

Denne rapport  
tilhører

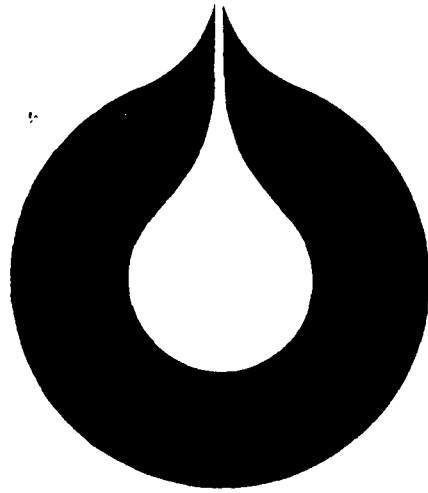
 **STATOIL**

**L&U DOK.SENTER**

L.NR. 30284070021

KODE Well 3 1/2-4 nr 27

Returneres etter bruk



**statoil**

Quick-look evaluation

Well: 31/2-4

Operasjonsteknologi - Stavanger

Statoil - January 1981

Engineer: J.I. Skagen

**Den norske stats oljeselskap a.s**

Quick-look evaluation

Well: 31/2-4

Operasjonsteknologi - Stavanger

Statoil - January 1981

Engineer: J.I. Skagen

Preliminary petrophysical evaluation of 31/2-4

Two methods have been applied for this evaluation, the shaly sand method by using the Nigeria-equation and the Waxman - Smith method by using the cation - exchange - capacity theory.

The main problem with this evaluation is the high mica-content which effects the GR-log and the grain density.

No shale was observed in this reservoir and therefore the shale volume is set to zero.

Three zones of interest have been evaluated, the gas zone from 1366 to 1568 m RKB, the oil zone from 1568 to 1580 m RKB and the water zone from 1580 to 1600 m RKB.

Most of the parameters used for the evaluation are based on the 31/2-1 well.

The plots needed for the Waxman - Smith evaluation are based on 31/2-1 data.

## INPUT DATA

LOGS:            Laterolog Deep            (RLLD)  
                 Laterolog Shallow        (RLLS)  
                 Microspherical Focused Log (RXO)  
                 Formation Density Log     (RHOB)  
                 Compensated Neutron Log    (PHIN)  
                 Induction Log Deep (RILD) (X1)  
                 Gamma Ray Log            (GR)

Core data:       No core data is used.

## EVALUATION

The evaluation has been divided into the intervals:

1366 - 1568 m RKB ; gas zone  
1568 - 1580 m RKB ; oil zone  
1580 - 1600 m RKB ; water zone

The MSFL-log is used as RXO log. The RT log is evaluated by using:

RT = 1.7·RLLD - 0.7·RLLS in h.c. zones  
RT = RILD in water bearing zones

The shale content in this reservoir sand is very small and VSH is set to zero.

Micaceous sandstones: GR > 62,  $\gamma_G = 2.67$   
Clean sandstones: GR < 62,  $\gamma_G = 2.65$

Mud filtrate resistivity: Rmf = 0.10 (41 000 ppm)  
Formation water resistivity: Rw = 0.06 (70 000 ppm)  
Formation temperature: T = 125°F  
Gas density: 0.12  
Oil density: 0.88 at 125°F  
Water density: 1.045  
Mud filtrate density: 1.027

The final porosity (PHIF):

$$\phi = \frac{\rho_G - \rho_{HOB}}{\rho_G - \rho_{fl}}$$

for all three zones, with different fluid densities. The fluid densities are found from several steps of SXO calculations (F = 8.5).

$$SXO = \sqrt{\frac{F \cdot Rmf}{RXO}}$$

Cut off values applied to this well:

$\phi$  > 24 % (i.e. k = 1 md)  
Vsh < 40 % (unimportant, Vsh = 0)  
Sw > 65 %

#### Nigeria formula exponents

Lithology factor (a) = 0.62  
Cementation exponent (m) = 2  
Saturation exponent (n) = 2

#### Waxman - Smith exponents

B-factor: 9.0 at 125°F  
Saturation exponent (n) = 2  
F\* = A · (PHIF) EXP (-B)  
A = .532618  
B = -0.188956

QV = C · (PHI) EXP (-E)  
C = .001495  
E = -3.748

(see attached plots of data from 31/2-1).



Shaly sand evaluation

Nigeria equation

STATISTICS

FIELD: . . . . . BLOCK 31/2  
 WELL: . . . . . 31-2-4  
 DATE: . . . . . 10.19.04 20 JANUARY 1981  
 ENGINEER: . . . . . JIS

DEPTH INTERVAL: . . . . 1366.00 TO 1580.00  
 APPLIED CUTOFFS:

. VSH: GREATER THAN 0.40  
 . PHIF: LESS THAN 0.24  
 . SW: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 214.000  
 AVERAGE . . . <PHIF> . . . 0.266  
 AVERAGE . . . <VSHALE> . . . 0.000  
 AVERAGE . . . <SW> . . . . 0.142  
 W.AVERAGE . . <SW> ♦ <PHIF> 0.106  
 AVERAGE . . . <SH> . . . . 0.865  
 VOID VOLUME: . . . (<PHIF>). 56.904  
 HC VOID VOLUME . . (<SH>♦) . 50.890  
 RES HC VOID VOLUME (<SHR>♦). 28.371  
 MOV HC VOID VOLUME . . . . . 22.518

NET PAY

THICKNESS: . . . . . 140.750  
 AVERAGE . . . <PHIF> . . . 0.307  
 AVERAGE . . . <VSHALE> . . . 0.000  
 AVERAGE . . . <SW> . . . . 0.069  
 W.AVERAGE . . <SW> ♦ <PHIF> 0.062  
 AVERAGE . . . <SH> . . . . 0.931  
 VOID VOLUME: . . . (<PHIF>). 43.240  
 HC VOID VOLUME . . (<SH>♦) . 40.571  
 RES HC VOID VOLUME (<SHR>♦). 23.029  
 MOV HC VOID VOLUME . . . . . 17.542

Total h.c. zone:  
 1366 - 1580 m RKB

NET SAND

THICKNESS: . . . . . 140.750  
 AVERAGE . . . <PHIF> . . . 0.307  
 AVERAGE . . . <VSHALE> . . . 0.000  
 AVERAGE . . . <SW> . . . . 0.069  
 W.AVERAGE . . <SW> ♦ <PHIF> 0.062  
 AVERAGE . . . <SH> . . . . 0.931  
 VOID VOLUME: . . . (<PHIF>). 43.240  
 HC VOID VOLUME . . (<SH>♦) . 40.571  
 RES HC VOID VOLUME (<SHR>♦). 23.029  
 MOV HC VOID VOLUME . . . . . 17.542

NET / GROSS RATIOS

HNETPAY / HGROSS SAND = 0.65771  
 HNETSAND / HGROSS SAND = 0.65771  
 HNETPAY / HNETSAND = 1.00000



STATISTICS

FIELD: . . . . . BLOCK 31/2  
 WELL: . . . . . 31-2-4  
 DATE: . . . . . 10.22.50 20 JANUARY 1981  
 ENGINEER: . . . . . JIS

DEPTH INTERVAL: . . . 1366.00 TO 1568.00  
 APPLIED CUTOFFS:

. VSH: GREATER THAN 0.40  
 . PHIF: LESS THAN 0.24  
 . SW: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 202.000  
 AVERAGE . . . (PHIF) . . . 0.265  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SW) . . . . 0.135  
 W.AVERAGE . . (SW) \* (PHIF) . 0.097  
 AVERAGE . . . (SH) . . . . 0.873  
 VOID VOLUME: . . . (PHIF) . . 53.576  
 HC VOID VOLUME . . (SH) \* . . 48.368  
 RES HC VOID VOLUME (SHR) \* . . 26.636  
 MOV HC VOID VOLUME . . . . . 21.733

NET PAY

THICKNESS: . . . . . 132.000  
 AVERAGE . . . (PHIF) . . . 0.308  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SW) . . . . 0.059  
 W.AVERAGE . . (SW) \* (PHIF) . 0.052  
 AVERAGE . . . (SH) . . . . 0.941  
 VOID VOLUME: . . . (PHIF) . . 40.610  
 HC VOID VOLUME . . (SH) \* . . 38.487  
 RES HC VOID VOLUME (SHR) \* . . 21.607  
 MOV HC VOID VOLUME . . . . . 16.881

Gas zone:  
 1366 - 1568 m RKB

NET SAND

THICKNESS: . . . . . 132.000  
 AVERAGE . . . (PHIF) . . . 0.308  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SW) . . . . 0.059  
 W.AVERAGE . . (SW) \* (PHIF) . 0.052  
 AVERAGE . . . (SH) . . . . 0.941  
 VOID VOLUME: . . . (PHIF) . . 40.610  
 HC VOID VOLUME . . (SH) \* . . 38.487  
 RES HC VOID VOLUME (SHR) \* . . 21.607  
 MOV HC VOID VOLUME . . . . . 16.881

NET / GROSS RATIOS

HNETPAY / HGROSS SAND = 0.65347  
 HNETSAND / HGROSS SAND = 0.65347  
 HNETPAY / HNETSAND = 1.00000

STATISTICS

FIELD: . . . . . BLOCK 31/2  
 WELL: . . . . . 31-2-4  
 DATE: . . . . . 10.26.08 20 JANUARY 1981  
 ENGINEER: . . . . . JIS

DEPTH INTERVAL: . . . 1568.00 TO 1580.00  
 APPLIED CUTOFFS:

. VSH: GREATER THAN 0.40  
 . PHIF: LESS THAN 0.24  
 . SW: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 12.000  
 AVERAGE . . . (PHIF) . . . 0.277  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SM) . . . . . 0.268  
 W.AVERAGE . . . (SM) ♦ (PHIF) 0.242  
 AVERAGE . . . (SH) . . . . . 0.732  
 VOID VOLUME: . . . (PHIF) . . . 3.328  
 HC VOID VOLUME . . (SH) ♦ . . . 2.522  
 RES HC VOID VOLUME (SHR) ♦ . . 1.736  
 MOV HC VOID VOLUME . . . . . 0.786

NET PAY

THICKNESS: . . . . . 8.750  
 AVERAGE . . . (PHIF) . . . 0.301  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SM) . . . . . 0.218  
 W.AVERAGE . . . (SM) ♦ (PHIF) 0.208  
 AVERAGE . . . (SH) . . . . . 0.782  
 VOID VOLUME: . . . (PHIF) . . . 2.630  
 HC VOID VOLUME . . (SH) ♦ . . . 2.084  
 RES HC VOID VOLUME (SHR) ♦ . . 1.423  
 MOV HC VOID VOLUME . . . . . 0.661

Oil zone:  
 1568 - 1580 m RKB

NET SAND

THICKNESS: . . . . . 8.750  
 AVERAGE . . . (PHIF) . . . 0.301  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SM) . . . . . 0.218  
 W.AVERAGE . . . (SM) ♦ (PHIF) 0.208  
 AVERAGE . . . (SH) . . . . . 0.782  
 VOID VOLUME: . . . (PHIF) . . . 2.630  
 HC VOID VOLUME . . (SH) ♦ . . . 2.084  
 RES HC VOID VOLUME (SHR) ♦ . . 1.423  
 MOV HC VOID VOLUME . . . . . 0.661

NET / GROSS RATIOS

HNTPAY / HGROSS SAND = 0.72917  
 HNETSAND / HGROSS SAND = 0.72917  
 HNTPAY / HNETSAND = 1.00000

Waxman - Smith evaluation

Cation - exchange - capacity

31/2-1

$$Q_v = a \cdot \phi^{-b}$$

Sample no.	Porosity	Qv
2	.341	0.06
8	.309	0.12
14	.380	0.05
17	.287	0.23
19	.323	0.02
21	.358	0.10
22	.248	0.25
24	.292	0.13

Linear regression:  $a = 14.915 \cdot 10^{-4}$   
 $b = -3.748$

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

$$R_w = 0.06$$

$$B = 9 \text{ at } 125^\circ\text{F}$$

Qv	F	F*	$\phi$ , Porosity
0.0623	6.4	6.615	0.3659
0.0958	14.3	15.040	0.3294
0.1028	13.3	14.039	0.3232
0.0621	6.4	6.615	0.3698
0.1616	20.6	22.397	0.2865
0.0852	13.2	13.808	0.3398
0.1025	12.0	12.664	0.3235
0.0865	11.2	11.723	0.3385
0.2787	21.6	24.851	0.2477
0.1510	21.0	22.713	0.2917

$$F^* = a \cdot \phi^{-m}$$

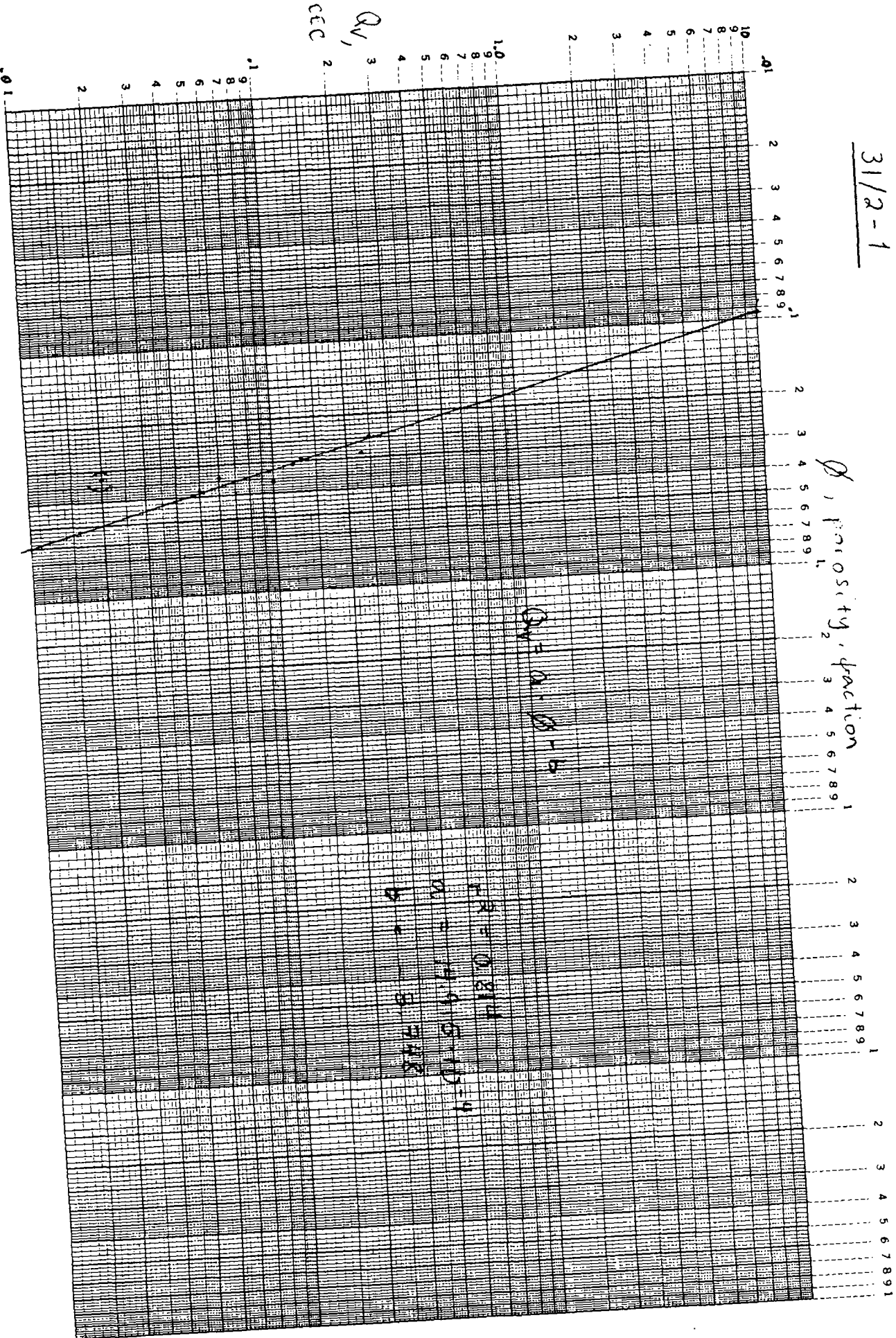
Linear regression:  $a = .532618$   
 $m = -0.188956$

31/2-1

$\phi$ , porosity, fraction

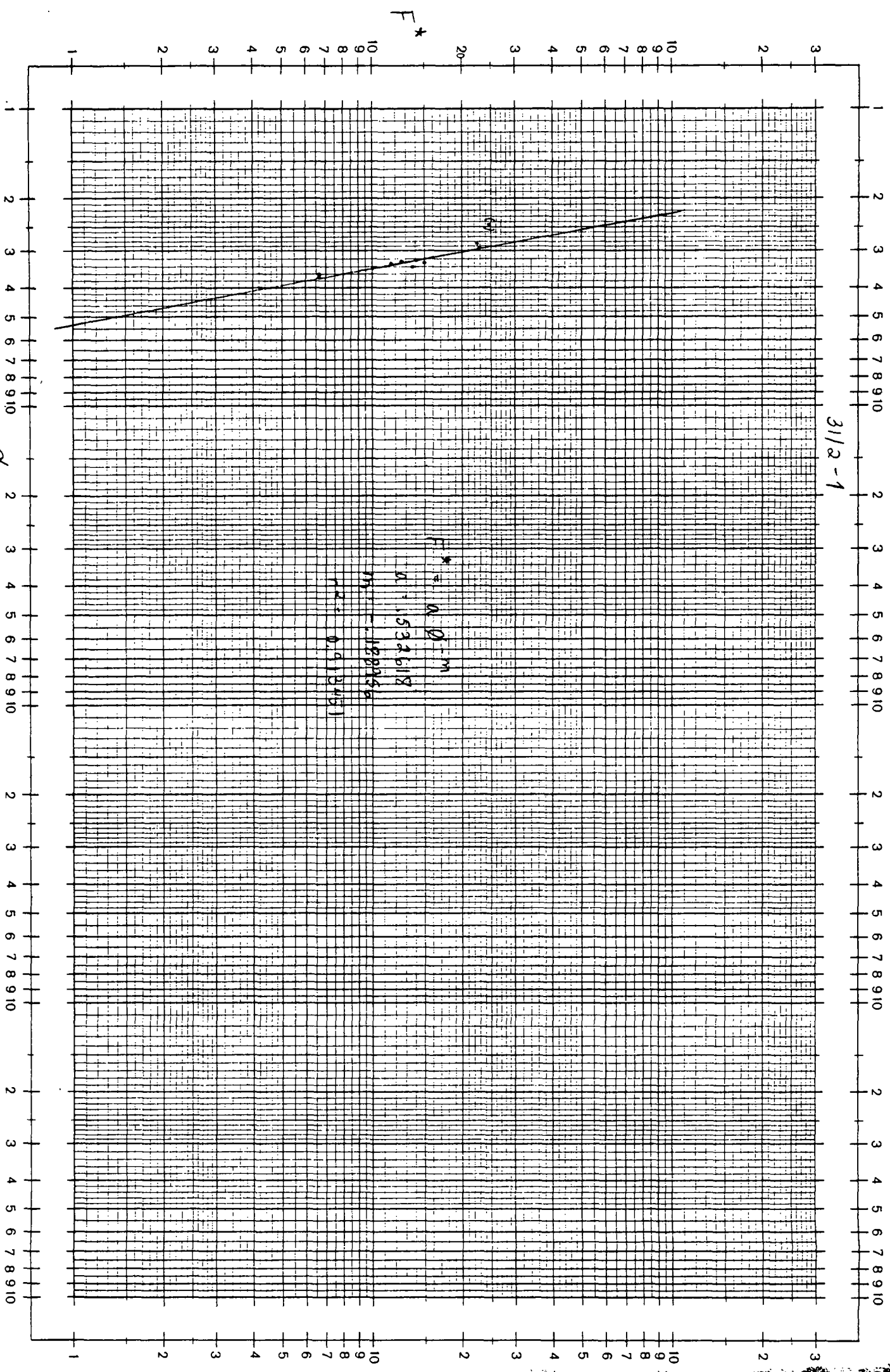
$Q_v = a \cdot \phi - b$

$a = 0.814$   
 $b = 0.148$



$Q_v$ ,  
CEC

31/2-1



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Bestell-Nr. 667152, Nr. 369 1/2. MADE IN GERMANY

Beide Achsen logar geteilt von 1 bis 10000 und 1 bis 300 Einheit 62,5 mm

STATISTICS

FIELD: . . . . . BLOCK 31/2  
WELL: . . . . . 31-2-4  
DATE: . . . . . 09.55.25 20 JANUARY 1981  
ENGINEER: . . . . . JIS

DEPTH INTERVAL: . . . 1366.00 TO 1580.00  
APPLIED CUTOFFS:

. VSH: GREATER THAN 0.40  
. PHIF: LESS THAN 0.24  
. SM: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 214.000  
AVERAGE . . . (PHIF) . . . 0.266  
AVERAGE . . . (VSHALE) . . . 0.000  
AVERAGE . . . (SM) . . . 0.020  
W.AVERAGE . . . (SM) \* (PHIF) . . . 0.018  
AVERAGE . . . (SH) . . . 0.980  
VOID VOLUME: . . . ((PHIF) \* . . . 56.904  
HC VOID VOLUME . . . ((SH) \* . . . 55.866  
RES HC VOID VOLUME ((SHR) \* . . . 51.040  
MOV HC VOID VOLUME . . . . . 4.826

NET PAY

THICKNESS: . . . . . 140.750  
AVERAGE . . . (PHIF) . . . 0.307  
AVERAGE . . . (VSHALE) . . . 0.000  
AVERAGE . . . (SM) . . . 0.014  
W.AVERAGE . . . (SM) \* (PHIF) . . . 0.013  
AVERAGE . . . (SH) . . . 0.986  
VOID VOLUME: . . . ((PHIF) \* . . . 43.240  
HC VOID VOLUME . . . ((SH) \* . . . 42.670  
RES HC VOID VOLUME ((SHR) \* . . . 38.573  
MOV HC VOID VOLUME . . . . . 4.097

Total h.c. zone:  
1366 - 1580 m RKB

NET SAND

THICKNESS: . . . . . 140.750  
AVERAGE . . . (PHIF) . . . 0.307  
AVERAGE . . . (VSHALE) . . . 0.000  
AVERAGE . . . (SM) . . . 0.014  
W.AVERAGE . . . (SM) \* (PHIF) . . . 0.013  
AVERAGE . . . (SH) . . . 0.986  
VOID VOLUME: . . . ((PHIF) \* . . . 43.240  
HC VOID VOLUME . . . ((SH) \* . . . 42.670  
RES HC VOID VOLUME ((SHR) \* . . . 38.573  
MOV HC VOID VOLUME . . . . . 4.097

NET / GROSS RATIOS

HNTPAY / HGROSS SAND = 0.65771  
HNESAND / HGROSS SAND = 0.65771  
HNTPAY / HNESAND = 1.00000

STATISTICS

FIELD: . . . . . BLOCK 31/2  
 WELL: . . . . . 31-2-4  
 DATE: . . . . . 09.59.43 20 JANUARY 1981  
 ENGINEER: . . . . . JIS

DEPTH INTERVAL: . . . 1366.00 TO 1568.00  
 APPLIED CUTOFFS:

. VSH: GREATER THAN 0.40  
 . PHIF: LESS THAN 0.24  
 . SW: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 202.000  
 AVERAGE . . . (PHIF) . . . 0.265  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SW) . . . 0.019  
 W.AVERAGE . . (SW) ♦ (PHIF) . . 0.016  
 AVERAGE . . . (SH) . . . 0.981  
 VOID VOLUME: . . . (PHIF) . . . 53.576  
 HC VOID VOLUME . . (SH) ♦ . . . 52.696  
 RES HC VOID VOLUME (SHR) ♦ . . . 48.049  
 MOV HC VOID VOLUME . . . . . 4.647

NET PAY

THICKNESS: . . . . . 132.000  
 AVERAGE . . . (PHIF) . . . 0.308  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SW) . . . 0.012  
 W.AVERAGE . . (SW) ♦ (PHIF) . . 0.011  
 AVERAGE . . . (SH) . . . 0.988  
 VOID VOLUME: . . . (PHIF) . . . 40.610  
 HC VOID VOLUME . . (SH) ♦ . . . 40.159  
 RES HC VOID VOLUME (SHR) ♦ . . . 36.219  
 MOV HC VOID VOLUME . . . . . 3.941

Gas zone:  
 1366 - 1568 m RKB

NET SAND

THICKNESS: . . . . . 132.000  
 AVERAGE . . . (PHIF) . . . 0.308  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SW) . . . 0.012  
 W.AVERAGE . . (SW) ♦ (PHIF) . . 0.011  
 AVERAGE . . . (SH) . . . 0.988  
 VOID VOLUME: . . . (PHIF) . . . 40.610  
 HC VOID VOLUME . . (SH) ♦ . . . 40.159  
 RES HC VOID VOLUME (SHR) ♦ . . . 36.219  
 MOV HC VOID VOLUME . . . . . 3.941

NET / GROSS RATIOS

HNETPAY / HGROSS SAND = 0.65347  
 HNETSAND / HGROSS SAND = 0.65347  
 HNETPAY / HNETSAND = 1.00000



STATISTICS

FIELD: . . . . . BLOCK 31/2  
 WELL: . . . . . 31-2-4  
 DATE: . . . . . 10.05.46 20 JANUARY 1981  
 ENGINEER: . . . . . JIS

DEPTH INTERVAL: . . . 1568.00 TO 1580.00  
 APPLIED CUTOFFS:

. VSH: GREATER THAN 0.40  
 . PHIF: LESS THAN 0.24  
 . SW: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 12.000  
 AVERAGE . . . (PHIF) . . . 0.277  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SW) . . . . 0.050  
 W.AVERAGE . . (SW) \* (PHIF) . 0.047  
 AVERAGE . . . (SH) . . . . 0.950  
 VOID VOLUME: . . . ((PHIF)) . 3.328  
 HC VOID VOLUME . . (SH) \* . . 3.170  
 RES HC VOID VOLUME ((SHR) \* . . 2.992  
 MOV HC VOID VOLUME . . . . . 0.179

NET PAY

THICKNESS: . . . . . 8.750  
 AVERAGE . . . (PHIF) . . . 0.301  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SW) . . . . 0.047  
 W.AVERAGE . . (SW) \* (PHIF) . 0.045  
 AVERAGE . . . (SH) . . . . 0.953  
 VOID VOLUME: . . . ((PHIF)) . 2.630  
 HC VOID VOLUME . . (SH) \* . . 2.511  
 RES HC VOID VOLUME ((SHR) \* . . 2.354  
 MOV HC VOID VOLUME . . . . . 0.157

Oil zone:  
 1568 - 1580 m RKB

NET SAND

THICKNESS: . . . . . 8.750  
 AVERAGE . . . (PHIF) . . . 0.301  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SW) . . . . 0.047  
 W.AVERAGE . . (SW) \* (PHIF) . 0.045  
 AVERAGE . . . (SH) . . . . 0.953  
 VOID VOLUME: . . . ((PHIF)) . 2.630  
 HC VOID VOLUME . . (SH) \* . . 2.511  
 RES HC VOID VOLUME ((SHR) \* . . 2.354  
 MOV HC VOID VOLUME . . . . . 0.157

NET / GROSS RATIOS

HNETPAY / HGROSS SAND = 0.72917  
 HNETSAND / HGROSS SAND = 0.72917  
 HNETPAY / HNETSAND = 1.00000