IKU

Confidential

INSTITUTT FOR KONTINENTALSOKKELUNDERSØKELSER

CONTINENTAL SHELF INSTITUTE

Håkon Magnussons gt. 1B — N-7000 Trondheim — Telephone (075) 15660 — Telex 55548

REPORT TITLE/ TITTEL

Source Rock Evaluation of well 7/11-7.

CLIENT/ OPPDRAGSGIVER

Phillips Petroleum Co. Norway

RESPONSIBLE SCIENTIST/ PROSJEKTANSVARLIG

P.B. Hall

AUTHORS/ FORFATTERE

I.K. Almås, F. Bessessen, P.B. Hall, N. Mills and J.O. Vigran

DATE/ DATO	REPORT NO./RAPPORT NR.	NO. OF PAGES/ ANT.SIDER	NO. OF ENCLOSURES/ ANT. BILAG
17.11.83	05.0181	119	6

SUMMARY/ SAMMENDRAG

Eighty cuttings samples plus some sidewall cores and full core samples from 7/11-7 were analysed. The analysed sequence was divided into 8 zones: five zones were identified within the Tertiary, consisting of different claystones from 4570' - 11000'. Tertiary and Cretaceous limestones occur between 11000' and to 14450'. Jurassic shales and sandstone to 14980'. Triassic sandstones and claystones and Zechstein evaporites below 14980'. Two organic carbon rich sequences were found; in zone B, (Tertiary 5980'-8260') there are immature brown-grey claystones which have a fair - good potential for wet gas and condensate, and in zone G (14450'-14920'), brownish-black and grey-black Kimmeridge Clay Formation shales have a good - rich potential for wet gas and condensate and probably have already yielded some hydrocarbons. These shales are oil window and approaching condensate window maturity.

The remaining zones have only poor potential source rocks.

KEY WORDS/ STIKKORD

Source Rock | Evaluation

Potential | Maturity/Migration

CONTENTS

	Page
EXPERIMENTAL PROCEDURES	4
Total Organic Carbon	4
Rock-Eval Pyrolysis	4
Extraction and Chromatographic Separation	5
Vitrinite Reflectance	5
Processing of Samples and Evaluation of Visual Kerogen	7
Gas Chromatographic Analysis	8
INTRODUCTION	10
Lithology and Variation in Organic Carbon Contents	13
Rock-Eval Pyrolysis	15
Analysis of Extractable Organic Matter	18
Examination in Reflected Light	22
Analyses in Transmitted Light	31
CONCLUSIONS	34
Source Rocks, Richness, Type and Hydrocarbon Potential	34
Maturity	34
Migrated Hydrocarbons	37
REFERENCES	38
TABLES	
Table 1: Lithology and Total Organic Carbon Measurements	39
Table 2: Rock-Eval Pyrolysis	60
Table 3: Concentration of EOM and Chromatographic Fractions	62
Table 4: Weight of EOM and Chromatographic Fractions	63
Table 5: Concentration of EOM and Chromatographic Fractions	64
Table 6: Composition in % of Material Extracted from the Rock	65
Table 7: Tabulation of Data from the Gas Chromatograms	66
Table 8: Aromatic Hydrocarbon Ratios	67
Table 9: Tabulation of Maturity Data	68
Table 10: Visual Kerogen Analysis	71

APPENDICES

APPENDIX 1: Saturated Hydrocarbon Gas Chromatograms 78
APPENDIX 2: Aromatic Hydrocarbon Gas Chromatograms 89
APPENDIX 3: Vitrinite Reflectance Histograms 95

EXPERIMENTAL PROCEDURES

Screening Analysis

Total Organic Carbon

After lithological description, picked cuttings of various lithologies in each sample were crushed in a centrifugal mill. Careful picking was necessary to remove contaminants such as paint and plastic fragments and lubricants (grease particles) introduced during the drilling operation. Aliquots of the samples were then weighed into Leco Crucibles and treated with hot 2N HCl to remove carbonate, and washed four times with distilled water to remove traces of hydrochloric acid. The crucibles were then dried at 60°C for 12 hours. The samples were analysed using a Leco EC 12 carbon analyser to determine the total organic carbon (TOC). The TOC values and lithological description are given in table 1. Figure 1 shows the plot of the lithology and TOC values.

Rock-Eval Pyrolysis

Crushed samples (100mgs) were put into platinum crucibles, the bottoms and covers of which are made of sintered steel, and analysed on a Rock-Eval II pyrolysis apparatus (Espitalié et al. 1977). The data from these analyses is presented in table 2. Figure 2 shows the plot of this data.

Follow-up Analysis

Extraction, Fractionation by medium pressure liquid chromatography (MPLC), Gas chromatography (GC)

Extraction and Chromatographic Separation

Samples for extraction and further analysis were selected on the basis of the screening analysis data. Approximately 50 grams of each sample was extracted using dichloromethane (300ml) as solvent. For some samples, only a smaller amount of the chosen lithology was available for extraction , and the amount of DCM applied was reduced accordingly. Activated copper filings were added to the samples, prior to the extraction (to remove free sulphur). Extraction was performed by using an Ilado homogenizer. A powdered rock sample was placed in a centrifuge tube with the dichloromethane and homogenised for 10 minutes. Samples were then centrifuged and the supernatant decanted into a round-bottom flask. After extraction, the solvent was reduced to low bulk on a Buchi Rotavapor and the extracts were then transferred to small (2ml) vials before the rest of the solvent was removed using a gentle stream of nitrogen. The amount of extractable organic material (EOM) was determined by weighing.

The EOM was then separated into saturated and aromatic hydrocarbons and NSO compounds using a medium pressure liquid chromatography system based on the design of Radke et.al. (1980). Hexane was used as eluant, and was removed from the saturated and aromatic hydrocarbon fractions in the same manner as previously described for DCM. The results for the various fractions are given in table 3-6, and plots of certain values from the data are shown in figures 3 and 5.

Vitrinite Reflectance

Whole rock samples were used. The samples were mounted in Bakelite resin blocks; care being taken during the setting of the plastic to avoid temperatures in excess of 100^{o}C. The samples were then ground, initially on a diamond lap followed by two grades of corundum paper. All grinding and subsequent polishing stages in the preparation were carried out using isopropyl alcohol as lubricant, since water leads to the swelling and disintegration of the clay fraction of the samples.

Polishing of the samples was performed on Selvyt cloths using three grades of alumina, 5/20, 3/50 and Gamma, followed by careful cleaning of the surface.

Reflectance determinations were carried out on a Leitz M.P.V. microphotometer under oil immersion, R.I. 1.518 at a wavelength of 546 nm.

The surface of the polished block was searched by the operator for suitable areas of vitrinitic material in the sediment. The reflectance of the organic particle was determined relative to optical glass standards of known reflectance. Where possible, a minimum of twenty individual particles of vitrinite was measured, although in many cases this number could not be achieved.

The samples were also analysed in UV light, and the colour of the fluorescing material determined. Below, a scale comparing the vitrinite reflectance measurements and the fluorescence measurements is given.

VITRINITE REFLECTANCE R.AVER. 546 NM	0.20 1516	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10
% CARBON CONTENT DAF.	57	62	70	73	76	79	80.5	82.5	84	85.5
LIPTINITE FLUOR NM	725	750	790	820	840		860	890	940	
EXC. 400 nm BAR. 530 nm colour	G	$G/_Y$	Y	$Y/_O$	L.O	M.O.		D.O.	$O/_R$	R
zone	1	2	3	4	5	6		7	8	9

NOTE: Liptinite NM = Numerical measurements of overall spore colour and not peak fluorescence wavelength.

Relationship between liptinite fluorescence colour, vitrinite reflectance and carbon content is variable with depositional environment and catagenic history. The above is only a guide.

Liptinite will often appear to process to deep orange colour and then fade rather than develop or O/R red shade. Termination of fluorescence is also variable.

Results of this analysis are given in table 9, histograms in appendix 3 and plots of this data are shown in figure 5.

Processing of Samples and Evaluation of Visual Kerogen

Crushed rock samples were treated with hydrochloric and hydrofluoric acids to remove the minerals. A series of microscopic slides contain strew mounts of the residue:

T-slide represents the total acid insoluble residue.
N-slide represents a screened residue (15µ mesh).
O-slide contains palynodebris remaining after flotation ($ZnBr_2$) to remove heavy minerals.
X-slides contain oxidized residues, (oxidizing may be required to remove sapropel which embeds palynomorphs, or where high coalification prevents the identification of the various groups).

T and/or O slides are necessary to evaluate kerogen composition/-palynofacies which is closely related to sample lithology.

Screened or oxidized residues are normally required to concentrate the larger fragments, and to study palynomorphs (pollen, spores and dino-flagellates) and cuticles for paleodating and colour evaluation.

So far visual evaluation of kerogen has been undertaken from residues mounted in glycerine jelly, and studied by Leitz Dialux in normal light (halogene) using x10 and x63 objectives. By x63 magnification it is possible to distinguish single particles of diameters about 2 and, if required, to make a more refined classification of the screened residues (particles >15µ).

The colour evaluation is based on colour tones of spores and pollen (preferably) with supporting evidence from colour tones of other types of kerogen (woody material, cuticles and sapropel). These colours are dependant upon the maturity, but are also influenced by the paleo-

environment (lithology of the rock, oxidation and decay processes). The colours and the estimated colour index of an individual sample may therefore differ from those of the neighbouring samples. The techniques in visual kerogen studies are adopted from Staplin (1969) and Burgess (1974).

In interpretation of the maturity from the estimated colour indices we follow a general scheme that is calibrated against vitrinite reflectance values (R_o).

Ro	0.45	0.6	0.9	1.0	1.3
colour index	2-	2	2+	3-	3
Maturity intervals	Moderate mature	Mature (oil window)			Condensate window

Results of this analysis are given in table 9 (spore colouration) and table 10 (detailed composition).

Gas Chromatographic Analysis

The saturated and total aromatic fractions were analysed on a HP 5730 gas chromatograph fitted with a DB-1 (=OV-1) fused silica column (15m x 0.25mm i.d; 0.25 m film thickness). Hydrogen (0.7 ml/min) was used as carrier gas, and the injections were performed in split mode. The temperature of the GC oven was programmed from 80°C to 280°C.

Gas chromatogram traces are presented in appendix 1 for saturated hydrocarbons and 2 for aromatic hydrocarbons. CPI, C_{17}/Pristane and pristane/phytane ratios were calculated from peak areas. The peak processing was performed by a VG Multichrom Lab Data system. The data is presented in table 7. Plots of this data are presented in figure 4. Aromatics ratios were calculated from the original aromatic hydrocarbon recorder traces (not shown, only computer generated traces shown) and presented in table 8.

BURGESS, J.P., 1974: Microscopic examination of kerogen (dispersed organic matter) in petroleum exploration. Geol. Soc. America, Special paper 153. p.19-30.

ESPITALIE, J., MADEC, M., TISSOT, B., LEPLAT, P. and MENNIG, J.J., 1977: Source Rock Characterisation method for petroleum exploration. Rev. Inst F. Pétrole. March 1977.

RADKE, M., WILLSCH, H. and WELTE, D.H., 1980: Preparative hydrocarbon group type determination by automated medium pressure liquid chromatography. Anal. Chem. 52. p.406-411.

STAPLIN, F.L., 1969: Sedimentary organic matter, organic metamorphism, and oil and gas occurrence. Canadian Petrol. Geol. Bull., 17(1). p.47-66.

INTRODUCTION

The analysed section of the well 7/11-7 (see location map overleaf) was divided into eight zones which mark important lithological differences. The main variation used in zonation was that of the colour of claystones.

Marking of formation tops and a detailed lithological interpretation was not performed since analysis was not requested on every sample (sample interval was 30' from 4570'-9610' and every 10' below this, while analysis interval was every 450' from 4570-9610' and every 100' below this).

Phillips Petroleum supplied the latest information on formation tops, and this data has been incorporated into this report:

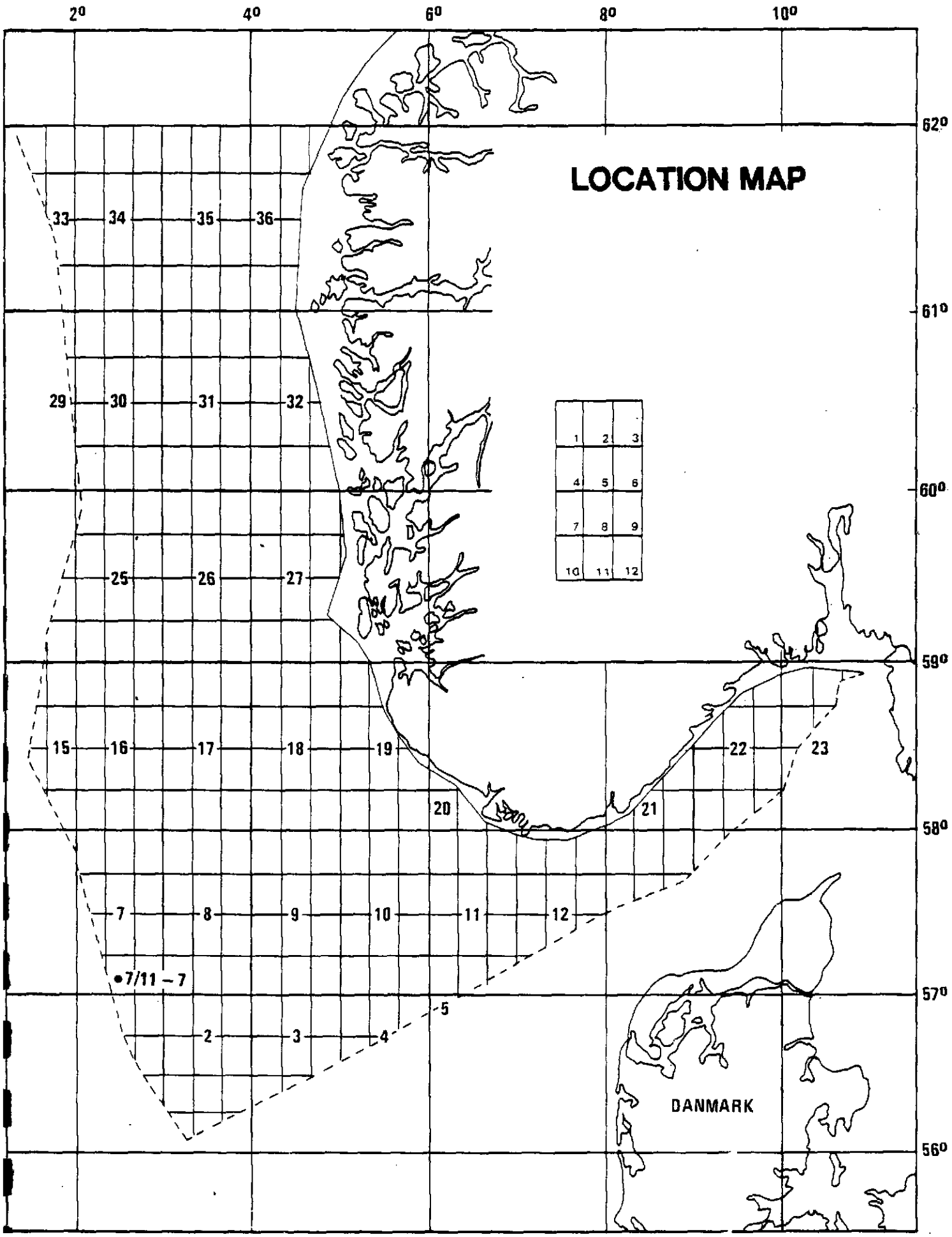
Tertiary not subdivided.	
Top Cretaceous	11121'
Top Lower Cretaceous	14167'
Top Jurassic, Kimmeridge Clay Fm.	14454'
Top Ula Fm.	14853'
Top Trias	14982'
Top Zechstain Anhydrite	15982'
Top Salt	16149'

The zonation used in this report is as follows:

Tertiary	Zone A	4570'- 5500'	light olive-grey claystones.
	Zone B	5980'- 8260'	brownish grey claystones.
	Zone C	8710'- 9160'	olive-grey claystones
	Zone D	9580'-10300'	claystones of various colours.
	Zone E	10390'-11000'	medium dark grey claystones, siltstones and sandstones.
Tertiary and Cretaceous	Zone F	11000'-14400'	white, off-white, grey limestones.
Jurassic	Zone G	14450'-14920'	brownish black and grey-black shales.

Jurassic/ Triassic	Zone H	14920'-16100'	This zone consists mostly of sandstones and greenish-grey claystones based on core samples. Brownish-black shales observed in cuttings are probably all cavings.

The boundaries of each zone are not precise since not all available samples were analysed.


LOCATION MAP
2°
4°
6°
8°
10°
62°
61°
60°
59°
58°
57°
56°
33
34
35
36
29
30
31
32
25
26
27
15
16
17
18
19
20
21
22
23
7
8
9
10
11
12
2
3
4
5
1
2
3
4
5
6
7
8
9
10
11
12
•7/11 – 7
DANMARK

Lithology and variation in organic carbon contents

TOC values are classified as follows:

<0.5%	:	poor source rock.
0.5-1.0%	:	fair source rock.
1.0-2.0%	:	good source rock.
>2.0%	:	rich source rock.

The data is presented at the back of the report in table 1, and figure 1 (enclosure).

TERTIARY (?-11121')

Zone A, 4570'-5500': Light olive grey to olive grey claystones in this zone have good total organic carbon contents (two values recorded; 1.21% and 1.85%).

Zone B, 5980'-8260': Brownish-grey and dusky yellowish-brown claystones in this zone have rich total organic carbon contents varying from 2.2-4.2% (average 3.2%).

Zone C, 8710'-9160': Olive grey and light olive grey claystones in this zone have good organic carbon contents (two values recorded; 1.12% and 1.21%).

Zone D, 9580'-10300': Claystones in this zone are of various colours, picked examples (without the brown-grey claystones) have total organic carbon contents of less than 1% (i.e. can be classified as poor to fair source rocks).

Zone E, 10390'-11000': The medium dark grey claystones in this zone have generally good organic carbon contents with an average of 1.1%. However, values show a decrease from a maximum of 1.52% at 10510' to 0.9% at 11000'.

Zone F Tertiary, 11000'-11121': Limestones in this zone have less than 0.3% TOC.

CRETACEOUS (11121'-14454')

Zone F, 11121-14400': Limestones in this zone have less than 0.3% TOC (Classified as poor source rocks).

JURASSIC (14454'-14982')

Zone G, 14450'-14920': Brownish black and grey-black shales are dominant in this zone (at least down to 14853' the top of the Ula Fm.) have rich organic carbon contents which vary from 2.9% to 7.7% (average of 5.3%). Below 14520' the shales are generally poorer in TOC than above this boundary. Also present towards the top of zone G are grey to medium dark grey waxy calcareous claystones with TOC contents less than 0.3%.

JURASSIC/TRIASSIC/PERMIAN (14920'-16100'+)

Zone H: Below 14920' most argillaceous lithologies are poor to fair in TOC content, the brown-black claystone in this section of the well is probably all caved material from zone G.

Rock-Eval Pyrolysis

A total of 46 samples were analysed using a Rock-Eval II pyrolysis instrument. The data is discussed below, the fact that the well was turbodrilled between 14004'-14923', which includes the main source rock horizon makes it hard to be absolutely sure that variations in kerogen type and Tmax are solely due to natural variations.

The data is presented in table 2 at the back of the report, and in figure 2 (enclosure).

The classification used here is as follows:

Petroleum potential
(S1 + S2)

<1	Poor source rock potential.
1-5	Fair source rock potential.
5+	Good source rock potential.

Zone A, 4570'-5500': Only one sample of the light olive-grey claystones above 5500' was analysed it has a hydrogen index indicative of a type IV kerogen (<50 mgs hc/g TOC). The low Tmax (421) indicates an immature sample. The high production index suggests the presence of migrated hydrocarbons. The low petroleum potential and low hydrogen index indicates that this claystone has a poor potential for dry gas.

Zone B, 5980'-8260' Six samples of the brownish-grey claystones from this section of the well were analysed. The hydrogen index values vary from 107-121 mgs hc/g TOC, indicating that these claystones contain type III kerogens. Tmax values vary from 425-434 indicating that samples are moderate mature at best. The low production indices (0.04-0.05) are to be expected for kerogens of low maturity which have not been invaded by migrant hydrocarbons. The fair - good petroleum potentials (2.2 -5.4, highest below 6460') of these type III kerogens indicates that claystones in zone B have a good potential as a source for wet gas and condensate.

Zone C, 8710'-9160': One sample of the brownish-grey claystone similar to zone B was analysed and shows similar characteristics in Rock-Eval data. Two samples of olive grey claystones from this section of the well

were also analysed. The kerogen is similar to the olive grey claystone in zone A. The Tmax is similar to zone B i.e. moderate mature. The higher production index values of these claystones, compared to those in zone B, is probably due to the presence of migrated hydrocarbons. The claystones in this section have a poor potential as a source for dry gas.

Zone D, 9580'-10300': The mixture of different coloured claystones in this zone have very low TOC contents and the kerogens are type IV and have no potential as source rocks. The Tmax values of 425/426 are probably low values, due to the inaccuracy in T_{max} measurement on very small S_2 peaks.

Zone E, 10390'-11000': This sequence consists of interbedded medium dark grey claystones and sandstone/siltstones. Six samples of the claystones were analysed by Rock-Eval pyrolysis. They have type III or IV kerogens with petroleum potentials averaging 1 kg hc/ton of rock. Tmax values from 433-438 indicate a sequence which is moderate mature to early oil window mature (but not peak oil generation). The high production indices indicate that there are migrated hydrocarbons present in this zone. There appears to be a decrease in kerogen quality downhole which is indicated by the hydrogen index falling from 114 to 40 associated with total organic carbon contents which decrease from 1.5%-0.9%.

In general the medium dark grey claystones in this section have a poor potential for wet gas.

Zone F, 11000'-14400': This zone consists dominantly of limestones with no hydrocarbon potential. Unfortunately there is so little organic matter in these limestones that Tmax values are inaccurate.

Zone G, 14450'-14920': The brownish-black and greyish-black shales in this zone constitute the main source rock of the well. Sixteen samples of these shales were analysed, although the lower four are mainly caved material. The hydrogen index varies from 62 to 198 which indicates type IV or III kerogen. The maturity indicated by Rock-Eval Tmax is within the oil window. The Tmax values are extremely variable 436-450 (average is 443) and the sidewall core values tend to have slightly higher values (442-450). This section of well was turbodrilled and it is possible that some sections of this interval have been more affected by the turbodrill heating effect than others. If the side-wall core data is considered to

be the most reliable, then the maturity of the zone is at, or past peak oil generation. The high production indices from 0.3-0.44 are values to be expected at peak oil generation.

The petroleum potentials (average ∿10kg hc/ton rock) vary considerably throughout the sequence, the highest values (>10) occur between 14450'-14470' (includes a sidewall sample) 14502' (sidewall) and 14520'-14530' and the lowest values (∿5) towards the base of the section 14690'-14700' and 14790'-14800'. The shales in this sequence generally have a rich potential as a source of wet gas and condensate.

Zone H below 14920': The samples analysed in this zone consist mostly of sandstones and low TOC, grey and grey-red claystones. One dark grey silty claystone from 16000' was analysed and gave no S_2 peak, ie. has no potential as a source rock.

Analysis of Extractable Organic Matter

A total of 10 picked samples was taken for extraction. The discussion of the data is divided into a discussion of extraction data plus saturated hydrocarbon gas chromatograms, and aromatic hydrocarbon gas chromatograms. Samples analysed come from zones B, C, E, G and H. The data is presented in tables 3-7 at the back of the report. Saturated hydrocarbon gas chromatograms are shown in appendix 1 at the end of the report, following the data tables. Figure 3 and 4 (enclosures) give this data in log format.

Source rock classification based on the amount and composition of bitumen.

Extractable organic matter (EOM in ppm)

Poor	<100ppm	EOM
Fair	100-200ppm	EOM
Good	200-500ppm	EOM
Rich	>500ppm	EOM

Extractable hydrocarbons (EHC in mgs per gram TOC)

Poor	<10 mgs/g	
Fair	10-20 mgs/g	
Good-Rich	20-100 mgs/g	
Stain	100+	(depends on the kerogen type, type I kerogens can yield more than 100 mgs/g).

Zone B: Two examples (A-8649, A-8679) of the brownish grey-dusky yellowish brown claystones from Zone B were extracted and fractionated, and saturated hydrocarbon gas chromatograms were obtained of both samples and an aromatic hydrocarbon gas chromatogram of the deeper sample (A-8679, 7780'-7810'). In the IKU classification, the amount of extractable organic matter >500 ppm indicates they are rich source rocks, whereas the amount of extractable hydrocarbons (normalised to organic carbon) indicates that they are only poor to fair sources. The explanation of this apparent contradiction is that from maturity measurements (Rock-Eval T_{max}, Vitrinite Reflectance and Thermal Alteration Index) the samples are immature and the kerogens will not have generated much soluble bitu-

men relative to organic carbon content. The low maturity of these two samples is supported by other data from the bitumen analysis. Thus the saturated hydrocarbon gas chromatograms show a bimodal n-alkane distribution ranging from nC_{11} to nC_{35}. The two modes have maximum n-alkanes at nC_{15} and nC_{29}. The high molecular weight distribution from nC_{21}-nC_{35} has a strong odd carbon number predominance, particularly from nC_{25} to nC_{31} (CPI_{26-28} = 2.1/2.2) indicative of a prominent input of immature, higher plant (terrestrial) matter. The high pristane/phytane ratios (2.8/4.1) are also indicative of a large input of terrestrial plant matter deposited in restricted or mildly anoxic conditions. In extremely anoxic conditions (anoxic bottom waters as well as sediments) values tend to be less than 2 and generally less than 1 when immature.

The prominence of the isoprenoids (pristane is the major peak in the chromatogram) and of compounds in the nC_{25}-nC_{31} region (which will include the biomarkers terpanes and steranes) versus the n-alkanes is another indication of the low maturity of the kerogen in the claystones. The low saturate/aromatic ratio (∿1) is also indicative of low maturity.

One example of the olive grey-light olive grey claystones between 8710'-9160 (Zone C) was extracted. This sample has a rich amount of extractable organic matter and is classified as a good source based on extractable hydrocarbons normalised to total organic carbon. This claystone is poorer in TOC than the brown-grey claystones from the zone above, and also in Rock-Eval petroleum potential (<1 compared to ∿2-5 for the brown-grey claystones). The higher value of extractable hydrocarbons (and also hydrocarbons as a percentage of total extract) is probably due to the presence of migrated hydrocarbons. This is supported by data from the saturated hydrocarbon gas chromatograms and Rock-Eval pyrolysis data. The Rock-Eval production index is high for this sample compared to values above. The saturated hydrocarbon gas chromatogram shows a front-end dominated unimodal distribution ranging from nC_{11} to nC_{35} with a maximum at nC_{15}. The CPI is lower (1.2) and the acyclic isoprenoid alkanes are less prominent than in the samples from zone B (although pristane is still the dominant alkane). However, the high molecular weight component from nC_{35}-nC_{31} (containing the biomarkers) is still prominent and indicates that the sample is still relatively immature. The high pristane/phytane ratio (4.7) suggests that the organic input was mainly terrestrial and was deposited into a mildly anoxic environment.

Zone E: The medium dark grey claystone from zone E (A-8812, 10590'-10600') show quite different characteristics to the two claystone types discussed above. There is a greater amount of EOM (rich source) and the amount of extractable hydrocarbons normalised to TOC is more than doubled compared to the claystones discussed previously (rich source). It is probable that this may be partly due to the presence of migrated hydrocarbons but mainly due to the sample being moderate-early mature, and that some bitumen has already been generated from kerogen. The saturated hydrocarbon gas chromatogram supports this suggestion. The n-alkane distribution ranging from nC_{11} to nC_{37} is front-end biased with a maximum at nC_{15}. However, there is a prominent shoulder of higher molecular weight n-alkanes to nC_{30}. There is a slight odd carbon number predominance (CPI C_{26-28} is 1.2). The isoprenoid biomarker components are less prominent than in claystones higher in the sequence. The pristane/nC_{17} alkane ratio is now less than 1, whereas in samples above this pristane was the dominant alkane. The pristane/phytane ratio of 2.4 and the prominent high molecular n-alkane component is indicative of a large terrestrial input as discussed previously.

No samples were extracted from the limestone sequence (Zone F) since the two Rock-Eval analyses do not indicate any source rock potential for this sequence, they probably contain only traces of bitumen.

Zone G: The brownish-black shale interval from 14450' to 14920' is considered to be the main source rock interval in this well based on data from TOC, Rock-Eval and soluble bitumen analyses.

Five samples of this shale were extracted and have very high quantities of EOM (average ∿7000ppm) indicating a rich source rock. Extractable hydrocarbons normalised to TOC values vary from 30 to 100 mgs/g (the low value being from a sidewall core sample; the average value is ∿ 74mgs/g TOC) also indicating a rich source rock. The saturated hydrocarbon gas chromatograms are all very similar. They show unimodal n-alkane distributions ranging from nC_{11} to nC_{35} with front-end biased maximum at nC_{13}. The n-alkanes above nC_{25} are a minor component, as are the isoprenoids (pristane/nC_{17} = ∿0.3). The data indicate that the samples are at peak oil generation, and may already have expelled some oil. Based on the hydrocarbon distributions and Rock-Eval hydrogen indices they are still a source for gas/condensate and light oil.

One sample of a silty dark grey claystone below the main source rock interval was extracted (A-9425, 16000'). It has a rich (just) abundance of EOM. The saturate/aromatic ratio is higher than the main source rock horizon. The higher content of saturated hydrocarbons is probably due to its higher maturity and perhaps different kerogen type. The saturated hydrocarbon gas chromatogram of this claystone is also different to those from the main source rock interval. The n-alkane envelope is dominated by a narrow range of compounds between nC_{11}-nC_{17} with a maximum at nC_{13}. The low TOC, high production index and the gas chromatogram suggests that the hydrocarbons in this sample consist chiefly of migrated hydrocarbons with a condensate distribution.

Aromatic hydrocarbons

Aromatic hydrocarbons of 5 selected samples from the 10 extracted samples were analysed by gas chromatography. The chromatograms are shown in appendix 2 at the back of the report, following the data tables.

One sample from the brownish-grey claystone sequence (zone B) was analysed (A-8679, 7780'-7810'). The general fingerprint is typical for an immature sample. The main aromatic hydrocarbons in moderate mature to condensate window-mature samples are alkylnaphthalenes and alkylphenanthrenes. The hydrocarbons in A-8679 are dominated by a few major resolved peaks, including aromatic steranes and triterpanes. The alkylnaphthalenes are not prominent.

One sample from the medium dark grey claystone sequence in zone E was analysed (A-8812: 10590'-10600'). Unlike the sample from zone B, alkylnaphthalenes and phenanthrenes are prominent. The trace is typical for a mature kerogen type II or III.

Three aromatic hydrocarbon traces from the main source rock interval (zone G) were obtained. They all show similar features. The alkylnaphthalenes (MN, DMN, TMN) dominate, and the alkylphenanthrenes (MP, DMP) are secondary in importance. The traces are typical for mature kerogens. A few of the aromatic hydrocarbon ratios which have been considered as maturity parameters (Radke et al., 1983) have been calculated for these and the one sample from zone E (see table 8 at the back of the report). The MPI 1 ratios are consistent with the maturity levels determined by conventional techniques (ie. past peak oil generation for the main source rock interval).

Examination in Reflected Light

Forty-five samples were examined in reflected light. All of the samples were prepared as whole rock blocks. Whilst attempting a reasonably even coverage of the well, where possible the same samples were chosen as were analysed by Rock-Eval pyrolysis and often extracted. In these cases usually the sample was selectively picked so that the same lithology was used for the different analyses to facilitate direct comparisons of maturity assessments. In other cases, due to uncertainty, bulk samples were taken. Some sections are more densely sampled when particular problems arose with the initial sample choices.

The top section of the well is very rich in bitumen wisps and bitumen staining. This section has low quantities of measurable material and the values are very low and consistent. This could be due to the known property of bitumen staining to lower the reflectance of associated vitrinite particles, or to a low geothermal gradient and the lower sensitivity of reflectance measurements at very low ranks.

It is unfortunate for this type of analysis that the well contains a 3400ft section of limestone/marl which is partially turbodrilled and is immediately followed by a further 600ft of shale/claystone which has to some degree been affected by turbodrilling. Both of these facts make the analyses in this zone less reliable. Beneath the in-situ shale there appears to be much caved shale which is usually avoided but is of approximately the same lithology as found in the turbodrilled section. The sandstone in this basal section appears minor and virtually barren.

Much of the maturity assessment from vitrinite reflectance in this well is therefore predictive and should be compared critically with other maturity parameters.

The samples are described below in increasing depth order and histograms displaying the results are given in appendix 3 following tables at the back of the report. Data is shown in table 9, and in figure 5 (enclosure).

Sample A-8954, 5020-5050ft: Claystone, Ro = 0.28(1)?
This maturity assessment is completely unreliable being based on only one measured particle. The sample contains a moderate amount of bitumen

wisps and a variable overall bitumen staining. There is a very low phytoclast content - a few inertinite/reworked vitrinite fragments and even fewer small, thin, unmeasurable, possible primary, vitrinite wisps. Green fluorescence is seen from a low to moderate spore content.

Sample A-8603, 5470-5500ft: Claystone, No Determination Possible/reworked? = 0.45-0.6
The organic material is almost completely bitumen wisps with a variable, though light, overall bitumen staining. There is a trace of reworked vitrinite and inertinite but no true vitrinite can be confidently identified. Bitumen has a reflectance of 0.16%. Green fluorescence is seen from spores and dinoflagellates.

Sample A-8635, 6430-6460ft: Mixed claystones, Ro = 0.28(5)
The sample contains dominantly bitumen of very low rank with variable bitumen staining. There is a trace of inertinite and reworked vitrinite together with possible primary vitrinite/high phase bitumen. The result is probably low due to bitumen staining. Green fluorescence is observed from a moderate spore content.

Sample A-8649, 6880-6910ft: Claystone, Ro = 0.29(10)
The sample is rich in bitumen which is more concentrated than in samples above and occurs as both wisps and staining. There are more phytoclasts than in samples above but these are mainly inertinite/reworked vitrinite. There is a moderate content of spores fluorescing green and fewer which fluoresce green/yellow.

Sample A-8664, 7330-7360ft: Claystone, Ro = 0.30(11)
There is a high content of bitumen wisps and staining but a low phytoclast content. The phytoclasts are mainly in a poor condition and are difficult to distinguish. There is still the possibility that the result is low due to bitumen staining. Green and green/yellow fluorescence is seen from a low content of spores.

Sample A-8679, 7780-7810ft: Claystone, Ro = 0.36(6)
The sample is very rich in bitumen staining. Some clasts also have a high content of bitumen wisps. There is a low content of other phytoclasts as very small, poor, fragments difficult to distinguish. The sample is very similar to the one above but does contain some higher reflecting material considered to be reworked. Green and green/yellow fluorescence is seen from spores which are abundant in some clasts.

Sample A-8694, 8230-8260ft: Claystone, Ro = 0.35(12)
The sample is rich in bitumen but low in phytoclasts. These are usually somewhat degraded in nature and it is possible that the result is low due to the bitumen staining. Green/yellow and possibly yellow/orange fluorescence is seen from a low content of spores.

Sample A-8709, 8680-8710ft: Claystone and sandstone, Ro = 0.50(4)
The claystone contains dominantly bitumen wisps with moderate to heavy, sometimes zoned, bitumen staining. There is very little vitrinite or inertinite and the result may be high. The lowest two valves giving an Ro of 0.45 might be more representative. There is green/yellow and yellow/orange fluorescence from spores. The former is most abundant and clearest but it is not possible to assess if this is from caved material.

Sample A-8724, 9130-9160ft: Claystone, Ro = 0.46(5)
Bitumen wisps/degraded spore fragments are still the most common organic constituent. The bitumen is more zoned than in samples above. There is only a trace of possible primary vitrinite and a trace of reworked vitrinite/inertinite with a reflectance of about 0.8-0.9%. Green/yellow fluorescence is seen from spores in probably-caved material. Yellow/orange fluorescence from a low - moderate spore content is probably more accurate.

Sample A-8740, 9580-9610ft: Mixed claystones, Ro = 0.40(7) and 0.58(6) (Overall = 0.48)
Some clasts are very bitumen rich but there is a low to moderate phytoclast content. This is possibly primary vitrinite but it is difficult to distinguish. Many clasts are associated with red-brown staining which possibly lowers the results. The overall value may be accurate despite the fact that no values fall in that Ro unit. There are a few good stringers. Caved material (?) shows green/yellow fluorescence. Otherwise, light orange fluorescence is seen from a low - moderate spore content.

Sample A-8762, 10090-10100ft: Mixed claystones, Ro = 0.45(4) and 0.64(2) (Overall = 0.51)
The sample has a low overall organic content. This is dominantly bitumen wisps and staining but this appears to be concentrated in certain lithologies. There is a low phytoclast content which is very variable in both type and reflectance. Some reworked material of 0.9% Ro is observed. A mixture of fluorescence colours are observed. Green fluorescence is pro-

bably from caved material whilst yellow/orange and light orange might be representative of true material.

Sample A-8772, 10190-10200ft: Mixed claystones, Ro = 0.42(2) and 0.58(4) (Overall = 0.53)
There is a low organic content. This consists of bitumen, vitrinite and inertinite all in small quantities but inertinite/reworked vitrinite is most abundant. The clasts are very variable and there are some signs of oxidation. There is a higher population of 0.75% but this appears reworked. There is a wide distribution of values. Green fluorescence is seen from spores probably in caved material. Otherwise there is only background fluorescence.

Sample A-8782, 10290-10300ft: Mixed claystones, Ro = 0.61(5)
The sample is very variable. There is a very low content of phytoclasts with approximately equal amounts of vitrinite, reworked vitrinite and inertinite. One population of Ro 1.00% is presumed reworked. The results are good for the lithology they are from but it is difficult to assess if this is in-situ. There is only a trace of yellow and yellow/orange fluorescence probably from caved material.

Sample A-8792, 10390-10400ft, Claystone, Ro = 0.45(5) and 0.61(2) (Overall = 0.50)
The organic content is very variable. There is a very low content of measurable vitrinite. The sample contains much drilling mud and is poor for this analysis. Reworked material of Ro = 1.00% is observed. There is light orange fluorescence from a moderate spore content.

Sample A-8803, 10500-10510ft: Claystone, Ro = 0.61(9)
There is a moderate organic content. Bitumen occurs as wisps and variable staining. There is a moderate phytoclast content but this is dominantly reworked vitrinite/inertinite. The vitrinite appears good. Some of the sample appears oxidised. This is a good sample if the claystone is in situ. Green fluorescence is seen from caved material. Otherwise there is a low content of spores fluorescing light orange.

Sample A-8812, 10590-10600ft: Mixed claystones, Ro = 0.63(15)
There is a moderate organic content in some clasts with a good content of primary vitrinite, bitumen wisps and bitumen staining. There is a low content of inertinite/reworked vitrinite of Ro = 0.9%. If this is

in situ it is a good indicator of maturity. Light orange and mid orange fluorescence is seen from a moderate spore content.

Sample A-8832, 10790-10800ft: Claystone, Ro = 0.66(22)
There is a moderate to high content of bitumen, vitrinite and inertinite. There is a good content of vitrinite with some good stringers. The stringers do not appear to be affected by bitumen and if this claystone is in situ it is possibly the best indicator of maturity so far. There is a moderate content of spores fluorescing mid-orange. This sample is good for fluorescence.

Sample A-8862, 11090-11100ft: Mixed claystones and limestone, Ro = 0.71(5) (or 0.65(3) and 0.79(2)?)
There is a low to moderate phytoclast content. This is dominantly inertinite but there is some reworked vitrinite and a low content of possible primary vitrinite. There is a variable content of bitumen wisps and staining in the clayey sections. A mixture of fluorescence colours is seen - yellow/orange, light orange and mid-orange.

Sample A-8968, 11390-11400ft: Limestone, No Determination Possible/ reworked = 0.96(2)?
This is almost a pure limestone. There are a few inertinite/reworked vitrinite fragments loose from the rock matrix. Only mineral fluorescence is observed.

Sample A-8988, 11590-11600ft: Limestone, No Determination Possible/ reworked = 1.20?
This is a very clean limestone with a trace of oxidation. One reworked fragment was located in a shaley section. Only mineral fluorescence is observed.

Sample A-9008, 11790-11800ft: Limestone, No Determination Possible/ reworked = 1.04?
This is almost pure limestone. There is one clast of claystone/shale with a few (reworked?) stringers. This is probably a reworked/contaminant fragment. Only mineral fluorescence is observed.

Sample A-9048, 12190-12200ft: Limestone, No Determination Possible
No organic matter observed. Only mineral fluorescence is observed.

Sample A-9068, 12390-12400ft: Limestone, No Determination Possible/ reworked = 1.25?
Apart from one reworked fragment the sample is barren. One possible algal fragment is observed by its green/yellow fluorescence but this is probably contamination.

Sample A-9088, 12590-12600ft: Limestone, No Determination Possible/ reworked = 1.40?
The sample is very pure apart from some reworked material in a shale fragment which is not considered representative. Only mineral fluorescence is observed.

Sample A-9118, 12890-12900ft: Limestone, Ro = 0.83(3)? NDP?
The sample is overall very clean. There is a trace of bitumen and a few clasts of primary vitrinite in shale fragments - it is not clear if this shale is an inpure part of the limestone or if it is contaminant! Only mineral fluorescence is observed.

Sample A-9158, 13290-13300ft: Limestone, No Determination Possible
The sample is barren apart from lignite additive. Only mineral fluorescence is observed.

Sample A-9178, 13490-13500ft: Limestone, No Determination Possible
As above, the sample is barren apart from a trace of lignite additive. Some of the limestone appears oxidised. Only mineral fluorescence is observed.

Sample A-9188, 13590-13600ft: Limestone, No Determination Possible
Apart from a very few shaley fragments with a high bitumen content the sample is barren. Only dull background fluorescence is observed.

Sample A-9198, 13690-13700ft: Limestone and claystone, No Determination Possible
The sample is virtually barren, containing only a little reworked material with a reflectance of approximately 1.15-1.20%. Only mineral fluorescence is observed.

Sample A-9237, 14090-14100ft: Limestone, No Determination Possible
The sample contains only a trace of reworked/inertinite material Ro = 1.6%. No organic fluorescence is observed.

Sample A-9257, 14290-14300ft: Limestone and claystone, No Determination Possible
Either the sample is slightly altered or it contains an unidentified additive. There is only a low content of inertinite fragments (and some reworked vitrinite?). A trace of light orange fluorescence is seen from the claystone.

Sample A-9273, 14450-14460ft: Claystone/shale, No Determination Possible
The sample is overwhelmingly packed with pyrite! It appears altered (turbodrilled?). There is a trace of inertinite and possibly bitumen intimate with the pyrite. The less affected material has a trace of mid-orange fluorescence.

Sample A-9441, 14464ft (swc): Claystone/shale, Ro = 0.74(15)
The sample is very rich in bitumen and pyrite. The remainder is difficult to identify, the phytoclasts appearing "grained" and gnarled (possibly some drilling effect despite being a swc?). There is a wide distribution of values. Mid to deep orange fluorescence is observed from spore? fragments and there is a diffuse orange/brown fluorescence.

Sample A-9275, 14470-14480ft: Claystone/Shale, Ro = 0.75(1)?
The sample is packed with pyrite. There are a few inertinite fragments in the less pyritic clasts, otherwise the sample is poor. Only one fragment of possible primary vitrinite was measurable. Mid-orange and deep orange fluorescence was seen from fragments - the latter most abundant.

Sample A-9277, 14490-14500ft: Claystone/shale, Ro = 0.86(5)
Most of the sample appears affected by (turbo?) drilling - it is cracked, vesiculated and disturbed. As above, the sample is almost totally pyritic. One clast has an associated coaly particle - this could be contaminant but the measurements are totally from this clast. Apart from this there is only a trace of inertinite. Mid-deep orange fluorescence is observed from possible spore fragments. There is also orange/brown background fluorescence.

Sample A-9443, 14516ft (swc): Shale, Ro = 0.77(20)
As above, this is a dark shale lithology (with a bitumen rich groundmass?). The sample is moderately rich in phytoclasts, however they appear gnarled and dirty. It is difficult to distinguish primary and reworked vitrinite. There is a good, but wide, distribution of values about the

mean. Deep orange fluorescence is observed from (spore?) fragments and there is a dull matrix fluorescence.

Sample A-9297, 14690-14700ft: Claystone/shale, Ro = 0.91(6)
There is a low to moderate organic content. This is dominantly inertinite. Some particulate vitrinite was measured. Distinction of reworked vitrinite is difficult. There is a wide distribution of valves. Deep orange fluorescence is seen from a few fragments and one possible hydrocarbon speck (?).

Sample A-9307, 14790-14800ft: Claystone/shale, Ro = 0.53(6), 0.72(1) and 1.01(2)
This is a very confusing sample and there is low confidence in any of the values. The sample is bitumen rich. There is a moderate phytoclast content but this is dominantly inertinite/reworked vitrinite. The vitrinite is all very variable. The sample includes possible caved/contaminant material. There is deep orange fluorescence from a low spore content.

Sample A-9327, 14990-15000ft: Claystones/shale, Ro = 0.80(9), 0.96(1) and 1.18(1)
In parts the sample is very rich in pyrite (as the samples above - these sections often appear bitumen rich too). However, there appears to be more than one claystone so caving is a possibility. There is a moderate phytoclast content but this is dominantly poor inertinite/reworked vitrinite. Most phytoclasts are small and gnarled and difficult to distinguish. There is deep orange (possibly orange/red?) fluorescence from a low spore content.

Sample A-9462, 15011ft (core): Sandstone, No Determination Possible
The sample is barren apart from a few bitumen and fibrous fragments interstitial to the mineral grains. The latter might be contaminant from drilling mud. There is a trace of deep orange (spore?) fragments.

Sample A-9473, 15094ft (core): Claystone, No Determination Possible
There is a low organic content which consists of inertinite only. No fluorescence is observed.

Sample A-9357, 15290-15300ft: Sandstone and shale, Ro = 0.76(1) and 1.02(6)
The sandstone is barren. The shale is similar to above samples but appears

less pyritic (and less affected?). Most measurements are from loose fragments - reworked or contamination is possible. The shale is described as caved in the lithological description but some appears slightly different from above. If it is caved then maybe the sample should be classified as "No Determination Possible". Deep orange fluorescence is observed from unidentified fragments.

Sample A-9385, 15590-15600ft: Mixed shales/claystones, sandstone and drilling mud, Ro = 0.79(2) and 1.11(4)
As a bulk sample this is terrible! It is impossible to distinguish cavings and true material. There is a low overall organic content but this is dominantly inertinite and some reworked vitrinite with only a trace of possible primary vitrinite. The few measurements represent a broad range of values (see histogram) and the groupings are quite random! There is a trace of deep orange or orange/red fragments (spores?).

Sample A-9405, 15790-15800ft: Sandstone and shale/claystone, No Determination Possible
The sandstone is barren and variably oxidised. The shale contains phytoclasts of inertinite, reworked and primary vitrinite. However, the shale is very similar to material above and appears caved (the reflectance is 0.6-0.7%). There is a trace of deep orange fluorescence from (spore?) fragments.

Sample A-9425, 15990-16000ft: Sandstone and mixed claystones/shale
Ro = 0.73(2), 0.95(3) and 1.21(3)
The sandstone shows some oxidation. Some of the claystone/shale is most probably caved but some has material of high Ro. There is an overall low phytoclast content. The grouping of values is almost meaningless. Mid to deep orange fluorescence is observed from spores (?).

Sample A-9434, 16090-16100ft: Shale and sandstone, Ro = 0.93(8) and 1.22(3) (overall = 1.01)
The sandstone is minor and barren. The shale contains dominantly bitumen which is intimate with the mineral matrix. The sample is very pyritic and it is difficult as the shale might be caved? Mid to deep orange fluorescence is seen from fragments but it is doubtful if these are spores.

Analyses in Transmitted Light

The organic material of well 7/11-7 was evaluated on the basis of 20 samples between 5470 feet and 16000 feet. The material was obtained from 18 samples of picked lithologies from ditch cuttings and 2 sidewall cores (14464 feet and 14502 feet). The data are shown in table 9 and figure 5 (enclosure).

The well is divided in three intervals on the basis of maturity

5470 feet to 8710 feet	immature TAI 1/1+
9580 feet to 12500 feet	immature TAI 2-, 2-/2 colours may be influenced by lithology
14464 feet to T.D.	mature TAI 2+, 3-, 3/3+

Evaluations of colour indices below 14464 feet are based on material that clearly has been exposed to high temperatures that have changed the structures of the wall material.

Partly the observed changes (partial cracking of wall material) are such as are linked with a short period of strong heating. Terrestrial remains seem to dominate and include cuticles and wood in variable proportions.

A-8603, 5470-500 feet; A-8635, 6430-460 feet; A-8649, 6880-910 feet:
The variably pyritic residues consist dominantly of amorphous material. Aggregates embed well preserved dinoflagellate cysts. Bacterial and fungal remains are observed in the matrix. Woody material and pollen are subordinate.
Colour index: 1, 1/1+.

A-8664, 7330-360 feet: The residue consists of strongly sapropelised material as granulate to flaky aggregates. Woody material probably is more important than it is in samples above.
Colour index: 1, 1/1+.

A-8679, 7780-810 feet: Strongly degraded woody material (vitrinite and semifusinite) dominates in this pyritic residue. The aggregates have granulate texture and show remains of fungi and bacteria.
Colour index: 1, 1/1+.

A-8694, 8230-260 feet; A-8709, 8680-710 feet: The residues contain dominantly woody material (vitrinite and semifusinite) together with cuticles, pollen and spores The material is strongly biodegraded and occurs as fluffy aggregates.
Colour index: 1, 1/1+.

A-8740, 9580-650 feet: The organic material is dominantly woody and resembles that of 8230/260 and 8680/710 feet above. But there are also abundant acid resistant minerals, partly as aggregates together with organic material.

The walls are very thin (etched). The preservation of pollen grains, seems controlled by the lithology. Some darker material present, probably has been derived from reworked older deposits.
Colour index: 1/1+, 1+/2-, 2-.

A-8803, 10500-510 feet: A strongly pyritic residue dominated by large sheets of material, probably thin cuticles. Abundant structured woody material (semifusinite) and Early Tertiary pollen.
Colour index: 2-.

A-8852, 10990-11000 feet: Well dispersed poorly preserved woody material (vitrinite, semifusinite). Sapropelised remains have a grey amorphous character compared with samples above. Some cuticles.
Colour index: 2-/2.

A-9078, 12490-500 feet: A very sparse residue, mostly consisting of acid resistant minerals. After screening remain darkly stained fairly well preserved cysts and opaque structured woody material.
Colour index: 2-/2.

A-9441, 14464 feet sidewall core; A-9275, 14470-80 feet; A-9442, 14502 feet swc; A-9280, 14520-30 feet; A-9287, 14620-30 feet; A-9327, 14990-15000 feet: Residues consist of dense nearly opaque organic aggregates. Small aggregates (translucent) contain strongly degraded material, apparently from terrestrial sources. The main input looks like sheets of poorly preserved material that were evaluated as cuticles. Wall material seems very thin with adhering granules. There are variable colours of pollen. Occasional woody particles have a more fresh appearance.
Colour index: 2+, 3-, 3/3+ (2-/2) (14464 feet swc TAI 2+).

A-9351, 15290-3000 feet; A-9385, 15590-600 feet: The residues resembled those above, but may have been more strongly sapropelised.
Colour index: 3-, 3/3+.

A-9425, 15990-16000 feet: The organic remains are poorly preserved and have more of grey amorphous character. The residue is rich in acid resistant minerals.
Colour index: ?2+, 3/3+.

CONCLUSIONS

Source rocks, richness, type and hydrocarbon potential

The Tertiary sequence which was analysed (4970'-11000') was subdivided into five zones based on colour variations of the claystones. Claystones in zone A (4570'-5500'), zone C (8710'-9160') and zone D (9580'-10300') have organic carbon contents between 1-2% in zones A and C and less than 1% in zone D. Kerogen is classified as type IV based on Rock-Eval pyrolysis, and the kerogens consist mostly of amorphous and woody material. The claystones in these zones have poor potential for dry gas. Zone B (5980'-8260') consists mostly of brown-grey claystones which have rich amounts of total organic carbon >(average 3.2%). The kerogen is classified as type III and consists mostly of woody material and cuticles. There appears to be a slight difference in both kerogen compositions (and petroleum potentials) above and below 7000', being dominantly amorphous pyritic residues above 7000' and more woody material below 7000'. The saturated hydrocarbon data indicates a dominant terrestrial input. The kerogen is fairly uniform. Throughout the section Rock-Eval petroleum potentials vary from 2-5 which with the above data indicates that the claystones have a fair - good potential as source rocks for wet gas and condensate.

Zone D (10390'-11000') This sequence consists of siltstones, sandstones and medium dark grey claystones. The last have TOC values from 1.5% at the top to 0.9% at the bottom of the zone. The kerogen type also varies from type III at the top to type IV at the bottom. Kerogens are composed of woody material (and pollen towards the top) with a major input of cuticular material. Rock-Eval petroleum potentials average approximately 1kg hc/ton rock. The data indicate that these claystones have a poor potential for wet gas.

The limestones from 11000' to 14450' of Tertiary and Cretaceous age (zone F) are virtually barren of organic matter and have no potential as source rocks.

The Kimmeridge Clay Formation sequence in this well 14454'-14853' is included in zone G (14450'-14920'). The zone is dominated by brownish-black and greyish-black shales, which are rich in total organic carbon (average 5.3%). Based on TOC contents a division of the zone was made

into two: 14450-14520' (with average TOC contents of 6.5%) and below 14520' (average TOC = 4.4%). Rock-Eval pyrolysis indicates that shales contain mostly type III kerogen, the lower part has lower hydrogen indices (generally) and could be classified as poorer type III kerogen. Kerogen compositions (visual analysis) appear as a mixture of terrestrial derived material, cuticles, pollen and wood. The maturity (see below) is past peak oil generation in these shales and the original kerogen type was probably type II (i.e. they had a good potential for oil).

The extract data indicate that the amounts of extractable organic matter are very high (7000ppm) and percentage of hydrocarbons is high (50-70%) and mainly of n-alkanes less than nC_{25}. The data suggest that the shales are at peak oil generation and will yield condensate or light oils. They have perhaps already expelled some hydrocarbons.

The whole shale sequence has a rich potential (particularly 14450'-14520') as a source for wet gas, condensate and light oil.

The bottom part of the Jurassic is represented by the Ula formation (14853'-14892') and below this are barren claystones and sandstones of Triassic age. The brown-black shales recorded below 14853' are presumably caved shales from the Kimmeridge Clay formation since they have similar kerogen type and potential.

Maturity

For the purposes of this discussion the analysed section can be divided into 4 sections:

a) Tertiary claystones 4970'-11000'.
b) Tertiary-Cretaceous limestones, 11000-14450'.
c) Jurassic claystones, 14450'-14853'.
d) Jurassic, Triassic and Permian sandstones, claystones and evaporites - below 14853'.

a) The Tertiary sequence, vitrinite reflectance changes from 0.3% at 7360' to 0.66% at 10800'. Rock-Eval T_{max} from 421 at 5050' to 436/438 at 11000'. Spore colouration indicates a change from 1 to 2-/2 over the same interval. Therefore maturity changes from immature to moderate mature - early mature between 9000-10500' and oil window mature between 10500-11000'.

b) Tertiary/Cretaceous limestone sequence is unfortunately almost barren of organic material and no good maturity measurements could be obtained.

c) and d)

Good maturity measurements could only be obtained for brown-black and grey-black shales in the Kimmeridge Clay Formation. The rest of the well consisted of mostly barren sandstones and claystones. Vitrinite reflectance values varied from 0.74% to 0.91% in the Kimmeridge Clay sequence from 14464'-14700'. Rock-Eval T_{max} values are very erratic throughout the section varying from 436-451 (average 443). Spore colouration indicates that maturity approaches condensate window in this section (equivalent to 1.0-1.3% Ro). The data indicate that the Kimmeridge sequence is within, or just past, peak oil generation (equivalent to a vitrinite reflectance range of 0.8-1.0%).

Measurement of aromatic ratios was performed on zone D and G samples. These ratios have been used by Radke in a number of papers (1982, 1982, 1983) as maturity parameters. Based on Radke's curve (1983) a vitrinite reflectance of roughly 0.7% was calculated for 10000' and 0.9% at 14500' which agrees fairly well with the measured vitrinite reflectance data.

The Kimmeridge sequence has been turbodrilled and it is known that maturity levels can be increased considerably by the high temperatures that can generated during turbodrilling. It is hard to judge the effect that turbodrilling has had, since there is nothing to compare with the turbodrilled material. However, the shales do not appear to be greatly altered (although see visual kerogen discussion) and data from sidewall cores (which should be less affected by turbodrilling) does not contradict data from the cuttings samples (in fact Rock-Eval T_{max} values of sidewall cores are higher!). However, the considerable variability in Rock-Eval T_{max} might indicate localised heating effects.

It is concluded that

a) The oil window is between 10500 (0.6% Ro) and 15000' (1.0% Ro).

b) Peak oil generation (0.8-0.9%) occurs between 12500'-14000'.

Conclusions on potential and maturity are shown in figure 6 (enclosure).

Migrated Hydrocarbons

There is a sharp increase in the Rock-Eval production indices at about 10000' from values generally less than 0.1 above 10000' to values above 0.2 between 10000 and 11000' mainly in the medium dark grey claystones of zone E. This is unlikely to be due only to the increase in maturity, since production indices increase considerably over a short range. In addition the value for extractable hydrocarbons normalised to organic carbon for one zone E claystone is high (60 mgs hc/g TOC) for a moderate mature type III kerogen. It is probable that the hydrocarbons in these claystones contain migrated hydrocarbons.

A dark grey silty claystone from 16000' also contains a very high proportion of hydrocarbons (in a narrow range mostly between nC_{10}-nC_{20}) in the soluble bitumen, for a poor organic carbon content, it is suggested that migrated hydrocarbons are present in this claystone.

Hydrocarbons in the Kimmeridge Clay Formation shales are dominated by n-alkanes between nC_{10}-nC_{25} however they can be considered to be indigenous to this sequence, and some expulsion of hydrocarbons has probably occurred from this sequence.

REFERENCES

RADKE, M., and WELTE, D.H., 1983: The methyl phenanthrene index (MPI): A maturity parameter based on aromatic hydrocarbons. Paper presented at 1981 Advances in Organic Geochemistry, Bergen (Editor M. Bjorøy), p.504-512.

RADKE, M., WELTE, D.H. and WILLSCH, H., 1982: Geochemical study on a well in the Western Canada Basin: relation of the aromatic distribution pattern to maturity of organic matter. Geochim. Cosmochim. Acta. Vol.46, p.1-10.

RADKE, M., WILLSCH, H., LEYTHAUSER, D. and TEICHMULLER, M., 1982: Aromatic components of coal: relation of distribution pattern to rank. Geochim. Cosmochim. Acta. Vol.46, p-1831-1848.

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology	
A-8939	4570-4600		95%	Casing cement, white, abundant minute black specks
			5%	Claystone, light olive grey, silty, slightly micromicaceous, containing scattered plant fragments, non-calcareous
			Sm.am.	Steel shavings from drill bit
A-8954	5020-5050	B 1.21	100%	Claystone, light olive grey - olive grey, silty, micromicaceous, containing scattered plant fragments, non-calcareous
			Sm.am.	Consolidated drilling dust, light brown
A-8603	5470-5500	B 1.85	100%	Claystone, light olive grey - olive grey, as above
			Sm.am.	As above
A-8620	5980-6010	B 2.30	100%	Claystone, brownish grey, silty, micromicaceous, containing scattered minute plant fragments, non-calcareous
			Sm.am.	Consolidated drilling dust, brownish grey
A-8635	6430-6460	B 2.19	95%	Claystone, as above
			5%	Consolidated drilling dust, brownish grey
A-8649	6880-6910	B 3.32	95%	Claystone, brownish grey - dusky yellowish brown, silty, micromicaceous, non-calcareous, partly subfissile
			5%	Consolidated drilling dust, brownish grey

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-8664	7330-7360	B 3.83	90% Claystone, brownish grey - dusky brown, silty, micromicaceous, containing scattered plant fragments, occasionally white very fine, spots (?biogenic), non-calcareous
			7% Claystone, light olive grey, slightly micaceous
			3% Siderite, dusky brown
A-8679	7780-7810	B 3.54	95% Claystone, brownish grey - dusky brown, silty, micromicaceous, micropyritic in parts, containing scattered plant fragments, occasionally white very fine spots (?biogenic), non-calcareous, very thinly laminated in parts
			5% Siderite, dusky brown - dusky yellowish brown, waxy, occasionally microsucrosic
A-8694	8230-8260	B 2.74	92% Claystone, brownish grey - dusky brown, silty
			8% Limestone/Siderite, dusky brown
A-8709	8680-8710	1.21	50% Claystone, olive grey - light olive grey, slightly micromicaceous, partly micropyritic, non-calcareous
		4.18	45% Claystone, brownish grey - dusky brown, as above
			5% Limestone/Dolomite, off-white
A-8724	9130-9160	1.12	70% Claystone, olive grey - light olive grey, as above
			25% Claystone, brownish grey - dusky brown, as above
			5% Limestone/Dolomite, off-white

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-8740	9580-9610	2.63	50% Claystone, brownish grey - dusky brown, as above
		2.82	40% Claystone, light grey, slightly greenish in parts, slightly micromicaceous, non-calcareous
			10% Claystone, olive grey - light olive grey
A-8758	10050-10060	0.46	70% Claystone, varicoloured, light grey, slightly greenish, olive grey, light brownish grey, dark grey laminae is observed, slightly micromicaceous, trace micropyrite, non-calcareous
			30% Claystone, brownish grey - dusky brown, as above, ?caved
			Sm.am. Siderite
A-8762	10090-10100	0.68	95% Claystone, varicoloured, some off-white, partly pyritic claystone fragments are observed, else as above
			5% Claystone, brownish grey - dusky brown, as above, ?caved
A-8772	10190-10200	0.54	80% Claystone, varicoloured, as above
			15% Claystone, brownish grey - dusky brown, as above, ?caved
			5% Claystone, very dusky red
			Sm.am. *Limestone/Dolomite/Siderite*
A-8782	10290-10300	0.39	75% Claystone, varicoloured, as above
		3.64	15% Claystone, brownish grey (dusky brown), as above
			5% Claystone, very dusky red, as above
			5% Limestone, white - brownish grey
			Sm.am. Pyrite

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-8792	10390-10400		60% Casing cement, white, light brown, with abundant minute black specs
		1.31	40% Claystone, medium dark grey, micromicaceous, non-calcareous, thinly laminated in parts
			Sm.am. Claystone, greenish grey
A-8803	10500-10510	1.52	50% Claystone, medium dark grey, as above
			50% Sand/Sandstone, very fine to coarse, poorly sorted, mainly Quartz, vitreous, subangular to subrounded, partly with light brown staining
A-8812	10590-10600	1.07	65% Claystone, medium dark grey, as above
			35% Siltstone/Sandstone, grains (very fine) in white - light brown cement, ?Kaolinite, slightly glauconitic, partly argillaceous, non-calcareous
A-8822	10690-10700	1.04	40% Claystone, medium dark grey, as above
		0.42	30% Claystone, light greenish grey - greenish grey, waxy, slightly micromicaceous, non-calcareous
			30% Sandstone/Siltstone, as above
			Sm.am. Limestone, white, light brown
A-8832	10790-10800	0.98	40% Claystone, medium dark grey, as above
			40% Sandstone (Siltstone), as above
			20% Claystone, light greenish grey, etc., as above

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-8842	10890-10900		40% Sandstone (Siltstone), as above
		0.96	35% Claystone, medium dark grey, some dark grey fragments, else as above
		0.34	25% Claystone, light greenish grey - greenish grey, as above
A-8852	10990-11000		30% Sandstone, very fine - fine, subangular to subrounded, glassy grains, light brown-white cement, partly calcite cemented, trace glauconite, partly argillaceous, some coarse grained sand is observed
		0.20	25% Limestone, white - off-white, chalky in parts, containing fossil fragments
		0.90	25% Claystone, medium dark grey - dark grey, as above
			20% Claystone, light greenish grey, greenish grey, as above
A-8862	11090-11100	0.27	70% Limestone/Marl, off-white - light grey - grey, occasionally chalky
			20% Claystone, medium dark grey - dark grey, as above, caved
			10% Claystone, greenish grey - light greenish grey, as above, caved
A-8872	11190-11200	0.09	80% Limestone, white, chalky, containing fossil fragments
			10% Limestone/Marl, light grey - grey, as above
			10% Claystone, medium dark grey - dark grey, as above, caved

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-8933	11290-11300	0.17	85% Limestone, white, as above 5% Limestone/Marl, light grey - grey, as above 5% Claystone, as above, caved 5% Sandstone, very fine - fine, glassy, white, mainly Quartz, calcite cemented
A-8968	11390-11400	B 0.10	100% Limestone, white, as above Sm.am. Limestone/Marl, as above; Claystone, as above
A-9878	11490-11500		60% Casing cement, white - light brown, abundant minute black specks 40% Limestone, white, as above
A-8988	11590-11600	0.14	100% Limestone, white - off-white, fossiliferous micrite Sm.am. Claystone, dark grey, caved
A-8998	11690-11700		100% Limestone, as above Sm.am. As above
A-9008	11790-11800	0.12	100% Limestone, as above Sm.am. As above
A-9018	11890-11900		100% Limestone, as above Sm.am. As above
A-9028	11990-12000	0.12	100% Limestone, as above Sm.am. As above
A-9038	12090-12100		100% Limestone, as above Sm.am. As above

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-9048	12190-12200	0.13	100% Limestone, as above Sm.am. As above
A-9058	12290-12300		100% Limestone, as above Sm.am. As above
A-9068	12390-12400	0.19	100% Limestone, as above Sm.am. As above
A-9078	12490-12500		100% Limestone, off-white - pinkish grey, else as above Sm.am. As above
A-9088	12590-12600	0.13	100% Limestone, off-white - pinkish grey, fissile, else as above
A-9108	12790-12800		100% Limestone, pale red - greyish red, fragments affected by turbodrilling, else as above Sm.am. Claystone (caved); Coal, (trace)
A-9118	12890-12900	0.15	100% Limestone, off-white, occasionally grey, fossiliferous micrite Sm.am. Coal (trace); Pyrite (trace)
A-9128	12990-13000		100% Limestone, off-white, occasionally grey, as above Sm.am. Coal (trace); Pyrite (trace)
A-9138	13090-13100	0.10	100% Limestone, as above Sm.am. Coal (trace)
A-9148	13190-13200		100% Limestone, as above Sm.am. Coal; Pyrite (trace)

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-9158	13290-133300	0.23	100% Limestone, as above Sm.am. Coal (trace); Pyrite (trace); Marl (medium dark grey)
A-9168	13390-13400		100% Limestone, as above Sm.am. Coal; Pyrite (trace); Marl (as above)
A-9178	13490-13500	0.10	100% Limestone, off-white - pale brown, partly argillaceous, containing silica grains and glauconite
A-9188	13590-13600		100% Limestone, off white - pale brown, as above Sm.am. Coal (abundant)
A-9198	13690-13700	0.17	100% Limestone, off white - light grey, occasionally pale brown, mainly fossiliferous micrite, grainy and glauconitic in parts, occasionally argillaceous Sm.am. Coal; Marl (medium dark grey)
A-9208	13790-13800		100% Limestone, off white - light brownish grey, fossiliferous micrite Sm.am. Coal (trace); Marl (medium dark grey)
A-9218	13890-13900	0.23	100% Limestone, light brownish grey, mainly fossiliferous, micrite Sm.am. Marl (medium dark grey)
A-9227	13990-14000		100% Limestone, light brownish grey, as above
A-9237	14090-14100	0.56	100% Limestone, as above, fragments affected by tubodrilling

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-9247	14190-14200	0.29	90% Marl, grey, fragments affected by turbodrilling 10% Limestone, as above
A-9257	14290-14300	B 0.54	95% Marl/Limestone, fragments deformed by turbodrilling, off-white - medium grey 5% Claystone, dark grey, pale reddish brown Sm.am. Coal (affected by turbodrilling); Sandstone (very fine, glauconitic)
A-9267	14390-14400		70% Limestone, off-white - light greyish brown, partly affected by turbodrilling 25% Marl, grey, partly affected by turbodrilling 5% Claystone, dark grey, pale reddish brown Sm.am. Coal
A-9273	14450-14460	6.58	80% Shale, brownish black, greyish black, fissile, trace micropyrite, slightly micromicaceous, calcareous, carbonaceous, fragments affected by turbodrilling, strongly deformed fragments react as marl with 10% HCl (?contaminated by drilling mud)
		0.22	15% Claystone, grey (medium dark grey), waxy, micropyritic, very calcareous 5% Limestone, white - off-white

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-9275	14470-14480	5.26	50% Shale, brownish black - greyish black, as above, fragments affected by turbodrilling, as above
		0.25	50% Claystone, grey (medium dark grey), waxy, micropyritic in parts, calcareous
			Sm.am. Claystone, (dark reddish brown); Claystone (dark greenish grey, very pyritic); Limestone (white)
A-9277	14490-14500	B 6.72	95% Shale, brownish black - greyish black, slightly silty, fissile, slightly micropyritic, trace micromica, carbonaceous, slightly calcarous, fragments more or less deformed by turbodrilling, strongly deformed fragments react as marl (?contaminated by drilling mud)
			5% Claystone, grey (medium dark grey), as above
			Sm.am. Limestone (white)
A-9278	14500-14510	B 6.83	95% Shale, less calcareous, else as above
			5% Claystone, as above
			Sm.am. Limestone, (white)
A-9279	14510-14520	B 7.22	100% Shale, greyish black - brownish black, fragments affected by turbodrilling, as above
			Sm.am. Claystone, grey (medium dark grey) as above; Limestone (white)
A-9280	14520-14530	B 3.98	100% Shale, partly affected by turbodrilling, else as above
			Sm.am. As above

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-9287	14590-14600	7.68	75% Shale, brownish black - greyish black, slightly silty, slightly micromicaceous, slightly micropyritic, carbonaceous, non-calcareous
		3.98	25% Fragments affected by turbodrilling, brownish black, deformed, calcareous, caved
			Sm.am. Claystone, as above/Limestone (white)
A-9297	14690-14700	B 3.85	80% Shale, as above
			15% Fragments affected by turbodrilling, as above
			Sm.am. Limestone (white); Claystone, as above
A-9307	14790-14800	3.83	70% Shale, as above
			30% Fragments affected by turbodrilling, very calcareous, as above
			Sm.am. Limestone (white); Claystone, as above
A-9317	14890-14900	2.89	90% Shale, brownish black, greyish black, as above
			5% Limestone, white - medium grey, argillaceous and sandy in parts
			3% Sandstone, white, glassy, very fine - fine, moderately sorted, calcite cement is observed
			2% Claystone, grey (medium dark grey), as above (?caved)

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC		Lithology
				The interval from 14923'-15152' is cored. Due to this A-9327 and A-9337 consist mainly of caved material.
A-9327	14990-15000	B 3.13	90%	Shale, brownish black - greyish black, as above
			7%	Claystone, grey (medium dark grey), as above (?caved)
			3%	Limestone, as above
			Sm.am.	Additives (fibrous fragments)
A-9337	15090-15100	4.05	70%	Shale, brownish black - greyish black, as above
			10%	Sand/Sandstone, white, glassy, mainly quartz, very fine - fine (medium), moderately sorted, subangular - angular, loose
			10%	Claystone, grey (medium dark grey) as above (?caved)
			5%	Claystone, greenish grey, micaceous
			5%	Limestone, as above
A-9347	15190-15200		50%	Additives, nut shells, dark yellowish brown
			20%	Sandstone, white, medium grey, greenish grey, glassy, mainly Quartz, very fine - medium (coarse), moderately sorted, subangular - subrounded, micaceous, partly glauconitic, dolomite cemented
		3.18	15%	Shale, brownish black, as above, ?caved
			10%	Dolostone, medium grey, slightly greenish, contain silt, occasionally glauconitic
			5%	Claystone, grey - medium dark grey, as above, caved
			Sm.am.	Mica (abundant, ?additive)

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-9357	15290-15300		70% Sand/Sandstone, as above
		4.10	25% Shale, brownish black - greyish black, ?caved
			5% Claystone, dark reddish brown, silty, micaceous, slightly micropyritic, non-calcareous
			Sm.am. Limestone (white, off-white, medium grey), (abundant)
A-9367	15390-15400	0.10	70% Sandstone, white, clear, glassy, mainly Quartz, fine - medium (coarse), moderately sorted, subangular - subrounded (rounded), micaceous, dolomite cemented, some reddish orange grains occurs
		3.91	25% Shale, brownish black - greyish black, ?caved
			5% Limestone, white - light grey
A-9377	15490-15500		70% Sandstone, occasionally greenish grey, else as above
			25% Shale, brownish black - greyish black, ?caved
			3% Claystone, dark reddish brown, silty, micaceous, slightly micropyritic, non-calcareous
			2% Claystone, greenish grey, micaceous
			Sm.am. Limestone, white - light grey (abundant)

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC		Lithology
A-9385	15590-15600	3.08	40%	Shale, brownish black - greyish black, ?caved
		0.11	35%	Sandstone, greyish red - greyish brown, glassy, very fine - fine, grading to sandy siltstone, slightly micromicaceous, dolomite/?calcite cemented
			10%	Sandstone, white etc., as above
			5%	Claystone, grey, micropyritic, caved
			4%	Claystone, greyish red - greyish brown, slightly micaceous, non-calcareous
			3%	Marl, greyish red with white mottles
			3%	Limestone, white - light grey
A-9395	15690-15700		75%	Sand/Sandstone, white, clear, glassy with some reddish orange and greyish green grains, mainly Quartz, fine - medium, subangular - subrounded, micaceous, dolomite cemented in parts
		3.51	20%	Shale, brownish black - greyish black, as above, caved
			5%	Limestone, white - light grey
			Sm.am.	Claystone (greyish brown) claystone (grey, pyritic); Claystone (greenish grey); Marl (greyish red with white mottles

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-9405	15790-15800		70% Sandstone, pale reddish brown, glassy, fine - medium, mainly subangular Quartz grains, slightly micromicaceous, calcareous in parts
			15% Sandstone, white, clear etc., as above
			15% Shale, brownish black - greyish black, caved
			Sm.am. Limestone (white - light grey), Claystone (greyish brown)
A-9415	15890-15900		40% Sandstone, pale reddish brown, as above
		0.12	30% Claystone, greyish brown, silty in parts, micromicaceous, non-calcareous
		0.15	15% Claystone, dark greenish grey, micaceous
			15% Shale, brownish black - greyish black, ?caved
			Sm.am. Limestone (white - light grey)
A-9425	15990-16000	4.37	30% Shale, brownish black - greyish black, as above, ?caved
		0.07	30% Claystone, greyish brown, silty in parts, as above
		0.46	30% Claystone, dark grey, very silty, sandy (very fine), shiny, very micromicaceous, slightly micropyritic, carbonaceous, non-calcareous
			4% Claystone, dark greenish grey, as above
			3% Sandstone, pale reddish brown, white, as above
			3% Limestone, white - light grey

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-9434	16090-16100	3.76	40% Shale, brownish black - greyish black, as above, ?caved
		0.28	35% Claystone, light grey, disintegrates in 10% HCl
			10% Limestone, white - light grey
			5% Claystone, dark grey, shiny, as above
			5% Sandstone, white, as above
			5% Claystone, greyish brown, as above
			Sm.am. Claystone, dark greenish grey

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
			SIDEWALL CORES
A-9441	14464	8.32	Claystone/Shale, greyish black - brownish black, slightly silty, slightly micro-micaceous, slightly micropyritic, carbon-aceous, slightly calcareous
A-9442	14502	8.40	Claystone/Shale, very slightly to non-calcareous, else as above
A-9443	14516	5.91	Claystone/Shale, as above
A-9444	15248		Claystone, medium grey, mud contaminated
A-9445	15681.8		Sandstone, white light grey - brown, with mud laminae, very soft
A-9446	15710.8		Sand/Sandstone, fine - medium grained light grey - brown, calcareous, soft, clayey matrix
A-9447	15867.8		Sand/Sandstone, as above
A-9448	15911.8		Sand/Sandstone, as above, slightly red-brown
A-9449	15951.8		Sand/Sandstone, red-brown, clayey
A-9450	15957.8		Sandstone, pale grey, green, fine - medium grained, micaceous, dolomite, cal-careous, some clay fragments

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
			CORES
A-9451	14940		Sandstone, medium grey - brownish grey, very fine - medium, subangular - sub-rounded, moderately sorted, micaceous, argillaceous, calcareous in parts, with some scattered organic fragments, hard, dense
A-9452	14946		Sandstone, very fine - fine (medium), else as above
A-9453	14949		Sandstone, as above
A-9454	14970		Sandstone, pyritic in parts, else as above
A-9455	14985		Sandstone, light brownish grey, interlaminated with a dark grey Sandstone (probably staining), mainly Quartz, very fine to very coarse, subangular - rounded, poorly sorted, micaceous, argillaceous, trace pyrite
A-9456	14986	0.18	Claystone, greenish grey, hard, blocky, compact, micromicaceous, abundant pyrite nodules, non-calcareous
A-9457	14992	0.08	Claystone, silty, slightly pyritic, else as above
A-9458	14997		Siltstone, greenish grey, argillaceous, hard, compact, blocky, shiny, very micro-micaceous, non-calcareous

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-9459	15002		Sandstone, greenish grey, very fine, argillaceous, hard compact, blocky, shiny, very micromicaceous,
A-9460	15006		Sandstone, light grey, slightly greenish, mainly quartz, fine - medium, subangular to subrounded, moderately sorted, argillaceous, very micaceous, slightly calcareous non-calcareous
A-9461	15000		Sandstone, white, glassy, with scattered green grains, less argillaceous, else as above
A-9462	15011	0.28	Claystone, dark grey, slightly brownish, very silty, occasionally sandy (very fine), hard, compact, blocky, micromicaceous, slightly carbonaceous, slightly calcareous, some inclusions of the above Sandstone is observed, ?burrows
A-9463	15031	0.17	Claystone, greenish grey, silty, occasionally, sandy (very fine), hard, blocky, compact, shiny, very micromicaceous, non-calcareous
A-9464	15041		Claystone, greenish grey, as above
A-9465	15052	0.19	Claystone, greenish grey, slightly silty, slickensides, else as above

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-9466	15054		Claystone, dark greenish grey, very silty, occasionally sandy (very fine), hard, blocky, compact, micromicaceous, non-calcareous
A-9467	15058	0.17	Claystone, dark greenish grey, with slickensides, else as above
A-9468	15065		Siltstone, sandy, clayey, dark greenish grey, else as above
A-9469	15072		Siltstone, dark greenish grey, slickensides is not observed, as above
A-9470	15077		Sandstone, greenish grey, fine - medium laminated, moderately sorted, argillaceous, micaceous, very silica cemented, hard, blocky, dense, non-calcareous
A-9471	15081	0.16	Claystone, greenish grey, silty, sandy (very fine), hard, blocky, compact, micromicaceous, non-calcareous
A-9472	15084		Sandstone, light greenish grey, fine - medium, subangular - subrounded, mainly Quartz, moderately sorted, micromicaceous, hard, dense
A-9473	15094	0.42	Claystone, dark grey - dark greenish, grey, silty, slightly sandy (very fine), micromicaceous, non-calcareous, hard, blocky, compact, slickensided

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 7/11-7

Sample	Depth (ft)	TOC	Lithology
A-9474	15099	0.04	Claystone, as above
A-9475	15142	0.16	Claystone, dark brownish red, micromicaceous, hard, blocky, dense

TABLE 2.

R O C K E V A L P Y R O L Y S E S

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	S1+S2	PROD. INDEX S1/(S1+S2)	TEMP. MAX (C)
A 8954	5050	0.08	0.50	1.28	1.21	41	106	0.58	0.14	421
		Clst lt -olv - gy								
A 8603	5500	0.17	2.00	1.77	1.85	108	96	2.17	0.08	434
		Clst brn - gy								
A 8635	6460	0.14	2.63	1.98	2.19	120	90	2.77	0.05	425
		Clst brn - gy								
A 8649	6910	0.16	4.01	1.89	3.32	121	57	4.17	0.04	428
		Clst brn - gy -Yellowish brn								
A 8664	7360	0.19	4.40	1.67	3.83	115	44	4.59	0.04	428
		Clst brn - gy -brn								
A 8679	7810	0.19	4.09	1.82	3.54	116	51	4.28	0.04	434
		Clst brn - gy -brn								
A 8694	8260	0.15	2.93	1.47	2.74	107	54	3.08	0.05	429
		Clst brn - gy -brn								
A 8709	8710	0.28	5.07	1.41	4.18	121	34	5.35	0.05	426
		Clst brn - gy								
A 8709	8710	0.10	0.73	0.81	1.21	60	67	0.83	0.12	428
		Clst olv - gy								
A 8724	9160	0.11	0.79	0.59	1.12	71	53	0.90	0.12	429
		Clst olv - gy								
A 8740	9610	0.18	3.36	0.86	2.63	128	33	3.54	0.05	435
		Clst brn - gy -brn								
A 8758	10060	0.13	0.14	0.55	0.46	30	120	0.27	0.48	425
		Clst varicoloured								
A 8772	10200	0.09	0.29	0.63	0.54	54	117	0.38	0.24	426
		Clst varicoloured								
A 8803	10510	0.61	1.74	0.62	1.52	114	41	2.35	0.26	433
		Clst med.dk gy								
A 8812	10600	0.24	0.98	0.49	1.07	92	46	1.22	0.20	436
		Clst med.dk gy								
A 8822	10700	0.22	0.68	0.32	1.04	65	31	0.90	0.24	437
		Clst med.dk gy								
A 8832	10800	0.17	0.48	0.27	0.98	49	28	0.65	0.26	437
		Clst med.dk gy								
A 8842	10900	0.22	0.45	0.40	0.96	47	42	0.67	0.33	438
		Clst med.dk gy								
A 8852	11000	0.14	0.36	0.20	0.90	40	22	0.50	0.28	436
		Clst med.dk gy								
A 9198	13700	0.05	0.00	0.62	0.17	0	365	0.05	1.00	200
		Ls								
A 9218	13900	0.11	0.00	0.61	0.23	0	265	0.11	1.00	318
		Ls								
A 9273	14460	3.85	6.69	1.20	6.58	102	18	10.54	0.37	436
		Sh brn - bl								
A 9441	14464 SWC	4.62	15.21	0.81	8.32	183	10	19.83	0.23	450

DATE : 25 - 10 - 83.

TABLE 2.

R O C K E V A L P Y R O L Y S E S

IKU No.	DEPTH m/ft		S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	S1+S2	PROD. INDEX S1/(S1+S2)	TEMP. MAX (C)
A 9275	14480		0.19	0.06	0.48	0.25	24	192	0.25	0.76	399
			Clst	gy - dk - gy							
A 9275	14480		3.38	6.38	1.01	5.62	114	18	9.76	0.35	437
			Sh	brn - bl							
A 9277	14500		2.54	5.51	1.41	6.72	82	21	8.05	0.32	443
			Sh	brn - bl - gy							
A 9442	14502		3.70	11.71	0.75	8.40	139	9	15.41	0.24	450
			SWC								
A 9278	14510		2.76	5.09	1.51	6.83	75	22	7.85	0.35	438
			Sh	brn - bl - gy							
A 9443	14516		2.87	5.79	0.81	5.91	98	14	8.66	0.33	442
			SWC								
A 9279	14520		2.94	6.05	1.39	7.22	84	19	8.99	0.33	436
			Sh	gy - bl							
A 9280	14530		3.73	7.88	1.05	3.98	198	26	11.61	0.32	438
			Sh	gy - bl							
A 9287	14630		2.73	5.13	0.78	7.68	67	10	7.86	0.35	451
			Sh	brn - bl - gy							
A 9297	14700		2.31	2.92	1.48	3.85	76	38	5.23	0.44	444
			Sh	brn - bl - gy							
A 9307	14800		1.73	2.39	1.17	3.83	62	31	4.12	0.42	444
			Sh	brn - bl - gy							
A 9317	14900		2.20	2.61	1.42	2.89	90	49	4.81	0.46	447
			Sh	brn - bl - gy							
A 9327	15000		3.07	4.72	1.33	3.13	151	42	7.79	0.39	447
			Sh	brn - bl - gy							
A 9337	15100		2.20	3.12	1.23	4.05	77	30	5.32	0.41	443
			Sh	brn - bl - gy							
A 9385	15600		2.01	2.54	1.27	3.08	82	41	4.55	0.44	440
			Sh	brn - bl							
A 9415	15900		0.12	0.00	0.58	0.15	0	387	0.12	1.00	200
			Clst	gy -brn							
A 9415	15900		0.25	0.00	0.86	0.12	0	717	0.25	1.00	200
			Clst	dk - gn - gy							
A 9425	16000		0.25	0.00	0.40	0.46	0	87	0.25	1.00	200
			Clst	gy -brn							
A 9425	16000		2.57	4.25	1.18	4.37	97	27	6.82	0.38	447
			Clst	dk - gy							
A 9434	16100		2.33	3.53	1.47	3.76	94	39	5.86	0.40	446
			Sh	brn - bl - gy							

DATE : 16 - 11 - 83.

T A B L E : 3.

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKU-No	DEPTH (m)	Rock Extr. (g)	EOM (mg)	Sat. (mg)	Aro. (mg)	HC (mg)	Non HC (mg)	TOC (%)
A 8649	6910	31.9	28.3	5.3	4.9	10.2	18.1	3.32
A 8679	7810	16.3	23.9	3.0	3.4	6.4	17.5	3.54
A 8724	9160	50.1	37.3	10.6	8.8	19.4	17.9	1.58
A 8812	10600	50.1	98.7	19.3	17.9	37.2	61.5	1.23
A 9273	14460	50.0	341.5	125.5	71.7	197.2	144.3	5.08
A 9442 SWC	14502	15.8	136.4	26.2	16.9	43.1	93.3	8.40
A 9280	14530	50.0	487.5	167.1	95.1	262.2	225.3	7.73
A 9297	14700	50.2	234.4	124.7	51.5	176.2	58.2	4.01
A 9317	14900	50.0	263.3	113.6	40.8	154.4	108.9	2.96
A 9425	16000	40.0	20.3	8.4	2.4	10.8	9.5	0.62

DATE : 30 - 10 - 83.

T A B L E : 4.

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm OF rock)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
A 8649	6910	888	166	154	320	568
A 8679	7810	1468	184	209	393	1075
A 8724	9160	744	212	176	387	357
A 8812	10600	1971	386	357	743	1228
A 9273	14460	6823	2507	1433	3940	2883
A 9442	14502'	8611	1654	1067	2721	5890
A 9280	14530	9746	3341	1901	5242	4504
A 9297	14700	4670	2485	1026	3511	1160
A 9317	14900	5268	2273	816	3089	2179
A 9425	16000'	507	210	60	270	237

DATE : 30 - 10 - 83.

T A B L E : 5.

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
A 8649	6910	26.8	5.0	4.6	9.6	17.1
A 8679	7810	41.5	5.2	5.9	11.1	30.4
A 8724	9160	47.1	13.4	11.1	24.5	22.6
A 8812	10600	160.3	31.4	29.1	60.4	99.8
A 9273	14460	134.3	49.4	28.2	77.6	56.8
A 9442	14502	102.5	19.7	12.7	32.4	70.1
A 9280	14530	126.1	43.2	24.6	67.8	58.3
A 9297	14700	116.5	62.0	25.6	87.5	28.9
A 9317	14900	178.0	76.8	27.6	104.4	73.6
A 9425	16000	81.8	33.9	9.7	43.5	38.3

DATE : 30 - 10 - 83.

TABLE : 6.

COMPOSITION IN % OF MATERIAL EXTRACTED FROM THE ROCK

IKU-No	DEPTH (m)	Sat / EOM	Aro / EOM	HC / EOM	SAT / Aro	Non HC / EOM	HC / Non HC
A 8649	6910	18.7	17.3	36.0	108.2	64.0	56.4
A 8679	7810	12.6	14.2	26.8	88.2	73.2	36.6
A 8724	9160	28.4	23.6	52.0	120.5	48.0	108.4
A 8812	10600	19.6	18.1	37.7	107.9	62.3	60.5
A 9273	14460	36.7	21.0	57.7	175.0	42.3	136.7
A 9442	14502	19.2	12.4	31.6	155.0	68.4	46.2
A 9280	14530	34.3	19.5	53.8	175.7	46.2	116.4
A 9297	14700	53.2	22.0	75.2	242.1	24.8	302.7
A 9317	14900	43.1	15.5	58.6	278.4	41.4	141.8
A 9425	16000	41.4	11.8	53.2	350.0	46.8	113.7

DATE : 30 - 10 - 83.

T A B L E 7.

TABULATION OF DATA FROM THE GASCHROMATOGRAMS

IKU No.	DEPTH (m)	PRISTANE / n-C17	PRISTANE / PHYTANE	CPI
A 8649	6910	4.9	2.8	2.1
A 8679	7810	6.1	4.1	2.2
A 8724	9160	2.0	4.7	1.2
A 8812	10600	0.8	2.4	1.2
A 9273	14460	0.2	1.4	0.9
A 9442 SWC	14502	0.2	1.5	1.0
A 9280	14530	0.1	1.1	1.0
A 9297	14700	0.3	1.4	1.0
A 9317	14900	0.4	1.4	1.0
A 9425	16000	0.3	1.6	1.0

DATE : 1 - 11 - 83.

Table 8: Aromatic Hydrocarbon Ratios

IKU Code	Depth	MNR	DMNR	MPI 1	%Ro (approx.)
A-8812	10600'	1.57	3.12	0.66	0.7%
A-9273	14460'	1.61	3.34	0.84	0.9%
A-9280	14530'	1.43	4.03	0.96	1.0%
A-9317	14900'	1.65	3.36	0.85	0.9%

KEY

MNR = 2/1-methylnapthalene ratio

$$\text{DMNR} = \frac{2,6+2,7}{1,5}\text{ -dimethylnaphthalene ratio}$$

$$\text{MPI 1} = \frac{1.5 \times (3MP + 2MP)}{P + 9MP + 1MP}$$

P = Phenanthrene
MP = Methylphenanthrene

%Ro = Calculated reflectance value based on curve from the paper of Radke et al. (1983).

IKU

T A B L E 9.

TABULATION OF MATURITY DATA

IKU No.	DEPTH (m/ft)	VITRINITE REFLECTANCE Ro(%) and Counts	MATURATION INDEX (TAI)	FLUOR-ESCENCE
A 8954	5050	0.28(1)	N.A.	1
		Clst —		
A 8603	5500	N.D.P.	1 1/1+	1
		Clst —		
A 8635	6460	0.28(5)	1 1/1+	1
		Clst —		
A 8649	6910	0.29(10)	1 1/1+	1/2
		Clst —		
A 8664	7360	0.30(11)	1 1/1+	1/2
		Clst —		
A 8679	7810	0.36(6)	1/1+	1/2
		Clst —		
A 8694	8260	0.35(12)	1/1+	2/4
		Clst —		
A 8709	8710	0.45(2) 0.55(2)	1/1+	2/4
		Clst —		
A 8724	9160	0.46(5)	N.A.	2/4
		Clst —		
A 8740	9610	0.40(7) 0.58(6)	1/1+ 1+/2-	2/5
		Clst —	2-	
A 8762	10100	0.45(4) 0.64(2)	N.A.	4/5
		Clst —		
A 8772	10200	0.42(2) 0.58(4)	N.A.	2
		Clst —		
A 8782	10300	0.61(5)	N.A.	3/4
		Clst —		
A 8792	10400	0.45(5) 0.61(2)	N.A.	5
		Clst —		
A 8803	10510	0.61(9)	2-	1/5
		Clst —		
A 8812	10600	0.63(15)	N.A.	5/6
		Clst —		
A 8832	10800	0.66(22)	N.A.	6
		Clst —		
A 8852	11000	N.A.	2-/2	
		Limst. —		
A 8862	11100	0.71(5)	N.A.	
		Limst. —		
A 8962	11400	N.D.P.	N.A.	
		Limst. —		
A 8980	11600	N.D.P.	N.A.	
		Limst. —		
A 9008	11800	N.D.P.	N.A.	
		Limst. —		
A 9048	12200	N.D.P.	N.A.	
		Limst. —		

DATE : 14 - 11 - 83.

IKU

T A B L E 9.

TABULATION OF MATURITY DATA

IKU No.	DEPTH (m/ft)	VITRINITE REFLECTANCE Ro(%) and Counts	MATURATION INDEX (TAI)	FLUOR-ESCENCE
A 9068	12400	N.D.P.	N.A.	
		Limst –		
A 9078	12500	N.A.	2-/2	
		Limest. –		
A 9088	12600	N.D.P.	N.A.	
		Limest. –		
A 9118	12900	0.83(3)	N.A.	
		Limest. –		
A 9158	13300	N.D.P.	N.A.	
		Limst. –		
A 9178	13500	N.D.P.	N.A.	
		Limest. –		
A 9188	13600	N.D.P.	N.A.	
		Limest. –		
A 9198	13700	N.D.P.	N.A.	
		Limest./Clst –		
A 9237	14100	N.D.P.	N.A.	
		Limest. –		
A 9257	14300	N.D.P.	N.A.	5
		Limest/Clst –		
A 9273	14460	N.D.P.	N.A.	6
		Clst/SL –		
A 9441	14464	0.74(15)	2+ 3/3+	6/7
		Clst/SL :SWC –		
A 9275	14480	0.75(1)	2 3-	6/7
		Clst/SL –	3/3+	
A 9277	14500	0.86(5)	N.A.	6/7
		Clst/SL –		
A 9442	14502	N.A.	3- 3/3+	
		SWC –		
A 9443	14516	0.77(20)	N.A.	7
		Shale:SWC –		
A 9280	14530	N.A.	3- 3/3+	
		Shale –		
A 9287	14630	N.A.	3- 3/3+	
		Shale –		
A 9297	14700	0.82(3) 1.00(3)	N.A.	7
		Clst/SL –		
A 9307	14800	0.56(6) 0.72(1) 1.01(2)	N.A.	7
		Clst/SL –		
A 9327	15000	0.80(9) 0.96(1) 1.18(1)	3- 3/3+	7/8
		Clst/SL –		
A 9462	15011	N.D.P.	N.A.	7
		Sst:CORE –		
A 9473	15094	N.D.P.	N.A.	
		Clst:CORE –		

DATE : 14 - 11 - 83.

IKU

T A B L E 9.

TABULATION OF MATURITY DATA

IKU No.	DEPTH (m/ft)	VITRINITE REFLECTANCE Ro(%) and Counts	MATURATION INDEX (TAI)	FLUOR-ESCENCE
A 9357	15300	0.76(1) 1.02(6) Sst/SL –	3- 3/3+	7
A 9385	15600	0.79(2) 0.95(3) 1.21(3) Sst/Clst –	?2+ 3/3+	6/7
A 9405	15800	N.D.P. Sst/Clst –	N.A.	7
A 9425	16000	0.73(2) 0.95(3) 1.21(3) Sst/Clst –	?2+ 3/3+	6/7
A 9434	16100	0.93(8) 1.22(3) Shale/Sst –	N.A.	6/7

DATE : 14 - 11 - 83.

IKU

Visual Kerogen Analysis

TABLE NO.: 10.
WELL NO.: 7/11-7

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-8603	5470-500 Clayst.	Am, Cy/W, P	F-M	good	1, 1/1+	Fluffy amorphous material embeds dinoflagellate cysts, a rich and varied assemblage. Bact/fungal spores. Some pyrite framboids.
A-8635	6450-460 Clayst.	Am, Cy/	F-M	good	1, 1/1+	Pyritic aggregates of amorphous material. Varied cysts, as above. More abundant pollen and spores and woody material.
A-8649	6880-910 Clayst.	Am, Cy/W, P, S, Cut	F-M	good	1, 1/1+	Dense, pyritic aggregates, flaky or grannulate texture.

ABBREVATIONS

Am	Amorphous	Cy	Cysts, algae	W	Woody material	F	Fine
He	Herbaceous	P	Pollen grains	C	Coal	M	Medium
Cut	Cuticles	S	Spores	RI	Reworked	L	Large

IKU

Visual Kerogen Analysis

TABLE NO.: 10.
WELL NO.: 7/11-7

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-8664	7330-360 Clayst.	W, Cut, P, S/Am, Cy	F-M	poor-fair	1, 1/1+	Granulate to flaky aggregates of strongly sapropelised material. The origin of the material and relative proportions are uncertain.
A-8679	7780-810 Clayst.	W, WR!, Cut, P/Am, Cy	F-M	good to fair	1/1+	Granulate pyritic aggregates with remains of fungi/bacteria. Strongly degraded woody material. vitrinite and semifusinite. Small rounded aggregates in between. Strong biodegradation.

ABBREVATIONS

Am	Amorphous	Cy	Cysts, algae	W	Woody material	F	Fine
He	Herbaceous	P	Pollen grains	C	Coal	M	Medium
Cut	Cuticles	S	Spores	R!	Reworked	L	Large

IKU

Visual Kerogen Analysis

TABLE NO.: 10.
WELL NO.: 7/11-7

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-8694	8230-260 Clayst.	W, Cut, WR!, P, S/Am, Cy	F-M	good to fair	1/1+	Fluffy amorphous and aggregates of mostly sapropelised former structured material. Biodegraded land plants.
A-8709	8680-710 Clayst.	W, Cut, WR!, P, S/Am, Cy	F-M	good to fair	1/1+	As 8230-260m above, biodegraded terrestrial remains. Vitrinite and semifusinite.
A-8740	9580-610 Clayst.	*W, Cut, WR!, P, S/Am, Cy	F-M-L	good to poor	1/1+, 1+/2-, 2-	Dominantly organic material as 8230-260m and 8680-710m. *More acid resistant minerals, partly as inorganic/organic aggregates. Very thinwalled pollen seem to have deeper colourtones than in layers above.

ABBREVATIONS

Am	Amorphous	Cy	Cysts, algae	W	Woody material	F	Fine
He	Herbaceous	P	Pollen grains	C	Coal	M	Medium
Cut	Cuticles	S	Spores	R!	Reworked	L	Large

IKU

Visual Kerogen Analysis

TABLE NO.: 10.
WELL NO.: 7/11-7

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-8803	10500-510 Clayst.	Cut, W, WR!, P, S/Am, Cy	F-M-L	good	2-	Strongly pyritic residue. Sheets of material, ?leaf remains, seem very abundant. Early Tertiary pollen very abundant. Semifusinite and fusinite.
A-8852	10990 - 11000 Limest.	W, WR!, Cut, P, S/Am, Cy	F-M-	good to poor	2-/2	Disperse residue. More grey amorphous character. Woody material (vitr. semi/fusin) poorly preserved.
A-9078	12490-500 Limest.	*Cy, WR!	M	fair to good	2-/2	*Dominantly minerals, which prevent quantitative estimates. Occasional dark stained cysts and opague lath shaped woody material.

ABBREVATIONS

Am	Amorphous	Cy	Cysts, algae	W	Woody material	F	Fine
He	Herbaceous	P	Pollen grains	C	Coal	M	Medium
Cut	Cuticles	S	Spores	RI	Reworked	L	Large

IKU

Visual Kerogen Analysis

TABLE NO.: 10.
WELL NO.: 7/11-7

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-9441	14464 swc	?Cut, W, P, S/?	F-M-L	poor	2+, 3/3+	Dense opague aggregates of material. Small particles are strongly degraded as if exposed to strong heating. We tentatively suggest mainly terrestrial sources.
A-9275	14470-480 Shale (turbodr.)	?Cut, W, P, S/?	F-M-L	poor	2, 3-, 3/3+	Dense aggregates of material as 14464 swc. Sheets of strongly degraded ?cuticles. The material seems exposed to strong heating. Some particles have lighter amber colours.
A-9442	14502 swc	?Cut, W, P, S/?	F-M-L	poor	3-, 3/3+	As for 14470-480.

ABBREVATIONS

Am	Amorphous	Cy	Cysts, algae	W	Woody material	F	Fine
He	Herbaceous	P	Pollen grains	C	Coal	M	Medium
Cut	Cuticles	S	Spores	R!	Reworked	L	Large

IKU

Visual Kerogen Analysis

TABLE NO.: 10.
WELL NO.: 7/11-7

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-9280	14520-530 Shale (turbodr.)	?Cut, W, P, S/A?	F-M-L	poor	3-, 3/3+	As for 14470-480.
A-9287	14620-30 Shale	?Cut, W, P, S/?	F-M-L	poor	3-, 3/3+	Sapropelised pyritic sample. The material seems to have been exposed to strong heating. Wall material of pollen is cracked and stained. Occasionally vitrinite particles have brighter colours.
A-9327	14990 - 15000 Shale	W, Cut, P, S/?	F-M-L	poor	3-, 3/3+	As mentioned for 14620-30 above. Some of the woody particles are less affected.

ABBREVATIONS

Am	Amorphous	Cy	Cysts, algae	W	Woody material	F	Fine
He	Herbaceous	P	Pollen grains	C	Coal	M	Medium
Cut	Cuticles	S	Spores	R!	Reworked	L	Large

IKU

Visual Kerogen Analysis

TABLE NO.: 10.
WELL NO.: 7/11-7

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-9357	15290-300 Shale	W, Cut, P, S/?	F-M-L	poor	3-, 3/3+	Amorphous or strongly sapropelised material.
A-9385	15590-600 Shale	W, Cut, P, S/?	F-M-L	poor	3/3+	Resembles 15290-300.
A-9425	15990 - 16000 Silty	*W/?Am	F-M	poor	?2+, 3/3+	*Rich in acid resistant minerals. More of a grey amorphous character.

ABBREVATIONS

Am	Amorphous	Cy	Cysts, algae	W	Woody material	F	Fine
He	Herbaceous	P	Pollen grains	C	Coal	M	Medium
Cut	Cuticles	S	Spores	R!	Reworked	L	Large

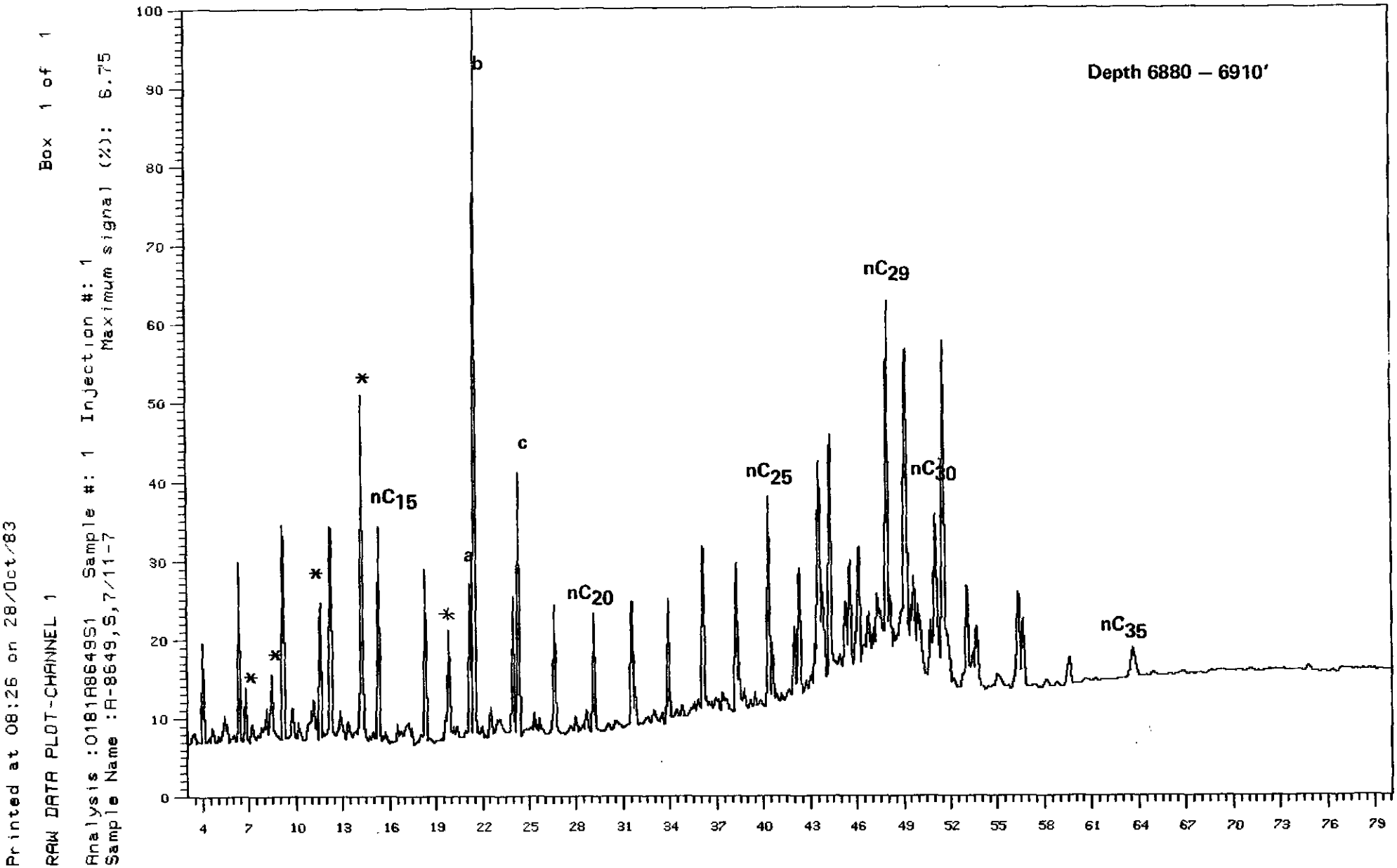
IKU

APPENDIX 1

SATURATED HYDROCARBON GAS CHROMATOGRAMS

a = nC_{17}-alkane
b = pristane
c = phytane

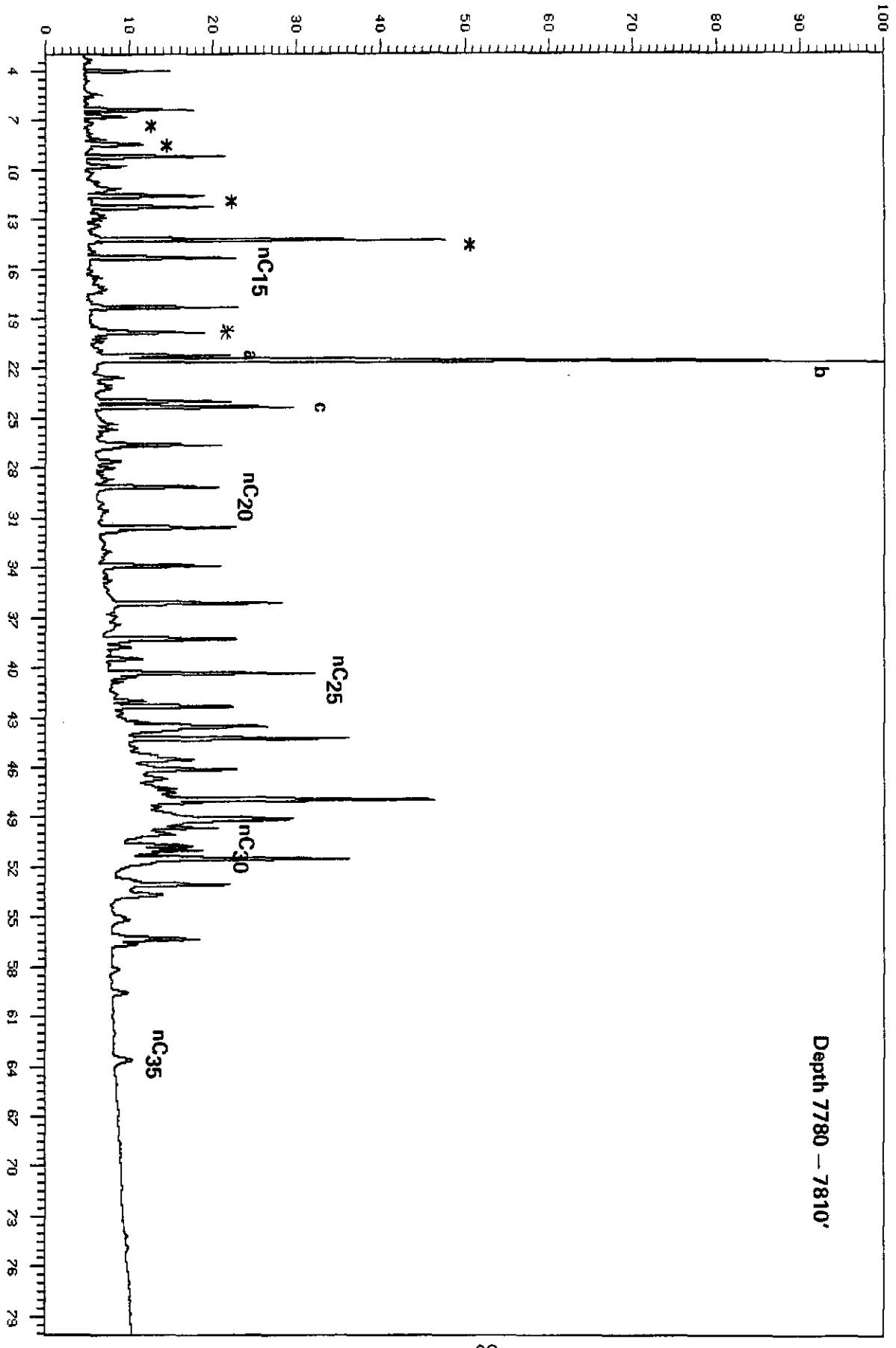
* = other acyclic isoprenoids besides pristane and phytane


Printed at 08:26 on 28/Oct/83
RAW DATA PLOT-CHANNEL 1
Box 1 of 1
Analysis :0181A864951 Sample #: 1 Injection #: 1
Sample Name :A-8649,S,7/11-7
Maximum signal (%): 6.75
Depth 6880 – 6910'
nC15
nC20
nC25
nC29
nC30
nC35
a
b
c
*
- 79 -

Printed at 08:24 on 28/Oct/83

RAW DATA PLOT-CHANNEL 1 Box 1 of 1

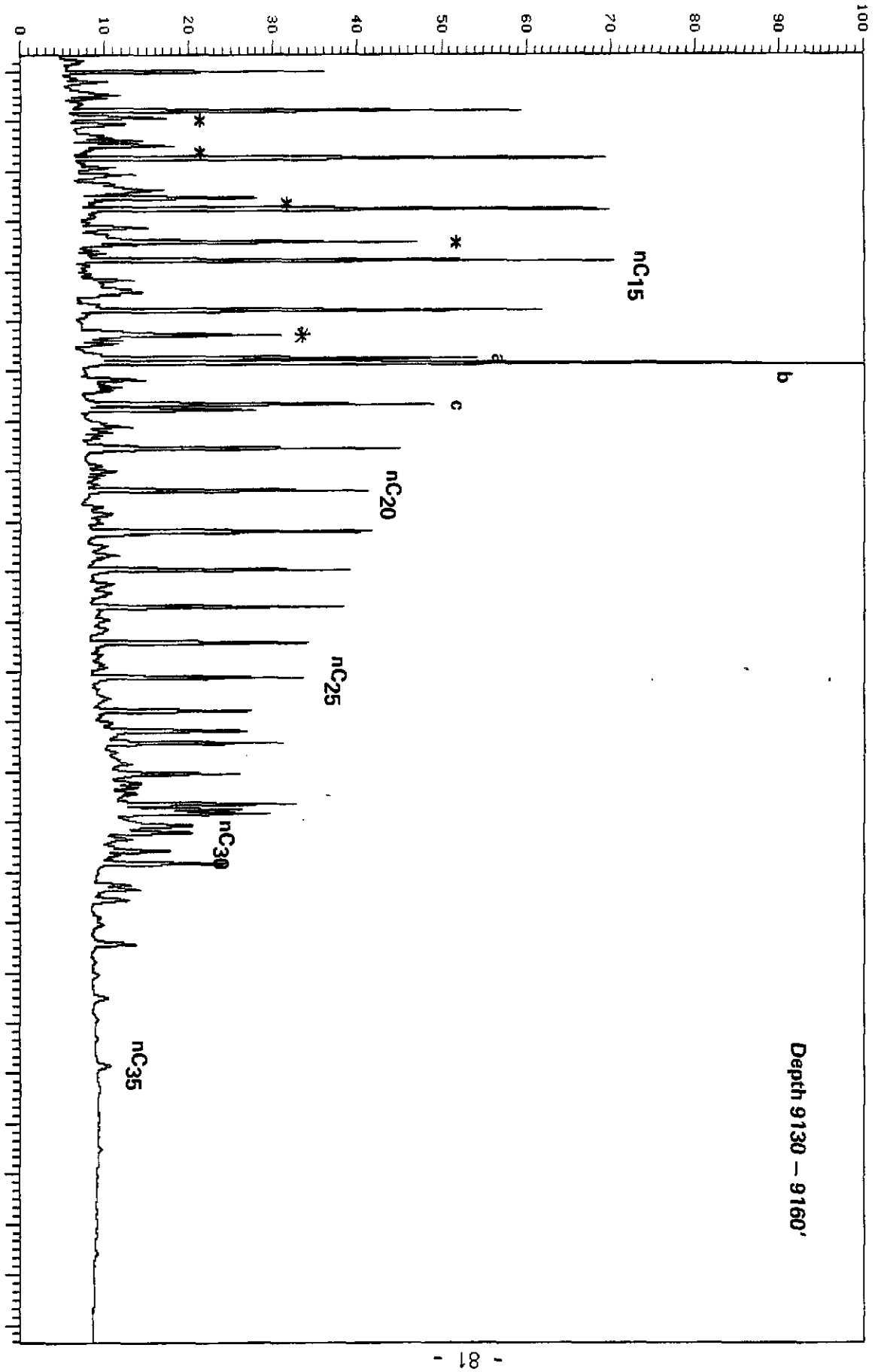
Analysis :0181A8679S1 Sample #: 1 Injection #: 1
Sample Name :A-8679,S,7/11-7 Maximum signal (%): 9.75



Printed at 09:32 on 28/Oct/83

RAW DATA PLOT-CHANNEL 1 Box 1 of 1

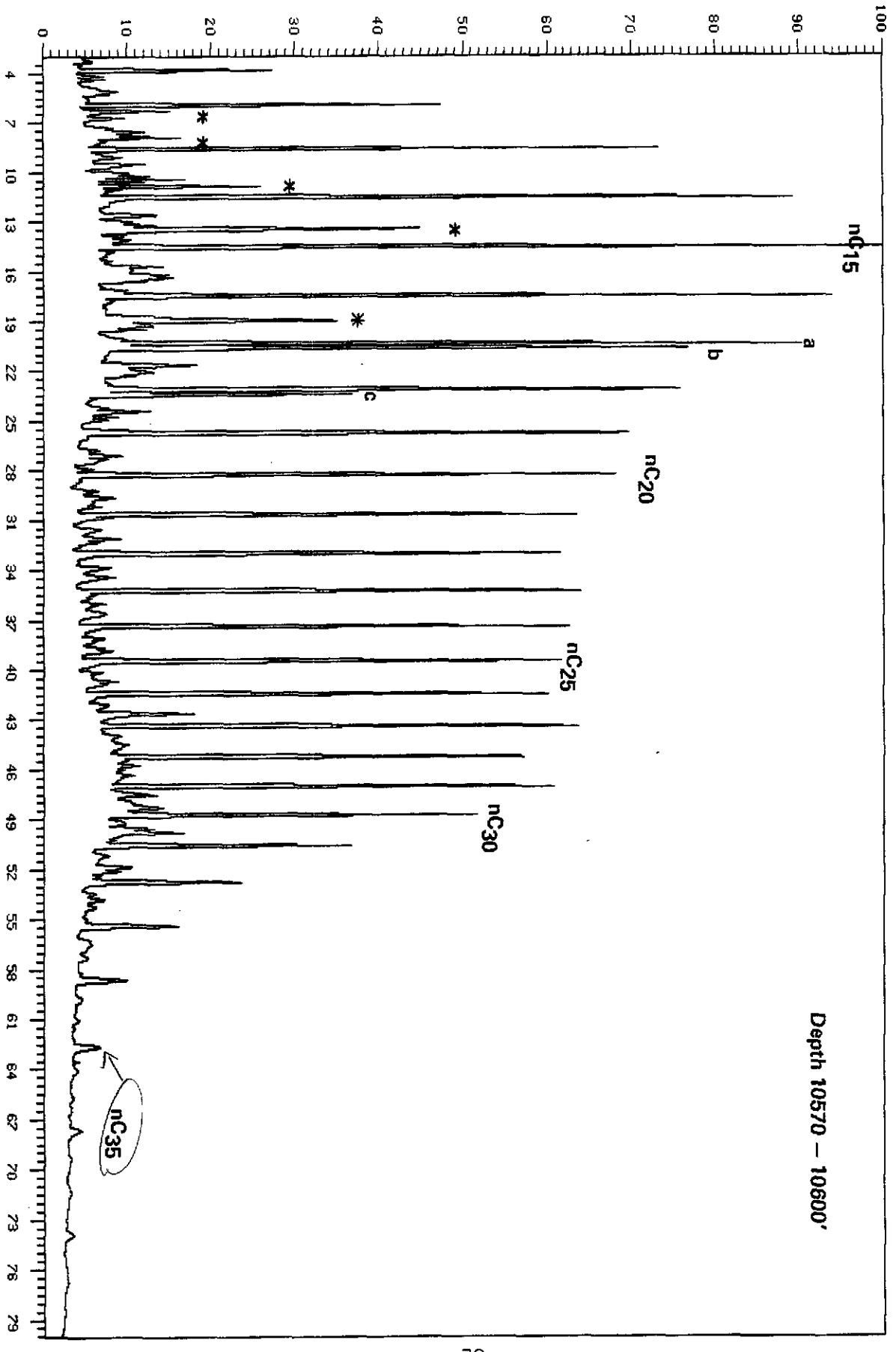
Analysis :0181A8724S1 Sample #: 1 Injection #: 1
Sample Name :A-8724,S,7/11-7 Maximum signal (%): 12.31



Printed at 09:44 on 28/Oct/83

RAW DATA PLOT-CHANNEL 1 Box 1 of 1

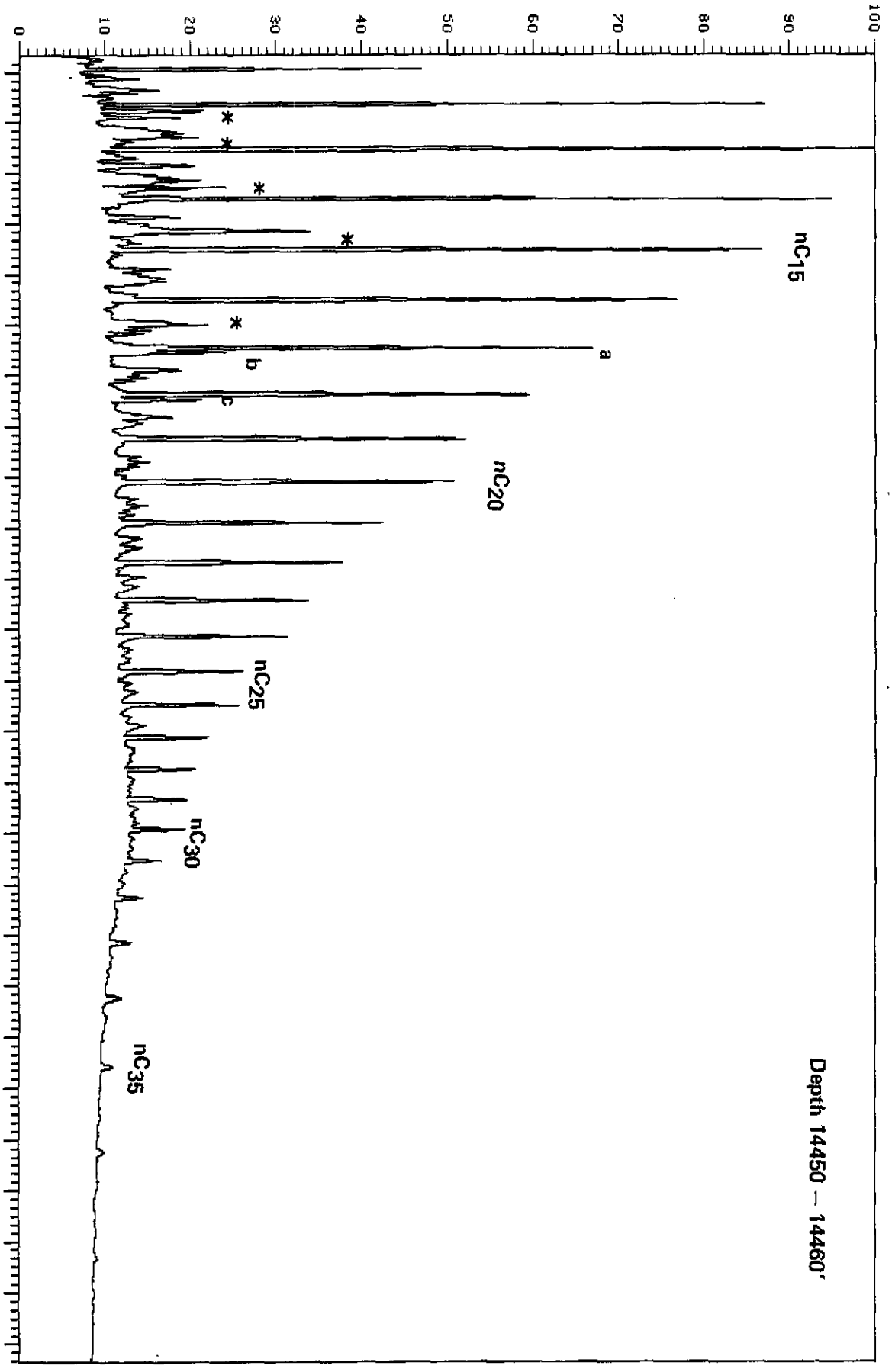
Analysis :0181A8812S1 Sample #: 1 Injection #: 1
Sample Name :A-8812,S,7/11-7 Maximum signal (%): 11.50



Printed at 09:34 on 28/Oct/83

RAW DATA PLOT-CHANNEL 1 Box 1 of 1

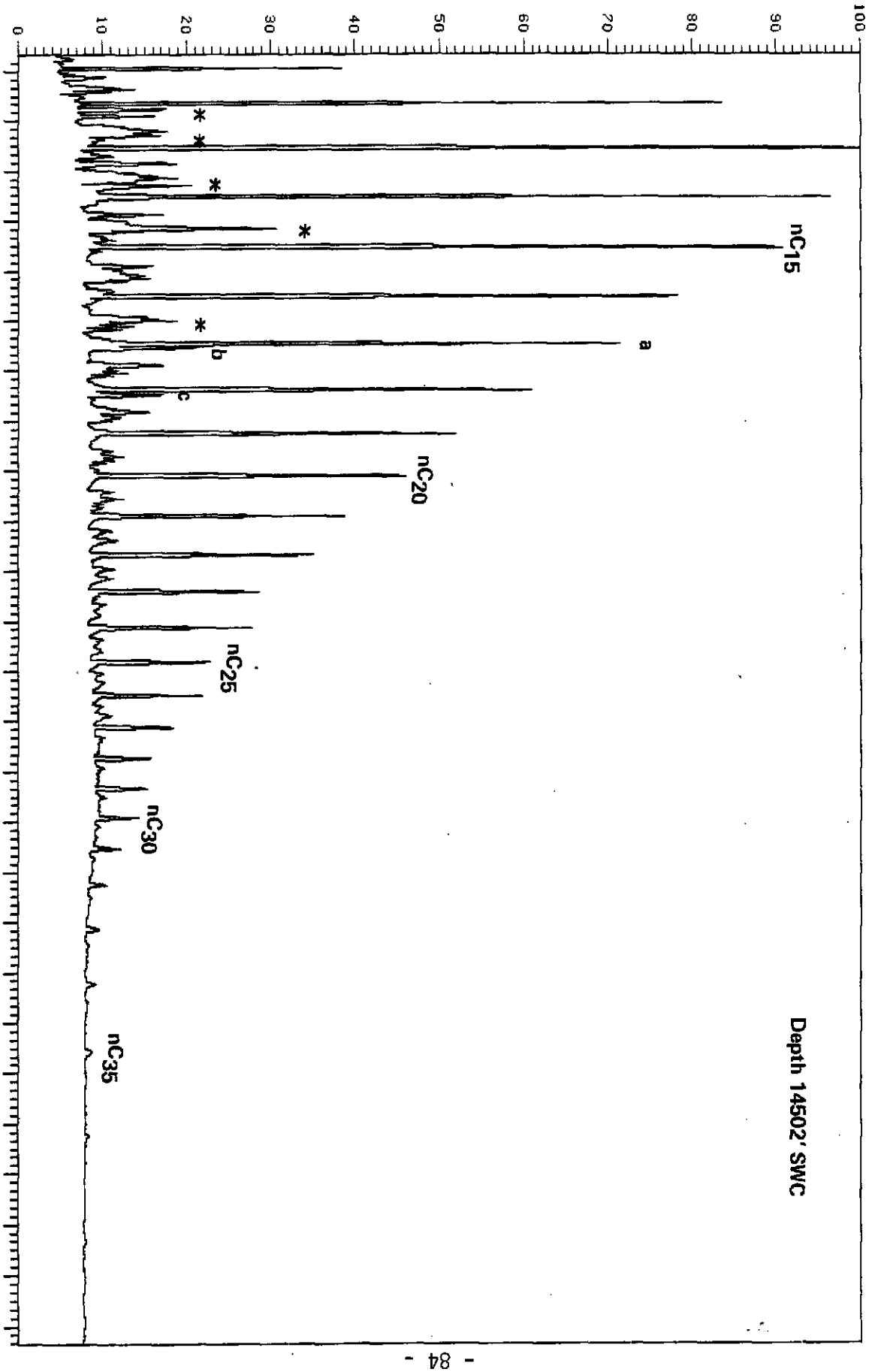
Analysis :0181A9273S1 Sample #: 1 Injection #: 1
Sample Name :A-9273,S,7/11-7 Maximum signal (%): 10.83



Printed at 15:22 on 28/Oct/83

RAW DATA PLOT-CHANNEL 1 Box 1 of 1

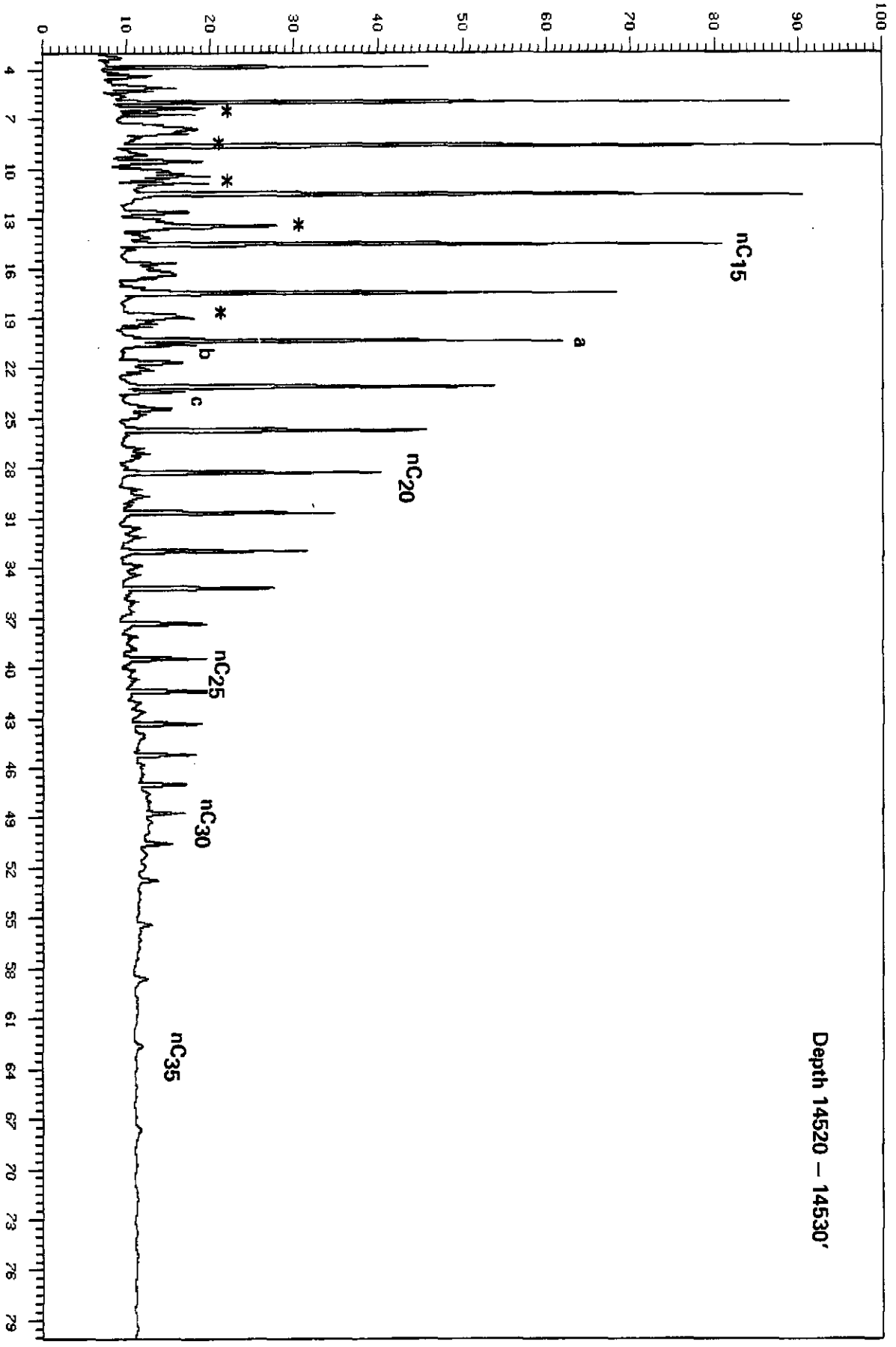
Analysis :0181A9442S1 Sample #: 1 Injection #: 1
Sample Name :A-9442,S,7/11-7 Maximum signal (%): 12.79

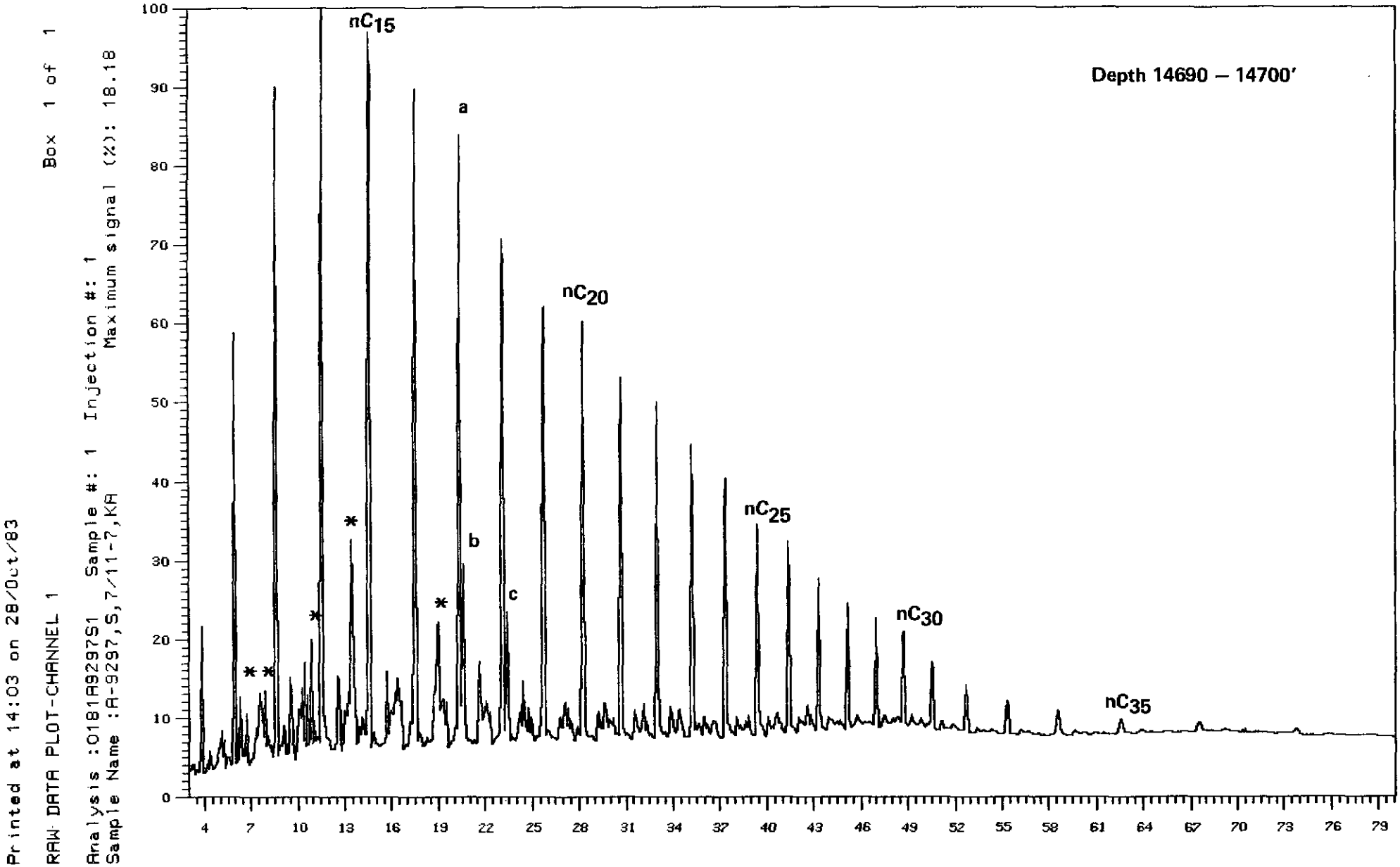


Printed at 14:01 on 28/Oct/83

RAW DATA PLOT-CHANNEL 1 Box 1 of 1

Analysis :0181A9280S1 Sample #: 1 Injection #: 1
Sample Name :A-9280,S,7/11-7,KA Maximum signal (%): 8.05

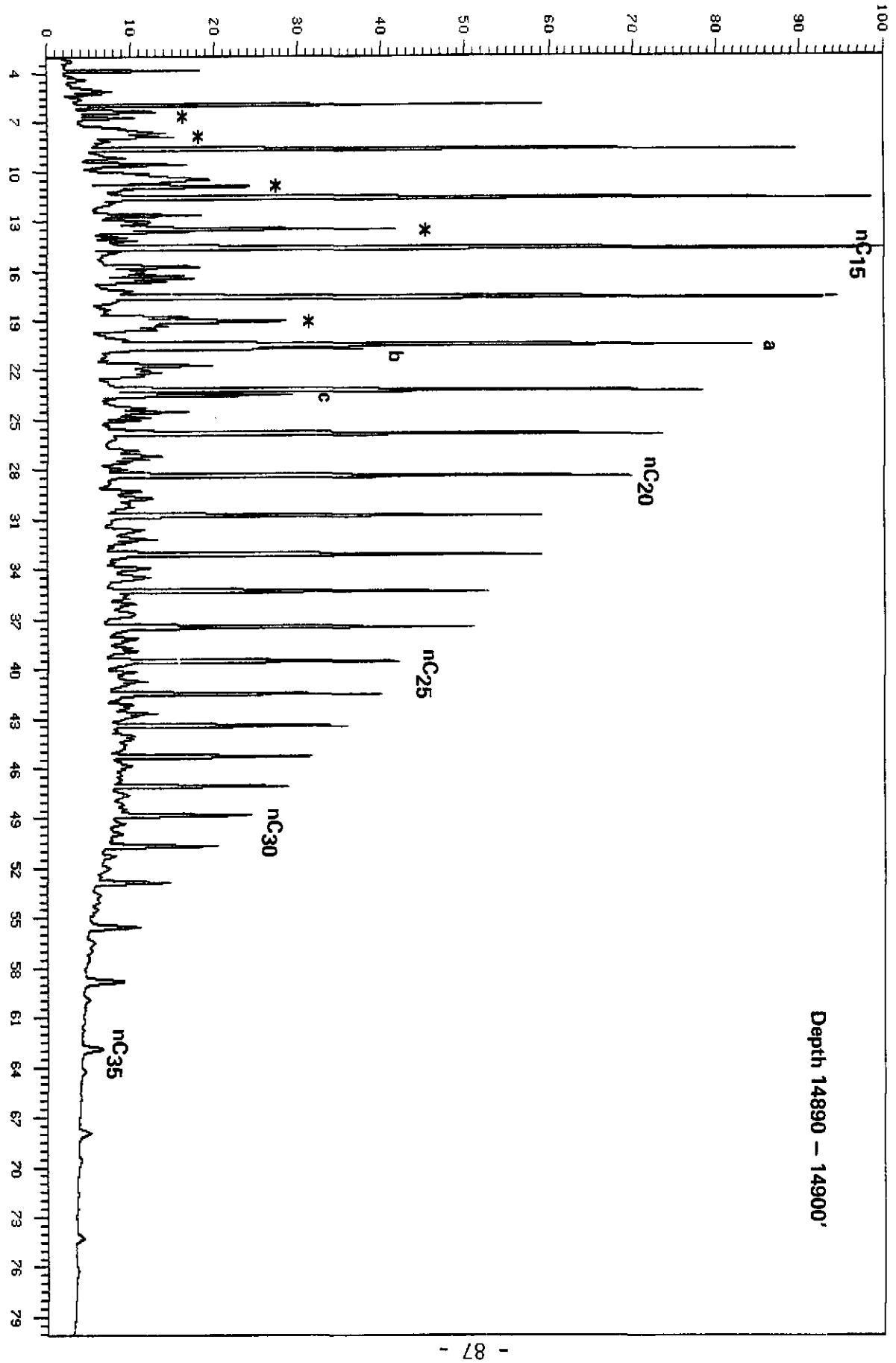



Printed at 14:03 on 28/Oct/83
RAW DATA PLOT-CHANNEL 1
Box 1 of 1
Analysis :0181A9297S1 Sample #: 1 Injection #: 1
Sample Name :A-9297,S,7/11-7,KA Maximum signal (%): 18.18
Depth 14690 – 14700'
nC15
nC20
nC25
nC30
nC35
a
b
c
*
100
90
80
70
60
50
40
30
20
10
0
4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76 79

Printed at 09:36 on 28/Oct/83

RAW DATA PLOT-CHANNEL 1 Box 1 of 1

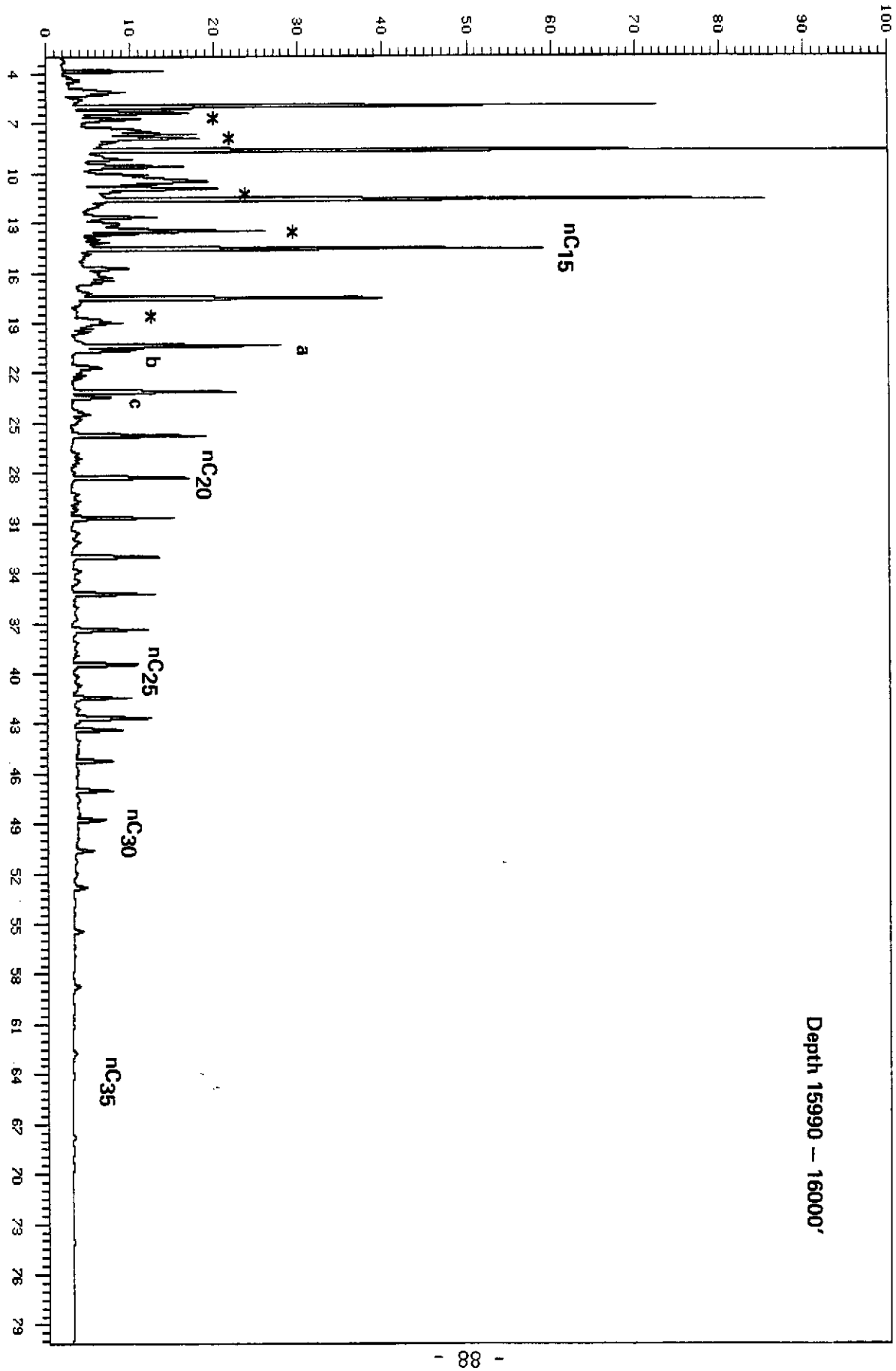
Analysis :0181H9317S1 Sample #: 1 Injection #: 1
Sample Name :A-9317,S,7/11-7 Maximum signal (%): 34.41



Printed at 08:43 on 28/Oct/83

RAW DATA PLOT-CHANNEL 1 Box 1 of 1

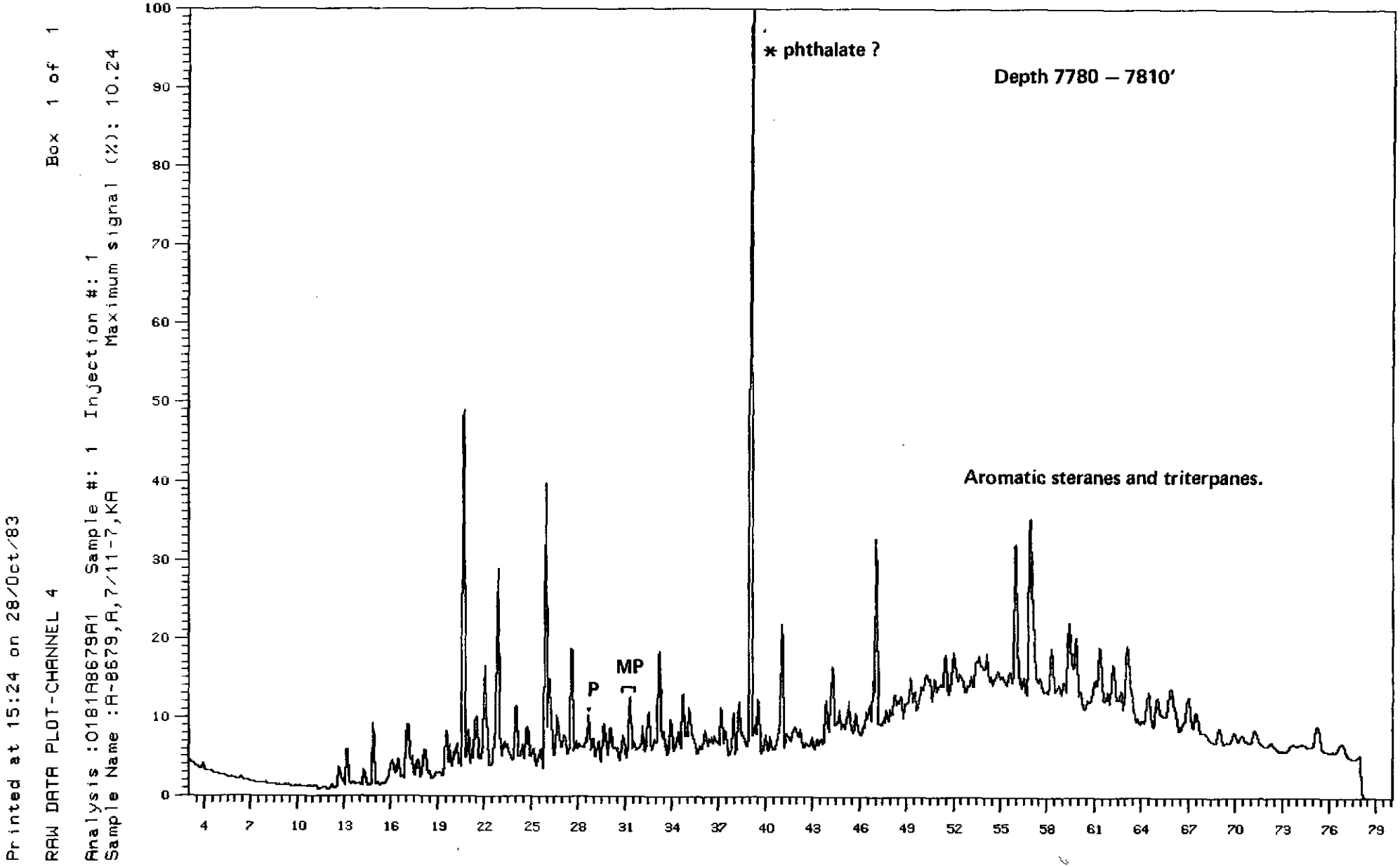
Analysis :0181A9425S1 Sample #: 1 Injection #: 1
Sample Name :A-9425,S,7/11-7 Maximum signal (%): 30.89



APPENDIX 2

AROMATIC HYDROCARBON GAS CHROMATOGRAMS

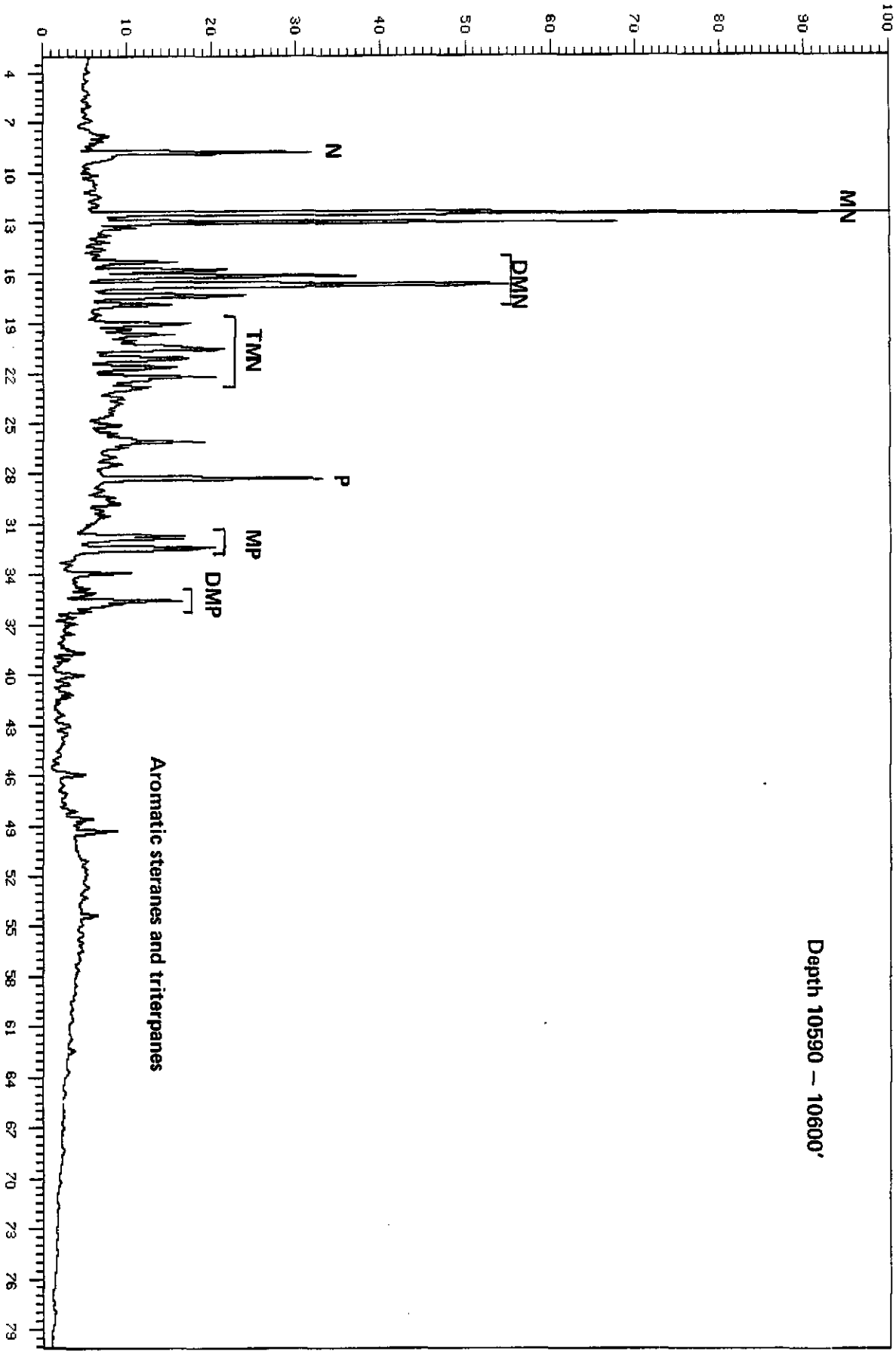
N	=	Napthalene
MN	=	Methylnaphthalene
DMN	=	Dimethylnapthalene
TMN	=	Trimethylnaphthalene
P	=	Phenanthrene
MP	=	Methylphenanthrenes
DMP	=	Dimethylphenanthrenes


Printed at 15:24 on 28/Oct/83
RAW DATA PLOT-CHANNEL 4
Box 1 of 1
Analysis :0181A8679A1 Sample #: 1 Injection #: 1
Sample Name :A-8679,A,7/11-7,KA Maximum signal (%): 10.24
* phthalate ?
Depth 7780 – 7810'
Aromatic steranes and triterpanes.
P
MP
100
90
80
70
60
50
40
30
20
10
0
4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76 79

Printed at 11:12 on 10/Nov/83

RAW DATA PLOT-CHANNEL 4 Box 1 of 1

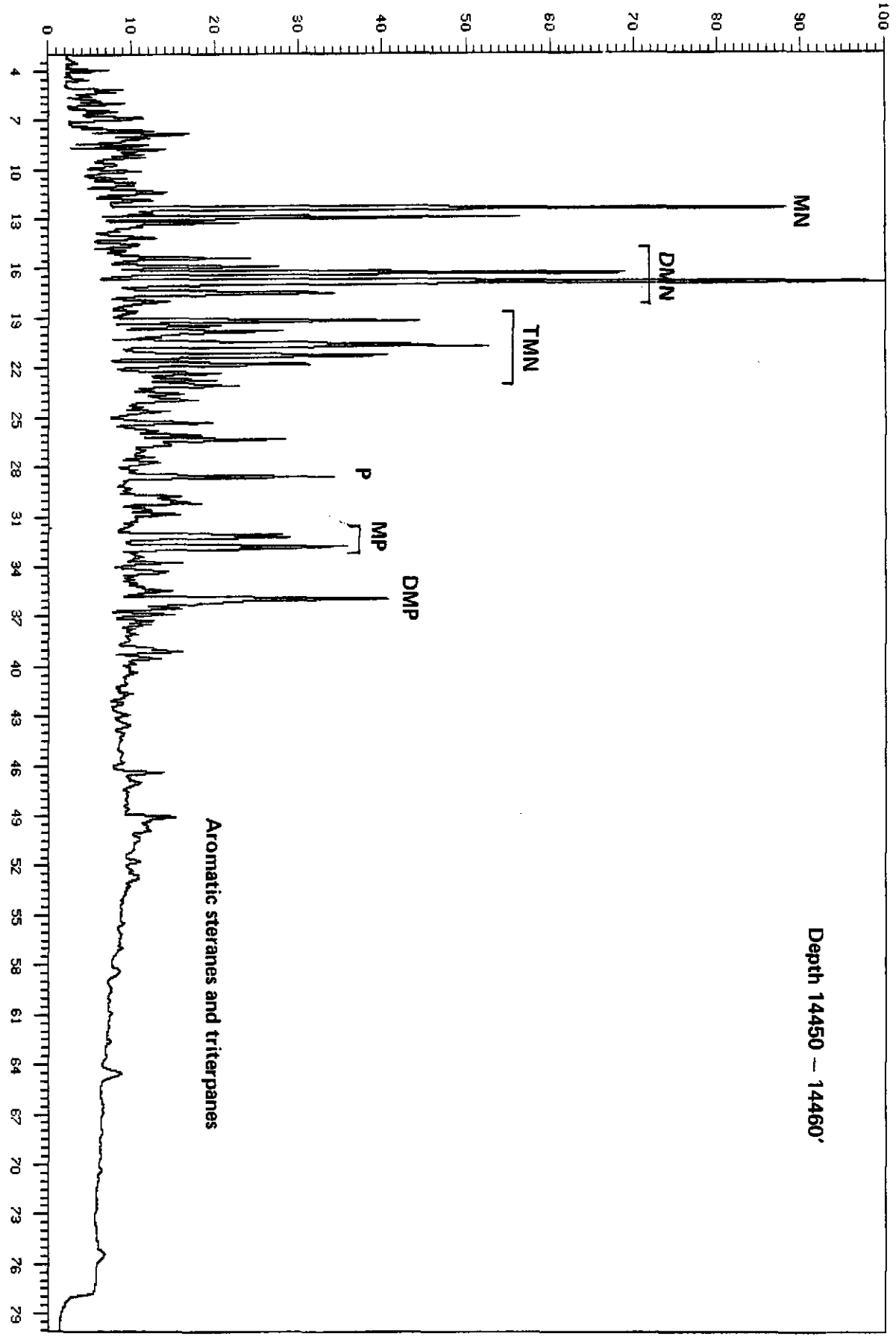
Analysis :0181A8812A2 Sample #: 1 Injection #: 1
Sample Name :A-8812,A,0181,KA Maximum signal (%): 13.19



Printed at 14:59 on 28/Oct/83

RAW DATA PLOT-CHANNEL 4 Box 1 of 1

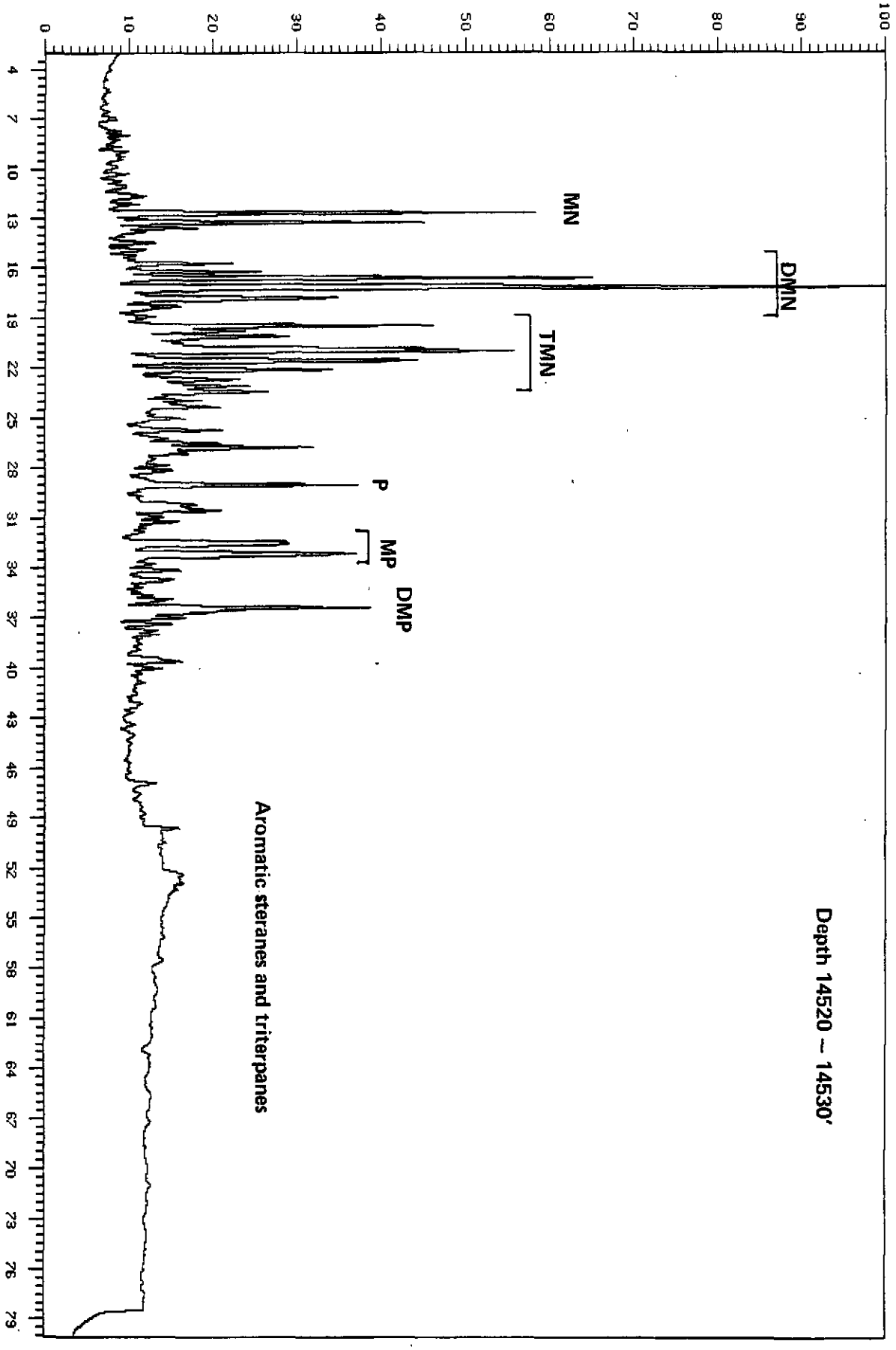
Analysis :0181A9273A1 Sample #: 1 Injection #: 1
Sample Name :A9273,A,7/11-7,KA Maximum signal (%): 16.80



Printed at 15:19 on 28/Oct/83

RAW DATA PLOT-CHANNEL 4 Box 1 of 1

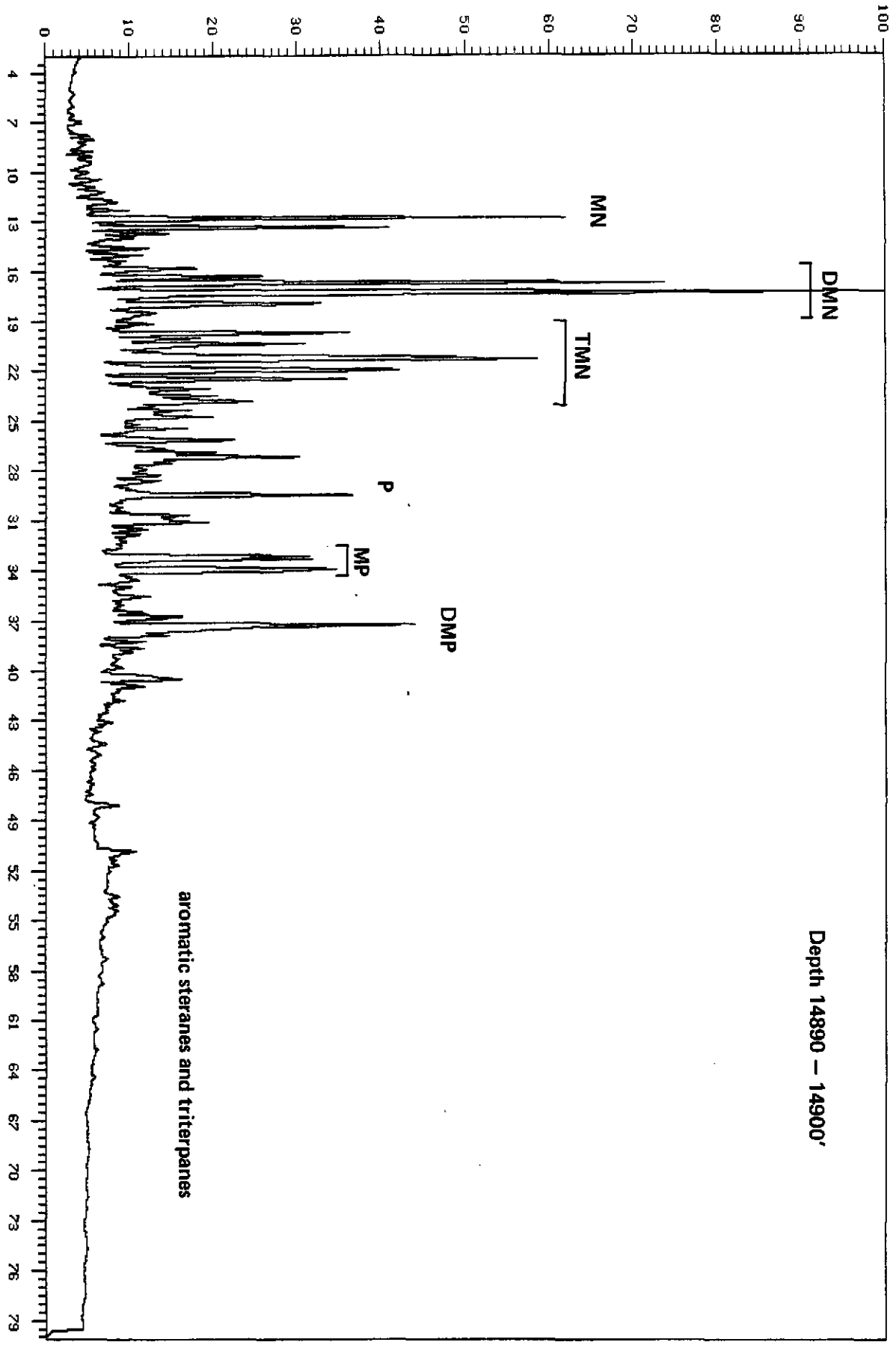
Analysis :0181A9280A1 Sample #: 1 Injection #: 1
Sample Name :A-9280,A,7/11-7,KA Maximum signal (%): 7.34



Printed at 13:06 on 29/Oct/83

RAW DATA PLOT-CHANNEL 4 Box 1 of 1

Analysis :0181A9317A1 Sample #: 1 Injection #: 1
Sample Name :A-9317,A,7/11-7,KA Maximum signal (%): 9.91



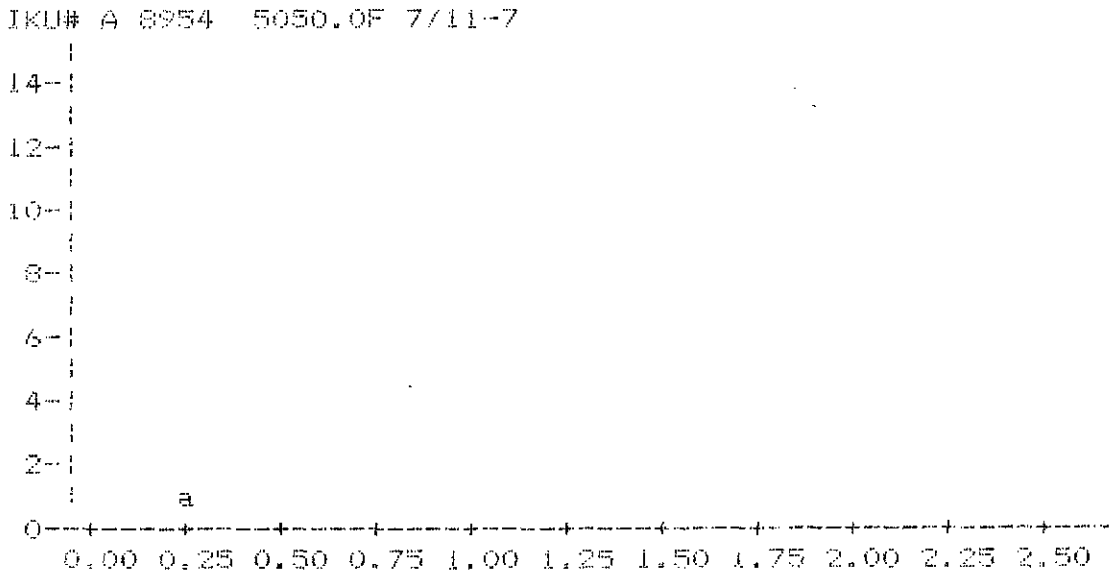
APPENDIX 3

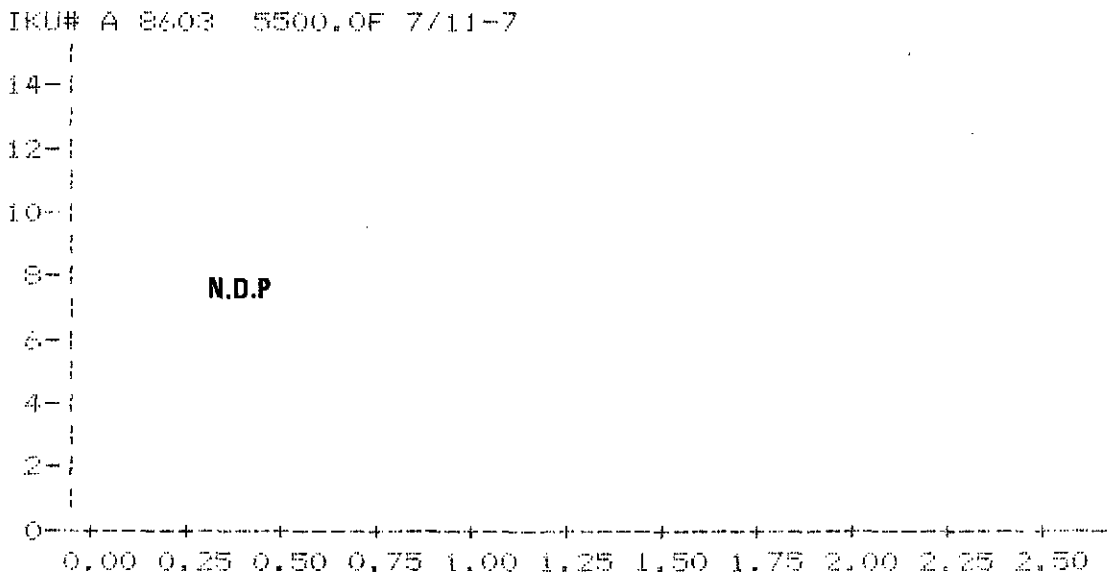
IKU

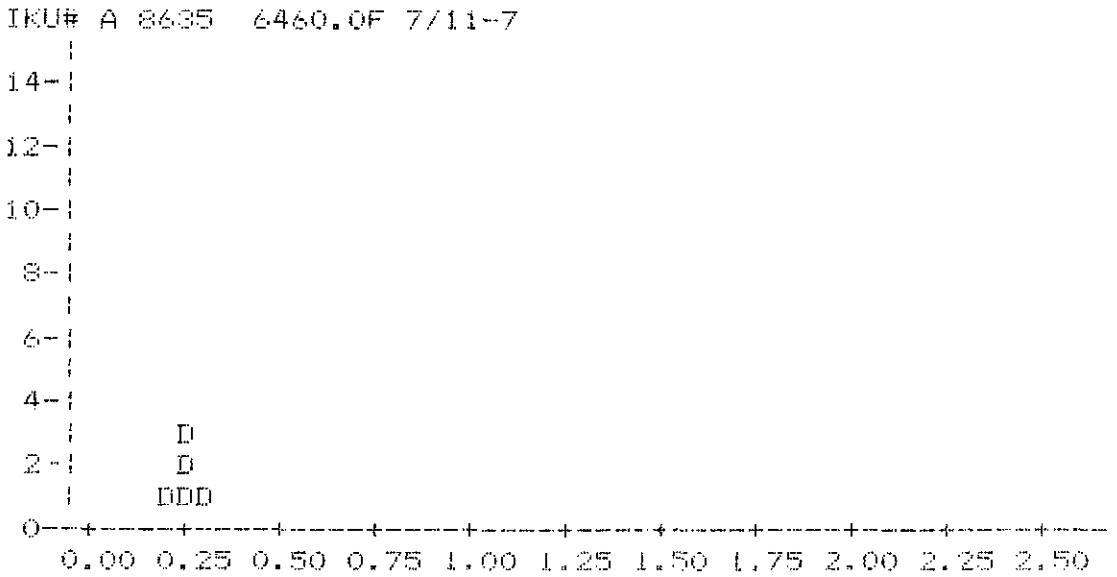
VITRINITE REFLECTANCE HISTOGRAMS

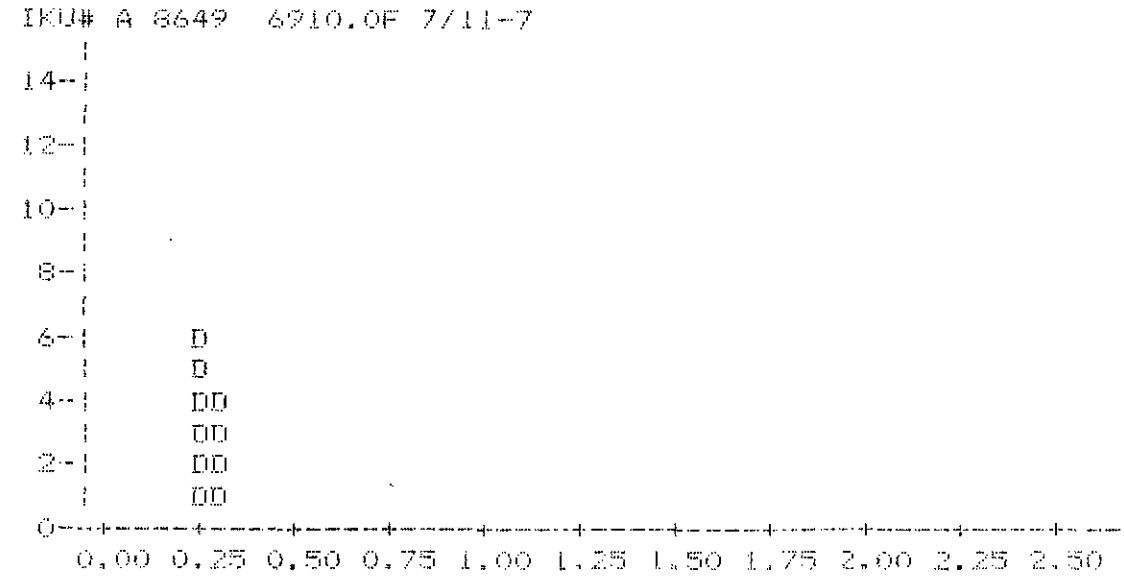
Key:-

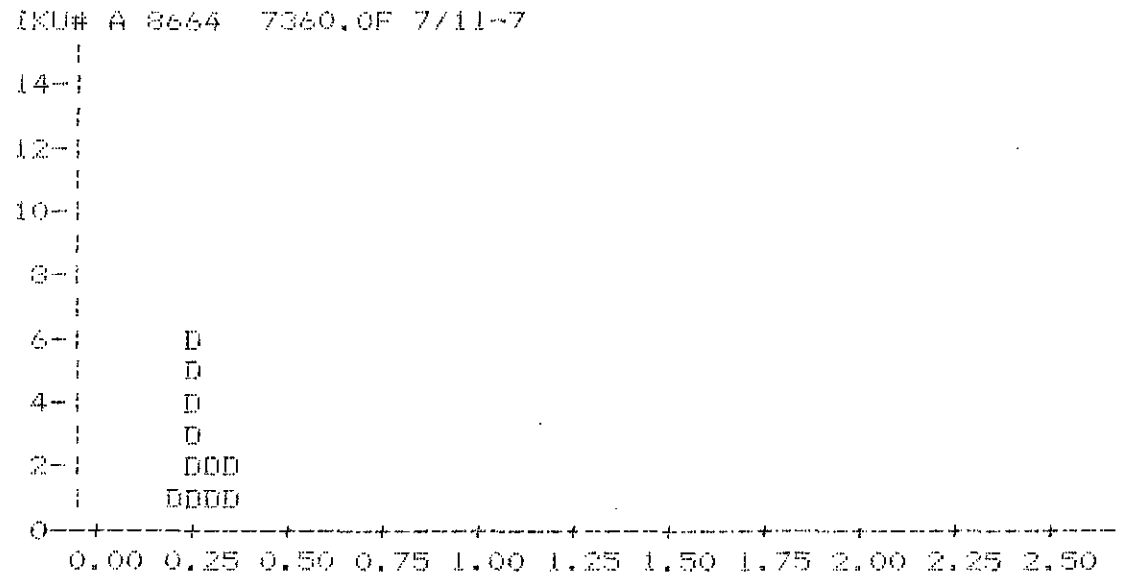
A	=	Light grey/olive grey claystone
B	=	Medium - dark grey claystone
D	=	Brown/brown-grey claystone
H	=	Claystone/Shale, brown/black
J	=	Limestone/Marl
U	=	Bulk samples taken or lithology not clear.
	*	Lower case letters used when the measurement is not considered primary/reliable
N.D.P.	=	No Determination Possible Either no Vitrinite was found on a standard size block or none of the material was considered primary.
PP	=	Primary Population, Y = Relevant population considered a good indication of maturity, N = relevant population not representative (caved, reworked, contaminant?)
LOW +		
HIGH	=	Population limits of that population.
# VAL	=	Number of measurements in that population.

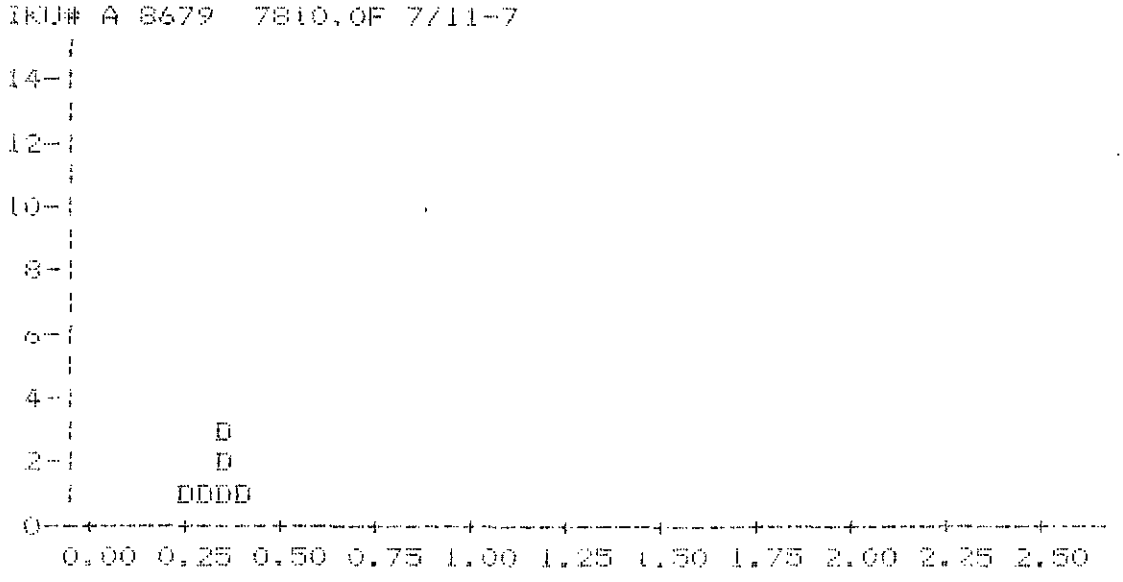

IKU# A 8954 5050.0F 7/11-7
14
12
10
8
6
4
2
0
a
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

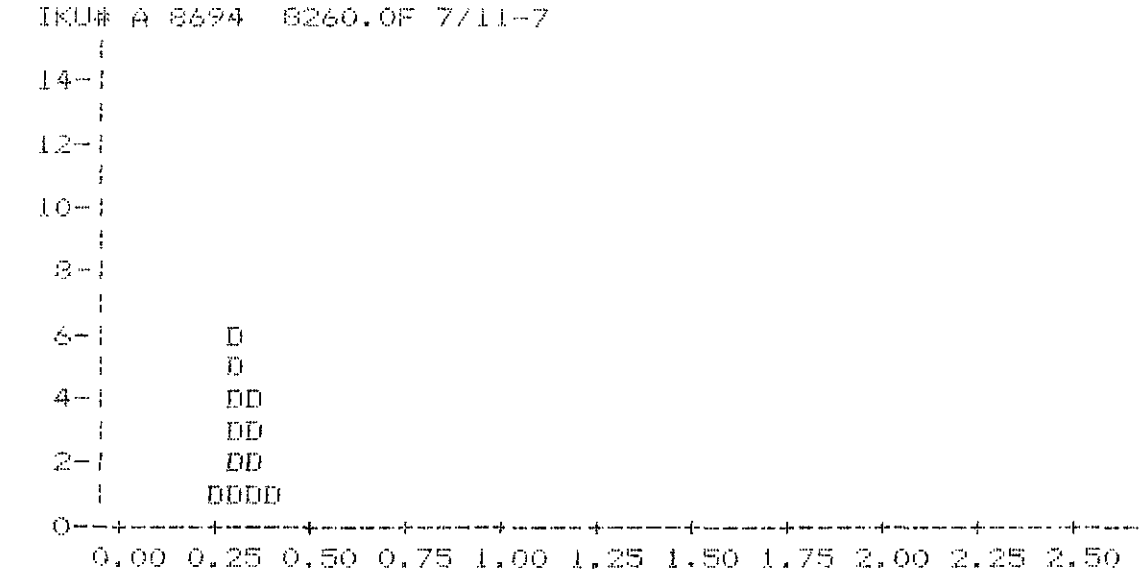

IKU# A 8403 5500.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

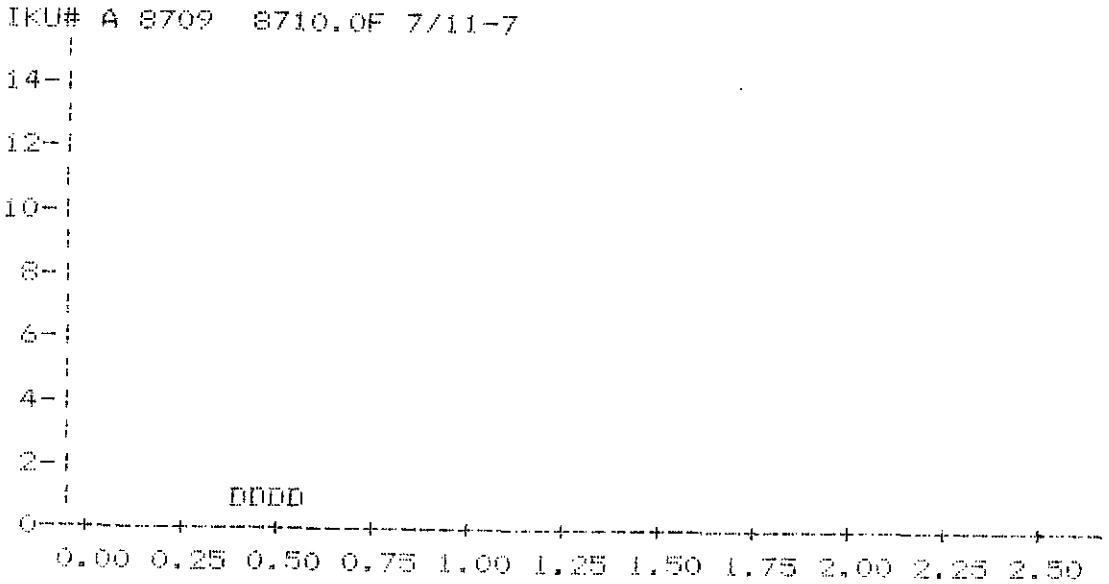

IKU# A 8635 6460.0F 7/11-7
14
12
10
8
6
4
2
0
D
D
DDD
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

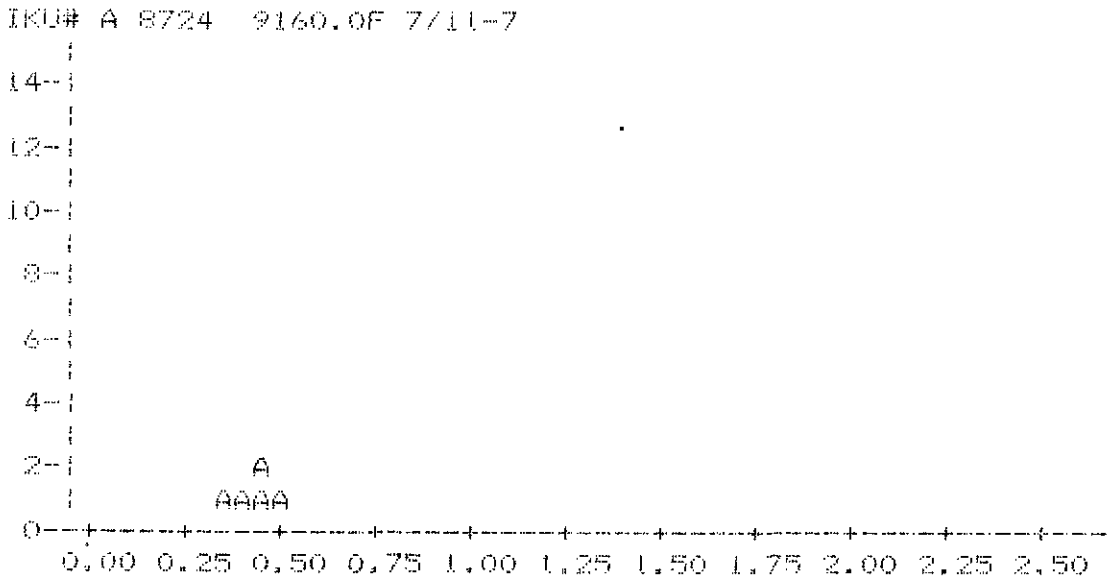

IKU# A 8649 6910.0F 7/11-7
14
12
10
8
6
4
2
0
D
D
DD
DD
DD
DD
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

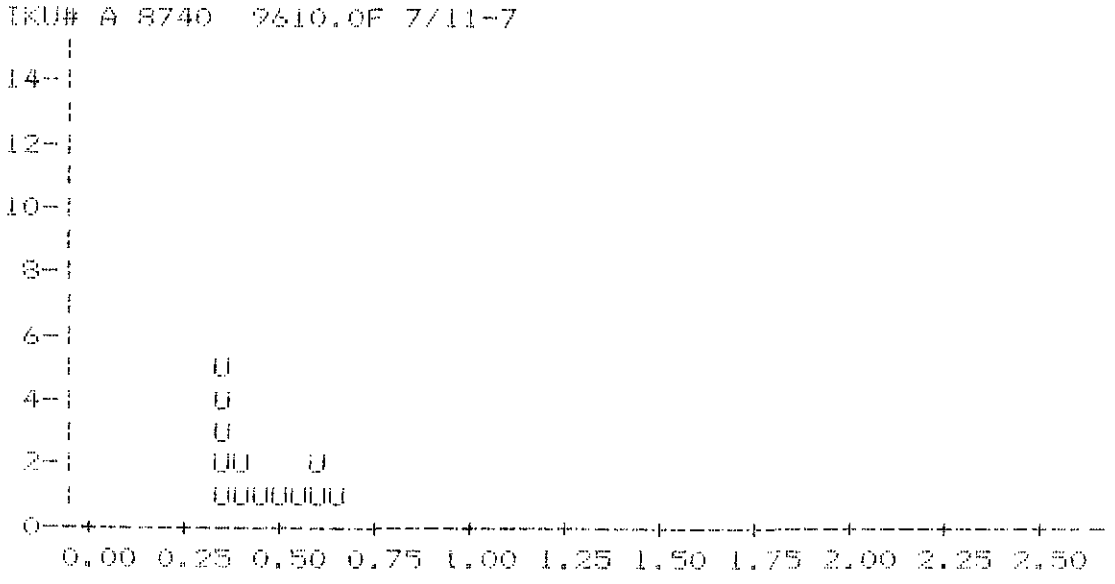

IKU# A 8664 7360.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

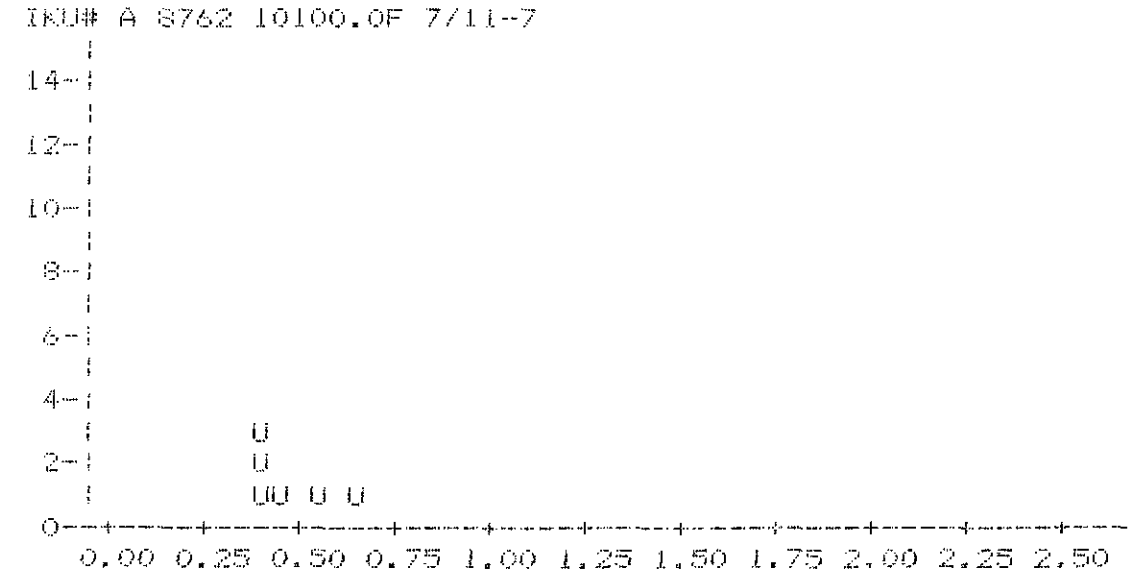

IKU# A 8679 7810.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

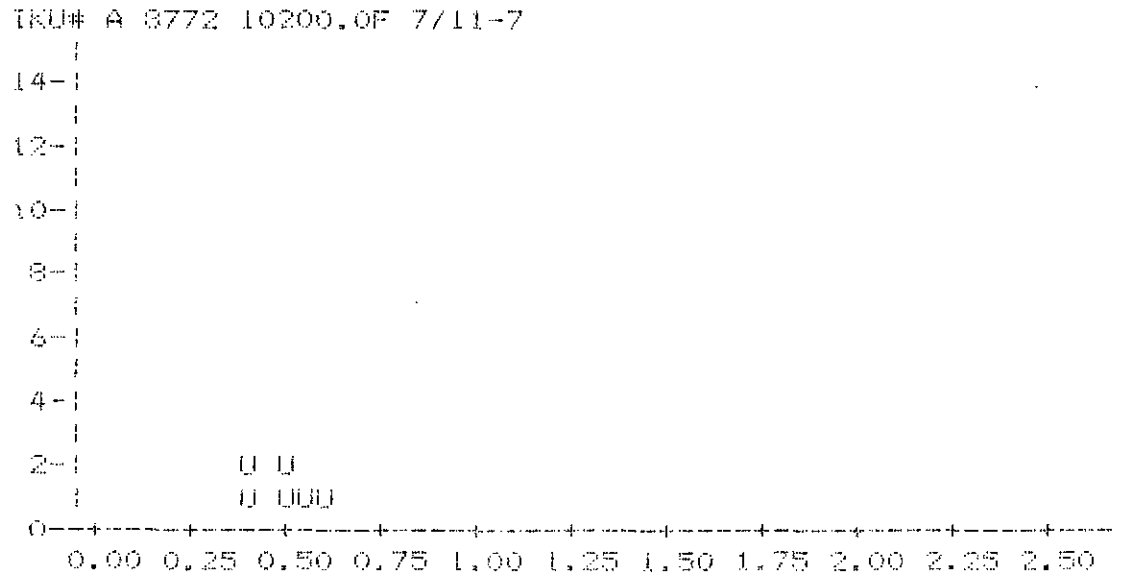

IKU# A 8694 8260.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

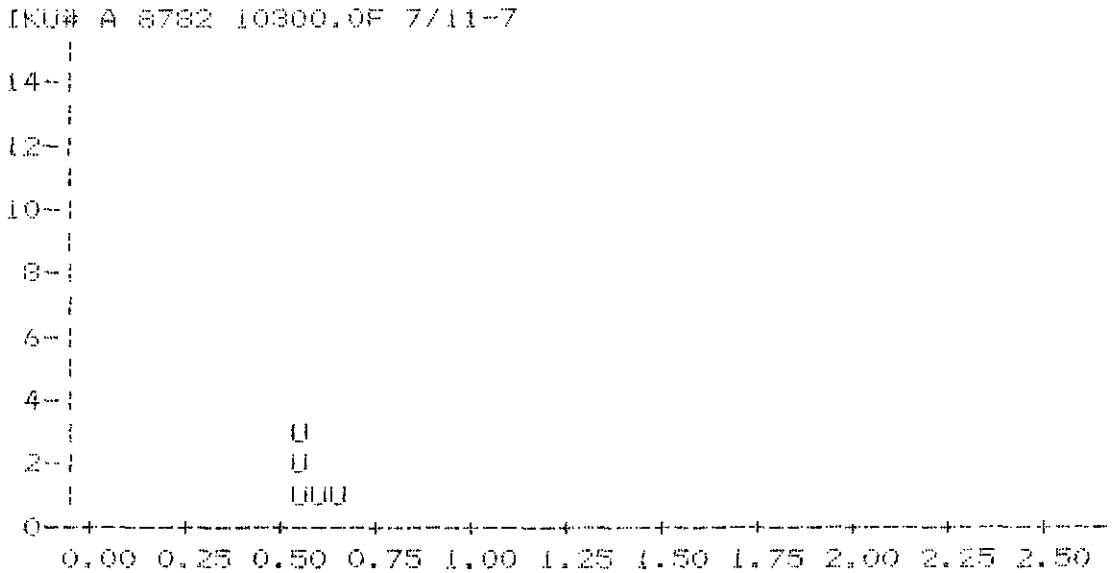

IKU# A 8709 8710.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

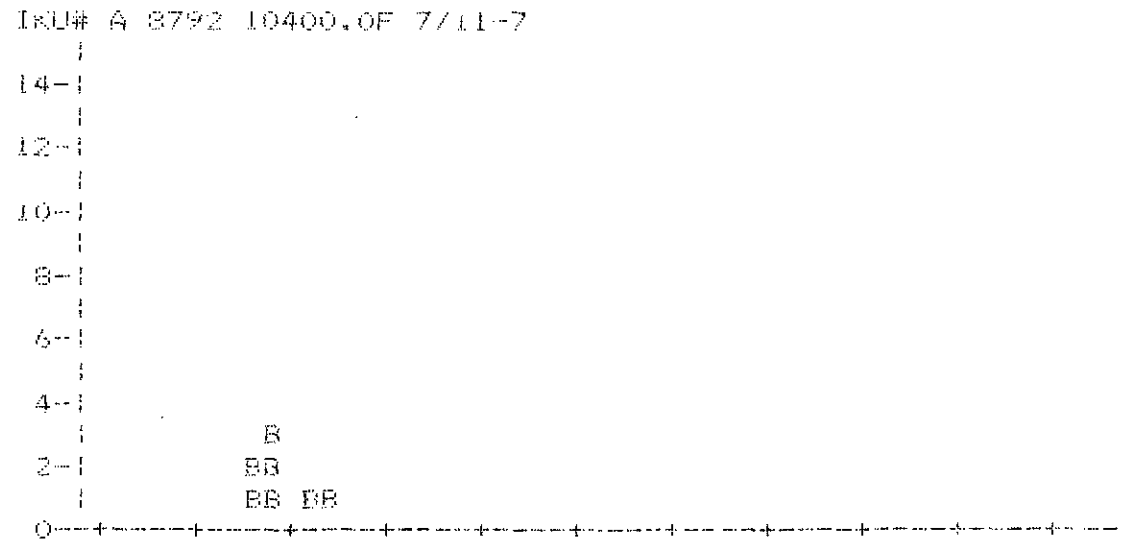

IKU# A 8724 9160.0F 7/11-7
14
12
10
8
6
4
2
0
A
AAAA
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

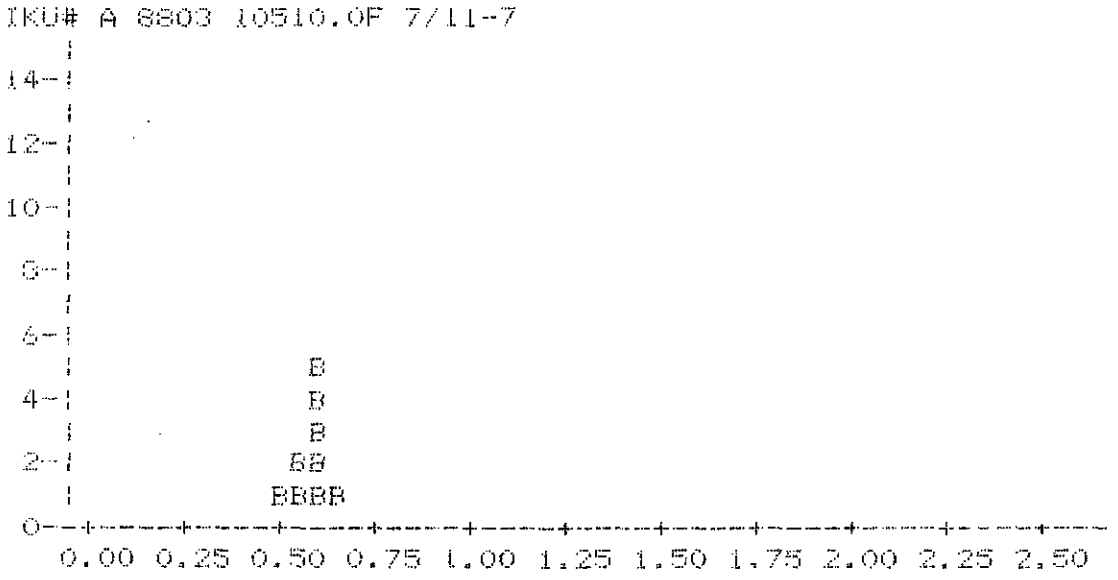

IKU# A 8740 9610.0F 7/11-7
14
12
10
8
6
4
2
0
U
U
U
UU U
UUUUUUU
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

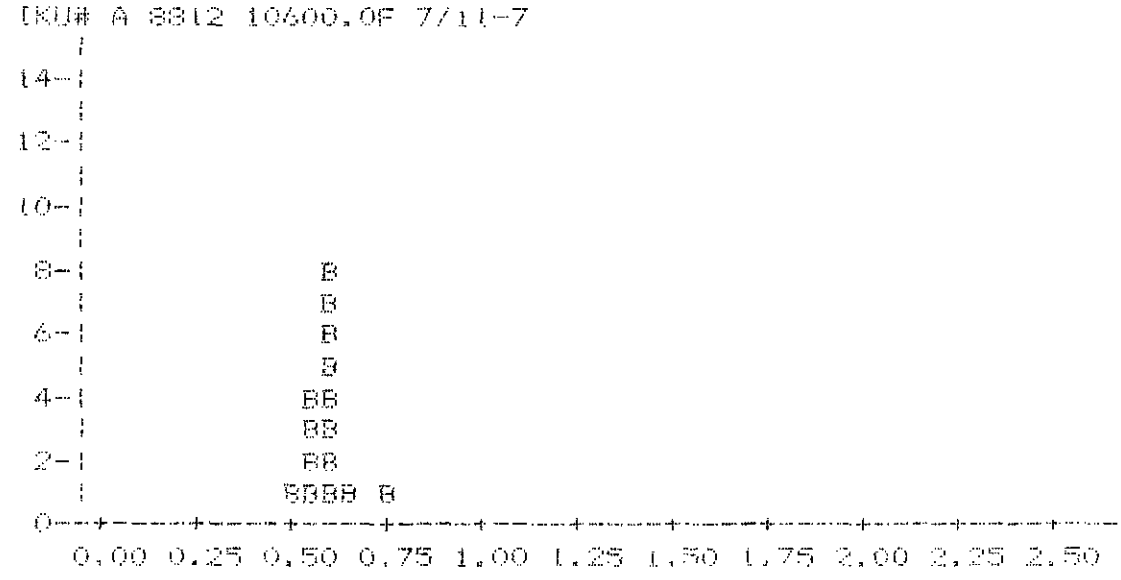

IKU# A 8762 10100.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

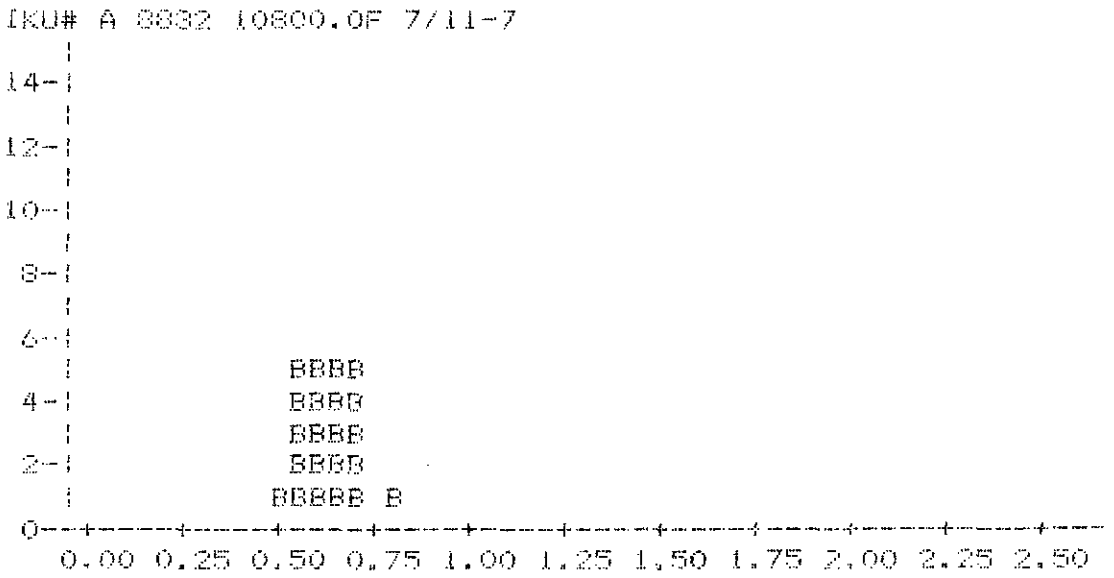

IKU# A 8772 10200.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

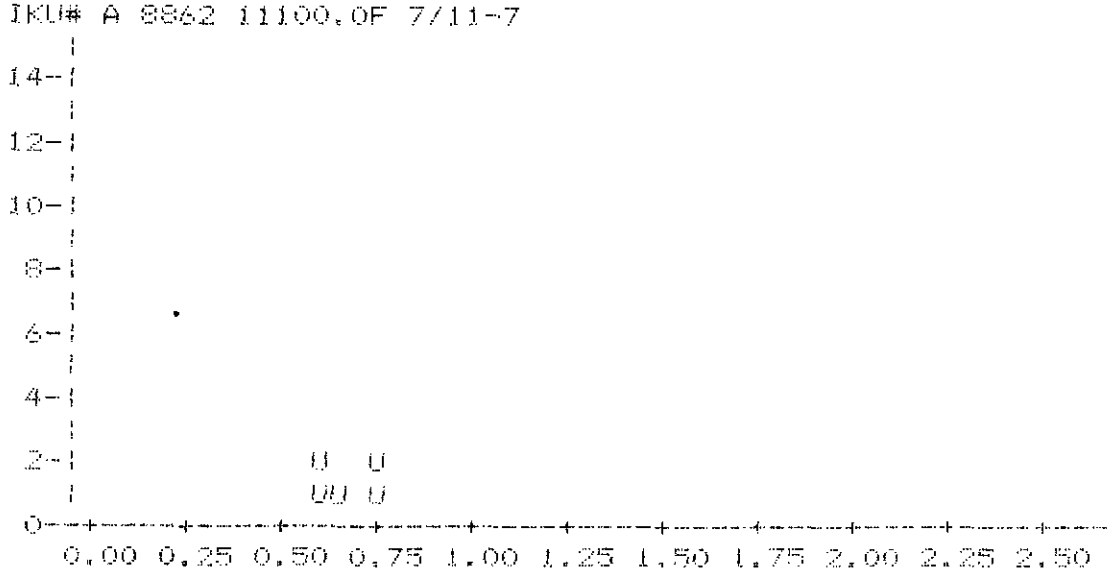

INU# A 8782 10300.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

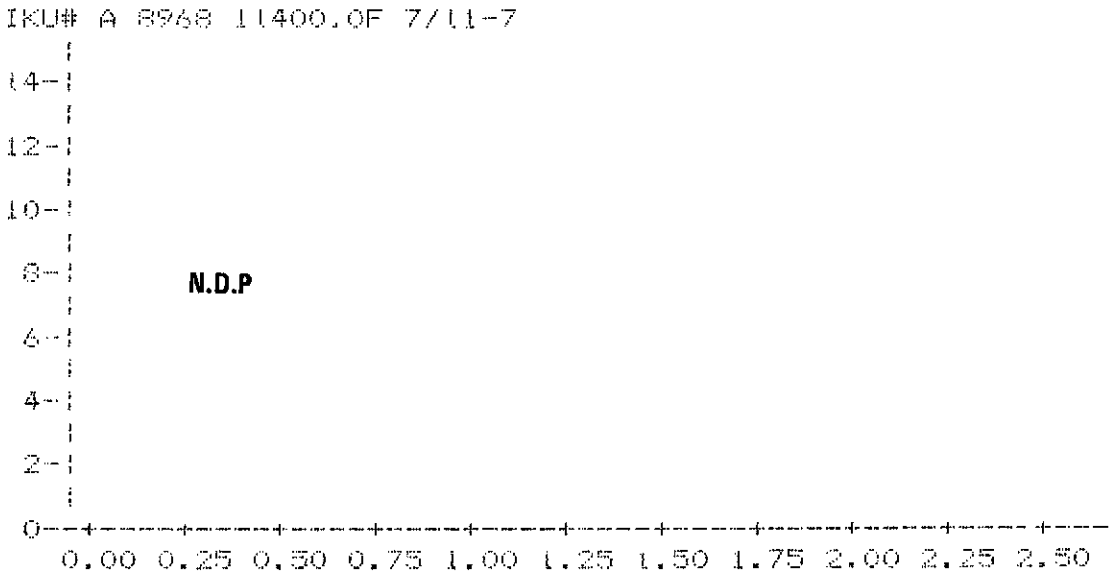

INU# A 8792 10400.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

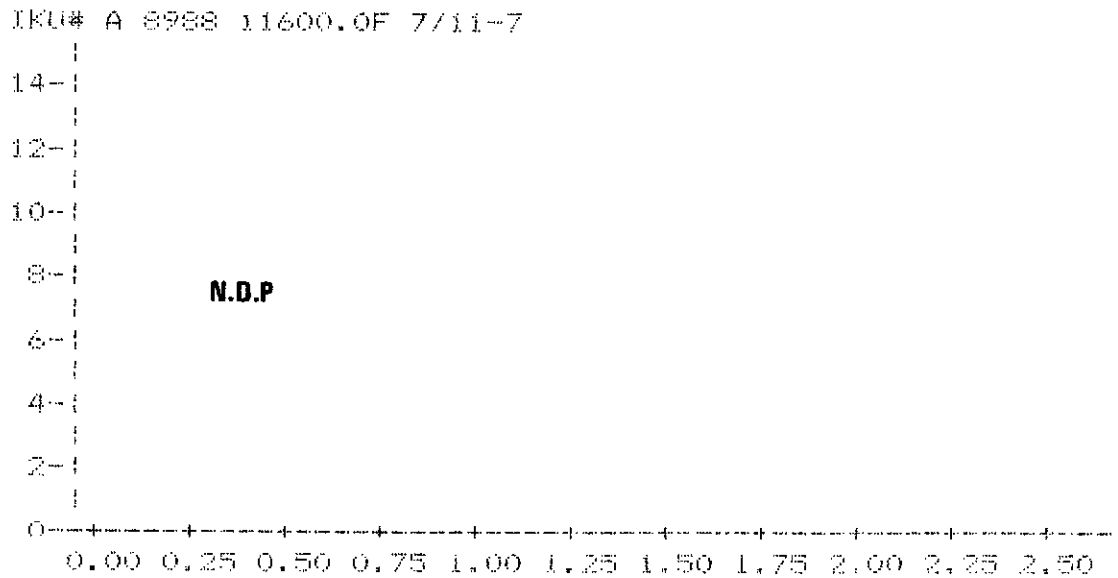

IKU# A 8803 10510.0F 7/11-7
14
12
10
8
6
4
2
0
B
B
B
BB
BBBB
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

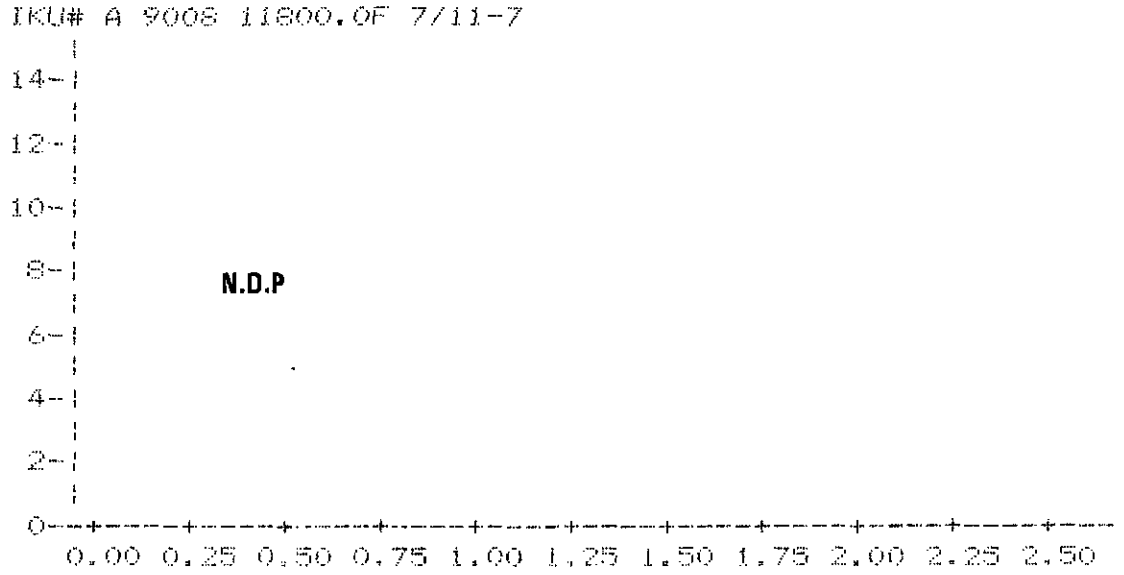

IKU# A 8812 10600.0F 7/11-7
14
12
10
8
6
4
2
0
B
B
B
B
BB
BB
BB
BBBB B
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

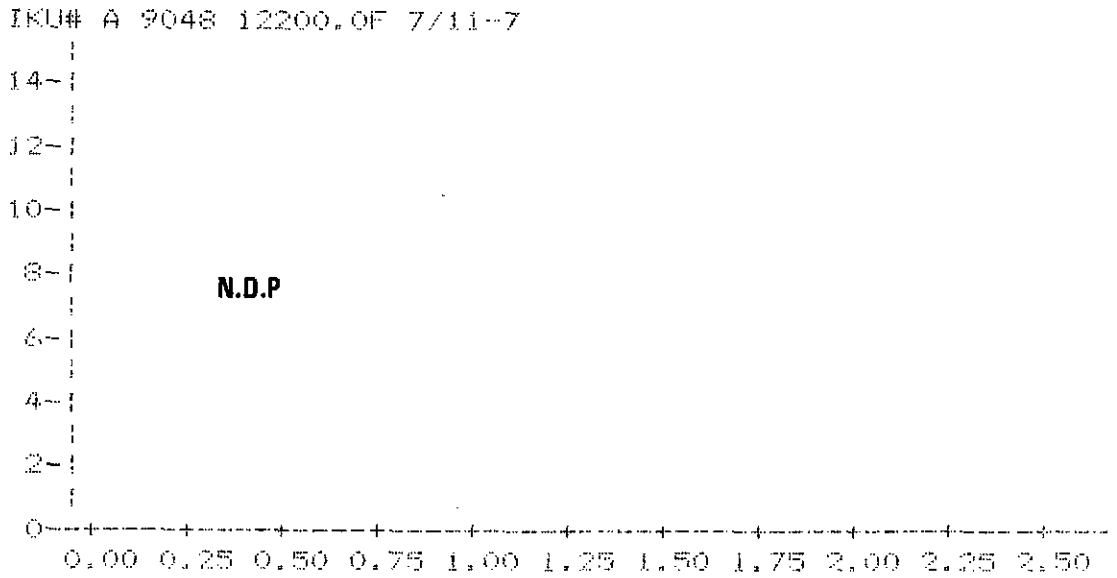

IKU# A 8832 10800.0F 7/11-7
14
12
10
8
6
4
2
0
BBBB
BBBB
BBBB
BBBB
BBBBB B
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

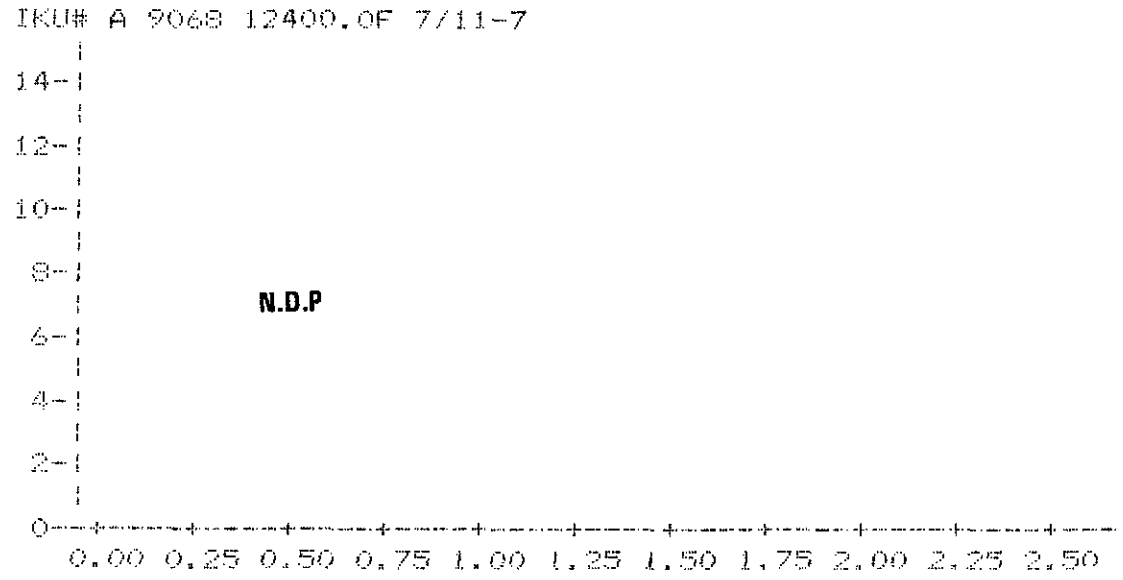

IKU# A 8862 11100.0F 7/11-7
14
12
10
8
6
4
2
0
U U
UU U
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

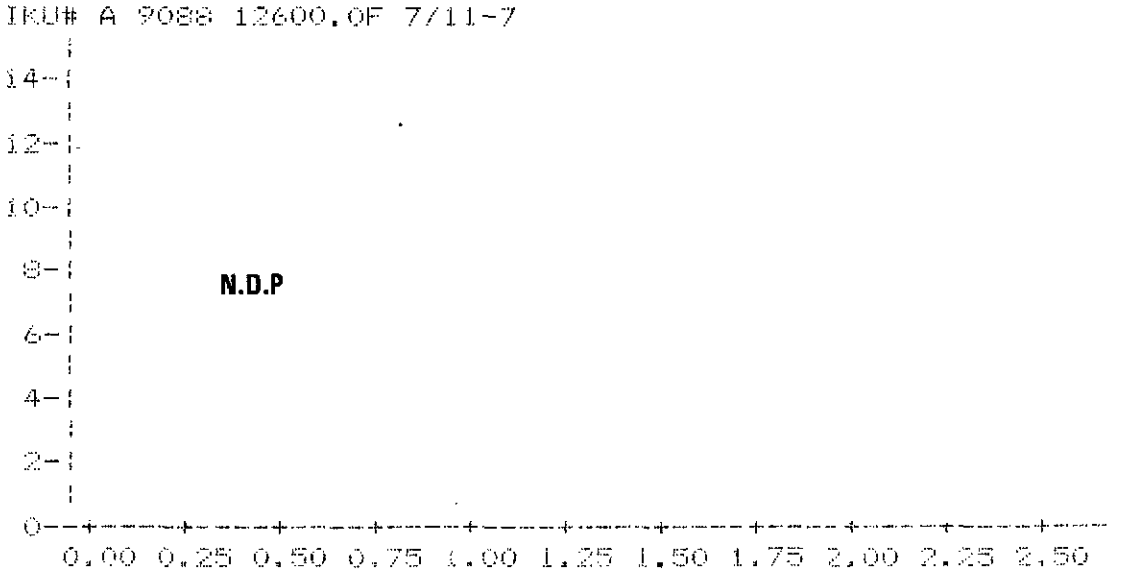

IKU# A 8968 11400.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

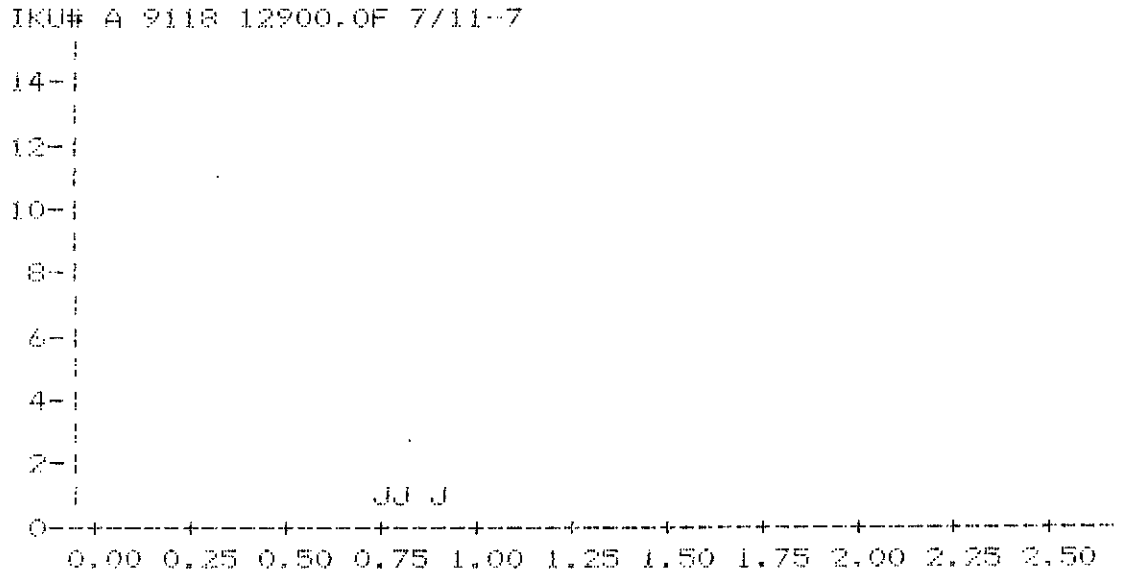

IKU# A 8988 11600.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

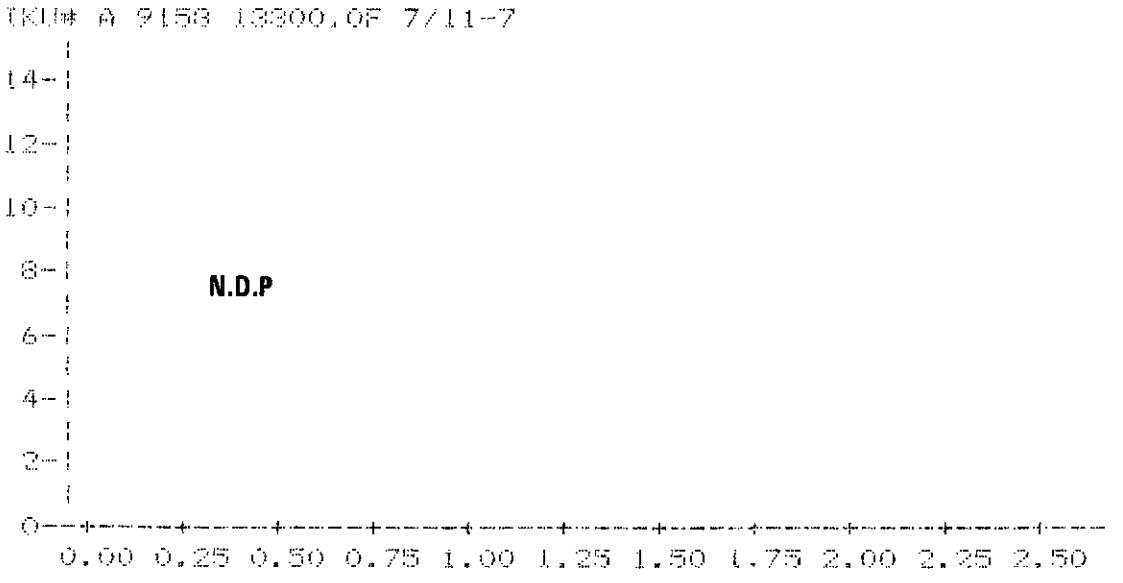

IKU# A 9008 11800.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

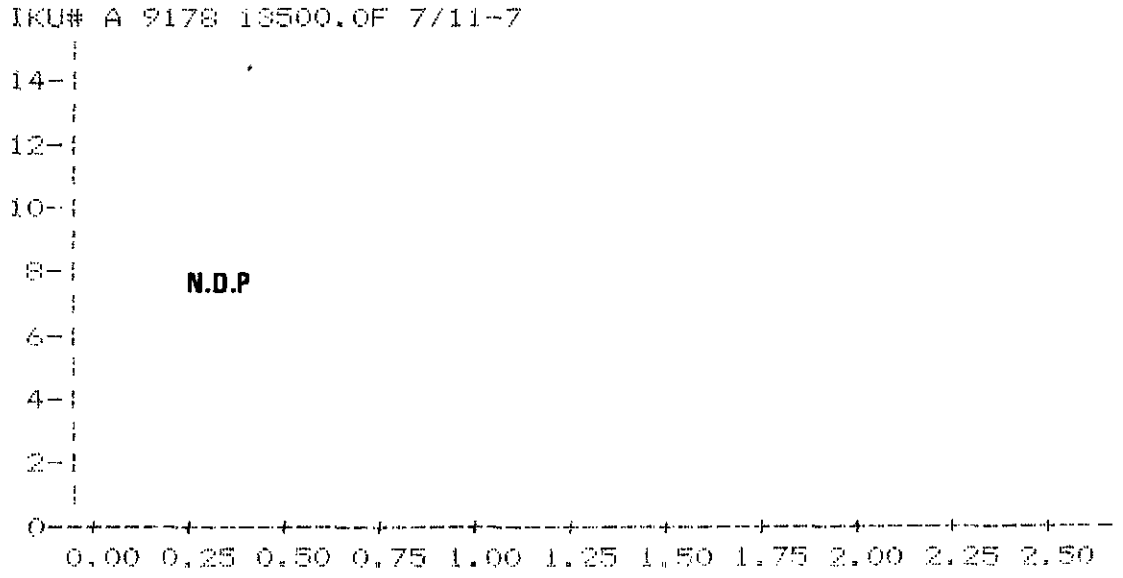

IKU# A 9048 12200.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

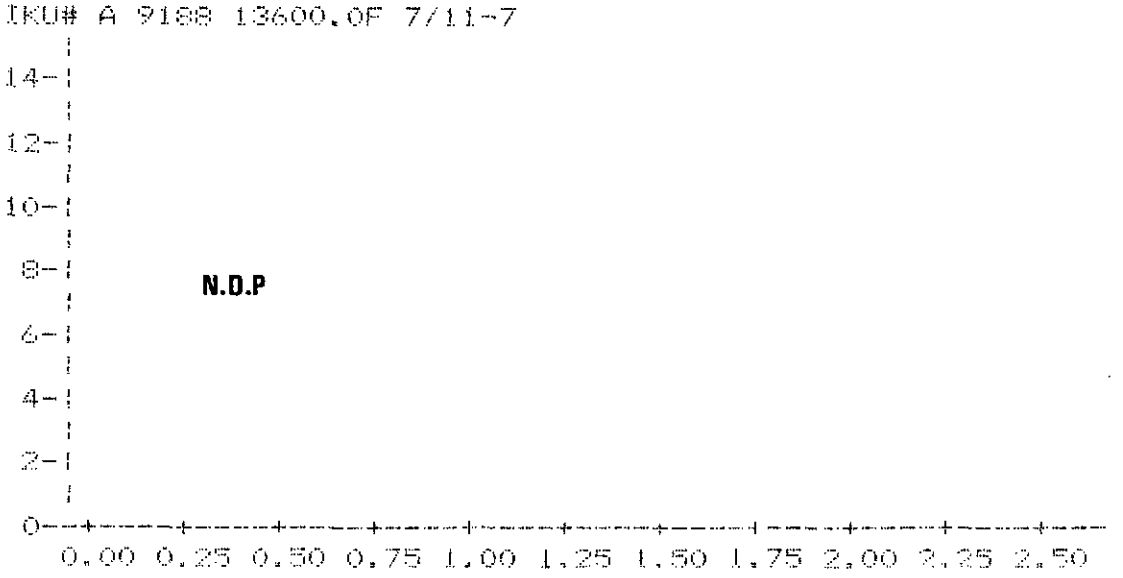

IKU# A 9068 12400.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

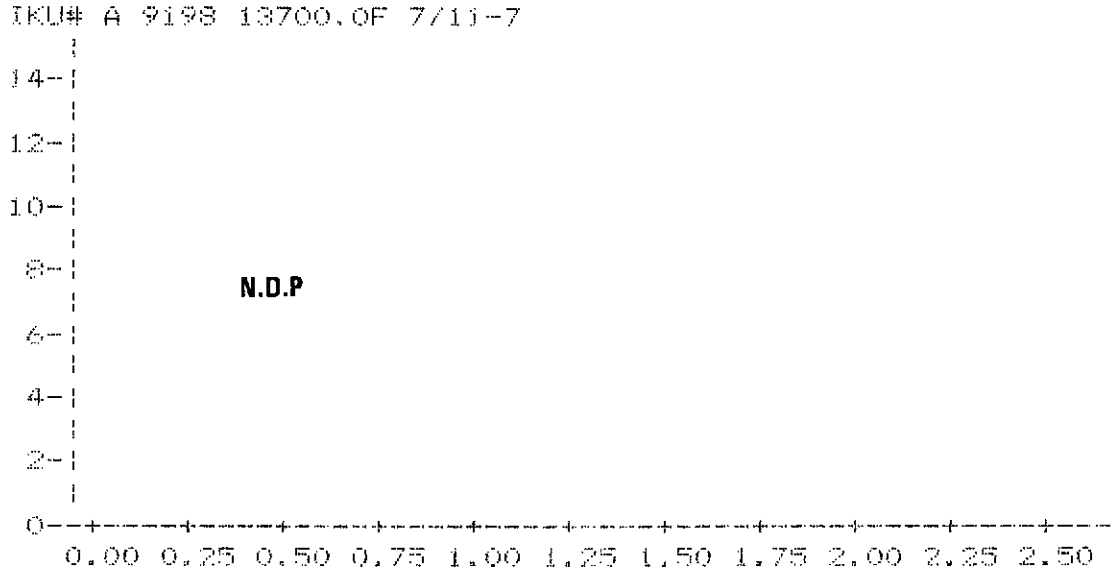

IKU# A 9088 12600.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

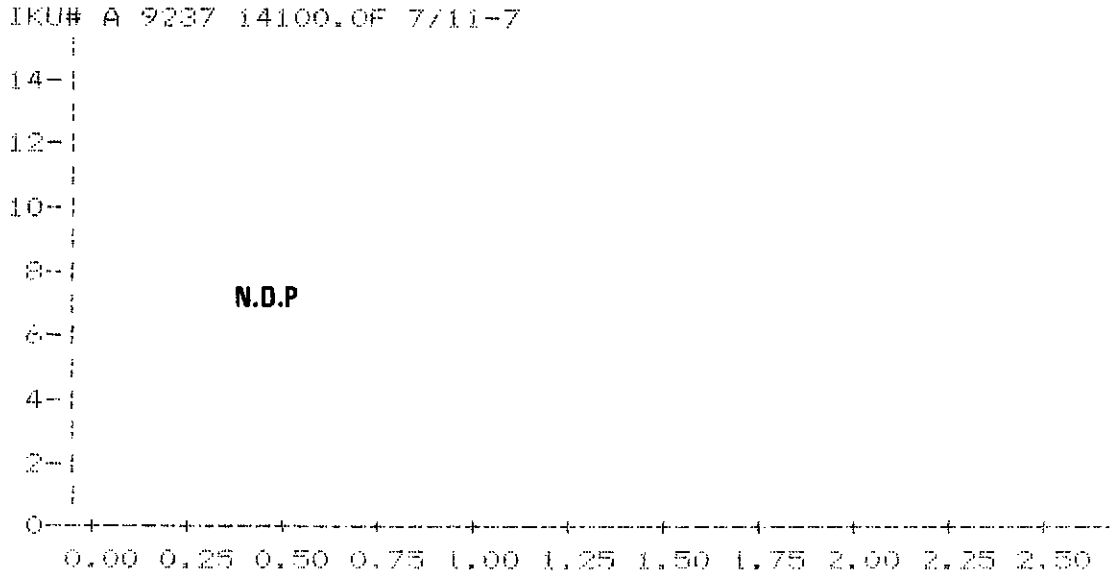

IKU# A 9118 12900.0F 7/11-7
14
12
10
8
6
4
2
0
JJ J
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

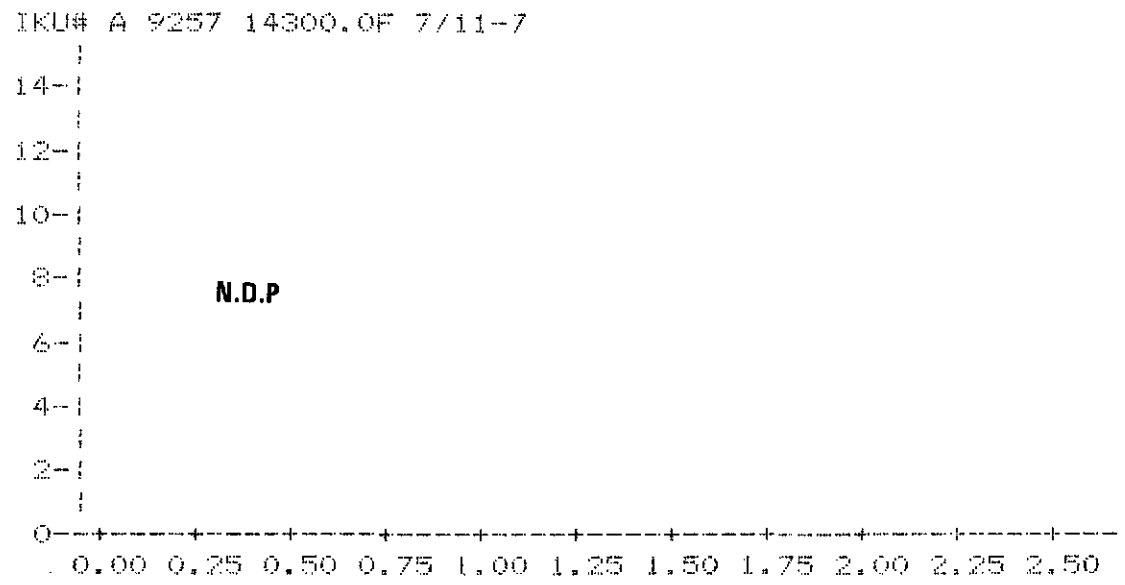

IKU# A 9158 13300.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

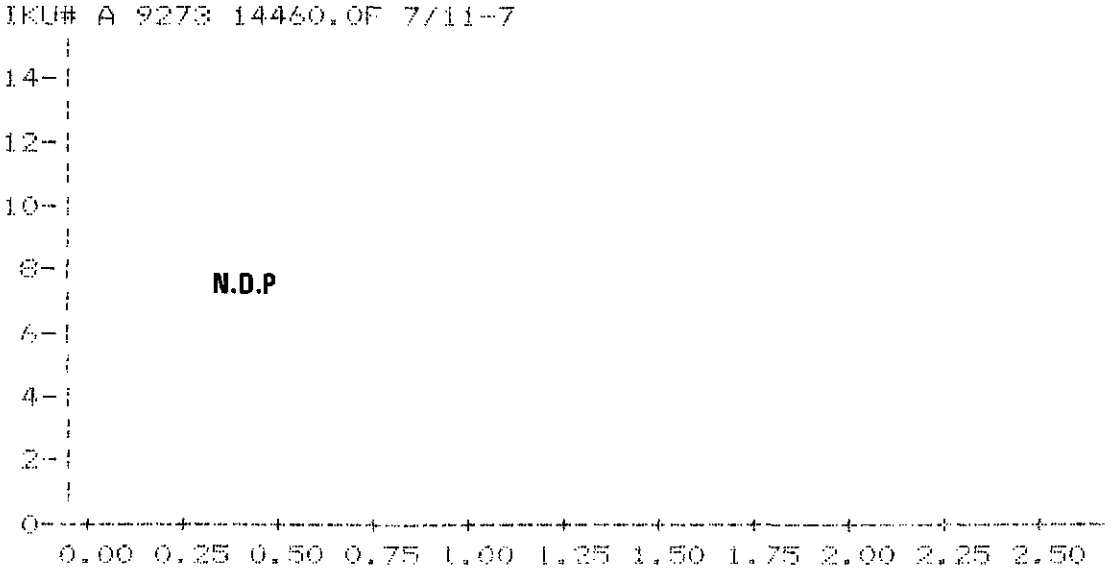

IKU# A 9178 13500.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

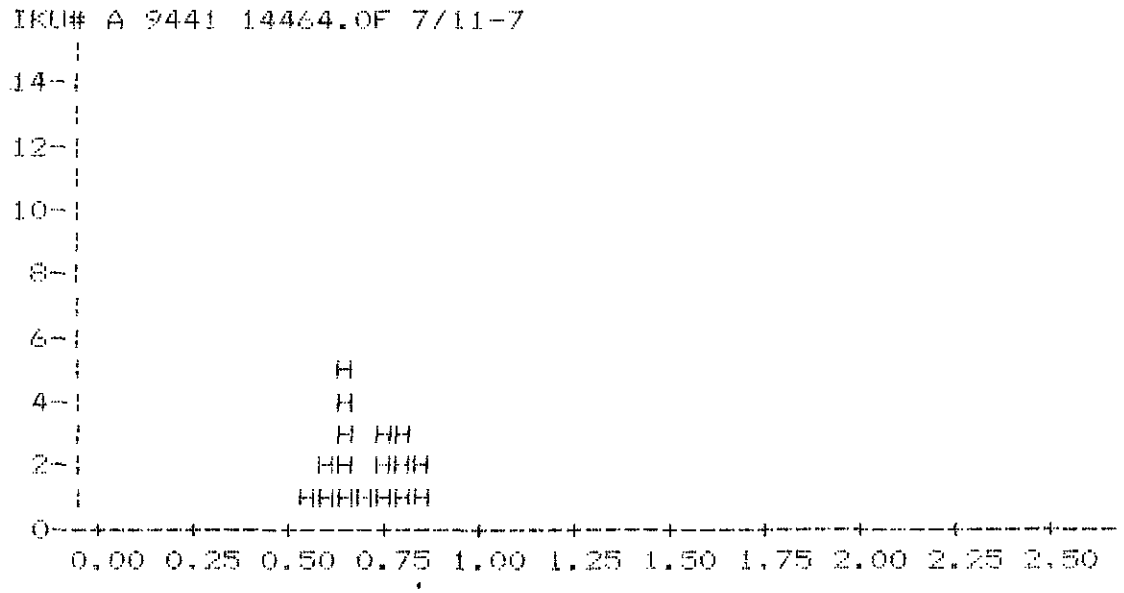

IKU# A 9188 13600.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

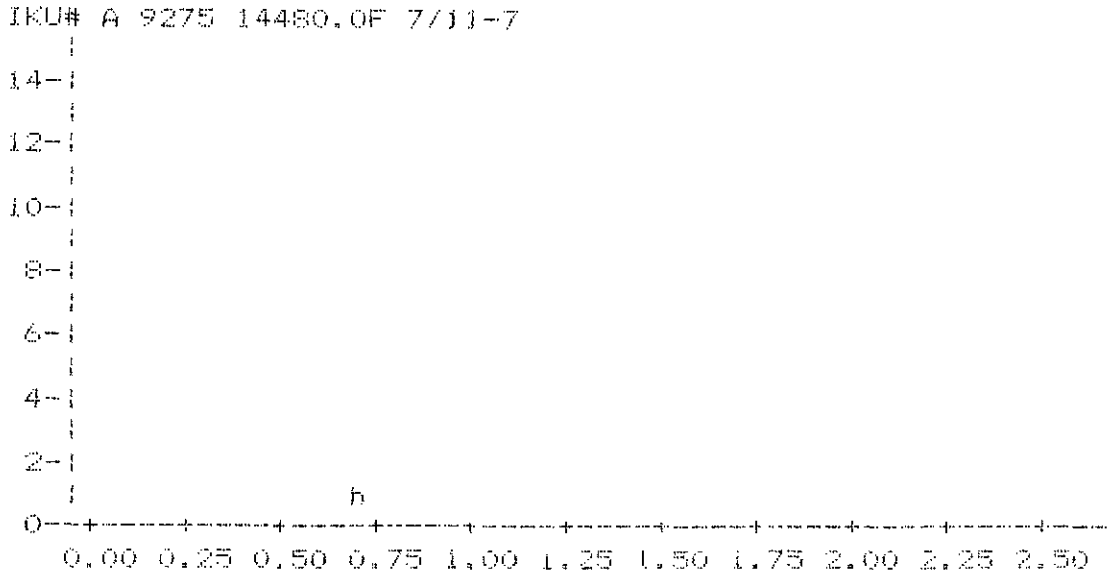

IKU# A 9198 13700.OF 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

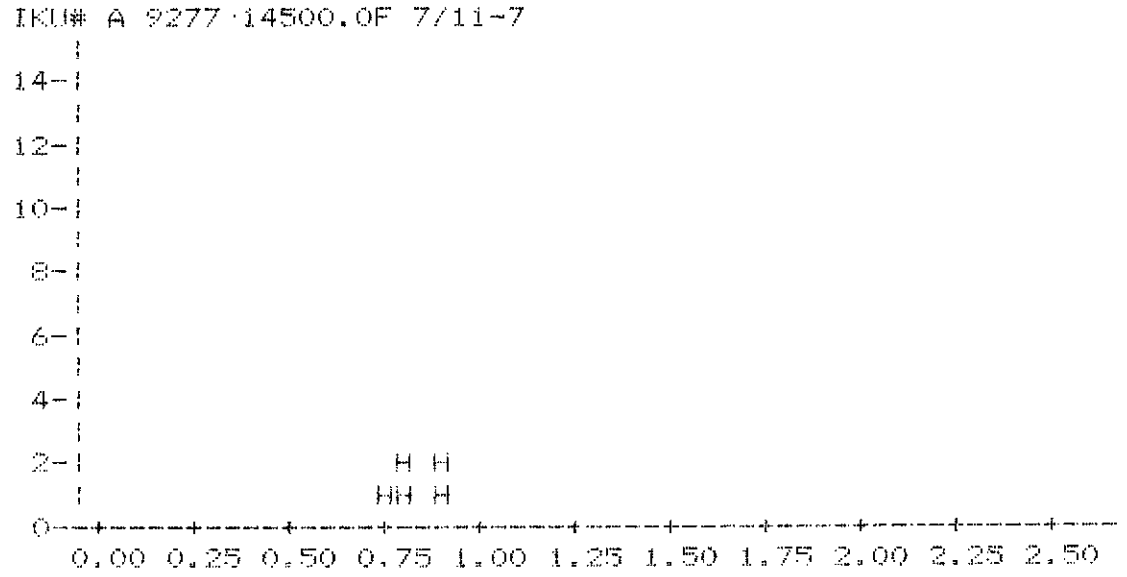

IKU# A 9237 14100.OF 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

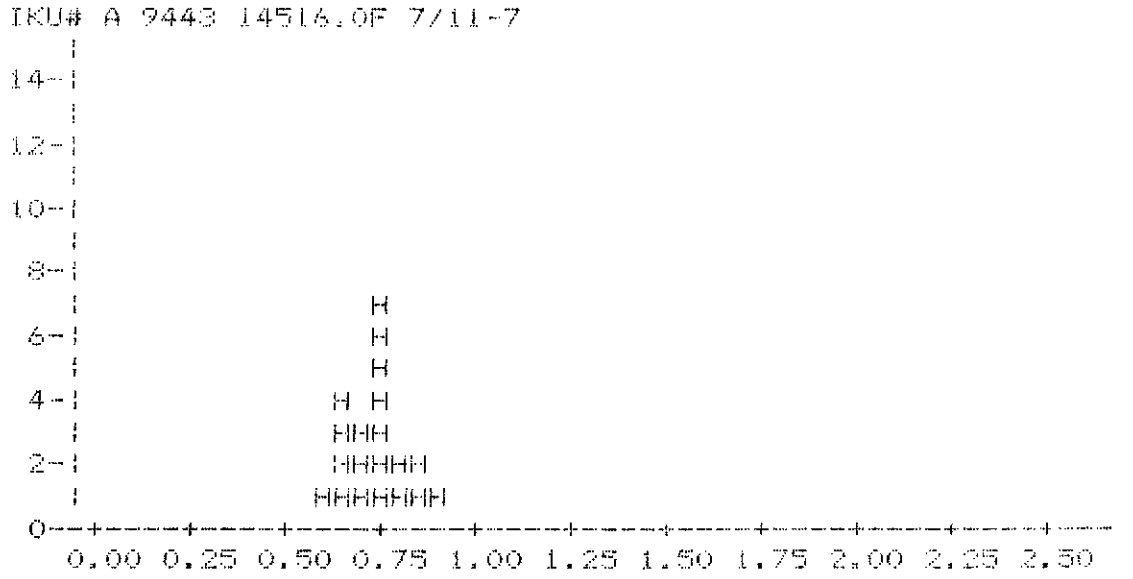

IKU# A 9257 14300.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

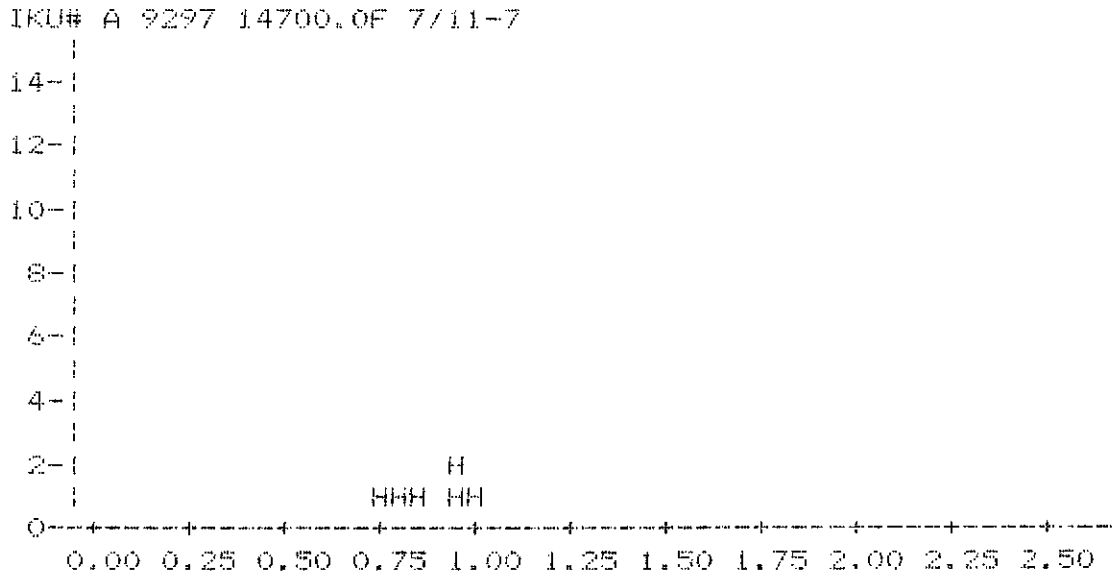

IKU# A 9273 14460.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

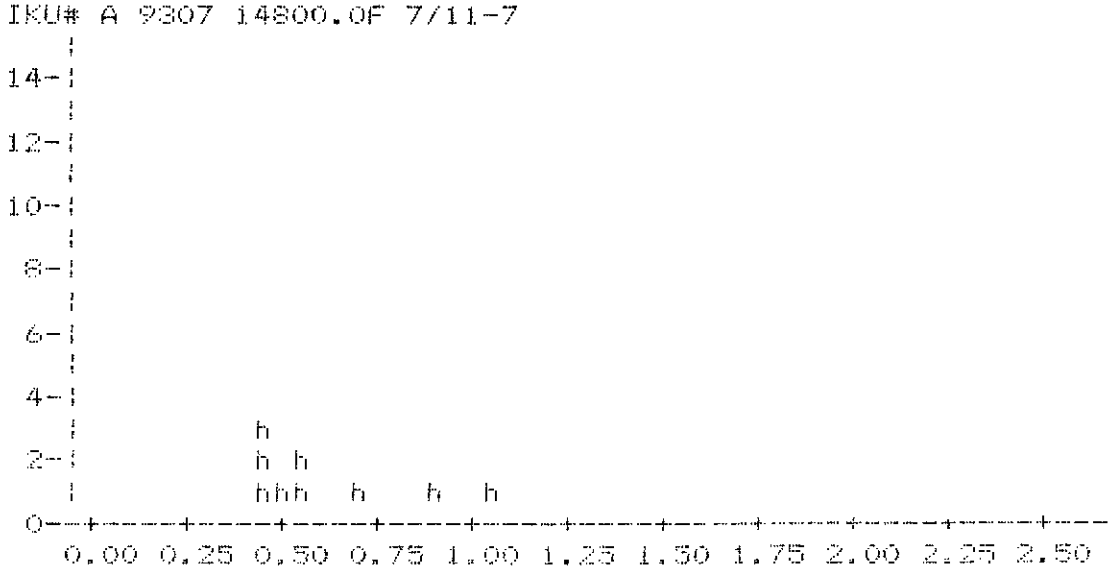

IKU# A 9441 14464.OF 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

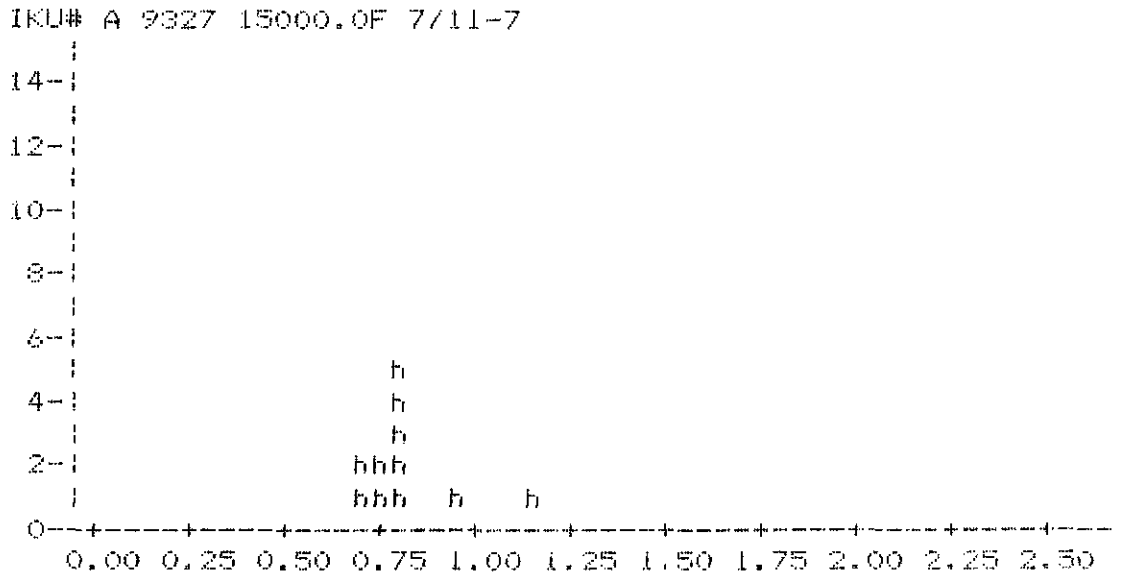

IKU# A 9275 14480.OF 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

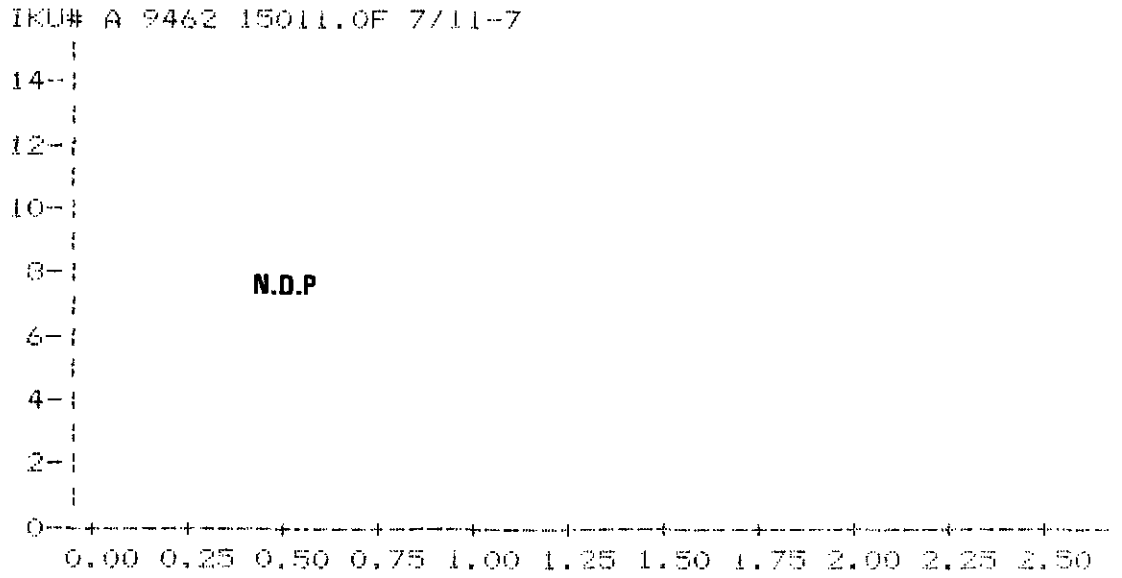

IKU# A 9277 14500.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

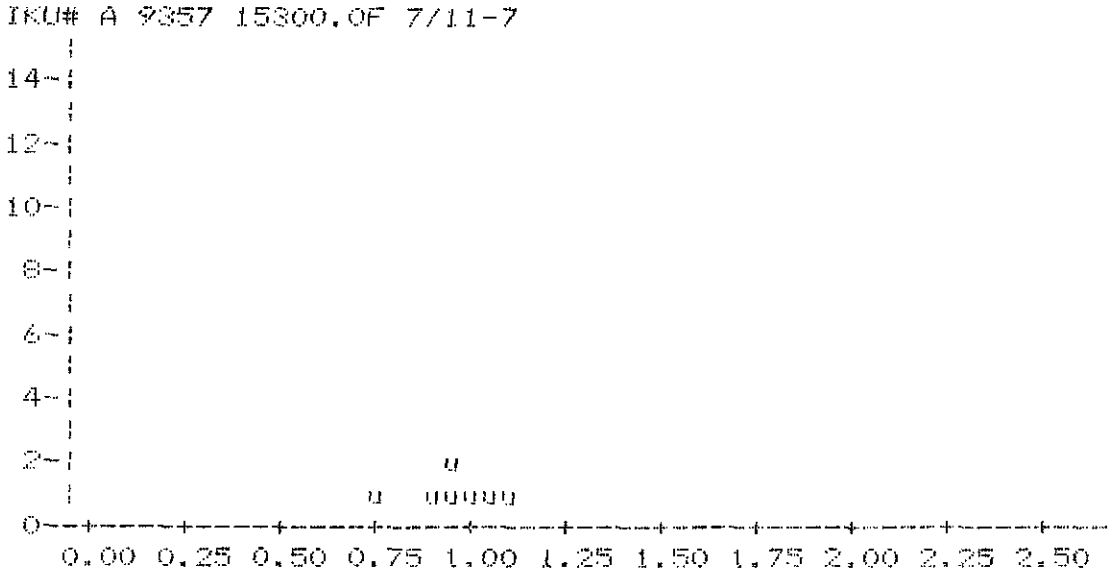

IKU# A 9443 14516.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

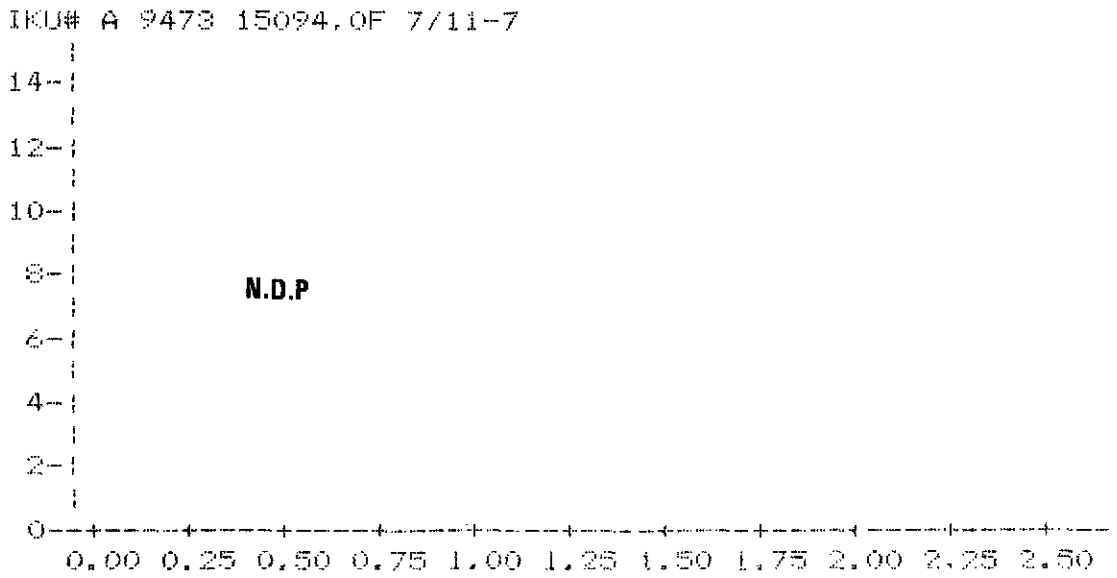

IKU# A 9297 14700.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

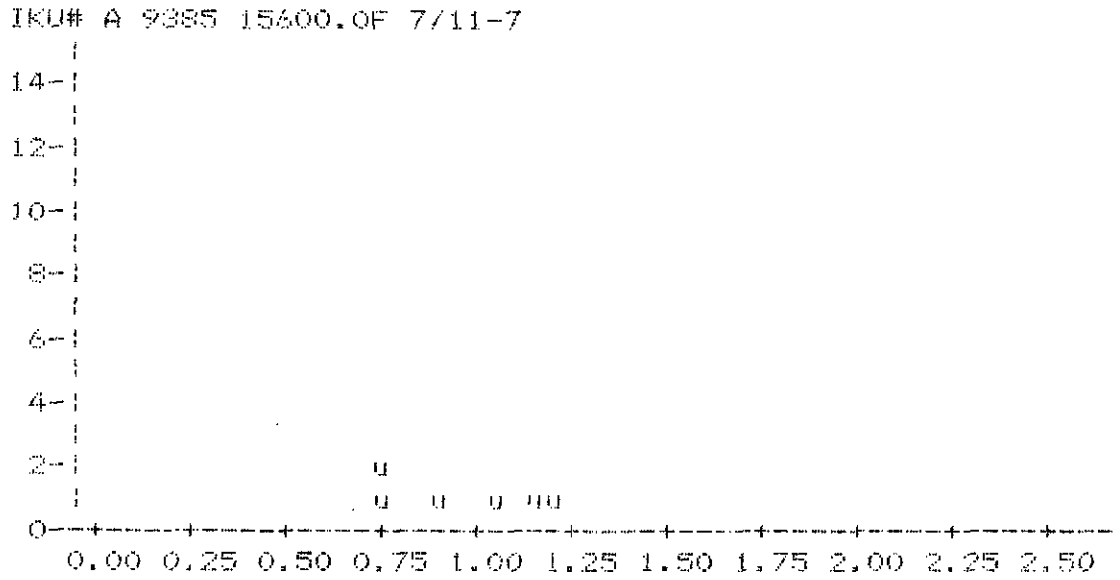

IKU# A 9307 14800.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

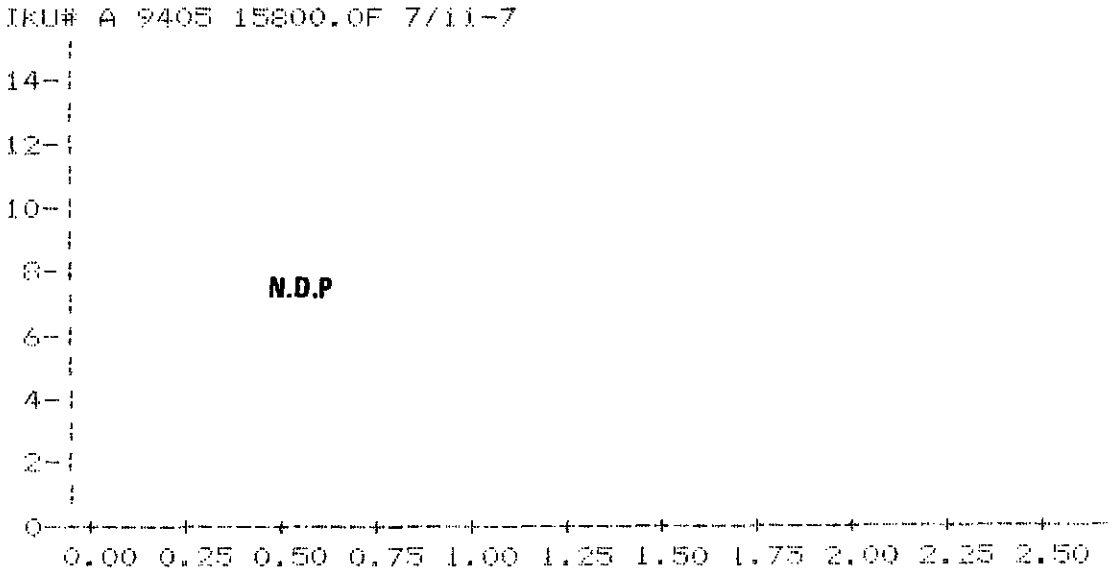

IKU# A 9327 15000.0F 7/11-7
14
12
10
8
6
4
2
0
h
hhh
hhh h h
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

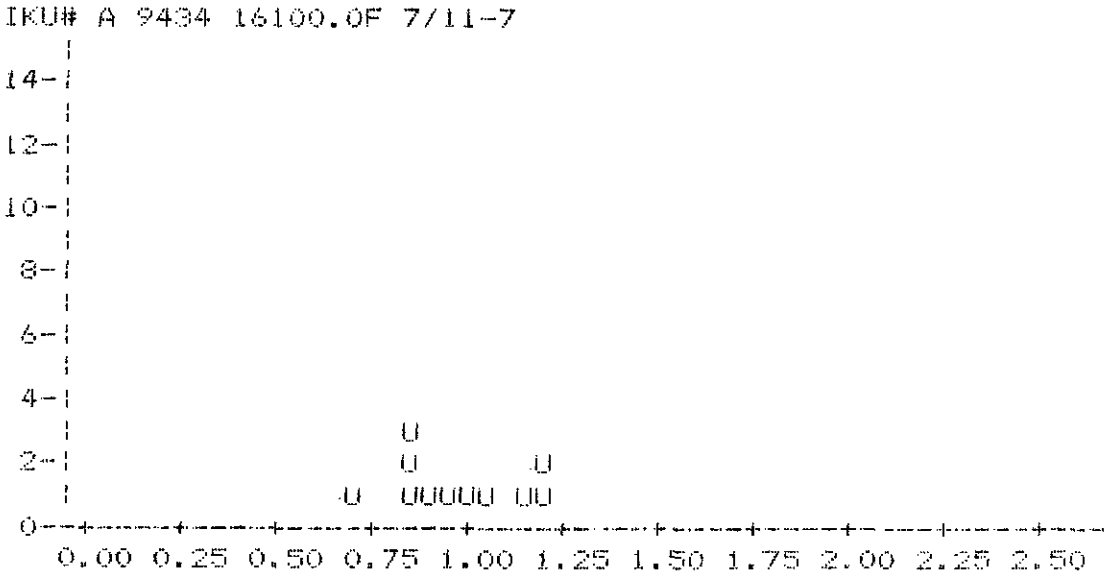

IKU# A 9462 15011.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

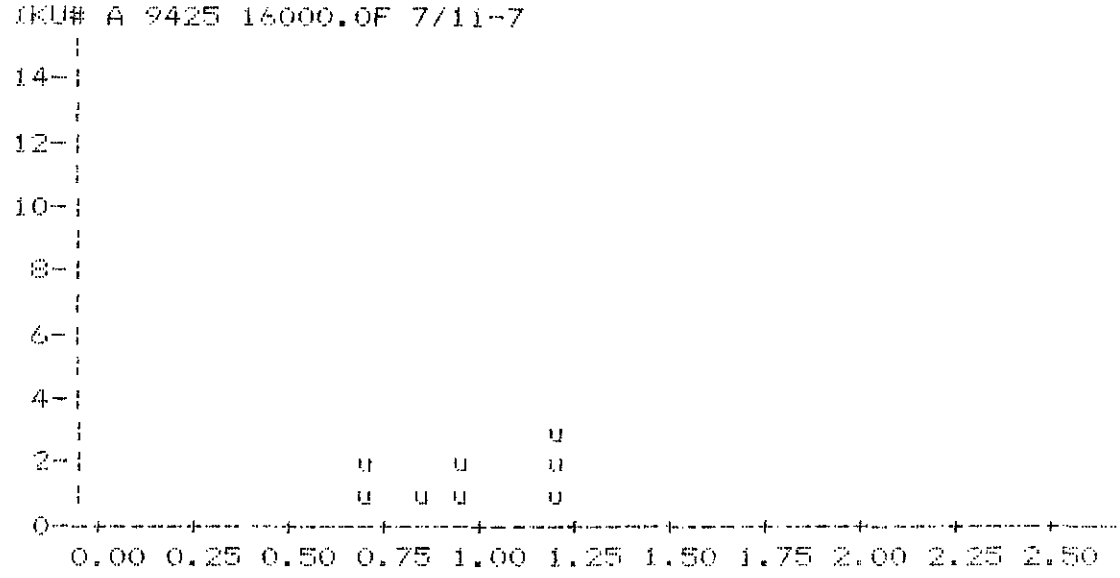

IKU# A 9357 15300.OF 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50


IKU# A 9473 15094.OF 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50


IKU# A 9385 15600.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50


IKU# A 9405 15800.0F 7/11-7
14
12
10
8
6
4
2
0
N.D.P
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

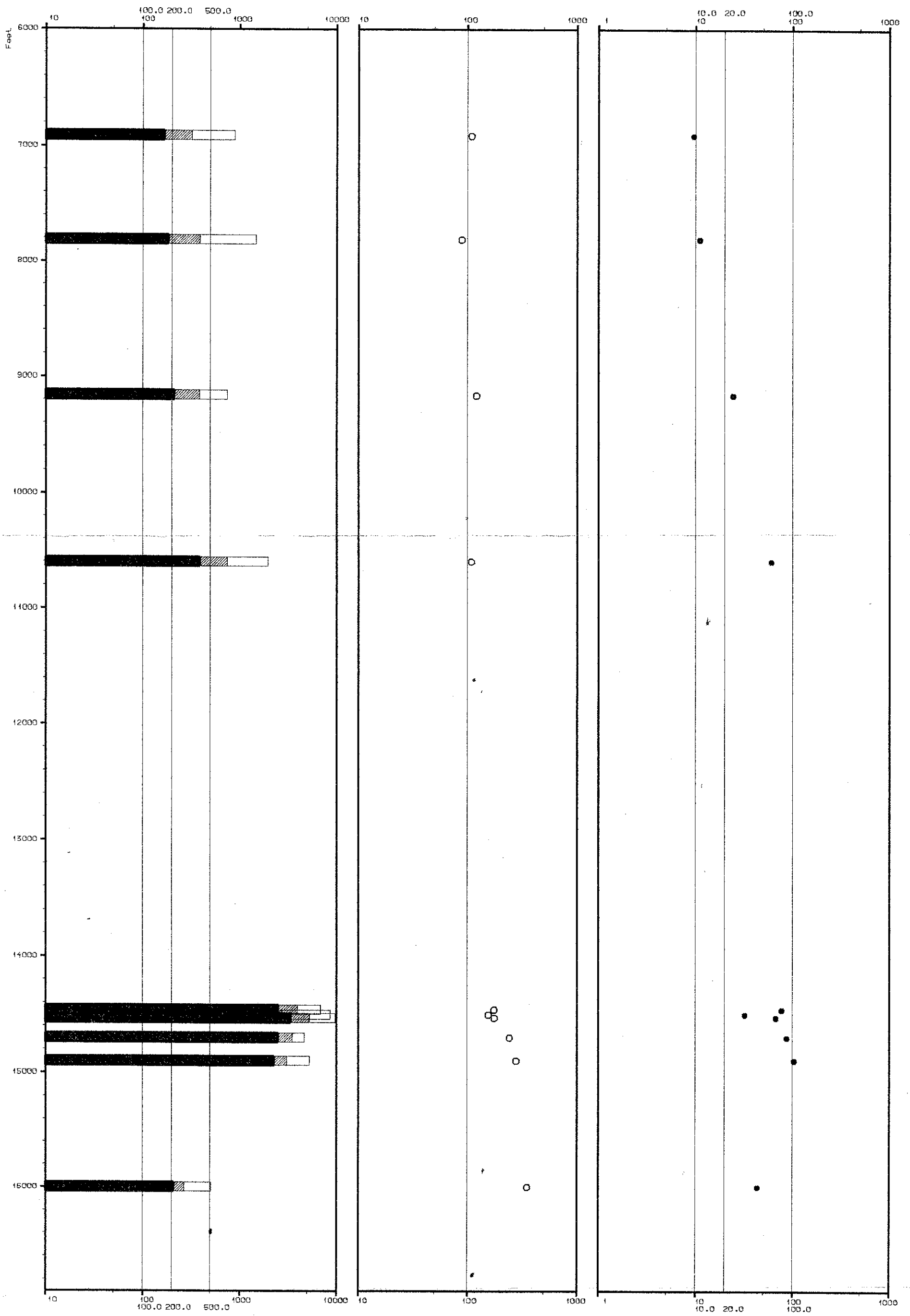

IKU# A 9434 16100.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50


IKU# A 9425 16000.0F 7/11-7
14
12
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

Organic Geochemistry Department

C_{15}^{+} HYDROCARBONS

Well no: 7/11 – 7
Company: Phillips Petroleum

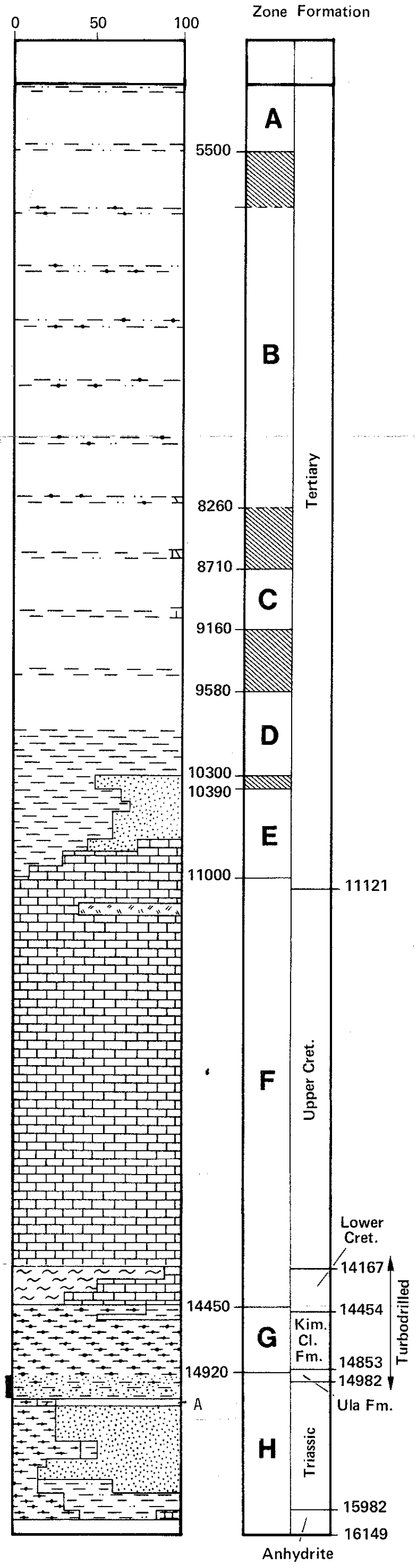


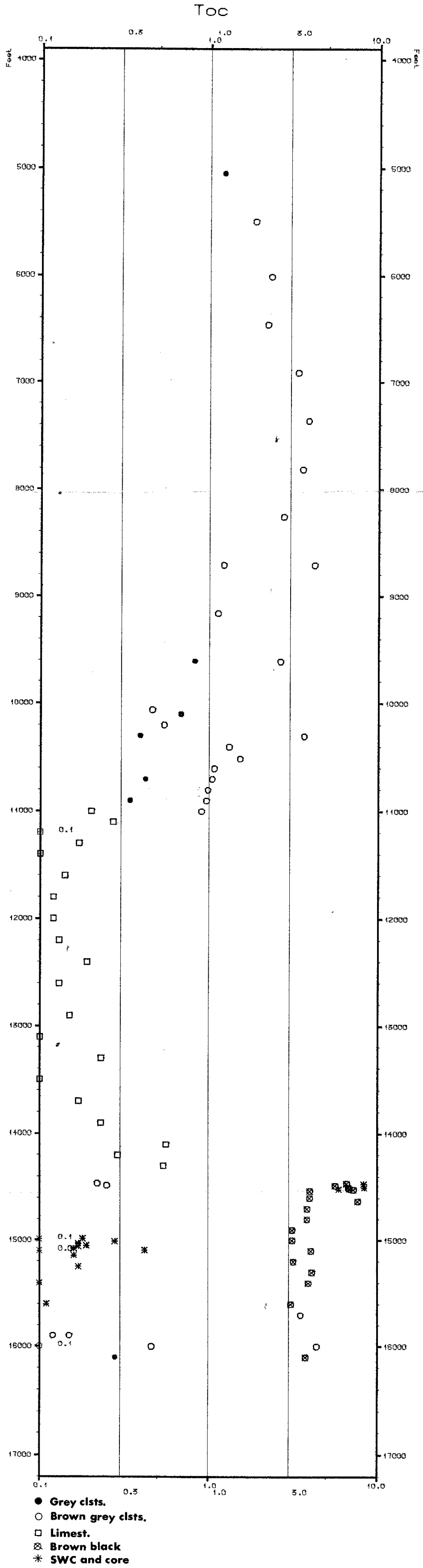
Sat. Aro. NSO Asp

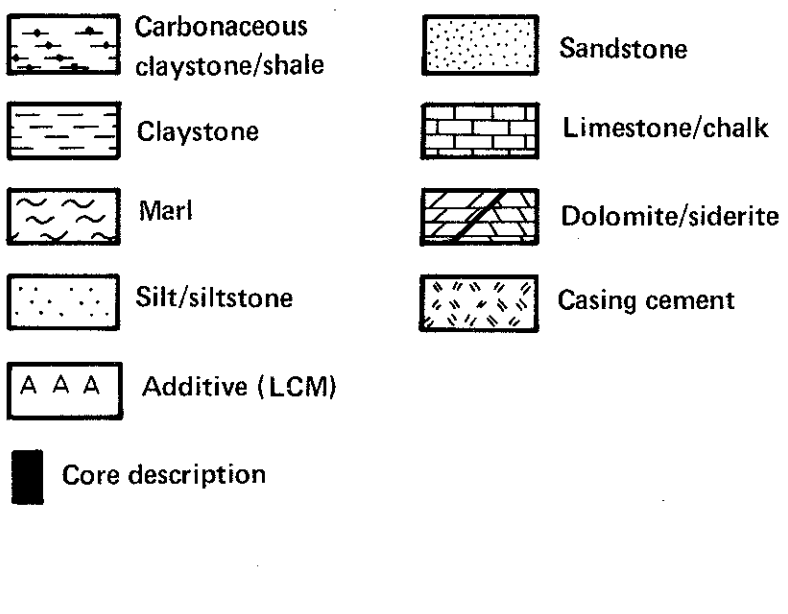
Organic Geochemistry Department

TOTAL ORGANIC CARBON (TOC)

Well no: 7/11 – 7
Company: Phillips Petroleum



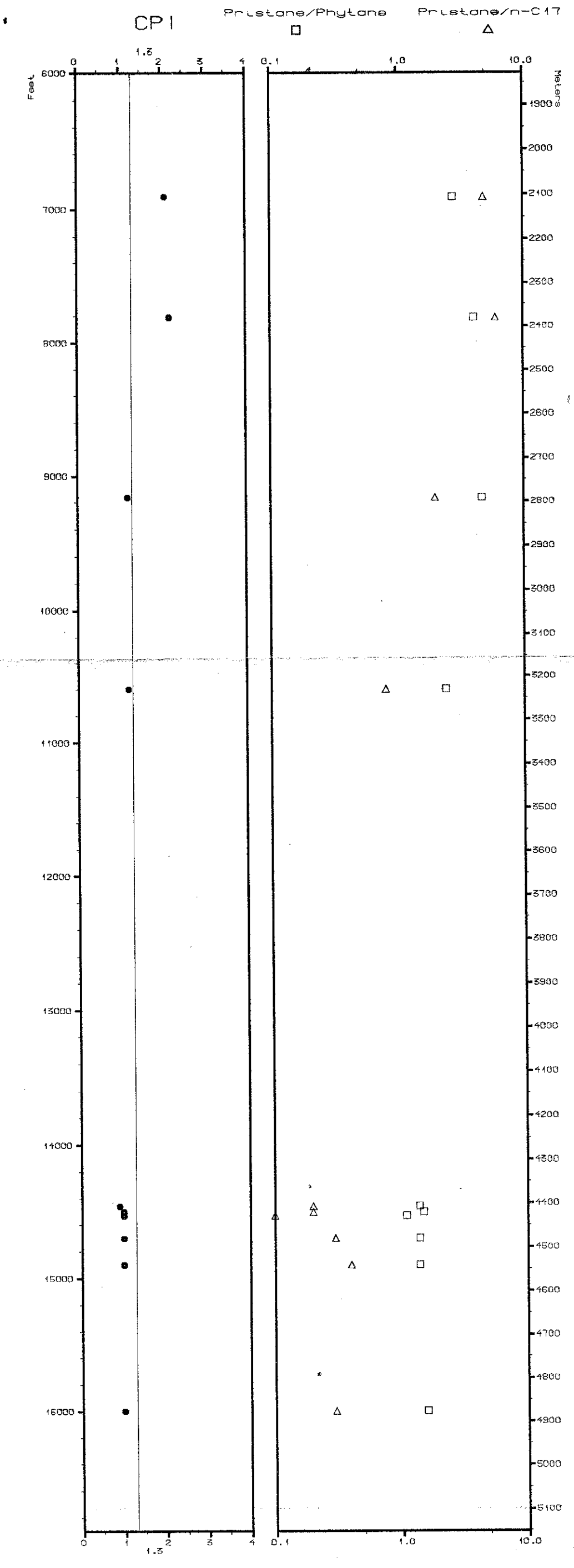




Organic Geochemistry Department

C_{15}^{+} SATURATED HYDROCARBONS

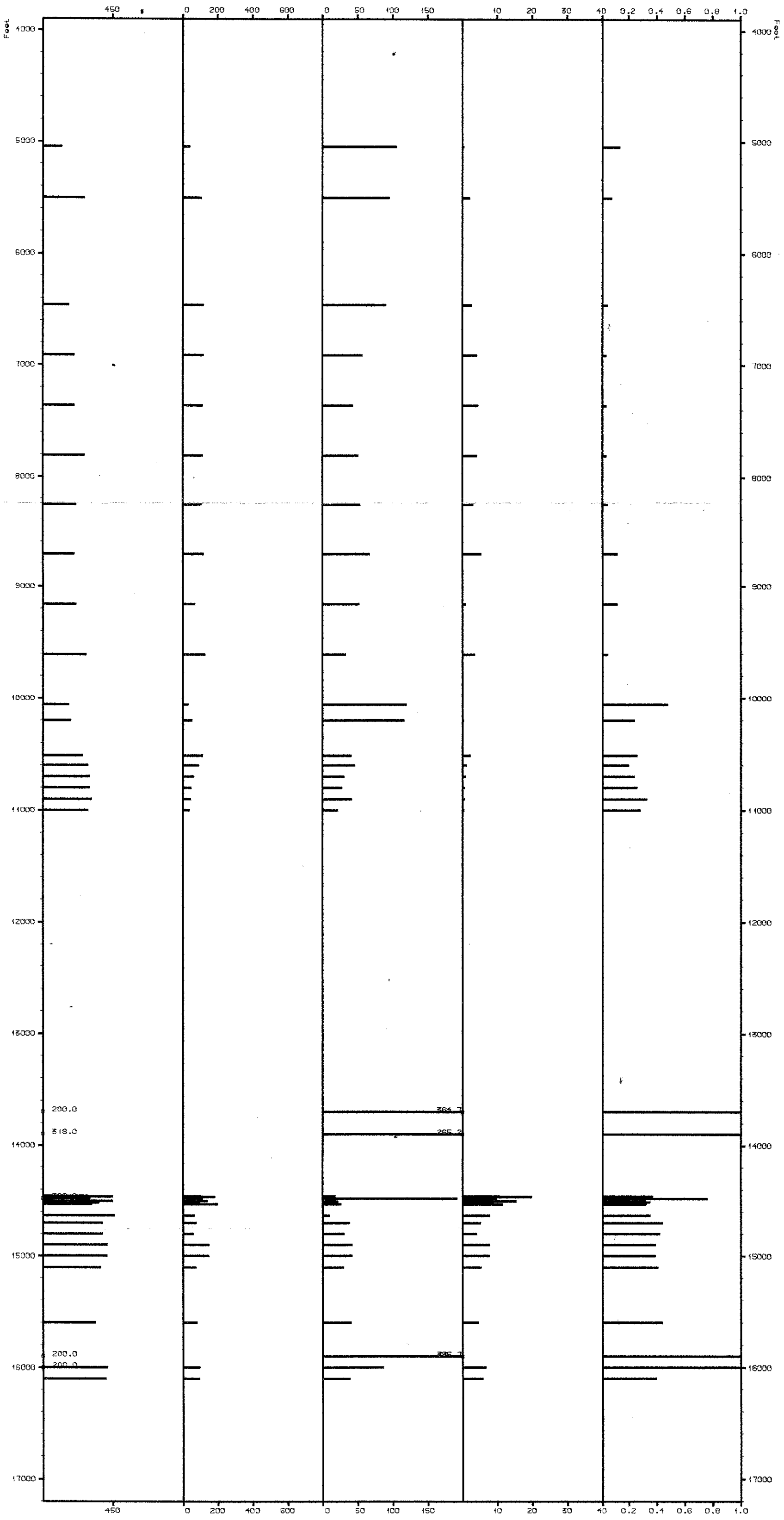
Well no: 7/11 – 7
Company: Phillips Petroleum



Organic Geochemistry Department

ROCK-EVAL PYROLYSIS

Well no: 7/11 – 7
Company: Phillips Petroleum

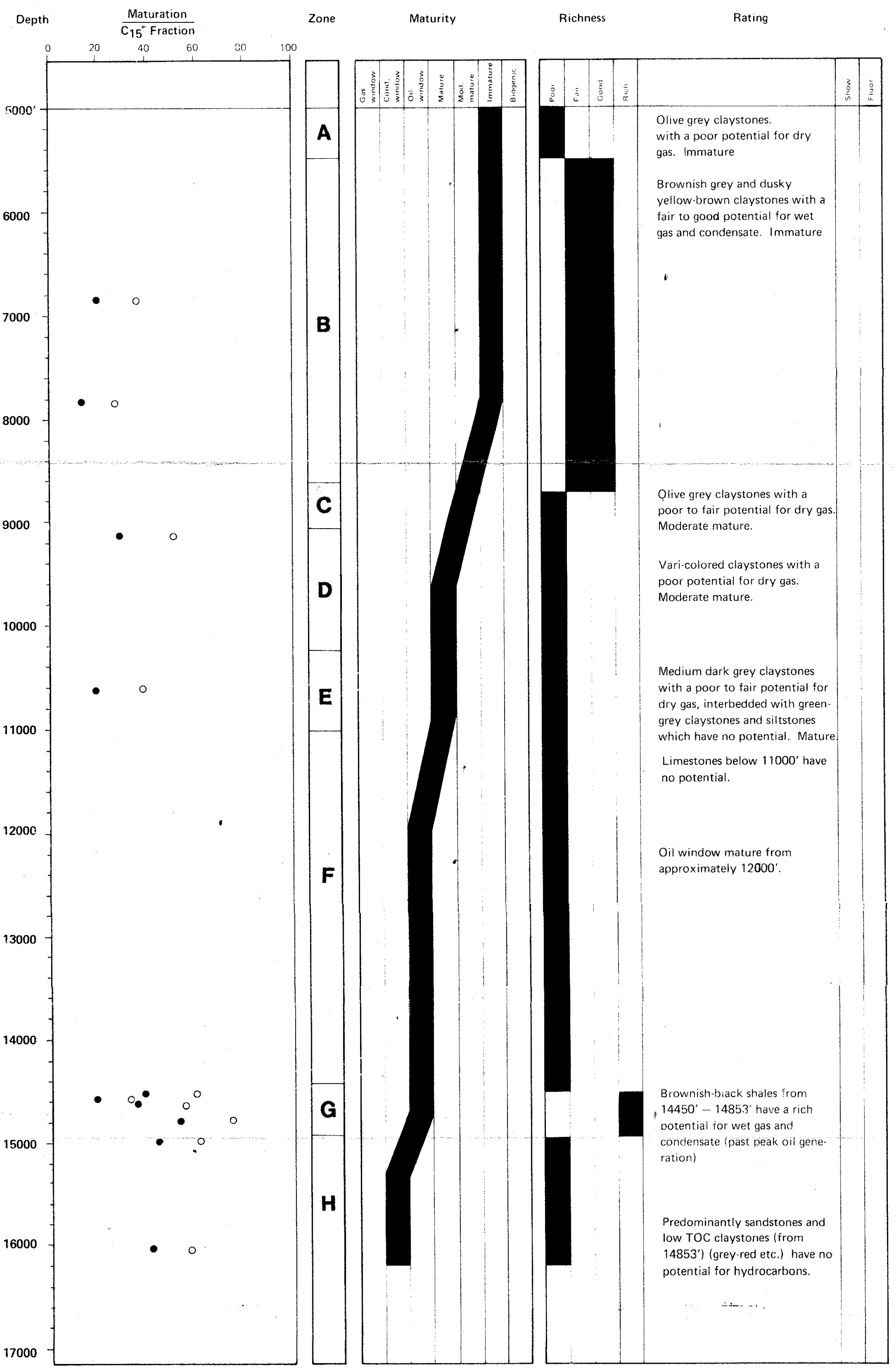


Organic Geochemistry Department

INTERPRETATION DIAGRAM

Well no.: 7/11 — 7
Company: Phillips Petroleum

SUMMARY OF SOURCE POTENTIAL



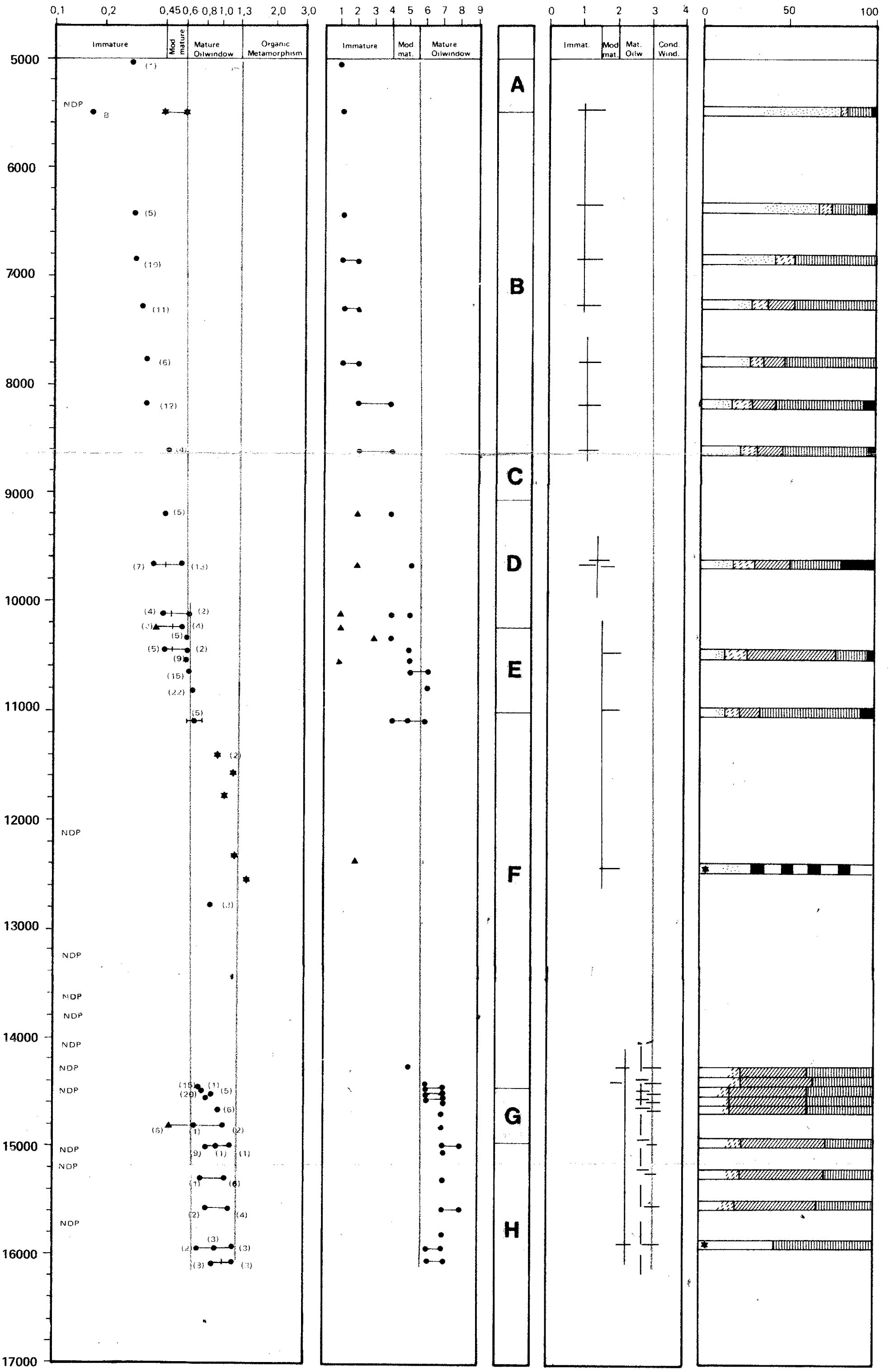
Sat: Saturated Hydrocarbons.
HC: Hydrocarbons.
EOM: Extractable Organic Matter.

Organic Geochemistry Department

MATURATION

Well no.: 7/11 – 7
Company: Phillips Petroleum

VISUAL KEROGEN
COLORATION AND COMPOSITION OF ORGANIC RESIDUE

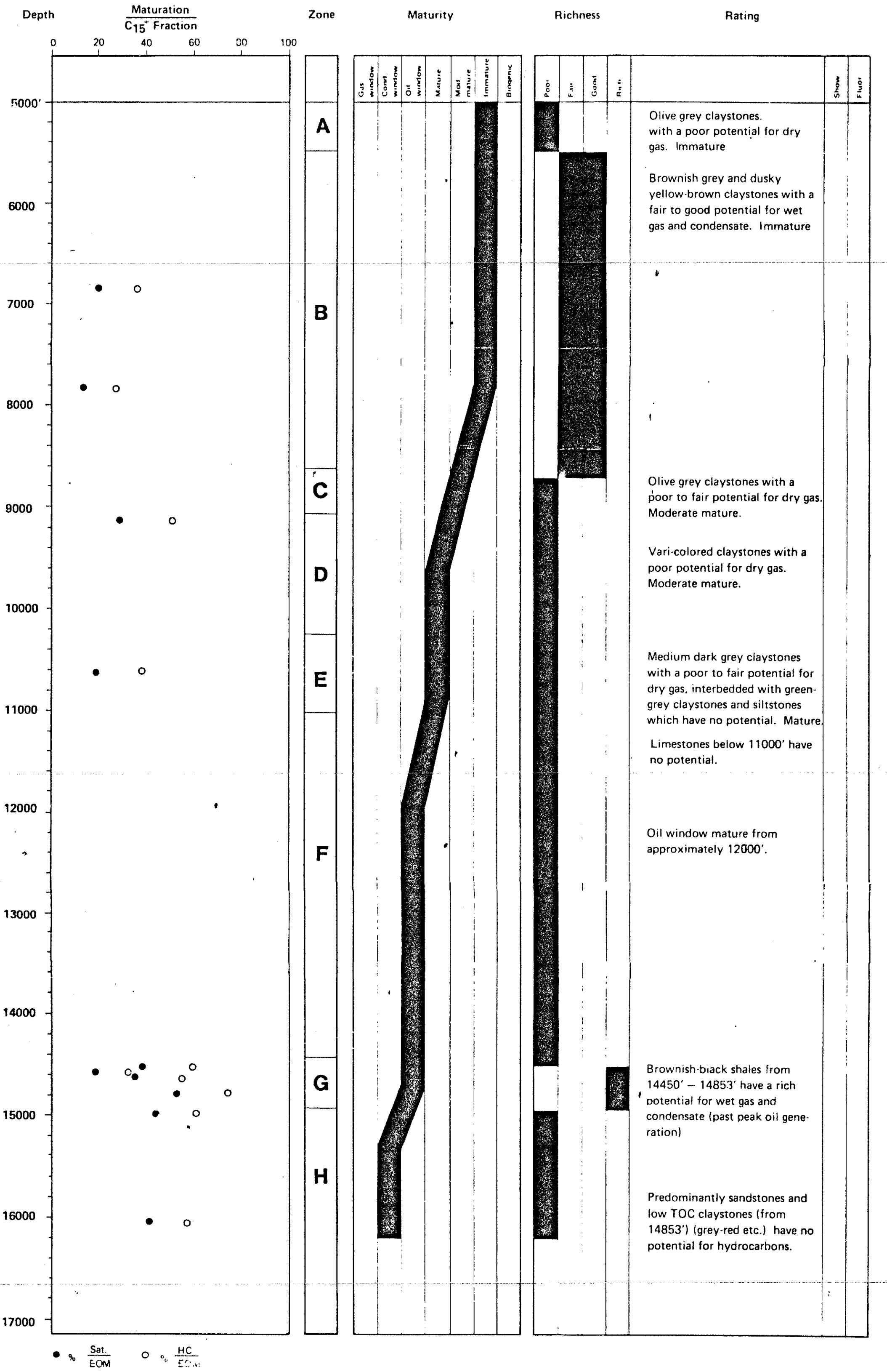


IKU Organic Geochemistry Department

INTERPRETATION DIAGRAM

Well no.: 7/11 – 7
Company: Phillips Petroleum

SUMMARY OF SOURCE POTENTIAL



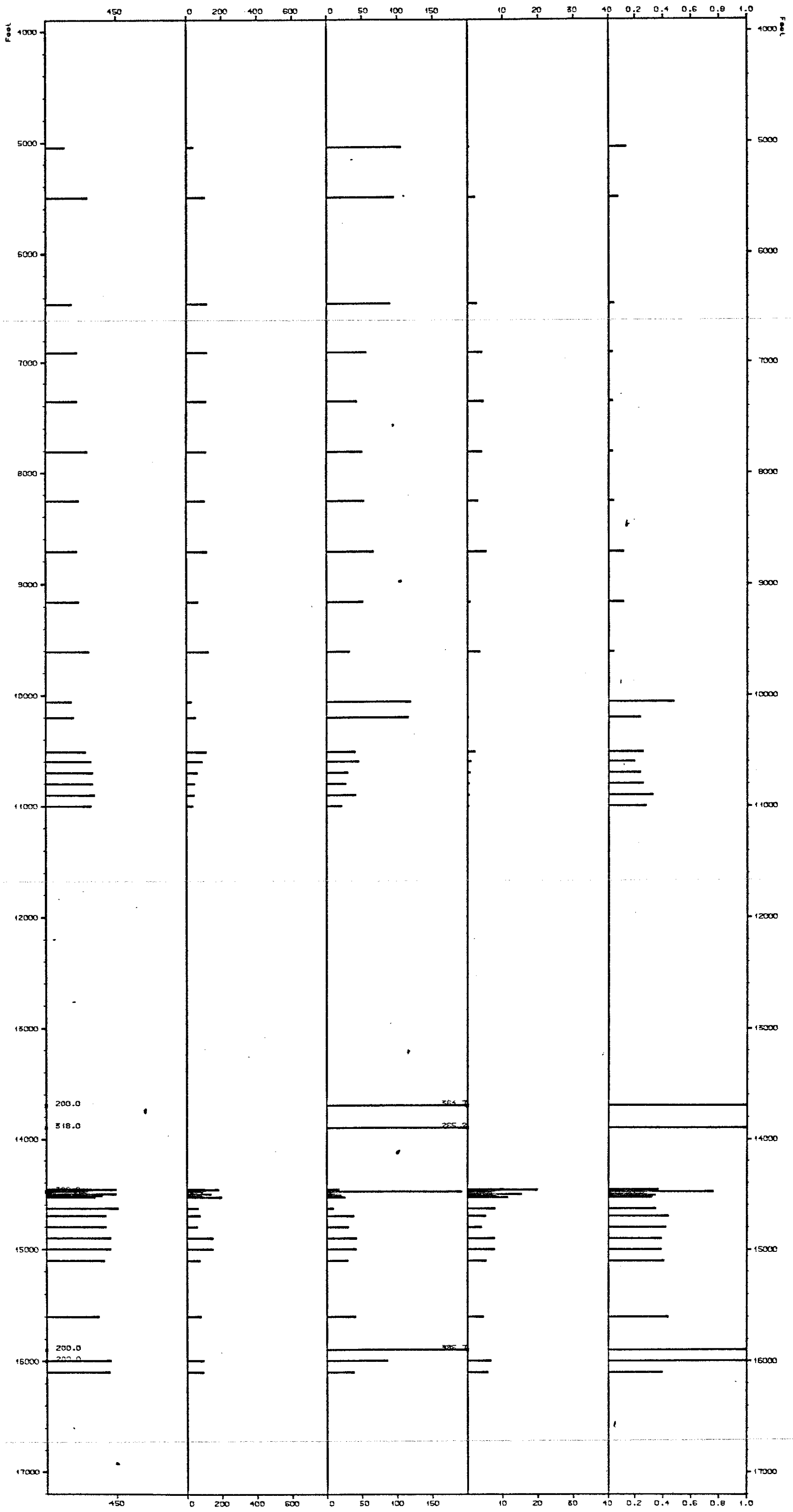
Sat: Saturated Hydrocarbons.
HC: Hydrocarbons.
EOM: Extractable Organic Matter.

7/11-7

IKU Organic Geochemistry Department

ROCK-EVAL PYROLYSIS

Well no: 7/11 – 7
Company: Phillips Petroleum



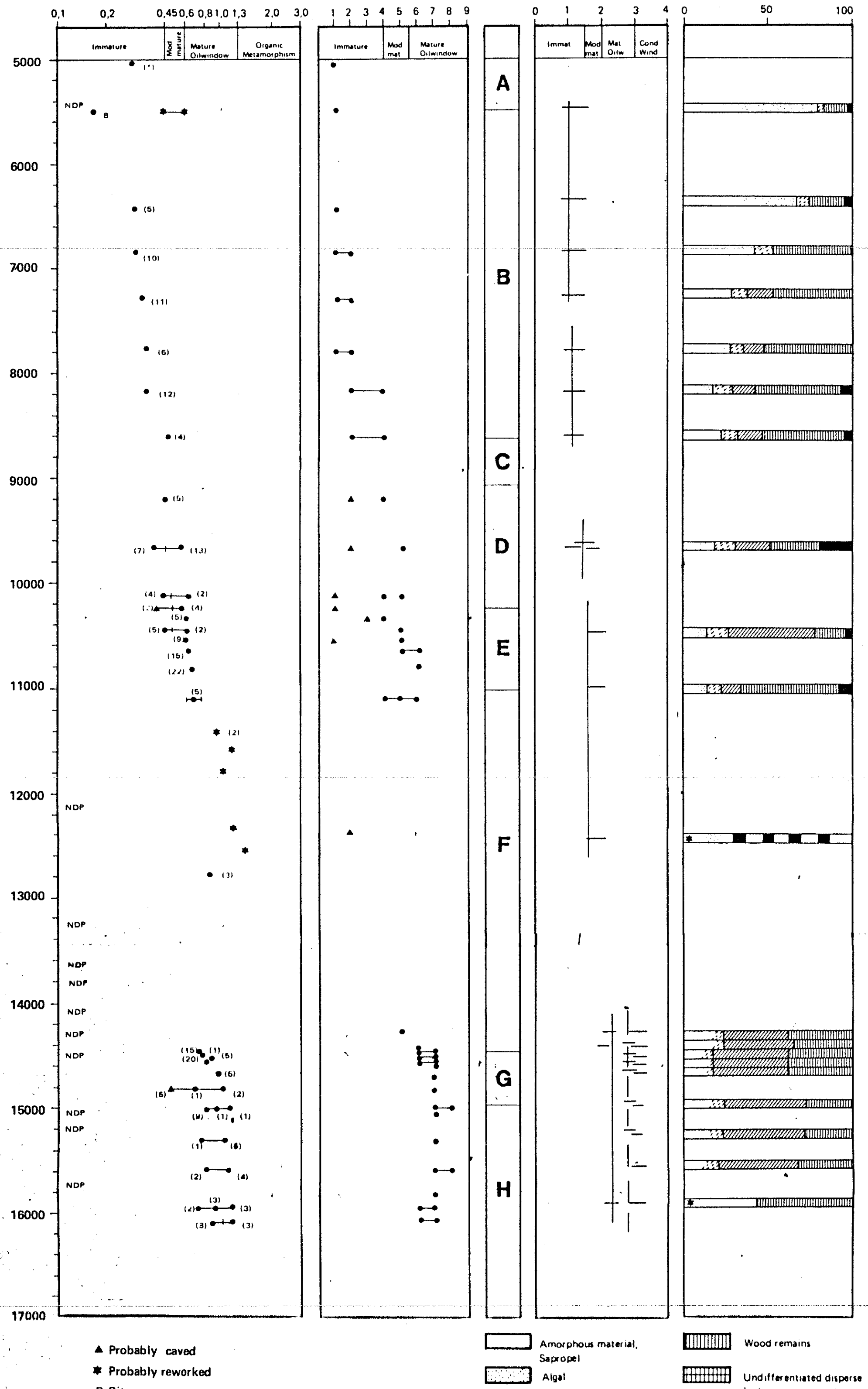
7/11-7

IKU Organic Geochemistry Department

MATURATION

Well no.: 7/11 – 7
Company: Phillips Petroleum

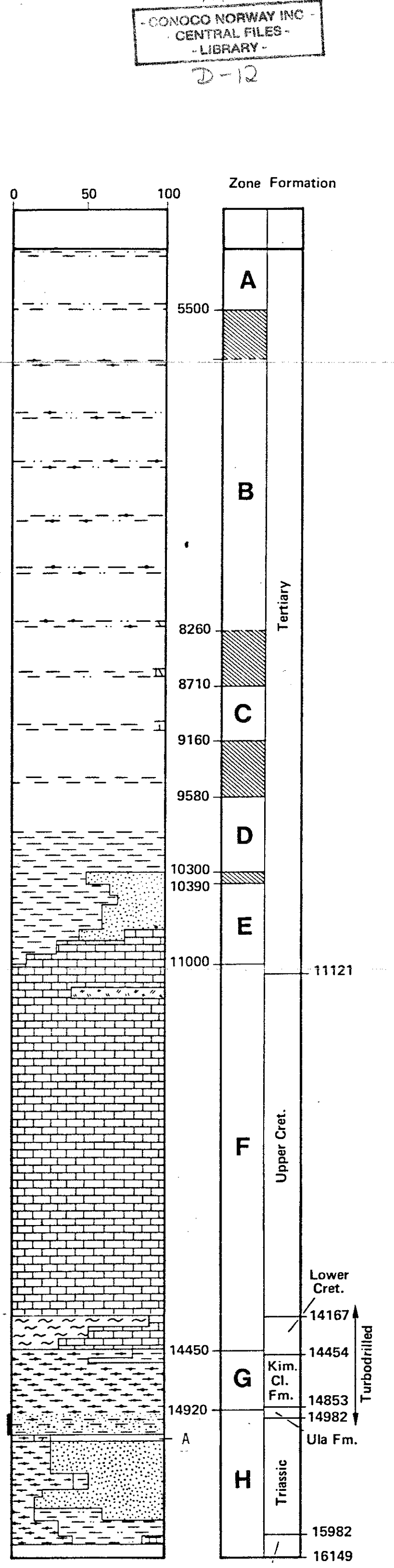
VISUAL KEROGEN
COLORATION AND COMPOSITION OF ORGANIC RESIDUE

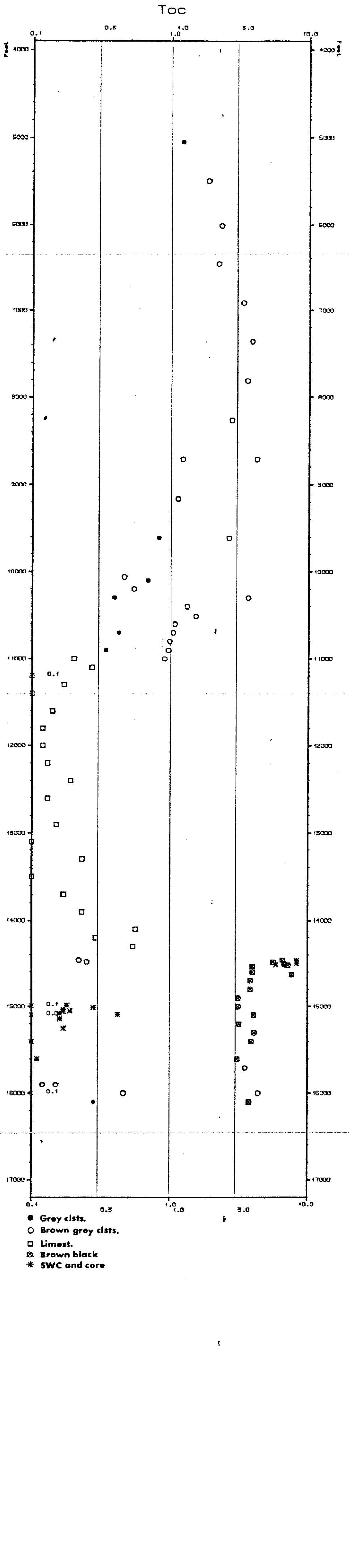


Organic Geochemistry Department

TOTAL ORGANIC CARBON (TOC)

Well no: 7/11 – 7
Company: Phillips Petroleum





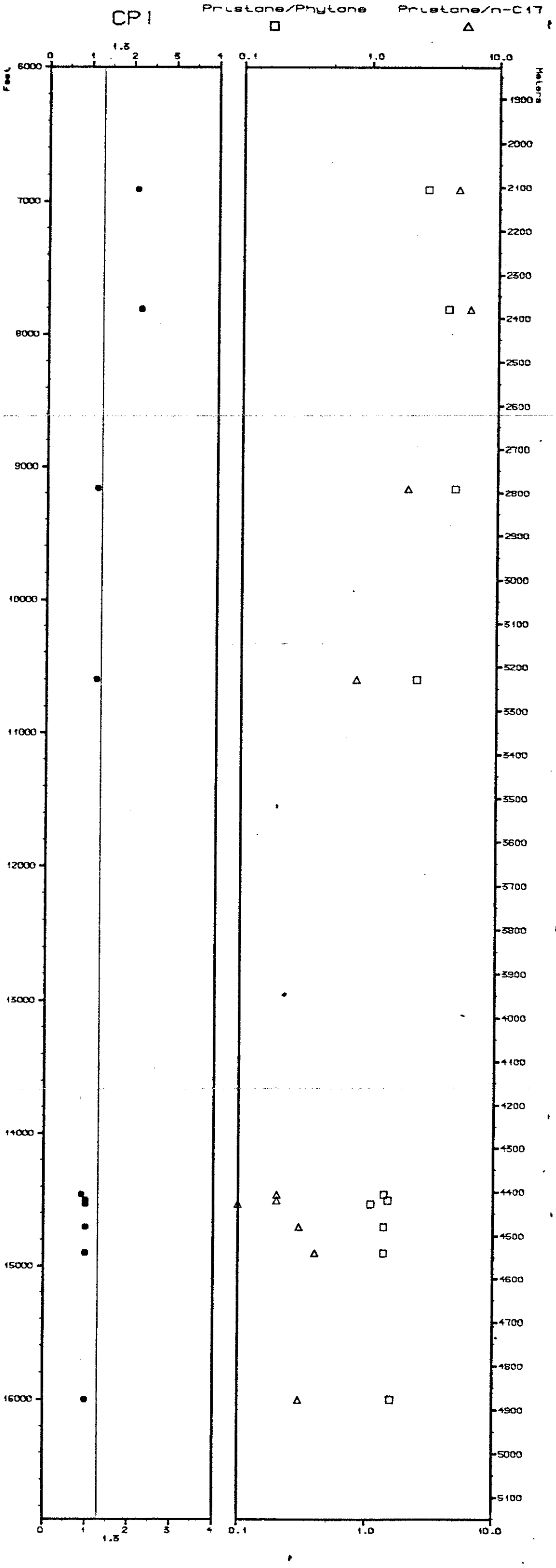
Carbonaceous claystone/shale
Claystone
Marl
Silt/siltstone
A A A Additive (LCM)
Core description
Sandstone
Limestone/chalk
Dolomite/siderite
Casing cement

● Grey clsts.
○ Brown grey clsts.
□ Limest.
⊠ Brown black
✳ SWC and core

Organic Geochemistry Department

C_{15}^{+} SATURATED HYDROCARBONS

Well no: 7/11 – 7
Company: Phillips Petroleum



7/11-7

IKU Organic Geochemistry Department

C_{15}^{+} HYDROCARBONS

Well no: 7/11 – 7
Company: Phillips Petroleum