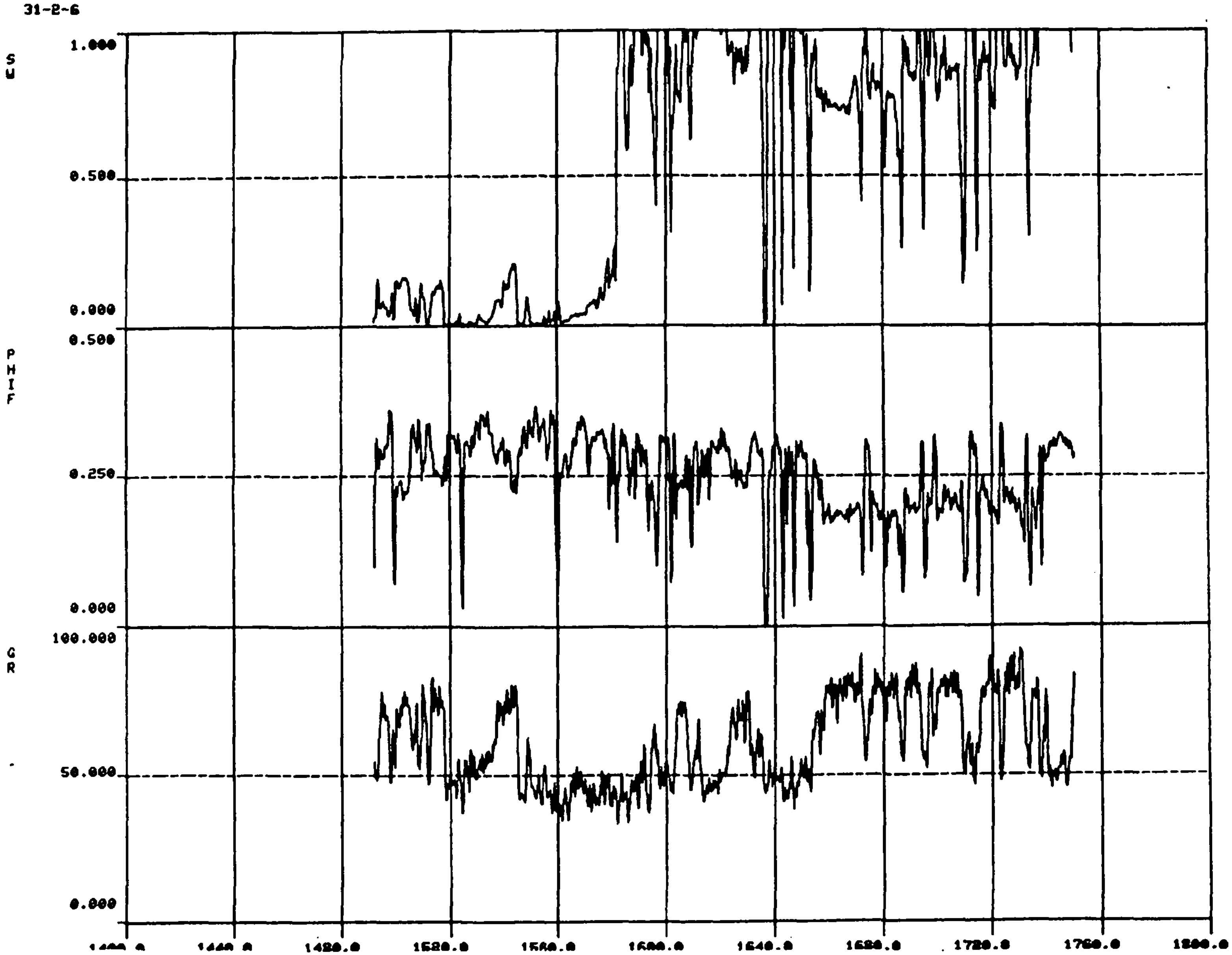
*[1] for depth interval 1545-1604



[illegible] 3 GR,PHIF,SW 31/2-6

```
NB!!!  CALCULATIONS MAY TAKE SOME TIME!!!!!!



 S T A T I S T I C S
*********************

FIELD: . . . . . . . . . .              31-2
WELL:  . . . . . 10.19.47.
ENGINEER: . . . . . . . . . UF

DEPTH INTERVAL:  . . .  1492.00 TO  1750.00
APPLIED CUTOFFS:
.              USH:  GREATER THAN       0.40
.             PHIF:     LESS THAN       0.12
.               SW:  GREATER THAN       0.65


 T O T A L   D E P T H
*******************************************
THICKNESS: . . . . . . . . .     258.000
AVERAGE  . . . 'PHIF'  . . .       0.251
AVERAGE  . . . 'VSHALE'  . .       0.000
AVERAGE  . . . 'SW'  . . . .       0.617
W.AVERAGE  . . 'SW' * 'PHIF'       0.595
AVERAGE  . . . 'SH'  . . . .       0.410
VOID VOLUME: . . . ('PHIF').      64.768
HC VOID VOLUME . . ('SH'*) .      28.266
RES HC VOID VOLUME ('SHR'*).      15.267
MOV HC VOID VOLUME . . . . .      12.999
*******************************************


 N E T    P A Y
*******************************************
THICKNESS: . . . . . . . . .      92.750
AVERAGE  . . . 'PHIF'  . . .       0.290
AVERAGE  . . . 'VSHALE'  . .       0.000
AVERAGE  . . . 'SW'  . . . .       0.091 ×
W.AVERAGE  . . 'SW' * 'PHIF'       0.078
AVERAGE  . . . 'SH'  . . . .       0.909
VOID VOLUME: . . . ('PHIF').      26.857
HC VOID VOLUME . . ('SH'*) .      24.763
RES HC VOID VOLUME ('SHR'*).      10.931
MOV HC VOID VOLUME . . . . .      13.831
*******************************************
.

 N E T   S A N D
*******************************************
THICKNESS: . . . . . . . . .     245.750
AVERAGE  . . . 'PHIF'  . . .       0.260
AVERAGE  . . . 'VSHALE'  . .       0.000
AVERAGE  . . . 'SW'  . . . .       0.630
W.AVERAGE  . . 'SW' * 'PHIF'       0.597
AVERAGE  . . . 'SH'  . . . .       0.401
VOID VOLUME: . . . ('PHIF').      63.851
HC VOID VOLUME . . ('SH'*) .      27.729
RES HC VOID VOLUME ('SHR'*).      14.529
MOV HC VOID VOLUME . . . . .      13.201
*******************************************

 N E T / G R O S S    R A T I O S
*******************************************

HNETPAY /HGROSS SAND =  0.35950
HNETSAND/HGROSS SAND =  0.95252
HNETPAY /HNETSAND    =  0.37742
*******************************************

VIL DU KJ\RE NY STATISTIKK P] ANNET DYBDE-INTERVALL?
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FIG 4   STATISTICS TOTAL INTERVAL 31/2-6

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NB!!! CALCULATIONS MAY TAKE SOME TIME!!!!!!


 S T A T I S T I C S
*********************

FIELD: . . . . . . . . . .                 31-2
WELL:  . . . . . 10.21.25.
ENGINEER:. . . . . . . . . UF

DEPTH INTERVAL:  . . .  1492.00 TO  1498.00
APPLIED CUTOFFS:
.               USH:  GREATER THAN      0.40
.              PHIF:     LESS THAN      0.12
.                SW:  GREATER THAN      0.65

 T O T A L    D E P T H
*******************************************
THICKNESS: . . . . . . . . .        6.000
AVERAGE  . . . 'PHIF'  . . .        0.283
AVERAGE  . . . 'VSHALE'  . .        0.000
AVERAGE  . . . 'SW'  . . . .        0.066
W.AVERAGE  . . 'SW' * 'PHIF'        0.067
AVERAGE  . . . 'SH'  . . . .        0.934
VOID VOLUME: . . . ('PHIF').        1.700
HC VOID VOLUME . . ('SH'*) .        1.585
RES HC VOID VOLUME ('SHR'*).        0.616
MOV HC VOID VOLUME . . . . .        0.970
*******************************************

 N E T     P A Y
*******************************************
THICKNESS: . . . . . . . . .        5.750
AVERAGE  . . . 'PHIF'  . . .        0.291
AVERAGE  . . . 'VSHALE'  . .        0.000
AVERAGE  . . . 'SW'  . . . .        0.069
W.AVERAGE  . . 'SW' * 'PHIF'        0.068
AVERAGE  . . . 'SH'  . . . .        0.931
VOID VOLUME: . . . ('PHIF').        1.676
HC VOID VOLUME . . ('SH'*) .        1.561
RES HC VOID VOLUME ('SHR'*).        0.595
MOV HC VOID VOLUME . . . . .        0.966
*******************************************
.
 N E T     S A N D
*******************************************
THICKNESS: . . . . . . . . .        5.750
AVERAGE  . . . 'PHIF'  . . .        0.291
AVERAGE  . . . 'VSHALE'  . .        0.000
AVERAGE  . . . 'SW'  . . . .        0.069
W.AVERAGE  . . 'SW' * 'PHIF'        0.068
AVERAGE  . . . 'SH'  . . . .        0.931
VOID VOLUME: . . . ('PHIF').        1.676
HC VOID VOLUME . . ('SH'*) .        1.561
RES HC VOID VOLUME ('SHR'*).        0.595
MOV HC VOID VOLUME . . . . .        0.966
*******************************************

 N E T / G R O S S     R A T I O S
******************************************

HNETPAY /HGROSS SAND =  0.95833
HNETSAND/HGROSS SAND =  0.95833
HNETPAY /HNETSAND    =  1.00000
******************************************

VIL DU KJ\RE NY STATISTIKK P] ANNET DYBDE-INTERVALL?
```

FIG 5.   STATISTICS   UNIT IX

```
NB!!!  CALCULATIONS MAY TAKE SOME TIME!!!!!!


 S T A T I S T I C S
*********************

FIELD: . . . . . . . . . .              31-2
WELL:  . . . . . 10.21.49.
ENGINEER:. . . . . . . . . . UF

DEPTH INTERVAL:  . . .  1498.00 TO  1518.00
APPLIED CUTOFFS:
.             VSH:  GREATER THAN       0.40
.            PHIF:     LESS THAN       0.12
.              SW:  GREATER THAN       0.65

 T O T A L    D E P T H
******************************************
THICKNESS: . . . . . . . . . .     20.000
AVERAGE  . . . 'PHIF'  . . .        0.268
AVERAGE  . . . 'VSHALE'  . .        0.000
AVERAGE  . . . 'SW'   . . . .       0.096
W.AVERAGE  . . 'SW' * 'PHIF'        0.091
AVERAGE  . . . 'SH'   . . . .       0.904
VOID VOLUME: . . . ('PHIF').        5.365
HC VOID VOLUME . . ('SH'*) .        4.878
RES HC VOID VOLUME ('SHR'*).        2.283
MOV HC VOID VOLUME . . . . .        2.595
******************************************

 N E T    P A Y
******************************************
THICKNESS: . . . . . . . . . .     19.500
AVERAGE  . . . 'PHIF'  . . .        0.273
AVERAGE  . . . 'VSHALE'  . .        0.000
AVERAGE  . . . 'SW'   . . . .       0.098
W.AVERAGE  . . 'SW' * 'PHIF'        0.091
AVERAGE  . . . 'SH'   . . . .       0.902
VOID VOLUME: . . . ('PHIF').        5.323
HC VOID VOLUME . . ('SH'*) .        4.837
RES HC VOID VOLUME ('SHR'*).        2.245
MOV HC VOID VOLUME . . . . .        2.592
******************************************
 -
 N E T    S A N D
******************************************
THICKNESS: . . . . . . . . . .     19.500
AVERAGE  . . . 'PHIF'  . . .        0.273
AVERAGE  . . . 'VSHALE'  . .        0.000
AVERAGE  . . . 'SW'   . . . .       0.098
W.AVERAGE  . . 'SW' * 'PHIF'        0.091
AVERAGE  . . . 'SH'   . . . .       0.902
VOID VOLUME: . . . ('PHIF').        5.323
HC VOID VOLUME . . ('SH'*) .        4.837
RES HC VOID VOLUME ('SHR'*).        2.245
MOV HC VOID VOLUME . . . . .        2.592
******************************************


 N E T / G R O S S    R A T I O S
*****************************************

HNETPAY /HGROSS SAND =  0.97500
HNETSAND/HGROSS SAND =  0.97500
HNETPAY /HNETSAND    =  1.00000
*****************************************

VIL DU KJ\RE NY STATISTIKK PJ ANNET DYBDE-INTERVALL?
```

FIG 6.   STATISTICS   UNIT VIII

```
NB!!!  CALCULATIONS MAY TAKE SOME TIME!!!!!!



 S T A T I S T I C S
*********************

FIELD: . . . . . . . . . . .                 31-2
WELL:  . . . . . 10.22.17.
ENGINEER:. . . . . . . . . . UF

DEPTH INTERVAL:  . . .  1518.00 TO  1545.00
APPLIED CUTOFFS:
.               VSH:  GREATER THAN       0.40
.              PHIF:     LESS THAN       0.12
.                SW:  GREATER THAN       0.65

 T O T A L   D E P T H
*****************************************
THICKNESS: . . . . . . . . .       27.000
AVERAGE  . . . 'PHIF'  . . .        0.294
AVERAGE  . . . 'VSHALE'  . .        0.000
AVERAGE  . . . 'SW'  . . . .        0.050
W.AVERAGE  . . 'SW' * 'PHIF'        0.047
AVERAGE  . . . 'SH'  . . . .        0.950
VOID VOLUME: . . . ('PHIF').        7.944
HC VOID VOLUME . . ('SH'*) .        7.572
RES HC VOID VOLUME ('SHR'*).        3.144
MOV HC VOID VOLUME . . . . .        4.428
*****************************************

 N E T    P A Y
*****************************************
THICKNESS: . . . . . . . . .       26.500
AVERAGE  . . . 'PHIF'  . . .        0.299
AVERAGE  . . . 'VSHALE'  . .        0.000
AVERAGE  . . . 'SW'  . . . .        0.051
W.AVERAGE  . . 'SW' * 'PHIF'        0.047
AVERAGE  . . . 'SH'  . . . .        0.949
VOID VOLUME: . . . ('PHIF').        7.917
HC VOID VOLUME . . ('SH'*) .        7.545
RES HC VOID VOLUME ('SHR'*).        3.117
MOV HC VOID VOLUME . . . . .        4.428
*****************************************

 N E T    S A N D
*****************************************
THICKNESS: . . . . . . . . .       26.500
AVERAGE  . . . 'PHIF'  . . .        0.299
AVERAGE  . . . 'VSHALE'  . .        0.000
AVERAGE  . . . 'SW'  . . . .        0.051
W.AVERAGE  . . 'SW' * 'PHIF'        0.047
AVERAGE  . . . 'SH'  . . . .        0.949
VOID VOLUME: . . . ('PHIF').        7.917
HC VOID VOLUME . . ('SH'*) .        7.545
RES HC VOID VOLUME ('SHR'*).        3.117
```

```
MOV HC VOID VOLUME . . . . .        4.428
*****************************************

 N E T / G R O S S    R A T I O S
****************************************

HNETPAY /HGROSS SAND =  0.98148
HNETSAND/HGROSS SAND =  0.98148
HNETPAY /HNETSAND    =  1.00000
****************************************

VIL DU KJ\RE NY STATISTIKK PJ ANNET DYBDE-INTERVALL?
```

FIG 7.   STATISTICS   UNIT VII

```
NB!!!  CALCULATIONS MAY TAKE SOME TIME!!!!!!



 S T A T I S T I C S
*********************

FIELD: . . . . . . . . . .             31-2
WELL:  . . . . . 10.22.44.                ~
ENGINEER:. . . . . . . . . . UF

DEPTH INTERVAL:  . . .  1545.00 TO  1654.00
APPLIED CUTOFFS:
.              USH:  GREATER THAN      0.40
.             PHIF:     LESS THAN      0.12
.               SW:  GREATER THAN      0.65


 T O T A L   D E P T H
******************************************
THICKNESS: . . . . . . . . .   109.000
AVERAGE  . . . 'PHIF'  . . .     0.269
AVERAGE  . . . 'VSHALE'  . .     0.000
AVERAGE  . . . 'SW'  . . . .     0.649
W.AVERAGE  . . 'SW' * 'PHIF'     0.640
AVERAGE  . . . 'SH'  . . . .     0.384
VOID VOLUME: . . . ('PHIF').    29.343
HC VOID VOLUME . . ('SH'*) .    11.726
RES HC VOID VOLUME ('SHR'*).     6.039
MOV HC VOID VOLUME . . . . .     5.687
******************************************


 N E T    P A Y
******************************************
THICKNESS: . . . . . . . . .    39.250
AVERAGE  . . . 'PHIF'  . . .     0.296
AVERAGE  . . . 'VSHALE'  . .     0.000
AVERAGE  . . . 'SW'  . . . .     0.096
W.AVERAGE  . . 'SW' * 'PHIF'     0.081
AVERAGE  . . . 'SH'  . . . .     0.904
VOID VOLUME: . . . ('PHIF').    11.637
HC VOID VOLUME . . ('SH'*) .    10.689
RES HC VOID VOLUME ('SHR'*).     4.832
MOV HC VOID VOLUME . . . . .     5.858
******************************************


 N E T    S A N D
******************************************
THICKNESS: . . . . . . . . .   103.500
AVERAGE  . . . 'PHIF'  . . .     0.280
AVERAGE  . . . 'VSHALE'  . .     0.000
AVERAGE  . . . 'SW'  . . . .     0.666
W.AVERAGE  . . 'SW' * 'PHIF'     0.641
AVERAGE  . . . 'SH'  . . . .     0.375
VOID VOLUME: . . . ('PHIF').    28.989
HC VOID VOLUME . . ('SH'*) .    11.530
RES HC VOID VOLUME ('SHR'*).     5.703
```

```
MOV HC VOID VOLUME . . . . .      5.887
******************************************


 N E T / G R O S S    R A T I O S
*****************************************

HNETPAY /HGROSS SAND =  0.36009
HNETSAND/HGROSS SAND =  0.94954
HNETPAY /HNETSAND    =  0.37923
*****************************************

VIL DU KJ\RE NY STATISTIKK P] ANNET DYBDE-INTERVALL?
```

FIG 8.   STATISTICS UNIT VI

```
NB!!!  CALCULATIONS MAY TAKE SOME TIME!!!!!!


 S T A T I S T I C S
*********************

FIELD: . . . . . . . . . .             31-2
WELL:  . . . . . 10.23.15.
ENGINEER:. . . . . . . . . UF

DEPTH INTERVAL:  . . .  1654.00 TO  1672.00
APPLIED CUTOFFS:
.              VSH:  GREATER THAN      0.40
.             PHIF:     LESS THAN      0.12
.               SW:  GREATER THAN      0.65

 T O T A L    D E P T H
********************************************
THICKNESS: . . . . . . . . .      18.000
AVERAGE  . . . 'PHIF'  . . .       0.198
AVERAGE  . . . 'VSHALE'  . .       0.000
AVERAGE  . . . 'SW'  . . . .       0.772
W.AVERAGE  . . 'SW' * 'PHIF'       0.778
AVERAGE  . . . 'SH'  . . . .       0.228
VOID VOLUME: . . . ('PHIF').       3.567
HC VOID VOLUME . . ('SH'*) .       0.793
RES HC VOID VOLUME ('SHR'*).       1.025
MOV HC VOID VOLUME . . . . .       0.000
********************************************

 N E T    P A Y
********************************************
THICKNESS: . . . . . . . . .       0.000
********************************************

 N E T    S A N D
********************************************
THICKNESS: . . . . . . . . .      18.000
AVERAGE  . . . 'PHIF'  . . .       0.198
AVERAGE  . . . 'VSHALE'  . .       0.000
AVERAGE  . . . 'SW'  . . . .       0.772
W.AVERAGE  . . 'SW' * 'PHIF'       0.778
AVERAGE  . . . 'SH'  . . . .       0.228
VOID VOLUME: . . . ('PHIF').       3.567
HC VOID VOLUME . . ('SH'*) .       0.793
RES HC VOID VOLUME ('SHR'*).       1.025
MOV HC VOID VOLUME . . . . .       0.000
********************************************

 N E T / G R O S S    R A T I O S
*******************************************

HNETPAY /HGROSS SAND =  0.00000
HNETSAND/HGROSS SAND =  1.00000
```

```
 HNETPAY /HNETSAND    =  0.00000
 ********************************************

VIL DU KJ\RE NY STATISTIKK PJ ANNET DYBDE-INTERVALL?
```

FIG 9   STATISTICS   UNIT V

```
NB!!! CALCULATIONS MAY TAKE SOME TIME!!!!!!



 S T A T I S T I C S
**********************

FIELD: . . . . . . . . . .            31-2
WELL:  . . . . . 10.23.48.    19 AUGBST2-62982
ENGINEER:. . . . . . . . . UF

DEPTH INTERVAL:  . . .  1672.00 TO  1750.00
APPLIED CUTOFFS:
.              VSH:  GREATER THAN      0.40
.             PHIF:     LESS THAN      0.12
.               SW:  GREATER THAN      0.65


 T O T A L   D E P T H
******************************************
THICKNESS: . . . . . . . . .      78.000
AVERAGE  . . . 'PHIF'  . . .       0.216
AVERAGE  . . . 'VSHALE'  . .       0.000
AVERAGE  . . . 'SW'  . . . .       0.908
W.AVERAGE  . . 'SW' * 'PHIF'       0.951
AVERAGE  . . . 'SH'  . . . .       0.136
VOID VOLUME: . . . ('PHIF').      16.850
HC VOID VOLUME . . ('SH'*) .       1.713
RES HC VOID VOLUME ('SHR'*).       2.161
MOV HC VOID VOLUME . . . . .       0.000
******************************************


 N E T    P A Y
******************************************
THICKNESS: . . . . . . . . .       1.750
AVERAGE  . . . 'PHIF'  . . .       0.174
AVERAGE  . . . 'VSHALE'  . .       0.000
AVERAGE  . . . 'SW'  . . . .       0.564
W.AVERAGE  . . 'SW' * 'PHIF'       0.570
AVERAGE  . . . 'SH'  . . . .       0.436
VOID VOLUME: . . . ('PHIF').       0.304
HC VOID VOLUME . . ('SH'*) .       0.131
RES HC VOID VOLUME ('SHR'*).       0.143
MOV HC VOID VOLUME . . . . .       0.000
******************************************


 N E T    S A N D
******************************************
THICKNESS: . . . . . . . . .      72.500
AVERAGE  . . . 'PHIF'  . . .       0.226
AVERAGE  . . . 'VSHALE'  . .       0.000
AVERAGE  . . . 'SU'  . . . .       0.943
W.AVERAGE  . . 'SW' * 'PHIF'       0.964
AVERAGE  . . . 'SH'  . . . .       0.104
VOID VOLUME: . . . ('PHIF').      16.380
HC VOID VOLUME . . ('SH'*) .       1.464
RES HC VOID VOLUME ('SHR'*).       1.843
```

```
MOV HC VOID VOLUME . . . . .       0.000
******************************************


 N E T / G R O S S    R A T I O S
*****************************************

HNETPAY /HGROSS SAND =  0.02244
HNETSAND/HGROSS SAND =  0.92949
HNETPAY /HNETSAND    =  0.02414
*****************************************

VIL DU KJ\RE NY STATISTIKK PJ ANNET DYBDE-INTERVALL?
```

FIG 10.   STATISTICS   UNIT IV

```
NB!!!  CALCULATIONS MAY TAKE SOME TIME!!!!!!



 S T A T I S T I C S
*********************

FIELD: . . . . . . . . . .            31-2
WELL:  . . . . . 12.58.12.
ENGINEER:. . . . . . . . . UF

DEPTH INTERVAL:  . . .  1492.00 TO  1571.50
APPLIED CUTOFFS:
.              VSH:  GREATER THAN      0.40
.             PHIF:     LESS THAN      0.12
.               SW:  GREATER THAN      0.65


 T O T A L    D E P T H
******************************************
THICKNESS: . . . . . . . . .      79.500
AVERAGE  . . . 'PHIF'  . . .       0.289
AVERAGE  . . . 'VSHALE'  . .       0.000
AVERAGE  . . . 'SW'  . . . .       0.055
W.AVERAGE  . . 'SW' * 'PHIF'       0.051
AVERAGE  . . . 'SH'  . . . .       0.945
VOID VOLUME: . . . ('PHIF').      23.003
HC VOID VOLUME . . ('SH'*) .      21.825
RES HC VOID VOLUME ('SHR'*).       9.585
MOV HC VOID VOLUME . . . . .      12.240
******************************************


 N E T    P A Y
******************************************
THICKNESS: . . . . . . . . .      77.500
AVERAGE  . . . 'PHIF'  . . .       0.295
AVERAGE  . . . 'VSHALE'  . .       0.000
AVERAGE  . . . 'SW'  . . . .       0.056
W.AVERAGE  . . 'SW' * 'PHIF'       0.051
AVERAGE  . . . 'SH'  . . . .       0.944
VOID VOLUME: . . . ('PHIF').      22.840
HC VOID VOLUME . . ('SH'*) .      21.665
RES HC VOID VOLUME ('SHR'*).       9.436
MOV HC VOID VOLUME . . . . .      12.229
******************************************


 N E T    S A N D
******************************************
THICKNESS: . . . . . . . . .      77.500
AVERAGE  . . . 'PHIF'  . . .       0.295
AVERAGE  . . . 'VSHALE'  . .       0.000
AVERAGE  . . . 'SW'  . . . .       0.056
W.AVERAGE  . . 'SW' * 'PHIF'       0.051
AVERAGE  . . . 'SH'  . . . .       0.944
VOID VOLUME: . . . ('PHIF').      22.840
HC VOID VOLUME . . ('SH'*) .      21.665
RES HC VOID VOLUME ('SHR'*).       9.436
```

```
MOV HC VOID VOLUME . . . . .      12.229
******************************************

 N E T / G R O S S     R A T I O S
******************************************

HNETPAY /HGROSS SAND =  0.97484
HNETSAND/HGROSS SAND =  0.97484
HNETPAY /HNETSAND    =  1.00000
******************************************

VIL DU KJ\RE NY STATISTIKK P] ANNET DYBDE-INTERVALL?
```

FIG 11.   STATISTICS   GAS ZONE (1492 - 1571.5)

```
NB!!!  CALCULATIONS MAY TAKE SOME TIME!!!!!!



 S T A T I S T I C S
*********************

FIELD: . . . . . . . . . .               31-2
WELL:  . . . . . 12.59.23.
BREEWEER:. . . . . . . . . UF

DEPTH INTERVAL:  . . .  1571.50 TO  1582.00
APPLIED CUTOFFS:
.              VSH:  GREATER THAN      0.40
.             PHIF:     LESS THAN      0.12
.               SU:  GREATER THAN      0.65

 T O T A L    D E P T H
******************************************
THICKNESS: . . . . . . . . .   10.500
AVERAGE  . . . 'PHIF'  . . .    0.295
AVERAGE  . . . 'VSHALE'  . .    0.000
AVERAGE  . . . 'SW'  . . . .    0.123
W.AVERAGE  . . 'SW' * 'PHIF'    0.121
AVERAGE  . . . 'SH'  . . . .    0.877
VOID VOLUME: . . . ('PHIF').    3.100
HC VOID VOLUME . . ('SH'*) .    2.725
RES HC VOID VOLUME ('SHR'*).    1.057
MOV HC VOID VOLUME . . . . .    1.668
******************************************

 N E T     P A Y
******************************************
THICKNESS: . . . . . . . . .   10.500
AVERAGE  . . . 'PHIF'  . . .    0.295
AVERAGE  . . . 'VSHALE'  . .    0.000
AVERAGE  . . . 'SW'  . . . .    0.123
W.AVERAGE  . . 'SW' * 'PHIF'    0.121
AVERAGE  . . . 'SH'  . . . .    0.877
VOID VOLUME: . . . ('PHIF').    3.100
HC VOID VOLUME . . ('SH'*) .    2.725
RES HC VOID VOLUME ('SHR'*).    1.057
MOV HC VOID VOLUME . . . . .    1.668
******************************************

 N E T     S A N D
******************************************
THICKNESS: . . . . . . . . .   10.500
AVERAGE  . . . 'PHIF'  . . .    0.295
AVERAGE  . . . 'VSHALE'  . .    0.000
AVERAGE  . . . 'SU'  . . . .    0.123
U.AVERAGE  . . 'SU' * 'PHIF'    0.121
AVERAGE  . . . 'SH'  . . . .    0.877
VOID VOLUME: . . . ('PHIF').    3.100
HC VOID VOLUME . . ('SH'*) .    2.725
RES HC VOID VOLUME ('SHR'*).    1.057
```

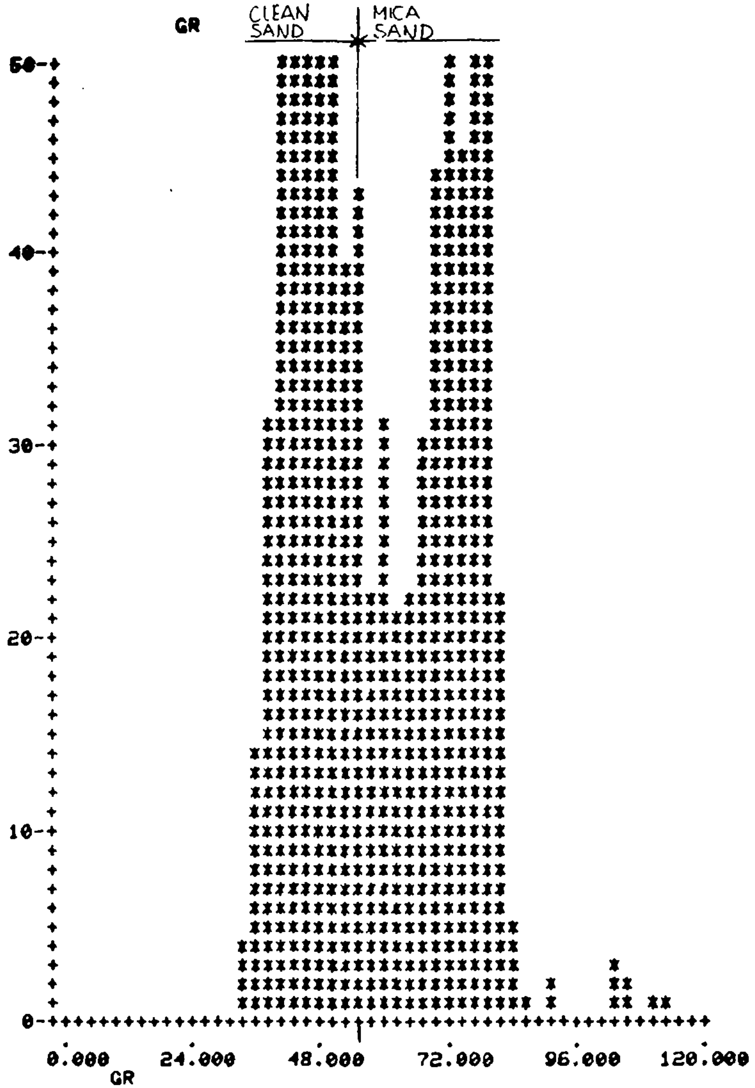
```
MOV HC VOID VOLUME . . . . .    1.668
******************************************

 N E T / G R O S S     R A T I O S
*****************************************

HNETPAY /HGROSS SAND -  1.00000
HNETSAND/HGROSS SAND -  1.00000
HNETPAY /HNETSAND    -  1.00000
*****************************************

VIL DU KJ\RE NY STATISTIKK PJ ANNET DYBDE-INTERVALL?
```

FIG 12. STATISTICS OIL ZONE (1571.5 - 1582)

```
NB!!!  CALCULATIONS MAY TAKE SOME TIME!!!!!!



 S T A T I S T I C S
*********************

FIELD: . . . . . . . . . .              31-2
WELL:  . . . . . 10.25.42.
ENGINEER:. . . . . . . . . UF

DEPTH INTERVAL:  . . .  1582.00 TO  1750.00
APPLIED CUTOFFS:
.               USH:  GREATER THAN      0.40
.              PHIF:     LESS THAN      0.12
.               SW:  GREATER THAN      0.65

 T O T A L    D E P T H
******************************************
THICKNESS: . . . . . . . . .    168.000
AVERAGE  . . . 'PHIF'  . . .      0.230
AVERAGE  . . . 'USHALE'  . .      0.000
AVERAGE  . . . 'SW'  . . . .      0.914
W.AVERAGE  . . 'SW' * 'PHIF'      0.957
AVERAGE  . . . 'SH'  . . . .      0.128
VOID VOLUME: . . . ('PHIF').     38.665
HC VOID VOLUME . . ('SH'*) .      3.716
RES HC VOID VOLUME ('SHR'*).      4.625
MOV HC VOID VOLUME . . . . .      0.000
******************************************

 N E T     P A Y
******************************************
THICKNESS: . . . . . . . . .      4.750
AVERAGE  . . . 'PHIF'  . . .      0.193
AVERAGE  . . . 'USHALE'  . .      0.000
AVERAGE  . . . 'SW'  . . . .      0.590
W.AVERAGE  . . 'SW' * 'PHIF'      0.593
AVERAGE  . . . 'SH'  . . . .      0.410
VOID VOLUME: . . . ('PHIF').      0.917
HC VOID VOLUME . . ('SH'*) .      0.373
RES HC VOID VOLUME ('SHR'*).      0.439
MOV HC VOID VOLUME . . . . .      0.000
******************************************

 N E T     S A N D
******************************************
THICKNESS: . . . . . . . . .    157.750
AVERAGE  . . . 'PHIF'  . . .      0.240
AVERAGE  . . . 'USHALE'  . .      0.000
AVERAGE  . . . 'SW'  . . . .      0.946
W.AVERAGE  . . 'SW' * 'PHIF'      0.965
AVERAGE  . . . 'SH'  . . . .      0.102
VOID VOLUME: . . . ('PHIF').     37.911
HC VOID VOLUME . . ('SH'*) .      3.339
RES HC VOID VOLUME ('SHR'*).      4.036
```

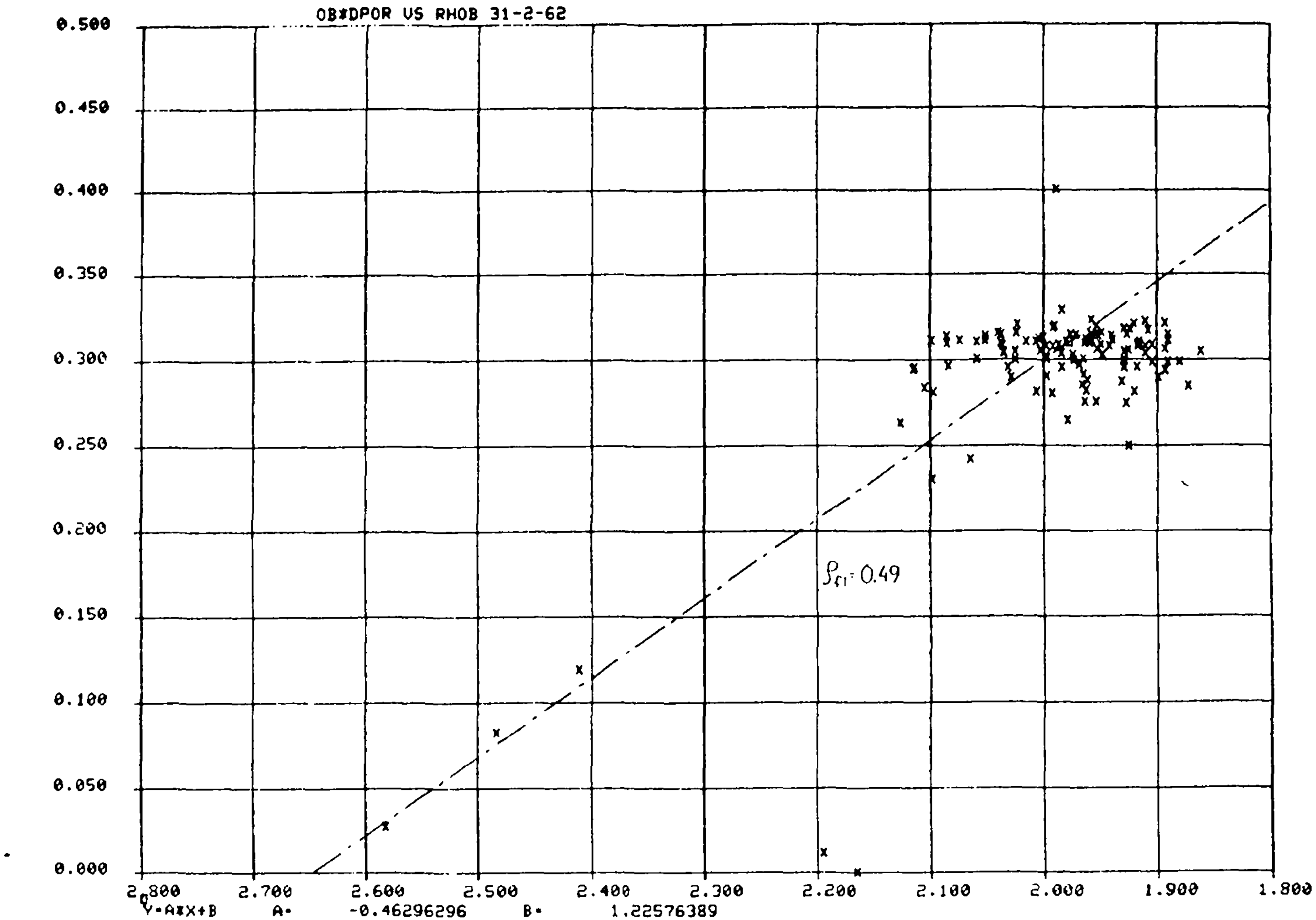
```
MOV HC VOID VOLUME . . . . .      0.000
******************************************

 N E T / G R O S S    R A T I O S
*****************************************

HNETPAY /HGROSS SAND =  0.02827
HNETSAND/HGROSS SAND =  0.93899
HNETPAY /HNETSAND    =  0.03011
*****************************************

VIL DU KJ\RE NY STATISTIKK P] ANNET DYBDE-INTERVALL?
```

FIG 13. STATISTICS WATER ZONE (1572 - 1750)



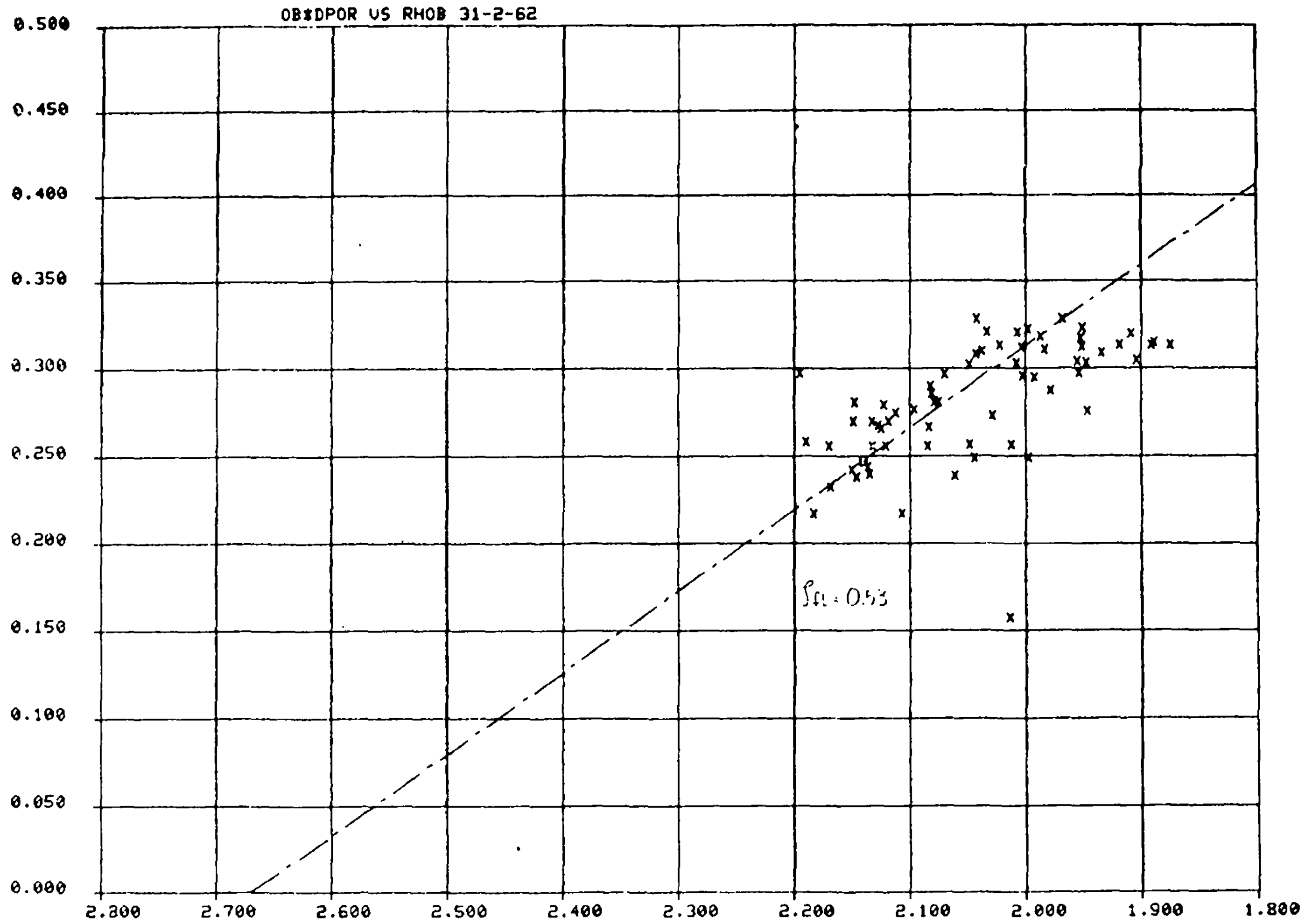
```
WELL    531-2-6           DEPTH:   1480.00   1700.00   TOTAL:   879
X.AV:   59.6280
   P L O T T E D   B Y :   U FALT
```

Fig. 14 HISTOGRAM GR 31-2-6



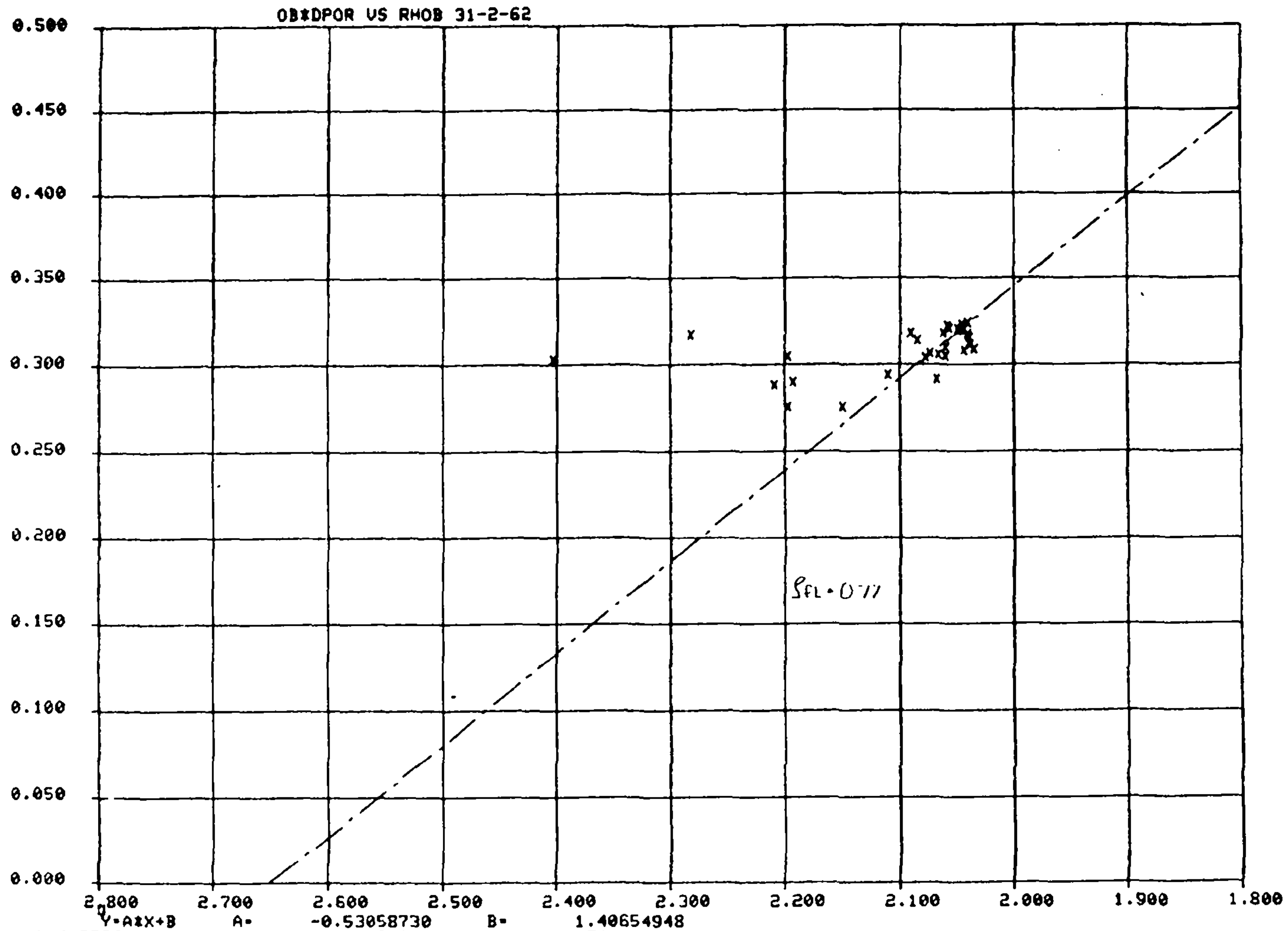
```
Y=A*X+B      A=       -0.46296296       B=      1.22576389
THE LINE INTERSECTS THE RIGHT Y-AXIS AT THE POINT      0.392
THE LINE INTERSECTS THE LOWER X-AXIS AT THE POINT      2.648
OK?
JA

WELL    PLOT1              DEPTH:   1481.00    1572.00    TOTAL:    115    X.AV:     1.9943    Y.AV:     0.2920
Z = GR            ,    0.00     ,    55.00

   P L O T T E D   B Y :  UF
```

Fig. 15 CORR CORE POROSITY VS FDC 31/2-6
GAS ZONE GR < 55 API



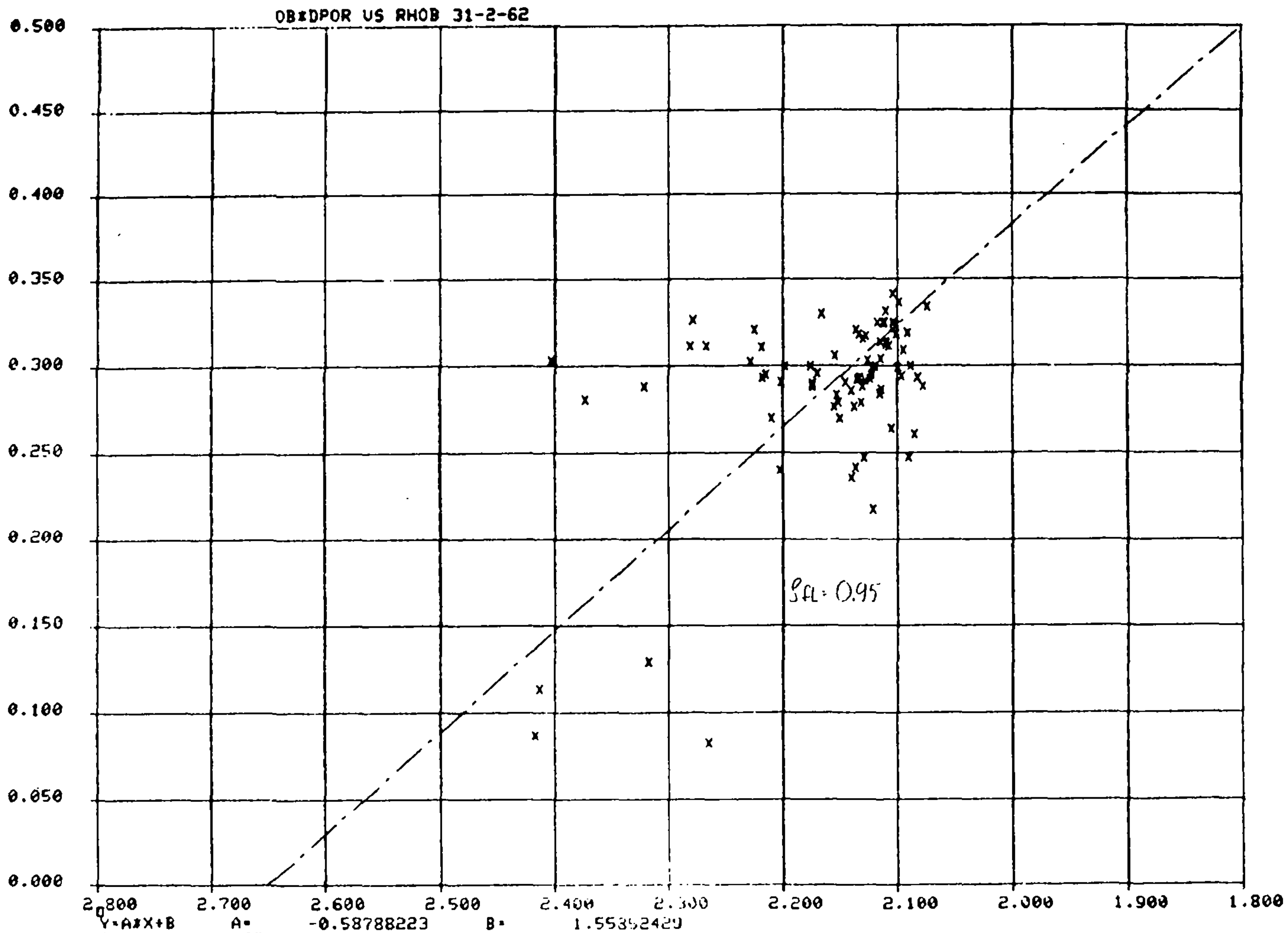
```
     Y=A*X+B      A=      -0.46745372      B=      1.24785242
THE LINE INTEPSECTS THE RIGHT Y-AXIS AT THE POINT      0.406
THE LINE INTERSECTS THE LOWER X-AXIS AT THE POINT      2.669
OK?
JA

WELL   PLOT1            DEPTH:   1481.00   1572.00   TOTAL:    65    X.AV:    2.0441   Y.AV:    0.2823
Z = GR           ,   55.00    ,   140.00

    P L O T T E D   B Y :  UF
```

Fig. 16 [illegible] POROSITY VS FDC 31/2 6
[illegible] GR<55 API



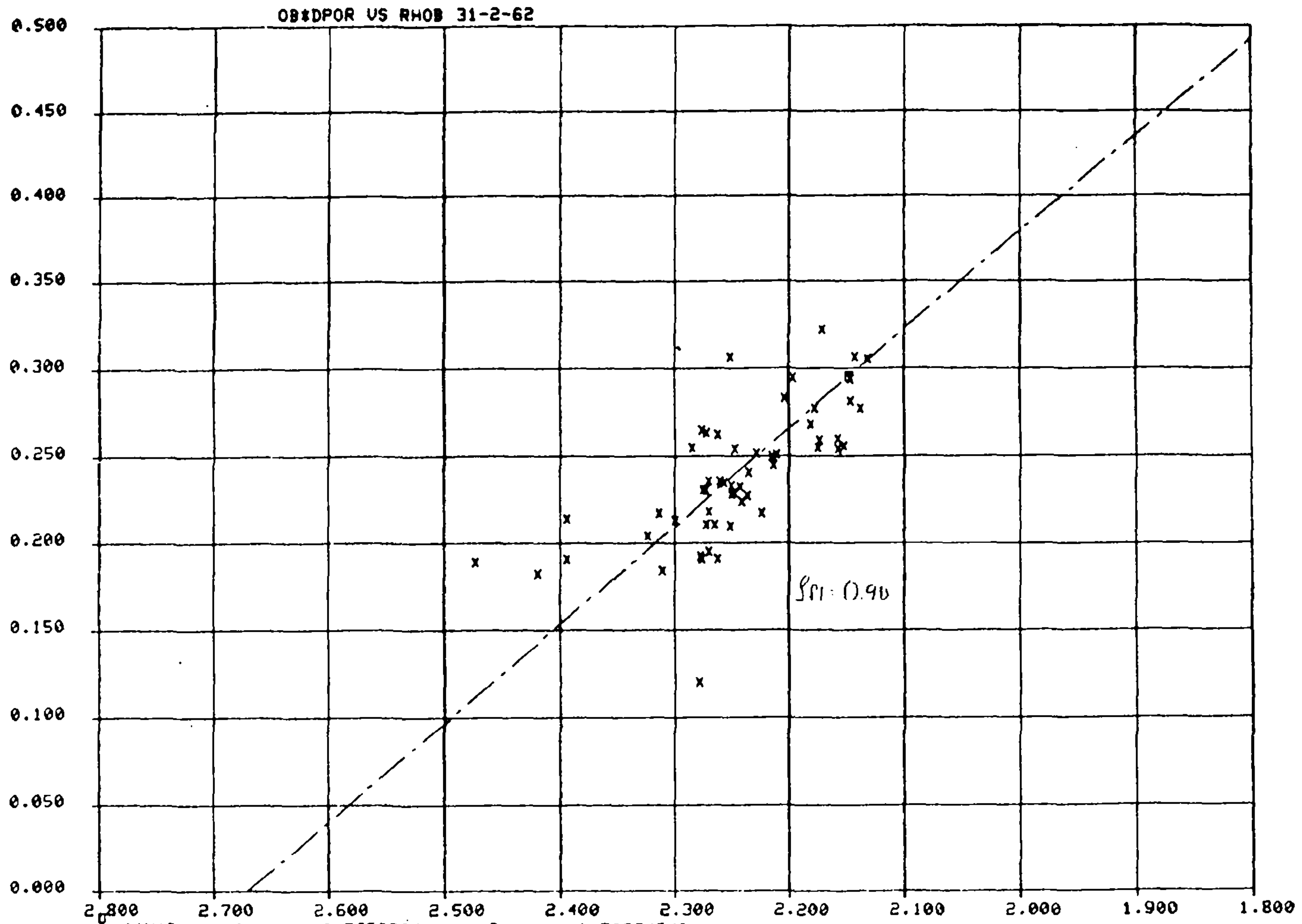
```
   Y=A*X+B        A=      -0.53058730     B=       1.40654948
THE LINE INTERSECTS THE RIGHT Y-AXIS AT THE POINT      0.451
THE LINE INTERSECTS THE LOWER X-AXIS AT THE POINT      2.651
OK?
JA

WELL   PLOT1              DEPTH:   1572.00    1582.00   TOTAL:    28    X.AV:     2.1030   Y.AV:     0.3078
Z = GR            ,     0.00     ,    55.00

   P L O T T E D   B Y :  UF
```

Fig. 17 CORE CELL POROSITY VS FDC 31/2-6
OIL ZONE GR<55 API



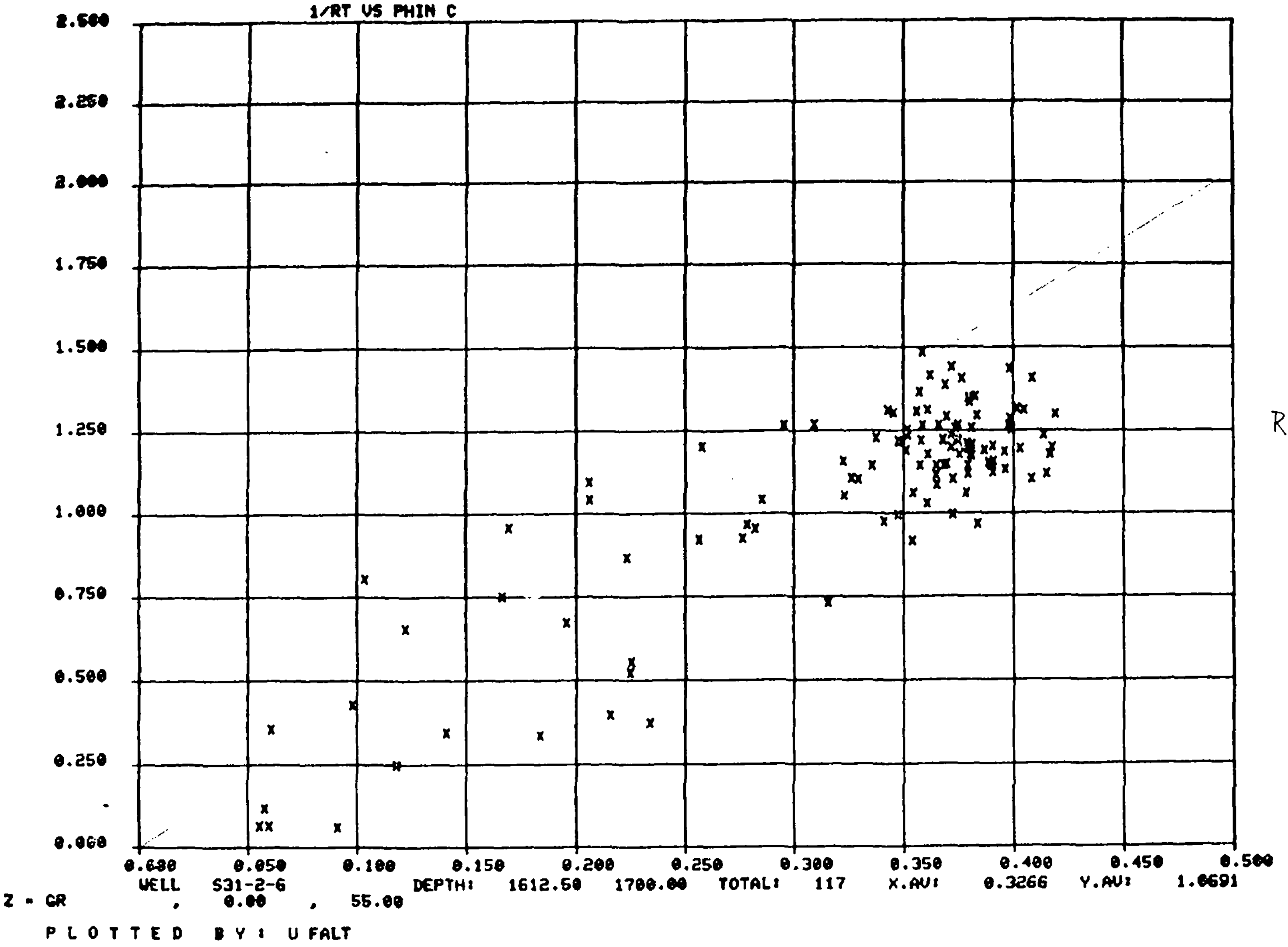
```
 Y=A*X+B     A=     -0.58788223      B=      1.55352429
THE LINE INTERSECTS THE UPPER X-AXIS AT THE POINT      1.801
THE LINE INTERSECTS THE LOWER X-AXIS AT THE POINT      2.651
OK?
JA

WELL   PLOT1           DEPTH:  1582.00   1750.00   TOTAL:    77    X.AV:    2.1610   Y.AV:    0.2862
Z = GR         ,    0.00    ,    55.00

    P L O T T E D   B Y :  UF
```

Fig. 18 [illegible] POROSITY VS RHOB 31/2-6
WATER ZONE GR<55 API



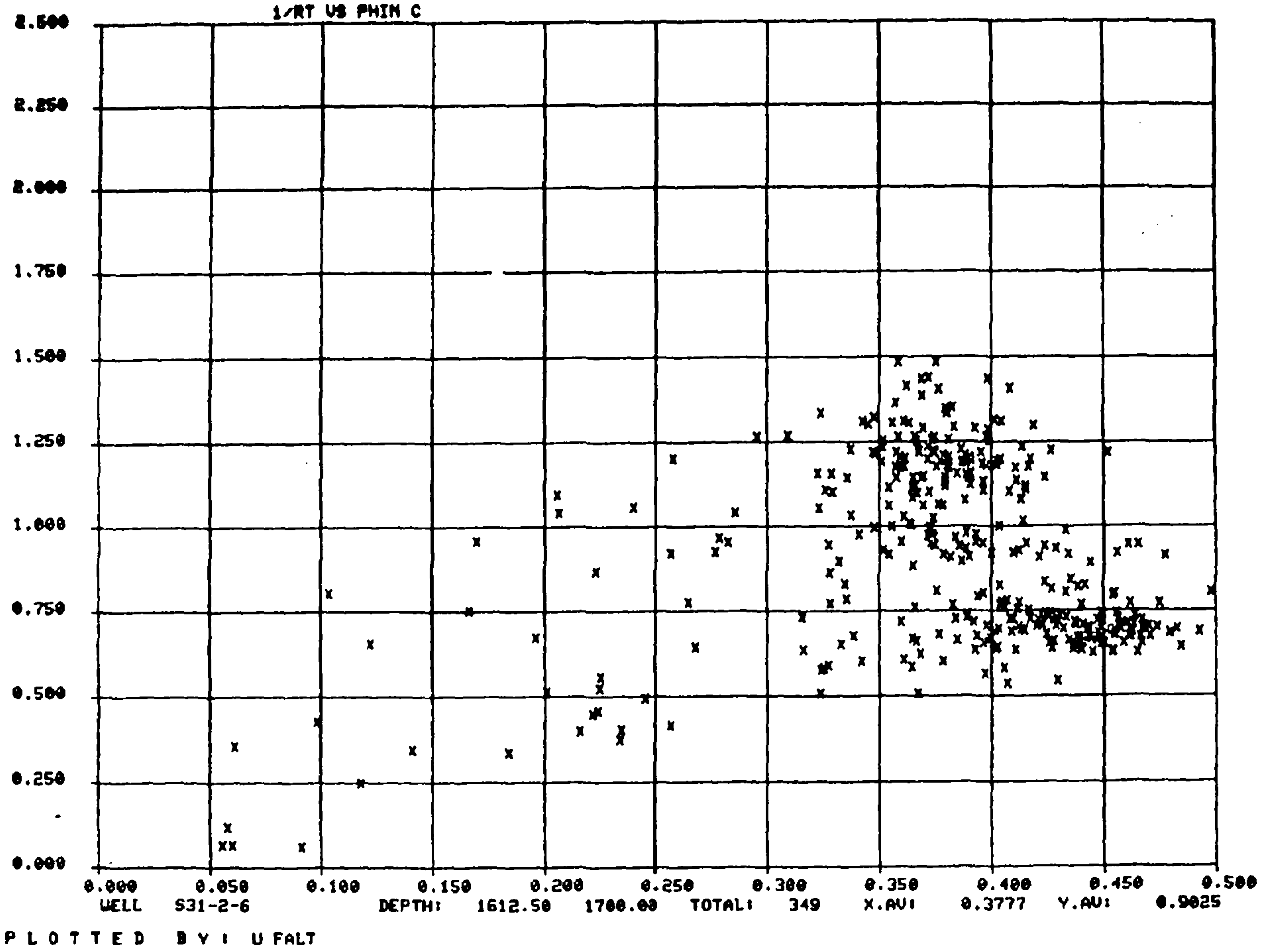
```
Y=A*X+B      A=     -0.56508241      B=      1.50934940
THE LINE INTERSECTS THE RIGHT Y-AXIS AT THE POINT      0.492
THE LINE INTEPSECTS THE LOWER X-AXIS AT THE POINT      2.671
OK?
JA

WELL   PLOT1              DEPTH:   1582.00   1750.00   TOTAL:    55    X.AV:    2.2460   Y.AV:    0.2389
Z = GR          ,   55.00     ,   140.00

    P L O T T E D   B Y :  UF
```

Fig. 19 [illegible] vs [illegible] 31/2-6 [illegible]



$R_w = 0.078$

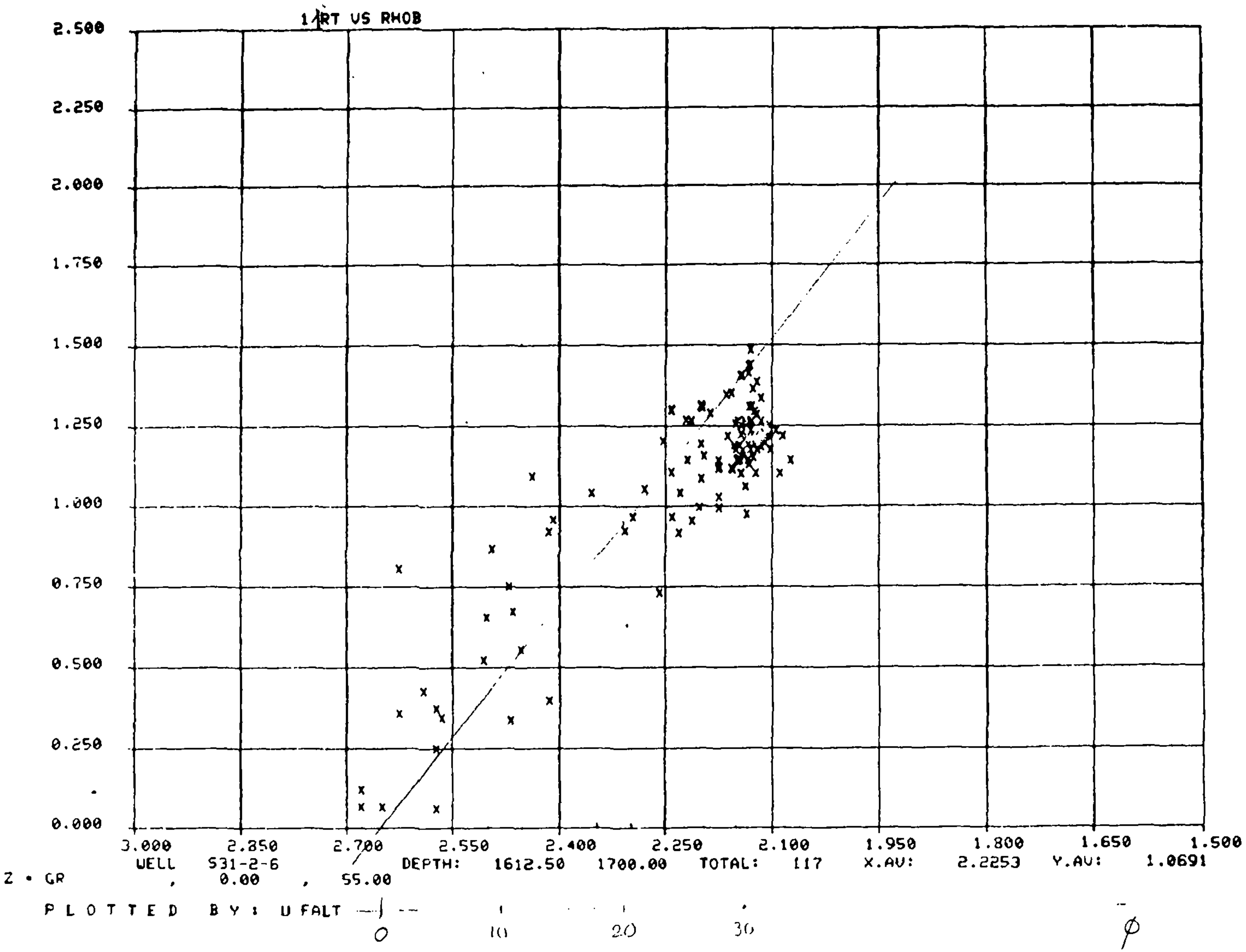
Fig. 20 R_w CALCULATION FROM $1/\sqrt{R_t}$ VS PHIN



a lot of spread

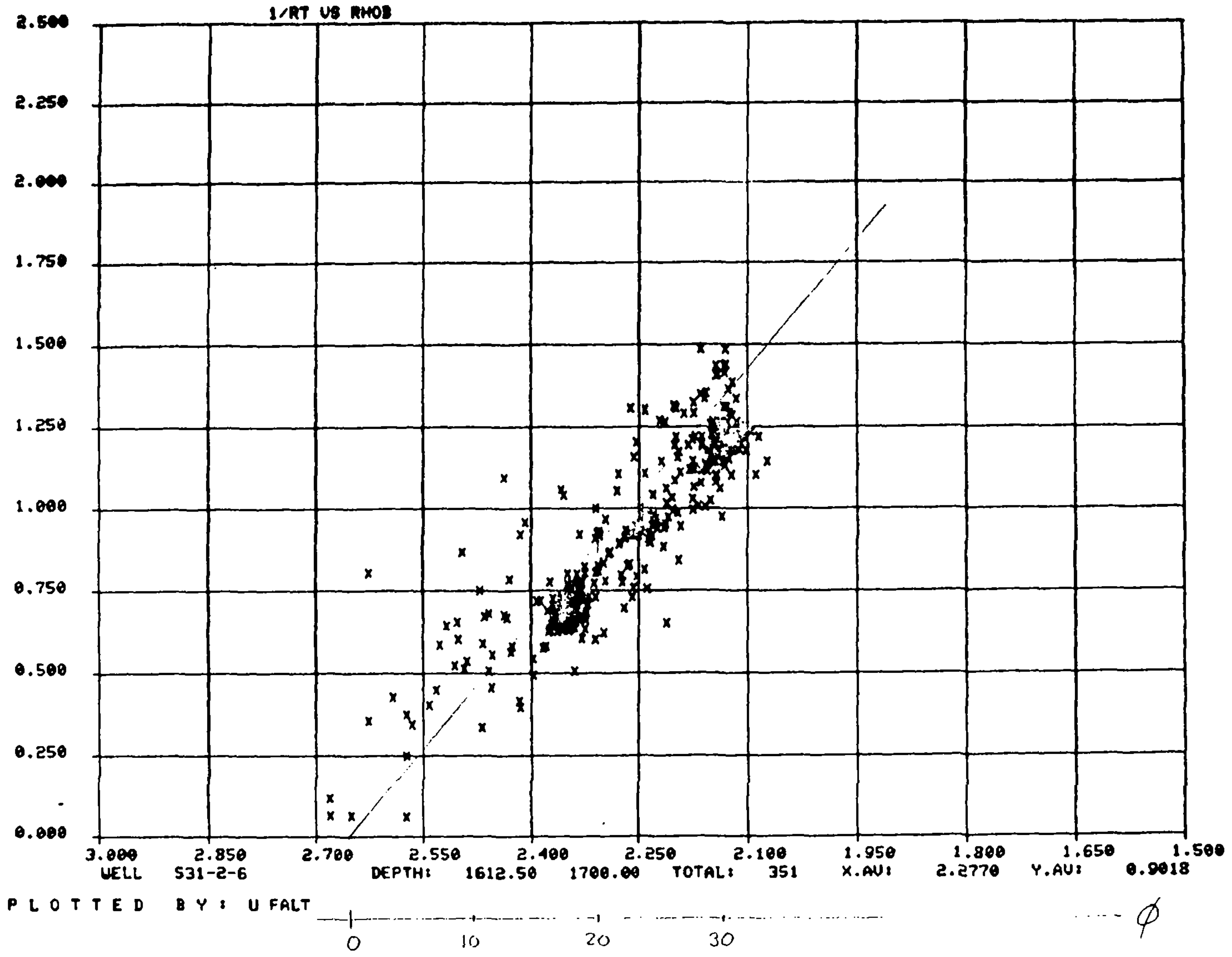
R_w : 0.080 ± ?

Fig. 21 R_w CALCULATION FROM $1/\sqrt{R_t}$ VS PHIN



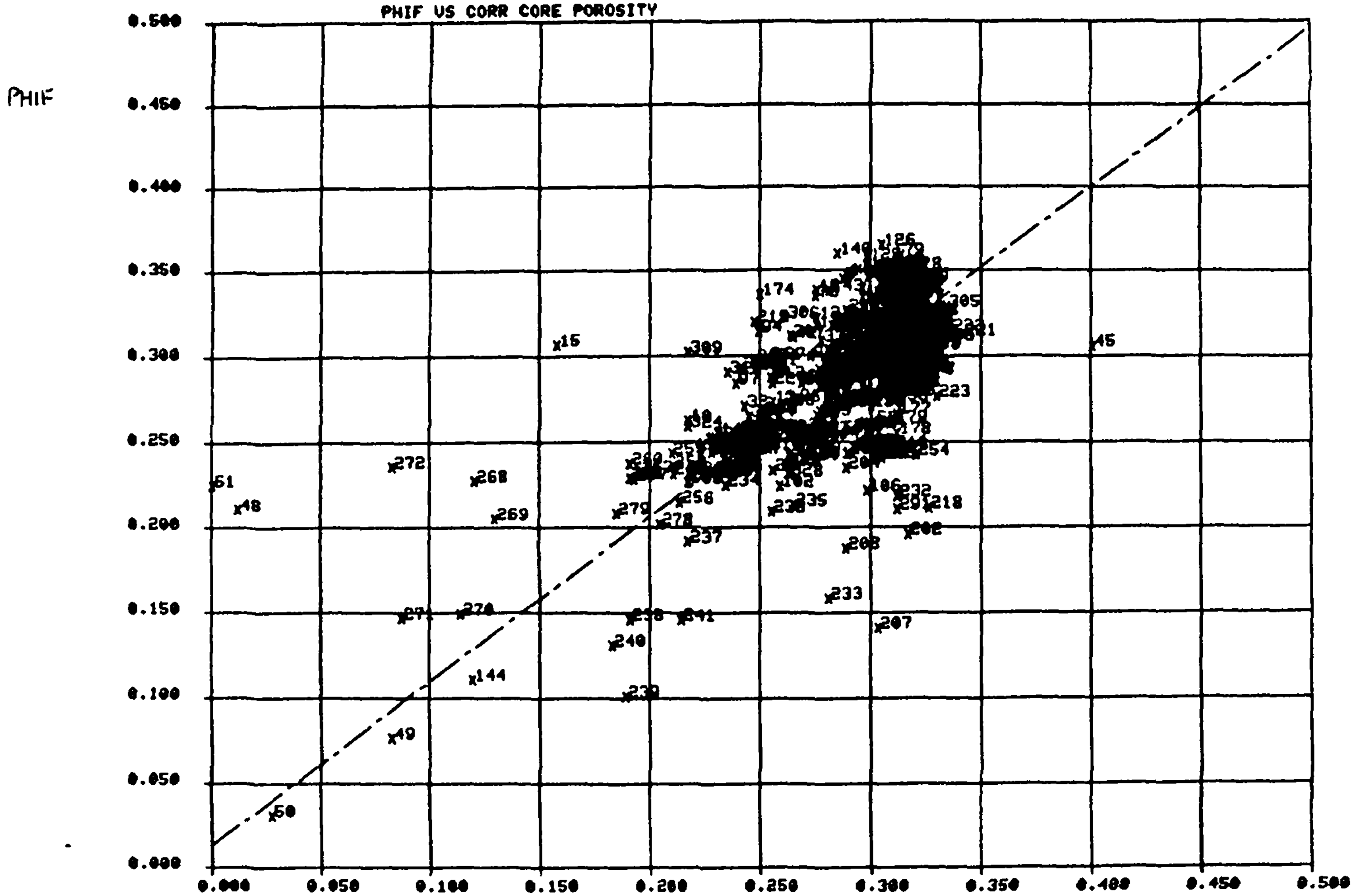
$R_w = 0.055$

FIg. 22 Rw CALCULATION FROM $1/\sqrt{R_t}$ vs RHOB



$R_w = 0.063\ \Omega m$

Fig. 23 R_w CALCULATION FROM $1/\sqrt{R_t}$ vs RHOB



```
        A=     0.96606776     B=     0.01353622     C2=     0.43978972
DO YOU WANT TO DELETE ANY POINTS?
NO

WELL   PLOT1            DEPTH:   1490.00   1750.00   TOTAL:   338   X.AV:   0.2814   Y.AV:   0.2854

   P L O T T E D   B Y :  UF
```

Fig. 24 [illegible]

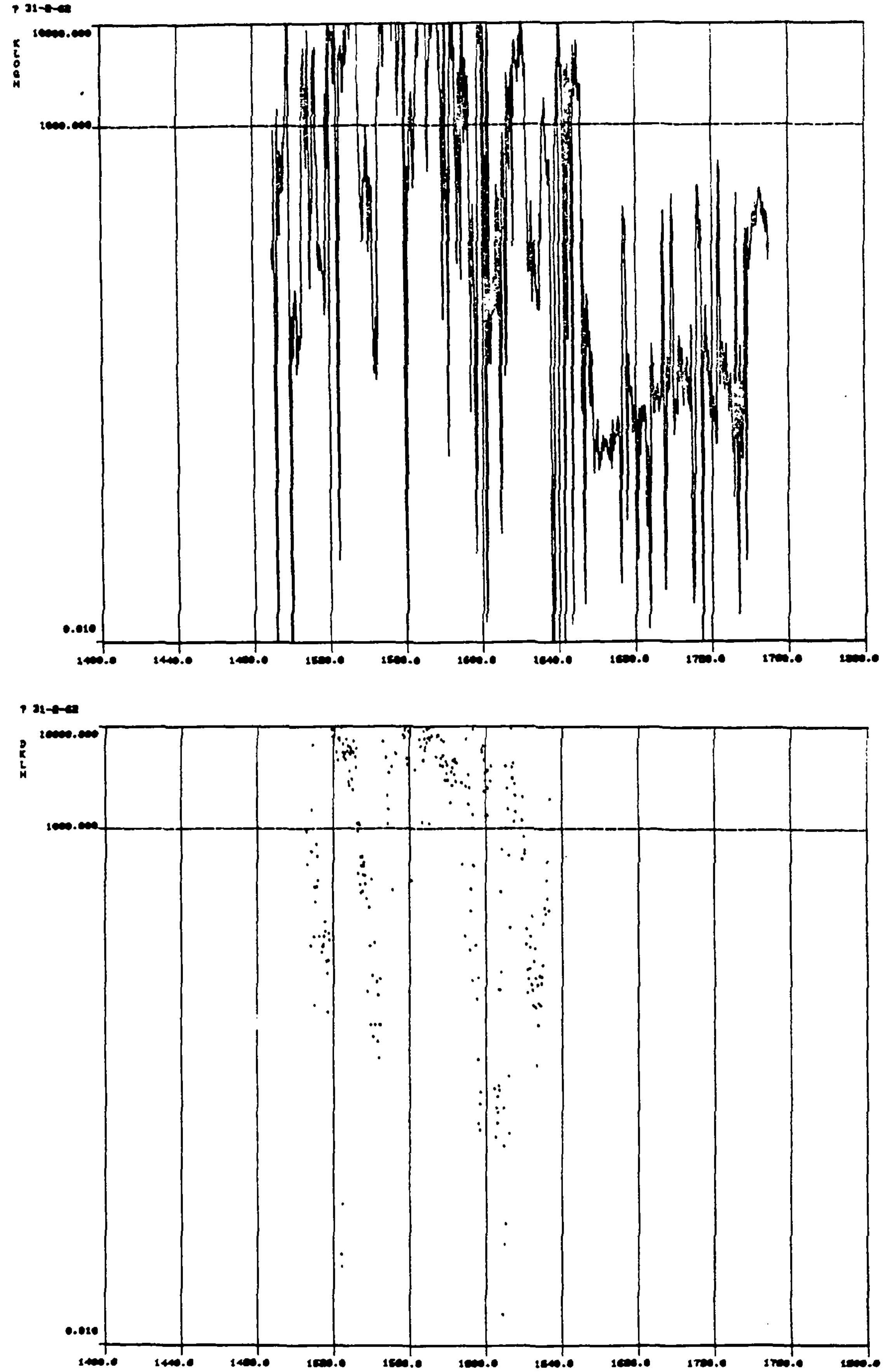


FIG 25. LOG DERIVED PERMEABILITY AND CORE PERMEABILITY 31/2-6

APPENDIX

CPI-LOG

31/2-6

TROLL