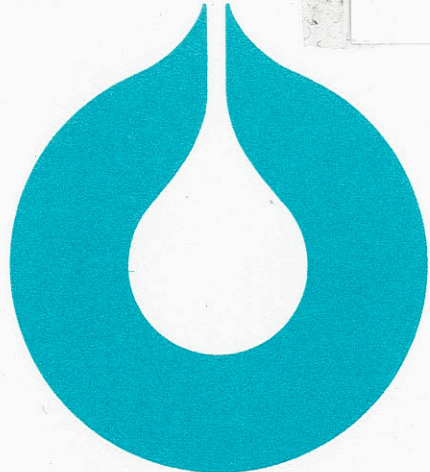


Denne rapport



statoil

TBP distillation of condensate from
6407/1-2 DST 1

**STATOIL
EXPLORATION & PRODUCTION
LABORATORY**

by
Hans Petter Rønningsen

July-83

LAB 8

Prepared

Approved

Den norske stats oljeselskap a.s



Classification

Requested by

Jon Hanstveit

Subtitle

Co-workers

Oddbjørn Kopperstad, Eivind Osjord,
Terje Schmitt.

Title

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LAB 83.36

Prepared

Hans P. Rønningsen

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Approved

D. Malthe-Sørensen
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1. SUMMARY

This report presents the results from a true boiling point distillation, performed on a 179.5ml sample from single flash of separator liquid, bottle no. 821217 from 6407/1-2 DST 1.

The sample was fractionated from room temperature to 153.1°C at atmospheric pressure, and from 71.4°C to 202.9°C at 25.4 mbar reduced pressure (corresponds to range 153.1°C - 331.0°C at atmospheric pressure).

Table 1.

Summary of some essential data for condensate from 6407/1-2 DST 1.

	Condensate	C ₁₀ ⁺	C ₂₀ ⁺
Density (15°C, g·cm ⁻³)	0.799	0.848	0.890
Molecular weight	147	226	379
% by weight of total sample	100	64.02	24.40

2. METHODS AND EQUIPMENT

2.1 Distillation

TBP distillation was performed according to ASTM D-2892 with a Fisher HMS 500 distillation apparatus.

Fractions were collected according to the boiling point ranges between successive n-alkanes as given by Katz and Firoozabadi (1). The light end fractions (C_{10}) were separated at atmospheric pressure, the $C_{10}+$ -fractions at reduced pressure (25.4mbar).

2.2 Gas chromatographic analysis

Component analysis of gas and liquid fractions was performed using a Hewlett Packard 5880 gas chromatographic system.

Chromatographic conditions :

Column for gas fraction : Chrompack 50m x 0.23mm i.d.
WCOT, Cp sil 5 on fused silica,
filmthickness 0.3 m.

Column for liquid fractions: Chrompack 25m x 0.22mm i.d.
WCOT, Cp sil 5 on fused silica,
filmthickness 0.14 m.

Carrier gas : Helium, 22 cm/sec linear
velocity at 10°C.

Detector : Flame ionization, nitrogen
make-up gas, 320°C.

Injection : All glass splitter, with a
packed "Jennings tube". Split
ratio 1:80, temp. 310°C for
liquid and 200°C for gas
fraction.

Temp. program : For fractions $<C_{12}$ injection-temp. was 10°C , isothermal 4 min then $4^{\circ}\text{C}/\text{min}$. For fractions $C_{12} - C_{19}$ injectiontemp. was 100°C . For gas fraction -30° isothermal 4 min, then $8^{\circ}\text{C}/\text{min}$ to 160°C .

Gas chromatogram of the collected fractions are enclosed in the appendix , as is the fingerprint chromatogram of total condensate 6407/1-2, DST 1.

2.3 Other measurements

Molecular weights were determined by freezing point depression using a Cryette cryoscope, with benzene as reference substance.

Densities were measured using a Paar 602 frequency densiometer thermostatted at 15°C . The $C_{20}+$ -fraction was measured at 40°C , and the measured density corrected to 15°C according to API standard 2540 (2).

3. RESULTS

Compositional data from the TBP distillation is given in table 2.

The calculated density of the distillate

$$S = \frac{\text{cum. weight}}{\text{cum. volume}}$$

and % by volume distilled are given in table 3, whereas calculated molecular weights and densities are given in table 4.

In table 5, % by weight overlap between fractions are given for each cut.

The composition of the gas and the light end fractions ($< C_9$) as determined by GC is given in table 6 and 7.

Ratios involving C_{19} and C_{20} isoprenoid hydrocarbons are given in table 8.

In table 9, the PNA-distribution of fractions up to C_{10} , as determined by GC, is given.

REFERENCES

1. Katz, D.L., Firoozabadi, A., Journ. Petr. Tech., Nov. 1978, 1650.
2. Manual of Petroleum Measurement Standards, table 53A, First edition, August 1980.

Table 2

TBP distillation data for single flash condensate from separator
liquid 6407/1-2 DST 1.

Fraction	Cut point ¹ (°C, 760mm Hg)	Actual cut head- temp. at 25.4mbar	Density at 15°C (gcm ⁻³)	Mol. weight	% by weight of condensate	% by weight distilled	Mole percent	% by volume of condensate
Gas			0.511	47	0.471	0.471	1.466	0.728
Cold trap	< 36.5	-	0.617	70	8.488	8.959	17.733	10.867
C ₆	69.2	-	0.684	85	3.493	12.452	6.009	4.037
C ₇	98.9	-	0.743	93	8.882	21.334	13.966	9.444
C ₈	126.1	-	0.753	107	7.860	29.194	10.742	8.241
C ₉	151.3	-	0.776	120	7.102	36.296	8.655	7.232
C ₁₀ ⁺	> 151.3	-	0.848	226	64.015	-	41.422	59.618
C ₁₀	174.6	71.4	0.790	134	5.402	41.699	5.896	5.405
C ₁₁	196.4	89.3	0.795	147	4.746	46.445	4.721	4.714
C ₁₂	216.8	106.0	0.807	161	4.358	50.802	3.958	4.268
C ₁₃	235.9	122.0	0.823	174	4.588	55.390	3.856	4.405
C ₁₄	253.9	137.4	0.831	188	4.358	59.748	3.390	4.141
C ₁₅	271.1	151.7	0.836	202	4.037	63.785	2.922	3.813
C ₁₆	287.3	164.5	0.843	217	3.037	66.821	2.046	2.847
C ₁₇	303.0	178.4	0.840	234	3.601	70.422	2.250	3.386
C ₁₈	317.0	190.9	0.845	251	2.776	73.198	1.617	2.596
C ₁₉	331.0	202.9	0.856	259	2.406	75.604	1.358	2.220
C ₂₀ ⁺	> 331.0	> 202.9	0.890	397	24.396	100.000	9.413	21.656

Recovery of sample: 99.8% by weight Loss: 0.2%

1) According to Katz and Firoozabadi. Boiling point of
n-alkane plus 0.5°C.

*) Calculations based on GC-data.

Table 3. Cumulative weight and volume, % by volume distilled and calculated density.

$$s = \text{cum.weight} / \text{cum.volume}$$

Fraction	Cum. weight	Cum. volume	<u>Cum.weight</u> cum.volume	% by volume distilled
Gas	0.674	1.319	0.511	0.728
Cold trap	12.820	21.005	0.610	11.596
C ₆	17.818	28.317	0.629	15.633
C ₇	30.527	45.425	0.672	25.077
C ₈	41.774	60.353	0.692	33.318
C ₉	51.937	73.453	0.707	40.550
C ₁₀	59.667	83.244	0.717	45.955
C ₁₁	66.458	91.783	0.724	50.669
C ₁₂	72.693	99.513	0.730	54.936
C ₁₃	79.258	107.493	0.737	59.341
C ₁₄	85.494	114.994	0.743	63.482
C ₁₅	91.270	121.901	0.749	67.296
C ₁₆	95.616	127.058	0.753	70.142
C ₁₇	100.768	133.191	0.757	73.528
C ₁₈	104.740	137.894	0.760	76.124
C ₁₉	108.183	141.915	0.762	78.344

Table 4 Measured and calculated molecular weights and densities from distillation of 6407/1-2 DST 1 condensate.

	Condensate	C ₁₀ ⁺	C ₂₀ ⁺
Measured MW		226	379
Calculated MW using C ₁₀ ⁺ MW	147		
Calculated MW using C ₂₀ ⁺ MW	146	225	
Measured densities	0.799	0.848	0.890
Calculated density using C ₁₀ ⁺ density	0.791		
Calculated density using C ₂₀ ⁺ density	0.790	0.846	

Table 5. Weight distribution and % overlap between fractions from distillation of 6407/1-2 DST 1 condensate.

Fraction	% by weight of condensate	% by weight overlap between fractions
Gas	0.471	-
Cold trap	8.488	-
C ₆	3.493	3:77:20
C ₇	8.882	6:74:20
C ₈	7.860	10:81:9
C ₉	7.102	8:81:11
C ₁₀	5.402	7:81:12
C ₁₁	4.746	12:75:13
C ₁₂	4.358	13:71:16
C ₁₃	4.588	10:77:13
C ₁₄	4.358	12:71:17
C ₁₅	4.037	13:73:14
C ₁₆	3.037	12:76:12
C ₁₇	3.601	8:69:23
C ₁₈	2.776	5:76:19
C ₁₉	2.406	8:70:22

Table 6. Total composition of gas and lightend fractions (<C₉) as determined by GC. % by weight of total condensate:

Component (fraction)	% by weight of condensate
C ₁	0.01 1)
C ₂	0.06 1)
C ₃	0.29 1)
i-C ₄	0.36
n-C ₄	1.59
i-C ₅	1.91
n-C ₅	3.01
C ₆ 2)	4.88
C ₇ 2)	8.24
C ₈ 2)	8.71

1) Unreliable because of evaporaton prior to distillation.

2) Without overlap to adjacent fractions.

Table 7. Content of some abundant identified light end compounds in condensate 6407/1-2 DST 1 as determined by GC.

Compound	% by weight of condensate
n-hexane	2.111
Cyclohexane	2.032
2-methylhexane	0.902
n-heptane	1.889
Methylcyclohexane	2.715
Toluene	1.048
4-methylheptane	1.122
n-octane	1.495
m+p-xylene	1.034
o-xylene	0.802
n-nonane	1.471

Table 8. Characteristic isoprenoid hydrocarbon ratios of 6407/1-2
DST 1 condensate.

	Ratio
C ₁₇ /pristane	1.45
C ₁₈ /phytane	1.63
Pristane/phytane	1.26

Table 9. PNA-distribution of light end fraction (% by weight)*

Fraction	Paraffines	Naphtenes	Aromatics
C ₆	72.9	23.1	-
C ₇	45.6	51.0	3.4
C ₈	49.9	34.0	16.1
C ₉	58.0	17.0	25.0

* In fact area % from integrated gas chromatograms, which is converted to wt % by assuming equal FID respons to the different compounds.

- Boiling point vs. % by volume distilled
 □ Calculated density of distillate recovered
 $S = \frac{\text{cum.weight}}{\text{cum.volume}}$ vs. % by volume distilled

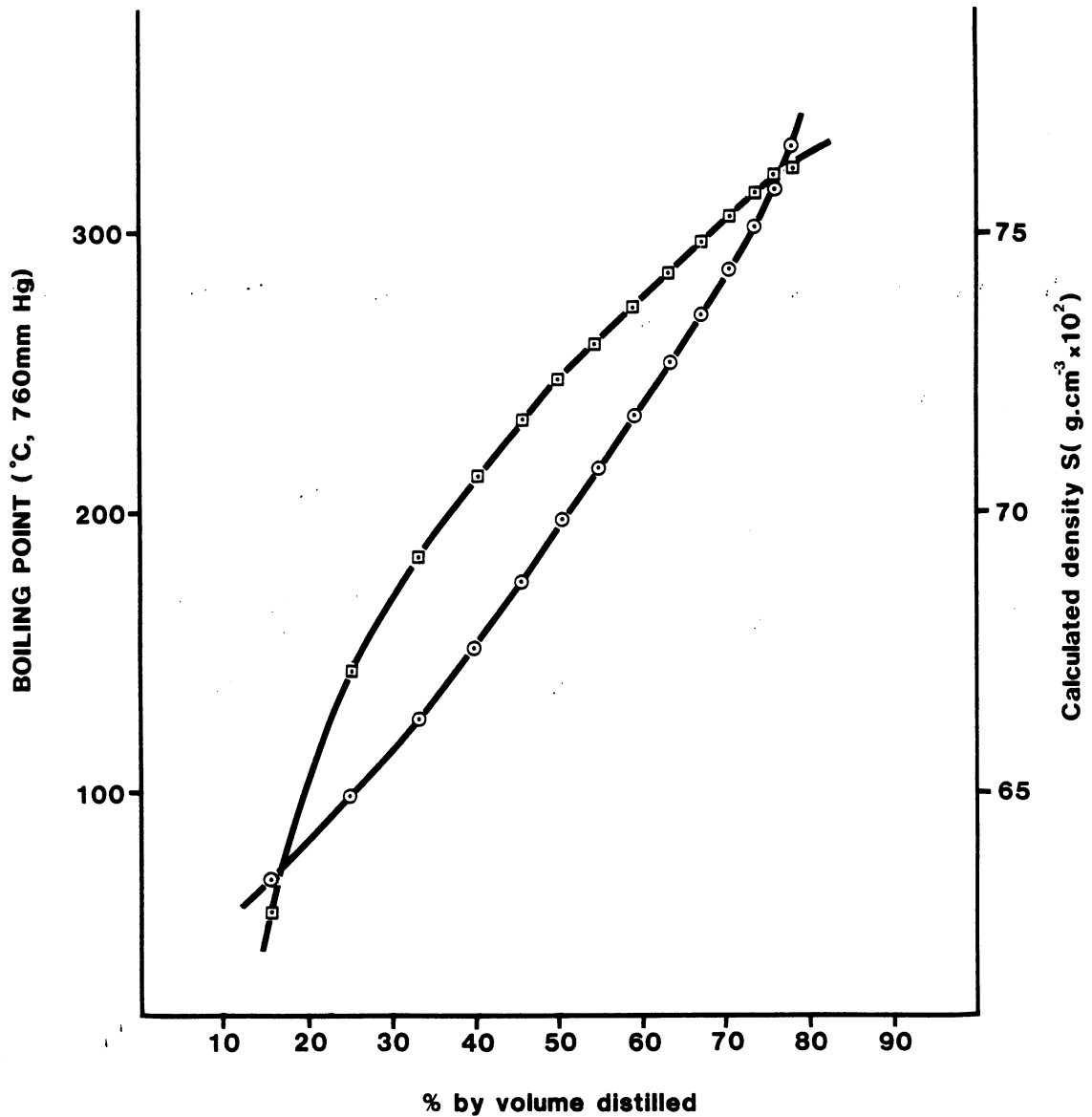
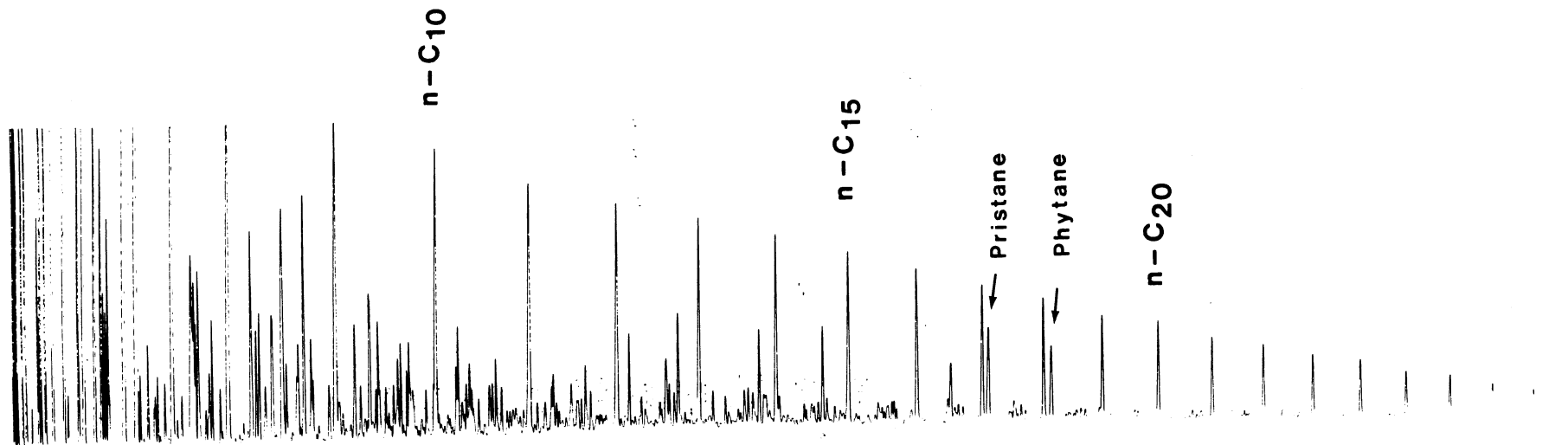
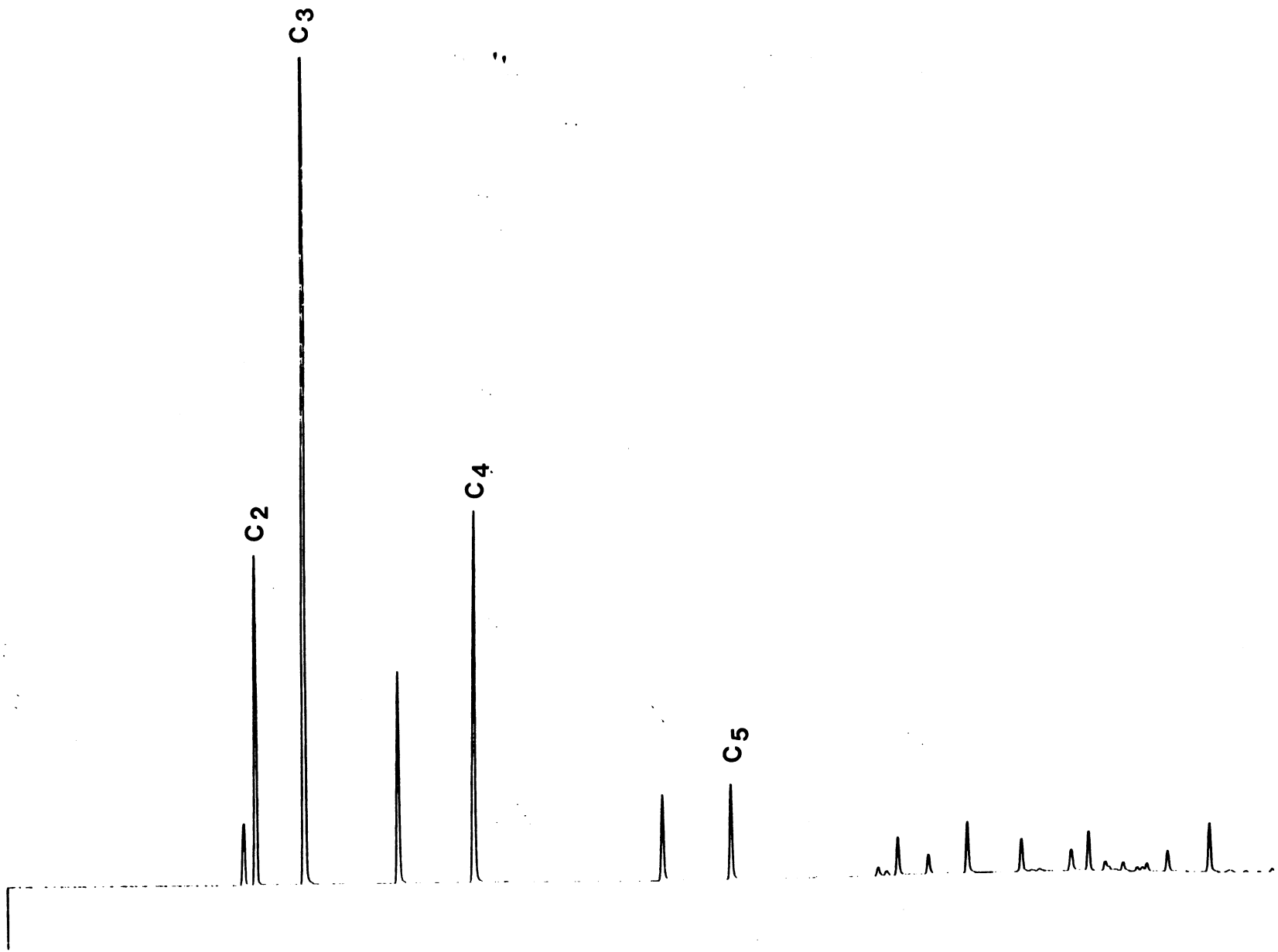


FIG. 1 TBP- AND DENSITY- PROFILES FOR CONDENSATE 6407/1-2

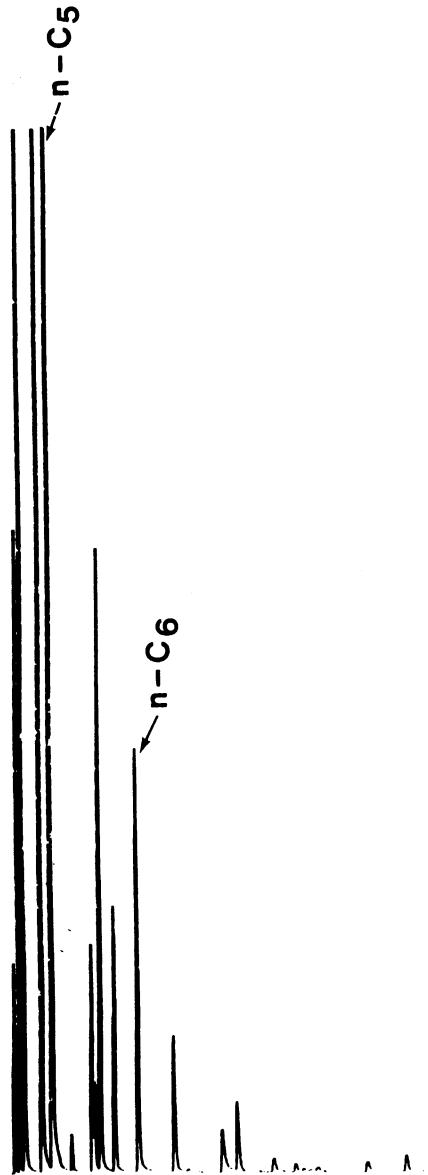
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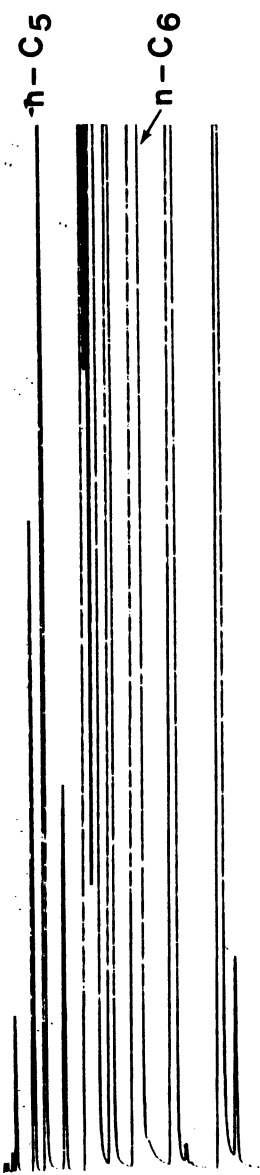
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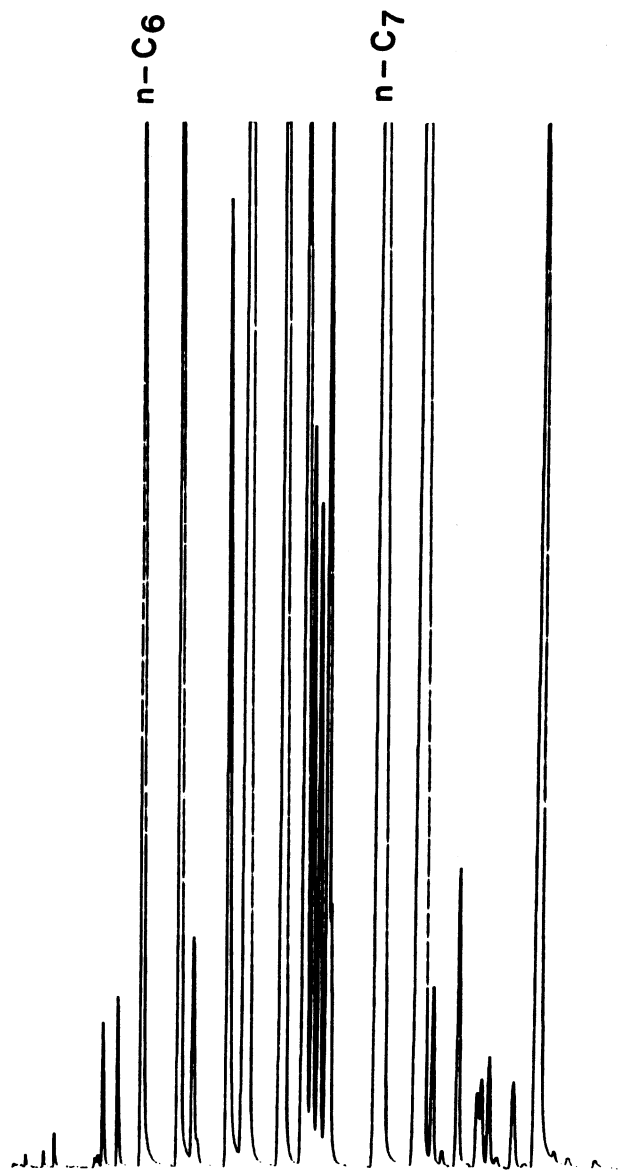
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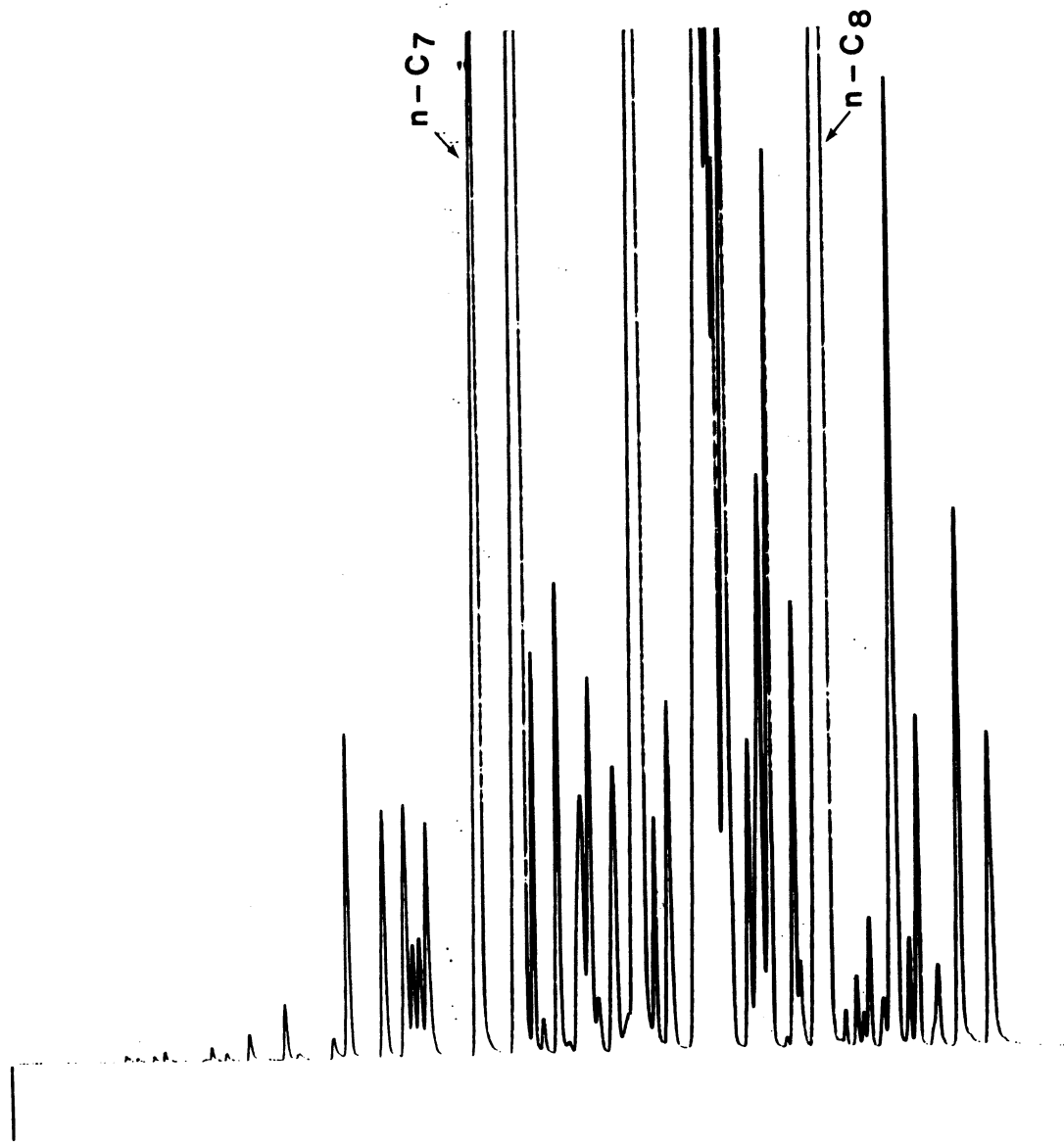
COLD TRAP-FRACTION



C6 - FRACTION

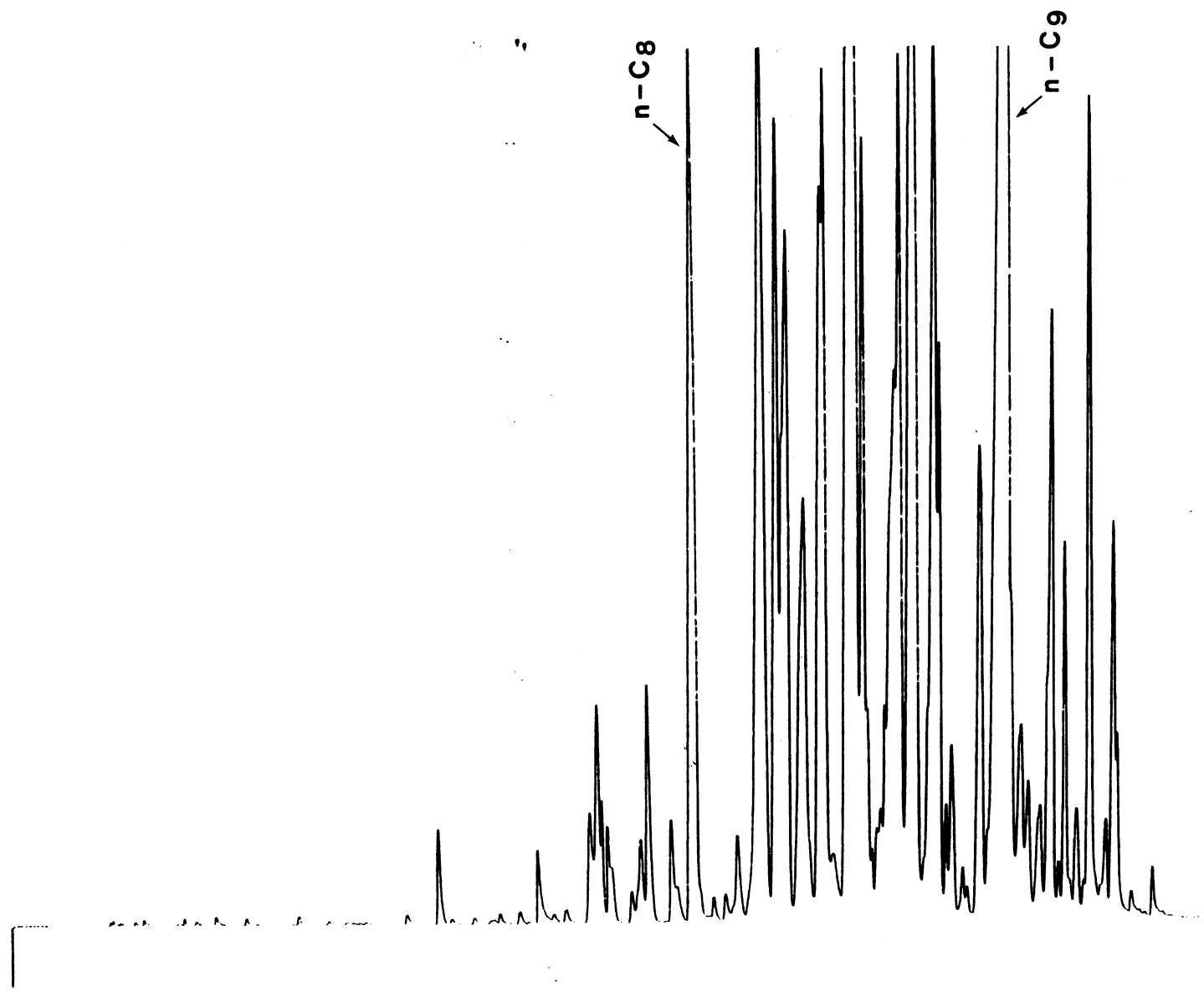


C7 - FRACTION

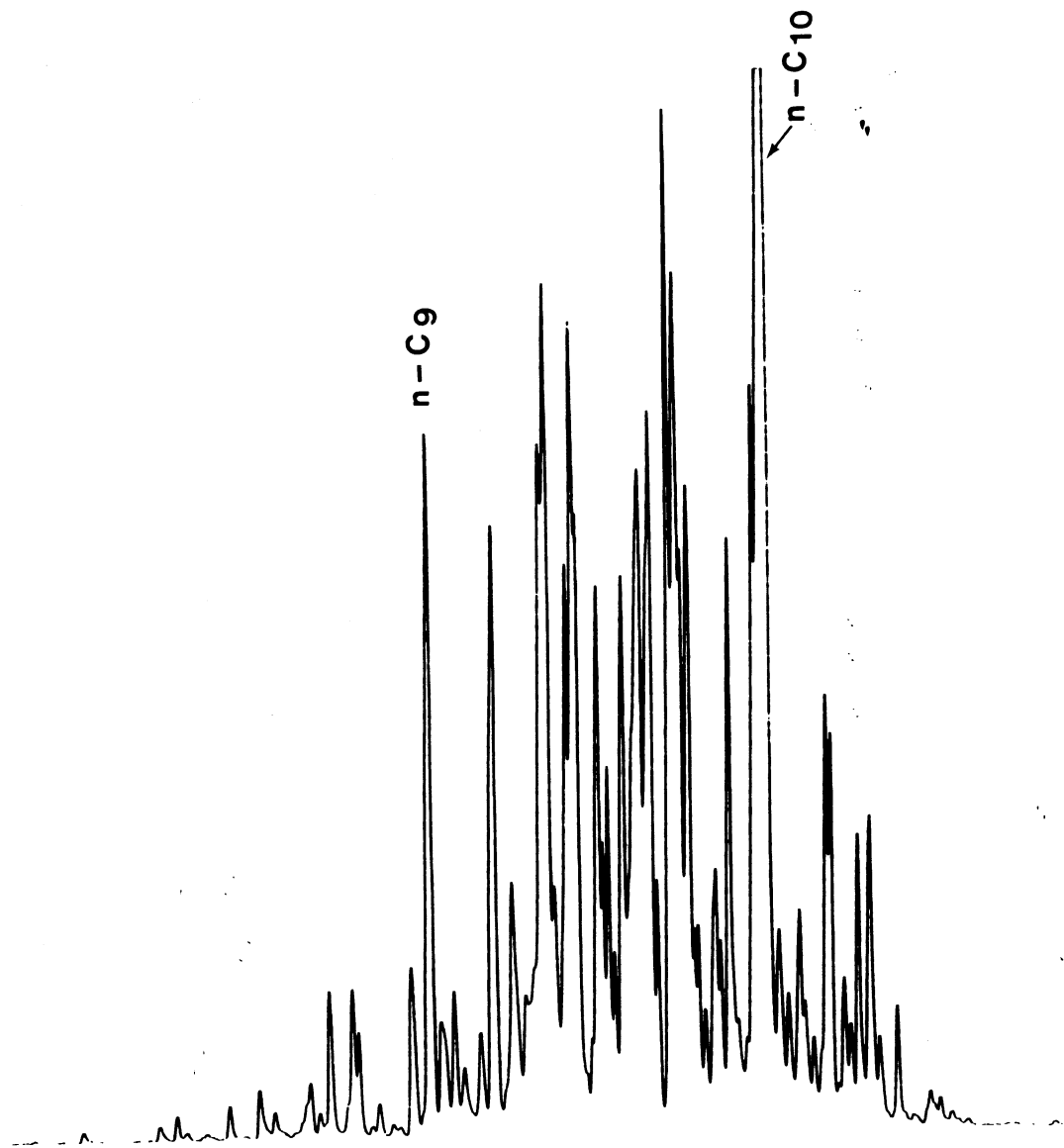


C8 - FRACTION

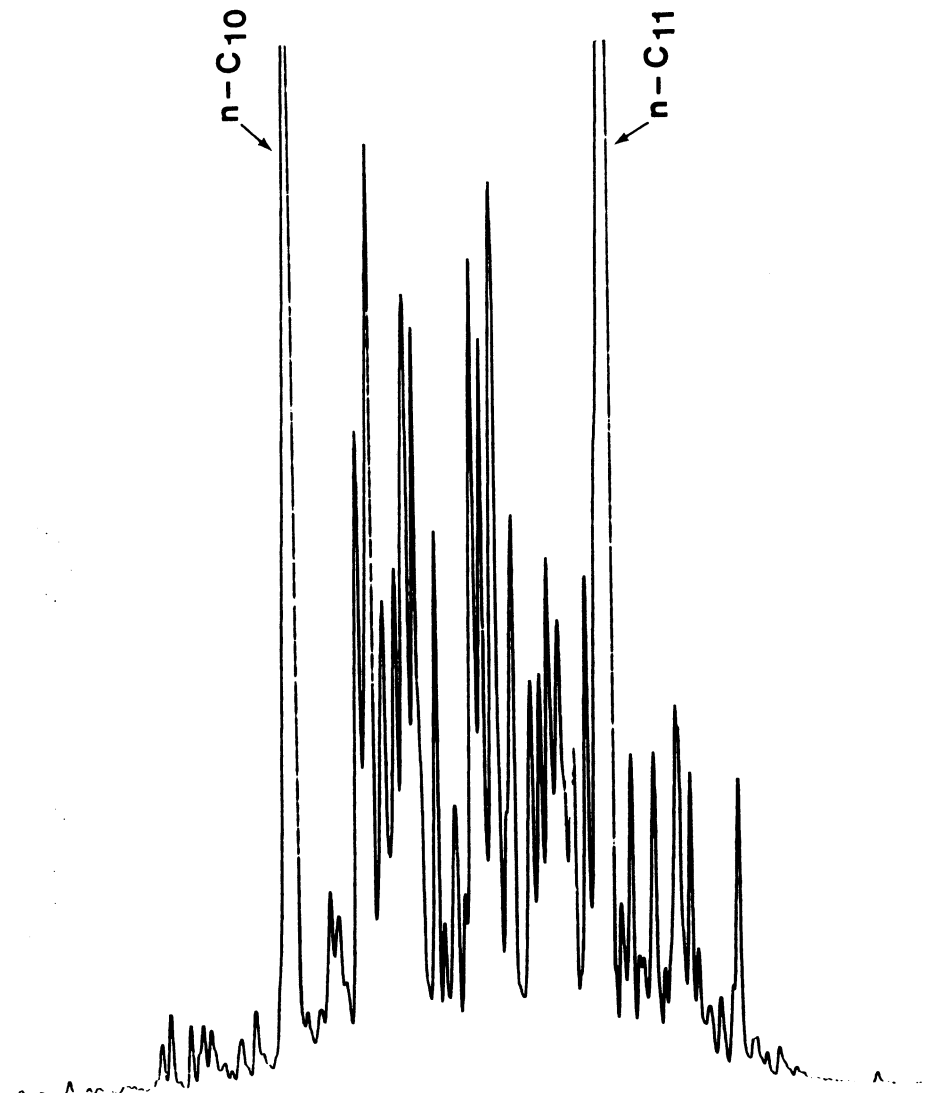




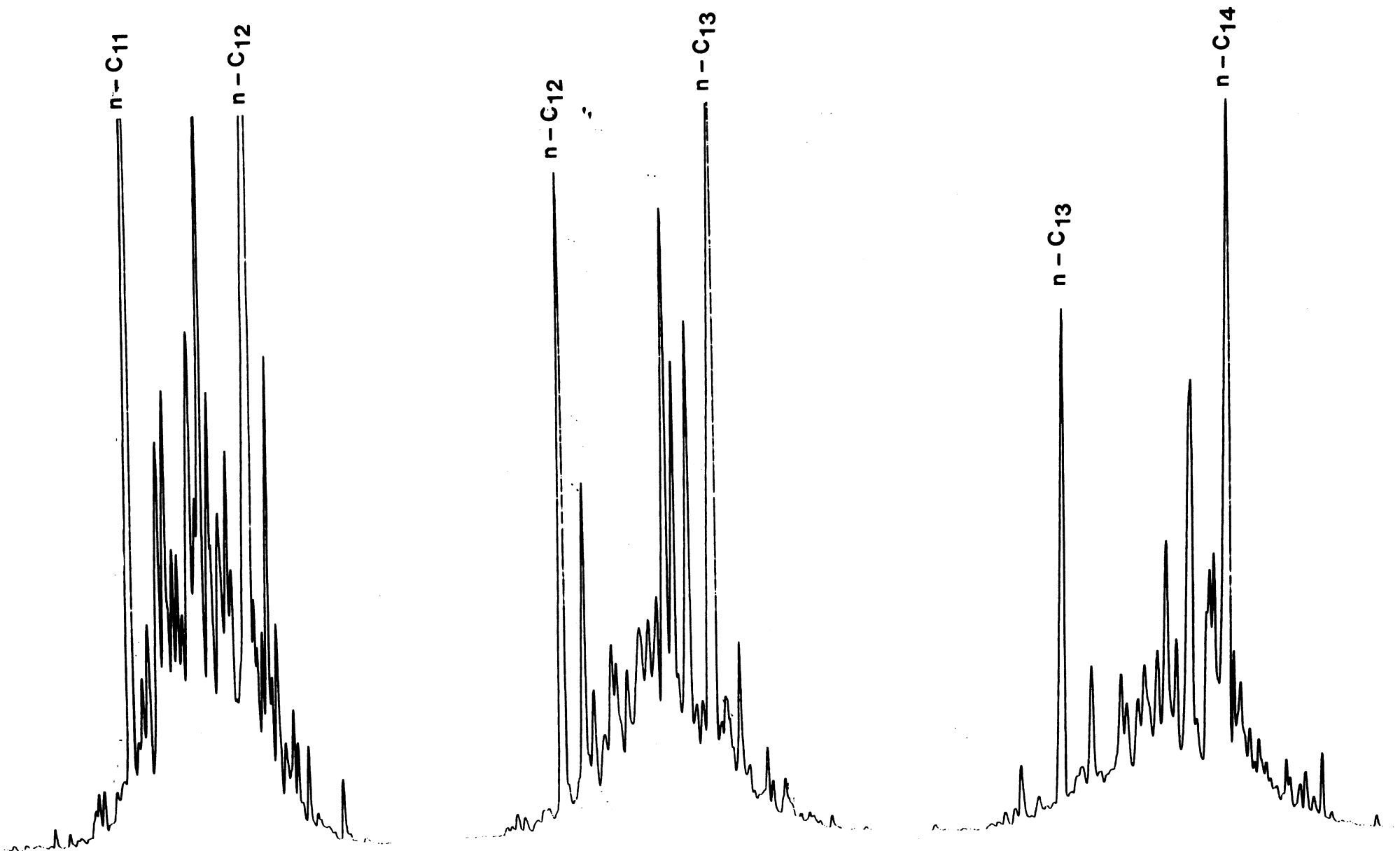
C9 - FRACTION



C10 - FRACTION



C11 - FRACTION

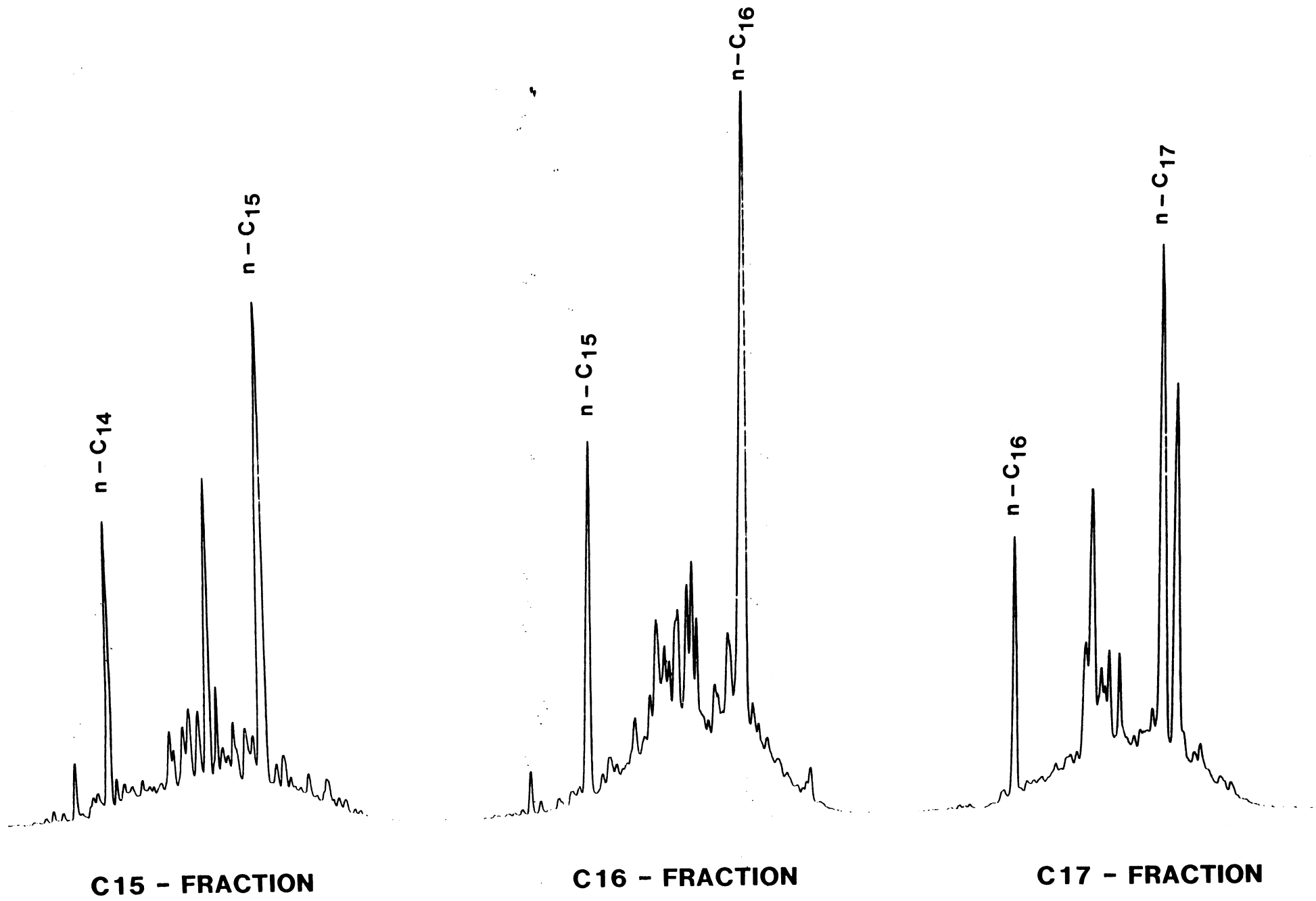


C12 - FRACTION

C13 - FRACTION

C14 - FRACTION

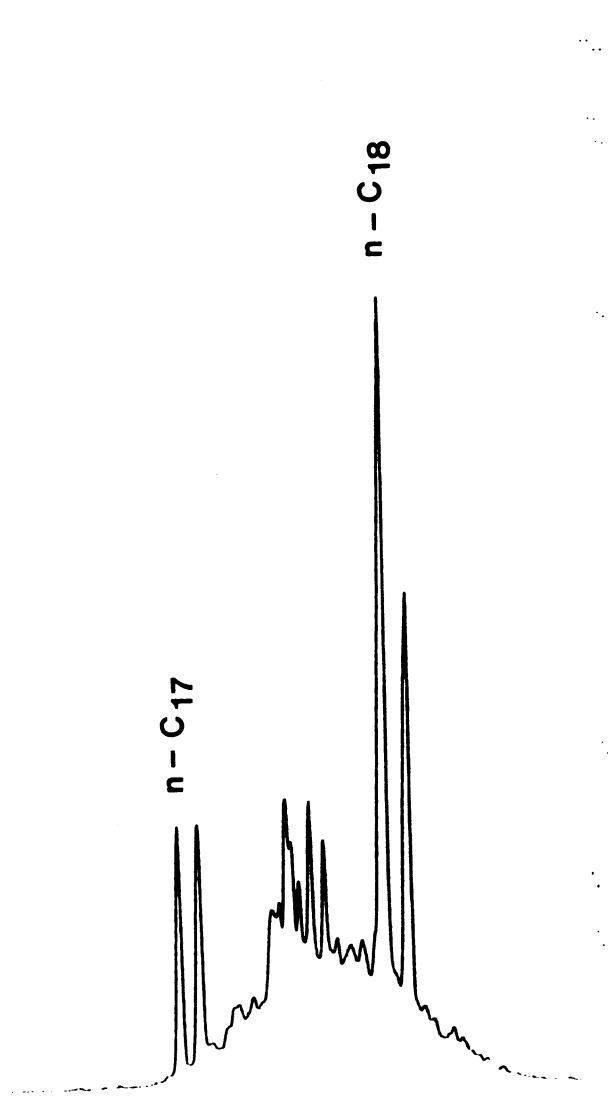




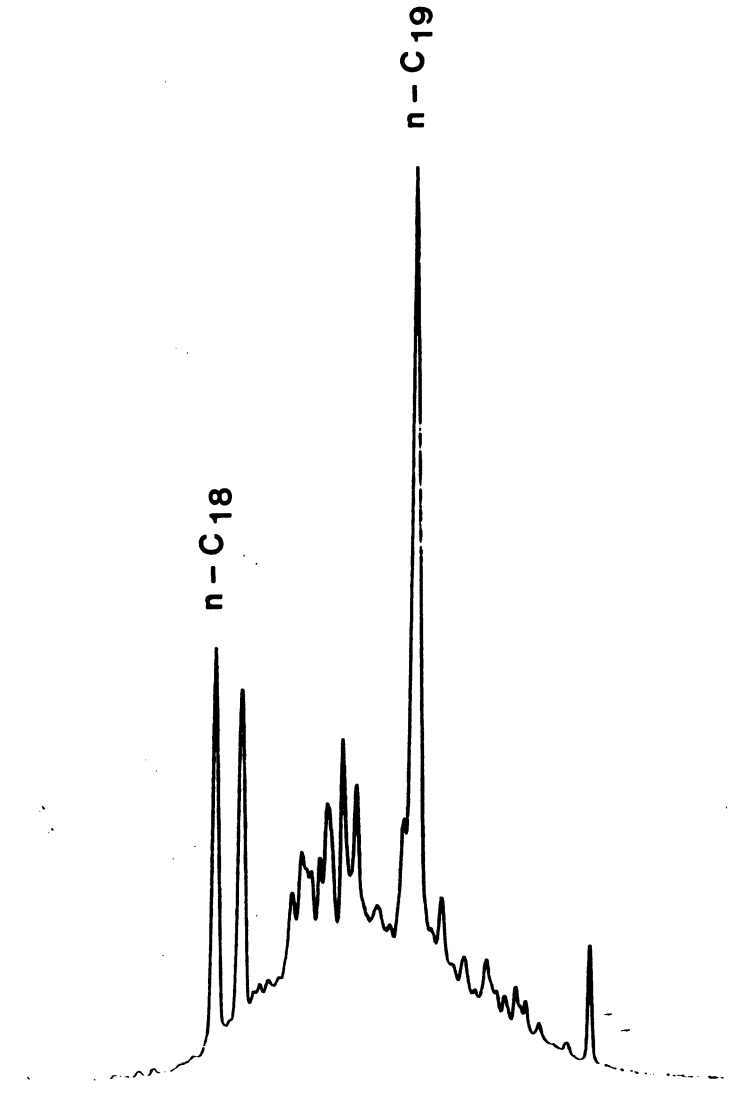
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C17 - FRACTION



C18 - FRACTION



C19 - FRACTION