Source rock analysis of well 34/10-17.

CLIENT/ OPPDRAGSGIVER

Statoil

RESPONSIBLE SCIENTIST/ PROSJEKTANSVARLIG

Nigel Mills

AUTHORS/ FORFATTERE

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SUMMARY/ SAMMENDRAG

See next page.

KEY WORDS/ STIKKORD

Source Rock	
34/10-17	

The analysed sequence of the well was divided into 5 zones:

Zone A (230-890m): The zone consist mainly of sandstone and sandy claystone. It is immature and has a very poor source potential for oil and gas.

Zone B (890-1700m): This zone consists predominantly of claystone, It is immature with extremely poor source potential for oil and gas.

Zone C (1700-2615m): This zone consists of various types of claystone. It is immature to moderate mature and has poor source potential for oil and gas.

Zone D (2690-3155m): This zone is characterized by a grey black claystone. The zone is immature to moderate mature and shows a fair to good potential for gas (some samples affected by turbo drilling).

Zone E (3155-3470m): This zone consists mainly of claystone. It is moderate mature to mature and has a poor potential for oil or gas (poor to fair potential at the base).

CONTENTS

EXPERIMENTAL AND DESCRIPTION OF INTERPRETATION LEVELS

Headspace Gas Analysis

One ml. of the headspace gas from each of the cans was analysed gas chromatographically for light hydrocarbons. The results are shown in Table 1a. The canned samples were washed with temperated water on 4, 2, 1 and 0.125 mm sieves to remove drilling mud and thereafter dried at 35^{o}C.

Occluded Gas

An aliquot of the 1-2 mm fraction of each sample before drying was crushed in water using an airtight ball mill, and one ml. of the head-space analysed chromatographically. The results are shown in Table 1b.

The composite gas data are also plotted and shown in enclosure 1.

Total Organic Carbon (TOC)

Picked cuttings of the various lithologies in each sample was crushed in a centrifugal mill. Aliquots of the samples were then weighed into Leco crucibles and treated with hot 2N HCl to remove carbonate and washed twice with distilled water to remove traces of HCl. The crucibles were then placed in a vacuum oven at 50^{o}C and evacuated to 20 mm Hg for 12 hrs. The samples were then analysed on a Leco E C 12 carbon analyser, to determine the total organic carbon (TOC).

The results are shown in table 2 with the lithological description, also in enclosure 2.

Extractable Organic Matter (EOM)

From the TOC results samples were selected for extraction. Of the selected samples, approximately 100 gm of each was extracted in a flow through system (Radke et al,, 1978, Anal. Chem. 49, 663-665) for 10 min. using dichloromethane (DCM) as solvent. The DCM used as solvent was distilled in an all glass apparatus to remove contaminants.

Activated copper filings were used to remove any free sulphur from the samples.

After extraction, the solvent was removed on a Buchi Rotavapor and transferred to a 50 ml flask. The rest of the solvent was then removed and the amount of extractable organic matter (EOM) determined.

Chromatographic Separation

The extractable organic matter (EOM) was separated into saturated fraction, aromatic fraction and non hydrocarbon fraction using a MPLC system with hexane as eluant (Radke et al., Anal. Chem., 1980). The various fractions were evaporated on a Buchi Rotavapor and transferred to glassvials and dried in a stream of nitrogen. The various results are given in Tables 3-6, and in enclosure 3.

Gas Chromatographic Analyses

The saturated and aromatic hydrocarbon fractions were each diluted with n-hexane and analysed on a HP 5730 A gas chromatograph, fitted with a 25 m OV101 glass capillary column and an automatic injection system. Hydrogen (0.7 ml/min.) was used as carrier gas and the injection was performed in the split mode (1:20). Ratios determined from the saturated hydrocarbon gas chromatograms are shown in table 7, and in enclosure 4.

Vitrinite Reflectance

Vitrinite reflectance measurements of the samples, taken at various intervals, were done at IKU. 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 1516	0.20		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.

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 (15 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 dinoflagellates) 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 >15).

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 paleoenvironment (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

Rock-Eval Pyrolysis

100 mg crushed sample was put into a platinum crucible whose bottom and cover are made of sintered steel and analysed on a Rock-Eval pyrolyser.

Pyrolysis Gas Chromatography (Py-GC)

Py-GC

20-30 mg of thermoextracted whole rock sample was programmed pyrolysed in helium (260^oC to 520^o at 35^oC/min.) in a furnace type pyrolyzer. The outlet of the pyrolyzer was directly connected to a splitter (30:1) and a fused silica capillary column. The pyrolysis product was trapped in a cooled (liq. Nitrogen) U-shaped section at the front of the column.

The outlet of the splitter was directly connected to a FID detector and the course of the pyrolysis could be followed by the detector response of the bulk pyrolysis product (30:1) which was recorded as a broad peak. At the end of the pyrolysis the pyrolysis product was injected on to the capillary column at ambient temperature (by removing the nitrogen bath) and analysed under the GC conditions given below.

GC-conditions

Column: 25m OV-1, I.D. 0.3 mm, fused silica capillary column.
Carrier gas: Helium with inlet pressure 10 psi. Flow; ca. 1.5. ml/min.
Oven programme: 40^o - 270^oC at 4^oC/min.

RESULTS AND DISCUSSION

On the basis of results from headspace and occluded gas analyses together with the lithological description, the analysed sequence is divided into five broad zones. The boundaries of these zones delineate either the sharpest changes in percentage lithology as described from the washed cuttings themselves or the more marked of the fluctuates in light hydrocarbon composition. (Many smaller variations especially in the light hydrocarbon composition may be noted as possible subdivisions but are generally more minor and may be due to slight lithological variation).

The trends in results from further analyses may well cross these established zones and vary within them.

The five zones used here are:

Zone A: 230- 890m
Zone B: 890-1700m
Zone C: 1700-2690m
Zone D: 2690-3155m
Zone E: 3155-3470m

Light Hydrocarbon Analysis and Lithological Description

Zone A; 230-890m: The zone begins with a dominance of fine sand to gravel together with a large input of shell fragments and including in places foraminifera. The sand element is dominant throughout the zone and consists of white fine to coarse subrounded quartz fragments whilst the more gravel element is made up of gneisses with muscovite feldspar etc. Towards the base of the zone an olive-green to grey sandy claystone is observed the amounts of which fluctuate but never surpass the sand except in sample A-4117 which is contaminated by cement apparently to the detriment of the sand content.

With the exception of the sample with the high cement content (A-4117, 680-710m) all of the samples have good to rich abundances of C_1-C_4 hydrocarbon. The bottom two samples very greatly from the trend (are being very much higher and the other considerably lower). Methane is by far the most dominant component with only traces of the other C_1-C_4 compounds present (and this is mainly ethane) whilst no C_5+ compounds are recorded. Wetness values are consequently very low and iC_4/nC_4 ratios not recorded. The present is probably immature biogenic gas.

Zone B; 890-1700m: This zone sees an increase in the amount of claystone to 50% in the first sample though this is similar in colour to the claystone in the zone above. There is also 20% of consolidated sandstone together with more minor sand and cement. After this claystone becomes by far the most dominant if not the only lithology present. There is a change in the claystone to a more light brownish grey to olive grey sandy variety and light olive brown. The light hydrocarbon analyses show a sharp decrease in the total abundance of C_1-C_4 compounds to poor abundances and at least down to 1460m this is totally methane. Down to 1700m the values are still poor (almost negligible) but they do contain some C_2-C_4 compounds (samples A-4145 and A-4147 even register small amounts of C_5+). Due to the small amounts involved the wetness values must be treated cautiously but are far too high in places. iC_4/nC_4 ratios cannot be calculated as none of these compounds is detected.

Zone C; 1700-2615m: This zone begins with the input of a subfissile red-brown, brown claystone not previously seen. This is accompanied by 4% of a dark greyish green, dark grey and dark green claystone which increases in importance with depth down to 2030m. Here lignite additive is also present in one sample A-4161 (2030-2060m) and below this for two samples a separate grey sandy claystone is seen in more minor amounts (this may be caved). The rest of the zone has varying but minor amounts of lignite additive plus some greyish white sandstone (up to 35% of the sample) towards the base.

In terms of light hydrocarbon abundances the first sample in this zone would still be classified as poor although it shows an 8 fold increase in total abundances of C_1-C_4 compounds over most of the samples in zone B.

The rest of the samples have fair abundances increasing to good and rich at the base. This zone sees a more substantial and consistant production of C_2-C_4 and C_5+ compounds.

Wetness values are higher and show an increase towards the base where the values are very high C_5+ compounds although now recorded are generally of poor abundance although samples A-4157 (1910-1940m) and A-4159 (1970-2000m) have fair quotation and the samples from 2480-2495m and below have good abundances. iC_4/nC_4 values have irregularities but generally have values of 0.5 to 0.8 which would indicate moderately mature to mature samples or high biodegradation.

Zone D; 2690-3155m: This zone is particularly noticeable for the change in lithology to an dark grey to black, brownish black subfissile partly carbonaceous claystone. There are still significant quantities of light brownish grey claystone but this is never dominant. Some sandstone is also observed in several samples. The proportion of this dark grey to black claystone peaks several terms within the zone at about 80-90% of the samples. This may be an indication of rapidly varying but regularly repeating environments and sediment influx or it may be due to drilling techniques and caving. Varying amounts of additive, steel fragments and deformed material are noted and the samples show clear signs of turbo drilling from 2870m.

Some coal (up to 15%) is observed towards the base but it is not clear if this could be in-situ or additive. Cement and minor amounts of marl are also noted. From 3080m some staining is noted on the fragments.

This zone sees a major increase in the abundances of light hydrocarbons. The top samples (down to 3005m) have very rich abundances of C_1-C_4 compounds (15000µl gas/kg rock to 222000µl gas/kg rock). Below this there is a dramatic decrease in absolute values but the abundances are still good (2400-5600µl gas/kg rock). These values are still better than those from zones above. Such a peaking of total abundances may be due either to an dramatic increase in total organic content, an improvement in the kerogen type or an increase in maturity (to peak maturity?). Methane is no longer the overwhelming dominant component of the C_1-C_4 compounds and wetness values are very high (28-97% mostly at the higher end) iC_4/nC_4 values decrease from the zones above (possibly indicating decreased biodegradation) and show a general decrease down the zone. With only a couple of exceptions C_5+ abundances are also rich for the first time in the well but as with the C_1-C_4 compounds these tend to peak and the decrease towards the bottom of the zone.

Zone E; 3155-3470m: Apart from the bottom 30m (for which two samples indicate a dominance of white, clear sand with minor claystone) the whole of this zone is almost completely composed of dark grey to greyish black claystone which is brownish in places. However, turbo drilling has affected most samples through may decrease at the base.

The total abundances of C_1-C_4 hydrocarbons remain good (4000-9500µl g/kg rock) and are similar to those found at the base of zone D. Whilst rather erratic, the proportion of C_2-C_4 compounds is again quite high giving wetness values ranging from 16-90%. C_5+ abundances also vary but are fair for most of the zone but with the section 3320-3395m being generally poorer. The iC_4/nC_4 values begin quite low but there are very similar to or may be slightly higher than the values at the base of zone D.

Total Organic Carbon

Zone A; 230-890m: Due to an initially unsuitable lithology samples at the top of this zone were not analysed for total organic carbon. Three samples of the olive green sandy claystone were analysed and these have increasing organic contents with depth but all of the values being classified as only fair.

Zone B; 890-1700m: Nine samples from this zone were analysed for total organic carbon (two lithologies in one of the samples). The first sample is the same lithology as found above (olive to olive grey, sandy claystone) and it has a fair but slightly reduced TOC value (0.65%). Below this three samples (from 1070-1280m) of light brownish grey to olive grey claystone are analysed together with a subfissile brownish grey claystone as a duplicate in one sample (A-4132, 1160-1190m). The values for these lithologies are all good (1.10-1.45%). The remaining samples in this zone show a clear decrease in total organic carbon contents with depth from 0.84% to 0.33% despite the fact that all of the analyses were undertaken on a dark greenish grey, grey, fissile to subfissile claystone. These would be classified as only fair organic contents.

Zone C; 1700-2615m: Twenty two samples from this zone were analysed for total organic carbon. The zone begins with a similar dark grey, dark greenish grey claystone but there is more of a black element in it and though only fair the TOC is slightly higher than for the similar lithology in zone B (here it is 0.49%). The next sample (A-4155, 1850-1880m) contains a light greenish grey subfissile claystone and a dark grey, dark green-grey claystone as above. These have TOC's of 0.77 and 1.14 respectively which are somewhat elevated from values above without any clear indication why. From this point (1910m) the grey to dark greenish grey claystone is dominant throughout and is the lithology analysed. The values for this lithology are fair throughout ranging from 0.49% to 0.92%. The last sample in this zone A-4193 (2600-2615m) also contains 30% dark brownish grey fissile claystone which has a good TOC of 1.80%.

Zone D; 2690-3155m: In this zone the dominant dark grey to black, brownish black subfissile claystone was mainly analysed together with more minor light brownish grey. Values throughout this zone are high (total range 1.42-12.91%) with the highest values being in the grey-black claystone particularly between about 2700m and 2915m. Below 2915m down to 3020m the values are still rich (3.31-4.88%) but below this they drop noticeably (though still remaining good) to values between 1.43 and 1.96%.

Some samples within this zone are seen to be affected by turbo drilling whilst others have varying degrees of staining visible.

Zone E; 3155-3470m: This zone continues with the dark grey to greyish black claystone being almost exclusive. Total organic carbon values are very consistent within the zone and are good (ranging from 1.48 to 1.87%).

Extraction and Chromatographic Separation

On the basis of Rock-Eval Pyrolysis data a total of fifteen samples were chosen for extraction and chromatographic separation. Gas chromatograms of the saturated fractions are given at the back of this report.

Zone A; 230-890m: No samples from this zone were extracted.

Zone B; 890-1700m: Two samples from this zone were extracted (A-4129, 1070-1100m; and A-4141, 1430-1460m). The analyses were done on different lithologies (A-4129 - light brownish grey-olive grey claystone, TOC 1.19; A-4141 - dark greenish grey claystone, TOC 0.62) and the samples are separated by over 300m.

In terms of total extractable organic material (EOM) A-4129 would be classified as having a fair extractability whilst A-4141 has a poor extractability (in terms of ppm of sediment extracted). When there results are normalised to organic carbon content both samples would be classified as fair. This indicates that whilst sample A-4141 has a lower organic content than A-4129 the material present is more easily extracted. For the extractable hydrocarbon (EHC) both samples have poor to fair extractabilities as ppm of sediment but when this is normalised to organic carbon content A-4129 would be classified as poor whilst A-4141 has a fair extractability. This indicates that A-4141 has a more hydrocarbon rich organic content than A-4129. Furthermore it can be seen that A-4129 contains twice the amount of non-hydrocarbon that A-4141 does. The high content of non-hydrocarbons can be an indication of low maturity. The ratio of saturates to aromatics is high in both samples though as discussed it is much higher for A-4141.

The gas chromatograms of the saturated hydrocarbons are very similar in that they are both strongly bimodal and at the higher molecular weight end both have a maximum at nC_{29} and a clear terrestrial input with a high CPI (identical) indicating immaturity.

The lower molecular weight end (with maximum at nC_{16} in A-4129 and nC_{17} in A-4141) might have been an indication of a marine input to the sample giving a mixed origin. However, in this case it is thought to be more likely due to migrated hydrocarbons or drilling mud contamination (diesel would peak lower though) and to some extent this is confirmed by the moderate to high production indices - A-4129 has a stronger low molecular weight distribution and a higher production index. Microscopical analysis would also indicate that a more terrestrial (and higher molecular weight) material is the original organic input. A high pristane to phytane ratio in this case is probably more indicative of organic input (terrestrial) than of maturity.

The presence of squalane in significant amounts is noted and may indicate an anoxic environment of deposition.

Zone C; 1700-2615m: Five samples from this zone were extracted (A-4155, 1850-1880m: A-7174, 2300-2330m: A-4183, 2450-2465m: A-4187, 2510-2525m and A-4193, 2600-2615m).

With the exception of A-4193 (2600-2615m) the analyses were performed on a variably greenish grey subfissile claystone. In A-4193 the dark brownish grey fissile claystone was extracted. This sample also had a significantly higher TOC than the rest of the samples (approximately 1.80, approximately three times those of samples A-4174, A-4183 and A-4187) however sample A-4155 also has a larger value than the rest. To some extent this is reflected in the extractabilities - A-4193 has by far the highest EOM content (it would be classified as a good extractability). However, A-4155 does not have the second highest value in ppm of sediment as might be expected. The next highest extractability is for sample A-4187 with a fair extractability. The rest of the samples including the A-4155 with significantly higher TOC all have poor extractabilities. When these are normalised to organic carbon the same order of extractability is found for the samples with both A-4187 and A-4193 being possibly classified as having good extractabilities whilst the rest are poor. This indicates a better organic material in these two lowermost samples than in the rest (irrespective of TOC contents). In terms of total extractable hydrocarbons (as ppm of sediment) A-4193 is again much better than the rest (good extractability) whilst A-4155 and A-4187 both have fair extractabilities and the rest poor. When normalised to organic carbon content these figures again indicate a greatly improved kerogen (in terms of quantity extractable) at the base of this zone (good extractabilities for A-4187 and A-4193 and poor to fair for the rest). However, the amounts of non-hydrocarbon also increase down the zone. Saturates to aromatics ratios vary greatly but are highest in samples A-4187 and A-4155. Hydrocarbons constitute high proportions of the total EOM (48 to 90%).

The gas chromatograms of the saturated hydrocarbons for this zone have some similarities with those from zone B (i.e. either a bimodal distribution or a high medium to high molecular weight "shoulder". There is possibly more dominance of the medium to high molecular weight end in samples from this zone. The high molecular weight end has a maximum at nC_{23} or nC_{27} together with high CPI's indicating immature terrestrially dominated samples. Samples A-4155 (1850-1880m) and A-4174 (2315-2330m) both have high production indices which might indicate that in these samples the lower molecular weight end could be due to migrated or contaminant hydrocarbons whereas in sample A-4193 (2600-2615m) there is a very low production index and, though not high, the hydrogen index is improved possibly indicating that there is a more mixed kerogen input in this sample.

Sample A-4183 (2450-2465m) though very similar to all of the gas chromatograms for this zone possibly shows a stronger input of lower molecular weight material. There is a moderate production index.

Sample A-4187 (2510-2525m) has a very high squalane content and possibly more unresolved material but is otherwise very similar to the rest in this zone. The high production index may be connected with the higher amount of unresolved material.

<u>Zone D; 2690-3155m</u>: Four samples from this zone were extracted (A-5435, 2765m-2780m: A-5438, 2810-2825m: A-5442, 2870-2885m and A-5453, 3035-3050m). The top three samples are all analysed on the dark grey to greyish black claystone element which has the highest TOC values recorded in the well. The bottom sample (A-5453) has a much lower TOC but this is still good (1.76%).

In terms of ppm of sediment extracted all of the samples have rich extractabilities. The notable point of the EOM in ppm of sediment is that the sample with the lowest TOC (A-5453: 3035-3050m) has the highest extractability whilst the sample with the highest TOC (A-5438, 2810-2825m) has the lowest value. This ought to give an indication of the quality of the organic material. However Rock-Eval data would seem to indicate that the sample A-5438 (with highest TOC) should be the better quality. When this data is normalised to organic carbon content sample A-5453 still has a rich extractability whilst the others have fair extractabilities except A-5438 organic again which has a poor value.

In terms of extractable hydrocarbons, which would be a better guide to organic material quality, it is again sample A-5453 which has the highest value and a very rich extractability. However all of the others would also be classed as rich extractabilities (though A-5438 is again the lowest despite indication of a richer kerogen in the Rock-Eval data. When normalised to organic carbon again only A-5453 has a rich extractability whilst A-5442 is good, A-5435 fair and A-5438 is poor. A-5435 has the highest proportion of saturates relative to aromatics and the highest proportion of its EOM as saturates. This zone is by far the richest yet - especially the bottom two samples.

The gas chromatograms of the saturated hydrocarbons show a broadly similar aspect to those from samples above and are very similar to each other. The general picture is a bimodal distribution (with low production indices this would be taken to indicate dual terrestrial and marine input) with the relative proportion donated by each area varying slightly. Sample A-5435 appears dominantly terrestrial but is difficult to compare and has a large area of unresolved complex material. However alkanes as low a nC_{11} are significant. Pristane is the dominant peak with nC_{15} the dominant n-alkane at the low end and nC_{25} or nC_{27} at the high molecular weight end. The sample has a high CPI.

Sample A-5438 is a clearer chromatograph and ranges from nC_{12} to nC_{33}. There is a bimodal distribution dominated by Pristane followed by nC_{15} at the low end and by nC_{25} at the higher end. The sample has a high CPI and a high pristane to phytane ratio - the latter probably being more of an environmental/input indicator.

Sample A-5442 again has a bimodal nature but appears to contain more material of lower molecular weight (marine input?). Pristane again is very high and there is a high CPI nC_{27} is dominant at the high molecular weight end and there is a very noticeable squalane input.

Sample A-5453 (3035-3050m) differs from the rest of the samples but has most similarities with A-5435 (2765-2780m). It is completely dominated by unresolved material at the higher molecular weight end although the production index in this case is not high and it is the only sample in which pristane does not dominate the nC_{17}. It still displays a bimodal distribution but the higher molecular weight end is difficult to assess.

The high amount of unresolved material in A-5435 and especially in A-5453 could be due to either biodegradation or mud additive. (Probably pipe dope).

<u>Zone E; 3155-3470m</u>: Four samples from zone E were extracted (A-5462, 3170-3185m: A-5468, 3260-3275m: A-5476, 3380-3395m and A-5482, 3455-3470m). These were all dark grey to greyish black claystones with good TOC's (but not as high as zone D). The gas chromatograms of the saturated hydrocarbon fraction for the samples in this zone are basically very similar. They differ only in the amount of unresolved material (A-5468 and A-5462 being highest), the proportion of squalane present (A-5468 having the highest proportion) and in the fact that A-5462 has a lower molecular weight maximum at nC_{19} whilst the rest have maximum at nC_{17}.

The high amount of unresolved material in the bottom sample of zone D and the top two of zone E could indicate a short ranged environmental factors or a specific additive over that depth interval.

Apart from the first sample (A-5462, 3170-3185m) which has a good extractability, all of the samples have rich extractabilities. Sample A-5468 (3260-3275m) has the highest value for EOM in the analysed samples. When normalised to organic carbon content both sample A-5468 and the bottom sample (A-5482, 3455-3470m) have rich extractabilities - though A-5468 is by far the highest whilst samples A-5462 and A-5476 have fair and good extractabilities respectively. In terms of hydrocarbons the top two samples have rich extractabilities (A-5468 is again by far the highest) and although sample A-5462 has the lowest EOM as ppm of sediment it has the second highest value for extractable hydrocarbons indicating a better quality organic material at least the A-5476 and A-5482 at the bottom of the zone. This order of extractability is continued when the values are normalised to organic carbon with A-5468 having a rich value A-5462 and A-5476 are good and A-5482 is only fair.

As a proportion of hydrocarbon in the EOM sample A-5462 has by far the highest values whereas the saturates to aromatic ratio is highest for A-5468 and proportion of non-hydrocarbons is highest for A-5482.

Sample A-5476 (3380-3395m) shows a front biased distribution with a shoulder/bimodality peaking at nC_{23} or nC_{25}. In the lower molecular weight end nC_{17} is the dominant compound and the dominance of pristane is not seen.

Sample A-5468. The chromatograms show a bimodal distribution of alkanes with maxima at nC_{17} and nC_{27} indicating both terrestrial and marine sources for the organic matter. The CPI is fairly high indicating immaturity. There is a prominent squalane peak. There is a fair large amount of unresolved material, this is probably contamination from mud additives.

Sample A-5462 shows a high CPI but not such a marked bimodal distribution as A-5468. The maximum is at nC_{27}. This chromatogram also shows the prominent squalane peak seen in A-5468, but contains a smaller amount of unresolved material.

The CPI is moderately high as is the pristane phytane ratio.

In comparison to A-5476 sample A-5482 (3455-34790m) shows a greater proportion of higher molecular weight compounds (terrestrial input) and shows a definite maximum at nC_{25} and not a clear bimodality. The pristane/phytane ratio is again high as found higher in the well.

Rock-Eval Pyrolysis

Zone A; 230-890m: Two samples from this zone were pyrolysed on a Rock-Eval instrument. These were the bottom two samples in the zone and were olive grey - green claystones with fair TOC's. The low T_{max} values indicate that the samples are immature. Hydrogen and oxygen indices are indicative of type IV kerogen (inertinite or reworked vitrinite) low hydrogen index and high oxygen index. The petroleum potential for both samples is poor and this together with the samples from this zone have no potential s source rocks for hydrocarbons (oil or gas). For samples of this suggested maturity the moderate production indices would appear to be high. This could be due to migrated hydrocarbons (possibly the material described as "degraded bitumen" or "slight bitumen staining" in the reflected light analyses.

Zone B; 890-1700m: Eight samples from this zone were analysed (two from samples A-4132, 1160-1190m). Most of the T_{max} values are slightly higher than the samples in zone A but are still well within the range of values normally taken to indicate immature samples. The T_{max} value for sample A-4147 (1610-1640m) is excessively low (320) and the parameter was probably recorded on bitumens/asphaltenes. Apart from the uppermost sample which has a very high oxygen index both hydrogen and oxygen indices are low for the whole zone. These values indicate the presence of a dominantly type IV kerogen (possibly with some type III accounting for lower oxygen indices?) Samples within a small subsection of the zone (1100-1190m) have noticeably higher petroleum potentials than the rest of the zone (though all of the values would be classed as poor) and these correspond nicely with the slightly higher hydrogen indices. TOC values and a different lithology (a light brownish grey to olive grey claystone as opposed to the olive grey and green grey claystones in the rest of the zone). At the top of the zone the production indices are low to moderate and may be only a little above what might be expected for this maturity. However the bottom three samples have values which possibly indicate free (migrated?) hydrocarbons. The bottom sample has the highest production index and this corresponds with and may be a reason for the abnormally low T_{max} found for that sample (A-4147).

As noted above all of the petroleum potentials for this zone are poor and in combination with the kerogen type indicated to be present this zone would not be expected to have any source rock potential for oil or gas.

Zone C; 1700-2615m: Twenty four samples from this zone were analysed (including some duplicates on a second lithology within some samples). There is a shift towards higher T_{max} values (general range 420-434) but these would still only indicate immature to possibly moderately mature samples. There is a slight increase with depth to the T_{max} values. Again some of the samples have very low T_{max} values (<400) and some of these are noted as containing "some concentrations of bitumen". It is possible that the T_{max} parameter has been recorded from the bitumen/asphaltene component rather than the kerogen.

Petroleum potentials for this zone are very poor (with the exception of the dark brown grey claystone of A-4193 which has a fair potential) and in combination with proposed kerogen types would indicate that the zone has no source rock potential for significant quantities of oil or gas.

Zone D; 2690-3155m: Fourteen samples from this zone were analysed. T_{max} values indicate immature to moderately mature samples (424-431). Whilst the value for the grey brown claystone in A-5442 (2870-2885m) is probably recorded on bitumen/asphaltenes. There is considerable improvement in some of the hydrogen indices in this zone especially between A-5435 (2765-2780m) and A-5442 (2870-2885m) where four out of five values for hydrogen and oxygen indices would imply the presence of a more type III kerogen. The rest of the zone (except perhaps A-5453 (3035-3050m)) would appear to contain type IV (or perhaps mixed type III/IV) kerogen. Production indices throughout this zone are lower than anywhere higher in the well and are more what one would expect if the samples are only moderately mature and do not contain migrated hydrocarbons. With the exception of the bottom two samples within this zone (A-5453: 3070-3085m and A-5459: 3125-3140m) which both have poor petroleum potentials the petroleum potentials for this zone are mostly improved on those for zones above except for the last sample in zone C. Most of the values would be classified as only fair but those samples with the highest hydrogen indices (A-5435: 2765-2780m, and A-5438:

2810-2825m) together with A-5442 (2870-2885m) - the dark green - grey element - have good to rich potentials. This zone could possibly be classified on the basis of Rock-Eval data as having a fair to good potential probably for gas (due to the kerogen type) but with a richer zone within it. The turbo drilling observed in the lithological description may have affected the samples such that they appear poorer than they might otherwise have been.

Zone E; 3155-3470m: Twelve samples from this zone were analysed. The T_{max} values are in general slightly higher than values for zone E but are still indicative of only moderately mature samples. The analyses were done on the dark grey to greyish black claystone element similar to that found above. The TOC values for all of these samples are good but the low hydrogen index and generally low oxygen index are indicative of a contamination of the some poor kerogen type (essentially on type IV inertinite/reworked vitrinite mix with at best a little type III input). The petroleum potentials fluctuate but would be classified as poor for all of the samples except the bottom one (A-5482, 3455-3470m) which has a poor to fair potential - it also has the highest hydrogen index though still only of type III/IV kerogen. The kerogen type present throughout when combined with the suggested petroleum potentials would indicate that the zone has no or only very poor potentials as a source rock for gas. The production indices are generally of the same low to moderate values seen in zone D and would be expected for samples of this maturity although the poor kerogen present might not be expected to have generated any S_1. Two exceptions to the low production indices are samples A-5477 (3395-3410m) and A-5479 (3410-3425m). Both of these samples have lower T_{max} values than the rest of the zone (402 and 352 respectively) and have very high oxygen indices together with low S_2 peaks. This might indicate that the T_{max} has been recorded on bitumens or asphaltenes which could have contributed to the S_1 in otherwise very poor samples.

Pyrolysis-Gas Chromatography (Py-GC)

15 extracted whole rock samples were analysed by Py-GC. The instrumental conditions are described in the experimental section. Based on retention and mass spectrometric data from other kerogens the peaks in the pyrograms are tentatively identified; the numbered peaks are n-alkene/n-alkane doublets of the corresponding carbon number. The n-alkenes have the shorter retention time. T=toluene; X=(m+p)-xylenes, N=naphthalene; C_1N=2- and 1-methyl naphthalenes; C_2N=C_2-alkyl naphthalenes (dimethyl and ethyl naphthalenes); Pr=pristenes.

A-4129 (1100m), A-4141 (1460m), A-4155 (1880m), A-4174 (2330m), A-4183 (2465m) and A-4187 (2525m)

The pyrograms of these six samples are overall very similar showing a short range aliphatic homology ranging from C_8 to ca. C_{15}. The abundance of aromatic compounds are high. The pyrograms show type III/IV or IV kerogen fingerprints. Type IV kerogen is used to describe the inertinite group of macerals or reworked material with a poor potential for hydrocarbons (mainly gas).

A-4193 (2615m) and A-5435 (2780m)

The pyrograms show an n-alkene/n-alkane homology ranging from C_8 to ca. C_{30}. The abundance of naphthalenes in the C_{11} to C_{14} region is high indicating an input of material derived from higher plants. The pyrograms show type III kerogen fingerprints.

A-5438 (2825m)

The low intensity of the peaks in the pyrogram is caused by low concentration or instrument sensitivity. Generally the pyrogram is similar to A-4193 and A-5435, i.e. a type III kerogen fingerprint.

A-5442 (2885m), A-5453 (3050m), A-5462 (3185m), A-5468 (3275m), A-5476 (3395m) and A-5482 (3470m)

The pyrograms of these six samples are very similar to A-4193. However, the abundance of naphthalenes is slightly higher than in A-4193. The pyrograms of these six samples show a type III kerogen fingerprint.

Examination in Reflected Light

Thirty-five samples were chosen for analysis in reflected light. The samples were chosen on the basis of assuring a relatively even coverage of the analysed sequence but also using data from TOC and Rock-Eval to attempt to choose those samples with a good organic content and those thought to have a most likely vitrinite (type III) nature. Unfortunately from the outset despite some good to rich TOC values the kerogen typing from Rock-Eval Hydrogen and Oxygen Indices did not look promising. Almost all of the data indicated kerogen type IV (inertinite and/or reworked vitrinite) to be the dominant contributor throughout the well. This is in very good agreement with the reflected light analyses which in terms of vitrinite reflectance are poor throughout due to a paucity of primary vitrinite and a overwhelming dominance of inertinite/reworked material together with (in some cases) surprisingly little visible organic matter.

Fluorescence colours in this well are very useful and would confirm suspicions that at the top of the well the samples are immature but results include reworked material whilst at the bottom of the well the values may be slightly low due to caving which in a relatively monotonous sequence such as this is very difficult to decipher. The analysed samples are described below and results tabulated elsewhere.

Sample A-4120, 770-800m: Sandstone and claystone, Ro = 0.40(5)
The sandstone is barren and the claystone has only a low organic content. The bitumen is degraded and there is very little vitrinite (everything located is measured). There is a trace of green fluorescence from spores.

Sample A-4123, 860-890m: Sandstone and claystone, Ro = 0.41(5)
The sample is dominantly sandstone but the claystone was used for the analysis. The sample is poor and very soft. The organic material is dominantly bitumen wisps with slight staining. A trace of green fluorescence is observed from spores.

Sample A-4129, 1070-1100m: Claystone, Ro = 0.38(3)
There is a very low organic content composed of bitumen with occasional inertinite/reworked vitrinite fragments and three possible primary

vitrinite particles. The sample is very poor for this type of analysis. Green fluorescence is seen from spores.

Sample A-4135, 1250-1280m: Claystone (sandy), Ro = 0.38(1)
There is a very low organic content. This is dominantly bitumen wisps (though few) together with rounded inertinite and reworked vitrinite fragments. Most of the bitumen is gnarled. The sample is very poor for this type of analysis. Green fluorescence is seen from spores.

Sample A-4143, 1490-1520m: Claystone, Ro = 0.32(1)
The sample contains only a trace of inertinite/reworked vitrinite plus a little bitumen and bitumen wisps. Only one measurable fragment was located (this may be bitumen). The sample is terrible for this type of analysis. Green fluorescence is seen from unidentified fragments.

Sample A-4153, 1790-1820m: Claystone, No Determination Possible
There is a very low organic content (almost nil). This is composed of a trace of bitumen staining in some clasts together with very occasional inertinite/reworked vitrinite fragments which are generally small and poor. Green fluorescence is observed from spores and minerals.

Sample A-4157, 1910-1940m: Claystone, Ro = 0.44(1) and 0.59(2)
There is a low organic content and this is very dominantly inertinite and reworked vitrinite as small rounded fragments. There are occasional concentrations of bitumen and bitumen staining. Only three possible primary vitrinite fragments were observed and the higher "population" is most probably reworked. The sample is terrible and the values are not reliable. Green and green/yellow fluorescence is observed from spores.

Sample A-6679, 1951m (swc): Claystone, Ro = 0.36(11)
The sample has a low to moderate organic content. This includes a moderate amount of bitumen together with dominantly reworked vitrinite and inertinite. The proposed primary vitrinite is clean but of low reflectance. Green/yellow and yellow/orange fluorescence is seen from spores.

Sample A-6681, 2014m (swc): Claystone, No Determination Possible
There is a very low organic content. Only very small rounded inertinite fragments plus a few of high reflectance reworked vitrinite were observed. Possible green/yellow spore fluorescence is observed.

Sample A-4161, 2030-2060m: Claystone, Ro = 0.39(3) and 0.54(1)
The organic content is almost completely very small inertinite and reworked vitrinite fragments with occasional bitumen. Some pyrite is altered. The sample is poor. Only green fluorescence from forams is recognisable.

Sample A-6682, 2081m (swc): Claystone (calcareous), Ro = 0.33(1) and 0.59(3)
There is a very low organic content and this is very dominantly inertinite with some reworked vitrinite material. Again the sample is poor and the values may be unreliable and meaningless. A trace of yellow/-orange spores are observed in ultra violet light.

Sample A-4164, 2120-2150m: Claystone, Ro = 0.34(1) and 0.61(1)
The sample has a very low organic content. This is only inertinite and reworked vitrinite in any significant amounts. Two very different fragments were measurable. The sample might well be of "no determination possible" as it is of little use for this type of analysis. Green mineral fluorescence and green/yellow spore fluorescence are observed.

Sample A-4170, 2255-2270m: Claystone, Ro = 0.49(3)
There is a very low organic content. This is almost completely reworked vitrinite and inertinite. There is a trace of poor bitumen wisps. Three possible primary vitrinite fragments of poor quality are recorded. These may divide as 0.41(1) and 0.53(2) but on so little information this is not clear. There is a trace of yellow and yellow/orange spore fluorescence.

Sample A-6683, 2158m (swc): Claystone, Ro = 0.54(1)
There is a very low organic content. This is dominantly inertinite and reworked vitrinite. One possible primary vitrinite fragment is located. The sample is terrible. Green/yellow and yellow/orange spore fluorescence is observed.

Sample A-6684, 2234m (swc): Claystone, Ro = 0.39(2) and 0.57(4)
The sample is poor. It has a low organic content which consists dominantly of reworked vitrinite and inertinite. All possible primary vitrinite located is recorded. A mixture of fluorescence colours is seen including green/yellow, yellow/orange and light orange - the latter two being thought more representative.

Sample A-6686, 2367m (swc): Claystone, No Determination Possible
There is a very low organic content. This is almost completely inertinite with a low amount of small reworked vitrinite fragments. A trace of good spore fluorescence in seen from yellow to yellow orange spores.

Sample A-4178, 2375-2390m: Claystone, Ro = 0.53(5)
There is a low to moderate organic content. This is almost totally inertinite and reworked vitrinite. There are a few dubious fragments recorded but this is difficult as they tend to be pitted and not clear. Green fluorescence is seen from spores - caved?

Sample A-4185, 2480-2495m: Claystone, Ro = 0.53(3)
This sample is very similar to the one above and could indicate caving or a very monotonous sequence. It is very dominated by rounded inertinite fragments and rewored vitrinite but most possible organic material is not confidently identifiable. Reworked material has a reflectance of >0.9% and only a few fragments of lower than this are recorded. A trace of green/yellow and yellow/orange spore fluorescence is observed.

Sample A-6688, 2484m (swc): Claystone (sandy), Ro = 0.54(7)
There is a low organic content which is dominantly poor, small, rounded inertinite fragments. There are only a few poor vitrinite fragments. Green/yellow fluorescence is observed from spores and a trace of algae.

Sample A-4189, 2540-2555m: Claystone, sandstone, lignite, Ro = 0.53(6)
The sandstone is virtually barren. The lignite is additive (0.25% Ro). The claystone has a low to moderate organic content but this is dominantly reworked vitrinite and inertinite. The sample is poor. Light orange to mid orange spore fluorescence is observed.

Sample A-6689, 2553m, (swc): Claystone, No Determination Possible
There is a low to moderate organic content but this is almost completely inertinite with some possible reworked vitrinite but nothing recognisable as primary material. No fluorescence is observed.

Sample A-6690, 2584m (swc) Claystone, Ro = 0.59(5)
There is a low organic content. This is dominantly inertinite and reworked material. There is only a trace of possible primary vitrinite. There are traces of oxidation. The values have a poor distribution. Yellow/orange to light orange (spore?) fluorescence is observed.

Sample A-4193, 2600-2615m: Claystone, Ro = 0.55(6)
There is a moderate organic content. The material is very variable. Some clasts have a moderately rich bitumen content whilst others are rich in inertinite or reworked vitrinite. There is a low vitrinite content. Yellow/orange to light orange (spore?) fluorescence is observed.

Sample A-5430, 2690-2705m: Mixed claystones, Ro = 0.58(17)
The sample has a rich organic content. This is still dominantly inertinite and reworked vitrinite but there is a moderate bitumen staining in places and a moderate vitrinite content. Some high concentrations of pyrite are observed. Light orange algae and spore fluorescence is observed.

Sample A-5432, 2720-2735m: Claystone, Ro = 0.57(8)
The sample has a high content of inertinite with subordinate reworked vitrinite. These are of poor to fair preservation. There is a low content of primary vitrinite. Some pyrite oxidation is observed. Light orange to mid orange fluorescence is observed from spores.

Sample A-5435, 2765-2780m: Claystone, Ro = 0.56(4) and 0.73(2)
The sample is rich in organic material but this is very dominantly inertinite together with some reworked vitrinite. It is difficult to assess bitumen staining because there has also been some pyrite breakdown. There is very little possible primary vitrinite. It is a bad sample. There may be one population but there are not enough values to decide. Dull mid orange fluorescence is observed from spores.

Sample A-5438, 2810-2825m: Mixed Claystone, Coal and Drilling Mud, Ro = 0.54(22)
The sample is rich. There are two claystones. One is very rich in large organic fragments, mainly vitrinite. The coal is of approximately the same reflectance and is therefore possibly in-situ. This is a good sample but the value seems low (caved?). Mid orange fluorescence is observed from spores/resin plus some green fluorescence from caved material.

Sample A-5440, 2840-2855m: Mixed claystones, Ro = 0.55(20)
There is a variable organic content. The dominant claystone is rich but contains mainly inertinite and reworked vitrinite. The minority claystone is rich in vitrinite and spores(?) and has cleaner vitrinite. Fluorescence is seen from one deep orange (hydrocarbon?) speck.

Sample A-5447, 2945-2960m: Mixed claystones, Ro = 0.51(13)
The sample has a moderate to high organic content. The material is clean but very dominantly inertinite plus reworked vitrinite. The possible primary vitrinite is moderately clean but dominantly particulate. The value may be low. There is light orange fluorescence from possible spores and green mineral fluorescence.

Sample A-5453, 3035-3050m: Claystone plus many additives, Ro = 0.60(13)
There is a moderate to good organic content in the claystone. This is dominantly inertinite but there is some reworked and primary vitrinite. Some bitumen is observed and is variably degraded/stained. The distribution is bimodal and the value may be low. Fluorescence is observed from light orange to mid orange spores and a trace of green dinoflagellates.

Sample A-5459, 3125-3140m: Claystone, Ro = 0.54(3) and 0.72(10)
The sample has a moderate organic content. Again this appears to be dominantly inertinite together with some reworked vitrinite. The vitrinite measured as possible primary vitrinite is rather varied. A mixture of fluorescence colours are observed including yellow/orange, light orange and mid orange.

Sample A-5464, 3200-3215m: Siltstone/turbodrilled lithology plus claystone and lignite, Ro = 0.58(3) and 0.82(1)
The lithology apparently affected by turbodrilling appears barren. The claystone has a moderate organic content but this is dominantly inertinite similar to above (caved?). The sample is poor. Only yellow/-orange fluorescence is observed and it is believed to be from caved material.

Sample A-5473, 3335-3350m: Turbodrilled lithology plus claystone, Ro = 0.62(10)
The turbodrilled lithology is as above. The claystone has a moderate organic content which is dominantly inertinite and reworked vitrinite but it also includes some bitumen and slight staining together with a trace of vitrinite. There is a trace of mid orange to deep orange spore fluorescence.

Sample A-5479, 3410-3425m: Turbodrilled lithology plus claystone, Ro = 0.64(5) and 0.85(1)
The claystone has a moderate organic content but this is dominantly inertinite with only a trace of bitumen and vitrinite. Mid orange to deep orange fluorescence is observed from spores.

Sample A-5282, 3455-3470m: Mixed claystone, sandstone, coal, Ro = 0.63(18)
The sandstone is barren but the claystone has a moderate organic content. There is a good mixture of phytoclasts. This includes some good clean vitrinite. Relatively speaking there is a good sample but may be low. There is a trace of mid orange fluorescence from algae.

Analysis in Transmitted Light

The acid insoluble organic matter of 34/10-17 was investigated on the basis of 30 samples. The sample material represents selected lithologies from ditch cuttings between 770m and 3470m.

Material from terrestrial, mostly woody, sources dominates. At 2600m and below cuticles, pollen and spores seem more important. However, the strong degradation of the material, prevents confident distinctions of their relative proportions.

The occurrences of grey amorphous material and of granulate grey aggregates at 3200/15m, 3260/75m and 3335/50m, to lesser degree at 3380/95m, caused some problems for interpretations. We connect the preservation features of these samples with the drilling process, suggesting that turbo drilling and heating of the rocks caused a partial break down (cracking) of the organic material.

The deposits were evaluated as immature (TAI 1/1+) at 1780/1820m and above, as at the top of the oil window (TAI 2-/2) from 1910/40 and down the hole. (3455/70m).

From the analyses in transmitted light the most interesting part in this well seems to be from 2600m and below, particularly from 3035/50m apparently being deposited under stronger marine influence.

Description of samples

770/800m and 860/90m: Strongly pyritic residues of degraded finely disseminated material partly as aggregates. (Woody material seems dominant). Well preserved structured fragments of land plants (cuticles and semifusinite). Palynomorphs are stained.
Colour index: 1/1+.

1070/1100m and 1250/80m: Strongly pyritic residues, partly as aggregates, consisting of true amorphous and finely disseminated mostly woody material. Relatively a reduction of cuticles and spores and increase of dinoflagellates (a rich and well preserved assemblage). Palynomophs are stained as above.
Colour index: 1/1+.

1490/1520m: Pyritic residue of rounded aggregates also enclosing some acid resistant minerals. Woody material dominates. Palynomorphs are well preserved and include pollen, as dominants, and fairly common spores.
Colour index: 1/1+ or 1+.

1780/1820m: Irregular loose aggregates of amorphous and sapropelised material, mostly wood and degraded cuticles. Pollen, spores, fairly large cuticular fragments and cysts are embedded in the aggregates.
Colour index: 1/1+, 1+.

1910/40m: Sparse residues of light coloured sapropelised woody material and grey amorphous aggregates. Some semifusinite - fusinite and inertinite. Well preserved cysts.
Colour index: 2-/2, 2.

2030/60m, 2120/50m, 2255/70m, 2375/90m, 2480/95m: Sparse pyritic residues. Woody material dominates and seems etched with dull colours. Some black coaly material. Pollen and cysts are well preserved. Cysts dominate palynomorphs. Grey amorphous material is subordinate.
Colour index: 1/1+, 2-/2, 2.

2540/55m: The residue is a mixture of grey granulate aggregates and of light coloured sapropelised material mostly of woody origin. True sapropel seems subordinate. Fairly well preserved cysts.
Colour index: 2-/2, 2.

2600/15, 6990/76705m, 2870/85m: Fairly rich residues mostly of strongly degraded woody material, that tend to form aggregates. Woody and cuticular debris may be difficult to distinguish from true amorphous material due to their dissolved structures. Relative proportions drawn in the maturation diagram should be regarded as tentative. This poor preservation of the palynomorphs group is seen, especially in the pollen and spores.
Colour index: 2-/2.

2720/35m, 2765/80m, 2810/25m: The above residues are distinguished by their content of denser aggregates of mostly woody material. They pollen

and spores are better preserved, and the woody material retain more of the original structures.
Colour index: 2-/2 to 2.

2840/55m, 2': This residue is distinguished by the larger proportion of good semifusinite - fusinite particles and by the larger proportion of pollen grains in relation to other palynomorphs. Spores and pollen walls are etched and bleached.
Colour index: 2-/2 to 2.

2870/85m: Composition as above of mainly woody material the only feature separating is the stronger biodegradation.
Colour index: 2-/2 to 2.

2945/60m: Strong degradation otherwise as for 2870/85m. Etched and bleached palynomorphs, pollen grains dominated.
Colour index: 2-/2 to 2.

3005/20m: Woody material dominates as for the entire interval but in this residue is represented by fairly coarse fragments of vitrinite, semifusinite, fusinite and inertinite. Palynomorphs as above 2945/60m are etched and bleached.
Colour index: 2-/2 to 2.

3035/50m, 3125/40m: The residues consist of strongly sapropelised woody material as above. Aggregates of material embed better preserved particles of wood, cuticles, pollen, spores and dinoflagellate cysts. Nanno ceratopsis is very abundant. Botryococcus is present.
Colour index: 2-/2 to 2.

3200/15m, 3260/75m, 3335/50m, 3380/95m: The residues probably are affected by the high temperatures during the drilling process. Sample material seems originally to have been related with that of 3035/50m and 3125/40m, but has been transformed into greyish granulate aggregates. The original wall material is broken down to very thin films. Interpretation of changes has been based on the lowest residue which still contains Nannoceratopses and other palynomorphs. Rare Botryococcus.
Colour index: 2-/2 to 2.

3410/25m, 3455/70m: Variably degraded material. Residues sapropelised woody material and cuticles (20-30%), also large well preserved particles of semifusinite and cuticles. Palynomorphs are fairly well preserved and light coloured. Some *Botryococcus*.
Colour index: 2-/2 to 2.

CONCLUSIONS

The maturity of the analysed sequence from the well 34/10-17 is based mainly as vitrinite reflectance, spore fluorescence spore coloration and the T_{max} from Rock-Eval pyrolysis. The richness of the samples is based on TOC and Rock-Eval pyrolysis with additional information being supplied from the abundance of light hydrocarbons. Source rock quality is based mainly on pyrolysis, both Rock-Eval and pyrolysis gc and visual kerogen examination.

Zone A (230-890m): This zone consists predominantly of sandstone and sandy claystone. The claystone appearing towards the base of the zone but never forms the dominant lithology. TOC analyses were not carried out on the sands and gravels at the top of this zone. The samples of the lower olive green claystone showed increasing TOC with depth - but this is only rated as fair. The claystone in this zone contains type IV kerogen. Visual kerogen analysis indicates a large proportion of terrestrial material. The zone is immature with very poor potential for hydrocarbons (oil and gas).

Zone B (890-1700m): This zone contains a greater proportion of claystone than the overlying one. The claystone in the upper part of the zone has a fair TOC content. Below this, apart from sample A-4132 (1160-1190m) which has a good TOC rating, the claystones show fair but decreasing TOC values. Rock-Eval pyrolysis indicates a type IV kerogen with some type III material to account for the low oxygen index. Visual kerogen analyses bear this out showing that woody material is present and dominates in some samples. The zone is immature with extremely poor source potential for oil or gas.

Zone C (1700-2615m): The top of the zone is characterized by a red-brown claystone. A darker claystone is also present and increasing in proportion to the total lithology with depth. TOC values for the dark claystone are fair to good throughout the zone. A dark brownish grey claystone which appears at the base of the zone shows a good TOC (1.8%). The Rock-Eval pyrolysis results indicate type IV and type III/IV kerogen. This is also evident from the visual kerogen analyses which indicate mainly terrestrial material. The zone is immature to moderate mature and has poor source rock potential for oil or gas.

<u>Zone D (2690-3155m)</u>: The dominant lithology in this zone is dark grey/-black claystone. Varying amounts of sandstone are present within this zone. Some coal is observed near the base but this may be an additive. TOC values are good to rich throughout the zone. The richest values are in the black claystone between 2700m and 2915m. Most of the zone contains type IV or type III/IV kerogen but there is zone between 2765-2885m where a more hydrogen rich type III kerogen is present. This zone is immature to moderate mature with a fair to good potential for gas. Some of the samples in this zone appear to have been affected by turbo drilling.

<u>Zone E (3155-3470m)</u>: The dominant lithology in this zone is a grey black claystone. TOC values are consistently good throughout the zone. Rock-Eval results indicate a type IV kerogen with, possibly, some type III input. Visual kerogen analysis indicates the presence of abundant terrestrial material and also indicates that high temperatures during turbo-drilling have affected the residues in this zone (especially samples at 3200/25m, 3260/75m, 3335/50m and 3380/95m).This zone is moderately mature to mature and has a poor potential for oil or gas (at the base the potential is poor to fair).

IKU

TABLE I a.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS IN HEADSPACE.

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 4102	260	5797						5797		0.00	
A 4105	350	11042						11042		0.00	
A 4108	440	14682	35	38		39		14794	111	0.75	0.00
A 4111	530	10241	75					10316	75	0.72	
A 4114	620	18694	13					18708	13	0.07	
A 4117	710	2634	4					2638	4	0.15	
A 4120	800	50516	39					50555	39	0.08	
A 4123	890	3812						3812		0.00	
A 4126	980	25						25		0.00	
A 4129	1100	185						185		0.00	
A 4132	1190	123						123		0.00	
A 4135	1280	78						78		0.00	
A 4138	1370	98						98		0.00	
A 4141	1460	72						72		0.00	
A 4143	1520	47	12					59	12	20.93	
A 4145	1580	31	24	9			23	64	33	51.56	
A 4147	1640	39	30	4			11	74	35	46.83	
A 4149	1700	42	30	7				79	37	46.54	
A 4151	1760	606	38	12			22	656	50	7.61	
A 4153	1820	960	215	87	73	28	260	1364	403	29.59	2.60
A 4155	1880	1034	315	149	99	93	427	1690	655	38.78	1.06
A 4157	1940	889	105	201	156	224	646	1574	685	43.54	0.70
A 4159	2000	1154	102	136	76	104	177	1571	417	26.56	0.73

DATE : 8 - 6 - 83.

IKU

TABLE I a.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS IN HEADSPACE.

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 4161	2060	1268	102	91	55	59	103	1575	307	19.52	0.92
A 4162	2090	1586	106	121	66	89	256	1968	382	19.40	0.74
A 4164	2150	978	89	63	22			1153	175	15.16	
A 4166	2210	2668	244	116	34	36	103	3077	430	13.87	0.94
A 4168	2240	2872	280	163	28			3344	471	14.10	
A 4170	2270	1818	186	120			199	2124	306	14.40	
A 4172	2300	955	100	78	19		68	1154	198	17.18	
A 4174	2330	1523	163	123	28	38	80	1876	353	18.84	0.74
A 4176	2360	796	79	72	21		35	968	171	17.70	
A 4178	2390	388	55	34	8	8	11	493	105	21.26	1.00
A 4180	2420	896	135	116		32	30	1179	283	23.98	0.00
A 4181	2435	887	109	89	18	18	17	1121	234	20.90	0.98
A 4183	2465	591	117	138	33	32	26	911	320	35.15	1.02
A 4185	2495	2566	411	388	86	85	20	3536	970	27.43	1.01
A 4187	2525	1144	280	288	62	63	46	1837	694	37.75	0.98
A 4189	2555	2426	568	670	159	176		3999	1573	39.33	0.90
A 4191	2585	1108	256	567	352	569	1742	2852	1745	61.16	0.62
A 4193	2615	3739	2394	3873	1730	2997	8858	14733	10994	74.62	0.58

DATE : 8 - 6 - 83.

IKU

TABLE I a.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS IN HEADSPACE.

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 5430	2705	8365	6529	6790	1545	2053	3225	25282	16917	66.91	0.75
A 5431	2720	10891	9997	9084	1796	2208	1304	33977	23086	67.95	0.81
A 5432	2735	13025	10784	8944	1955	2411	2065	37119	24094	64.91	0.81
A 5433	2750	14874	9131	7743	1854	2412	3182	36014	21141	58.70	0.77
A 5434	2765	1357	3032	1875	269	423	532	6955	5599	80.49	0.64
A 5435	2780	16691	7018	3786	633	810	756	28938	12247	42.32	0.78
A 5436	2795	14080	9911	10122	2620	3236	4006	39978	25898	64.78	0.81
A 5437	2810	76598	26402	9374	1188	1586	1337	115148	38549	33.48	0.75
A 5438	2825	105133	40884	14773	1837	2671	3413	165298	60165	36.40	0.69
A 5439	2840	16326	9842	3928	521	755	849	31372	15046	47.96	0.69
A 5440	2855	6482	4663	3240	511	762	705	15658	9176	58.60	0.67
A 5441	2870	12173	4027	2027	362	460	383	19049	6876	36.10	0.79
A 5442	2885	19247	7469	3550	600	804	937	31671	12424	39.23	0.75
A 5443	2900	10035	4210	1938	361	464	655	17009	6974	41.00	0.78
A 5444	2915	10173	4233	2748	500	746	694	18401	8228	44.71	0.67
A 5445	2930	3788	3012	2205	376	648	1528	10029	6241	62.23	0.58
A 5446	2945	6537	2144	1321	218	320	315	10539	4002	37.97	0.68
A 5447	2960	4528	2259	1674	300	461	422	9222	4694	50.90	0.65
A 5448	2975	2963	1219	951	173	275	296	5582	2618	46.91	0.63
A 5449	2990	7243	2919	1914	305	490	514	12872	5628	43.73	0.62
A 5450	3005	6033	3520	3132	521	923	944	14129	8096	57.30	0.56
A 5451	3020			O P E N	L I D						
A 5452	3035			O P E N	L I D						

DATE : 9 - 6 - 83.

IKU

TABLE I a.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS IN HEADSPACE.

IKU no.	DEPTH m/Ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 5453	3050	1611	603	558	67	141	323	2980	1369	45.95	0.48
A 5454	3065	636	409	658	121	286		2110	1474	69.85	0.42
A 5455	3085	396	219	359	73	173	252	1220	824	67.56	0.42
A 5456	3095			O P E N	L I D						
A 5457	3110	2367	1068	1692	345	873	947	6346	3979	62.70	0.40
A 5458	3125	524	271	288	45	97	129	1225	701	57.25	0.46
A 5459	3140	12	5					17	5	27.76	
A 5460	3155	199	86	148	20	53	56	507	307	60.64	0.37
A 5461	3170	144	69	149	24	57	84	443	299	67.57	0.42
A 5462	3185	666	24	399	58	140	170	1287	621	48.24	0.42
A 5463	3200	364	98	174			123	636	272	42.76	
A 5464	3215	287	70	110	6	46	43	518	231	44.54	0.12
A 5465	3230	65	16	19				100	35	35.25	
A 5466	3245	536	154	207	9	265	142	1171	635	54.25	0.03
A 5467	3260	132	38	58			41	228	96	42.06	
A 5468	3275			O P E N	L I D						
A 5469	3290	425	131	203	27	86	304	873	447	51.25	0.31
A 5470	3305	209	54	58	11	28	14	360	151	41.91	0.38
A 5471	3320	353	119	185	16	66	284	738	386	52.23	0.25
A 5472	3335	16						16		0.00	
A 5473	3350	310	112	164	13		139	599	289	48.28	
A 5474	3365	367	117	180	19	70	174	754	387	51.30	0.28
A 5475	3380	63	20	27				111	47	42.75	

DATE : 9 - 6 - 83.

IKU

TABLE I a.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS IN HEADSPACE.

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 5476	3395	324	123	188	23	56	123	714	390	54.60	0.42
A 5477	3410	233	121	231	40	95	210	720	487	67.61	0.42
A 5479	3425	273	131	216	31	69	155	719	446	62.06	0.44
A 5480	3440	215	103	118	22	37	78	494	280	56.60	0.60
A 5481	3455	59	73	74	11	19	28	235	176	75.06	0.58
A 5482	3470	3117	525	336	40	72	59	4090	973	23.80	0.56

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IKU

TABLE I b.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS IN CUTTINGS .

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 4102	260		O P E N		L I D						
A 4105	350		O P E N		L I D						
A 4108	440	544						544		0.00	
A 4111	530	469						469		0.00	
A 4114	620		O P E N		L I D						
A 4117	710		O P E N		L I D						
A 4120	800		O P E N		L I D						
A 4123	890		O P E N		L I D						
A 4126	980	119						119		0.00	
A 4129	1100	112	16	12				140	28	20.11	
A 4132	1190	113	20	15	6			155	41	26.77	
A 4135	1280	159	65	7				231	73	31.36	
A 4138	1370	46						46		0.00	
A 4141	1460	65	9					74	9	12.44	
A 4143	1520	59						59		0.00	
A 4145	1580	32						32		0.00	
A 4147	1640		O P E N		L I D						
A 4149	1700		O P E N		L I D						
A 4151	1760	18		5			182	23	5	20.82	
A 4153	1820						396				
A 4155	1880		O P E N		L I D						
A 4157	1940	36		15	14	43	1441	109	72	66.66	0.33
A 4159	2000	58	11	47	66	143	1002	325	267	82.26	0.46

DATE : 8 - 6 - 83.

IKU

TABLE I b.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS IN CUTTINGS .

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 4161	2060	55		8		18	89	81	26	31.89	0.00
A 4162	2090	51		8			74	60	8	14.16	
A 4164	2150	91		11	9	19	93	129	39	29.83	0.50
A 4166	2210		O P E N		L I D						
A 4168	2240		O P E N		L I D						
A 4170	2270	73				7	43	80	7	8.43	0.00
A 4172	2300	76	6	17	8		73	108	32	29.49	
A 4174	2330	56	8	13		13	36	90	34	38.17	0.00
A 4176	2360	71	8	25	15	31	98	150	79	52.79	0.50
A 4178	2390	84	11	22	9	16	31	142	58	40.83	0.56
A 4180	2420	74	10	27		19	28	131	56	43.13	0.00
A 4181	2435	96	16	45	19	34	45	211	115	54.61	0.57
A 4183	2465	95	25	71	28	49	67	268	173	64.57	0.58
A 4185	2495	128	48	113	43	77	78	408	281	68.77	0.55
A 4187	2525	117	37	126	55	94	88	429	312	72.75	0.58
A 4189	2555	95	9	46	24	47	52	221	126	57.13	0.51
A 4191	2585	98	18	83	59	142	443	400	302	75.48	0.41
A 4193	2615	207	880	2799	1235	2354	1756	7475	7268	97.23	0.52

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IKU

TABLE 1 b.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS IN CUTTINGS .

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WETNESS (%)	iC4 / nC4
A 5430	2705	624	3412	8156	2568	5350	6893	20110	19486	96.90	0.48
A 5431	2720	531	4748	10450	3179	6723	8180	25631	25100	97.93	0.47
A 5432	2735	850	5036	10986	3785	7800	11654	28538	27688	97.02	0.40
A 5433	2750	1559	8197	9800	2539	5315	7154	27409	25850	94.31	0.48
A 5434	2765	1363	33216	27652	4444	8159	7241	74834	73472	98.18	0.54
A 5435	2780	2451	10630	11673	2560	5301	5705	32615	30164	92.48	0.48
A 5436	2795	2228	5089	9611	3230	7241	12150	27399	25171	91.87	0.45
A 5437	2810	6381	27391	23112	3742	7275	6343	67900	61519	90.60	0.51
A 5438	2825	4511	26061	18326	2558	4843	3909	56298	51787	91.99	0.53
A 5439	2840	5727	27184	20838	3159	6037	5044	62945	57219	90.90	0.52
A 5440	2855	4415	15376	14778	2997	5735	5430	43302	38886	89.80	0.52
A 5441	2870	5111	15406	13583	2599	5425	5618	42124	37013	87.87	0.48
A 5442	2885	4095	15299	12297	2339	4960	5405	38990	34894	89.50	0.47
A 5443	2900	6094	15786	12084	2131	4384	4674	40479	34385	84.94	0.49
A 5444	2915	6023	17085	14736	2762	5891	7618	46496	40474	87.05	0.47
A 5445	2930	1200	2568	4069	1044	2497	3536	11377	10178	89.45	0.42
A 5446	2945	1858	3517	3969	917	2205	2619	12467	10609	85.10	0.42
A 5447	2960	1619	5534	6176	1446	3235	3093	18009	16390	91.01	0.45
A 5448	2975	953	2736	3286	823	1711	1643	9509	8556	89.98	0.48
A 5449	2990	1028	4301	6353	1607	3731	3901	17020	15991	93.96	0.43
A 5450	3005	537	2537	3772	908	2277	2711	10030	9493	94.65	0.40
A 5451	3020	OPEN LID									
A 5452	3035	OPEN LID									

DATE : 9 - 6 - 83.

IKU

TABLE I b.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS IN CUTTINGS .

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 5453	3050	99	241	860	231	701	655	2131	2032	95.36	0.33
A 5454	3065	118	164	567	156	541	701	1546	1428	92.38	0.29
A 5455	3085	208	143	603	176	664	1373	1795	1587	88.39	0.27
A 5456	3095		O P E N		L I D						
A 5457	3110	141	115	606	174	701	1035	1736	1595	91.88	0.25
A 5458	3125	172	437	1168	286	859	911	2923	2750	94.10	0.33
A 5459	3140	12047	1558	1588	339	1247	1993	16779	4732	28.20	0.27
A 5460	3155	2558	417	779	200	689	1123	4642	2085	44.90	0.29
A 5461	3170	3050	344	362	92	353	690	4202	1152	27.41	0.26
A 5462	3185	4602	465	380	103	386	1003	5936	1334	22.47	0.27
A 5463	3200	6239	546	249	23	204	810	7261	1022	14.07	0.11
A 5464	3215	7619	764	276	66	202	705	8926	1307	14.65	0.33
A 5465	3230	4580	646	346	91	301	1262	5963	1384	23.20	0.30
A 5466	3245	3388	618	659	191	637	1527	5494	2106	38.33	0.30
A 5467	3260	4860	978	551	154	451	2046	6993	2133	30.50	0.34
A 5468	3275	4747	962	580	165	452	2071	6905	2158	31.26	0.36
A 5469	3290	3513	620	365	98	291	876	4886	1374	28.11	0.34
A 5470	3305	5306	947	633	163	499	1431	7548	2243	29.71	0.33
A 5471	3320	505	69	50	14	50	59	687	181	26.41	0.27
A 5472	3335	5713	814	538	145	449	721	7659	1946	25.41	0.32
A 5473	3350	5717	882	534	135	402	713	7671	1954	25.47	0.34
A 5474	3365	5338	825	510	128	377	664	7178	1840	25.63	0.34
A 5475	3380	6138	993	870	238	714	1085	8953	2815	31.44	0.33

DATE : 9 - 6 - 83.

IKU

TABLE I b.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS IN CUTTINGS .

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 5476	3395	4408	652	620	175	555	875	6410	2002	31.23	0.32
A 5477	3410	1824	320	621	186	594	1005	3545	1721	48.55	0.31
A 5479	3425	2478	388	606	179	568	898	4219	1741	41.27	0.32
A 5480	3440	1705	324	756	255	795	1569	3836	2130	55.54	0.32
A 5481	3455	358	327	1332	431	1263	1630	3710	3352	90.36	0.34
A 5482	3470	3094	4340	5655	1031	2648	2391	16767	13673	81.55	0.39

DATE : 9 - 6 - 83.

IKU

TABLE I c.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS (Ia + Ib) .

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 4102	260	5797						5797		0.00	
A 4105	350	11042						11042		0.00	
A 4108	440	15226	35	38		39		15337	111	0.73	0.00
A 4111	530	10710	75					10785	75	0.69	
A 4114	620	18694	13					18708	13	0.07	
A 4117	710	2634	4					2638	4	0.15	
A 4120	800	50516	39					50555	39	0.08	
A 4123	890	3812						3812		0.00	
A 4126	980	144						144		0.00	
A 4129	1100	297	16	12				325	28	8.68	
A 4132	1190	236	20	15	6			277	41	14.94	
A 4135	1280	237	65	7				309	73	23.47	
A 4138	1370	144						144		0.00	
A 4141	1460	137	9					146	9	6.29	
A 4143	1520	105	12					118	12	10.50	
A 4145	1580	63	24	9			23	96	33	34.23	
A 4147	1640	39	30	4			11	74	35	46.83	
A 4149	1700	42	30	7				79	37	46.54	
A 4151	1760	624	38	17			204	679	55	8.05	
A 4153	1820	960	215	87	73	28	656	1364	403	29.59	2.60
A 4155	1880	1034	315	142	99	93	427	1690	655	38.78	1.06
A 4157	1940	925	105	216	170	267	2087	1683	758	45.03	0.64
A 4159	2000	1211	113	183	141	247	1186	1896	684	36.10	0.57

DATE : 8 - 6 - 83.

IKU

TABLE I c.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS (Ia + Ib) .

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 ----- nC4
A 4161	2060	1323	102	99	55	78	192	1656	333	20.12	0.70
A 4162	2090	1637	106	129	66	89	329	2027	390	19.24	0.74
A 4164	2150	1069	89	74	32	19	93	1283	213	16.64	1.72
A 4166	2210	2668	244	116	34	36	102	3097	430	13.87	0.94
A 4168	2240	2872	280	163	28			3344	471	14.10	
A 4170	2270	1891	186	120		7	241	2204	313	14.18	0.00
A 4172	2300	1032	107	96	28		140	1262	230	18.23	
A 4174	2330	1578	171	137	28	51	116	1966	388	19.72	0.55
A 4176	2360	867	87	97	36	31	133	1118	251	22.43	1.18
A 4178	2390	472	66	56	17	24	41	635	163	25.64	0.70
A 4180	2420	971	146	143		51	59	1310	339	25.90	0.00
A 4181	2435	983	126	134	37	53	61	1332	350	26.24	0.71
A 4183	2465	686	142	209	61	81	93	1179	493	41.83	0.76
A 4185	2495	2694	459	501	129	162	98	3945	1251	31.71	0.79
A 4187	2525	1261	318	413	117	158	135	2267	1006	44.38	0.74
A 4189	2555	2521	577	716	183	223	52	4220	1699	40.27	0.82
A 4191	2585	1206	274	650	411	712	2186	3252	2046	62.92	0.58
A 4193	2615	3946	3274	6672	2965	5351	10614	22208	18262	82.23	0.55

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DATE : 8 - 6 - 83.

IKU

TABLE I c.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS (Ia + Ib) .

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 5430	2705	8990	9941	14946	4113	7404	10117	45393	36403	80.20	0.56
A 5431	2720	11421	14745	19534	4976	8931	9484	59607	48186	80.84	0.56
A 5432	2735	13876	15820	19930	5740	10291	13719	65657	51781	78.87	0.56
A 5433	2750	16432	17328	17543	4393	7727	10335	63423	46991	74.09	0.57
A 5434	2765	2719	36248	29527	4713	8583	7773	81790	79070	96.68	0.55
A 5435	2780	19142	17647	15459	3193	6112	6460	61553	42411	68.90	0.52
A 5436	2795	16308	15000	19733	5858	10478	16157	67377	51069	75.80	0.56
A 5437	2810	82979	53792	32486	4929	8861	7683	183048	100068	54.67	0.56
A 5438	2825	109643	66945	33099	4395	7514	7322	221596	111952	50.52	0.59
A 5439	2840	22053	37026	24766	3681	6792	5893	94318	72265	76.62	0.54
A 5440	2855	10898	20039	18018	3508	6497	6135	58959	48062	81.52	0.54
A 5441	2870	17284	19434	15610	2961	5885	6001	61173	43889	71.75	0.50
A 5442	2885	23342	22768	15847	2939	5764	6342	70661	47318	66.97	0.51
A 5443	2900	16129	19997	14022	2492	4848	5329	57488	41359	71.94	0.51
A 5444	2915	16196	21318	17485	3262	6637	8312	64898	48702	75.04	0.49
A 5445	2930	4988	5580	6274	1420	3145	5065	21406	16418	76.70	0.45
A 5446	2945	8395	5660	5290	1136	2525	2934	23006	14611	63.51	0.45
A 5447	2960	6147	7793	7849	1746	3696	3515	27231	21084	77.42	0.47
A 5448	2975	3917	3955	4237	996	1986	1940	15091	11174	74.05	0.50
A 5449	2990	8272	7220	8266	1912	4221	4415	29891	21620	72.33	0.45
A 5450	3005	6570	6057	6904	1428	3199	3655	24159	17589	72.80	0.45
A 5451	3020	O P E N	L I D								
A 5452	3035	O P E N	L I D								

DATE : 9 - 6 - 83.

IKU

TABLE I c.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS (Ia + Ib) .

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 5453	3050	1709	844	1418	298	841	978	5110	3401	66.55	0.35
A 5454	3065	754	573	1225	278	827	701	3656	2902	79.38	0.34
A 5455	3085	604	362	963	249	838	1625	3016	2411	79.96	0.30
A 5456	3095	O P E N L I D									
A 5457	3110	2508	1183	2298	519	1574	1982	8083	5574	68.97	0.33
A 5458	3125	696	708	1456	331	957	1040	4148	3452	83.22	0.35
A 5459	3140	12059	1562	1588	339	1247	1993	16796	4736	28.20	0.27
A 5460	3155	2757	503	927	220	742	1179	5149	2392	46.45	0.30
A 5461	3170	3194	413	511	117	411	773	4645	1451	31.24	0.28
A 5462	3185	5268	489	779	161	526	1173	7223	1955	27.07	0.31
A 5463	3200	6603	645	422	23	204	933	7897	1294	16.38	0.11
A 5464	3215	7906	834	386	71	247	748	9444	1538	16.29	0.29
A 5465	3230	4644	662	366	91	301	1262	6063	1419	23.40	0.30
A 5466	3245	3924	771	867	201	902	1668	6665	2741	41.12	0.22
A 5467	3260	4992	1016	608	154	451	2087	7222	2229	30.87	0.34
A 5468	3275	4747	962	580	165	452	2071	6905	2158	31.26	0.36
A 5469	3290	3938	750	568	125	377	1180	5759	1821	31.62	0.33
A 5470	3305	5515	1002	691	173	527	1445	7908	2393	30.26	0.33
A 5471	3320	858	187	234	30	116	343	1425	567	39.79	0.26
A 5472	3335	5730	814	538	145	449	721	7676	1946	25.35	0.32
A 5473	3350	6027	994	699	148	402	852	8270	2243	27.12	0.37
A 5474	3365	5705	942	690	148	448	858	7932	2227	28.07	0.33
A 5475	3380	6202	1013	897	238	714	1085	9064	2862	31.58	0.33

DATE : 9 - 6 - 83.

IKU

TABLE I c.

CONCENTRATION (ul Gas / kg Rock) OF C1 - C7 HYDROCARBONS (Ia + Ib).

IKU no.	DEPTH m/ft	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
A 5476	3395	4733	774	807	198	611	997	7124	2392	33.57	0.32
A 5477	3410	2057	441	852	226	689	1214	4264	2208	51.77	0.33
A 5479	3425	2751	519	822	210	637	1053	4938	2187	44.30	0.33
A 5480	3440	1920	427	875	277	831	1647	4330	2410	55.66	0.33
A 5481	3455	416	400	1406	441	1282	1658	3945	3528	89.45	0.34
A 5482	3470	6210	4865	5991	1071	2720	2449	20857	14646	70.22	0.39

DATE : 9 - 6 - 83.

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-4102	230-260		90%	Fine sand to gravel, subrounded and rounded, some subangular and angular. The sand consists mainly of quartz, while the coarser parts are composed of gneisses with quartz, muscovite, feldspar, chlorite, etc. and sedimentary rocks such as glauconitic clayey sandstones, chert, siderite, claystones
			10%	Shell fragments
A-4105	320-350		95%	Fine sand to gravel, as above
			5%	Shell fragments
A-4108	410-440		90%	Fine sand to gravel as above but with a decrease in grain size
			10%	Shell fragments and foraminifera
			Sm.am.	Pyrite; Mica, ?additive
A-4111	500-530		95%	Fine sand to gravel consisting mainly of quartz and gneiss fragments
			5%	Shell fragments
A-4114	590-620		85%	Fine sand to gravel, as above
			5%	Claystone, grey - olive grey, occasionally slightly silty, sandy, micromicaceous, very slightly calcareous
			10%	Shell fragments
			Sm.am.	Pyrite
A-4117	680-710		55%	Cement
		0.32	35%	Claystone, olive grey - green, sandy, very fine, subangular
			10%	Rock fragments and quartz

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-4120	770-800		55%	Sand, quartz, clear, white, fine - coarse, mainly subrounded - rounded
		0.77	25%	Claystone, olive grey - green, sandy, micaceous, calcareous, occasionally pyritic
			15%	Shell fragments and foraminifera
			5%	Rock fragments
			Sm.am.	Pyrite
A-4123	860-890		20%	Cement
			30%	Sand, quartz, coarse - very coarse, subrounded, some stained, green by Glauconite, minor amounts of fine subangular quartz
		0.81	30%	Claystone, olive green, as above
			5%	Shell fragments, rounded
			10%	Glauconite
			Sm.am.	Glauconitic Sandstone, (brownish), olive grey, clayey, pyritic in parts
A-4126	950-980		15%	Cement
			10%	Sand, quartz, coarse, very coarse, subrounded
		0.65	50%	Claystone, olive - olive grey, sandy, micaceous, calcareous, occasionally slightly glauconitic
			20%	Sandstone, glauconitic, brownish grey, argillaceous, pyritic, calcareous - slightly calcareous
			5%	Glauconite
			Sm.am.	Shell fragments

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-4129	1070-1100	1.19	95%	Claystone, light brownish grey - olive grey, slightly micromicaceous, partly sandy, partly glauconitic (slightly), abundant sponge spicules
			5%	Sand, quartz, coarse, very coarse granules, medium, fine, mostly sub-rounded
			Sm.am.	Claystone, brown - dark brown, sandy, micaceous, sponge spicules; Glauconite
A-4132	1160-1190	1.22	65%	Claystone, light olive brown, occasionally slightly sandy, micro-micaceous, non-calcareous
		1.45	25%	Claystone, brownish grey, micromicaceous, partly subfissile, non calcareous
			10%	Sand, quartz, fine - medium subrounded, rounded
			Sm.am.	Pyrite
A-4135	1250-1280		20%	Claystone, light olive brown, as above, occasionally with slickensides
		1.10	80%	Claystone, brownish grey, as above, non calcareous
			Sm.am.	Sand, as above
A-4138	1340-1370	0.84	95%	Claystone, dark greenish grey, grey, micromicaceous, non-calcareous, occasionally slightly pyritic, partly subfissile
			5%	Claystone, light olive brown, as above
			Sm.am.	Sand, as above

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Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-4141	1430-1460	0.62	95%	Claystone, dark greenish grey, as above
			3%	Sand, quartz, clear, medium - coarse, fine, rounded
			2%	Claystone, light olive brown
			Sm.am.	Glauconite; Claystone, green - dark green
A-4143	1490-1520	0.61	97%	Claystone, dark greenish grey - brownish grey, as above, but becoming partly waxy
			2%	Claystone, light brown
			1%	Sand, as above
			Sm.am.	Claystone, dark green; ?Siderite, sideritic Claystone, brown, hard
A-4145	1550-1580		100%	Claystone, dark grey - dark greenish grey, occasionally brownish grey, some waxy, fissile - subfissile, (as 1490-1520m)
			Sm.am.	Sand; Claystone, light brown; Siderite
A-4147	1610-1640	0.38	100%	Claystone, dark grey - greenish grey, slightly micromicaceous, non calcareous, fissile - subfissile
			Sm.am.	Claystone, light brownish white, slightly calcareous

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Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-4149	1670-1700	0.33	100%	Claystone, dark grey - greenish grey, as above
			Sm.am.	Sand/Sandstone, quartz, clear, medium, coarse, subangular - subrounded, occasionally cemented by Pyrite; Siderite, brown
A-4151	1730-1760		40%	Claystone, dark greyish green, dark grey, dark green, slightly micromicaceous, some waxy in parts subfissile - fissile
			60%	Claystone, red-brown, brown, slightly micromicaceous, calcareous, subfissile
			Sm.am.	Claystone, bluish, tuffaceous; Siderite
A-4153	1790-1820	0.49	45%	Claystone, dark grey, dark greenish grey, grey, greyish black, occasionally mottled and tuffaceous
			55%	Claystone, red-brown, non to slightly calcareous, otherwise as above
A-4155	1850-1880	0.77	70%	Claystone, light greenish grey, slightly micaceous, non calcareous, subfissile
		1.14	20%	Claystone, dark grey, dark green - grey, as above
			10%	Claystone, red-brown, as above

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Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-4157	1910-1940		15%	Cement
		0.49	85%	Claystone, grey - dark greenish grey, grey, greenish grey, occasionally tuffaceous
			Sm.am.	Sandstone, very fine - fine, subangular, argillaceous, micaceous; Coal, lignite, ?additive; Sand, quartz, medium subrounded
A-4159	1970-2000	0.69	95%	Claystone, dark greenish grey, grey, occasionally dark greenish brown, micro-micaceous, tuffaceous in parts
			3%	Sandstone/Sand, medium, fine, subrounded, subangular
			2%	Coal
			Sm.am.	Shell fragments some staining on fragments
A-4161	2030-2060	0.64	80%	Claystone, dark greenish grey, micromicaceous, fissile, very contaminated
			20%	Coal/Lignite, ?additive
			Sm.am.	Limestone, light brown; Sand, quartz, medium, subrounded; Sandstone, fine, argillaceous
A-4162	2060-2090	0.62	80%	Claystone, dark greenish grey - greenish grey, subfissile, as above
		0.52	15%	Claystone, grey, sandy, silty, very fine, glauconitic in parts, calcareous, occasionally marly, micaceous
			5%	Limestone, light brownish white
			Sm.am.	as above

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-4164	2120-2150	0.61	60%	Claystone, greenish grey, as above, occasionally calcareous
			38%	Claystone, grey, slightly greenish, sandy, occasionally glauconitic, very calcareous - calcareous, as above
			2%	Lignite, ?additive
			Sm.am.	Limestone, light brown
			Trace	Sand, quartz, medium subrounded contaminated fragments
A-4166	2180-2210	0.65	100%	Claystone, grey, slightly greenish grey, sandy in parts, calcareous, micro-micaceous
				Abundant Coal/Lignite as above, some contamination
A-4168	2225-2240	0.58	100%	Claystone, grey, calcareous, as above
			Sm.am.	as above, some staining
A-4170	2255-2270	0.64	100%	Claystone, grey, as above
A-4172	2285-2300	0.74	90%	Claystone, dark greenish grey, slightly micromicaceous, fissile, non calcareous
			10%	Lignite/Coal, ?additive
			Sm.am.	Sandstone, very fine, argillaceous; Sideritic Claystone, brown; Claystone, red-brown, Abundant staining

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-4174	2315-2330	0.68	95%	Claystone, greenish grey, micromicaceous, non - very slightly calcareous, fissile
			3%	Sideritic Claystone, brown - light brown, hard
			2%	Coal/lignite, as above
			Sm.am.	Claystone, red-brown; Pyrite, some staining
A-4176	2345-2360	0.63	99%	Claystone, grey, as above
			1%	Sideritic Claystone, light brown - as above
			Sm.am.	Coal/Lignite; Claystone, red-brown, some staining
A-4178	2375-2390	0.68	96%	Claystone, grey, greenish grey, as above
			4%	Coal/Lignite
			Sm.am.	Sideritic Claystone, light brown - brown, abundant staining
A-4180	2405-2420	0.92	97%	Claystone, grey - greenish grey, as above
			3%	Coal/Lignite
			Sm.am.	Sideritic Claystone, as above, Marl/Limestone, light brown; Sand- stone, greyish white, glauconitic
A-4181	2420-2435	0.60	100%	Claystone, grey, as above
			Sm.am.	Sideritic Claystone; Claystone, red-brown; Coal/Lignite Only slightly stained

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-4183	2450-2465	0.69	93%	Claystone, grey as above
			5%	Sandstone, white, very fine - silty, argillaceous, subangular, glauconitic, occasionally micaceous and carbonaceous
			1%	Sideritic Claystone, light brown
			1%	Coal/Lignite
			Sm.am.	Claystone, red-brown; Pyrite, some staining
A-4185	2480-2495	0.62	93%	Claystone, grey, as above, occasionally sandy, getting occasionally laminated
			7%	Sandstone, greyish white
			Sm.am.	Sideritic Claystone, Coal/Lignite
			Trace	Sand, quartz, medium, well rounded
				Some staining
A-4187	2510-2525	0.61	65%	Claystone, grey, as above
		0.51	35%	Sandstone, greyish white, as above
			Sm.am.	as above, Claystone, red-brown
				Some staining
A-4189	2540-2555	0.73	80%	Claystone, grey (slightly greenish), silty and sandy in parts, very fine, micromicaceous
			10%	Sandstone, greyish white, very fine, silty, argillaceous, glauconitic, occasionally slightly pyritic, calcareous
			10%	Lignite/Coal, ?additive
			Sm.am.	As above
				Very abundant staining

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-4191	2570-2585	0.55	85%	Claystone, grey, as above
			14%	Sandstone, greyish white, as above
			1%	Sideritic Claystone, light brown
			Sm.am.	As above
				Some staining
A-4193	2600-2615	0.92	61%	Claystone, grey, as above
		1.80	30%	Claystone, dark brownish grey, micromicaceous, fissile, occasionally some waxy
			3%	Sandstone, greyish white, as above
			5%	Marl, light brown
			1%	Sideritic Claystone, light brown
			Sm.am.	Claystone, red-brown; Coal/Lignite (additive)
				Some staining
A-5430	2690-2705	4.43	60%	Claystone, dark grey - black, brownish black, micromicaceous - micaceous, carbonaceous, partly coaly, pyritic in parts, subfissile
			20%	Claystone, grey, light brownish grey - white, occasionally marly
			20%	Sand, quartz, fine - coarse, subangular - subrounded
			Sm.am.	coal, mica, claystone, brownish black, deformed fragments
				Abundant steel fragments, Some staining of cuttings

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC	Lithology	
A-5431	2705-2720	3.73	75%	Claystone, dark grey - black, as above
			15%	Claystone, dark brownish black, often as rounded fragments, soft
			10%	Claystone, grey, light brownish grey
			Sm.am.	Coal; Sand
				Abundant steel fragments
A-5432	2720-2735	5.12	85%	Claystone, dark greyish black, micromicaceous, micaceous, carbonaceous, as above
			15%	Claystone, grey, light brownish grey, non calcareous - marly
			Sm.am.	Sand; Claystone, brownish black; Claystone, red-brown, Nut shells, abundant steel fragments
A-5433	2735-2750	5.30	50%	Claystone, dark grey - greyish black as above, occasionally silty
			45%	Claystone, brownish black, deformed fragments
			5%	Cement
A-5434	2750-2765	5.30	55%	Claystone, dark grey - greyish black as above
		4.69	35%	Claystone (underclay), greyish brown - brown, waxy, carbonaceous
			5%	Coal, associated with the underclay
			5%	Cement
			Sm.am.	Sand
				Abundant steel fragments

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC	Lithology	
A-5435	2765-2780	8.11	40%	Claystone, dark grey - greyish black, as above
		1.42	55%	Claystone, pale brownish grey, waxy
			3%	Claystone, brownish black
			2%	Sand, fine - medium, subangular - subrounded
			Sm.am.	Coal; Cement; Nut shells
				Abundant steel fragments
A-5436	2780-2795	4.53	60%	Claystone, dark grey - greyish black, as above
			20%	Claystone, brownish black, rounded fragments
			15%	Additive, greyish white, white
			5%	Light brownish, occasionally calcareous
A-5437	2795-2810	6.32	62%	Claystone, dark grey - greyish black, micromicaceous - micaceous, carbonaceous, pyritic, subfissile, as above
			30%	Claystone, pale brown - pale greyish brown, waxy, occasionally carbonaceous
			3%	Coal
			5%	Cement
			Sm.am.	Sand; Pyrite; Pipe dope; Mica
				Abundant steel fragments

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-5438	2810-2825	11.26	65%	Claystone, dark grey - black, as above
		1.55	25%	Claystone, brown - pale brown, brown-grey, waxy, carbonaceous
			5%	Sand, quartz, fine, medium, coarse, subangular, angular, subrounded
			5%	Coal
				Abundant steel fragments
			Sm.am.	Nut shell; Mica; Pipe dope
A-5439	2825-2840	10.13	65%	Claystone, dark grey - black, as above
		1.71	25%	Claystone, pale brown - brown-grey, waxy, as above
			6%	Coal
			4%	Cement
			Sm.am.	as above, Sand
				Abundant steel fragments
A-5440	2840-2855	6.18	90%	Claystone, dark greyish black, micromicaceous, micaceous, silty, carbonaceous, pyritic, subfissile
			5%	Claystone, light brown, grey, greenish grey, waxy
			5%	Cement
			Sm.am.	Coal; Steel fragments; Mica; some contamination
				Staining on fragments

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-5441	2855-2870	6.42	85%	Claystone, dark grey - greyish black, as above
			10%	Claystone, grey - dark grey, waxy
			5%	Cement
				Abundant steel fragments
			Sm.am.	Coal; Sand; Mica; Pipe dope
A-5442	2870-2885	4.26	35%	Claystone, dark grey - greyish black, as above
		2.48	50%	Claystone, greyish brown, brown, grey, dark grey, waxy
			10%	Claystone, grey - light brownish grey, calcareous
			5%	Cement
			Sm.am.	As above
				Abundant steel fragments,
				The lithologies are becoming altered by turbodrilling
A-5443	2885-2900	12.91	40%	Claystone, dark grey - greyish black, as above
			20%	Claystone, brown, brown-grey, waxy
			3%	Sandstone, very fine, angular
			22%	Turbodrill-affected lithologies
			5%	Cement
			Sm.am.	Sand; Coal; Mica; steel fragments
A-5444	2900-2915	10.38	20%	Claystone, dark grey - greyish black, as above
			25%	Claystone, brown, grey, waxy
			55%	Turbodrill-affected lithologies
			Sm.am.	Sand/Sandstone; Silty Claystone/Siltstone, grey; Cement; Pyrite; Steel fragments

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC	Lithology	
A-5445	2915-2930		25%	Claystone, dark grey - greyish black, occasionally silty, as above
			15%	Claystone, grey, brown-grey, waxy
			60%	Turbodrill-affected lithologies, greyish white
			Sm.am.	As above, Pipe dope
A-5446	2930-2945	3.85	40%	Claystone, dark greyish black, less micaceous than above, carbonaceous, pyritic, subfissile
			5%	Claystone, brown-grey, waxy
			5%	Claystone, light brown, calcareous
			45%	Turbodrill-affected lithologies, greyish white
			5%	Cement
			Sm.am.	Sand, medium, fine, coarse Abundant steel fragments
A-5447	2945-2960	4.88	85%	Claystone, dark greyish black, as above
			10%	Claystone, brown, brown-grey, waxy
			5%	Cement
			Sm.am.	Claystone, greenish grey; Coal; Mica; Sand; Claystone, red-brown; Pipe dope; Steel fragments

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-5448	2960-2975	4.40	85%	Claystone, dark greyish black, silty, occasionally slightly sandy, micromicaceous, micaceous, carbonaceous, subfissile, as above
			5%	Sandstone, fine, subangular, argillaceous and carbonaceous in parts, very slightly glauconitic
			3%	Sand, medium, subangular, subrounded, some rounded
			2%	Claystone, greenish grey
			5%	Kaolin?, mud additive
			Sm.am.	Cement; Pyrite; Coal; Steel fragments; Mica; Pipe dope
				Some staining on cuttings
A-5449	2975-2990	4.14	60%	Claystone, dark greyish black, as above
			25%	Sandstone, fine, subangular, slightly glauconitic, micaceous, occasionally slightly calcareous, pyritic in parts
			5%	Sand, medium, coarse, fine, subangular - subrounded
			10%	Kaolin
			Sm.am.	Claystone, greenish grey, otherwise as above

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC	Lithology	
A-5450	2990-3005	4.03	50%	Claystone, dark greyish black, as above
			40%	Sandstone, Sand, white as above
			5%	Kaolin
			4%	Claystone, brownish grey, occasionally waxy
			3%	Coal
			Sm.am.	As above
				Some staining of fragments
A-5451	3005-3020		70%	Cement
		3.31	30%	Claystone, dark greyish black, as above
			Sm.am.	Sandstone/Sand; Coal; Pyrite
A-5452	3020-3035		60%	Cement
		1.96	25%	Claystone, grey, non micaceous, disintegrates in 10% HCl
			15%	Coal
			Sm.am.	Claystone, dark greyish black, micaceous, carbonaceous, pipe dope
A-5453	3035-3050		30%	Cement
		1.76	60%	Claystone, dark grey, micromicaceous, slightly carbonaceous in parts, fissile
			5%	Claystone, grey
			5%	Coal
			Sm.am.	Nut shells
A-5454	3050-3065		15%	Cement
		1.58	75%	Claystone, dark grey, as above
			10%	Coal
			Sm.am.	Sandstone/Sand; Steel fragments
				Abundant staining on fragments

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-5455	3070-3085		15%	Cement
		1.54	80%	Claystone, dark grey, as above
			5%	Marl, light brown, occasionally slightly carbonaceous
				Abundant Coal; Steel fragments
			Sm.am.	Sand; Pyrite
A-5456	3080-3095		10%	Cement
		1.58	70%	Claystone, dark grey, as above
			10%	Marl/Claystone, light brown
			5%	Coal
			Sm.am.	Claystone, red-brown; Sand; Pyrite
				Abundant steel fragments and LCM
				Some staining on fragments
A-5457	3095-3110		10%	Cement
		1.50	80%	Claystone, dark grey, as above
			5%	Marl, light brown-grey, calcareous
			5%	Coal
			Sm.am.	Sand; Pyrite; Steel fragments
				Some staining
A-5458	3110-3125		5%	Cement
		1.43	95%	Claystone, dark grey - greyish black, micromicaceous, some carbonaceous, fissile - subfissile
			Sm.am.	As above, Coal
A-5459	3125-3140	1.77	100%	Claystone, dark grey - greyish black, as above
			Sm.am.	As above, Cement
				Some staining on fragments

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-5460	3140-3155	1.43	70%	Claystone, dark grey - greyish black, as above
			28%	Turbodrill-affected lithologies, grey
			2%	Sandstone, fine, angular - subangular
			Sm.am.	As above
				Some staining
A-5461	3155-3170	1.74	100%	Claystone, dark grey - greyish black, affected by turbodrilling
			Sm.am.	Sandstone; Cement
				Some staining on fragments
A-5462	3170-3185	1.65	100%	Claystone as above
			Sm.am.	As above
A-5463	3185-3200	1.68	100%	Claystone, as above
			Sm.am.	As above
				Abundant staining
A-5464	3200-3215	1.62	96%	Claystone, as above
			4%	Coal
			Sm.am.	As above
A-5465	3215-3230	1.63	95%	Claystone, as above
			5%	Coal
			Sm.am.	As above
A-5466	3230-3245	1.87	100%	Claystone, as above
			Sm.am.	As above plus Coal

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC	Lithology	
A-5467	3245-3260	1.63	100%	Claystone, as above
			Sm.am.	As above
A-5468	3260-3275	1.71	100%	Claystone, dark grey, some brownish, otherwise as above
			Sm.am.	Coal; Cement
A-5469	3275-3290	1.61	100%	Claystone, dark grey, as above
			Sm.am.	As above
A-5470	3290-3305	1.52	95%	Claystone, dark grey (brownish), as above
			5%	Cement
			Sm.am.	Coal
A-5471	3305-3320	1.55	100%	Claystone, dark grey, as above
			Sm.am.	Coal; Cement; Sand
A-5472	3320-3335	1.48	97%	Claystone, dark grey - greyish black
			3%	Coal
			Sm.am.	Cement; Sand
				Some staining
A-5473	3335-3350	1.54	100%	Claystone, dark grey - greyish black, as above
			Sm.am.	Coal; Cement
A-5474	3350-3365	1.56	100%	Claystone, dark grey
			Sm.am.	As above

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-17

Sample	Depth (m)	TOC		Lithology
A-5475	3365-3380	1.60	100%	Claystone, dark grey - greyish black, slightly less affected by turbodrilling than the samples above
A-5476	3380-3395	1.54	100%	Claystone, dark grey - greyish black, as above
A-5477	3395-3410	1.53	90%	Claystone, dark grey - greyish black, as above
		1.77	10%	Claystone, brown, micromicaceous, fissile
A-5479	3410-3425	1.50	100%	Claystone, dark grey - greyish black, as above
			15%	Claystone, brown, as above
			Sm.am.	Pyrite
A-5480	3425-3440	1.51	100%	Claystone, dark grey - brownish grey, partially affected by turbodrilling
			Sm.am.	As above
A-5481	3440-3455		90%	Sand, white, clear, medium fine, coarse, subangular - angular
		1.44	10%	Claystone, brownish grey - dark grey, micromicaceous, subfissile
A-5482	3455-3470		85%	Sand, as above
		1.65	15%	Claystone, as above, occasionally waxy
			Sm.am.	Coal

TABLE : 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 4129	1100	12.6	4.8	0.7	0.6	1.3	3.5	1.19
A 4141	1460	16.0	2.6	1.1	0.6	1.7	0.9	0.62
A 4155	1800	9.1	1.8	1.0	0.6	1.6	0.2	1.14
A 4174	2330	11.6	1.0	0.2	0.5	0.7	0.3	0.68
A 4183	2465	19.5	2.0	1.0	0.8	1.8	0.2	0.69
A 4187	2525	17.7	5.4	1.8	1.1	2.9	2.5	0.61
A 4193	2615	6.3	6.0	0.6	2.3	2.9	3.1	1.00
A 5435	2780	13.7	30.2	8.6	12.3	20.9	9.3	8.11
A 5438	2825	4.0	4.4	1.0	1.6	2.5	1.9	11.26
A 5442	2885	11.6	24.1	4.9	8.0	13.0	11.1	4.26
A 5453	3050	2.5	9.3	3.2	3.0	6.2	3.1	1.76
A 5462	3185	2.3	1.9	0.7	1.0	1.7	0.2	1.65
A 5468	3275	1.0	4.1	0.7	0.8	1.6	2.5	1.71
A 5476	3395	3.9	5.6	0.8	1.1	1.9	3.7	1.56
A 5482	3470	2.5	5.2	0.2	0.6	0.8	4.4	1.65

DATE : 7 - 7 - 83.

IKU

TABLE : 4.

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm OF rock)

IKU No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
A 4129	1100	382	57	48	105	277
A 4141	1460	163	68	38	105	58
A 4155	1800	193	103	64	168	26
A 4174	2330	86	21	41	62	24
A 4183	2465	102	49	43	92	10
A 4187	2525	305	102	61	163	142
A 4193	2615	949	75	381	456	494
A 5435	2780	2206	631	894	1525	681
A 5438	2825	1097	239	389	628	469
A 5442	2985	2078	424	693	1117	960
A 5453	3050	3750	1306	1210	2516	1234
A 5462	3185	809	306	409	715	94
A 5468	3275	4100	720	840	1560	2540
A 5476	3395	1432	215	276	491	941
A 5482	3470	2072	96	239	335	1737

DATE : 7 - 7 83.

TABLE : 5.

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU No.	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
A 4127	1100	32.1	4.8	4.0	8.8	23.2
A 4141	1460	26.2	10.8	6.1	16.9	9.3
A 4155	2000	17.0	9.0	5.7	14.7	2.3
A 4174	2330	12.7	3.1	6.1	9.2	3.6
A 4183	2465	14.9	7.1	6.2	13.4	1.5
A 4187	2525	50.0	16.7	10.0	26.7	23.3
A 4193	2615	52.7	5.3	20.0	25.3	27.4
A 5435	2780	27.2	7.8	11.0	18.8	8.4
A 5438	2825	9.7	2.1	3.5	5.6	4.2
A 5442	2885	48.8	10.0	16.3	26.3	22.5
A 5453	3050	213.1	74.2	68.7	143.0	70.1
A 5462	3185	49.0	18.6	24.8	43.3	5.7
A 5468	3275	239.8	42.1	49.1	91.2	148.5
A 5476	3395	91.8	13.8	17.7	31.5	60.3
A 5482	3470	125.6	5.8	14.5	20.3	105.3

DATE : 7 - 7 - 83.

IKU

T A B L E : [illegible]

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 4129	1100	15.0	12.5	27.5	120.0	72.5	37.9
A 4141	1460	41.5	23.1	64.6	180.0	35.4	182.6
A 4155	1880	53.3	33.3	86.7	160.0	13.3	650.0
A 4174	2330	24.0	48.0	72.0	50.0	28.0	257.1
A 4183	2465	48.0	42.0	90.0	114.3	10.0	900.0
A 4187	2525	33.3	20.0	53.3	166.7	46.7	114.3
A 4193	2615	10.0	38.0	48.0	26.3	52.0	92.3
A 5435	2780	28.6	40.5	69.1	70.6	30.9	224.0
A 5438	2825	21.8	35.5	57.3	61.5	42.7	134.0
A 5442	2885	20.4	33.4	53.8	61.2	46.2	116.3
A 5453	3050	34.8	32.3	67.1	108.0	32.9	203.9
A 5462	3105	37.9	50.5	88.4	75.0	11.6	763.6
A 5468	3275	17.6	20.5	38.0	85.7	62.0	61.4
A 5476	3395	15.0	19.3	34.3	77.8	65.7	52.2
A 5482	3470	4.6	11.5	16.2	40.0	83.8	19.3

DATE : 7 - 7 - 83.

IKU

TABLE 7

TABULATION OF DATAS FROM THE GASCHROMATOGRAMS

IKU No.	DEPTH (m)	PRISTANE / n-C17	PRISTANE / PHYTANE	CPI
A 4129	1100	0.7	1.6	2.4
A 4141	1460	0.6	1.3	2.4
A 4155	1880	1.0	1.0	1.2
A 4174	2330	0.7	1.8	1.6
A 4183	2465	0.9	2.1	1.9
A 4187	2525	0.9	2.1	1.7
A 4193	2615	1.6	2.9	1.8
A 5435	2780	2.1	3.6	1.6
A 5438	2825	2.0	4.6	2.1
A 5442	2885	1.6	3.5	1.9
A 5453	3050	0.8	2.1	1.1
A 5462	3185	1.1	2.0	1.3
A 5468	3275	0.9	2.2	1.2
A 5476	3395	0.9	1.7	1.4
A 5482	3470	1.0	2.8	1.5

DATE : 13 - 7 - 83.

IKU

TABLE 8

ROCK EVAL PYROLYSEN

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OR GAS CONTENT S1+S2	PROD. INDEX S1/(S1+S2)	TEMP. MAX (C)
A 4120	800	0.14	0.30	1.33	0.77	39	173	0.44	0.32	412
A 4123	890	0.11	0.32	1.06	0.81	40	131	0.43	0.26	411
A 4126	980	0.10	0.26	2.11	0.65	40	325	0.36	0.28	417
A 4129	1100	0.26	1.25	0.52	1.19	105	44	1.51	0.17	407
A 4132	1190	0.19	1.06	0.73	1.22	87	60	1.25	0.15	416
		Clst lt olv brn								
A 4133	1190	0.22	1.01	0.62	1.45	70	43	1.23	0.18	418
		Clst brn - gy								
A 4135	1280	0.12	0.52	0.42	1.10	47	38	0.64	0.19	414
		Clst brn - gy								
A 4141	1460	0.12	0.25	0.45	0.62	40	73	0.37	0.32	415
A 4143	1520	0.12	0.22	0.32	0.61	36	52	0.34	0.35	416
A 4147	1640	0.06	0.07	0.47	0.38	18	124	0.13	0.46	320
A 4153	1820	0.07	0.23	0.17	0.49	47	35	0.30	0.23	420
		Clst dk - gy								
A 4155	1880	0.12	0.22	0.33	0.77	29	43	0.34	0.35	421
		Clst lt - gn - gy								
A 4155	1880	0.10	0.33	0.42	1.14	29	37	0.43	0.23	[illegible]
		Clst dk - gy								
A 4157	1940	0.06	0.04	0.76	0.49	8	155	0.10	0.60	398
A 4159	2000	0.06	0.12	0.38	0.69	17	55	0.18	0.33	427
A 4161	2060	0.07	0.06	0.51	0.64	9	80	0.13	0.54	347
A 4162	2090	0.07	0.09	0.56	0.62	15	90	0.16	0.44	423
		Clst dk - gn - gy								
A 4164	2150	0.08	0.08	0.62	0.61	13	102	0.16	0.50	392
		Clst gn - gy								
A 4166	2210	0.08	0.15	0.47	0.65	23	72	0.23	0.35	424
A 4168	2240	0.07	0.08	0.43	0.58	14	74	0.15	0.47	392
A 4170	2270	0.08	0.11	0.43	0.64	17	67	0.19	0.42	[illegible]
A 4172	2300	0.05	0.13	0.56	0.74	18	76	0.18	0.28	[illegible]
A 4174	2330	0.13	0.10	0.59	0.68	15	87	0.23	0.57	424

DATE : 29 - 6 - 83.

TABLE 8

ROCK EVAL PYROLYSES

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OR GAS CONTENT S1+S2	PROD. INDEX S1/(S1+S2)	TEMP. MAX (C)
A 4176	2360	0.04	0.10	0.41	0.63	16	65	0.14	0.29	427
A 4178	2390	0.08	0.11	0.55	0.68	16	81	0.19	0.42	426
A 4180	2420	0.08	0.18	0.65	0.92	20	71	0.26	0.31	433
A 4181	2435	0.07	0.14	0.44	0.60	23	73	0.21	0.33	428
A 4183	2465	0.13	0.61	0.46	0.69	88	67	0.74	0.18	431
A 4185	2495	0.09	0.13	0.48	0.62	21	77	0.22	0.41	427
A 4187	2525	0.14	0.12	0.56	0.61	20	92	0.26	0.54	429
		Clst gr								
A 4189	2555	0.06	0.12	0.46	0.73	16	63	0.18	0.33	427
A 4191	2585	0.09	0.08	0.45	0.55	15	82	0.17	0.53	427
A 4193	2615	0.15	0.41	0.40	0.92	45	52	0.56	0.27	434
		Clst gr								
A 4193	[illegible]	0.24	2.88	0.68	1.80	160	38	3.12	0.08	426
		Clst dk-brn-gr								
A 5430	2705	0.48	3.33	0.87	4.43	75	20	3.81	0.13	430
A 5432	2735	0.69	5.06	0.67	5.12	99	13	5.75	0.12	426
		Clst dk-gr-bl								
A 5435	2780	1.29	12.88	1.00	8.11	159	12	14.17	0.09	424
		Clst dk-gr								
A 54[illegible]	[illegible]	0.16	2.02	0.93	1.42	142	65	2.18	0.07	42[illegible]
		Clst brn-gr								
A 5438	2825	2.37	27.33	1.12	11.26	243	10	29.70	0.08	425
		Clst dk-gr-bl								
A 5440	2855	0.74	4.88	0.89	6.18	79	14	5.62	0.13	427
A 5442	2885	0.56	5.72	0.94	4.26	134	22	6.28	0.09	428
		Clst dk-gr-gn								
A 5444	[illegible]	1.64	2.32	9.62	2.40	94	391	3.96	0.41	309
		Clst gr-brn								
A 5447	2960	0.60	4.00	1.12	4.08	98	27	4.60	0.13	429
A 5449	2990	0.41	2.63	0.74	4.14	64	18	3.04	0.13	430
A 5451	3020	0.42	3.20	1.20	3.31	97	36	3.62	0.12	430
A 5453	3050	0.27	1.93	0.86	1.76	110	49	2.20	0.12	430

DATE : 29 - 6 - 83.

TABLE 8

ROCK EVAL PYROLYSES

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OR GAS CONTENT S1+S2	PROD. INDEX S1/S1+S2	TEMP. MAX (C)
A 5455	3085	0.15	0.83	0.72	1.54	54	47	0.95	0.15	430
A 5459	3140	0.22	1.56	0.79	1.77	88	45	1.78	0.12	431
A 5462	3185	0.21	1.17	0.40	1.65	71	24	1.38	0.15	431
A 5464	3215	0.13	0.61	0.47	1.62	38	29	0.74	0.18	429
A 5466	3245	0.17	0.83	0.59	1.87	44	32	1.00	0.17	429
A 5468	3275	0.14	1.43	0.42	1.71	84	25	1.57	0.09	430
A 5470	3305	0.08	0.53	0.42	1.52	35	28	0.61	0.13	432
A 5473	3350	0.14	1.06	0.34	1.54	69	22	1.20	0.12	432
A 5474	3365	0.09	0.70	0.34	1.56	45	22	0.79	0.11	434
A 5476	3395	0.13	1.26	0.30	1.54	82	19	1.39	0.09	434
A 5477	3410	0.19	0.41	4.57	1.77	23	258	0.60	0.32	402
		Clst	brn							
A 5479	3425	0.14	0.21	5.66	1.77	12	320	0.35	0.40	351
		Clst	brn							
A 5481	3455	0.11	1.14	0.31	1.44	79	22	1.25	0.09	432
A 5482	3470	0.18	1.85	0.48	1.65	112	29	2.03	0.09	433

DATE : 29 - 6 - 83.

IKU

Visual Kerogen Analysis

TABLE NO.: 9
WELL NO.: 34/10-17

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-4120	770-800	W, Cut, P, S, WR!/Am, Cy	F-M	good	1/1+	Strongly pyritic residues. Degraded and finely disseminated material dominates partly as aggregates. There are also well preserved. Structures fragments of land plants (semifusinite and cuticles). Palynomorphs are stained.
A-4123	860-890	W, Cut, P, S, WR!/Am, Cy	F-M	good	1/1+	As above partly aggregates of degraded, finely disseminated material, dominated by wood remains.

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

086/q/ah/1

IKU

Visual Kerogen Analysis

TABLE NO.: 9
WELL NO.: 34/10-17

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-4129	1070-1100	Am, Cy/W, P, S	F-M	good	1/1+	As above pyritic aggregates but a far stronger influx of well preserved dinoflagellates and reduction of cuticles. The amorphous material seems more light coloured. Traces of fungi and faunal activity.
A-4135	1250-1280	Am, Cy/W, P, S	F-M	good	1/1+	As above 1070-1100m.

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

086/q/ah/2

IKU

Visual Kerogen Analysis

TABLE NO.: 9
WELL NO.: 34/10-17

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-4143	1490-1520	W, P, S, WR!/Am, Cy	F-M	good	1/1+, 1+	Pyritic residue as above stronger tendency for rounded aggregates of true sapropel and sapropelised material and with some acid resistant minerals left. Bisaccate pollen dominates palynomorphs. Spores are fairly common.
A-4153	1780-1820	W, Cut, P, S, WR!/Am, Cy	F-M-L	good	1/1+, 1+	Pyritic irregular loose aggregates of amorphous and sapropelised material embedding pollen spores biodegraded thin cuticles and dinoflagellate cysts. Increase of semifusinite and inertinite.

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.: 9
WELL NO.: 34/10-17

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-4157	1910-1940	*W, WR!, P/Am, Cy	F-M	good to fair	2-/2, 2	*Sparse residue. Light coloured sapropelised woody material, grey amorphous aggregates some semifusinite, inertinite.
A-4161	2030-2060	*W, WR!, P/Am, Cy	F-M	good	2-/2, 2-	*Sparse residue. Etched woody fragments and grey amorphous material.
A-4164	2120-2150	*W, WR!, P/Am, Cy	F-M	fair	1/1+, 2-/2	*Resembles 2030-2060m above.
A-4170	2255-2270	*W, WR!, P/Am, Cy	F-M	fair	2-, 2-/2, 2	*Resembles 2030-2060m above. Loose aggregates of grey amorphous material embed etched woody small particles, cysts. Abundant pyrite.

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

086/q/ah/3

IKU

Visual Kerogen Analysis

TABLE NO.: 9
WELL NO.: 34/10-17

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-4178	2375-2390	*W, WR!, P/AM, Cy	F-M	fair - good	2-/2	*As above.
A-4185	2480-2495	*W, WR!, P/Am, Cy	F-M	good to fair	2-/2, 2	*As above, dinoflagellates dominate palynomorphs.
A-4189	2540-2555	W, WR!/Am, Cy	F-M	fair	2-/2, 2	Mixture of grey amorphous aggregates and light coloured amorphous material. Better preserved woody material (Re-worked coaly fragments) seems indigenous.

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.: 9
WELL NO.: 34/10-17

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-4193	2600-2615	W, Cut, P, S/Am, Cy	F-M-L	fair to poor	2-/2	Abundant pyrite. Spores, pollen and dinoflagellates with adhering degraded material. Strongly biodegraded cuticles. Thin walled crumbled palynomorphs that have a very light colour.
A-5430	6990-2705	W, Cut, P, S, WR!/Am, Cy	F-M	fair	2-	Fairly dense, pyritic aggregates of degraded material seem derived mostly of woody structured material.
A-5432	2720-2735	W, Cut, P, WR!/Am, Cy	F-M-L	good	2-/2, 2	As above but somewhat darker with strongly degraded woody material. Good Jurassic pollen spore assemblage. Semifusinite.

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.: 9
WELL NO.: 34/10-17

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-5435	2765-2780	W, P, S, WR!, Cut/Am, Cy	F-M-L	good	2-/2, 2	As 2720-2735m.
A-5438	2810-2825	W, P, S, WR!, Cut/Am, Cy	F-M-L	good	2-/2, 2	Dense coaly aggregates, mostly of woody material. A rich and well preserved spore assemblage.
A-5440	2840-2855	W, P, S, Cut/Am, Cy	F-M-L	fair to poor	2-/2, 2	Composition as 2810-2825m but more of semifusinite. Relative increase in bisaccate pollen and reduction of spores. Etching and bleaching of spore walls.
A-5442	2870-2885	W, P, S/Am, Cy	F-M-L	fair	2-/2, 2	Strong biodegradation otherwise as 2825 and 2855m.

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**

086/q/ah/6

IKU

Visual Kerogen Analysis

TABLE NO.: 9
WELL NO.: 34/10-17

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-5447	2945-2960m	W, Cut, WR!, P, S/Am, Cy	F-M-L	fair to good	2-/2, 2	Material as discrete particles, and aggregates as above. Palynomorphs embedded in degraded mostly woody material. Semi-fusinite is common. Bleached thin walled palynomorphs with dull colours.
A-5451	3005-3020	W, WR!, P, S, Cut/Am, Cy	M-L	fair	2-/2, 2	Woody coaly particles including all forms also inertinite and fusinite. Palynomorphs as above bleached thin walled. Cuticles.

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

086/q/ah/6.1

IKU

Visual Kerogen Analysis

TABLE NO.: 9
WELL NO.: 34/10-17

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-5453	3035-3050	W, WR!, P, S, Cut/Am, Cy	F-M-L	fair	2-/2, 2	Small aggregates of amorphous and strongly sapropelised wood embedding woody particles. Cuticles, pollen, spores and Nannoceratopses and other dinoflagellates. Well preserved semifusinite. Botryococcus.
A-5459	3125-3140	W, WR!, Cut, P, S/Am, Cy	F-M-L	fair	2-/2, 2	As 3035-50m.
A-5479	3410-3425	W, Cut, WR!, P, S/Am, Cy	F-M-L	fair - good		The sample looks normal compared with the interval above. Strongly degraded remains, very light coloured cuticles, pollen, spores - Botryococcus.

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

086/q/ah/7

IKU

Visual Kerogen Analysis

TABLE NO.: 9
WELL NO.: 34/10-17

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-5482	3455-3470	W, Cut, WR!, P, S/Am, Cy	F-M-L	good - fair		As above but relative increase in large semifusinite/fusinite particles. in cuticles and spores.
A-5464	3200-3215	Am and W/W	F-M	-	-	Pyritic residue of dense grey amorphous aggregates. Resin and good vitrinite fragments as if derived from a different lithology.
A-5468	3260-3275	Am and W/W	F-M		2-/2, 2	Pyritic residue. Grey amorphous often rounded aggregates and dark woody fragments are mixed with material with light coloured well preserved pollen and spores. Rare Botryococcus.

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

086/q/ah/8

IKU

Visual Kerogen Analysis

TABLE NO.: 9
WELL NO.: 34/10-17

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-5473	3335-3350	Am and W/W, P, S	F-M		2-/2, 2	Pyritic residue. Well dispersed fine material and grey amorphous aggregates. Ad mixtures of material (embedding?) light coloured pollen and spores. Rare Botryococcus.
A-5476	3380-3395	Am, Cy/W,//			2-/2, 2	As the sample above. Well preserved Nannoceratopses are changes: light coloured but very thin walled as if exposed to strong heating. High magnification shows that other films are abundant but very thin (ghosts).

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

TABLE 10

TABULATION OF MATURITY DATA

IKU No.	DEPTH (m/ft)	VITRINITE REFLECTANCE Ro(%) and Counts	MATURATION INDEX (TAI)	FLUOR ESCENCE
A 4120	800	0.40(5)	1/1+	1
		Sst+Clst		
A 4127	870	0.41(9)	1/1+	1
		Sst+Clst		
A 4129	1100	0.38(3)	1/1+	1
		Clst		
A 4135	1230	0.38(1)	1/1+	1
		Clst		
A 4143	1520	0.37(1)	1/1+,1+	1
		Clst		
A 4153	1870	N.D.P.	1/1+,1+	1
		Clst		
A 4157	1940	0.44(1) 0.52(2)	2-/2,2	1/2
		Clst		
A 6679	1951	0.36(11)	N.A.	2/4
		Clst		
A 6681	2014	N.D.P.	N.A.	2
		Clst		
A 4161	2060	0.39(4) 0.54(1)	2-/2,2-	0
		Clst		
A 6682	2081	0.33(1) 0.59(3)	N.A.	4
		Clst		
A 4164	2150	0.34(1) 0.61(1)	1/1+,2-/2	1/2
		Clst		
A 6683	2158	0.54(1)	N.A.	2/4
		Clst		
A 6684	2231	0.[illegible](2) 0.57(4)	N.A.	2/4/5
		Clst		
A 4170	2270	0.47(3)	2-,2-/2,2	3/4
		Clst		
A 6686	2367	N.D.P.	N.A.	3/4
		Clst		
A 4173	2390	0.33(5)	2-/2	1
		Clst		
A 6688	2404	0.54(7)	N.A.	2
		Clst		
A 4185	2495	0.53(3)	2-/2,2	2/4
		Clst		
A 6689	2553	N.D.P.	N.A.	0
		Clst		
A 4189	2555	0.53(6)	2-/2,2	3/6
		Clst Sst Lignite		
A 6690	2584	0.37(5)	N.A.	3/5
		Clst		

DATE: 8 - 7 - 83.

IKU

TABLE 10

TABULATION OF MATURITY DATA

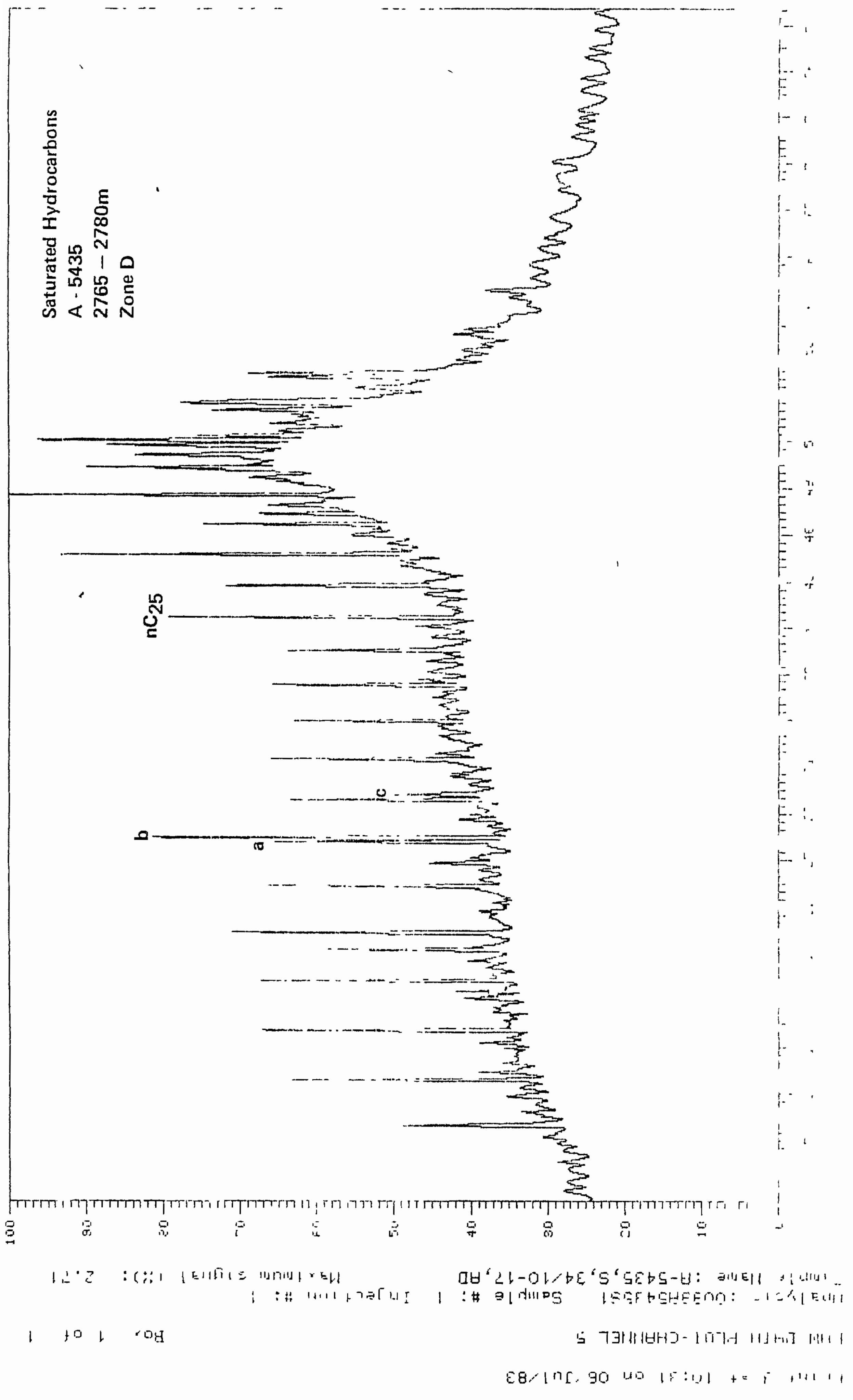
IKU No.	DEPTH (M/FT)	VITRINITE REFLECTANCE Ro(%) and Counts	MATURATION INDEX (TAI)	FLUORESCENCE
A 4199	2615	0.55(6) Clst	2/2	4/5
A 5430	2705	0.58(17) Clsts	2-	5
A 5432	2735	0.57(8) Clst	2-/2,2	5/6
A 5437	2780	0.56(4) 0.73(3) Clst	2-/2.2	6
A 5438	2825	0.54(32) Clst Coal Add.	2-/2.2	6
A 5440	2855	0.55(20) Clsts	2-/2.2	7
A 5447	2960	0.51(13) Clsts	2-/2.2	5
A 5455	3050	0.60(13) Clst+Add.	2-/2.2	5/6
A 5459	3140	0.54(3) 0.72(10) Clst	2-/2.2	4/5/6
A 5464	3215	0.56(3) 0.81(1) Clst+Turbo	N.D.P.	4
A 5473	3350	0.62(10) Clst+Turbo	2-/2,2	5/6
A 5477	3425	0.64(5) 0.85(1) Clst+Turbo	2-/2.2	5/6
A 5482	3470	0.63(18) Clst Sst Coal	2-/2.2	6

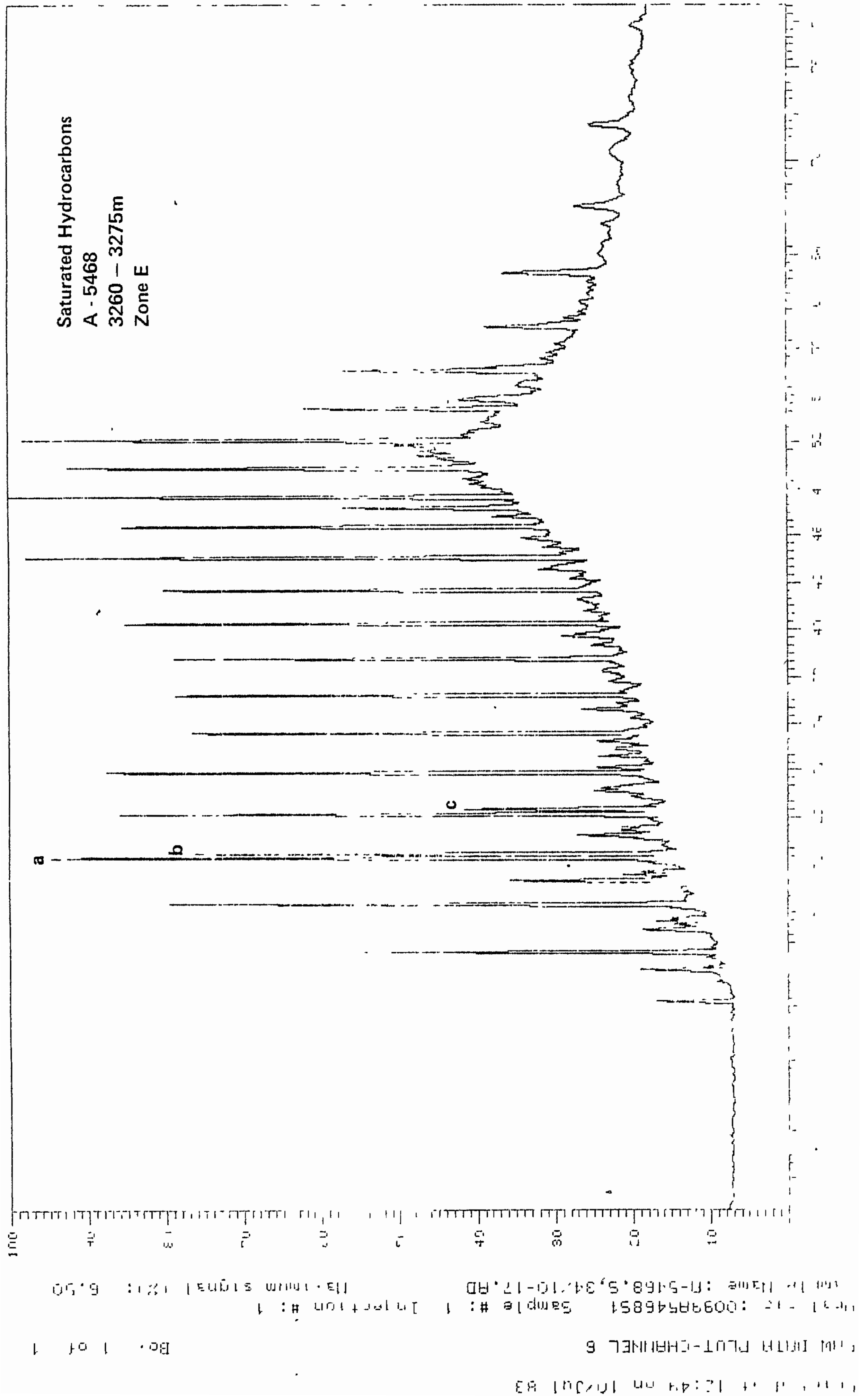
DATE : 8 - 7 - 86.

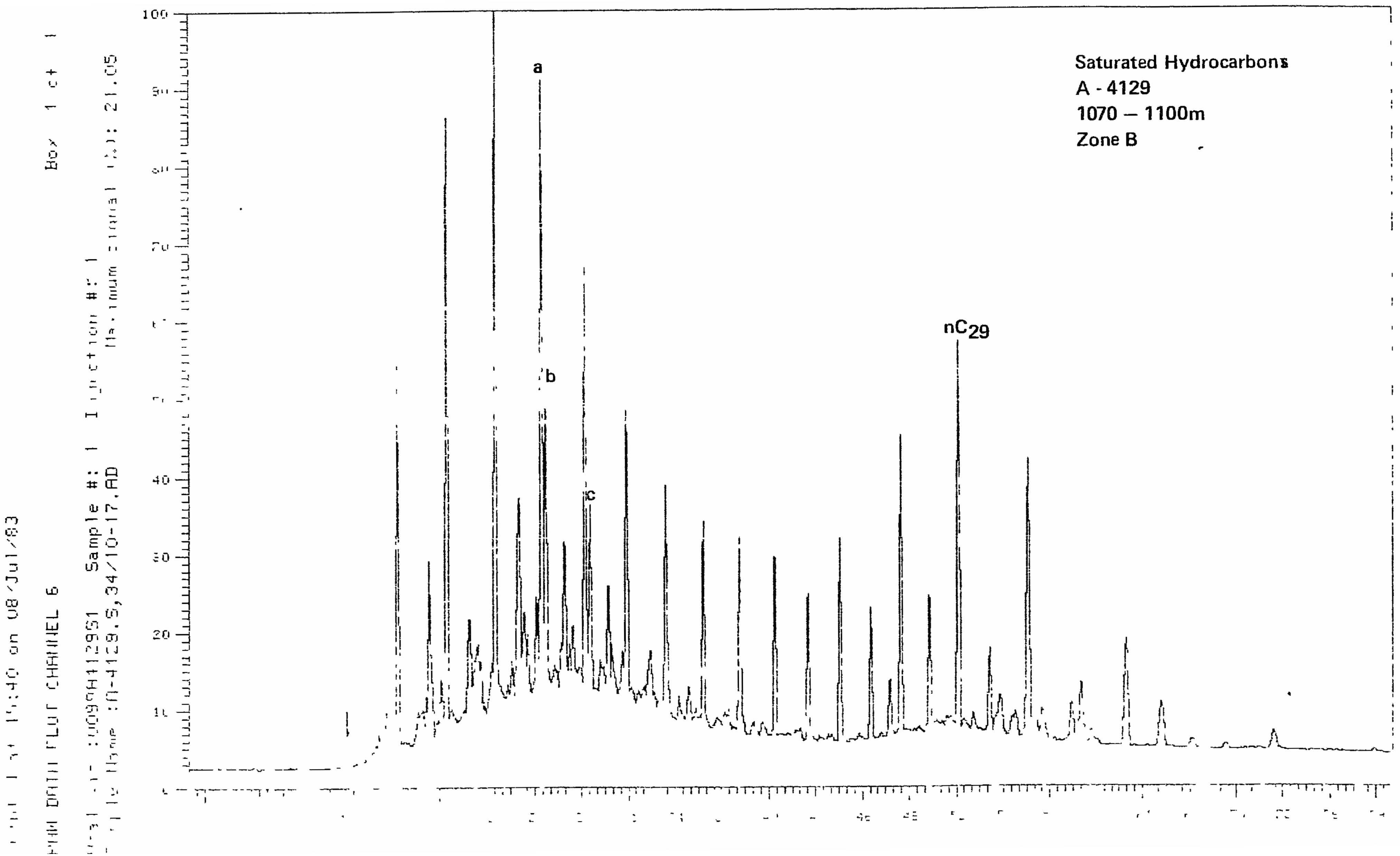
Saturated Hydrocarbon Gas Chromatograms

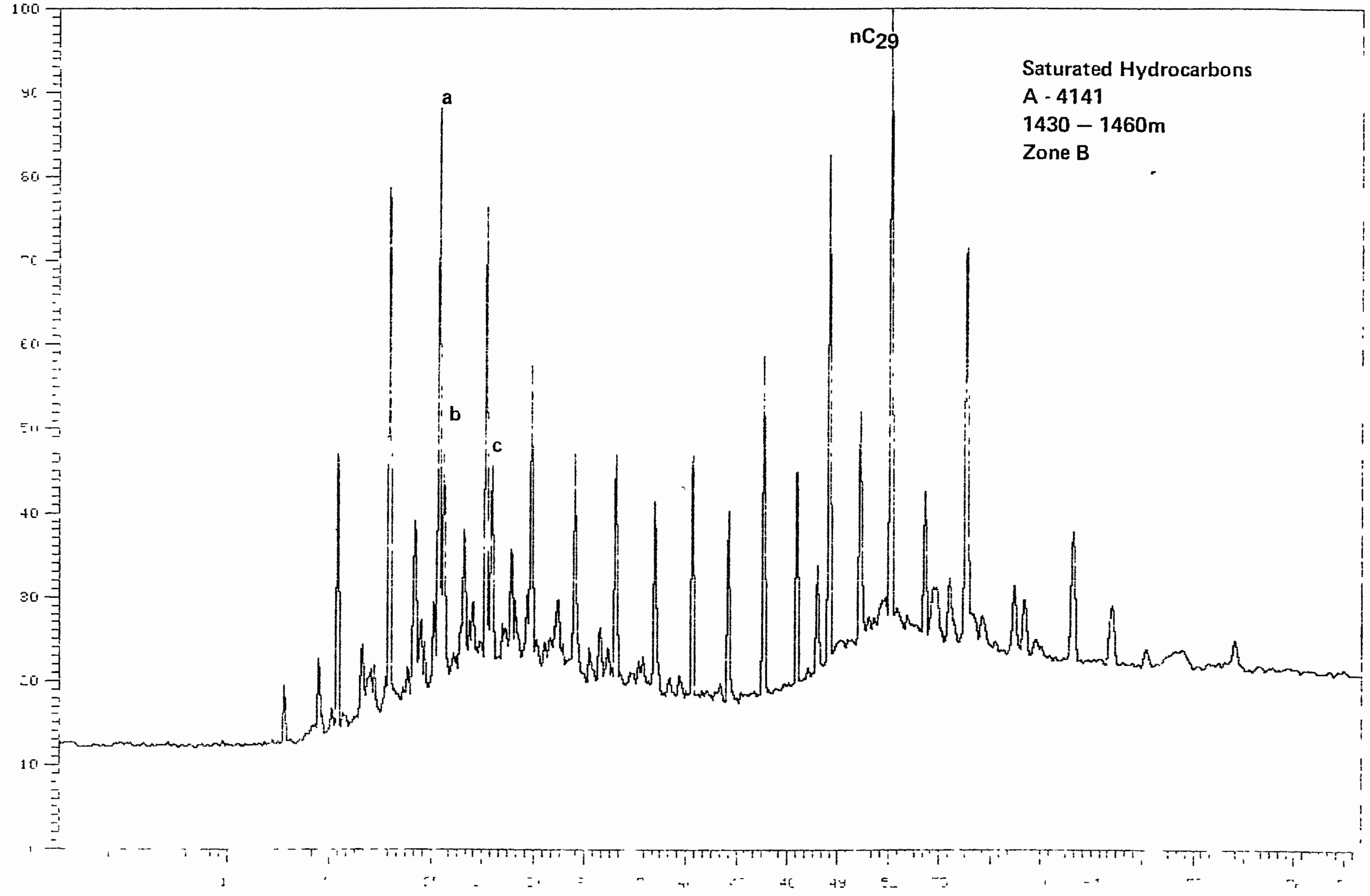
a = nC_{17}
b = pristane
c = phytane

Squalane occurs between nC_{26} and nC_{27}


Saturated Hydrocarbons
A - 5435
2765 — 2780m
Zone D
nC25
a
b
c


Saturated Hydrocarbons
A - 5468
3260 – 3275m
Zone E
a
b
c


Saturated Hydrocarbons
A - 4129
1070 — 1100m
Zone B
a
b
c
nC29
100
40
30
20
DATA PLOT CHANNEL 6
Box
Sample #: 1
Injection #: 1
:A-4129.S,34/10-17.AD
21.05
15:40 on 08/Jul/83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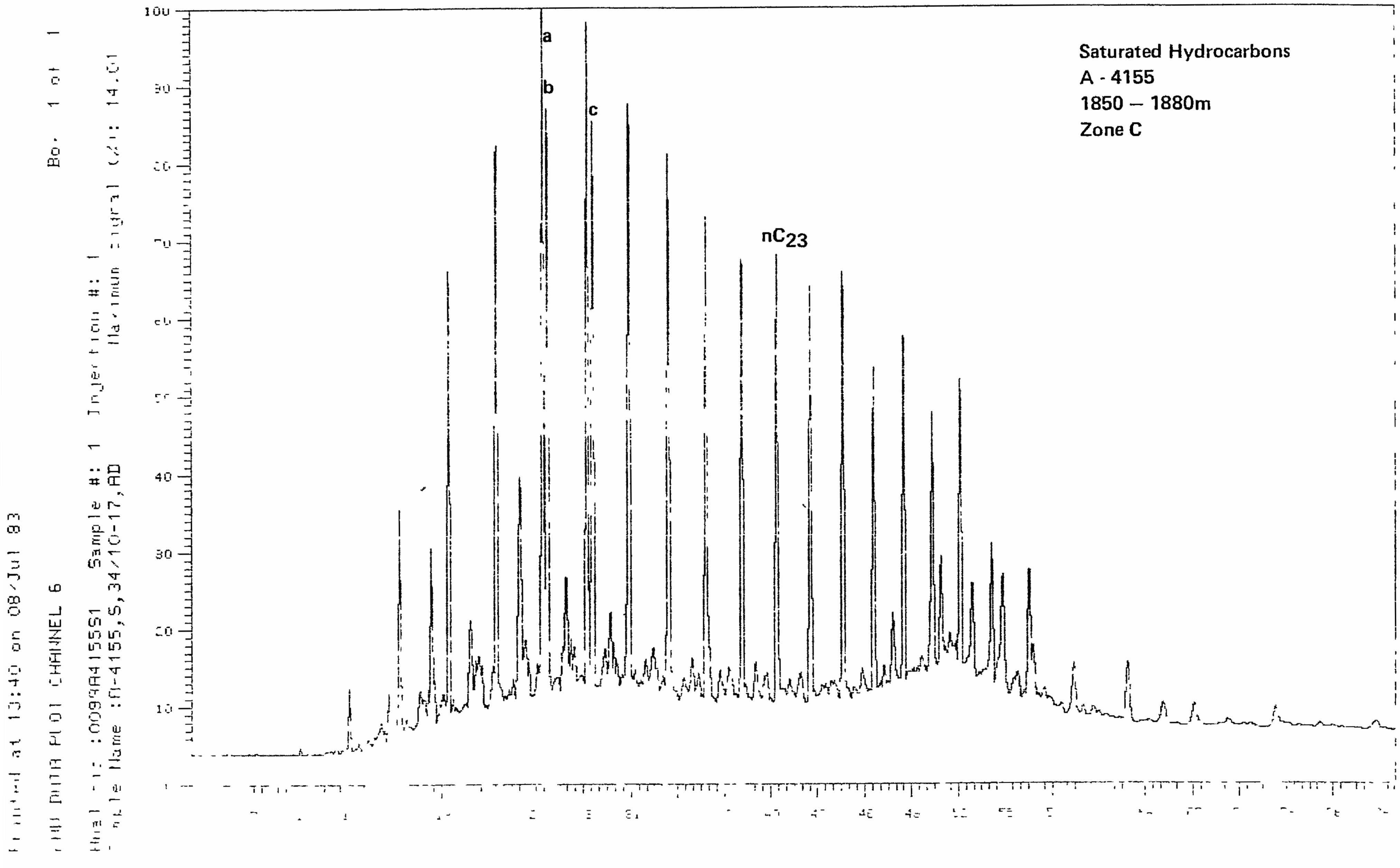
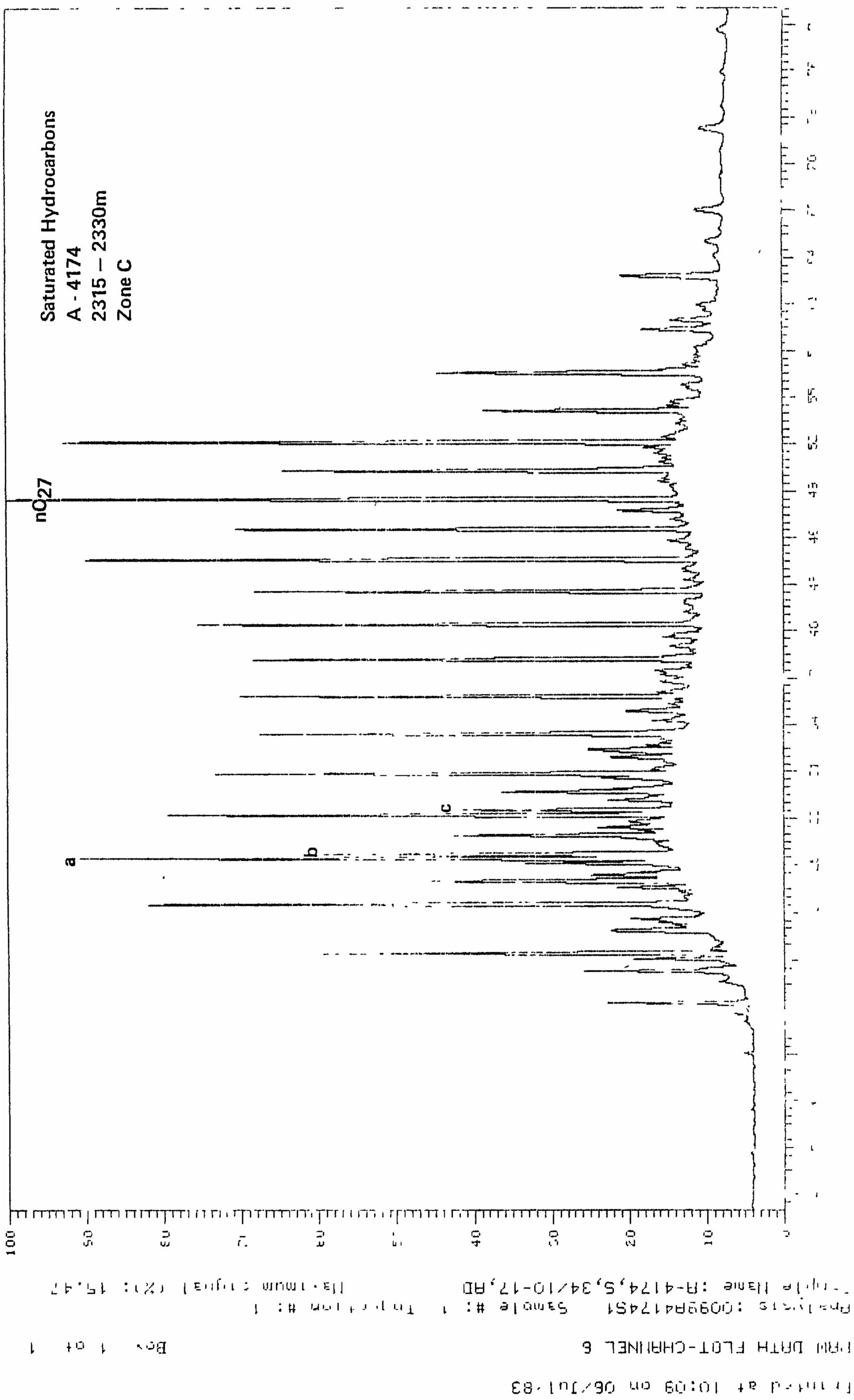
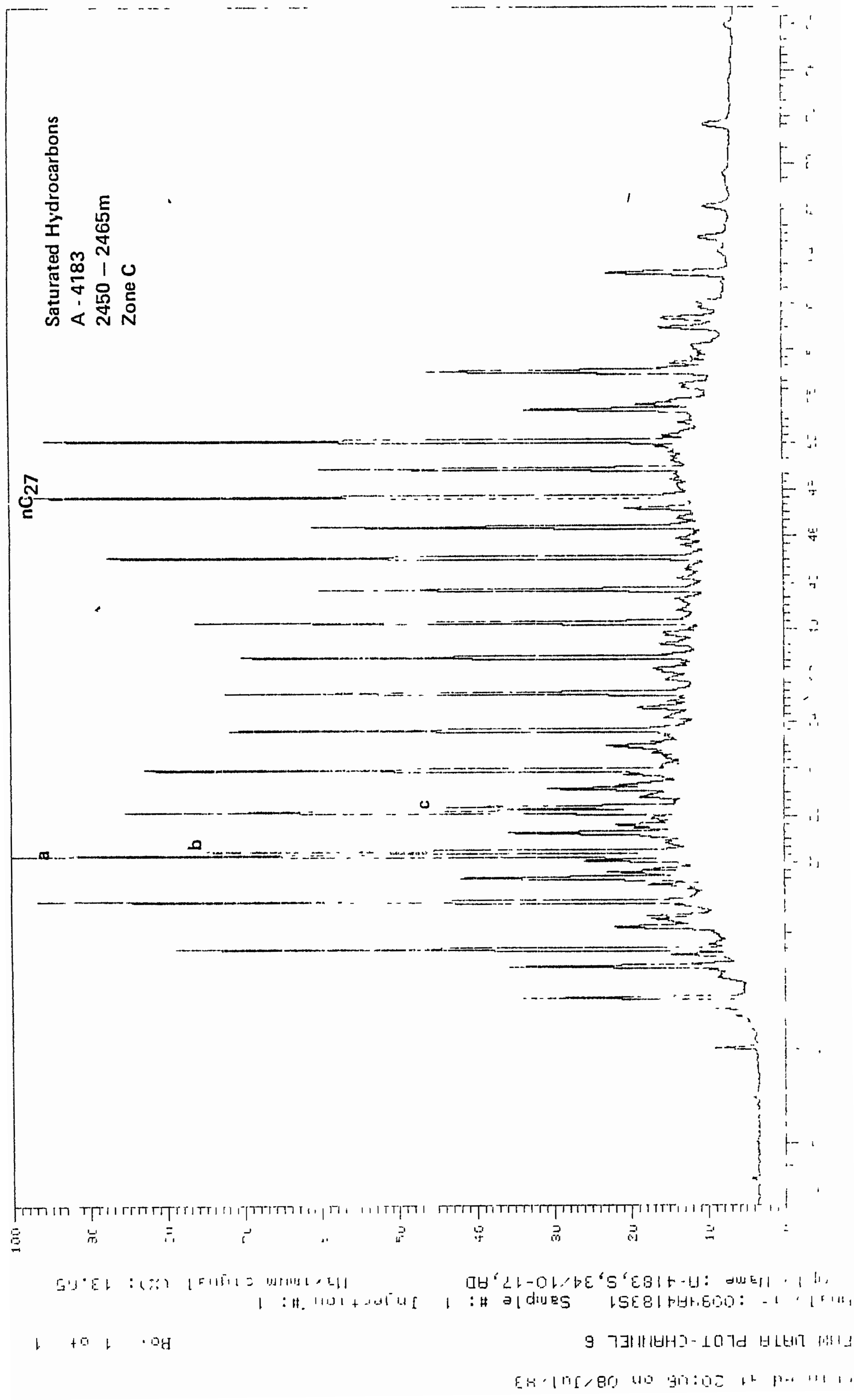
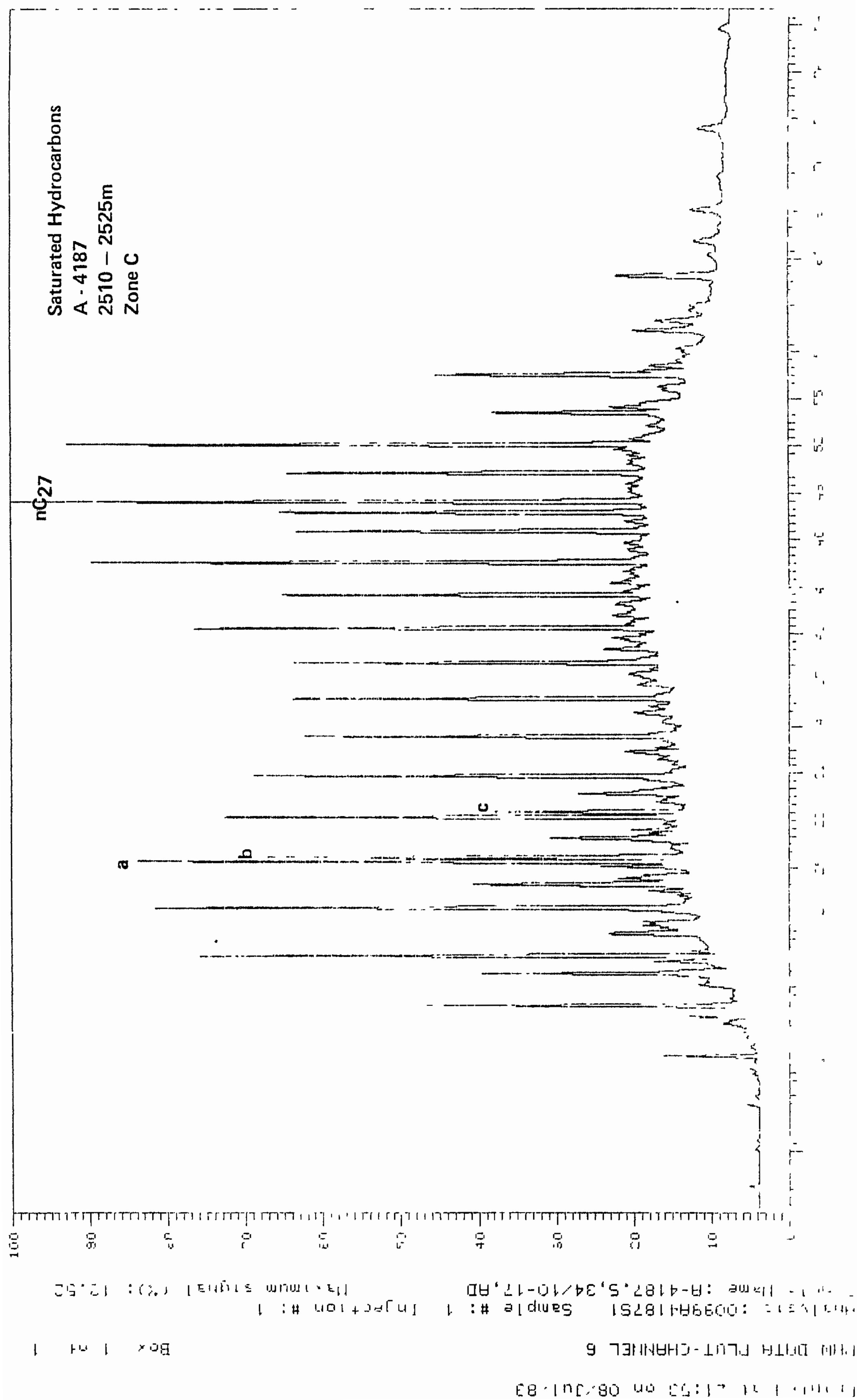
A - 4141
1430 — 1460m
Zone B
nC29
a
b
c


Printed at 13:40 on 08/Jul 83
HB DATA PLOT CHANNEL 6
Raw File :0099A41555I Sample #: 1 Injection #: 1
Sample Name :A-4155,S,34/10-17,AD Maximum Signal (%): 14.01
Bo. 1 of 1
Saturated Hydrocarbons
A - 4155
1850 — 1880m
Zone C
a
b
c
nC23
100
90
80
70
60
50
40
30
20
10


Saturated Hydrocarbons
A - 4174
2315 – 2330m
Zone C
nC27
a
b
c

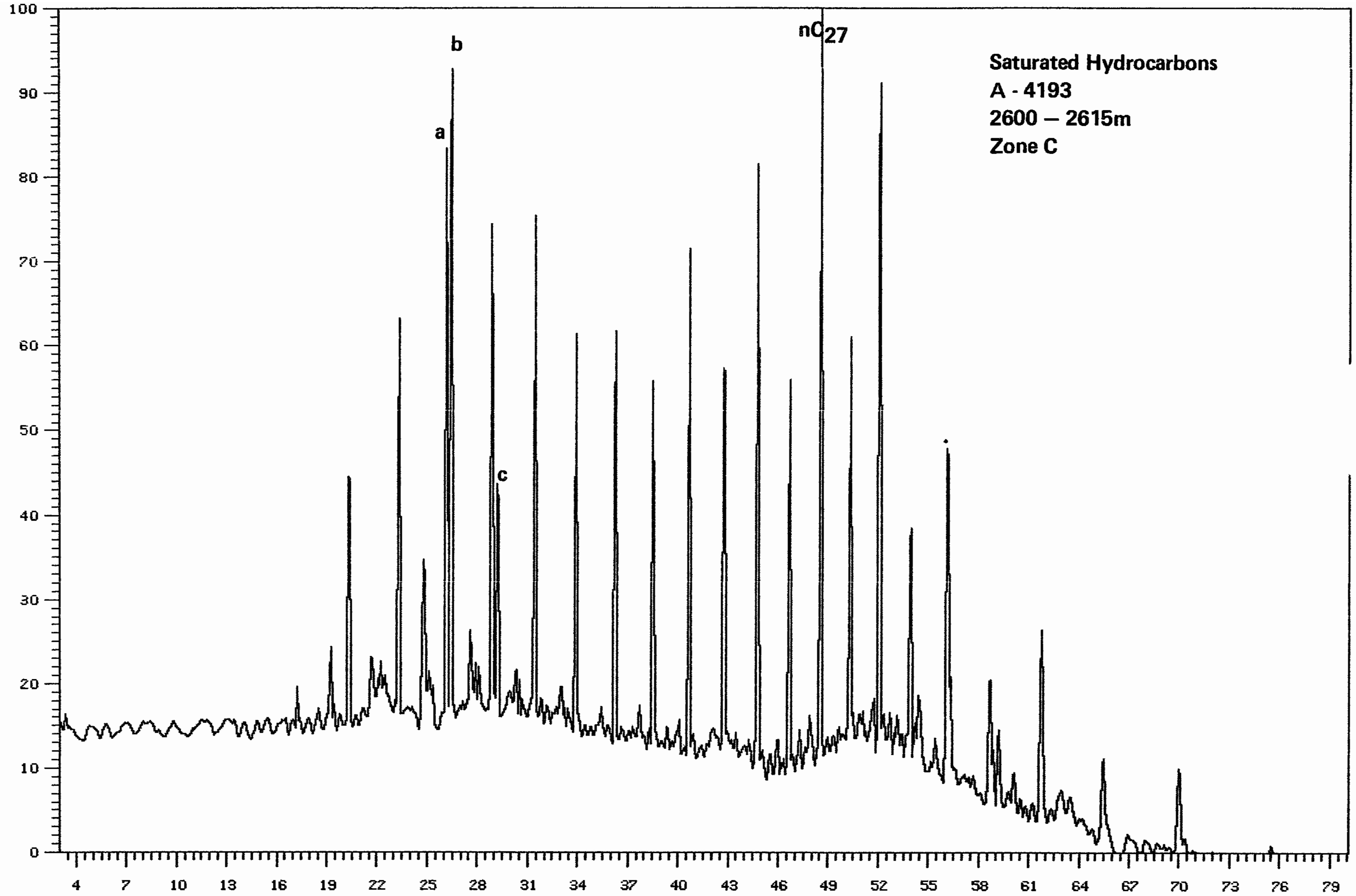

Saturated Hydrocarbons
A - 4183
2450 – 2465m
Zone C
nC27
a
b
c
FID DATA PLOT-CHANNEL 6
Sample #: 1
Name :A-4183,S,34/10-17,AD

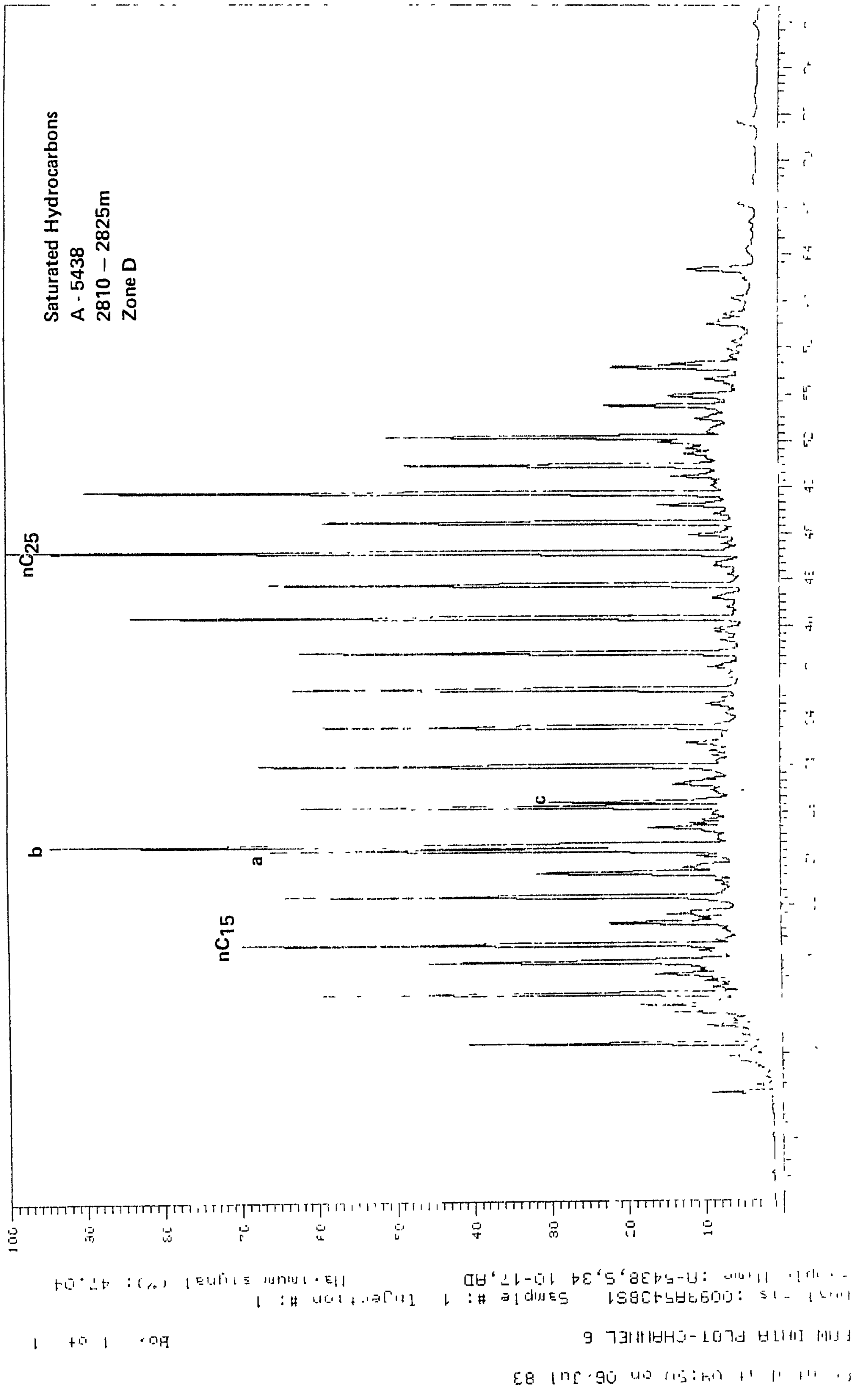

Saturated Hydrocarbons
A - 4187
2510 – 2525m
Zone C
nC27
a
b
c
HP DATA PLOT-CHANNEL 6
Sample #: 1 Injection #: 1

Printed at 12:35 on 05/Jul/83

RAW DATA PLOT-CHANNEL 5 Box 1 of 1

Analysis :0099A4193S2 Sample #: 1 Injection #: 1
Sample Name :A-4193,S,34/10-17,AD Maximum signal (%): 4.58

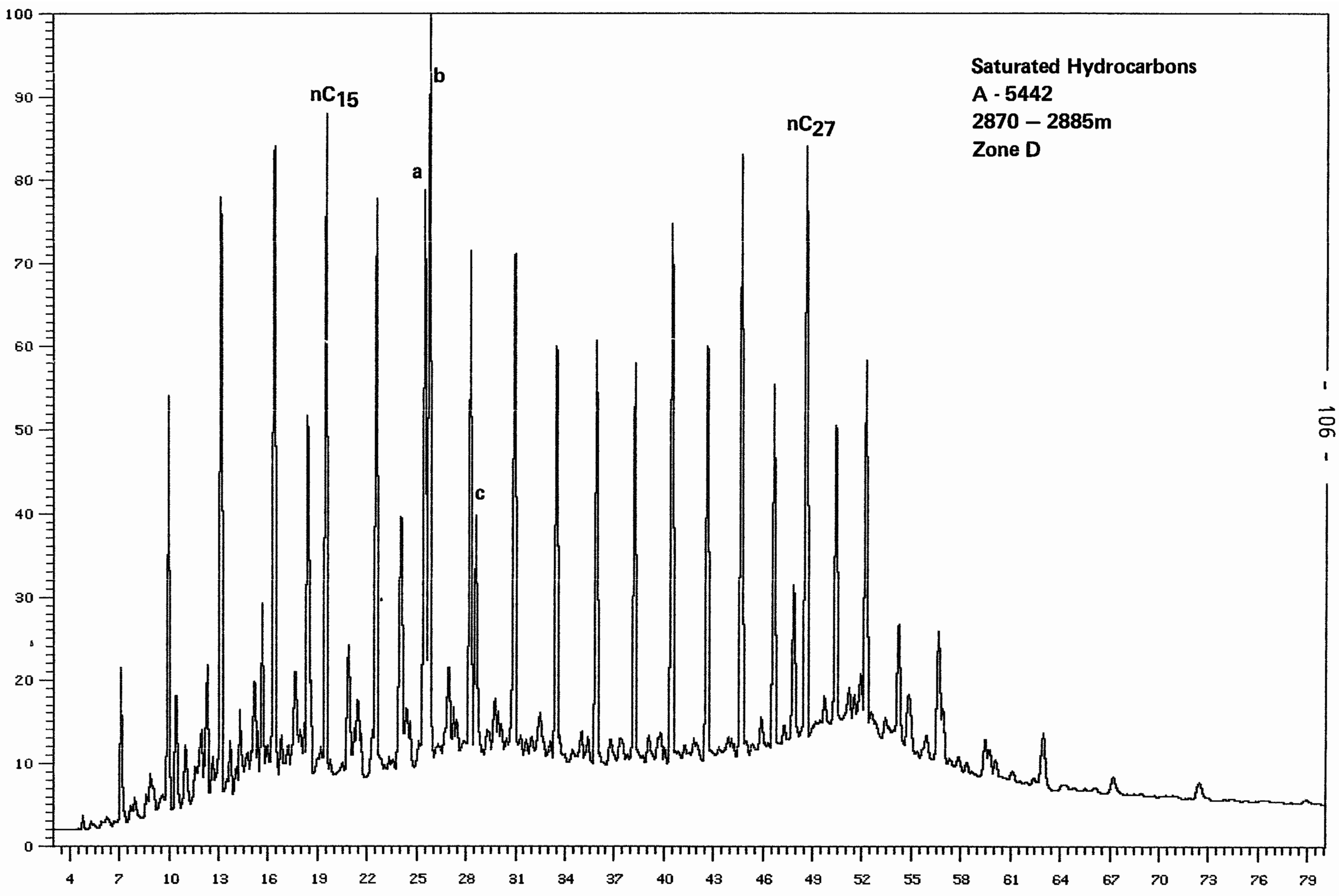



Saturated Hydrocarbons
A - 5438
2810 – 2825m
Zone D
nC25
nC15
a
b
c
100
90
80
70
60
50
40
30
20
10
FID DATA PLOT-CHANNEL 6
Sample #: 1 Injection #: 1
Maximum signal (%): 47.04
06.Jul 83

Printed at 08:37 on 05/Jul/83

RAW DATA PLOT-CHANNEL 6 Box 1 of 1

Analysis :0099R544251 Sample #: 1 Injection #: 1
Sample Name :A-5442,S,34/10-17,AD Maximum signal (%): 27.56

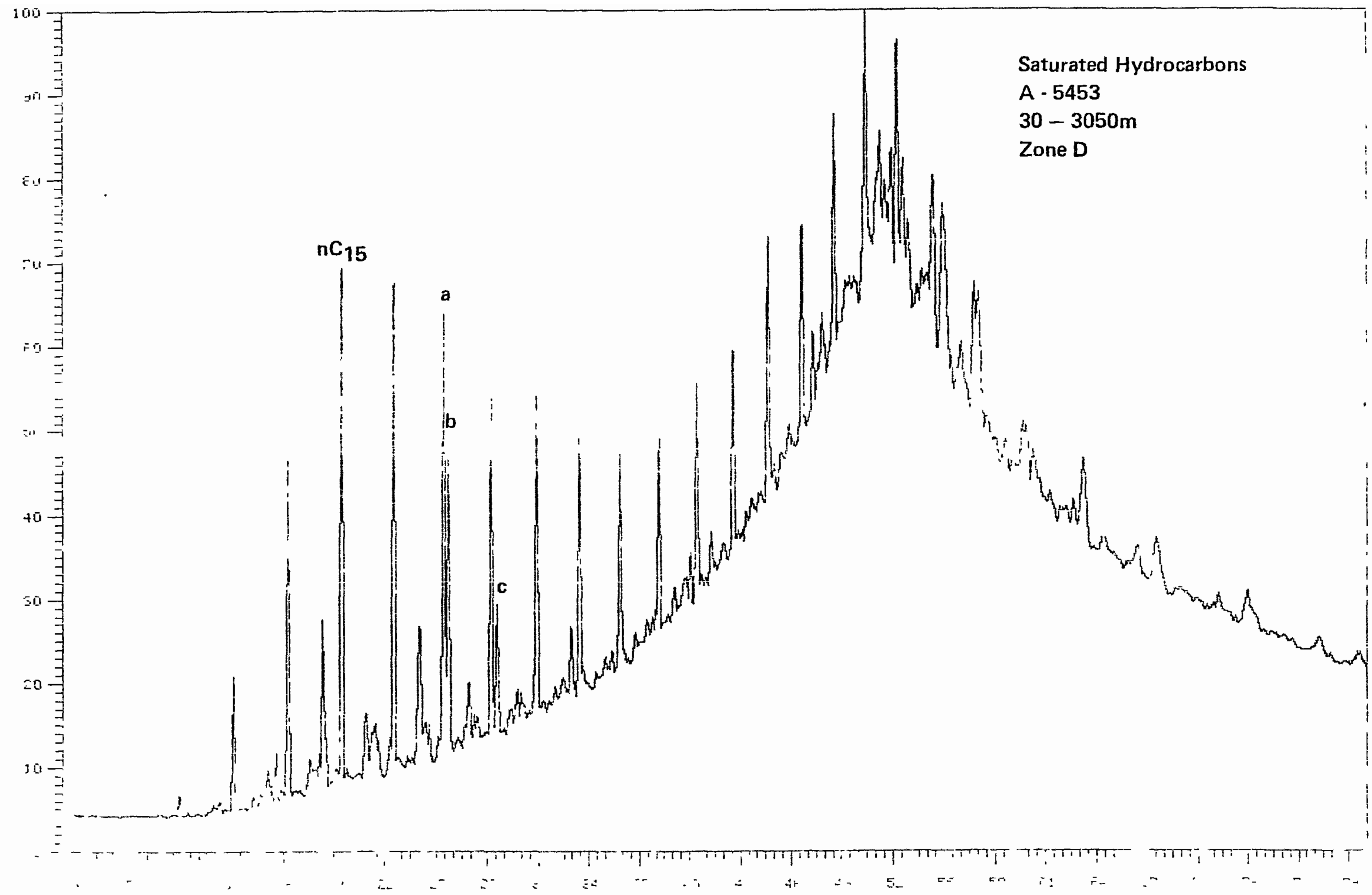


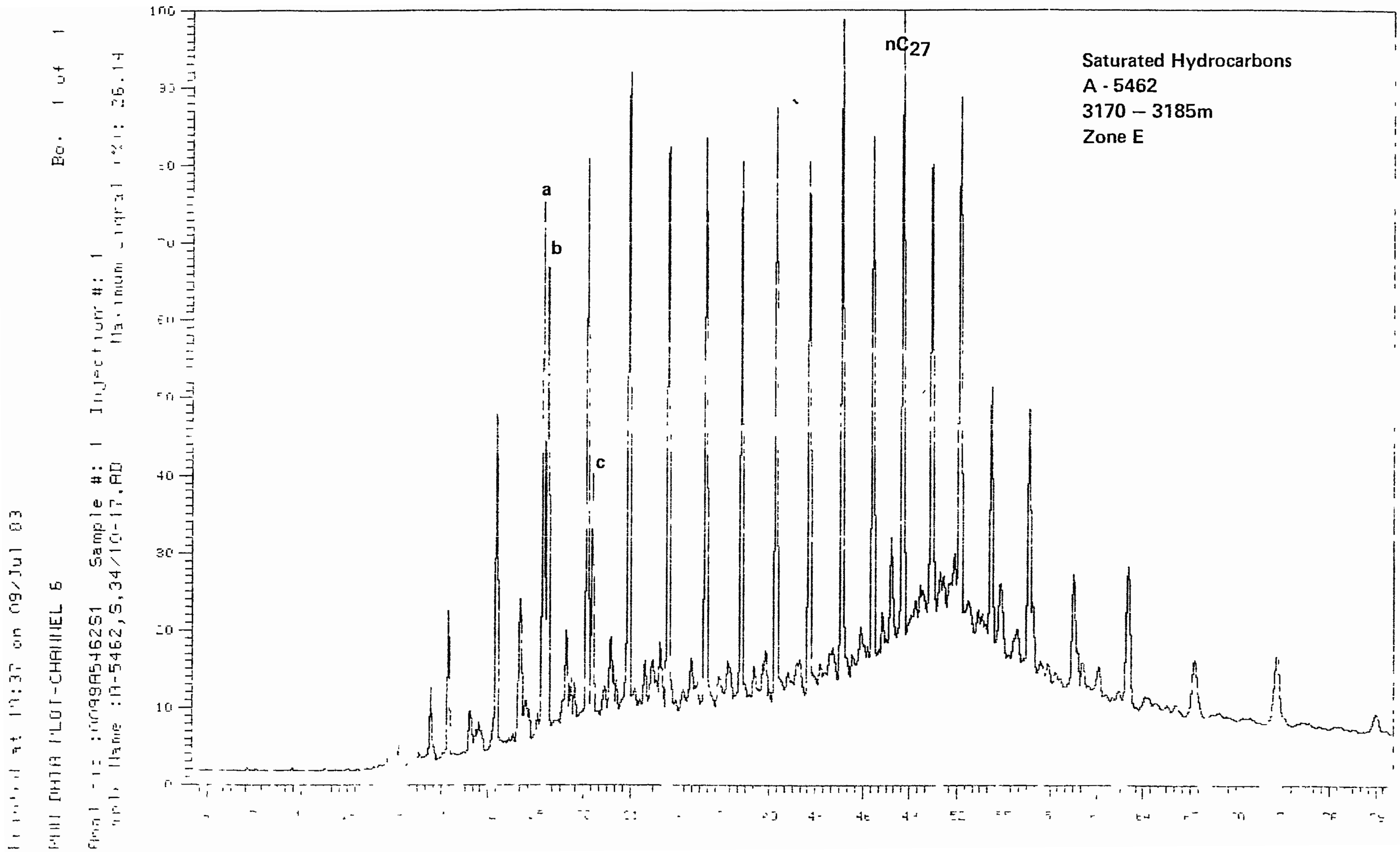
Printed at 12:03 on 08/Jul/83

PGM DATA PLOT-CHANNEL 6 Box 1 of 1

:0099A545351 Sample #: 1 Injection #: 1

Sample Name :A-5453,S,34/10-17.AD Maximum Signal (%): 11.85



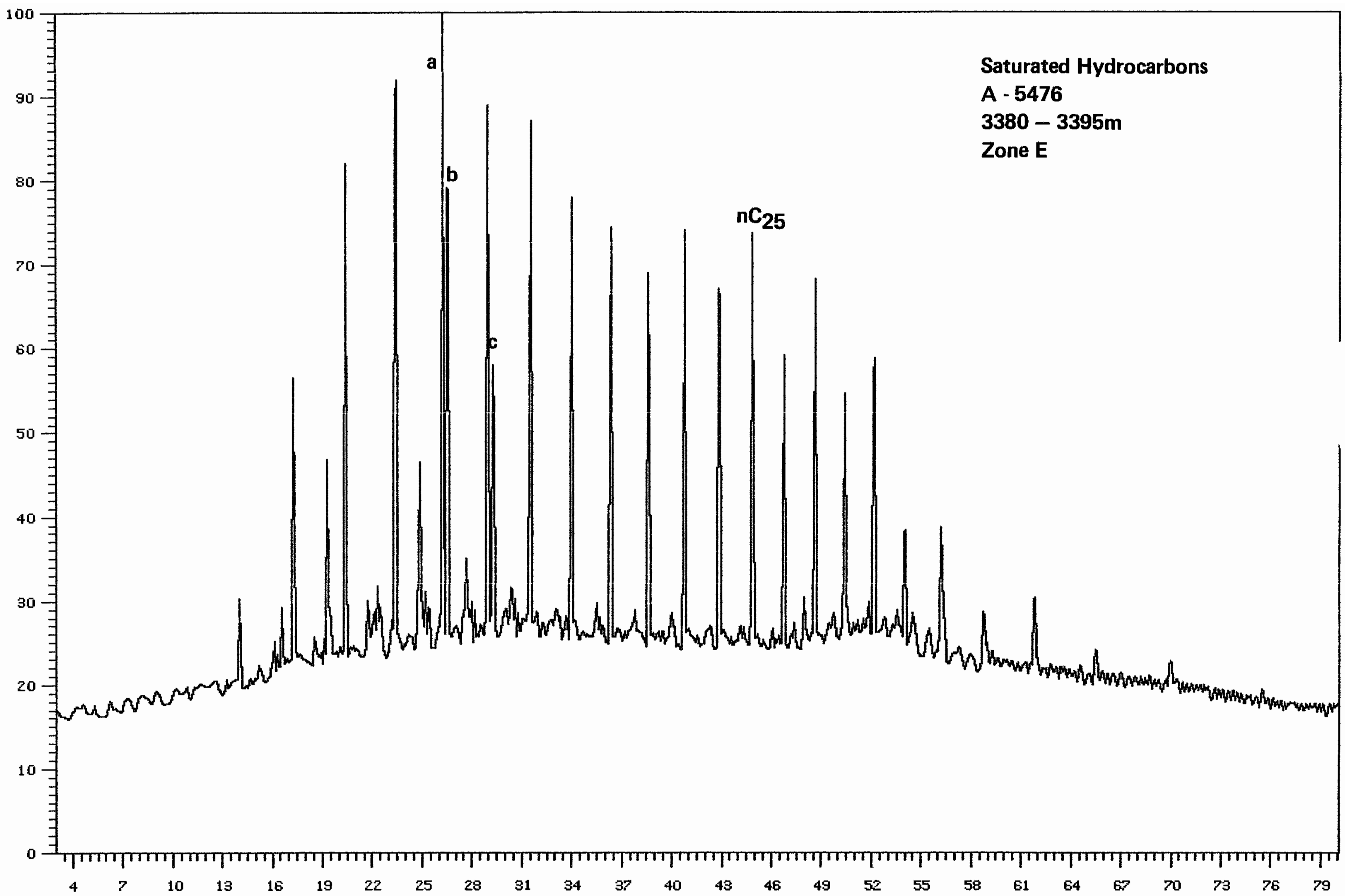


Saturated Hydrocarbons
A - 5462
3170 – 3185m
Zone E
nC27
a
b
c
0
10
30
40
80
100
Printed at 11:37 on 09/Jul 83
DATA PLOT-CHANNEL 6
Sample #: 1
Injection #: 1
Name :A-5462,S,34/10-17,AD

Printed at 09:10 on 05/Jul/83

RAW DATA PLOT-CHANNEL 5 Box 1 of 1

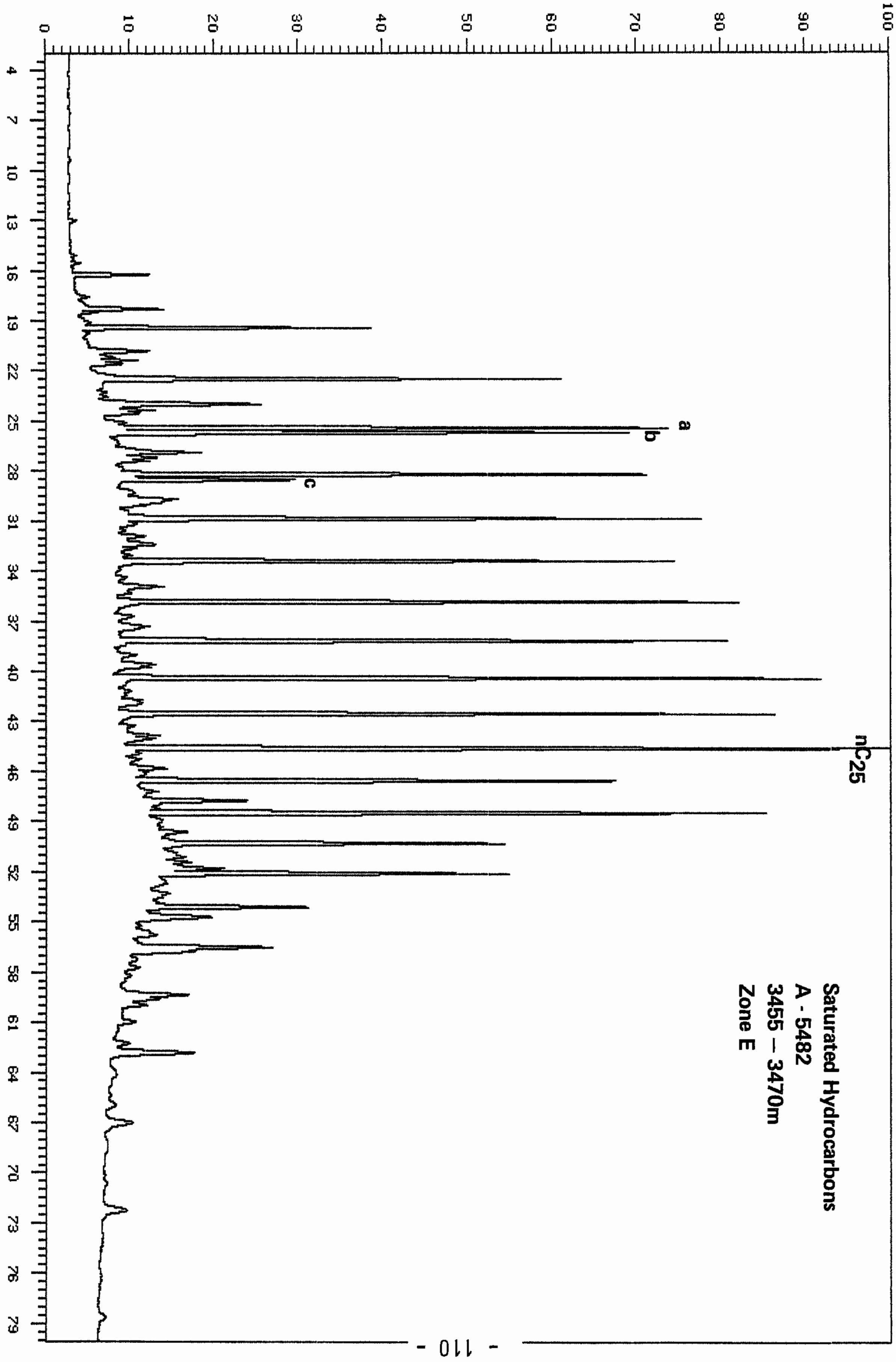
Analysis :0099A547651 Sample #: 1 Injection #: 1
Sample Name :A-5476,S,34/10-17,AD Maximum signal (%): 5.51



Printed at 09:01 on 05/Jul/83

RAW DATA PLOT-CHANNEL 6 | Box 1 of 1

Analysis :0099A5482S1   Sample #: 1   Injection #: 1
Sample Name :A-5482,S,34/10-17,AD   Maximum signal (%): 19.29

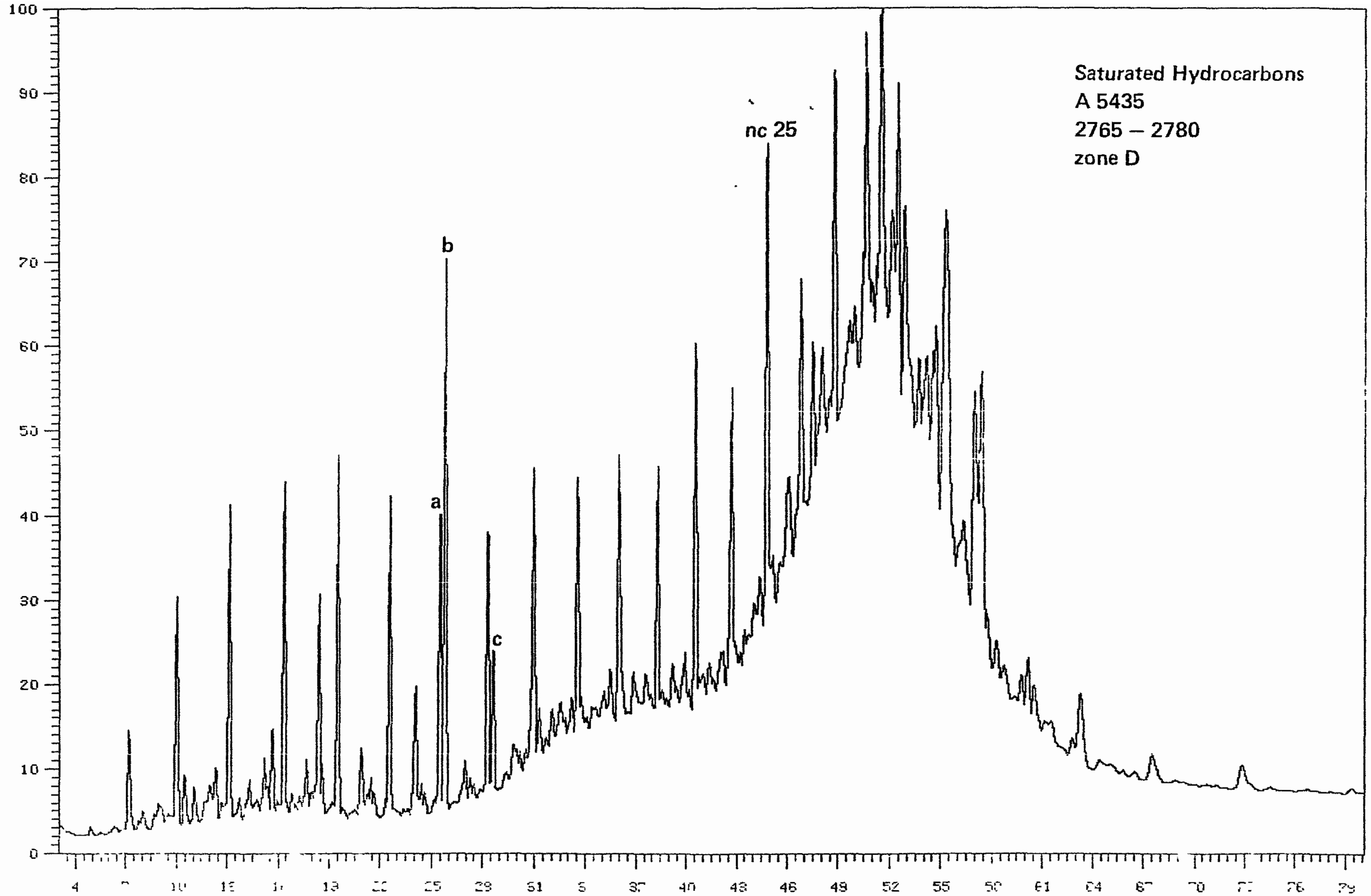


Printed at 12:39 on 12/Jul/83

RAW DATA PLOT-CHANNEL 6 Box 1 of 1

Analysis :0099A5435S1 Sample #: 1 Injection #: 1

Sample Name :A-5435,S,34/10-17,AD Maximum signal (%): 22.30

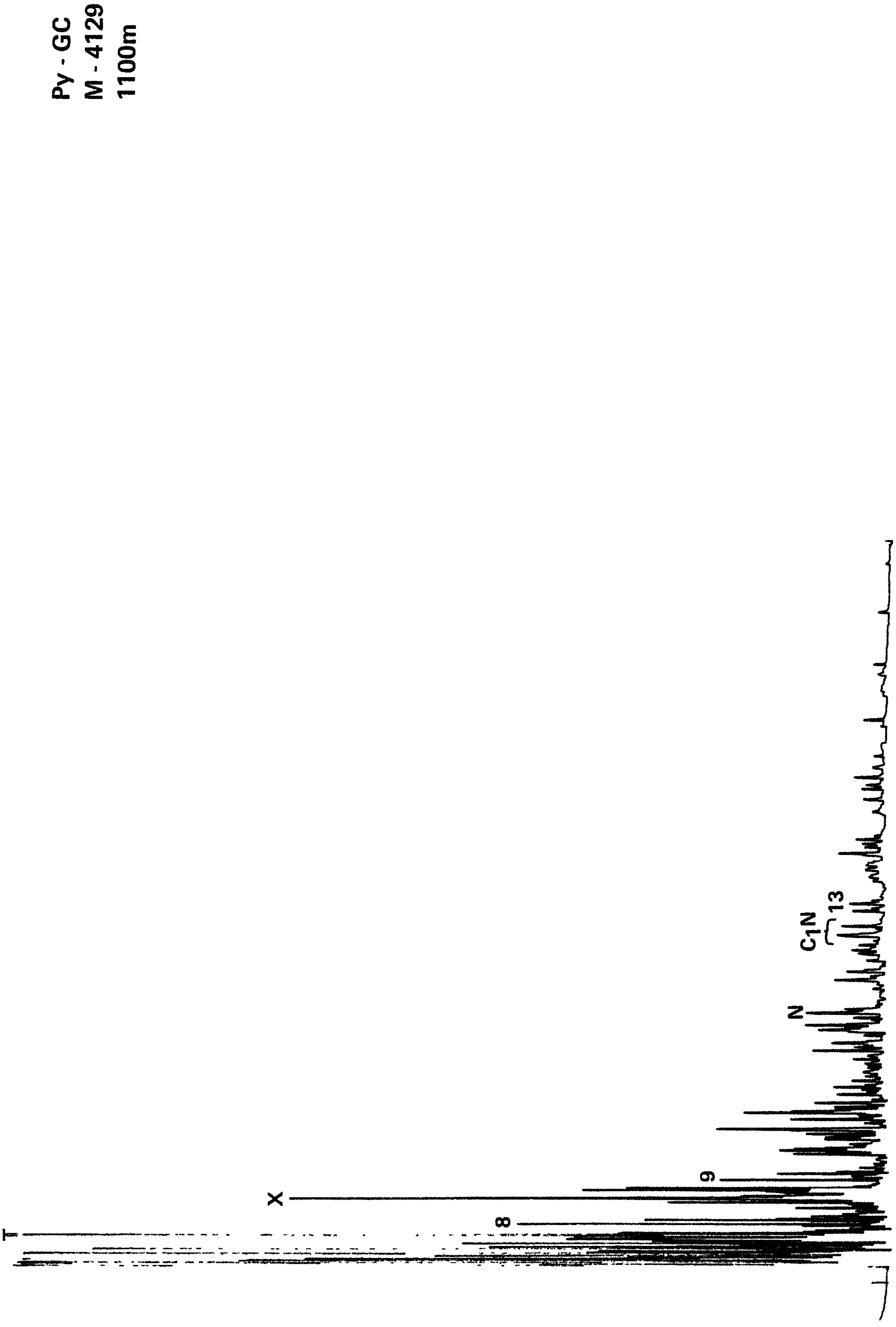


IKU

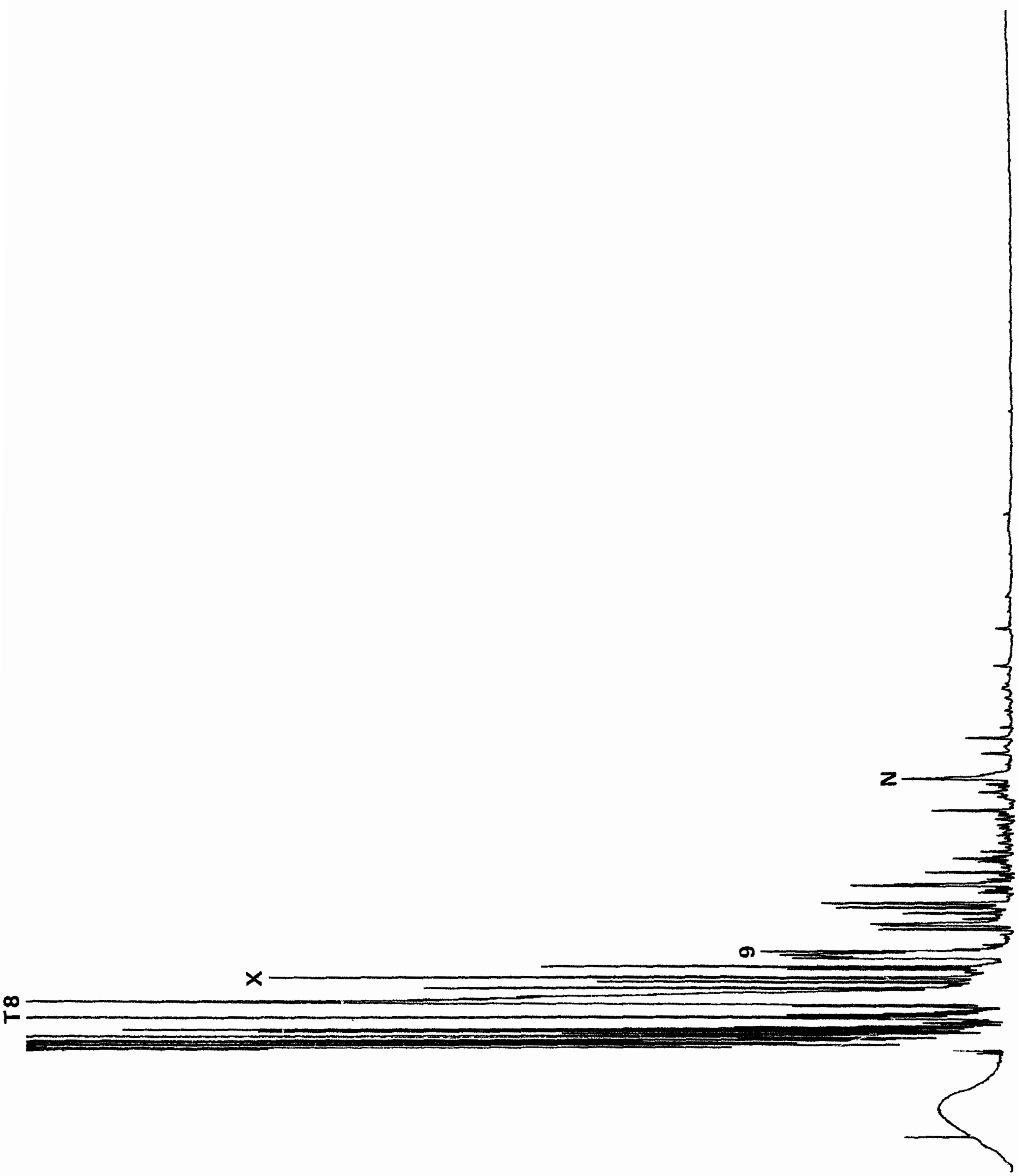
Pyrolysis Gas Chromatography

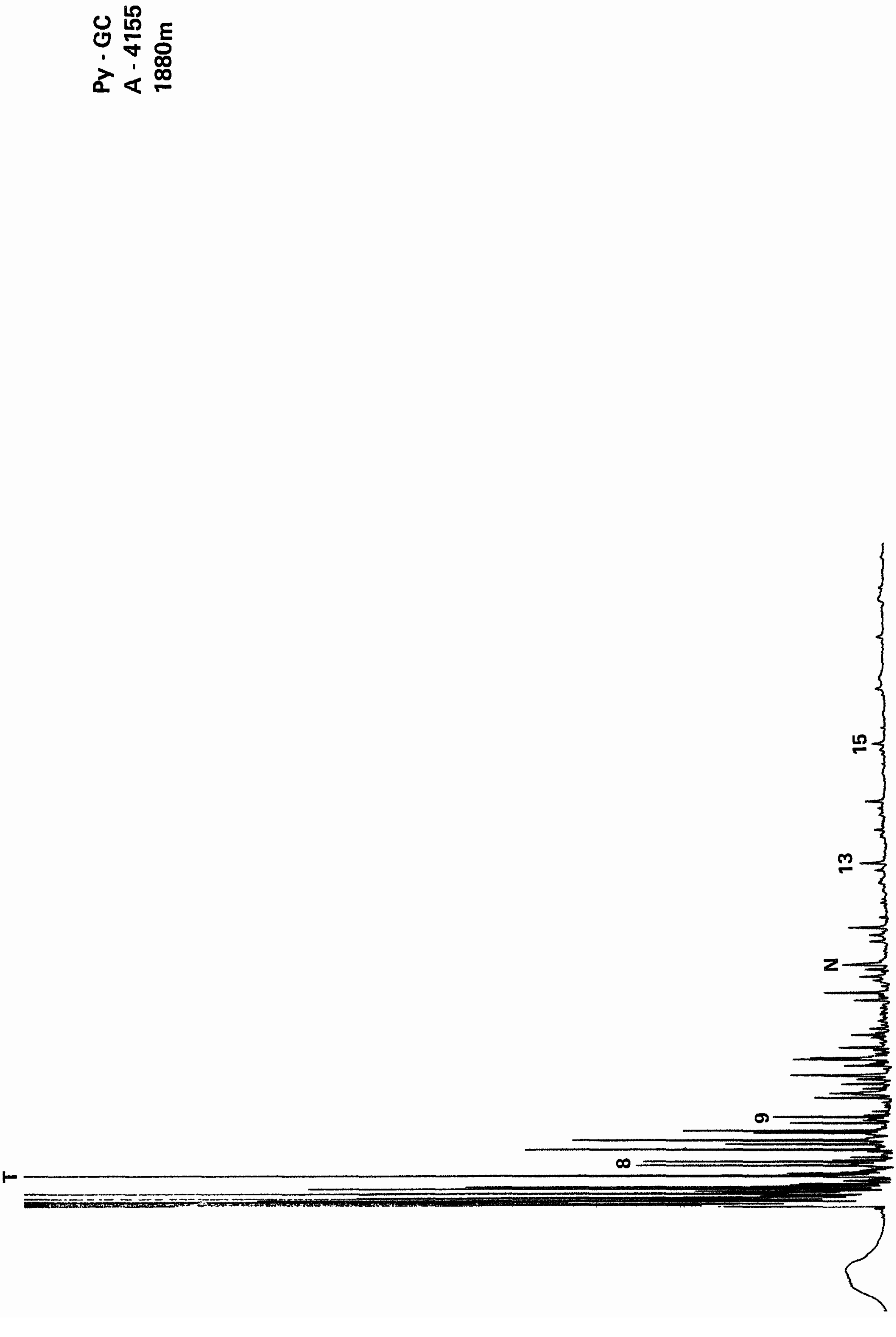
T - Toluene
X - Xylene
N - Napthalene
C_1N - Methyl naphthalene

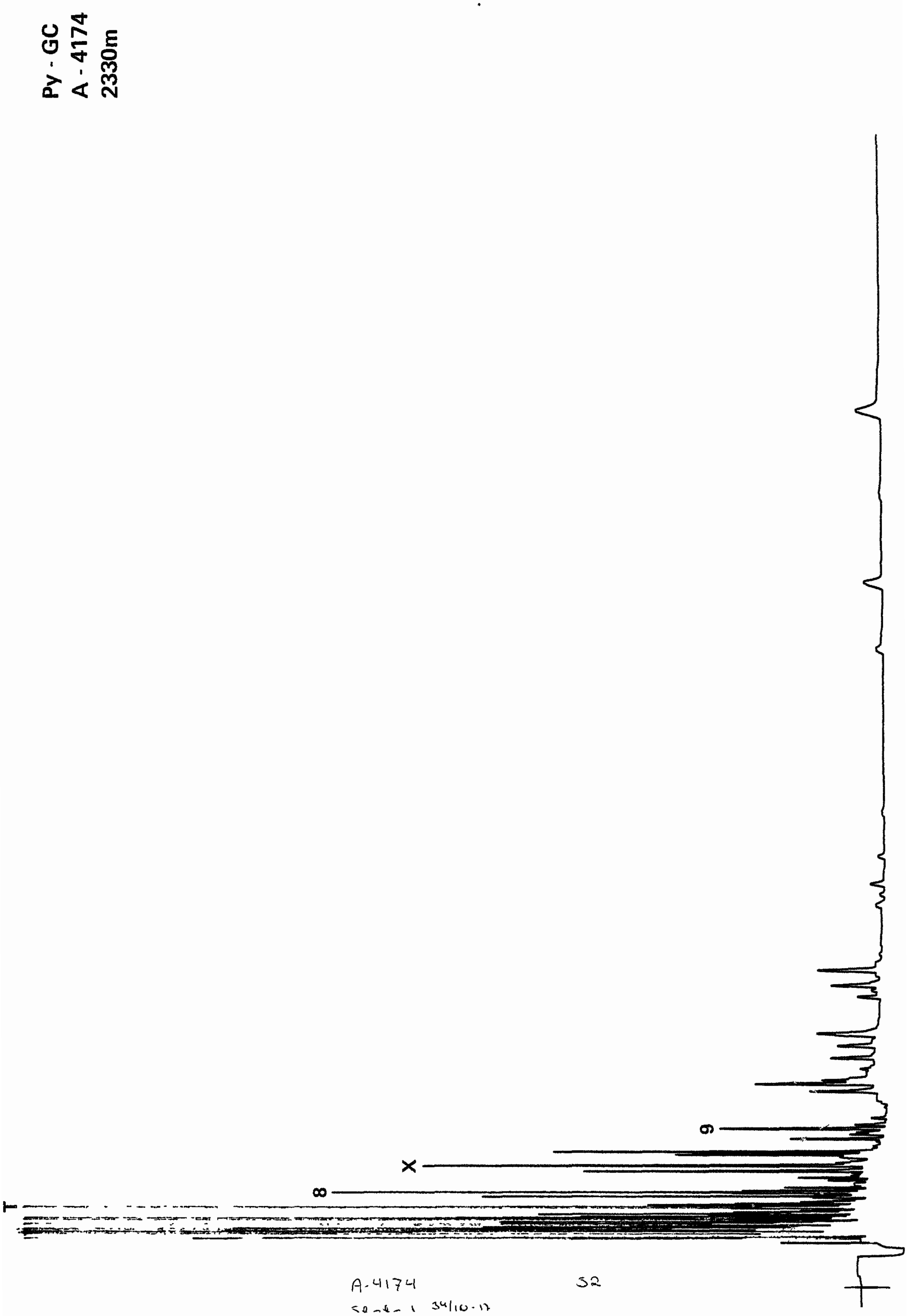
The numbers are the carbon number of the n-alkanes

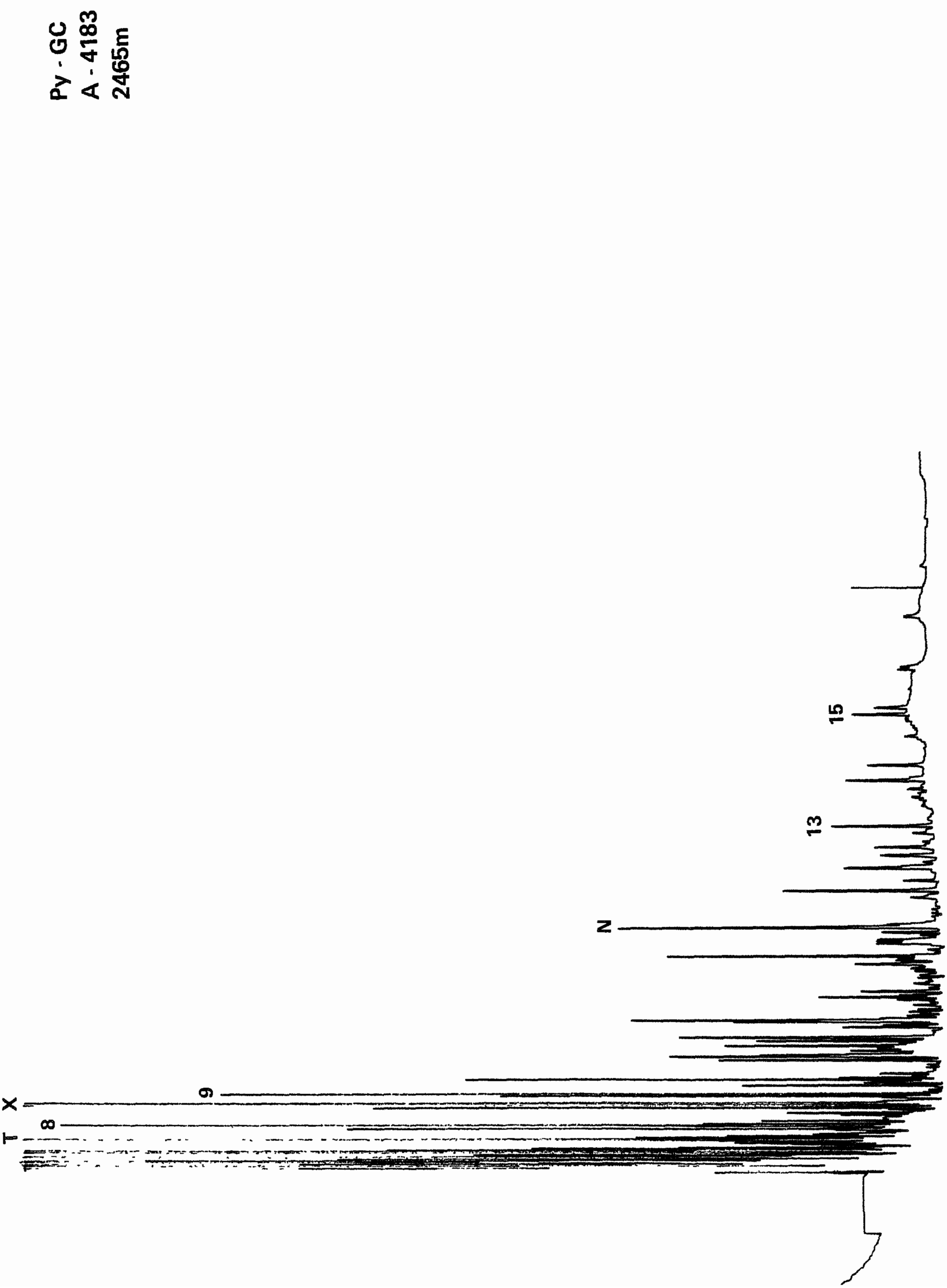

Py - GC
M - 4129
1100m
T
X
8
9
N
C_1N
13

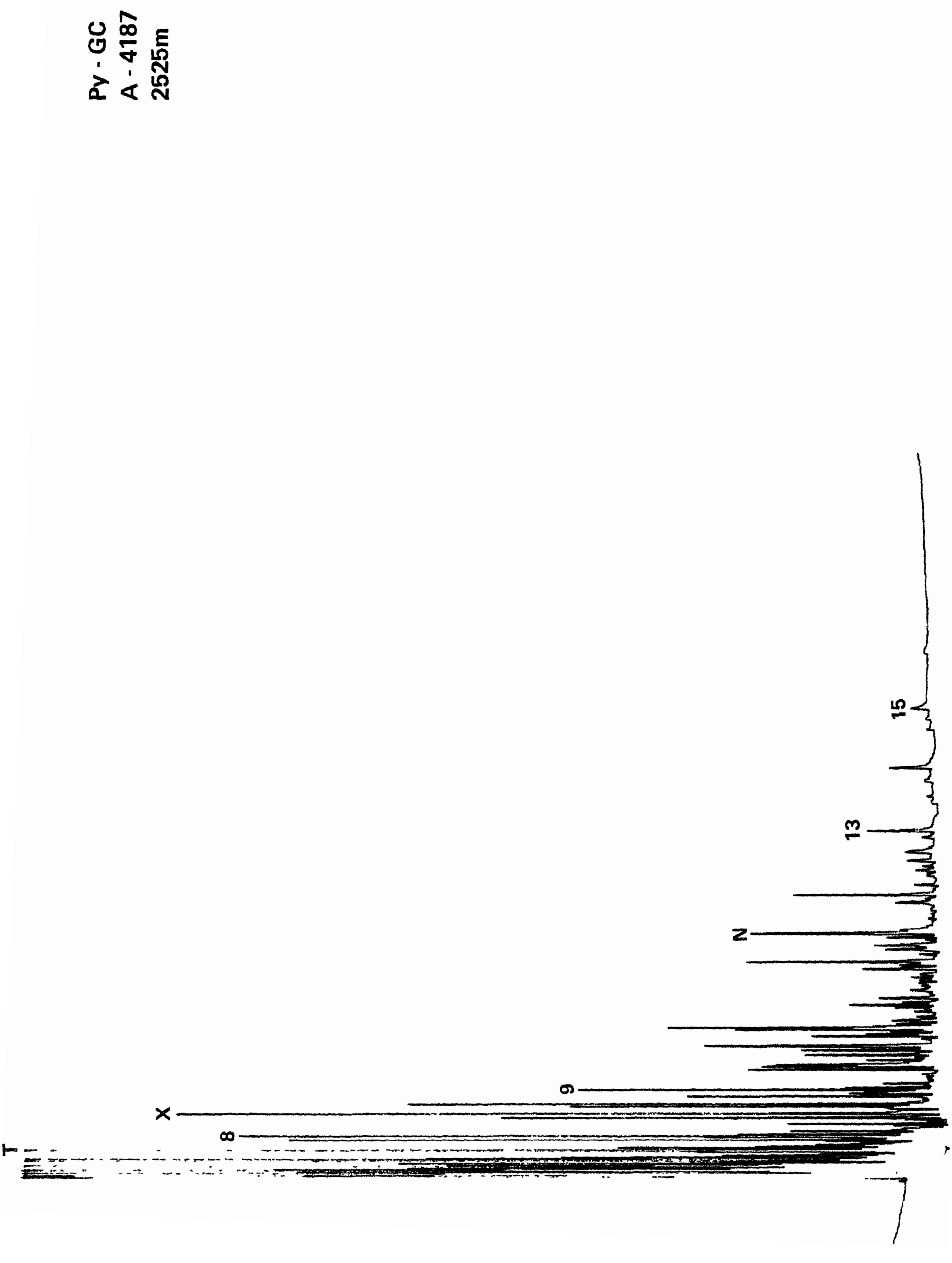
Py - GC
A - 4141
1460m

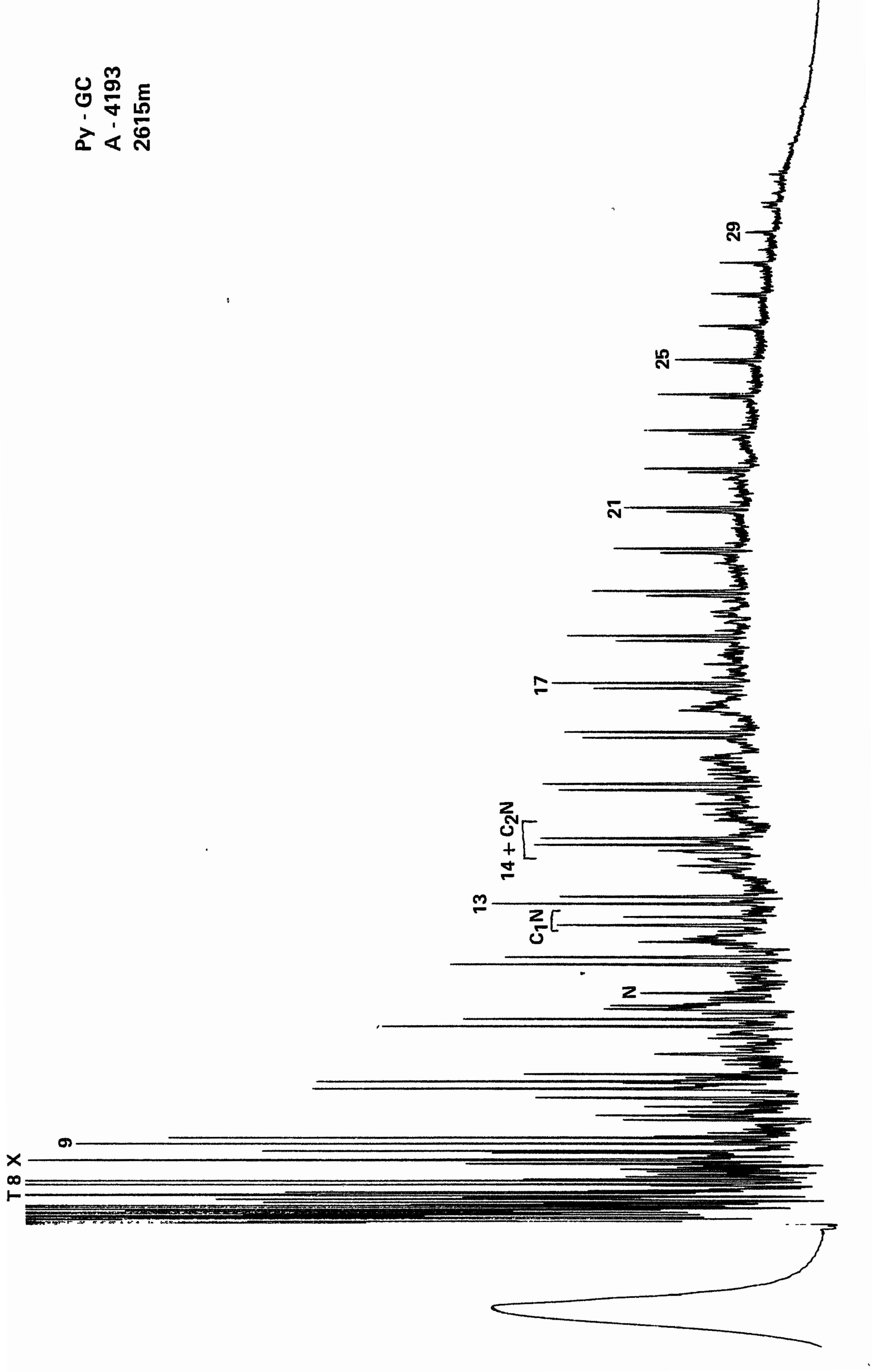


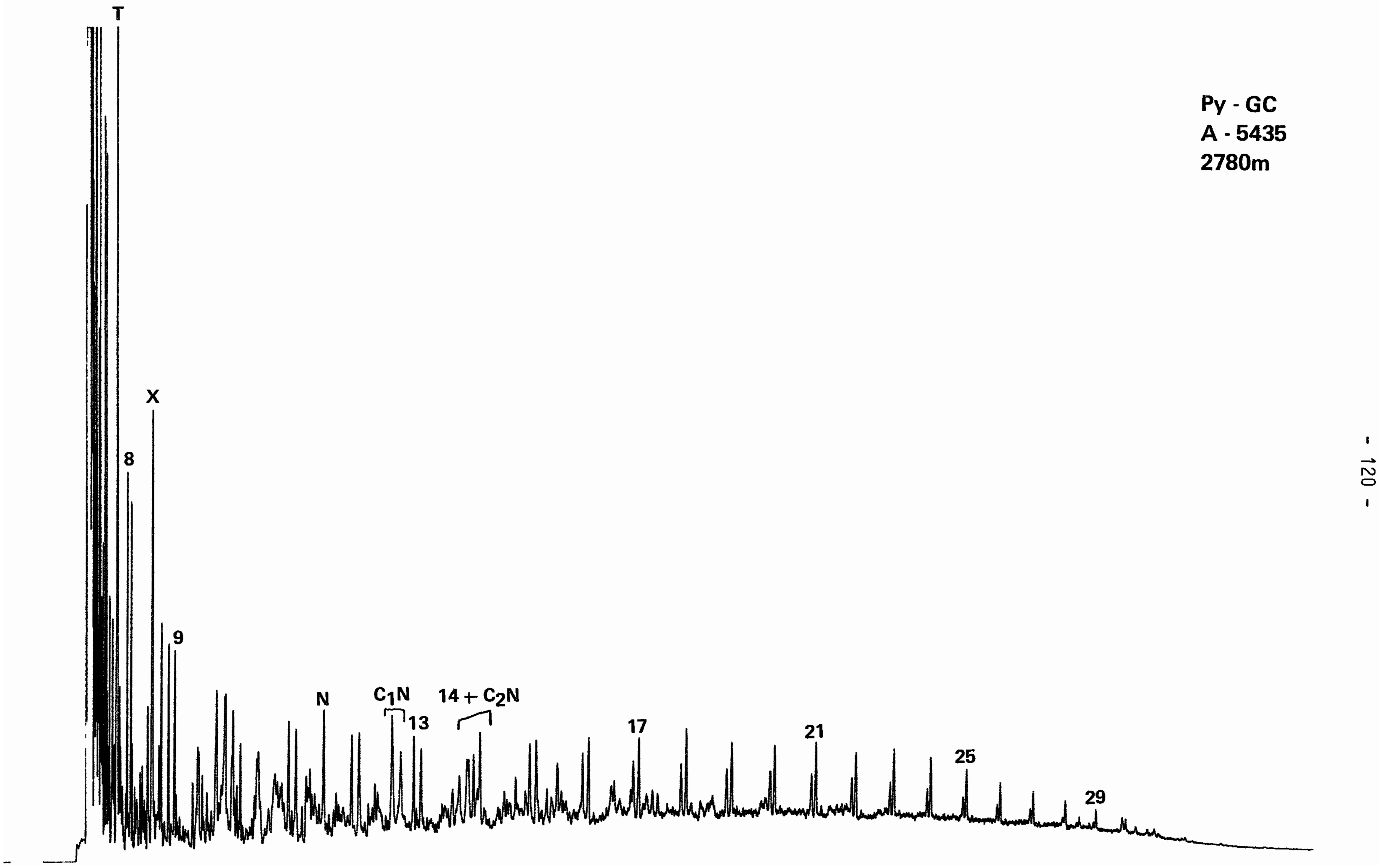

Py - GC
A - 4155
1880m
T
8
9
N
13
15

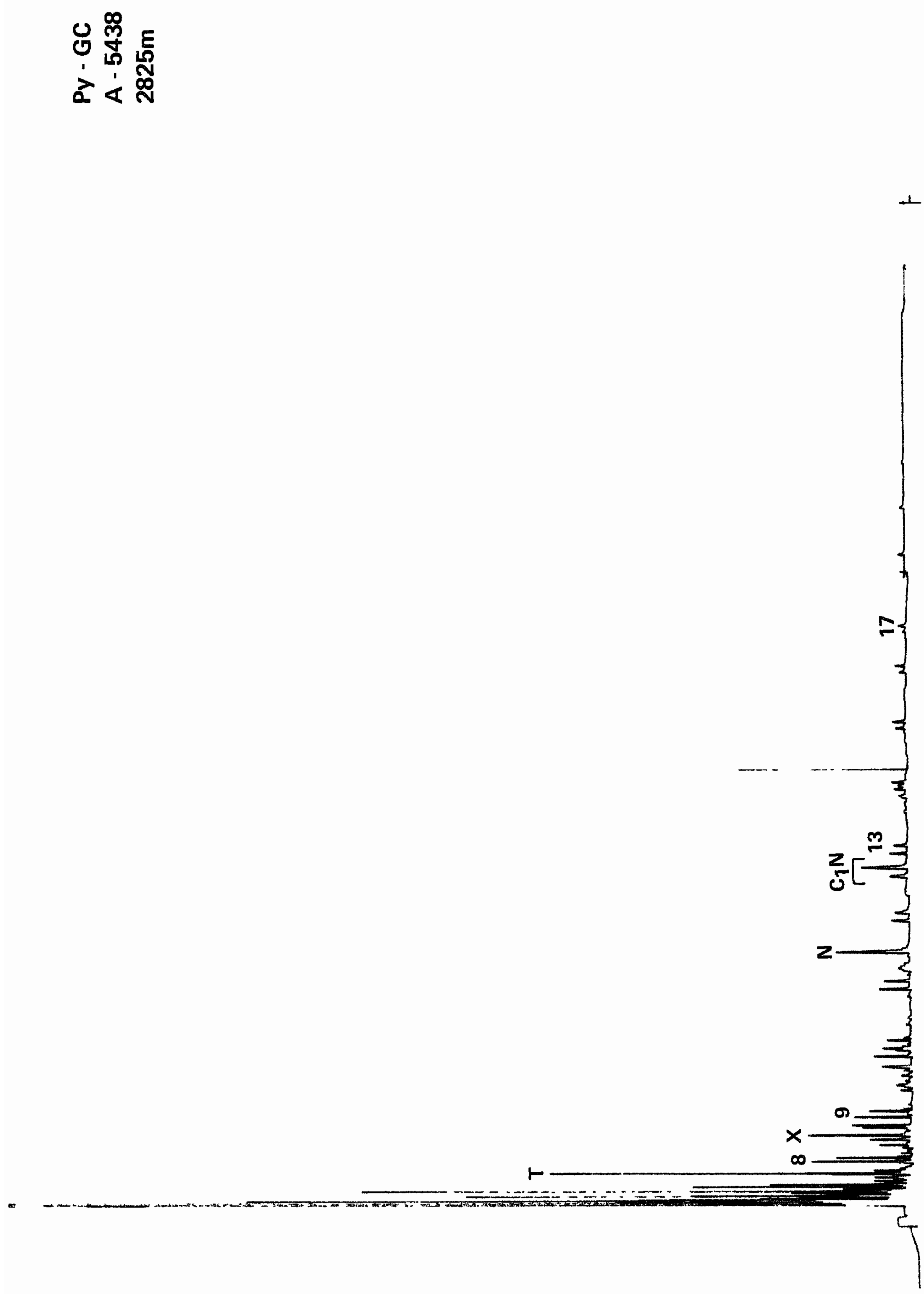

Py - GC
A - 4174
2330m
T
8
X
9
A-4174
52

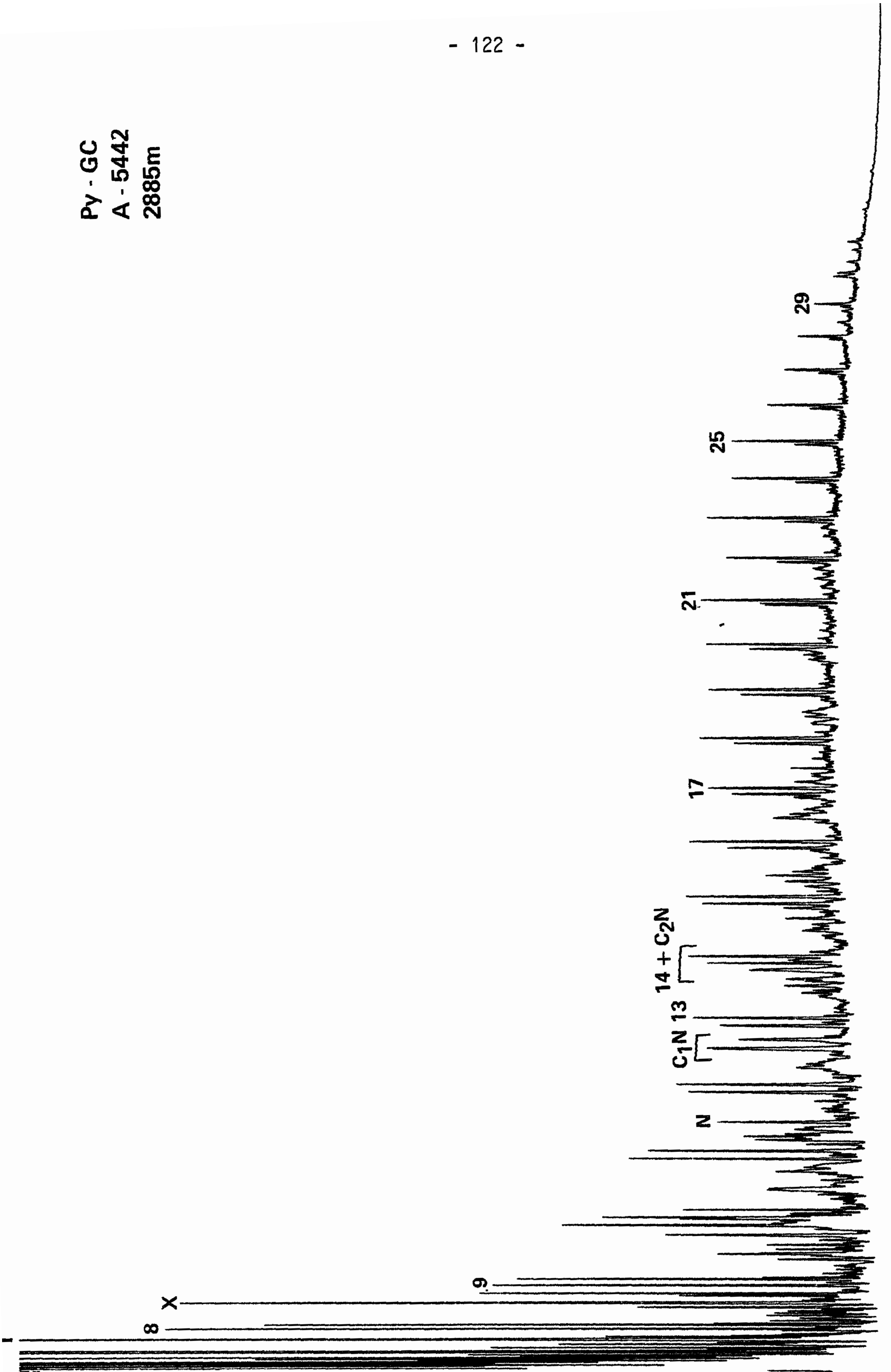

Py - GC
A - 4183
2465m
T
X
8
9
N
13
15

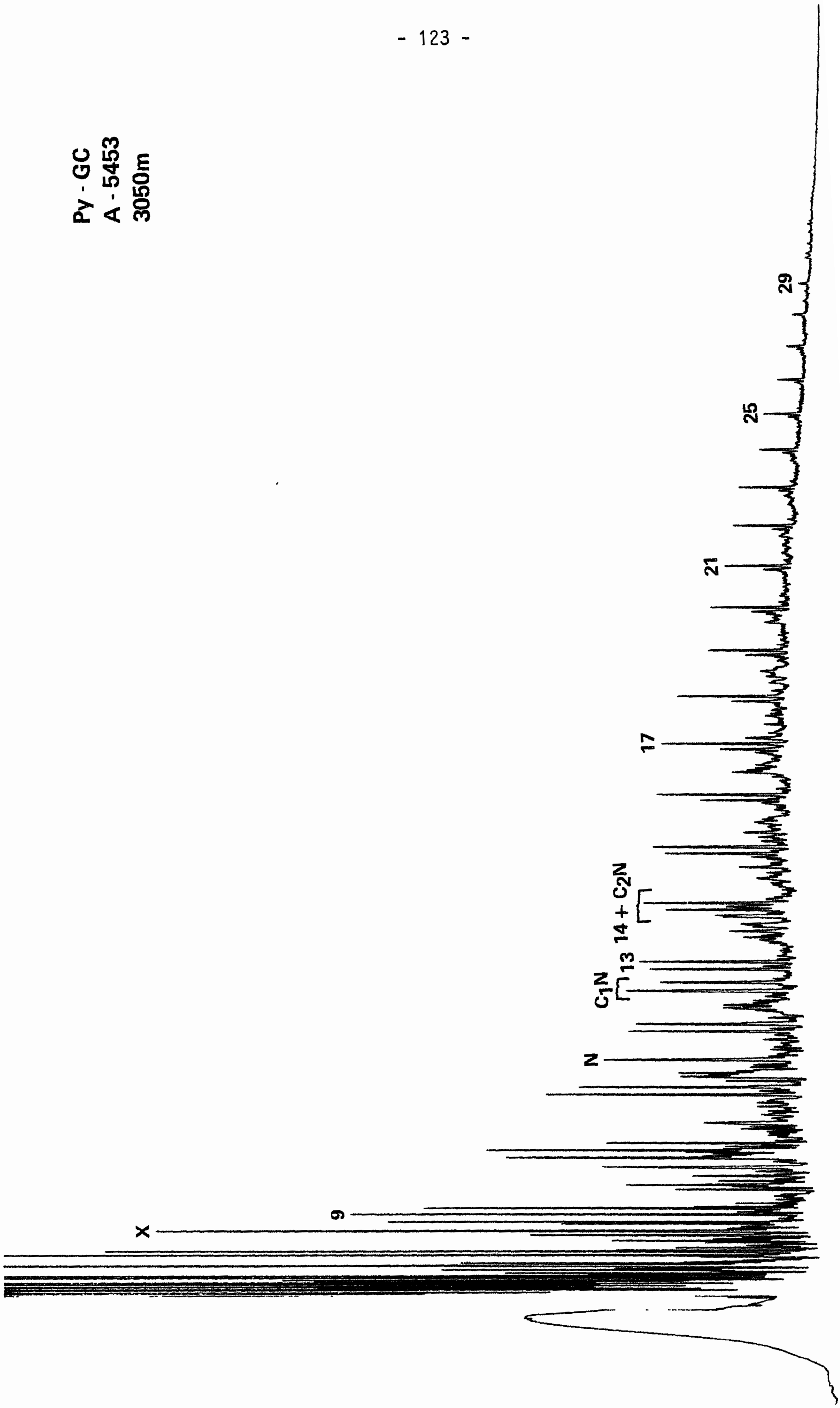

Py - GC
A - 4187
2525m
T
8
X
9
N
13
15

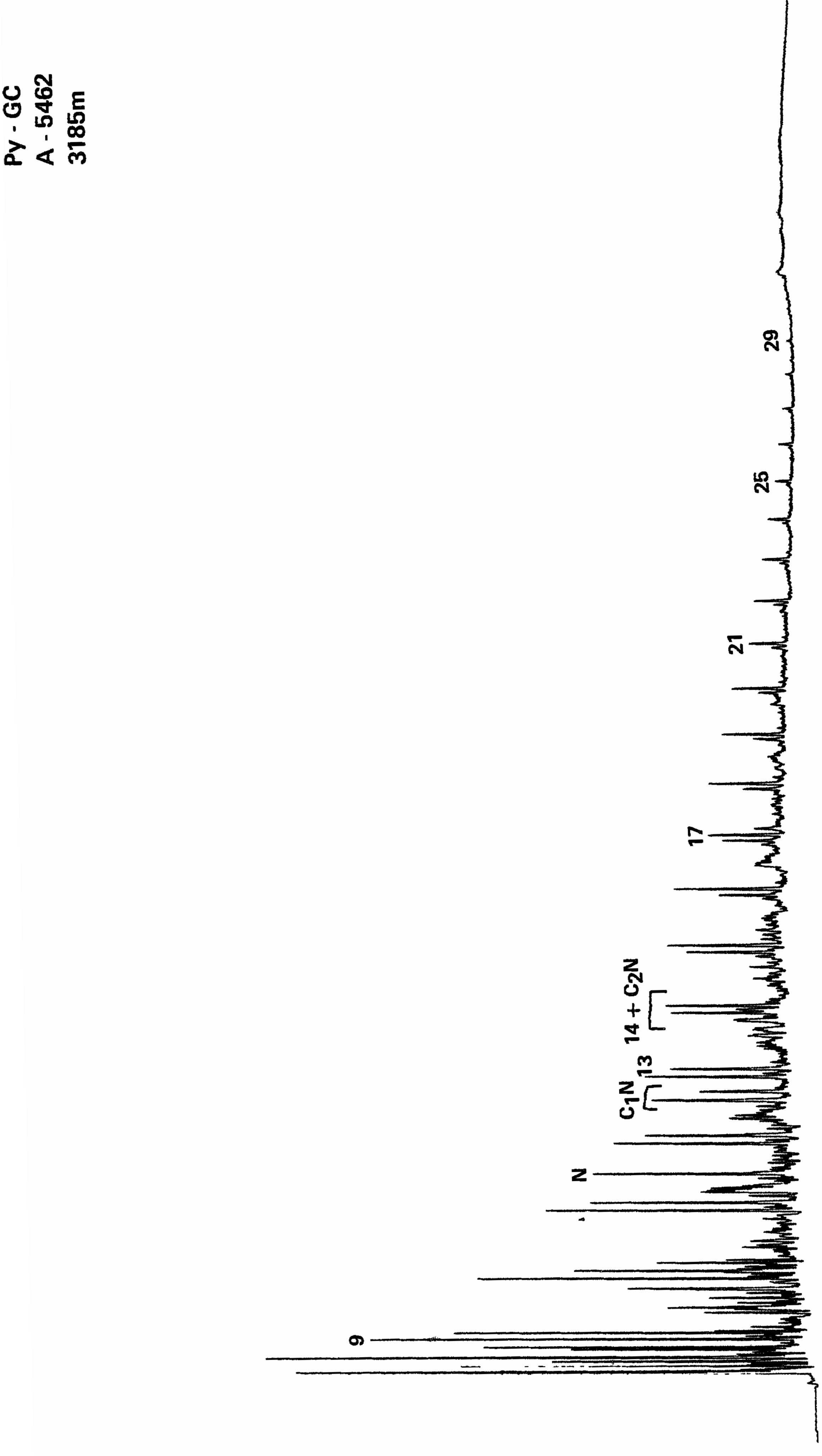

Py - GC
A - 4193
2615m
29
25
21
17
14 + C2N
13
C1N
N
9
T 8 X

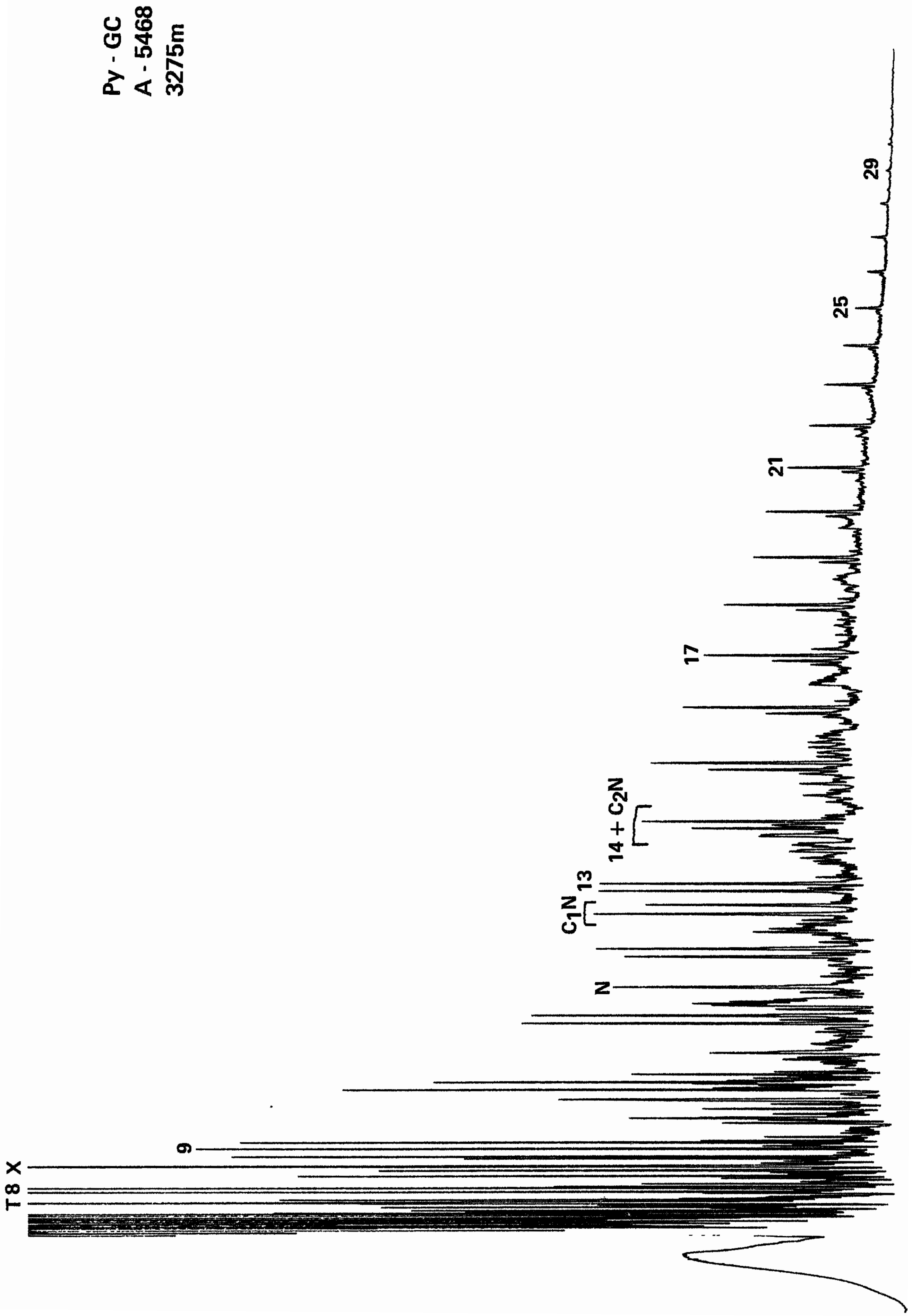

T
8
X
9
N
C1N
13
14 + C2N
17
21
25
29
Py - GC
A - 5435
2780m

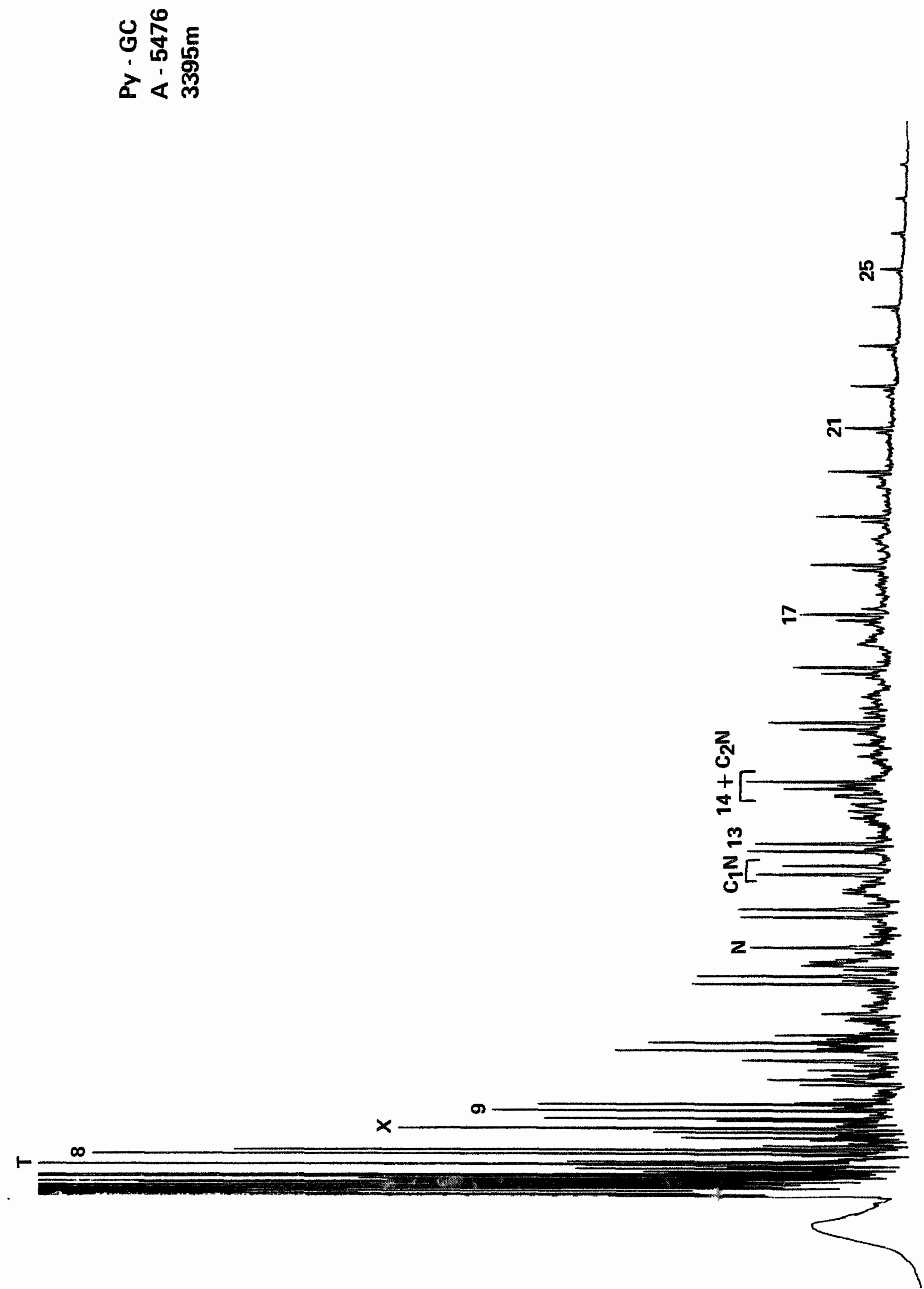

Py - GC
A - 5438
2825m
T
8
X
9
N
C_1N
13
17

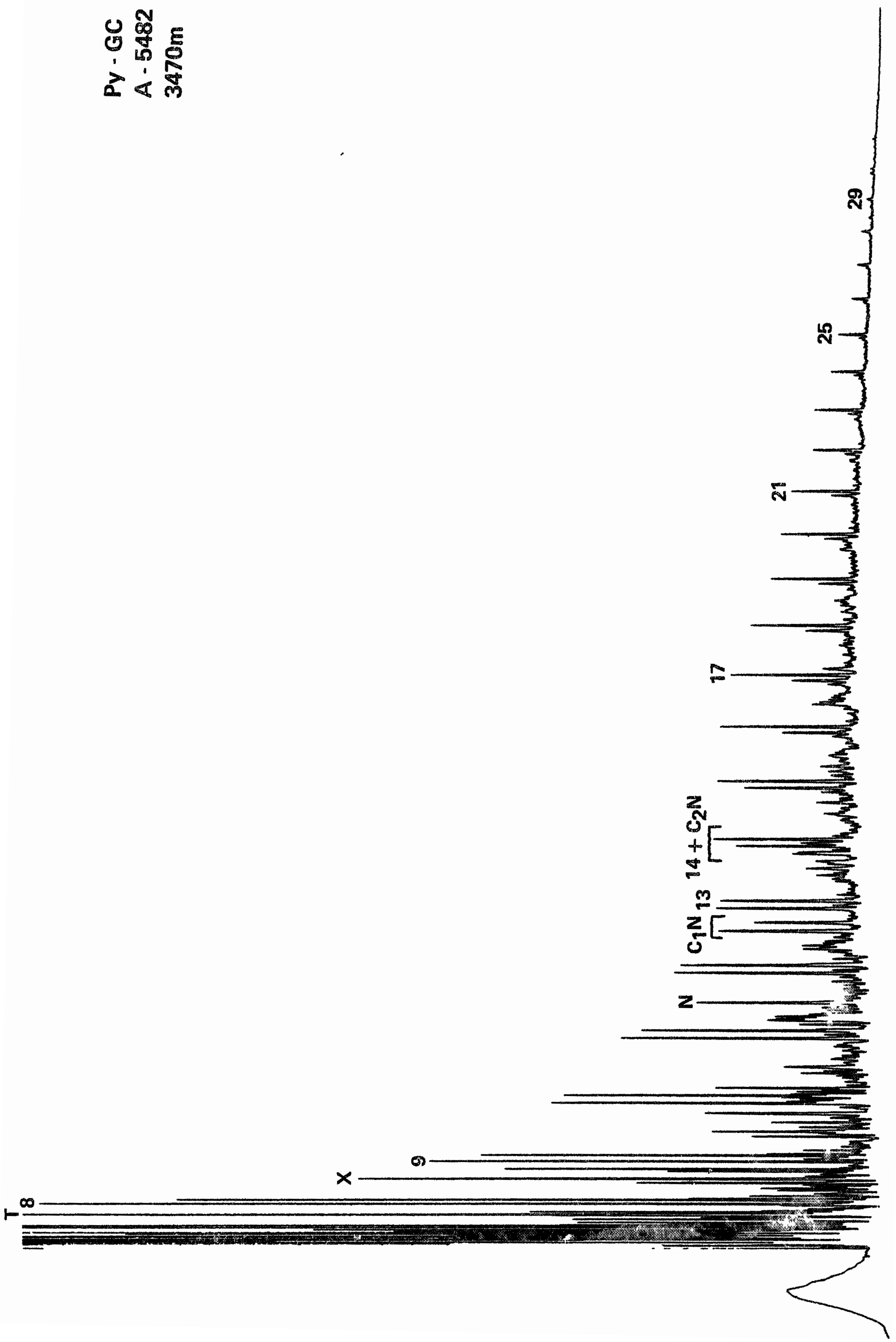

Py - GC
A - 5442
2885m
29
25
21
17
14 + C_2N
13
C_1N
N
9
X
8


Py - GC
A - 5453
3050m
29
25
21
17
14 + C2N
13
C1N
N
9
X


Py - GC
A - 5462
3185m
9
N
C_1N
13
14 + C_2N
17
21
25
29


Py - GC
A - 5468
3275m
T8 X
9
N
C_1N
13
14 + C_2N
17
21
25
29


Py - GC
A - 5476
3395m
T
8
X
9
N
C_1N
13
14 + C_2N
17
21
25


Py - GC
A - 5482
3470m
T
8
X
9
N
C1N
13
14 + C2N
17
21
25
29

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INTERPRETATION DIAGRAM

Well no.: 34/10 – 17
Company: STATOIL

SUMMARY OF SOURCE POTENTIAL

C_{15}^{+} SATURATED HYDROCARBONS
Presentation of Analytical Data

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C_{15}^{+} HYDROCARBONS
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TOTAL ORGANIC CARBON (TOC)
Presentation of Analytical Data

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$C_1 - C_7$ HYDROCARBONS
Presentation of Analytical Data

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ROCK-EVAL PYROLYSIS

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MATURATION

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VISUAL KEROGEN
COLORATION AND COMPOSITION OF ORGANIC RESIDUE