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PRESSURE PREDICTION
30-2-1 NORTH AND 30-2-1 SOUTH

Engineers: B.Hultberg/H.M.Strømmevold
LET - BERGEN
November 1981

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INTRODUCTION

This pressure development has been compared to other wells in the area with typical Viking Graben on one side and wells on the Bergen High on the other. The wells drilled so far in blocks 30/4, 30/7 and 30/3 have been important for this prediction, see fig. 1, 2 and 3. The locations of 30-2-1 North and South are both close to the location of 30-3-1. They are therefore assumed to show a similar pressure pattern to 30-3-1. It should be kept in mind that this pressure prediction will be revised if pressure data from 30-3-1 phase 2 are available before spudding 30-2-1 north or south.

This prediction follows in a broad sense the prediction of 30-3-1 phase 2, to which we refer.

PRESSURE PREDICTION 30-2-1 NORTH AND 30-2-1 SOUTH

The pore pressure predictions for 30-2-1 north and south are presented as figures 4 and 5.

Tertiary

Normal hydrostatic gradient will be present down to Lower Eocene - 1700m, from where a slight build-up of overpressure starts. A maximum gradient of 1.25 g/cc is believed to be present at the Tertiary/Cretaceous boundary.

Cretaceous

A rather sharp increase in the pressure gradient will probably occur down to - 2400m with a maximum pressure of approximately 1.65 g/cc. Deeper there are indications that the pore pressure gradient will be constant or slightly decreasing, 1.61 - 1.65 g/cc, through most of the Upper Cretaceous section.

While drilling this section in 30-3-1 phase 1, gas peaks were reported, leading to an excessive raise in mud weight.

Intermediate logs showed that these peaks resulted from interbedded lithology rather than produced gas.

A second transition zone will probably be encountered at the Cretaceous/Jurassic boundary.

Jurassic

Figure 6 shows the RFT measurements obtained so far on these blocks for the Brent and Statfjord formations.

Only well 30-4-2 has RFT measurements in the Statfjord formation.

As figure 6 illustrates, there are at least two seperate pressure regimes in blocks 30-4 and 30-7; quite possibly all three wells are representing separate regimes. This illustrates the difficulties involved in making reliable pressure predictions for the heavily faulted Viking Graben.

The pressure is expected to increase rapidly through the Upper Jurassic shales to reach approximately 2.0 g/cc at the top of the Brent sands.

The pressure distribution through the Upper Jurassic sequence is uncertain, but it is expected that the maximum pressures will be encountered in the top of Brent.

It should be kept in mind that the Graben wells have experienced gradients up to 2.05 g/cc at this level.

In the sand a drop in pressure gradient will be observed according to the fluid present.

Due to the thick Dunlin shale sequence, there is a possibility for a pressure barrier between Brent and Statfjord. Consequently an increase in pressure gradient when entering the Statfjord sands could be present.

Sparse amount of pressure information is available from this sequence.

Some graben wells have shown the same gradient in top Statfjord as in top Brent, i.e. approximately 2.0 g/cc. The uncertainty involved here is greater.

It should be noted that well 30/4-2 exhibits such a pressure distribution, but pressures in Statfjord are lower than in Brent. (Figure 6)

Through the thick lower Jurassic/Triassic sands pressure communication can be assumed, and a pressure regression is expected.

FRACTURE GRADIENT PREDICTION

Very few formation integrity tests have been made in Jurassic formations, but the ones available all show an integrity of 2.1 g/cc or more below 4000 m.

Leak-off values from wells in blocks 30-4, 30-7 and 30-3 are plotted on figure 4 and 5.

OVERBURDEN GRADIENT

The overburden gradient from 30-3-1 phase 1, and the prediction for phase 2 are shown in figure 7. The computed overburden is from integrating Formation density logs. The predicted gradient from 3718 m and downwards is a prolongation of the above with an inclination of the curve as seen in other graben wells. The overburden in 30-2-1 N and S will be very similar to 30-3-1.

HYDROSTATIC GRADIENT

An average hydrostatic gradient of 1.03 g/cc can be assumed and used in quantitative pressure calculations.

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CONCLUSION AND RECOMMENDATIONS

For pressure detection while drilling, ROP, the Dc-exponent, and gas will probably be the best indications.

Intermediate log runs should be considered to get a better estimate of pore pressure. The sonic log has proven to be the best tool in that case. To reach TD will probably be a very close balance between "kick" and "lost circulation", and the best possible estimate of pore pressure is important.

MIDDLE JURASSIC PORE PRESS. GRAD.

FOR VIKING GRABEN

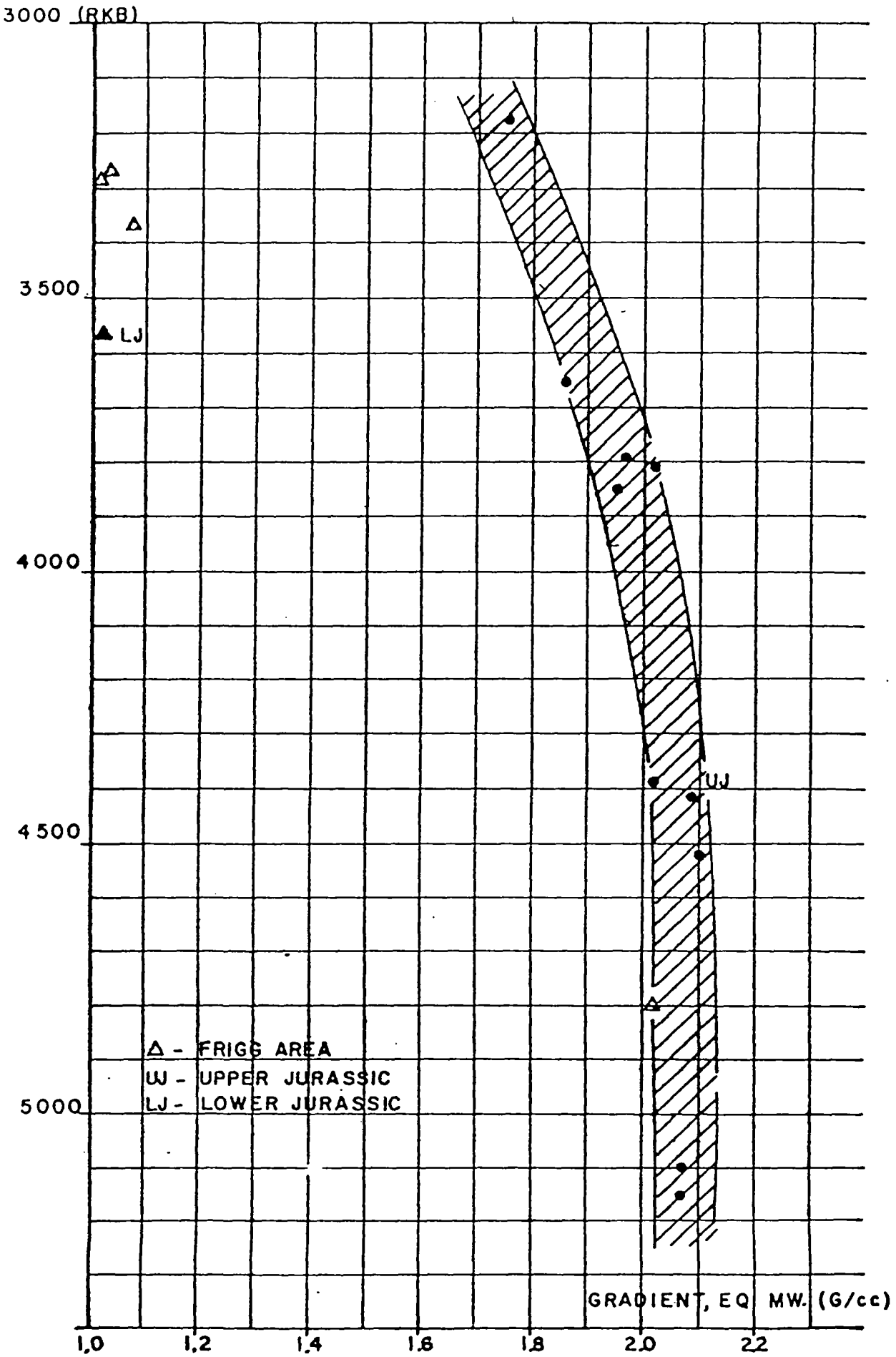
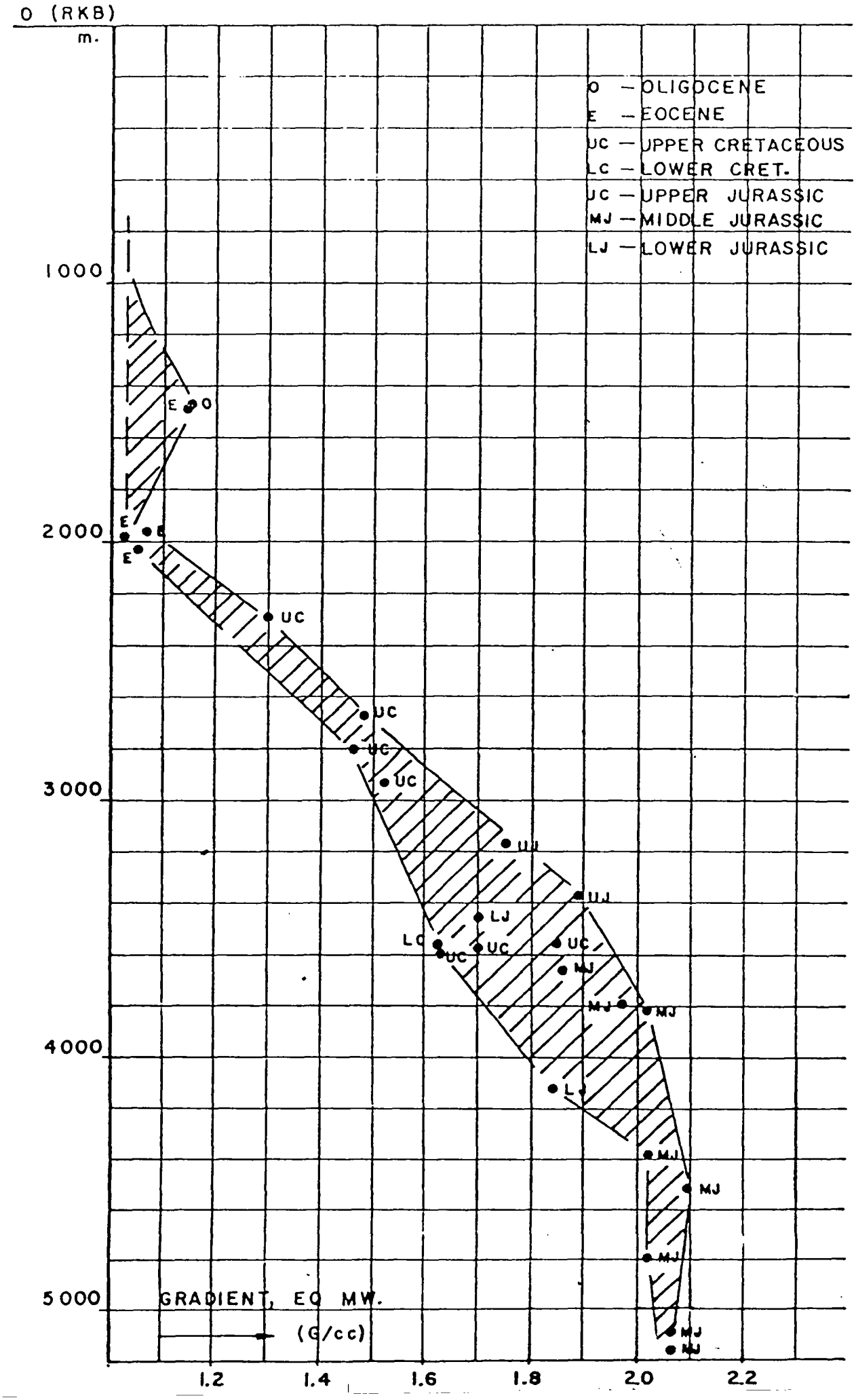


Fig. 2

PORE PRESSURE GRADIENT VIKING GRABEN



VIKING GRABEN
FORMATION INTEGRITY

Fig. 3

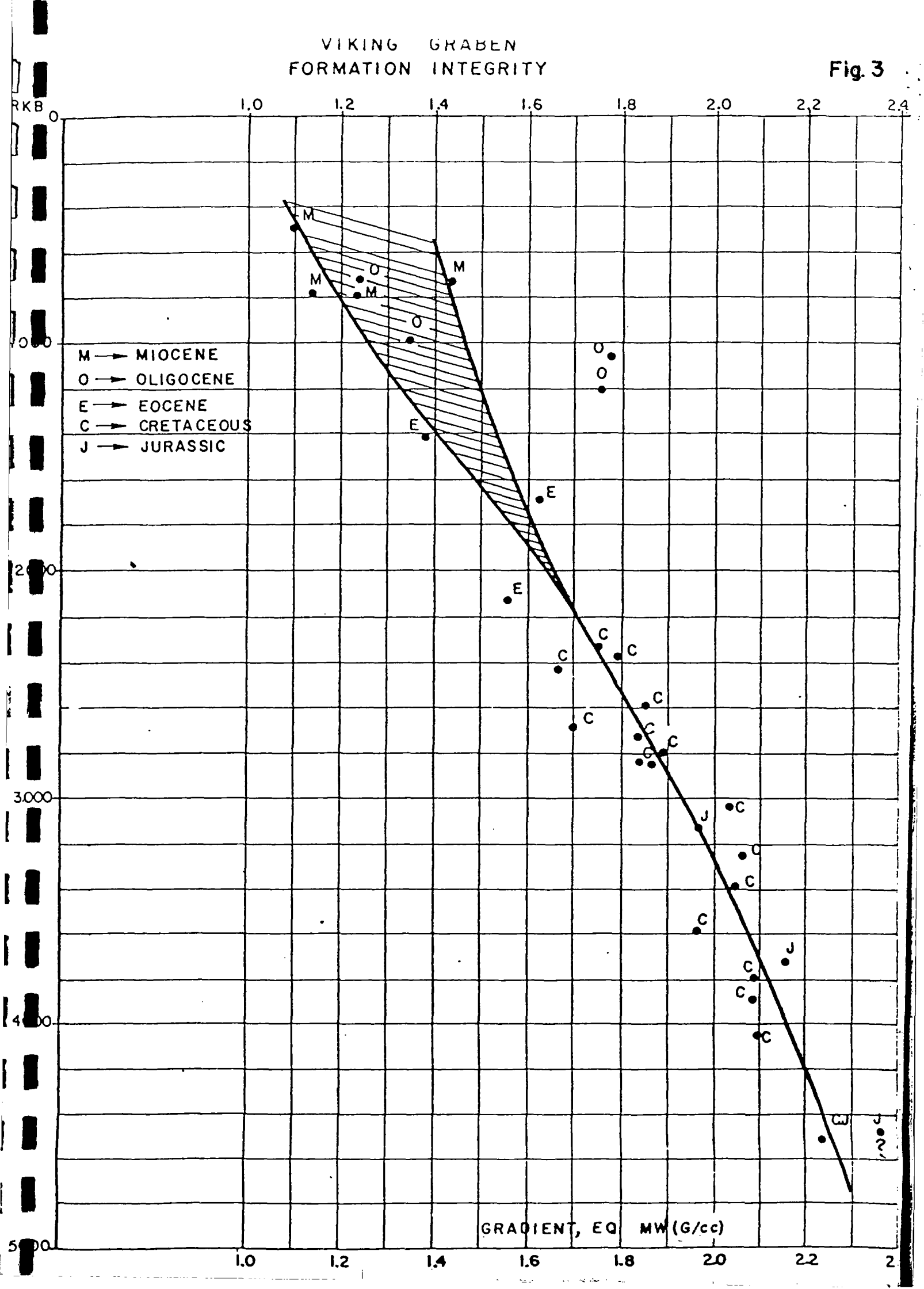


Fig. 4

PREDICTED PRESSURE GRADIENT 30/2-1 (NORTH)

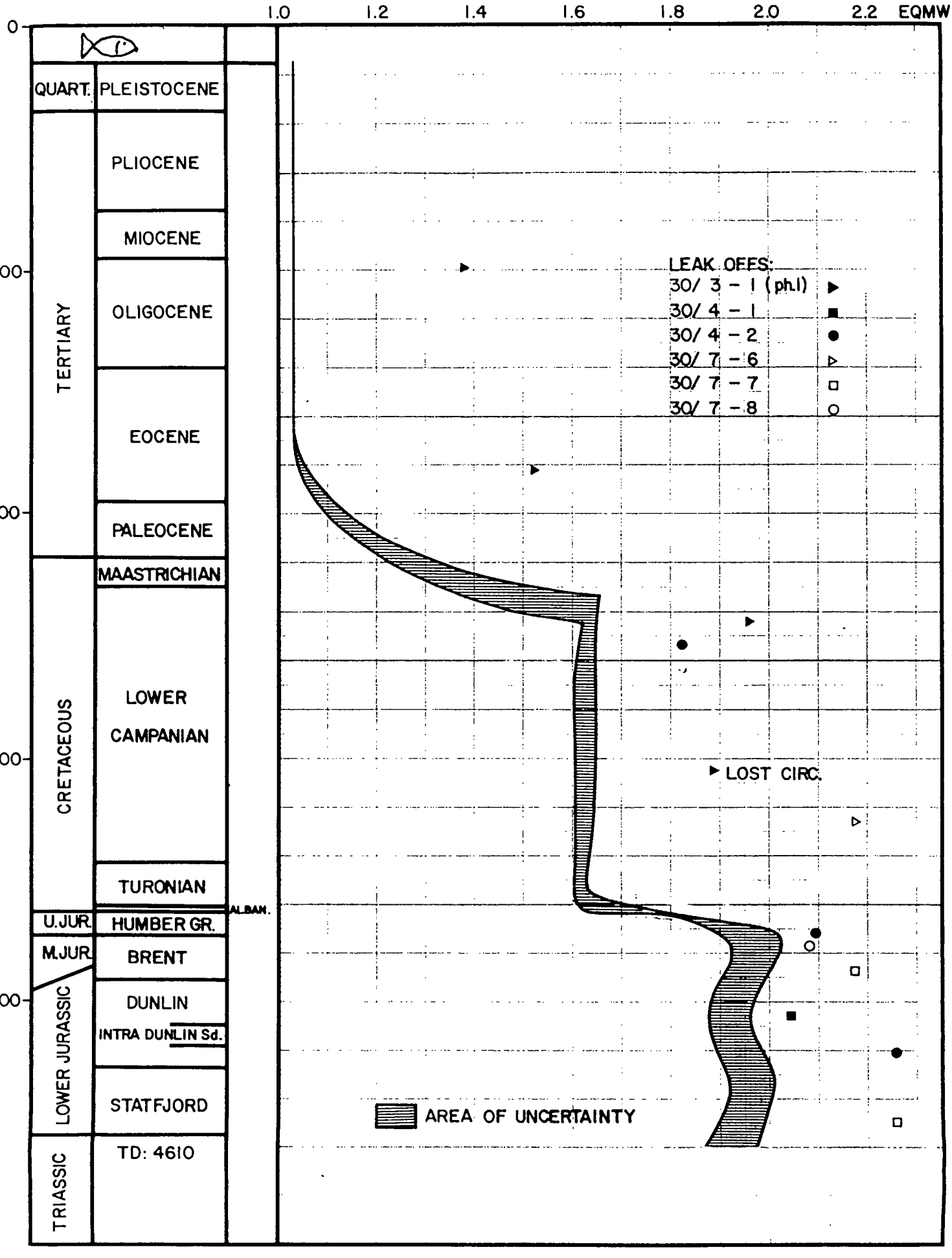
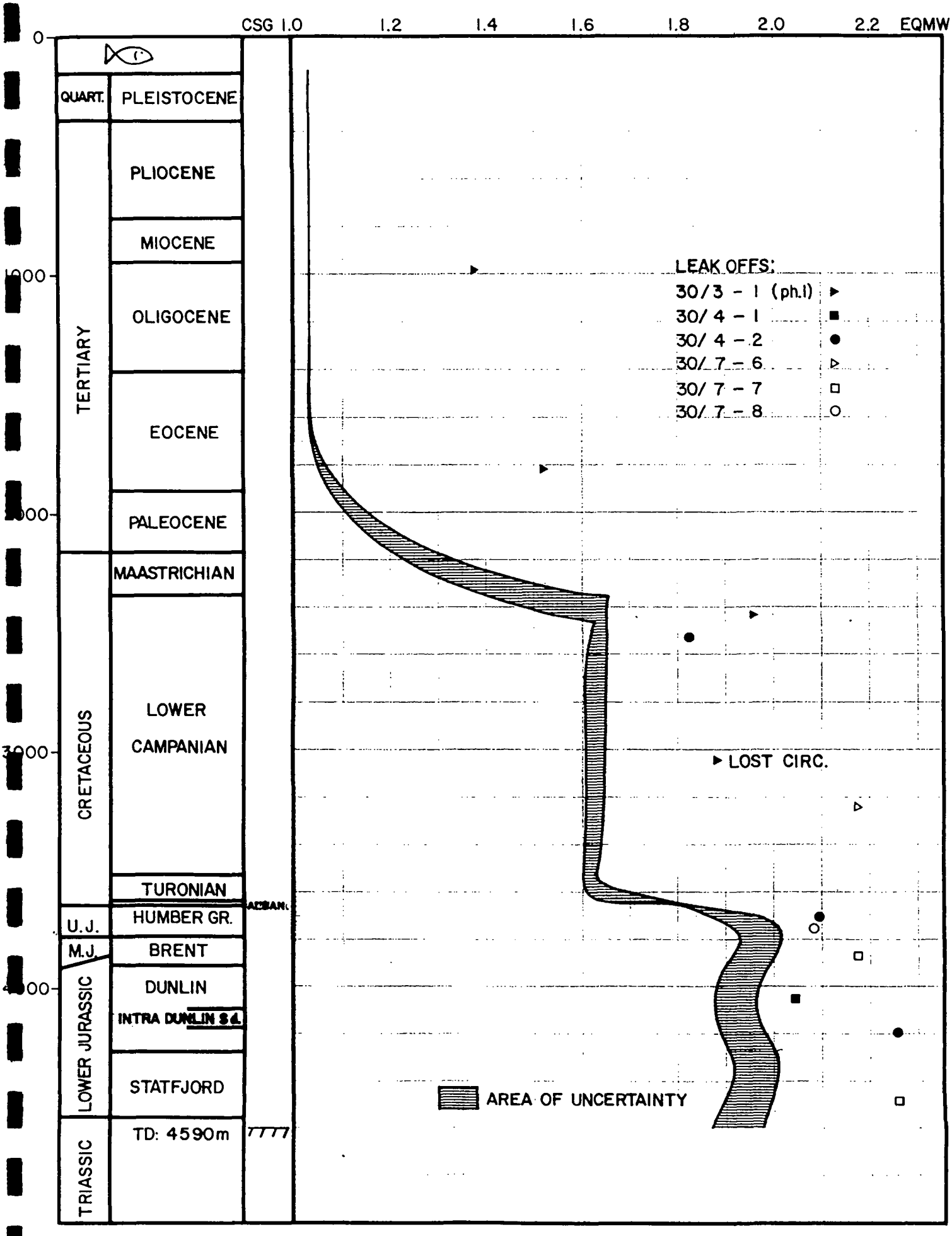


Fig. 5

PREDICTED PRESSURE GRADIENT 30/2 - 1 (SOUTH)



WELL 30/3-1, PHASE I, COMPUTED OVERBURDEN GRADIENT AND PREDICTION FOR PHASE II.

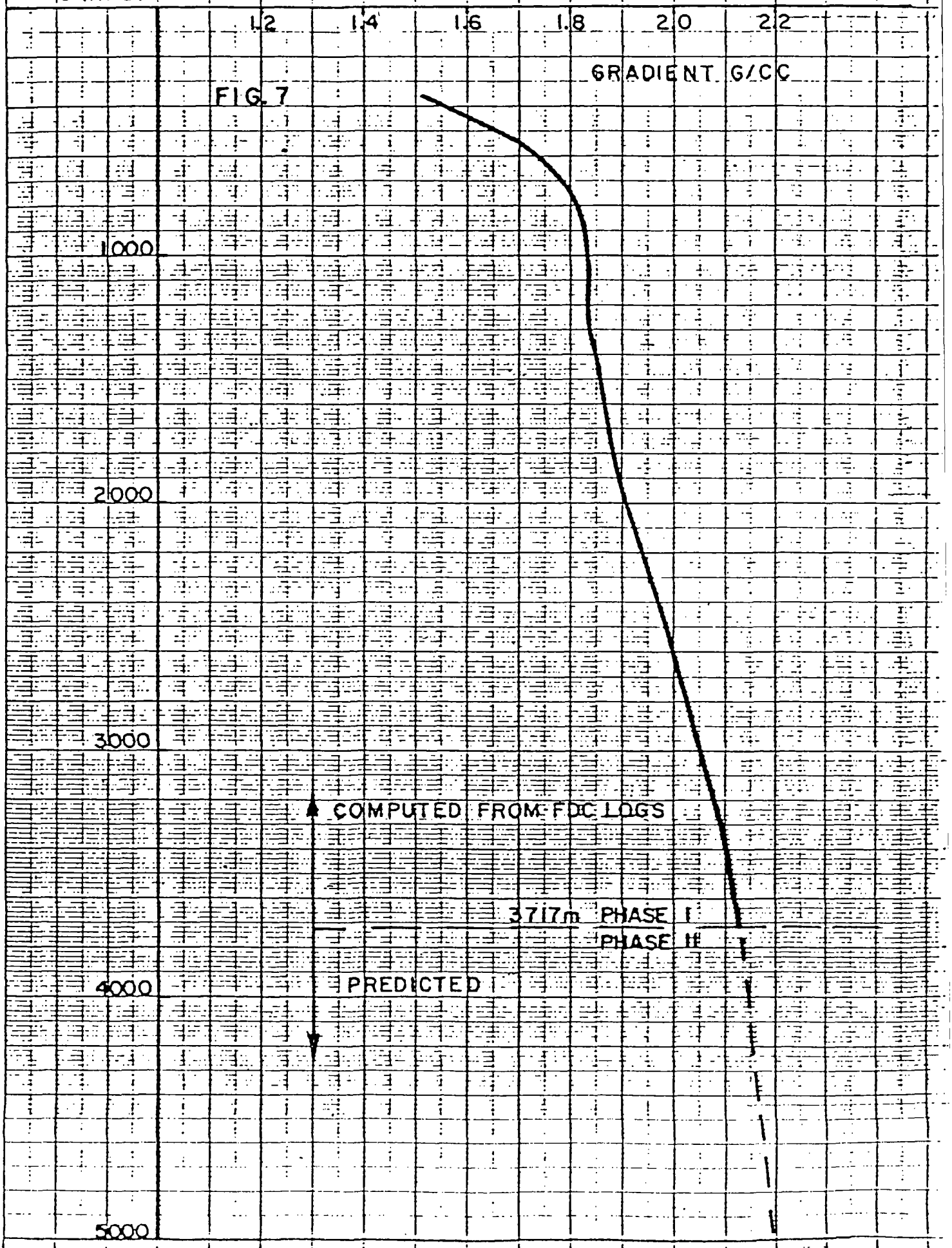
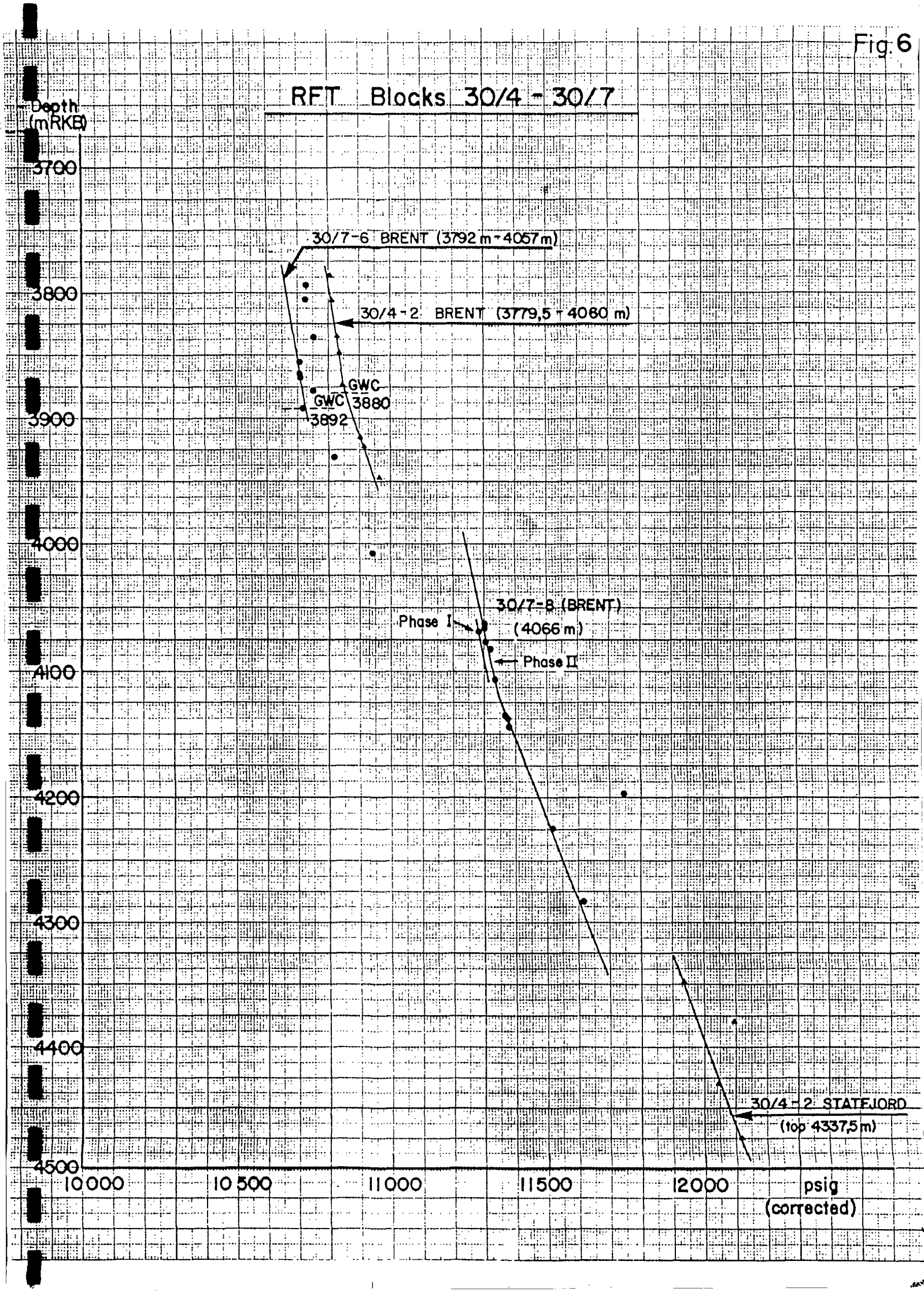


FIG. 7

Fig. 6


RFT Blocks 30/4 - 30/7
Depth (mRKB)
3700
3800
3900
4000
4100
4200
4300
4400
4500
30/7-6 BRENT (3792 m - 4057 m)
30/4-2 BRENT (3779,5 - 4060 m)
GWC 3880
GWC 3892
30/7-8 (BRENT) (4066 m)
Phase I
Phase II
30/4-2 STATFJORD (top 4337,5 m)
10 000
10 500
11 000
11 500
12 000
psig (corrected)