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Title
The use of organic geochemical methods to define the lower oil contact in the Tomma I/II fm. reservoir, well 6406/3-2 (Alpha)

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Key words Geochemistry, migrated hydrocarbons, oil contact, Tomma formation.

Abstract Geochemical methods were used to establish the lower oil contact in the Tomma I/II fm. reservoir, well 6406/3-2, Haltenbanken. Rock-eval screening of 18 core samples were performed which also formed the basis for the selction of a limited number of samples around the Tomma II fm. top for further analysis. The oil contact was found at approximately 4030 m RKB, 13 meters below the top Tomma II fm. The well logs which are in very good accordance with the geochemical results indicate that it is not an oil water contact but the lithological boundary between the reservoir sand and the more fine grained, silty, cemented materials below.
The oil-bearing reservoir has a thichness of 100 m. The present study has shown that geochemical methods are valuable tools to define oil contact/reservoir thichness in detail.

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4/3-87
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C O N T E N T S

THE USE OF ORGANIC GEOCHEMICAL METHODS TO DEFINE THE LOWER OIL CONTACT IN THE TOMMA I/TOMMA II FM., WELL 6406/3-2.

1 Introduction

The present study was undertaken to see if the use of geochemical methods could establish the lower oil contact in Tomma I/Tomma II formation in well 6406/3-2.

A further aim was to test if such analyses are of general value in the search for hydrocarbon contacts/reservoir thicknesses in detail.

All the present work was performed in the Geochemistry section, Statoil geological laboratory, in accordance with Statoils analytical requirements for organic geochemistry and reporting.

The structure (alpha) and the position of the well are shown in figure 1.


6°40'
65°00'
7°00'
65°00'
λ
α
6406/3-2
64°45'
6°40'
7°00'
64°45'
0
km
5
1 : 25 000
statoil
Block 6406/3
TOP MIDDLE JURASSIC
SST(Tomma FM)
Structural time map

Fig.1

2 Analytical results and discussion

A number of one DST sample and eighteen rock samples from the Tomma I and Tomma II formations from the well 6406/3-2 were chosen for this study. The core samples were from the interval 4010 - 4044 m RKB, to cover the lower part of Tomma I and the upper half of Tomma II. The results are shown in tables 1 and 2 and visualized in figure 2.

A constant shift of + 5.5 meters between the core depth and the log depths has been adjusted for (see the tables).

A gas chromatogram of the DST sample from the Tomma I reservoir was recorded for a qualitative comparsion with the C_{15+} fraction gas chromatograms of the core extracts. All gas chromatograms are enclosed in appendix I. The thermal extract gas chromatograms of the same core samples, recorded for a qualitative comparison with the liquid extract results, are enclosed in appendix II.

A rock-eval screening of the core samples was performed prior to the selection of a limited number of samples for further analytical procedures. These analyses, with the exception of the result from sample at 4027.6 m, show a fairly constant rock-eval S1 within the range of 1.9 - 0.9 mg HC/g rock from the sample range 4015.5 - 4029.7 m RKB (approx. log depth). A drop in the S1 value at 4027.6 metres is probably due to somewhat more cemented and fine grained material (this can also be seen from the logs). Approximately 2 metres deeper the lithology again exhibits a texture that is comparable with the section above 4027.6 metres. All the samples from 4032 m RKB (approx.) to the deepest sample studied, show permanently very low amounts of free hydrocarbons (S1), possibly due to a more fine grained and/or cemented lithology.

The production index (PI) shows a similar trend to the rock-eval S1 results, and the amounts of the total extractable organic matter (EOM) from the chosen core samples further support the mentioned trend.

TABLE 1

ROCK-EVAL DATA

STATOIL SAMPLE NUMBER	SAMPLE* DEPTH mKB	LOG DEPTH mKB	S1 (mg/g)	S2 (mg/g)	PRODUCTION INDEX	Tmax (%C)
S1997	4010.0	4015.5	1.69	0.17	0.91	411
S1998	4012.2	4017.7	1.89	0.25	0.88	399
S1999	4014.1	4019.6	1.72	0.25	0.88	394
S2000	4016.2	4021.7	1.47	0.27	0.84	395
S2001	4018.0	4023.5	0.87	0.43	0.67	375
S2002	4020.2	4025.7	1.53	0.38	0.81	390
S2003	4022.2	4027.7	0.04	0.23	0.15	453
S2004	4024.2	4029.7	1.50	0.54	0.74	397
S2005	4026.5	4032.0	0.00	0.11	0.00	357
S2006	4028.2	4033.7	0.01	0.14	0.07	364
S2007	4030.0	4035.5	0.04	0.26	0.13	457
S2008	4032.1	4037.6	0.05	0.24	0.18	442
S2009	4034.1	4039.6	0.17	0.78	0.18	451
S2010	4036.1	4041.6	0.11	0.49	0.18	453
S2011	4038.1	4043.6	0.09	0.45	0.17	449
S2012	4039.9	4045.4	0.20	0.91	0.18	448
S2013	4042.1	4047.6	0.03	0.13	0.19	456
S2014	4044.0	4049.5	0.04	0.22	0.15	440

* CORE SAMPLES

TABLE 2

EXTRACT AND CHROMATOGRAPHIC DATA

STATOIL SAMPLE NUMBER	SAMPLE* DEPTH mKB	LOG DEPTH mKB	EOM ppm OF ROCK	ASPHALTENES ppm OF ROCK	% OF ROCK	Pr / nC_{17}	Ph / nC_{18}	Pr / Ph
S1997	4010.0	4015.5	3068	324	10.6	0.87	0.77	1.28
S1998	4012.2	4017.7	3500	359	10.2	0.86	0.83	1.16
S1999	4014.1	4019.6	3300	322	9.6	0.85	0.78	1.33
S2000	4016.2	4021.7	1900	131	7.1	0.89	0.85	1.23
S2001	4018.0	4023.0	2200	126	5.6	0.88	0.87	1.13
S2002	4020.2	4025.7	2800	183	6.6	0.90	0.88	1.21
S2003	4022.2	4027.7	146	86	59.1	0.64	0.71	1.31
S2004	4024.2	4029.7	2800	125	4.5	0.92	0.87	1.21
S2005	4026.5	4032.0	109	42	38.8	0.60	0.93	0.98
S1994	DST-2	3937-3995						

* CORE SAMPLES

The geochemical results correlated against the core description and the gamma ray and resistivity logs, Tomma fm. well 6406/3-2.

Statoil

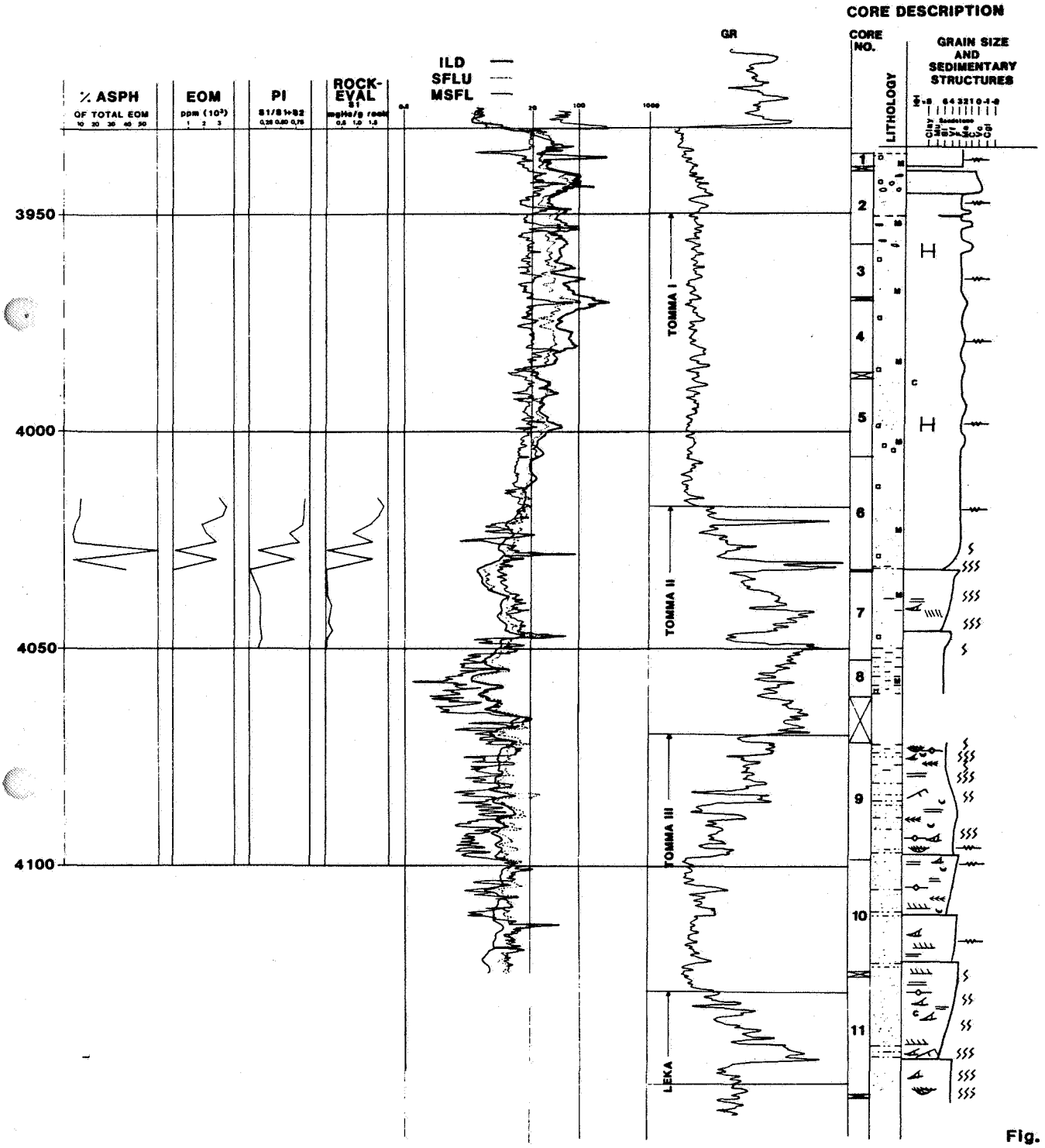


Fig. 2

The amounts of asphaltenes in the core extracts measured in percentage of the EOM, are relatively low in the zones where the presence of migrated and accumulated hydrocarbons has been established. Where the amount of hydrocarbons drops off, however, the relative amounts of asphaltenes in the core extracts increase to values up to as much as 59% of the total EOM .

In general, the thermal extract gas chromatograms are fairly similar to the liquid extract counterparts. The latter, however, appears to contain somewhat more of the heavier components as the chromatograms are indicating n-paraffins up to approximately n-C_{38}. The two core samples, from which the screening analyses gave low values for the free hydrocarbons (S1), show almost barren chromatograms with respect to both thermal and liquid extracted hydrocarbons.

Taking the gas chromatographic baseline into consideration, the upper part of the DST-2 gas chromatogram is not too different from the C_{15+} gas chromatograms of the liquid extracts from the core samples.

3 Conclusions

The present results indicate a lower oil contact within the Tomma II formation between 12 -14 metres below the established Tomma II formation top at 4017.5 m RKB. That means an oil leg to a depth of 4029.75 - 4032.0 m RKB (loggers depth). The contact is probably not an oil-water contact since comparison between the geochemical results and the well logs (fig. 2) indicate a lithological texture change from sand to more fine grained, silty, cemented material at approximately 4030 m RKB.

The plots of the core in question also show a transition from a more coarse grained sand to a more fine grained lithology within the same interval.

The Tomma I and Tomma II reservoir with a total thickness of 100 metres, is interpreted to contain oil throughout the whole reservoir sequence.

The present study has shown that geochemical methods and in particular the Rock-eval apparatus are valuable tools to define oil contact/reservoir thickness in detail. Geochemistry will specifically be very usefull in situations where it is difficult to establish oil contacts directly from the well logs.

4 Recommendations

The usefulness of a Rock-eval apparatus has been established during the present study. The turn-over time for one analysis is about 20 minutes and the result is a screening of migrated hydrocarbons and source rock characteristics.

It is therefore recommended to have an Oil-Show-Analyser (OSA) available offshore for continuous geochemical well logging. This can be of great help in designing the SWC-program, the coring and testing of a well.

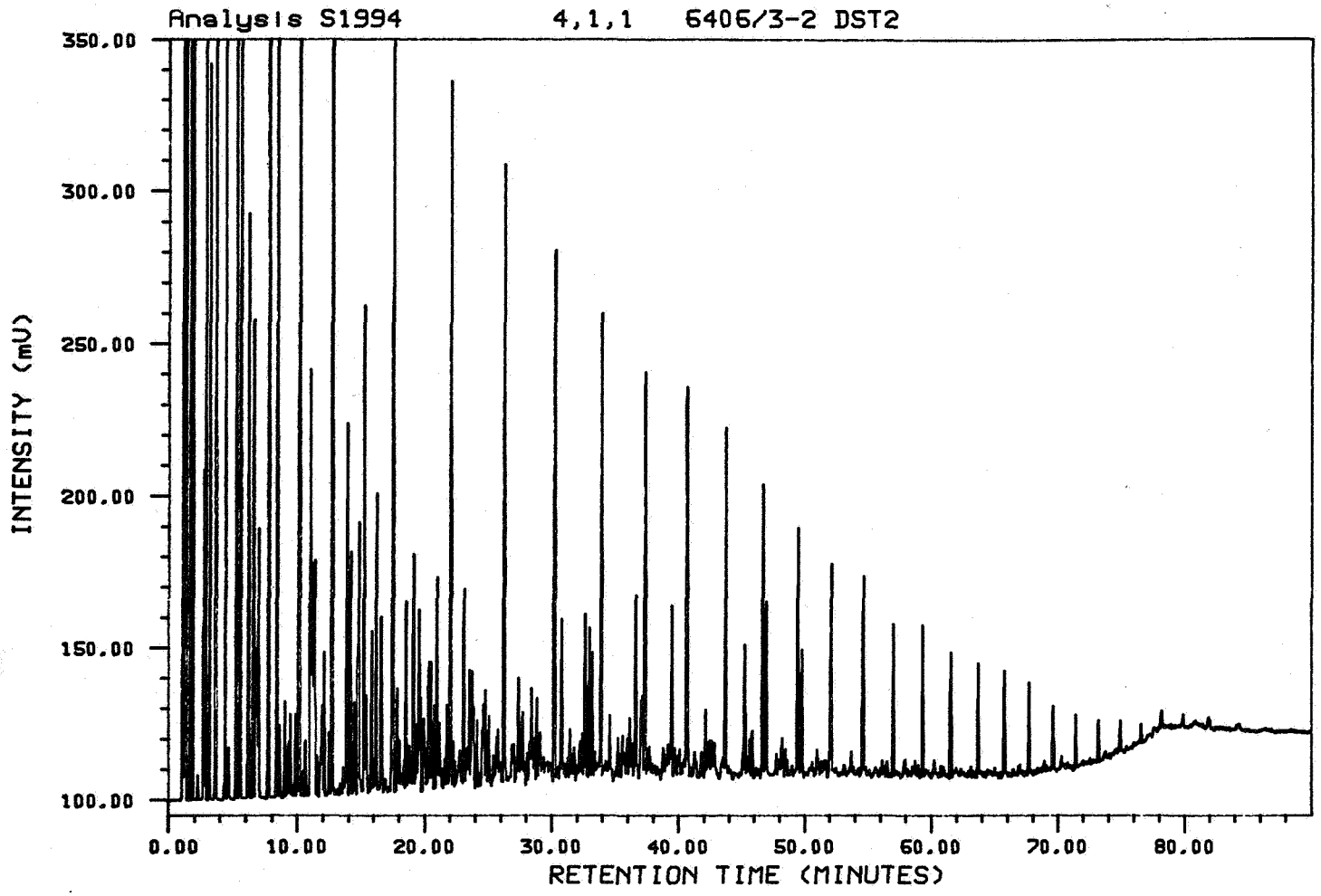
The cost is, futhermore, low compared to on-shore analyses as the geochemical logging is based on dayly rent and on-shore analyses on single sample price.

5 Litterature

Geco: Statoil Conventional Core Analyses Well: 6406/3-2, October 1986.

Geco: Statoil, Well 6406/3-2, Core 1 - 17 Core Photographes.

A P P E N D I X 1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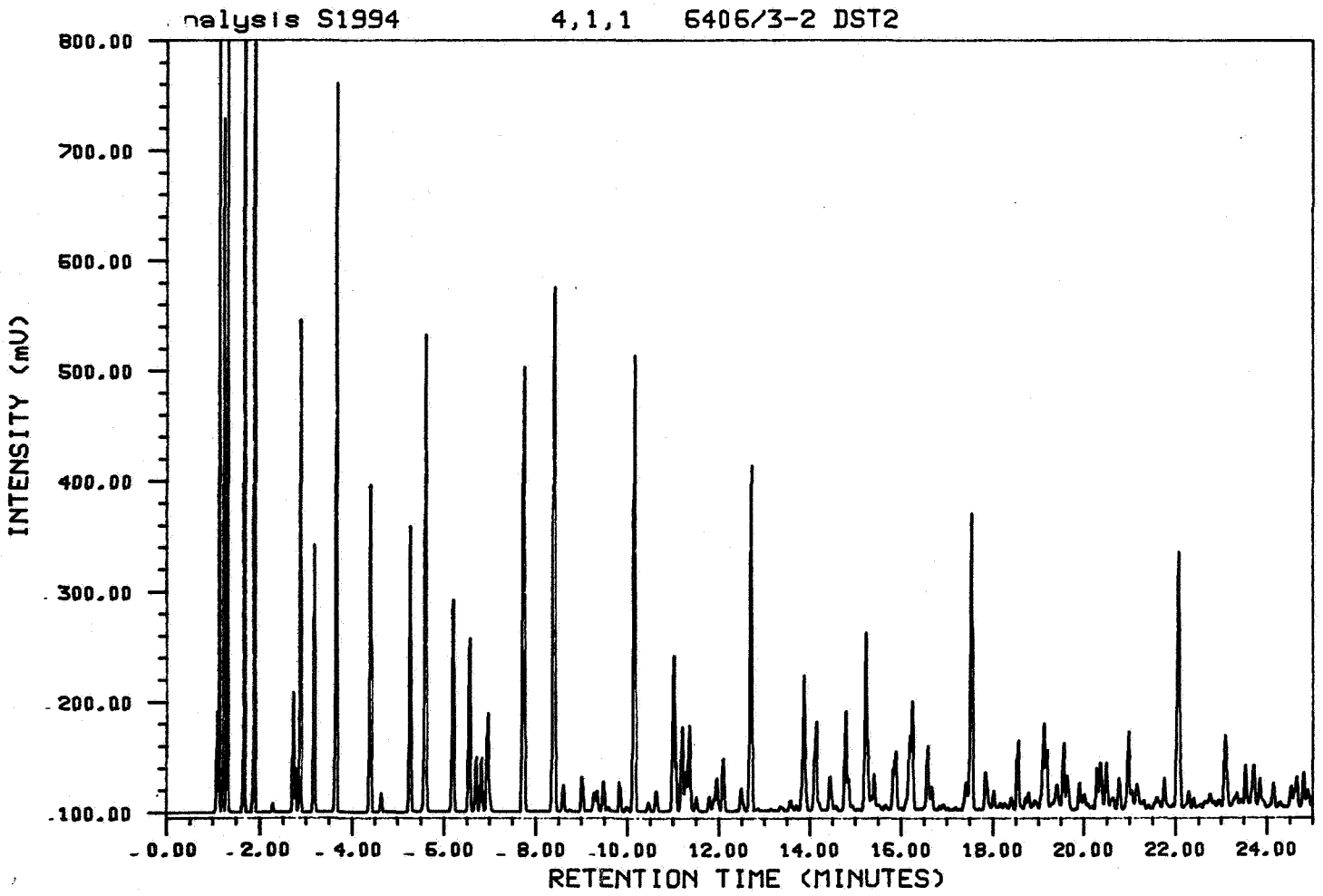
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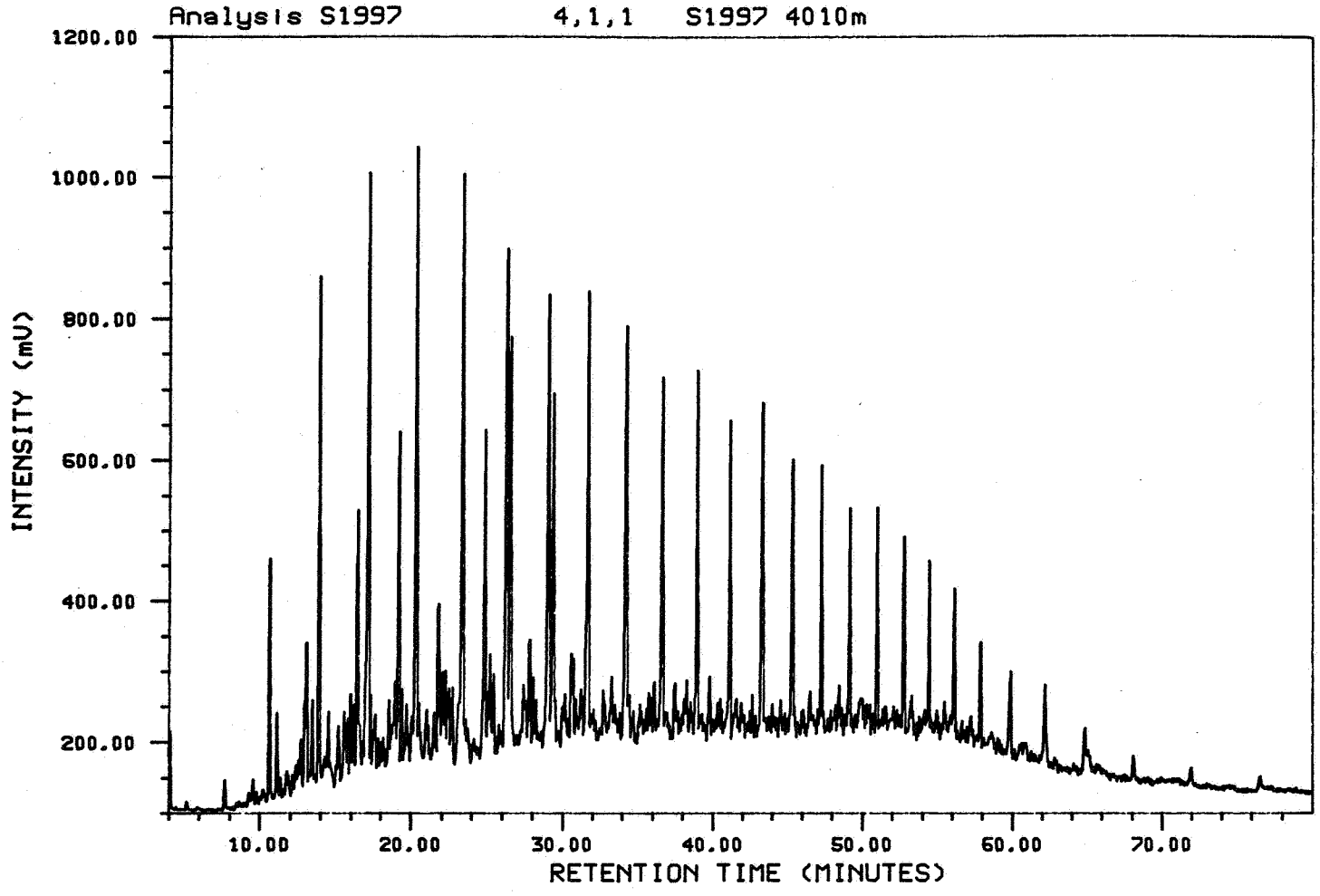
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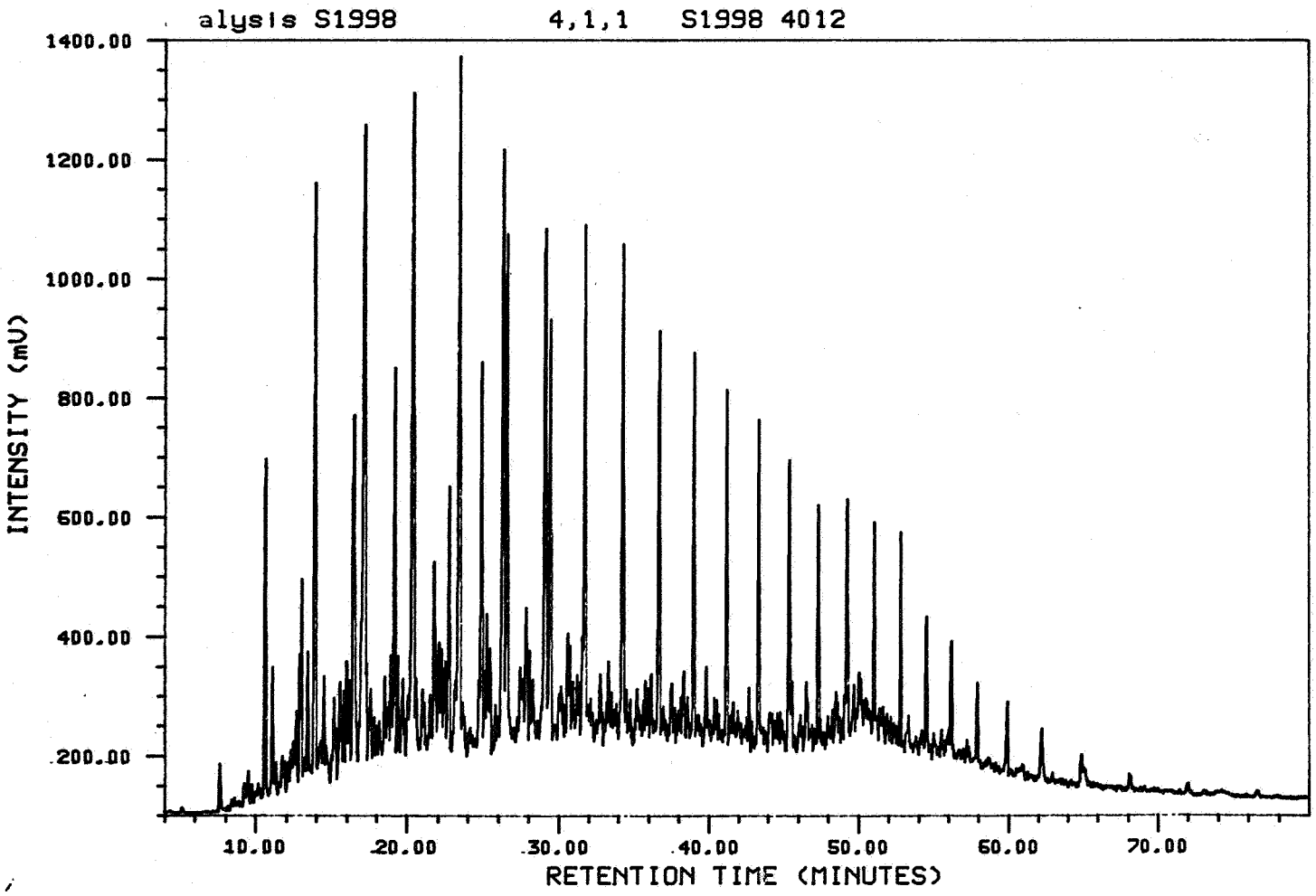
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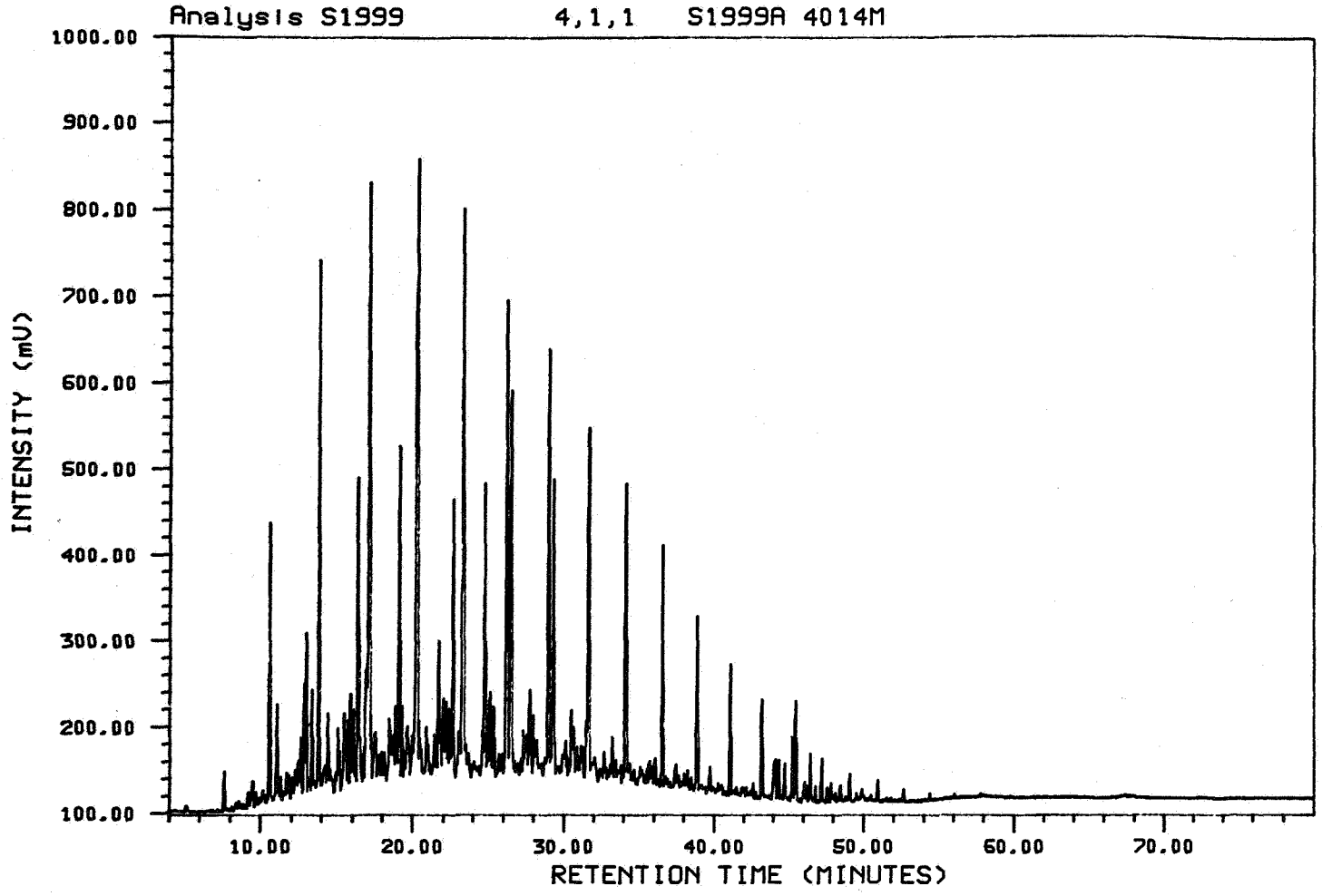
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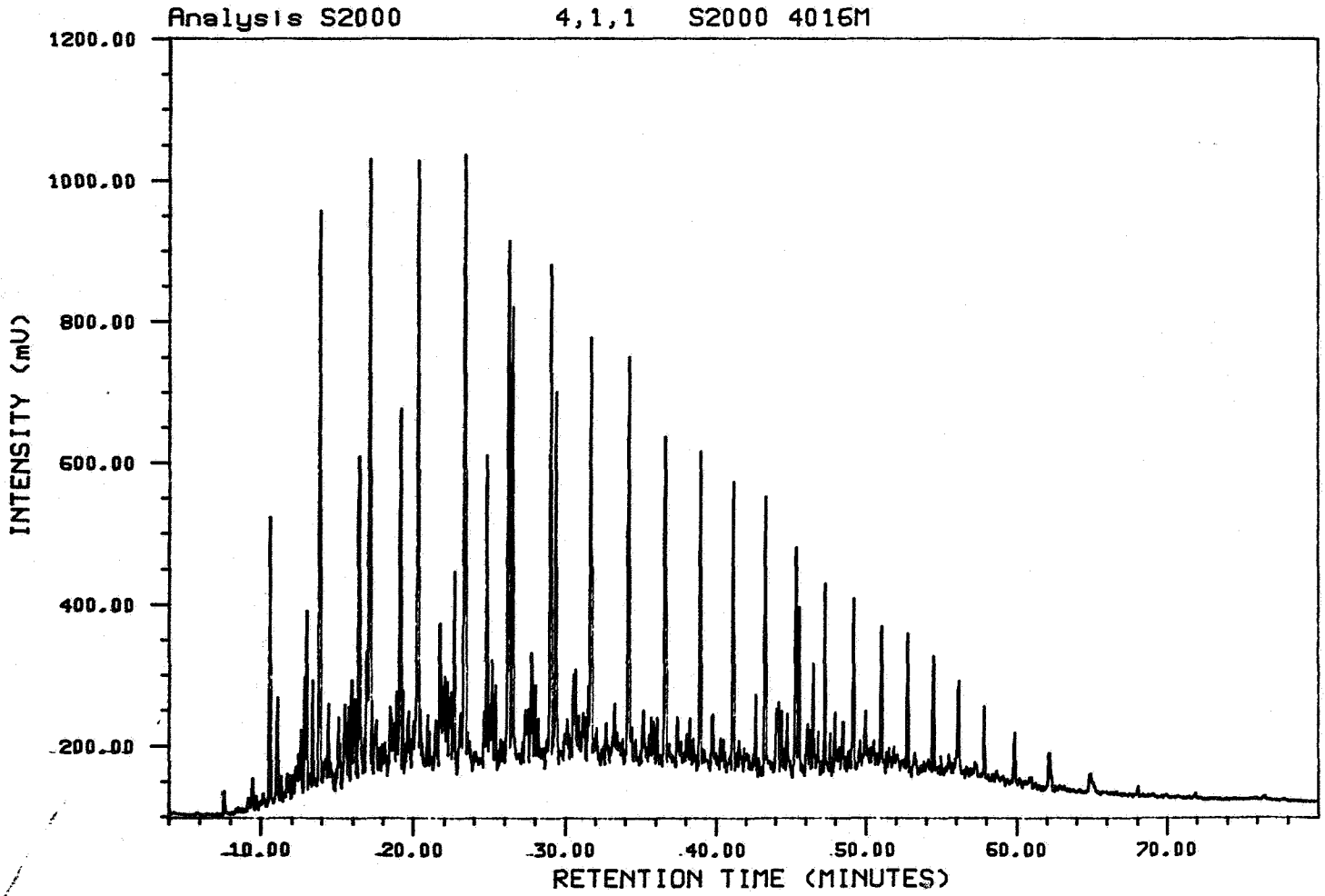
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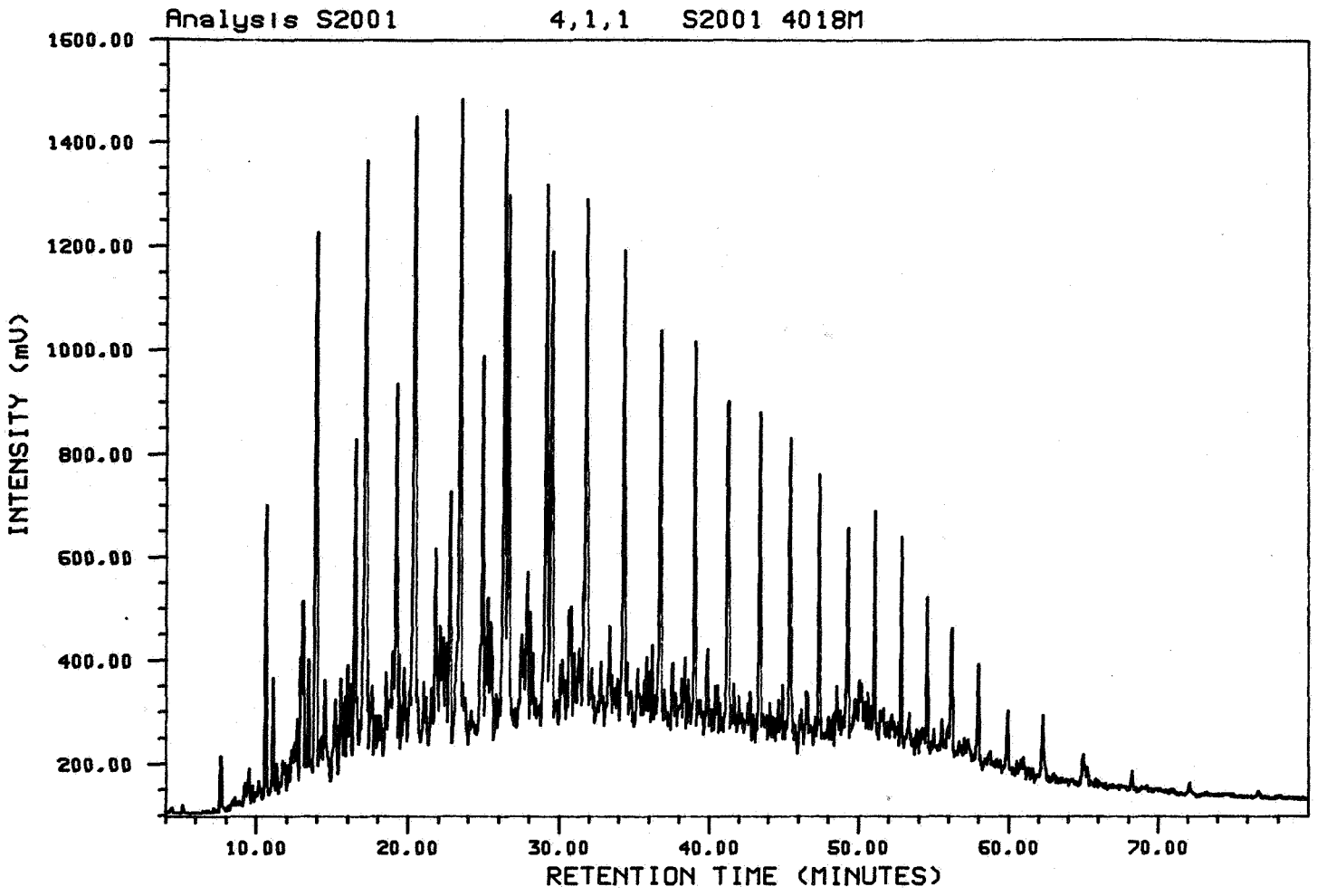
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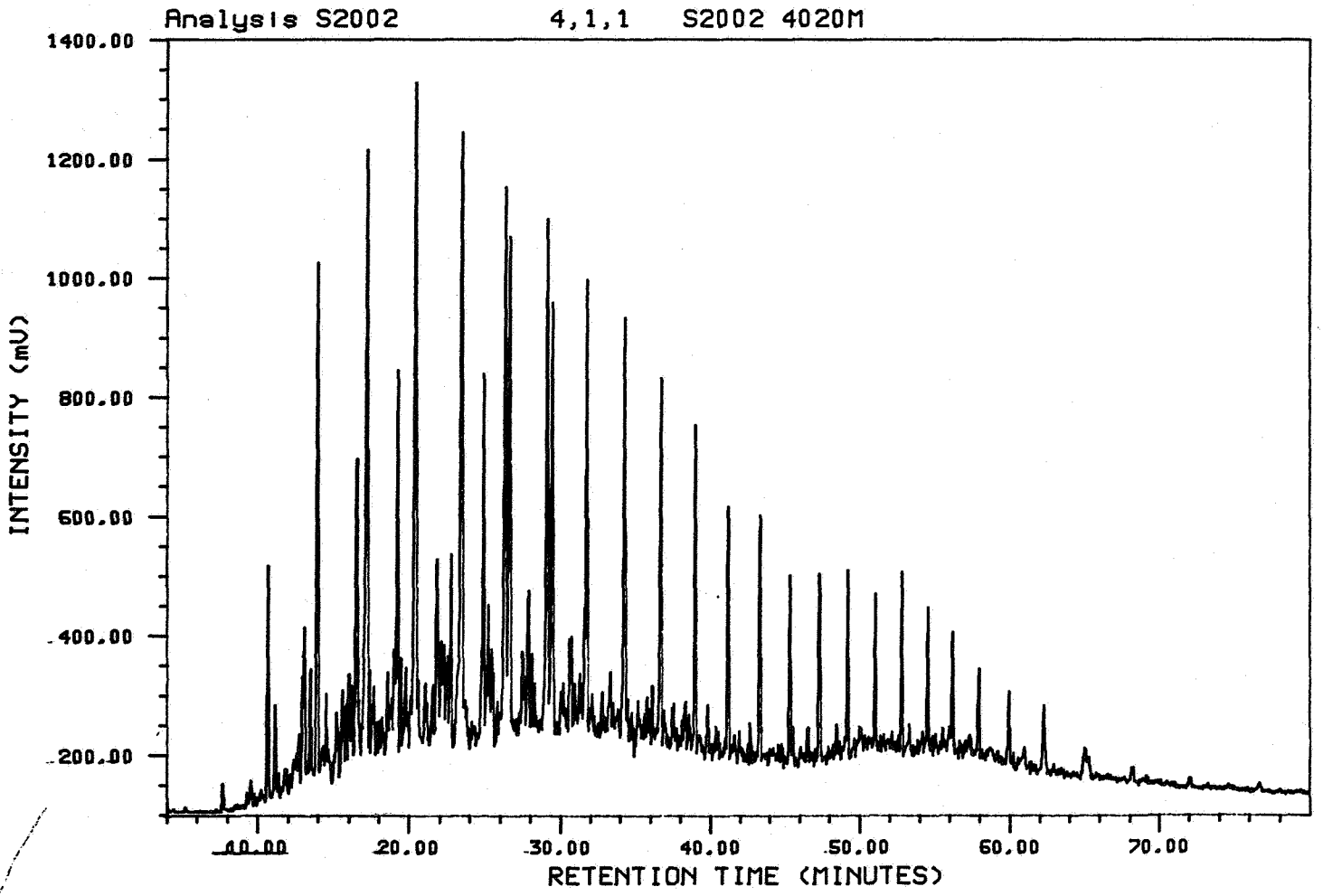
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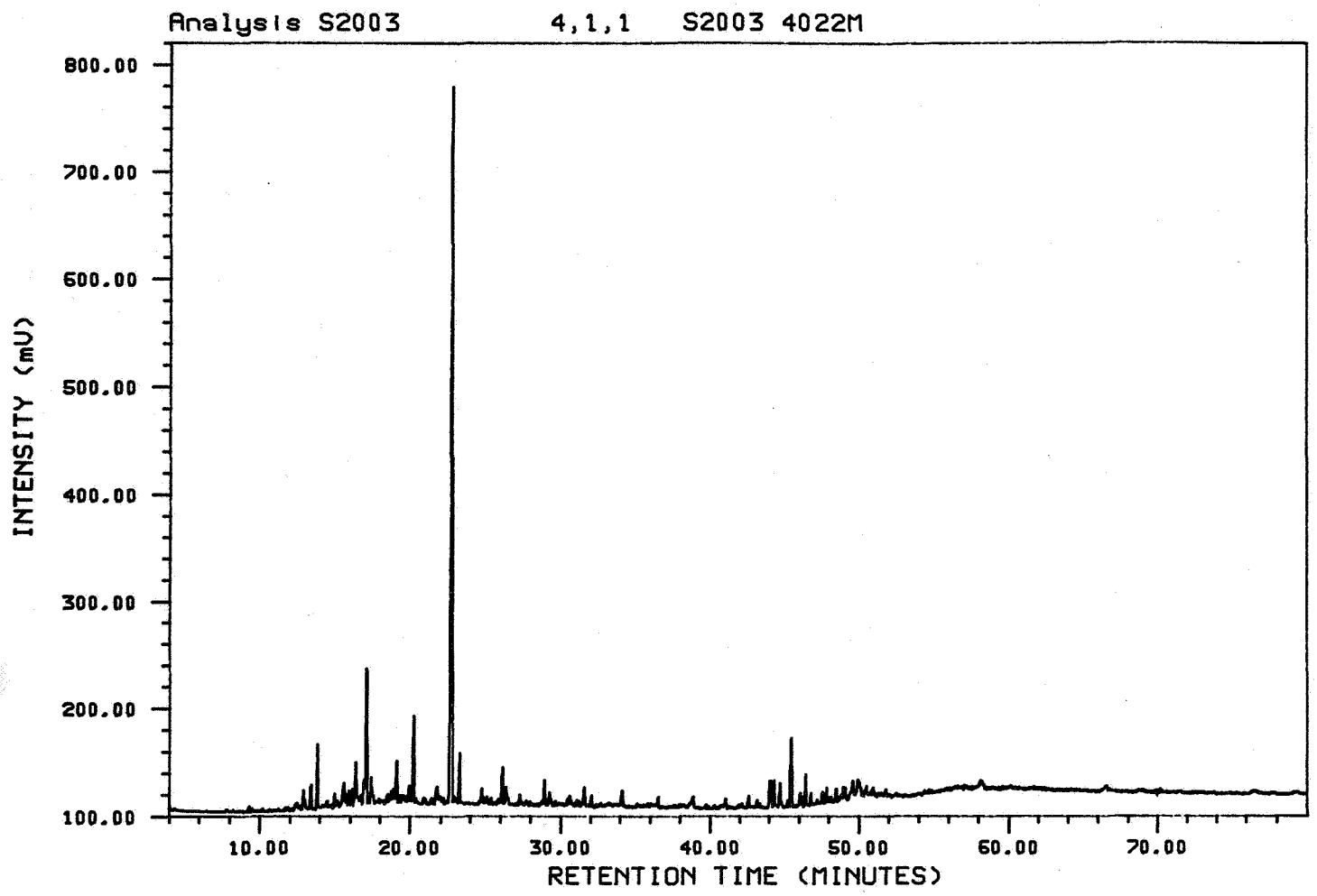
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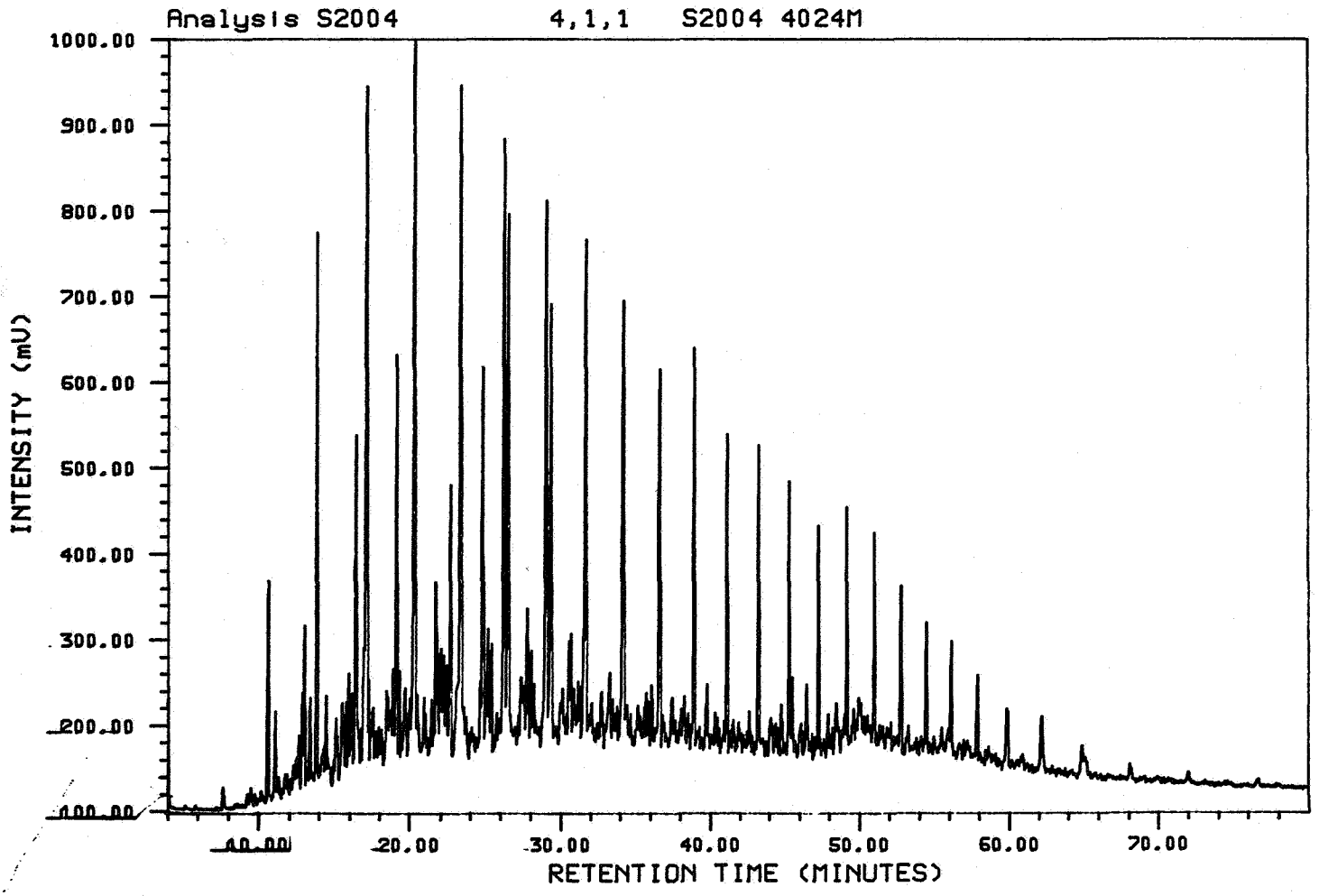
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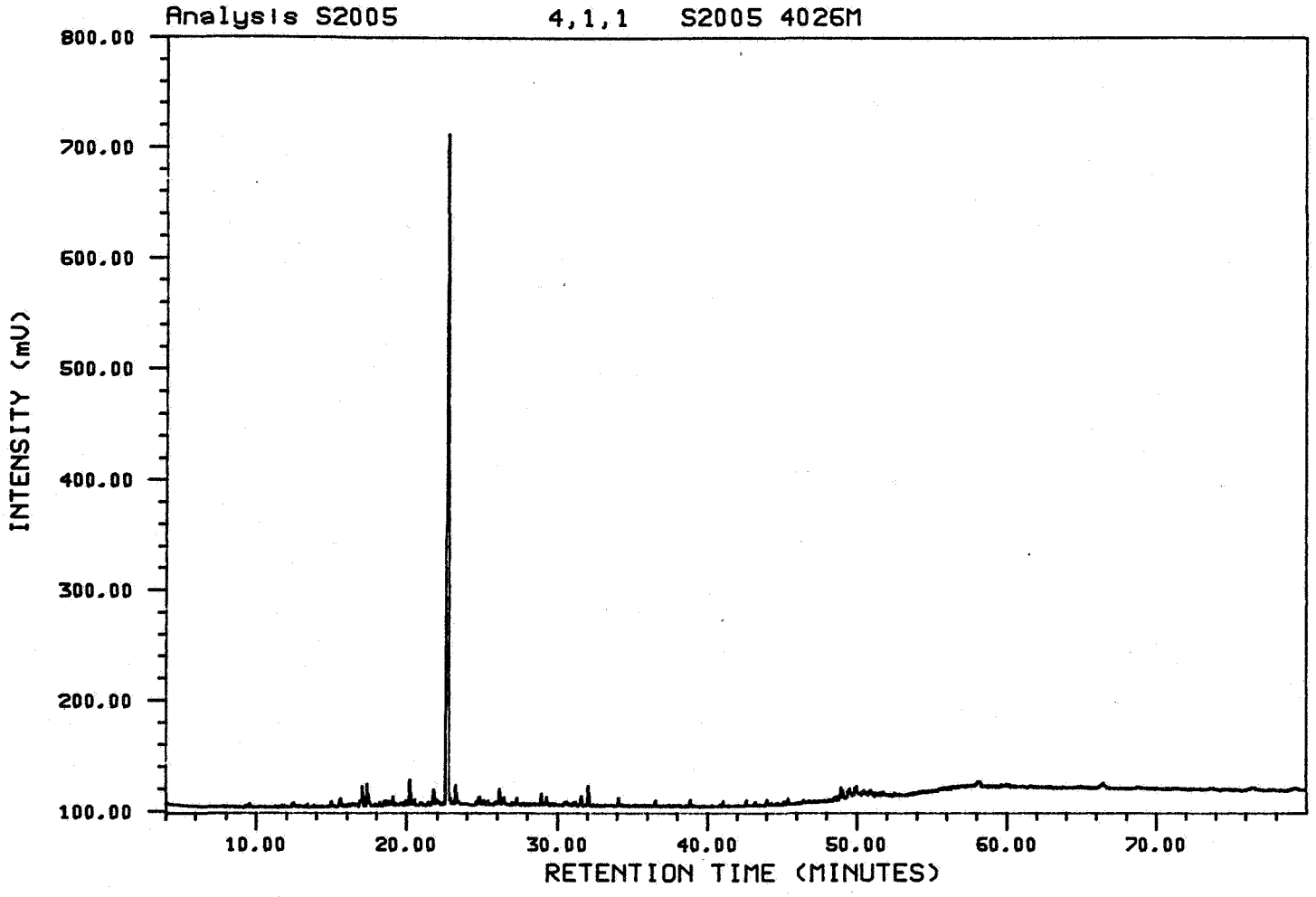
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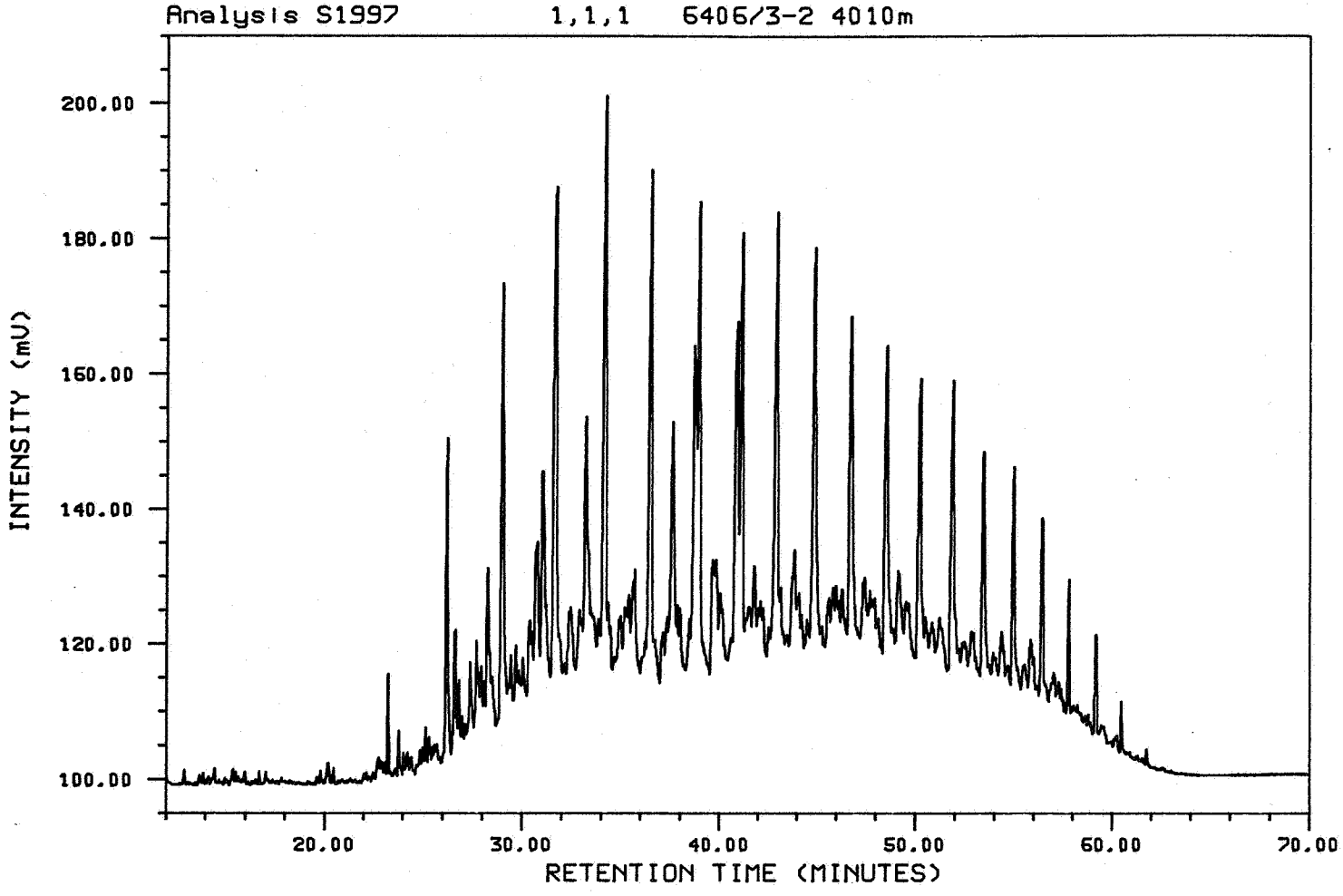
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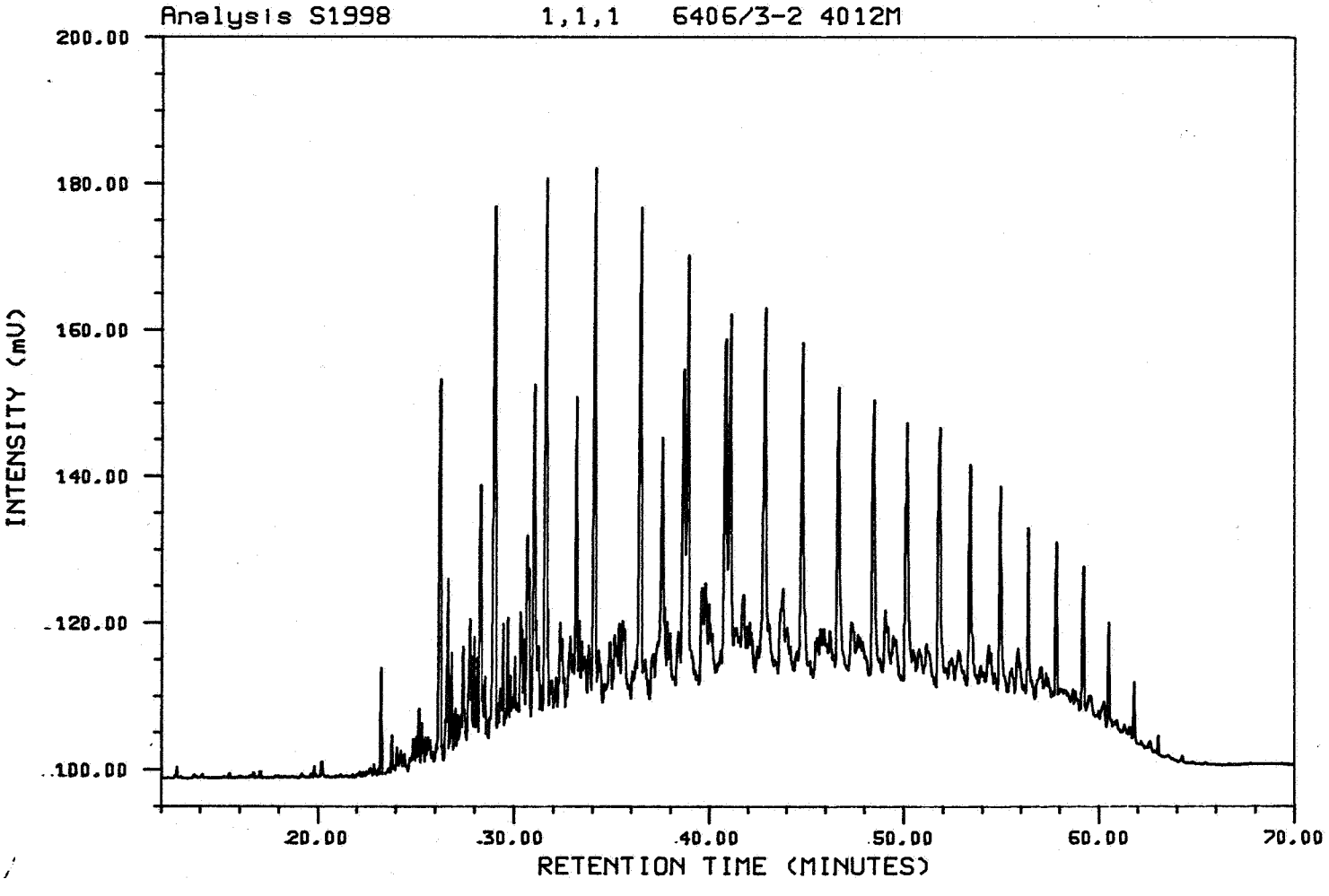
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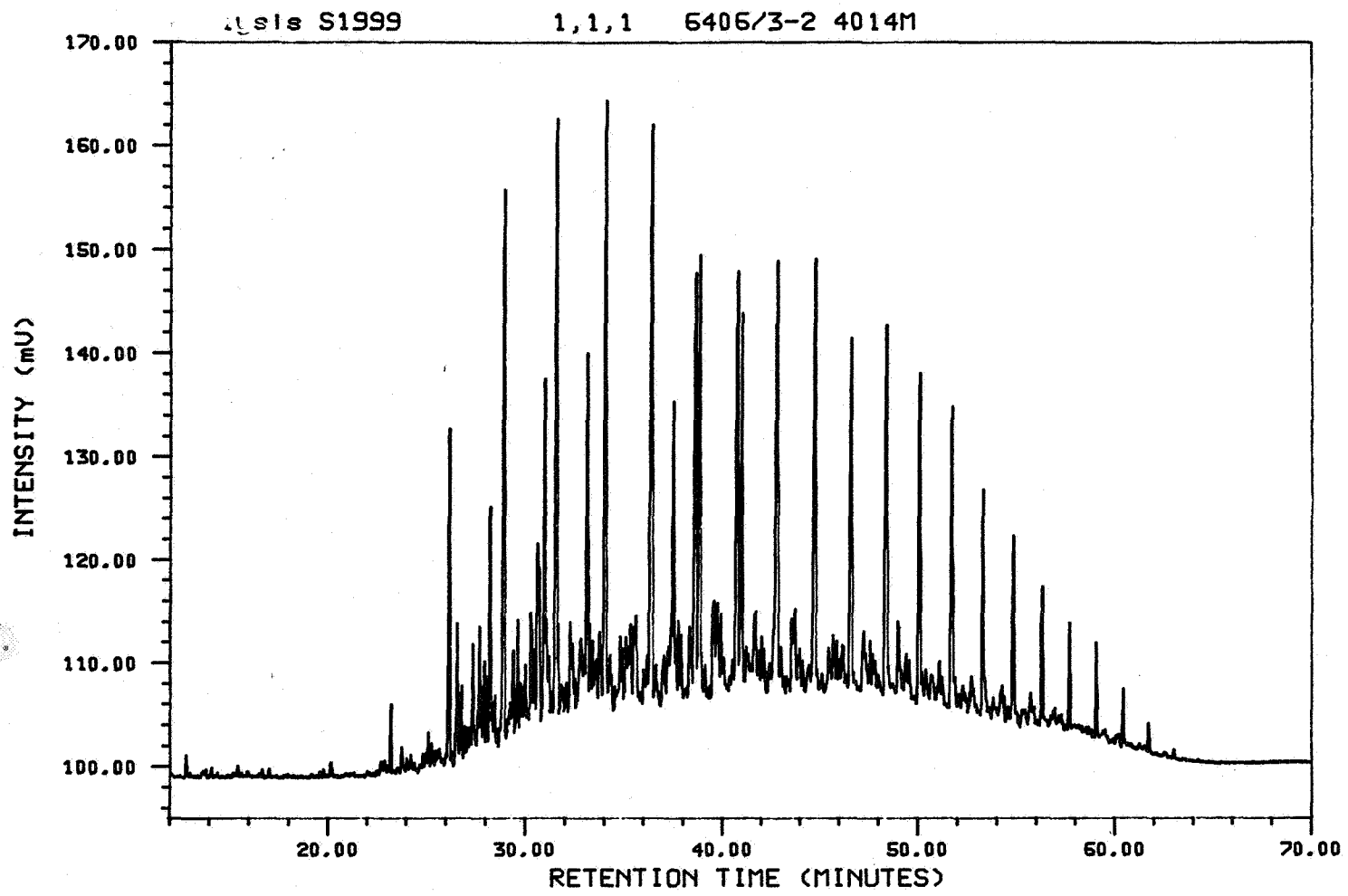
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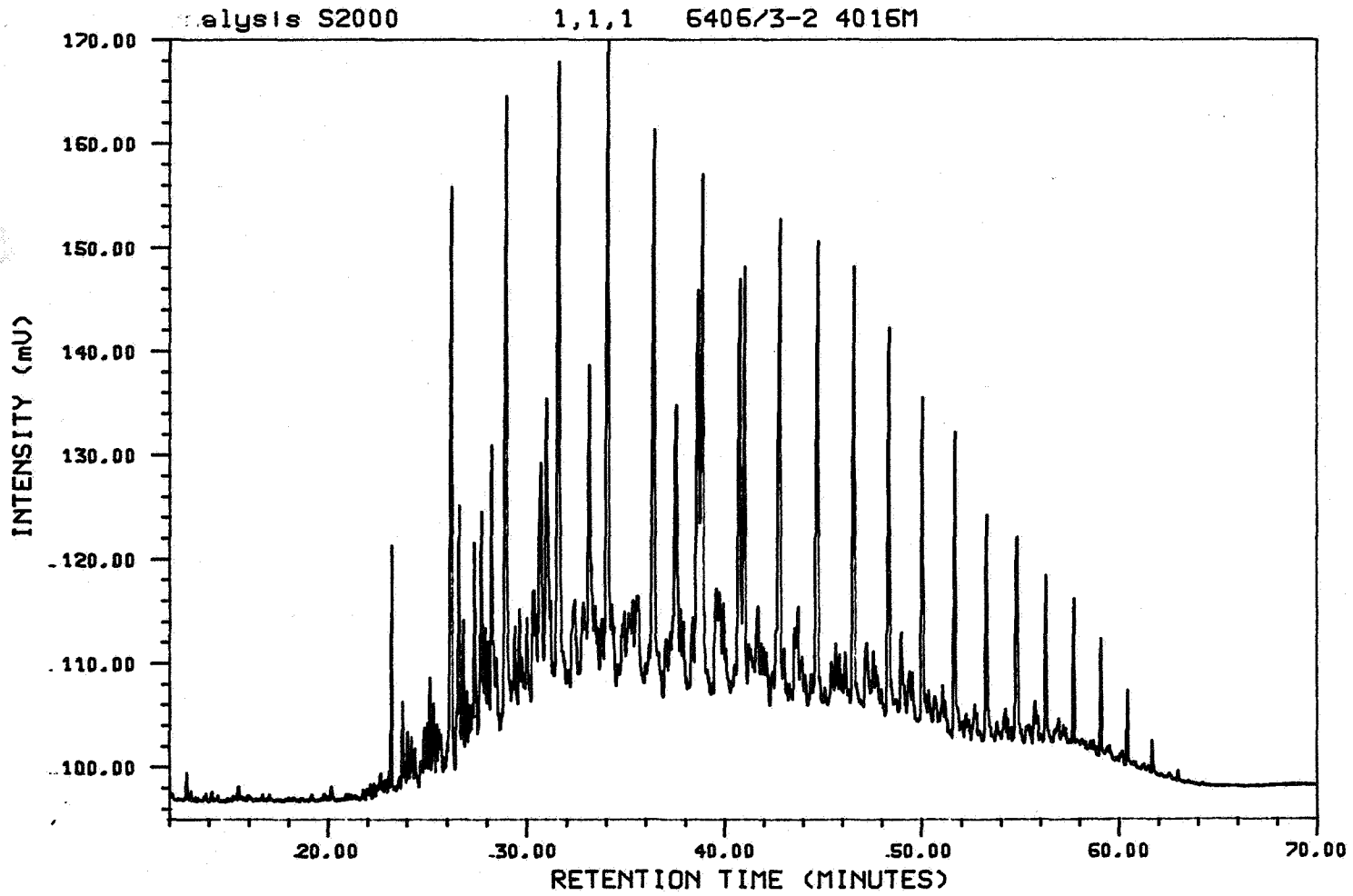
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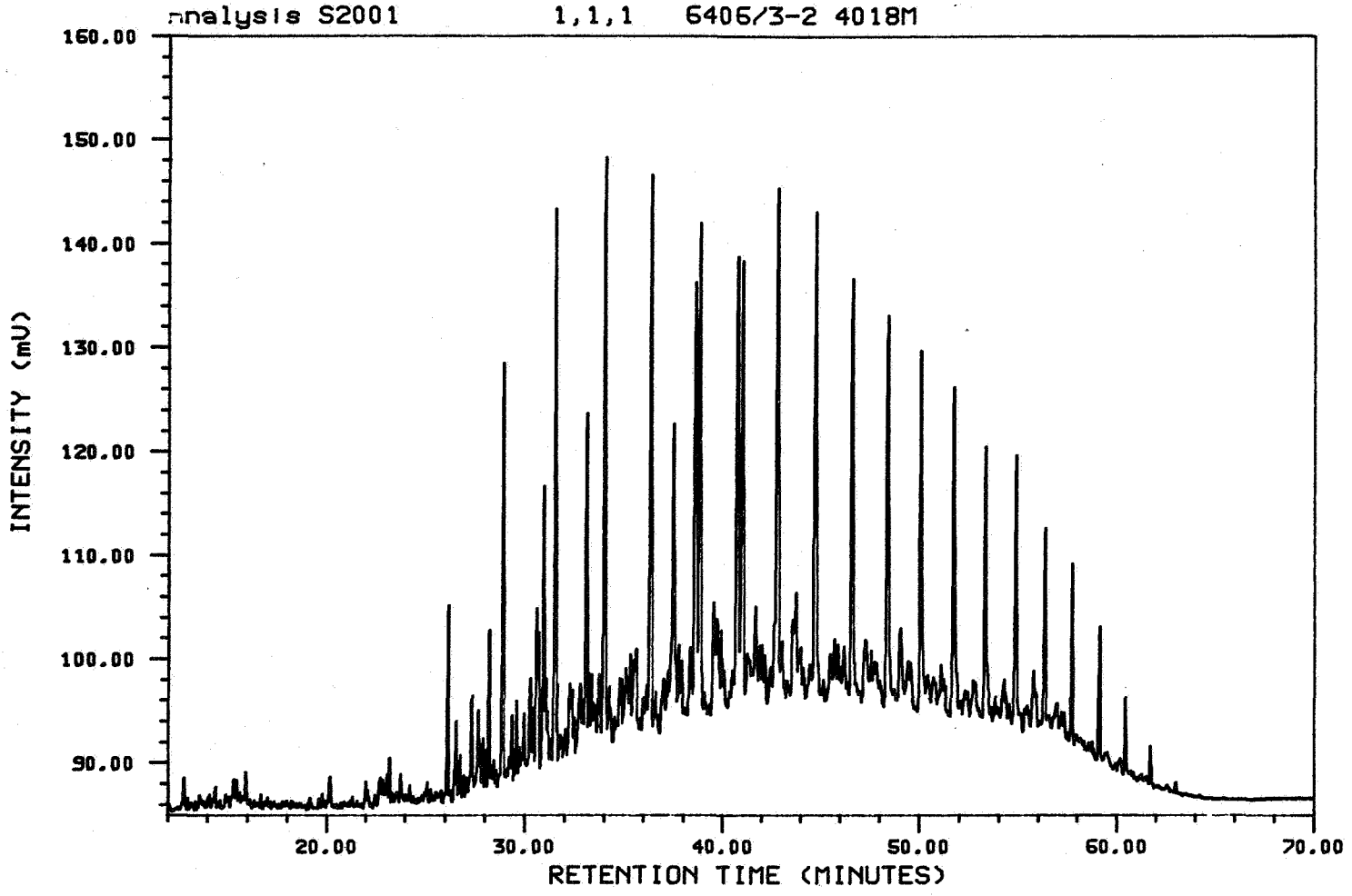
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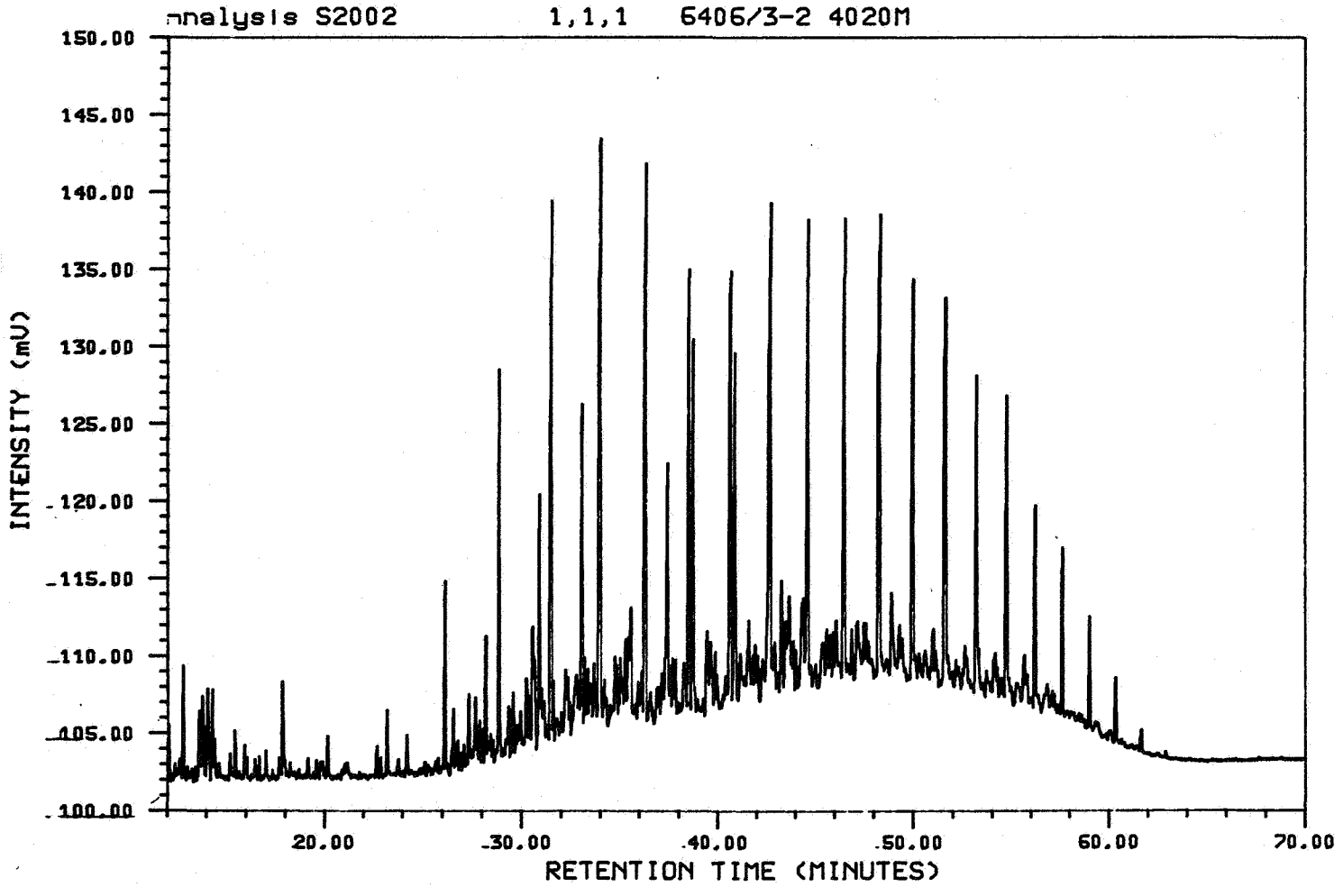
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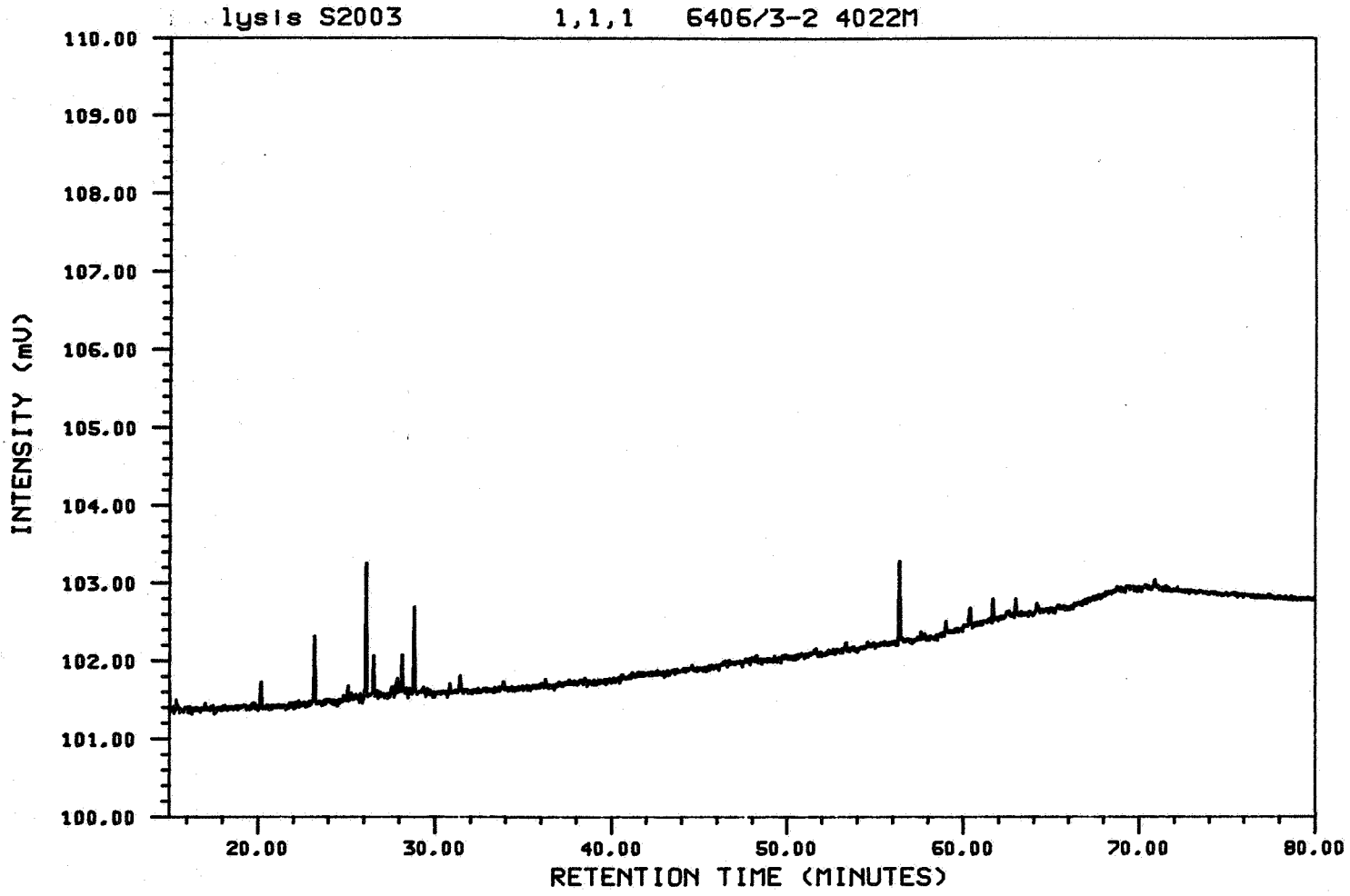
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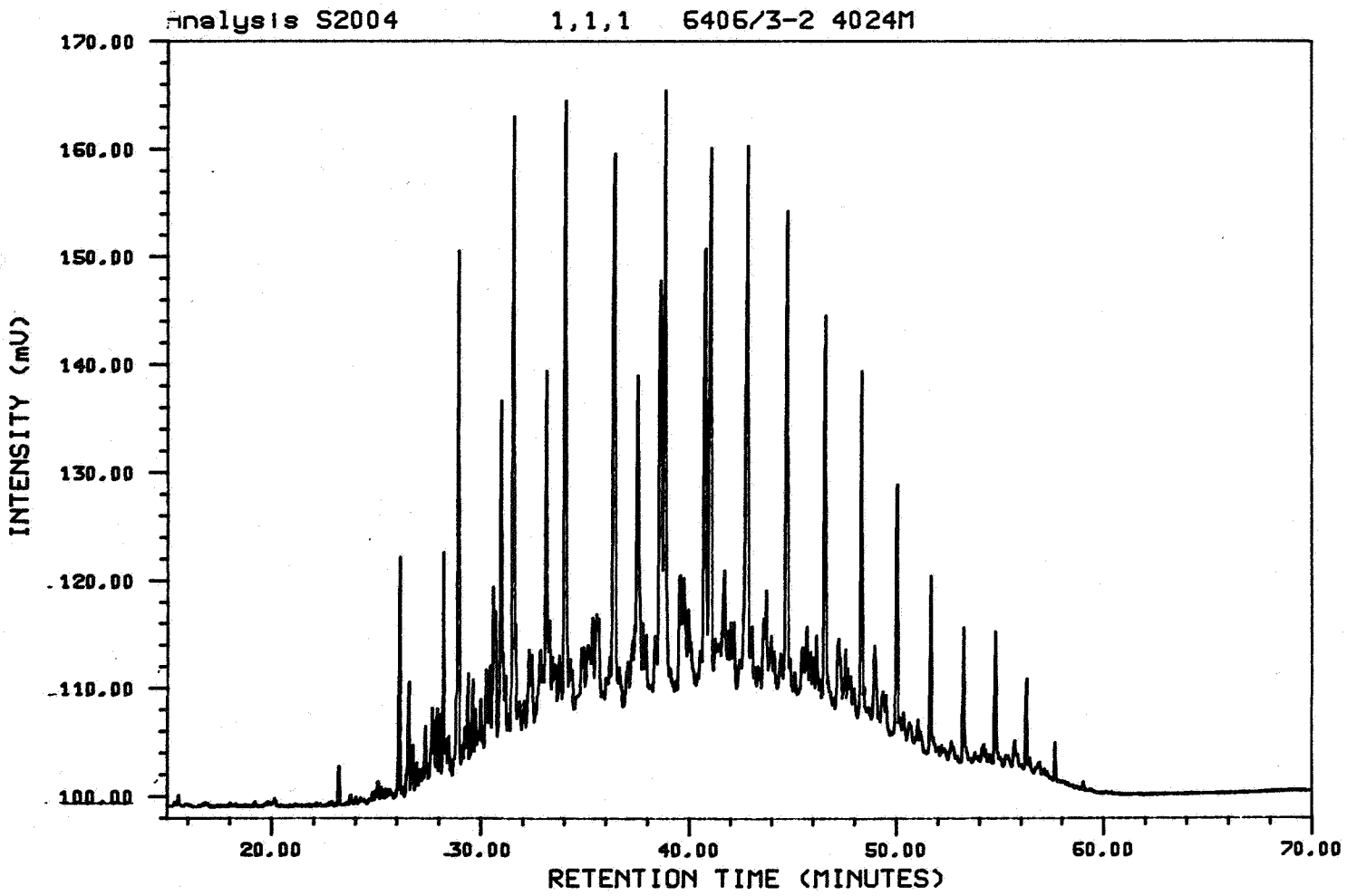
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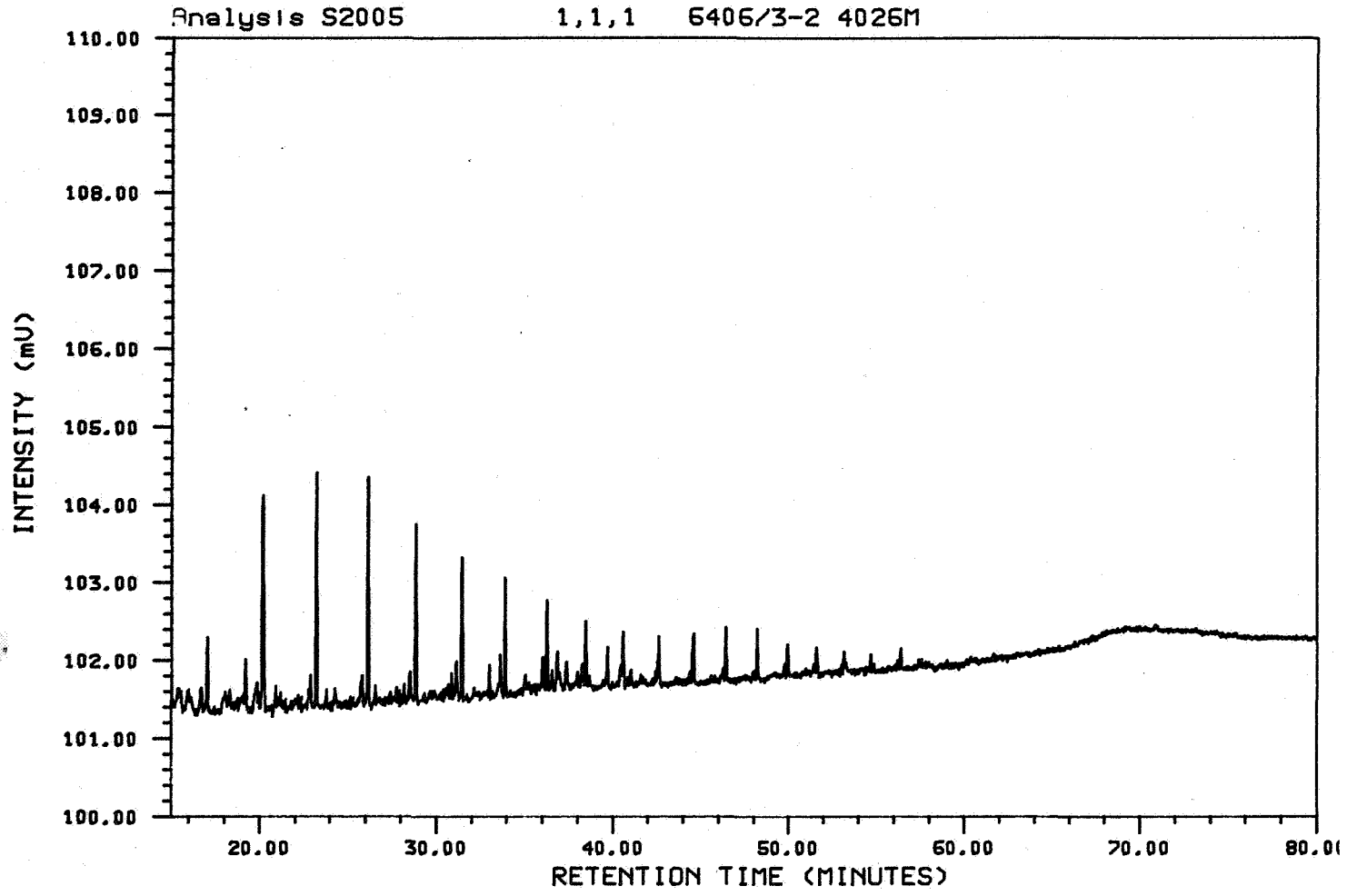
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INTENSITY (mV)
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RETENTION TIME (MINUTES)