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

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REPORT TITLE/ TITTEL

Source Rock Analysis of well 24/12-2

CLIENT/ OPPDRAGSGIVER

STATOIL

RESPONSIBLE SCIENTIST/ PROSJEKTANSVARLIG

P.B. Hall

AUTHORS/ FORFATTERE

P.B. Hall, P. Svensson and J.O. Vigran

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SUMMARY/ SAMMENDRAG

The analysed sequence in this well was divided into 6 zones:-

Zone A; 3750-3990m consists mostly of turbodrilled marls and claystone with no source rock potential.

Zone B; 3990-4140m and Zone C; 4140-4260m have thin horizons of dark grey shales, with 1-2% TOC consisting of mature oil window kerogen type III with a poor potential as source rocks for hydrocarbons.

Zones D-F; 4260-4900m contain dark shales which dominate the lithologies from 4260-4900m have from 2-8% TOC and can be divided into three zones:- (i) Between 4260-4340m, originally type II or mixed type II/III kerogens. At the high maturity level (%Ro=1%) they have generated most of their oil potential, although they still have a fair-good potential for gas. (ii) Between 4340-4740m, originally type III kerogens but at high maturity level (Ro=1.0-1.3%) they have lost most of their source rock potential - poor source rock potential. (iii) Between 4740-4900m, originally mixed type II/III kerogen, but at the high maturity (Ro>1.3%) in this section, they have lost most of the source rock potential for gas and oil - poor source rock potential.

KEY WORDS/ STIKKORD

Source Rock

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 headspace analysed chromatographically. The results are shown in Table 1b.

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).

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 Table III-VI.

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).

Vitrinite Reflectance

Samples, taken at various intervals, were sent for vitrinite reflectance measurements to Geoconsultants, Newcastle-upon-Tyne. 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. 1.516 at a wavelength of 546 nm.

The field measured was varied to suit the size of the organic particle, but was usually of the order of 2 micron diameter.

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 are 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 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 >15µ).

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

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

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

Rock-Eval Pyrolysis

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

Pyrolysis-Gas Chromatography (Py-GC)

25 mg of extracted kerogen concentrates were programmed pyrolysed (in helium) from 250°C-500°C at a rate of 25°C/min. A furnace type pyrolyser directly connected to a splitter and fused silica capillary column was used. The pyrolysis product was trapped in a U-shaped part of the column which was cooled in a liquid N_2 nitrogen bath. At the end of the pyrolysis the pyrolysis product was injected by removing the nitrogen bath at a GC-oven temperature of 30°C.

GC chromatographic conditions:-

Column: 25m OV-101 fused silica capillary.
Carrier gas: Helium with inlet pressure 10psi.
Oven program: 30°-260°C at 4°C/min.
Split: 1:20

RESULTS AND DISCUSSION

Light Hydrocarbon Analysis and Lithology

On the basis of light hydrocarbon analysis and lithological description, the analysed sequence (3750-4900 metres) was divided into 6 zones:-

A: 3750-3990m
B: 3990-4140m
C: 4140-4260m
D: 4260-4650m
E: 4650-4710m
F: 4710-4900m

Zone A: 3750-3990 metres. This zone consists mostly of turbodrilled marls and grey claystones. Abundance of C_1-C_4 hydrocarbons is good. Wetness is low (<30%). iC_4/nC_4 ratio is low indicating a mature zone. The abundance of C_5+ hydrocarbons is good decreasing gradually downhole to poor.

Zone B: 3990-4140m. Similar lithologies to the above zone but also some limestones and dark grey claystones. C_1-C_4 abundances are good and are slightly higher than Zone A. Wetness shows a sharp rise at the top of the zone going from 30% up to 70%- C_5+ hydrocarbons increase to a maximum at about 4180m (good abundances) which coincides with the section containing limestone and dark grey claystones.

Zone C: 4140-4260m. This zone has a similar mixture of lithologies to zone B, but there is probably less of dark grey claystones. Wetness is highest in this section (approaching 90%), and C_1-C_4 and C_5+ abundances are fair to good.

Zone D: 4260-4660m. Consists predominantly of dark grey, black and brown-black claystones and minor sandstones. The abundance of C_1-C_4 and C_5+ is highest in this zone (good for both). Wetness shows a slight decrease going downhole, and iC_4/nC_4 an increase. The gas is most probably generated in situ from the dark claystones.

Zone E: 4660-4710m. There is less of dark claystones and more grey claystones and some sandstones in this zone. C_1-C_4 gas abundances are still good but C_5+ abundances are mostly fair. There is a sharp drop in percentage wetness (from 75%- 25%) and the iC_4/nC_4 ratio continues to increase.

Zone F: 4710-4900m. Consists mostly of dark claystones and sandstones. C_1-C_4 gas abundances remain good, and there is an increase in wetness from 30% in zone E to 60% in zone F at 4800m decreasing downhole thereafter. The iC_4/nC_4 ratio shows a large increase in this zone. There is a gradual trend in zones D, E and F to dry gas going downhole. This suggests a maturity level approaching the boundary between condensate and dry gas zones.

Total Organic Carbon (TOC)

Shales/claystones which constituted more than 10% of a sample were analysed. Occasionally shales/claystones of different colours were picked and analysed separately. A few limestones were picked and analysed where they made up more than 10% of a sample, Clean sands and sandstones were not analysed.

Zone A: 3750-3990m. A few grey claystone/marl samples were analysed from this zone, they have fair to good TOC values.

Zone B: 3990-4140m. Fair TOC values were found in grey claystones/-marls, and generally good TOC values (1-2%) in grey to dark grey claystones. Some limestones grey and brownish-white have fair TOC values (0.6%).

Zone C: 4140-4260m. There are two main lithologies; light grey-grey marl/claystone with generally fair TOC values (<1%) and grey claystones (some dark grey) with good TOC values (1-2%).

Zones D, E and F: 4260-4900m. Dominantly dark grey and brown-black claystones with rich TOC values from 2% up to 8%. Most values are between 4 and 7%, low values 2-4% are associated with chert? horizons and sandy horizons between 4330-4430m. In zones E and F below 4650m there is more grey claystones (with fair TOC values) and sandstones.

Extraction

Eighteen samples from the analysed sequence (3750-4900m) were taken for analysis of the extractable organic matter (EOM). The discussion is limited to the quantitative data and the saturated hydrocarbon gas chromatograms. The aromatic hydrocarbon gas chromatograms are discussed separately.

Zone A: Two samples were analysed from this zone; 3780-3810m (M365) and 3870-3900m (M368). They consist mostly of marl and some grey claystone. They have poor-fair abundance of extractable hydrocarbons and fair to good extractabilities (i.e. hydrocarbons/TOC: mgs/gm). The percentages of saturates is high in M368 (38%) and low in M365 (12%). However, the gas chromatograms of the two saturated hydrocarbon fractions are similar. They exhibit smooth bimodal n-alkane distributions from nC_{12}-nC_{35} with maxima at nC_{17-18} and nC_{26-27}. The dominant maximum is at nC_{17-18} in M365 and at nC_{26-27} in M368. The pristane/-phytane and pristane/nC_{17} values are low and the CPI is near to 1. The saturated hydrocarbon distributions suggest a derivation from mature terrestrial plus reworked material.

Zone B: Three samples were analysed from this zone; 3990-4000m (M961), 3990-4020m (M372) and 4020-4050m (M373). They consist mostly of grey to dark grey claystones. They have fair to good abundances of extractable hydrocarbons and extractabilities. Saturated hydrocarbon content is high (43%, 35% and 48% respectively). The saturated hydrocarbon gas chromatograms of the first two resemble those from zone A and have probably been derived from similar kerogen types (although there is a distinct odd predominance between nC_{21}-nC_{31} in M372 perhaps indicating less reworked material in this sample or immature caved material from higher levels). The lowermost sample M373 is quite different it has a smooth, unimodal, front-end biased n-alkane distribution with a maximum at nC_{14} and low pristane/phytane and pristane/nC_{17} ratios. This distribution is characteristic of mature hydrocarbons from type II or type II/III or highly mature hydrocarbons from type III kerogens. These hydrocarbons may be either migrated or generated in situ. Contamination from mud additives such as diesel oil is also possible (although samples were washed 3 times with DCM before grinding and extraction to minimise such contamination).

Zones C and D: Nine samples (mainly from zone D) were extracted. The sample from zone C, 4230-4260m (M380) contains some dark grey and brown-black claystone with rich TOC values, it has a good abundance of extractable hydrocarbons and a rich extractability. Four samples consisting of these claystones, from 4270-4410m have rich abundances of extractable hydrocarbon and rich extractabilities. They also have the highest saturated hydrocarbon contents (44-56%). The four remaining samples from 4440-4650m have good abundances of extractable hydrocarbons and fair to good extractabilities (saturated hydrocarbon percentages from 34-52%). The highest aromatic hydrocarbon percentages were found in the eight samples from zone D. The saturated hydrocarbon gas chromatograms of all the samples from zones C and D are very similar to M373 in zone B, i.e. smooth, unimodal front-end biased n-alkane distribution with a maximum between nC_{12}-nC_{15}. The possible origins of this hydrocarbon pattern has been discussed already, in connection with sample M373.

Zones E and F: Four samples from these two zones (4650-4900m) were extracted. They have fair to good abundances of extractable hydrocarbons and except for the uppermost sample (4680-4710m, M625) they have poor extractabilities. Saturated hydrocarbon percentages are less than 30% in zone F. The saturated hydrocarbon gas chromatograms resemble those from zones C and D.

A major conclusion to be made from this data is that the analysed sequence generally shows highly mature hydrocarbon distributions, probably generated in situ (particularly zone D) from kerogen type III or mixed type II/III. Also, in the zones E and F claystones are depleted in saturated hydrocarbons.

Aromatic Hydrocarbons

The aromatic hydrocarbon gas chromatograms were obtained from the same samples used for the saturated hydrocarbon gas chromatograms. A number of variations can be seen in these gas chromatograms. Regions in which several, known compound types elute have been marked on the gas chromatograms:-

Methyl naphthalenes - A

Dimethyl and ethyl naphthalenes - B
Trimethyl naphthalenes - C
Methyl Phenanthrenes - D
Dimethyl Phenanthrenes - E

P = Phenanthrene
E = region of aromatised steranes and triterpanes

In addition there are three prominent peaks of unknown compounds which have been marked X, Y and Z. Rather than discuss the variations in these traces by zones, the following trends can be seen throughout the analysed section:-

The first three samples (3780-4000m) are dominated by phenanthrene and methyl-phenanthrenes. In the lowest sample a complex mixture in region E is seen. Below 4020 metres the alkyl-naphthalenes (A, B and C) are more prominent. There is a variable contribution from higher molecular weight material in region E. Sample 4380-4410m in zone D is unusual in that phenanthrene and methyl phenanthrenes are only minor components in comparison with the rest of the samples. This may be related to the occurrence of sandstone horizons in this section. Additional prominent peaks (not identified) X, Y and Z are particularly prominent between 3990-4050m and 4470-4770m.

Trends evident in variations of the relative amounts of phenanthrene and methyl phenanthrenes include:-

1) The peak height of phenanthrene is greater than the methyl phenanthrenes above 4000 metres and approximately equal from 4000-4470 metres. Immediately below 4470 metres the peak height of phenanthrene is again greater than the methyl phenanthrenes. The difference in peak height then decreases downhole.

2) The first two methyl phenanthrenes compounds become dominant over the later eluting pair below 4470 metres. This is most probably a maturation induced change.

Prominent methyl phenanthrenes are often found in aromatic hydrocarbon fractions from coals and type III kerogens, which may indicate that

the samples above 4000 metres are derived from type III kerogens. The remaining samples are probably derived from a mature to highly mature type III or mixed type II/III kerogen.

Examination in Reflected Light

2000m: Shale, Ro=0,51(5)

The sample has bitumen wisps and a moderate staining with a low phytoclast content. Inertinite particles are dominant. It has a few wisps and particles of vitrinite. UV light shows no fluorescence and the exinite content is nil.

2100m: Shale, Ro=0,39(2)

The sample has a moderate to rich organic content in bitumen wisps and staining but a low phytoclast content. It consists almost wholly of inertinite particles with a trace only of vitrinite wisps. UV light shows yellow fluorescence from spores and a trace only of exinite.

2200m: Shale, Ro=0,40(12)

The sample has bitumen wisps and staining with a low phytoclast content. There are equal proportions of vitrinite and inertinite particles present. UV light shows yellow and yellow/orange fluorescence from spores and a trace only of exinite.

2300m: Drilling mud and Shale, Ro=0,54(9)

The sample has a few shale cuttings have occasional bitumen blebs. It has a low phytoclast content with a few inertinite particles and vitrinite wisps. UV light shows yellow/orange fluorescence from spores and a trace only of exinite.

2400m: Sandstone, Shale + Coal Traces, Ro=0,37(14)

The sample has bitumen wisps and light staining and a low phytoclast content. Inertinite particles are dominant. There are a few wisps and particles of vitrinite present together with some loose coal fragments. UV light shows no fluorescence and the exinite content is nil.

2500m: Shale and Sandstone, Ro=0,43(13)

The sample has a trace only of inertinite particles with a few wisps and particles of vitrinite. It has bitumen wisps and staining. UV light shows no fluorescence and the exinite content is nil.

2600m: Shale and Sandstone, Ro=0,56(4)

The sample has a low phytoclast content. It consists of inertinite particles and a few vitrinite wisps and particles. UV light shows yellow/orange fluorescence from spores and a trace only of exinite.

3005m: Turbo-drilled, Shale and Coal Traces, Ro=0,27(9)

The sample has a low phytoclast content. It consists wholly of inertinite particles and a few loose coal cuttings. UV light shows yellow/orange fluorescence from hydrocarbon specks in one cuttings grain; the exinite content is nil.

3100m: Turbo-drilled and Shale. N.D.P. (no determination possible)

The sample has a low to moderate phytoclast content. It consists wholly of small inertinite particles. UV light shows no fluorescence and the exinite content is nil.

3200m: Turbo-drilled and Shale Traces, Ro=0,33(2)

The sample has a low phytoclast content. It consists almost wholly of inertinite and one coal particle. UV light shows no fluorescence and the exinite content is nil.

3300m: Limestone and Shale Traces, N.D.P.

The sample has a trace only of bitumen staining and only a handfull of inertinite particles and no vitrinite. UV light shows no fluorescence and the exinite content is nil.

3400m: Turbo drilled lithologies and Shale Traces, N.D.P.

The sample has a trace only of phytoclast and consists wholly of inertinite particles. UV light shows yellow fluorescence from spores and a trace only of exinite.

3500m: Turbo drilled, Shale and Limestone Traces, Ro=0,39(1) and 0,64(1)

The sample has a low phytoclast content. It consists almost wholly of small inertinite particles together with two vitrinite particles. UV light shows no fluorescence and the exinite content is nil.

3600m: Turbo drilled. N.D.P.

No true sediment was located in the sample. UV light shows no fluorescence and the exinite content is nil.

3700m: Turbo drilled and Shale Traces, Ro=,47(2)

The sample has a low phytoclast content. It consists wholly of small inertinite particles and one loose vitrinite particle. UV light shows no fluorescence and the exinite content is nil.

3800m: Turbo drilled and Shale Traces. N.D.P.

The sample has a trace only of phytoclasts and consists wholly of inertinite particles. UV light shows no fluorescence and the exinite content is nil.

3870-3900m: Turbo drilled and Shale Traces, Ro=0,29(2)

The sample has a low phytoclast content. It consists almost wholly of very small particles of inertinite and one coal cutting. UV light shows no fluorescence and the exinite content is nil.

3990-4020m: Shale and Limestone Traces, Ro=1,52(19)

The sample has a trace of bitumen staining and a moderate phytoclast content. It consists of wisps and particles of inertinite and vitrinite. It is probably wholly reworked but no lower Ro values. UV light shows mid orange fluorescence from carbonate and the exinite content is nil.

4030m: Turbo drilled and Shale, Ro=0,39(1) and 1,66(10)

The sample has a trace only of bitumen wisps and a moderate phytoclast content. It consists of inertinite particles with subordinate vitrinite wisps and particles. UV light shows no fluorescence and the exinite content is nil.

4060m: Shale, Turbo-drilled and Carbonate, Ro=0,27(2) and 1,64(19)

The sample has a trace only of bitumen staining. It has a moderate phytoclast content. Inertinite particles are dominant and it has a few doubtful vitrinite particles which are possibly reworked. UV light shows no definite organic fluorescence and the exinite content is nil.

4050-4080m: Shale and Turbo-drilled, Ro=1,69(20)

The sample has minor bitumen staining and wisps and a moderate phytoclast content mostly in darker shale lithologies. It contains inertinite and vitrinite particles all with high Ro values and differentiation is difficult. UV light shows no fluorescence and the exinite content is nil.

4080-4110m: Shale, Turbo-drilled and Sandstone, Ro=0,47(1) and 1,60(17)

The sample has a slight bitumen staining and wisps and a moderate phytoclast content. It contains inertinite and vitrinite particles but differentiation is difficult, they are possibly reworked. UV light shows no fluorescence and the exinite content is nil.

4170-4200m: Shale and Turbo-drilled lithologies, Ro=1,61(15)

The sample has a variable bitumen staining which is strong in pyritic cuttings. It has a moderate phytoclast content. It contains inertinite and vitrinite particles. The lowest Ro values measured are possibly reworked. UV light shows fluorescence from carbonate and the exinite content is nil.

4250m: Shale and Turbo-drilled, Ro=1,59(17)

The sample has occasional bitumen wisps. It has a low phytoclast content. It contains a few inertinite and vitrinite particles which are possibly wholly reworked. UV light shows fluorescence from carbonate and the exinite content is nil.

4260-4290m: Turbo-drilled and Shale, Ro=0,30(11) and 1,50(7)

The sample has a moderate phytoclast content and a few loose coal fragments with low Ro values. There are both inertinite and vitrinite particles present but differentiation is difficult. UV light shows no fluorescence and the exinite content is nil.

4300m: Turbo-drilled and Calcareous Shale, Ro=0,62(1)

The sample has only a few true sediment cuttings with one vitrinite wisps and occasionally some reworked particles. UV light shows no organic fluorescence and the exinite content is nil.

4310m: Turbo-drilled and Pyritic Shale, Ro=0,54(4), 0,83(10) and 1,47(4)

The sample is bitumen saturated with a low phytoclast content. It contains inertinite and vitrinite particles. UV light shows no fluorescence and the exinite content is nil.

4320-4350m: Turbo-drilled and Pyritic Shale, Ro=0,54(9)

The sample has a low phytoclast content. Inertinite particles are dominant with a few vitrinite particles. UV light shows no fluorescence and the exinite content is nil.

4370m: Shale and Turbo-drilled, Ro=0,57(2) and 1,27(3)

The sample has bitumen wisps and light staining with a low phytoclast content. It has small inertinite particles with only a handfull of possible vitrinite particles. UV light shows fluorescence from carbonate and possible hydrocarbon specks and the exinite content is nil.

4390m: Turbo-drilled and Shale, Ro=0,92(1) and 1,41(1)

The sample has heavy bitumen staining in some cuttings and a very low phytoclast content. It contains two possible vitrinite particles. UV light shows no fluorescence and the exinite content is nil.

4420m: Pyritic Shale and Turbo-drilled, Ro=0,33(1), 0,73(1), 1,10(9) and 1,82(4)

The sample contains pyritic shale which is bitumen saturated. It has a low phytoclast content. There are some inertinite and vitrinite particles present. The lowest Ro values measured are possibly reworked. UV light shows mid orange fluorescence from carbonate and the exinite content is nil.

4430m: Pyritic Shale and Turbo-drilled, Ro=0,30(8) and 1,19(2)

The sample has bitumen wisps and a low phytoclast content. Inertinite particles are dominant. There are a couple of vitrinite wisps and loose coal cuttings. UV light shows no fluorescence and the exinite content is nil.

4450m: Shale and Turbo-drilled, Ro=1,11(1) and 1,93(1)

The sample contains bitumen wisps and has a low phytoclast content. There are a few small inertinite particles with a couple of possible vitrinite particles present. UV light shows fluorescence from hydrocarbon specks and the exinite content is nil.

4460m: Turbo-drilled and Shale. N.D.P.

The sample has bitumen wisps and staining with a low phytoclast content. There are a few inertinite particles only and no vitrinite. UV light shows mid orange fluorescence from carbonate and the exinite content is nil.

4490m: Shale and Turbo-drilled, Ro=0,34(1) and 1,40(4)

The sample has bitumen wisps and staining and a low phytoclast content. Inertinite particles are dominant. There is one coal fragment and a trace only of vitrinite particles. UV light shows fluorescence from hydrocarbon specks and the exinite content is nil.

4510m: Turbo-drilled and Shale, Ro=1,37(6)

The sample has bitumen wisps and staining with a trace only of phytoclasts. It contains inertinite particles with a handfull only of vitrinite particles. UV light shows no fluorescence and the exinite content is nil.

4540m: Shale and Turbo-drilled, Ro=1,36(5)

The sample has a few bitumen wisps and a trace only of phytoclasts. It contains inertinite particles and a few vitrinite wisps. UV light shows no fluorescence and the exinite content is nil.

4550m: Turbo-drilled and Pyritic Shale, Ro=1,39(11)

The sample has a very strong bitumen staining. There is a trace only of phytoclasts. It contains inertinite and reworked particles and a few possible vitrinite particles. UV light shows mid orange fluorescence from carbonate and a the exinite content is nil.

4570m: Mixed Shale Lithologies, Carbonate and Turbo-drilled. N.D.P.

The sample has bitumen staining and wisps with a variable organic content and a trace only of phytoclasts. There are a few particles of inertinite and reworked material. UV light shows yellow/orange fluorescence from hydrocarbon specks and possible spores with a trace only of exinite.

4560-4590m: Pyritic Shale and Turbo-drilled, Ro=1,33(3)

The sample has strong bitumen staining and wisps and a trace of phytoclasts. It contains inertinite particles with a few vitrinite wisps. UV light shows mid orange fluorescence from carbonate and the exinite content is nil.

4610m: Mixed Shale and Carbonate with Turbo-drilled, Ro=0,75(1) and 1,23(1)

The pyritic shale in the sample shows strong bitumen staining. There is a trace only of inertinite and reworked particles and a couple of possible vitrinite particles. UV light shows mid orange fluorescence from carbonate and the exinite content is nil.

4630m: Turbo-drilled and Pyritic Shale, Ro=0,95(1) and 1,59(1)

The sample has bitumen wisps and a strong staining and a trace only of phytoclasts., Inertinite particles are dominant but there are a couple of vitrinite wisps. UV light shows no organic fluorescence and the exinite content is nil.

4670m: Shale, Carbonate and Turbo-drilled, Ro=1,69(1)

The sample is virtually barren and has bitumen wisps and staining. It has a few inertinite particles and only one small vitrinite wisp was located. UV light shows mid orange fluorescence from carbonate and the exinite content is nil.

4680-4710m: Pyritic Shale, Shale and Turbo-drilled, Ro=1,63(3)

The sample has bitumen wisps and staining with a low phytoclast content, which consists almost entirely of inertinite particles and wisps; with two good vitrinite particles. UV light shows mid orange fluorescence from carbonate and the exinite content is nil.

4730m: Shale, Pyritic Shale and Turbo-drilled, Ro=0,28(5) and 1,62(7)

The sample has a low phytoclast content. It consists of inertinite particles and a trace only of vitrinite particles with a few loose coal cuttings. It has bitumen staining. UV light shows fluorescence from hydrocarbon specks and the exinite content is nil.

4750m: Mixed Shale Lithologies, Carbonate and Turbo-drilled, Ro=0,35(10) and 1,10(3)

Some cuttings in the sample show strong bitumen staining. The sample has a trace only of phytoclasts and a few inertinite and reworked particles. There are some loose coal cuttings present with low Ro values. UV light shows fluorescence from hydrocarbon specks and possible light orange spores and a trace only of exinite.

4777,5m: Shale, Pyritic Shale and Turbo-drilled, Ro=0,28(1) and 1,54(13)

The sample has bitumen staining and wisps and a low phytoclast content. It consists of an equal proportion of inertinite and vitrinite particles and wisps and one loose coal fragment. UV light shows mid orange fluorescence from carbonate and hydrocarbon specks and the exinite content is nil.

4790m: Shale, Pyritic Shale and Turbo-drilled, Ro=1,31(2)

The sample has bitumen wisps and strong staining with a low phytoclast content. It contains almost entirely inertinite but has one vitrinite particle and one coal fragment. UV light shows deep orange fluorescence from carbonate and the exinite content is nil.

4810m: Shale, Pyritic Shale and Turbo-drilled, Ro=0,38(2) and 1,40(6)

The sample has strong bitumen staining and a low phytoclast content. It contains inertinite particles and a trace only of vitrinite wisps and one loose coal cuttings. UV light shows fluorescence from hydrocarbon specks and the exinite content is nil.

4822,5m: Shale, Pyritic Shale and Turbo-drilled, Ro=1,60(20)

The sample has bitumen wisps and strong staining with a low phytoclast content. It consists of vitrinite and inertinite particles. UV light shows mid orange fluorescence from carbonate and hydrocarbons and the exinite content is nil.

4850m: Shale, Pyritic Shale and Turbo-drilled, Ro=1,54(15)

The sample has bitumen wisps and strong staining with a low phytoclast content. It consists of inertinite particles with a trace only of vitrinite wisps and particles. UV light shows deep orange fluorescence from carbonate and the exinite content is nil.

4870m: Shale, Pyritic Shale and Turbo-drilled, Ro=0,17(1) and 1,14(7)

The sample has strong bitumen wisps and staining with a low phytoclast content. It contains inertinite particles and a trace only of

vitrinite wisps and particles. UV light shows mid orange fluorescence from carbonate and the exinite content is nil.

4880m: Shale, Pyritic Shale and Turbo-drilled, Ro=0,33(1) and 1,69(15)

The sample has strong bitumen staining and wisps with a low phytoclast content. Inertinite particles are dominant with subordinate vitrinite wisps and particles. UV light shows mid and deep orange fluorescence from carbonate and hydrocarbon specks and the exinite content is nil.

4897,5m: Calcareous Shale, Ro=1,25(10)

The sample has a moderate bitumen staining and wisps. It has a low content of inertinite and very gnarled high Ro vitrinite particles. The lowest Ro material was measured. UV light shows mid to deep orange fluorescence from carbonate and the exinite content is nil.

5000m: Shale and Turbo-drilled, Ro=0,72(1) and 1,66(13)

The sample has bitumen wisps and staining and a low content of inertinite particles with subordinate vitrinite particles and wisps. UV light shows mid orange fluorescence from carbonate and the exinite content is nil.

5100m: Shale, Pyritic Shale and Turbo-drilled, Ro=1,78(3)

The sample has bitumen wisps and staining and a low phytoclast content. Inertinite particles are dominant but there are a few possible vitrinite particles. UV light shows mid orange fluorescence from carbonate and the exinite content is nil.

Analysis in Transmitted Light

The section between 3780m and 4880m is represented by 27 samples (picked lithologies of ditch cuttings). The interval has been drilled by turbine drill which has caused heat-induced alterations of the cuttings. The colour studies of pollen and spores have therefore been controlled by a restricted number of sidewall cores (4262m, 4350m, 4456m, 4500m, 4757m and 4898m).

On the basis of kerogen content and composition we can distinguish five main intervals in this well: 3780-3900m, 3990-4260m and 4280-. The maturity of the material appears to be from the lowest end of the oil window or on the boundary with the condensate window.

Compared with other North Sea wells the acid resistant residues below 4260m are characterised by organic material of extremely poor preservation. The main reason appears to be mineral recrystallization that has affected and damaged most of the primary structures.

Samples 3780-3900m: Amorphous material dominates and is recorded in aggregates. There is a small portion of woody material together with well or fairly well preserved dinoflagellate cysts.

Colour index: indeterminate.

Samples 3990-4260m: The residues are generally small and are dominated by woody remains. The woody material of most samples is recorded as aggregates together with true amorphous material. The structure of these aggregates varies from granulate to flaky and is controlled by the lithology. High content of pyrite in the sample from 4030m coincides with a large amount of cuticles. Fairly well preserved and rich cyst assemblages are present throughout the interval.

Colour index: 2+, 2+/3-

Potential as source rock for gas mainly.

Samples 4280-4340m: The residues consist of opaque, very dense aggregates which we believe are derived mainly from terrestrial sources (cuticles and woody). There is abundant pyrite. The palynomorphs, cysts and pollen are mostly of poor preservation.

Colour index: 3-, 3-/3

Potential as source rock for gas.

Samples (4410m) 4430-4750m: Most of the residues of this interval are opaque, dense aggregates of granular structure which are probably

derived from woody material and true amorphous material in about equal proportions. The uppermost (4430m) and lowermost (4750m) samples show more strongly sorted material with larger amounts of woody material.

Colour index: 2+/3-, 3-

Potential as source rock for gas.

Samples 4750-4880m: The organic residues of this interval are heavily altered by embedded acid-resistant minerals. Identification of the primary kerogen types is arbitrary, but we believe terrestrial sources dominate.

Colour index: 3-/3

Potential as source rock mainly for gas.

Rock-Eval Pyrolysis

A total of 45 samples from the analysed sequence in this well were taken for Rock-Eval analysis. The results are discussed below:-

Zone A: Three samples from zone A were analysed and gave very poor results. The hydrogen indices are very low or zero. The petroleum potential is limited to the soluble material present, represented by the S1 peak.

Zone B: 7 samples from zone B were analysed and show similar character to zone A. T_{max} indicates a highly mature zone - oil window maturity.

Zone C: 3 samples from C were analysed and show similar characteristics to zone B.

Zone D, E and F: 37 samples from this zone were analysed they all consist of TOC-rich, type III kerogens which are highly mature (T_{max} 440). They can be divided into two groups; from 4260-4500 metres, hydrogen indices are generally greater than 50, but mostly less than 100 and oxygen indices vary from 6-35. Below 4500m hydrogen indices are less than 50 and oxygen indices vary from 7-26. In these 3 zones the production index also shows interesting trends, with values between 0.10 and 0.31 down to 4440m, below which there is a rapid increase to 0.82 at 4650m declining thereafter to values of around 0.4 towards the base (4900m). The T_{max} values also show a prominent increase above 4800m reaching values of 450-460 around 4900m. The apparent decrease in T_{max} values (<440 in many cases) between 4100-4700m is probably due to generation of asphaltic material giving anomalously low values. Type III kerogens have apparently yielded gas and some liquid hydrocarbons from 4000-4900m (mostly 4260-4900m) and are probably almost depleted in hydrocarbon generating material below 4500m as indicated by the production index values, and the low hydrogen indices. The occasional high hydrogen indices (>100) of zone D between 4260m and 4560m probably represent type II/III at the oil window approaching condensate window maturity in this section.

Pyrolysis-Gas Chromatography (Py-GC)

Six samples of extracted kerogen concentrates (prepared by treatment with HCl/HF) were analysed by pyrolysis-GC. The instrumental conditions are discussed in the experimental section. The results are discussed below.

Based on mass spectrometri-(S) and retention data from Py-GC/MS of other kerogens, peaks in the pyrograms are tentatively identified;

The numbered peaks are n-alkene/n-alkane doublets of the carbon number. The n-alkenes have the shorter retention time. T=toluene; X=isomeric xylenes; I=Indane; n=napthalene, 1- and 2-MeN=1- and 2-methyl naphthalene.

M-961 (3990-4000m): The pyrogram is dominated by low molecular weight compounds in the region C_1-C_{15} (unresolved gas peak plus C_8-C_{15}) and the abundance of aromatics is far greater than aliphatic compounds. (Note that some of the aromatic peaks are far off scale in the pyrograms.)

This chromatographic picture is consistent with the high rank of the sample and the high abundance of aromatics relative to aliphatic compounds indicates a type III kerogen.

M-380: The pyrogram of this sample is very similar to M-961, i.e. type III kerogen.

M-1002: The pyrogram is very similar to M-961, i.e. type III kerogen.

M-621 and M-623: The pyrograms of these two samples are very similar showing the same general picture as the other pyrograms, i.e. type III kerogen. However, the aliphatic homology extends up to ca. C_{25} which might imply an input of more lipid rich material.

CONCLUSIONS

The maturity of the analysed sequence (3750-4900m) from the well 24/12-2 is based mainly on vitrinite reflectance, spore coloration and T_{max} values from Rock-Eval pyrolysis. The richness of the samples is based on TOC and Rock-Eval pyrolysis with additional evidence from the abundance of light hydrocarbons and C_{15}^{+} extractable hydrocarbons. Source rock quality is based mainly on pyrolysis, both Rock-Eval and pyrolysis-gas chromatography and on visual kerogen examination.

Zone A: (3750-3990m) This zone has been turbodrilled and consists mostly of grey marls and claystones. Vitrinite reflectance data is poor for this zone and no good readings were obtained, therefore maturity is based on Rock-Eval T_{max} values which are between 440 and 450. Values as high as this indicate oil window maturity; hydrogen indices indicate poor type III or IV kerogens. The saturated hydrocarbon distributions suggest a terrestrial origin for the organic matter in this zone. The aromatic hydrocarbon distributions are considered to be characteristic for mature type III kerogens. The very high Rock-Eval production indices of this zone in comparison with lower zones suggests introduced hydrocarbons i.e. either through migrated or contaminant hydrocarbons (for example from diesel used as a mud additive). The zone has a poor source rock potential.

Zones B and C: (3990-4260m) Consists of a variety of lithologies, which have been turbodrilled. Lithologies include grey marls and claystones with the same characteristics and source rock potential as in Zone A. There are also grey and light brown limestones in both zones B and C, which have fair TOC values, but Rock-Eval pyrolysis data indicates mostly reworked or material derived from sub-aerial environments (i.e. type IV kerogens with very low hydrogen indices). The high maturity of these two zones (see below) indicates that any hydrocarbon potential these limestones may have had has been lost (i.e. generated and migrated). Some coal was recorded in this section however it is probable that this is mostly (if not all) lignite additive.

The most promising source rocks in these two zones (particularly zone B from 3990-4080m) are dark grey claystones, with generally good TOC

values from 1-2%. Maximum values of 2,05% between 4030-4040m, and 2.2% between 4110-4140m and 4180-4190m. Rock-Eval pyrolysis data is similar to that for grey claystones from these two zones and from zone A. This indicates that the kerogens in the dark grey claystones are mature oil window.(T_{max} >440 generally) and are poor type III or type IV kerogens. Vitrinite reflectance measurements in this section suggest condensate window maturity (Ro >1.3%). However the vitrinites measured were probably mostly reworked material. Examination of kerogens, from the dark grey claystones, in transmitted light indicates mostly woody material (of oil window maturity), except for a sample from 4020-4030m in which a large amount of cuticles were seen. Saturated hydrocarbon distributions from zones B and C are characteristic for highly mature type II or III kerogens. The aromatic hydrocarbon distributions are richer in alkyl naphthalenes (relative to phenanthrenes); distributions being characteristic of type III or II kerogens. Pyrolysis gas chromatograms of samples from these two zones are dominated by aromatic hydrocarbons and the light hydrocarbons (C_1-C_7). The alkane-alkene homology (from nC_7-nC_{30} approximately seen in most type II and mixed type II/III kerogens) is absent or is a very minor component, suggesting that straight chain material (if any) has already been lost.

The dark grey claystones have already yielded (probably most gas), and now have only a poor potential as source rocks for gas.

Zones D, E and F: (4260-4900m) These three zones are composed mostly of dark grey, black and brownish-black claystones with 2-8% TOC. There are occasional thin limestone bands, and sandstones between 4320-4440m and below 4700 metres. The Rock-Eval pyrolysis data allows a division of the dark claystones into two main sections; from 4260-4470m and from 4470-4900m. Above 4470 metres the hydrogen indices are generally greater than 50 mgs HC/gm C; below 4470 metres the hydrogen indices are less than 50 mgs HC/gm C. At the high maturity level which the section from 4260-4470m has reached (vitrinite reflectance from 1-1.3%) the kerogen type was originally type III and mixed type II/III with perhaps small amounts of type II kerogen. Below 4470 metres mostly highly mature type III, or mixed type II/III kerogens are present between 4740 and 4850m in particular. Examination of kerogens in transmitted light indicates predominantly terrestrial material

throughout zones D, E and F. Cuticles are prominent between 4280-4340m and 4740-4850m. T_{max} values show a definite increase below 4770 metres reaching a value around 460 at 4900 metres, which suggest that this part of the well (zone F) is of condensate window maturity. Vitrinite reflectance measurements are generally greater than 1.3% and spore colours 3- to 3.

Rock-Eval production indices are very high between 4470 and 4770m. They are probably caused by hydrocarbons generated from the kerogens in a monotonous dark claystone sequence. Below and above this section the production index values are much less, and coincide with the occurrence of sandstones. The lower values in claystones associated with sandstones is due, perhaps, to depletion through migration into the sandstones. Sediments within the sandstone-rich horizons show fluorescence from hydrocarbons under ultra violet reflected light.

Extractabilities are generally low (<50 mgs/g C) and saturated hydrocarbon percentages and C_5+ hydrocarbon abundances show a gradual decrease downhole which is in agreement with the oil window to condensate window maturity going from zone D to zone F.

Saturated hydrocarbon distributions resemble those from zones B and C and are characteristic of highly mature hydrocarbons from either type II or III kerogens. The aromatic hydrocarbon distributions are also very similar to zones B and C. There is a noticeable change in the distribution of the alkyl phenanthrenes; the first eluting pair dominate below 4470 metres and the later eluting pair dominate above this level. This change is probably a maturity controlled change which occurs within the condensate window. Pyrolysis-gas chromatography indicates similar products from the kerogens as for zones B and C; predominantly light hydrocarbons with some mono- and diaromatics.

The maturity of the section of the well from 4260 to 4900 metres changes from oil window to condensate window maturity between 4400 and 4800 metres. The dark claystones throughout have already produced significant amounts of hydrocarbons. From 4260-4470 metres dark claystones have a fair to good potential for gas, below this the dark claystones have a poor to fair potential for gas.

IKU

TABLE I a.

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

IKU No.	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
M364	3780	1463	353	527	202	385	842	2930	1467	50.07	.52
M365	3810	680	102	127	49	90	467	1048	368	35.11	.54
M366	3840	981	127	161	45	71	462	1385	404	29.17	.63
M367	3870	72	201	183	46	62	168	564	492	87.23	.74
M368	3900	477	100	45	11	10	69	643	166	25.82	1.10
M369	3930	754	254	102	15	20	58	1145	391	34.15	.75
M370	3960	287	120	45	7	7	21	466	179	38.41	1.00
M371	3990	1537	940	212	18	18	47	2725	1188	43.60	1.00
M372	4020	3888	2576	945	131	189	428	7729	3841	49.70	.69
M373	4050	11764	6149	9107	2503	5165	9397	34688	22924	66.09	.48
M374	4080	6689	4875	11289	3146	6970	11921	32969	26280	79.71	.45
M375	4110	7836	4308	4036	881	1813	4293	18874	11038	58.48	.49
M376	4140	4585	2217	1203	168	319	570	8492	3907	46.01	.53
M377	4170	753	639	362	58	99	90	1911	1158	60.60	.59
M378	4200	4845	2144	1202	172	339	503	8702	3857	44.32	.51
M379	4230	1981	1384	847	177	373	831	4762	2781	58.40	.47
M380	4260	4246	2624	2738	561	1463	1831	11632	7386	63.50	.38
M381	4290	8204	4848	5441	1020	2429	2235	21942	13738	62.61	.42
M382	4320	6253	7161	6164	876	1967	908	22421	16168	72.11	.45
M613	4350	13302	5778	4774	822	1503	1788	26179	12877	49.19	.55
M614	4380	10469	3115	1890	332	531	800	16337	5868	35.92	.63
M615	4410	7251	5991	4008	5818	958	952	24026	16775	69.82	6.07
M616	4440	8681	1925	1055	179	291	330	12131	3450	28.44	.62
M617	4470	3950	1044	523	94	154	308	5765	1815	31.48	.61
M618	4500	15795	2838	1146	178	262	370	20219	4424	21.88	.68

IKU

TABLE I a.

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

IKU No.	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
M619	4530	5777	1888	1243	246	480	862	9634	3857	40.04	.51
M620	4560	1326	470	290	44	66	53	2196	870	39.62	.67
M621	4590	2256	654	299	48	74	96	3331	1075	32.27	.65
M622	4620	760	317	169	169	28	38	1443	683	47.33	6.04
M623	4650	4883	748	271	42	58	62	6002	1119	18.64	.72
M624	4680	14843	1947	663	101	131	279	17685	2842	16.07	.77
M625	4710	10957	773	389	74	100	2	12293	1336	10.87	.74
M626	4740	4427	691	240	44	58	131	5460	1033	18.92	.76
M627	4770	15212	2502	647	101	115	101	18577	3365	18.11	.88
M628	4800	9487	1267	363	65	76	199	11258	1771	15.73	.86
M629	4830	10552	2544	627	92	104	81	13919	3367	24.19	.88
M630	4860	23117	3285	688	107	101	160	27298	4181	15.32	1.06
M631	4890	12988	1405	207	32	23	18	14655	1667	11.37	1.39
M632	4920	21276	521	95	14	11	21	21917	641	2.92	1.27

IKU

TABLE I b.

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

IKU No.	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
M364	3780	5668	407	157	83	272	16034	6587	919	13.95	.31
M365	3810	2853	149	55	16	46	4460	3119	266	8.53	.35
M366	3840	102	8	7	5	25	2135	147	45	30.61	.20
M367	3870	3135	138	113	21	93	432	3500	365	10.43	.23
M368	3900	5789	298	348	73	234	3109	6742	953	14.14	.31
M369	3930	3396	184	218	44	110	347	3952	556	14.07	.40
M370	3960	3001	205	197	28	72	92	3503	502	14.33	.39
M371	3990	2144	870	793	60	171	83	4038	1894	46.90	.35
M372	4020	317	2465	2200	190	541	398	5713	5396	94.45	.35
M373	4050	1716	2811	4656	1169	4302	9409	14654	12938	88.29	.27
M374	4080	2940	1371	4711	2094	8151	23523	19267	16327	84.74	.26
M375	4110	2465	1592	3410	722	3462	9572	11651	9186	78.84	.21
M376	4140	150	99	128	27	71	212	475	325	68.42	.38
M377	4170	1012	1614	2807	605	2132	3448	8170	7158	87.61	.28
M378	4200	495	1004	1611	285	1108	2345	4503	4008	89.01	.26
M379	4230	780	1640	3300	983	3628	2866	10331	9551	92.45	.27
M380	4260	747	2282	9229	3932	12699	17787	28889	28142	97.41	.31
M381	4290	747	2282	9229	3932	12699	17787	28889	28142	97.41	.31
M382	4320	O P E N		L I D .							
M613	4350	3090	5018	15008	6109	15972	20269	45197	42107	93.16	.38
M614	4380	27325	16730	28561	10878	24057	24245	107551	80226	74.59	.45
M615	4410	20250	13810	38679	14998	30017	24052	117754	97504	82.80	.50
M616	4440	16777	21451	40826	13540	25008	16516	117602	100825	85.73	.54
M617	4470	15838	14280	16706	4350	9539	7753	60713	44875	73.91	.46
M618	4500	16636	17016	15982	4007	8489	8672	62130	45494	73.22	.47

IKU

TABLE I b.

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

IKU No.	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
M619	4530	12142	15938	17850	5231	10359	9639	61520	49378	80.26	.50
M620	4560	3476	8438	24189	8997	14761	10776	59861	56385	94.19	.61
M621	4590	16017	12876	13290	4152	6620	6186	52955	36938	69.75	.63
M622	4620	21756	13756	13936	4520	6352	4953	60320	38564	63.93	.71
M623	4650	25347	14829	13337	3672	4437	3148	61622	36275	58.87	.83
M624	4680	49266	7537	7966	2718	4282	7425	71769	22503	31.35	.63
M625	4710	52135	7392	7139	2062	2690	2689	71418	19283	27.00	.77
M626	4740	42042	7274	6982	1638	2261	2518	60197	18155	30.16	.72
M627	4770	19015	16543	11878	3158	3268	2887	53862	34847	64.70	.97
M628	4800	18277	22697	18737	5177	5099	2997	69987	51710	73.89	1.02
M629	4830	24431	31247	13530	2264	1869	848	73341	48910	66.69	1.21
M630	4860	31313	35256	13344	2149	1676	654	83738	52425	62.61	1.28
M631	4890	55087	48442	14804	2645	1729	719	122707	67620	55.11	1.53
M632	4920	73790	40572	8685	1516	789	384	125352	51562	41.13	1.92

IKU

TABLE I c.

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

IKU No.	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
M364	3780	7131	760	684	285	657	16876	9517	2386	25.07	.43
M365	3810	3533	251	182	65	136	4927	4167	634	15.21	.48
M366	3840	1083	135	168	50	96	2597	1532	449	29.31	.52
M367	3870	3207	339	296	67	155	600	4064	857	21.09	.43
M368	3900	6266	398	393	84	244	3178	7385	1119	15.15	.34
M369	3930	4150	438	320	59	130	405	5097	947	18.58	.45
M370	3960	3288	325	242	35	79	113	3969	681	17.16	.44
M371	3990	3681	1810	1005	78	189	130	6763	3082	45.57	.41
M372	4020	4205	5041	3145	321	730	826	13442	9237	68.72	.44
M373	4050	13480	8960	13763	3672	9467	18806	49342	35862	72.68	.39
M374	4080	9629	6246	16000	5240	15121	35444	52236	42607	81.57	.35
M375	4110	10301	5900	7446	1603	5275	13865	30525	20224	66.25	.30
M376	4140	4735	2316	1331	195	390	782	8967	4232	47.20	.50
M377	4170	1765	2253	3169	663	2231	3538	10081	8316	82.49	.30
M378	4200	5340	3148	2813	457	1447	2848	13205	7865	59.56	.32
M379	4230	2761	3024	4147	1160	4001	3697	15093	12332	81.71	.29
M380	4260	4993	4906	11967	4493	14162	19618	40521	35528	87.68	.32
M381	4290	8951	7130	14670	4952	15128	20022	50831	41880	82.39	.33
M382	4320	6253	7161	6164	876	1967	908	22421	16168	72.11	.45
M613	4350	16392	10796	19782	6931	17475	22057	71376	54984	77.03	.40
M614	4380	37794	19845	30451	11210	24588	25045	123888	86094	69.49	.46
M615	4410	27501	19801	42687	20816	30975	25004	141780	114279	80.60	.67
M616	4440	25458	23376	41881	13719	25299	16846	129733	104275	80.38	.54
M617	4470	19788	15324	17229	4444	9693	8061	66478	46690	70.23	.46
M618	4500	32431	19854	17128	4185	8751	9042	82349	49918	60.62	.48

IKU

TABLE I c.

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

IKU No.	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 / nC4
M619	4530	17919	17826	19093	5477	10839	10501	71154	53235	74.82	.51
M620	4560	4802	8908	24479	9041	14827	10829	62057	57255	92.26	.61
M621	4590	18273	13530	13589	4200	6694	6282	56286	38013	67.54	.63
M622	4620	22516	14073	14105	4689	6380	4991	61763	39247	63.54	.73
M623	4650	30230	15577	13608	3714	4495	3210	67624	37394	55.30	.83
M624	4680	64109	9484	8629	2819	4413	7704	89454	25345	28.33	.64
M625	4710	63092	8165	7528	2136	2790	2691	83711	20619	24.63	.77
M626	4740	46469	7965	7222	1682	2319	2649	65657	19188	29.22	.73
M627	4770	34227	19045	12525	3259	3383	2988	72439	38212	52.75	.96
M628	4800	27764	23964	19100	5242	5175	3196	81245	53481	65.83	1.01
M629	4830	34983	33791	14157	2356	1973	929	87260	52277	59.91	1.19
M630	4860	54430	38541	14032	2256	1777	814	111036	56606	50.98	1.27
M631	4890	68075	49847	15011	2677	1752	737	137362	69287	50.44	1.53
M632	4920	95066	41093	8780	1530	800	405	147269	52203	35.45	1.91

IKU

LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC		Lithology
	3750-3760		80%	Marl/Limestone (turbodrilled)
			20%	Claystone, grey, (turbodrilled)
	3760-3770		75%	Marl/Limestone, grey
			25%	Claystone, grey, light brownish grey, both turbodrilled
M364	3750-3780		80%	Marl/Limestone (turbodrilled)
			20%	Claystone, grey (turbodrilled)
	3790		70%	As above
			30%	
	3800		95%	Turbodrilled Claystone/Marl
			5%	Limestone/Marl, greyish white-white
M365	3780-3810	0.55 0.44	80%	Marl/Limestone, grey to dark grey
			20%	Claystone, grey, dark grey
	3820		90%	As above
			10%	
	3830		90%	As above
			10%	
M366	3840		70%	Marl/Limestone?
			30%	Claystone, as above
	3850		100%	Marl/Claystone, grey to dark grey
	3860		90%	Marl/Claystone, as above
			10%	Claystone, as above, some greenish-grey
M367	3840-3870		96%	Marl/Claystone, grey to dark grey
			3%	Chalk/Limestone, white, light greyish-brownish white, soft
			1%	Claystone, greenish grey-grey, calcareous
			Obs.	Sandstone, white, medium
	3880		95%	Marl/Claystone, as above
			3%	Claystone, as above
			2%	Limestone, as above
	3890		95%	Marl/Claystone, as above
			5%	Limestone/Marl, as above

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology
M368	3870-3900	1.02	98% Marl/Claystone, grey, turbodrilled 1% Claystone, greenish grey-grey, as as above 1% Limestone, as above
	3910		100% Marl/Claystone, as above
M956	3920		95% Claystones and Marl? Turbodrilled 5% Claystones, grey, light grey, light brownish grey
M369	3900-3930		100% Marl/Claystone, dark grey-light grey turbodrilled
M957	3940		90% Claystone, Marl, turbodrilled 7.5% Claystone, grey, calcareous, slightly pyritic, soft 2.5% Claystone, greenish grey, grey, micaceous, subfissile, light
M958	3950		90% Claystone, Marl, turbodrilled 4% Claystone, light, grey, as above 6% Claystone, greenish grey, grey, as above
M370	3930-3960		95% Marl/Claystone, as above, turbodrilled 3% Claystone, grey, occasionally micaceous fissile-subfissile, slightly calcareous 2% Claystone, greenish grey, non calcareous
M959	3970		95% Claystone, Marl, turbodrilled 4% Claystone, greenish grey, grey, as above 1% Claystone, light grey, as above Sm.am. Coal
M960	3980	0.74	60% Claystone, Marl, turbodrilled 40% Claystone, greenish grey, grey, occasionally interbedded subfissile Obs. Claystone, red-brown Sm.am. Claystone, light grey, as above

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology	
M371	3960-3990		60%	Marl/Claystone, as above, turbodrilled
		1.80	15%	Claystone, dark grey-grey, micaceous, subfissile-fissile
		0.77	25%	Claystone, light grey, occasionally micaceous, subfissile
			Sm.am.	Cement; Claystone, dark grey-black, light green
M961	4000	0.84	55%	Claystone, grey, slightly micaceous, subfissile
		1.68	30%	Claystone, grey-dark grey
			10%	Siderite
M962	4010		20%	Claystone, grey, as above
		1.39	70%	Claystone, dark grey-grey, slightly brownish grey
			5%	Siderite, as above
			5%	Claystone, grey, brown-grey, soft, disintegrates
			Sm.am.	Cement
M372	3990-4020		7%	Marl/Claystone, as above, turbodrilled
		0.90	50%	Claystone, grey-light grey, slightly micaceous, subfissile
		1.67	40%	Claystone, dark grey, micaceous, fissile
			3%	Sandstone, light brownish white, very fine, calcareous
				Some oil stained cuttings - contamination?
M963	4030	1.70	45%	Claystone, grey, dark grey-grey
		0.37	50%	Marl, brownish-grey, soft, occasionally grading to Limestone, slightly pyritic in parts
			5%	Limestone, greyish white, light brown-grey
M964	4040		5%	Turbodrilled Claystone, Marl
			15%	Limestone, light brown, argillaceous, hard
		2.05	40%	Claystone, grey, dark grey, fissile
			40%	Marl, Claystone, grey-light grey, soft
			Sm.am.	Pyrite

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC		Lithology
M373	4020-		10%	Turbodrilled Claystones/Marl
	4050	1.34	35%	Claystone, grey,dark grey, as above
		0.58	40%	Claystone, light grey, as above occasionally slightly pyritic
			10%	Limestone, brownish-white (light) hard, slightly pyritic
			5%	Limestone, light greyish white, soft
			Sm.am.	Pyrite
M965	4060		5%	Turbodrilled Claystone, Marl
			30%	Limestone, as above
			30%	Marl, Claystone, as above
			10%	Claystone, dark grey, subfissile
		0.78	25%	Claystone, grey, micaceous, subfissile
M966	4070		10%	Turbodrilled Claystone, Marl
			5%	Limestone, light brown, as above
		0.66	60%	Marl, light grey-brownish grey, occasionally sandy
			5%	Claystone, dark grey, fissile
M374	4050-		5%	Turbodrilled material, as above
	4080	1.63	20%	Claystone, grey-dark grey, as above
			30%	Claystone, light grey, as above
		0.59	30%	Limestone/Marl, light greyish white, soft, occasionally pyritic
M967	4090		30%	Turbodrilled Claystone, Marl
			28%	Claystone, grey, slightly greenish grey, some light brown-grey
			30%	Marl/Limestone, light grey-light brownish grey, as above
			2%	Coal/Lignite
M968	4100		57%	Turbodrilled Claystone, Marl
		1.07	25%	Claystone, grey, as above
		0.54	15%	Marl/Limestone, as above
			3%	Lignite/Coal, ?additive
M375	4080-		25%	Turbodrilled, as above
	4110	1.09	20%	Claystone, grey-dark grey, as above
			15%	Claystone, light grey, as above
		0.63	10%	Claystone, light brownish grey, calcareous
			5%	Limestone, light brownish white
		0.55	20%	Limestone/Marl, as above
			5%	Coal/Wood fragments

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II

WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology	
M969	4120		40%	Turbodrilled Claystone/Marl
			3%	Claystone, dark grey-grey, micaceous, lusteous, fissile
		0.94	30%	Claystone, grey, as above
		0.62	26%	Marl, silty, sandy, as above
			1%	Coal/Lignite
M970	4130		20%	Coal/Lignite
			20%	Turbodrilled Claystone/Marl
		1.11	25%	Claystone, grey, as above
			5%	Claystone, dark grey-grey, as above
		0.76	30%	Marl, as above
			Obs.	Sand, Mud, sub-angular-subrounded
M376	4110-4140		20%	Turbodrilled, as above
			5%	Claystone, grey-dark grey, as above
		0.38	40%	Claystone, light grey, some slightly greenish grey, as above
		0.56	30%	Marl/Claystone, light brownish-grey, grey occasionally sandy
			5%	Coal
			Sm.am.	Pyrite; Sand; Siltstone, white
M971	4150		5%	Coal/Lignite
			5%	Turbodrilled Claystone/Marl
			10%	Marl, as above
		2.21	20%	Claytone, dark grey-grey, fissile, occasionally waxy
		0.66	40%	Claystone, grey, light grey, partly sandy, calcareous, subfissile
			Sm.am.	Pyrite
M972	4160		60%	Turbodrilled Claystone/Marl
			5%	Claystone, dark grey, subfissile
			4%	Limestone/Marl, light brownish white
			1%	Coal/Lignite
		1.10	30%	Claystone, grey, as above
M377	4140-4170		43%	Turbodrilled, as above
			5%	Claystone, dark grey-grey, micaceous occasionally pyritic, slightly calcareous, subfissile
		1.11	20%	Claystone, light grey-grey, as above
			30%	Claystone/Marl, light grey, soft
			2%	Coal
			Obs.	Claystone, black, waxy, some contaminations by oil, as above

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology	
M973	4180		70%	Turbodrilled Claystone/Marl
			5%	Limestone/Marl, light brownish-yellowish white, sandy
			5%	Claystone, dark grey, as above
		0.85	20%	Claystone, grey-light grey, as above
M974	4190	2.21	15%	Claystone, dark grey, subfissile, often pyritic, some greyish black
		0.55	80%	Claystone, grey, light grey, partly sandy
			5%	Coal, Lignite, grading to a clayey Sandstone
			Sm.am.	Limestone
M378	4170-4200		45%	Marl/Claystone? Turbodrilled
		1.11	40%	Claystone, grey, some dark grey-green occasionally micaceous, subfissile, slightly calcareous
		0.72	10%	Marl/Limestone, light brownish white-white, soft
			5%	Coal/Wood fragments
			Sm.am.	Pyrite
			Obs.	Sand, coarse, subrounded
M993	4210		20%	Cement and turbodrilled Claystone
			5%	Claystone, dark grey
		0.80	70%	Claystone, grey
			5%	Limestone, Marl
M994	4220		50%	Turbodrilled Marl, Claystone, Cement
			10%	Marl/Limestone
			3%	Claystone, dark grey
		0.66	37%	Claystone, grey, slightly brownish grey
			Sm.am.	Sandstone, grey, argillaceous
M379	4200-4230	1.08	40%	Claystone, grey, some dark grey, as above
		1.19	20%	Marl/Limestone, as above
			59%	Marl/Claystone, as above, ?turbo-drilled
			1%	Coal
			Obs.	Sandstone, fine, clayey, glauconitic

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology
M995	4240		20% Turbodrilled Claystone
			5% Claystone, dark grey
			5% Limestone/Marl, pyritic
		0.98	65% Claystone, grey, slightly brownish grey
			5% Limestone, light brown, subfissile
			Sm.am. Coal/Lignite
M996	4250		15% Turbodrilled Claystone
			10% Limestone, argillaceous, light brown occasionally hard Marl
			5% Claystone, dark grey
			5% Marl/Claystone, brown-grey
		1.22	50% Claystone, grey, slightly brownish grey, light grey, as above
		0.45	15% Claystone, light grey, calcareous
MM380	4230-4260	4.31	15% Claystone, dark brownish grey, pyritic rounded fragments
		1.59	60% Claystone, grey, dark grey, as above
			15% Claystone/Marl ?turbodrilled
			5% Marl/Limestone, as above
			Sm.am. Coal
M977	4270	5.08	80% Claystone, dark brownish grey, rounded fragments
		0.49	10% Claystone, light grey, calcareous
		1.42	10% Claystone, grey
			Sm.am. Sand, Pyrite
M998	4280	6.60	90% Claystone, dark brownish grey, as above
			7% Claystone, light grey-white, as above
			3% Claystone, grey
M381	4260-4290	5.41	90% Claystone, dark brownish grey, as above
		0.71	10% Claystone, grey, greenish grey, light grey, calcareous
			Sm.am. Limestone; Coal; Pyrite
M999	4300	5.83	92% Claystone, dark brownish black
			7% Claystone, light grey-white
			1% Claystone, grey
			Sm.am. Limestone; Pyrite

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology	
M1000	4310	7.14	10%	Claystone, dark brownish black, rounded fragments, as above
		6.94	60%	Claystone, dark brownish black, micaceous, lusterous, pyritic, slightly laminated
		0.44	25%	Claystone, light grey-greyish white, calcareous
			5%	Limestone, light brownish grey
M382	4290-4320	5.32	87%	Claystone, dark brown, as above
		0.67	13%	Claystone, light grey, grey
			Sm.am.	As above, Sandstone
			Obs.	Chert
M1001	4330		5%	Claystone, dark brownish black, as above
		4.34	40%	Claystone, black, cherty, hard
		3.09	15%	Chert, black
		0.64	25%	Claystone, grey-light grey, light brownish grey, calcareous
			15%	Limestone, as above
M1002	4340	5.68	80%	Claystone, brownish black, rounded fragments
			15%	Claystone/Chert, black
			4%	Claystone, light grey
			1%	Sandstone, medium-fine, subangular often cemented by Pyrite
M613	4320-4350	5.68	85%	Claystone, dark brownish black, rounded fragments, occasionally pyritic
			5%	Sandstone, greyish white, fine, occasionally cemented by Pyrite, micaceous, glauconitic
			8%	Claystone, grey-light grey, micaceous, slightly calcareous
			1%	Coal
			1%	Claystone, black
M1003	4360		10%	Sandstone, greyish-brownish white fine, angular-subangular, calcareous
		5.87	50%	Claystone, brownish black
		3.44	30%	Claystone, carbonaceous, black slickensides
		0.70	10%	Claystone, light grey, as above
			Sm.am.	Coal; Chert, black

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II

WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology
M1004	4370		15% Sandstone, as above
			6% Claystone, light grey, as above
			9% Claystone, black, carbonaceous, as above
		5.21	70% Claystone, brownish black, rounded fragments, as above
			Sm.am. Coal; Chert, black
M614	4350-4380	5.10	75% Claystone, dark brownish black, as above
			5% Coal/carbonaceous Claystone, black
			10% Sandstone, brown-brownish white, as above
		0.58	10% Claystone, grey-light grey, as above
			Sm.am. Limestone, brownish grey, hard
M1013	4390		30% Claystone, dark brownish grey, rounded fragments, as above
		5.00	60% Claystone, black, carbonaceous, as above
			4% Sandstone, as above
			6% Claystone, light grey, as above
M1014	4400		8% Claystone, dark brownish grey
		0.54	15% Claystone, grey, light grey, light greenish grey
			2% Limestone
		2.16	75% Claystone, black-greyish black, carbonaceous?, cokey?, as above
			Sm.am. Sandstone
M615	4380-4410	5.07	50% Claystone, dark brownish black, as above
			15% Sandstone, fine, medium, angular, subangular, brown-brownish grey, clayey, cemented by Pyrite, hard
			5% Claystone, grey-light grey, as above
		2.82	30% Claystone, black-dark grey, sandy, occasionally grading to Sandstone, medium, subangular-subrounded
			Sm.am. Limestone, grey, hard; Coal
M1015	4420		15% Sandstone, fine
			5% Limestone, light brownish white
		4.48	30% Claystone, dark brownish grey-black, occasionally sandy, occasionally fissile
		0.68	50% Claystone, grey, light grey

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology	
M1016	4430	5.17	40%	Claystone, brownish black, rounded fragments
			4%	Claystone, light grey
			1%	Sandstone
		4.13	55%	Claystone, black, occasionally cherty, grading to Chert
			Sm.am.	Coal
M616	4410-4440	4.28	45%	Claystone, dark brownish black-brown, as above
			15%	Sandstone, as above
			30%	Claystone, black-dark greyish black
		0.58	10%	Claystone, light grey-grey, calcareous, occasionally silty
			Sm.am.	Limestone; Coal
M1017	4450	6.10	40%	Claystone, brownish black, rounded fragments, as above
			5%	Claystone, light grey
		5.06	55%	Claystone, black, as above
			Sm.am.	Sand
M1018	4460	4.96	50%	Claystone, brownish black, as above
		4.26	42%	Claystone, black, as above
			8%	Claystone, light grey, as above
			Sm.am.	Limestone
M617	4440-4470	5.59	40%	Claystone, dark brownish black, soft as above
		4.65	50%	Claystone, dark grey to black, carbonaceous, partly very hard
			7%	Claystone, light grey, calcareous
			1%	Limestone
			1%	Sandstone
			1%	Coal
M1019	4480	5.56	35%	Claystone, brownish black, rounded fragments, as above
			50%	Claystone, black, possibly deformed brownish black, Claystone by the drilling
		0.73	10%	Claystone, light grey, calcareous
			5%	Limestone/Marl, greyish-brownish white

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology	
M1020	4490	5.81	35%	Claystone, brownish black, occasionally sandy, as above
			45%	Claystone, black, as above
			4%	Claystone, brownish black and Limestone, interlaminated, soft rounded fragments
			5%	Sandstone, fine, calcareous
		0.64	11%	Claystone, grey-light grey, light brownish grey, calcareous
M618	4470-4500	6.24	50%	Claystone, dark brownish black, as above
		5.42	40%	Claystone, dark greyish black, as above
			8%	Claystone, grey-light grey, as above
			2%	Limestone, light brownish white, hard
			Sm.am.	Coal; Sandstone
M1021	4510	6.90	60%	Claystone, brownish black, rounded fragments, soft
			25%	Claystone, black, as above
			7%	Claystone, light grey-grey
			8%	Marl/Limestone, brownish white, occasionally sandy, occasionally pyritic
			Sm.am.	Sandstone
M1022	4520		6%	Claystone, brownish black, as above
			4%	Claystone, black, subfissile, pyritic
		0.57	85%	Claystone, greyish white, calcareous sandy, grey-light grey
			4%	Limestone, light brownish white
			1%	Sandstone
M619	4500-4530	5.48	45%	Claystone, dark greyish brown, as above
		7.56	35%	Claystone, dark greyish black, as above
			15%	Claystone, light grey, as above
			5%	Limestone, as above
M1023	4540	6.73	90%	Claystone, brownish black, soft deformed fragments, occasionally observed with thin Limestone, white laminae
			7%	Claystone, greyish white, very calcareous, micaceous
			2%	Limestone, light brownish white
			1%	Sandstone

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology
M1024	4550	7.09	90% Claystone, brownish black, as above 6% Claystone, sandy, greyish white, very calcareous 2% Limestone, white, soft, light brownish white, hard 2% Sandstone, brownish grey, argillaceous
M620	4530-4560	7.15	90% Claystone, dark brownish black, black soft-firm, occasionally slightly micaceous 8% Claystone, light grey-whitish grey, slightly calcareous 1% Limestone 1% Sandstone, fine, slightly glauconitic
M1025	4570	7.09 0.47	80% Claystone, brownish black, more deformed by turbo then above, silty 15% Claystone, light grey-greyish white, calcareous, pyritic 3% Sandstone 2% Limestone, greyish white, hard
M1026	4580	7.01 0.59	45% Claystone, brownish black, some deformed by turbodrill 5% Claystone, dark grey-black, lustrous, micaceous 35% Claystone, light grey, occasionally very calcareous, occasionally sandy 10% Limestone, white-light brownish white 5% Sandstone, fine, angular, argillaceous, calcareous
M621	4560-4590	6.42 0.56	85% Claystone, dark brownish black, as above 12% Claystone, light grey-whitish grey 3% Sandstone, medium, fine, argillaceous, pyritic Sm.am. Limestone
M1027	4600	6.24	95% Claystone, brownish-black, turbodrilled, about 20% undeformed 4% Claystone, grey-light grey, greyish white 1% Sandstone

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LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II

WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology
M1028	4610	6.67	92% Claystone, brownish-black, 15% undeformed 4% Claystone, grey, light grey 3% Limestone, greyish white, hard 1% Siltstone, yellow, grey
M622	4590-4620	6.63	85% Claystone, occasionally sandy, dark brownish black, black, as above
		0.54	10% Claystone, sandy, light grey 3% Sandstone 2% Limestone
M1029	4630	6.13	94% Claystone, brownish black-black, 20% undeformed 4% Claystone, grey-light grey 1% Limestone, greyish white 1% Sandstone
M1030	4640	5.13	92% Claystone, brownish black-black, occasionally greyish black, 25% undeformed fragments 6% Claystone, light grey 2% Limestone, greyish white
M623	4620-4650	6.73	90% Claystone, dark brownish black, black, as above 8% Claystone, light grey, greenish grey, pyritic in parts 1% Limestone, brownish white 1% Sandstone
M1031	4660	7.11	87% Claystone, brownish black, 40% deformed by turbodrill 9% Claystone, grey-light grey, greyish white 4% Limestone, greyish white
M1032	4670	5.81	88% Claystone, dark brownish grey-black, 35% undeformed, as above 9% Claystone, light grey, as above 3% Limestone, as above
M624	4650-4680	7.49	70% Claystone, dark brownish grey-black, grey
		0.65	25% Claystone, grey-light grey, greenish grey, micaceous, calcareous, partly sandy 3% Limestone, greyish white, hard 2% Coal

IKU

LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology	
M1033	4690	6.03	87%	Claystone, dark brownish grey-black, 20% undeformed, as above
		0.56	10%	Claystone, light grey, grey, as above
			3%	Limestone, as above
M1034	4700	4.66	25%	Claystone, dark brown-black, deformed by turbodrill
			70%	Claystone, light grey-greyish white, silty, micaceous, calcareous, grey
			2%	Limestone, as above
			3%	Sandstone, fine, argillaceous, sub-rounded, subangular
M625	4680-4710	5.64	80%	Claystone, dark brownish black-grey, dark grey
		0.53	20%	Claystone, grey-light grey, light greenish grey
M1035	4720	4.23	50%	Claystone, dark brown-black, about 80% deformed by turbodrill
		0.70	20%	Claystone, light grey
			30%	Sandstone, medium-fine, argillaceous, occasionally glauconitic
M1036	4730	4.43	85%	Claystone, dark brown-black, 70% deformed by turbo
		0.45	10%	Claystone, light grey
			5%	Sandstone
M626	4710-4740	5.10	50%	Claystone, dark brownish grey-black, dark grey
		0.48	30%	Claystone, grey-light grey
			20%	Sandstone, medium, angular-subrounded, argillaceous, hard
			Sm.am.	Coal; Limestone
M1037	4750	5.30	20%	Claystone, dark brown, partly affected by turbo
		1.22	20%	Claystone, grey
		0.44	20%	Claystone/Marl, light grey-greyish, white
			40%	Sandstone, as above, obs. Coal
M1038	4760		85%	Sandstone, medium-fine, subangular-subrounded, very calcareous, slightly glauconitic, occasionally very argilleceous
			8%	Claystone, dark grey-black
			7%	Claystone, light grey
			Sm.am.	Limestone; Pyrite; Coal

IKU

LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology	
M627	4740-4770	6.20 0.72	30% 40% 30%	Claystone, dark brownish black-grey Claystone, grey, light grey Sandstone/Sand, as above, calcareous
M1039	4777.5	7.06 0.57	50% 35% 12% 3%	Claystone, dark brown-black, black, pyritic Sandstone, fine-medium, greyish-brownish white, glauconitic Claystone, light grey Limestone
M1040	4790	6.01	85% 6% 8% 1%	Claystone, dark brown-black, about 60% affected by turbo Sandstone, fine-medium Claystone, light grey Limestone
M628	4770-4800	6.42	70% 5% 25%	Claystone, dark brownish black, black, lusteous, micaceous, carbonaceous Claystone, grey, light grey Sandstone, brownish grey-grey, fine-medium, occasionally very calcareous, occasionally very argillaceous, slightly glauconitic
M1041	4810	6.88 0.86	60% 30% 7% 3%	Claystone, dark grey-black, sandy, micaceous, lusteous, subfissile, grading into Sandstone, dark grey-brownish white, fine calcareous Claystone, light grey Limestone, light brown, fine-very fine
M1042	4822.5	6.04 0.50	50% 40% 9% 1%	Claystone, dark grey-black, as above Sandstone, brown-grey Claystone, greenish-grey Limestone, brownish-grey
M629	4800-4830	5.74	65% 30% 5% Sm.am.	Claystone, dark brownish grey-black, partly sandy, lusteous, micaceous Sandstone, greyish white, fine Claystone, grey Coal
M1043	4840	6.06 0.81	70% 28% 2%	Claystone, dark grey-black, as above, fissile Sandstone, fine-medium, as above Claystone, greenish grey

IKU

LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II
WELL NO.: 24/12-2

Sample	Depth	TOC		Lithology
M1044	4850	5.83	35%	Claystone, dark grey-black, as above
		0.39	55%	Sandstone, as above, occasionally slightly glauconitic, laminated and interbedded with Claystone, dark grey-black
			9%	Claystone, grey-greenish grey
			1%	Limestone
M630	4830-4860	6.75	55%	Claystone, dark grey-black, subfissile, carbonaceous
			30%	Sandstone, as above
		0.56	15%	Claystone, grey
			Sm.am.	Coal, wood fragments
M1045	4870	5.19	85%	Claystone, black-dark grey, as above
			10%	Sandstone, as above
			5%	Claystone, light grey-greenish, grey
M1046	4880	5.85	70%	Claystone, black-dark grey, as above
			20%	Sandstone, as above
			10%	Claystone, light grey
			Sm.am.	Limestone, white sandy
M631	4860-4890	5.64	65%	Claystone, dark grey-black, as above
			25%	Sandstone, brownish grey-greyish white, fine-medium, argillaceous, partly pyritic
		0.57	10%	Claystone, grey-light grey
			Sm.am.	Limestone
M1047	4897.5	4.92	90%	Claystone, dark grey-black, fissile, some lighter grey, spotted, very calcareous
			7%	Sandstone, as above, occasionally very calcareous
			3%	Claystone, light grey
M632	4890-4920	4.98	85%	Claystone, occasionally sandy, dark grey-black, as above
		0.55	10%	Claystone, greyish white-grey
			5%	Sandstone, as above

IKU

S.W.C.

LITHOLOGY AND TOTAL ORGANIC CARBON MEASUREMENTS

TABLE NO.: II

WELL NO.: 24/12-2

Sample	Depth	TOC	Lithology
	4262.5	4.89%	Claystone, black, lusteous, slightly calcareous-calcareous, micaceous, firm-soft
	4456	6.49%	Claystone, black-dark grey, non calcareous, subfissile, slightly micaceous, carbonaceous
	4597.5	8.00%	sandy Claystone, black, occasionally very calcareous, carbonaceous, coal fragments, wood fragments
			Quartz, fine-medium, clear, brittle
		Abn.	Very fine grained Pyrite (black, framboidal), some micaceous, loose

IKU

T A B L E : III

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKU-No	DEPTH (m)	Rock Extr. (g)	EOM (mg)	Sat. (mg)	Aro. (mg)	HC (mg)	Non HC (mg)	TOC (%)
M365	3810	31.3	17.2	2.0	.8	2.8	14.4	.5
M368	3900	32.3	15.4	5.8	.8	6.6	8.8	1.7
M961	4000	23.7	6.1	2.6	.8	3.4	2.7	.8
M372	4020	20.2	4.0	1.4	1.4	2.8	1.2	1.0
M373	4050	27.2	13.3	6.4	2.2	8.6	4.7	1.0
M380	4260	45.1	21.5	12.0	3.2	15.2	6.3	1.0
M998	4280	32.1	68.4	31.4	4.4	35.8	32.6	4.5
M382	4320	50.9	173.3	94.0	27.5	121.5	51.8	4.0
M1002	4340	42.5	86.8	38.4	16.4	54.8	32.0	4.5
M615	4410	10.2	20.1	8.8	4.3	13.1	7.0	4.5
M617	4470	23.3	13.7	7.1	3.4	10.5	3.2	2.6
M619	4530	40.3	32.6	11.3	5.2	16.5	16.1	2.2
M621	4590	42.4	24.4	8.2	4.9	13.1	11.3	2.6
M623	4650	26.0	19.1	8.3	4.6	12.9	6.2	2.5
M625	4710	32.5	18.8	6.7	2.6	9.3	9.5	1.9
M627	4770	40.1	28.7	5.9	.8	6.7	22.0	1.8
M629	4830	51.3	28.2	8.0	5.4	13.4	14.8	3.9
M631	4890	48.2	19.3	3.5	1.1	4.6	14.7	3.8

IKU

T A B L E : IV

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
M365	3810	550	64	26	89	460
M368	3900	477	180	25	204	272
M961	4000	257	110	34	143	114
M372	4020	198	69	69	139	59
M373	4050	489	235	81	316	173
M380	4260	477	266	71	337	140
M998	4280	2131	978	137	1115	1016
M382	4320	3405	1847	540	2387	1018
M1002	4340	2042	904	386	1289	753
M615	4410	1971	863	422	1284	686
M617	4470	588	305	146	451	137
M619	4530	809	280	129	409	400
M621	4590	575	193	116	309	267
M623	4650	735	319	177	496	238
M625	4710	578	206	80	286	292
M627	4770	716	147	20	167	549
M629	4830	550	156	105	261	288
M631	4890	400	73	23	95	305

IKU

T A B L E : V

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
M365	3810	103.7	12.1	4.8	16.9	86.8
M368	3900	28.5	10.8	1.5	12.2	16.3
M961	4000	32.2	13.7	4.2	17.9	14.2
M372	4020	19.8	6.9	6.9	13.9	5.9
M373	4050	48.9	23.5	8.1	31.6	17.3
M380	4260	47.7	26.6	7.1	33.7	14.0
M998	4280	47.4	21.7	3.0	24.8	22.6
M382	4320	85.1	46.2	13.5	59.7	25.4
M1002	4340	45.4	20.1	8.6	28.7	16.7
M615	4410	43.8	19.2	9.4	28.5	15.3
M617	4470	22.6	11.7	5.6	17.3	5.3
M619	4530	36.8	12.7	5.9	18.6	18.2
M621	4590	22.1	7.4	4.4	11.9	10.3
M623	4650	29.4	12.8	7.1	19.8	9.5
M625	4710	30.4	10.9	4.2	15.1	15.4
M627	4770	39.8	8.2	1.1	9.3	30.5
M629	4830	14.1	4.0	2.7	6.7	7.4
M631	4890	10.5	1.9	.6	2.5	8.0

IKU

T A B L E : VI

COMPOSITION IN % OF THE MATERIAL EXTRACTED FROM THE ROCK

IKU-No	DEPTH (m)	Sat / EOM	Aro / EOM	HC / EOM	Sat / Aro	Non HC / EOM	HC / Non HC
M365	3810	11.6	4.7	16.3	250.0	83.7	19.4
M368	3900	37.7	5.2	42.9	725.0	57.1	75.0
M961	4000	42.6	13.1	55.7	325.0	44.3	125.9
M372	4020	35.0	35.0	70.0	100.0	30.0	233.3
M373	4050	48.1	16.5	64.7	290.9	35.3	183.0
M380	4260	55.8	14.9	70.7	375.0	29.3	241.3
M998	4280	45.9	6.4	52.3	713.6	47.7	109.8
M382	4320	54.2	15.9	70.1	341.8	29.9	234.6
M1002	4340	44.2	18.9	63.1	234.1	36.9	171.2
M615	4410	43.8	21.4	65.2	204.7	34.8	187.1
M617	4470	51.8	24.8	76.6	208.8	23.4	328.1
M619	4530	34.7	16.0	50.6	217.3	49.4	102.5
M621	4590	33.6	20.1	53.7	167.3	46.3	115.9
M623	4650	43.5	24.1	67.5	180.4	32.5	208.1
M625	4710	35.6	13.8	49.5	257.7	50.5	97.9
M627	4770	20.6	2.8	23.3	737.5	76.7	30.5
M629	4830	28.4	19.1	47.5	148.1	52.5	90.5
M631	4890	18.1	5.7	23.8	318.2	76.2	31.3

TABLE VII

TABULATION OF DATAS FROM THE GASCHROMATOGRAMS

IKU No.	DEPTH (m)	PRISTANE / n-C17	PRISTANE / PHYTANE	CPI
M365	3810	.4	1.1	1.0
M368	3900	.4	1.2	1.0
M961	4000	.4	1.2	1.1
M372	4020	.4	1.4	1.5
M373	4050	.3	1.4	1.0
M380	4260	.4	1.5	.9
M998	4280	.4	1.3	1.0
M382	4320	.3	1.4	.9
M1002	4340	.3	1.6	.9
M615	4410	.2	1.5	1.0
M617	4470	.2	1.2	1.0
M619	4530	.2	1.6	.8
M621	4590	.3	1.4	1.1
M623	4650	.3	1.6	.9
M625	4710	.3	1.4	1.0
M627	4770	.4	1.4	1.0
M629	4830	.3	1.7	.9
M631	4890	.3	1.7	1.1

IKU

VITRINITE REFLECTANCE MEASUREMENTS

TABLE NO.: VIIIA

WELL NO. 24/12-2

Sample	Depth	Vitrinite reflectance	Fluorescence in UV light	Exinite content
	2000	0.51(5)	Nil	Nil
	2100	0.39(2)	Yellow	Trace
	2200	0.40(12)	Yellow/Yellow-Orange	Trace
	2300	0.54(9)	Yellow-Orange	Trace
	2400	0.37(14)	Nil	Nil
	2500	0.43(13)	Nil	Nil
	2600	0.56(4)	Yellow-Orange	Trace
	3005	0.27(9)	Yellow-Orange Hydrocarbons	Nil
	3100	N.D.P.	-	-
	3200	0.33(2)	Nil	Nil
	3300	N.D.P.	-	-
	3400	N.D.P.	-	-
	3500	0.39(1), 0.64(1)	Nil	Nil
	3600	N.D.P.	-	-
	3700	0.47(2)	Nil	Nil
	3800	N.D.P.	-	-
M368	3870-3900	0.29(2)	Nil	Nil
M372	3990-4020	1.52(19)	Mid-Orange from Carbonate	Nil
M963	4020-4030	0.39(1), 1.66(10)	Nil	Nil
M965	4050-4060	0.27(2), 1.64(19)	Nil	Nil
M374	4050-4080	1.69(20)	Nil	Nil
M375	4080-4110	0.47(1), 1.60(17)	Nil	Nil
M378	4170-4200	1.61(15)	Some from Carbonate	Nil
M996	4240-4250	0.59(17)	Some from Carbonate	Nil
M381	4260-4290	0.30(11), 1.50(7)	Nil	Nil

IKU

VITRINITE REFLECTANCE MEASUREMENTS

TABLE NO.: VIIIA

WELL NO. 24/12-2

Sample	Depth	Vitrinite reflectance	Fluorescence in UV light	Exinite content
M999	4290-4300	0.62(1)	Nil	Nil
M1000	4300-4310	0.54(4),0.83(10), 1.47(4)	Nil	Nil
M613	4320-4350	0.54(9)	Nil	Nil
M1004	4360-4370	0.57(2), 1.27(3)	Some from Carbonate and Hydrocarbon Specks	Nil
M1013	4380-4390	0.92(1), 1.41(1)	Nil	Nil
M1015	4410-4420	0.33(1), 0.73(1), 1.1(9), 1.82(4)	Mid-Orange from Carbonate	Nil
M1016	4420-4430	0.30(8), 1.19(2)	Nil	Nil
	4450	1.11(1), 1.93(1)	Some from Hydrocarbon Specks	Nil
M1017	4450-4460	N.D.P.	-	-
M1020	4480-4490	0.34(1), 1.40(4)	Some from Hydrocarbon Specks	-
M1021	4300-4510	1.37(6)	Nil	Nil
M1023	4530-4540	1.36(5)	Nil	Nil
M1024	4540-4550	1.39(11)	Mid-Orange from Carbonate	Nil
M1025	4560-4570	N.D.P.	-	-
M621	4560-4590	1.33(3)	Mid-Orange from Carbonate	Nil
M1028	4600-4610	0.75(1), 1.23(1	Mid-Orange from Carbonate	Nil
M1029	4620-4630	0.95(1), 1.59(1	Nil	Nil

IKU

VITRINITE REFLECTANCE MEASUREMENTS

TABLE NO.: VIIIA

WELL NO. 24/12-2

Sample	Depth	Vitrinite reflectance	Fluorescence in UV light	Exinite content
M1032	4660-4670	1.69(1)	Mid-Orange from Carbonate	Nil
M625	4680-4710	1.63(3)	Mid-Orange from Carbonate	Nil
M1036	4720-4730	0.28(5), 1.62(7)	Some from Hydrocarbon Specks	Nil
M1037	4740-4750	0.35(10), 1.10(3)	Some from Hydrocarbon Specks Light Orange from Spores?	Trace
M1039	4777.5	0.28(1), 1.54(13)	Mid-Orange from Carbonate and Hydrocarbon Specks	Nil
M1040	4780-4790	1.31(2)	Deep Orange from Carbonate	Nil
M1041	4800-4810	0.38(2), 1.40(6)	Some from Hydrocarbon Specks	Nil
M1042	4822.5	1.60(20)	Mid-Orange from Carbonate and Hydrocarbons	Nil
M1044	4840-4850	1.54(15)	Deep Orange from Carbonate	Nil
M1045	4860-4870	0.17(1), 1.14(7)	Mid-Orange from Carbonate	Nil
M1046	4870-4880	0.33(1), 1.69(15)	Mid-Deep Orange from Carbonate and Hydrocarbon Specks	Nil
M1047	4897.5	1.25(10)	Mid-Deep Orange from Carbonate	Nil
	4990-5000	0.72(1), 1.66(13)	Mid-Orange from Carbonate	Nil
	5090-5100	1.78(3)	Mid-Orange from Carbonate	Nil

IKU

VISUAL KEROGEN ANALYSIS

TABLE NO.: VIIIB
WELL: 24/12-2

Sample	Depth	Composition of residue	Particle size	Preservation-palynomorphs	Thermal maturation index	Remarks
M365	3780-3810	Am,Cy/W,WR!	F	good		Dense aggregates of combined organic/inorganic structure. Mostly amorphous.
M368	3870-3900	Am/W,WR!	F	?		As above, but more of acid resistant minerals.
M372	3990-4020	*W,WR!	F-M			Acid resistant minerals only including pyrite framboids. Some inertinite/fusinite and vitrinite, semifusinite.
M961	4000	W,WR!/Am,Cy	F-M	good-fair	2+	Varied woody particles as above. Amorphous aggregates. Cysts are stained, dark coloured.

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.: VIIIB
WELL: 24/12-2

Sample	Depth	Composition of residue	Particle size	Preservation-palynomorphs	Thermal maturation index	Remarks
M963	4030	W,WR/Am,Cy	F-M	good-fair	2+/3-	Small amorphous aggregates, partly of flaky structure. Rich in pyrite.
M373	4020-4050	W,Cut,WR!/Am,Cy	F-M	good-fair		Sapropelised cuticles in addition to material recognised in 4030.
	4120	W,WR!,P/AM,Cy	F-M	good	2/2+	Fairly light coloured pollen in comparison with samples above and below. More well sorted disperse material.
M380	(4230-4260) 4262 swc	W,WR!,Cut,P/Am,Cy	F-M	good-fair	2+/3-	As above, but also aggregates of inorganic/organic material.

ABBREVATIONS

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

IKU

VISUAL KEROGEN ANALYSIS

TABLE NO.: VIIIB
WELL: 24/12-2

Sample	Depth	Composition of residue	Particle size	Preservation-palynomorphs	Thermal maturation index	Remarks
	4280	W,Cut,WR!,P/Am,Cy	F-M-L	fair-poor	2+/3-	Very dense opaque aggregates, a major part of which is evaluated as of cuticular origin. Abundant pyrite. Fairly thin-walled crumbled palynomorphs.
M382	4290-4320	*?(Am)	F	poor		Aggregates with embedded acid resistant minerals.
M615	(4340) 4350 swc	Cut,W,WR!,P/Am	F-M-L	poor-fair	3-/3 3-	Dense aggregates, abundant pyrite. Relative proportions are uncertain.

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.: VIIIB
WELL: 24/12-2

Sample	Depth	Composition of residue	Particle size	Preservation-palynomorphs	Thermal maturation index	Remarks
M1002	4380-4410	W,Cut,WR!,P/Am,Cy	F-M-L	poor-fair	3-/3	As above.
	4430	W,WR!/Am	F-M	very poor		Stronger sorting than above. Rich in vitrinite.
M617	(4440-4470) 4456 swc	Cut,W,WR!/?Am	F-M	very poor	3-	Very dense aggregates of sapropelised cuticles and woody material.
M619	(4500-4530) 4500 swc	Am/W	F-M	very poor	2+/3-	Granulate aggregates of in-organic/organic material partly large mineral crys-tals.

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.: VIIIB
WELL: 24/12-2

Sample	Depth	Composition of residue	Particle size	Preservation-palynomorphs	Thermal maturation index	Remarks
M621	4560-4590	Am/W	F-M	very poor		As above.
	4610	Am/W	F-M	very poor		As above but the residue is rich in acid resistant minerals.
M623	(4620-4650) 4673 swc	Am/W	F-M	very poor	2+/3-	As 4610.
M625	4680-4710	W/Am	F-M	very poor		Residue as 4610 and 4620-50.
	4690	W/Am	F-M	very poor		More pyrite aggregates, as above with large crystals embedded. Fungal spores?

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.: VIIIB
WELL: 24/12-2

Sample	Depth	Composition of residue	Particle size	Preservation-palynomorphs	Thermal maturation index	Remarks
	4750	*W/Am	F-M	very poor		Stronger sorting, more vitrinite.
M627	4740-4770	Cut,W,WR!,P/Am,Cy	F-M-L	poor	2+/3-	Dense pyritic aggregates, apparently a major part was derived from cuticles.
M629	4810	Cut,W,WR!/Am	F-M-L	very poor		Abundant acid resistant minerals also embedded in the aggregates. Distinction of categories is difficult.
	4800-4830	*Cut,W,WR!/Am	F-M	very poor		The residues below resemble 4810.
	4850	*Cut,W,WR!/Am	F-M	very poor		

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.: VIIIB
WELL: 24/12-2

Sample	Depth	Composition of residue	Particle size	Preservation-palynomorphs	Thermal maturation index	Remarks
M631	4860-4890	*W,Cut,WR!/Am	F-M	very poor		
	(4880) 4898 swc	*W,Cut,WR!/Am	F-M	very poor	3-/3	

ABBREVATIONS

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

IKU

TABLE IX

ROCK EVAL PYROLYSES

IKU No.	DEPTH (m)	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT S1+S2	PROD. INDEX S1/(S1+S2)	TEMP. max (C)
M371	3990 Clst dk gy	.40	.09	.67	1.80	5	37	.49	.82	442
M961	4000 Clst gy	.52	.00	.63	.84		75	.52	1.00	
M961	4000 Clst dk gy	.29	.00	.75	1.68		45	.29	1.00	
M962	4010 Clst dk gy	.28	.00	.66	1.39		47	.28	1.00	
M372	4020 Clst dk gy	.17	.03	.65	1.67	2	39	.20	.85	450
M963	4030 Clst dk gy	.38	.34	.55	1.70	20	32	.72	.53	445
M373	4050 Clst dk gy	.07	.05	.58	1.34	4	43	.12	.58	449
M374	4080 Clst dk gy	.23	.44	.60	1.63	27	37	.67	.34	449
M374	4080 Ls	.59	.41	1.18	.59	69	200	1.00	.59	418
M375	4110 Clst dk gy	.44	.18	.46	1.09	17	42	.62	.71	446
M375	4110 Clst bn-gy	.26	.00	.39	.63		62	.26	1.00	
M378	4200 Clst gy	.17	.04	.39	1.11	4	35	.21	.81	443
M379	4230 Clst dk gy	.29	.21	.52	1.08	19	48	.50	.58	442
M379	4230 Ls	.23	.11	2.00	1.19	9	168	.34	.68	419
M380	4260 Clst dk bn-gy	1.79	3.96	.88	4.31	92	20	5.75	.31	432
M380	4260 Clst dk gy	.10	.06	.56	1.59	4	35	.16	.63	446
M997	4270 Clst dk bn-gy	1.94	4.47	.59	5.08	88	12	6.41	.30	436
M998	4280 Clst dk bn-gy	2.38	6.19	.63	6.60	94	10	8.57	.28	433
M381	4290 Clst dk bn-gy	3.32	6.23	.74	5.41	115	14	9.55	.35	438
M1000	4310 Clst dk bn-gy	1.88	6.98	.41	7.14	98	6	8.86	.21	442
M1000	4310 Clst bn black	2.04	6.18	.99	6.94	89	14	8.22	.25	438
M382	4320 Clst dk bn-gy	3.43	7.90	.67	5.32	148	13	11.33	.30	443
M1002	4340 Clst bn black	.38	1.83	.77	5.68	32	14	2.21	.17	440
M1003	4360 Clst bn black	.55	3.01	.79	5.87	51	13	3.56	.15	442
M1003	4360 Clst black	.24	.00	.83	3.44		24	.24	1.00	

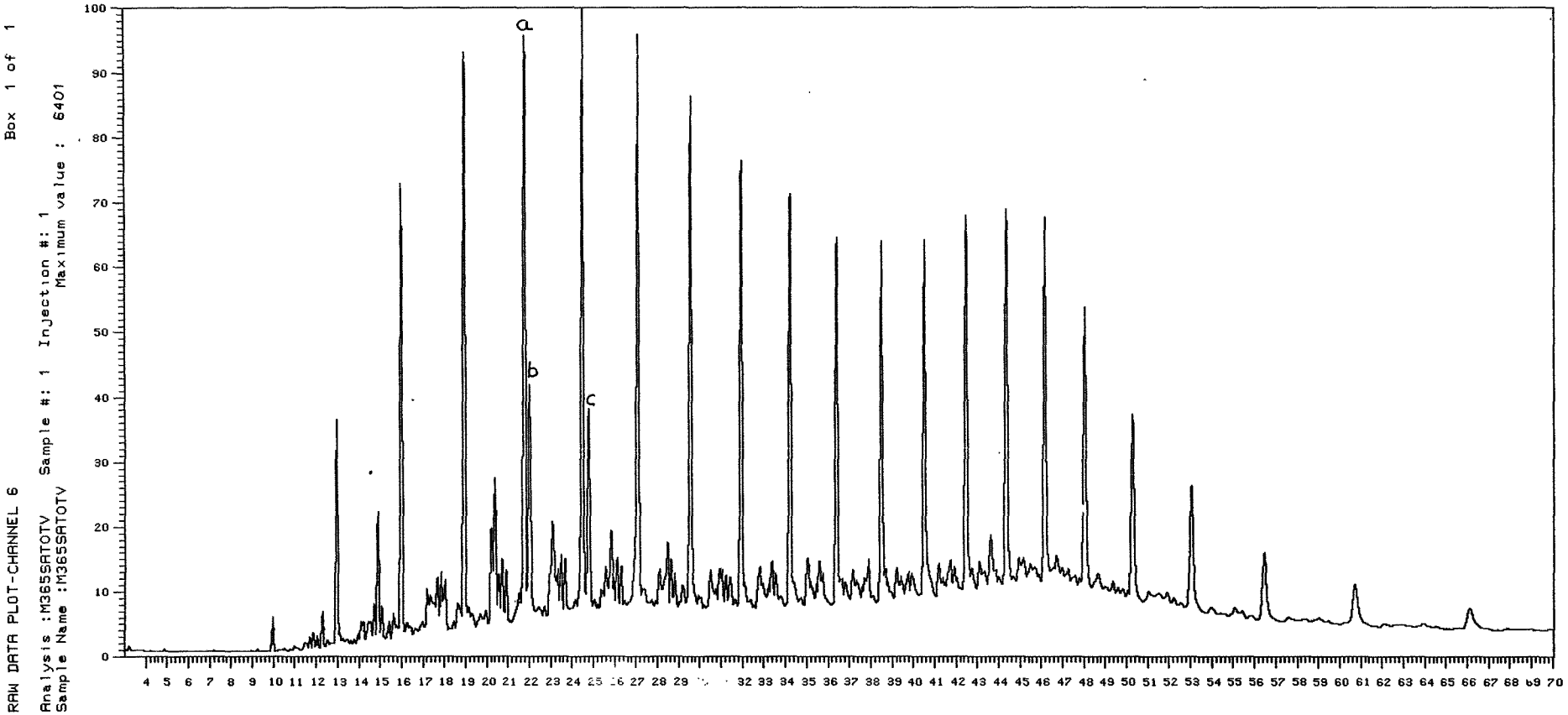
IKU

TABLE IX

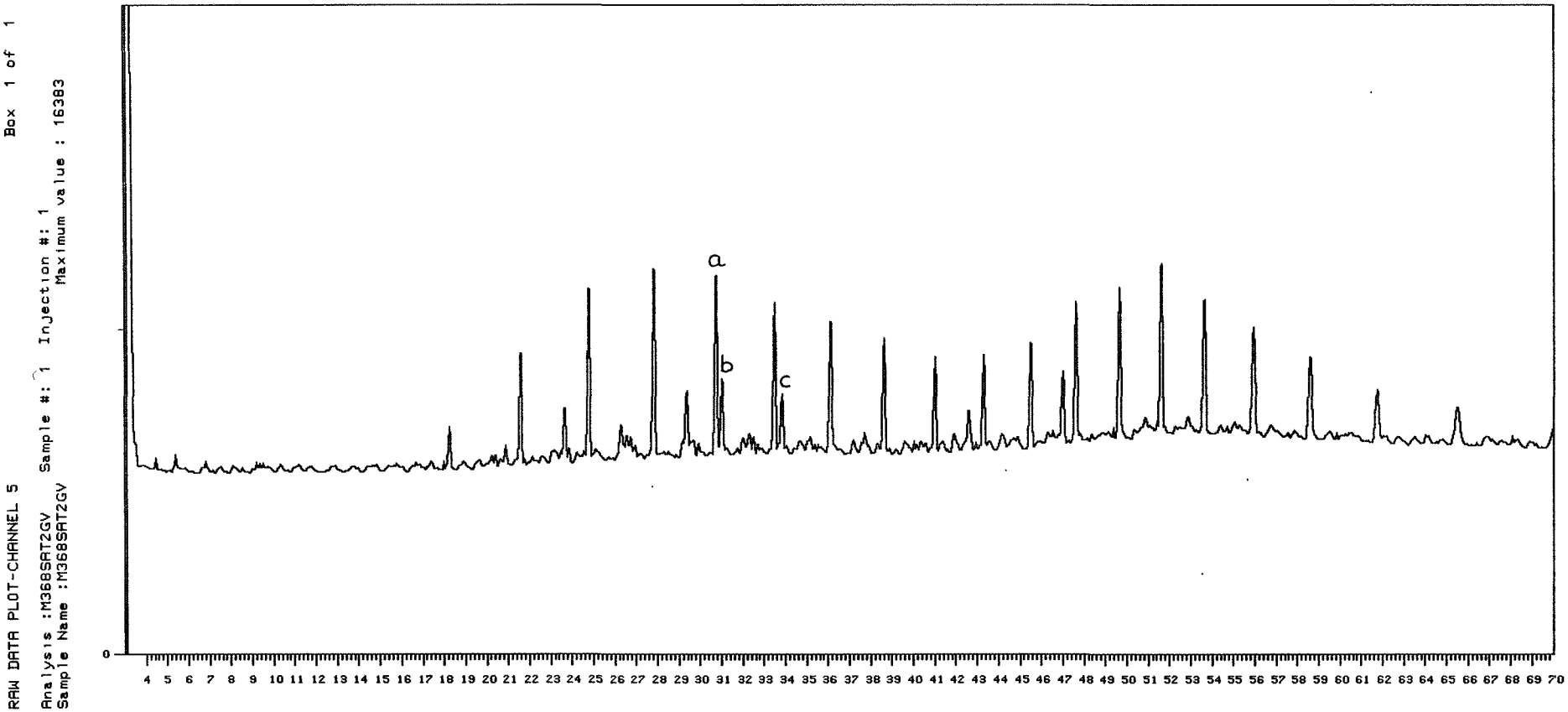
ROCK EVAL PYROLYSES

IKU No.	DEPTH (m)		S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT S1+S2	PROD. INDEX S1/(S1+S2)	TEMP. max (C)
M614	4380		.59	1.71	.88	5.10	34	17	2.30	.26	440
	Clst	bn black									
M1013	4390		.18	1.69	.71	3.38	50	21	1.87	.10	442
	Clst	dk bn-gy									
M1013	4390		.28	.00	.83	5.00		17	.28	1.00	
	Clst	black									
M616	4440		.76	2.17	.60	4.28	51	14	2.93	.26	448
	Clst	bn black									
M617	4470		2.18	3.21	.91	5.59	57	16	5.39	.40	439
	Clst	bn black									
M618	4500		1.82	2.95	.79	6.24	47	13	4.77	.38	440
	Clst	bn black									
M619	4530		.62	.00	.69	5.48		13	.62	1.00	
	Clst	dk bn-gy									
M620	4560		1.55	.77	.71	7.15	11	10	2.32	.67	439
	Clst	bn black									
M621	4590		1.65	1.06	.74	6.42	17	12	2.71	.61	440
	Clst	bn black									
M622	4620		1.34	.32	.94	6.63	5	14	1.66	.81	432
	Clst	bn black									
M623	4650		1.52	.33	.77	6.73	5	11	1.85	.82	439
	Clst	bn black									
M624	4680		2.46	.97	.76	7.49	13	10	3.43	.72	434
	Clst	dk bn-gy									
M625	4710		1.07	1.06	.91	5.64	19	16	2.13	.50	432
	Clst	dk bn-gy									
M626	4740		1.10	1.02	1.31	5.10	20	26	2.12	.52	440
	Clst	dk bn-gy									
M627	4770		1.68	2.58	.46	6.20	42	7	4.26	.39	447
	Clst	dk bn-gy									
M628	4800		1.56	1.48	.79	6.42	23	12	3.04	.51	445
	Clst	bn black									
M629	4830		1.13	1.46	.65	5.74	25	11	2.59	.44	456
	Clst	bn black									
M630	4860		1.14	1.44	.87	6.75	21	13	2.58	.44	452
	Clst	bn black									
M631	4890		.88	1.03	.96	5.64	18	17	1.91	.46	455
	Clst	bn black									
M632	4920		.55	.85	.83	4.98	17	17	1.40	.39	461
	Clst	bn black									

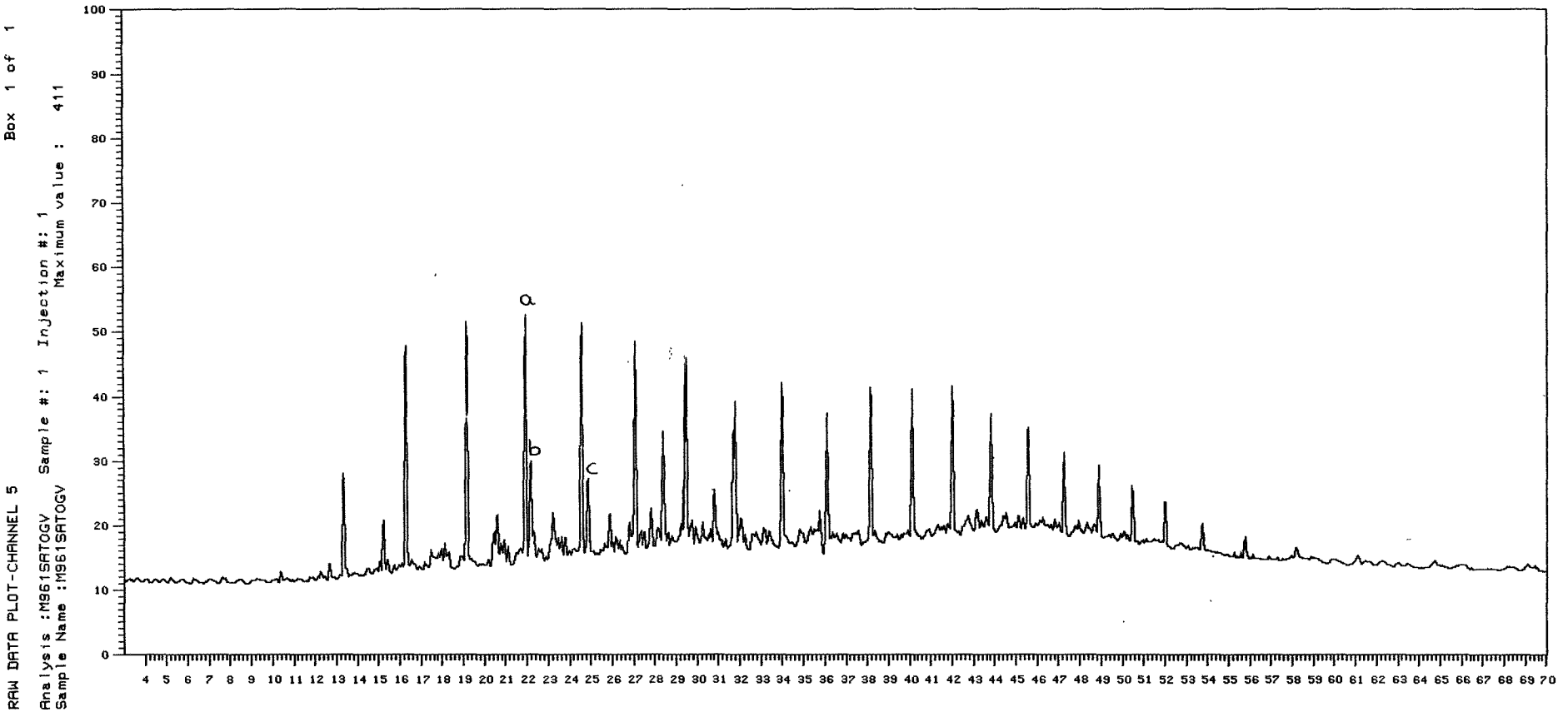
Saturated hydrocarbons
3780–3810 m



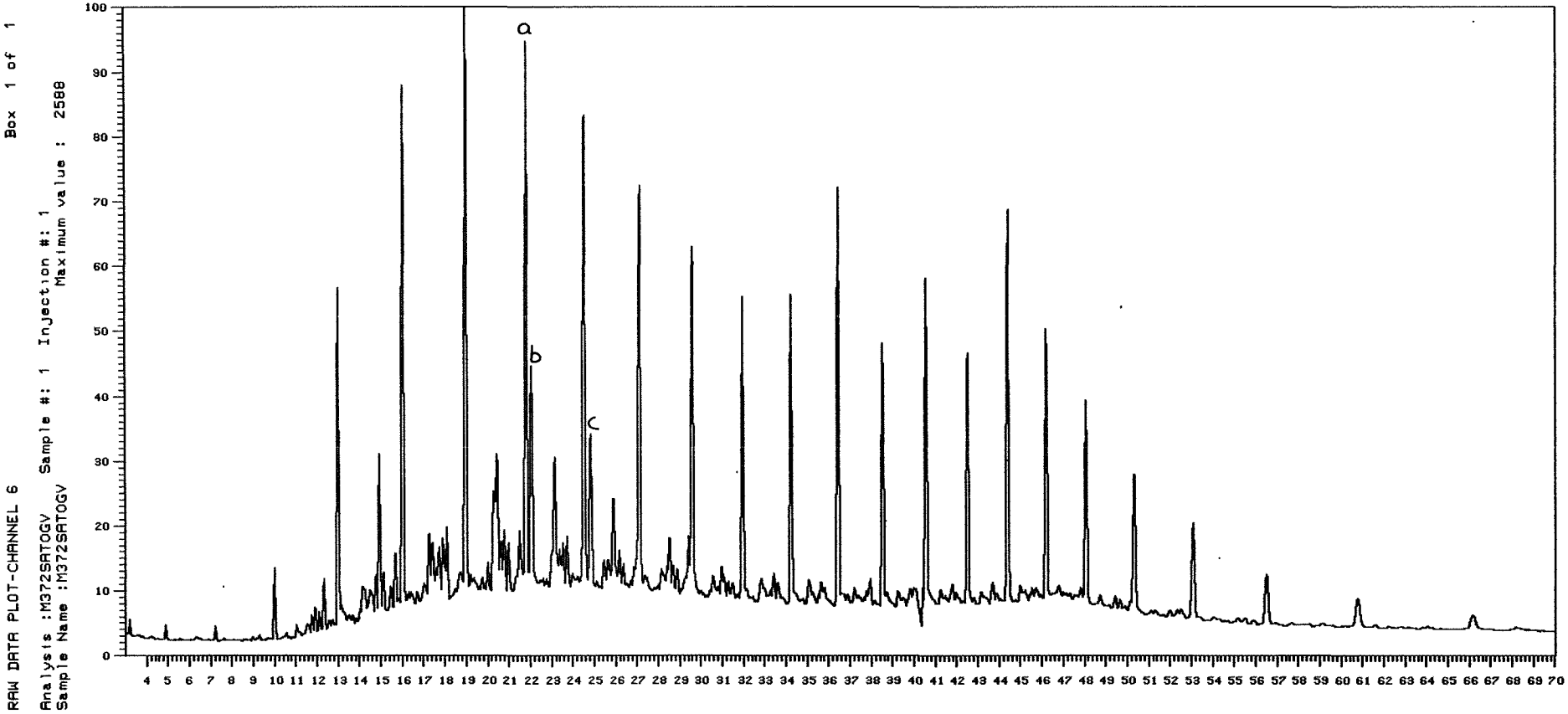
Saturated hydrocarbons
3870–3900 m



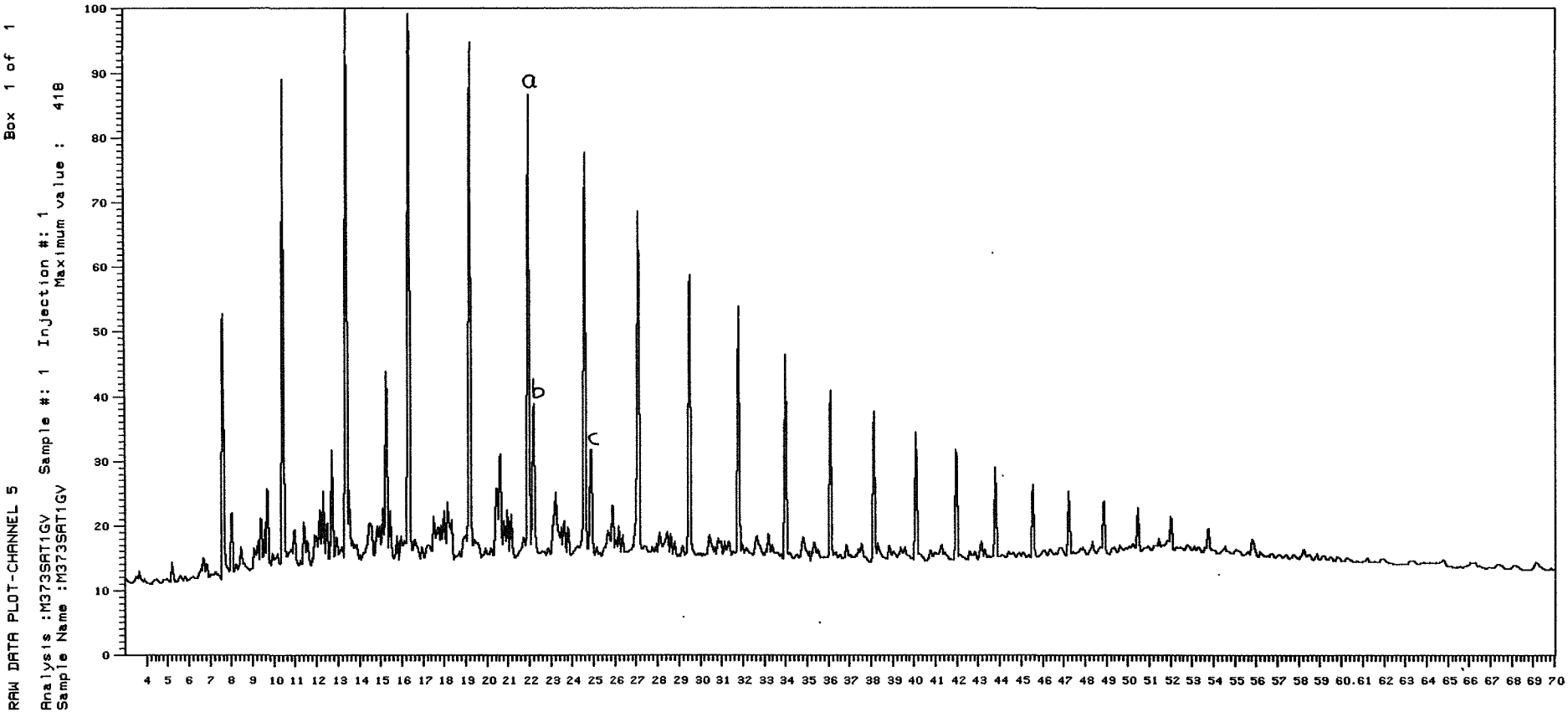
Saturated hydrocarbons
3990–4000 m



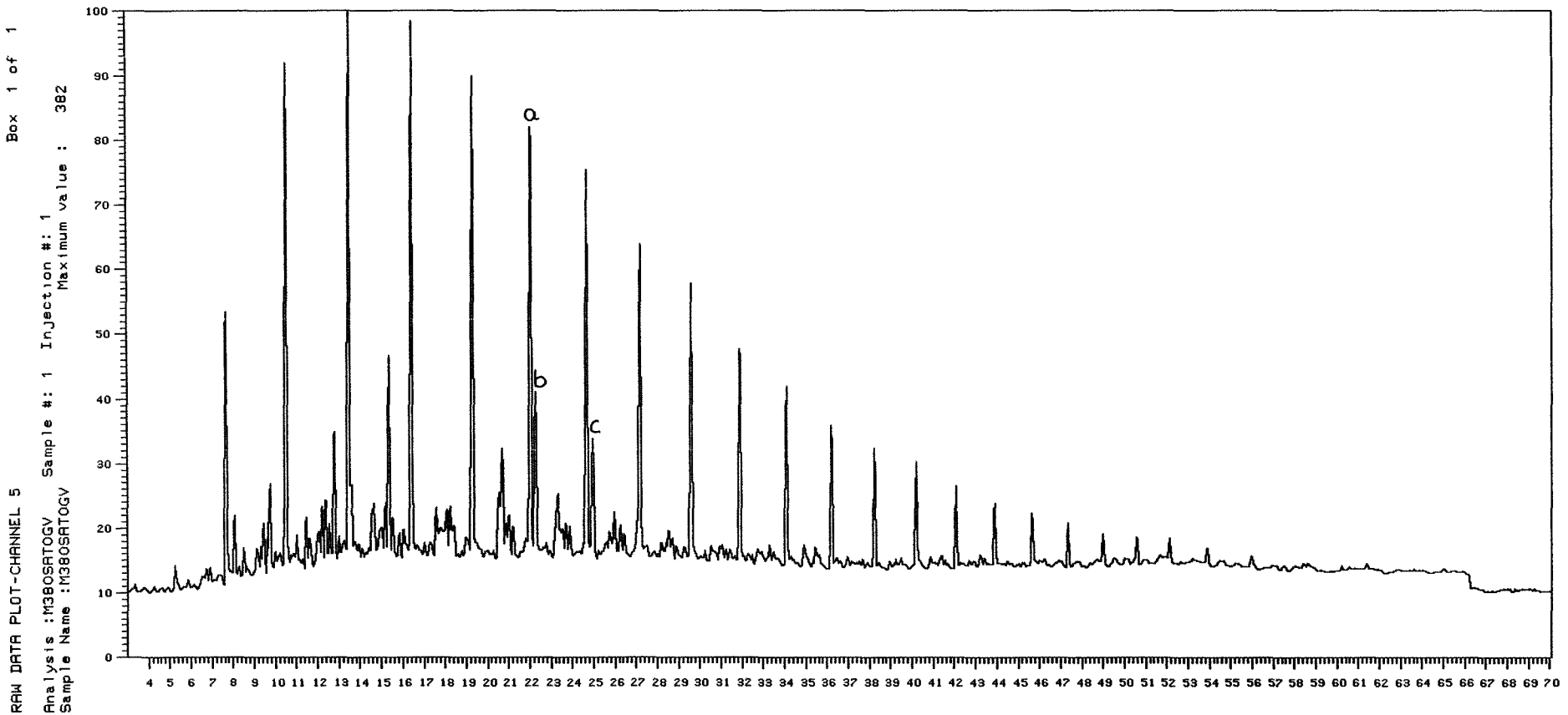
Saturated hydrocarbons
3990–4020 m



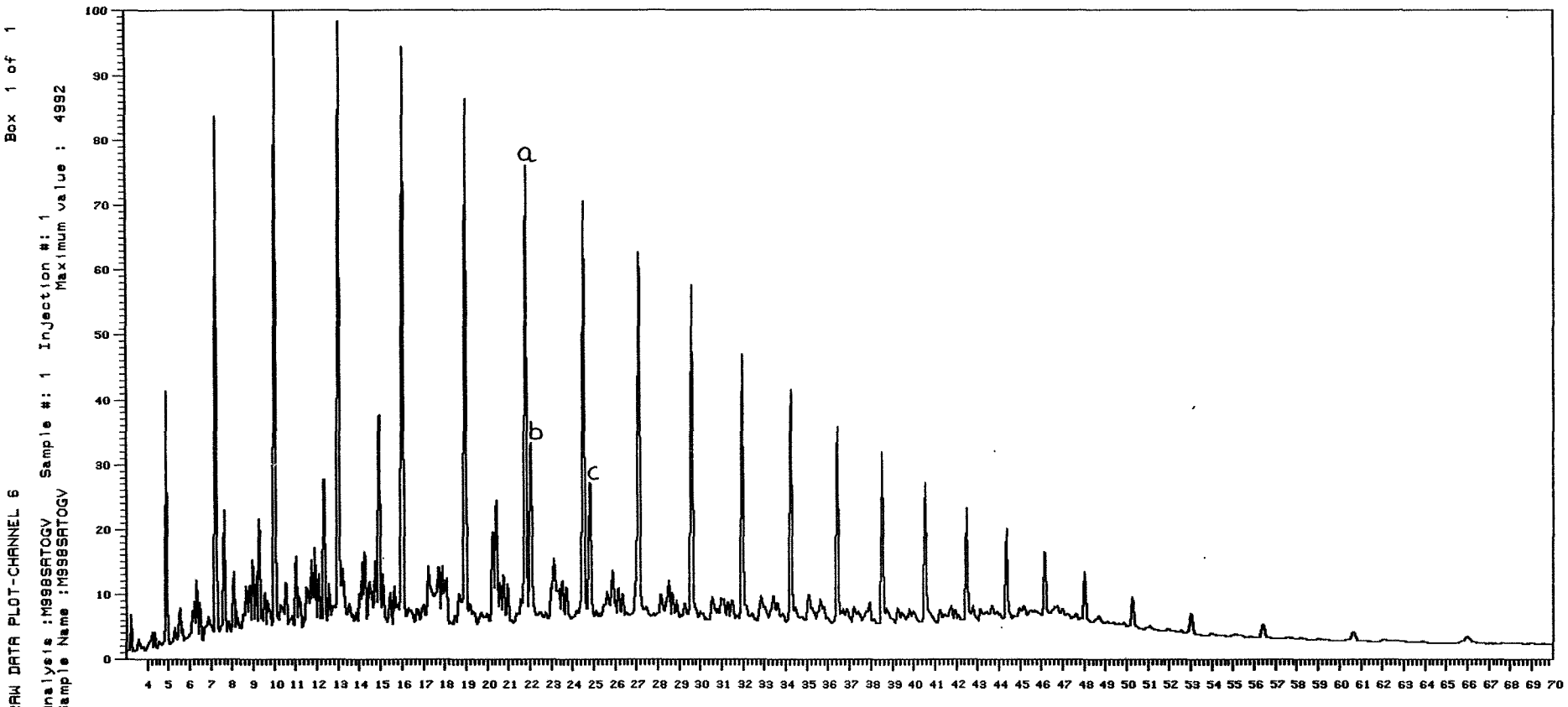
Saturated hydrocarbons
4020–4050 m



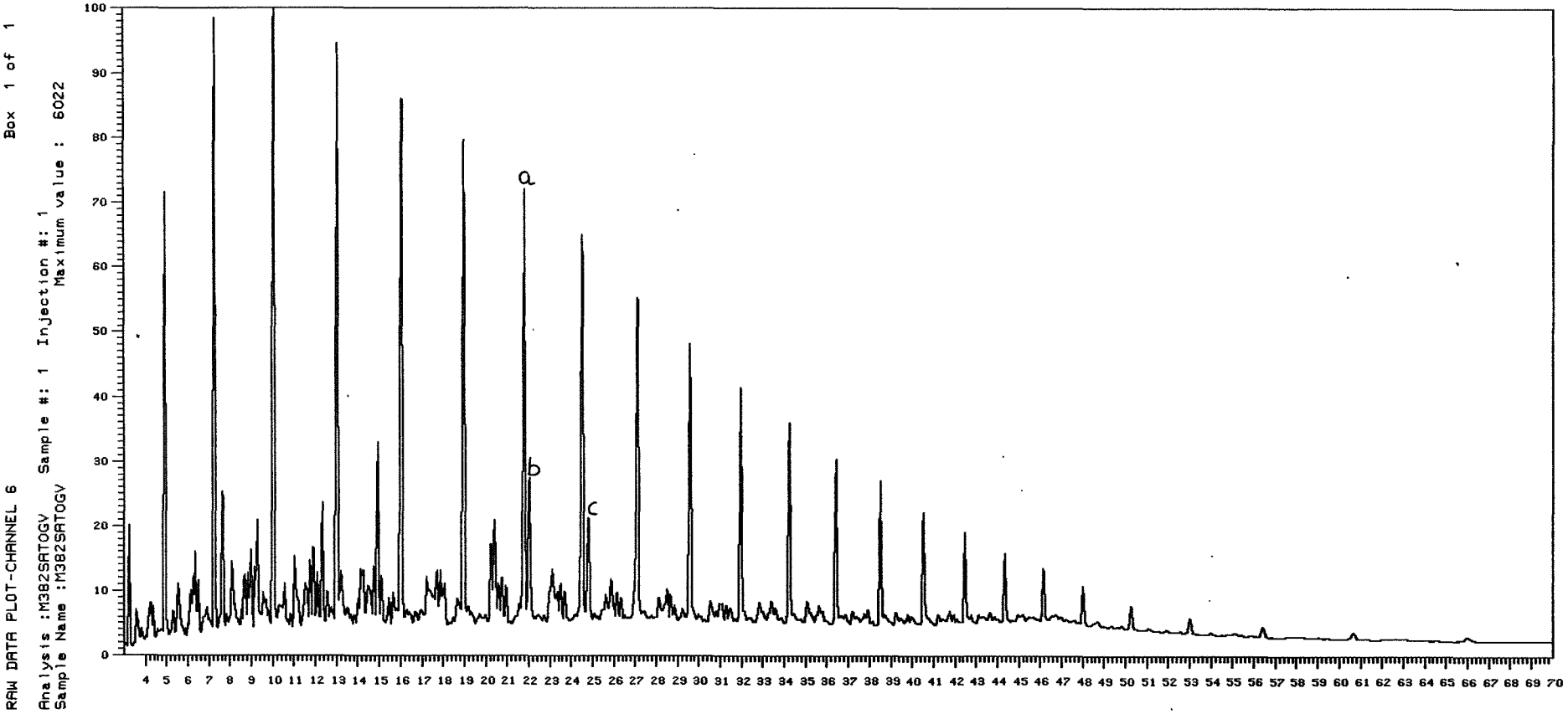
Saturated hydrocarbons
4230–4260 m



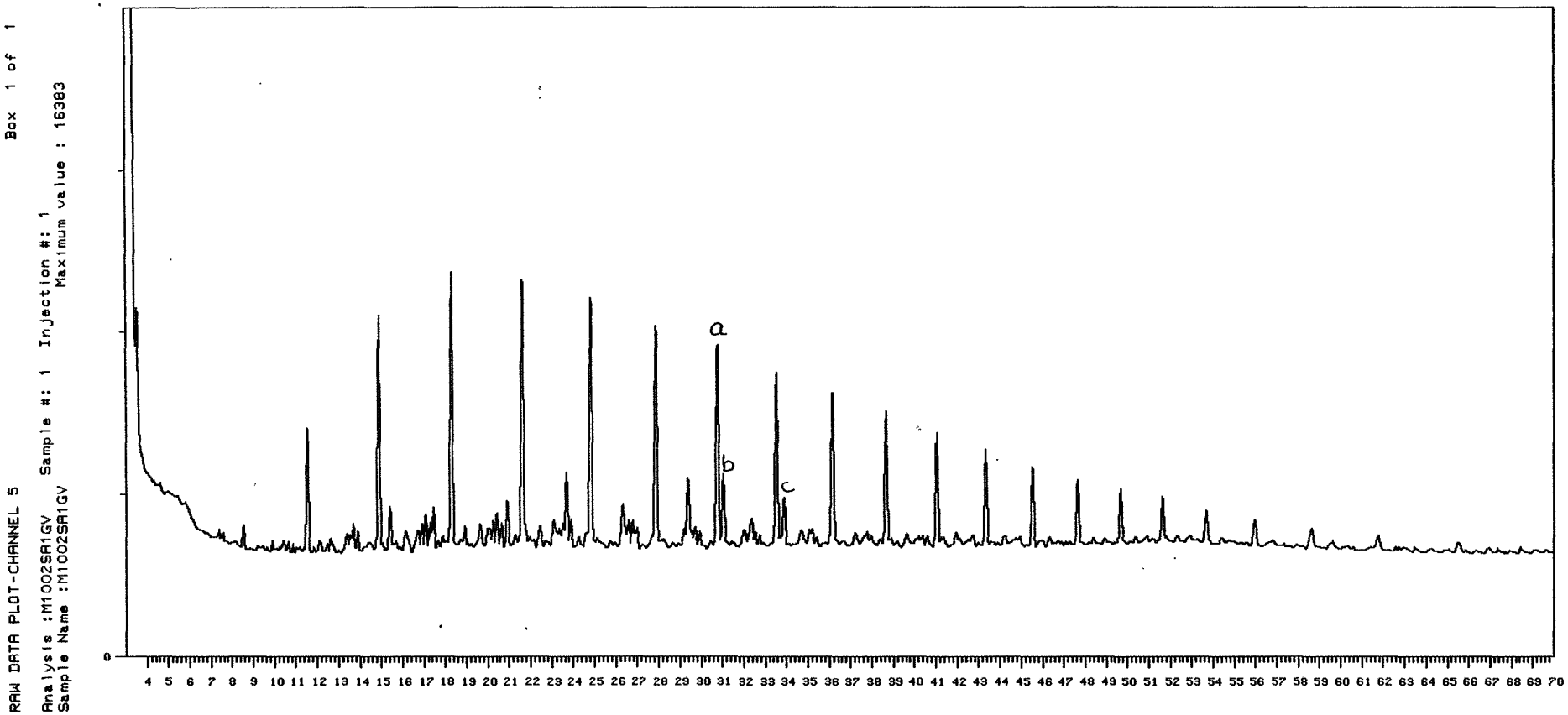
Saturated hydrocarbons
4270–4280 m



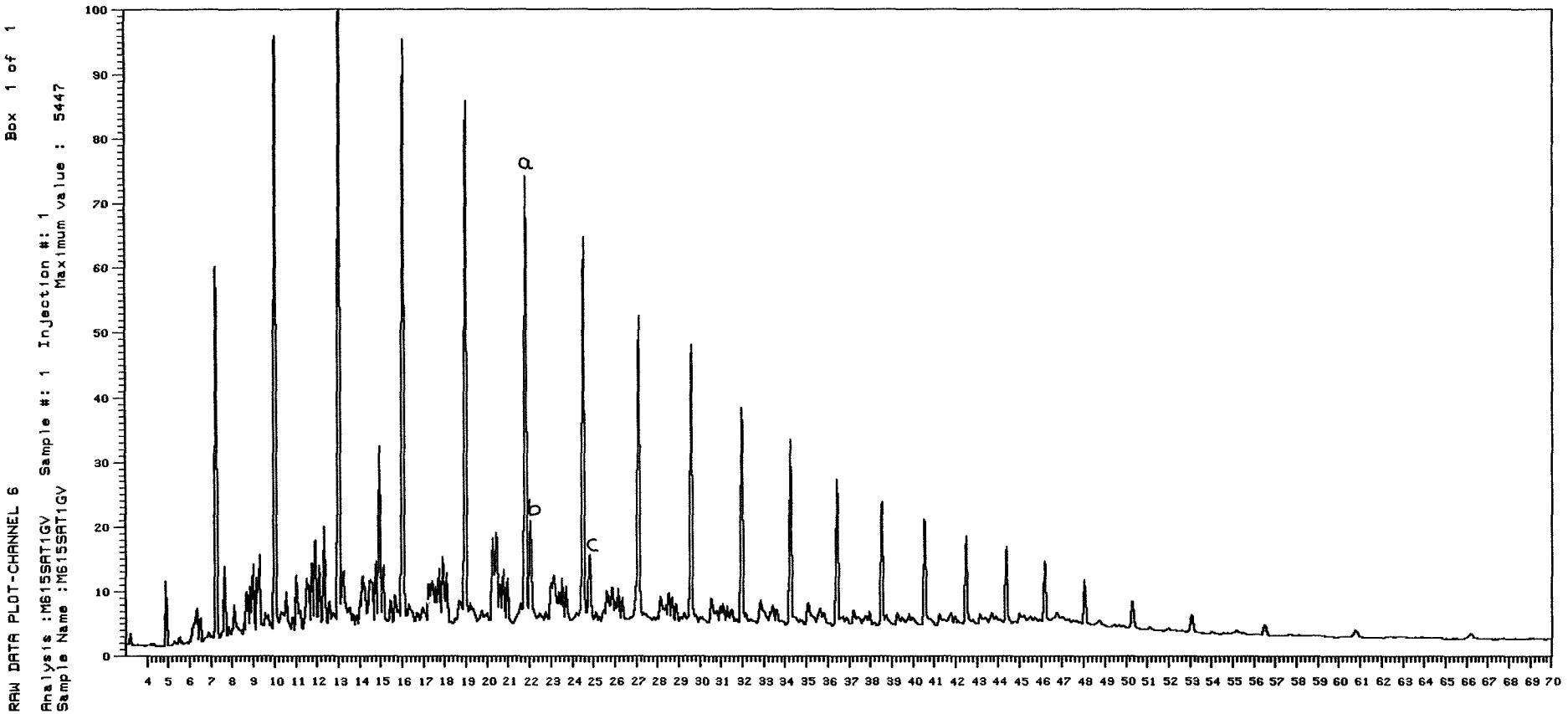
Saturated hydrocarbons
4290–4320 m



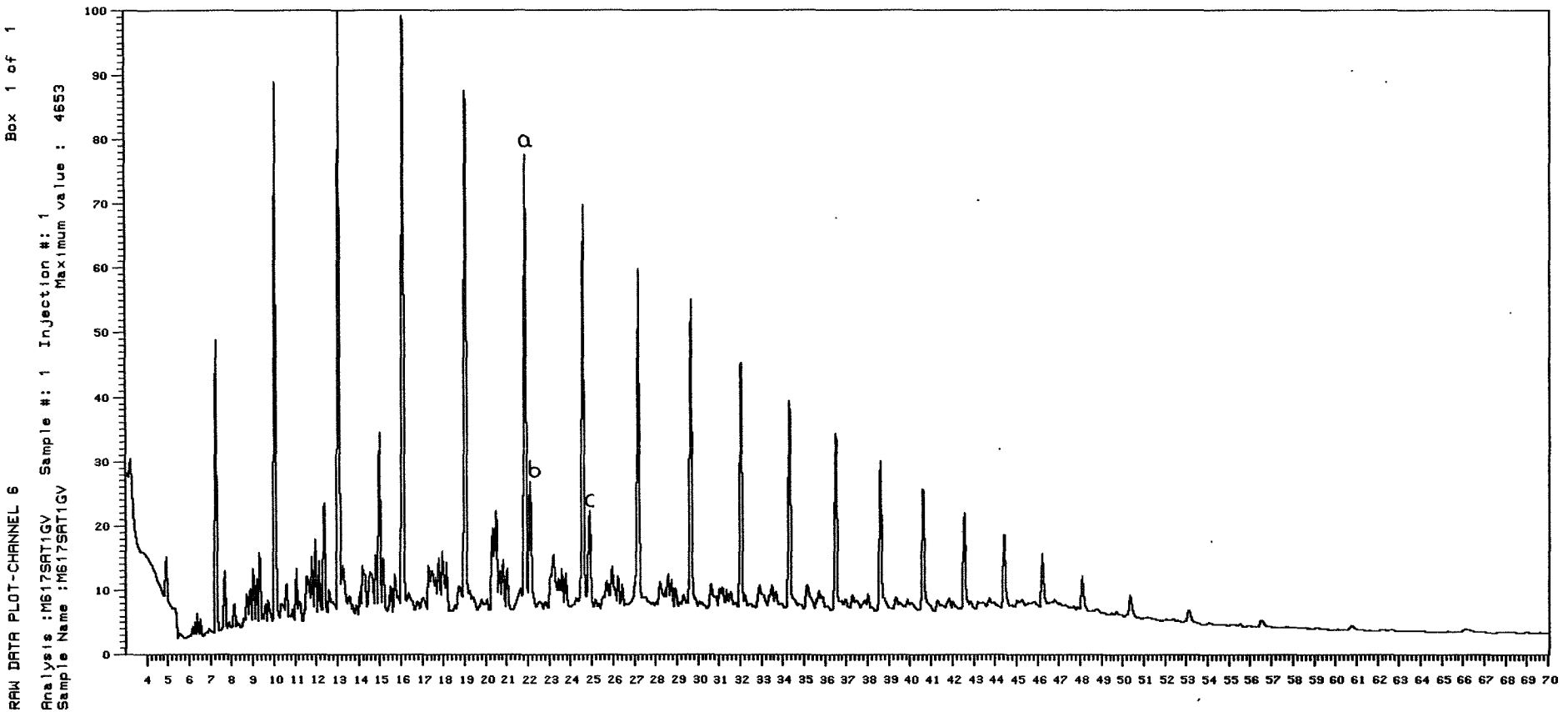
Saturated hydrocarbons
4330–4340 m



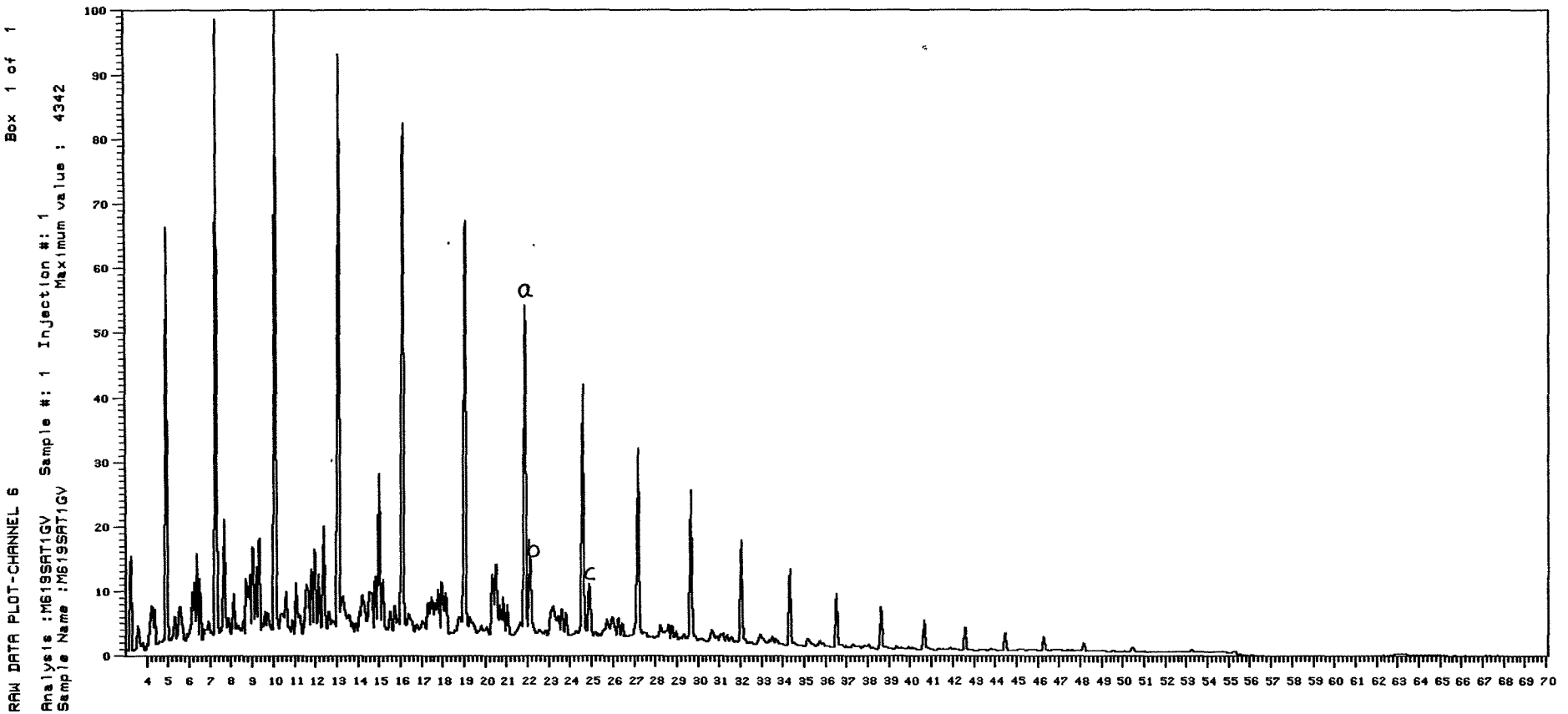
Saturated hydrocarbons
4380–4410 m



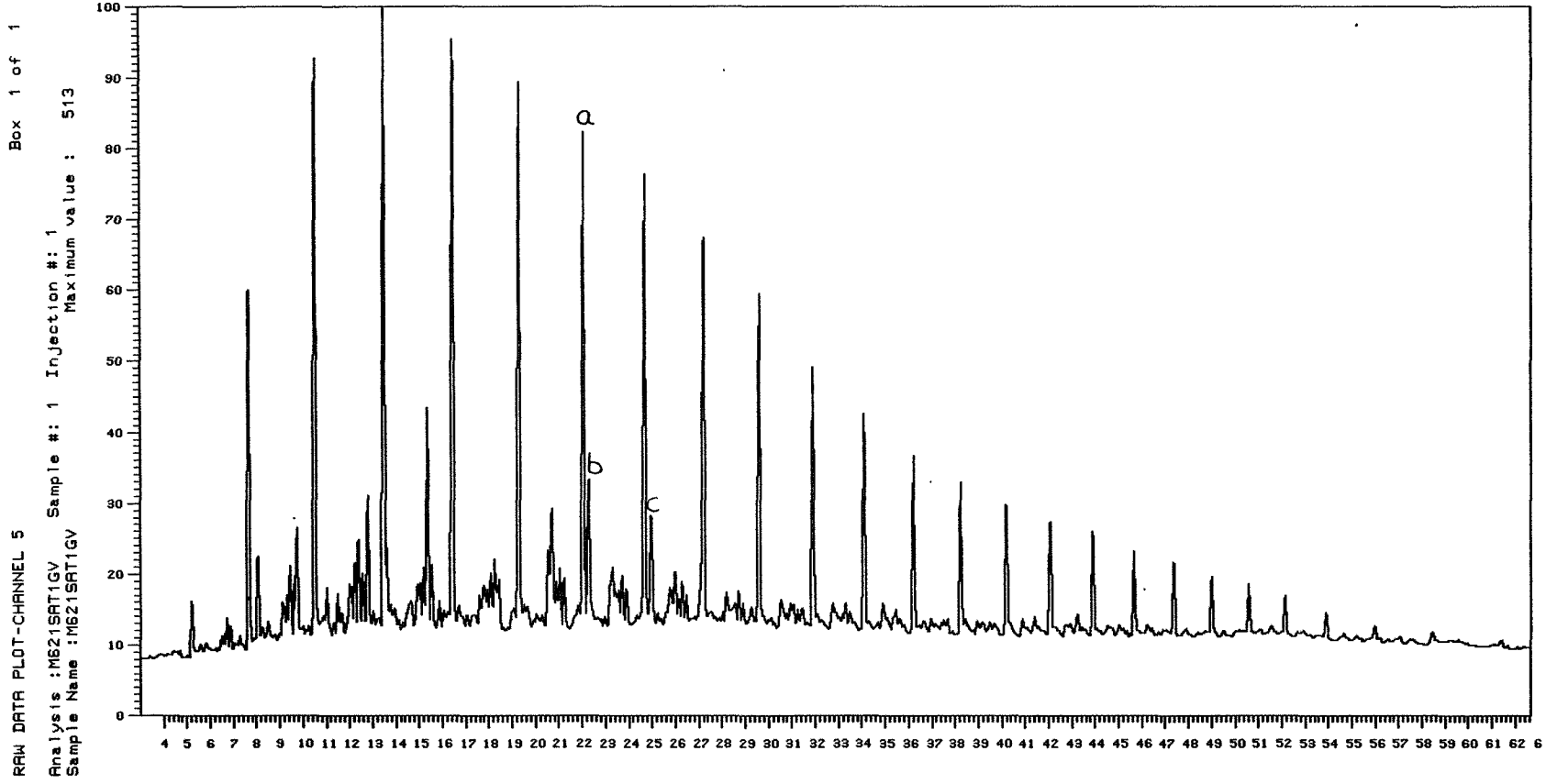
Saturated hydrocarbons
4440–4470 m



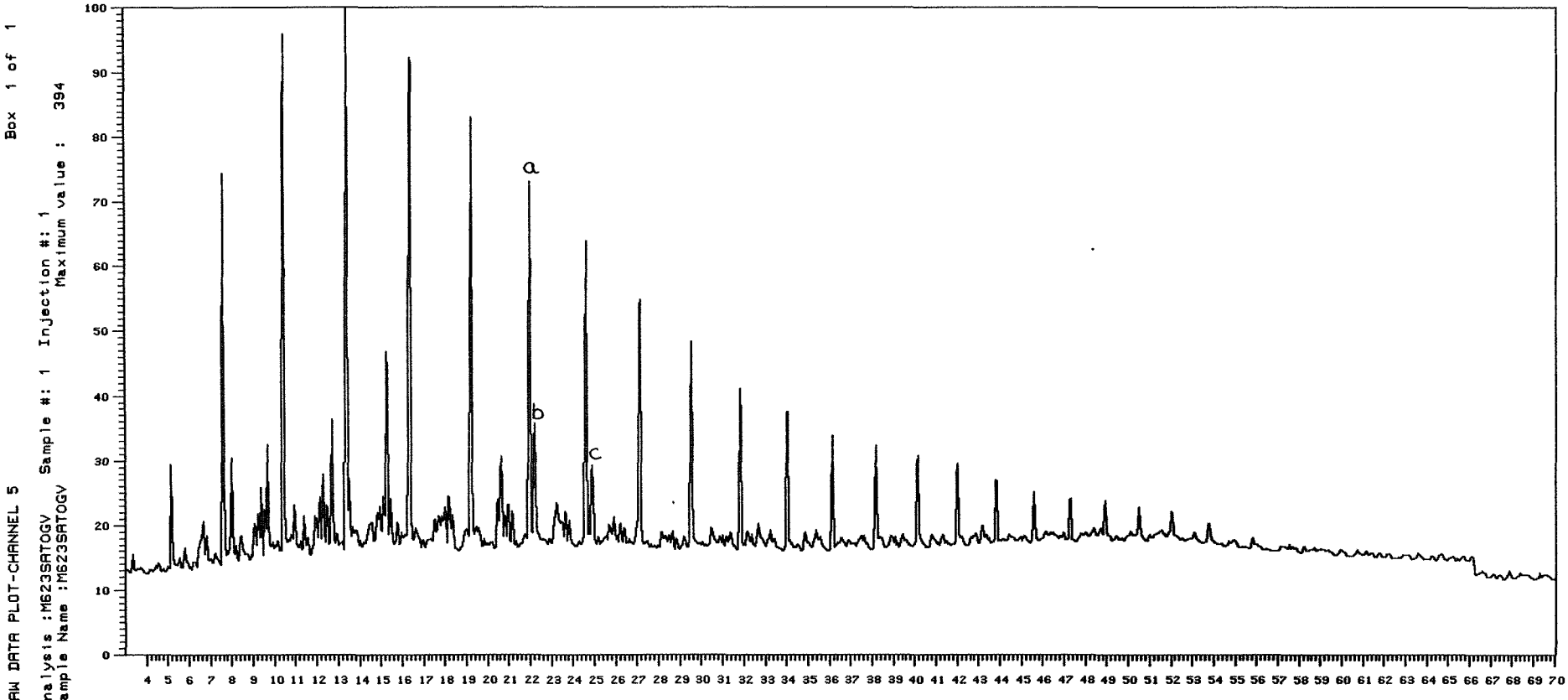
Saturated hydrocarbons
4500–4530 m



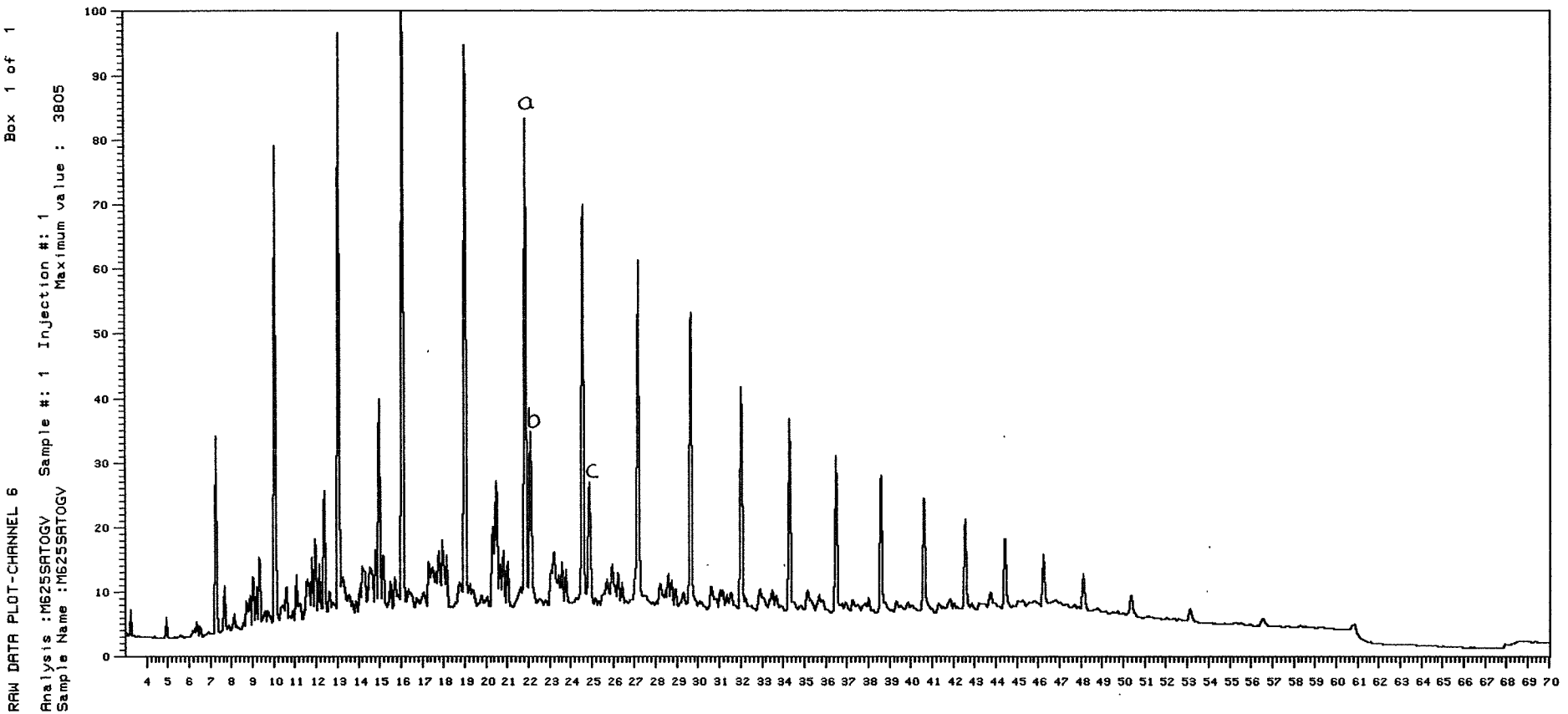
Saturated hydrocarbons
4560–4590 m



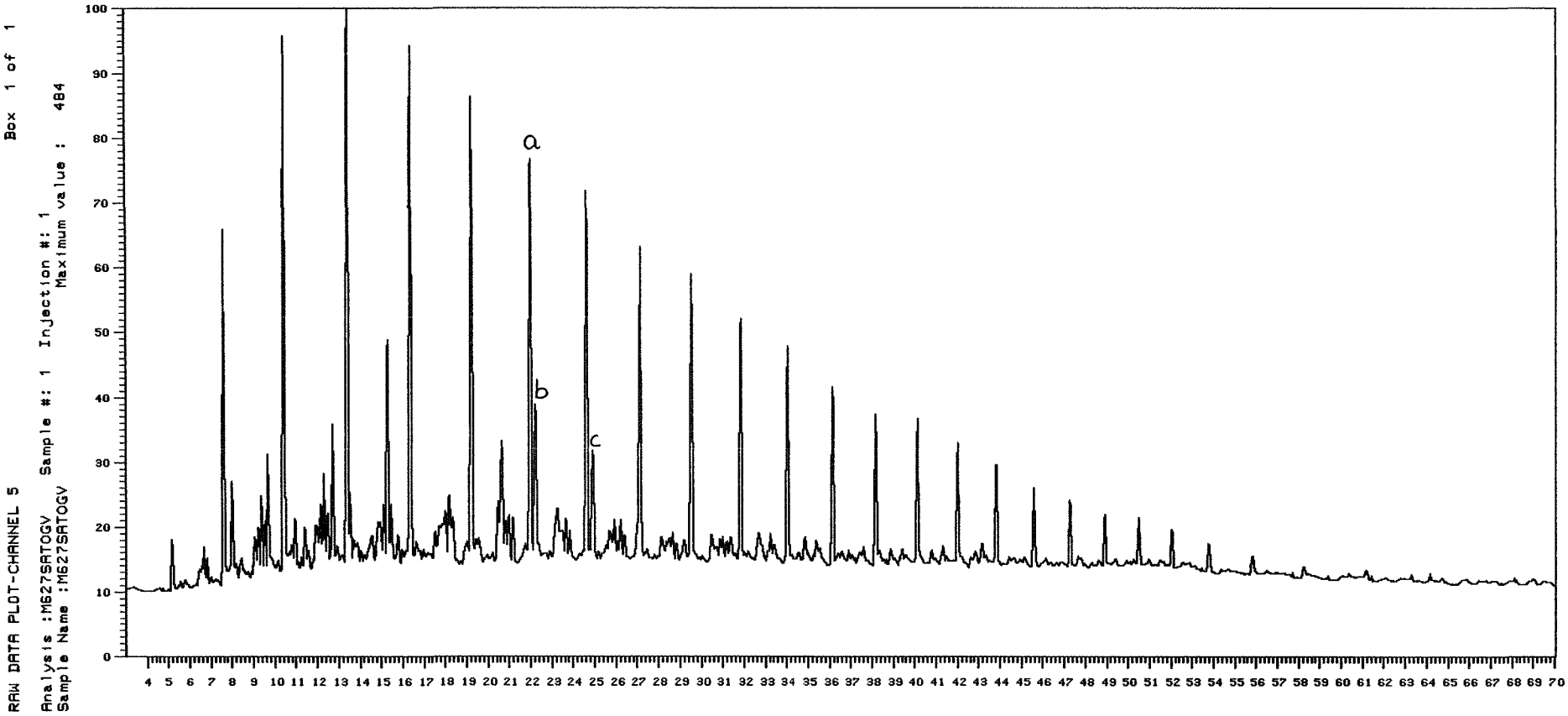
Saturated hydrocarbons
4620–4650 m



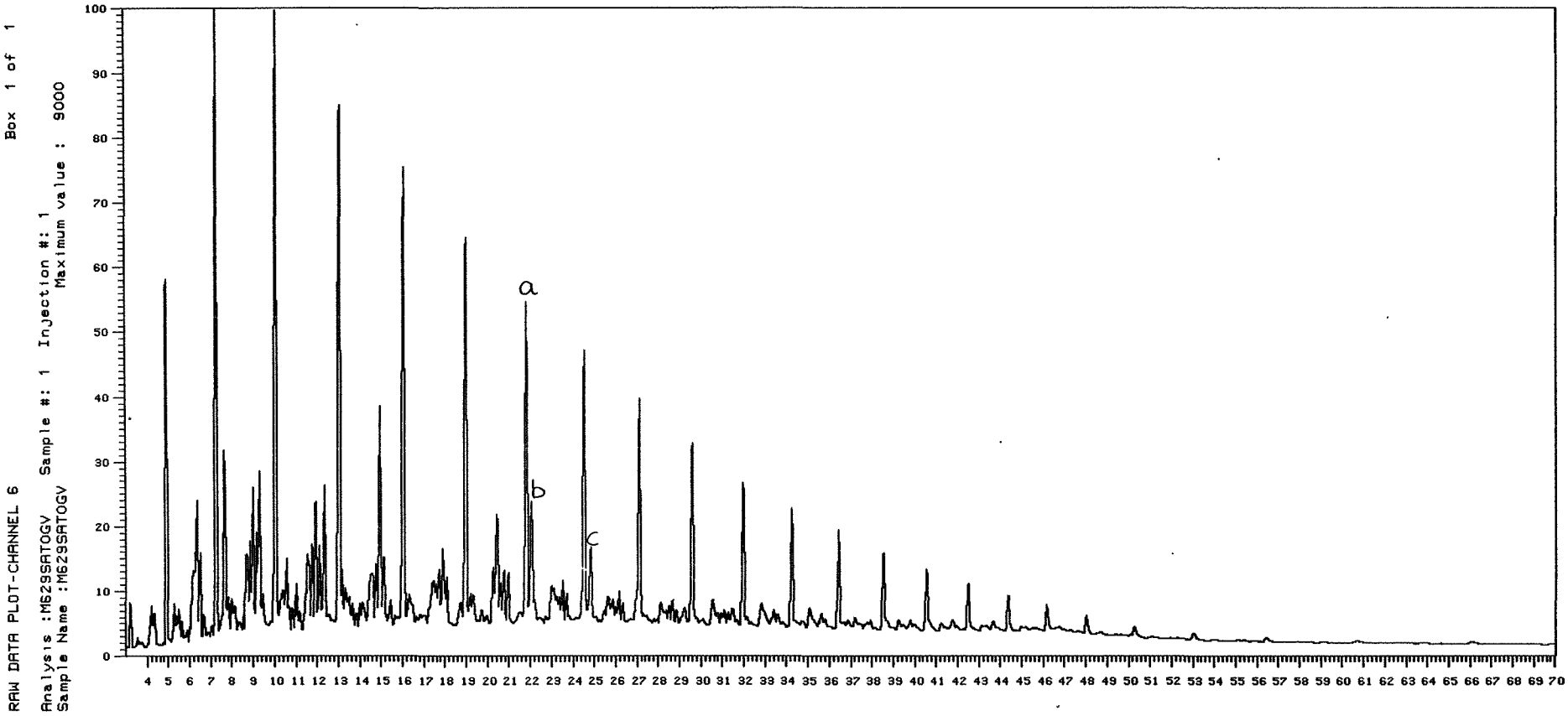
Saturated hydrocarbons
4680–4710 m



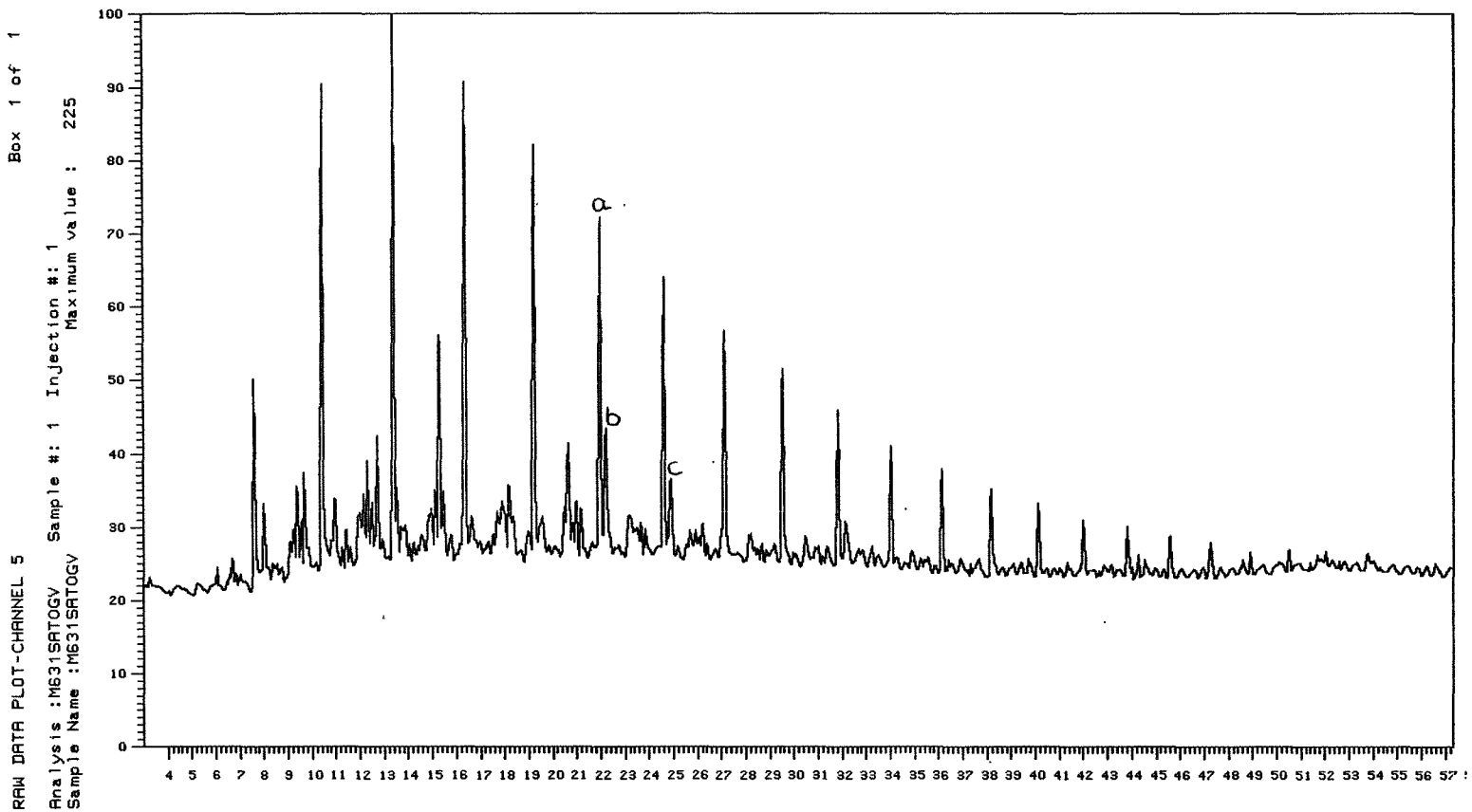
Saturated hydrocarbons
4740–4770 m



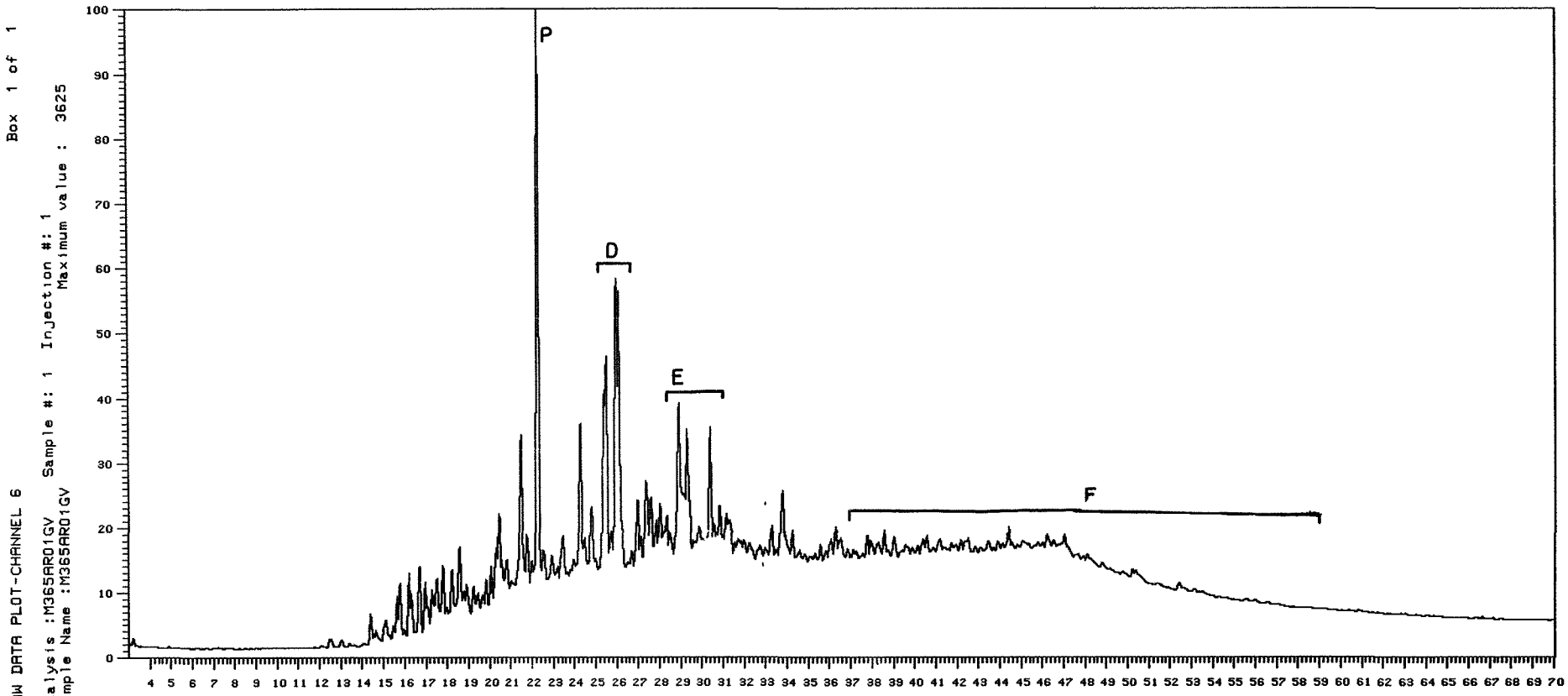
Saturated hydrocarbons
4800–4830 m



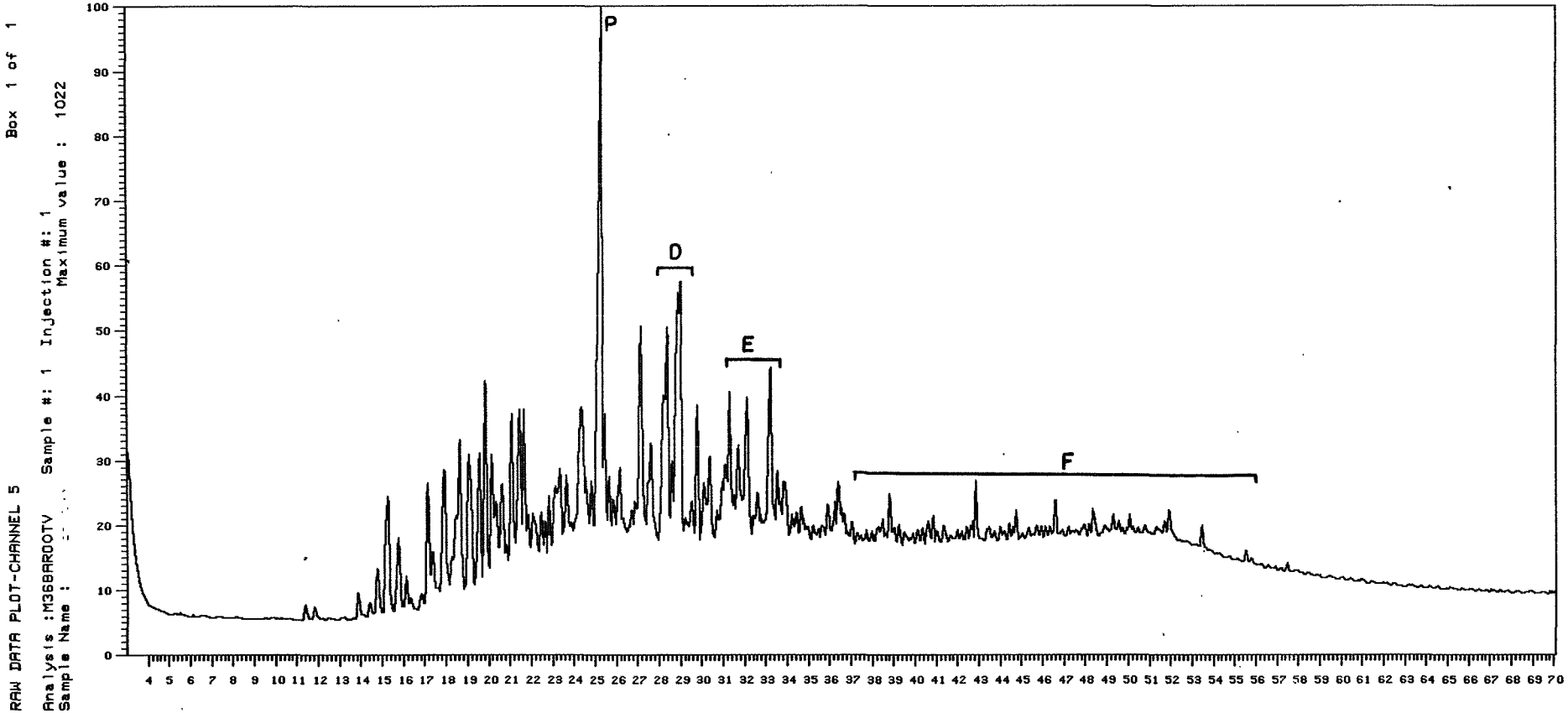
Saturated hydrocarbons
4860–4890 m



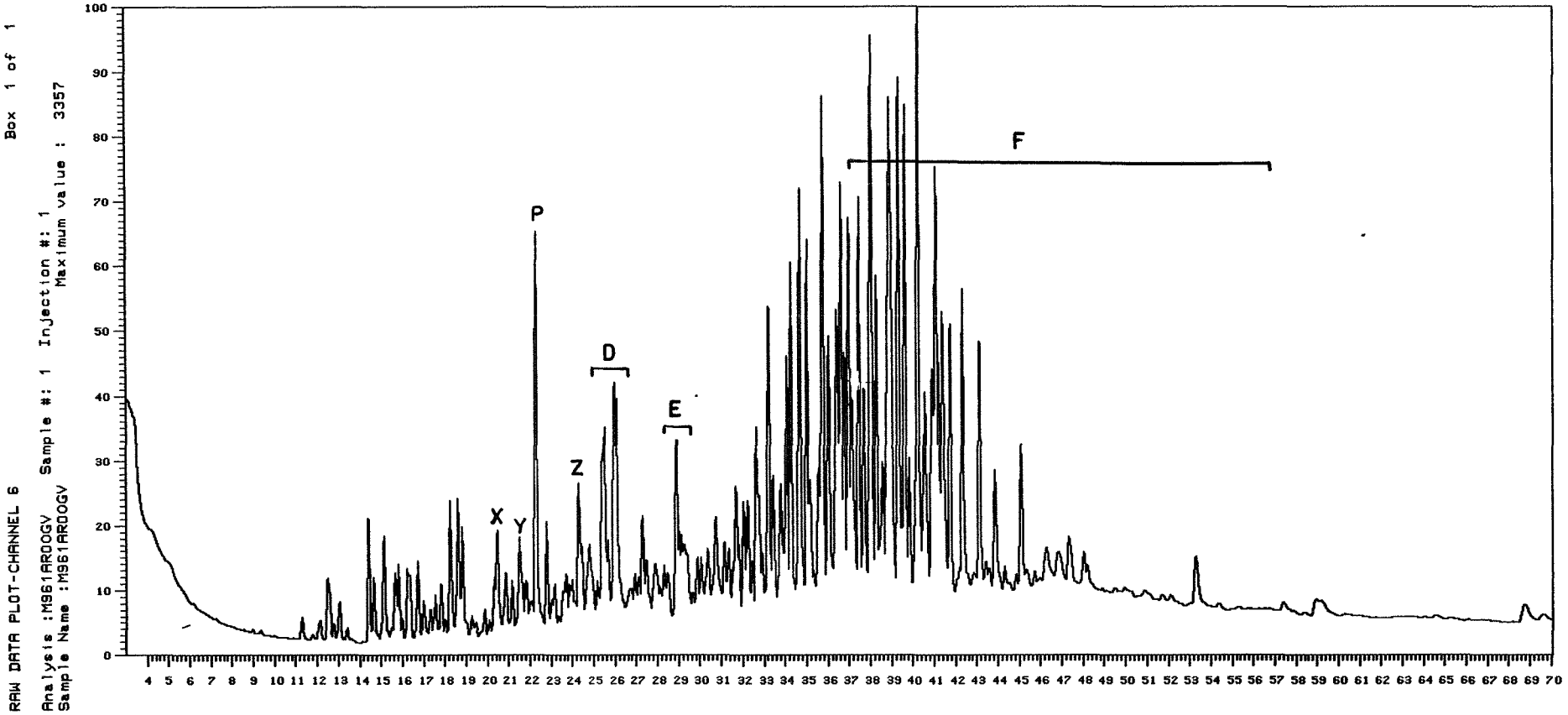
Aromatic hydrocarbons
3780–3810 m



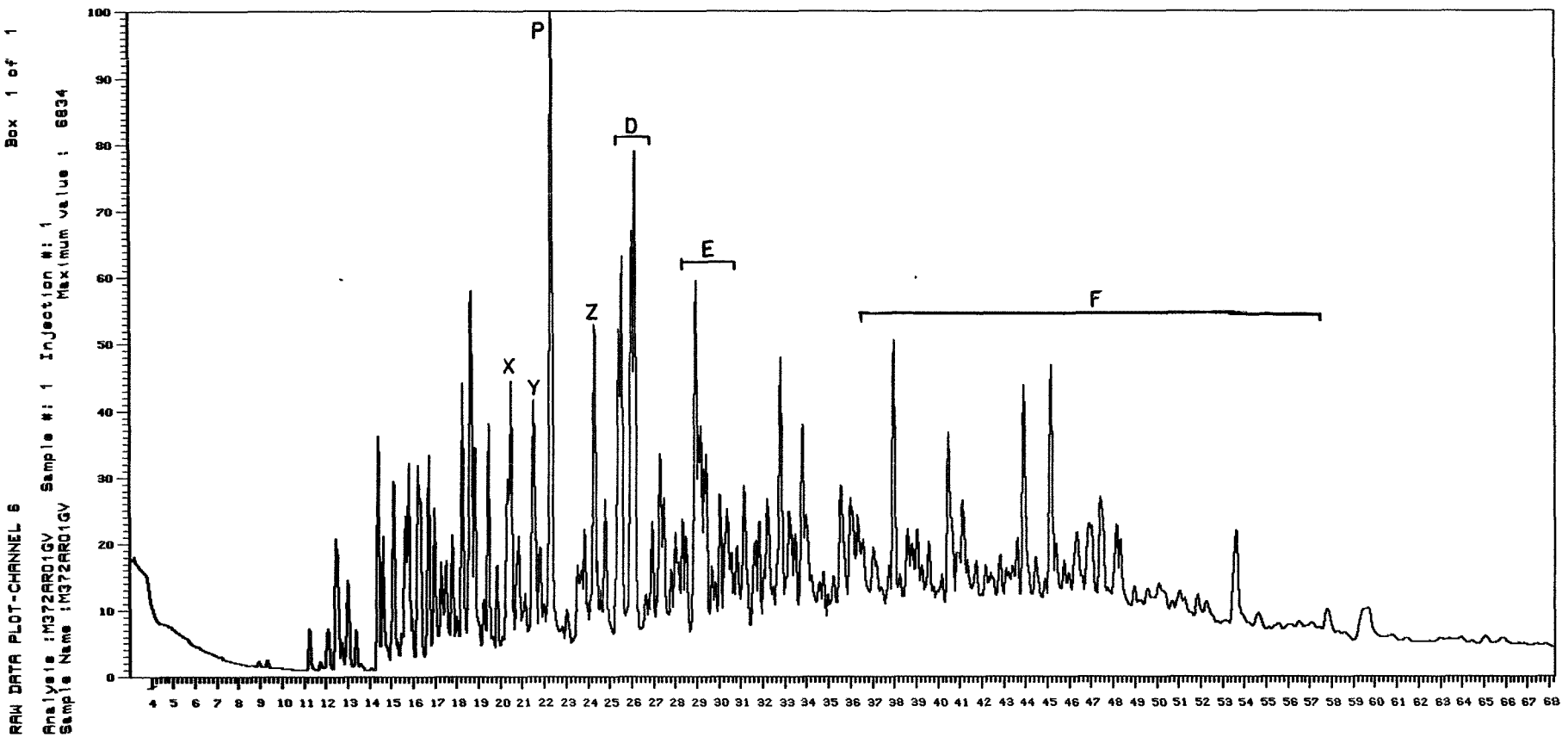
Aromatic hydrocarbons
3870–3900 m



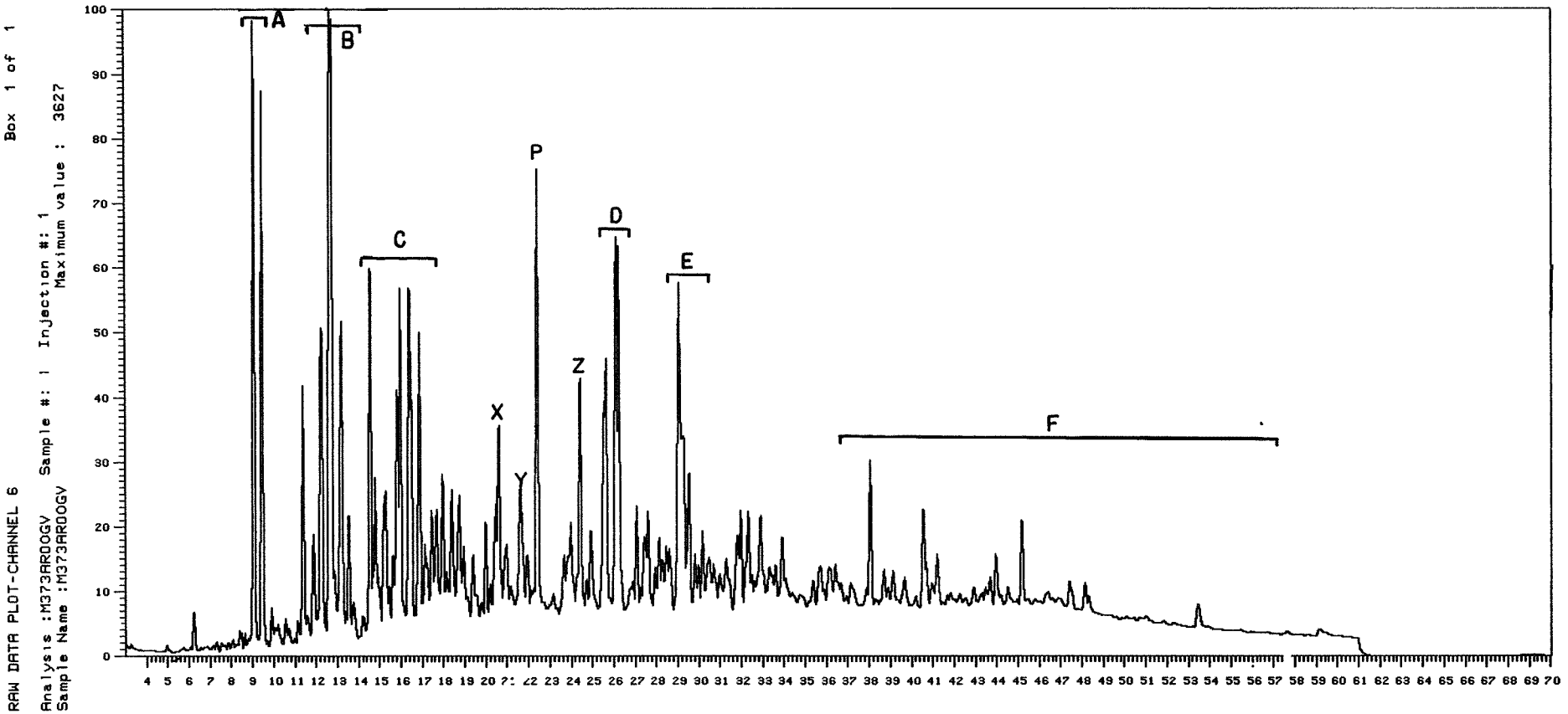
Aromatic hydrocarbons
3990–4000 m



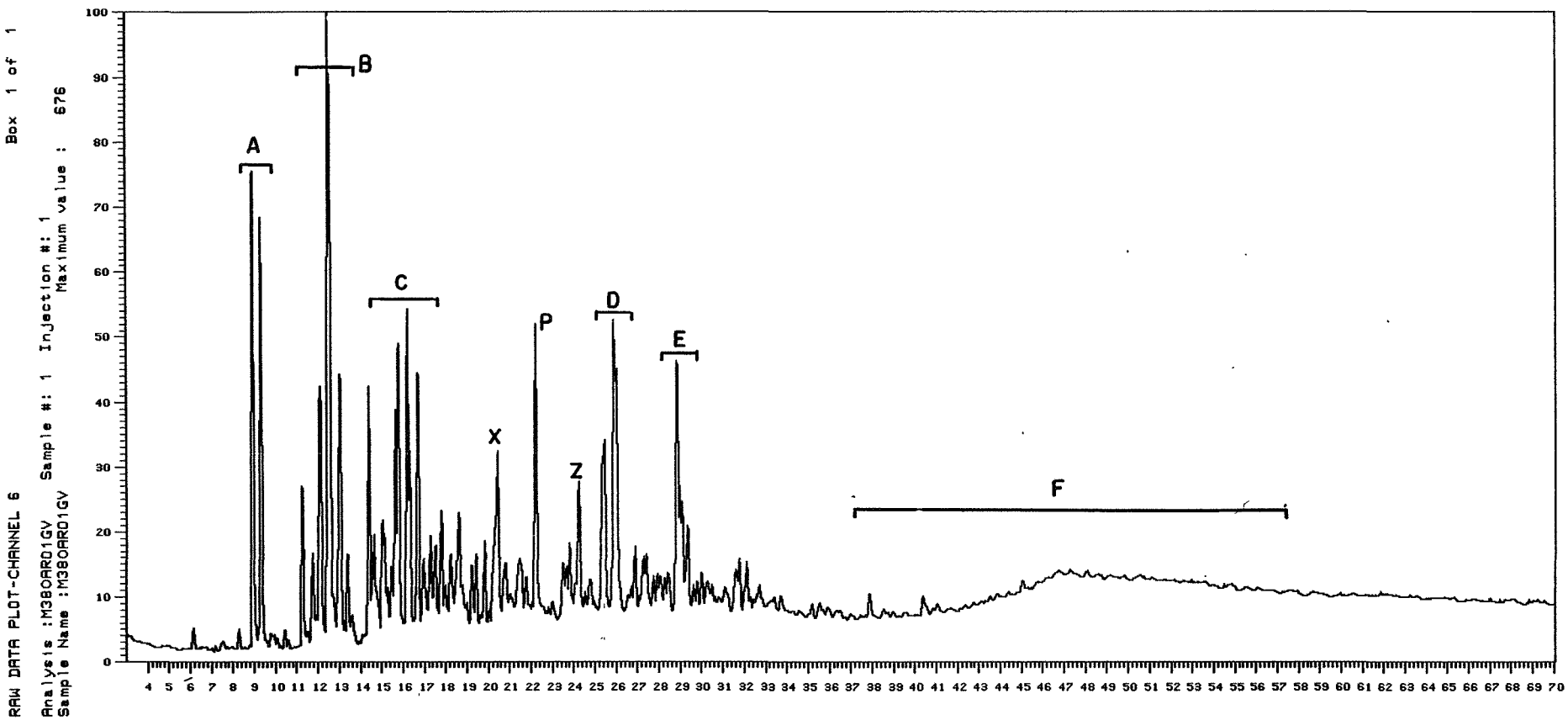
Aromatic hydrocarbons
3990–4020 m



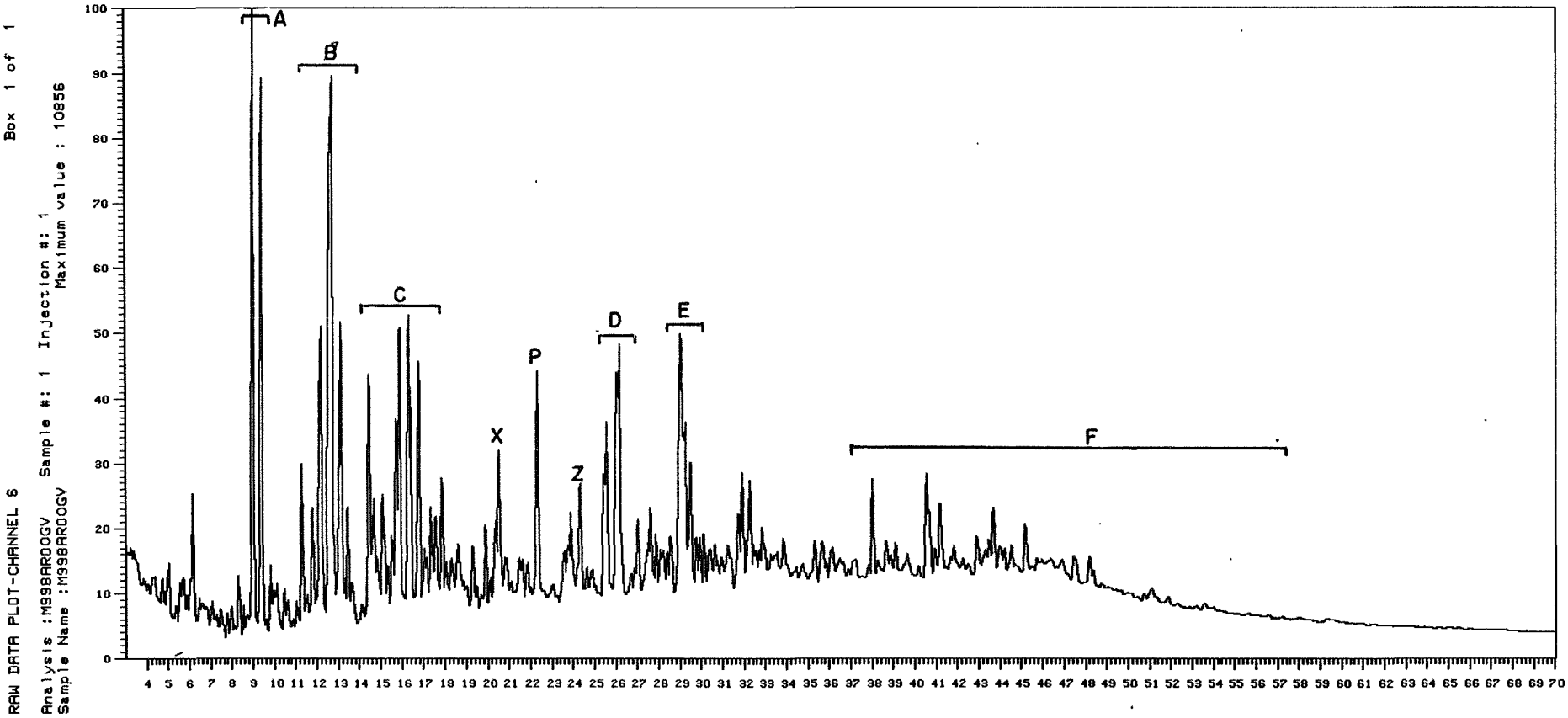
Aromatic hydrocarbons
4020–4050 m



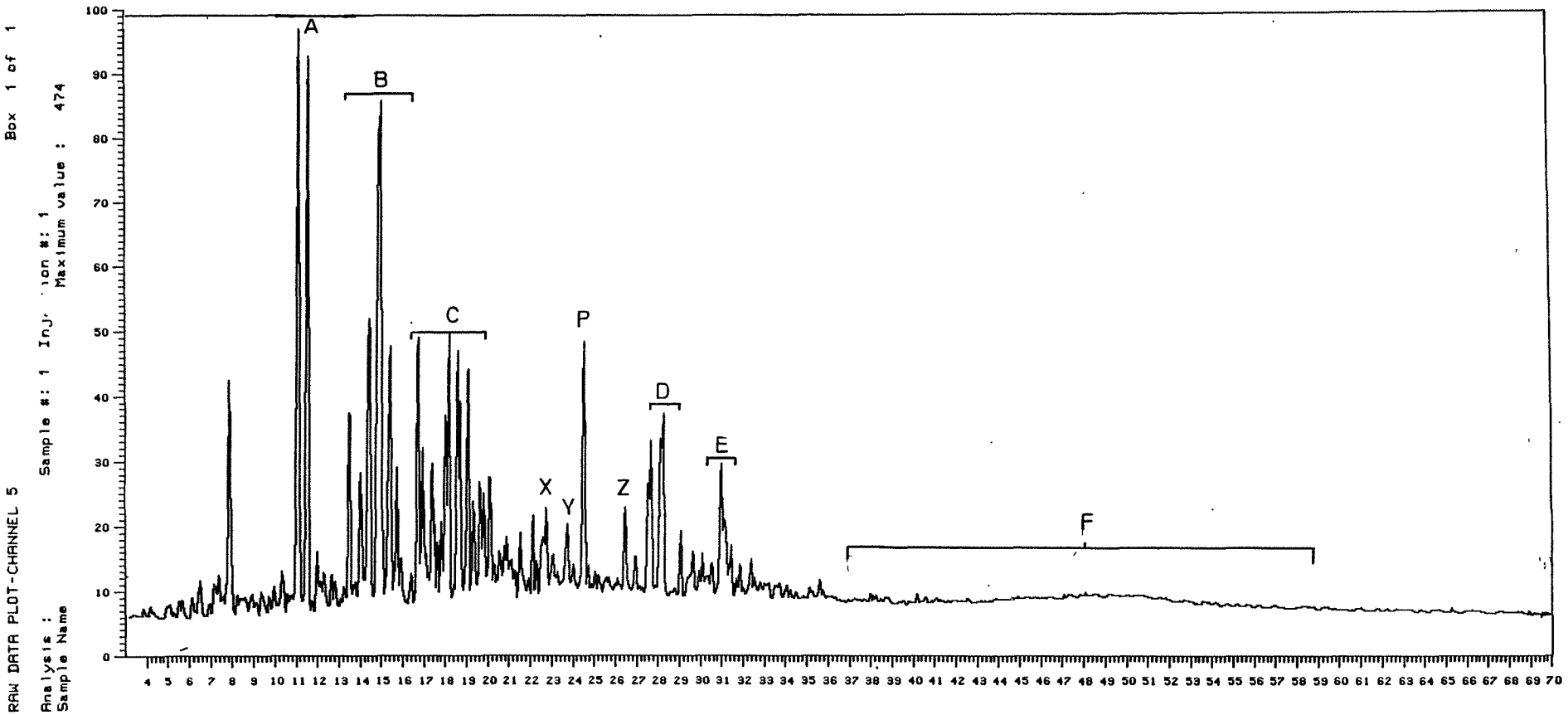
Aromatic hydrocarbons
4230–4260 m



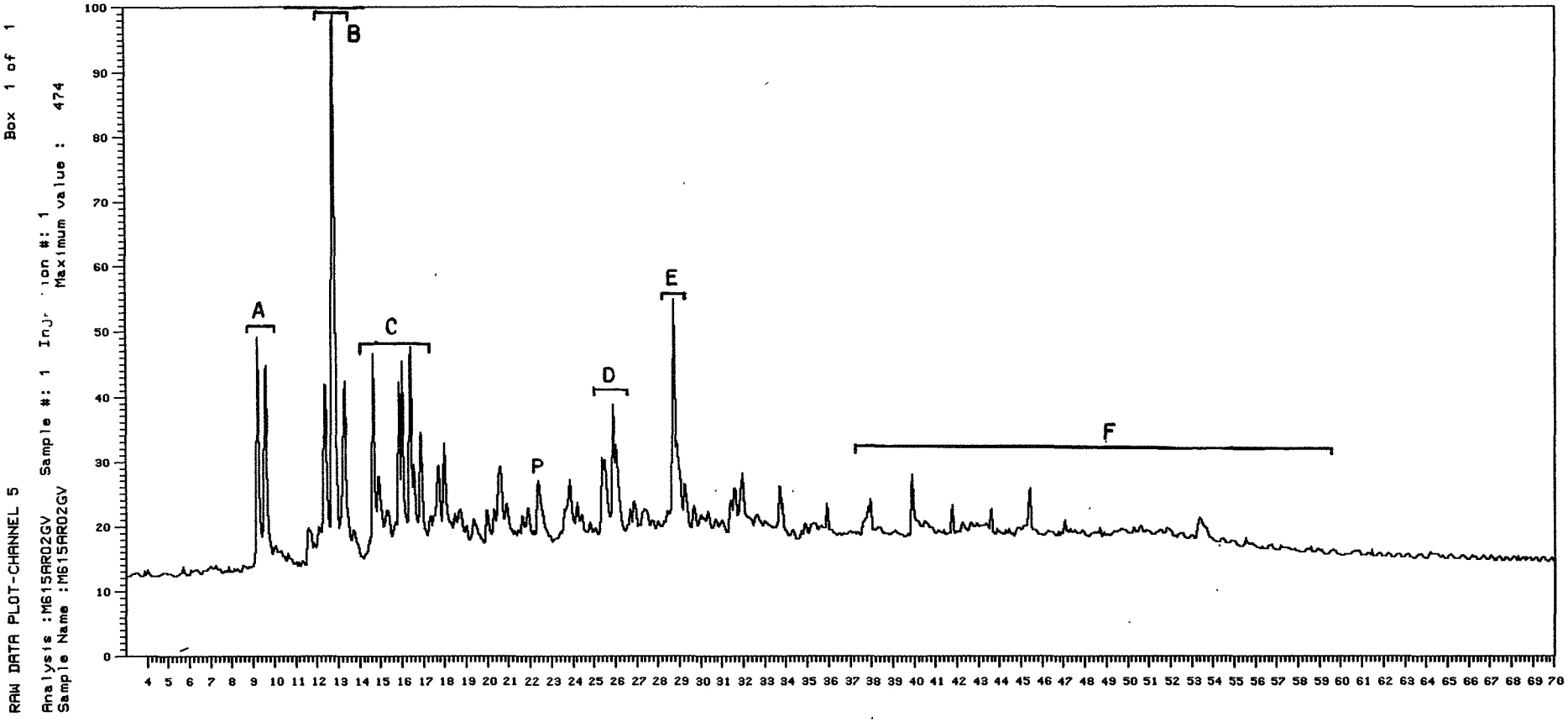
Aromatic hydrocarbons
4270–4280 m



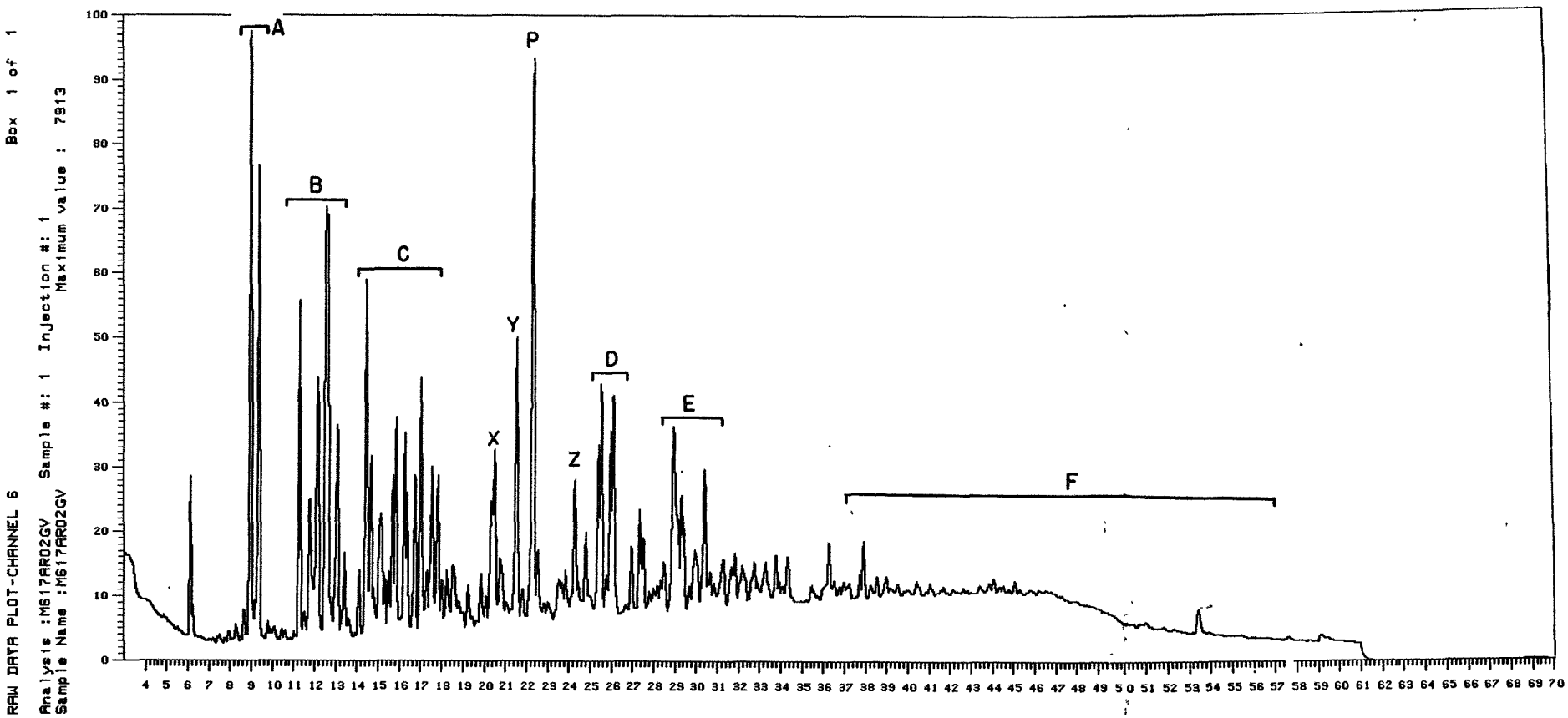
Aromatic hydrocarbons
4330-4340m



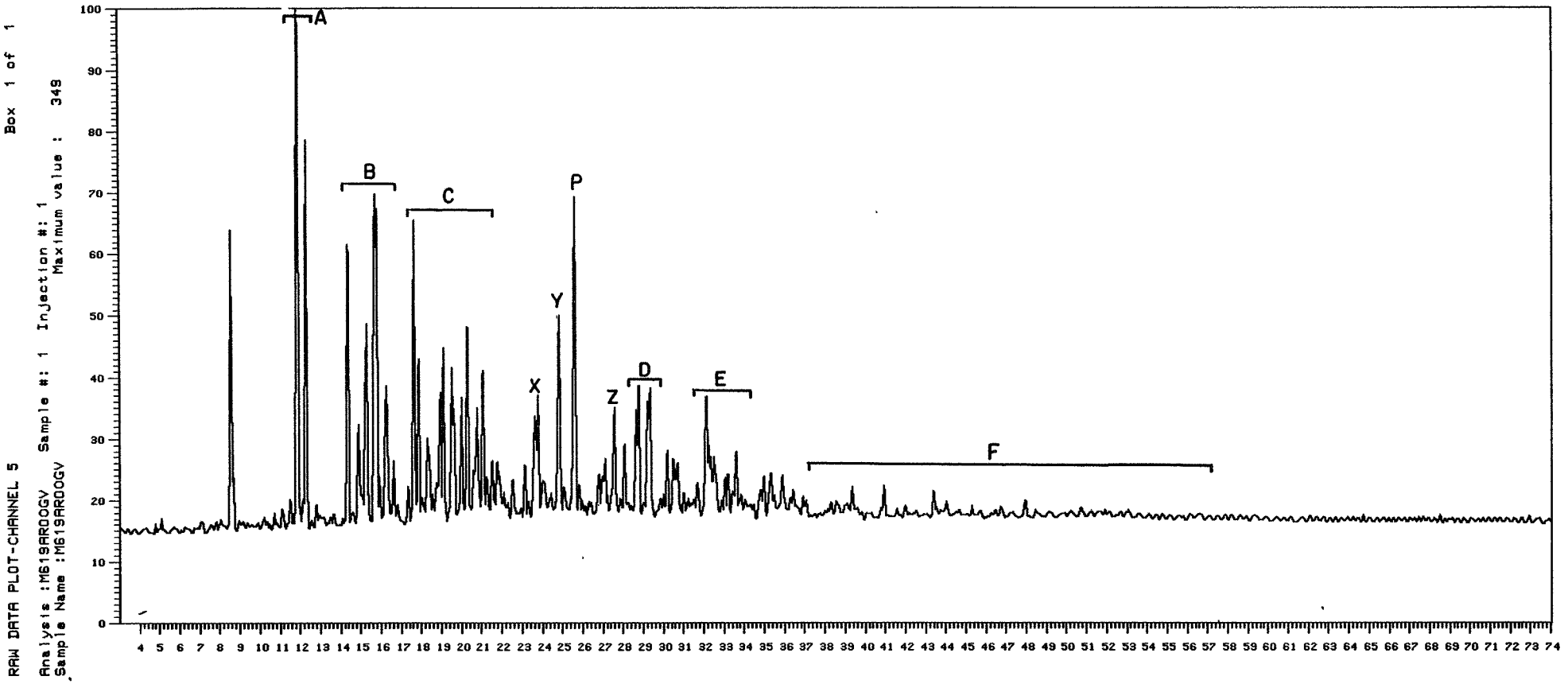
Aromatic hydrocarbons
4380–4410 m



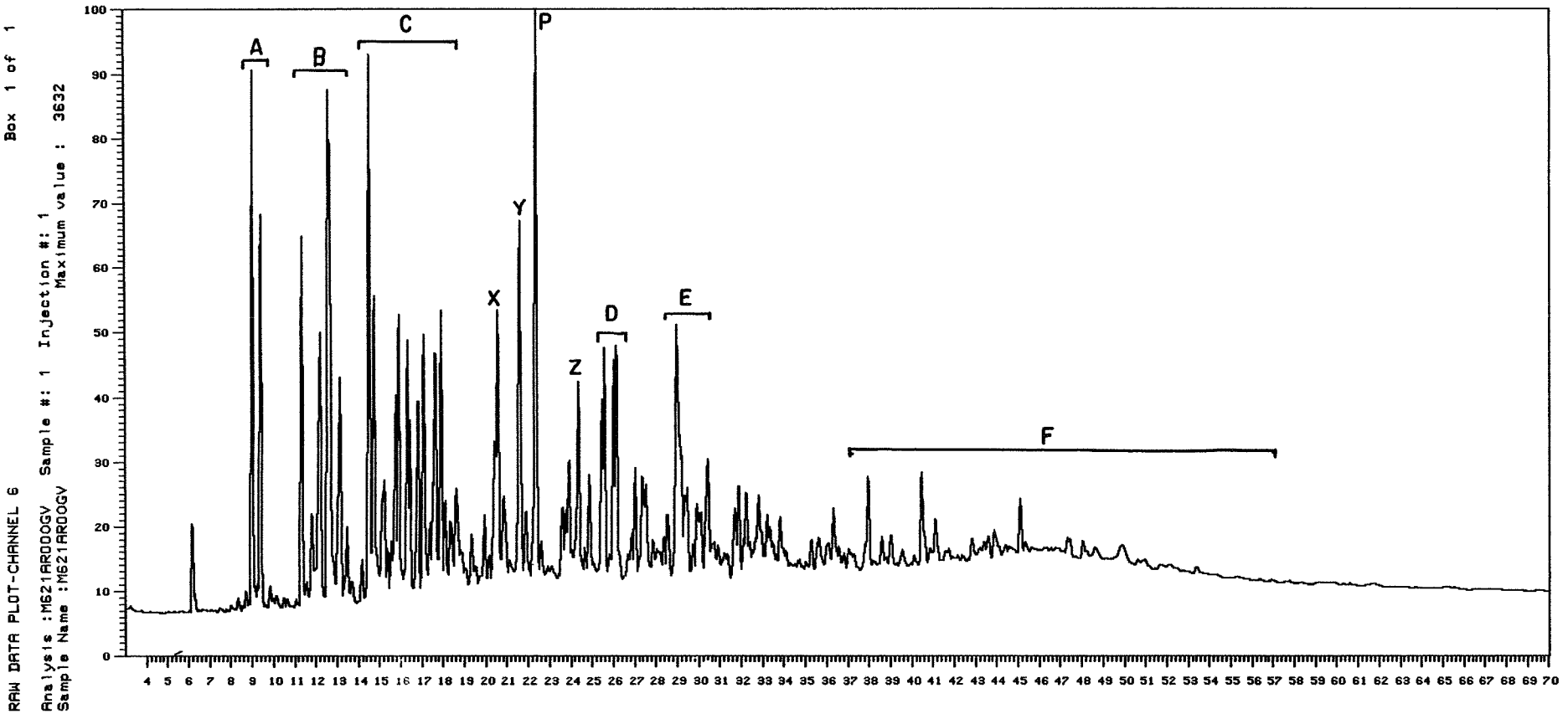
Aromatic hydrocarbons
4440–4470 m



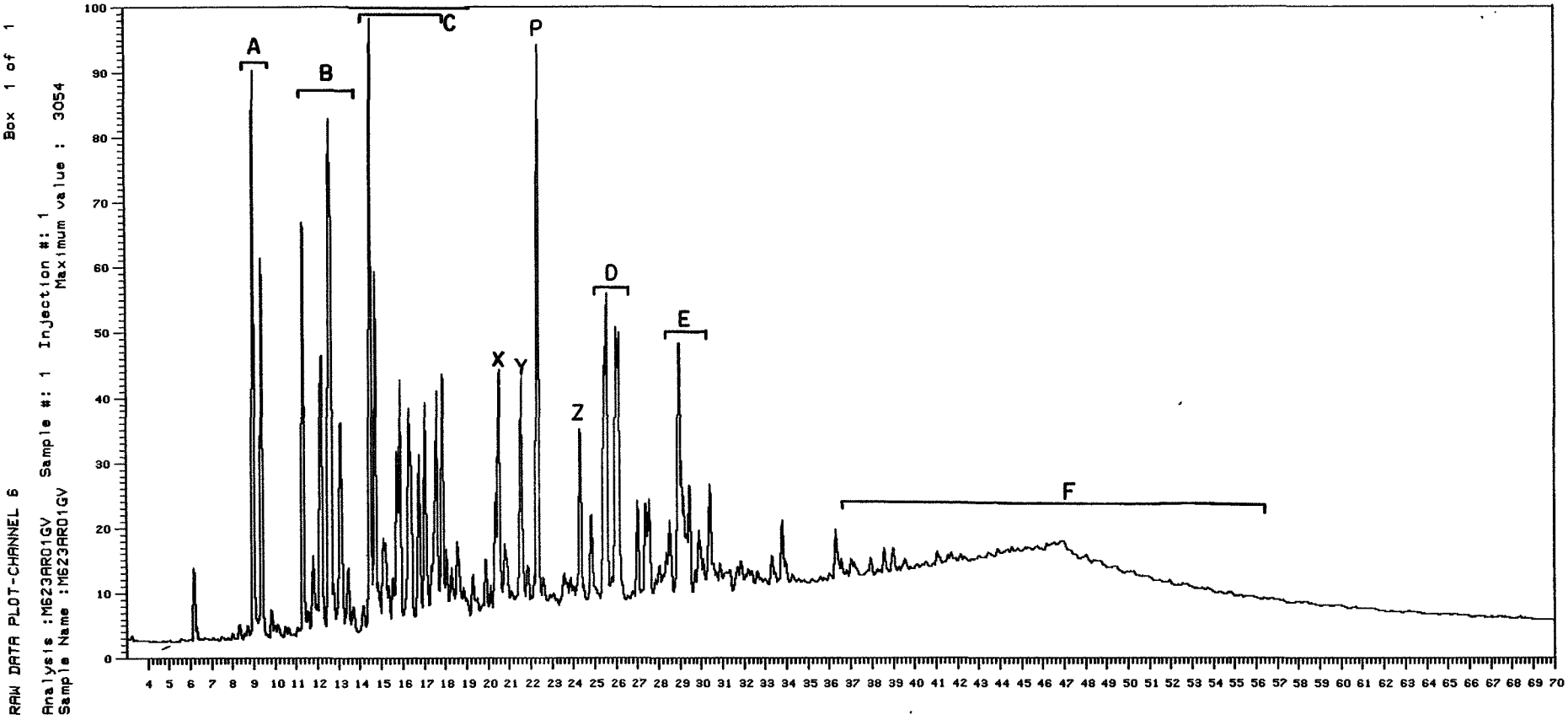
Aromatic hydrocarbons
4500–4530 m



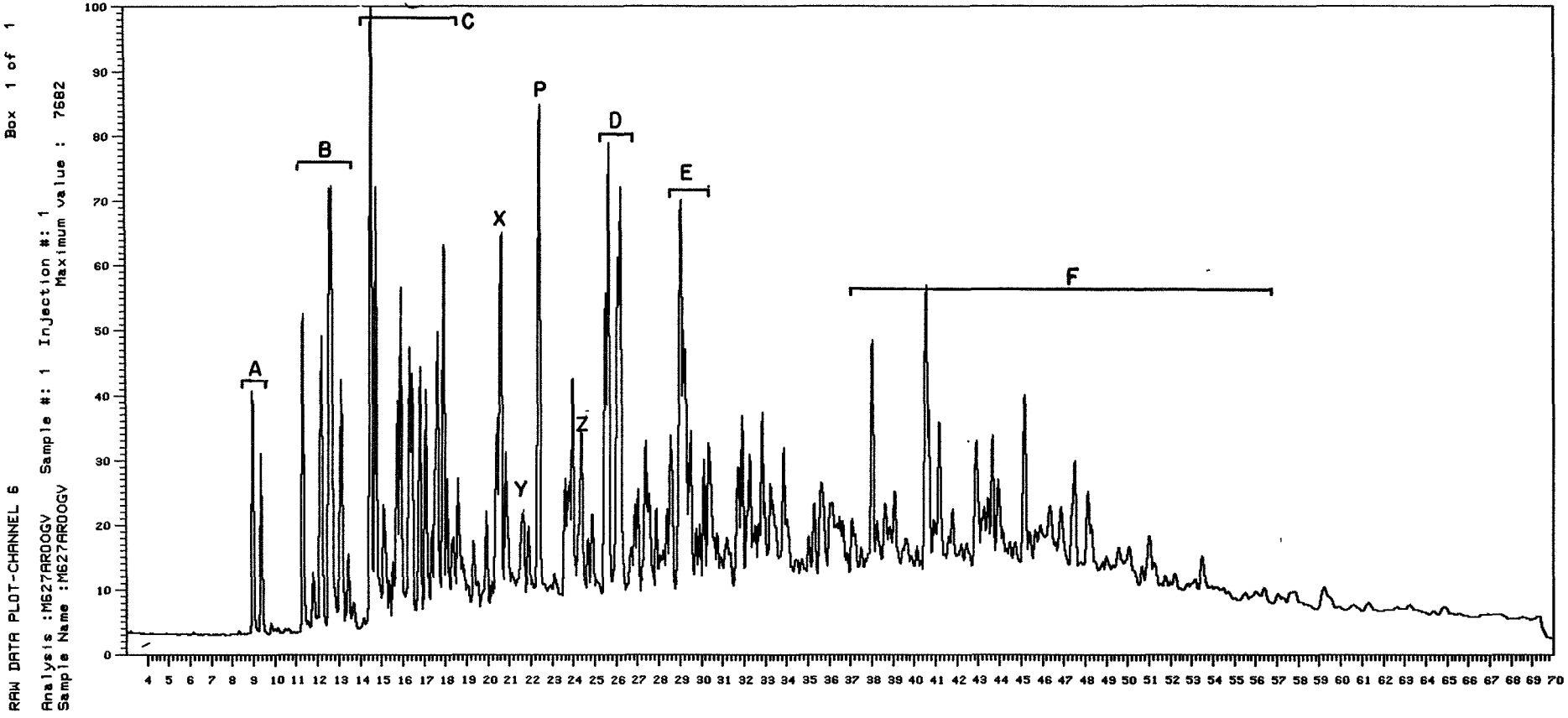
Aromatic hydrocarbons
4560–4590 m



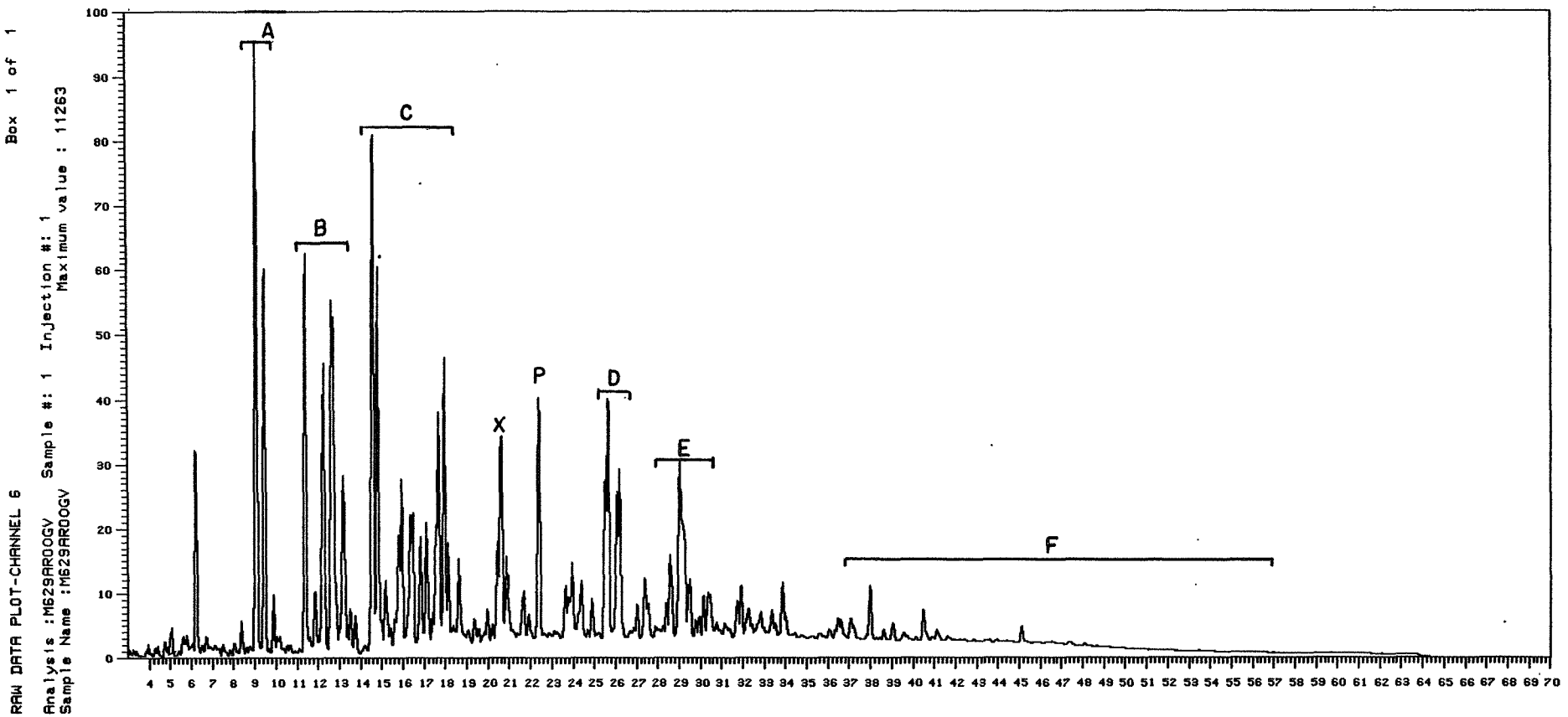
Aromatic hydrocarbons
4620–4650 m



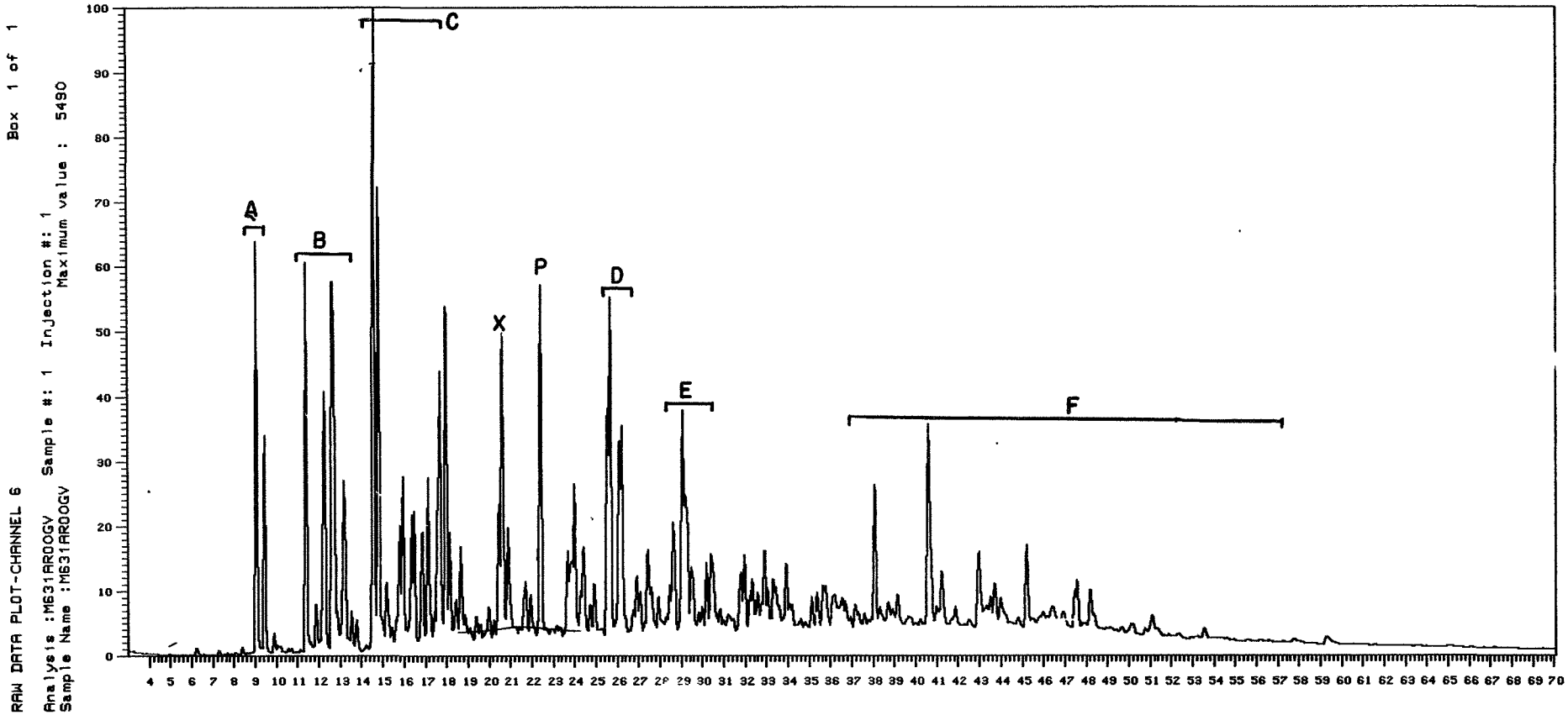
Aromatic hydrocarbons
4740–4770 m



Aromatic hydrocarbons
4800–4830 m



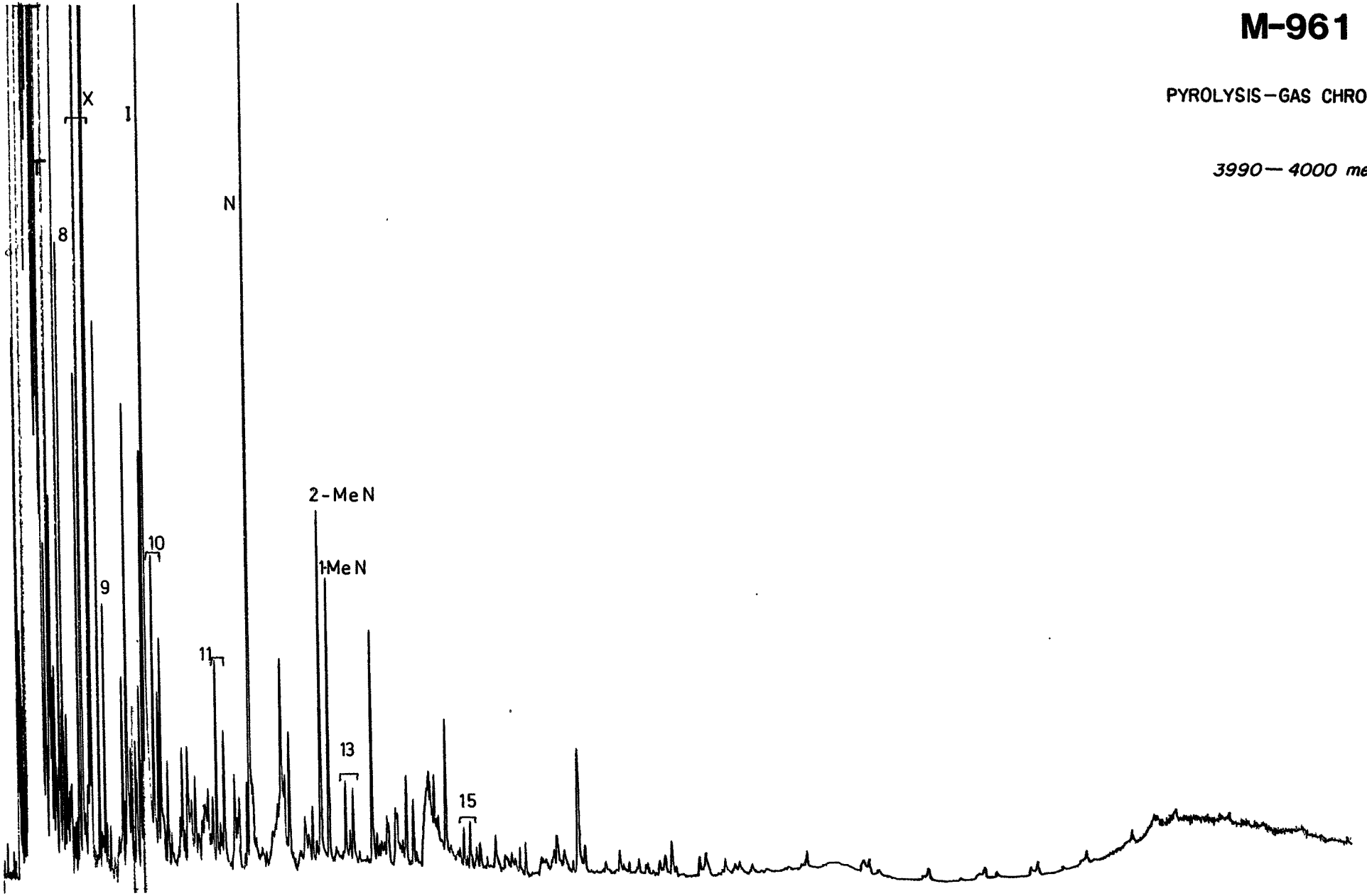
Aromatic hydrocarbons
4860–4890 m



M-961

PYROLYSIS–GAS CHROMATOGRAM

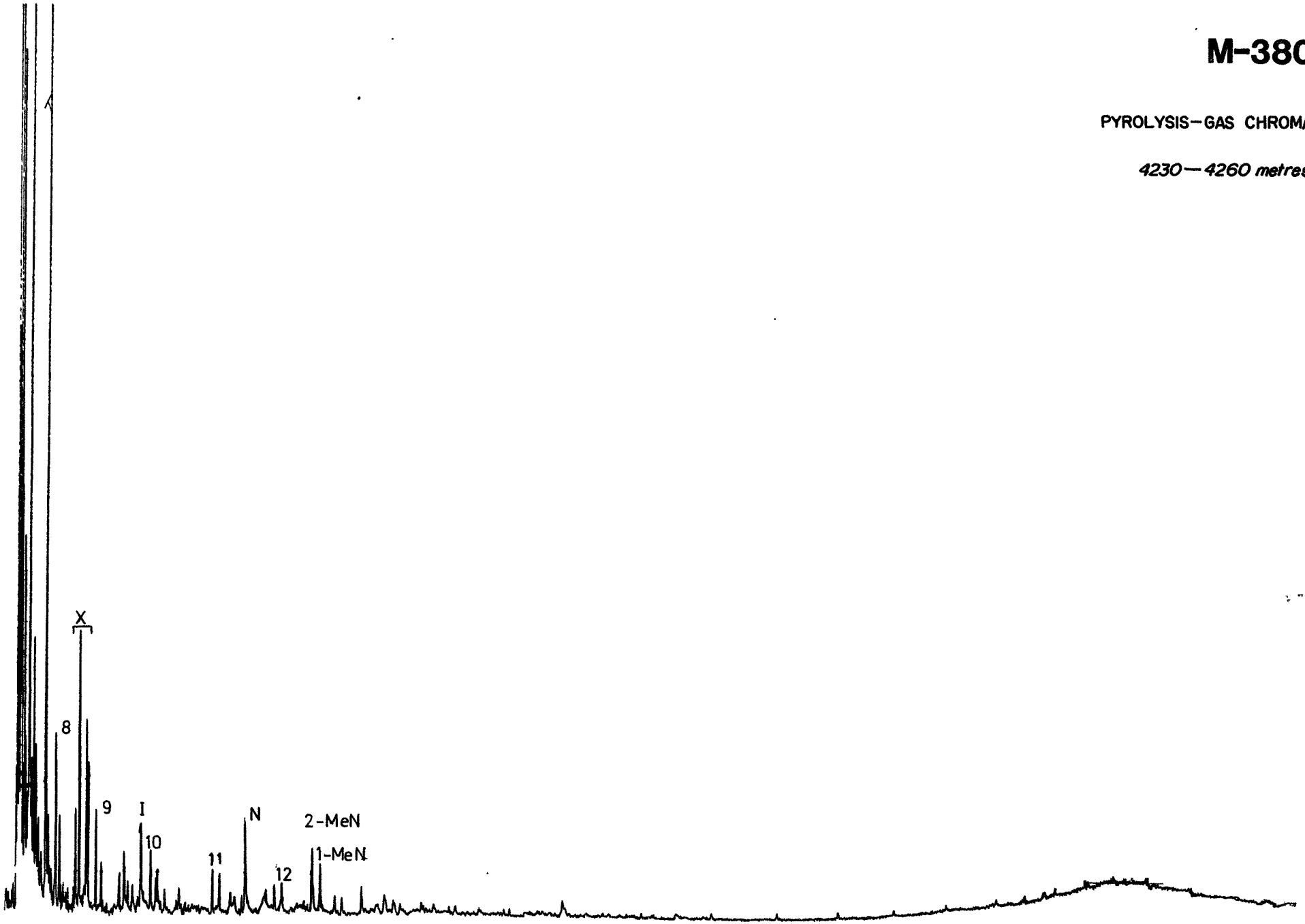
3990 — 4000 metres



M-380

PYROLYSIS–GAS CHROMATOGRAM

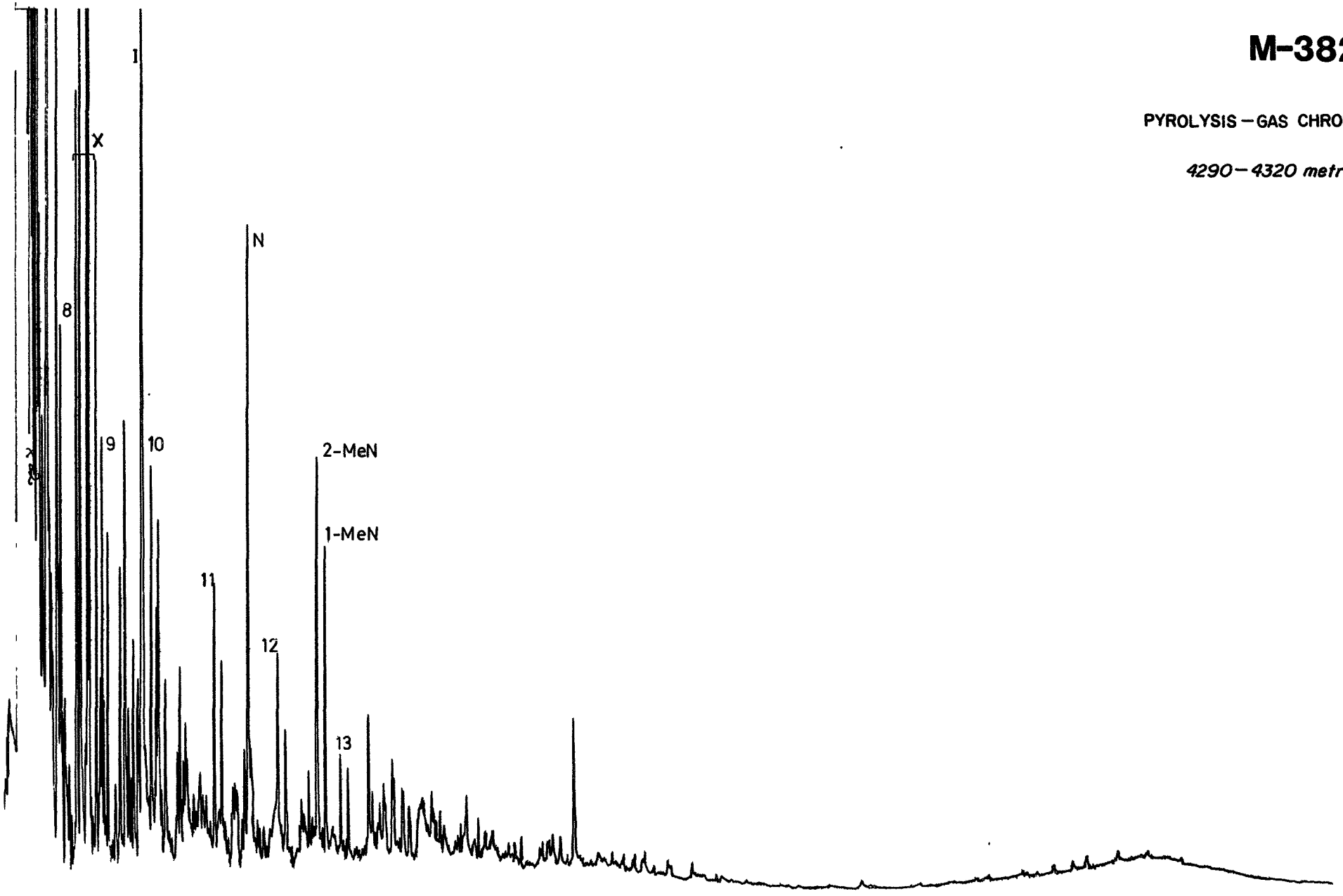
4230—4260 metres



M-382

PYROLYSIS – GAS CHROMATOGRAM

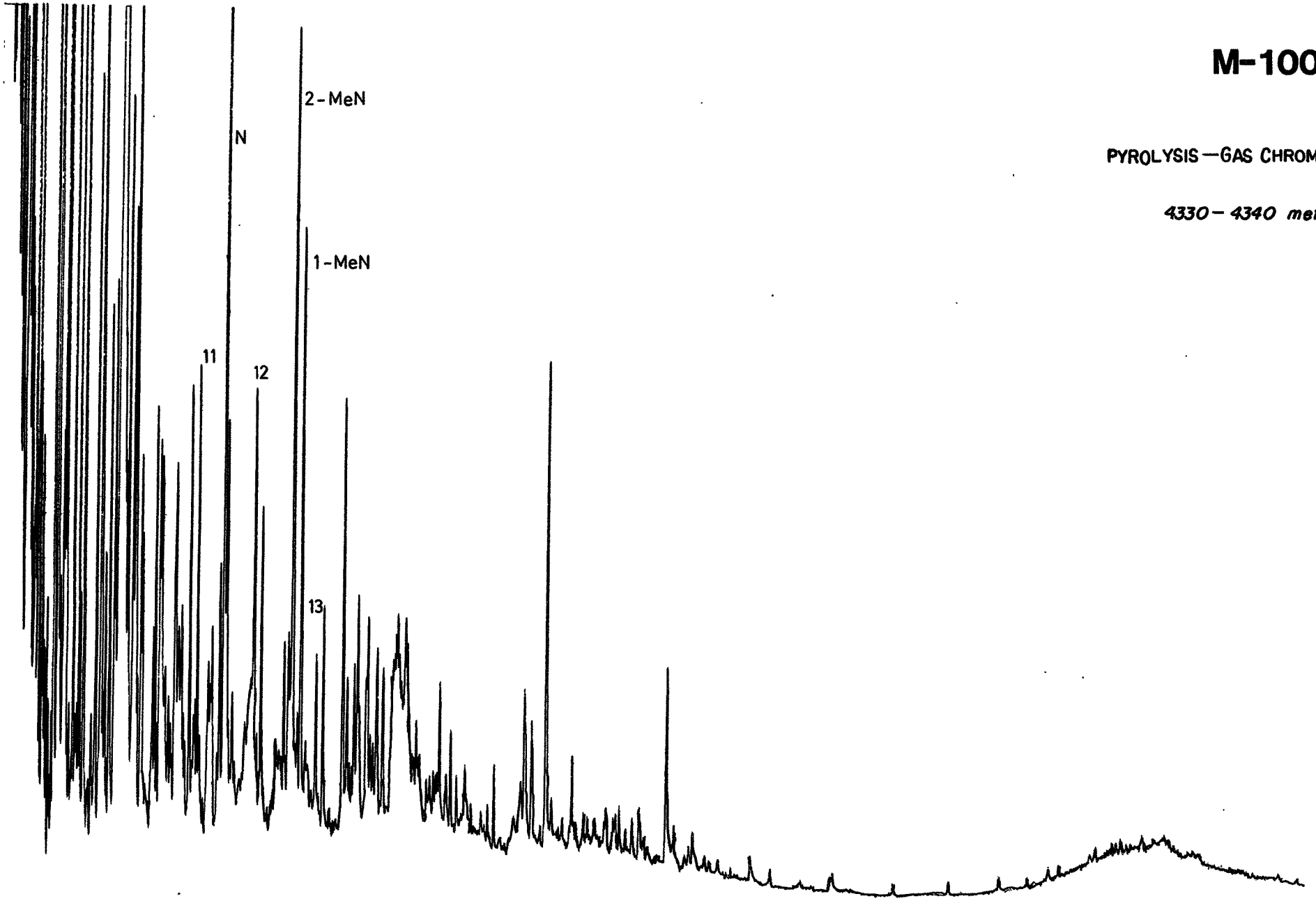
4290 – 4320 metres



M-1002

PYROLYSIS—GAS CHROMATOGRAM

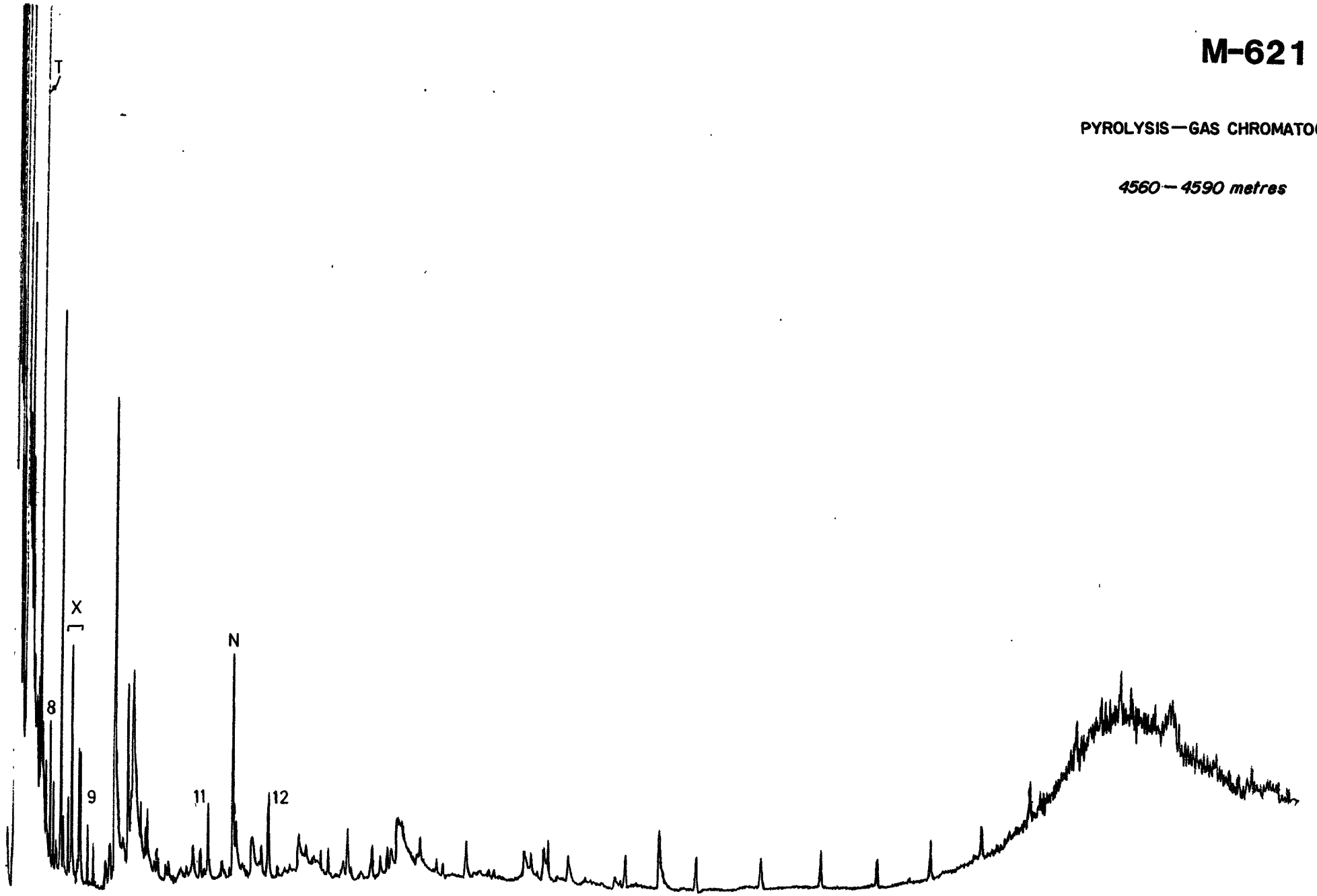
4330 – 4340 metres



M-621

PYROLYSIS—GAS CHROMATOGRAM

4560—4590 metres



M-623

PYROLYSIS – GAS CHROMATOGRAM

4620 – 4650 metres