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PETROLEUM GEOCHEMISTRY REPORT

PREPARED FOR

NORSK HYDRO

The Geochemical Evaluation of Sediments from Well:7/11-6.

March 1983.

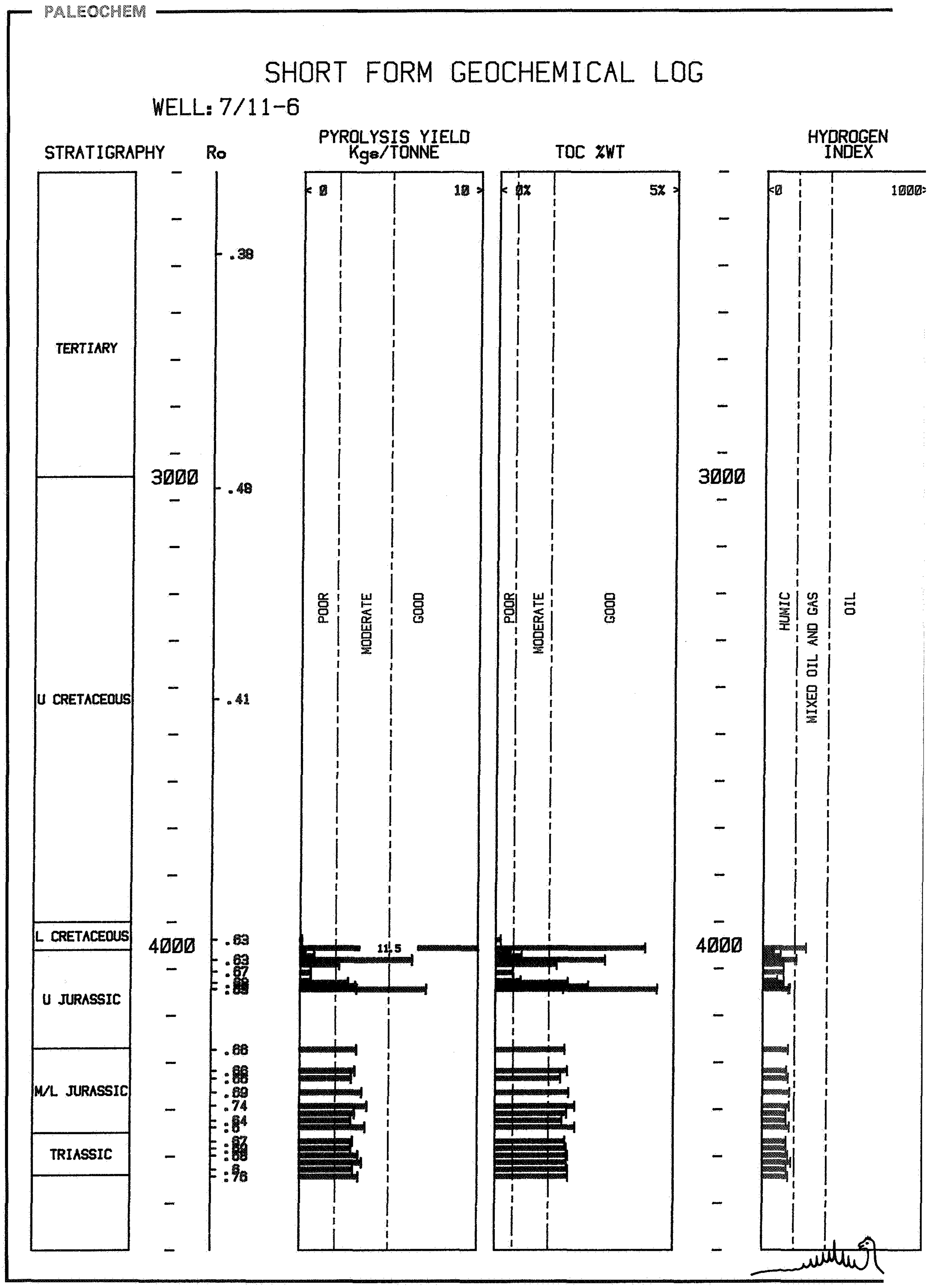
Contents

Summary

A total of twenty-four cuttings samples and five sidewall core samples were used for a comprehensive geochemical study of Well: 7/11-6. Maturity estimations were severely hampered both by intense bitumen staining and cavings in some sections of the well, but it was inferred that the Tertiary and Upper Cretaceous sediments were immature for any hydrocarbon generation. Sediments from the Lower Cretaceous and Jurassic are mature for liquid hydrocarbon generation. Sediments with good hydrocarbon potentials were observed in proximity to the Lower Cretaceous/Upper Jurassic boundary and the Upper Jurassic sections of the well. Jurassic sediments were classed as being formerly oil prone, although predominantly gas/condensate prone present-day on-structure, 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 high wax crude oils are present in the Jurassic and Triassic intervals. More sohpisticated analyses are recommended to determine the provenance of these oils, very similar in composition to the 7/11-5 analyses.

SHORT FORM GEOCHEMICAL LOG



1. Introduction

A total of twenty-four cuttings samples and five sidewall core samples from the depth interval 2500 m - 4490 m and dated Tertiary to Triassic (Norsk Hydro data), were used for a detailed geochemical study of Well: 7/11-6.

Maturity estimations using Vitrinite Reflectance measurements and spore fluorescence colours, were obtained throughout the interval in an attempt to establish a maturation profile for this well. Spore Colouration indices from Visual Kerogen description and Carbon Preference Indices from Soluble Extract Studies were used to corroborate reflectance measurements and assess true maturation levels.

Pyrolysis techniques were used to establish hydrocarbon source potential and the likely hydrocarbon products or source type where the potentials were sufficiently high. Hydrocarbon typing using pyrolysis measurements was supported by the Visual Kerogen descriptions completed at the same depth. Total Organic Carbon measurements were determined to provide additional information concerning the richness of the sediments, and for calculation of hydrogen indices.

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^{o}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 (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 vapour 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 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 to $C_{36}+$ 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 is a valuable method for volumetric studies of the amounts of paraffinic, naphthenic or naphtheno-aromatic hydrocarbons which a potential source-rock can generate at various levels of maturities. Thus, for Kerogens which have $\frac{\Sigma C_1 - C_5}{\Sigma C_5 - C_{36}+}$ ratios the following classification is used.

<u>Wet Gases</u> Oil	
0.25	Oil Prone Type 1 Kerogens (Hydrogen Index ≥ 400)
0.25 - ≤0.7	Mixed Oil and Gas Prone Kerogens (Hydrogen Index ≥ 200 ≤ 400).
≥ 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 Chromatograph 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:-

Onset of Liquid Hydrocarbon Generation	Ro = 0.45% to 0.6%
Onset of Gaseous Hydrocarbon Generation	Ro = 0.70%- 1.0%
Peak Oil Generation	Ro = 0.70% - 0.9%
Oil Floor	Ro = 1.3%
Gas Floor	Ro = 3.2%

Estimations of maturity using Vitrinite Reflectance measurements above were impossible to assess, due to both the influence of bitumen staining and also to the influence of cavings in some intervals. Bitumen staining has been associated with artificially lowering the reflectivity values of vitrinite macerals. Thus, no statistical correlation of reflectance values and calculations of hydrocarbon generation thresholds could be completed. However, it is suggested that Tertiary and Upper Cretaceous sediments are immature for any hydrocarbon generation. Lower Cretaceous and Jurassic sediments appear to have crossed the threshold for liquid hydrocarbon generation and in some cases may be approaching the gaseous hydrocarbon threshold. Jurassic sediments on-structure at 4485 m - 4500 m and deeper have formerly passed peak oil generation. Spore fluorescence colours of yellow-orange for Tertiary and Upper Cretaceous sediments and light-deep orange for Lower Cretaceous and

and Jurassic samples provided further support for the maturity estimations of sediments in this well.

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

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

Spore Colour Indices from Visual Kerogen descriptions (Table 2) suggest that the sediments below 4215 m have crossed the threshold of peak oil generation and are approaching the oil floor. This descrepancy in maturity parameters is thought to be due to the intense bitumen staining causing lower vitrinite reflectance values observed during reflected light microscopy. It is evident that production indices at and below 4 Km similarly indicate $\gtrsim$ 30 Kerogen degradation to oil products.

(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 below.

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 any 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 15.0 Kg./tonne rock
Excellent	>15 Kg./tonne rock

*1 Kg./tonne oil generated/tonne rock = 18 - 21 bbls oil/acre ft (0.02 bbls/M^3 rock; SG 2.7).

In addition, P1, P2 and TOC values can be used to derive the Hydrogen Index (HI) and the Production Index (PI) as follows:

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

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

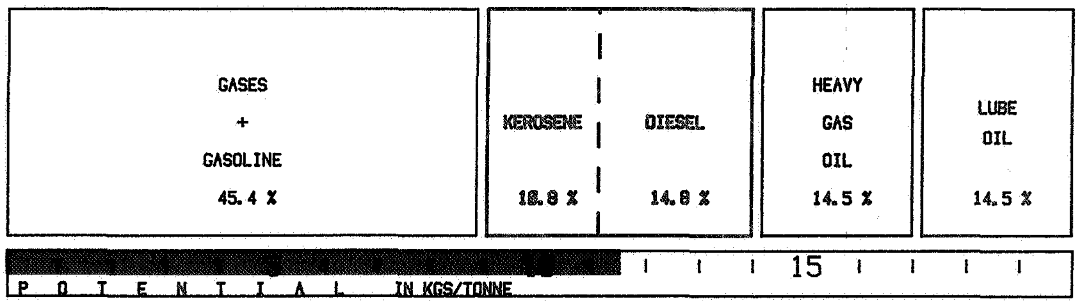
The HI is independent of the abundance of organic matter present in a sediment and can be used to determine the type of Kerogen (oil and/or gas prone) present in a source-rock. In general, the higher the hydrogen index, the more oil prone the Kerogen, as demonstrated on the summary log at the front of 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 is equivalent to 10% generation.

(i) <u>Lower Cretaceous</u>

The Total Organic Carbon (TOC) content values obtained for Lower Cretaceous sediments, 3950 m - 4010 m, ranged from poor to good, with one sediment at 3998 - 4013 m which straddles the Lower Cretaceous/Upper Jurassic boundary showing good organic carbon contents. Hydrocarbon potential ratings from Screening Pyrolysis measurements were in good agreement with the Total Organic Carbon measurements (0.1 - 11.5 Kg./tonne rock).

Visual Kerogen descriptions were completed on one sample at 3998 m - 4013 m. The descriptions suggested that the sediment contained abundant amorphous algal material and was classed as being predominantly oil prone. Extended pyrolysis measurements completed on the sample at 3998 m - 4013 m, however, demonstrated that the sediment is gas/ condensate prone at the present-day. The relative amounts of gases and gasoline range Kerogen breakdown products was 45.4% as illustrated overleaf.

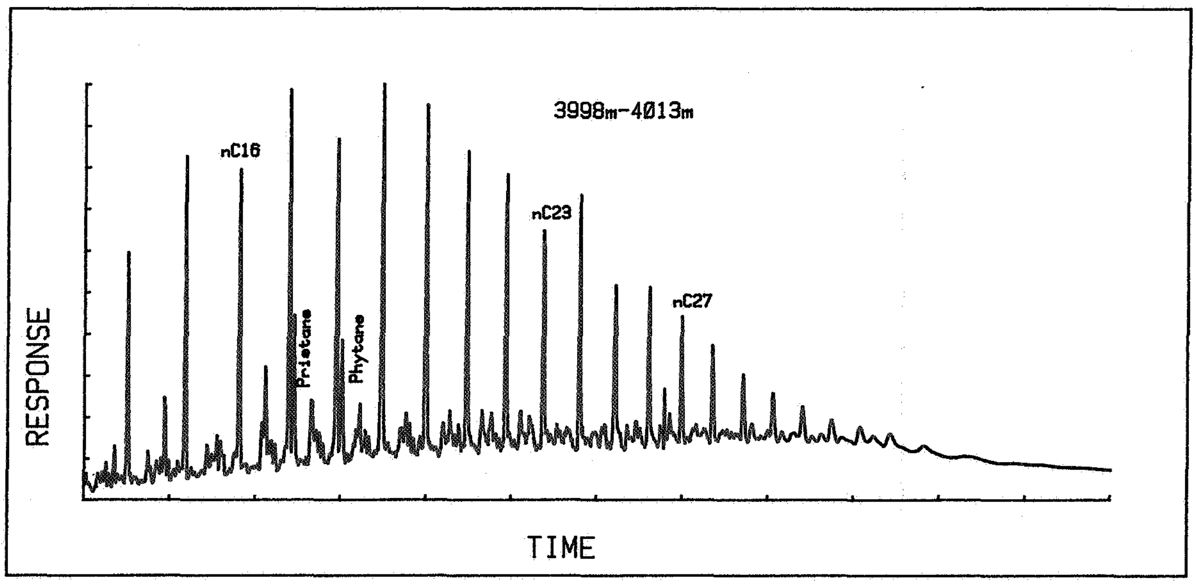


SEDIMENT EXTRACT 3998m-4013m

This suggests that the original oil prone Kerogen material identified by Visual Kerogen descriptions has generated its previous oil potential (Spore Colour Index 5, Hydrogen Index 270) at a former stage in its history.

It was observed that the Lower Cretaceous sediments had Production Indices of ca .25. This suggests that the amount of hydrocarbon generation that has occurred is $\geq$ 25%. 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 up to 3.9 Kg./tonne. (81 bbls/acre ft, 0.08 bbl/M^3 rock)..

Soluble Extract studies completed on the sediment at 3998 m - 4013 m showed n-alkane distributions consistent with a migrated high wax crude oil distribution, It is suggested that the crude oil has been sourced from mature Kerogens of mixed plant input, as the n-alkane distribution illustrated below, with n-alkanes extending beyond nC_{30} number.



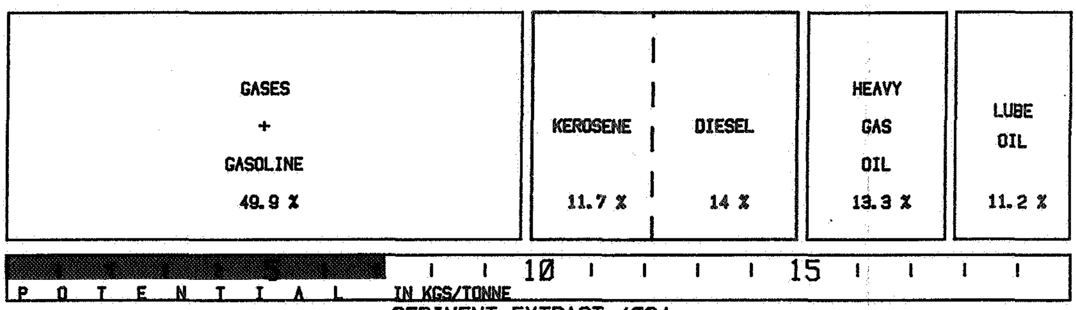
(ii) Upper Jurassic

Total Organic Carbon contents of sediments from the Upper Jurassic, 4010 m - 4205 m, showed poor to good organic carbon (TOC % wt range 0.42 - 4.53%) with the majority of the samples showing good organic carbon.

Screening Pyrolysis measurements were in general agreement with the TOC measurements, but four sediments at 4033 - 4048 m, 4080 m, 4085 m - 4100 m, and 4087 m were downrated to moderate hydrocarbon source potential. It is considered that this downrating in potential was 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.

Visual Kerogen descriptions were completed on four sediments from the Upper Jurassic at 4031 m, 4080m, 4087 m, and 4094 m. The descriptions suggested that the sediments contain abundant quantities of amorphous algal material and dinoglagelata cysts as well as trace/common amounts of terrestrial plant material, and were classified as predominantly oil prone.

However, Extended Pyrolysis measurements completed on the same four Upper Jurassic sediments, demonstrated that all the sediments would be predominantly gas/condensate prone at the present day. The relative amounts of gases and gasoline range Kerogen breakdown products was 48.5% - 61.7%, as illustrated below.

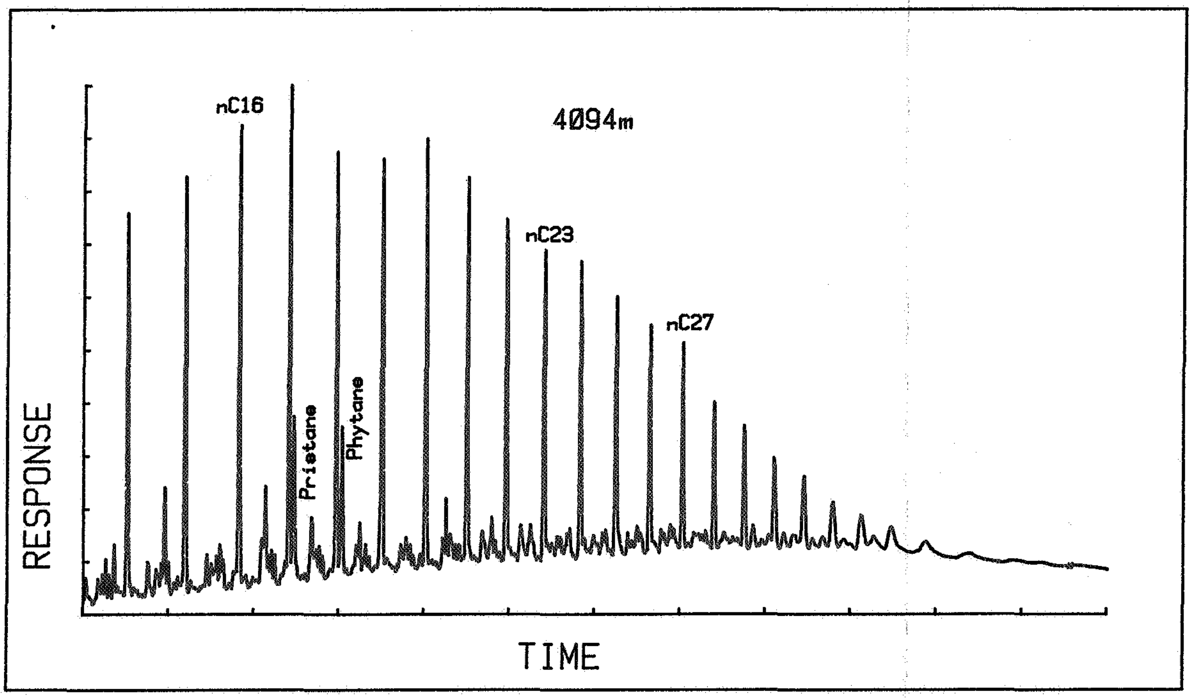


SEDIMENT EXTRACT 4094m

Therefore this suggests, as in the Cretaceous interval, that the original oil prone Kerogen material has already generated its previous oil potential. This accounts for the low Hydrogen Indices shown by the Upper Jurassic sediments (Table 4). Although no biostratigraphic dating has been supplied, it is believed that these source-rocks are from the Kimmeridge Clay Formation.

Sediments from the Jurassic had transformation ratios of <u>ca</u> .37. This suggests that the amount of hydro-carbon generation that has occurred is ≥ 37%. These Jurassic source rocks have formerly generated a crude oil, the majority of which has migrated out of the sequence leaving residual P1 values of up to 3.4 Kg./tonne.

Soluble Extract studies completed on four sediments from this stratigraphic interval showed n-alkane distributions of a migrated or in situ generated high wax crude similar to the n-alkane distributions observed in the Cretaceous section of this well.

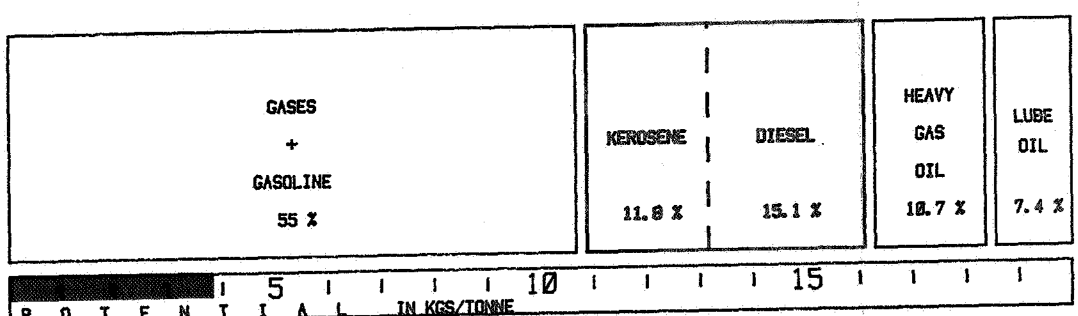


(iii) Middle and Lower Jurassic

Total Organic Carbon contents of sediments from this stratigraphic interval (4205 m - 4400 m) showed good organic carbon (TOC % wt. range 1.83 - 2.24%). Screening pyrolysis measurements downrated all these sediments to moderate hydrocarbon potential (2.9 - 3.8 Kg./tonne). This lower potential is due in part to inertinitic material identified during reflected light microscopy studies and to former hydrocarbons generated.

Hydrocarbon typing using Visual Kerogen descriptions suggested that two sediments from the Middle and Lower Jurassic at 4260 m - 4275 m and 4335 m - 4350 m had no significant potential to source hydrocarbons. A sediment at 4380 m - 4395 m was classified as being predominantly oil prone, while a sediment at 4308 m - 4320 m was classified as being predominantly oil prone with additional potential to source gas.

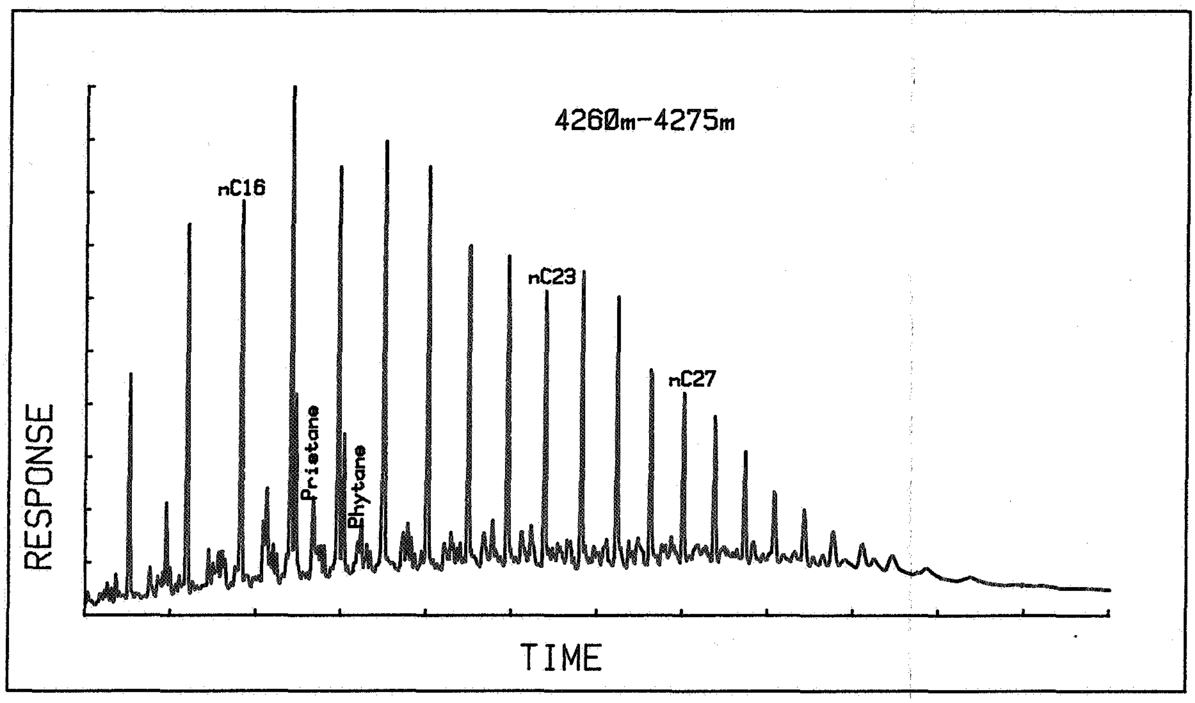
Extended Pyrolysis measurements completed on four sediments from the Middle and Lower Jurassic interval, demonstrated that all the sediments examined would be predominantly gas/condensate prone at this level of maturity. The relative amounts of gases and gasoline range Kerogen breakdown products was 53.5 - 59.0% as illustrated below.



SEDIMENT EXTRACT 4335m-4350m

The estimated amount of hydrocarbon generation that has occurred for this stratigraphic interval is $\geq$ 34%. Much of the crude oil generation may have migrated out of the sequence leaving residual P1 values of up to 1.8 Kg./tonne rock for Middle and Lower Jurassic sediments. Without sophisticated $\delta^{13}C$ isotope and computerised gas chromatographic/ mass spectrometric (cgc/ms) data, it is not possible to distinguish whether migrated or <u>in situ</u> generated oil is present.

Soluble Extract studies completed on four sediments from this stratigraphic interval showed n-alkane distributions which represented migrated or in situ generated crude oil distributions, similar to the n-alkane distributions showed in the Cretaceous and Upper Jurassic stratigraphic intervals. The oil present in these sediments represents a high wax crude with n-alkane distribution extending beyond nC_{30} carbon number, indicative of a significant terrestrial plant contribution, as illustrated below.



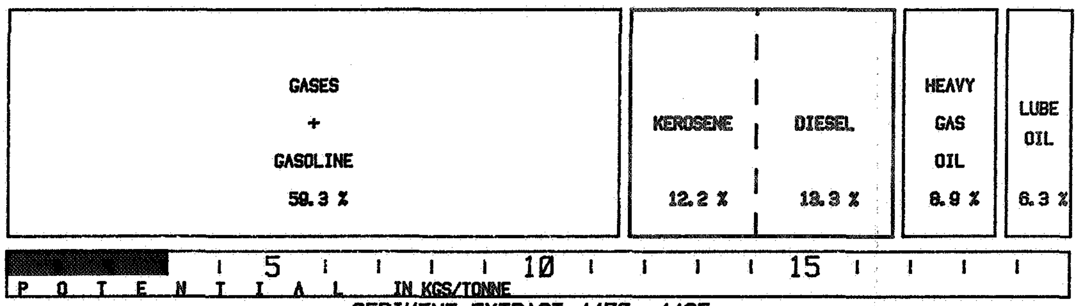
(iv) <u>Triassic</u>

Sediments from the Triassic interval 4415 m - 4500 m showed good Total Organic Carbon contents (TOC % wt range 1.96 - 2.04%).

Screening Pyrolysis measurements downgraded all of these sediments to moderate hydrocarbon source potential (2.9 - 3.5 Kg./tonne rock). The Triassic sediments have already generated an estimated 34 - 36% of their original hydrocarbon potential on-structure at equivalent reflectances up to 0.76 Ro. Hydrogen Indices are low (150 - 180) characteristic of future potential to generate only gas and some "condensate like" distributions.

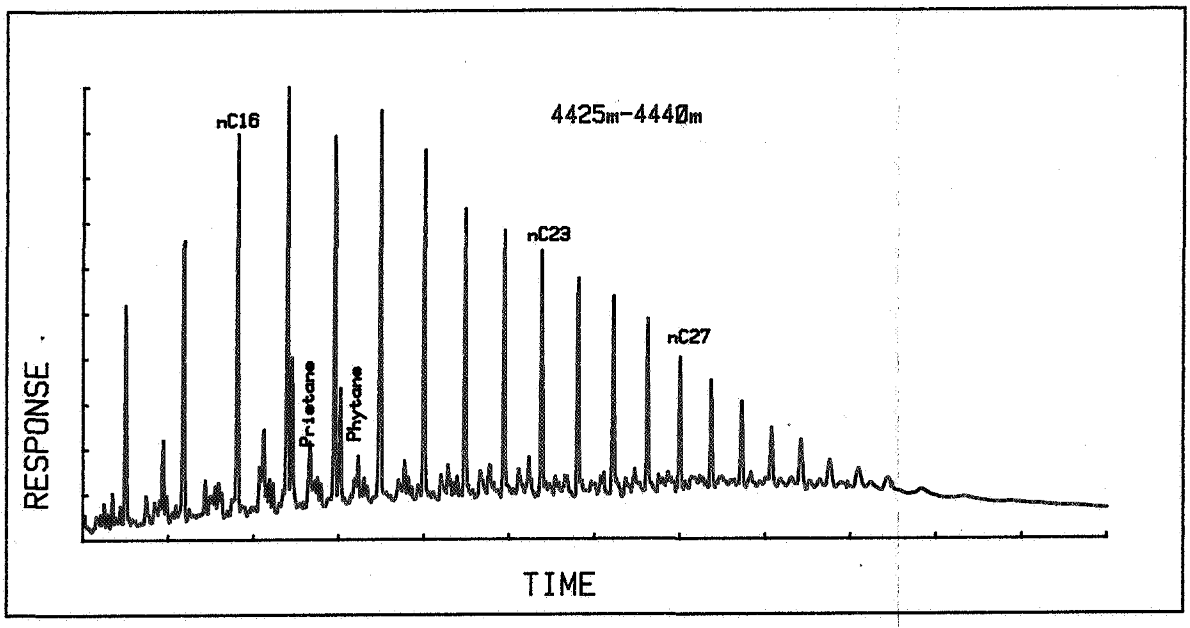
Hydrocarbon typing using Visual Kerogen descriptions suggested that sediments at 4425 m - 4440 m and 4470 m - 4485 m had no significant potential to source hydrocarbons.

Extended Pyrolysis measurements suggested that these sediments would generate predominantly gaseous hydrocarbons. The relative amounts of gases and gasoline range Kerogen breakdown products fell in the range 59.3 - 60.1% as illustrated below.



SEDIMENT EXTRACT 4470m-4485m

Soluble Extract studies demonstrated that the sediments at 4425 m - 4440 m and 4470 m - 4485 m have a high wax crude oil distributions, similar to the distribution observed in the Cretaceous and Jurassic stratigraphic intervals of this well, which suggests that a migrated oil is present in this interval, not necessarily generated in situ from Kerogens. Isotope and cgc/ms studies are recommended to differentiate between these two provenances.


4425m-4440m
nC16
Pristane
Phytane
nC23
nC27
RESPONSE
TIME

4. Conclusions

i) Maturity estimations completed on sediments from this well were hampered by the presence of cavings in some sections, as well as the presence of intense bitumen staining. It was suggested that Tertiary and Upper Cretaceous sediments are immature for any hydrocarbon generation. Sediments from the Lower Cretaceous and Jurassic are mature for liquid hydrocarbon generation. A Triassic sediment at 4485 m - 4500 m has reached sufficient maturity to generate gas and condensate hydrocarbons. Upper Jurassic Kerogens have generated an estimated $>$25 - 37% of their original hydrocarbon potential on-structure and have probably passed peak oil generation. Carbon preference indices of unit denote mature oil distributions equivalent to peak oil generation or beyond.

ii) Sediments rated as having good hydrocarbon potentials were identified in the Lower Cretaceous/Upper Jurassic boundary, and the Upper Jurassic section of this well. Sediments from the Middle and Lower Jurassic and the Triassic were given moderate hydrocarbon potential ratings.

iii) Sediments from the Lower Cretaceous/Upper Jurassic boundary, the Upper Jurassic and two sediments from the Middle/Lower Jurassic, were classed as being formerly oil prone, although predominantly gas/ condensate prone present-day on-structure. It is suggested that these oil prone Kerogens have already generated a crude oil on-structure, much of which has migrated out of the sequence.

iv) The Cretaceous/Jurassic and Jurassic sediments from the interval 3998 m - 4094 m contain a migrated or in situ generated high wax crude oil, with a much higher wax content 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 reveal that generation on-structure was a former and rapid event due to the $>$3 Km Tertiary overburden present.

5. Recommendations

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

ii) 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 and sterane distributions and their epimer ratios will establish whether or not the 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).

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	VITRINITE REFLECTANCE DATA				
Depth m	Reflectivity Ro$_{(Ave)}$				
	Autochthonous		Allochthonous		Spore Fluorescence
2500-2550		$0.38_{(22)}$*			Yellow/mid Orange
3000-3050		$0.48_{(4)}$*	$0.62_{(1)}$		Yellow/orange
3450-3500		$0.41_{(20)}$*			Yellow/orange
3998-4013	$0.42_{(21)}$*	$0.63_{(3)}$		$0.86_{(1)}$	NDP
4031		$0.63_{(2)}$*	$0.77_{(1)}$	$0.96_{(2)}$	NDP
4050-4065		$0.67_{(2)}$*			Deep orange
4080	$0.52_{(6)}$*	$0.68_{(14)}$			Mid orange
4085-4100		$0.69_{(2)}$*		$1.04_{(3)}$	Mid orange
4087		$0.62_{(4)}$*	$0.81_{(5)}$		NDP
4094		$0.65_{(5)}$*			Mid orange
4215-4230	$0.53_{(1)}$*	$0.66_{(3)}$	$0.75_{(2)}$	$0.93_{(2)}$	Light/mid orange
4260-4275	$0.48_{(1)}$*	$0.66_{(3)}$	$0.83_{(1)}$		Deep orange
4278-4290	$0.57_{(2)}$*	$0.66_{(5)}$	$0.72_{(3)}$		Mid orange
4308-4320	$0.57_{(2)}$*	$0.69_{(2)}$	$0.85_{(1)}$		Mid orange
4335-4350	$0.53_{(2)}$*	$0.74_{(7)}$	$0.86_{(1)}$		Mid orange
4368-4380	$0.46_{(3)}$*	$0.64_{(2)}$		$0.92_{(3)}$	Mid orange
4380-4395	$0.38_{(11)}$*	$0.60_{(2)}$			Mid orange
4410-4425	$0.50_{(1)}$*	$0.67_{(1)}$	$0.80_{(1)}$	$1.01_{(4)}$	Mid orange
4425-4440	$0.49_{(3)}$*	$0.69_{(4)}$			Mid orange

Table 1.

Well No: 7/11-6

	VITRINITE REFLECTANCE DATA		
Depth m	Reflectivity Ro $_{(Ave)}$		
	Autochthonous	Allochthonous	Spore Fluorescence
4440-4455	$0.68_{(3)}$ $0.81_{(3)}$	$1.11_{(2)}$	Mid-deep orange
4470-4485	$0.60_{(11)}$ *		Mid-deep orange
4485-4500	$0.76_{(8)}$ *	$1.10_{(1)}$	Mid orange

Figures in parenthesis refer to the number of measurements completed.

NDP = No determination possible

Table 1 - continued.

Well No: 7/11-6

VISUAL KEROGEN DATA

Depth m	Cuticle	Brown Wood	Black Wood & Inertinite	Amorphous	Predominant Source Type	Colour Maturation Rating
3998-4013	*	Trace	Trace	Abundant	Oil	5
4031	o*	Trace	Trace	Abundant	Oil	5/6
4080	o*	Trace	Common	Abundant	Oil	5/6
4087	o*	Trace	Common	Abundant	Oil	5/6
4094	o*	Trace	Trace	Abundant	Oil	5
4260-75	o*	Trace	Common	Abundant	None	5
4308-20	o	Trace	Common	Common	Oil/Sub.Gas	5/6
4335-50	o*	Trace	Common	Common	None	5/6
4380-95	-	Trace	Trace	Trace	Oil	5/6
4425-40	o*	Trace	Trace	Abundant	None	5/6
4470-85	o*	Trace	Trace	Common	None	5/6

o Acritarchs
* Dinoflagellata Cysts.

Table 2.

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Well No: 7/11-6

GENERAL WELL DATA

Depth m	Age	Sample Type	Lithology	Total Organic Carbon Content (TOC) % wt.
3980-3995	Lower Cretaceous	Cuttings	Shale	0.14
3998-4013	Lower Cretaceous / Upper Jurassic	Cuttings	Shale	4.19
4015-4030	Upper Jurassic	Cuttings	Shale	0.73
4016	Upper Jurassic	SWC	Claystone	0.42
4031	Upper Jurassic	SWC	Shale	3.06
4033-4048	Upper Jurassic	Cuttings	Shale	1.71
4050-4065	Upper Jurassic	Cuttings	Shale	0.48
4068-4083	Upper Jurassic	Cuttings	Shale	0.70
4080	Upper Jurassic	SWC	Shale	2.02
4085-4100	Upper Jurassic	Cuttings	Shale	1.90 (2.08R)
4087	Upper Jurassic	SWC	Siltstone	2.59
4094	Upper Jurassic	SWC	Shale	4.53
4215-4230	Middle and Lower Jurassic	Cuttings	Shale	1.95
4260-4275	Middle and Lower Jurassic	Cuttings	Shale	2.02
4278-4290	Middle and Lower Jurassic	Cuttings	Shale	1.83

Table 3

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Well No: 7/11-6

GENERAL WELL DATA

Depth m	Age	Sample Type	Lithology	Total Organic Carbon Contents (TOC) % wt.
4308-4320	Middle and Lower Jurassic	Cuttings	Shale	2.06
4335-4350	Middle and Lower Jurassic	Cuttings	Shale	2.24
4353-4365	Middle and Lower Jurassic	Cuttings	Shale	2.01
4368-4380	Middle and Lower Jurassic	Cuttings	Shale	1.88
4380-4395	Middle and Lower Jurassic	Cuttings	Shale	2.24 (2.12R)
4410-4425	Triassic	Cuttings	Shale	1.96 (1.91R)
4425-4440	Triassic	Cuttings	Shale	2.00
4440-4455	Triassic	Cuttings	Shale	2.04
4455-4470	Triassic	Cuttings	Shale	2.00
4470-4485	Triassic	Cuttings	Shale	2.04
4485-4500	Triassic	Cuttings	Shale	2.04

R = Repeat Value

Table 3 - continued.

Well No: 7/11-6

PYROLYSIS DATA

Depth m	Yield (Kg./tonne) P1 Peak	P2 Peak	Production Index +	Hydrogen Index
3980-3995	<0.1 (<0.1R)	0.1 (<0.1R)	.09	NDP
3998-4013	3.9	11.5	.25	270
4015-4030	0.3	0.8	.27	110
4016	0.2	0.3	.40	70
4031	2.5	6.3	.28	210
4033-4048	1.1	2.2	.33	130
4050-4065	0.3	0.6	.33	130
4068-4083	0.4	0.6	.40	90
4080	1.4	2.7	.34	130
4085-4100	1.8	3.2	.25	170
4087	1.8	3.1	.37	120
4094	3.4 (2.7R)	7.1 (7.4R)	.32	160
4215-4230	1.6	3.2	.33	160
4260-4275	1.7	3.1	.35	150
4278-4290	1.4 (1.3R)	2.9 (2.8R)	.32	160
4308-4320	1.8	3.5	.34	170
4335-4350	1.8	3.8	.32	170
4353-4365	1.7	3.1	.35	150
4368-4380	1.5	2.9	.34	150
4380-4395	1.8	3.7	.32	170
4410-4425	1.7	3.0	.36	150
4425-4440	1.6	2.9	.36	150

+ Reveals the presence of <u>in situ</u> generated or migrated oil.
See Recommendations.

Table 4.

Well No: 7/11-6

PYROLYSIS DATA

Depth m	Yield (Kg./tonne) P1 Peak	P2 Peak	Production Index +	Hydrogen Index
4440-4455	1.7	3.3	.34	160
4455-4470	1.9	3.5	.35	180
4470-4485	1.6	3.0	.34	150
4485-4500	1.8 (1.8R)	3.3 (3.3R)	.35	160

R = Repeat Value

+ Reveals the presence of in situ generated or migrated oil. See Recommendations.

Table 4 - continued.

Well No: 7/11-6

SOLUBLE EXTRACT DATA

Depth	Total Soluble Extract (TSE) % wt.	Saturate Alkane Content (SAC) % TSE	Carbon Preference Index
3998-4013	1.13	11.5	1.0
4031	0.680	13.3	1.1
4080	0.305	8.5	1.0
4087	0.518	17.3	1.0
4094	0.921	12.2	1.0
4260-4276	0.345	22.3	1.0
4308-4320	0.317	16.0	1.0
4335-4350	0.299	20.1	1.0
4380-4395	0.357	27.4	1.1
4425-4440	0.313	25.7	1.0
4470-4485	0.335	25.6	1.0

Table 5.

Well No: 7/11-6

KERGOGEN BREAKDOWN PRODUCTS (%)

Depth	Gases + Gasoline	Kerosene	Diesel	Heavy Gas Oil	Lubricating Oil
3998-4013	45.4	10.8	14.8	14.5	14.5
4031	48.8	11.5	15.0	13.4	11.3
4080	61.7	12.2	12.9	8.3	4.9
4087	48.5	12.6	17.4	13.3	8.1
4094	49.9	11.7	14.0	13.3	11.2
4260-4275	53.6	11.7	14.7	10.9	9.1
4308-4320	53.5	10.5	15.0	10.2	10.7
4335-4350	55.0	11.8	15.1	10.7	7.4
4380-4395	59.0	11.6	14.0	9.1	6.2
4425-4440	60.1	12.1	13.7	8.3	5.8
4470-4485	59.3	12.2	13.3	8.9	6.3

Table 6.

PALEOCHEM

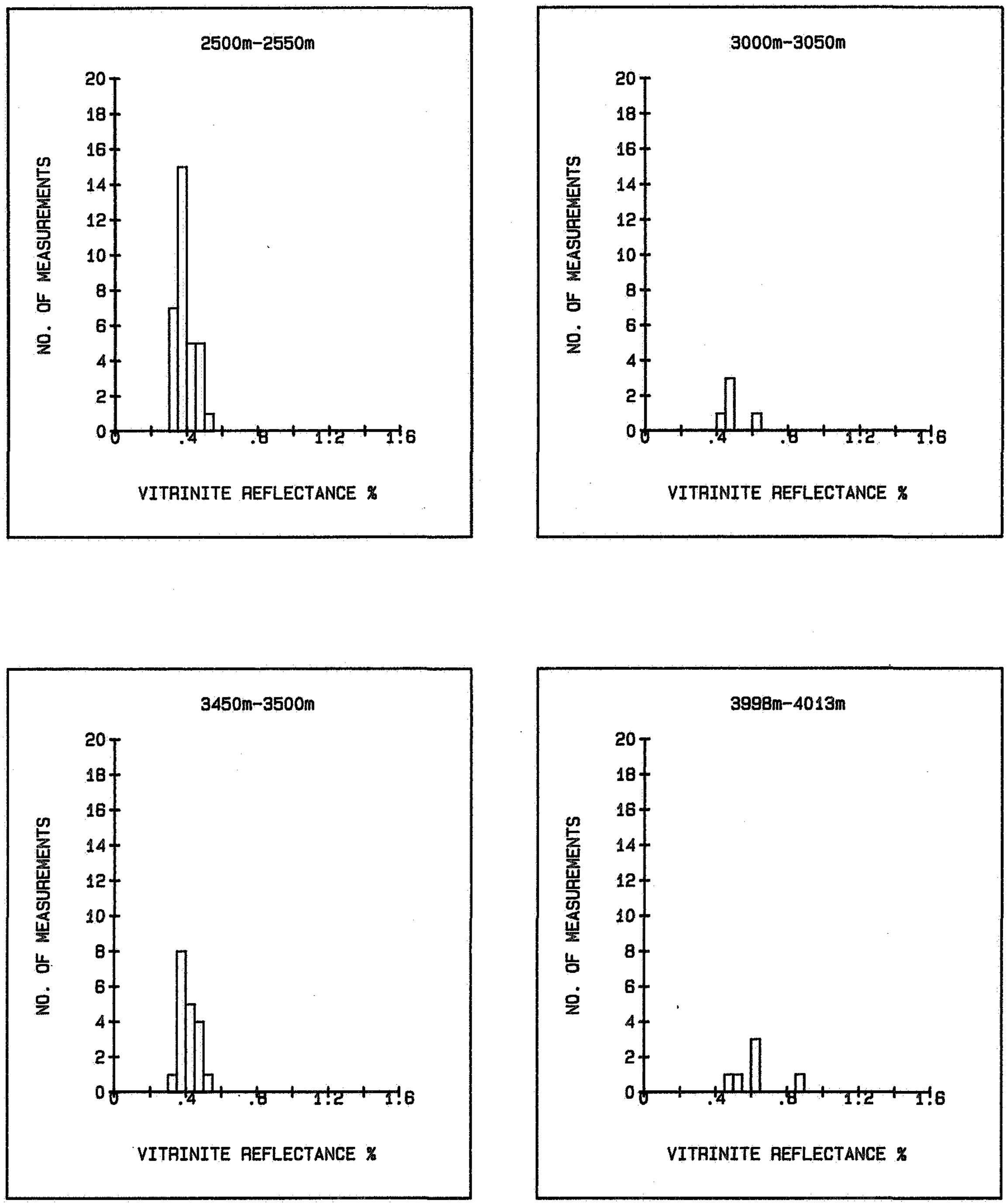

2500m-2550m
3000m-3050m
3450m-3500m
3998m-4013m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
0
2
4
6
8
10
12
14
16
18
20
.4
.8
1.2
1.6

Figure 1.

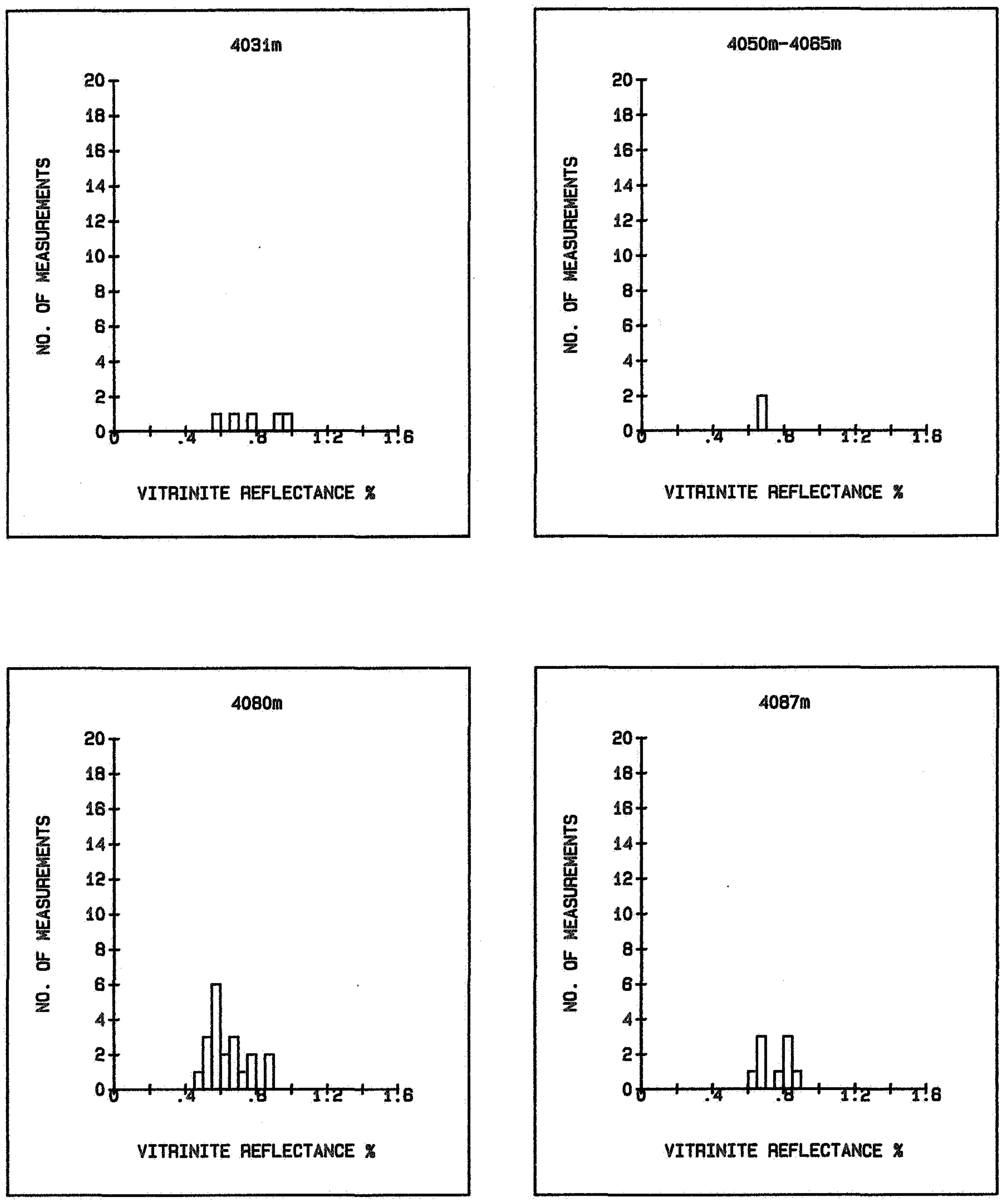

4031m
4050m-4065m
4080m
4087m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
0
2
4
6
8
10
12
14
16
18
20
.4
.8
1.2
1.6

Figure 2.

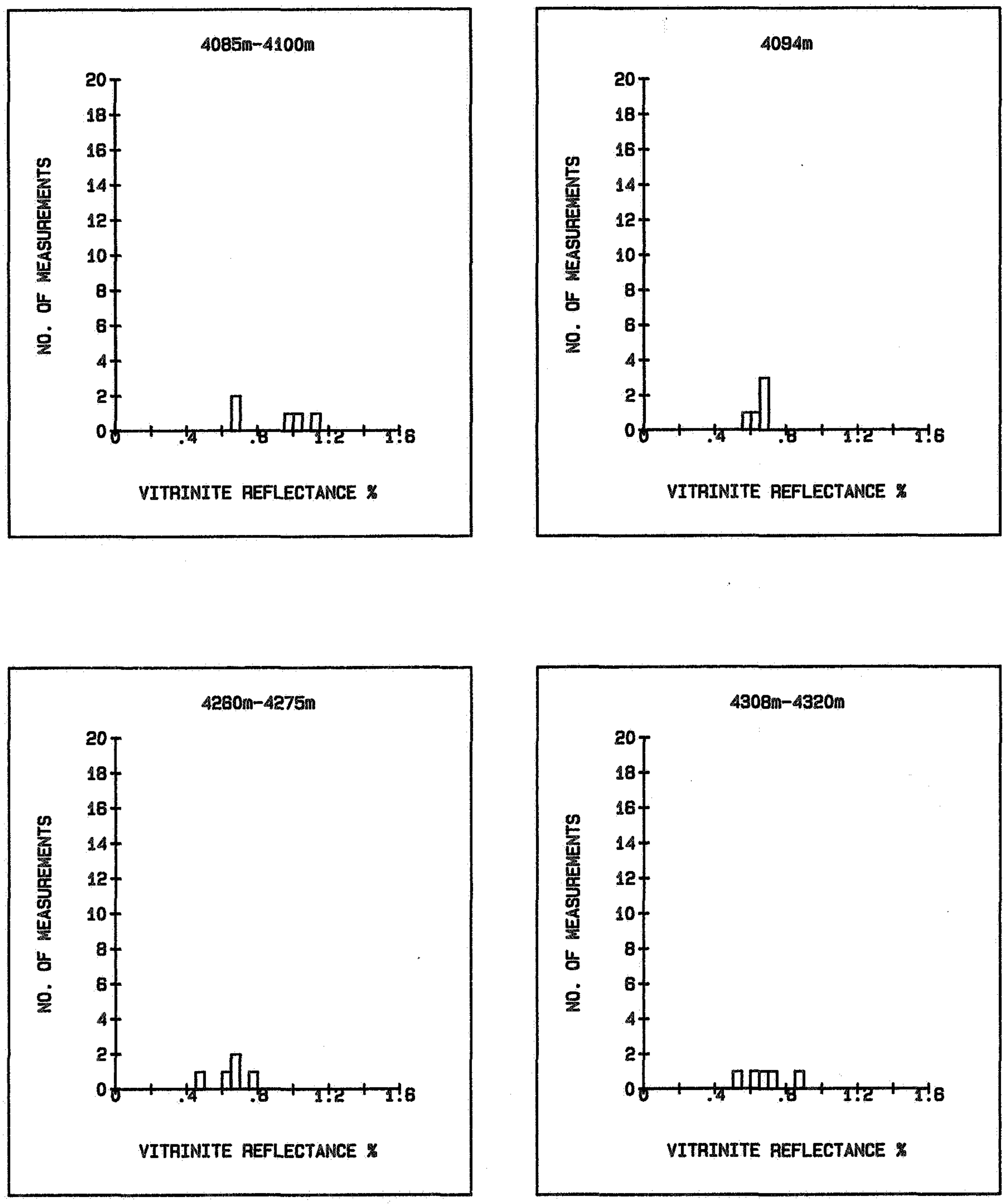

4085m-4100m
4094m
4260m-4275m
4308m-4320m
NO. OF MEASUREMENTS
20
18
16
14
12
10
8
6
4
2
0
0
.4
.8
1.2
1.6
VITRINITE REFLECTANCE %

Figure 3.

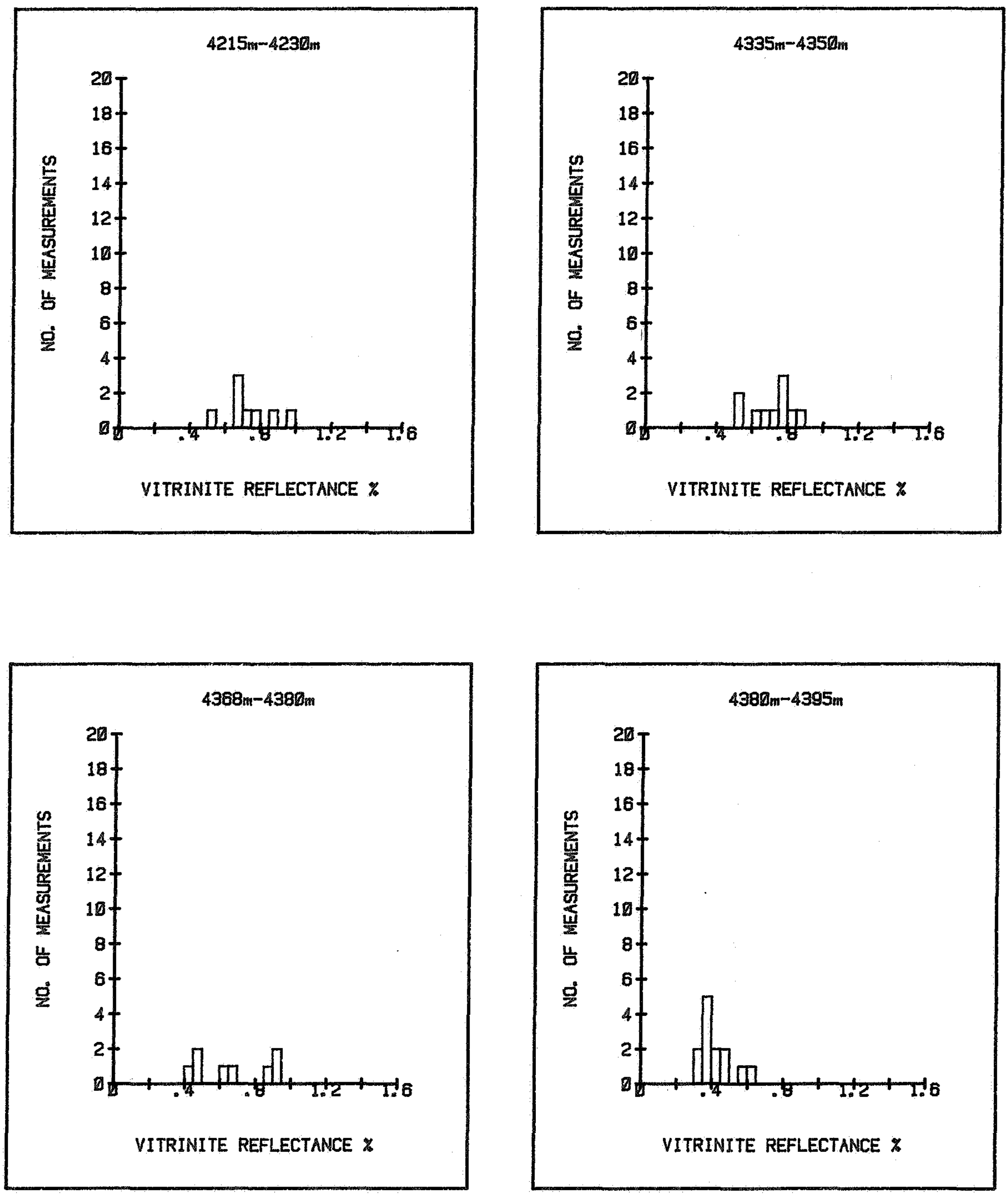

4215m-4230m
4335m-4350m
4368m-4380m
4380m-4395m
NO. OF MEASUREMENTS
VITRINITE REFLECTANCE %
0
2
4
6
8
10
12
14
16
18
20
.4
.8
1.2
1.6

Figure 4.

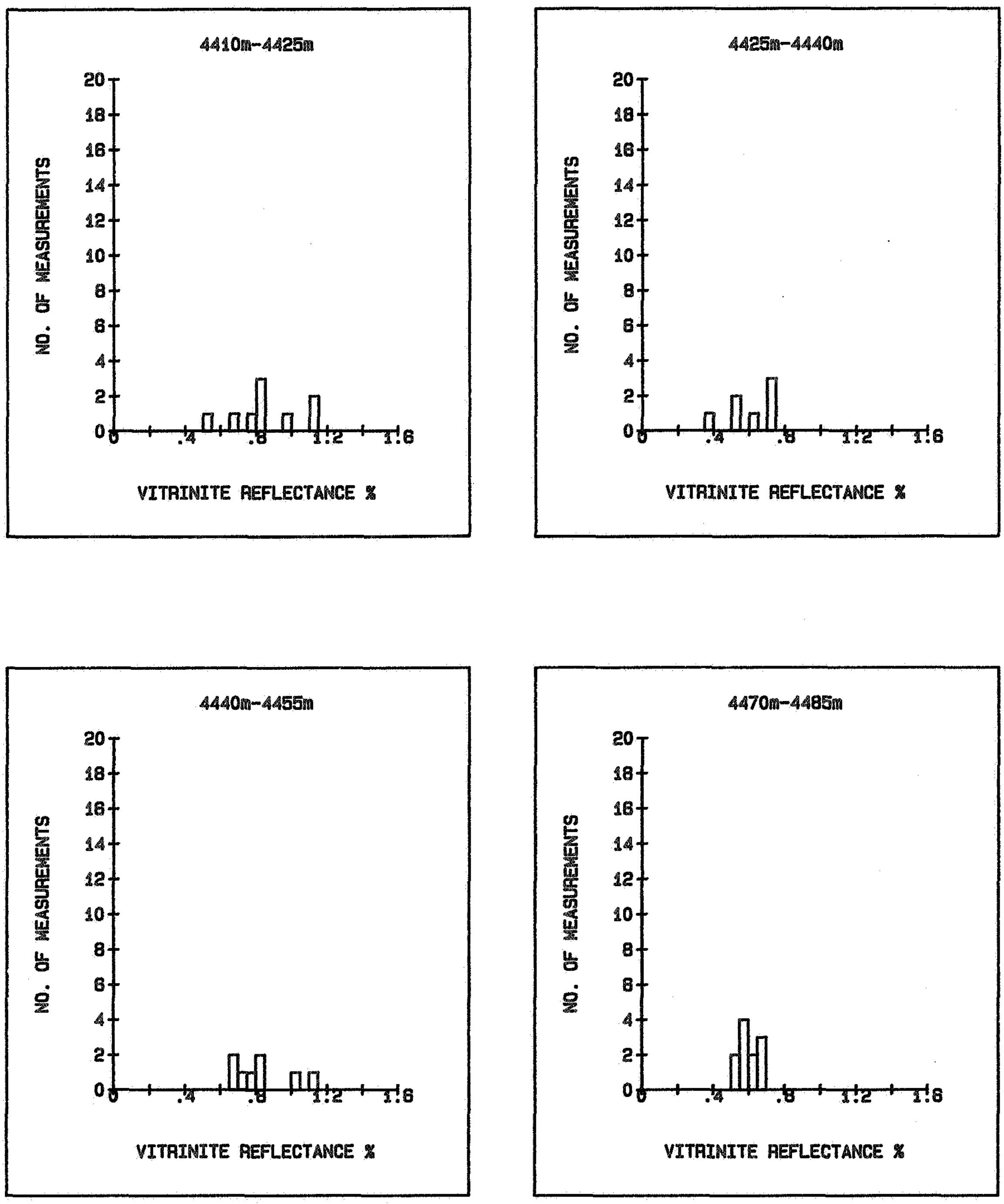
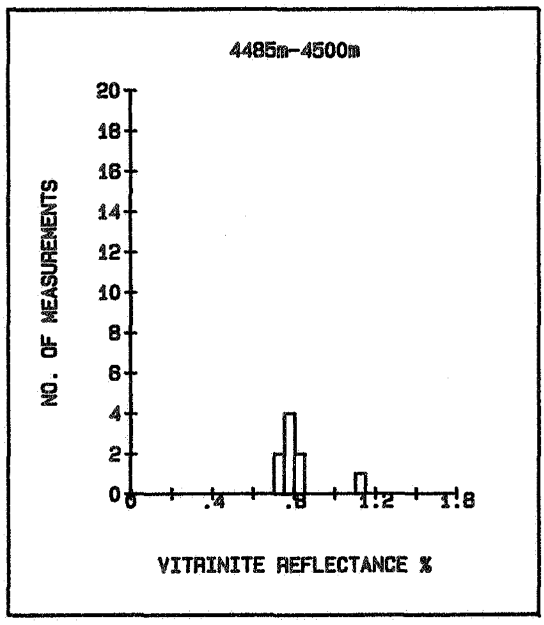
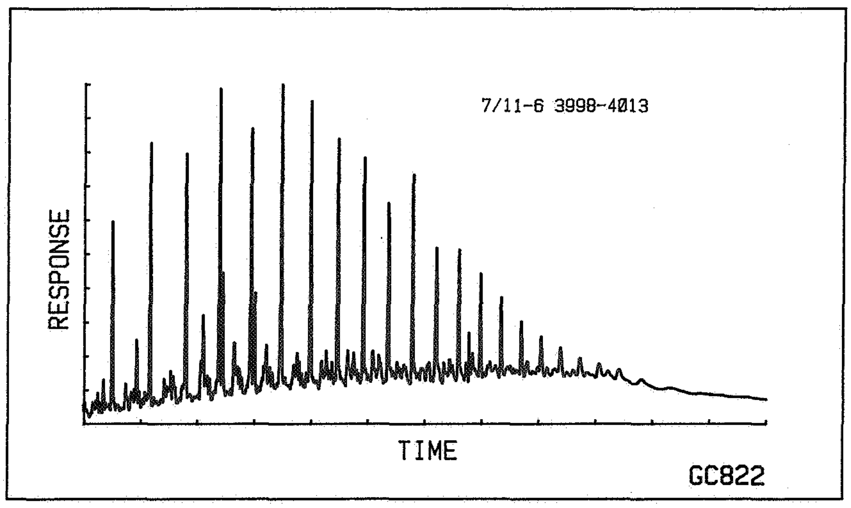

4410m-4425m
4425m-4440m
4440m-4455m
4470m-4485m
NO. OF MEASUREMENTS
0
2
4
6
8
10
12
14
16
18
20
0
.4
.8
1.2
1.6
VITRINITE REFLECTANCE %

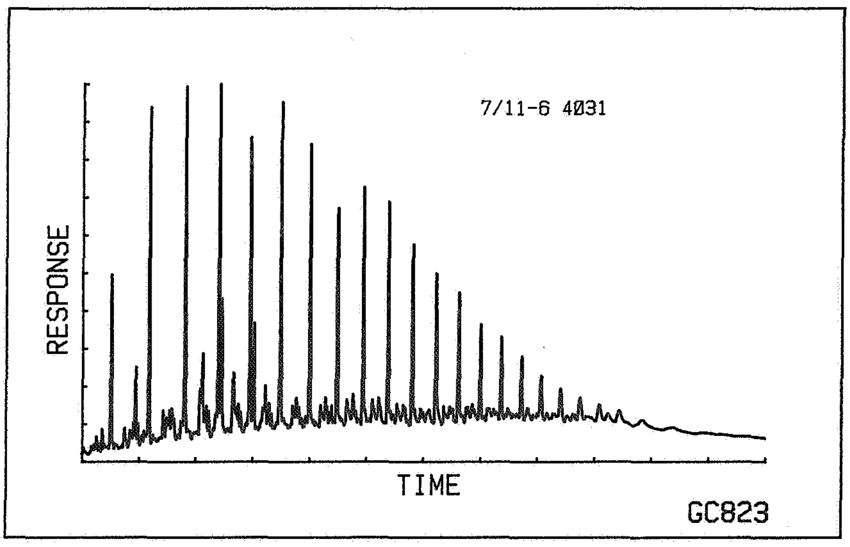
Figure 5.



4485m-4500m
NO. OF MEASUREMENTS
20
18
16
14
12
10
8
6
4
2
0
0
.4
.8
1.2
1.6
VITRINITE REFLECTANCE %

Figure 6.


7/11-6 3998-4013
RESPONSE
TIME
GC822


7/11-6 4031
RESPONSE
TIME
GC823

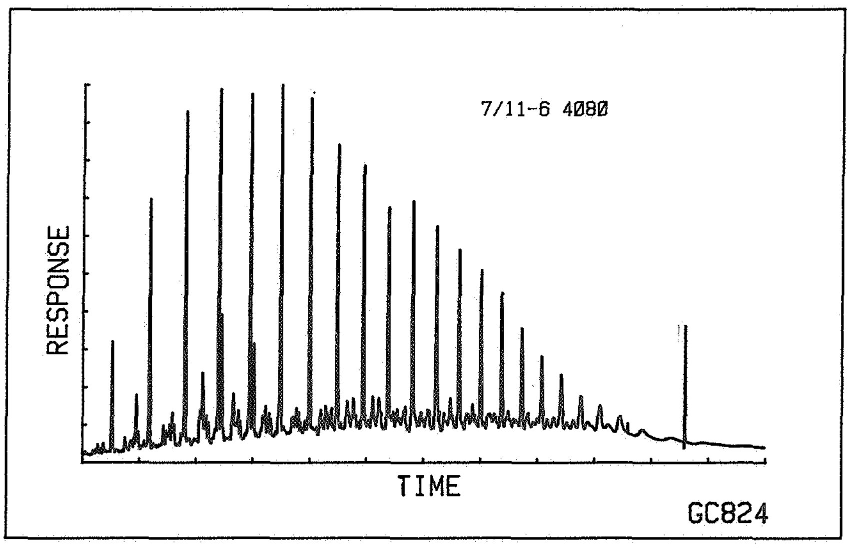

7/11-6 4080
RESPONSE
TIME
GC824

Figure 7.

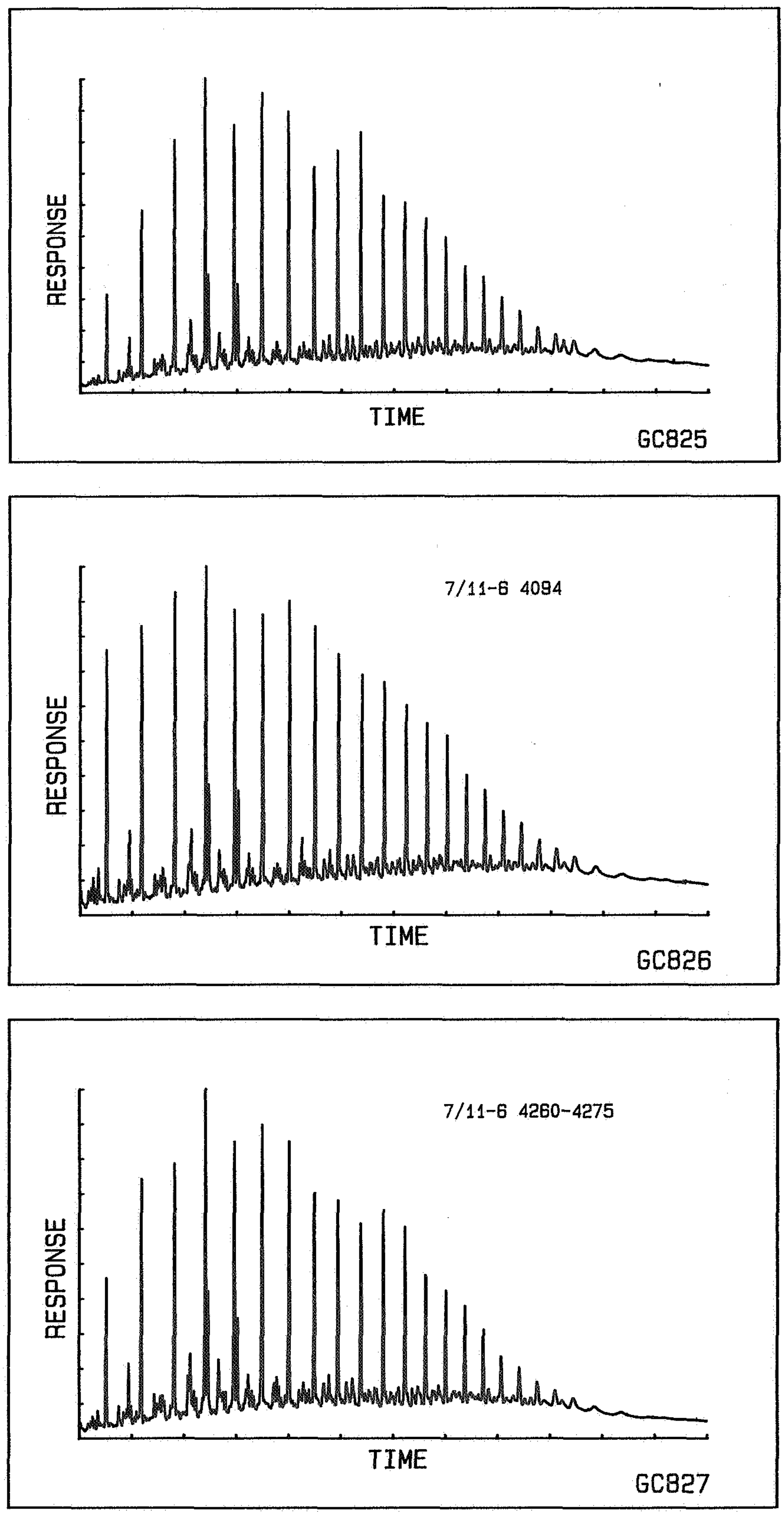

RESPONSE
TIME
GC825
7/11-6 4094
RESPONSE
TIME
GC826
7/11-6 4260-4275
RESPONSE
TIME
GC827

Figure 8.

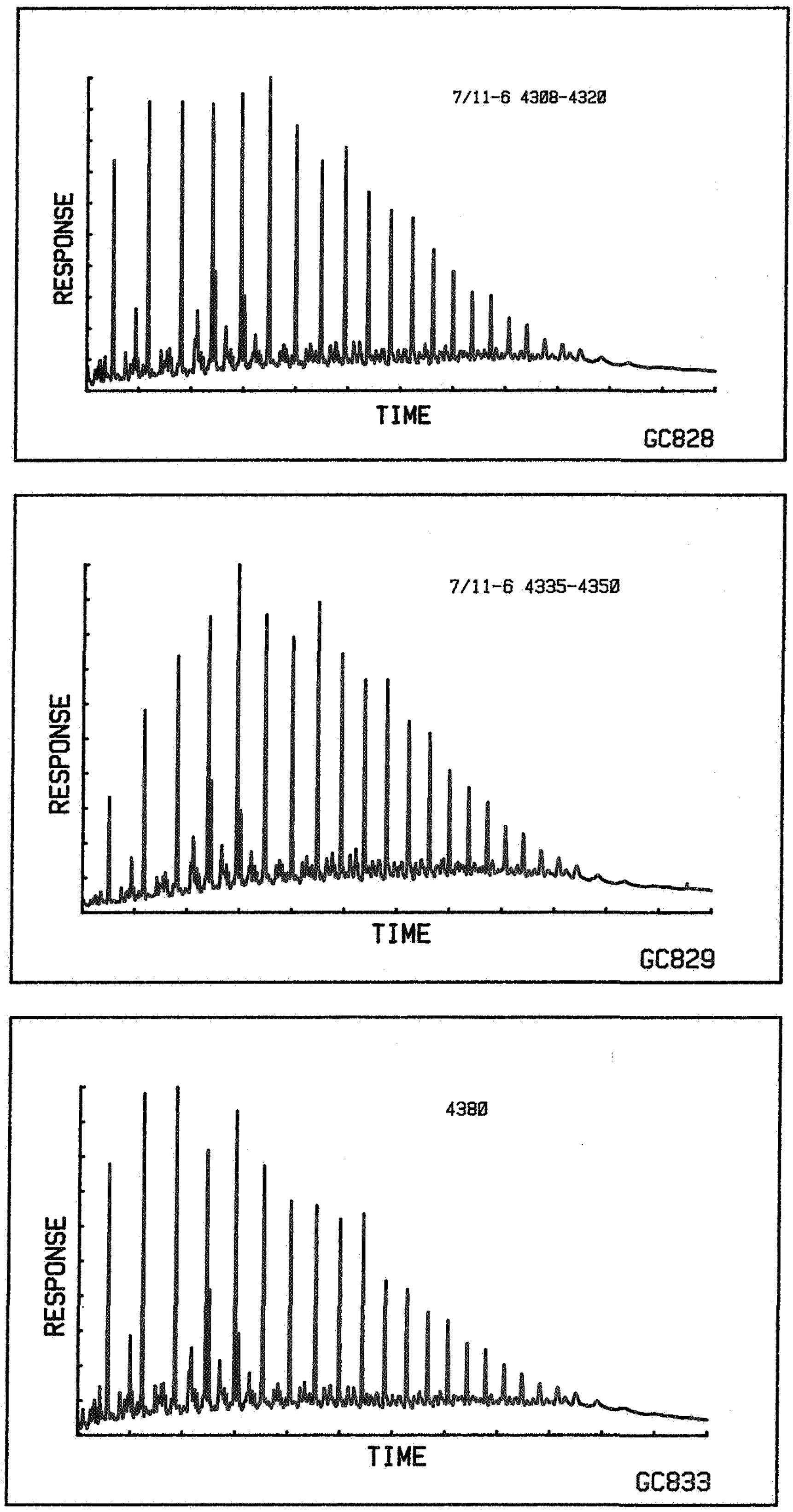

7/11-6 4308-4320
RESPONSE
TIME
GC828
7/11-6 4335-4350
RESPONSE
TIME
GC829
4380
RESPONSE
TIME
GC833

Figure 9.

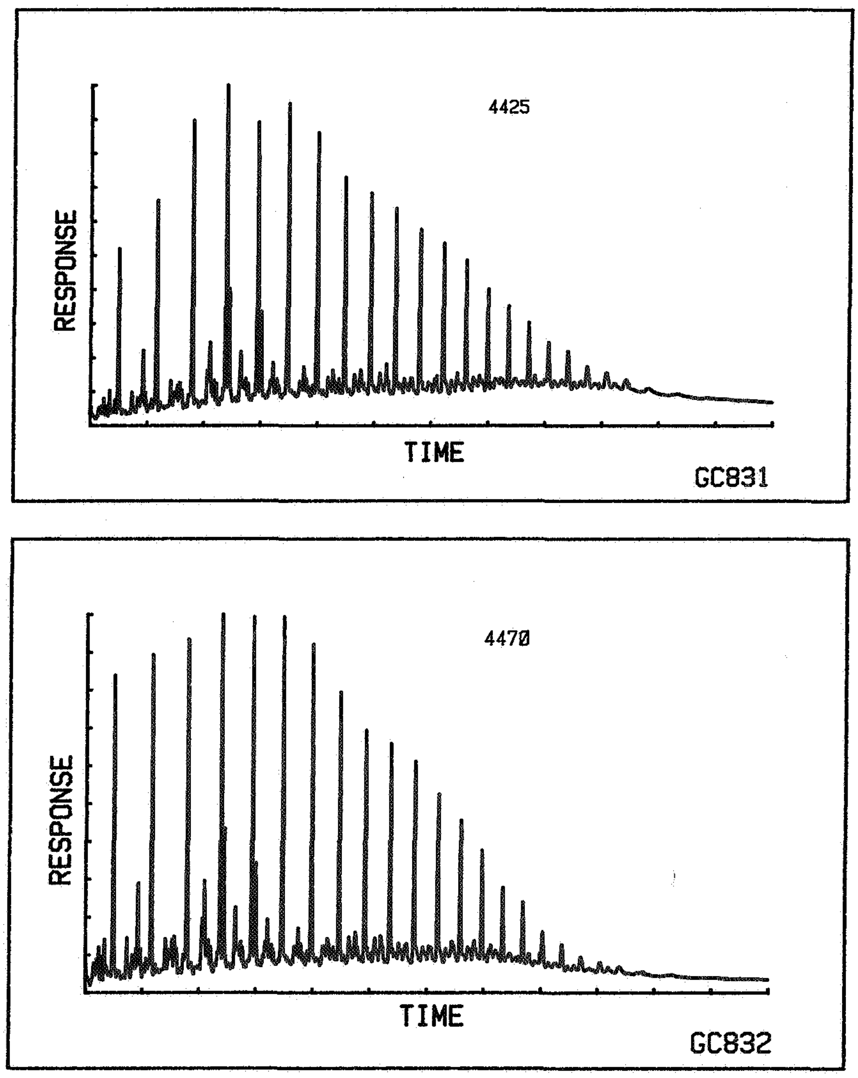


Figure 10.