

Technical Service Report

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SOURCE ROCK AND DOM EVALUATION

WELL 25/12-1, NORWAY

by

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Investigation

912.416

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EXPLORATIE EN PRODUKTIE LABORATORIUM

RIJSWIJK, THE NETHERLANDS

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KEYWORDS

Source rock, Carbonization, DOM, well 25/12-1, Norway

I. INTRODUCTION

Geochemical investigations have been carried out on a suite of samples from the well as mentioned on the title page.

These investigations have been carried out to evaluate the presence and quality of source-rock layers, to establish the DOM trend and indicate the zone of possible oil and/or gas generation at the location of the well.

II. EVALUATION OF SOURCE-ROCK PROPERTIES

a. Source-rock indications

These indications have been determined by pyrolysis-sniffing¹ of the original samples. Moderate to high indications may indicate genuine source-rock properties or migrated oil or may be due to the presence of contaminants such as diesel oil used in the drilling fluid. To distinguish between the first possibility and the latter two, original samples with strong indications are remeasured after extraction with chloroform. Intervals or samples with high indications after extraction are investigated microscopically to ensure that the high values indicate genuine source-rock properties and are not due to contaminants insoluble in chloroform (such as walnut shells or other lost circulation material of an organic nature).

The results are given in the geochemical log (enclosure 1). For the location of the well see figure 1.

b. Type of organic matter

The type of organic matter present in the samples was determined by pyrolysis/gas solid chromatography^{2,3}. This is an empirical method in which the organic matter is ranked on the basis of its hydrogen content. The hydrogen content is lowest for organic matter of humic type and increases in order of the types: mainly humic, mixture, mainly kerogenous and kerogenous. Organic matter of humic type is a precursor of gas. Organic matter of mainly humic

type is also a precursor of gas; if sufficient quantities are present it may also yield oil. Organic matter of mixed type is a precursor of light oil (usually of a paraffinic nature) and gas. Organic matter of mainly kerogenous and kerogenous types are precursors of oil and gas.

The results have been included in the geochemical log.

III. DEGREE OF ORGANIC METAMORPHISM

a. Results

DOM values have been determined by measurement of vitrinite reflectance⁴.

The results are plotted as a function of depth in figure 2 in the form of DOM histograms. Any histogram that could not be accommodated on figure 2 is given in subsequent figures.

In general, the mode value of the histogram may or may not represent the true DOM of the stratum from which the sample is taken. The DOM obtained from cuttings may have been influenced by vitrite from cavings. Alternatively, the DOM may refer to reworked, resedimented or allochthonous vitrinite. However, it is probable that the DOM obtained for samples with histograms that have a rather sharp mode value does represent the true-layer DOM.

b. Compatible DOM

The compatible DOM is that which is in accordance with the present subsurface temperature and age of the formation in question. Knowledge of the compatible DOM is required to indicate the zone of possible oil generation (so-called cooking pot).

The dashed line in figure 2 indicates the compatible DOM trend based on⁵⁻⁷ the present subsurface temperature gradient as indicated in the last figure. The temperature gradient is based on BHTs measured during logging after applying the so-called Middle East correction⁸. If only a solid line is given in figure 2, the compatible DOM coincides with the true-layer DOM trend.

The compatible DOM values 60 and 75 indicate the limits of the zone in which oil generation may take place. Source rocks for oil located within these limits are expected to generate oil. The major gas generation takes place below the level indicated by the compatible DOM 75.

In those cases where it can be assumed that the strata are presently at their maximum depth of burial, the compatible DOM also indicates the predicted true-layer DOM.

c. True-layer DOM

The true-layer DOM is the DOM that a humic coal would have when subjected to the same burial/temperature history as the formation in question.

The solid line in figure 2 is considered to indicate the trend of the true-layer DOM. It is based on those DOM values that are believed to be reliable. In this connection it can be remarked ⁹ that the standard deviation in the DOM measurement, including the variability occurring in nature, is 4 DOM units. The shape of the line, that is the rate of DOM increase as a function of DOM, is based on accumulated experience.

If the area has been uplifted, in the sense that the strata were once at greater depth, or if they have been at higher temperature, the true-layer DOM is higher than the compatible DOM. Source rocks with a true-layer DOM between 60 and 75 are mature for oil. If these source rocks have been uplifted, the true-layer DOM is incompatible.

Mature source rocks for oil have generated oil when the relevant strata have dropped below the level of the compatible DOM 60. Mature source rocks for oil lying outside the interval between the compatible DOM 60 and 75 levels are not expected to generate oil at present.

IV. DISCUSSION AND CONCLUSIONS

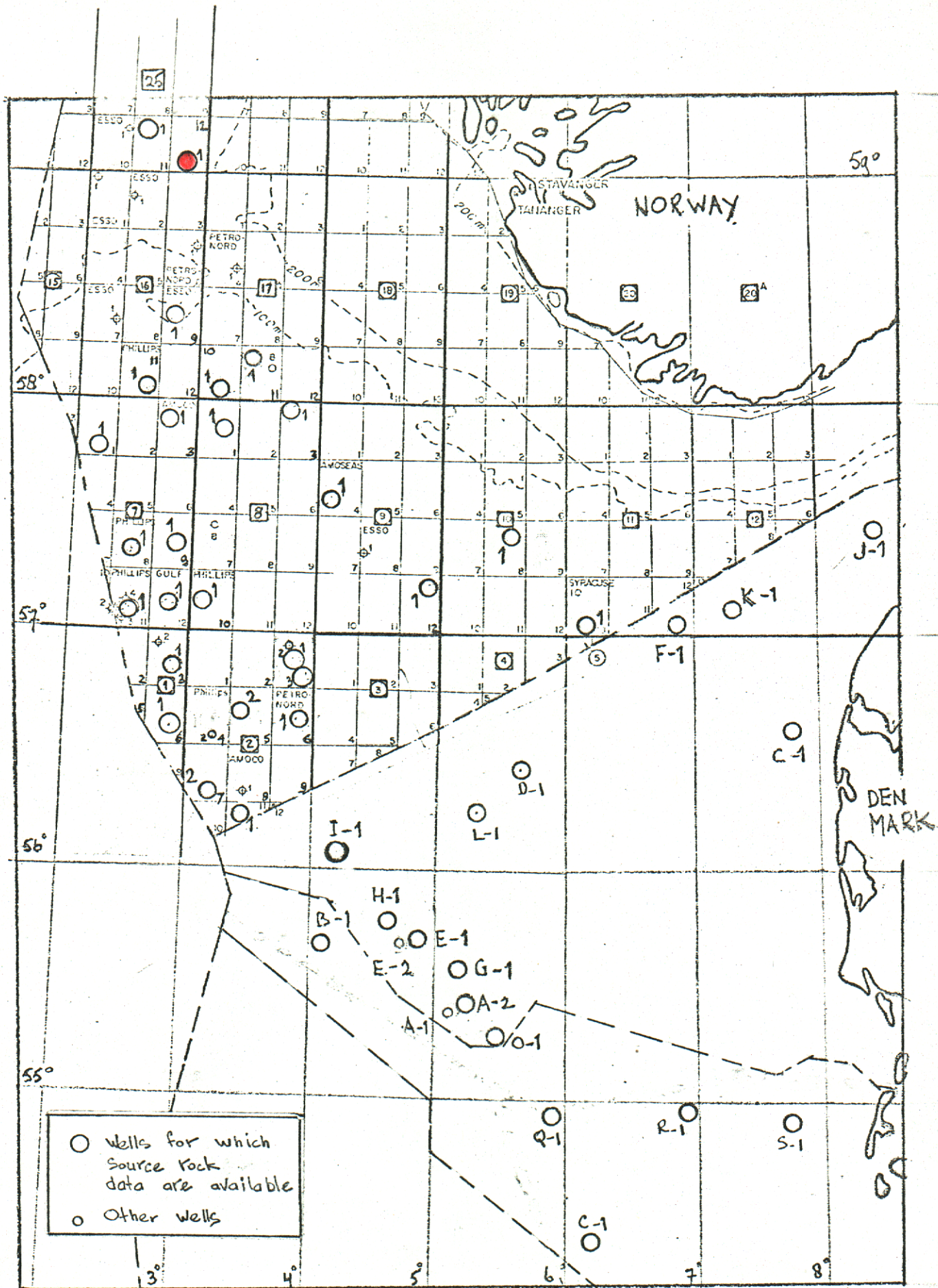
Interval 7190 - 8020 ft (Jurassic) contains source rocks for oil (and gas). Most of the organic matter is concentrated in the top part of this interval (7190 - 7540 ft). At the location of well 25/12-1 this source rock is still immature for oil.

True-layer DOM values have not been determined as the investigated sediments do not contain vitrinite. If it can be assumed that the sediments are at present at their greatest depth reached ever, the compatible DOM trend as given in figure 2 also indicates the true-layer DOM trend. If this is not the case, the true-layer DOM values are higher than those indicated by the compatible trend.

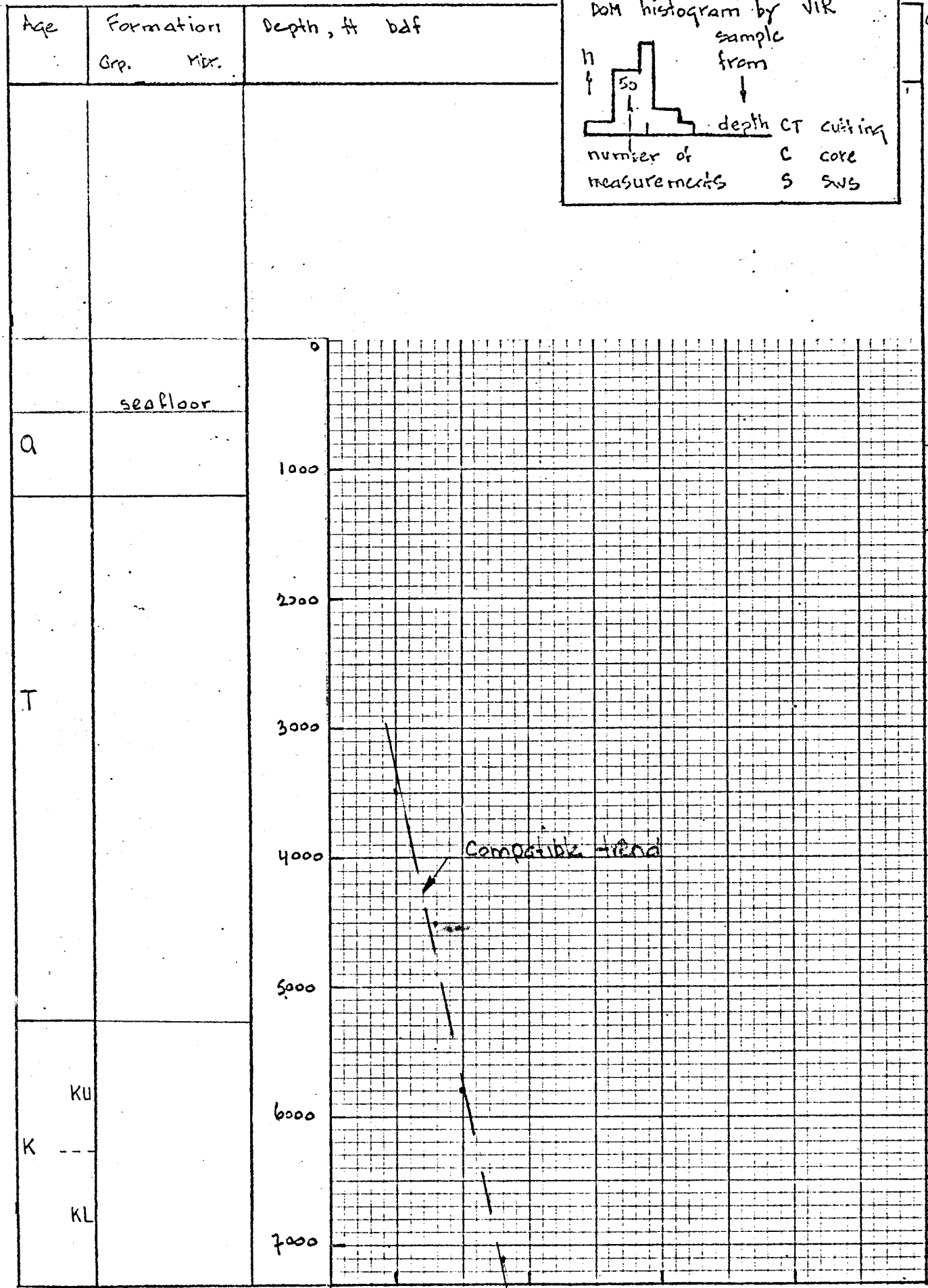
The zone of possible oil generation at the location of the well, as indicated by the compatible DOM 60 and 75 levels, is between 8000 ft and about 14000 ft.

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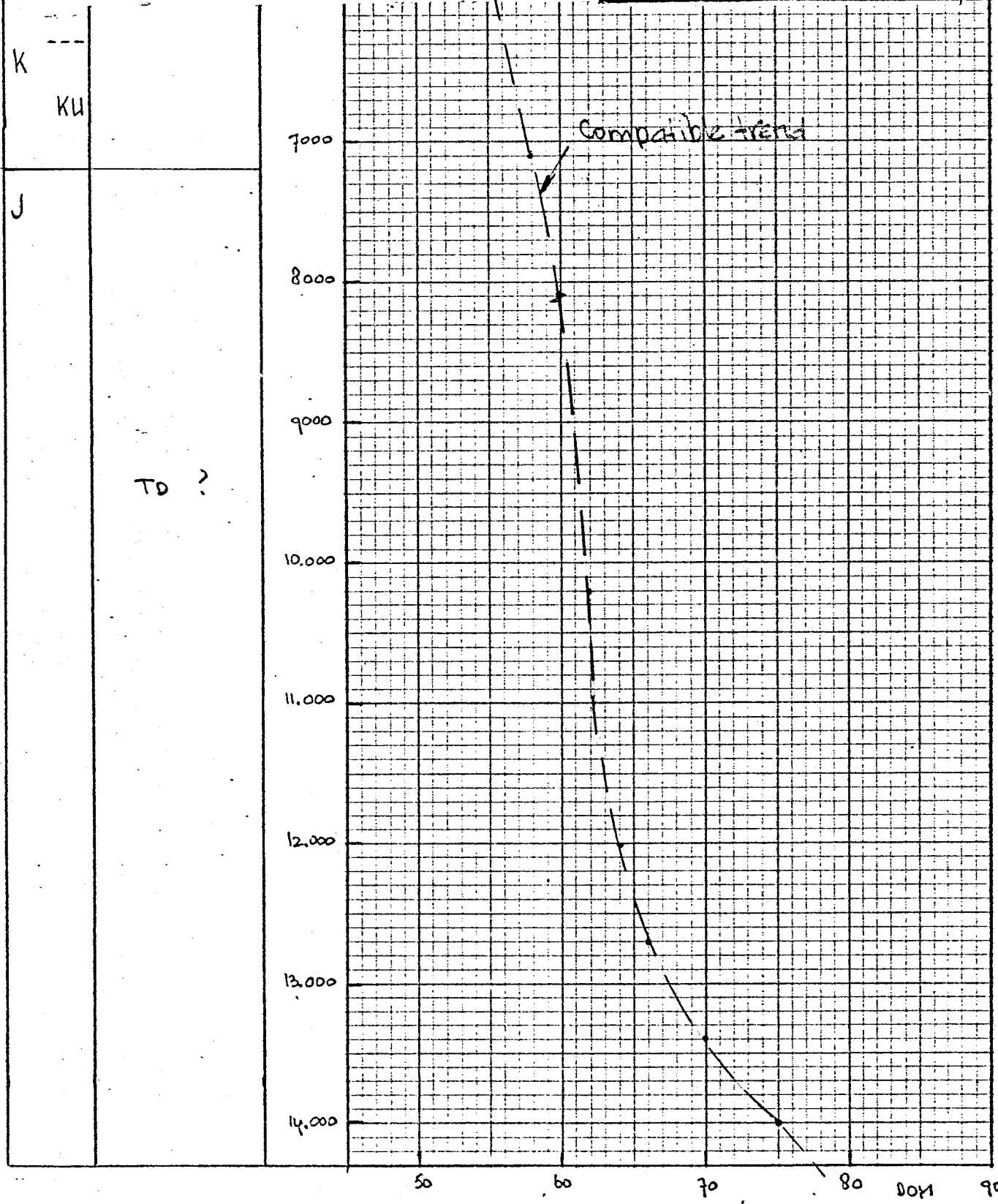
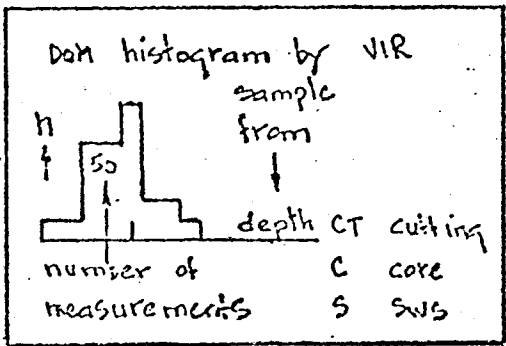
LOCATION MAP



DOM AS A FUNCTION OF DEPTH, WELL - 25 / 12 - 1.

FIG: 2^a

| Age | Formation Grp. Mbr. | Depth, ft bdf |
|-----|------------------------|---------------|
|-----|------------------------|---------------|



TO ?

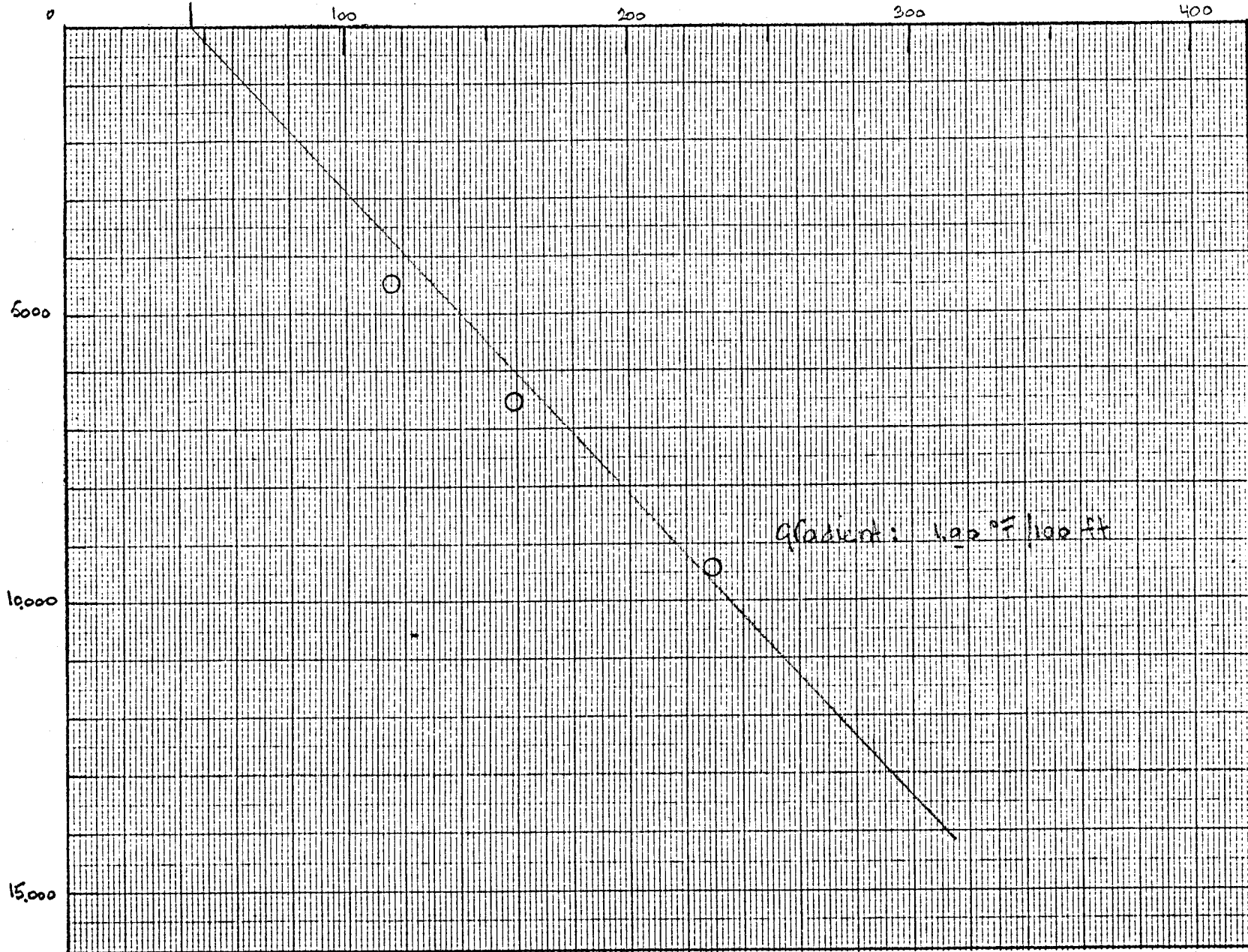
Compatible trend

DOM AS A FUNCTION OF DEPTH, WELL 25 / 12 - 1

FIG: 2b

Depth, ft

BIT of , corrected (Middle East cor.)



Subsurface temperature as a function of depth.

Well 25/12-1

Fig: 3

REGEO-GEOCHEMICAL

Country: NORWAY

Sheet 1 of 1

E 102

E 024919N590147

R 101

00 25112-1

R 101

90 RKTR DO 50.74 EP

DATE: 7402 REJMAN/DJELWART

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43

| | | Depth | g | Source | Type | DOM |
|------|--|-------|------------|--------|---------|------------|
| | | ddf | Identifier | Rock | of | Compatible |
| | | | 10 | ind. | organic | True |
| | | | Depth | unit | matter | Unconf. |
| GCO1 | | N*** | N | Z | Z | N** |
| | | | | | | Z |
| | | | | | | Z |
| | | | | | | N** |
| | | | | | | N** |
| | | | | | | Z |
| | | 5800 | 01 | F | | 50 |
| | | 5800 | 0 | | | 55 |
| | | 7100 | 0 | | | 58 |
| | | 8000 | 0 | | | 60 |
| | | 11000 | 0 | | | 62 |
| | | 12000 | 0 | | | 64 |
| | | 12700 | 0 | | | 66 |
| | | 13400 | 0 | | | 70 |
| | | 14000 | 0 | | | 75 |
| | | 61001 | | | | |
| | | 71901 | | 0 | | |
| | | 75401 | | 700 | K | |
| | | 80201 | | 150 | K | |

This data sheet is added to facilitate those who wish to plot source rock and DOM information by computer. Information on the program is available from Central Offices, The Hague.

GEOCHEMICAL LOG

WELL 25/12-1

SCALE 1:5000

| AGE | FORMATION | DEPTH IN FT | LITHOLOGY | DOM | SOURCE ROCK INDICATION OF ORIGINAL SAMPLE | | | | | | SOURCE ROCK INDICATION OF SAMPLE AFTER EXTRACTION WITH CHLOROFORM | | | | | | DEPTH IN FT | ORGANIC CARBON %wt. | TYPE OF ORGANIC MATTER | |
|-----|-----------|-------------|-----------|-----|---|-----|-----|-----|-----|-----|---|-----|-----|-----|-----|-----|-------------|---------------------|------------------------|------------|
| | | | | | 100 | 200 | 300 | 400 | 500 | 600 | 100 | 200 | 300 | 400 | 500 | 600 | | | | |
| | | 0 | | | | | | | | | | | | | | | | | | |
| | | 500 | seafloor | | | | | | | | | | | | | | | | | |
| Q | PS | 1000 | | | | | | | | | | | | | | | | | | |
| | ? | 1000 | | | | | | | | | | | | | | | | | | |
| | | 1500 | | | | | | | | | | | | | | | | | | |
| | PL | 2000 | | | | | | | | | | | | | | | | | | |
| T | | 2500 | | | | | | | | | | | | | | | | | | |
| | | 3000 | | | | | | | | | | | | | | | | | | |
| | MI | 3500 | | | | | | | | | | | | | | | | | | |
| | | 4000 | | | | | | | | | | | | | | | | | | |
| | OL | 4000 | | | | | | | | | | | | | | | | | | |
| | | 4500 | | | | | | | | | | | | | | | | | | |
| | EO | 4500 | | | | | | | | | | | | | | | | | | |
| | | 5000 | | | | | | | | | | | | | | | | | | |
| | PC | 5000 | | | | | | | | | | | | | | | | | | |
| | MA | 5500 | | | | | | | | | | | | | | | | | | |
| Ku | CA | 5500 | | | | | | | | | | | | | | | | | | |
| | SA | 6000 | | | | | | | | | | | | | | | | | | |
| K | ? CE | 6000 | | | | | | | | | | | | | | | | | | |
| | | 6500 | | | | | | | | | | | | | | | | | | |
| KL | AB | 6500 | | | | | | | | | | | | | | | | | | |
| | AP | 7000 | | | | | | | | | | | | | | | | | | |
| | HT | 7000 | | | | | | | | | | | | | | | | | | |
| J | | 7500 | | | | | | | | | | | | | | | | | | KEROGENOUS |
| | | 7500 | | | | | | | | | | | | | | | | | | KEROGENOUS |
| | | 7500 | | | | | | | | | | | | | | | | | | KEROGENOUS |
| | | 7500 | | | | | | | | | | | | | | | | | | KEROGENOUS |
| | | 8000 | | | | | | | | | | | | | | | | | | KEROGENOUS |
| | | 8500 | | | | | | | | | | | | | | | | | | |
| | | 9000 | | | | | | | | | | | | | | | | | | |
| | | 9500 | | | | | | | | | | | | | | | | | | |
| | | 10000 | | | | | | | | | | | | | | | | | | |

VALUES SMALLER THAN 30 ARE CONSIDERED NOT TO BE OF SIGNIFICANCE

INTERVAL 7190 - 8020 FT CONTAINS SOURCE ROCKS, FOR OIL.

| | |
|---|--------------------|
| Koninklijke/Shell Exploratie en Productie Laboratorium | |
| GEOCHEMICAL LOG OF 25/12-1 NORWAY | |
| Author: Dlw | Date: 12. 2. 74 |
| Rep: 2KTR 0050. 74 | Encl: 1 Draw.no: I |