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REGIONAL PETROLEUM GEOCHEMISTRY
BLOCK 24/12 AND
SURROUNDING AREAS

Well NOCS 15/5-1

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SUMMARY

The well NOCS 15/5-1 is situated distant to the south of block 24/12 in the axial area of the South Viking Graben, within the Dagny satellite field to the Sleipner gas field. This was drilled to a depth of 3775 m, having TD in the Lower Jurassic Statfjord Fm. The well was plugged and abandoned as a gas/condensate discovery.

Samples were analysed over the interval 2155 - 3775 m, of Palaeocene to Lower Jurassic age.

The potential source rocks in this well, represented by the Draupne Fm. siltstones and the liptinitic coals and carbargillites of the Brent Gp., having rich and fair/good present potential for oil and gas respectively, are mainly early mature. The oil window (Ro 0.6 %) is estimated to occur at approximately 3650 m in the lower part of the Brent Gp. The bulk of hydrocarbons present in these source rocks are therefore early in-situ generated.

The Post-Jurassic section is virtually barren of migrated hydrocarbons, the traces of the free compounds present here being interpreted to be mainly contaminants. The upper Brent Gp. sandstones (approx. 3560 - 3610 m) contain abundant mature, light, marine-sourced oils, together with early/moderate mature oils which are locally sourced. The former oils probably have a typical Draupne-type source. The lower Brent Gp. and Statfjord Fm. are practically barren of migrated hydrocarbons.

INTRODUCTION

The well NOCS 15/5-1 is situated near the eastern margin of NOCS block 15/5 in the Dagny satellite, to the north of the Sleipner Field and south of block 24/12 in the South Viking Graben. The well was drilled in 1977-78 and was plugged and abandoned as a gas/condensate discovery, having TD at 3775 m RKB in the Lower Jurassic.

A total of 97 samples was collected at the Norwegian Petroleum Directorate in Stavanger. The samples between 2155 m and 3775 m RKB were washed and lithologically described. The analysed interval is from 2215 m to 3775 m RKB, including formations of Palaeocene to Lower Jurassic age.

From the 97 samples examined, 51 lithologies from 51 samples were selected for screening analysis (TOC and Rock-Eval pyrolysis). Based on the results of these, the following number of samples were selected for further analyses:

Thermal extraction - pyrolysis gas chromatography	17 samples
Extraction, MPLC fractionation, saturated and aromatic hydrocarbon - gas chromatography	11 samples
Vitrinite reflectance microscopy	10 samples
Visual kerogen composition	8 samples
Gas chromatography - mass spectrometry of saturated and aromatic hydrocarbons	6 samples
Stable carbon isotope analysis of $C_{15}+$ fractions	6 samples

Samples lists and tabulated analytical data are displayed in Appendix 1.

General well data is as follows:

Position	:	58°35'04.39"N 01°39'08.35"E
Elevation	:	25 m
Water depth	:	119 m
Status	:	P & A oil and gas discovery

Based on information from logs and lithologies, the following stratigraphic sub-division of the well has been used:

<u>Palaeocene</u>	
Rogaland Group	? 2155 - 2644 m
Heimdal Formation	? 2155 - 2573 m
Lista Formation	2573 - 2610 m
Maureen Formation	2610 - 2644 m
<u>Upper Cretaceous</u>	
Chalk Group	2644 - 3170 m
Ekofisk Formation (Danian)	2644 - 2701 m
Tor Formation	2701 - 2904 m
Flounder/Hod Formations	2904 - 3170 m
Shetland Group	3170 - 3375 m
Plenus Marl Formation	3170 - 3299 m
Hidra Formation	3299 - 3375 m
<u>Lower Cretaceous</u>	
Cromer Knoll Group	3375 - 3492 m
Rødby Formation	3375 - 3431 m
Valhall Formation	3431 - 3492 m

Upper Jurassic	
Viking Group	3492 - 3560 m
Draupne Formation	3492 - 3560 m
Middle Jurassic	
Brent/Vestland Group	3560 - 3722 m
Lower Jurassic	
Statfjord Formation	3722 - 3775 m, TD

LITHOLOGY AND TOTAL ORGANIC CARBON CONTENT

Figure 2 shows a generalized lithological column with relevant stratigraphic data and Total Organic Carbon (TOC) contents over the analysed interval of the well.

Full lithology descriptions for all samples and TOC contents of analysed lithologies are given in Table 1. Ninety-seven samples were described and fifty-one individual lithologies were analysed for TOC content.

The samples are described in a stratigraphic context below.

Palaeocene

Rogaland Group (? 2155 - 2644 m)

Heimdal Formation (? 2155 - 2573 m)

Fifteen samples were described from this interval, these containing mainly either medium grey to light olive-grey shale or coarse white, generally loose kaolinitic sandstone down to 2395 m and almost exclusively sand/sandstone below this. Four sandstones and one siltstone were analysed for TOC content. The siltstone had a rich TOC content of 3.14 %, while the sandstones contained fair to good TOC contents (for sandstones) of 0.1 - 0.35 %.

Lista Formation (2573 - 2610 m)

Maureen Formation (2610 - 2644 m)

No samples were analysed from these intervals.

Upper Cretaceous

Chalk Group (2644 - 3170 m)

Ekofisk Formation (2644 - 2701 m)

Two samples were described from the Ekofisk Fm. interval, these having mainly either medium grey to dark greenish grey shale (upper sample) or white chalky carbonate (lower sample). The latter sample also contained equivalent amounts of pale yellow-brown and light greenish grey marl. The carbonate sample was analysed for TOC content, this being fair (for a carbonate) at 0.19 %.

Tor Formation (2701 - 2904 m)

Seven samples were described from this formation. These samples contained mainly carbonate or marl similar to that in the overlying interval, together with often equivalent amounts of indurated (turbodrilled) rock fragments. One sample of marl and one of carbonate were analysed for TOC content. These have poor to fair TOC contents (for marls/ carbonates) of 0.16 % and 0.09 % respectively.

Flounder/Hod Formation (2904 - 3170 m)

Nine samples were described from this interval, these being dominated by light grey and greyish red marl as the in-situ component. Abundant to dominant amounts of indurated rock fragments are also commonly present. Two samples, one of marl and one of carbonate were analysed from this interval. These contained poor to fair TOC contents (for carbonates/ marls) of 0.2 % and 0.08 % respectively.

Shetland Group (3170 - 3375 m)

Plenus Marl Formation (3170 - 3299 m)

Two samples were described, the uppermost containing mainly light chalky carbonate and subordinate marl, the lower containing mainly white to light orange, calcareous, glauconitic sandstone and abundant silty marl. The sandstone was analysed, this having a fair TOC (for a sandstone) of 0.16 %.

Hidra Formation (3299 - 3375 m)

Three samples were described from this formation, these having mainly grey and greyish red, silty marls with subordinate chalky carbonate. One sample of marl and one of carbonate were analysed for TOC content, these being good and fair respectively (0.31 % and 0.09 %) for such lithologies.

Lower Cretaceous

Cromer Knoll Group (3375 - 3492 m)

Rødby Formation (3375 - 3431 m)

Two samples were described, one having mainly marl similar to that of the overlying formation, the other having mainly light - dark grey and greyish red, silty, micaceous shale. Contamination including tar-like additive is significant in these samples. No samples were analysed from this interval.

Valhall Formation (3431 - 3492 m)

Two samples were described, both being overwhelmingly dominated by shales similar to those above. One analysed sample of this shale yielded a fair TOC content of 0.53 %.

Upper Jurassic

Viking Group (3492 - 3558 m)

Draupne Formation (3482 - 3558 m)

Eleven samples were described from the Draupne Fm. The two uppermost samples contained mainly shales similar to those of the overlying formations which are probably caved, together with abundant amounts of dusky brown/dusky yellow-brown siltstone which is interpreted as being the in-situ component. This dark siltstone dominates the remaining samples from this interval. Eight samples of siltstone were analysed for TOC content, these having consistently rich amounts in the range 4.1 - 7.1 %.

Middle Jurassic

Brent Group (3558 - 3722 m)

Thirty-one samples, including twelve core-chip samples, were described from the Brent Gp. Down to ~ 3615 m the in-situ lithology is light grey to pale yellow/dark yellow-brown non-calcareous cemented sandstone which is well represented only in core material. Below this, to 3645 m, coal is dominant both in cuttings and core. Down to the base of the interval there occur brownish grey to dusky yellow-brown, carbonaceous shales, with abundant amounts of coal and generally accessory calcareous sandstone.

Lower Jurassic

Statfjord Formation (3722 - 3775 m, TD)

This interval is represented mainly by white to light orange calcareous, cemented sandstone in the eleven cuttings samples examined. Abundant amounts of shale or argillaceous coal also occur locally.

ROCK-EVAL ANALYSIS

Fifty-one individual lithologies, representing fifty-one samples, were analysed by Rock-Eval pyrolysis. Figures 3 and 4 show relevant data (Production Indices and Tmax data respectively) from these analyses. Figure 5 shows Tmax plotted against hydrogen index. The source-rock potential of the individual stratigraphic units is discussed in terms of kerogen type and richness data. Evidence for generation and migration, together with a maturity evaluation, are presented in general terms for the well as a whole.

Kerogen Type and Richness
(Hydrogen Index, Oxygen Index and Petroleum Potential)

Palaeocene

Rogaland Group (? 2155 - 2644 m)

Heimdal Formation (? 2155 - 2573 m)

Only four sandstones and one siltstone were analysed from this interval. The siltstone has a hydrogen index (102 mg HC/gTOC), indicating kerogen type III-IV. The petroleum potential of this is fair at 3.7 mg HC/g rock.

Lista Formation (2573 - 2610 m)

Maureen Formation (2610 - 2644 m)

No samples were analysed from these intervals.

Upper Cretaceous

Chalk Group (2644 - 3170 m)

Shetland Group (3170 - 3375 m)

The carbonates and marls analysed from this group have hydrogen index and TOC data showing them to be virtually barren of pyrolysable organic matter. Hydrogen indices range from the indeterminately low (S_2 below detection limit) to 32 mg HC/g TOC. The petroleum potentials of all these samples are poor, ranging 0 - 0.2 mg HC/g rock. The Upper Cretaceous sequence has therefore no source rock potential.

Lower Cretaceous

Cromer Knoll Group (3375 - 3492 m)

Valhall Formation (3431 - 3492 m)

The single shale analysed from the Lower Cretaceous has results similar to samples of the overlying interval. This contains only kerogen type IV, with no potential for generation of significant hydrocarbons. The calculated petroleum potential is very poor at 0.1 mg HC/g rock.

Upper Jurassic

Viking Group (3492 - 3558 m)

Draupne Formation (3492 - 3558 m)

The siltstones from the Draupne Fm. have hydrogen indices showing the presence of type II kerogen at the top of the formation (HI 468 mg HC/g TOC), which becomes type II-II/III at depth (HI 313 - 229 mg HC/g TOC). The petroleum potential of this formation is rich throughout (18.3 - 23.4 mg HC/g rock), demonstrating the excellent source potential of the Draupne Fm. for oil and mixed oil and gas.

Middle Jurassic

Brent Group (3558 - 3722 m)

The commonly carbonaceous shales analysed from this interval have hydrogen indices ranging from 223 to 300 mg HC/g TOC, oxygen indices ranging 8 - 22 mg CO_2/g TOC and petroleum potentials ranging from fair to rich (3.9 - 39.8 mg HC/g rock). The coals analysed have hydrogen and oxygen indices ranging 182 - 269 mg HC/g TOC and 12 - 18 mg CO_2/g TOC respectively and very rich petroleum potentials of 115 - 173 mg HC/g rock. This data suggests the shaly and coaly horizons within the Brent Gp. to contain kerogen types II/III-III and to have generally very good potentials for the generation of mixed oil and gas.

Lower Jurassic

Statfjord Formation (3722 - 3775 m, TD)

Only sandstones were analysed from this interval.

Generation and Migration
(Production Index, $S_1/(S_1+S_2)$)

From Figure 3 it can be seen that the production indices (PI) of the Palaeocene and Upper Cretaceous sandstones, carbonates and marls are quite high, ranging approximately 0.3 - 1.0. This, however, reflects mainly the very low S_2 values of between below detection limit and 0.07 mg HC/g rock. It can, therefore, be concluded that these units do not contain any significant quantities of migrated hydrocarbons. A similar conclusion can be drawn for the Lower Cretaceous shale, which has no generation potential. The Draupne Fm. siltstones have low production indices of around 0.2, showing that these have not yet begun to generate hydrocarbons. The Brent Gp. sandstones, however, have high production indices (0.7 - 0.8) in the upper levels, down to 3609 m, which cannot be explained by low S_2 values. Below this, the Brent Gp. sandstones have low production indices of ~ 0.1 - 0.3. The sandstones, therefore, appear to contain significant amounts of free hydrocarbons, either migrated or as contaminants, in the upper levels, but are more or less barren below at least ~ 3615 m. The coals and shales from the Brent Gp., having very good generative potentials, have only low production indices of around 0.1 and less, indicating that they have not yet generated significant amounts of hydrocarbons. In the case of the coals, however, the very high S_2 values will have depressed their production indices. The Statfjord Fm. sandstones have lowish production indices in the range 0.2 - 0.3 and low S_1 peaks, showing them to be devoid of any significant migrated hydrocarbons.

Maturity (Tmax)

The Tmax data for the well suggests the Draupne Fm. siltstones to be early mature (428 - 433°C), while the Brent Gp. shales and coals are in the upper part of the oil window (generally 435 - 442°C.).

THERMAL EXTRACTION - GAS CHROMATOGRAPHY

Seventeen samples were thermally extracted from well NOCS 15/5-1. Exemplary thermal extract chromatograms are shown in Figures 6a-i.

Palaeocene

Rogaland Group (? 2155 - 2644 m)

Heimdal Formation (? 2155 - 2573 m)

One sample of pale brown siltstone and one of white/light yellow-brown sandstone were analysed from the Palaeocene interval. The chromatogram of the siltstone shows minor amounts of gaseous hydrocarbons, together with a distinct suite of hydrocarbons between nC_{12} and nC_{17}, which probably represent migrated light oil or condensate, the lack of an unresolved envelope probably excluding contamination. It is not possible to comment further on this oil as the amounts of isoprenoids present are too small for source/maturity assessments (Figure 6a). The chromatogram of the sandstone shows a similar migrated suite which is somewhat heavier and richer in aromatics compared with that in the siltstone. The high peaks in this sample which are not identified may indicate contamination at this level.

Upper Cretaceous

Chalk Group (2644 - 3170 m)

Ekofisk Formation (2644 - 2701 m)

No samples were thermally extracted from this interval.

Tor Formation (2701 - 2904 m)

One sample of pale yellow-brown and light greenish grey marl was analysed from this interval at 2705 m. The chromatogram of this sample is similar to that of the siltstone from the Palaeocene, showing traces of gas together with minor amounts of a suite of n-alkanes having moderate aromatics in the range nC_{13} - nC_{18} and a slight unresolved hump. This may indicate either migrated hydrocarbons, or perhaps more likely contaminant since the isoprenoids/unresolved envelope is more prominent. The cuttings are noted to contain various contaminants including coal-additive.

Flounder/Hod Formation (2904 - 3170 m)

One sample of light grey and greyish red marls was thermally extracted from this interval at 3060 m. This was found to contain only traces of free hydrocarbons having distributions similar to those in the marl of the overlying formation.

Shetland Group (3170 - 3375 m)

No samples were thermally extracted from this interval.

Lower Cretaceous

Cromer Knoll Group (3375 - 3492 m)

No samples were thermally extracted from this interval.

Upper Jurassic

Viking Group (3492 - 3558 m)

Draupne Formation (3492 - 3558 m)

Three samples of dusky brown/dusky yellow-brown to brownish black siltstone were thermally extracted from the Draupne Fm. The two upper samples (3493 m, 3518 m) have similar chromatograms, showing them to contain moderately abundant amounts of a range of n-alkanes between nC_{11} and nC_{28} (Figure 6b). Most of the light n-alkanes have probably been lost over the past 10 years storage, those hydrocarbons remaining suggesting that the oil was only early to moderate mature. Aromatics are not especially prominent, which together with the isoprenoid contents ratios suggest generation from a source rock having more reducive marine than oxidative terrestrial conditions. However, the loss of n-alkanes may have changed these ratios in favour of an apparently less mature, more terrestrial source. These hydrocarbons are probably mainly in-situ generated. The lowermost sample (3555 m) has quite a different chromatogram, this having a very narrow population of hydrocarbons between nC_{15} and nC_{24} on a pronounced unresolved hump which almost certainly represents contamination (Figure C6).

Middle Jurassic

Brent Group (3558 - 3722 m)

Seven samples, three of sandstone core-chips, one of coal and three of brownish grey to dusky yellow-brown shale, were thermally extracted from the Brent Gp.

Of the three sandstones, the two uppermost (3561.30 m, 3580.28 m) have suites of n-alkanes ranging nC_{14} - nC_{27}, with maxima at nC_{22} and nC_{25} (Figure 6d), while the lowermost (3615.20 m) has in addition a whole range of light hydrocarbons which are rich in aromatics/isoprenoids (Figure 6e). The heavier range of hydrocarbons, which probably represents a migrated oil is present in abundant amounts in the sample from 3580.28 m (Figure 6e), otherwise only in moderately abundant amounts. Although somewhat low in concentration for categorial assessment, the pristane and phytane contents suggest the oil to be mature to well-mature. The additional light hydrocarbons in the lowermost sample may well be in-situ generated or locally migrated, this sandstone having a significant clayey component.

The chromatogram of the coal core-chip sample (3619.85 m) shows similar characteristics to that of the overlying sandstone sample at the lighter end, confirming that terrestrial kerogen is responsible for the free hydrocarbons in the sandstone sample. This chromatogram is fairly typical for free in-situ generated hydrocarbons in a moderately mature liptinitic coal, having abundant aromatics in particular m+p xylenes and naphthalenes (Figure 6g). The three shale cuttings samples analysed have chromatograms which are broadly similar to each other, with a range of n-alkanes to nC_{22-25} having maxima at the gas end, also at around nC_{13}. The traces show the same characteristics as those of the overlying coal and dirty sandstone samples, the mainly free in-situ generated hydrocarbons having abundant aromatics and isoprenoids. The lowermost sample has a maximum extending to heavier n-alkanes which suggests that heavier migrated hydrocarbons similar to those in the overlying sandstones are also present. Generally, the contents of pristane and phytane confirm the terrestrial nature of the source kerogen for the lighter free hydrocarbons, also suggesting moderate maturity (Figure 6h).

Lower Jurassic

Statfjord Formation (3722 - 3775 m, TD)

One sample of white to light orange sandstone from this interval was thermally extracted. This has a chromatogram having trace gas and traces of a suite of migrated hydrocarbons ranging nC_{13} - nC_{27}. The high ratios of pristane and phytane to the n-alkanes at this depth suggest that a large amount of n-alkanes has been removed, either in storage or by natural washing of the sandstone (Figure 6i).

PYROLYSIS - GAS CHROMATOGRAPHY

Seventeen samples were pyrolysed from NOCS 15/5-1. Pyrolysis GC data is presented in Table 3, and in a Pyrolysis products triangle in Figure 8. Typical pyrograms are shown in Figures 7a-g.

Palaeocene

Rogaland Group (? 2155 - 2644 m)

Heimdal Formation (? 2155 - 2573 m)

One sample of siltstone and one of sandstone were pyrolysed from this interval. The pyrogram of the siltstone shows a low yield of pyrolysates with alkanes to C_{26} accompanied by abundant aromatics/isoprenoids, indicating low maturity type III kerogen (Figure 7a). The sandstone is virtually barren of pyrolysable matter.

Upper Cretaceous

Chalk Group (2644 - 3170 m)

Ekofisk Formation (2644 - 2701 m)

No samples were pyrolysed from this interval.

Tor Formation (2701 - 2904 m)

Flounder/Hod Formation (2904 - 3170 m)

One sample of marl from each of these intervals was analysed, these being virtually barren of pyrolysable material and yielding only traces of gas.

Shetland Group (3170 - 3375 m)

No samples were pyrolysed from this interval.

Lower Cretaceous

Cromer Knoll Group (3375 - 3492 m)

No samples were pyrolysed from this interval.

Upper Jurassic

Viking Group (3492 - 3558 m)

Draupne Formation (3492 - 3558 m)

Three dark siltstones were pyrolysed from the Draupne Fm. Similar to the thermal extraction results, the two upper samples have very similar pyrograms, while the lowermost sample is quite different. The former have good yields with alkene/alkane homologies on a rising baseline to C_{28} and low aromatics contents typical of type II-II/III kerogen. The profile of the pyrogram suggests moderate maturity (Figure 7b). The lowermost sample, of outwardly similar siltstone, has a much lower yield, and of a series triplets out to C_{19} followed by a distinct population between C_{20} and C_{29} on an unresolved hump. This is characteristic of ligno-sulphonate additive. The most abundant lighter peaks are the first of each triplet, probably representing alkenes which are derived by pyrolysis of the mud additives. The heavier suite may well be due to heavy components carried over from S_1 (Figure 7c).

Middle Jurassic

Brent Group (3558 - 3722 m)

Seven samples consisting of three sandstone core-chip samples, one coal sample and three shale samples were pyrolysed from this interval.

Of the three sandstone samples, the two uppermost have similar pyrograms consisting of relatively small amounts of a series of lighter hydrocarbons to C_{19-23} followed by rich amounts of a distinct population between C_{24} and C_{34}. The sample from 3580.28 m is particularly rich (Figure 7d). These may represent heavy components carried over from the free thermally liberated hydrocarbons of S_1. This heavy suite is virtually a clean wax however, the origin of this being unknown. The lowermost sandstone sample (3615.2 m) has quite a different pyrogram, showing it to contain kerogen type II/III-III, this being in the clayey component of the sandstone which is recorded as being a "dirty" sandstone (Figure 7e). The coal core-chip sample (3619.85 m) has a pyrogram which is fairly typical for a moderately mature coal, though the aromatics are not too prominent for a coal. This is fairly typical for the liptinitic Brent coals. The three shales analysed from the Brent Gp. have almost identical pyrograms showing good yields of mainly alkanes to C_{30}.

Aromatic compounds are not particularly prominent and the pyrolysate traces suggest moderately mature kerogen of type II/III (Figure 7f).

Lower Jurassic

Statfjord Formation (3722 - 3775 m, TD)

One sample of sandstone from 7343 m was pyrolysed. The pyrogram shows minor yields of alkanes to C_{30-31}, aromatic compounds not being prominent, such that this sandstone can either be interpreted to contain small amounts of mature type II/III-III kerogen, or the sandstone is contaminated by clayey coal particles which are abundant in the cuttings sample (Figure 7g).

In summary, the thermal extraction and pyrolysis-GC results show the presence of either traces of migrated oil or contamination in the Palaeocene Heimdal Fm. and the Upper Cretaceous formations. The free hydrocarbons in the Draupne Fm. are probably mainly in-situ generated, these siltstones having a rich potential (kerogen type II-II/III), but only moderate maturity. Contamination also appears to be present locally at these levels. Within the Brent Gp. sandstones there occur migrated, now quite heavy hydrocarbons, as well as lighter hydrocarbons generated from more terrestrially influenced kerogen. The sandstones are at least locally impure, containing kerogen type II/III-III similar to that in the coal, while the underlying shales have good kerogen of type II/III of moderate maturity - ? early maturity. The coal and shales contain lighter free hydrocarbons with aromatic contents which are higher than that one would expect from the indigenous kerogen, suggesting migrated light hydrocarbons from a mature terrestrially influenced kerogen. Heavier migrated hydrocarbons similar to those in

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the sandstones are present locally. The Lower Jurassic Statfjord Fm. sand sample is probably contaminated by coal particles, but contains a suite of heavy migrated hydrocarbons where the bulk of alkanes have probably been removed either during storage or by a washing process. The pyrolysis-GC composition triangle (Figure 8) shows the light character of the Palaeocene pyrolysates compared with those from the Jurassic which reflects the difference in kerogen type. The pyrolysates of samples from the Draupne Fm., Brent Gp. and Statfjord Fm. show a trend of quite variable $C_{15}+$ content at the expense of both C1 - C_5 and C_6 - C_{14} which mainly reflects the presence of either heavy contaminants or heavy migrated hydrocarbons carried over from S_1.

EXTRACTION DATA

Eleven samples were extracted, fractionated and the hydrocarbons analysed by gas chromatography. The extraction data is listed in Tables 4-6 and plotted in Enclosure 2. Typical saturate chromatograms are shown in Figures 9a-f and typical aromatics chromatograms in Figures 10a-h, while all chromatograms are located in Appendix 4.

The extraction data shows the Palaeocene Heimdal Fm. siltstone to contain a good content of extractable organic matter (1913 ppm EOM) and a rich content of extractable hydrocarbons (652 ppm EHC). When normalized against TOC, however, these become only fair (65 mg EOM/g TOC) and marginally good (22 mg EHC/g TOC). The hydrocarbons constitute only 34 % of EOM, these, however, having a high saturate: aromatic ratio of 4.0. This data suggests the presence of traces of free hydrocarbons which are either contaminants or migrated and mature.

The extraction data for the two Draupne Fm. siltstones analysed shows them to contain very rich EOM and EHC contents (~ 11000 ppm and 6000 ppm respectively). When normalized against TOC these are good and still rich (120 - 150 mg EOM/g TOC and 66 - 85 g EHC/g TOC). The hydrocarbons in these siltstones constitute 55 - 57 % of EOM and have low saturate:aromatic ratios (0.74 - 0.78). This data suggests that the rich kerogen in these siltstones has already begun to generate hydrocarbons at moderate maturity.

For the Brent Gp. sandstones (all core-chip samples) the extraction data shows poor to rich EOM contents (456 - 2287 ppm) and good to rich EHC contents (256 - 1451 ppm), these having no pattern with depth. When normalized against TOC these are poor to rich (77 - 610 mg EOM/g TOC) and rich (61 - 426 mg EHC/g TOC). The hydrocarbons in the sandstones constitute 44 - 79 % of EOM, these having moderate to high saturate:aromatic ratios of 1.1 - 6.0. This data suggests the Brent sandstones to contain variable amounts of free hydrocarbons which have varying maturity, possibly also from different sources which may reflect mixtures of migrated hydrocarbons and locally (?coal) generated hydrocarbons.

The data for the Brent Gp. coal sample (core-chips from 3619.85 m) shows this to contain very rich EOM and EHC contents (40232 ppm and 7206 ppm respectively), these however being only fair when normalized against TOC (75 mg EOM/g TOC, 13 mg EHC/g TOC). The hydrocarbons constitute only 18 % of EOM, the bulk of this being as asphaltenes (68 %). The saturate:aromatic ratio is low - 0.39. This data suggests that the Brent Gp. coal kerogen has already been converted to substantial amounts of asphaltenes and that hydrocarbons have also been generated.

Saturated Hydrocarbons

Palaeocene

Rogaland Group (? 2155 - 2644 m)

Heimdal Formation (? 2155 - 2573 m)

The siltstone analysed from this formation at 2305 m has a saturate chromatogram showing a main light population of n-alkanes ranging nC_{13} - nC_{19} centred around nC_{15-19}, which tails off to nC_{33} (Figure 9a). The pristane/nC_{17} and phytane/nC_{18} ratios for these are quite low (0.52), showing them to be mature/well mature, while the pristane/phytane ratios (1.4) suggests that these were generated in a source rock with conditions which were not particularly anoxic.

These hydrocarbons are considered to be either migrated condensate or contamination, though the former appears more likely from the thermal extraction chromatogram.

Upper Jurassic

Viking Group (3492 - 3558 m)

Draupne Formation (3492 - 3558 m)

Two samples of similar dark siltstone were analysed from this interval at 3493 m and 3555 m. Their saturate chromatograms, unlike their thermal extract chromatograms, are very similar, showing a full range of mainly light n-alkanes, these ranging nC_{13} - nC_{36}(+) with a maximum around nC_{16} (Figure 9b). The pristane/nC_{17} and phytane/nC_{18} ratios (0.7 - 0.8 and ~ 0.8 respectively) suggest moderately mature hydrocarbons, these having been generated in-situ.

Middle Jurassic

Brent Group (3558 - 3722 m)

The seven sandstones (core-chips) analysed from the Brent Gp. mainly have saturate chromatograms showing a full range of n-alkanes between nC_{14} and nC_{37}(+) centred around nC_{19-23} in the upper samples, becoming heavier with increasing depth to include increasing amounts of n-alkanes and a less clear maximum centred more around nC_{23-24} (Figures 9c, e). At 3590.21 m, however, the n-alkanes occur as a distinct heavy population centred around nC_{25-27} (Figure 9d), this population probably giving rise to the heavier ranges noted in the lower samples, as a shoulder over this range is evident in several of these samples. The pristane/nC_{17} and phytane/nC_{18} ratios for the hydrocarbons in these sandstones (0.34 - 0.67 and 0.35 - 0.59 respectively) suggest mature to well-mature hydrocarbons, there possibly being a vague increase in maturity with depth.

The pristane/phytane ratios range 0.85 - 1.12 with no evident depth trend, suggesting a source rock neither particularly oxic nor anoxic. These hydrocarbons are considered to be mainly migrated light oils, probably mixed with lesser amounts of hydrocarbons generated early in the coal and good quality kerogen carbargillite horizons which occur in the Brent Gp. The Brent Gp. liptinitic coal analysed (core-chips, 3619.85 m) has a saturate chromatogram showing a shorter range of n-alkanes compared with that in the sandstones, nC_{12} - nC_{34}, with no particular maximum (Figure 9f). The ratios of pristane/nC_{17} and pristane/phytane are also very different, all being very much greater from those of the sandstones (pristane/nC_{17} 3.6 and pristane/phytane 6.6 compared with averages of ~ 0.6 and ~ 1.0 respectively for the sandstones). Biomarker compounds are also evident in the saturate chromatogram of the coal. This data suggests the hydrocarbons extracted from the coal to be in-situ generated but relatively immature.

Aromatic Hydrocarbons

Palaeocene

Rogaland Group (? 2155 - 2644 m)

Heimdal Formation (? 2155 - 2573 m)

The FID chromatogram of the siltstone from this formation shows only phenanthrene and methyl phenanthrenes on a distinct unresolved hump. The methyl phenanthrene ratios suggest these hydrocarbons to be quite mature (Figure 10a). The FPD chromatogram here shows only noise.

Upper Jurassic

Viking Group (3492 - 3558 m)

Draupne Formation (3492 - 3558 m)

The FID chromatograms of the two Draupne siltstone samples are reasonably similar, having dominant phenanthrene and methyl phenanthrenes on a broad unresolved envelope with abundant unidentified compounds. The dimethyl naphthalene ratios are only reliable for the lowermost sample (Figure 10b) and show the hydrocarbons to be immature to moderately mature. The methyl phenanthrene ratios also suggest moderate maturity. The FPD chromatograms for these siltstones are also similar, showing dominant dibenzothiophene. The sulphur aromatic ratios, particularly 4/1MDBT, show the hydrocarbons to be immature/moderately mature (Figure 10c).

Middle Jurassic

Brent Group (3558 - 3722 m)

The sandstones analysed from core-chips in this interval have very variable FID chromatograms. In the case of many of the samples these show either large unresolved envelopes or noise with the phenanthrenes together with unidentified components as the only major peaks (Figure 10d). In other cases there also occur significant, though generally still subordinate amounts of the dimethyl naphthalenes (Figure 10e). The ratios, where reliable, are also quite variable and suggest the free hydrocarbons in the Brent sandstones to be immature to mature, probably due to variable mixtures of hydrocarbons from different sources. The FPD chromatograms of the Brent sandstones often show only noise, particularly in the upper levels. However, the dibenzothiophene ratios for the hydrocarbons, where these are reliable, all show these to be early mature/mature and are quite different (particularly 4/1MDBT) to those of the Draupne shale hydrocarbons, containing much lower dibenzothiophene contents (Figure 10f).

The FID chromatogram of the Brent Gp. coal is quite different to that of the Brent sandstones and the Draupne shale, having strongly dominant methylated naphthalenes, there being only traces of the phenanthrenes (Figure 10g). The methyl and dimethyl naphthalene ratios suggest a range of different maturities (well-mature to immature), but this may well be due to the presence of condensate which would increase the amounts of the methyl naphthalenes generally and interfere with the MN ratios.

The FPD chromatogram of the coal aromatics is different to those of the Brent sandstones, being more similar to, but more mature than, the Draupne siltstone. There is increased dibenzothiophene and decreased 4/1 MDBT, indicating a lower (moderate/early) maturity (Figure 10h).

In summary, the extraction results suggest the Palaeocene Heimdal Fm. siltstones to contain minor mature free hydrocarbons representing either contamination or migrated hydrocarbons, most likely the latter (? remains of condensate). The Draupne Fm. siltstones contain moderately mature early in-situ generated hydrocarbons. The Brent Gp. sandstones contain significant amounts of mature/well-mature light migrated oils in quite variable amounts which are also variable mixed with lesser amounts of probably locally migrated hydrocarbons generated in the coals and carbargil-lites seams in this sequence. The Brent (liptinitic) coal analysed contains mainly asphaltenes, but also moderate/ early mature in-situ generated hydrocarbons.

VITRINITE REFLECTANCE

A total of nine ditch cuttings samples and one core chippings sample was analysed from the interval 2185 - 3743 m in the NOCS well 15/5-1. A vitrinite reflectance versus depth plot is shown in Figure 11 and thermal maturity data are listed in Table 7. All vitrinite reflectance histograms are located in Appendix 2.

The upper four samples (2185 m, 2395 m, 2645 m, 3215 m) are characterized by siltstones and sandstones. The phytoclast content is low and comprises predominant inertinite (70 - 90 %) and reworked particles (10 - 30 %), but only trace abundances of poor quality vitrinite. Samples at 2185 m and 2395 m have variable, moderate to strong bitumen staining, whereas the lower two samples have only a slight staining. In blue light fluorescence the first three samples contain a moderate abundance of liptinitic material. This is essentially comprised of mixed spores and algae with minor amounts of dinoflagellates. Spores fluoresce light orange - mid orange (5 - 6) with a moderate to high fluorescence intensity. The lower sample is virtually devoid of fluorescing material, except trace mid to dark orange spore shreds (6 - 7).

A siltstone at 3365 m is virtually barren. Dispersed fine inertinite and trace vitrinite particles are present. Bitumen staining is trace, but there is a significant amount of haematite staining. In blue light scattered spores and algae represent the liptinite fraction. The spores fluoresce mid orange - dark orange with a very low intensity.

The two underlying samples (3505 m, 3538 m) comprise pyritic, heavily stained, finely laminated silty shales. The phytoclast content is high and predominantly inertinitic, although bituminite is significant and accounts for 8 % at

3505 m, but 40 % at 3538 m. Poor to fair quality vitrinite represents between 10 - 15 % of the total phytoclast content. Trace amounts of degradofusinite are also present in both samples. Bitumen staining and wisping are high and the samples are very pyritic. Under blue fluorescence light the samples are extremely liptinite rich and comprises a predominance of matrix bituminite, a high algal and spore shred content, additional tasmanites algae and hydrocarbon globules exude into the immersion oil. Green fluorescing terpenites (a leaf secretion) have also been tentatively identified. Spores fluoresce a good mid orange with a moderate fluorescence intensity.

One core chip sample at 3624.5 m is a coal. Good quality telocollinite accounts for over 80 %, inertinite 12 % and liptinite 8 % of the total phytoclast content. In fluorescence blue light there is a very high spore concentration together with minor fluorescing cuticular bands. Spores fluoresce a good light orange colour.

The two samples below (3675 m, 3743 m) contain a marl and minor coaly/carbargillite clasts. The phytoclast content in the coal is high and contains almost 75 % of good quality vitrinite, although there is a subtle gradation to semifusinite. In contrast, the marl is virtually devoid of phytoclasts. In blue light these samples contain a moderate to high abundance of liptinite. This is dominated by spores with minor resins, yellow fluorescing tasmanites algae, matrix bituminite (weak red-brown) and light orange fluorescing cuticle. Spores fluoresce mid orange with a moderate to high fluorescence intensity.

There is a fair agreement between spore fluorescence colour and vitrinite reflectance data, although the upper samples are slightly oxidised and give a slightly higher vitrinite reflectance than expected. Vitrinite reflectance increases from 0.56 % at 2185 m (unreliable) to 0.61 % at 3743 m (reliable).

Using the above data, a vitrinite reflectance versus depth is proposed. This indicates the well reaches early maturity (0.5 % Ro) at the approximate depth of 2750 m and becomes oil window mature (0.6 % Ro) by about 3650 m.

VISUAL KEROGEN COMPOSITION

Enclosure 4 shows thermal maturity data for the well NOCS 15/5-1 plotted against lithology and depth. Figure 12 shows a triangular plot of the kerogen composition for the well, while Table 8 lists the detailed kerogen composition of the samples examined. Thermal maturity data (Spore Colour Index) is included in Table 7.

Kerogen type is discussed according to the stratigraphic units of the well. Thermal maturity estimates based on spore colour index and spore fluorescence are presented in general terms for the well as a whole.

Eight samples from this well were examined optically. Samples were examined from 2305 m (Palaeocene: Heimdal Fm.) to 3708 m (Middle Jurassic: Brent Gp.).

Kerogen Typing

Palaeocene

Heimdal Formation (2155 - 2573 m)

One sample of siltstone was examined from this interval. This contained abundant (30 %) liptinite, mainly as lipto-detrinite and well-degraded, low fluorescence amorphinite of mainly reworked origin, together with mixed spores, cuticle, algae and common dinoflagellates. Vitrinite is dominant (70 %), mainly as part bitumen-stained woody material, while only trace (reworked) inertinite is present.

According to its gross liptinite content, this lithology has potential for mainly gaseous hydrocarbons. However, the reworked nature of the bulk of the liptinite would reduce this substantially. The lithology is therefore considered only to have limited potential for gas.

Upper Cretaceous

Chalk Group (2644 - 3375 m)

Flounder/Hod Formation (2904 - 3170 m)

One sample of marl from 2305 m was examined from this formation, this having only accessory (10 %) liptinite mainly as reworked material. The lithology is dominated by vitrinite (80 %), again mainly detrital, while accessory inertodetrinite is also present.

This lithology has virtually no potential for the generation of hydrocarbons.

Lower Cretaceous (3875 - 3431 m)

No samples were examined from this interval.

Upper Jurassic

Viking Group (3492 - 3558 m)

Draupne Formation (3492 - 3558 m)

Three samples of dark shale were examined from this interval at 3060 m, 3493 m and 3518 m. These all contained very similar kerogen assemblages, with strongly dominant liptinite (70 - 80 %), mainly as poor/moderately preserved algae and amorphinite with subordinate spores, dinoflagellates and local cuticle and bituminite. The only major discernible difference lies in the lowermost sample which appears to be more woody. Vitrinite is moderately abundant (15 - 20 %) in all samples as woody material and in amorphous vitro-humic matter. Only minor to accessory inertinite is present.

Such kerogen assemblages have excellent potential for the generation of oil or mainly oil.

Middle Jurassic

Brent Group (3558 - 3722 m)

Three samples were examined from this interval - a coal from core-chips at 3619.85 m and two shales from 3665 m and 3708 m.

The coal sample contains only accessory/significant (15 %) liptinite as mixed algae, spores and cuticle, being strongly dominated by bitumen-soaked telinite-collinite and bituminite. Only minor semifusinite inertinite is present. The shale samples vary somewhat in texture, the upper being coarse-grained with good preservation, the lower being fine grained with a poorly preserved groundmass of fine to amorphous liptinite. The gross compositions of these shales are, however, similar, having abundant (60, 65 %) liptinite. The upper sample has abundant cuticle and otherwise abundant spores and algae, while the lower sample has an algal bias. Oxidation of clasts is evident. Vitrinite as woody and reworked clasts is abundant in both samples (25, 30 %), the upper shale being particularly bitumen stained. Only accessory (10 %) inertinite is present.

These samples suggest the Brent Gp. shales, which have partly the same colour as the Draupne shales, ranging to brownish grey, to have good potential for the generation of mainly oil hydrocarbons. The coal has excellent potential for the generation of at least gaseous hydrocarbons. However, in assessing the potential of the Brent Gp. as a whole, the dilution effect of the Brent Gp. sandstones must be taken into account.

Maturity

The spore colour index data for the individual samples suggests the well to be immature/moderately mature in the Palaeocene. No reliable data could be acquired from the Cretaceous sample. The Draupne Fm. and Brent Fm. samples range from moderately mature to mature, though this is based on a limited number of available good spores in the two uppermost Draupne Fm. samples and in the Brent coal. Based on this limited SCI data, the linear regression line can be used to place the top of the oil window (SCI 6.0) tentatively at about 3750 m for type II kerogen.

ISOTOPE ANALYSIS OF $C_{15}+$ FRACTIONS

The following samples were analysed from well NOCS 15/5-1; four core chip samples from the Brent Gp. from 3561.3 m, 3590.21 m, 3609.3 m, all being sandstones, and 3619.85 m - a coal; and two siltstone cuttings samples from 2305 m (Heimdal Fm.) and 3555 m (Draupne Fm.). In total six samples.

Figures 13 show a plot of the $\delta^{13}C$ isotope values of the saturated versus aromatic hydrocarbons and the Galimov plots of the $\delta^{13}C$ isotopic values of the various fractions from the extracted material of the six samples. All data are listed in Tables 9a and 9b in Appendix 1.

In Figures 13 and from Table 9a it can be seen that two of the Brent Gp. sandstone samples (from 3561.3 m and 3609.3 m) have very similar isotope data. These data suggest that the hydrocarbons are derived from a marine source. The isotope data for the Draupne Fm. are very similar to those for the two Brent Gp. samples. It appears that the hydrocarbons in the two Brent Gp. samples described could very well be derived from a source rock similar to the Draupne Fm. of this well. The third sandstone sample from the Brent Gp. (the middle one from 3590.21 m) has isotope values significantly different from the two other Brent Gp. sandstones, in fact the values appears to be intermediate between those of the Brent Gp. coals sample and those of the other Brent Gp. sandstones. It is suggested that during extraction some hydrocarbons derived from coal particles in the sandstone sample have mixed with migrated hydrocarbons of the same type as those found in the two other Brent Gp. sandstones. The Brent Gp. coal sample has isotope values indicating a marine source of the hydrocarbons, which does not make sense for a coal sample. However, the coal sample is situated very close to sandstones that are known to contain migrated hydro-carbons (that above described Brent Gp. sandstones) and it is likely that the coal has also been affected by the same migrated hydrocarbons.

The isotope values of the Heimdal Fm. siltstone sample are different to those of the other analysed samples. The isotope data indicates a marine source for the hydrocarbons. It is possible that the difference in isotope values between the Brent Gp. sandstones/Draupne Fm. siltstone and the Heimdal Fm. siltstone could be due to migration effects, i.e. the migration pathway have been different/longer for the Heimdal Fm. hydrocarbons.

In short: The Brent Gp. samples appear to contain migrated hydrocarbons from a marine source, this source being similar to the Draupne Fm. present in this well. The Heimdal Fm. sample contains migrated hydrocarbons that at least has followed another (longer?) migration pathway than the Brent Gp. hydrocarbons.

Sofer, Z. (1984). Stable carbon isotope composition of crude oils: Application to source depositional environments and petroleum alteration. Bull. Am. Ass. Pet. Geol. Vol. 68. No. 1, p 31-49.

GAS CHROMATOGRAPHY - MASS SPECTROMETRY

Six samples, one siltstone sample from the Heimdal Fm. at 2305 m, one siltstone sample from the Draupne Fm. at 3555 m and four samples from the Brent Gp., three sandstone samples from 3561.3 m, 3590.21 m and 3609.30 m and a coal sample from 3619.85 m respectively. Figures 14a to e show typical fragmentograms. All data is presented in Tables 10A to I and all fragmentograms are located in Appendix 5.

Saturated Hydrocarbons

Heimdal Formation

Terpanes

The M/Z 163 fragmentogram is useful in the identification of the relative amounts of steranes and triterpanes and particularly in identification of demethylated hopanes and 4 methyl steranes. For the siltstone sample from 2305 m in the Heimdal Fm. this fragmentogram shows a low signal to noise ratio with only two peaks present, these being unidentified. These peaks are in the terpane range of the fragmentogram. The M/Z 177 fragmentogram also shows two peaks, but these are different to the ones recorded in the M/Z 163 fragmentogram. These peaks do not elute in the M/Z 191 fragmentogram and they might represent demethylated triterpanes. The M/Z 191 fragmentogram shows a strange pattern. The largest peak elutes close to where the C_{31} hopanes would elute, but it is not believed to represent this. The regular hopanes are only minor components, but the C_{27}, C_{29} and C_{30} hopanes are recognized. The M/Z 205 fragmentogram also shows a strange pattern with mainly two peaks, one being dominant and close to where the C_{32} hopanes would elute, and one close to where the C_{31} hopanes would elute. The latter is identical to the large peak registered in the M/Z 191 fragmentogram. The largest of these peaks most probably represents a methylated terpane. The fragmentograms of the molecular ions are not very informative, but the few data here, indicate that this sample contains both methylated and demethylated triterpanes.

Steranes

The M/Z 149 fragmentogram shows a low signal to noise ratio. The single peak eluting with a retention time approximately 42 minutes is not identified. The M/Z 189 fragmentogram shows only background material, while the M/Z 259 fragmentogram has a low signal to noise ratio where the C_{27} and C_{29} rearranged steranes can be recognized. The C_{27} components are slightly more abundant than the C_{29} components.

The M/Z 217 and 218 fragmentograms also show a low signal to noise ratio and evaluation is therefore not possible. The M/Z 218 fragmentogram shows one large peak with a retention time approximately 44 minutes. This peak is not identified. None of the fragmentograms of the molecular ions show any signals that can be identified.

The saturated hydrocarbon data for the Heimdal Fm. sample suggests either traces of light migrated mature oils, or more likely the presence of contaminants.

Draupne Formation

The M/Z 163 fragmentogram of the siltstone from 3555 m in the Draupne Fm. shows a good abundance of both steranes and terpanes. There is approximately equal abundance of steranes and triterpanes in this sample (Figure 14a). Of the steranes, the rearranged components are most abundant. A similar situation is recorded for the M/Z 177 fragmentogram of this sample. The M/Z 191 fragmentogram shows mainly pentacyclic triterpanes with 17α(H) 21β(H) hopane as the most abundant (Figure 14b). Bisnorhopane is present in this sample, which shows a surprisingly large abundance of C_3 hopanes compared with C_{34} hopanes. This is registered in some of the analysed samples in this region and could be an artifact of some of the source rocks in the area. There are hardly any tricyclic terpanes present in this sample. The M/Z 205 fragmentogram shows only the C_{31} hopane isomers together with a small peak representing the C_{30} hopane. The 17β(H) 21α(H) homohopane is only minor, clearly showing the high maturity of this sample. The fragmentograms of the molecular ions verify what has been discussed above.

Steranes

The M/Z 149 fragmentogram verifies what was recorded in the M/Z 163 and 177 fragmentograms with a good abundance of both steranes and triterpanes. The M/Z 189 and 259 fragmentograms show a good abundance of rearranged steranes with the C_{27} components being slightly more abundant than the C_{29} components, Figure 14c.

The M/Z 217 and 218 fragmentograms show a good abundance of C_{27} - C_{29} steranes, both rearranged and regular isomers. The ratio of $C_{21}+C_{22}/C_{27}-C_{29}$ indicates a low maturity in this sample in contradiction to the terpane data. The fragmentograms of the molecular ions clearly show the rearranged components to be far more abundant than the regular steranes in all of the C_{27} - C_{29} compounds. This could be caused by both increased maturity and differing source input.

Brent Group

The results for the samples analysed from this group are variable. The M/Z 163 fragmentograms show the sandstone sample from 3561.3 m to have a good abundance of mainly steranes with the terpane signals being of a lower abundance. The two other sandstone samples both show an unresolved envelope at the front end of the fragmentogram. The signal to noise ratio of the sample from 3590.21 m is low and further evaluation if therefore not possible, while the sample from 3609.3 m shows mainly terpanes. These data would indicate that the hydrocarbons in the sandstone samples are different, especially in the samples from 3561.3 m and 3609.3 m. It is not possible to evaluate the sample from 3590.21 m due to the low signal to noise ratio. The coal sample from 3619.85 m shows only triterpanes where bisnorhopane has the largest peak (Figure 14d). The M/Z 177 fragmentogram verifies that recorded in the M/Z 163 fragmentograms. The coal sample from 3619.85 m shows the 17α(H) 21β(H) norhopane as the largest peak. The M/Z 191 fragmentograms also show different patterns in the three sandstone samples. The samples from 3561.3 m and 3609.3 m show mainly pentacyclic triterpanes and there is a good correlation for these compounds between these two samples, which both show bisnorhopane to be present besides a relative abundance of C_{35} hopanes compared to the C_{34} components. The sample from 3590.21 m shows, however, mainly tricyclic terpanes, with the C_{23} isomer as the largest peak, together with 17α(H) 21β(H) hopane. The signal to noise ratio is low, but the large relative abundance of tricyclic terpanes in this sample indicates it to have been sourced from a different kerogen than the other samples. The coal sample from 3619.85 m shows almost entirely pentacyclic triterpanes where bisnorhopane, 17α(H) 21β(H) norhopane and 17α(H) 21β(H) hopane have almost equal peak heights as 17α(H) trisnorhopane (Figure 14e). It is surprising that a coal sample has such a large abundance of bisnorhopane, since this is normally associated with marine deposits in the Viking Graben. The M/Z 205 fragmentograms show the C_3 components in the three sandstone samples, while the coal sample also shows signals from the same compounds that gave the major signals in the M/Z 191 fragmentograms. The fragmentograms of the molecular ions verify what has been discussed above.

Steranes

The M/Z 149 fragmentograms verify what was recorded in the M/Z 163 and 177 fragmentograms. The M/Z 189 fragmentograms show a slight variation in the three sandstone samples. This is particularly a larger abundance of light molecular weight steranes in the samples from 3590.21 m and 3609.3 m compared with the sample from 3561.3 m and a reverse situation for the C_{27} rearranged steranes. This is in good agreement with the terpane data. The coal samples shows almost entirely C_{29} components. The M/Z 259 fragmentograms verify what has been recorded for the M/Z 189 fragmentograms, both for the sandstone samples and the coal sample from 3619.85 m.

The variation in relative abundance of the various steranes in the three sandstone samples as discussed for the M/Z 189 and 259 fragmentograms is also recorded in the M/Z 217 and 218 fragmentograms. These data would clearly indicate the hydrocarbons found in the sample from 3561.3 m to have been sourced from a different source to that of the hydrocarbons found in the sandstone samples from 3590.21 m and 3609.3 m. The coal sample from 3619.85 m contains almost entirely C_{29} rearranged and regular steranes. The fragmentograms of the molecular ions verify what has been discussed above.

Aromatic Hydrocarbons

Heimdal Formation

Alkyl Benzenes

C_2- and C_4-benzenes were monitored using the M/Z 106 and 134 fragmentograms.

The siltstone sample from 2305 m in the Heimdal Fm. shows a narrow band of doublets for C_2 benzenes covering the C_{15} - C_{25} range with a maximum at C_{17}. There is also a single peak eluting between the C_{24} and C_{25} doublets. The M/Z 134 fragmentogram shows a small unresolved envelope with a number of irregular peaks. It is not possible to undertake any further evaluation of this fragmentogram.

Alkyl Naphthalenes

M/Z 142, 156 and 170 fragmentograms were used to monitor the C_1-, C_2- and C_3-naphthalenes. Owing to the nature of the samples, only the C_3-naphthalenes could be evaluated. Even in these, the lower molecular weight compounds have been lost, so that no satisfactory conclusions can be drawn.

Phenanthrene and Alkyl Phenanthrenes

Phenanthrene (and anthracene), C_1-, C_2- and C_3-phenanthrene were monitored using the M/Z 178, 192, 206 and 220 fragmentograms. The sample from 2305 m in the Heimdal Fm. does not show any sign of anthracene. Only the single peak for phenanthrene is recorded in the sample. The M/Z 192 fragmentogram shows the two doublets for methylphenanthrenes. The

2-methyl- and 9-methylphenanthrenes have the largest peaks with 1-methylphenanthrene being 90 % of the two other peaks. 3-methylphenanthrene is the smallest of the peaks. A pattern as seen here is not common for the North Sea samples and could be caused by alterations in the reservoirs. The M/Z 206 and 220 fragmentograms show patterns typical of well mature hydrocarbons.

Alkyl Dibenzothiophenes

C_1- and C_2-dibenzothiophenes were monitored using M/Z 198 and 212 fragmentograms. The C_1-dibenzothiophenes are dominated by the 4-methyl compound. The high 4/1 and 3+2/1 ratios for this sample indicate that it is highly mature. Similarly, in the C_2-dibenzothiophenes the early eluting compounds dominate, which is typical of highly mature source rocks.

Aromatic Steranes

The monoaromatic and triaromatic steranes were monitored using the M/Z 253 and 231 fragmentograms respectively. The monoaromatic steranes have a high noise to signal ratio and are dominated by peak C_1 and an unknown peak eluting in front of the light molecular compounds. It is, however, suspected that the peaks eluting in the high molecular monosterane range also include compounds which are not monoaromatic steranes, with M/Z 253 fragmentation. For example benzophyrenes may contribute if present in large amounts relative to residual monoaromatic steranes. The triaromatic steranes are dominated by the low molecular weight C_{20} and C_{21} compounds, produced by sidechain scission of the C_{26} - C_{28} compounds during maturation. Clearly, this sample contains hydrocarbons which are highly mature with virtually 80 % $C_{20} - C_{21}/C_{26} - C_{28}$.

Draupne Formation

Alkyl Benzenes

The M/Z 106 fragmentogram of the siltstone sample from 3555 m in the Draupne Fm. is dominated by a single peak eluting between the C_{24} and C_{25} doublets, representing C_2 benzenes. The C_2 benzenes are shown as doublets in the C_{13} - C_{36} range, with a maximum at C_{16}. There is a regular, slow decrease in the abundance of the doublets with increasing molecular weight from C_{16}. The M/Z 134 fragmentogram shows a large unresolved envelope together with a large number of unidentified peaks in the low molecular weight range.

Alkyl Naphthalenes

The M/Z 142 fragmentogram shows the 1-methylnaphthalene to dominate with 2-methylnaphthalene having a relative abundance of approximately 50 %. There are, however, clear signs that this sample has lost components with low boiling-point and this may have affected the ratios between the methylnaphthalenes and further evaluation is therefore not undertaken. The M/Z 156 fragmentogram shows a typical pattern for C_2 naphthalenes with 1,3+1,7 and 1,6 dimethyl naphthalenes as the largest peaks, while the M/Z 170 fragmentogram shows a pattern often seen for mature hydrocarbons in samples from the North Sea.

Phenanthrene and Alkyl Phenanthrenes

There is no anthracene in this sample, which shows only the single peak for phenanthrene in the M/Z 178 fragmentogram. The M/Z 192 fragmentogram shows the two doublets for methylphenantrenes with the doublet consisting of 9- and 1-methylphenanthrene being the larger. The doublet with 3- and 2-methylphenanthrene has an abundance of approximately 50 % of the other doublet. The pattern seen here is typical of mature hydrocarbons in North Sea samples. The M/Z 206 and 220 fragmentograms both show patterns which are typical of mature hydrocarbons in North Sea samples.

Alkyl Dibenzothiophenes

The M/Z 190 fragmentogram shows the 4-methyl dibenzothiophene as the largest peak, but with 1-methyl dibenzothiophene as the second largest peak. This is surprising compared with the other results, since a pattern as seen here would normally indicate moderate mature samples. The M/Z 212 fragmentogram shows the peaks with the highest retention times to be most abundant. This would also indicate a moderate mature sample.

Aromatic Steranes

The M/Z 253 fragmentogram shows peaks E_1 and G_1 to be most abundant. The light molecular component has a low abundance, while peaks C_1, D_1 and H_1 have an abundance of 50 - 60 % of peaks E_1 and G_1. The pattern seen here is typical of mature hydrocarbons from the North Sea. This is verified by the M/Z 231 fragmentogram, which shows the light molecular weight triaromatic steranes to have a moderate abundance compared to the C_{26} - C_{27} components.

Brent Group

Alkyl Benzenes

The M/Z 106 fragmentograms of the four samples from the Brent Gp. vary. The two sandstone samples from 3561.3 m and 3609.3 m have a distribution similar to that found in the siltstone sample in the Draupne Fm., while the sandstone sample from 3590.21 m has a distribution similar to that found in the siltstone sample from 2305 m in the Heimdal Fm. The coal sample from 3619.85 m shows a distribution different to all other samples in this well. The doublets of C_2 benzenes from C_{11} - C_{28} are registered, but there are also a number of other peaks. Some components elute together with the foremost peak in some of the doublets, for example C_{18}, C_{22} and C_{24}, causing "distortion" of the doublets. It is not known what these components are. The M/Z 134 fragmentograms show a large unresolved envelope in all three sandstone samples, together with a large number of peaks which may represent two homologous series of compounds. These peaks are not identified. The coal sample from 3619.85 m shows a large peak with a retention time of approximately 22.5 minutes and a few other distinctive peaks with lower abundances. None of these peaks are identified. The pattern seen here is different to those normally found in North Sea hydrocarbon samples.

Alkyl Naphthalenes

The M/Z 142 fragmentograms clearly show losses of components with lower boiling-points in the three sandstone samples and evaluation of these are therefore not undertaken. The coal sample shows the 2 methylnaphthalene to be the most abundant. The M/Z 156 and 170 fragmentograms are also affected by the loss of low boiling-point components, while the coal sample shows the 1,6 dimethylnaphthalene to be most abundant. The rest of the peaks, apart from 1,3+1,7 dimethylnaphthalenes, are only minor components in the M/Z 156 fragmentogram, while the M/Z 170 fragmentogram is dominated by the 1,2,4+1,2,5 trimethylnaphthalene peak.

Phenanthrene and Alkyl Phenanthrenes

None of the sandstone samples show any sign of anthracene, while the coal sample shows a small abundance of anthracene in the M/Z 178 fragmentogram. The M/Z 192 fragmentograms show the two doublets in all four samples. The three sandstone samples all show the 1-methyl- and 9-methylphenanthrene doublet to be most prominent. Except for a slight increase in the relative abundance of the 2-methylphenanthrene peak, these three samples show a distribution similar to that found in the Draupne Fm. samples. The coal sample from 3619.85 m shows a completely different pattern, with 1-methylphenanthrene as the largest peak and 2-methyl- and 9-methylphenanthrene showing a relative abundance of approximately 60 %. There also occurs a peak eluting between the two doublets of methylphenanthrenes. This is most probably a methylanthracene. The M/Z 206 fragmentograms for the three sandstone samples are similar with the peak representing 1,3+2,10+3,9+3,10 dimethylphenanthrene as the largest peak. Except for a high relative abundance of the 1,7 dimethyl-phenanthrene peak, the pattern seen in these three samples is similar to that found in the Draupne Fm. samples. The pattern in the coal sample from 3619.85 m is different. This shows the 1,7 dimethylphenanthrene as the largest peak. The M/Z 220 fragmentograms are similar in the three sandstone samples, while the coal sample shows a completely different pattern with a larger relative abundance of the components with higher retention times, in good agreement with other data for this sample.

Alkyl Dibenzothiophenes

All the samples from the Brent Gp. show the 4-methyl dibenzothiophene to be most abundant. There is a slight decrease in the 3+2-methyl- and 1-methyl-dibenzothiophene peaks compared with the 4-methyl-dibenzothiophene peak with increasing depth. Such a decrease in relative abundance is also recorded in the 1-methyl-dibenzothiophene compared with the 3+2-methyl dibenzothiophene peak with increasing depth. Such differences indicate increasing maturity with increasing depth. Since these are sandstone samples, it is believed that this might not be a maturity effect, but that it might be caused by mixing of hydrocarbons in the reservoir. The coal sample shows a number of peaks in addition to the methyl dibenzothiophene peaks. These peaks are not identified. The M/Z 212 fragmentograms of the C_2 dibenzothiophenes register the same phenomenas as reported for the methyldibenzothiophenes.

Aromatic Steranes

The M/Z 253 fragmentograms for monoaromatic steranes in the three sandstone samples show the same pattern as that seen in the Draupne Fm. sample, while the coal sample shows only one peak, eluting in front of the C_{21} monoaromatic sterane. This peak is not identified. Some small peaks are also registered in the C_{27} - C_{29} monoaromatic sterane range, but these are too small to be positively identified. The M/Z 231 fragmentograms vary slightly for the three sandstone samples, mainly in an increase of the relative abundance of the light molecular components with increasing depth, which would indicate an increasing maturity with increasing depth. Except for this, the pattern is similar to that seen in the Draupne Fm. sample. The pattern for the coal sample is completely different to all the other samples. The light molecular samples almost disappear in the background noise, while peak e_1, i.e. S_{20} C_{28} triaromatic sterane is the most abundant peak.

CONCLUSIONS

The following conclusions have been made on the basis of the analyses performed on well NOCS 15/5-1.

Source Rock Potential

Post Jurassic (0 - 3492 m)

This interval contains no prospective source rocks.

Upper Jurassic

Viking Group (3492 - 3560 m)

Draupne Formation (3492 - 3560 m)

The siltstones of this formation are rich source rocks for oil and mixed oil/gas, having kerogen type II in the upper levels, grading to kerogen type II/III - III with depth. The average hydrogen index for these siltstones is 295 mg HC/g TOC, with a rich average TOC content of 4.8 % and rich petroleum potential of 21 mg HC/g rock.

Middle Jurassic

Brent Group (3560 - 3722 m)

This interval contains coals and carbargillites which are quite liptinitic, having kerogen type II/III - III, hydrogen indices being in the range 182 - 300 mg HC/g TOC. TOC contents range 1.6 - 63 %, with good petroleum potentials of 4 - 169 mg HC/g rock. The Brent interval in this well is therefore considered to be a fair/good source for mixed oil and gas.

Lower Jurassic

Statfjord Formation (3722 - 3775 m, TD)

This interval appears to consist mainly of sands with no source potential, the carbonaceous shales and coals occurring here being caved from the Brent Gp.

Generation and Migration

The Draupne Fm. siltstones have not yet generated significant amounts of hydrocarbons. The Brent Gp. coals and carbargillites are similarly at an early mature stage, only the lowermost levels here being within the oil window. The majority of hydrocarbons found in the source rocks in this well are therefore mainly early in-situ generated.

Regarding migrated hydrocarbons, the Post-Jurassic contains traces of free hydrocarbons which are considered to be mainly due to contamination.

The upper levels of the Brent Gp. (approximately 3560 - 3610 m) contain abundant mature/well-mature migrated light oils together with less mature oils which are probably locally migrated, having been sourced in the prolific kerogen of the Brent Gp. coals/carbargillites. The general fingerprints of the Brent Gp. oils suggest them to have been sourced in a Draupne type (marine) lithology.

The Statfjord Fm. sandstones do not contain any significant hydrocarbon accumulations except traces of gas and migrated (from the Brent Gp.) hydrocarbons.

Maturity

The well 15/5-1 is mainly immature/moderately mature in the Palaeocene and Cretaceous sections. The major part of the potential source rocks lie at early maturity (Ro > 0.5 %), the top of the oil window (Ro 0.6 %) occurring at approximately 3650 m in the lower part of the Brent Gp. interval.

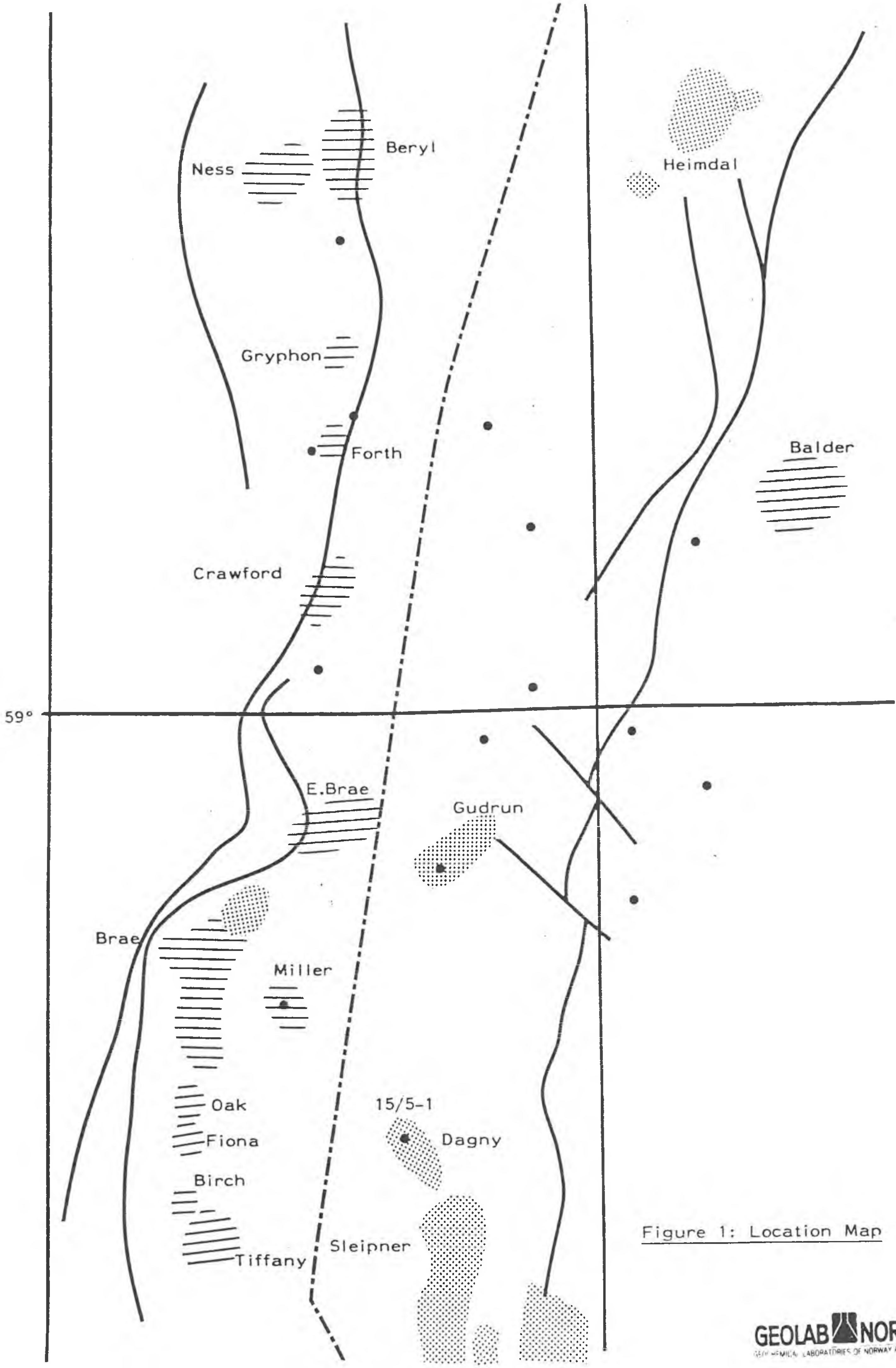

Figure 1: Location Map

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LEGEND FOR FIGURES:

TOC versus Depth

Production Indices versus Depth

Tmax versus Depth

+ Shale/Claystone
x Siltstones
o Coals
▷ Carbonates
◇ Sandstones
⊠ Anhydrite
⊕ Marls
□ Bulk

Figure: 2

Client: VARIOUS

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TOC Data for Well NOCS 15/5-1

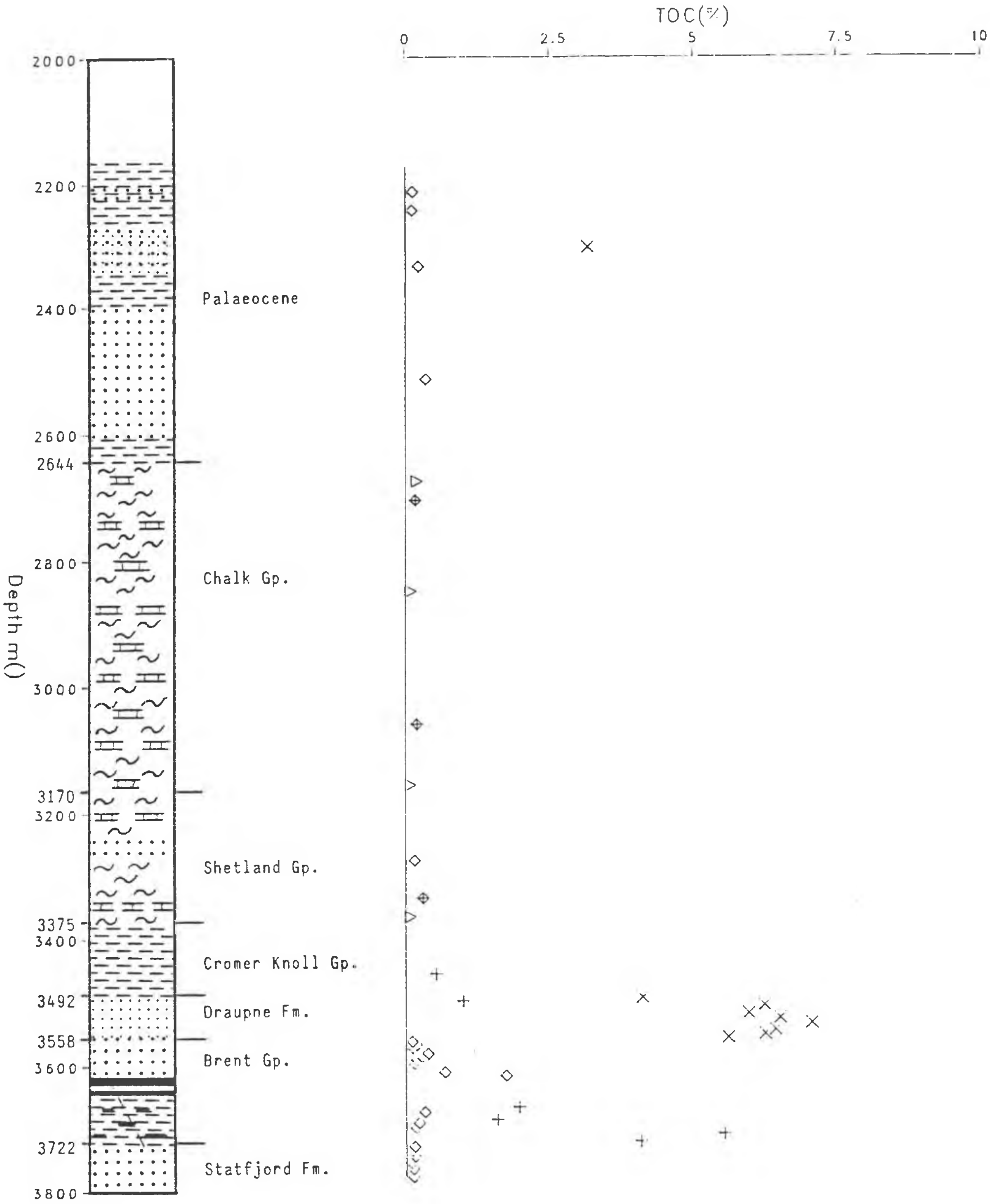

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Figure 3

Production Index Data for Well NOCS 15/5-1

Client: VARIOUS

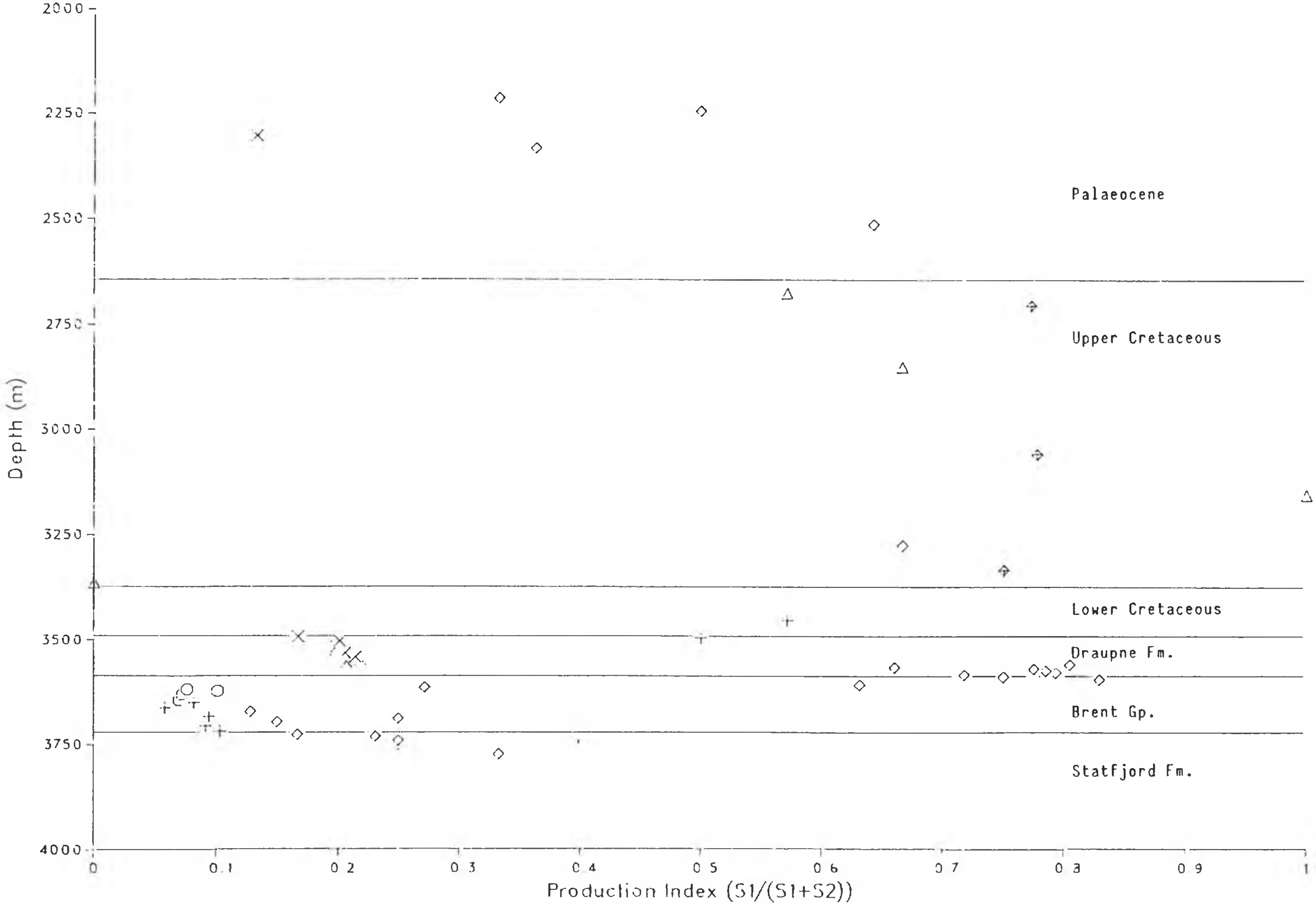

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Figure: 4

Client: VARIOUS

Tmax Data for Well NOCS 15/5-1

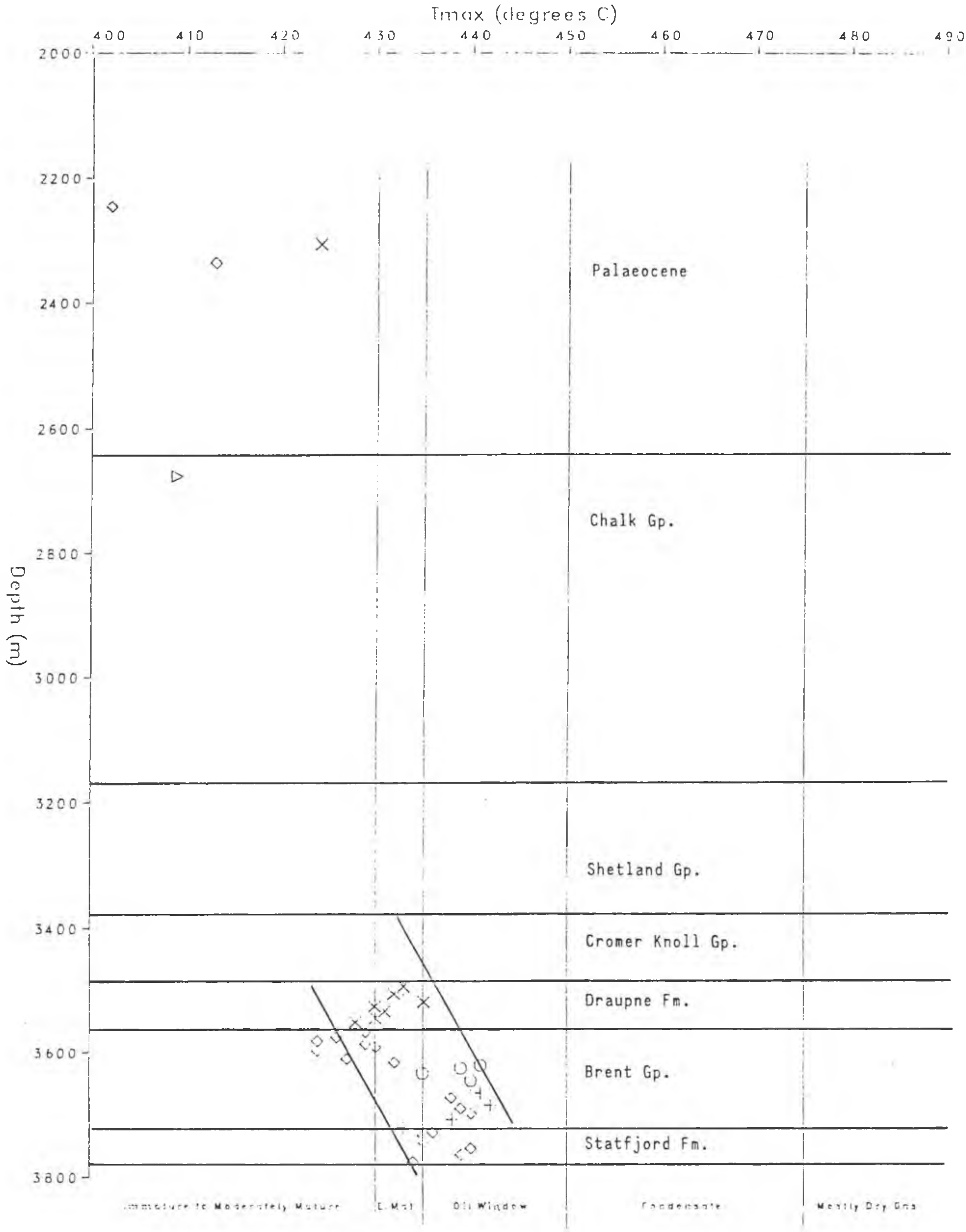

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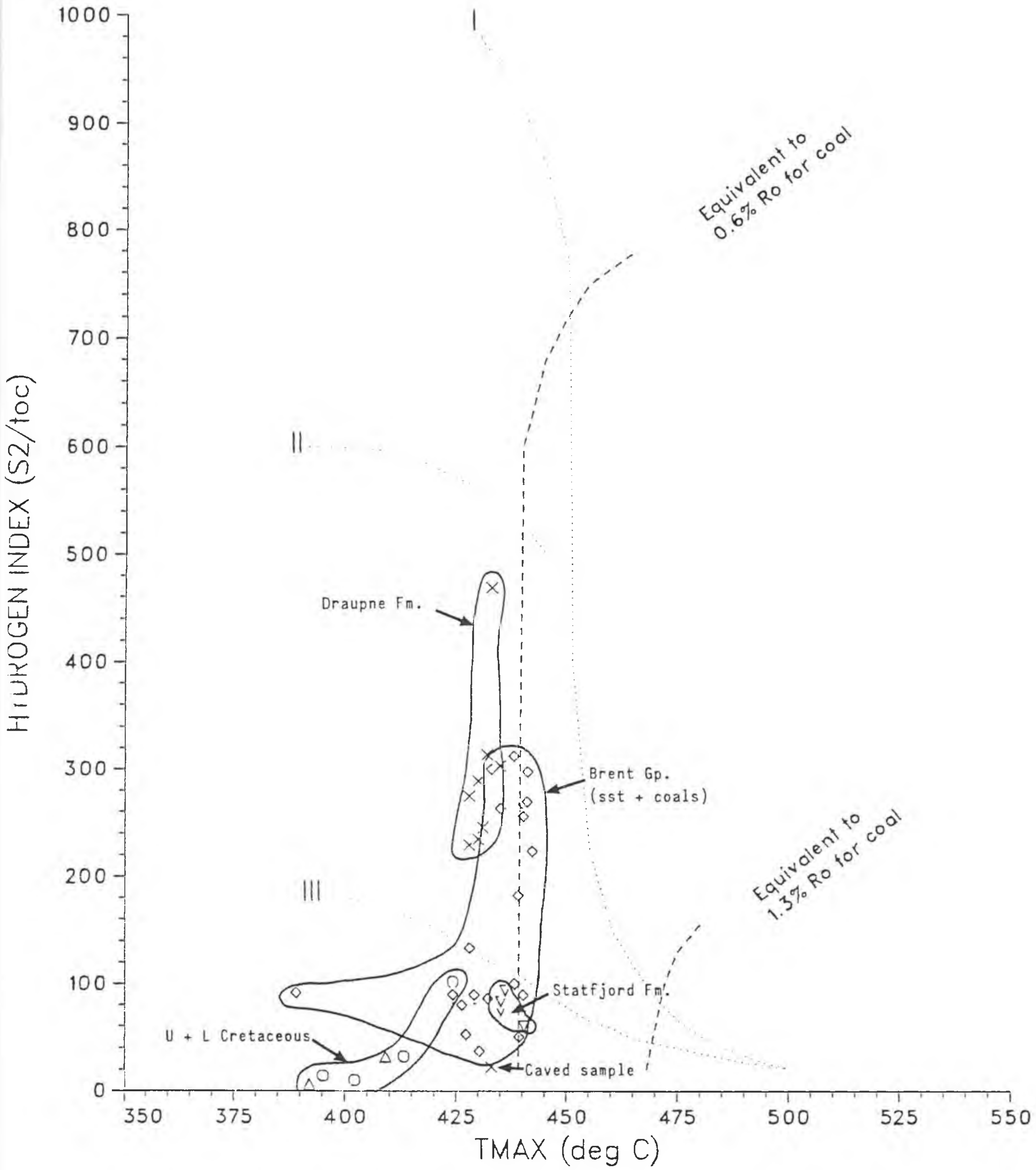
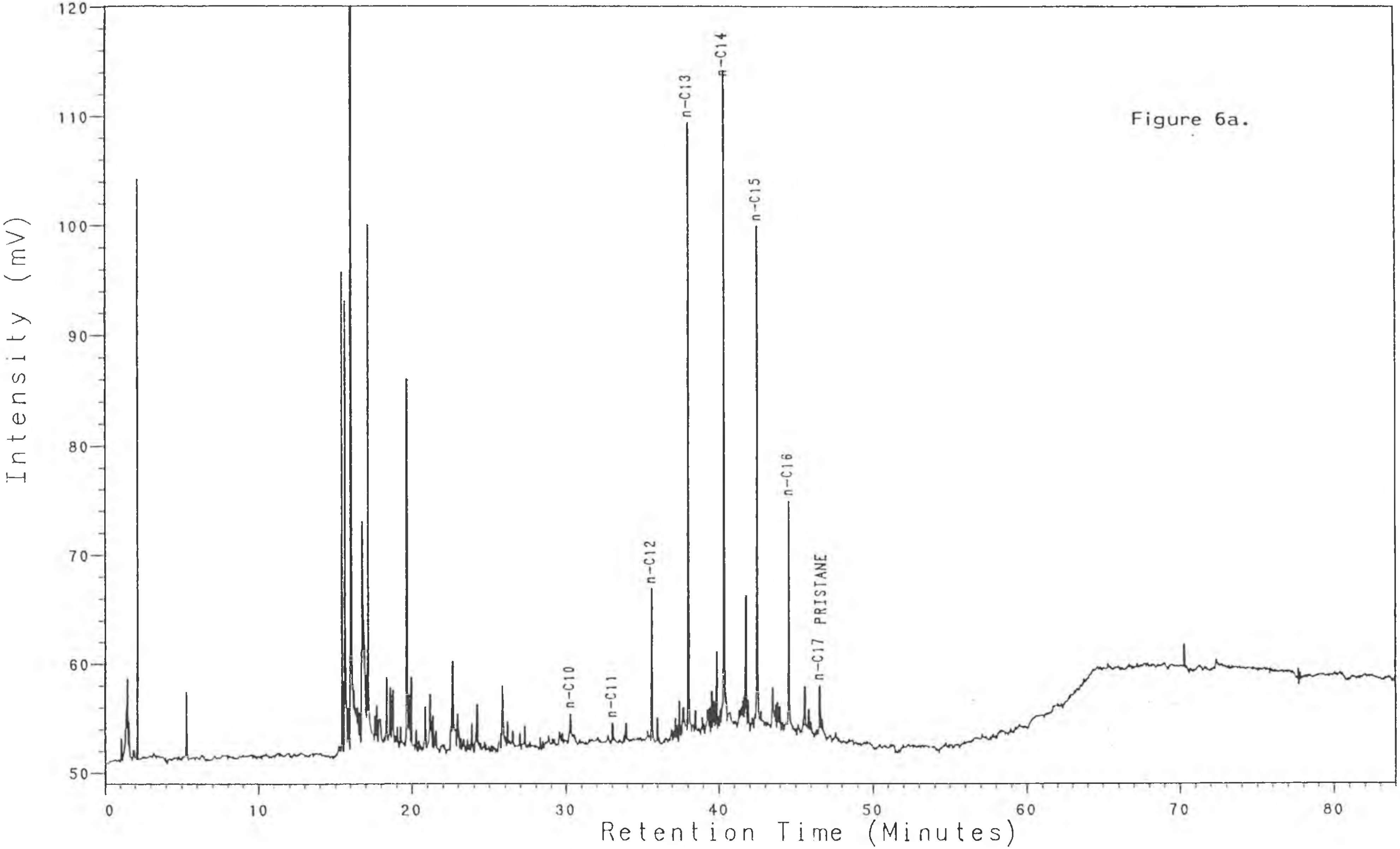
Figure 5 : Hydrogen Index v.s. Tmax values
Well NOCS 15/5-1



Analysis PC9400875 30, 1, 1 15/5-1, 2305m



WELL NOCS 15/5-1 2305m
THERMAL EXTRACTION GC (S1)
Sltst:pl brn

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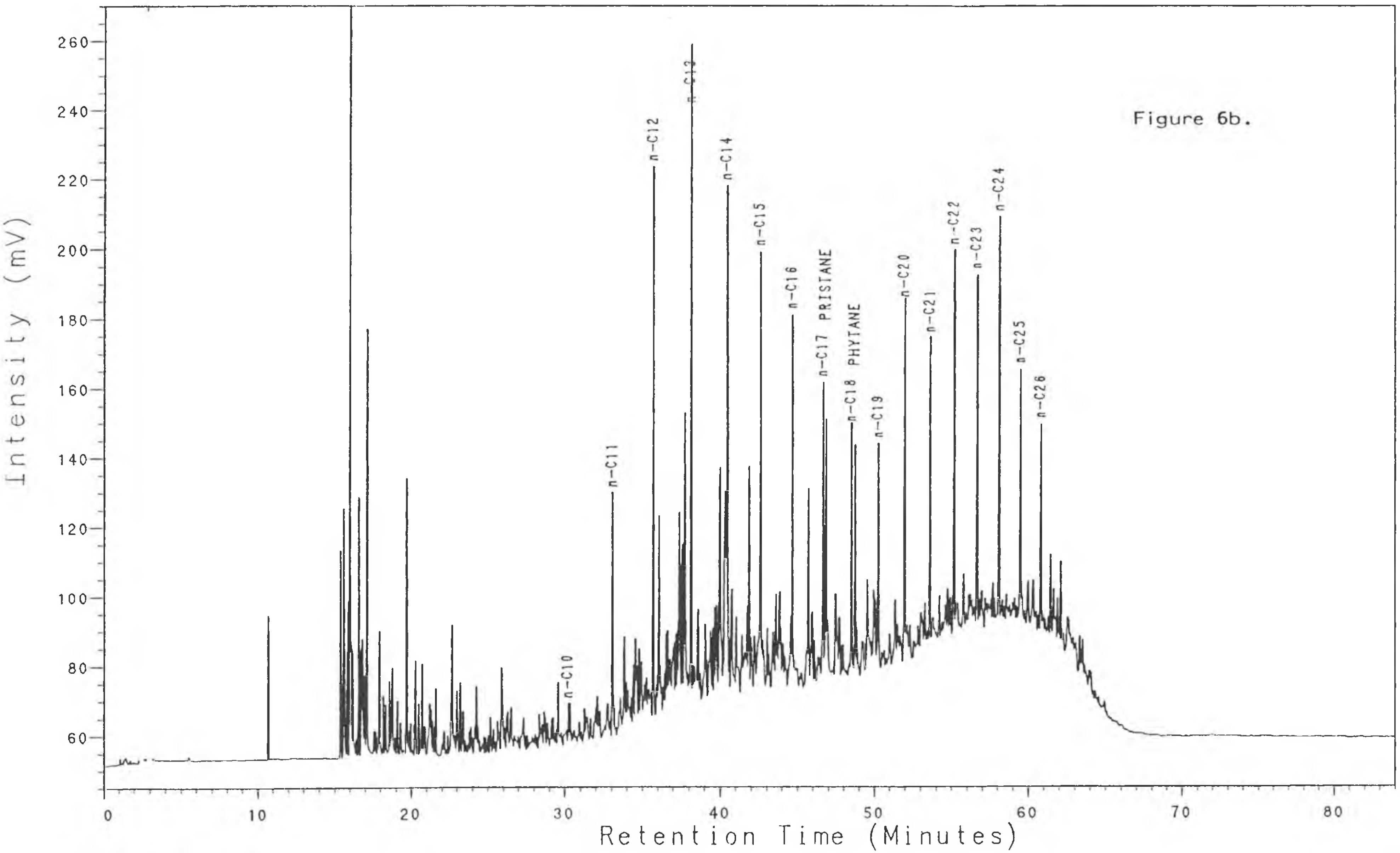
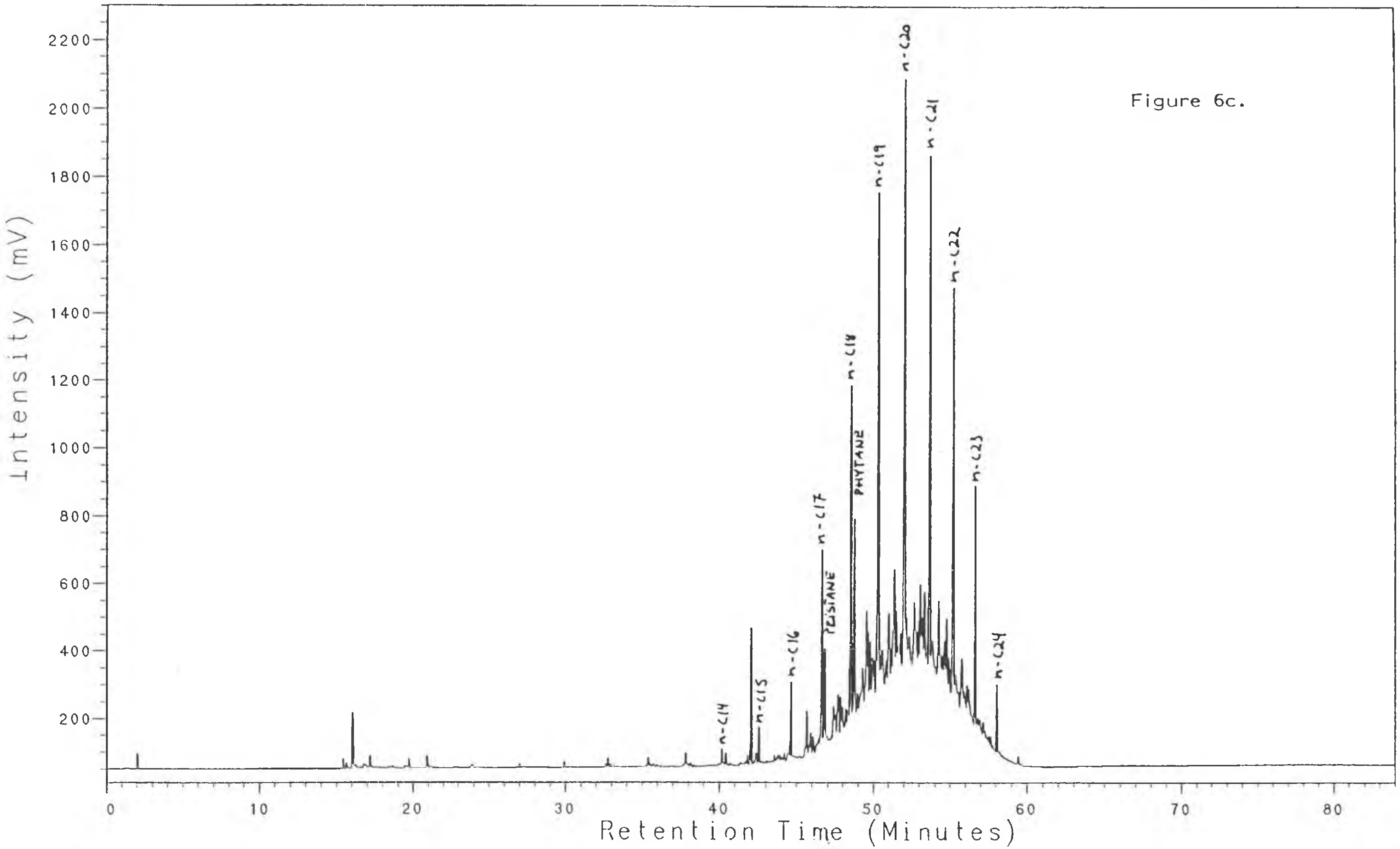
Analysis PC9400304 30, 1, 1 15/5-1, 3493m



WELL NOCS 15/5-1 3493m
THERMAL EXTRACTION GC (S1)
Sltst:dsk brn to dsk y brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

Analysis PC9400402 30, 1, 1 15/5-1, 3555m



WELL NOCS 15/5-1 3555m
THERMAL EXTRACTION GC (S1)
Sltst:dsk y brn to brn blk

GEOLAB NOR
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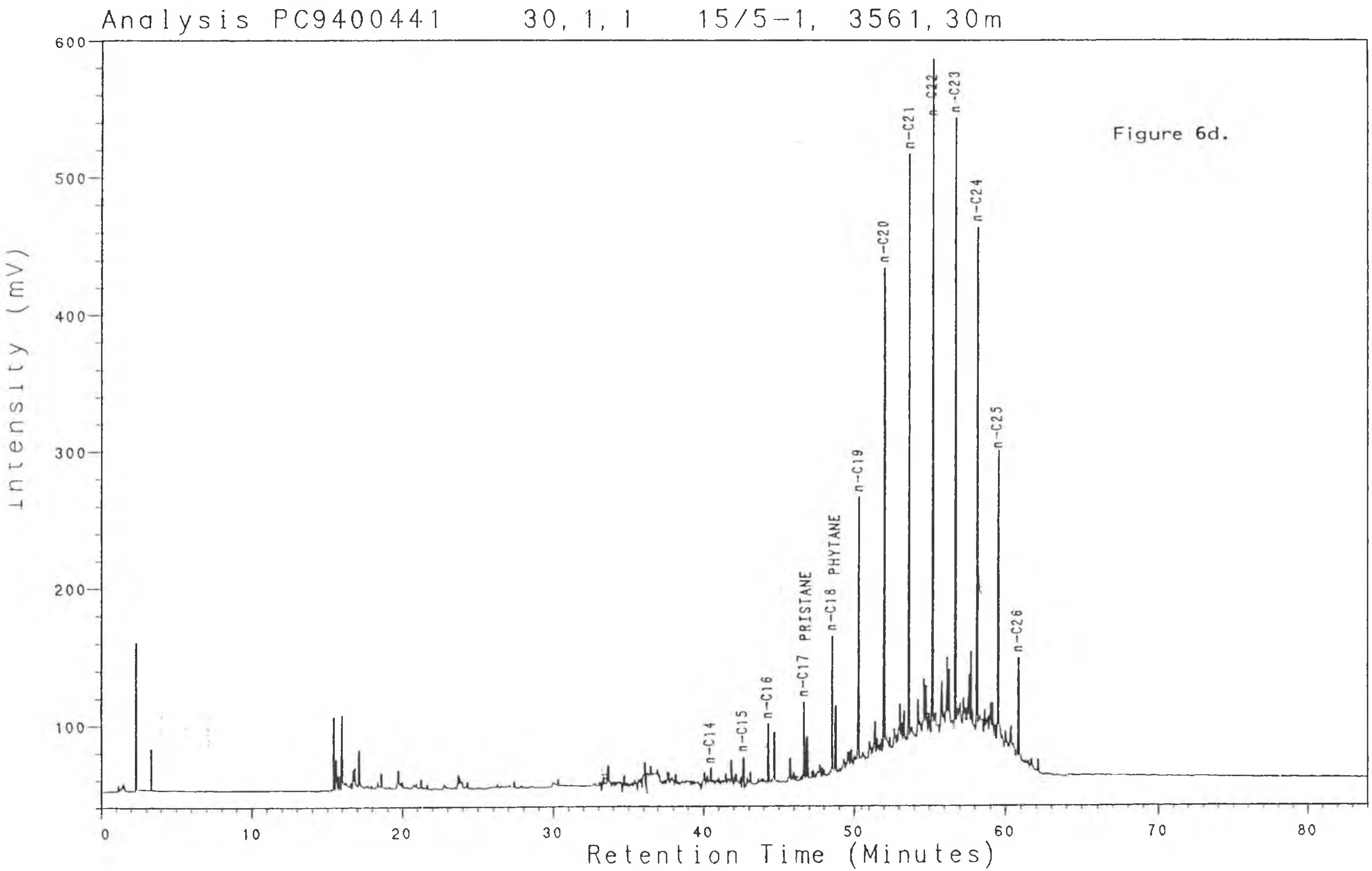
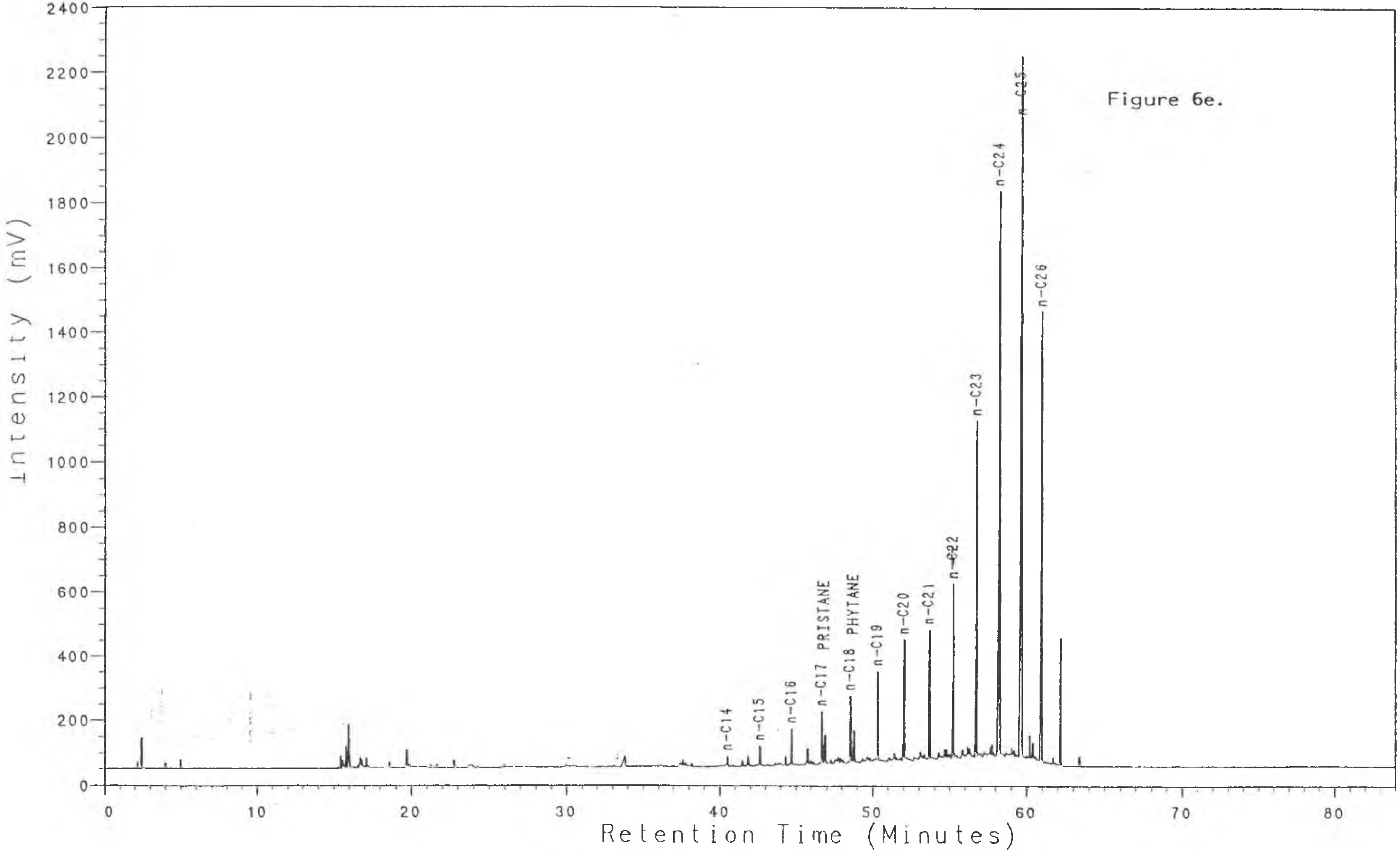


WELL NOCS 15/5-1 3561.30m ccp
THERMAL EXTRACTION GC (S1)
Sst:pl y brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

Analysis PC9400481 30, 1, 1 15/5-1, 3580,28m



WELL NOCS 15/5-1 3580.28m ccp
THERMAL EXTRACTION GC (S1)
Sst:lt y brn

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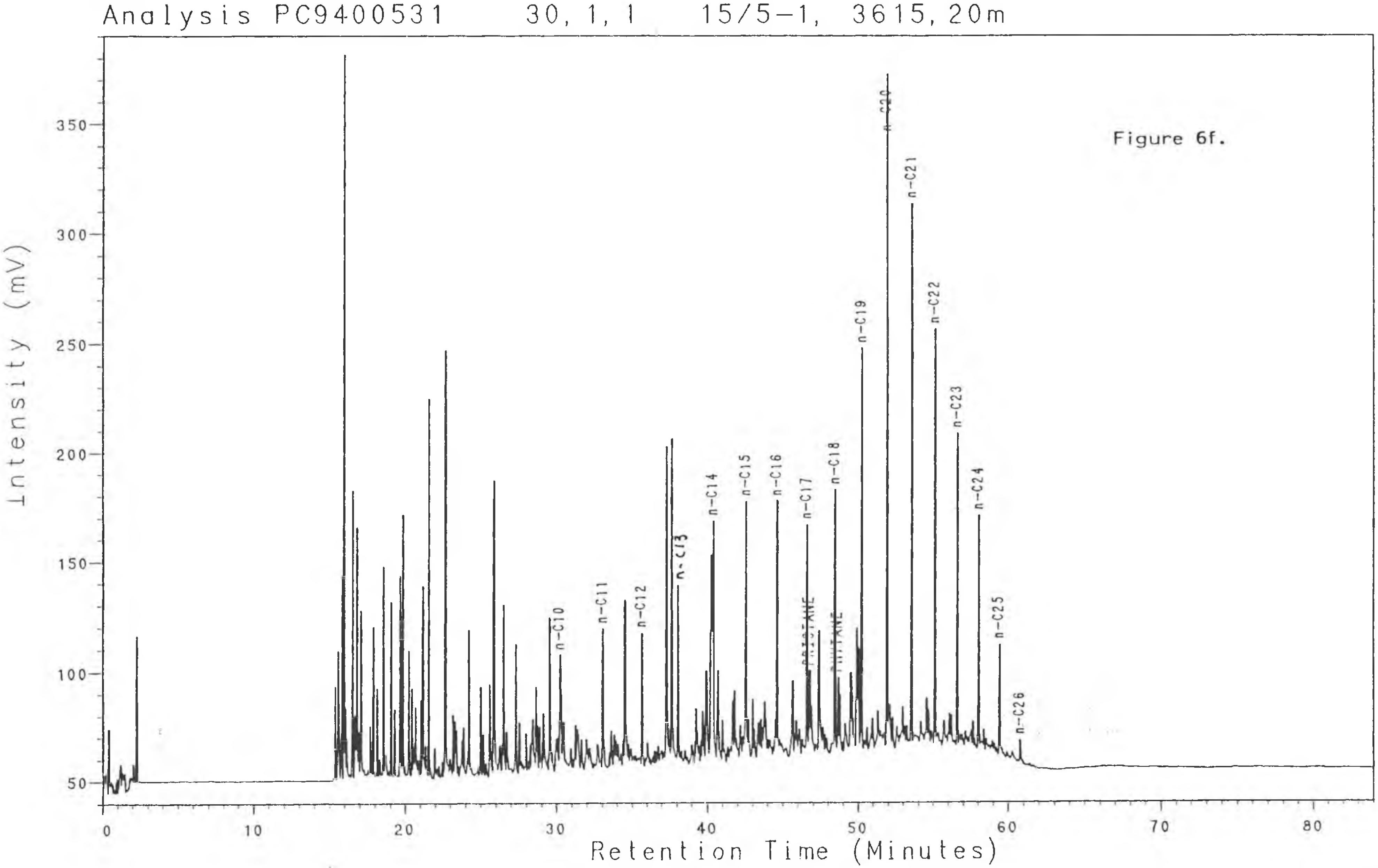

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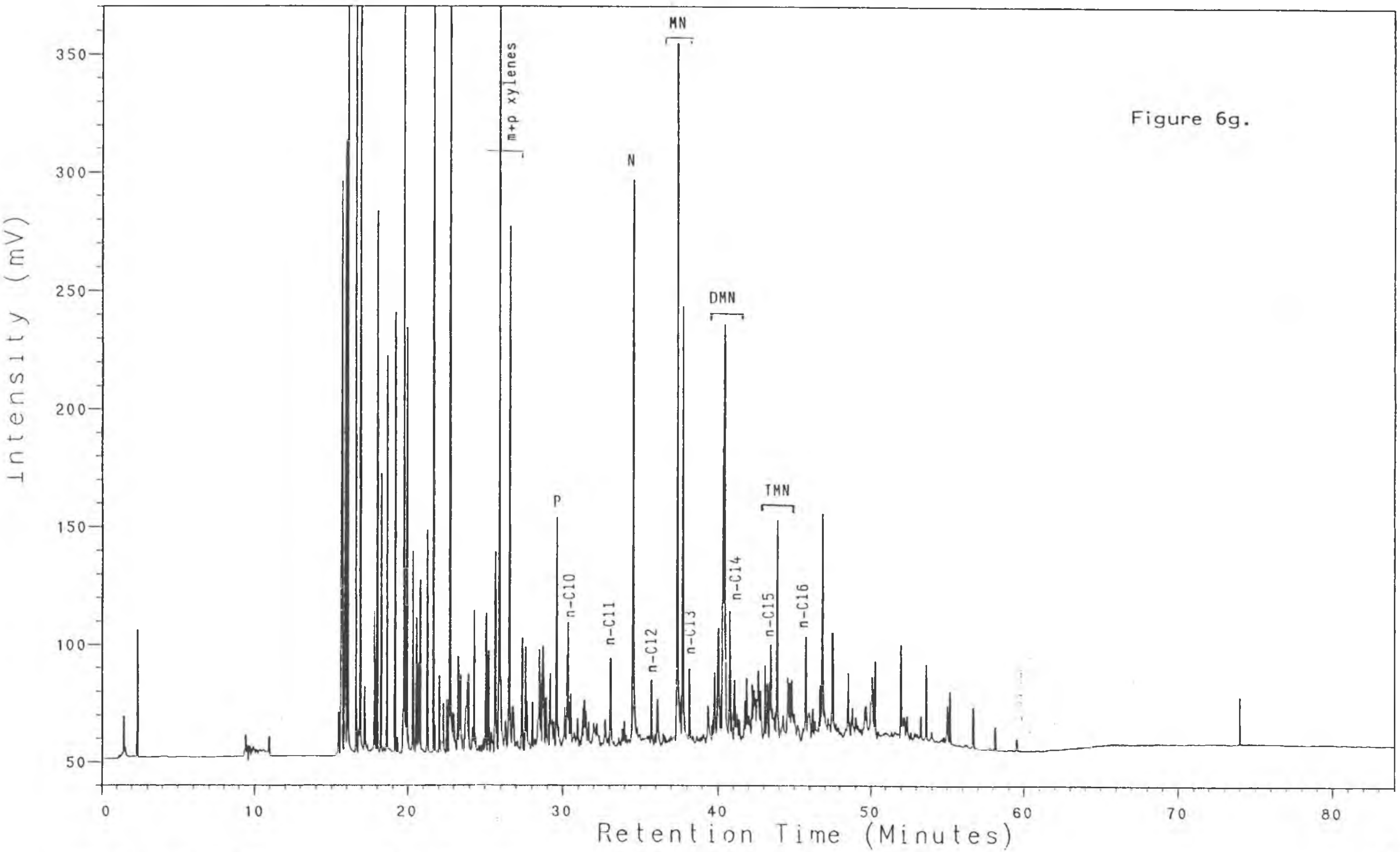
WELL NOCS 15/5-1 3615.20m ccp
THERMAL EXTRACTION GC (S1)
Sst:drk y brn

Analysis PC9400541 30, 1, 1 15/5-1, 3619, 85m



WELL NOCS 15/5-1 3619.85m ccp
THERMAL EXTRACTION GC (S1)
Coal:blk

GEOLAB NOR
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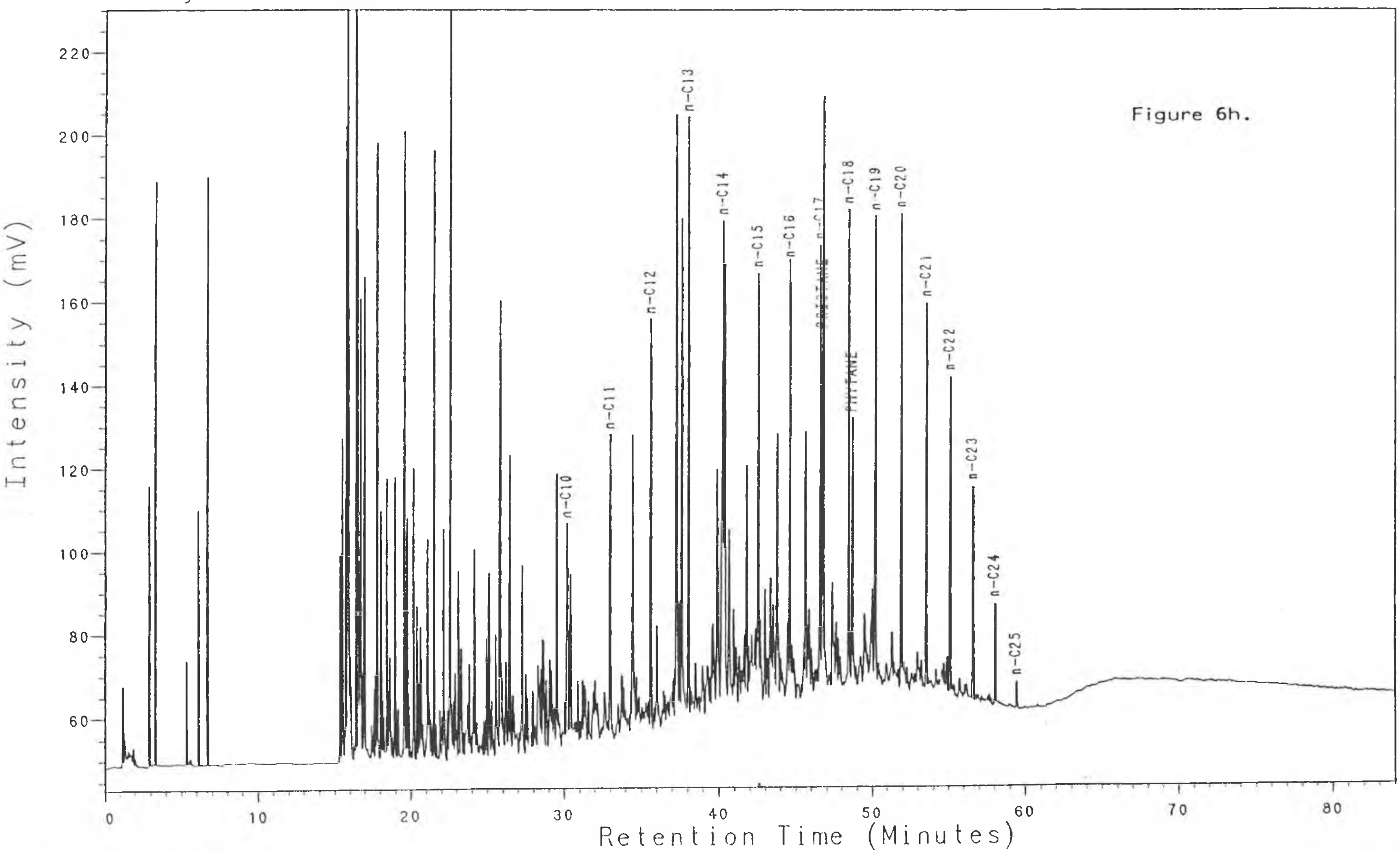
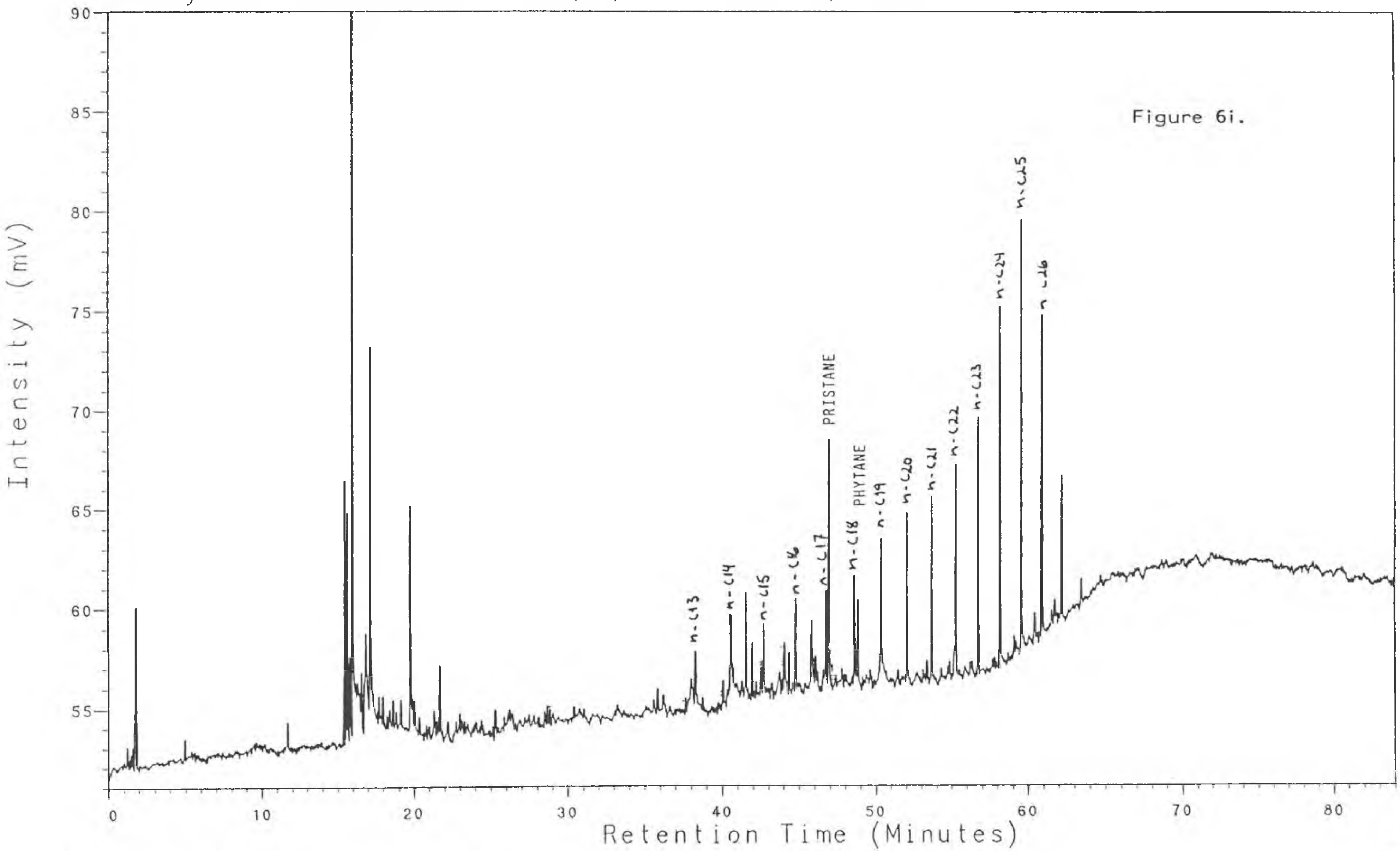
Analysis PC9400691   30, 1, 1   15/5-1, 3708m



WELL NOCS 15/5-1   3708m
THERMAL EXTRACTION GC (S1)
Clst:dsk y brn to brn blk,brn

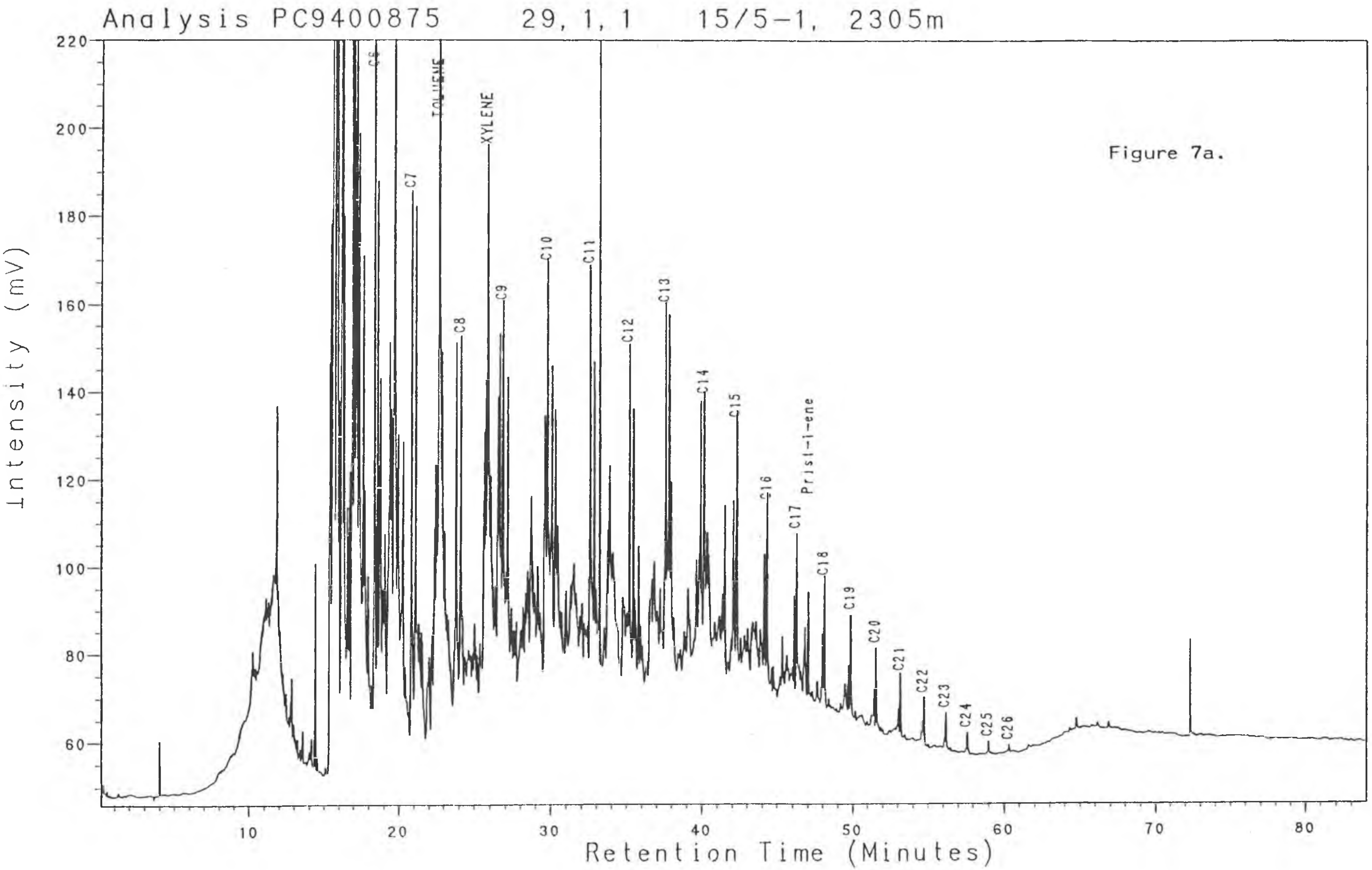
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

Analysis PC9400754   30, 1, 1   15/5-1, 3743m



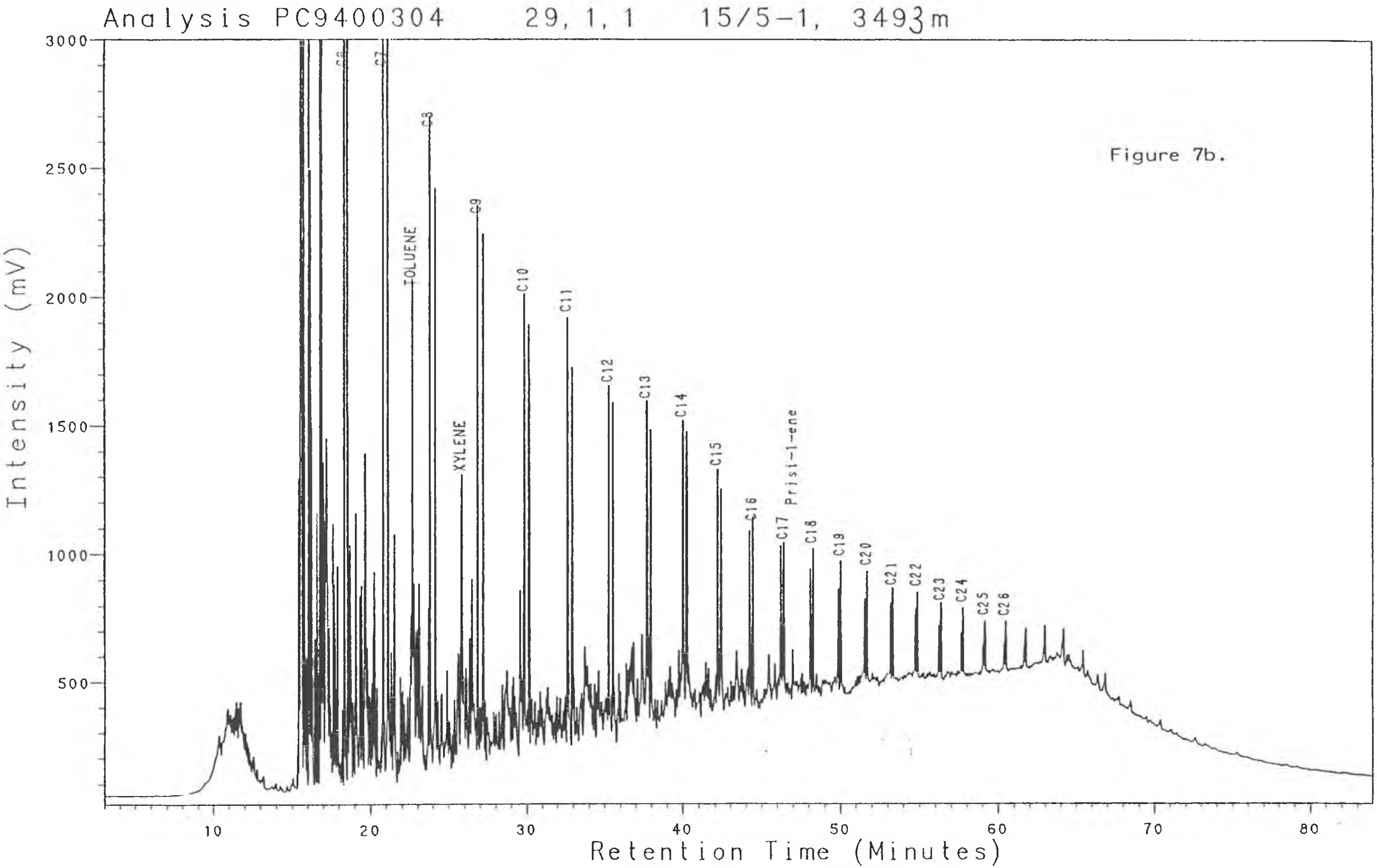
WELL NOCS 15/5-1   3743m
THERMAL EXTRACTION GC (S1)
Sst:w to lt or

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S



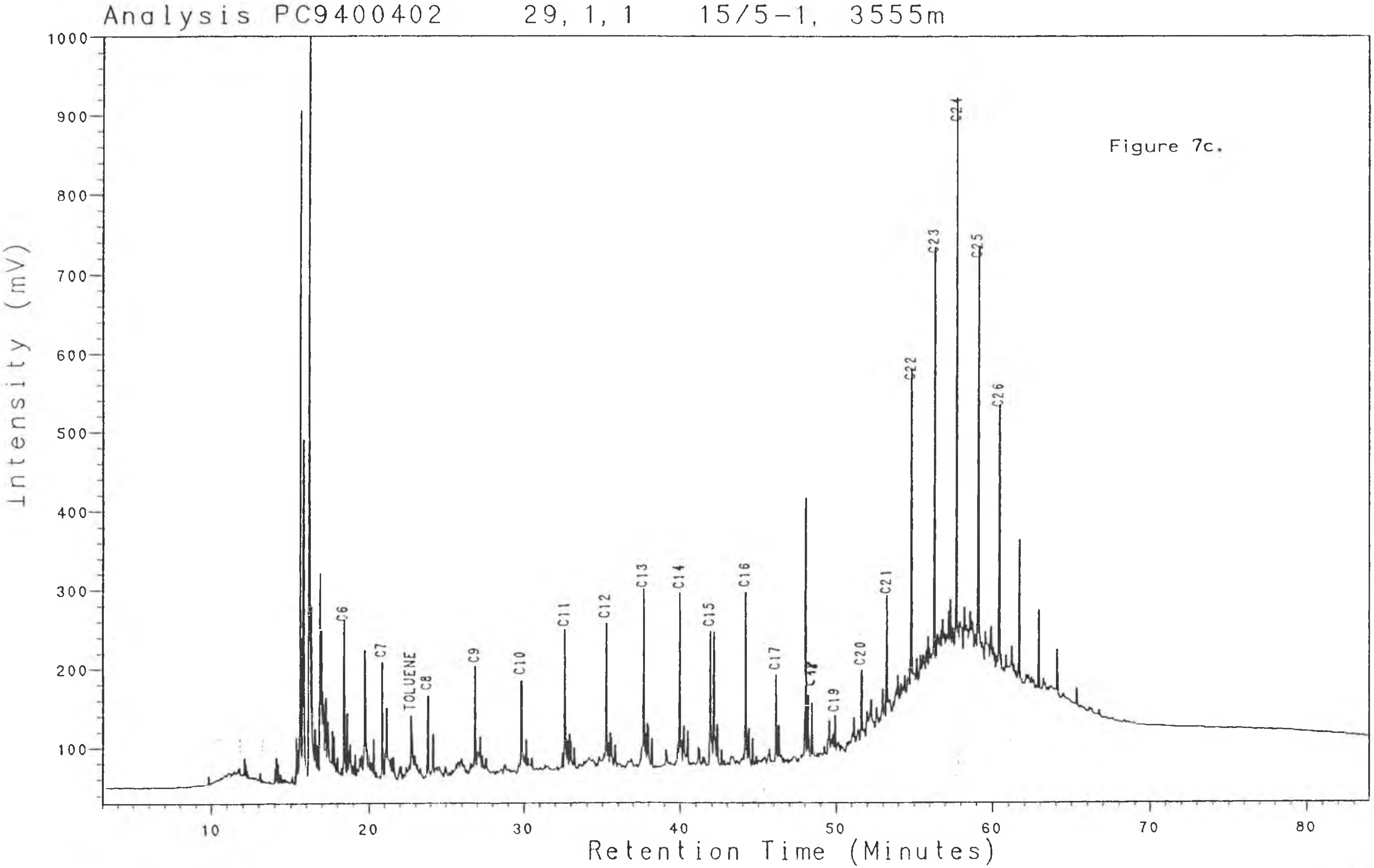
WELL NOCS 15/5-1 2305m
PYROLYSIS GC (S2)
Sltst:pl brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A



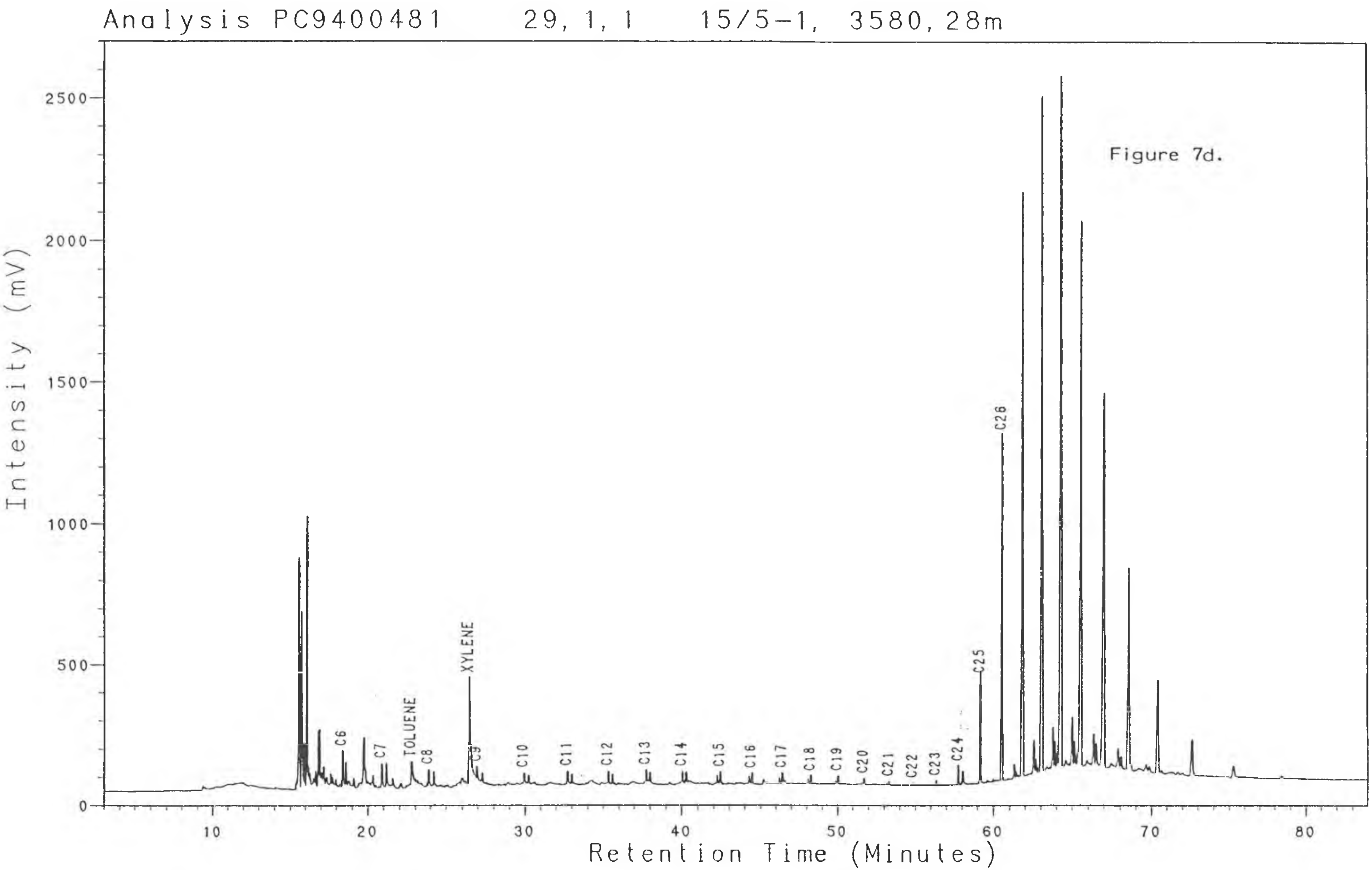
WELL NOCS 15/5-1 3493m
PYROLYSIS GC (S2)
Sltst:dsk brn to dsk y brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S



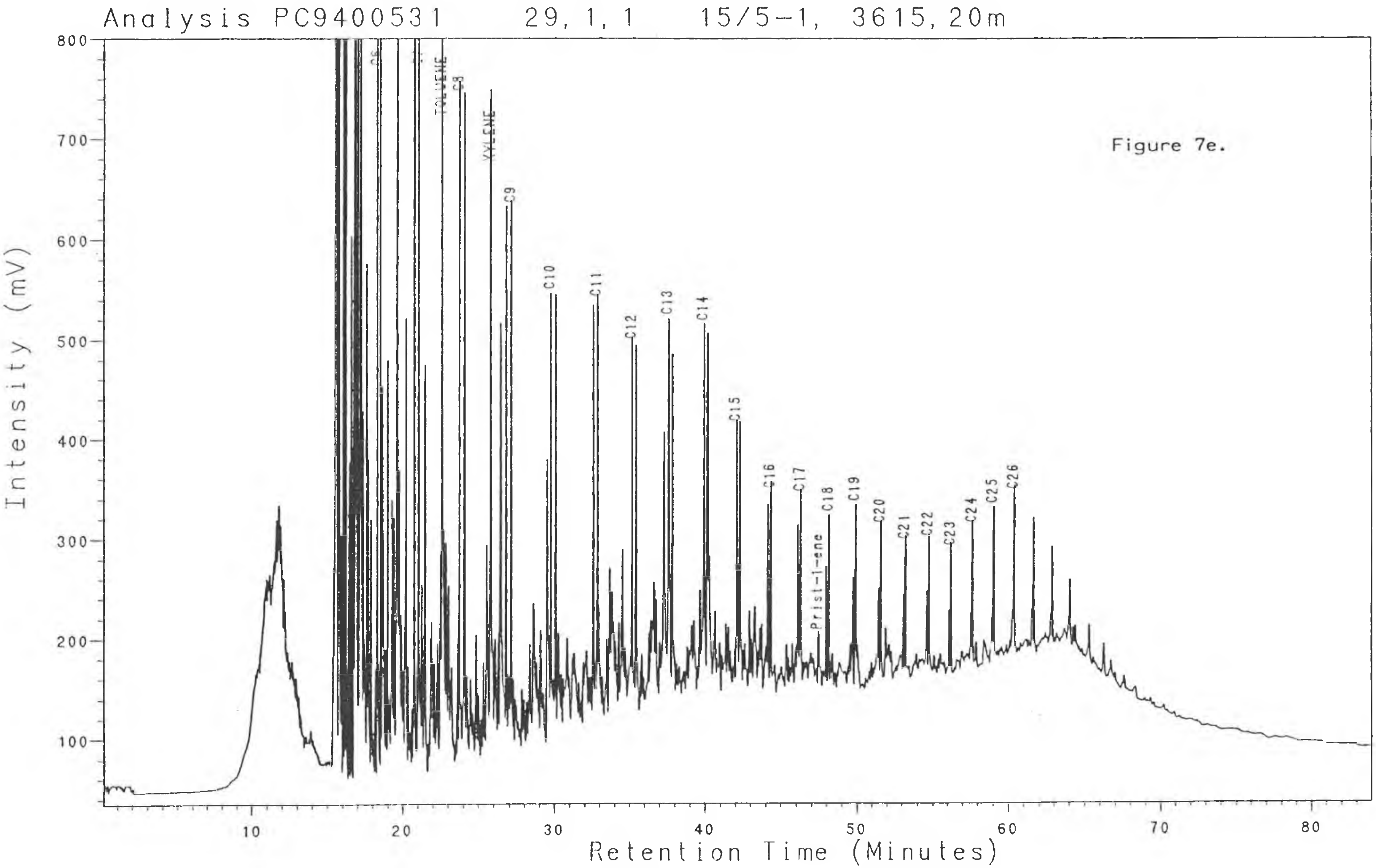
WELL NOCS 15/5-1 3555m
PYROLYSIS GC (S2)
Sltst:dsk y brn to brn blk

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S



WELL NOCS 15/5-1 3580.28m ccp
PYROLYSIS GC (S2)
Sst:lt y brn

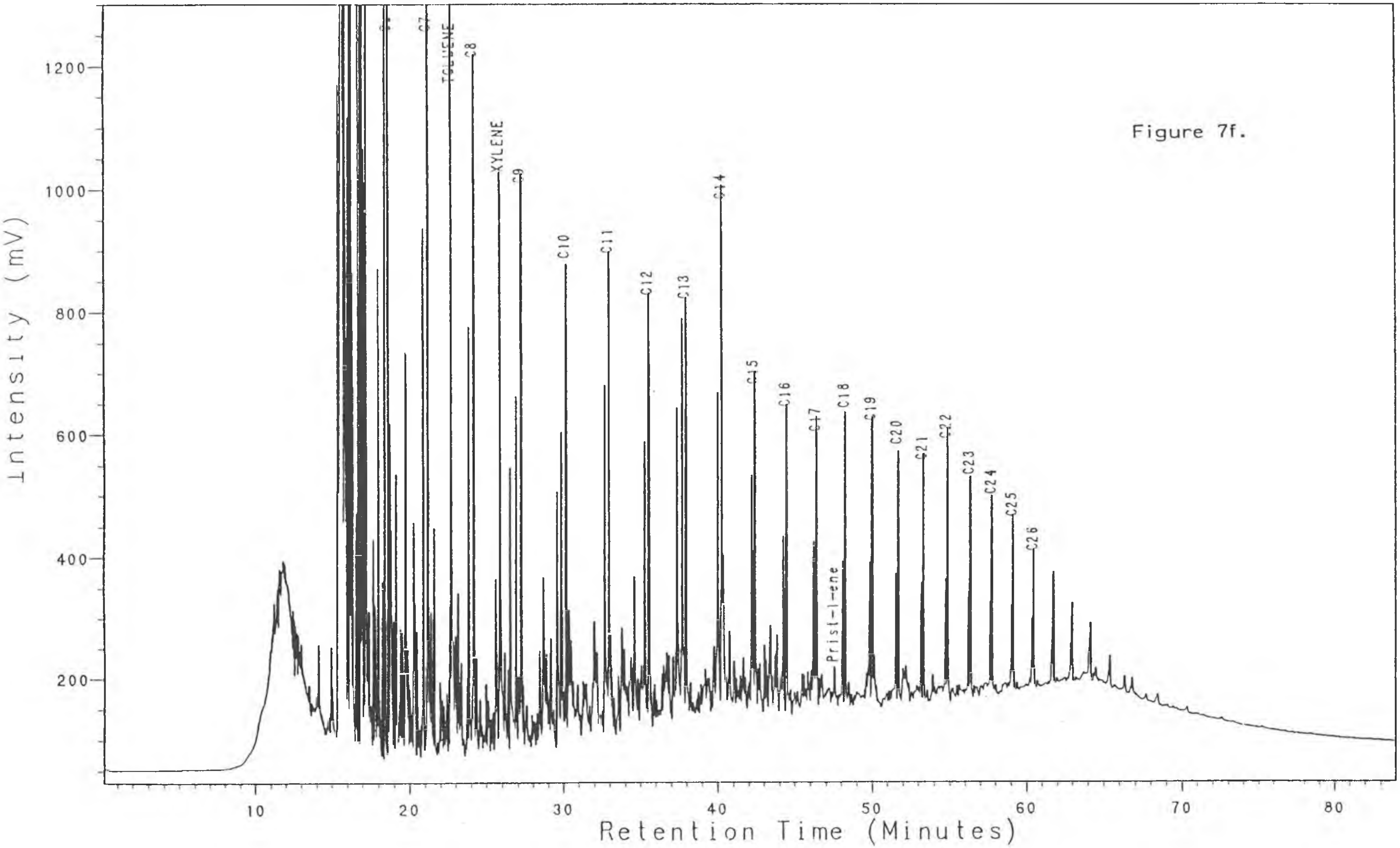
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S



WELL NOCS 15/5-1 3615.20m ccp
PYROLYSIS GC (S2)
Sst:drk y brn

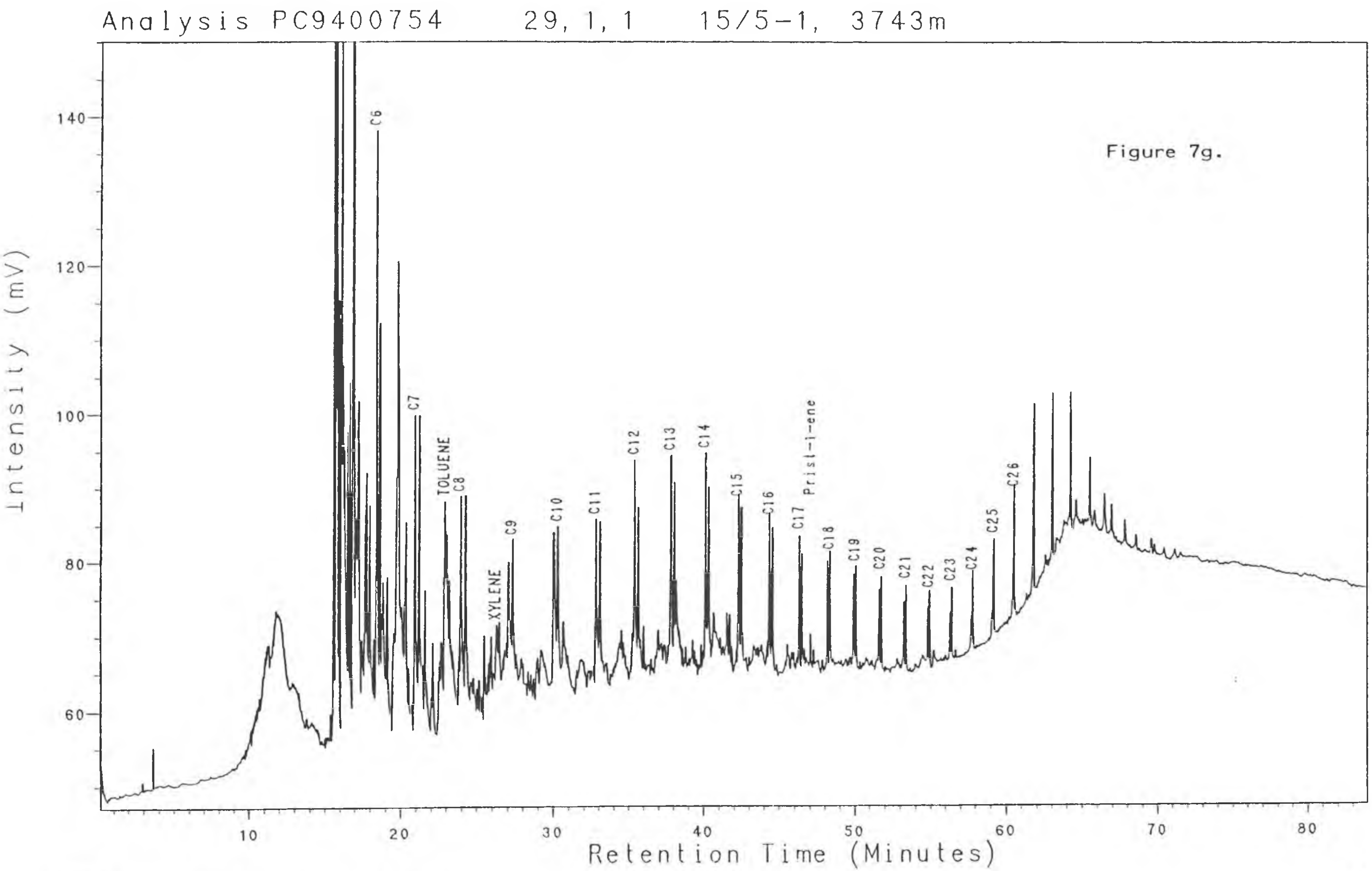
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

Analysis PC9400621   29, 1, 1   15/5-1, 3665m



WELL NOCS 15/5-1   3665m
PYROLYSIS GC (S2)
Clst:brn gy to dsk y brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

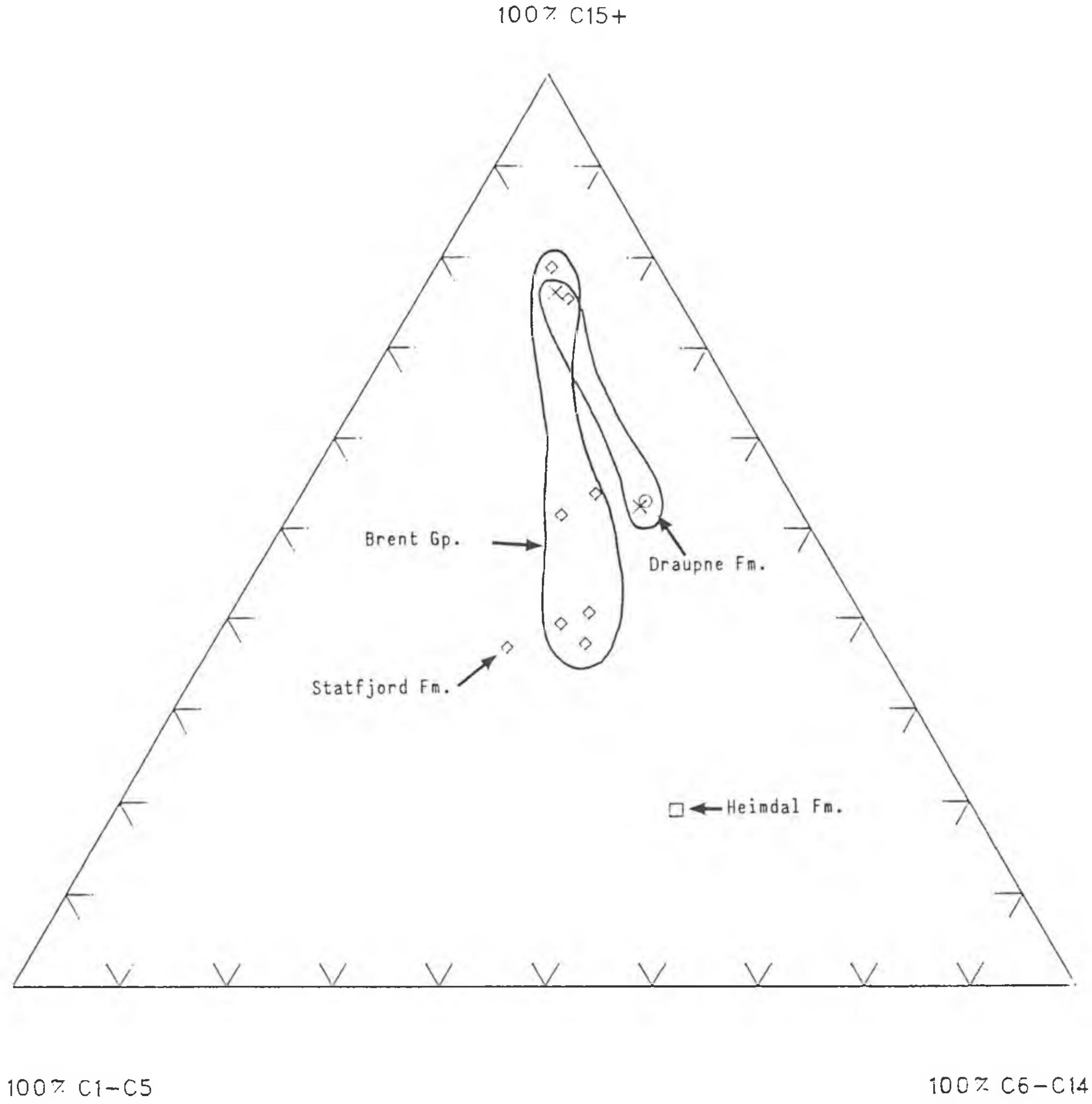


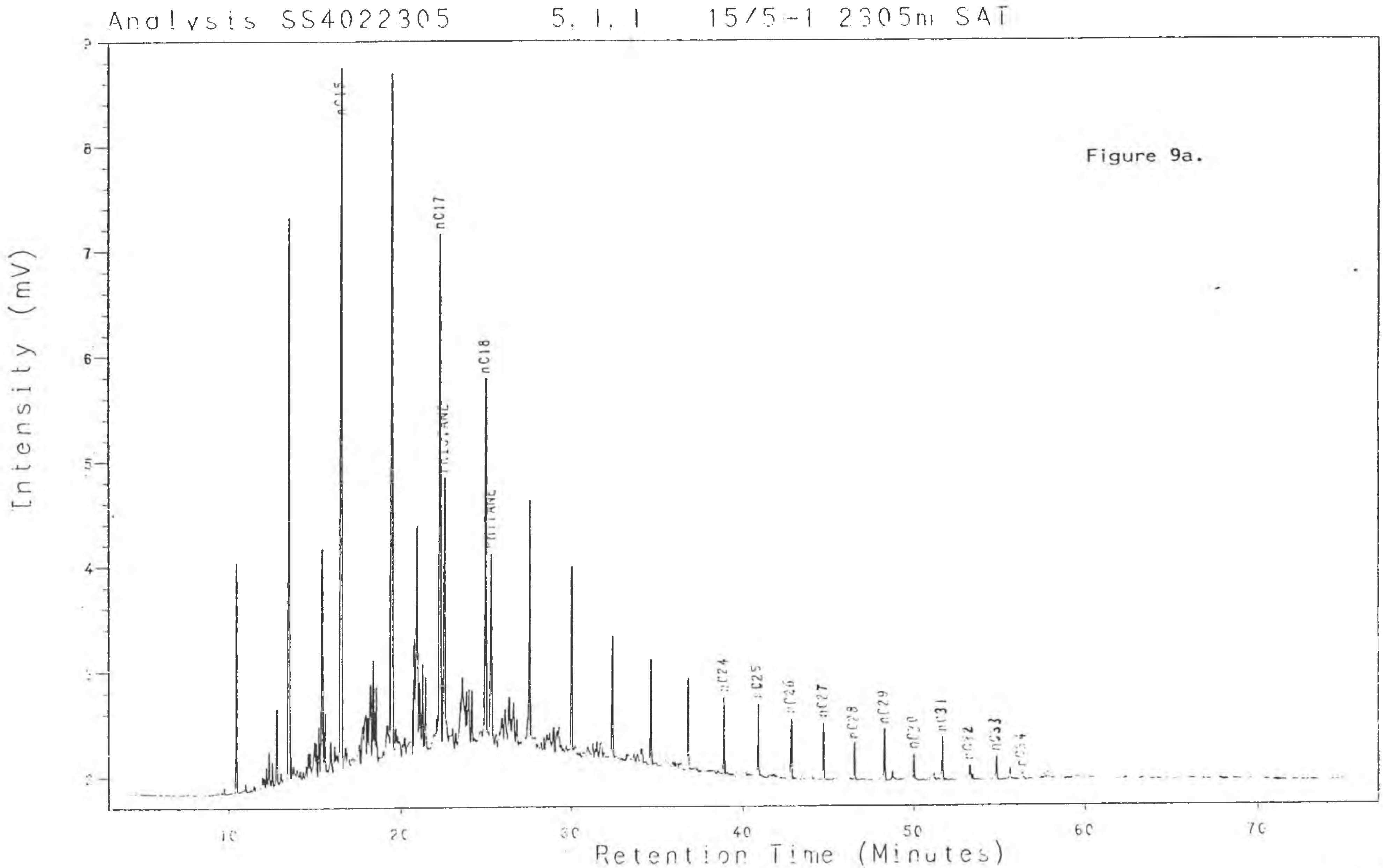
WELL NOCS 15/5-1 **3743m**
PYROLYSIS GC (S2)
Sst:w to lt or

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

Figure 8 : Pyrolysis GC Composition

Well NOCS 15/5-1

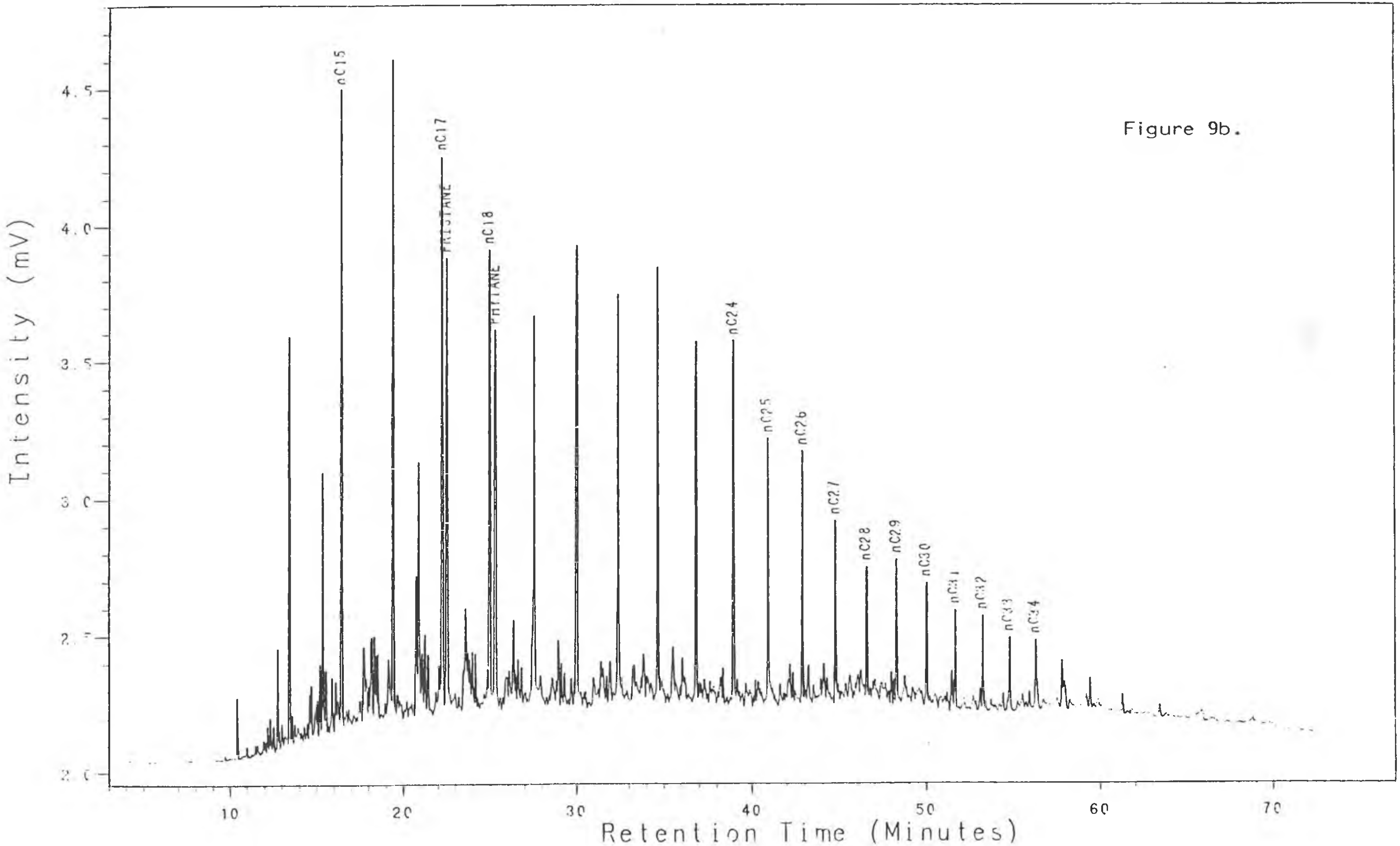




WELL NOCS 15/5-1 2305m
SATURATED GC
Sltst:pl brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

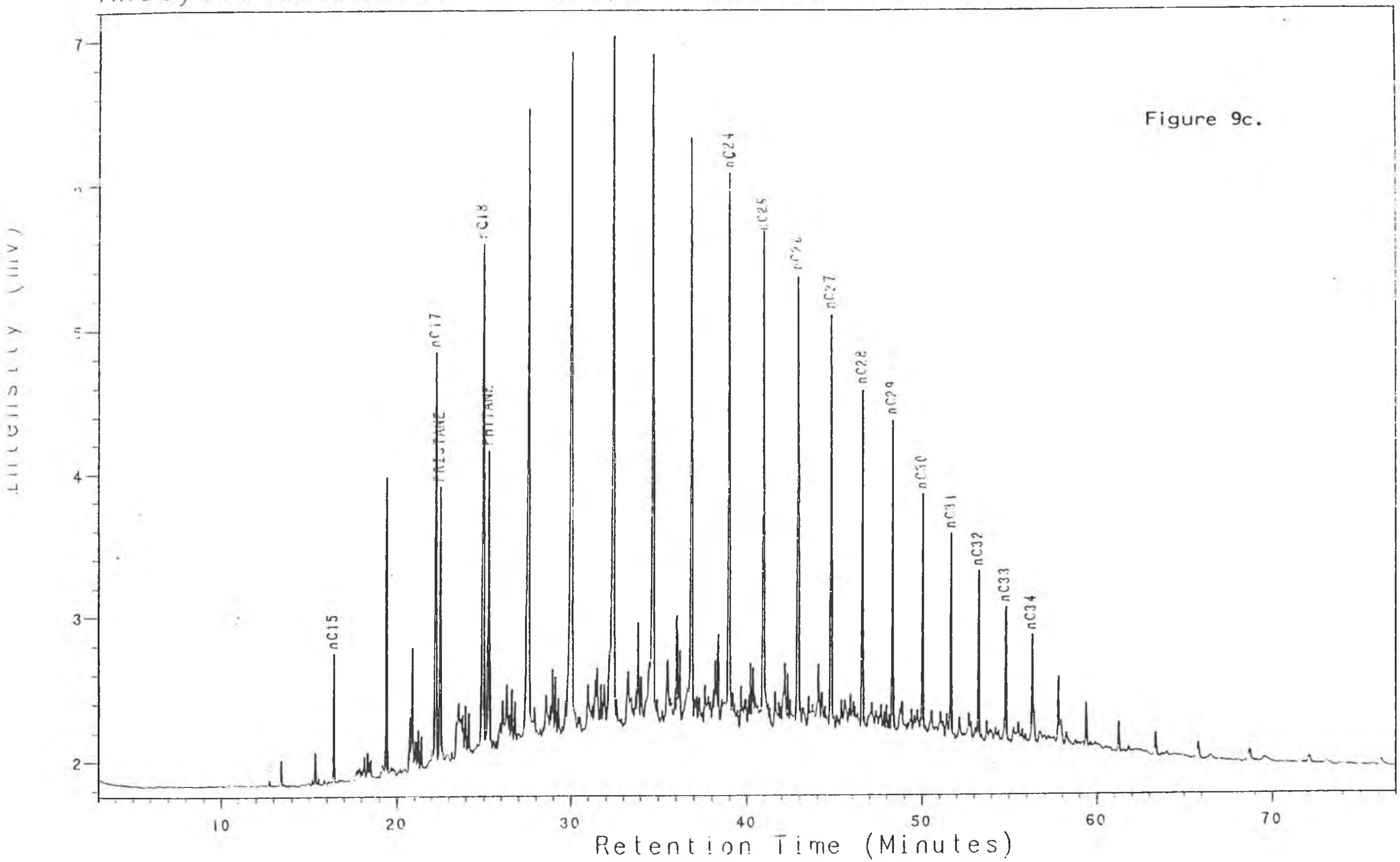
Analysis SS4023493 5.1.1 15/5-1 3493m SAT



WELL NOCS 15/5-1 3493m
SATURATED GC
Sltst:dsk brn to dsk y brn

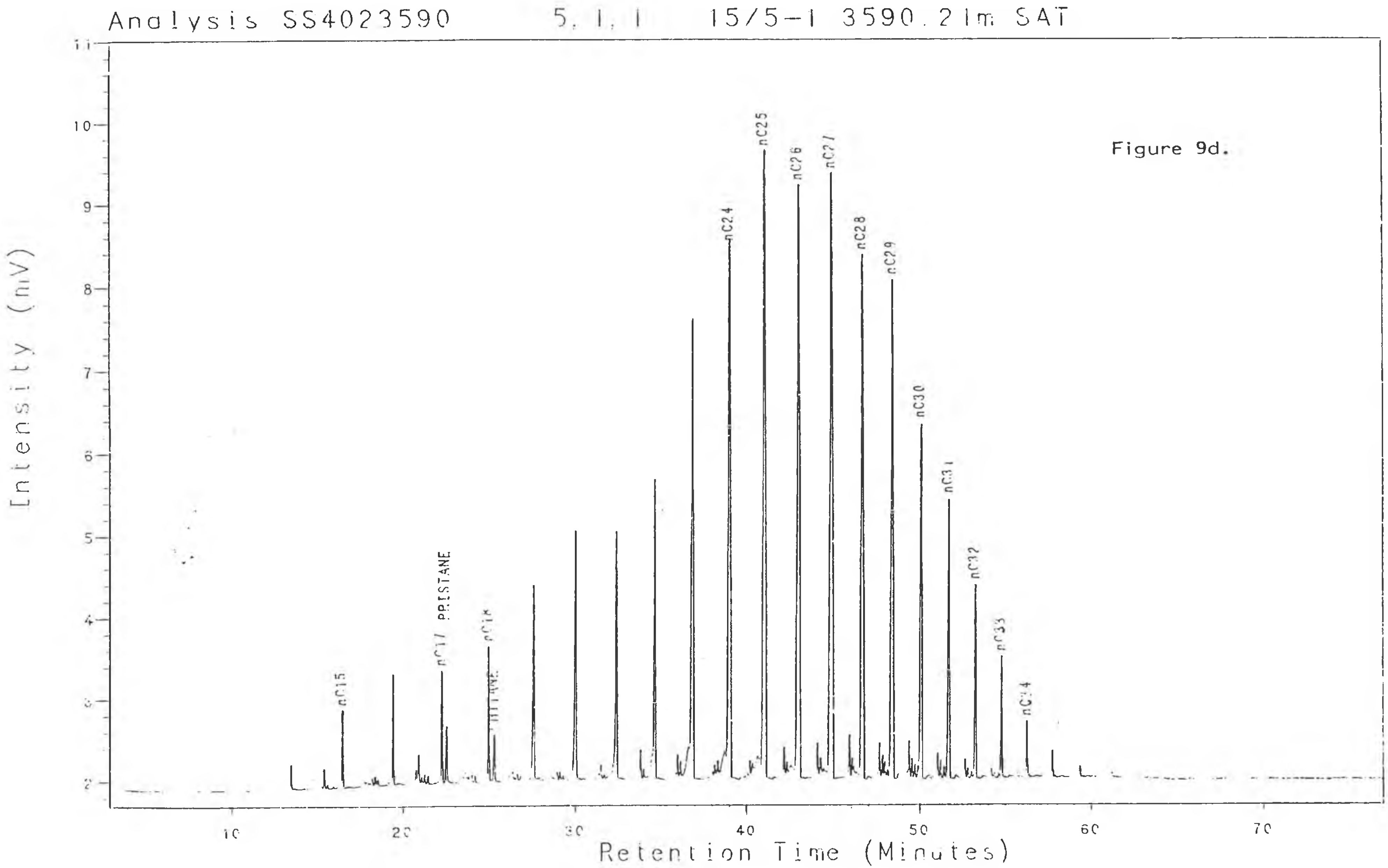
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

Analysis SS4023561 5.1.1 15/5-1 3561.30m SAT



WELL NOCS 15/5-1 3561.30m ccp
SATURATED GC
Sst:pl y brn

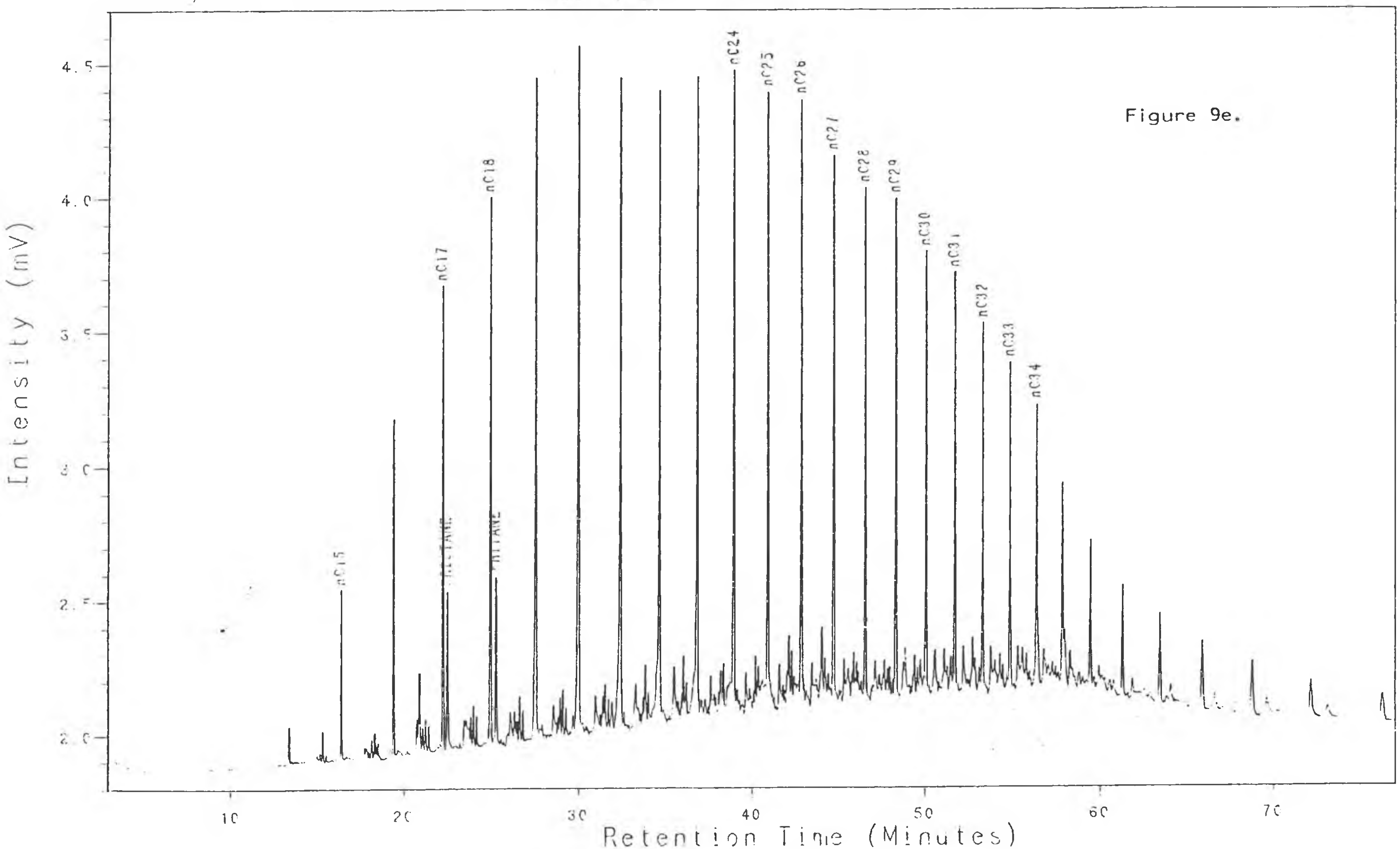
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S



WELL NOCS 15/5-1 3590.21m ccp
SATURATED GC
Sst:lt gy

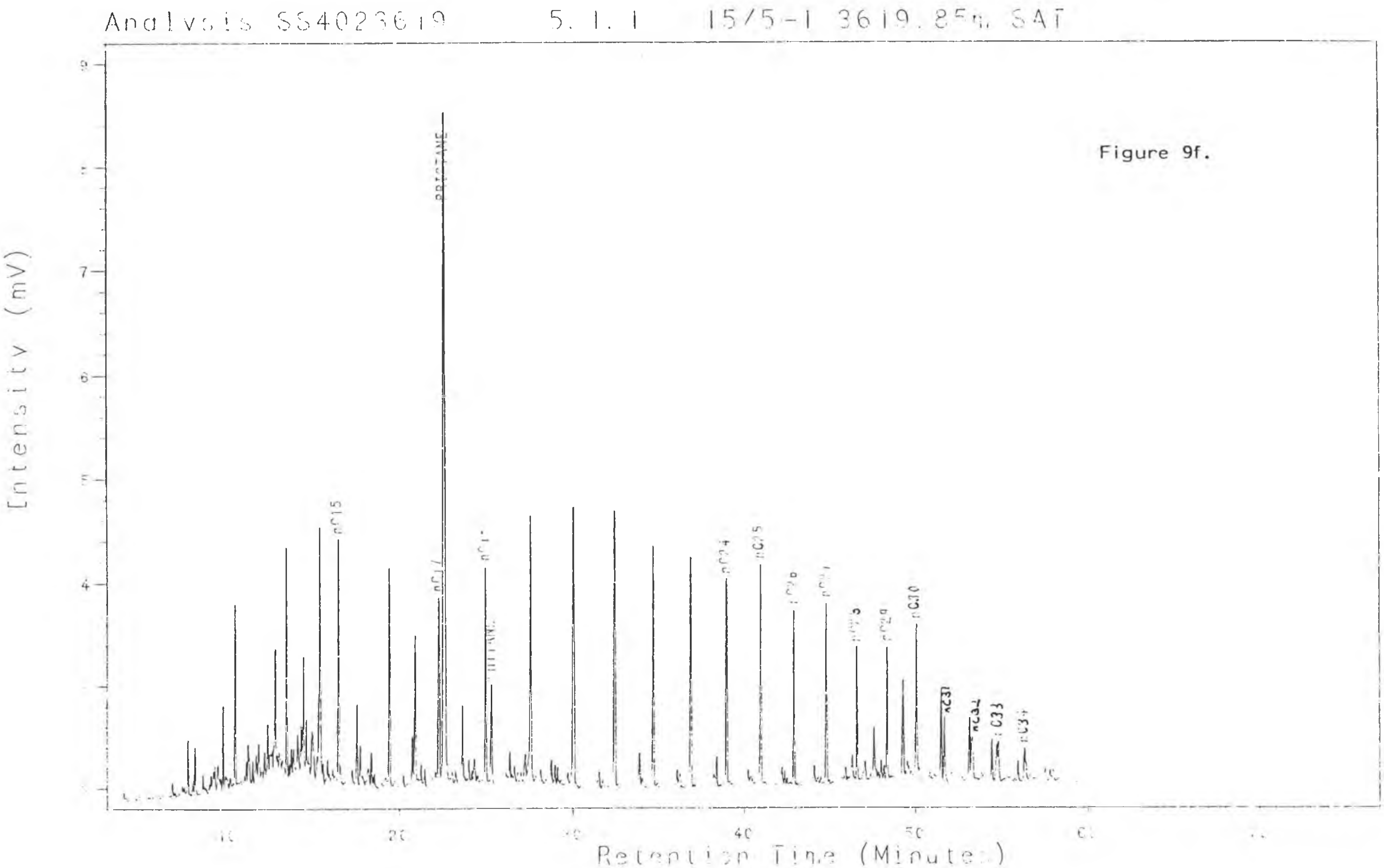
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY

Analysis SS4023609 5.1.1 15/5-1 3609.30m SAT



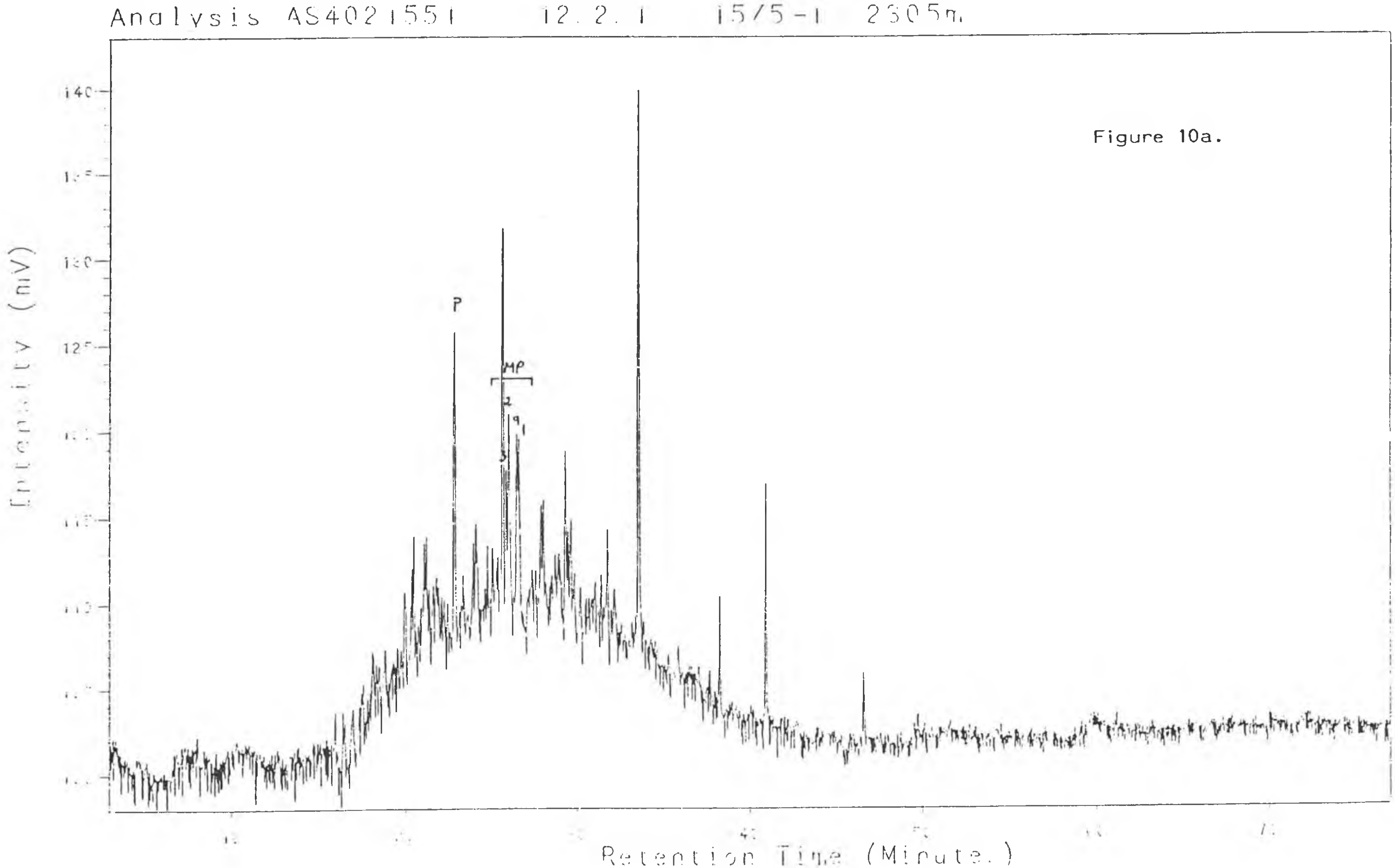
WELL NOCS 15/5-1 3609.30m ccp
SATURATED GC
Sst:drk y brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S



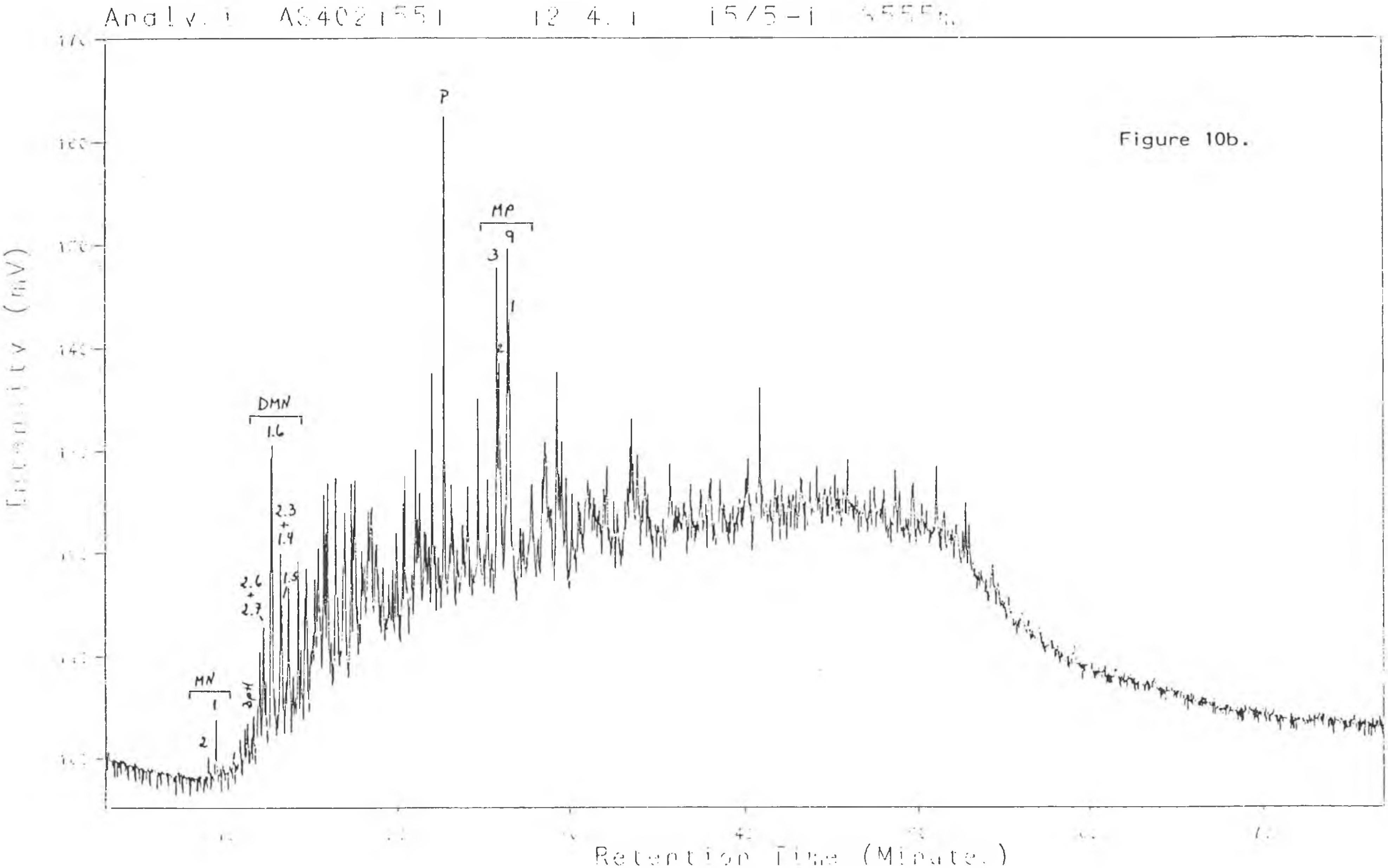
WELL NOCS 15/5-1 3619.85m ccp
SATURATED GC
Coal:blk

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A



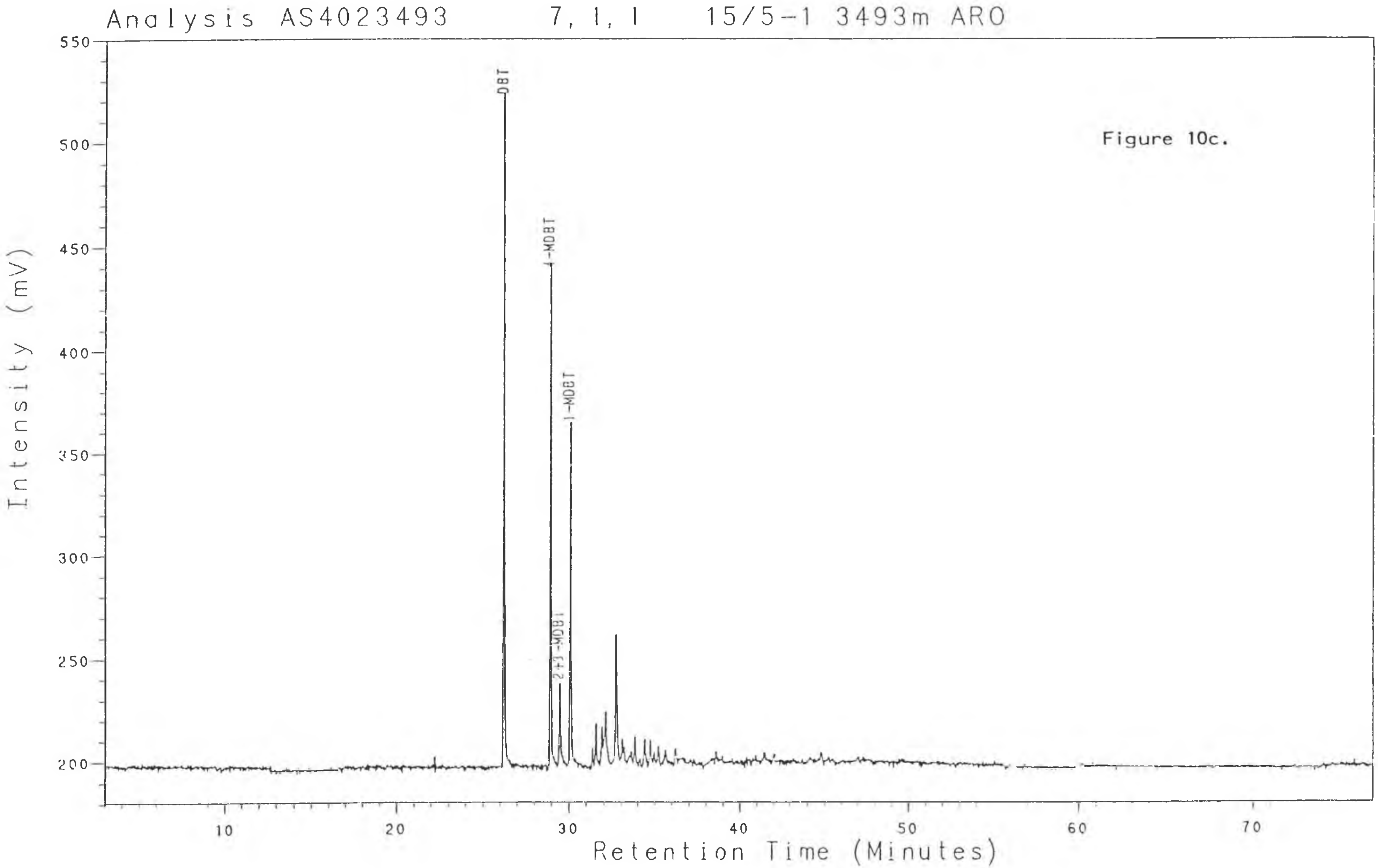
WELL NOCS 15/5-1 2305m
AROMATIC GC (FID)
Sltst:pl brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A



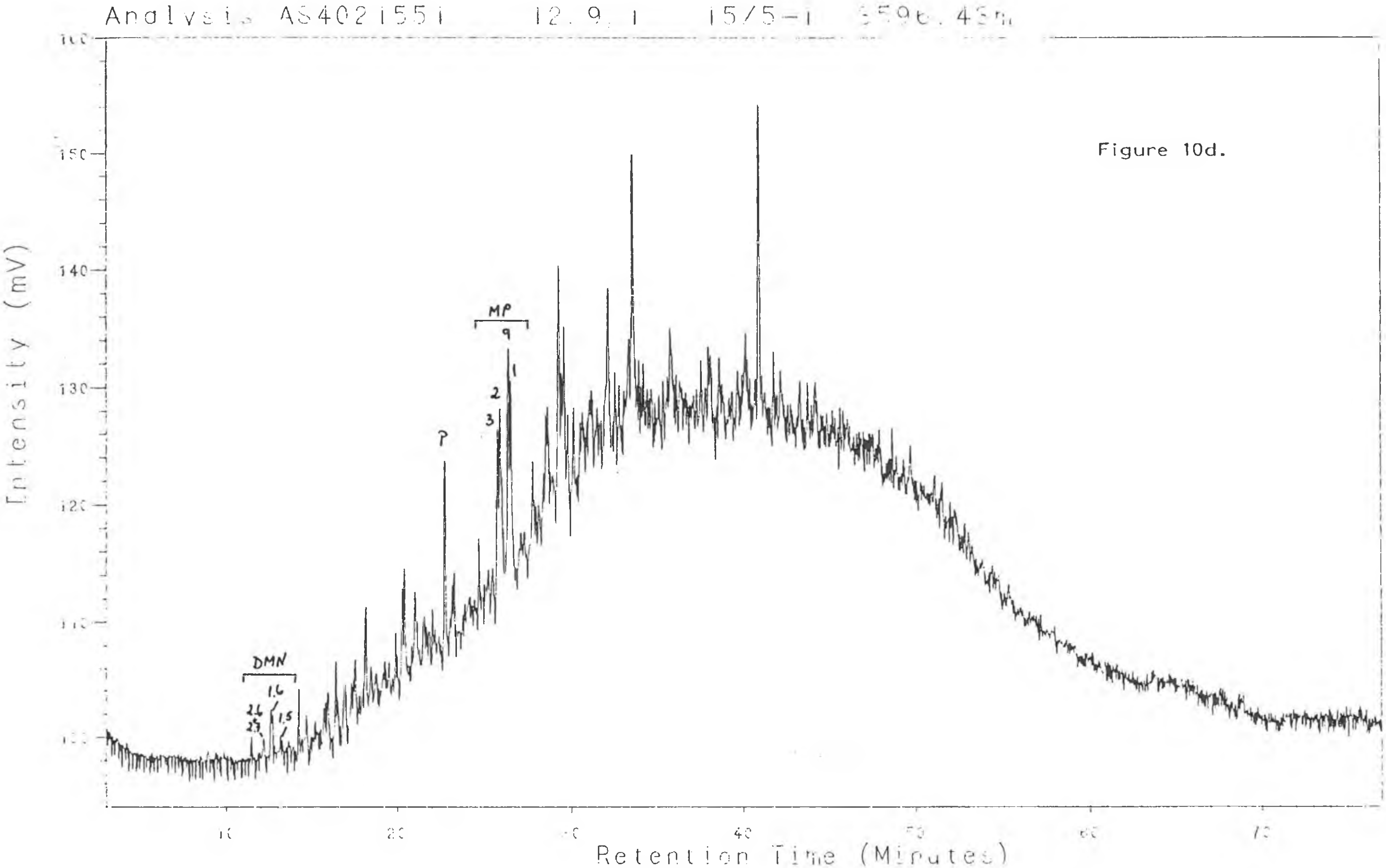
WELL NOCS 15/5-1 3555m
AROMATIC GC (FID)
Sltst:dsk y brn to brn blk

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A



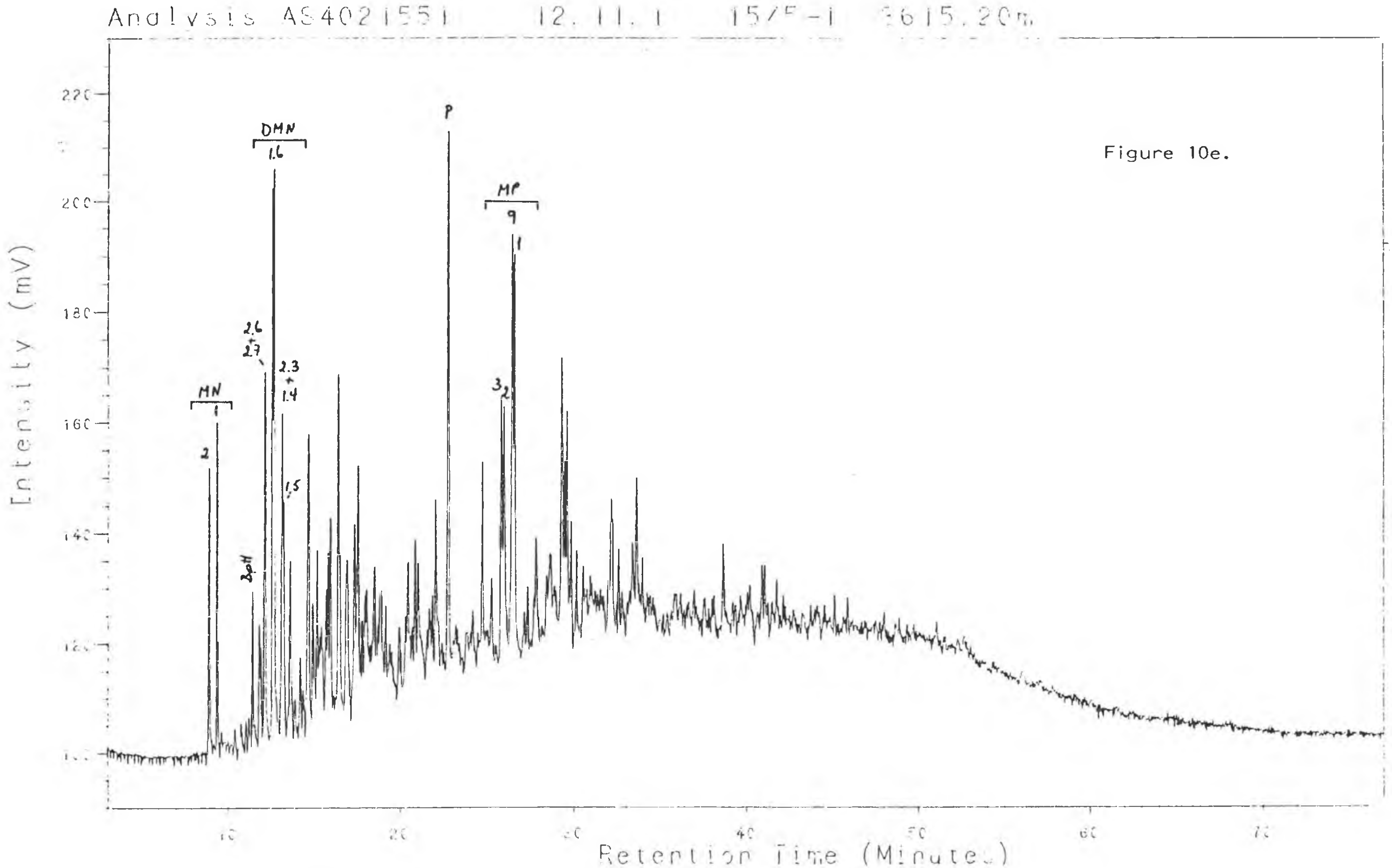
WELL NOCS 15/5-1 3493m
AROMATIC GC (FPD)
Sltst:dsk brn to dsk y brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY



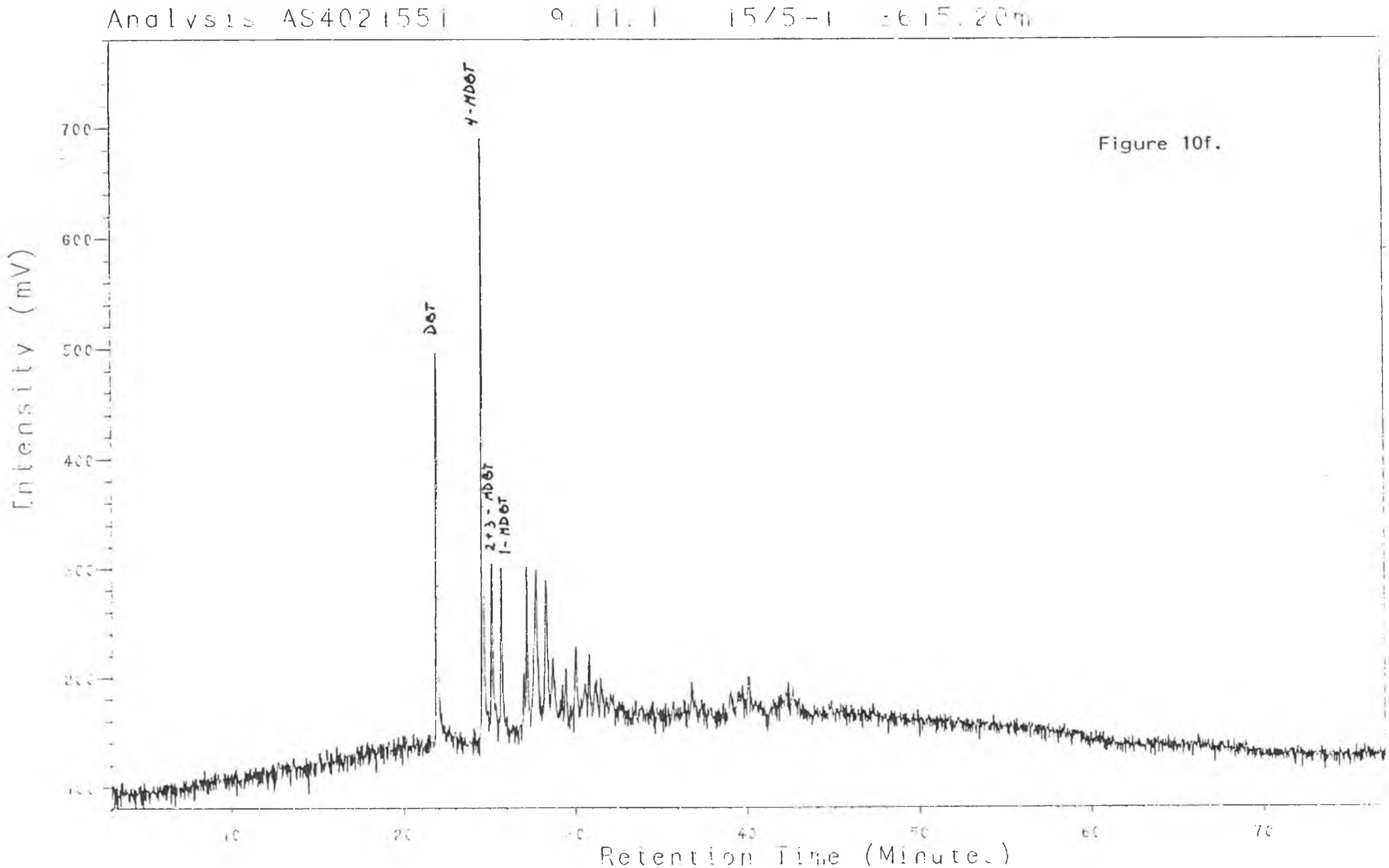
WELL NOCS 15/5-1 3596.43m ccp
AROMATIC GC (FID)
Sst:lt y brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A



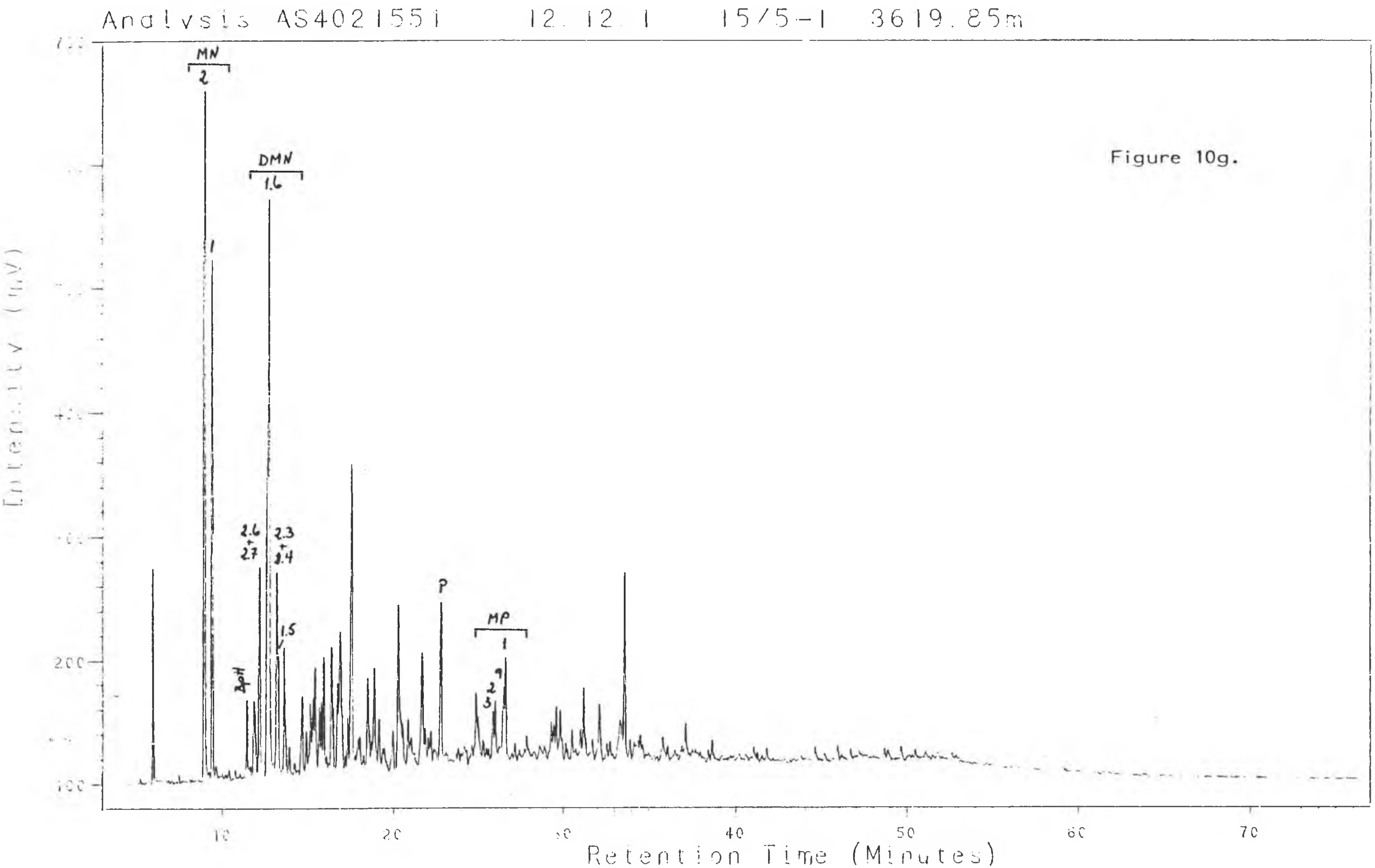
WELL NOCS 15/5-1 3615.20m ccp
AROMATIC GC (FID)
Sst:drk y brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S



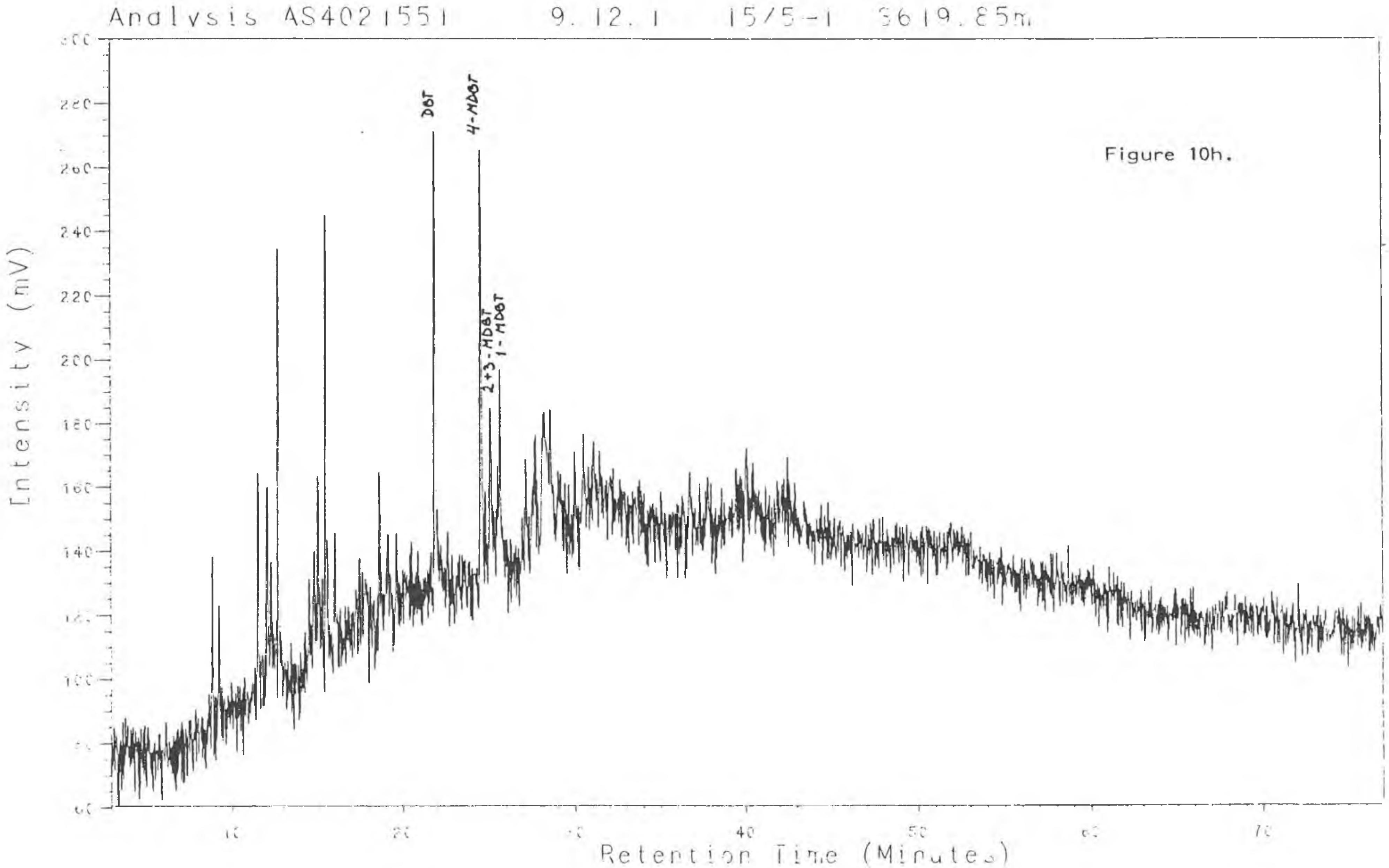
WELL NOCS 15/5-1 3615.20m ccp
AROMATIC GC (FPD)
Sst:drk y brn

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A



WELL NOCS 15/5-1 3619.85m ccp
AROMATIC GC (FID)
Coal:blk

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A



WELL NOCS 15/5-1 3619.85m ccp
AROMATIC GC (FPD)
Coal:blk

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Figure 11: Vitrinite Reflectance versus Depth
Well NOCS 15/5-1

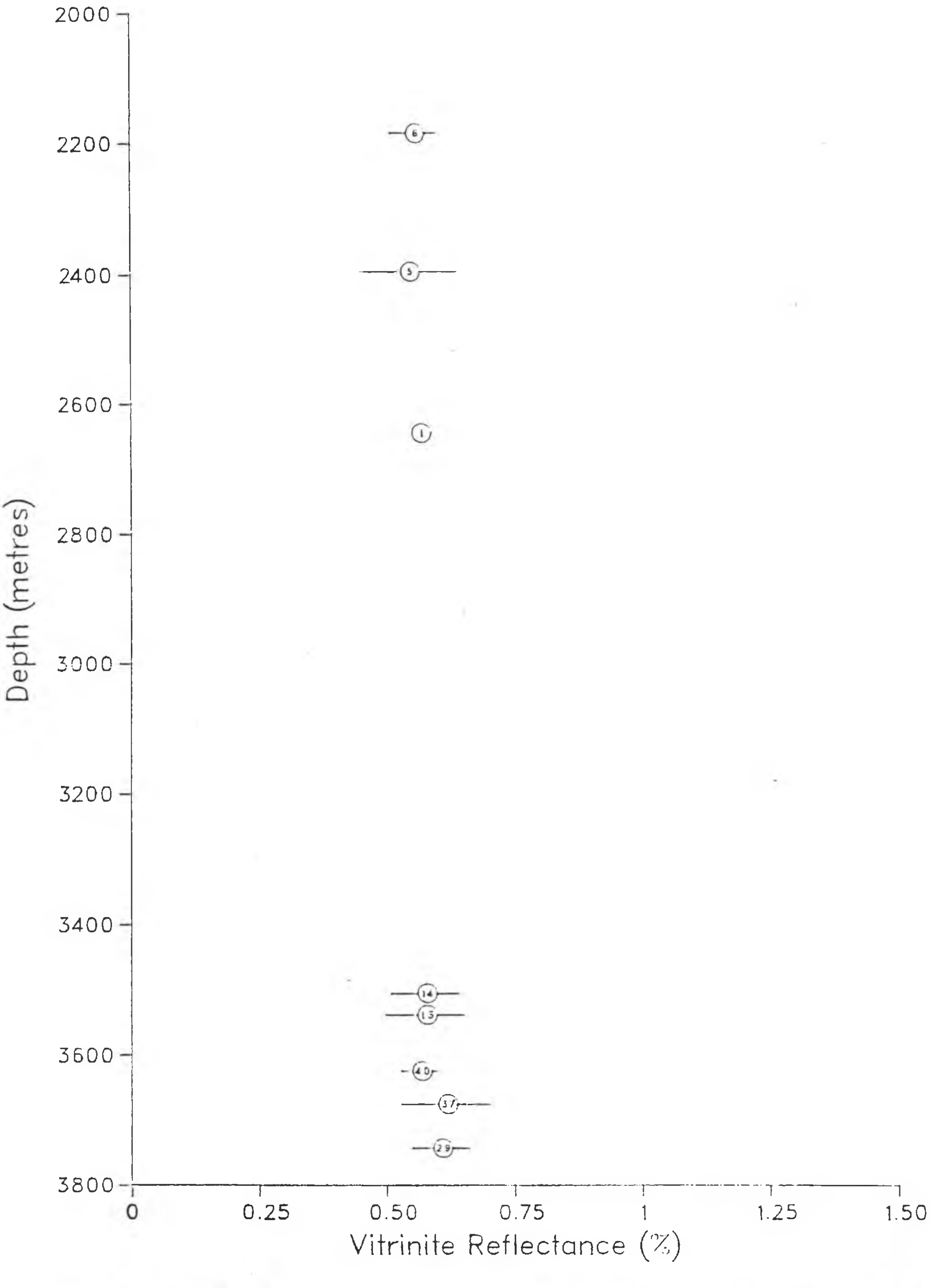


Figure 12: Kerogen Composition and Potential Hydrocarbon Products

Well NOCS 15/5-1

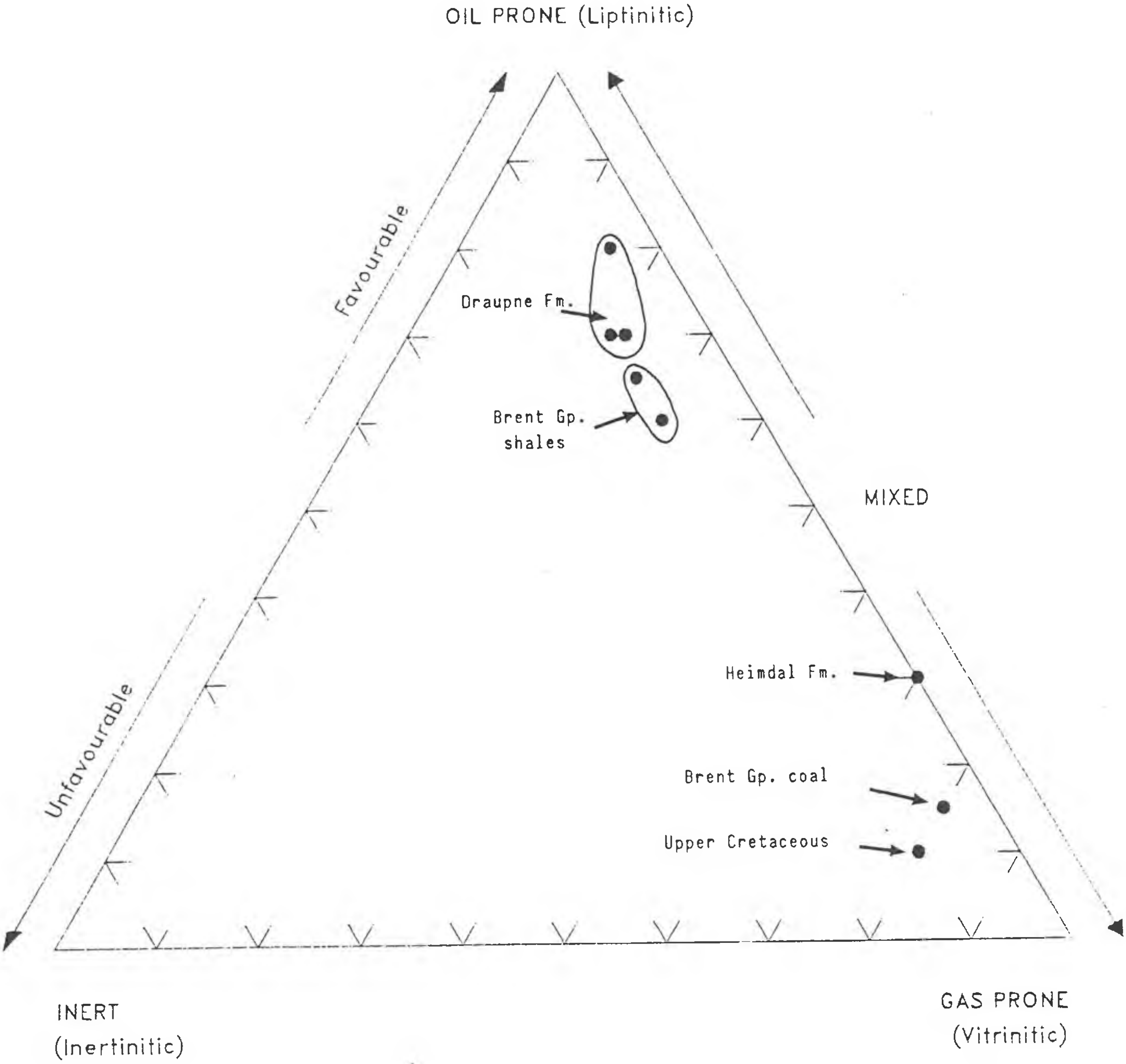


Figure 13a: Aromatic v.s. saturate isotope values

Well NOCS 15/5-1

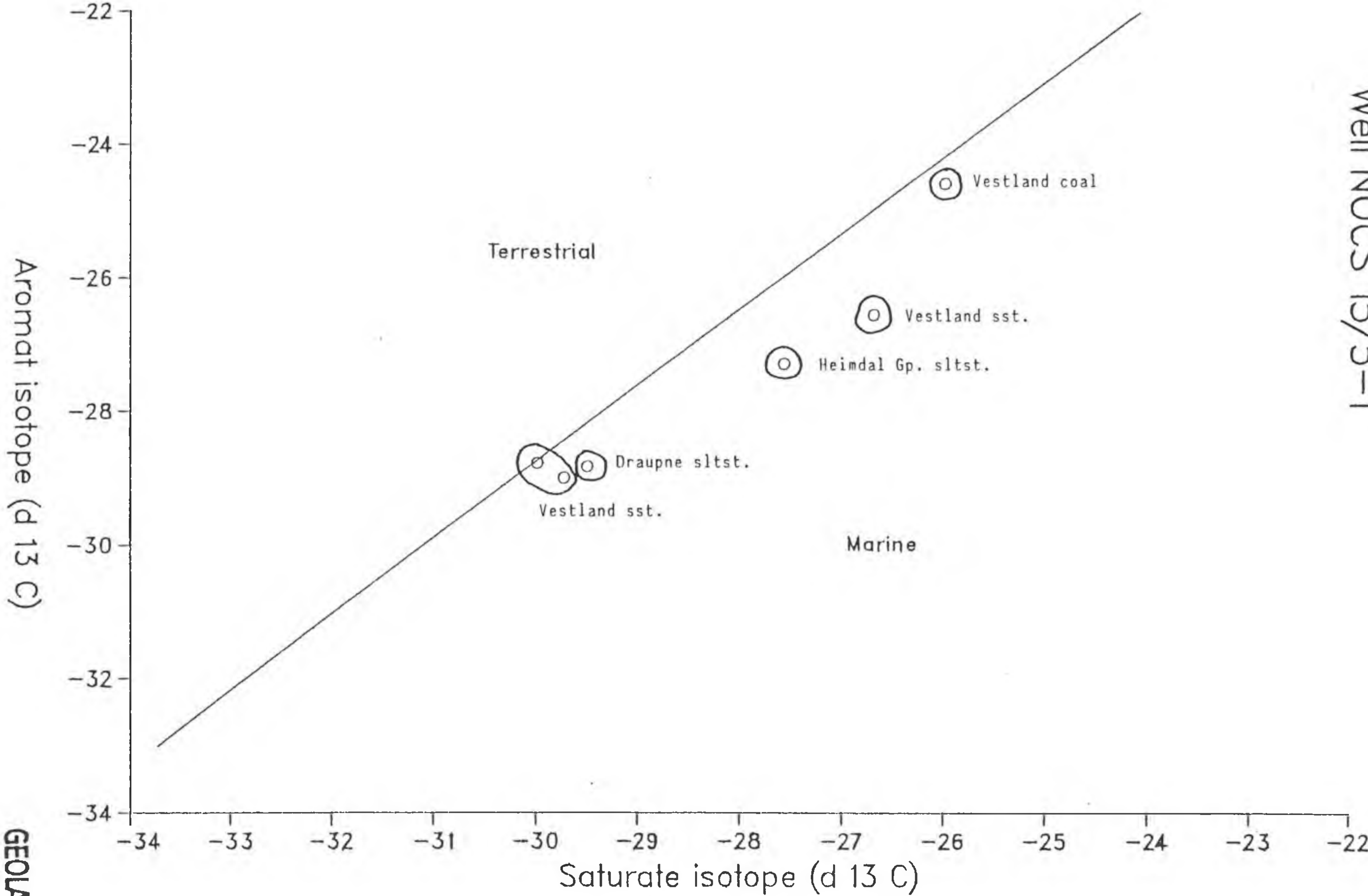
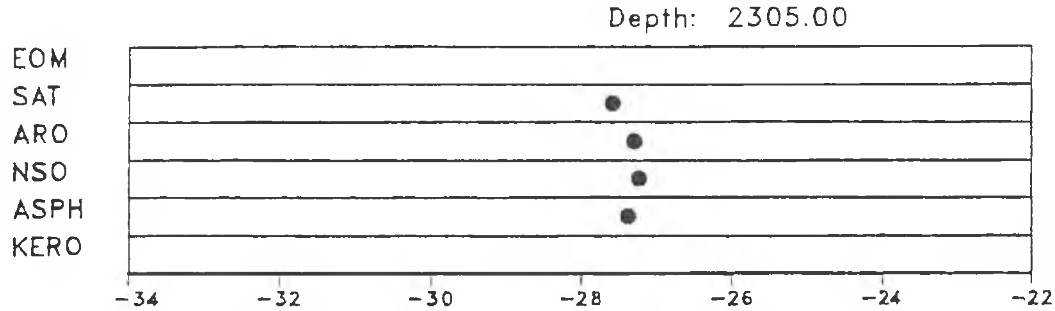
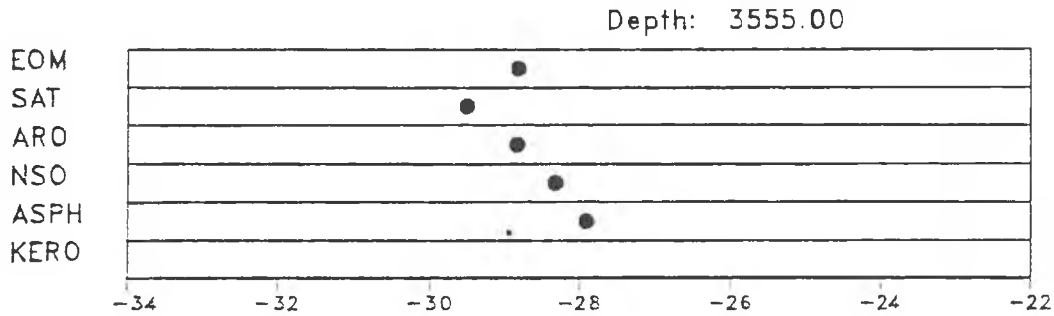
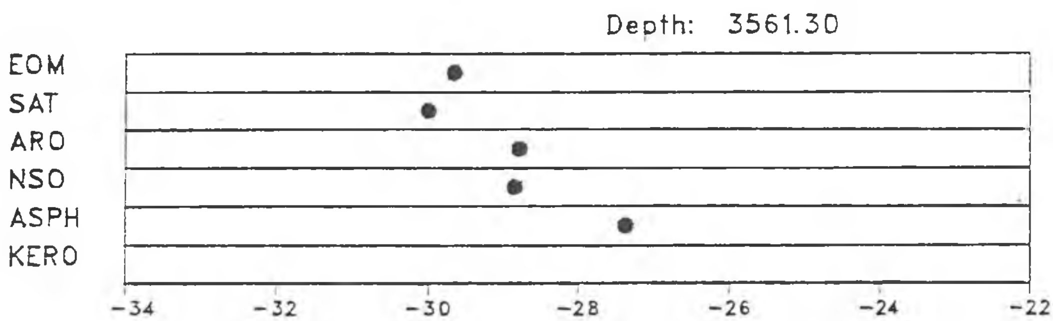


Figure 13b:13C/12C isotope ratios. Galimov plot.
Well NOCS 15/5–1







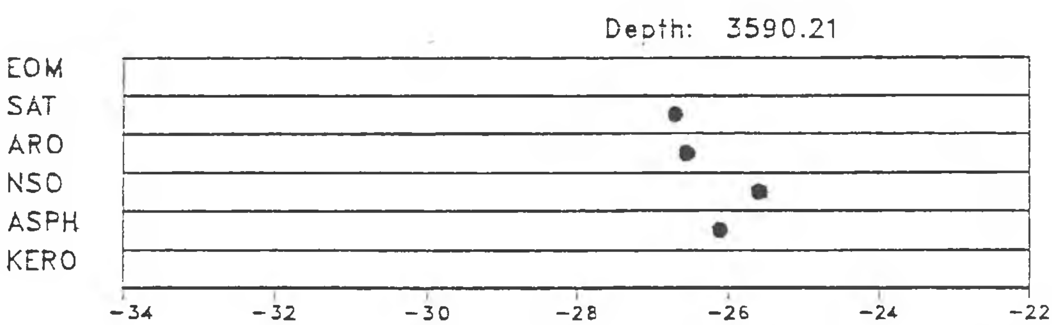
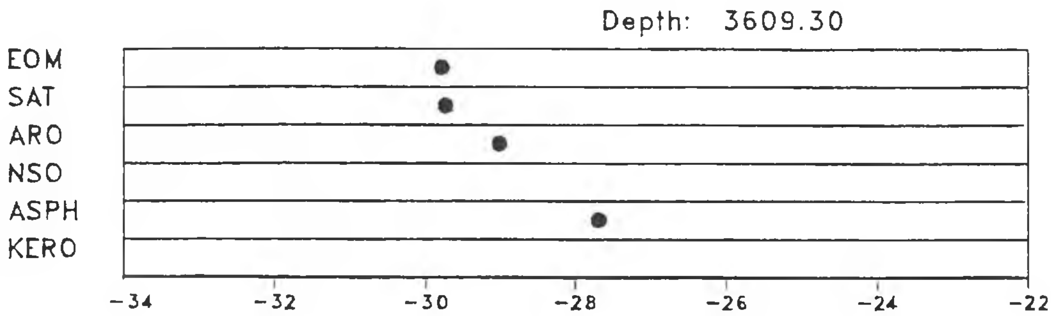
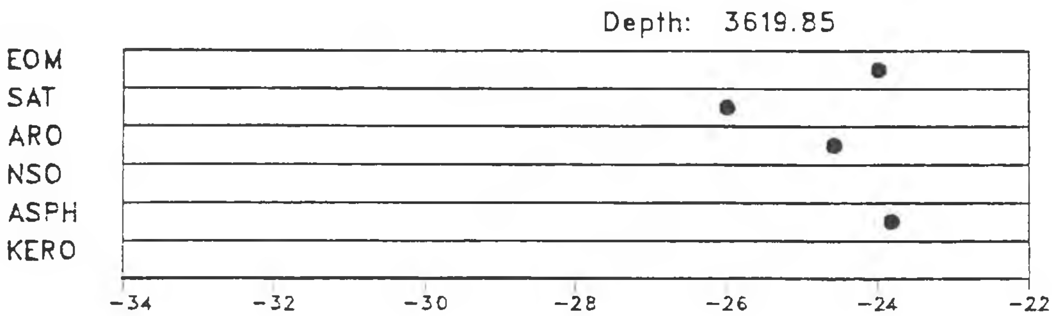
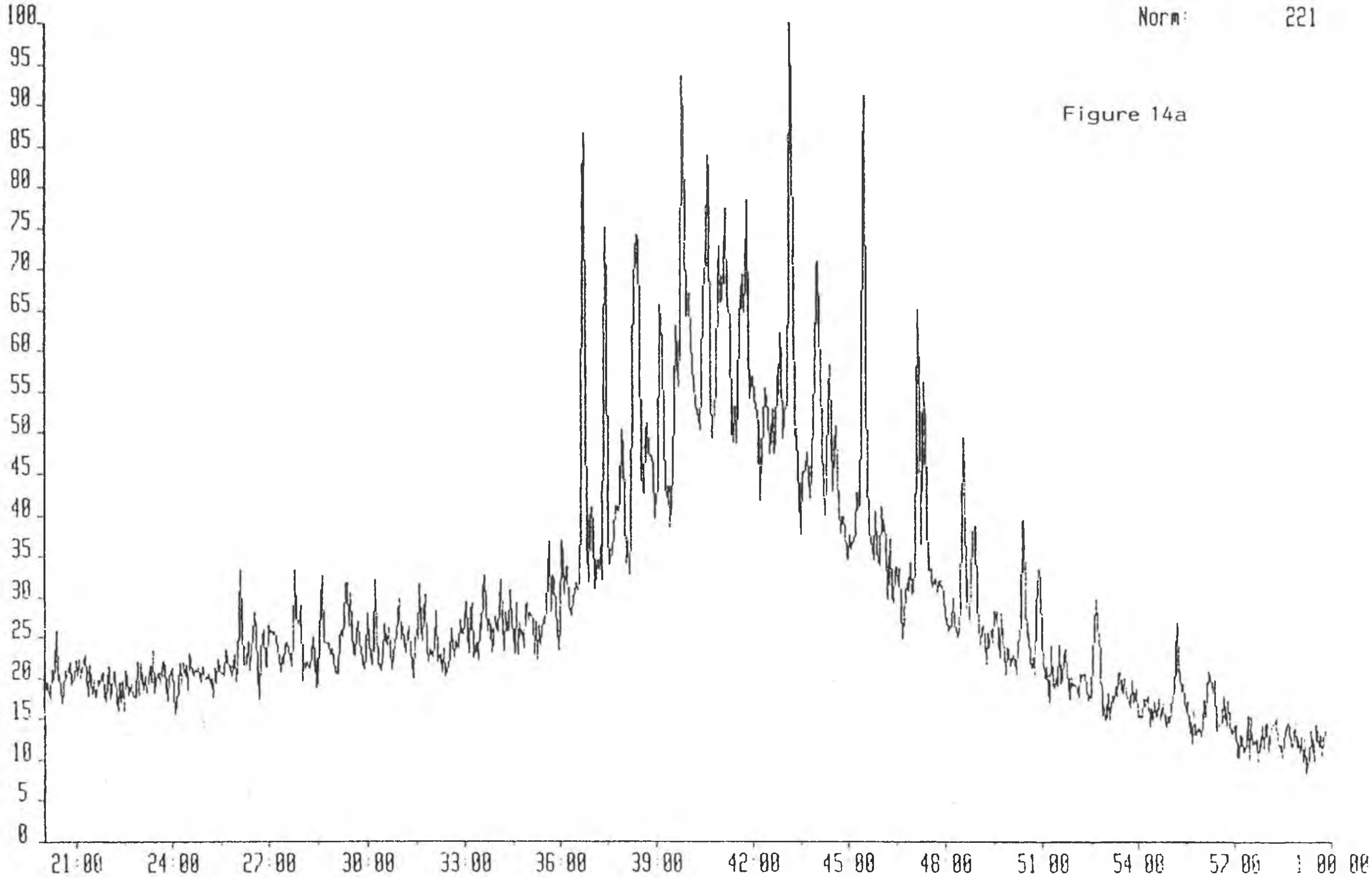


Figure 13b:13C/12C isotope ratios. Galimov plot.
Well NOCS 15/5-1



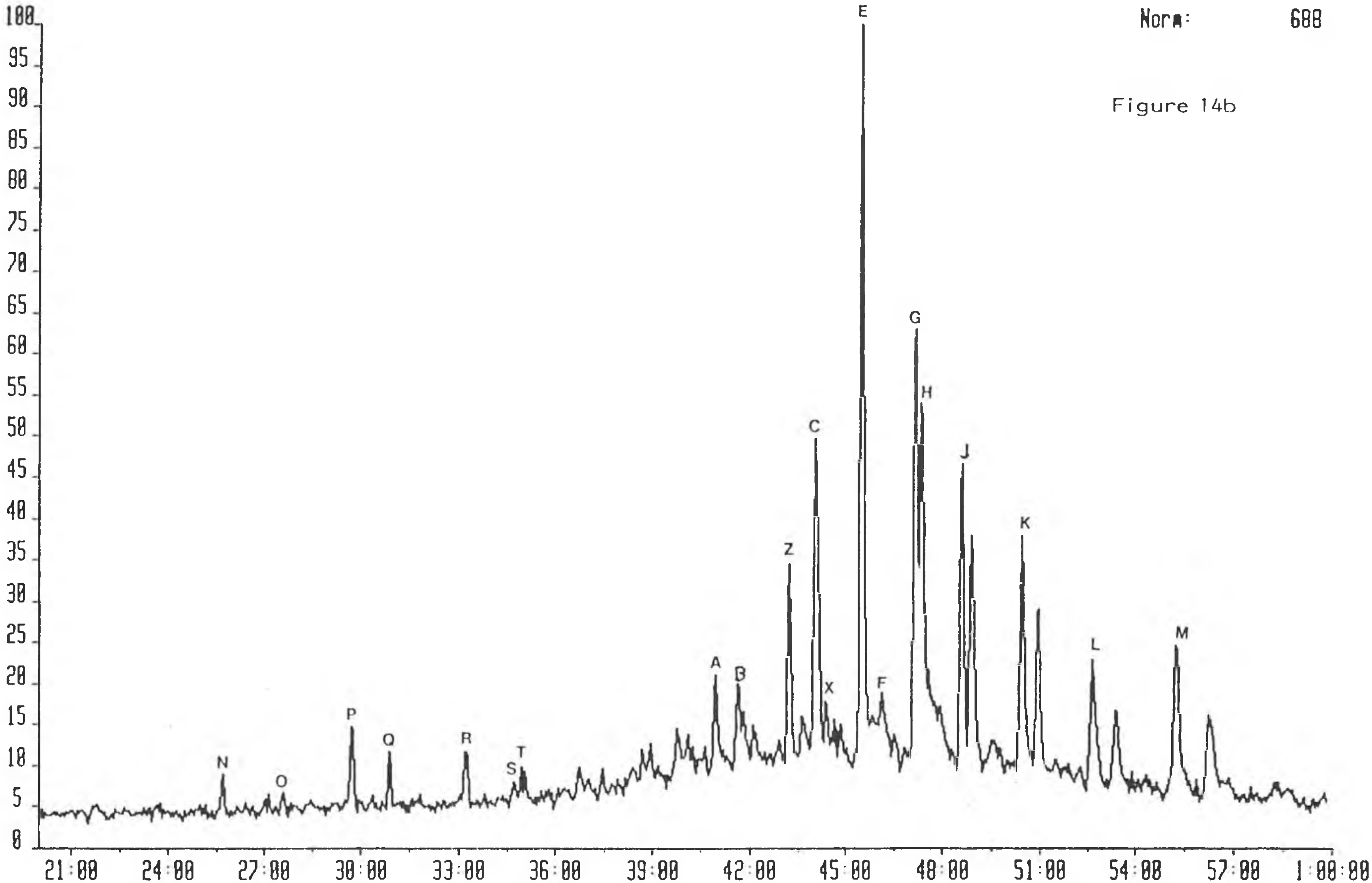


S02412 8-DEC-89 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 13 Injection 1 Group 1 Mass 163.1405
Text WELL 15/5-1, 3555M, SATURATED FRACTION



S02412 8-DEC-89 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 13 Injection 1 Group 1 Mass 191.1000
Text:WELL 15/5-1, 3555M, SATURATED FRACTION

Figure 14b



GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

S02412 8-DEC-89 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 13 Injection 1 Group 1 Mass 259.2427
Text:WELL 15/5-1, 3555M, SATURATED FRACTION

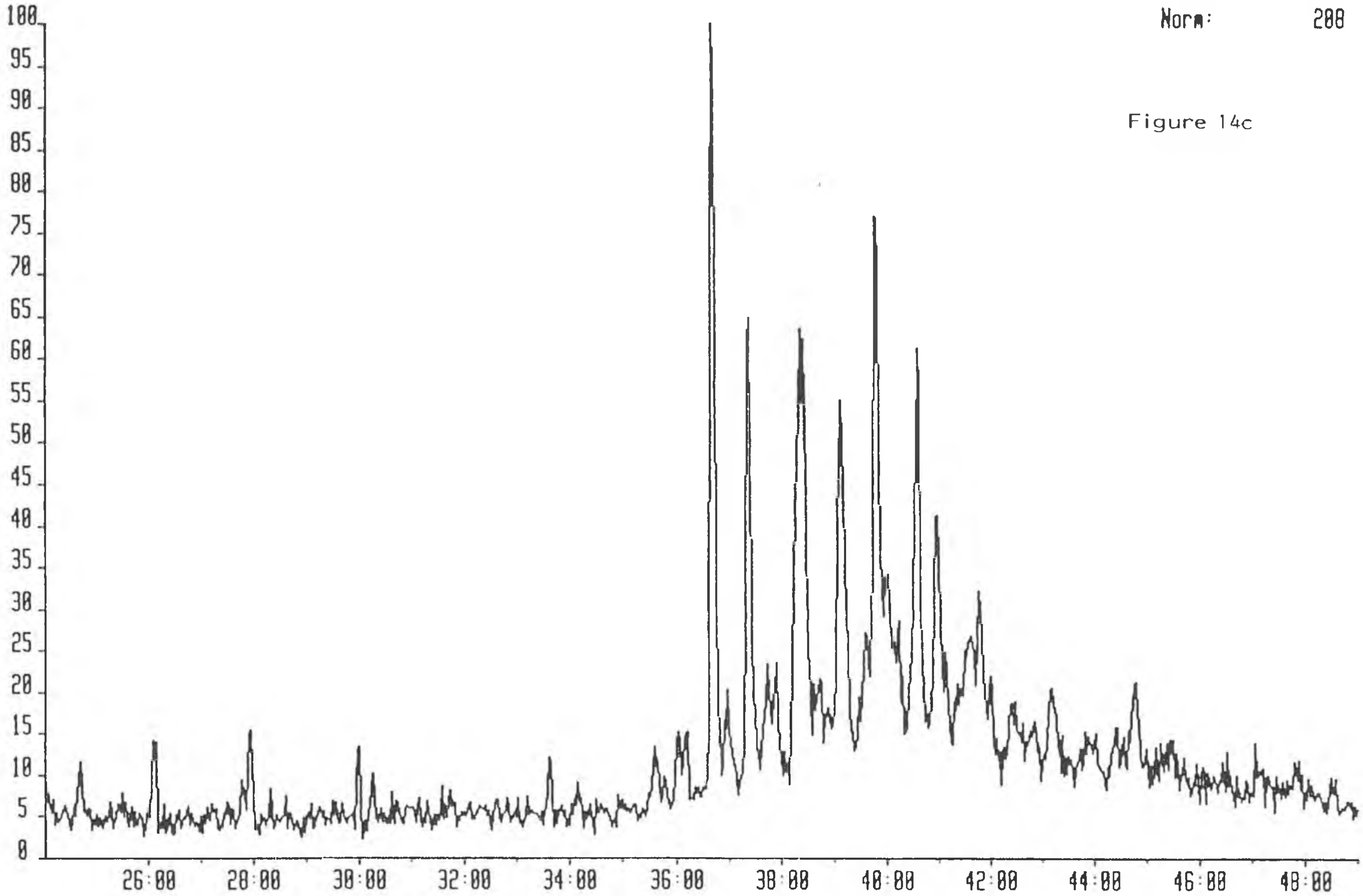


Figure 14c

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

S02412 8-DEC-89 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 17 Injection 1 Group 1 Mass 163.1485
Text:WELL 15/5-1, 3619.85M, SATURATED FRACTION

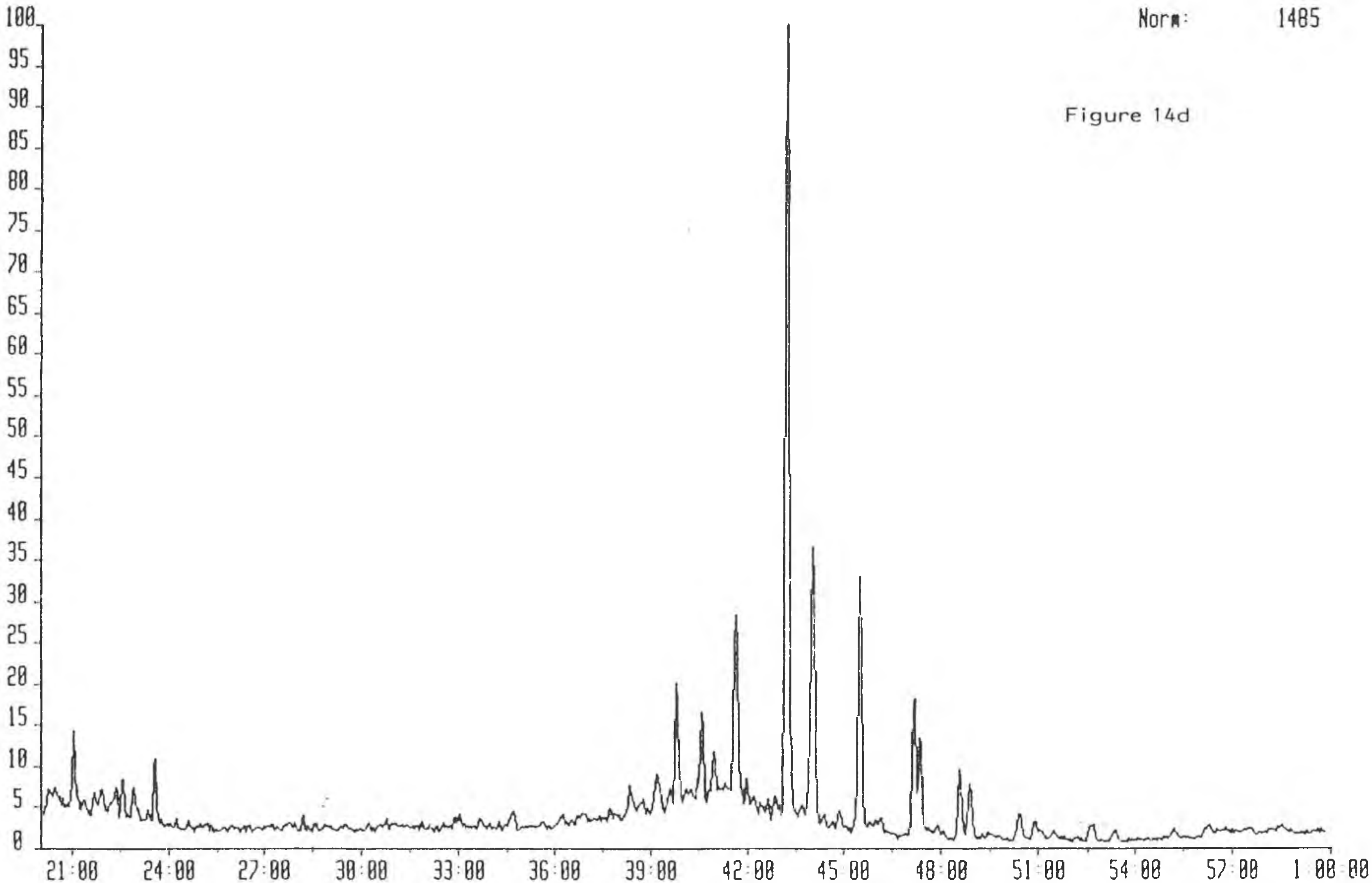


Figure 14d

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

S02412 8-DEC-89 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 17 Injection 1 Group 1 Mass 191.1000
Text:WELL 15/5-1, 3619.85M, SATURATED FRACTION

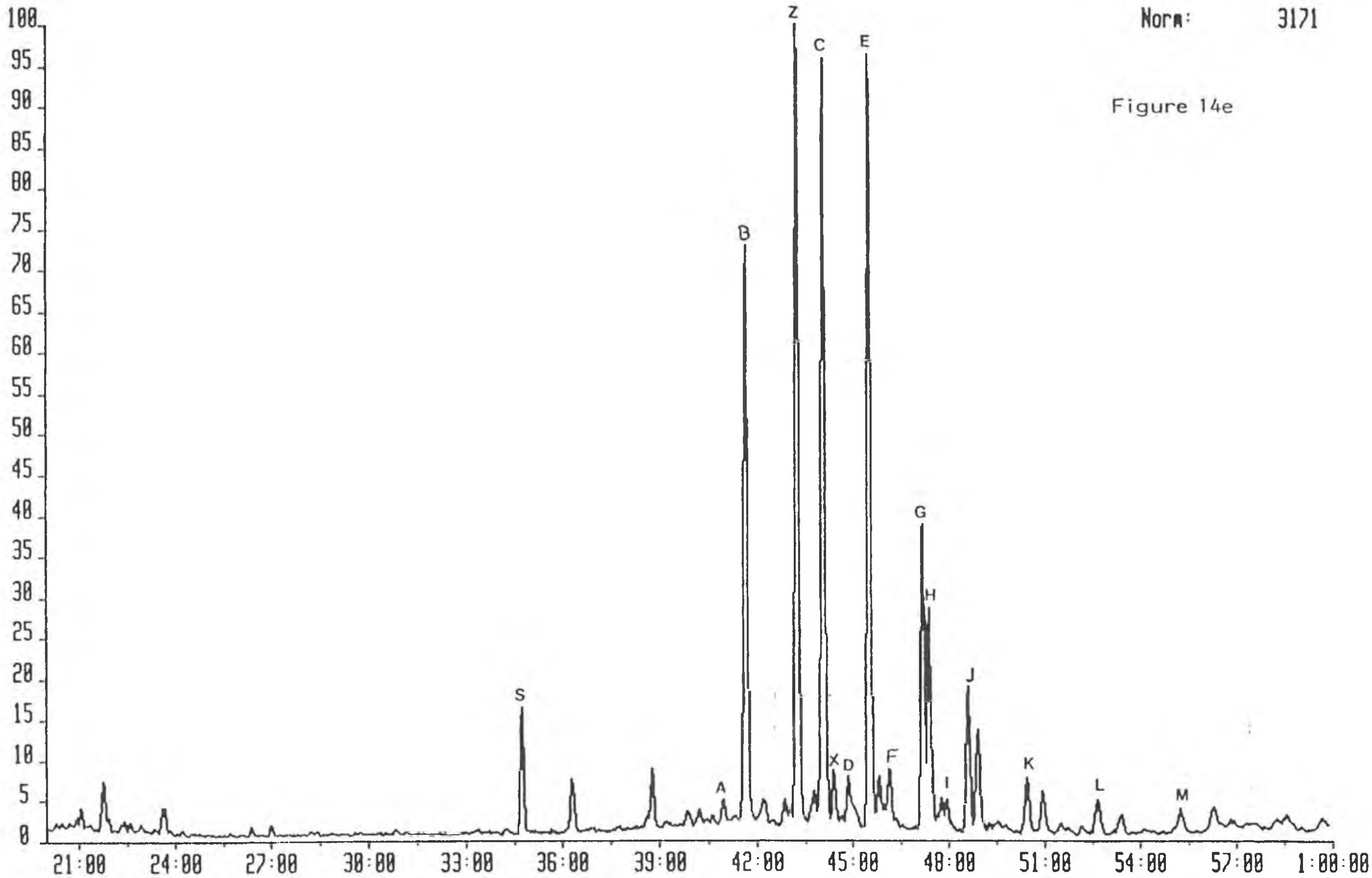


Figure 14e

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

TABLES

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Depth Cvd	Type TOC%	%	Grp Frm Age / Lithology description	Trb	Sample
2185.00				Mont Heim Palaeocene		0083
			100	Sh/Clst: m gy to lt ol gy		0083-1L
			tr	Sh/Clst: gy red		0083-2L
			tr	Ca : m brn		0083-3L
2215.00				Mont Heim Palaeocene		0084
			80	Sh/Clst: m gy to lt ol gy		0084-1L
		0.11	15	S/Sst : w, calc, pyr, cem, l		0084-4L
			5	Sh/Clst: gy red		0084-2L
			tr	Ca : m brn		0084-3L
			tr	Cont : prp		0084-5L
			tr	Coal : blk		0084-6L
2245.00				Mont Heim Palaeocene		0085
		0.10	50	S/Sst : w, crs, cem, l, kln		0085-4L
			45	Sh/Clst: m gy to lt ol gy		0085-1L
			5	Sh/Clst: gy red		0085-2L
			tr	Ca : m brn		0085-3L
			tr	Cont : prp		0085-5L
			tr	Coal : blk		0085-6L
2275.00				Mont Heim Palaeocene		0086
			100	Sh/Clst: m gy to lt ol gy		0086-1L
			tr	Sh/Clst: gy red		0086-2L
			tr	Ca : or gy to m brn		0086-3L
			tr	S/Sst : w, calc, crs, cem, l, kln		0086-4L
			tr	Cont : prp		0086-5L
			tr	Coal : blk		0086-6L
			tr	Sltst : pl brn, mic		0086-7L

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Depth Cvd	Type TOC%	%	Grp / Frm / Age / Lithology description	Trb	Sample
2305.00				Mont Heim Palaeocene		0087
			45	S/Sst : w, calc, crs, l, kln		0087-3L
		3.14	40	Sltst : pl brn, mic		0087-5L
			15	Sh/Clst: m gy to lt ol gy		0087-1L
			tr	Sh/Clst: gy red		0087-2L
			tr	Cont : prp		0087-4L
2335.00				Mont Heim Palaeocene		0088
		0.22	55	S/Sst : w, calc, crs, cem, l, kln		0088-3L
			25	Sh/Clst: m gy to lt ol gy		0088-1L
			20	Sltst : pl brn, mic		0088-5L
			tr	Sh/Clst: gy red		0088-2L
			tr	Cont : prp		0088-4L
2365.00				Mont Heim Palaeocene		0089
			95	Sh/Clst: m gy to lt ol gy		0089-1L
			5	Sltst : pl brn, mic		0089-5L
			tr	Sh/Clst: gy red		0089-2L
			tr	S/Sst : w, calc, crs, cem, l, kln		0089-3L
			tr	Cont : prp		0089-4L
2395.00				Mont Heim Palaeocene		0091
			55	Sh/Clst: m gy to lt ol gy		0091-1L
			30	S/Sst : w to lt y brn, crs, l		0091-2L
			15	Sltst : pl brn, mic		0091-3L
			tr	Coal : blk		0091-4L
2425.00				Mont Heim Palaeocene		0090
			85	S/Sst : w to lt y brn, crs, l		0090-2L
			15	Sh/Clst: m gy to lt ol gy		0090-1L
			tr	Sltst : pl brn, mic		0090-3L
			tr	Coal : blk		0090-4L

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Depth Cvd	Type TOC%	%	Grp Frm Age / Lithology description	Trb	Sample
2445.00				Mont Heim Palaeocene		0093
			90	S/Sst : w to lt y brn, crs, l		0093-2L
			10	Sh/Clst: m gy to lt ol gy		0093-1L
			tr	Sltst : pl brn, mic		0093-3L
			tr	Coal : blk		0093-4L
2485.00				Mont Heim Palaeocene		0092
			100	S/Sst : w to lt y brn, crs, l		0092-2L
			tr	Sh/Clst: m gy to lt ol gy		0092-1L
			tr	Sltst : pl brn, mic		0092-3L
			tr	Coal : blk		0092-4L
2515.00				Mont Heim Palaeocene		0094
		0.35	65	S/Sst : w to lt y brn, calc, crs, cem, l, kln		0094-2L
			30	Sh/Clst: m gy to lt ol gy		0094-1L
			5	Coal : blk		0094-4L
			tr	Sltst : pl brn, mic		0094-3L
			tr	Sh/Clst: gy red		0094-5L
2545.00				Mont Heim Palaeocene		0095
			100	S/Sst : w to lt y brn, calc, l, kln		0095-2L
			tr	Sh/Clst: m gy to lt ol gy		0095-1L
			tr	Sltst : pl brn, mic		0095-3L
			tr	Coal : blk		0095-4L
			tr	Sh/Clst: gy red		0095-5L
2575.00				Mont Heim Palaeocene		0096
			100	S/Sst : w to lt y brn, l		0096-2L
			tr	Sh/Clst: m gy to lt ol gy		0096-1L
			tr	Sltst : pl brn, mic		0096-3L
			tr	Coal : blk		0096-4L
			tr	Sh/Clst: gy red		0096-5L

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth		Type		Grp Frm Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
2585.00				Mont Heim Palaeocene		0097
			55	S/Sst : w to lt y brn, l		0097-2L
			45	Sh/Clst: gy gn to m gy		0097-1L
			tr	Sltst : pl brn, mic		0097-3L
			tr	Cont : prp, fib		0097-4L
			tr	Sh/Clst: gy red		0097-5L
2645.00				Chal Ekof U.Cretaceous		0001
			70	Sh/Clst: m gy to drk gn gy		0001-2L
			20	S/Sst : w, calc, l		0001-1L
			10	Sltst : pl y brn, mic		0001-3L
			tr	Cont : Coal-ad, prp		0001-4L
2675.00				Chal Ekof U.Cretaceous		0002
		0.19	50	Ca : w, chk		0002-4L
			45	Marl : pl y brn, lt gn gy		0002-5L
			5	Sh/Clst: m gy to drk gn gy		0002-2L
			tr	S/Sst : w, calc, l		0002-1L
			tr	Cont : Coal-ad, prp		0002-3L
2705.00				Chal Tor U.Cretaceous		0003
			50	Ca : w, chk		0003-4L
		0.16	50	Marl : pl y brn, lt gn gy		0003-5L
			tr	S/Sst : w, calc, l		0003-1L
			tr	Sh/Clst: m gy to drk gn gy		0003-2L
			tr	Cont : Coal-ad, prp, dd, fib		0003-3L
2735.00				Chal Tor U.Cretaceous		0004
			80	Cont : cem		0004-6L
			20	Marl : pl y brn, lt gn gy		0004-5L
			tr	S/Sst : w, calc, l		0004-1L
			tr	Sh/Clst: m gy to drk gn gy		0004-2L
			tr	Cont : prp, dd, fib		0004-3L
			tr	Ca : w, chk		0004-4L

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Depth Cvd	Type TOC%	%	Grp / Lithology description	Frm	Age	Trb	Sample
2765.00				Chal	Tor	U.Cretaceous		0005
			50	Ca : lt or to gy pi, chk				0005-1L
			50	Cont : cem, prp, dd, fib, tar-ad				0005-3L
			tr	Marl : pl y brn, lt gn gy				0005-2L
2795.00				Chal	Tor	U.Cretaceous		0006
			65	Other : lt gy, trbofgs				0006-4L
			20	Marl : lt gy				0006-2L
			10	Cont : Coal-ad, prp, tar-ad				0006-3L
			5	Ca : lt or to gy pi, chk				0006-1L
2820.00				Chal	Tor	U.Cretaceous		0007
			45	Ca : lt or to gy pi, chk				0007-1L
			45	Other : lt gy to gy pi, trbofgs				0007-4L
			5	Sh/Clst: lt gy to m gy, calc				0007-2L
			5	Cont : prp				0007-3L
2850.00				Chal	Tor	U.Cretaceous		0008
		0.09	50	Ca : lt or to gy pi, chk				0008-1L
			35	Other : lt gy to gy pi, trbofgs				0008-4L
			15	Sh/Clst: m gy, calc				0008-2L
			tr	Cont : prp				0008-3L
2880.00				Chal	Tor	U.Cretaceous		0009
			50	Ca : lt or to gy pi, chk				0009-1L
			35	Other : lt gy to gy pi, trbofgs				0009-4L
			10	Marl : lt gy to m gy				0009-2L
			5	Cont : prp, tar-ad				0009-3L

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth (Int Cvd)	Type (TOC%)	%	Grp	Frm	Age / Lithology description	Trb	Sample
2910.00			Chal	F/h	U.Cretaceous		0010
		50	Ca		: lt or to gy pi, chk		0010-1L
		35	Other		: lt gy to gy pi, trbofgs		0010-4L
		10	Sh/Clst		: m brn, calc		0010-2L
		5	Cont		: prp		0010-3L
2940.00			Chal	F/h	U.Cretaceous		0011
		90	Other		: lt gy to gy pi, trbofgs		0011-4L
		10	Sh/Clst		: lt gy to m gy, calc		0011-2L
		tr	Cont		: prp		0011-3L
2970.00			Chal	F/h	U.Cretaceous		0012
		95	Other		: gy red to gy pi, trbofgs		0012-4L
		5	Sh/Clst		: lt gy to m gy, calc		0012-2L
		tr	Ca		: lt or to gy pi, chk		0012-1L
		tr	Cont		: prp		0012-3L
3000.00			Chal	F/h	U.Cretaceous		0013
		85	Other		: gy red to gy pi, trbofgs		0013-4L
		5	Sh/Clst		: lt gy to m gy, calc		0013-2L
		5	Cont		: prp		0013-3L
		5	Marl		: gy red		0013-5L
		tr	Ca		: lt or to gy pi, chk		0013-1L
3030.00			Chal	F/h	U.Cretaceous		0014
		50	Cont		: prp		0014-2L
		40	Marl		: lt gy, gy red		0014-4L
		10	Other		: gy red to gy pi, trbofgs		0014-3L
		tr	Ca		: lt or to gy pi, chk		0014-1L

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Depth Cvd	Type TOC%	%	Grp / Lithology description	Frm	Age	Trb	Sample
3060.00				Chal	F/h	U.Cretaceous		0015
		0.20	90	Marl : lt gy, gy red				0015-4L
			5	Cont : prp				0015-2L
			5	Other : gy red to gy pi, trbofgs				0015-3L
			tr	Ca : lt or to gy pi, chk				0015-1L
3095.00				Chal	F/h	U.Cretaceous		0016
			50	Marl : lt gy, gy red				0016-4L
			30	Other : gy red to gy pi, trbofgs				0016-3L
			20	Cont : Coal-ad, prp				0016-2L
			tr	Ca : lt or to gy pi, chk				0016-1L
3125.00				Chal	F/h	U.Cretaceous		0017
			55	Other : gy red to gy pi, trbofgs				0017-3L
			45	Marl : lt gy, gy red				0017-4L
			tr	Ca : lt or to gy pi, chk				0017-1L
			tr	Cont : prp, tar-ad				0017-2L
3155.00				Chal	F/h	U.Cretaceous		0018
		0.08	50	Ca : lt or to lt gy				0018-1L
			50	Marl : lt gy, gy red				0018-4L
			tr	Other : gy red to gy pi, trbofgs				0018-3L
3185.00				Chal	Plen	U.Cretaceous		0019
			80	Ca : lt or, chk				0019-1L
			20	Marl : lt gy, gy red				0019-3L
			tr	Cont : fib				0019-2L

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int Cvd	Type TOC%	%	Grp / Lithology description	Frm	Age	Trb	Sample
3215.00			Chal	Plen	U.Cretaceous		0020
		50	Ca : lt or, chk				0020-1L
		50	Marl : lt gy to m gy, gy red				0020-3L
		tr	Cont : Coal-ad, prp				0020-2L
3245.00			Chal	Plen	U.Cretaceous		0021
		85	Ca : lt or, chk				0021-1L
		15	Marl : lt gy to m gy, gy red				0021-3L
		tr	Cont : Coal-ad, prp				0021-2L
3275.00			Chal	Plen	U.Cretaceous		0022
	0.16	65	S/Sst : w to lt or, calc, glauc				0022-4L
		30	Marl : lt gy to m gy, gy red, slt				0022-3L
		5	Ca : lt or, chk				0022-1L
		tr	Cont : Coal-ad, prp				0022-2L
3305.00			Chal	Hidr	U.Cretaceous		0023
		85	Marl : lt gy to m gy, gy red, slt				0023-3L
		5	Ca : lt or, chk				0023-1L
		5	Cont : prp, dd, tar-ad				0023-2L
		5	S/Sst : w to lt or, calc, glauc				0023-4L
3335.00			Chal	Hidr	U.Cretaceous		0024
	0.31	90	Marl : lt gy to m gy, gy red, slt				0024-3L
		10	Ca : lt or, chk				0024-1L
		tr	Cont : dd				0024-2L
		tr	S/Sst : w to lt or, calc, glauc				0024-4L

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Depth Cvd	Type TOC%	%	Grp / Lithology description	Frm	Age	Trb	Sample
3365.00				Chal	Hidr	U.Cretaceous		0025
		0.09	50	Ca : lt or, chk				0025-1L
			50	Marl : lt gy to m gy, gy red, slt, mic				0025-3L
			tr	Cont : dd				0025-2L
			tr	Sh/Clst: drk gy				0025-4L
3395.00				Crom	Rødb	L.Cretaceous		0026
			80	Marl : lt gy to drk gy, gy red, slt, mic				0026-3L
			20	Cont : prp, dd, tar-ad				0026-2L
			tr	Ca : lt or, chk				0026-1L
3425.00				Crom	Rødb	L.Cretaceous		0027
			90	Sh/Clst: lt gy to drk gy, gy red, calc, slt, mic				0027-3L
			10	Cont : prp, dd, tar-ad				0027-2L
			tr	Ca : lt or, chk				0027-1L
3455.00				Crom	Valh	L.Cretaceous		0028
		0.53	100	Sh/Clst: lt gy to drk gy, gy red, slt, mic				0028-2L
			tr	Ca : lt or, chk				0028-1L
			tr	Ca : brn gy to pl y brn, dol				0028-3L
			tr	Other : pyr				0028-4L
3485.00				Crom	Valh	L.Cretaceous		0029
			95	Sh/Clst: lt gy to drk gy, gy red, slt, mic				0029-2L
			5	Ca : lt or to lt gy, cly				0029-1L
			tr	Ca : brn gy to pl y brn, dol				0029-3L
			tr	Other : pyr				0029-4L
			tr	Cont : Coal-ad				0029-5L

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Cvd	Type TOC%	%	Grp Frm Age / Lithology description	Trb	Sample
3493.00				Viki Drau U.Jurassic		0030
			80	Sh/Clst: lt gy to drk gy, gy red, slt, mic		0030-2L
		4.09	20	Sltst : dsk brn to dsk y brn		0030-4L
			tr	Ca : lt or to lt gy, cly		0030-1L
			tr	Ca : brn gy to pl y brn, dol		0030-3L
3498.00				Viki Drau U.Jurassic		0031
		1.00	75	Sh/Clst: lt gy to drk gy, gy red, slt, mic		0031-2L
			25	Sltst : dsk brn to dsk y brn		0031-4L
			tr	Ca : lt or to lt gy, cly		0031-1L
			tr	Ca : brn gy to pl y brn, dol		0031-3L
3505.00				Viki Drau U.Jurassic		0032
		6.23	90	Sltst : dsk y brn, carb		0032-4L
			10	Sh/Clst: lt gy to drk gy, gy red, slt, mic		0032-2L
			tr	Ca : lt or to lt gy, cly		0032-1L
			tr	Ca : brn gy to pl y brn, dol		0032-3L
			tr	Coal : blk		0032-5L
3513.00				Viki Drau U.Jurassic		0033
			60	Cont : cem, prp		0033-6L
			35	Sh/Clst: lt gy to drk gy, gy red, slt, mic		0033-2L
			5	Sltst : dsk y brn, carb		0033-4L
			tr	Ca : lt or to lt gy, cly		0033-1L
			tr	Ca : brn gy to pl y brn, dol		0033-3L
			tr	Coal : blk		0033-5L
3518.00				Viki Drau U.Jurassic		0034
		5.97	90	Sltst : dsk y brn to brn blk, carb		0034-3L
			10	Cont : prp		0034-4L
			tr	Sh/Clst: lt gy to drk gy, gy red, slt, mic		0034-1L
			tr	Ca : brn gy to pl y brn, dol		0034-2L

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Depth Cvd	Type TOC%	%	Grp	Frm	Age / Lithology description	Trb	Sample
3525.00				Viki	Drau	U.Jurassic		0035
		6.50	100	Sltst		: dsk y brn to brn blk, carb		0035-2L
			tr	Sh/Clst		: lt gy to drk gy, gy red, slt, mic		0035-1L
			tr	Cont		: Coal-ad, prp		0035-3L
3533.00				Viki	Drau	U.Jurassic		0036
		7.05	95	Sltst		: dsk y brn to brn blk, carb		0036-2L
			5	Cont		: prp		0036-3L
			tr	Sh/Clst		: lt gy to drk gy, gy red, slt, mic		0036-1L
3538.00				Viki	Drau	U.Jurassic		0037
			100	Sltst		: dsk y brn to brn blk, carb		0037-2L
			tr	Sh/Clst		: lt gy to drk gy, gy red, slt, mic		0037-1L
			tr	Cont		: prp, fib		0037-3L
3543.00				Viki	Drau	U.Jurassic		0038
		6.43	100	Sltst		: dsk y brn to brn blk, carb		0038-2L
			tr	Sh/Clst		: lt gy to drk gy, gy red, slt, mic		0038-1L
			tr	Cont		: prp, fib		0038-3L
3550.00				Viki	Drau	U.Jurassic		0039
		6.25	100	Sltst		: dsk y brn to brn blk, carb		0039-2L
			tr	Sh/Clst		: lt gy to drk gy, gy red, slt, mic		0039-1L
			tr	Cont		: Coal-ad, prp		0039-3L
3555.00				Viki	Drau	U.Jurassic		0040
		5.61	100	Sltst		: dsk y brn to brn blk, carb		0040-2L
			tr	Sh/Clst		: lt gy to drk gy, gy red, slt, mic		0040-1L
			tr	Cont		: prp, fib		0040-3L

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Cvd	Type TOC%	%	Grp / Lithology	Frm	Age / Lithology description	Trb	Sample
3561.30	ccp			Brnt		M.Jurassic		0044
		0.12	100	S/Sst		: pl y brn, cem		0044-1L
3563.00				Brnt		M.Jurassic		0041
			70	Sltst		: dsk y brn to brn blk, carb		0041-1L
			30	Cont		: cem, prp		0041-2L
			tr	Coal		: blk		0041-3L
			tr	Ca		: pl brn to dsk brn		0041-4L
			tr	S/Sst		: pl brn, glauc, cem		0041-5L
3566.50	ccp			Brnt		M.Jurassic		0045
		0.19	100	S/Sst		: pl y brn, cem		0045-1L
3570.00				Brnt		M.Jurassic		0042
			65	Sltst		: dsk y brn to brn blk, carb		0042-1L
			35	Cont		: cem, prp, tar-ad		0042-2L
			tr	Coal		: blk		0042-3L
			tr	Ca		: pl brn to dsk brn		0042-4L
			tr	S/Sst		: pl brn, glauc, cem		0042-5L
3571.00	ccp			Brnt		M.Jurassic		0046
		0.12	100	S/Sst		: lt gy, cem		0046-1L
3573.00				Brnt		M.Jurassic		0043
			65	Sltst		: dsk y brn to brn blk, carb		0043-1L
			35	Cont		: cem, prp, tar-ad		0043-2L
			tr	Coal		: blk		0043-3L
			tr	Ca		: pl brn to dsk brn		0043-4L
			tr	S/Sst		: pl brn, glauc, cem		0043-5L

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Depth Cvd	Type / TOC%	%	Grp / Lithology description	Frm	Age	Trb	Sample
3574.91		ccp		Brnt		M.Jurassic		0047
		0.15	100	S/Sst : lt gy to pl y brn, mic, cem				0047-1L
3580.28		ccp		Brnt		M.Jurassic		0048
		0.39	100	S/Sst : lt y brn, cem				0048-1L
3585.59		ccp		Brnt		M.Jurassic		0049
		0.28	100	S/Sst : lt gy to lt y brn, cem				0049-1L
3590.21		ccp		Brnt		M.Jurassic		0050
		0.19	100	S/Sst : lt gy, cem				0050-1L
3596.43		ccp		Brnt		M.Jurassic		0051
		0.15	100	S/Sst : lt y brn, cem				0051-1L
3609.30		ccp		Brnt		M.Jurassic		0052
		0.67	100	S/Sst : drk y brn, cem				0052-1L
3615.20		ccp		Brnt		M.Jurassic		0053
		1.74	100	S/Sst : drk y brn, cly, cem, lam				0053-1L
3619.85		ccp		Brnt		M.Jurassic		0054
		52.67	100	Coal : blk				0054-1L

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth (Int Cvd)	Type / TOC%	%	Grp / Lithology description	Frm	Age	Trb	Sample
3624.50	ccp		Brnt		M.Jurassic		0055
	56.85	100	Coal : blk				0055-1L
3628.00			Brnt		M.Jurassic		0056
		90	Coal : brn blk to blk				0056-3L
		10	Sh/Clst: dsk y brn to brn blk, carb				0056-2L
		tr	S/Sst : gy, cem				0056-1L
3633.00			Brnt		M.Jurassic		0057
	59.53	95	Coal : brn blk to blk				0057-3L
		5	Sh/Clst: dsk y brn to brn blk, carb				0057-2L
		tr	S/Sst : gy, cem				0057-1L
3640.00			Brnt		M.Jurassic		0058
		100	Coal : brn blk to blk				0058-2L
		tr	Sh/Clst: dsk y brn to brn blk, carb				0058-1L
3645.00			Brnt		M.Jurassic		0059
	62.78	95	Coal : brn blk to blk				0059-2L
		5	Sh/Clst: dsk y brn to brn blk, carb				0059-1L
3653.00			Brnt		M.Jurassic		0060
	13.67	60	Sh/Clst: dsk y brn to brn blk, carb				0060-1L
		25	Coal : brn blk to blk				0060-2L
		10	S/Sst : lt or, cem				0060-4L
		5	Cont : prp				0060-3L

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GEOCHEMICAL LABORATORIES OF NORWAY A.S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Cvd	Type TOC%	%	Grp	Frm	Age / Lithology description	Trb	Sample
3658.00				Brnt		M.Jurassic		0061
			65	Sh/Clst:		dsk y brn to brn blk, brn gy, carb, slt		0061-1L
			25	Coal		: brn blk to blk		0061-2L
			10	Cont		: prp		0061-3L
			tr	S/Sst		: lt or, cem		0061-4L
3665.00				Brnt		M.Jurassic		0062
		1.96	80	Sh/Clst:		brn gy to dsk y brn		0062-1L
			15	Coal		: blk		0062-2L
			5	S/Sst		: lt or, calc, cem		0062-4L
			tr	Cont		: prp		0062-3L
3673.00				Brnt		M.Jurassic		0063
		0.34	40	S/Sst		: lt or, calc, cem		0063-4L
			35	Sh/Clst:		brn gy to dsk y brn		0063-1L
			15	Coal		: blk		0063-2L
			10	Cont		: prp		0063-3L
3675.00				Brnt		M.Jurassic		0064
			65	Coal		: blk, cly		0064-2L
			15	Sh/Clst:		brn gy to dsk y brn		0064-1L
			15	S/Sst		: lt or, calc, cem		0064-4L
			5	Cont		: prp		0064-3L
3685.00				Brnt		M.Jurassic		0065
		1.59	70	Sh/Clst:		brn gy to dsk y brn		0065-1L
			15	S/Sst		: lt or, calc, cem		0065-4L
			10	Coal		: blk, cly		0065-2L
			5	Cont		: prp		0065-3L

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Depth Cvd	Type TOC%	%	Grp	Frm	Age / Lithology description	Trb	Sample
3690.00				Brnt		M.Jurassic		0066
			40	Sh/Clst:		brn gy to dsk y brn		0066-1L
		0.24	30	S/Sst :		w to lt or, calc, cem		0066-4L
			25	Coal :		blk, cly		0066-2L
			5	Cont :		prp		0066-3L
3698.00				Brnt		M.Jurassic		0067
		0.19	55	S/Sst :		w to lt or, calc, cem		0067-4L
			30	Sh/Clst:		brn gy to dsk y brn, carb		0067-1L
			10	Coal :		blk, cly		0067-2L
			5	Cont :		prp		0067-3L
3703.00				Brnt		M.Jurassic		0068
			65	Sh/Clst:		brn gy to dsk y brn, carb		0068-1L
			20	Coal :		blk		0068-2L
			15	S/Sst :		w to lt or, calc, cem		0068-4L
			tr	Cont :		prp		0068-3L
3708.00				Brnt		M.Jurassic		0069
		5.53	60	Sh/Clst:		dsk y brn to brn blk, brn gy, carb		0069-1L
			40	Coal :		blk		0069-2L
			tr	Cont :		prp		0069-3L
			tr	S/Sst :		w to lt or, calc, cem		0069-4L
3715.00				Brnt		M.Jurassic		0070
			70	Sh/Clst:		dsk y brn to brn blk, brn gy, carb		0070-1L
			25	Coal :		blk		0070-2L
			5	S/Sst :		w to lt or, calc, cem		0070-4L
			tr	Cont :		prp		0070-3L

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GEOCHEMICAL LABORATORIES OF NORWAY A.S

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Depth Cvd	Type TOC%	%	Grp	Frm	Age / Lithology description	Trb	Sample
3720.00				Brnt		M.Jurassic		0071
		4.08	50	Sh/Clst:		brn gy to dsk y brn, carb		0071-1L
			25	Coal		: blk		0071-2L
			25	S/Sst		: w to lt or, cem		0071-4L
			tr	Cont		: prp		0071-3L
3728.00						Triassic		0072
		0.16	65	S/Sst		: w to lt or, cem		0072-4L
			20	Sh/Clst:		brn gy to dsk y brn, carb		0072-1L
			10	Coal		: blk		0072-2L
			5	Sltst		: gy red, mic		0072-5L
			tr	Cont		: prp		0072-3L
3733.00						Triassic		0073
		0.12	70	S/Sst		: w to lt or, crs, cem		0073-4L
			15	Coal		: blk		0073-2L
			10	Sh/Clst:		brn gy to dsk y brn, carb		0073-1L
			5	Sltst		: gy red, mic		0073-5L
			tr	Cont		: prp		0073-3L
3738.00						Triassic		0074
			55	S/Sst		: w to lt or, crs, cem		0074-4L
			25	Sh/Clst:		brn gy to dsk y brn, carb		0074-1L
			20	Coal		: blk		0074-2L
			tr	Cont		: prp		0074-3L
			tr	Sltst		: gy red, mic		0074-5L
3743.00						Triassic		0075
		0.16	50	S/Sst		: w to lt or, crs, cem		0075-4L
			35	Coal		: blk, cly		0075-2L
			15	Sh/Clst:		brn gy to dsk y brn, carb		0075-1L
			tr	Cont		: prp		0075-3L
			tr	Sltst		: gy red, mic		0075-5L

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Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Cvd	Type TOC%	%	Grp Frm Age / Lithology description	Trb	Sample
3748.00				Triassic		0076
			55	S/Sst : w to lt or, crs, cem		0076-4L
			25	Sh/Clst: brn gy to dsk y brn, carb		0076-1L
			20	Coal : blk, cly		0076-2L
			tr	Cont : prp		0076-3L
			tr	Sltst : gy red, mic		0076-5L
3753.00				Triassic		0077
		0.10	50	S/Sst : w to lt or, calc, cem		0077-4L
			35	Sh/Clst: brn gy to dsk y brn		0077-1L
			15	Coal : blk, cly		0077-2L
			tr	Cont : prp		0077-3L
			tr	Sltst : gy red, mic		0077-5L
3758.00				Triassic		0078
			50	S/Sst : w to lt or, calc, cem		0078-4L
			30	Coal : blk, cly		0078-2L
			20	Sh/Clst: brn gy to dsk y brn		0078-1L
			tr	Cont : prp		0078-3L
			tr	Sltst : gy red, mic		0078-5L
3763.00				Triassic		0079
			60	Sh/Clst: brn gy to dsk brn		0079-1L
		0.13	25	S/Sst : w to lt or, calc, cem		0079-4L
			15	Coal : blk, cly		0079-2L
			tr	Cont : prp		0079-3L
			tr	Sltst : gy red, mic		0079-5L
3768.00				Triassic		0080
			55	S/Sst : w to lt or, calc, cem		0080-4L
			25	Sh/Clst: brn gy to dsk brn		0080-1L
			20	Coal : blk		0080-2L
			tr	Cont : prp		0080-3L
			tr	Sltst : gy red, mic		0080-5L

Table 1 : Lithology description for well NOCS 15/5-1

Depth unit of measure: m

Depth Int	Depth Cvd	Type TOC%	%	Grp / Frm / Age / Lithology description	Trb	Sample
3773.00				Triassic		0081
			60	S/Sst : w to lt or, calc, crs, cem, l		0081-4L
			30	Sh/Clst: brn gy to dsk brn		0081-1L
			5	Coal : blk		0081-2L
			5	Sltst : gy red, mic		0081-5L
			tr	Cont : prp		0081-3L
3775.00				Triassic		0082
		0.13	85	S/Sst : w to lt or, calc, crs, cem, l		0082-4L
			10	Sh/Clst: brn gy to dsk brn, carb		0082-1L
			5	Coal : blk		0082-2L
			tr	Cont : prp		0082-3L
			tr	Sltst : gy red, mic		0082-5L

Table 2 : Rock-Eval table for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology	S1	S2	S3	S2/S3	TOC	HI	OI	PP	PI	Tmax	Sample
2215.00	cut	S/Sst : w	0.01	0.02	0.56	0.04	0.11	18	509	-	0.33	342	0084-4L
2245.00	cut	S/Sst : w	0.01	0.01	0.09	0.11	0.10	10	90	-	0.50	402	0085-4L
2305.00	cut	Sltst : pl brn	0.49	3.20	2.20	1.45	3.14	102	70	3.7	0.13	424	0087-5L
2335.00	cut	S/Sst : w	0.04	0.07	0.24	0.29	0.22	32	109	0.1	0.36	413	0088-3L
2515.00	cut	S/Sst : w to lt y brn	0.09	0.05	0.53	0.09	0.35	14	151	0.1	0.64	395	0094-2L
2675.00	cut	Ca : w	0.08	0.06	0.61	0.10	0.19	32	321	0.1	0.57	409	0002-4L
2705.00	cut	Marl : pl y brn, lt gn gy	0.17	0.05	0.42	0.12	0.16	31	263	0.2	0.77	339	0003-5L
2850.00	cut	Ca : lt or to gy pi	0.02	0.01	0.33	0.03	0.09	11	367	-	0.67	332	0008-1L
3060.00	cut	Marl : lt gy, gy red	0.14	0.04	0.27	0.15	0.20	20	135	0.2	0.78	299	0015-4L
3155.00	cut	Ca : lt or to lt gy	0.03	-	0.17	-	0.08	-	213	-	1.00	300	0018-1L
3275.00	cut	S/Sst : w to lt or	0.02	0.01	0.15	0.07	0.16	6	94	-	0.67	392	0022-4L
3335.00	cut	Marl : lt gy to m gy, gy red	0.03	0.01	1.10	0.01	0.31	3	355	-	0.75	329	0024-3L
3365.00	cut	Ca : lt or	-	-	0.21	-	0.09	-	233	-	-	255	0025-1L
3455.00	cut	Sh/Clst: lt gy to drk gy, gy red	0.04	0.03	0.13	0.23	0.53	6	25	0.1	0.57	343	0028-2L
3493.00	cut	Sltst : dsk brn to dsk y brn	3.84	19.16	0.54	35.48	4.09	468	13	23.0	0.17	433	0030-4L

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Depth unit of measure: m

Depth	Typ	Lithology	S1	S2	S3	S2/S3	TOC	HI	OI	PP	PI	Tmax	Sample
3498.00	cut	Sh/Clst: lt gy to drk gy, gy red	0.22	0.22	0.41	0.54	1.00	22	41	0.4	0.50	433	0031-2L
3505.00	cut	Sltst : dsk y brn	4.92	19.53	0.65	30.05	6.23	313	10	24.5	0.20	432	0032-4L
3518.00	cut	Sltst : dsk y brn to brn blk	4.47	18.08	0.51	35.45	5.97	303	9	22.5	0.20	435	0034-3L
3525.00	cut	Sltst : dsk y brn to brn blk	4.62	18.75	0.77	24.35	6.50	288	12	23.4	0.20	430	0035-2L
3533.00	cut	Sltst : dsk y brn to brn blk	4.48	17.30	0.92	18.80	7.05	245	13	21.8	0.21	431	0036-2L
3543.00	cut	Sltst : dsk y brn to brn blk	4.11	15.08	0.73	20.66	6.43	235	11	19.2	0.21	430	0038-2L
3550.00	cut	Sltst : dsk y brn to brn blk	4.00	14.31	0.75	19.08	6.25	229	12	18.3	0.22	428	0039-2L
3555.00	cut	Sltst : dsk y brn to brn blk	4.01	15.41	0.82	18.79	5.61	275	15	19.4	0.21	428	0040-2L
3561.30	ccp	S/Sst : pl y brn	0.66	0.16	0.71	0.23	0.12	133	592	0.8	0.80	428	0044-1L
3566.50	ccp	S/Sst : pl y brn	0.33	0.17	0.56	0.30	0.19	89	295	0.5	0.66	429	0045-1L
3571.00	ccp	S/Sst : lt gy	0.38	0.11	0.37	0.30	0.12	92	308	0.5	0.78	389	0046-1L
3574.91	ccp	S/Sst : lt gy to pl y brn	0.44	0.12	0.53	0.23	0.15	80	353	0.6	0.79	426	0047-1L
3580.28	ccp	S/Sst : lt y brn	1.35	0.35	0.58	0.60	0.39	90	149	1.7	0.79	424	0048-1L
3585.59	ccp	S/Sst : lt gy to lt y brn	0.61	0.24	0.48	0.50	0.28	86	171	0.9	0.72	429	0049-1L
3590.21	ccp	S/Sst : lt gy	0.21	0.07	0.55	0.13	0.19	37	289	0.3	0.75	430	0050-1L

Table 2 : Rock-Eval table for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology	S1	S2	S3	S2/S3	TOC	HI	OI	PP	PI	Tmax	Sample
3596.43	ccp	S/Sst : lt y brn	0.63	0.13	0.27	0.48	0.15	87	180	0.8	0.83	424	0051-1L
3609.30	ccp	S/Sst : drk y brn	0.60	0.35	0.28	1.25	0.67	52	42	1.0	0.63	427	0052-1L
3615.20	ccp	S/Sst : drk y brn	0.56	1.50	0.39	3.85	1.74	86	22	2.1	0.27	432	0053-1L
3619.85	ccp	Coal : blk	11.77	141.88	8.11	17.49	52.67	269	15	153.7	0.08	441	0054-1L
3624.50	ccp	Coal : blk	11.69	103.38	10.50	9.85	56.85	182	18	115.1	0.10	439	0055-1L
3633.00	cut	Coal : brn blk to blk	12.27	156.81	8.18	19.17	59.53	263	14	169.1	0.07	435	0057-3L
3645.00	cut	Coal : brn blk to blk	12.06	160.51	7.41	21.66	62.78	256	12	172.6	0.07	440	0059-2L
3653.00	cut	Sh/Clst: dsk y brn to brn blk	3.28	36.52	1.13	32.32	13.67	267	8	39.8	0.08	440	0060-1L
3665.00	cut	Sh/Clst: brn gy to dsk y brn	0.36	5.83	0.44	13.25	1.96	297	22	6.2	0.06	441	0062-1L
3673.00	cut	S/Sst : lt or	0.05	0.34	0.25	1.36	0.34	100	74	0.4	0.13	438	0063-4L
3685.00	cut	Sh/Clst: brn gy to dsk y brn	0.37	3.55	0.27	13.15	1.59	223	17	3.9	0.09	442	0065-1L
3690.00	cut	S/Sst : w to lt or	0.04	0.12	0.10	1.20	0.24	50	42	0.2	0.25	439	0066-4L
3698.00	cut	S/Sst : w to lt or	0.03	0.17	0.11	1.55	0.19	89	58	0.2	0.15	440	0067-4L
3708.00	cut	Sh/Clst: dsk y brn to brn blk, brn gy	1.74	17.27	0.60	28.78	5.53	312	11	19.0	0.09	438	0069-1L

Depth unit of measure: m

Depth	Typ	Lithology	S1	S2	S3	S2/S3	TOC	HI	OI	PP	PI	Tmax	Sample
3720.00	cut	Sh/Clst: brn gy to dsk y brn	1.41	12.23	0.77	15.88	4.08	300	19	13.6	0.10	433	0071-1L
3728.00	cut	S/Sst : w to lt or	0.03	0.15	0.30	0.50	0.16	94	188	0.2	0.17	436	0072-4L
3733.00	cut	S/Sst : w to lt or	0.03	0.10	0.13	0.77	0.12	83	108	0.1	0.23	435	0073-4L
3743.00	cut	S/Sst : w to lt or	0.04	0.12	0.12	1.00	0.16	75	75	0.2	0.25	435	0075-4L
3753.00	cut	S/Sst : w to lt or	0.02	0.06	0.04	1.50	0.10	60	40	0.1	0.25	440	0077-4L
3763.00	cut	S/Sst : w to lt or	0.02	0.06	0.03	2.00	0.13	46	23	0.1	0.25	439	0079-4L
3775.00	cut	S/Sst : w to lt or	0.02	0.04	0.05	0.80	0.13	31	38	0.1	0.33	434	0082-4L

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Table 3 : Pyrolysis GC Data (S2 peak) as Percentage of Total Area for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology	C1	C2-C5	C6-C14	C15+	S2 from Rock-Eval	Sample
2305.00	cut	Sltst : pl brn	7.01	23.03	51.76	19.19	3.20	0087-5L
2515.00	cut	S/Sst : w to lt y brn	-	-	-	-	0.05	0094-2L
2705.00	cut	Marl : pl y brn, lt gn gy	-	-	-	-	0.05	0003-5L
3060.00	cut	Marl : lt gy, gy red	-	-	-	-	0.04	0015-4L
3493.00	cut	Sltst : dsk brn to dsk y brn	2.67	11.48	32.73	53.12	19.16	0030-4L
3518.00	cut	Sltst : dsk y brn to brn blk	3.86	11.11	32.51	52.51	18.08	0034-3L
3555.00	cut	Sltst : dsk y brn to brn blk	1.28	9.97	12.60	76.15	15.41	0040-2L
3561.30	ccp	S/Sst : pl y brn	2.40	7.78	10.88	78.95	0.16	0044-1L
3580.28	ccp	S/Sst : lt y brn	2.62	7.80	14.15	75.44	0.35	0048-1L
3615.20	ccp	S/Sst : drk y brn	7.43	18.12	33.72	40.73	1.50	0053-1L
3619.85	ccp	Coal : blk	8.54	14.33	25.56	51.58	141.88	0054-1L
3665.00	cut	Sh/Clst: brn gy to dsk y brn	8.41	20.48	31.63	39.48	5.83	0062-1L
3685.00	cut	Sh/Clst: brn gy to dsk y brn	7.96	19.71	35.09	37.25	3.55	0065-1L
3708.00	cut	Sh/Clst: dsk y brn to brn blk, brn gy	5.29	13.19	27.59	53.94	17.27	0069-1L

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Table 3 : Pyrolysis GC Data (S2 peak) as Percentage of Total Area for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology		C1	C2-C5	C6-C14	C15+	S2 from Rock-Eval	Sample
3743.00	cut	S/Sst : w to lt or		7.74	27.47	27.98	36.81	0.12	0075-4L

Table 4 a: Weight of EOM and Chromatographic Fraction for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology	Rock Extracted (g)	EOM (mg)	Sat (mg)	Aro (mg)	Asph (mg)	NSO (mg)	HC (mg)	Non-HC (mg)	TOC(e) (%)	Sample
2305.00	cut	Sltst : pl brn	2.3	4.4	1.2	0.3	1.4	1.5	1.5	2.9	2.95	0087-5L
3493.00	cut	Sltst : dsk brn to dsk y brn	1.4	15.6	3.7	4.9	1.6	5.4	8.6	7.0	9.11	0030-4L
3555.00	cut	Sltst : dsk y brn to brn blk	2.6	27.9	6.9	8.9	1.7	10.4	15.8	12.1	7.22	0040-2L
3561.30	ccp	S/Sst : pl y brn	11.6	13.4	3.6	3.1	0.1	6.6	6.7	6.7	0.19	0044-1L
3580.28	ccp	S/Sst : lt y brn	10.3	4.2	2.1	0.6	0.8	0.7	2.6	1.5	0.38	0048-1L
3585.59	ccp	S/Sst : lt gy to lt y brn	10.7	15.9	8.8	3.5	0.7	3.0	12.2	3.7	0.41	0049-1L
3590.21	ccp	S/Sst : lt gy	11.8	7.1	2.7	0.4	0.2	3.8	3.2	4.0	0.13	0050-1L
3596.43	ccp	S/Sst : lt y brn	10.9	17.2	9.1	3.0	2.6	2.6	12.0	5.2	0.26	0051-1L
3609.30	ccp	S/Sst : drk y brn	10.1	4.6	1.9	1.7	0.1	0.9	3.6	1.0	0.59	0052-1L
3615.20	ccp	S/Sst : drk y brn	10.8	24.8	9.4	6.4	1.6	7.5	15.7	9.1	1.47	0053-1L
3619.85	ccp	Coal : blk	4.3	173.0	8.6	22.4	116.8	25.2	31.0	142.0	53.70	0054-1L

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Table 4 b: Concentration of EOM and Chromatographic Fraction (wt ppm rock) for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology	EOM	Sat	Aro	Asph	NSO	HC	Non-HC	Sample
2305.00	cut	Sltst : pl brn	1913	521	130	608	652	652	1260	0087-5L
3493.00	cut	Sltst : dsk brn to dsk y brn	10909	2552	3454	1118	3783	6006	4902	0030-4L
3555.00	cut	Sltst : dsk y brn to brn blk	10813	2689	3437	658	4027	6127	4686	0040-2L
3561.30	ccp	S/Sst : pl y brn	1160	315	264	8	571	580	580	0044-1L
3580.28	ccp	S/Sst : lt y brn	406	201	55	77	72	256	149	0048-1L
3585.59	ccp	S/Sst : lt gy to lt y brn	1491	822	325	65	277	1148	343	0049-1L
3590.21	ccp	S/Sst : lt gy	603	229	38	17	318	267	335	0050-1L
3596.43	ccp	S/Sst : lt y brn	1585	835	271	239	238	1106	478	0051-1L
3609.30	ccp	S/Sst : drk y brn	456	189	170	9	86	360	96	0052-1L
3615.20	ccp	S/Sst : drk y brn	2287	862	588	147	689	1451	836	0053-1L
3619.85	ccp	Coal : blk	40232	2004	5202	27162	5862	7206	33025	0054-1L

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Table 4 c: Concentration of EOM and Chromatographic Fraction (mg/g TOC(e)) for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology	EOM	Sat	Aro	Asph	NSO	HC	Non-HC	Sample
2305.00	cut	Sltst : pl brn	64.85	17.69	4.42	20.63	22.11	22.11	42.74	0087-5L
3493.00	cut	Sltst : dsk brn to dsk y brn	119.75	28.02	37.92	12.28	41.53	65.94	53.81	0030-4L
3555.00	cut	Sltst : dsk y brn to brn blk	149.78	37.26	47.62	9.13	55.78	84.87	64.90	0040-2L
3561.30	ccp	S/Sst : pl y brn	610.62	165.87	139.44	4.56	300.75	305.31	305.31	0044-1L
3580.28	ccp	S/Sst : lt y brn	106.89	52.94	14.51	20.36	19.09	67.44	39.45	0048-1L
3585.59	ccp	S/Sst : lt gy to lt y brn	363.79	200.66	79.39	16.02	67.73	280.05	83.74	0049-1L
3590.21	ccp	S/Sst : lt gy	464.42	176.61	29.43	13.08	245.29	206.04	258.37	0050-1L
3596.43	ccp	S/Sst : lt y brn	609.71	321.16	104.57	92.17	91.81	425.74	183.98	0051-1L
3609.30	ccp	S/Sst : drk y brn	77.35	32.12	28.92	1.68	14.63	61.04	16.31	0052-1L
3615.20	ccp	S/Sst : drk y brn	155.63	58.68	40.04	10.04	46.88	98.71	56.92	0053-1L
3619.85	ccp	Coal : blk	74.92	3.73	9.69	50.58	10.92	13.42	61.50	0054-1L

Table 4 d: Composition of material extracted from the rock (%) for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology		Sat / EOM	Aro / EOM	Asph / EOM	NSO / EOM	HC / EOM	Non-HC / EOM	Sat / Aro	HC / Non-HC	Sample
2305.00	cut	Sltst	: pl brn	27.27	6.82	31.82	34.09	34.09	65.91	400.00	51.72	0087-5L
3493.00	cut	Sltst	: dsk brn to dsk y brn	23.40	31.67	10.26	34.68	55.06	44.94	73.89	122.54	0030-4L
3555.00	cut	Sltst	: dsk y brn to brn blk	24.87	31.79	6.09	37.24	56.67	43.33	78.24	130.77	0040-2L
3561.30	ccp	S/Sst	: pl y brn	27.16	22.84	0.75	49.25	50.00	50.00	118.95	100.00	0044-1L
3580.28	ccp	S/Sst	: lt y brn	49.52	13.57	19.05	17.86	63.10	36.90	364.91	170.97	0048-1L
3585.59	ccp	S/Sst	: lt gy to lt y brn	55.16	21.82	4.40	18.62	76.98	23.02	252.74	334.43	0049-1L
3590.21	ccp	S/Sst	: lt gy	38.03	6.34	2.82	52.82	44.37	55.63	600.00	79.75	0050-1L
3596.43	ccp	S/Sst	: lt y brn	52.67	17.15	15.12	15.06	69.83	30.17	307.12	231.41	0051-1L
3609.30	ccp	S/Sst	: drk y brn	41.52	37.39	2.17	18.91	78.91	21.09	111.05	374.23	0052-1L
3615.20	ccp	S/Sst	: drk y brn	37.70	25.73	6.45	30.12	63.43	36.57	146.55	173.43	0053-1L
3619.85	ccp	Coal	: blk	4.98	12.93	67.51	14.57	17.91	82.09	38.53	21.82	0054-1L

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Table 5 : Saturated Hydrocarbon Ratios for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology	Pristane / nC17	Pristane / Phytane	Pristane + Phytane / nC17 + nC18	Phytane / nC18	CPI	Sample
2305.00	cut	Sltst : pl brn	0.52	1.41	0.52	0.52	1.39	0087-5L
3493.00	cut	Sltst : dsk brn to dsk y brn	0.82	1.21	0.82	0.83	0.96	0030-4L
3555.00	cut	Sltst : dsk y brn to brn blk	0.66	0.95	0.72	0.78	0.96	0040-2L
3561.30	ccp	S/Sst : pl y brn	0.67	0.92	0.63	0.59	1.09	0044-1L
3580.28	ccp	S/Sst : lt y brn	0.60	1.06	0.56	0.53	1.05	0048-1L
3585.59	ccp	S/Sst : lt gy to lt y brn	0.65	1.12	0.61	0.57	1.06	0049-1L
3590.21	ccp	S/Sst : lt gy	0.51	1.23	0.42	0.35	1.12	0050-1L
3596.43	ccp	S/Sst : lt y brn	0.62	0.85	0.57	0.53	1.07	0051-1L
3609.30	ccp	S/Sst : drk y brn	0.34	0.93	0.32	0.31	1.04	0052-1L
3615.20	ccp	S/Sst : drk y brn	0.49	1.10	0.47	0.44	1.06	0053-1L
3619.85	ccp	Coal : blk	3.60	6.62	1.91	0.47	0.95	0054-1L

Table 6 : Aromatic Hydrocarbon Ratios for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology	MNR	DMNR	BPhR	2/1MP	MPI1	MPI2	Rc	DBT/P	4/1MDBT	(3+2) /1MDBT	Sample
2305.00	cut	Sltst : pl brn	-	-	-	-	1.27	1.38	1.16	-	-	-	0087-5L
3493.00	cut	Sltst : dsk brn to dsk y brn	-	0.44	-	0.65	0.52	0.50	0.71	0.50	1.45	0.25	0030-4L
3555.00	cut	Sltst : dsk y brn to brn blk	0.47	0.69	0.21	-	0.64	-	0.78	3.22	-	-	0040-2L
3561.30	ccp	S/Sst : pl y brn	-	-	-	-	1.62	1.75	1.37	-	-	-	0044-1L
3580.28	ccp	S/Sst : lt y brn	-	-	-	-	0.61	-	0.77	-	-	-	0048-1L
3585.59	ccp	S/Sst : lt gy to lt y brn	0.83	0.95	-	-	1.24	1.27	1.14	0.41	2.01	0.96	0049-1L
3590.21	ccp	S/Sst : lt gy	-	-	-	-	0.36	-	0.62	-	-	-	0050-1L
3596.43	ccp	S/Sst : lt y brn	-	0.92	-	-	1.44	1.48	1.26	-	2.67	0.98	0051-1L
3609.30	ccp	S/Sst : drk y brn	0.82	0.84	-	-	0.59	-	0.75	0.32	1.98	-	0052-1L
3615.20	ccp	S/Sst : drk y brn	0.87	1.12	0.29	-	0.93	0.91	0.96	0.26	2.91	1.02	0053-1L
3619.85	ccp	Coal : blk	1.32	1.80	0.25	0.66	0.58	0.62	0.75	-	1.59	0.90	0054-1L

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Table 7 : Thermal Maturity Data for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology	Vitrinite Reflectance (%)	Number of Readings	Standard Deviation	Spore Fluorescence Colour	SCI	Tmax (^{o}C)	Sample
2185.00	cut	bulk	0.56	6	0.05	5-6	-	-	0083-0B
2305.00	cut	Sltst : pl brn	-	-	-	-	4.0	424	0087-5L
2395.00	cut	bulk	0.55	5	0.10	5	-	-	0091-0B
2645.00	cut	bulk	0.57	1	0.00	5-6	-	-	0001-0B
3060.00	cut	Marl : lt gy, gy red	-	-	-	-	NDP	299	0015-4L
3215.00	cut	bulk	NDP	-	-	6-7	-	-	0020-0B
3365.00	cut	bulk	NDP	-	-	6-7 (?)	-	-	0025-0B
3493.00	cut	Sltst : dsk brn to dsk y brn	-	-	-	-	5.0(?)	433	0030-4L
3505.00	cut	bulk	0.58	14	0.07	6	-	-	0032-0B
3518.00	cut	Sltst : dsk y brn to brn blk	-	-	-	-	5.5(?)	435	0034-3L
3538.00	cut	bulk	0.58	13	0.08	6	-	-	0037-0B
3555.00	cut	Sltst : dsk y brn to brn blk	-	-	-	-	6.0	428	0040-2L
3619.85	ccp	Coal : blk	-	-	-	-	5.5(?)	441	0054-1L
3624.50	ccp	bulk	0.57	40	0.04	5-6	-	-	0055-0B

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Depth unit of measure: m

Depth	Typ	Lithology	Vitrinite Reflectance (%)	Number of Readings	Standard Deviation	Spore Fluorescence Colour	SCI	Tmax (°C)	Sample
3665.00	cut	Sh/Clst: brn gy to dsk y brn	-	-	-	-	5.5-6.0	441	0062-1L
3675.00	cut	bulk	0.62	37	0.09	6-7	-	-	0064-0B
3708.00	cut	Sh/Clst: dsk y brn to brn blk, brn gy	-	-	-	-	6.0-6.5	438	0069-1L
3743.00	cut	bulk	0.61	29	0.06	6	-	-	0075-0B

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Table 8 : Visual Kerogen Composition Data for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology	LIPT %	AmorL	LipDet	Sp/Pol	Cuticl	Resin	Algae	Dinofl	Acrit	BitL	INERT %	Fusin	SemFus	IntDet	Micrin	Sclero	BitI	VITR %	Telin	Collin	VitDet	AmorV	BitV	Sample
2305.00	cut	Sltst : pl brn	30	**	**	*	*		*	*		?	TR			*				70	**	*				0087-5L
3060.00	cut	Marl : lt gy, gy red	10	**	**	*			*				10			*				80	*	*	**	*		0015-4L
3493.00	cut	Sltst : dsk brn to dsk y brn	80	**		*			**	*			5			*				15	*	*		*		~~0030-4L~~
3518.00	cut	Sltst : dsk y brn to brn blk	70	**		*	*		**	*		*	10	*	*	*				20	*	*				0034-3L
3555.00	cut	Sltst : dsk y brn to brn blk	70	**		*			**				10	*	*	*				20	*	*		*		0040-2L
3619.85	ccp	Coal : blk	15			*	*		*				5		*					80	*	*			*	0054-1L
3665.00	cut	Sh/Clst: brn gy to dsk y brn	60	*	*	**	**		**				10		*					30	*	*	*			0062-1L
3708.00	cut	Sh/Clst: dsk y brn to brn blk, brn gy	65	**	*	*			**				10			*				25	*		**			0069-1L

Table 9a : Tabulation of carbon isotope data for EOM/EOM - fractions or Oils for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology	EOM/Oil	Saturated	Aromatic	NSO	Asphaltenes	Kerogen	Sample
2305.00	cut		-	-27.57	-27.28	-27.22	-27.37	-	0087-5L
3555.00	cut		-28.82	-29.50	-28.83	-28.32	-27.90	-	0040-2L
3561.30	ccp		-29.65	-29.99	-28.78	-28.85	-27.36	-	0044-1L
3590.21	ccp		-	-26.69	-26.54	-25.59	-26.11	-	0050-1L
3609.30	ccp		-29.78	-29.73	-29.00	-	-27.68	-	0052-1L
3619.85	ccp		-23.98	-25.99	-24.57	-	-23.81	-	0054-1L

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Table 9b : Tabulation of cv values from carbon isotope data for well NOCS 15/5-1

Depth unit of measure: m

Depth	Typ	Lithology		Saturated	Aromatic	cv value	Interpretation	Sample
2305.00	cut			-27.57	-27.28	-2.46	Marine	0087-5L
3555.00	cut			-29.50	-28.83	-1.02	Marine	0040-2L
3561.30	ccp			-29.99	-28.78	0.33	Marine	0044-1L
3590.21	ccp			-26.69	-26.54	-3.04	Marine	0050-1L
3609.30	ccp			-29.73	-29.00	-0.81	Marine	0052-1L
3619.85	ccp			-25.99	-24.57	-0.44	Marine	0054-1L

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Table 10A: Variation in Triterpane Distribution (peak height) for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	B/A	B/B+A	B / B+E+F	C/E	C/C+E	X/E	Z/E	Z/C	Z/Z+E	Q/E	E/E+F	C+D / C+D+E+F	D+F/C+E	J1 / J1+J2%	Sample
2305.00	Sltst	1.43	0.59	0.14	0.57	0.36	0.05	0.19	0.33	0.16	0.23	0.56	0.42	0.96	53.14	0087-5
3555.00	Sltst	0.93	0.48	0.10	0.43	0.30	0.06	0.28	0.64	0.22	0.07	0.95	0.31	0.07	56.86	0040-2
3561.30	S/Sst	0.72	0.42	0.12	0.54	0.35	0.10	0.40	0.73	0.28	0.15	0.89	0.35	0.11	61.77	0044-1
3590.21	S/Sst	0.77	0.44	0.11	0.54	0.35	0.06	0.25	0.46	0.20	0.45	0.83	0.31	0.13	54.48	0050-1
3609.30	S/Sst	0.59	0.37	0.19	0.50	0.33	0.14	0.37	0.74	0.27	0.23	0.90	0.31	0.08	64.14	0052-1
3619.85	Coal	27.42	0.96	0.42	0.95	0.49	0.06	1.05	1.10	0.51	-	0.94	0.49	0.06	59.94	0054-1

Table 10B: Variation in Sterane Distribution (peak height) for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	Ratio1	Ratio2	Ratio3	Ratio4	Ratio5	Ratio6	Ratio7	Ratio8	Ratio9	Ratio10	Sample
2305.00	Sltst	0.59	19.33	79.63	1.03	0.91	0.47	0.38	0.66	0.24	2.42	0087-5
3555.00	Sltst	0.64	49.82	80.93	0.94	0.81	0.17	0.12	0.68	0.99	4.23	0040-2
3561.30	S/Sst	0.68	44.46	79.39	0.99	0.81	0.26	0.18	0.66	0.80	3.47	0044-1
3590.21	S/Sst	0.68	64.87	75.07	1.00	0.70	0.57	0.45	0.60	1.85	4.29	0050-1
3609.30	S/Sst	0.68	51.51	73.95	0.93	0.73	0.39	0.26	0.59	1.06	2.93	0052-1
3619.85	Coal	0.29	50.10	86.87	0.12	0.87	0.02	0.02	0.77	1.00	6.63	0054-1

Ratio1: a / a + j
Ratio2: q / q + t * 100%
Ratio3: 2(r + s)/(q + t + 2(r + s)) * 100%
Ratio4: a + b + c + d / h + k + l + n
Ratio5: r + s / r + s + q
Ratio6: u + v / u + v + q + r + s + t
Ratio7: u + v / u + v + i + m + n + q + r + s + t
Ratio8: r + s / q + r + s + t
Ratio9: q / t
Ratio10: r + s / t

Table 10C: Raw GCMS triterpane data (peak height) for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	p	q	r	s	t	a	b	z	c	Sample
2305.00	Sltst	26.59	13.18	9.06	9.62	3.11	12.27	17.51	10.98	32.87	0087-5
3555.00	Sltst	67.03	40.30	41.34	19.44	23.07	67.90	62.82	150.59	235.07	0040-2
3561.30	S/Sst	76.77	68.40	53.28	43.32	28.05	100.08	72.29	179.86	246.96	0044-1
3590.21	S/Sst	84.67	48.06	23.09	20.39	10.39	20.89	16.17	26.24	57.14	0050-1
3609.30	S/Sst	276.70	242.70	175.28	138.65	68.79	459.25	272.91	393.43	531.07	0052-1

Depth	x	d	e	f	g	h	i	j1
2305.00	2.72	40.86	57.54	45.71	18.87	142.80*	57.31	8.37
3555.00	33.82	22.21	544.43	31.02	326.68	261.62	13.28	228.80
3561.30	45.83	25.11	453.16	55.24	242.27	165.60	20.53	178.96
3590.21	6.68	0.00	105.88	21.36	47.02	37.23	6.65	24.12
3609.30	150.28	0.00	1067.67	123.12	489.17	316.73	51.05	268.06

Depth	j2	k1	k2	l1	l2	m1	m2
2305.00	7.38	5.94	0.00	2.39	0.00	0.00	0.00
3555.00	173.61	185.71	127.77	96.89	64.92	114.91	62.35
3561.30	110.76	129.65	67.87	57.86	33.89	46.99	41.44
3590.21	20.15	23.35	8.15	10.05	0.00	0.00	0.00
3609.30	149.85	184.95	117.65	78.16	59.26	68.73	30.31

* = uncertain measurement, coelutes with strong unidetified p

Table 10C: Raw GCMS triterpane data (peak height) for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	p	q	r	s	t	a	b	z	c	Sample
3619.85	Coal	0.00	0.00	0.00	417.70	0.00	74.12	2032.56	2816.64	2566.73	0054-1

Depth	x	d	e	f	g	h	i	j1
3619.85	164.50	158.51	2689.41	156.64	1109.14	752.04	71.72	508.78

Depth	j2	k1	k2	l1	l2	m1	m2
3619.85	340.08	200.55	139.32	124.64	67.12	72.70	73.45

Table 10D: Raw GCMS sterane data (peak height) for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	u	v	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	Sample
2305.00	Sltst	22.86	10.04	21.91	9.43	3.73	10.98	10.98	5.77	9.71	19.53	7.85	15.47	10.90	5.48	0.00	8.98	8.41	7.56	2.41	12.19	12.19	10.06	0087-5
3555.00	Sltst	76.28	44.95	254.85	163.98	55.87	153.58	153.58	109.71	132.03	299.62	170.86	143.57	179.52	58.45	19.34	128.71	157.00	80.28	94.67	201.66	201.66	95.35	0040-2
3561.30	S/Sst	97.08	62.76	275.54	172.52	47.20	146.27	133.65	84.89	98.67	263.79	128.07	127.18	173.86	89.09	40.94	122.68	134.43	49.82	68.62	148.64	148.64	85.73	0044-1
3590.21	S/Sst	40.97	31.84	32.41	21.50	3.94	9.96	12.48	10.41	6.93	33.31	16.68	15.44	14.60	7.62	5.32	12.52	15.64	8.31	14.44	18.12	15.40	7.82	0050-1
3609.30	S/Sst	359.56	257.23	791.29	511.51	154.07	447.79	447.79	255.43	172.26	809.31	404.06	375.45	457.07	391.86	0.00	398.90	402.92	119.54	209.23	288.29	288.29	197.00	0052-1

Table 10D: Raw GCMS sterane data (peak height) for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	u	v	a	b	c	d	e	f	g	Sample	h	i	j	k	l	m	n	o	p	q	r	s	t
3619.85	Coal	27.96	11.21	41.66	25.79	6.24	72.77	85.29	109.49	0.00	0054-1	529.75	69.44	102.61	326.37	144.86	19.74	186.39	111.08	63.95	207.77	686.22	686.22	206.97

Depth unit of measure: m

Depth	Lithology	u	v	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	Sample
2305.00	Sltst	22.86	10.04	21.91	9.43	3.73	10.98	10.98	5.77	9.71	19.53	7.85	15.47	10.90	5.48	0.00	8.98	8.41	7.56	2.41	12.19	12.19	10.06	0087-5
3555.00	Sltst	76.28	44.95	254.85	163.98	55.87	153.58	153.58	109.71	132.03	299.62	170.86	143.57	179.52	58.45	19.34	128.71	157.00	80.28	94.67	201.66	201.66	95.35	0040-2
3561.30	S/Sst	97.08	62.76	275.54	172.52	47.20	146.27	133.65	84.89	98.67	263.79	128.07	127.18	173.86	89.09	40.94	122.68	134.43	49.82	68.62	148.64	148.64	85.73	0044-1
3590.21	S/Sst	40.97	31.84	32.41	21.50	3.94	9.96	12.48	10.41	6.93	33.31	16.68	15.44	14.60	7.62	5.32	12.52	15.64	8.31	14.44	18.12	15.40	7.82	0050-1
3609.30	S/Sst	359.56	257.23	791.29	511.51	154.07	447.79	447.79	255.43	172.26	809.31	404.06	375.45	457.07	391.86	0.00	398.90	402.92	119.54	209.23	288.29	288.29	197.00	0052-1

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GEOCHEMICAL LABORATORIES OF NORWAY A/S

Table 10D: Raw GCMS sterane data (peak height) for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	u	v	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	Sample
3619.85	Coal	27.96	11.21	41.66	25.79	6.24	72.77	85.29	109.49	0.00	529.75	69.44	102.61	326.37	144.86	19.74	186.39	111.08	63.95	207.77	686.22	686.22	206.97	0054-1

Table 10E: Aromatisation of Steranes for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	Ratio1	Ratio2	Sample
2305.00	Sltst	0.56	1.00	0087-5
3555.00	Sltst	0.36	0.97	0040-2
3561.30	S/Sst	0.44	0.92	0044-1
3590.21	S/Sst	0.41	0.86	0050-1
3609.30	S/Sst	0.35	0.93	0052-1
3619.85	Coal	0.07	1.00	0054-1

Ratio1: $\frac{C1+D1+E1+F1+G1+H1+I1}{C1+D1+E1+F1+G1+H1+I1 + c1+d1+e1+f1+g1}$

Ratio2: g1 / g1 + I1

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Table 10F: Variation in Triaromatic Sterane Distribution for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	Ratio1	Ratio2	Ratio3	Ratio4	Ratio5	Sample
2305.00	Sltst	0.82	0.79	0.52	0.53	0.60	0087-5
3555.00	Sltst	0.42	0.40	0.18	0.17	0.25	0040-2
3561.30	S/Sst	0.57	0.56	0.29	0.27	0.35	0044-1
3590.21	S/Sst	0.70	0.71	0.41	0.38	0.49	0050-1
3609.30	S/Sst	0.62	0.62	0.37	0.33	0.45	0052-1
3619.85	Coal	0.16	0.16	0.11	0.07	0.30	0054-1

Ratio1: a1 / a1 + g1
Ratio2: b1 / b1 + g1
Ratio3: a1 + b1 / a1 + b1 + c1 + d1 + e1 + f1 + g1
Ratio4: a1 / a1 + e1 + f1 + g1
Ratio5: a1 / a1 + d1

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Table 10G: Variation in Monoaromatic Sterane Distribution for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	Ratio1	Ratio2	Ratio3	Ratio4	Sample
2305.00	Sltst	0.57	0.54	0.38	0.35	0087-5
3555.00	Sltst	0.27	0.19	0.16	0.13	0040-2
3561.30	S/Sst	0.34	0.23	0.21	0.17	0044-1
3590.21	S/Sst	0.38	0.24	0.24	0.19	0050-1
3609.30	S/Sst	0.39	0.30	0.24	0.20	0052-1
3619.85	Coal	0.02	0.13	0.01	0.03	0054-1

Ratio1: A1 / A1 + E1
Ratio2: B1 / B1 + E1
Ratio3: A1 / A1 + E1 + G1
Ratio4: A1+B1 / A1+B1+C1+D1+E1+F1+G1+H1+I1

Table 10H: Raw GCMS monoaromatic sterane data (peak height) for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	a1	b1	c1	d1	e1	f1	g1	h1	i1	Sample
2305.00	Sltst	11.45	10.24	6.25	6.81	8.67	0.66	10.24	6.88	0.00	0087-5
3555.00	Sltst	77.68	50.20	134.95	122.13	208.62	33.03	201.64	113.12	7.96	0040-2
3561.30	S/Sst	129.61	75.10	174.94	139.76	253.22	45.24	243.52	146.24	18.10	0044-1
3590.21	S/Sst	14.80	7.53	11.07	13.57	23.98	5.28	23.24	13.99	3.26	0050-1
3609.30	S/Sst	127.76	82.44	143.67	124.15	195.80	48.16	202.04	129.89	20.32	0052-1
3619.85	Coal	0.26	1.63	0.00	0.00	10.91	7.12	27.45	22.22	0.00	0054-1

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Table 10I: Raw GCMS trioaromatic sterane data (peak height) for Well NOCS 15/5-1

Depth unit of measure: m

Depth	Lithology	a1	b1	c1	d1	e1	f1	g1	Sample
2305.00	Sltst	18.28	15.18	2.85	12.09	8.00	4.52	3.97	0087-5
3555.00	Sltst	172.34	157.35	122.38	510.03	274.22	324.30	233.68	0040-2
3561.30	S/Sst	261.18	254.76	105.07	478.63	253.18	255.37	198.17	0044-1
3590.21	S/Sst	47.32	48.97	10.94	48.68	33.63	23.74	20.43	0050-1
3609.30	S/Sst	457.31	471.26	127.26	551.70	374.77	269.70	284.06	0052-1
3619.85	Coal	54.47	52.94	24.12	128.57	373.91	94.10	287.75	0054-1

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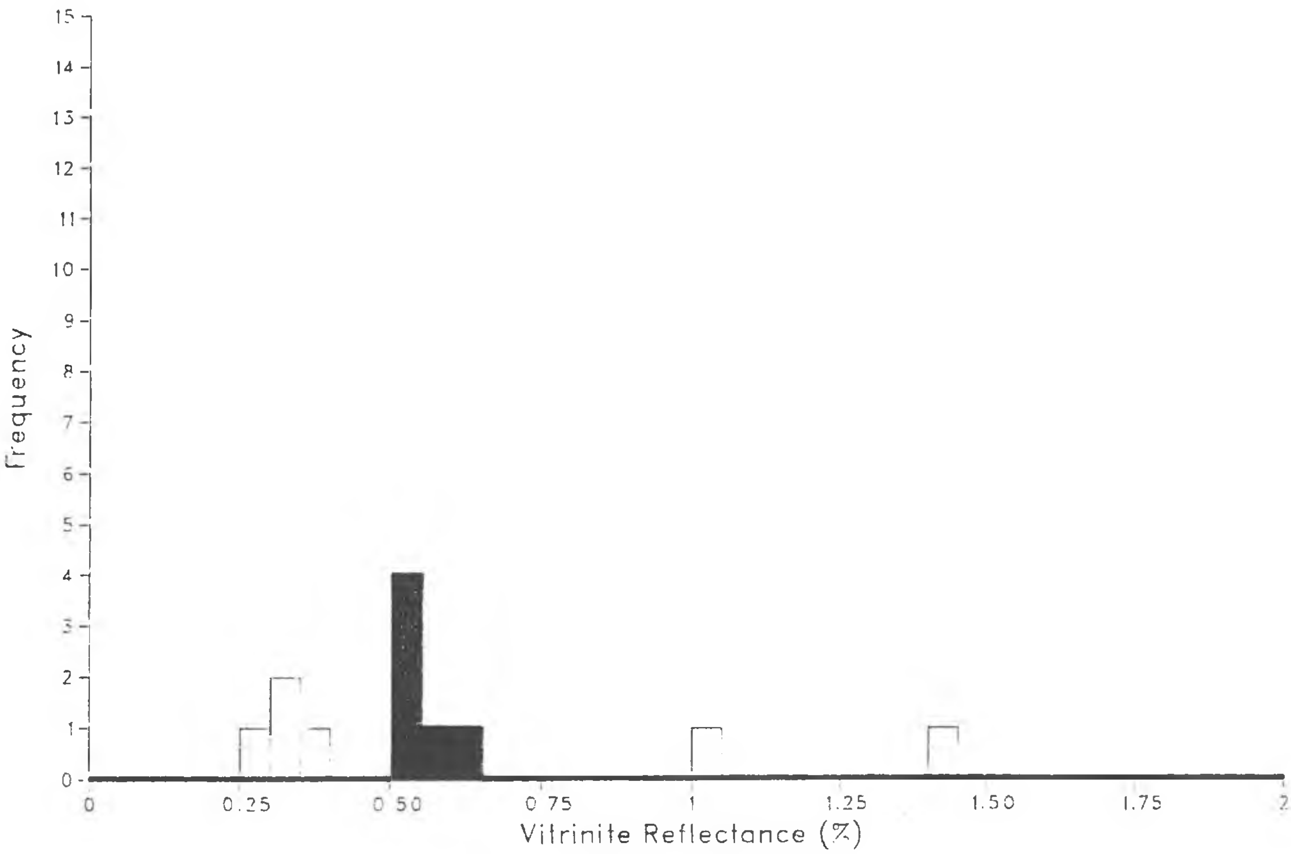
GEOCHEMICAL LABORATORIES OF NORWAY A/S

VITRINITE REFLECTANCE HISTOGRAMS

Vitrinite Reflectance Histogram

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

Well: NOCS 15/5-1
Depth: 2185.00(m.)
Sample: 83- 0b



Statistics:	Mean	St.Dev.	n
Indigenous Population (from 0.500 to 0.650):	0.56	0.05	6
Population Two (from 0.250 to 0.400):	0.32	0.04	4
Population Three (from 1.000 to 1.050):	1.03	0.00	1
Population Four (from 1.400 to 1.450):	1.40	0.00	1

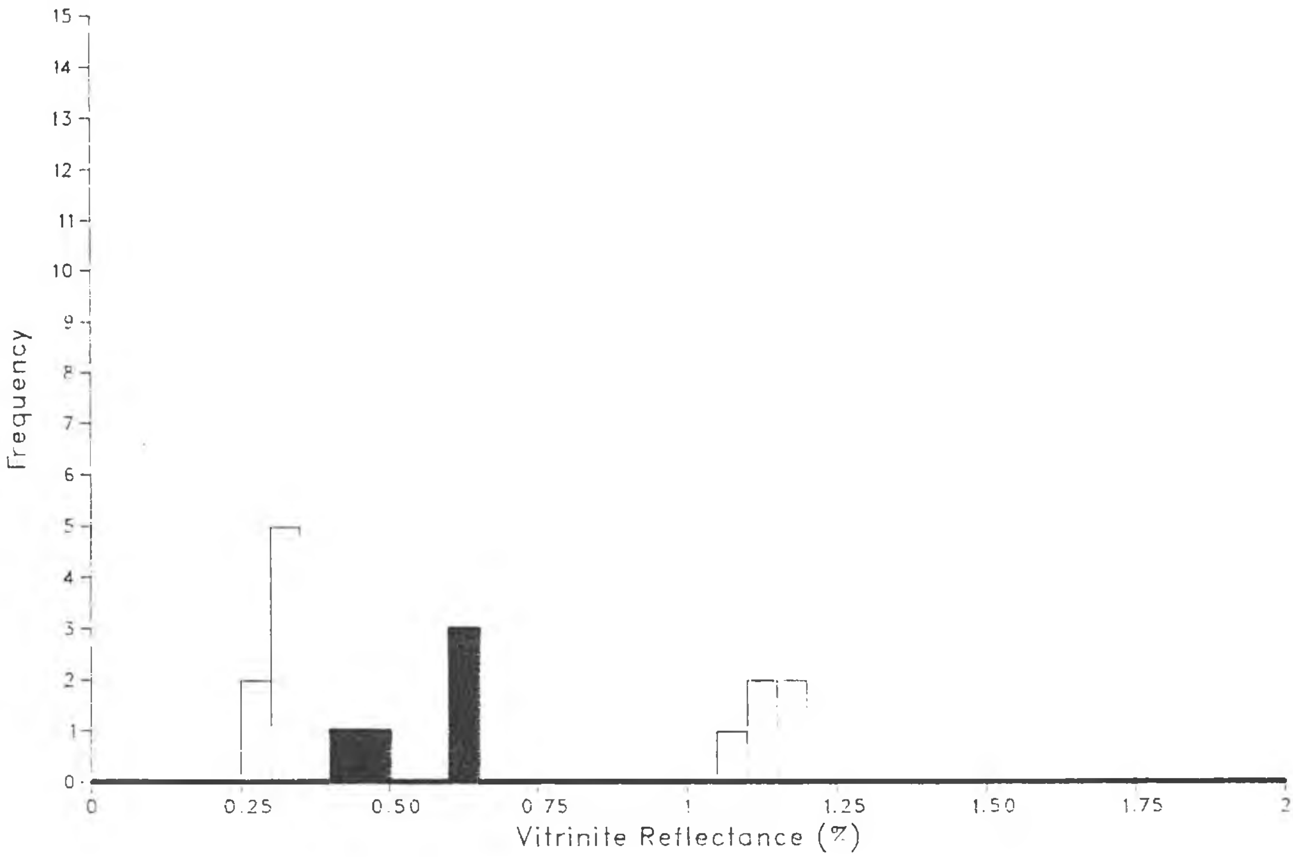
Readings:

0.282 0.328 0.334 0.355 0.509 0.517 0.534 0.539 0.597 0.645
1.028 1.403

Vitrinite Reflectance Histogram

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

Well: NOCS 15/5-1
Depth: 2395.00(m)
Sample: 91- 0b



Statistics:	Mean	St.Dev.	n
Indigenous Population (from 0.400 to 0.650):	0.55	0.10	5
Population Two (from 0.250 to 0.350):	0.31	0.03	7
Population Three (from 1.050 to 1.200):	1.14	0.04	5

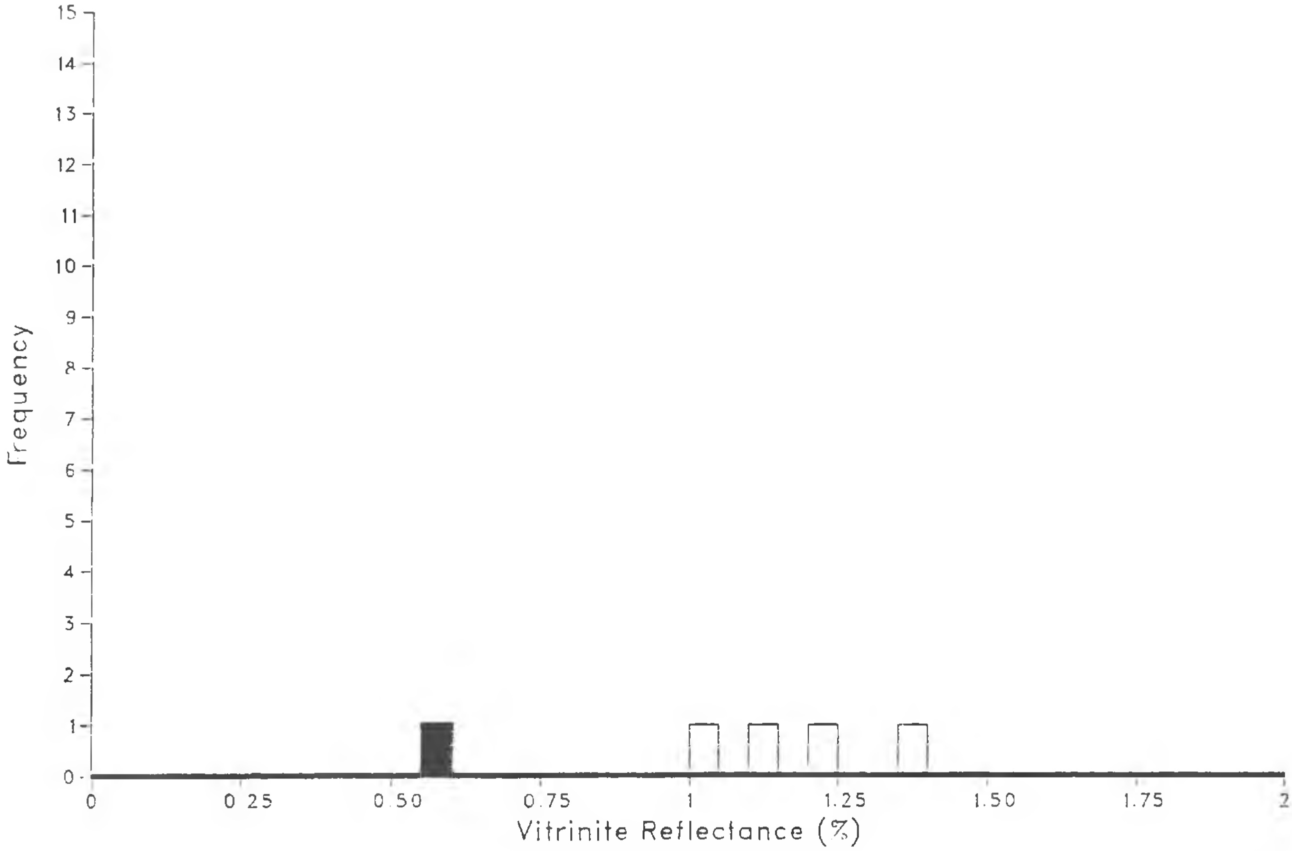
Readings:

0.267	0.272	0.308	0.322	0.331	0.333	0.345	0.442	0.459	0.621
0.622	0.629	1.096	1.104	1.134	1.171	1.197			

Vitrinite Reflectance Histogram

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Well: NOCS 15/5-1
Depth: 2645.00(m)
Sample: 1- 0b



Statistics:	Mean	St.Dev.	n
Indigenous Population (from 0.550 to 0.600):	0.57	0.00	1
Population Two (from 1.000 to 1.250):	1.12	0.11	3
Population Three (from 1.350 to 1.400):	1.39	0.00	1

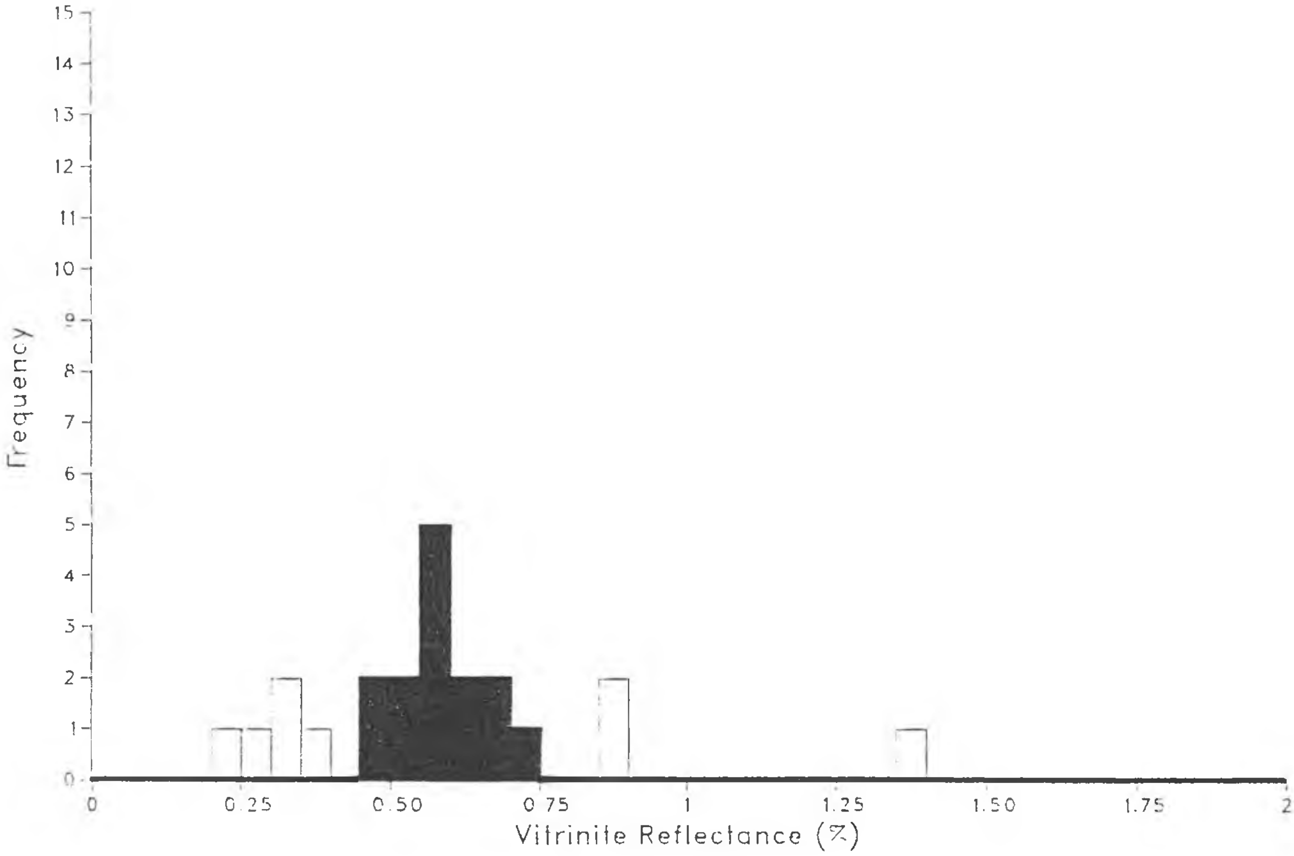
Readings:

0.569 1.015 1.107 1.232 1.392

Vitrinite Reflectance Histogram

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Well: NOCS 15/5-1
Depth: 3505.00(m.)
Sample: 32-0b



Statistics:	Mean	St.Dev.	n
Indigenous Population (from 0.450 to 0.750):	0.58	0.07	14
Population Two (from 0.200 to 0.450):	0.32	0.08	6
Population Three (from 0.850 to 0.900):	0.86	0.02	2
Population Four (from 1.350 to 1.400):	1.39	0.00	1

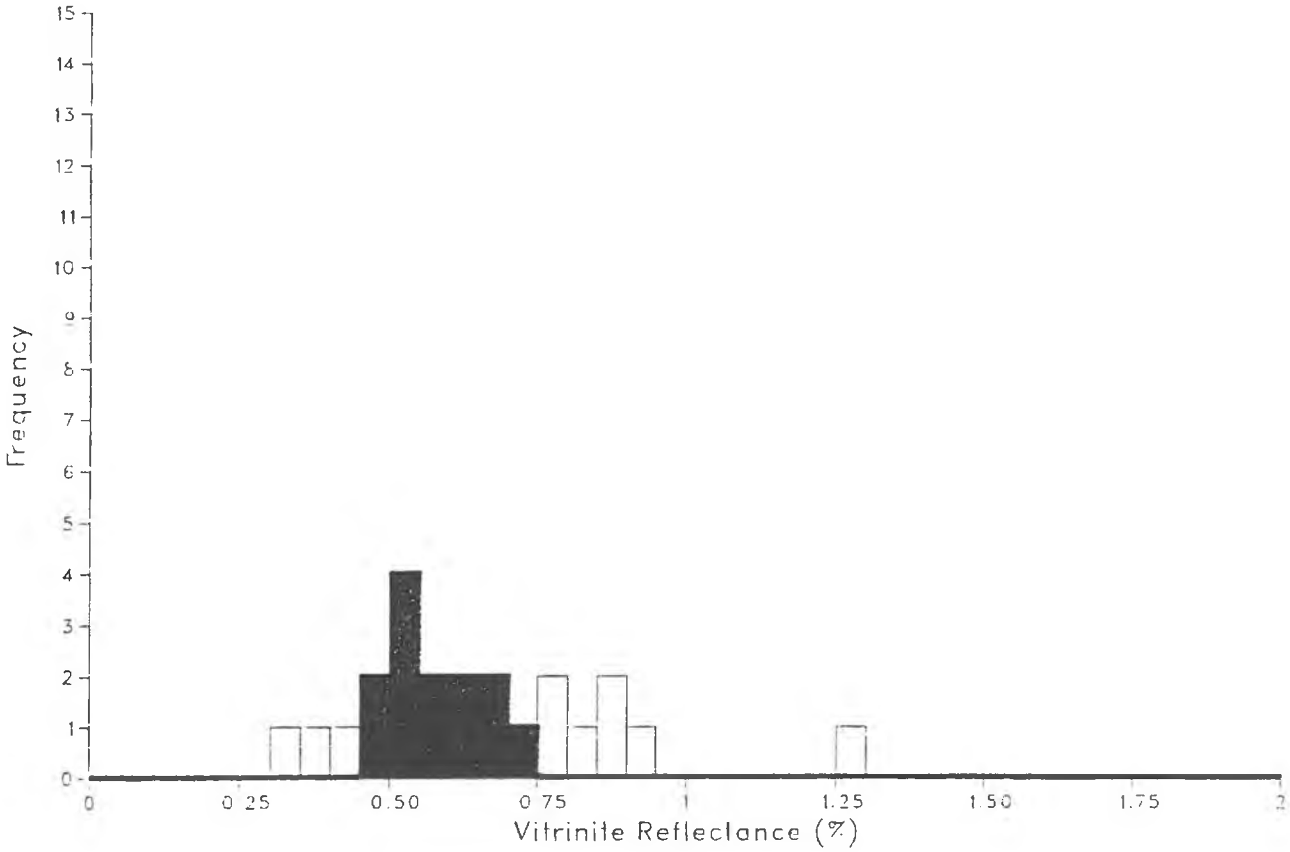
Readings:

0.203	0.265	0.305	0.332	0.358	0.450	0.497	0.536	0.543	0.567
0.574	0.577	0.587	0.592	0.602	0.602	0.655	0.685	0.722	0.852
0.876	1.386								

Vitrinite Reflectance Histogram

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Well: NOCS 15/5-1
Depth: 3538.00(m)
Sample: 37- 0b



Statistics:	Mean	St.Dev.	n
Indigenous Population (from 0.450 to 0.700):	0.58	0.08	13
Population Two (from 0.300 to 0.450):	0.40	0.06	4
Population Three (from 0.700 to 0.950):	0.82	0.08	7
Population Four (from 1.250 to 1.300):	1.26	0.00	1

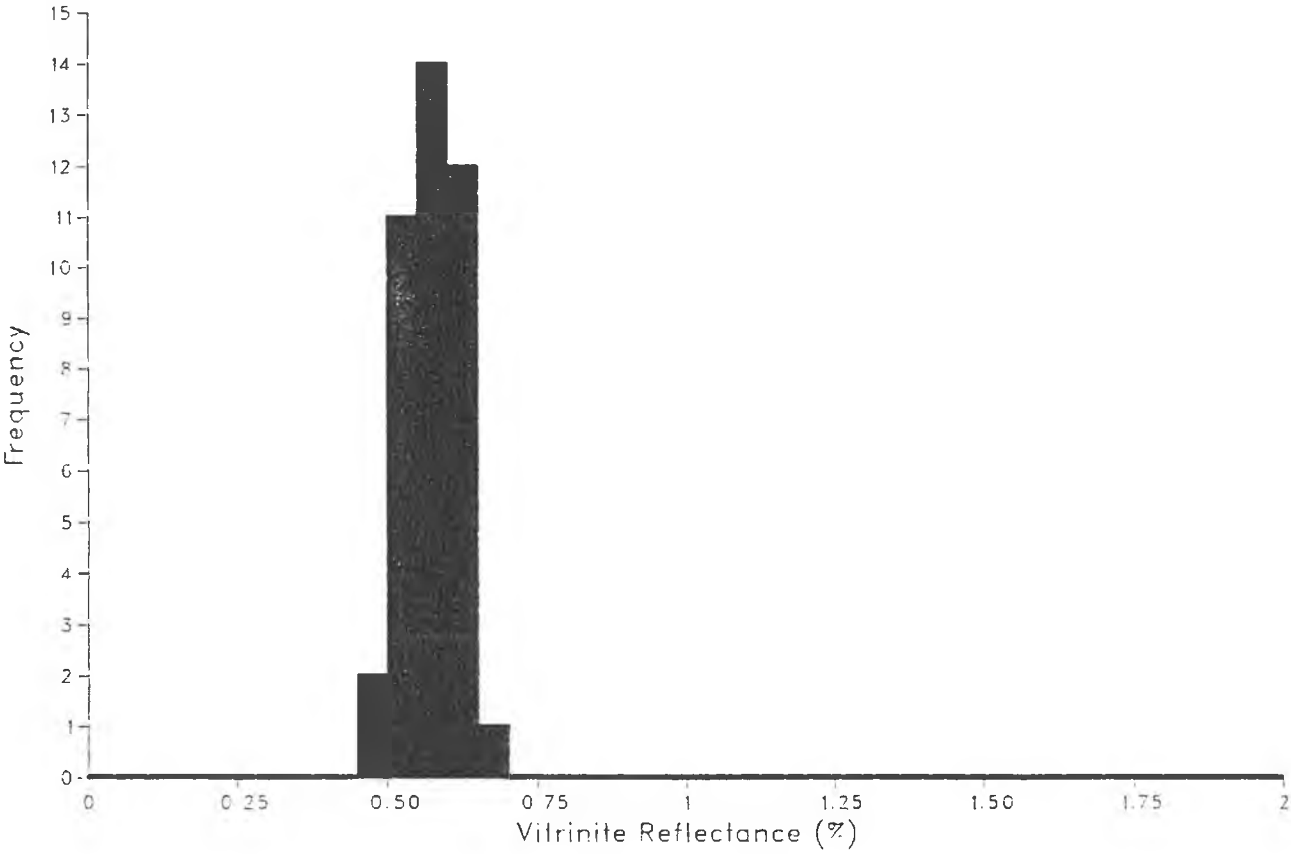
Readings:

0.309	0.399	0.430	0.450	0.479	0.516	0.522	0.531	0.539	0.580
0.581	0.642	0.643	0.671	0.697	0.700	0.770	0.788	0.823	0.857
0.872	0.929	1.257							

Vitrinite Reflectance Histogram

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Well: NOCS 15/5-1
Depth: 3624.50(m)
Sample: 55- 0b



Statistics	Mean	St.Dev.	n
Indigenous Population (from 0.450 to 0.700):	0.57	0.04	40

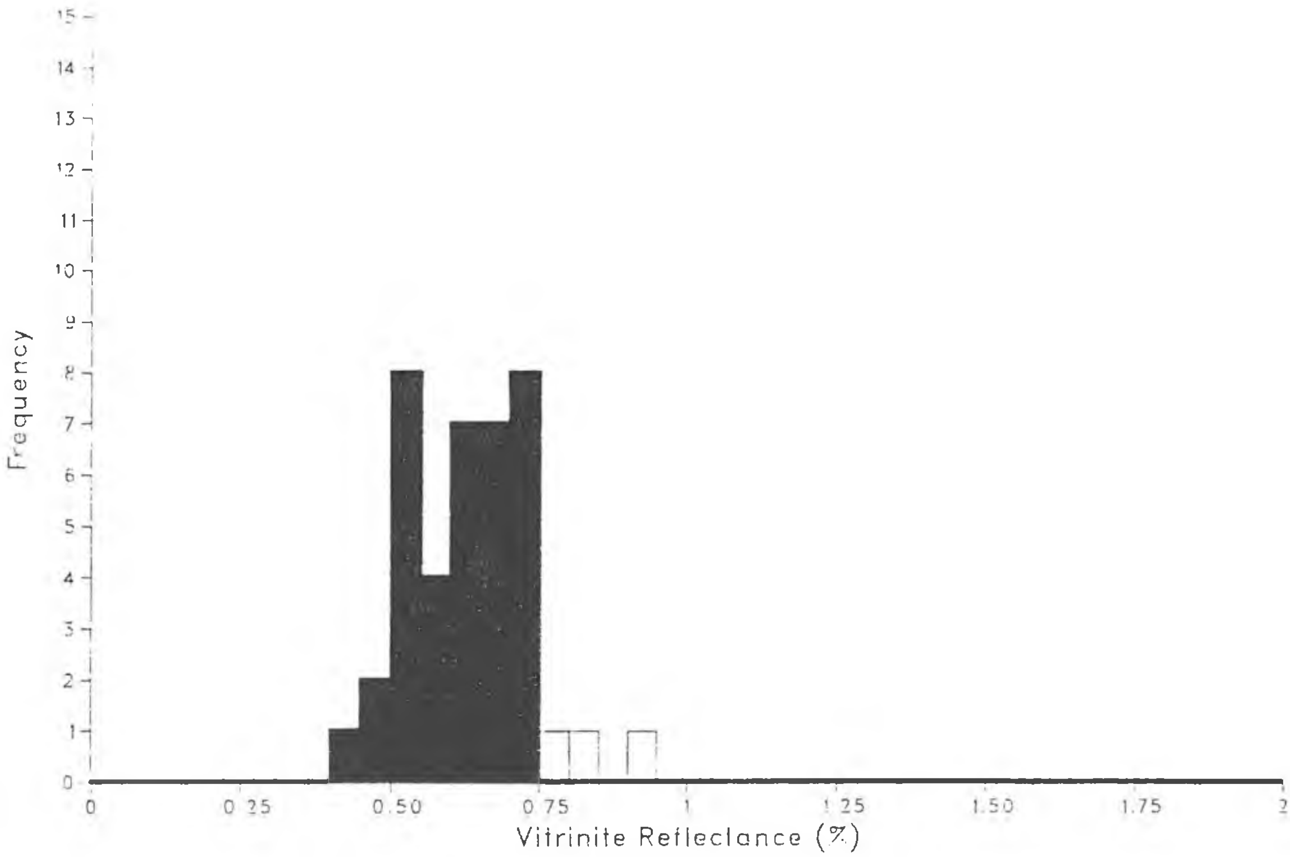
Readings:

0.458	0.486	0.527	0.534	0.534	0.535	0.537	0.540	0.542	0.544
0.545	0.546	0.547	0.552	0.554	0.557	0.557	0.558	0.562	0.564
0.565	0.575	0.578	0.579	0.583	0.588	0.597	0.605	0.605	0.613
0.614	0.614	0.615	0.628	0.635	0.635	0.635	0.639	0.639	0.663

Vitrinite Reflectance Histogram

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Well: NOCS 15/5-1
Depth: 3675.00(m)
Sample: 64-0b



Statistics:	Mean	St.Dev.	n
Indigenous Population (from 0.400 to 0.750):	0.62	0.09	37
Population Two (from 0.750 to 0.950):	0.83	0.07	3

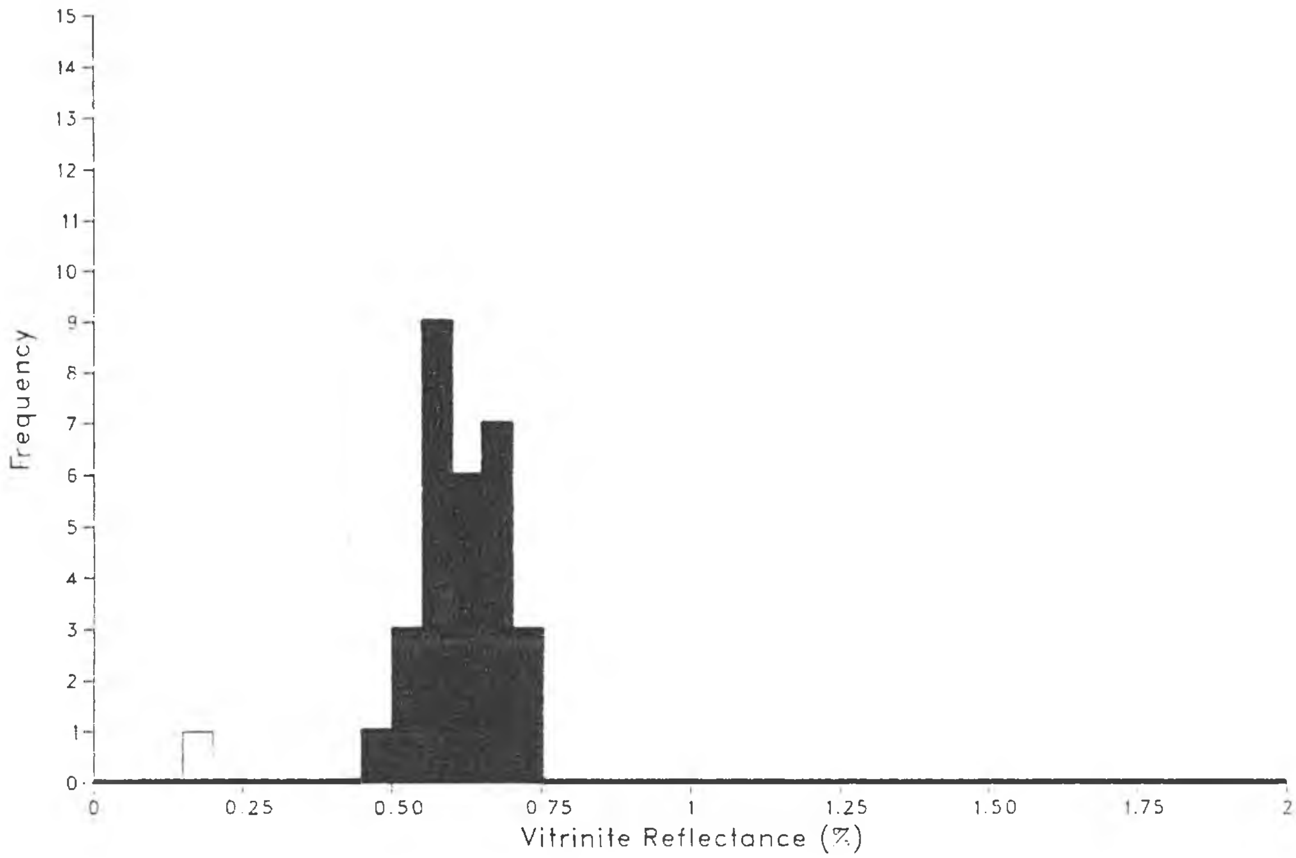
Readings:

0.438	0.457	0.484	0.502	0.504	0.504	0.528	0.536	0.540	0.545
0.547	0.574	0.577	0.578	0.596	0.608	0.613	0.631	0.631	0.631
0.642	0.649	0.655	0.661	0.669	0.673	0.673	0.680	0.687	0.702
0.704	0.705	0.712	0.741	0.746	0.746	0.747	0.772	0.817	0.915

Vitrinite Reflectance Histogram

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

Well: NOCS 15/5-1
Depth: 3743 00(m)
Sample: 75- 0b



Statistics:	Mean	St.Dev.	n
Indigenous Population (from 0.450 to 0.750):	0.61	0.06	29
Population Two (from 0.150 to 0.200):	0.19	0.00	1

Readings:

0.188	0.472	0.523	0.542	0.545	0.553	0.568	0.571	0.572	0.576
0.577	0.578	0.581	0.594	0.601	0.609	0.625	0.642	0.645	0.648
0.651	0.656	0.658	0.660	0.664	0.669	0.677	0.708	0.716	0.724