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REPORT TITLE/ TITTEL

Source Rock Analyses of Well 34/10-16.

CLIENT/ OPPDRAGSGIVER

Statoil

RESPONSIBLE SCIENTIST/ PROSJEKTANSVARLIG

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SUMMARY/ SAMMENDRAG

The sequence analysed (230-4042m) was divided into 8 zones:

Zone A; 230- 620m: Contains Quartz, rock fragments and fossils - no potential.
Zone B; 620-1040m: Immature. Possibly contains migrated hydrocarbons.
Zone C; 1040-2030m: Immature. Fair potential as a source for gas.
Zone D; 2030-2810m: Moderately mature. Poor potential for gas only.
Zone E; 2810-3020m: Moderately mature. Poor potential for gas.
Zone F; 3020-3790m: Moderately mature/oil window. Top section most promising source rock.
Zone G; 3790-4000m: Top oil window maturity. Fair potential for gas.
Zone H; 4000-4042m: Fair organic content. Red claystone - oxidised?

The well ranges from immature at the top to just within the oil window at the base.

The section at the top of zone F appears to have the best source rock potential (3000-3200m depth).

KEY WORDS/ STIKKORD

34/10-16 | Immature
Source Rock

084/d/1

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°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°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 µ 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 µ).

The colour evaluation is based on colour tones of spores and pollen (preferably) with supporting evidence from colour tones of other types of kerogen (woody material, cuticles and sapropel). These colours are dependant upon the maturity, but are also influenced by the paleo-environment (lithology of the rock, oxidation and decay processes). The colours and the estimated colour index of an individual sample may therefore differ from those of the neighbouring samples. The techniques in visual kerogen studies are adopted from Staplin (1969) and Burgess (1974).

In interpretation of the maturity from the estimated colour indices we follow a general scheme that is calibrated against vitrinite reflectance values (R_0).

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^{o}C to 520^{o} at 35^{o}C/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^{o}C at 4^{o}C/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 eight zones. This is done in order to facilitate interpretation and for easier handling and comparison of results. There may be further subdivisions possible within some zones or alternatively results from further analyses may be seen to be similar over zone boundaries and not follow the early pattern.

The eight zones used here are:

Zone A : 230- 620m
Zone B : 620-1040m
Zone C : 1040-2030m
Zone D : 2030-2810m
Zone E : 2810-3020m
Zone F : 3020-3790m
Zone G : 3790-4000m
Zone H : 4000-4042m

Light Hydrocarbon Analysis

Zone A; 230-620m: This zone begins with a dominance of quartz together with varying but minor amounts of chert, limestone, rock fragments and fossils. The proportion of rock fragments shows a general increase with depth within the zone at the expense notably of the quartz. The last sample in the zone consists almost exclusively of cement. The C_1-C_4 hydrocarbons are completely dominated by methane with only four samples containing any other compounds (and this is confined to ethane and propane). Total abundances of C_1-C_4 hydrocarbons fluctuate within the zone from poor (minimum 175µl/kg rock) to rich (maximum 30030µl/kg rock), but the majority are only poor to fair. Higher values may possibly be associated with higher proportions of rock fragments. No C_5+ hydrocarbons are detected in any of the samples. Apart from the first sample the wetness of the zone is low or nil. The methane is probably immature biogenic gas.

Zone B; 620-1040m: This zone continues with varying proportions of rock fragments and quartz but is distinguished by most samples containing varying amounts of an olive-grey silty and sandy claystone (maximum 40%). Towards the base of the zone glauconite is observed in considerable quantities.

Again, throughout this zone the C_1-C_4 hydrocarbons are completely dominated by methane which is very abundant at the top of the zone. There is a sharp break in methane abundance to poor levels from 800m to the base of the zone. This can be related to a decreased content of both claystone and rock fragments but the relationships may be coincidental.

Zone C; 1040-2030m: The zone begins with samples composed almost completely of olive-grey micaceous claystone. This includes various proportions of greenish and brownish grey through to red-brown claystone but it is the dominant or exclusive lithology throughout the zone. At 1220-1250m, 15% of a brown-olive grey silty shale is recorded but it appears to have no effect on the light hydrocarbon abundances.

Apart from one sample (1100-1130m) the abundance of C_1-C_4 hydrocarbons is poor throughout the zone and is almost exclusively (biogenic?) methane except for the last sample (2000-2030m) which contains C_1-C_4 hydrocarbons in minor amounts and has the first occurrence of C_5+ (which is also greater than the methane). Wetness is only recorded towards the base of the zone and is low.

Zone D; 2030-2810m: The claystone continues as the dominant lithology throughout this zone. It is olive grey, greenish grey to pale brown/red-brown. Traces of coal are occasionally associated with it. Towards the base of the zone the claystone becomes more silty and a siltstone is also recorded (up to 15%).

In this zone methane is no longer as dominant among the light hydrocarbons. Initially, abundances of C_1-C_4 hydrocarbons are poor but from 2210m this increases to fair and remains so throughout the zone with the last sample having rich abundances. There is a more significant production of C_2-C_4 and C_5+ hydrocarbons in this zone and a general increase is seen in both abundance of C_1-C_4 hydrocarbons and in the wetness values with depth. C_5+ compounds show a less marked increase with depth from poor to fair abundances. iC_4/nC_4 ratios can be calculated in this zone for the first time in the well. These values are moderate to high which could indicate biodegradation in this zone.

Zone E; 2810-3020m: Zone E continues with total dominance of the more or less silty claystone as in the zone above. From 2960m traces of coal (5%) and shale (3%) are found.

Abundances of C_1-C_4 hydrocarbons fluctuate wildly within this zone but are generally higher than in zone D. The wetness values (after a decrease from zone D seen in the first sample) show a clear increase within depth apart from the sample from 2960-2990m but this is still high. iC_4/nC_4 ratios are still high and increased from zone D and may show a trend to increase with depth indicating still possible biodegradation. C_5+ abundances are low throughout the zone.

Zone F; 3020-3790m: This zone begins with a dominance of black to dark olive-grey shale/claystone, shale and coal. The proportion of this black carbonaceous claystone/shale decreases to 25% at 3460-3490m where olive grey, dark olive grey and grey claystone becomes dominant. (The sequence 3140-3460m is missing). At 3550-3580m there is a significant input of quartz again but as this in such abundances here is an isolated case it may be caved from the upper zones. From 3580m to the base of the zone, turbodrilled claystone dominates the samples.

It is difficult to follow trends in the light hydrocarbon abundances with such a large section of the zone missing. However, there is a general increase in C_1-C_4 abundances compared to zone E and all of the values are high.

Apart from the last sample (3760-3790m) wetness values show a general decrease with depth throughout the zone. iC_4/nC_4 ratios are low and very consistent which could indicate immaturity and a lack of biodegradation. C_5+ values are increased from zone E and are fair to good throughout.

Zone G; 3790-4000m: In this zone quartz again dominates the samples but at the top there is also dark grey claystone (no signs of turbodrilling) and coal/lignite recorded. This generally decreases in the zone and the minor claystone appears turbodrilled (this may be caved).

Light hydrocarbons are very abundant and are higher than in zone F but the C_1-C_4 show a decrease with depth (though still remaining high). C_5+ abundances are generally high. Wetness values fluctuate but finish slightly higher at the bottom than at the top. iC_4/nC_4 ratios remain constant.

Zone H; 4000-4042m: This zone is very narrow and is represented by two samples only in which red-brown and grey claystone dominates.

This zone shows a decrease in C_1-C_4 hydrocarbons in the two samples which have fair and good abundances. C_5+ abundances are fair and good. Wetness increases with depth whilst the iC_4/nC_4 ratio is constant.

Total Organic Carbon

Zone A; 230-620m: Due to the lithology present no samples from this zone were analysed for total organic carbon content.

Zone B; 620-1040m: Five samples from this zone were analysed. These were all taken from the olive-grey or olive-brown silty claystone component which comprised from 5% to 40% of the samples. The samples all have good to rich organic carbon contents and after an increase between the first and second samples there is an overall decrease with depth.

Zone C; 1040-2030m: The zone begins with a rich claystone (TOC=2.48%) similar to those in the zone above. After this the values begin to decrease to good and then to fair. The change from good to fair may be associated with a change from olive-grey claystones to a more brownish grey variety. Below 1500m the values are only fair and fluctuate slightly but may show a minor increase with depth.

Zone D; 2030-2810m: The lithology in this zone is fairly consistent (olive-grey to greenish grey, occasionally red-brown claystone) with an increase in silt content with depth. Within the claystone there is a slight increase in organic carbon content with depth though all values are only classified as fair. The siltstone at 2660-2690m has a poor to fair content.

Zone E; 2810-3020m: There is an initial decrease in organic carbon content on entering this zone but then the values rise to a maximum 1.12% at 2900-2930m. From here the values decrease again steadily to 0.65% at the base. The lithology is olive grey to grey throughout and the organic contents are fair to good.

Zone F; 3020-3790m: This zone contains more shale/black carbonaceous claystone lithologies at the top but is turbo drilled and more variable at the base. The top shale samples have rich organic carbon contents but the highest value (37.84% at 3080-3110m) is probably contaminated by coal as may be the olive grey claystone at this depth as in a TOC of 4.70% is much higher than other samples of this lithology. A more acceptable value for this lithology is found in the sample 3110-3140m (0.55%).

After the gap in the sequence the dark grey to black claystone is present for only one sample 3460-3490m and still has a rich organic carbon content. The olive grey claystone here again has values similar to those found above for this lithology. From 3490m to 3580m the olive grey and light grey claystone has rich organic carbon contents. Below this the claystone appears turbodrilled and where taken the total organic carbon values are lower but still good or fair.

Zone G; 3790-4000m: In this zone another claystone is introduced. This is dark grey and fissile and has rich organic carbon contents (2.18% to 3.45% TOC).

Zone H; 4000-4042m: Only one of the two samples in this zone was analysed for total organic carbon. This is a mixed claystone possibly affected by turbodrilling and it has only a fair organic carbon content (0.75%).

Extraction and Chromatographic Separation

Zone A; 230-620m: No samples from this zone were extracted.

Zone B; 620-1040m: One sample from this zone was analysed (M-3956, 620-650m). The grey to olive-grey claystone with a TOC of 1.65% was extracted and has a good extractability of organic material relative to rock extracted but only a fair extractability when this is normalized to organic carbon. The same pattern is seen for the extractable hydrocarbons fraction. There is a higher content of extractable non-hydrocarbons than of extractable hydrocarbons and this is often the case with immature samples. The ratio of saturates to aromatics is high in this sample.

The gas chromatogram of the saturated hydrocarbons shows a bimodal distribution dominated by the lower molecular weight end (nC_{18} is the dominant component). This part of the chromatogram shows a smooth distribution and could be due to contaminants from the drilling mud (although this usually peaks at lower carbon numbers) or free (migrated?) hydrocarbons in the sample. The Rock-Eval production index is moderate to high and could imply migrated hydrocarbons are present. The higher molecular weight end of the chromatogram shows a large envelope of unresolved complex material together with the saturated hydrocarbon input from terrestrial material. The CPI is moderate. The pristane/phytane ratio is similar to that found in immature samples and the unusual presence of squalane has also often been associated with immature sediments.

Squalane is believed to be derived from squalene which can be abundant in bacteria. The squalene appears to be better preserved where anaerobic conditions have prevailed and therefore in such environments the possibility of squalene reduction to squalane is greater. The abundance of pyrite and amorphous material as seen from transmitted light analyses would support such a conclusion of anaerobic conditions.

Zone C; 1040-2030m: One sample from this zone was extracted (A-3970, 1040-1070m). This shows a rich abundance of extractable organic material in ppm of rock but this is dramatically reduced to only a fair extractability when normalised to organic carbon. This can be due to low maturity of the sample. There is a far extractability of hydrocarbons but this is poor when normalised to organic carbon. There is a very high proportion of extractable non-hydrocarbons (83%) and this is another sign of an immature sample.

The gas chromatogram of the saturated hydrocarbons is to some extent similar to the sample from zone B. Again the distribution is bimodal and nC_{18} is dominant at the lower molecular weight end. There is not the same prominent envelope of unresolved complex material in this sample. However, the unusual presence of squalane in some abundance is again noted. The CPI is high and indicates immature samples. The pristane to phytane ratio is possibly more affected by kerogen type than maturity. The lower molecular weight distribution is probably influenced by free hydrocarbons. The higher molecular weight end signifies the input of terrestrial material.

Zone D; 2030-2810m: No samples from this zone were extracted.

Zone E; 2810-3020m: One sample from this zone was extracted (A-4031, 2870-2900m). The sample has a fair extractability which is also fair when normalised to organic carbon. The extractability of hydrocarbons is fair for A-4031 and remains fair when normalised to organic carbon. This could be due to the immature nature of the sample (non-hydrocarbons again constitute a moderate to high proportion of the extractable organic matter (56%) indicating immaturity).

The gas chromatogram of the saturated hydrocarbons shows a small unresolved hump at the higher molecular weight end and has indications of a terrestrial input. However, nC_{18} is again the dominant component and the distribution is similar to those of samples above but with a few more lower molecular weight compounds.

Zone F; 3020-3790m: Five samples from this zone were extracted (A-4036, 3020-3050m; A-4038, 3080-3110m; A-4039, 3110-3140m; A-4041, 3490-3520m; and A-4043, 3550-3580m).

Sample A-4036 has a rich extractability but this is only fair when the value is normalised to organic carbon. In terms of extractable hydrocarbons the value changes from good to fair when normalised to organic carbon, again an indication of an immature/moderately mature sample. The gas chromatogram of the saturated hydrocarbons has a maximum at nC_{15} and does not show the same roundness of distribution of the lower molecular weight end that was found in samples above. This, together with a low Rock-Eval production index could indicate that the pattern is due to a more mixed kerogen nature rather than migrated hydrocarbons/contamination. The high pristane content could be indicative of terrestrial input or less reducing conditions at the time of deposition.

Sample A-4038 has a rich extractability but this is drastically reduced when normalised to the organic carbon content as for immature samples. An even greater discrepancy is seen between the extractabilities of hydrocarbons when quoted as ppm of rock and then normalised to organic carbon. The extractable organic material shows an overwhelming dominance of non-hydrocarbons (89%) whilst saturates greatly dominate over the aromatics fraction. The gas chromatogram of the saturated hydrocarbons shows a strong dominance of higher molecular weight compounds with a very high CPI (maximum at nC_{29}) and a few geochemical fossils. This indicates immaturity/moderate maturity. The overall distribution and the pristane content indicates terrestrial (coal?) conditions.

Sample A-4039 is almost identical to sample A-4036 in every respect except that the CPI is slightly higher and the maximum is at nC_{29} and the overall picture indicates a more prominent terrestrial input.

Sample A-4041 is even more similar to A-4036, the only difference being that nC_{15} is the overall dominant peak here (in A-4036 pristane slightly exceeded nC_{15}). Also there is a slightly improved extractability of hydrocarbons as ppm of rock but this is reduced when normalised to organic carbon.

Sample A-4043 shows a good extractability of organic material which is reduced to fair when normalised to organic carbon. This pattern is repeated for the extractable hydrocarbons. The gas chromatogram of the saturated hydrocarbons shows a smooth distribution of the lower molecular weight compounds with a maximum at nC_{15} and with a shoulder from nC_{23}. This could indicate a mixed kerogen input but the smoothness and distribution of the lower end may reflect migrated hydrocarbons/contamination from drilling mud additives. The presence of free hydrocarbons is not conclusively supported from from the Rock-Eval production index.

Zone G; 3790-4000m: Three samples from this zone were extracted (A-4051, 3790-3820m; A-4052, 3820-3850 and A-4057, 3970-4000m).
There is an increase in extractable organic material with depth in this zone with A-4051 having a good/rich extractability and the other two having increasingly rich values. The same pattern is seen when the values are normalised to organic carbon although the value for A-4052 is reduced slightly. In terms of extractable hydrocarbons both A-4051 and A-4052 have good extractabilities whilst A-4057 is rich. In terms of the values when normalised to organic carbon the first two samples have fair extractabilities and the latter good.

The gas chromatograms of the saturated hydrocarbons are similar for all of the samples. These show a dominance of lower molecular weight compounds with a maximum at nC_{15}. Rock-Eval production indices do not indicate excessive free hydrocarbons and this is therefore possibly part of the original kerogen (the samples here are slightly more mature though only bordering on the oil window and this may be expected). There is a shoulder of higher molecular weight compounds with a maximum at nC_{25} in all cases. The isoprenoid ratios are similar for all of the samples and indicate a terrestrial input.

Zone H; 4000-4042m: No samples from this zone were extracted.

Rock-Eval Pyrolysis

Zone A; 230-620m: No samples from this zone were analysed.

Zone B; 620-1040m: Five samples from this zone were pyrolysed on a Rock-Eval instrument. All of the samples were olive grey or brown claystones and all had good to rich TOC's. All of the samples have low T_{max} values indicating immaturity. Sample A-3962 (800-830m) has a very low T_{max} (371) which is probably caused by bitumens/asphaltenes. Apart from the uppermost sample (A-3956, 620-650m) which shows some peculiarities in other analyses and here has hydrogen and oxygen indices indicative of type IV kerogen, the samples appear to contain type III or mixed III/IV kerogen. Moderately high production indices indicate the possibility of migrated hydrocarbons present in the samples - especially the top three. The petroleum potential as expressed by S_1+S_2 is variable being only poor in the uppermost sample but fair to good in the rest. This could be as a consequence of the S_1 peak indicating migrated/contaminant hydrocarbons especially at this maturity. The potential would be for gas only due to the kerogen type indicated here.

Zone C; 1040-2030m: Seven samples from this zone were analysed. Again, low T_{max} values would indicate immature samples although A-3980 (1340-1370m) and A-3993 (1730-1760m) have such low values that the parameter has probably been assessed on asphaltenes (analysis in reflected light indicates the dominance of bitumens). The kerogen type as defined by hydrogen and oxygen indices is somewhat variable. The top three samples (from 1040 to 1190m) indicate kerogen type III whilst the two samples between 1220m and 1370m have values more in the range of type IV. The sample at 1430-1460m (A-3983) indicates a type III or mixed III/IV kerogen and the bottom sample (A-3993, 1730-1760m) is again more of a type IV. Production indices are moderate to high and at this maturity could indicate the presence of migrated hydrocarbons. Petroleum potentials also vary considerably and reflect the organic type. Taking accepted levels for poor, fair, good and rich potentials, the type III kerogens defined here all have fair to good potentials whilst the more type IV kerogens show poor potentials. In all cases this would be for gas.

Zone D; 2030-2810m: Three samples from this zone were analysed. The T_{max} data for all of the samples is poor indicating that the parameter was possibly taken from bitumen/asphaltenes. Hydrogen and oxygen indices would imply a more type IV, inertinitic, kerogen or reworked type III vitrinite. Production indices are again quite high for the supposed maturity at this level and migrated/contaminant hydrocarbons must be suspected. Petroleum potentials are poor throughout the zone and the potential would be for gas only.

Zone E; 2810-3020m: Two samples from this zone were analysed by Rock-Eval pyrolysis. T_{max} values are higher than for any samples above but would still indicate that the samples are immature to moderately mature. The upper sample (A-4031, 2870-2900m) contains kerogen type III according to hydrogen and oxygen indices whilst the lower sample (A-4033, 2930-2960m) contains kerogen type IV. Production indices are lower than for the samples in the zone above but are still not as low as might be expected for clean samples at this maturity. The petroleum potential is fair for A-4031 but poor for A-4033. This would be for gas only due to the kerogen type.

Zone F; 3020-3790m: Eight samples from this zone were analysed. Apart from sample A-4038 (3090-3110m) the T_{max} values show a steady increase and indicate moderately mature samples bordering on the oil window maturity. Hydrogen and oxygen indices in general indicate type III kerogen with the exceptions of A-4036 and A-4039 which possibly include some mixed type II/III and A-4040 and A-4044 which indicate type IV kerogen (inertinite or reworked vitrinite). Production indices are generally low (apart from in the samples containing type IV kerogen) and are more in line with the expected values for the maturity. Petroleum potential again accurately reflects the kerogen types with A-4020 and A-4044 (type IV) having poor potentials whilst A-4043 (3550-3580m) has a fair potential and the rest have good potentials. The potential in most cases would be mainly for gas with possibly oil in the mixed type II/III samples.

Sample A-4038 (3080-3110m) is anomalous in this sequence and although it is defined as a black claystone the gas chromatographic analysis and microscopic evidence indicate the presence of low rank coal or lignite (this is very low rank and may be additive). Such material in the sample would account for the high TOC value, the very high S_2 and consequently high petroleum potential.

Zone G; 3790-4000m: Four samples from this zone were analysed. These samples are very similar in every respect (lithology, TOC values and Rock-Eval data). T_{max} values are indicative of samples on the boundary of or just within the oil window. Production indices are low and in accordance with the maturity. They do not indicate the presence of migrated hydrocarbons. Hydrogen and oxygen indices indicate type III kerogens. The petroleum potentials all fall within the "fair" range but the potential as a consequence of the kerogen type would be for gas.

Zone H; 4000-4042m: No samples from this zone were analysed.

Analyses in Transmitted Light

The acid insoluble sedimentary matter of 34/10-16 was investigated on the basis of 26 samples. The samples are picked lithologies from ditch cuttings between 650m and 3970m.

True amorphous material was evaluated as fairly abundant in the upper part of the well (down to 2900m). Terrestrial material, mostly from woody sources, dominates from 3020m down the hole (to 3970m). Cuticles are very abundant at the 3020/50m and 3110/40m levels.

The material was evaluated as immature, at 1730/60m and above (TAI 1/1+). A generally higher maturity, was recorded from 2720/50m and below (TAI 2-/2 to 2) and corresponds with a maturity at the top of the oil window. The most interesting section as a possible source rock seems to be located at about 3020m to 3140m in samples rich in cuticles.

Description of samples

620/50m and 650/80m: Small residues which after screening consisted of aggregates of combined inorganic/organic sources. The relative proportions are rather uncertain as distinction of true amorphous material is difficult.
Colour index: 1/1+.

1040/70m: Strongly pyritic residue consisting of dominantly sapropelised woody material. Distinction of true amorphous material is difficult but it was evaluated as fairly important. Well preserved cysts are abundant but enclosed and obscured by amorphous material.
Colour index: 1/1+.

1100/30m: Very pyritic residue containing larger aggregates but of the same composition as above. Most palynomorphs are obscured and stained. Vitrinite is pale. The amorphous material is difficult to estimate. Very little inertinite is seen.
Colour index: 1+.

1160/90m: Composition as for the residue above but there are more firm aggregates. Palynomorphs include well preserved cysts and pollen which have colours influenced by natural staining.
Colour index: 1/1+, 1+.

1220/50m: Pyritic residue with larger but less dense aggregates of sapropelised terrestrial material embedding palynomorphs and pale woody fragments. Palynomorphs appear immature but are possibly stained. Preservation is good.
Colour index: 1+/2-.

1340/70m: Fine amorphous material (about 30%) as clouds embedding a dominant element of woody particles and well preserved cysts. Cuticles and pollen are subordinate.
Colour index: 2-.

1430/60m: Aggregates of strongly sapropelised terrestrial material with a high pyrite content. Palynomorphs are generally obscured but are well preserved and appear stained. Clean woody material is subordinate and pale.
Colour index: 1+/2-.

1730/60m: Clouds of amorphous material (about 50%) as in 1340/70m but cysts seem relatively less abundant. Woody particles are second dominant.
Colour index: 1/1+, 2-.

2420/50m: Amorphous material in aggregates dominates. The material is now grey as opposed to brown above. This embeds pyrite and dark, reworked woody fragments with lighter vitrinite. Cysts and pollen appear fewer than above but are variably stained possibly resulting in a higher colour index.
Colour index: 2-/2.

2720/50m: Woody and reworked woody material (inertinite) dominate and are embedded by grey amorphous material.
Colour index: 2-/2, 2 (colour tone is controlled by the lithology and the corresponding index somewhat high as an indicator of maturation).

2780/2810m: Dominantly reworked woody material plus primary vitrinite in a fine grained brown-grey amorphous mass. Some vitrinite appears etched and as with the sample above the colour index may be affected by lithology. Palynomorphs are subordinate.
Colour index: 2-/2.

2930/60m: Dominantly terrestrial material in strongly sapropelised aggregates (brown-grey). Most of this appears to be reworked material or inertinite. Possible vitrinite fragments appear rich brown.
Colour index: 2-, 2-/2.

3020/50m, 3110/40m: The fairly coarse sapropelised residues contain dominantly terrestrial material. Cuticles dominate (3110/40m) or equal the woody material. The structures are better preserved than above. Palynomorphs, dominantly pollen, are fairly well preserved. Tasmanitids are present.
Colour index: 2-/2, 2, 1/1+.

3080/3100m: Almost exclusively woody material (vitrinite, rich brown) with a few possible cuticles and some spores.
Colour index: 1+/2-, 2-, 2-/2.

3460/90m (olive-grey claystone): Small residue dominated by mostly structured woody material. About 25% amorphous material. Palynomorphs include mainly dinoflagellate cysts.
Colour index: 2-/2, 2.

3460/90m (dark grey claystone): The residue resembles the one above but is coarser and somewhat larger. Aggregates of amorphous material embed a major component of vitrinite particles. Semifusinite/fusinite make up the bulk of the coarse material. Pollen and spores are well or fairly well preserved.
Colour index: 2-/2, 2.

3490/3520m: Woody material (mainly reworked or inertinite) embedded in amorphous material. Pyritic residue. Moderate vitrinite and spore content.
Colour index: 2-/2, 2.

3550/80m: Sapropelised, strongly biodegraded material, dominantly wood. The relative proportion of semifusinite/fusinite is increased in comparison with 3460/90m.
Colour index: 2-/2, 2.

3580/3610m: Sapropelised terrestrial material (brown-grey) embedding structured woody fragments dominantly inertinite and/or reworked vitrinite. Palynomorphs are difficult to assess.
Colour index: 2.

3790/3820m: The sapropelised residue as above consists of a major woody element. The amount of cuticles seems relatively increased but is subordinate as above. Pollen and spores are fairly well to well preserved.
Colour index: 2-/2, 2.

3820/50m: As above with cleaner palynomorphs but dominated by woody material.
Colour index: 2-/2, 2.

3940/70m: Close resemblance with the composition 3790/3820m above, but pollen and spores are generally less well preserved.
Colour index: 2-/2, 2.

3970/4000m: Dominantly woody material in loose sapropel aggregates. As above palynomorph preservation poor to fair.
Colour index: 2.

Examination in Reflected Light

Twenty three samples were chosen from well 34/10-16 for examination in reflected light. These range from 1000m to 4000m. At the top of this section the samples are dominated by bitumen. Between 1300m and 2400m the samples chosen contain only reworked vitrinite and/or inertinite. Below this, the amount of clean, measurable vitrinite appears to increase but only becomes "adequate" at about 3500m. This agrees well with transmitted light descriptions. The analysed samples are described below.

Sample A-3970, 1040-1070m: Claystone, Ro = 0.36(8)
There is a very low organic content. This is very dominantly bitumen with only a trace of vitrinite and inertinite. Reworked material has a reflectance of approximately 0.7%. There is also some very low rank lignite present (Ro = 0.2-0.25%) but this is probably additive. Green fluorescence is observed from spores, resin and dinoflagellate cysts.

Sample A-3972, 1100-1130m: Claystone, Ro = 0.35(9)
The sample has a very low organic content. This is very dominantly bitumen with variable bitumen staining. There is a trace of vitrinite and inertinite is very rare. Green fluorescence is seen from spores, resin and dinoflagellate cysts.

Sample A-3974, 1160-1190m: Claystone, Ro = 0.50(1)
The sample is practically barren. Only one vitrinite phytoclast was observed and it is most probably reworked. There is some brown staining, possibly organic. The sample has an immature appearance. Green fluorescence is seen from dinoflagellate cysts together with green and green/ yellow fluorescence from spores.

Sample A-3976, 1220-1250m: Claystone, Ro = 0.41(3)
There is a very low organic content. This is dominantly bitumen blobs and bitumen wisps with some staining. Only 3 possible primary vitrinite fragments were observed and there is only a trace of inertinite. Green fluorescence is observed from spores, resin and dinoflagellate cysts.

Sample A-3980, 1340-1370m: Claystone and sandstone, No Determination Possible
The sample is virtually barren. There are a few bitumen fragments with some possible bitumen staining. The sample appears immature. No fluorescence is observed.

Sample A-3983, 1430-1460m: Claystone and sandstone, No Determination Possible
There is a very low organic content. This consists of a trace of inertinite together with occasional degraded bitumen wisps and possible bitumen staining. No vitrinite was located. The sample appears similar to A-3980. Fluorescence is seen from green/yellow (spore?) fragments.

Sample A-3993, 1730-1760m: Claystone, No Determination Possible
This sample is very similar to the last two. There is only a trace of bitumen recognised. Fluorescence is seen from green/yellow spores and dinoflagellate cysts.

Sample A-4016, 2420-2450m: Claystone, Ro = 0.24(2) and 0.64(2)
The sample is poor. It is dominated by bitumen and reworked vitrinite/inertinite but the organic content in general is very low. The result is almost meaningless on so few particles and the lowest is probably on bitumen whilst the highest is from reworked. No fluorescence is observed.

Sample A-4026, 2720-2750m: Claystone and siltstone, No Determination Possible
The sample has a low organic content which is exclusively small, gnarled inertinite fragments. No true vitrinite is considered present. Fluorescence is seen from yellow/orange unidentified fragments.

Sample A-4028, 2780-2810m: Silty claystone, Ro = 0.54(3)
The overall organic content is low but it is very localised and concentrated. It is dominantly inertinite and reworked material with only a trace of vitrinite and bitumen. Yellow/orange and light orange fluorescence is observed.

Sample A-4031, 2870-2900m: Silty claystone, No Determination Possible
The sample has a moderate organic content but this is exclusively reworked vitrinite and inertinite. Yellow/orange fluorescence is observed.

Sample A-4033, 2930-2960m: Claystone, Ro = 0.53(7)
There is a low to moderate organic content but this is very dominantly inertinite and reworked vitrinite. However, there are a few good vitrinite particles. Yellow/orange to light orange fluorescence is observed together with one possible green hydrocarbon speck.

Sample A-4036, 3020-3050m: Claystone, Ro = 0.38(3)
The sample is very bitumen rich and the value is most probably from some of this or vitrinite affected by bitumen staining. Inertinite is also abundant. There is some evidence of slight oxidation. Fluorescence is observed from green/yellow and yellow/orange fragments.

Sample A-4038, 3080-3110m: Lignite and mixed claystones, Ro = 0.32(3), 0.54(3) and 0.75(2)
The claystones have very different organic contents. Some are very rich but contain only large masses of swirled, very low rank, bitumen. Another claystone is cleaner and contains small bitumen wisps and variable staining. The third claystone contains reworked vitrinite and inertinite with very little primary vitrinite. The values are consequently few and varied. Green/yellow fluorescence is observed from spores and resin.

Sample A-4039, 3110-3140m: Lignite (additive?) Ro = 0.24(10)
This is very low rank with good cell structures. It is most probably additive. Green/yellow fluorescence is observed from spores and resin.

Sample A-4040, 3460-3490m: Coals and calcareous claystones, Ro = 0.57(8)
The sample contains two coals. One is a very low rank lignite as above and is assumed to be additive. The second coal though minor has a good mixed maceral content and may be in-situ. This is recorded. Green and green/yellow fluorescence is observed from spores and resin.

Sample A-4041, 3490-3520m: Claystone, Ro = 0.56(8)
The sample has a very variable organic content. Some clasts have quite rich organic contents but contain very dominantly reworked vitrinite and inertinite. Others are very pyritic and contain almost exclusively bitumen and bitumen staining - these may be caved. Yellow/orange and light orange fluorescence is observed.

Sample A-4043, 3550-3580m: Claystone, Ro = 0.60(20)
The sample is very variable but has a good mixture of organic material. There is heavy bitumen staining in places. This is a good sample if in situ. Light orange and mid orange fluorescence is observed.

Sample A-4044, 3580-3610m: Claystone, Ro = 0.61(3)
The sample contains two lithologies. One is very pyritic and barren of organic material whilst the second contains almost totally inertinite. Only three possible primary vitrinite fragments were located and these are very variable. Light orange to mid orange fluorescence is observed.

Sample A-4051, 3790-3820m: Silty claystone, Ro = 0.67(14)
Some areas have a high concentration of bitumen blobs and heavy bitumen staining. There is a moderate vitrinite content but most is reworked. Inertinite appears very ragged. Light orange and mid orange fluorescence is observed. The latter is most dominant.

Sample A-4052, 3820-3850m: Claystone, Ro = 0.66(19)
There is a moderate organic content. This is dominantly reworked vitrinite and inertinite. There is some good primary vitrinite but in general it is very variable. There is bitumen staining in places. Mid orange fluorescence is dominant but some light orange is also observed.

Sample A-4056, 3940-3970m: Claystone, Ro = 0.64(20)
The sample is very rich. It contains dominantly inertinite but there is also a moderate to high bitumen content and heavy bitumen staining in places. There is a low to moderate content of clean vitrinite, most of which occurs as particles but there are a few good wisps. There is a wide, slightly bimodal, distribution to the values. Mid orange fluorescence is observed.

Sample A-4057, 3970-4000m: Ro = 0.69(25)
There is a moderate to rich phytoclast content. This is dominantly inertinite and reworked vitrinite. There is a moderate content of primary vitrinite but this is very variable resulting in a bimodal distribution of values (peaks approximately 0.60 and 0.80%). Bitumen and bitumen staining are locally abundant. Mid orange fluorescence is observed.

Pyrolysis-Gas Chromatography (Py-GC)

11 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; P=phenol; C_1N=2- and 1-methyl naphthalenes; C_2N=C_2-alkyl naphthalenes (dimethyl and ethyl naphthalenes); Pr=pristenes.

A-3956 (650m): The pyrogram shows a short aliphatic homology ranging from C_8 to ca C_{17}. The abundance of unidentified peaks (presumably aromatics) are high. It is difficult to interpret the pyrogram, however, it is similar to pyrograms of some terrestrial derived type III and reworked kerogens.

A-3970 (1070m): The pyrogram shows a short aliphatic homology ranging from C_8 to ca. C_{20}. It also shows some similarity to the pyrogram of A-3956 and is difficult to interpret. However, the pyrogram is similar to pyrograms of immature type III kerogens.

A-4031 (2900m): The pyrogram of this sample is overall very similar to A-3970, i.e. a type III kerogen fingerprint.

A-4036 (3050m): The pyrogram shows an n-alkene/n-alkane homology ranging from C_8 to ca. C_{30}. Generally the pyrogram shows a type II kerogen fingerprint. However, the abundance of alkyl naphthalenes in the C_{12} to C_{14} region is quite high indicating an input of material derived from higher plants, i.e. the pyrogram shows a mixed type II/III kerogen fingerprint.

A-4038 (3110m): The pyrogram shows an n-alkene/n-alkane homology ranging from C_8 to ca. C_{32} with a high abundance in the C_{21} to C_{32} region indicating an input of lipid rich material with a high carbon number (cuticles, resins etc.). The abundance of phenol is high indicating input of material from higher plants. Generally the pyrogram shows a type III kerogen fingerprint.

A-4939 (3140m) and A-4041 (3520m): The pyrogram of these two samples are very similar to A-4036, i.e. the pyrograms show a mixed type II/III kerogen fingerprint.

A-4043 (3580m), A-4051 (3820m), A-4052 (3850m) and A-4057 (4000m): The pyrograms of these four samples are very similar to A-4036. However, the abundance of alkyl naphthalenes are slightly higher than in A-4036 indicating a higher input of kerogen type III type material (higher plant material) in these four samples. The pyrograms show mixed type III/II kerogen fingerprints.

CONCLUSIONS

Zone A; 230-620m: This zone consists of quartz, rock fragments and fossils. No further analyses were performed as these lithologies in the zone are not believed to have any potential for hydrocarbons.

Zone B; 620-1040m: The zone contains variable amounts of quartz, claystone and rock fragments. The claystone is light olive grey and is variably silty, sandy and calcareous. Some of this lithology was chosen for the analyses. The claystone has good to rich organic carbon contents (1.25-2.75% TOC). The samples contain dominantly type III or mixed type III/IV kerogen as defined from Rock-Eval hydrogen and oxygen indices. The whole zone is immature (TAI = 1/1+, T_{max} <422). Some of the zone possibly contains migrated hydrocarbons. The data indicates that the samples have mixed potentials but the zone as a whole probably has only a fair potential as a source for gas.

Zone C; 1040-2030m: Zone C is dominated by a greenish-grey to brownish grey fissile claystone. At the top of the zone the claystone is more olive grey and less fissile. Here, TOC values are good to rich (1.45 to 2.48% TOC). The 15% shale at 1220-1250m has a TOC of 1.47% but is an isolated example. The more fissile greenish grey claystone of this zone has lower TOC values (0.44-0.83%). The whole zone is immature (T_{max} <415, Ro 0.35-0.40%, TAI = 1/1+,1+ to 2-) and contain dominantly type III or mixed type III/IV kerogen. There is an indication of the possible presence of migrated hydrocarbons. Visual kerogen descriptions indicate the presence of strongly sapropelised terrestrial material. The data indicates that the zone as a whole has a fair potential as a source rock for gas.

Zone D; 2030-2810m: This zone contains the olive grey to greenish grey and red-brown claystone found above. The silty content increases with depth as does the organic content. TOC values range from 0.47 to 0.95% within the claystone and two siltstone samples have 0.33% and 0.75% TOC. The zone is moderately mature (<0.55% Ro and 2-/2 TAI) and may contain migrated hydrocarbons (high production indices). The kerogen type III/IV has a poor potential as a source rock for gas only.

Zone E; 2810-3020m: The claystone is still the dominant lithology but the TOC values are generally higher than in the zone above (values range from 0.65 to 1.12%). The zone is moderately mature (T_{max} = 427 and 432, Ro = 0.53% and TAI = 2-/2) but as a consequence of the kerogen type (III and IV) and the petroleum potentials of the samples analysed, the zone would have only a poor potential as a source rock for gas.

Zone F; 3020-3790m: This zone contains more carbonaceous, black claystone or shale together with variable amounts of coal and the olive grey claystone found above. TOC values are good to rich for the black claystone but only fair for most of the olive grey claystone. The zone is moderately mature approaching oil window maturity (T_{max} = 430-435, Ro = 0.55-0.6% and TAI = 2-/2,2).

Although the Rock-Eval pyrolysis data indicates type II/III, III and IV kerogens to be present visual kerogen descriptions imply the presence of cuticles in some abundance and tasmanitids in the uppermost (most hydrogen rich) samples. Apart from the obviously inertinitic (type IV) rich samples the zone has a good potential as a source rock. The hydrogen indices may be "diluted" by the terrestrial input and coal/lignite (additive?) found around this depth. It is therefore possible that the top section appears of poorer quality than it may really be. Visual assessment indicate the top of this zone to be the most promising section for a source rock.

Zone G; 3790-4000m: The zone contains a major input of quartz (sandstone) together with coal/lignite and dark grey claystone as found above. The dark grey claystones have rich organic contents (2.18-3.45% TOC). The zone probably enters the oil window maturity but is only at the top end (T_{max} = 437, Ro = 0.65-0.70% and TAI = 2-/2,2). Rock-Eval pyrolysis indicates type III kerogens which would agree with data from other analyses. On the basis of the data the zone has a fair potential as a source rock for gas.

Zone H; 4000-4042m: This zone contains red-brown claystone possibly indicating some oxidation. One sample was analysed and has a fair TOC (0.75%). No further analyses were performed.

General

The sequence analysed has a range of maturity from very immature to just within the oil window. Because of the generally low maturity the validity of low rank coal/lignite is difficult to assess and needs recourse to logs to determine the probability of this being in situ.

No outstanding source rock presents itself but combined factors point to the top of zone F being the most favourable.

Certain samples (A-3956, A-3957 and A-4038) appear problematical from the pyrolysis data and contain unidentified compounds. Often very immature samples have complex composition and this may be the explanation of a number of unidentified peaks. However, why only certain samples should be so affected is not clear.

Samples A-3956 and A-3957 both contain the unusual compound squalane in some abundance as indicated in the section on extraction. The possible origin of squalane is briefly mentioned in the extraction section and its occurrence in large amounts when associated with complex pyrograms with distributions not previously observed, together with strong indications of anaerobic conditions (high phytane content, amorphous (sapropelised) kerogen and high pyrite content) is interesting but no firm conclusion can be drawn at present on the significance of these associations.

IKU

TABLE I a.

CONCENTRATION (nl 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	WETNESS (%)	iC4 / nC4
A 3943	260	96						96		0.00	
A 3944	290	1712						1712		0.00	
A 3945	320	864						864		0.00	
A 3946	350	131						131		0.00	
A 3947	380	8444						8444		0.00	
A 3948	410	1780						1780		0.00	
A 3949	440	9248						9248		0.00	
A 3950	470	56						56		0.00	
A 3951	500	232						232		0.00	
A 3952	530	420						420		0.00	
A 3953	560	29454	15					29469	15	0.05	
A 3954	590	1511						1511		0.00	
A 3956	650	79528						79528		0.00	
A 3957	680	88491						88491		0.00	
A 3958	710	26525						26525		0.00	
A 3960	770	99328	82					99411	82	0.08	
A 3962	830	57						57		0.00	
A 3964	890	297						297		0.00	
A 3966	950	83						83		0.00	
A 3968	1010	766						766		0.00	
A 3970	1070	36						36		0.00	
A 3972	1130	1401						1401		0.00	
A 3974	1190	29						29		0.00	

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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 3976	1250	72						72		0.00	
A 3980	1370	398						398		0.00	
A 3983	1460	15						15		0.00	
A 3985	1520	59						59		0.00	
A 3987	1580	281						281		0.00	
A 3989	1640	163						163		0.00	
A 3991	1700	237						237		0.00	
A 3993	1760	131						131		0.00	
A 3995	1820	898	5	2				905	7	0.78	
A 3997	1880	55						55		0.00	
A 4000	1970	160						160		0.00	
A 4002	2030	117	8	17			250	142	25	17.72	
A 4004	2090	68						68		0.00	
A 4005	2120	177	9	12	19	26	62	242	65	27.04	0.73
A 4006	2150	463	22	22	26	29	82	561	99	17.58	0.93
A 4008	2210	153						153		0.00	
A 4009	2240	1882	170	235	147	171	101	2606	724	27.77	0.86
A 4011	2300	1919	190	264	110	129	165	2611	692	26.51	0.86
A 4012	2330	1503	92	104		66		1766	262	14.84	0.00
A 4014	2390	1915	162	255	124	164		2619	704	26.89	0.75
A 4016	2450	1045	167	345	181	264	301	2002	957	47.79	0.69
A 4017	2480	261	65	189	129	180	223	824	563	68.29	0.72
A 4018	2510	97	7	22		32	73	157	60	38.35	0.00

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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 4019	2540	89						89		0.00	
A 4020	2570	514	110	347	239	328	425	1537	1024	66.57	0.73
A 4022	2630	86	9	39	40	47		222	135	61.04	0.85
A 4024	2690	106		19				125	19	15.06	
A 4026	2750	22						22		0.00	
A 4028	2810	3435	868	1730	917	834	774	7784	4349	55.87	1.10
A 4029	2870	502	41	118				660	159	24.05	
A 4030	2870	7210	3894	6145	2055	1480	357	20785	13575	65.31	1.39
A 4031	2900	21		7				28	7	24.19	
A 4032	2930	3107	8155	1475	486	432	198	13654	10547	77.25	1.12
A 4033	2960	21		7				28	7	24.19	
A 4034	2990	1675	670	1092	298	408	327	4143	2469	59.58	0.73
A 4036	3050	828	1008	1715	381	844	905	4776	3948	82.66	0.45
A 4038	3110	6971	4348	4507	646	1577	961	18049	11078	61.38	0.41
A 4039	3140	1699	1030	862	134	291	243	4016	2317	57.70	0.46
A 4040	3490	2051	912	802	87	313	233	4164	2114	50.76	0.28
A 4041	3520	8292	2325	1334	183	416	434	12550	4258	33.93	0.44
A 4043	3580	26	2					27	2	6.08	
A 4044	3610	3477	647	388	52	145	270	4709	1232	26.17	0.36
A 4045	3640	919	243	204	26	96	240	1489	570	38.28	0.27
A 4046	3670	2369	698	603	73	238	631	3981	1611	40.48	0.31
A 4048	3730	6252	1450	1145	140	576	2366	9563	3311	34.62	0.24
A 4049	3760	941	248	196	25	75	178	1486	544	36.62	0.34

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IKU

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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 4050	3790	686	217	191	23	69	161	1186	500	42.17	0.33
A 4051	3820	23605	3795	2113	226	607	673	30345	6740	22.21	0.37
A 4052	3850	20504	2269	1038	98	270	272	24179	3675	15.20	0.36
A 4053	3880	1887	339	221	30	69	119	2546	659	25.90	0.44
A 4054	3910	4079	1023	671	102	2172	236	8047	3968	49.31	0.05
A 4055	3940	2208	487	252	31	68	81	3046	838	27.51	0.46
A 4056	3970	4205	631	306	45	93	111	5279	1075	20.35	0.48
A 4057	4000	3322	450	269	32	80	120	4153	831	20.01	0.40
A 4058	4030	846	289	191	20	56	89	1402	557	39.69	0.36
A 4059	4042	321	110	95	13	27	57	566	245	43.31	0.49

DATE : 11 - 5 - 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 3943	260	5	163					168	163	97.12	
A 3944	290	6	128					134	128	95.27	
A 3945	320	258						258		0.00	
A 3946	350	31	8	5				45	14	30.67	
A 3947	380	511						511		0.00	
A 3948	410	487						487		0.00	
A 3949	440	328						328		0.00	
A 3950	470	298						298		0.00	
A 3951	500	427						427		0.00	
A 3952	530	471						471		0.00	
A 3953	560	561						561		0.00	
A 3954	590	533						533		0.00	
A 3956	650	487						487		0.00	
A 3957	680	431						431		0.00	
A 3958	710	75						75		0.00	
A 3960	770										
A 3962	830	743						743		0.00	
A 3964	890	701						701		0.00	
A 3966	950	193						193		0.00	
A 3968	1010	183						183		0.00	
A 3970	1070										
A 3972	1130	87						87		0.00	
A 3974	1190	38						38		0.00	

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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 3976	1250	36						36		0.00	
A 3980	1370	27						27		0.00	
A 3983	1460	35						35		0.00	
A 3985	1520	25						25		0.00	
A 3987	1580	12						12		0.00	
A 3989	1640	70						70		0.00	
A 3991	1700	61						61		0.00	
A 3993	1760	46						46		0.00	
A 3995	1820	29						29		0.00	
A 3997	1880	52						52		0.00	
A 4000	1970	36	6	7	13			62	26	42.24	
A 4002	2030	107	5	9	12	16	141	149	42	28.21	0.79
A 4004	2090	4						4		0.00	
A 4005	2120	91		6	19	36	903	152	61	40.04	0.52
A 4006	2150	57						57		0.00	
A 4008	2210	90		8	11	20	205	129	39	30.29	0.57
A 4009	2240	127		22	40	65	357	254	128	50.17	0.61
A 4011	2300	123		29	23	48	147	223	100	44.74	0.49
A 4012	2330	210	20	39	45	81	186	395	185	46.91	0.55
A 4014	2390	40			372			412	372	90.27	
A 4016	2450	63		21	23	52	79	159	96	60.31	0.44
A 4017	2480	104	9	68	95	208	1124	485	380	78.44	0.46
A 4018	2510	94	52	35	77	43	102	301	208	68.88	1.81

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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 4019	2540	136	167		108	247	494	658	522	79.39	0.44
A 4020	2570	133		95	109	260	351	598	464	77.69	0.42
A 4022	2630	107	14	67	80	186	866	454	347	76.40	0.43
A 4024	2690	285	40	225	308	725	1418	1582	1297	81.99	0.43
A 4026	2750	205	70	345	338	701		1659	1454	87.65	0.48
A 4028	2810										
A 4029	2870	196	56	282	228	358	1313	1119	924	82.52	0.64
A 4030	2870	106	89	477	230	287	196	1188	1082	91.09	0.80
A 4031	2900	238	108	266	115	167	307	894	657	73.42	0.69
A 4032	2930	210	85	349	184	258	176	1085	875	80.66	0.71
A 4033	2960	140	9	247	165	320	584	880	740	84.06	0.51
A 4034	2990	110		13				123	13	10.34	
A 4036	3050	122	47	40	7	21		237	115	48.36	0.36
A 4038	3110	746	1502	3499	881	2815	3424	9443	8697	92.10	0.31
A 4039	3140	1886	4080	7454	1988	5243	6804	20651	18765	90.87	0.38
A 4040	3490	1829	3736	5100	952	2640	4131	14257	12428	87.17	0.36
A 4041	3520	7	165	14		11	19	197	190	96.56	0.00
A 4043	3580	6356	3134	3676	728	2759	6803	16653	10297	61.83	0.26
A 4044	3610	6785	1467	1484	352	1331	1752	11418	4634	40.58	0.26
A 4045	3640	9932	2134	1346	305	1112	3403	14830	4897	33.02	0.27
A 4046	3670	10561	1929	1075	217	781	2683	14563	4002	27.48	0.28
A 4048	3730	17127	2414	844	198	602	2465	21184	4057	19.15	0.33
A 4049	3760	11210	1501	520	120	426	1672	13777	2567	18.64	0.28

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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 4050	3790	4730	4133	3386	582	2055	2966	14885	10155	68.22	0.28
A 4051	3820	5678	6768	6349	1072	3845	5089	23712	18035	76.06	0.28
A 4052	3850	7321	1336	1381	314	1279	3372	11631	4310	37.06	0.25
A 4053	3880	26898	430	4158	864	3052	2742	35402	8504	24.02	0.28
A 4054	3910	7531	1491	2273	488	1880	3168	13663	6131	44.88	0.26
A 4055	3940	4524	2649	2920	590	2243	4394	12926	8402	65.00	0.26
A 4056	3970	192	293	401	89	327	702	1302	1110	85.28	0.27
A 4057	4000	2207	1709	2232	503	2043	4860	8694	6487	74.61	0.25
A 4058	4030	197	147	294	60	238	522	935	739	78.97	0.25
A 4059	4042	900	345	873	193	852	2422	3162	2263	71.55	0.23

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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 3943	260	101	163					264	163	61.82	
A 3944	290	1718	128					1846	128	6.91	
A 3945	320	1122						1122		0.00	
A 3946	350	162	8	5				175	14	7.81	
A 3947	380	8955						8955		0.00	
A 3948	410	2267						2267		0.00	
A 3949	440	9576						9576		0.00	
A 3950	470	354						354		0.00	
A 3951	500	659						659		0.00	
A 3952	530	891						891		0.00	
A 3953	560	30015	15					30030	15	0.05	
A 3954	590	2044						2044		0.00	
A 3956	650	80015						80015		0.00	
A 3957	680	88922						88922		0.00	
A 3958	710	26600						26600		0.00	
A 3960	770	99328	82					99411	82	0.08	
A 3962	830	800						800		0.00	
A 3964	890	998						998		0.00	
A 3966	950	275						275		0.00	
A 3968	1010	950						950		0.00	
A 3970	1070	36						36		0.00	
A 3972	1130	1488						1488		0.00	
A 3974	1190	67						67		0.00	

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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 3976	1250	107						107		0.00	
A 3980	1370	425						425		0.00	
A 3983	1460	49						49		0.00	
A 3985	1520	83						83		0.00	
A 3987	1580	293						293		0.00	
A 3989	1640	233						233		0.00	
A 3991	1700	297						297		0.00	
A 3993	1760	177						177		0.00	
A 3995	1820	927	5	2				934	7	0.76	
A 3997	1880	108						108		0.00	
A 4000	1970	196	6	7	13			222	26	11.79	
A 4002	2030	224	13	26	12	16	391	291	67	23.10	0.79
A 4004	2090	72						72		0.00	
A 4005	2120	268	9	18	38	62	965	394	126	32.06	0.61
A 4006	2150	520	22	22	26	29	82	618	99	15.96	0.93
A 4008	2210	243		8	11	20	205	282	39	13.85	0.57
A 4009	2240	2009	170	257	187	237	459	2860	851	29.76	0.79
A 4011	2300	2042	190	293	134	176	312	2834	792	27.95	0.76
A 4012	2330	1713	112	143	45	148	186	2161	447	20.71	0.30
A 4014	2390	1955	162	255	495	164		3030	1076	35.50	3.02
A 4016	2450	1108	167	366	204	315	380	2160	1052	48.71	0.65
A 4017	2480	366	74	257	224	307	1347	1309	943	72.05	0.58
A 4018	2510	191	59	57	77	74	174	459	268	58.40	1.04

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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 4019	2540	225	167		108	247	494	747	522	69.93	0.44
A 4020	2570	647	110	442	348	588	775	2135	1488	69.69	0.59
A 4022	2630	194	23	106	120	233	866	676	483	71.36	0.52
A 4024	2690	391	40	243	308	725	1418	1707	1316	77.08	0.43
A 4026	2750	227	70	345	338	701		1681	1454	86.52	0.48
A 4028	2810	3435	868	1730	917	834	774	7784	4349	55.87	1.10
A 4029	2870	697	97	400	228	358	1313	1780	1082	60.82	0.64
A 4030	2870	7316	3983	6622	2285	1767	552	21973	14657	66.70	1.29
A 4031	2900	259	108	273	115	167	307	922	663	71.95	0.69
A 4032	2930	3317	8239	1825	670	689	374	14740	11423	77.50	0.97
A 4033	2960	161	9	253	165	320	584	908	746	82.25	0.51
A 4034	2990	1785	670	1105	298	408	327	4266	2481	58.16	0.73
A 4036	3050	951	1055	1755	388	864	905	5013	4062	81.03	0.45
A 4038	3110	7717	5850	8006	1527	4392	4385	27492	19775	71.93	0.35
A 4039	3140	3585	5110	8317	2122	5534	7047	24668	21083	85.47	0.38
A 4040	3490	3880	4648	5901	1040	2952	4364	18421	14542	78.94	0.35
A 4041	3520	8299	2490	1349	183	426	453	12747	4448	34.89	0.43
A 4043	3580	6382	3135	3676	728	2759	6803	16680	10299	61.74	0.26
A 4044	3610	10262	2114	1872	403	1476	2022	16128	5866	36.37	0.27
A 4045	3640	10851	2378	1550	331	1208	3644	16319	5467	33.50	0.27
A 4046	3670	12930	2627	1678	290	1019	3314	18544	5614	30.27	0.28
A 4048	3730	23379	3864	1989	337	1178	4831	30747	7368	23.96	0.29
A 4049	3760	12151	1750	716	145	500	1850	15263	3112	20.39	0.29

DATE : 11 - 5 - 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 4050	3790	5416	4350	3577	605	2124	3127	16071	10655	66.30	0.28
A 4051	3820	29283	10563	8462	1298	4452	5762	54057	24775	45.83	0.29
A 4052	3850	27825	3605	2419	413	1549	3645	35810	7985	22.30	0.27
A 4053	3880	28784	769	4380	894	3121	2861	37948	9164	24.15	0.29
A 4054	3910	11611	2514	2944	590	4052	3403	21710	10099	46.52	0.15
A 4055	3940	6732	3136	3172	621	2311	4476	15972	9240	57.85	0.27
A 4056	3970	4396	925	707	133	419	814	6581	2185	33.20	0.32
A 4057	4000	5529	2160	2501	535	2122	4980	12847	7318	56.96	0.25
A 4058	4030	1042	437	484	80	294	611	2338	1295	55.40	0.27
A 4059	4042	1221	455	968	206	879	2479	3729	2508	67.26	0.23

DATE : 11 - 5 - 83.

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC	Lithology	
A-3943	230-260		78%	Quartz
			10%	Chert, yellowish white, dark reddish brown, black
			10%	Limestone, white, occasionally with chert
			2%	Rock fragments
			Trace	Fossils; Glauconite; Muscovite, Pyrite, Biotite
A-3944	260-290		90%	Quartz
			3%	Limestone, white with chert
			3%	Chert, as above
			3%	Rock fragments
			1%	Fossils
			Trace	Glauconite; Cement
A-3945	290-320		90%	Quartz
			3%	Chert, white, yellowish, brown, black
			2%	Limestone, white, fossiliferous, glauconitic, occasionally with chert
			2%	Fossils
			3%	Rock fragments
			Trace	Glauconite; Pyrite
A-3946	320-350		50%	Quartz
			21%	Chert, brown, grey, black
			20%	Fossils
			5%	Limestone, pure white
			4%	Rock fragments
			Trace	Glauconite; Muscovite

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC	Lithology	
A-3947	350-380		55%	Quartz
			30%	Fossils
			4%	Limestone, white, pure
			3%	Chert, brown
			8%	Rock fragments
			Trace	Pyrite
A-3948	380-410		50%	Quartz
			40%	Rock fragments
			10%	Fossils
			Trace	Glauconite; Pyrite; Limestone, grey, white
A-3949	410-440		50%	Quartz
			10%	Fossils
			40%	Rock fragments
			Trace	Limestone, as above; Muscovite
A-3950	440-470		40%	Fossils
			30%	Quartz
			30%	Rock fragments
			Trace	Claystone, calcareous, grey
A-3951	470-500		90%	Rock fragments
			8%	Fossils
			2%	Quartz
			Trace	Pyrite; Claystone, grey, calcareous
A-3952	500-530		95%	Rock fragments
			3%	Fossils
			2%	Quartz
			Trace	Limestone, banded dark grey and yellowish white

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-3953	530-560		95%	Rock fragments
			3%	Fossils
			2%	Quartz
			Trace	Limestone, white, grey
A-3954	560-590		75%	Rock fragments
			20%	Quartz
			3%	Fossils
			2%	Claystone, light grey, olive grey, silty
A-3955	590-620		95%	Cement
			4%	Rock fragments
			1%	Claystone, sandy, micaceous, calcareous
			Trace	Fossils; Biotite
A-3956	620-650	1.65	40%	Claystone, silty, sandy, micaceous, calcareous, grey to olive grey
			40%	Rock fragments
			8%	Quartz
			2%	Fossils
			Trace	Glauconite; Limestone, grey; Muscovite; Pyrite; Cement
A-3957	650-680		60%	Quartz
		2.75	15%	Claystone, light olive grey, silty, calcareous
			5%	Fossils
			20%	Rock fragments
			Trace	Chert, dark grey, black; Muscovite; Biotite; Pyrite; Cement, small amounts

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-3958	680-710		60%	Quartz
			25%	Rock fragments
			10%	Fossils
			5%	Cement
			Trace	Chert, as above; Claystone, as above
A-3960	740-770		75%	Quartz
			20%	Rock fragments
			5%	Fossils
			Trace	Claystone, as above; Pyrite; Cement
A-3962	800-830		70%	Quartz
			10%	Coal, dark brown, black
		2.33	10%	Claystone, olive-grey, silty
			5%	Fossils
			5%	Cement
			Trace	Muscovite; Rock fragments
A-3964	860-890		95%	Quartz
			5%	Fossils
			Sm.am.	Claystone/Siltstone, yellowish white, calcareous; Pyrite; Glauconite; Muscovite
A-3966	920-950		50%	Quartz
		1.55	5%	Claystone/Siltstone, olive-brown, glauconitic
			45%	Glauconite?
			Sm.am.	Fossils; Muscovite

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-3968	980-1010		60%	Quartz
		1.25	20%	Claystone, olive-grey, silty, micaceous with glauconite
			20%	Glauconite
			Trace	Pyrite; Fossils; Muscovite
			Sm.am.	Cement
A-3970	1040-1070	2.48	98%	Claystone, olive-grey, micaceous, occasionally glauconitic, sponge spicules
			2%	Glauconite
			Sm.am.	Quartz
			Trace	Coal
A-3972	1100-1130	1.81	100%	Claystone, olive-grey, glauconitic, micaceous, fossiliferous (sponge spicules)
			Trace	Glauconite; Quartz
A-3974	1160-1190	1.45	100%	Claystone, light olive-grey to olive grey, micaceous, partly fissile, occasional sponge spicules, occasionally silty with glauconite
			Trace	Quartz; Pyrite; Muscovite
A-3976	1220-1250	1.74	75%	Claystone, light yellowish grey, silty, micaceous, calcareous
		1.47	15%	Shale, brown-olive grey, silty
			10%	Quartz
			Trace	Glauconite; Muscovite

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-3980	1340-1370	0.83	95%	Claystone, greenish grey, brownish grey, fissile, micaceous
			2%	Claystone, yellowish white, silty, micaceous
			3%	Quartz
			Trace	Glauconite; Muscovite; Pyrite
A-3983	1430-1460	0.81	85%	Claystone, brownish grey, greenish grey, micaceous, fissile
			7%	Claystone, yellowish white, silty, with glauconite, micaceous
			8%	Quartz
			Trace	Rock fragments; Muscovite; Cement
A-3985	1490-1520	0.44	15%	Claystone, fissile, greenish grey, brownish grey
			85%	Quartz
			Trace	Claystone, yellowish white, silty, micaceous; Muscovite; Biotite; Limestone, black; Pyrite
A-3987	1550-1580	0.48	99%	Claystone, fissile, greenish grey, fossiliferous
			1%	Quartz, rounded
			Trace	Quartz, angular, pyrite cemented; Claystone, white, yellow, calcareous
A-3989	1610-1640	0.47	100%	Claystone, fissile, greenish grey, fossiliferous
			Trace	Fossils; Claystone; white, occasionally yellowish, calcareous; Pyrite; Quartz

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC	Lithology
A-3991	1670-1700	0.45	100% Claystone, as above Trace Claystone, yellow, white, calcareous Quartz; Pyrite
A-3993	1730-1760	0.54	100% Claystone, fissile, greenish grey, brownish grey Trace Claystone, white, silty, micaceous, calcareous; Quartz
A-3995	1790-1820	0.48	100% Claystone, red-brown, greenish grey, fissile Trace Claystone, yellowish white, silty, calcareous; Cement
A-3997	1850-1880	0.67	100% Claystone, red-brown, greenish-grey, fissile; occasionally: pyritic, calcareous, silty Coal observed Sm.am. Quartz; Muscovite; Biotite; Glauconite; Claystone, olive-grey, micaceous, contains sponge spicules, non-fissile; Cement
A-4000	1940-1970	0.62	100% Claystone, greenish-grey, fissile, occasionally silty and micaceous Trace Chert, grey to olive-brown Sm.am. Cement
A-4002	2000-2030	0.54	100% Claystone, greenish-grey to pale red-brown, fissile. Occasionally glauconitic and/or micaceous. Occasionally silty. Sm.am. Claystone, olive grey, non-fissile, micaceous; Quartz; Muscovite; Cement

080/C/jbl/7

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC	Lithology	
A-4004	2060-2090	0.60	100%	Claystone, as above
			Sm.am.	Limestone, white, fine grained; Fossils, columnar growth of calcite crystals
			Trace	Muscovite; Quartz; Pyrite; Glauconite; Claystone, non-fissile, olive-grey, micaceous
			Sm.am.	Cement
A-4005	2090-2120	0.49	100%	Claystone, olive-grey to pale red-brown. Occasionally very calcareous. Occasionally glauconitic, micaceous
			Sm.am.	Calcite; Muscovite; Glauconite; Quartz
			Trace	Cement
A-4006	2120-2150	0.47	100%	Claystone, greenish-grey, fissile, occasionally with coal, occasionally micaceous. Sm.am. of Siltstone.
			Sm.am.	Muscovite; Pyrite; Fossils, as above Cement
A-4008	2180-2210	0.48	99%	Claystone, greenish grey, poor fissility, partly micaceous, occasionally silty, some grains are pyritic
			1%	Limestone, white, yellow, occasionally fossiliferous
			Sm.am.	Cement; Quartz; Muscovite; Pyrite

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-4009	2210-2240	0.53	97%	Claystone, as above
			3%	Claystone, olive-grey, silty, glauconitic, occasionally pyritic
			Sm.am.	Calcite; Muscovite; Pyrite
A-4011	2270-2300	0.51	100%	Claystone, as above, occasionally with coal
			Sm.am.	Limestone, as above; Cement
			Trace	Quartz; Muscovite; Pyrite; Glauconite
A-4012	2300-2330	0.51	100%	Claystone, greenish grey, some red-brown grains with glauconite; occasionally with coal; micaceous, poor fissility, occasionally pyritic
			Sm.am.	Cement; Muscovite; Limestone, white; Fossils, columnar calcite crystals
			Trace	Quartz; Chert; Pyrite, Glauconite; Siderite?
A-4014	2360-2390	0.64	100%	Claystone, as above
			Sm.am.	Limestone, as above; Fossils, as above; Muscovite; Quartz; Cement
A-4016	2420-2450	0.72	95%	Claystone, as above
			5%	Siderite, brown, microcrystalline
			Sm.am.	Limestone and Fossils, as above; Pyrite; Muscovite; Cement

081/j/ah/1

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-4017	2450-2480	0.63	98%	Claystone, olive-grey; occasionally silty; occasionally glauconitic, occasionally pyritic
			2%	Siderite, olive-brown
			Sm.am.	Calcite; Pyrite; Fossils
			Trace	Cement
A-4018	2480-2510	0.73	95%	Claystone, pale greenish grey to greenish grey, occasionally pyritic, occasionally with coal
			5%	Cement
			Sm.am.	Siderite; Muscovite; Pyrite; Chert
A-4019	2510-2540	0.51	100%	Claystone, as above, traces of coal
			Sm.am.	Siderite; Calcite; Pyrite; Glauconite
			Trace	Cement
A-4020	2540-2570	0.68	99%	Claystone/silty Claystone, greenish grey, occasionally glauconitic, occasionally with coal, poor fissility
			1%	Claystone, olive brown, no fissility
			Sm.am.	Cement; Pyrite; Muscovite; Calcite
A-4022	2600-2630	0.73	97%	Claystone/silty Claystone, as above
			3%	Siltstone, grey, calcite-cemented, contains coal, occasionally pyritic, micaceous, glauconitic
A-4024	2660-2690	0.66	90%	Claystone, as above, occasionally red-brown
		0.33	10%	Siltstone, as above
			Sm.am.	Pyrite; Muscovite; Biotite; Calcite

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-4025	2690-2720	0.69	98%	Claystone/Siltstone, Claystone, as above, reacts weakly with HCl, Siltstone, grey, glauconitic, occasionally with coal, occasionally calcareous
			2%	Siderite, microcrystalline, euhedral crystals observed
			Trace	Claystone, white to light-grey, fossiliferous, calcareous
			Sm.am.	Pyrite; Muscovite; Cement; Steel fragments
A-4026	2720-2750	0.95	85%	Claystone, as above
		0.75	15%	Siltstone, as above
			Sm.am.	Cement; Siderite; Dolomite; Limestone; Muscovite; Biotite; Pyrite
			Trace	Glauconite
A-4028	2780-2810	0.93	100%	Claystone/Siltstone, as above
			Sm.am.	Calcite; Pyrite
			Trace	Chert; Fossils
A-4029	2810-2840	0.72	100%	Claystone/Siltstone, as above
			Sm.am.	Calcite, brown and white; Fossils, columnar calcite; Pyrite; Limestone, white; Steel fragments
			Trace	Quartz
A-4030	2840-2870	0.84	100%	Claystone, grey, olive-grey, occasionally silty with glauconite, calcareous, occasionally pyritic
			Sm.am.	Limestone, white; Fossils; Muscovite

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-4031	2870-2900	1.11	100%	Claystone with sm.am. of siltstone, olive grey to light grey, poor fissility. Occasionally with framboidal pyrite, weakly calcareous
			Sm.am.	Claystone, light olive-brown, glauconitic, non-fissile, calcareous; Calcite (fossil fragments); Steel and grease
A-4032	2900-2930	1.12	100%	Claystone, as above
			Sm.am.	Limestone; Muscovite
			Trace	Fossils
A-4033	2930-2960	0.90	60%	Claystone, grey - olive grey, poor fissility, calcareous
			40%	Cement
			Sm.am.	Coal; Calcite; Quartz; Steel fragments; Grease
A-4034	2960-2990	0.72	60%	Claystone, light to dark olive grey, red-brown, calcareous, occasionally glauconitic and/or micaceous
			35%	Cement
			5%	Coal
			Trace	Fossils; Pyrite; Steel fragments and grease

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-4035	2990-3020	0.65	92%	Claystone, greenish grey and red-brown, fissile, calcareous
			5%	Coal
			3%	Shale, dark grey/black, fissile, calcareous
			Sm.am.	Limestone, white; Calcite (fossil fragments?); Steel; Grease
			Trace	Muscovite
A-4036	3020-3050	2.63	90%	Shale/Claystone, black to dark olive grey, red-brown
			5%	Coal
			5%	Cement
			Sm.am.	Pyrite; Steel fragments and Grease
A-4038	3080-3110	37.84	80%	Claystone (shale), black, carbonaceous, poor fissility
			10%	Coal
		4.70	5%	Claystone, grey, olive grey, fissile, occasionally micaceous and silty, calcareous, also non-fissile, light olive grey glauconitic
			5%	Cement
A-4039	3110-3140	3.95	30%	Shale, as above, occasionally glauconitic
			60%	Coal
		0.55	8%	Claystone, as above
			2%	Cement
			Sm.am.	Grease; Steel

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-4040	3460-3490	7.96	25%	Claystone, dark grey, black, carbonaceous, fissile to subfissile
		0.77	50%	Claystone, olive grey to dark olive grey, micaceous, carbonaceous?, calcareous, occasionally pyritic, occasionally silty
			25%	Coal
			Sm.am.	Claystone/Siltstone, red-brown, very calcareous; Quartz; Pyrite; Siderite; Calcite
A-4041	3490-3520	3.00	90%	Claystone, light grey, dark grey, red-brown, grey varieties are weakly calcareous, carbonaceous, fissile, red variety is very calcareous; shows poor fissility
			6%	Coal
			3%	Cement
			1%	Limestone, white, olive brown, clayey
			Sm.am.	Pyrite; Quartz; Muscovite
A-4043	3550-3580	2.32	45%	Claystone, olive grey to dark olive grey as above
			5%	Claystone, black, dark grey, as above
			50%	Calcite-cemented Quartz (coarse Siltstone/Sandstone)
			Sm.am.	Claystone/Siltstone, as above; Cement; Pyrite

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-4044	3580-3610	1.19	85%	Claystone, grey (turbodrilled)
			8%	Quartz
			2%	Coal
		1.75	5%	Claystone, dark grey, black, as above
			Sm.am.	Claystone/Siltstone; olive brown, red-brown, calcareous, non-fissile
A-4045	3610-3640		95%	Claystone (turbodrilled)
			5%	Coal/Lignite?
			Sm.am.	Claystone, dark grey, black, as above; Claystone/Siltstone, as above
			Trace	Quartz
A-4046	3640-3670		95%	Claystone (turbodrilled)
			2%	Coal/Lignite?
			3%	Claystone, as above
			Sm.am.	Claystone/Siltstone, as above; Quartz; Calcite-cemented, coarse Siltstone/Sandstone
			Trace	Cement
A-4048	3700-3730		96%	Claystone, turbodrilled
			3%	Coal/Lignite
			1%	Claystone, dark grey, black, fissile, carboniferous
			Trace	Cement; Steel
			Sm.am.	Grease
A-4049	3730-3760		98%	Claystone, turbodrilled
			2%	Coal/Lignite
			Sm.am.	Claystone, olive brown, red-brown
			Trace	Cement; Steel

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC	Lithology	
A-4050	3760-3790	0.87	90%	Claystone, turbodrilled
			3%	Claystone, olive grey, dark grey, fissile, micaceous
			7%	Coal/Lignite
			Sm.am.	Claystone, red-brown, calcareous; Siltstone, olive brown, micaceous, calcareous, sideritic?
			Trace	Fossils; Cement; Steel
A-4051	3790-3820		50%	Quartz, occasionally Calcite-cemented
		2.18	30%	Claystone, dark grey, micaceous, carboniferous?, fissile
			20%	Coal/Lignite?
			Sm.am.	Claystone, turbodrilled
A-4052	3820-3850		60%	Quartz, as above
		3.45	15%	Claystone, as above
			25%	Coal/Lignite?
			Sm.am.	Claystone/Siltstone, red-brown, very calcareous
			Sm.am.	Calcite, brown; Sideritic?
			Trade	Cement
A-4053	3850-3880		85%	Quartz
			10%	Coal/Lignite
			3%	Claystone, dark grey, as above
			2%	Claystone, turbodrilled
			Sm.am.	Cement

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-4054	3880-3910		80%	Quartz
			15%	Coal/Lignite
			2%	Claystone, as above
			3%	Claystone, turbodrilled
			Sm.am.	Cement
A-4055	3910-3940		80%	Quartz
		2.71	5%	Claystone, as above
			10%	Claystone, turbodrilled
			5%	Coal/Lignite
			Trace	Pyrite
			Sm.am.	Siltstone, light grey
A-4056	3940-3970		70%	Quartz
		2.73	25%	Claystone, dark grey, fissile, as above
			5%	Coal/Lignite?
			Sm.am.	Claystone, red-brown, occasionally turbodrilled fragments
			Trace	Cement
A-4057	3970-4000		70%	Quartz
			15%	Claystone, light grey, occasionally red-brown, turbodrilled
			15%	Coal/Lignite?
		2.26	10%	Claystone, dark grey, as above
			Sm.am.	Cement
A-4058	4000-4030	0.75	90%	Claystone, red-brown, light grey (cement?), dark grey, (turbodrilled)
			3%	Claystone, dark grey, as above
			5%	Coal/Lignite
			2%	Quartz
			Sm.am.	Cement
			Trace	Glauconitic Sandstone

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 2
WELL NO.: 34/10-16

Sample	Depth (m)	TOC		Lithology
A-4059	4030-4042		62%	Claystone, red-brown, grey/dark grey, light grey (cement?), turbodrilled, Siltstone, pale green, non-calcareous
			5%	Claystone, dark grey, as above
			30%	Quartz
			3%	Coal/Lignite
			Trace	Sandstone/Siltstone, Glauconite

081/j/ah/10

T A B L E : 3.

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKU-No	DEPTH (m)	Rock Extr. (g)	EOM (mg)	Sat. (mg)	Aro. (mg)	HC (mg)	Non HC (mg)	TOC (%)
A 3956	650	12.9	8.2	2.5	1.3	3.8	4.4	1.65
A 3970	1070	2.6	2.9	0.2	0.3	0.5	2.4	2.48
A 4031	2900	22.9	11.0	3.0	1.8	4.8	6.2	1.11
A 4036	3050	23.9	28.0	4.0	3.3	7.3	20.7	2.63
A 4038	3110	8.5	80.1	6.6	2.5	9.1	71.0	37.84
A 4039	3140	14.1	21.0	2.5	2.5	5.0	16.0	3.95
A 4041	3520	25.3	34.5	6.0	7.7	13.7	20.8	3.00
A 4043	3580	25.2	24.1	5.0	4.8	9.8	14.3	2.32
A 4051	3820	17.2	19.1	1.6	3.3	4.9	14.2	2.18
A 4052	3850	25.0	35.3	3.2	7.8	11.0	24.3	3.45
A 4057	4000	9.1	16.5	2.2	6.5	8.7	7.8	2.26

DATE : 14 - 6 - 83.

IKU

T A B L E : 4.

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm OF rock)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
A 3956	650	636	194	101	295	341
A 3970	1070	1098	76	114	189	909
A 4031	2900	480	131	78	209	270
A 4036	3050	1172	167	138	305	866
A 4038	3110	9435	777	294	1072	8363
A 4039	3140	1490	177	177	355	1136
A 4041	3520	1365	237	305	542	823
A 4043	3580	957	199	191	389	568
A 4051	3820	994	83	172	255	739
A 4052	3850	1410	128	312	439	971
A 4057	4000	1811	241	714	955	856

DATE : 14 - 6 - 83.

IKU

T A B L E : 3.

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
A 3956	650	38.5	11.7	6.1	17.9	20.7
A 3970	1070	44.3	3.1	4.6	7.6	36.7
A 4031	2900	43.2	11.3	7.1	18.9	24.4
A 4036	3050	44.5	6.4	5.3	11.6	32.9
A 4038	3110	24.9	2.1	0.8	2.8	22.1
A 4039	3140	37.7	4.5	4.5	9.0	28.7
A 4041	3520	45.5	7.9	10.2	18.1	27.4
A 4043	3580	41.3	8.6	8.2	16.8	24.5
A 4051	3820	45.6	3.8	7.9	11.7	33.9
A 4052	3850	40.9	3.7	9.0	12.7	28.1
A 4057	4000	80.1	10.7	31.6	42.3	37.9

DATE : 14 - 6 - 83.

T A B L E : 6.

COMPOSITION IN % OF MATERIAL EXTRACTED FROM THE ROCK.

IKU-No	DEPTH (m)	Sat / EOM	Aro / EOM	HC / EOM	SAT / Aro	Non HC / EOM	HC / Non HC
A 3956	650	30.5	15.9	46.3	192.0	53.7	86.4
A 3970	1070	6.9	10.3	17.2	66.7	82.8	20.0
A 4031	2900	27.3	16.4	43.6	166.7	56.4	77.4
A 4036	3050	14.3	11.6	26.1	121.2	73.9	35.3
A 4038	3110	8.2	3.1	11.4	264.0	88.6	12.8
A 4039	3140	11.9	11.9	23.8	100.0	76.2	31.3
A 4041	3520	17.4	22.3	39.7	77.9	60.3	65.9
A 4043	3580	20.7	19.9	40.7	104.2	59.3	68.5
A 4051	3820	8.4	17.3	25.7	48.5	74.3	34.5
A 4052	3850	9.1	22.1	31.2	41.0	68.8	45.3
A 4057	4000	13.3	39.4	52.7	33.8	47.3	111.5

DATE : 14 - 6 - 83.

IKU

T A B L E 7

TABULATION OF DATAS FROM THE GASCHROMATOGRAMS

IKU No.	DEPTH (m)	PRISTANE / n-C17	PRISTANE / PHYTANE	CPI
A 3956	650	0.8	1.2	1.2
A 3970	1070	0.9	1.6	1.6
A 4031	2900	0.8	1.9	1.0
A 4036	3050	1.6	2.1	1.1
A 4038	3110	1.1	2.3	3.0
A 4039	3140	1.6	2.4	1.9
A 4041	3520	1.4	2.0	1.1
A 4043	3580	0.9	2.1	1.5
A 4051	3820	0.9	3.3	1.3
A 4052	3850	1.1	3.1	1.1
A 4057	4000	0.9	3.1	1.3

DATE : 14 - 6 - 83.

IKU

TABLE 8.

ROCK EVAL PYROLYSES

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT S1+S2	PROD. INDEX S1/S1+S2	TEMP. MAX (C)
A 3956	650	0.43	0.66	0.90	1.65	40	55	1.09	0.39	422
		Clst								
A 3957	680	4.78	5.17	2.98	2.75	188	108	9.95	0.48	420
		Clst lt -olv - gy								
A 3962	830	6.68	4.62	1.40	2.33	198	60	11.30	0.59	371
		Clst lt -olv - gy								
A 3966	950	0.53	1.60	1.11	1.55	103	72	2.13	0.25	415
		Clst olv -brn								
A 3968	1010	0.53	1.39	0.98	1.25	111	78	1.92	0.28	417
		Clst olv - gy								
A 3970	1070	1.43	5.32	1.25	2.48	215	50	6.75	0.21	405
		Clst olv - gy								
A 3972	1130	0.77	2.92	1.09	1.81	161	60	3.69	0.21	410
		Clst olv - gy								
A 3974	1190	0.61	2.02	1.11	1.45	139	77	2.63	0.23	413
		Clst lt -olv - gy								
A 3976	1250	0.38	0.78	1.36	1.74	45	78	1.16	0.33	401
		Clst								
A 3980	1370	0.23	0.40	0.85	0.83	48	102	0.63	0.37	352
		Clst gn - gy								
A 3983	1460	0.60	1.86	1.16	0.81	230	143	2.46	0.24	411
		Clst brn - gy								
A 3993	1760	0.11	0.17	0.57	0.54	31	106	0.28	0.39	387
		Clst								
A 4016	2450	0.29	0.43	0.64	0.72	60	89	0.72	0.40	341
		Clst								
A 4026	2750	0.37	0.75	0.49	0.95	79	52	1.12	0.33	385
		Clst								
A 4028	2810	0.48	0.97	0.53	0.93	104	57	1.45	0.33	382
		Clst								
A 4031	2900	0.69	1.72	0.56	1.11	155	50	2.41	0.29	427
		Clst								
A 4033	2960	0.17	0.66	0.44	0.90	73	49	0.83	0.20	432
		Clst								
A 4036	3050	0.50	6.23	0.30	2.63	237	11	6.73	0.07	431
		Clst								
A 4038	3110	7.29	51.49	36.12	37.84	136	95	58.78	0.12	422
		Clst blk								
A 4039	3140	0.67	9.18	0.69	3.95	232	17	9.85	0.07	431
		Sh								
A 4040	3490	1.17	10.37	2.49	7.96	130	31	11.54	0.10	432
		Clst dk - gy								
A 4040	3490	0.15	0.14	0.58	0.77	18	75	0.29	0.52	431
		Clst olv - gy								
A 4041	3520	0.77	5.82	0.57	3.00	194	19	6.59	0.12	434
		Clst lt - gn								

IKU

TABLE 8.

ROCK EVAL PYROLYSES

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT S1+S2	PROD. INDEX S1/S1+S2	TEMP. MAX (C)
A 4043	3580	0.54	3.60	0.39	2.32	155	17	4.14	0.13	435
		Clst	olv - gn							
A 4044	3610	0.25	0.33	0.54	1.19	28	45	0.58	0.43	435
		Clst	gn							
A 4051	3820	0.41	2.80	0.43	2.18	128	20	3.21	0.13	436
		Clst	dk - gn							
A 4052	3850	0.73	4.41	0.64	3.45	128	19	5.14	0.14	433
		Clst	dk - gn							
A 4056	3970	0.50	2.98	0.44	2.73	109	16	3.48	0.14	437
		Clst	dk - gn							
A 4057	4000	0.45	2.29	0.46	2.26	101	20	2.74	0.16	437
		Clst	dk - gn							

DATE : 27 - 5 - 83.

IKU

Visual Kerogen Analysis

TABLE NO.: 9
WELL NO.: 34/10-16

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-3956	620-50	*(Am), Cy/W, Cut, WR!, P	F-M-L	good	1/1+	*Screened residue. Aggregates of combined inorganic/organic sources.
A-3957	650-680	*Am, WR!, W, Cut	F-M	N.D.P.	N.D.P.	*As above.
A-3970	1040-70	W, WR!/Am, Cy	F-M	good	1/1+	Strongly pyritic and sapropelised material embeds palynomorphs (cysts).
A-3972	1100-30	W, WR!, Am, Cut, P, Cy	F-M	good	1+	Larger aggregates. Pyritic sapropelised terrestrial material embedding palynomorphs.
A-3974	1160-90	W, WR!, Cut, P/Am, Cy	F-M-L	good	1/1+, 1+	Firm aggregates, pyritic and with a major input of woody/sapropelised woody material. Cysts embedded. Partly natural staining. Richer in pollen than the samples above.
A-3976	1220-50	W, Am, P, Cut, Cy	F-M	good	1+/2-	Larger aggregates, less dense, pyritic, as above. Radiolaria present.

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

083/o/ah/5

Visual Kerogen Analysis

TABLE NO.: 9
WELL NO.: 34/10-16

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-3980	1340-70	W, WR!, Cut, P/Am, Cy	F-M	good	2-	Fluffy clouds of material. A rich and varied cyst assemblage.
A-3983	1430-60	Am, W, Cy, P	F-M	good	1+/2-	Well preserved cysts.
A-3993	1730-60	Am, Cy/W, P	F-M	good	1/1+, 2-	Clouds of material. Cysts less abundant.
A-4016	2420-50	W, WR!, Am, P, Cy	F-M	fair to good	2-/2	Grey amorphous aggregates. Fewer palynomorphs more woody material (reworked).
A-4026	2720-50	W, WR!/Am, Cy	F-M	good	2-/2, 2	Grey amorphous material embedding naturally stained cysts, and inertinite/oxidised woody material.
A-4028	2780-2810	W, WR!, Am, Cy	F-M	good	2-/2	Dominated by material most of which is reworked.
A-4031	2870-2900	W, WR!, P, S/Am, Cy	F-M	fair to good	2-/2, 2	Grey amorphous, partly aggregates. Grey small vitrinite particles.

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.: 34/10-16

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-4033	2930-60	W, WR!, Am, P	F-M	fair	2-, 2-/2	Dominantly reworked and inertinitic material in amorphous aggregates.
A-4036	3020-50	W, Cut, WR!, P, S/Am, Cy	F-M-L	fair to poor	1/1+, 2-/2	Structures better preserved than above. Bright colours. Tasmanitids etc.
A-4038	3090-3110	W, Cut, S, Am	F-M-L	fair to good	1+/2-, 2-, 2-/2.	Very dominantly terrestrial material (vitrinite and cuticles).
A-4039	3110-40	Cut, W, WR!, P, S/Am, Cy	F-M-L	fair	2-/2, 2	Increase in cuticles.
A-4040	3460-90 clst. olive gy.	W, WR!, P/Am, Cy	F-M	fair to poor	2-/2, 2	Small finely disperse residue. Woody material dominated by fusinite/semi. fusinite. Palynomorphs dominantly Jurassic cysts.
A-4040	3460-90 clst. dk. gy.	W, WR!, P, S/Am, Cy	F-M	fair to good	2-/2, 2	Coarser residues dominated by fusinite/semifusinite particles. Aggregates contain a main element of vitrinite particles.

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.: 34/10-16

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
A-4041	3490-3520	W, WR!, Am, S	F-M	fair	2-/2, 2	Increase in reworked and inertinite content.
A-4043	3550-80	W, WR!, P/Am, Cy	F-M-L	fair to good	2-/2, 2	Dominantly wood that shows biodegradation. Semifusinite fusinite increased from above.
A-4044	3580-3610	WR!, W, Am, S, P, Cut	F-M	fair	2	Dominantly inertinite in sapropelised material.
A-4051	3790-3820	W, WR!, Cut, P, S/Am, Cy	F-M-L	fair to good	2-/2, 2	Stronger sapropelisation. Increase in cuticles.
A-4052	3820-3850	W, WR!, Cut, S, P, Am	F-M-L	fair to good	2-/2, 2	As above.
A-4056	3940-70	W, WR!, Cut, P, S/Am,	F-M-L	fair	2-/2, 2	As above.
A-4057	3970-4000	W, WR!, Am, S, P	F-M-L	poor to fair	2	As above. Palynomorphs less well preserved.

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

Vitrinite Reflectance measurements

TABLE NO.: 10
WELL NO.: 34/10-16

Sample	Depth (m)	Vitrinite reflectance	Fluorescence in UV light	Exinite content
A-3970	1070	0.36(8)	Green spores, resin and dinoflagellate cysts	Low
A-3972	1130	0.35(9)	Green spores, resin and dinoflagellate cysts	Low
A-3974	1190	0.50(1) Reworked?	Green dinoflagellate cysts and green and green/yellow spores	Low
A-3976	1250	0.41(3)	Green spores, resin and dinoflagellate cysts	Low-moderate
A-3980	1370	N.D.P.	Nil	Nil
A-3983	1460	N.D.P.	Green/yellow (spore?) fragments	Trace?
A-3993	1760	N.D.P.	Green/yellow spores and cysts?	Low
A-4016	2450	0.24(2) and 0.64(2)	Nil	Nil
A-4026	2750	N.D.P.	Yellow/orange fragments	Trace?
A-4028	2810	0.54(3)	Yellow/orange to light orange	Trace
A-4031	2900	N.D.P.	Yellow/orange	Low
A-4033	2960	0.53(7)	Yellow/orange to light orange spores, possibly one green hydrocarbon speck	Low

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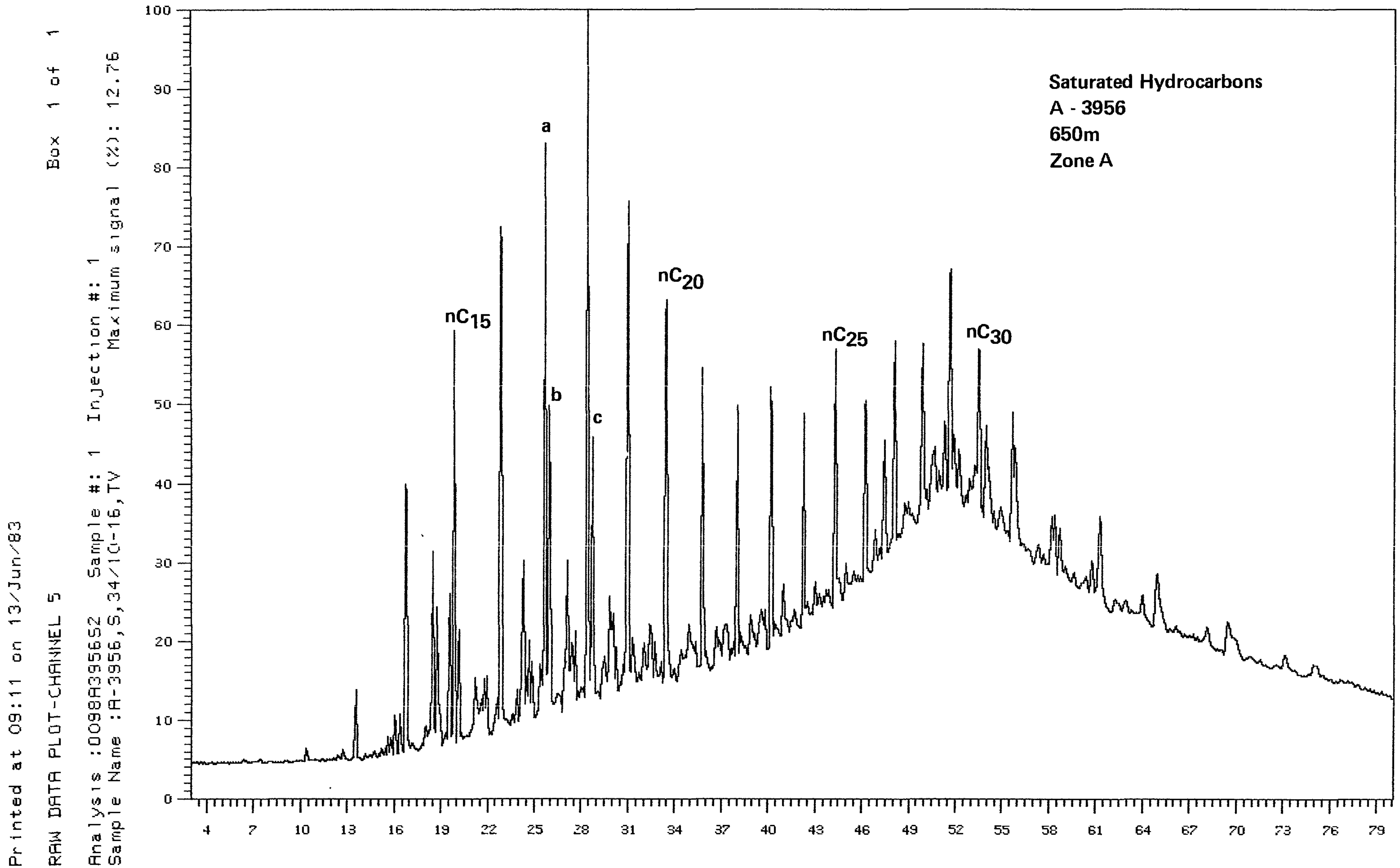
Vitrinite Reflectance measurements

TABLE NO.: 10
WELL NO.: 34/10-16

Sample	Depth (m)	Vitrinite reflectance	Fluorescence in UV light	Exinite content
A-4036	3050	0.38(3)	Green/yellow and yellow/orange fragments	Low-moderate
A-4038	3110	0.32(3) and 0.54(3)	Green/yellow spores and resin in lignite	Very abundant
A-4039	3140	0.24(10)	Green and yellow spores and resin in lignite (additive?)	Very abundant
A-4040	3490	0.57(8)	Green and green/yellow spores and resin	Low
A-4041	3520	0.56(8)	Yellow/orange and light orange	Moderate
A-4043	3580	0.60(20)	Light orange - mid orange	Moderate
A-4044	3610	0.61(3)	Light orange - mid orange	Low
A-4051	3820	0.67(14)	Light orange and mid orange (dominantly the latter)	Low - moderate
A-4052	3850	0.66(19)	Mid orange spores dominate but a few light orange are present	Moderate
A-4056	3970	0.64(20)	Mid orange	Moderate to rich
A-4057	4000	0.69(25)	Mid orange	Moderate

GAS CHROMATOGRAMS OF
SATURATED HYDROCARBONS

a = nC_{17}
b = Pristane
c = Phytane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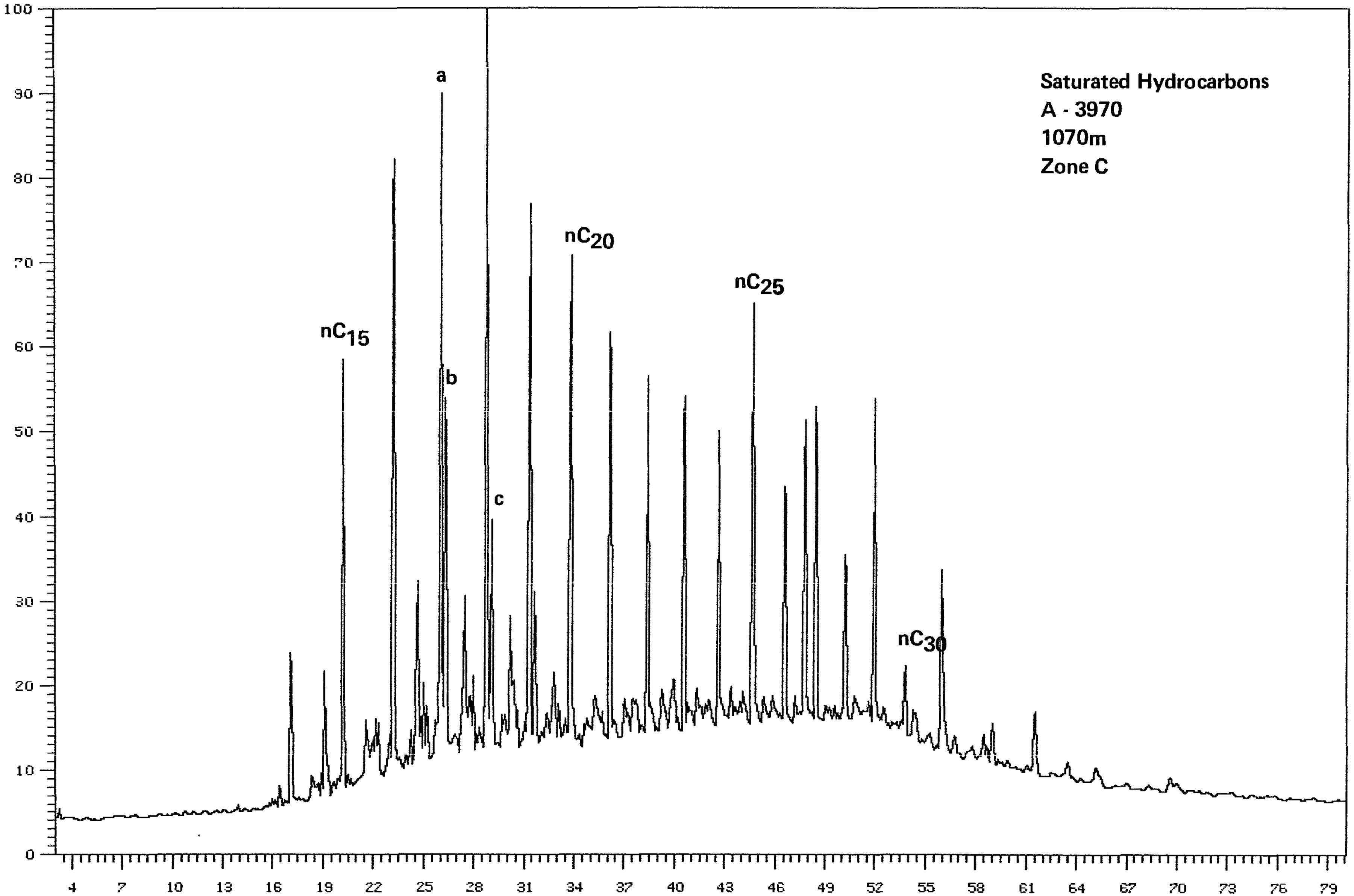
RAW DATA PLOT-CHANNEL 5
Box 1 of 1
Analysis :0098A395652
Sample #: 1
Injection #: 1
Sample Name :A-3956,S,34/10-16,TV
Maximum signal (%): 12.76
Saturated Hydrocarbons
A - 3956
650m
Zone A
nC15
a
b
c
nC20
nC25
nC30

Printed at 10:27 on 07/Jun/83 Box 1 of 1
RAW DATA PLOT-CHANNEL 5
Analysis :0098A397051 Sample #: 1 Injection #: 1
Sample Name :A-3970,S,34/10-16,TV Maximum signal (%): 13.25



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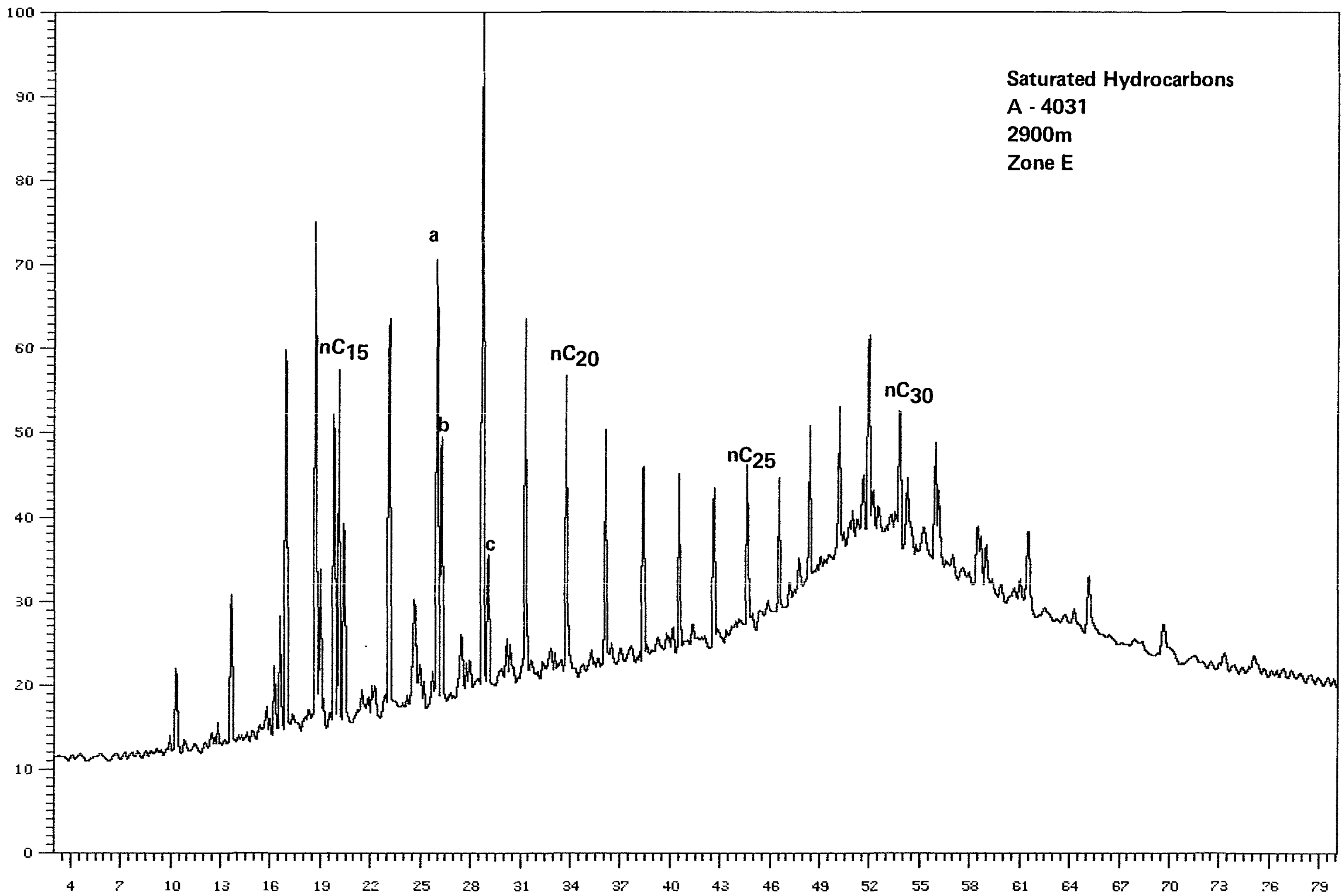
RAW DATA PLOT-CHANNEL 5

Box 1 of 1

Analysis :0098A4031S1 Sample #: 1 Injection #: 1

Sample Name :A-4031,S,34/10-16,TV Maximum signal (%): 4.87



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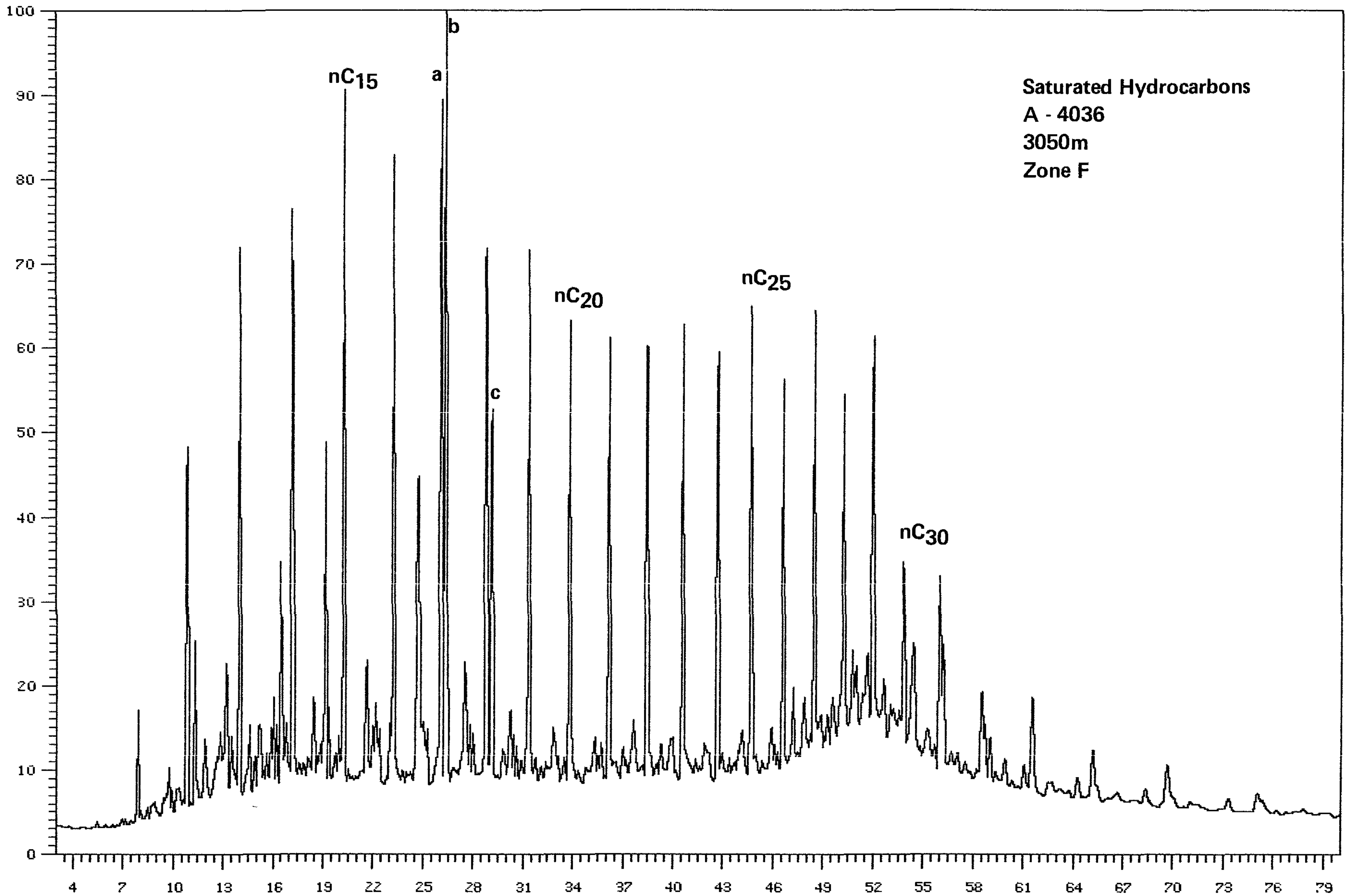
RAW DATA PLOT-CHANNEL 5

Analysis :0098A403651   Sample #: 1   Injection #: 1   Box 1 of 1
Sample Name :A-4036,S,34/10-16,TV   Maximum signal (%): 16.45



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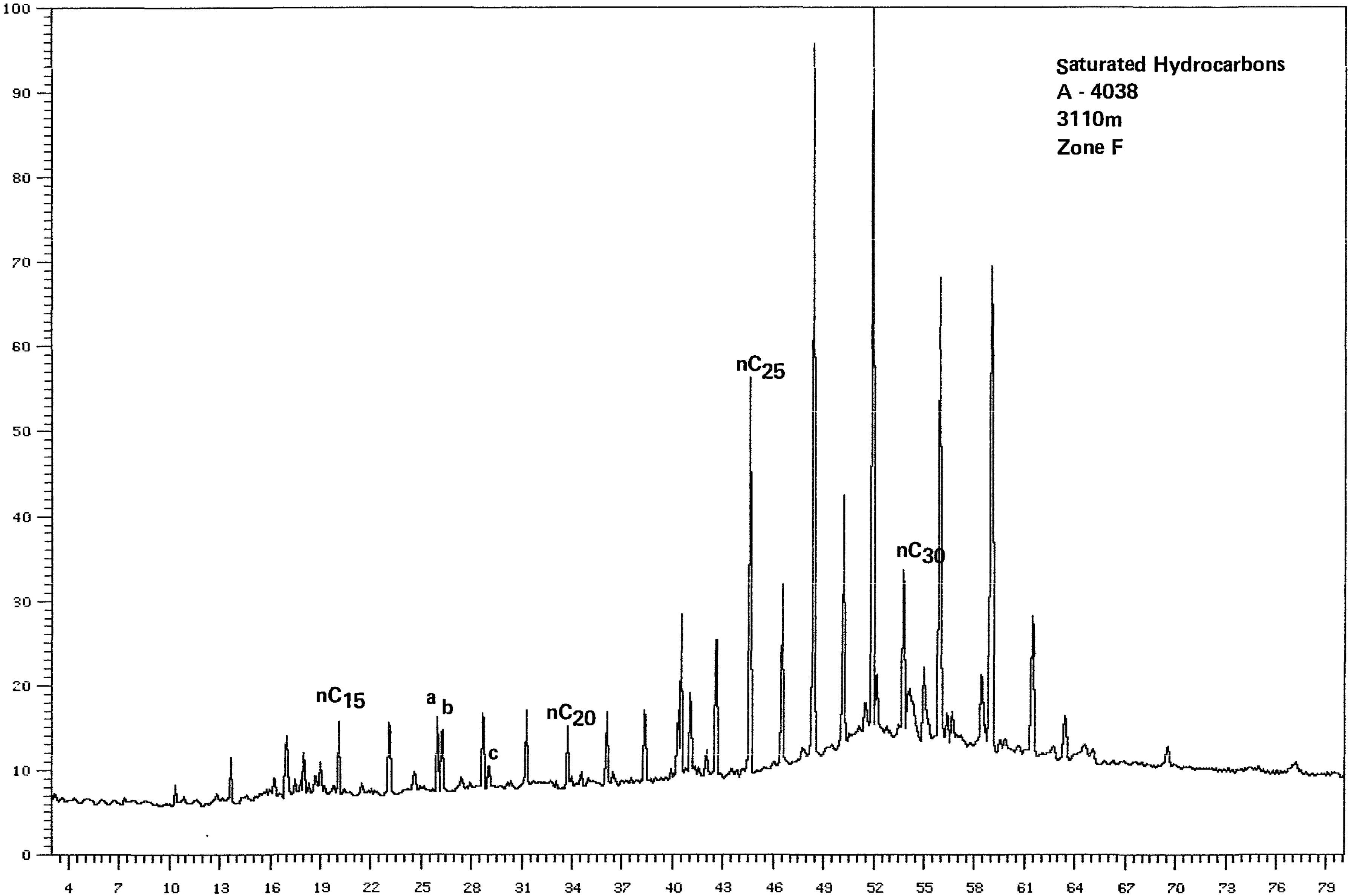
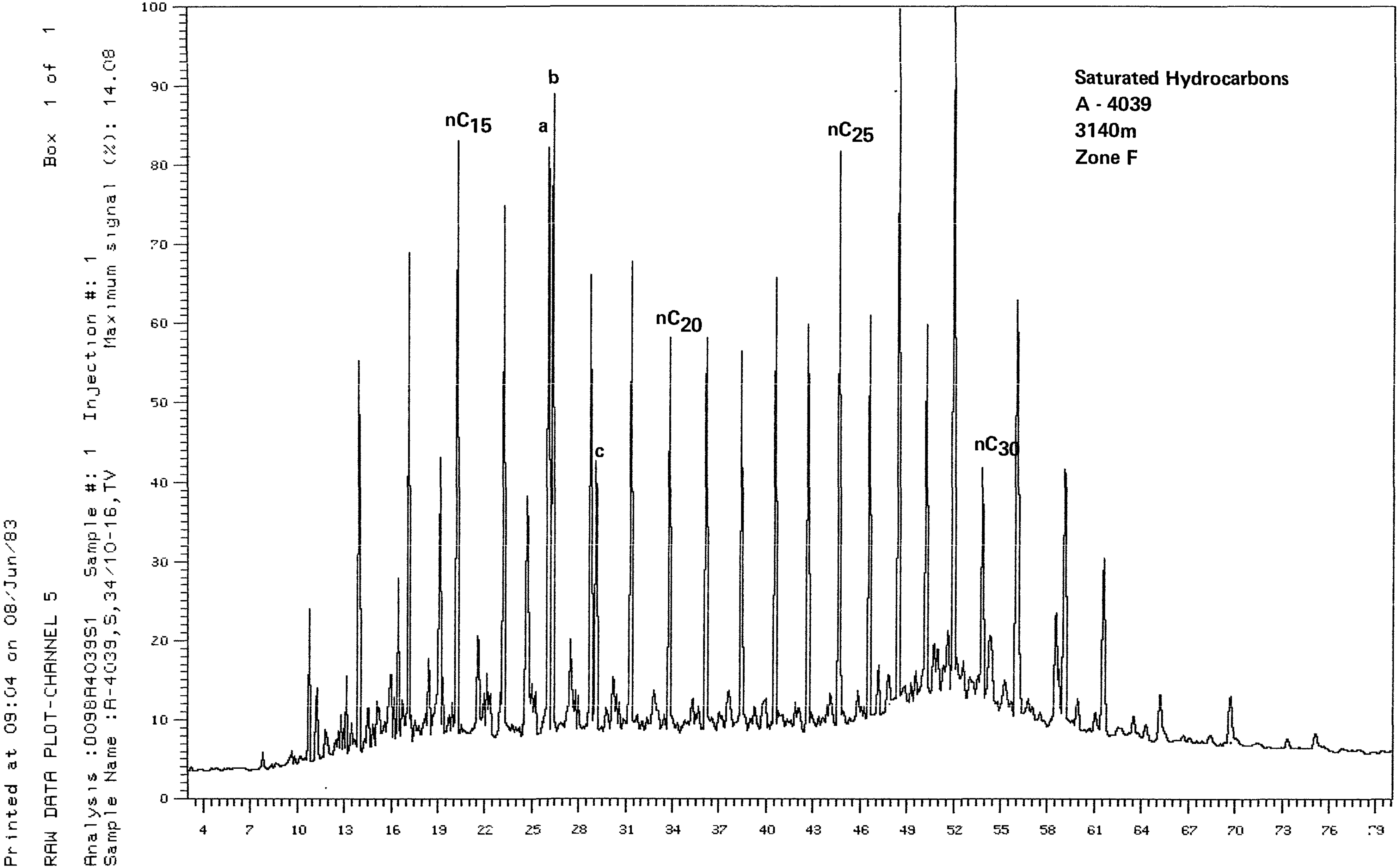
RAW DATA PLOT-CHANNEL 5

Analysis :DO98A4038S1 Sample #: 1 Injection #: 1

Sample Name :A-4038,S,34/10-16,TV Maximum signal (%): 7.27

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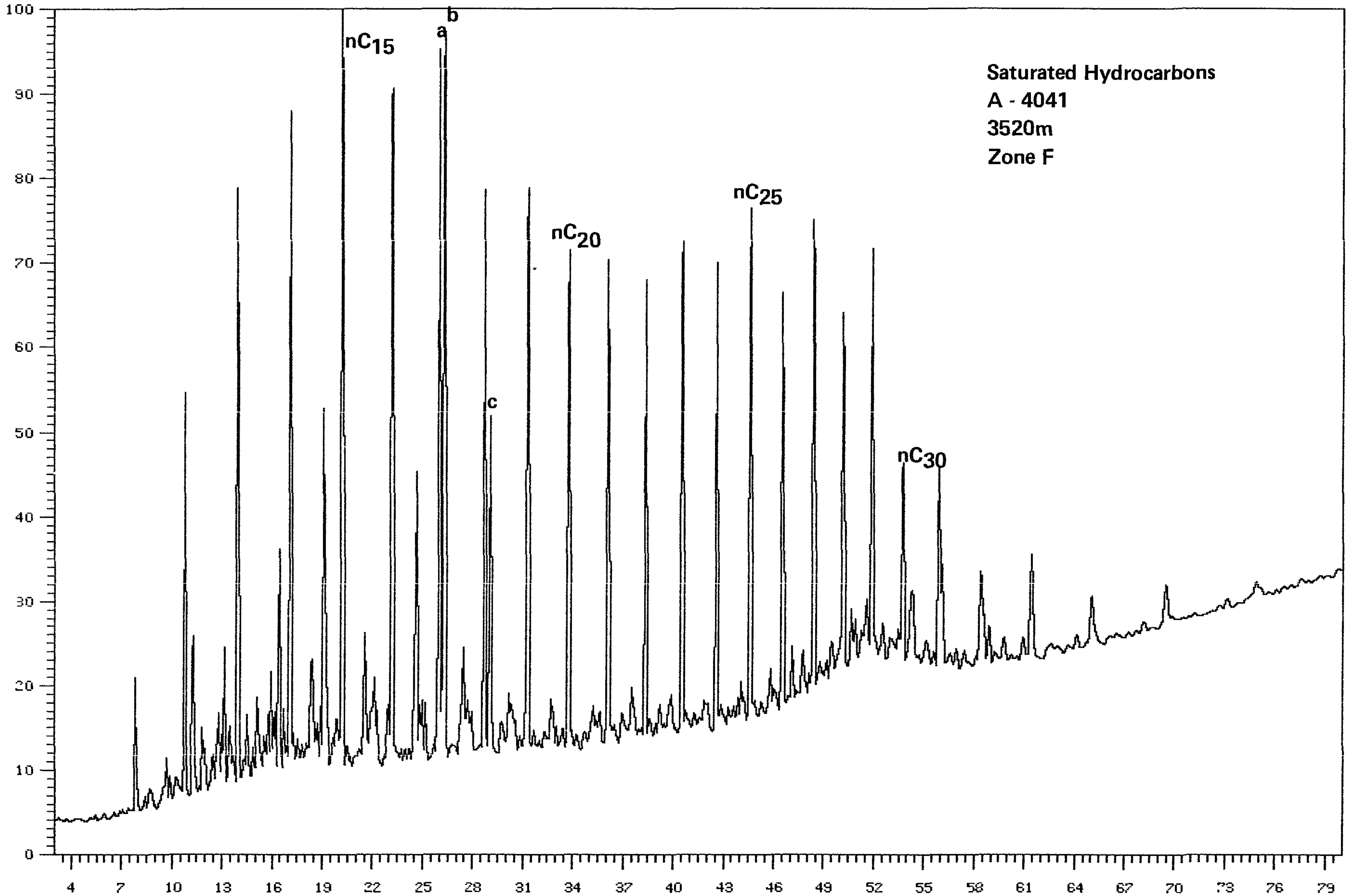
RAW DATA PLOT-CHANNEL 5
Box 1 of 1
Analysis :0098A4039S1 Sample #: 1 Injection #: 1
Sample Name :A-4039,S,34/10-16,TV Maximum signal (%): 14.08
Saturated Hydrocarbons
A - 4039
3140m
Zone F
nC15
a
b
c
nC20
nC25
nC30

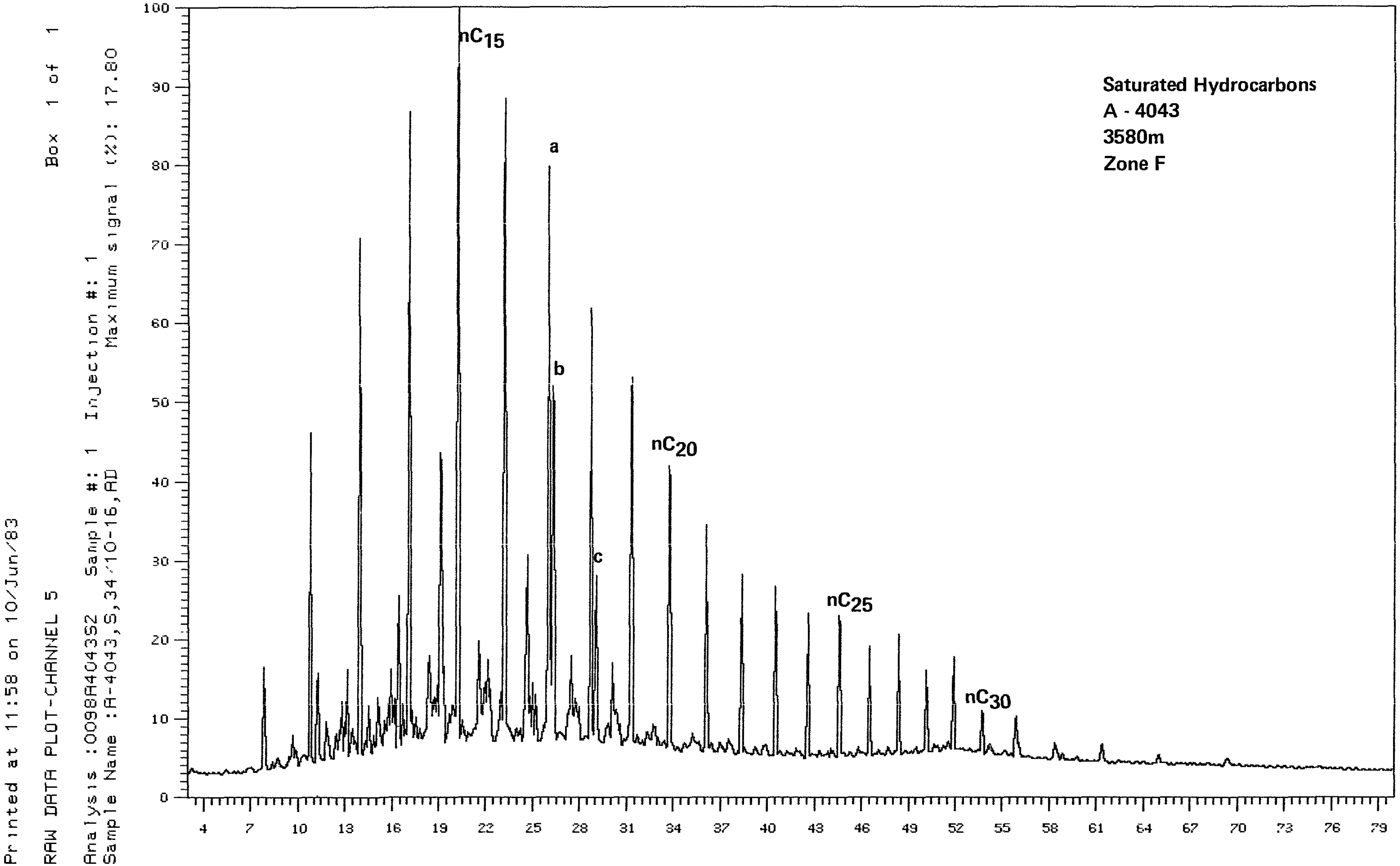
Printed at 14:43 on 08/Jun/83

RAW DATA PLOT-CHANNEL 5

Analysis :0098A404151   Sample #: 1   Injection #: 1
Sample Name :A-4041,S,34/10-16,TV   Maximum signal (%): 17.35

Box 1 of 1




Saturated Hydrocarbons
A - 4043
3580m
Zone F
nC15
a
b
c
nC20
nC25
nC30
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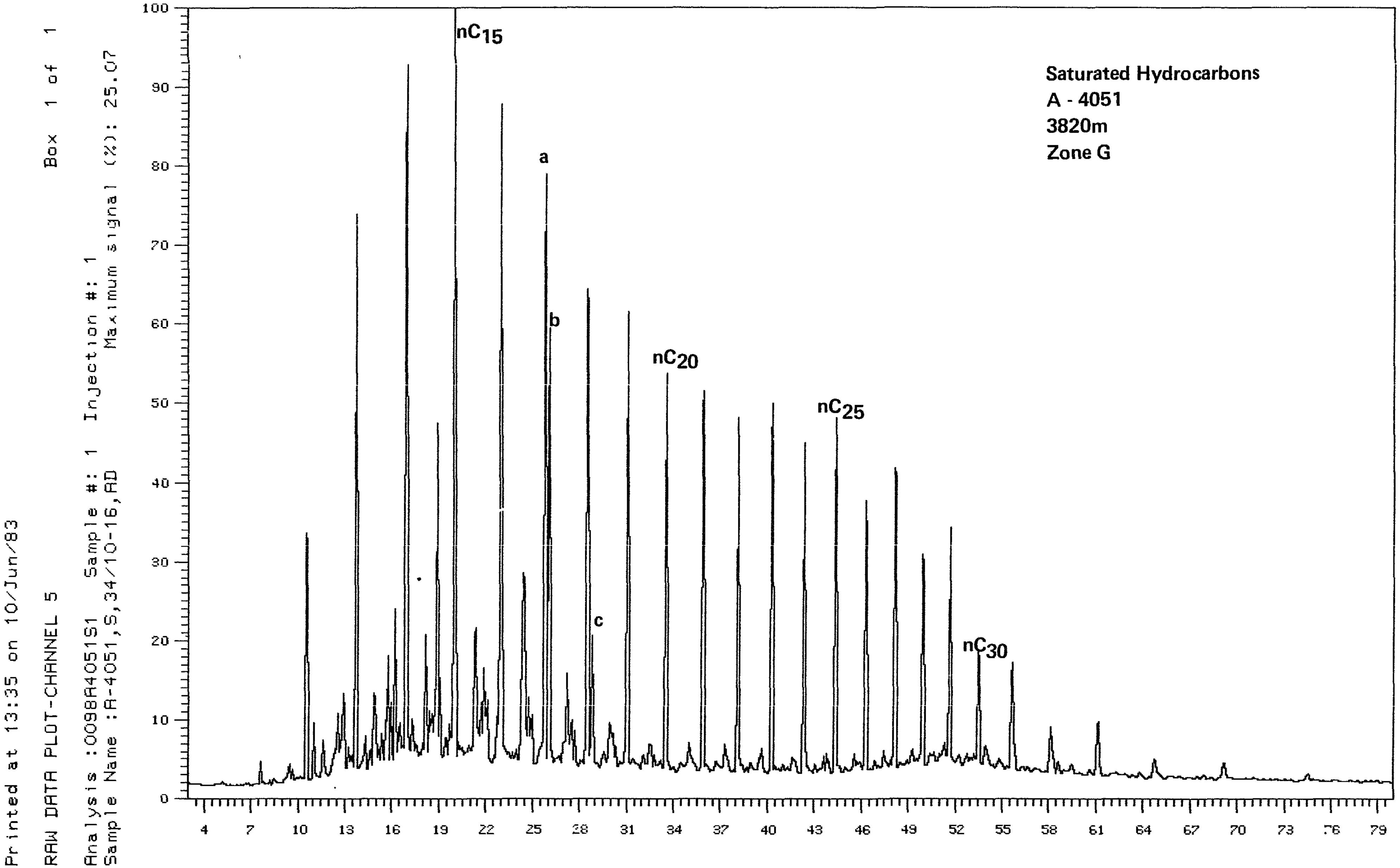
RAW DATA PLOT-CHANNEL 5
Box 1 of 1
Analysis :0098A404352 Sample #: 1 Injection #: 1
Sample Name :A-4043,S,34/10-16,AD
Maximum signal (%): 17.80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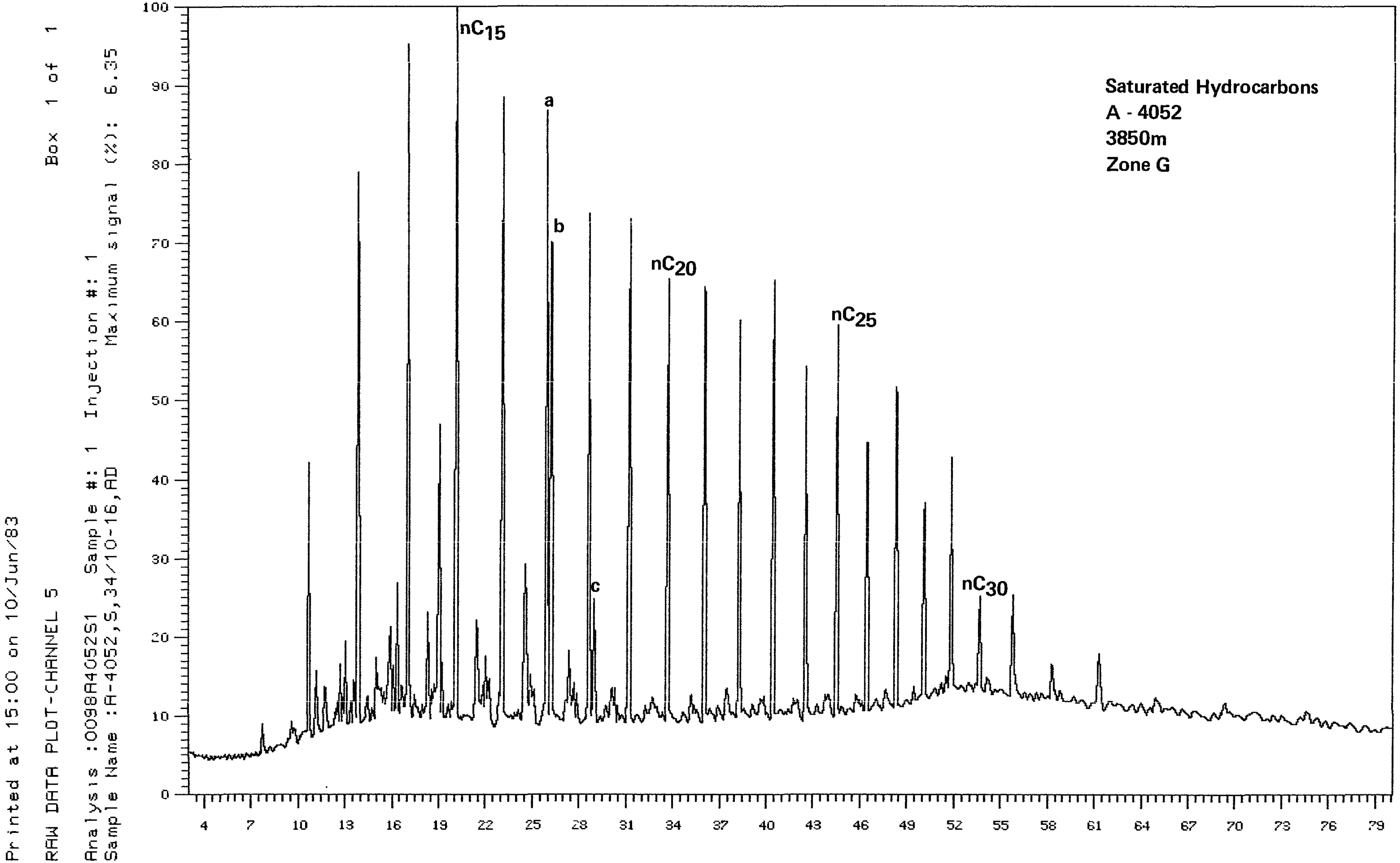
RAW DATA PLOT-CHANNEL 5
Box 1 of 1
Analysis :0098A4051S1 Sample #: 1 Injection #: 1
Sample Name :A-4051,S,34/10-16,AD
Maximum signal (%): 25.07
Saturated Hydrocarbons
A - 4051
3820m
Zone G
nC15
a
b
c
nC20
nC25
nC30
0
10
20
30
40
50
60
70
80
90
100
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
55
58
61
64
67
70
73
76
79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RAW DATA PLOT-CHANNEL 5
Box 1 of 1
Analysis :0098A405251
Sample #: 1
Injection #: 1
Sample Name :A-4052,S,34/10-16,AD
Maximum signal (%): 6.35
Saturated Hydrocarbons
A - 4052
3850m
Zone G
nC15
a
b
c
nC20
nC25
nC30
0
10
20
30
40
50
60
70
80
90
100
4
7
10
13
16
19
22
25
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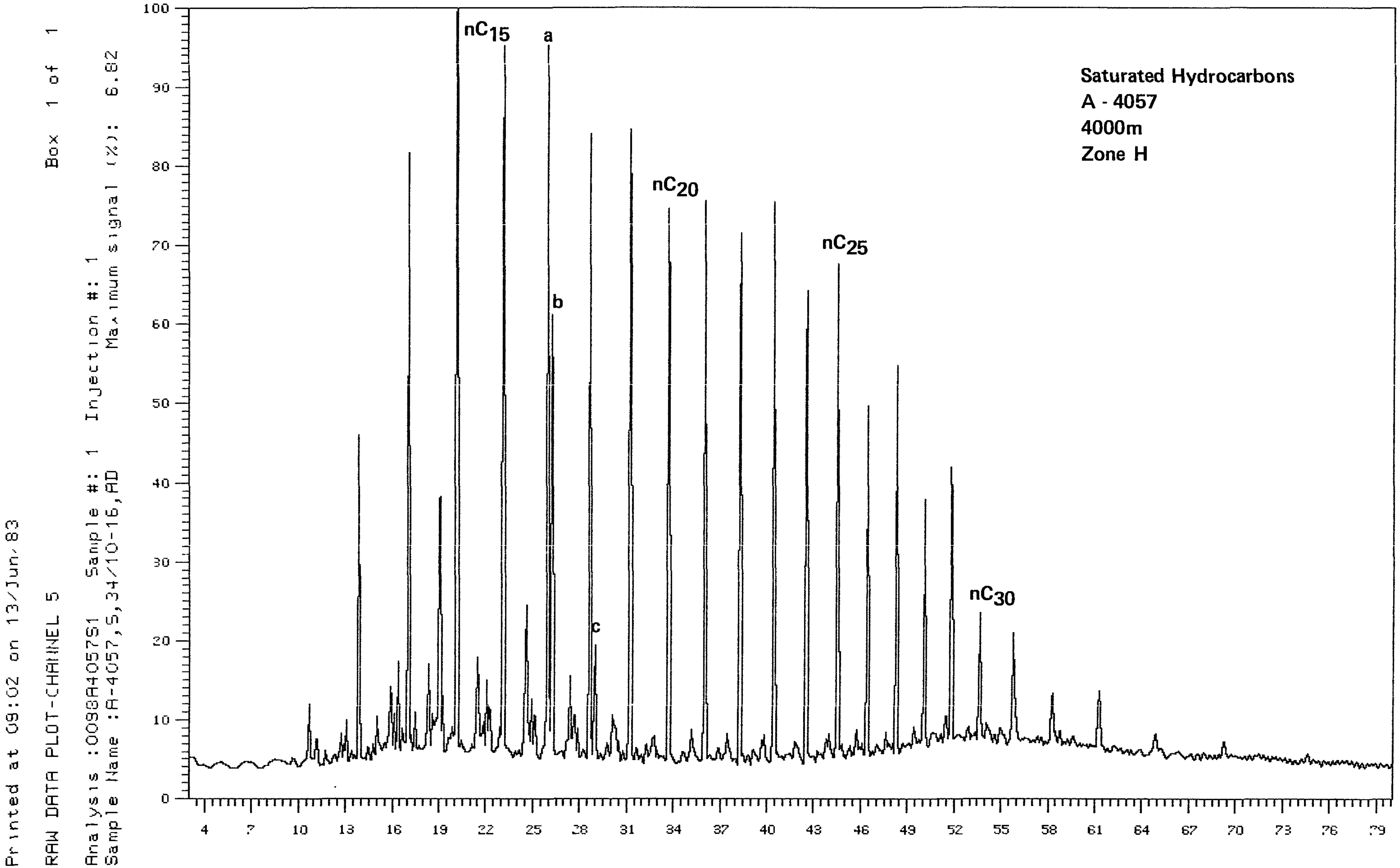
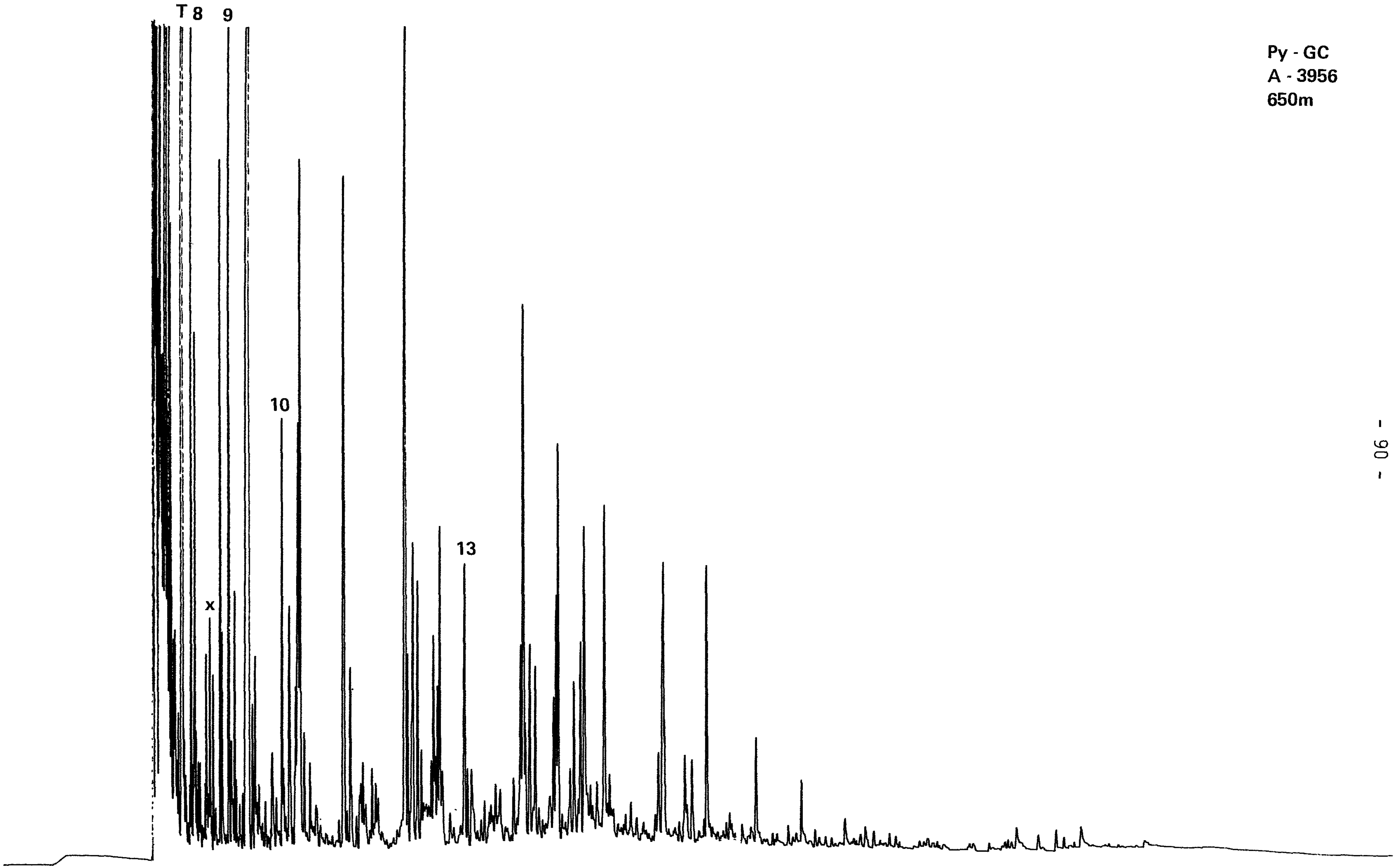
34
37
40
43
46
49
52
55
58
61
64
67
70
73
76
79

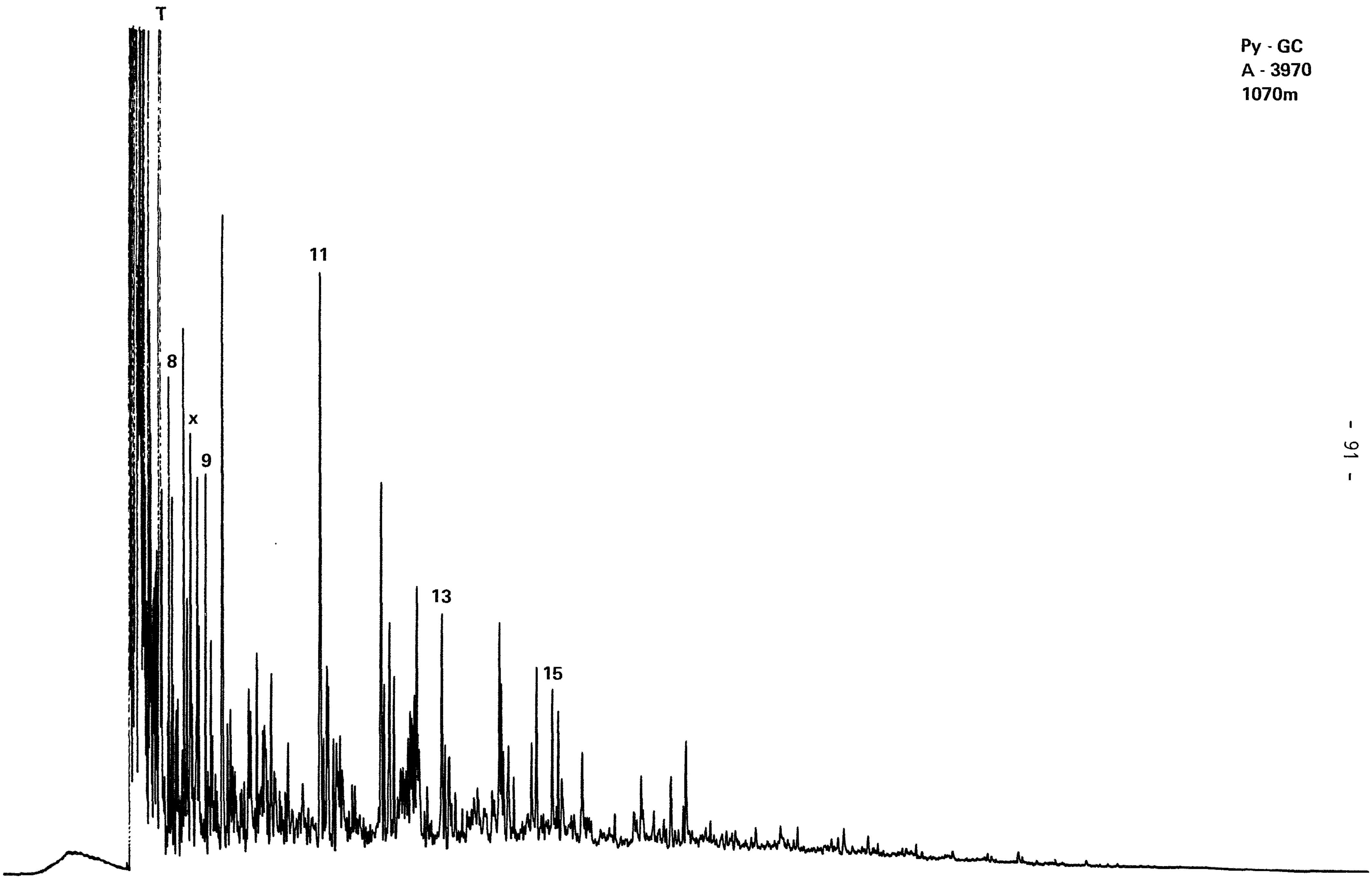


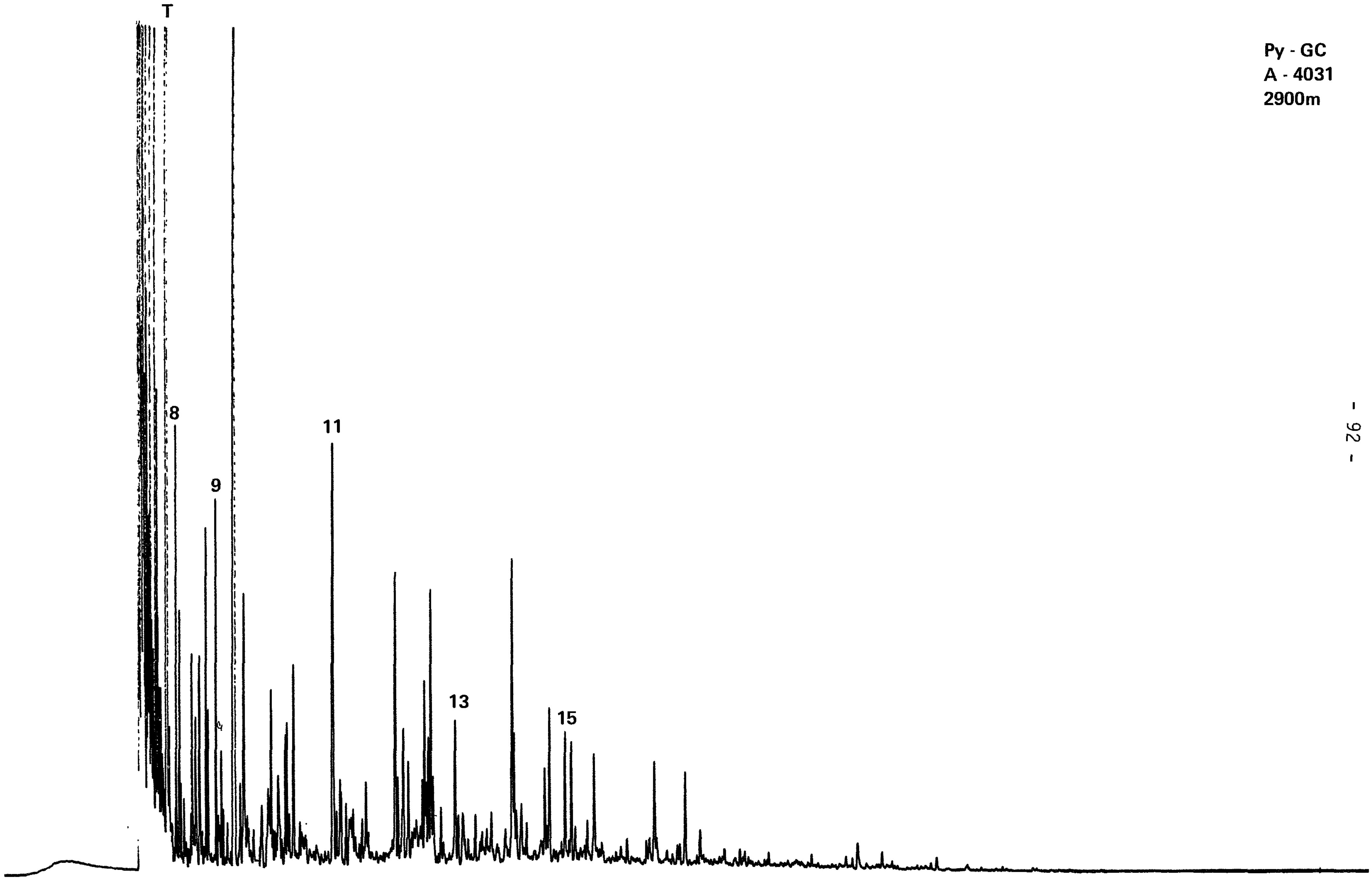
Saturated Hydrocarbons
A - 4057
4000m
Zone H
nC15
a
b
c
nC20
nC25
nC30
Printed at 09:02 on 13/Jun/83
RAW DATA PLOT-CHANNEL 5
Box 1 of 1
Analysis :0098A4057S1 Sample #: 1 Injection #: 1
Sample Name :A-4057,5,34/10-16,AD Maximum signal (%): 6.82

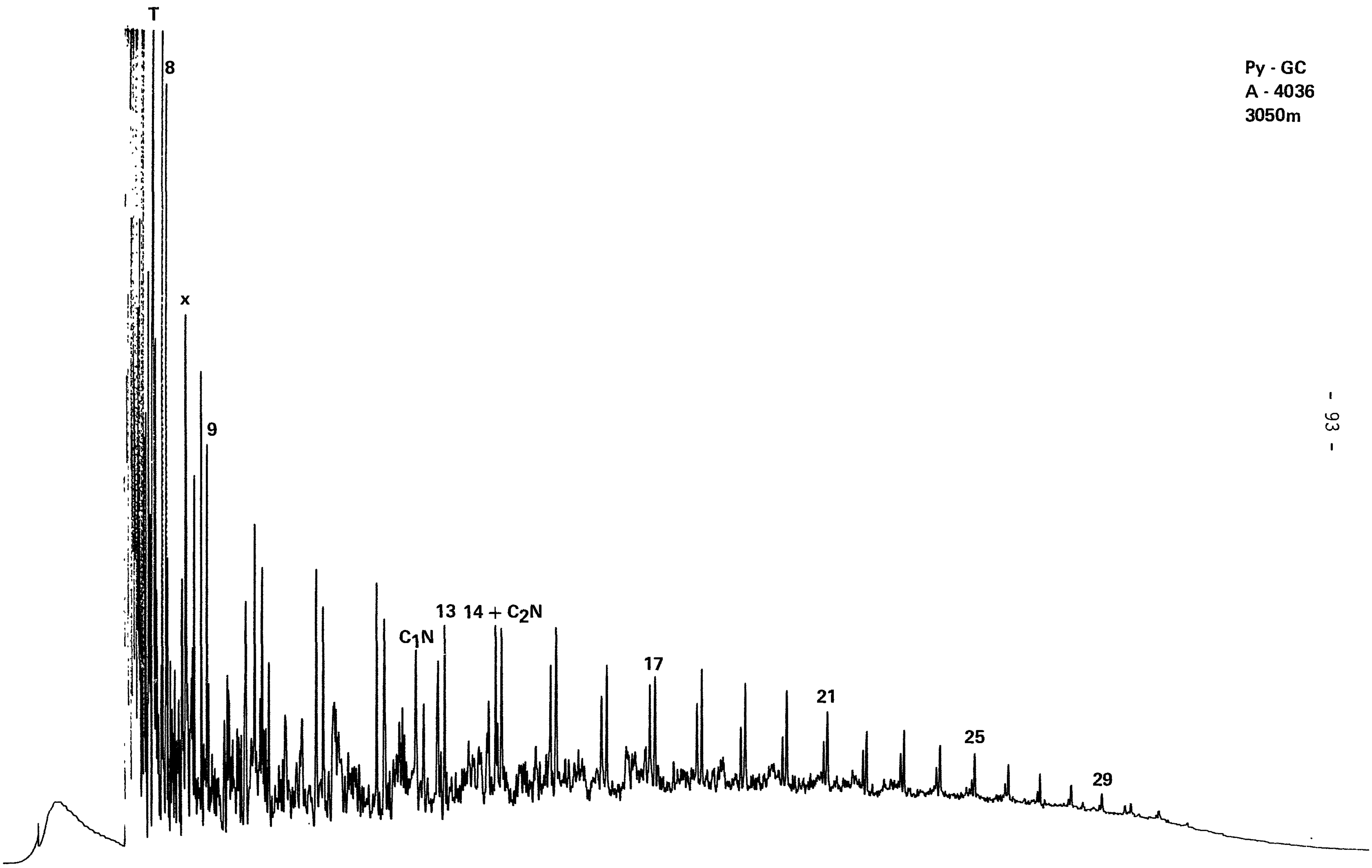
PYROLYSIS - GAS CHROMATOGRAMS

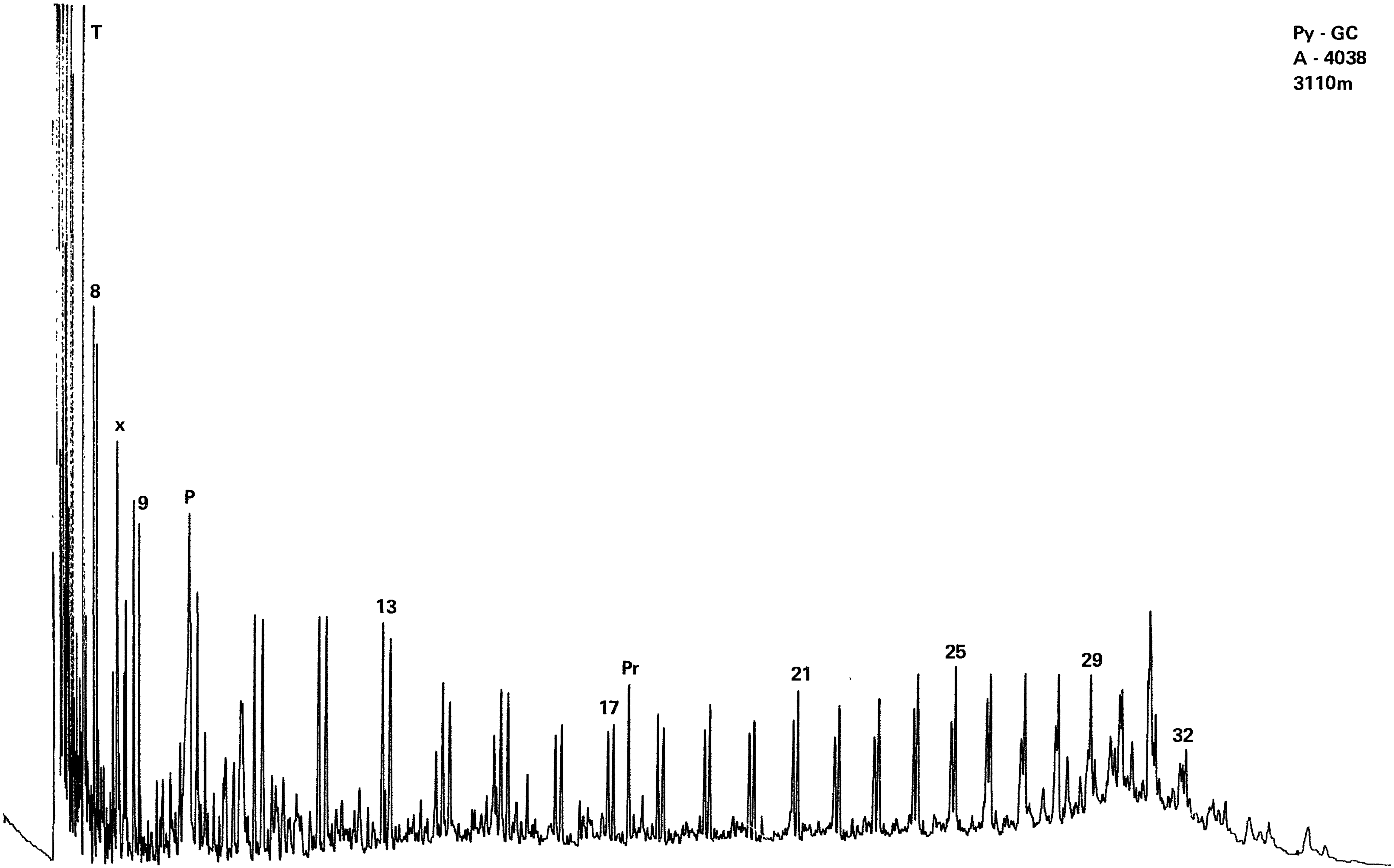
(See text for key to chromatograms)

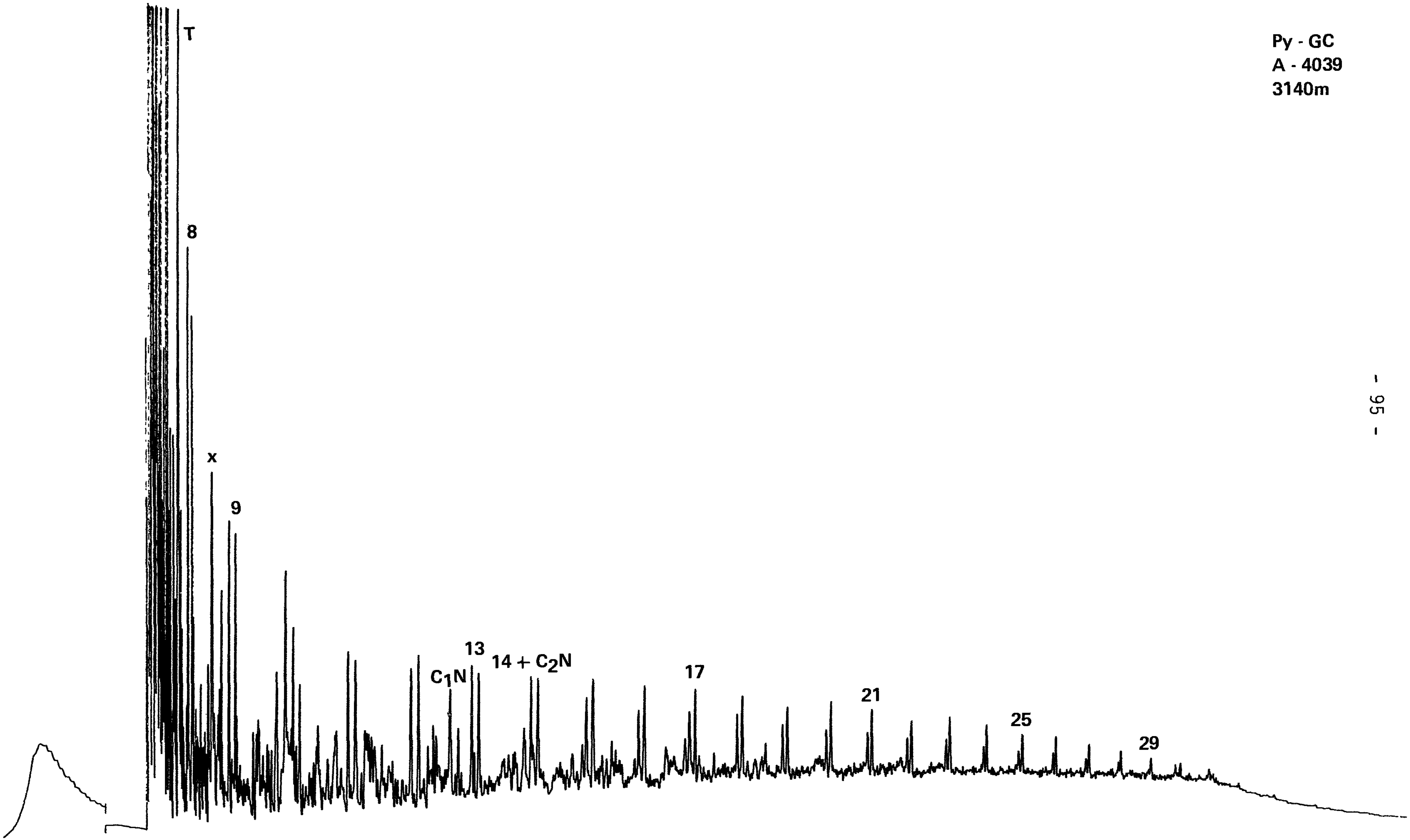

T
8
9
10
x
13
Py - GC
A - 3956
650m

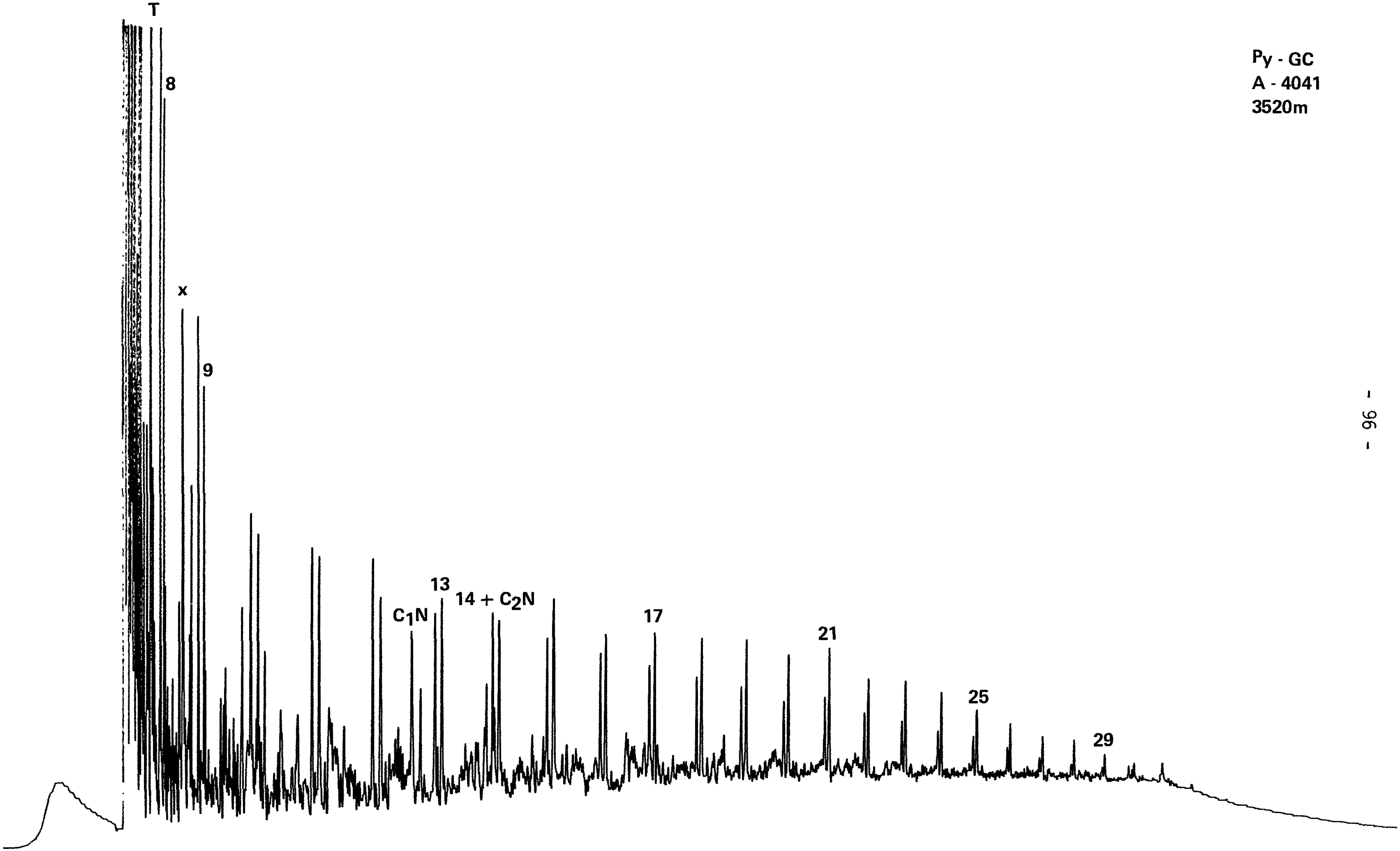

T
8
x
9
11
13
15
Py - GC
A - 3970
1070m

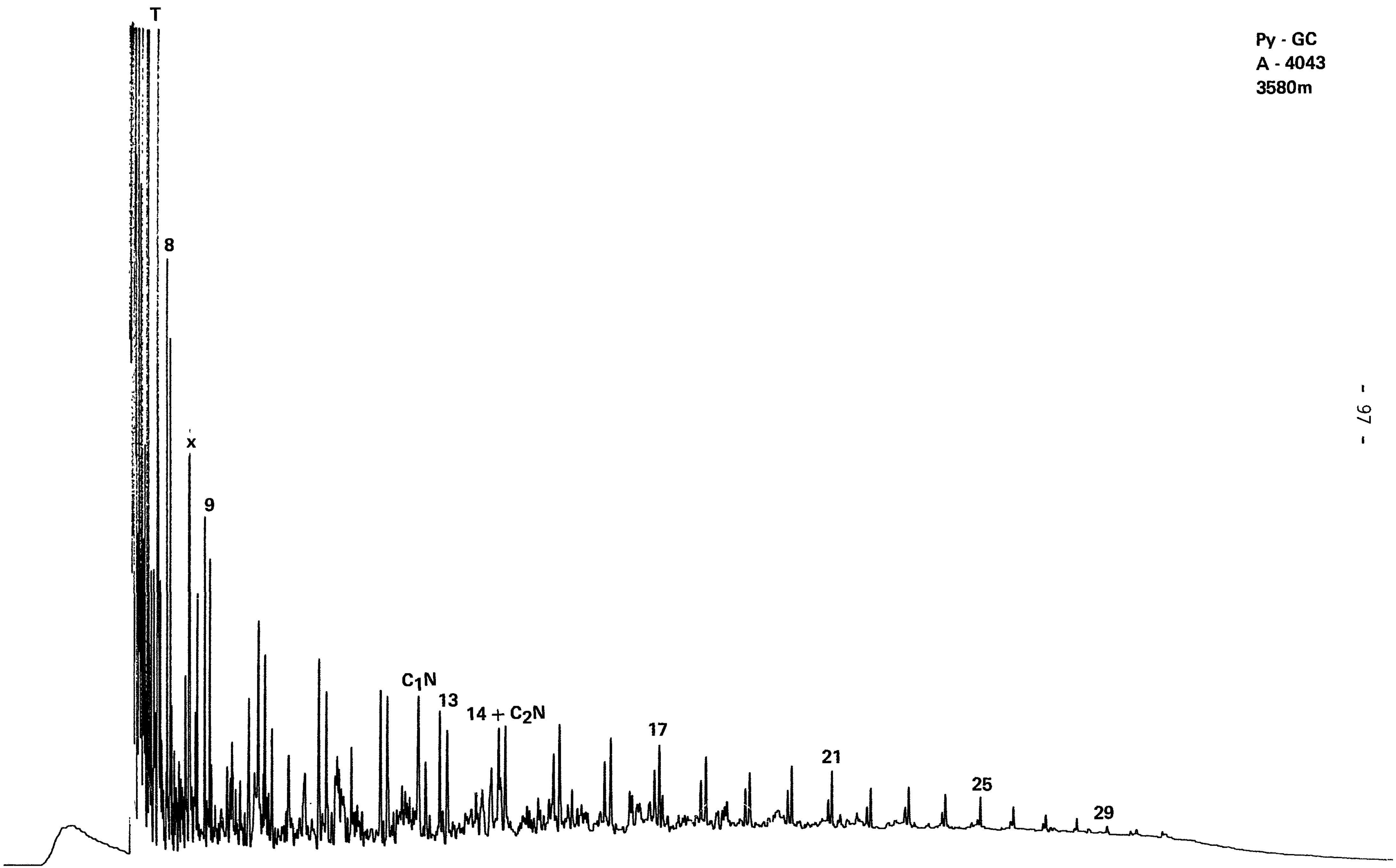

Py - GC
A - 4031
2900m
T
8
9
11
13
15

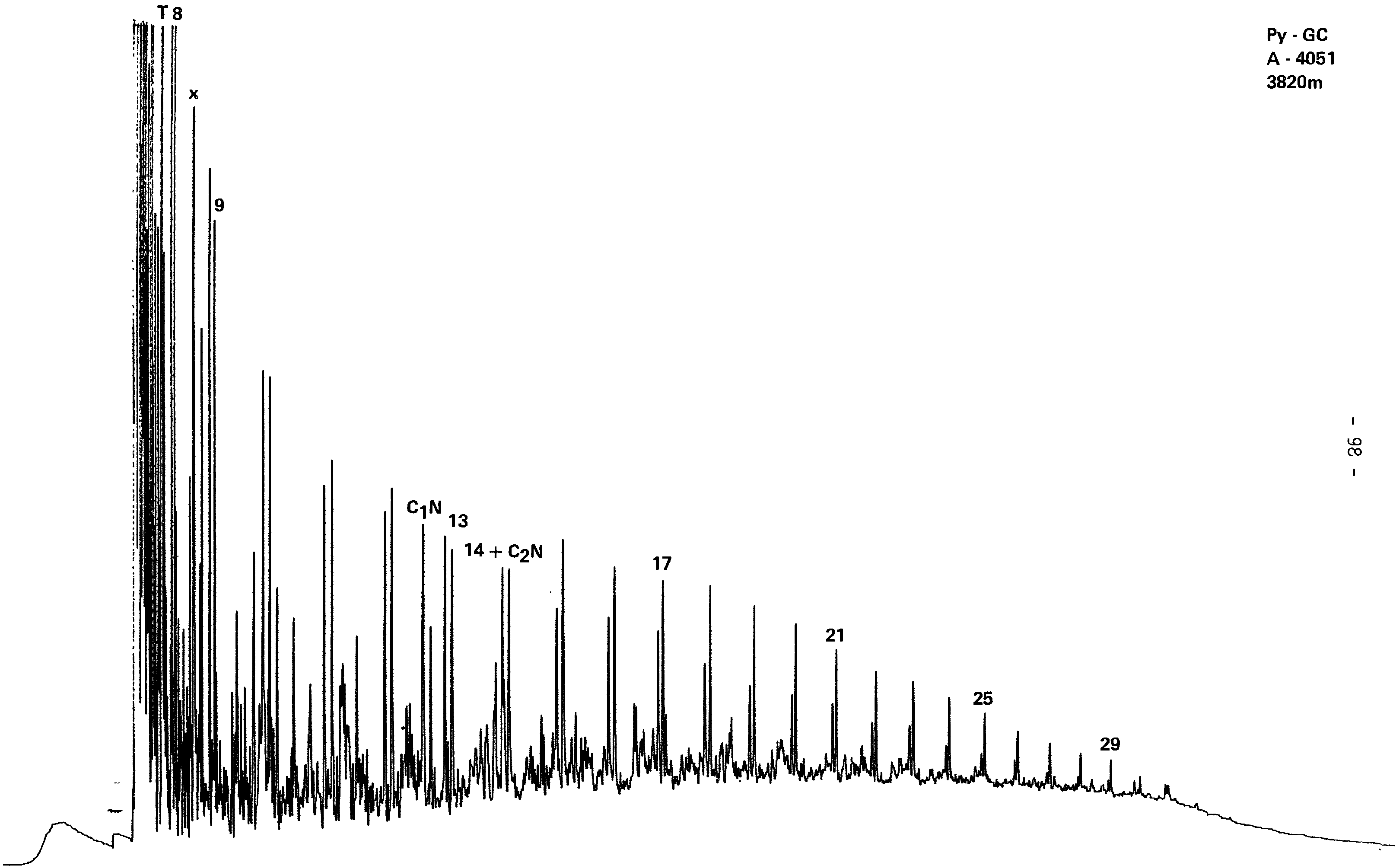

Py - GC
A - 4036
3050m
T
8
x
9
C1N
13
14 + C2N
17
21
25
29


Py - GC
A - 4038
3110m
T
8
x
9
P
13
17
Pr
21
25
29
32

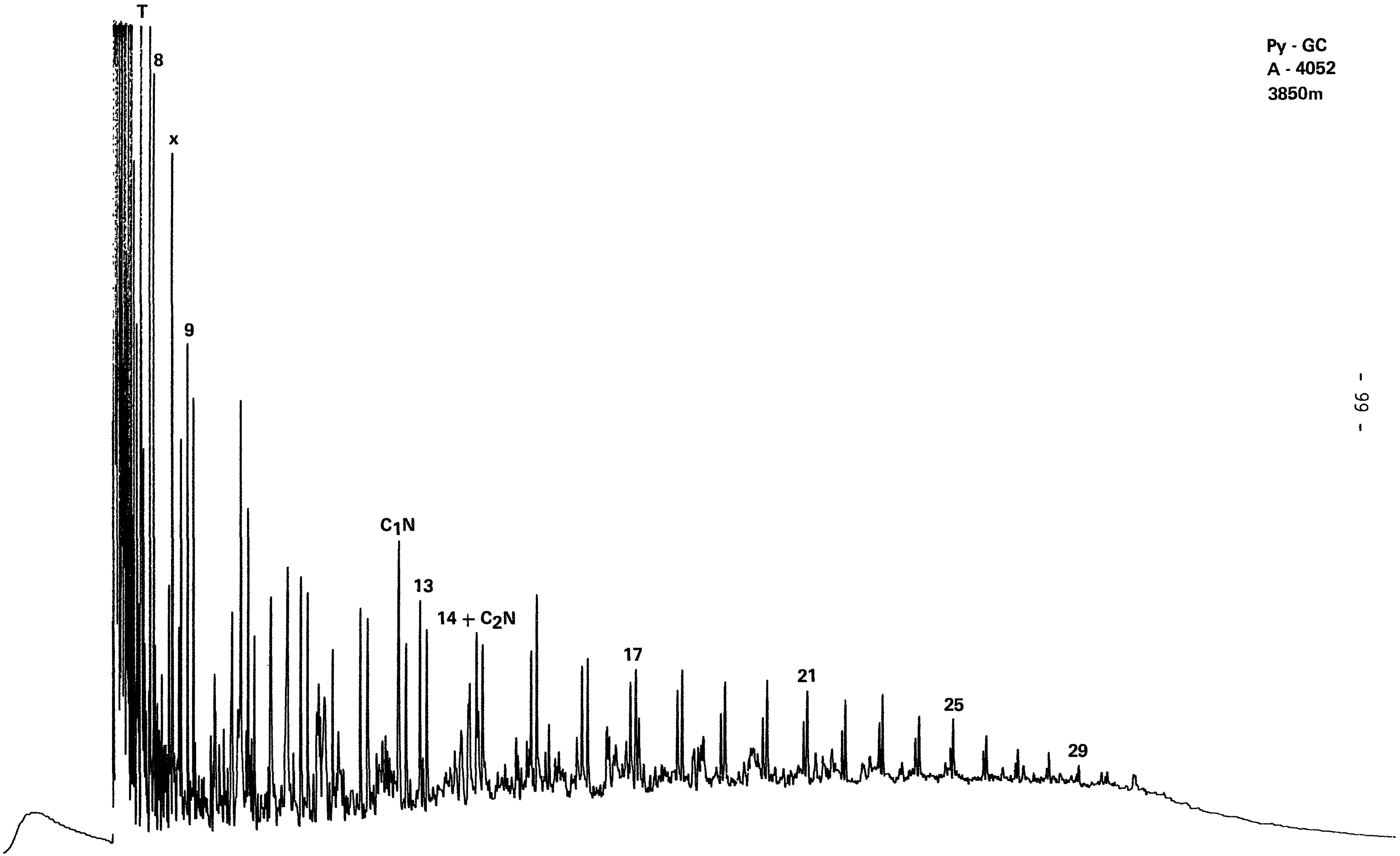

Py - GC
A - 4039
3140m
T
8
x
9
C1N
13
14 + C2N
17
21
25
29

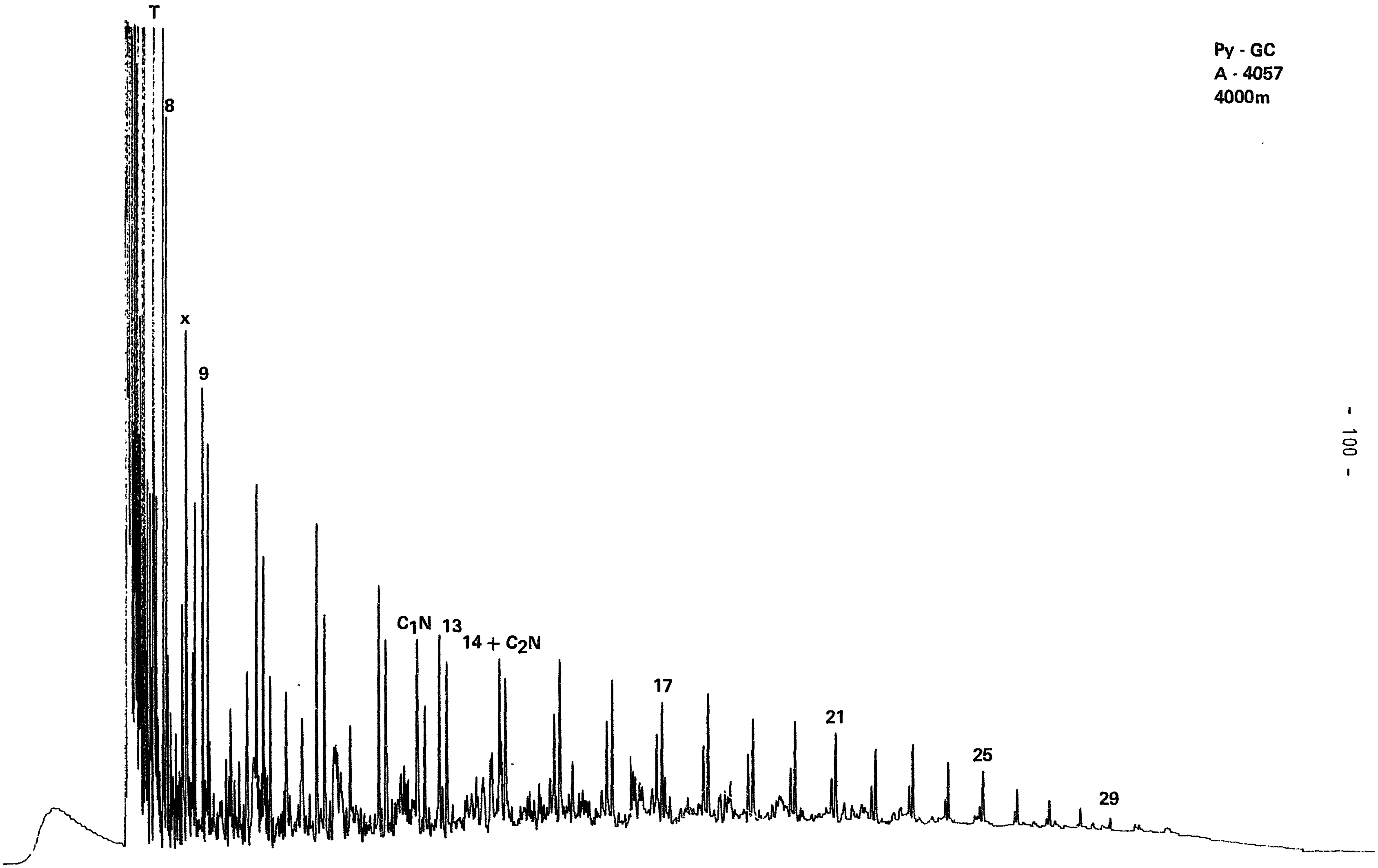

Py - GC
A - 4041
3520m
T
8
x
9
C_1N
13
$14 + C_2N$
17
21
25
29


Py - GC
A - 4043
3580m
T
8
x
9
C_1N
13
14 + C_2N
17
21
25
29



Py - GC
A - 4051
3820m
T
8
x
9
C1N
13
14 + C2N
17
21
25
29


T
8
x
9
C_1N
13
14 + C_2N
17
21
25
29
Py - GC
A - 4052
3850m


Py - GC
A - 4057
4000m
T
8
x
9
C_1N
13
14 + C_2N
17
21
25
29

IKU Organic Geochemistry Department

MATURATION

Well no.: 34/10 – 16
Company: STATOIL

VISUAL KEROGEN
COLORATION AND COMPOSITION OF ORGANIC RESIDUE

IKU Organic Geochemistry Department.

ROCK-EVAL PYROLYSIS

Well no.: 34/10 – 16
Company: STATOIL

IKU

Organic Geochemistry Department

INTERPRETATION DIAGRAM

Well no: 34/10 – 16
Company: STATOIL

SUMMARY OF SOURCE POTENTIAL

● % $\frac{Sat.}{EOM}$ ○ % $\frac{HC}{EOM}$

Sat: Saturated Hydrocarbons
HC: Hydrocarbons
EMO: Extractable Organic Matter

IKU Organic Geochemistry Department

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

Well no.: 34/10 – 16
Company: STATOIL

Sat: Saturated Hydrocarbons
Aro: Aromatic Hydrocarbons
Asp: Asphaltenes

TOC: Total Organic Carbon
HC: Hydrocarbons
NSO: Nitrogen, Sulphur and Oxygen containing compounds

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C_{15}^{+} SATURATED HYDROCARBONS

Presentation of Analytical Data

Well no.: 34/10 – 16
Company: STATOIL

TOTAL ORGANIC CARBON (TOC)
Presentation of Analytical Data

IKU Organic Geochemistry Department

Well no.: 34/10 – 16
Company: STATOIL

Organic Geochemistry Department

C_1 - C_7 HYDROCARBONS
Presentation of Analytical Data

Well no.: 34/10 – 16
Company: STATOIL