

**ROBERTSON RESEARCH INTERNATIONAL LIMITED**

REPORT NO. 4643P/D

**GEOCHEMICAL STUDIES ON OIL FROM  
NORWEGIAN NORTH SEA WELL, SAGA 34/4 - 1.**

by

**A. G. COLLINS  
B. S. COOPER  
J. McEWAN**

PROJECT NO. RRPS/812/D/25015

**Prepared by:**

Robertson Research International Limited,  
Ty'n-y-Coed,  
Llanrhos,  
Llandudno,  
Gwynedd LL30 1SA,  
Wales,  
U.K.

**Prepared for:**

Saga Petroleum A/S,  
P.O. Box 550,  
N - 1301 Sandvika,  
Norway.

September, 1981

## CONTENTS

	<u>Page No.</u>
SUMMARY	i
I INTRODUCTION	1
II ANALYSES AND INTERPRETATION	2
1. Bulk properties	
2. Gas contents	
3. Gasoline contents	
4. Gas chromatography of alkanes	
5. Gas chromatography of aromatics	
6. Gas chromatography - mass spectrometry	
7. Carbon isotope ratios	
III CONCLUSIONS	4

### TABLES

1. Analyses of Bulk Compositions of Oil
2. Analyses of Light Gas Components of Oil
3. Gasoline Hydrocarbon Analysis Data
4. Carbon Isotope Ratios of Components of Oil

### FIGURES

1. Gas Chromatogram of Alkanes
2. Gas Chromatogram of Branched/Cyclic Alkanes
3. Gas Chromatogram of Aromatic Fraction
4. Fragmentograms of Alkanes at m/e 191, 217 and 259

SUMMARY

Oil from the Saga 34/4-1 well in the Norwegian sector of the Northern North Sea has been analysed. Analyses of the bulk properties are tabulated together with details of gasoline contents and carbon isotope ratios. Gas chromatograms of alkane, branched and cyclic alkane and aromatic fractions are figured.

It is concluded that the oil from the 34/4-1 well is derived from a waxy, land plant dominated source.

INTRODUCTION

Oil from the Norwegian North Sea well, Saga 34/4-1, has been comprehensively analysed to determine abundances of major and minor components. The oil was received in March, 1981 and analyses were completed and reported in the period up to July, 1981. In total the analysis comprises determinations of:-

API gravity

Volatile (to 210°C) content

Sulphur content

Nickel content

Vanadium content

Abundances of gas and gasoline components

Abundances of C<sub>15</sub>+ hydrocarbon fractions

Gas chromatography of total alkane, branched with cyclic alkane and aromatic components

Gas chromatography - massspectrometry of triterpane, sterane and rearranged sterane components

Carbon isotope ratios of C<sub>15</sub>+(alkane and aromatic) components and polar components.

# Saga Petroleum a.s.

Head office:  
PO. Box 550  
N-1301 Sandvika  
Norway  
Tel. + 47 2 54 39 50  
Telex 18 852 saga n

Regional office, Stavanger:  
PO. Box 5021 Dusavik  
N-4001 Stavanger  
Norway  
Tel. + 47 45 41 900  
Telex 33 244 saga n

Statoil  
Deminex (Norge) A/S  
Deminex, Essen  
Amoco Norway Oil Company  
Amerada Petroleum Corp. of Norway  
Texas Eastern Norwegian Inc.  
Norwegian Petroleum Directorate  
Saga, Stavanger

- Attn. J. Henden  
- Attn. I. Tangen  
- Attn. U. Schmitz  
- Attn. C. F. Campbell  
- Attn. W. M. Walton  
- Attn. H. Snarvold  
- Attn. I. Aarseth  
- Attn. J. W. Gorgas

Your ref.

Your letter of

Our ref.

Sandvika

TOT/mj

November 17, 1981

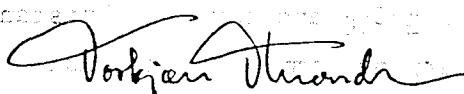
Dear Sirs,

Re.: OIL ANALYSIS REPORT 34/4-1 (Robertson Research)

Printing error on table 2. For n-butane read i-butane and vice versa.  
i/n-butane ratios should then read 0.26.

Interpretation (page 2, section 2) should be altered to predominance of  
n-butane over i-butane indicating mature/late mature part of oil window.  
Ratio is normal for North Sea oils.

Yours sincerely  
Saga Petroleum a.s.



Torbjørn O. Throndsen

ANALYSES AND INTERPRETATION1. Bulk Properties (Table 1)

The oil is a brown, mobile liquid. The °API gravity is in the medium to light oil range and the volatile content of 35.7% suggests a light oil - condensate composition. The Sulphur, Nickel and Vanadium contents of the 34/4-1 oil are very low.

The relative amounts of the hydrocarbon fractions in the 34/4-1 topped oil are consistent with its gravity and volatile content.

2. Gas Contents (Table 2)

The marked predominance of *i*-butane over *n*-butane in the oil indicates an origin either from the immature/mature or mature/postmature transitions of the oil generation zone, although the actual value for the ratio is high for North Sea oils. This may indicate a source rock other than the Late Jurassic.

3. Gasoline Contents (Table 3)

The distinctive feature of the analyses is the relatively high benzene to methyl cyclohexane content and indicates derivation from a late mature source rock.

4. Gas chromatography of alkanes (Figure 1)

The oil shows a wide range of alkanes reaching *n*-C<sub>30</sub> and beyond. Pristane is dominant over phytane but sterane and triterpane components are not distinct. These characteristics suggest an origin in land plant waxy debris which has reached a moderate level of maturity.

5. Gas chromatography of aromatics (Figure 3)

The analysis shows that the aromatic fraction is composed of a restricted number of dominant components and is similar to other oils of 40° to 50° API gravity and to source rocks which have reached a middle to late maturity.

6. Gas chromatography - mass spectrometry (Figure 4)

The mass fragmentograms at *m/e* 191, 217 and 259 have been compared with

similar data from source rocks containing various types of kerogen. The fragmentogram for 34/4-1 oil is very similar to fragmentograms of extracts from kerogen composed of land plant debris, particularly in the lack of triterpenoid components in the n-C<sub>24</sub> to n-C<sub>28</sub> region and in the great variety of steranes shown by m/e 217.

7. Carbon isotope ratios (Table 4)

The ratios of the fractions of the oil are close to  $-30^{\circ}/\text{‰}$ , indicating a definite land plant origin.

III

CONCLUSIONS

1. The relative contents of iso-alkanes in the gasoline fraction are not typical of Northern North Sea oils.
2. All of the analytical data show that the 34/4-1 oil is derived from a land plant, waxy source.



Table 1

Analyses of Bulk Compositions of Oil

	<u>34/4-1</u>
API Gravity (20°C), degrees	39.2
Fraction boiling below 210°C, %	35.7
Sulphur content, %	0.38
Nickel content	less than 2 ppm
Vanadium content	less than 2 ppm
Alkane content of topped oil, %	79.4
Aromatic content of topped oil, %	8.0
Resene content of topped oil, %	10.5
Soluble asphaltene content of topped oil, %	2.1
Asphaltene content by precipitation %	0.5

Table 2

Analyses of Light Gas Components of Oil

Concentration in ppm

	<u>34/4-1</u>
Methane	-
Ethane	-
Propane	-
n-Butane	4850
i-Butane	18500
<u>i-Butane</u>	3.8
<u>n-Butane</u>	

COMPANY: SAGA

WELL: 34/4-1

LOCATION: NORWEGIAN NORTH SEA

DEPTH:	OIL						
GASOLINE HYDROCARBON COMPONENTS	RELATIVE GASOLINE HYDROCARBON COMPONENT ABUNDANCES (%)						
i-BUTANE	3.2						
n-BUTANE	12.2						
i-PENTANE	9.3						
n-PENTANE	17.2						
2,2-DIMETHYL BUTANE	0.2						
CYCLOPENTANE	1.6						
2,3-DIMETHYL BUTANE	0.5						
2-METHYL PENTANE	4.1						
3-METHYL PENTANE	2.5						
n-HEXANE	8.3						
2,2-DIMETHYL PENTANE / METHYL CYCLOPENTANE	4.4						
2,4-DIMETHYL PENTANE	0.4						
BENZENE	1.6						
3,3-DIMETHYL PENTANE	tr						
CYCLOHEXANE	4.4						
2-METHYL HEXANE	2.6						
1,1-DIMETHYL CYCLOPENTANE	0.6						
3-METHYL HEXANE	2.3						
1, cis-3-DIMETHYL CYCLOPENTANE	0.8						
1, trans-3-DIMETHYL CYCLOPENTANE	1.1						
1, trans-2-DIMETHYL CYCLOPENTANE	2.0						
3-ETHYL PENTANE	-						
n-HEPTANE	6.7						
1, cis-2-DIMETHYL CYCLOPENTANE / METHYL CYCLOHEXANE	8.3						
ETHYL CYCLOPENTANE	0.9						
TOLUENE	4.8						
TOTAL ABUNDANCE ppm	151610						
ORGANIC CARBON (%)							
GASOLINE ABUNDANCE AT 1% ORGANIC CARBON							

Note: Total gasoline abundance values are expressed as weight of gas relative to weight of wet rock.

TABLE 3 Gasoline Hydrocarbon Analysis Data

Table 4

Carbon Isotope Ratios of Components of Oil

	<u>34/4-1</u>
Methane	-
Ethane	-
Propane	-
Butanes	-
Alkanes of topped oil	-30.7
Aromatics of topped oil	-30.1
Resenes of topped oil	-29.7
Asphaltenes of topped oil	-30.0

Values are quoted in parts per mil measured against PDB standard

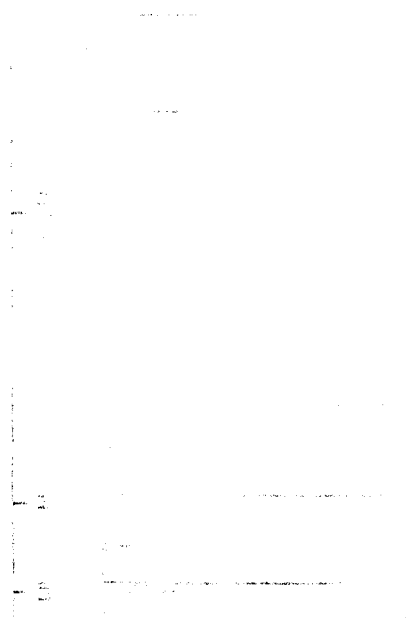
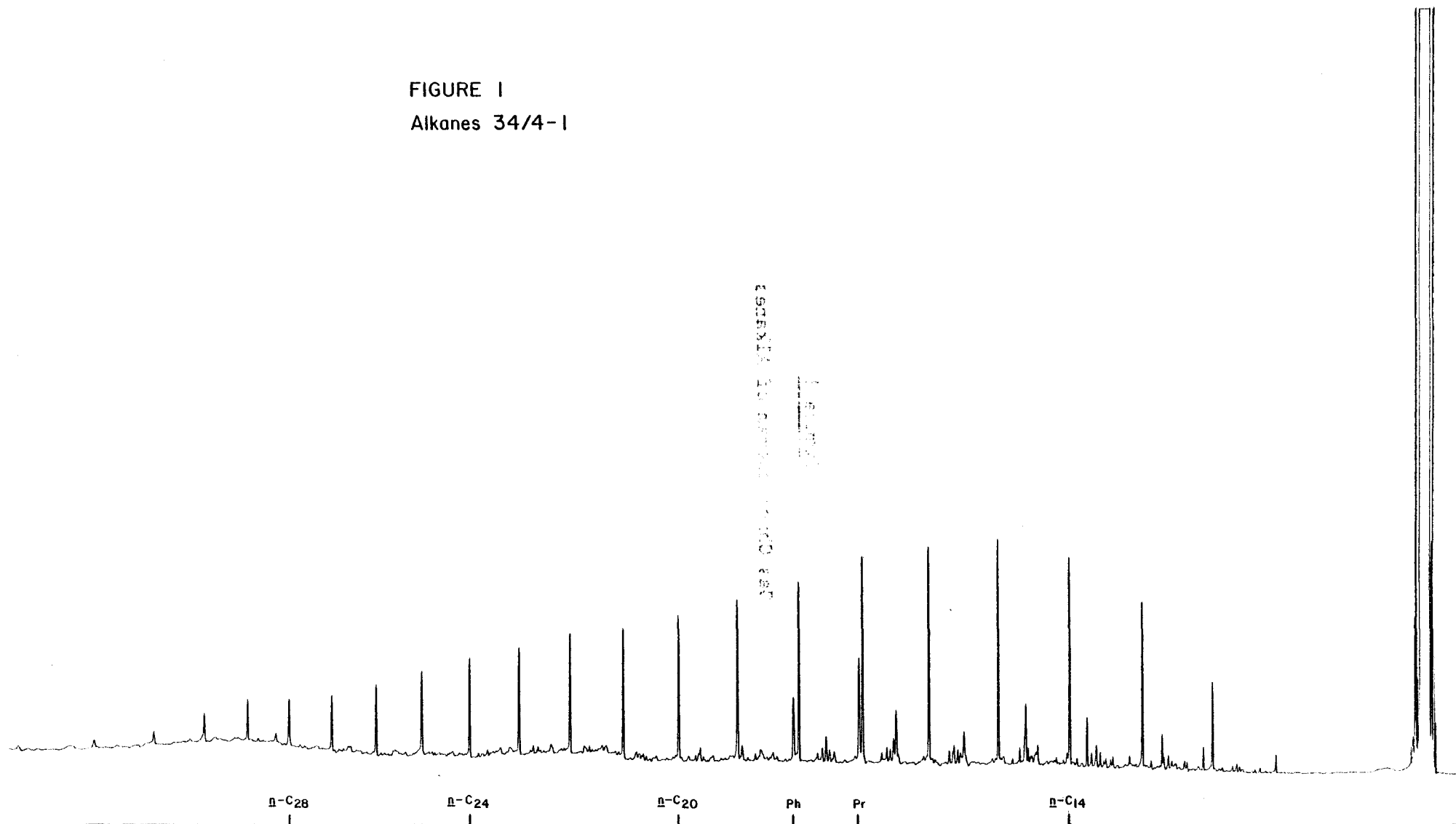


Figure 1

Gas Chromatogram of Alkanes

FIGURE 1  
Alkanes 34/4-1



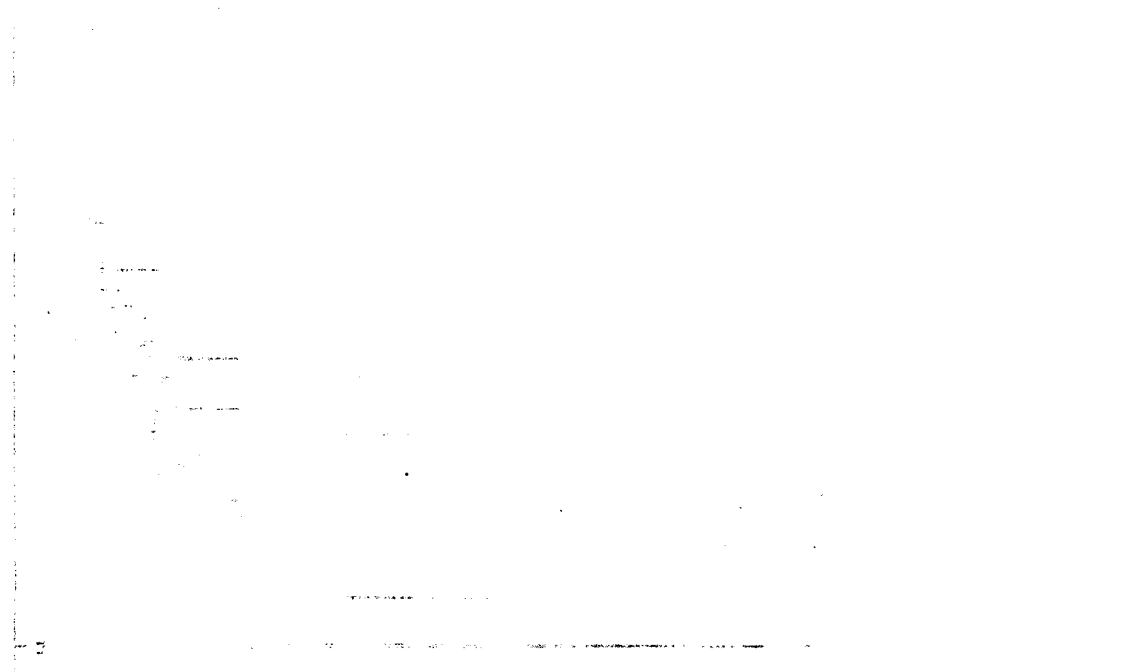


Figure 2

Gas Chromatogram of Branched/Cyclic Alkanes

Robertson Research  
1988

FIGURE 2

Branched / Cyclic Alkanes 34/4-1

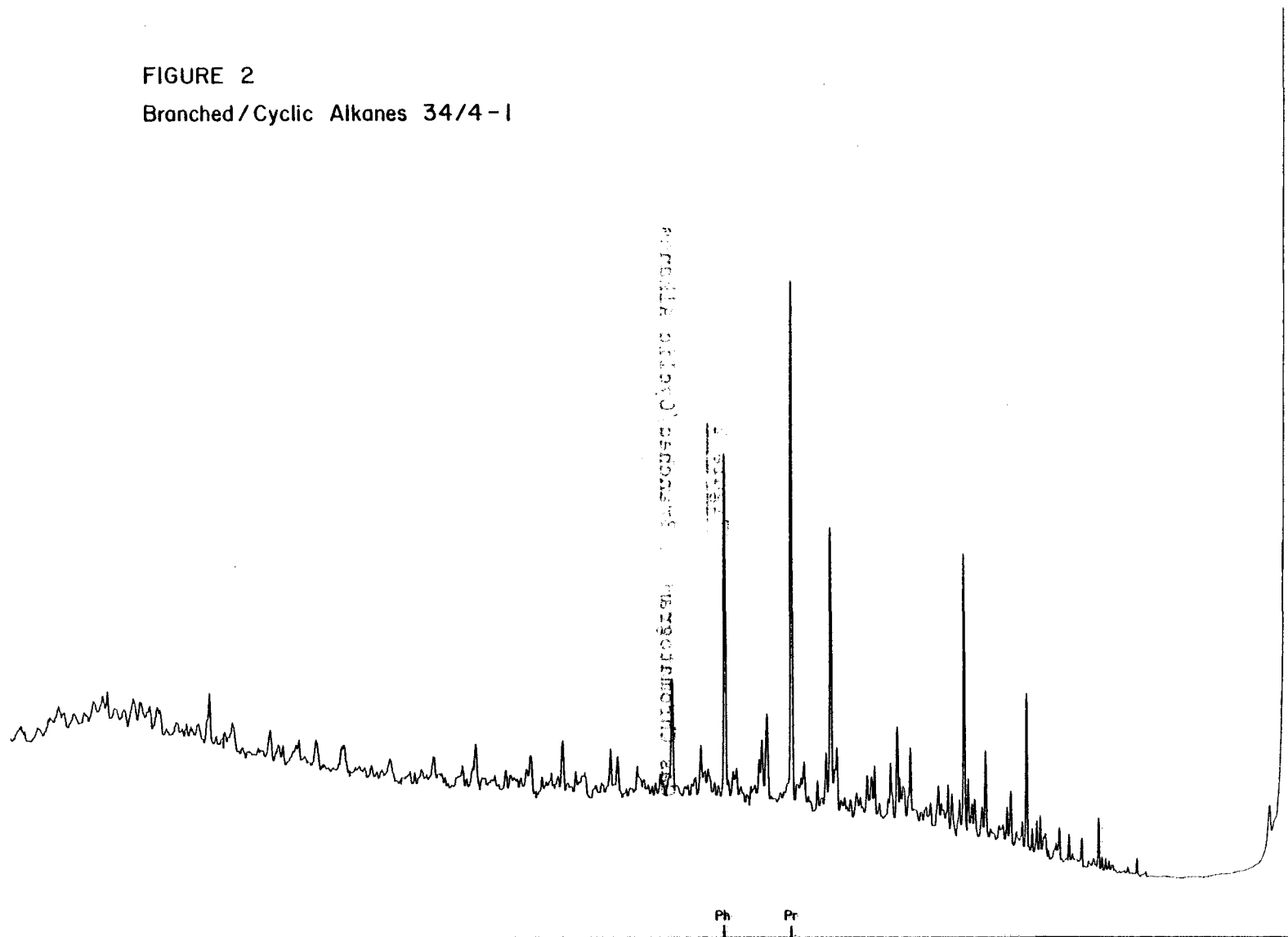


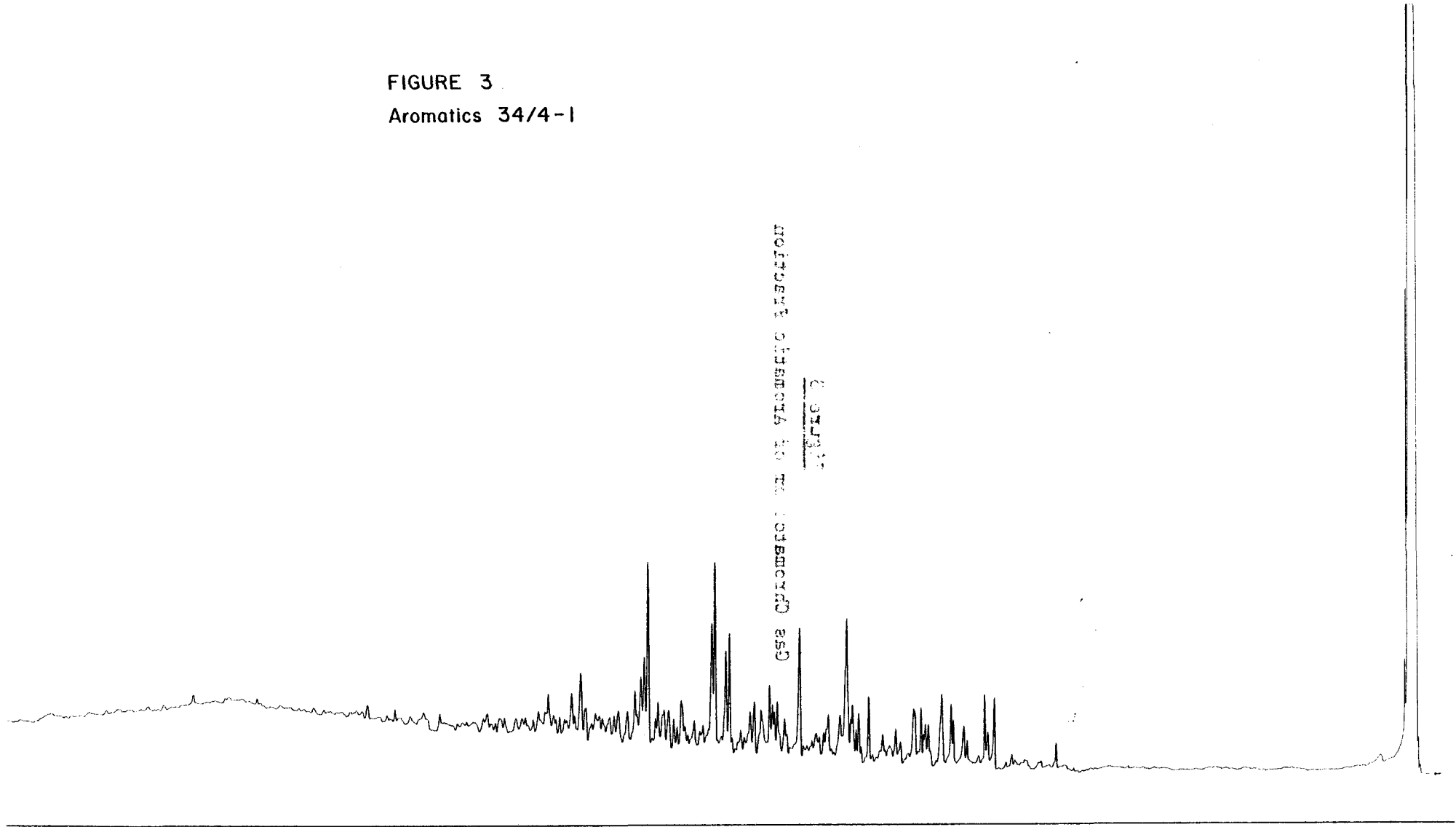


Figure 3

Gas Chromatogram of Aromatic Fraction

2.11017  
1.11017

FIGURE 3  
Aromatics 34/4-1



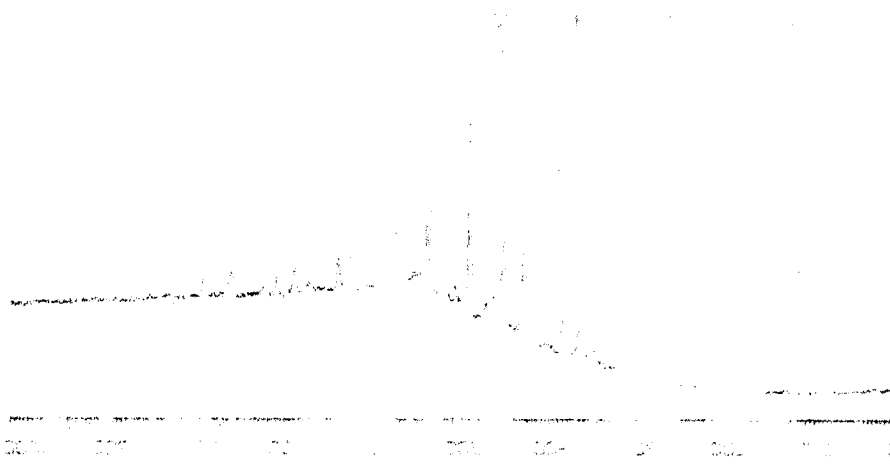


Figure 4

Fragmentograms of Alkanes at m/e 191, 217 and 259

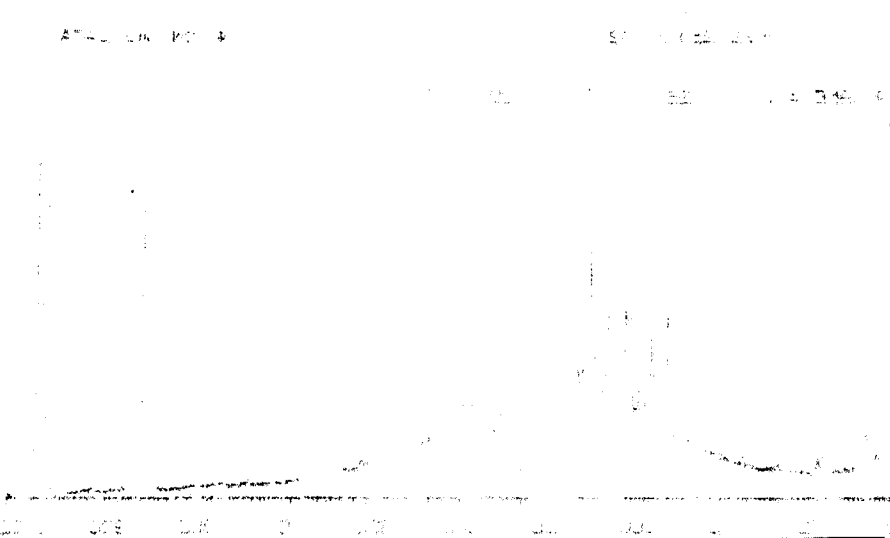
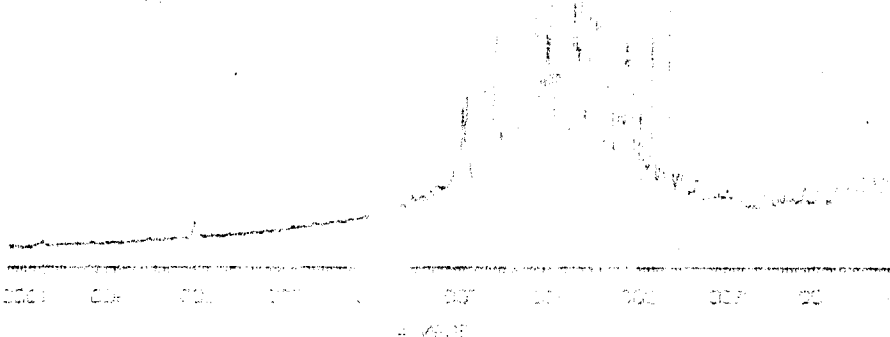


FIGURE 4

