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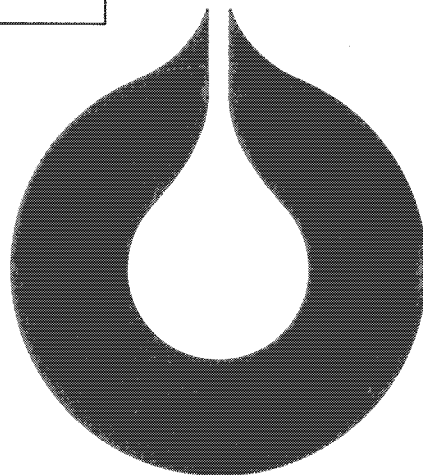
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statoil

Analysis of FMT- and seal peel
from 15/9-18

STATOIL
EXPLORATION & PRODUCTION
LABORATORY

Den norske stats oljeselskap a.s

SUMMARY

U&P's KJEMILAB was requested to undertake some chemical analysis on FMT-samples from well 15/9-18. In addition, a seal peel from the same well has been extracted and analysed. It is obvious from these analyses that all samples contain hydrocarbons. The following six samples have been used in a comparison study: 15/9-7 DST 1, 15/9-8 DST 1, 15/9-11 DST 1, 15/9-13 RFT no.1, 15/9-15 DST 1 and 15/9-17 DST. In addition a condensate from 6407/2-1 has been included. It is concluded that from the GC-fingerprint analyses the hydrocarbons of the seal peel does not show a clear resemblance to a specific condensate from wells in the Sleipner field. The amount of hydrocarbons was measured to be 0,2 g/l in the FMT-chambers and 5 g/kg in the seal peel.

INTRODUCTION

At the beginning of this project, FMT-samples from 15/9-18 collected by two different chambers were received for chemical analysis. Samples were from the 2 3/4- and 6 gal. chamber, collected 24-2-84 at 3240 m. The samples were extracted, filtrated and finally concentrated on a rotavapor prior to the gas chromatographic analysis. Hydrocarbons were detected.

In agreement with LET-S it was decided to repeat the analysis on a seal peel from the same depth as the FMT samples were collected. The extract from the seal peel showed a gas chromatogram which seemed to be compareable with other chromatograms of condensates from the Sleipner field. The main reasons for analysing a seal peel were:

1. The hydrocarbons in the FMT-chamber might not be representative for those in the reservoir. The main fraction in the FMT-samples was water.
2. Considering the small amount of hydrocarbons in the FMT-samples one could not exclude the possibility of contamination.

In addition, after the findings of hydrocarbons in the seal peel, LET-S wanted a finger print analysis based on gas chromatograms of the extracted seal peel from 15/9-18 and condensates from 15/9-7-8-11-13-15-17. This finger print analysis was ment to examine any similarity or difference between the hydrocarbons in 15/9-18 to those in different condensates from the jurassic layer.

METHODE AND EQUIPMENT.

1. Extraction and work - up procedure:

a) FMT-samples.

Two replica of 1 l each from the 2 3/4 and 6 gal chamber have been extracted and analysed. The extraction was performed by shaking the sample in a separatory funnel with dichloromethane as the solvent. Each sample is extracted 3 times with totally 150 ml dichlorometane. The liquid phase was then filtered on a 0,45 ~~µm~~ FH Millipore filter, prior to volum reduction by rotavapor.

b) Seal peel sample.

About 300 g of the inner part of the seal peel sample is crushed in a mortar. Two aliqouts of 50 g were extracted with 150 ml dichloromethane. After volum reduction on a rotavapor the concentrated extracts were stored in a refrigerator for 24 hours. Most of the particles will then precipitate. The liquid phase are transferred to new sample vials before injection on the gas chromatograph.

25 weight percent 2 metyl heptane is added as internal standard to all the samples, which have been quantified.

c)

The five drill stem test (DST) samples and one bottom hole sample from the RFT tool, used for the comparison study, have been stored for various lenght of time.

2. Gas chromatographic conditions:

Gas chromatographic analysis of the liquid fractions were performed on a Perkin Elmer sigma 2000 Gas Chromatographic system fitted with a flame ionisation detector.

Column: SGE bonded phase, 25X 0.22 mm internal diameter

Column: code: 25 Q CZ/BP1 0.25

Carrier gas: Helium 31.8 cm/sec linear
velocity at 120°C.

Detector: a) Flame ionisation Temp. 350°C

Injector: a) Split
b) Splitless 0.5 min. Temp. 350°C

Temp. program: Start temp 25°C
Isothermal for 4 min
10°C/min to 100°C
7°C/min to 300°C
Isothermal for 15 min.

RESULTS

I. The FMT samples.

One gas chromatogram from each FMT chamber is included in the appendix. There is no significant difference between the two chambers either in composition or concentration of extracted hydrocarbons. The amount of hydrocarbons have been quantified to 0.2 g/l. The distribution pattern of n-alkanes, seen in the gas chromatogram, with a slight decrease to about n-C35 is comparable with different condensates from the Sleipner field.^{1,2} It is reasonable to believe that the unresolved complex mixture (UCM) between nC10 to nC20 occur because we are dealing with water based samples, and the most water soluble hydrocarbons will probably dominate. However no attempt have been made to determine what kind of compounds dominate the UCM.

II. The seal peel.

The crushed seal peel had a dark colour and a typical "oil" odor. The extract was completely black, and after extraction the seal peel has changed to a pink grey colour (sandy material). A gas chromatogram from the seal peel is included in the appendix. The amount of hydrocarbons is measured to 5 g/kg rock. In the gas chromatogram, there is a slight decrease of n-alkanes to about n35. As stated previously, this is found in many different condensates from the Sleipner field. The black colour of the extract does mean that we have isolated asfaltenic compounds from the seal peel. In condensates sampled by drill stem tests, these compounds are not present. Further, it must be kept in mind that the most volatile hydrocarbons are lost by the present work-up procedure.

On the basis of the analysis performed it is not possible to decide with certainty whether we have to do with a condensate or an oil sample.

III Comparison study

Since the hydrocarbon profile from the seal peel showed some resemblance with previous condensates from the Sleipner field, we were requested to do a fingerprint analysis including the extracted seal peel from 15/9-18 and six defined condensates from the jurassic structure in the Sleipner field. These are: 15/9-7, -8, -11, -15, -17. Additionally one condensate from Haltenbanken (6407/2-1) has been included.

The fingerprint analysis have been performed focusing on the distribution of n-alkanes between nC10 and nC30. In fig. 1 the normal paraffins are plotted as the peak area realtiv to the peak area of n-C18 for each sample.

Ratio plot of 18 other selcted peaks in the gas chromatogram is included in this finger print analysis. Fig 2 shows the identification of these peaks. Each peak is normalized to the next n-alkan. The result is visualized in a histogram (fig.3).

15/9-7 DST 1 and 15/9-8 DST 1 have privously been proved to exhibit very common characteristics.² This is confirmed in this report. 15/9-13 RFT no.1 and 15/9-15 DST 1 do also show close to identical gas chromatograms. The gas chromatogram of the extracted seal peel from 15/9-18 is comparable with those of condensates from the Sleipner field. By carefully studing fig.1 and 3 the extracted seal peel seems to match 15/9-11 DST 1 more then any of the others. On the other hand the performed finger print analysis were not able to

discriminate between Sleipner condensates and one sample from Haltenbanken (6407/2-1). This implies that from this analysis we can not decide with certainty whether or not we have a condensate in 15/9-18.

CONCLUSION

Hydrocarbons is extracted from both the 2 3/4- and 6 gal chamber in a FMT test from 15/9-18, 3420 m. Hydrocarbons is also present in a seal peel sample from the same depth.

From the fingerprint analysis based on gas chromatography the extracted seal peel from 15/9-18 is comparable to Sleipner condensates. However, it is not possible to determine a detailed similarity between the extracted seal peel and a spesific condensate.

Because of the high sensivity of the GC-analysis we would recommend that in any furhter comparison study within this project, all samples will pass through the same work-up procedyre. This means for instance that one does not compare a seal peal extract with a condensate sampled by a drill stem test.

To be able to decide with certainty whether or not the hydrocarbons in 15/9-18 are a condensate we suppose that a bottom hole sample of hydrocarbons is necessary.

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Eivind H. Osjord:

Chemical comparison of oil and condensate samples from the Sleipner field. STATOIL REPORT 1981.

Kjell Øygaard: Chemical comparison of condensate samples from the Sleipner field. STATOIL REPORT 1982.

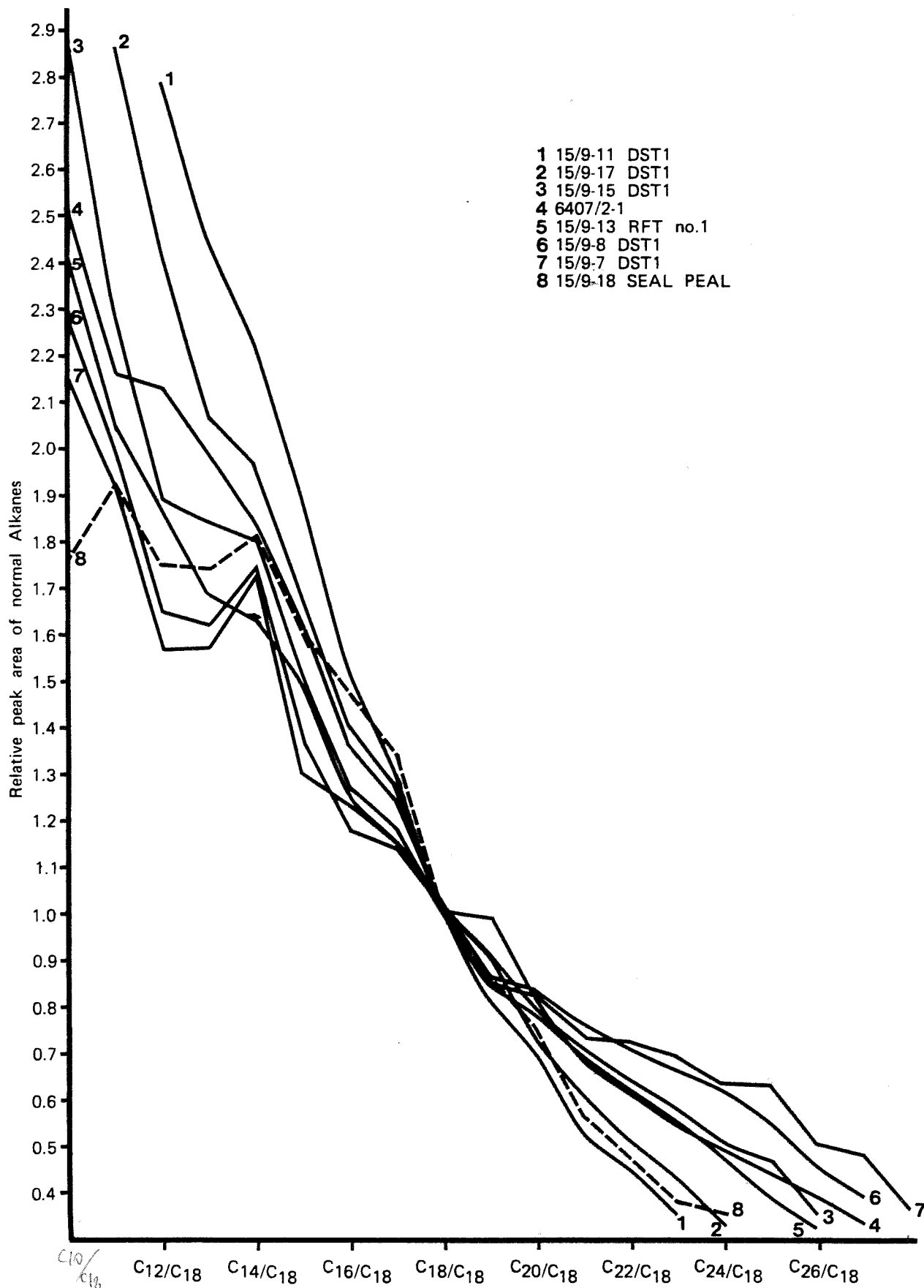
| | C10 | C11 | C12 | C13 | C14 | C15 | C16 | C17 | C18 | C19 | C20 | C21 | C22 | C23 | C24 | C25 | C26 | C27 | C28 | C29 | C30 |
|---------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|
| | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 | C18 |
| 15/9-7 DST 1A | 2.14 | 1.91 | 1.57 | 1.57 | 1.73 | 1.37 | 1.18 | 1.14 | 1.00 | 0.85 | 0.82 | 0.73 | 0.72 | 0.69 | 0.63 | 0.63 | 0.50 | 0.48 | 0.36 | 0.34 | |
| 15/9-8 DST 1 | 2.27 | 2.00 | 1.65 | 1.62 | 1.74 | 1.30 | 1.23 | 1.15 | 1.00 | 0.86 | 0.83 | 0.76 | 0.71 | 0.66 | 0.62 | 0.54 | 0.45 | 0.39 | 0.28 | 0.26 | |
| 15/9-11 DST 1 | 4.05 | 3.43 | 2.79 | 2.45 | 2.23 | 1.89 | 1.51 | 1.30 | 1.00 | 0.81 | 0.70 | 0.52 | 0.45 | 0.35 | 0.29 | | | | | | |
| 15/9-13 DST 1 | 2.39 | 2.05 | 1.86 | 1.69 | 1.63 | 1.49 | 1.24 | 1.15 | 1.00 | 0.84 | 0.78 | 0.69 | 0.62 | 0.55 | 0.47 | 0.39 | 0.32 | 0.26 | | | |
| 15/9-15 DST 1 | 2.86 | 2.29 | 1.89 | 1.84 | 1.80 | 1.50 | 1.27 | 1.18 | 1.00 | 0.91 | 0.79 | 0.71 | 0.64 | 0.58 | 0.50 | 0.47 | 0.35 | 0.29 | | | |
| 15/9-17 DST 1 | 3.55 | 2.87 | 2.42 | 2.07 | 1.96 | 1.67 | 1.40 | 1.27 | 1.00 | 0.91 | 0.72 | 0.61 | 0.51 | 0.43 | 0.33 | 0.29 | | | | | |
| 15/9-18 | 1.77 | 1.92 | 1.75 | 1.74 | 1.81 | 1.60 | 1.47 | 1.34 | 1.00 | 0.86 | 0.74 | 0.56 | 0.47 | 0.38 | 0.35 | 0.24 | 0.21 | | | | |
| 6407/2-1 | 2.50 | 2.16 | 2.13 | 1.84 | 1.84 | 1.61 | 1.36 | 1.24 | 1.00 | 0.99 | 0.81 | 0.68 | 0.61 | 0.54 | 0.49 | 0.44 | 0.39 | 0.33 | 0.30 | | |

TABELL 1. Relative peak area of normal paraffins from the gas chromatogram.

| PEAK NO. | 15/9-7 | 15/9-8 | 15/9-11 | 15/9-13 | 15/9-15 | 15/9-17 | 15/9-18 | |
|---------------|--------|--------|---------|----------|---------|---------|----------|-----------|
| | DST 1 | DST 1 | DST 1 | RFT no.1 | DST 1 | DST 1 | 6407/2-1 | SEAL PEEL |
| 1 | 0.335 | 0.330 | 0.247 | 0.343 | 0.294 | 0.296 | 0.295 | 0.320 |
| 2 | 0.322 | 0.328 | 0.149 | 0.291 | 0.236 | 0.203 | 0.121 | 0.160 |
| 3 | 0.233 | 0.230 | 0.188 | 0.224 | 0.180 | 0.159 | 0.152 | 0.204 |
| 4 | 0.167 | 0.168 | 0.178 | 0.164 | 0.141 | 0.148 | 0.209 | 0.178 |
| 5 | 0.123 | 0.120 | 0.090 | 0.129 | 0.105 | 0.093 | 0.119 | 0.125 |
| 6 | 0.294 | 0.291 | 0.112 | 0.203 | 0.183 | 0.114 | 0.076 | 0.122 |
| 7 | 0.190 | 0.195 | 0.256 | 0.213 | 0.180 | 0.190 | 0.291 | 0.271 |
| 8 | 0.338 | 0.339 | 0.263 | 0.350 | 2.291 | 0.230 | 0.283 | 0.295 |
| 9 | 0.266 | 0.255 | 0.235 | 0.283 | 0.238 | 0.212 | 0.255 | 0.275 |
| 10 | 0.564 | 0.544 | 0.263 | 0.387 | 0.424 | 0.289 | 0.282 | 0.353 |
| 11 | 0.193 | 0.217 | 0.272 | 0.203 | 0.177 | 0.219 | 0.357 | 0.340 |
| 12 | 0.725 | 0.708 | 0.281 | 0.590 | 0.528 | 0.352 | 0.447 | 0.319 |
| 13 | 0.087 | 0.094 | 0.092 | 0.105 | 0.109 | 0.096 | 0.172 | 0.103 |
| 14 | 0.195 | 0.199 | 0.339 | 0.215 | 0.199 | 0.223 | 0.382 | 0.446 |
| 15 | 0.362 | 0.431 | 0.528 | 0.373 | 0.407 | 0.450 | 0.486 | 0.682 |
| 16 | 0.316 | 0.314 | 0.422 | 0.362 | 0.354 | 0.364 | 0.523 | 0.695 |
| <i>Pr.</i> 17 | 0.961 | 0.999 | 0.887 | 1.088 | 1.093 | 1.130 | 0.800 | 1.026 |
| <i>Ph.</i> 18 | 0.440 | 0.458 | 0.781 | 0.440 | 0.403 | 0.419 | 0.816 | 1.276 |

TABELL 2. Relative peak area of 18 selected peaks from the gas chromatogram.

Fig. 1 Normal alkane peak area distribution



**Fig. 2 Gas chromatogram showing the 18 selected peaks
used in the finger print analysis**

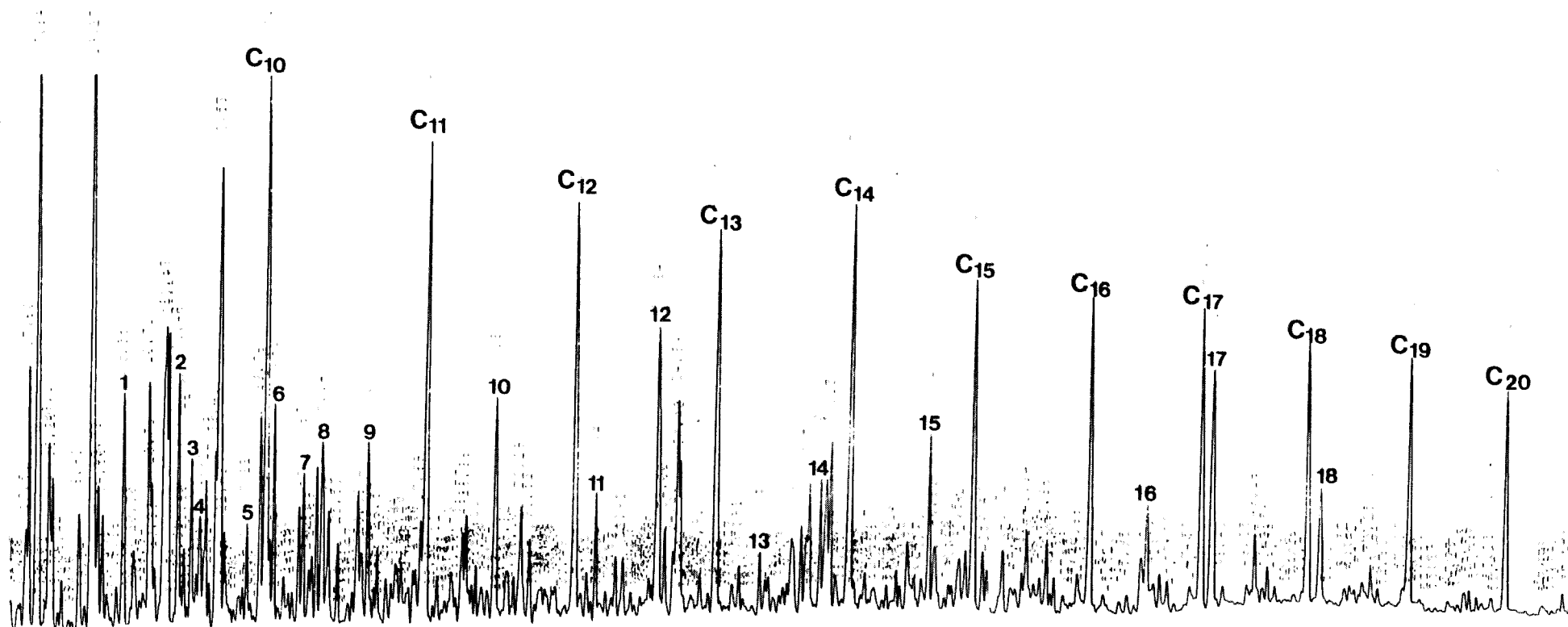


Fig. 3 histogram showing the relative intensity of 18 selected peaks in the gas chromatogram

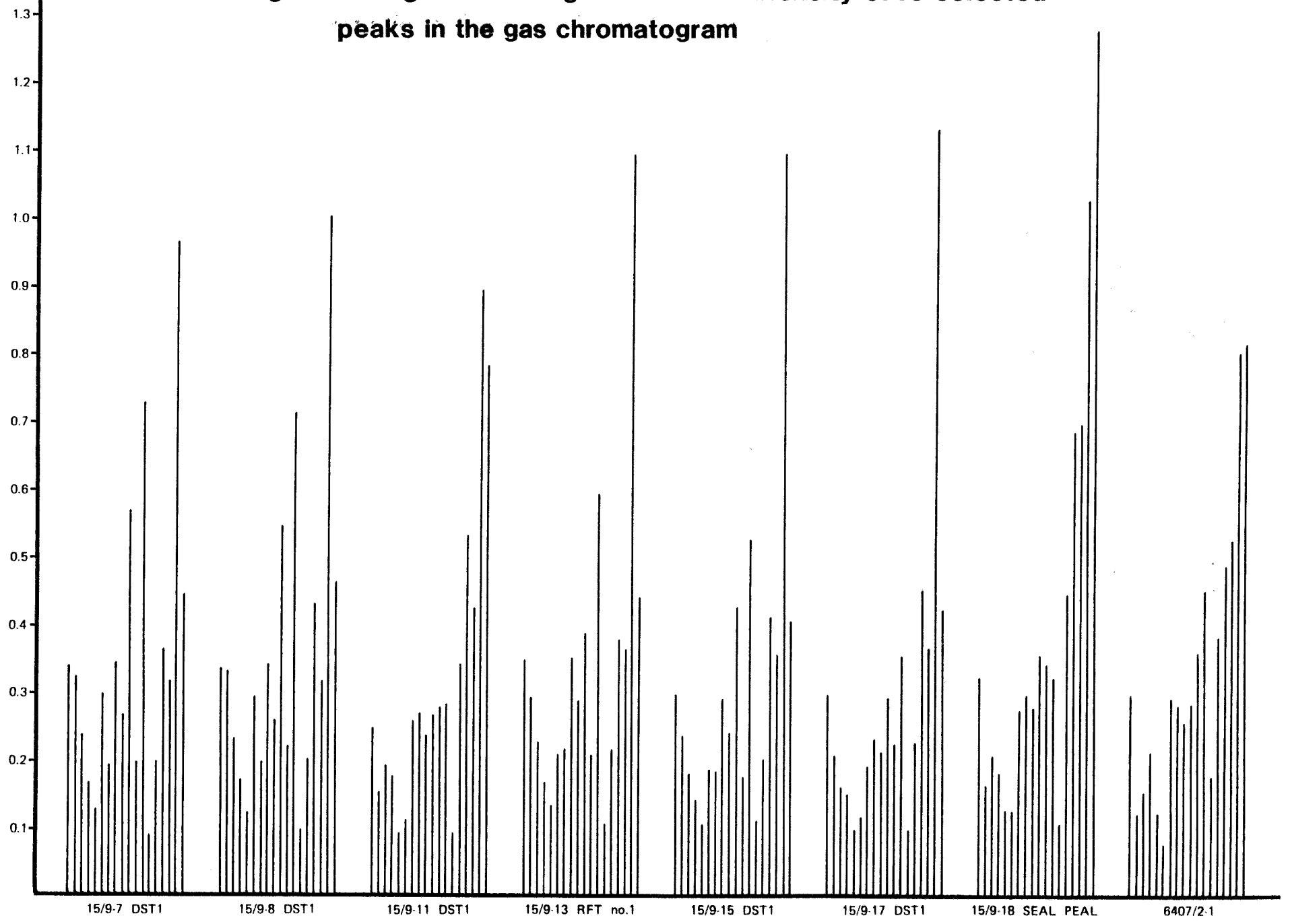
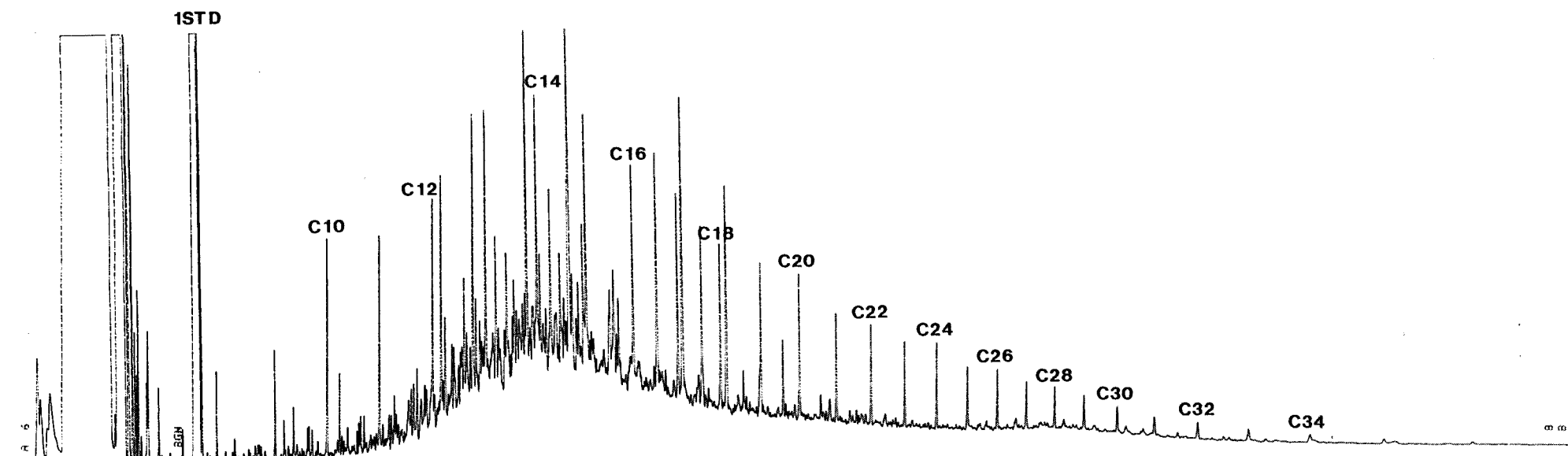


Fig. 4



Chromatogram of extracted FMT, 23/4gal, 15/9-18

Fig. 5

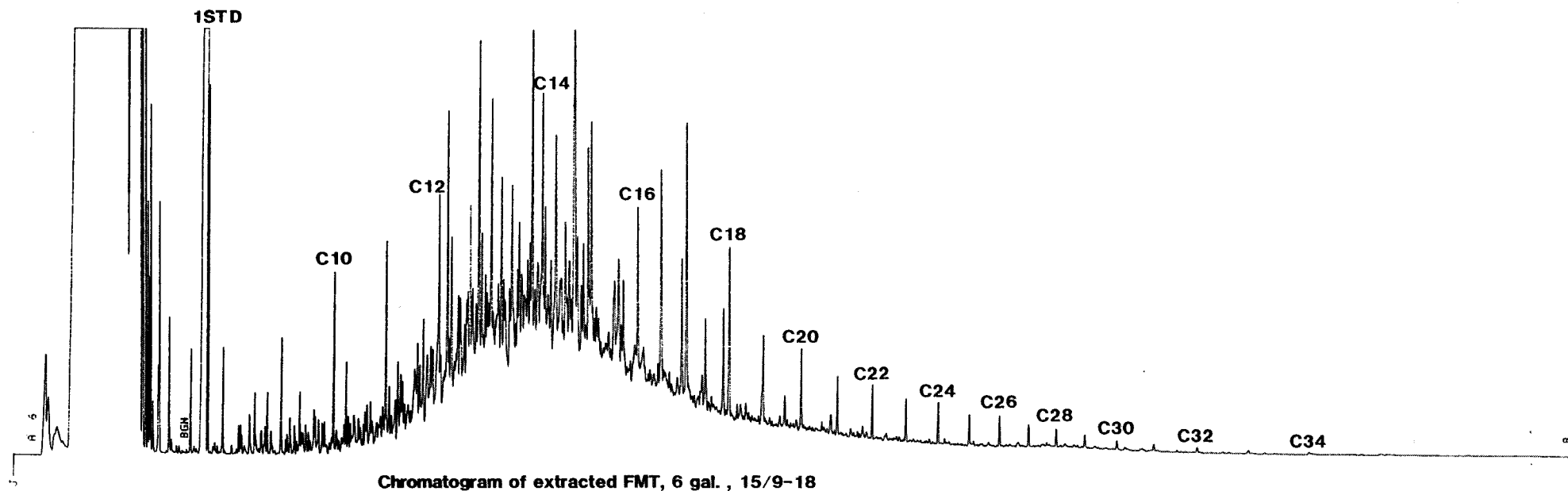
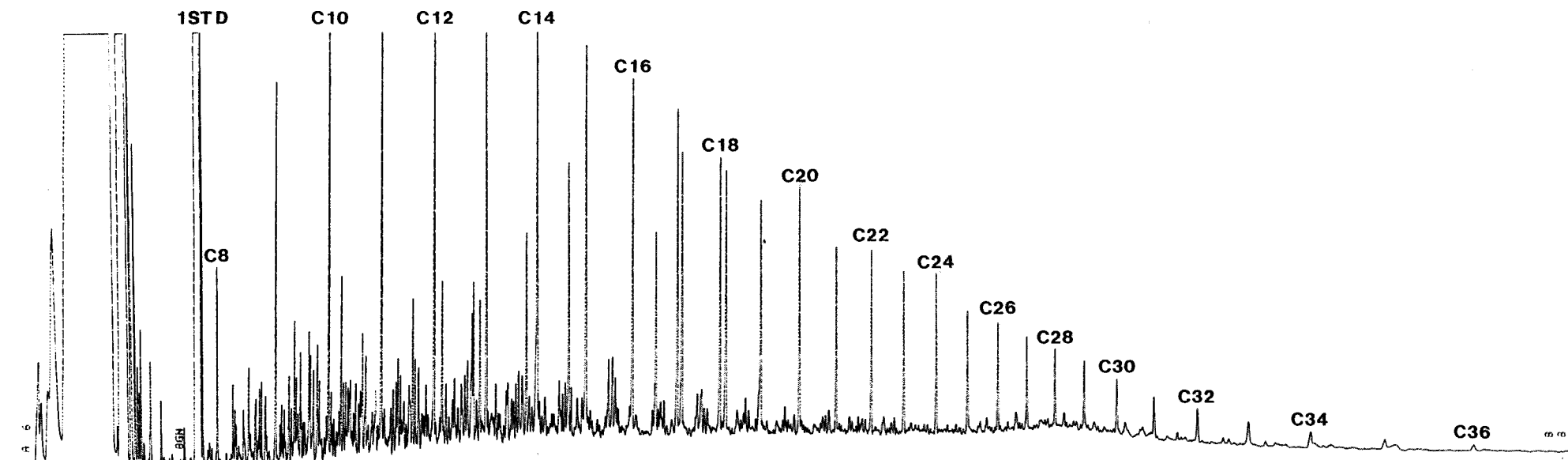


Fig. 6



Chromatogram of extracted seal-peal 3239.75-3240.00m, 15/9-18