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GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

Hornebergveien 5 - P.O.Box 1581
7001 Trondheim - Norway
Tlf.: (47-7) 96 40 00
Telefax: 96 59 74
Telex: 65706 Geono n

Well: 2/7-20

REPORT : Oil Sample Analysis

CLIENT(S) : Phillips Petroleum Company Norway

RESPONSIBLE SCIENTIST : Alan G. Rowley

AUTHORS : Malvin Bjorøy

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CONTENTS

	Page no.
Introduction	1
Results and Discussion	2
GC - MS Analysis	3
Conclusions	6
Analytical Methods	7

Tables

Whole Oil Chromatograms

Saturated Fraction Chromatograms

Aromatic Fraction Chromatograms

GC - MS Fragmentograms

INTRODUCTION

Two canned mud samples from well 2/7-20 were received for analysis to evaluate if there was oil in the samples. Both samples were badly shaken up and the contents had the appearance of a "mousse". A number of various separation techniques were tried, including centrifugation, water separation and organic solvent separation. These techniques gave enough material for analyses, but quantitative measurements of oil in the samples could not be undertaken.

RESULTS AND DISCUSSION

1. Whole Oil Analysis

Gas chromatographic analysis of the two oil samples give typical chromatograms of an oil, with an n-alkane distribution from C_7 - C_{38}. There is some variation between the two samples, especially in the light end. This variation is most probably due to the sampling and problems in separating the oil from the mud in the laboratory.

2. GC Analysis of Saturated and Aromatic Hydrocarbons

The two samples were separated on an MPLC system and each of the saturated and aromatic hydrocarbon fractions analysed by capillary gas chromatography. The gas chromatograms of the saturated hydrocarbon fractions show almost identical patterns for n-alkanes and isoprenoids. Farnacene is the largest of the isoprenoids and the n-alkanes show a front biased distribution with a maximum at nC_{15} and a steady decrease in intensity up to nC_{38}. nC_{23} is slightly larger than nC_{22} and nC_{24} in both samples. The pattern seen here is typical for well mature oils. The FID gas chromatograms of the aromatic hydrocarbons vary somewhat in the low molecular range for the two samples. This is mainly due to a loss of these compounds in the work up process for the sample collected on 25/12. Apart from this, the two samples show almost identical patterns, typical for well mature hydrocarbons. The methylphenanthrenes are quite abundant in these samples and evaluation of maturity from these data indicate a maturity of approximately 1.0 % vitrinite reflectance. The FPD gas chromatograms show mainly 4 methyldibenzothiophene. The 1 methyldibenzothiophene peak is very small. This supports the maturity data from the FID gas chromatogram, showing a well mature oil.

GC - MS ANALYSIS

Only one of the samples, 26/12, was analysed by GC - MS, and the data from the saturated and aromatic hydrocarbon fractions are discussed below.

Saturated Fraction

Terpanes

The M/Z 177 fragmentogram shows mainly the peaks from rearranged steranes. The triterpanes are not recognized in this fragmentogram, which indicates a well mature oil of marine origin. The M/Z 191 fragmentogram shows some tricyclic terpanes together with the pentacyclic triterpanes, which are more dominant. The 17 α trisnorhopane is large compared to what is normally found in Central Graben oils, whilst the heavier components are reduced. This clearly shows the high maturity for this sample. The unidentified C_{30} pentacyclic triterpane marked X, is also very abundant, again, a good indication of high maturity for this sample.

Steranes

The M/Z 259 fragmentogram shows a large amount of rearranged steranes, with the C_{27} components slightly more abundant than the C_{29} components. The M/Z 217 fragmentogram shows that the rearranged steranes are more abundant than the regular steranes, typical for Central Graben oils. The C_{29} regular steranes are relatively abundant in this sample. This is also seen for the M/Z 218 fragmentograms. Patterns such as this are unusual for marine oils and fit quite well with the large amount of heavy n-alkanes with a CPI > 1,

which indicates an input from a mixture of kerogen type II/III, not a pure type II kerogen.

Aromatic Hydrocarbons

Alkyl Benzenes

The M/Z 106 fragmentogram shows the typical pattern of doublets seen for source rocks and oils in the Central Graben. The M/Z 134 fragmentogram shows a large number of peaks which are not identified. The pattern is strange and not possible to evaluate further.

Naphthalenes

The M/Z 142 fragmentogram shows the doublet for methylnaphthalenes with 2 methylnaphthalene as the largest peak. The M/Z 156 fragmentogram shows the C_2 naphthalenes. The 2,6 + 2,7 dimethylnaphthalene doublet has an unusually large relative abundance in this sample. The M/Z 170 fragmentogram shows the typical pattern for C_3 naphthalenes.

Phenanthrenes

The M/Z 178 fragmentogram shows only phenanthrene. There is no signal from anthracene observed in this sample. The M/Z 192 fragmentogram shows the two doublets for methylphenanthrenes. The 3+2 methylphenanthrene doublet is most abundant, indicating a high maturity. The M/Z 206 fragmentograms show the typical patterns for C_2- and C_3 phenanthrenes respectively.

Dibenzothiophenes

The M/Z 198 fragmentogram shows the three peaks for methyldibenzothiophenes where 4 methyldibenzothiophene is the most abundant peak and 1 methyldibenzothiophene is a minor peak, clearly showing the high maturity of this sample. The M/Z 212 fragmentogram shows the typical pattern for C_2 dibenzothiophenes.

Aromatic Steranes

Neither the M/Z 231 nor the M/Z 253 show peaks which can be recognized at triaromatic or monoaromatic steranes, due to the high maturity of the sample.

CONCLUSIONS

The two samples from 2/7-20 contain a similar type of oil. The small differences seen are probably due to variations in sampling. The oil is a typical Central Graben oil with a maturity equivalent to approximately 1.0 % vitrinite reflectance. The large proportion of C_{29} regular steranes, together with the large amount of heavy n-alkanes and a CPI > 1.0, indicate the oil to be generated from kerogen type II/III.

ANALYTICAL METHODS

Whole Oil

Whole oil chromatograms are determined on a gas chromatograph fitted with a split injector, 25m SE54 capillary column and effluent splitter connected to FID and sulphur mode FPD detectors allowing simultaneous determination of hydrocarbons and sulphur compounds. Approximately 0.1 microlitres of whole oil are injected and the temperature program on the chromatograph runs from -10°C to 300°C at 4°C/min.

Liquid chromatographic separation

Chromatographic separation is performed using an MPLC system developed by the company. The oil (after removal of asphaltenes) is injected into the MPLC and chromatographed using hexane as eluent. This effects a separation into saturated and aromatic fractions which are collected and concentrated on a rotary evaporator, at 35°C and 200 mB, to remove the bulk of the hexane. The fractions are then transferred to small tared vials and evaporated to dryness in a stream of nitrogen. The vials are re-weighed to obtain the weights of both fractions. The weight of the NSO fraction, which is retained on the chromatography column, is obtained by difference.

Gas chromatographic analyses

Saturated fraction

The instrument used for this analysis is a gas chromatograph with a 25 m OV1 column, split injector and FID detector.

The carrier gas is helium and the temperature program runs isothermally at 60°C, for 2 minutes and then rises to 290°C at a rate of 4°C/min.

The sample of saturated fraction is diluted by 1:20 with hexane and a 1 microlitre aliquot of this is injected into the instrument.

Aromatic fraction

The instrument used is a gas chromatograph with a 25 m SE-54 capillary column, split injector and effluent splitter leading to FID and FPD detectors, allowing simultaneous analysis of hydrocarbons and sulphur compounds. The carrier gas is helium and the temperature program runs from 60°C to 300°C at a rate of 4°C/min.

The sample of aromatic fraction is diluted by 1:20 with hexane and a 1 microlitre aliquot of this is injected into the instrument.

Experimental, 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 OV-1 capillary column (25m x 0.22 mm i.d.) directly into the ion source. Helium (10psi) was used as carrier gas and the injections were performed in splittless mode. The GC oven was programmed from 50°C to 150°C at 35°C/min. at which point the programme rate was 4°C/min up to 280° where the column was held isothermally for 37 min. For the aromatic hydrocarbons, the GC oven was programmed from 50oC to 280°C at 5°C/min. and held isothermally at 280°C for 22 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 was 2500 (10% valley) for most of the samples, but had to be decreased to 1000 for some samples to improve the sensitivity of some mass fragmentograms.

The datasystem used was a VG PDP11/73 system. The samples were analysed in multiple ion detection mode (MID) at a scan cycle time of approximately 1,8 sec.

Calculation of peak ratios was done from peak height in the appropriate mass fragmentograms.

In the discussion of the GC-MS data, the results will be discussed by area. The wells within an area will be discussed separately. In the discussion, samples within one formation are discussed together. The discussion is further divided into types of compounds as follows:

Saturated Fractions:

Terpanes:

The most commonly used fragmentions for detection of terpanes are M/Z 163 for detection of 25,28,30 trisnor-moretane 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, 384, 398, 412 and 426 are also recorded for identification of C_{27}, C_{28}, C_{29}, C_{30} and C_{31} triterpanes respectively.

Steranes:

The most commonly used fragmentions for detection of steranes are M/Z 149 to distinguish between 5 α and 5 β 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 14 β (H), 17 β (H) steranes. The molecular ions M/Z 372, 386, 400 and 414 are also recorded for identification of C_{27}, C_{28}, C_{29} and C_{30} steranes respectively.

Bicyclanes:

The fragmentions M/Z 123, 179 and 193 are normally used for

the detection of the bicyclanes (sesquiterpanes and diterpanes). M/Z 123 will detect all bicyclanes while M/Z 179 and 193 will show the C_{14} and C_{15} bicyclanes respectively.

Aromatic Fractions:

Alkyl-substituted Benzenes:

The M/Z 106 fragmentions 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 fragmention. M/Z 148 can be used for the detection of C_5-alkylbenzenes, but will also give signals for methyl-substituted benzothiophenes.

Naphthalenes:

Methylnaphthalenes are normally detected by the M/Z 142 fragmention 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 fragmentions are used for methyl-substituted dibenzothiophenes and dimethyl-substituted dibenzothiophenes respectively.

Phenanthrenes:

Phenanthrene is detected using the M/Z 178 fragmention. Anthracene will, if present also give a signal in the M/Z 178 fragmention. Methyl-substituted phenanthrenes give signals in the M/Z 192 fragmention while the M/Z 206 fragmention shows the dimethyl-substituted phenanthrenes.

Aromatic Steranes:

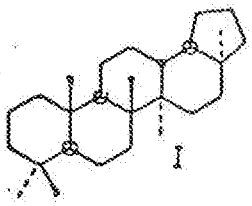
Monoaromatic steranes are detected using the M/Z 253 fragmention while the triaromatic steranes are detected using the M/Z 231 fragmention.

2a. 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.	18 α trisnorneohopane (T_S)	$C_{27}H_{44}$	(I)
B.	17 α trisnorhopane (T_M)	$C_{27}H_{46}$	(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.	βα hopane	$C_{30}H_{52}$	(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 αβ tetrakishomohopane	$C_{34}H_{60}$	(II, R=i-C_7H_{15})
	22R αβ tetrakishomohopane	$C_{34}H_{60}$	(II, R=i-C_7H_{15})
M.	22S αβ pentakishomohopane	$C_{35}H_{62}$	(II, R=i-C_8H_{17})
	22R 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



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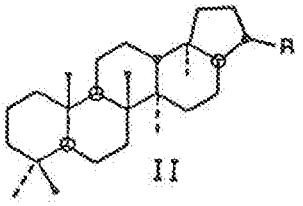

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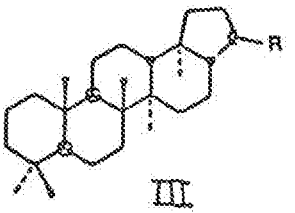

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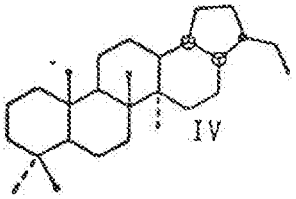

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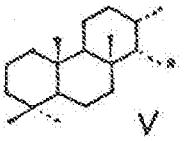

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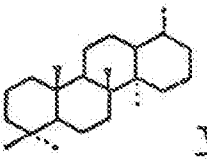

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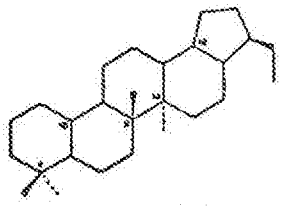


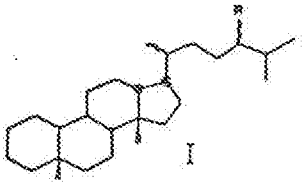
VII

2b. 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 methyldiacholestane	$C_{28}H_{50}$	(I, R=CH_3)
f.	20R βα 24 methyldiacholestane	$C_{28}H_{50}$	(I, R=CH_3)
g.	20S αβ 24 methyldiacholestane	$C_{28}H_{50}$	(II, R=CH_3)
	+ 20S ααα cholestane	$C_{27}H_{48}$	(III, R=H)
h.	20S βα 24 ethyldiacholestane	$C_{29}H_{52}$	(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 methyldiacholestane	$C_{28}H_{50}$	(II, R=CH_3)
j.	20R ααα cholestane	$C_{27}H_{48}$	(III, R=H)
k.	20R βα 24 ethyldiacholestane	$C_{29}H_{52}$	(I, R=C_2H_5)
l.	20S αβ 24 ethyldiacholestane	$C_{29}H_{52}$	(II, R=C_2H_5)
m.	20S ααα 24 methylcholestane	$C_{28}H_{50}$	(III, R=CH_3)
n.	20R αββ 24 methylcholestane	$C_{28}H_{50}$	(IV, R=CH_3)
	+ 20R αβ 24 ethyldiacholestane	$C_{29}H_{52}$	(II, R=C_2H_5)
o.	20S αββ 24 methylcholestane	$C_{28}H_{50}$	(IV, R=CH_3)
p.	20R ααα 24 methylcholestane	$C_{28}H_{50}$	(III, R=CH_3)
q.	20S ααα 24 ethylcholestane	$C_{29}H_{52}$	(III, R=C_2H_5)
r.	20R αββ 24 ethylcholestane	$C_{29}H_{52}$	(IV, R=C_2H_5)
s.	20S αββ 24 ethylcholestane	$C_{29}H_{52}$	(IV, R=C_2H_5)
t.	20R ααα 24 ethylcholestane	$C_{29}H_{52}$	(III, R=C_2H_5)
u.	5 α sterane	$C_{21}H_{36}$	(VI, R=C_2H_5)
V.	5 α sterane	$C_{22}H_{38}$	(VI, R=C_3H_7)

STRUCTURES REFRESENTING STERANES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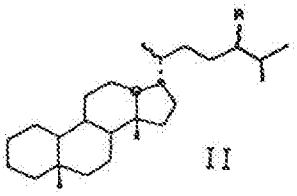
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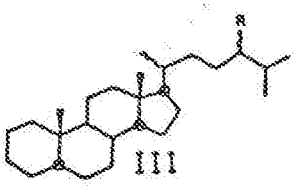
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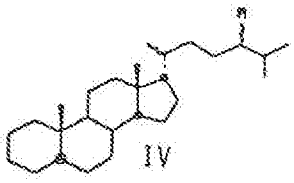
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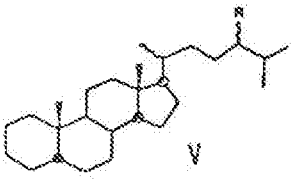
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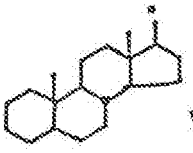
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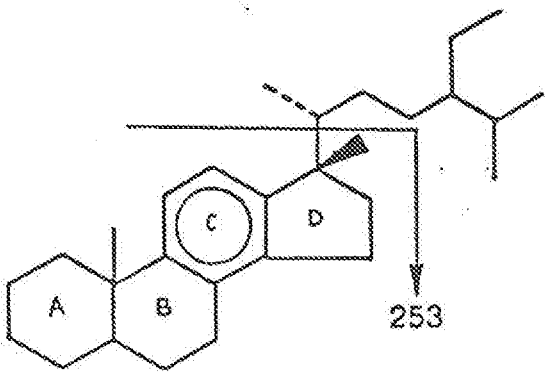
Mass Fragmentograms representing Monoaromatic Steranes
(M/Z 253)

Description of C-ring monoaromatic steroid hydrocarbons

Peak	Substituents R_1	R_2	R_3	R_4	Abbreviation of Compound
A1					C_{21}MA
B1					C_{22}MA
C1	β(H)	CH_3	S(CH_3)	H	βSC_{27}MA
	CH_3	H	S(CH_3)	H	SC_{27}DMA
	β(H)	CH_3	R(CH_3)	H	βRC_{27}MA
D1	CH_3	H	R(CH_3)	H	RC_{27}DMA
	α(H)	CH_3	S(CH_3)	H	αSC_{27}MA
E1	β(H)	CH_3	S(CH_3)	CH_3	βSC_{28}MA
	CH_3	H	S(CH_3)	CH_3	SC_{28}DMA
F1	α(H)	CH_3	R(CH_3)	H	αRC_{27}MA
	α(H)	CH_3	S(CH_3)	CH_3	αSC_{28}MA
	β(H)	CH_3	R(CH_3)	CH_3	βRC_{28}MA
G1	CH_3	H	R(CH_3)	CH_3	RC_{28}DMA
	β(H)	CH_3	S(CH_3)	C_2H_5	βSC_{29}MA
	CH_3	H	S(CH_3)	C_2H_5	SC_{29}DMA
	α(H)	CH_3	R(CH_3)	CH_3	αRC_{28}MA
H1	β(H)	CH_3	R(CH_3)	C_2H_5	βRC_{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	αRC_{29}MA

STRUCTURES REPRESENTING MONOAROMATIC STERANES:



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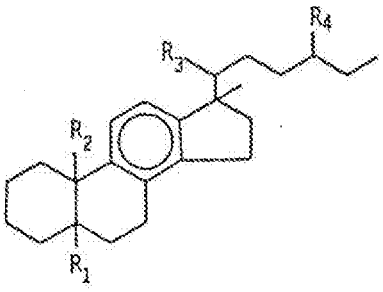
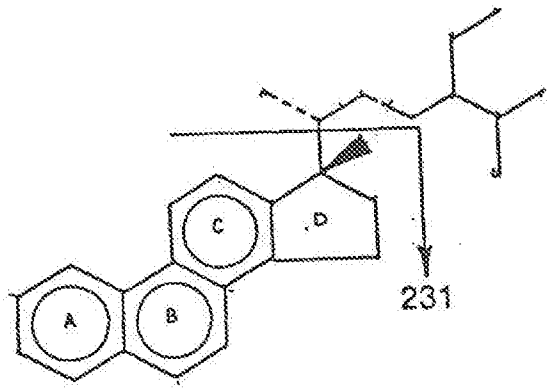


Mass Fragmentograms representing Triaromatic Steranes
(M/Z 231)

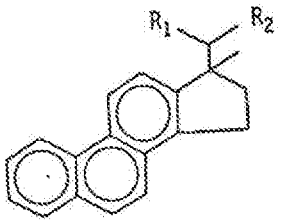
Description of ABC-ring triaromatic steroid hydrocarbons

Peak	Substituents R_1	R_2	Abbreviation of Compound
a1	CH_3	H	$C_{20}TA$
b1	CH_3	CH_3	$C_{21}TA$
c1	$S(CH_3)$	C_6H_{13}	$SC_{26}TA$
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



TABLES

Table 1 : Saturated Hydrocarbon Ratios for well PHILLIPS

Depth unit of measure: 1

Depth	Typ	Lithology	Pristane nC17	Pristane Phytane	Pristane + Phytane nC17 + nC18	Phytane nC18	CPI	Sample
25.00			0.57	1.36	0.52	0.46	1.18	003-0B
26.00			0.47	1.30	0.44	0.40	1.06	002-0B

Table 2 : Aromatic Hydrocarbon Ratios for well PHILLIPS

Depth unit of measure: 1

Depth	Typ	Lithology	MNR	DMNR	BPhR	2/1MP	MPI1	MPI2	DBT/P	4/1MDBT	(3+2)/1MDBT	Sample
25.00			-	1.62	-	1.41	1.02	1.10	0.34	86.18	12.76	003-0B
26.00			1.53	2.41	0.20	1.51	1.06	1.07	0.19	26.25	4.75	002-0B

Table 3: Variation in Triterpane Distribution for Well PHILLIPS

Depth unit of measure: 1

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
26.00	bulk	0.46	0.32	0.23	0.81	0.45	0.71	-	-	-	-	0.83	0.44	0.18	64.71	002-0

Table 4: Variation in Sterane Distribution for Well PHILLIPS

Depth unit of measure: 1

Depth	Lithology	Ratio1	Ratio2	Ratio3	Ratio4	Ratio5	Ratio6	Ratio7	Sample
26.00	bulk	0.83	54.72	74.88	1.18	0.73	0.28	0.22	002-0

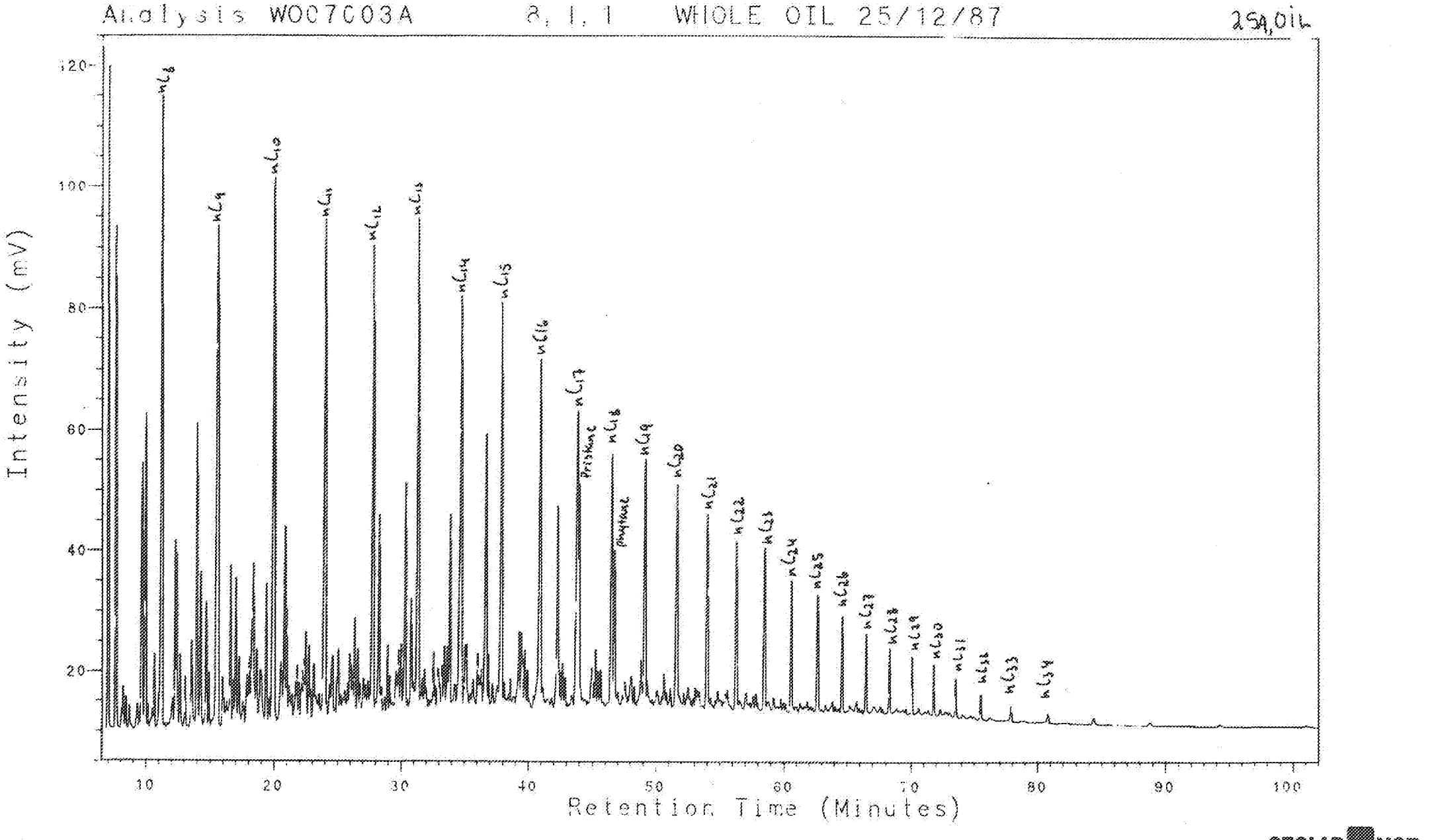
Ratio1: a / a + j
Ratio2: q / q + t * 100%
Ratio3: 2(r + s)/(q + t + 2(r + s)) * 100%
Ratio4: a + b + c + d / h + k + l + n

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

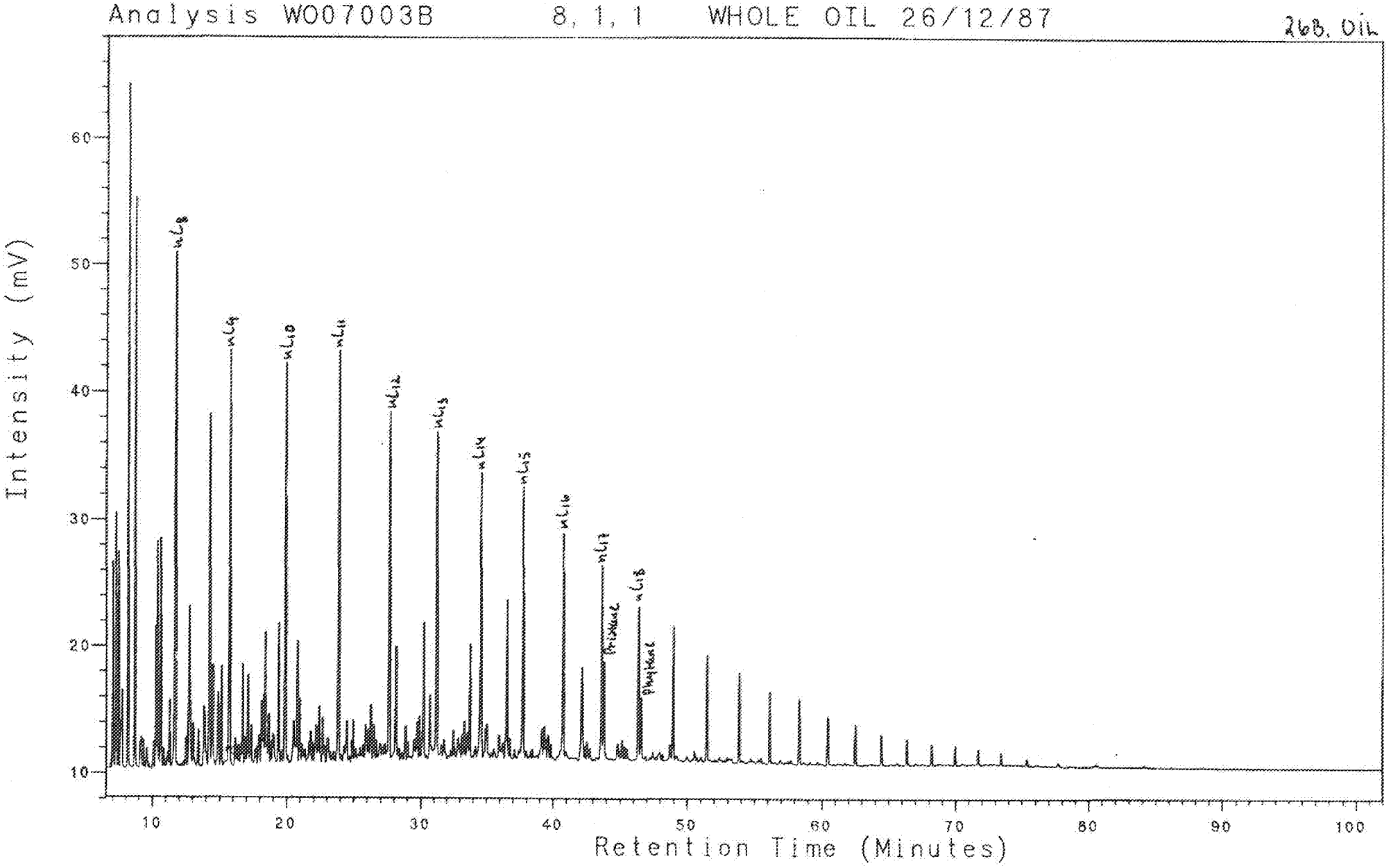
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

WHOLE OIL CHROMATOGRAMS

OF SAMPLE 25A AND 26B (FID)



GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

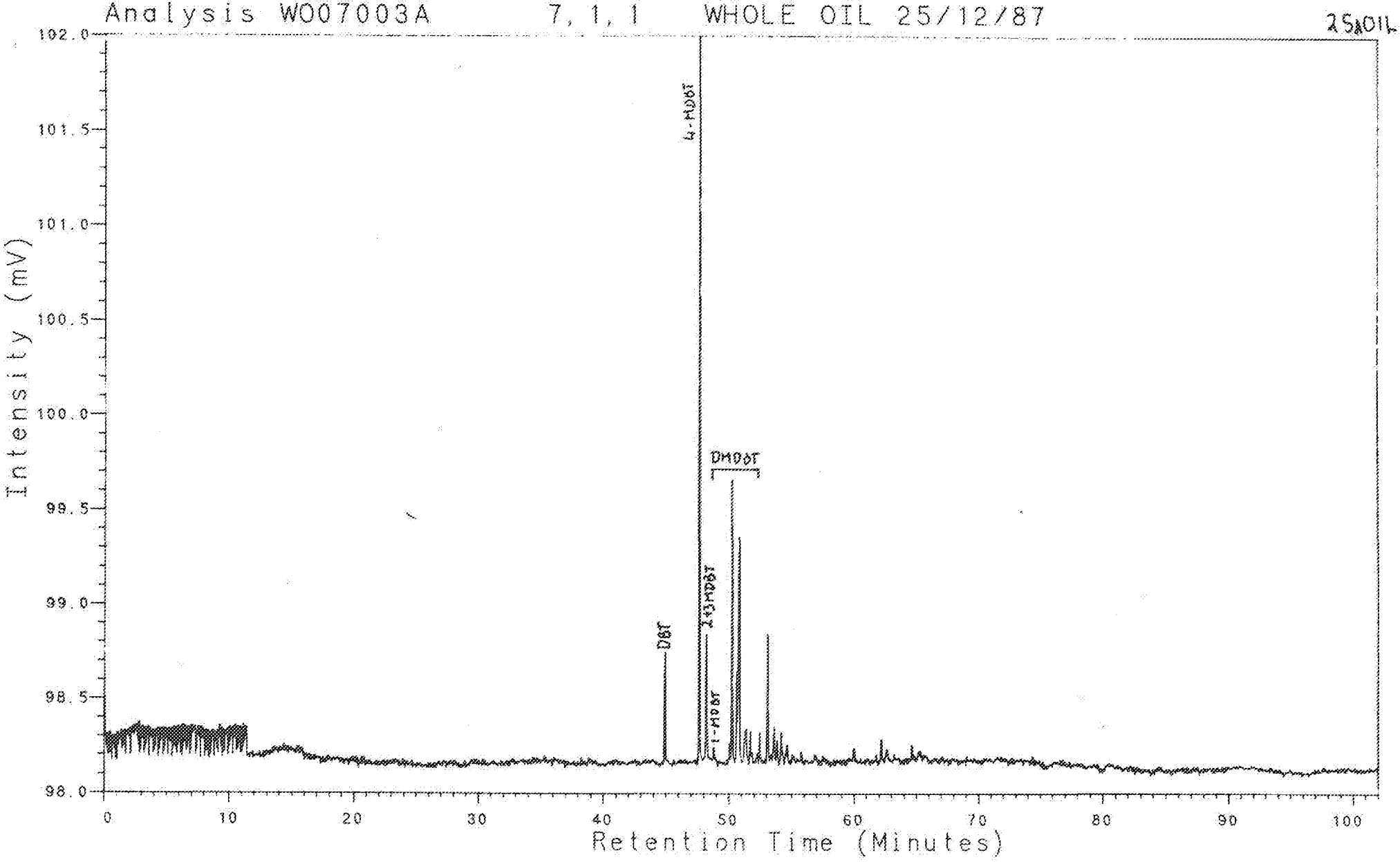


GEOLAB NOR
GEOCHEMICAL LABORATORY OF NORWAY A/S

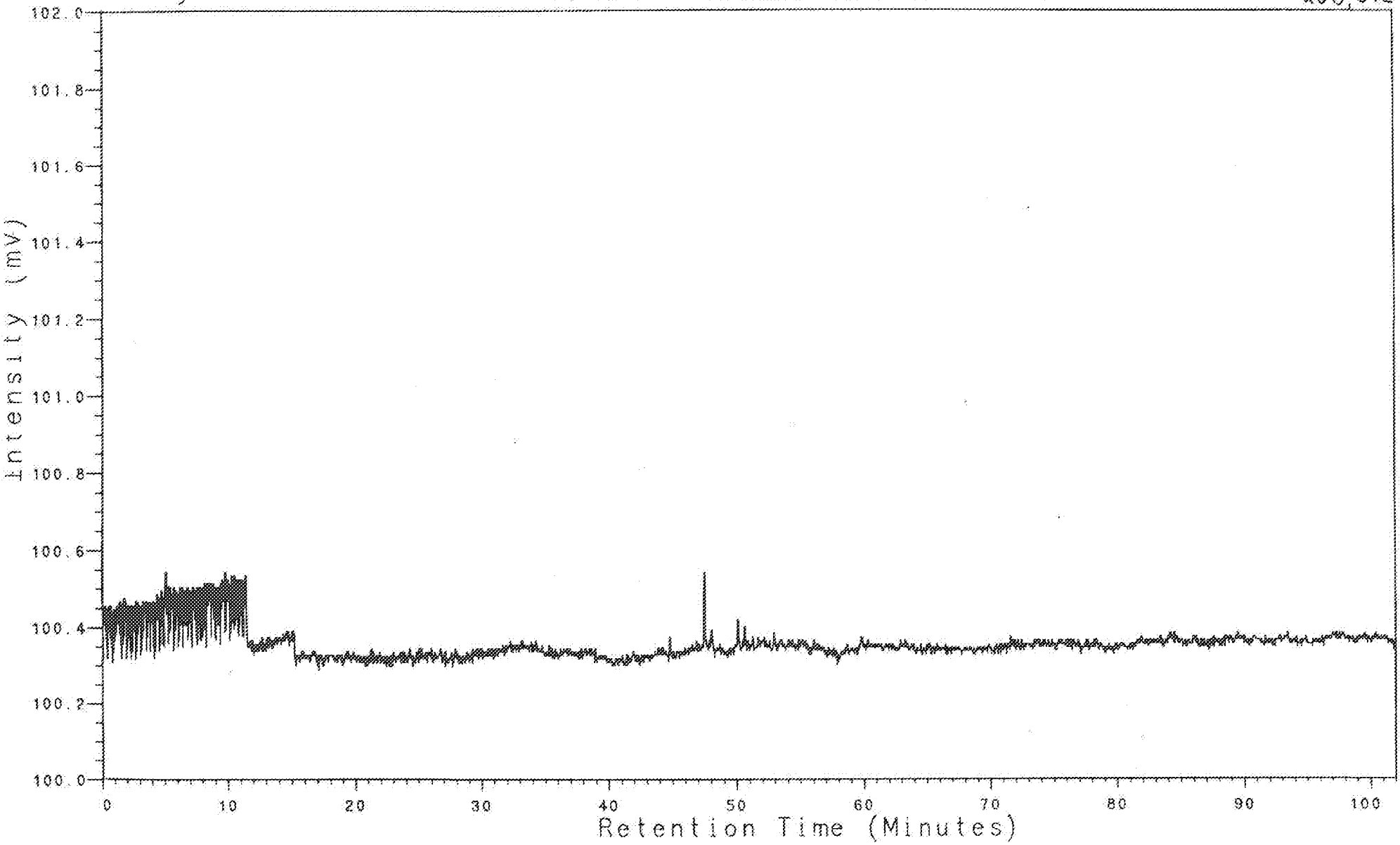
GEOLAB NOR
GEOCHEMICAL LABORATERIES OF NORWAY A.S

WHOLE OIL CHROMATOGRAMS

OF SAMPLE 25A AND 26B (FPD)



GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

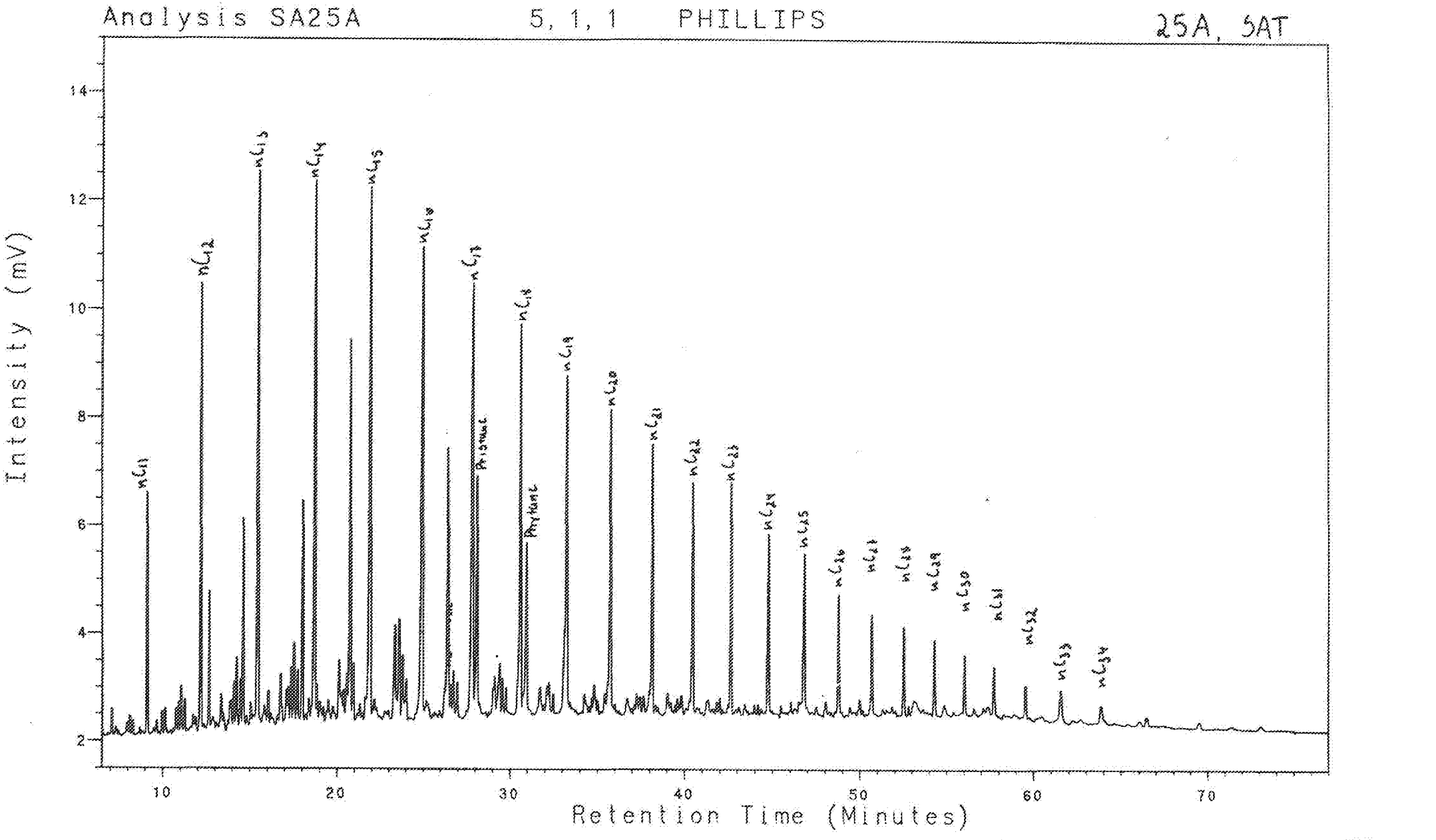

Analysis WO07003B 7, 1, 1 WHOLE OIL 26/12/87
26B, oil
Intensity (mV)
102.0
101.8
101.6
101.4
101.2
101.0
100.8
100.6
100.4
100.2
100.0
0
10
20
30
40
50
60
70
80
90
100
Retention Time (Minutes)

GEOLAB NOR

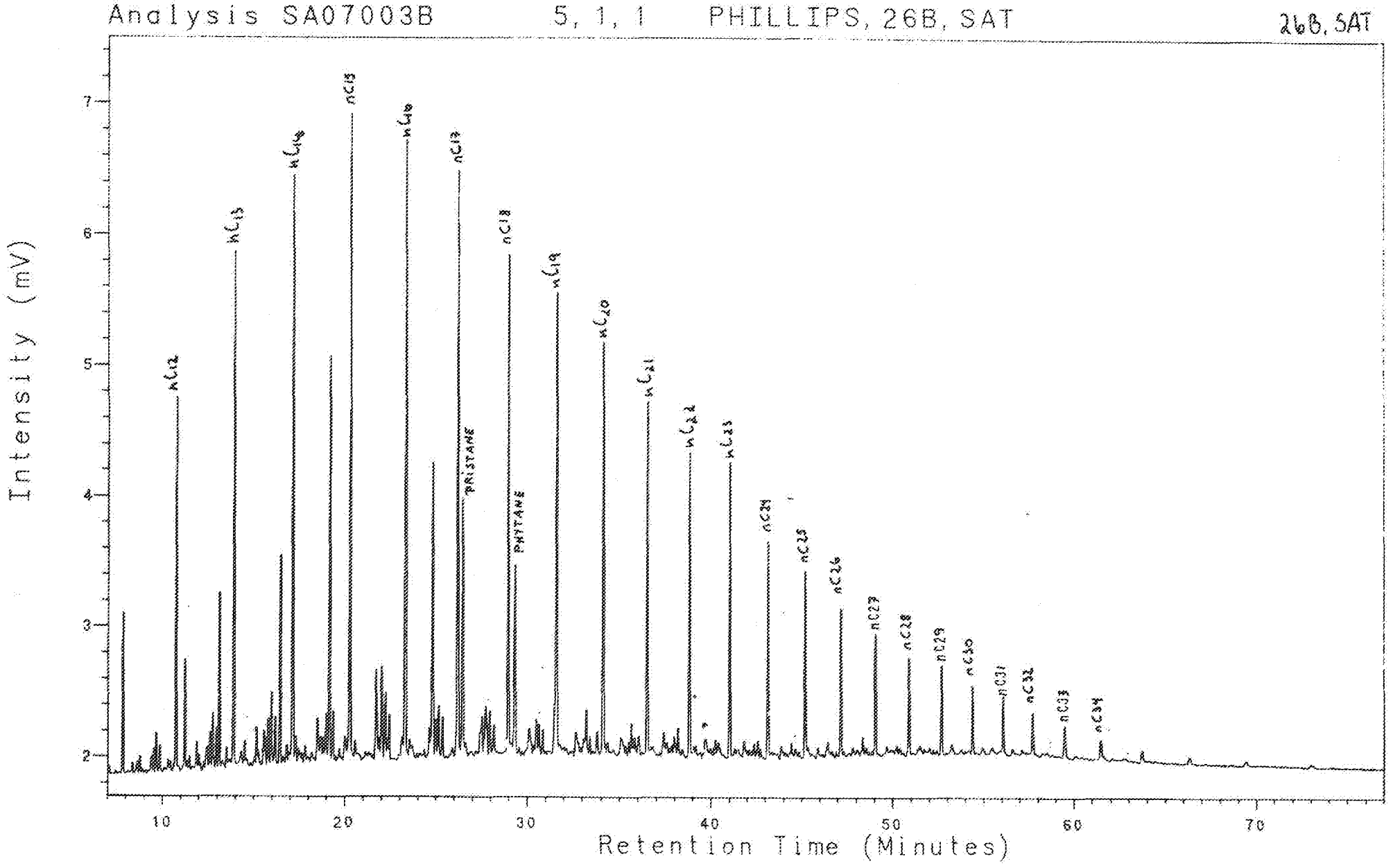
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

SATURATED FRACTION CHROMATOGRAMS

OF SAMPLE 25A and 26B



GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

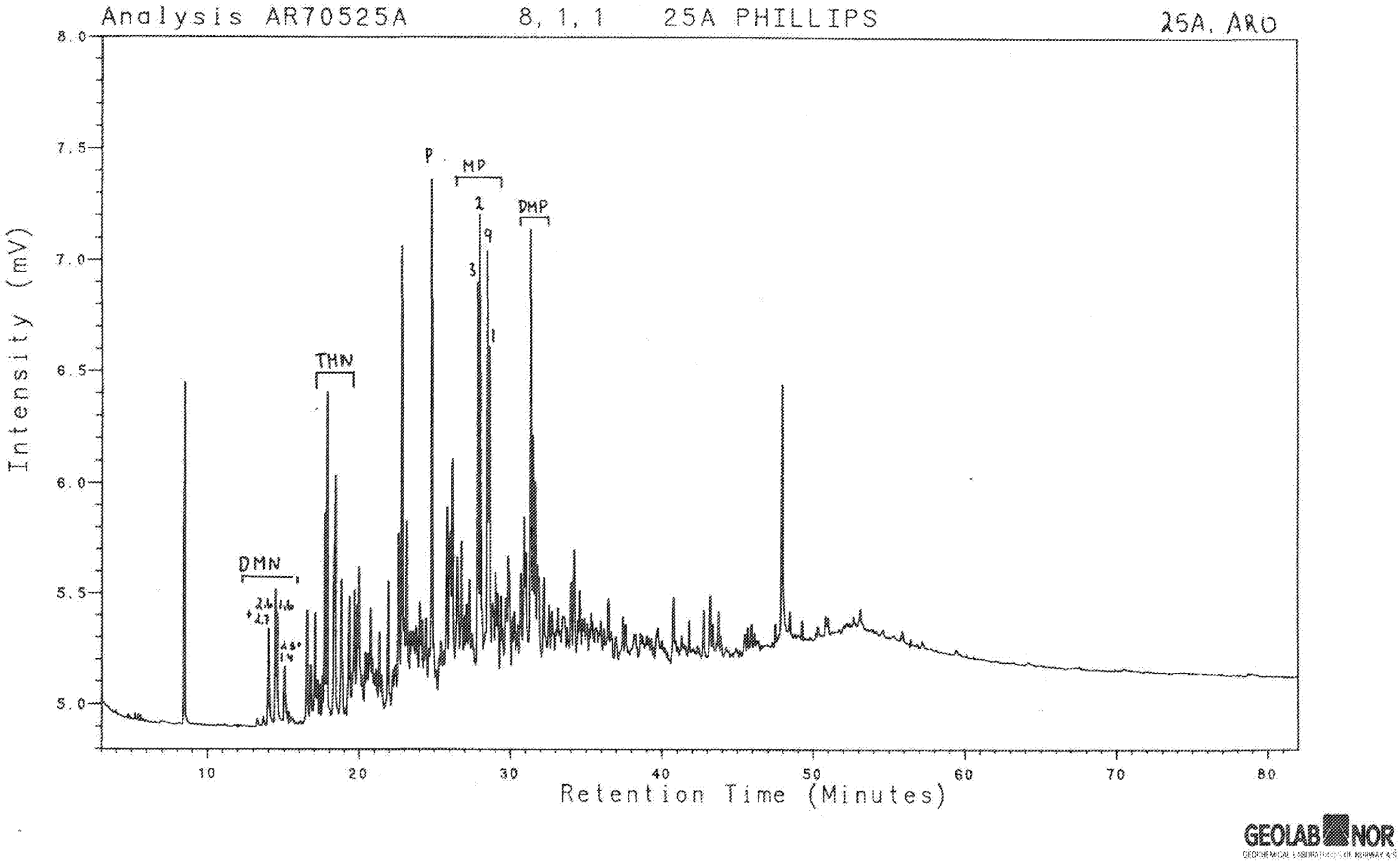


GEOLAB NOR
GEOCHEMICAL LABORATORY OF NORWAY A.S

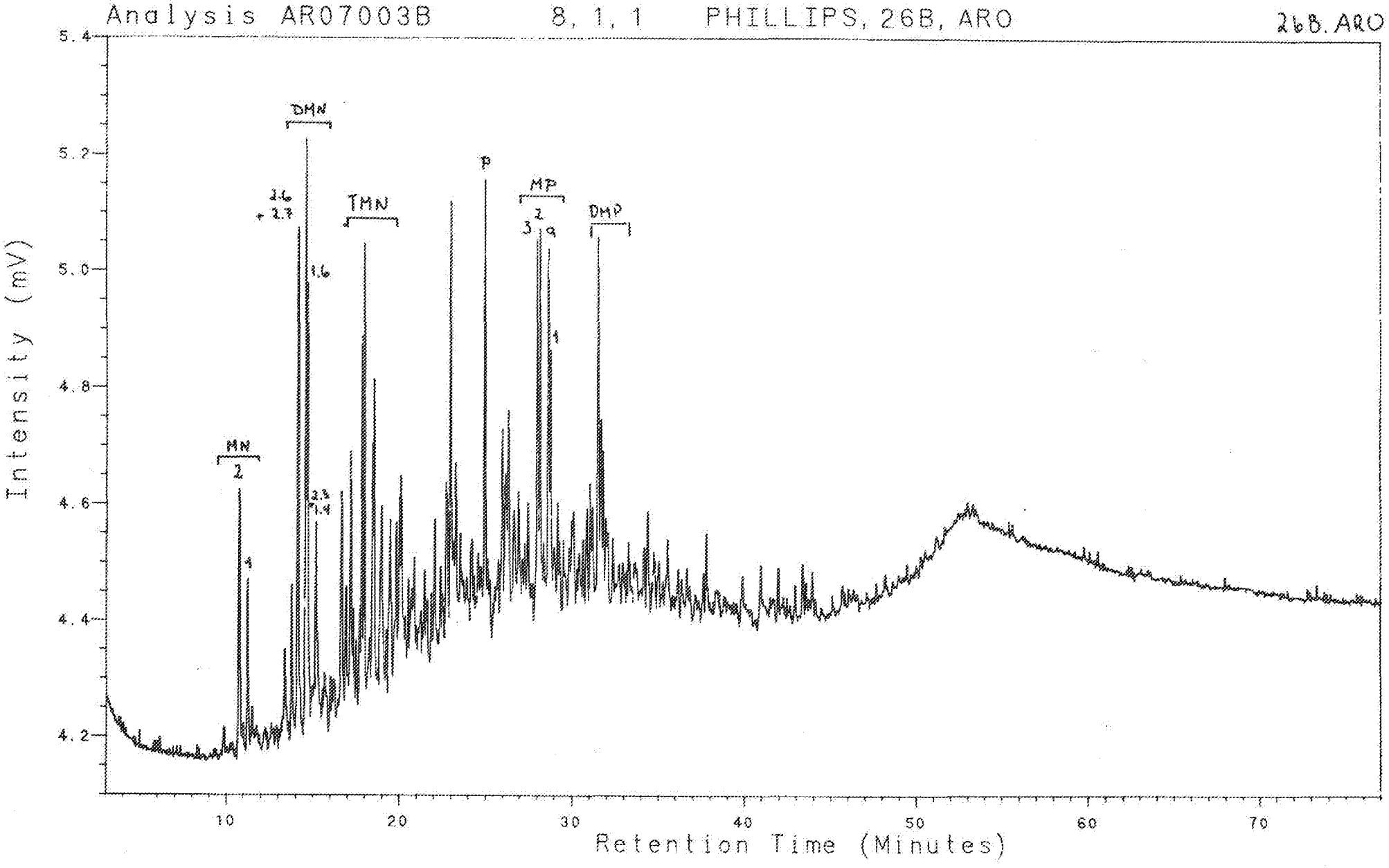
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

AROMATIC FRACTION CHROMATOGRAMS

OF SAMPLE 25A AND 26B (FID)



GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

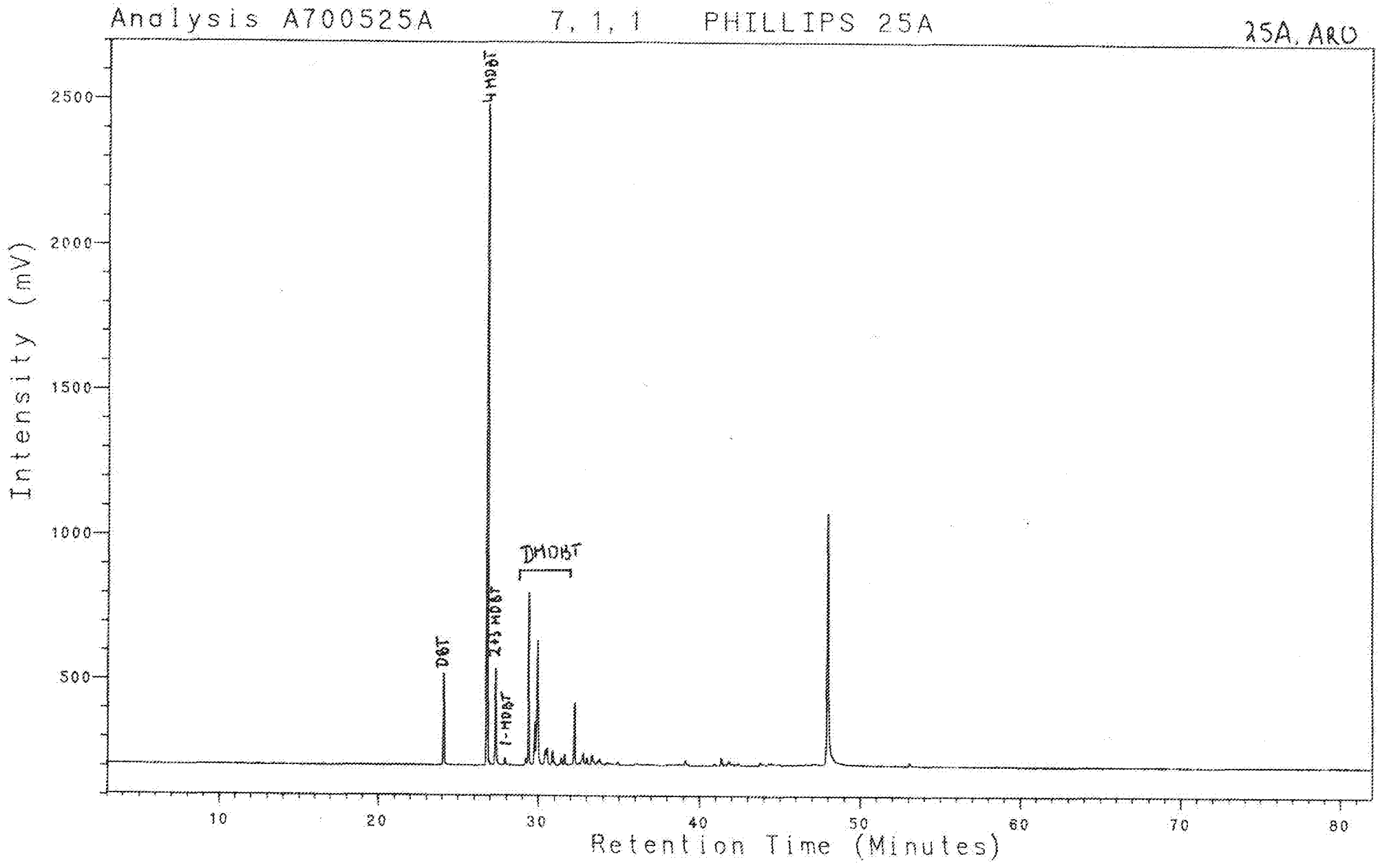


GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

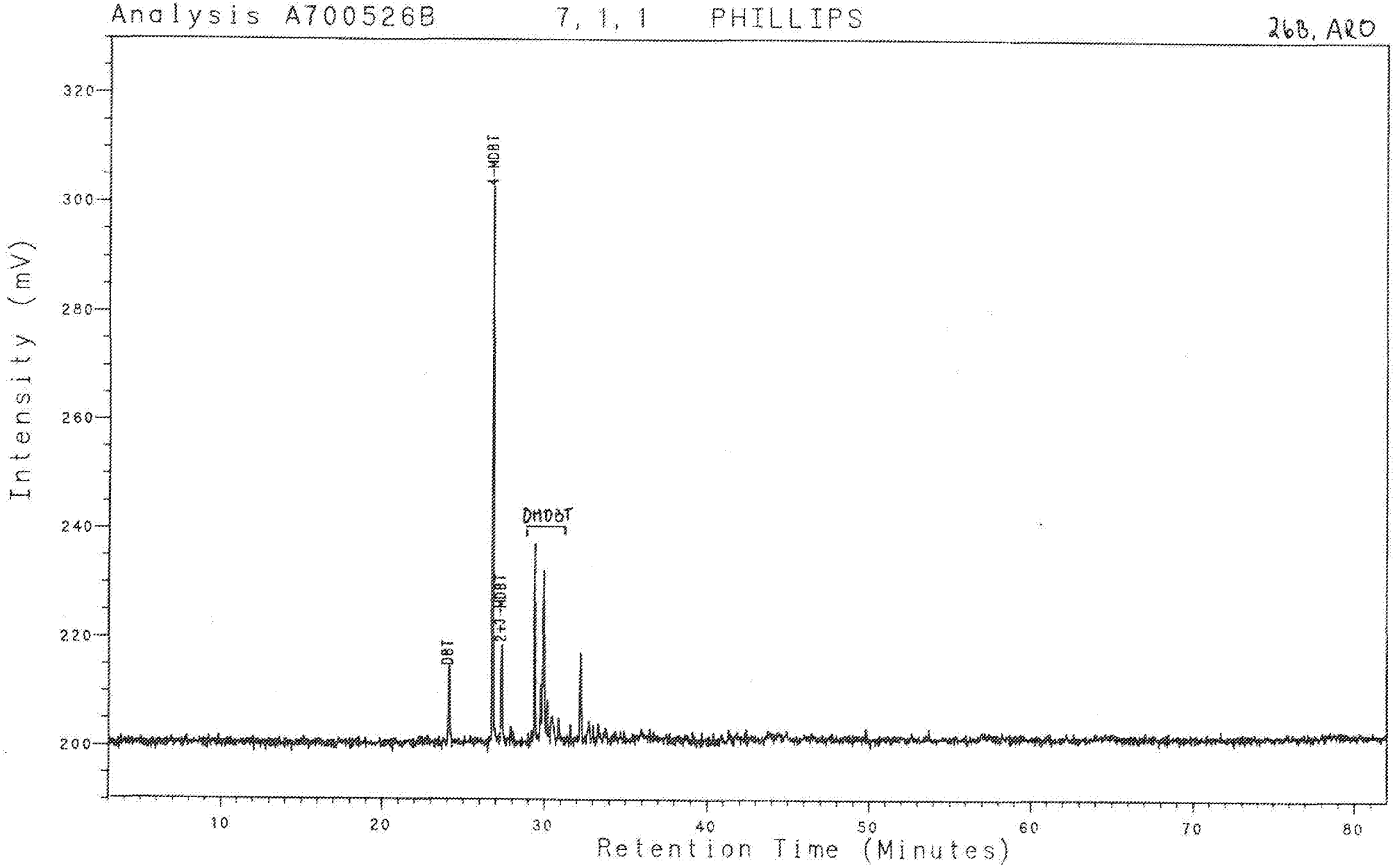
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

AROMATIC FRACTION CHROMATOGRAMS

OF SAMPLE 25A AND 26B (FPD)



GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S


Analysis A700526B 7, 1, 1 PHILLIPS
26B, ARO
Intensity (mV)
320
300
280
260
240
220
200
4-MDBT
DMDBT
DBT
10
20
30
40
50
60
70
80
Retention Time (Minutes)

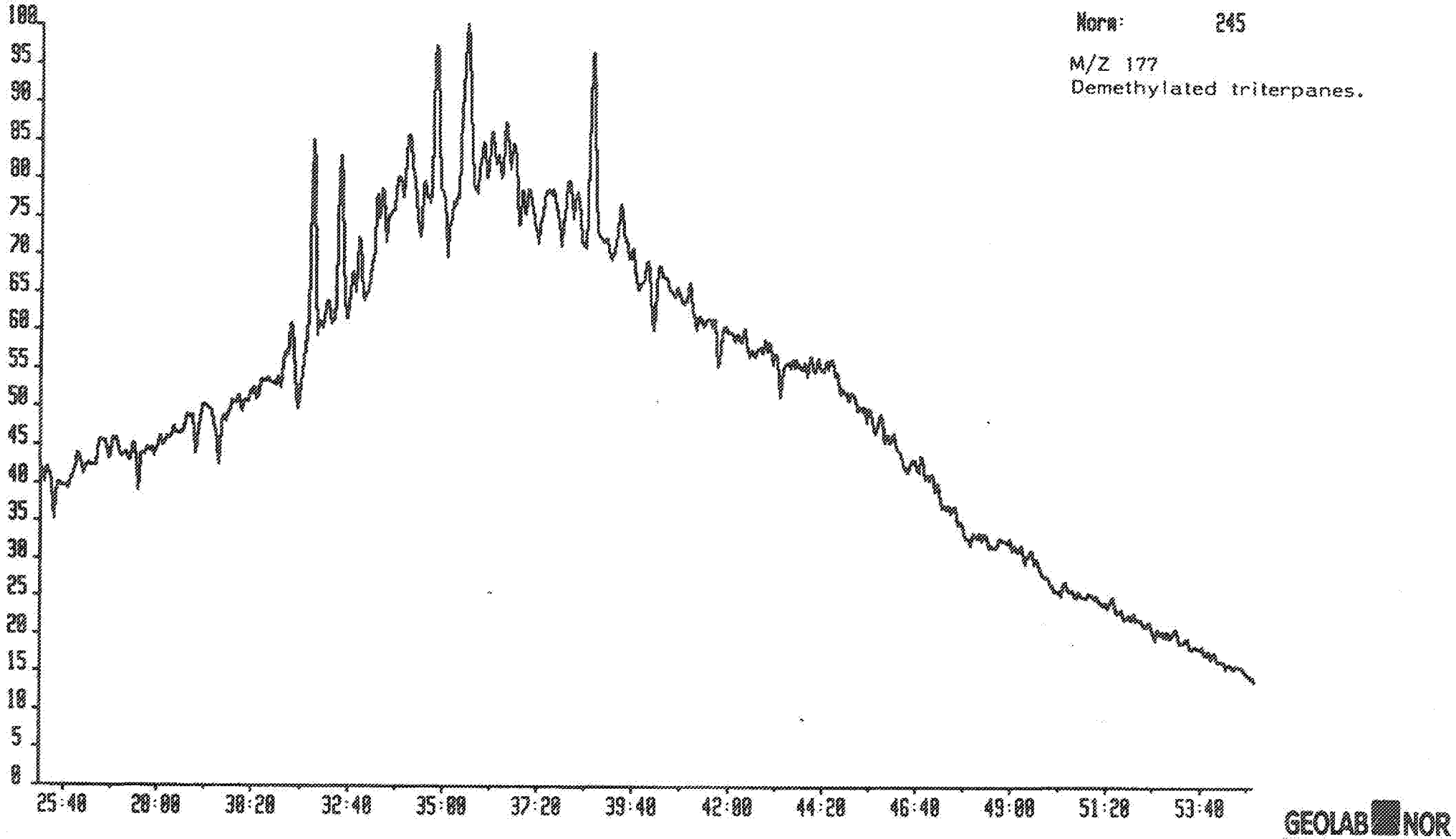
GEOLAB NOR

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

GC - MS FRAGMENTOGRAMS

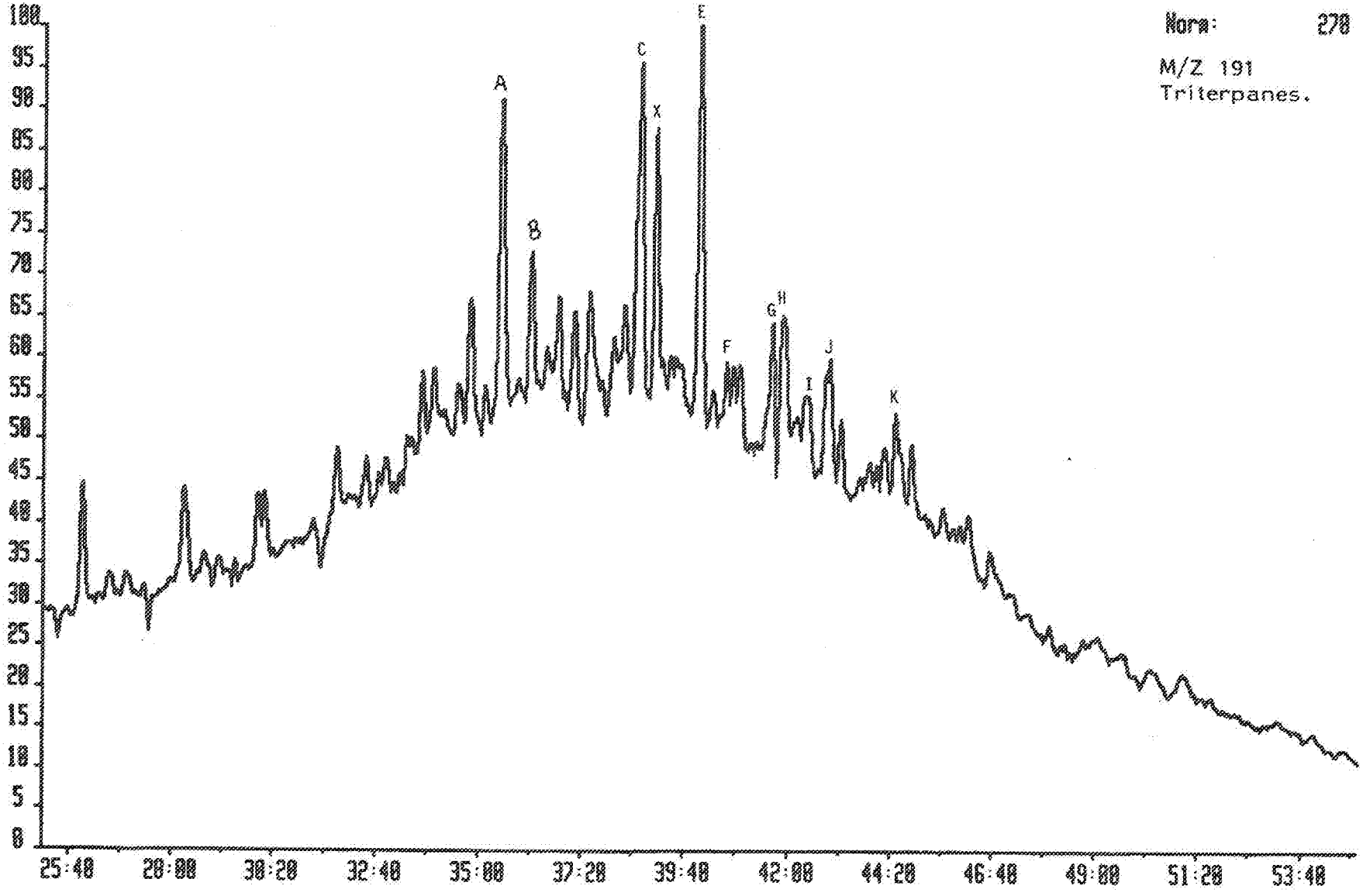
OF SAMPLE 26B

PHILIPSGR 18-JAN-88 Sir:Magnetic TS250 Acnt:GEOLAB System:ARCOSAT
Sample 1 Injection 1 Group 1 Mass 177.1642
Text:SAMPLE 268, SATURATED FRACTION FROM OIL



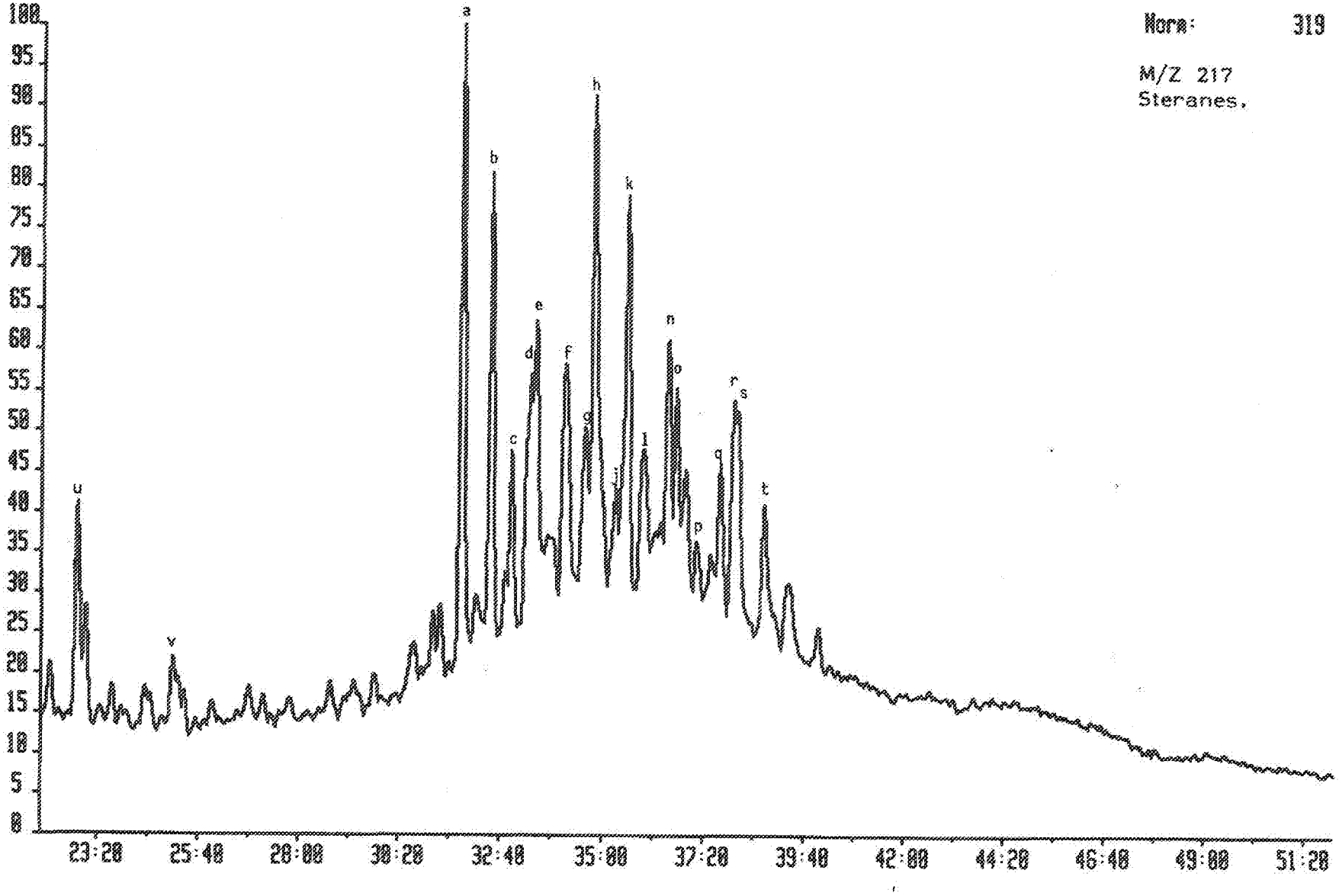
GEOLAB NOR
GEOCHEMICAL LABORATORIES NORWAY A/S

PHILIPS6A 10-JAN-88 Sir:Magnetic TS250 Acnt:GEOLAB System:ARCOSAT
Sample 1 Injection 1 Group 1 Mass 191.1000
Text:SAMPLE 268, SATURATED FRACTION FROM OIL



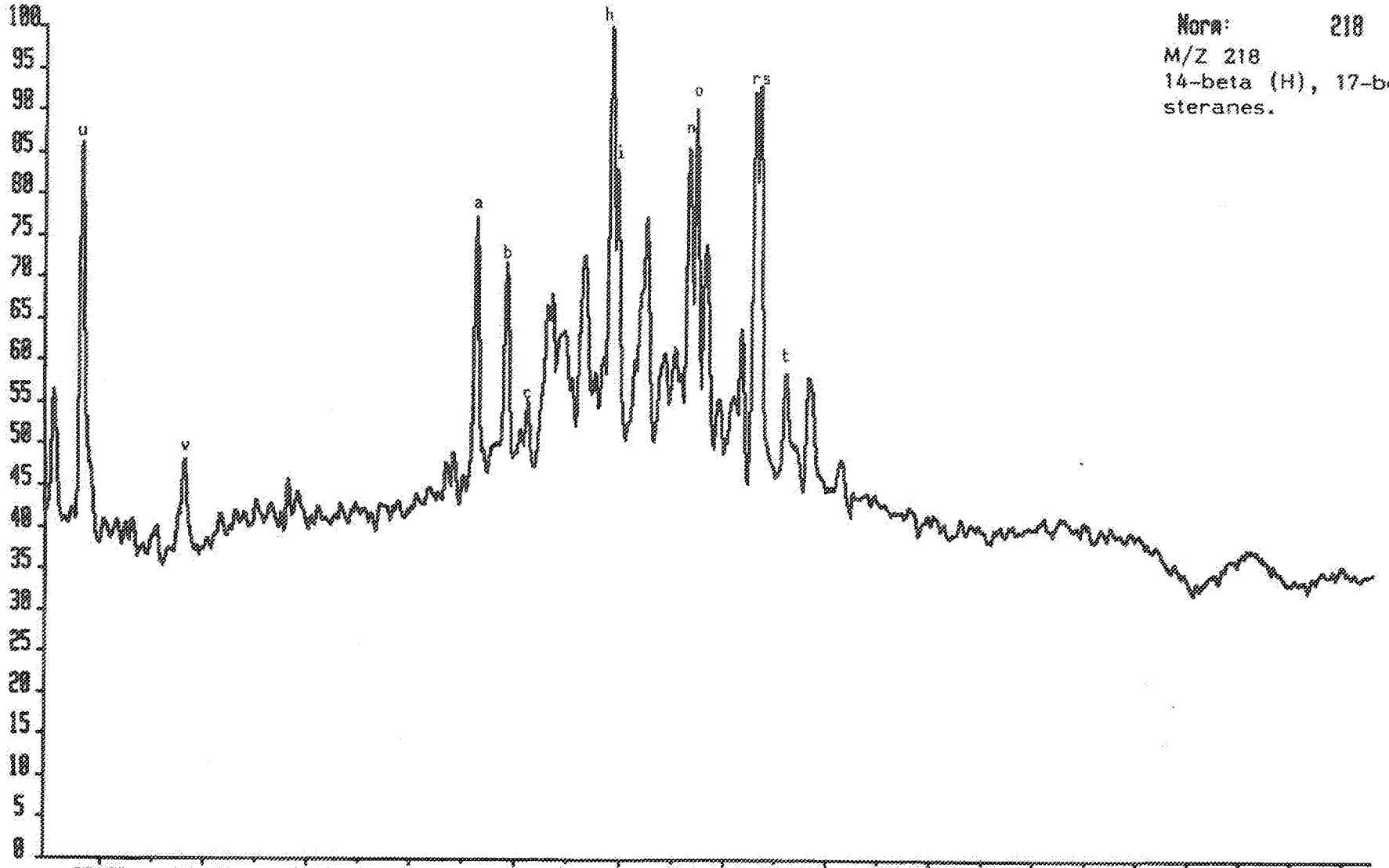
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY AS

PHILIPS6R 10-JAN-88 Slr:Magnetic TS250 Acnt:GEOLAB System:ARCOSAT
Sample 1 Injection 1 Group 1 Mass 217.1956
Text:SAMPLE 268, SATURATED FRACTION FROM OIL



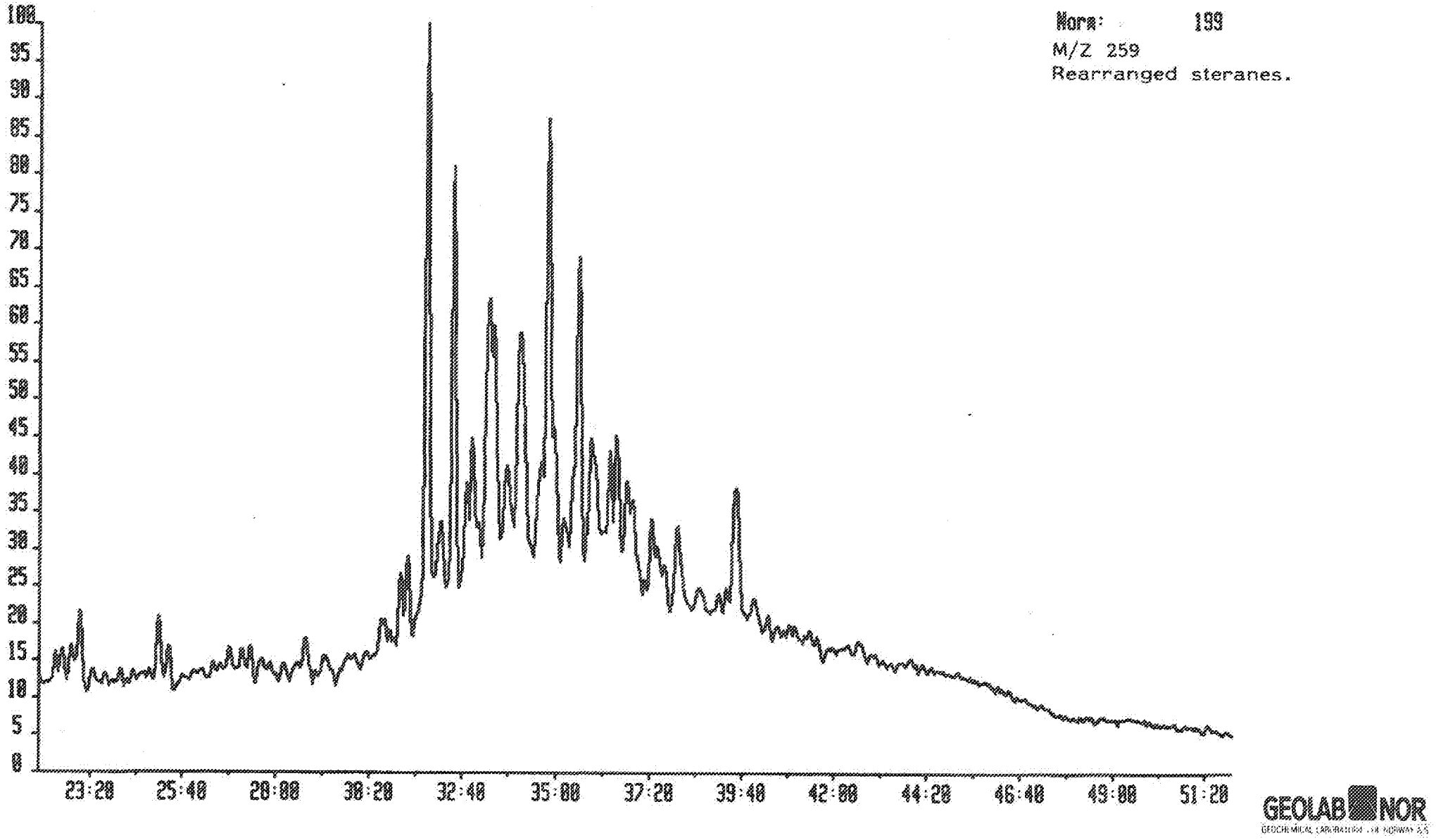
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

PHILIPSGA 10-JAN-88 Sir:Magnetic TS250 Acnt:GEOLAB System:ARCOSAT
Sample 1 Injection 1 Group 1 Mass 218.2034
Text:SAMPLE 268, SATURATED FRACTION FROM OIL



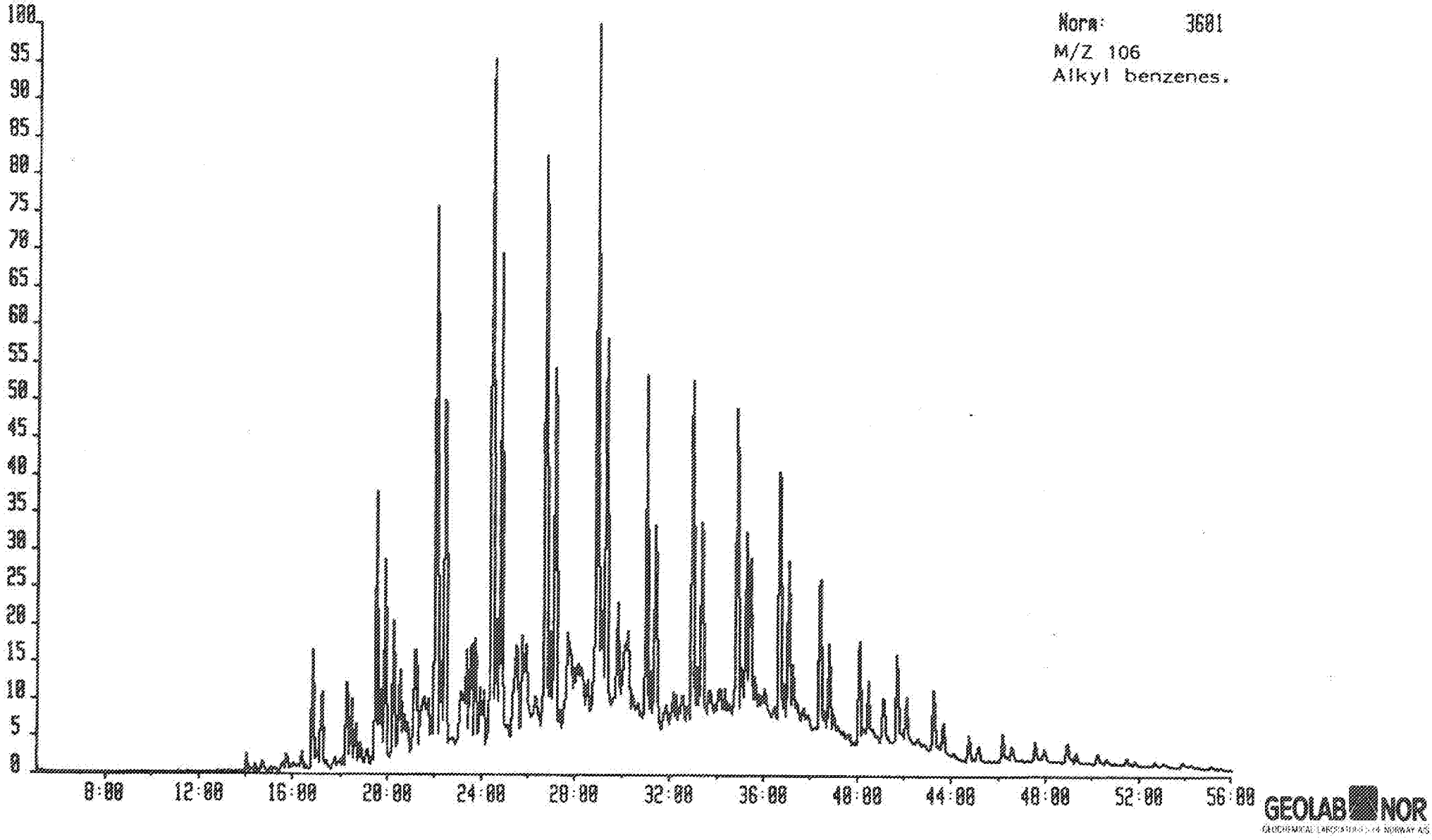
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

PHILIPS66 10-JAN-88 Sir:Magnetic TS250 Acnt:GEOLAB System:ARCOSAT
Sample 1 Injection 1 Group 1 Mass 259.2427
Text:SAMPLE 268, SATURATED FRACTION FROM OIL



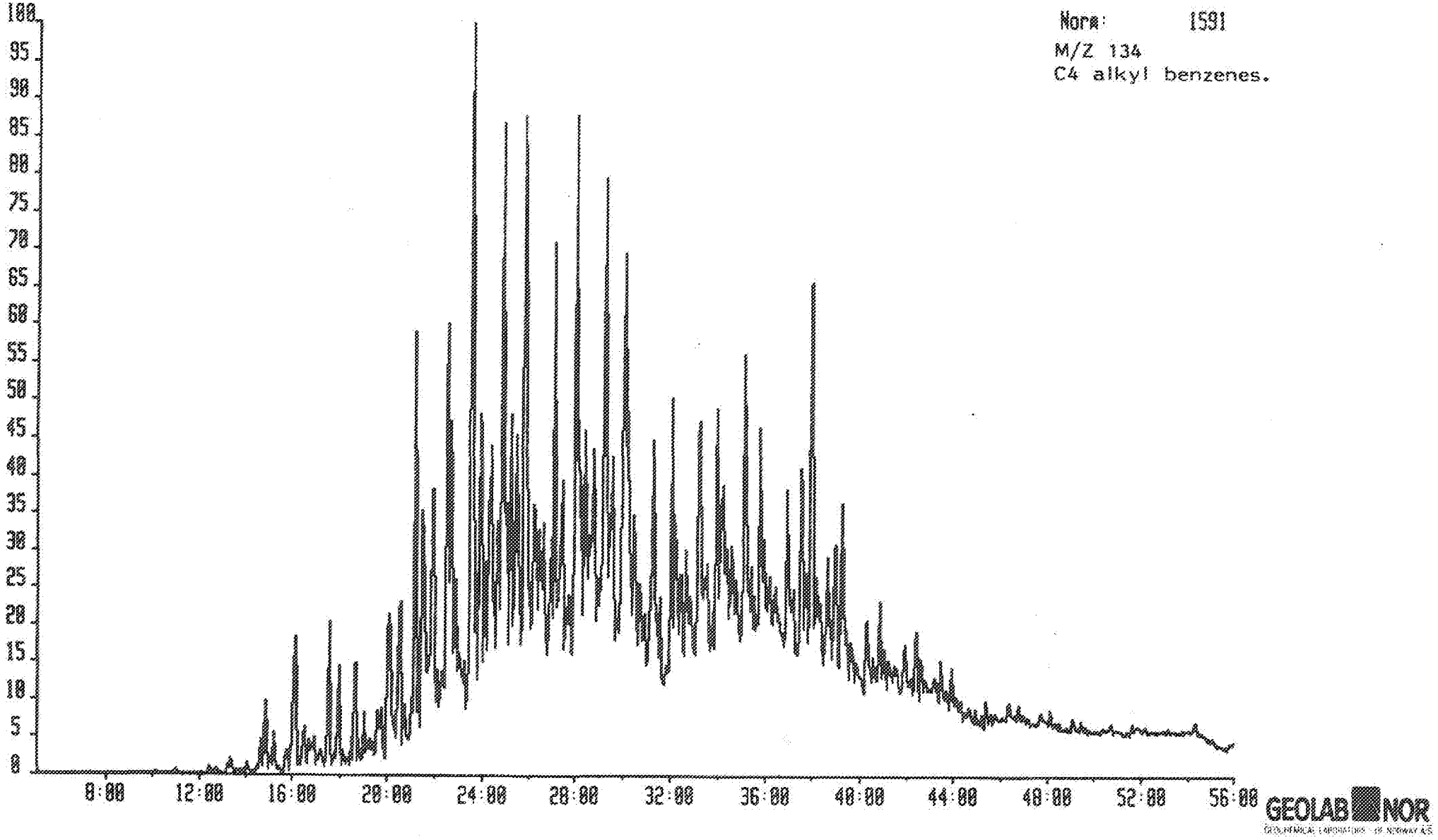
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

PHILLIPS3 8-JAN-88 Sir:Magnetic TS250 Acnt:GEOLAB System:AR01
Sample 1 Injection 1 Group 1 Mass 186.0783
Text:SAMPLE 268, AROMATIC FRACTION FROM OIL



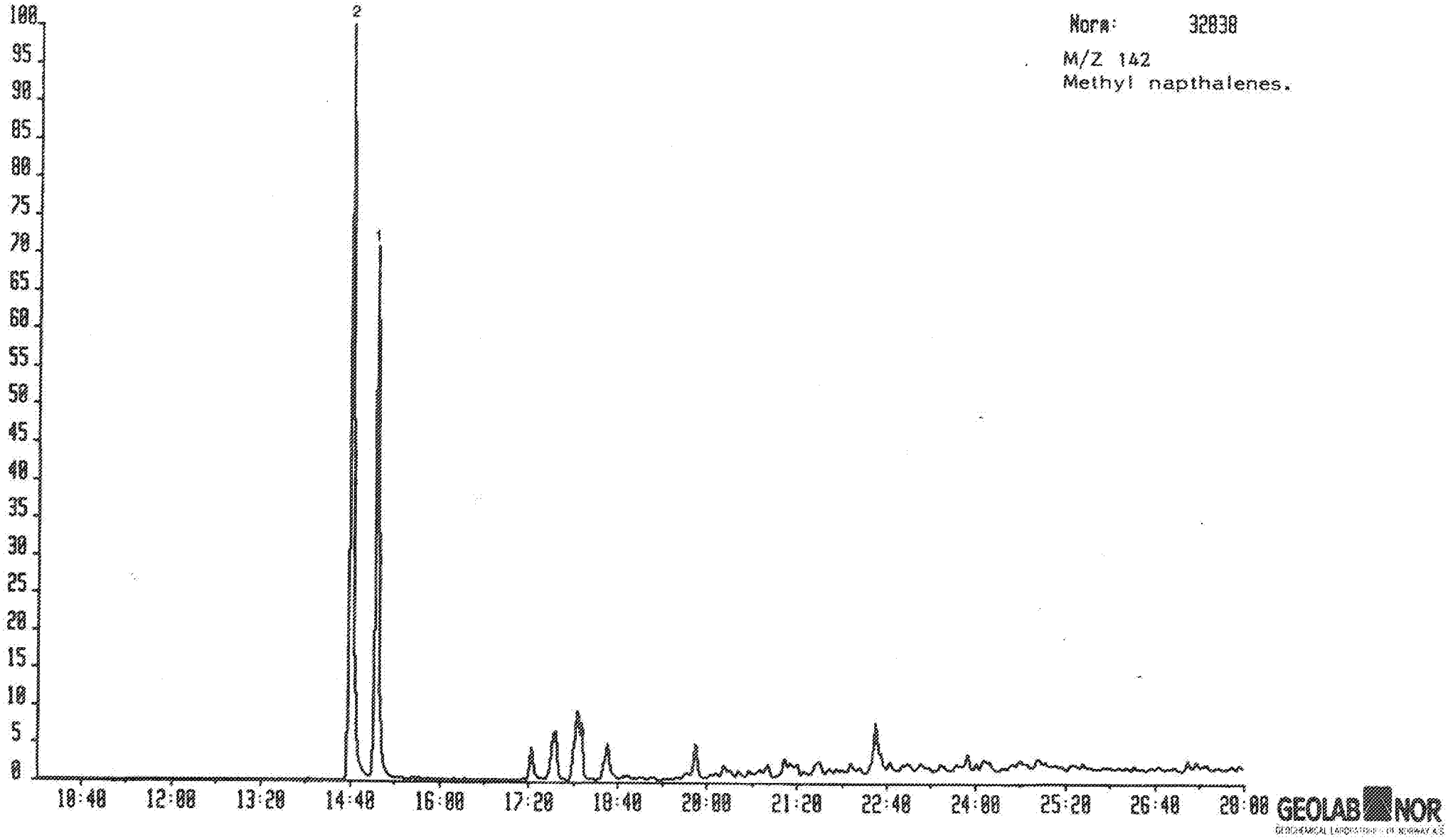
GEOLAB NOR

PHILLIPS3 8-JAN-88 Sir:Magnetic TS250 Acnt:GEOLAB System:ARO1
Sample 1 Injection 1 Group 1 Mass 134.1096
Text:SAMPLE 26B, AROMATIC FRACTION FROM OIL



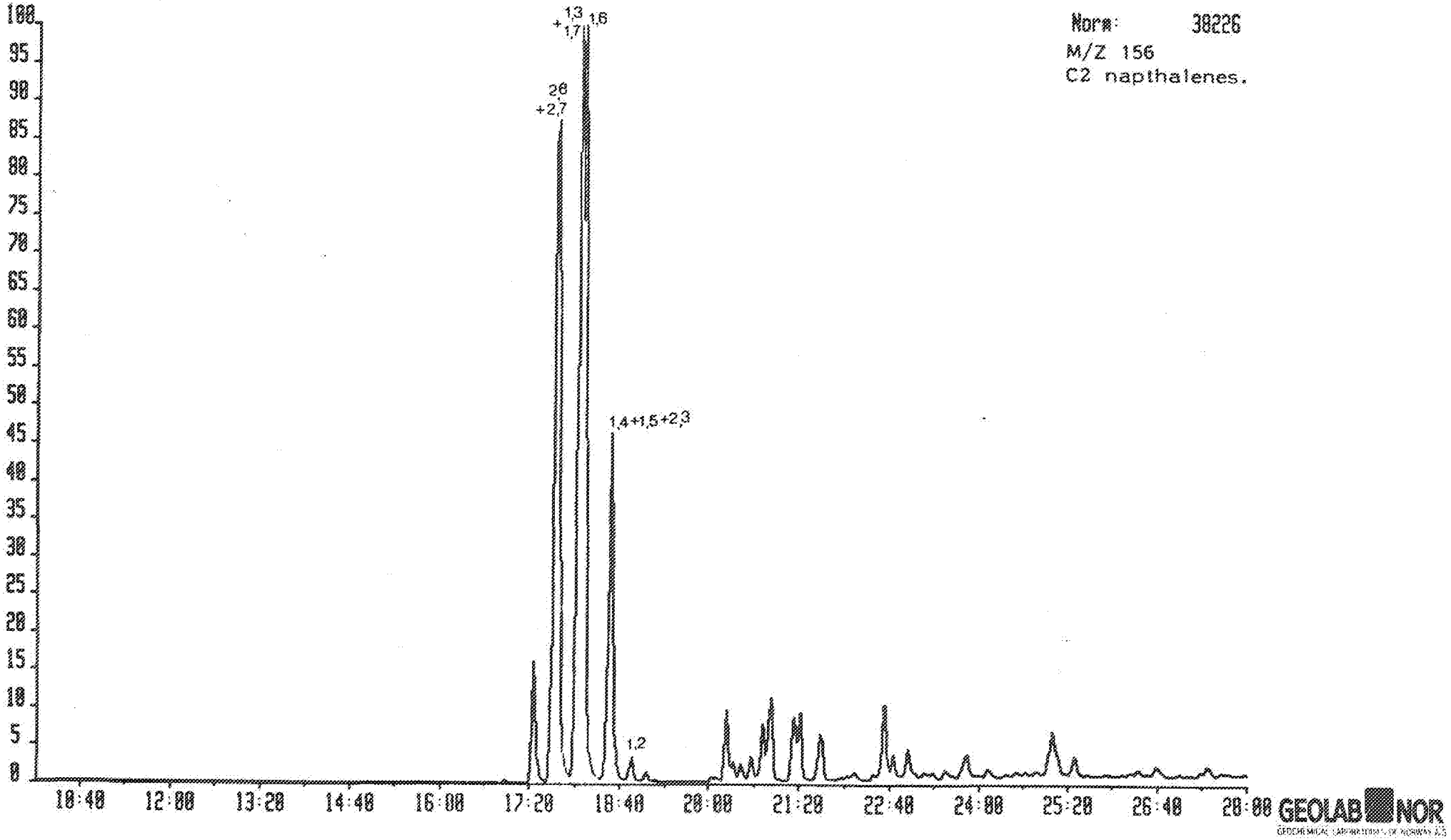
GEOLAB NOR
GEOCHEMICAL LABORATORIES - A NORWAY A/S

PHILLIPS3 8-JAN-88 Sir:Magnetic TS250 Acnt:GEOLAB System:AR01
Sample 1 Injection 1 Group 1 Mass 142.0783
Text:SAMPLE 268, AROMATIC FRACTION FROM OIL



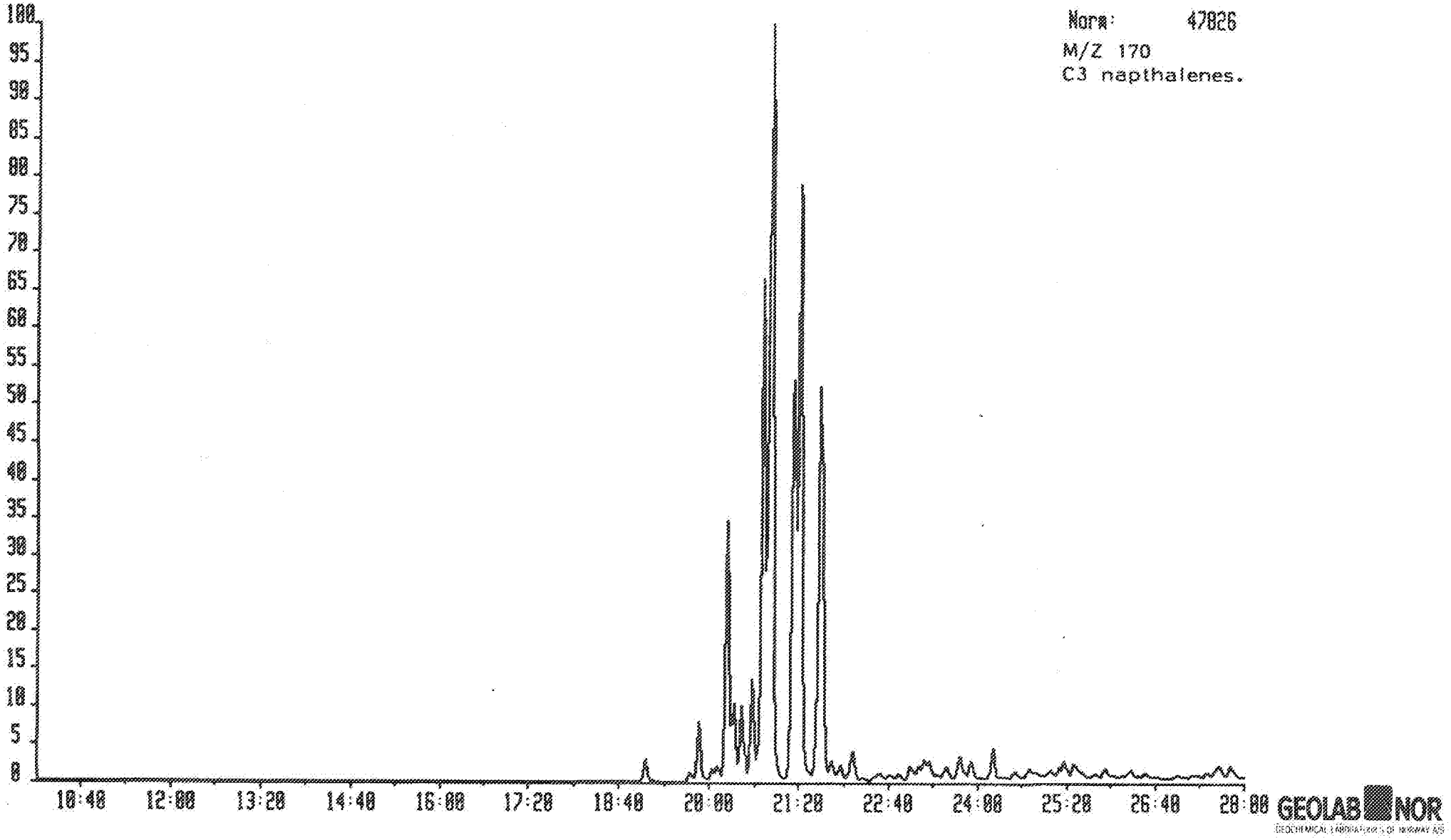
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

PHILLIPS3 8-JAN-88 Str:Magnetic TS250 Acnt:GEOLAB System:ARO1
Sample 1 Injection 1 Group 1 Mass 156.0939
Text:SAMPLE 26B, AROMATIC FRACTION FROM OIL



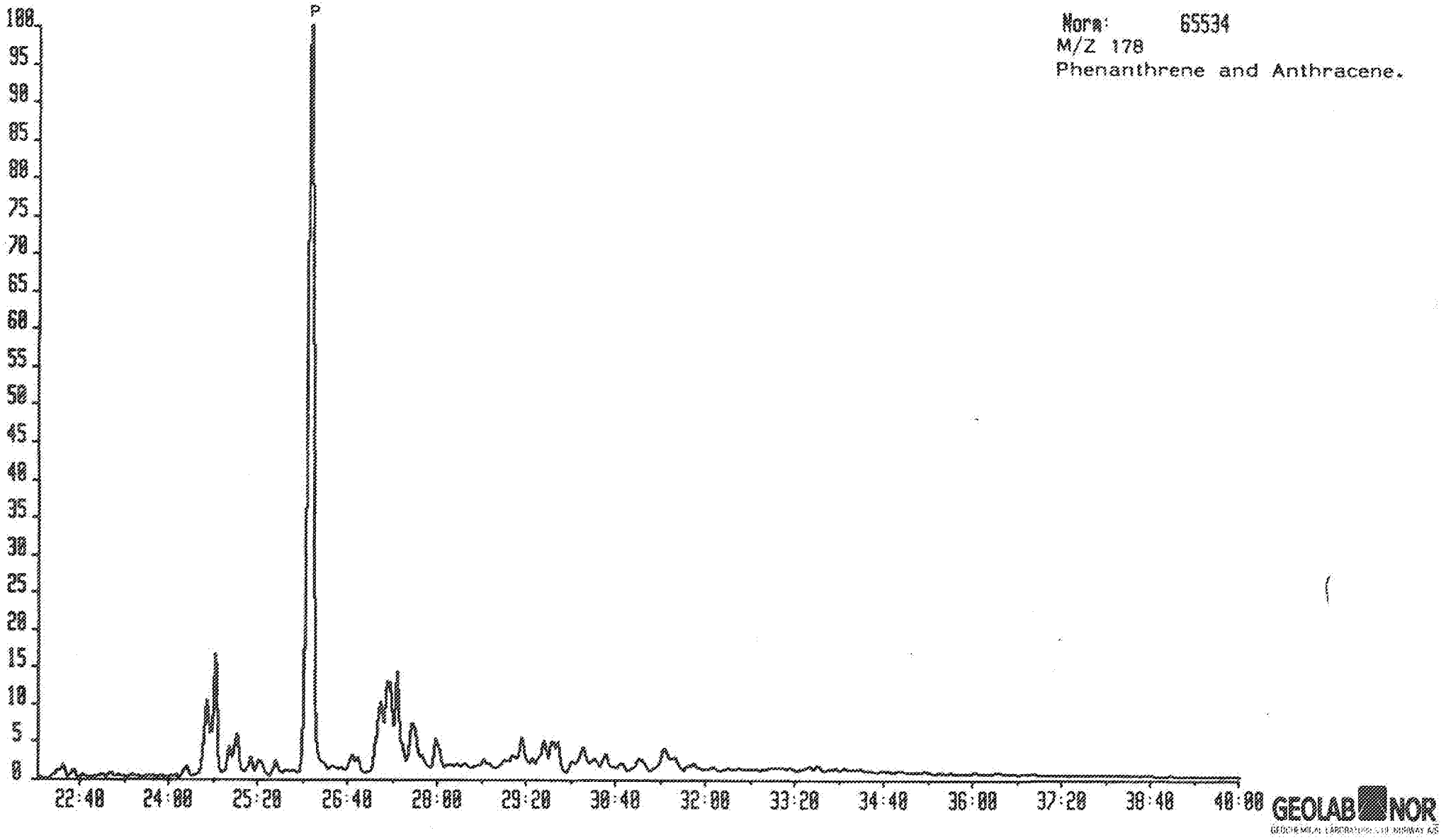
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

PHILLIPS3 8-JAN-88 Sir:Magnetic TS250 Acnt:GEOLAB System:AR01
Sample 1 Injection 1 Group 1 Mass 170.1096
Text:SAMPLE 26B, AROMATIC FRACTION FROM OIL



GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

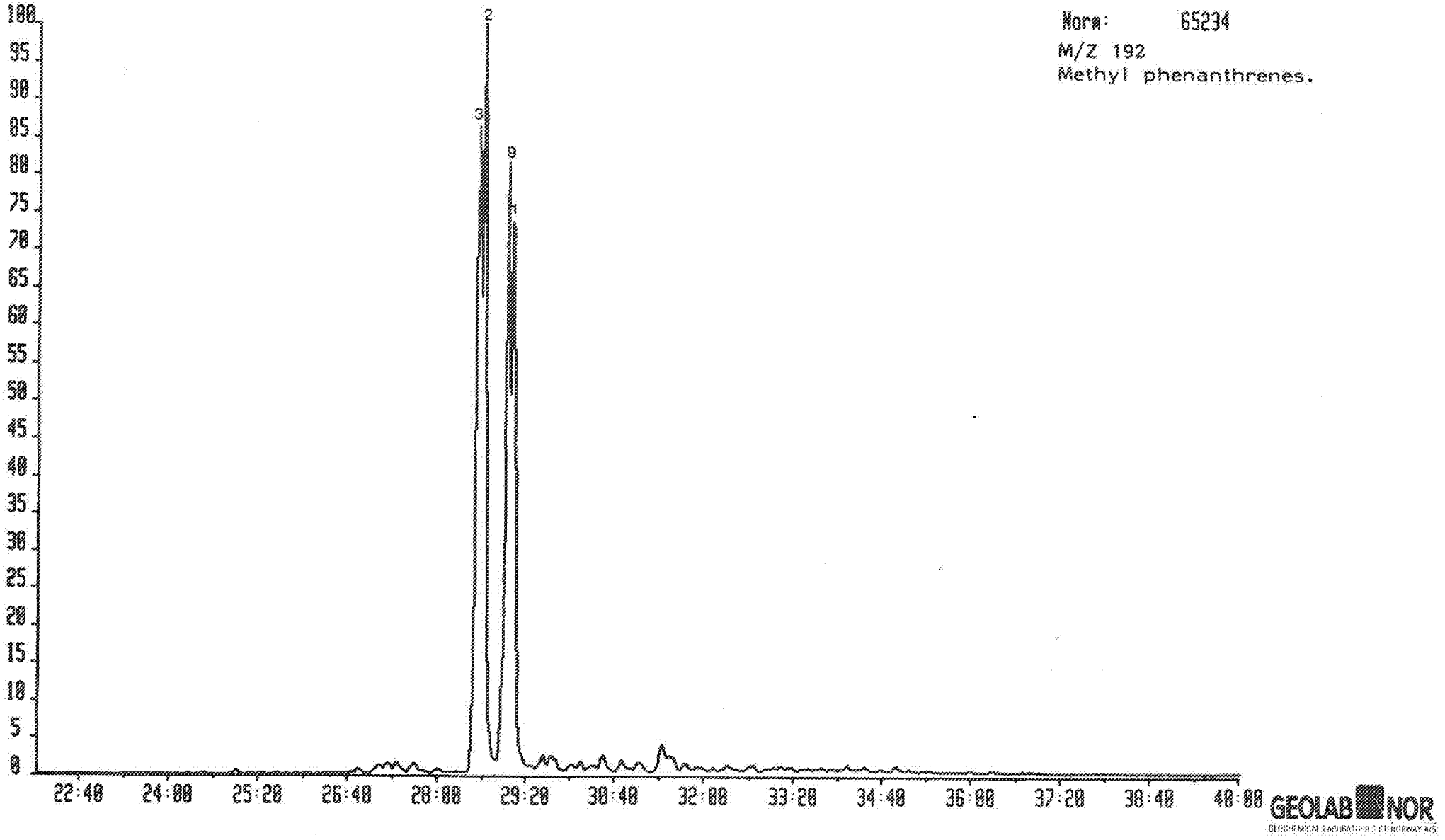
PHILLIPS3 8-JAN-88 Sir:Magnetic TS250 Acnt:GEOLAB System:ARO1
Sample 1 Injection 1 Group 1 Mass 178.0783
Text:SAMPLE 26B, AROMATIC FRACTION FROM OIL



Norm: 65534
M/Z 178
Phenanthrene and Anthracene.

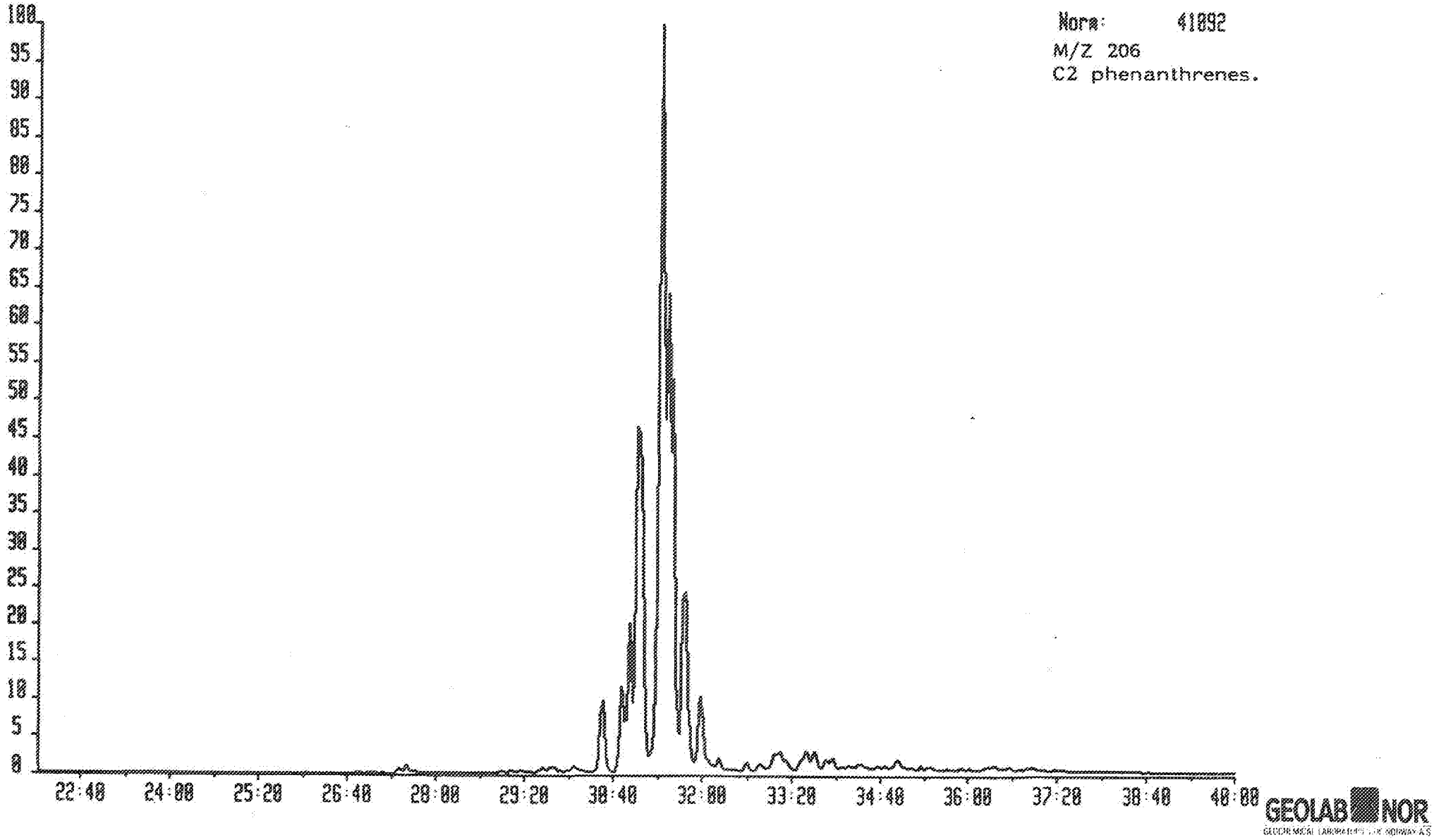
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

PHILLIPS3 8-JAN-88 Sir:Magnetic TS250 Acnt:GEOLAB Systen:AR01
Sample 1 Injection 1 Group 1 Mass 192.0939
Text:SAMPLE 268, AROMATIC FRACTION FROM OIL



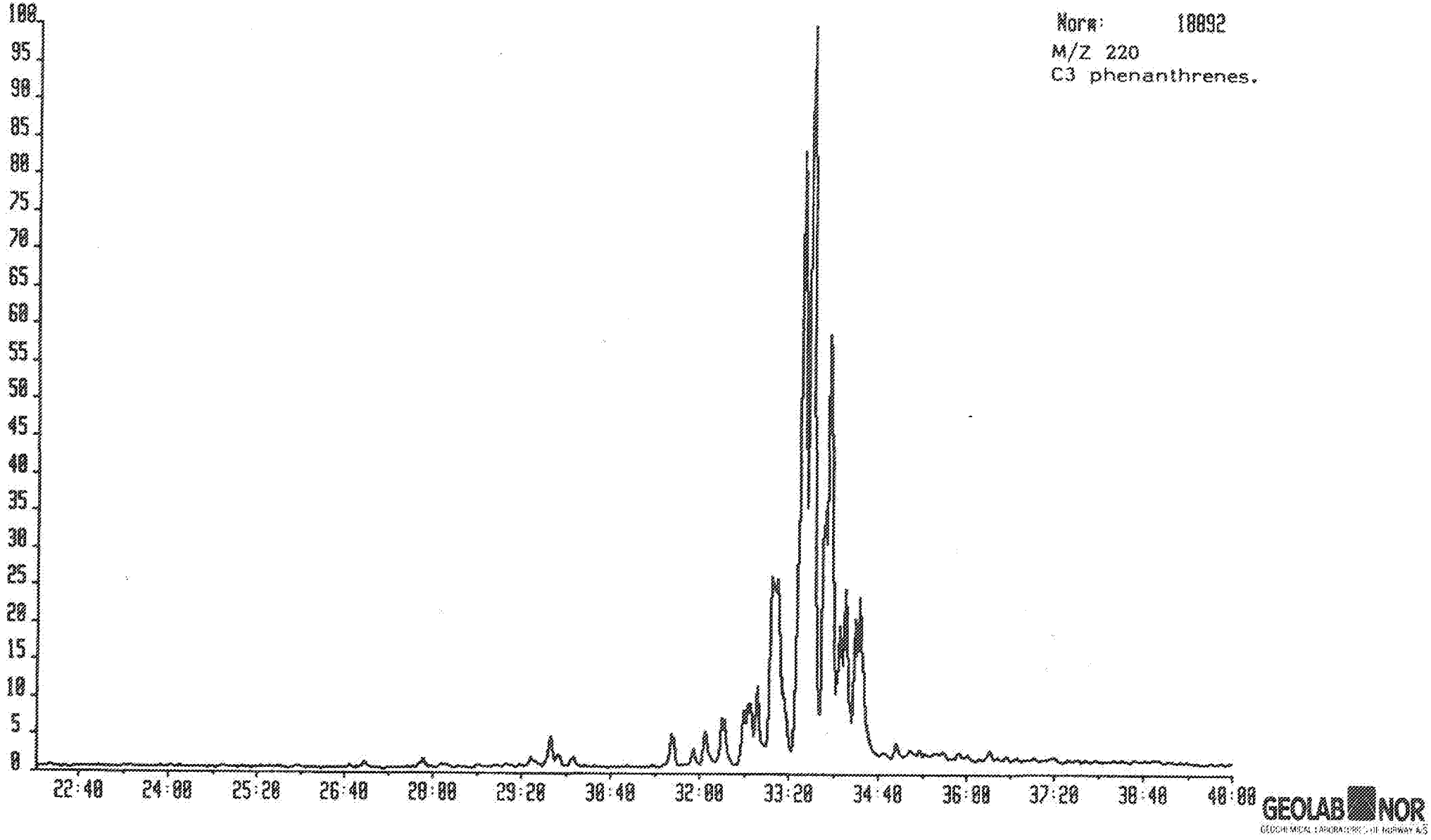
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

PHILLIPS3 8-JAN-88 Str:Magnetic TS250 Acnt:GEOLAB System:ARO1
Sample 1 Injection 1 Group 1 Mass 206.1096
Text:SAMPLE 268, AROMATIC FRACTION FROM OIL



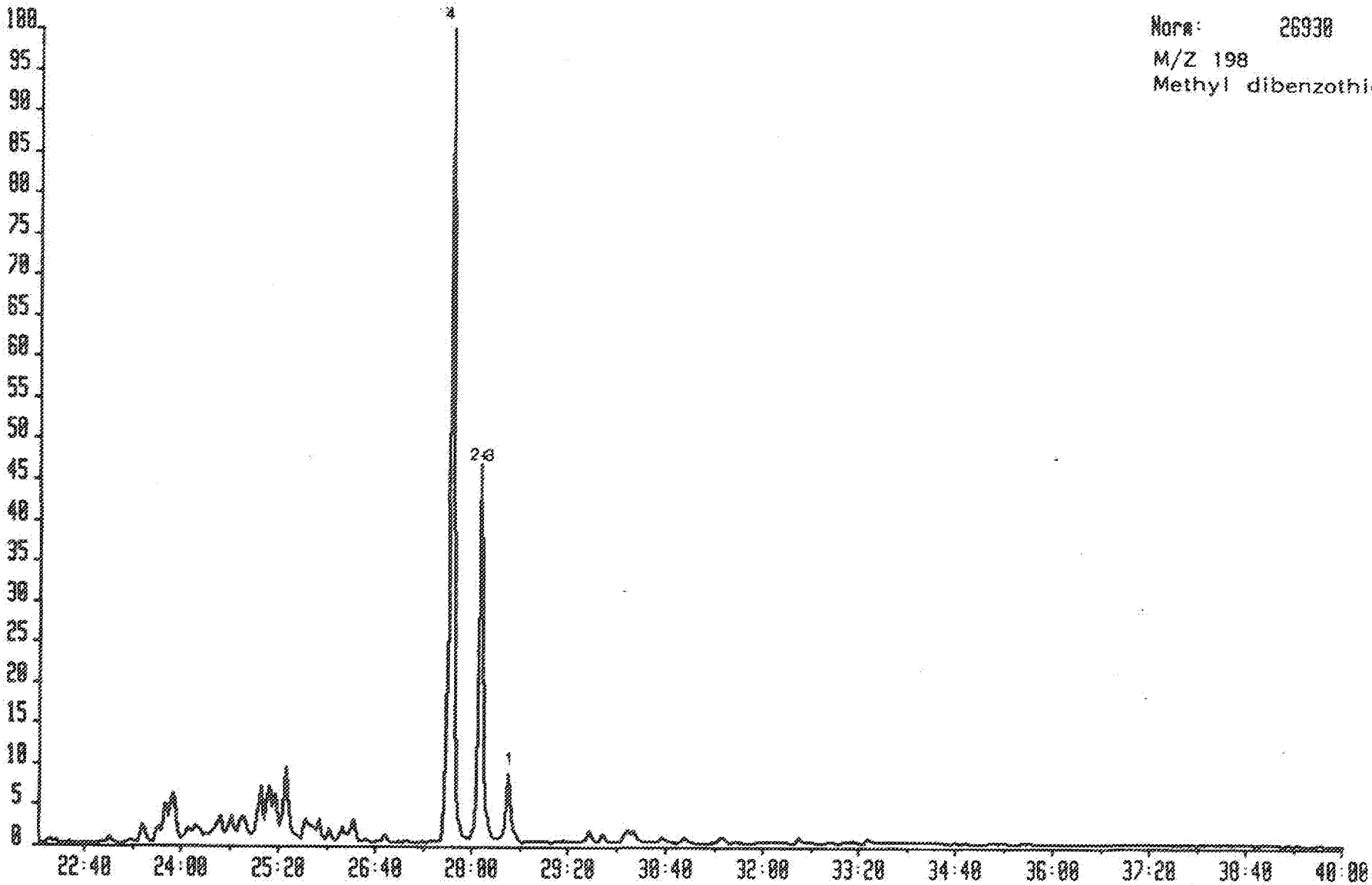
GEOLAB NOR

PHILLIPS3 8-JAN-88 Str:Magnetic TS250 Acnt:GEOLAB System:AR01
Sample 1 Injection 1 Group 1 Mass 220.1253
Text:SAMPLE 268, AROMATIC FRACTION FROM OIL



GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

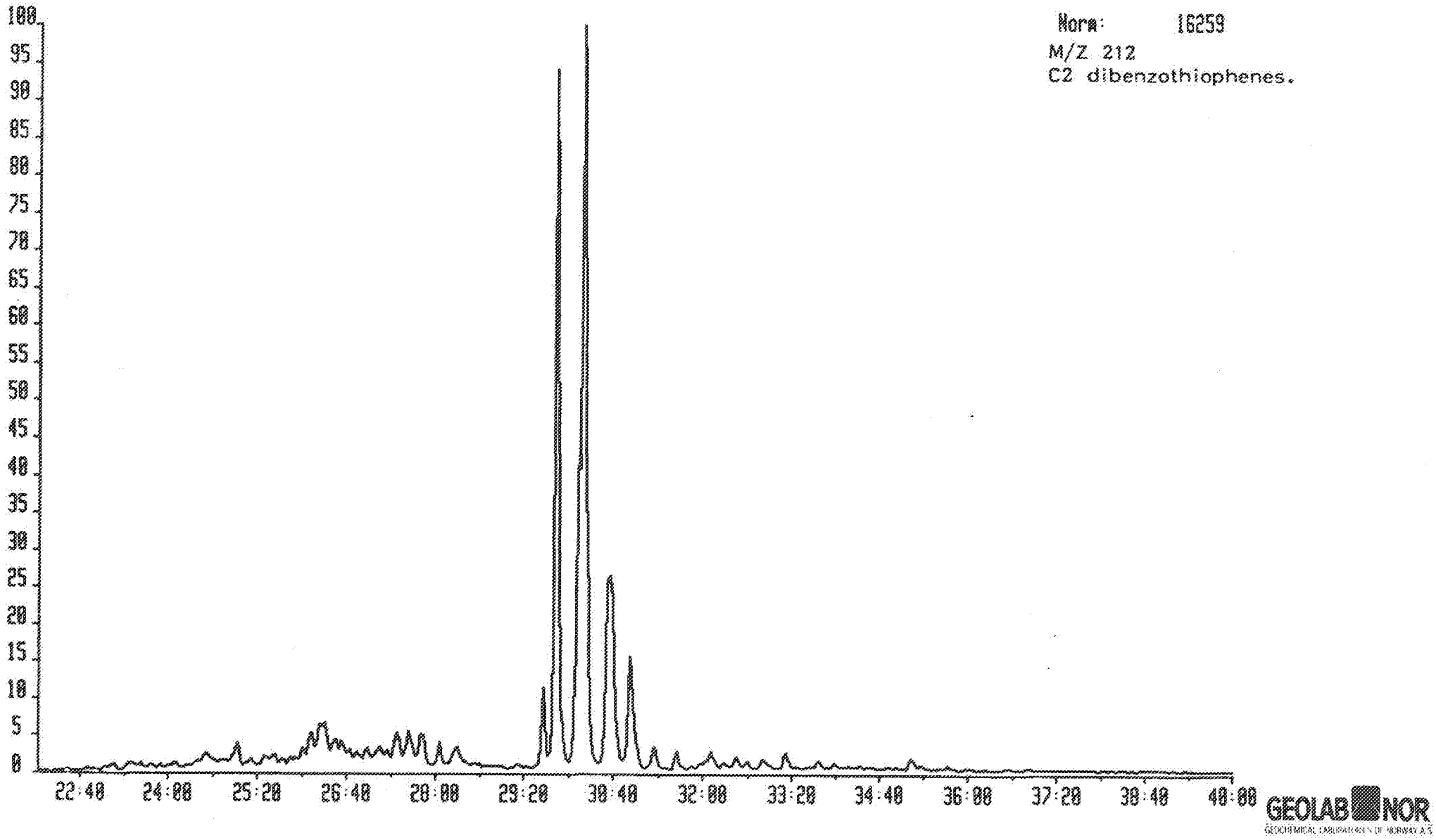
PHILLIPS3 8-JAN-88 Str:Magnetic TS250 Acnt:GEOLAB System:ARO1
Sample 1 Injection 1 Group 1 Mass 198.0503
Text:SAMPLE 268, AROMATIC FRACTION FROM OIL



Nora: 26938
M/Z 198
Methyl dibenzothiophenes.

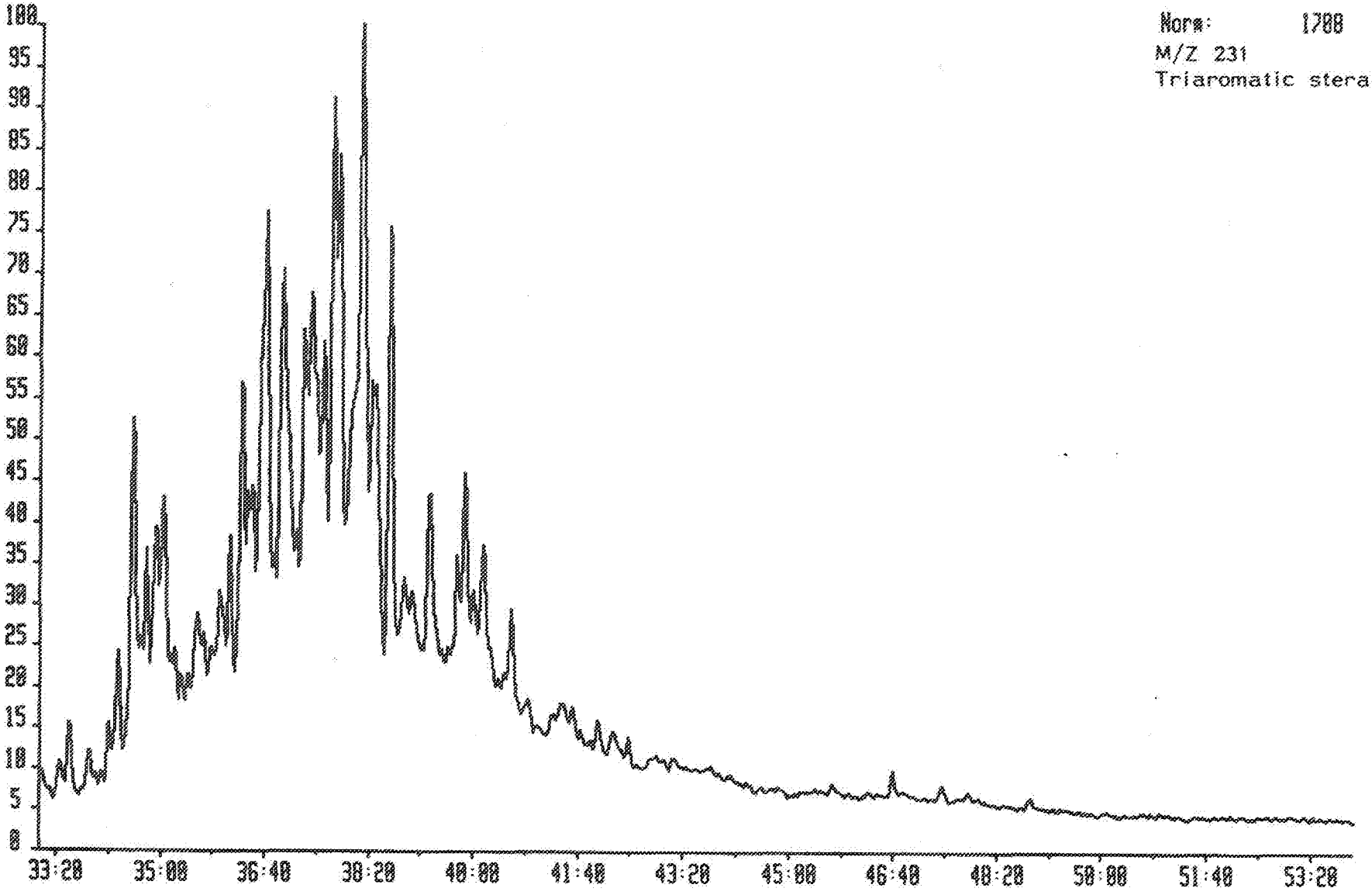
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A.S

PHILLIPS3 8-JAN-88 Str:Magnetic TS250 Acnt:GEOLAB System:ARO1
Sample 1 Injection 1 Group 1 Mass 212.0660
Text:SAMPLE 260, AROMATIC FRACTION FROM OIL



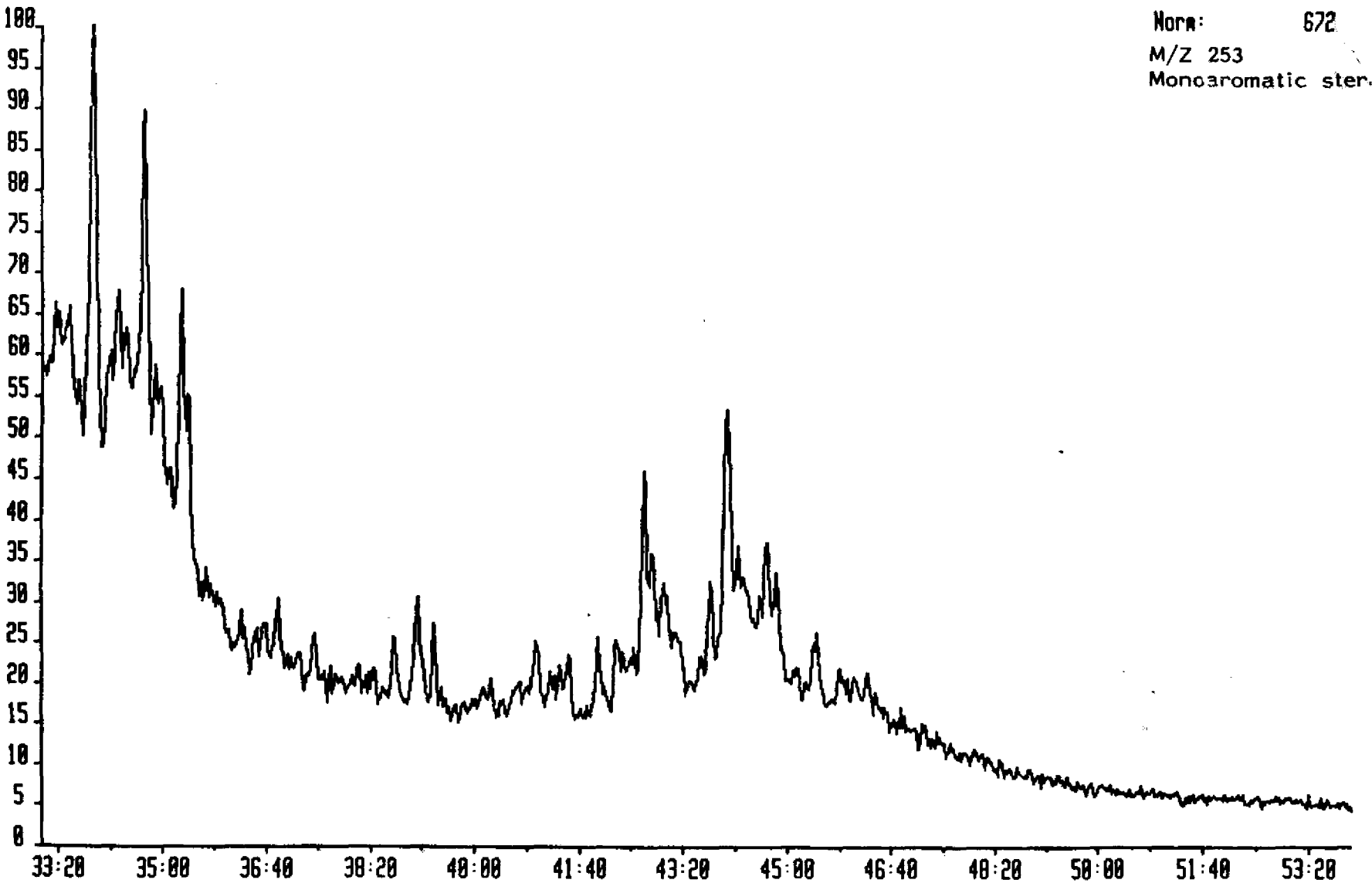
GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

PHILLIPS3 8-JAN-88 Str:Magnetic TS250 Acnt:GEOLAB System:ARO1
Sample 1 Injection 1 Group 1 Mass 231.1174
Text:SAMPLE 268, AROMATIC FRACTION FROM OIL



GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S

PHILLIPS3 8-JAN-88 Sir:Magnetic TS250 Acnt:GEOLAB System:ARO1
Sample 1 Injection 1 Group 1 Mass 253.1956
Text:SAMPLE 268, AROMATIC FRACTION FROM OIL



Norm: 672
M/Z 253
Monoaromatic ster.

GEOLAB NOR
GEOCHEMICAL LABORATORIES OF NORWAY A/S