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PETROLEUM GEOCHEMISTRY REPORT

PREPARED FOR

NORSK HYDRO.

Geochemical Source Rock Evaluation of Sediments from
Well: 7/11-5.

March 1983.

Contents

Summary

A total of twenty-eight cuttings samples and thirteen sidewall core samples were used for a comprehensive geochemical study of Well: 7/11-5. A maturation profile was established using a statistical correlation of Vitrinite Reflectance measurements, from which the threshold for the generation of liquid hydrocarbons was calculated to be 3400 ± 229 m.

Sediments with moderate /good hydrocarbon potential were observed in the Jurassic and Triassic sections of this well. Jurassic and Triassic sediments were classed as being predominantly gas/condensate prone. Jurassic sediments from 4040 m - 4140 m were considered to be formerly oil prone, and it was suggested that these oil prone Kerogens have already generated a crude oil on-structure much of which has migrated out of the sequence.

It is suggested that two separate non-biodegraded oils (a heavy wax crude, and a lighter more mature crude) have migrated into the sequence in the Jurassic and Triassic intervals.

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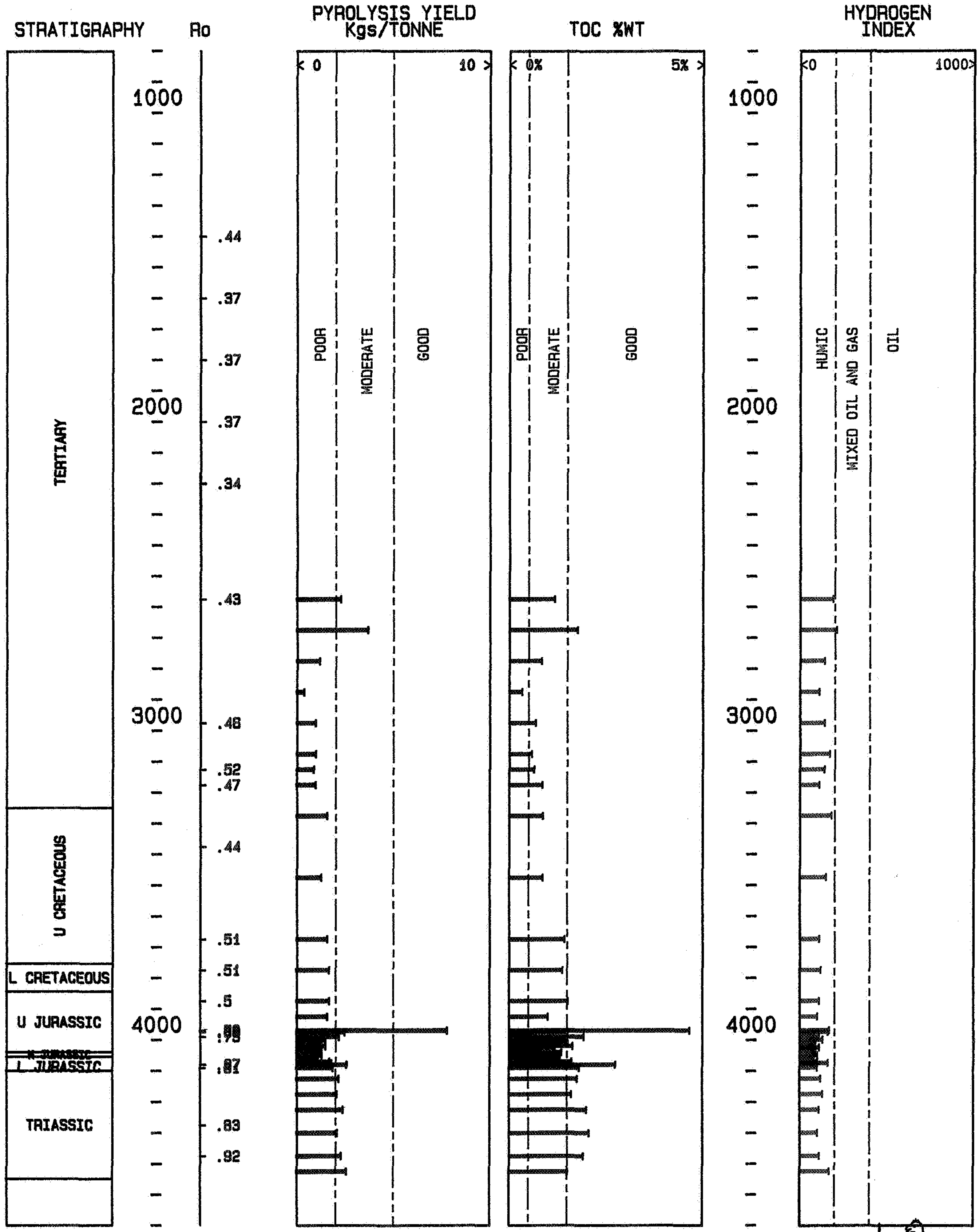
SHORT FORM GEOCHEMICAL LOG

WELL: 7/11-5



1. Introduction

A total of twenty-eight cuttings samples and thirteen sidewall core samples from the depth interval 1000 m to 4500 m and dated Tertiary to Triassic (Norske Hydro data) were used for a detailed geochemical study of Well: 7/11-5.

Maturity estimations using Vitrinite Reflectance and Spore Fluorescence measurements were completed throughout the interval examined in an attempt to establish a maturation profile for this well. Spore Colouration ratings from Visual Kerogen descriptions and Carbon Preference Indices from Soluble Extract studies were used to support the reflectance measurements in assessing the true maturation levels.

Pyrolysis techniques were used to establish the hydrocarbon source potential and the likely hydrocarbon products or source oil and/or gas type where potentials were sufficiently high. Where possible hydrocarbon typing using pyrolysis was supported by Visual Kerogen descriptions completed at the same depth range. Total Organic Carbon was measured, to produce additional information concerning the richness of the sediments as defined solely by their organic contents.

2. Samples and Techniques

All the cuttings samples were received in tin cans. The sidewall cores were received in glass 'Schlumberger' jars. The cuttings samples and the sidewall core samples were washed to remove all traces of drilling mud. All these washed samples were air dried under controlled conditions at 40°C. The samples were then carefully hand picked to remove obvious caved material and concentrate a single, potentially organic rich lithology (e.g. mudstones, shales, calcareous mudstones).

Samples for Vitrinite Reflectance measurements were coarsely ground to ca 1 mm, mounted in an epoxy resin block and polished. Reflectivity values were measured using a reflected light microscope, with an oil immersion objective. The results of these measurements are shown in Table 1.

Samples for Visual Kerogen description were treated with mineral acid. The remaining debris was sedimented onto a microscope slide and examined using a transmitted light microscope. The results of the Visual Kerogen descriptions and assessments of Spore Colouration are shown in Table 2. The range of Spore Colouration is from 1 - 7 and the colour taken as representing the onset of liquid hydrocarbon generation is 3/4.

Samples for Total Organic Carbon measurements were finely ground and sieved to achieve homogeneity, then digested with fuming hydrochloric acid to remove mineral carbonate. The decarbonated samples were then combusted in a Carlo Erba 1106 Carbon, Hydrogen, Nitrogen analyser and their total organic carbon content determined, relative to those of calibrated standards. The results of these measurements are shown in Table 3.

Samples for Screening Pyrolysis (P_1, P_2 HI analyses) were also ground and sieved and then examined using a modified Hewlett-Packard 5711 Gas Chromatograph, to measure their ultimate hydrocarbon potential. Samples were subjected to two initial isothermal heating periods of 150°C and 325°C and then ramped to 575°C. Two peaks of interpretive significance were evolved, which are conventionally referred to as P1 and P2 and were related to those of a calibrated standard. Three to four standards are run daily to ensure accuracy. The Hydrogen Index is derived from the P2 and TOC values and is further used to characterise oil and/or gas Kerogens. The results of Screening Pyrolysis are shown in Table 4.

Ground samples for Extended Pyrolysis were extracted with dichloromethane before being heated to 550°C and examined using a modified Hewlett-Packard 5880 Gas Chromatograph. The hydrocarbons evolved were separated according to their boiling points on a non-polar column. This method is adopted in order to analyse the distribution of C_1 - C_5 gaseous hydrocarbons and C_5 - C_{36}+ liquid hydrocarbons generated from the Kerogen. It complements the Visual Kerogen identification of oil and gas prone Kerogens. The ratio of wet gases/oil components of paraffinic, naphthenic or naphtheno-aromatic hydrocarbons which a potential source-rock can generate at various levels of maturities. Thus, for Kerogens which have

$$\frac{\sum C_1 - C_5}{\sum C_5 - C_{36}+}$$

ratios the following classification is used.

<u>Wet Gases</u> Oil	
$\leqslant 0.25$	Oil Prone Type 1 Kerogens (Hydrogen Index 400).
$0.25 \leqslant 0.7$	Mixed Oil and Gas Prone Kerogens (Hydrogen Index 200 - 400).
$\geqslant 0.7$	Gas Prone (Humic Coals) (Hydrogen Index 200).

Ground samples for Soluble Extract studies were extracted with geochemical grade dichloromethane, using a high velocity liquid mixer. Excess solvent was removed by evaporation and the remaining extract was separated on activated silica, to provide a saturate alkane fraction for gas chromatographic analysis. The saturate alkane fractions were examined by quartz capillary gas chromatography using a Carlo Erba 2151 Gas Chromatography with Grob-type splitless injector system. The results of these measurements are represented in Table 5.

3. Results and Discussion

(a) Maturity

Various maturity threshold values based on Vitrinite Reflectance measurements are quoted in the literature (1) but the threshold values adhered to by Paleochem and consequently used in this report are as follows:

Oil Generation Threshold	Ro = 0.45% to 0.6%
Gas Generation Threshold	Ro = 0.70% - 1.0%
Peak Oil Generation	Ro = 0.70% - 0.9%
Oil Floor	Ro = 1.3%
Gas Floor	Ro = 3.2%

Despite the effects of intense cavings in some intervals, reliable statistical correlation of autochthonous material was achieved. Correlation of the vitrinite measurementes gave a linear correlation coefficient of 0.92 and a least square fit of 0.86, from which the following generation threshold values and error ranges were calculated:-

Onset of Liquid Hydrocabon Generation	3400 ± 229 m
Onset of Gas Generation	4051 ± 259 m
Peak Oil Generation	4412 ± 330 m

These depths are present day depths and do not necessarily correspond to former maximum burial depth.

The thermal alteration scale (Spore Colours) from Visual Kerogen Determinations used by Paleochem and its relationship to maturation parameters and hydrocarbon products is given overleaf:

Thermal Alteration Scale	Spore Colour	Threshold Value
1	Very pale yellow	
2	Yellow	
3	Yellow/orange	
		3/4 Oil Generation
4	Orange	
		4/5 Gas Generation
5	Brown	Peak Oil Generation
		5/6 Oil Floor
6	Brown/black	
7	Black	7 Dry Gas Floor

Spore Colour indices from Visual Kerogen descriptions (Table 2) were in general agreement with the maturation trend predicted by statistical correlation of vitrinite measurements. Spore fluorescence colours of yellow-orange for Cretaceous sediments and mid orange to deep orange for Jurassic and Triassic sediments provided further support for the maturity estimations of sediments examined in this well.

(b) Source Potential

Samples having Total Organic Carbon values below 0.5% are generally regarded as containing insufficient organic material to be of commercial value (2). Thus this value is used as a cut-off point in this report, unless screening pyrolysis indicates otherwise. Source potential ratings based on conventional geochemical data are given overleaf:-

Poor	Less than 0.5% TOC
Moderate	0.5% to 1.5% TOC
Good	Greater than 1.5% TOC

Pyrolytic methods are widely used for estimating the generation capabilities of potential source-rocks (3). Pyrolysis techniques have superseded the more traditional method of assessing hydrocarbon potential using Total Organic Carbon measurements, because they provide more meaningful data. Pyrolysis does not take into account and reworked and/or inertinite present in source-rocks. Inertinite adds to the organic carbon value, but has very limited or no hydrocarbon potential.

The first peak (P1) is often considered as representative of the quantity of free hydrocarbons that were present in the sediment at the time of sampling. The second peak is considered to be representative of the quantity of hydrocarbons present and yet to be generated. The P2 peak is produced by conversion of the Kerogen in the rock sample by thermal cracking in the instrument. This is generally considered to be a reasonable estimate of the amount of hydrocarbons, theoretically remaining to be generated by the complete conversion of the Kerogen in sediments under natural conditions throughout their geological lifetime.

Both the P1 and P2 yields are expressed in Kg./tonne. Comparison of pyrolysis data with conventional geochemical data to provide hydrocarbon potential ratings gives P2 yield values in practical exploration terms of:

Poor	0.1 to 2.0 Kg./tonne rock
Moderate	2.0 to 5.0 Kg./tonne rock
Good	$>$5.0 to $\leq$15.0 Kg./tonne rock
Excellent	$>$15.0 Kg./tonne rock

*1 kg. oil generated/tonne rock = 18 - 22 bbls oil/acre ft (0.02 bbls/M^3 rock - SG 2.7).

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In addition, P1 P3 and TOC values can be used to derive the Hydrogen Index (HI) and the Production Index (PI) as follows:

$$\text{Hydrogen Index} = \frac{\text{P2 yield} \times 100}{\text{\% TOC}}$$

$$\text{Production Index} = \frac{\text{P1}}{\text{P1} + \text{P2}}$$

The HI is independent of the abundance of organic matter present in a sediment and can be used to determine the type of Kerogen (oil and/or gas prone) present in a source-rock. In general, the higher the hydrogen index, the more oil prone the Kerogen, as demonstrated on the summary log at the front of this report.

The production index is a quantitative evaluation of hydrocarbon generation from Kerogen. The P1 yield represents the fraction of the sediment transformed into hydrocarbons unless affected by migrated hydrocarbons or contaminants. The P2 yield represents hydrocarbons yet to be generated. If unaffected by migrated hydrocarbons or by contaminants, the P1/P1 + P2 ratio determines the minimum amount of hydrocarbon generation, which has formerly or is occurring on-structure at the present day.

It is possible that some of the generated hydrocarbons have migrated from the mature source-rock. Hence, the P1/P1 + P2 ratio represents a minimum value. A P1/P1 + P2 ratio of 0.1 equivalent to 10% generation is equated with a maturity $\geq$ OGT. If no migration has occurred, and this is not common, a ratio of 0.5 is equated with $\geq$ peak oil generation.

i) Tertiary

The Total Organic Carbon (TOC) content values obtained for Tertiary sediments 2600 - 3250 m ranged from poor to good

(TOC % wt 0.34 - 1.77) with the majority of the samples showing moderate organic richness.

Hydrocarbon potential ratings from Screening Pyrolysis measurements, with the exception of one sample at 2700 - 2750 m, gave poor hydrocarbon potentials (0.4 - 2.3 Kg./tonne). The sample at 2700 m - 2750 m had moderate hydrocarbon potential, 3.7 Kg./tonne. This downrating in source potential is probably due to the presence of significant quantities of inertinite and reworked material observed during reflected light microscopy studies. Reworked material and inertinite have limited and no hydrocarbon potential respectively. Hydrogen Indices are markedly low in this interval with the exception at 2700 - 2750 m.

Extended Pyrolysis measurements, Visual Kerogen descriptions and Soluble Extract studies were not completed on sediments from this stratigraphic interval due to their negligible source potential observed during screening pyrolysis measurements.

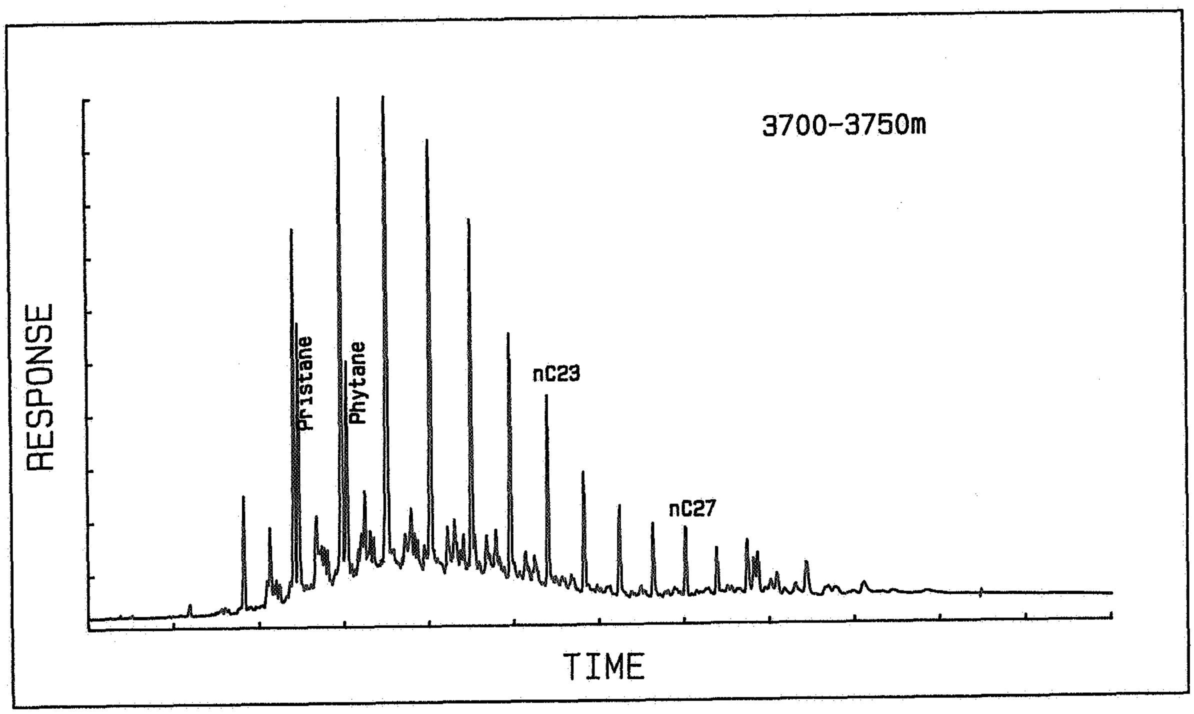
ii) <u>Cretaceous</u>

The Total Organic Carbon contents of the Cretaceous sediments 3300 m - 3850 m showed moderate organic richness (0.88 - 1.44% range). Screening pyrolysis measurements downrated all the sediments from this stratigraphic interval to poor and poor/moderate hydrocarbon potential (1.3 - 1.7 Kg./tonne). It is considered that this downrating in potential was partly due to the present of inertinitic material identified by reflected light microscopy.

Visual Kerogen descriptions completed on one sediment from the Cretaceous at 3700 m - 3750 m suggested that if the sediment had any significant generative potential it would be classified as being predominantly oil prone. A low P2 potential and low HI index reveals that this microscopic assessment is fallacious.

Extended Pyrolysis measurements completed on the same sediment were unreliable and could not be used in this assessment due to the low P2 value (<2 Kg./tonne) observed during Screening Pyrolysis studies. Thus, the sediment has no commercial potential.

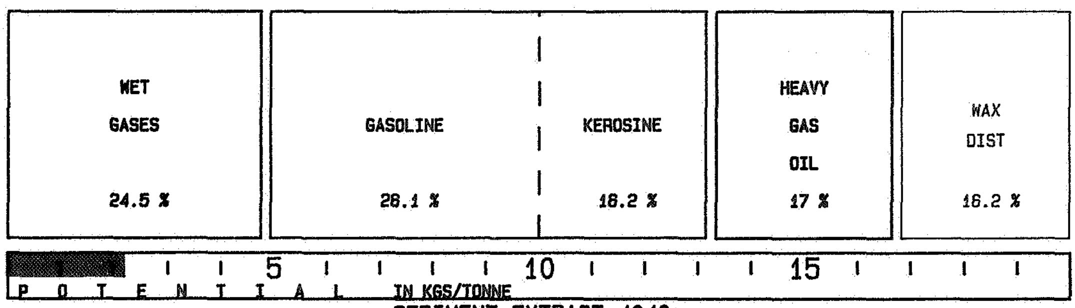
Soluble Extract studies completed on the sample at 3700 - 50 m showed n-alkane distributions consistent with a predominantly marine algae input, suggested from Visual Kerogen descriptions. The n-alkane distribution of the sediment at 3700 - 50 m showed n-alkanes eluting predominantly in the nC_{17} - nC_{23} carbon number range, as illustrated below. Although present in low abundance (production index = .06) and consequently not considered to be a migrated oil (oil stain), it is possible that this distribution represents a gas oil cut added to the drilling mud.



iii) <u>Jurassic</u>

The sediments from this stratigraphic interval, 3900 - 4200 m, contained moderate to good organic carbon contents (TOC % wt. range 0.64 - 4.67). Screening Pyrolysis measurements revealed poor to good hydrocarbon potential. Low Hydrogen Indices are partly due to the presence of inertinitic material identified by reflected light microscopy. Hydrocarbon typing using Visual Kerogen descriptions suggested that the sediment at 3900 - 3950 m would be predominantly gas prone. The sediments at 4000 - 4050 m and 4020m showed negligible hydrocarbon source potential. In contrast, three sediments at 4040 m, 4130 m and 4140 m were classified as being predominantly oil prone. These Jurassic analyses are regarded as subjective assessments due to the presence of inertinite and low hydrogen indices.

Extended Pyrolysis measurements completed on six samples from the Jurassic, demonstrated that all sediments examined would be predominantly gas/condensate prone at this level of maturity. The relative amounts of gases and gasoline range Kerogen breakdown products was 39.5 -58.6% as illustrated below.

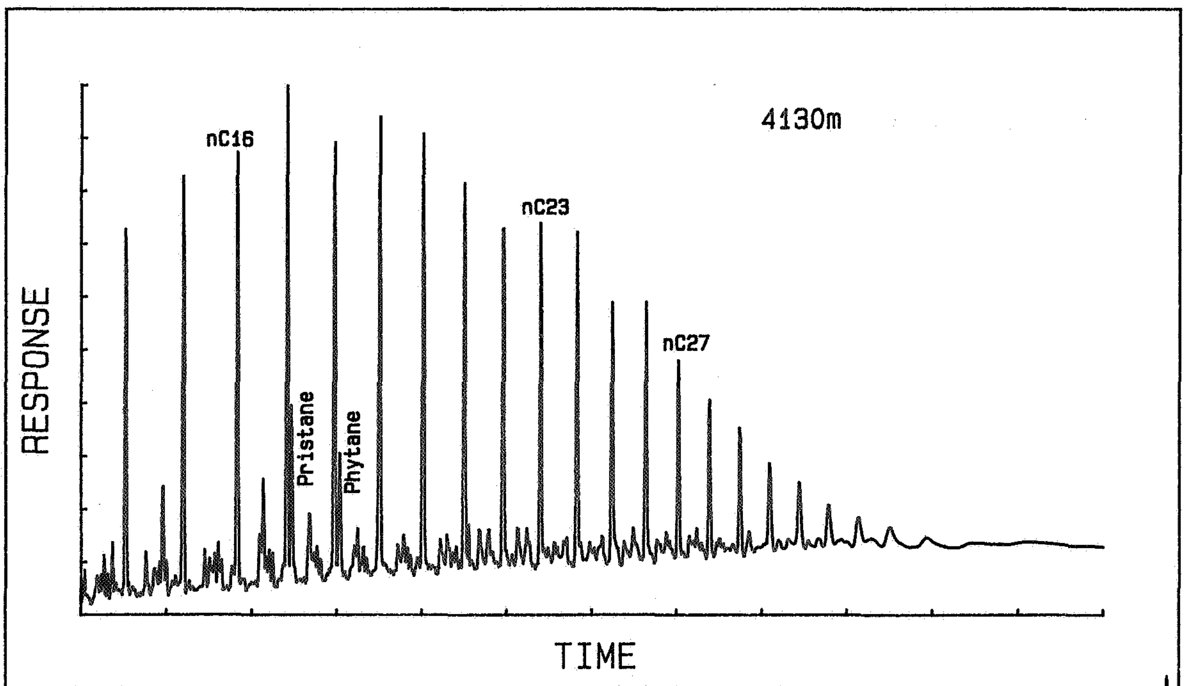


SEDIMENT EXTRACT 4040m

This suggests that the original oil prone Kerogen material as identified by Visual Kerogen descriptions has generated its previous oil potential (Spore Colour Index, Hydrogen Index 160) at some former stage, commencement probably in Late Cretaceous/Tertiary times. This accounts for the low Hydrogen Indices shown by the Upper Jurassic sediments, Table 4.

It was observed that sediments from 4040 - 4140 m had Transformation Ratios of .29. This suggests that the amount of hydrocarbon generation that has occurred is $\geq$ 29%. During the past history of migration, these source rocks have generated a crude oil which has migrated out of the sequence leaving residual P1 values of ca 1.0 Kg./tonne for Jurassic sediments.

Soluble Extract studies were completed on six sediments from this stratigraphic interval. The n-alkane distributions of sediments at 4020 m and 4040 m as well as sediments at 4130 m and 4140 m represent migrated or in situ generated crude oil distributions. It is suggested that the migrated oil present in these sediments is a high wax crude with n-alkane distributions extending beyond nC_{30} carbon number, indicative of a significant terrestrial plant input as illustrated below.



In contrast, the n-alkane distributions of sediments from 3900 - 50 m and 4000 - 50 m suggested that a lighter more mature non-biodegraded crude oil has migrated into these sediments, or a gas oil cut has been added to the drilling mud. Volumetric predictions of amounts of oil produced and expulsion can be determined, upon request, if required.

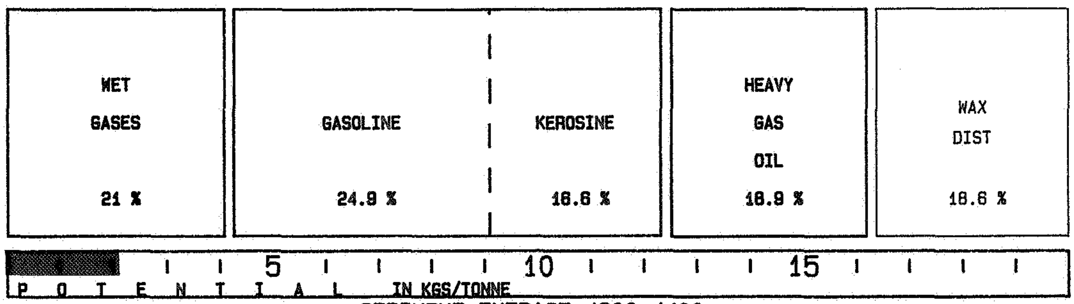
iv) Triassic

Sediments from the Triassic interval (4250 m - 4500 m) showed good Total Organic Carbon contents (TOC % wt range 1.52 - 2.07).

Screening Pyrolysis measurements in general downgraded the TOC measurements to moderate hydrocarbon source potential (2.1 - 2.6 Kg./tonne). The Triassic Kerogens have already generated an estimated ≥ 27% to 32% of their original hydrocarbon potential on-structure at equivalent reflectances up to 0.92 Ro. Hydrogen Indices are low (110 - 170) characteristic of future potential to generate only gas.

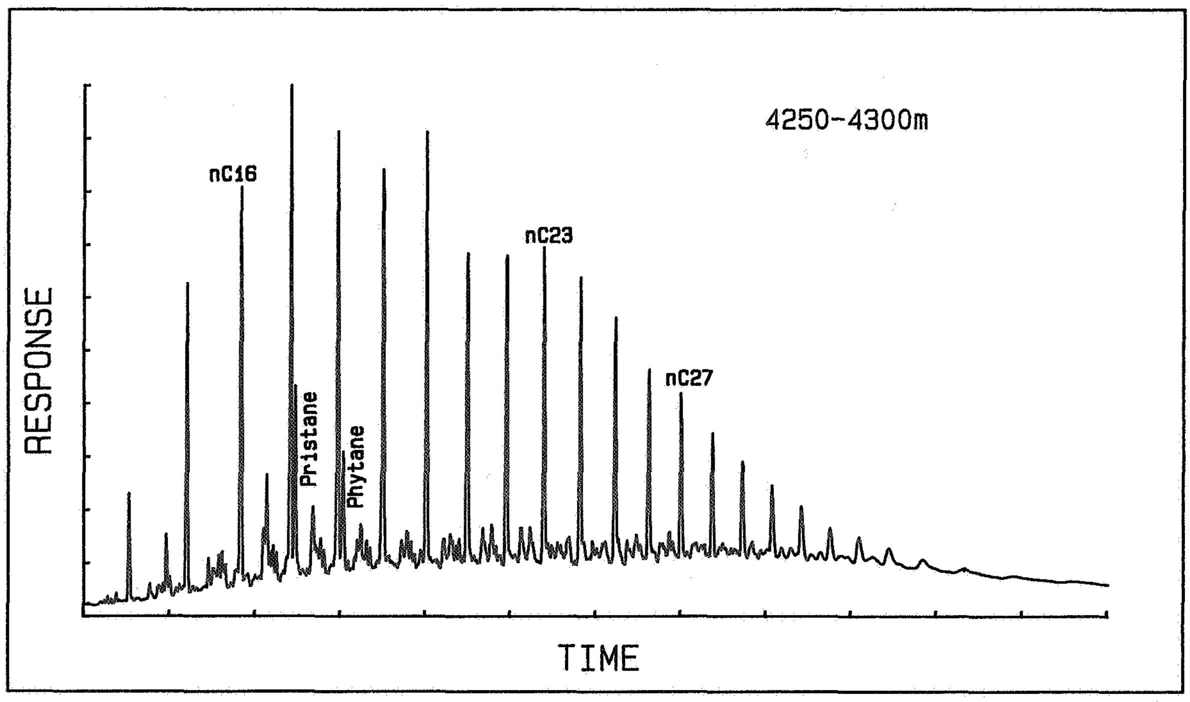
Kerogen typing by Visual Kerogen descriptions of sediments suggested that sediments 4250 - 4450 m had no significant potential to source hydrocarbons.

Extended Pyrolysis measurements suggested that these moderate potentials would generate gas/condensate only. The relative amounts of wet gases and gasoline range Kerogen breakdown products fell in the range 45.0 to 50.3% as illustrated below, where the production of a relatively high proportion of gases is confirmed.

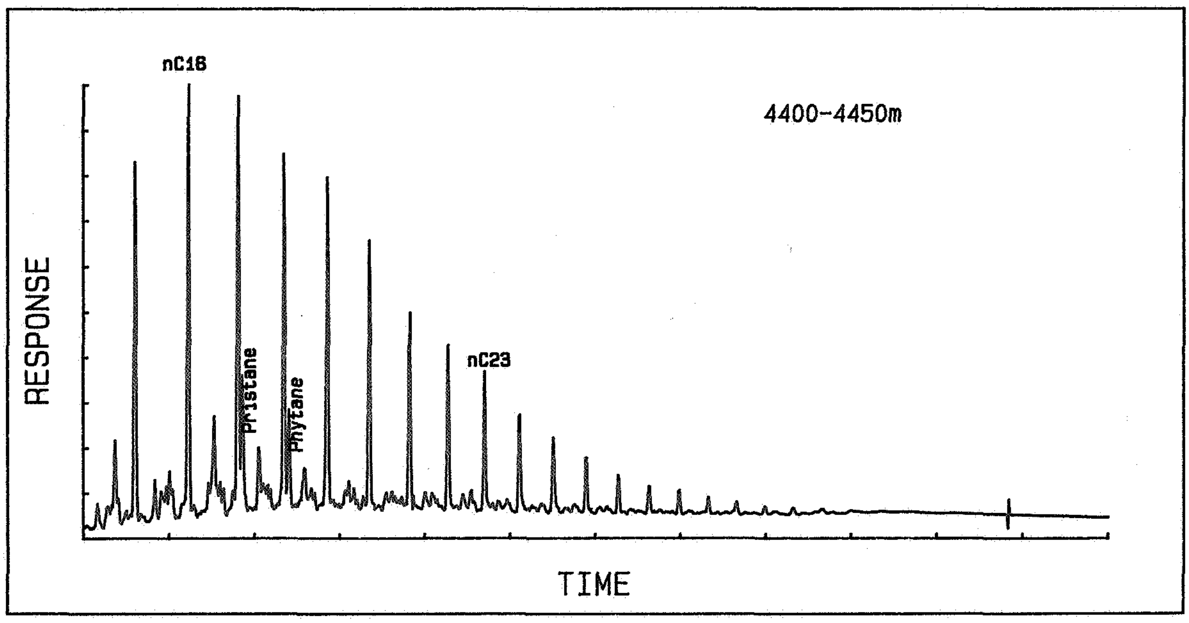


SEDIMENT EXTRACT 4300-4400m

Soluble Extract studies demonstrated that the sediment at 4250 - 4300 m had a high wax crude oil n-alkane distribution, similar to the distributions observed at 4020 m and 4140 m in the Jurassic interval of this well, and suggests that a migrated oil is present in this interval, not necessarily generated in situ from Kerogens. It is suggested that the Jurassic sediments perhaps on the downthrown side of the structure have generated oil which has migrated into the sequence.



N-alkane distributions of two sediments at 4400 - 50 m and 4300 - 4400 m were similar in appearance to the lighter migrated oil (possible gas/oil cut) recognised in the Jurassic interval between 3900 - 4050 m. The majority of the n-alkanes elute between nC_{15} and nC_{20} carbon number, as illustrated below.



This suggests that this interval contains either a second migrated oil which is lighter and perhaps sourced from Kerogens of greater maturity than the first crude oil, or a gas oil cut has been added to the drilling mud. It is recommended that radically differing interpretations should be further investigated by carbon isotope ($\delta^{13}C$) and computerised gas chromatography/mass spectrometry (cgc/ms) of soluble extracts.

4. Conclusions

i) A statistical correlation of Vitrinite Reflectance measurements were completed which predicted a liquid hydrocarbon generation threshold of 3400 $\pm$ 229 m, a gas generation threshold of 4051 m $\pm$ 259 m and a Peak Oil generation threshold of 4412 $\pm$ 330 m present day.

ii) Sediments rated as having moderate to good hydrocarbon potentials were identified in the Jurassic and Triassic sections of this well.

iii) Sediments from the Jurassic and Triassic were classed as formerly oil prone although predominantly gas prone present-day onstructure. Jurassic sediments from 4040, 4130 and 4140 m are considered to be formerly oil prone and it is suggested that these oil prone Kerogens have already generated a crude oil on-structure, much of which has migrated out of sequence. Two oil types are present although one type is <u>suggestive</u> of a gas oil cut additive.

iv) It was suggested that the Jurassic sediments from the depth interval 4020 - 4140 m and the Triassic sediments from 4250 - 4300 m contained migrated or in situ generated high wax crude oil, much higher than conventional KCF crudes. Further characterisation of hydrocarbon provenance cannot be made until more sophisticated $\delta^{13}C$ and cgc/ms studies are undertaken.

v) High production indices and maturity profiles reveal that generation on-structure was a former and rapid event due to the $>$ 3 Km Tertiary overburden present.

5. Recommendations

i) $\delta^{13}C$ and cgc/ms studies are required to recognise whether or not a contaminant gas oil cut has been added to the drilling mud.

ii) $\delta^{13}C$ data of soluble extracts and fractionated products should be compared with $\delta^{13}C$ data for Kerogen contents in Jurassic and Triassic sediments. Such data should be compared with whole oil $\delta^{13}C$ and fractionated oils, in order to construct Galimov type profiles.

iii) CGC/MS studies should be undertaken to establish whether C_{27}, C_{28} and C_{29} cholestanes, isocholestanes and diacholestane distributions and their diastereoisomer ratios are similar to either KCF or Lias type oils. Similar hopane distributions and epimer ratios will establish whether or not these oils are of KCF origin.

References

1. Dow W.G. — J. Geochem Expl. 7 pp. 79 - 99 (1977).

2. Ronov A.B. — Geochemistry No.5, pp. 510 - 536. (1958).

3. Clementz D.M. — Offshore Technology Conference, p. 465 (1979).

Well No: 7/11-5

VITRINITE REFLECTANCE DATA

Depth m.	Reflectivity Ro (Ave)				
	Autochthonous		Allochthonous		Spore Fluorescence
1000-1100				0.78 (17)	Yellow-orange -light orange
1200-1300			0.63 (1)	0.85 (2)	Yellow-orange
1400-1500		0.44 (1)		0.97 (6)	Yellow-orange
1600-1700		0.37 (20)			Yellow-orange
1800-1900		0.37 (13)			Yellow-orange
2000-2100		0.37 (12)			Yellow-orange
2200-2300		0.34 (21)			NDP
2600-2650		0.43 (13)	0.55 (1)		Yellow-orange
3000-3050		0.46 (3)	0.63 (6)		Light orange
3150-3200	*0.38 (5)	0.52 (1)	0.75 (4)		Yellow-orange
3200-3250		0.47 (20)	0.73 (1)		Yellow-orange -light orange
3400-3450		0.44 (20)			Yellow-orange -light orange
3700-3750	*0.30 (1)	0.51 (12)			Yellow-orange
3800-3850	*0.34 (12)	0.51 (2)	0.60 (1)		Yellow-orange -light orange
3900-3950		0.50 (12)			Yellow-orange -light orange
3950-4000	*0.34 (21)				Yellow-orange -light orange

Table 1.

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Well No: 7/11-5

VITRINITE REFLECTANCE DATA

Depth m.	Reflectivity Ro (Ave)				
	Autochthonous			Allochthonous	Spore Fluoreseence
4020	*0.30 (1)	0.58 (1)			NDP
4000-4050	*0.30 (13)	0.69 (4)			Mid-orange
4040		0.73 (1)	0.99 (1)	1.26 (2)	Deep orange
4100-4150	*0.57 (1)				Yellow-orange -light orange
4130		0.87 (6)	1.13 (6)	1.22 (1)	Mid-orange
4140		0.81 (2)	1.0 (2)		Mid-deep orange
4250-4300	*0.34 (15)				NDP
4300-4350		0.83 (1)	0.99 (5)	1.34 (1)	Mid-orange
4350-4400	*0.43 (4)				Light-Mid orange
4400-4450	*0.57 (2)	0.92 (6)			Mid-orange

Figures in Parenthesis refer to the number of measurements completed.

Table 1 - continued.

Well No: 7/11-5

VISUAL KEROGEN DATA

Depth m.	Cuticle + Palynomorphs	Brown Wood	Black Wood & Inertinite	Amorphous	Predominant Source Type	Colour Maturation Rating
3700-50	– *	Trace	Trace	Trace	Oil	3
3900-50	Trace o *	Common	Trace	Trace	Gas	3
4000-50	– *	–	Trace	Trace	–	4/5
4020	–	–	Trace	–	–	5
4040	– o *	Trace	Trace	Common	Oil	5
4130	– *	Trace	Trace	Common	Oil	5
4140	– *	Trace	Trace	Common	Oil	5
4250-4300	– o *	Trace	Common	Trace	None	5/6
4300-4400	– o *	Common	Common	Trace	None	5/6
4400-4450	– o *	Trace	Abundant	Common	None	5/6

* Dinoflagelata cysts
o Acritarchs.

Table 2.

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Well No: 7/11-5

GENERAL WELL DATA

Sample Type	Age	Depth m.	Lithology	Total Organic Carbon Content (TOC) % wt.
Cuttings	Tertiary	2600/50	Siltstone	1.18
Cuttings	Tertiary	2700/50	Siltstone	1.77
Cuttings	Tertiary	2800/50	Siltstone	0.84
Cuttings	Tertiary	2900/50	Siltstone	0.34
Cuttings	Tertiary	3000/40	Shale	0.69
Cuttings	Tertiary	3100/50	Shale	0.59
Cuttings	Tertiary	3150/3200	Shale	0.65
Cuttings	Tertiary	3200/50	Shale	0.87
Cuttings	Upper Cretaceous	3300/50	Shale	0.88
Cuttings	Upper Cretaceous	3500/50	Shale	0.88
Cuttings	Upper Cretaceous	3700/50	Siltstone	1.44
Cuttings	Lower Cretaceous	3800/50	Siltstone	1.39
Cuttings	Upper Jurassic	3900/50	Siltstone	1.53
Cuttings	Upper Jurassic	3950/4000	Siltstone	1.01
Cuttings	Upper Jurassic	4000/40	Shale	1.52 (1.52R)
SWC	Upper Jurassic	4020	Shale	4.67
SWC	Upper Jurassic	4030	Shale	0.64
SWC	Upper Jurassic	4040	Shale	1.94
SWC	Upper Jurassic	4050	Siltstone	1.48
Cuttings	Upper Jurassic	4050/4100	Shale	1.19

Table 3.

Well No: 7/11-5

GENERAL WELL DATA

Sample Type	Age	Depth m.	Lithology	Total Organic Carbon Content (TOC) % wt.
SWC	Upper Jurassic	4060	Siltstone	1.52
SWC	Upper Jurassic	4070	Siltstone	1.65 (1.57R)
SWC	Upper Jurassic	4080	Shale	0.82
SWC	Middle Jurassic	4090	Shale	1.36
SWC	Middle Jurassic	4100	Shale	1.32
Cuttings	Lower Jurassic	4100/50	Shale	1.10
SWC	Lower Jurassic	4110	Shale	1.30
SWC	Lower Jurassic	4120	Shale	1.62
SWC	Lower Jurassic	4130	Shale	2.75
SWC	Lower Jurassic	4140	Shale	1.82
Cuttings	Lower Jurassic	4150/4200	Shale	1.77
Cuttings	Triassic	4200/4250	Shale	1.62
Cuttings	Triassic	4250/4300	Shale	2.01
Cuttings	Triassic	4300/4400	Shale	2.07
Cuttings	Triassic	4400/4450	Shale	1.92
Cuttings	Triassic	4450/4500	Shale	1.52

R = Repeat Value

Table 3 - Continued.

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Well No: 7/11-5

Pyrolysis Data

Depth m.	Yield (Kg./tonne) P1	P2	Production Index	Hydrogen Index
2600-50	0.4 (0.4R)	2.3 (2.5R)	.15	190
2700-50	0.3	3.7	.07	210
2800-50	0.1	1.2	.07	140
2900-50	<0.1 (<0.1R)	0.4 (0.4R)	0.20	110
3000-50	<0.1	1.0	.09	140
3100-50	0.1	1.0	.09	170
3150-3200	0.1	0.9	0.10	140
3200-50	<0.1	1.0	.09	110
3300-50	<0.1	1.6	.06	180
3500-50	<0.1	1.3	.07	150
3700-50	<0.1	1.6	.06	110
3800-50	<0.1	1.7	.05	120
3900-50	0.7	1.7	.29	110
3950-4000	0.3	1.6	.52	100
4000-50	1.0 (0.9R)	2.5 (2.5R)	.28	160
4020	2.9 (2.8R)	7.8 (7.5R)	.27	168
4020 Ext.	0.3	6.0	.04	130
4030	0.2	0.5	.28	80
4040	1.0	2.2	.31	110
4050	0.7	1.5	.31	130
4040-4100	0.5	1.3	.28	110

Table 4.

PALEOCHEM

Well No: 7/11-5

Pyrolysis Data

Depth m.	Yield (Kg./tonne) P1	P2	Production Index	Hydrogen Index
4060	9.7	1.3	0.50	90
4070	0.7	1.5	.31	90
4080	0.5	0.7	.41	90
4090	0.5	1.2	.29	90
4100	1.0	1.3	.43	100
4100-50	0.6	1.8	.25	160
4110	0.9	1.1	.45	80
4120	1.4	1.7	.45	100
4130	2.5	2.6	.49	90
4140	1.0	1.9	.34	100
4150-4200	0.8	2.2	.26	120
4200-50	0.7 (0.8R)	2.1 (2.2R)	.25	130
4250-4300	1.0	2.4	.29	110
4300-4400	1.0	2.1	.32	100
4400-50	0.8	2.3	.25	110
4450-4500	1.0	2.6	.28	170

R = Repeat Value

Table 4 - continued.

Well No: 7/11-5

SOLUBLE EXTRACT DATA

Depth m.	Total Soluble Extract (TSE) % wt.	Saturate Alkane Content (SAC) % TSE	Carbon Preference Index
3700-3750	0.542	11.5	*
3900-3950	0.246	26.2	*
4020	0.780	5.5	1.0
4000-4050	0.171	20.8	*
4040	0.246	32.3	1.0
4130	0.303	14.9	1.0
4140	0.470	27.9	1.0
4250	0.274	30.3	1.0
4300-4400	0.210	18.5	*
4400-4450	0.212	26.1	*

* CPI values not determined due to co-elution of compounds other than n-alkanes.

Table 5.

Well No: 7/11-5

KEROGEN BREAKDOWN PRODUCTS %

Depth m.	Gas + Wet Gases	Gasoline	Kerosene	Heavy Gas Oil	Wax Distillate	Gas + Wet Gases / Oil
3700-50			Not accurate due to low P2 values			≥.22?
3900-50	22.2	23.5	15.5	19.8	19.0	≥.28
4000-50	16.2	23.3	14.9	20.5	25.1	≥.19
4020	22.6	25.7	19.4	19.9	12.4	≥.29
4040	24.5	26.1	16.2	17.0	16.2	≥.33
4130	23.8	28.0	16.9	16.9	13.8	≥.32
4140	17.9	26.8	16.8	19.1	19.5	≥.22
4250-4300	25.0	25.3	15.2	18.0	16.5	≥.33
4300-4400	21.0	24.9	16.6	18.9	18.6	≥.27
4400-4450	18.8	26.2	16.5	20.9	17.5	≥.23

Table 6.

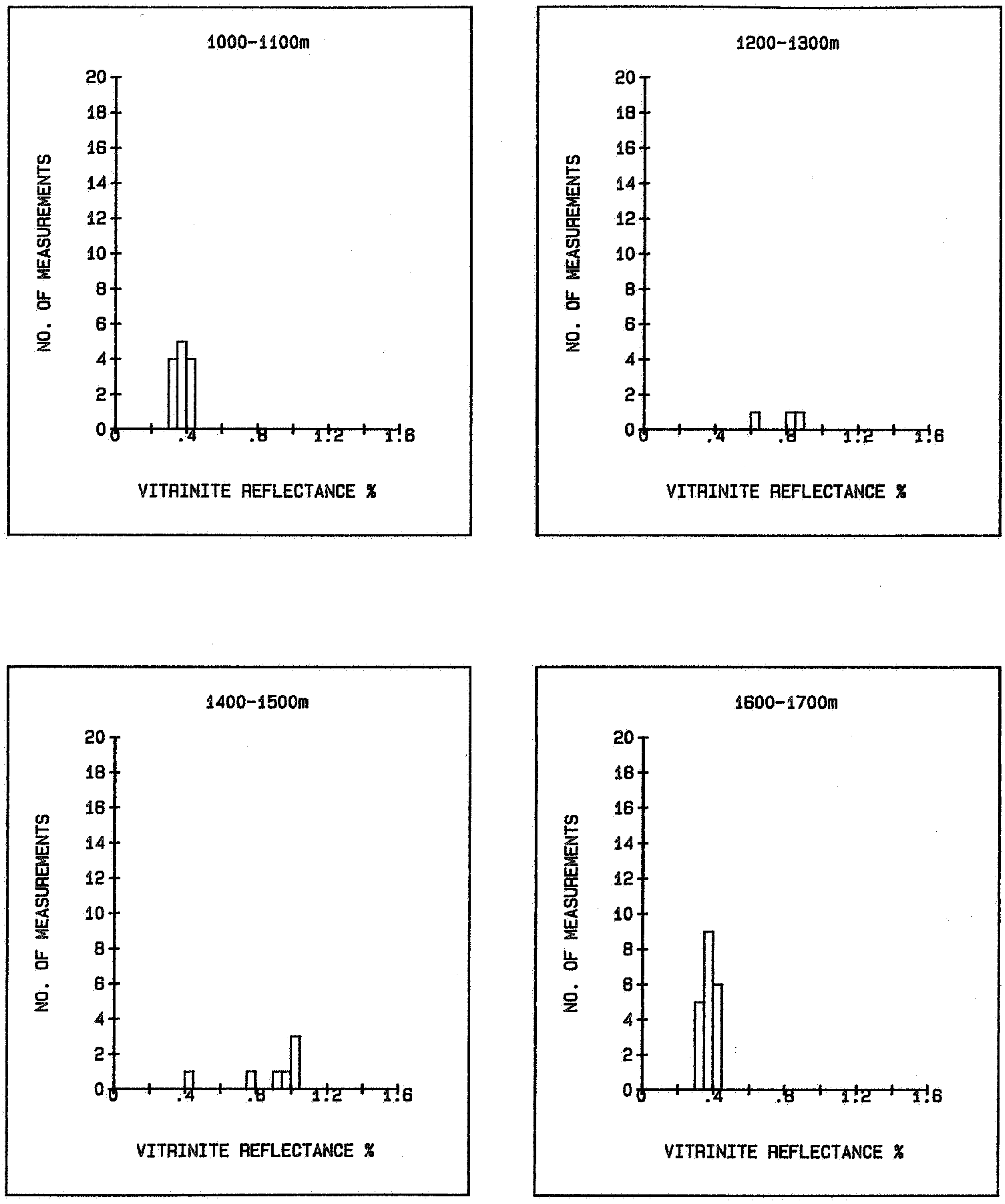

1000-1100m
1200-1300m
1400-1500m
1600-1700m
NO. OF MEASUREMENTS
0
2
4
6
8
10
12
14
16
18
20
VITRINITE REFLECTANCE %
0
.4
.8
1.2
1.6

Figure 1.

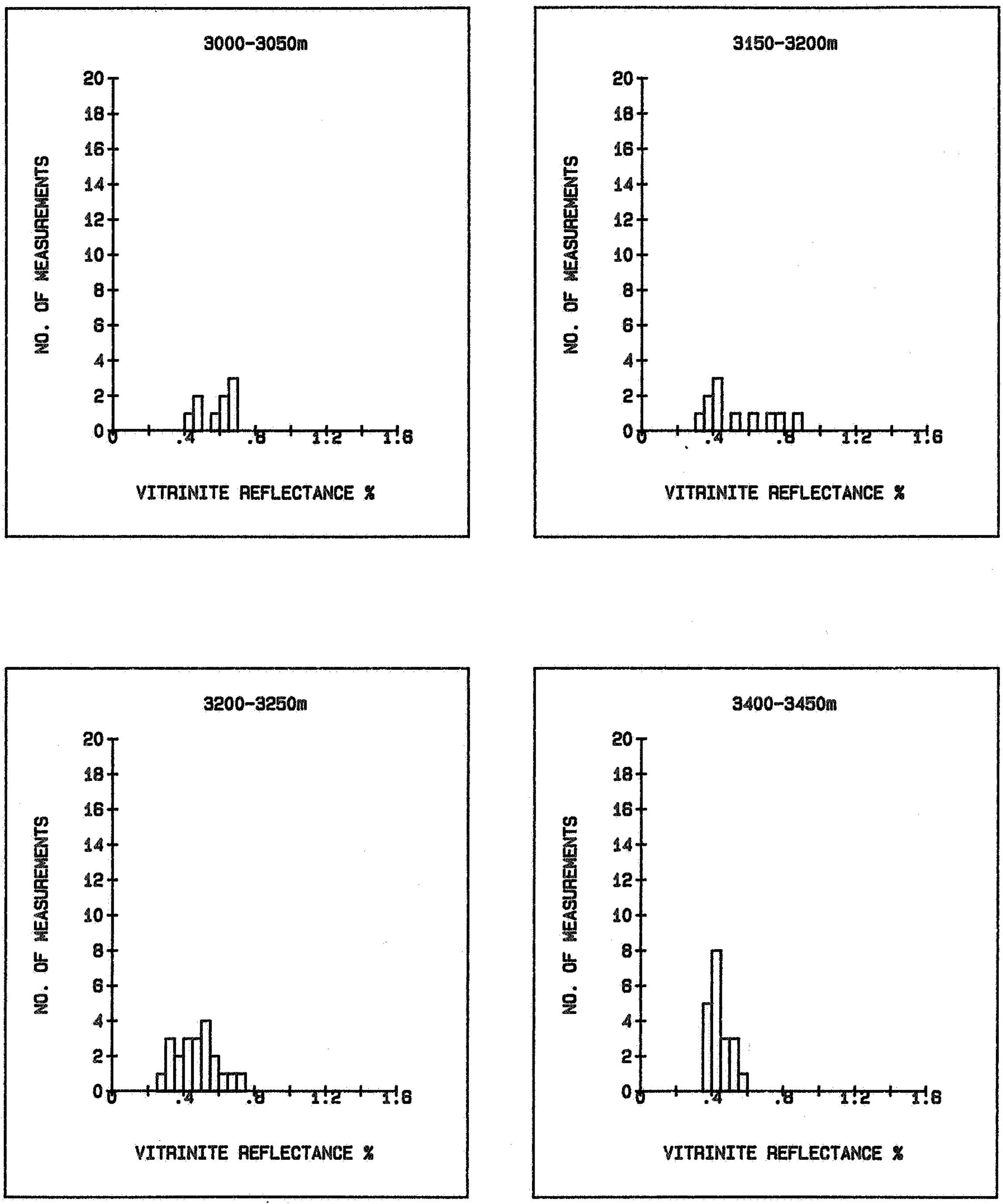

3000-3050m
3150-3200m
3200-3250m
3400-3450m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
0
2
4
6
8
10
12
14
16
18
20
.4
.8
1.2
1.6

Figure 3.

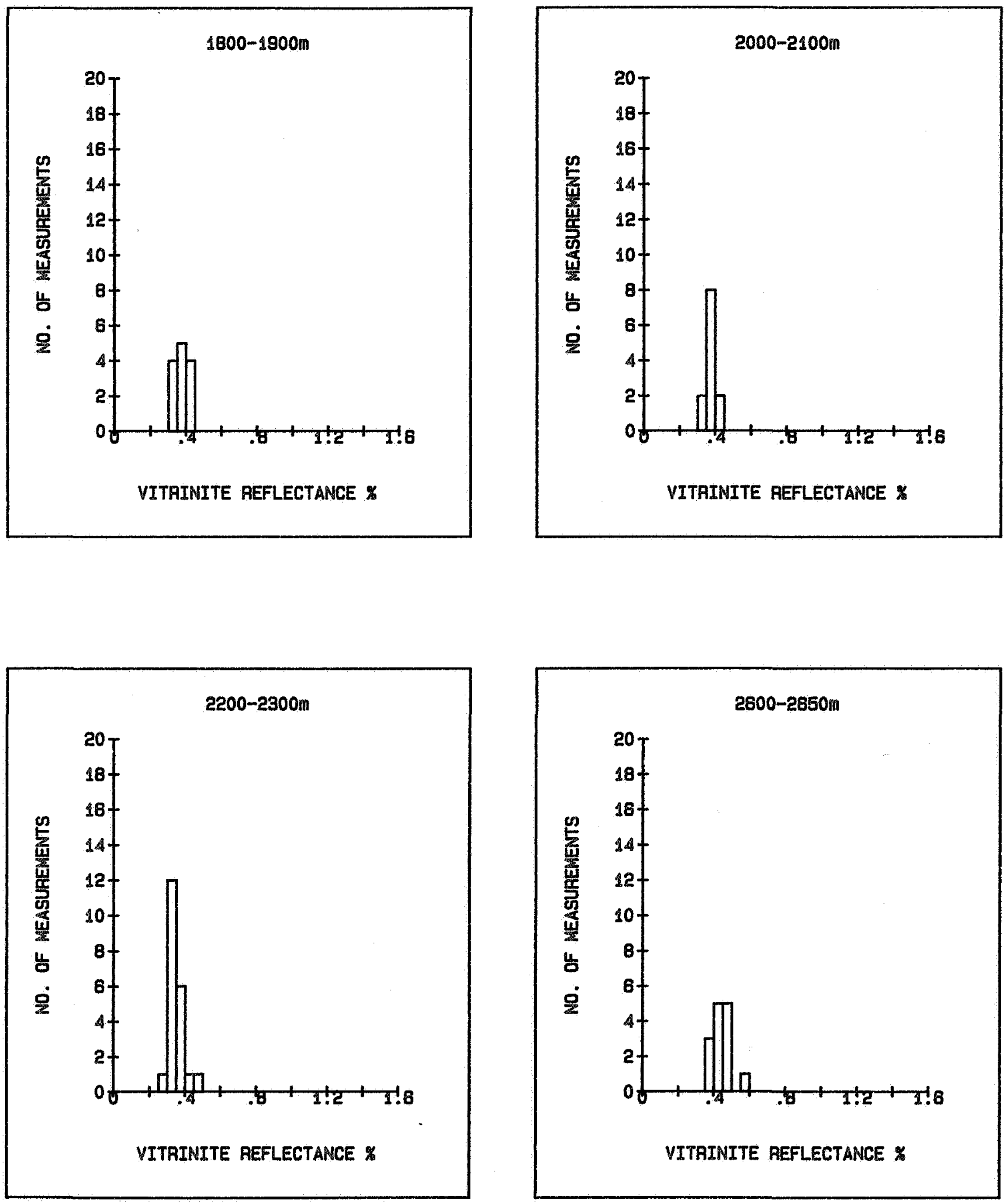

1800-1900m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
2000-2100m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
2200-2300m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
2600-2650m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %

Figure 2.

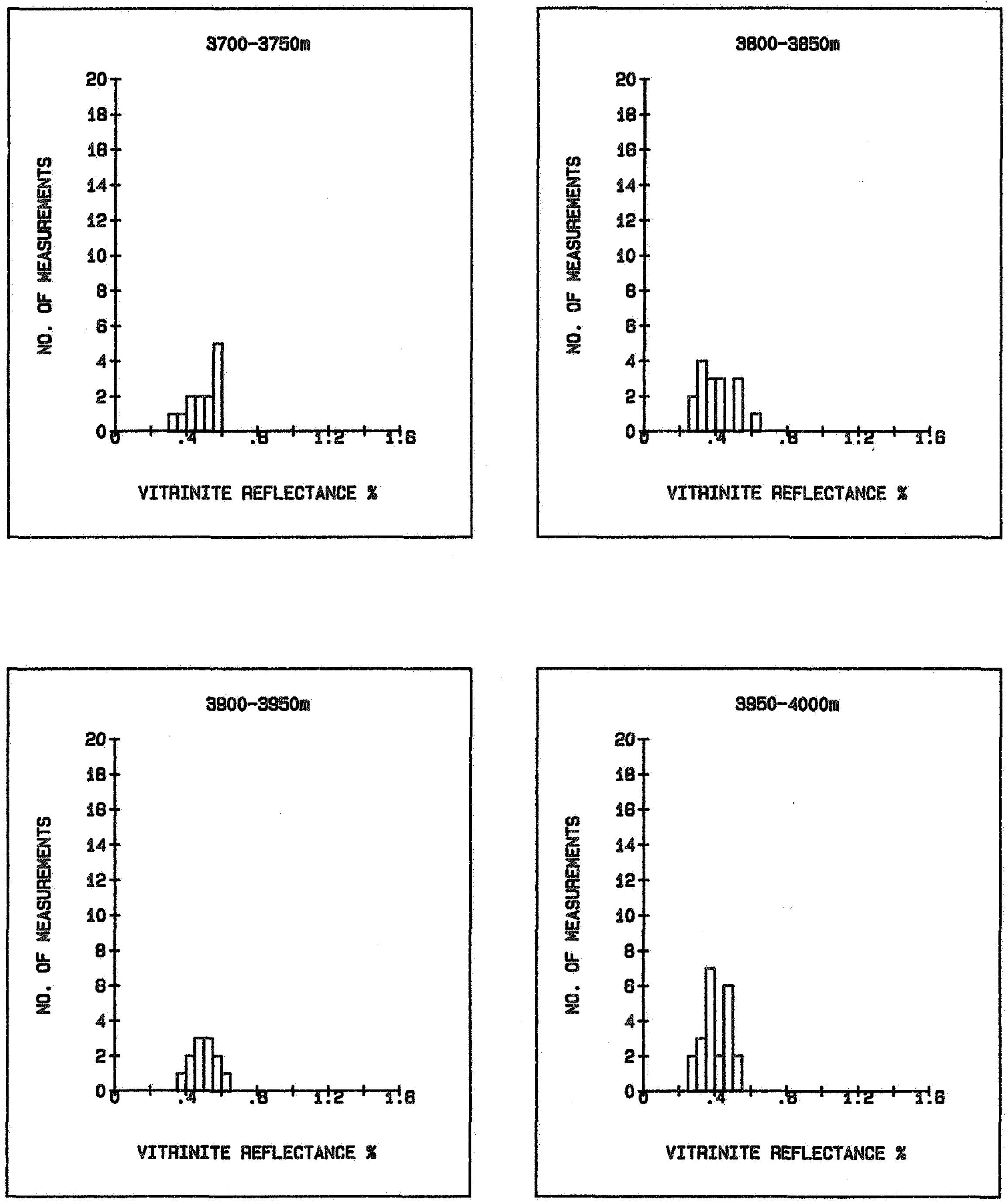

3700-3750m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
3800-3850m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
3900-3950m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
3950-4000m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %

Figure 4.

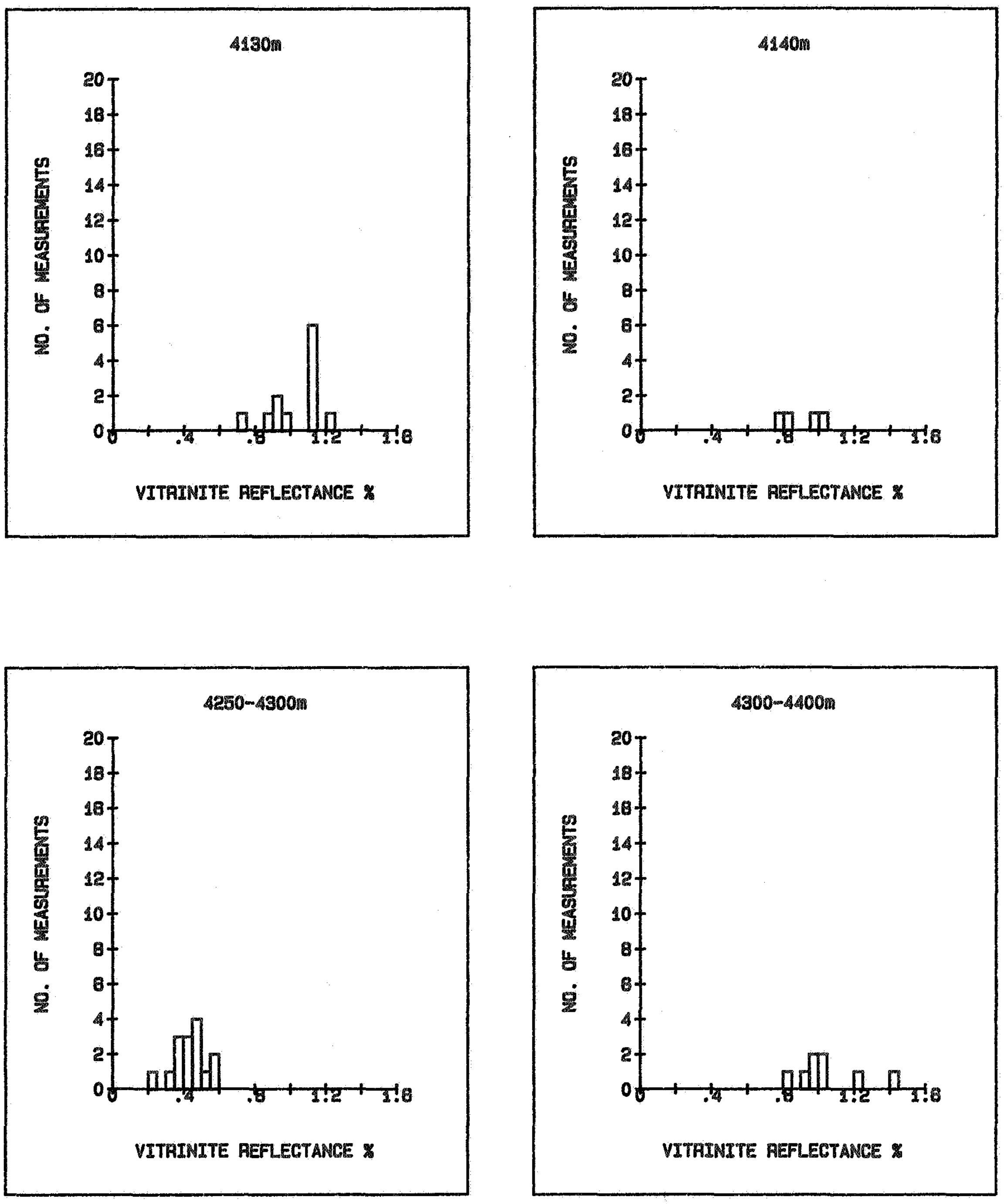

4130m
4140m
4250-4300m
4300-4400m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
0
2
4
6
8
10
12
14
16
18
20
0
.4
.8
1.2
1.6

Figure 6.

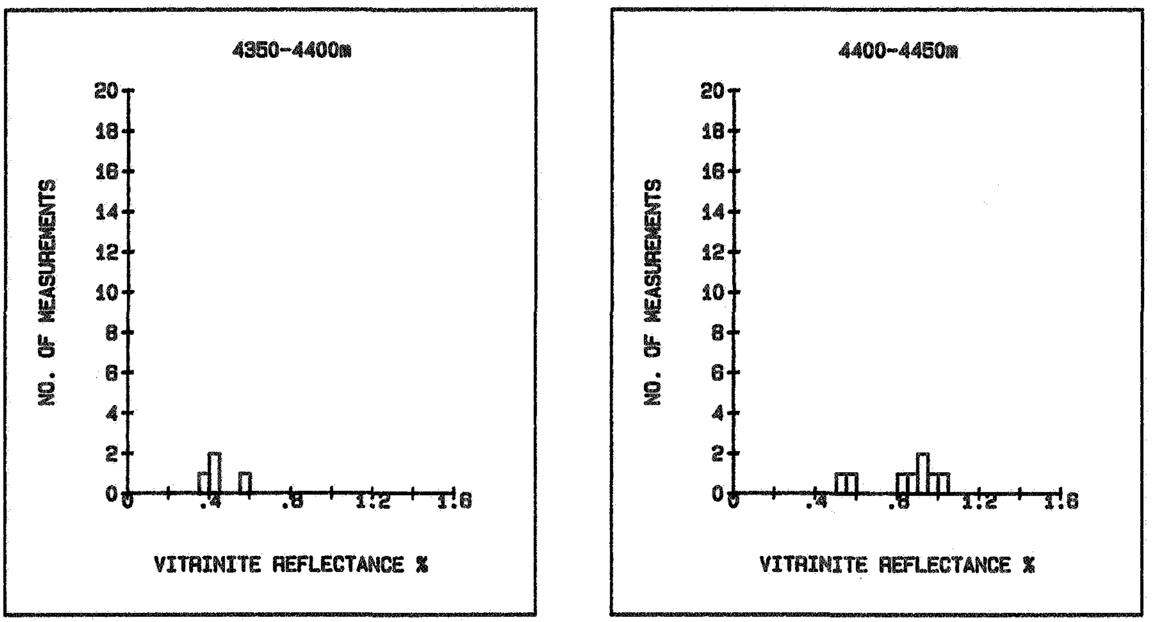
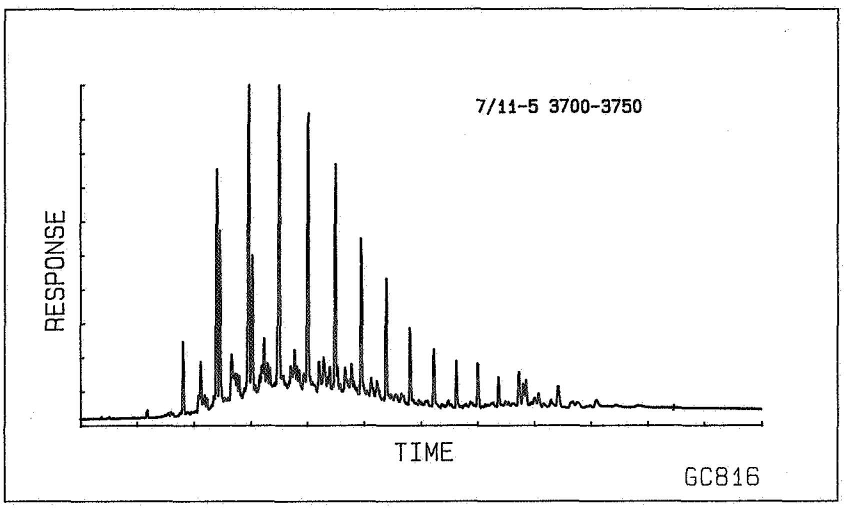
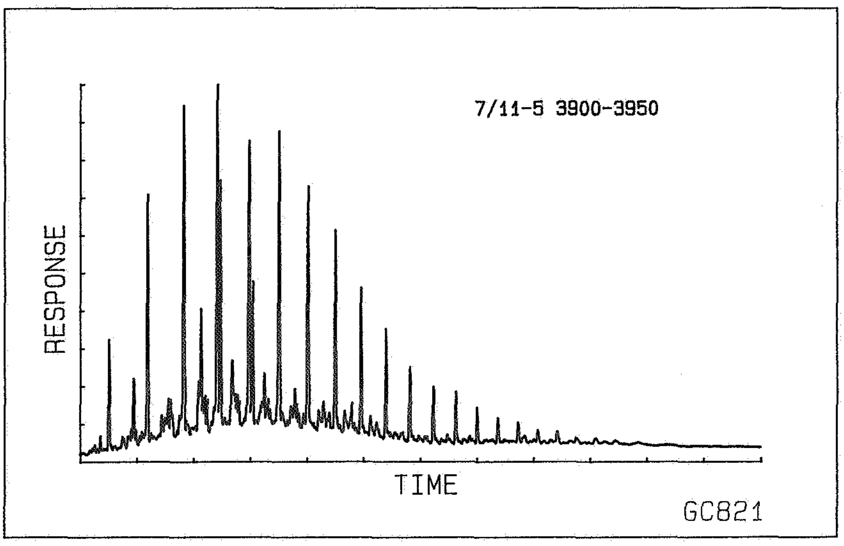

4350-4400m
NO. OF MEASUREMENTS
20
18
16
14
12
10
8
6
4
2
0
0
.4
.8
1.2
1.6
VITRINITE REFLECTANCE %
4400-4450m
NO. OF MEASUREMENTS
20
18
16
14
12
10
8
6
4
2
0
0
.4
.8
1.2
1.6
VITRINITE REFLECTANCE %

Figure 7.


7/11-5 3700-3750
RESPONSE
TIME
GC816


7/11-5 3900-3950
RESPONSE
TIME
GC821

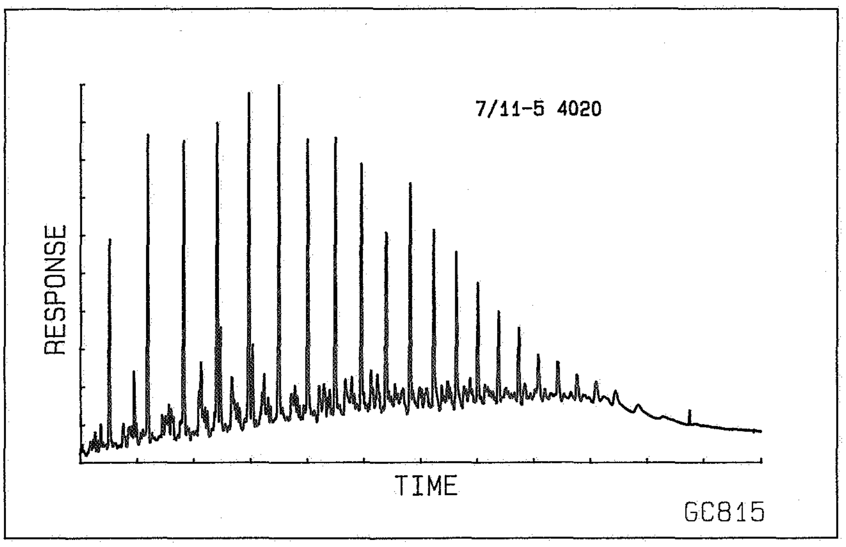
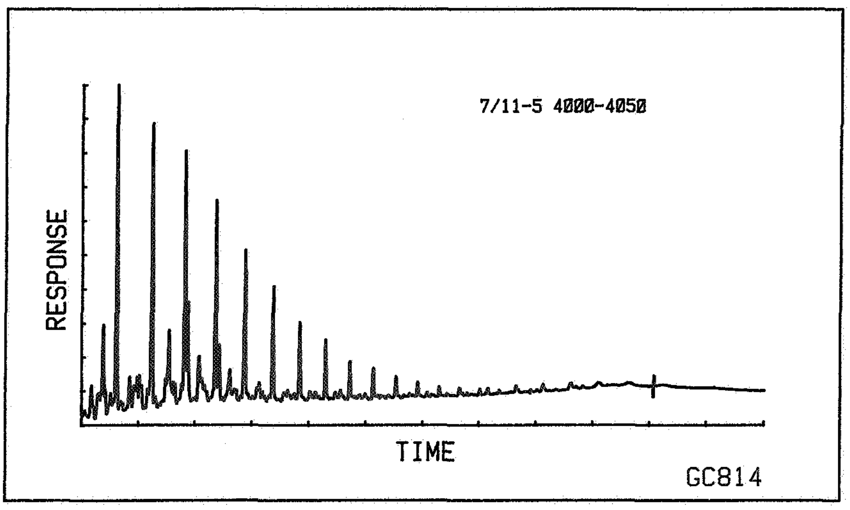
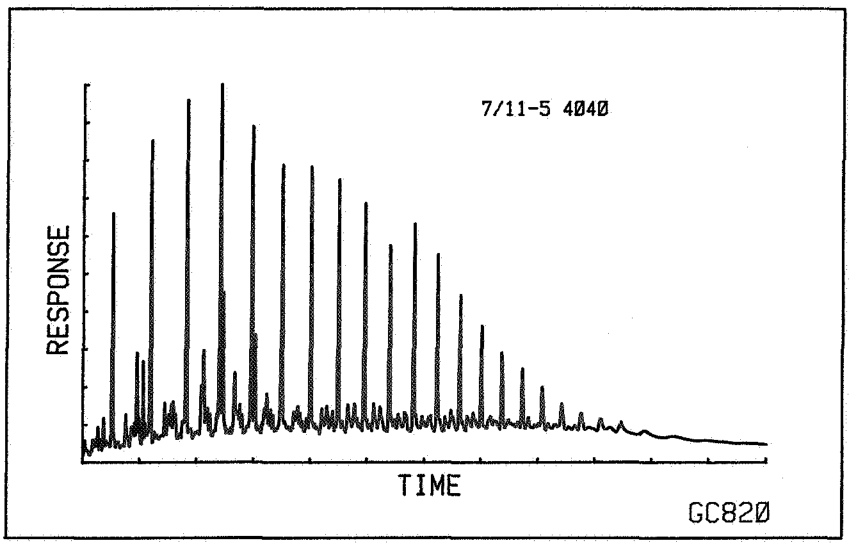

7/11-5 4020
RESPONSE
TIME
GC815

Figure 8.


7/11-5 4000-4050
RESPONSE
TIME
GC814


7/11-5 4040
RESPONSE
TIME
GC820

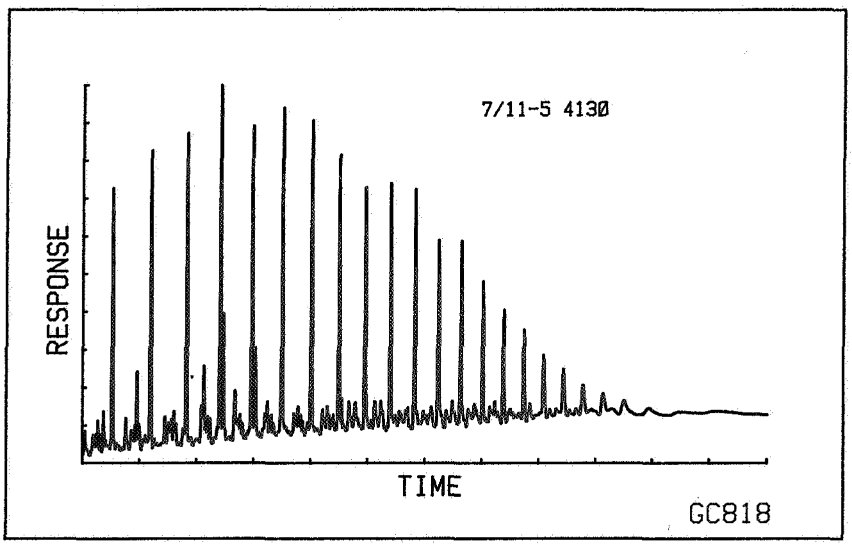

7/11-5 4130
RESPONSE
TIME
GC818

Figure 9.

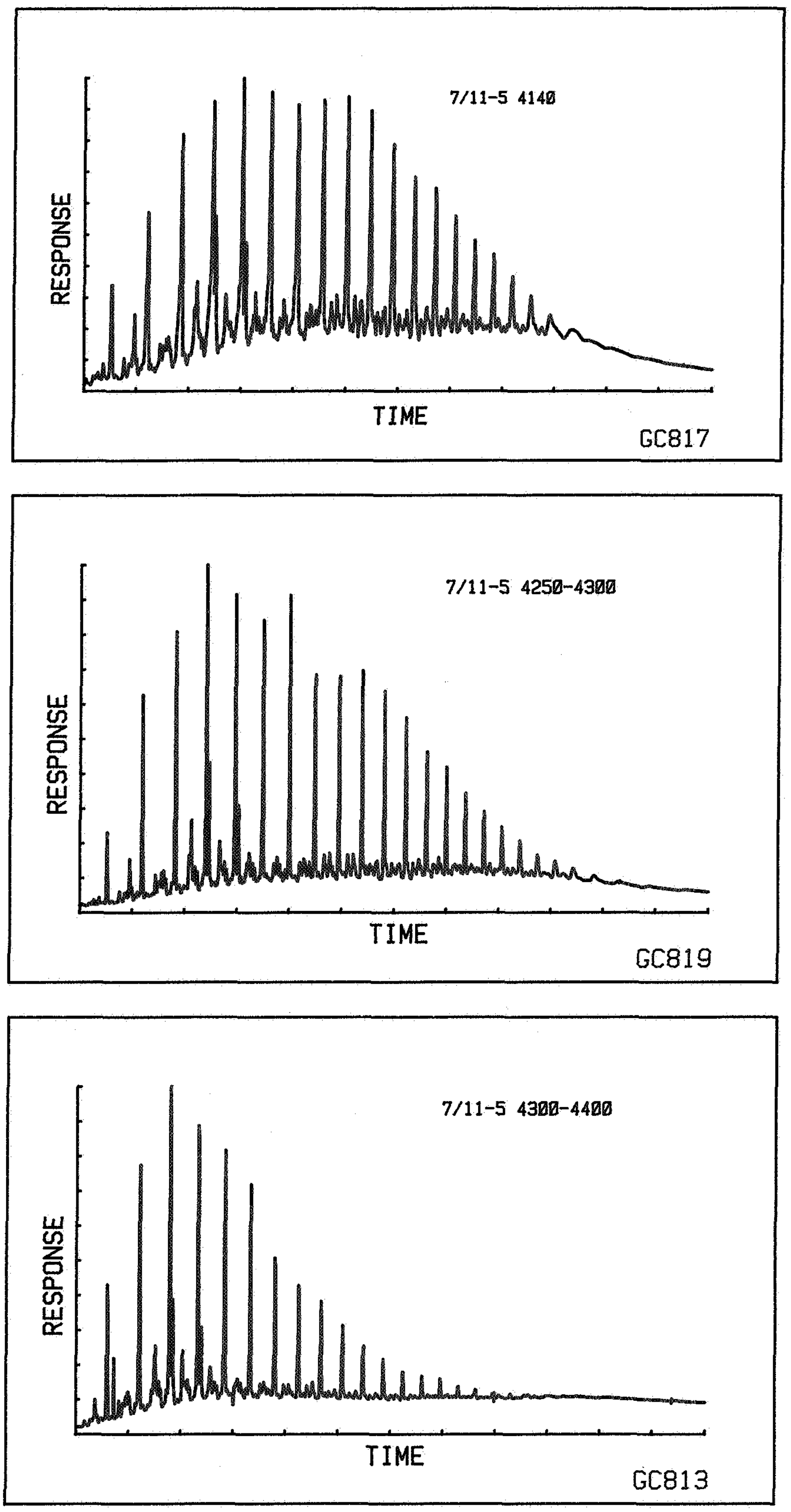

7/11-5 4140
RESPONSE
TIME
GC817
7/11-5 4250-4300
RESPONSE
TIME
GC819
7/11-5 4300-4400
RESPONSE
TIME
GC813

Figure 10.

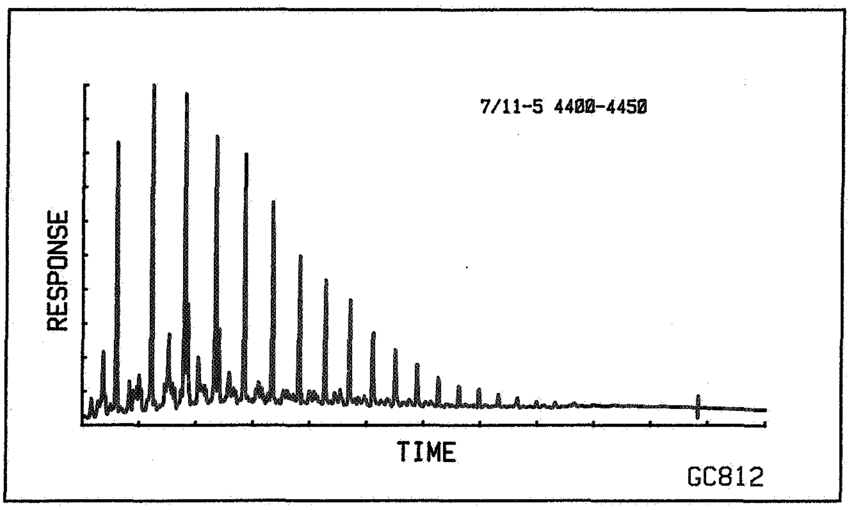


Figure 11.

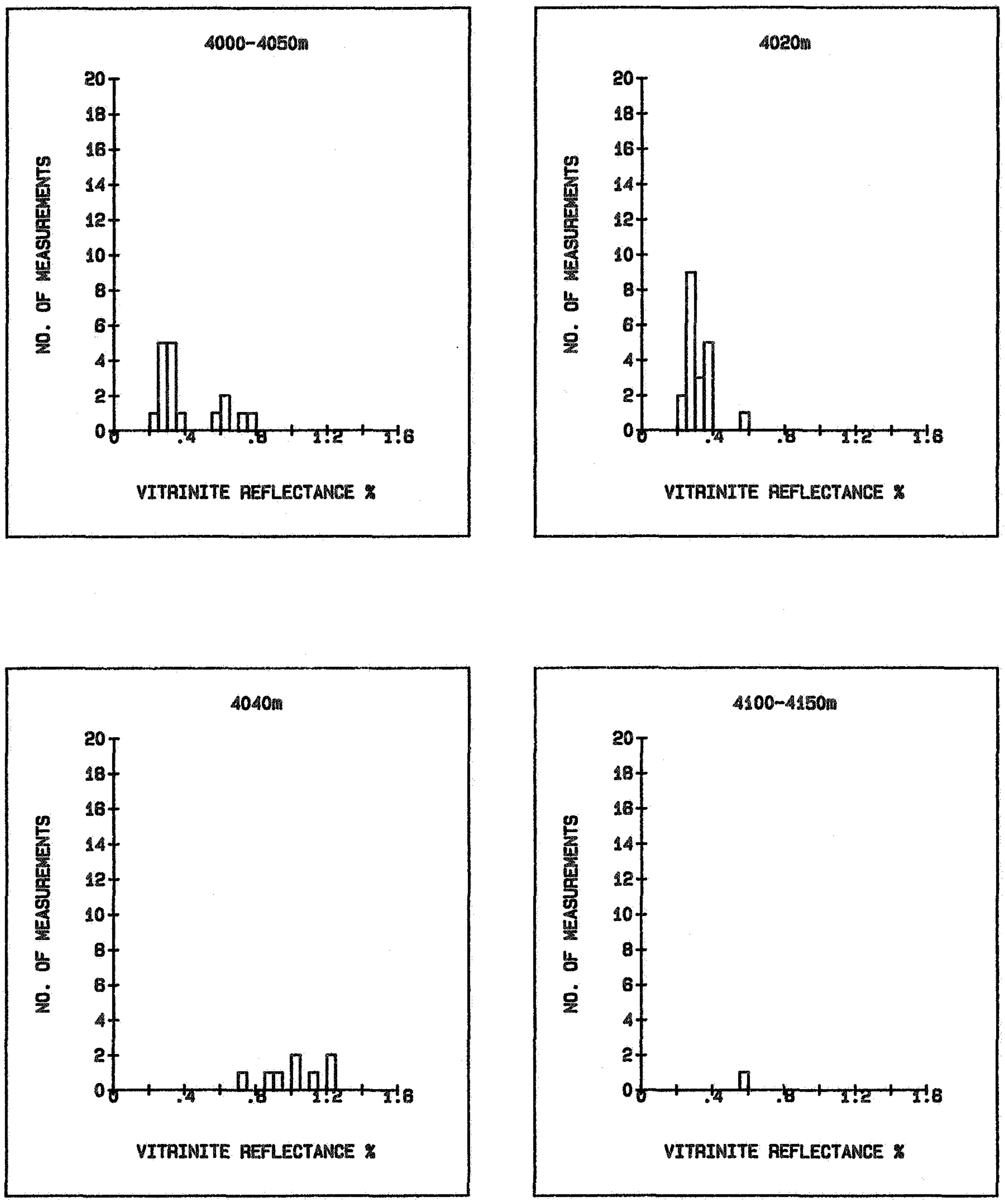

4000-4050m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
4020m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
4040m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
4100-4150m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %

Figure 5.