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Systems Engineering Associates
7349 Worthington-Galena Road
Columbus, Ohio 43085
Attn: Ronald N. Thaman

The AAN solicits contributions from forensic scientists, arson investigators, and interested parties which have some unique or routine analysis which helps in the identification of flammable liquid or explosive residues. Articles herein express the views and opinions of the authors, which are not necessarily those of the AAN or Systems Engineering Associates (SEA).

THE USE OF BODY TISSUE AND FLUIDS IN AN ARSON INVESTIGATION

by

Charles A. Guinther, Jr.; Robert D. Moss;
Ronald N. Thaman; Michael P. Carrocci;
Mark J. Mulcahy; and Henry Regalado

S.E.A., Inc.
7349 Worthington-Galena Road
Columbus, Ohio 43085

Through the evolution of fire investigation, there is always a new method of taking samples at the fire scene or even a new type of sample which can be taken. One of the samples which is often overlooked is the remains of an animal or even the remains of a human being. By reviewing three case studies, the value of such samples in some fire cases becomes obvious.

Case 1

A fire and explosion occurred in a cabinet finishing warehouse which caused total destruction to the structure. A woman, inside the building at the time of the fire/ explosion, stated to other parties that her dog was acting strange just prior to her seeing a flash of fire race across the floor. She ran from the building after the explosion occurred. She refused to be interviewed by any investigators. Upon digging through the remains of the building, the carcus of the dog was found. Blood samples from the dog's heart were taken along with the lungs.

Analysis of the lung tissue was inconclusive by gas chromatography techniques; however, the results of the blood sample analysis by gas chromatography revealed the presence of propane gas in the blood stream. With this information, the investigator then interviewed personnel of the company and found out that there was a truck within the structure whose fuel system had recently been converted to propane. It was further revealed that a propane control valve on the truck fuel tank would sometimes stick open and allow the propane gas to be released into the atmosphere. Since the valve had malfunctioned previously and the truck was the only source of propane present, the truck was determined to be the cause of the fire/explosion.

Case 2

Another case involved the analysis of the remains of horses. A fire occurred at a barn and it was suspected that drugs were used to kill the animals and then the barn was set on fire. At the scene, samples of the liver and blood were taken from several of the animals. The blood was analyzed for the presence of drugs and carbon dioxide (CO_2). The liver samples were analyzed for the presence of drugs. No drugs were isolated in either the blood or the liver samples taken; however, there were elevated levels of CO_2 present in the blood of the animal samples. These results indicate that there were no drugs in the animals, which would have been used to put them to sleep. Further, the high level of CO_2 present in the blood system thus indicated that the animals were still breathing at the time of the fire.

<u>Case 3</u>

The last case involves a fire in which two women were victims of a fire. The fire investigator took samples of fire debris at the scene and the results of the analysis were positive for gasoline. During the autopsy, it was learned that the younger woman had a large hole in the skull cavity. Also during the autopsy, the lungs of both were taken for analysis. The analysis of the lung tissue determined that charcoal lighter fluid was present in the victims' lungs. This finding was perplexing since gasoline was found throughout the premises. However, through investigation, it was learned that a can of charcoal lighter was present near the location of the bodies and that it was empty. Through further investigation and interviews, it was learned also that the two women were having an argument in which the younger woman struck the older woman. The older woman was then knocked unconscious. At this point in time, the husband of the older woman entered and struck the younger woman on the head with a ball peen hammer (this is supported by the hole present in her head). He then thought both women were dead, so he poured charcoal lighter fluid on the bodies and gasoline throughout the house.

From these three cases it can be seen that body tissues and fluid can be of great benefit to the fire investigator, not only in determining the cause of the fire, but to help determine if there were any outside circumstances involved with the fire.

The Detection of Arson Accelerants

Using

Headspace Gas Chromatography & A Wide-Bore Capillary Column

Thomas A. Brettell*, Penelope Moore, Marie LaMachia

Forensic Science Bureau
New Jersey State Police
P. O. Box 7068
West Trenton, New Jersey 08625

And

Robert L. Grob, Ph.D.

Chemistry Department
Villanova University
Villanova, PA 19085

INTRODUCTION

Among the various responsibilities of the forensic laboratory is the examination of evidence from the scenes of suspicious fires. The detection of accelerants is the primary purpose of this type of examination and several different techniques are presently being used in forensic laboratories. Some of the techniques used to detect the presence of accelerants are solvent extraction (1), heated headspace sampling (2-10), steam distillation (11,12), and sorbent concentration followed by thermal desorption (13-18) or elution with an organic solvent (19-24). All of the techniques result with samples being injected into a gas chromatograph for analysis and yielding chromatograms which can be compared to known standards to determine the presence of an accelerant.

Heated headspace followed by gas-liquid chromatography (GLC) continues to be the method of choice by many forensic scientists for initial screening of this type of evidence because of the speed with which a large number of samples can be analyzed (10). The ease of sample preparation and versatility of handling different types of physical evidence also make this technique very attractive.

The use of GLC as an analytical tool for potential accelerant detection in fire debris samples has been an established technique for over 20 years (1,25). Historically packed columns have been used for this type of analysis for a variety of reasons. Although forensic scientists realize the increased efficiency and powerful separation potential of capillary columns, the wide concentration range and variety of accelerants encountered in this type of evidence has basically kept the packed column as the mainstay of heated headspace GLC. Now with the availability of wide bore (0.5mm I.D. or greater) capillary columns and their increased sample capacity (up to 15,000 ng per sample component) the analysis of accelerants by heated headspace can be performed using these columns.

This communication will show that the analysis of accelerants from evidence of suspicious fires can be performed routinely using a SPB-1 wide-bore (0.75mm I.D.) bonded phase capillary column and heated headspace sampling.

Experimental

A Varian 3700 gas chromatograph equipped with dual flame ionization detectors was utilized throughout the investigation. A 30 meter (0.75mm I.D. with a 1.00 micron film thickness) SPB-1 bonded phase glass capillary column was used for the analyses. The column, purchased from Supelco, Inc., Bellefonte, Pa., was a glass column mounted on a protective metal cage which incorporated two capillary column butt connectors that connected the glass column ends to lengths of flexible, deactivated 0.32mm I.D. fused silica tubing. Specially deactivated sleeves (¼in. O.D. x 2mm I.D. x 4in.) were inserted into the injection and detector ports with the proper connections to the capillary reducer connections. Helium carrier gas was used at 6mL/min. and Helium make-up gas was used at 30mL/min.

A 20 ft. metal column (1/8" I.D.) containing 3% SP-2100 on Supelcoport 80/100 was also used in the analyses. The operating conditions for both columns are listed in Table 1. All samples were prepared by placing known amounts of liquid accelerants on a clean Kimwipe and placing it in a clean one gallon paint can. All of the standard accelerants were purchased from common commercial sources and analyzed fresh. The gallon paint cans were punctured with a hammer and nail punch and covered with filament reinforced tape. The samples were then placed in an oven at 100°C for thirty minutes, removed and appropriate headspace samples were taken with clean disposable 1mL syringes.

RESULTS AND DISCUSSION

The most important advantage of the wide-bore capillary column is the ability to inject samples with a component mass of up to 15μg directly onto the column and still obtain capillary column efficiency(26). With the wide concentration range and variety of accelerants possible this becomes an attractive quality in column selection in arson analysis because the analyst can utilize the capacity similar to packed columns while obtaining capillary column resolution. One can appreciate these advantages by comparing separations of some common accelerants on a wide-bore capillary column and the corresponding packed column. Figures 1 and 2 show characteristic gasoline patterns for the 3% SP-2100 packed column and the SPB-1 wide-bore capillary column, respectively. The improved resolution of the SPB-1 column over the 3% SP-2100 packed column for the same group of peaks can easily be seen. For example, looking at the three groups of peaks marked A, B, and C the increased resolution is obvious. For the B and C groups of peaks the actual number of peaks present for comparison purposes has actually increased. This is important because it increases the number of points of comparison and makes the comparison more valid -- an important feature for forensic purposes.

We chose the SPB-1 wide-bore capillary to compare to the packed column because we routinely use the 3% SP-2100 column for casework and the SPB-1 closely resembles the SP-2100 in behavior. This choice was also based on the 1983 Crime Laboratory Proficiency Testing Program Statistics (see Table II and III) showing that the most popular liquid phase for packed and capillary columns is the methylsilicone stationary phase (SP-2100 or OV-101) (27). The reason methylsilicone phases are such a popular choice for accelerant separations is the fact that they offer superior resolution of the higher boiling components of accelerant mixtures such as in kerosene and diesel fuel. Figure 3 illustrates this nicely by showing the separation of kerosene on the 3% SP-2100 packed column. The separation of the straight chain hydrocarbons C_9-C_{16} is easily discernable. Figure 4 shows the improved resolution of the same separation on the SPB-1 wide-bore capillary column. The peaks are not only sharper but there are more peaks detectable between the straight chain hydrocarbons. These peaks are reproducible and again, as in the case of gasoline, make the comparison more meaningful.

Other examples of chromatograms from the SPB-1 column are shown in Figures 5-9. Figure 10 shows a mixture of gasoline and kerosene (10µL/10µL in a gallon can) run on the SPB-1 column. The patterns of each accelerant are easily discernable (see Figures 2 and 4). There appears to be no loss in sensitivity when using the wide-bore column over the packed column when injecting comparative volumes. For casework we have chosen to inject a 0.5mL-1.0mL headspace sample to minimize deterioration of the column. However, a larger volume can be injected if more sensitivity is needed.

Wide-bore capillary columns also offer some advantages over narrow-bore capillary columns for accelerant detection. For example, narrow-bore capillary columns usually require the sample to be split (50:1-100:1) resulting in a loss in sensitivity and information. Wide-bore capillary columns do not. Low carrier gas flow rates (~1.0mL/min.) for narrow-bore capillary columns require better than average flow controllers and make-up gas. Wide-bore capillary columns, on the other hand, can be run on packed column instruments (with adapter kits for the injector and detector ports). One other important advantage of the bonded-phase-wide-bore capillary column is that if it does become overloaded or contaminated, the column can be taken out of the gas chromatograph, thoroughly rinsed with solvent, and then reconditioned to be used again.

CONCLUSION

Wide-bore capillary columns can be a viable alternative to packed columns when performing heated headspace analysis of arson accelerants. The use of a SPB-1 bonded-phase column offers increased resolution over methylsilicone packed columns with no loss in sensitivity; with the added advantage of being able to clean the column and not having to repack or replace it. The advantage of being able to inject samples of large component masses and still obtain capillary column efficiency offers the forensic scientist an attractive alternative to the more commonly used packed columns.

References

1. J.W. Brackett, Jr., J. Criminal Law, Criminology and Police Science, 1955, 46, 554.

2. C.R. Midkiff, Jr. and W.D. Washington, J.A.O.A.C., 1972, 55(4), 840.

3. J. Nowicki and C. Strock, Arson Anal. Newsletter, 1983, 7, No. 5, 6, 98.

4. J.H. Yip and E.G. Clair, Can. Soc. Forensic Sci. J., 1976, 9, No. 2, 75.

5. D.G. Kubler, D. Greene, C. Stackhouse and T. Stoudemeyer, Arson Anal. Newsletter, 1981, 5, No. 5, 64.

6. C.R. Midkiff, Arson Anal. Newsletter, 1978, 2, No. 6, 8.

7. J.D. DeHann, Arson Anal. Newsletter, 1979, 3, No. 1, 1.

8. W.L. Holz, Arson Anal. Newsletter, 1978, 2, No. 2, 2.

9. W.L. Holz, Arson Anal. Newsletter, 1980, 4, No. 1, 4.

10. P. Loscalzo, P. DeForest and J.M. Chao, Arson Anal. Newsletter, 1977, 1, No. 6, 4.

11. R. Hrynchuk, R. Cameron and P.G. Rogers, Can. Soc. Forensic Sci. J., 1977, 10, No. 2, 41.

12. R.W. Clodfelter,and E.E. Heske, J. Forensic Chem., 1978, 22, 116.

13. J.D. Twibell and J.M. Home, Nature, 1977, 268, 711.

14. J.D. Twibell, J.M. Home, and K.W. Smalldon, Chromatographia, 1981, 14, 366.

15. R. Saferstein and S. A. Park, J. Forensic Sci., 1982, 27, 484.

16. J. Andrasko, J. Forensic Sci., 1983, 28, 230.

17. J.D. Twibell, J.M. Home and K.W. Smalldon, HOCRE Report No. 368, 1980.

18. S.E. White, Arson Anal. Newsletter, 1978, 2, No. 7, 1.

19. R.E. Baldwin, Arson Anal. Newsletter, 1977, 1, No. 6, 9.

20. J.E. Chrostowski and R.N. Holmes, Arson Anal. Newsletter, 1979, 3, No. 5, 1.

21. D.G. Kubler, R. Given and C. Stackhouse, Arson Anal. Newsletter, 1981, 5, No. 6, 82.

22. D.G. Kubler and C. Stackhouse, Arson Anal. Newsletter, 1982, 6, No. 4, 73.

23. J.A. Juhala, Arson Anal. Newsletter, 1982, 6, No. 2, 32.

24. J.P. Klosterman, Arson Anal. Newsletter, 1983, 7, No. 2, 44.

25. B.V. Ettling, J. Forensic Sci., 1963, 8, 261.

26. Supelco Reporter, 1985, IV, No. 1, 4.

27. Crime Laboratory Proficiency Testing Program, Arson Analysis Report No. 83-11, 1983. Collaborative Testing Services, Inc., 8343-A Greensboro Drive, McLean, VA. 22102.

Acknowledgement

The authors would like to thank Cherie Maher and Maria Sinibaldi for their help in the development of this work and the N.J. State Police for permitting the study to be completed.

Table I

Column Conditions

Column:	SP-2100	SPB-1 WCOT
WT%	3	--
Support	Supelcoport	--
Length	20 ft.	30m
Mesh	80/100	--
I.D.	1/8''	0.75mm
Column Temp.	50°C 5 min. 12°C/min. 280°C 5 min.	40°C 4 min. 12°C/min. 250°C 5 min.
Det. Temp.	300°C	280°C
Inj. Temp.	250°C	250°C
Carrier (Rate)	Helium 30mL/min.	Helium 6 mL/min.
Sample Size	2mL	0.5-1mL

Table II

1983

Packed Columns - (36 Labs)

Length	Column	Diameter	Volume of Injection: Liquid	Volume of Injection: Vapor
8-20 ft.	3% SP-2100	2mm	5-10μL	1-3mL (ten laboratories)
10-20 ft.	10% SP-2100	2mm	5-10μL	1-3mL (eleven laboratories)
6-10 ft.	5-7% Bentone-34/5-10% Didecylphthalate	2mm	--	1-3mL (seven laboratories)
6 ft.	Bentone-34/SP-1200	2mm	4μL	2mL
10 ft.	Carbopack/1500 0.2% Carbowax	2mm	--	3mL
6 ft.	10% UCW-982	2mm	3μL	1-3mL
20 ft.	0.3% WHP	2mm	--	--
6 ft.	3% OV-1	2mm	2μL	1mL (two laboratories)
10 ft.	4% Dexsil	2mm	0.5-5μL	--
6 ft.	15% Carbowax 20m	4mm	--	1mL

Table III

1983

Capillary Columns - (18 Labs)

Length	Liquid Phase	Diameter	Injection Liquid	Injection Vapor	Split Ratio
12.5-25m	Methylsilicone	0.2-31mm	0.2-4μL	2mL (Six Labs)	50:1-100:1
60m	Methylsilicone	0.25mm	--	500μL	No split, 40:1, 50:1
12m-30m	SP-2100	0.2-2.5mm	0.2-3μL	3mL (Seven Labs)	40:1→200:1
30m	FS DB-1	0.25mm	--	1mL	90:1
30m	DB-5	0.32mm	2μL	0.5mL	100:1
100 ft.	SCOT DC-550	--	1μL	--	10:1
50m	SCOT Apiezon L	0.32mm	0.4μL	2mL	15:1

Table IV

DETECTION LIMITS OF SOME ACCELERANTS

	static headspace	
	µl/gal	[ppm]
methanol	> 0.1	0.26
ethanol	> 0.1	0.26
Isopropanol	> 0.1	0.26
gasoline	5	1.32
charcoal lighter fluid	1.2	0.32
kerosene	5	1.32
fuel oil no. 2	10	2.63
diesel fuel	10	2.63

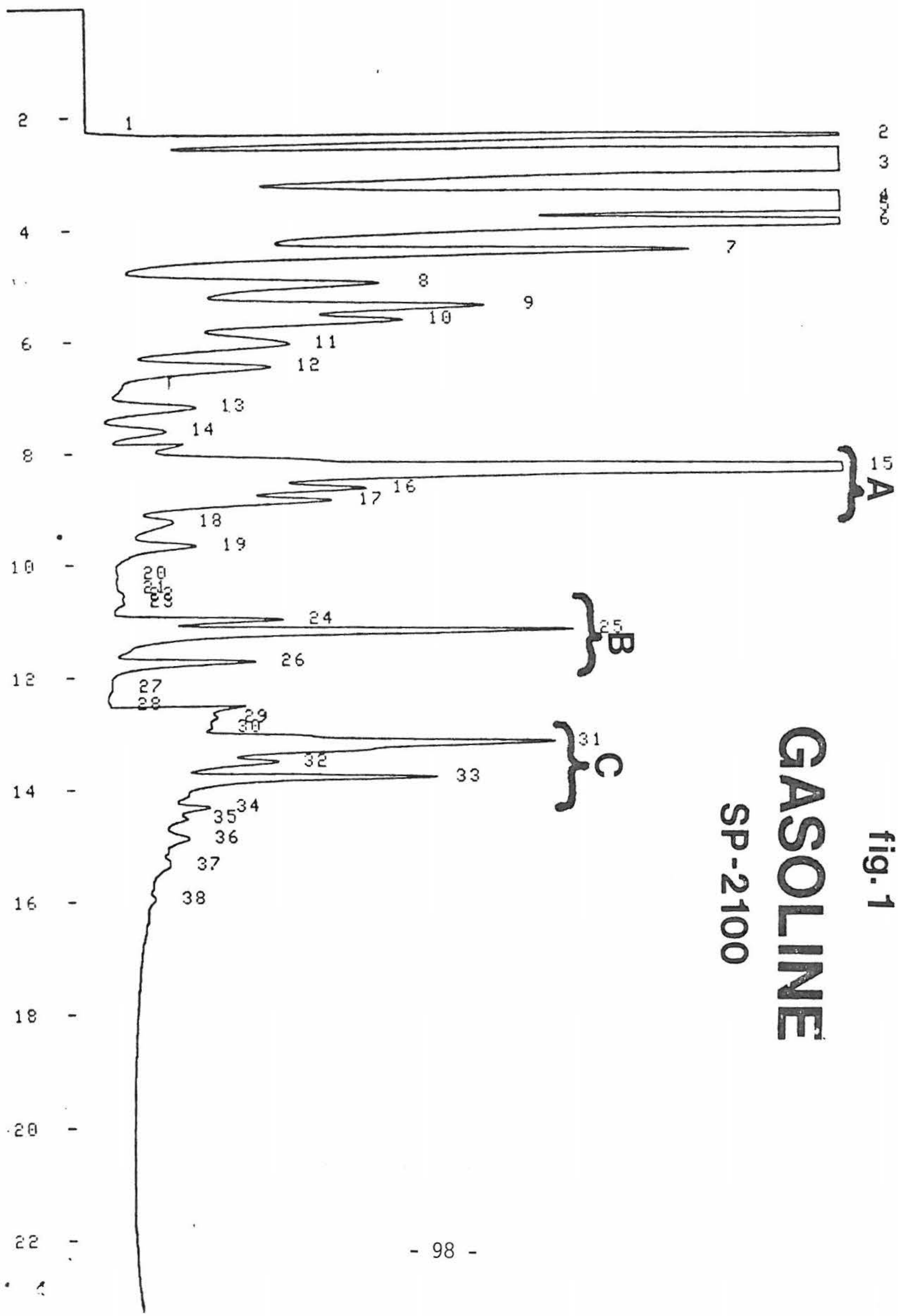


fig. 1 GASOLINE SP-2100

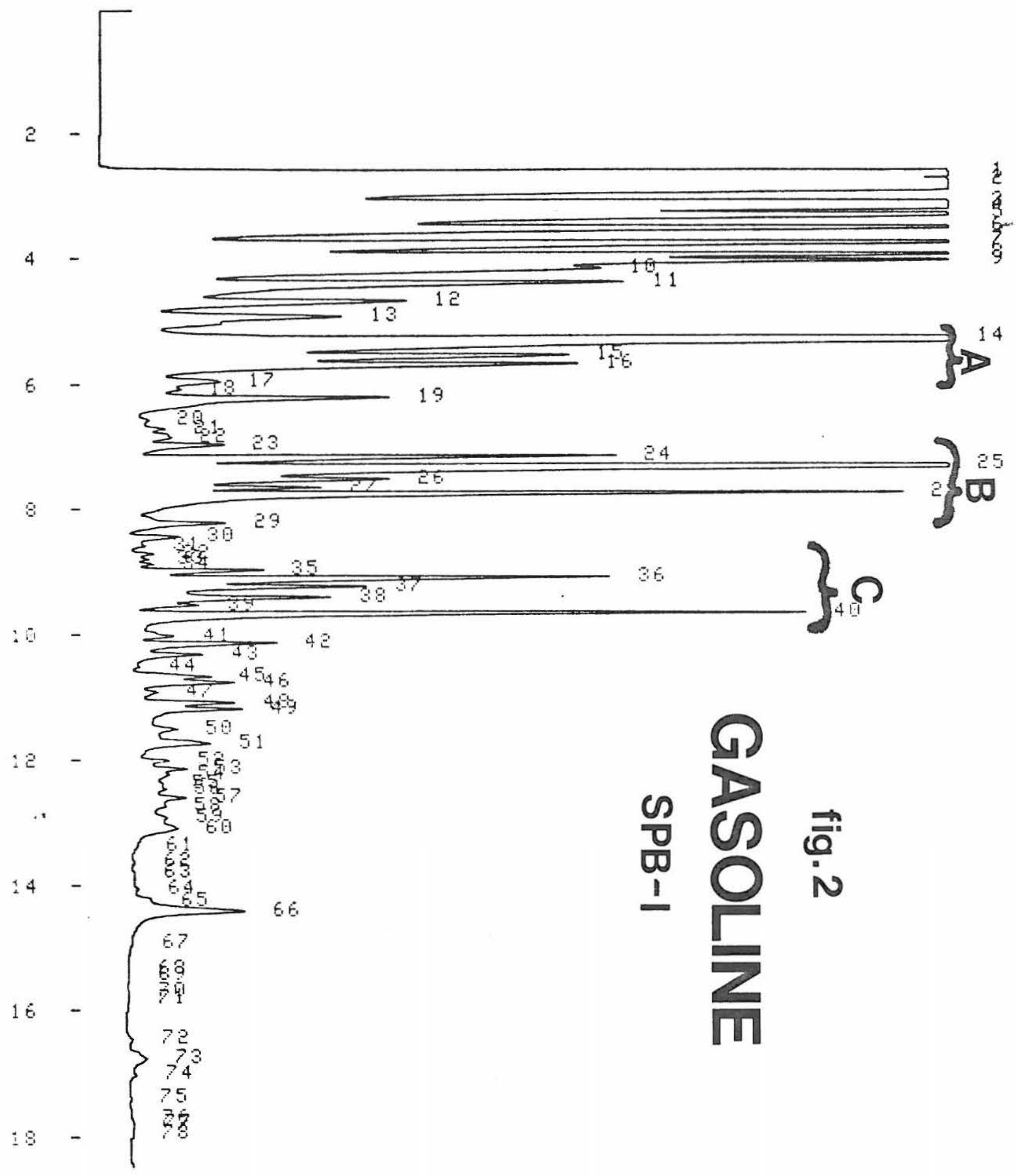


fig. 2
GASOLINE
SPB-I

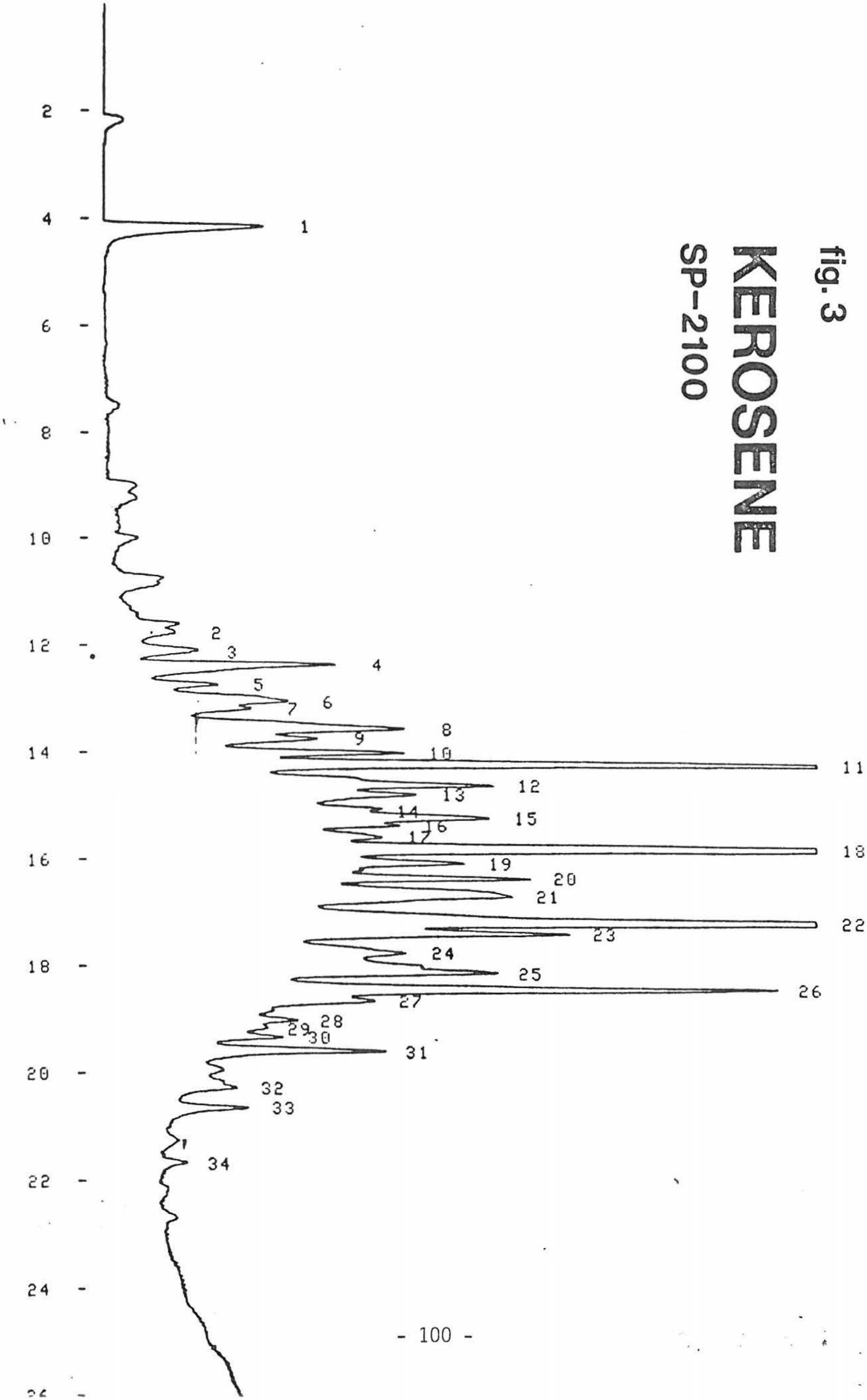
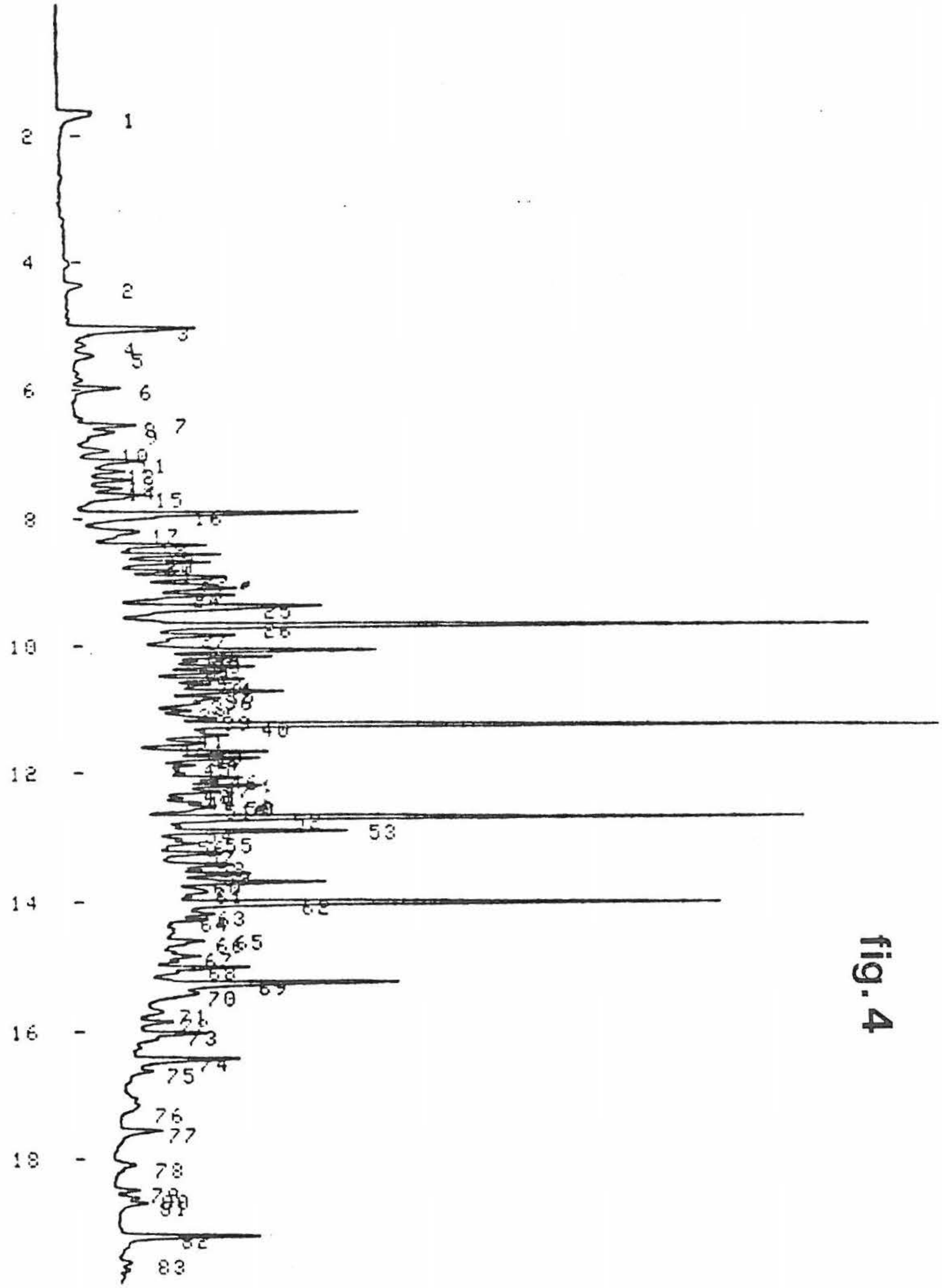
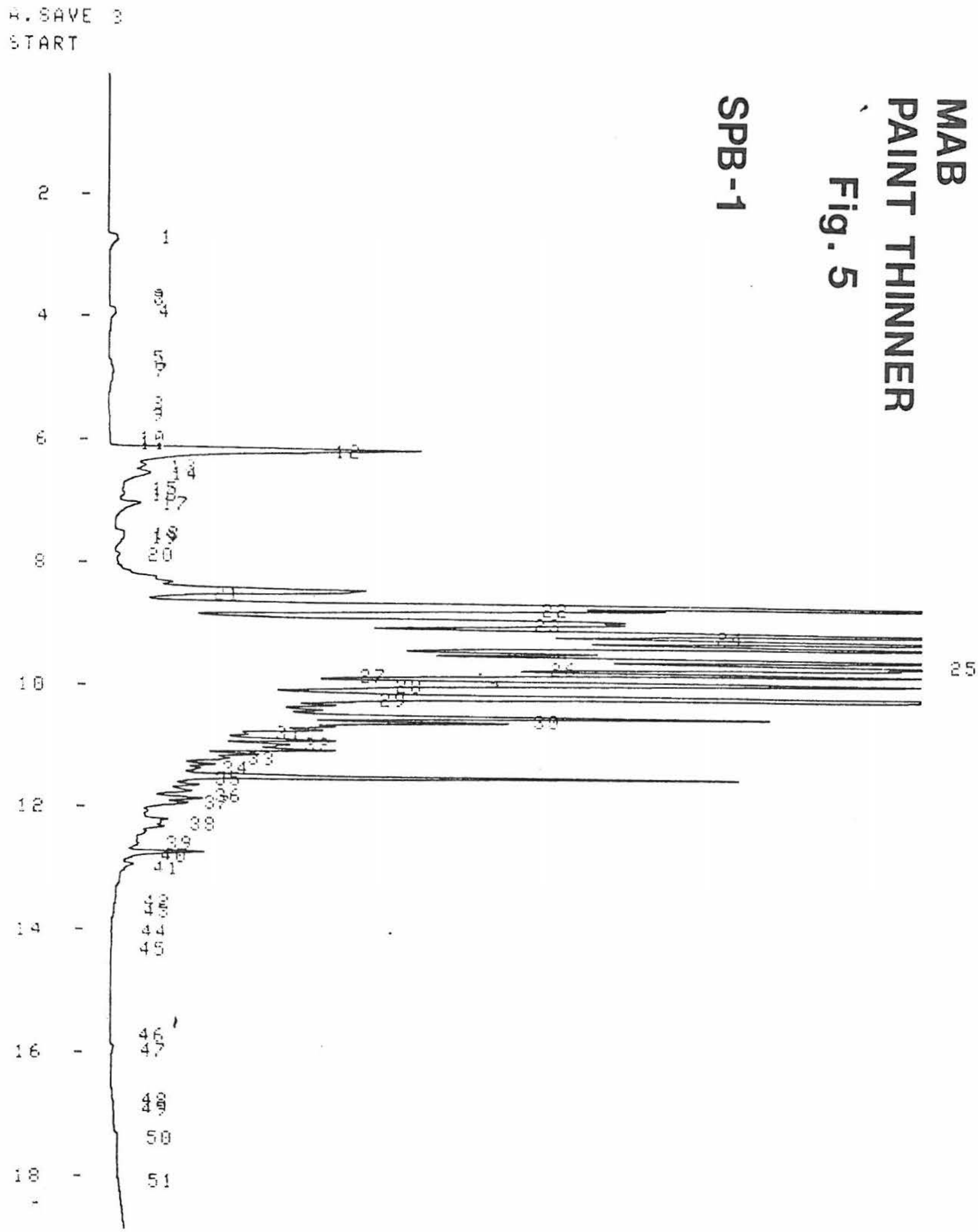


fig. 3
KEROSENE
SP-2100



Kerosene
SPB-1
fig. 4

MAB PAINT THINNER
Fig. 5
SPB-1



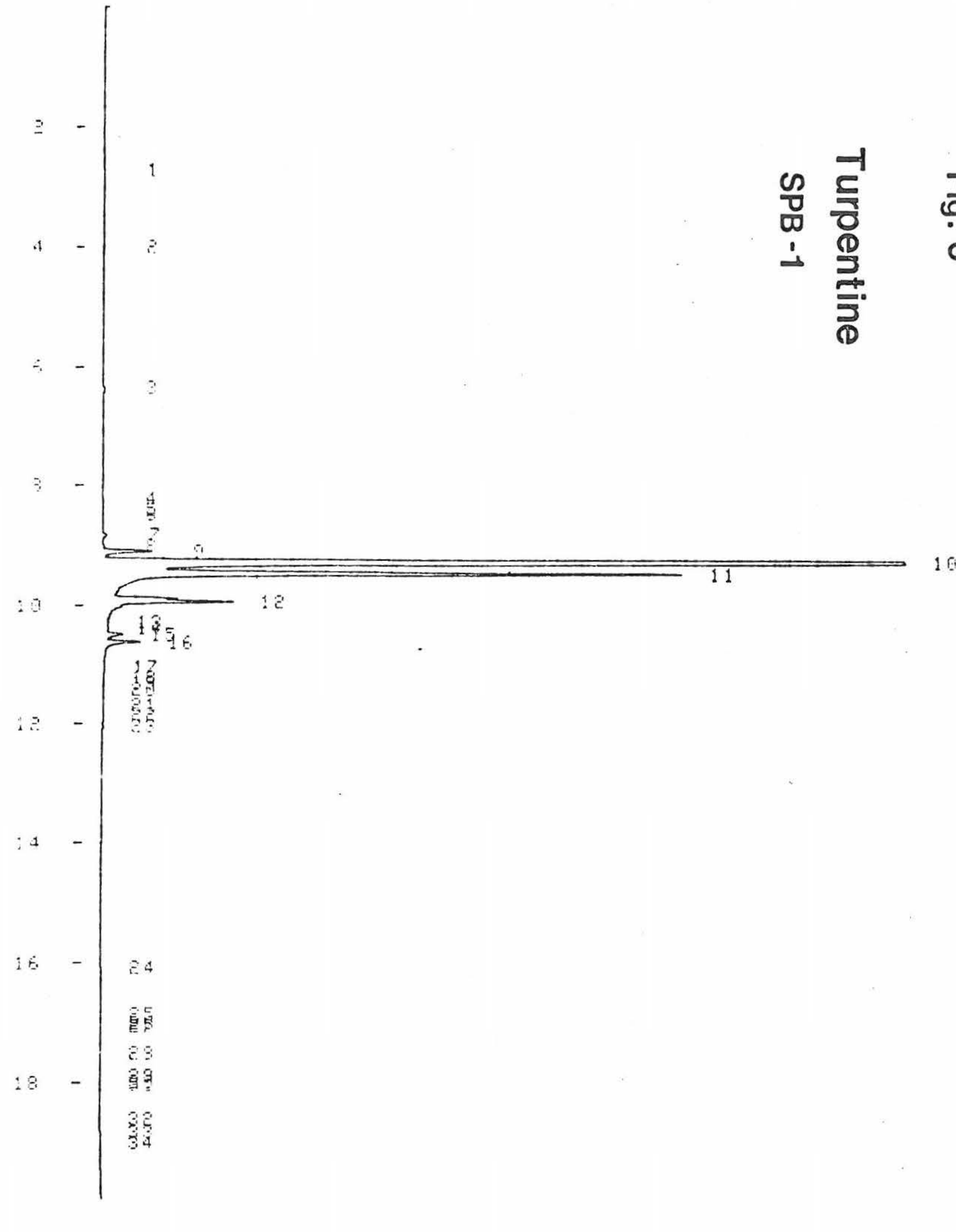


Fig. 6
Turpentine
SPB-1

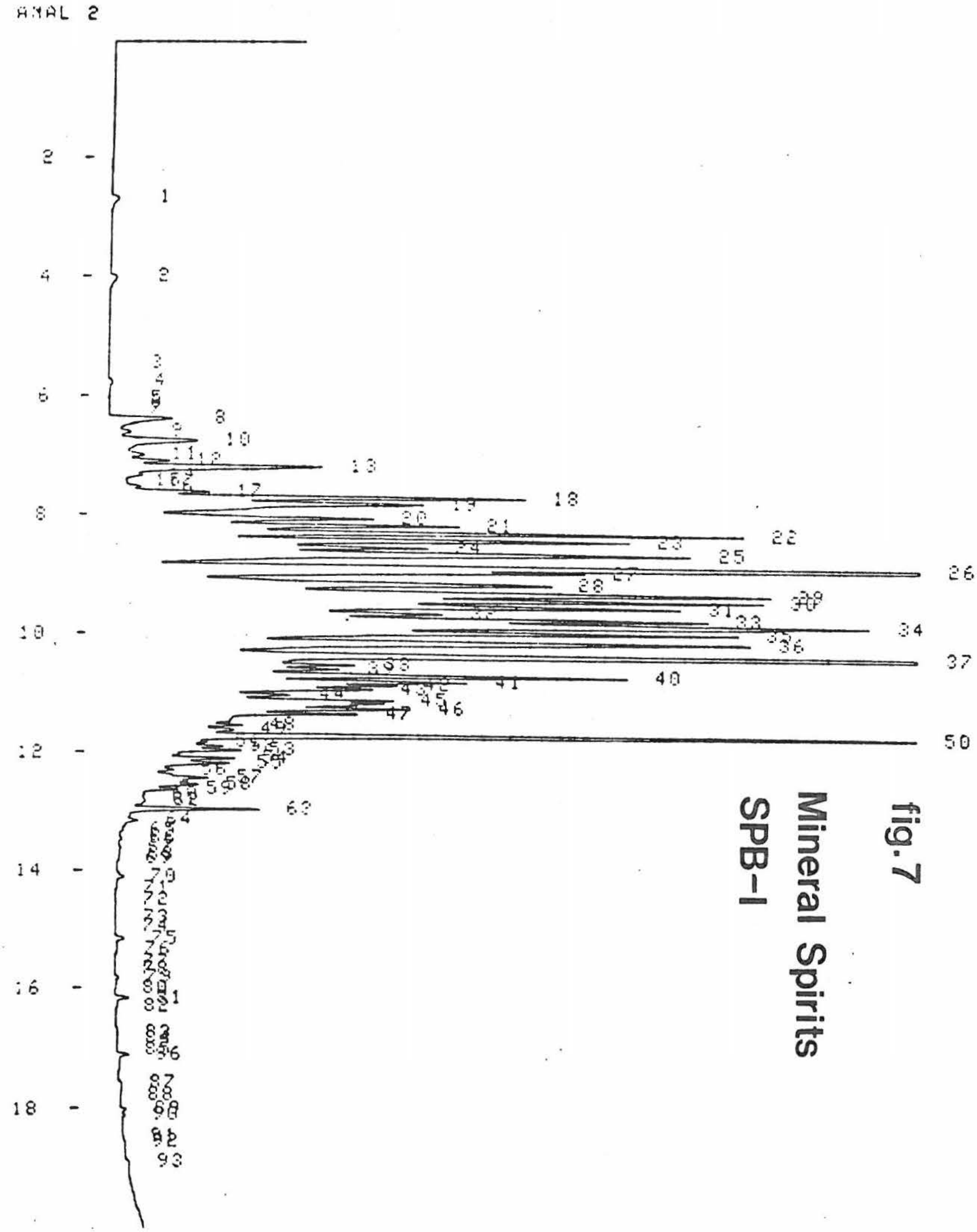
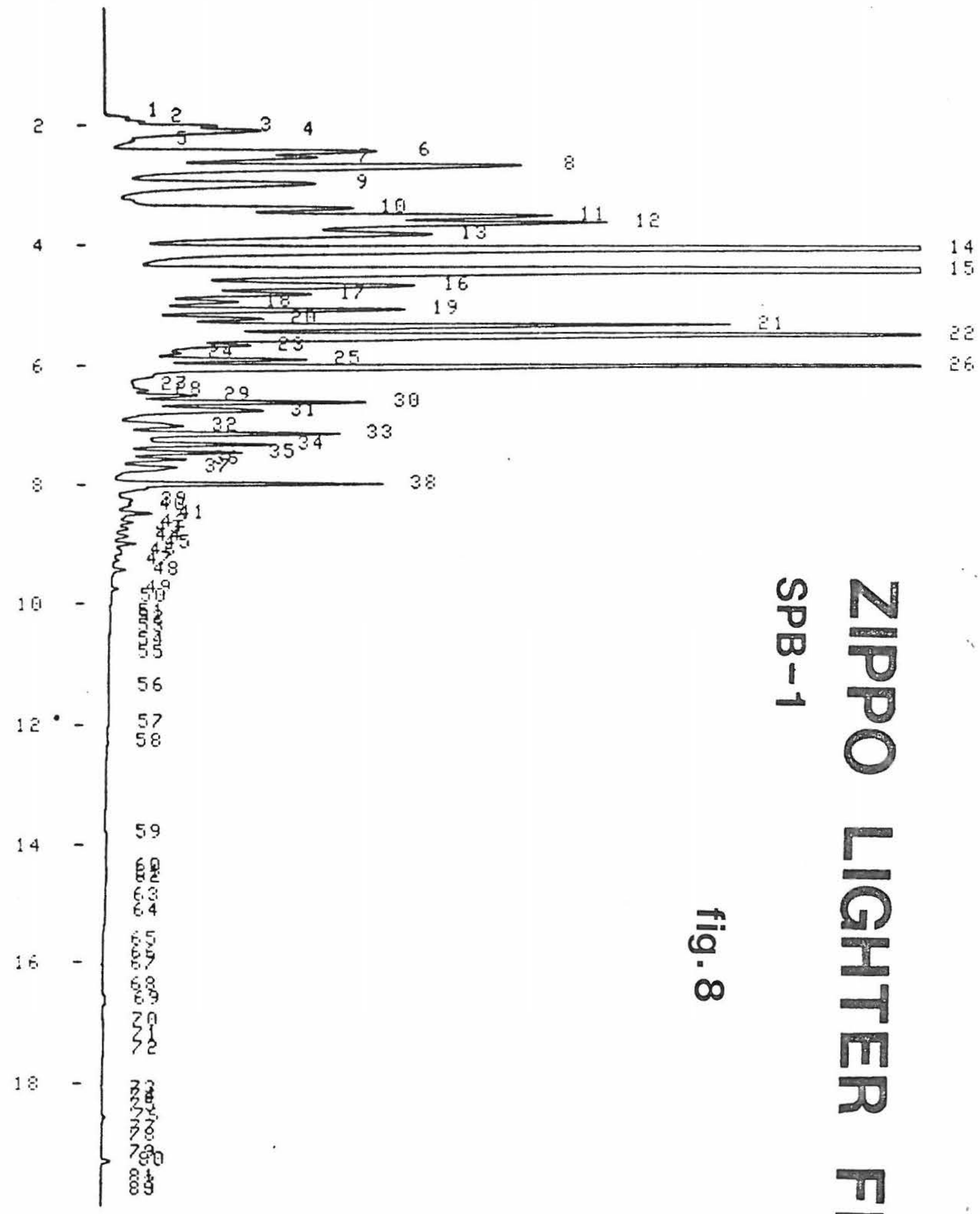


fig.7
Mineral Spirits
SPB-I

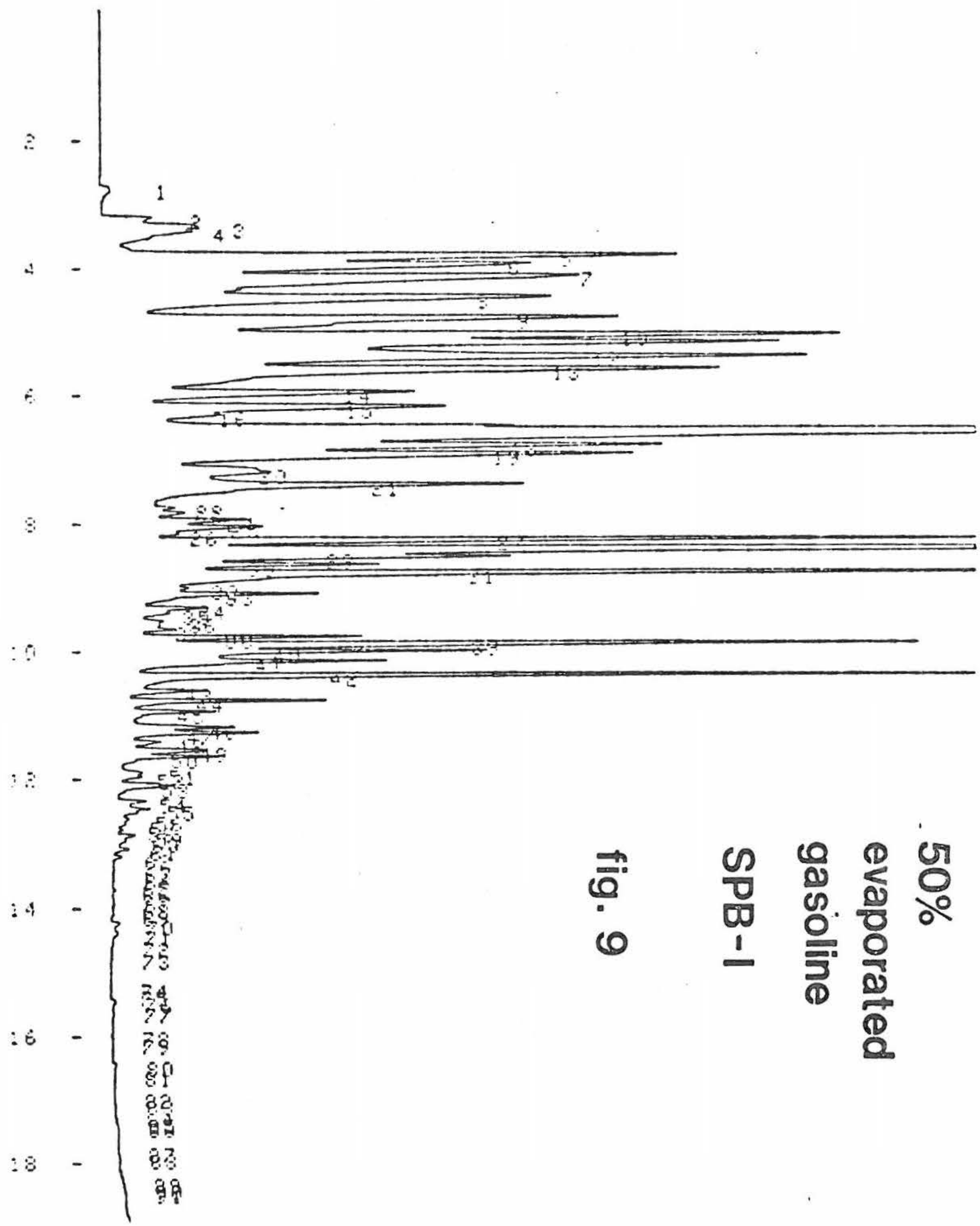
ANAL 4



ZIPPO LIGHTER FLUID
SPB-1

fig. 8

RUN
OPERATOR? TAB
DATE? 9-7-84
COLUMN,#? A
LENGTH(FT.)? 30METERS
INLET(PSIG)? 60

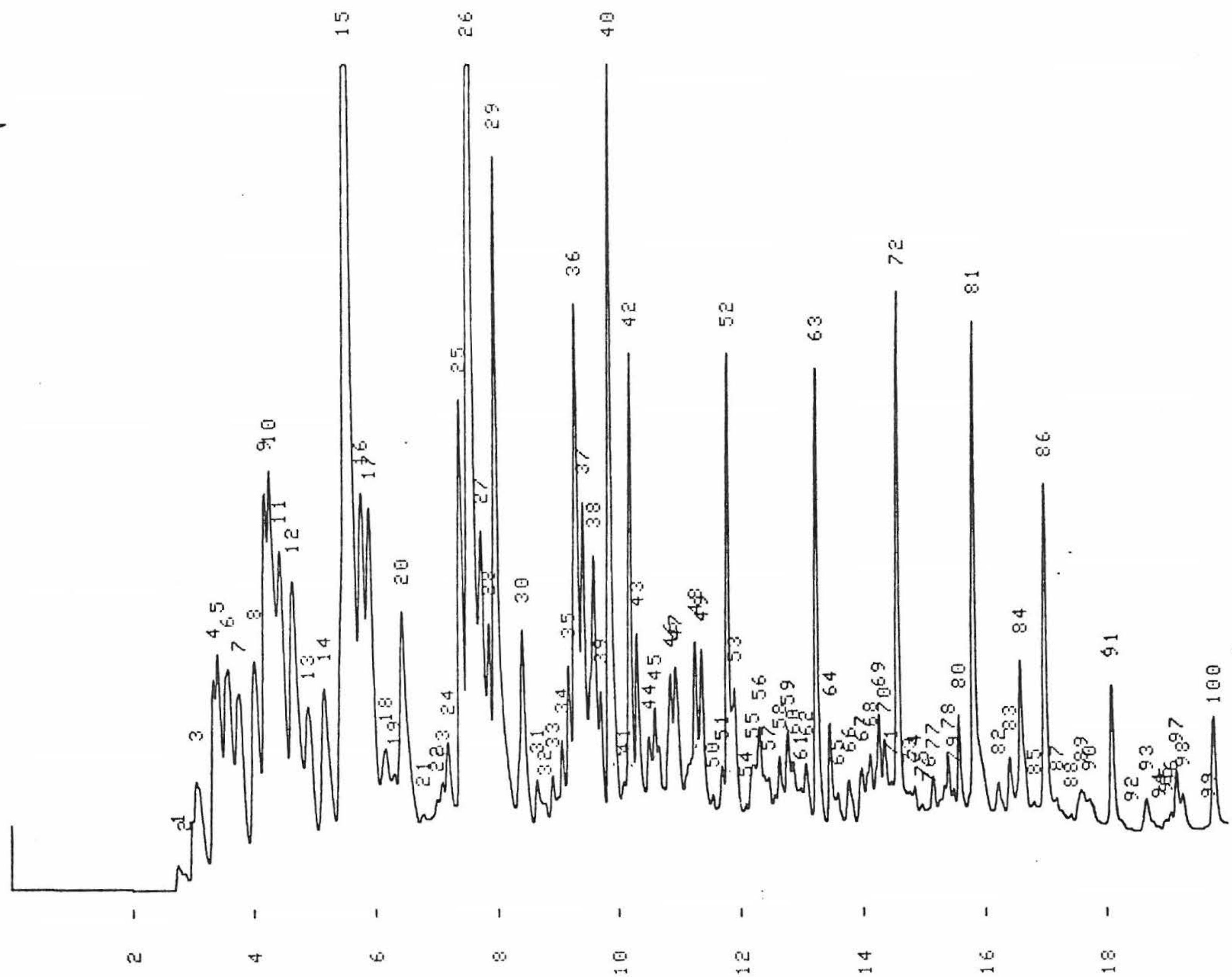


50% evaporated gasoline SPB-I

fig. 9

GASOLINE - KEROSENE MIXTURE SPB-1

fig. 10



AA Notes

IMPORTANT NOTICE

As all of you are probably aware, the AAN has suffered from reader apathy from its conception. The reader apathy transfers into AAN's that are not issued on a timely schedule due to lack of articles and information.

Accordingly, no AAN was published in "1985" for invoicing purposes. Monies sent to cover your subscription for 1985 will be applied to 1986.

Hopefully, the subscription year 1986 will bring in sufficient articles and information to keep us on schedule.

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