GEOLAB NOR

# Geochemical Analysis Report for

# NOCS 31/4-7


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# Summary

The interval 2010 - 2500 m of well NOCS 31/4-7 was analysed, this well being located in the Brage field on the east margin of the North Viking Graben.

The potential source rocks of interest in this well are the silty shales of the Lower Jurassic Drake Formation which have fair potential for oil and gas, together with similar marine, algal-rich shale seams in the underlying Cook Formation. However the Drake Formation of this well is apparently weathered in the upper levels, such that this unit could be a very interesting source alternative elsewhere in the area. The Upper Jurassic is represented only by the the Heather formation, consisting of gas-prone shales.

The top of the oil window for type II kerogen is interpreted to occur at 2350 - 2400 m, i.e. in the Lower Jurassic Amundsen Formation. The potential source rocks of the Drake Formation are therefore at an early mature stage, containing mainly early in-situ generated condensate-range hydrocarbons which may however be detected in the overlying units. The base of the oil window is placed tentatively by extrapolation at approximately 2950 m, i.e. well below TD.

Regarding migrated hydrocarbons, the Upper Cretaceous Shetland Group carbonates contain small amounts of well mature residual oils, while the siltstones/shales of the Heather Formation are stained throughout by migrated hydrocarbons. In the upper levels these have a mature/well mature (? 0.7 % Ro) marine (? Draupne-type) signature, while those in the lower levels may well be mixtures of the latter plus hydrocarbons generated in a Drake-type source at a greater depth down-dip. The sands of the Cook and Amundsen formations are practically barren of migrated hydrocarbons. The Statfjord Formation contains abundant, well mature (?0.7-1.0 % Ro) migrated oil which appears to have been co-sourced by a (?)Draupne type source and a (?)Drake type source.

*Chapter 1*

# Introduction

## 1.1 General Comments

Well NOCS 31/4-7 is located in the Brage field, east of the Oseberg field on the north-west margin of the Horda Platform of the North Sea. This has TD at 2505 m in the Lower Jurassic, having been drilled by Norsk Hydro in 1984. Hydrocarbons were reported to have been detected in the Upper Jurassic Heather formation, the Lower Jurassic Drake formation and the upper section of the Statfjord formation, where a flowing DST was recorded.

In this report emphasis is placed on characterization of the hydrocarbons in the shows detected and that of the oil recovered. In addition the potential source rocks of the Viking and Dunlin Groups are assessed.

## 1.2 Analytical Program

The following analytical program was performed on well 31/4-7 over the interval 1000 - 2500 m.

| Analysis type | No of samples | Figures | Tables |
|---|---|---|---|
| Lithology description | 150 | 1 | 1 |
| Rock Eval Pyrolysis, TOC | 56 | 2-4 | 2 |
| Thermal extraction GC (GHM $S_1$) | 22 | 5a-d | |
| Pyrolysis GC (GHM $S_2$) | 22 | 6a-e,7 | 3 |
| Soxhlet extraction | 6 | 4 | |
| MPLC separation | 6 | 4 | |
| Saturated hydrocarbon GC | 6 | 8a-d | 5 |
| Aromatic hydrocarbon GC | 6 | 9a-e | 6 |
| Vitrinite reflectance | 13 | 10 | 7 |
| Visual kerogen microscopy | 9 | 11 | 7,8 |
| Isotope composition of $C_{15}$+ fractions | 5 | 12,13 | 9 |
| Gas chromatography - Mass Spectrometry | 5 | 14a-j | 10 |

## 1.3 Stratigraphy

The following stratigraphy and formation tops, based on information from the NPD, have been used in this report.

| Lithostratigraphic Unit | Age | Top RKB | Thickness |
|---|---|---|---|
| Nordland Group | Tertiary | 163 m | 802 m |
| Utsira Formation | Tertiary | 725 m | 240 m |
| Hordaland Group | Tertiary | 965 m | 804 m |
| Rogaland Group | Tertiary | 1769 m | 218 m |
| Balder Formation | Tertiary | 1769 m | 61 m |
| Sele Formation | Tertiary | 1830 m | 39 m |
| Lista Formation | Tertiary | 1869 m | 118 m |
| Shetland Group | U. Cretaceous | 1987 m | 39 m |
| Viking Group | U. Jurassic | 2026 m | 76 m |
| Heather Formation | U. Jurassic | 2026 m | 76 m |
| Dunlin Group | L. Jurassic | 2102 m | 282 m |
| Drake Formation | L. Jurassic | 2102 m | 134 m |
| Cook Formation | L. Jurassic | 2236 m | 47 m |
| Amundsen Formation | L. Jurassic | 2283 m | 101 m |
| Statfjord Formation | L. Jurassic | 2384 m | 121 m+ |
| Total Depth | | 2505 m | |

*Chapter 2*

# Screening Analyses

## 2.1 Lithology, TOC and Rock Eval

A total of 150 cuttings and core-chip samples was described, screening analyses being performed on picked lithologies from the U. Cretaceous Shetland Gp to the L. Jurassic Statfjord Fm over the interval 2010 - 2500 m. TOC, production index and Tmax are plotted against depth in Figures 1-3, while TOC is also included in the lithological descriptions, Table 1. Figure 4 shows a Tmax - hydrogen index crossplot.

### 2.1.1 Source Rock Potential

The Shetland Gp cuttings samples consist of mixed medium grey calcareous shales and white to light orange carbonates. One carbonate sample was analysed from this interval, together with two carbonate samples from the underlying Heather Fm interval which are interpreted to be caved from the Shetland Gp. None of these have any source potential, being screened only for the presence of migrated hydrocarbons (see below).

The Heather Fm is well represented by core-chip samples which show it to consist of brownish to dark grey clayey siltstone or silty shale. These have mainly fair to good TOC contents (0.34 - 1.87 %), the deepest (and darkest) shale being rich (2.7 %), such that there appears to be a general increase in organic content with depth. The hydrogen indices are more consistent, ranging 114 - 231 mg HC/g TOC, suggesting type III kerogen. Petroleum potentials are poor to fair at ~ 1 - 4 mg HC/g rock. The Rock Eval data therefore infers the Heather Fm of this well to have at best only fair potential for gas with minor (heavy) oil.

The Drake Fm is represented by core-chips down to 2150.5 m, which show this to consist of light to medium grey silty shales and clayey siltstone, with a calcareous sandstone horizon at ~ 2115 - 2125 m. Below 2150.5 m the cuttings samples contain mixtures of the same shales/siltstones together with accessory to moderate amounts of coarse, loose sand (decreasing with depth and possibly caved?) and similar amounts of caved carbonate. The shales and siltstones in the cored section have fair to good TOC contents (0.86 - 1.88 %) and hydrogen indices ranging 60 -251 mg HC/g TOC, there being a marked increase between 2125 m and 2130 m, possibly reflecting a weathered top to the formation. The cuttings samples from below follow this trend, having fair to (mainly) good TOC contents (0.85 - 1.91 %) and hydrogen indices indicating kerogen type II/III, ranging 102 - 433 mg HC/g TOC. Petroleum potentials also increase downwards through the Drake Fm, ranging from poor/fair in the upper levels to mainly good in the lower levels, being on average fair at ~ 3.5 mg HC/g rock. From this data the Drake Fm is considered to have a fair potential for mixed oil and gas below 2130 m. If the top 30 m is indeed weathered, then the Drake Fm could be considerd an interesting alternative source rock where better preserved elsewhere in the north Viking Graben.

Only cuttings were available from the Cook Fm, these being dominated by loose sand down to 2255 m and mixtures of sand and light coloured siltstone below. Moderate amounts of medium to brownish grey shale are also present throughout. One sample of this shale was analysed, this having data similar to that of the lower shales of the Drake Fm, i.e. indicating a fair potential for mixed oil and gas. The extent to which these shales are caved from the Drake Fm is unknown. Considering the overwhelming abundance of sand and siltstone however, the Cook Fm as a whole is not considered to have any source potential of interest.

The Amundsen Fm cuttings are throughout composed of mixtures of white to light grey silty and kaolinitic sandstone together with brownish grey calcareous shales. The shales analysed have good TOC contents (1.16 - 1.63 %) and hydrogen indices indicating mainly type III kerogen (153 - 193 mg HC/g TOC, the uppermost sample at 279 mg HC/g TOC possibly being caved). Petroleum potentials are mainly fair at ~ 2 - 3 mg HC/g rock. These shales therefore have fair to low potential for gas. Considering their dilution by sands the overall potential of the Amundsen Fm is considered to be very poor.

The Statfjord Fm cuttings are overwhelmingly dominated by loose sands and this unit is therefore eliminated as a potential source horizon. Thin coal/shale beds occur locally, the single analysed shale from near TD having a poor TOC content but a high hydrogen index (475 mg HC/g TOC) indicating type II kerogen, possibly reflecting rare episodes of algal-rich lagoonal sedimentation, though the anomalously high Tmax suggests that some form of pyrolysable contamination cannot be ruled out.

### 2.1.2 Maturity

The Tmax data defines a fair thermal maturity trend, indicating the top of the oil window (435°C for type II kerogen) to occur at approximately 2200 m, i.e. near the base of the Drake Fm.

### 2.1.3 Generation and Migration

The production indices of the Heather Fm siltstones are rather high (~ 0.2 - 0.4) considering their immaturity according to Tmax, combined with the somewhat mediochre (gas-prone) nature of the kerogen in these samples. It is therefore considered that the Heather Fm siltstones are stained by either migrated hydrocarbons or contaminants, though the latter are much less likely since the samples are all from core-chips. The Heather Fm itself is not thought to have generated any hydrocarbons of significance.

The Drake Fm shales and siltstones appear to have production indices compatible with their depth of burial, ranging from less than 0.1 to ~ 0.2 and are therefore considered to lie mainly at an early mature stage. Considering the good quality of the kerogen in this unit, especially at depth, it may be expected that the shales have generated at least early condensates and small amounts of light oil.

Regarding migrated hydrocarbons, the production index and $S_1$ data for the U. Cretaceous carbonates show these to contain significant amounts of either migrated or contaminant hydrocarbons. In addition the high hydrogen index of the uppermost sample (360 mg HC/g TOC), equivalent to type II kerogen, suggests the presence of of either asphaltenes from residual oil or some form of pyrolysable contaminant.

As noted above, the Heather Fm siltstones contain either contaminant or (more likely) migrated hydrocarbons. It may be speculated that these are rather light since the hydrogen indices seem low-to-normal for the Heather Fm, i.e. asphaltenes from residual oils are absent.

The sandstones of the Drake, Cook and Amundsen formations have low production indices and $S_1$ values, locally anomalously high production index data being caused by both low $S_1$ and $S_2$ values (near detection limit). It is interpreted that these are practically barren of migrated hydrocarbons.

In the Statfjord Fm, where a flowing DST was recorded in the uppermost levels, the sandstones have moderate to high production indices which cannot be explained by very low $S_2$ values. The $S_1$ values are however rather low, mainly around 0.1 -0.2 mg HC/g rock. It is therefore interpreted that migrated hydrocarbons are present throughout the Statfjord Fm interval, though the amounts of these now present in the cuttings are small. This possibly reflects a light composition of the original oils in this formation but is also certainly a consequence of the loose, coarse-grained nature of the sands, where the migrated hydrocarbons are easily lost during drilling/sample storage and washing.

*Chapter 3*

# Detailed Geochemical Analyses

## 3.1 GHM - Thermal Extraction

Twenty-two samples were analysed by thermal extraction - gas chromatography. Exemplary chromatograms are shown in Figures 5a-d, while all chromatograms are included in Appendix 3.

One carbonate sample from the Shetland Group interval and a carbonate caved into the underlying Heather Fm were analysed. The free hydrocarbons in the upper sample are dominated by a suite of heavy alkanes with a maximum around $nC_{30-31}$ on an unresolved hump typical of residual hydrocarbons. The low pristane/$nC_{17}$ and phytane/$nC_{18}$ ratios suggest a well mature oil (Figure 5a). The caved carbonate sample is dominated by a narrow population with a maximum around $nC_{14-15}$ and an unresolved hump at 45 - 58 minutes retention time. The former could represent the remains of a migrated condensate while the latter could represent either traces of contaminant or residual oil (see also pyrolysis GC section).

Three siltstones and a shale, all core-chips, from the Heather Fm were analysed. The two uppermost siltstones (2045 m, 2065 m) are dominated by either gaseous components or a suite of hydrocarbons centered around $nC_{13-15}$ similar to those occurring in the lower carbonate sample. These are interpreted to be the remains of migrated condensates, the lighter fractions having been lost (Figure 5b). The rather high pristane/phytane ratios could infer a strongly terrestrially influenced source rock for these hydrocarbons. The lowest siltstone sample (2080 m) contains relatively abundant amounts of a suite of hydrocarbons ranging $nC_{13-26}$ on a slight unresolved hump which clearly represent the remains of a migrated light oil. Again the high pristane/phytane ratio suggests a source kerogen with abundant terrestrial input, while the isoprenoid/n-alkane ratios suggest a mature to well mature oil (Figure 5c). The Heather Fm shale (2095 m) is virtually barren of free hydrocarbons.

Five shales and siltstones from the Drake Fm were analysed, all these containing suites of hydrocarbons similar to those occurring in the Heather Fm siltstones and the lower Shetland Gp carbonate, e.g. Figure 5d. The isoprenoid/n-alkane ratios are high for these samples, suggesting immaturity which is compatible with the screening maturity data, though these ratios may well be spuriously elevated due to selective loss of alkanes. The pristane/phytane ratios appear high, similar to those of the migrated hydrocarbons occurring in the overlying samples, indicating a strong terrestrial input. These hydrocarbons are interpreted to be the remains of in-situ, early generated condensates. The similarity between these and the migrated hydrocarbons occurring in the overlying units suggests that the latter could have been generated in the Drake Fm at a higher maturity.

The Cook Fm cuttings' sands and shales contain similar hydrocarbons to those in the Drake Fm and the same conclusions apply, i.e. the unit contains small amounts of locally generated/migrated condensate-range hydrocarbons. The sample from 2245 m may also contain the remains of light oil.

The Amundsen Fm shales similarly contain small amounts of the same type of hydrocarbons.

Two Statfjord Fm sandstone cuttings samples analysed appear to have both the hydrocarbons detected above and probably locally generated, aromatic-rich, hydrocarbons from coal/shale beds. The Statfjord Fm shale analysed contains only small amounts of in-situ generated aromatic-rich hydrocarbons.

## 3.2 GHM Pyrolysis - Gas Chromatography

Twenty-two samples were analysed by pyrolysis - gas chromatography. Data is presented in Table 3 and plotted in a pyrolysis products triangle, Figure 7. Exemplary pyrograms are shown in Figures 6a-e, while all pyrograms are included in Appendix 3.

The Shetland Gp carbonate samples have pyrolysates up to $C_{26}$+, with fair to very good alkane-alkene homologies. In the uppermost sample in particular the alkenes are strongly dominant over the corresponding alkanes (up to $C_{22}$). These are typical of the products of asphaltenes from residual oil (Figure 6a).

In the Heather Fm core samples, all but the uppermost have pyrolysates showing good homologies to $C_{26}$ suggestive of type II/III-III kerogen (Figure 6b). The form of these chromatographic traces suggest somewhat better kerogen than that which is inferred by the hydrogen index data, possibly due to staining by traces of pyrolysable residual hydrocarbons. The uppermost sample shows only small amounts of gaseous pyrolysates.

The Drake Fm shales and siltstone mainly show pyrolysates with good to excellent homologies to $C_{26}$+, where the lower samples have notably lower aromatics contents and kerogen type II, while those above have kerogen type II/III. The uppermost sample has a very poor pyrolysate composition, showing practically only gaseous components, kerogen type IV (Figures 6c,d).

The Cook Fm lithologies have in part similar pyrograms to those of the Drake Fm, suggesting kerogen type II-II/III for the shale (possibly caved?) and either traces of asphaltene staining or inclusion of rich kerogen in the sandstones and carbonate.

The uppermost Amundsen Fm shale has a pyrogram suggesting type II kerogen and the same conclusions apply. The lower shales have pyrolysates which have much higher aromatics contents typical of coaly shales and type III kerogen (Figure 6e). Related pyrolysis products are also seen in the Amundsen Fm sandstone sample, indicating this to contain gas-prone kerogen and to be barren of any asphaltenes from residual migrated oil.

The same is the case for the Statfjord Fm sandstone cuttings samples, which appear to contain coal/shale particles with kerogen type III. The Statfjord Fm shale has a very poor pyrolysate composition, kerogen type IV.

## 3.3 Solvent Extraction and Chromatography

Seven samples were extracted and these, together with an oil recovered from 2389.9 - 2397.9 m, were separated by MPLC and the saturated and aromatic fractions subjected to gas chromatography. Extraction and separation data are presented in Tables 4a-e, while the saturated and aromatic ratios are shown in Tables 5 and 6 respectively. Exemplary saturated and aromatic chromatograms are shown in Figures 8a-d and 9a-e respectively.

### 3.3.1 Extraction

Three Heather Fm siltstones were analysed, these containing fair - good contents of extractable organic matter (EOM), 828 - 1924 ppm, and good - rich contents of extractable hydrocarbons (EHC), 468 - 1316 ppm. When normalized against TOC these become fair - rich (81 -274 mg EOM/g TOC and good - rich (46 -171 mg EHC/g TOC). The hydrocarbons constitute ~ 48 - 68 % of EOM and have low to high saturated:aromatic hydrocarbon ratios of ~ 0.34 - 3.41, increasing sharply with depth. This data suggests the lower Heather Fm siltstones to be stained by mature migrated hydrocarbons, at least from 2065 m and below, while the upper levels contain relatively less mature hydrocarbons.

The Drake Fm shale (core-chips) has only a fair content of EOM (645 ppm), though a good EHC content (270 ppm). When normalized against TOC these become poor and marginally fair respectively (33 mg EOM/g TOC, 14 mg EHC/g TOC). Hydrocarbons constitute about 42 % of the EOM, these having a moderate saturated: aromatic hydrocarbon ratio of ~ 1.36. These are interpreted to be early in-situ generation products. Conversely the composite siltstone (cuttings) sample has rich EOM and EHC contents (3592 and 1456 ppm respectively) which remain so after normalizing against TOC (363 mg EOM/g TOC and 147 mg EHC/g TOC). However the hydrocarbons here still constitute only about 41 % of EOM and have a moderate saturated:aromatic ratio of 1.5, similar to the shale core sample. These hydrocarbons are also interpreted to be in-situ generated. The differences between these samples' data is attributed to the better quality of kerogen in the lower (siltstone) sample.

The Cook Fm shale has good and rich EOM and EHC contents respectively (1904 and 619 ppm). When normalized against TOC these become fair and good however (87mg EOM/g TOC and 28 mg EHC/g TOC). Hydrocarbons constitute only about 33 % of EOM and have a moderate saturated:aromatic ratio of 1.6. Similar to the hydrocarbons above these are interpreted to be in-situ generated.

The Statfjord Fm oil analysed contains about 79 % hydrocarbons which have a high saturated:aromatic ratio of around 2.57, typical of well mature migrated hydrocarbons.

### 3.3.2 Saturated Hydrocarbon Chromatography

The three Heather Fm siltstones have quite variable saturated hydrocarbon chromatograms. The uppermost sample (2045 m) shows a broad range of n-alkanes ranging $nC_{16}$ - $nC_{40}$+ with a maximum around $nC_{20-22}$ (Figure 8a). The pristane:$nC_{17}$ and phytane:$nC_{18}$ ratios are probably spuriously elevated due to selective loss of the alkanes but indicate mature hydrocarbons, certainly more mature than that suggested by Tmax. The CPI values close to 1.0 also support this. The pristane:phytane ratio is low and fairly typical for marine-dominated U. Jurassic source rocks. The samples below this (2065 m and 2080 m) are more similar to each other, showing a distribution skewed towards lighter n-alkanes compared with the upper sample, having a maximum around $nC_{13-16}$ (Figure 8b). The pristane:phytane ratios are also different, being significantly higher than in the upper sample, suggesting an abundant input of terrestrial material into the source rock. Similar to the upper sample however the isoprenoid:n-alkane ratios suggest mature hydrocarbons. These traces therefore indicate the Heather Fm siltstones to be stained by migrated hydrocarbons from two sources of similar maturity but having different kerogen compositions.

The two Drake Fm samples have notably different chromatograms to the above, showing two maxima, one around $nC_{13-16}$ and one around $nC_{25-27}$. The high odd carbon number preference and evident biomarker compounds indicate immature hydrocarbons in accordance with other maturity data indicating early in-situ generation products, while the isoprenoid:n-alkane ratios indicate more mature hydrocarbons. The siltstone in particular appears to be stained by mature hydrocarbons in addition to containing in-situ generated hydrocarbons (Figure 8c). The lower pristane:phytane ratio in this sample suggests the staining hydrocarbons to have had a more marine-sourced character.

The Cook Fm shale chromatogram is similar to that of the Drake Fm shale and the same conclusions apply, i.e. in-situ generated hydrocarbons are dominant.

Regarding the Statfjord Fm oil, the whole oil GC FID trace shows an aromatic-poor oil with n-alkanes extending to $nC_{34}$, where the isoprenoid:n-alkane ratios indicate a mature oil from what was probably a marine-dominated source rock. The saturated hydrocarbon trace is perhaps most similar to that of the hydrocarbons extracted from the uppermost Heather Fm siltstone sample, with a dominantly marine signature. The distibution of the oil is more skewed towards lighter n-alkanes, but this is to be expected (Figure 8d).

### 3.3.3 Aromatic Hydrocarbon Chromatography

Similar to the saturate fraction, the uppermost Heather Fm sample has a quite different aromatic trace to those of the two underlying samples. The upper sample shows only phenanthrene and dominant methyl phenanthrenes on a large unresolved hump, the methyl naphthalenes being absent (Figure 9a). The 3+2/9+1 MP ratio is notably lower than in the underlying samples, suggesting the oil in the upper siltstone to be much more mature (possibly around peak oil maturity?). The underlying siltstones have equivalent or dominant methyl naphthalenes and notably higher phenanthrene contents (Figure 9b). The methyl naphthalene and phenanthrene ratios show these oils to be mature, though not as mature as that in the upper siltstone. The abundance of methyl naphthalenes could infer these migrated hydrocarbons to have a condensate range, while their absence and the unresolved hump in the upper sample suggest a heavier, residual nature for the migrated hydrocarbons in the upper levels.

The two Drake Fm samples have very different aromatic traces to each other. The upper (shale core) sample has very strongly dominant methyl naphthalenes, phenanthrene/methyl phenanthrenes being in low abundance and yielding poorly reliable ratios. The methyl naphthalene ratios indicate hydrocarbons at an early mature to mature stage which is compatible with their being mainly in-situ generated, but possibly mixed with staining migrated hydrocarbons (Figure 9c). The lower (siltstone composite cuttings) sample has a trace showing only noise and unidentified peaks.

The Cook Fm shale sample has an aromatics trace fairly similar to one of the Drake Fm samples, with equivalent amounts of methyl naphthalenes and methyl phenanthrenes, also abundant (?)trimethyl naphthalenes. Aromatic biomarker compounds are however much more evident (Figure 9d). The MN ratios infer these hydrocarbons to be moderate to early mature and the MP ratios suggest upper oil window maturity, suggesting less influence from staining by migrated hydrocarbons.

The Statfjord Fm DST oil has an aromatics trace most similar to that of the upper Drake Fm sample, showing almost only methyl naphthalenes, the MP ratios being unreliable. The MN ratios suggest a mature oil (Figure 9e).

The FPD traces of all the samples analysed show only noise.

## 3.4 Vitrinite Reflectance

Twelve samples were subject to vitrinite reflectance analysis, these covering the interval 1000 - 2500 m. Maturity data is presented in Table 7 and is plotted against depth in Figure 10. The individual sample histograms are included in the Appendix.

### 3.4.1 Description of Samples

The five Hordaland Gp samples analysed contain mainly only trace phytoclast contents (inertinite, vitrinite) with trace to moderate spore/pollen contents fluorescing yellow to yellow-orange. Dinoflagellates are observed at 1160 m and 1740 m, while the sample from 1600 m contains trace hydrocarbon specks. Otherwise staining is generally moderate but moderate - strong at 1440 m.

The Rogaland Gp sample has trace phytoclasts of which practically 100 % is inertinite, yellow-orange fluorescent spores occurring in traces. Staining is light.

The two Heather Fm samples contain trace to moderate phytoclast contents, mainly inertinite with up to moderate contents of yellow to light orange fluorescent spores. Staining is light to strong while there is a low to strong bitumen wisp content.

The Drake Fm sample has a low - moderate phytoclast content, this being the first sample where vitrinite occurs in an abundant amount (30 %). There is also a moderate to rich content of yellow-orange fluorescent spores, also Tasmanites-type algae. Staining is light.

The Amundsen Fm sample has a moderate phytoclast content, mainly inertinitic but with moderately abundant (20 %) vitrinite. There is a moderate content of yellow-orange fluorescing spores. Staining in this sample is moderate while there is a rich content of bitumen wisps.

Two samples were analysed from the Statfjord Fm, one coal and one silty shale. The latter contained virtually no measurable phytoclasts, only trace spores being observed. No bitumen staining was observed, rather an overall hematitic staining. The coal consisted practically only of vitrinite containing a low content of yellow fluorescent hydrocarbons along internal fractures.

### 3.4.2 Maturity

The maturity assessment for this well is made difficult by the paucity of measurable vitrinite clasts in many of the samples, particularly above 2215 m. Oxidation is also apparent in many of the samples. According to the individual samples vitrinite reflectance data the entire well sequence is immature, the maximum being 0.46 % Ro, i.e moderate to early mature, at 2500 m. This is generally supported by the spore fluorescence, although at 2095 m the spores suggest a higher maturity than the vitrinite reflectance (of 0.37 %). The linear regression line for all reflectance data places the top of the oil window (0.6 % Ro) at approximately 2950 m, i.e. below TD. This is far deeper than the estimates from all other methods. From Figure 10 it can be seen that two parallel trends may occur, the lower part of the well being relatively "less mature", which may be due to staining from the Shetland Group downward. The trend in the upper part of the well, when extrapolated, reaches oil window maturity at approximately 2400 m, which is much closer to the estimates from other methods.

## 3.5 Visual Kerogen Microscopy

Nine samples from well NOCS 31/4-7 were examined, these spanning the depth range 1440 - 2500 m. The detailed kerogen compositions are shown in Table 8 while the gross compositions are plotted in a triangular diagram, Figure 11. Maturity data (Spore Colour Index) is included in Table 7.

### 3.5.1 Kerogen Typing

The two samples from the Hordaland and Rogaland groups contain accessory to abundant amounts of liptinite, this however being clearly of a reworked nature, while the indigenous spores also appear to be oxidized. Vitrinite and inertinite are also largely reworked and these lithologies can be dismissed as potential source rocks.

The two Heather Fm samples, one siltstone and one shale, have generally similar kerogen concentrate textures, being coarse grained and well preserved, differing in the proportion of liptinite present. Liptinite content ranges from 30 % in the upper sample to 65 % in the lower sample, being composed mainly of spores with subordinate cuticle or liptodetrinite. Woody vitrinite and inertinite occur in abundant amounts. These clearly strongly terrestrially dominated kerogen compositions show the Heather Fm to have only a fair potential for generation of mainly gas.

The two Drake Fm shales examined contain abundant to strongly dominant amounts of liptinite (55 - 90 %). In the upper (core-chip) sample this is mainly as coarse grained, well preserved spores and high-H spore air sacks. Liptinite in the lower (cuttings) sample is mainly in the form of mixed spores and brown/yellow brown fluorescent amorphinite. Both samples have subordinate algae but abundant dinoflagellates. Non-bituminous woody (telinite-collinite) vitrinite occurs in abundant to trace amounts. These compositions suggest the Drake Fm to have a distinctly more marine character compared with the Heather Fm, moreso toward the lower levels of the formation. The samples infer the Drake Fm to have good potential for the generation of mixed oil and gas.

The Cook Fm shale has a kerogen texture similar to that of the uppermost Drake Fm sample, containing abundant (50 %) liptinite which consists mainly of spores/high-H air sacks and abundant cuticle. Algae (mainly of Botryococcus type) are subordinate. Partly bitumen stained woody vitrinite and mainly fusinitic - semifusinitic inertinite occur in abundant amounts (20 - 30 %). This kerogen assemblage is interpreted to have good potential for generation of mixed oil and (? mainly) gas.

The Amundsen Fm shale contains a lesser, moderately abundant amount of liptinite (20 %), though similar to the Cook Fm sample this is composed mainly of spores/air sacks and cuticle with well preserved Botryococcus algae. Vitrinite is however dominant (65 %), this being of a type quite different to that in the overlying intervals, being partly bitumen stained and of telinite clasts which appear to have undergone pyritic replacement. This kerogen composition suggests the Amundsen Fm to have a fair potential for mainly gas with lesser amounts of (? mainly heavy) oil.

The kerogen preparation of the Statfjord Fm shale contained insufficient organic matter for reliable kerogen typing. The phytocalsts present include spores, ?bituminite and reworked vitrinite and inertinite, and would appear to represent an oxic terrestrial environment. This lithology can be dismissed as a source rock.

### 3.5.2 Maturity

The maturity assessment of this well is made difficult in the upper levels (?including the Heather Fm) by spore oxidation, also by the occurrence of anomalously (white) fluorescent spores in the uppermost Drake Fm sample. According to the individual sample data the top of the oil window (SCI 6.0 for type II kerogen) occurs between 2265 m and 2350 m. The linear regression line for all SCI data places the top at approximately 2350 m, i.e. in the lower part of the Amundsen Fm, while the oil floor (SCI 8.0) is tentatively placed by extrapolation at approximately 3042 m, i.e. below TD.

## 3.6 Isotope Analysis of $C_{15}$+ Fractions

Five samples were analysed, comprising two from the Heather Fm, one each from the Drake and Cook formations and an oil sample from the 2389.9 - 2397.9 m interval in the Statfjord Fm. Data is listed in Tables 9a,b. Figures 12 and 13 show a crossplot of $\delta^{13}C$ of saturated versus aromatic compounds and the Galimov-style plots of isotopic composition of the $C_{15}$+ fractions respectively.

The hydrocarbons extracted from all the samples from the Heather, Drake and Cook formations plot in the marine field of Figure 12, the Heather Fm samples however having a lighter isotopic composition, particularly for the saturated fraction, compared with those from the Drake and Cook formations. The oil from the Statfjord Fm has the lightest composition of all, this being reasonably close to that of the Heather Fm hydrocarbons. The relative plotting positions of the Viking Gp and Dunlin Gp samples could be interpreted as indicating a markedly higher maturity for the hydrocarbons in the Dunlin Gp However, this contradicts all other geochemical data for these hydrocarbons which show the Dunlin Gp hydrocarbons to be distinctly less mature (early, in-situ generated) compared with those in the Viking Gp (mature - well mature, migrated). The differences in isotopic compositions recorded for the hydrocarbons in the Dunlin Gp on the one hand and the Viking Gp and oil on the other are therefore thought to be due to source differences rather than maturity differences. The difference in composition between the oil and the Heather Fm hydrocarbons is not great and may not be significant, but may reflect stronger biodegradation of the hydrocarbons in the Heather Fm.

## 3.7 Gas Chromatography - Mass Spectrometry

The $C_{15}$+ saturated and aromatic hydrocarbon fractions of five samples were analysed by GC-MS, these comprising two from the Heather Fm, one each from the Drake and Cook formations and an oil sample from the DST in the Statfjord Fm. GC-MS data is presented in Tables 10a-i, while exemplary fragmentograms are shown in Figures 14a-j.

### 3.7.1 Potential Source Rocks

Saturated hydrocarbons

The M/Z 163 fragmentograms of the two Heather Fm siltstones are different, that of the upper sample showing dominant steranes, while the lower sample shows considerable amounts of triterpanes also present, indicating a greater terrestrial influence. The prominence of the peak*, identified as either a $C_{29}$ demethylated hopane or the latter plus coeluting 28,30 bisnorhopane, could infer the hydro-carbons in the lower siltstone to be biodegraded (Figure 14a). Peak ** may be a $C_{29}$ demethylated hopane.The M/Z 191 traces for these samples are similar to each other, showing the triterpanes to be dominated by the $C_{30}$ $\alpha\beta$ hopane. The $T_m/T_s$ ratios (peaks B/A) are similar, suggesting mature hydrocarbons, but the lower sample has a much greater content of 28,30 bisnorhopane (Z), indicating a special type of microbial input (Figure 14e). The M/Z 177 traces also show a relatively greater marine input in the upper sample. The terpane ratio reflecting the 22R-22S conversion with advancing maturity (J1/J1+J2) and similarly that reflecting the $\beta\alpha$-$\alpha\beta$ conversion (D+F/C+E) indicate mature hydrocarbons, those in the lower sample possibly being slightly less mature. For the steranes, the M/Z 217 traces of the Heather Fm siltstones are similar, showing a dominantly marine source, though there is a greater abundance of heavier ($C_{29}$) steranes in the lower sample reflecting greater terrestrial (higher land plant kerogen) influence (Figure 14h). A low maturity is confirmed by the ratios reflecting the 20R-20S conversion (e.g. q/q+t) and the ααα-αββ conversion e.g. r+s/q+r+s+t), which suggest a maturity in the upper part of the oil window (?Ro 0.6 - 0.7 %). The saturated hydrocarbon GC - MS data for the Heather Fm hydrocarbons therefore confirm other data which suggest these to consist mainly of mature hydrocarbons from a dominantly marine source.

The M/Z 163 traces of the Drake and Cook Fm samples are different to those of the Heather Fm samples. Although the hydrocarbons are still dominantly marine in character these show lesser amounts of the heavier ($C_{32}$+) triterpanes but prominent amounts of the $C_{29}$ and (particularly) $C_{30}$ triterpanes as well as a prominent amount of what is tentatively identified as 25,28,30 trisnorhopane (*) in the upper sample and tentatively $C_{27}$ and $C_{28}$ demethylated hopanes (**) in the lower sample (Figures 14b,c). The M/Z 191 traces of the Dunlin Gp samples are similar to each other and show distinct maturity differences to those of the Heather Fm. The B/A ($T_m/T_s$) ratio is much higher, indicating immature hydrocarbons, though this may be exaggerated by the presence of hydrocarbons derived from waxy land-plant material, locally abundant cuticle having been recorded in the kerogen concentrates (Figure 14f). The low matuurity is confirmed by the state of the 22R-22S and αβ-βα conversions (J1/J1+J2 and D+F/C+E ratios). Regarding the steranes, the M/Z 217 traces of the Dunlin Gp hydrocarbons are different to those of the Heather Fm, having lesser amounts of the $C_{27}$ members and higher amounts of 20R ααα ethylcholestane (Figure 14i). Again the maturity of these hydrocarbons is shown to be significantly lower (immature) than those of the Heather Fm by the low 20R-20S and ααα-αββ conversion states, e.g ratios q/t and r+s/q+r+s+t.

Aromatic Hydrocarbons

The M/Z 106 alkyl benzene traces of the Heather Fm samples show good homologies centered around $C_{20-21}$ in the upper sample and $C_{17}$ in the lower sample, there also being an unidentified compound eluting between $C_{26}$ and $C_{27}$ which is particularly prominent in the lower sample. That these are mature are shown by, for example, the high 2/1 methyl naphthalene ratios (M/Z 142), the moderately high 3+2/9+1 methyl ratios (M/Z 192) and the 4/1 methyl dibenzothiophene ratio (M/Z 198) which suggest a maturity of approximately 0.7 - 1.0 % Ro, the lower sample being the more mature. Only the upper sample yielded triaromatic sterane data of use, this having an abundant amount of $C_{20}$ and $C_{21}$ members showing advanced breakdown of the side-chains in M/Z 231 due to maturity. M/Z 253 and the aromatization data also show the hydrocarbons to be mature to well mature.

The Dunlin Gp samples have similar M/Z 106 traces to each other, not dissimilar to that of the lower Heather Fm sample. The methyl naphthalene (M/Z 142) traces are however quite different, showing the hydrocarbons here to be much less mature than those in the Heather Fm, with low 2/1 ratios. Curiously the methyl phenanthrenes (M/Z 192) suggest the maturity of the hydrocarbons to be not greatly different to those of the Heather Fm, but again other ratios, e.g. the 4/1 dibenzothiophene (M/Z 198) support other data showing the Dunlin Gp hydrocarbons to be relatively immature. This is confirmed by the aromatic sterane data.

In summary for the possible source rock lithologies of this well, the Heather Fm siltstones appear to contain mature to well-mature (?close to 0.7 % Ro) hydrocarbons that are incompatible with their hosts maturity, these hydrocarbons having been derived from a marine-dominated source. The hydrocarbons in the upper Heather Fm sample appear more marine compared with those in the underlying sample according to the saturated hydrocarbon data. The Heather Fm therefore appears to contain mainly migrated hydrocarbons, while the Drake and Cook formations contain immature hydrocarbons which are also marine dominated but which have a source influenced by input of waxy land-plant material, these probably being in-situ generated.

### 3.7.2 Migrated Hydrocarbons

As noted above, the Heather Fm contains mainly migrated hydrocarbons. Apart from this, one oil sample from a DST in the Statfjord Fm was analysed.

Saturated hydrocarbons

M/Z 163 for the oil has similarities to those of both the lower Heather Fm and Cook Fm hydrocarbons, having a high E peak (as in the Dunlin Gp samples) and two prominent peaks tentatively identified as 25,28,30 trisnorhopane (*) and 28,30 bisnorhopane (**) (Figure 14d) which are also tentatively identified in the Heather Fm samples. The heavier ($C_{29}$) triterpanes are also evident as in the upper Heather Fm sample. In M/Z 191 however the maturity parameter B/A and the triterpane distribution clearly shows a greater likeness to the Heather Fm hydrocarbons (Figure 14g). The M/Z 177 traces are also more similar to those of the latter. The triterpane ratios reflecting the 22R-22S and $\beta\alpha$ - $\alpha\beta$ conversions with greater maturity (e.g. J1/J1+J2 and D+F/C+E respectively) also confirm the maturity (?mid-oil window, 0.7 - 0.8 % Ro) similarity. Regarding the steranes, the M/Z 217 fragmentogram is most similar to those of the Heather Fm hydrocarbons, especially as regards maturity, though the oil has a notably higher content of the $C_{29}$ $\alpha\beta\beta$ ethylcholestanes (peaks r,s) (Figure 14j). According to the ratios reflecting the 20R-20S and $\alpha\alpha\alpha$-$\alpha\beta\beta$ conversions with advancing maturity (e.g. ratios 2,9 and 3,5,8,10 respectively) the oil is mature to well mature (? 0.7 - 1.0 % Ro).

Aromatic Hydrocarbons

The M/Z 106 trace for the oil is most similar to that of the lower Heather Fm sample but has relatively abundant light-end components (to be expected) and a large unidentified peak for the $C_{13}$ member. The 2/1 methyl naphthalene ratio (M/Z 142) indicates a maturity lying between those of the Heather Fm and Dunlin Gp samples, while the 2,6+2,7/1,4+1,5+2,3 dimethyl naphthalene ratio (M/Z 156) indicates a maturity clearly more similar to that of the upper Heather Fm sample (the lower sample being more mature). The 3+2/9+1 methyl phenanthrene ratio (M/Z 192), in contrast to all other data, infers a maturity even lower than (or approximately equivalent to) that of the Dunlin Gp samples. However the 4/1 dibenzothiophene ratio

(M/Z 198) confirms other data showing the oil to be mature - well mature. Regarding the aromatic steranes (M/Z 231 and 253), the oil shows triaromatic sterane levels similar to the upper Heather Fm sample, though there is clearly a greater proportion of $C_{26-28}$ members contra the $C_{20}$ and $C_{21}$ members, suggesting a markedly lower maturity for the oil. This may however be a reservoir effect. The monoaromatic steranes however show a similar maturity to the Heather Fm hydrocarbons, with similar amounts of $C_{21}$ and $C_{22}$ compounds contra $C_{27}$ - $C_{29}$ compounds. In distribution the monoaromatic steranes appear similar to the upper Heather Fm sample, though lacking in the unidentified peak recorded at about 49.5 min. in the latter. The aromatization ratios are also similar to those of the upper Heather Fm sample.

In summary the GC-MS data for the migrated hydrocarbons show the oil in the Statfjord Fm. to be similar in maturity to the migrated hydrocarbons in the upper levels of the Heather Fm as far as the aromatic hydrocarbons are concerned. As far as the source is concerned, the oil has similarities to both the migrated hydrocarbons in the Heather Fm and the mainly in-situ generated hydrocarbons in the Dunlin Gp.

*Chapter 4*

# Conclusions

## 4.1 Source Rock Potential

The Heather Fm of well NOCS 31/4-7 consists of brownish to dark grey siltstones/shales having fair organic matter contents (max. 1.9 % TOC), terrestrially dominated kerogen type III with fair petroleum potentials (max.4 mg HC/g rock). These have potential for mainly gas with lesser amounts of (?mainly heavy) oil.

The Drake Fm consists of medium grey silty shales with moderate amounts of sands occurring below about 2150 m. The shales have fair to good organic matter contents (max. 1.9 % TOC) and poor to fair petroleum potentials averaging ~ 3.5 mg HC/g rock. The Drake Fm has an overall fair potential for mixed oil and gas over a ~ 106 m interval below ~ 2130 m. However, the upper levels of this formation may be weathered, with consequently very poor potential kerogen type IV, while below this the quality of the kerogen increases from marine (spore/cuticle rich) type II/III to marine (alginite/cuticle rich) type II with increasing depth. The Drake Fm may therefore be a source horizon of very good potential elsewhere in this region.

The Cook and Amundsen formations are mainly sand units with consequently poor overall potential for hydrocarbon generation. However, there appear to occur limited beds of shale having potential as good as that of the lower Drake Fm shales.

The Statfjord Fm is again a sand unit, having shale and coal seams having at best only gas-prone kerogen type III. The formation can therefore be dismissed as a potential source unit.

## 4.2 Maturity

The maturity data from this well is somewhat conflicting. Tmax temperatures and spore colour indices indicate the top of the oil window to occur between 2200 m and 2350 m, i.e. in the lower part of the Dunlin Gp, while vitrinite reflectance suggests (by extrapolation) either a depth of approximately 2950 m, i.e. well below TD, or at approximately 2400 m if staining has lowered the reflectance in the lower levels of the well. Spore fluorescence from the vitrinite samples locally suggests a higher maturity than that of the recorded reflectance and greater credence is given to the spore/Tmax conclusions, especially when the conclusions from the geochemical maturity parameters are also taken into account (see below).

## 4.3 Generation

The mainly gas-prone kerogen of the Heather Fm is quite immature, no significant hydrocarbons having been generated from this formation.

From the geochemical parameters (production indices, thermal and solvent extract chromatogaphy and GC-MS) the Drake Fm shales contain mainly relatively immature hydrocarbons which are in-situ generated, the shales lying at an early mature stage (?0.5 - 0.6 % Ro). The bulk of their potential therefore remains intact. The same is the case with the shales from the Cook and Amundsen Fm intervals, which may infer the top of the oil window to occur closer to the estimate from spore colour index (2350 m).

The gas-prone coals of the Statfjord Fm have generated only small amounts of aromatic hydrocarbon rich products.

## 4.4 Migration

The migrated hydrocarbons throughout the Heather Fm were all originally mainly condensates, those in the upper levels are relatively heavy according to all data and have a greater marine dominance, the lower hydrocarbons having been generated in a distinctly more terrestrially influenced source rock. There is somewhat conflicting data regarding the relative maturities of the hydrocarbons at the different levels. According to extraction and GC data of the saturated fractions the lower hydrocarbons are more mature whereas GC data of the aromatic fractions infers the upper hydrocarbons to be more mature. GC-MS data of the saturated fractions suggests the upper hydrocarbons to be more mature, while that of the aromatic fractions suggests the lower hydrocarbons to be more mature. These maturity differences are however small (?range 0.6 - 0.8 % Ro), such that the discrepancies between data from different fractions and methods may be a result of measurements on sample materials having differing proportions of hydrocarbons from at least two sources. It may be that the lower levels of the Heather Fm are affected by relatively less mature, lighter, hydrocarbons generated down-dip in the Drake Fm where it is of oil window maturity, while the upper levels contain mainly "unadulterated" more mature hydrocarbons generated in a more marine influenced (? U.Jurassic) source rock at greater depths.

The Drake and Cook formations contain mainly in-situ generated condensatic hydrocarbons but the more silty horizons may be stained by traces of more mature migrated hydrocarbons having a more marine signature.

The Statfjord Fm contains abundant migrated hydrocarbons, these being well mature (? 0.7 - 1.0 % Ro). The source of the oil (DST 2389.9 - 2397.9 m) is not clear, the saturated fraction being similar to that of the migrated hydrocarbons in the upper levels of the Heather Fm and the aromatic fraction being similar to that of the mainly in-situ generated hydrocarbons in the Drake Fm. According to GC-MS of the saturated fraction the oil has source similarities to both the lower Heather Fm and Cook Fm hydrocarbons. GC-MS of the aromatic fraction however shows similarities with the migrated hydrocarbons in the upper parts of the Heather Fm. It is therefore likely that the oil in the Statfjord Fm is co-sourced by an upper Jurassic (? Draupne) type source and a Drake-type source.

# LEGEND TO FIGURES 1, 2 AND 3

+ Shales
X Siltstones
○ Coals
▷ Carbonates
◇ Sandstones
□ Bulk

Figure: 1

Client: VARIOUS

# TOC Data for Well NOCS 31/4-7

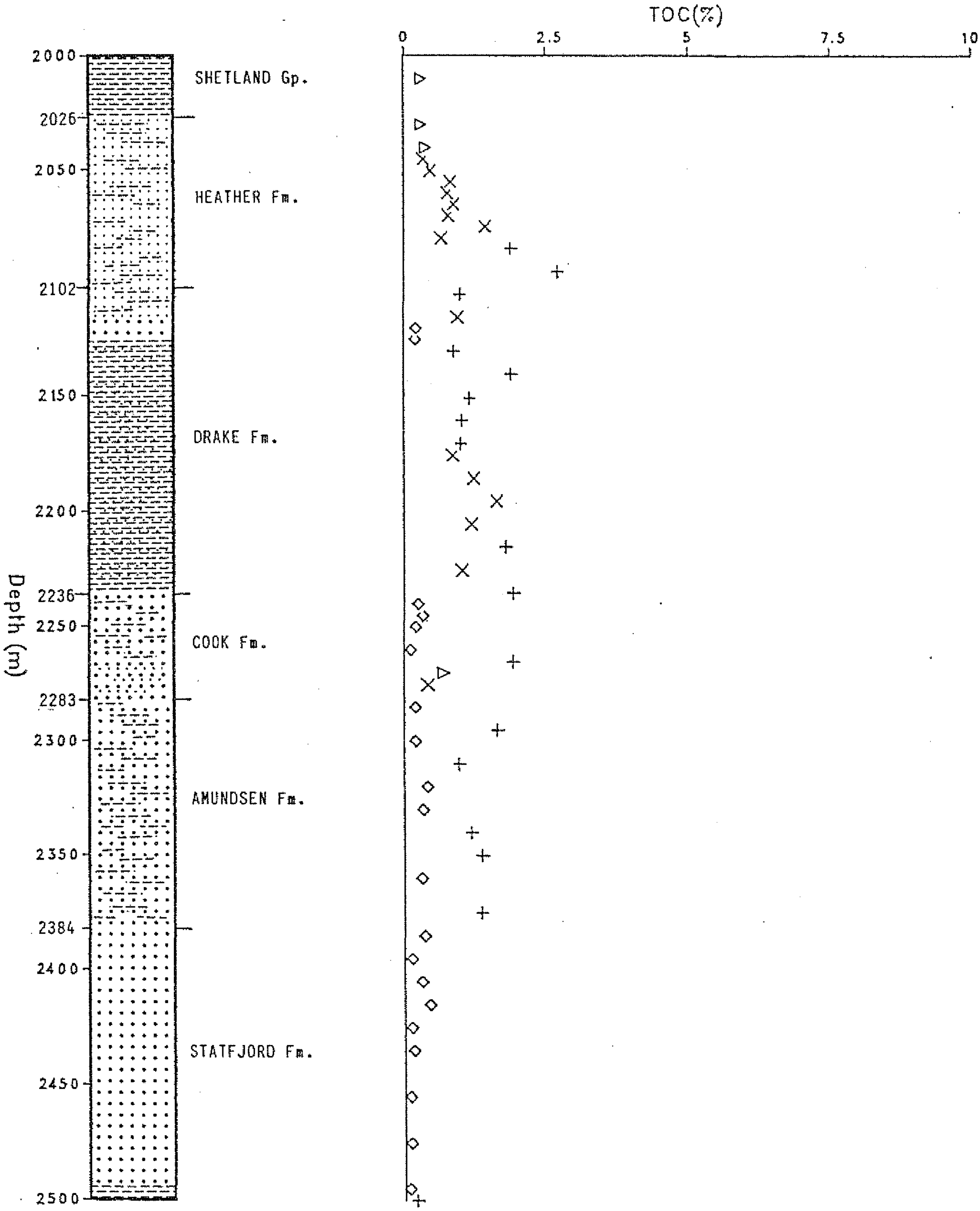


Figure: 2 Client: VARIOUS GEOLAB NOR

# Production Index Data for Well NOCS 31/4-7

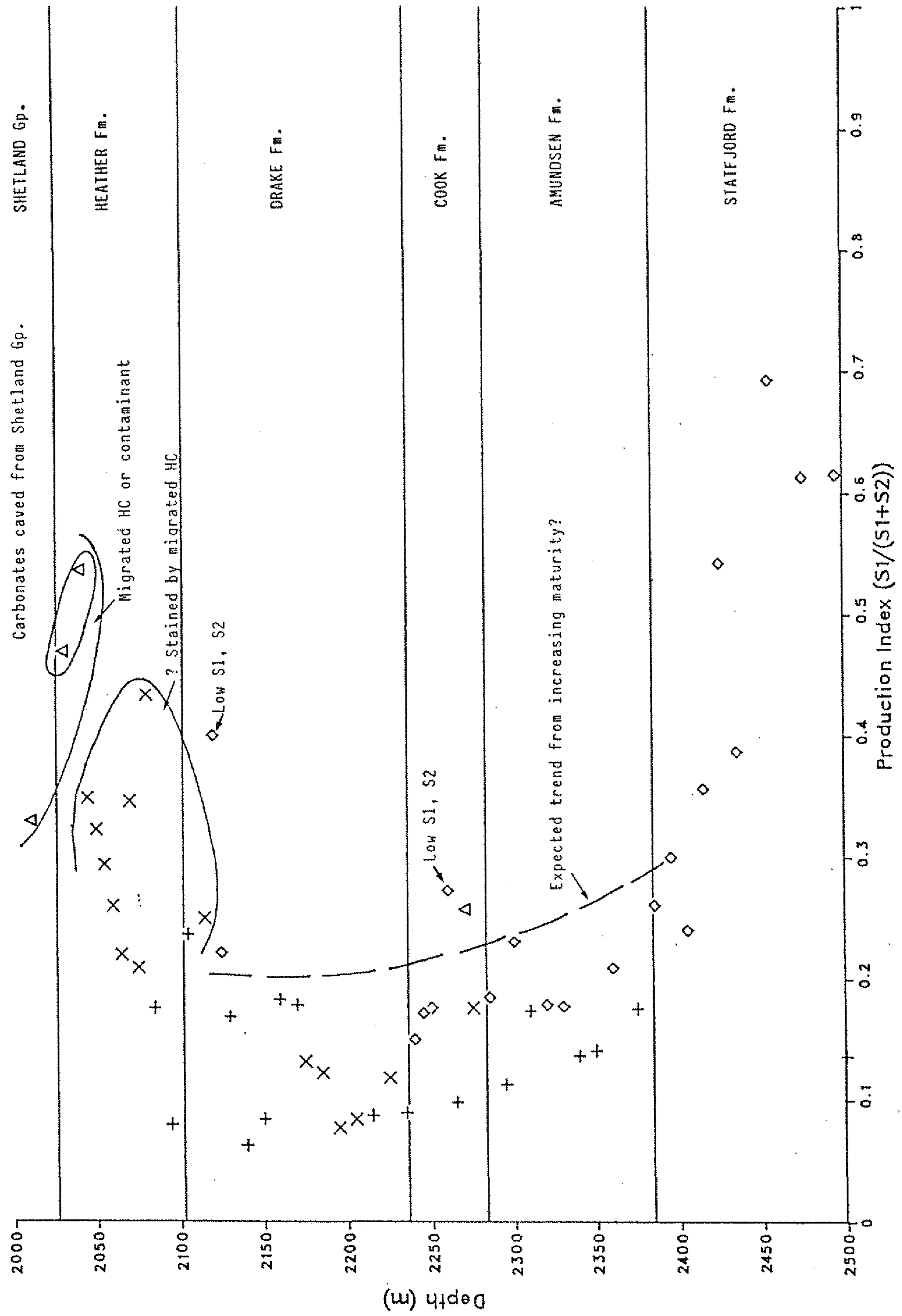
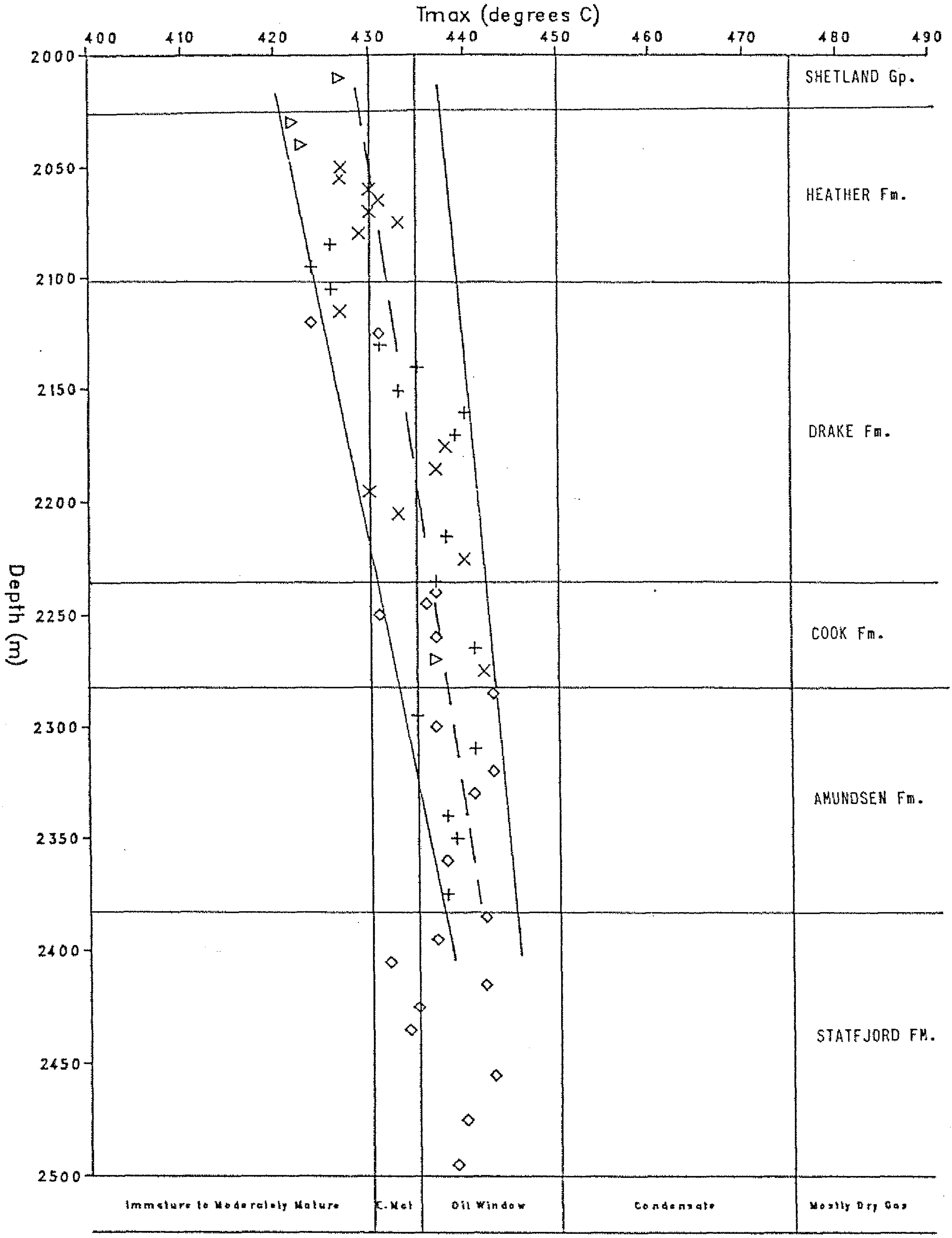


Figure: 3

Client: VARIOUS

GEOLAB NOR

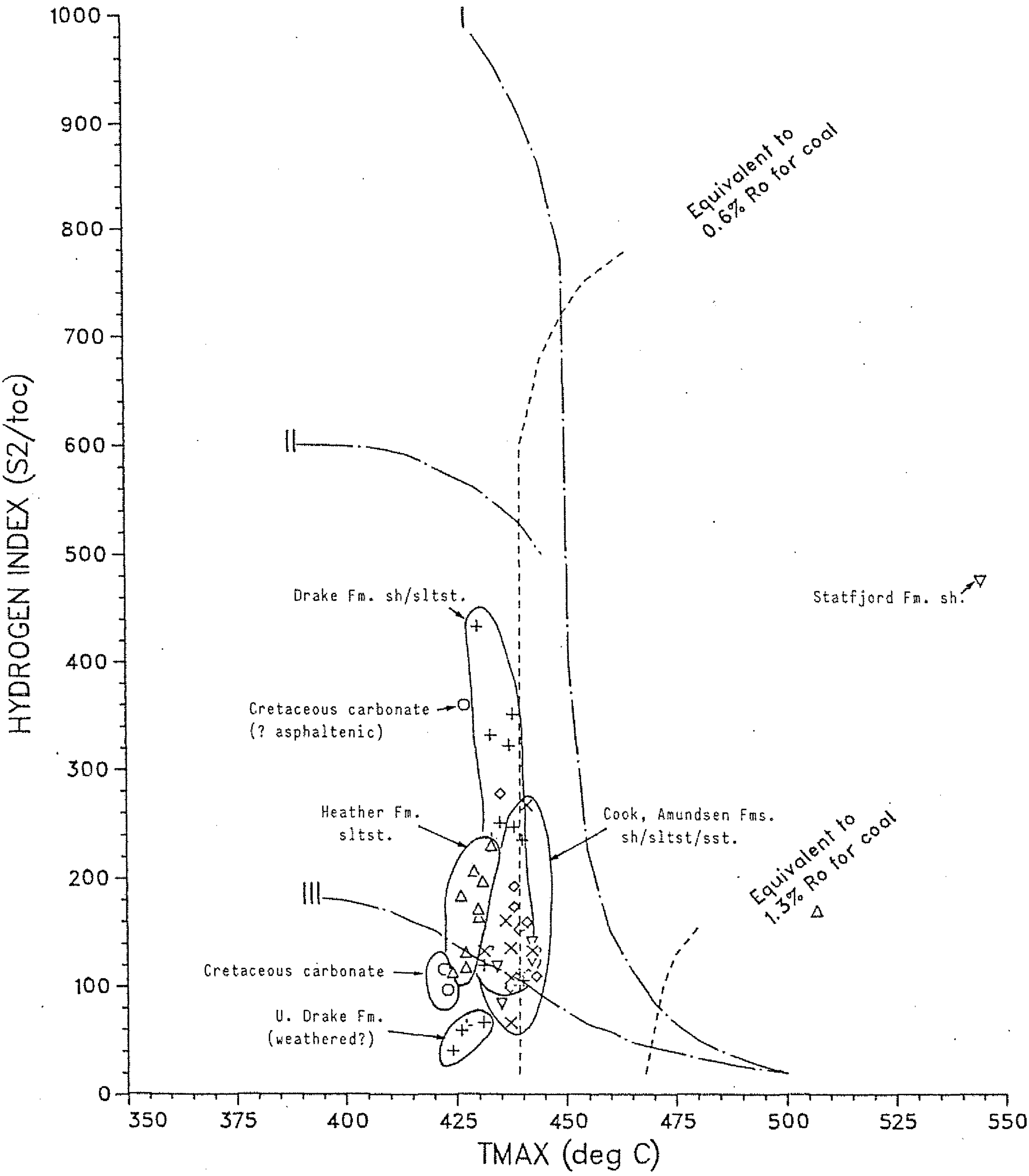
# Tmax Data for Well NOCS 31/4-7




*GEOLAB NOR a/s – Geochemical Laboratories of Norway*

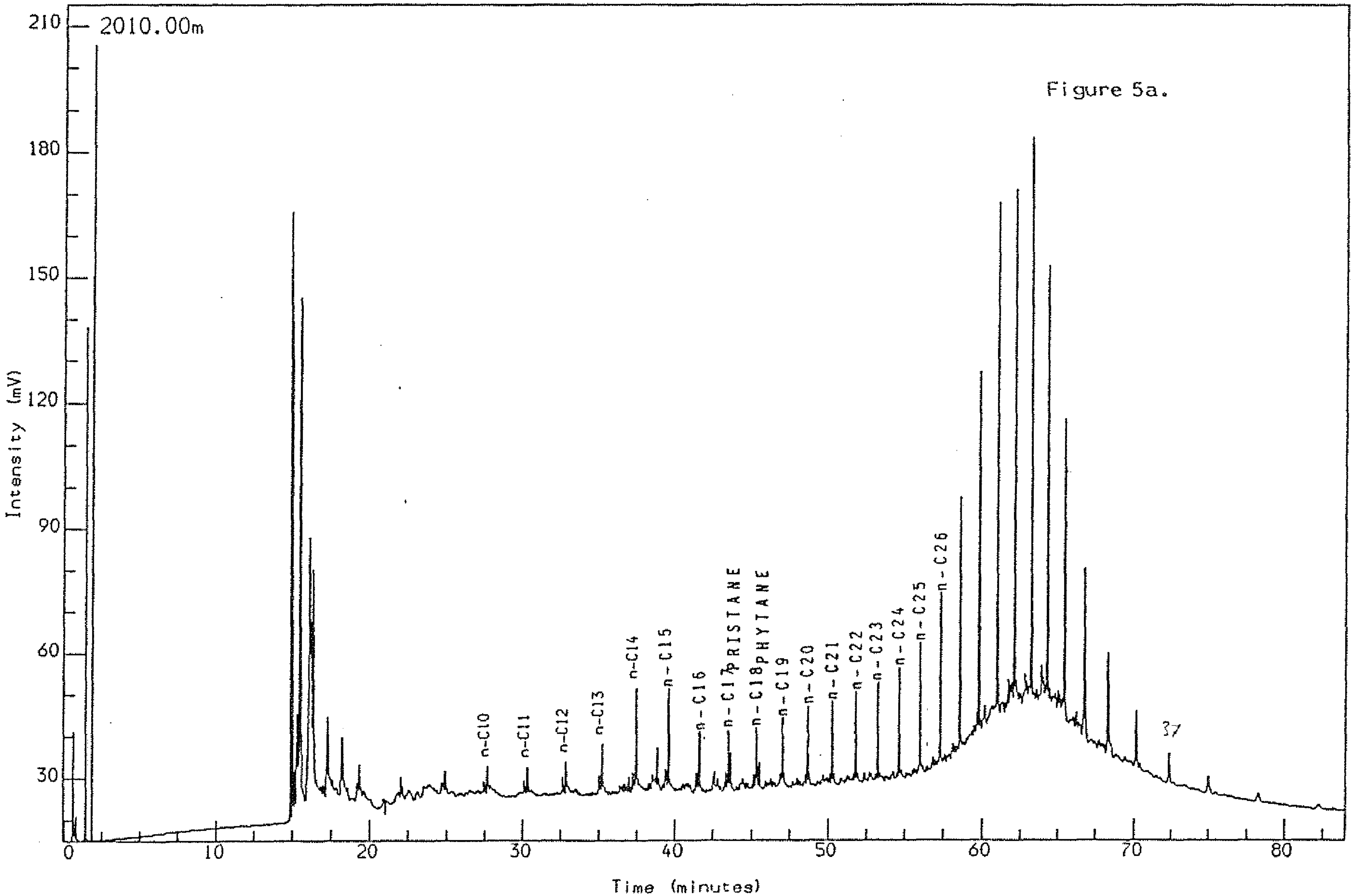
GEOLAB NOR

# Figure 4 : Hydrogen Index v.s. Tmax values
## Well NOCS 31/4-7



Analysis Name : [522006] 23 PF1100752,1,1.

Multichrom




WELL NOCS 31/4-7 2010.00m cut

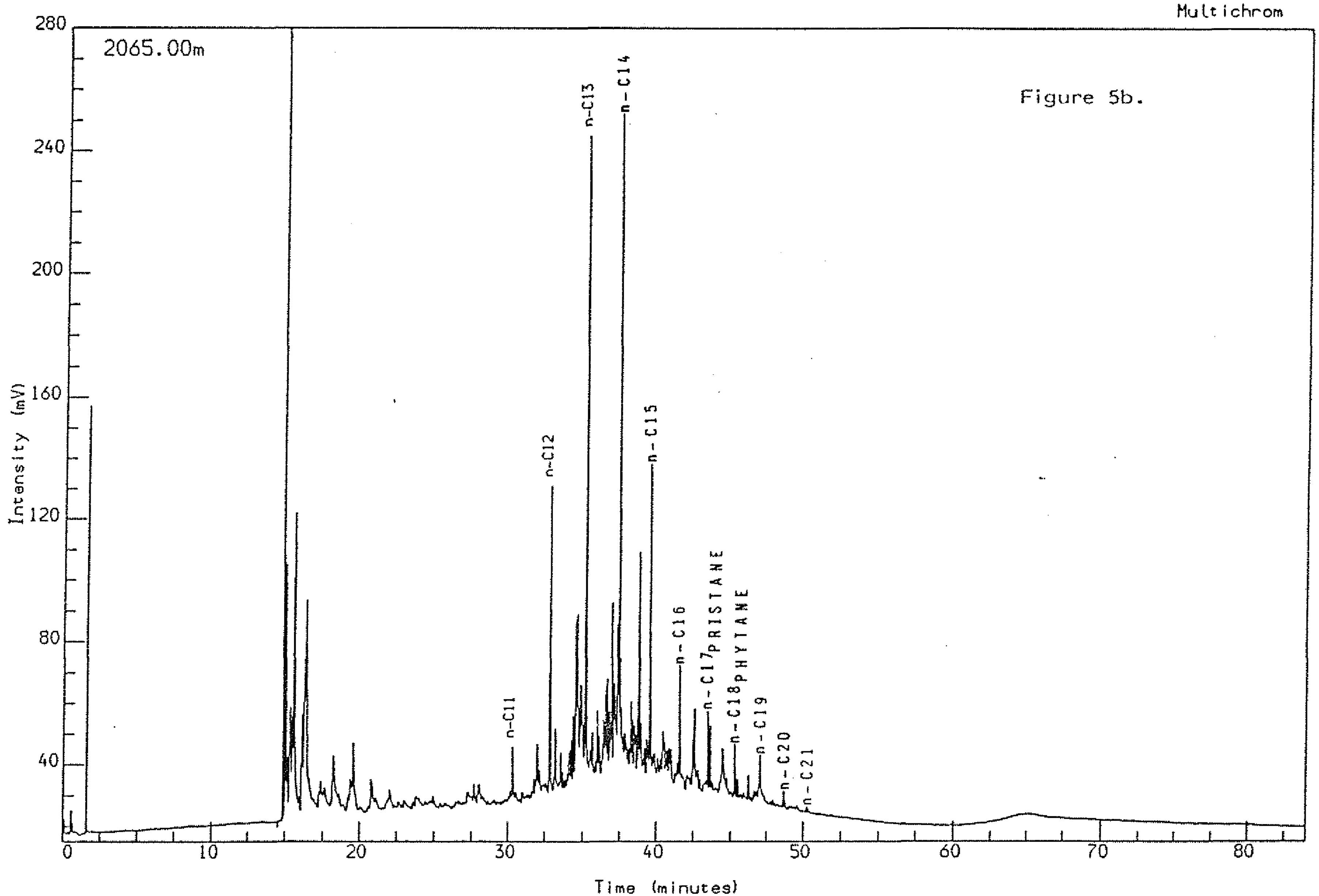
THERMAL EXTRACTION GC (S1)

Ca: lt or

Reported on 17-JUN-1991 at 12:18

GEOLAB NOR

Analysis Name : [522006] 23 PF1100051.1.1.




WELL NOCS 31/4-7 2065.00m ccp

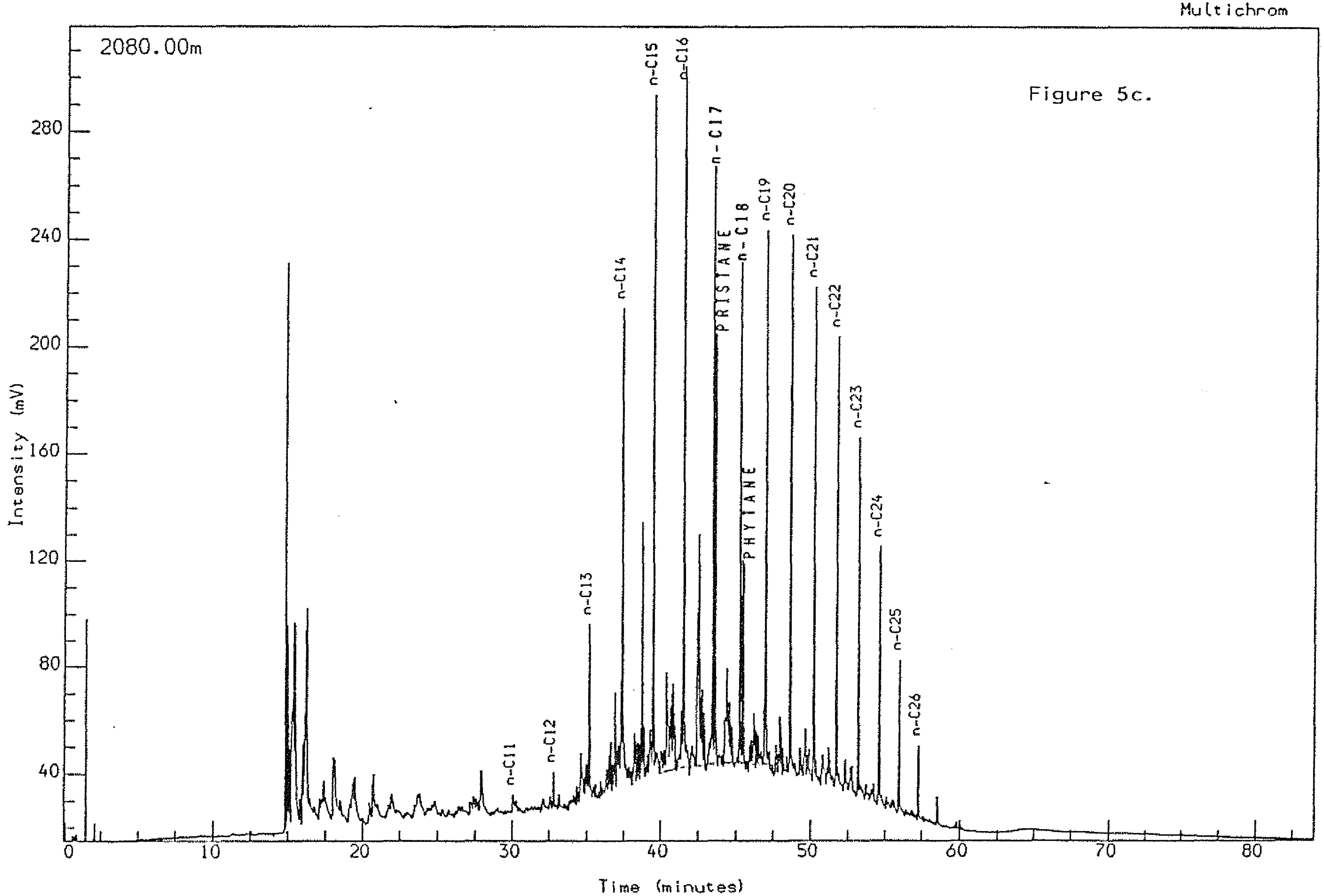
THERMAL EXTRACTION GC (S1)

Sltst: lt gy to lt brn gy

Reported on 17-JUN-1991 at 12:26

GEOLAB NOR

Analysis Name : [522006] 23 PF1100081,1,1.




WELL NOCS 31/4-7 2080.00m ccp

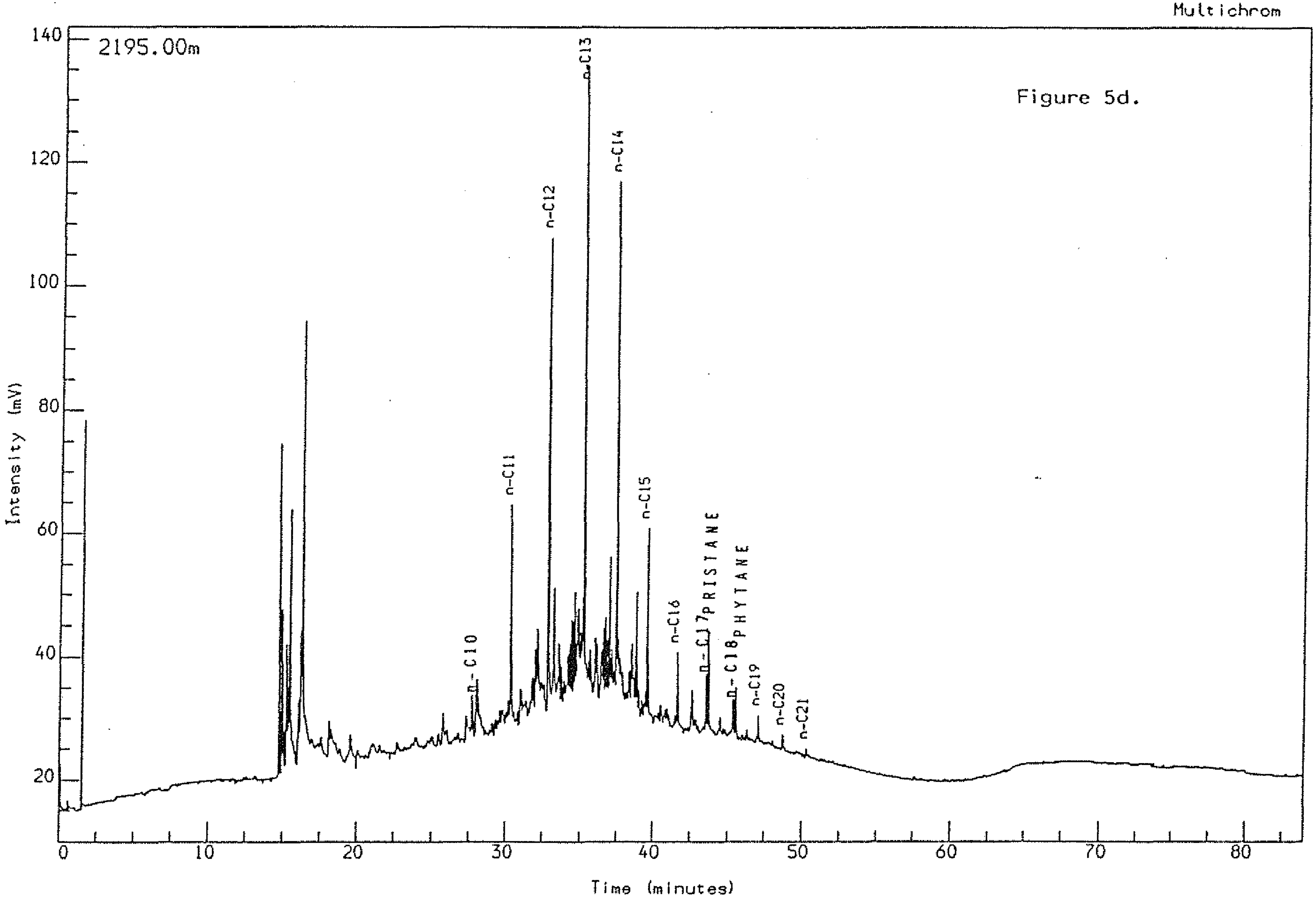
THERMAL EXTRACTION GC (S1)

Sltst: lt brn gy

Reported on 17-JUN-1991 at 12:28

GEOLAB NOR

Analysis Name : [522006] 23 PF1100901,1,1.



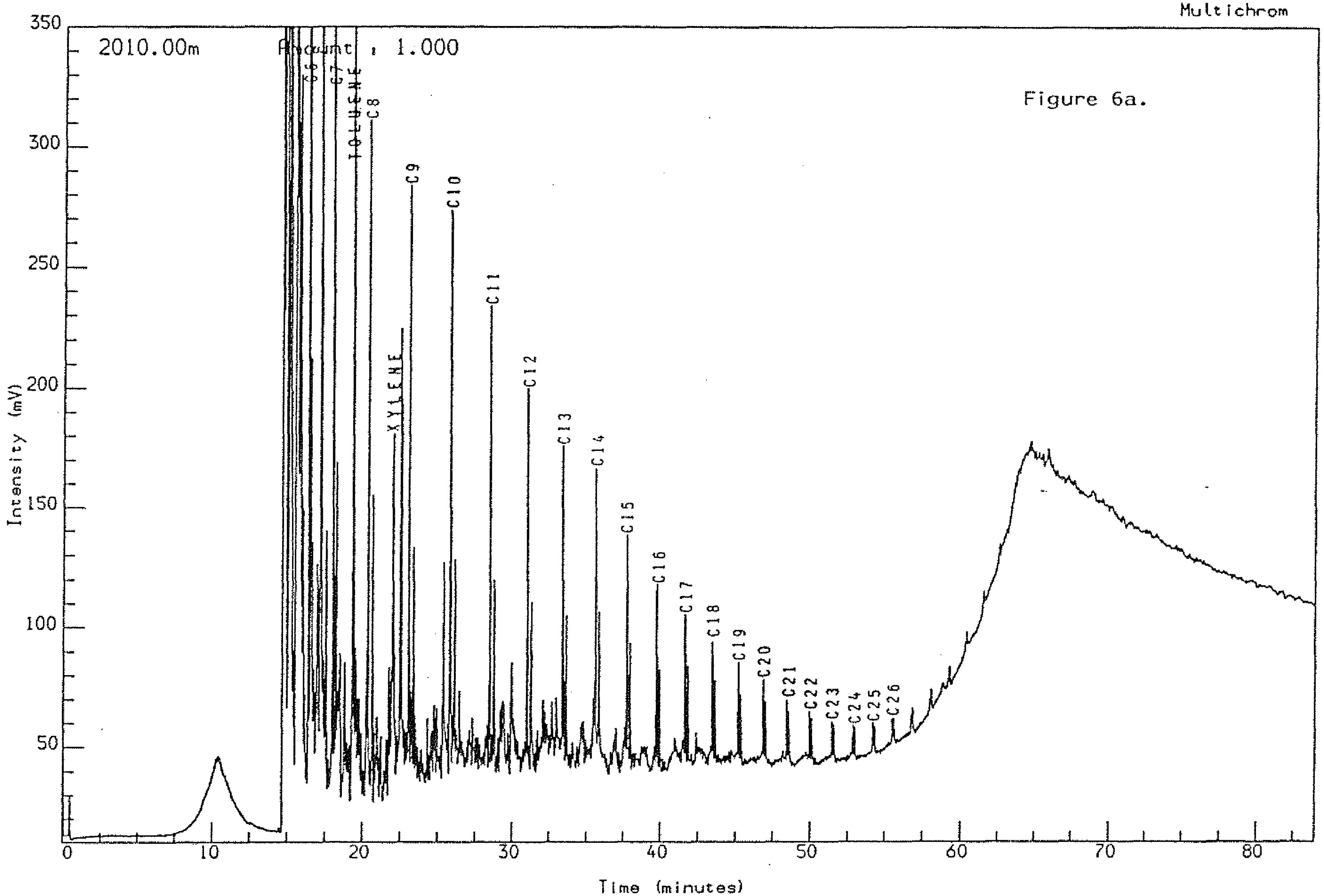

WELL NOCS 31/4-7 2195.00m cut Reported on 18-JUN-1991 at 08:00

THERMAL EXTRACTION GC (S1)

Sltst: lt gy to w

GEOLAB NOR

Analysis Name : [522006] 24 PF1100752,1,1.




WELL NOCS 31/4-7 2010.00m cut Reported on 18-JUN-1991 at 08:18

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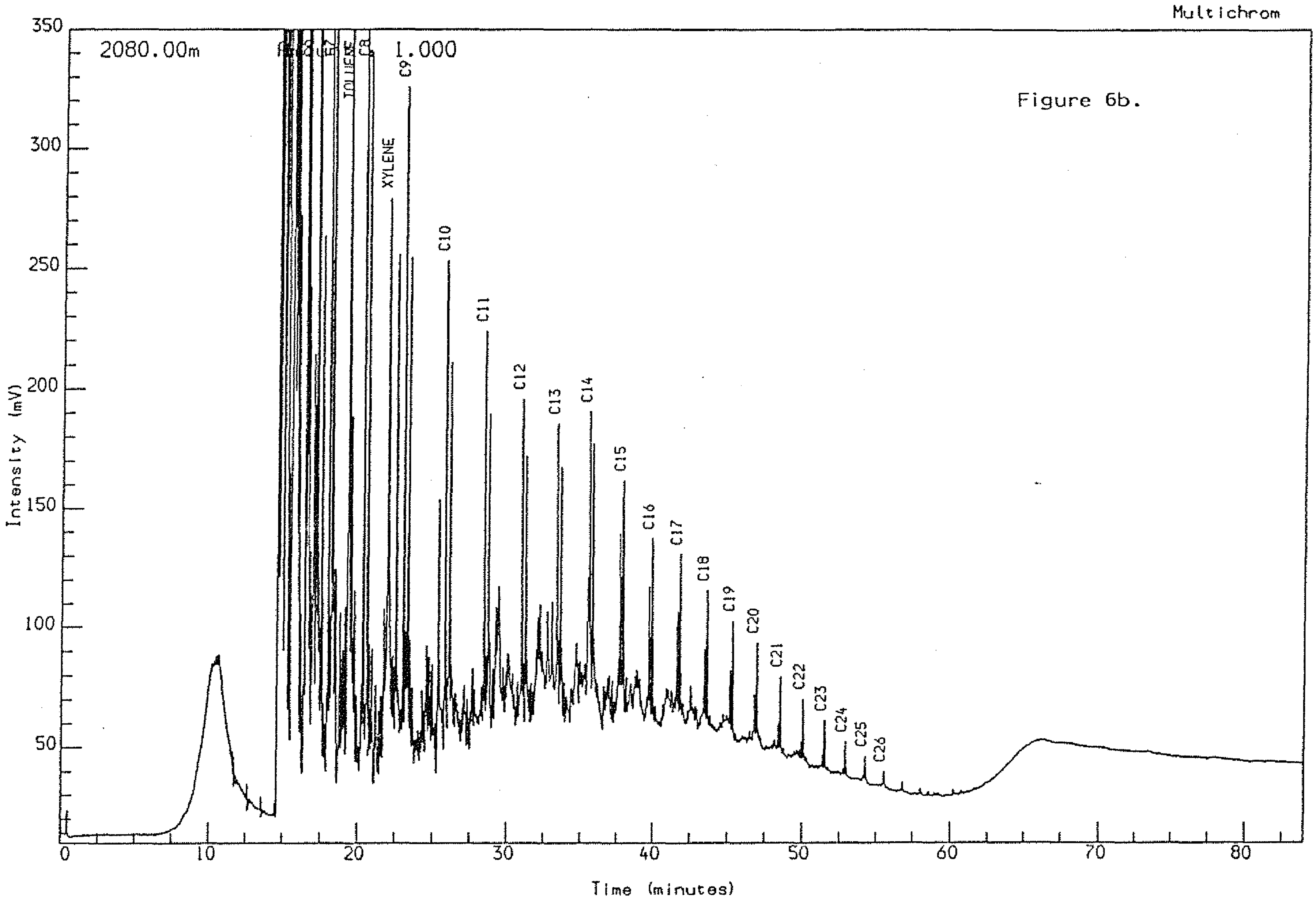
Ca: lt or

GEOLAB NOR

Analysis Name : [522006] 24 PF1100081,1,1.

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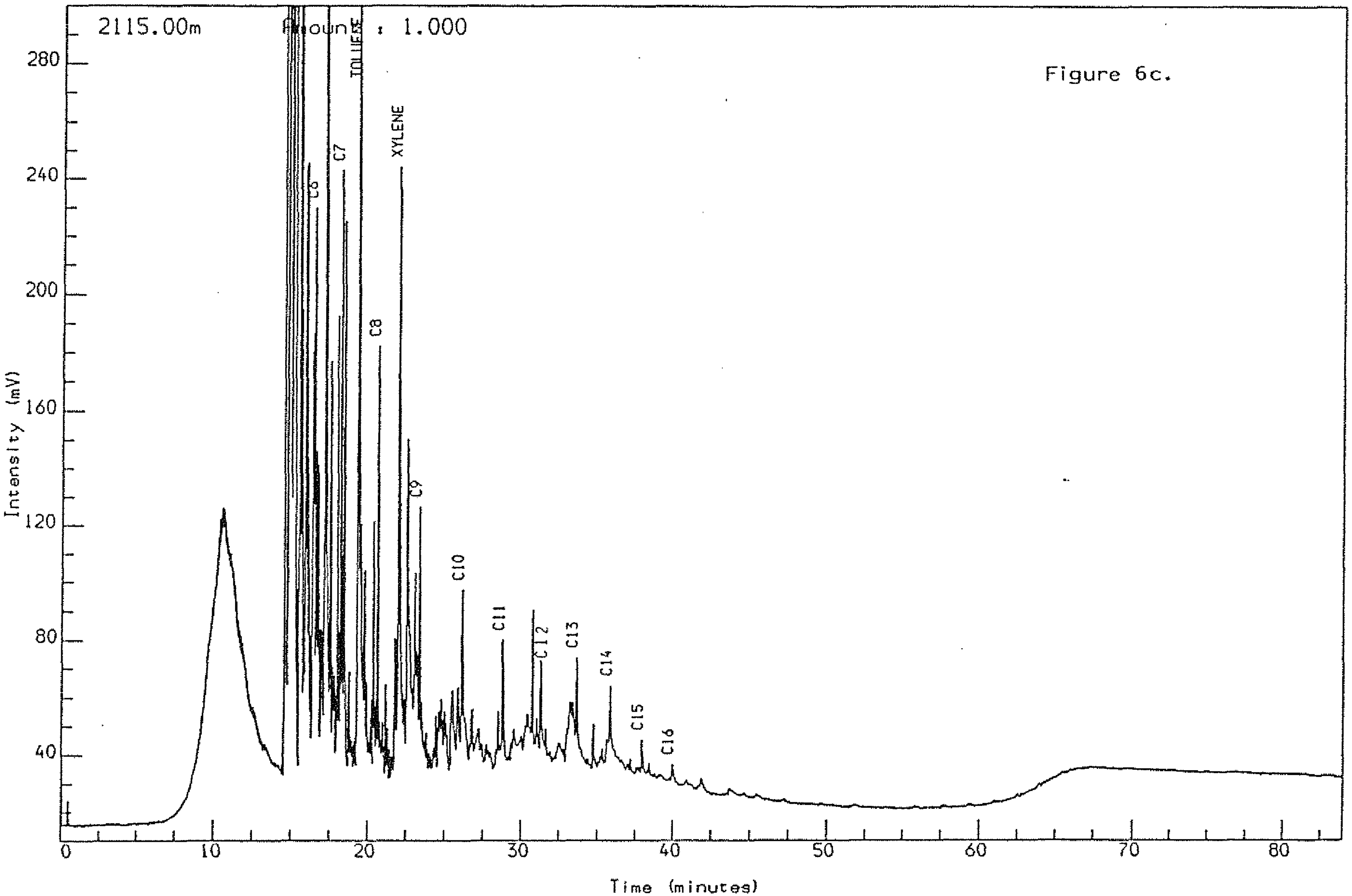
PYROLYSIS GC (S2)

Sltst: lt brn gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1100151,1,1.

Multichrom

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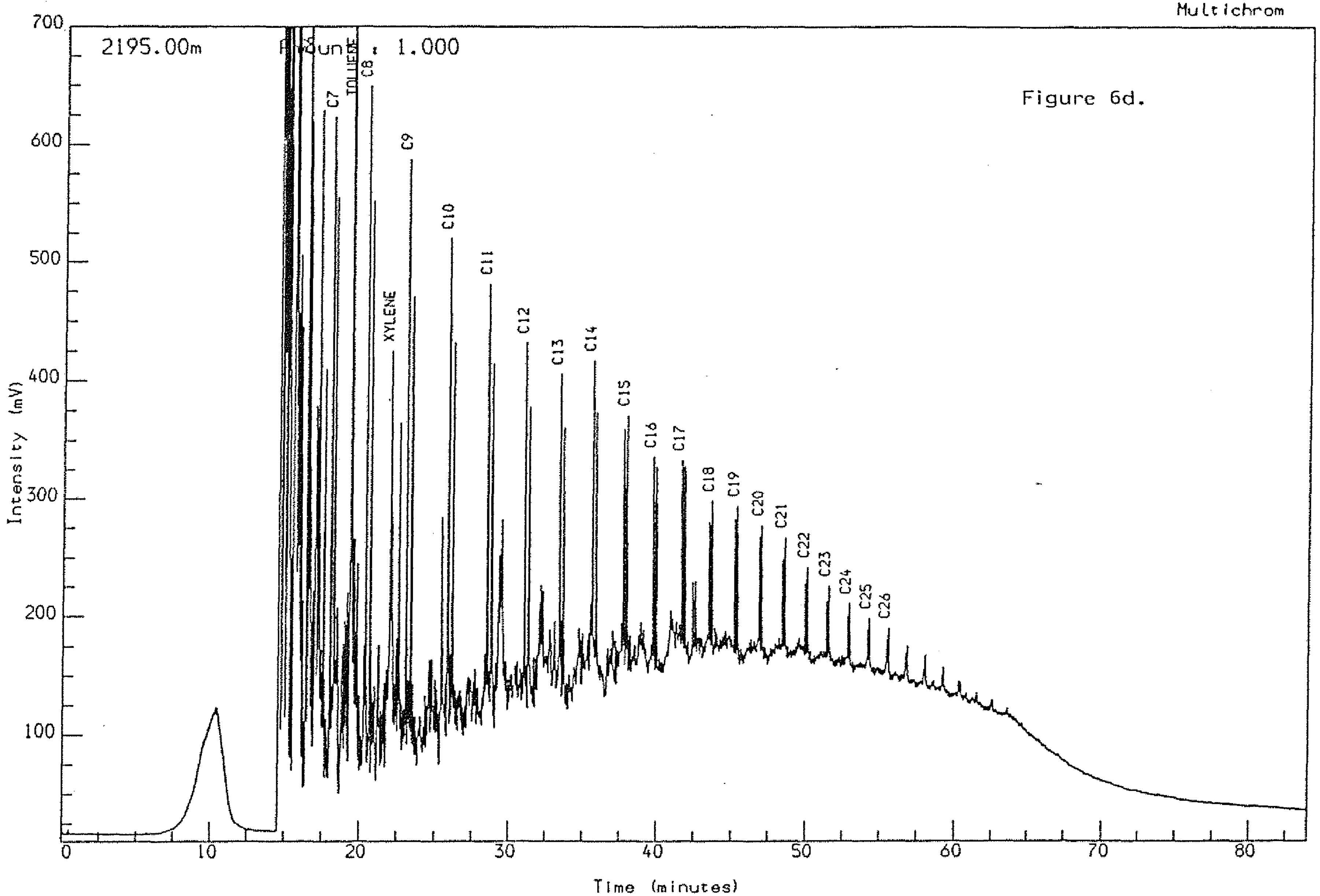
Sltst: lt gy to m gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1100901.1.1.




WELL NOCS 31/4-7 2195.00m cut Reported on 18-JUN-1991 at 08:35

PYROLYSIS GC (S2)

Sltst: lt gy to w

GEOLAB NOR

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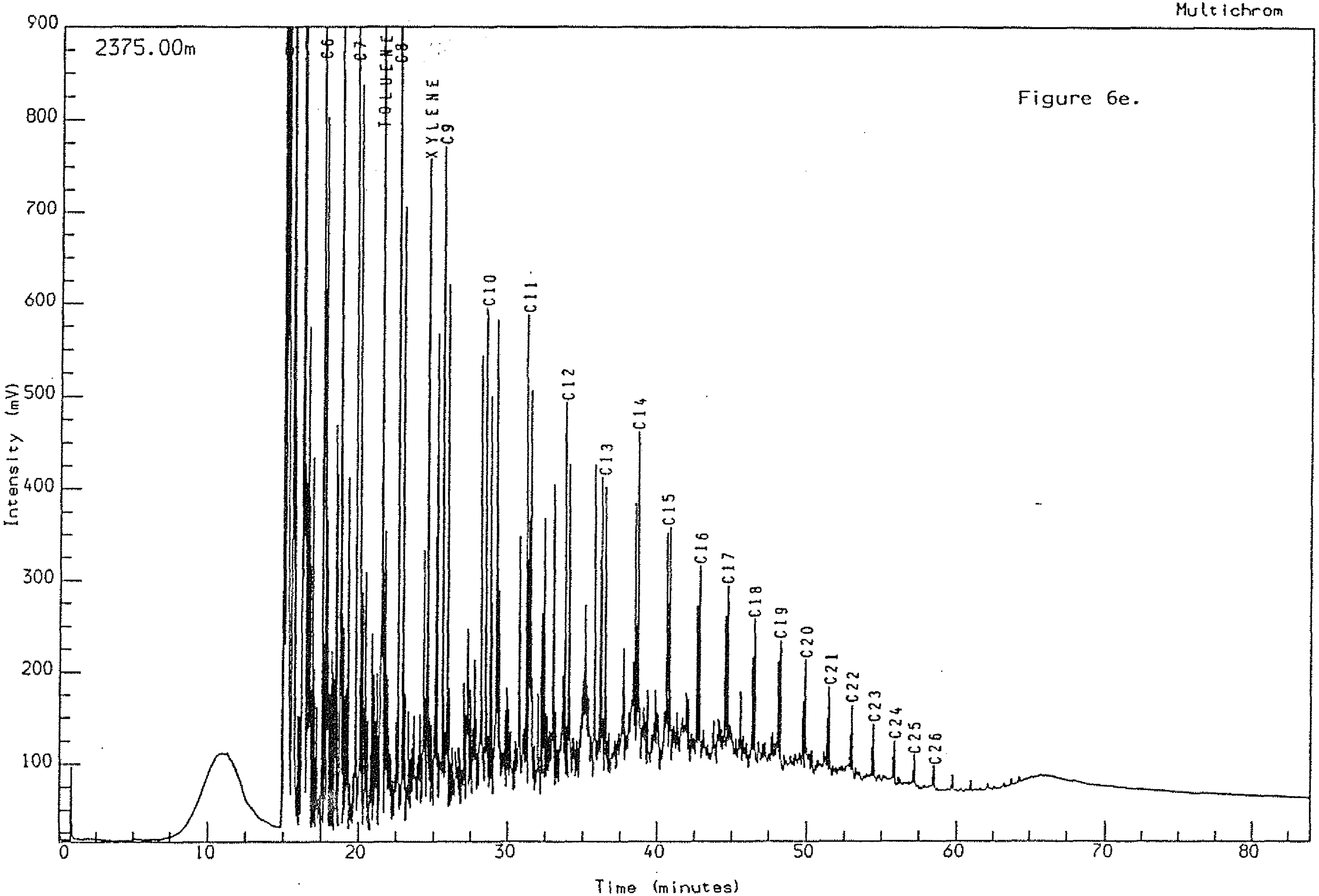


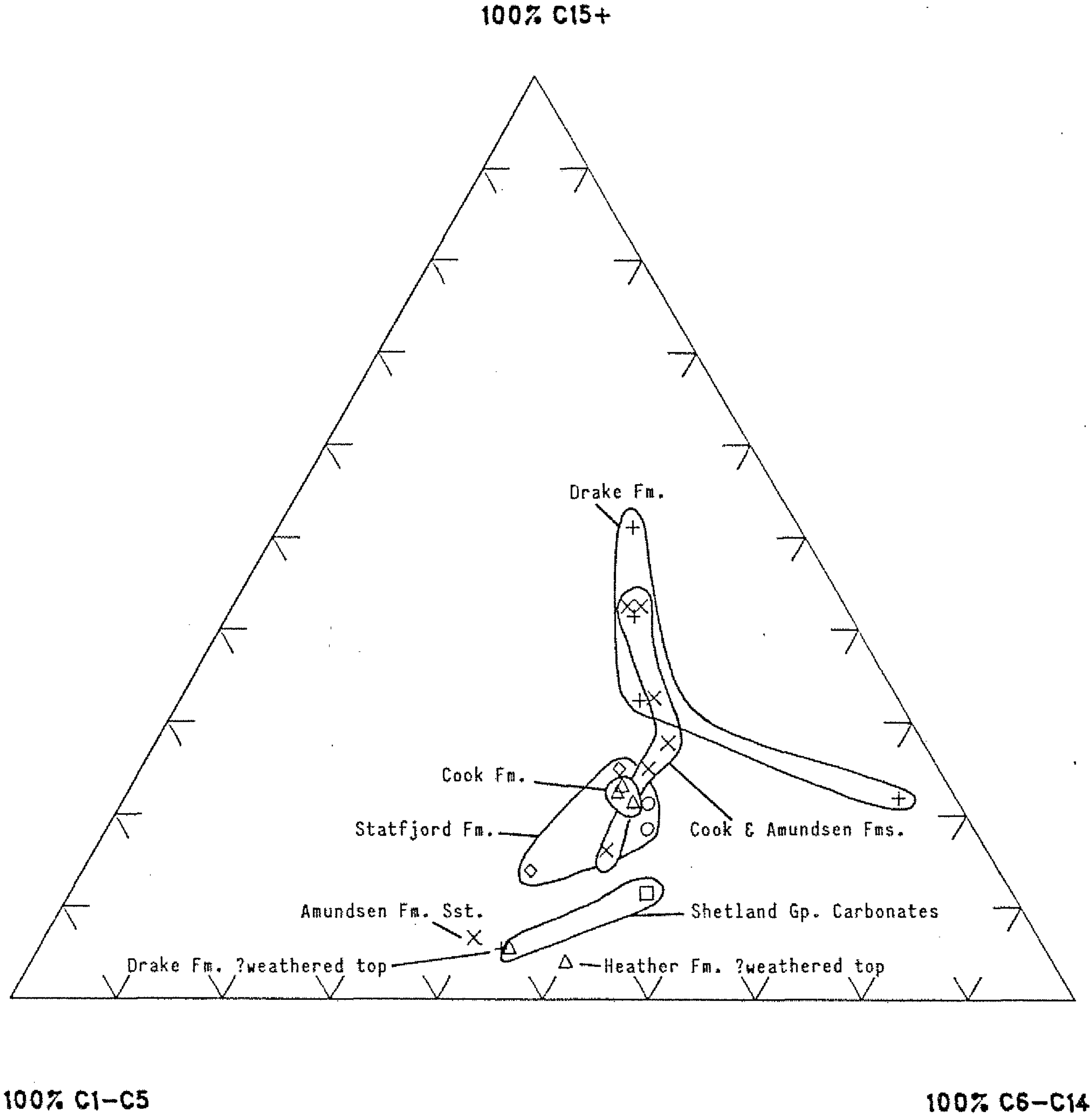

WELL NOCS 31/4-7 2375.00m cut Reported on 15-JUL-1991 at 10:03
PYROLYSIS GC (S2)
Sh/Clst: m gy

GEOLAB NOR

GEOLAB NOR

Figure 7 : Pyrolysis GC Composition

Well NOCS 31/4-7



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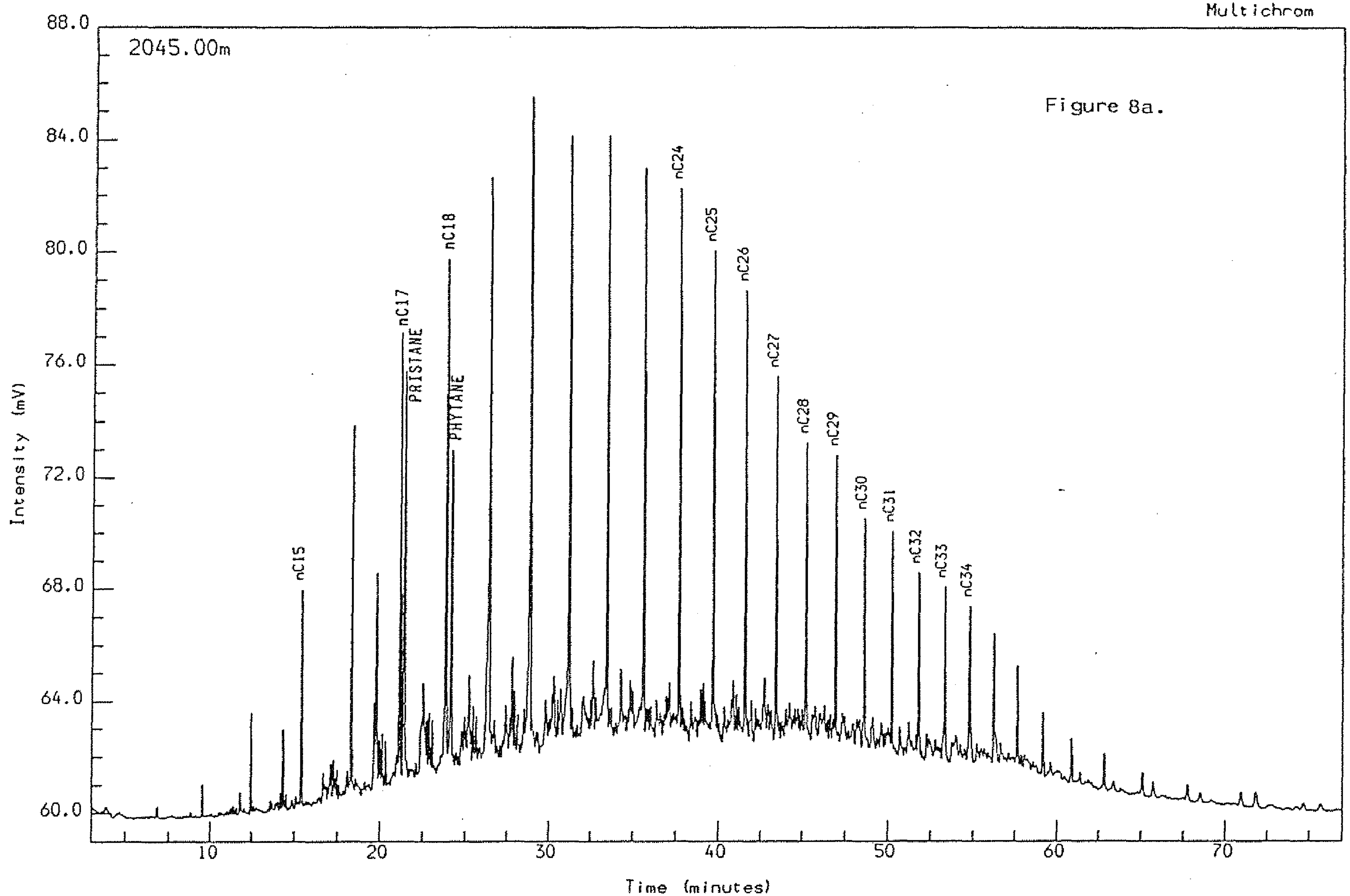


WELL NOCS 31/4-7 2045.00m ccp
SATURATED GC
Sltst: lt gy

Reported on 10-JUL-1991 at 10:44

GEOLAB NOR

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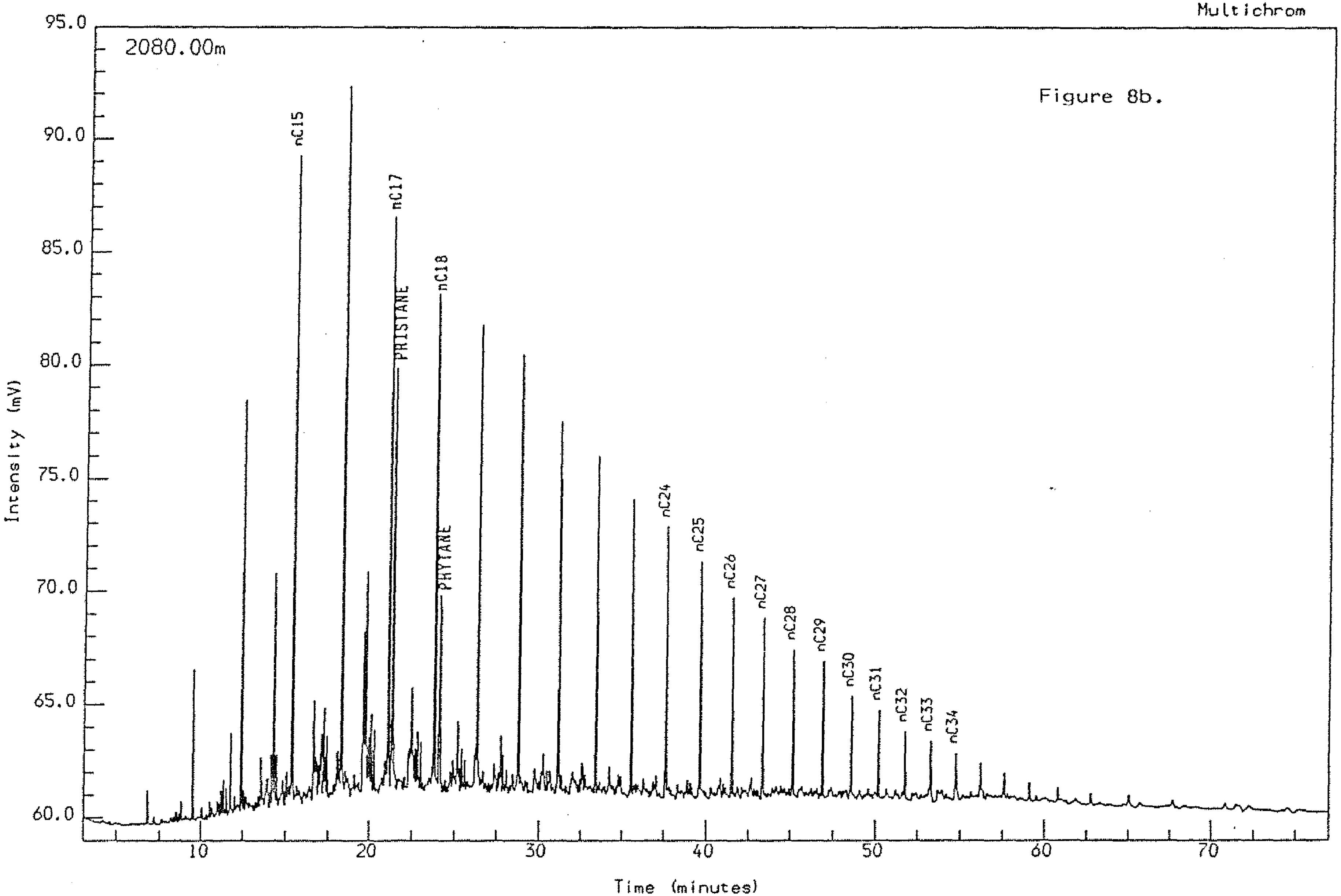


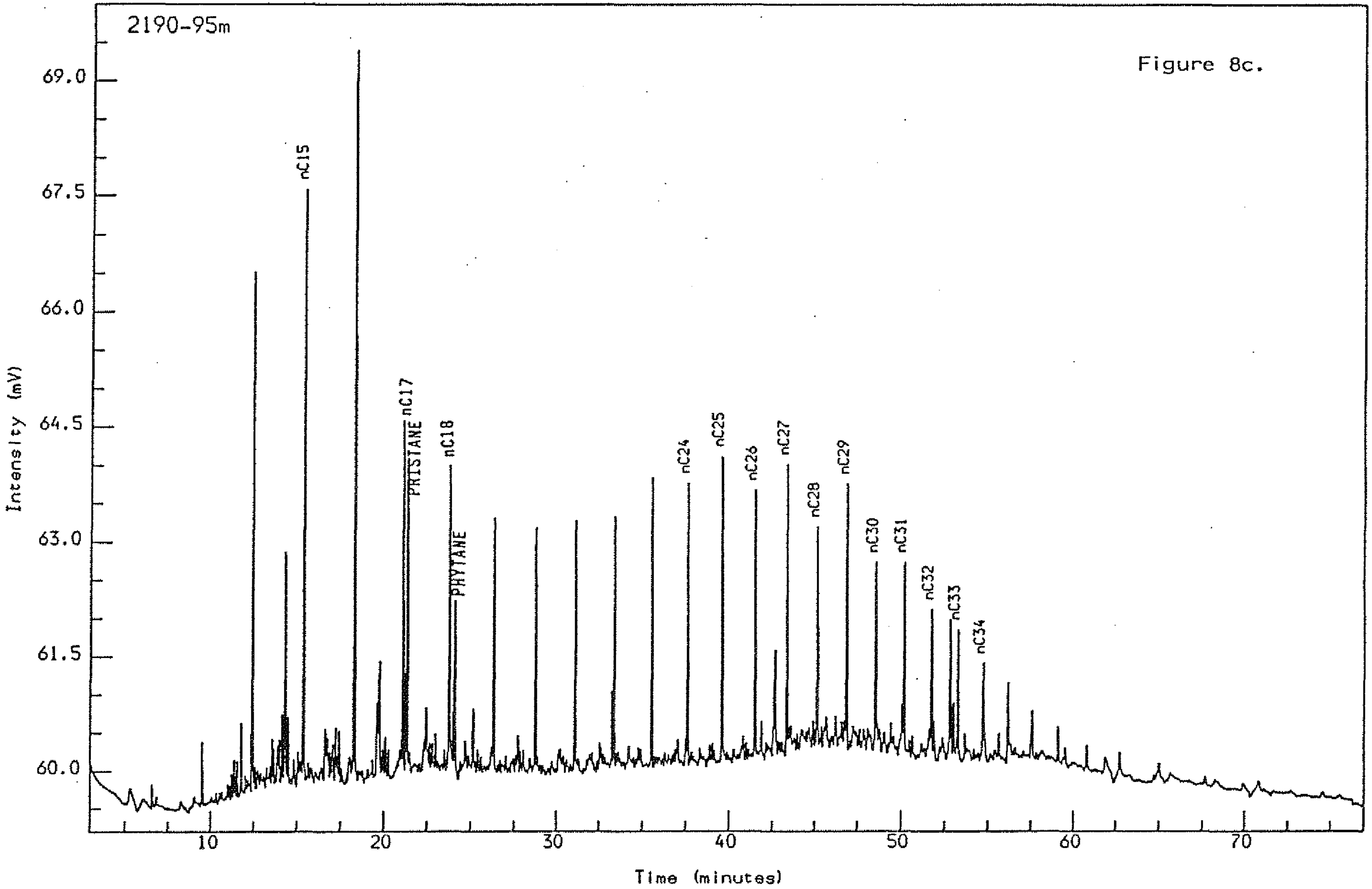

WELL NOCS 31/4-7 2080.00m ccp
SATURATED GC
Sltst: lt brn gy

Reported on 10-JUL-1991 at 10:50

GEOLAB NOR

Analysis Name : [522006] 11 SF1101520B,1,1.

Multichrom

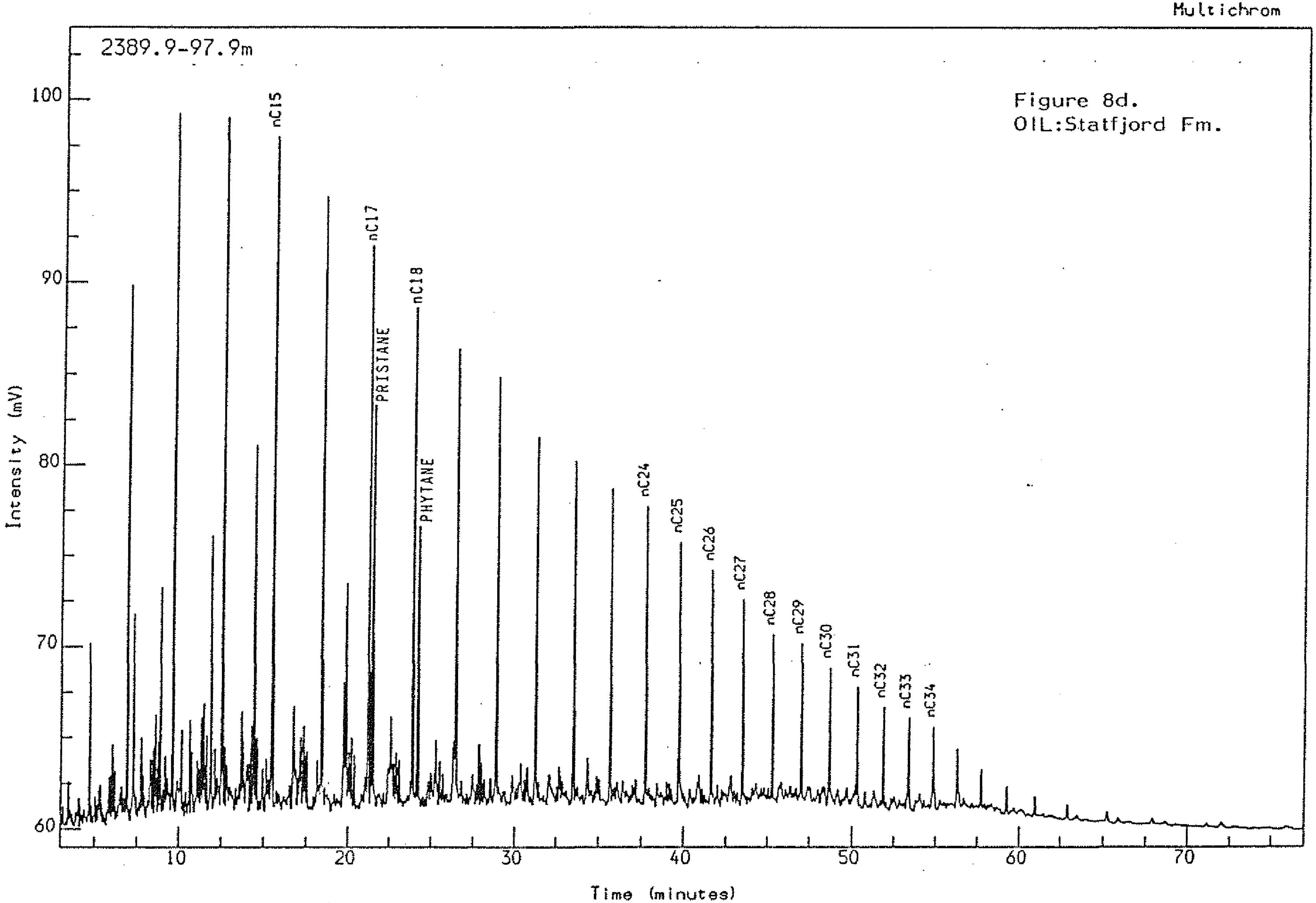



WELL NOCS 31/4-7 2190-2195m cut
SATURATED GC
Sltst.:lt gy to w

Reported on 10-JUL-1991 at 10:55

GEOLAB NOR

Analysis Name : [522006] 11 SF1101510B,1,1.




WELL NOCS 31/4-7 2389.90-97.90m
SATURATED GC

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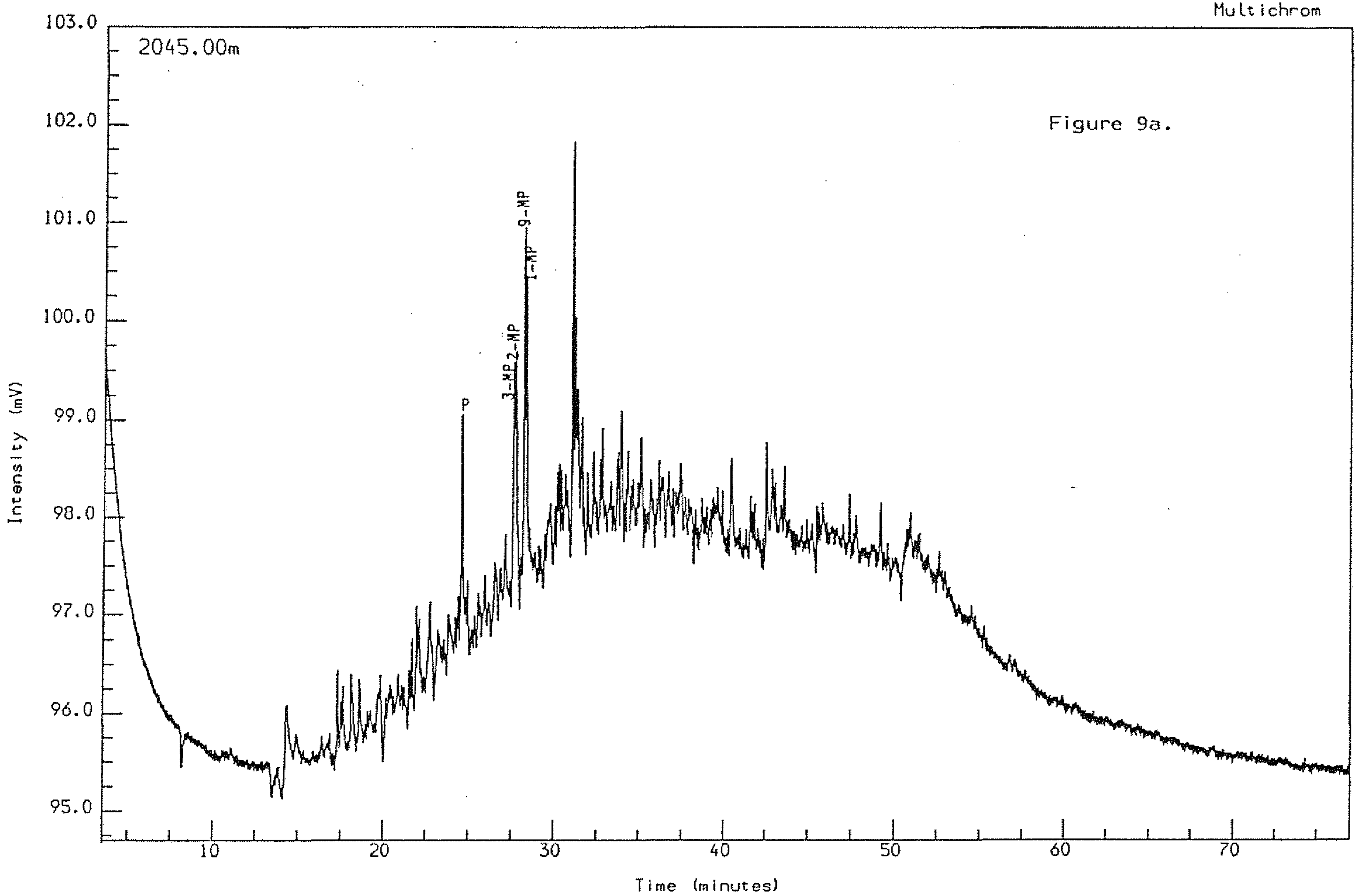
GEOLAB NOR

Analysis Name : [522006] 9 AF1100011L,1,1.



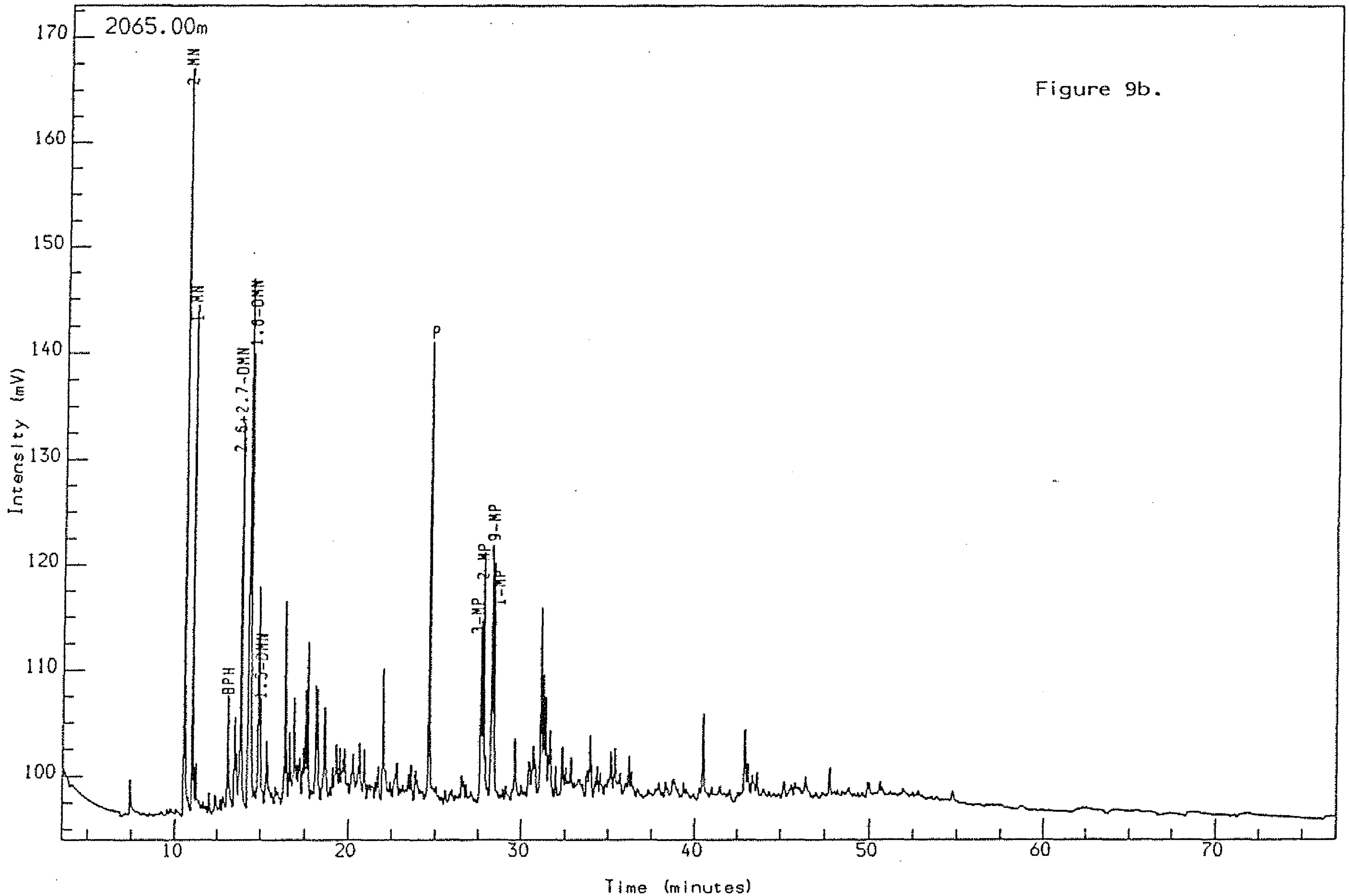

WELL NOCS 31/4-7 2045.00m ccp
AROMATIC GC (FID)
Sltst: lt gy

Reported on 10-JUL-1991 at 10:59

GEOLAB NOR

Analysis Name : [522006] 9 AF1100051L.1,1.

Multichrom



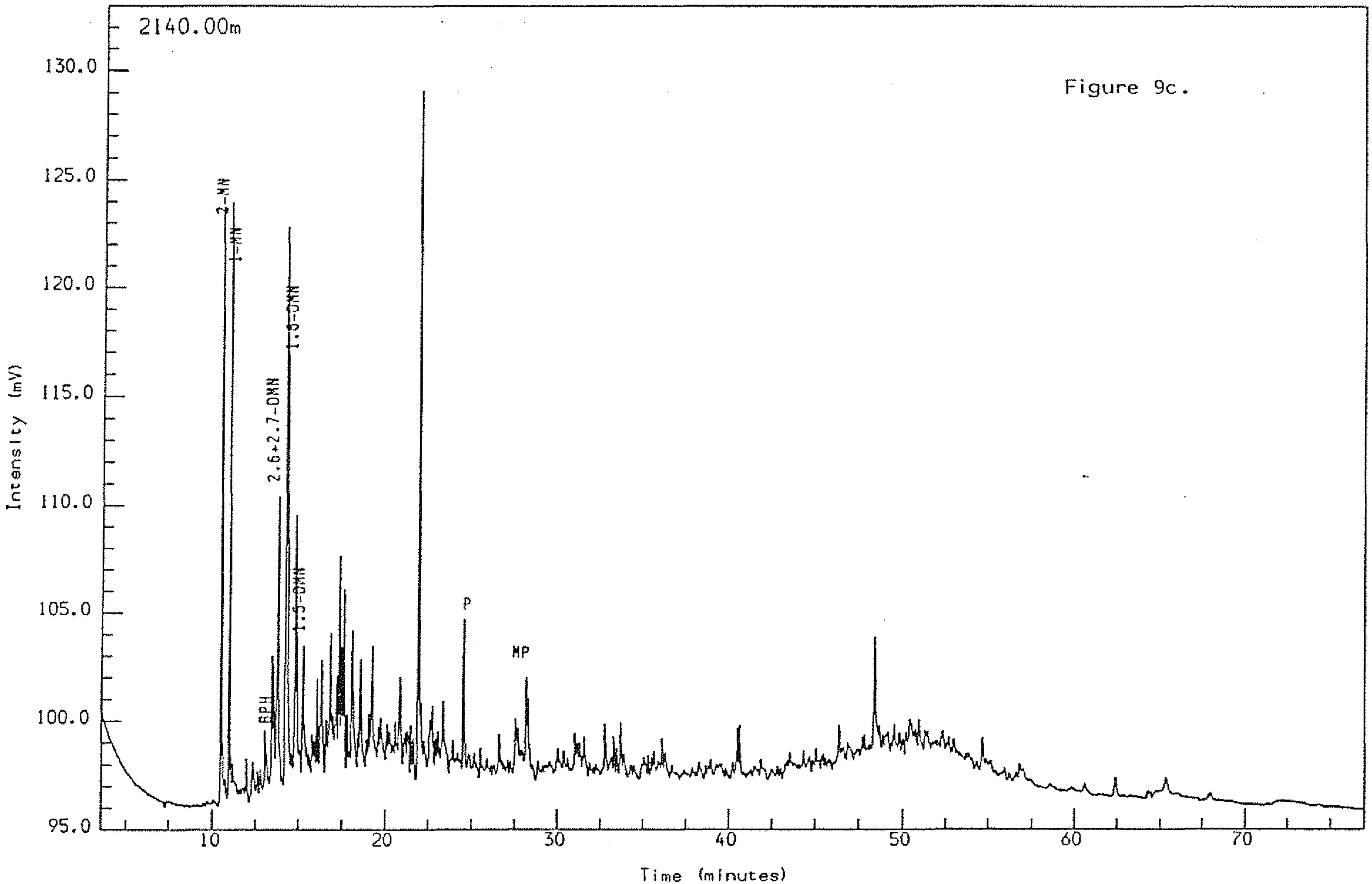

WELL NOCS 31/4-7 2065.00m ccp
AROMATIC GC (FID)
Sltst: lt gy to lt brn gy

Reported on 10-JUL-1991 at 11:01

GEOLAB NOR

Analysis Name : [522006] 9 AF1100201L,1,1.

Multichrom

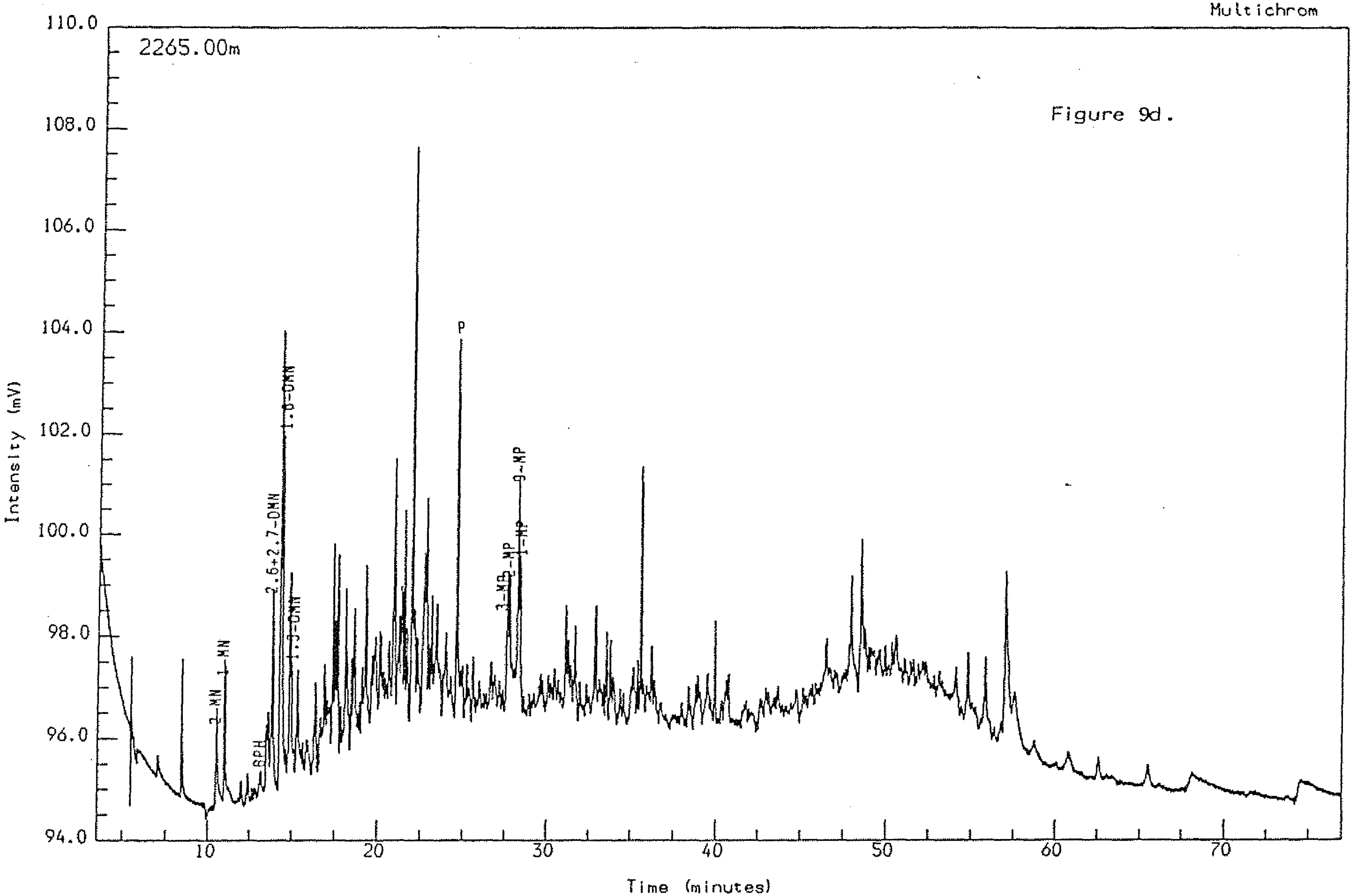



WELL NOCS 31/4-7 2140.00m ccp
AROMATIC GC (FID)
Sh/Clst: pl y brn

Reported on 10-JUL-1991 at 11:06

GEOLAB NOR

Analysis Name : [522006] 9 AF1101042L,1,1.



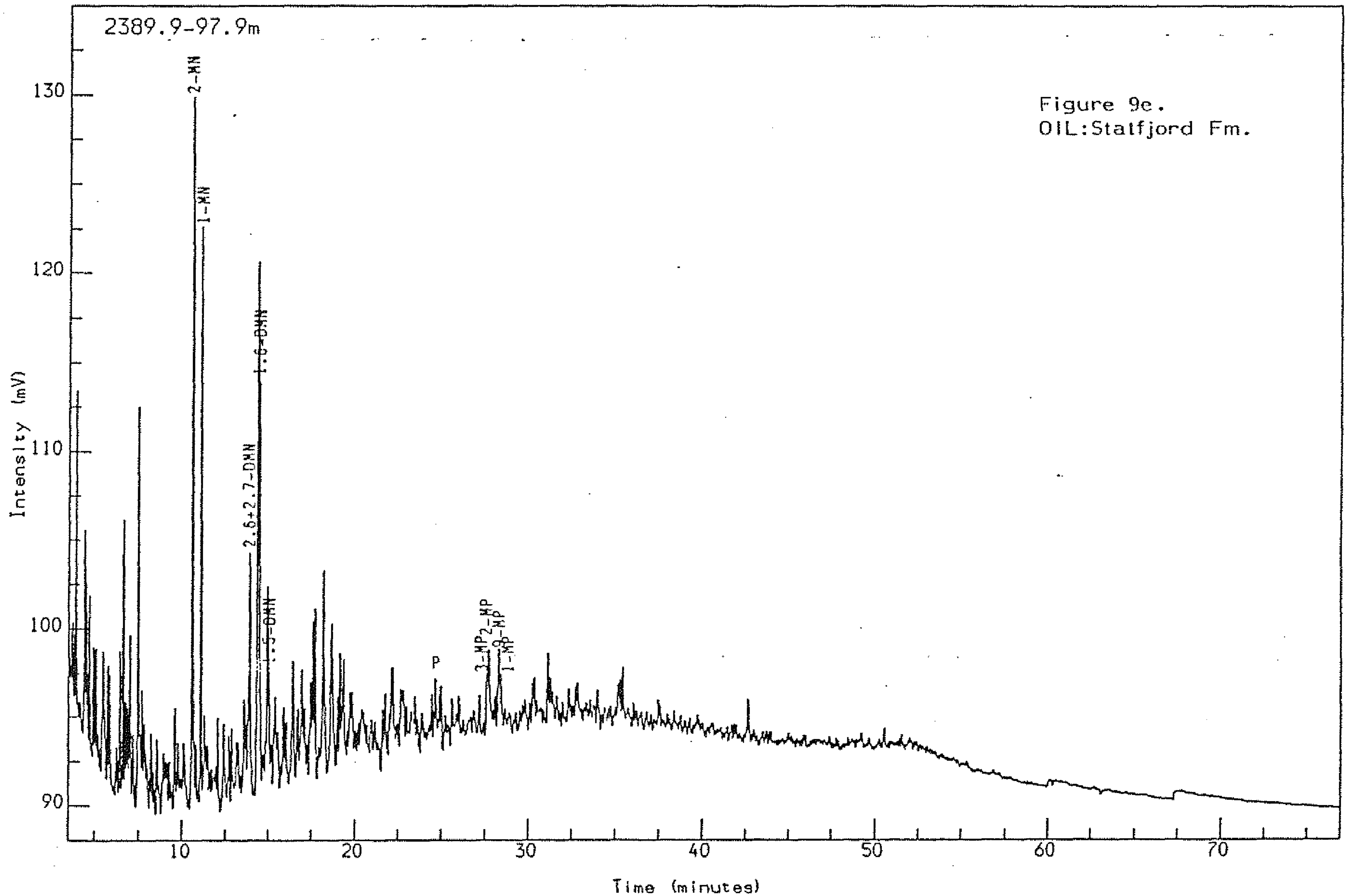

WELL NOCS 31/4-7 2265.00m cut
AROMATIC GC (FID)
Sh/Clst: m gy to brn gy

Reported on 10-JUL-1991 at 11:15

GEOLAB NOR

Analysis Name : [522006] 9·AF1101510B.1.1.

Multichrom




WELL NOCS 31/4-7 2389.90-97.90m
AROMATIC GC (FID)

Reported on 22-MAY-1991 at 08:34

GEOLAB NOR

# Figure 10: Vitrinite Reflectance versus Depth
## Well NOCS 31/4-7

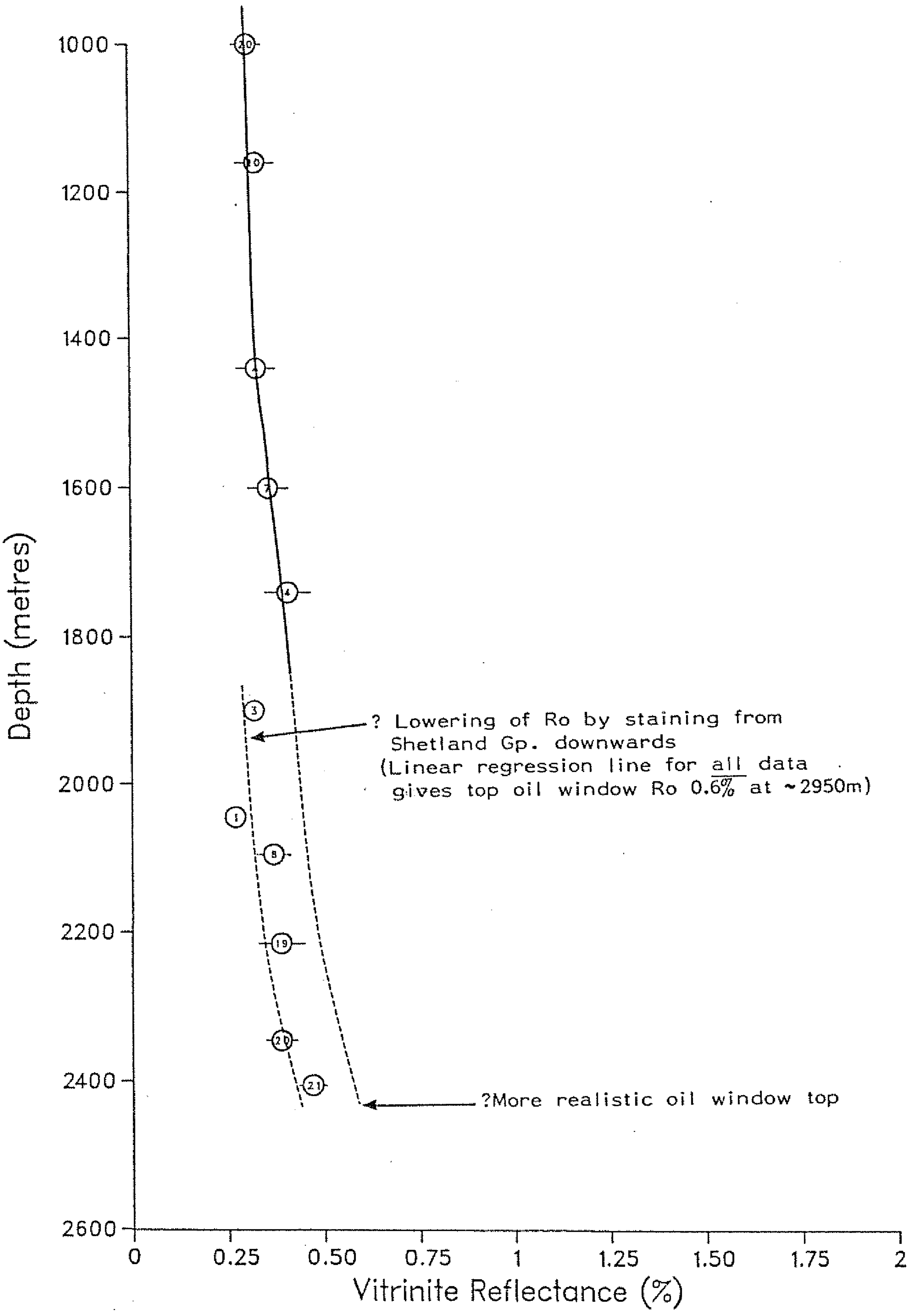
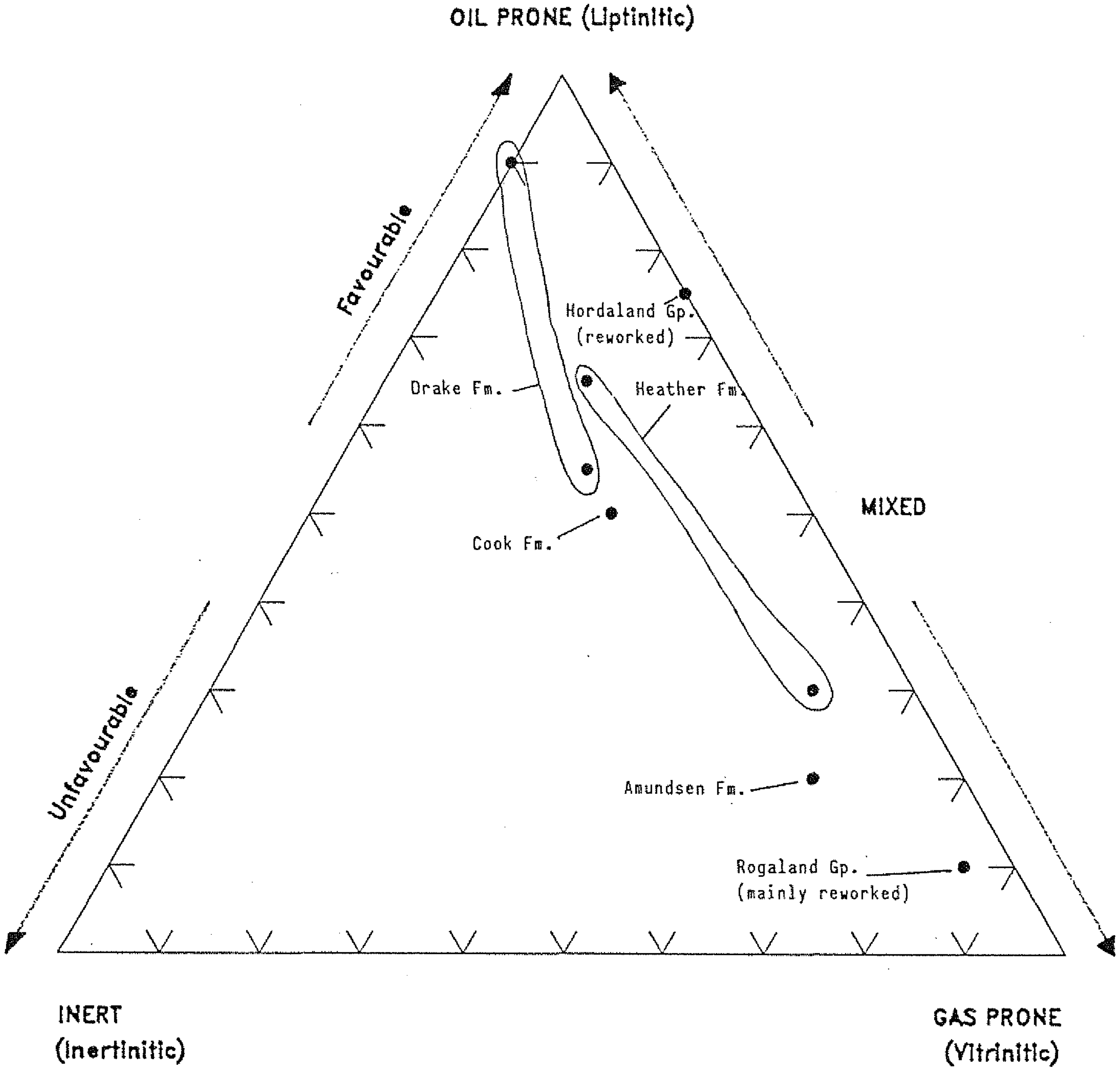
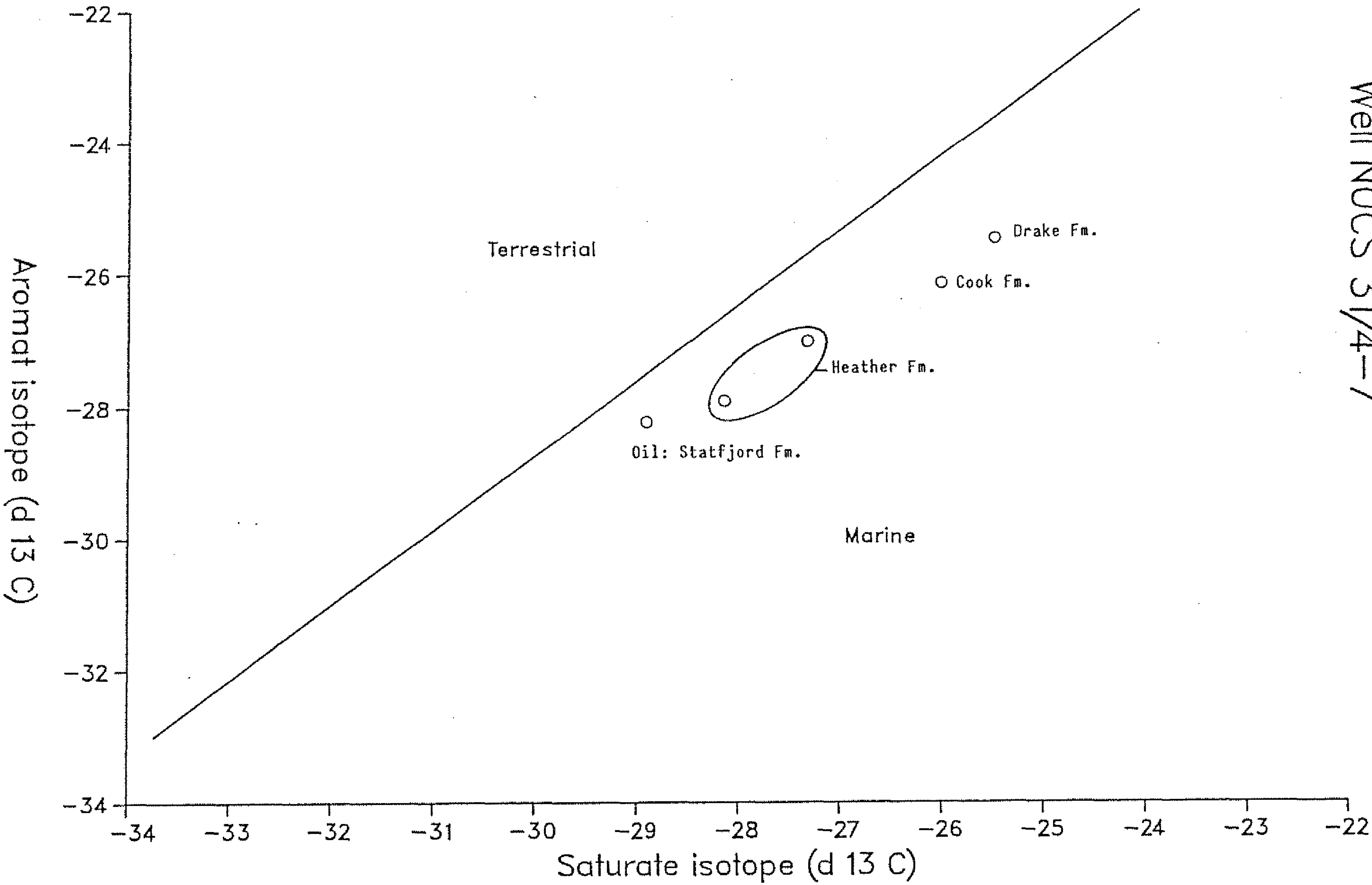


Figure 11: Kerogen Composition and Potential Hydrocarbon Products

Well NOCS 31/4-7



# Figure 12: Aromatic v.s. saturate isotope values
## Well NOCS 31/4-7

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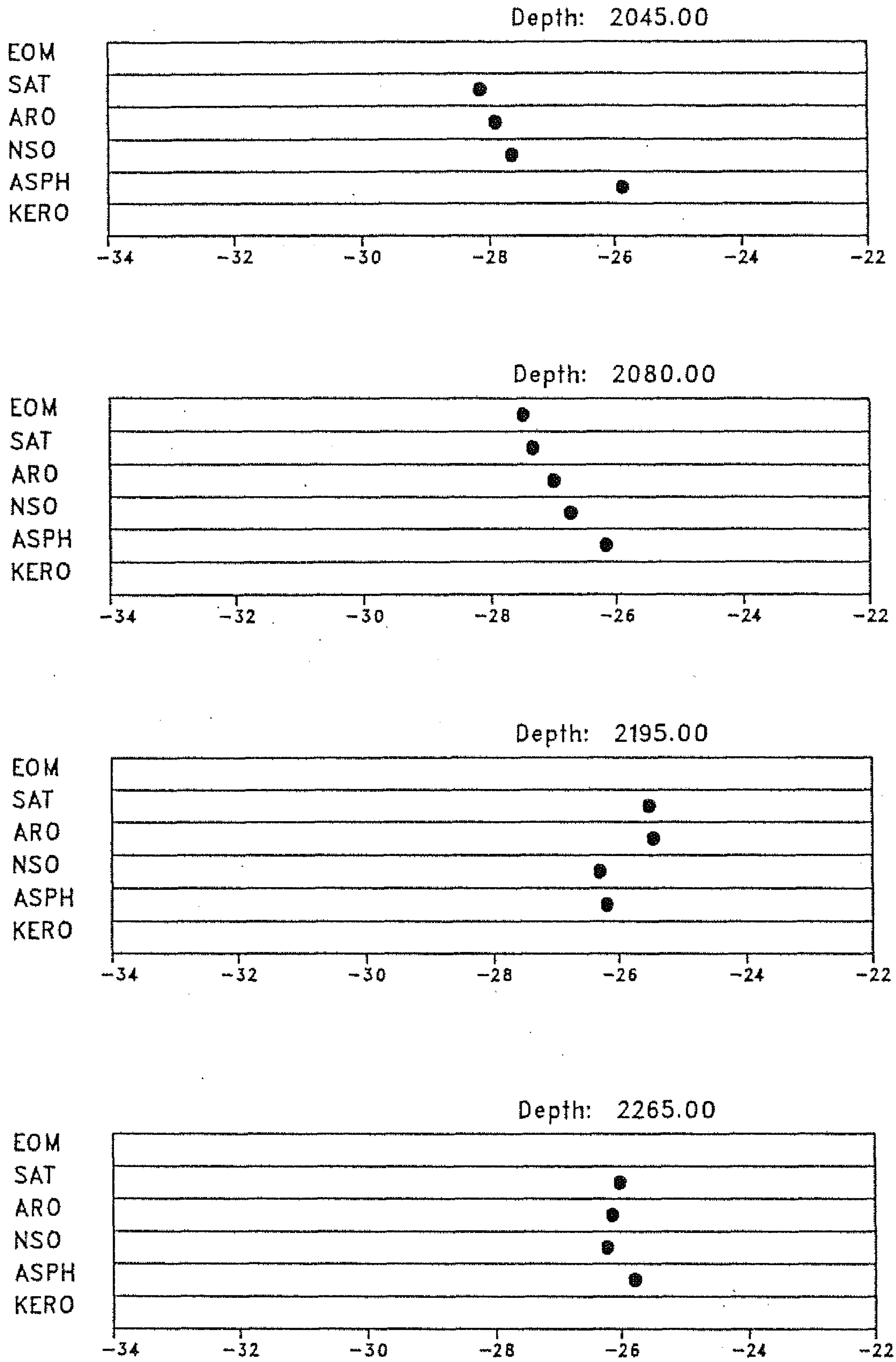
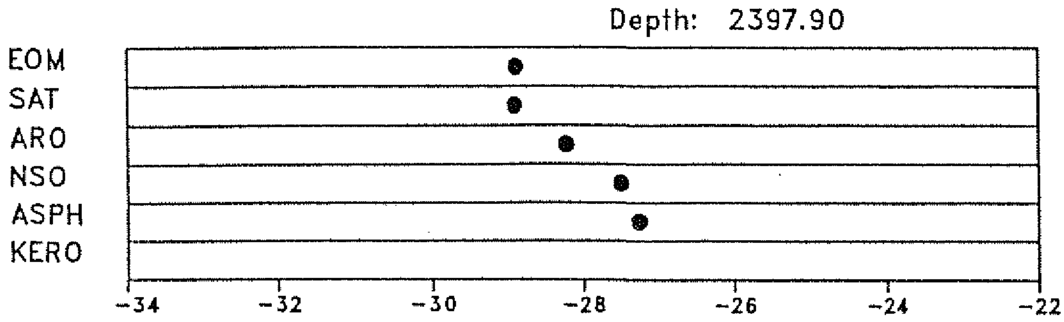
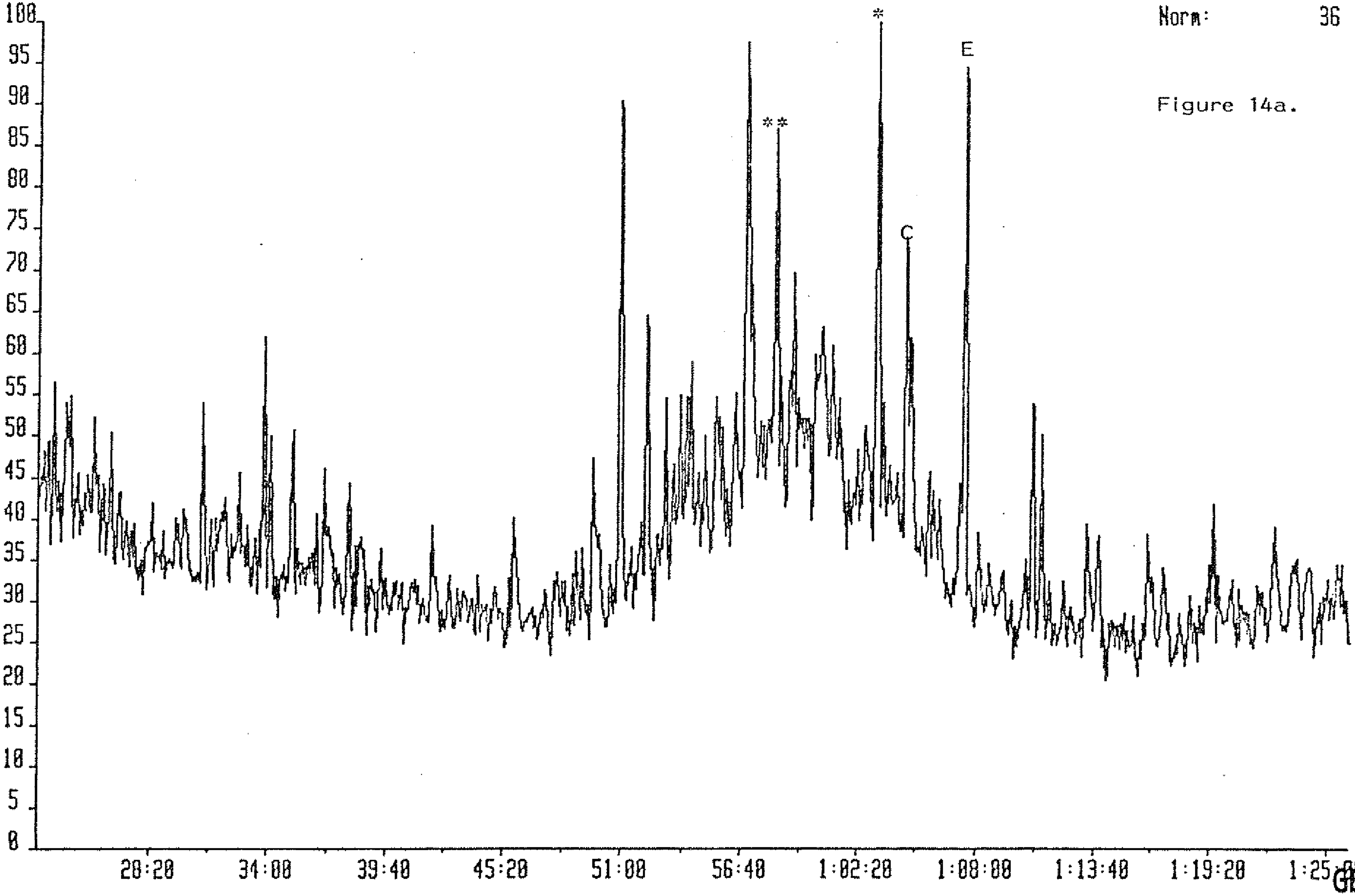
# Figure 13: 13C/12C isotope ratios. Galimov plot. Well NOCS 31/4-7



# Figure 13: 13C/12C isotope ratios. Galimov plot. Well NOCS 31/4-7



KEYSAT3 29-JUL-91 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 3 Injection 1 Group 1 Mass 163.1485
Text:WELL 31/4-7, 2080M, SATURATED FRACTION

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KEYSAT4 29-JUL-91 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 1 Injection 1 Group 1 Mass 163.1485
Text:WELL 31/4-7, 2190-95M, SATURATED FRACTION

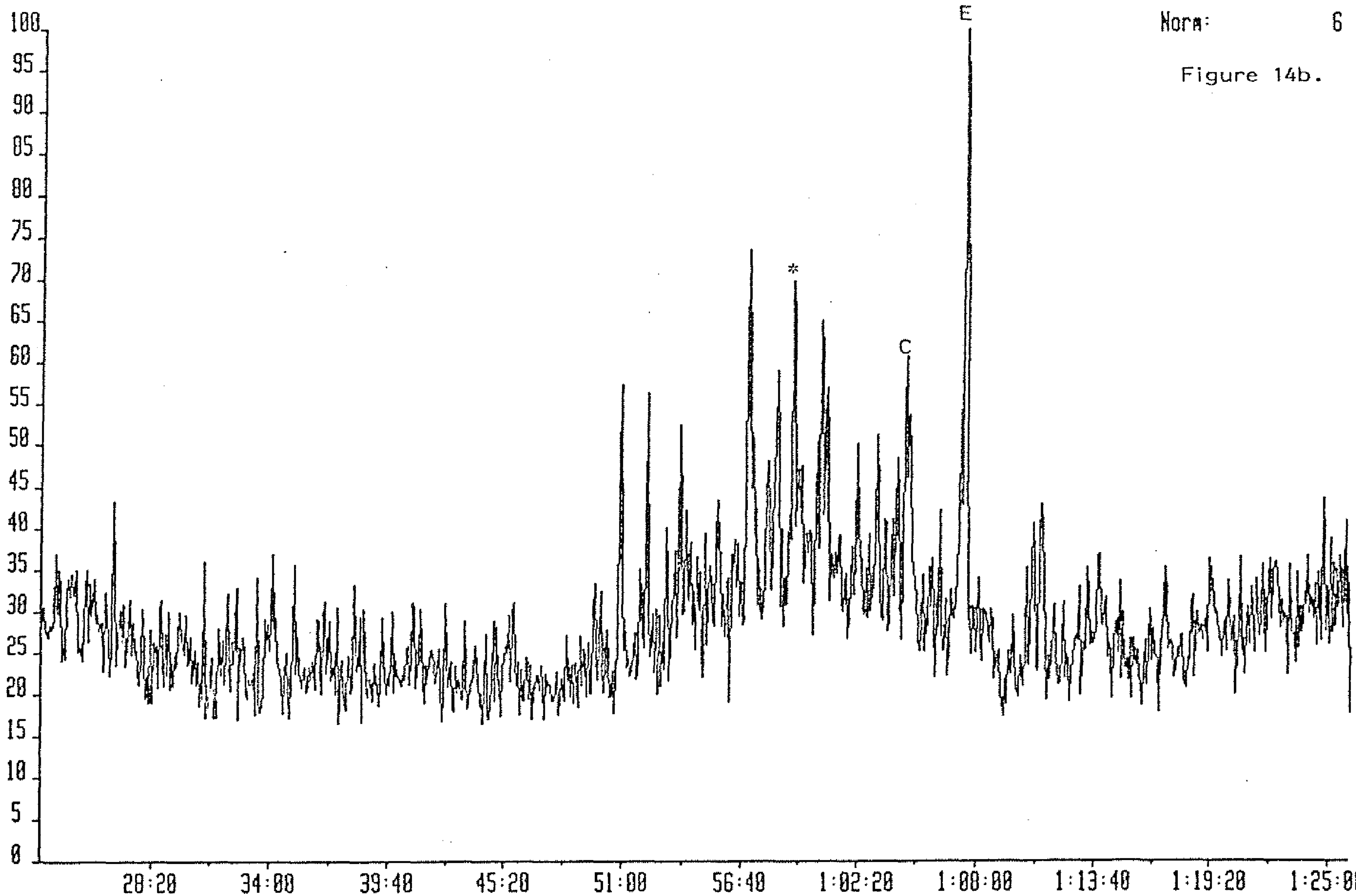
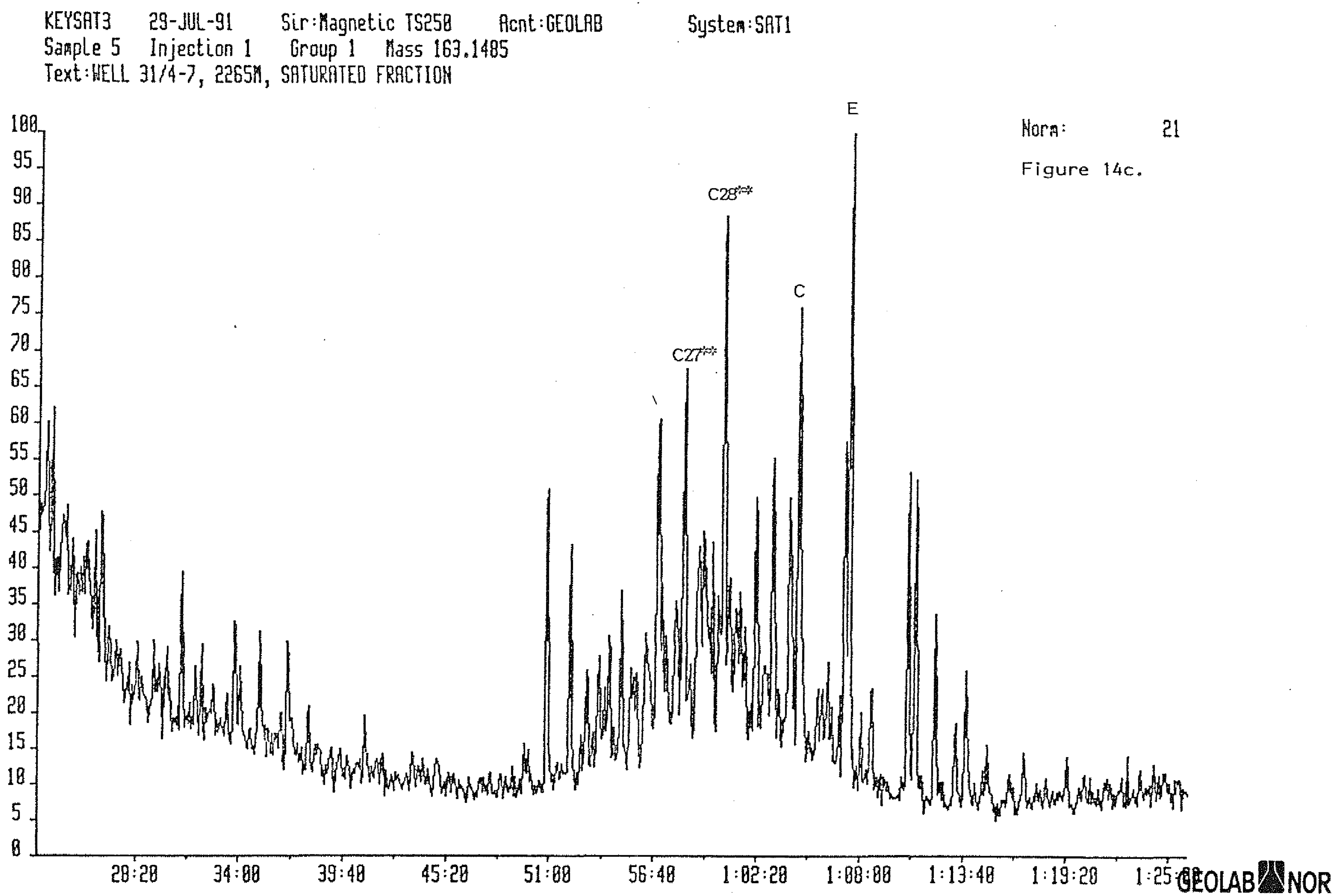
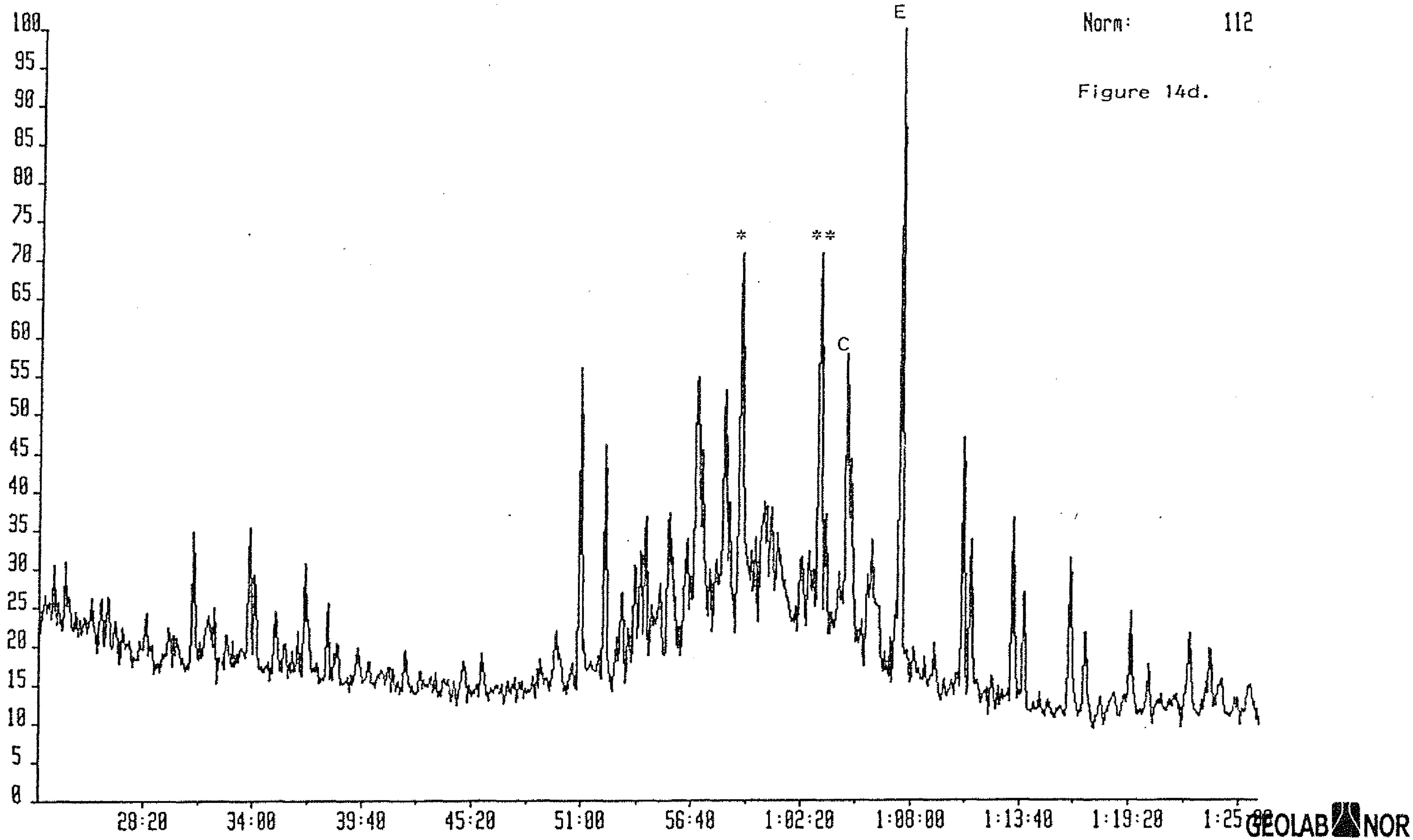



Figure 14b.

GEOLAB NOR


KEYSAT3 29-JUL-91 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 5 Injection 1 Group 1 Mass 163.1485
Text:WELL 31/4-7, 2265M, SATURATED FRACTION
Norm: 21
E
C28**
C
C27**
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
28:20
34:00
39:40
45:20
51:00
56:40
1:02:20
1:08:00
1:13:40
1:19:20
1:25:00
GEOLAB NOR
Figure 14c.

KEYSAT3    29-JUL-91    Sir:Magnetic TS250    Acnt:GEOLAB    System:SAT1
Sample 6   Injection 1   Group 1   Mass 163.1485
Text:WELL 31/4-7, 2389.9-97.9M, SATURATED FRACTION FROM OIL



KEYSAT3 29-JUL-91 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 3 Injection 1 Group 1 Mass 191.1800
Text:WELL 31/4-7, 2000M, SATURATED FRACTION

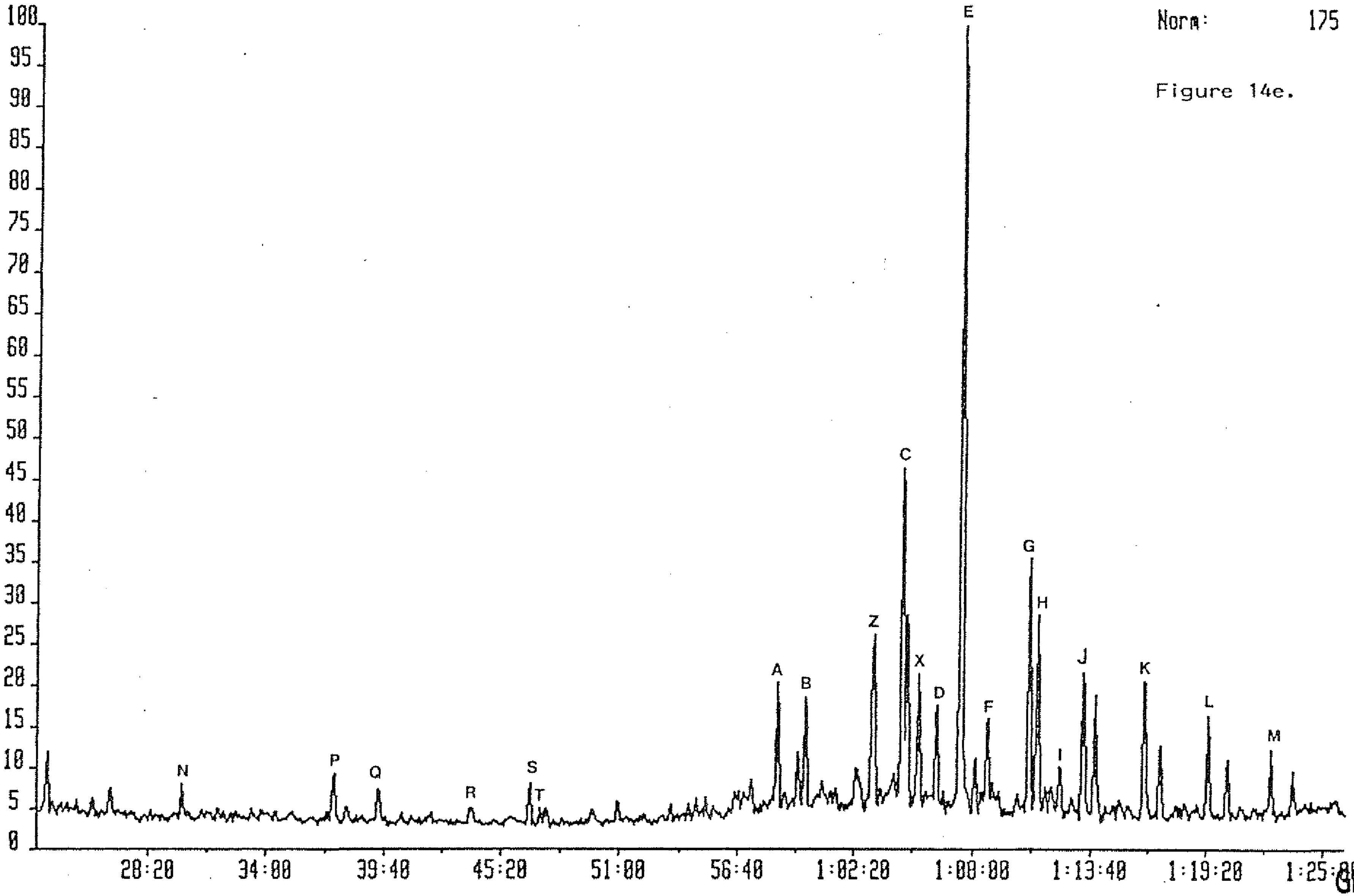



Figure 14e.

GEOLAB NOR

KEYSAT3 29-JUL-91 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 5 Injection 1 Group 1 Mass 191.1000
Text:WELL 31/4-7, 2265M, SATURATED FRACTION

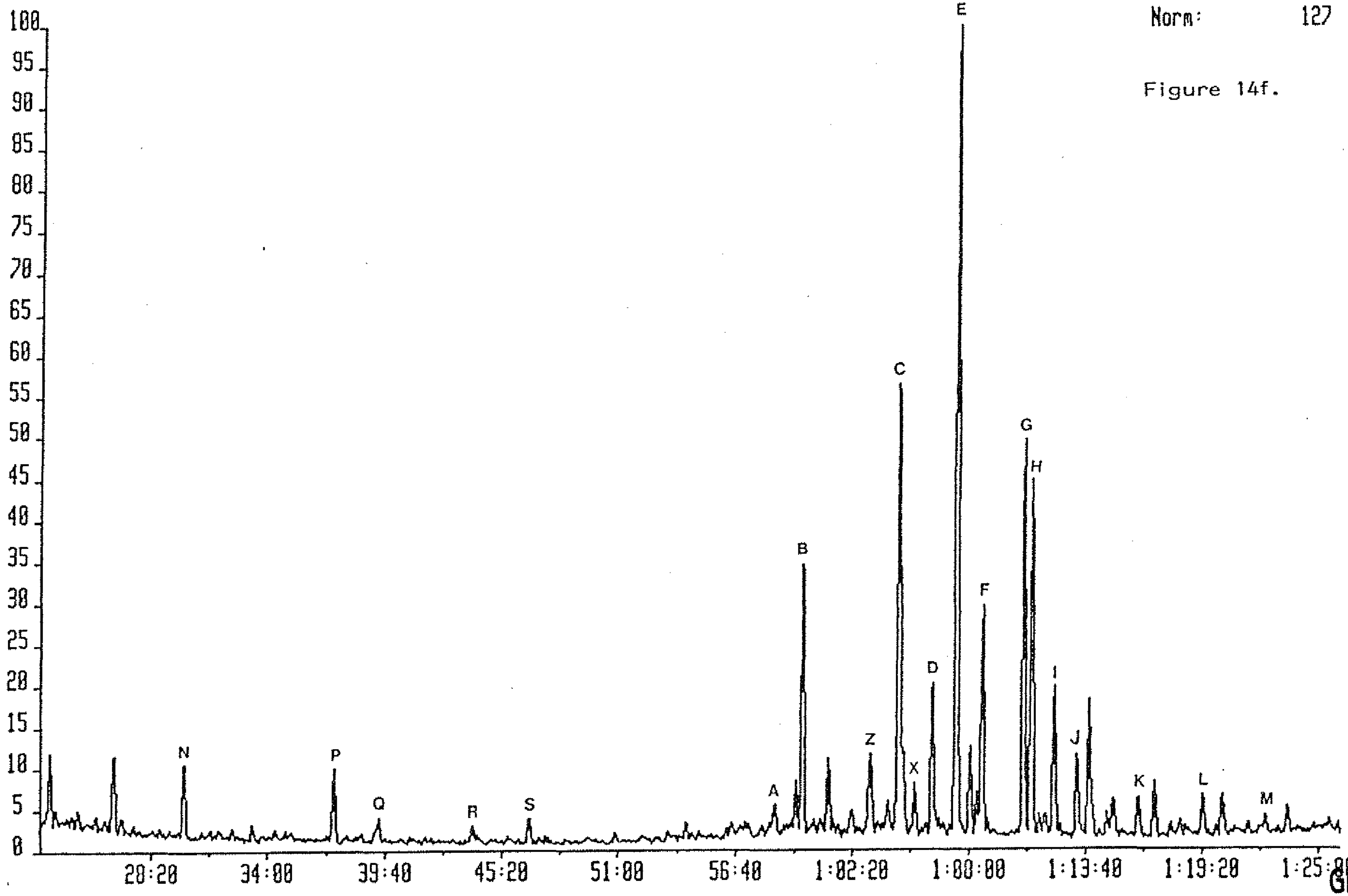



Figure 14f.

GEOLAB NOR

KEYSAT3 29-JUL-91 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 6 Injection 1 Group 1 Mass 191.1000
Text:WELL 31/4-7, 2309.9-97.9M, SATURATED FRACTION FROM OIL

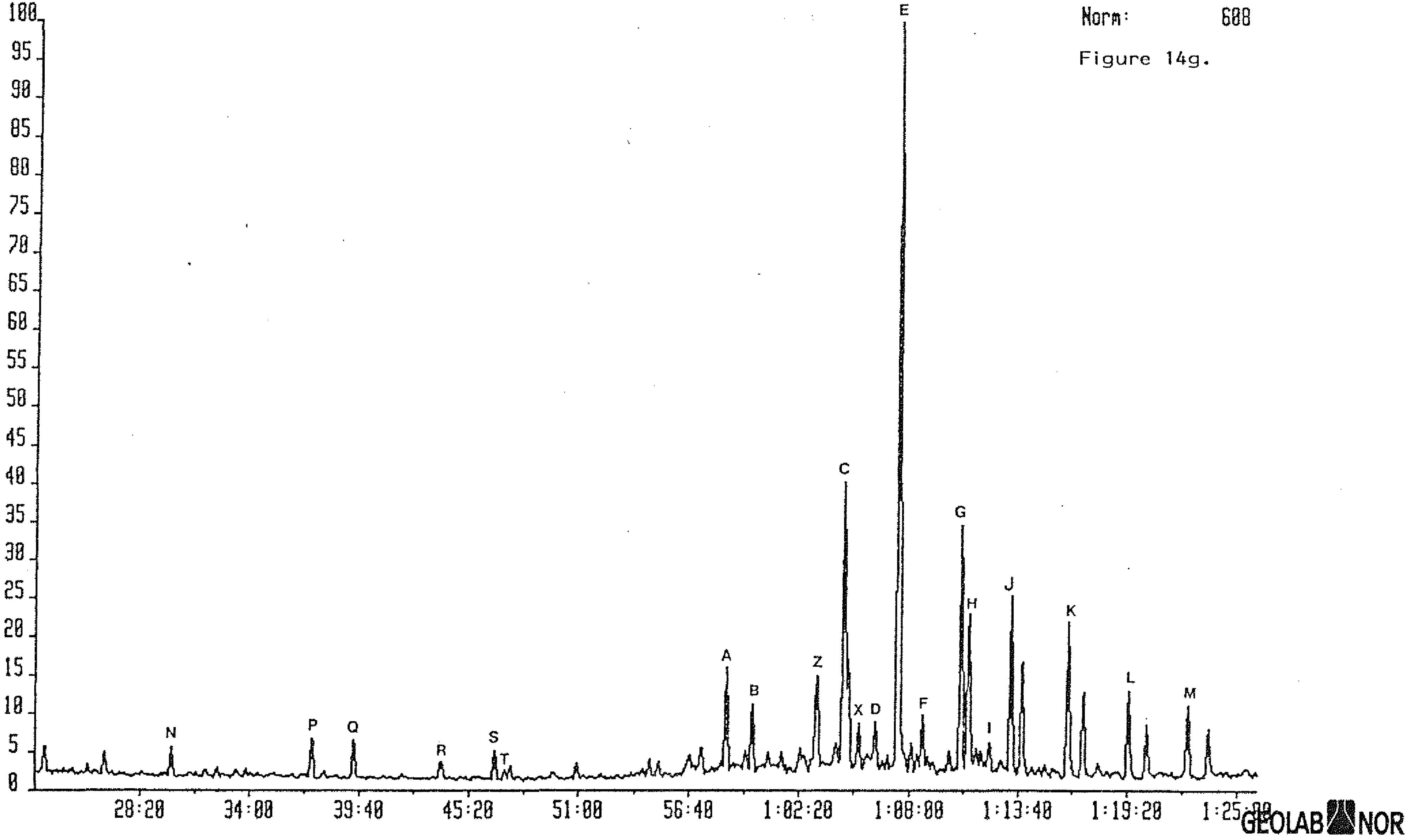



Figure 14g.

KEYSAT3 29-JUL-91 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 2 Injection 1 Group 1 Mass 217.1956
Text:WELL 31/4-7, 2045M, SATURATED FRACTION

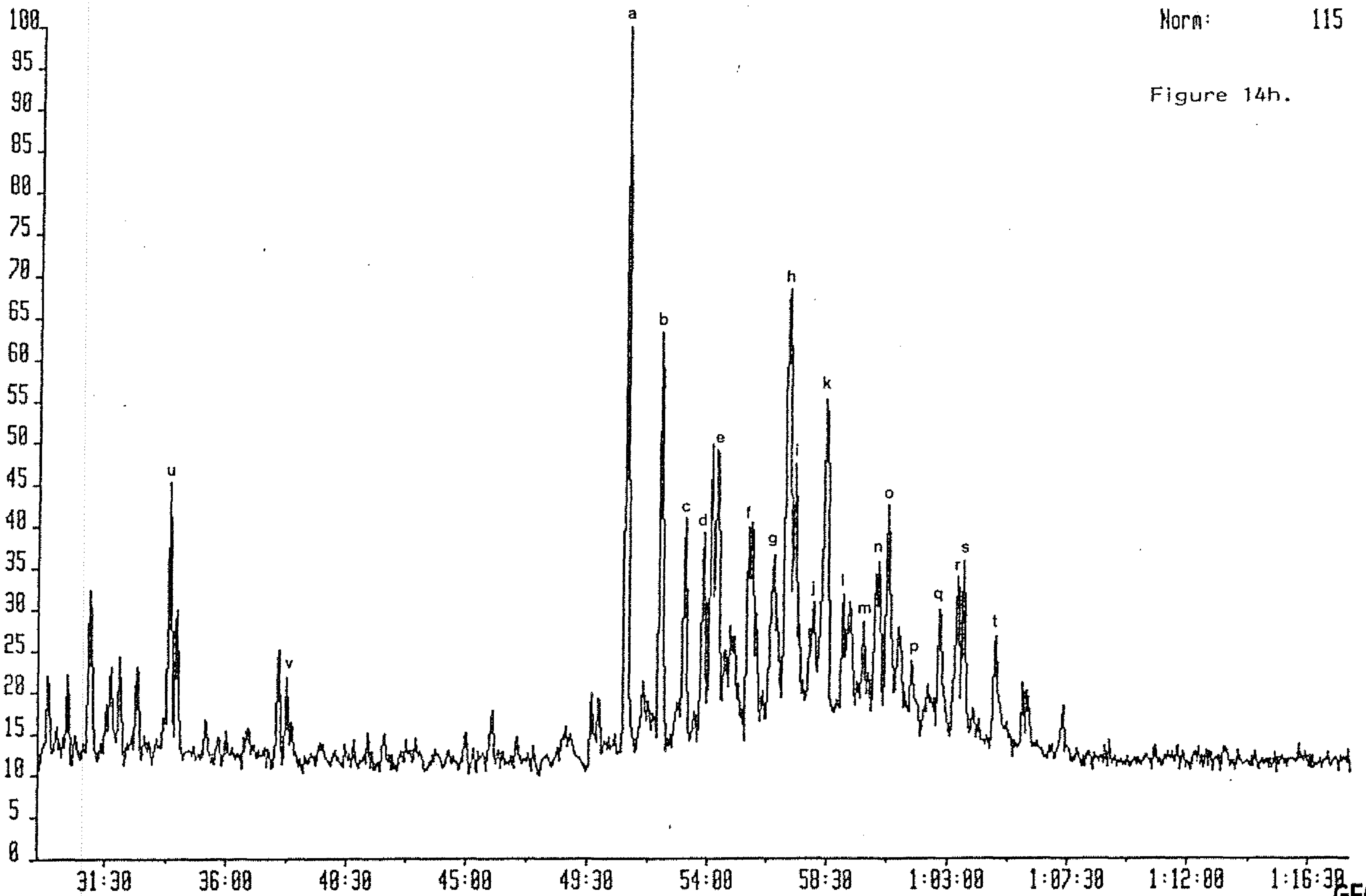



Figure 14h.

GEOLAB NOR

KEYSAT3 29-JUL-91 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 5 Injection 1 Group 1 Mass 217.1956
Text:WELL 31/4-7, 2265M, SATURATED FRACTION

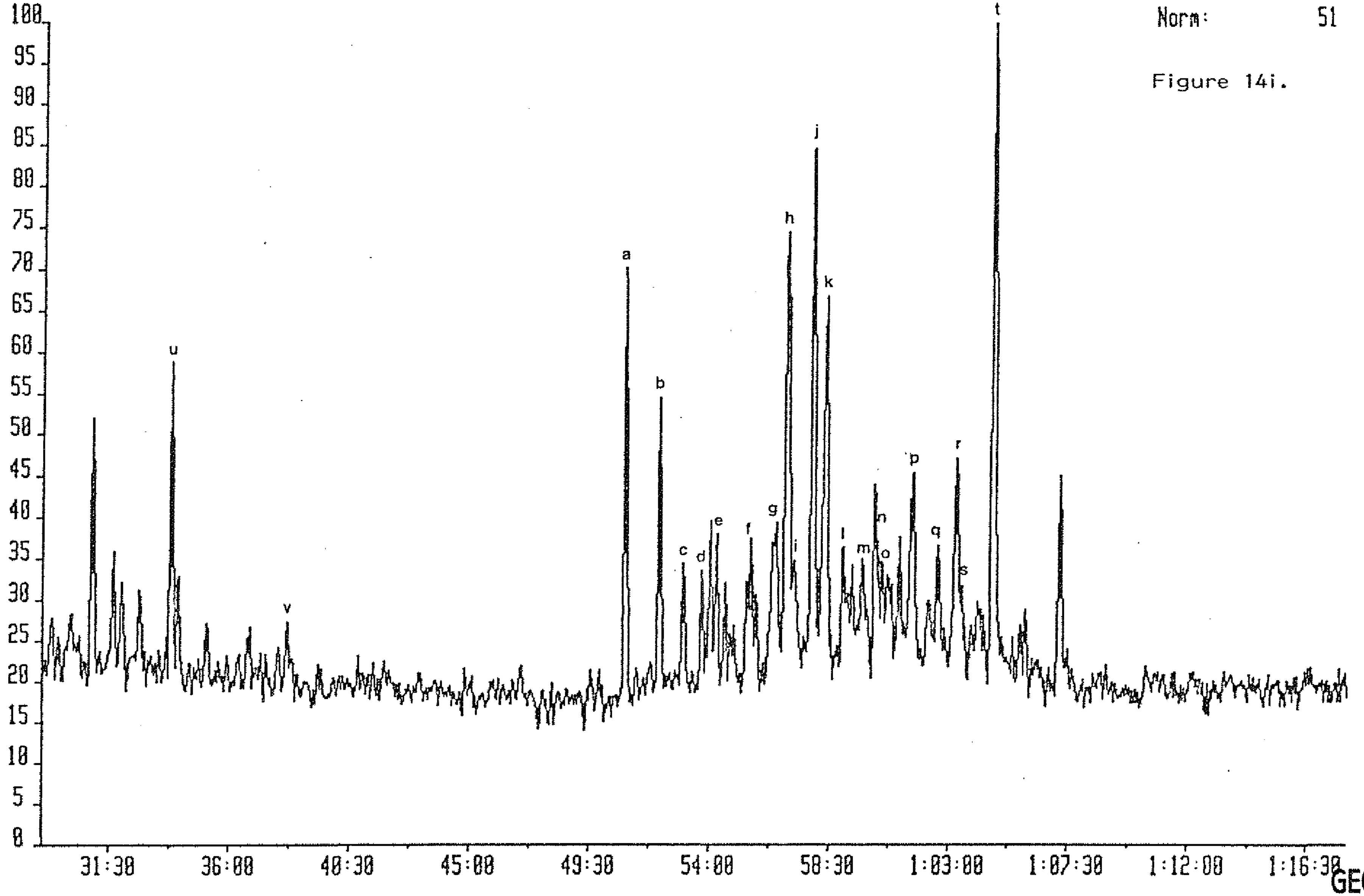



Figure 14i.

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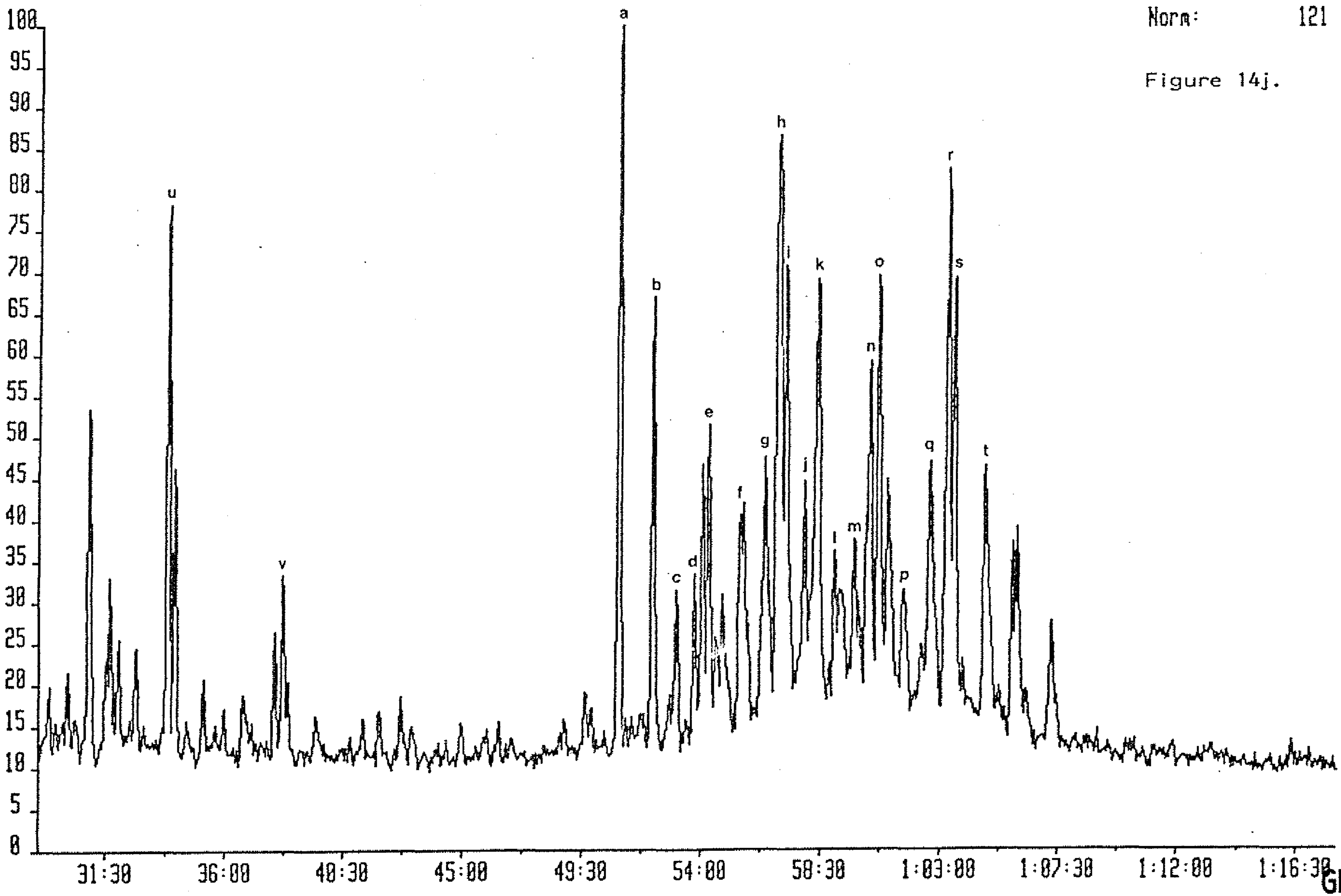
KEYSAT3 29-JUL-91 Sir:Magnetic TS250 Acnt:GEOLAB System:SAT1
Sample 6 Injection 1 Group 1 Mass 217.1956
Text:WELL 31/4-7, 2389.9-97.9M, SATURATED FRACTION FROM OIL

Norm: 121

Figure 14j.




GEOLAB NOR

INTERPRETATION LIMITS

ANALYSIS PROCEDURES

ABBREVIATIONS

*Interpretation Limits*

All analyses and interpretation in this report have been performed by Geolab Nor, unless specifically stated otherwise. The interpretation is based on the analytical results in this report, information supplied and quoted by the client, and general public knowledge of the area in which the well is located. The interpretation is right to the best of Geolab Nor's knowledge, but as Geolab Nor does not have access to either all geological nor geochemical information of the area of the well, Geolab Nor's interpretation must be used at the client's own risk.

The following interpretation limits have been used in this report. These limits have been established by Geolab Nor, on the basis of it's experience and in conjunction with other published data and must not be regarded as absolute.

**Maturity Interpretation (Simplified)**

| Vitrinite % Ro | Generation |
|---|---|
| 0.2-0.5 | Immature |
| 0.5-0.6 | Oil threshold |
| 0.6-1.0 | Oil window |
| 1.0-1.3 | Condensate window |
| 1.3-2.0 | Gas window |

**Maturity Interpretations**

| Vitrinite % Ro | Generation | Expulsion |
|---|---|---|
| < 0.5 | Immature | |
| 0.5 | Oil threshold, early mature | Early Condensate (sometimes) |
| 0.6 | Start main oil generation, top oil window | |
| 0.6-0.7 | | Start liquid expulsion from rich source rocks |
| 0.7 | Start peak oil generation, gas generation threshold from coal | |
| 0.7-0.8 | Peak oil generation | |
| 0.8 | End peak oil generation | |
| 0.9 | Late mature | |
| 1.0 | Base oil window | Start condensate expulsion from lean source rocks |
| 1.3 | Base condensate window, oil floor | Main gas expulsion phase |
| 1.5 | Peak gas generation from coal | |
| 2.0 | Wet gas floor | |

The term "condensate" is an engineering term. This engineering meaning of the word is not implied here. The term is used for historical reasons (in geochemistry) and is interpreted as:

Condensate window = Liquid preservation window, i.e. maturity range in which oil has started to crack to gas but where still some of the hydrocarbons are in the liquid hydrocarbon range (under surface conditions and temperatures).

## Source Rock Richness

| TOC% | Petroleum* Potential | EOM(ppm) | EOM/TOC# | HC(ppm) | HC/TOC# | Level |
|---|---|---|---|---|---|---|
| 0.0-0.3 | <2 | <500 | <50 | <100 | <10 | Poor |
| 0.3-1.0 | 2-6 | 500-1000 | 50-100 | 100-200 | 10-20 | Fair |
| 1.0-2.0 | 6-15 | 1000-2000 | 100-200 | 200-500 | 20-50 | Good |
| 2.0-5.0 | 15-25 | >2000 | >200 | >500 | >50 | Rich |
| >5.0 | >25 | >>2000 | >>200 | >>500 | >>50 | Very Rich |

<u>NOTE</u> * = mg HC/g rock
# = mg EOM or HC/g TOC

## Kerogen Typing based on Rock-Eval Pyrolysis of Whole Rock

| Ro < 0.5% | | Ro =0.8-1.0% | | Interpretation | |
|---|---|---|---|---|---|
| HI | OI | HI | OI | Kero. Type | HC Species |
| >700 | 10-40 | 200-250 | 1020 | I | Paraffinic Oil |
| 350-700 | 20-60 | 200-250 | 10-20 | II | Oil |
| 200-350 | 40-80 | 100-150 | 20-40 | II/III | Oil/Gas |
| 100-200 | 50-150 | 50-150 | 20-60 | III | Gas-condensate |
| 0-100 | 20-200 | <50 | 20-100 | IV | No potential |

## Kerogen Typing based on GHM Pyrolysis - Source Rocks

n-octene + m,p-xylene + phenol = 100 %

| Compound | Kerogen type | Interpretation |
|---|---|---|
| n-octene > 60 % | I-II + Asph* | Oil-prone + asphaltenes |
| n-octene > 20 % < 60 % | III | Gas-prone |
| n-octene < 20 % | IV | Inert |

* If asphaltene from oil or extract, not from coal
See also octene/xylene/phenol triangular plot

## Kerogen Typing based on GHM Pyrolysis - Source Rocks

| Range of hydrocarbons | Interpretation of pyrolysis products |
|---|---|
| C1 ~100 % | Dry gas only |
| C2-C5 ~100 % | Wet gas only |
| C1-C5 > 50 % | Predominantly gas |
| C6-C14 > 50 % | Light oil/condensate |
| C15+ ≈40-50 % | Predominantly oil |

**Hydrocarbon Typing based on GHM Pyrolysis - Oil Shows**

| Range of hydrocarbons | Interpretation of pyrolysis products |
|---|---|
| C15+ ~100 % | Heavy oil / residual oil |
| C15+ > 50 % | Some heavy oil / residual oil |

See also pyrolysate composition triangle.

## Source Rock Depositional Environment based on saturated HC GC - General Indicators

| Pristane/phytane | Source rock interpretation |
|---|---|
| <1 | Marine, hypersaline, saline lacustrine |
| 1 - 3 | Marine or lacustrine with variable land plant input |
| >3 | Predominant land plant input or none marine |

| CPI, pre peak oil generation | Source rock interpretation |
|---|---|
| <1 | Marine, saline lacustrine evaporites |
| 1 - 2 | Mixed marine/terrestrial source rock or freshwater/lacustrine |
| >2 | Mainly terrestrial source rock |

## Comparison of Aromatic Hydrocarbon Maturity Parameters

| Vitrinite % Ro | DMNR | 4/1 MDBT |
|---|---|---|
| 0.6 | | 2.0 |
| 0.7 | 1.0 | |
| 0.8 | | 10.0 |
| 1.3 | 2.0 | |

## Source Rock Depositional Environment and Maturities based on Stable carbon Isotope Data

Most of the interpretation of stable carbon isotope data is based on cross-plotting and a visual examination of the plotted data. The interpretation limits are shown in the enclosed figures.

## Comparison of GC-MS Parameters

Applicable only for marine type II kerogen with low terrestrial input. For definition of J1, J2, D, F, C, E, q, t, r and s see GC-MS definitions.

| Vitrinite % Ro | % J1/(J1+J2) | (D+F)/(C+E) | % q/(q+t) | (r+s)/(q+t+r+s) |
|---|---|---|---|---|
| 0.5 | 45 | 0.25 | 20 | 0.37 |
| 0.6 | 55 | 0.15 | | |
| 0.6-0.7 | | | 50 | |
| 0.7-0.9 | | | | 0.60 |

*Experimental Procedures*

## Headspace Gas Analysis

The analysis is performed using a PERKIN ELMER 8310 gas chromatograph with a 2 mm PORA PAK Q 80/100 packed column and a loop injector. The carrier gas used is nitrogen and the column is run isothermally at 150°C, with back-flush.

From each sample can, 2 ml of headspace gas is taken and injected into the gas chromatograph for analysis of the C1 to C7 range of hydrocarbons. Correlation and quantitation is achieved by use of external standards.

## Occluded Gas Analysis

The gas chromatograph used for this analysis is identical to that used for headspace gas analysis and is operated under the same conditions.

The canned samples are washed in temperated water to remove drilling contaminants and sieved on a 2 mm mesh sieve to remove large, caved rock fragments. Approximately 25 mg of sieved sample is then immersed in 25 ml of water and crushed in an airtight ball mill. After crushing, 2 ml of the emitted gas is taken from the ball mill and injected into the gas chromatograph.

## Total Organic Carbon (TOC) Analysis

This analysis is performed using a LECO CS244 Carbon Analyzer.
Hand-picked lithology(ies) from cuttings samples is(are) crushed using a pestle and mortar and approximately 200 mg (50 mg for coals) is accurately weighed into LECO crucibles.
The samples are then treated three times with 10% hydrochloric acid, to remove oxidized (carbonate) carbon, and washed four times with distilled water. The samples are dried on a hotplate at 100°C and then loaded into the instrument for analysis of total organic carbon. Total carbon is also analyzed using the same instrument but approximately 200 mg of whole rock is used instead. The oxidized (carbonate) carbon can be calculated by weight difference.
Total organic carbon can also be analyzed on the ROCK-EVAL II Pyrolyser during the normal run of the instrument.

## Rock-Eval Pyrolysis

This analysis is performed using a ROCK-EVAL II Pyrolyser into which approximately 100 mg of whole rock is loaded. Analysis involves heating the sample, from 300°C to 600°C, in an inert atmosphere (helium) to release the free hydrocarbons present (the S1 peak) and then pyrolysed (the S2 peak), both of which are detected by a FID. In the temperature interval between 300°C and 390°C, the released gases are split and a proportion passed through a carbon dioxide trap, which is connected to a thermal conductivity detector (TCD). The value obtained from the TCD corresponds to the amount of oxygen contained in the kerogen of the sample and is reported as the S3 peak.
The ROCK-EVAL II Pyrolyser also analyses the TOC of each sample subsequent to pyrolysis.

## Thermal Extraction/Pyrolysis Gas Chromatography

The instrument used for this analysis is a Varian 3200/3500 Gas Chromatograph interfaced to a pyrolysis oven (the pyrolyser). A very small amount (< 2 mg) of whole rock sample is loaded on the pyrolyser and heated isothermally, at 300°C, for 4 minutes, during which time thermal extraction of the free hydrocarbons occurs (equivalent to the S1 peak of Rock-Eval). The released gases pass to a 25 m OV1 column with a nitrogen-cooled trap.

After 4 minutes the pyrolysis oven heats up to 550°C, at a rate of 37°C per minute, causing bound hydrocarbons to be released from the kerogen (equivalent to the S2 peak of Rock-Eval). These gases are passed through a 25 m OV1 column with a nitrogen-cooled trap.

The temperature program of the oven, in which the columns are housed is 0°C to 290°C at a rate of 4°C/min. Both the columns are linked to a FID detector.

## Solvent Extraction of Organic Matter (EOM)

The samples are extracted using a Tecator Soxtec HT-System. Carefully weighed sample is taken in a pre-extracted thimble. Some activated copper is added to the extraction cup and dicholoromethane is used as an extraction solvent. The samples are boiled for 1 hour and rinsed for 2 hours. If the samples contain more than 10% TOC, then the whole procedure is repeated once. The resulting solution is filtered and the solvent removed by use of a rota-vaporator (200mb, 30°C). The amount of EOM is gravimetrically established.

## Removal of Asphaltenes

Asphaltenes are removed from the EOM by precipitation in n-pentane. The amount of n-hexane to be used is prescribed by the formula:

$$\frac{\text{weight of EOM(g)} \times 40}{\text{density of n-hexane (g/cc)} \times 1000} = \text{amount of n-hexane (ml)}$$

The resulting solution and the precipitate is then poured into a pre-weighed plastic column containing a small amount of activated silica. The solution+precipitate is allowed to run through the column. The separated precipitate is collected, dried and weighed. The amount of asphaltenes recovered is calculated by weight difference. The solvent from the resulting solution is evaporated using a rotary evaporator, at 35°C and the dried sample either processed immediately, or stored in a freezer.

## Chromatographic Separation of deasphaltened EOM

Chromatographic separation is performed using an MPLC system developed by the company. The EOM (minus asphaltenes) is injected into the MPLC and separated using hexane as an eluent. The saturated and aromatic hydrocarbon fractions are collected and the solvent removed using a rotary evaporator at 35°C. The fractions are then transferred to small pre-weighed vials and evaporated to dryness in a stream of nitrogen. The vials are re-weighed to obtain the weights of both the saturated and aromatic fractions. The weight of the NSO fraction which is retained on the column, is obtained by weight difference.

## Gas Chromatographic Analyses

Saturated hydrocarbon fractions:

The instrument used for this analysis is a PERKIN ELMER 8320 Gas Chromatograph equipped with an FID detector and an OV1 column. The carrier gas is helium and the temperature program runs isothermally at 80°C for 2 minutes and then rises to 300°C at a rate of 4°C/min. Final hold time is 20 minutes. The saturated hydrocarbon fraction is diluted by 1:30 and a 1 microlitre aliquot of this is injected into the instrument.

Aromatic hydrocarbon fractions:

The instrument used is a PERKIN ELMER SIGMA 2000 Gas Chromatograph with a

50 m SE-54 packed column, split injector and a column splitter leading to an FID and an FPD detector, which allows simultaneous analysis of co-eluting hydrocarbons and sulphur compounds. The carrier gas is helium and the temperature program runs from 80°C to 280°C at a rate of 4°C/min. Final hold time is 25 minutes. The aromatic hydrocarbon fraction is diluted by 1:30 and a 1 microlitre aliquot of this is injected into the instrument.

**Combined Gas Chromatography - Mass Spectrometry (GC-MS)**

The GC-MS analyses were performed on a VG TS250 system interfaced to a Hewlett Packard 5890 gas chromatograph. The GC was fitted with a fused silica SE54 capillary column (50 m x 0.22 mm i.d.) directly into the ion source. Helium (12 psi) was used as carrier gas and the injections were performed in splitless mode. The GC oven was programmed from 45°C to 150°C at 35°C/min, at which point the programme rate was 2°C/min up to 310°C where the column was held isothermally for 15 min. For the aromatic hydrocarbons, the GC oven was programmed from 50°C to 310°C at 5°C/min. and held isothermally at 310°C for 15 min. The mass spectrometer was operated in electron impact (EI) mode at 70 eV electron energy, a trap current of 500 uA and a source temperature of 220°C. The instrument resolution used was 1500 (10 % value).

The data system used was a VG PDP11/73 system. The samples were analysed in multiple ion detection mode (MID) at a scan cycle time of approximately 1.1 sec. Calculation of peak ratios was done from peak heights in the appropriate mass fragmentograms.

<u>Saturated Fractions</u>

**Terpanes**
The most commonly used fragment ions for detection of terpanes are M/Z 163 for detection of 25,28,30 trisnormoretane or 25,28,30 trisnorhopane, M/Z 177 for detection of demethylated hopanes or moretanes, M/Z 191 for detection of tricyclic, tetracyclic- and pentacyclic terpanes and M/Z 205 for methylated hopanes or moretanes. The molecular ions M/Z 370 and 384 are also recorded for identification of $C_{27}$ and $C_{28}$ triterpanes respectively.

**Steranes**
The most commonly used fragment ions for detection of steranes are M/Z 149 to distinguish between 5α and 5β steranes, M/Z 189 and 259 for detection of rearranged steranes, M/Z 217 for detection of rearranged and normal steranes and M/Z 218 for detection of 14α(H) 17β(H) steranes.

The M/Z 231 fragment ion is used to detect possible aromatic contamination of the saturated fraction. It is also used for detection of methyl steranes.

Aromatic Fractions

### Alkyl-substituted Benzenes
The M/Z 106 fragment ion is often used to detect the alkyl-substituted benzenes. It is especially useful for the detection of di-substituted benzenes. M/Z 134 can also be used for the detection of $C_4$-alkylbenzenes, but benzothiophene will also give a signal with this fragment ion.

### Naphthalenes
Methyl naphthalenes are normally detected by the M/Z 142 fragment ion, while $C_2$-naphthalenes are detected by M/Z 156 and $C_3$-naphthalenes by M/Z 170.

### Benzothiophenes and Dibenzothiophenes
Benzothiophene can be detected, as mentioned above, by M/Z 134. The M/Z 198 and M/Z 212 fragment ions are used for methyl-substituted dibenzothiophenes and dimethyl-substituted dibenzo-thiophenes respectively.

### Phenanthrenes
Phenanthrene is detected using the M/Z 178 fragment ion. Anthracene will, if present, also give a signal in the M/Z 178 fragment ion. Methyl-substituted phenanthrenes give signals in the M/Z 192 fragment ion, while the M/Z 206 fragment ion shows the dimethyl-substituted phenanthrenes and the M/Z 220 fragment ion shows the $C_3$ substituted phenanthrenes.

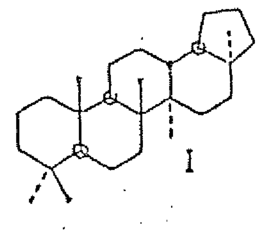
### Aromatic Steranes
Monoaromatic steranes are detected using the M/Z 253 fragment ion, while the triaromatic steranes are detected using the M/Z 231 fragment ion.

## Mass Fragmentograms representing Terpanes
## (M/Z 163, 177, 191, 205, 370, 384, 398, 412 and 426)

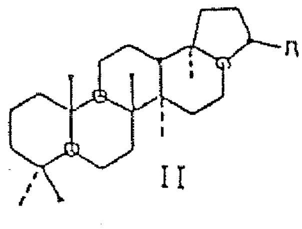
Peak Identification: (α and β refer to hydrogen atoms at C-17 and C-21 respectively unless indicated otherwise)

| | | | |
|---|---|---|---|
| A. | 18α trisnorneohopane (Ts) | $C_{27}H_{44}$ | ( I) |
| B. | 17α trisnorhopane (Tm) | $C_{27}H_{46}$ | ( II, R=H) |
| Z. | Bisnorhopane | $C_{28}H_{48}$ | ( IV) |
| C. | αβ norhopane | $C_{29}H_{50}$ | ( II, R=$C_2H_5$) |
| D. | βα norhopane | $C_{29}H_{50}$ | ( III, R=$C_2H_5$) |
| E. | αβ hopane | $C_{30}H_{52}$ | ( II, R=i-$C_3H_7$) |
| F. | αβ hopane | $C_{30}H_{50}$ | ( III, R=i-$C_3H_7$) |
| G. | 22S αβ homohopane | $C_{31}H_{54}$ | ( II, R=i-$C_4H_9$) |
| H. | 22R αβ homohopane | $C_{31}H_{54}$ | ( II, R=i-$C_4H_9$) |
| I. | βα homomoretane | $C_{31}H_{54}$ | ( III, R=i-$C_4H_9$) |
| J. | 22S αβ bishomohopane | $C_{32}H_{56}$ | ( II, R=i-$C_5H_{11}$) |
| | 22R αβ bishomohopane | $C_{32}H_{56}$ | ( II, R=i-$C_5H_{11}$) |
| K. | 22S αβ trishomohopane | $C_{33}H_{58}$ | ( II, R=i-$C_6H_{13}$) |
| | 22R αβ trishomohopane | $C_{33}H_{58}$ | ( II, R=i-$C_6H_{13}$) |
| L. | 22S αα tetrakishomohopane | $C_{34}H_{60}$ | ( II, R=i-$C_7H_{15}$) |
| | 22E αβ tetrakishomohopane | $C_{34}H_{60}$ | ( II, R=i-$C_7H_{15}$) |
| M. | 22S αβ pentakishomohopane | $C_{35}H_{62}$ | ( II, E=i-$C_8H_{17}$) |
| | 22E αβ pentakishomohopane | $C_{35}H_{62}$ | ( II, R=i-$C_8H_{17}$) |
| P. | Tricyclic terpane | $C_{23}H_{42}$ | ( V, R=i-$C_4H_9$) |
| Q. | Tricyclic terpane | $C_{24}H_{44}$ | ( V, R=i-$C_5H_{11}$) |
| R. | Tricyclic terpane (17R, 17S) | $C_{25}H_{66}$ | ( V, R=i-$C_6H_{13}$) |
| S. | Tetracyclic terpane | $C_{24}H_{42}$ | ( VI) |
| T. | Tricyclic terpane (17R, 17S) | $C_{26}H_{48}$ | ( V, R=i-$C_7H_{15}$) |
| N. | Tricyclic terpane | $C_{21}H_{38}$ | ( V, R=$C_2H_5$) |
| O. | Tricyclic terpane | $C_{22}H_{40}$ | ( V, R=$C_3H_7$) |
| Y. | 25,28,30-trisnorhopane/moretane | $C_{27}H_{46}$ | ( VII) |
| X. | Unknown triterpane | $C_{30}H_{52}$ | |

STRUCTURES REPRESENTING TERPANES



I



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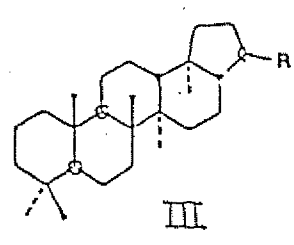

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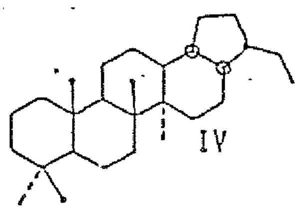

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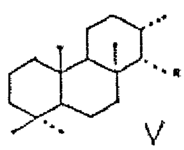
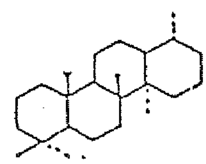
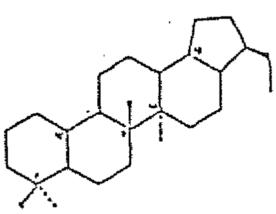


V



VI



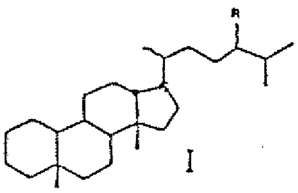
VII

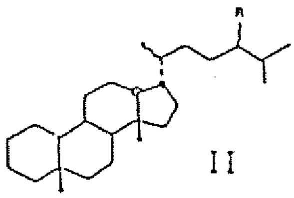
## Mass Fragmentograms representing Steranes
## (M/Z 149, 189, 217, 218, 259, 372, 386, 400 and 414)

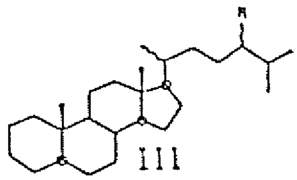
Peak Identifications: α and β refer to hydrogen atoms at C-5, C-14 and C-17 in regular steranes and at C-13 and C-17 in diasteranes).

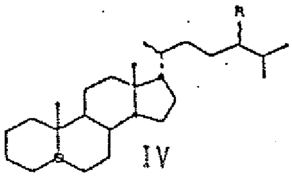
| | | | |
|---|---|---|---|
| a. | 20S βα diacholestane | $C_{27}H_{48}$ | ( I, R=H) |
| b. | 20R βα diacholestane | $C_{27}H_{48}$ | ( I, R=H) |
| c. | 20S αβ diacholestane | $C_{27}H_{48}$ | ( II, R=H) |
| d. | 20R αβ diacholestane | $C_{27}H_{48}$ | ( II, R=H) |
| e. | 20S βα 24-methyl-diacholestane | $C_{28}H_{50}$ | ( I, $R=CH_3$) |
| f. | 20R βα 24-methyl-diacholestane | $C_{28}H_{50}$ | ( I, $R=CH_3$) |
| g. | 20S αβ 24-methyl-diacholestane | $C_{28}H_{50}$ | ( II, $R=CH_3$) |
| | + 20S ααα cholestane | $C_{27}H_{48}$ | (III, R=H) |
| h. | 20S βα 24-ethyl-diacholestane | $C_{29}H_{52}$ | ( II, $R=C_2H_5$) |
| | + 20R αββ cholestane | $C_{27}H_{48}$ | ( IV, R=H) |
| i. | 20S αββ cholestane | $C_{27}H_{48}$ | ( IV, R=H) |
| | + 20R αβ 24-methyl-diacholestane | $C_{28}H_{50}$ | ( II, $R=CH_3$) |
| j. | 20R ααα cholestane | $C_{27}H_{48}$ | (III, R=H) |
| k. | 20R βα 24-ethyl-diacholestane | $C_{29}H_{52}$ | ( I, $R=C_2H_5$) |
| l. | 20R αβ 24-ethyl-diacholestane | $C_{29}H_{52}$ | ( II, $R=C_2H_5$) |
| m. | 20S ααα 24-methyl-cholestane | $C_{28}H_{50}$ | (III, $R=CH_3$) |
| n. | 20R αββ 24-methyl-cholestane | $C_{28}H_{50}$ | ( IV, $R=CH_3$) |
| | + 20R αβ 24-ethyl-diacholestane | $C_{29}H_{52}$ | ( II, $R=C_2H_5$) |
| o. | 20S αββ 24-methyl-cholestane | $C_{28}H_{50}$ | ( IV, $R=CH_3$) |
| p. | 20R ααα 24-methyl-cholestane | $C_{28}H_{50}$ | (III, $R=CH_3$) |
| q. | 20S ααα 24-ethyl-cholestane | $C_{29}H_{52}$ | (III, $R=C_2H_5$) |
| r. | 20R αββ 24-ethyl-cholestane | $C_{29}H_{52}$ | ( IV, $R=C_2H_5$) |
| s. | 20S αββ 24-ethyl-cholestane | $C_{29}H_{52}$ | ( IV, $R=C_2H_5$) |
| t. | 20R ααα 24-ethyl-cholestane | $C_{29}H_{52}$ | (III, $R=C_2H_5$) |
| u. | 5α sterane | $C_{21}H_{36}$ | ( VI, $R=C_2H_5$) |
| v. | 5α sterane | $C_{22}H_{38}$ | ( VI, $R=C_3H_7$) |

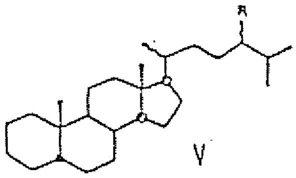
STRUCTURES REPRESENTING STERANES

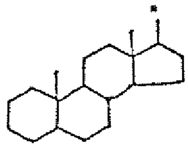

I


II


III


IV


V

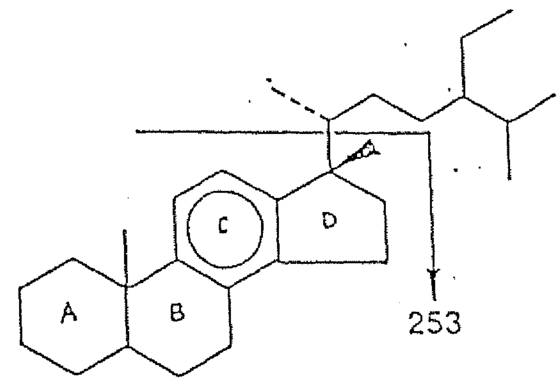

VI

## Mass Fragmentograms representing Monoaromatic Steranes (M/Z 253)

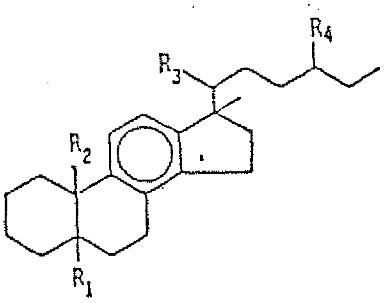
Description of C-ring monoaromatic steroid hydrocarbons

| Peak | $R_1$ | Substituents $R_2$ | $R_3$ | $R_4$ | Abbreviation of Compound |
|---|---|---|---|---|---|
| A1 | | | | | $C_{21}M$ |
| B1 | | | | | $C_{22}MA$ |
| C1 | β(H) | $CH_3$ | $S(CH_3)$ | H | $\beta SC_{27}MA$ |
| | β(H) | $CH_3$ | $R(CH_3)$ | H | $\beta RC_{27}MA$ |
| D1 | $CH_3$ | H | $R(CH_3)$ | H | $RC_{27}DMA$ |
| | α(H) | $CH_3$ | $S(CH_3)$ | H | $\alpha SC_{27}MA$ |
| E1 | β(H) | $CH_3$ | $S(CH_3)$ | $CH_3$ | $\beta SC_{28}MA$ |
| | $CH_3$ | H | $S(CH_3)$ | $CH_3$ | $SC_{28}DMA$ |
| F1 | α(H) | $CH_3$ | $R(CH_3)$ | H | $\alpha RC_{27}MA$ |
| | α(H) | $CH_3$ | $S(CH_3)$ | $CH_3$ | $\alpha SC_{28}MA$ |
| | β(H) | $CH_3$ | $R(CH_3)$ | $CH_3$ | $\beta RC_{28}MA$ |
| G1 | $CH_3$ | H | $R(CH_3)$ | $CH_3$ | $RC_{28}DMA$ |
| | β(H) | $CH_3$ | $S(CH_3)$ | $C_2H_5$ | $\beta SC_{29}MA$ |
| | $CH_3$ | H | $S(CH_3)$ | $C_2H_5$ | $SC_{29}DMA$ |
| | α(H) | $CH_3$ | $R(CH_3)$ | $CH_3$ | $\alpha RC_{28}MA$ |
| H1 | β(H) | $CH_3$ | $R(CH_3)$ | $C_2H_5$ | $\beta RC_{29}MA$ |
| | $CH_3$ | H | $R(CH_3)$ | $C_2H_5$ | $RC_{29}DMA$ |
| I1 | α(H) | $CH_3$ | $R(CH_3)$ | $C_2H_5$ | $\alpha RC_{29}MA$ |

STRUCTURES REPRESENTING MONOAROMATIC STERANES:




I

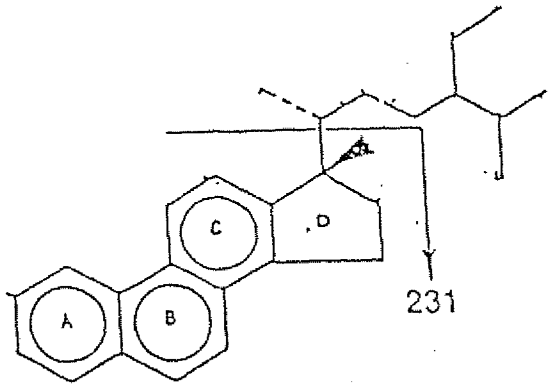


## Mass Fragmentograms representing Triaromatic Steranes (M/Z 231)

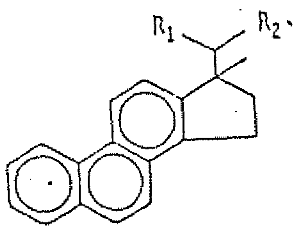
Description of ABC-ring triaromatic steroid hydrocarbons

| | Substituents | | Abbreviation |
|---|---|---|---|
| Peak | $R_1$ | $R_2$ | of Compound |
| a1 | $CH_3$ | H | $C_{20}TA$ |
| b1 | $CH_3$ | $CH_3$ | $C_{21}TA$ |
| c1 | $S(CH_3)$ | $C_6H_{1\text{-}3}$ | $SC_{26}TA$ |
| d1 | $R(CH_3)$ | $C_6H_{13}$ | $RC_{26}TA$ |
| | $S(CH_3)$ | $C_7H_{15}$ | $SC_{27}TA$ |
| e1 | $S(CH_3)$ | $C_8H_{17}$ | $SC_{28}TA$ |
| f1 | $S(CH_3)$ | $C_7H_{15}$ | $RC_{27}TA$ |
| g1 | $R(CH_3)$ | $C_8H_{17}$ | $RC_{28}TA$ |

STRUCTURES REPRESENTING TRIAROMATIC STERANES




II



## Isotope Ratio Mass Spectrometry

The isotope analysis were performed on a dual inlet VG SIRA 10 instrument. The combustion of the samples were done by a Carlo Erba EA 1108 element analyser directly connected to the inlet system of the mass spectrometer.

The combustion temperature was 1020oC and the carrier gas used was Helium. After the combustion $H_2O$ and $CO_2$ were trapped in different cool traps. The $CO_2$ gas was then heated up before it was admitted to the mass spectrometer. The whole operation was controlled by an IBM PC50 computer system.

## δ-values

The isotope ratios are given as δ-values in ‰ versus the PDB-standard:

$$\delta^{13}C \quad = (R\ \text{sample} - R\ \text{standard}/R\ \text{standard}) \times 1000$$
$$R = {}^{13}C/{}^{12}C$$

The PDB-standard (a marine chalk of the Pee Dee-formation, USA) was created by Craig 1957. All results of $^{13}C/^{12}C$-analysis of organic matter today are calculated (Craig correction) against this international standard.

## Reproducibility

The precision of the combustion system and the mass spectrometer is controlled by determination of an international calibrated standard, NBS22 oil and a house standard carbon. Double analysis on samples are also done.

## List of abbreviations used for lithology description

(sorted alphabetically)

| | | |
|---|---|---|
| ang | = | angular |
| bar | = | Baryte (mud additive) |
| bl | = | blue/blueish |
| blk | = | black |
| br | = | brittle |
| brn | = | brown/brownish |
| Ca | = | Carbonate (limestone/chalk/dolomite/siderite) |
| calc | = | calcareous |
| carb | = | carbonaceous |
| cem | = | cement used as additive (under "cont") or to describe cemented S/Sst |
| Chert | = | Chert |
| chk | = | Chalk/chalky |
| cly | = | clayey/shaley |
| cngl | = | conglomeratic |
| Coal | = | Coal |
| Coal-ad | = | Coal-like additive (e.g. chromlignosulfonate) |
| Congl | = | Conglomerate |
| Cont | = | Contaminant(s) |
| crs | = | coarse grained |
| dd | = | dried drilling mud |
| dol | = | Dolomite/dolomitic |
| drk | = | dark (colour) |
| dsk | = | dusk/dusky (colour) |
| evap | = | Salt/Gypsum/Halite (natural "Other" or as additive "Cont" |
| f | = | fine grained |
| fib | = | fibres (mud additive/contamination) |
| fis | = | fissile |
| fos | = | fossiliferous |
| glauc | = | glauconite/glauconitic |
| gn | = | green/greenish |
| gy | = | grey/greyish |
| hd | = | hard |
| ign | = | Igneous (material derived from igneous source) |
| Kaolin | = | Kaolin(ite) |
| kln | = | kaolinitic |
| l | = | loose |
| lam | = | laminated/laminae |
| lt | = | light (colour) |
| m | = | medium (colour or grain size) |
| Marl | = | Marl (calcareous claystone/mudstone) |
| mic | = | micaceous |
| Mica-ad | = | Mica used as mud additive |
| mrl | = | marly |

| | | |
|---|---|---|
| No Mat. | = | No material left over after washing |
| ns | = | nutshells (mud additive) |
| ol | = | olive |
| ool | = | Oolite/oolitic |
| or | = | orange |
| Other | = | Other lithology/mineral, specified after this word |
| pi | = | pink/pinkish |
| pl | = | pale (colour) |
| prp | = | paint/rust/plastic contaminations/additives |
| pu | = | purple |
| pyr | = | Pyrite/pyritic |
| red | = | red/reddish |
| rnd | = | round/rounded |
| s | = | sandy |
| S/Sst | = | Sand and/or sandstone |
| Sh/Clst | = | Shale and/or claystone |
| sid | = | Siderite/sideritic |
| sil | = | siliceous/cherty |
| slt | = | silty |
| Sltst | = | siltstone |
| st | = | stained (with natural oil or oil-like additive) |
| tar-ad | = | Tar-like additive (e.g. "Black Magic") |
| Tuff | = | Tuff |
| tuff | = | tuffaceous |
| v col | = | various colours |
| w | = | white |
| wx | = | waxy |
| y | = | yellow/yellowish |

# Appendix 1

## Tables

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type / TOC% | % | Grp / Lithology description | Frm | Age | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 1000.00 | | | | Hrdl | | Oligocene-Eocene | | 0023 |
| | | | 100 | Sh/Clst: pl y brn, calc, slt | | | | 0023-1L |
| | | | tr | S/Sst : lt gy, crs, l | | | | 0023-2L |
| | | | tr | Ca : lt or | | | | 0023-3L |
| 1020.00 | | | | Hrdl | | Oligocene-Eocene | | 0024 |
| | | | 100 | Sh/Clst: lt y brn to pl y brn, calc, slt | | | | 0024-1L |
| | | | tr | Cont : prp | | | | 0024-2L |
| 1040.00 | | | | Hrdl | | Oligocene-Eocene | | 0025 |
| | | | 100 | Sh/Clst: lt y brn to pl y brn, calc, slt | | | | 0025-1L |
| | | | tr | Cont : prp | | | | 0025-2L |
| 1060.00 | | | | Hrdl | | Oligocene-Eocene | | 0035 |
| | | | 100 | Sh/Clst: lt y brn to pl y brn, slt, calc | | | | 0035-1L |
| 1080.00 | | | | Hrdl | | Oligocene-Eocene | | 0036 |
| | | | 100 | Sh/Clst: lt y brn to pl y brn, slt, calc | | | | 0036-1L |
| 1100.00 | | | | Hrdl | | Oligocene-Eocene | | 0037 |
| | | | 100 | Sh/Clst: lt y brn to pl y brn, slt | | | | 0037-1L |
| | | | tr | S/Sst : w to lt gy, crs, l | | | | 0037-2L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth | Type | | Grp | Frm | Age | Trb | Sample |
|---|---|---|---|---|---|---|---|
| Int Cvd | TOC% | % | Lithology description | | | | |
| 1120.00 | | | Hrdl | | Oligocene-Eocene | | 0038 |
| | | 95 | Sh/Clst: lt y brn to pl y brn, slt | | | | 0038-1L |
| | | 5 | S/Sst : w to lt gy, crs, l | | | | 0038-2L |
| 1140.00 | | | Hrdl | | Oligocene-Eocene | | 0039 |
| | | 85 | S/Sst : w to lt gy, crs, l | | | | 0039-2L |
| | | 15 | Sh/Clst: lt y brn to pl y brn, slt | | | | 0039-1L |
| | | tr | Cont : prp | | | | 0039-3L |
| 1160.00 | | | Hrdl | | Oligocene-Eocene | | 0040 |
| | | 100 | Sh/Clst: lt y brn, slt, calc | | | | 0040-1L |
| | | tr | S/Sst : w to lt gy, crs, l | | | | 0040-2L |
| 1180.00 | | | Hrdl | | Oligocene-Eocene | | 0041 |
| | | 100 | Sh/Clst: lt y brn, calc | | | | 0041-1L |
| | | tr | S/Sst : w to lt gy, crs, l | | | | 0041-2L |
| 1200.00 | | | Hrdl | | Oligocene-Eocene | | 0042 |
| | | 75 | S/Sst : w to lt gy, crs, l | | | | 0042-2L |
| | | 25 | Sh/Clst: lt y brn to pl y brn to lt brn gy | | | | 0042-1L |
| | | tr | Cont : prp | | | | 0042-3L |
| 1220.00 | | | Hrdl | | Oligocene-Eocene | | 0043 |
| | | 50 | Sh/Clst: lt y brn to pl y brn to lt brn gy | | | | 0043-1L |
| | | 50 | S/Sst : w to lt gy, crs, l | | | | 0043-2L |
| | | tr | Ca : lt or | | | | 0043-3L |
| | | tr | Cont : prp | | | | 0043-4L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Cvd | Type TOC% | % | Grp / Lithology description | Frm | Age | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 1240.00 | | | | Hrdl | | Oligocene-Eocene | | 0044 |
| | | | 100 | Sh/Clst: pl y brn to lt brn gy | | | | 0044-1L |
| | | | tr | S/Sst : w to lt gy, crs, l | | | | 0044-2L |
| 1260.00 | | | | Hrdl | | Oligocene-Eocene | | 0026 |
| | | | 100 | Sh/Clst: lt y brn to pl y brn | | | | 0026-1L |
| 1280.00 | | | | Hrdl | | Oligocene-Eocene | | 0027 |
| | | | 100 | Sh/Clst: pl y brn to lt brn gy | | | | 0027-1L |
| 1300.00 | | | | Hrdl | | Oligocene-Eocene | | 0028 |
| | | | 100 | Sh/Clst: pl y brn to lt brn gy | | | | 0028-1L |
| 1320.00 | | | | Hrdl | | Oligocene-Eocene | | 0029 |
| | | | 100 | Sh/Clst: pl y brn to lt brn gy | | | | 0029-1L |
| 1340.00 | | | | Hrdl | | Oligocene-Eocene | | 0030 |
| | | | 100 | Sh/Clst: pl y brn to lt brn gy | | | | 0030-1L |
| 1360.00 | | | | Hrdl | | Oligocene-Eocene | | 0031 |
| | | | 100 | Sh/Clst: lt brn gy to pl y brn | | | | 0031-1L |
| | | | tr | Ca : lt or | | | | 0031-2L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp / Frm / Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|
| 1380.00 | | | | Hrdl Oligocene-Eocene | | 0032 |
| | | | 100 | Sh/Clst: lt brn gy to pl y brn | | 0032-1L |
| | | | tr | Ca : lt or, fos | | 0032-2L |
| | | | tr | S/Sst : lt gy, f, l | | 0032-3L |
| 1400.00 | | | | Hrdl Oligocene-Eocene | | 0033 |
| | | | 100 | Sh/Clst: lt brn gy to pl y brn | | 0033-1L |
| 1420.00 | | | | Hrdl Oligocene-Eocene | | 0045 |
| | | | 100 | Sh/Clst: pl y brn to lt brn gy | | 0045-1L |
| 1440.00 | | | | Hrdl Oligocene-Eocene | | 0046 |
| | | | 100 | Sh/Clst: pl y brn to lt brn gy | | 0046-1L |
| 1460.00 | | | | Hrdl Oligocene-Eocene | | 0047 |
| | | | 100 | Sh/Clst: lt brn gy | | 0047-1L |
| 1480.00 | | | | Hrdl Oligocene-Eocene | | 0034 |
| | | | 100 | Sh/Clst: lt brn gy to pl y brn | | 0034-1L |
| 1500.00 | | | | Hrdl Oligocene-Eocene | | 0048 |
| | | | 50 | Sh/Clst: lt brn gy | | 0048-1L |
| | | | 50 | Sh/Clst: pl ol | | 0048-2L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp | Frm | Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 1520.00 | | | | Hrdl | | Oligocene-Eocene | | 0049 |
| | | | 100 | Sh/Clst: | | y gy to lt ol gy | | 0049-1L |
| | | | tr | Ca : | | lt or to or gy | | 0049-2L |
| 1540.00 | | | | Hrdl | | Oligocene-Eocene | | 0050 |
| | | | 100 | Sh/Clst: | | y gy to lt ol gy to lt brn gy | | 0050-1L |
| 1560.00 | | | | Hrdl | | Oligocene-Eocene | | 0051 |
| | | | 100 | Sh/Clst: | | pl ol to lt ol gy to lt brn gy | | 0051-1L |
| 1580.00 | | | | Hrdl | | Oligocene-Eocene | | 0052 |
| | | | 100 | Sh/Clst: | | pl ol to lt ol gy to lt brn gy | | 0052-1L |
| 1600.00 | | | | Hrdl | | Oligocene-Eocene | | 0053 |
| | | | 100 | Sh/Clst: | | pl ol to lt ol gy | | 0053-1L |
| 1620.00 | | | | Hrdl | | Oligocene-Eocene | | 0054 |
| | | | 100 | Sh/Clst: | | pl ol to lt ol gy | | 0054-1L |
| 1640.00 | | | | Hrdl | | Oligocene-Eocene | | 0055 |
| | | | 100 | Sh/Clst: | | pl ol to lt ol gy | | 0055-1L |
| 1660.00 | | | | Hrdl | | Oligocene-Eocene | | 0056 |
| | | | 100 | Sh/Clst: | | pl ol to lt ol gy | | 0056-1L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp | Frm | Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 1680.00 | | | | Hrdl | | Oligocene-Eocene | | 0057 |
| | | | 100 | Sh/Clst: | | y gy to lt gy to lt brn gy | | 0057-1L |
| 1700.00 | | | | Hrdl | | Oligocene-Eocene | | 0058 |
| | | | 100 | Sh/Clst: | | y gy to lt gy to lt brn gy | | 0058-1L |
| 1720.00 | | | | Hrdl | | Oligocene-Eocene | | 0059 |
| | | | 100 | Sh/Clst: | | y gy to lt gy to lt brn gy | | 0059-1L |
| 1740.00 | | | | Hrdl | | Oligocene-Eocene | | 0060 |
| | | | 100 | Sh/Clst: | | y gy to lt gy to lt brn gy | | 0060-1L |
| 1760.00 | | | | Hrdl | | Oligocene-Eocene | | 0061 |
| | | | 75 | Sh/Clst: | | m brn to pl brn | | 0061-1L |
| | | | 25 | Sh/Clst: | | y gy to lt gy | | 0061-2L |
| | | | tr | Ca : | | lt or to or gy | | 0061-3L |
| 1780.00 | | | | Rogl | Bald | Paleocene | | 0062 |
| | | | 100 | Sh/Clst: | | lt gy | | 0062-1L |
| | | | tr | Sh/Clst: | | m brn to pl brn | | 0062-2L |
| | | | tr | Ca : | | lt or | | 0062-3L |
| 1800.00 | | | | Rogl | Bald | Paleocene | | 0063 |
| | | | 100 | Sh/Clst: | | lt gy | | 0063-1L |
| | | | tr | Sh/Clst: | | m brn to pl brn | | 0063-2L |
| | | | tr | Ca : | | lt or | | 0063-3L |

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Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp | Frm | Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 1820.00 | | | | Rogl | Bald | Paleocene | | 0064 |
| | | | 65 | Sh/Clst: lt gy to y gy to pl ol, calc | | | | 0064-1L |
| | | | 15 | Sh/Clst: m brn to pl brn to lt brn gy | | | | 0064-2L |
| | | | 10 | Ca : lt or to lt gy | | | | 0064-3L |
| | | | 5 | S/Sst : lt gy to pl y, crs, l | | | | 0064-4L |
| | | | 5 | Cont : prp, dd | | | | 0064-5L |
| 1840.00 | | | | Rogl | Sele | Paleocene | | 0065 |
| | | | 100 | Sh/Clst: m gy | | | | 0065-1L |
| | | | tr | Cont : dd, prp | | | | 0065-2L |
| 1860.00 | | | | Rogl | Sele | Paleocene | | 0066 |
| | | | 100 | Sh/Clst: m gy to lt gy | | | | 0066-1L |
| 1880.00 | | | | Rogl | List | Paleocene | | 0067 |
| | | | 100 | Sh/Clst: m gy | | | | 0067-1L |
| | | | tr | Ca : lt or | | | | 0067-2L |
| | | | tr | Cont : dd, prp | | | | 0067-3L |
| 1900.00 | | | | Rogl | List | Paleocene | | 0068 |
| | | | 100 | Sh/Clst: m gy | | | | 0068-1L |
| | | | tr | Ca : lt or | | | | 0068-2L |
| | | | tr | Cont : dd, prp | | | | 0068-3L |
| 1920.00 | | | | Rogl | List | Paleocene | | 0069 |
| | | | 100 | Sh/Clst: m gy | | | | 0069-1L |
| | | | tr | Ca : lt or | | | | 0069-2L |
| | | | tr | Cont : dd, prp | | | | 0069-3L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp / Frm / Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|
| 1940.00 | | | | Rogl List Paleocene | | 0070 |
| | | | 100 | Sh/Clst: m gy | | 0070-1L |
| | | | tr | S/Sst : pl or, crs, l | | 0070-2L |
| | | | tr | Cont : dd, prp | | 0070-3L |
| 1960.00 | | | | Rogl List Paleocene | | 0071 |
| | | | 95 | Sh/Clst: m gy | | 0071-1L |
| | | | 5 | Cont : dd, prp | | 0071-3L |
| | | | tr | Ca : lt or | | 0071-2L |
| 1980.00 | | | | Rogl List Paleocene | | 0072 |
| | | | 100 | Sh/Clst: m gy, calc | | 0072-1L |
| | | | tr | Ca : lt or to w | | 0072-2L |
| | | | tr | Cont : dd, prp | | 0072-3L |
| 2000.00 | | | | Shet U.Cretaceous | | 0073 |
| | | | 75 | Sh/Clst: m gy, calc | | 0073-1L |
| | | | 25 | Ca : lt or | | 0073-2L |
| | | | tr | Cont : dd, prp | | 0073-3L |
| 2005.00 | | | | Shet U.Cretaceous | | 0074 |
| | | | 80 | Sh/Clst: m gy, calc | | 0074-1L |
| | | | 20 | Ca : lt or | | 0074-2L |
| | | | tr | Cont : dd, prp | | 0074-3L |
| 2010.00 | | | | Shet U.Cretaceous | | 0075 |
| | | | 70 | Ca : lt or | | 0075-2L |
| | | | 30 | Sh/Clst: m gy, calc | | 0075-1L |
| | | | tr | Sh/Clst: pl brn | | 0075-3L |
| | | | tr | Cont : dd, prp | | 0075-4L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp | Frm | Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2015.00 | | | | Shet | | U.Cretaceous | | 0076 |
| | | | 85 | Sh/Clst: | | m gy, calc | | 0076-1L |
| | | | 15 | Ca | | lt or | | 0076-2L |
| | | | tr | Cont | | dd, prp | | 0076-3L |
| 2020.00 | | | | Shet | | U.Cretaceous | | 0077 |
| | | | 100 | Sh/Clst: | | m gy, calc | | 0077-1L |
| | | | tr | Ca | | lt or | | 0077-2L |
| | | | tr | Cont | | dd, prp | | 0077-3L |
| 2025.00 | | | | Shet | | U.Cretaceous | | 0078 |
| | | | 95 | Sh/Clst: | | m gy, calc, slt | | 0078-1L |
| | | | 5 | Cont | | dd, prp | | 0078-3L |
| | | | tr | Ca | | lt or | | 0078-2L |
| 2030.00 | | | | Viki | Heat | U.Jurassic | | 0079 |
| | | | 60 | Sh/Clst: | | m gy, calc | | 0079-1L |
| | | | 35 | Ca | | w to lt or | | 0079-2L |
| | | | 5 | S/Sst | | lt gy to pl brn, f, crs, l | | 0079-3L |
| | | | tr | Cont | | prp | | 0079-4L |
| 2035.00 | | | | Viki | Heat | U.Jurassic | | 0080 |
| | | | 60 | Sh/Clst: | | m gy, calc | | 0080-1L |
| | | | 25 | Sltst | | m gy to brn gy, mic | | 0080-2L |
| | | | 15 | Ca | | w to lt or to lt gy, mrl | | 0080-3L |
| | | | tr | Cont | | prp | | 0080-4L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Cvd | Type TOC% | % | Grp / Lithology description | Frm | Age | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2040.00 | | | | Viki | Heat | U.Jurassic | | 0081 |
| | | | 50 | Ca : w to lt or to lt gy, mrl | | | | 0081-3L |
| | | | 30 | Sltst : lt gy to lt brn gy, mic | | | | 0081-2L |
| | | | 20 | Sh/Clst: m gy, calc | | | | 0081-1L |
| | | | tr | Cont : prp | | | | 0081-4L |
| 2045.00 | | ccp | | Viki | Heat | U.Jurassic | | 0001 |
| | | | 100 | Sltst : lt gy, mic | | | | 0001-1L |
| 2050.00 | | ccp | | Viki | Heat | U.Jurassic | | 0002 |
| | | | 100 | Sltst : lt gy to lt brn gy, mic, s | | | | 0002-1L |
| 2055.00 | | ccp | | Viki | Heat | U.Jurassic | | 0003 |
| | | | 100 | Sltst : lt gy to lt brn gy, mic | | | | 0003-1L |
| 2060.00 | | ccp | | Viki | Heat | U.Jurassic | | 0004 |
| | | | 100 | Sltst : lt gy to lt brn gy, mic, cly | | | | 0004-1L |
| 2065.00 | | ccp | | Viki | Heat | U.Jurassic | | 0005 |
| | | | 100 | Sltst : lt gy to lt brn gy, mic, cly | | | | 0005-1L |
| 2070.00 | | ccp | | Viki | Heat | U.Jurassic | | 0006 |
| | | | 100 | Sltst : lt brn gy, mic, cly | | | | 0006-1L |

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Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp Frm Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|
| 2075.00 | | ccp | | Viki Heat U.Jurassic | | 0007 |
| | | | 100 | Sltst : lt brn gy, mic, cly | | 0007-1L |
| 2080.00 | | ccp | | Viki Heat U.Jurassic | | 0008 |
| | | | 100 | Sltst : lt brn gy, mic, cly | | 0008-1L |
| 2085.00 | | ccp | | Viki Heat U.Jurassic | | 0009 |
| | | | 100 | Sh/Clst: brn gy, mic, slt | | 0009-1L |
| 2090.00 | | ccp | | Viki Heat U.Jurassic | | 0010 |
| | | | 100 | Sh/Clst: brn gy, mic, slt | | 0010-1L |
| 2095.00 | | ccp | | Viki Heat U.Jurassic | | 0011 |
| | | | 100 | Sh/Clst: drk gy | | 0011-1L |
| 2100.00 | | ccp | | Viki Heat U.Jurassic | | 0012 |
| | | | 100 | Sh/Clst: lt brn gy, mic | | 0012-1L |
| 2105.00 | | ccp | | Dunl Drak L.Jurassic | | 0013 |
| | | | 100 | Sh/Clst: m gy, slt | | 0013-1L |
| 2110.00 | | ccp | | Dunl Drak L.Jurassic | | 0014 |
| | | | 100 | Sh/Clst: m gy, slt, mic | | 0014-1L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Cvd | Type TOC% | % | Grp Frm Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|
| 2115.00 | | ccp | | Dunl Drak L.Jurassic | | 0015 |
| | | | 100 | Sltst : lt gy to m gy, mic, cly | | 0015-1L |
| 2120.00 | | ccp | | Dunl Drak L.Jurassic | | 0016 |
| | | | 100 | S/Sst : lt gy to lt brn gy, crs, hd | | 0016-1L |
| 2125.00 | | ccp | | Dunl Drak L.Jurassic | | 0017 |
| | | | 100 | S/Sst : lt gy, f, hd, calc | | 0017-1L |
| 2130.00 | | ccp | | Dunl Drak L.Jurassic | | 0018 |
| | | | 100 | Sh/Clst: lt gy, slt | | 0018-1L |
| | | | tr | Sltst : w | | 0018-2L |
| 2135.00 | | ccp | | Dunl Drak L.Jurassic | | 0019 |
| | | | 100 | Sh/Clst: lt gy, slt | | 0019-1L |
| | | | tr | Sltst : w | | 0019-2L |
| 2140.00 | | ccp | | Dunl Drak L.Jurassic | | 0020 |
| | | | 100 | Sh/Clst: pl y brn | | 0020-1L |
| 2145.00 | | ccp | | Dunl Drak L.Jurassic | | 0021 |
| | | | 100 | Sh/Clst: m gy, mic, slt | | 0021-1L |
| | | | tr | Sltst : w to lt gy | | 0021-2L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Cvd | Type / TOC% | % | Grp / Lithology description | Frm | Age | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2150.50 | | ccp | | Dunl | Drak | L.Jurassic | | 0022 |
| | | | 100 | Sh/Clst: m gy, mic | | | | 0022-1L |
| 2155.00 | | | | Dunl | Drak | L.Jurassic | | 0082 |
| | | | 100 | Sh/Clst: m gy, mic | | | | 0082-1L |
| | | | tr | Ca : lt or | | | | 0082-2L |
| | | | tr | Cont : prp | | | | 0082-3L |
| 2160.00 | | | | Dunl | Drak | L.Jurassic | | 0083 |
| | | | 100 | Sh/Clst: m gy, mic | | | | 0083-1L |
| | | | tr | Cont : prp | | | | 0083-2L |
| 2165.00 | | | | Dunl | Drak | L.Jurassic | | 0084 |
| | | | 70 | Sh/Clst: m gy, mic | | | | 0084-1L |
| | | | 30 | S/Sst : w to lt gy, crs, l | | | | 0084-2L |
| | | | tr | Cont : Mica-ad, prp | | | | 0084-3L |
| 2170.00 | | | | Dunl | Drak | L.Jurassic | | 0085 |
| | | | 75 | Sh/Clst: m gy, mic | | | | 0085-1L |
| | | | 10 | S/Sst : w to lt gy, crs, l | | | | 0085-2L |
| | | | 10 | Sltst : lt gy to w, kln | | | | 0085-3L |
| | | | 5 | Cont : dd, prp | | | | 0085-4L |
| | | | tr | Ca : lt or to lt gy, mrl | | | | 0085-5L |
| 2175.00 | | | | Dunl | Drak | L.Jurassic | | 0086 |
| | | | 50 | Sh/Clst: m gy, mic | | | | 0086-1L |
| | | | 25 | Sltst : lt gy to w, kln | | | | 0086-3L |
| | | | 20 | S/Sst : w to lt gy, crs, l | | | | 0086-2L |
| | | | 5 | Cont : dd, prp | | | | 0086-4L |
| | | | tr | Ca : lt or to lt gy, mrl | | | | 0086-5L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth (Int / Cvd) | Type / TOC% | % | Grp / Frm / Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|
| 2180.00 | | | Dunl Drak L.Jurassic | | 0087 |
| | | 60 | Sh/Clst: m gy, mic | | 0087-1L |
| | | 25 | Sltst : lt gy to w, kln | | 0087-3L |
| | | 15 | S/Sst : w to lt gy, crs, l | | 0087-2L |
| | | tr | Cont : dd, prp | | 0087-4L |
| 2185.00 | | | Dunl Drak L.Jurassic | | 0088 |
| | | 60 | Sltst : lt gy to w, kln | | 0088-1L |
| | | 30 | Sh/Clst: m gy | | 0088-2L |
| | | 10 | S/Sst : w to lt gy, crs, l | | 0088-3L |
| | | tr | Ca : w to lt or | | 0088-4L |
| 2190.00 | | | Dunl Drak L.Jurassic | | 0089 |
| | | 45 | Sh/Clst: m gy | | 0089-2L |
| | | 40 | Sltst : lt gy to w, kln | | 0089-1L |
| | | 10 | S/Sst : w to lt gy, crs, l | | 0089-3L |
| | | 5 | Ca : w to lt or | | 0089-4L |
| 2195.00 | | | Dunl Drak L.Jurassic | | 0090 |
| | | 55 | Sh/Clst: m gy | | 0090-2L |
| | | 40 | Sltst : lt gy to w, kln | | 0090-1L |
| | | 5 | Cont : dd, prp | | 0090-4L |
| | | tr | S/Sst : w to lt gy, crs, l | | 0090-3L |
| 2200.00 | | | Dunl Drak L.Jurassic | | 0091 |
| | | 50 | Sltst : lt gy to w, kln | | 0091-1L |
| | | 50 | Sh/Clst: m gy, mic | | 0091-2L |
| | | tr | Cont : dd, prp | | 0091-3L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp | Frm | Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2205.00 | | | | Dunl | Drak | L.Jurassic | | 0092 |
| | | | 50 | | | Sh/Clst: m gy, mic | | 0092-2L |
| | | | 40 | | | Sltst : lt gy to w, kln | | 0092-1L |
| | | | 5 | | | S/Sst : w to lt gy, crs, l | | 0092-3L |
| | | | 5 | | | Ca : w to lt or to lt gy, mrl | | 0092-4L |
| | | | tr | | | Cont : prp | | 0092-5L |
| 2210.00 | | | | Dunl | Drak | L.Jurassic | | 0093 |
| | | | 50 | | | Sh/Clst: m gy, mic | | 0093-2L |
| | | | 25 | | | Ca : w to lt or to lt gy, mrl | | 0093-4L |
| | | | 20 | | | Sltst : lt gy to w, kln | | 0093-1L |
| | | | 5 | | | S/Sst : w to lt gy, crs, l | | 0093-3L |
| | | | tr | | | Cont : prp | | 0093-5L |
| 2215.00 | | | | Dunl | Drak | L.Jurassic | | 0094 |
| | | | 50 | | | Sh/Clst: m gy, mic | | 0094-2L |
| | | | 35 | | | Sltst : lt gy to w, kln | | 0094-1L |
| | | | 10 | | | Ca : w to lt or to lt gy, mrl | | 0094-4L |
| | | | 5 | | | S/Sst : w to lt gy, crs, l | | 0094-3L |
| | | | tr | | | Cont : prp | | 0094-5L |
| 2220.00 | | | | Dunl | Drak | L.Jurassic | | 0095 |
| | | | 50 | | | Sltst : lt gy to w, kln | | 0095-1L |
| | | | 50 | | | Sh/Clst: m gy, mic | | 0095-2L |
| | | | tr | | | Ca : w to lt or to lt gy, mrl | | 0095-3L |
| | | | tr | | | Cont : prp | | 0095-4L |
| 2225.00 | | | | Dunl | Drak | L.Jurassic | | 0096 |
| | | | 50 | | | Sltst : lt gy to m gy, kln | | 0096-1L |
| | | | 50 | | | Sh/Clst: m gy, mic | | 0096-2L |
| | | | tr | | | Cont : prp | | 0096-3L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp / Lithology description | Frm | Age | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2230.00 | | | | Dunl | Drak | L.Jurassic | | 0097 |
| | | | 100 | Sh/Clst: lt gy to m gy, slt | | | | 0097-1L |
| | | | tr | Ca : w to lt or, mrl | | | | 0097-2L |
| | | | tr | Cont : prp | | | | 0097-3L |
| 2235.00 | | | | Dunl | Drak | L.Jurassic | | 0098 |
| | | | 100 | Sh/Clst: lt gy to m gy, slt | | | | 0098-1L |
| | | | tr | Ca : w to lt or, mrl | | | | 0098-2L |
| | | | tr | Cont : prp | | | | 0098-3L |
| 2240.00 | | | | Dunl | Cook | L.Jurassic | | 0099 |
| | | | 60 | S/Sst : lt gy, crs, l | | | | 0099-1L |
| | | | 25 | Sh/Clst: m gy | | | | 0099-2L |
| | | | 10 | Sltst : lt gy to w, kln | | | | 0099-3L |
| | | | 5 | Ca : w to lt or | | | | 0099-4L |
| | | | tr | Cont : prp | | | | 0099-5L |
| 2245.00 | | | | Dunl | Cook | L.Jurassic | | 0100 |
| | | | 70 | S/Sst : lt gy, crs, l | | | | 0100-1L |
| | | | 20 | Sh/Clst: m gy | | | | 0100-2L |
| | | | 5 | Sltst : lt gy to w, kln | | | | 0100-3L |
| | | | 5 | Cont : dd, prp | | | | 0100-5L |
| | | | tr | Ca : w to lt or | | | | 0100-4L |
| 2250.00 | | | | Dunl | Cook | L.Jurassic | | 0101 |
| | | | 75 | S/Sst : lt gy, crs, l | | | | 0101-1L |
| | | | 20 | Sh/Clst: m gy | | | | 0101-2L |
| | | | 5 | Cont : dd, prp | | | | 0101-5L |
| | | | tr | Sltst : lt gy to w, kln | | | | 0101-3L |
| | | | tr | Ca : w to lt or | | | | 0101-4L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp / Lithology description | Frm | Age | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2255.00 | | | | Dunl | Cook | L.Jurassic | | 0102 |
| | | | 80 | S/Sst : lt gy, crs, l | | | | 0102-1L |
| | | | 15 | Sh/Clst: m gy, mic | | | | 0102-2L |
| | | | 5 | Sltst : lt gy to w, kln | | | | 0102-3L |
| | | | tr | Ca : w to lt or to or gy | | | | 0102-4L |
| | | | tr | Cont : dd, prp | | | | 0102-5L |
| 2260.00 | | | | Dunl | Cook | L.Jurassic | | 0103 |
| | | | 40 | S/Sst : lt gy, crs, l | | | | 0103-1L |
| | | | 40 | Sltst : lt gy to w, kln | | | | 0103-3L |
| | | | 15 | Sh/Clst: m gy, mic | | | | 0103-2L |
| | | | 5 | Ca : w to lt or to or gy | | | | 0103-4L |
| | | | tr | Cont : dd, prp | | | | 0103-5L |
| 2265.00 | | | | Dunl | Cook | L.Jurassic | | 0104 |
| | | | 30 | Sh/Clst: m gy to brn gy, mic | | | | 0104-2L |
| | | | 30 | Ca : w to lt or to or gy | | | | 0104-4L |
| | | | 20 | Sltst : lt gy to w, kln | | | | 0104-3L |
| | | | 15 | S/Sst : lt gy to w, crs, l | | | | 0104-1L |
| | | | 5 | Cont : dd, prp | | | | 0104-5L |
| 2270.00 | | | | Dunl | Cook | L.Jurassic | | 0105 |
| | | | 30 | S/Sst : lt gy to w, crs, l | | | | 0105-1L |
| | | | 25 | Sh/Clst: m gy to brn gy, mic | | | | 0105-2L |
| | | | 25 | Ca : w to lt or to or gy | | | | 0105-4L |
| | | | 20 | Sltst : lt gy to w, kln | | | | 0105-3L |
| | | | tr | Cont : dd, prp | | | | 0105-5L |
| 2275.00 | | | | Dunl | Cook | L.Jurassic | | 0106 |
| | | | 65 | Sltst : lt gy to w, kln | | | | 0106-3L |
| | | | 15 | Sh/Clst: m gy to brn gy, mic | | | | 0106-2L |
| | | | 15 | Ca : w to lt or to or gy | | | | 0106-4L |
| | | | 5 | S/Sst : lt gy to w, crs, l | | | | 0106-1L |
| | | | tr | Cont : dd, prp | | | | 0106-5L |

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Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp Frm Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|
| 2280.00 | | | | Dunl Cook L.Jurassic | | 0107 |
| | | | 65 | Sltst : lt gy to w, kln | | 0107-3L |
| | | | 15 | Sh/Clst: m gy to brn gy, mic | | 0107-2L |
| | | | 15 | Ca : w to lt or to or gy | | 0107-4L |
| | | | 5 | S/Sst : lt gy to w, crs, l | | 0107-1L |
| | | | tr | Cont : dd, prp | | 0107-5L |
| 2285.00 | | | | Dunl Amun L.Jurassic | | 0108 |
| | | | 50 | Sh/Clst: m gy to brn gy | | 0108-1L |
| | | | 40 | S/Sst : w to lt gy, f, slt, kln, crs, l | | 0108-2L |
| | | | 10 | Ca : w to lt or | | 0108-3L |
| 2290.00 | | | | Dunl Amun L.Jurassic | | 0109 |
| | | | 60 | S/Sst : w to lt gy, f, slt, kln, crs, l | | 0109-2L |
| | | | 30 | Sh/Clst: m gy to brn gy | | 0109-1L |
| | | | 10 | Ca : w to lt or | | 0109-3L |
| | | | tr | Cont : prp | | 0109-4L |
| 2295.00 | | | | Dunl Amun L.Jurassic | | 0110 |
| | | | 35 | Sh/Clst: m gy to brn gy | | 0110-1L |
| | | | 35 | S/Sst : w to lt gy, f, slt, kln, crs, l | | 0110-2L |
| | | | 20 | Ca : w to lt or | | 0110-3L |
| | | | 10 | Cont : dd, prp | | 0110-4L |
| 2300.00 | | | | Dunl Amun L.Jurassic | | 0111 |
| | | | 80 | S/Sst : w to lt gy, f, slt, kln | | 0111-2L |
| | | | 10 | Sh/Clst: m gy to brn gy | | 0111-1L |
| | | | 5 | Ca : w to lt or | | 0111-3L |
| | | | 5 | Cont : dd, prp | | 0111-4L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp / Lithology description | Frm | Age | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2305.00 | | | | Dunl | Amun | L.Jurassic | | 0112 |
| | | | 70 | S/Sst : w to lt gy, f, slt, kln | | | | 0112-2L |
| | | | 15 | Sh/Clst: m gy to brn gy | | | | 0112-1L |
| | | | 10 | Ca : w to lt or | | | | 0112-3L |
| | | | 5 | Cont : dd, prp | | | | 0112-4L |
| 2310.00 | | | | Dunl | Amun | L.Jurassic | | 0113 |
| | | | 30 | Sh/Clst: m gy to brn gy | | | | 0113-1L |
| | | | 30 | S/Sst : w to lt gy, f, slt, kln | | | | 0113-2L |
| | | | 30 | Ca : w to lt or | | | | 0113-3L |
| | | | 10 | Cont : dd, prp | | | | 0113-4L |
| 2315.00 | | | | Dunl | Amun | L.Jurassic | | 0114 |
| | | | 40 | Sh/Clst: m gy to brn gy | | | | 0114-1L |
| | | | 40 | S/Sst : w to lt gy, f, slt, kln, crs, l | | | | 0114-2L |
| | | | 15 | Ca : w to lt or | | | | 0114-3L |
| | | | 5 | Cont : dd, prp | | | | 0114-4L |
| 2320.00 | | | | Dunl | Amun | L.Jurassic | | 0115 |
| | | | 60 | S/Sst : w to lt gy, f, slt, kln, crs, l | | | | 0115-2L |
| | | | 25 | Sh/Clst: m gy to brn gy | | | | 0115-1L |
| | | | 10 | Ca : w to lt or | | | | 0115-3L |
| | | | 5 | Cont : dd, prp | | | | 0115-4L |
| 2325.00 | | | | Dunl | Amun | L.Jurassic | | 0116 |
| | | | 75 | Sh/Clst: m gy to brn gy | | | | 0116-1L |
| | | | 15 | S/Sst : w to lt gy, f, slt, kln, crs, l | | | | 0116-2L |
| | | | 5 | Ca : w to lt or | | | | 0116-3L |
| | | | 5 | Cont : dd, prp | | | | 0116-4L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp | Frm | Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2330.00 | | | | Dunl | Amun | L.Jurassic | | 0117 |
| | | | 50 | S/Sst | | : w to lt gy, f, slt, kln, crs, l | | 0117-2L |
| | | | 40 | Sh/Clst | | : m gy to brn gy | | 0117-1L |
| | | | 5 | Ca | | : w to lt or | | 0117-3L |
| | | | 5 | Cont | | : dd, prp | | 0117-4L |
| 2335.00 | | | | Dunl | Amun | L.Jurassic | | 0118 |
| | | | 60 | Sh/Clst | | : m gy to brn gy | | 0118-1L |
| | | | 20 | S/Sst | | : w to lt gy, f, slt, kln, crs, l | | 0118-2L |
| | | | 15 | Cont | | : dd, prp | | 0118-4L |
| | | | 5 | Ca | | : w to lt or | | 0118-3L |
| 2340.00 | | | | Dunl | Amun | L.Jurassic | | 0119 |
| | | | 60 | Sh/Clst | | : m gy to brn gy | | 0119-1L |
| | | | 20 | S/Sst | | : w to lt gy, f, slt, kln, crs, l | | 0119-2L |
| | | | 15 | Cont | | : dd, prp | | 0119-4L |
| | | | 5 | Ca | | : w to lt or | | 0119-3L |
| 2345.00 | | | | Dunl | Amun | L.Jurassic | | 0120 |
| | | | 80 | Sh/Clst | | : m gy, calc | | 0120-1L |
| | | | 10 | S/Sst | | : w to lt gy, f, slt, kln | | 0120-2L |
| | | | 5 | Ca | | : w to lt or | | 0120-3L |
| | | | 5 | Cont | | : dd, prp | | 0120-4L |
| 2350.00 | | | | Dunl | Amun | L.Jurassic | | 0121 |
| | | | 50 | Sh/Clst | | : m gy, calc | | 0121-1L |
| | | | 40 | S/Sst | | : w to lt gy, f, slt, kln | | 0121-2L |
| | | | 5 | Ca | | : w to lt or | | 0121-3L |
| | | | 5 | Cont | | : dd, prp | | 0121-4L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp / Lithology | Frm | Age / description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2355.00 | | | | Dunl | Amun | L.Jurassic | | 0122 |
| | | | 60 | S/Sst | | : w to lt gy, f, slt, kln | | 0122-2L |
| | | | 30 | Sh/Clst | | : m gy, calc | | 0122-1L |
| | | | 10 | Cont | | : dd, prp | | 0122-4L |
| | | | tr | Ca | | : w to lt or | | 0122-3L |
| 2360.00 | | | | Dunl | Amun | L.Jurassic | | 0123 |
| | | | 65 | S/Sst | | : w to lt gy, f, slt, kln | | 0123-2L |
| | | | 30 | Sh/Clst | | : m gy, calc | | 0123-1L |
| | | | 5 | Cont | | : dd, prp | | 0123-4L |
| | | | tr | Ca | | : w to lt or | | 0123-3L |
| 2370.00 | | | | Dunl | Amun | L.Jurassic | | 0124 |
| | | | 40 | Sh/Clst | | : m gy, calc | | 0124-1L |
| | | | 40 | S/Sst | | : w to lt gy, f, slt, kln | | 0124-2L |
| | | | 15 | Cont | | : dd, prp | | 0124-4L |
| | | | 5 | Ca | | : w to lt or | | 0124-3L |
| 2375.00 | | | | Dunl | Amun | L.Jurassic | | 0125 |
| | | | 70 | Sh/Clst | | : m gy | | 0125-1L |
| | | | 20 | S/Sst | | : w to lt gy, f, slt, kln | | 0125-2L |
| | | | 10 | Cont | | : dd, prp | | 0125-3L |
| 2380.00 | | | | Dunl | Amun | L.Jurassic | | 0126 |
| | | | 70 | Sh/Clst | | : m gy | | 0126-1L |
| | | | 20 | S/Sst | | : w to lt gy, f, slt, kln | | 0126-2L |
| | | | 10 | Cont | | : dd, prp | | 0126-3L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp Frm Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|
| 2385.00 | | | | Dunl Stat L.Jurassic | | 0127 |
| | | | 60 | S/Sst : w to lt gy, crs, l, f, slt, kln | | 0127-1L |
| | | | 30 | Sh/Clst: lt gy to m gy, mic | | 0127-2L |
| | | | 5 | Ca : w to lt or | | 0127-3L |
| | | | 5 | Cont : dd, prp | | 0127-4L |
| | | | tr | Coal : blk, wx | | 0127-5L |
| 2390.00 | | | | Dunl Stat L.Jurassic | | 0128 |
| | | | 50 | S/Sst : w to lt gy, crs, l, f, slt, kln | | 0128-1L |
| | | | 25 | Sh/Clst: lt gy to m gy, mic | | 0128-2L |
| | | | 15 | Sh/Clst: drk gy to brn blk | | 0128-3L |
| | | | 5 | Ca : w to lt or | | 0128-4L |
| | | | 5 | Cont : dd, prp | | 0128-5L |
| | | | tr | Coal : blk, wx | | 0128-6L |
| 2395.00 | | | | Dunl Stat L.Jurassic | | 0129 |
| | | | 40 | S/Sst : w to lt gy, crs, l, f, slt, kln | | 0129-1L |
| | | | 30 | Sh/Clst: lt gy to m gy, mic | | 0129-2L |
| | | | 20 | Sh/Clst: drk gy to dsk brn to brn blk | | 0129-3L |
| | | | 5 | Ca : w to lt or | | 0129-4L |
| | | | 5 | Cont : dd, prp | | 0129-5L |
| | | | tr | Coal : blk, wx | | 0129-6L |
| 2400.00 | | | | Dunl Stat L.Jurassic | | 0130 |
| | | | 90 | S/Sst : w to lt gy, crs, l, f, slt, kln | | 0130-1L |
| | | | 5 | Sh/Clst: lt gy to m gy, mic | | 0130-2L |
| | | | 5 | Sh/Clst: drk gy to dsk brn to brn blk | | 0130-3L |
| | | | tr | Ca : w to lt or | | 0130-4L |
| | | | tr | Cont : dd, prp | | 0130-5L |
| | | | tr | Coal : blk, wx | | 0130-6L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Cvd | Type TOC% | % | Grp | Frm | Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2405.00 | | | | Dunl | Stat | L.Jurassic | | 0131 |
| | | | 95 | S/Sst | | : w to lt gy, crs, l, f, slt, kln | | 0131-1L |
| | | | 5 | Coal | | : blk, wx | | 0131-6L |
| | | | tr | Sh/Clst | | : lt gy to m gy, mic | | 0131-2L |
| | | | tr | Sh/Clst | | : drk gy to dsk brn to brn blk | | 0131-3L |
| | | | tr | Ca | | : w to lt or | | 0131-4L |
| | | | tr | Cont | | : dd, prp | | 0131-5L |
| 2410.00 | | | | Dunl | Stat | L.Jurassic | | 0132 |
| | | | 95 | S/Sst | | : w to lt gy, crs, l, f, kln | | 0132-1L |
| | | | 5 | Coal | | : blk, wx | | 0132-6L |
| | | | tr | Sh/Clst | | : lt gy to m gy, mic | | 0132-2L |
| | | | tr | Sh/Clst | | : drk gy to dsk brn to brn blk | | 0132-3L |
| | | | tr | Ca | | : w to lt or | | 0132-4L |
| | | | tr | Cont | | : dd, prp | | 0132-5L |
| 2415.00 | | | | Dunl | Stat | L.Jurassic | | 0133 |
| | | | 95 | S/Sst | | : w to lt gy, crs, l, f, kln | | 0133-1L |
| | | | 5 | Coal | | : blk, wx | | 0133-6L |
| | | | tr | Sh/Clst | | : lt gy to m gy, mic | | 0133-2L |
| | | | tr | Sh/Clst | | : drk gy to dsk brn to brn blk | | 0133-3L |
| | | | tr | Ca | | : w to lt or | | 0133-4L |
| | | | tr | Cont | | : dd, prp | | 0133-5L |
| 2420.00 | | | | Dunl | Stat | L.Jurassic | | 0134 |
| | | | 100 | S/Sst | | : w to lt gy, crs, l, f, kln | | 0134-1L |
| | | | tr | Sh/Clst | | : lt gy to m gy, mic | | 0134-2L |
| | | | tr | Sh/Clst | | : drk gy to dsk brn to brn blk | | 0134-3L |
| | | | tr | Ca | | : w to lt or | | 0134-4L |
| | | | tr | Cont | | : dd, prp | | 0134-5L |
| | | | tr | Coal | | : blk, wx | | 0134-6L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp | Frm | Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2425.00 | | | | Dunl | Stat | L.Jurassic | | 0135 |
| | | | 100 | S/Sst | | : w to lt gy, crs, l, f, kln | | 0135-1L |
| | | | tr | Sh/Clst: | | lt gy to m gy, mic | | 0135-2L |
| | | | tr | Sh/Clst: | | drk gy to dsk brn to brn blk | | 0135-3L |
| | | | tr | Coal | | : blk, wx | | 0135-4L |
| | | | tr | Cont | | : prp | | 0135-5L |
| 2430.00 | | | | Dunl | Stat | L.Jurassic | | 0136 |
| | | | 100 | S/Sst | | : w to lt gy, crs, l, f, kln | | 0136-1L |
| | | | tr | Sh/Clst: | | lt gy to m gy, mic | | 0136-2L |
| | | | tr | Sh/Clst: | | drk gy to dsk brn to brn blk | | 0136-3L |
| | | | tr | Coal | | : blk, wx | | 0136-4L |
| | | | tr | Kaolin | | : w | | 0136-5L |
| | | | tr | Cont | | : prp | | 0136-6L |
| 2435.00 | | | | Dunl | Stat | L.Jurassic | | 0137 |
| | | | 95 | S/Sst | | : w to lt gy, crs, l | | 0137-1L |
| | | | 5 | Sh/Clst: | | brn blk | | 0137-2L |
| | | | tr | Sh/Clst: | | lt gy to m gy, mic, calc | | 0137-3L |
| | | | tr | Coal | | : blk, wx | | 0137-4L |
| | | | tr | Kaolin | | : w | | 0137-5L |
| | | | tr | Cont | | : prp | | 0137-6L |
| 2440.00 | | | | Dunl | Stat | L.Jurassic | | 0138 |
| | | | 95 | S/Sst | | : w to lt gy, crs, l | | 0138-1L |
| | | | 5 | Sh/Clst: | | brn blk | | 0138-2L |
| | | | tr | Sh/Clst: | | lt gy to m gy, mic, calc | | 0138-3L |
| | | | tr | Kaolin | | : w | | 0138-4L |
| | | | tr | Cont | | : prp, dd | | 0138-5L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Cvd | Type TOC% | % | Grp | Frm | Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2445.00 | | | | Dunl | Stat | L.Jurassic | | 0139 |
| | | | 100 | S/Sst | | : w to lt gy, crs, l | | 0139-1L |
| | | | tr | Sh/Clst | | : brn blk | | 0139-2L |
| | | | tr | Sh/Clst | | : lt gy to m gy, mic, calc | | 0139-3L |
| | | | tr | Kaolin | | : w | | 0139-4L |
| | | | tr | Cont | | : prp, dd | | 0139-5L |
| 2450.00 | | | | Dunl | Stat | L.Jurassic | | 0140 |
| | | | 100 | S/Sst | | : w to lt gy, crs, l | | 0140-1L |
| | | | tr | Sh/Clst | | : brn blk | | 0140-2L |
| | | | tr | Sh/Clst | | : lt gy to m gy, mic, calc | | 0140-3L |
| | | | tr | Kaolin | | : w | | 0140-4L |
| | | | tr | Coal | | : blk, wx | | 0140-5L |
| 2455.00 | | | | Dunl | Stat | L.Jurassic | | 0141 |
| | | | 100 | S/Sst | | : w to lt gy, crs, l | | 0141-1L |
| | | | tr | Sh/Clst | | : brn blk | | 0141-2L |
| | | | tr | Sh/Clst | | : lt gy to m gy, mic, calc | | 0141-3L |
| | | | tr | Kaolin | | : w | | 0141-4L |
| | | | tr | Coal | | : blk, wx | | 0141-5L |
| 2460.00 | | | | Dunl | Stat | L.Jurassic | | 0142 |
| | | | 95 | S/Sst | | : w to lt gy, crs, l | | 0142-1L |
| | | | 5 | Sh/Clst | | : lt gy to m gy, mic, calc | | 0142-3L |
| | | | tr | Sh/Clst | | : brn blk | | 0142-2L |
| | | | tr | Kaolin | | : w | | 0142-4L |
| | | | tr | Cont | | : prp | | 0142-5L |
| 2465.00 | | | | Dunl | Stat | L.Jurassic | | 0143 |
| | | | 100 | S/Sst | | : w to lt gy, crs, l | | 0143-1L |
| | | | tr | Sh/Clst | | : lt gy to m gy, mic | | 0143-2L |
| | | | tr | Sh/Clst | | : brn blk | | 0143-3L |
| | | | tr | Cont | | : prp | | 0143-4L |

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Depth Cvd | Type TOC% | % | Grp | Frm | Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2470.00 | | | | Dunl | Stat | L.Jurassic | | 0144 |
| | | | 100 | S/Sst | | : w to lt gy, crs, l | | 0144-1L |
| | | | tr | Sh/Clst: | | lt gy to m gy, mic | | 0144-2L |
| | | | tr | Sh/Clst: | | brn blk | | 0144-3L |
| | | | tr | Kaolin | | : w | | 0144-4L |
| | | | tr | Cont | | : prp, dd | | 0144-5L |
| 2475.00 | | | | Dunl | Stat | L.Jurassic | | 0145 |
| | | | 100 | S/Sst | | : w to lt gy, crs, l | | 0145-1L |
| | | | tr | Sh/Clst: | | lt gy to m gy, mic | | 0145-2L |
| | | | tr | Sh/Clst: | | brn blk | | 0145-3L |
| | | | tr | Kaolin | | : w | | 0145-4L |
| | | | tr | Cont | | : prp, dd | | 0145-5L |
| 2480.00 | | | | Dunl | Stat | L.Jurassic | | 0146 |
| | | | 95 | S/Sst | | : w to lt gy, crs, l | | 0146-1L |
| | | | 5 | Sh/Clst: | | lt gy to m gy, mic | | 0146-2L |
| | | | tr | Sh/Clst: | | brn blk | | 0146-3L |
| | | | tr | Kaolin | | : w | | 0146-4L |
| | | | tr | Cont | | : prp, dd | | 0146-5L |
| 2485.00 | | | | Dunl | Stat | L.Jurassic | | 0147 |
| | | | 95 | S/Sst | | : w to lt gy, crs, l | | 0147-1L |
| | | | 5 | Sh/Clst: | | lt gy to m gy, mic | | 0147-2L |
| | | | tr | Sh/Clst: | | brn blk | | 0147-3L |
| | | | tr | Kaolin | | : w | | 0147-4L |
| | | | tr | Cont | | : prp, dd | | 0147-5L |
| 2490.00 | | | | Dunl | Stat | L.Jurassic | | 0148 |
| | | | 95 | S/Sst | | : w to lt gy, crs, l | | 0148-1L |
| | | | 5 | Sh/Clst: | | lt gy to m gy, mic | | 0148-2L |
| | | | tr | Sh/Clst: | | brn blk | | 0148-3L |
| | | | tr | Kaolin | | : w | | 0148-4L |
| | | | tr | Cont | | : prp, dd | | 0148-5L |

GEOLAB NOR

Table 1 : Lithology description for well NOCS 31/4-7

Depth unit of measure: m

| Depth Int | Cvd | Type TOC% | % | Grp | Frm | Age / Lithology description | Trb | Sample |
|---|---|---|---|---|---|---|---|---|
| 2495.00 | | | | Dunl | Stat | L.Jurassic | | 0149 |
| | | | 80 | S/Sst | | : w to lt gy, crs, l | | 0149-1L |
| | | | 10 | Sh/Clst: | | lt gy to m gy, mic | | 0149-2L |
| | | | 5 | Kaolin | | : w | | 0149-4L |
| | | | 5 | Sh/Clst: | | m brn to pl brn | | 0149-5L |
| | | | tr | Sh/Clst: | | brn blk | | 0149-3L |
| | | | tr | Cont | | : prp, dd | | 0149-6L |
| 2500.00 | | | | Dunl | Stat | L.Jurassic | | 0150 |
| | | | 60 | S/Sst | | : w to lt gy, crs, l | | 0150-1L |
| | | | 25 | Sh/Clst: | | m brn to pl brn | | 0150-5L |
| | | | 10 | Sh/Clst: | | lt gy to m gy, mic | | 0150-2L |
| | | | 5 | Kaolin | | : w | | 0150-4L |
| | | | tr | Sh/Clst: | | brn blk | | 0150-3L |
| | | | tr | Cont | | : prp, dd | | 0150-6L |

Table 2 : Rock-Eval table for well NOCS 31/4-7



Depth unit of measure: m

| Depth | Typ | Lithology | S1 | S2 | S3 | S2/S3 | TOC | HI | OI | PP | PI | Tmax | Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2010.00 | cut | Ca : lt or | 0.53 | 1.08 | 0.59 | 1.83 | 0.30 | 360 | 197 | 1.6 | 0.33 | 427 | 0075-2L |
| 2030.00 | cut | Ca : w to lt or | 0.31 | 0.35 | 1.30 | 0.27 | 0.30 | 117 | 433 | 0.7 | 0.47 | 422 | 0079-2L |
| 2040.00 | cut | Ca : w to lt or to lt gy | 0.44 | 0.38 | 1.34 | 0.28 | 0.39 | 97 | 344 | 0.8 | 0.54 | 423 | 0081-3L |
| 2045.00 | ccp | Sltst : lt gy | 0.31 | 0.58 | 0.15 | 3.87 | 0.34 | 171 | 44 | 0.9 | 0.35 | 507 | 0001-1L |
| 2050.00 | ccp | Sltst : lt gy to lt brn gy | 0.29 | 0.61 | 0.15 | 4.07 | 0.46 | 133 | 33 | 0.9 | 0.32 | 427 | 0002-1L |
| 2055.00 | ccp | Sltst : lt gy to lt brn gy | 0.40 | 0.96 | 0.09 | 10.67 | 0.81 | 119 | 11 | 1.4 | 0.29 | 427 | 0003-1L |
| 2060.00 | ccp | Sltst : lt gy to lt brn gy | 0.46 | 1.31 | 0.12 | 10.92 | 0.76 | 172 | 16 | 1.8 | 0.26 | 430 | 0004-1L |
| 2065.00 | ccp | Sltst : lt gy to lt brn gy | 0.48 | 1.70 | 0.19 | 8.95 | 0.86 | 198 | 22 | 2.2 | 0.22 | 431 | 0005-1L |
| 2070.00 | ccp | Sltst : lt brn gy | 0.67 | 1.27 | 0.10 | 12.70 | 0.77 | 165 | 13 | 1.9 | 0.35 | 430 | 0006-1L |
| 2075.00 | ccp | Sltst : lt brn gy | 0.87 | 3.28 | 0.17 | 19.29 | 1.42 | 231 | 12 | 4.2 | 0.21 | 433 | 0007-1L |
| 2080.00 | ccp | Sltst : lt brn gy | 1.03 | 1.35 | 0.22 | 6.14 | 0.65 | 208 | 34 | 2.4 | 0.43 | 429 | 0008-1L |
| 2085.00 | ccp | Sh/Clst: brn gy | 0.74 | 3.45 | 0.25 | 13.80 | 1.87 | 184 | 13 | 4.2 | 0.18 | 426 | 0009-1L |
| 2095.00 | ccp | Sh/Clst: drk gy | 0.27 | 3.08 | 0.46 | 6.70 | 2.70 | 114 | 17 | 3.3 | 0.08 | 424 | 0011-1L |
| 2105.00 | ccp | Sh/Clst: m gy | 0.18 | 0.58 | 0.22 | 2.64 | 0.97 | 60 | 23 | 0.8 | 0.24 | 426 | 0013-1L |
| 2115.00 | ccp | Sltst : lt gy to m gy | 0.20 | 0.60 | 0.45 | 1.33 | 0.94 | 64 | 48 | 0.8 | 0.25 | 427 | 0015-1L |

Table 2 : Rock-Eval table for well NOCS 31/4-7

Depth unit of measure: m

| Depth | Typ | Lithology | S1 | S2 | S3 | S2/S3 | TOC | HI | OI | PP | PI | Tmax | Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2120.00 | ccp | S/Sst : lt gy to lt brn gy | 0.06 | 0.09 | 0.20 | 0.45 | 0.22 | 41 | 91 | 0.2 | 0.40 | 424 | 0016-1L |
| 2125.00 | ccp | S/Sst : lt gy | 0.04 | 0.14 | 1.25 | 0.11 | 0.21 | 67 | 595 | 0.2 | 0.22 | 431 | 0017-1L |
| 2130.00 | ccp | Sh/Clst: lt gy | 0.21 | 1.03 | 0.44 | 2.34 | 0.86 | 120 | 51 | 1.2 | 0.17 | 431 | 0018-1L |
| 2140.00 | ccp | Sh/Clst: pl y brn | 0.32 | 4.72 | 2.07 | 2.28 | 1.88 | 251 | 110 | 5.0 | 0.06 | 435 | 0020-1L |
| 2150.50 | ccp | Sh/Clst: m gy | 0.25 | 2.70 | 1.58 | 1.71 | 1.14 | 237 | 139 | 3.0 | 0.08 | 433 | 0022-1L |
| 2160.00 | cut | Sh/Clst: m gy | 0.24 | 1.07 | 0.97 | 1.10 | 1.01 | 106 | 96 | 1.3 | 0.18 | 440 | 0083-1L |
| 2170.00 | cut | Sh/Clst: m gy | 0.22 | 1.01 | 0.96 | 1.05 | 0.99 | 102 | 97 | 1.2 | 0.18 | 439 | 0085-1L |
| 2175.00 | cut | Sltst : lt gy to w | 0.32 | 2.10 | 0.75 | 2.80 | 0.85 | 247 | 88 | 2.4 | 0.13 | 438 | 0086-3L |
| 2185.00 | cut | Sltst : lt gy to w | 0.55 | 3.93 | 0.57 | 6.89 | 1.22 | 322 | 47 | 4.5 | 0.12 | 437 | 0088-1L |
| 2195.00 | cut | Sltst : lt gy to w | 0.59 | 7.01 | 0.58 | 12.09 | 1.62 | 433 | 36 | 7.6 | 0.08 | 430 | 0090-1L |
| 2205.00 | cut | Sltst : lt gy to w | 0.36 | 3.92 | 0.56 | 7.00 | 1.18 | 332 | 47 | 4.3 | 0.08 | 433 | 0092-1L |
| 2215.00 | cut | Sh/Clst: m gy | 0.60 | 6.25 | 0.83 | 7.53 | 1.78 | 351 | 47 | 6.8 | 0.09 | 438 | 0094-2L |
| 2225.00 | cut | Sltst : lt gy to m gy | 0.32 | 2.38 | 0.70 | 3.40 | 1.01 | 236 | 69 | 2.7 | 0.12 | 440 | 0096-1L |
| 2235.00 | cut | Sh/Clst: lt gy to m gy | 0.61 | 6.18 | 1.00 | 6.18 | 1.91 | 324 | 52 | 6.8 | 0.09 | 437 | 0098-1L |
| 2240.00 | cut | S/Sst : lt gy | 0.06 | 0.34 | 0.36 | 0.94 | 0.25 | 136 | 144 | 0.4 | 0.15 | 437 | 0099-1L |

Depth unit of measure: m

| Depth | Typ | Lithology | S1 | S2 | S3 | S2/S3 | TOC | HI | OI | PP | PI | Tmax | Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2245.00 | cut | S/Sst : lt gy | 0.11 | 0.53 | 0.38 | 1.39 | 0.33 | 161 | 115 | 0.6 | 0.17 | 436 | 0100-1L |
| 2250.00 | cut | S/Sst : lt gy | 0.06 | 0.28 | 0.22 | 1.27 | 0.21 | 133 | 105 | 0.3 | 0.18 | 431 | 0101-1L |
| 2260.00 | cut | S/Sst : lt gy | 0.03 | 0.08 | 0.10 | 0.80 | 0.12 | 67 | 83 | 0.1 | 0.27 | 437 | 0103-1L |
| 2265.00 | cut | Sh/Clst: m gy to brn gy | 0.56 | 5.11 | 0.71 | 7.20 | 1.91 | 268 | 37 | 5.7 | 0.10 | 441 | 0104-2L |
| 2270.00 | cut | Ca : w to lt or to or gy | 0.26 | 0.75 | 2.13 | 0.35 | 0.69 | 109 | 309 | 1.0 | 0.26 | 437 | 0105-4L |
| 2275.00 | cut | Sltst : lt gy to w | 0.12 | 0.56 | 0.28 | 2.00 | 0.42 | 133 | 67 | 0.7 | 0.18 | 442 | 0106-3L |
| 2285.00 | cut | S/Sst : w to lt gy | 0.05 | 0.22 | 0.16 | 1.38 | 0.20 | 110 | 80 | 0.3 | 0.19 | 443 | 0108-2L |
| 2295.00 | cut | Sh/Clst: m gy to brn gy | 0.58 | 4.54 | 0.73 | 6.22 | 1.63 | 279 | 45 | 5.1 | 0.11 | 435 | 0110-1L |
| 2300.00 | cut | S/Sst : w to lt gy | 0.06 | 0.20 | 0.18 | 1.11 | 0.20 | 100 | 90 | 0.3 | 0.23 | 437 | 0111-2L |
| 2310.00 | cut | Sh/Clst: m gy to brn gy | 0.32 | 1.52 | 0.73 | 2.08 | 0.95 | 160 | 77 | 1.8 | 0.17 | 441 | 0113-1L |
| 2320.00 | cut | S/Sst : w to lt gy | 0.12 | 0.55 | 0.35 | 1.57 | 0.41 | 134 | 85 | 0.7 | 0.18 | 443 | 0115-2L |
| 2330.00 | cut | S/Sst : w to lt gy | 0.08 | 0.37 | 0.31 | 1.19 | 0.33 | 112 | 94 | 0.5 | 0.18 | 441 | 0117-2L |
| 2340.00 | cut | Sh/Clst: m gy to brn gy | 0.32 | 2.02 | 0.82 | 2.46 | 1.16 | 174 | 71 | 2.3 | 0.14 | 438 | 0119-1L |
| 2350.00 | cut | Sh/Clst: m gy | 0.34 | 2.07 | 0.78 | 2.65 | 1.35 | 153 | 58 | 2.4 | 0.14 | 439 | 0121-1L |
| 2360.00 | cut | S/Sst : w to lt gy | 0.09 | 0.34 | 0.38 | 0.89 | 0.31 | 110 | 123 | 0.4 | 0.21 | 438 | 0123-2L |

Table 2 : Rock-Eval table for well NOCS 31/4-7 

Depth unit of measure: m

| Depth | Typ | Lithology | S1 | S2 | S3 | S2/S3 | TOC | HI | OI | PP | PI | Tmax | Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2375.00 | cut | Sh/Clst: m gy | 0.55 | 2.58 | 0.72 | 3.58 | 1.34 | 193 | 54 | 3.1 | 0.18 | 438 | 0125-1L |
| 2385.00 | cut | S/Sst : w to lt gy | 0.18 | 0.51 | 0.27 | 1.89 | 0.36 | 142 | 75 | 0.7 | 0.26 | 442 | 0127-1L |
| 2395.00 | cut | S/Sst : w to lt gy | 0.06 | 0.14 | 0.14 | 1.00 | 0.14 | 100 | 100 | 0.2 | 0.30 | 437 | 0129-1L |
| 2405.00 | cut | S/Sst : w to lt gy | 0.13 | 0.41 | 0.27 | 1.52 | 0.31 | 132 | 87 | 0.5 | 0.24 | 432 | 0131-1L |
| 2415.00 | cut | S/Sst : w to lt gy | 0.31 | 0.56 | 0.22 | 2.55 | 0.45 | 124 | 49 | 0.9 | 0.36 | 442 | 0133-1L |
| 2425.00 | cut | S/Sst : w to lt gy | 0.13 | 0.11 | 0.11 | 1.00 | 0.13 | 85 | 85 | 0.2 | 0.54 | 435 | 0135-1L |
| 2435.00 | cut | S/Sst : w to lt gy | 0.12 | 0.19 | 0.15 | 1.27 | 0.16 | 119 | 94 | 0.3 | 0.39 | 434 | 0137-1L |
| 2455.00 | cut | S/Sst : w to lt gy | 0.27 | 0.12 | 0.07 | 1.71 | 0.10 | 120 | 70 | 0.4 | 0.69 | 443 | 0141-1L |
| 2475.00 | cut | S/Sst : w to lt gy | 0.19 | 0.12 | 0.08 | 1.50 | 0.11 | 109 | 73 | 0.3 | 0.61 | 440 | 0145-1L |
| 2495.00 | cut | S/Sst : w to lt gy | 0.16 | 0.10 | 0.06 | 1.67 | 0.09 | 111 | 67 | 0.3 | 0.62 | 439 | 0149-1L |
| 2500.00 | cut | Sh/Clst: m brn to pl brn | 0.15 | 0.95 | 0.81 | 1.17 | 0.20 | 475 | 405 | 1.1 | 0.14 | 545 | 0150-5L |

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Table 3 : Pyrolysis GC Data (S2 peak) as Percentage of Total Area for Well NOCS 31/4-7

Depth unit of measure: m

| Depth | Typ | Lithology | C1 | C2-C5 | C6-C14 | C15+ | S2 from Rock-Eval | Sample |
|---|---|---|---|---|---|---|---|---|
| 2010.00 | cut | Ca : lt or | 4.81 | 29.48 | 54.19 | 11.52 | 1.08 | 0075-2L |
| 2040.00 | cut | Ca : w to lt or to lt gy | 17.01 | 33.18 | 44.17 | 5.64 | 0.38 | 0081-3L |
| 2045.00 | ccp | Sltst : lt gy | 8.29 | 37.31 | 50.21 | 4.19 | 0.58 | 0001-1L |
| 2065.00 | ccp | Sltst : lt gy to lt brn gy | 6.63 | 24.74 | 46.14 | 22.49 | 1.70 | 0005-1L |
| 2080.00 | ccp | Sltst : lt brn gy | 6.24 | 24.19 | 48.13 | 21.44 | 1.35 | 0008-1L |
| 2095.00 | ccp | Sh/Clst: drk gy | 5.79 | 24.79 | 46.25 | 23.17 | 3.08 | 0011-1L |
| 2115.00 | ccp | Sltst : lt gy to m gy | 16.82 | 34.33 | 43.46 | 5.40 | 0.60 | 0015-1L |
| 2140.00 | ccp | Sh/Clst: pl y brn | 5.32 | 19.09 | 43.31 | 32.28 | 4.72 | 0020-1L |
| 2170.00 | cut | Sh/Clst: m gy | 5.24 | 0.06 | 72.86 | 21.84 | 1.01 | 0085-1L |
| 2195.00 | cut | Sltst : lt gy to w | 2.52 | 12.96 | 33.46 | 51.07 | 7.01 | 0090-1L |
| 2235.00 | cut | Sh/Clst: lt gy to m gy | 3.90 | 16.39 | 38.37 | 41.34 | 6.18 | 0098-1L |
| 2240.00 | cut | S/Sst : lt gy | 5.01 | 24.15 | 49.64 | 21.20 | 0.34 | 0099-1L |
| 2245.00 | cut | S/Sst : lt gy | 4.81 | 18.05 | 44.54 | 32.60 | 0.53 | 0100-1L |
| 2265.00 | cut | Sh/Clst: m gy to brn gy | 4.34 | 14.72 | 38.50 | 42.44 | 5.11 | 0104-2L |

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Table 3 : Pyrolysis GC Data (S2 peak) as Percentage of Total Area for Well NOCS 31/4-7

Depth unit of measure: m

| Depth | Typ | Lithology | C1 | C2-C5 | C6-C14 | C15+ | S2 from Rock-Eval | Sample |
|---|---|---|---|---|---|---|---|---|
| 2270.00 | cut | Ca : w to lt or to or gy | 8.56 | 27.12 | 48.18 | 16.14 | 0.75 | 0105-4L |
| 2295.00 | cut | Sh/Clst: m gy to brn gy | 4.02 | 16.29 | 37.24 | 42.45 | 4.54 | 0110-1L |
| 2320.00 | cut | S/Sst : w to lt gy | 13.81 | 39.23 | 40.30 | 6.65 | 0.55 | 0115-2L |
| 2350.00 | cut | Sh/Clst: m gy | 6.42 | 20.82 | 47.80 | 24.96 | 2.07 | 0121-1L |
| 2375.00 | cut | Sh/Clst: m gy | 6.16 | 17.87 | 48.26 | 27.71 | 2.58 | 0125-1L |
| 2385.00 | cut | S/Sst : w to lt gy | 9.89 | 20.78 | 50.90 | 18.43 | 0.51 | 0127-1L |
| 2415.00 | cut | S/Sst : w to lt gy | 8.76 | 21.23 | 45.05 | 24.96 | 0.56 | 0133-1L |
| 2500.00 | cut | Sh/Clst: m brn to pl brn | 10.63 | 33.32 | 42.11 | 13.94 | 0.95 | 0150-5L |

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Table 4 a: Weight of EOM and Chromatographic Fraction for well NOCS 31/4-7



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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | ccp | Sltst : lt gy | 5.7 | 8.9 | 1.1 | 3.2 | 0.7 | 3.9 | 4.3 | 4.6 | 0.57 | 0001-1L |
| 2065.00 | ccp | Sltst : lt gy to lt brn gy | 8.3 | 6.9 | 2.1 | 1.8 | 0.6 | 2.4 | 3.9 | 3.0 | 1.02 | 0005-1L |
| 2080.00 | ccp | Sltst : lt brn gy | 9.0 | 17.4 | 9.2 | 2.7 | 0.8 | 4.7 | 11.9 | 5.5 | 0.77 | 0008-1L |
| 2140.00 | ccp | Sh/Clst: pl y brn | 9.6 | 6.2 | 1.5 | 1.1 | 0.7 | 2.9 | 2.6 | 3.6 | 1.95 | 0020-1L |
| 2195.00 | com | Composite sample - see table 4 e | 1.0 | 3.7 | 0.9 | 0.6 | 0.5 | 1.7 | 1.5 | 2.2 | 0.99 | 0152-0B |
| 2265.00 | cut | Sh/Clst: m gy to brn gy | 2.1 | 4.0 | 0.8 | 0.5 | 0.6 | 2.1 | 1.3 | 2.7 | 2.18 | 0104-2L |
| 2397.90 | oil | bulk | - | 70.2 | 40.1 | 15.6 | 10.9 | 3.6 | 55.7 | 14.5 | - | 0151-0B |

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Table 4 b: Concentration of EOM and Chromatographic Fraction (wt ppm rock) for well NOCS 31/4-7

Depth unit of measure: m

| Depth | Typ | Lithology | EOM | Sat | Aro | Asph | NSO | HC | Non-HC | Sample |
|---|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | ccp | Sltst : lt gy | 1561 | 192 | 561 | 122 | 684 | 754 | 807 | 0001-1L |
| 2065.00 | ccp | Sltst : lt gy to lt brn gy | 828 | 252 | 216 | 72 | 288 | 468 | 360 | 0005-1L |
| 2080.00 | ccp | Sltst : lt brn gy | 1924 | 1017 | 298 | 88 | 519 | 1316 | 608 | 0008-1L |
| 2140.00 | ccp | Sh/Clst: pl y brn | 645 | 156 | 114 | 72 | 302 | 270 | 374 | 0020-1L |
| 2195.00 | com | Composite sample - see table 4 e | 3592 | 873 | 582 | 485 | 1650 | 1456 | 2135 | 0152-0B |
| 2265.00 | cut | Sh/Clst: m gy to brn gy | 1904 | 380 | 238 | 285 | 1000 | 619 | 1285 | 0104-2L |
| 2397.90 | oil | bulk | - | - | - | - | - | - | - | 0151-0B |

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Table 4 c: Concentration of EOM and Chromatographic Fraction (mg/g TOC(e)) for well NOCS 31/4-7



Depth unit of measure: m

| Depth | Typ | Lithology | EOM | Sat | Aro | Asph | NSO | HC | Non-HC | Sample |
|---|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | ccp | Sltst : lt gy | 273.93 | 33.86 | 98.49 | 21.55 | 120.04 | 132.35 | 141.58 | 0001-1L |
| 2065.00 | ccp | Sltst : lt gy to lt brn gy | 81.21 | 24.72 | 21.18 | 7.06 | 28.25 | 45.90 | 35.31 | 0005-1L |
| 2080.00 | ccp | Sltst : lt brn gy | 249.97 | 132.17 | 38.79 | 11.49 | 67.52 | 170.96 | 79.01 | 0008-1L |
| 2140.00 | ccp | Sh/Clst: pl y brn | 33.12 | 8.01 | 5.88 | 3.74 | 15.49 | 13.89 | 19.23 | 0020-1L |
| 2195.00 | com | Composite sample - see table 4 e | 362.85 | 88.26 | 58.84 | 49.03 | 166.72 | 147.10 | 215.75 | 0152-0B |
| 2265.00 | cut | Sh/Clst: m gy to brn gy | 87.37 | 17.47 | 10.92 | 13.11 | 45.87 | 28.40 | 58.98 | 0104-2L |
| 2397.90 | oil | bulk | - | - | - | - | - | - | - | 0151-0B |

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Table 4 d: Composition of material extracted from the rock (%) for well NOCS 31/4-7

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | ccp | Sltst : lt gy | 12.36 | 35.96 | 7.87 | 43.82 | 48.31 | 51.69 | 34.38 | 93.48 | 0001-1L |
| 2065.00 | ccp | Sltst : lt gy to lt brn gy | 30.43 | 26.09 | 8.70 | 34.78 | 56.52 | 43.48 | 116.67 | 130.00 | 0005-1L |
| 2080.00 | ccp | Sltst : lt brn gy | 52.87 | 15.52 | 4.60 | 27.01 | 68.39 | 31.61 | 340.74 | 216.36 | 0008-1L |
| 2140.00 | ccp | Sh/Clst: pl y brn | 24.19 | 17.74 | 11.29 | 46.77 | 41.94 | 58.06 | 136.36 | 72.22 | 0020-1L |
| 2195.00 | com | Composite sample - see table 4 e | 24.32 | 16.22 | 13.51 | 45.95 | 40.54 | 59.46 | 150.00 | 68.18 | 0152-0B |
| 2265.00 | cut | Sh/Clst: m gy to brn gy | 20.00 | 12.50 | 15.00 | 52.50 | 32.50 | 67.50 | 160.00 | 48.15 | 0104-2L |
| 2397.90 | oil | bulk | 57.12 | 22.22 | 15.53 | 5.13 | 79.34 | 20.66 | 257.05 | 384.14 | 0151-0B |

Table 4 e: List of composite samples appearing in the extraction tables for well NOCS 31/4-7 

Depth unit of measure: m

NOTE: Depths shown in tables 4 a to d correspond to the composite samples' lower depth.

| Upper depth | Lower depth | Typ | Sample | Depth | Typ | Lithology | Sample |
|---|---|---|---|---|---|---|---|
| 2190.00 | 2195.00 | com | 0152-0B is composed of: | 2190.00 | cut | Sltst : lt gy to w, kln | 0089-1L |
| | | | | 2195.00 | cut | Sltst : lt gy to w, kln | 0090-1L |

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Table 5 : Saturated Hydrocarbon Ratios for well NOCS 31/4-7



Depth unit of measure: m

| Depth | Typ | Lithology | Pristane / nC17 | Pristane / Phytane | Pristane + Phytane / nC17 + nC18 | Phytane / nC18 | CPI | Sample |
|---|---|---|---|---|---|---|---|---|
| 2045.00 | ccp | Sltst : lt gy | 0.91 | 1.30 | 0.76 | 0.63 | 1.04 | 0001-1L |
| 2065.00 | ccp | Sltst : lt gy to lt brn gy | 0.68 | 2.44 | 0.52 | 0.33 | 1.07 | 0005-1L |
| 2080.00 | ccp | Sltst : lt brn gy | 0.74 | 2.16 | 0.58 | 0.39 | 1.04 | 0008-1L |
| 2140.00 | ccp | Sh/Clst: pl y brn | 1.14 | 4.35 | 0.80 | 0.35 | 1.85 | 0020-1L |
| 2195.00 | com | bulk | 0.90 | 1.90 | 0.74 | 0.56 | 1.15 | 0152-0B |
| 2265.00 | cut | Sh/Clst: m gy to brn gy | 0.88 | 1.87 | 0.73 | 0.55 | 1.42 | 0104-2L |
| 2397.90 | oil | bulk | 0.72 | 1.44 | 0.64 | 0.56 | 1.05 | 0151-0B |

Table 6 : Aromatic Hydrocarbon Ratios for well NOCS 31/4-7



Depth unit of measure: m

| Depth | Typ | Lithology | MNR | DMNR | BPhR | 2/1MP | MPI1 | MPI2 | Rc | DBT/P | 4/1MDBT | (3+2) /1MDBT | Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | ccp | Sltst : lt gy | - | - | - | 0.81 | 0.81 | 0.82 | 0.89 | - | - | - | 0001-1L |
| 2065.00 | ccp | Sltst : lt gy to lt brn gy | 1.49 | 3.65 | 0.25 | 1.05 | 0.68 | 0.79 | 0.81 | - | - | - | 0005-1L |
| 2080.00 | ccp | Sltst : lt brn gy | 1.47 | 3.35 | 0.19 | 1.09 | 0.71 | 0.75 | 0.83 | - | - | - | 0008-1L |
| 2140.00 | ccp | Sh/Clst: pl y brn | 1.00 | 2.03 | 0.13 | 0.62 | 0.49 | 0.44 | 0.69 | - | - | - | 0020-1L |
| 2195.00 | com | bulk | - | - | - | - | - | - | - | - | - | - | 0152-0B |
| 2265.00 | cut | Sh/Clst: m gy to brn gy | 0.66 | 1.70 | 0.05 | 0.88 | 0.55 | 0.54 | 0.73 | - | - | - | 0104-2L |
| 2397.90 | oil | bulk | 1.22 | 2.03 | - | - | 0.45 | - | 0.67 | - | - | - | 0151-0B |

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Table 7 : Thermal Maturity Data for well NOCS 31/4-7

Depth unit of measure: m

| Depth | Typ | Lithology | Vitrinite Reflectance (%) | Number of Readings | Standard Deviation | Spore Fluorescence Colour | SCI | Tmax (°C) | Sample |
|---|---|---|---|---|---|---|---|---|---|
| 1000.00 | cut | bulk | 0.31 | 20 | 0.04 | 3-4 | - | - | 0023-0B |
| 1160.00 | cut | bulk | 0.33 | 10 | 0.05 | 4 | - | - | 0040-0B |
| 1440.00 | cut | bulk | 0.33 | 4 | 0.05 | 3-5 | - | - | 0046-0B |
| 1440.00 | cut | Sh/Clst: pl y brn to lt brn gy | - | - | - | - | 3.5 | - | 0046-1L |
| 1600.00 | cut | bulk | 0.36 | 7 | 0.05 | 3-5 | - | - | 0053-0B |
| 1740.00 | cut | bulk | 0.41 | 4 | 0.06 | 4 | - | - | 0060-0B |
| 1900.00 | cut | bulk | 0.32 | 3 | 0.03 | 4 | - | - | 0068-0B |
| 1900.00 | cut | Sh/Clst: m gy | - | - | - | - | 4.5(??) | - | 0068-1L |
| 2045.00 | ccp | bulk | 0.27 | 1 | 0.00 | 0 | - | - | 0001-0B |
| 2065.00 | ccp | Sltst : lt gy to lt brn gy | - | - | - | - | 5.0 | 431 | 0005-1L |
| 2095.00 | ccp | bulk | 0.37 | 8 | 0.04 | 4+5 | - | - | 0011-0B |
| 2095.00 | ccp | Sh/Clst: drk gy | - | - | - | - | 5.0-5.5 | 424 | 0011-1L |
| 2140.00 | ccp | Sh/Clst: pl y brn | - | - | - | - | 5.5-6.0 | 435 | 0020-1L |
| 2215.00 | cut | bulk | 0.39 | 19 | 0.06 | 4 | - | - | 0094-0B |

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Table 7 : Thermal Maturity Data for well NOCS 31/4-7

Depth unit of measure: m

| Depth | Typ | Lithology | Vitrinite Reflectance (%) | Number of Readings | Standard Deviation | Spore Fluorescence Colour | SCI | Tmax (°C) | Sample |
|---|---|---|---|---|---|---|---|---|---|
| 2235.00 | cut | Sh/Clst: lt gy to m gy | - | - | - | - | 5.5-6.0 | 437 | 0098-1L |
| 2265.00 | cut | Sh/Clst: m gy to brn gy | - | - | - | - | 5.5-6.0 | 441 | 0104-2L |
| 2345.00 | cut | bulk | 0.39 | 20 | 0.04 | 4 | - | - | 0120-0B |
| 2350.00 | cut | Sh/Clst: m gy | - | - | - | - | 6.0 | 439 | 0121-1L |
| 2405.00 | cut | bulk | 0.47 | 21 | 0.03 | 0 | - | - | 0131-0B |
| 2500.00 | cut | bulk | NDP | - | - | 4 | - | - | 0150-0B |
| 2500.00 | cut | Sh/Clst: m brn to pl brn | - | - | - | - | 6.0-6.5(?) | 545 | 0150-5L |

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Table 8 : Visual Kerogen Composition Data for well NOCS 31/4-7 

Depth unit of measure: m

| Depth | Typ | Lithology | LIPT % | Amor L | Lipt Det | Sp/Pol | Cuticl | Resin | Algae | Dinofl | Acrit | Bit L | INERT % | Fusin | SemFus | IntDet | Micrin | Sclero | Bit I | VITR % | Tellin | Collin | VitDet | Amor V | Bit V | Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1440.00 | cut | Sh/Clst: pl y brn to lt brn gy | 75 | | ** | * | | | * | ? | | | TR | | | * | | | | 25 | | | * | | | 0046-1L |
| 1900.00 | cut | Sh/Clst: m gy | 10 | | ** | * | | | * | * | | | 5 | | | * | | | | 85 | | | * | | | 0068-1L |
| 2065.00 | ccp | Sltst : lt gy to lt brn gy | 30 | | * | ** | | | | | | | 10 | | ** | * | | | | 60 | * | | * | | | 0005-1L |
| 2095.00 | ccp | Sh/Clst: drk gy | 65 | | | ** | * | | | ? | | | 15 | | * | | | | | 20 | ** | * | | | | 0011-1L |
| 2140.00 | ccp | Sh/Clst: pl y brn | 55 | | * | ** | | | * | * | | | 20 | | * | | | | | 25 | ** | * | | | | 0020-1L |
| 2235.00 | cut | Sh/Clst: lt gy to m gy | 90 | ** | | ** | | | * | ** | | | 10 | | | * | | | | TR | * | | ** | | | 0098-1L |
| 2265.00 | cut | Sh/Clst: m gy to brn gy | 50 | | * | ** | * | | * | | | | 20 | * | * | * | | | | 30 | ** | * | | | | 0104-2L |
| 2350.00 | cut | Sh/Clst: m gy | 20 | | * | ** | * | | * | ? | | | 15 | | * | ** | | | | 65 | ** | * | ** | | | 0121-1L |
| 2500.00 | cut | Sh/Clst: m brn to pl brn | NDP | | | * | | | | | | ? | NDP | | | * | | | | NDP | | | * | | | 0150-5L |

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Table 9a : Tabulation of carbon isotope data for EOM/EOM - fractions or Oils for well NOCS 31/4-7



Depth unit of measure: m

| Depth | Typ | Lithology | EOM/Oil | Saturated | Aromatic | NSO | Asphaltenes | Kerogen | Sample |
|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | ccp | | - | -28.15 | -27.90 | -27.64 | -25.87 | - | 0001-1L |
| 2080.00 | ccp | | -27.49 | -27.33 | -27.00 | -26.73 | -26.17 | - | 0008-1L |
| 2195.00 | cut | | - | -25.51 | -25.45 | -26.31 | -26.20 | - | 0090-1L |
| 2265.00 | cut | | - | -26.02 | -26.14 | -26.23 | -25.78 | - | 0104-2L |
| 2397.90 | oil | | -28.89 | -28.91 | -28.22 | -27.50 | -27.26 | - | 0151-0B |

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Table 9b : Tabulation of cv values from carbon isotope data for well NOCS 31/4-7



Depth unit of measure: m

| Depth | Typ | Lithology | Saturated | Aromatic | cv value | Interpretation | Sample |
|---|---|---|---|---|---|---|---|
| 2045.00 | ccp | | -28.15 | -27.90 | -2.37 | Marine | 0001-1L |
| 2080.00 | ccp | | -27.33 | -27.00 | -2.45 | Marine | 0008-1L |
| 2195.00 | cut | | -25.51 | -25.45 | -3.61 | Marine | 0090-1L |
| 2265.00 | cut | | -26.02 | -26.14 | -3.85 | Marine | 0104-2L |
| 2397.90 | oil | | -28.91 | -28.22 | -1.16 | Marine | 0151-0B |

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Table 10A: Variation in Triterpane Distribution (peak height) for Well NOCS 31/4-7



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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | Sltst | 1.02 | 0.50 | 0.12 | 0.41 | 0.29 | 0.18 | 0.10 | 0.25 | 0.09 | 0.12 | 0.92 | 0.30 | 0.10 | 59.29 | 0001-1 |
| 2080.00 | Sltst | 0.90 | 0.47 | 0.11 | 0.44 | 0.30 | 0.17 | 0.22 | 0.51 | 0.18 | 0.05 | 0.89 | 0.33 | 0.17 | 52.52 | 0008-1 |
| 2195.00 | Sltst | 4.70 | 0.82 | 0.15 | 0.38 | 0.27 | 0.06 | 0.03 | 0.09 | 0.03 | 0.04 | 0.87 | 0.31 | 0.21 | 47.58 | 0090-1 |
| 2265.00 | Sh/Clst | 11.22 | 0.92 | 0.21 | 0.55 | 0.35 | 0.06 | 0.08 | 0.15 | 0.08 | 0.02 | 0.78 | 0.36 | 0.30 | 39.15 | 0104-2 |
| 2397.90 | bulk | 0.66 | 0.40 | 0.08 | 0.39 | 0.28 | 0.06 | 0.12 | 0.32 | 0.11 | 0.05 | 0.93 | 0.30 | 0.10 | 61.98 | 0151-0 |

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Table 10B: Variation in Sterane Distribution (peak height) for Well NOCS 31/4-7

Depth unit of measure: m

| Depth | Lithology | Ratio1 | Ratio2 | Ratio3 | Ratio4 | Ratio5 | Ratio6 | Ratio7 | Ratio8 | Ratio9 | Ratio10 | Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | Sltst | 0.89 | 52.92 | 76.73 | 1.63 | 0.76 | 0.40 | 0.26 | 0.62 | 1.12 | 3.50 | 0001-1 |
| 2080.00 | Sltst | 0.77 | 40.32 | 75.42 | 0.99 | 0.79 | 0.37 | 0.26 | 0.61 | 0.68 | 2.57 | 0008-1 |
| 2195.00 | Sltst | 0.50 | 23.19 | 38.54 | 1.07 | 0.57 | 0.22 | 0.17 | 0.24 | 0.30 | 0.41 | 0090-1 |
| 2265.00 | Sh/Clst | 0.46 | 13.58 | 45.25 | 1.03 | 0.75 | 0.27 | 0.23 | 0.29 | 0.16 | 0.48 | 0104-2 |
| 2397.90 | bulk | 0.78 | 46.11 | 80.95 | 1.03 | 0.82 | 0.33 | 0.23 | 0.68 | 0.86 | 3.94 | 0151-0 |

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

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Table 10C: Variation in Triaromatic Sterane Distribution for Well NOCS 31/4-7



Depth unit of measure: m

| Depth | Lithology | Ratio1 | Ratio2 | Ratio3 | Ratio4 | Ratio5 | Sample |
|---|---|---|---|---|---|---|---|
| 2045.00 | Sltst | 0.77 | 0.78 | 0.57 | 0.51 | 0.65 | 0001-1 |
| 2080.00 | Sltst | - | - | - | - | - | 0008-1 |
| 2195.00 | Sltst | - | - | - | - | - | 0090-1 |
| 2265.00 | Sh/Clst | - | - | - | - | - | 0104-2 |
| 2397.90 | bulk | 0.43 | 0.45 | 0.24 | 0.21 | 0.30 | 0151-0 |

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 10D: Variation in Monoaromatic Sterane Distribution for Well NOCS 31/4-7

Depth unit of measure: m

| Depth | Lithology | Ratio1 | Ratio2 | Ratio3 | Ratio4 | Sample |
|---|---|---|---|---|---|---|
| 2045.00 | Sltst | 0.45 | 0.39 | 0.31 | 0.28 | 0001-1 |
| 2080.00 | Sltst | 0.48 | 0.24 | 0.31 | 0.22 | 0008-1 |
| 2195.00 | Sltst | 0.09 | 0.04 | 0.05 | 0.04 | 0090-1 |
| 2265.00 | Sh/Clst | 0.20 | 0.10 | 0.12 | 0.09 | 0104-2 |
| 2397.90 | bulk | 0.40 | 0.28 | 0.26 | 0.22 | 0151-0 |

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

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Table 10E: Aromatisation of Steranes for Well NOCS 31/4-7



Depth unit of measure: m

| Depth | Lithology | Ratio1 | Ratio2 | Sample |
|---|---|---|---|---|
| 2045.00 | Sltst | 0.39 | 0.96 | 0001-1 |
| 2080.00 | Sltst | 1.00 | - | 0008-1 |
| 2195.00 | Sltst | 1.00 | - | 0090-1 |
| 2265.00 | Sh/Clst | 0.58 | 0.73 | 0104-2 |
| 2397.90 | bulk | 0.34 | 0.90 | 0151-0 |

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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Depth unit of measure: m

| Depth | Lithology | p | q | r | s | t | a | b | z | c | x | d | e | f | g | h | i | j1 | j2 | k1 | k2 | l1 | l2 | m1 | m2 | Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | Sltst | 27.18 | 16.25 | 8.76 | 9.46 | 5.94 | 19.55 | 19.85 | 13.80 | 56.03 | 24.64 | 7.77 | 137.45 | 11.28 | 66.11 | 45.91 | 9.74 | 50.75 | 34.85 | 45.55 | 28.37 | 29.49 | 19.53 | 28.48 | 16.99 | 0001-1 |
| 2080.00 | Sltst | 10.49 | 7.76 | 3.63 | 8.88 | 3.71 | 26.48 | 23.94 | 36.58 | 72.11 | 28.31 | 20.86 | 165.13 | 20.55 | 53.99 | 41.78 | 8.42 | 28.59 | 25.85 | 28.72 | 15.42 | 21.97 | 11.63 | 13.70 | 7.49 | 0008-1 |
| 2195.00 | Sltst | 3.10 | 1.23 | 1.11 | 1.63 | 1.38 | 1.44 | 6.77 | 1.17 | 12.89 | 1.90 | 4.50 | 34.04 | 5.23 | 9.72 | 8.64 | 3.56 | 2.66 | 2.93 | 2.10 | 2.09 | 1.31 | 2.43 | 1.81 | 0.00 | 0090-1 |
| 2265.00 | Sh/Clst | 10.38 | 3.06 | 2.39 | 3.56 | 0.72 | 3.70 | 41.51 | 10.35 | 67.93 | 7.66 | 22.96 | 124.14 | 34.67 | 60.97 | 53.89 | 22.75 | 12.12 | 18.84 | 5.22 | 8.32 | 5.38 | 5.86 | 2.49 | 3.87 | 0104-2 |
| 2397.90 | bulk | 30.49 | 29.32 | 13.75 | 23.08 | 6.54 | 81.47 | 53.49 | 72.59 | 228.24 | 32.39 | 36.45 | 587.38 | 43.90 | 194.96 | 122.88 | 25.04 | 141.53 | 86.82 | 121.62 | 66.93 | 65.54 | 41.56 | 52.39 | 36.78 | 0151-0 |

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Table 10G: Raw GCMS sterane data (peak height) for Well NOCS 31/4-7 

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | Sltst | 38.38 | 10.54 | 101.18 | 57.70 | 29.90 | 25.71 | 37.94 | 26.90 | 20.75 | 58.78 | 34.88 | 12.71 | 38.93 | 14.52 | 10.97 | 19.23 | 27.93 | 6.99 | 14.75 | 21.18 | 24.76 | 13.12 | 0001-1 |
| 2080.00 | Sltst | 30.98 | 12.87 | 45.47 | 28.69 | 13.38 | 10.31 | 19.39 | 12.71 | 14.87 | 39.90 | 24.13 | 13.65 | 28.77 | 11.07 | 6.10 | 19.33 | 21.67 | 6.40 | 11.92 | 22.67 | 22.68 | 17.64 | 0008-1 |
| 2195.00 | Sltst | 4.40 | 0.00 | 6.89 | 5.26 | 2.67 | 3.07 | 3.07 | 2.95 | 3.45 | 6.42 | 2.59 | 6.90 | 4.82 | 2.49 | 0.00 | 3.04 | 2.52 | 2.87 | 2.78 | 3.76 | 0.00 | 9.21 | 0090-1 |
| 2265.00 | Sh/Clst | 20.11 | 4.43 | 26.10 | 18.95 | 7.40 | 8.07 | 7.74 | 5.67 | 7.39 | 26.11 | 5.84 | 30.94 | 20.33 | 6.91 | 3.92 | 5.66 | 3.58 | 10.95 | 6.26 | 13.45 | 5.60 | 39.83 | 0104-2 |
| 2397.90 | bulk | 78.86 | 25.98 | 106.14 | 64.80 | 23.36 | 21.72 | 40.34 | 32.61 | 35.15 | 82.65 | 63.89 | 29.30 | 59.85 | 21.67 | 20.02 | 46.21 | 57.55 | 11.83 | 31.64 | 81.02 | 64.77 | 36.98 | 0151-0 |

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Table 10H: Raw GCMS trioaromatic sterane data (peak height) for Well NOCS 31/4-7 

Depth unit of measure: m

| Depth | Lithology | a1 | b1 | c1 | d1 | e1 | f1 | g1 | Sample |
|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | Sltst | 592.50 | 609.88 | 0.00 | 315.06 | 186.20 | 216.29 | 176.87 | 0001-1 |
| 2080.00 | Sltst | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0008-1 |
| 2195.00 | Sltst | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0090-1 |
| 2265.00 | Sh/Clst | 0.00 | 0.00 | 73.19 | 200.43 | 72.79 | 72.54 | 99.07 | 0104-2 |
| 2397.90 | bulk | 420.07 | 465.21 | 238.17 | 965.97 | 640.97 | 392.78 | 564.52 | 0151-0 |

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Table 10I: Raw GCMS monoaromatic sterane data (peak height) for Well NOCS 31/4-7



Depth unit of measure: m

| Depth | Lithology | a1 | b1 | c1 | d1 | e1 | f1 | g1 | h1 | i1 | Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2045.00 | Sltst | 129.04 | 101.32 | 96.40 | 79.65 | 157.65 | 50.59 | 123.09 | 65.66 | 7.16 | 0001-1 |
| 2080.00 | Sltst | 71.91 | 24.37 | 36.46 | 43.95 | 77.22 | 15.45 | 81.28 | 57.41 | 25.52 | 0008-1 |
| 2195.00 | Sltst | 9.14 | 3.39 | 27.74 | 31.13 | 89.27 | 5.14 | 75.50 | 59.30 | 20.19 | 0090-1 |
| 2265.00 | Sh/Clst | 49.65 | 21.39 | 73.25 | 84.97 | 196.79 | 23.82 | 172.23 | 114.22 | 36.93 | 0104-2 |
| 2397.90 | bulk | 260.64 | 148.91 | 200.88 | 122.58 | 391.04 | 87.72 | 339.89 | 218.27 | 61.37 | 0151-0 |

# Appendix 2

Vitrinie Reflectance Histograms

# Vitrinite Reflectance Histogram

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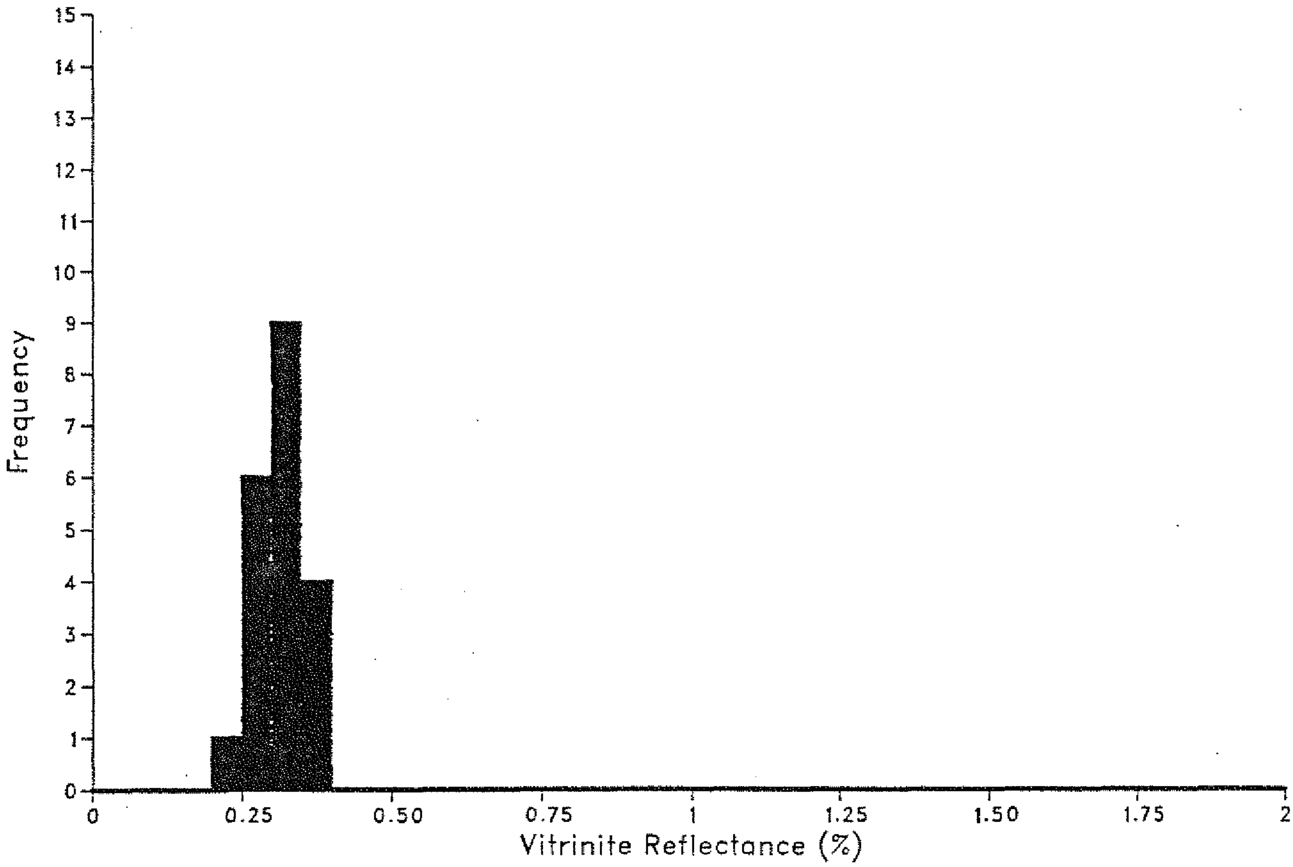
Well: NOCS 31/4-7
Depth: 1000.00(m )




| Statistics: | Mean | St.Dev. | n |
|---|---|---|---|
| Indigenous Population (from 0.200 to 0.400): | 0.31 | 0.04 | 20 |

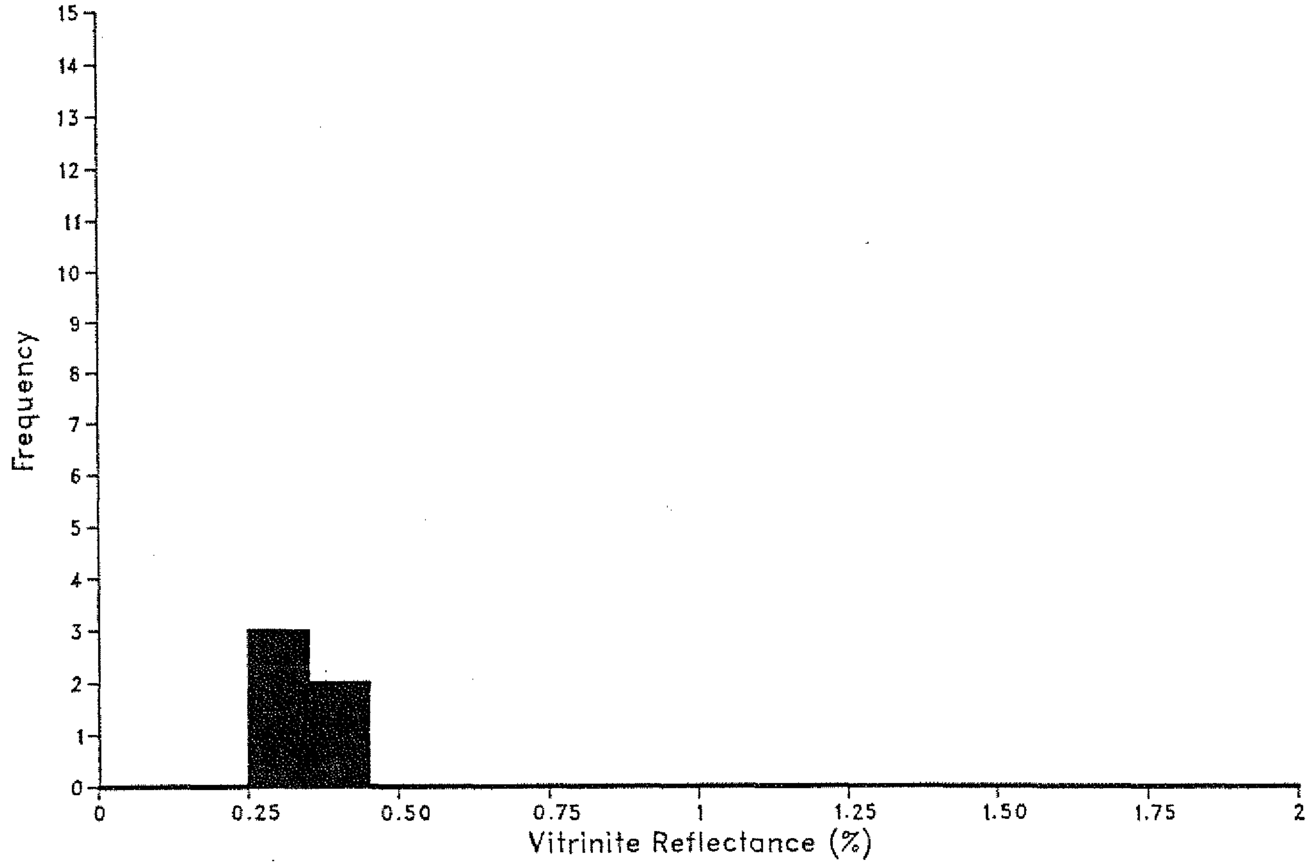
Readings:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.240 | 0.260 | 0.261 | 0.270 | 0.271 | 0.280 | 0.281 | 0.300 | 0.301 | 0.302 |
| 0.310 | 0.320 | 0.330 | 0.331 | 0.332 | 0.340 | 0.350 | 0.351 | 0.370 | 0.380 |

# Vitrinite Reflectance Histogram

GEOLAB NOR

Well: NOCS 31/4-7
Depth: 1160.00(m )




| Statistics: | Mean | St.Dev. | n |
|---|---|---|---|
| Indigenous Population (from 0.250 to 0.450): | 0.33 | 0.05 | 10 |

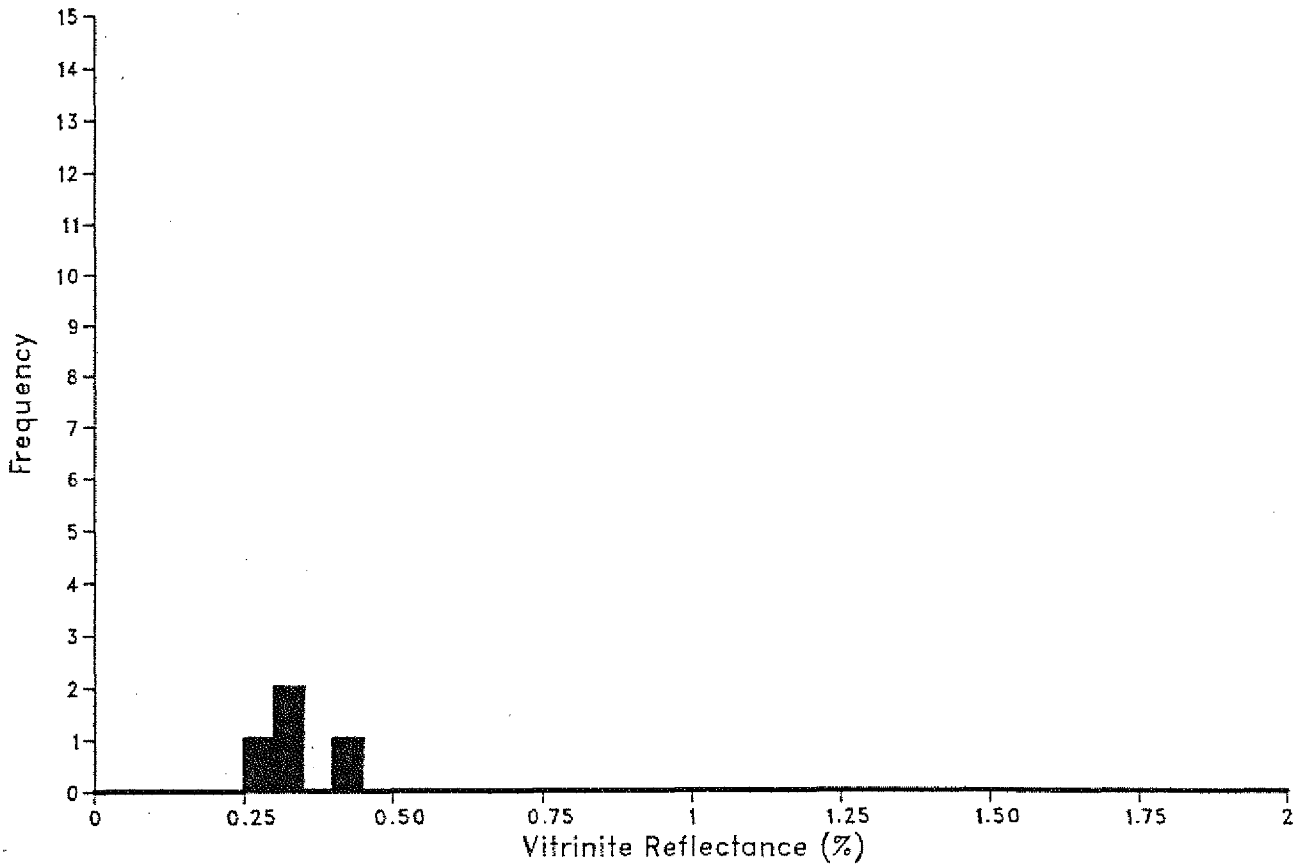
Readings:

0.290 0.291 0.292 0.300 0.310 0.311 0.350 0.351 0.410 0.420

# Vitrinite Reflectance Histogram

GEOLAB NOR

Well: NOCS 31/4-7
Depth: 1440.00(m )




| Statistics: | Mean | St.Dev. | n |
|---|---|---|---|
| Indigenous Population (from 0.250 to 0.400): | 0.33 | 0.05 | 4 |

Readings:

0.290 0.300 0.330 0.400

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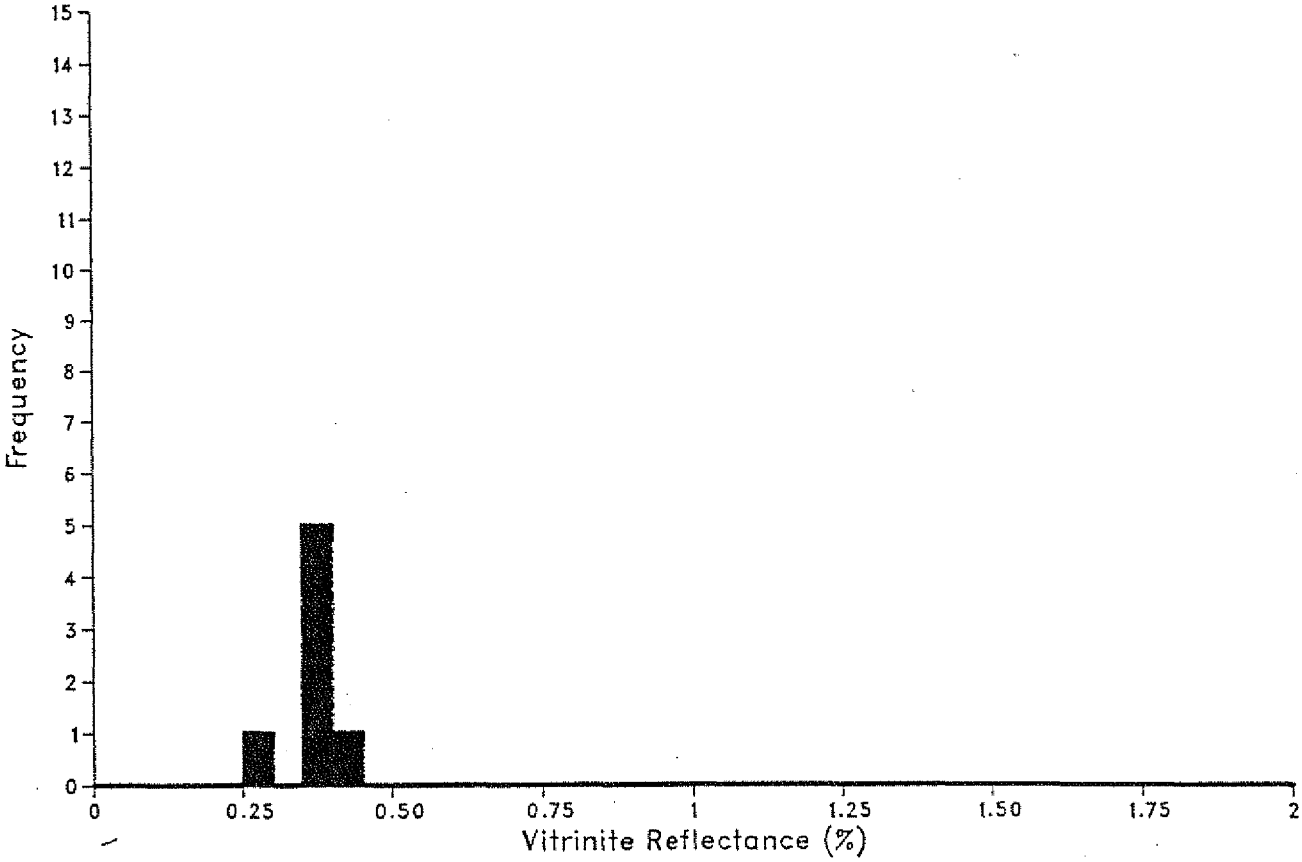
# Vitrinite Reflectance Histogram

GEOLAB NOR

Well: NOCS 31/4-7
Depth: 1600.00(m )




| Statistics: | Mean | St.Dev. | n |
|---|---|---|---|
| Indigenous Population (from 0.250 to 0.450): | 0.36 | 0.05 | 7 |

Readings:

0.250 0.350 0.360 0.370 0.380 0.381 0.420

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# Vitrinite Reflectance Histogram

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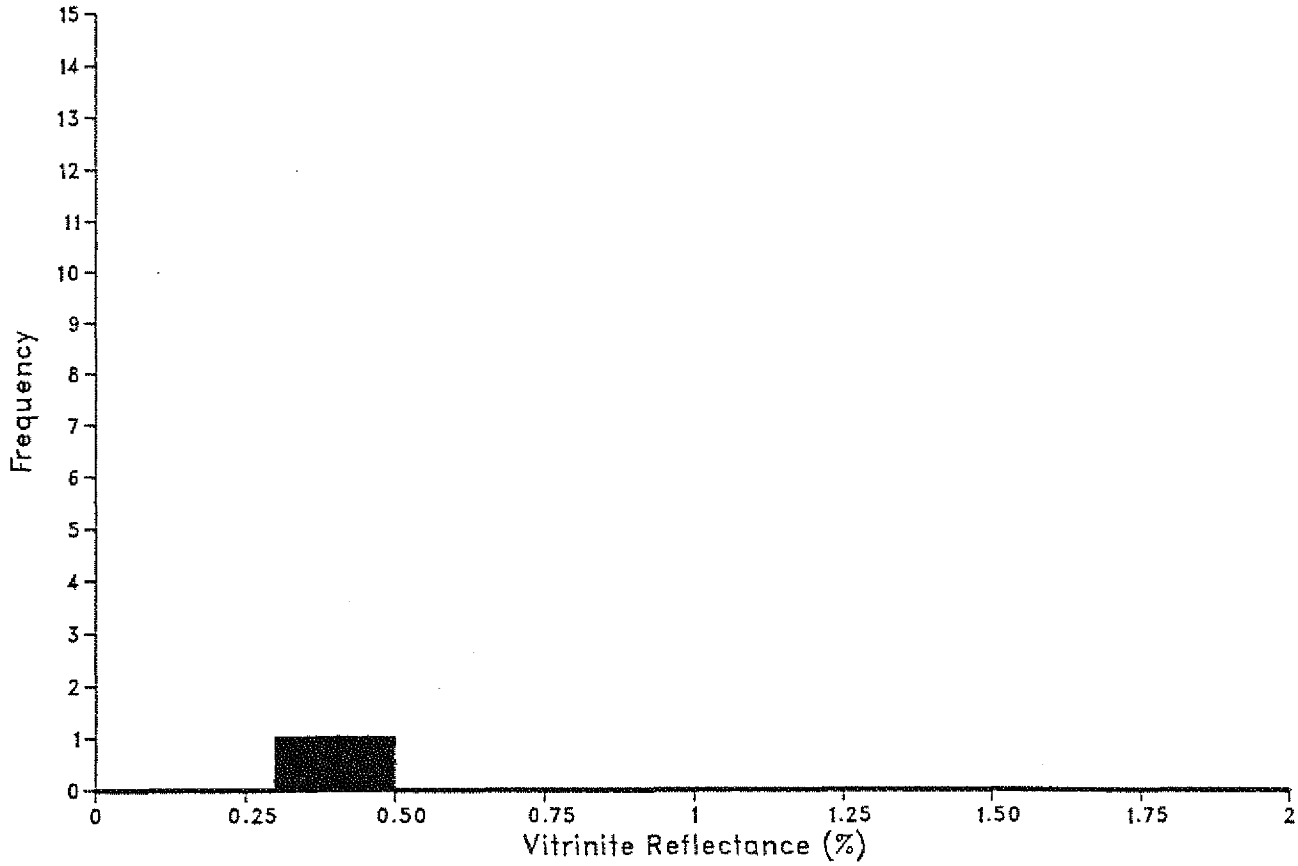
Well: NOCS 31/4-7
Depth: 1740.00(m )




| Statistics: | Mean | St.Dev. | n |
|---|---|---|---|
| Indigenous Population (from 0.300 to 0.500): | 0.41 | 0.06 | 4 |

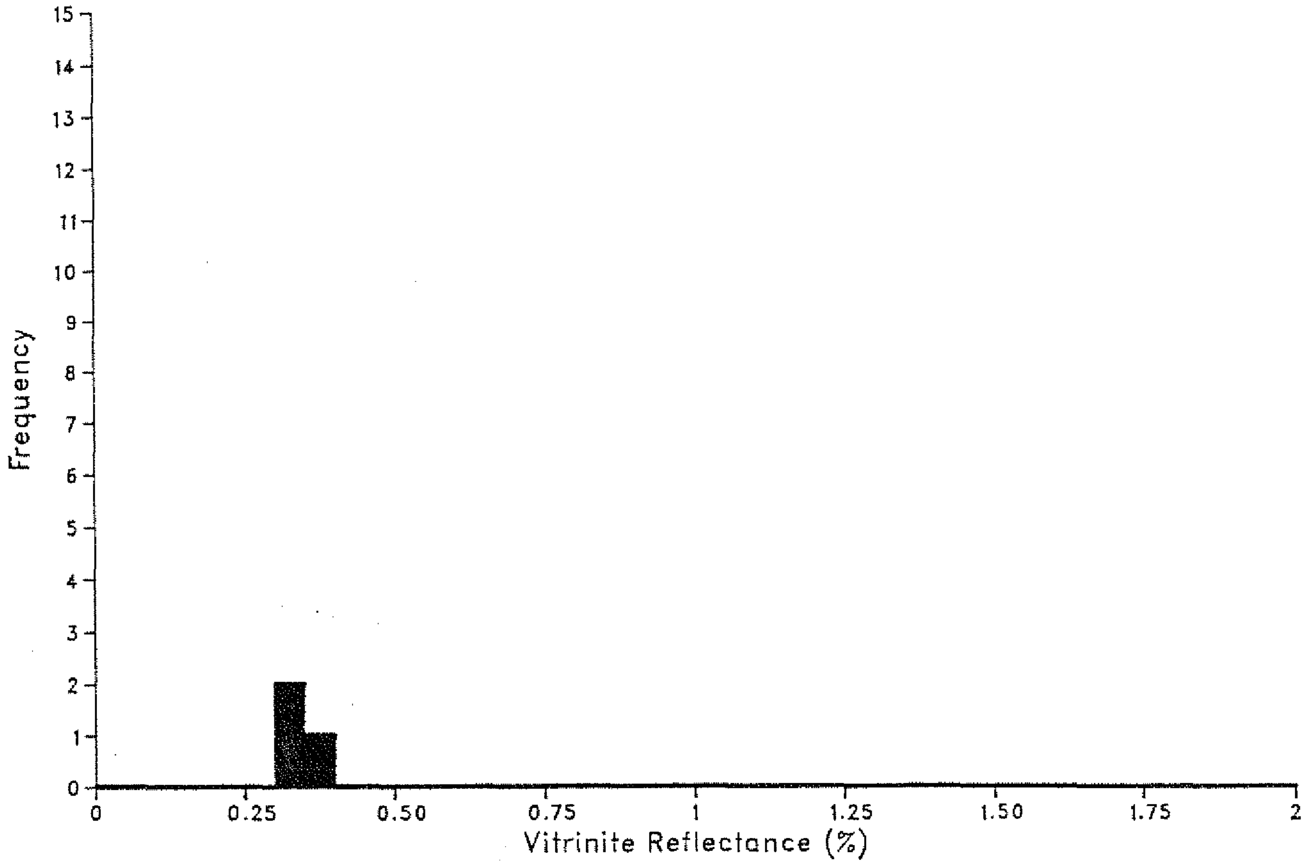
Readings:

0.340 0.390 0.430 0.480

# Vitrinite Reflectance Histogram

GEOLAB NOR

Well: NOCS 31/4-7
Depth: 1900.00(m )




| Statistics: | Mean | St.Dev. | n |
|---|---|---|---|
| Indigenous Population (from 0.300 to 0.350): | 0.32 | 0.03 | 3 |

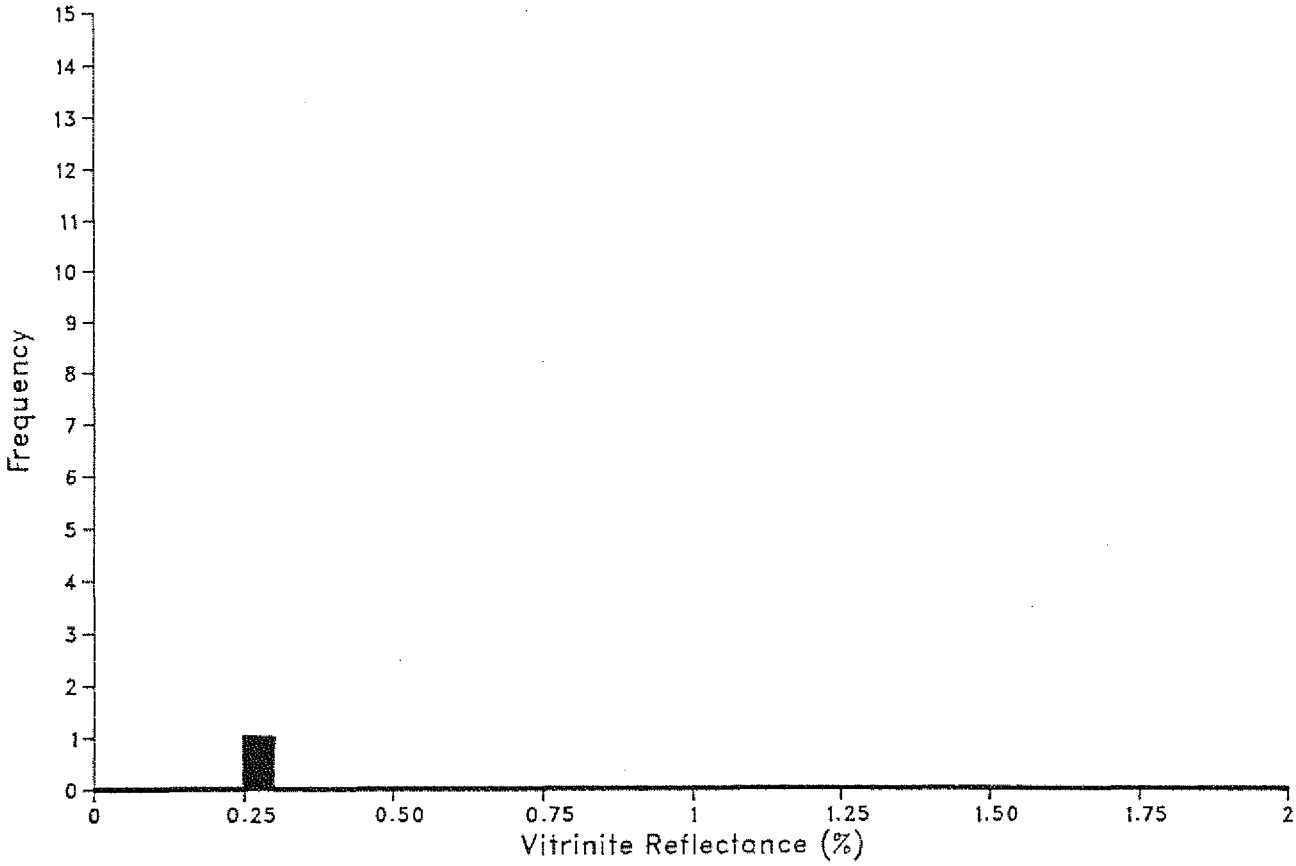
Readings:

0.300 0.320 0.350

# Vitrinite Reflectance Histogram

GEOLAB NOR

Well: NOCS 31/4-7
Depth: 2045.00(m )



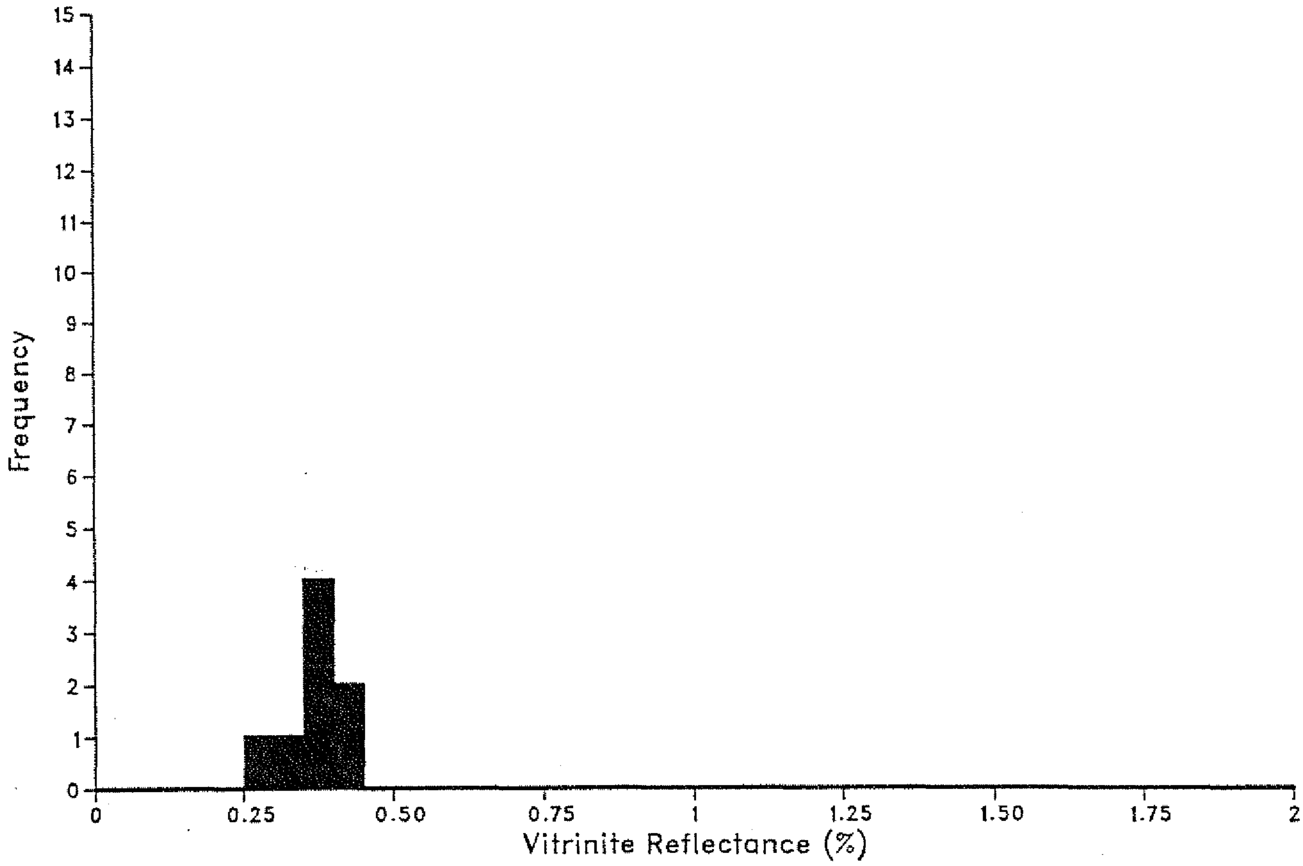

| Statistics: | Mean | St.Dev. | n |
|---|---|---|---|
| Indigenous Population (from 0.250 to 0.300):- | 0.27 | 0.00 | 1 |

Readings:
0.270

# Vitrinite Reflectance Histogram

GEOLAB NOR

Well: NOCS 31/4-7
Depth: 2095.00(m )




| Statistics: | Mean | St.Dev. | n |
|---|---|---|---|
| Indigenous Population (from 0.250 to 0.450): | 0.37 | 0.04 | 8 |

Readings:

0.290 0.330 0.360 0.370 0.371 0.380 0.400 0.440

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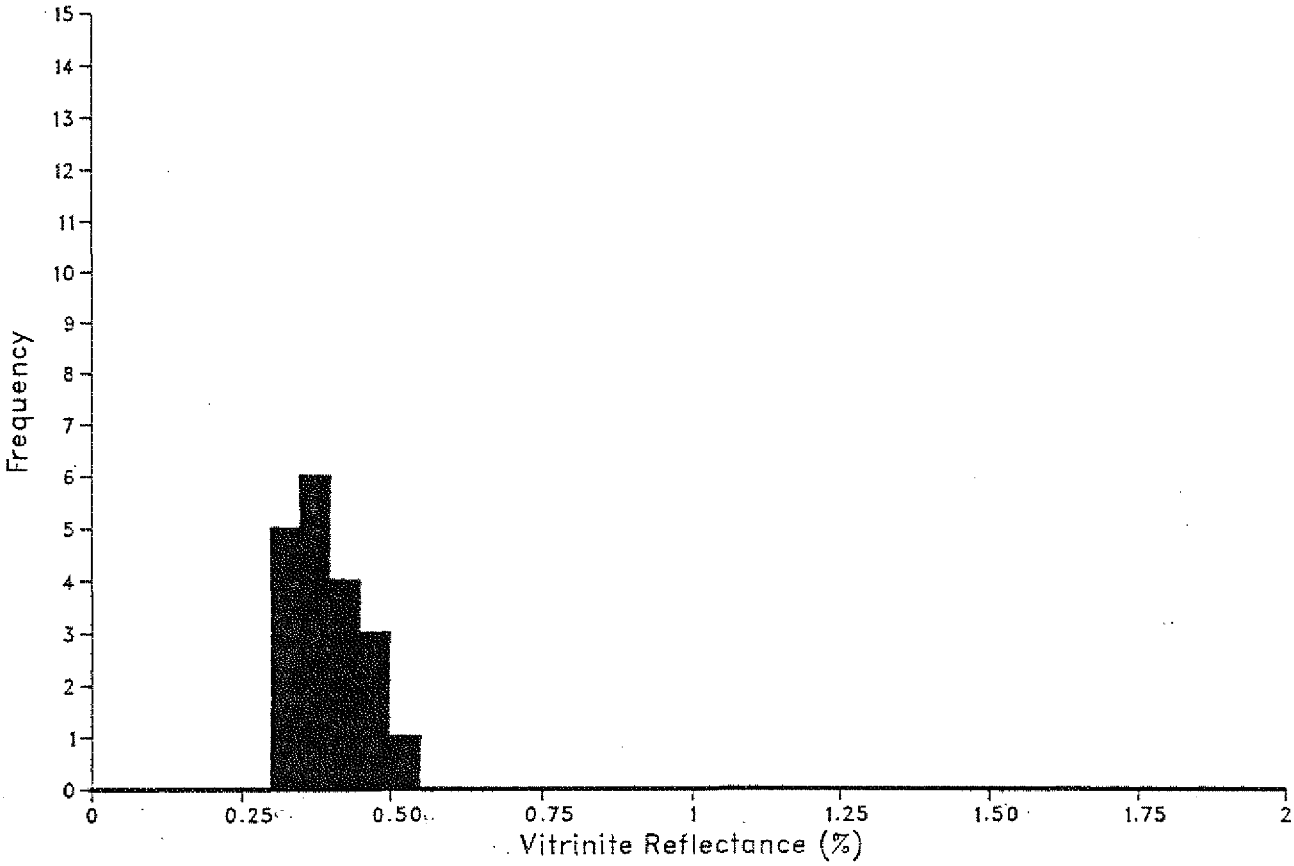
# Vitrinite Reflectance Histogram

GEOLAB NOR

Well: NOCS 31/4-7
Depth: 2215.00(m )




| Statistics: | Mean | St.Dev. | n |
|---|---|---|---|
| Indigenous Population (from 0.300 to 0.550): | 0.39 | 0.06 | 19 |

Readings:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 0.310 | 0.330 | 0.340 | 0.341 | 0.350 | 0.351 | 0.380 | 0.390 | 0.391 |
| 0.392 | 0.400 | 0.410 | 0.420 | 0.430 | 0.460 | 0.470 | 0.490 | 0.520 | |

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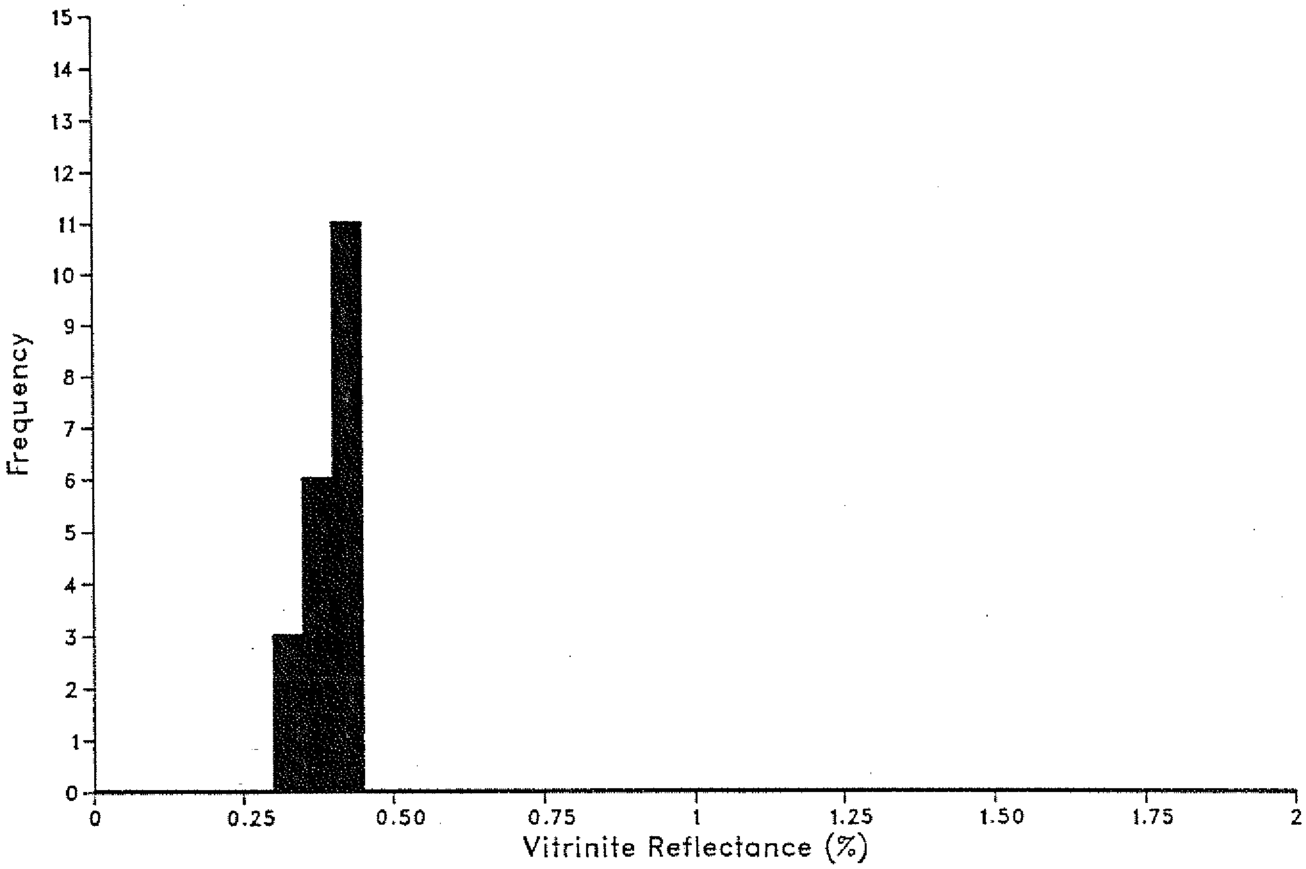
# Vitrinite Reflectance Histogram

GEOLAB NOR

Well: NOCS 31/4-7
Depth: 2345.00(m )




| Statistics: | Mean | St.Dev. | n |
|---|---|---|---|
| Indigenous Population (from 0.300 to 0.450): | 0.39 | 0.04 | 20 |

Readings:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.320 | 0.330 | 0.340 | 0.350 | 0.360 | 0.361 | 0.380 | 0.381 | 0.390 | 0.400 |
| 0.401 | 0.402 | 0.410 | 0.420 | 0.430 | 0.431 | 0.440 | 0.441 | 0.442 | 0.443 |

# Vitrinite Reflectance Histogram

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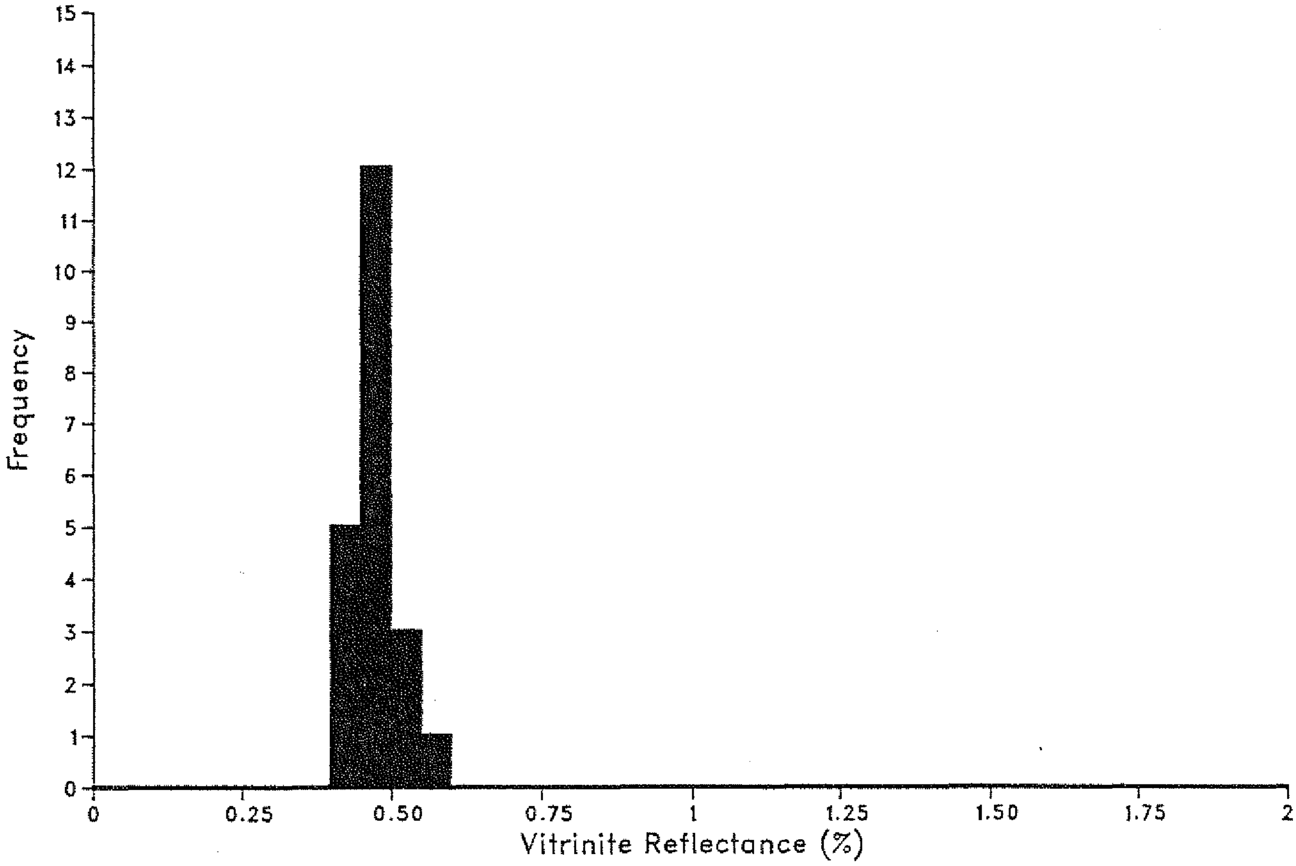
Well: NOCS 31/4-7
Depth: 2405.00(m )




| Statistics: | Mean | St.Dev. | n |
|---|---|---|---|
| Indigenous Population (from 0.400 to 0.550): | 0.47 | 0.03 | 21 |

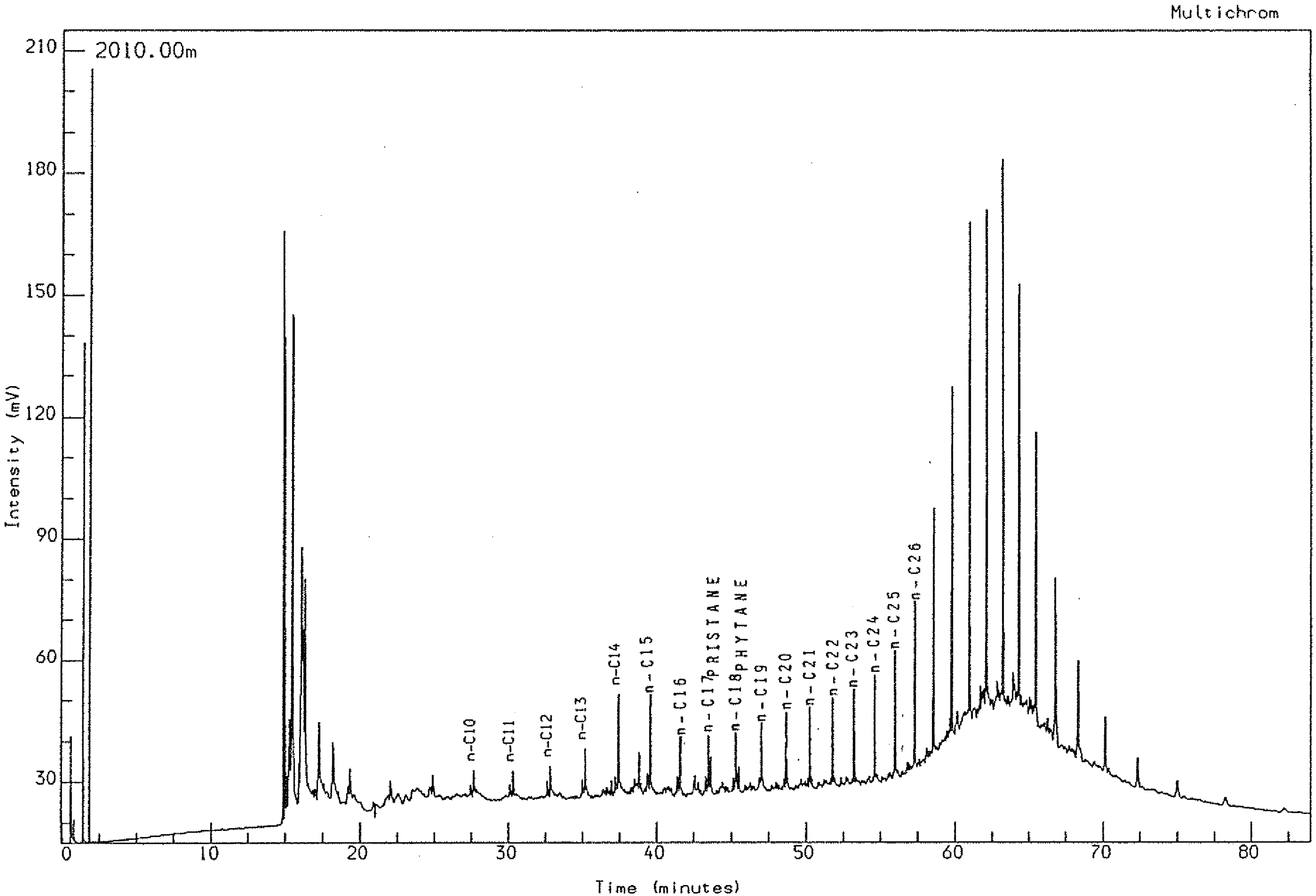
Readings:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.400 | 0.410 | 0.420 | 0.440 | 0.449 | 0.450 | 0.451 | 0.452 | 0.453 | 0.454 |
| 0.460 | 0.461 | 0.470 | 0.471 | 0.490 | 0.491 | 0.492 | 0.500 | 0.501 | 0.502 |
| 0.550 | | | | | | | | | |

# Appendix 3

## GHM-Thermal Extraction Gas Chromatograms and Pyrolysis Gas Chromatography (Pyrograms)

Analysis Name : [522006] 23 PF1100752,1,1.



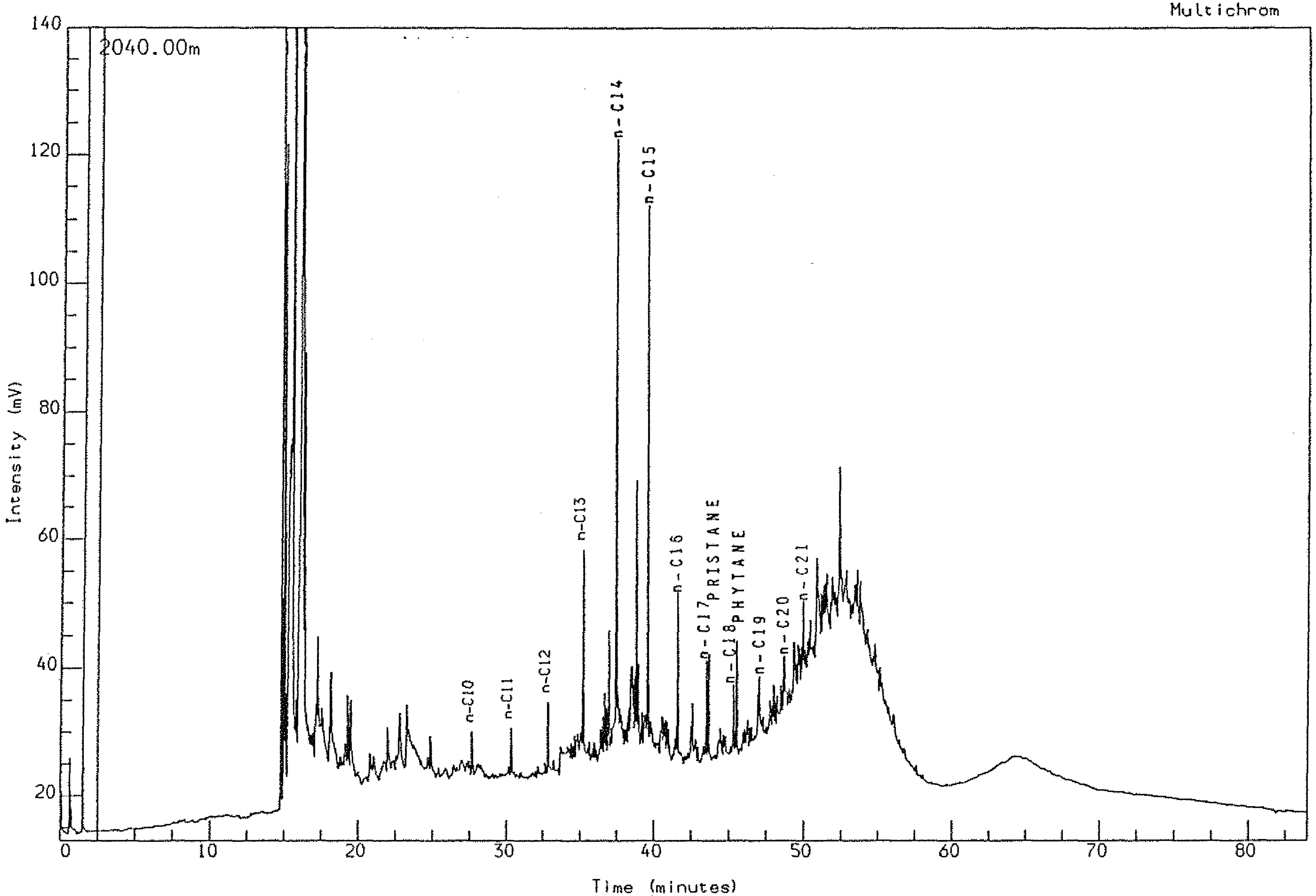

WELL NOCS 31/4-7 2010.00m cut Reported on 17-JUN-1991 at 12:18

THERMAL EXTRACTION GC (S1)

Cat lt or

GEOLAB NOR

Analysis Name : [522006] 23 PF1100813,1,1.

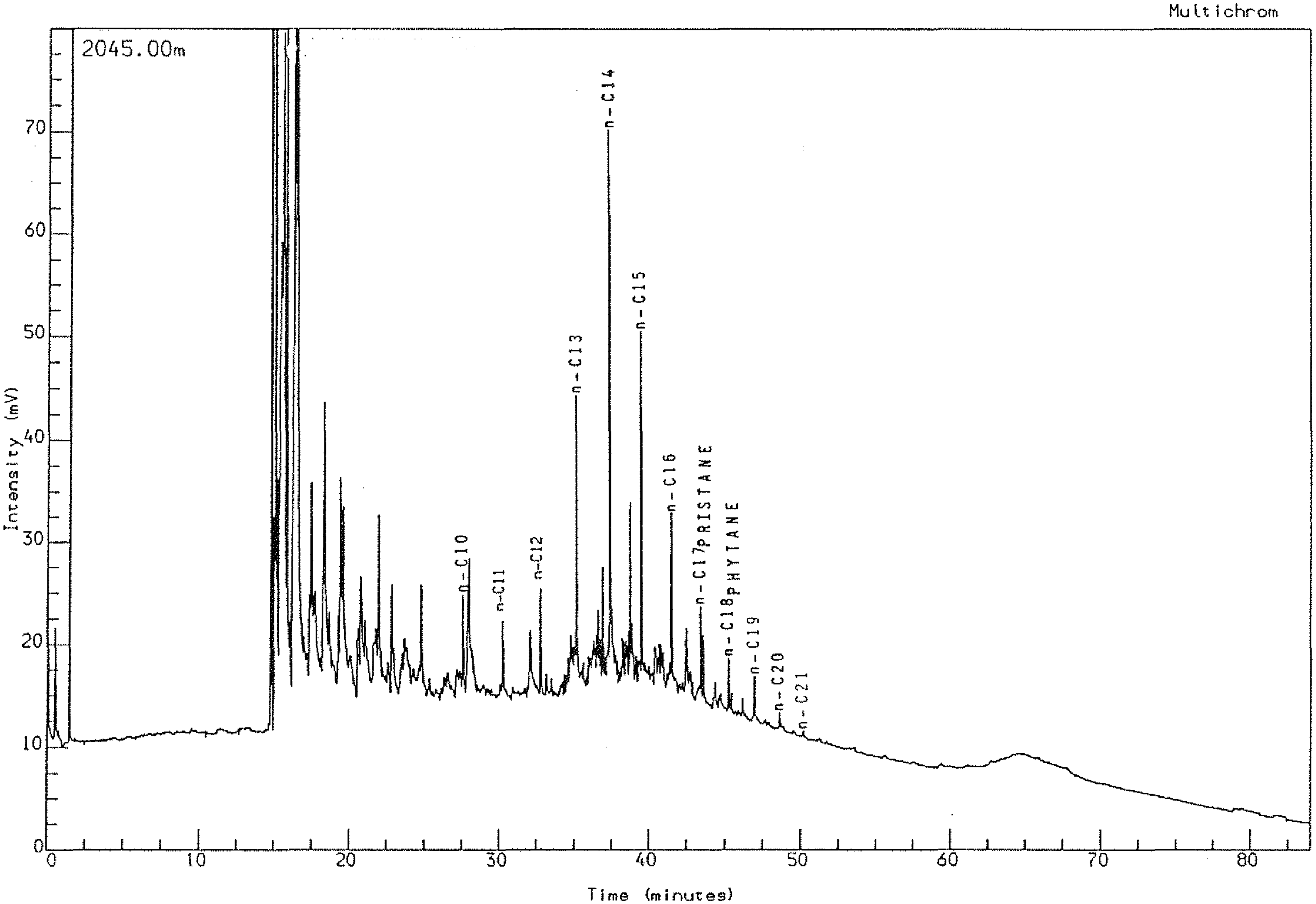



WELL NOCS 31/4-7 2040.00m cut
THERMAL EXTRACTION GC (S1)
Ca: w to lt or to lt gy

Reported on 17-JUN-1991 at 12:23

GEOLAB NOR

Analysis Name : [522006] 23 PF1100011,1,1.

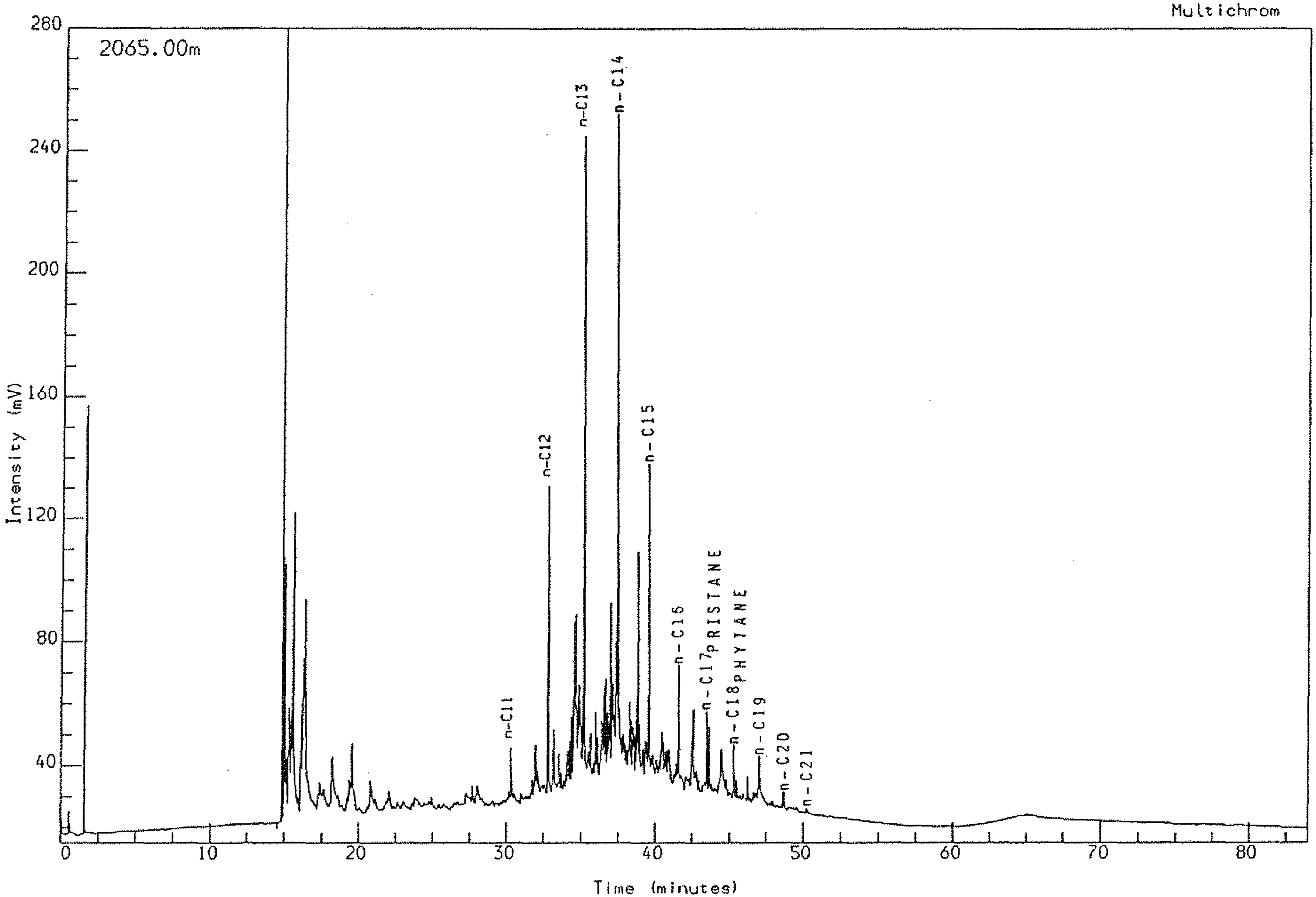



WELL NOCS 31/4-7 2045.00m ccp Reported on 17-JUN-1991 at 12:24

GEOLAB NOR

THERMAL EXTRACTION GC (S1)
Sltst: lt gy

Analysis Name : [522006] 23 PF1100051.1.1.

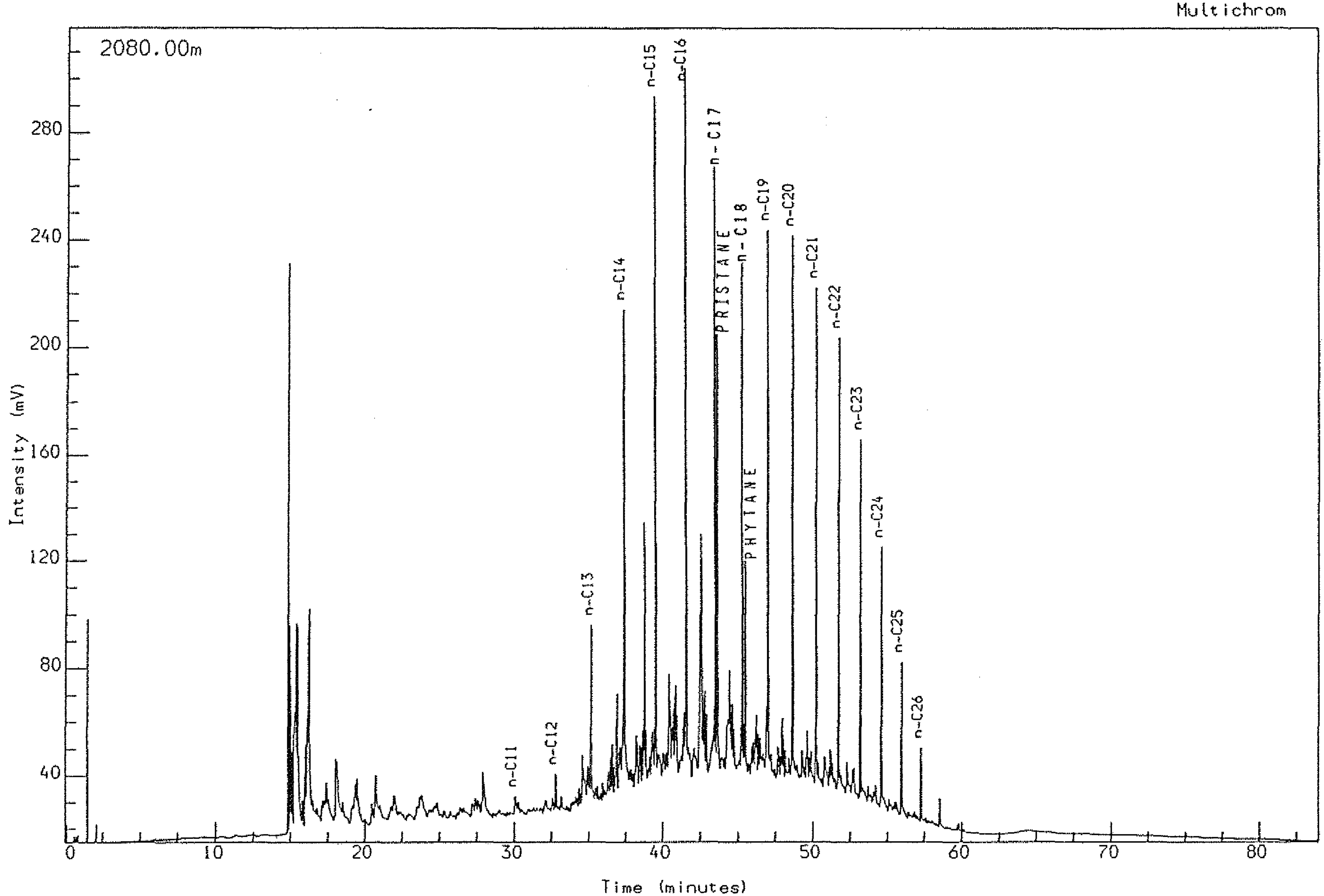



WELL NOCS 31/4-7 2065.00m ccp
THERMAL EXTRACTION GC (S1)
Sltst: lt gy to lt brn gy

Reported on 17-JUN-1991 at 12:26

GEOLAB NOR

Analysis Name : [522006] 23 PF1100081,1,1.




WELL NOCS 31/4-7 2080.00m ccp

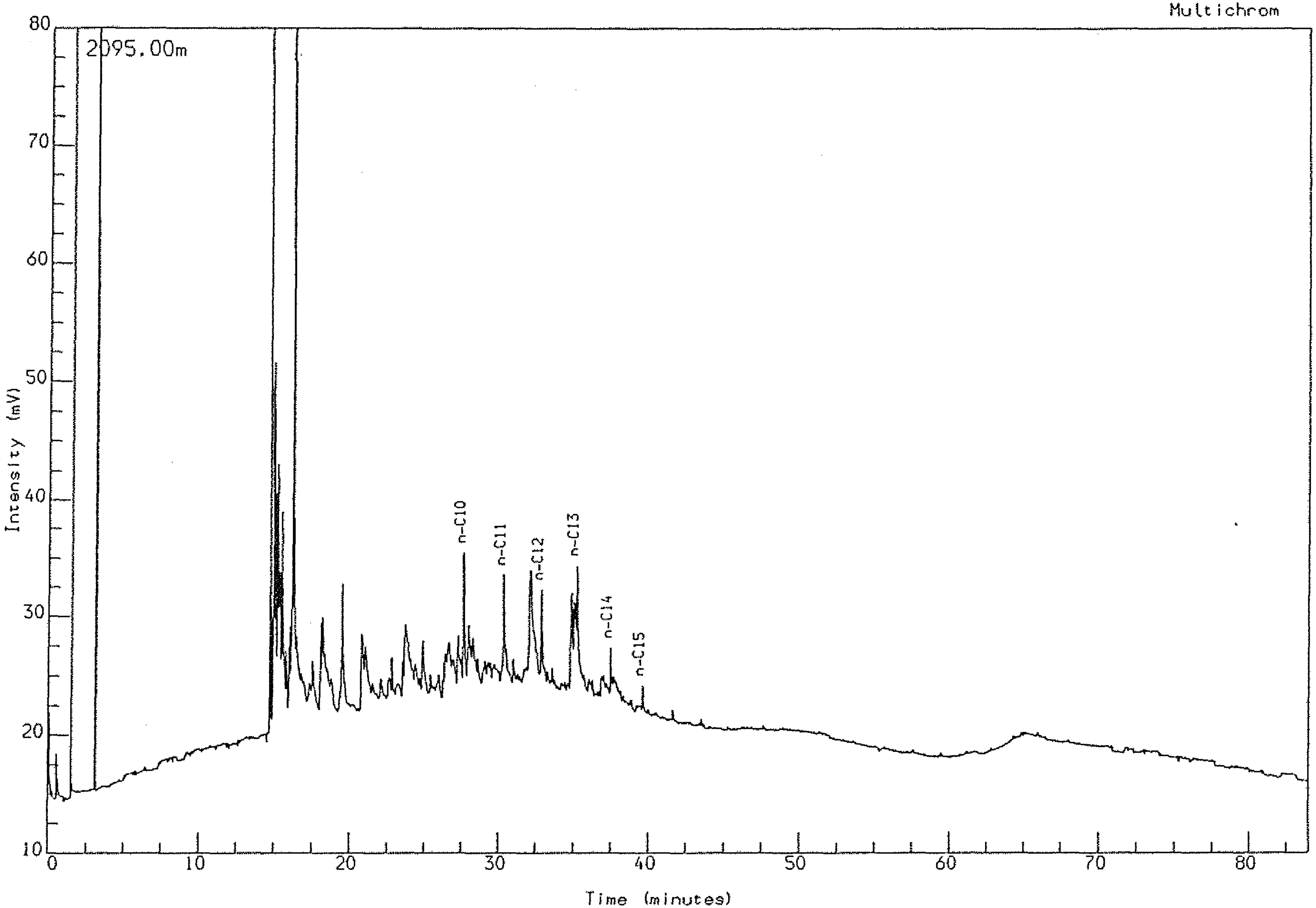
Reported on 17-JUN-1991 at 12:28

GEOLAB NOR

THERMAL EXTRACTION GC (S1)

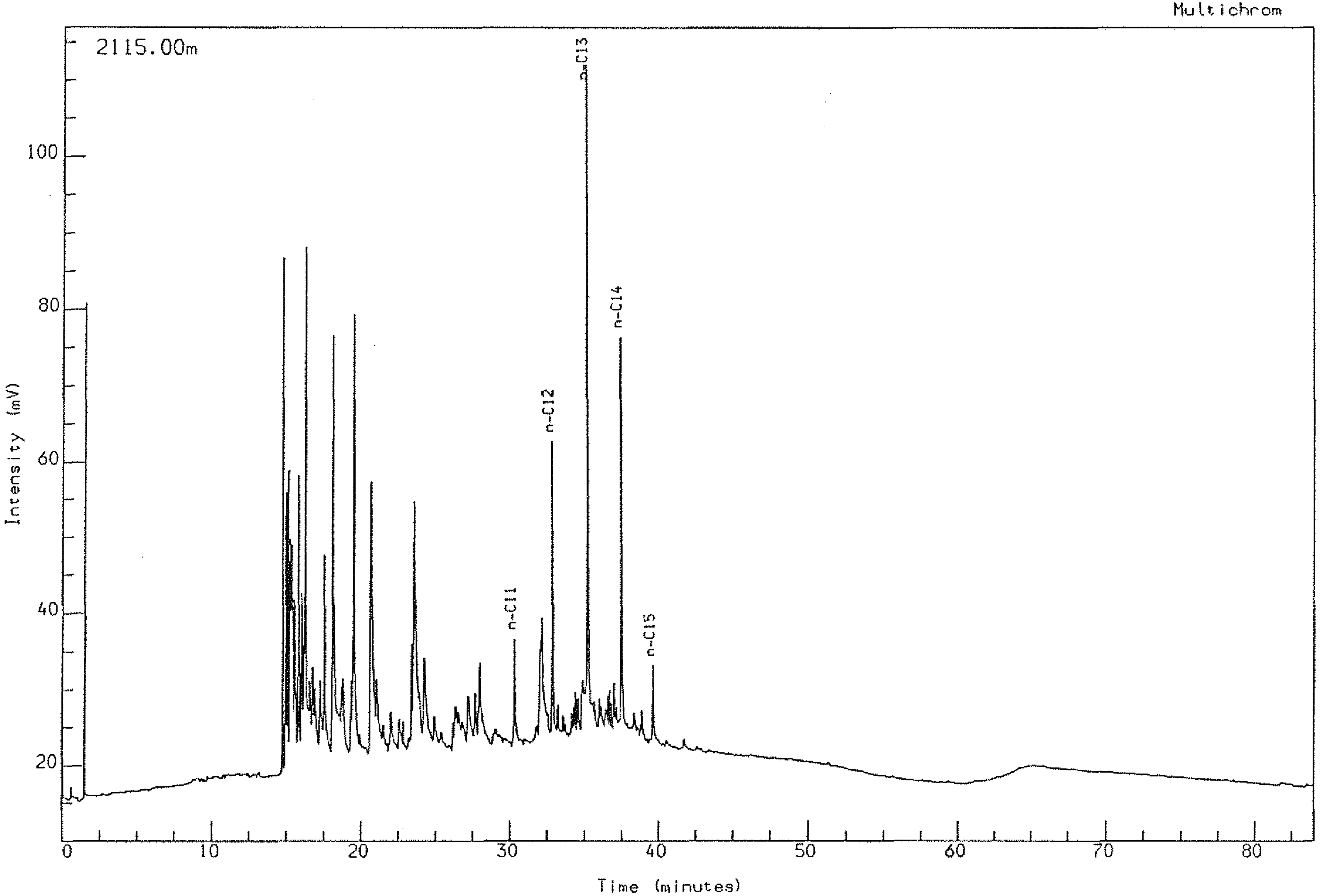
Sltst: lt brn gy

Analysis Name : [522006] 23 PF1100111.1,1.




WELL NOCS 31/4-7 2095.00m ccp Reported on 17-JUN-1991 at 12:30 GEOLAB NOR
THERMAL EXTRACTION GC (S1)
Sh/Clst: drk gy

Analysis Name : [522006] 23 PF1100151,1,1.




WELL NOCS 31/4-7 2115.00m ccp

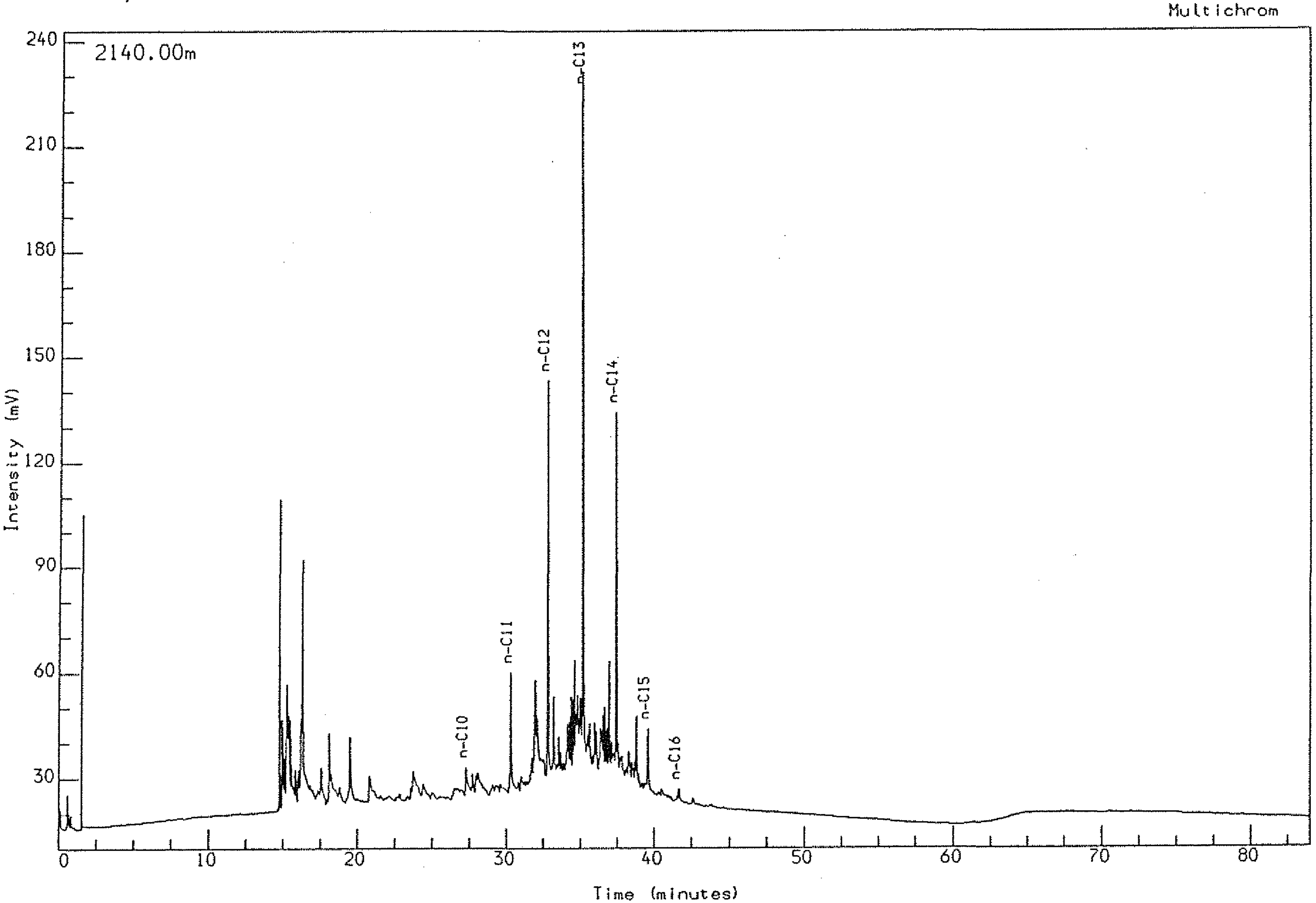
THERMAL EXTRACTION GC (S1)

Sltst: lt gy to m gy

Reported on 18-JUN-1991 at 07:57

GEOLAB NOR

Analysis Name : [522006] 23 PF1100201,1,1.

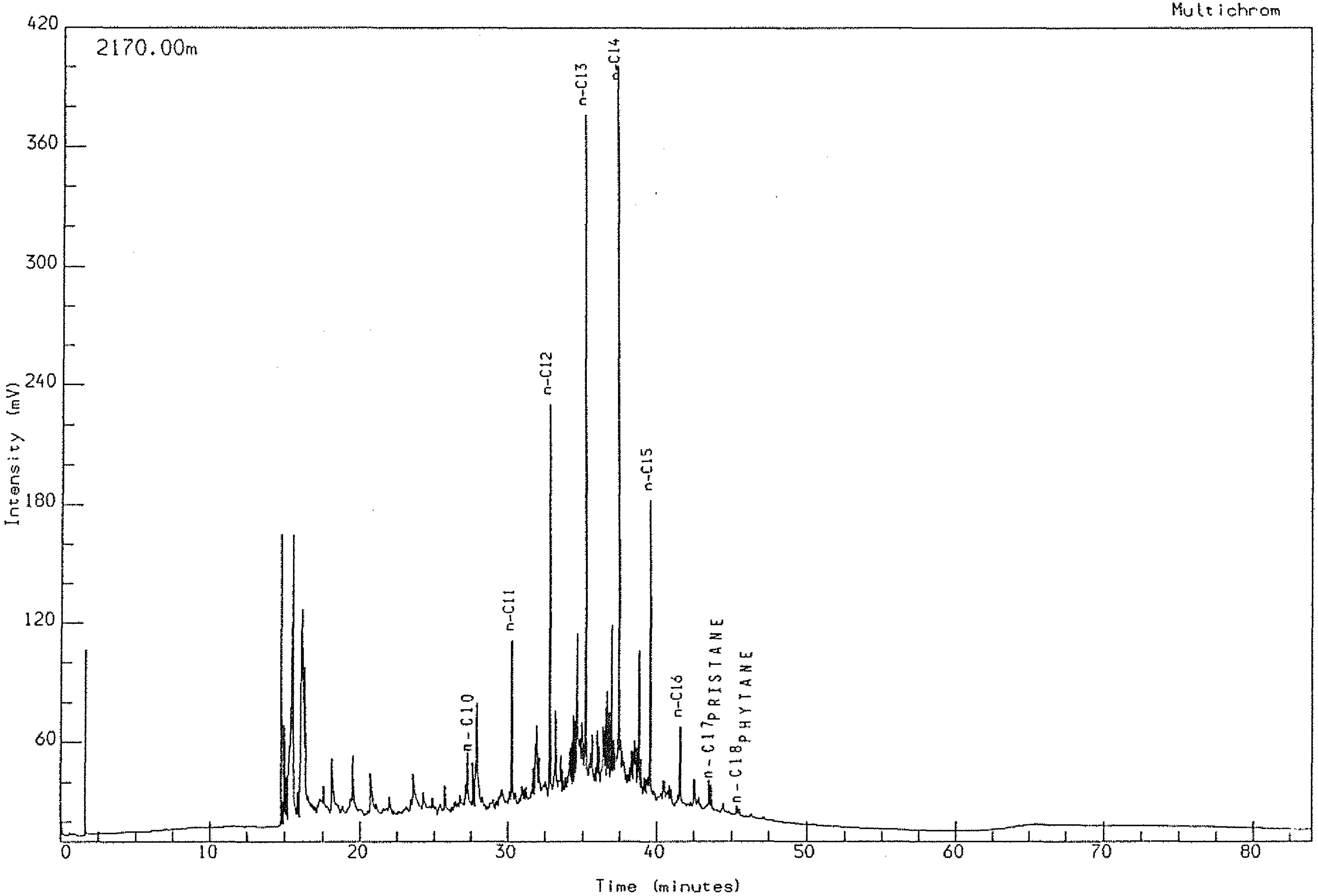



WELL NOCS 31/4-7 2140.00m ccp
THERMAL EXTRACTION GC (S1)
Sh/Clst: pl y brn

Reported on 18-JUN-1991 at 07:58

GEOLAB NOR

Analysis Name : [522006] 23 PF1100851,1,1.




WELL NOCS 31/4-7 2170.00m cut

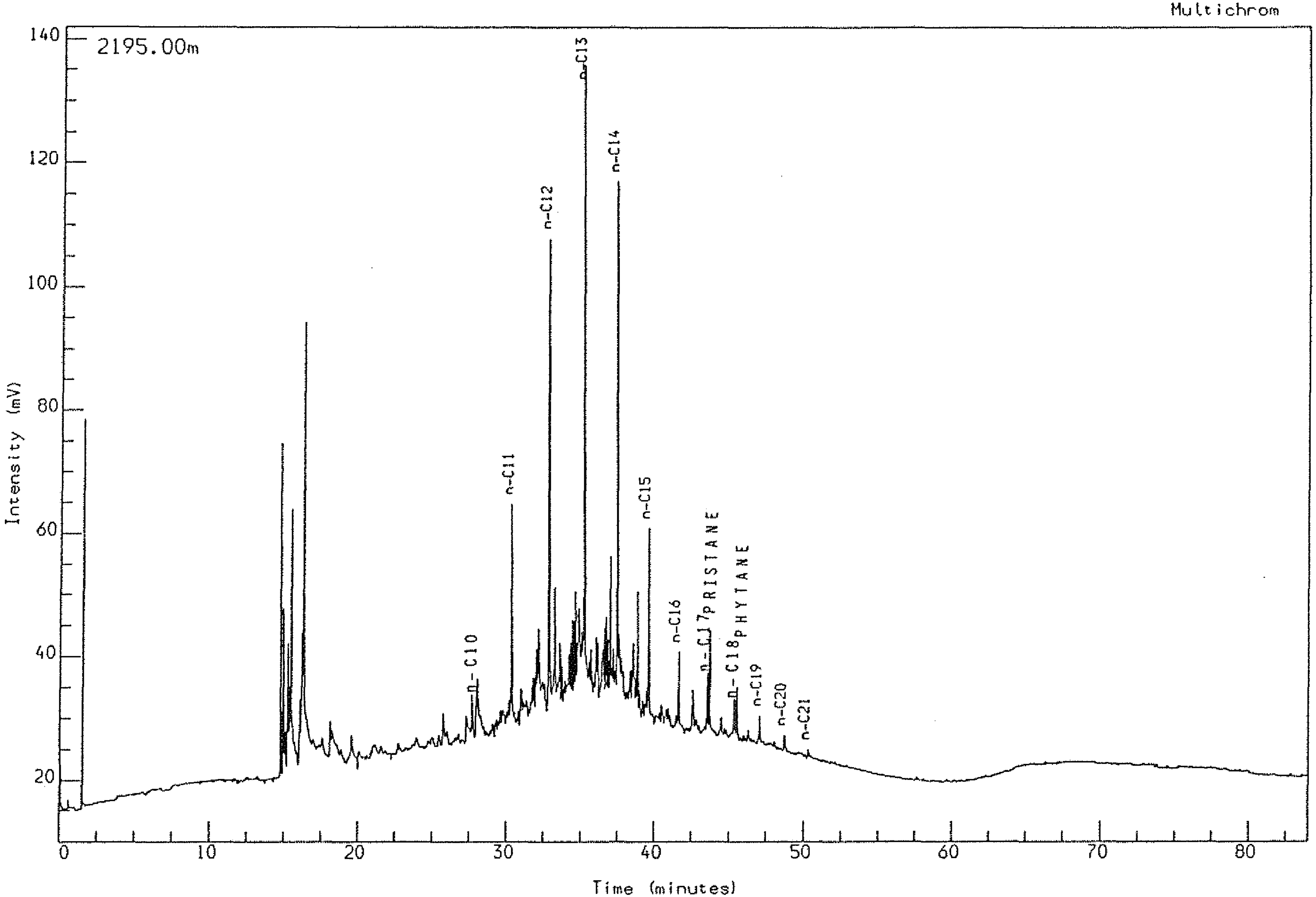
THERMAL EXTRACTION GC (S1)

Sh/Clst: m gy

Reported on 18-JUN-1991 at 07:59

GEOLAB NOR

Analysis Name : [522006] 23 PF1100901,1,1.




WELL NOCS 31/4-7 2195.00m cut

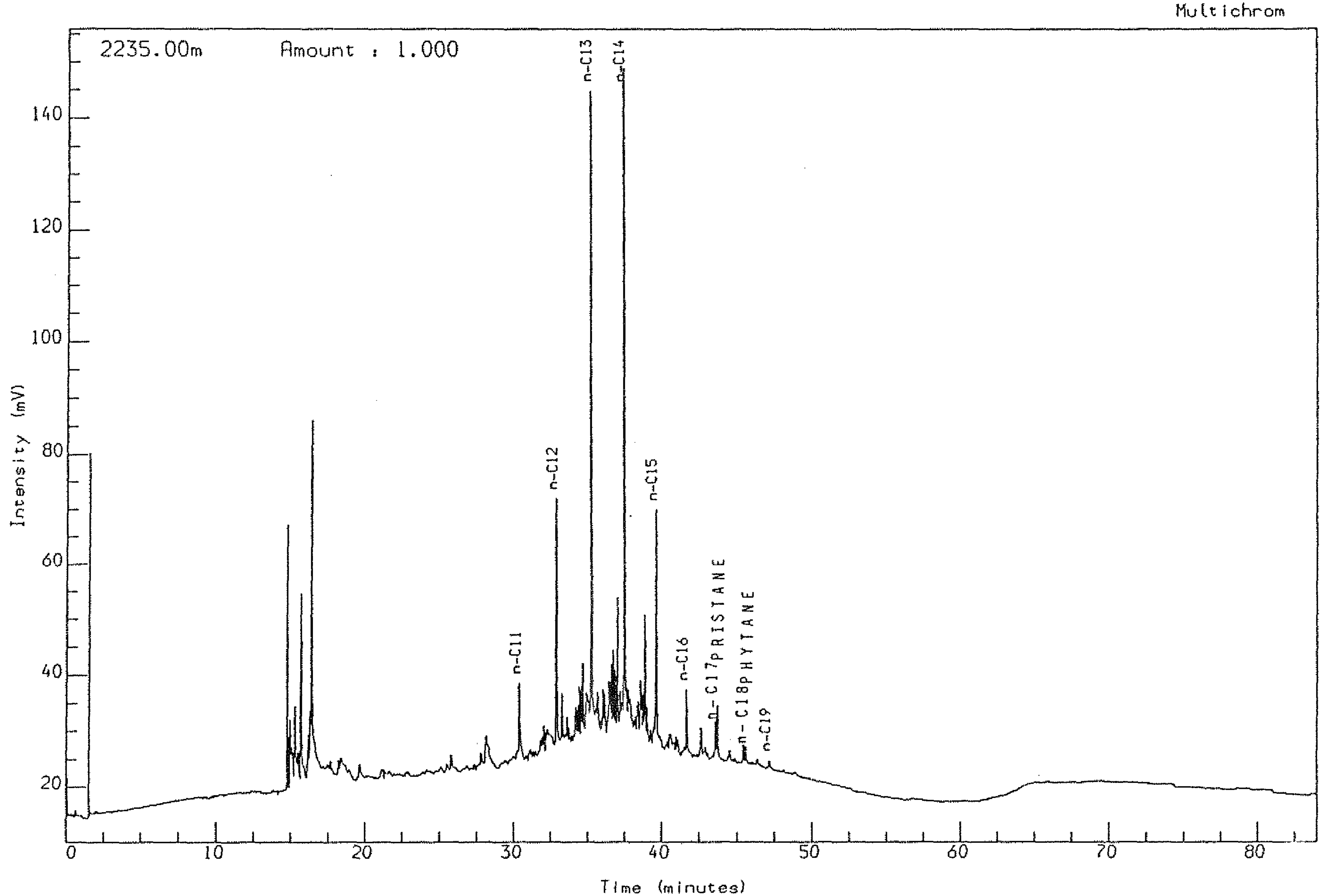
THERMAL EXTRACTION GC (S1)

Sltst: lt gy to w

Reported on 18-JUN-1991 at 08:00

GEOLAB NOR

Analysis Name : [522006] 23 PF1100981,1,1.

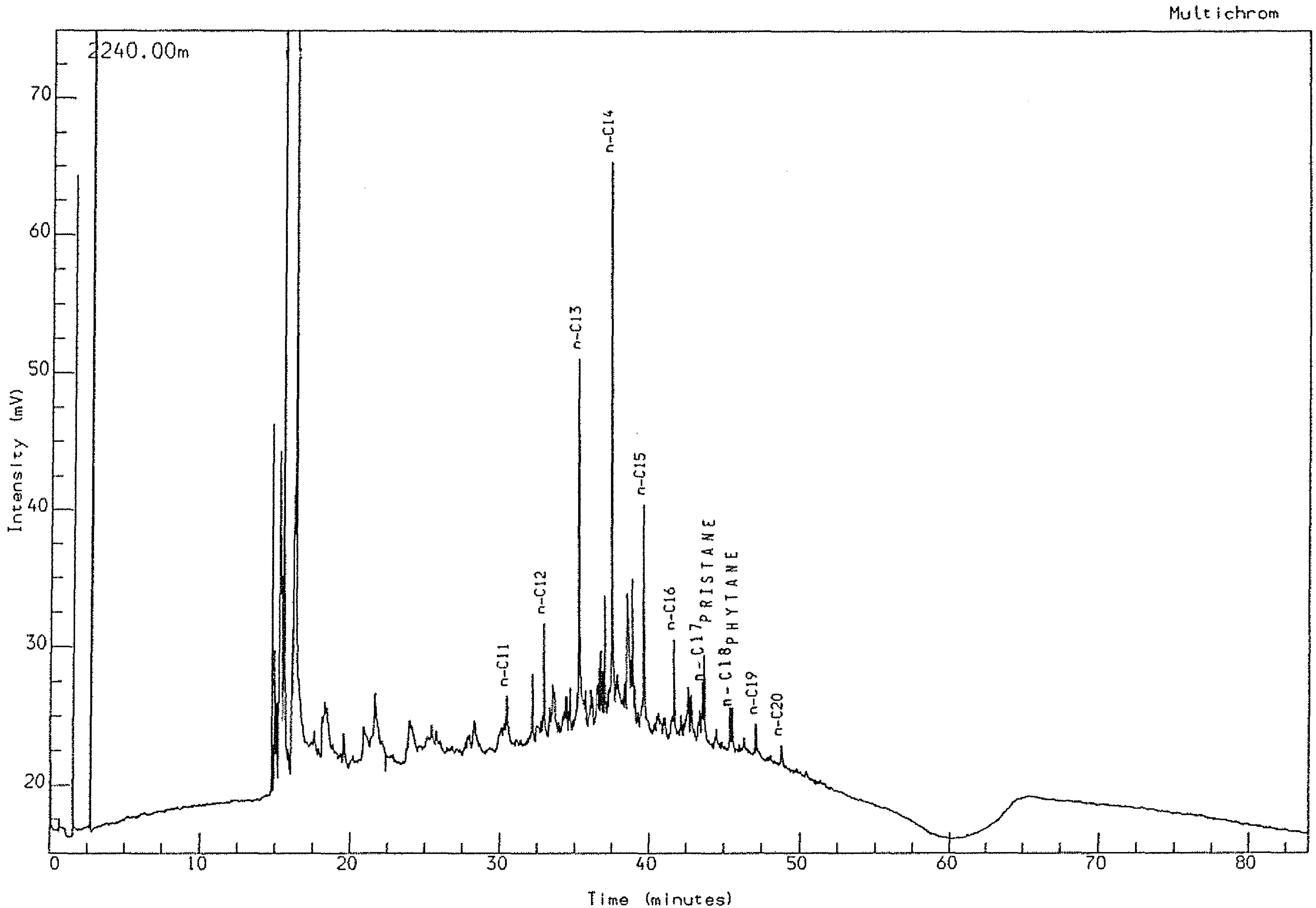



WELL NOCS 31/4-7 2235.00m cut
THERMAL EXTRACTION GC (S1)
Sh/Clst: lt gy to m gy

Reported on 16-JUL-1991 at 13:44

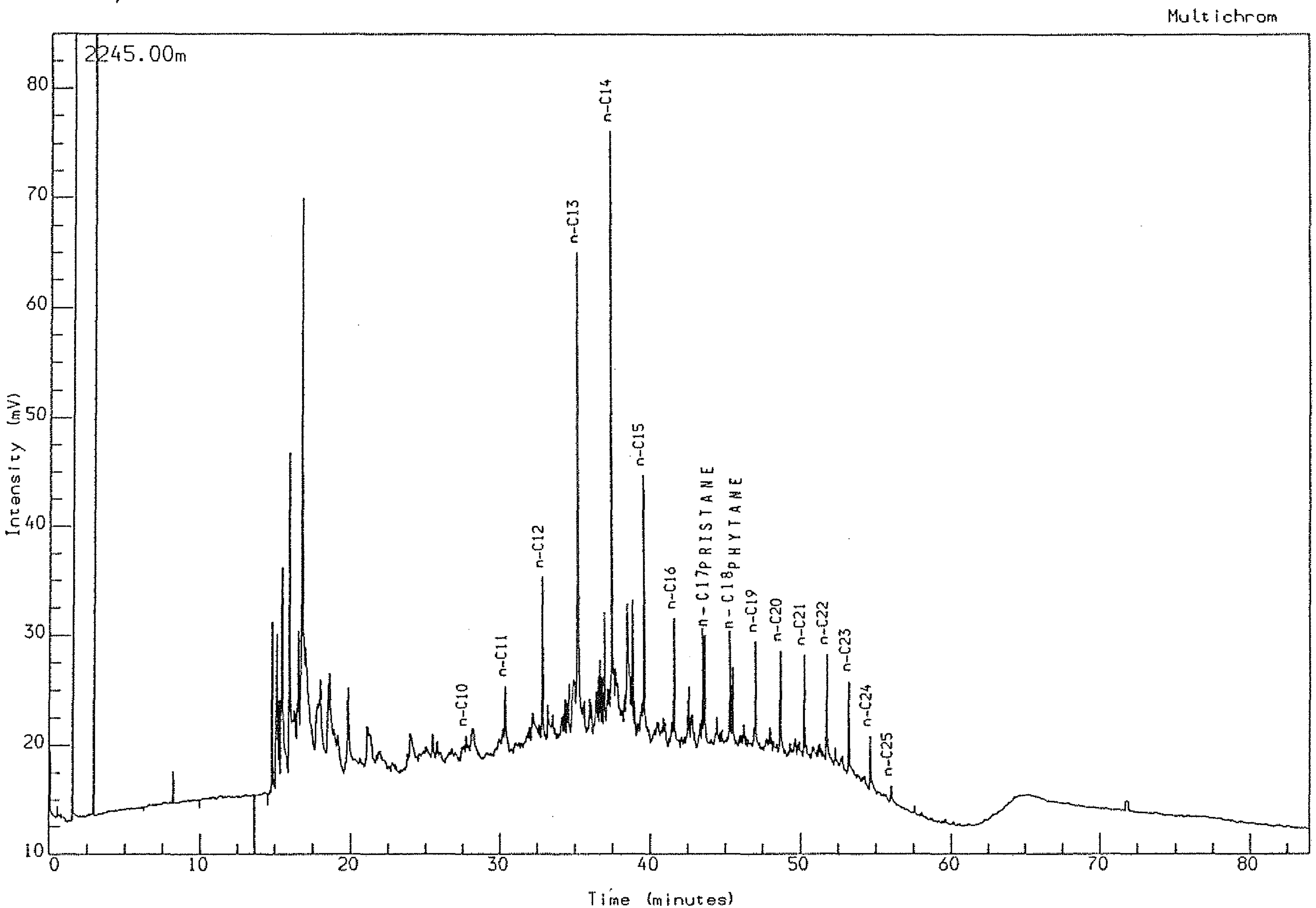
GEOLAB NOR

Analysis Name : [522006] 23 PF1100991,1,1.




WELL NOCS 31/4-7 2240.00m cut Reported on 18-JUN-1991 at 08:02 GEOLAB NOR
THERMAL EXTRACTION GC (S1)
S/Sst: lt gy

Analysis Name : [522006] 23 PF1101001,1,1.




WELL NOCS 31/4-7 2245.00m cut

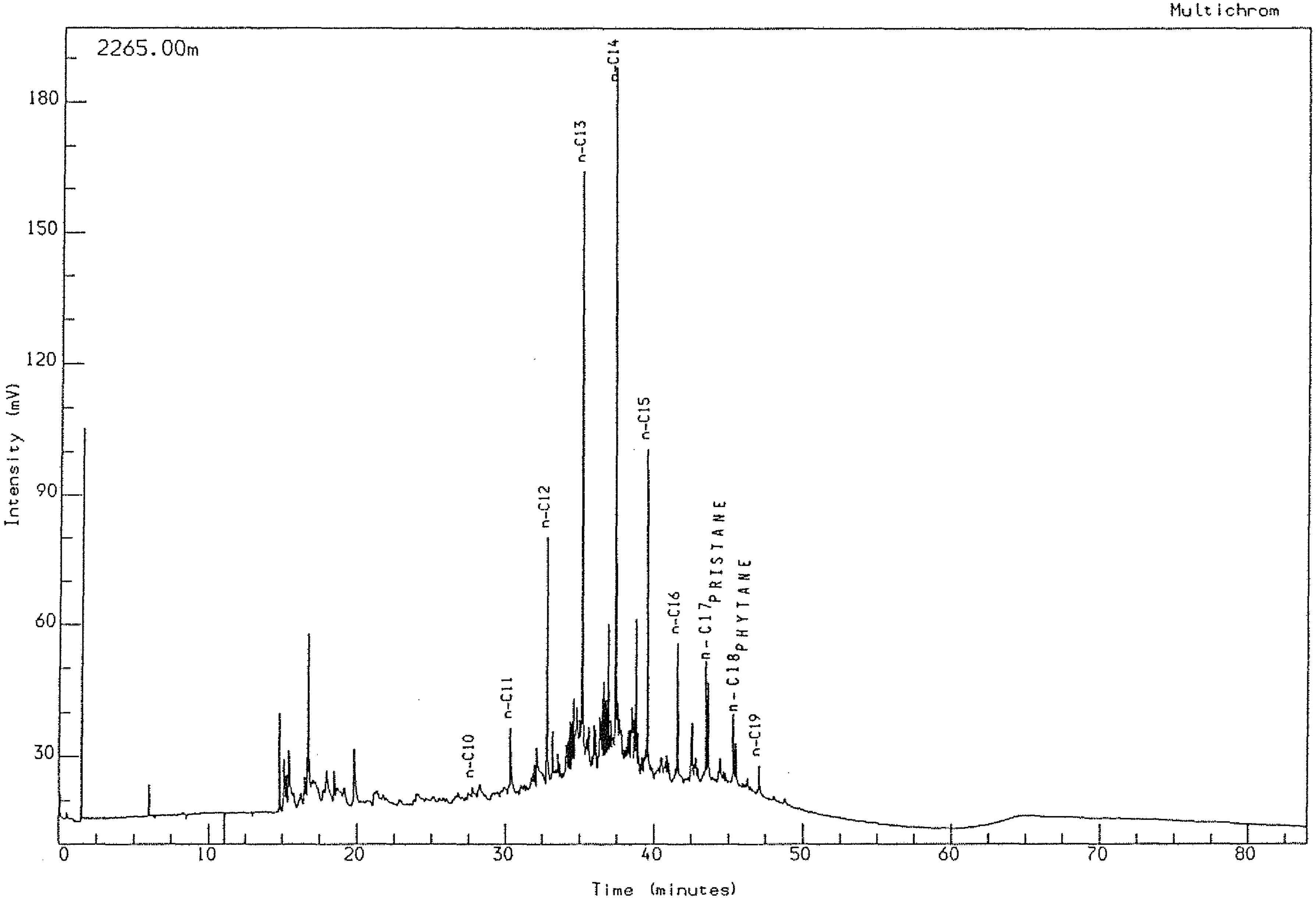
THERMAL EXTRACTION GC (S1)

S/Sst: lt gy

Reported on 18-JUN-1991 at 08:03

GEOLAB NOR

Analysis Name : [522006] 23 PF1101042,1,1.




WELL NOCS 31/4-7 2265.00m cut

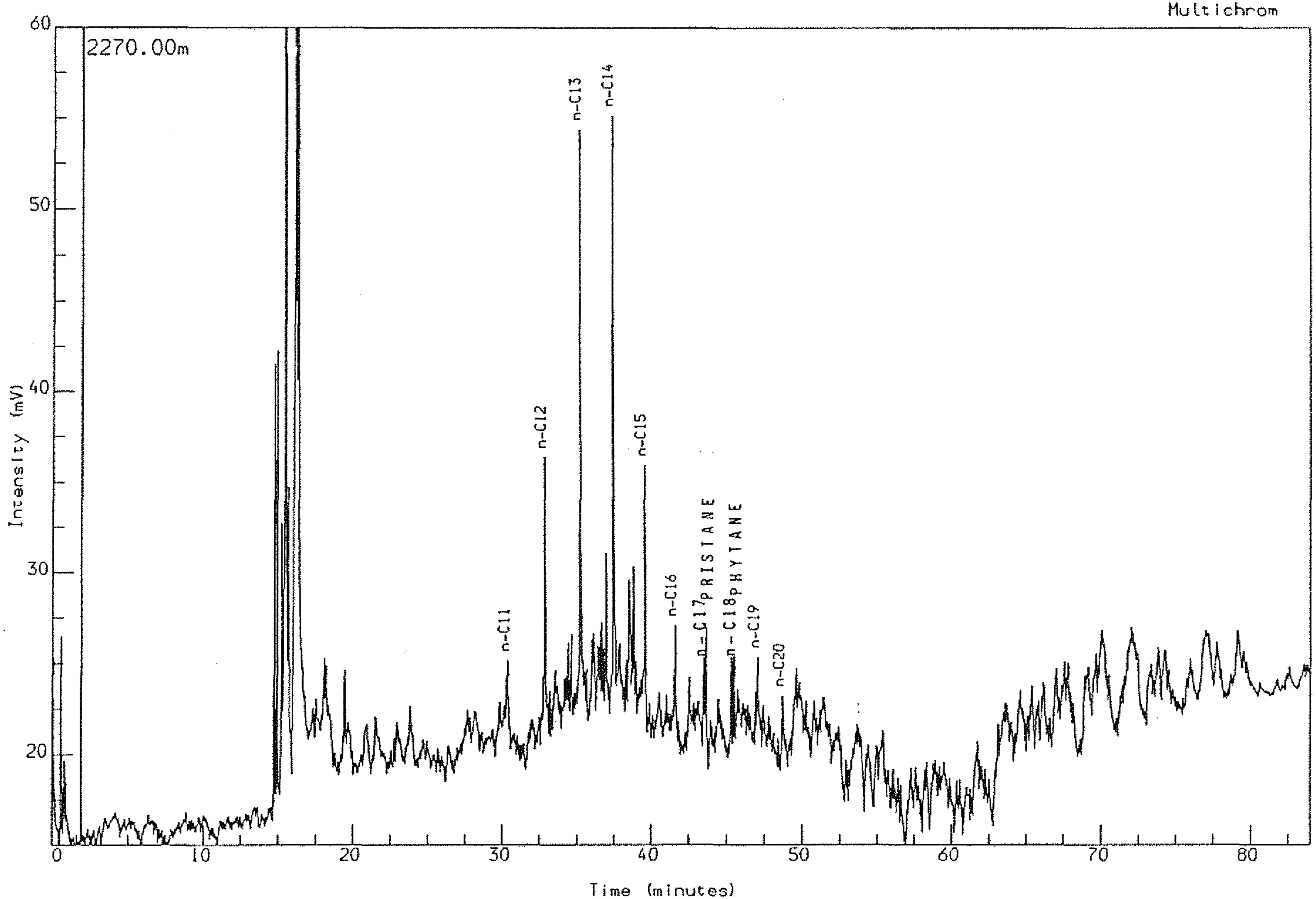
THERMAL EXTRACTION GC (S1)

Sh/Clst: m gy to brn gy

Reported on 18-JUN-1991 at 12:15

GEOLAB NOR

Analysis Name : [522006] 23 PF1101054,1,1.

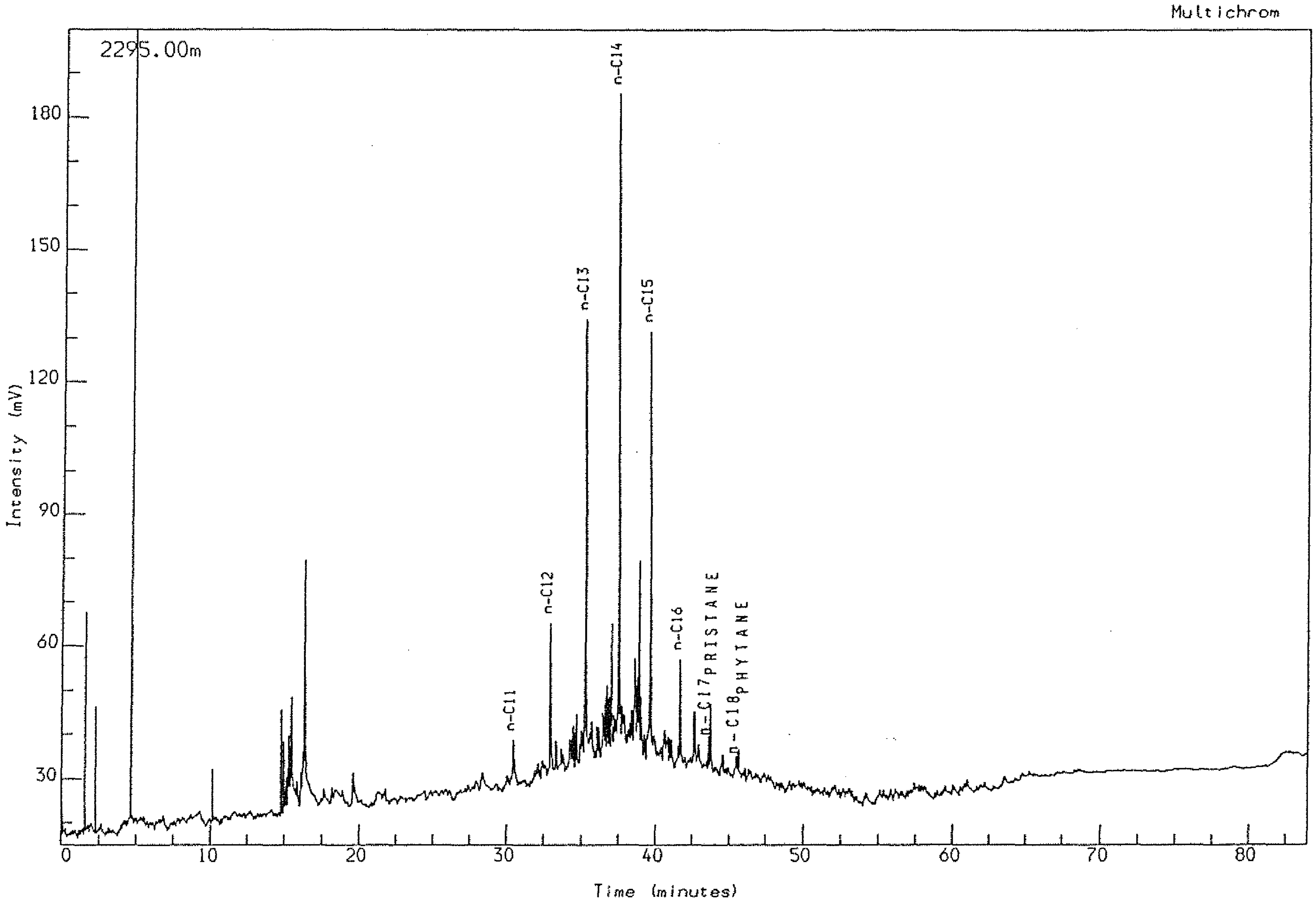



WELL NOCS 31/4-7 2270.00m cut
THERMAL EXTRACTION GC (S1)
Ca: w to lt or to or gy

Reported on 18-JUN-1991 at 10:05

GEOLAB NOR

Analysis Name : [522006] 23 PF1101101B,1,1.




WELL NOCS 31/4-7 2295.00m cut

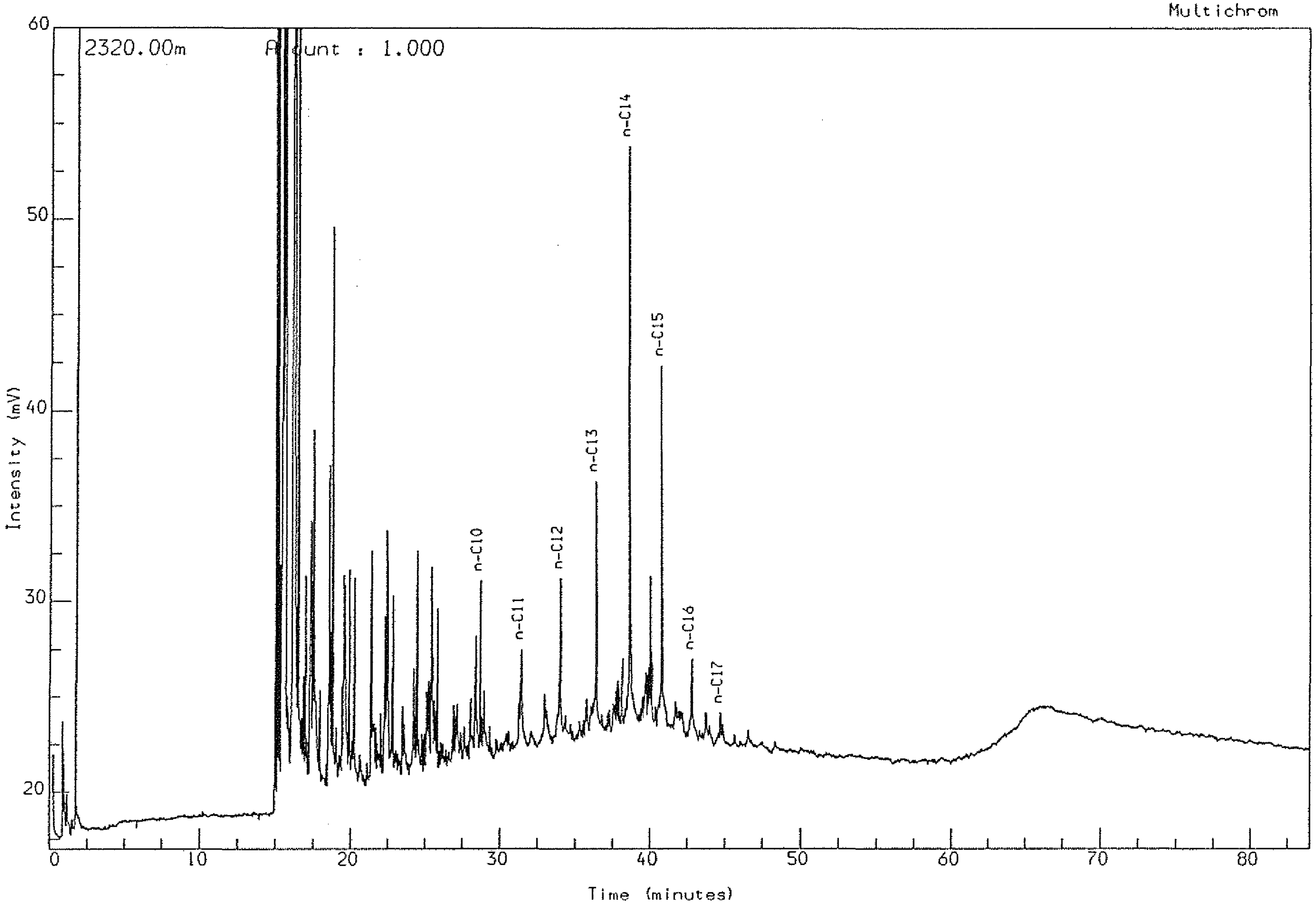
THERMAL EXTRACTION GC (S1)

Sh/Clst: m gy to brn gy

Reported on 18-JUN-1991 at 10:06

GEOLAB NOR

Analysis Name : [522006] 23 PF1101152D,1,1.

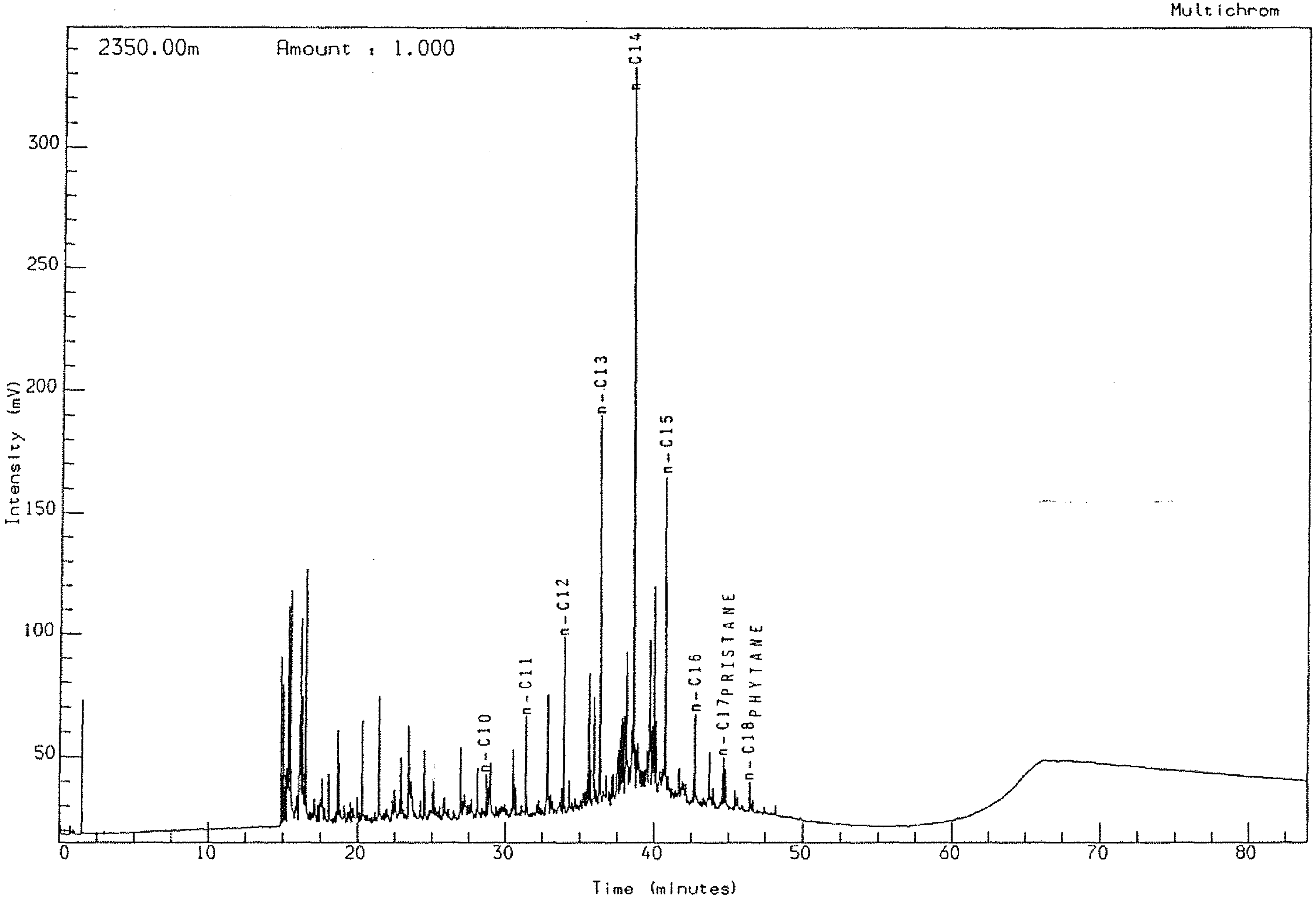



WELL NOCS 31/4-7 2320.00m cut
THERMAL EXTRACTION GC (S1)
S/Sst: w to lt gy

Reported on 22-AUG-1991 at 08:44

GEOLAB NOR

Analysis Name : [522006] 23 PF1101211,1,1.



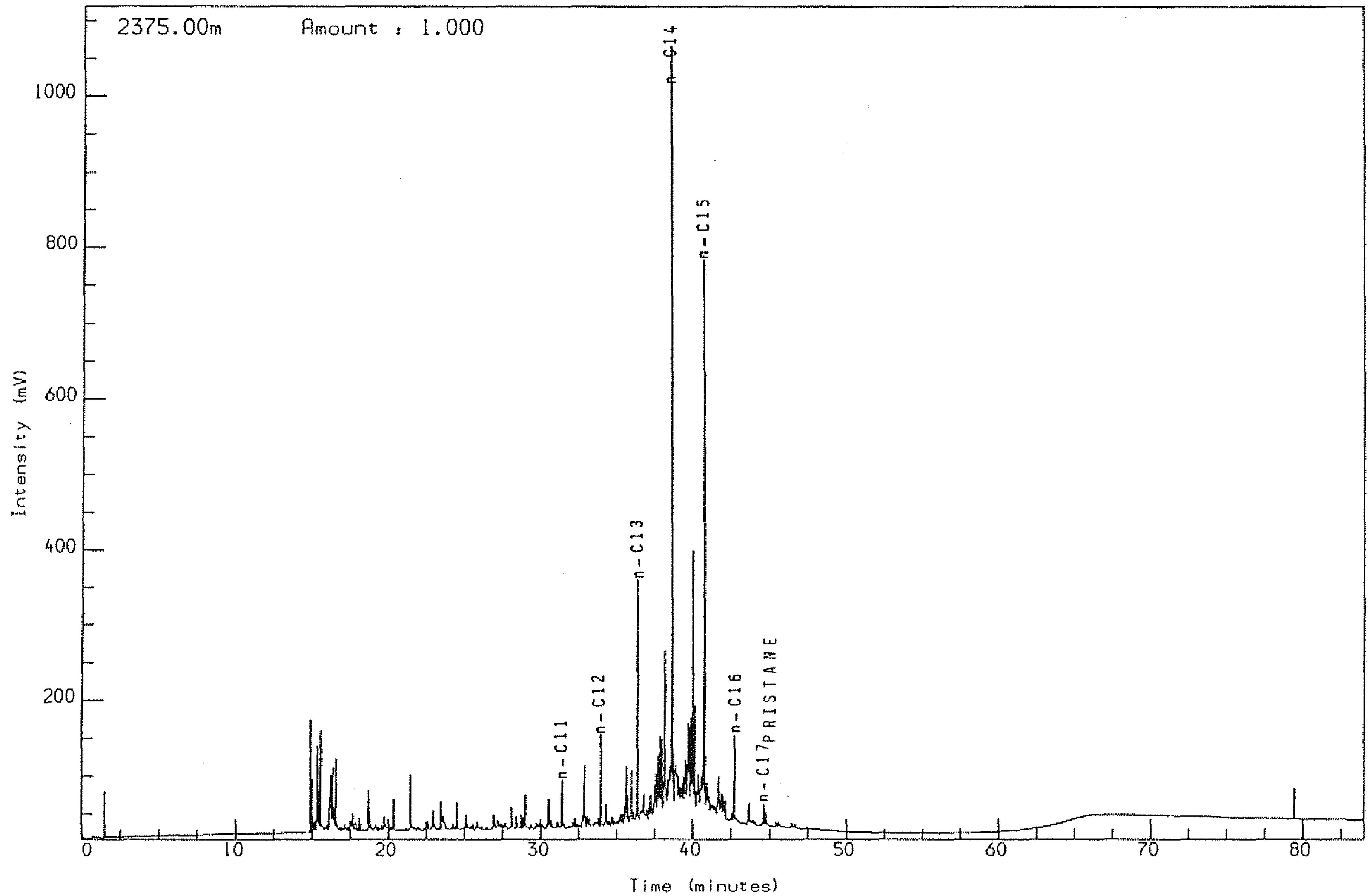

WELL NOCS 31/4-7 2350.00m cut
THERMAL EXTRACTION GC (S1)
Sh/Clst: m gy

Reported on 15-JUL-1991 at 09:40

GEOLAB NOR

Analysis Name : [522006] 23 PF1101251,1,1.

Multichrom




WELL NOCS 31/4-7 2375.00m cut

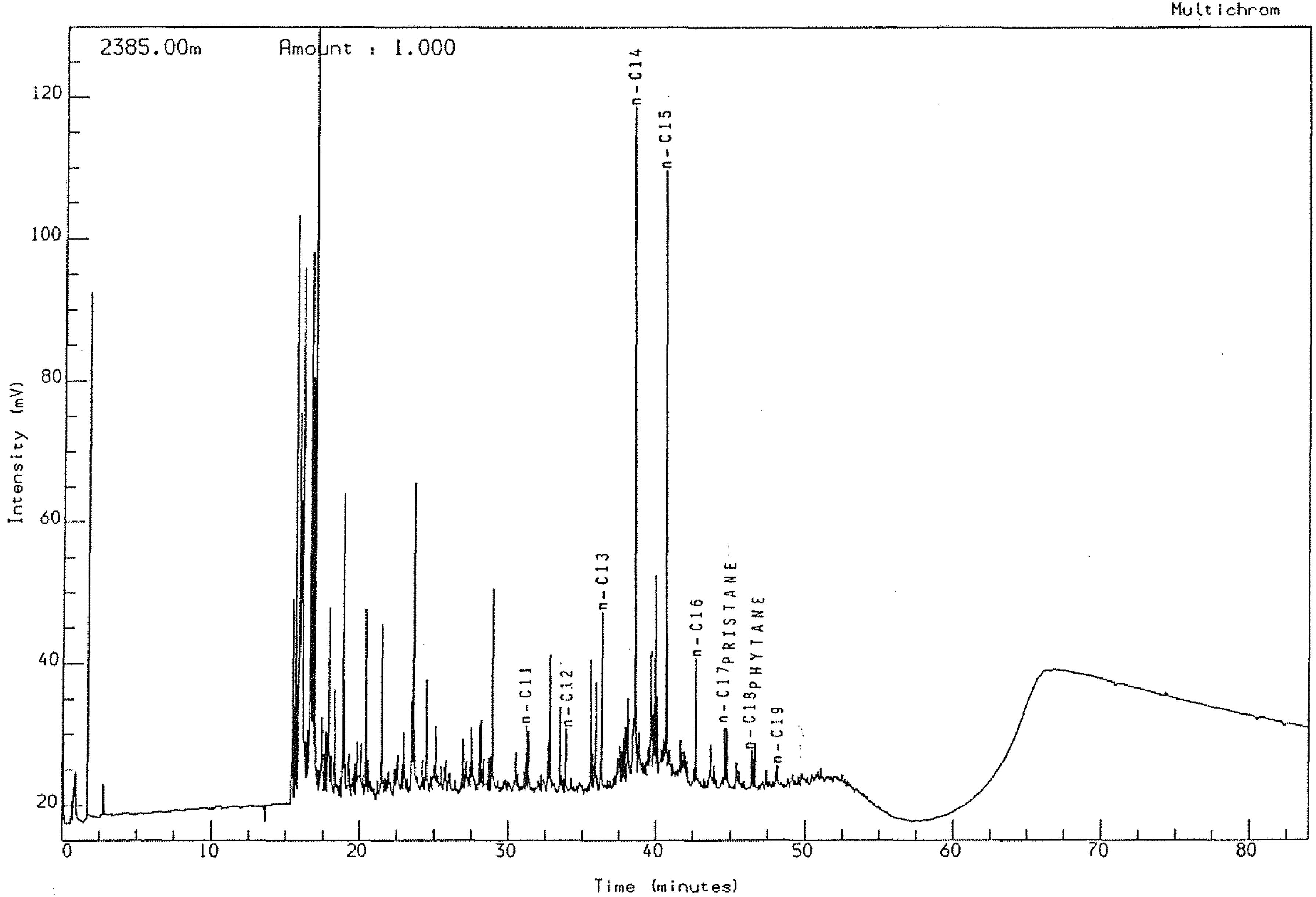
THERMAL EXTRACTION GC (S1)

Sh/Clst: m gy

Reported on 15-JUL-1991 at 09:41

GEOLAB NOR

Analysis Name : [522006] 23 PF1101271,1,1.



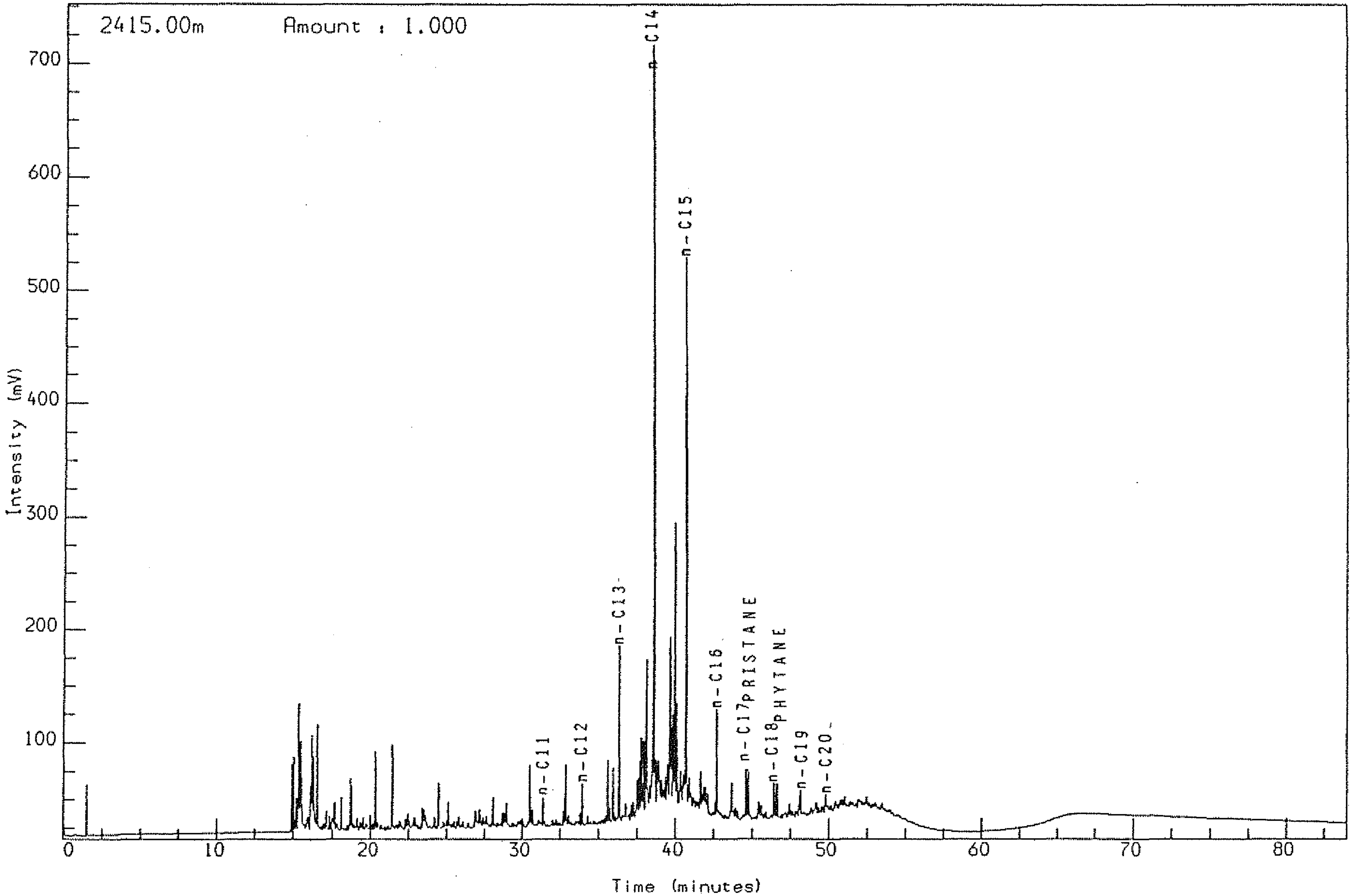

WELL NOCS 31/4-7 2385.00m cut
THERMAL EXTRACTION GC (S1)
S/Sst: w to lt gy

Reported on 15-JUL-1991 at 09:43

GEOLAB NOR

Analysis Name : [522006] 23 PF1101331,1,1.

Multichrom




WELL NOCS 31/4-7 2415.00m cut

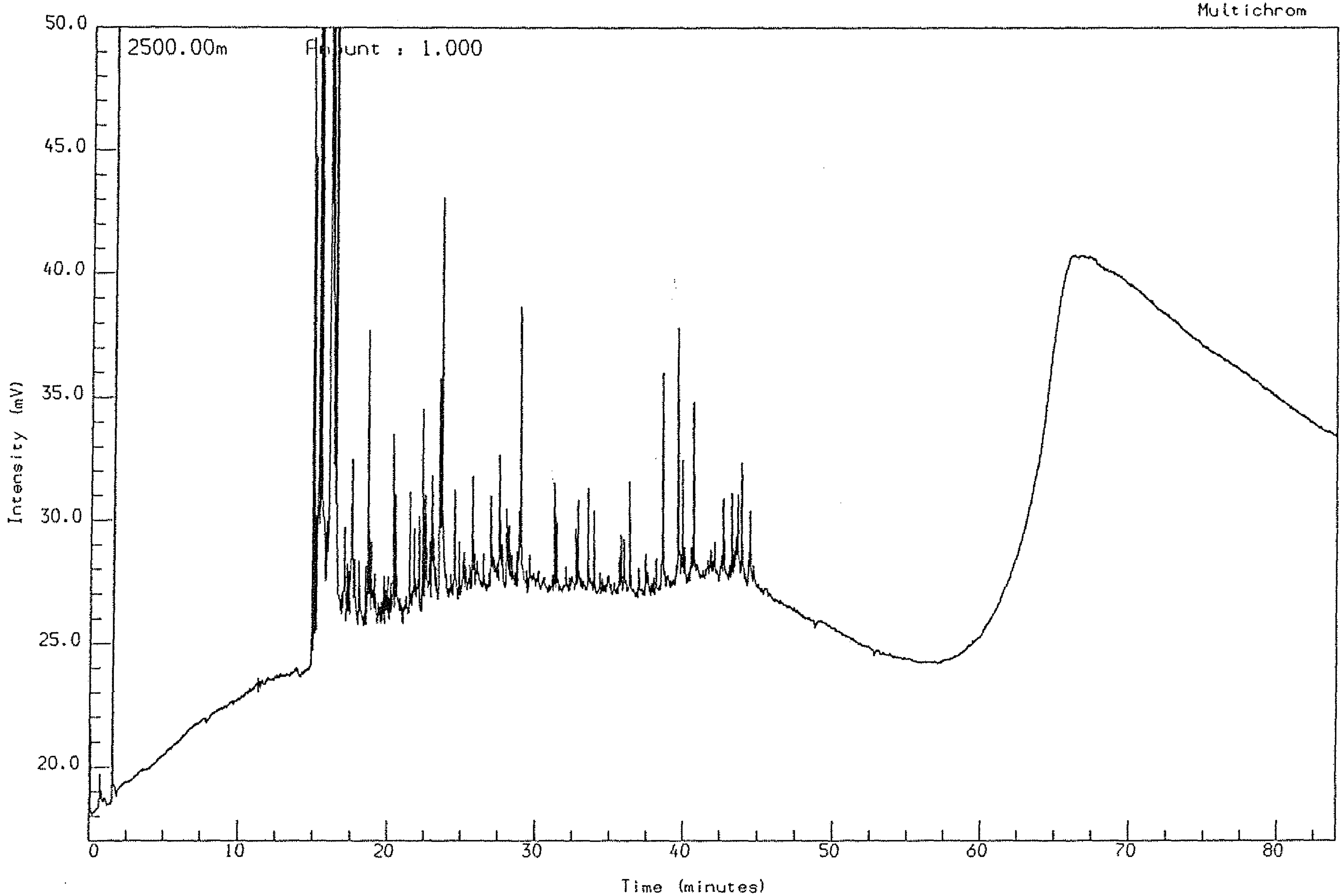
THERMAL EXTRACTION GC (S1)

S/Sst: w to lt gy

Reported on 15-JUL-1991 at 09:45

GEOLAB NOR

Analysis Name : [522006] 23 PF1101505,1,1.

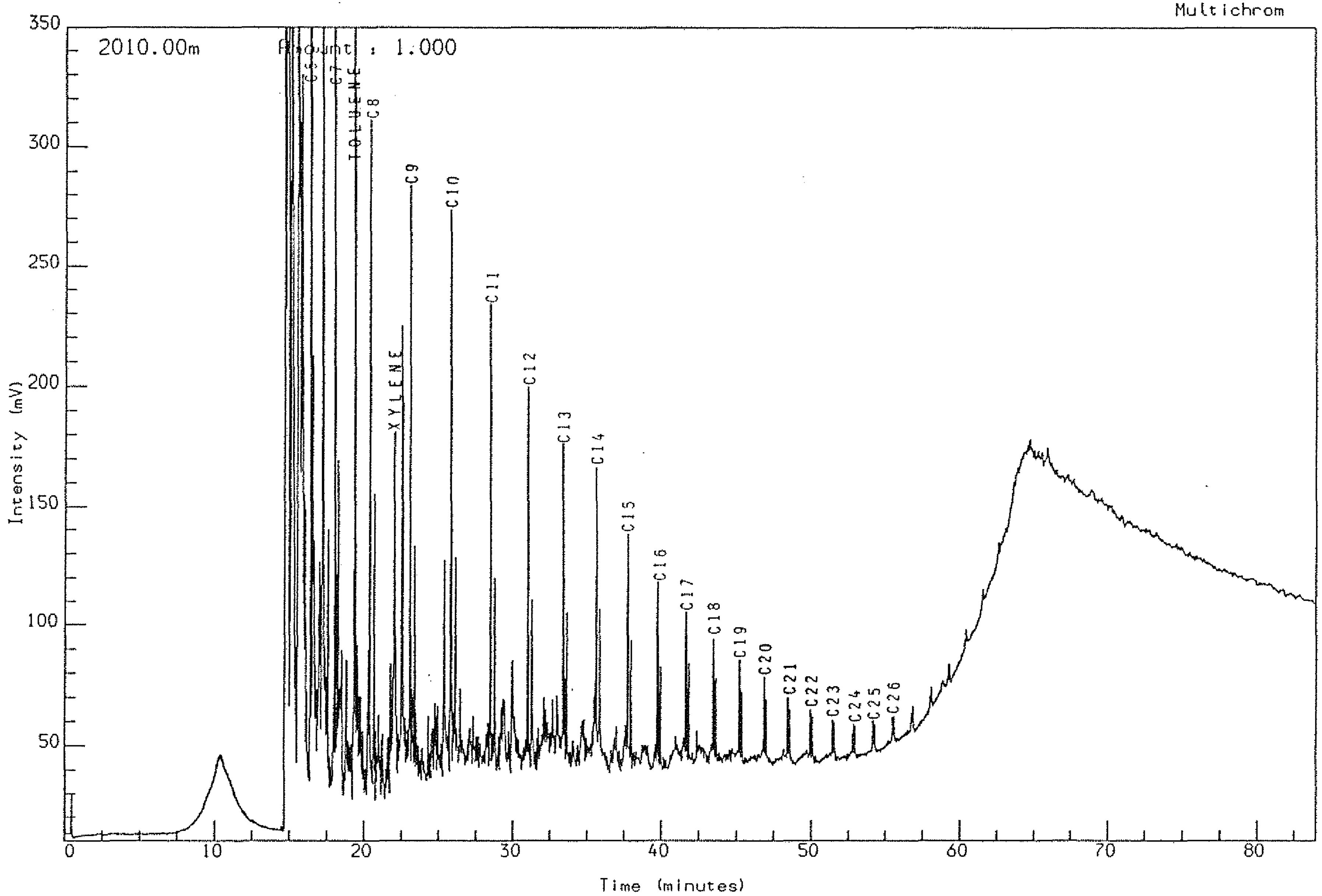



WELL NOCS 31/4-7 2500.00m cut
THERMAL EXTRACTION GC (S1)
Sh/Clst: m brn to pl brn

Reported on 15-JUL-1991 at 09:57

GEOLAB NOR

Analysis Name : [522006] 24 PF1100752,1,1.

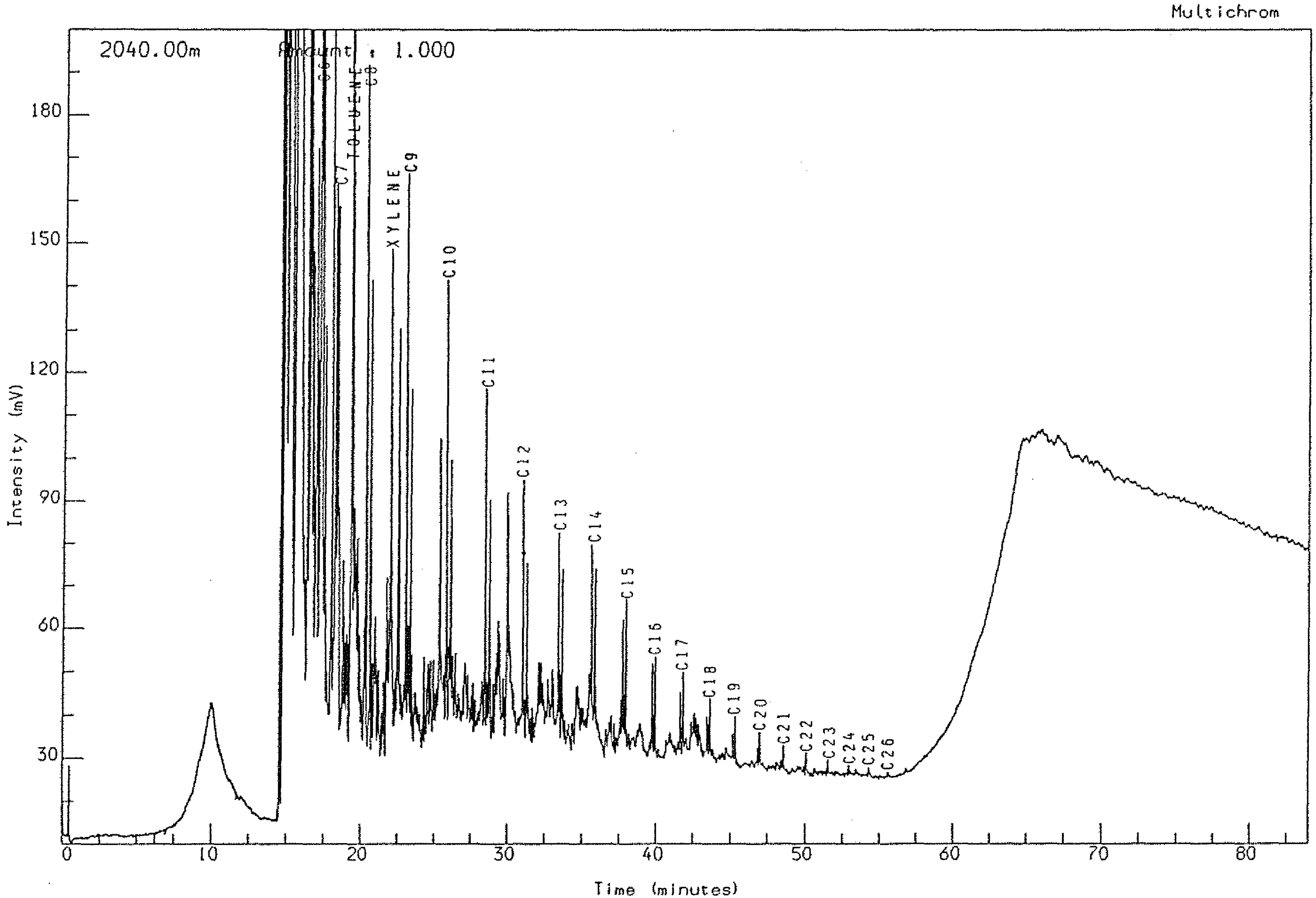



WELL NOCS 31/4-7 2010.00m cut Reported on 18-JUN-1991 at 08:18 GEOLAB NOR

PYROLYSIS GC (S2)

Ca: lt or

Analysis Name : [522006] 24 PF1100813,1,1.



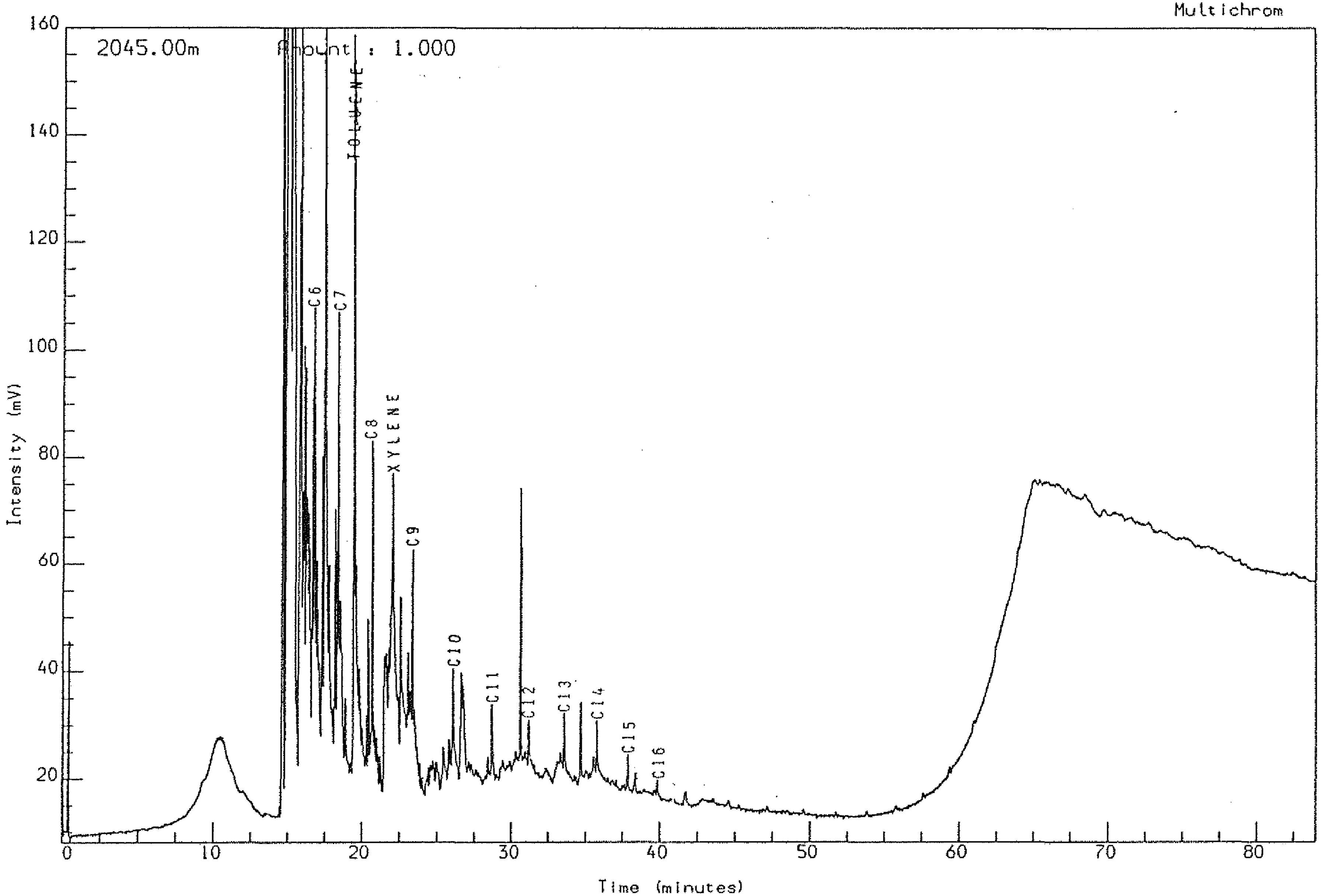

WELL NOCS 31/4-7 2040.00m cut Reported on 18-JUN-1991 at 08:20

PYROLYSIS GC (S2)

Ca: w to lt or to lt gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1100011,1,1.



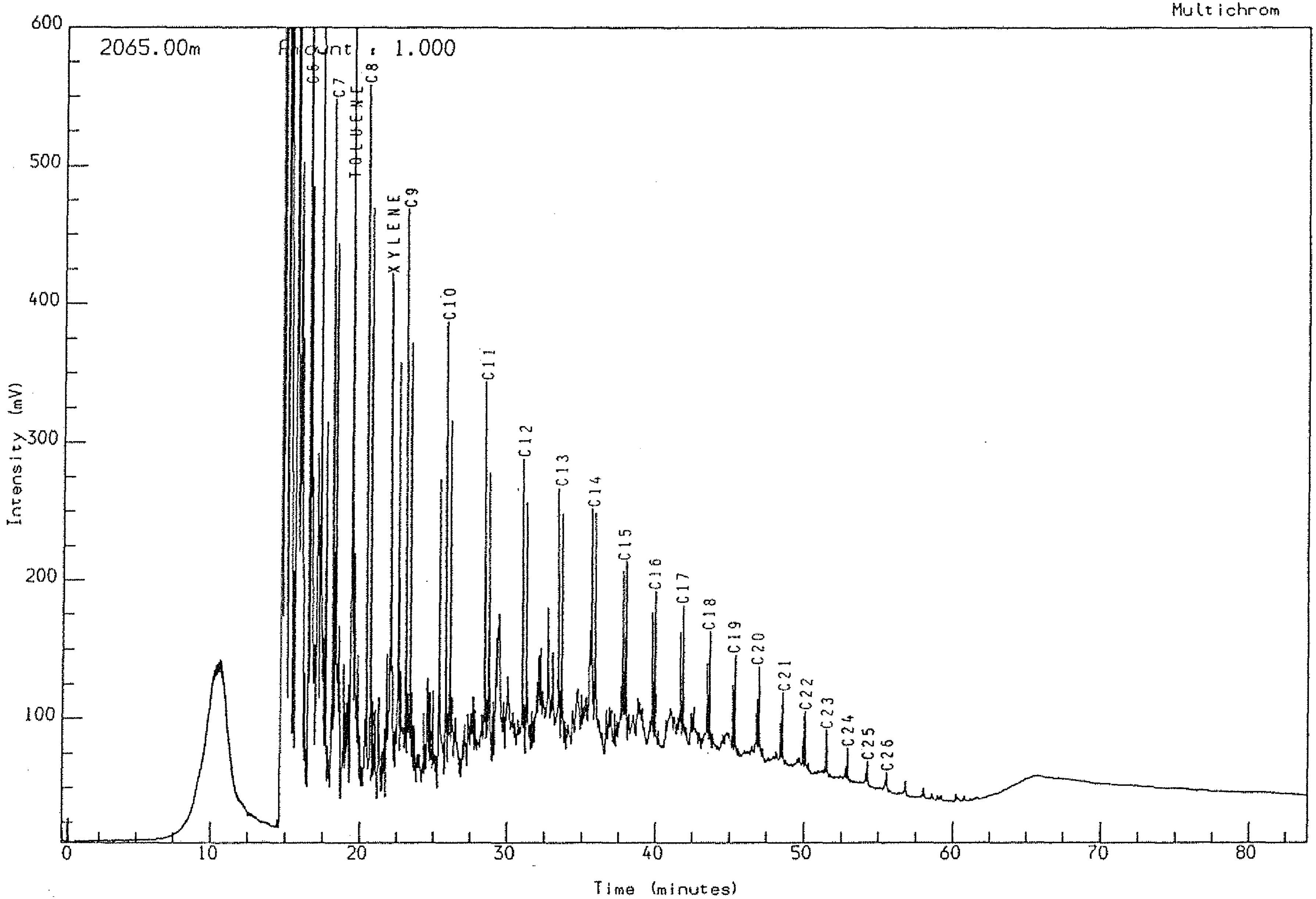

WELL NOCS 31/4-7 2045.00m ccp Reported on 18-JUN-1991 at 08:21

PYROLYSIS GC (S2)

Sltst: lt gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1100051,1,1.

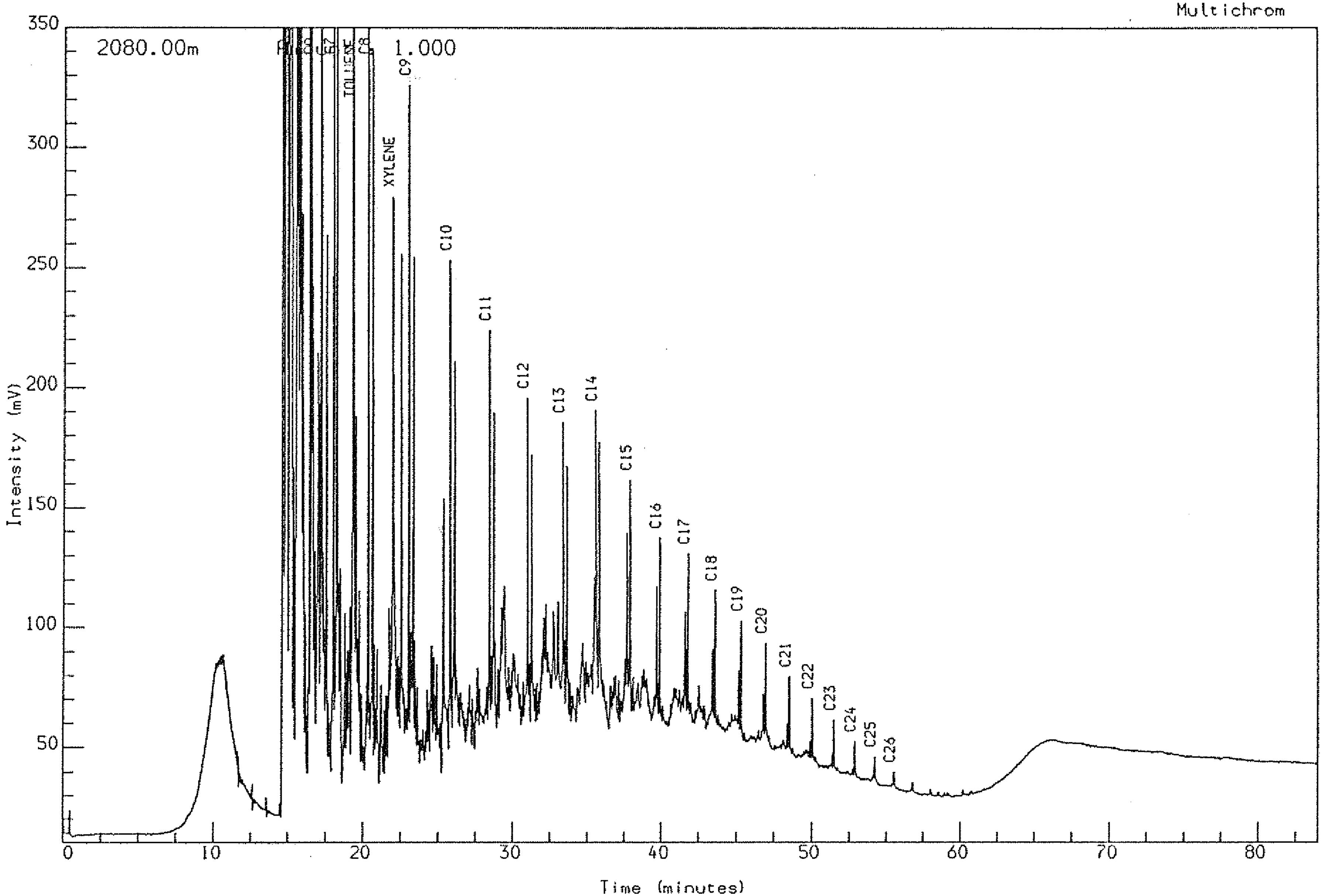



WELL NOCS 31/4-7 2065.00m ccp Reported on 18-JUN-1991 at 08:22 GEOLAB NOR

PYROLYSIS GC (S2)

Sltst: lt gy to lt brn gy

Analysis Name : [522006] 24 PF1100081.1.1.



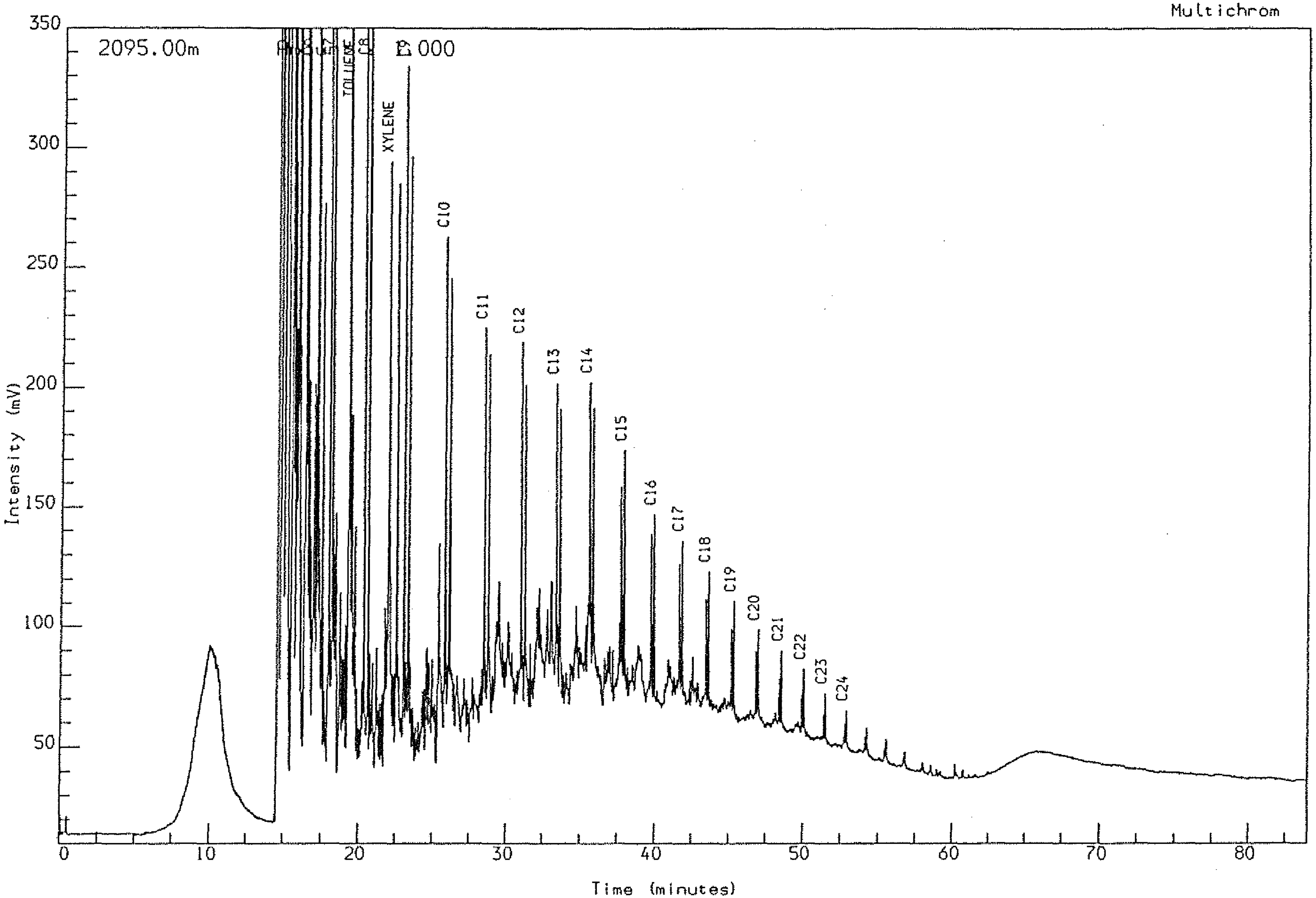

WELL NOCS 31/4-7 2080.00m ccp Reported on 18-JUN-1991 at 08:25

PYROLYSIS GC (S2)

Sltst: lt brn gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1100111.1.1.



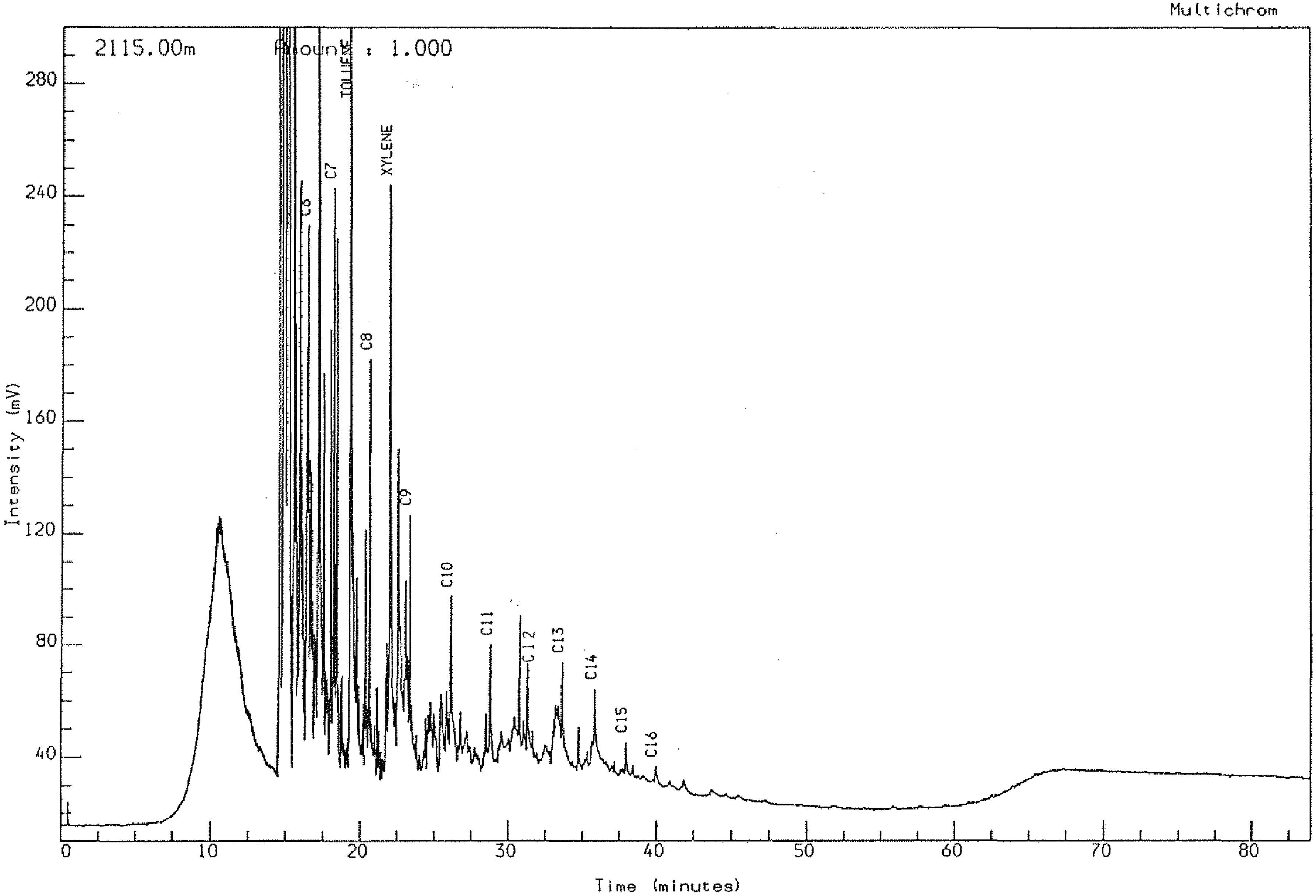

WELL NOCS 31/4-7 2095.00m ccp Reported on 18-JUN-1991 at 08:27

PYROLYSIS GC (S2)

Sh/Clst: drk gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1100151,1,1.



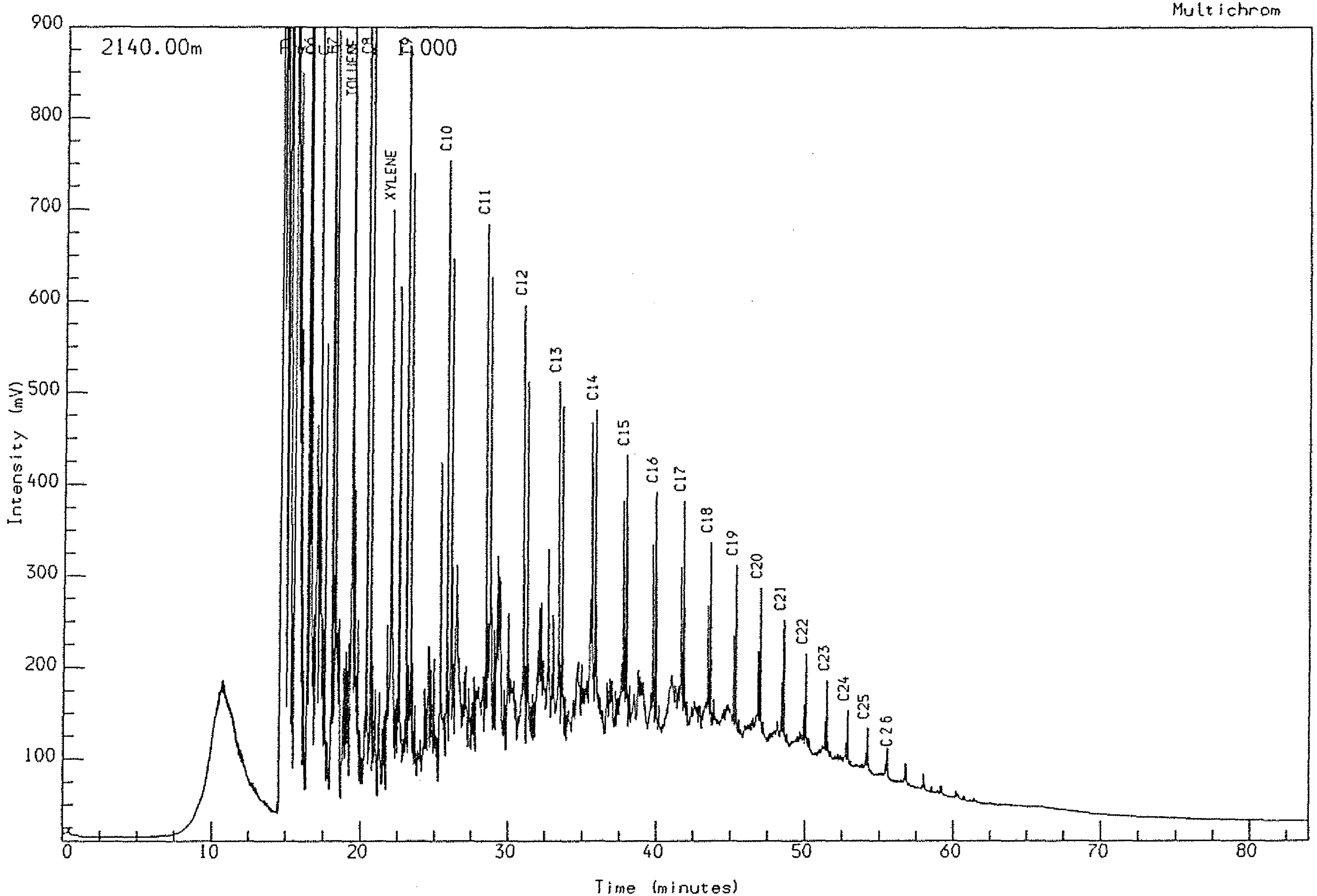

WELL NOCS 31/4-7 2115.00m ccp Reported on 18-JUN-1991 at 08:28

PYROLYSIS GC (S2)

Sltst: lt gy to m gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1100201.1.1.



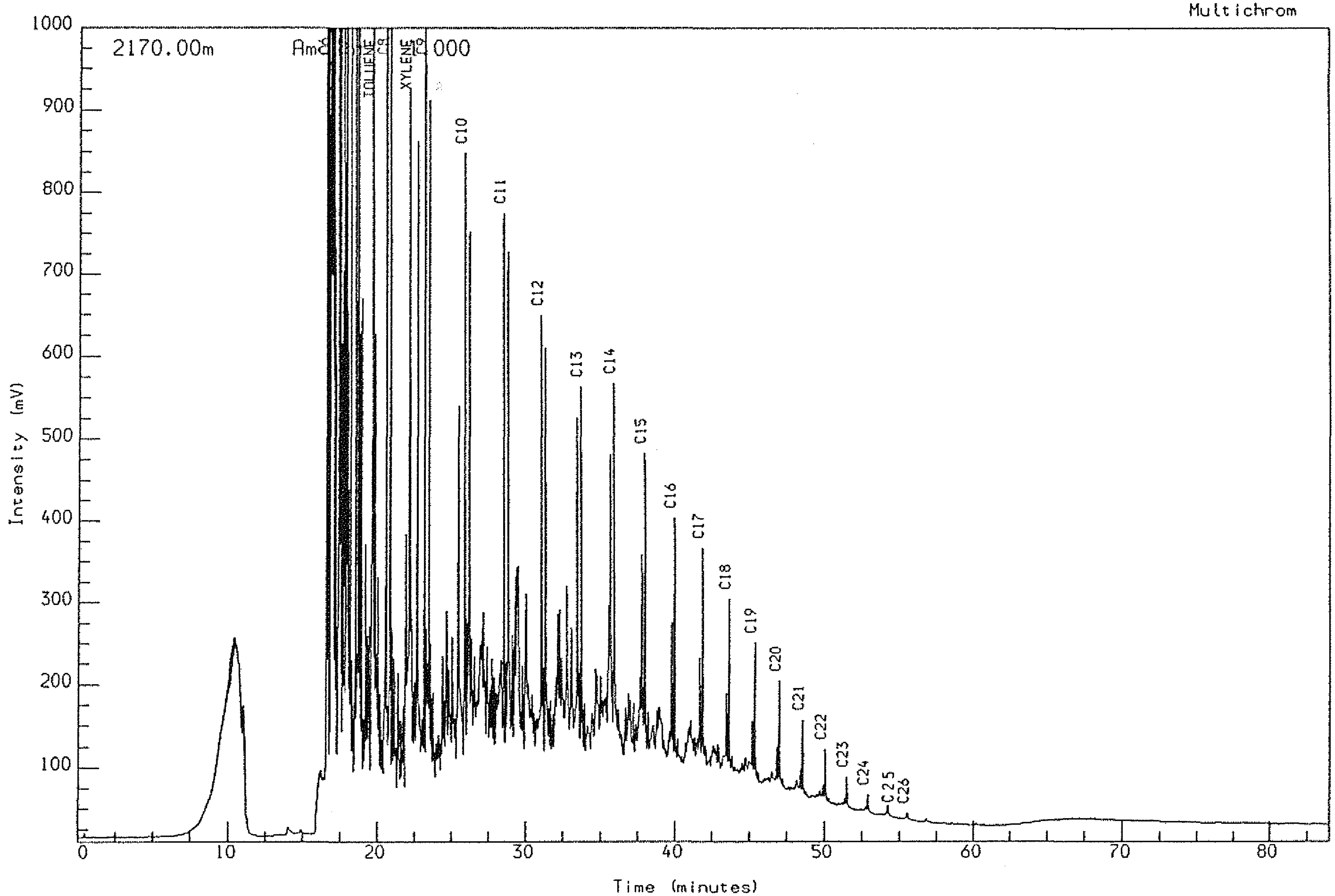

WELL NOCS 31/4-7 2140.00m ccp Reported on 18-JUN-1991 at 08:31

PYROLYSIS GC (S2)

Sh/Clst: pl y brn

GEOLAB NOR

Analysis Name : [522006] 24 PF1100851,1,1.

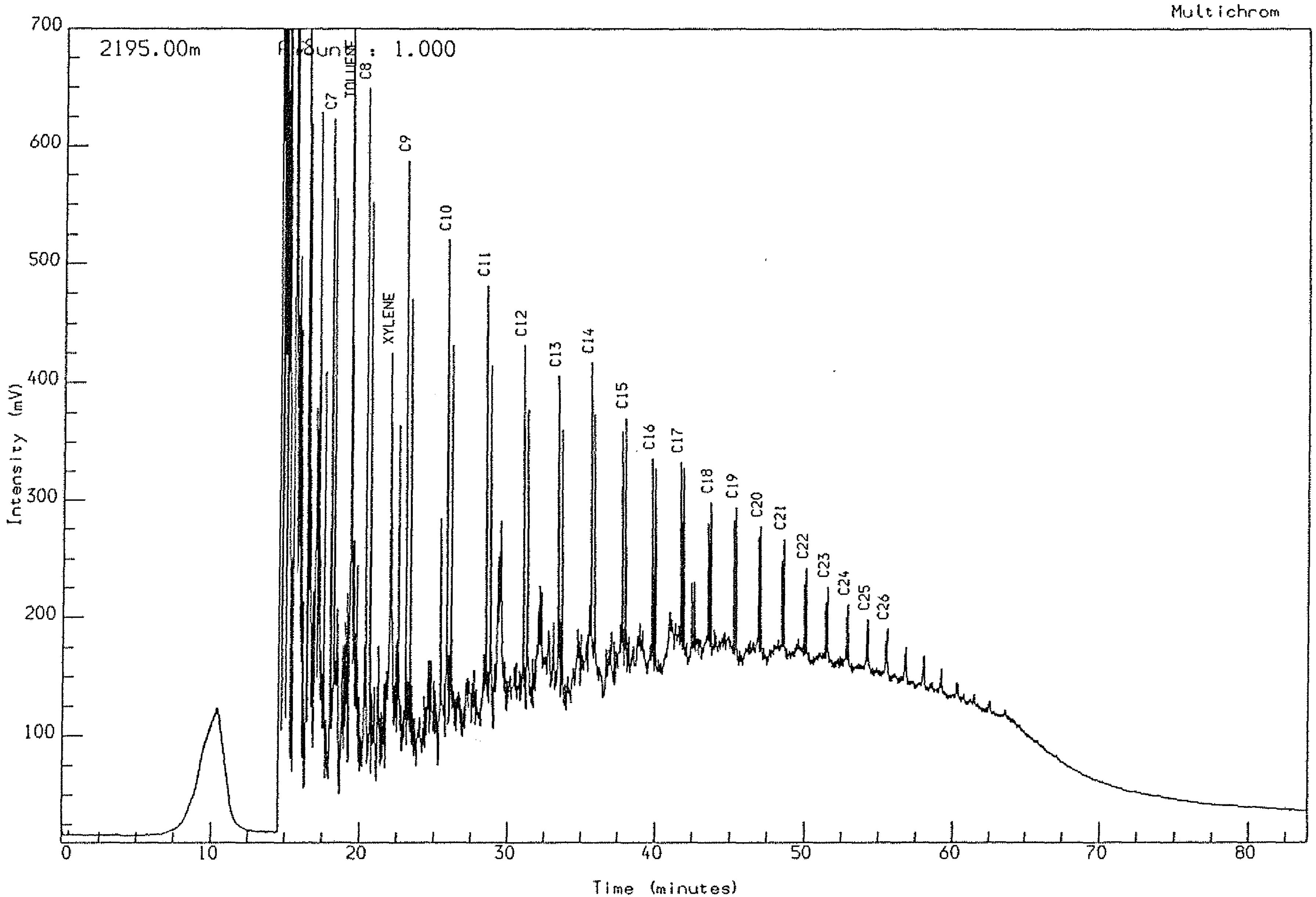



WELL NOCS 31/4-7 2170.00m cut Reported on 18-JUN-1991 at 08:33

PYROLYSIS GC (S2)

Sh/Clst: m gy

Analysis Name : [522006] 24 PF1100901,1,1.



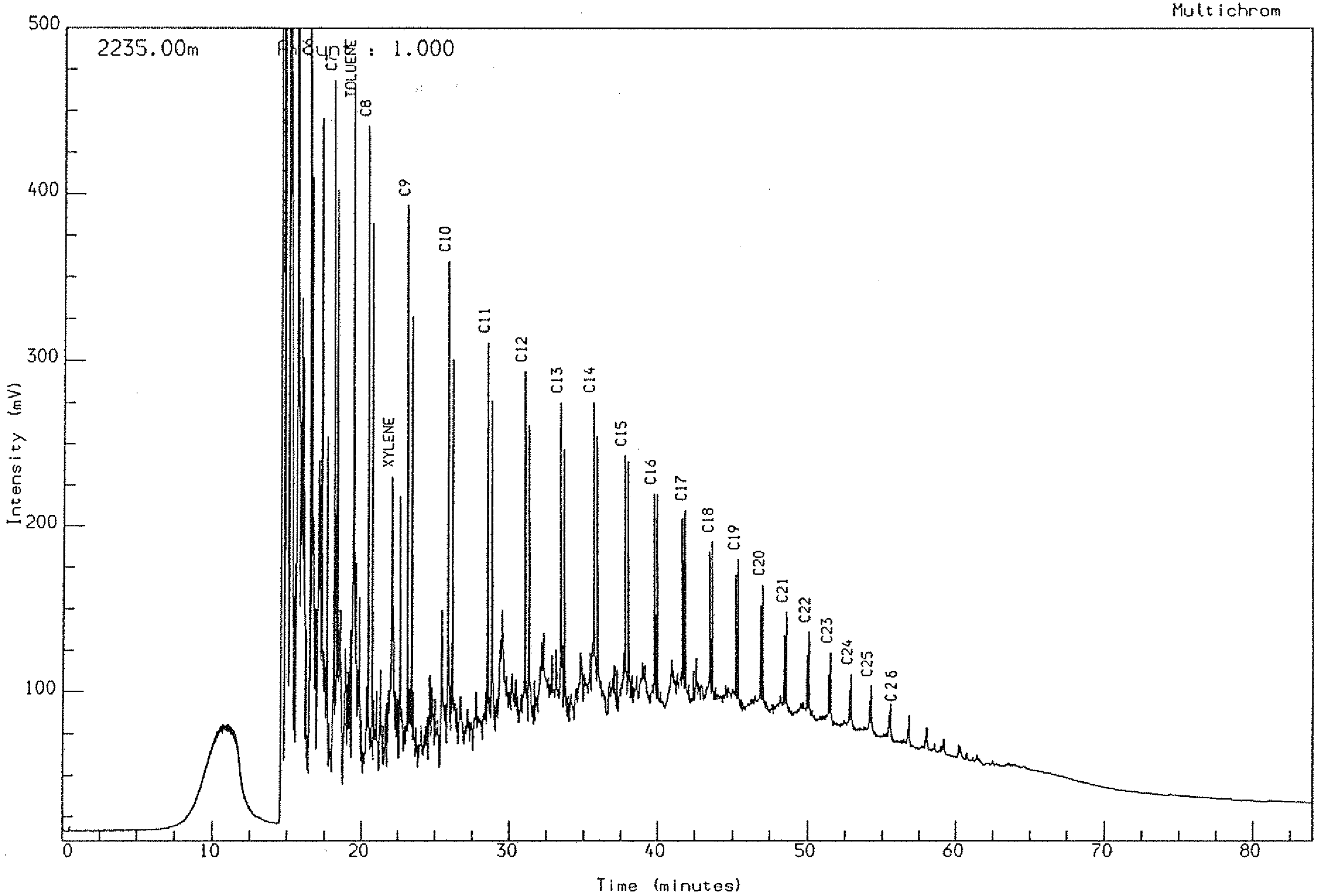

WELL NOCS 31/4-7 2195.00m cut Reported on 18-JUN-1991 at 08:35

PYROLYSIS GC (S2)

Sltst: lt gy to w

GEOLAB NOR

Analysis Name : [522006] 24 PF1100981,1,1.

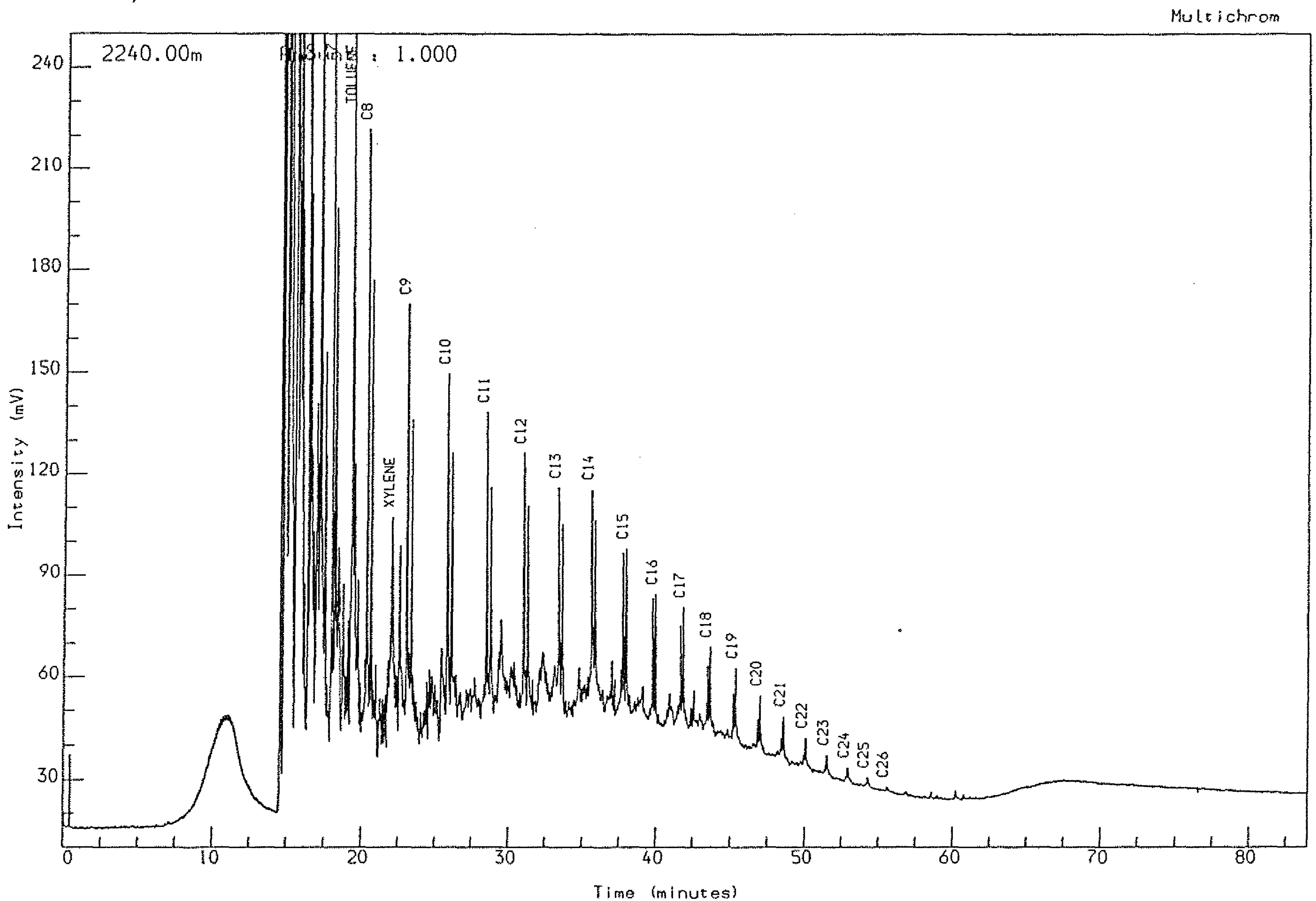



WELL NOCS 31/4-7 2235.00m cut Reported on 18-JUN-1991 at 09:52 GEOLAB NOR

PYROLYSIS GC (S2)

Sh/Clst: lt gy to m gy

Analysis Name : [522006] 24 PF1100991,1,1.



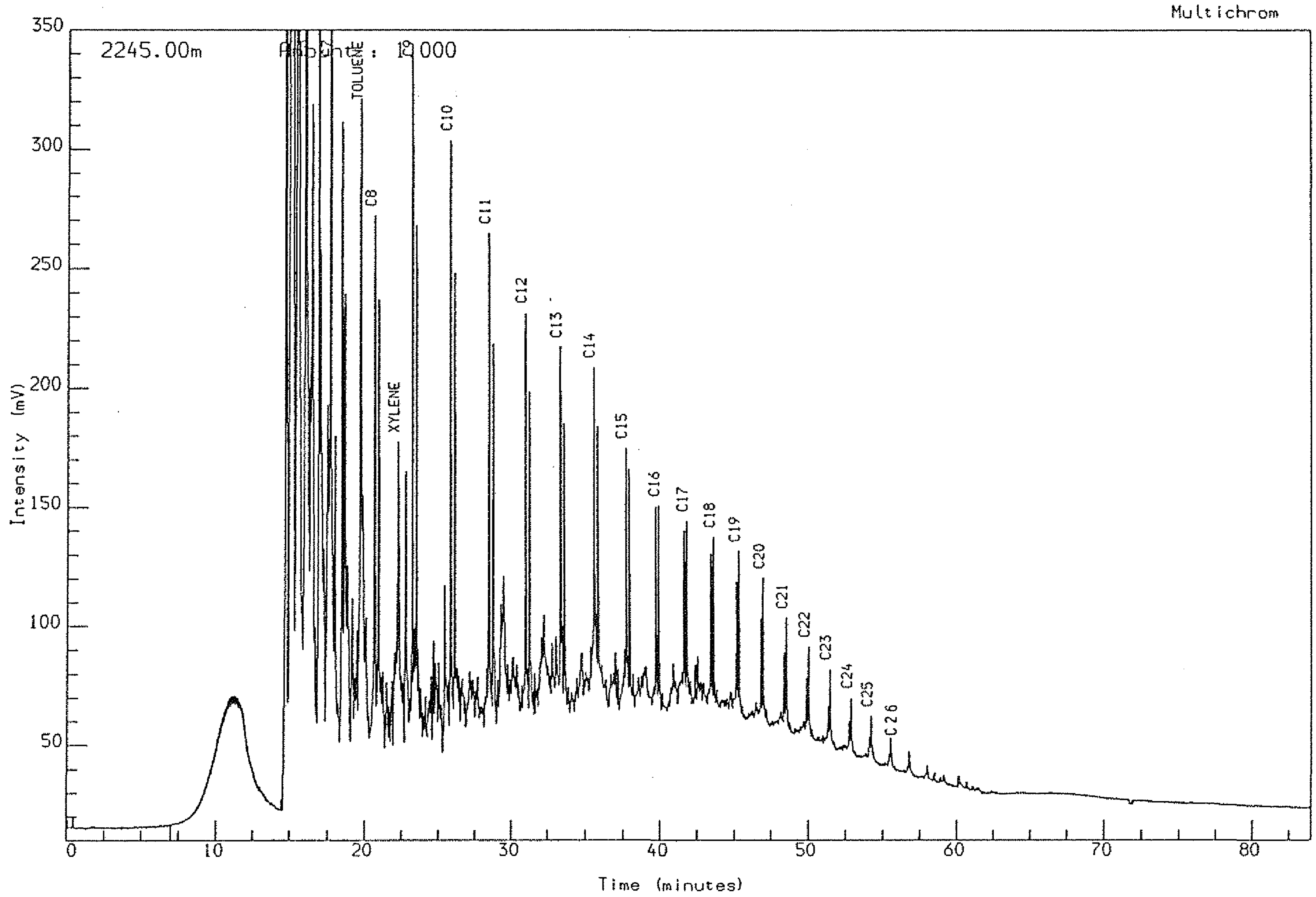

WELL NOCS 31/4-7 2240.00m cut Reported on 18-JUN-1991 at 15:30

PYROLYSIS GC (S2)

S/Sst: lt gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1101001,1,1.



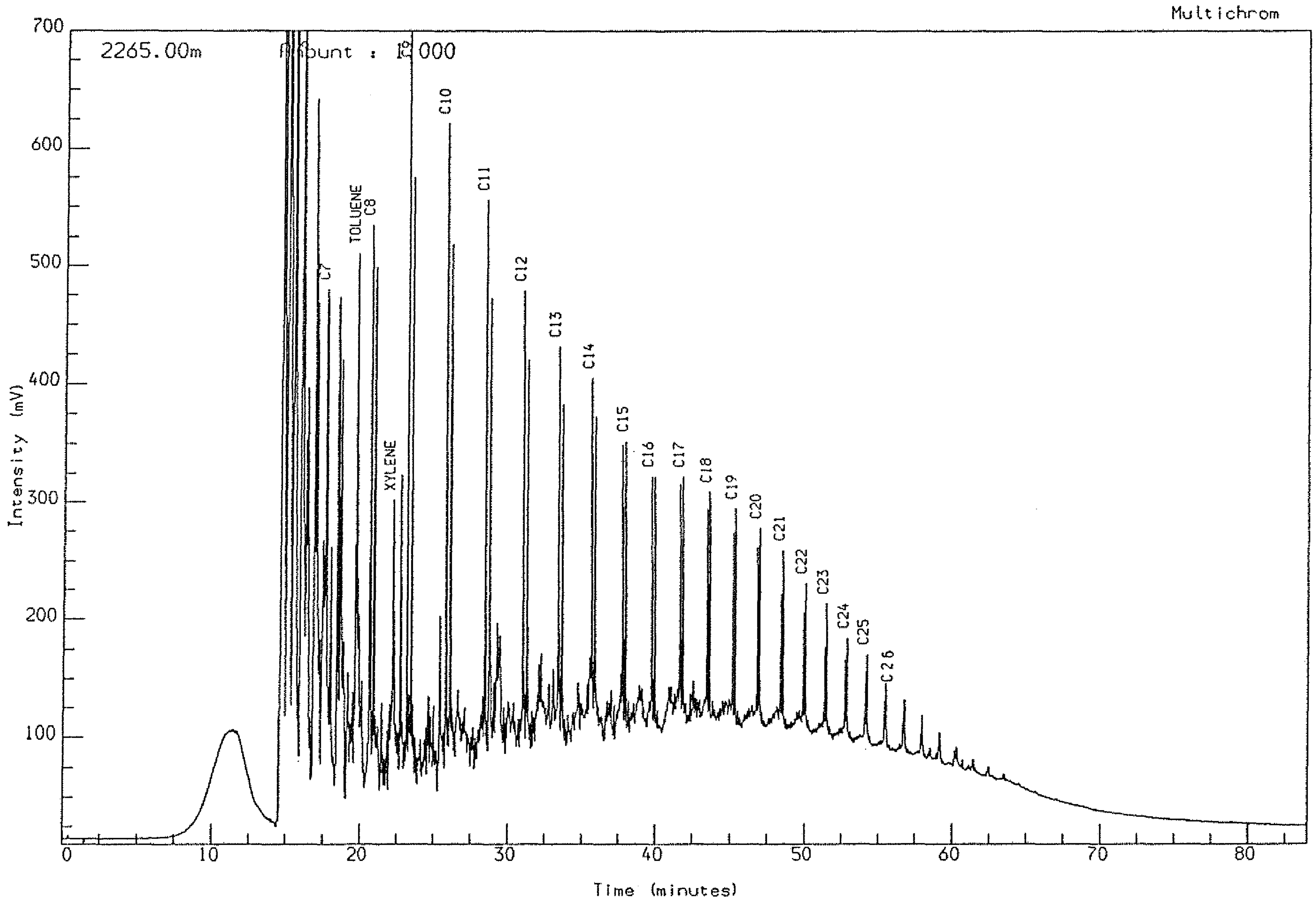

WELL NOCS 31/4-7 2245.00m cut Reported on 18-JUN-1991 at 09:55

PYROLYSIS GC (S2)

S/Sst: lt gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1101042,1,1.




WELL NOCS 31/4-7 2265.00m cut

PYROLYSIS GC (S2)

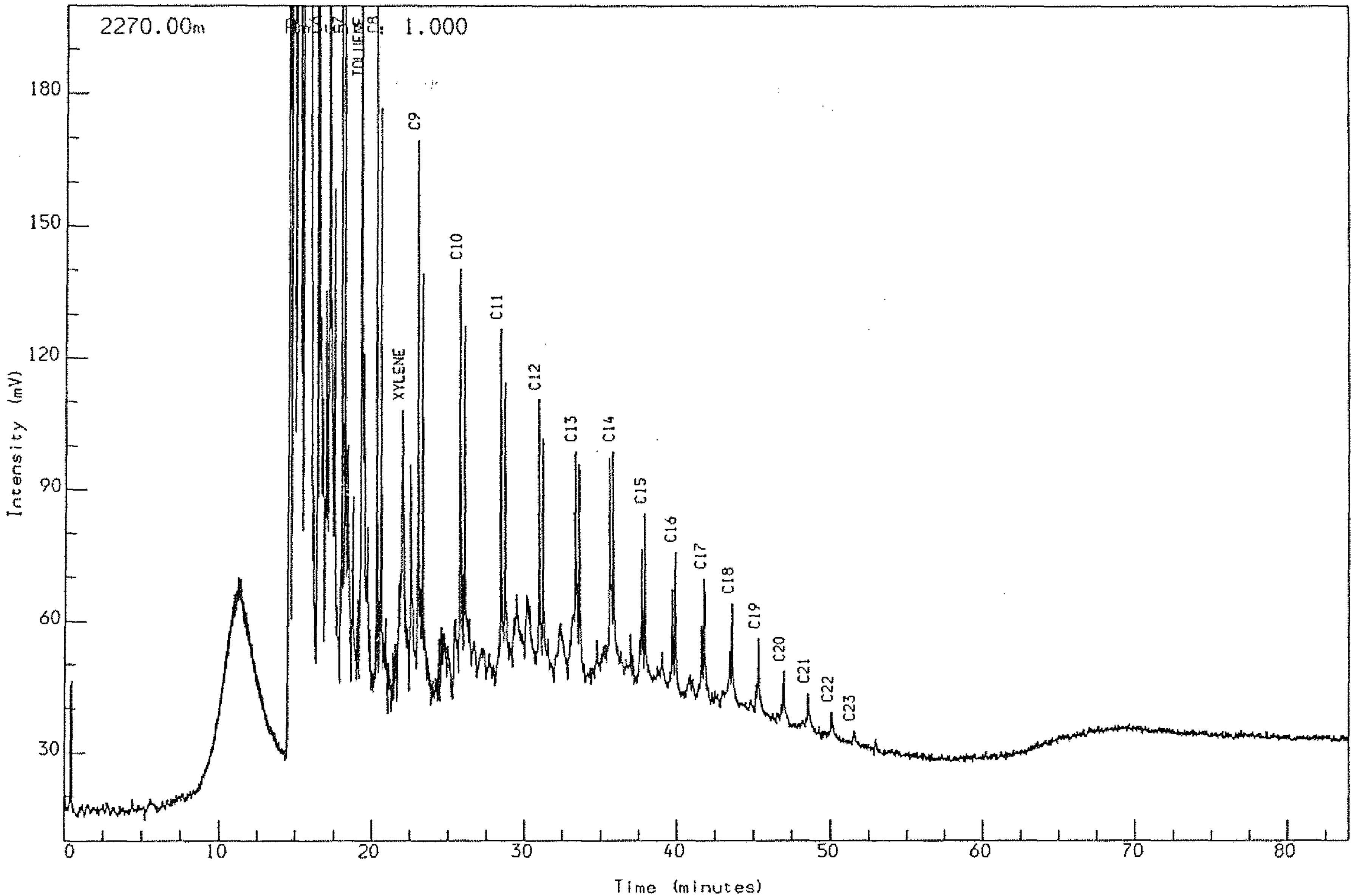
Sh/Clst: m gy to brn gy

Reported on 18-JUN-1991 at 10:09

GEOLAB NOR

Analysis Name : [522006] 24 PF1101054,1,1.

Multichrom



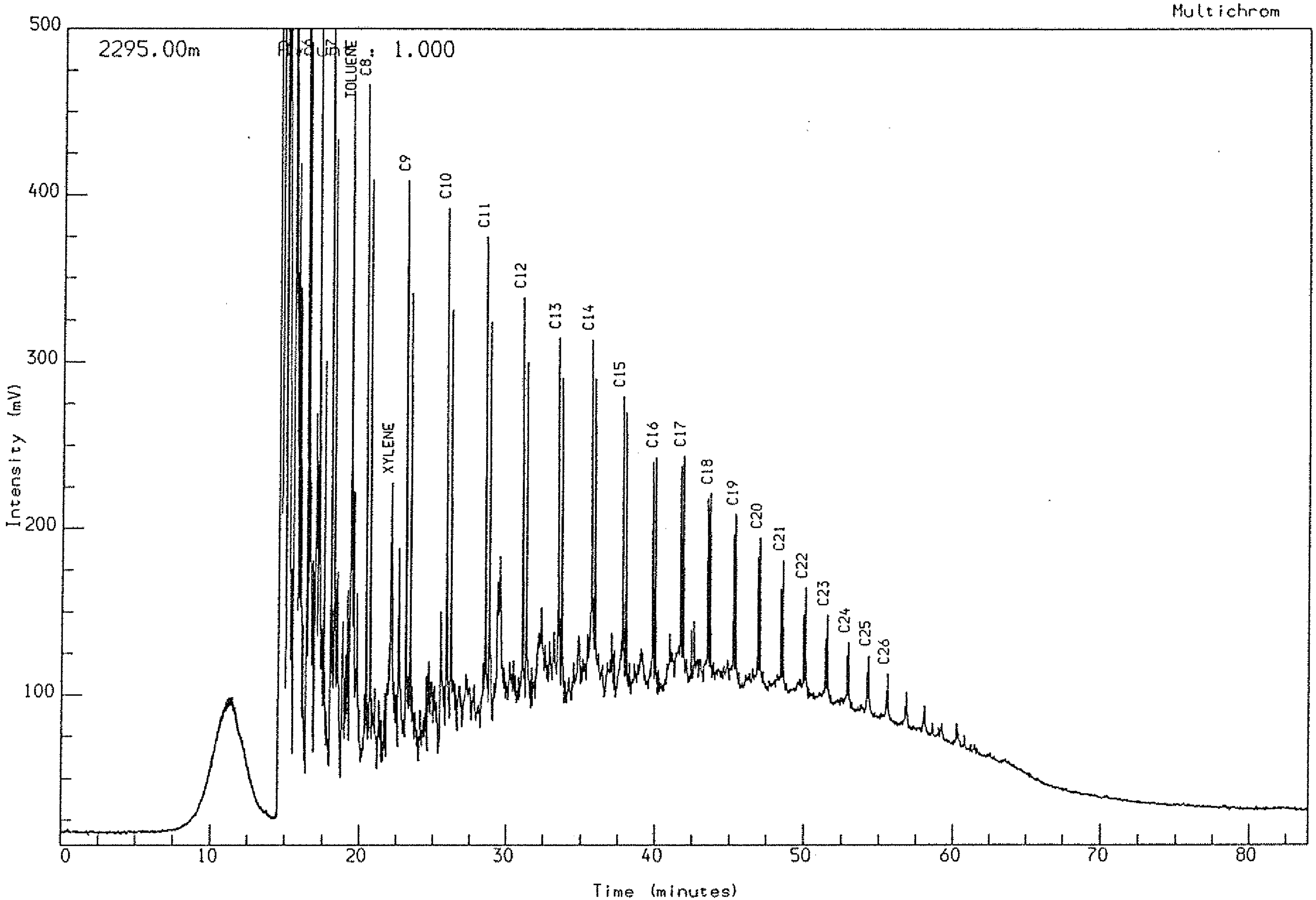

WELL NOCS 31/4-7 2270.00m cut Reported on 18-JUN-1991 at 10:10

PYROLYSIS GC (S2)

Ca: w to lt or to or gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1101101B,1,1.




WELL NOCS 31/4-7 2295.00m cut

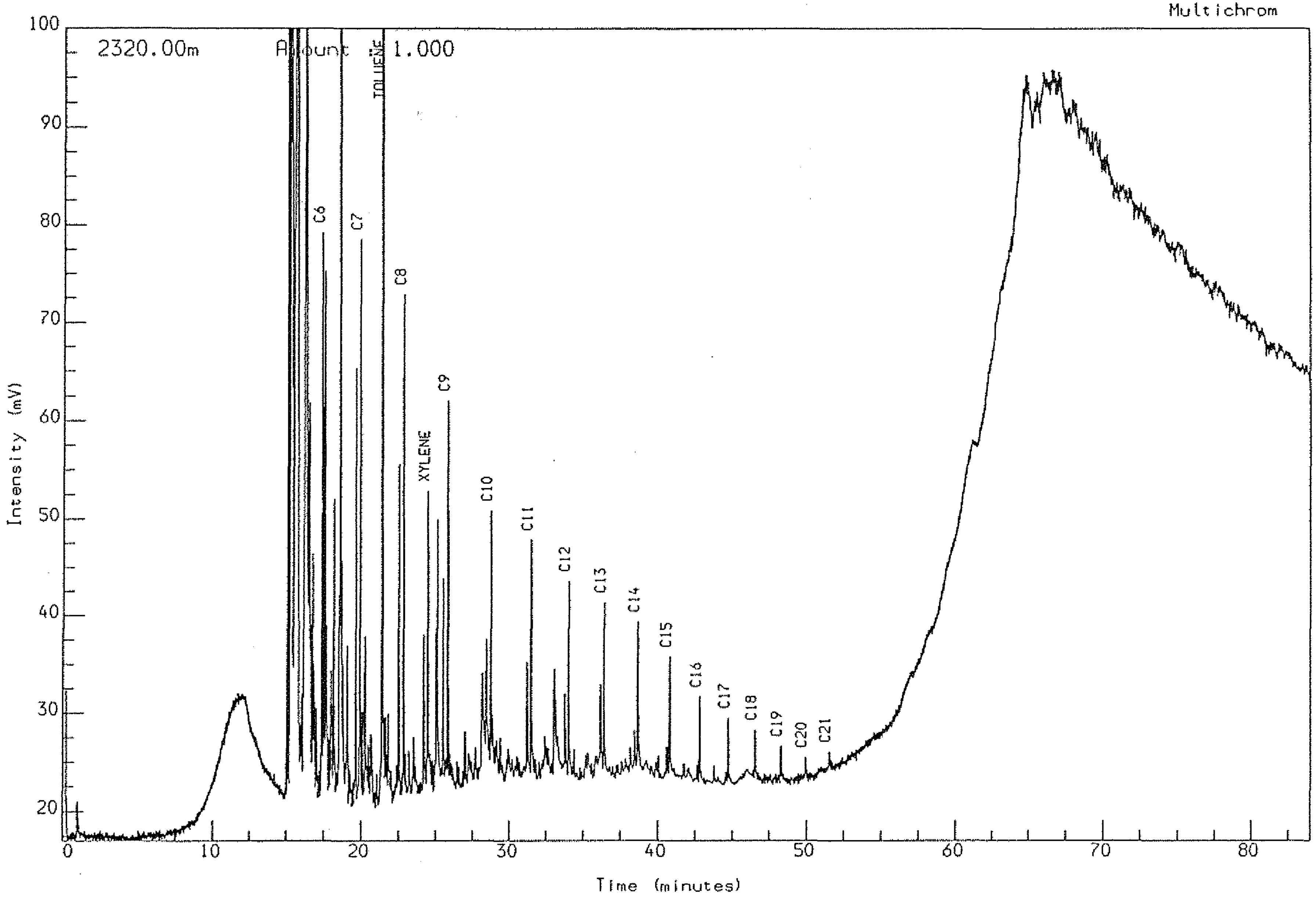
PYROLYSIS GC (S2)

Sh/Clst: m gy to brn gy

Reported on 18-JUN-1991 at 10:12

GEOLAB NOR

Analysis Name : [522006] 24 PF1101152D.1.1.

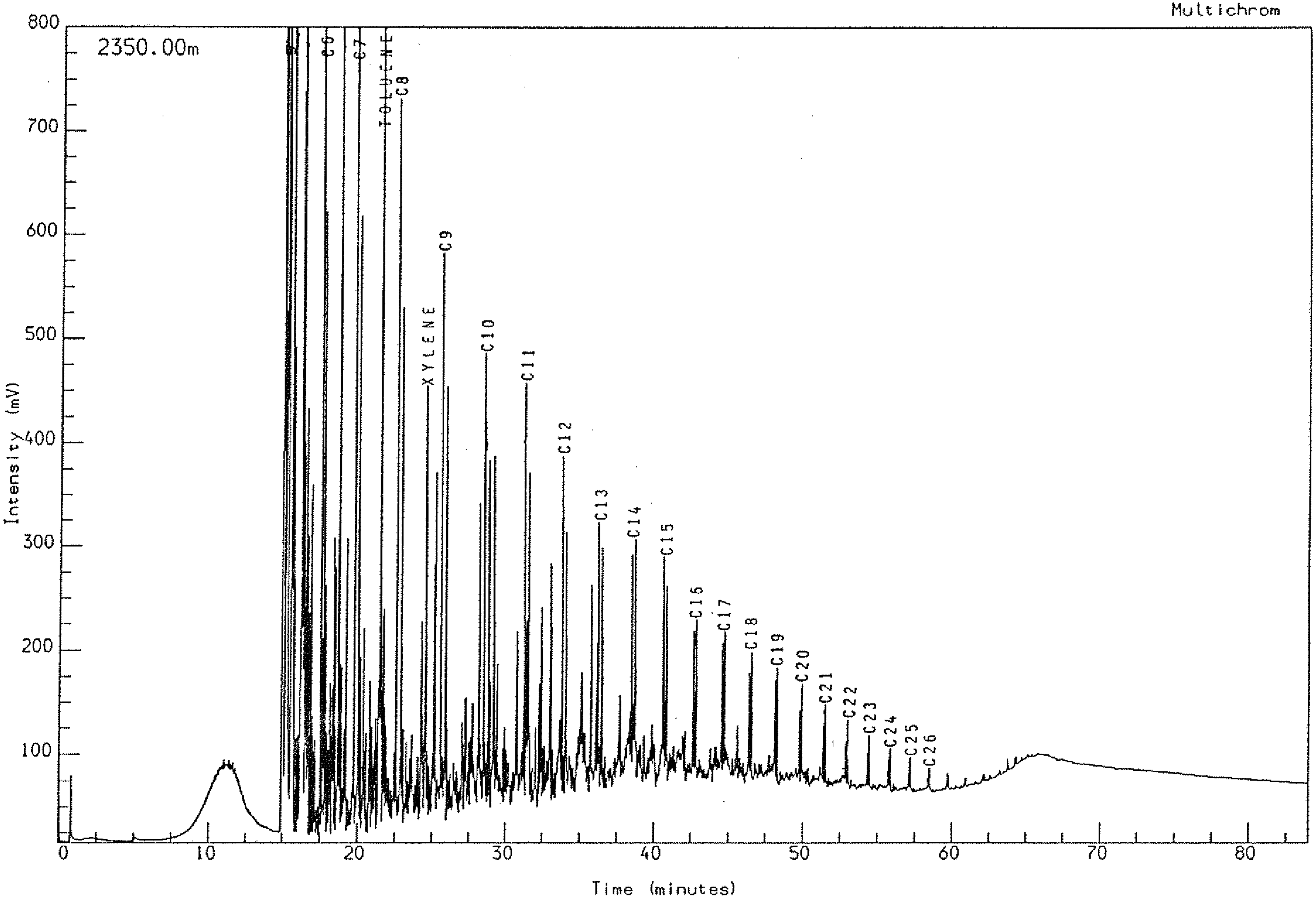



WELL NOCS 31/4-7 2320.00m cut
PYROLYSIS GC (S2)
S/Sst: w to lt gy

Reported on 22-AUG-1991 at 08:43

GEOLAB NOR

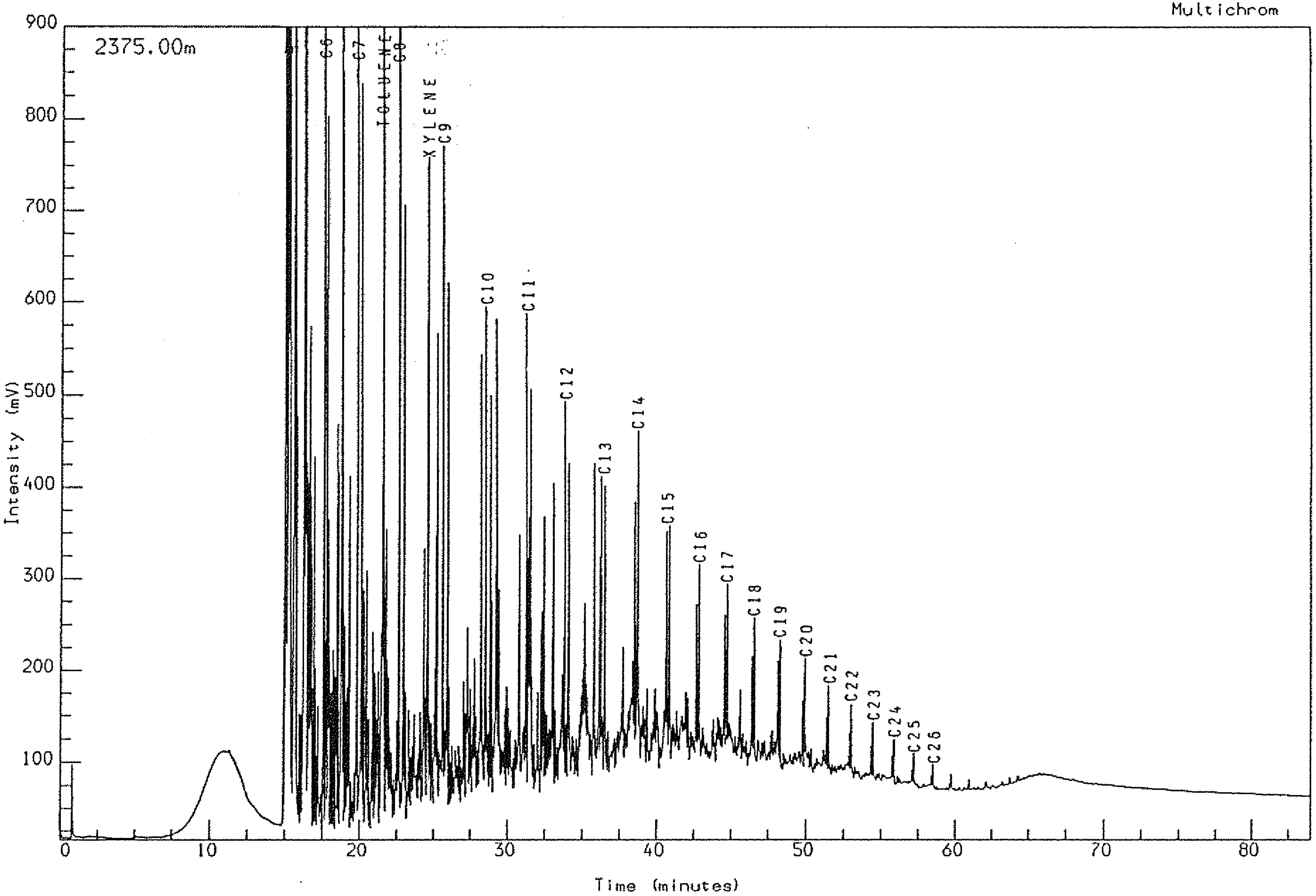
Analysis Name : [522006] 24 PF1101211,1,1.




WELL NOCS 31/4-7 2350.00m cut Reported on 15-JUL-1991 at 10:00
PYROLYSIS GC (S2)
Sh/Clst: m gy

GEOLAB NOR

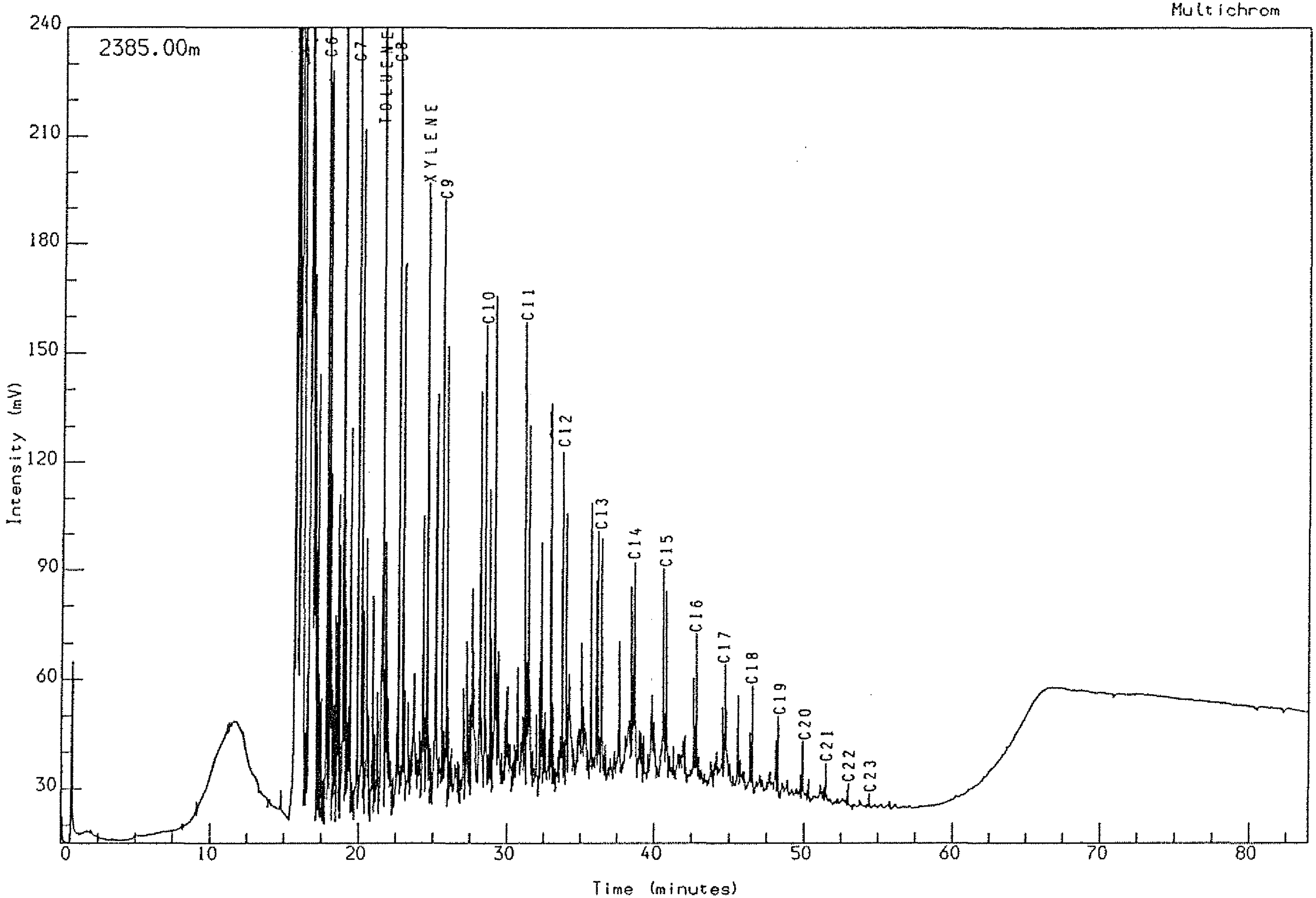
Analysis Name : [522006] 24 PF1101251,1,1.




WELL NOCS 31/4-7 2375.00m cut Reported on 15-JUL-1991 at 10:03
PYROLYSIS GC (S2)
Sh/Clst: m gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1101271.1.1.



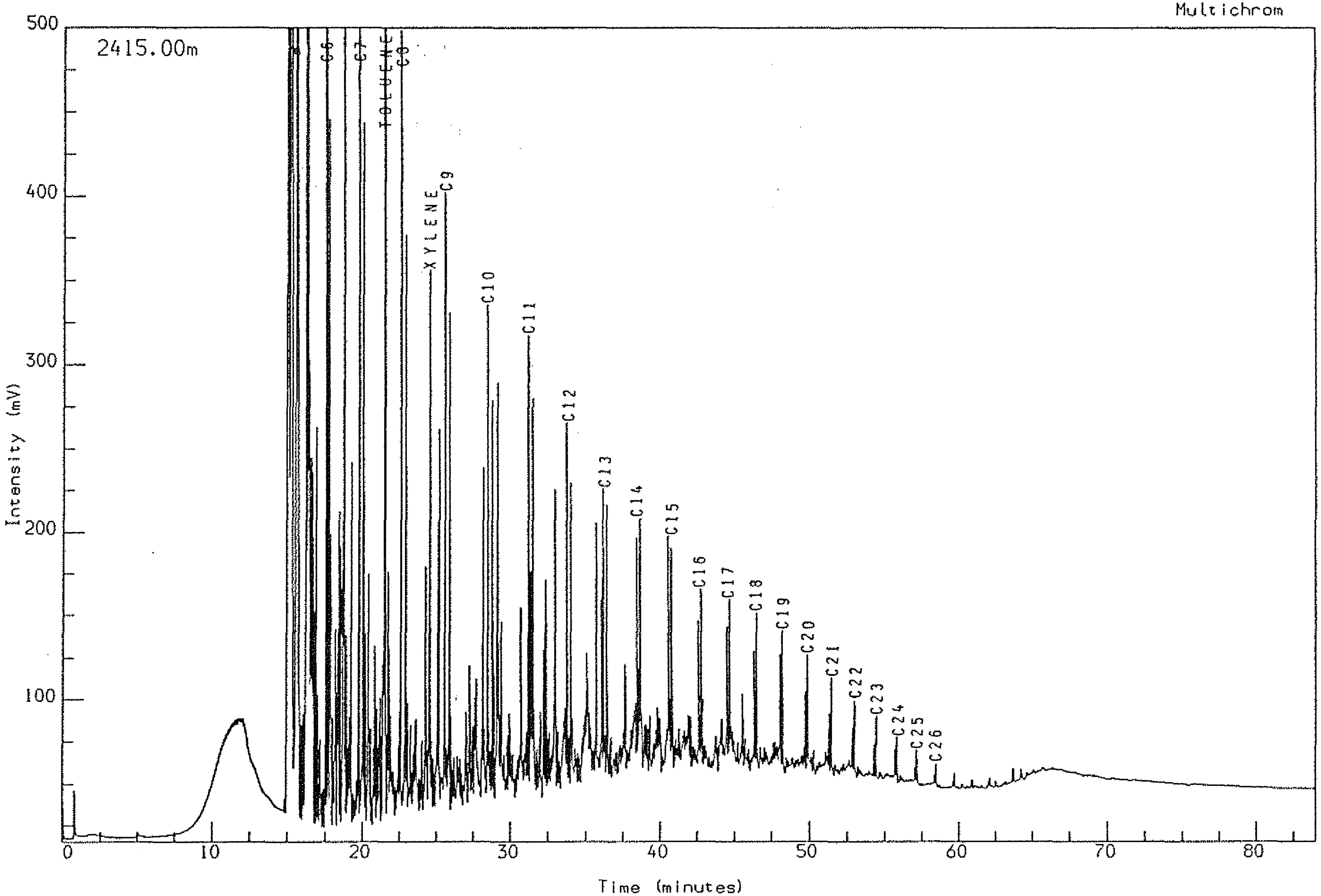

WELL NOCS 31/4-7 2385.00m cut Reported on 15-JUL-1991 at 10:06

PYROLYSIS GC (S2)

S/Sst: w to lt gy

GEOLAB NOR

Analysis Name : [522006] 24 PF1101331,1,1.



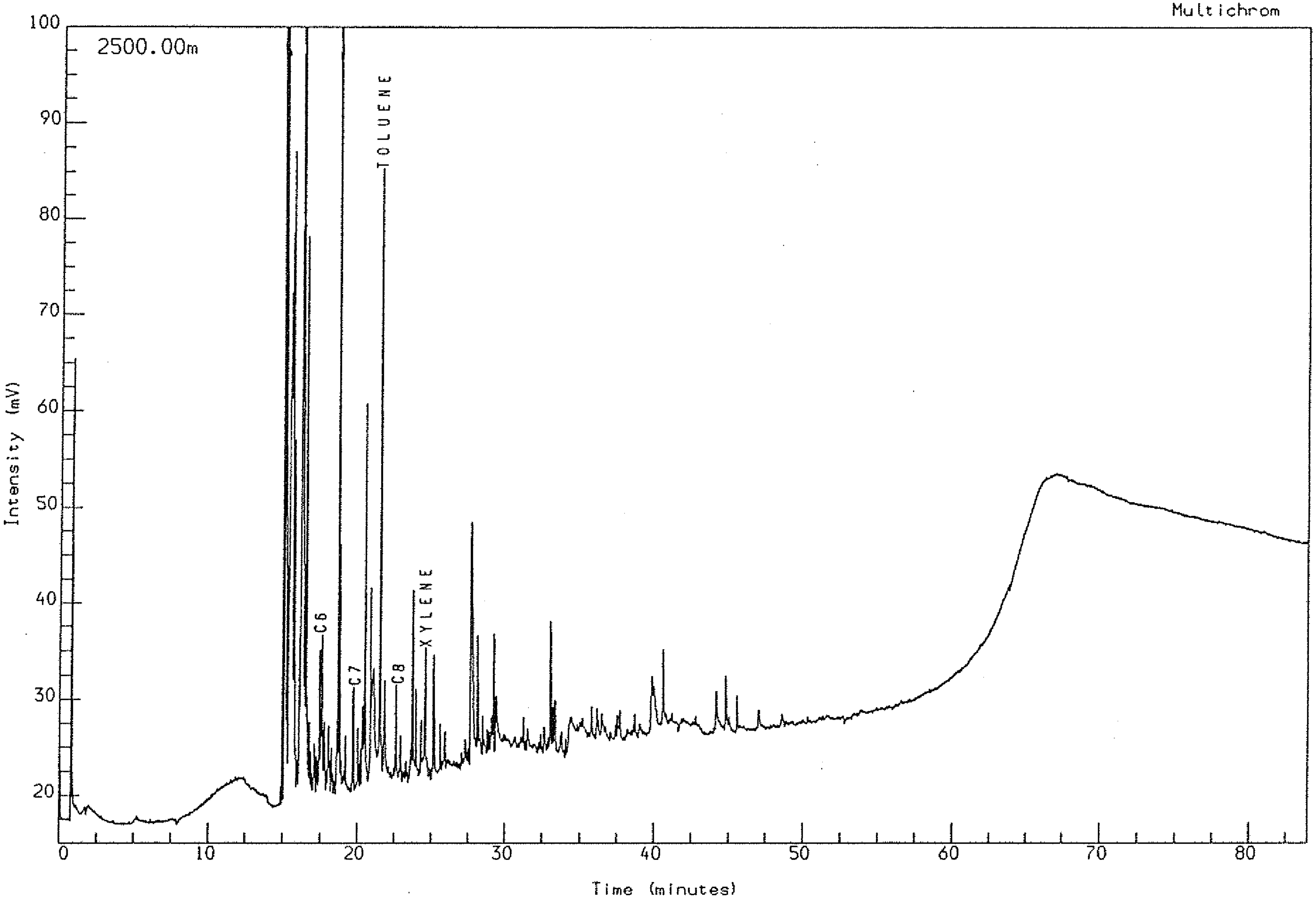

WELL NOCS 31/4-7
PYROLYSIS GC (S2)
S/Sst: w to lt gy

2415.00m cut

Reported on 15-JUL-1991 at 10:13

GEOLAB NOR

Analysis Name : [522006] 24 PF1101505.1.1.




WELL NOCS 31/4-7 2500.00m cut Reported on 15-JUL-1991 at 10:15
PYROLYSIS GC (S2)
Sh/Clst: m brn to pl brn

GEOLAB NOR

# Appendix 4

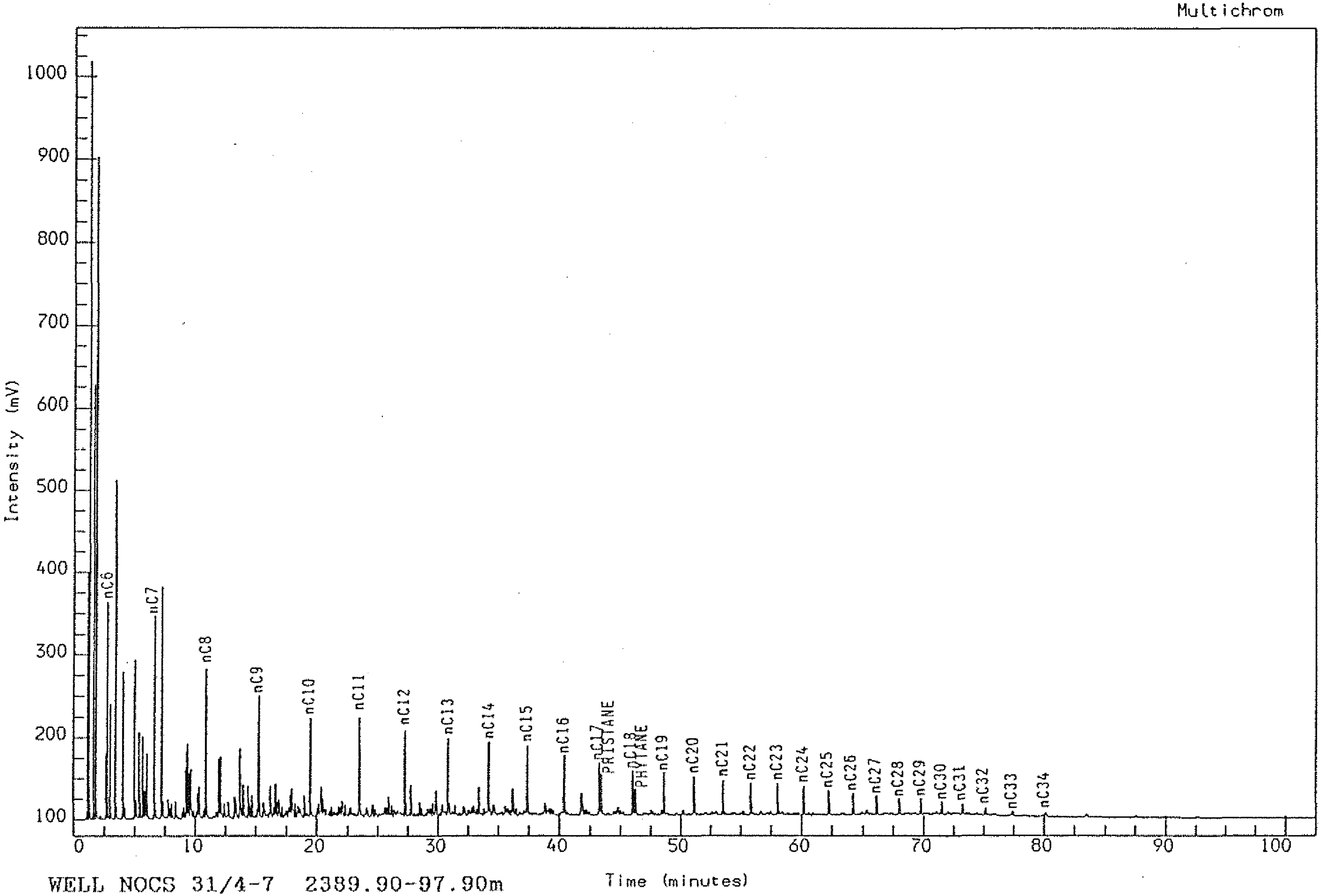
I Whole Extract Chromatograms (FID & FPD)

II Saturated Fraction Chromatograms (FID)

III Aromatic Fraction Chromatograms (FID& FPD)

Whole Extract Chromatograms (FID & FPD)

Analysis Name : [522006] 9 W01101510B,1,1.



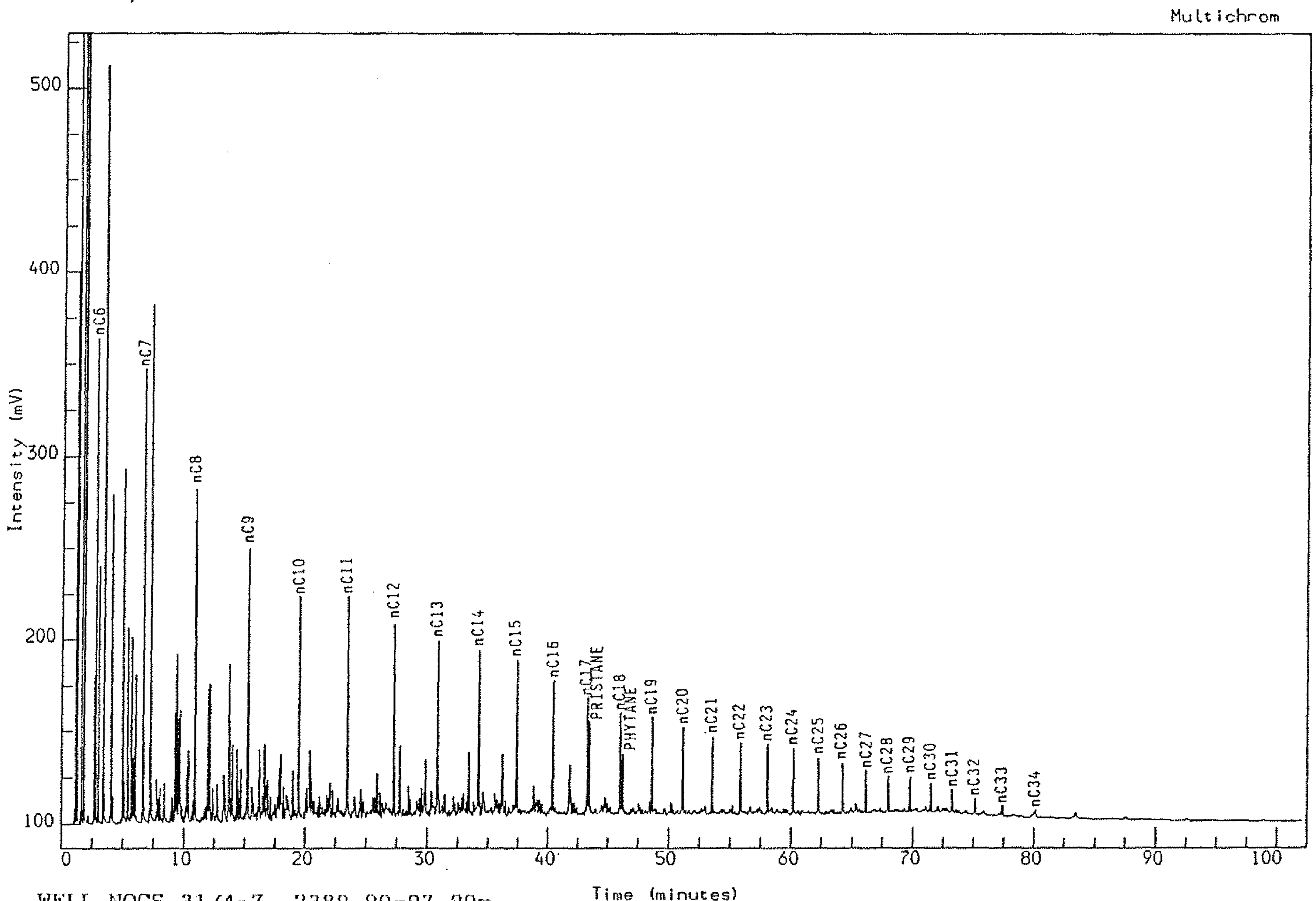

WELL NOCS 31/4-7 2389.90-97.90m

WHOIL OIL GC (FID)

Reported on 3-JUN-1991 at 08:45

GEOLAB NOR

Analysis Name : [522006] 9 W01101510B,1,1.



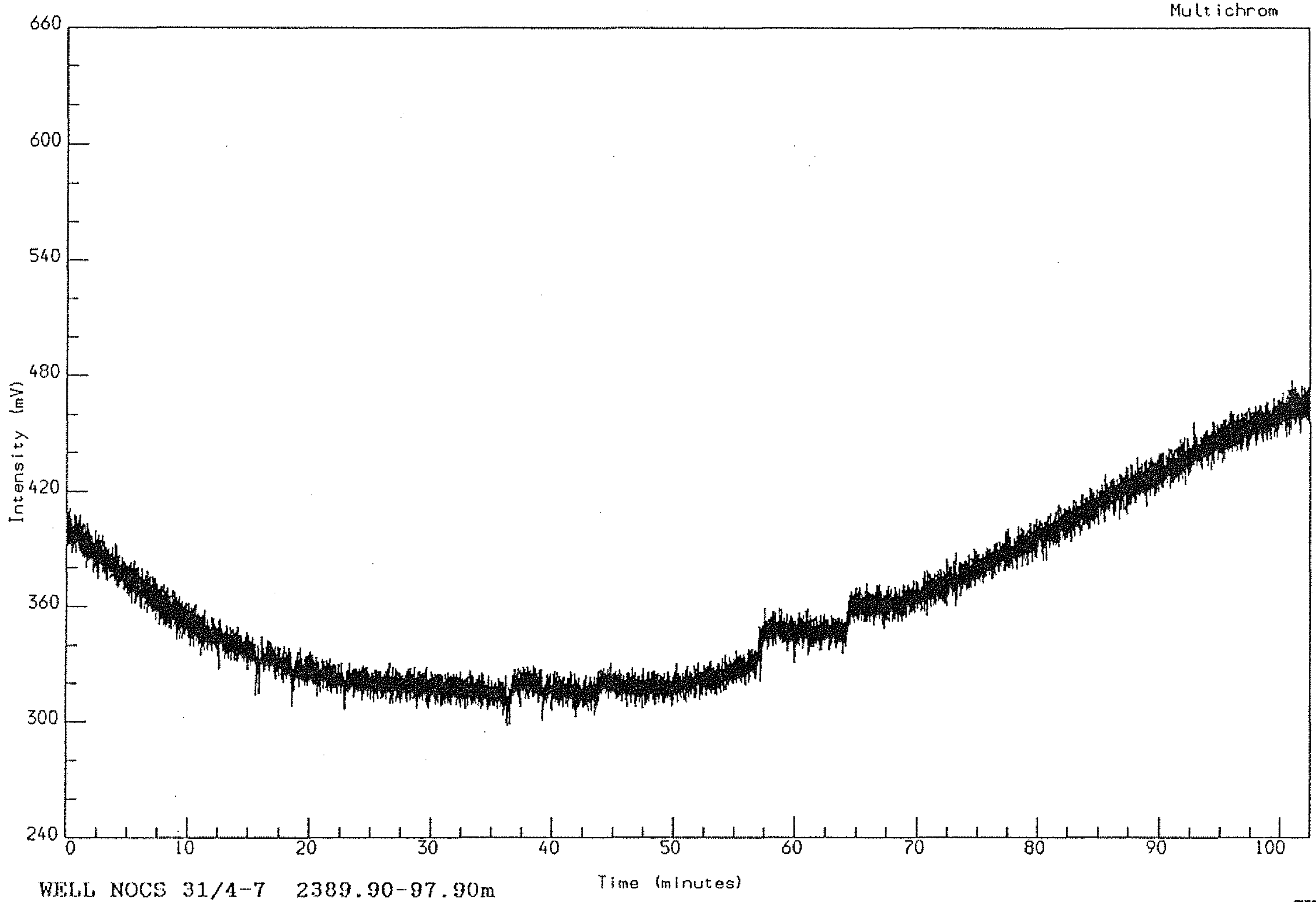

WELL NOCS 31/4-7 2389.90-97.90m

WHOIL OIL GC (FID)

Reported on 3-JUN-1991 at 08:46

GEOLAB NOR

Analysis Name : [522006] 10 W01101510B,1,1.




WELL NOCS 31/4-7 2389.90-97.90m

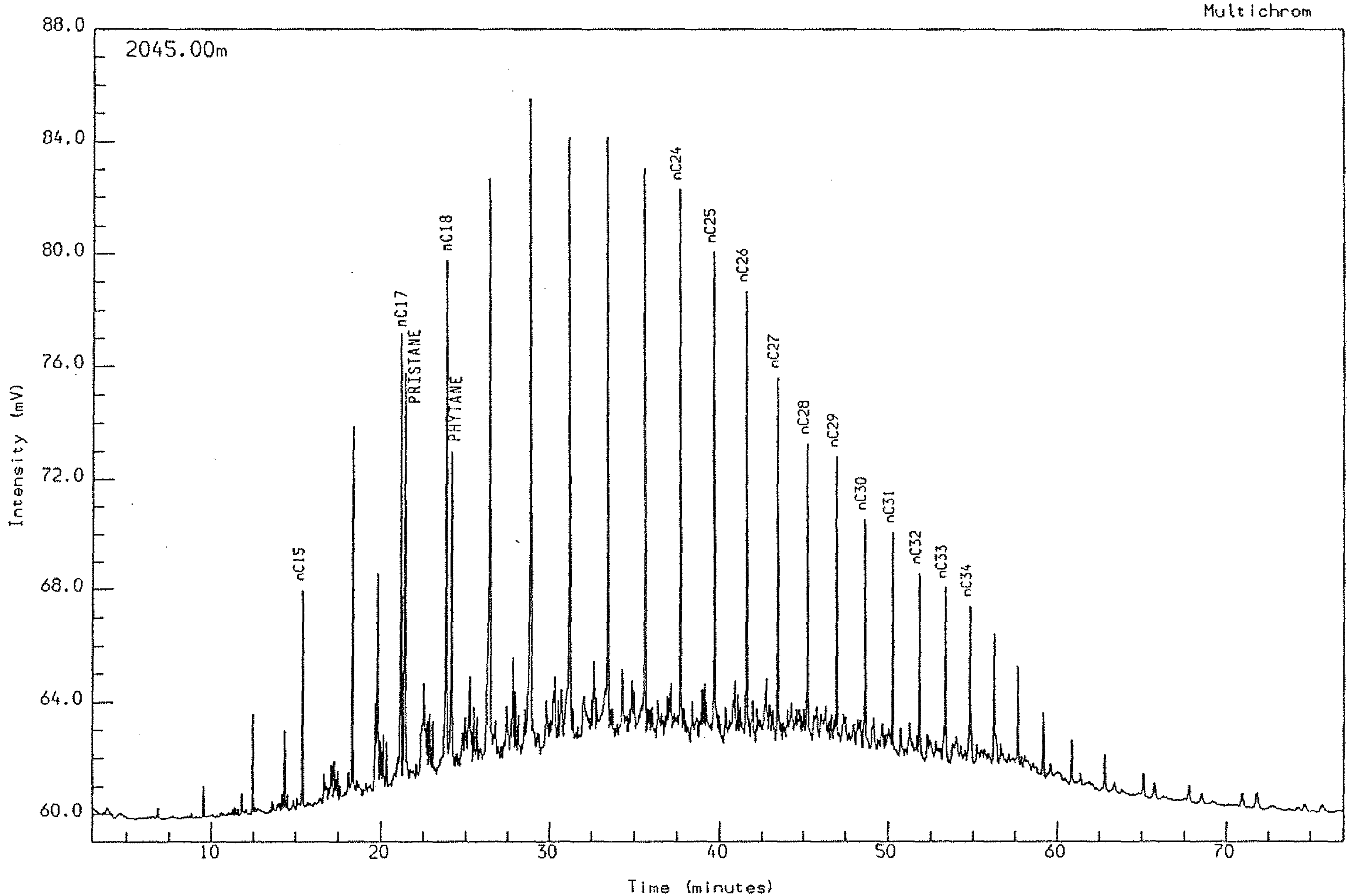
WHOIL OIL GC (FPD)

Reported on 3-JUN-1991 at 08:48

GEOLAB NOR

Saturated Fraction Chromatograms (FID)

Analysis Name : [522006] 11 SF1100011L,1,1.

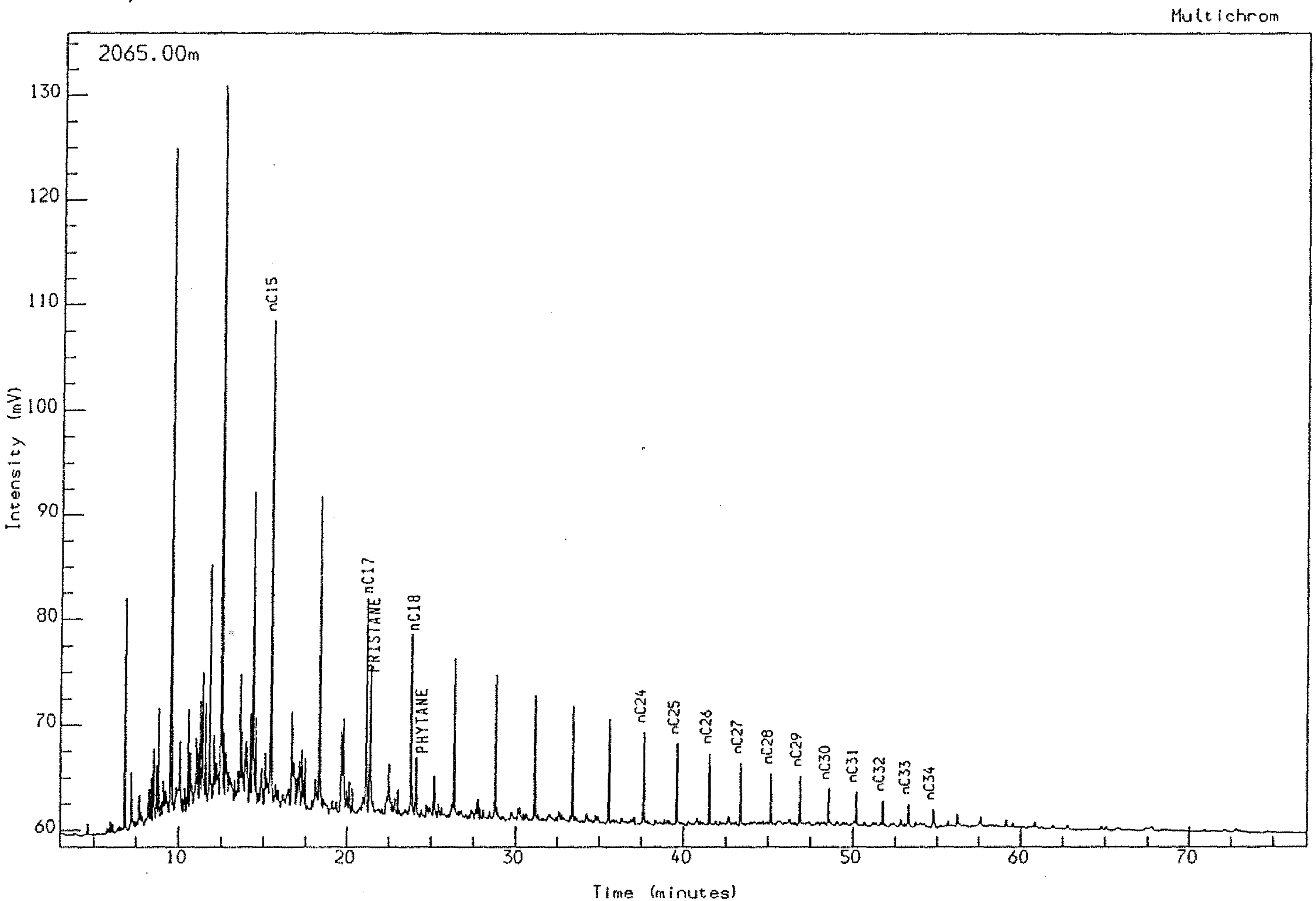



WELL NOCS 31/4-7 2045.00m ccp
SATURATED GC
Sltst: lt gy

Reported on 10-JUL-1991 at 10:44

GEOLAB NOR

Analysis Name : [522006] 11 SF1100051L,1,1.

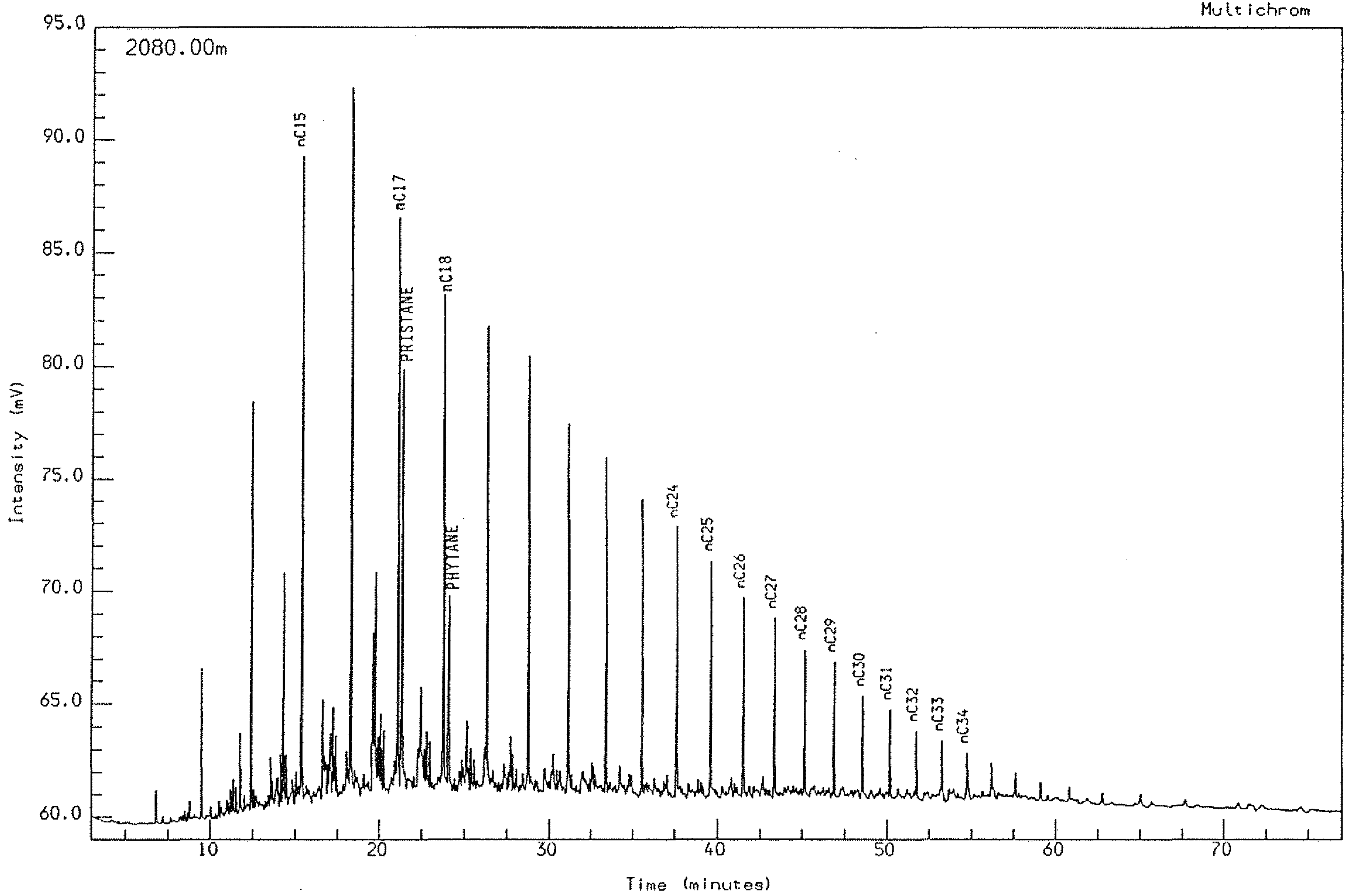



WELL NOCS 31/4-7 2065.00m ccp
SATURATED GC
Sltst: lt gy to lt brn gy

Reported on 10-JUL-1991 at 10:48

GEOLAB NOR

Analysis Name : [522006] 11 SF1100081L,1,1.

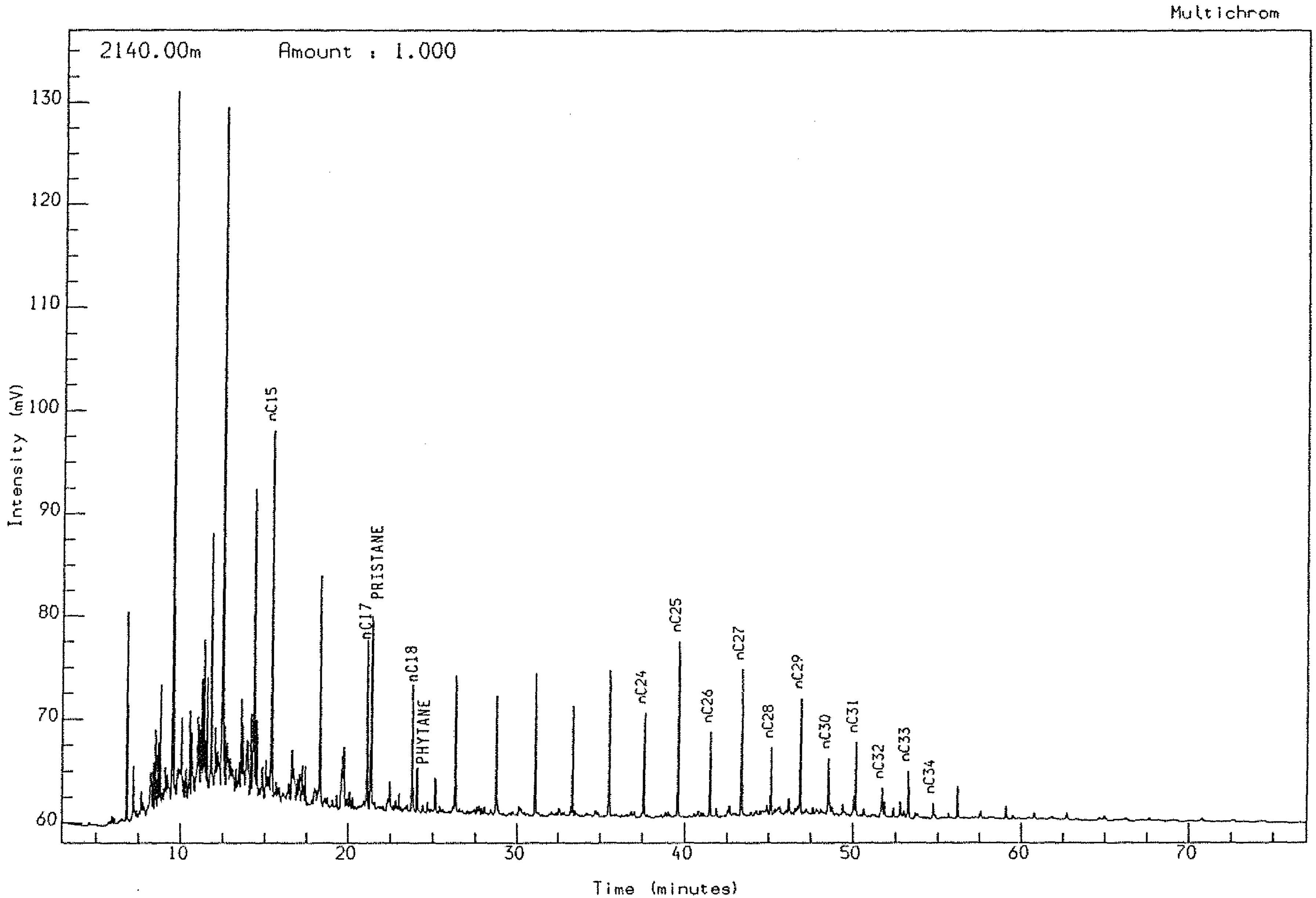



WELL NOCS 31/4-7 2080.00m ccp
SATURATED GC
Sltst: lt brn gy

Reported on 10-JUL-1991 at 10:50

GEOLAB NOR

Analysis Name : [522006] 11 SF1100201L,1,1.

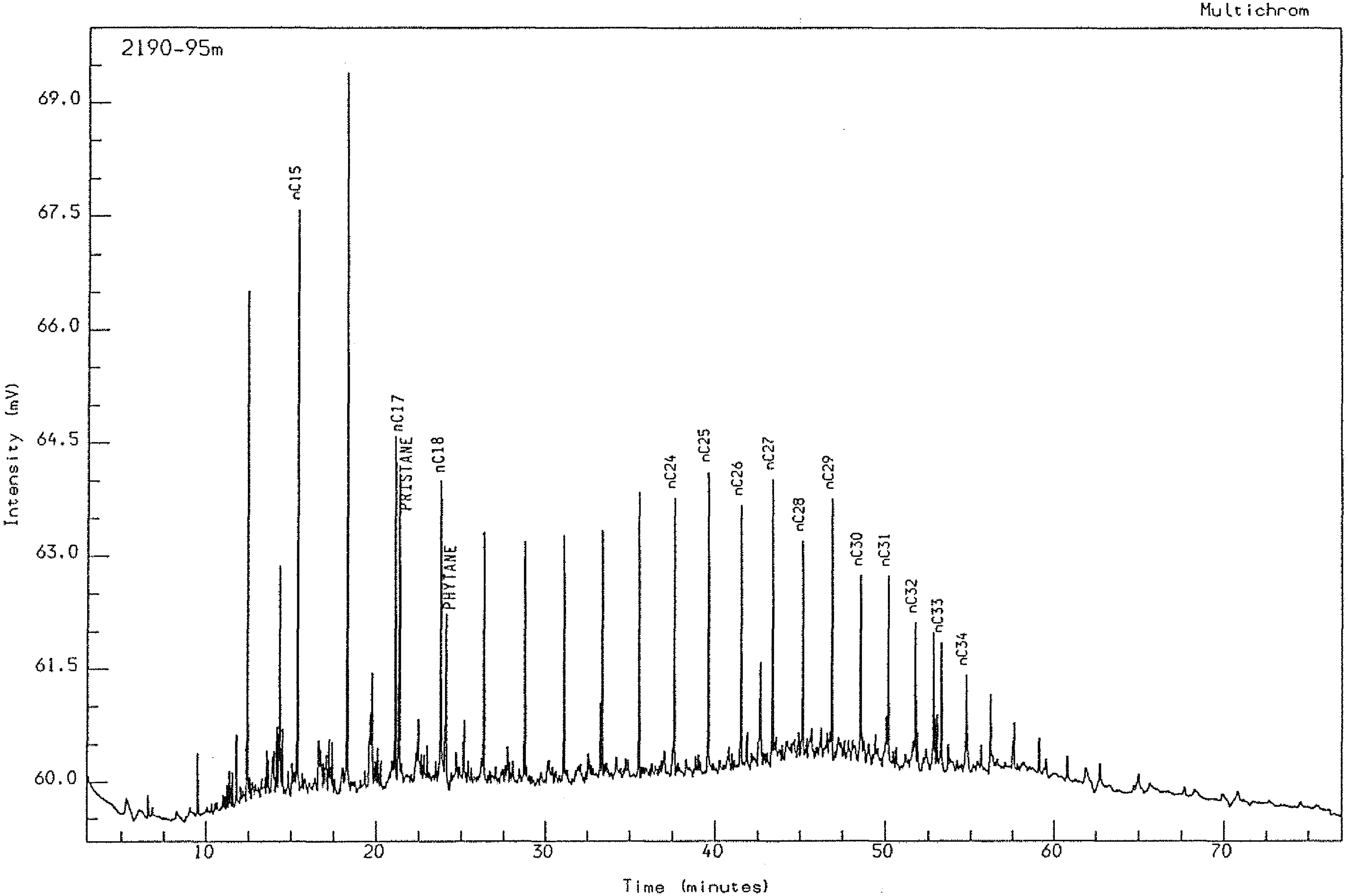



WELL NOCS 31/4-7 2140.00m ccp
SATURATED GC
Sh/Clst: pl y brn

Reported on 10-JUL-1991 at 10:53

GEOLAB NOR

Analysis Name : [522006] 11 SF1101520B,1,1.

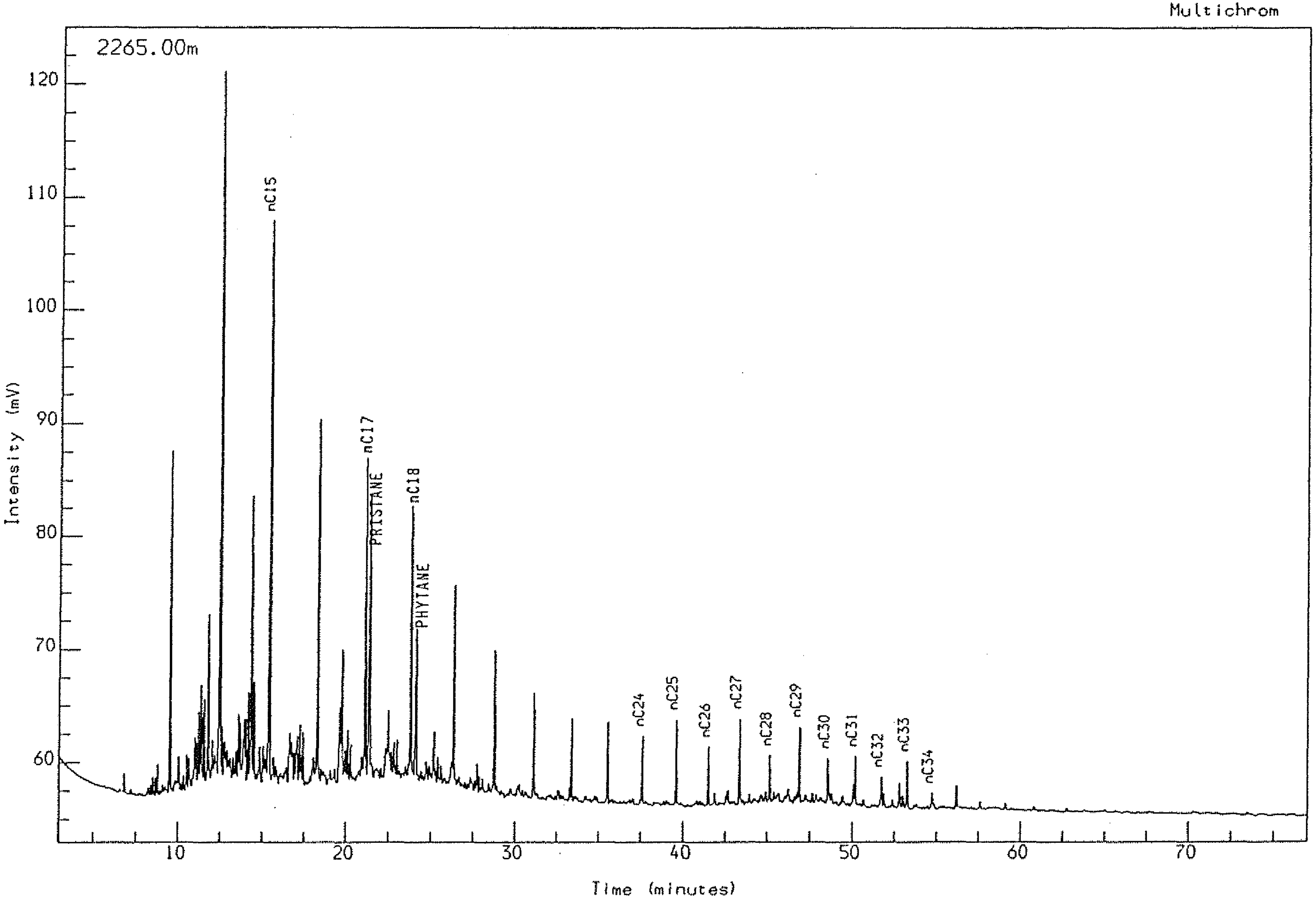



WELL NOCS 31/4-7 2190-2195m cut
SATURATED GC
Sltst:lt gy to w

Reported on 10-JUL-1991 at 10:55

GEOLAB NOR

Analysis Name : [522006] 11 SF1101042L,1,1.

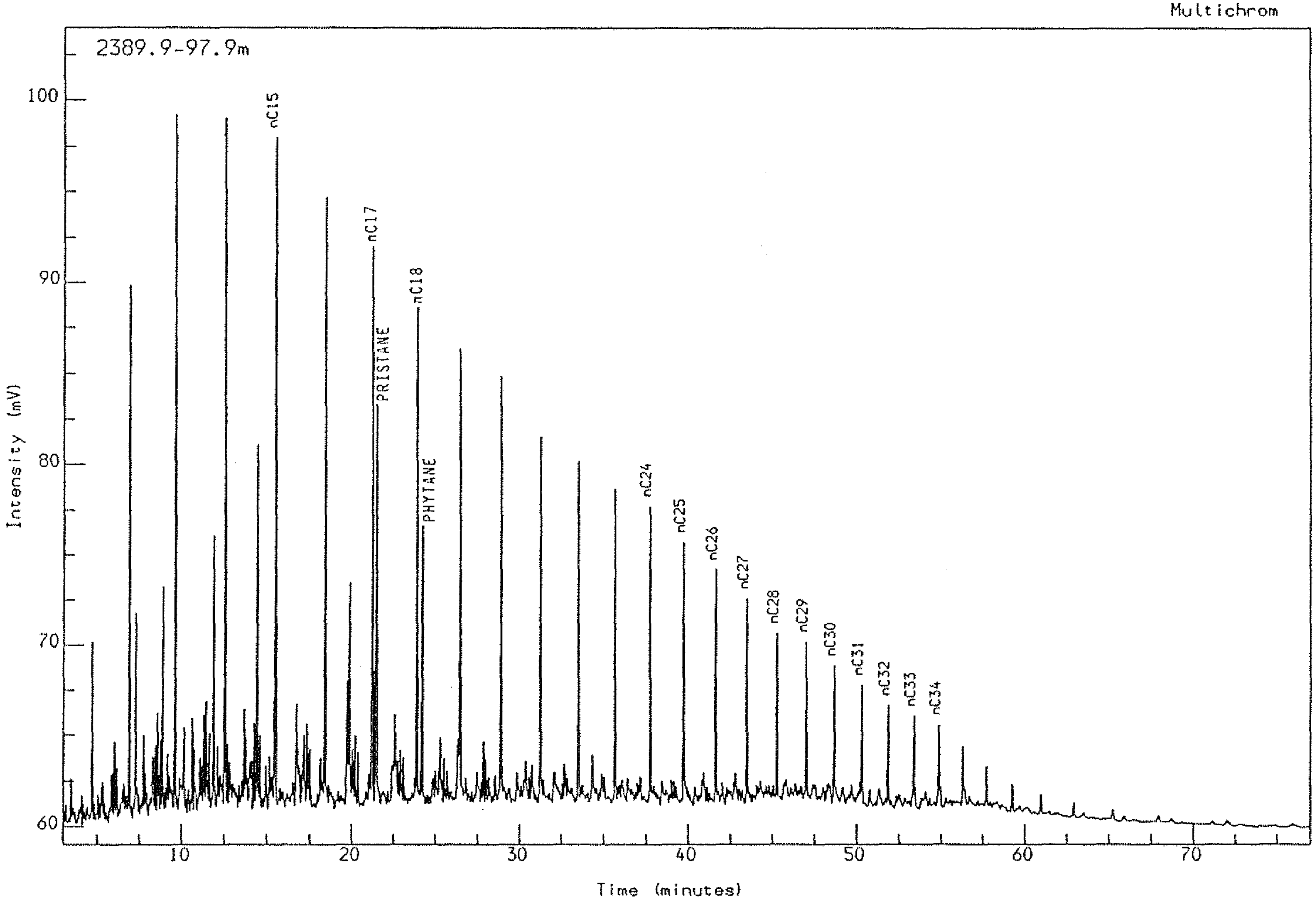



WELL NOCS 31/4-7 2265.00m cut
SATURATED GC
Sh/Clst: m gy to brn gy

Reported on 10-JUL-1991 at 14:43

GEOLAB NOR

Analysis Name : [522006] 11 SF1101510B,1,1.




WELL NOCS 31/4-7 2389.90-97.90m
SATURATED GC

Reported on 21-MAY-1991 at 16:00

GEOLAB NOR