SOUTH AUSTRALIA

DEPARTMENT OF MINES AND ENERGY

OPEN FILE ENVELOPE NO. 5876

OTWAY BASIN

SOURCE ROCK STUDIES - DATA
(Reports for the period
October 1981 - July 1991)

Submitted by

various petroleum exploration companies plus
SADME project officers

1991

ENVELOPE 5876

TENEMENT AND TENEMENT HOLDERS: not related.

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SEPARATELY HELD DATA

THESIS (held in MESA Library)

Padley, D., 1995. Petroleum geochemistry of the Otway Basin and the significance of coastal bitumen strandings on adjacent southern Australian beaches. University of Adelaide. Ph.D. thesis (unpublished).	Not microfilmed [747 pages]

SOURCE ROCK ANALYSES

OTWAY BASIN

AMDEL

OCTOBER 1981

Report No. 746/81

Distribution:

Australian Aquitaine Petroleum Pty Ltd

AAP	2
W.M.C.	1
B.M.R.	2
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INTRODUCTION

Fifteen samples of Early Cretaceous rocks, taken from conventional cores in exploration wells within the Gambier Embayment of the Otway Basin, were submitted to AMDEL for investigation of their petroleum source potential. The tests carried out were:-

AMDEL CODE	TEST
R3/3	Total organic carbon
R3/11	Vitrinite reflectance
R3/4	Extraction of organic matter
R3/5	Liquid Chromatographic separation of EOM
R3/6/1	Gas Chromatrography of saturates
R3/12	Petrography of organic matter

The data included herein is that which was forwarded to A.A.P. at the conclusion of the work. Brief lithology descriptions are also included. Five photomicrographs were also prepared, which are not included in this copy.

Australian Aquitaine Petroleum Limited

[redacted]

LITHOLOGY DESCRIPTIONS

SAMPLE NO.	
1	Trumpet No. 1, 4330.5 ft. Pretty Hill Sandstone; Shale, medium grey, firm, silty, irregularly interbedded with fine grained quartzose sandstone.
2	Lucindale No. 1, 2446 ft. Pretty Hill Sandstone; Siltstone, light grey, firm to medium hard, high clay content, finely pyritic and micaceous, occasional large and abundant fine coarse flakes.
3	Luncindale No. 1, 2449 ft Pretty Hill Sandstone; Siltstone, as per Sample 2.
4	Lucindale No. 1, 2756.5 ft. Pretty Hill Sandstone; Shale, light grey, hard, silty, finely micaceous, carbonaceous.
5	Robertson No. 1, 3258 ft, Eumeralla Fm. (?); Claystone, light olive grey, firm to medium hard, some degree of foliation along bedding, silty, micaceous, abundant coaly material.
6	Robertson No. 1, 3266 ft. Eumeralla Fm. (?); Shale, dark grey to black, firm to medium hard, blocky, micaceous.
7	Penola No. 1, 4397 ft. Pretty Hill Sst. (?); Claystone, grey to green grey, silty, micaceous, abundant carbonaceous - coaly flecks.
8	Penola No. 1, 4393 ft, Pretty Hill Sst. (?); Claystone, as per sample 7.
9	Chama No. 1A, 9015 ft. Eumeralla Fm; Siltstone, light grey to dark grey, very hard, very shaley in darker areas, micaceous, carbonaceous.
10	Chama No. 1A, 9005 ft. Eumeralla Fm; Siltstone, generally as per sample 9, grades in part to light grey Sandstone, very fine grained and very argillaceous.

SAMPLE NO.	
11	Chama No. 1A, 9011 ft, Eumeralla Fm; Siltstone, light to dark grey, large fragments of coaly material are commmon, very shaley in darker areas.
12	Chama No. 1A, 9012 ft. Eumeralla Fm; Siltstone, dark grey, hard, grading to light grey, argillaceous siltstone, slightly carbonaceous.
13	Crayfish No. A1, 9551.5 ft. Pretty Hill Sst.; Shale, medium grey, hard and massive, very silty, some well rounded fine quartz grains, finely pyritic and micaceous.
14	Crayfish No. A1, 9660 ft. Pretty Hill Sst.; Shale, as per sample 13.
15	Crayfish No. A1, 9963 ft. Pretty Hill Sst.; Shale, dark grey, hard, massive, with laminae of argillaceous siltstone and very fine grained sandstone.

[redacted]

1. INTRODUCTION

Fifteen samples from wells from the Otway Basin were received for assessment for hydrocarbon source rock potential. This report gives results of optical examination of the samples. A polished briquette was prepared from each of the samples by mounting in fibreglass and careful polishing with magnesium oxide powder. Each sample was then examined in polarized reflected light and in ultraviolet light also. Gross counting techniques were used to obtain the relative proportions of the maceral groups vitrinite, inertinite and exinite. A visual estimate was also made of the overall amount of the organic material in the sample. Where appropriate, photomicrographs were prepared. Where possible, the reflectance of vitrinite was determined using standard techniques.

2. DESCRIPTIONS OF SAMPLES

Sample: Trumpet No. 1; 4330.5'

The organic material in this sample is generally extremely fine-grained and most consists of more or less equant fragments of featureless reflective material classified as inertodetrinite. Coarser, similarly reflective material, shows an approach towards cell structure and is best regarded as semi-fusinite. Vitrinite is present as tabular wisps and fragments with a typical size of 40 x 10 microns. Exinite is only very rare and there were a few small indeterminate fragments of ?resinite. This material shows no fluorescence.

Sample: Lucindale No. 1; 2446'

The dispersed organic material in this sample ranges in size up to about 60 microns but most of it is inertinite and this is generally sufficiently well textured to be classified as semi-fusinite. Vitrinite generally forms in specific bands and discontinuous seams parallel to the bedding in the rock. Exinite is present wholly as a relatively coarse-grained resinite as shown in the photograph. It is interesting that even at the sub-mature level, the resinite shows virtually no fluorescence.

Sample: Lucindale No. 1; 2449'

This sample is similar to that described immediately above and it is characterised, as well, by the presence of exinite in bands and strips of resinite which shows little or no fluorescence. Also present in this sample, however, is rare cutinite. This maceral shows some fairly well defined fragments with a slightly browner, brighter fluorescence. The photographs show these exinite macerals in this sample. Vitrinite and inertinite are fine-grained but some of the inertinite may be classified as semi-fusinite as opposed to essentially featureless inertodetrinite. As is commonly the case in these samples vitrinite forms more elongate fragments commonly with a rectangular or tabular shape. In both this sample and that described above, the vitrinite appears to be well gelified and hard and takes a good polish.

Sample: Lucindale No. 1; 2756.5'

In contrast to the two samples described above, the organic material in this sample from Lucindale No. 1 consists very largely of vitrinite which is present as large, long fragments as much as 20 microns in width. The reflectivity is very low but a consistent set of 17 determinations was obtained. As far as can be determined the sample contains no inertinite. Possibly about 2-5% of the organic material is exinite and this forms rather ragged and scrappy fragments which are elongate and most similar to cutinite (?suberinite). This material shows virtually negligible fluorescence.

[redacted]

Sample: Robertson No. 1; 3258'

This appears to be a fairly rich sample of the order of 10-15% of identifiable organic material. Most of this is large strips of tabular vitrinite as shown in the photograph. The vitrinite is structureless and well gelified so that, despite the low maturity of the sample a consistent set of reflectance determinations could be obtained. The sample was searched systematically but apparently contained neither inertinite, exinite nor any fluorescence.

Sample: Robertson No. 1; 3266'

This sample, also, is rich in vitrinite but there is also some fine-grained inertodetrinite. The latter forms equant angular and featureless fragments and none show sufficient texture to be classified as semi-fusinite. The vitrinite itself forms large tabular fragments up to 0.2 mm in length. The material is hard and well polished and apparently well gelified even though the reflectance is of the order of 0.4% only. The sample contains neither exinite nor any fluorescence.

Sample: Penola No. 1; 4397'

The sample was searched systematically but is apparently completely barren.

Sample: Penola No. 1; 4393'

The organic material in this sample is largely inertinite and much of this is sufficiently coarse-grained and shows an approach towards a bogen structure so that is can be classified as semi-fusinite. The fragments are commonly up to about 100 microns in size. Vitrinite is generally somewhat finer-grained and forms tabular or blade-like fragments. Some of these are possibly somewhat degraded (?recycled) and have a reflectance of about 0.3%. These samples were not included while obtaining the reflectance determination quoted below. Exinite is wholly resinite and there are elongate pieces up to about 100 microns in length. This resinite is similar to that in the sample from Lucindate No. 1; 2446'. The organic material is randomly distributed in all of the fragments included in the polished section. The rock contains some brown translucent material (which shows no fluorescence) but this is possibly fine-grained exinite material of some kind.

Sample: Chama No. 1A; 9015'

This sample was difficult to evaluate but it certainly contains no exinite and no fluorescent material of any kind. It also possibly contains no vitirnite. It was difficult to distinguish whether the well distributed, very fine-grained material was inertodetrinite or vitrinite. Two reflectance determinations with a value of approximately 1% were obtained and, by analogy with the sample from 9011' it seems likely that these at least are vitrinite. In general, however, the great bulk of the organic material is clearly fine-grained inertodetrinite which forms small equant fragments very widely distributed through the sample.

Sample: Chama No. 1A; 9005'

The great bulk of the organic material in this sample is fine-grained inerto-detrinite much of which has a reflectivity of about 1.5%. Some less reflectant grains appear to be vitrinite and two of these were sufficiently large to obtain a reflectance value of 0.93% and 1.02%. The organic material is generally less than 30 microns in size. The sample contains neither exinite nor any fluorescent material.

Sample: Chama No. 1A; 9011'

The organic material is not randomly distributed throughout the fragments in this polished section and some are virtually barren. Most of the organic material is large, long strips with a reflectance of about 1% and it seems likely that these can safely be classified as vitrinite on the basis of the appearance of the material. Finer grained, elongate wisps and equant fragments are generally distinctly more reflective and these have been classified as inertodetrinite. The sample contains no exinite.

Sample: Chama No. 1A; 9012'

This sample is virtually barren and contains only traces of fine-grained inertodetrinite. There is no exinite.

Sample: Crayfish No. A-1; 9551.5'

The organic material consists very largely of inertodetrinite present as fragments less than 100 microns in size and commonly less than 30 microns. There is a minor amount of coarser-grained semi-fusinite showing some cellular structure and this commonly has a reflectivity of more than 1.5%. Vitrinite is rather porous and distinctly rare and occurs in only two patches in the polished section. The organic material is randomly scattered in silty horizons with a considerable amount of mica but other parts of the material are barren sandstones. Apparently the sample contains neither exinite nor any fluorescence.

Sample: Crayfish No. A-1; 9960'

The organic material is almost entirely inertinite but there are two patches with a distinctly lower reflectance and this material was assumed to be vitrinite. Unfortunately these fragments are less than 20 microns in size and the reflectance determinations are probably not as precise as is usually the case. Inertodetrinite is mainly present as distorted wisps up to about 100 microns in length. There is some semi-fusinite which shows a good cell structure in aggregates at least 50 microns in overall dimension. Elsewhere the inertodetrinite forms numerous equant patches not more than 20 microns in size. The sample contains no exinite.

Sample: Crayfish No. A-1; 9963'

All of the organic material in this sample is fine-grained featureless inertodetrinite. The sample contains neither vitrinite nor exinite.

Sample	Depth	Approx. % of Organic Material	Relative % Vitrinite	Inertinite	Exinite	Reflectance %	n*
Trumpet No. 1	4330.5	2	8	91	1	0.48	6
Lucindale No. 1	2446	7	22	76	2	0.44	13
	2449	5-7	28	69	3	0.43	11
	2756.5	10	>95	0	2-5	0.36	17
Robertson No. 1	3258	10-15	100	0	0	0.36	25
	3266	~20	71	29	0	0.39	20
Penola No. 1	4397			barren		-	
	4393	2	17	81	2	0.62	8
Chama No. 1A	9015	1	~10**	~90	0	0.99	2
	9005	2	2	98	0	0.97	2
	9011	3	~70	~30	0	0.96	14
	9012	<1	0	100	0	-	
Crayfish No. A-1	9551.5	5	3	97	0	0.52	2
	9960	3	~1	~99	0	0.52/0.75	-
	9963	2	0	100	0	-	

* number of determinations included in the mean value quoted.

** the tilde indicates values visually estimated rather than counted.

[redacted]

Summary of Analytical method

Total organic carbon was obtained by combustion after acid leaching of carbonate minerals. The finely pulverised sample was extracted with 87% chloroform - 13% methylalcohol and the extract evaporated to remove the solvent. Asphaltenes were removed from the extracted organic matter with petroleum ether and the asphaltene free fraction separated by liquid chromatography on 20 parts activated alumina under 80 parts activated silica gel. The saturates were eluted with petroleum ether, the aromatics with mixed solvent-benzene 15% in petroleum ether 85%, and the polar compounds with methanol containing approx. 10% benzene. Residual strongly polar compounds were not eluted.

The saturate fractions were examined by gas chromatography using the following operating parameters:

Column SCOT 45m x 0.5 mm diameter coated with OV101.
Injection and detection temp 300°C
FID detection
Nitrogen carrier 4 mls/minute
Column temperature 60° for 3 mins. then programmed at 4° per minute to 180°C, held for 1 minute and reprogrammed at 3° per minute to 255°C and held for 60 minutes.
Alkane concentrations were obtained by measurement of peak areas above naphthenic hump.

For mineral description all samples were cleaned of surface mud and tested with hydrochloric acid for carbonate minerals.

[redacted]

SOURCE ROCK

SAMPLE NO: *1*

WELL: *TRUMPET No. 1*

SAMPLE IDENTIFICATION:

DEPTH: *4330.5 ft.*

TYPE OF SAMPLE: *DRILL CORE*

Total organic carbon (TOC)	*0.85*	%
Weight of sample extracted	*56.25*	gm
Extracted organic matter (EOM)	*3042*	ppm
EOM as fraction of TOC	*357.9*	mg/g
Wt. EOM	*171.1*	mg

Analysis of extracted organic matter:-

Asphaltenes	*73.6*	% (wt)
Saturates	*2.9*	%
Aromatics	*1.3*	%
Resins	*6.4*	%
Loss on column	*15.8*	%

n-Alkane distribution of saturates:-

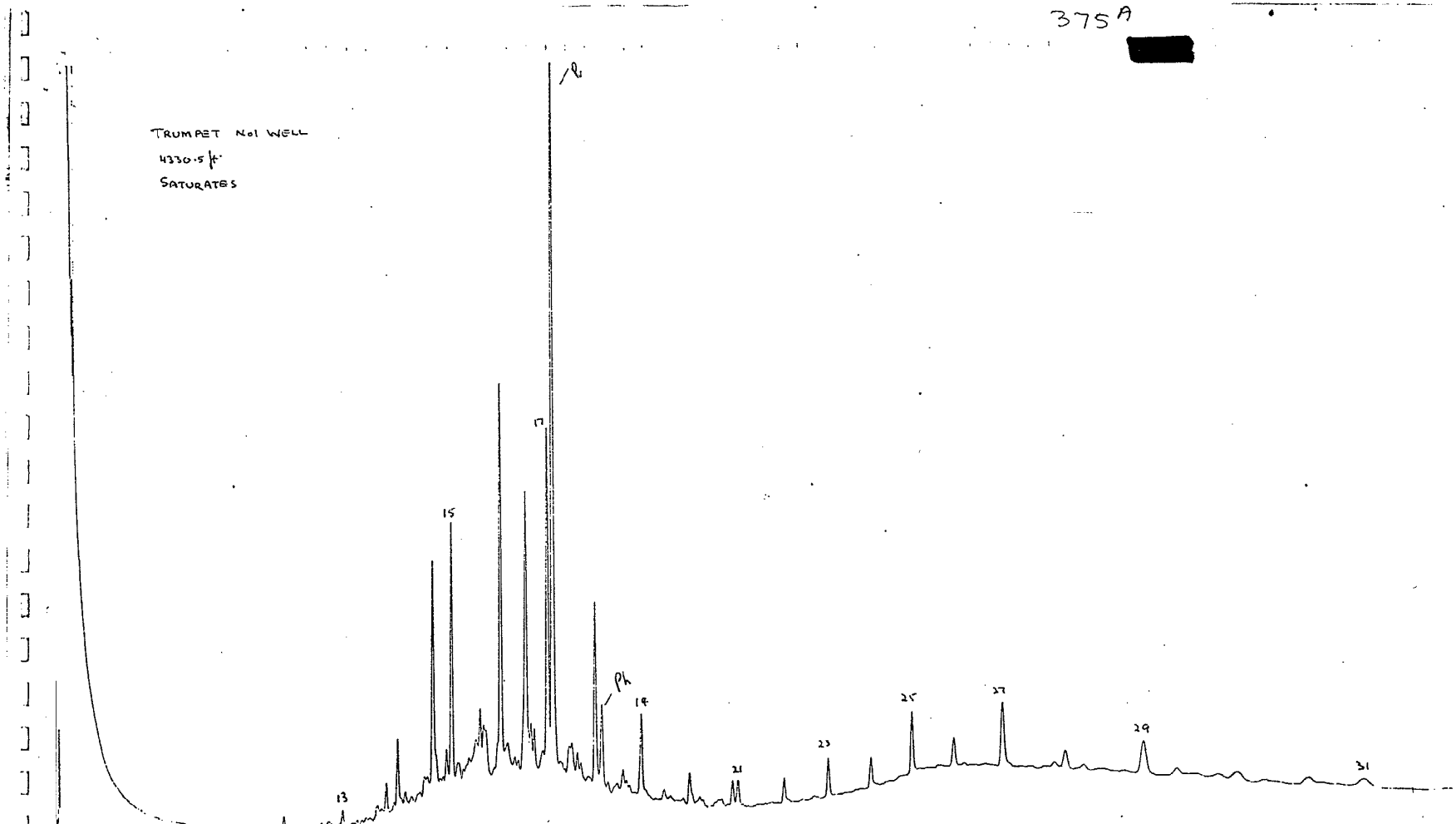
n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$

375A


TRUMPET No1 WELL
4330·5 ft
SATURATES
Pr
Ph
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[redacted]

SOURCE ROCK

SAMPLE NO(2

WELL: LUCINDALE No. 1

SAMPLE IDENTIFICATION:

Depth: 2446 ft.

TYPE OF SAMPLE: DRILL CORE

Total organic carbon (TOC)	1.70	%
Weight of sample extracted	33.5	gm
Extracted organic matter (EOM)	797	ppm
EOM as fraction of TOC	46.9	mg/g
Wt. EOM	26.7	mg

Analysis of extracted organic matter:-

Asphaltenes	45.9	% (wt)
Saturates	4.9	%
Aromatics	1.9	%
Resins	20.6	%
Loss on column	26.7	%

n-Alkane distribution of saturates:-

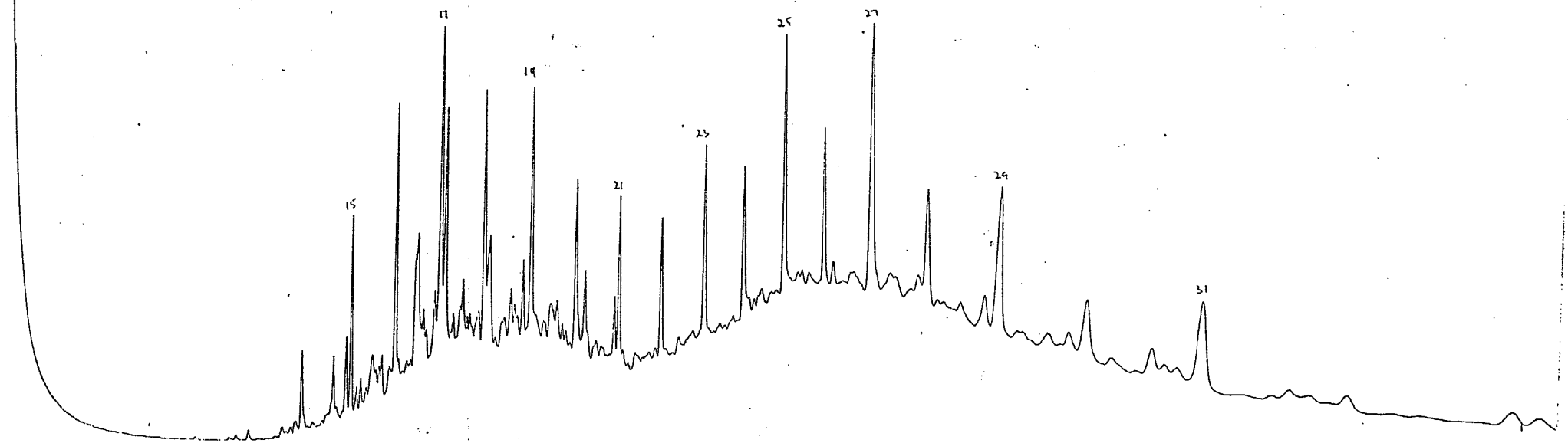
n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$

LUCINDALE No1 WELL
2446ft SATURATES.



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SOURCE ROCK

SAMPLE NO: 3

WELL: LUCINDALE No. 1

SAMPLE IDENTIFICATION:

DEPTH: 2449 ft.

TYPE OF SAMPLE: DRILL CORE

Total organic carbon (TOC)	1.50	%
Weight of sample extracted	51.10	gm
Extracted organic matter (EOM)	646	ppm
EOM as fraction of TOC	43.1	mg/g
Wt. EOM	33.0	mg

Analysis of extracted organic matter:-

Asphaltenes	47.3	% (wt)
Saturates	4.8	%
Aromatics	1.8	%
Resins	20.9	%
Loss on column	25.2	%

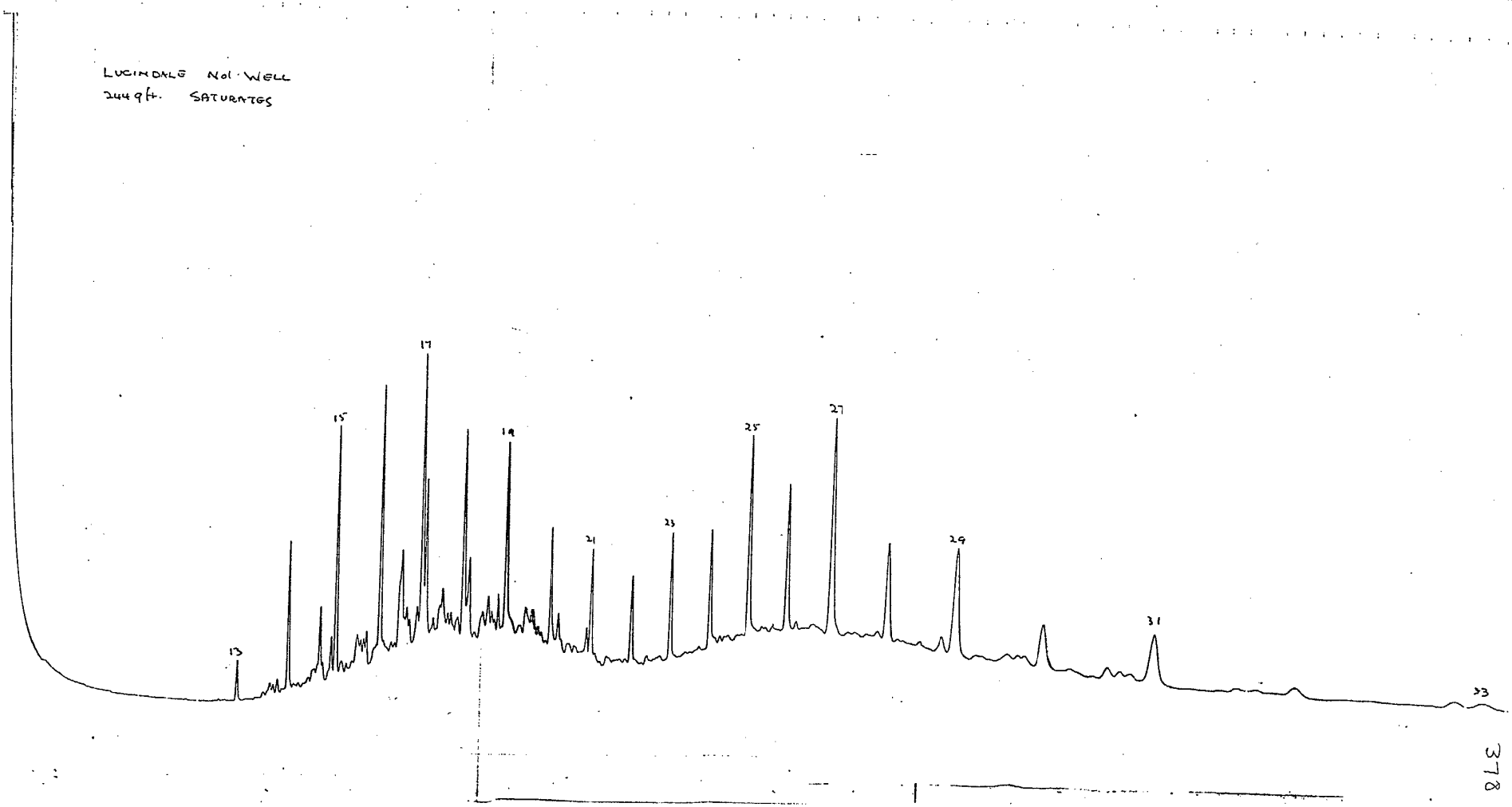
n-Alkane distribution of saturates:-

n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$


LUCINDALE No1 WELL
2449 ft. SATURATES
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31
33

[redacted]

SOURCE ROCK

SAMPLE NO: *4*

WELL: *LUCINDALE No. 1*

SAMPLE IDENTIFICATION:

DEPTH: *2756.5 ft.*

TYPE OF SAMPLE: *DRILL CORE*

Total organic carbon (TOC)	*3.35*	%
Weight of sample extracted	*27.25*	gm
Extracted organic matter (EOM)	*3119*	ppm
EOM as fraction of TOC	*93.1*	mg/g
Wt. EOM	*85.0*	mg

Analysis of extracted organic matter:-

Asphaltenes	*68.1*	% (wt)
Saturates	*2.4*	%
Aromatics	*1.2*	%
Resins	*14.7*	%
Loss on column	*13.6*	%

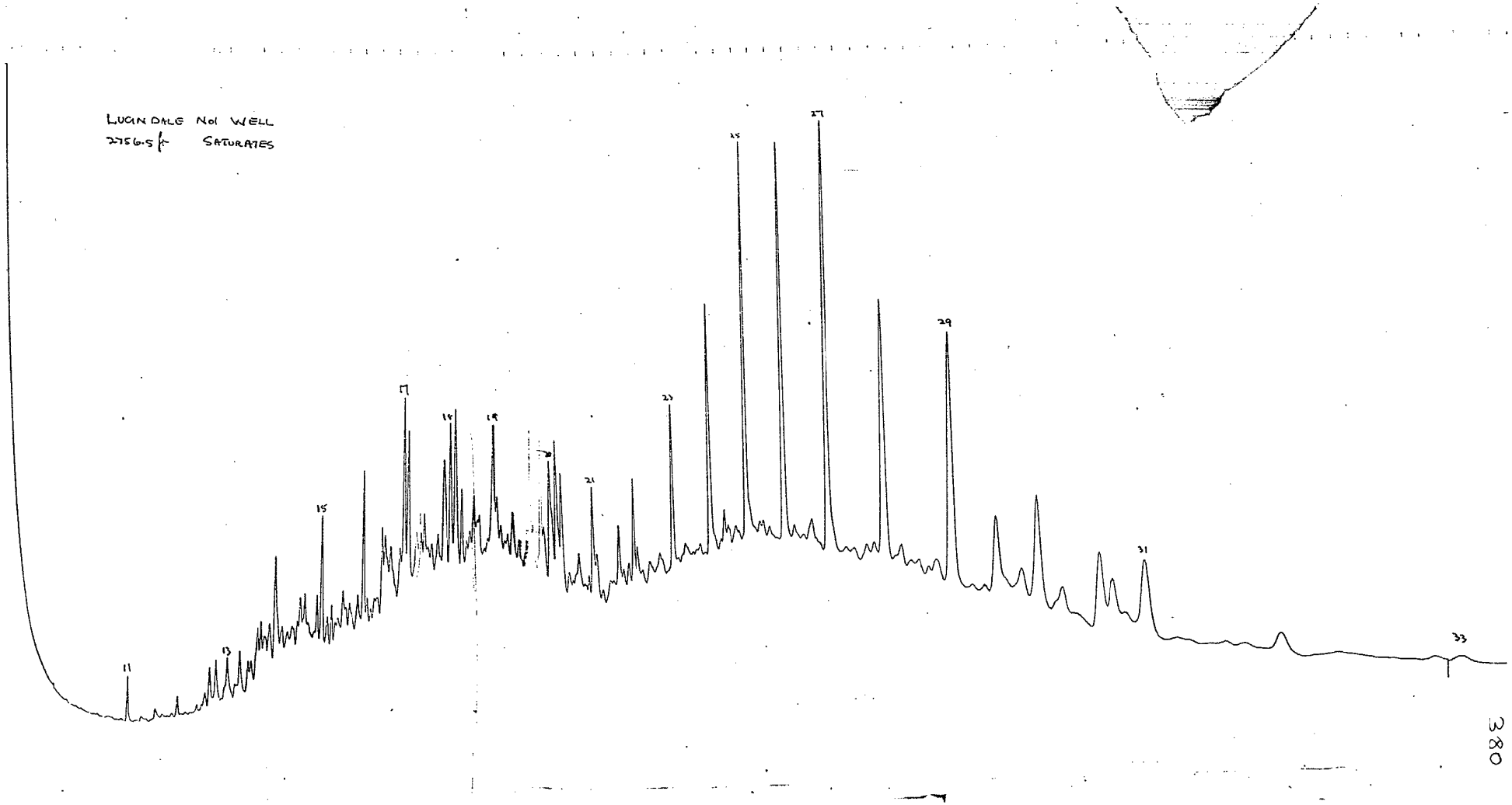
n-Alkane distribution of saturates:-

n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$


LUCIN DALE No1 WELL
2756.5 ft SATURATES
11
13
15
17
19
21
23
25
27
29
31
33

SOURCE ROCK

SAMPLE NO:	5
WELL:	ROBERTSON No. 1
SAMPLE IDENTIFICATION:	
DEPTH:	3258 ft.
TYPE OF SAMPLE:	DRILL CORE

Total organic carbon (TOC)	6.20	%
Weight of sample extracted	33.15	gm
Extracted organic matter (EOM)	5010	ppm
EOM as fraction of TOC	80.8	mg/g
Wt. EOM	166.1	mg

Analysis of extracted organic matter:-

Asphaltenes	54.3	% (wt)
Saturates	4.9	%
Aromatics	1.8	%
Resins	27.1	%
Loss on column	11.9	%

n-Alkane distribution of saturates:-

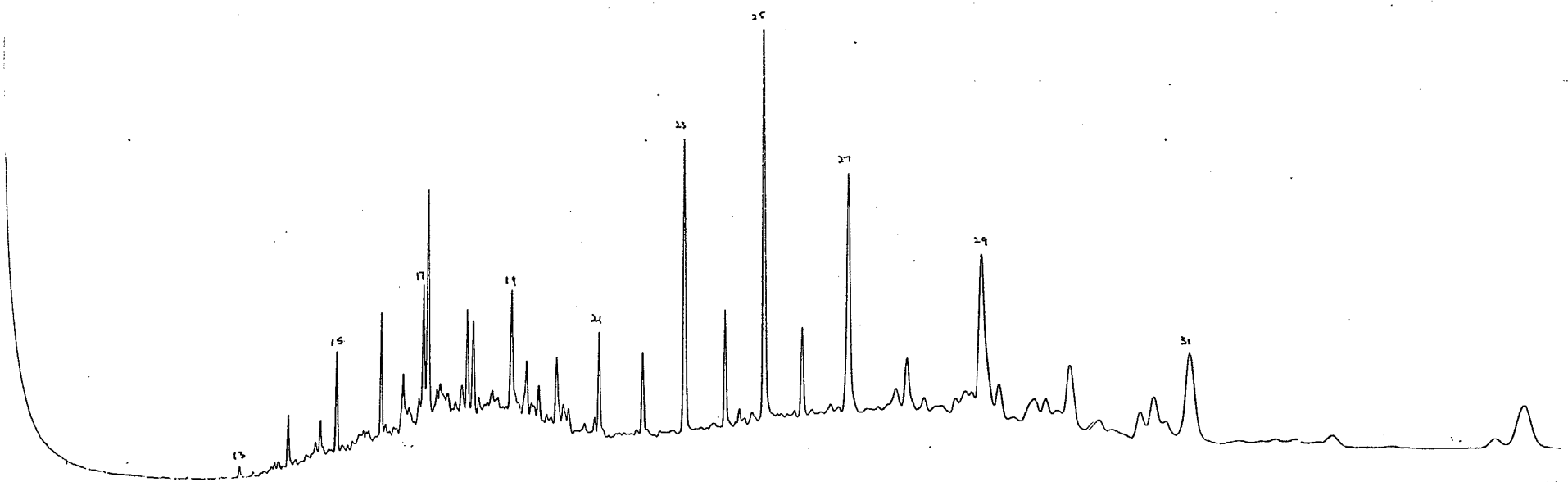
n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$

ROBERTSON No1 WELL
3258f SATURATES



[redacted]

SOURCE ROCK

SAMPLE NO: *6*

WELL: *ROBERTSON No. 1*

SAMPLE IDENTIFICATION:

DEPTH: *3266 ft.*

TYPE OF SAMPLE: *DRILL CORE*

Total organic carbon (TOC)	*3.25*	%
Weight of sample extracted	*35.8*	gm
Extracted organic matter (EOM)	*2958*	ppm
EOM as fraction of TOC	*91.0*	mg/g
Wt. EOM	*105.9*	mg

Analysis of extracted organic matter:-

Asphaltenes	*38.1*	% (wt)
Saturates	*8.5*	%
Aromatics	*2.5*	%
Resins	*31.2*	%
Loss on column	*19.7*	%

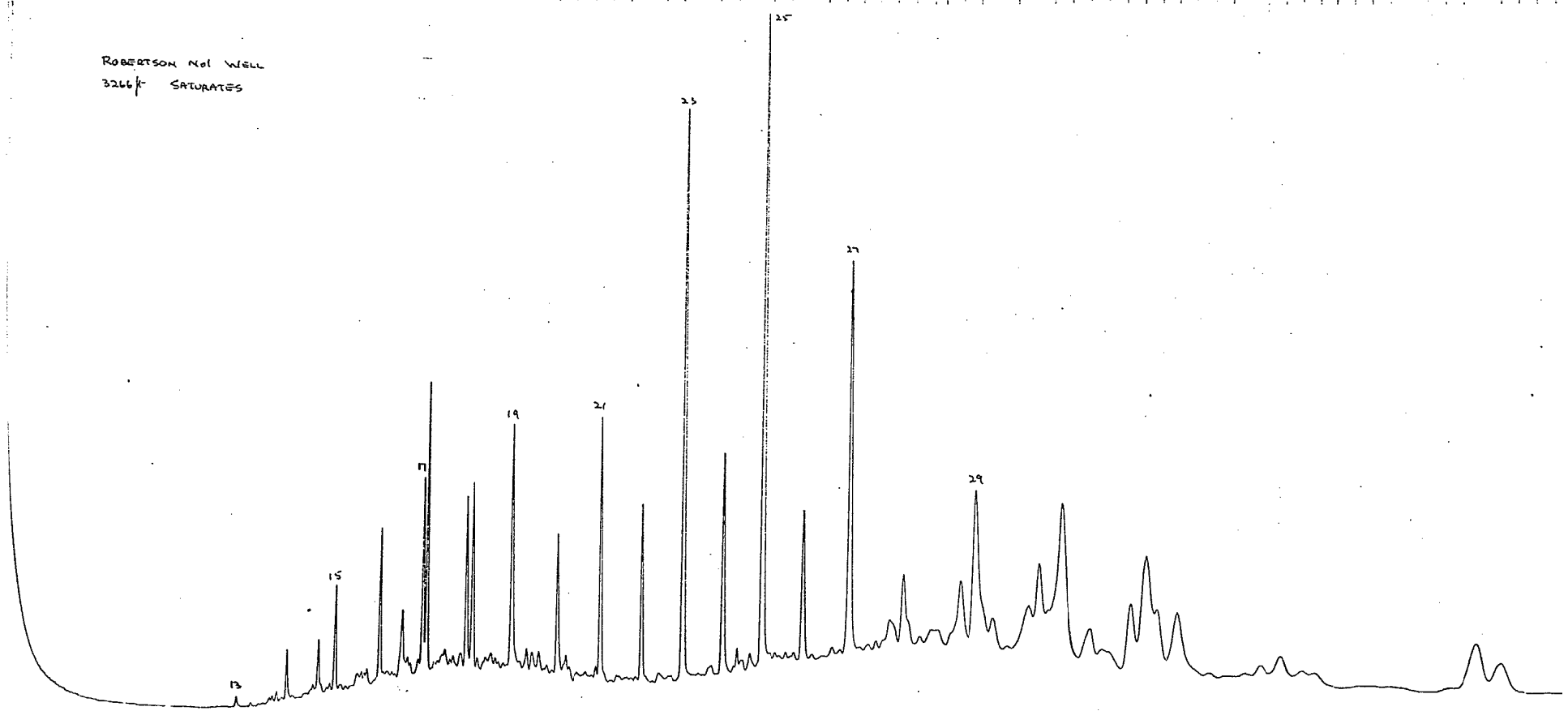
n-Alkane distribution of saturates:-

n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$


ROBERTSON No1 WELL
3266/t SATURATES
13
15
17
19
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23
25
27
29

SOURCE ROCK

SAMPLE NO: 7

WELL: PENOLA No. 1

SAMPLE IDENTIFICATION:

DEPTH: 4397 ft.

TYPE OF SAMPLE: DRILL CORE

Total organic carbon (TOC)	0.3	%
Weight of sample extracted	64.60	gm
Extracted organic matter (EOM)	203	ppm
EOM as fraction of TOC	67.6	mg/g
Wt. EOM	13.1	mg

Analysis of extracted organic matter:-

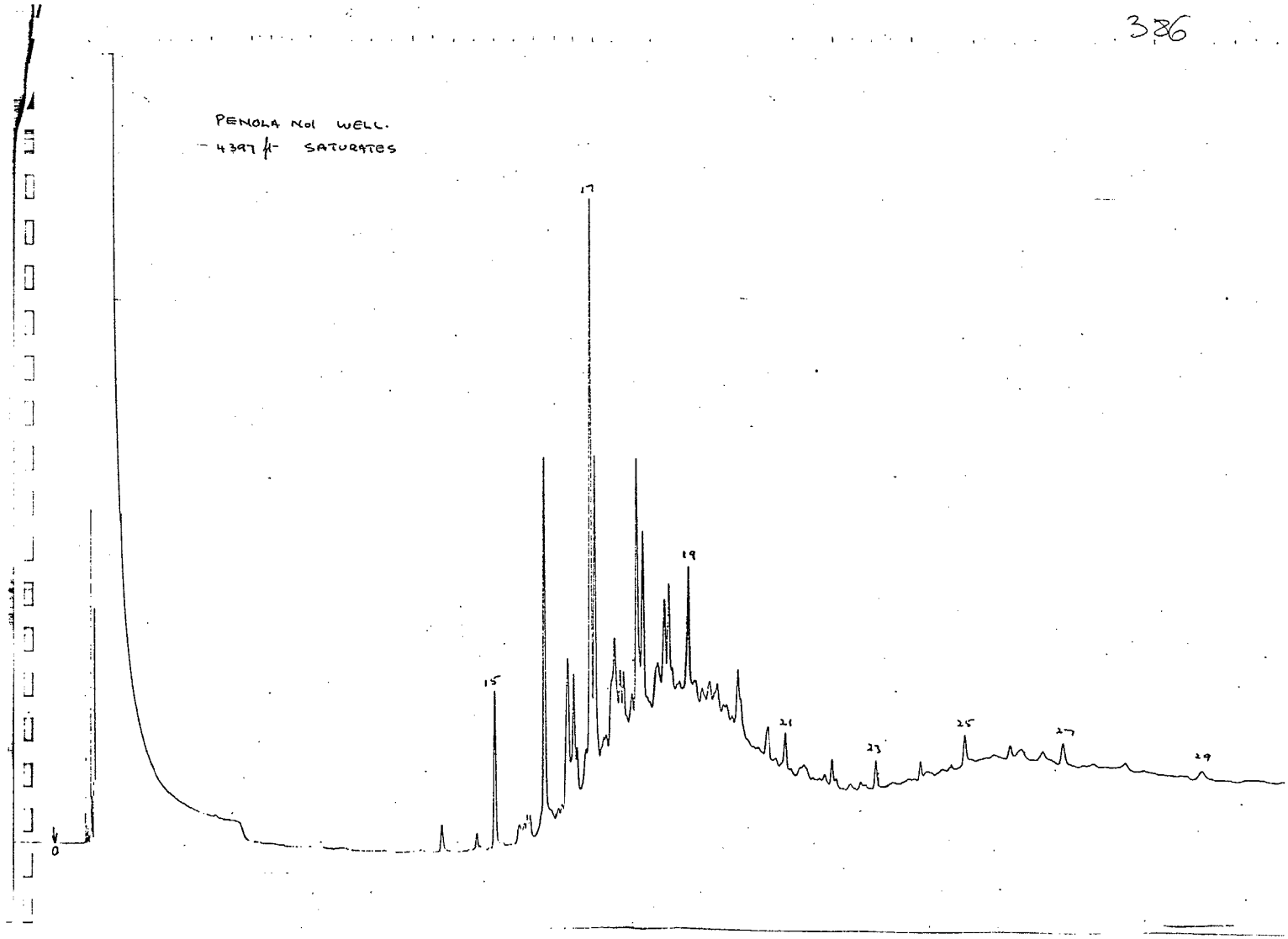
Asphaltenes	37.4	% (wt)
Saturates	24.4	%
Aromatics	3.8	%
Resins	24.4	%
Loss on column	10.0	%

n-Alkane distribution of saturates:-

n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph			
$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$


PENOLA No1 WELL.
4397 ft SATURATES
15
17
19
21
23
25
27
29
0

[redacted]

SOURCE ROCK

SAMPLE NO: *8*

WELL: *PENOLA No. 1*

SAMPLE IDENTIFICATION:

DEPTH: *4393 ft.*

TYPE OF SAMPLE: *DRILL CORE*

Total organic carbon (TOC)	*1.30*	%
Weight of sample extracted	*35.30*	gm
Extracted organic matter (EOM)	*622*	ppm
EOM as fraction of TOC	*47.9*	mg/g
Wt. EOM	*22.0*	mg

Analysis of extracted organic matter:-

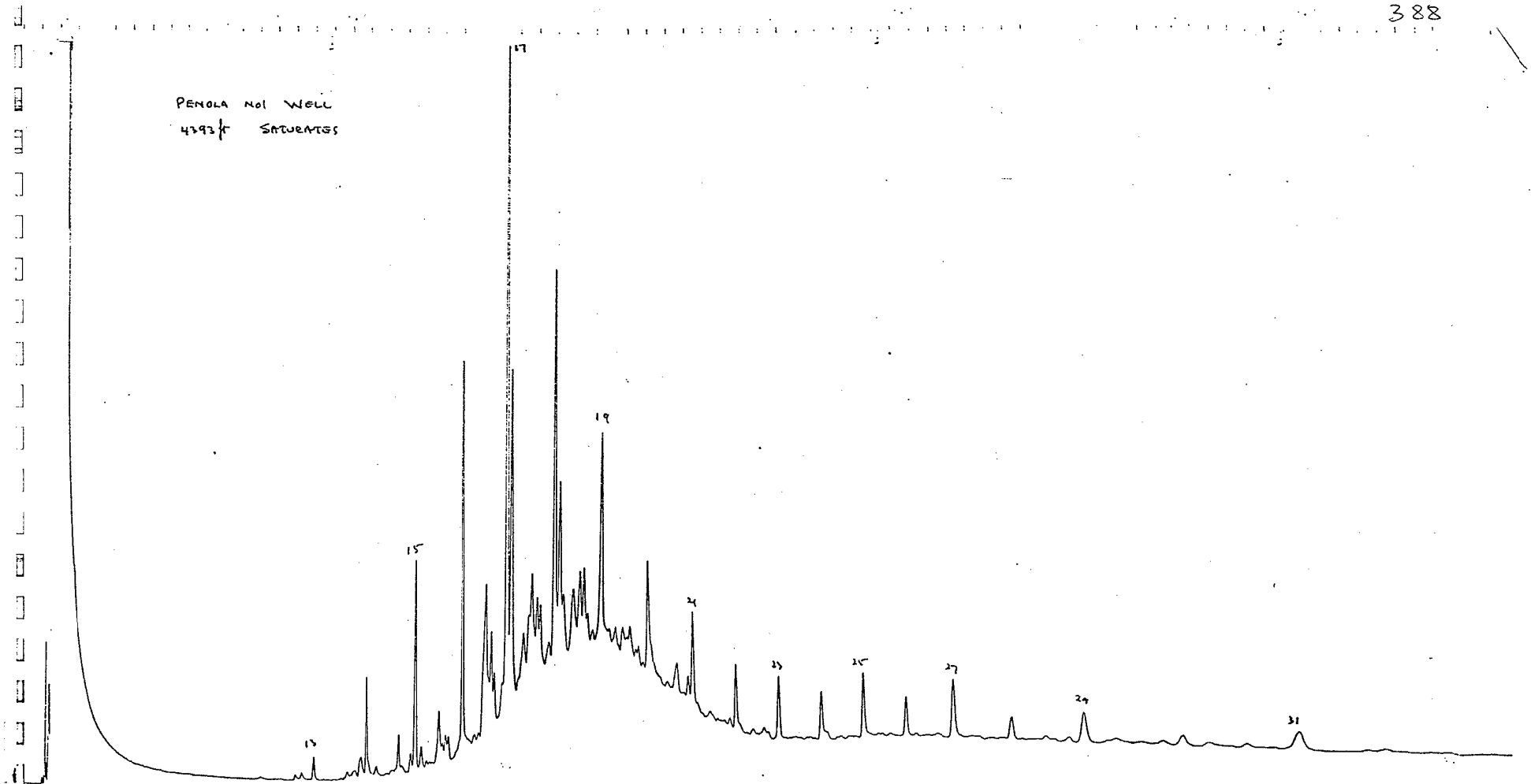
Asphaltenes	*54.5*	% (wt)
Saturates	*12.7*	%
Aromatics	*4.1*	%
Resins	*24.5*	%
Loss on column	*4.2*	%

n-Alkane distribution of saturates:-

n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph			
$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$


PENOLA No1 WELL
4293/T SATURATES
17
19
15
13
21
23
25
27
29
31
0

[redacted]

389

SOURCE ROCK

SAMPLE NO: 9

WELL: CHAMA No. 1A

SAMPLE IDENTIFICATION:

DEPTH: 9015 ft.

TYPE OF SAMPLE: DRILL CORE

Total organic carbon (TOC)	0.50	%
Weight of sample extracted	68.80	gm
Extracted organic matter (EOM)	465	ppm
EOM as fraction of TOC	93.0	mg/g
Wt. EOM	32.0	mg

Analysis of extracted organic matter:-

Asphaltenes	62.8	% (wt)
Saturates	6.3	%
Aromatics	7.8	%
Resins	12.5	%
Loss on column	10.6	%

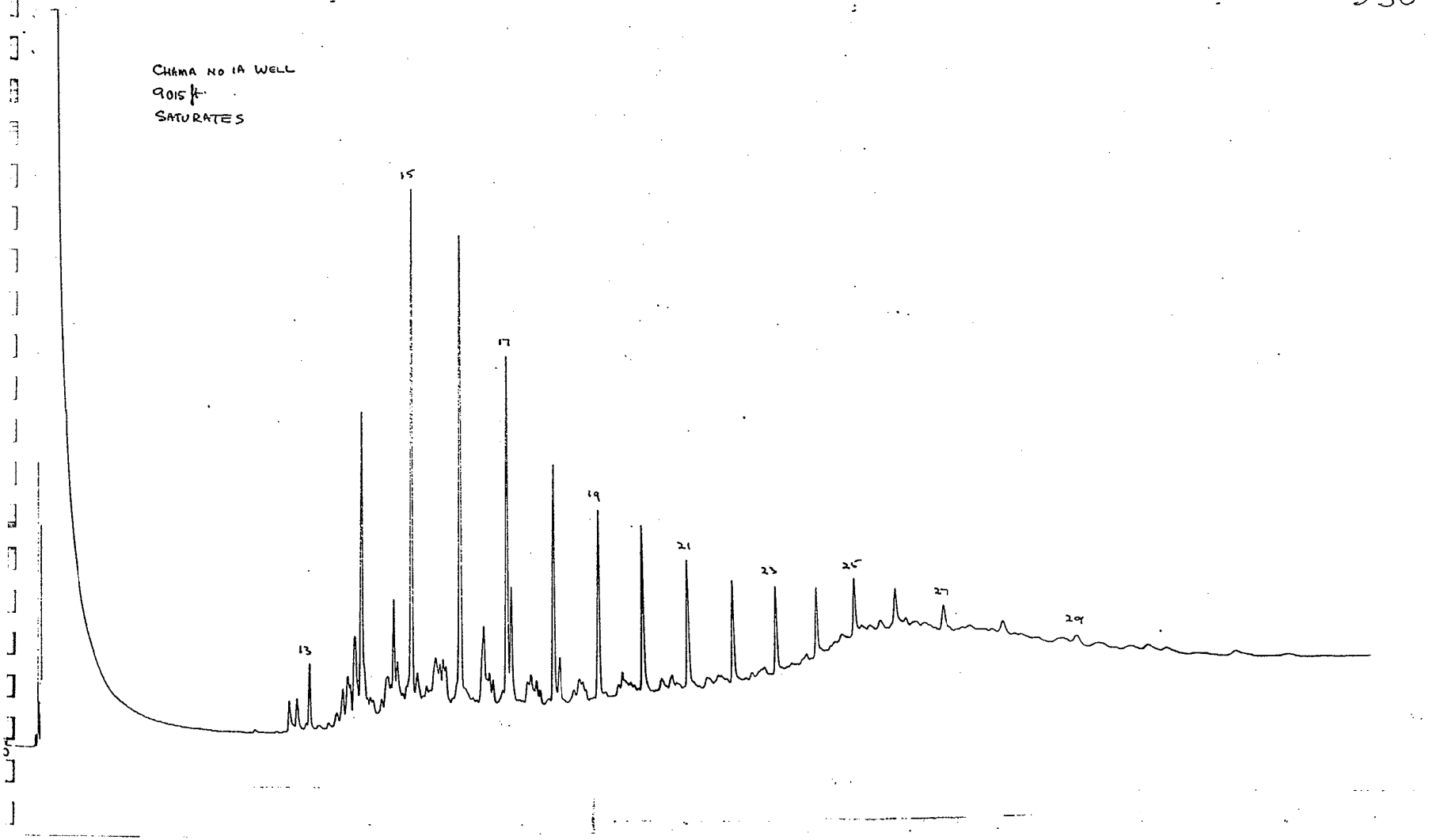
n-Alkane distribution of saturates:-

n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$


CHEMA NO 1A WELL
9015 ft
SATURATES
13
15
17
19
21
23
25
27
29

391

SOURCE ROCK

SAMPLE NO:	*10*
WELL:	*CHAMA NO. 1A*
SAMPLE IDENTIFICATION:	
DEPTH:	*9005 ft.*
TYPE OF SAMPLE:	*DRILL CORE*

Total organic carbon (TOC)	*0.70*	%
Weight of sample extracted	*32.70*	gm
Extracted organic matter (EOM)	*3058*	ppm
EOM as fraction of TOC	*235.2*	mg/g
Wt. EOM	*20.0*	mg

Analysis of extracted organic matter:-

Asphaltenes	*50.5*	% (wt)
Saturates	*8.5*	%
Aromatics	*3.5*	%
Resins	*20.0*	%
Loss on column	*17.5*	%

n-Alkane distribution of saturates:-

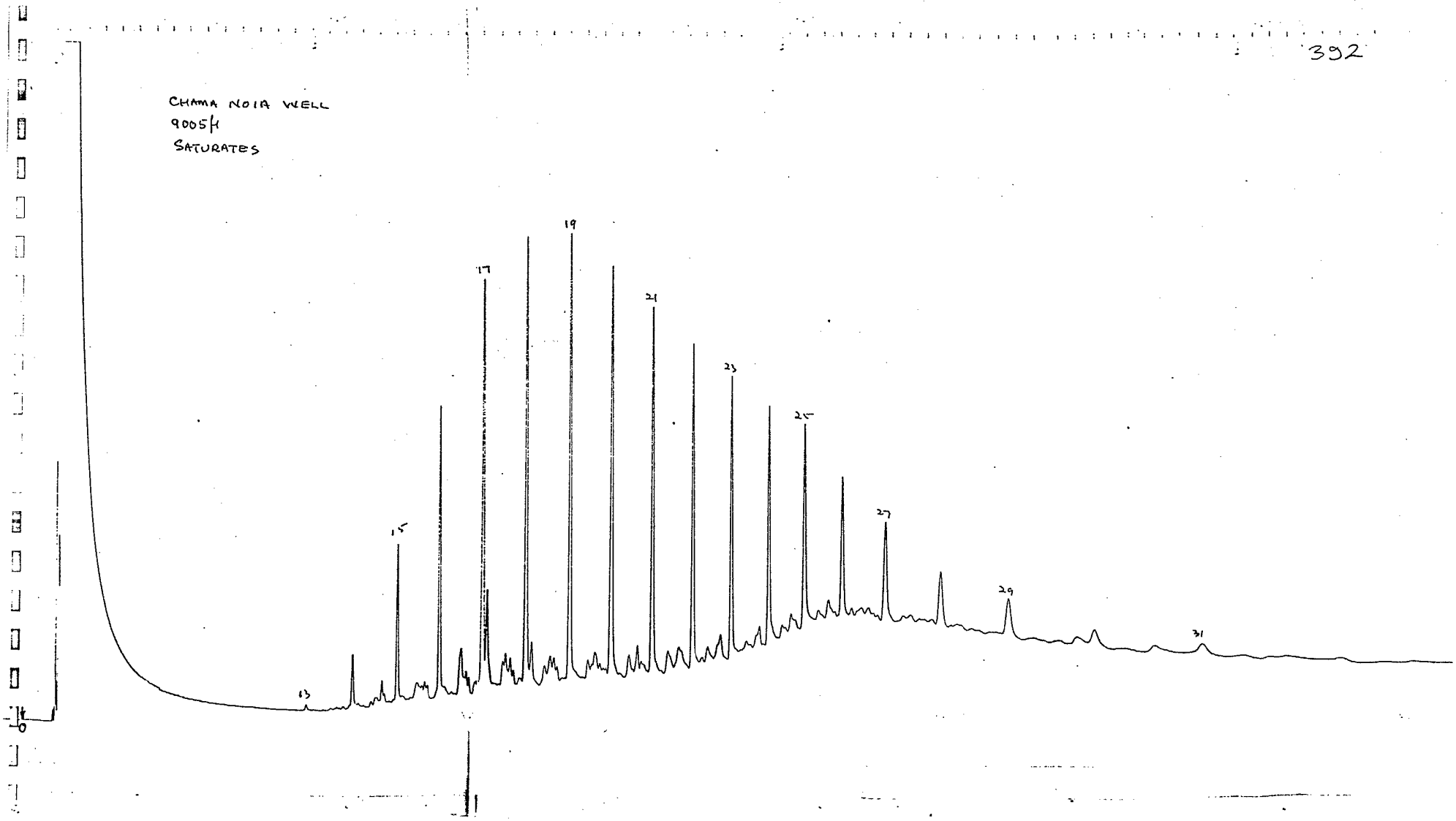
n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$

CHAMA NO1A WELL
9005ft
SATURATES



[redacted]

SOURCE ROCK

SAMPLE NO: *11*

WELL: *CHAMA NO. 1A*

SAMPLE IDENTIFICATION:

DEPTH: *9011 ft.*

TYPE OF SAMPLE: *DRILL CORE*

Total organic carbon (TOC)	*1.35*	%
Weight of sample extracted	*65.6*	gm
Extracted organic matter (EOM)	*1116*	ppm
EOM as fraction of TOC	*82.7*	mg/g
Wt. EOM	*73.2*	mg

Analysis of extracted organic matter:-

Asphaltenes	*69.1*	% (wt)
Saturates	*6.3*	%
Aromatics	*4.9*	%
Resins	*13.5*	%
Loss on column	*6.2*	%

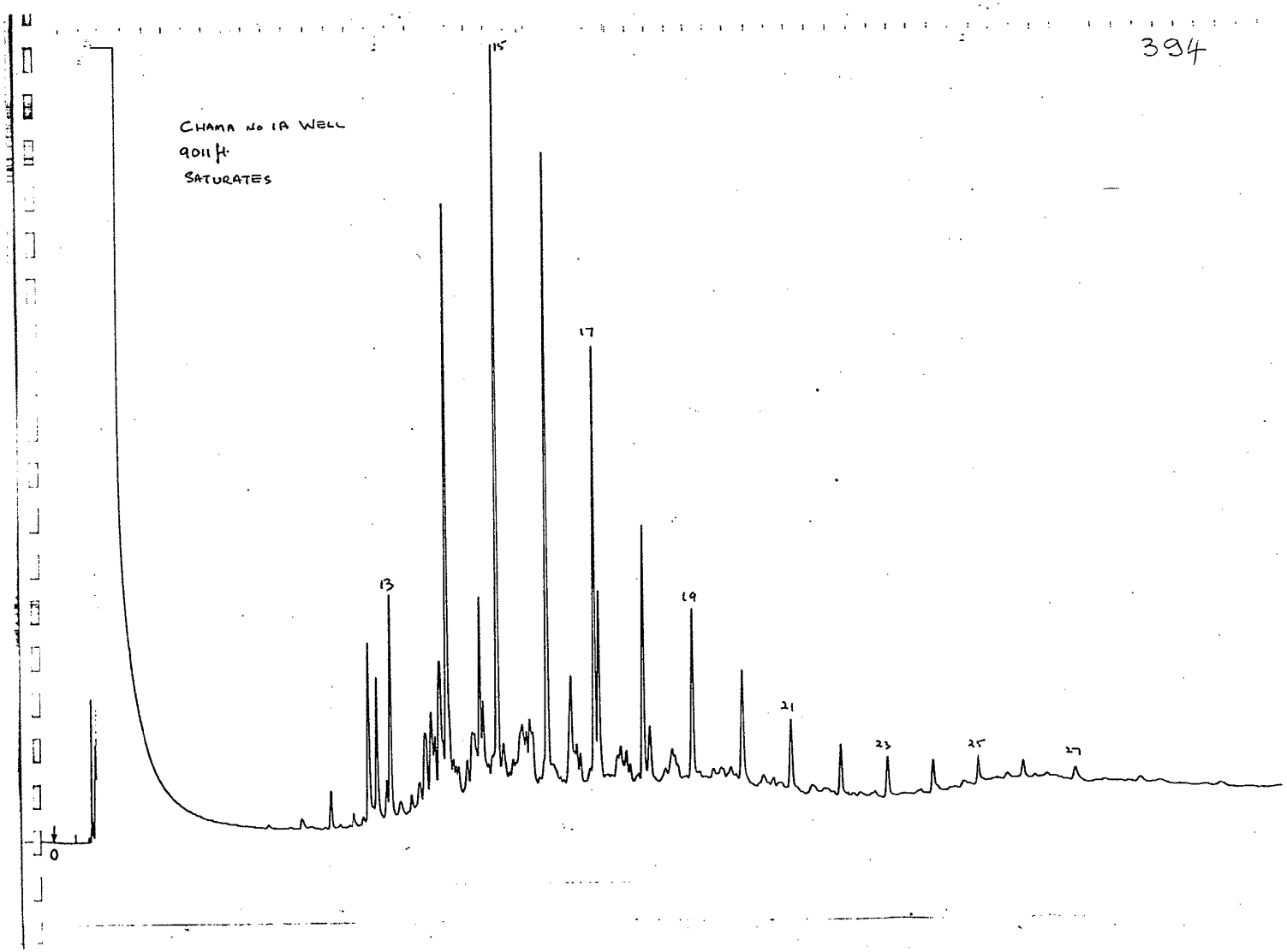
n-Alkane distribution of saturates:-

n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$


CHAMA No 1A WELL
9011 ft
SATURATES
13
15
17
19
21
23
25
27
0

SOURCE ROCK

SAMPLE NO: 12

WELL: CHAMA NO. 1A

SAMPLE IDENTIFICATION:

DEPTH: 9012 ft.

TYPE OF SAMPLE: DRILL CORE

Total organic carbon (TOC)	0.30	%
Weight of sample extracted	29.90	gm
Extracted organic matter (EOM)	291	ppm
EOM as fraction of TOC	97.0	mg/g
Wt. EOM	8.7	mg

Analysis of extracted organic matter:-

Asphaltenes	63.2	% (wt)
Saturates	2.3	%
Aromatics	1.2	%
Resins	16.1	%
Loss on column	17.2	%

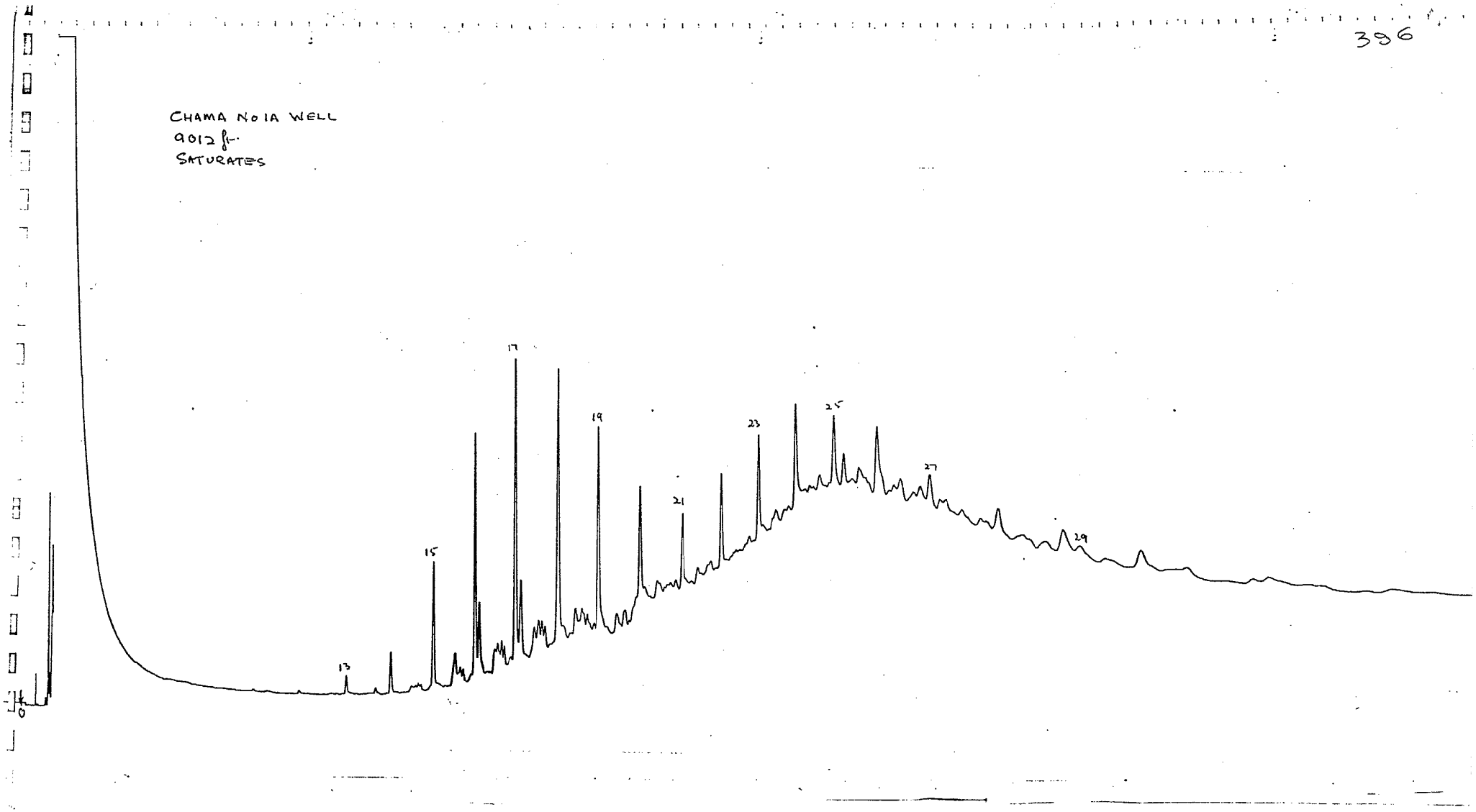
n-Alkane distribution of saturates:-

n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$


CHAMA No 1A WELL
9012 ft.
SATURATES
13
15
17
19
21
23
25
27
29

SOURCE ROCK

SAMPLE NO: *13*

WELL: *CRAYFISH No. A-1*

SAMPLE IDENTIFICATION:

DEPTH: *9551.5 ft.*

TYPE OF SAMPLE: *DRILL CORE*

Total organic carbon (TOC)	*1.40*	%
Weight of sample extracted	*53.90*	gm
Extracted organic matter (EOM)	*776*	ppm
EOM as fraction of TOC	*55.4*	mg/g
Wt. EOM	*41.8*	mg

Analysis of extracted organic matter:-

Asphaltenes	*59.8*	% (wt)
Saturates	*6.0*	%
Aromatics	*5.5*	%
Resins	*22.7*	%
Loss on column	*6.0*	%

n-Alkane distribution of saturates:-

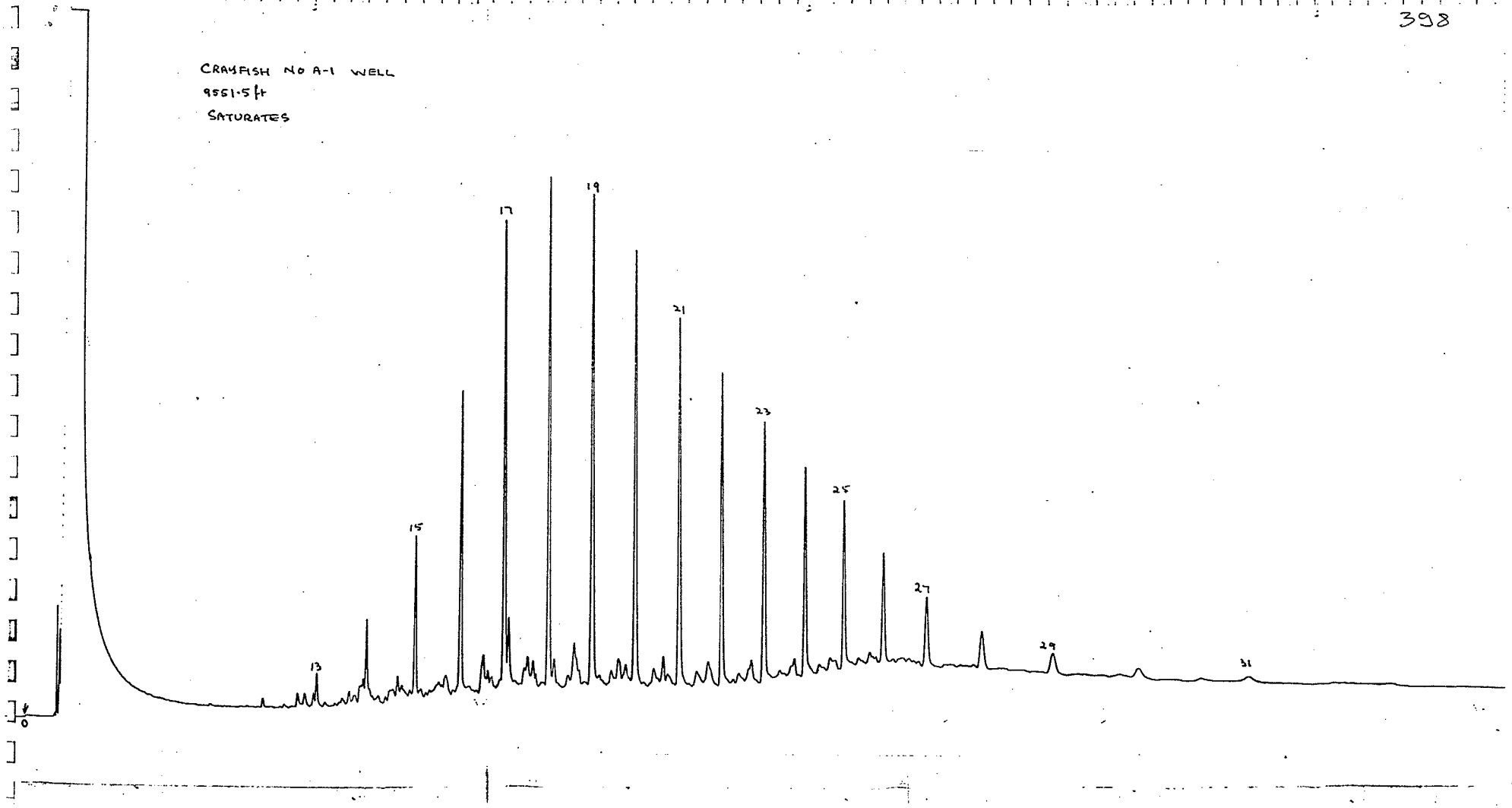
n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$

CRAYFISH No A-1 WELL
9551.5 ft
SATURATES



399

SOURCE ROCK

SAMPLE NO: *14*

WELL: *CRAYFISH No. A-1*

SAMPLE IDENTIFICATION:

DEPTH: *9960 ft.*

TYPE OF SAMPLE: *DRILL CORE*

Total organic carbon (TOC)	*0.95*	%
Weight of sample extracted	*46.40*	gm
Extracted organic matter (EOM)	*571*	ppm
EOM as fraction of TOC	*60.1*	mg/g
Wt. EOM	*26.5*	mg

Analysis of extracted organic matter:-

Asphaltenes	*63.0*	% (wt)
Saturates	*5.3*	%
Aromatics	*4.2*	%
Resins	*21.9*	%
Loss on column	*5.6*	%

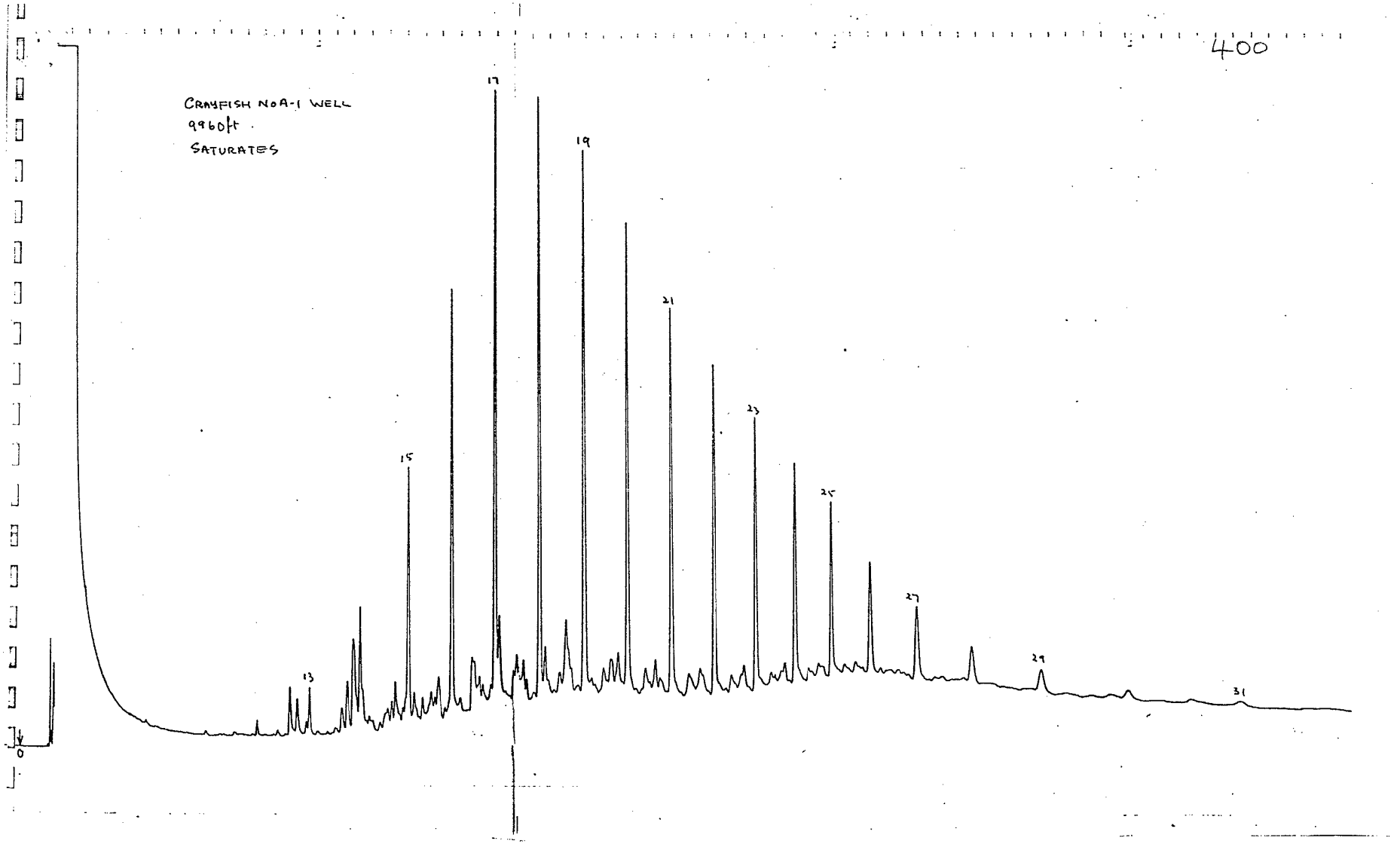
n-Alkane distribution of saturates:-

n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$


400
CRAYFISH NoA-1 WELL
9960ft
SATURATES
13
15
17
19
21
23
25
27
29
31
0

401

SOURCE ROCK

SAMPLE NO: *15*

WELL: *CRAYFISH No. A-1*

SAMPLE IDENTIFICATION:

DEPTH: *9963 ft.*

TYPE OF SAMPLE: *DRILL CORE*

Total organic carbon (TOC)	*1.00*	%
Weight of sample extracted	*34.00*	gm
Extracted organic matter (EOM)	*753*	ppm
EOM as fraction of TOC	*75.3*	mg/g
Wt. EOM	*25.6*	mg

Analysis of extracted organic matter:-

Asphaltenes	*49.2*	% (wt)
Saturates	*5.1*	%
Aromatics	*3.1*	%
Resins	*28.5*	%
Loss on column	*14.1*	%

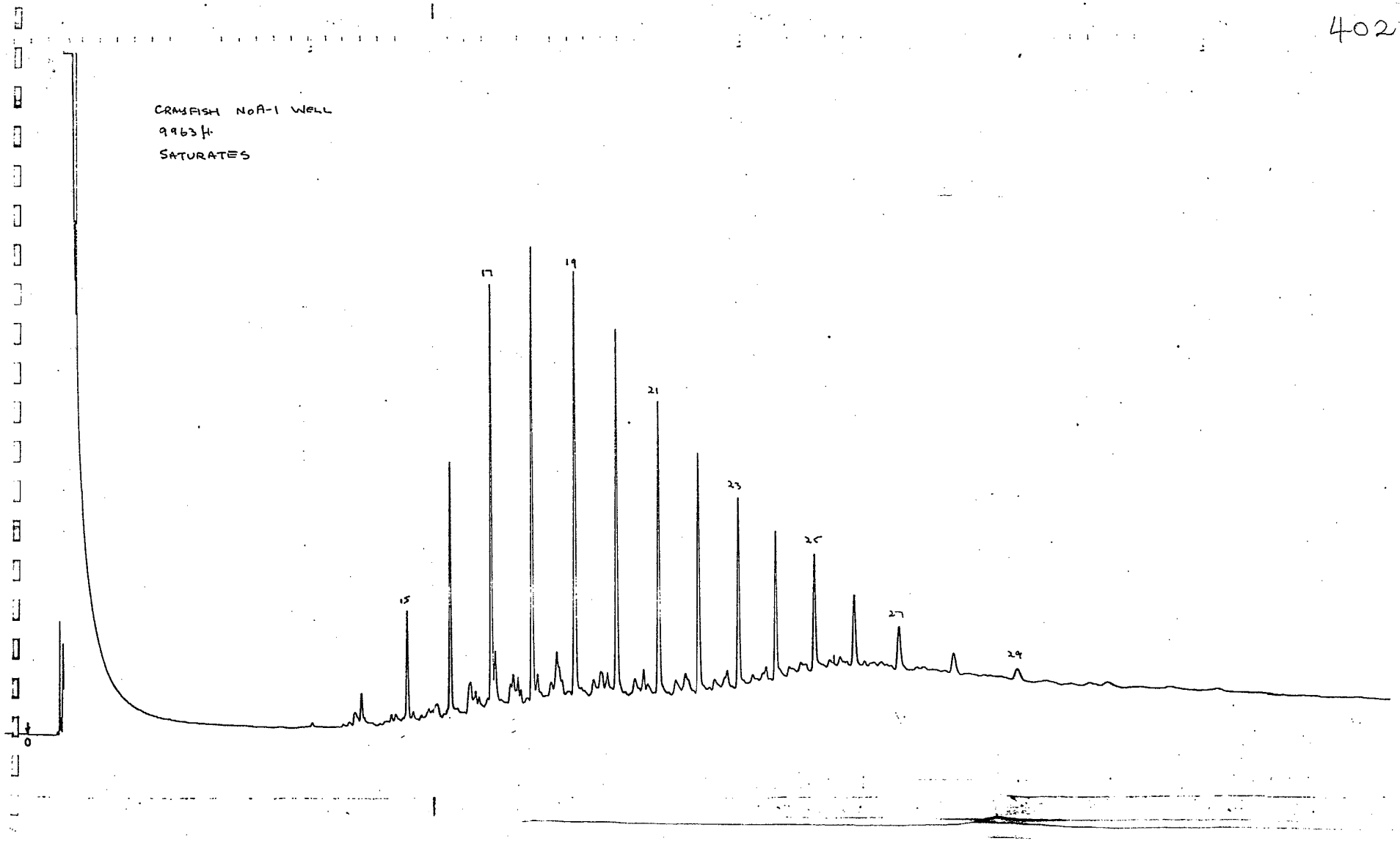
n-Alkane distribution of saturates:-

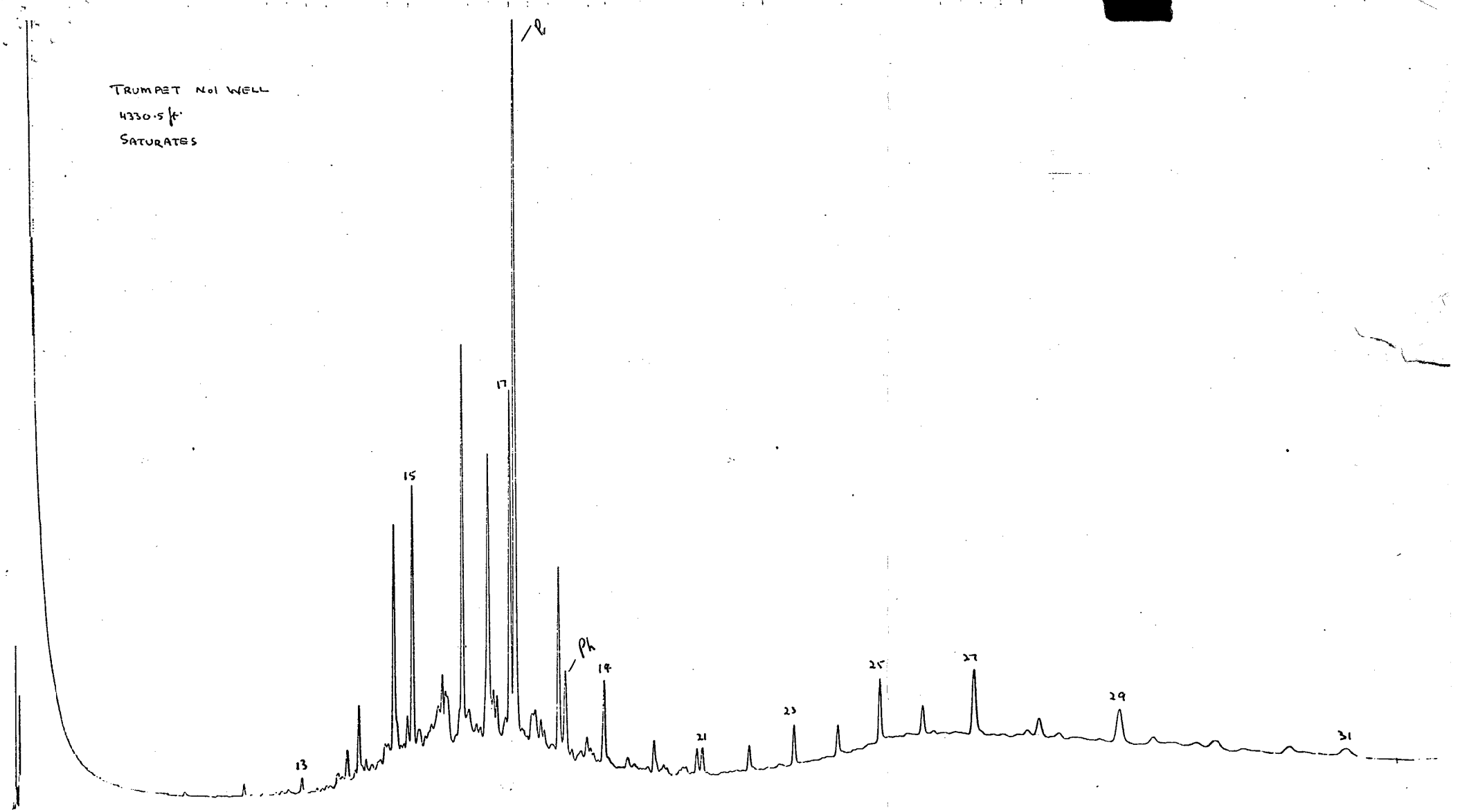
n-Alkane	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}
Rel abund.											
n-Alkane	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}
Rel abund.											

Isoprenoid distribution in saturates:

IP16	IP18	Pr	Ph

$\frac{IP16}{IP18}$	$\frac{IP18}{Pr}$	$\frac{Pr}{Ph}$	$\frac{IP16}{nC_{15}}$	$\frac{IP18}{nC_{16}}$	$\frac{Pr}{nC_{17}}$	$\frac{Ph}{nC_{18}}$


CRMSFISH NOA-1 WELL
9963 ft.
SATURATES
15
17
19
21
23
25
27
29


TRUMPET No1 WELL
4330.5 ft
SATURATES
Ph
13
15
17
19
21
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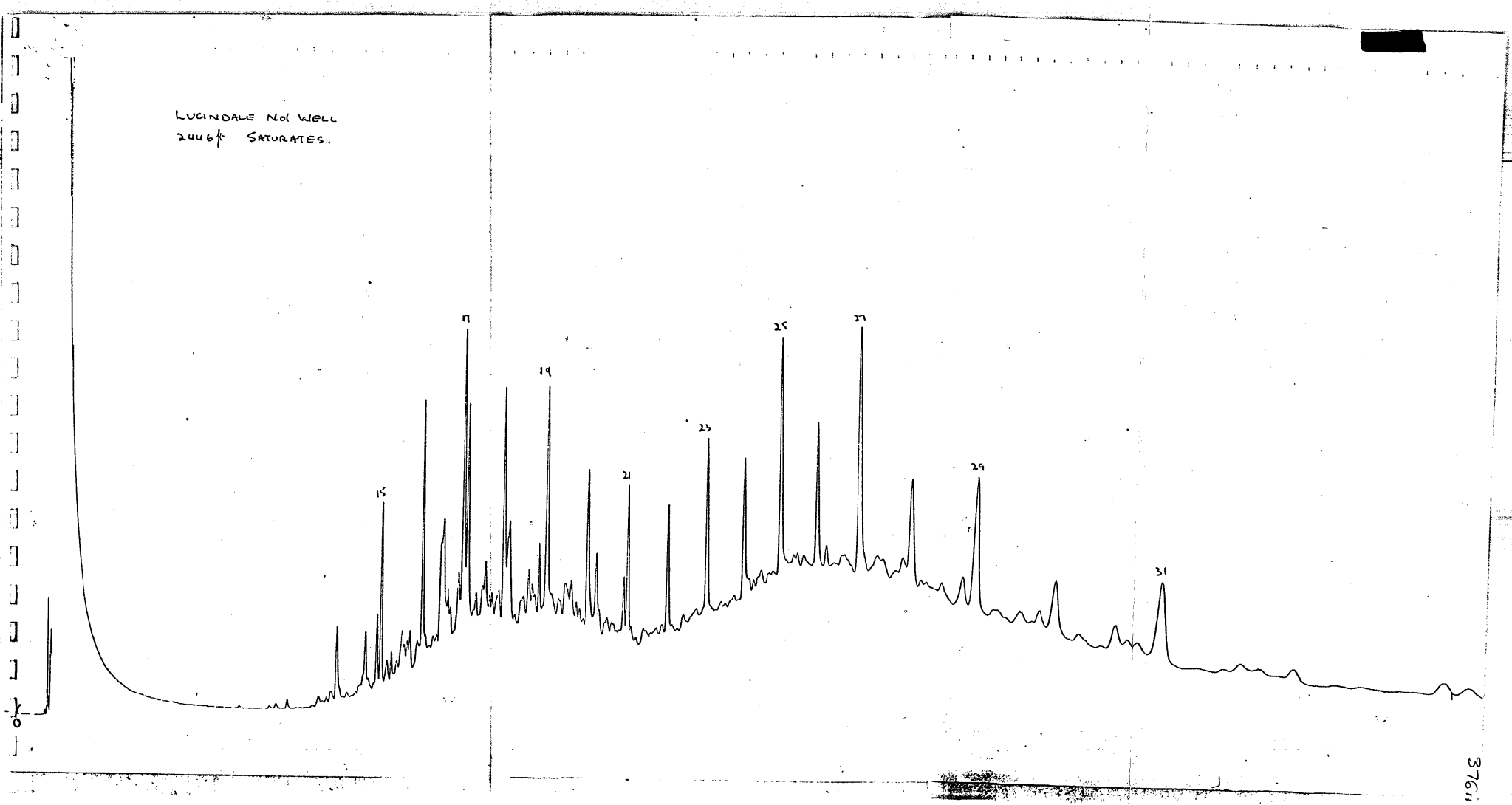
25
27
29
31


LUCINDALE No1 WELL
2446' SATURATES.
15
17
19
21
23
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27
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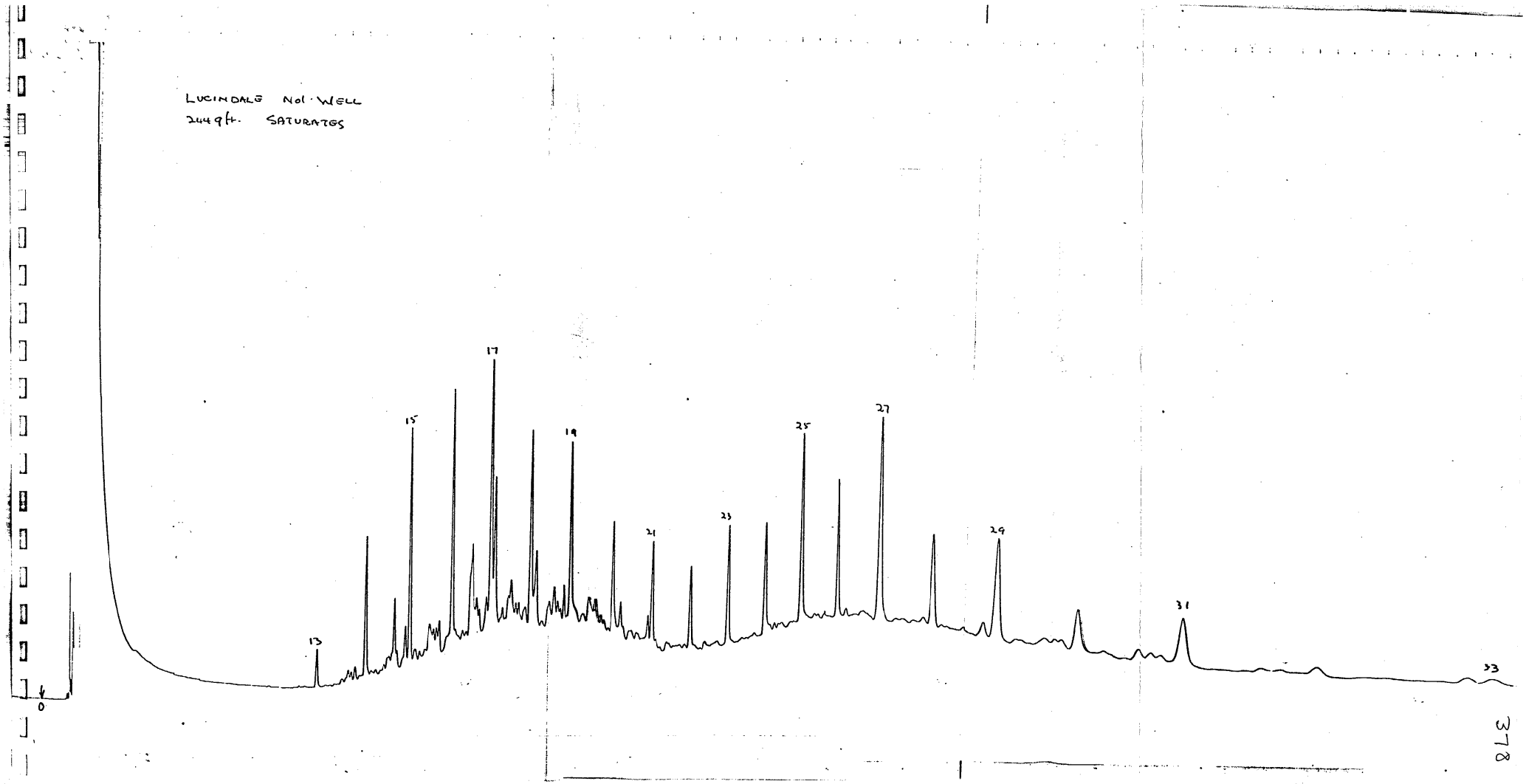
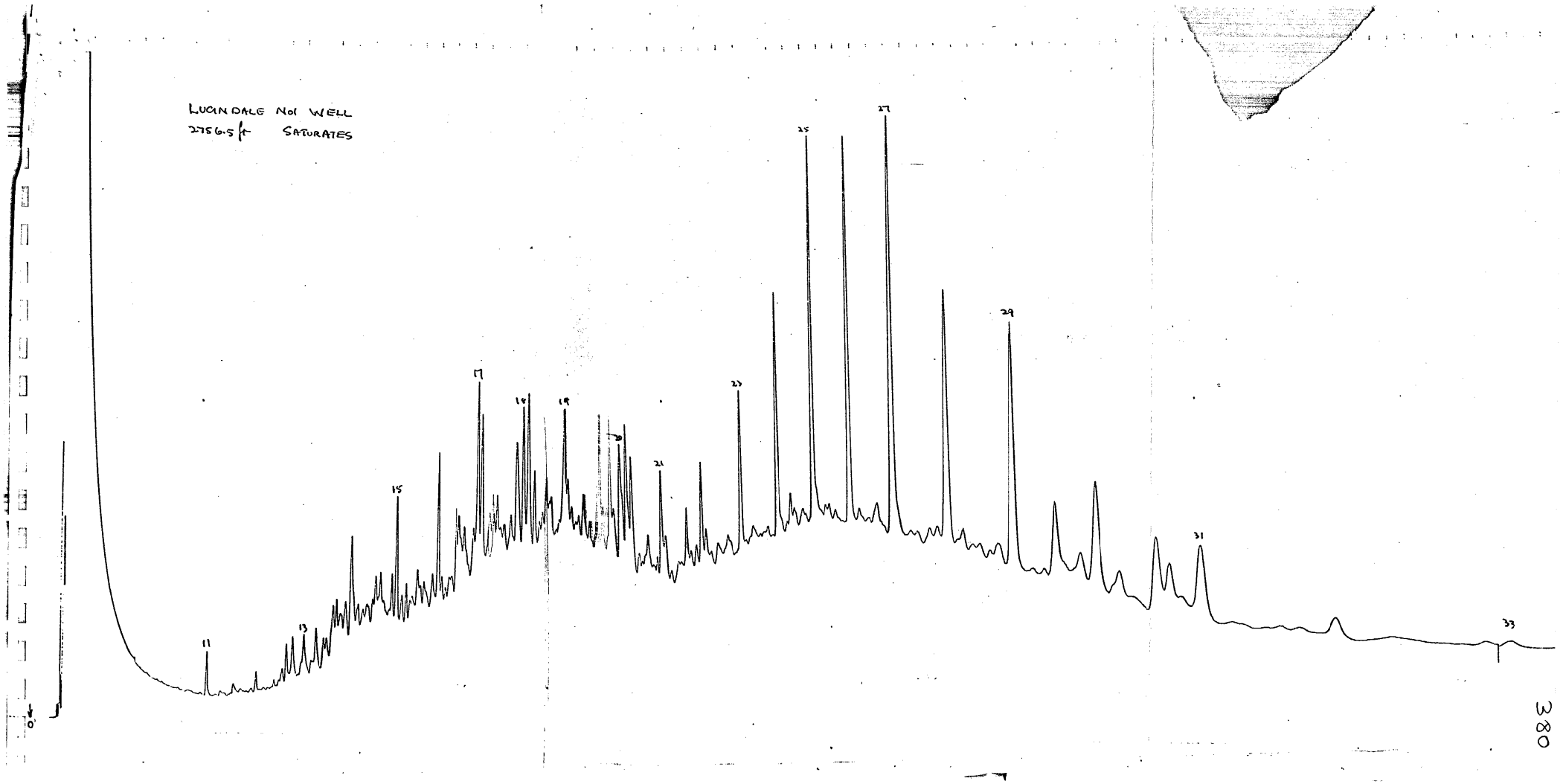
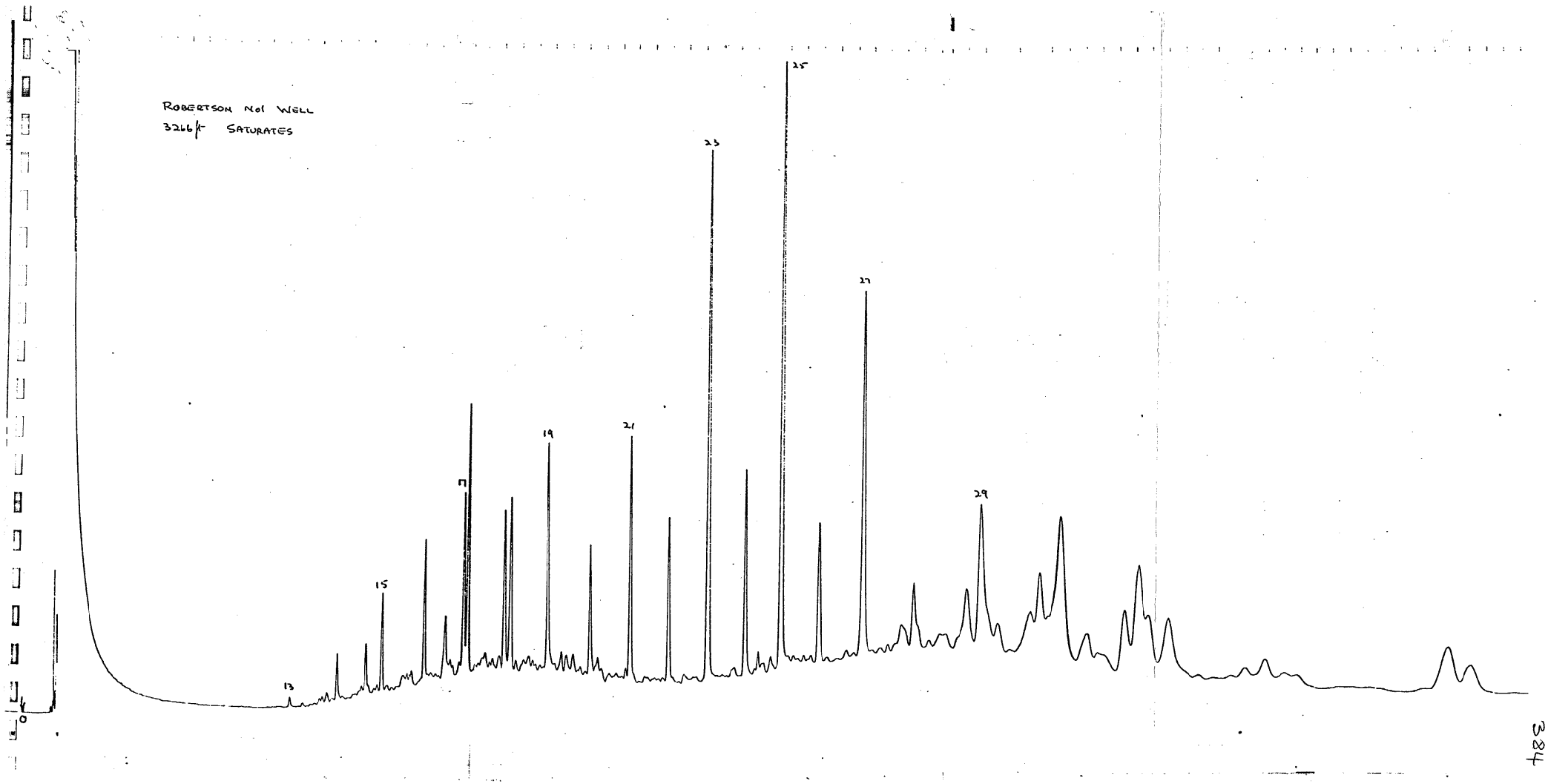
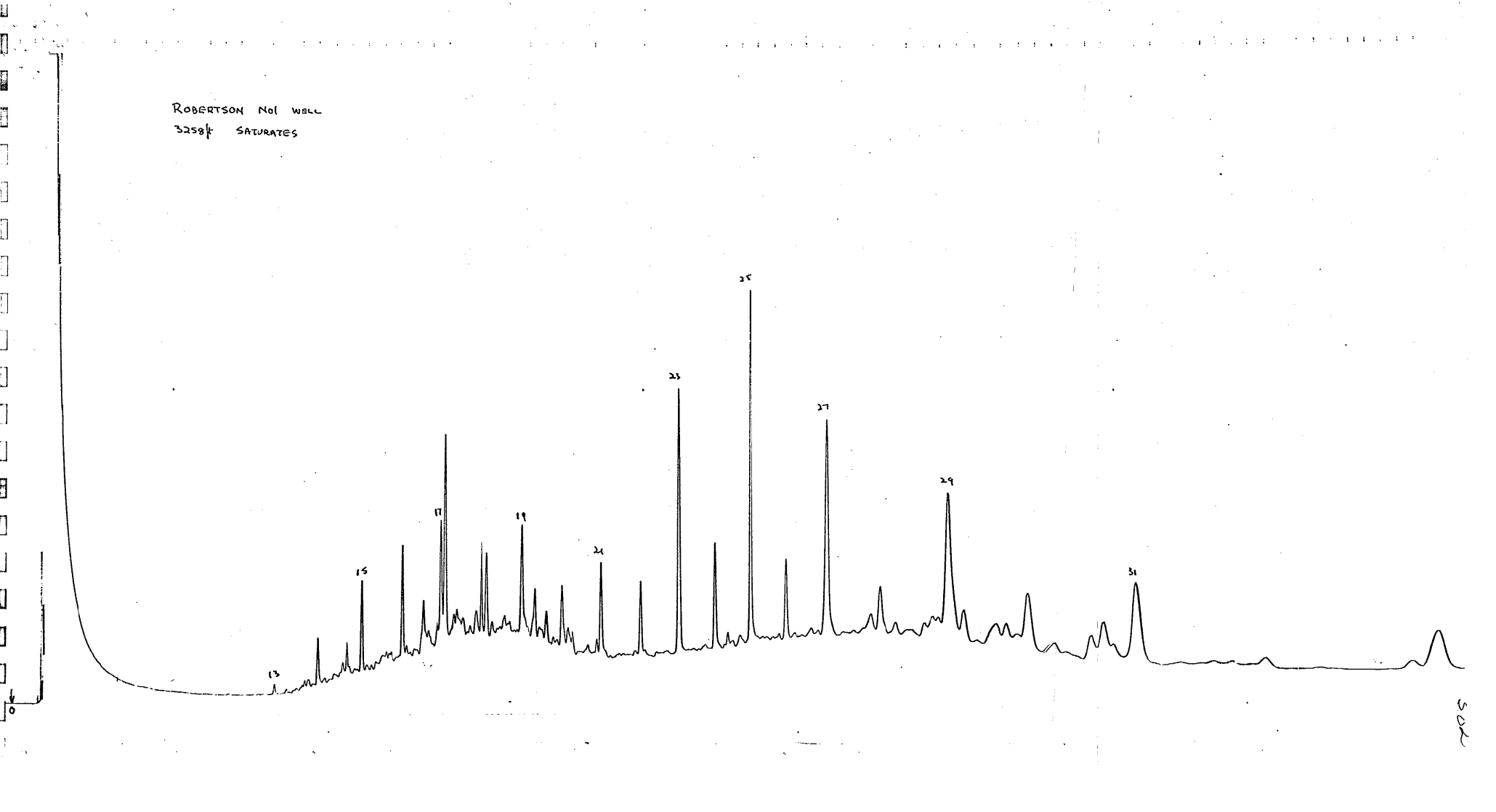
31


LUCINDALE No1 WELL
2449ft. SATURATES
0
13
15
17
19
21
23
25
27
29
31
33


LUCINDALE No1 WELL
2756.5 ft SATURATES
11
13
15
17
18
19
21
23
25
27
29
31
33


ROBERTSON No1 WELL
3266ft SATURATES
13
15
17
19
21
23
25
27
29


ROBERTSON No1 WELL
3258ft SATURATES
13
15
17
19
21
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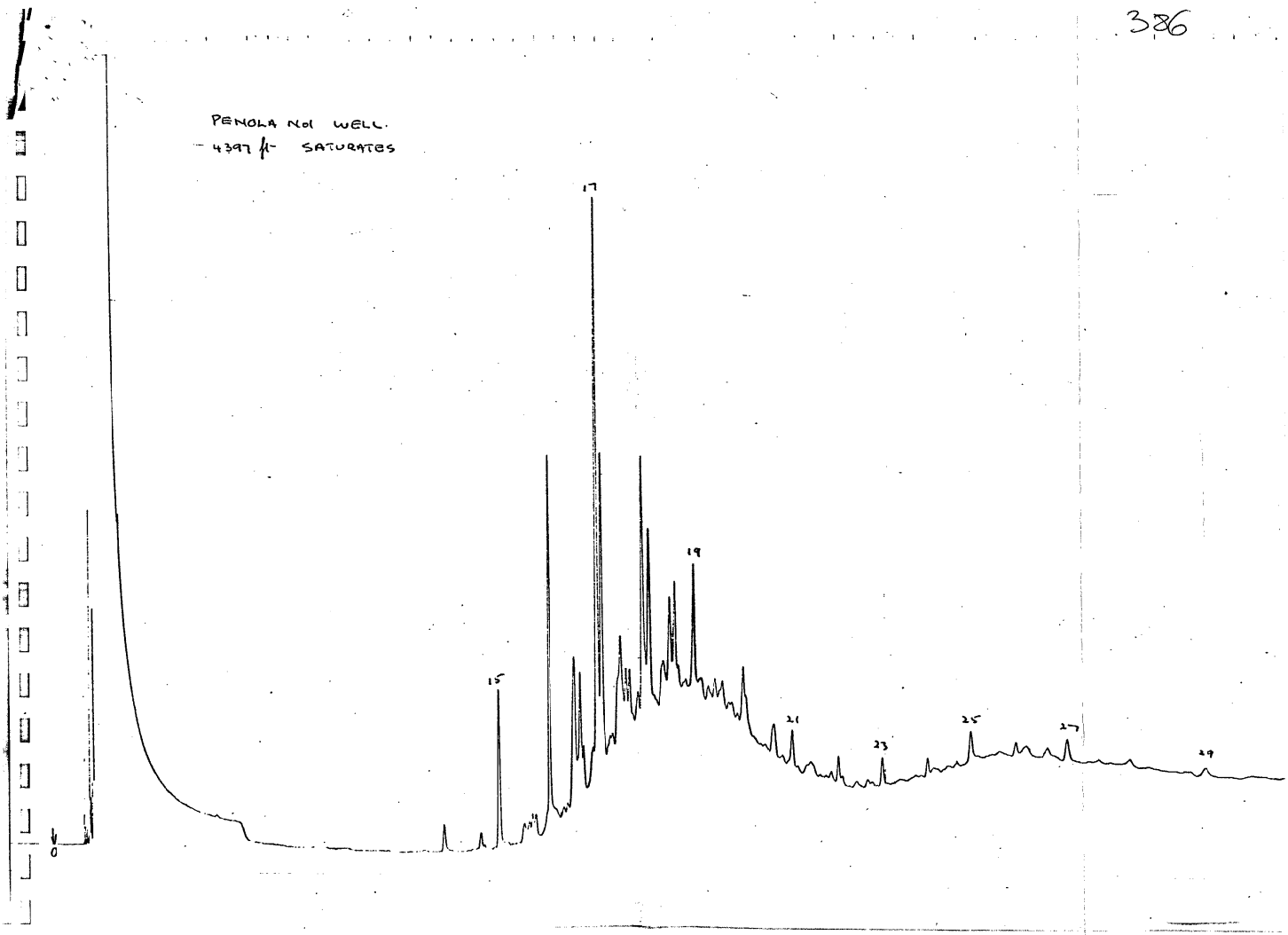
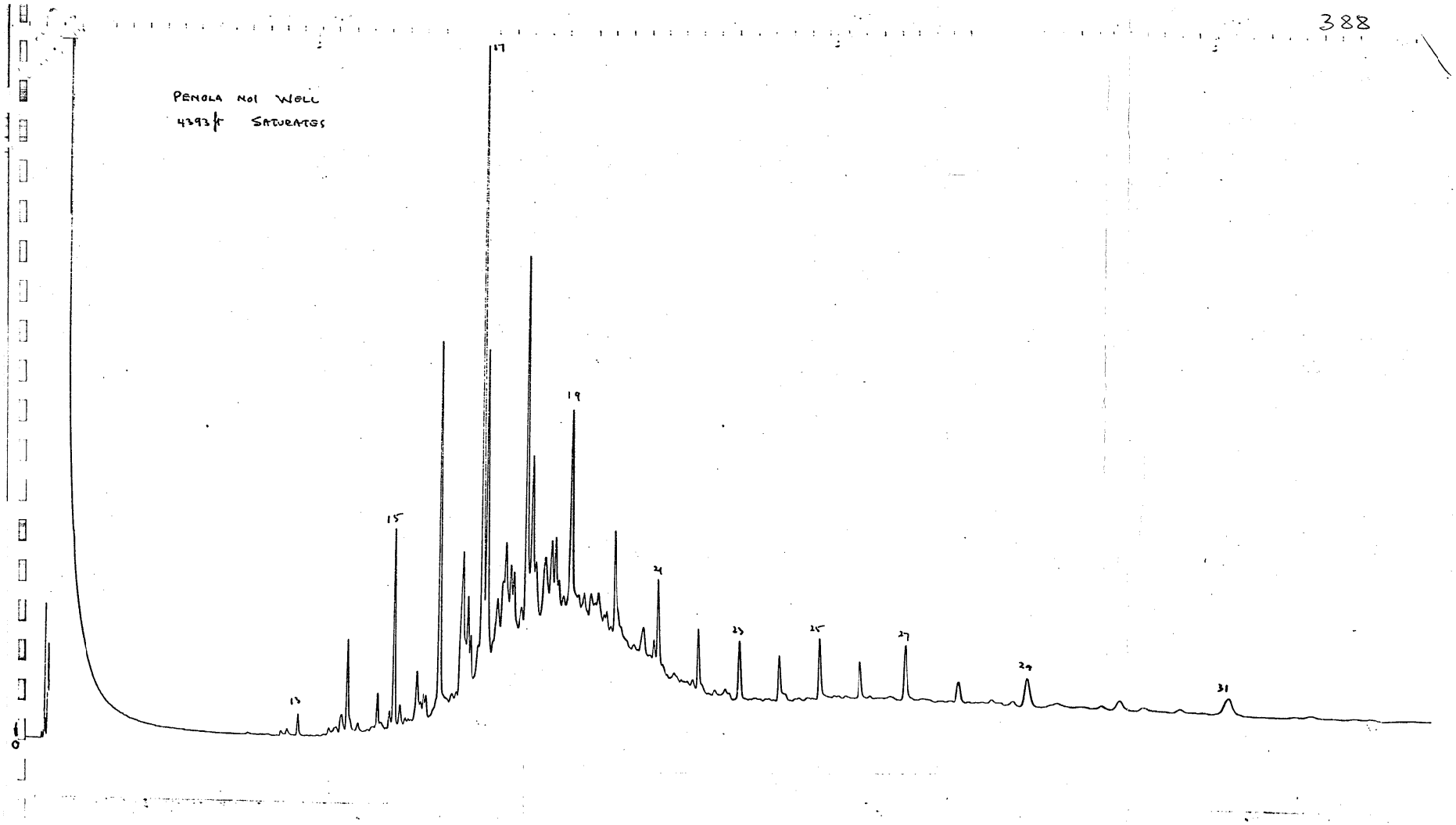
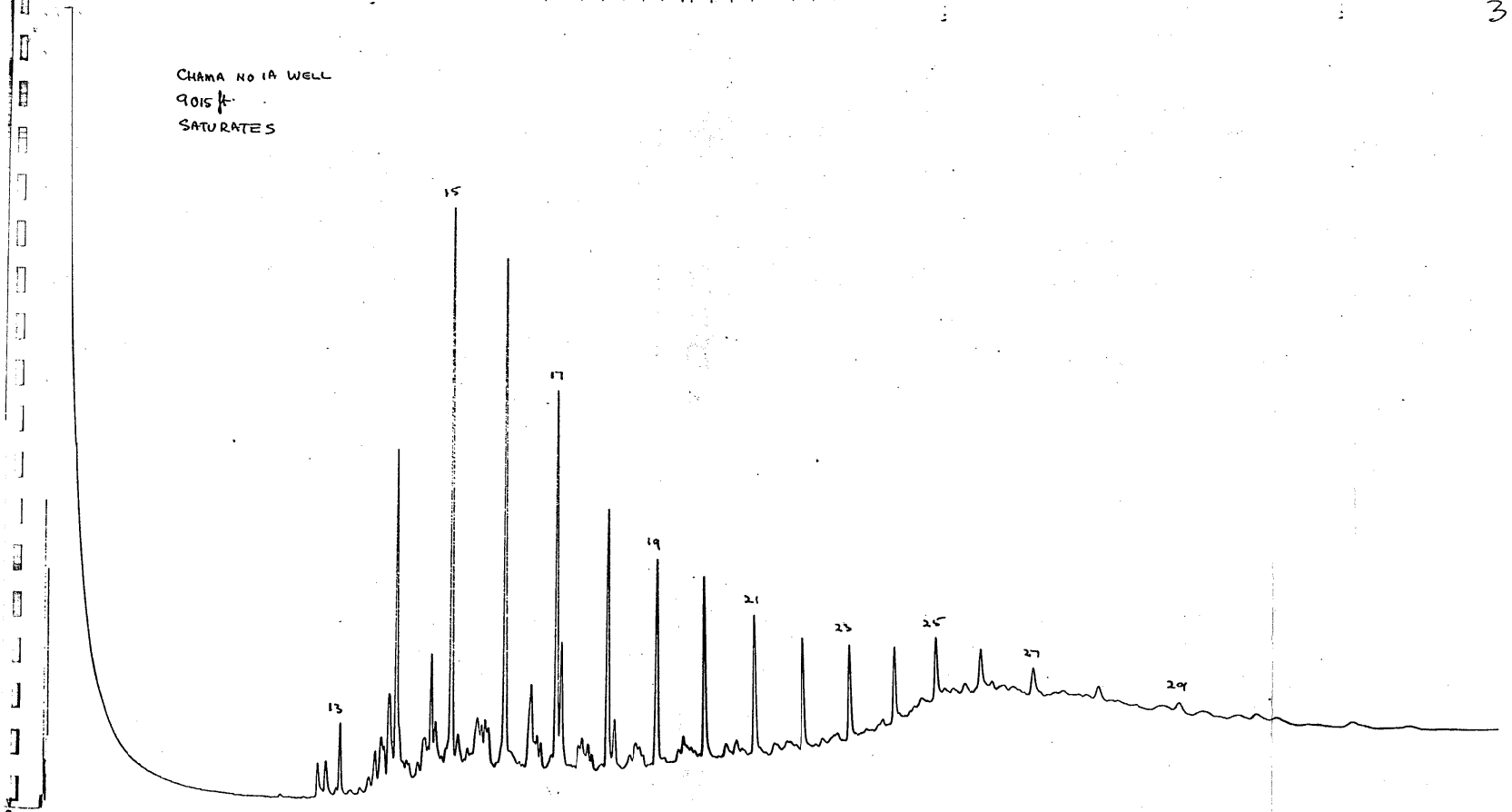
31
0
SAT

PENOLA No1 WELL.
4397 ft SATURATES

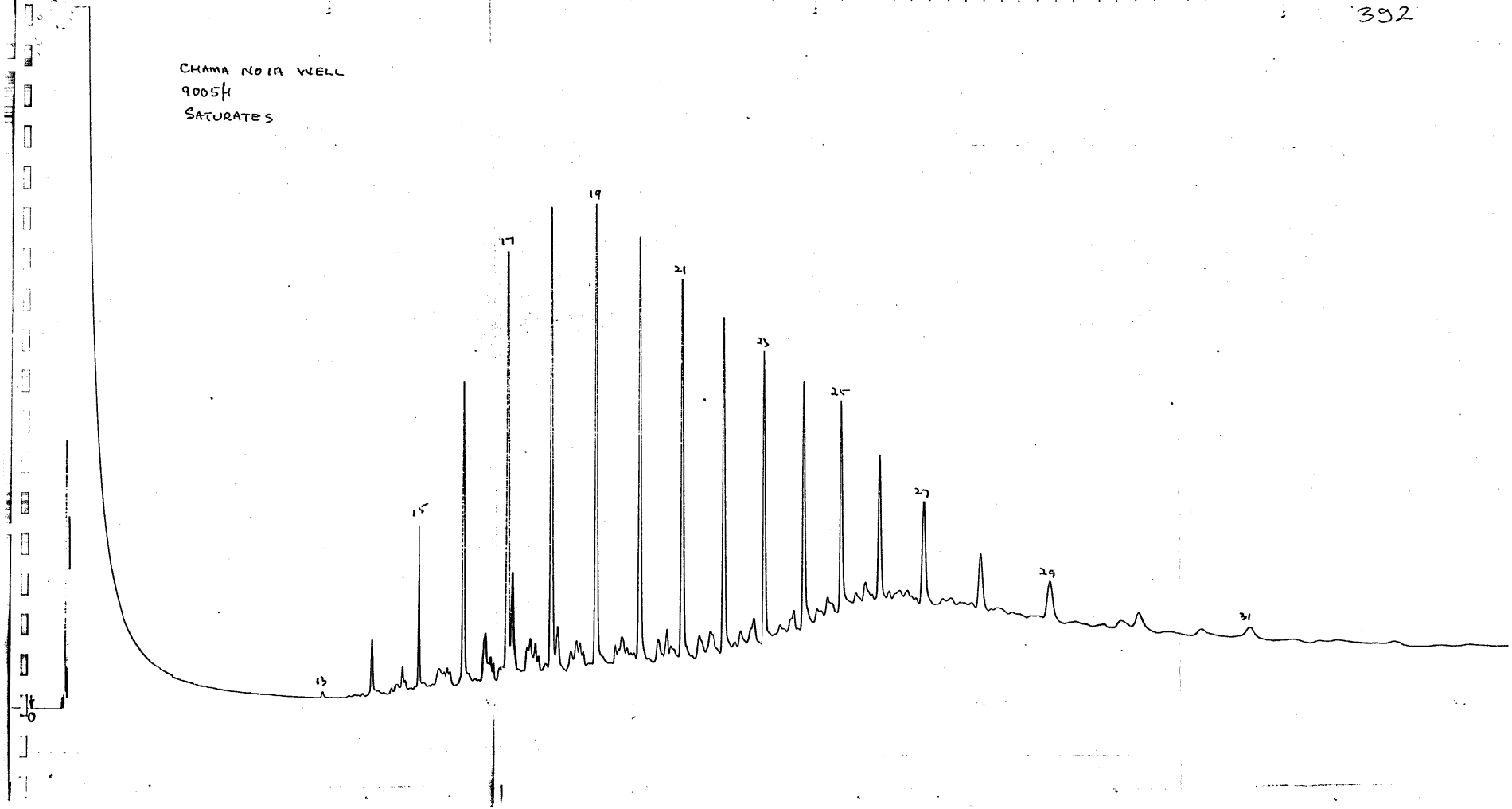


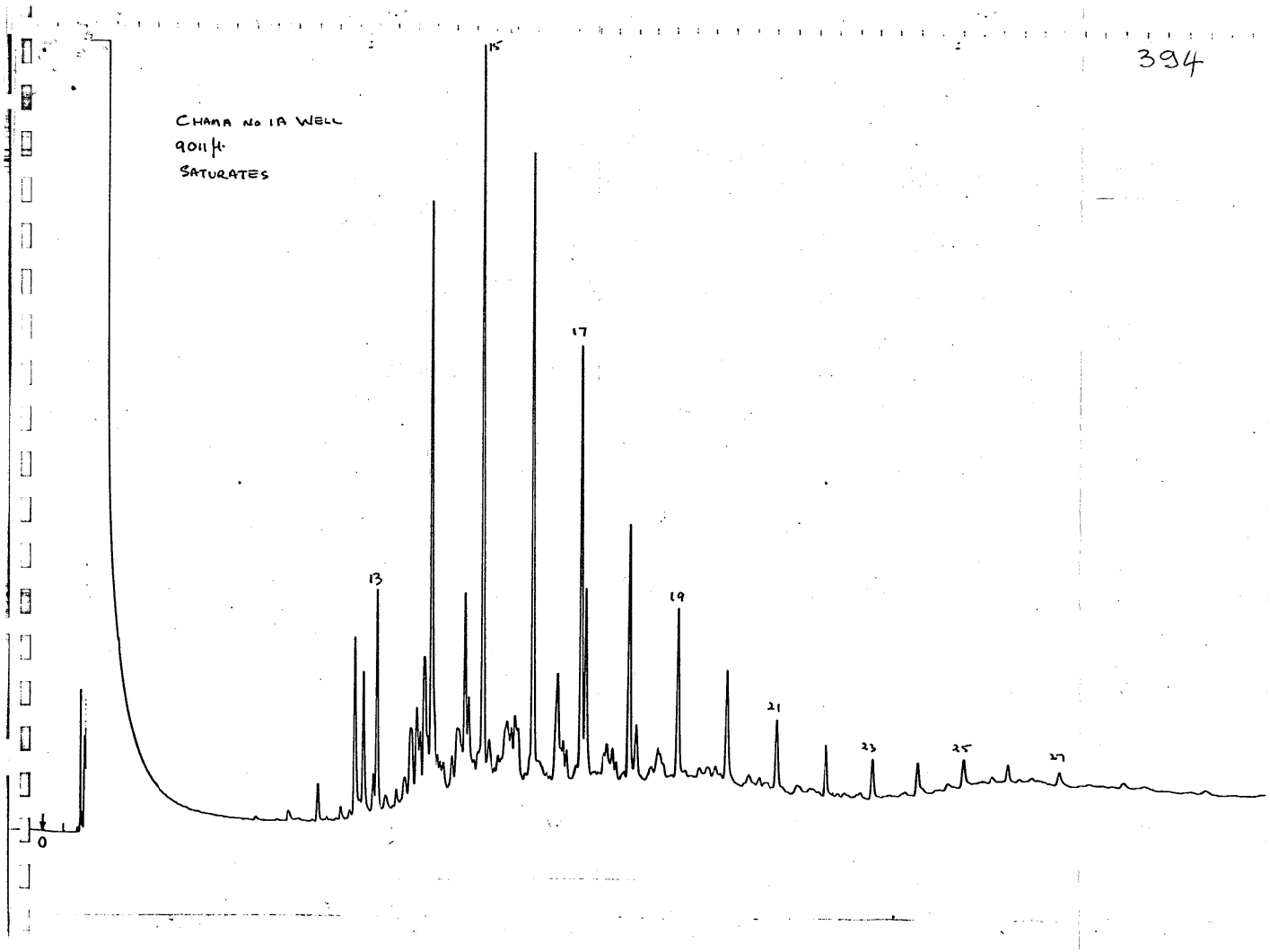

PENOLA No1 WELL
4393 ft SATURATES
13
15
17
19
21
23
25
27
29
31
0

CHAMA NO 1A WELL
9015 ft
SATURATES

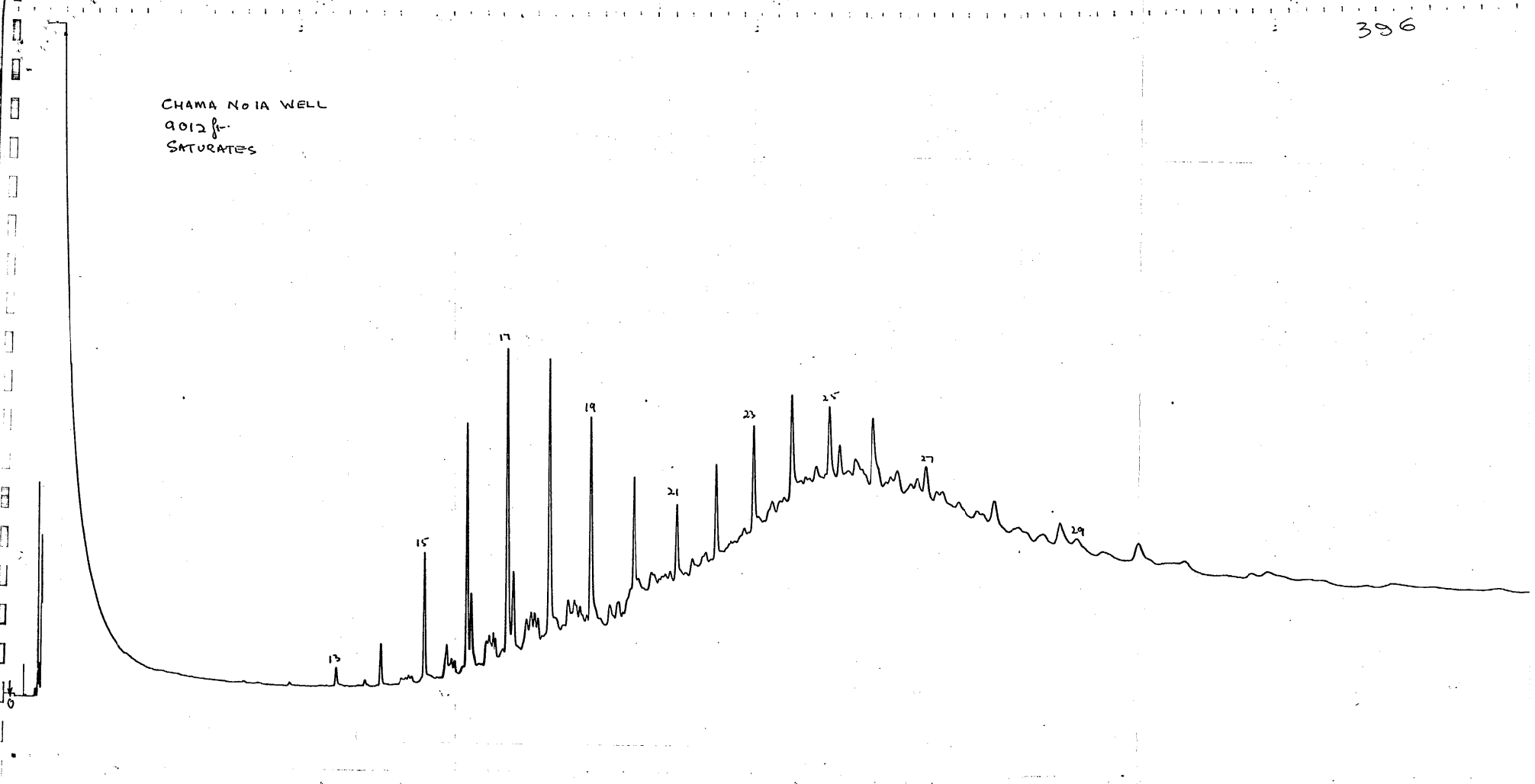


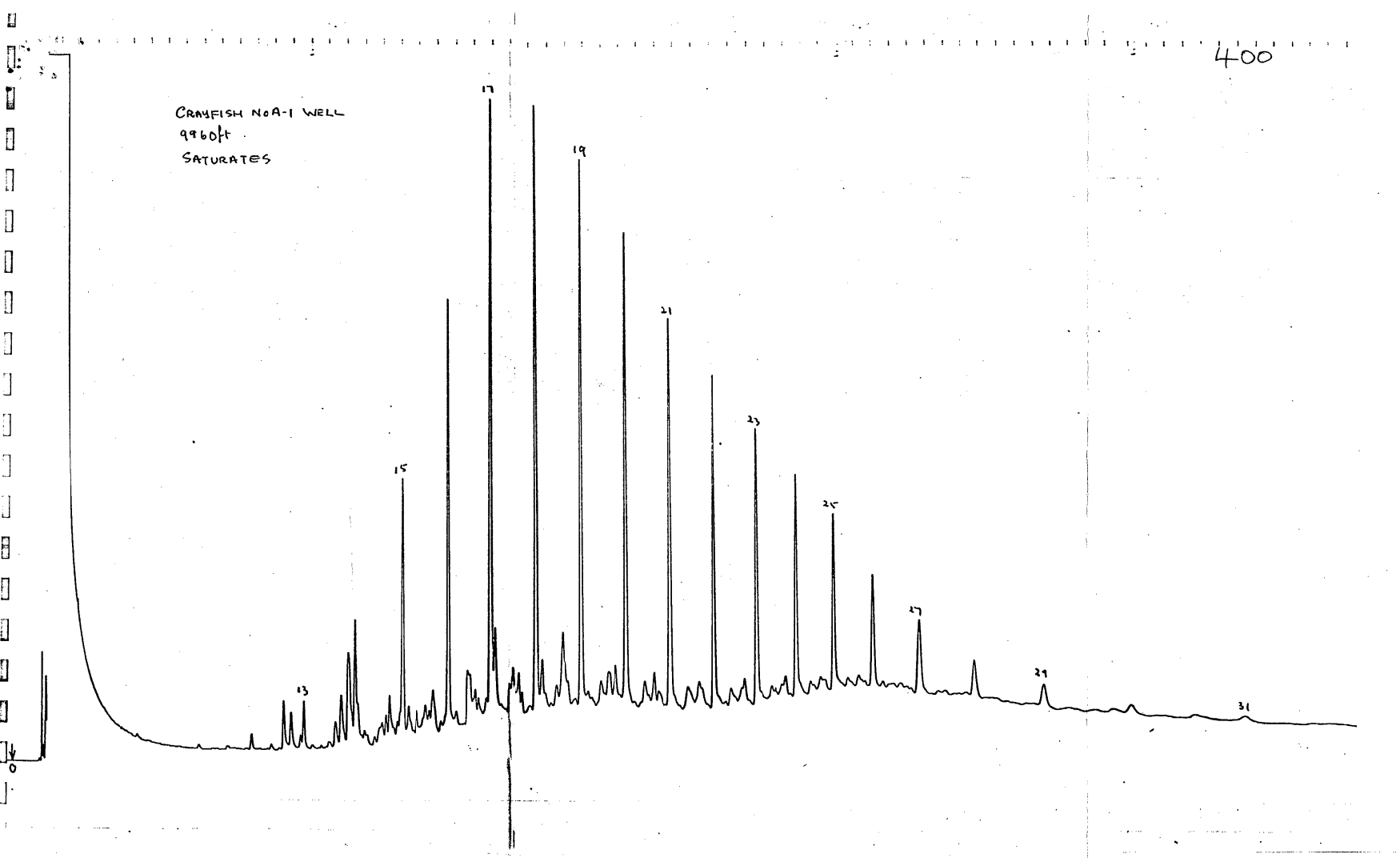
CHAMA NO 1A WELL
9005ft
SATURATES



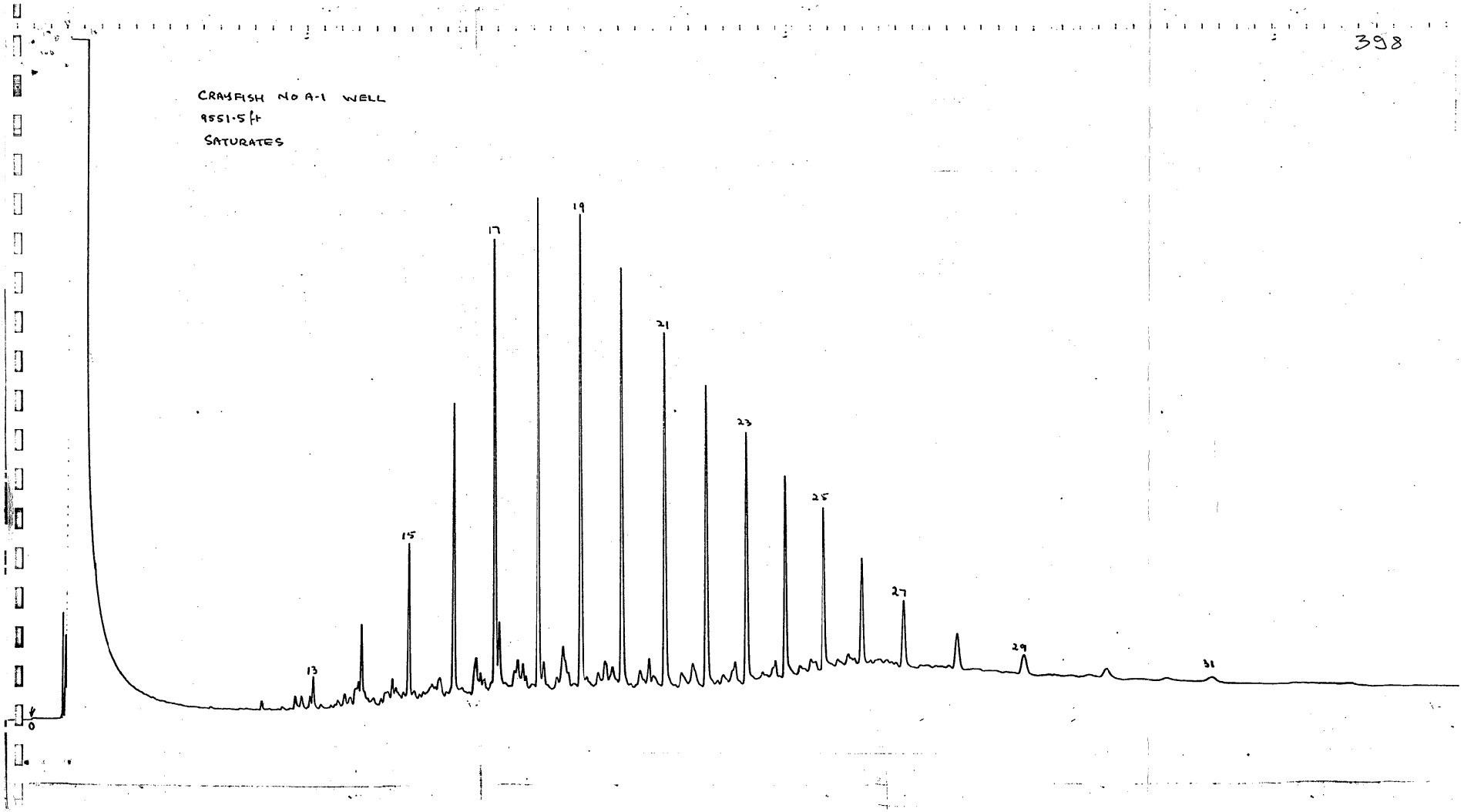

CHAMA No 1A WELL
9011 ft.
SATURATES
13
15
17
19
21
23
25
27
0

CHAMA No 1A WELL
9012 ft.
SATURATES




400
CRAYFISH NoA-1 WELL
9960ft
SATURATES
13
15
17
19
21
23
25
27
29
31
0

CRAYFISH NO A-1 WELL
9551.5 ft
SATURATES



CRAYFISH NoA-1 WELL
9963 ft
SATURATES