725.5

725.1

L-222

PRESSURE PREDICTION

WELL 34/10-4

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INTRODUCTION

A prediction of the pressure regime in well 34/10-4 has been worked out based on data from adjacent wells in the area. Same reports for 34/10-1, 2 and 3 can be used for more background data.

HYDROSTATIC GRADIENT

RFT-pressure measurements indicate a gradient of 1.001 gm/cc in Tertiary formations (34/10-2). The salinity in Brent formation in 34/10-3 was ~45000 ppm NaCl which gives a density of ~1.025 gm/cc equivalent. 34/10-1 RFT-measurements gave a water gradient in Statfjord formation of about 1.045 gm/cc.

OVERBURDEN GRADIENT

Prognosed overburden gradient and overburden gradients obtained from FDC-data in the area are plotted on enclosed graphs. (Fig. 1 and 5.)

FRACTURE GRADIENT

The predicted fracture gradient is based on the results from wells 34/10-1 and 3. This is in fair agreement with formation integrity tests in the area. (Fig. 1 and 4.)

PORE PRESSURE (Fig. 1 and 3)

Upper Tertiary: The formations down to 1150 - 1300 m will have normal pressure. The pressure transition zone will probably start at the base of the sandy section of Oligocene/ Top Eocene (~1300 m).

Paleocene : The pressure gradient will increase to a maximum in Paleocene. Data from 34/10-1 and 34/10-3 indicate that horizontal pressure communication does not exist in this formation. The pressure in Paleocene/ Cret. can be dependent on the thickness of Cretaceous formation.

Jurassic : The pressure gradient in Top Brent will be in the order of 1.71 - 1.73 gm/cc maximum. This is based on the DST pressure measurements in 34/10-1, and RFT measurements in 34/10-3. A graph of pressure vs depth and pressure gradient vs depth for this formation is enclosed.

The pressure gradient will decrease towards T.D.

EXPERIENCE FROM WELL 34/10-3 (Fig. 2)

The experience from well 34/10-3 is in fair agreement with the predicted data. The pressure regime is generally the same as experienced in 34/10-1 and 34/10-2; Upper Tertiary formations have normal hydrostatic pressure while lower Eocene, Paleocene, Cretaceous and Jurassic formations have abnormally high pressure.

Top of transition zone starts at a depth of ~1475 m which is the base of the sandy section in Oligocene and Eocene.

It is impossible to estimate the accurate pressure gradients in the transition zone from sonic and Dc-exponent. But the pressure gradient is probably close to the mud weight used. This is supported by the fact that the section from 1575 m to 9 5/8" csg shoe was drilled with connection gas and the trip gas at the 9 5/8" csg shoe was about 1300 units with 1.5 gm/cc mud weight.

The different faultblocks on this structure seem to be in pressure communication. The gradient for top Brent can therefore be accurately determined.

The reported leak-off tests are in line with the results from 34/10-1. The reported results at 9 5/8" and 7" csg shoes are abnormally high compared to the overburden pressure, specially that at the 7" liner shoe. The integrity test at the 9 5/8" shoe might have tested cemented formation (rat hole?). A second test after drilling some more formation at these depths should have been performed in order to verify the reported tests.

DRILLING CONSIDERATION

Quaternary and Upper Tertiary formations (down to ~850 m) usually contain gas, and high drill gas must be expected.

The silty formations in Paleocene usually contain gas, and high drill gas must be expected.

The 13 3/8" csg have been stuck on some wells on the area at a depth of ~1300 m. This can be due to differential sticking and/ or swelling clays.

CONCLUSIONS AND RECOMMENDATIONS

The pressures in 34/10-4 can be predicted fairly accurately. The most uncertain part is the Paleocene/ Cretaceous formations.

The data from 34/10-3 showed that the calculated pressures from sonic and Dc-exponent are very uncertain. It is therefore recommended to have pressure prediction personnel on board while drilling for the 13 3/8" shoe and during drilling of the Paleocene formation, in order to get a good seat for the 13 3/8" csg and to get a better understanding of pressure regime in Paleocene/ Cretaceous. This is necessary in order to possibly be able to optimize the drilling/ csg program for future wells.

The pressures in top Brent can be predicted accurately and will be in the order of 1.71 - 1.73 gm/cc for the prognosed depth.

GRAPHS

- Pressure Prediction 34/10-4
- Pressure composite 34/10-3
- Pressure gradients, East Shetland Basin
- Fracture gradients, " " "
- Overburden gradients in the area
- Pressure VS depth in Brent formation
- Pressure composite 34/10-1
- Pressure composite 34/10-2
- Pressure indicator plots 34/10-3

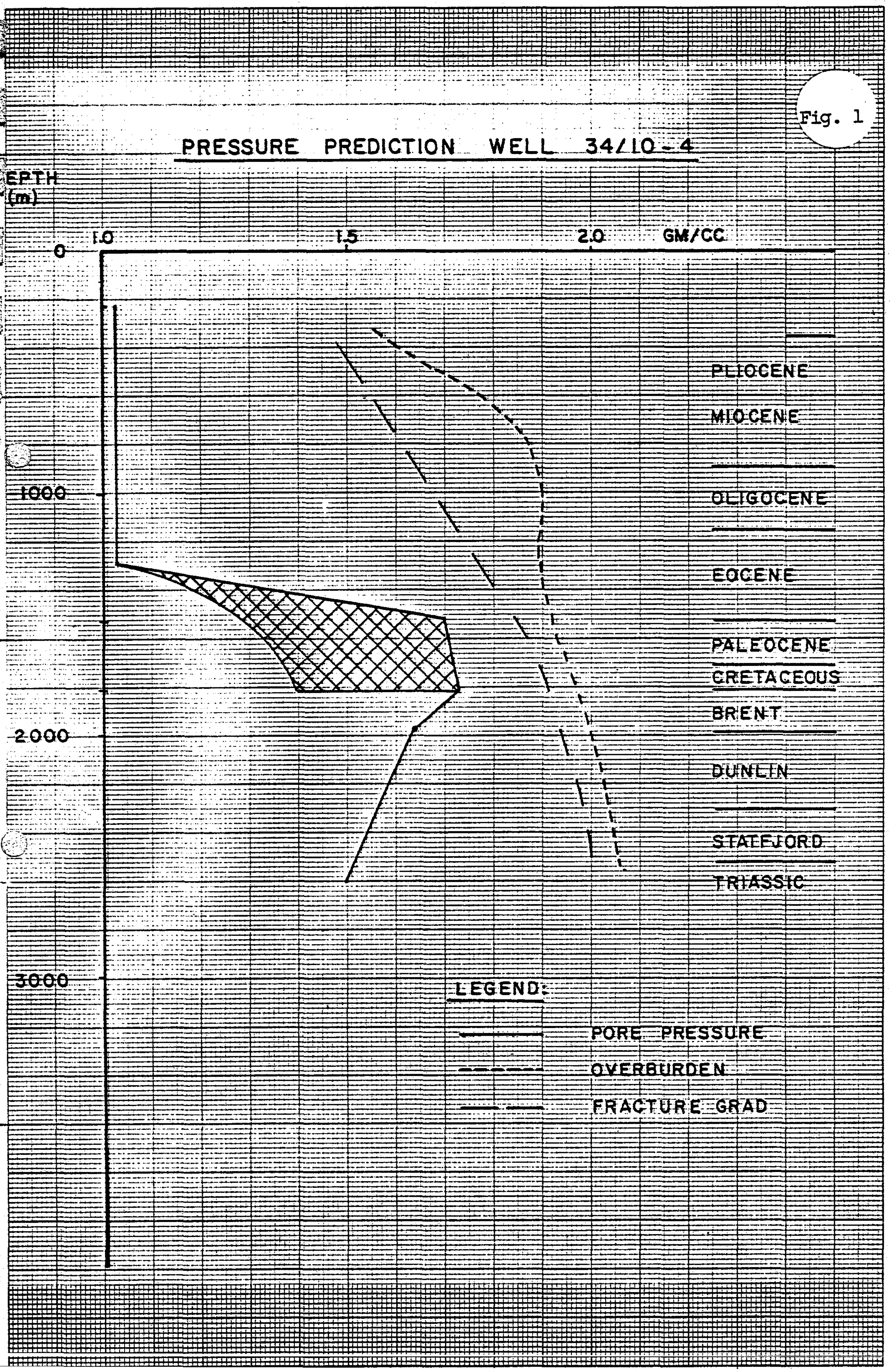


Fig. 1
PRESSURE PREDICTION WELL 34/10-4
EPTH
(m)
0
1000
2000
3000
1.0
1.5
2.0
GM/CC
PLIOCENE
MIOCENE
OLIGOCENE
EOCENE
PALEOCENE
CRETACEOUS
BRENT
DUNLIN
STATFJORD
TRIASSIC
LEGEND:
PORE PRESSURE
OVERBURDEN
FRACTURE GRAD

Fig. 2

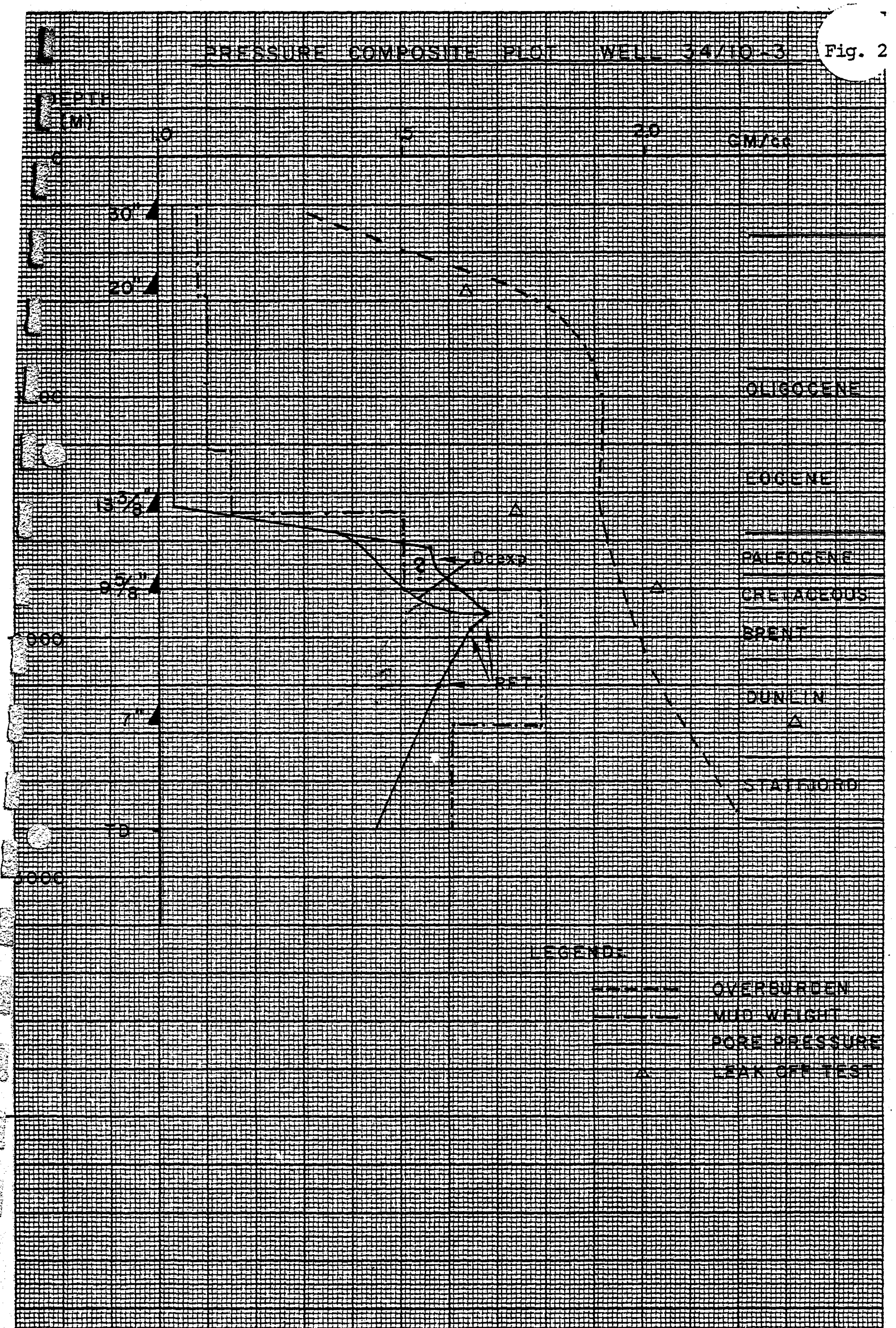
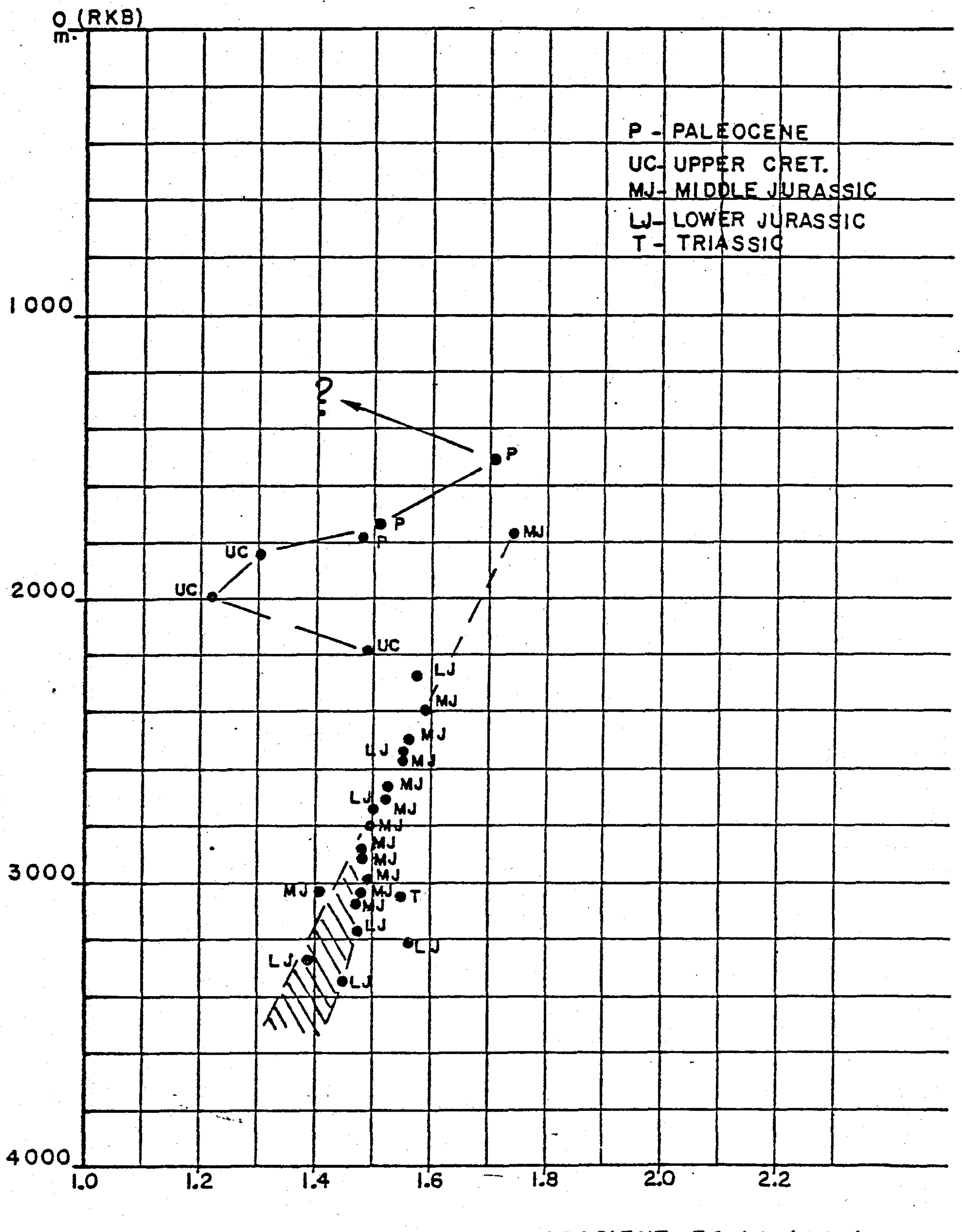

PRESSURE COMPOSITE PLOT WELL 34/10-3
DEPTH (M)
1.0
1.5
2.0
GM/cc
0
30"
20"
13⅜"
9⅝"
7"
TD
1000
2000
OLIGOCENE
EOCENE
PALEOGENE
CRETACEOUS
BRENT
DUNLIN
STATFJORD
Dcexp
RFT
LEGEND:
OVERBURDEN
MUD WEIGHT
PORE PRESSURE
LEAK OFF TEST

Fig. 3

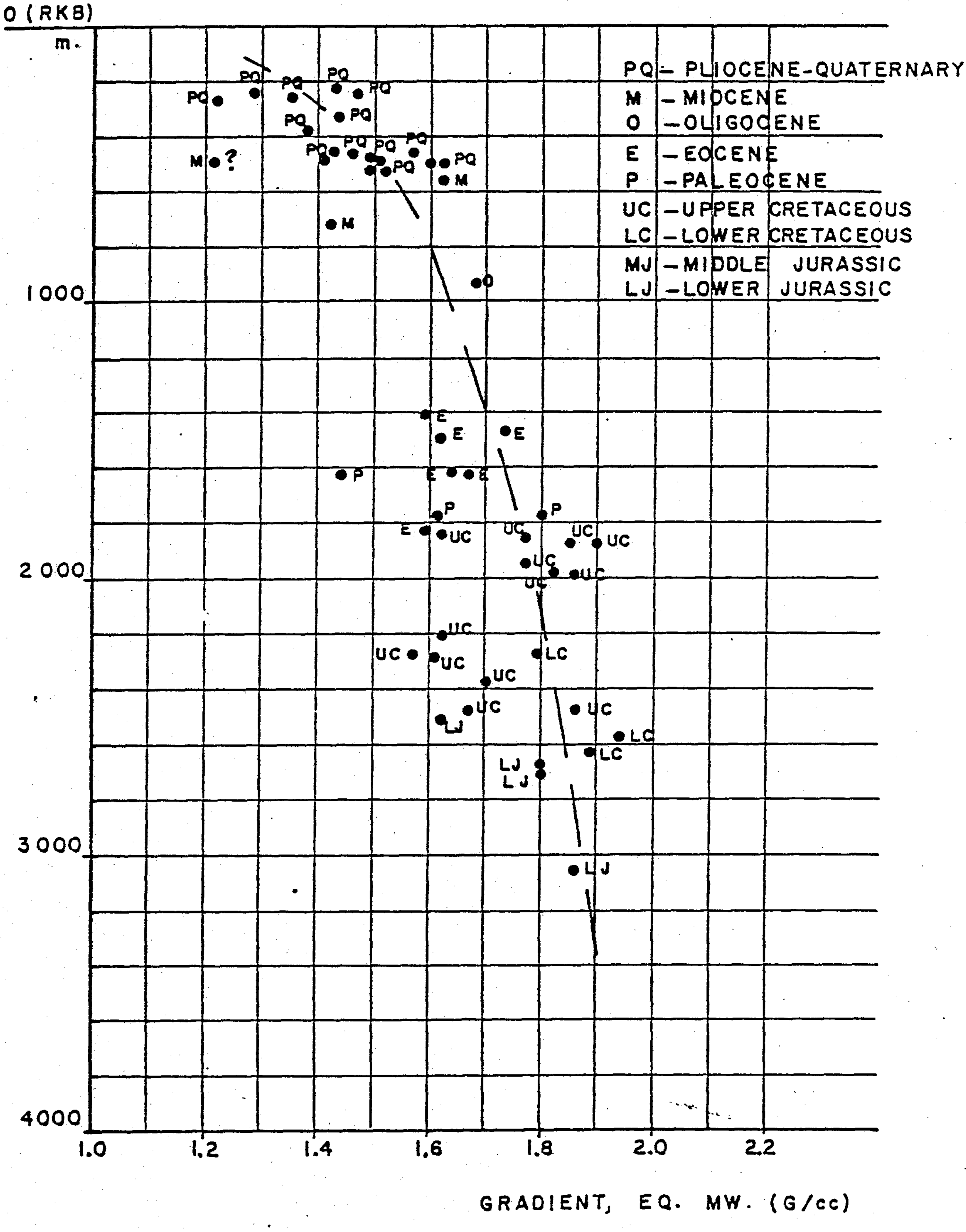
PORE PRESSURE GRADIENT

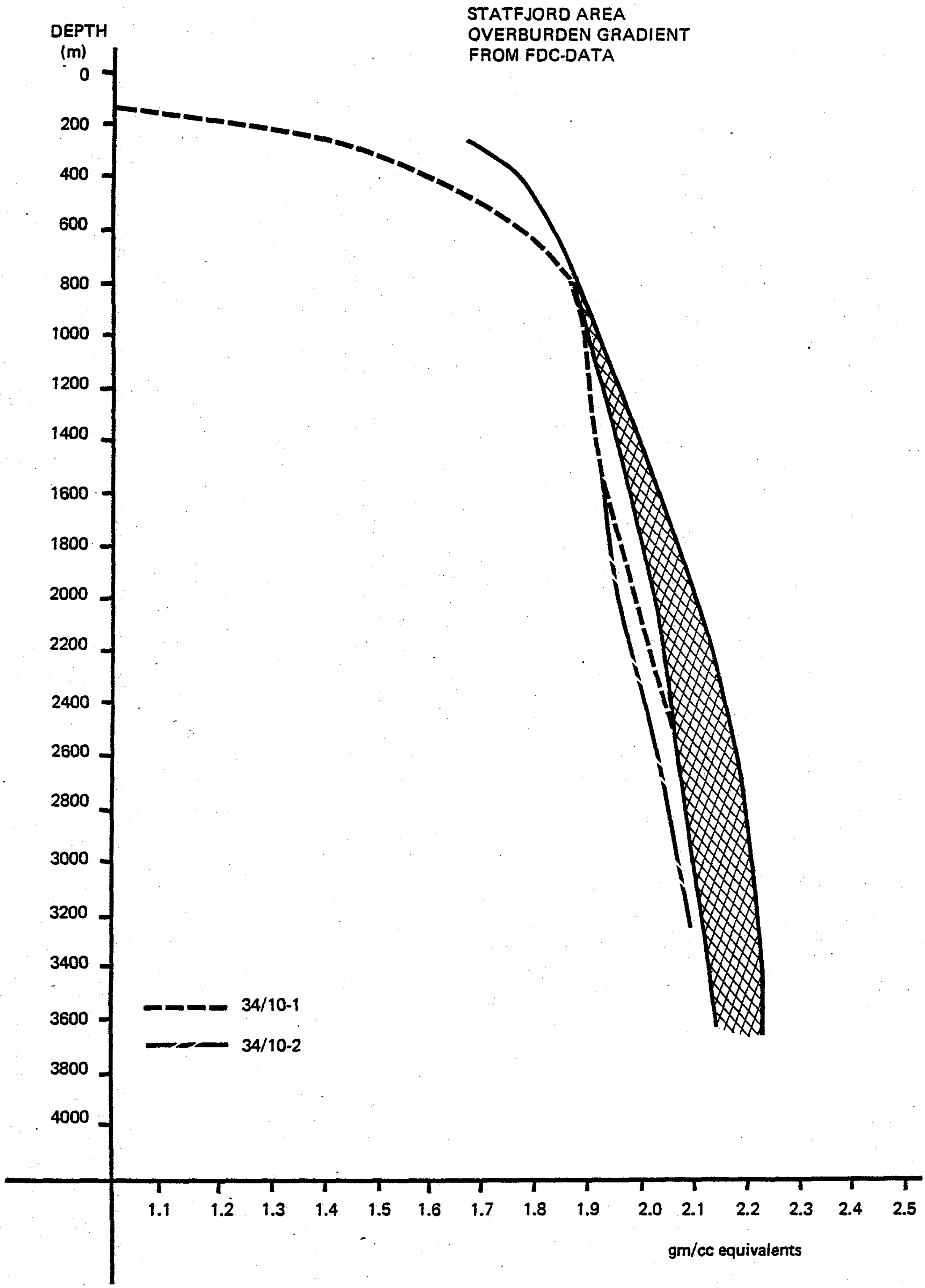
EAST SHETLAND BASIN



FORMATION INTEGRITY

EAST SHETLAND BASIN




STATFJORD AREA
OVERBURDEN GRADIENT
FROM FDC-DATA
DEPTH
(m)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
34/10-1
34/10-2
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
2.2
2.3
2.4
2.5
gm/cc equivalents

BRENT FORMATION

FORMATION PRESSURE AND PRESSURE GRADIENT VERSUS DEPTH IN 34/10-1 STRUCTURE. BASED ON DST AND RFT DATA FROM 34/10-1 (RKB = 25 m)

Fig. 6

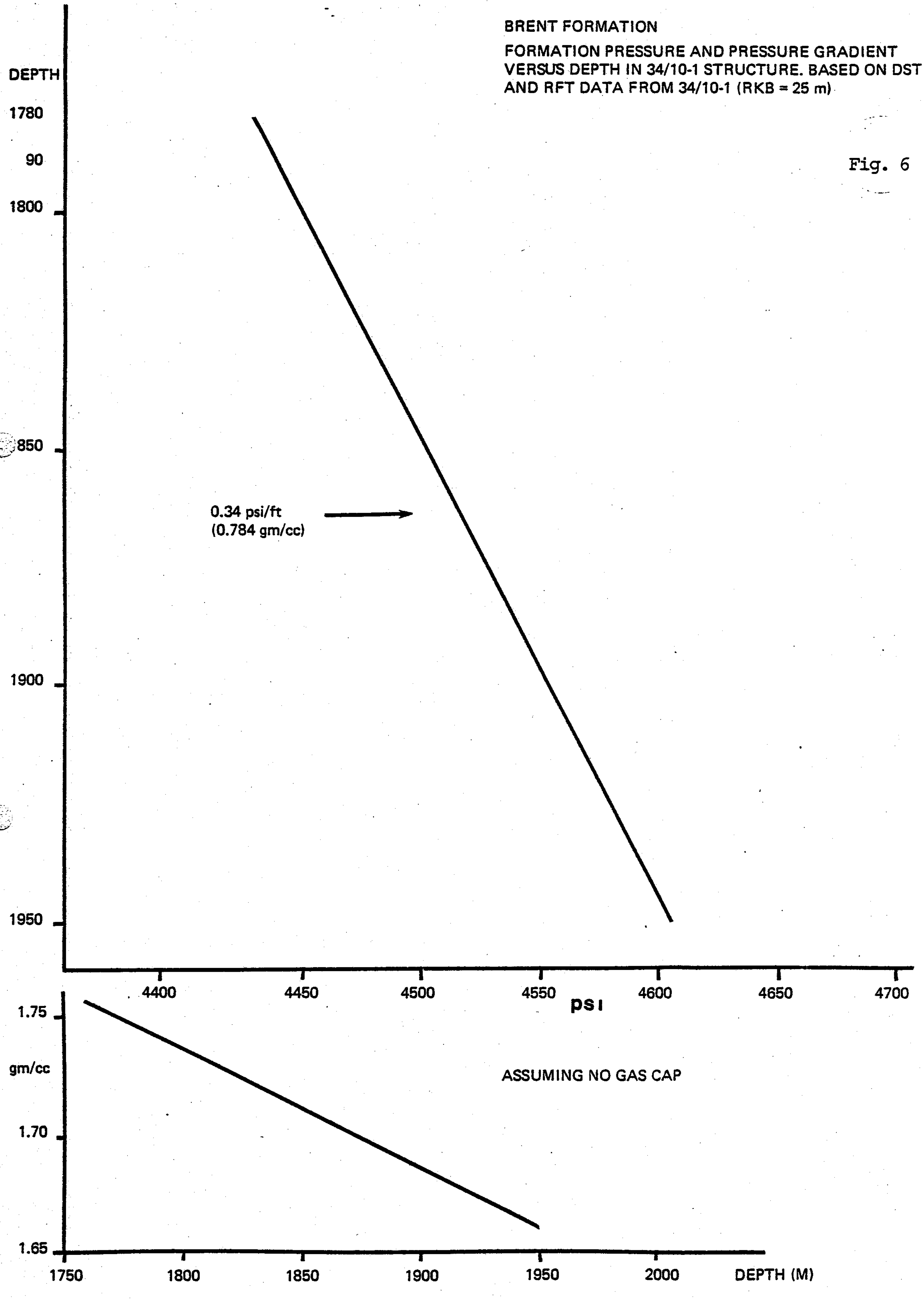
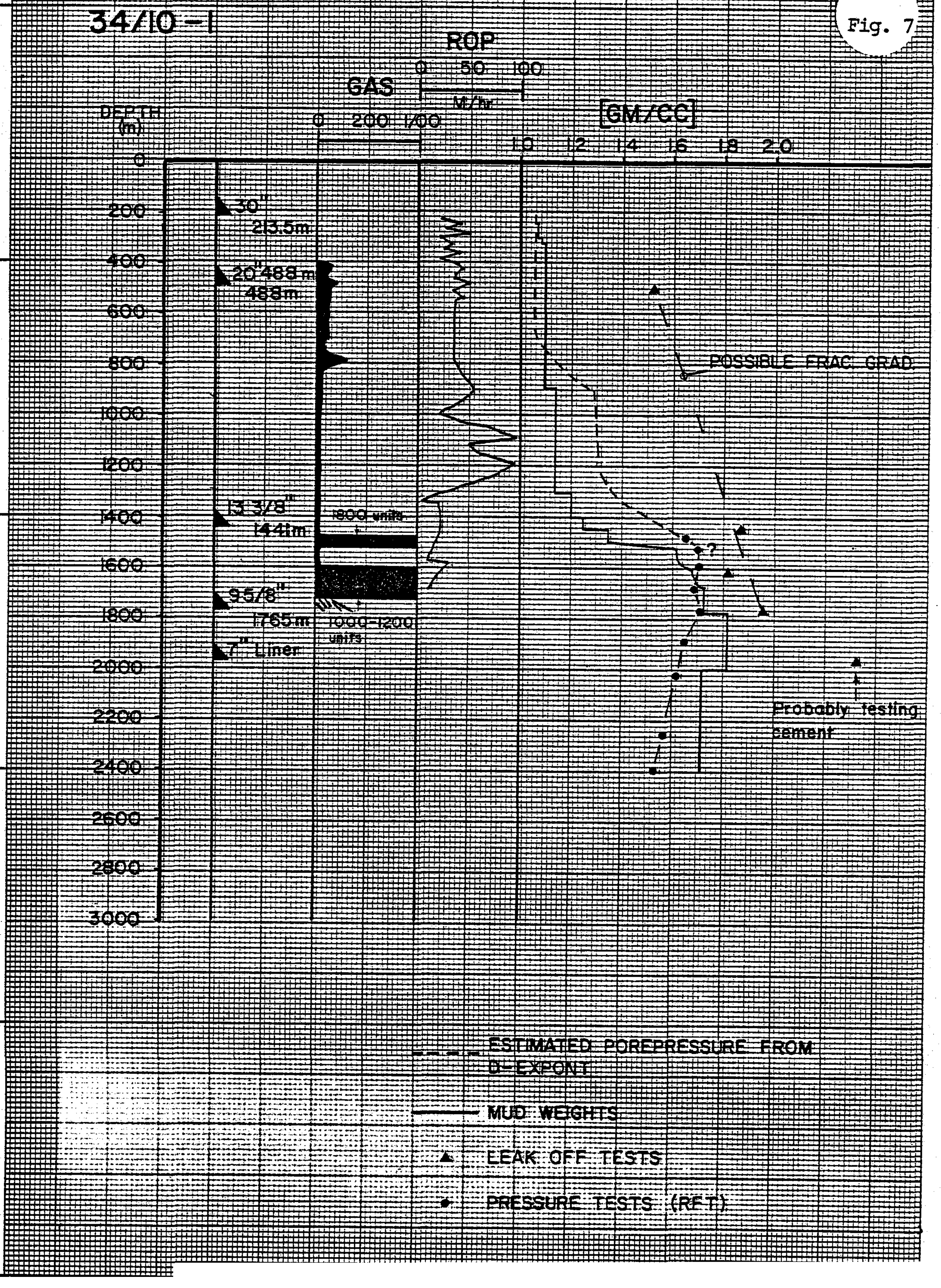


Fig. 7


34/10-1
ROP
0 50 100
M/hr
GAS
0 200 1/00
DEPTH (m)
[GM/CC]
1.0 1.2 1.4 1.6 1.8 2.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
30" 213.5m
20" 488 m 488m
13 3/8" 1441m
9 5/8" 1765 m
7" Liner
1800 units
1000-1200 units
POSSIBLE FRAC GRAD.
?
Probably testing cement
ESTIMATED POREPRESSURE FROM D-EXPONT
MUD WEIGHTS
LEAK OFF TESTS
PRESSURE TESTS (RFT)

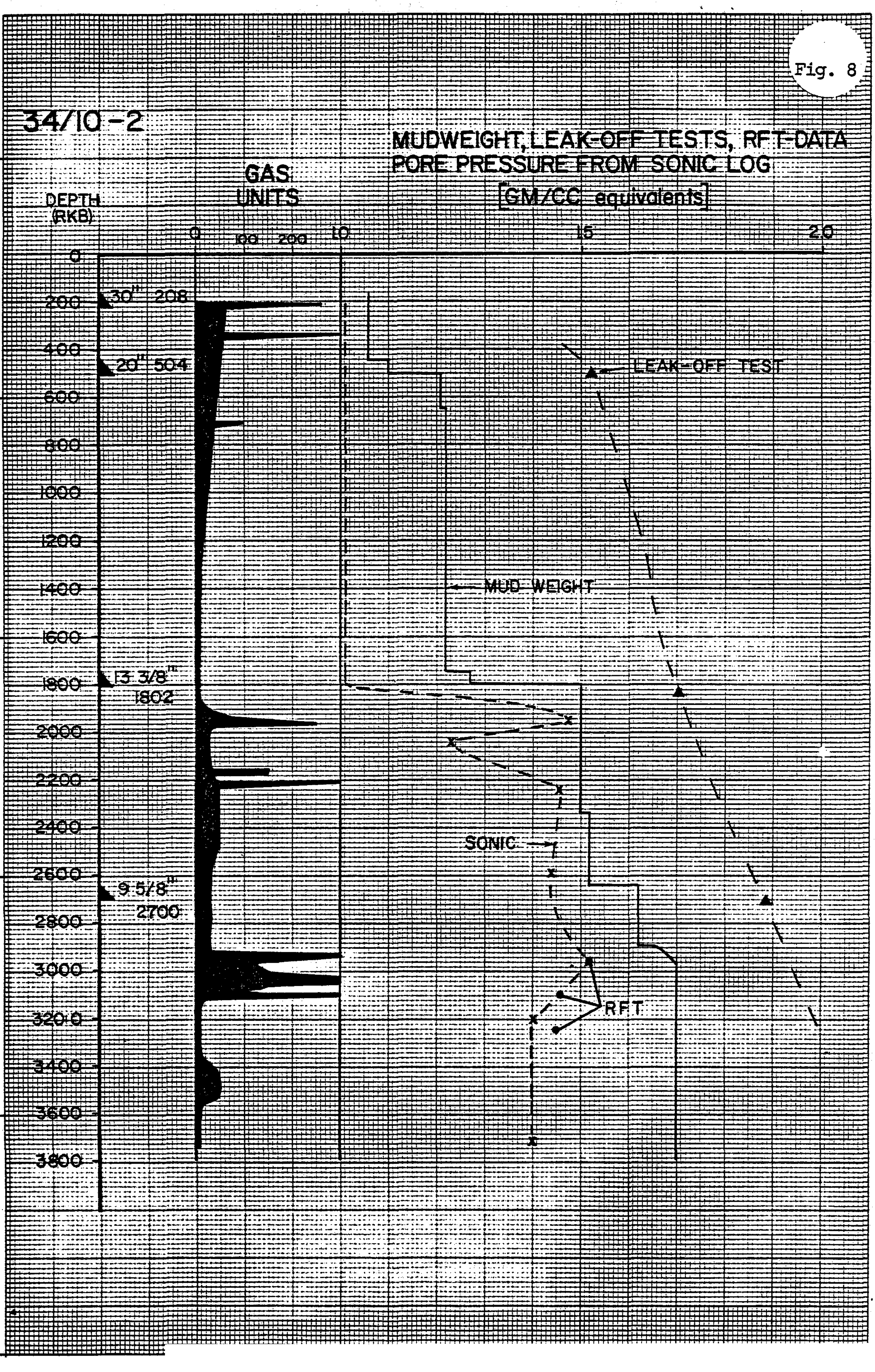
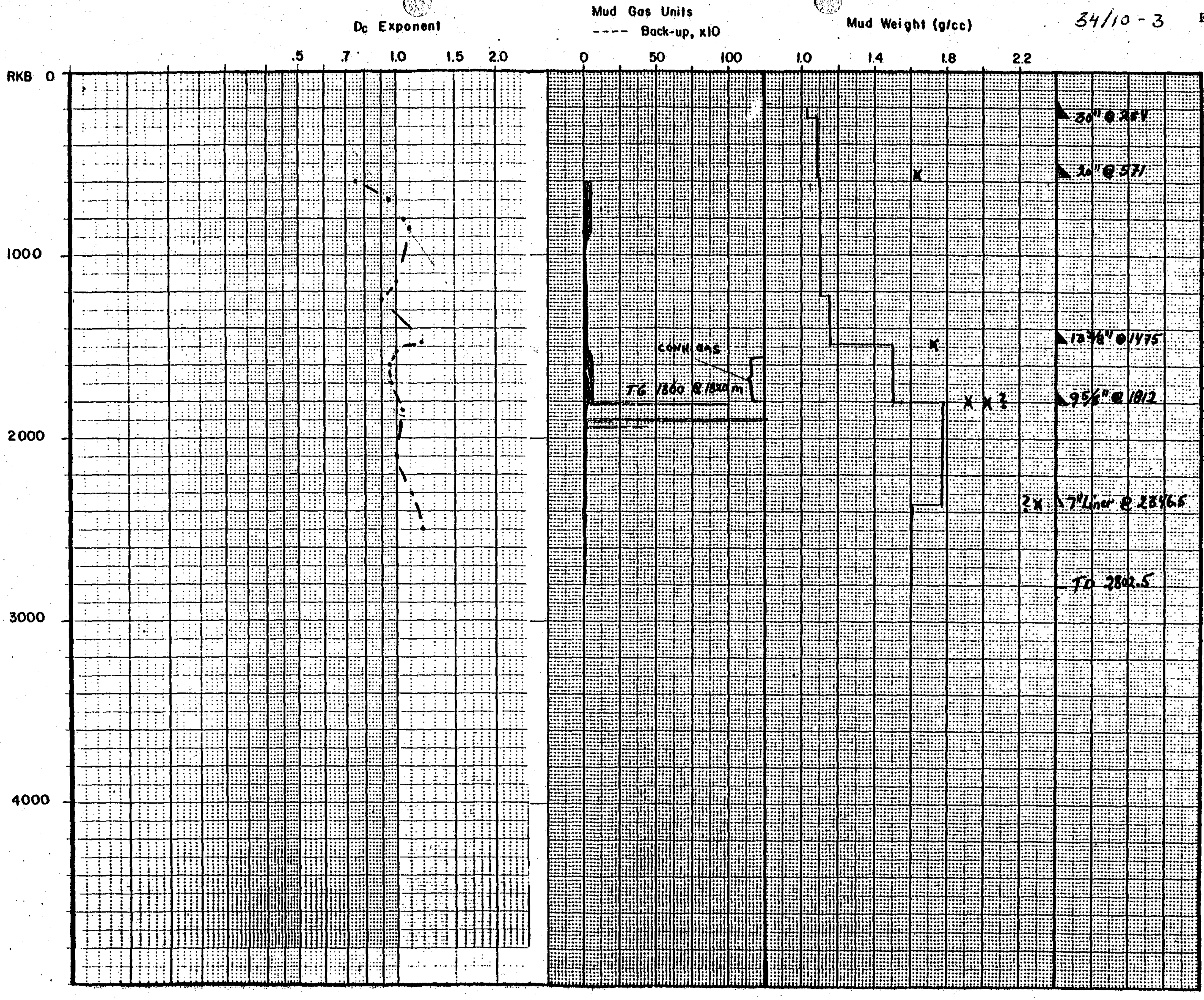


Fig. 8
34/10-2
MUDWEIGHT, LEAK-OFF TESTS, RFT-DATA
PORE PRESSURE FROM SONIC LOG
[GM/CC equivalents]
GAS UNITS
DEPTH (RKB)
0
100
200
1.0
1.5
2.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
30" 208
20" 504
13 3/8" 1802
9 5/8" 2700
LEAK-OFF TEST
MUD WEIGHT
SONIC
RFT

34/10 - 3 Fig. 9



Dc Exponent
Mud Gas Units
---- Back-up, x10
Mud Weight (g/cc)
.5 .7 1.0 1.5 2.0
0 50 100
1.0 1.4 1.8 2.2
RKB 0
1000
2000
3000
4000
CONN GAS
TG 1860 @ 1840 m
30" @ 284
20" @ 571
13 3/8" @ 1475
9 5/8" @ 1812
7" Liner @ 2846.5
TD 2802.5

34[redacted]3

Fig.10