U-22

BA-78-106-1

Technical Service Report August 1973

RKTR 0254.73

SOURCE ROCK AND CARBONIZATION EVALUATION WELL 17/10-1, NORWAY

by

K. Reiman & J.E.A.M. Dielwart

KONINKLIJKE/SHELL
EXPLORATIE EN PRODUKTIE LABORATORIUM
RIJSWIJK, THE NETHERLANDS

Technical Service Report August 1973

RKTR 0254.73

SOURCE ROCK AND CARBONIZATION EVALUATION WELL 17/10-1, NORWAY

by

K. Reiman & J.E.A.M. Dielwart

Sponsor: SIPM-EP/ A/S Norske Shell

In co-operation with:

J. Alblas
J.H.H. Gales-Maas
M.C.M. v.d. Knaap-Holierhoek
A. v.d. Meer

Investigation

9.12.895

Throughout the report the words 'Shell' and 'Group' are used collectively in relation to companies associated together under the name of the Royal Dutch/Shell Group of Companies.

KONINKLIJKE/SHELL
EXPLORATIE EN PRODUKTIE LABORATORIUM
RIJSWIJK, THE NETHERLANDS

CONTENTS

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 trend in fixed-carbon content, and to 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 for the original samples and, for those showing a high source-rock indication, also after extraction with warm chloroform.

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

The bars on the geochemical log are an approximate measure of the organic-carbon content of the samples. The column on the left represents indication of the organic-carbon content of the untreated samples, while the column on the right shows the organic-carbon content of the samples after chloroform extraction.

Moderate to high indications obtained for the original samples 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).

b. Type of organic matter

Knowledge of the type of organic matter is important because it is known that organic matter rich in hydrogen[1] (kerogen, kerogenous) is a precursor of oil. Organic matter poor in hydrogen (humic) yields only gas. The types of organic matter recognised range from kerogenous, through mainly kerogenous, mixture and mainly humic, to humic. In this order, the type indicates decreasing concentrations of hydrogen in the organic matter.

The type of organic matter was determined by gas chromatography[2] as well as by microscopic inspection. Organic matter of humic type is a precursor of gas. Organic matter of mainly humic type is also considered to be 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. MATURITY OF THE ORGANIC MATTER

a. General remarks and results

It is important to determine the effect of temperature on the organic matter present in source rocks, since the generation of oil and gas is closely connected with the influence of relatively high temperatures. The effect of temperature (or the degree of maturity) was established by determining the rank of constituent coal particles[3] by measurement of vitrinite reflectance[4-6]. Some 50 (maximum) reflectance measurements have been made for each sample, provided there was sufficient vitrinite present. The average value of these reflectances has been converted to fixed-carbon content (100 - volatile matter).

The results are plotted as function of depth in figure 2 in the form of fixed-carbon 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-layer fixed-carbon content (coal rank) of the stratum from which the sample is taken. The rank obtained from cuttings may have been influenced by vitrite

from cavings. Alternatively, the rank may refer to reworked, resedimented or allochthonous vitrinite. However, it is probable that the coal rank obtained for samples with fixed-carbon histograms that have a rather sharp mode value does represent the true rank of the stratum from which the sample originates.

b. Compatible fixed-carbon content

The compatible fixed-carbon content (compatible FCC) is that which is in accordance with the present depth of burial and age of the formation in question. Knowledge of the compatible FCC is required to indicate the zone of possible oil generation (so-called cooking pot) [7,8].

The dashed line in figure 2 indicates the compatible FCC. If only a solid line is given, the compatible FCC coincides with the so-called true-layer fixed-carbon content (true-layer FCC).

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

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

c. True-layer fixed-carbon content

The true-layer fixed-carbon content (true-layer FCC) is the FCC that a humic coal would have when subjected to the same burial as the formation in question.

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

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

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

IV. DISCUSSION AND CONCLUSIONS

Interval 8300 - at least 11779 ft (Jurassic/Triassic ?) contains source rocks for oil (and gas).

The zone of possible oil generation or cooking pot at the location of well 17/10-1, as indicated by the levels of compatible FCC 60 and 75, is between 9700 ft and about 15500 ft.

The above indicates that the source rock for oil below 9700 ft is now in the oil generation phase.

REFERENCES

1. Cane, R. F., The consitution and synthesis of oil shale.
Proc. 7th World Petr. Congress 3 (1967), pp. 681 - 689, Elsevier.

2. Feugere, F. & Gerard, R. E., Geochemical logging -- a new exploration tool.
World Oil, February 1970.

3. Ting, F. T. C., Reflectance of disseminated vitrinite as a diagenetic indicator in sedimentary rocks.
4th Ann. Geol. Soc. Amer., Northeastern Sect. Meet. Program (1), 61, 1969.

4. Kötter, K., Die mikroskopische Reflexionsmessung mit dem Photomultiplier und ihre Anwendung auf die Kohlenuntersuchung.
Brennst. Chemie 41 (1960), No. 9, pp. 263 - 272.

5. De Vries, H. A. W. & Bokhoven, C., Reflectance measurements on coal.
Geologie en Mijnbouw 47 (1968), No. 6, p. 243.

6. Wolf, M., Ein Inkohlungsprofil durch das Flözleere nördlich von Meschede.
Erdöl und Kohle 22 (1969), No. 4, pp. 185 - 187.

7. Vassoyevich, N. B., Korchagina, Yu. I., Lopatin, N. V. & Chernyshev, V. V., Principal phase of oil formation.
Internat. Geol. Rev. 12 (1970), No. 1.

8. Hood, A. & Gutjahr, C. C. M., Organic metamorphism and the generation of petroleum.
Presented at a Symposium on Advances in Petroleum Geochemistry, Annual GSA Meeting, Minneapolis, November 1972.

9. Landes, K. K., Eometamorphism can determine oil floor.
Oil and Gas Journal, 64 (1966), p. 172.

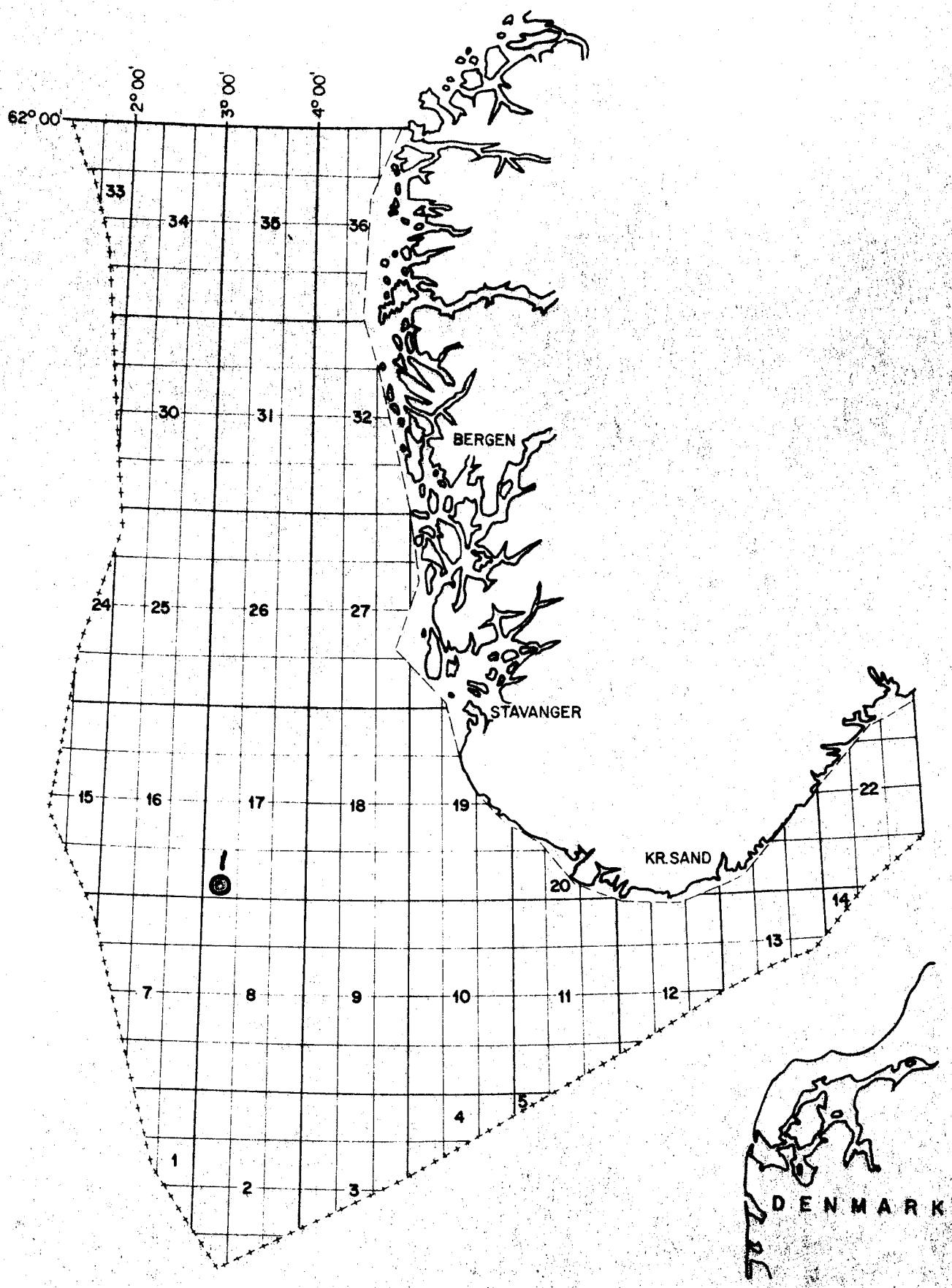
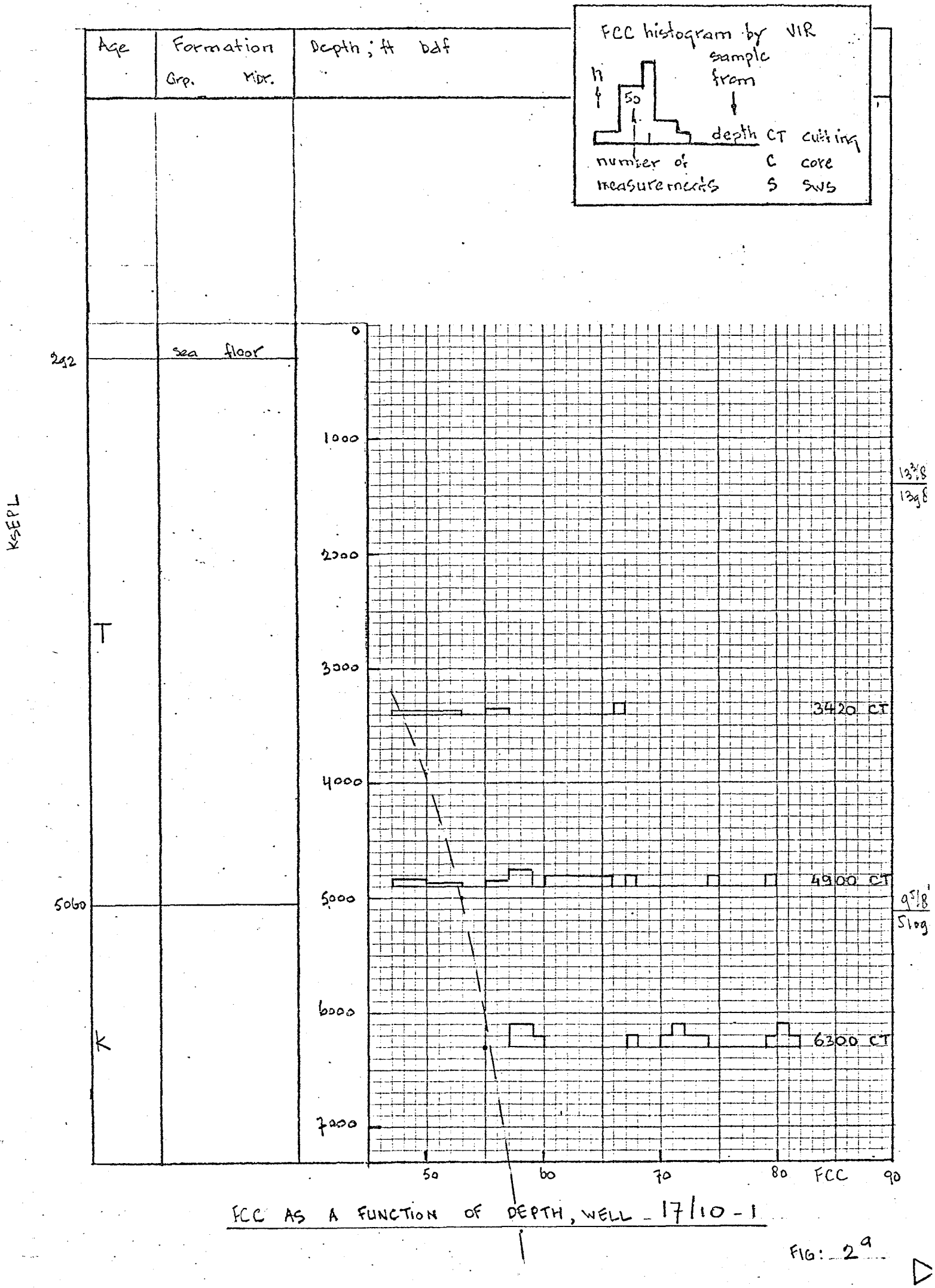
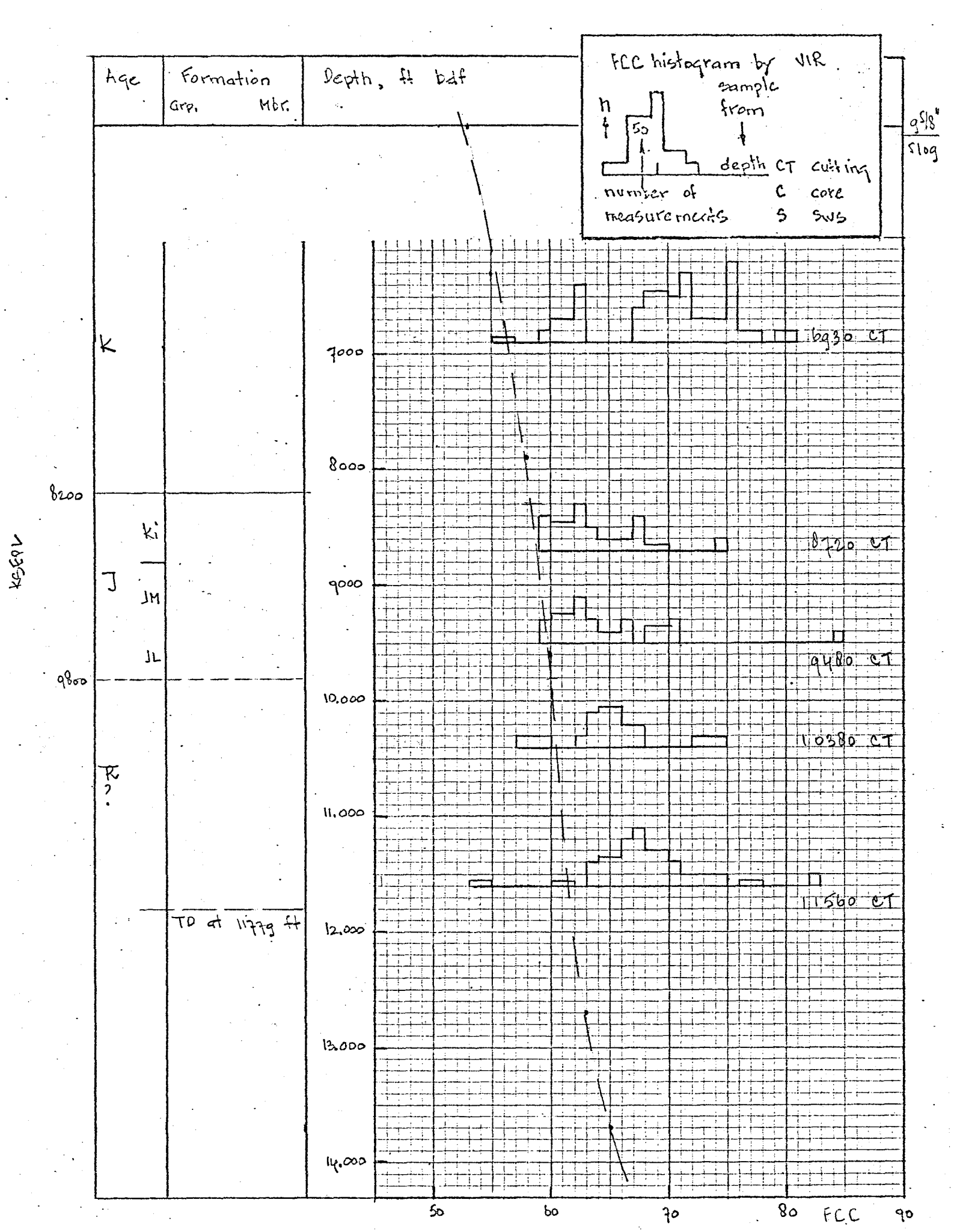


Fig. 1



FCC AS A FUNCTION OF DEPTH, WELL - 17/10-1

FIG: 2.9



FCC AS A FUNCTION OF DEPTH, WELL 17/10-1

Compatible DOM 75 at 15500 ft

FIG: 2b

GEOCHEMICAL LOG

SCALE 1:5000

WELL 17/10-1

AGE		FORMATION	DEPTH IN FT B DF	LITHOLOGY
T	PC		5000	
	KU		5500	
			6000	
K	AB		6500	
			7000	
			7500	
			8000	
	KI		8500	
J	JM		9000	
			9500	
	JL		10000	
			10500	
$\overline{K}$			11000	
			11500	
		T.D.11779'	12000	
			12500	
			13000	

SOURCE ROCK INDICATION OF ORIGINAL SAMPLE

100 200 300 400 500 600

SOURCE ROCK INDICATION OF SAMPLE AFTER EXTRACTION WITH CHLOROFORM

100 200 300 400 500 600

VALUES SMALLER THAN 30 ARE CONSIDERED NOT TO BE OF SIGNIFICANCE

INTERVAL 8300 – AT LEAST 11779 FT(TD) CONTAINS SOURCE ROCKS FOR OIL (AND GAS).

DEPTH IN FT B DF

5000 5500 6000 6500 7000 7500 8000 8500 9000 9500 10000 10500 11000 11500 12000

TYPE OF ORGANIC MATTER

HUMIC

MAINLY KEROGENOUS

KEROGENOUS

KEROGENOUS

KEROGENOUS

KEROGENOUS

KEROGENOUS

KEROGENOUS

KEROGENOUS

Koninklijke/Shell
Exploratie en Produktie Laboratorium

GEOCHEMICAL LOG
OF
17/10-1
NORWAY

Author: DIw | Date: 22.8.73.

Rep: RKTR 0254.73 | Encl: 1 | Draw.no: II

9.12.895