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SUMMARY/ SAMMENDRAG

Based on undertaken analyses - the analysed section was divided into six zones. Samples were not supplied for depth intervals: 850 - 1100m and 2800 - 3500m.

Zone A; 640 - 850m: Immature. No source rock potential

Zone B; 1100 - 2600m: Immature - moderate mature - fair potential for gas.

Zone C; 2600 - 2800m: Immature - fair to good potential for gas.

Zone D; 3500 - 3536m: Immature - moderate mature - poor/fair potential for gas.

Zone E; 3536 - 3800m: Immature to moderate mature, good - rich potential for oil and gas.

Zone F; 3800 - 4298m: Moderate - early mature. Fair - rich potential for oil and gas.

KEY WORDS/ STIKKORD

Source rock

Evaluation

15/8-1

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EXPERIMENTAL AND DESCRIPTION OF INTERPRETATION LEVELS

Total Organic Carbon (TOC)

Picked cuttings of the various lithologies in each sample were 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°C. The samples were then ground, initially on a diamond lap followed by two grades of corundum paper. All grinding and subsequent polishing stages in the preparation were carried out using isopropyl alcohol as lubricant, since water leads to the swelling and disintegration of the clay fraction of the samples.

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

Reflectance determinations were carried out on a Leitz M.P.V. microphotometer under oil immersion, R.I. 1.518 at a wavelength of 546 nm. The surface of the polished block was searched by the operator for suitable areas of vitrinitic material in the sediment. The reflectance of the organic particle was determined relative to optical glass standards of known reflectance. Where possible, a minimum of twenty individual particles of vitrinite was measured, although in many cases this number could not be achieved.

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

VITRINITE REFLECTANCE R.AVER. 546 NM	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10
	1516									

% CARBON CONTENT DAF.	57	62	70	73	76	79	80.5	82.5	84	85.5
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LIPTINITE FLUOR NM	725	750	790	820	840	860	890	940
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EXC. 400 nm BAR. 530 nm	colour	G	G/Y	Y	Y/O	L.O	M.O.	D.O.	O/R	R
	zone	1	2	3	4	5	6	7	8	9

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

Relationship between liptinite fluorescence colour, vitrinite reflectance and carbon content is variable with depositional environment and catagenic history. The above is only a guide. Liptinite will often appear to process to deep orange colour and then fade rather than develop or O/R red shade. Termination of fluorescence is also variable.

Processing of Samples and Evaluation of Visual Kerogen

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

T-slide represents the total acid insoluble residue.

N-slide represents a screened residue (15 mesh).

O-slide contains palynodebris remaining after flotation (ZnBr_2) to remove heavy minerals.

X-slides contain oxidized residues, (oxidizing may be required to remove sapropel which embeds palynomorphs, or where high coalification prevents the identification of the various groups).

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

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

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

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

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

R_o	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)

Two Py-GC methods were used in this study. A temperature programmed pyrolysis technique, Py-GC (Progr.), was applied for samples with TOC values of ca. 1% and lower. Flash pyrolysis at 600°C, Py-GC (600°C), was used for samples with TOC values higher than 1%.

Thermal Extraction

20-30mg of fine ground whole rock sample was placed in a boat shaped sample probe and heated in a stream of helium at 300°C for five minutes.

Py-GC (600°C)

A chemical Data Systems (CDS) Pyroprobe 120 interfaced to a Varian 3700 gas chromatograph was used for flash pyrolysis. Fine ground thermally extracted whole rock sample was suspended in methanol and added to the platinum ribbon sample probe with a disposable Pasteur pipette. The sample was flash pyrolysed and flushed directly onto a capillary column via a laboratory built interface/splitter and analysed under the GC conditions given below.

Instrumental conditions:

Pyrolysis: 600°C for 5 sec.. in nitrogen
Column: 25m OV-1 fused silica capillary; ID 0.3mm
Carrier gas: Nitrogen with inlet pressure 6 psi; Flow ca. 1.5ml/min.
Split ratio: 1:30.
Oven programme: 40°C/1 min. to 270°C at 4°C/min.

RESULTS AND DISCUSSION

Canned samples covering the interval 640 - 4298m were analysed and divided into 6 zones on the basis of TOC and lithological description.

- Zone A; 640 - 850m
- Zone B; 1100 - 2600m
- Zone C; 2600 - 2800m
- Zone D; 3500 - 3536m
- Zone E; 3536 - 3800m
- Zone F; 3800 - 4298m.

Total Organic Carbon

Organic carbon measurements were taken on the major lithology of each sample. In some samples several TOC measurements were taken for example when several claystones occurred in the same sample.

Zone A (640 - 850m).

3 samples from this zone were analysed. The lithology in this zone is sandstone and sandy claystone. The TOC measurements were taken on the sandy claystone. All contained under 1% organic carbon.

Zone B (1100 - 2600m).

Apart from some sandstone at the very top this zone is composed entirely of claystone. The organic carbon content of the topmost sample is under 1%. Below this the dominant lithology is a dark claystone rich in organic carbon (over 2%). There is some variation in TOC: this claystone is less carbon rich towards the middle of the zone (around 1350m). From 1850m a second claystone appears which is poorer in organic carbon (0.5 - 1%). This lithology continues to the base of the zone. The sample at 2395m contains a mixture of claystones of varying organic carbon content including a red-brown claystone poor in TOC.

Zone C (2600 - 2800m).

The lithology in this zone is dominantly sandstone with some claystone. The organic carbon content of the claystone varies from fair to good (between 0.5 and 2% TOC).

Zone D (3500 - 3536m).

The lithology is predominantly marly limestone with varying amounts, increasing towards the base, of dark claystone rich (4.26%) in organic carbon.

Zone E (3536 - 3800m).

The lithology varies through this zone but is predominantly claystone and carbonaceous claystone with local bands of limestone and coals. The abundance of coals increases towards the base of the zone. Organic carbon measurements were made on the dark claystone. The abundance of organic carbon changes with depth decreasing where the claystone becomes a minor constituent (viz limestone band between 3617 - 1641m). The claystone is rich in organic carbon throughout the zone. The sample at 3749m is a coal hence the very high organic carbon content.

Zone F (3800 - 4298m).

Ten samples were analysed. The dominant lithology is a dark claystone. The organic carbon content varies throughout the zone from good to rich except at 4100m where there is only 0.6% organic carbon. The samples from 3950m and 4001m are particularly rich carbonaceous shales (samples are mostly coals). A mixture of claystones of varying organic carbon content appear at the base of the zone (last sample 4298m). The olive grey - dark grey and brown- grey claystones have from 1.6 to 0.5% organic carbon. The green-grey and red-brown claystones have poor TOC values.

Rock-Eval Pyrolysis

Zone A (640 - 850m).

Two samples from this section were pyrolysed on a Rock-Eval instrument. The sample from 640m has a moderate/low HI and a low OI indicating kerogen type III. The sample from 750m has a low HI and high OI indicating kerogen type IV (inertinite or reworked material). Both samples have poor source rock potential. The low production index and T_{max} indicate that the samples are immature.

Zone B (1100 - 2600m).

A total of 19 samples from this zone were pyrolysed. The zone can be subdivided into three zones. An upper zone (1100 - 1150m) with type III kerogen and fair potential for gas, a middle zone (1150 - 1800m) still with type III kerogen but rather higher HI with a fair potential for gas and a lower zone (1800 - 2600m) with kerogen types III and III/IV the source potential varies from fair - poor. The low production indices indicate that these samples are immature.

Zone C (2600 - 2800m).

One sample from this zone was pyrolysed. The low HI indicates a type III kerogen.

Zone D (3500 - 3536m).

One sample from this zone was pyrolysed. The limestone (3506m) contains type II/IV kerogen (low HI high OI) and has poor source potential. The sample has a low production index and low T_{max} indicating that it is immature.

Zone E (3536 - 3800m).

A total of twenty samples from this zone were pyrolysed. The pyrolyses were carried out on the same claystone throughout the zone. The claystone shows some variations in hydrogen index through the zone. The top claystone sample (3542m) contains type III kerogen and has fair potential for gas. For the rest of the zone the kerogen is type II and type II/III. The sample at 3578m contains type II kerogen. The sample at 3749m is a coal hence the low OI and very high TOC. Zone E can be sub-divided on the basis of source rock potential: -from 3551 - 3641m there is a good potential for oil and gas: from 3641 - 3800m

there is a rich potential for oil and gas. The T_{max} and production indices are all low indicating that the samples are immature to moderate mature.

Zone F (3540 - 3800m).

Nine samples from this zone were pyrolysed. 3 claystone zones can be distinguished from the rock eval results and the lithology. An upper dark brown claystone (3851 - 3899m) containing type III kerogen. The samples are moderate mature with low production indices and have a fair potential for gas. A middle zone of dark claystone (3950 - 4001m) containing types II/III kerogen. These samples show rich potential for oil and gas (this claystone is described as an occasionally very carbonaceous and it is possible that these samples (3950m and 4001m) are not representative of the whole lithology). A lower paler claystone (4049 - 4250m) which contains type III kerogen. The source potential increases from poor to good through the zone. The T_{max} values are higher in this zone and the production indices are higher indicating that the samples are moderate mature to early mature.

Extraction and Chromatographic Separation

Zone A (640 - 850m)

No samples from this zone was extracted.

Zone B (1100 - 2600m)

3 samples from this zone were extracted. They show increasing extractability downwards through the zone from fair (1200m) to rich (1800m). The amount of hydrocarbons (p.p.m.) in the rock shows the same trend. When the results are normalised to organic carbon the extractability is seen to increase downwards even though the total amount of organic carbon decreases. The percentage of hydrocarbons in the extract decreases with depth. The amount of hydrocarbons is high for samples that are seen from other analyses (Rock-Eval etc.) to be immature. The high values may be caused by the presence of migrated hydrocarbons. The ratio of extractable hydrocarbons to organic carbon (mg HC/g. TOC) increases down through the zone from poor to rich. The saturate/aromatic ratios are high in this zone (with the exception of the sample at 1200m (M-9752) another indication of the presence of migrated hydrocarbons.

The gas chromatograms of the saturated hydrocarbon fractions show low pristane/phytane ratios and pristane/ nC_{17} ratios (possibly due to migrated hydrocarbons from a more mature source). The high CPI values indicate that the samples are immature. The distribution of the saturated hydrocarbons also shows the immaturity of these samples. M-9752 has a large peak at nC_{17} and there is noticeable odd carbon number dominance between nC_{25} and nC_{31} . The bimodal distribution of alkanes indicates mixed terrestrial and marine organic matter input. The gas chromatograms of the bottom two samples show a different n-alkane distribution with a smooth envelope of lower molecular weight alkanes and a lower amount of C_{25}^+ alkanes than seen in sample M-9752. This distribution probably represents migrated hydrocarbons rather than indigenous hydrocarbons. The n-alkane distribution is indicative of either a light oil or could be contamination as a result of using diesel as a mud additive.

Zone C (2600 - 2800m).

No samples from this zone were extracted.

Zone D (3500 - 3536m).

No samples from this zone were extracted.

Zone E (3536 - 3800m).

Nine samples from this zone were extracted, all with the exception of sample M-9609 (3560m) show rich extractability (sample M-9776 has a very high abundance of extractable organic matter as it is a coal). The concentrations of hydrocarbons in the rock sample varies through the zone but all samples are rich i.e. over 500 p.p.m.. The samples show good to rich extractability when normalised to organic carbons (except M-9609). Most of the samples contain under 35% hydrocarbons in the total extractable organic matter indicating that they are immature. The samples at 3560m and 3677m contain rather high proportions of hydrocarbons. This may be due to the presence of migrated hydrocarbons. The ratio of saturated/aromatic compounds is below 1 (i.e. low in saturates) except for the top two samples in the zone. The gas chromatograms of the saturated fractions show a general decrease in CPI over the whole range of samples. The lower CPI values in some samples are possible cases of migrated hydrocarbons for example M-9609 (3560m) which shows a high proportion of hydrocarbons in extractable organic matter and a lower CPI value. The pristane/phytane ratios fluctuate and are fairly high. The coal sample at 3749m shows very high pristane/phytane and pristane/nC₁₇ (this has often been observed in coals). The gas chromatograms indicate a slight variation in organic matter type through the zone but generally indicate type II/III organic matter with varying amounts of type III terrestrial components. Sample M-9611 shows a mainly type II input. One of the samples, M-9609 shows possible phthalate contamination (not conclusively identified) after the C₁₉ n-alkane peak.

Zone F (3800 - 4290m).

Three samples from this zone were extracted. All show rich extractability. The concentration of extractable organic matter increases with depth in this zone. The concentration of extractable hydrocarbons in the samples varies from good to rich. The percentage of hydrocarbons present in the extractable organic matter is low indicating that the samples are immature. The extractability normalised to organic carbon varies: at 3851m, rich: at 3899m, poor and at 4001m fair/good. The samples at 3899m and 4001m are especially low in hydrocarbons and

high in NSO compounds. The high NSO content is another indicator of immaturity. The ratio of saturated/aromatic compounds is under 1 (i.e. low). The gas chromatograms of the saturated fractions show a variation in pristane/phytane ratio: low in the middle of the zone although extractions were carried out on the same lithology throughout. The pristane/ nC_{17} shows a similar variation. The CPI values are approximately the same for all three samples. The distribution of n-alkanes is very similar for the top and bottom samples. The middle sample (3899m) has a large peak at nC_{19} . The saturated hydrocarbon gas chromatographic patterns are all dominated by the n-alkane envelope from C_{12} to C_{25} (maximum at nC_{15}). The distributions suggest that migrated hydrocarbons dominate.

Aromatic Hydrocarbons

Zone B (1200 - 1800m).

Three samples from this zone were analysed. Several groups of compounds have been tentatively identified: naphthalene, alkyl naphthalenes, phenanthrene, methyl phenanthrenes and undifferentiated aromatised steranes and triterpanes. A number of contaminants (peaks marked X on gas chromatograms) are present. These have not been identified. In sample M-9752 (1200m) the gas chromatogram is dominated by aromatised steranes and triterpanes characteristic of immature samples. In the other two samples the aromatised steranes and triterpanes are less dominant. The lower amount of the first methyl phenanthrene doublet is also an indication of low maturity. The lower two samples contain relatively high amounts of alkyl naphthalenes indicating a contribution from type II organic matter. The phenanthrenes present indicate some type III contribution. There is an increasing amount of unresolved material (NSO) downwards through the zone.

Zone E (3536 - 3800m).

Nine samples from this zone were analysed. The methyl phenanthrene ratio indicates that the samples are immature throughout the zone although the gradual decrease in the amount of aromatised steranes and triterpanes indicates increasing maturity. The amount of unresolved material fluctuates through the zone but is least in those samples where the naphthalenes predominate. In most samples the C_1 -naphthalenes dominate (i.e. compounds marked A in gas chromatograms). In the top four samples phenanthrene (P) and C_1 -phenanthrenes (D) are more prominent than in the rest of the samples from this zone and zone F. The coal towards the base of the zone is marked by having abundant C_2 and C_3 naphthalenes. This feature is not seen in samples of coaly or carbonaceous claystones from zones E or F, eg. M-9777, M-9778, M-9779 and M-9781. This is probably due to an important contribution from light aromatic hydrocarbons i.e. C_{1-17} , naphthalene rich, in these samples.

Zone F (3800 - 4290m).

Three samples in this zone have been analysed. The aromatic gas chromatograms are very similar. The methyl phenanthrene ratios indicate that all the samples are immature. The traces are dominated by the naphthalenes with lesser amounts of the phenanthrenes indicating type II/III organic matter.

Pyrolysis GC

Fifteen samples were analysed by pyrolysis-Gc. The instrumental conditions are discussed in the experimental section. The results are discussed below. The numbered peaks are alkene/alkane doublets of the corresponding carbon number. The n-alkanes have the shorter retention time. T = toluene, X = M+P xylenes and N = naphthalene. The pyrograms give a gas chromatographic picture of the S₂ peak in Rock-Eval pyrolysis.

Zone A

No samples pyrolysed.

Zone B

Three samples have been analysed. The GC's of M-9752 and M-9764 are dominated by the alkene/alkane homology which extends from C₁ - C₂₃. In M-9760 the aromatic component is more dominant. The naphthalenes are in relatively high concentration relative to the nC₁₃ alkene/alkane and the alkene/alkane homology does not extend as far (to higher carbon numbers) as does that in M-9752 and M-9764. Sample M-9752 contains some poorly resolved wide peaks between nC₁₁ and nC₁₄. The M-9752 and M-9764 traces indicate a type II/III kerogen. M-9776 appears to contain a larger amount of type III material.

Zone C

No samples pyrolysed.

Zone D

No samples pyrolysed.

Zone E

10 samples in this zone were pyrolysed. The GC traces are all fairly similar. They are generally dominated by the alkene/alkane homology. Usually nC₁ - nC₂₇ although the extent of this homology varies with variation in the input of plant waxes. In one sample in M-9776 it extends to nC₃₂. There are varying abundances of aromatic compounds present. Samples M-9624 and M-9777 contain a greater amount of aromatic material but generally the differences are fairly minor. The pyrolysis-gc results indicate type II/III and III/II kerogen. Sample M-9622 contains a lower amount of aromatics.

Its alkene/alkane homology shows a bimodal distribution with maxima at nC_{13} and nC_{17} and a lower alkene/alkane ratio than the other samples.

Zone F

3 samples from this zone were pyrolysed. Samples M-9778 and M-9781 have similar traces although M-9778 shows a larger relative amount of pristane. The pyrogram for M-9779 shows a smaller range of alkenes/alkanes extending from C_1 - C_{21} and has a larger abundance of aromatic material reflecting a greater contribution of type III organic matter to the kerogen. Kerogen type III/II.

Examination in Reflected Light

Sample M-9748, 750m: Sandstone and shale traces, $R_o = 0.33$ (3) and 0.88 (2)
The sandstone is barren. There is one loose coal fragment of high reflectance - probably contaminant/additive. There are a few shale cuttings with heavy bitumen staining and vitrinite particles. Ultra-violet light shows a trace of yellow and yellow/orange fluorescence.

Sample M-9750, 1100m: Sandstone and shale traces, $R_o = 0.28$ (2)
The sample is virtually barren with only two vitrinite particles in the shale content. No fluorescence is observed.

Sample M-9752, 1200m: Calcareous shale, $R_o = 0.32$ (20)
The sample has a moderate to strong overall bitumen staining with only a trace of vitrinite and inertinite particles. Ultra-violet light shows a low content of spores fluorescing green/yellow.

Sample M-9754, 1300m: Shale, $R_o = 0.33$ (20)
The sample has a moderate to strong overall bitumen staining. There is a low content of inertinite particles and a trace of vitrinite particles. There is a low to moderate content of green/yellow fluorescing spores.

Sample M-9755, 1350m: Shale, $R_o = 0.37$ (12)
There is a moderate to strong overall bitumen staining. There is a low content of inertinite and reworked vitrinite particles with only a trace of small vitrinite particles. Ultra-violet light shows green/yellow and light orange fluorescence from a low spore content.

Sample M-9757, 1460m: Shale, $R_o = 0.40$ (13)
The sample has a high content of strong bitumen staining and wisps with a low content of inertinite and reworked vitrinite particles. There is a trace of primary vitrinite particles. Ultra-violet light shows a low content of green/yellow spores.

Sample M-9759, 1550m: Marl and shale, $R_o = 0.32$ (5) and 0.57 (9)
The sample has a moderate to strong overall bitumen staining and plentiful wisps and blobs. There is a low content of inertinite and reworked vitrinite particles with only a trace of primary vitrinite particles. Ultra-violet light shows a low content of green/yellow fluorescing spores.

Sample M-9761, 1650m: Marl, Ro = 0.36 (3)

There is a high content of bitumen wisps and blobs with a moderate overall bitumen staining. There is only a trace of phytoclasts dominantly reworked vitrinite and three possible primary vitrinite particles. No fluorescence is observed.

Sample M-9764, 1800m: Shale, Ro = 0.39 (7)

The sample has a moderate bitumen staining and a high content of strong wisps and blobs. There is a trace of phytoclasts and a trace of reworked sediment and vitrinite wisps. Yellow and yellow/orange fluorescence is seen from a low spore content.

Sample M-9766, 1900m: Limestone and Shale, Ro = 0.45 (7)

The organic material in this sample is almost exclusively bitumen wisps and light to moderate bitumen staining in the shale fraction. There is a trace to low content of reworked and primary vitrinite particles. Ultra-violet light shows a low content of yellow spores.

Sample M-9768, 2100m: Shale, No Determination Possible

The sample has a high content of bitumen wisps and bitumen staining and a low content of inertinite particles but no vitrinite is recorded. No fluorescence is observed.

Sample M-9771, 2395m: Shale, Ro = 0.61 (8)

The sample has a moderate content of small bitumen wisps and staining. There is a trace of small reworked and primary vitrinite particles. The lowest Ro material was measured. There is a low content of yellow and yellow/orange spores.

Sample M-9772, 2500m: Shale, Ro = 0.49 (1) and 0.65 (1)

There is a low organic content. This is dominantly bitumen wisps. There is a variable but subordinate inertinite and reworked vitrinite content. Only two possible primary vitrinite particles are located. There is a low content of yellow/orange spores.

Sample M-9774, 2700m: Marl, Ro = 0.31 (20)

The sample has a moderate to strong bitumen staining together with bitumen wisps and blobs. There is a low content of small vitrinite particles and wisps and a trace of inertinite. Yellow/orange spore fluorescence is observed in low amounts.

Sample M-9604, 3509 - 3515m: Shale and limestone, No Determination Possible
The sample contains only small rounded inertinite and reworked particles with a trace of bitumen/resin smears. It is a poor sample. No fluorescence is observed.

Sample M-9605, 3518 - 3524m: Pyritic shale, $R_o = 0.52$ (8)
The sample is dominated by bitumen wisps but there is a low content of small primary vitrinite and reworked vitrinite particles. The low R_o vitrinite was measured. Fluorescence is seen from hydrocarbons.

Sample M-9608, 3545 - 3551m: Pyritic shale and siltstone, $R_o = 0.71$ (3)
The organic material is restricted to a couple of silt wisps. There are very few vitrinite particles and nothing of low R_o . Yellow and yellow/orange fluorescence is seen from hydrocarbons.

Sample M-9611, 3572 - 3578m: Shale, $R_o = 0.45$ (20)
The sample has a moderate organic content with bitumen wisps and light staining. There is a moderate content of inertinite and reworked vitrinite particles with only subordinate vitrinite wisps and particles. There is a moderate to rich content of yellow and yellow/orange spores.

Sample M-9613, 3590 - 3596m: Shale, $R_o = 0.54$ (5)
The sample has a moderate content dominated by inertinite and reworked vitrinite. There is also a locally high bitumen content. There is a low vitrinite content and a poor distribution of values. A low content of yellow/orange spores is observed.

Sample M-9615, 3608 - 3614m: Shale and siltstone, $R_o = 0.65$ (20)
The sample has a moderate to strong overall bitumen staining and content of bitumen wisps. There is a moderate content of inertinite and reworked vitrinite particles but only subordinate vitrinite particles and wisps. A moderate content of yellow and yellow/orange spores is seen in ultra-violet light.

Sample M-9617, 3626 - 3632m: Marl and shale, $R_o = 0.58$ (21)
The sample contains a light to moderate bitumen staining and a moderate content of bitumen wisps. There is also a low to moderate content of inertinite, reworked vitrinite and subordinate vitrinite particles. There is a moderate content of yellow/orange fluorescing spores.

Sample M-9619, 3644 - 3650m: Shale, Ro = 0.62 (20)

The sample contains moderate bitumen staining and plentiful bitumen wisps. There is a moderate inertinite and reworked vitrinite content with subordinate vitrinite particles and wisps. Ultra-violet light shows a moderate amount of yellow/orange fluorescence from spores and hydrocarbons wisps.

Sample M-9620, 3653 - 3659m: Shale, Ro = 0.62 (7)

The sample has a moderate to high organic content. This is dominantly inertinite and bitumen/bitumen staining. There is very little measurable vitrinite and most of this is small and gnarled. There is a poor distribution of values. There is a moderate content of yellow/orange to light orange spores.

Sample M-9622, 3671 - 3677m: Sandy shale, Ro = 0.61 (20)

The sample has a high organic content. This is dominantly inertinite but there are some areas with very heavy bitumen staining. There are a few good vitrinite stringers. There is a moderate content of yellow/orange and light orange spores.

Sample M-9624, 3701 - 3707m: Shale and silty shale, Ro = 0.58 (20)

There is a moderate overall content of bitumen staining and bitumen wisps. There is a moderate amount of inertinite and reworked vitrinite particles but subordinate vitrinite particles and wisps. There is a moderate content of yellow/orange fluorescing spores.

Sample M-9626, 3719 - 3725m: Shale, Ro = 0.59 (20)

The sample has a moderate to strong overall bitumen staining. There is a moderate content of vitrinite wisps and particles with subordinate inertinite. Ultra-violet light shows a moderate content of yellow and yellow/orange spores.

Sample M-9776, 3749m: Mixed shales, Ro = 0.61 (20)

The sample contains strong bitumen staining with a moderate content of vitrinite wisps and particles together with inertinite and reworked vitrinite wisps. There is a moderate to high content of light orange fluorescing spores.

Sample M-9777, 3800m: Shale and siltstone, Ro = 0.54 (20)

There is a strong overall bitumen staining with a low to moderate content of inertinite and reworked vitrinite particles and subordinate vitrinite particles and wisps. Ultra-violet light shows a moderate content of spores fluorescing light orange.

Sample M-9778, 3851m: Mixed shales, siltstones and carbonate, Ro = 0.61 (20)

Most cuttings contain strong bitumen staining and there is a moderate content of vitrinite particles with equal proportions of reworked and primary material. There is a trace to low content of yellow/orange and light orange fluorescence from spores.

Sample M-9779, 3890m: Mixed shales, Ro = 0.66 (7)

There is a variable strong bitumen staining throughout but phytoclasts are restricted to the silty cuttings and are dominantly inertinite and reworked vitrinite particles with subordinate primary vitrinite. There is a low to moderate content of mid-orange fluorescence from spores.

Sample M-9780, 3950m: Mixed shales and silt, Ro = 0.61 (20)

There is a moderate to strong bitumen staining and a moderate content of bitumen wisps. There is a moderate to high content of inertinite and reworked vitrinite particles and wisps. One coal particle is observed. There is a moderate to rich content of mid-orange to deep orange spores.

Sample M-9781, 4001m: Coal and shale, Ro = 0.76 (26)

The coal is normal and clean but inertinite rich. The shale is also organic rich. This is a good sample. Fluorescence is seen from mid-orange and deep orange spores.

Sample M-9783, 4100m: Mixed shales, Ro = 0.75 (25)

The sample has a moderate bitumen staining with a low to moderate content of vitrinite wisps and particles with a trace of reworked material. No fluorescence is observed.

Sample M-9784, 4150m: Shale, Ro = 0.77 (25)

The sample has signs of oxidation. There is a moderate content of bitumen staining and bitumen wisps. There is a low to moderate content in equal proportion of inertinite and vitrinite stringers and particles.

Ultra-violet light shows a low to moderate content of deep orange fluorescing spores.

Sample M-9785, 4199m: Shale, Ro = 0.76 (15)

The sample has a very variable organic content from clast to clast. There are some very good vitrinite stringers but bitumen is dominant. There is almost no inertinite. There is a moderate content of spores fluorescing deep orange.

Analyses in Transmitted Light

The sedimentary organic matter of well 15/8-1 has been evaluated on the basis of 38 samples. The material used for chemical processing are picked lithologies from ditch cuttings.

There is a relatively large number of samples, but they have been taken at irregular intervals. It is not possible, from the organic material alone, to tell the exact boundaries of the proposed zones. Apparently the boundaries are confined within the intervals lacking sample representation.

Based both on the relative composition and preservation of the sedimentary organic matter (including the palynomorphs), and the evaluated colour indices, we have subdivided as follow:

750m to 1100m	TAI <1
1200m to 2100m	TAI 1/1+
2395m to 2700m	TAI 1+
3509m to 3515m	
3545m to 3560m	TAI 2-
3572m to 3596m	TAI 2-
3608m to 3725m	TAI 2-/2
3749m	TAI 2
3800m to 3851m	TAI 2-/2
3899m	TAI 2
3950m to 4100m	TAI 2
4150m	TAI 2+/3-
4199m	TAI 2+/3-

750m and 1100m

The small residues contain aggregates of strongly degraded material probably derived from terrestrial sources. The lower sample is distinguished by a larger content of dark reworked fragments.

Colour index: 1-/1 and 1/1+.

1200m to 2100m

The pyritic residues consist of aggregates of strongly degraded material mostly of woody origin. True amorphous material is subordinate and diffi-

cult to distinguish from the degraded woody material. Palynomorphs are well represented but obscured by the organic matrix in which they are embedded.

Colour index: 1, 1/1+.

2395m to 2700m

Smaller residues with more well dispersed material than in the above interval. Woody material dominates and is less sapropelised in the upper samples (2395m, 2500m) than in the interval above.

Colour index: 1/1+, 1+/2-.

3509/15m

Very little organic material, mostly reworked woody particles. The colours are variable. Contaminants are present and the results have low confidence.

Colour index: N.D.P.

3545m to 3560m

Two residues where aggregates embed minute opaque adhering particles. Those are the main reason for our low confidence in the evaluated results. There seems to be a dominant terrestrial source for the strongly sapropelised material. There is some semifusinite/fusinite. Abundant palynomorphs include dinoflagellate cysts. The amount of true amorphous material was difficult to estimate.

Colour index: 2-.

3572m to 3596m

Well dispersed material mainly of woody origin. Abundant well preserved palynomorphs include mainly pollen and dinoflagellates. Contaminants from higher levels were rather common and we suspect that caved lithologies were present in the sample.

Colour index: 2-, 2-/2.

3608m to 3725m

The residues of this interval are fairly large, pyritic and have a strong woody component. Degraded woody material may form aggregates and embed particulate matter (semifusinite/fusinite, cuticles, pollen, spores and dinoflagellates). The relative amount of semifusinite/fusinite is high. Cuticles and pollen/spores are well preserved and regularly observed, and suggest that the deposition took place fairly close to vegetated

land areas. True sapropel seem subordinate.

Colour index: 2-/2, 2.

3740m

Dominantly woody (coaly) material. Subordinate, well preserved spores, and pollen and some cuticles.

Colour index: 2.

3800m to 3851m

As for 3701m to 3725m above, dominantly sapropelised woody material and semifusinite/fusinite. Some pyrite. The pollen grains are fairly well preserved. True sapropel is subordinate.

Colour index: 2-/2.

3899m

Small residue of well dispersed material. Rich in contaminants from layers above. Low confidence.

Colour index: 2, 2/2+.

3950m to 4100m

The residues contain mainly coaly particles which apparently have a major woody component. Well preserved spores and cuticles. The two lower residues, 4049m and 4100m, seem to contain more particulate material but also coaly fragments. Palynomorphs are well preserved.

Colour index: 2, 2/2+, 2+/3-. The variation is thought to be due to natural oxidation.

4150m

The residue is dominated by terrestrial material and was distinguished from 4049m and 4100m above only on the basis of higher colour index.

The apparently higher maturity could be environmentally controlled and too high as a maturation parameter.

Colour index: 2+/3-.

4199m

A flocculated to disperse matrix, mostly of sapropelised terrestrial material. Well preserved pollen and spores.

Colour index: 2+/3-, 3-.

CONCLUSIONS

The maturity of the analysed samples from well 15/8-1 is based mainly on vitrinite reflectance, kerogen colour in transmitted light and $T_{\max}$ values from Rock-Eval analysis. The richness of the samples is based on TOC, Rock-Eval pyrolysis with additional information being supplied from light hydrocarbon-concentrations and the abundance of extractable hydrocarbons. Source rock quality is based mostly on Rock-Eval pyrolysis with additional evidence coming from visual kerogen examination and from the saturated hydrocarbon gas chromatograms and from pyrolysis gas chromatography.

Zone A (640 - 850m).

This zone consists mainly of sandstone with lesser amounts of sandy claystone. The sandstone is barren and the claystone contains very little organic matter (TOC and reflected light examinations). There is poor source potential in this zone.

Zone B (1100 - 2600m).

The lithology is dominantly claystone with the exception of the top sample. The claystone is rich in organic carbon (over 2%) although amounts vary through the zone. The claystone contains type III and type III/IV kerogen and shows a very low HI. Rock-Eval results indicate that the samples are immature, this is in agreement with vitrinite reflectance results which indicate that the samples are immature to moderate mature. Fluorescence results also indicate immaturity. Fluorescence also indicated the possible presence of migrated hydrocarbons either a light oil or diesel contamination (from mud additive).

Zone C (2600 - 2800m).

The lithology in this zone is dominantly sandstone with minor amounts of claystone. The organic carbon content varies from fair to good. Rock-Eval results indicate type III kerogen with fair potential for gas. Vitrinite reflectance results indicate that the sample is immature.

Zone D (3500 - 3536m).

The dominant lithology in this zone is marly limestone. A dark claystone rich in organic carbon appears towards the base of the zone. Rock-Eval results indicate type III and type III/IV kerogen and a poor to fair potential for gas. Vitrinite reflectance indicates that the samples

are immature to moderate mature. Fluorescence indicated the presence of hydrocarbons but fluorescence maturity measurements were not possible in these samples.

Zone E (3536 - 3800m).

There are various lithologies in this zone but claystone dominates. There are local bands of limestone and of coal. The claystone is rich in organic carbon throughout the zone. The Rock-Eval analyses show that, with the exception of one sample, the claystone contains type II/III kerogen. This is in agreement with the visual kerogen analysis which shows a moderate to high exinite content. The zone can be divided into two on the basis of source rock potential: from 3551 - 3641m there is good potential for oil and gas and from 3641 - 3800m there is rich potential for oil and gas. The Rock-Eval results indicate that the samples are immature to moderate mature. The vitrinite reflectance results indicate that they are moderate mature to mature. Bitumen staining and fluorescence from hydrocarbons is also seen in these samples. The fluorescence results indicate moderate maturity.

Zone F (3800 - 4298m).

The dominant lithology in this zone is dark claystone good to rich in organic carbon except at the base where a number of claystones of varying organic content appear. Rock-Eval results distinguish 3 zones of potential in this depth interval. An upper dark brown claystone containing type III kerogen with fair potential for gas, a middle claystone zone containing type II/III kerogen with rich potential for oil and gas and a lower claystone zone containing type III kerogen with fair to good potential for gas. The Rock-Eval measurements indicate that the samples are moderate to early mature, the vitrinite reflectance results and fluorescence results are in agreement with this.



Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9747	640	0.86	Small sample 25% Sand, fine - medium, coarse, subangular - subrounded 10% Foraminifera and shell fragments 15% Clay, grounded fragments, stained brown 50% Clay, sandy, greenish - olive grey Sm.am. "Pipe dope"
M-9748	750	0.90	70% Sand, medium, coarse, very coarse, fine subangular, subrounded, some rounded, mostly quartz, some rock fragments, feldspar 25% Claystone, as above 5% Claystone, purple brown, micromicaceous Sm.am. Shell fragments
M-9749	850	0.59	60% Sand, quartz, mainly fine - medium, coarse, rock fragments, coarse very coarse, granules, else as above 40% Clay, olive - greenish grey Sm.am. Pyrite; Claystone, purple brown; Siderite
M-9750	1100	1.90	75% Sand, quartz, clear, fine - medium, coarse, subrounded, some rounded 4% Shell debris 6% Glauconite, deep green, fine - medium 15% Claystone, olive grey, brownish grey, brown, occasionally sandy, micromicaceous, some with spicules



IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9751	1150	0.96	90% Sandy Claystone, light brownish, olive grey, micaceous, often with sponge spicules 10% Siderite/sideritic Claystone, olive grey (yellowish) Abundant Sand, fine - medium, subangular - subrounded Sm.am. Glauconite Trace Coal (as a rather large fragment)
M-9752	1200	2.29	100% Claystone, olive grey, brownish olive grey, micaceous, with abundant sponge spicules, slightly pyritic Sm.am. Sand, fine - medium; Siderite
M-9753	1250	2.86	90% Claystone, brown (olive) with abundant sponge spicules, small shell fragments, observed with glauconite 10% Claystone, olive grey, as above
M-9754	1300	2.62	10% Cement 90% Claystone, brown (olive) as above Abundant Coal (?additives)
M-9755	1350	1.99	100% Claystone, brown, micaceous with sponge spicules Sm.am. Shell fragments
M-9756	1400	3.23	100% Claystone, dark brown, brown - light brown, as above Trace Glauconite



Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9757	1450	3.75	97% Claystone, dark brown, as above 3% Claystone, light brown - olive grey Trace Sandstone, very fine - fine
M-9758	1500	3.22	100% Claystone, dark brown, brown - light brown, as above Sm.am. Shell fragments; Sand, medium, subrounded - rounded
M-9759	1550	2.60	100% Claystone, dark brown, micromicaceous Abundant Glauconite Sm.am. Secondary Calcite, yellowish brown; Dolomite/dolomitic Claystone, grey; Pyrite
M-9760	1600	2.32	100% Claystone, dark brown, brown (olive), micromicaceous - micaceous, the dark brown often vich in foraminifera and sponge spicules Sm.am. Claystone, light brownish grey
M-9761	1650	1.99	100% Claystone, as above Sm.am. Glauconite
M-9762	1700	1.76	100% Claystone, dark brown - brown, less micaceous than above
M-9763	1750		Lost in trip
M-9764	1800	1.73	100% Claystone, dark brown - brown (greyish), as M-9762, occasionally very slightly carbonaceous Sm.am. Sphaerosiderite



Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9765	1850	1.63	100% Claystone, brownish grey, brown, micaceous, micromicaceous, slightly pyritic (framboidal) Trace Siderite (succrosic)
M-9766	1900	1.09 0.79	85% Claystone, brownish grey, as above 15% Claystone, greenish, non-micaceous, slightly subfissile Sm.am. Sandstone, very fine, subangular, glauconitic; Sideritic, Claystone, pale brown
M-9767	2000	0.99 1.62	5% Sand, quartz, clear, mostly medium rounded 80% Claystone, greenish, slightly micaceous 15% Claystone, brownish grey, as above
M-9768	2100	1.61	90% Claystone, brownish grey, micromicaceous, occasionally with sponge spicules, slightly pyritic 3% Sand, medium, fine, mostly subrounded - rounded 7% Claystone, greenish, subfissile Sm.am. Siderite (succrosic)
M-9769	2200		Sample missing



IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9770	2295	0.74	90% Claystone, pale greenish/bluish grey, very slightly micromicaceous, subfissile 7% Claystone, light brownish grey, as above 3% Sand, sandstone, fine, subangular - subrounded
M-9771	2395	0.31 1.04 1.16	25% Claystone, red-brown, subfissile 50% Claystone, greenish/bluish grey, as above 20% Claystone, brownish grey 5% Claystone, dark grey Sm.am. Limestone, light brownish white
M-9772	2500	0.91	5% Claystone, red-brown - purple, as above 90% Claystone, pale greenish grey, subfissile 5% Claystone, light brown
M-9773	2600	1.42 0.43	15% Sand, clear, coarse, medium, very coarse, mostly rounded 5% Claystone, red-brown 25% Claystone, brown - brown-grey, micaceous 55% Claystone, green (light), greenish grey, slightly bluish grey Sm.am. Claystone, dark brown, with sponge spicules



Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9774	2700	0.60 1.29	40% Sand, quartz, medium, coarse, fine, subrounded, rounded, etched surface 30% Claystone, grey - greenish grey 20% Claystone, light - pale brown 10% Sandstone, fine, medium, subangular - subrounded, calcareous, occasionally carbonaceous (woody Coal fragments) Sm.am. Claystone, red-brown
M-9775	2800	1.09	75% Sand, quartz, coarse, medium, mostly subrounded, rounded, etched surface 25% Claystone, grey - greenish grey, occasionally dark grey Sm.am. Claystone, light - pale brown, red-brown
M-9603	3500-3506	0.38	95% Limestone, marly, very slightly greenish white - greyish white 5% Claystone, light grey, calcareous Sm.am. Claystone, red-brown
M-9604	3509-3515	0.41	95% Limestone, as above, somewhat darker 3% Claystone, pale red-brown, calcareous 2% Claystone, grey, calcareous Sm.am. Claystone, grey - dark grey
M-9605	3528-3524	0.27	As above
M-9606	3527-3533	0.28	15% Claystone, red-brown 5% Limestone, light greyish white 80% Marl/marly Limestone, grey - light grey Sm.am. Claystone, dark grey



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Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9607	3536-3542	4.26	20% Claystone, dark olive black, pyritic, rounded fragments 10% Limestone, as above, occasionally pink 30% Marly Limestone, as above 40% Claystone, green - greenish grey Trace Sand, quartz, fine - medium, subangular, subrounded
M-9608	3545-3551	4.86	65% Claystone, dark olive black, as above 3% Limestone, as above 2% Claystone, red-brown 5% Marly Limestone, as above 25% Claystone, green, greenish grey
M-9609	3554-3560	4.70	80% Claystone, dark olive black, as above 15% Claystone, green, greenish grey 4% Claystone, red-brown 1% Limestone Sm.am. Claystone, Claystone, black, subfissile
M-9610	3563-3569		As above
M-9611	3572-3578	4.25	5% Claystone, red-brown 3% Limestone, greyish white 12% Claystone, grey - greenish grey, greenish 80% Claystone, black, pyritic, carbonaceous, micromicaceous Trace Sand, quartz, fine - medium, subrounded, some well rounded



IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9612	3581-3587	4.90	90% Claystone, dark brownish grey - black 5% Limestone, greyish white 2% Claystone, red-brown 3% Claystone, grey - greenish grey
M-9613	3590-3596	5.60	3% Claystone, red-brown 10% Limestone, greyish white, pink 10% Claystone, grey, greenish grey 77% Claystone, dark brownish grey - black, carbonaceous, micromicaceous, pyritic, occasionally with some Coal Trace Sand, as above
M-9614	3599-3605	5.56	3% Claystone, red-brown 10% Limestone, greyish white, some brownish white 10% Claystone, grey - greenish grey, slightly bluish grey 77% Claystone, as above, somewhat lighter, partly subfissile Sm.am. Sand, as above
M-9615	3608-3614	5.27	2% Claystone, red-brown 13% Limestone, greyish white, occasionally pyritic 30% Claystone, greenish grey 50% Claystone, dark grey - black, carbonaceous Trace Sand, quartz, fine, subangular - subrounded; Pyrite



IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9616	3617-3632	3.16	5% Claystone, red-brown 60% Limestone, grey, greyish white, light brownish white 5% Claystone, greenish grey 30% Claystone, dark grey - black, as above
M-9617	3626-3632	3.16	5% Claystone, red-brown 60% Limestone, grey, greyish white, light brownish white 5% Claystone, greenish grey 30% Claystone, dark grey - black, as above
M-9618	3635-3641	3.82	3% Claystone, red-brown 52% Limestone, as above 10% Claystone, greenish grey, grey 35% Claystone, dark grey - black, as above Sm.am. Pyrite
M-9619	3644-3650	6.98	5% Sand, quartz, clear, medium - coarse, subangular 2% Sandstone, clear, fine, subangular 2% Claystone, red-brown 13% Limestone, as above 18% Claystone, greenish grey 60% Claystone, dark grey - black
M-9620	3653-3659	5.23	50% Sand/Sandstone, quartz, clear, milky white, light brownish white, coarse, medium, some fine, subangular, subrounded 10% Limestone, greyish white, subfissile 10% Claystone, greenish grey 30% Claystone, dark grey - black



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Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9621	3662-3668		Sample missing
M-9622	3671-3677	5.20	85% Claystone, black (brownish), micromicaceous, lustrous, pyritic, subfissile 10% Limestone, greyish white 5% Claystone, greenish grey Sm.am. Claystone, red-brown Trace Sand, fine, medium; Coal
M-9623	3683-3689	6.32	25% Limestone, greyish white 25% Claystone, greenish grey 10% Coal 40% Claystone, dark grey - black Sm.am. Claystone, red-brown
M-9624	3701-3707	7.76	20% Limestone, greyish white 10% Claystone, greenish grey 3% Sand, quartz, fine - medium, subangular 67% Claystone, dark grey - black, carbonaceous, occasionally subfissile Sm.am. Claystone, red-brown; Coal
M-9625	3710-3716	5.41	85% Sand/Sandstone, quartz, light brownish white, medium, mostly subangular, occasionally with secondary crystall growth, argillaceous, some slightly pyritic 15% Claystone, dark grey - black Sm.am. Limestone, greyish white



IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9626	3719-3725	6.99	45% Sand/Sandstone, as above 5% Limestone, greyish white 50% Claystone, dark grey - black, as above Sm.am. Claystone, red-brown; Claystone, greenish grey
M-9776	3749	39.90	95% Coal, occasionally slightly argillaceous 5% Sandstone, fine, subangular Sm.am. Claystone, brown - brown-grey, occasionally very sandy, carbonaceous
M-9777	3800	5.02	25% Sandstone, fine - medium, subangular, argillaceous 7% Claystone, grey white, very calcareous 3% Limestone, white - brownish white 65% Claystone, occasionally sandy, dark grey - brownish grey
M-9778	3851	2.82	90% Claystone, dark brown, micromicaceous (slightly) partly subfissile, occasio- nally pyritic 7% Claystone, greyish white 3% Sandstone, fine - medium Sm.am. Coal
M-9779	3899	4.39	100% Claystone, dark brown, carbonaceous, occasionally with ?slickensides Sm.am. Gypsum/Anhydrite (?additive) often as rounded and deformed fragments



Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9780	3950	11.78	30% Claystone, dark brown - brown, slightly silty/sandy, occasionally very carbonaceous 60% Coal 10% Sandstone, greyish white - brownish white, fine - medium, argillaceous
M-9781	4001	17.84	35% Claystone, dark brown - black, with abundant thin coal lamina, micromicaceous, hard 65% Coal
M-9782	4049	2.26	25% Sandstone, white, very fine - fine, subangular, occasionally argillaceous 5% Coal 70% Claystone, (underclay) pale brownish grey - black, waxy, some slickensides, occasionally carbonaceous
M-9783	4100	0.64	20% Sandstone, as M-9782 5% Coal 75% Claystone (underclay), mainly olive grey, some pale brownish grey, waxy, occasionally carbonaceous Trace Pyrite
M-9784	4150	1.62	10% Coal 65% Claystone, grey, olive grey, as M-9783, less waxy 20% Cement



IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 15/8-1

Sample	Depth (m)	TOC	Lithology
M-9785	4199	2.77	5% Coal
			5% Claystone, dark grey
			40% Claystone, brown - brown-grey, waxy
			50% Claystone, sandy, green, red-brown
M-9786	4250	0.27	30% Claystone, green, often sandy and with claystone clasts; ?silicified w/spaero-siderite
		5.01	15% Claystone, brown, occasionally with coal strings
			55% Claystone, dark grey - black, with abundant secondary quartz or ?volcanic glass, silicified, hard
			Sm.am. Sand/Sandstone, medium
M-9787	4298	0.19	50% Claystone, green, often with red claystone clasts
		0.49	30% Claystone, red-brown - red, sandy
			5% Claystone, grey
			5% Sand, medium, fine, rounded, often red-stained
			10% Claystone, brown, often with thin coal lenses

T A B L E : 2.

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKU-No	DEPTH	Rock Extr.	EOM	Sat.	Aro.	HC	Non HC	TOC	
	(m)	(g)	(mg)	(mg)	(mg)	(mg)	(mg)	(%)	
=====									
M 9752	1200.00	9.8	2.0	0.6	0.7	1.3	0.7	2.29	I
M 9760	1600.00	35.3	23.7	7.0	3.1	10.1	13.6	2.32	I
M 9764	1800.00	14.6	16.5	4.6	1.7	6.2	10.3	1.73	I
M 9609	3560.00	11.7	2.7	0.8	0.6	1.4	1.3	4.70	I
M 9611	3578.00	9.6	26.7	4.8	3.6	8.4	18.3	4.25	I
M 9612	3587.00	4.8	15.4	2.2	2.9	5.0	10.4	4.90	I
M 9614	3605.00	31.6	116.2	12.5	15.8	28.3	87.9	5.56	I
M 9619	3650.00	37.2	152.0	21.4	26.2	47.7	104.3	6.98	I
M 9622	3677.00	8.2	38.1	5.9	9.4	15.2	22.9	5.20	I
M 9624	3707.00	28.3	119.8	8.8	13.4	22.2	97.6	7.76	I
M 9776	3749.00	6.6	239.8	15.4	15.8	31.2	208.6	39.90	I
M 9777	3800.00	33.1	128.2	20.5	21.7	42.2	86.0	5.02	I
M 9778	3851.00	42.1	93.4	14.8	19.7	34.4	59.0	2.82	I
M 9779	3899.00	47.4	198.0	9.4	10.0	19.4	178.6	4.39	I
M 9781	4001.00	8.9	210.5	11.5	13.0	24.6	185.9	17.84	I
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DATE : 28 - 1 - 83.

T A B L E : 3.

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm OF rock)

I	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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DATE : 28 - 1 - 83.

T A B L E : 4.

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
M 9752	1200.00	8.9	2.7	3.2	5.9	3.0
M 9760	1600.00	29.0	8.5	3.8	12.3	16.6
M 9764	1800.00	65.1	18.0	6.6	24.6	40.5
M 9609	3560.00	4.9	1.5	1.1	2.6	2.3
M 9611	3578.00	65.4	11.8	8.8	20.6	44.9
M 9612	3587.00	65.5	9.2	12.2	21.4	44.0
M 9614	3605.00	66.1	7.1	9.0	16.1	50.0
M 9619	3650.00	58.5	8.2	10.1	18.3	40.1
M 9622	3677.00	89.0	13.7	21.9	35.6	53.4
M 9624	3707.00	54.5	4.0	6.1	10.1	44.4
M 9776	3749.00	91.3	5.9	6.0	11.9	79.5
M 9777	3800.00	77.1	12.4	13.1	25.4	51.7
M 9778	3851.00	78.7	12.4	16.6	29.0	49.7
M 9779	3899.00	95.1	4.5	4.8	9.3	85.8
M 9781	4001.00	132.6	7.3	8.2	15.5	117.1

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T A B L E : 5.

COMPOSITION IN % OF MATERIAL EXTRACTED FROM THE ROCK

IKU-No	DEPTH	Sat	Aro	HC	SAT	Non HC	HC	I
	(m)	---	---	---	---	---	---	I
		EOM	EOM	EOM	Aro	EOM	Non HC	I
								I
M 9752	1200.00	30.0	36.0	66.0	83.3	34.0	194.1	I
M 9760	1600.00	29.4	13.2	42.5	223.1	57.5	74.0	I
M 9764	1800.00	27.6	10.2	37.8	271.4	62.2	60.8	I
M 9609	3560.00	31.1	22.2	53.3	140.0	46.7	114.3	I
M 9611	3578.00	18.0	13.5	31.5	133.3	68.5	45.9	I
M 9612	3587.00	14.0	18.7	32.7	75.0	67.3	48.6	I
M 9614	3605.00	10.7	13.6	24.4	78.8	75.6	32.2	I
M 9619	3650.00	14.1	17.3	31.4	81.7	68.6	45.7	I
M 9622	3677.00	15.4	24.6	40.0	62.8	60.0	66.7	I
M 9624	3707.00	7.3	11.2	18.5	65.2	81.5	22.7	I
M 9776	3749.00	6.4	6.6	13.0	97.0	87.0	15.0	I
M 9777	3800.00	16.0	16.9	33.0	94.6	67.0	49.2	I
M 9778	3851.00	15.8	21.1	36.9	75.0	63.1	58.4	I
M 9779	3899.00	4.7	5.1	9.8	94.0	90.2	10.9	I
M 9781	4001.00	5.5	6.2	11.7	88.7	88.3	13.2	I

DATE : 28 - 1 - 83.

T A B L E 6.

TABULATION OF DATAS FROM THE GASCHROMATOGRAMS

I	I	I	I	I	I	I	I
	IKU No.	DEPTH	PRISTANE	PRISTANE		CPI	
		(m)	n-C17	PHYTANE			
I	I	I	I	I	I	I	I
I	M 9752	1200	0.7	1.5		1.5	I
I							I
I	M 9760	1600	0.7	1.3		1.4	I
I							I
I	M 9764	1800	0.5	1.2		1.3	I
I							I
I	M 9609	3560	0.8	1.2		1.0	I
I							I
I	M 9611	3578	1.3	1.5		1.3	I
I							I
I	M 9612	3587	1.3	1.6		1.1	I
I							I
I	M 9614	3605	1.5	1.8		1.0	I
I							I
I	M 9619	3650	1.7	2.0		1.1	I
I							I
I	M 9622	3677	1.2	1.2		0.8	I
I							I
I	M 9624	3707	1.8	2.1		1.1	I
I							I
I	M 9776	3749	3.1	7.0		1.3	I
I							I
I	M 9777	3800	1.4	1.8		1.1	I
I							I
I	M 9778	3851	1.3	2.4		1.2	I
I							I
I	M 9779	3899	0.5	0.8		1.2	I
I							I
I	M 9781	4001	1.6	7.1		1.1	I
I							I

DATE : 31 - 1 - 83.

TABLE 7.

ROCK EVAL PYROLYSES

IKU No.	DEPTH m/ft	:	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT S1+S2	PROD. TEMP. INDEX S1 S1+S2	MAX (C)	I
M 9747	640	:	0.30	0.52	1.78	0.86	60	207	0.82	0.58	415	I
		:	Clst	sn - gy								I
M 9748	750	:	0.12	0.19	1.53	0.90	21	170	0.31	0.39	437	I
		:	Clst	sn - gy								I
M 9750	1100	:	0.42	1.08	2.12	1.90	57	112	1.50	0.28	418	I
		:	Clst	gy - sn - brn								I
M 9751	1150	:	0.31	0.69	1.01	0.96	72	105	1.00	0.31	417	I
		:	Clst	brn - gy								I
M 9752	1200	:	0.88	4.67	1.62	2.29	204	71	5.55	0.16	420	I
		:	Clst	gy - brn - gy								I
M 9753	1250	:	0.63	2.63	2.46	2.86	92	86	3.26	0.19	423	I
		:	Clst	brn								I
M 9754	1300	:	0.60	3.87	1.58	2.62	148	60	4.47	0.13	430	I
		:	Clst	brn								I
M 9755	1350	:	0.54	2.70	1.23	1.99	136	62	3.24	0.17	421	I
		:	Clst	brn								I
M 9756	1400	:	0.76	4.78	1.40	3.23	148	43	5.54	0.14	420	I
		:	Clst	dk - brn - brn								I
M 9757	1450	:	0.69	4.53	1.56	3.75	121	42	5.22	0.13	424	I
		:	Clst	dk - brn								I
M 9758	1500	:	0.68	3.84	1.42	3.22	119	44	4.52	0.15	426	I
		:	Clst	dk - brn - brn								I
M 9759	1550	:	0.83	3.61	1.09	2.60	139	42	4.44	0.19	421	I
		:	Clst	dk - brn								I
M 9760	1600	:	0.61	3.12	1.17	2.32	134	50	3.73	0.16	424	I
		:	Clst	dk - brn - brn								I
M 9761	1650	:	0.57	2.21	1.03	1.99	111	52	2.78	0.21	428	I
		:	Clst	dk - brn - brn								I
M 9764	1800	:	0.54	1.96	1.17	1.73	113	68	2.50	0.22	426	I
		:	Clst	dk - brn - brn								I
M 9765	1850	:	0.40	1.09	1.30	1.63	67	80	1.49	0.27	431	I
		:	Clst	brn - gy - brn								I
M 9767	2000	:	0.62	1.75	1.09	1.62	108	67	2.37	0.26	426	I
		:	Clst	brn - gy								I
M 9768	2100	:	0.45	1.56	0.88	1.61	97	55	2.01	0.22	428	I
		:	Clst	brn - gy								I
M 9771	2395	:	0.41	1.17	0.69	1.16	101	59	1.58	0.26	427	I
		:	Clst	brn - gy								I
M 9772	2500	:	0.16	0.32	0.46	0.91	35	51	0.48	0.33	429	I
		:	Clst	sn - gy								I
M 9773	2600	:	0.27	1.00	0.77	1.42	70	54	1.27	0.21	427	I
		:	Clst	brn - gy								I
M 9603	3506	:	0.18	0.16	0.30	0.38	42	79	0.34	0.53	437	I
		:	Ls	sn - wh - gy								I
M 9607	3542	:	1.50	0.99	0.54	4.26	23	13	2.49	0.60	420	I
		:	Clst	dk - blk								I

DATE : 19 - 1 - 83.

TABLE 7.

ROCK EVAL PYROLYSES

IKU No.	DEPTH m/ft	:	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT S1+S2	PROD. TEMP. INDEX S1 S1+S2	MAX (C)	I
M 9608	3551	:	2.40	15.12	0.63	4.86	311	13	17.52	0.14	421	I
		:	Clst	dk -blk								I
M 9609	3560	:	1.98	11.04	0.92	4.70	235	20	13.02	0.15	423	I
		:	Clst	dk -blk								I
M 9610	3569	:	1.97	12.53	0.90	4.47	280	20	14.50	0.14	422	I
		:	Clst	dk -blk								I
M 9611	3578	:	2.39	17.32	0.98	4.25	408	23	19.71	0.12	426	I
		:	Clst	blk								I
M 9612	3587	:	2.36	16.60	1.66	4.90	339	34	18.96	0.12	426	I
		:	Clst	dk -brn -gy								I
M 9613	3596	:	2.65	21.56	1.22	5.60	385	22	24.21	0.11	426	I
		:	Clst	dk -gy -blk								I
M 9614	3605	:	2.25	17.31	1.18	5.56	311	21	19.56	0.12	429	I
		:	Clst	dk -brn -blk								I
M 9615	3614	:	1.78	15.06	1.26	5.27	286	24	16.84	0.11	429	I
		:	Clst	dk -gy -blk								I
M 9616	3623	:	1.31	10.42	1.02	4.09	255	25	11.73	0.11	427	I
		:	Clst	dk -gy -blk								I
M 9617	3632	:	1.42	9.48	0.85	3.16	300	27	10.90	0.13	427	I
		:	Clst	dk -gy -blk								I
M 9618	3641	:	1.62	11.68	0.74	3.82	306	19	13.30	0.12	427	I
		:	Clst	dk -gy -blk								I
M 9619	3650	:	2.86	17.37	0.75	6.98	249	11	20.23	0.14	428	I
		:	Clst	dk -gy -blk								I
M 9620	3659	:	2.64	17.44	0.86	5.23	333	16	20.08	0.13	428	I
		:	Clst	dk -gy -blk								I
M 9622	3677	:	2.72	19.87	0.84	5.20	382	16	22.59	0.12	427	I
		:	Clst	blk								I
M 9623	3689	:	3.10	23.67	1.01	6.32	375	16	26.77	0.12	428	I
		:	Clst	dk -gy -blk								I
M 9624	3707	:	3.08	24.70	1.08	7.76	318	14	27.78	0.11	428	I
		:	Clst	dk -gy -blk								I
M 9625	3716	:	2.37	18.53	0.93	5.41	343	17	20.90	0.11	429	I
		:	Clst	dk -gy -blk								I
M 9626	3725	:	3.44	24.11	0.87	6.99	345	12	27.55	0.12	429	I
		:	Clst	dk -gy -blk								I
M 9776	3749	:	12.82	113.50	2.25	39.90	284	6	126.32	0.10	432	I
		:	Clst									I
M 9777	3800	:	1.45	10.80	1.80	5.02	215	36	12.25	0.12	427	I
		:	Clst	dk -gy -brn								I
M 9778	3851	:	0.58	3.72	1.78	2.82	132	63	4.30	0.13	433	I
		:	Clst	dk -brn								I
M 9779	3899	:	0.55	1.79	1.87	4.39	41	43	2.34	0.24	437	I
		:	Clst	dk -brn								I
M 9780	3950	:	3.73	28.10	1.39	11.78	239	12	31.83	0.12	436	I
		:	Clst	dk -brn -brn								I

DATE : 19 - 1 - 83.

TABLE 7.

ROCK EVAL PYROLYSES

IKU No.	DEPTH m/ft	:	S1	S2	S3	TOC	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT	PROD. INDEX S1	TEMP. MAX (C)
		:				(%)			S1+S2	S1+S2	
M 9781	4001	:	4.79	43.52	0.81	17.84	244	5	48.31	0.10	439
		:	Clst	dk -brn -blk							
M 9782	4049	:	0.42	3.14	0.39	2.26	139	17	3.56	0.12	445
		:	Clst	brn - gy -blk							
M 9783	4100	:	0.13	0.57	0.26	0.64	89	41	0.70	0.19	447
		:	Clst	gy							
M 9784	4150	:	0.32	1.75	0.50	1.62	108	31	2.07	0.15	448
		:	Clst	gy							
M 9785	4199	:	0.54	3.62	0.59	2.77	131	21	4.16	0.13	445
		:	Clst	brn -brn - gy							
M 9786	4250	:	1.05	8.43	0.59	5.01	168	12	9.48	0.11	426
		:	Clst	gn							

DATE : 19 - 1 - 83.



IKU

Vitrinite Reflectance measurements

TABLE NO.: 8.
WELL NO.: 15/8-1

Sample	Depth (m)	Vitrinite reflectance	Fluorescence in UV light	Exinite content
M-9748	750	0.33 (3) and 0.88 (2)	Yellow and yellow/orange spores	Trace
M-9750	1100	0.28 (2)	Nil	Nil
M-9752	1200	0.32 (20)	Green/yellow spores	Low
M-9754	1300	0.33 (20)	Green/yellow spores	Low-moderate
M-9755	1350	0.37 (12)	Green/yellow and light orange spores	Low
M-9757	1460	0.40 (13)	Green/yellow spores	Low
M-9759	1550	0.32 (5) and 0.57 (9)	Green/yellow spores	Low
M-9761	1650	0.36 (3)	Nil	Nil
M-9764	1800	0.39 (7)	Yellow and yellow/orange spores	Low
M-9766	1900	0.45 (7)	Yellow spores	Low
M-9768	2100	N.D.P.	Nil	Nil
M-9771	2395	0.61 (8)	Yellow and yellow/orange spores	Low
M-9772	2500	0.49 (1) and 0.65 (1)	Yellow orange spores	Low
M-9774	2700	0.31 (20)	Yellow/orange spores	Low



IKU

Vitrinite Reflectance measurements

TABLE NO.: 8.
WELL NO.: 15/8-1

Sample	Depth (m)	Vitrinite reflectance	Fluorescence in UV light	Exinite content
M-9604	3609 - 3615	N.D.P.	Nil	Nil
M-9605	3518 - 3524	0.52 (8)	Hydrocarbon fluorescence only	Nil
M-9608	3545 - 3551	0.71 (3)	Yellow and yellow/orange hydrocarbons	Nil
M-9611	3572 - 3578	0.45 (20)	Yellow and yellow/orange spores	Moderate to rich
M-9613	3590 - 3596	0.54 (5)	Yellow/orange spores	Low
M-9615	3608 - 3614	0.65 (20)	Yellow and yellow/orange spores	Moderate
M-9617	3626 - 3632	0.58 (21)	Yellow/orange spores	Moderate
M-9619	3644 - 3650	0.62 (20)	Yellow/orange spores and hydrocarbon wisps	Moderate
M-9620	3653 - 3659	0.62 (7)	Yellow/orange to light orange spores	Moderate
M-9622	3671 - 3677	0.61 (20)	Yellow/orange and light orange spores	Moderate
M-9624	3701 - 3707	0.58 (20)	Yellow/orange spores	Moderate
M-9626	3719 - 3725	0.59 (20)	Yellow and yellow/orange spores	Moderate



IKU

Vitrinite Reflectance measurements

TABLE NO.: 8.
WELL NO.: 15/8-1

Sample	Depth (m)	Vitrinite reflectance	Fluorescence in UV light	Exinite content
M-9776	3749	0.61 (20)	Light orange spores	Moderate-high
M-9777	3800	0.54 (20)	Light orange spores	Moderate
M-9778	3851	0.61 (20)	Yellow/orange and light orange spores	Trace-Low
M-9779	3890	0.66 (7)	Mid orange spores	Low-moderate
M-9780	3950	0.61 (20)	Mid orange to deep orange spores	Moderate-high
M-9781	4001	0.76 (26)	Mid orange and deep orange spores	Moderate
M-9783	4100	0.75 (25)	Nil	Nil
M-9784	4150	0.77 (25)	Deep orange spores	Low-moderate
M-9785	4199	0.76 (15)	Deep orange spores	Moderate

**IKU**

Visual Kerogen Analysis

TABLE NO.: 9.
WELL NO.: 15/8-1-

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
M-9748	750	He, P/Am	F-M	fair	1, 1/1+	Aggregates with grannulate to flaky structure. Pyritic. Strongly degraded. Acid resistant minerals. Small residue.
M-9750	1100	WR!, W, He, P/Am	F-M	fair	1, 1/1+	Partly as above but a higher proportion of inertinite fragments and vitrinite.
M-9752	1200	W, He, WR!, P/Am, Cy	F-M	good	1, 1/1+	Loose aggregates. Amorphous material sticks to and obscures fossils.
M-9754	1300	He, W, WR!, P/Am, Cy	F-M	good	1, 1/1+	As above. Decayed woody material increased.
M-9755	1350	He, W, Cut, P/Am, Cy	F-M	good	1, 1/1+	Resemblance with the 1200m and 1300m above, but former structured, sapropelised material dominates. Cuticles have not been confidently observed and could partly represent algal material.

ABBREVIATIONS

Am Amorphous
He Herbaceous
Cut Cuticles

Cy Cysts, algae
P Pollen grains
S Spores

W Woody material
C Coal
R! Reworked

F Fine
M Medium
L Large

Visual Kerogen Analysis

TABLE NO.: 9.
WELL NO.: 15/8-1

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
M-9757	1450	He, W, Cut, P/Am, Cy	F-M	good	1/1+, 1+	Resembles 1350m. Somewhat denser aggregates of organic material. Pyritic bisaccates, Tasmanites and cysts.
M-9759	1550	He, W, WR!, /Am, Cy	F-M	fair - poor	1/1+	As above.
M-9761	1650	He, W, WR!, Cut, P/Am, Cy	F-M	good	1/1+	As in the above interval very thin-walled pollen and cysts (preservation).
M-9764	1800	He, W, WR!, P, S/Am, Cy	F-M	fair - good	1/1+	Disperse residue. Very small woody particles or degradation products of wood.
M-9766	1900	He, W, WR!, P, S/Am, Cy	F-M	fair - good	1, 1/1+	Strongly pyritic residue of loose aggregates. Very thin-walled pollen and cysts.
M-9768	2100	He, W, WR!, P/Am, Cy	F-M	fair - good	1, 1/1+	Description as for 1800m.

ABBREVIATIONS

Am Amorphous
He Herbaceous
Cut Cuticles

Cy Cysts, algae
P Pollen grains
S Spores

W Woody material
C Coal
R! Reworked

F Fine
M Medium
L Large

**IKU**

Visual Kerogen Analysis

TABLE NO.: 9.
WELL NO.: 15/8-1

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
M-9771	2395	W, WR!, Cut, P/Am, Cy	F-M	good	1/1+, 1+/2-	Dispersed material. Abundant triporate pollen and cysts (E. Tertiary). Less strong sapropelisation. Semifusinite - fusinite.
M-9772	2500	W, WR!, Cut, P/Am, Cy	F-M	good	1+, 1+/2-	Small residue. Abundant pollen and cyst as in 2395m.
M-9773	2600	He, W, P/Am, Cy	F	good	1+, 1+/2-	As for 2500m but more acid-resistant minerals left together with radiolarians. Some staining of the material.
M-9774	2700	He, W, P/Am, Cy	F-M	fair - good	1+, 1+/2-	Small, well dispersed or loosely aggregated residue. Sapropelised material.
M-9604 material	3509-15	*Abundant reworked W		variable	N.D.P.	*Very little organic left. Mixed? assemblages. An oxidative environment.

ABBREVIATIONS

Am Amorphous
He Herbaceous
Cut Cuticles

Cy Cysts, algae
P Pollen grains
S Spores

W Woody material
C Coal
R! Reworked

F Fine
M Medium
L Large

Visual Kerogen Analysis

TABLE NO.: 9.
WELL NO.: 15/8-1

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
M-9608	3545-51	(?He/Am), WR!, W, P, S/Am, Cy	F-M	food	2-, 2-/2	(?He/Am) Adhering minute mineral particles prevents a closer classification on routine basis. Main composition otherwise as for samples 3572m to 3614m.
M-9609	3554-60	(?He/Am), W, WR!, P, S/Am, Cy	F-M	fair	2-, 2-/2	As for 3545m.
M-9611	3572-78	W, WR!, Cut, P/Am, Cy	F-M	good	2-, 2-/2	Disperse pyritic residue. Callialasporites and Sequoia.
M-9613	3590-96	W, WR!, P/Am, Cy	F-M	good	2-, 2-/2	As above.
M-9615	3608-14	WR!, W, P/Am, Cy	F-M	good	2-/2	Amorphous material in aggregates and semifusinite/fusinite/inertinite. Abundant pyrite.
M-9616	3617-23	WR!, W, Cut, P, S/Am	F-M-L	good	2	Even stronger influx of semifusinite/fusinite.
M-9617	3626-32	W, WR!, P/Am	F-M	fair to poor	2	Small residue. Very thin-walled material.

ABBREVIATIONS

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

Visual Kerogen Analysis

TABLE NO.: 9.
WELL NO.: 15/8-1

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
M-9619	3644-50	W, WR!, Cut, P/Am	F-M-L	fair	2	Semifusinite/fusinite.
M-9620	3653-59	W, WR!, Cut, P, S/Am	F-M-L	fair	2	As above.
M-9622	3671-77	W, WR!, Cut, P, S/Am	F-M-L	fair to good	1 - 1/1+, 2	Dense pyritic aggregates. Sapropelised material embeds semifusinite/fusinite, degraded. Very light coloured material contamination.
M-9624	3701-07	W, WR!, Cut, P/Am	F-M-L	fair to good	2-/2	Sapropelised woody material and semifusinite/fusinite. Botryococcus.
M-9626	3719-25	Wm WR!m Cut, P, S/Am	F-M-L	fair to good	2-/2	As for 3701-07m.
M-9776	3749	W, Cut, S, P/	F-M	good	2	Coaly fragments. Spores.
M-9777	3800	W, WR!, Cut, P/Am	F-M	fair to good	2-/2	Resemblance with 3719-25. Semifusinite/fusinite and vitrinite.
M-9778	3851	He, W, WR!	F-M	fair to poor	2-/2	More strongly sapropelised some pyrite.

ABBREVIATIONS

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.: 15/8-1

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
M-9779	3899	*W, WR!, /Am	F-M	variable	2, 2/2+	*Mainly well dispersed material with abundant pyrite. Rich in contaminants from layers above.
M-9780	3950	W, S, P, Cut	F-M	good	2, 2/2+	Coaly particles.
M-9781	4001	W, S, P, Cut	F-M	good	2+ - 2/2+	Coaly particles.
M-9782	4049	W, C, Cut, S, P/	F-M-L	good	2, 2/2+	Dispersed material, rich and varied spores. Dominates woody material.
M-9783	4100	W, WR!, S, P/Am	F-M-L	good	2, 2/2+	As for 4049m.
M-9784	4150	W, WR!, Cut, S, P/Am	F-M	good	2+/3-	Inertinite/fusinite/semi-fusinite, as in 4049m, 4100m.
M-4785	4191	He, W, WR!, C, P, S/Am	F	good to fair	2+/3-, 3-	Sapropelised material, a flocculated to disperse matrix. Well preserved spores/pollen of Middle to Early Jurassic nature. Woody material partly as dark coaly fragments

ABBREVIATIONS

Am Amorphous
He Herbaceous
Cut Cuticles

Cy Cysts, algae
P Pollen grains
S Spores

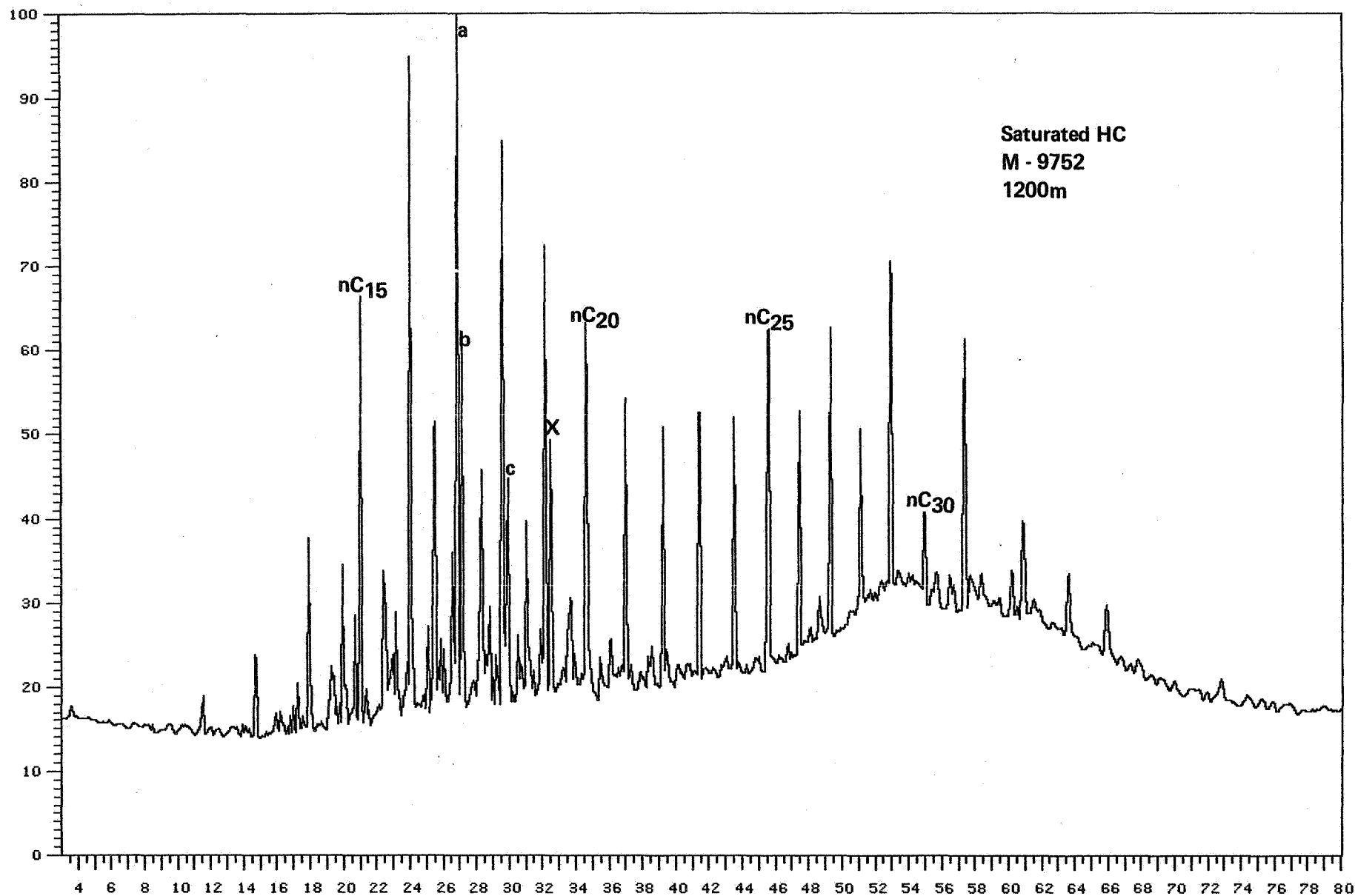
W Woody material
C Coal
R! Reworked

F Fine
M Medium
L Large

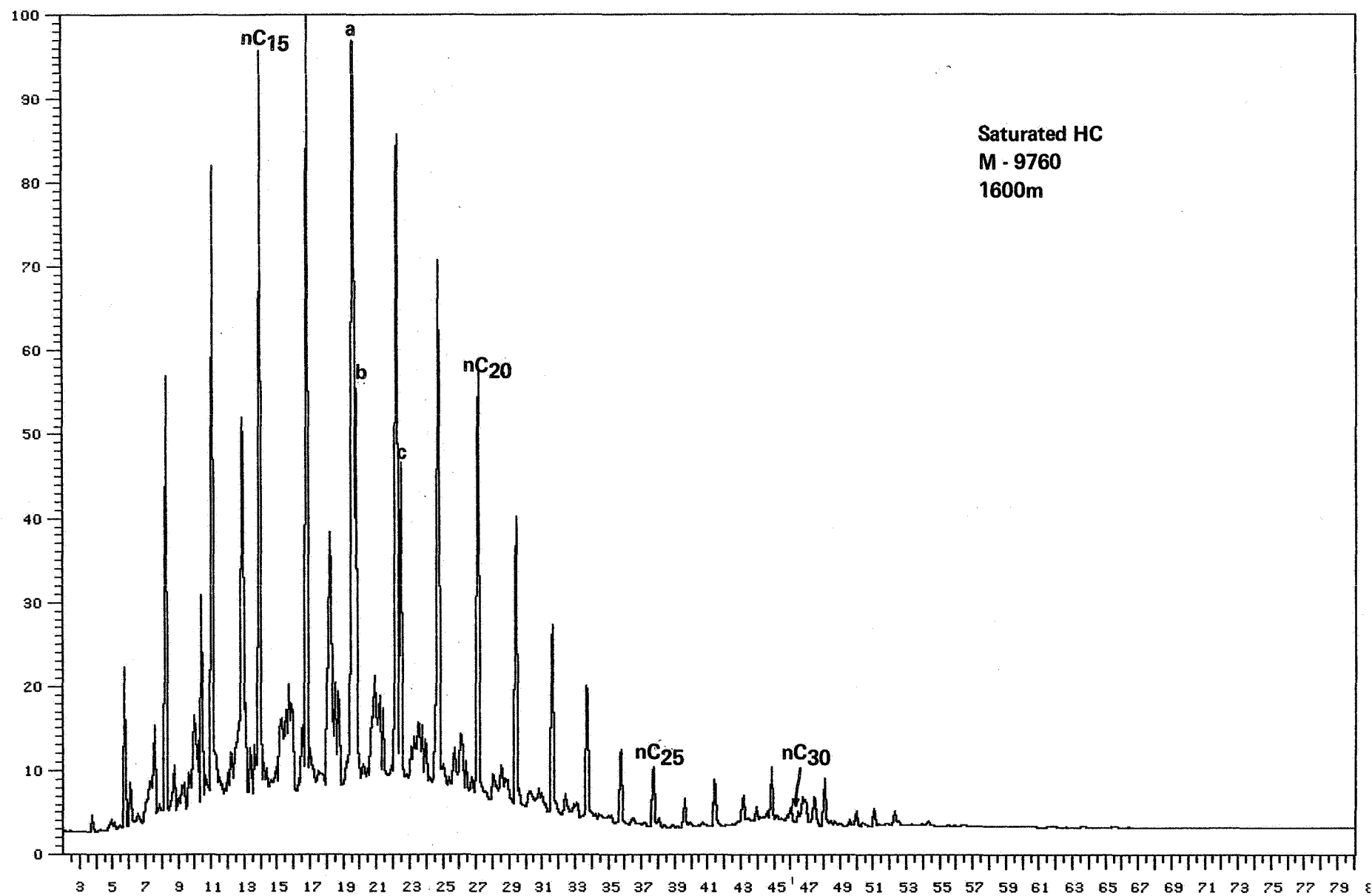
GAS CHROMATOGRAPHIC ANALYSIS
SATURATED HYDROCARBONS

Key. a = C₁₇
 b = pristane
 c = phytane

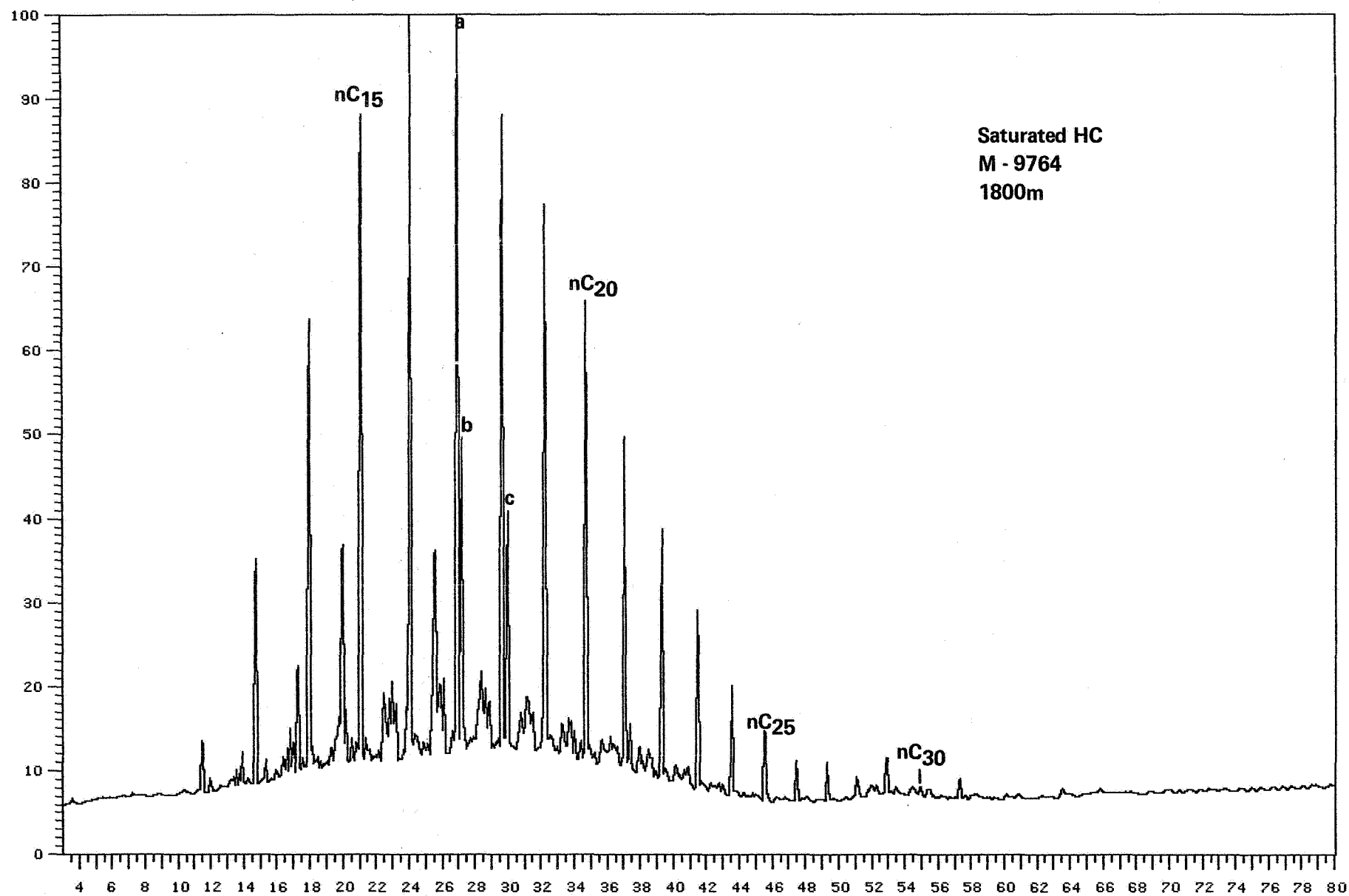
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Sample Name : M-9752, S, 15/8-1, AD Maximum value : 394



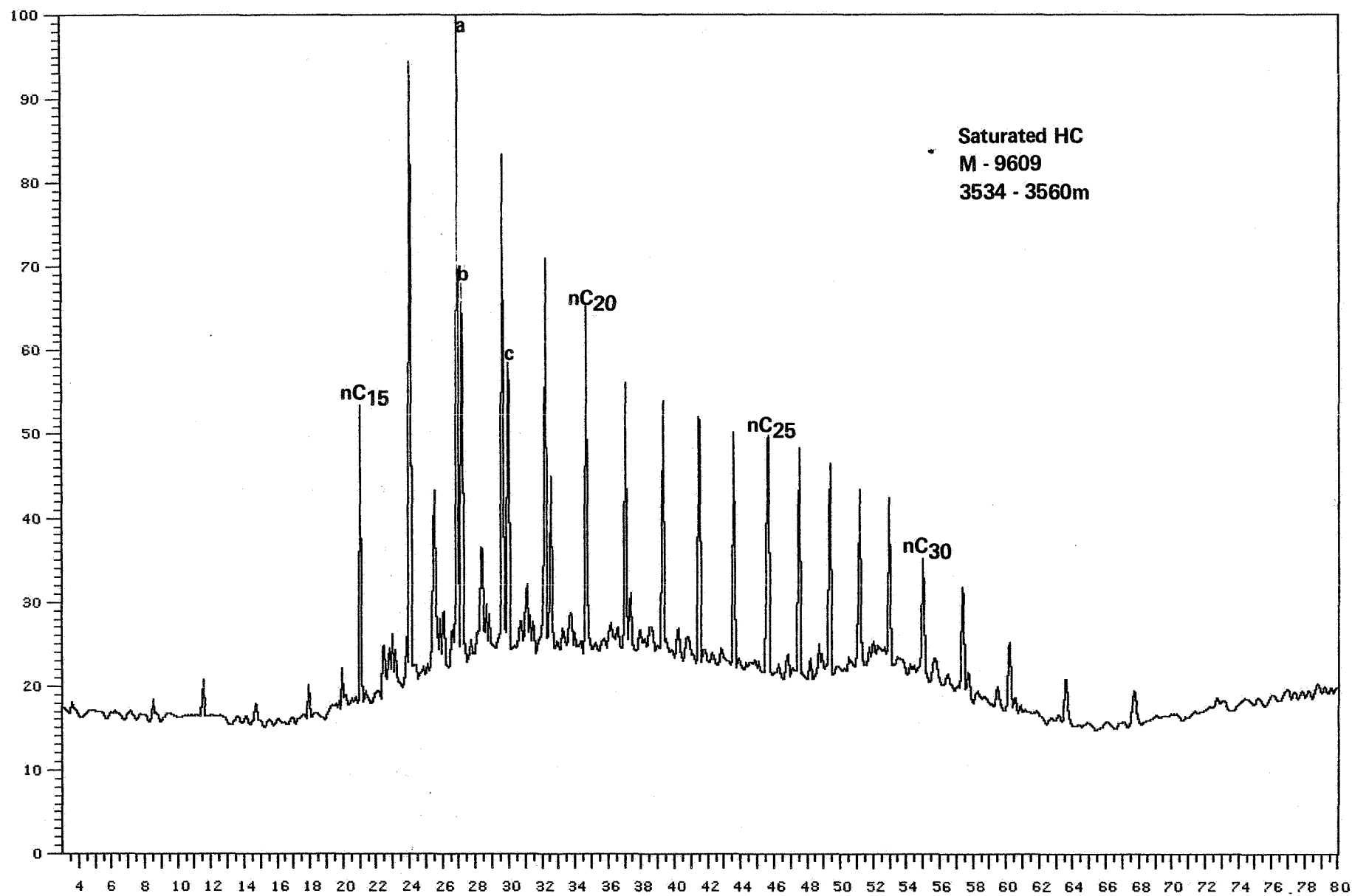
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Sample Name : M-9760,S,15/8-1,AD Maximum value : 3422



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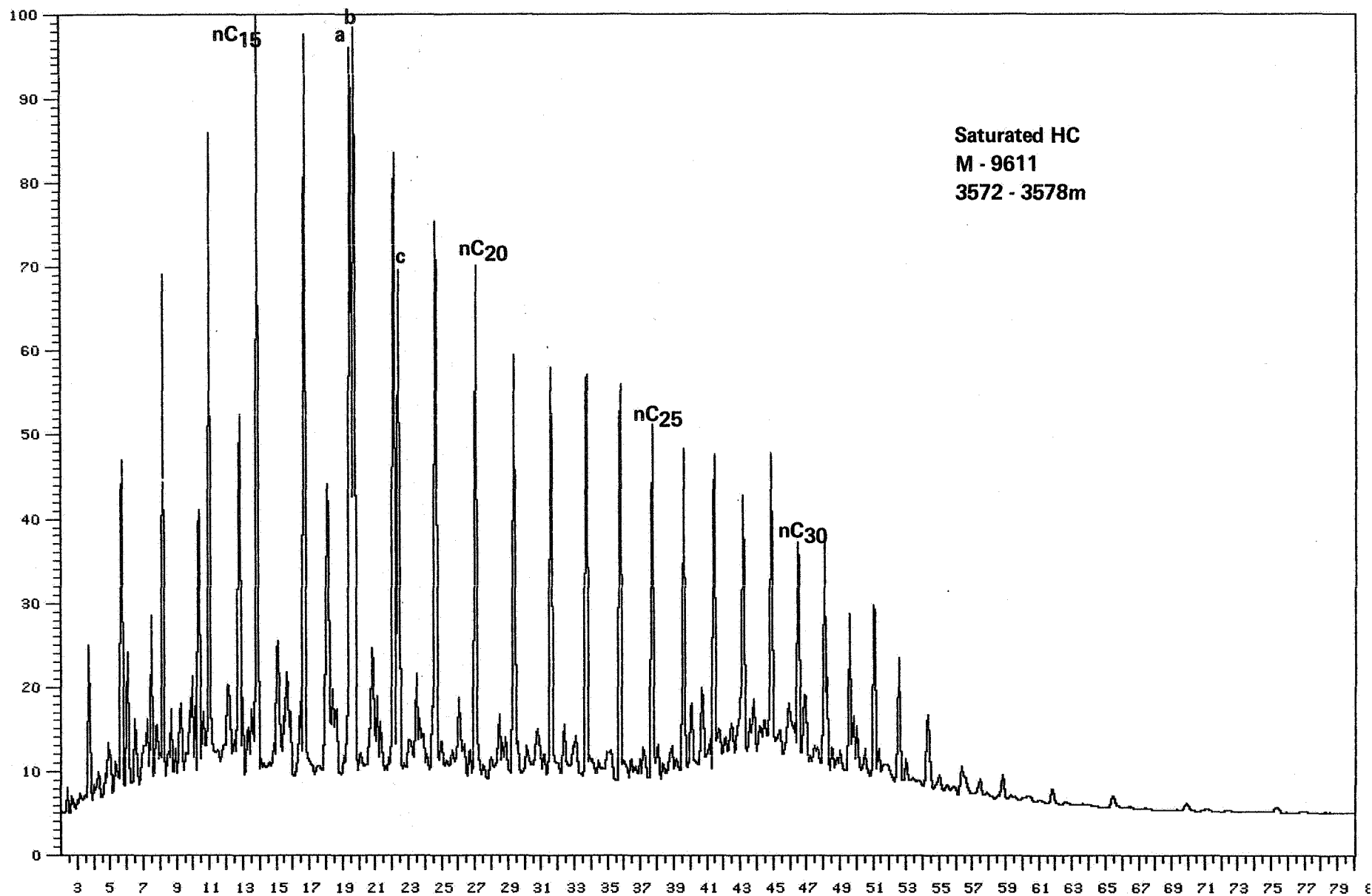


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Sample Name : M-9609,S,15/8-1,AD Maximum value : 436



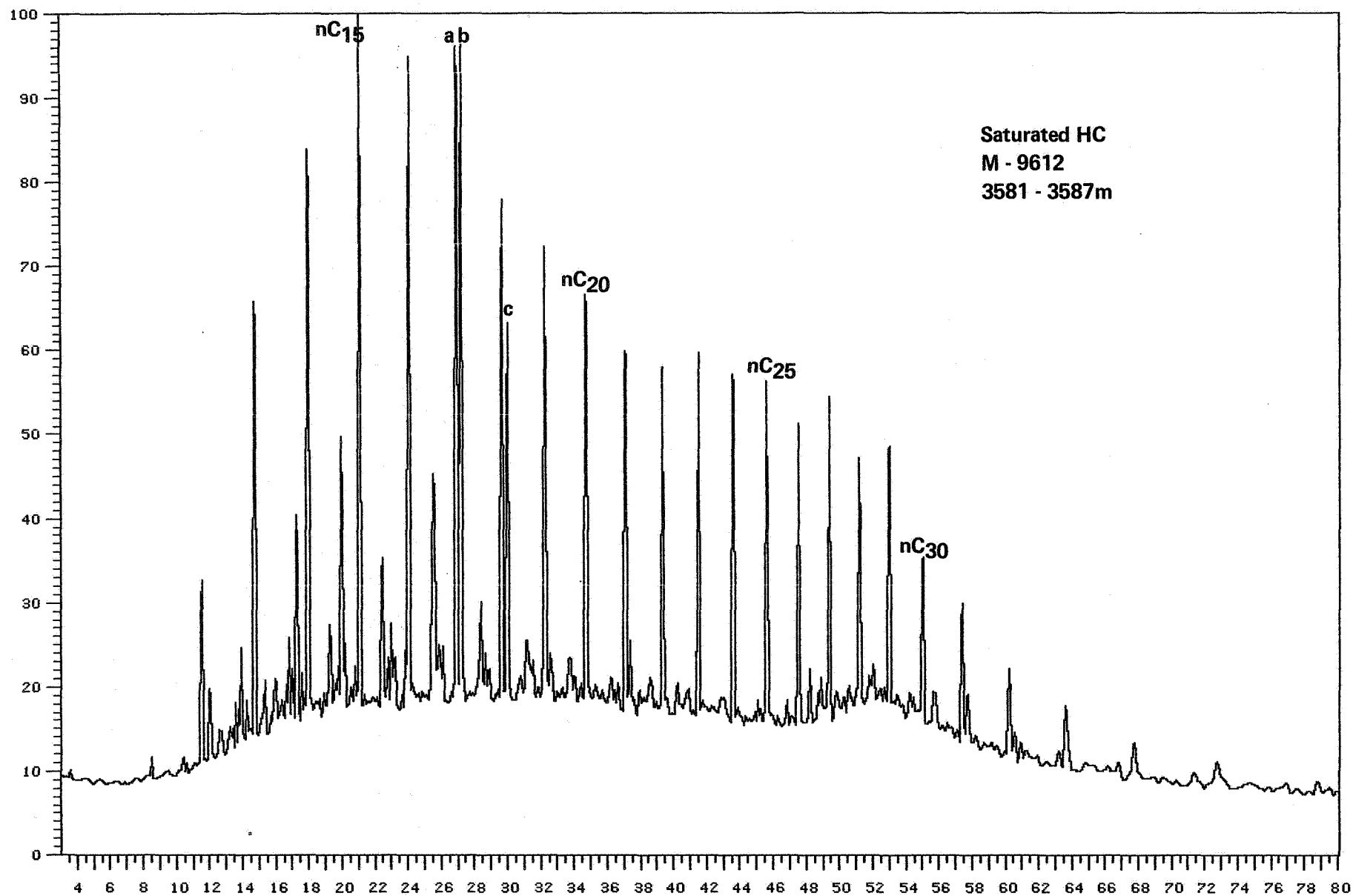
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Maximum value : 2192

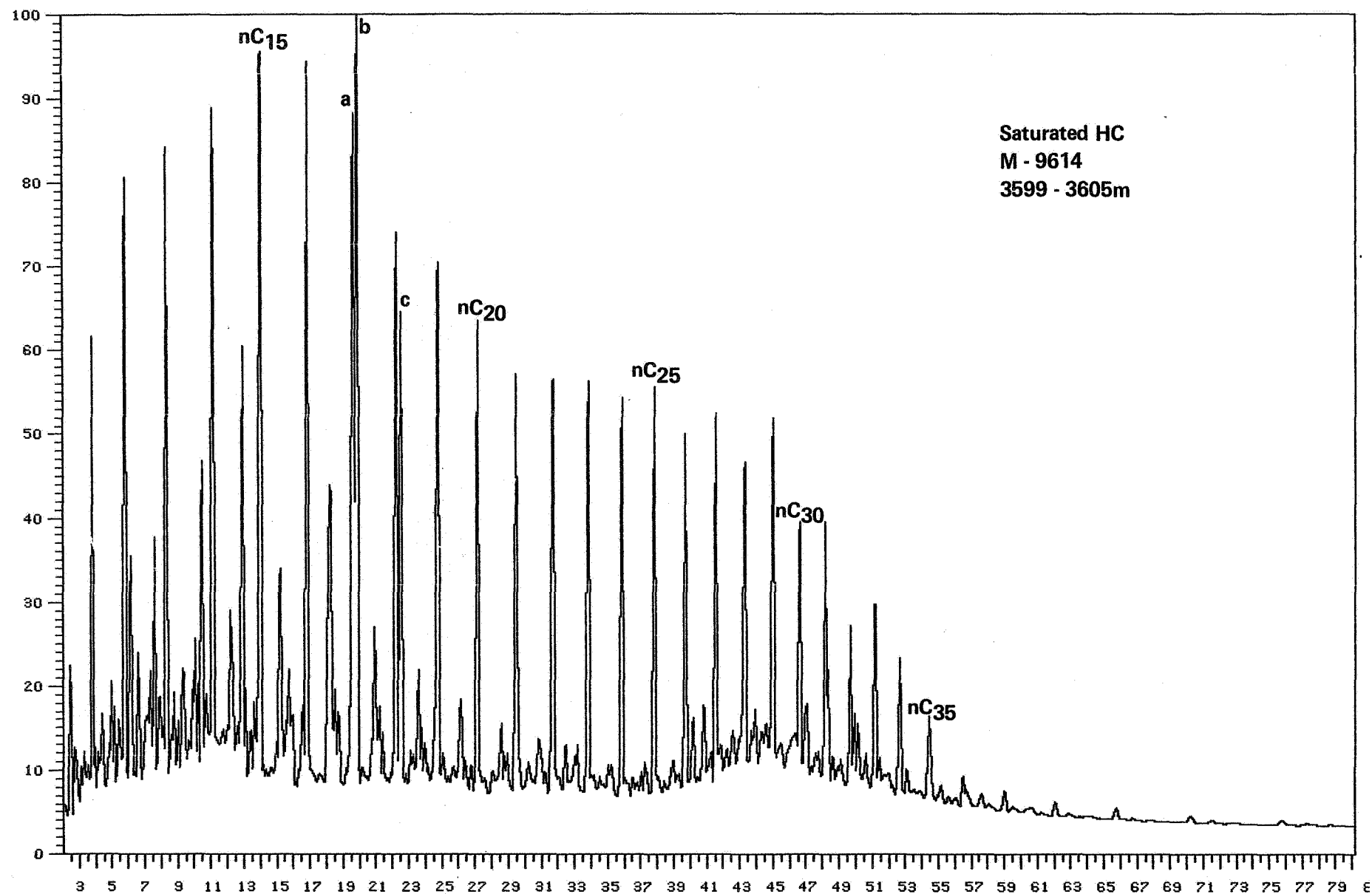


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Sample Name : M-9612,S,15/8-1,AD

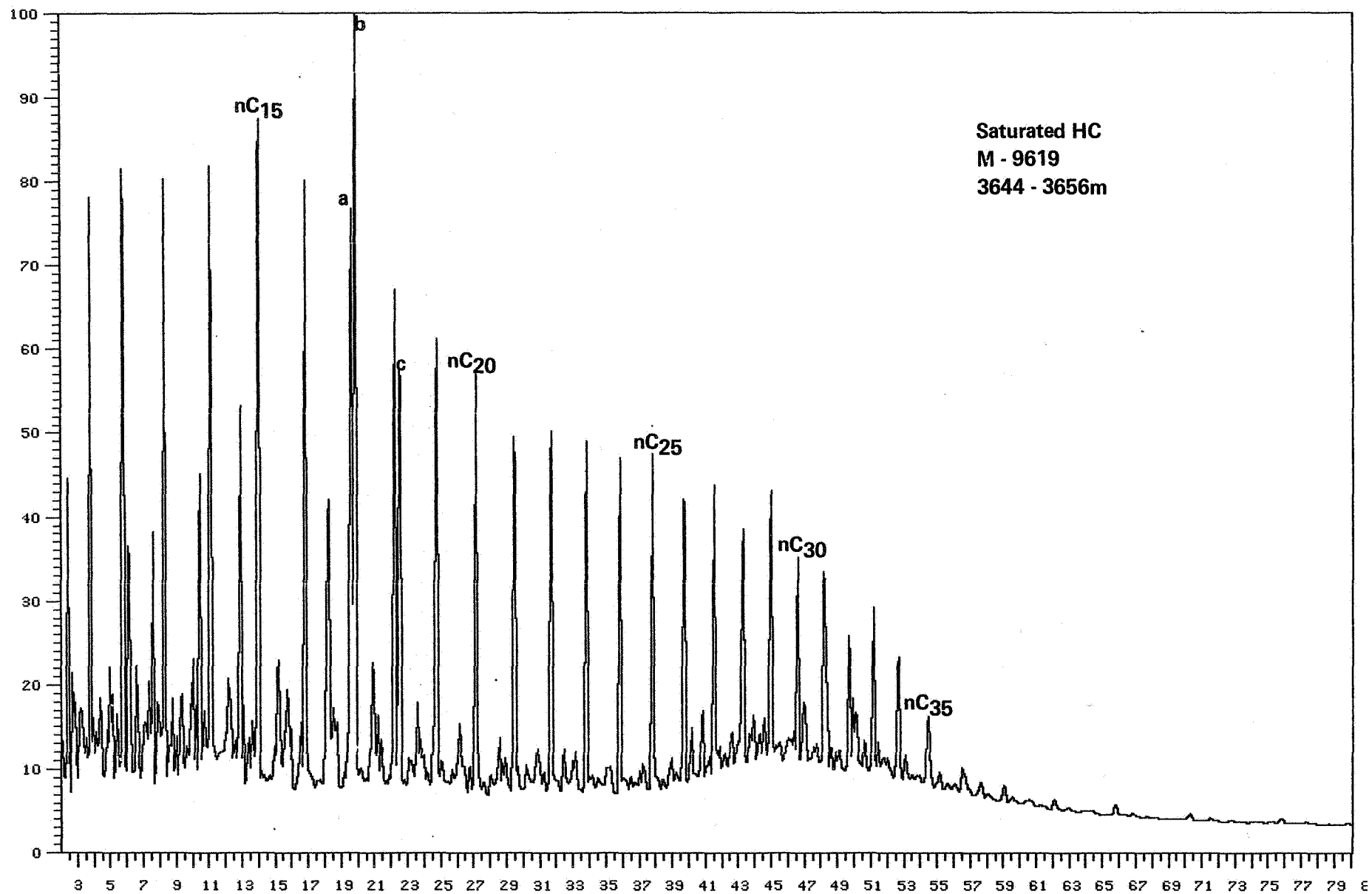
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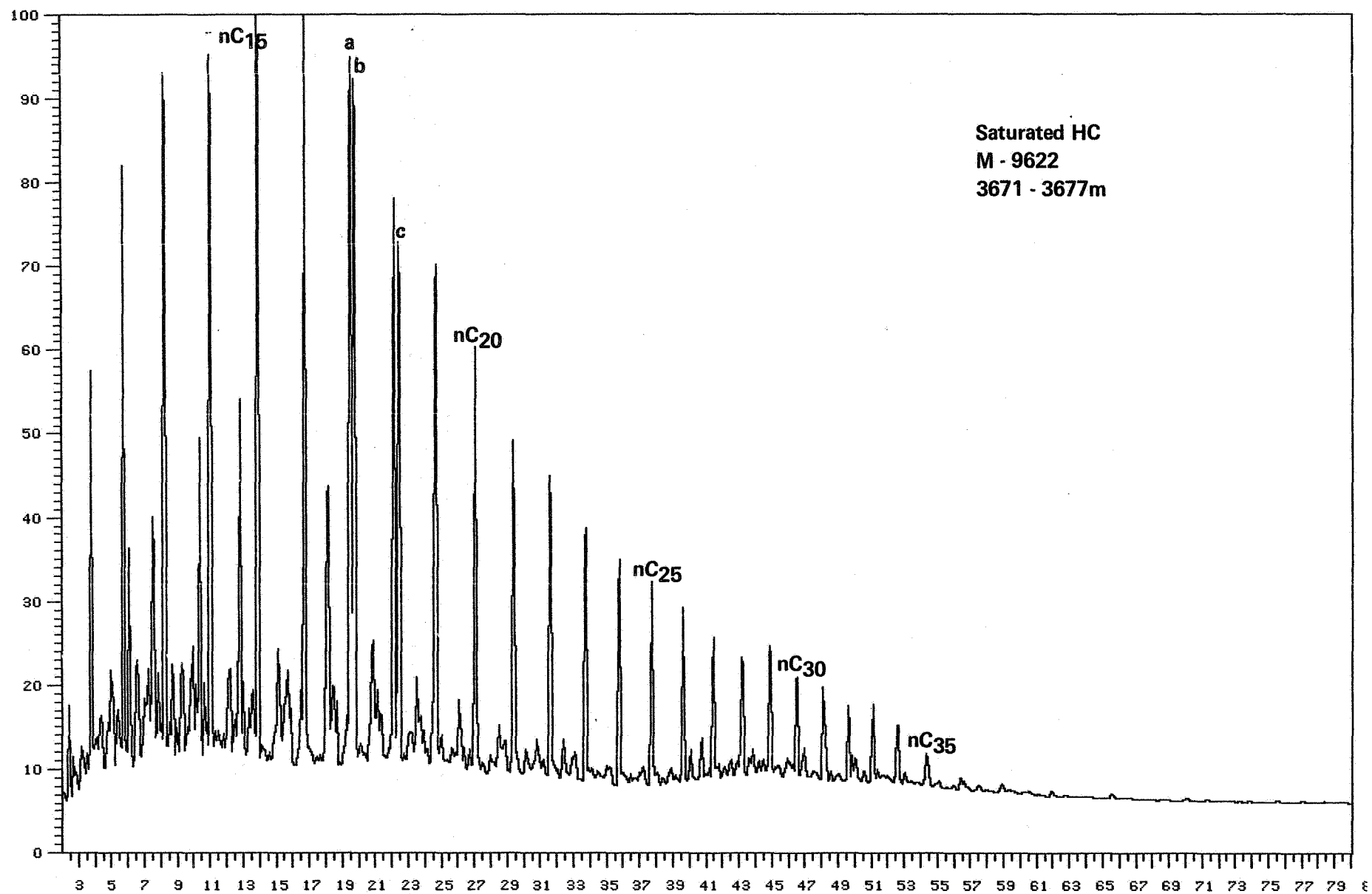
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Sample Name: M-9614, S, 15/8-1, AD Maximum value: 3979



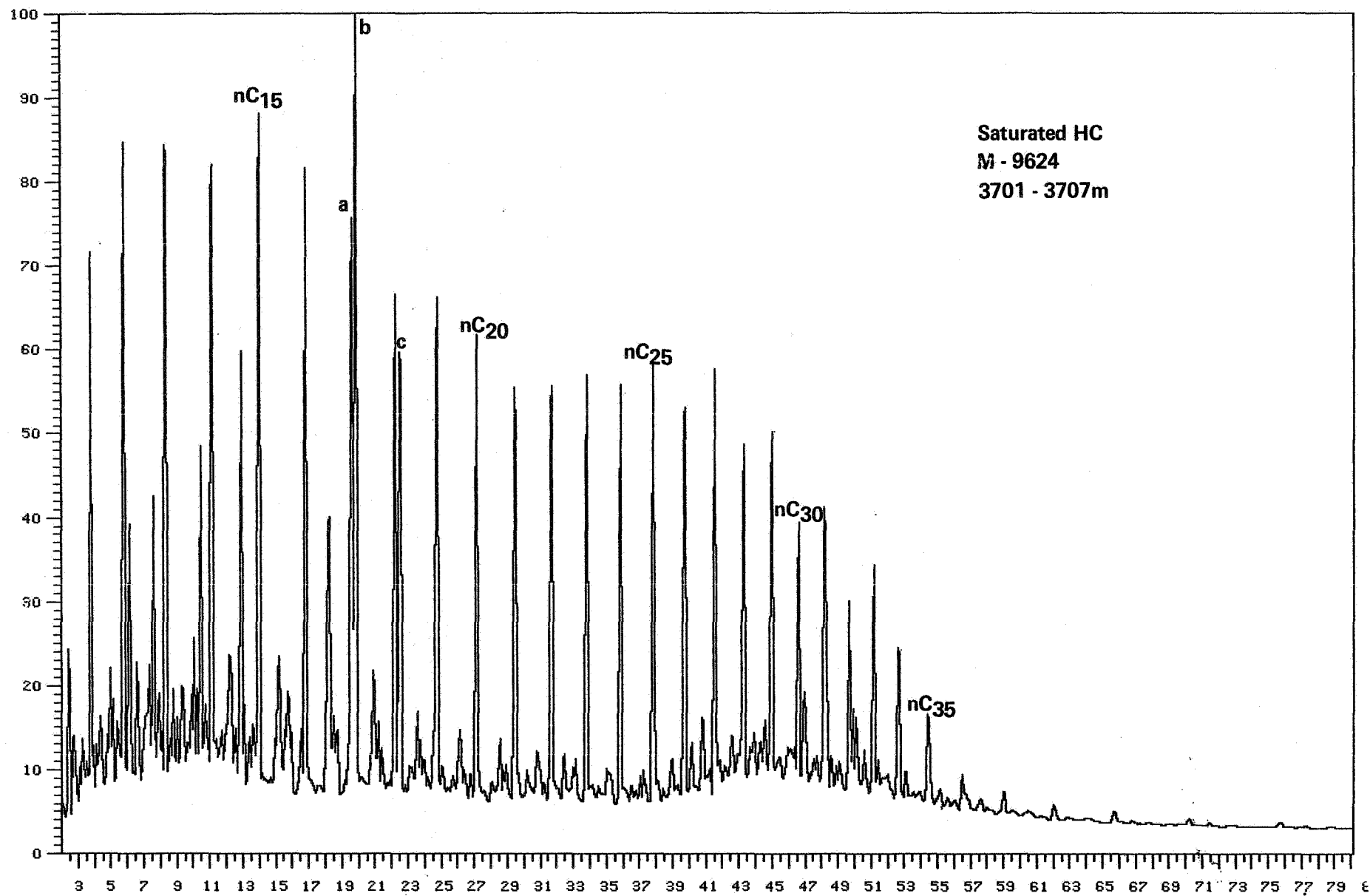
Analysis : 05752751 Sample #: 2 Injection #: 1
Sample Name : M-9619, S, 15/8-1, AD Maximum value : 4128



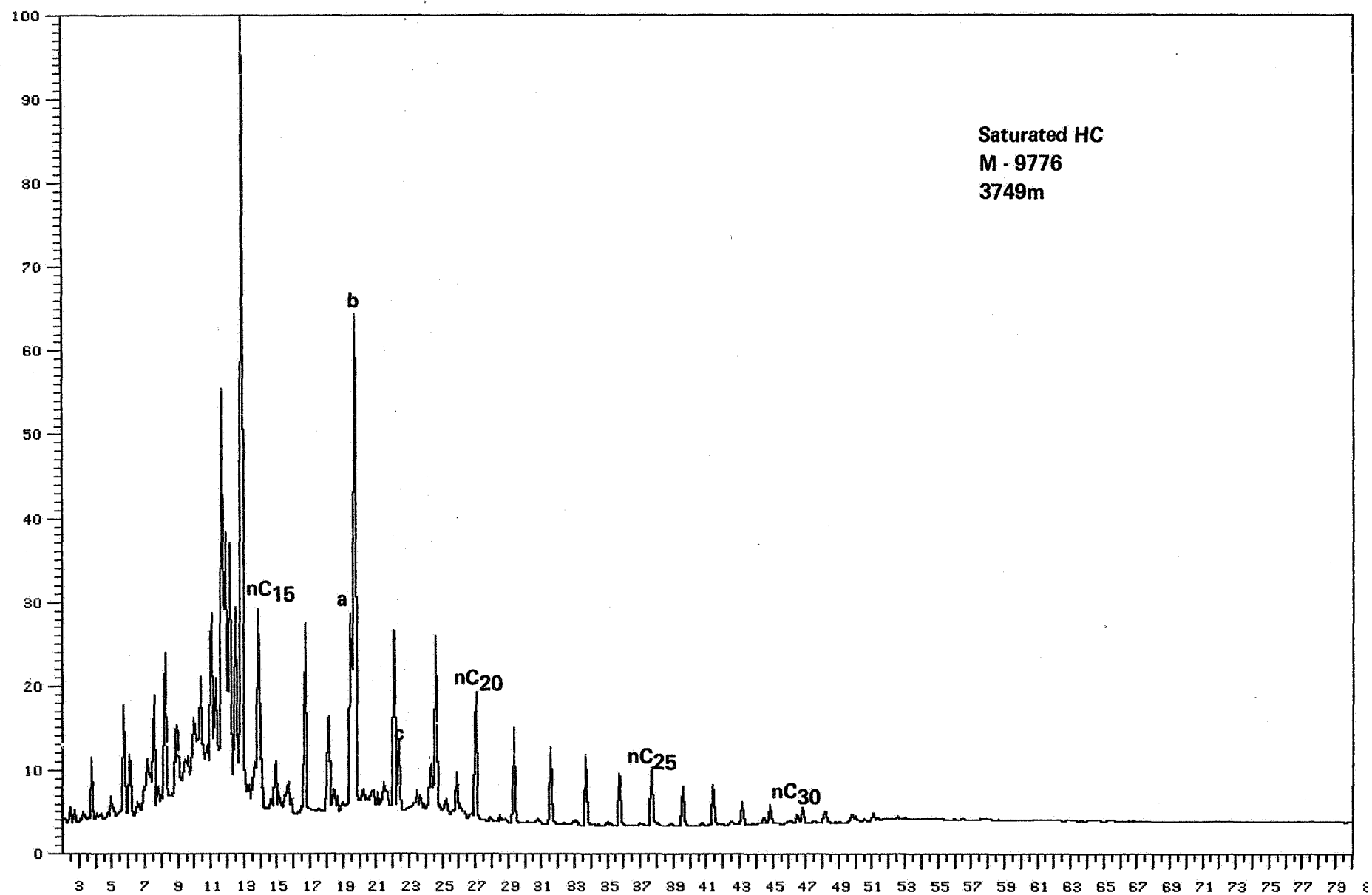
Analysis: 05752752 Sample #: 1 Injection #: 1
Sample Name: M-9622, S, 15/8-1, RD Maximum value: 1852



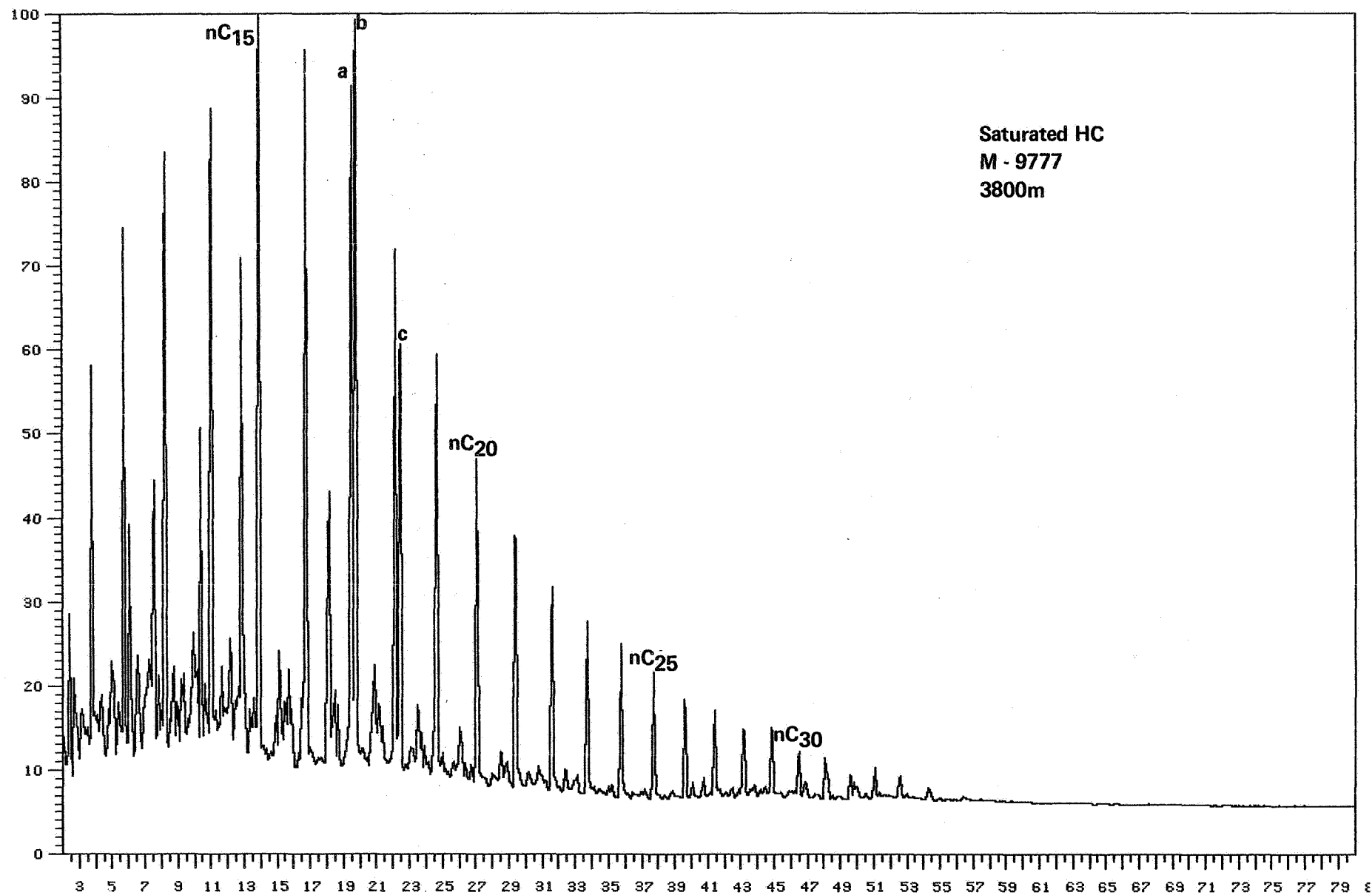
Analysis : 057527S1 Sample #: 3 Injection #: 1
Sample Name : M-9624, S, 15/8-1, RD Maximum value : 4429



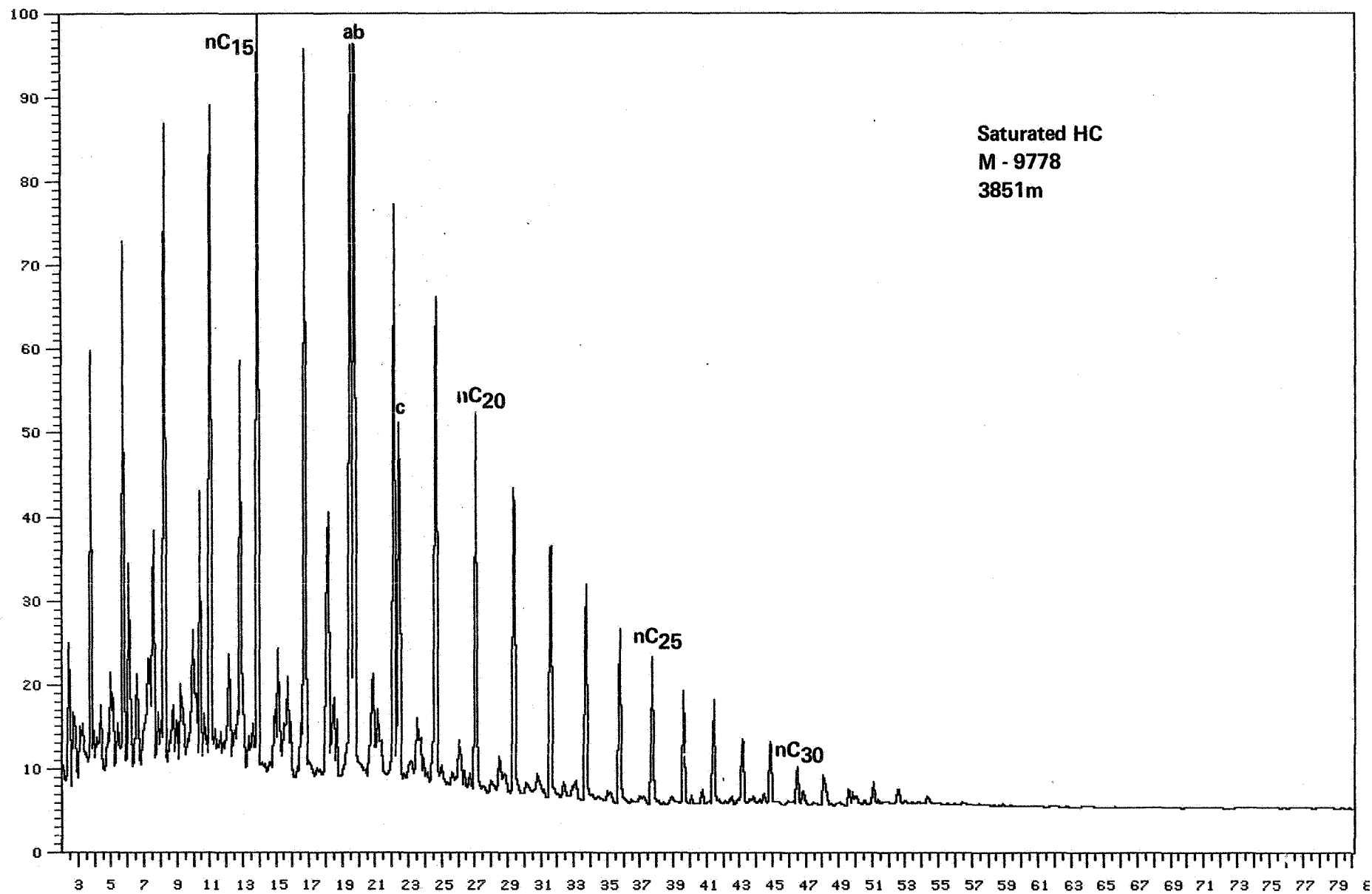
Analysis : 057527S2 Sample #: 3 Injection #: 1
Sample Name : M-9776, S, 15/8-1, AD Maximum value : 2596



Analysis : 057527S2 Sample #: 4 Injection #: 1
Sample Name : M-9777, S, 15/8-1, AD Maximum value : 1786



Analysis : 057527S2 Sample #: 5 Injection #: 1
Sample Name : M-9778,S,15/8-1,AD Maximum value : 1854

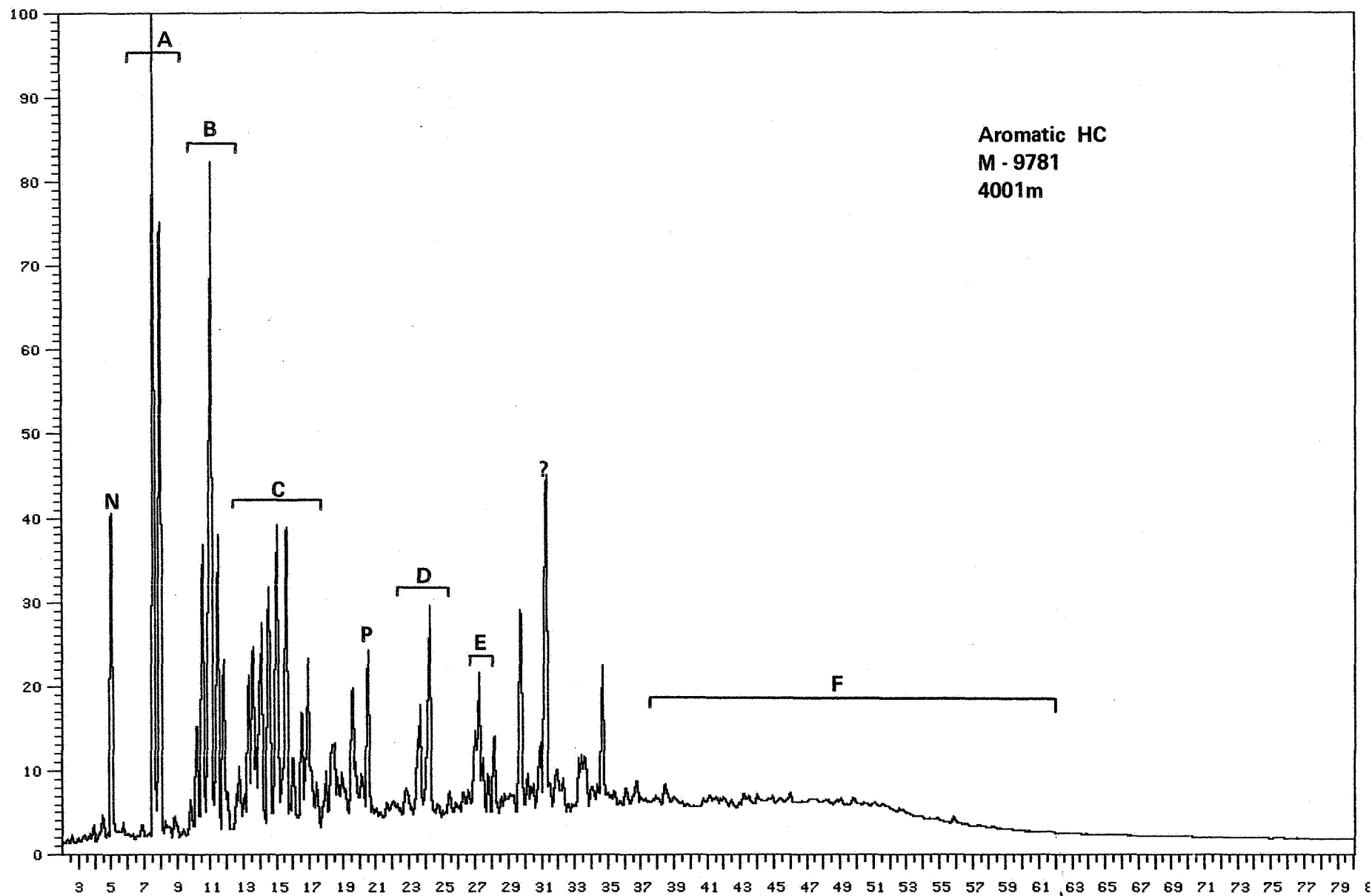


GAS CHROMATOGRAPHIC ANALYSIS
AROMATIC HYDROCARBONS

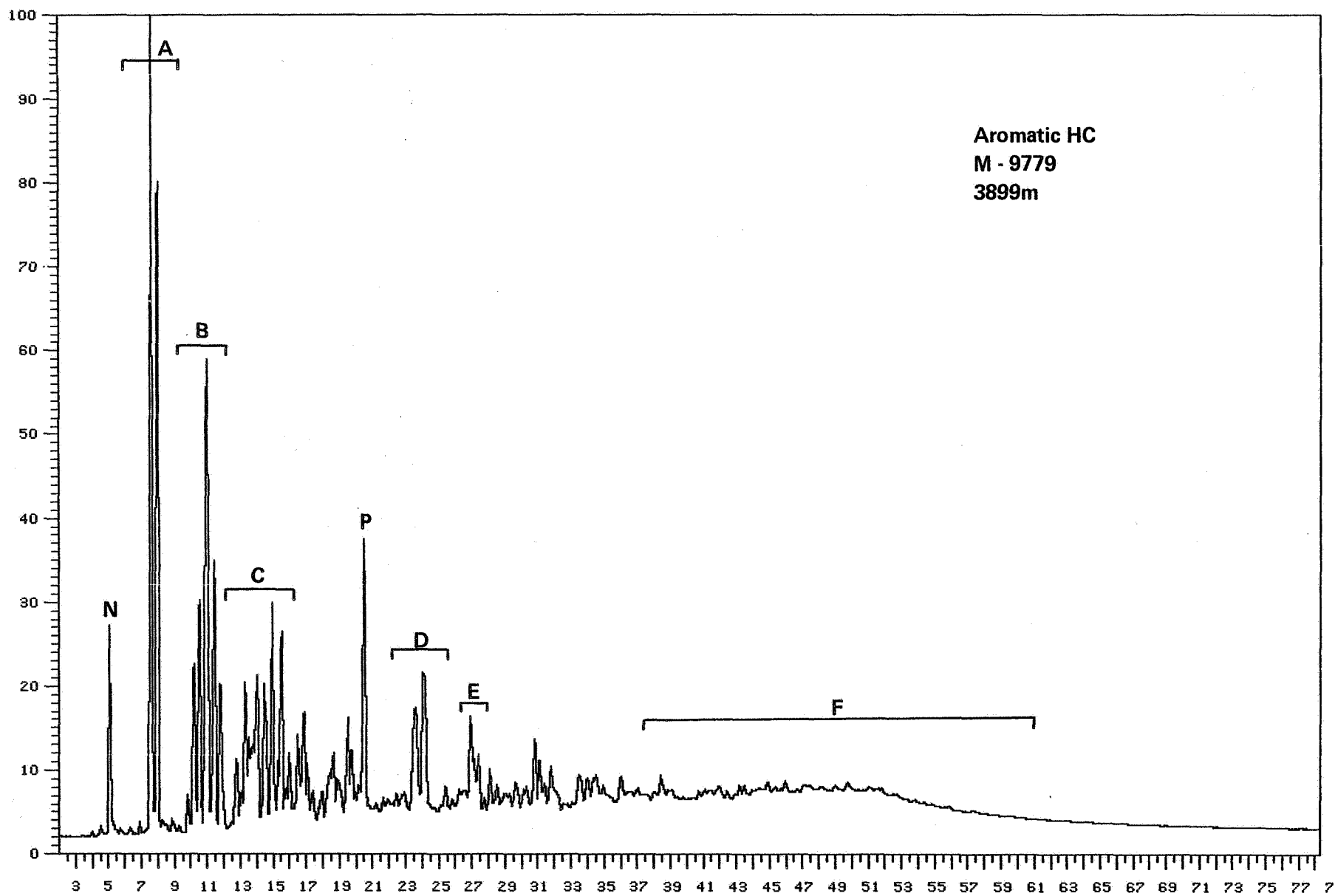
Key.

- A = naphthalene
- B = methyl naphthalenes
- C = phenanthrene
- D = methyl phenanthrenes - each of the two peaks is a doublet. Immature samples are usually indicated by a higher amount of the second peak relative to the first. An increase in maturity is accompanied by a relative increase in the first of the peaks.
- E = dimethyl phenanthrenes
- F = aromatised steranes and triterpanes
- X = probable contaminants

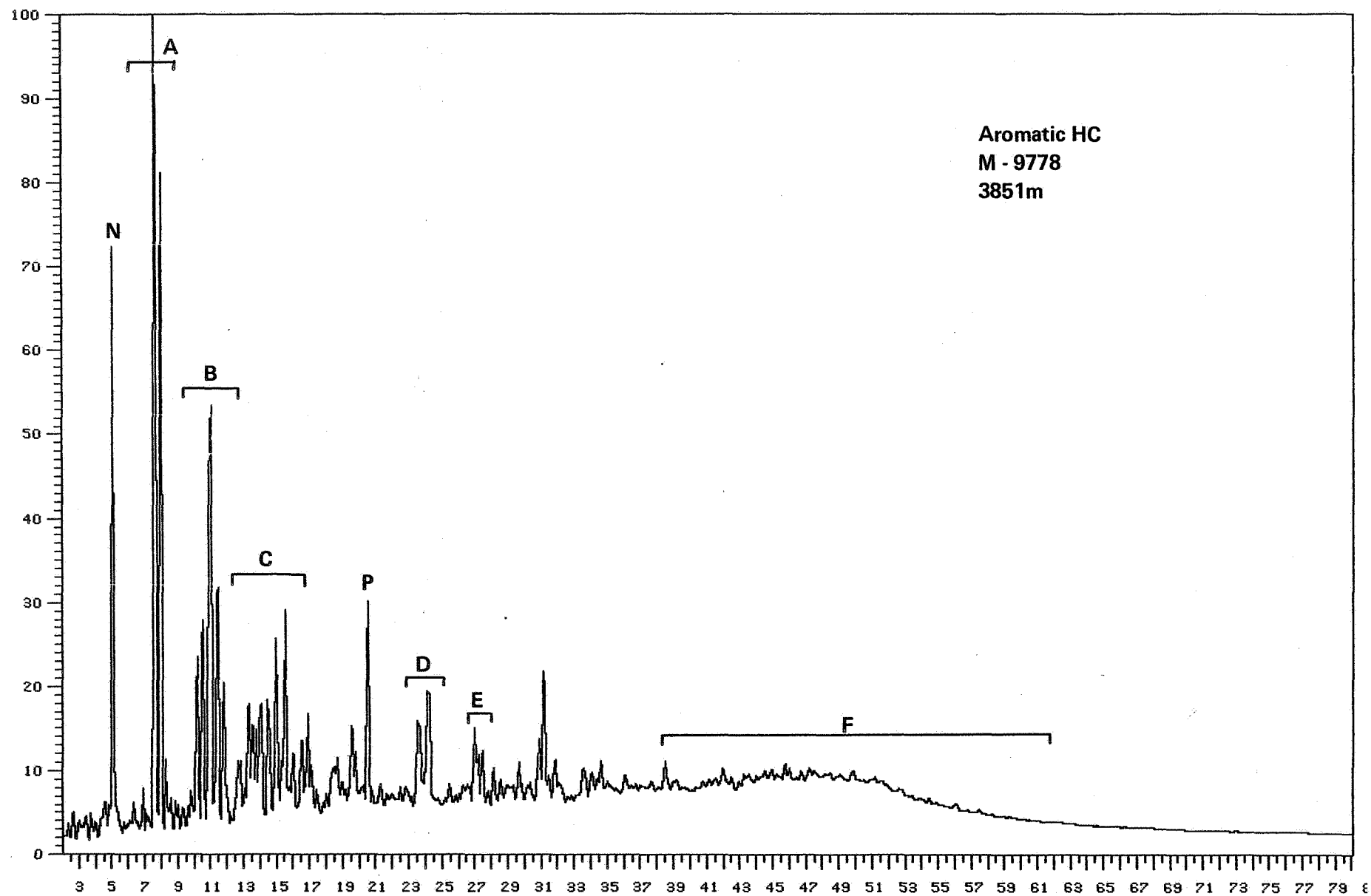
Analysis : 057527R3 Sample #: 5 Injection #: 1
Sample Name : M-9781, A, 15/8-1, RD Maximum value : 7354



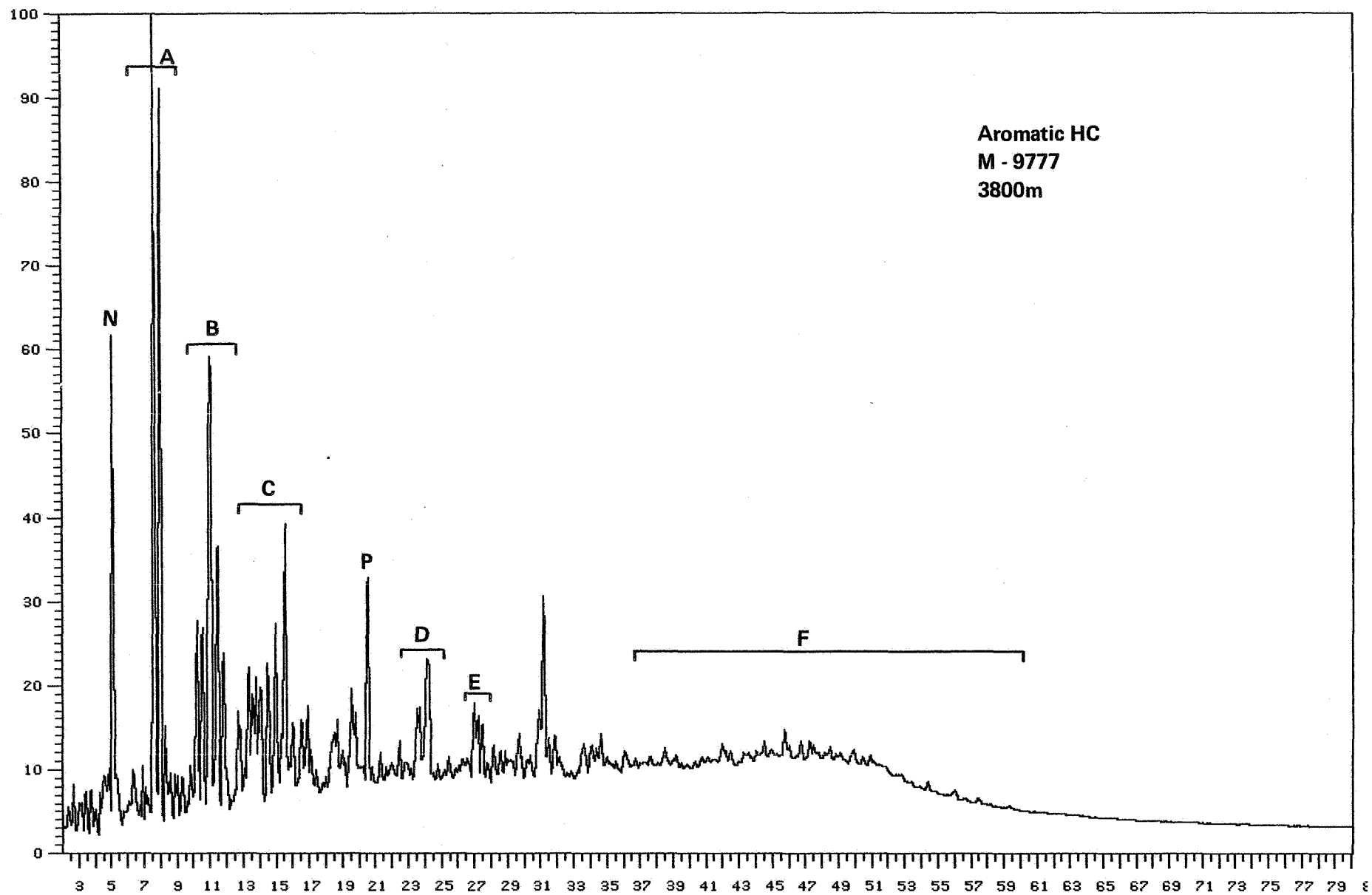
Analysis : 057527A3 Sample #: 4 Injection #: 1
Sample Name : M-9779, A, 15/8-1, AD Maximum value : 4717



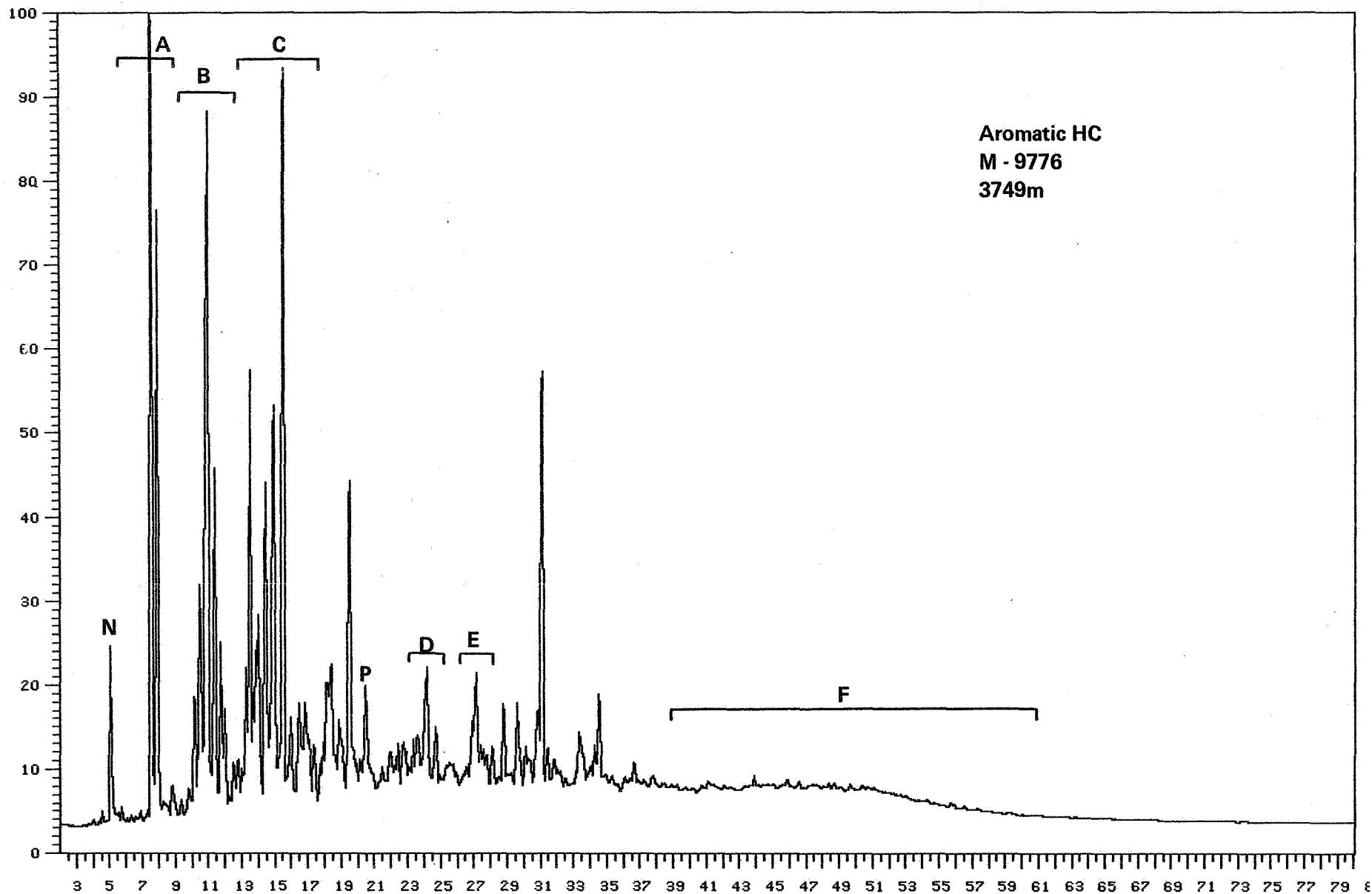
Analysis : 057527A3 Sample #: 3 Injection #: 1
Sample Name : M-9778, A, 15/8-1, AD Maximum value : 6320



Analysis : 057527R3 Sample #: 2 Injection #: 1
Sample Name : M-9777, A, 15/B-1, RD Maximum value : 4891

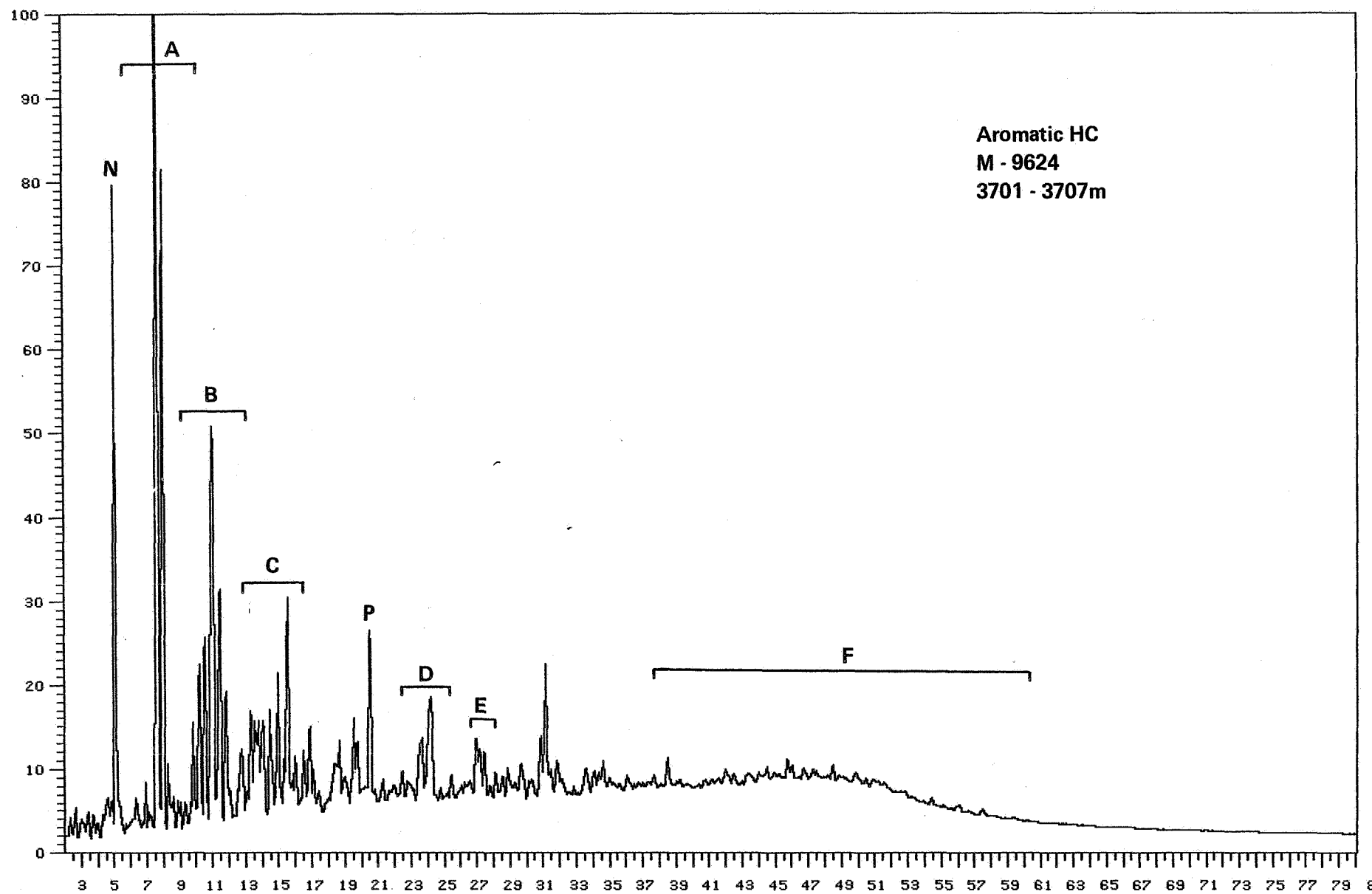


Analysis : 057527R4 Sample #: 1 Injection #: 1
Sample Name : M-9776, A, 15/8-1, AD Maximum value : 2711

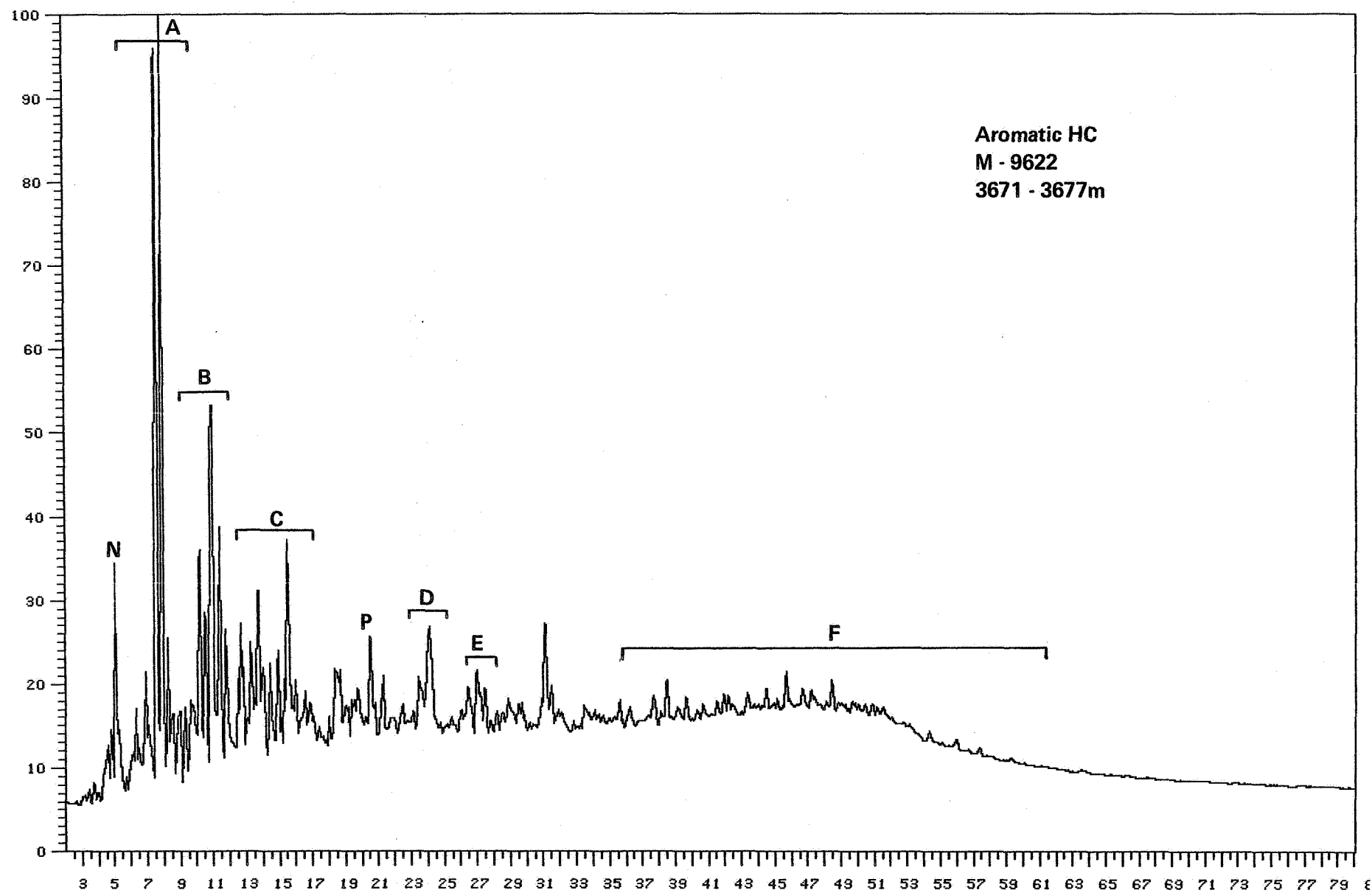


Aromatic HC
M - 9776
3749m

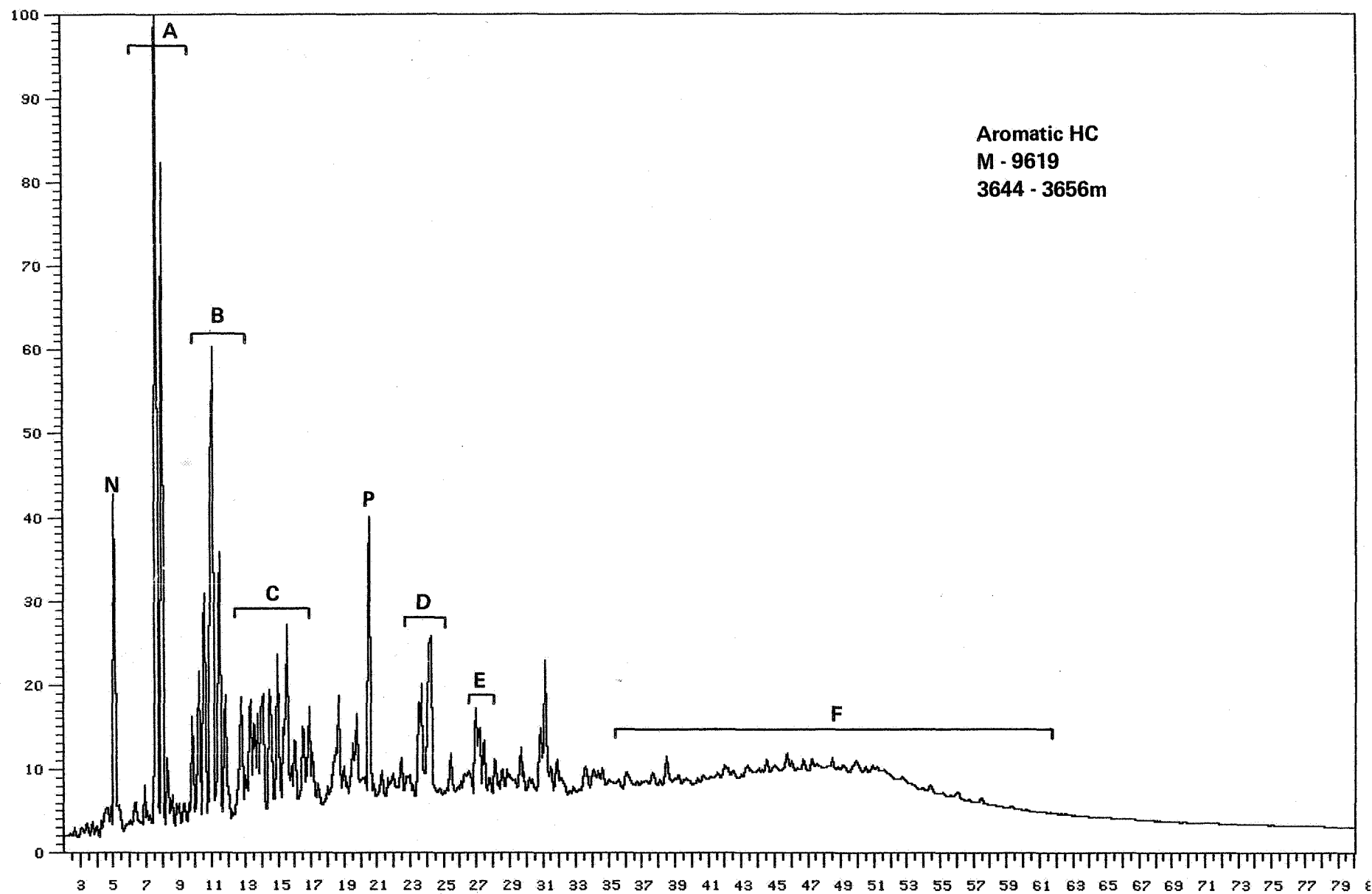
Analysis : 057527A2 Sample #: 2 Injection #: 1
Sample Name : M-9624, R15/8-1, RD Maximum value : 7015



Analysis : 057527R2 Sample f: 1 Injection f: 1
Sample Name : M-9622, A, 15/8-1, RD Maximum value : 1808

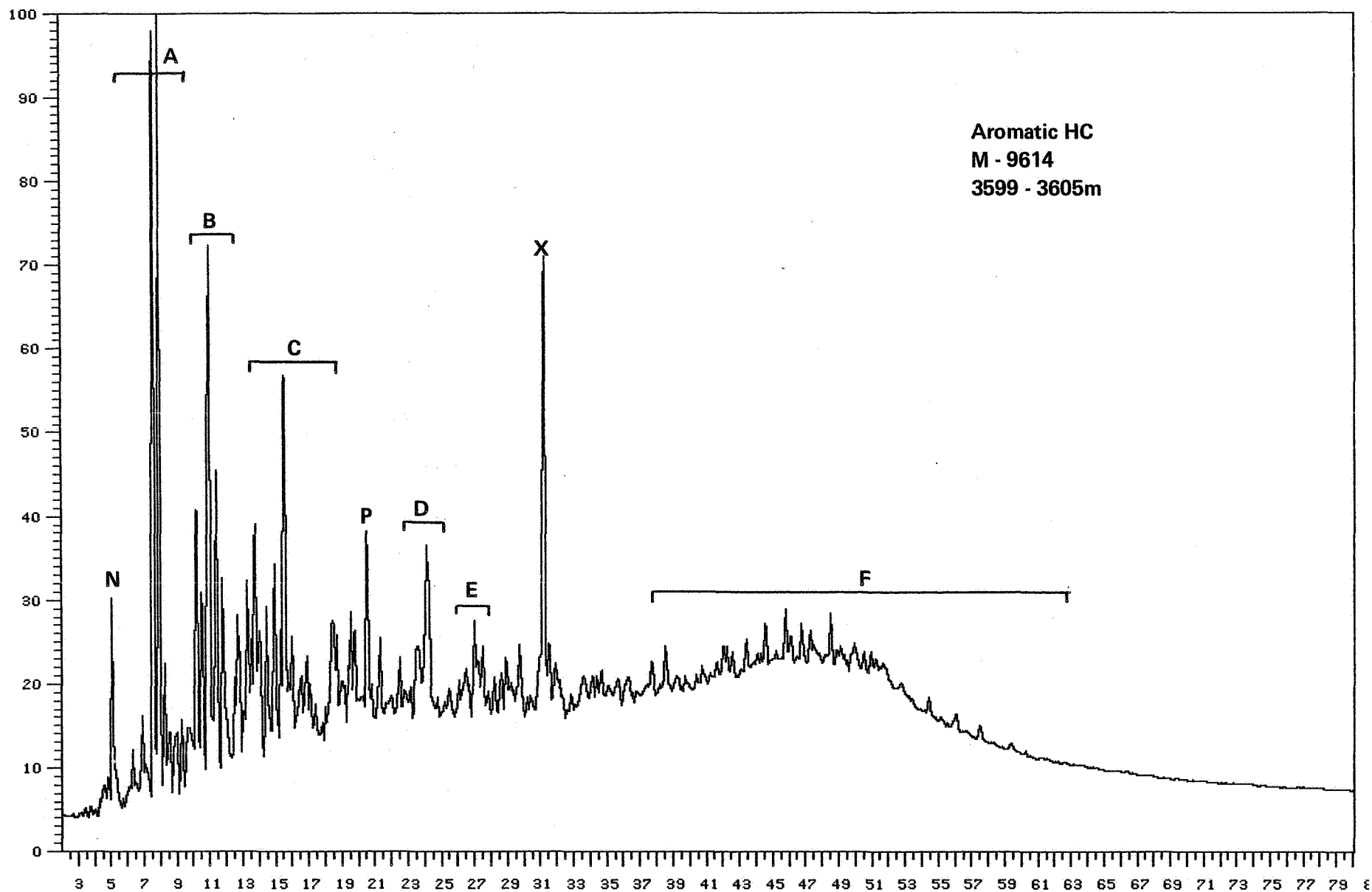


Analysis : 057527R1 Sample #: 2 Injection #: 1
 Sample Name : M-9619, A, 15/8-1, AD Maximum value : 5738



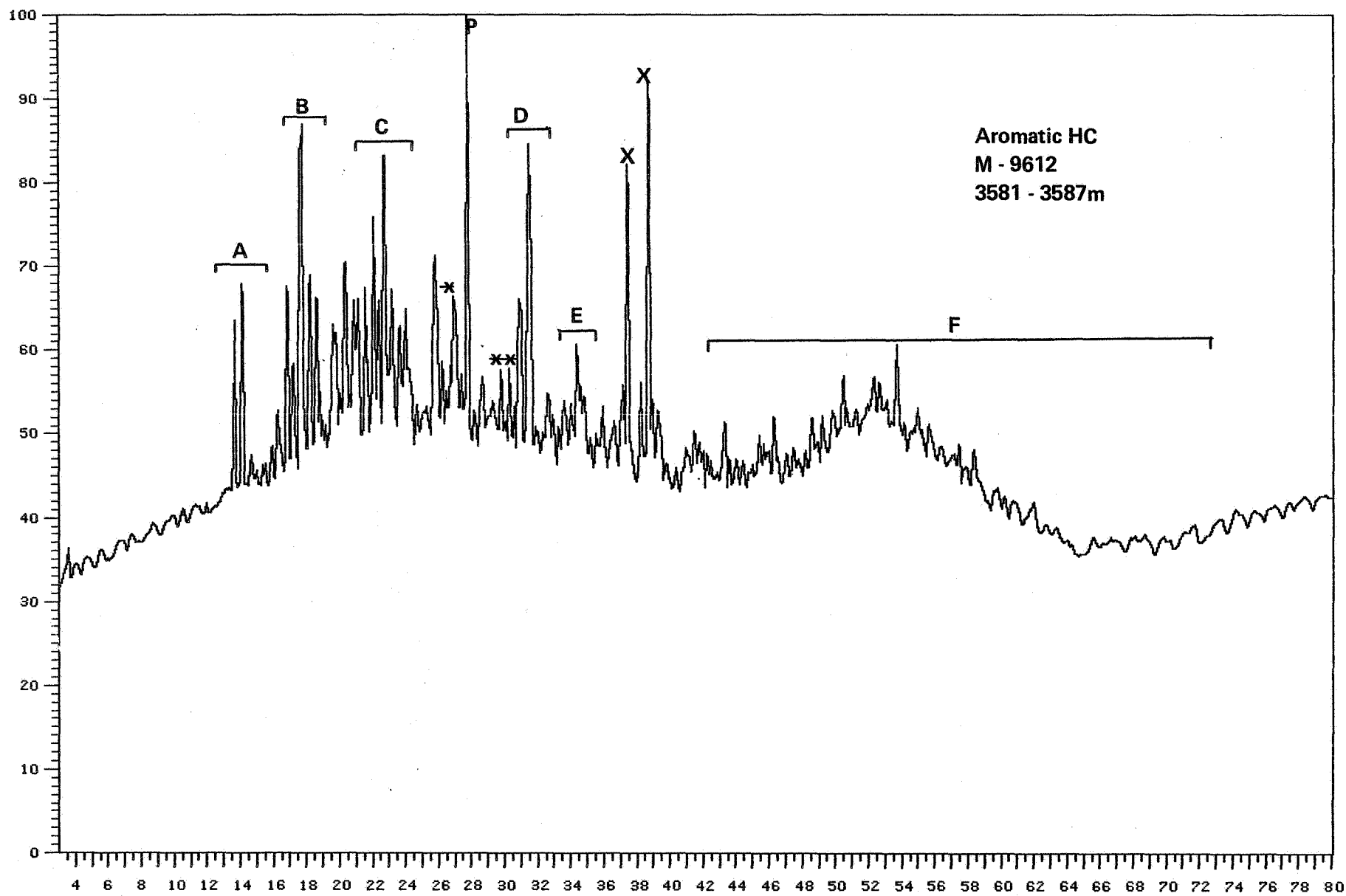
Aromatic HC
 M - 9619
 3644 - 3656m

Analysis : 057527R1 Sample #: 1 Injection #: 1
 Sample Name : M-9614, A, 15/8-1, AD Maximum value : 2553

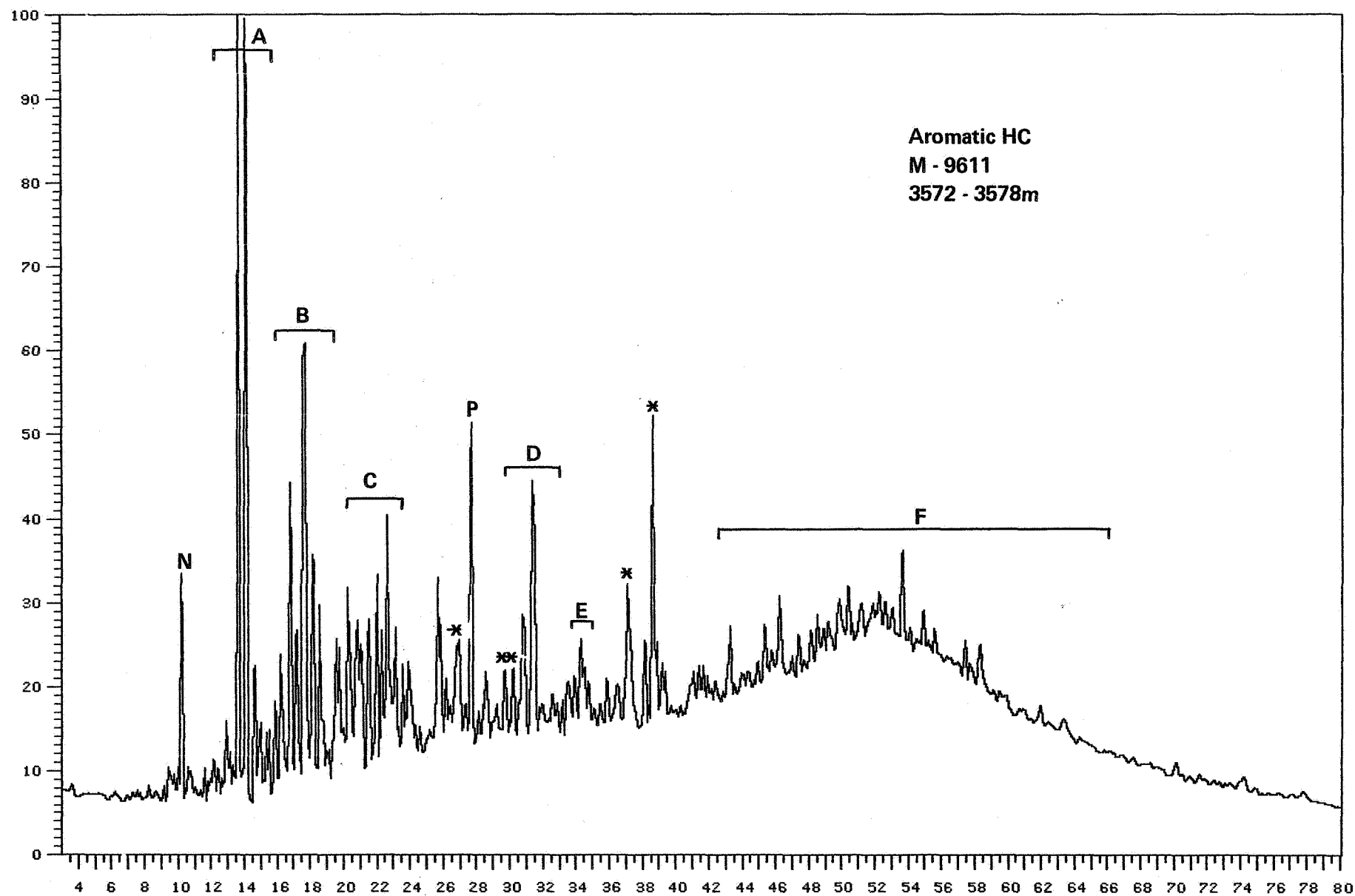


Aromatic HC
 M - 9614
 3599 - 3605m

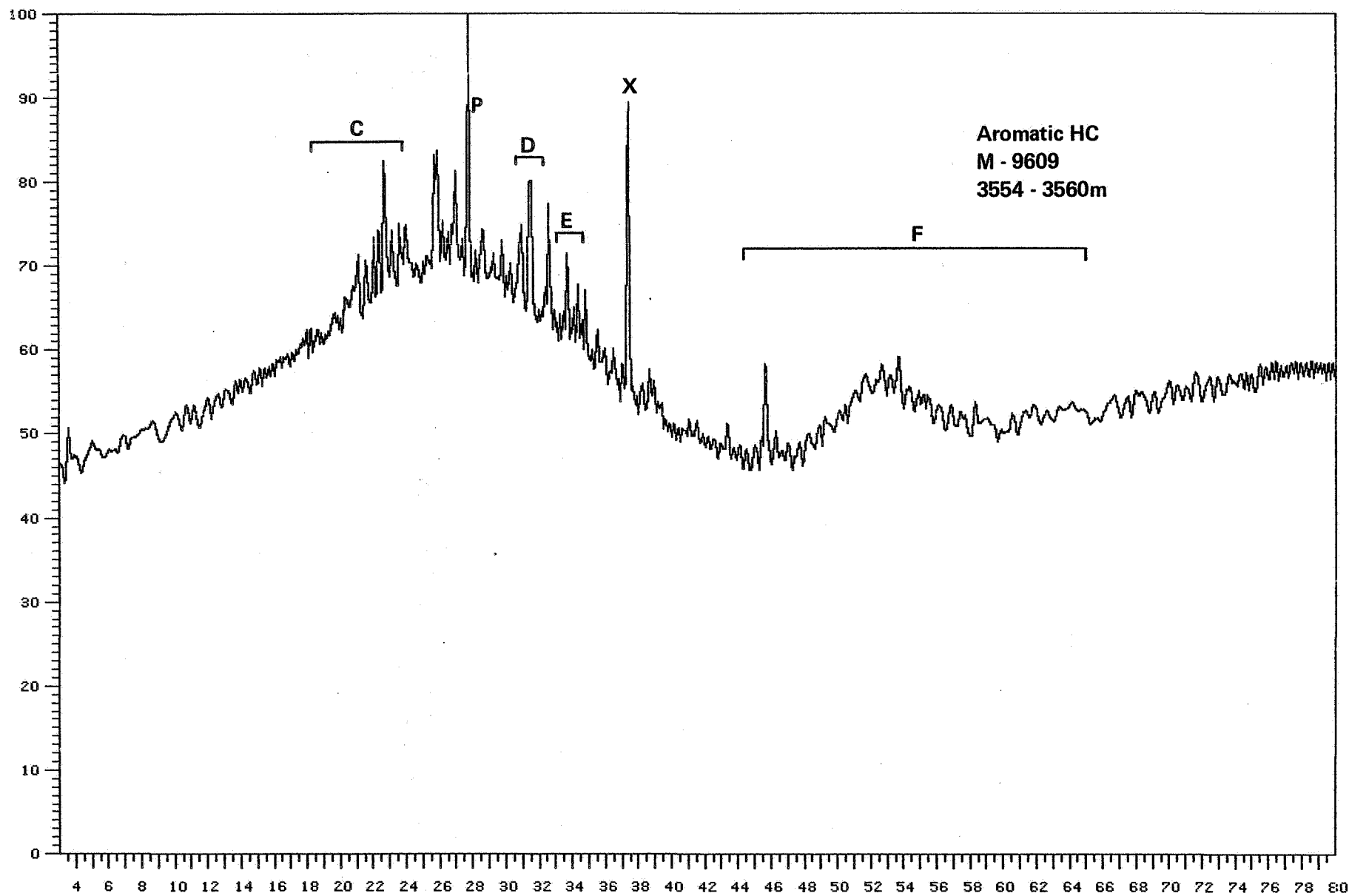
Analysis : 7527M9612A1 Sample #: 1 Injection #: 1
 Sample Name : M-9612, A, 15/8-1, AD Maximum value : 234



Analysis : 7527M9611A1 Sample #: 1 Injection #: 1
Sample Name : M-9611, A, 15/8-1, AD Maximum Value : 725

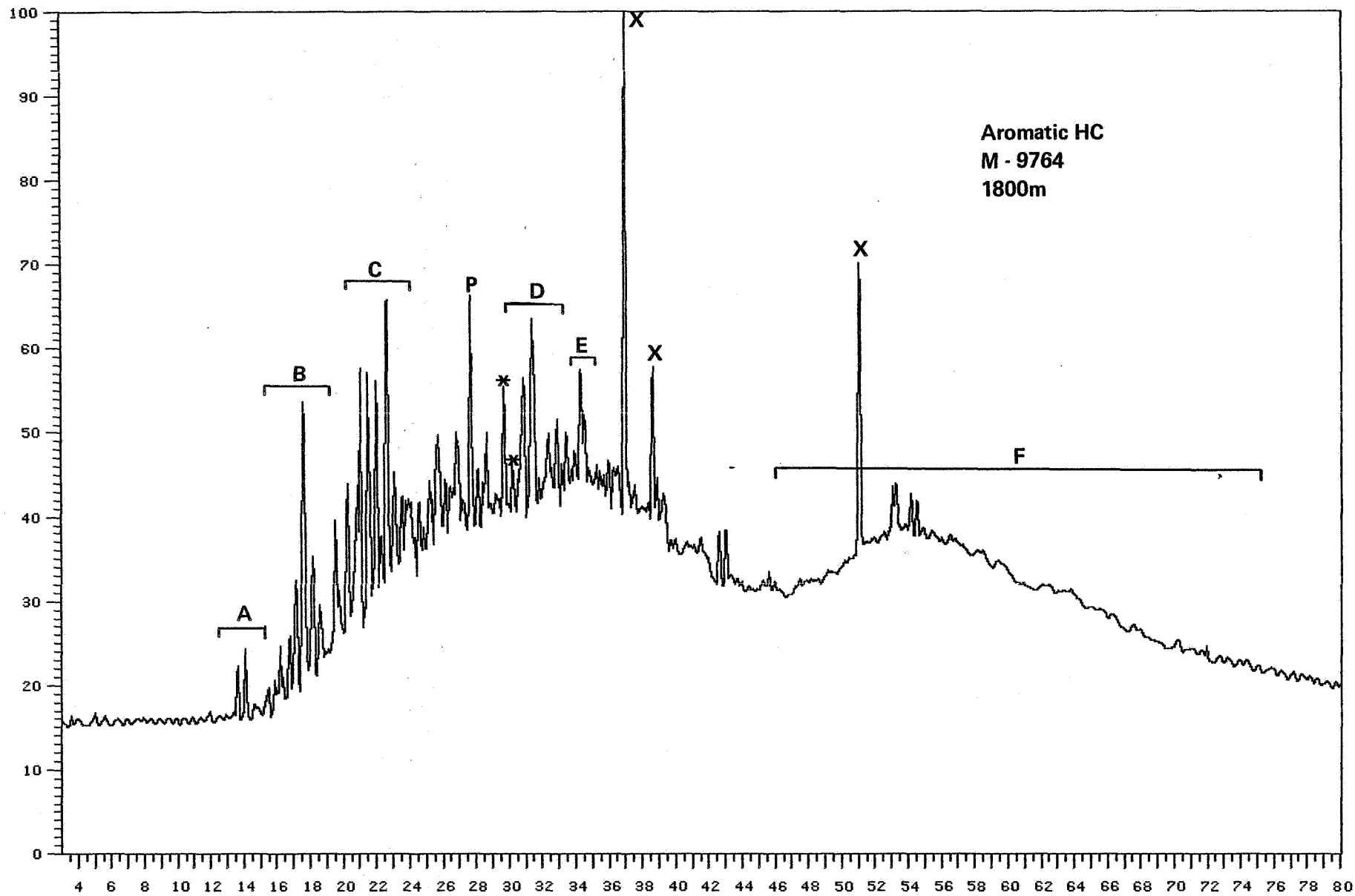


Analysis : 7527M9609A1 Sample #: 1 Injection #: 1
Sample Name : M-9609, A, 15/8-1, RD Maximum value : 164

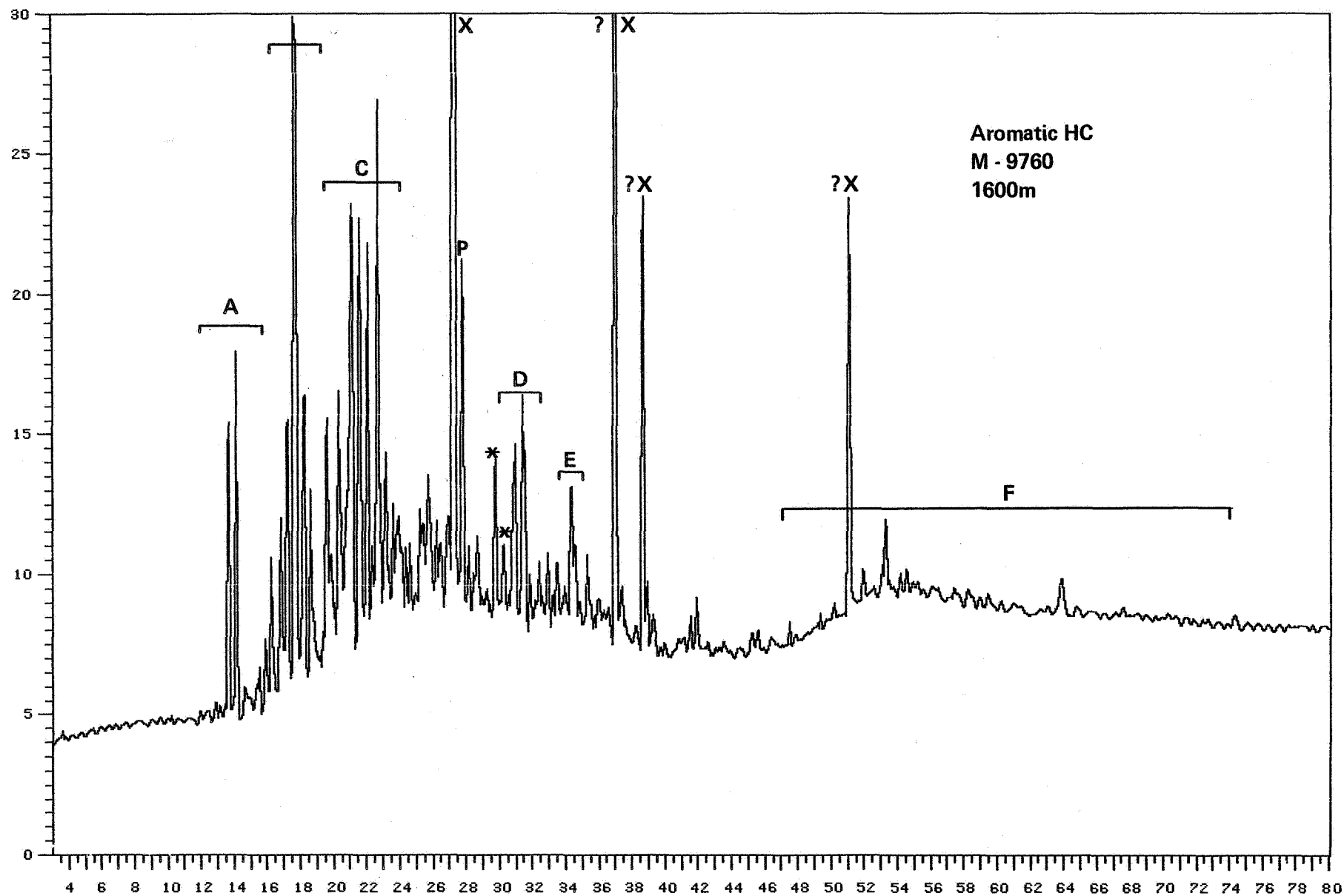


Analysis : 7527M9764R1 Sample #: 1 Injection #: 1

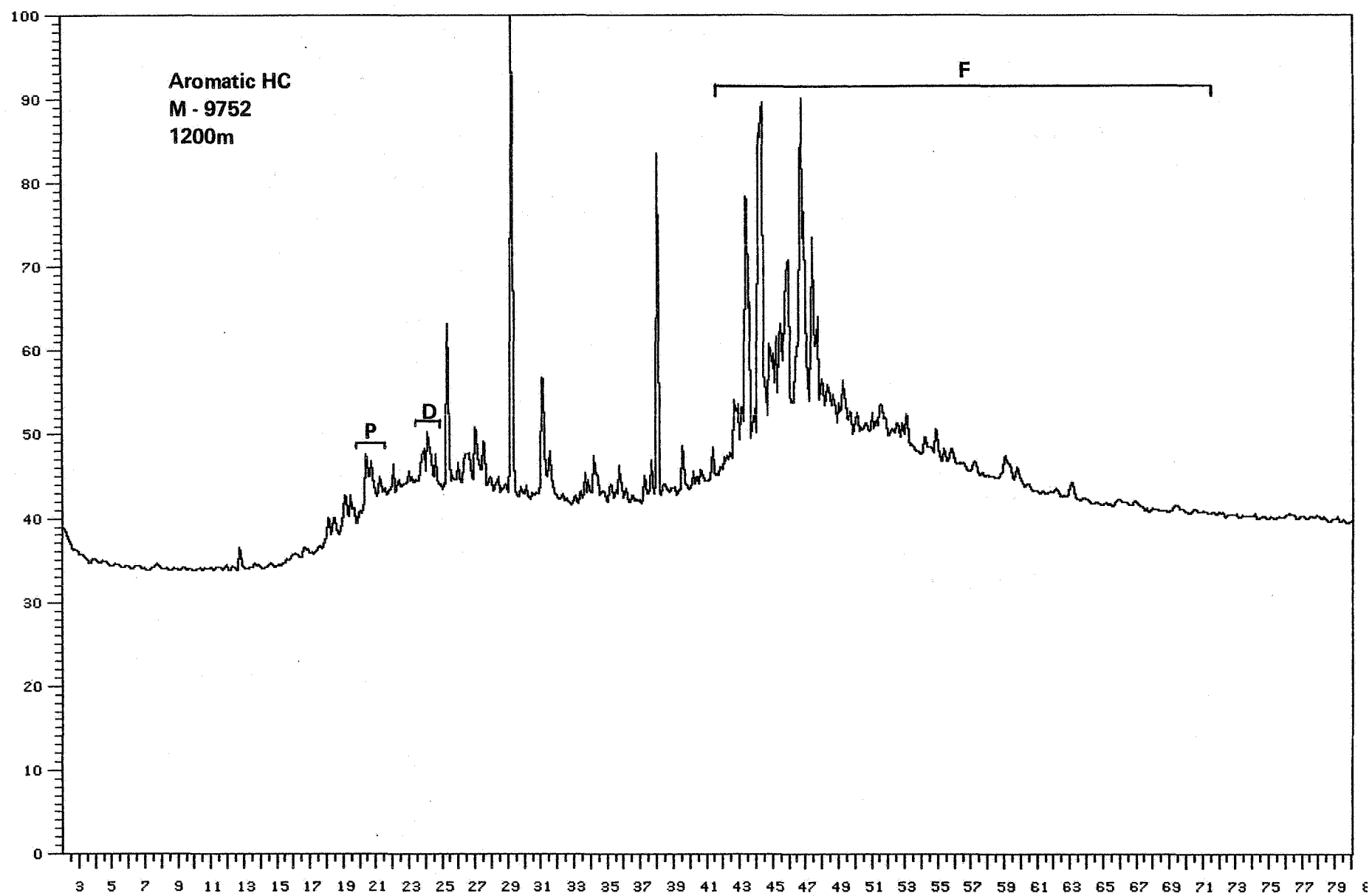
Sample Name : M-9764, A, 15/8-1, AD Maximum value : 461



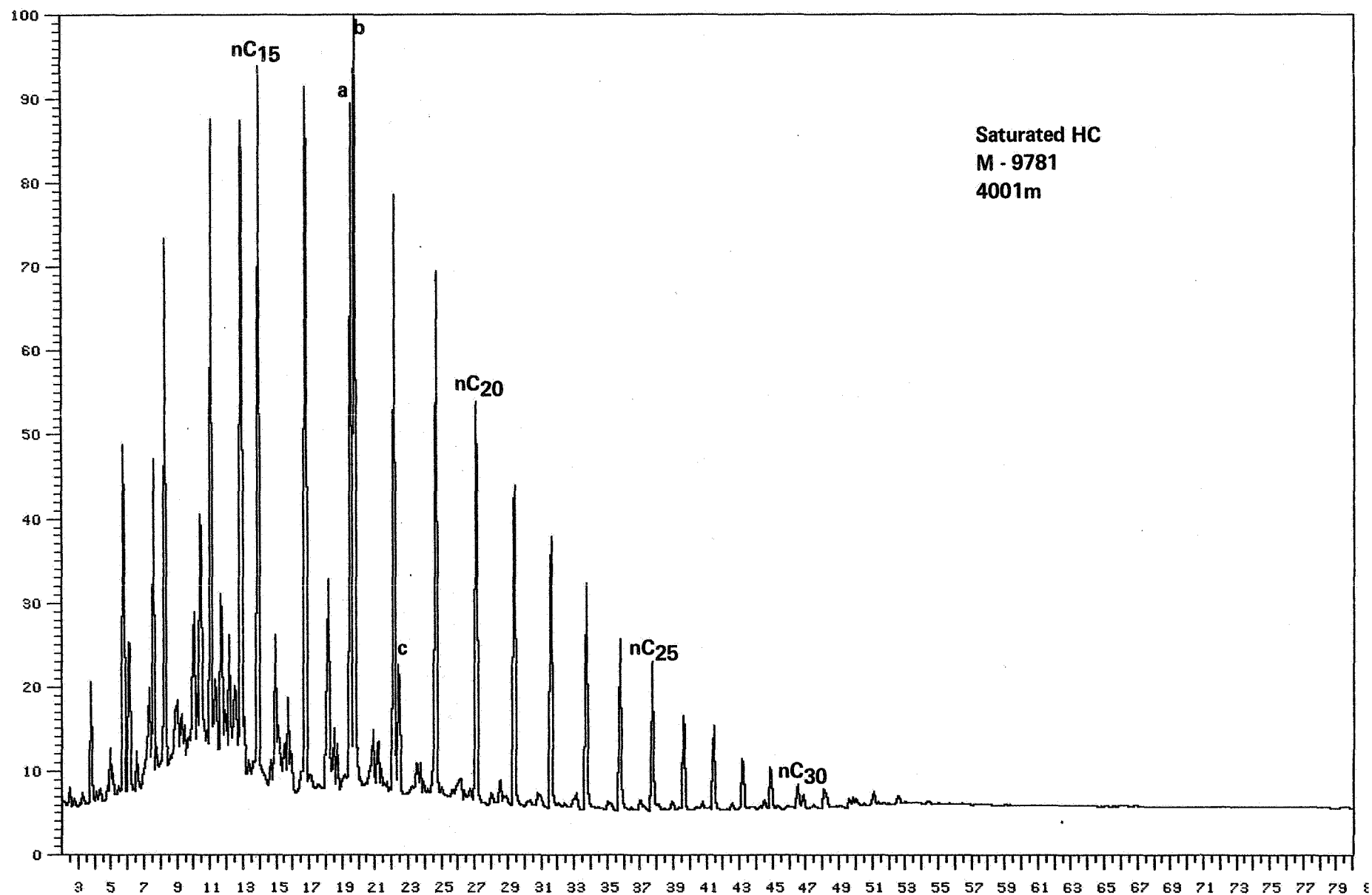
Analysis : 7527M9760A1 Sample #: 1 Injection #: 1
Sample Name : M-9760, A, 15/8-1, RD Maximum value : 1707



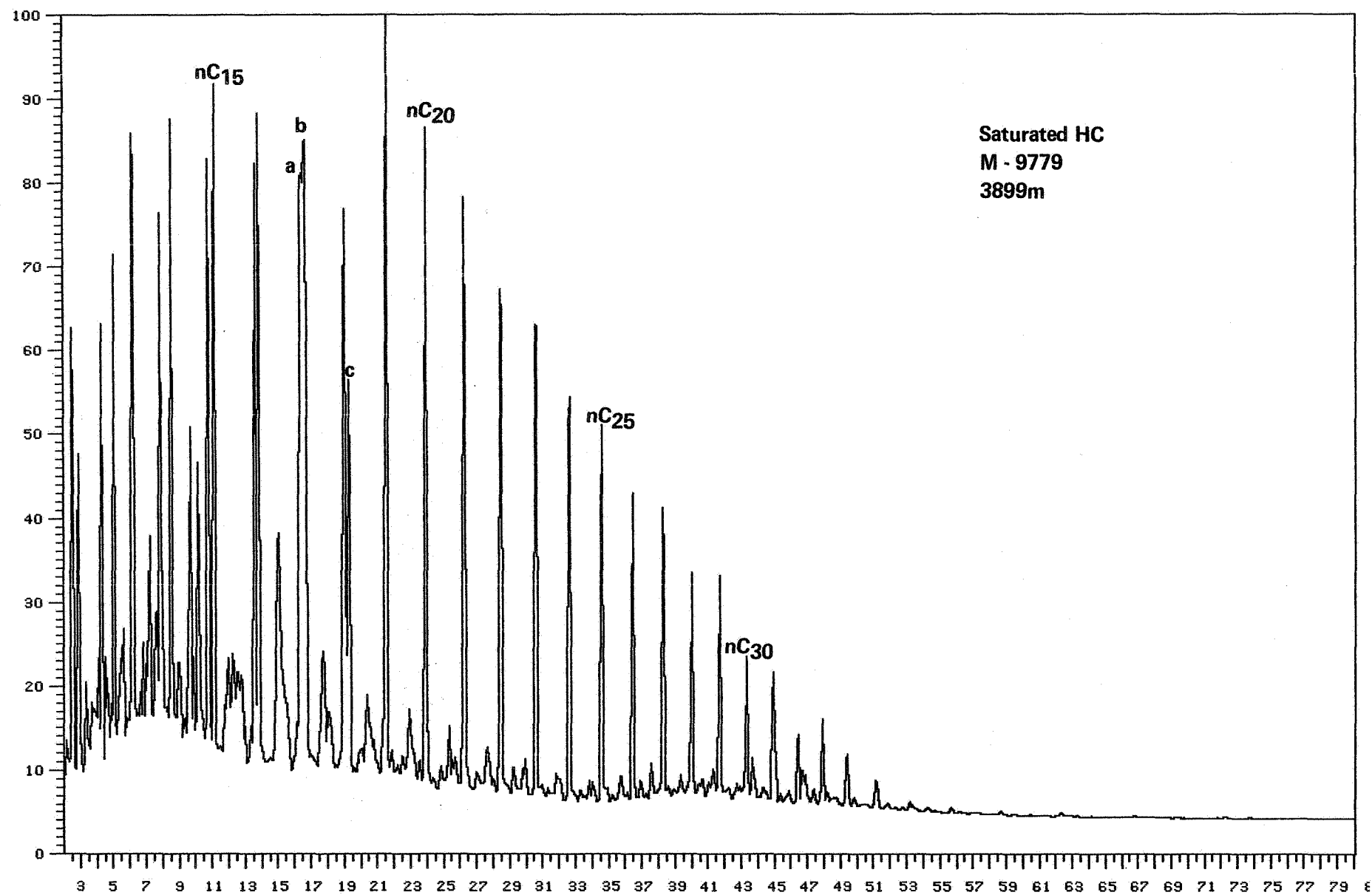
Analysis : 7527M9752A1 Sample #: 1 Injection #: 1
Sample Name : M-9752, A, 15/8-1, RD Maximum value : 277



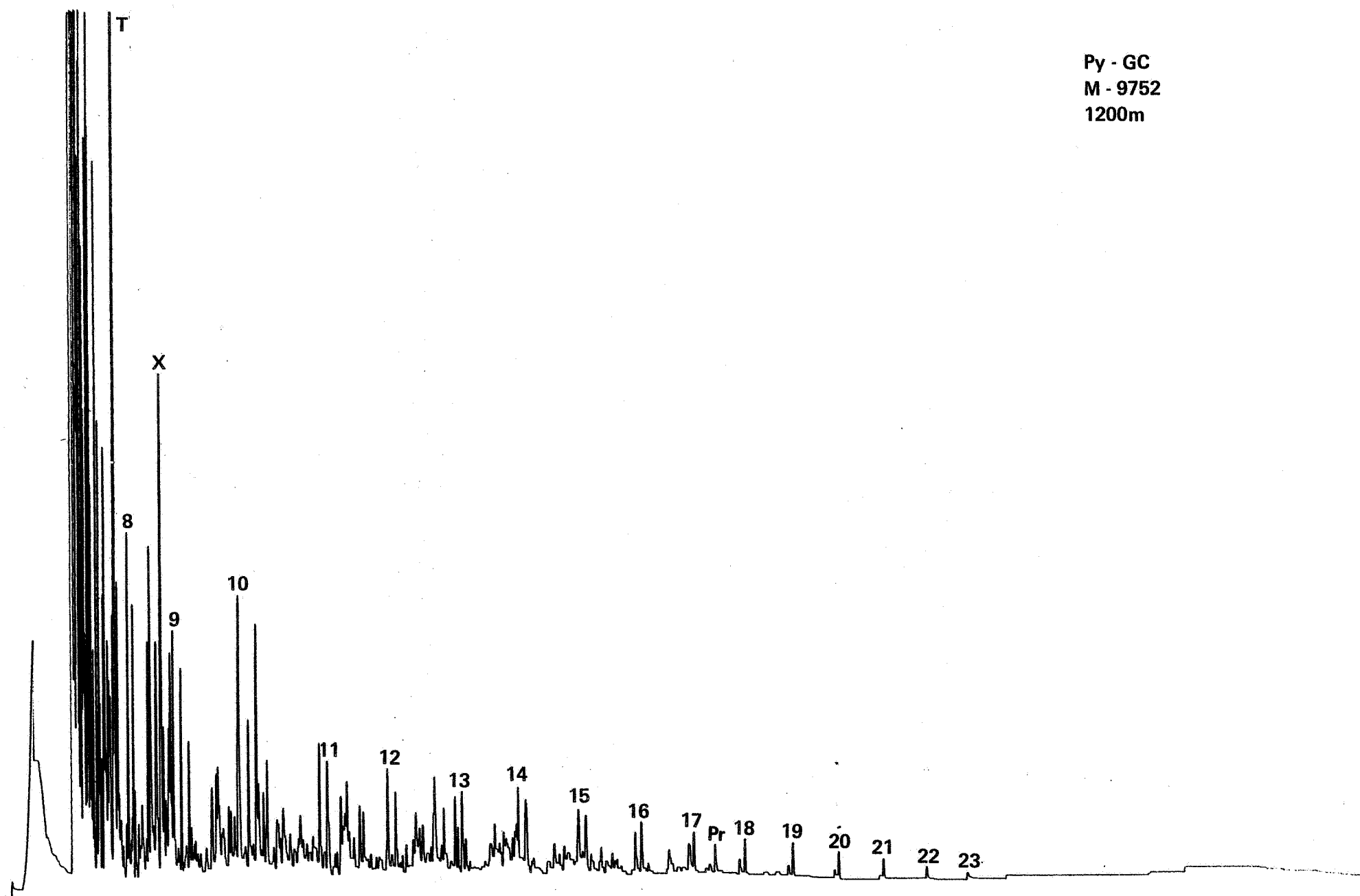
Analysis : 057527S2 Sample #: 7 Injection #: 1
Sample Name : M-9781, S, 15/8-1, RD Maximum value : 1665



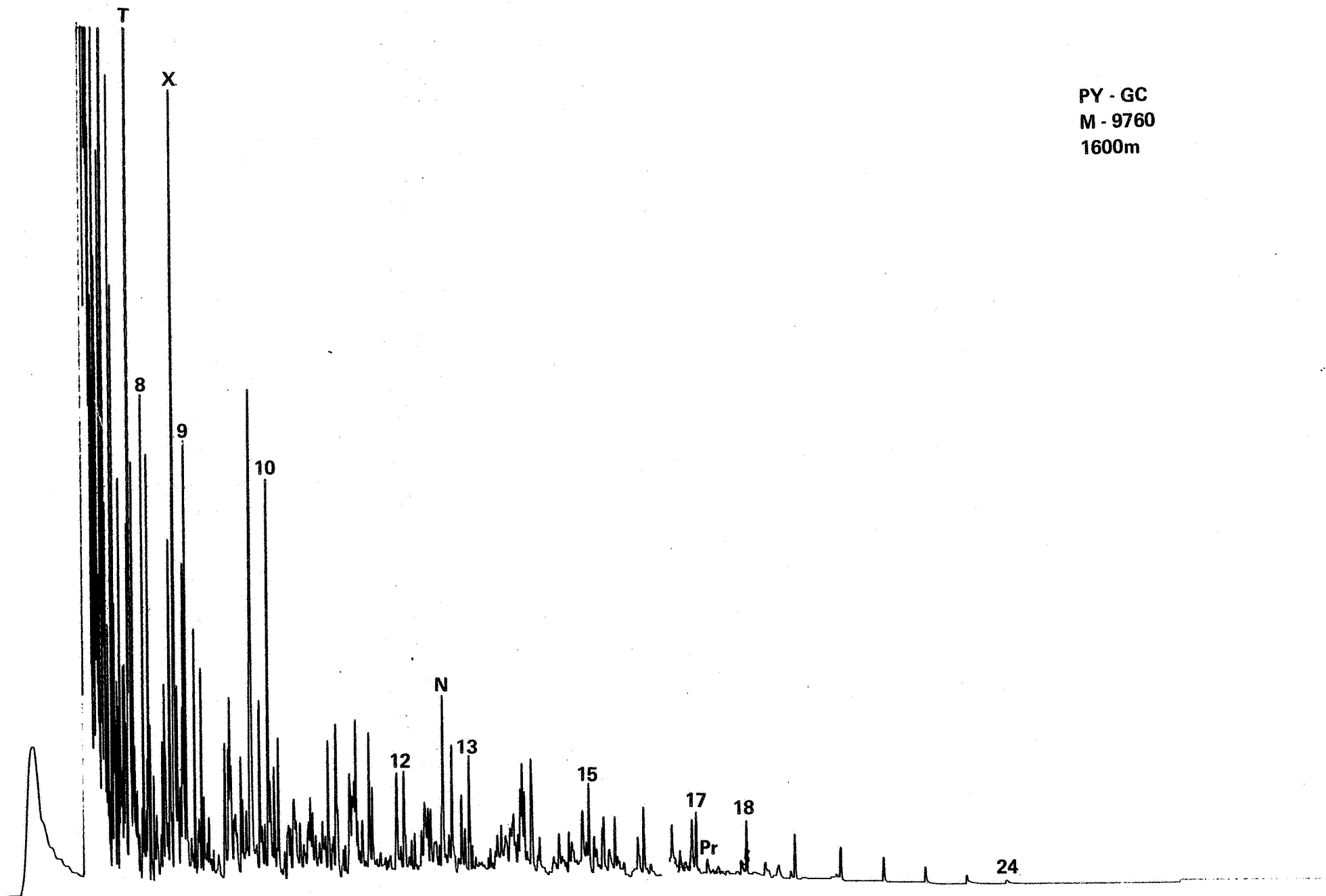
Analysis : 05752752 Sample #: 6 Injection #: 1
Sample Name : M-9779, S, 15/8-1, RD Maximum value : 2346



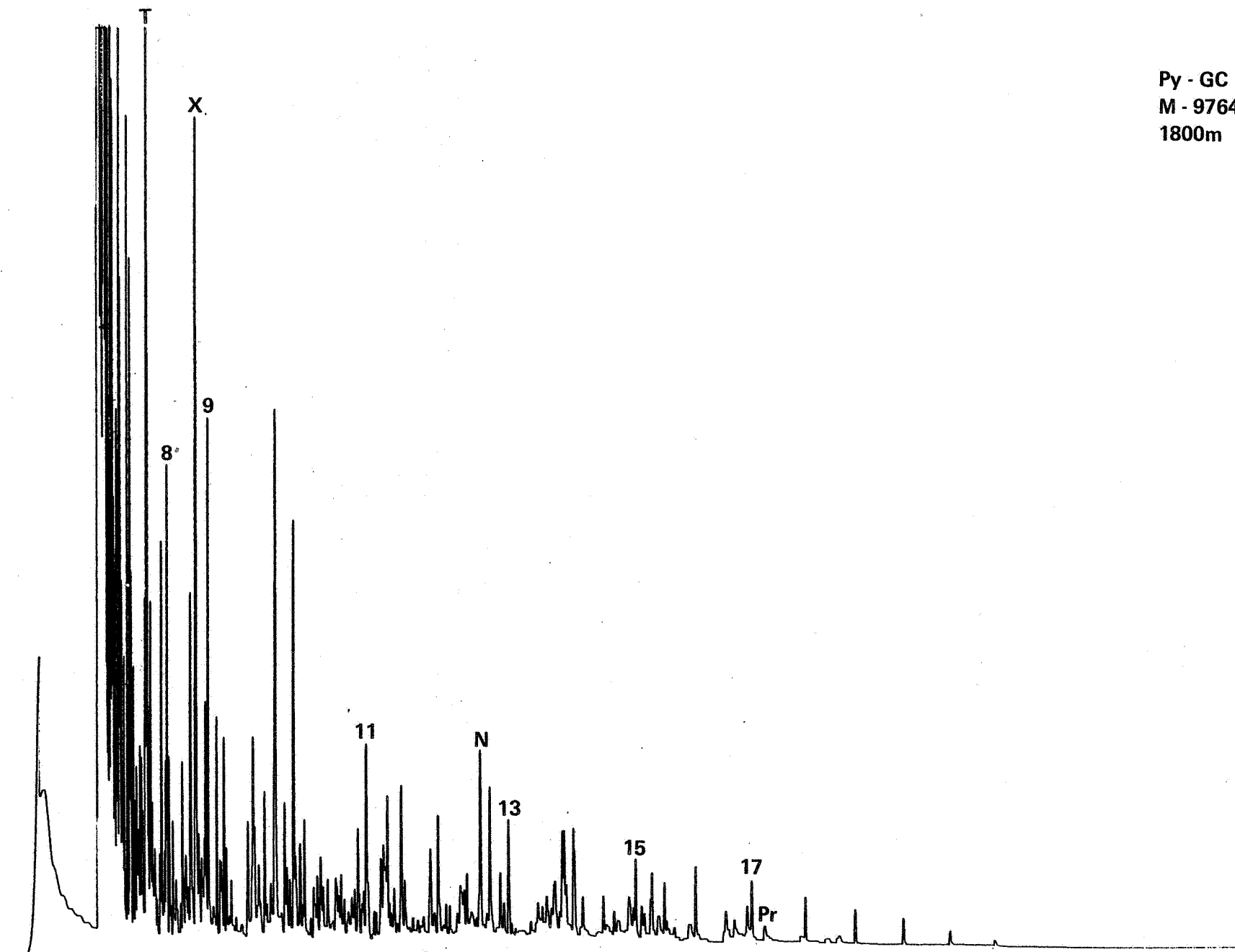
Py - GC
M - 9752
1200m



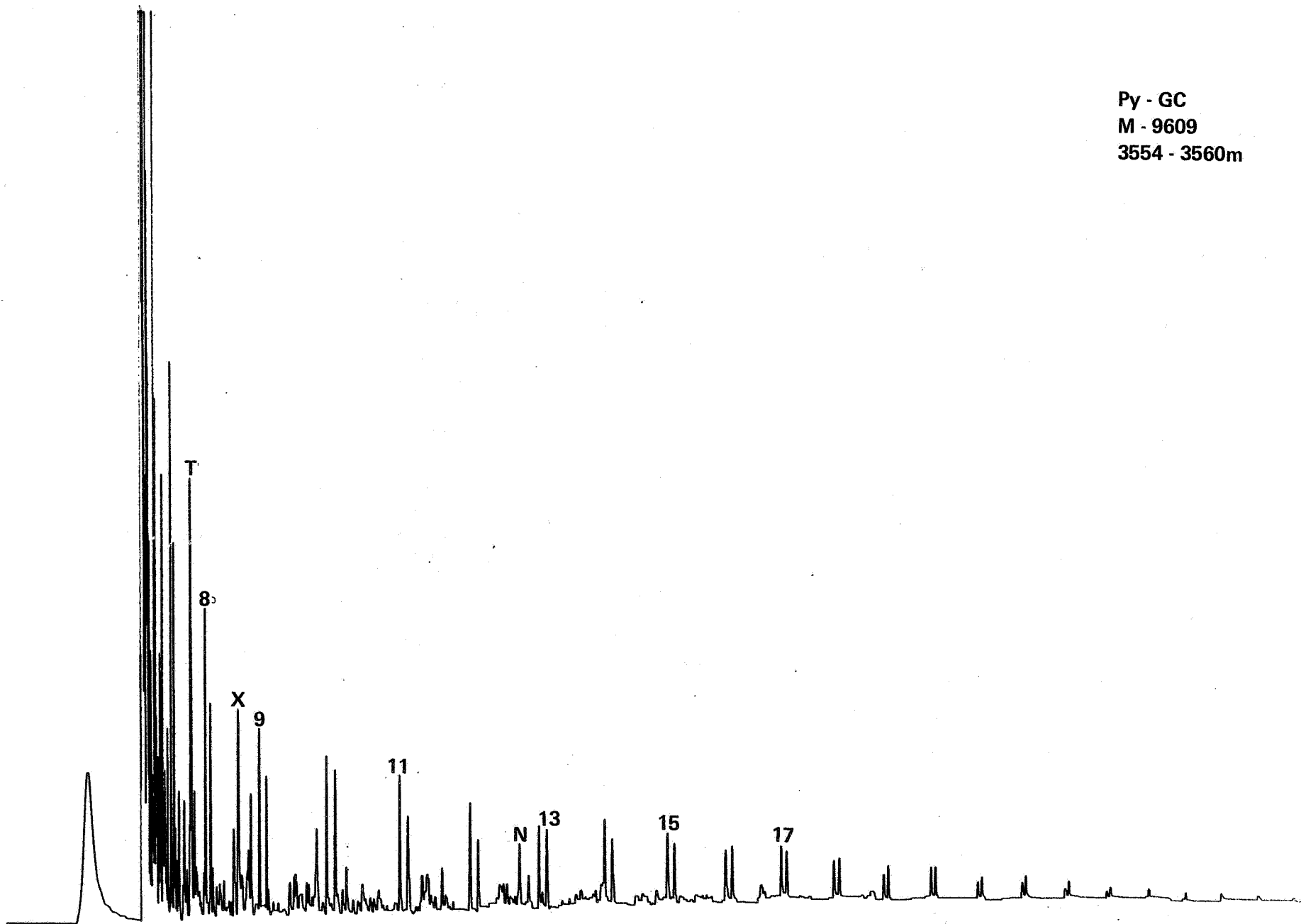
PY - GC
M - 9760
1600m



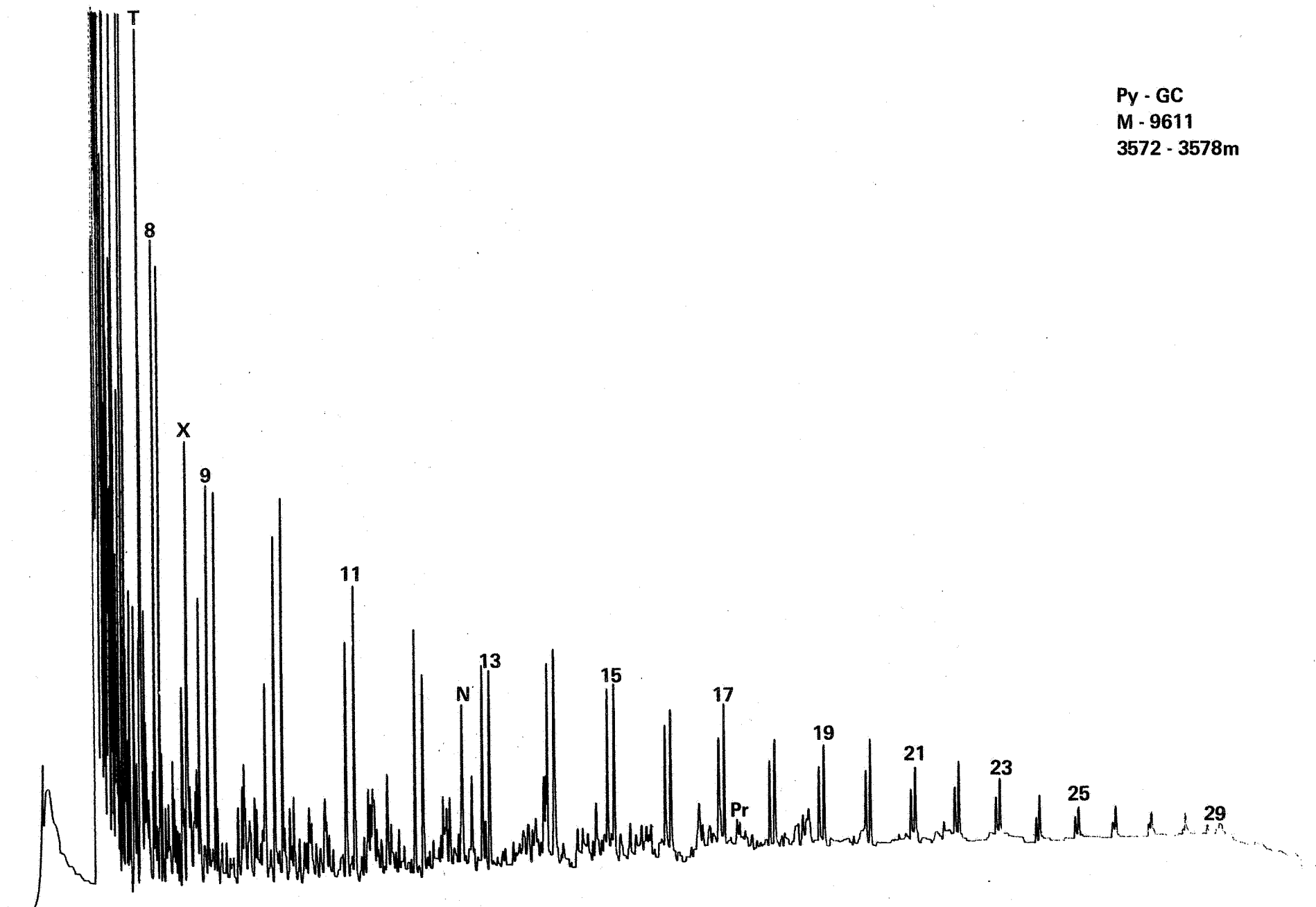
Py - GC
M - 9764
1800m



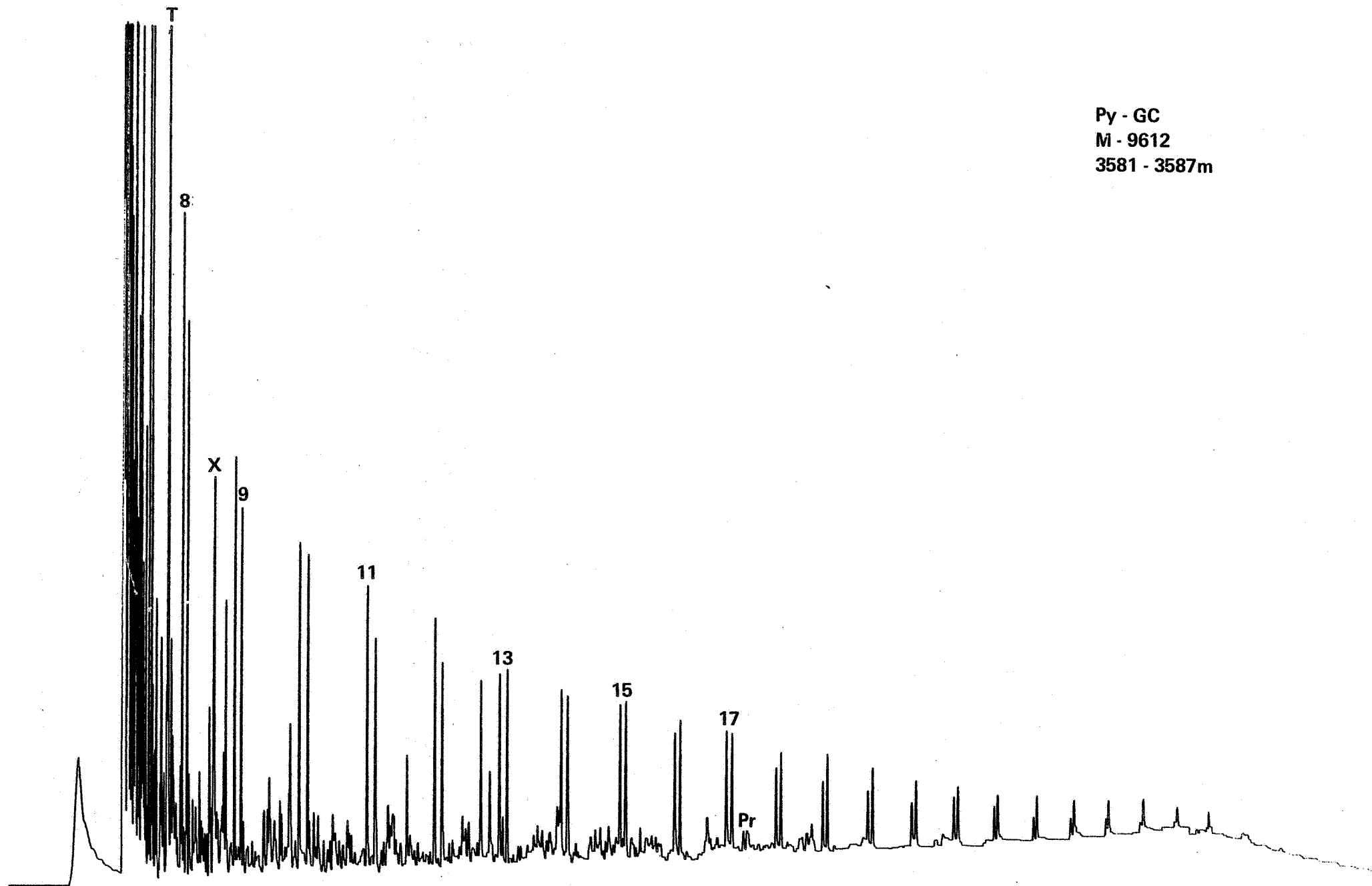
Py - GC
M - 9609
3554 - 3560m



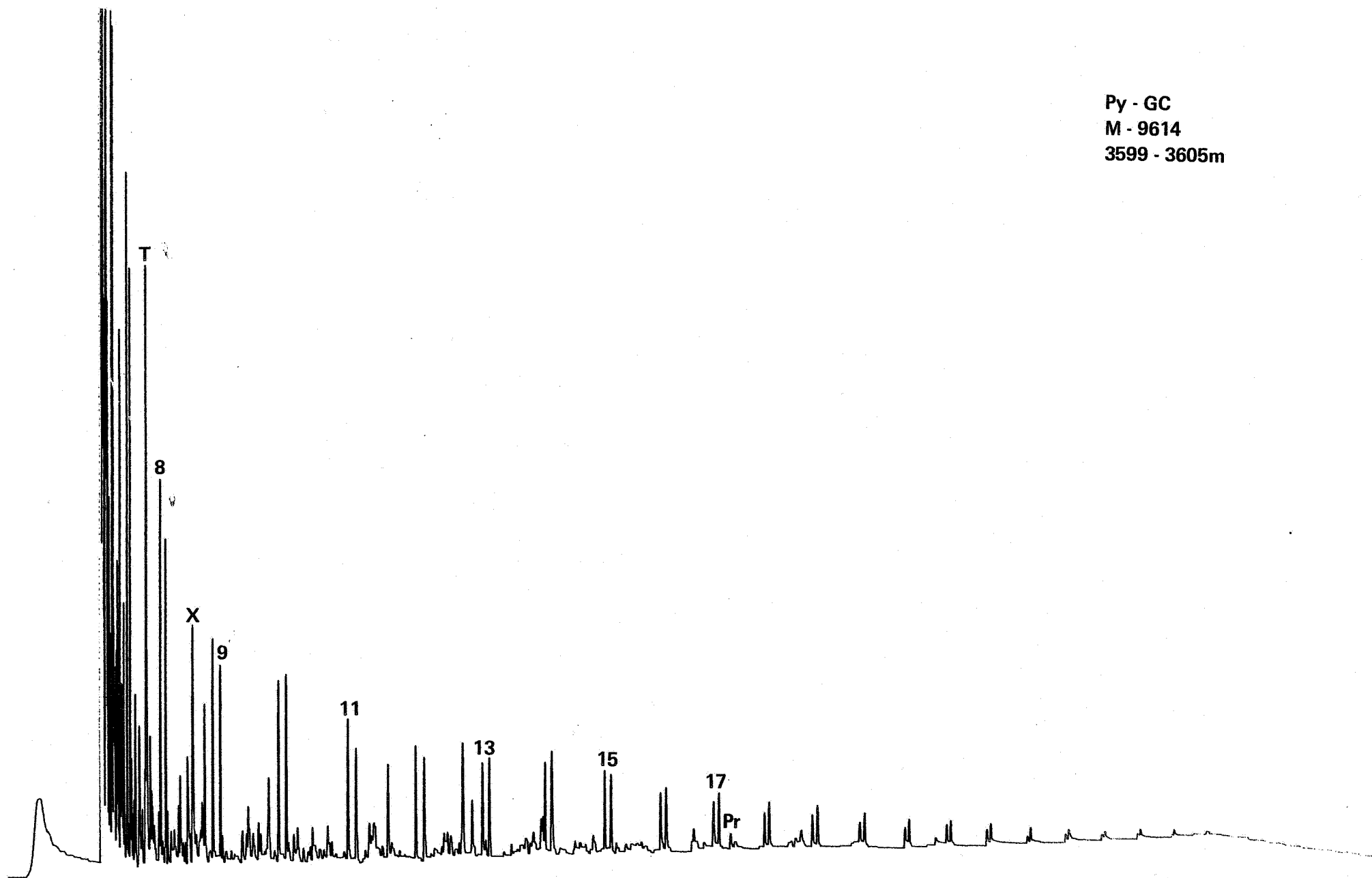
Py - GC
M - 9611
3572 - 3578m



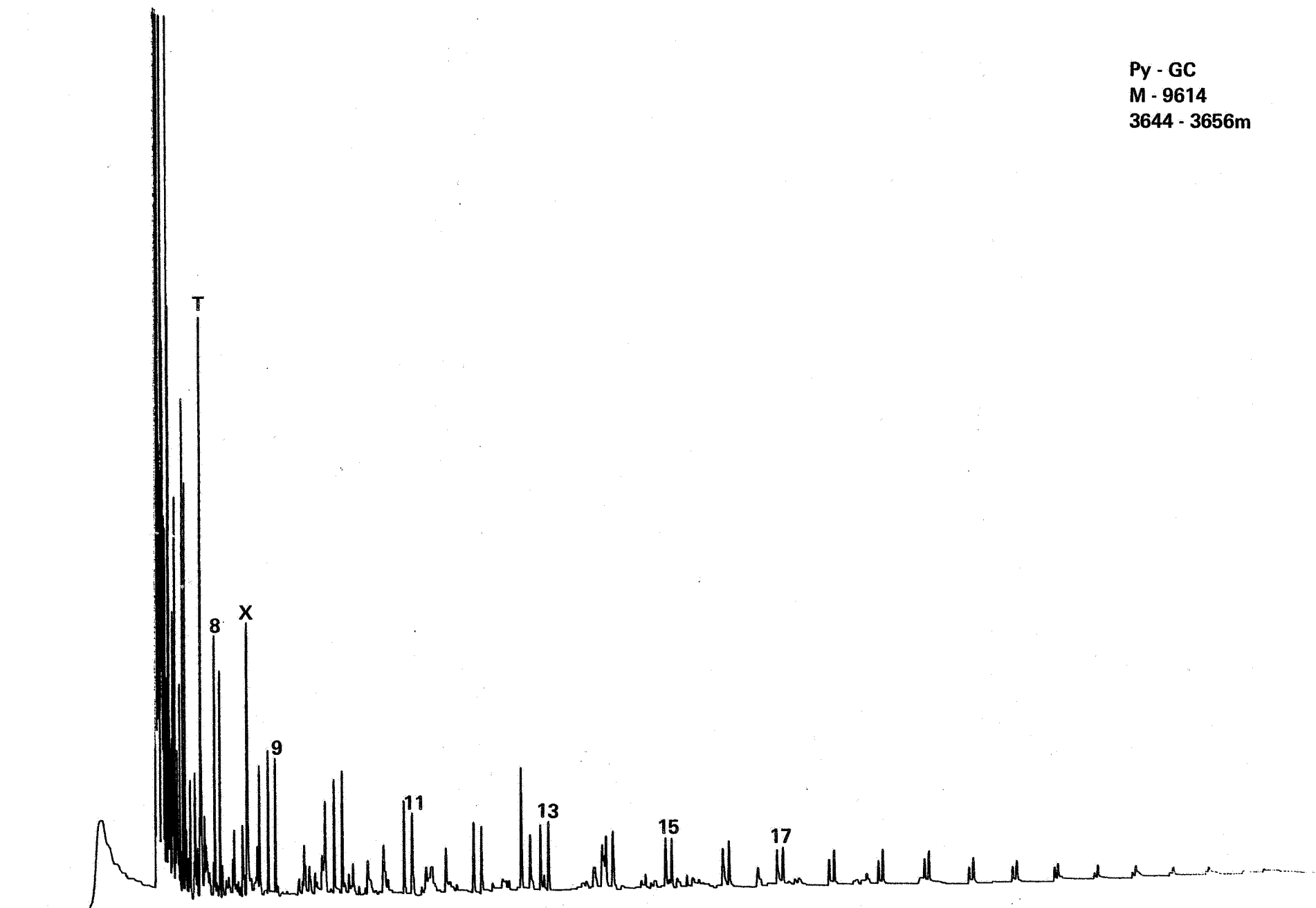
Py - GC
M - 9612
3581 - 3587m



Py - GC
M - 9614
3599 - 3605m

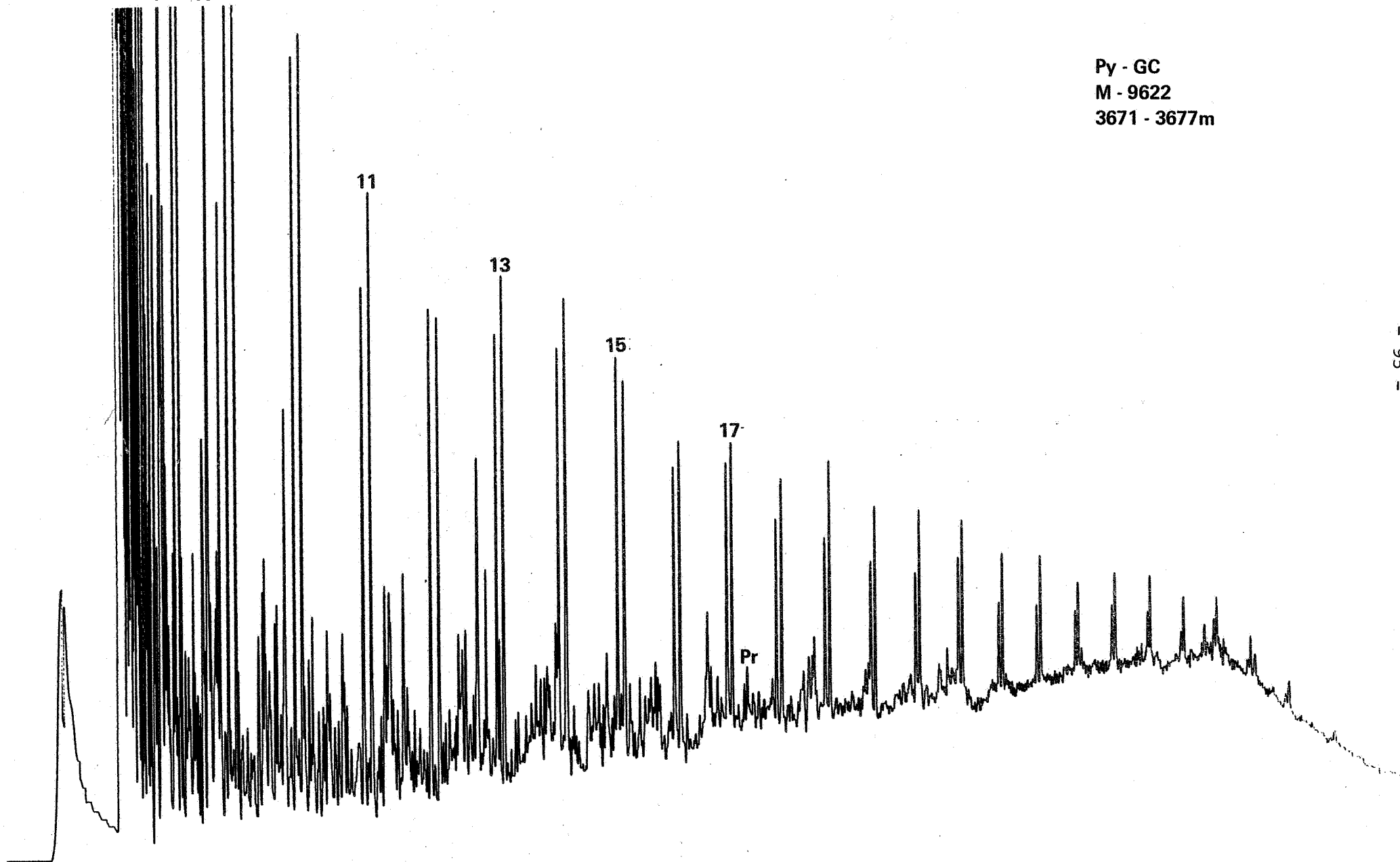


Py - GC
M - 9614
3644 - 3656m

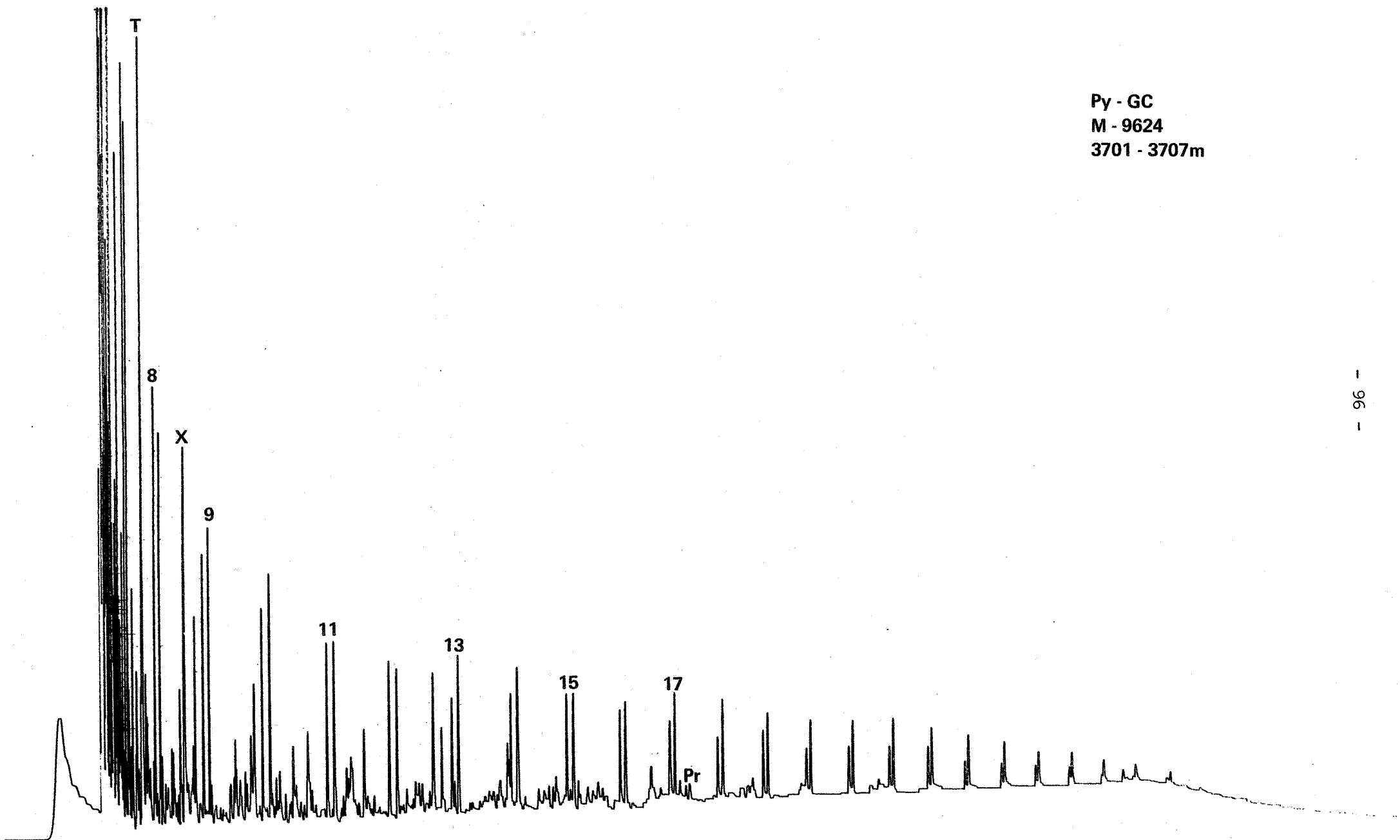


T 8 X 9

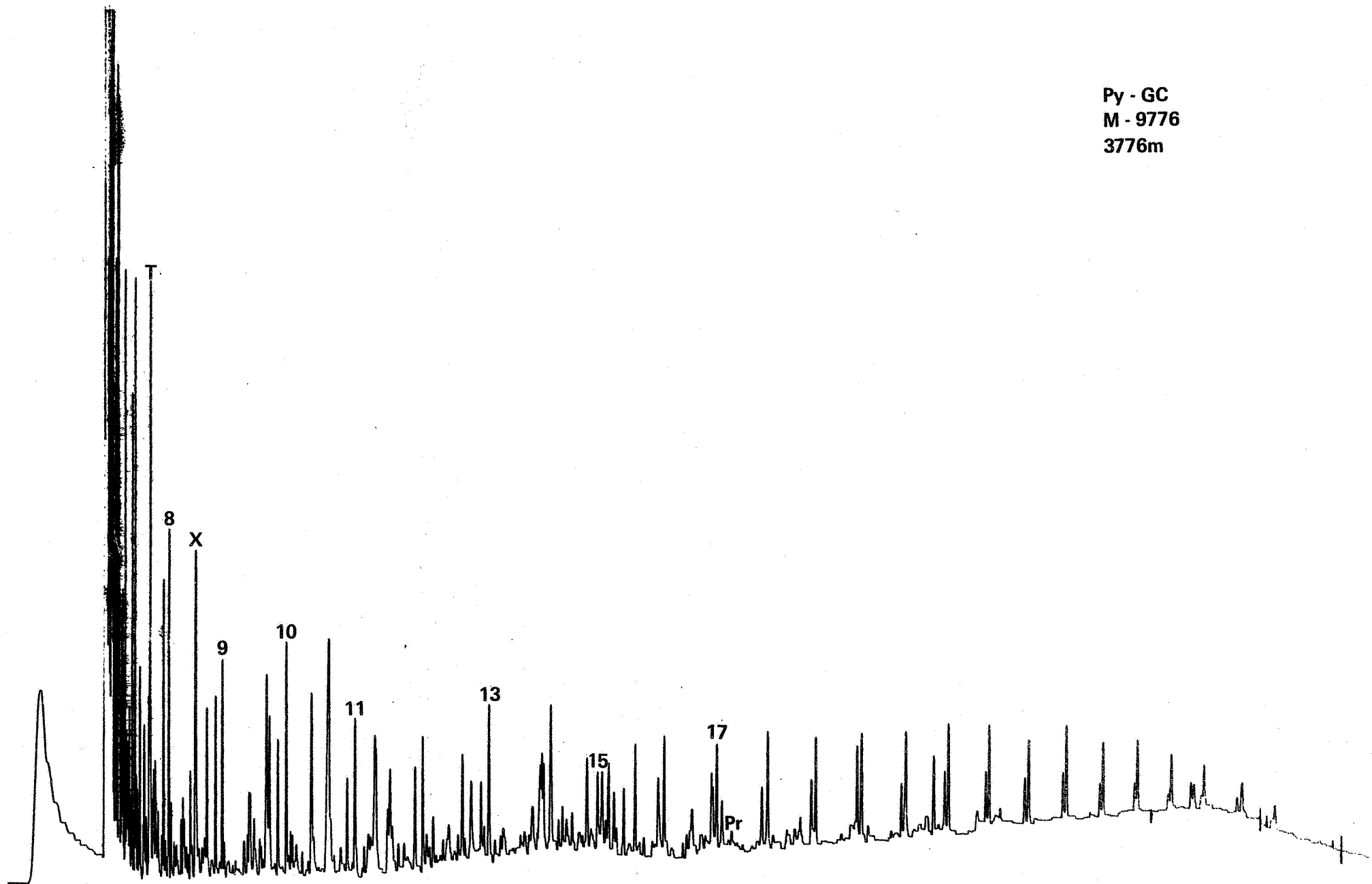
Py - GC
M - 9622
3671 - 3677m



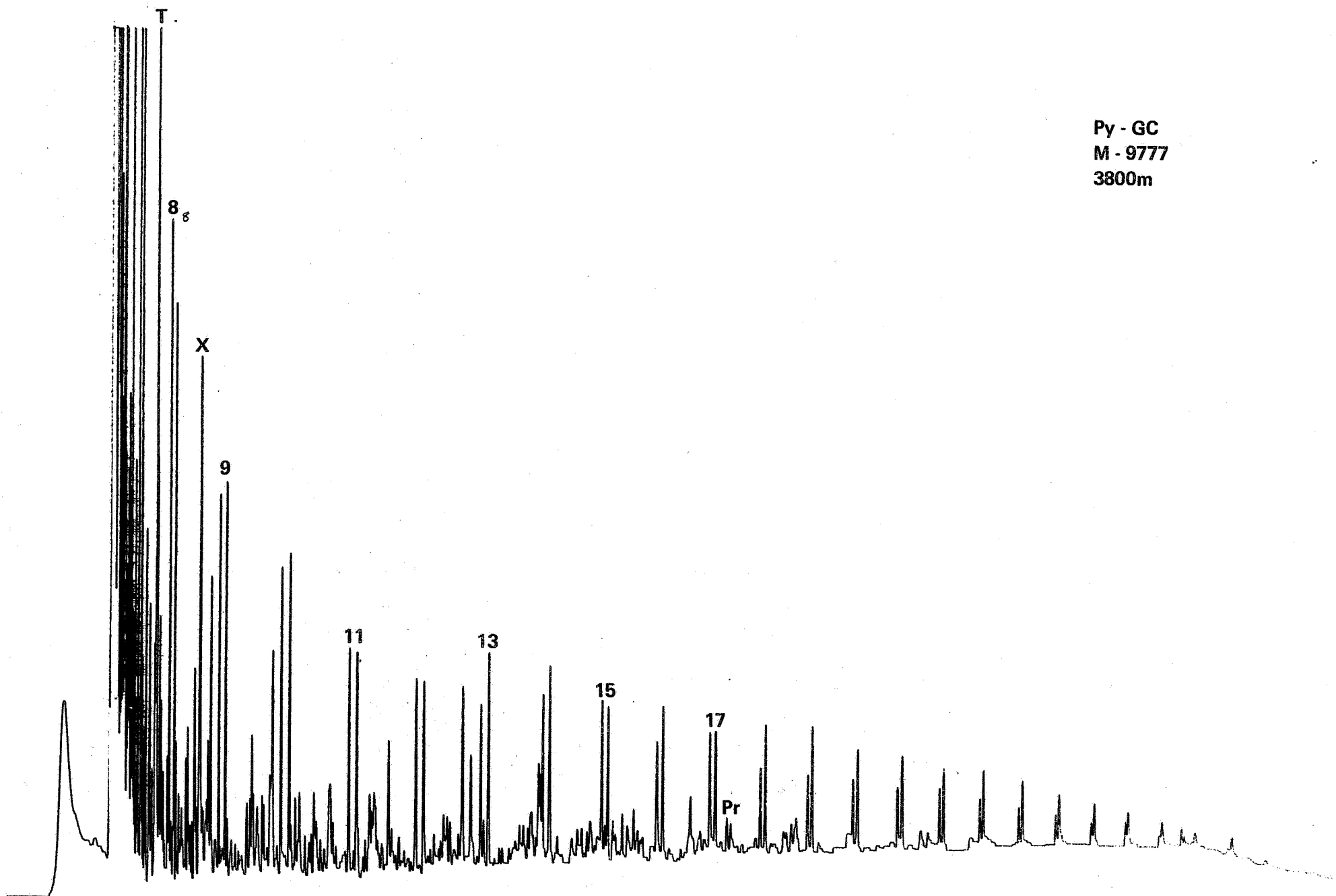
Py - GC
M - 9624
3701 - 3707m



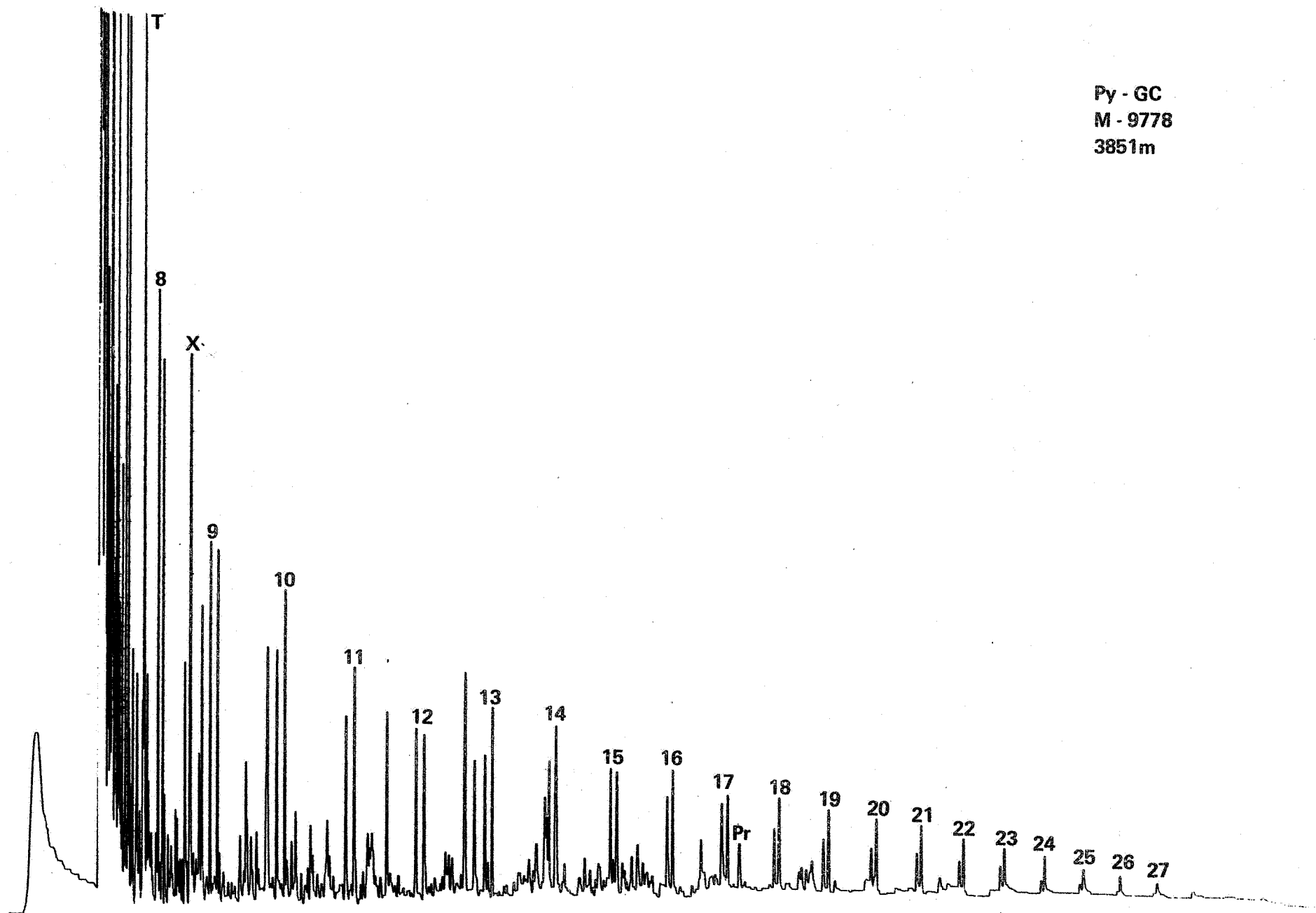
Py - GC
M - 9776
3776m



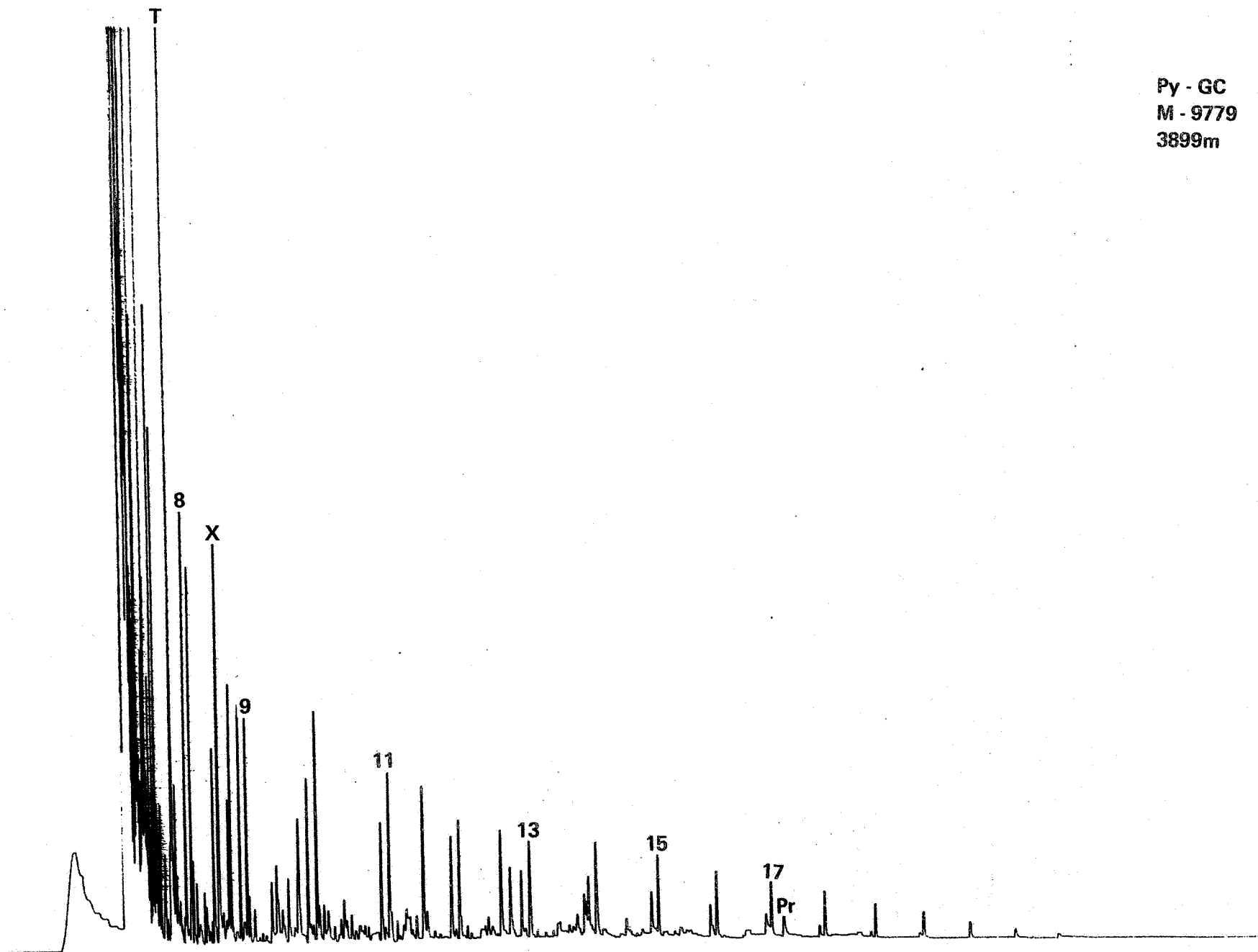
Py - GC
M - 9777
3800m



Py - GC
M - 9778
3851m



Py - GC
M - 9779
3899m



Py - GC
M - 9781
4001m

