OTWAY BASIN

AMDEL

SOURCE ROCK ANAL

FLAXMAN, MUSSEL, NAUTILUS, PECTEN, PRAWN.

TABLE 1: WELLS AND INTERVALS SAMPLED FOR SOURCE ROCK ANALYSIS

Well	Interval Sampled ft
Flaxmans-1	5510-5530
	8090-8150
	8950-9350
	9650-9680
	9950-10050
	10350-10400
Mussel-1	4680-4910
	7150-7210
	7730-7910
	7980-8030
Nautilus-1	5950-6950
Pecten-1	6930-6960
	8010-8050
	9230-9330
Prawn-A1	*9860
	9900-9910
	9940-9950
	10120-10130
	10210-10220
	10280-10290

*Core; all other samples cuttings

HYDROCARBON SOURCE POTENTIAL OF SELECTED ROCK SAMPLES FROM FIVE EXPLORATION WELLS, EASTERN OTWAY BASIN

Bass Strait Oil & Gas (Holdings) N.L.

F3/0/0-6901/84 July, 1984

BY

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07 SEP 1984

18 July 1984

OIL and GAS DIVISION

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Attention: Mr Richard Ingram

REPORT F6901/84

CLIENT REFERENCE:	Letter dated 28 May 1984
TITLE:	Hydrocarbon source potential of selected rock samples from five exploration wells, eastern Otway Basin.
MATERIAL:	Cuttings, core
LOCALITIES:	FLAXMANS-1, MUSSEL-1, NAUTILUS-1, PECTEN-1, PRAWN-A1
SAMPLE IDENTIFICATION:	As specified in report
DATE RECEIVED:	28 May 1984
WORK REQUIRED:	Total organic carbon. Rock-Eval pyrolysis. Liquid chromatography of extract. Gas chromatography of saturates. Kerogen isolation and analysis by pyrolysis-gas chromatography. Interpretation.

Investigation and Report by: Dr David M. McKirdy

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1. INTRODUCTION

Nineteen cuttings and one core sample from five petroleum exploration wells in the eastern Otway Basin were received for source rock analysis (Table 1). The resulting analytical data are used to assess the hydrocarbon generating potential (maturity, source richness, kerogen type) of the rocks sampled.

2. ANALYTICAL PROCEDURES

2.1 Sample Preparation

The rock samples (as received) were ground in a Siebtechnik mill for 20-3 secs.

2.2 Total Organic Carbon (TOC)

Total organic carbon was determined by digestion of a known weight (0.2-0.5 g) of powdered rock in 50% HCl to remove carbonates, followed by combustion in oxygen in the induction furnace of a Leco IR-12 Carbon Determinator and measurement of the resultant CO_2 by infra-red detection.

2.3 Rock-Eval Analysis

A 100 mg portion of powdered rock was analysed by the Rock-Eval pyrolysis technique (Girdel IFP-Fina Mark 2 instrument; operating mode, Cycle 1).

2.4 Extractable Organic Matter (EOM)

Powdered rock (10-60 g) was extracted with methylene chloride/methanol (85:15) in a Soxhlet apparatus for 24 hrs. Removal of solvent by careful rotary evaporation gave the crude extract (nominally C_{15+} EOM).

2.5 Liquid Chromatography

Asphaltenes were precipitated from the extract with petroleum ether (IP method 143/57), and the asphaltene-free fraction separated into saturated hydrocarbons, aromatic hydrocarbons and polar compounds (resins) by liquid chromatography on 20 parts activated alumina under 80 parts activated silica gel. The saturates were eluted with petroleum ether, the aromatics with petroleum ether/methylene chloride (91:9), and the resins with methanol/methylene chloride (65:35) followed by methanol.

2.6 Gas Chromatography

The saturated hydrocarbons (alkanes) were examined by gas chromatography using the following instrumental parameters:

Gas chromatograph:	Perkin Elmer Sigma 2 fitted with Grob injector.
Column:	25 m x 0.33 mm fused silica, SGE QC3/BP1
Detector:	FID
Injector and detector temperature:	280°C
Carrier gas:	H_2 at 9 psi
Column temperature:	80°C for 4 mins, then 5° per minute to 295°C and held at 295° until all peaks eluted.
Quantitation:	Relative concentrations of individual normal and isoprenoid alkanes obtained by measurement of peak areas with a Spectra-Physics SP4270 integrator.

2.7 Kerogen Isolation

Solvent-extracted rock powder was digested in 5N HCl on a steam bath, with occasional agitation, for 1-2 hours. The carbonate-free residue was then washed thoroughly with distilled water, before acid digestion in conc. HF/HCl (5:1) for 2-3 hours. The spent acid was carefully decanted and the residue washed in distilled water until neutral. The kerogen concentrate was then dried in air at 50°C.

2.8 Pyrolysis-Gas Chromatography (PGC)

The kerogen concentrate was analysed by pyrolysis-gas chromatography (PGC), as follows:

Instrument:	Chemical Data Systems Pyroprobe 120 solids pyrolyser (incorporating 382 extended temperature programming option), in tandem with Perkin Elmer Sigma 3 gas chromatograph.
Column:	25 m x 0.33 mm fused silica SGE QC3/BP1
Carrier gas:	He at 36 cm/sec
Detector:	FID
Injector and detector temperature:	280°C
Sample size:	5 mg
Pyrolysis temperature:	700°C for 30 sec.
Column temperature:	-40°C while trapping pyrolysate on front end of column; then 10°C for 3 min, 10-280°C at 5°/min, and held at 280°C.

3. RESULTS

TOC and Rock-Eval data on Flaxmans-1, Mussel-1, Nautilus-1, Pecten-1 and Prawn-A1 are listed in Tables 2-6, respectively. Figures 1-5 are cross plots of hydrogen index versus Tmax which demonstrate kerogen type and maturity for the sample suite from each of these wells.

EOM data on five samples from Flaxmans-1, Pecten-1 and Prawn-A1 high-graded by Rock-Eval analysis are presented in Tables 7-11, Figures 6-10 (saturates chromatograms) and Figures 11-15 (n-alkane and isoprenoid distributions).

Kerogen PGC data are summarised in Table 12 and plotted in Figure 16. Figures 17-20 are PGC traces of the four kerogens analysed.

4. DISCUSSION

4.1 Maturity

Rock-Eval pyrolysis data (Figs. 1-5) provide the following estimates of thermal maturity, expressed as vitrinite reflectance (VR):

Well	Interval ft	Tmax °C	Equiv. VR %
Flaxmans-1	8950-10360	440-451	0.6-0.9
Mussel-1	4680-8030	421-435	<0.5
Nautilus-1	5950-6950	429	<0.5
Pecten-1	8010-9330	443-444	∿0.7
Prawn-A1	9860-10290	425-437	0.4-0.6

These results are in reasonable to good agreement with published VR data for Pecten-1, Mussel-1 and Nautilus-1 (Middleton & Falvey, 1983).

The principal rank thresholds for hydrocarbon generation from terrigenous organic matter (after Snowdon & Powell, 1982; Powell & Snowdon, 1983; and Monnier *et al.*, 1983) are as follows:

Threshold	VR %
top oil window (resinite-rich)	0.45
top gas window	0.6
top oil window (resinite-poor)	0.7

Oil generation from algal and/or bacterial organic matter commences at VR = 0.5%.

Thus, only one of the samples analysed herein (viz. Flaxmans-1, 10350-10400 ft) comes from within the main zone of oil generation for terrigenous organic matter.

The low proportion of hydrocarbons (<30% of EOM) in the five rock extracts (Tables 7-11) also, in part, reflects this lack of maturity.

4.2 Source Richness

Three quarters of the samples examined have total organic carbon contents (Table 2) which exceed the minimum value (TOC = 0.5%) commonly considered necessary for the generation and expulsion of producible quantities of hydrocarbons from a fine-grained siliciclastic rock (shale, siltstone). TOC values greater than 2% probably indicate the presence of coal in the cuttings.

Source richness is in most cases poor, as indicated by potential hydrocarbon yields ($S_1 + S_2$) of less than 2 kg/tonne. However, the following samples have $S_1 + S_2$ values characteristic of fair to good oil-source rocks:

Well	Depth ft	$S_1 + S_2$ kg h'c/tonne	Richness
Flaxmans-1	9650-9680	11.0	good
Pecten-1	8010-8050	2.1	fair
Prawn-A1	9860	4.7	fair
	10210-10220	2.7	fair
	10280-10290	4.6	fair

4.3 Source Quality and Kerogen Type

Hydrogen indices in the range HI = 0-190 (Table 2) suggest that these rocks contain organic matter of humic Type III, tending to inertinitic Type IV, composition (Figs. 1-5).

Low hydrogen index values (HI <100) generally correlate with the presence of dry gas-prone, inertinite-rich dispersed organic matter (DOM).

Four samples appear to contain Type III kerogen which has significant liquids-generating potential. They are as follows:

Well	Depth ft	Hydrogen Index mg S_2/g TOC
Flaxmans-1	9650-9680	186
Prawn-A1	9860	176
	10210-10220	189
	10280-10290	179

The oil and gas-prone character of these kerogens is demonstrated by their PGC traces (Figs. 17-20). The pyrolysate of all four kerogens contains a high proportion of C_{15}+ n-alkenes/n-alkanes (Table 12). The somewhat more oil-prone nature of the Flaxmans-1 (9650-9680 feet) and Prawn-A1 (10280-10290 feet) kerogens (Fig. 16) is reflected in the higher abundance of n-alkyl moeities relative to aromatic products (labelled A).

The terrigenous (land-plant) source affinity of these kerogens, and of kerogen in the Pecten-1 (8010-8050 feet) sample, is confirmed by the high pristane/phytane ratios of their associated EOM (pr/ph = 3-8 : Tables 7-11). The lower pristane/phytane ratios (pr/ph ∿2) of the Prawn-A1 (9860-9870 and 10210-10220 feet) extracts correlate with anomalously high C_{15}+ hydrocarbon yields (83-100 mg/g TOC) and the occurrence of prominent naphthene humps in the saturates chromatograms (Tables 9 and 10, Figs. 8 and 9). Both these samples are from sandy intervals and may contain partially biodegraded reservoir bitumen. Alternatively, they may be contaminated (e.g. by pipe dope).

5. CONCLUSIONS AND RECOMMENDATIONS

1. Preliminary source-rock analysis of Cretaceous sediments from five wells in the eastern Otway Basin indicates that the well sections sampled, viz.

Flaxmans-1	5510-10050 feet
Mussel-1	4680-8030 feet
Nautilus-1	5950-6950 feet
Pecten-1	6930-9330 feet
Prawn-A1	9860-10290 feet

   all lie above the top of the oil-generation window for resinite-poor terrigenous organic matter. One Otway Group sample from below 10300 feet depth in Flaxmans-1 is oil-mature.

2. Siliciclastics represented by the cuttings and core examined generally contain poor quality, gas-prone terrigenous organic matter.

3. Notable exceptions are carbonaceous shale and siltstone from Flaxmans-1 (9650-9680 feet) and Prawn-A1 (9860 and 10210-10290 feet) in which oil and gas-prone, woody-herbaceous, Type III kerogen (HI $\sim$180 mg hydrocarbons/g TOC) is present. This particular organic facies, where it has attained somewhat higher levels of thermal maturity than exist at these two well localities, is a potential source of waxy paraffinic oil of the type found in Port Campbell-4.

4. The foregoing conclusions are based on only twenty spot samples from five exploration wells. Such sampling is totally inadequate and cannot be regarded as a valid assessment of the hydrocarbon source potential of the Cretaceous section in this part of the Otway Basin.

5. It is recommended that a more comprehensive program of source-rock screening by Rock-Eval pyrolysis be undertaken on cuttings from Flaxmans-1, Mussel-1, Pecten-1 and Prawn-A1, paying particular attention to the Otway Group (Eumeralla Formation). Samples high-graded by Rock-Eval analysis should also be subjected to organic petrological examination in order to establish the abundance and identity of the oil-prone liptinite (exinite) macerals.

6. REFERENCES

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AMDEL

ROCK-EVAL PYROLYSIS

Client BASS STRAIT OIL AND GAS

Well FLAXMANS #1

DEPTH	T MAX	S1	S2	S3	S1+S2	PI	S2/S3	PC	TOC	HI	O
5510.00	428	0.38	1.28	1.10	1.66	0.23	1.16	0.13	1.83	70	6
8090.00	361	0.03	0.05	0.23	0.08	0.37	0.21	0.00	0.25	20	9
8950.00	443	0.01	0.03	0.21	0.04	0.25	0.14	0.00	0.37	8	5
9650.00	440	0.88	10.15	0.35	11.03	0.08	29.00	0.91	5.45	186	
9950.00	330	0.01	0.03	0.21	0.04	0.25	0.14	0.00	0.31	10	8
10350.00	451	0.04	0.16	0.19	0.20	0.20	0.84	0.01	0.35	46	5

AMDEL

ROCK-EVAL PYROLYSIS

29/05/84

Client BASS STRAIT OIL AND GAS

Well MUSSEL #1

DEPTH	T MAX	S1	S2	S3	S1+S2	PI	S2/S3	PC	TOC	HI	OI
4680.00	435	0.08	0.35	0.75	0.43	0.19	0.46	0.03	1.00	35	75
7150.00	421	0.11	0.44	1.16	0.55	0.20	0.37	0.04	1.03	43	113
7730.00	429	0.09	0.45	0.89	0.54	0.17	0.50	0.04	1.35	33	66
7980.00	428	0.54	1.22	0.96	1.76	0.31	1.27	0.14	1.70	72	56

AMDEL

ROCK-EVAL PYROLYSIS

Client BASS STRAIT OIL AND GAS

Well NAUTILUS #1

DEPTH	T MAX	S1	S2	S3	S1+S2	PI	S2/S3	PC	TOC	HI	OI
5950.00	429	0.07	0.44	0.90	0.51	0.14	0.48	0.04	1.16	38	78

TABLE

AMDEL

Page

ROCK-EVAL PYROLYSIS

16/07/8

Client BASS STRAIT OIL AND GAS

Well PECTEN #1

DEPTH	T MAX	S1	S2	S3	S1+S2	PI	S2/S3	PC	TOC	HI	O
6930.00	455	0.03	0.00	0.27	0.03	1.00	0.00	0.00	0.25	0	10
8010.00	443	0.10	1.97	0.31	2.07	0.05	6.35	0.17	1.76	112	1
9230.00	444	0.03	0.34	0.26	0.37	0.08	1.30	0.03	0.63	54	4

AMDEL

ROCK-EVAL PYROLYSIS

Client BASS STRAIT OIL AND GAS

Well PRAWN #A1

DEPTH	T MAX	S1	S2	S3	S1+S2	PI	S2/S3	PC	TOC	HI	O
9860.00	425	1.09	3.60	0.66	4.69	0.23	5.45	0.39	2.04	176	3
9900.00	427	0.20	0.84	0.58	1.04	0.19	1.44	0.08	0.71	118	8
9940.00	433	0.06	0.52	0.55	0.58	0.10	0.94	0.04	0.70	74	7
10120.00	437	0.11	0.78	0.58	0.89	0.12	1.34	0.07	1.07	73	5
10210.00	429	0.42	2.23	0.48	2.65	0.16	4.64	0.22	1.18	189	4
10280.00	437	0.17	4.44	0.51	4.61	0.04	8.70	0.38	2.48	179	2

KEY TO ROCK-EVAL PYROLYSIS DATA SHEET

	PARAMETER	SPECIFICITY
T max	position of S_2 peak in temperature program (^{o}C)	Maturity/Kerogen type
S_1	kg hydrocarbons (extractable)/tonne rock	Kerogen type/Maturity/Migrated oil
S_2	kg hydrocarbons (kerogen pyrolysate)/tonne rock	Kerogen type/Maturity
S_3	kg CO_2 (organic)/tonne rock	Kerogen type/Maturity *
$S_1 + S_2$	Potential Yield	Organic richness/Kerogen type
PI	Production Index ($S_1/S_1 + S_2$)	Maturity/Migrated Oil
PC	Pyrolysable Carbon (wt. percent)	Organic richness/Kerogen type/Maturity
TOC	Total Organic Carbon (wt. percent)	Organic richness
HI	Hydrogen Index (mg h'c (S_2)/g TOC)	Kerogen type/Maturity
OI	Oxygen Index (mg CO_2(S_3)/g TOC)	Kerogen type/Maturity *

*Also subject to interference by CO_2 from decomposition of carbonate minerals.

TABLE 7

AMDEL

SOURCE ROCK ANALYSIS

WELL: FLAXMANS NO.1

SAMPLE: 9650 FT
TYPE OF SAMPLE: CUTTINGS

total organic carbon	5.45 %
weight of sample extracted	33.93 g
weight of eom	229.8 mg
extracted organic matter	6773 ppm
eom as fraction of toc	124.3 mg/g

ANALYSIS OF EXTRACTED ORGANIC MATTER, (%)

SATURATES	13.8
AROMATICS	4.4
RESINS	17.8
ASPHALTENES	63.9

N-ALKANE DISTRIBUTION IN SATURATES

C-NO.	%	C-NO.	%	C-NO.	%	C-NO.	%	C-NO.	%
12	1.6	17	10.0	22	6.1	27	1.7	32	.0
13	4.0	18	9.4	23	5.3	28	.8	33	.0
14	7.0	19	9.1	24	3.9	29	.5	34	.0
15	9.6	20	7.9	25	3.4	30	.3	35	.0
16	10.1	21	7.0	26	2.1	31	.2	36	.0

ISOPRENOID RATIOS

TMTD/pristane ratio	.52
norpristane/pristane ratio	.27
pristane/phytane ratio	7.74
pristane/C-17 ratio	.67
phytane/C-18 ratio	.09

TABLE 8

AMDEL
SOURCE ROCK ANALYSIS

WELL: PECTEN NO.1

SAMPLE: 8010 FT
TYPE OF SAMPLE: CUTTINGS

total organic carbon	1.76 %
weight of sample extracted	56.82 g
weight of eom	126.8 mg
extracted organic matter	2232 ppm
eom as fraction of toc	126.8 mg/g

ANALYSIS OF EXTRACTED ORGANIC MATTER, (%)

SATURATES	5.1
AROMATICS	3.5
RESINS	16.6
ASPHALTENES	74.8

N-ALKANE DISTRIBUTION IN SATURATES

C-NO.	%	C-NO.	%	C-NO.	%	C-NO.	%	C-NO.	%
12	3.7	17	12.1	22	2.7	27	1.4	32	.0
13	8.6	18	8.1	23	2.7	28	.5	33	.0
14	12.9	19	5.7	24	2.0	29	.5	34	.0
15	14.5	20	3.9	25	2.2	30	.2	35	.0
16	14.0	21	3.1	26	1.2	31	.1	36	.0

ISOPRENOID RATIOS

TMTD/pristane ratio	.59
norpristane/pristane ratio	.26
pristane/phytane ratio	6.38
pristane/C-17 ratio	.99
phytane/C-18 ratio	.23

TABLE 9

AMDEL

SOURCE ROCK ANALYSIS

WELL: PRAWN NO.A1

SAMPLE: 9860 FT
TYPE OF SAMPLE: CUTTINGS

total organic carbon	2.04 %
weight of sample extracted	15.97 g
weight of eom	147.7 mg
extracted organic matter	9249 ppm
eom as fraction of toc	453.4 mg/g

ANALYSIS OF EXTRACTED ORGANIC MATTER, (%)

SATURATES	13.3
AROMATICS	5.0
RESINS	23.1
ASPHALTENES	58.6

N-ALKANE DISTRIBUTION IN SATURATES

C-NO.	%	C-NO.	%	C-NO.	%	C-NO.	%	C-NO.	%
12	.1	17	5.0	22	8.8	27	6.4	32	.7
13	.4	18	6.0	23	6.7	28	4.1	33	1.0
14	1.0	19	7.6	24	6.0	29	4.2	34	.4
15	1.9	20	9.7	25	6.2	30	2.5	35	.2
16	3.2	21	10.4	26	5.9	31	1.6	36	.0

ISOPRENOID RATIOS

TMTD/pristane ratio	.22
norpristane/pristane ratio	.34
pristane/phytane ratio	2.17
pristane/C-17 ratio	1.02
phytane/C-18 ratio	.39

CARBON PREFERENCE INDEX (C-23 TO C-33):

C.P.I. = 1.23

TABLE 10

AMDEL
SOURCE ROCK ANALYSIS

WELL: PRAWN NO.A1

SAMPLE: 10210 FT
TYPE OF SAMPLE: CUTTINGS

total organic carbon	1.18 %
weight of sample extracted	9.83 g
weight of eom	44.6 mg
extracted organic matter	4537 ppm
eom as fraction of toc	384.5 mg/g

ANALYSIS OF EXTRACTED ORGANIC MATTER, (%)

SATURATES	17.7
AROMATICS	8.3
RESINS	39.9
ASPHALTENES	34.1

N-ALKANE DISTRIBUTION IN SATURATES

C-NO.	%	C-NO.	%	C-NO.	%	C-NO.	%	C-NO.	%
12	.2	17	9.4	22	6.8	27	4.1	32	.5
13	.7	18	8.9	23	5.8	28	3.0	33	.9
14	2.1	19	8.8	24	4.7	29	2.5	34	.4
15	4.1	20	10.9	25	4.3	30	1.2	35	.3
16	7.3	21	7.6	26	4.3	31	1.0	36	.2

ISOPRENOID RATIOS

TMTD/pristane ratio	.15
norpristane/pristane ratio	.40
pristane/phytane ratio	1.86
pristane/C-17 ratio	.84
phytane/C-18 ratio	.48

CARBON PREFERENCE INDEX (C-23 TO C-33):

C.P.I. = 1.15

TABLE 11

AMDEL

SOURCE ROCK ANALYSIS

WELL: PRAWN NO.A1

SAMPLE: 10280 FT
TYPE OF SAMPLE: CUTTINGS

total organic carbon	2.48 %
weight of sample extracted	10.91 g
weight of eom	24.2 mg
extracted organic matter	2218 ppm
eom as fraction of toc	89.4 mg/g

ANALYSIS OF EXTRACTED ORGANIC MATTER, (%)

SATURATES	14.3
AROMATICS	8.2
RESINS	4.4
ASPHALTENES	73.1

N-ALKANE DISTRIBUTION IN SATURATES

C-NO.	%	C-NO.	%	C-NO.	%	C-NO.	%	C-NO.	%
12	.1	17	10.6	22	6.7	27	3.3	32	.2
13	.6	18	9.9	23	6.4	28	1.7	33	.5
14	2.8	19	7.7	24	5.4	29	1.8	34	.0
15	6.7	20	8.1	25	5.3	30	.6	35	.0
16	10.3	21	7.1	26	3.6	31	.6	36	.0

ISOPRENOID RATIOS

TMTD/pristane ratio	.19
norpristane/pristane ratio	.29
pristane/phytane ratio	3.07
pristane/C-17 ratio	.93
phytane/C-18 ratio	.32

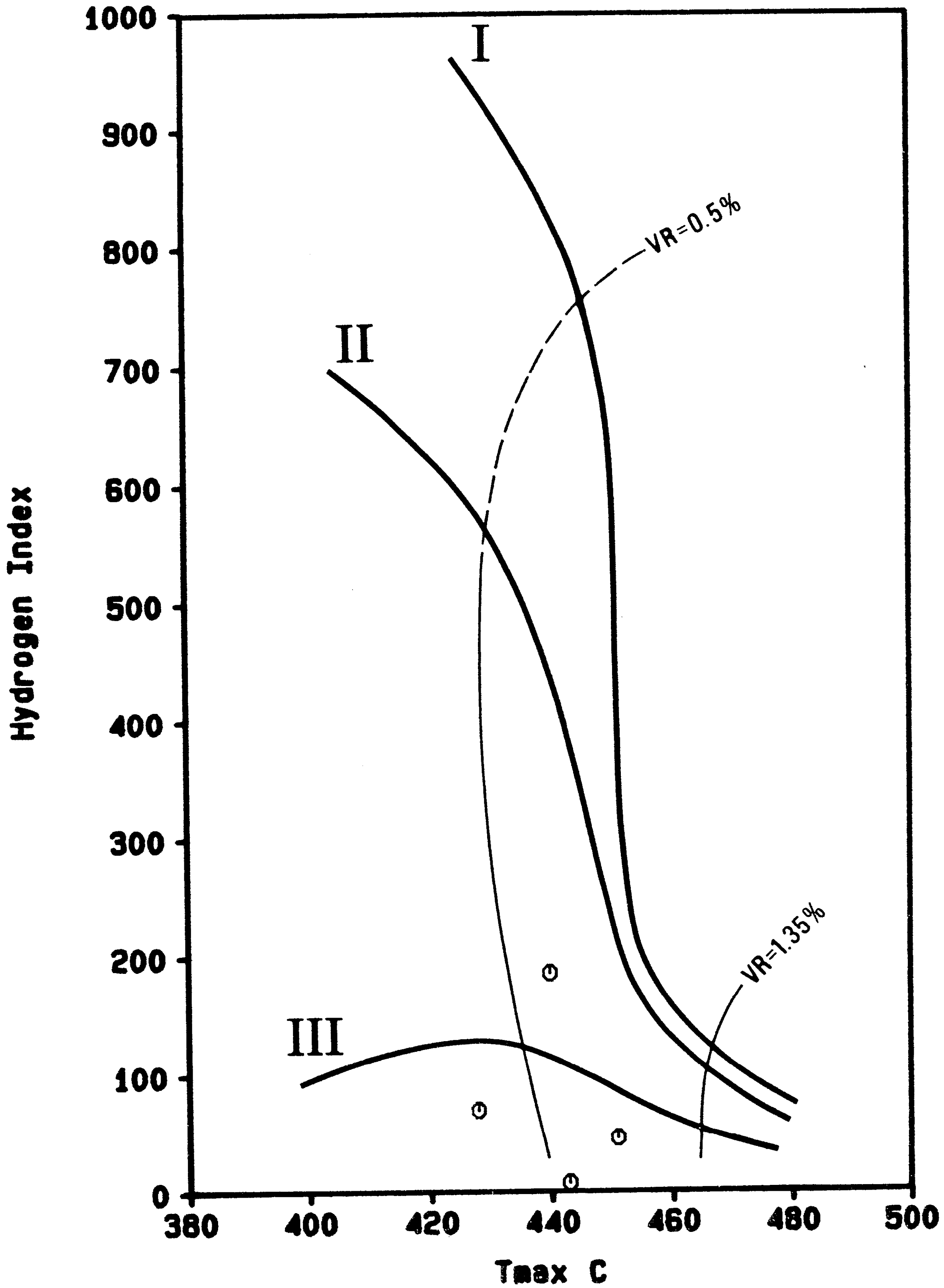
CARBON PREFERENCE INDEX (C-23 TO C-33):

C.P.I. = 1.43

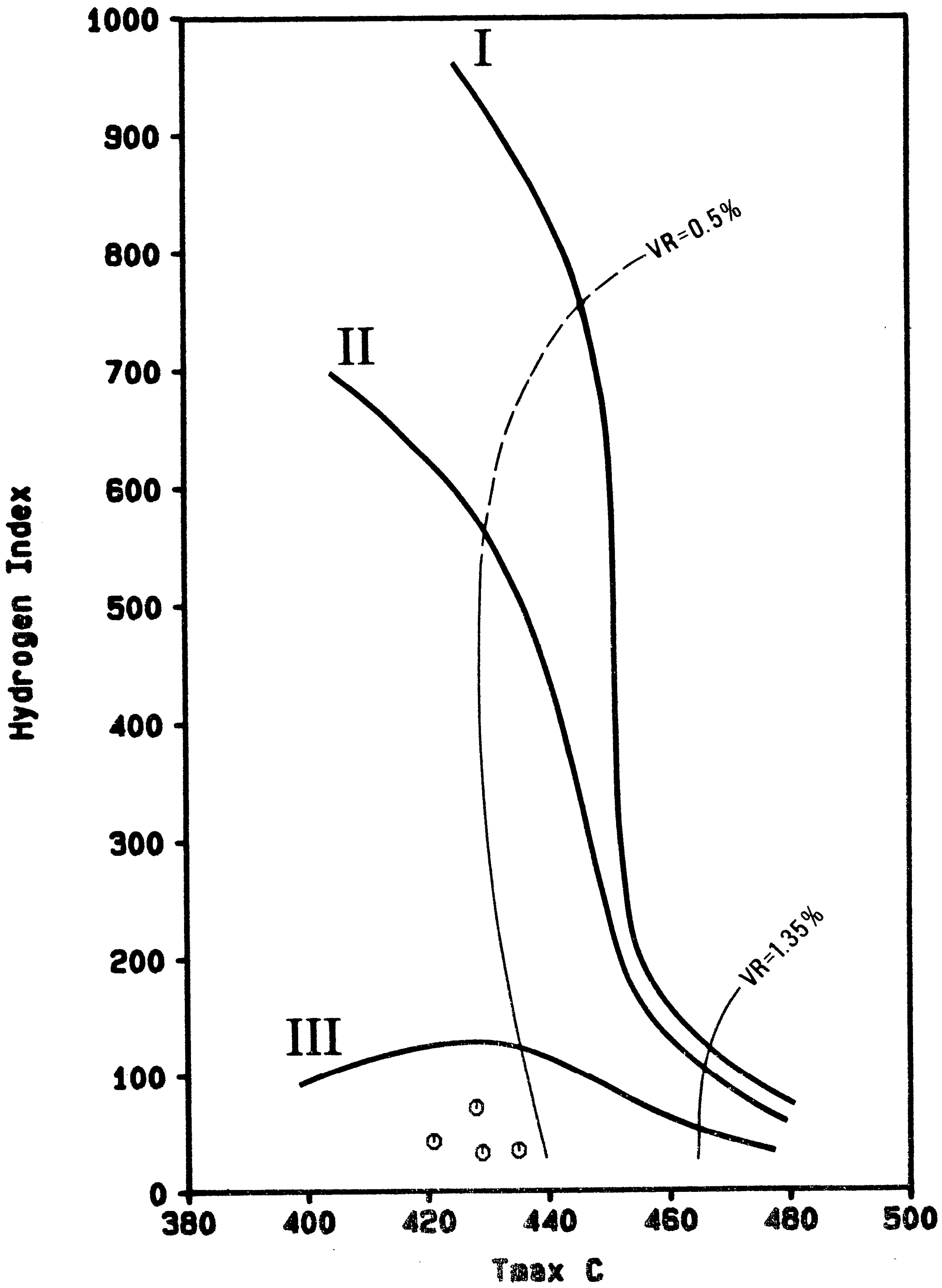
TABLE 12: PYROLYSIS-GC DATA ON KEROGEN CONCENTRATES FROM TWO EXPLORATION WELLS, EASTERN OTWAY BASIN

Well	Depth ft	TOC %	Kerogen concentrate %	Wt. loss after pyrolysis %	n-Alkenes + n-Alkanes			Toluene / n-Heptene	m+p-Xylene / n-Octene
					C_5-C_9 %	C_{10}-C_{14} %	C_{15}+ %		
Flaxmans-1	9650-9680	5.45	3.2	27.2	31	23	46	1.15	0.33
Prawn-A1	9860	2.04	2.9	9.0	27	25	48	1.45	0.91
	10210-10220	1.18	0.96	11.6	31	27	42	1.36	0.61
	10280-10290	2.48	1.6	19.6	25	20	55	0.74	0.46

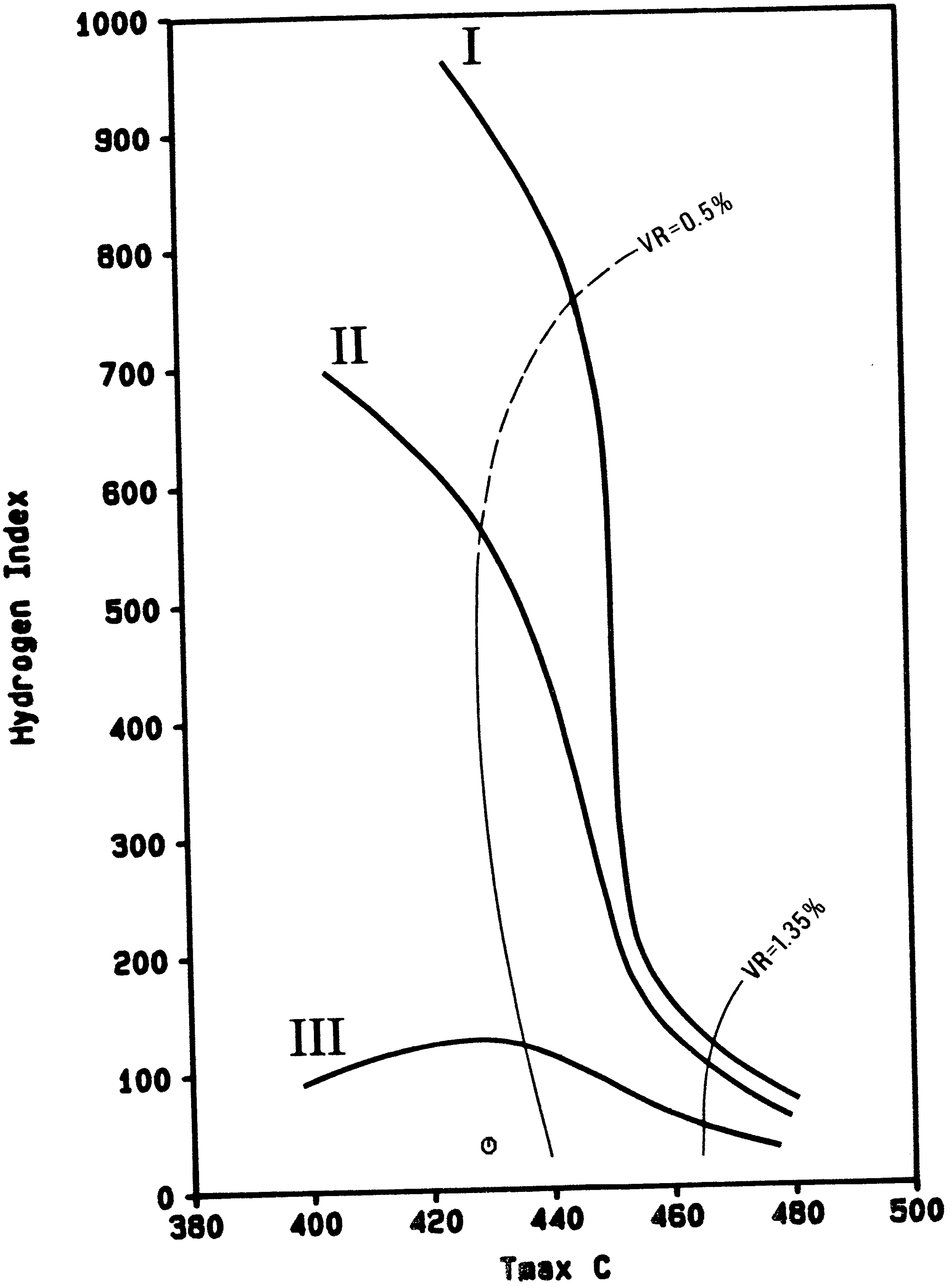
Client : BASS STRAIT OIL AND GAS
Well name : FLAXMANS #1



Client : BASS STRAIT OIL AND GAS
Well name : MUSSEL #1



Client : BASS STRAIT OIL AND GAS
Well name : NAUTILUS #1



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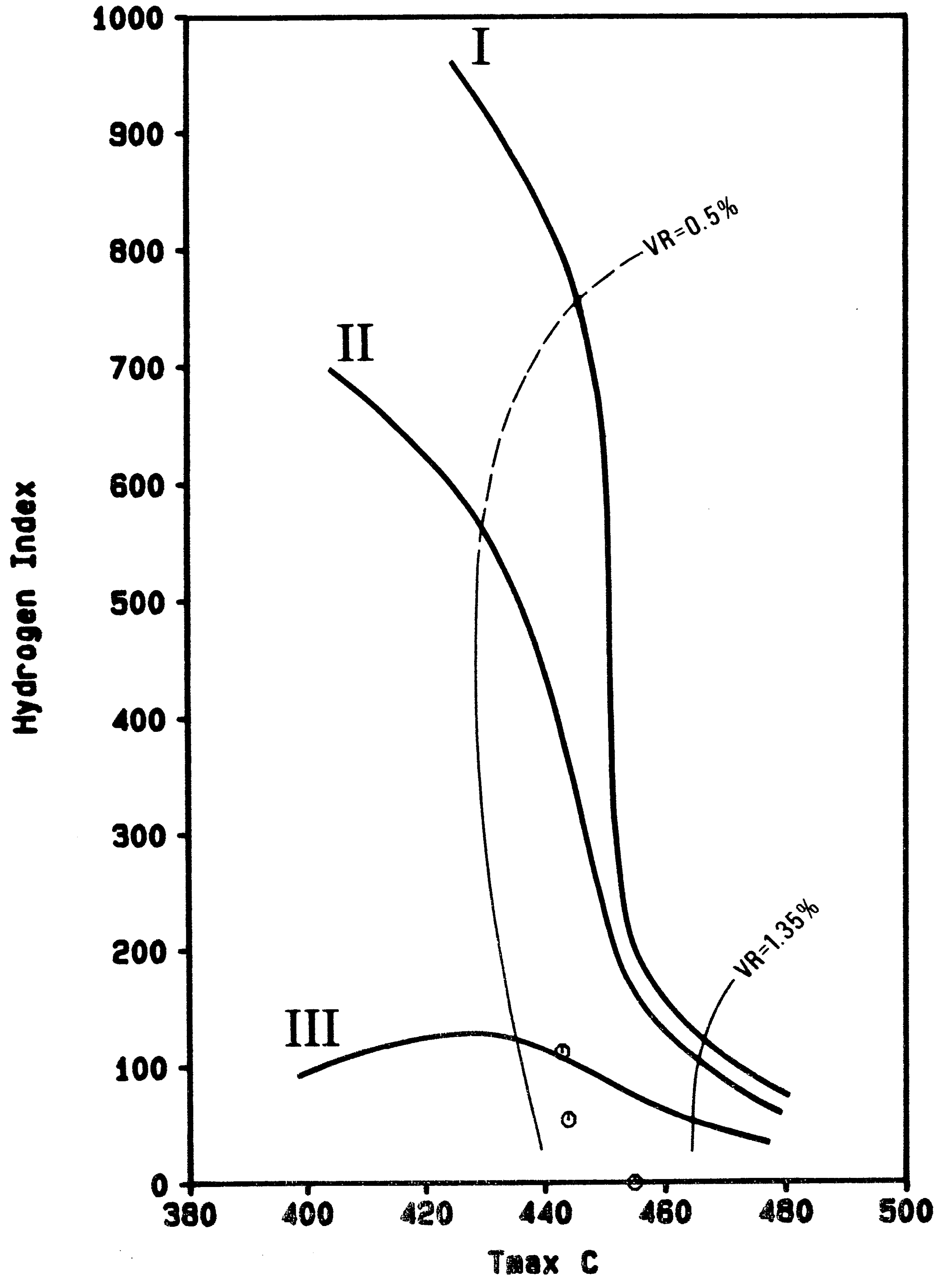
Client : BASS STRAIT OIL AND GAS
Well name : PECTEN #1



Client : BASS STRAIT OIL AND GAS
Well name : PRAWN #1

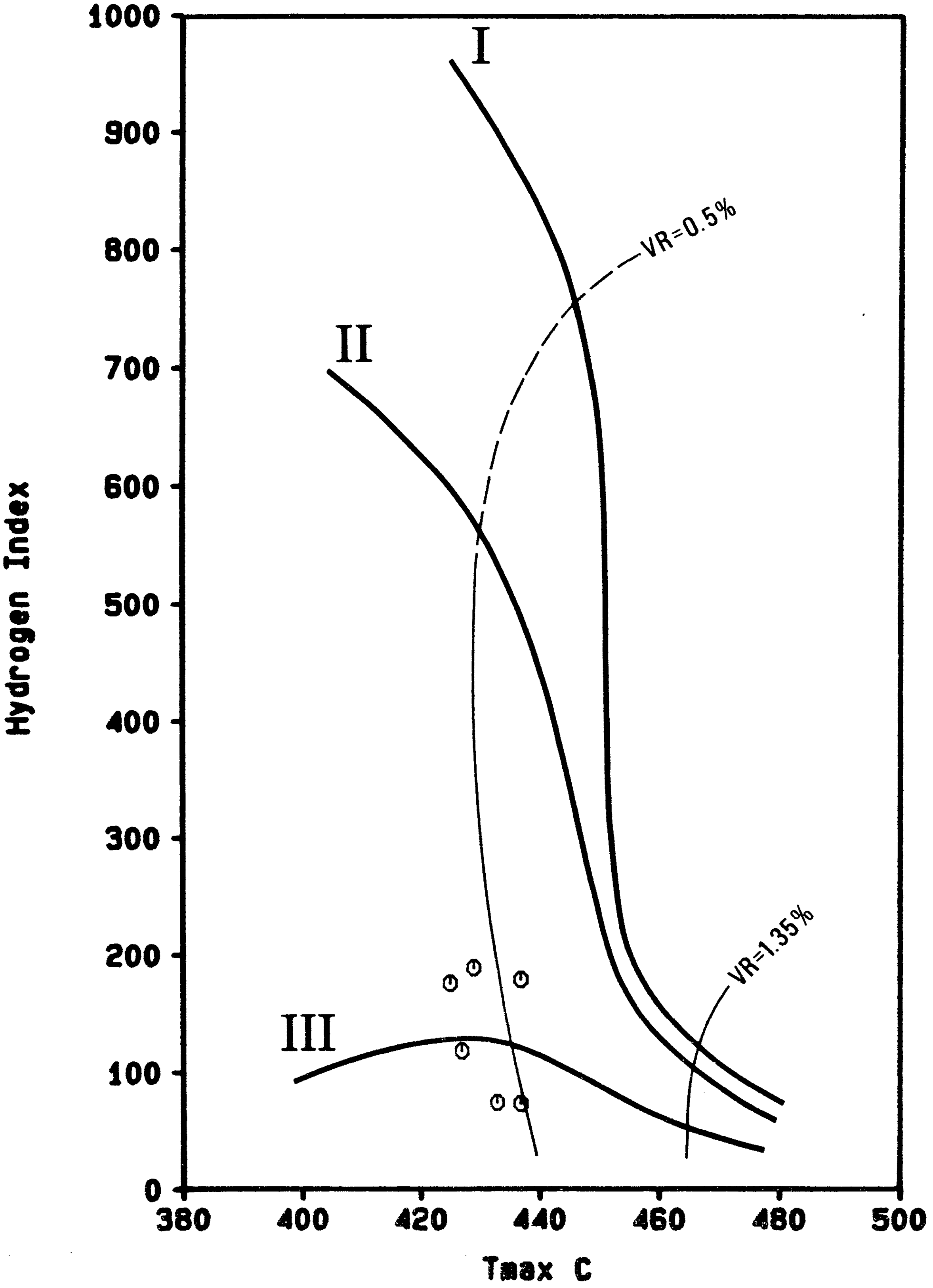


FIGURE 6

FLAXMANS NO.1
9650-9680 FT.
CUTTINGS
SATURATES

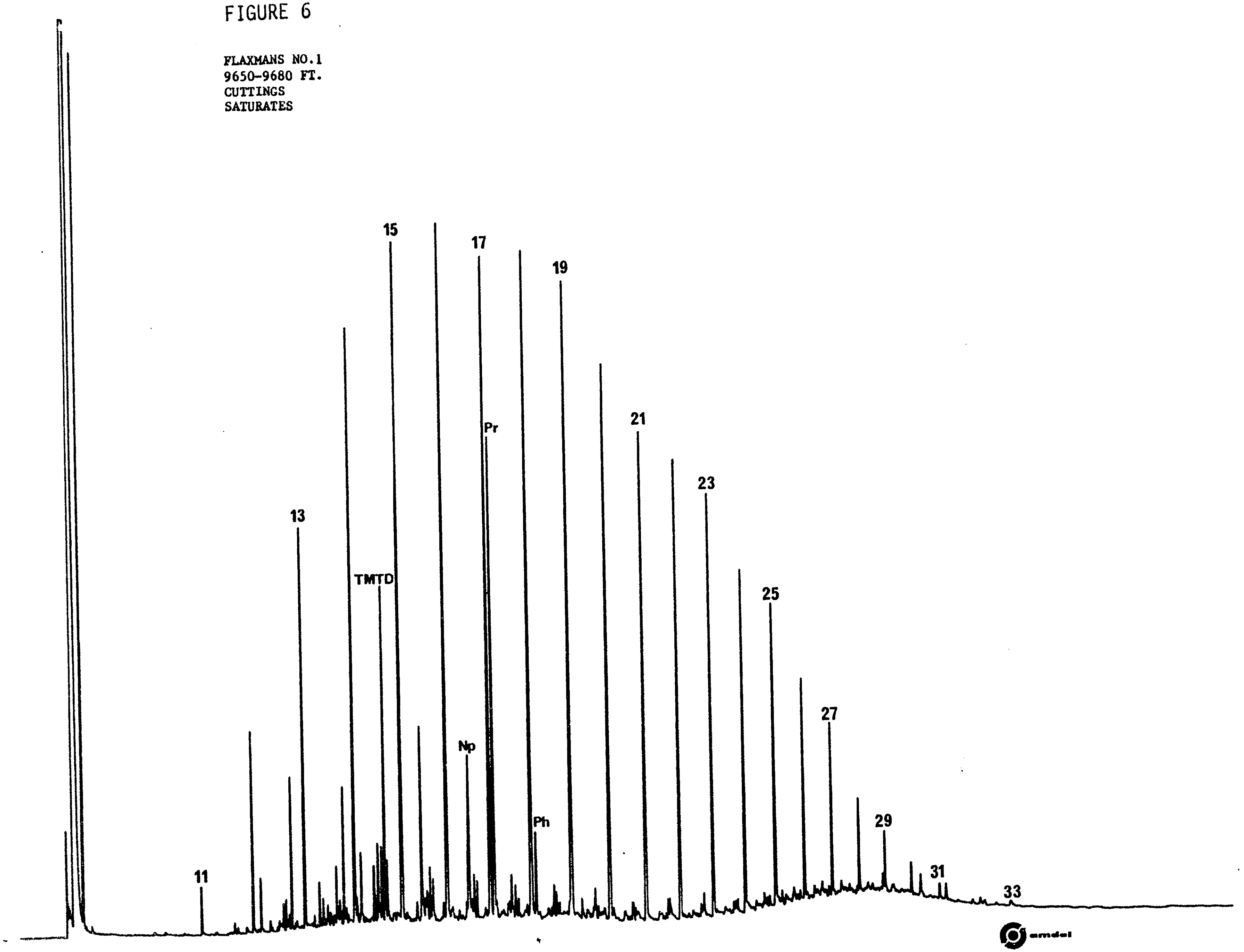


FIGURE 7

PECTEN NO.1
8010-8050 FT.
CUTTINGS
SATURATES

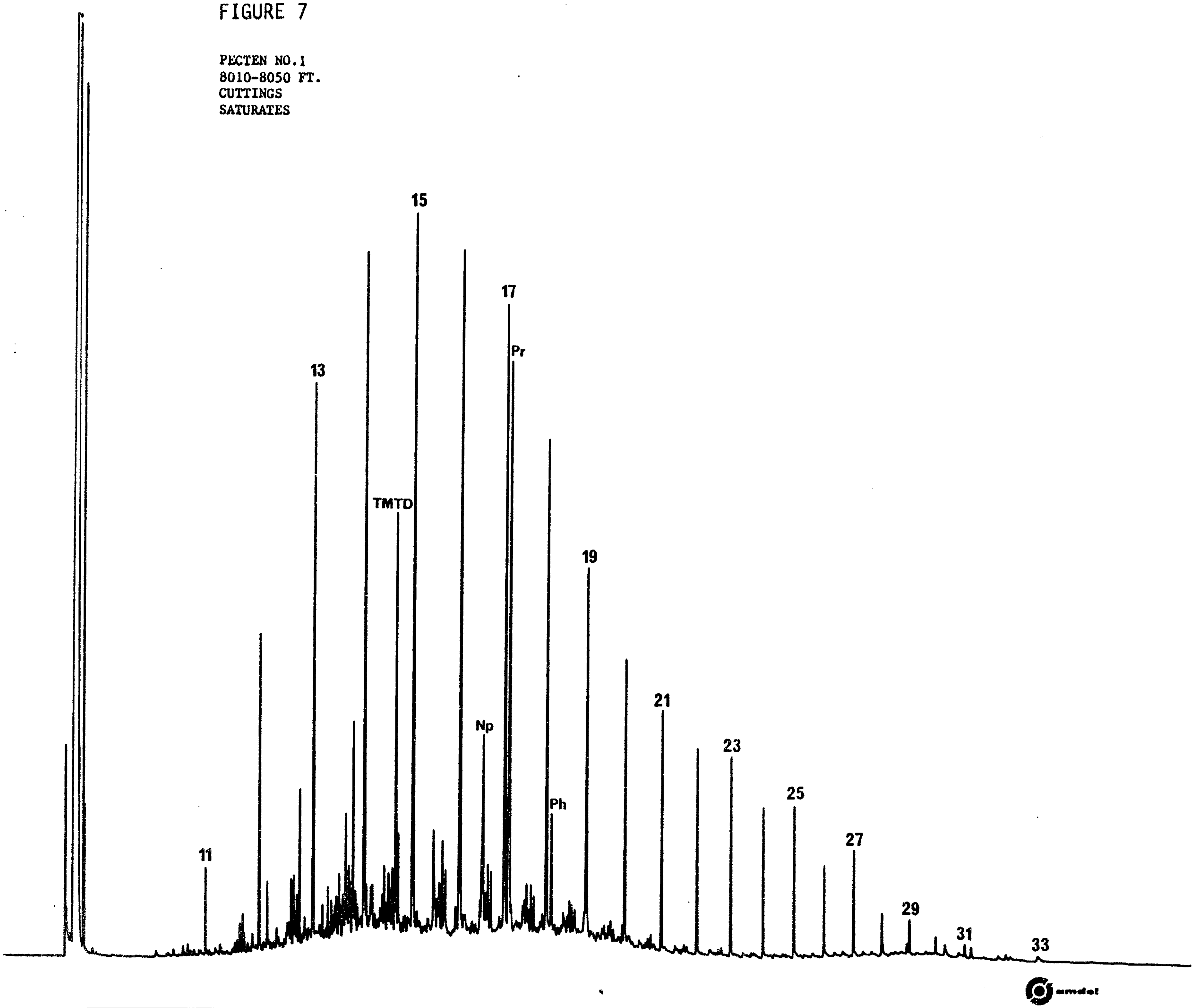


FIGURE 8

PRAWN NO.A1
9860 FT.
CUTTINGS
SATURATES

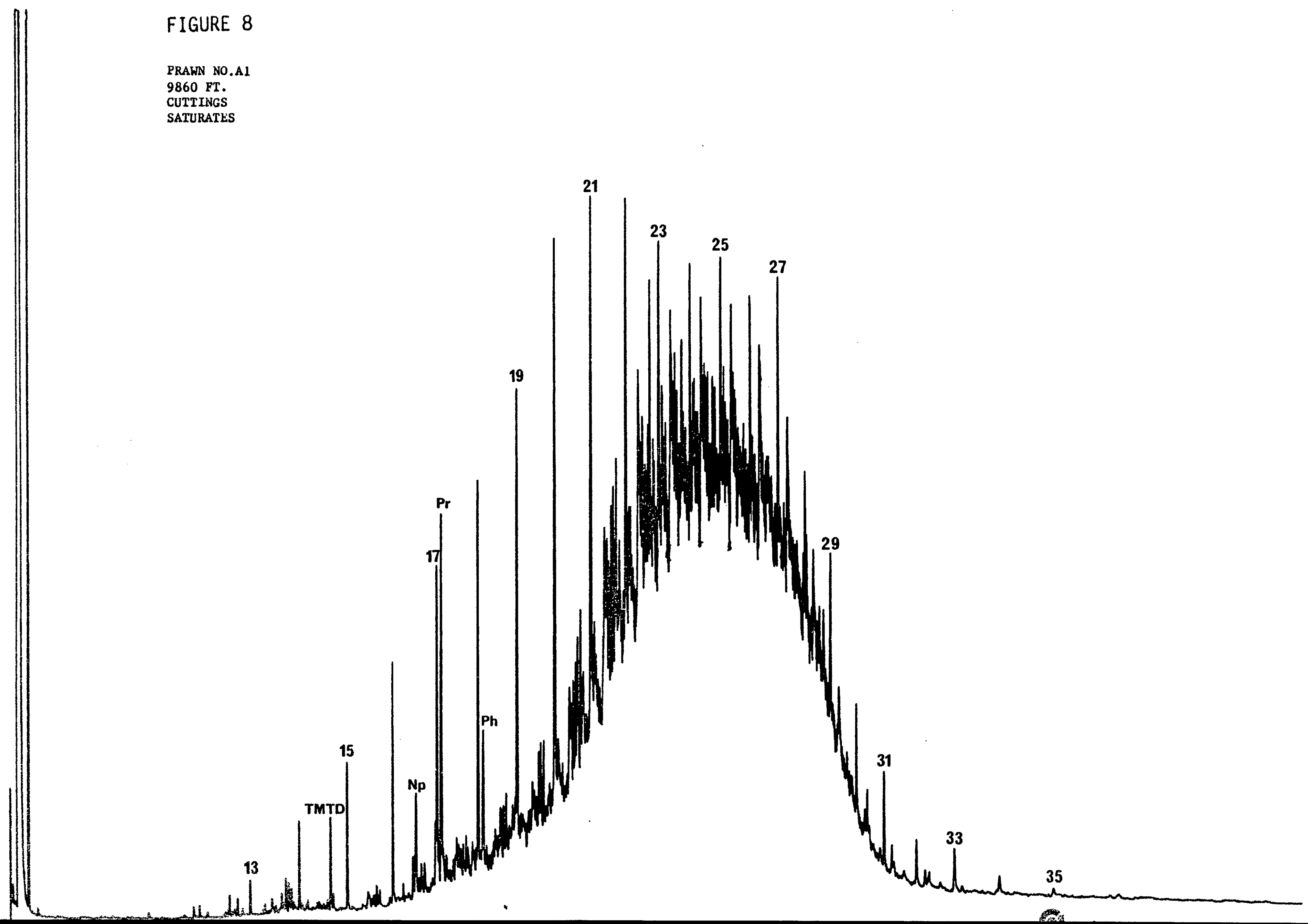


FIGURE 9

PRAWN NO.A1
10210 FT.
CUTTINGS
SATURATES

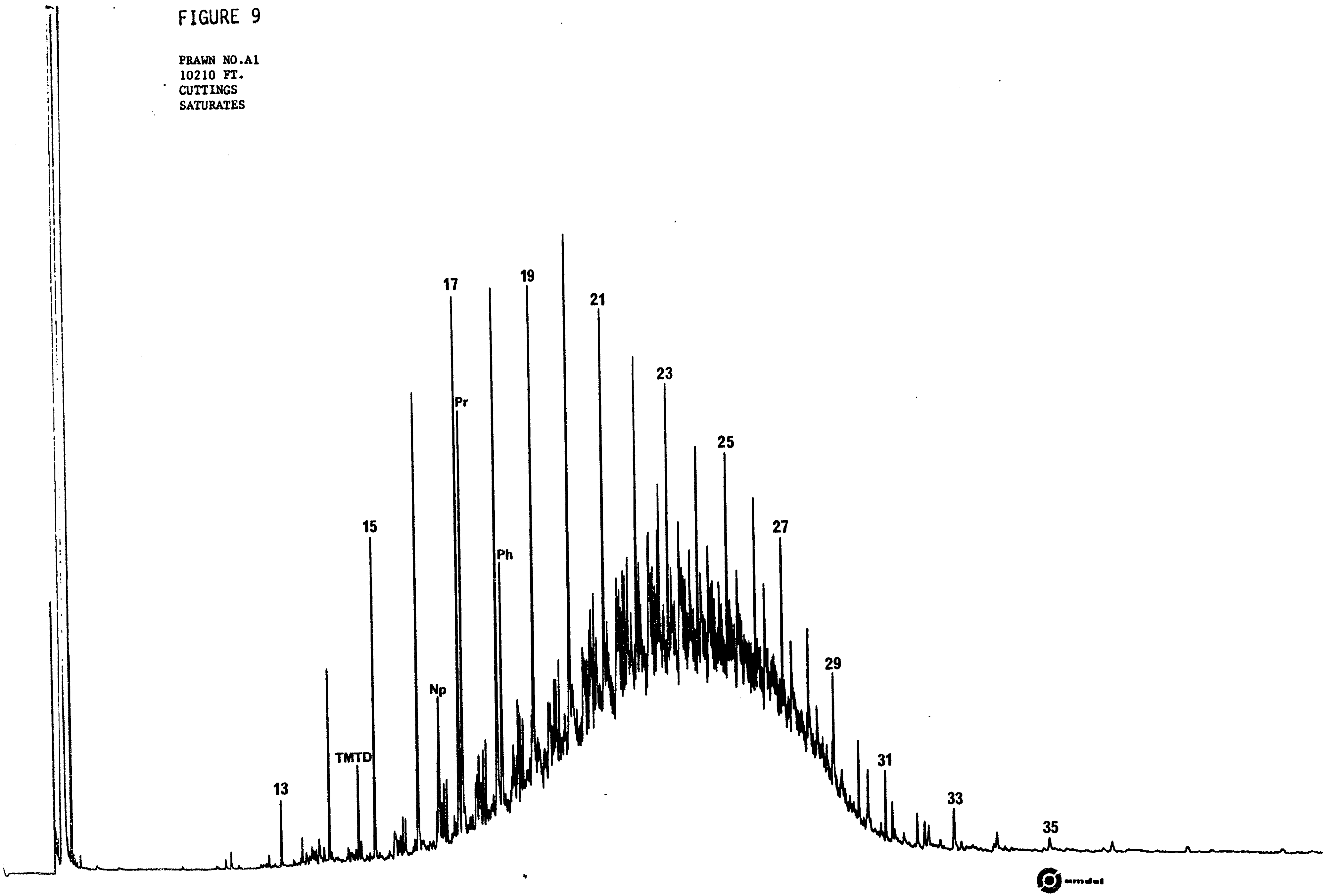


FIGURE 10

PRAWN NO.A1
10280 FT.
CUTTINGS
SATURATES

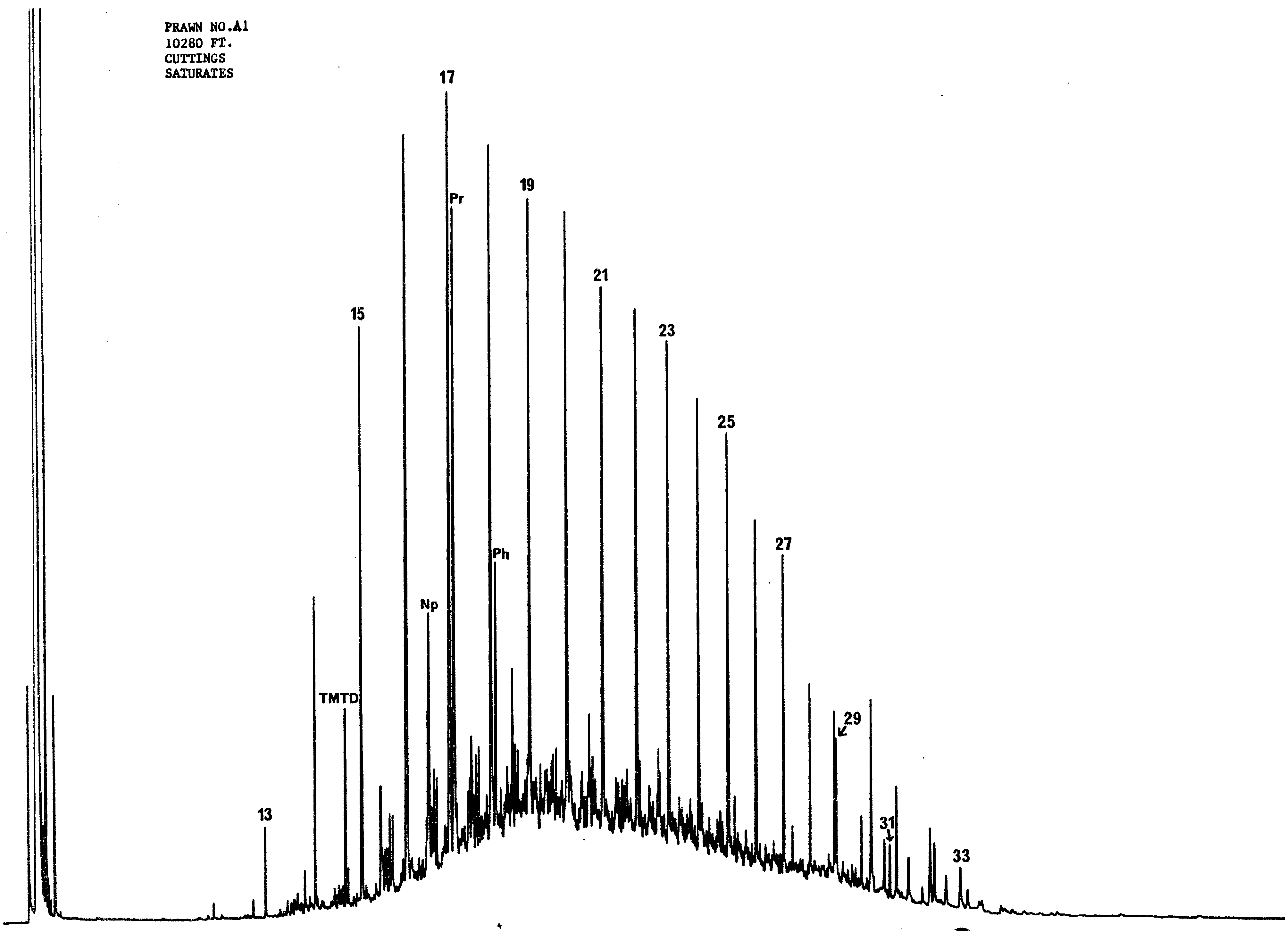


FIGURE 11

FLAXMANS NO.1
9650 FT

N-ALKANE AND ISOPRENOID DISTRIBUTION IN SATURATES

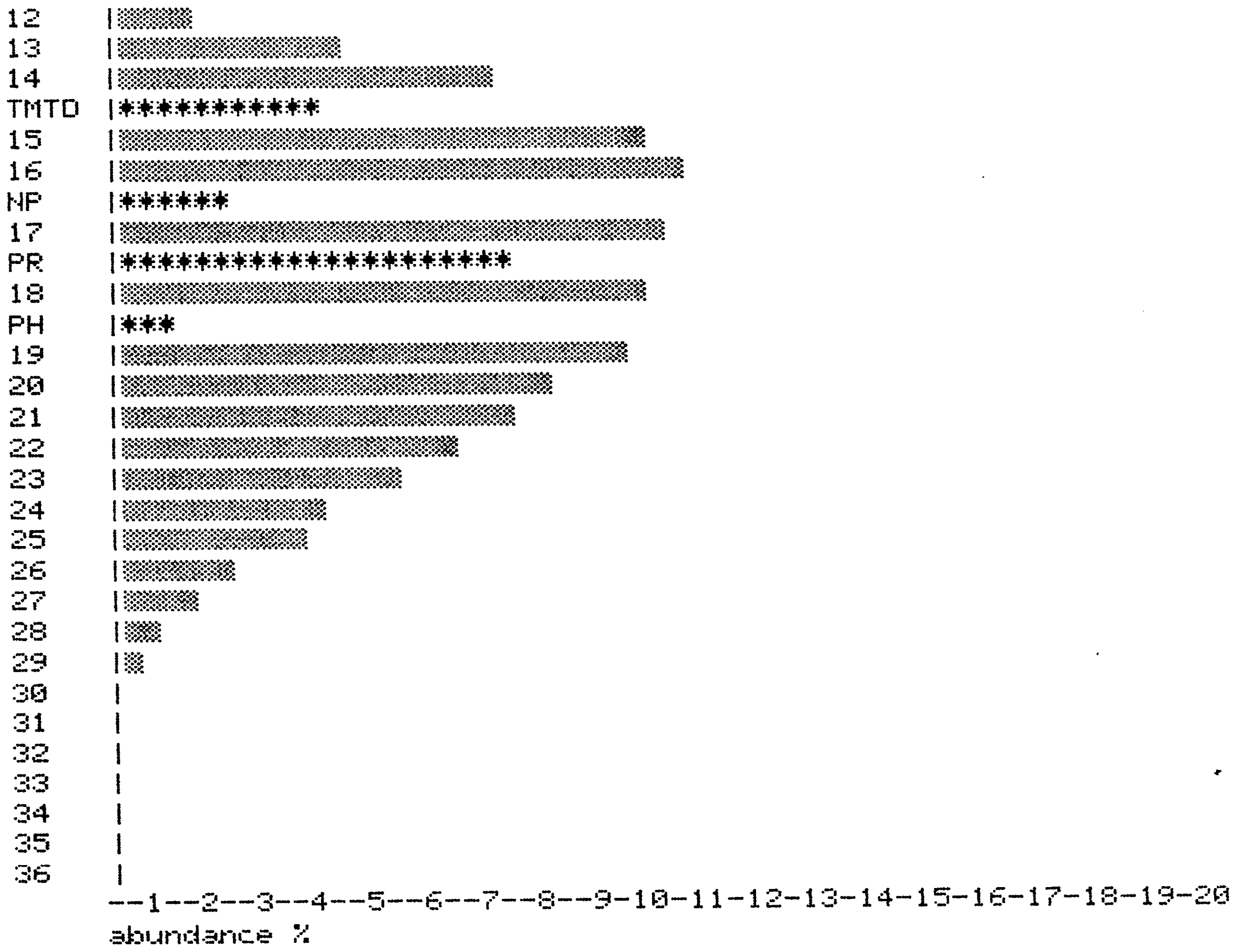


FIGURE 12

PECTEN NO.1
8010 FT

N-ALKANE AND ISOPRENOID DISTRIBUTION IN SATURATES

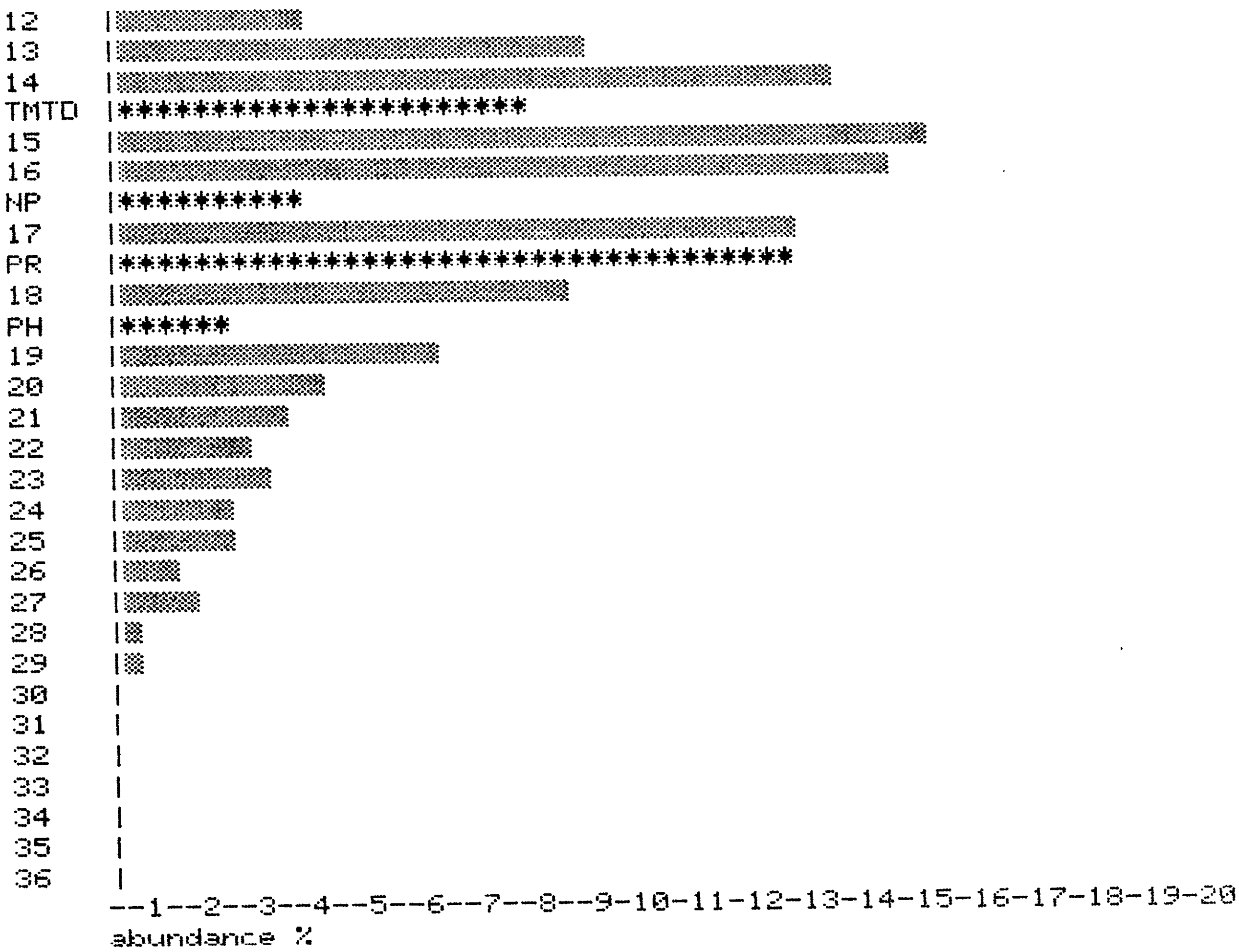


FIGURE 13

PRAWN NO.A1
9860 FT

N-ALKANE AND ISOPRENOID DISTRIBUTION IN SATURATES

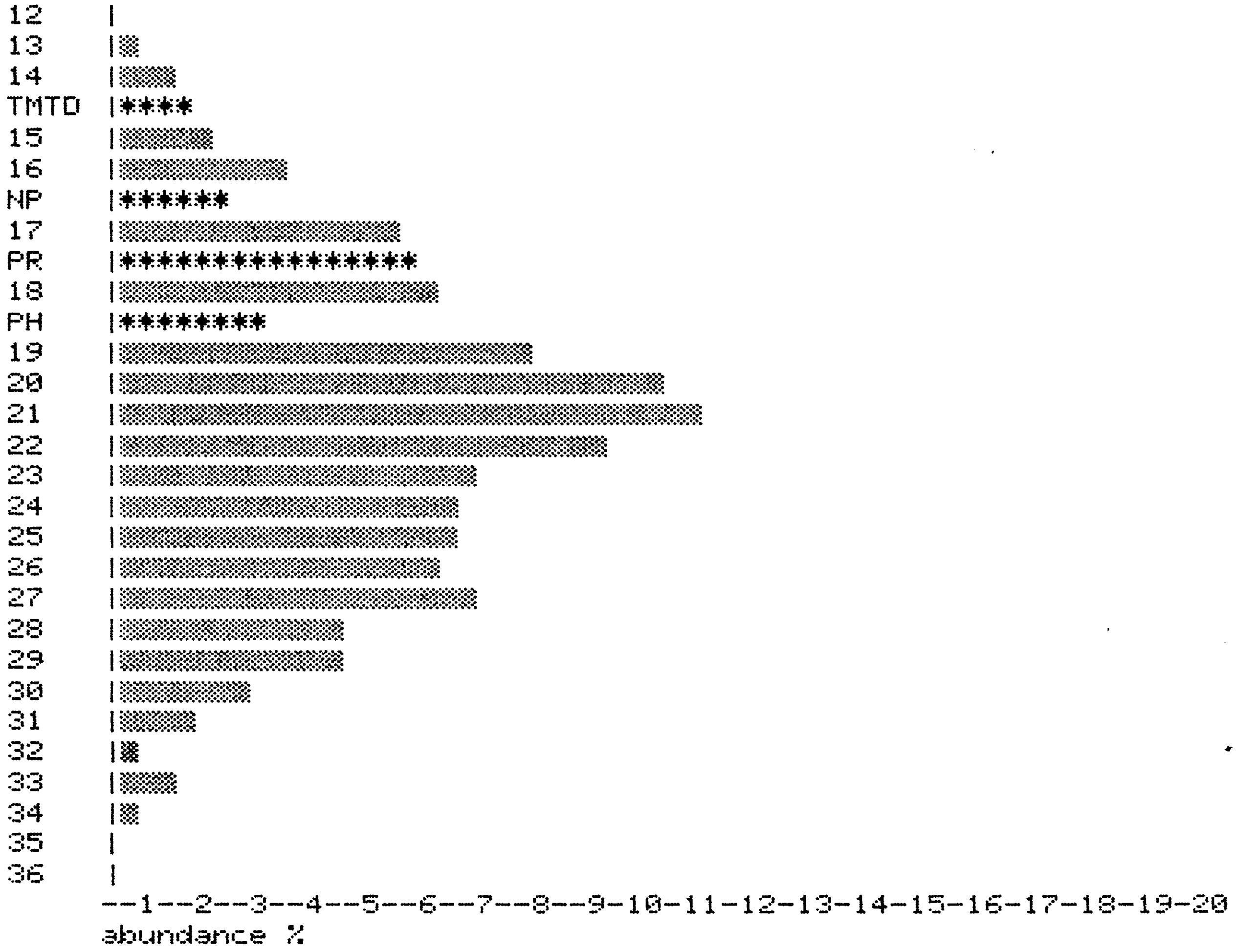


FIGURE 14

PRAWN NO.A1
10210 FT

N-ALKANE AND ISOPRENOID DISTRIBUTION IN SATURATES

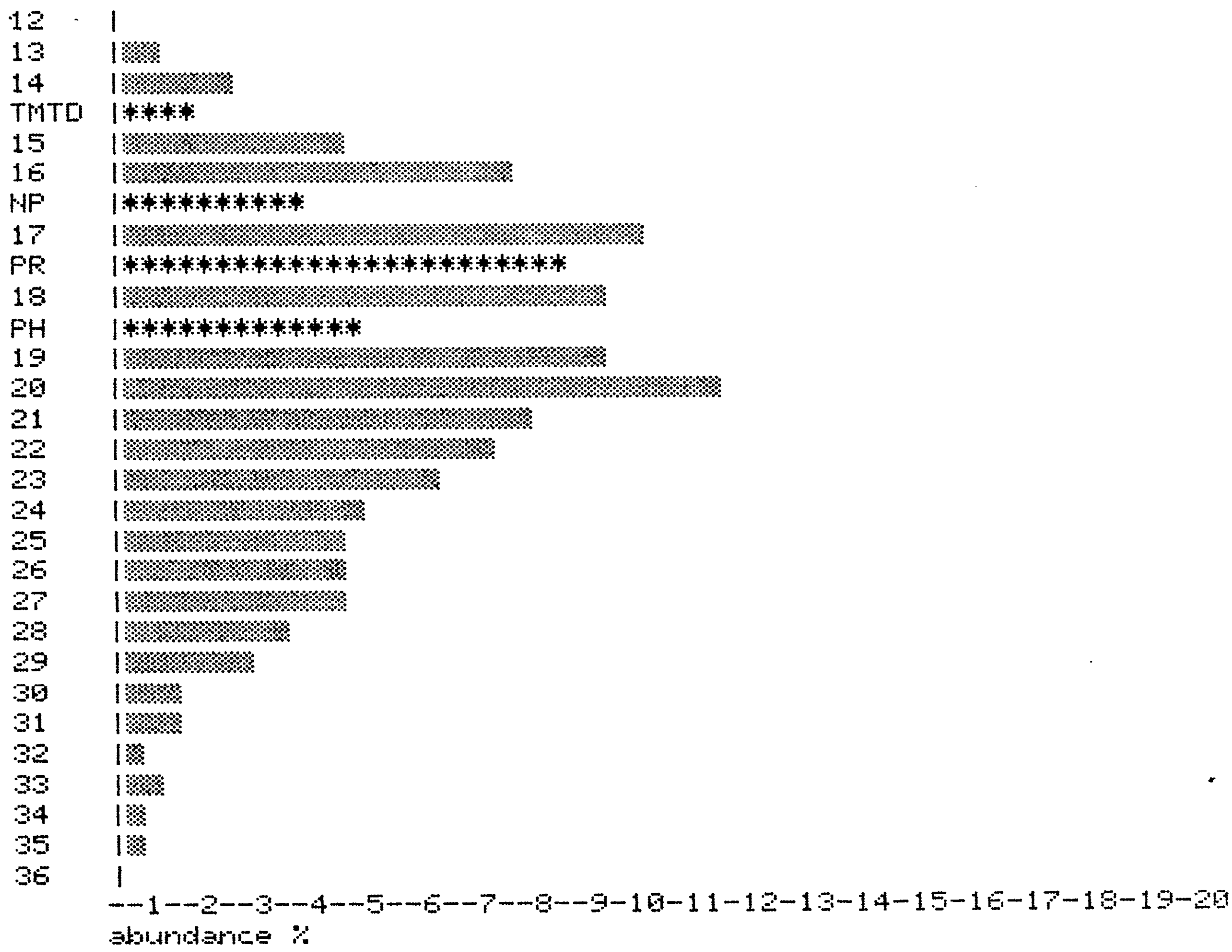


FIGURE 15

PRAWN NO.A1
10280 FT

N-ALKANE AND ISOPRENOID DISTRIBUTION IN SATURATES

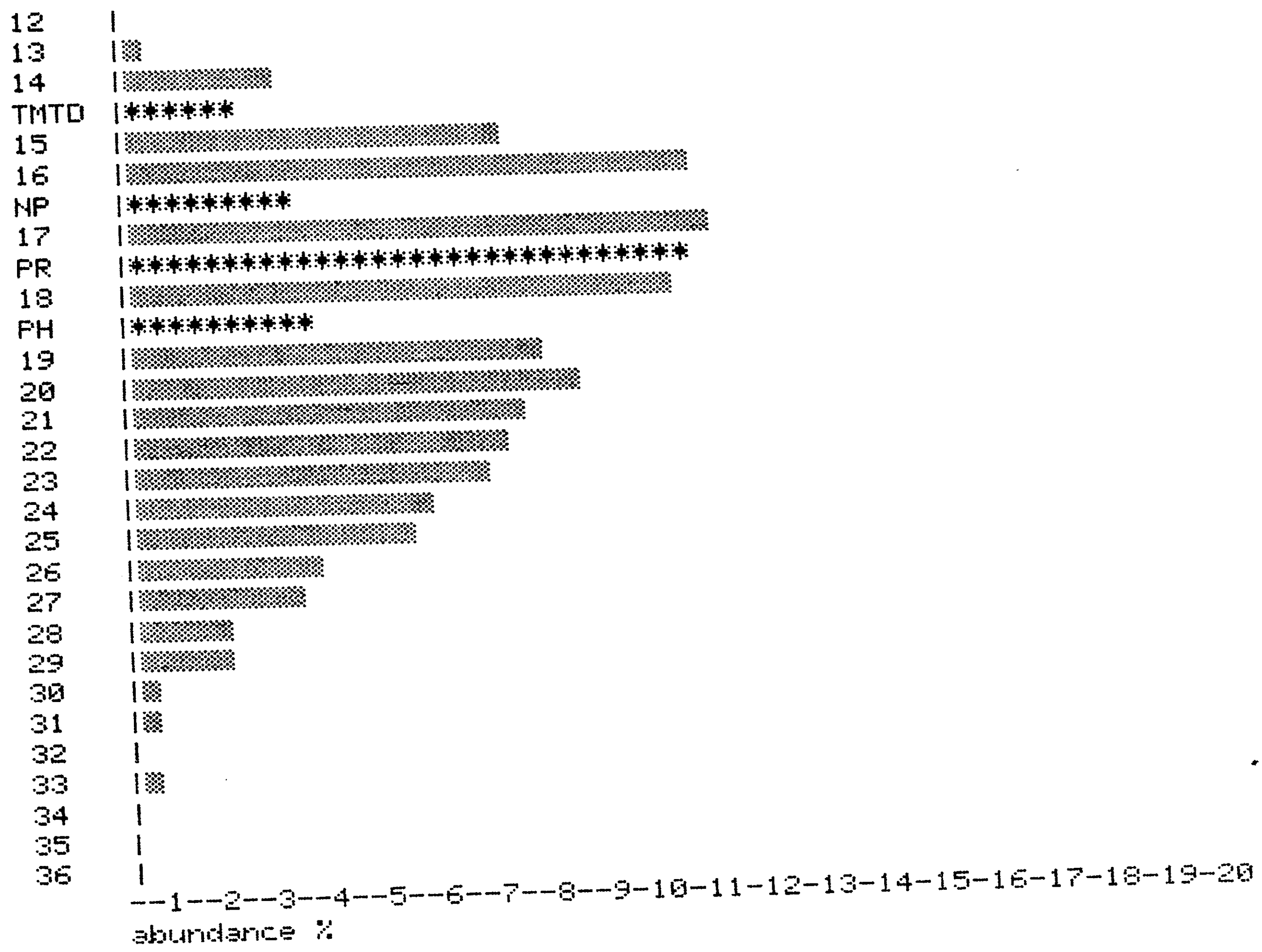
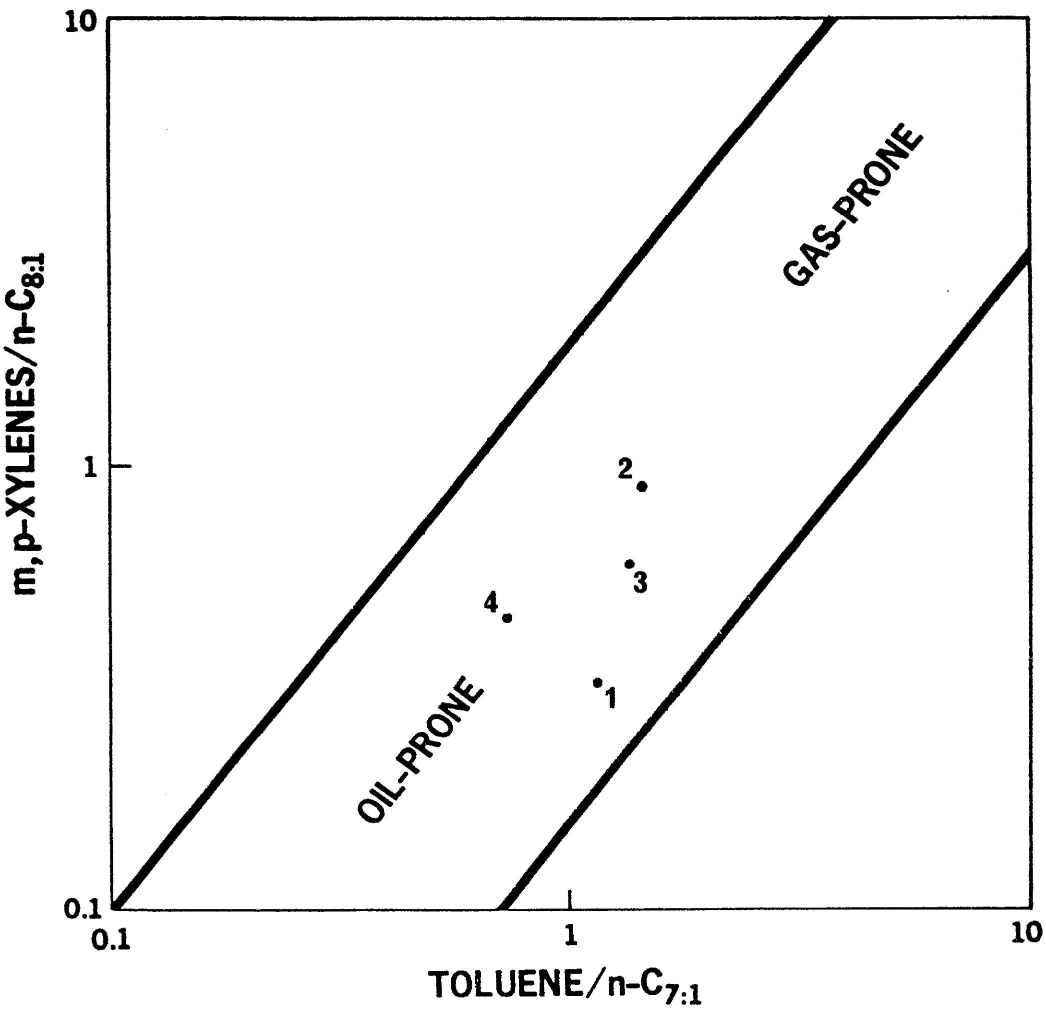


FIGURE 16

SOURCE QUALITY BASED ON
KEROGEN PYROLYSIS-GC



KEY

1. Flaxmans-1, 9650-9680 ft
2. Prawn-A1, 9860 ft
3. Prawn-A1, 10210-10220 ft
4. Prawn-A1, 10280-10290 ft

FIGURE 17

FLAXMANS NO.1
9650-9680 FT.
KEROGEN

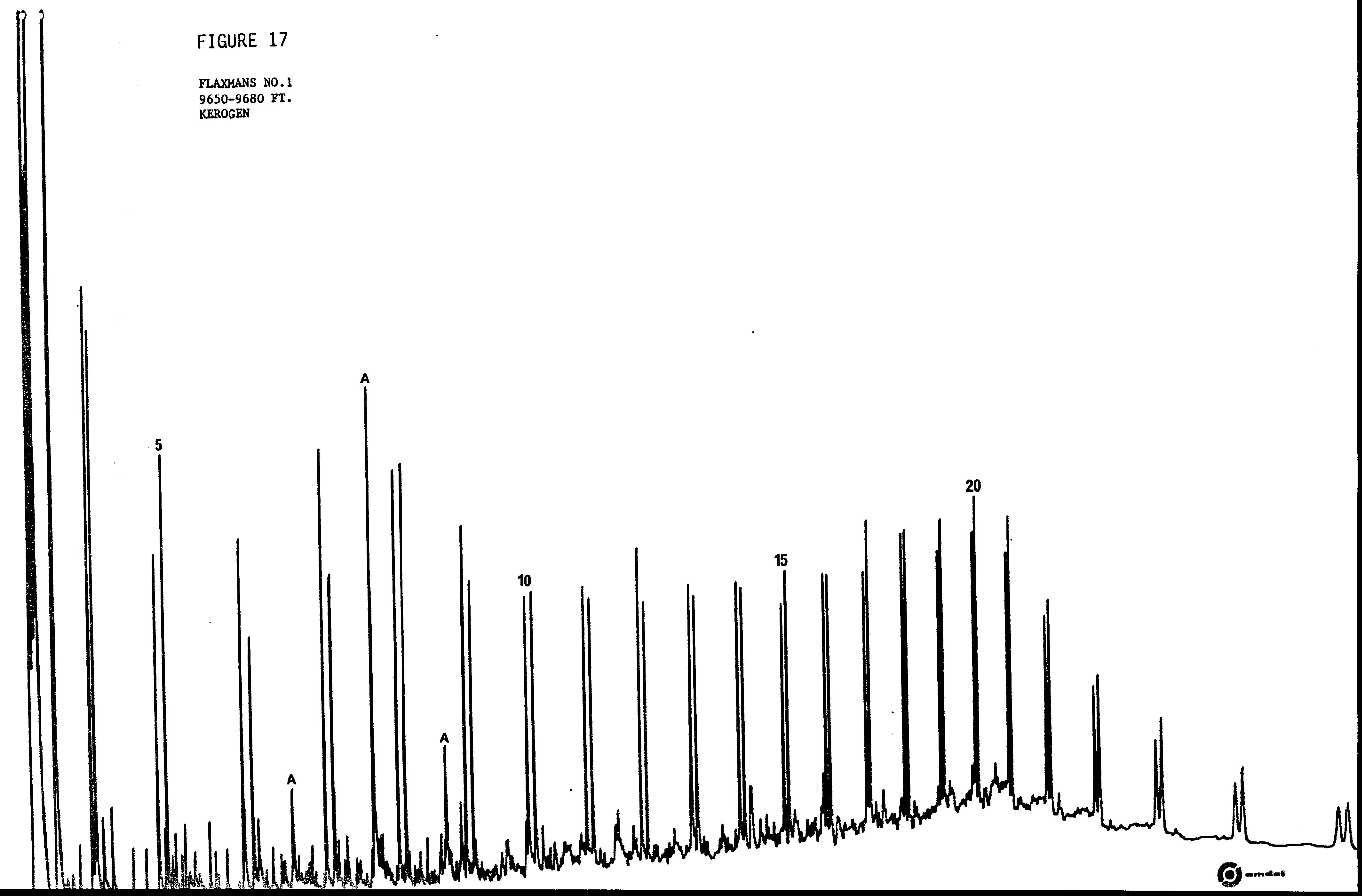


FIGURE 18

PRAWN NO.A1
9860 FT.
KEROGEN

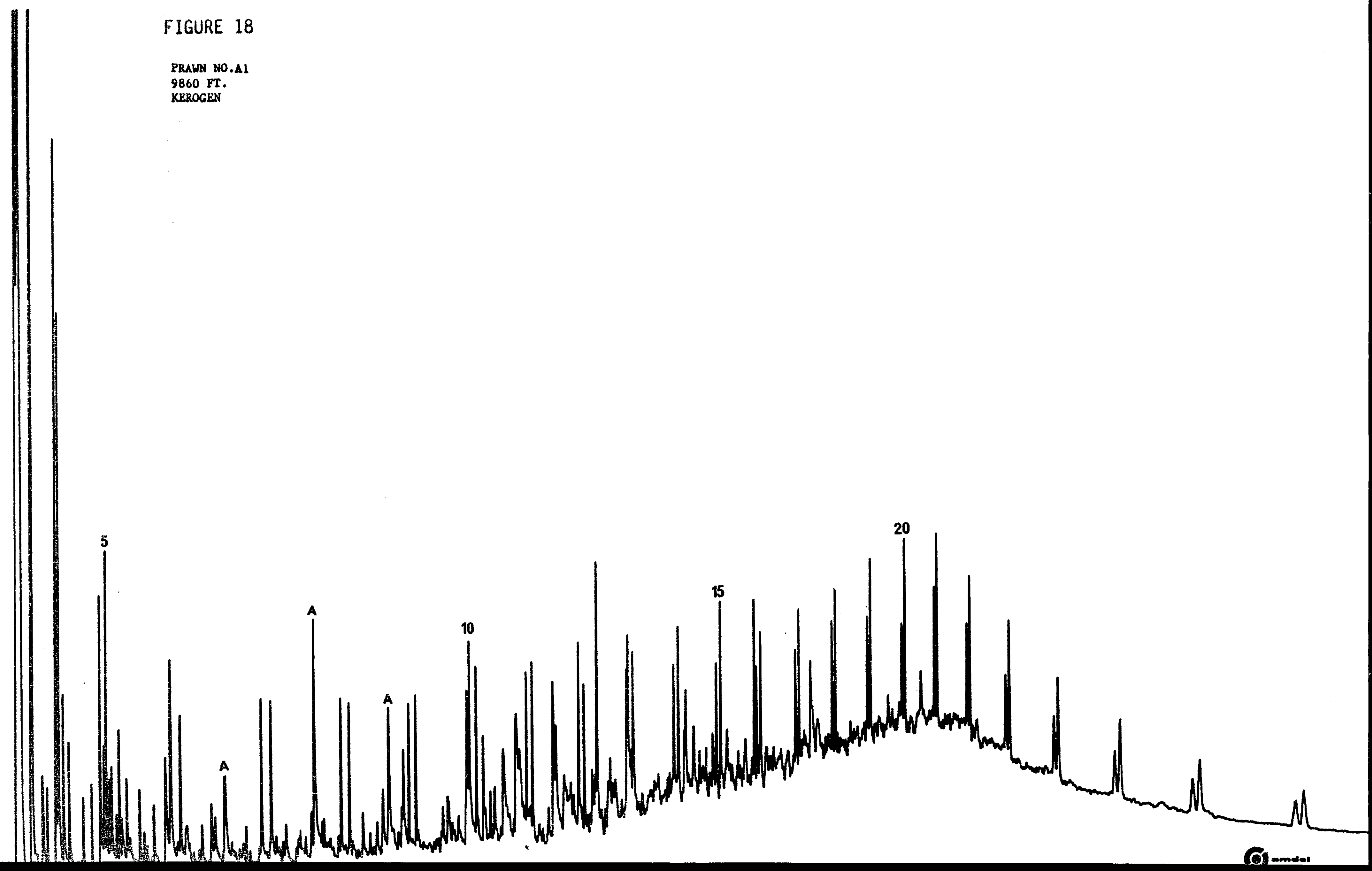


FIGURE 19

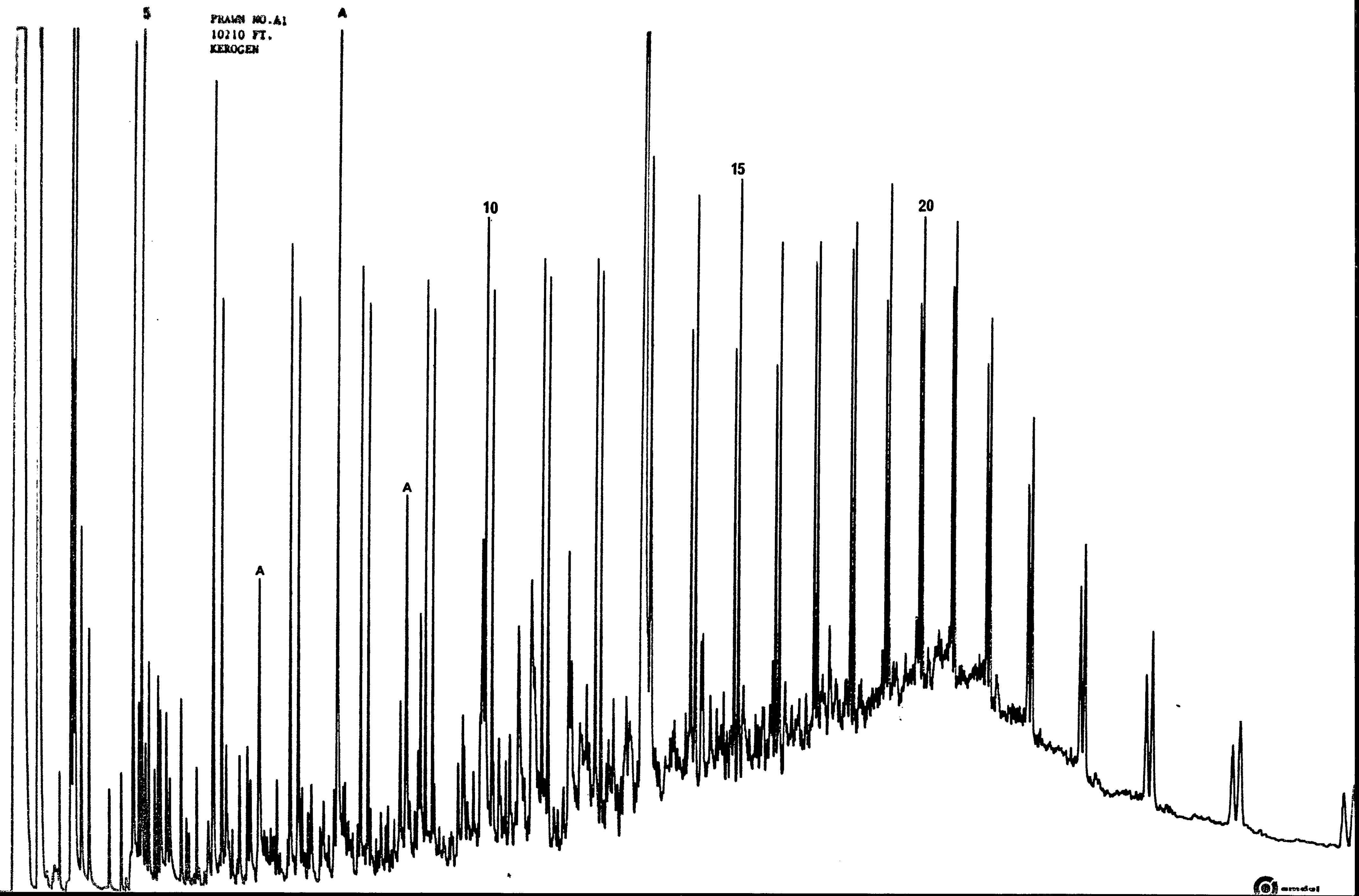


FIGURE 20

PRAWN NO.A1
10280 FT.
KEROGEN