Technical Service Report October 1974

RKTR 0270.74

SOURCE ROCK AND CARBONIZATION EVALUATION WELL ELF NORWAY 25/1-1

by

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

Sponsor: SIPM-EP/Shell Expro London

In co-operation with:
J. Jochemsz-Alblas
M. C. M. v. d. Knaap-Holierhoek

Investigation
912.460

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. DEGREE OF CARBONIZATION

a. General

It is important to determine the effect of temperature on the organic matter present in source rocks, as the generation of oil and gas is closely connected with the influence of relatively high temperatures.

The effect of temperature was established by determining the rank or carbonization of constituent coal particles[3] by measurement of vitrinite reflectance[4-6].

b. Results

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

The modal value of the histogram indicates the FCC of the sample, only, as it is the FCC of the vitrinite mostly present in the sample. It may or may not represent the FCC of the stratum from which the sample is taken. The FCC obtained from cuttings may have been influenced by caved vitrite. Alternatively, the FCC may refer to reworked or allochthonous vitrinite.

The true-layer FCC at a given horizon can only be obtained by measuring a number of samples spaced over a suitable interval. If the measured FCC values do increase as a function of depth in a manner which is expected it can be concluded that the measured vitrinite is autochthonous. The true-layer FCC at a given horizon is then given by the mean FCC/depth relation between the individual measurements as the standard deviation of the FCC measurement is about .4 FCC units.

If one or a few FCC measurements have been made and the results coincide with the compatible FCC trend, it is quite likely that measured FCC values indicate the true-layer FCC..

c. Compatible FCC

The compatible FCC is that which is in accordance with the present subsurface temperature and age of the formation in question. It is, among others, required to indicate the zone of possible oil and/or gas generation.

The dashed line in figure 2 indicates the compatible FCC. If only a solid line is given, the compatible FCC coincides with the true-layer FCC.

The compatible FCC 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 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.

d. True-layer FCC

The true-layer FCC of a stratum is the FCC a humic coal would have when subjected to the same burial/temperature history as the stratum in question.

The solid line in figure 2 is considered to indicate the true-layer FCC. It is based on those FCC values which are considered to be reliable. The shape of the line, that is the rate of FCC 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 a greater depth, or if they have been at higher temperature, 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 and are now outside the zone of possible oil generation, as indicated by the levels of compatible FCC 60 and 75, those mature source rocks do now not generate oil.

IV. DISCUSSION AND CONCLUSIONS

Source rocks, either for oil or gas, are not present in the tested interval 3250 - 4570 M (TD) which covers the Cenomanian to Middle Jurassic sediments.

True-layer FCC values could not be determined as it appeared that the tested samples do not contain vitrinite. If it may be assumed that the penetrated sediments are now at their maximum depth/temperature reached ever, the compatible FCC trend also gives the predicted true-layer FCC. At any rate, the compatible FCC trend gives the minimum possible true-layer FCC for the relevant depth.

The top of the zone of possible oil generation, as indicated by the compatible FCC 60 level, at the location of the well, is at a depth of 3700 m.

REFERENCES

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

2. Feugere, G. & Gerard, R.E., Geochemical logging ... a new exploration tool.
World Oil, 170 (1970), No. 2, pp. 37-40.

3. Ting, F.T.C., Reflectance of disseminated vitrinite as a diagenetic indicator in sedimentary rocks.
Abstracts with programs for 1969, 4th Ann. Meet. Geol Soc.Amer., Northeastern Sect. Part 1, p. 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, pp. 423-434.

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. 11, pp. 1276-1296.

8. Hood, A. & Gutjahr, C.C.M., Organic metamorphism and the generation of petroleum.
Abstracts with programs, 1972, Annual Meetings Geol. Soc. Amer., Minneapolis, 4 (1972), No. 7, pp. 542-543.

9. Landes, K.K., Eometamorphism can determine oil floor.
Oil and Gas Journal, 64 (2 May 1966), pp. 172-177.

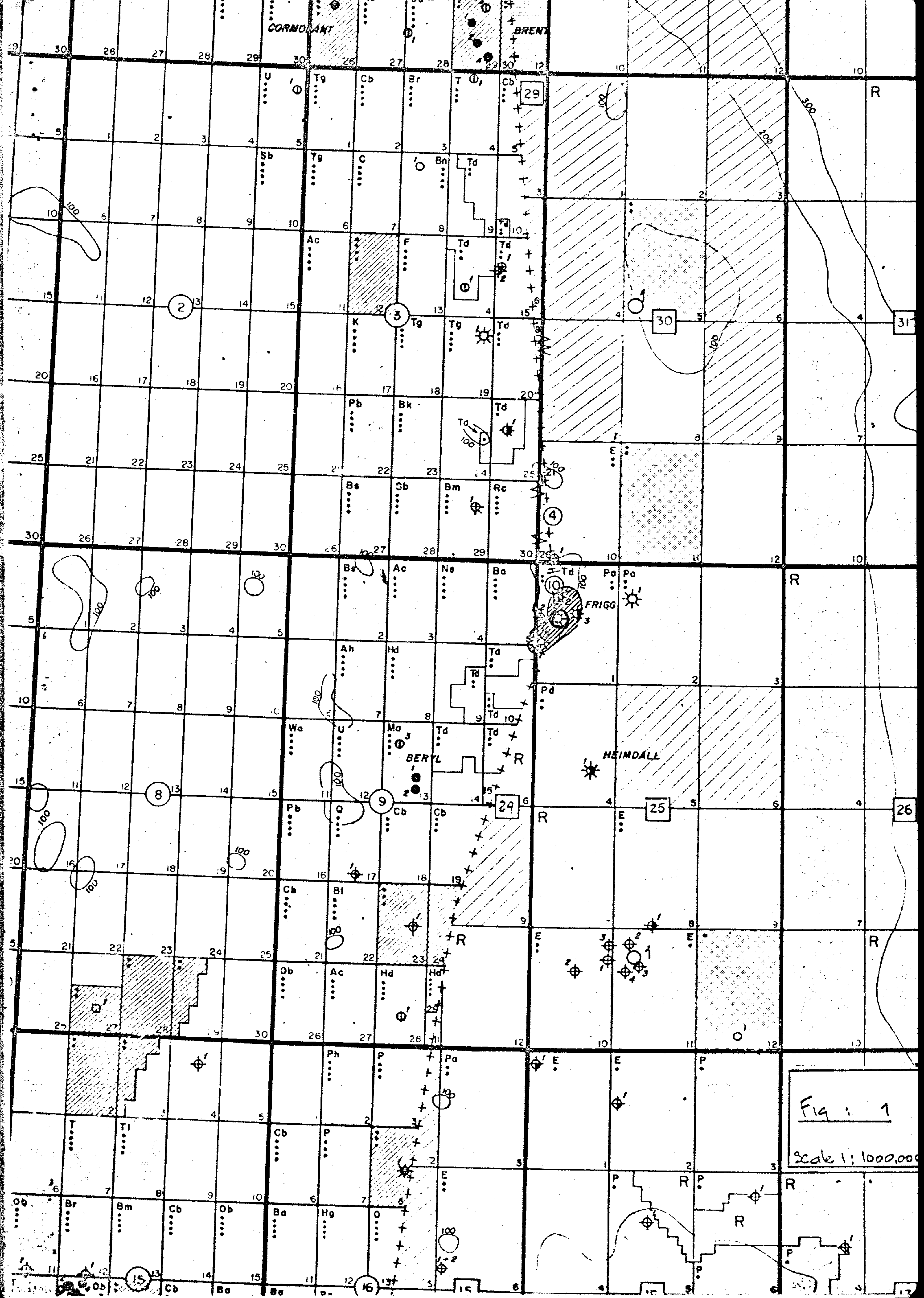
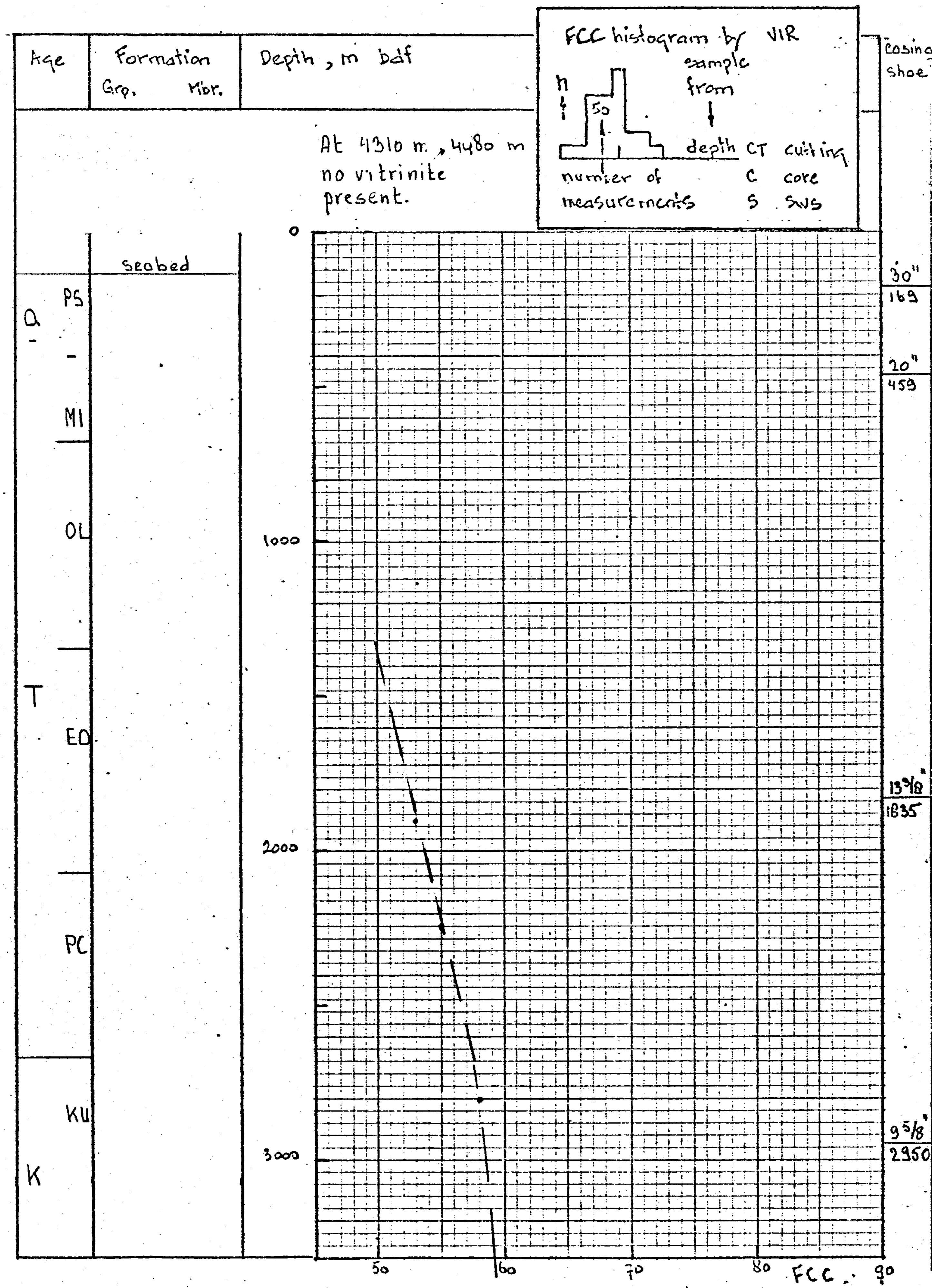


Fig : 1

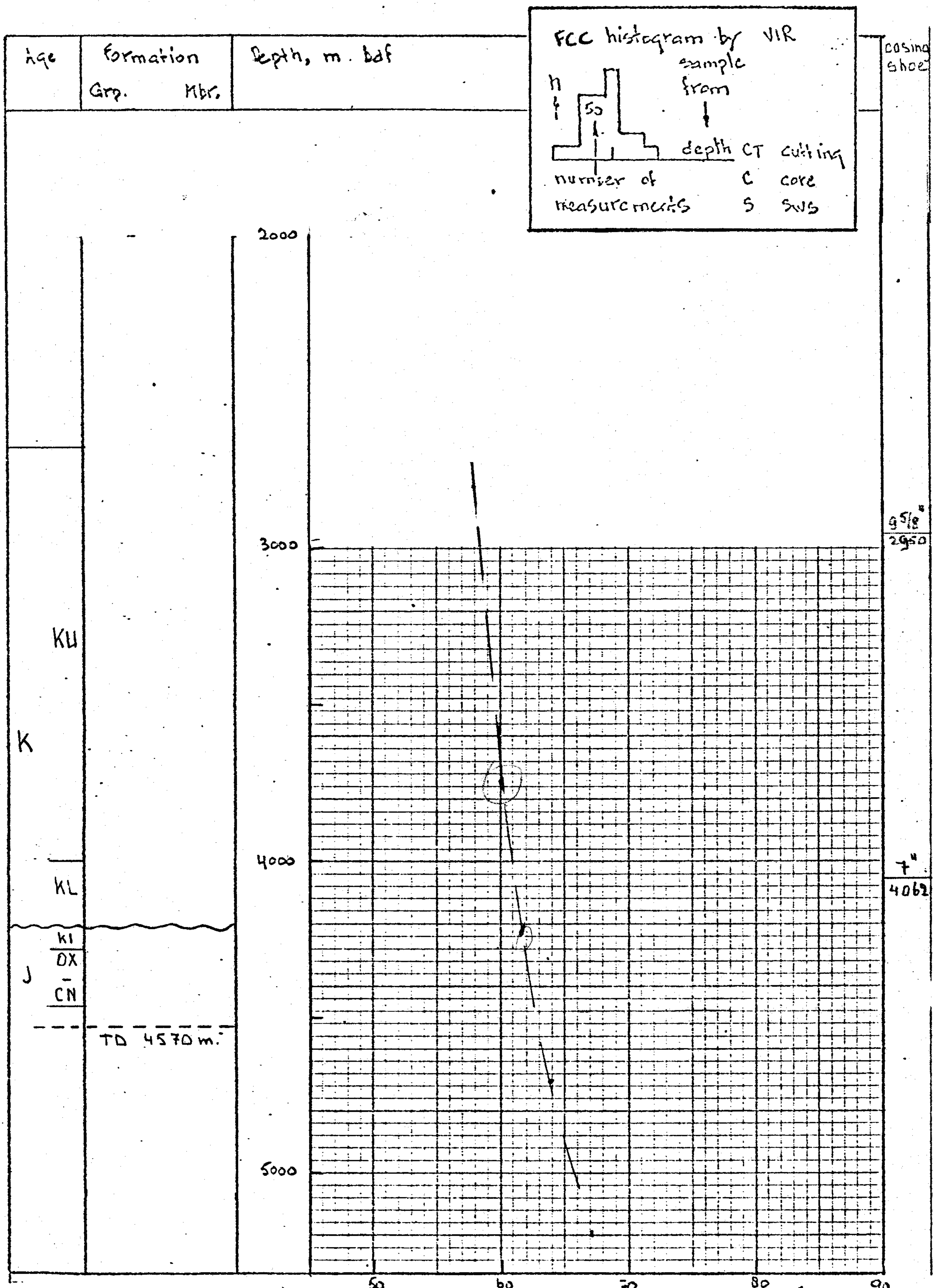
Scale 1: 1000,000



FCC AS A FUNCTION OF DEPTH, WELL 25/1-1

Fig: 2a

KSEPL



FCC AS A FUNCTION OF DEPTH, WELL 25/1-1

FIG: 2b

INITIAL DISTRIBUTION

6 copies SIPM

3 copies Shell Expro London