New Mexico Bureau of Mines and Mineral Resources
Open-File Report No. OF-271

CRUDE-OIL ANALYSES OF SAMPLES FROM THE HOSPAH (DAKOTA, GALLUP), MEDIA-ENTRADA, CHACO WASH (MENEFEE), AND TWO UNDESIGNATED (GALLUP) FIELDS, MCKINLEY COUNTY, NEW MEXICO

By Donald G. Van Delinder
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June 27, 1986

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June 27, 1986

Mr. Robert McKinney
GILA EXPLORATION INC.
839 Paseo de Peralta
Suite J
Santa Fe, New Mexico 87501

RE: Geochemical Characterization of Eight (8) McKinley County Oils

Dear Robert,

Sample Identification

The following oil samples were analyzed in this crude oil comparison study:

Sample Number	Field Name	Well Name	Location	Age and Geological Formation
3435-001*	Hogan	Gila Hogan #1	Sec16,T18N,R12W	Cretaceous Gallup
3449-001	Hogan	Gila Hogan #1	Sec16,T18N,R12W	Cretaceous Gallup
3449-002	Hogan	Gila Hogan #2	Sec16,T18N,R12W	Cretaceous Gallup
3449-003	Hospah	RR-A	Sec 1,T17N,R9W & Sec36,T18N,R9W	Cretaceous Lr.Gallup
3449-004	Media Entrada	---	Sec14,T19N,R3W & Sec15,T19N,R3W	Jurassic Entrada
3449-005	Hospah	---	Sec.1,T17N,R9W & Sec36,T18N,R9W	Cretaceous Up.Gallup
3449-006	Hospah	---	Sec.1,T17N,R9W & Sec36,T18N,R9W	Cretaceous Dakota
3449-007	Chaco Wash	---	Sec20,T20N,R9W & Sec29,T20N,R9W	Cretaceous Menefee
3449-008	---	Black NLC#1	Sec.9,T20N,R12W	Cretaceous Gallup

* analyzed earlier

Analyses Performed

		Table No.	Figure No.
1.	Detailed C4-C7 gasoline-range hydrocarbon gas-chromatographic analysis	I	1
2.	C15+ liquid chromatographic separation	II-A thru H	-
3.	GC analysis C15+ P-N hydrocarbon	III-A,III-B	2-10

Interpretations

The results of this study have indicated five (5) distinct oil family types as follows:

Family

Groups A,F — The samples 3449-006, -007, and -008 have a very similar C_4-C_7 molecular hydrocarbon composition (Figure 1) and are similar in C_{15+} P-N hydrocarbon composition. They can be considered to be part of a genetic family and are mature and unaltered (by bacteria). The oil sample 3435-001, produced initially from the Hogan #1 well, shares a fair resemblance in C_4-C_7 hydrocarbon composition (Figure 1) and is probably genetically related to these three oils.

Group B — The two oil samples 3449-001 and 3449-002, collected at the wellhead at the Hogan #1 and Hogan #2 wells respectively, resemble each other very closely in C_4-C_7 hydrocarbon composition (Figure 1) but, do not resemble any other oils in this study including the oil produced initially in the Hogan #1 well. These oils are apparently enriched in benzene and toluene; and are low in n-paraffins (nC_5, nC_6, and nC_7), cyclohexane, and methylcyclopentane; and are unusually rich in 1-1, 3-trimethylcyclopentane relative to the Hogan #1 oil sample 3435-001. These oils are also low in C_{15+} normal paraffins (Figures 4 and 5) a fact which may reflect bacterial biodegradation of these oils.

The reason(s) for these differences in oil types from the Gallup sand oil pool at the Hogan field is not known at this time.

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Group C

The oil sample 3449-003, produced from the Lower Gallup sand in the Hospah field does not resemble the other oils in this study. It is characterized by a predominance of methylcyclopentane, 1-t-2 dimethylcyclopentane and methylcyclohexane (Figure 1). This oil has been bacterially altered as evidenced by the low normal paraffin content in the C_4-C_7 range hydrocarbon as seen in the following table:

Sample No:	3435-001	3449-001	-002	-003	-004	-005	-006	-007	-008
nC5	5.8	0.3	0.4	1.1	7.3	7.6	15.5	5.3	7.5
nC6	10.3	0.2	0.5	1.1	24.6	8.0	7.3	11.3	12.0
nC7	8.4	2.3	1.8	0.6	23.8	4.5	2.3	9.3	8.7
TOTAL	24.5%	2.8%	2.7%	2.8%	55.7%	20.1%	25.1%	25.9%	28.2%
GROUP	A Moderately Rich probably related to Group F oils	B Lean n-paraffin depletion in C4-C7 and C15+ hydrocarbon fraction	B	C	D Rich	E Moderately Rich	F	F	F

Group D

The oil sample 3449-004, reservoired in the Jurassic-age Entrada Formation at the Media Entrada Field, is distinctively different than all other oils in the study and hence, probably represents a distinct genetic oil family. The $nC_5 + nC_6 + nC_7$ normal paraffin content comprises 55.7% of the C_4-C_7 gasoline-range fraction (Figure 1). The C_{15+} P-N hydrocarbon differs from that of Group F oils in the following characteristics:

(i) ipC_{19} (pristane)/ipC_{20} (phytane) is less than unity in this oil and greater than unity in the Group F oils

(ii) nC_{19} is greater than nC_{18}

(iii) this oil has an even-carbon normal paraffin preference in the C_{24}-C_{35} molecular range (Figure 6) (This could reflect a carbonate source for this oil) not found in the Group F oils.

Group E — The oil sample 3449-005, appears to be slightly altered by n-paraffin removal by bacteria - see Figure 7 and note predominance of isoprenoids (A,B,C) over the normal paraffins. The C_4-C_7 molecular composition appears to be different than the other oils.

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TABLE I

DETAILED C4-C7 HYDROCARBON ANALYSES

(NORMALIZED PERCENT)

GEOCHEM SAMPLE NUMBER	3449-001	3449-002	3449-003	3449-004	3449-005	3449-006	3449-007	3449-008
WELL DEPTH	-	-	-	-	-	-	-	-
ISOBUTANE	0.1	0.7	0.7	0.3	1.0	5.5	0.2	0.8
N-BUTANE	0.1	1.3	0.9	0.6	2.4	14.6	0.8	2.1
ISOPENTANE	0.3	0.5	1.7	3.0	8.6	21.2	4.6	6.7
N-PENTANE	0.3	0.4	1.1	7.3	7.6	15.5	5.3	7.5
2,2-DIMETHYLBUTANE	0.6	0.6	0.6	1.1	0.2	1.0	0.6	0.3
CYCLOPENTANE	0.0	0.0	0.2	0.1	0.4	0.8	0.5	0.5
2,3-DIMETHYLBUTANE	2.3	2.7	3.4	1.7	1.5	2.2	1.7	1.3
2-METHYLPENTANE	2.6	3.0	2.0	7.7	9.8	7.7	8.5	10.3
3-METHYLPENTANE	1.6	2.0	1.6	4.3	6.0	4.5	5.3	5.8
N-HEXANE	0.2	0.5	1.1	24.6	8.0	7.3	11.3	12.0
METHYCYCLOPENTANE	0.2	0.1	7.3	1.1	6.4	3.5	5.3	5.0
2,2-DIMETHYLPENTANE	4.2	4.6	1.3	1.1	0.4	0.4	1.0	0.6
BENZENE	8.0	8.6	3.8	1.1	1.4	0.7	1.6	1.4
2,4-DIMETHYLPENTANE	2.1	2.1	0.3	0.2	0.1	0.1	0.3	0.1
2,2,3-TRIMETHYLBUTANE	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.2	0.0	3.5	1.3	2.3	2.5	4.5	2.6
3,3-DIMETHYLPENTANE	1.7	1.6	0.4	0.7	0.1	0.2	0.5	0.2
1,1-DIMETHYLCYCLOPENTANE	0.3	0.0	2.9	0.5	1.0	0.3	1.1	0.8
2-METHYLHEXANE	4.5	4.1	6.6	3.7	4.4	1.7	8.3	7.2
2,3-DIMETHYLPENTANE	12.4	12.9	0.0	2.9	2.2	0.9	0.0	0.0
1,CIS-3-DIMETHYLCYCLOPENTANE	0.0	0.4	1.4	0.5	2.6	0.6	3.0	7.5
3-METHYLHEXANE	10.5	10.3	5.1	4.4	6.2	1.7	5.0	0.0
1 TRANS-3-DIMETHYLCYCLOPENTANE	1.0	0.5	5.6	0.4	2.8	0.4	1.7	1.8
1 TRANS-2-DIMETHYLCYCLOPENTANE	0.0	0.1	11.2	1.0	4.4	0.6	2.7	2.8
3-ETHYLPENTANE	1.7	1.7	2.0	0.4	0.8	0.1	0.6	0.6
2,2,4-TRIMETHYLPENTANE	1.8	1.8	0.3	0.2	0.1	0.0	0.0	0.0
N-HEPTANE	2.3	1.8	0.6	23.8	4.5	2.3	9.3	8.7
1,CIS-2-DIMETHYLCYCLOPENTANE	0.0	0.0	1.3	0.1	0.6	0.1	0.4	0.4
METHYCYCLOHEXANE	0.1	0.1	18.9	3.8	9.2	2.9	12.0	8.9
1,1,3-TRIMETHYLCYCLOPENTANE *	24.6	22.7	6.1	0.4	2.1	0.2	1.4	1.7
2,2-DIMETHYLHEXANE	3.7	3.3	0.5	0.3	0.2	0.1	0.5	0.3
ETHYLCYCLOPENTANE	0.0	0.0	1.8	0.2	0.6	0.1	0.5	0.8
TOLUENE	12.3	11.4	5.9	0.9	2.1	0.2	1.2	1.2
MOLECULAR RATIOS								
2-METHYLPENTANE/3-METHYLPENTANE	1.56	1.47	1.26	1.78	1.62	1.70	1.59	1.77
ISOPENTANE/N-PENTANE	0.84	1.22	1.55	0.42	1.14	1.36	0.86	0.90
CYCLOHEXANE/METHYLCYCLOPENTANE	0.80	0.71	0.48	1.21	0.37	0.74	0.85	0.52
METHYLCYCLOPENT/METHYLCYCLOHEX	2.52	0.81	0.38	0.30	0.70	1.20	0.45	0.57

* C8 COMPOUNDS

Table II-A

CRUDE OIL ANALYSIS RESULTS

GeoChem Sample No.: 3449-001

GROSS COMPOSITION

Less than C_{15+}	5.1%
C_{15+}	94.9%

C_{15+} COMPOSITION

Asphaltene (ASPH)	1.0%
Paraffin-Naphthene Hydrocarbons (P-N)	50.6%
Aromatic Hydrocarbons (AROM)	44.9%
Eluted NSO Compounds (NSO)	2.4%
Noneluted NSO Compounds (NSO)	1.1%

RATIOS

$$\frac{P\text{-}N}{AROM} = 1.13$$

$$\frac{ASPH}{NSO} = 0.32$$

Table II-B

CRUDE OIL ANALYSIS RESULTS

GeoChem Sample No.: 3449-002

GROSS COMPOSITION

Less than C_{15+}	7.2%
C_{15+}	92.8%

C_{15+} COMPOSITION

Asphaltene (ASPH)	3.2%
Paraffin-Naphthene Hydrocarbons (P-N)	52.4%
Aromatic Hydrocarbons (AROM)	41.3%
Eluted NSO Compounds (NSO)	2.1%
Noneluted NSO Compounds (NSO)	0.9%

RATIOS

$$\frac{\text{P-N}}{\text{AROM.}} = 1.27$$

$$\frac{\text{ASPH}}{\text{NSO}} = 1.06$$

Table II-C

CRUDE OIL ANALYSIS RESULTS

GeoChem Sample No.: 3449-003

GROSS COMPOSITION

Less than C_{15+}	3.7%
C_{15+}	96.3%

C_{15+} COMPOSITION

Asphaltene (ASPH)	15.8%
Paraffin-Naphthene Hydrocarbons (P-N)	36.8%
Aromatic Hydrocarbons (AROM)	37.3%
Eluted NSO Compounds (NSO)	5.7%
Noneluted NSO Compounds (NSO)	4.4%

RATIOS

$$\frac{\text{P-N}}{\text{AROM}} = 0.99$$

$$\frac{\text{ASPH}}{\text{NSO}} = 1.56$$

Table II-D

CRUDE OIL ANALYSIS RESULTS

GeoChem Sample No.: 3449-004

GROSS COMPOSITION

Less than C_{15+}	8.9%
C_{15+}	91.1%

C_{15+} COMPOSITION

Asphaltene (ASPH)	7.7%
Paraffin-Naphthene Hydrocarbons (P-N)	56.6%
Aromatic Hydrocarbons (AROM)	30.2%
Eluted NSO Compounds (NSO)	2.7%
Noneluted NSO Compounds (NSO)	2.7%

RATIOS

$$\frac{\text{P-N}}{\text{AROM}} = 1.87$$

$$\frac{\text{ASPH}}{\text{NSO}} = 1.43$$

Table II-E

CRUDE OIL ANALYSIS RESULTS

GeoChem Sample No.: 3449-005

GROSS COMPOSITION

Less than C_{15+}	15.1%
C_{15+}	84.9%

C_{15+} COMPOSITION

Asphaltene (ASPH)	10.5%
Paraffin-Naphthene Hydrocarbons (P-N)	46.1%
Aromatic Hydrocarbons (AROM)	41.0%
Eluted NSO Compounds (NSO)	1.4%
Noneluted NSO Compounds (NSO)	1.1%

RATIOS

$$\frac{\text{P-N}}{\text{AROM}} = 1.13$$

$$\frac{\text{ASPH}}{\text{NSO}} = 4.28$$

Table II-F

CRUDE OIL ANALYSIS RESULTS

GeoChem Sample No.: 3449-006

GROSS COMPOSITION

Less than C_{15+}	63.3%
C_{15+}	36.7%

C_{15+} COMPOSITION

Asphaltene (ASPH)	1.2%
Paraffin-Naphthene Hydrocarbons (P-N)	78.2%
Aromatic Hydrocarbons (AROM)	16.4%
Eluted NSO Compounds (NSO)	0.4%
Noneluted NSO Compounds (NSO)	3.8%

RATIOS

$$\frac{\text{P-N}}{\text{AROM}} = 4.77$$

$$\frac{\text{ASPH}}{\text{NSO}} = 0.29$$

Table II-G

CRUDE OIL ANALYSIS RESULTS

GeoChem Sample No.: 3449-007

GROSS COMPOSITION

Less than C_{15+}	32.4%
C_{15+}	67.6%

C_{15+} COMPOSITION

Asphaltene (ASPH)	2.6%
Paraffin-Naphthene Hydrocarbons (P-N)	64.3%
Aromatic Hydrocarbons (AROM)	30.6%
Eluted NSO Compounds (NSO)	0.5%
Noneluted NSO Compounds (NSO)	2.1%

RATIOS

$$\frac{P\text{-}N}{AROM} = 2.10$$

$$\frac{ASPH}{NSO} = 1.00$$

Table II-H

CRUDE OIL ANALYSIS RESULTS

GeoChem Sample No.: 3449-008

GROSS COMPOSITION

Less than C_{15+}	20.8%
C_{15+}	79.2%

C_{15+} COMPOSITION

Asphaltene (ASPH)	1.9%
Paraffin-Naphthene Hydrocarbons (P-N)	57.8%
Aromatic Hydrocarbons (AROM)	35.3%
Eluted NSO Compounds (NSO)	0.6%
Noneluted NSO Compounds (NSO)	4.4%

RATIOS

$$\frac{\text{P-N}}{\text{AROM}} = 1.64$$

$$\frac{\text{ASPH}}{\text{NSO}} = 0.38$$

TABLE III-A

Saturate Hydrocarbon Analyses

Summary of Paraffin-Naphthene Distribution

GeoChem Sample Number	Well Interval	% Paraffin	% Isoprenoid	% Naphthene	C-P Index A	C-P Index B	ip19/ip20
3449-001	-	13.5	2.7	83.8	1.01	1.23	1.29
3449-002	-	12.2	2.3	85.5	0.96	1.18	1.26
3449-003	-	3.2	0.9	95.9	-	-	1.41
3449-004	-	55.8	9.4	34.8	0.96	0.94	0.92
3449-005	-	27.7	9.3	63.0	0.98	1.04	1.70
3449-006	-	66.8	8.7	24.5	1.05	1.13	2.23
3449-007	-	38.9	5.8	55.3	1.01	1.05	1.79
3449-008	-	43.5	6.2	50.3	1.00	1.04	1.70

TABLE III-B

Saturate Hydrocarbon Analyses

Normalized Paraffin Distribution

GeoChem Sample Number	Well Interval	% nC15	% nC16	% nC17	% ip19	% nC18	% ip20	% nC19	% nC20	% nC21	% nC22	% nC23	% nC24	% nC25	% nC26	% nC27	% nC28	% nC29	% nC30	% nC31	% nC32	% nC33	% nC34	% nC35
3449-001	-	2.1	2.5	4.5	9.3	4.0	7.2	6.4	7.8	5.5	6.1	5.9	5.1	5.7	4.9	4.7	3.4	4.4	3.4	3.8	1.9	1.5	0.0	0.0
3449-002	-	0.4	3.1	5.0	8.8	4.6	7.0	6.2	8.4	5.1	5.7	5.5	5.7	5.7	4.2	4.4	3.9	4.2	3.7	3.9	2.0	1.7	0.9	0.0
3449-003	-	2.8	7.7	10.1	12.6	9.3	8.9	9.3	13.0	6.1	9.3	6.9	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3449-004	-	6.5	8.7	6.6	6.9	5.6	7.5	6.0	5.3	4.7	4.5	4.1	4.0	3.6	3.7	3.3	3.2	3.2	3.3	2.5	2.5	1.7	1.5	0.9
3449-005	-	1.7	2.4	2.5	15.8	3.4	9.3	5.3	4.4	4.2	4.5	4.6	4.8	4.6	4.6	4.6	4.4	4.5	4.1	3.7	2.7	2.0	1.3	0.9
3449-006	-	13.2	12.7	10.0	8.0	8.4	3.6	7.5	6.3	5.5	4.9	4.5	3.9	3.6	2.7	2.1	1.4	0.9	0.5	0.2	0.1	0.0	0.0	0.0
3449-007	-	9.8	9.9	7.2	8.4	6.9	4.7	6.8	6.0	5.5	5.1	4.6	4.2	3.8	3.4	3.0	2.6	2.2	1.7	1.6	1.1	0.8	0.5	0.3
3449-008	-	6.8	9.3	7.5	7.9	7.3	4.7	6.7	6.2	5.6	5.3	4.9	4.7	4.2	3.7	3.4	2.8	2.4	2.0	1.6	1.1	0.9	0.6	0.5

McKinley County Oils

Gasoline-range Hydrocarbon Composition

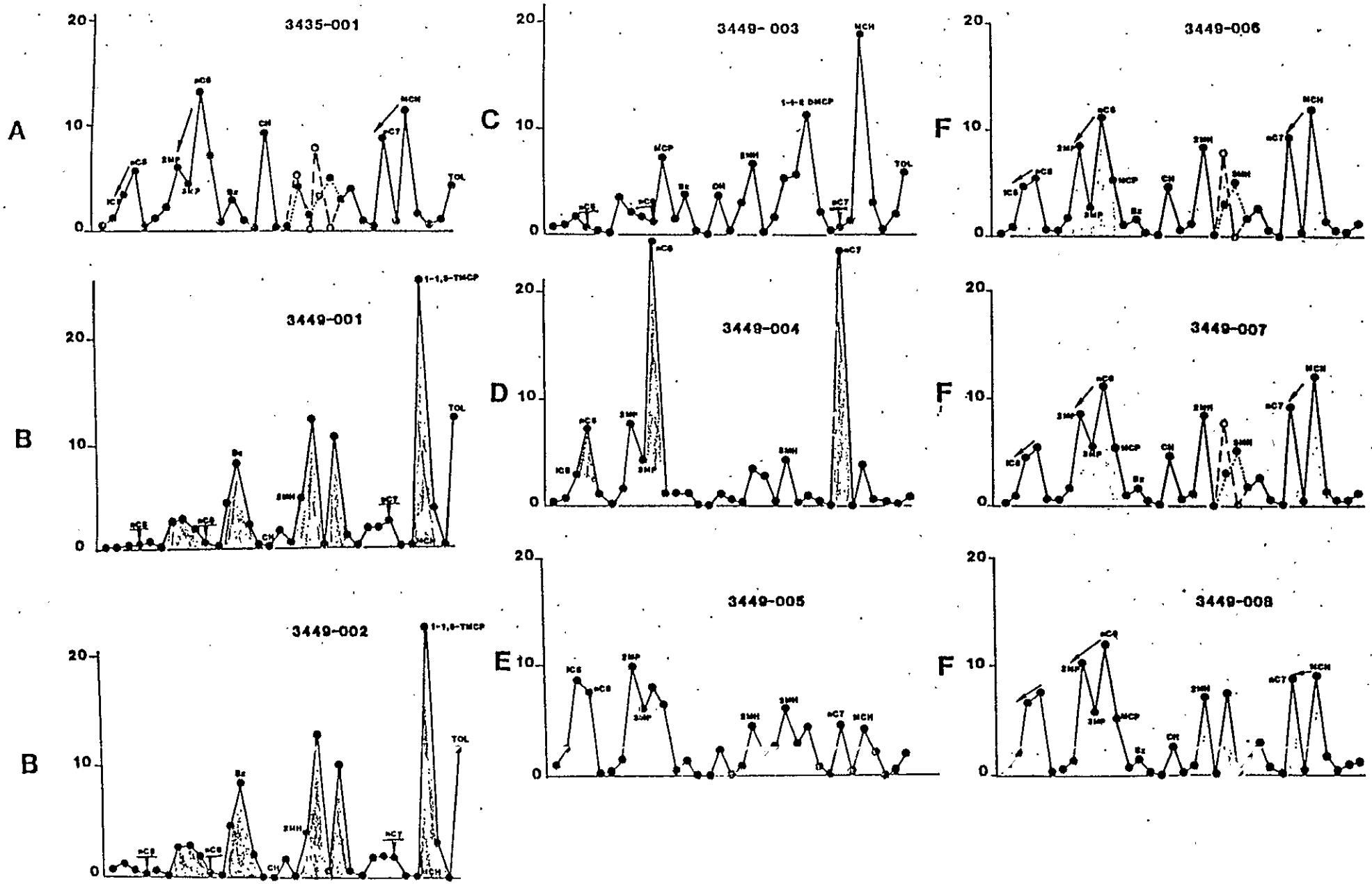

FIGURE 2

Sample Number - 3435 - 001

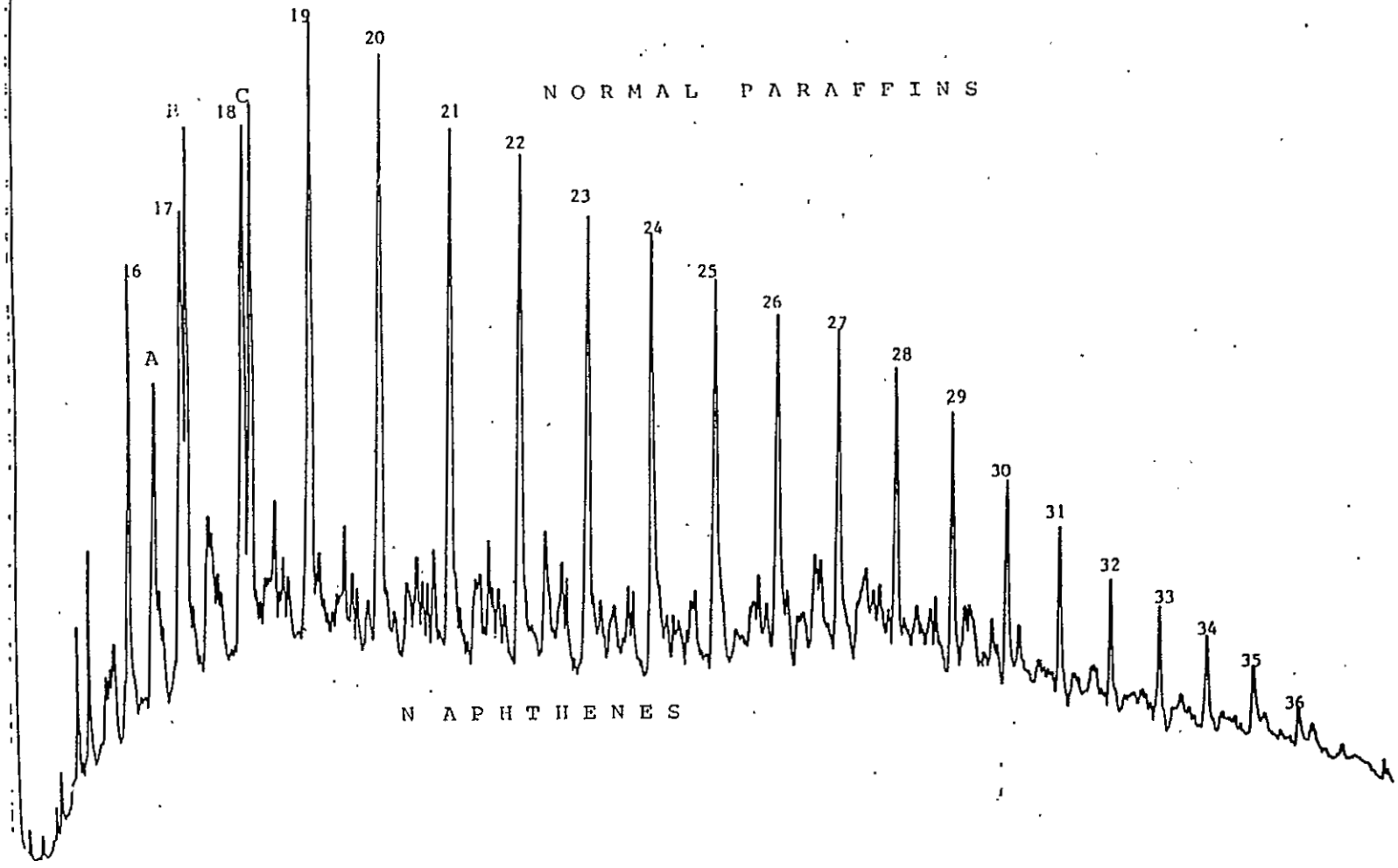

FIGURE 3

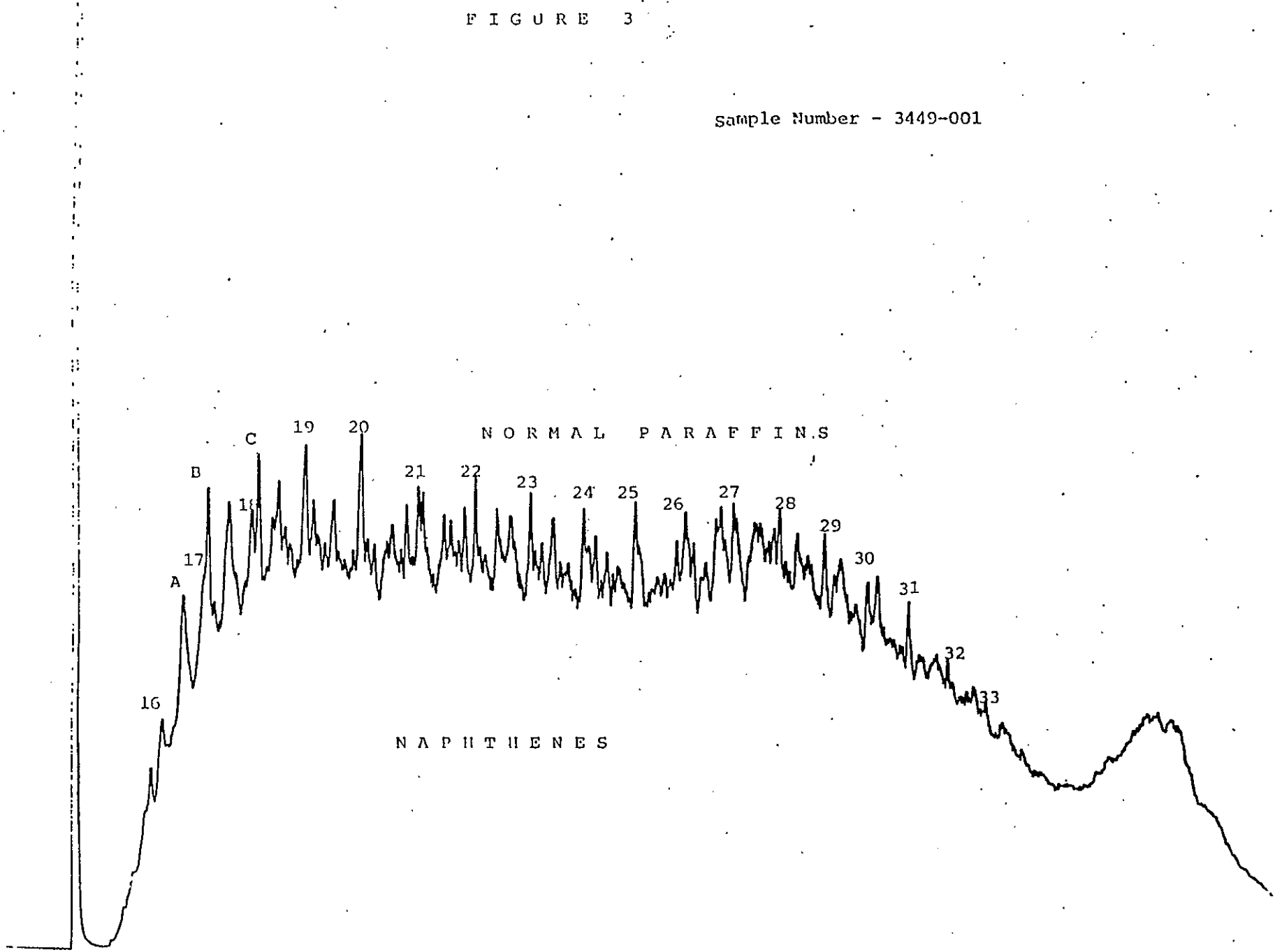
Sample Number - 3449-001
NORMAL PARAFFINS
NAPHTHENES
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FIGURE 4

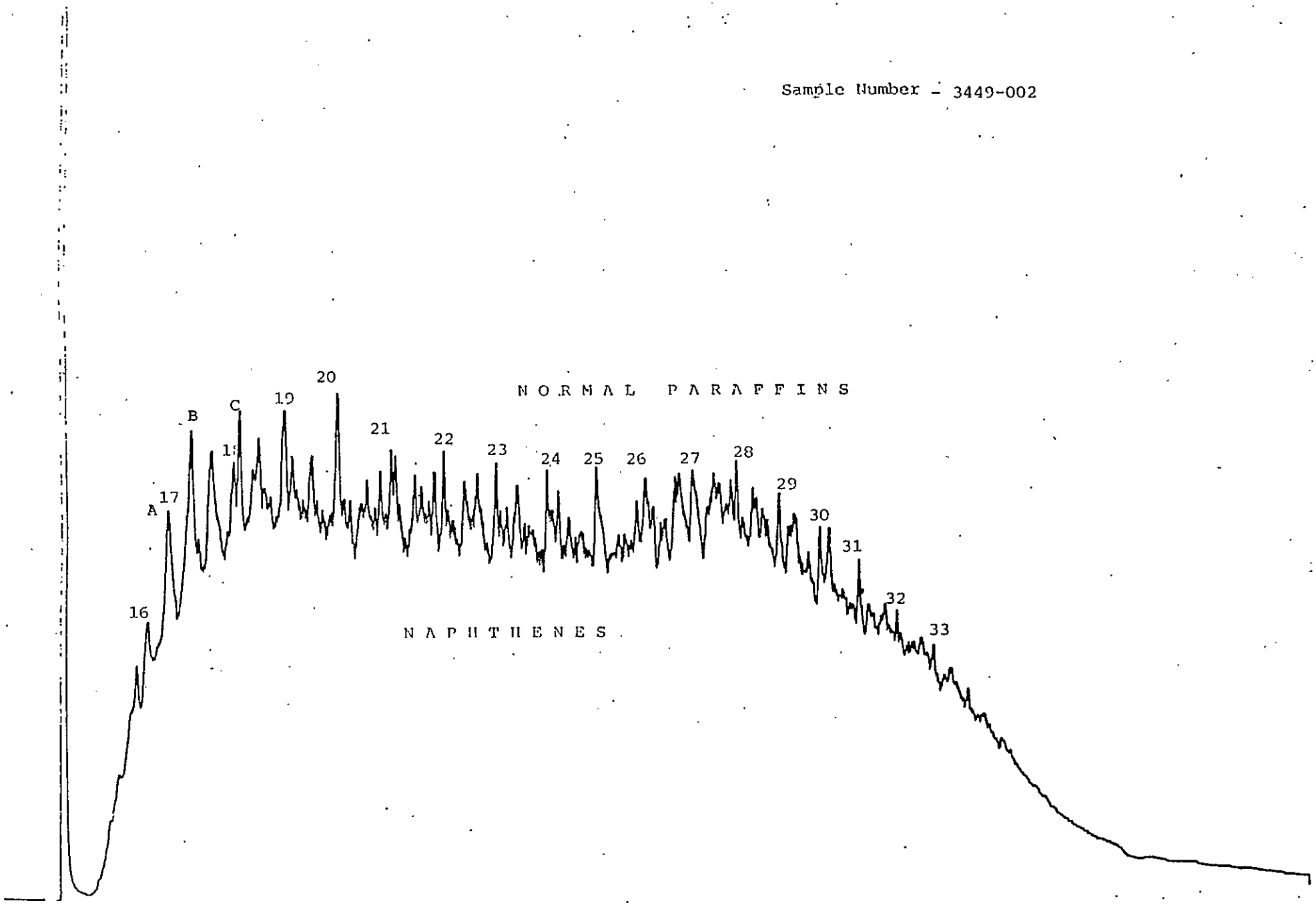
Sample Number - 3449-002
NORMAL PARAFFINS
NAPHTHENES
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FIGURE 5

Sample Number - 3449-003

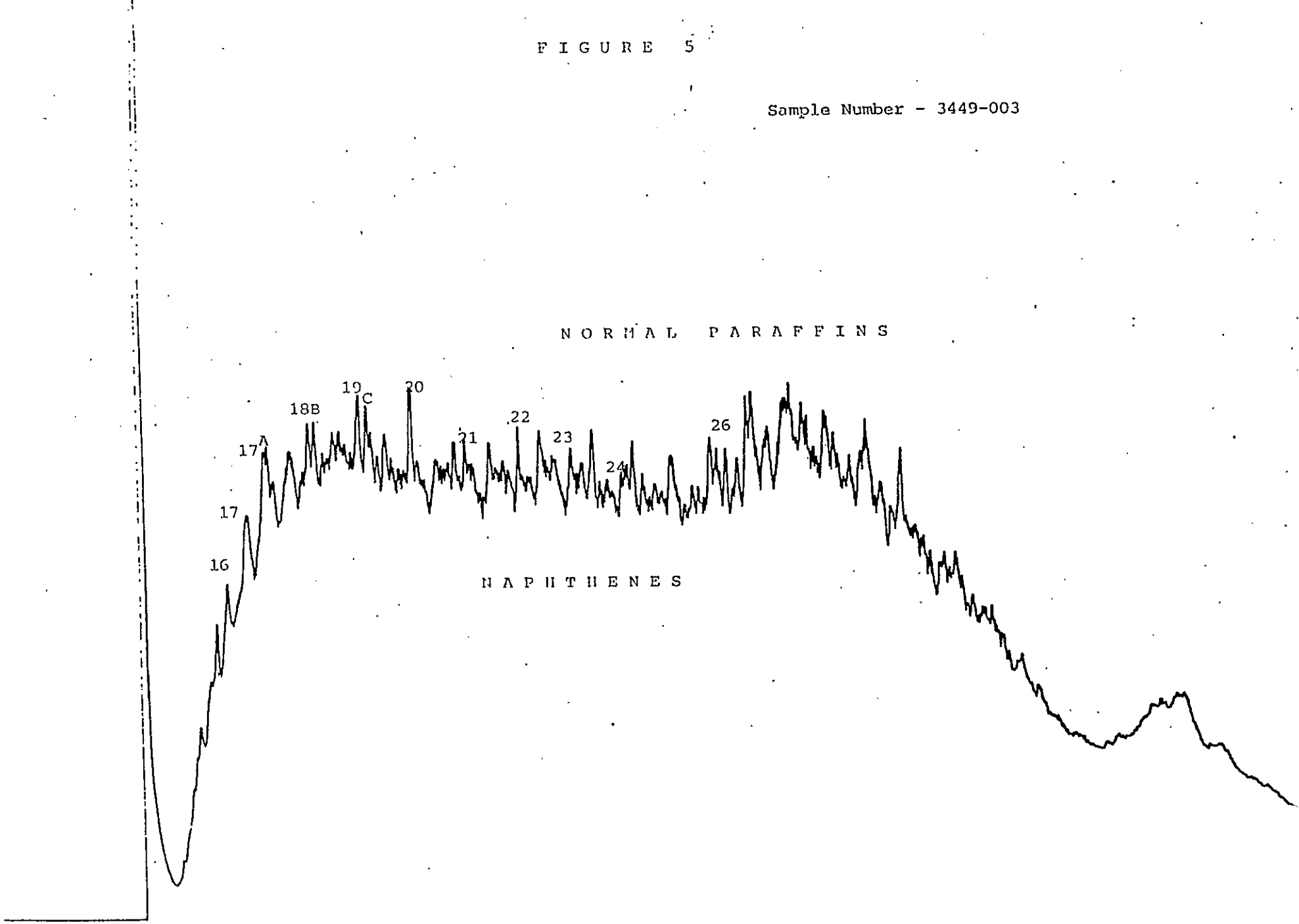


FIGURE 6

Sample Number - 3449-004

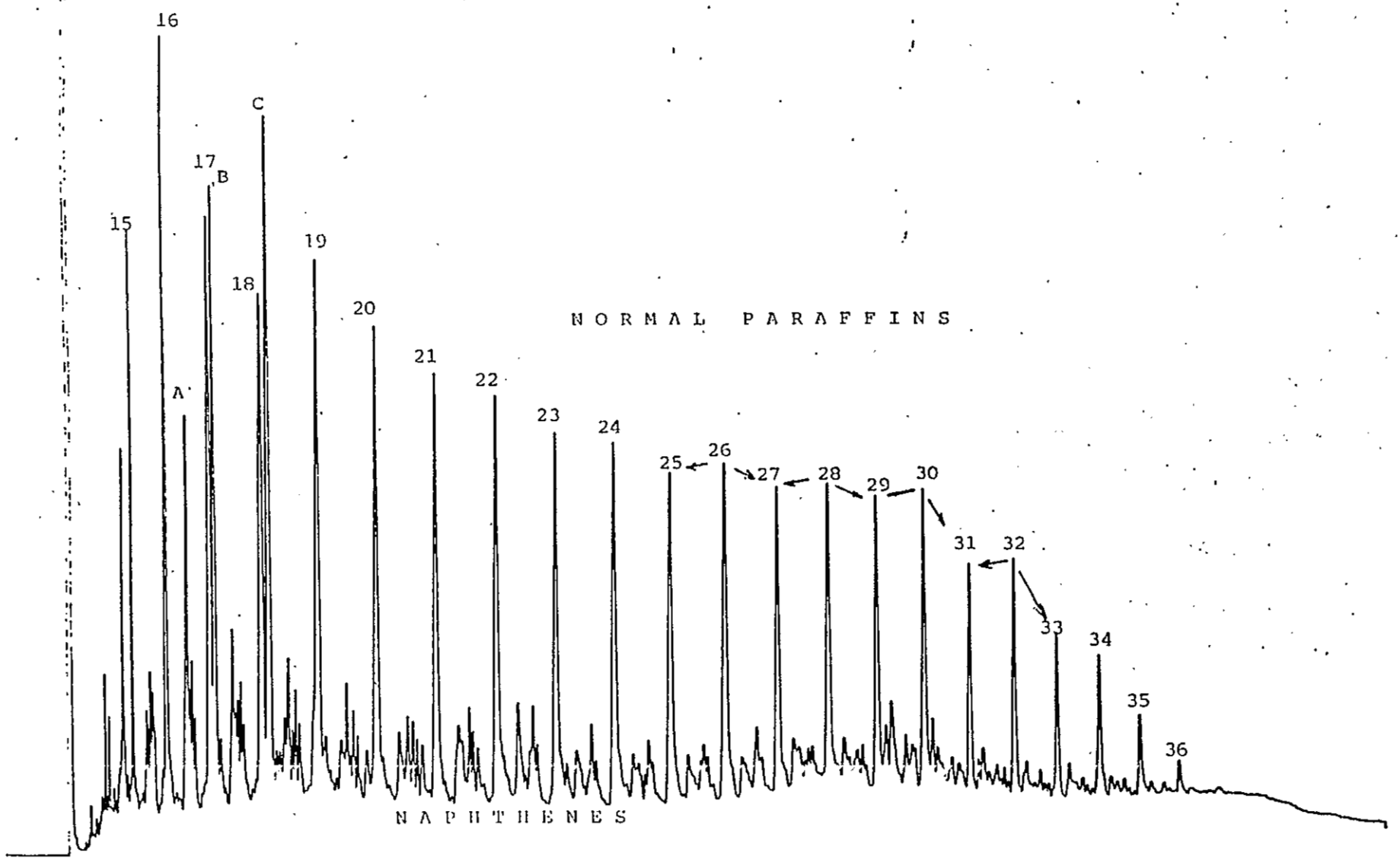


FIGURE 7

Sample Number - 3449-005

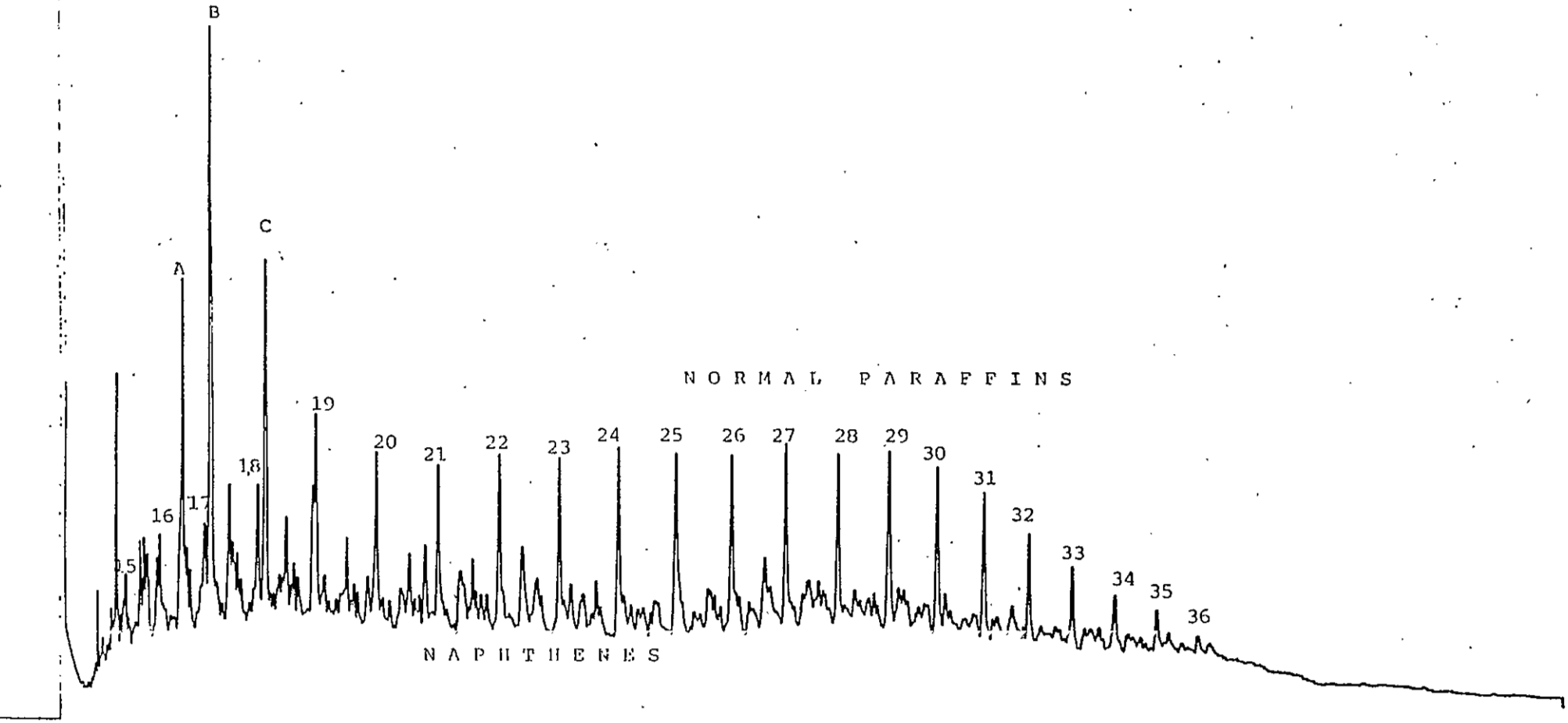


FIGURE 8

Sample Number - 3449-006

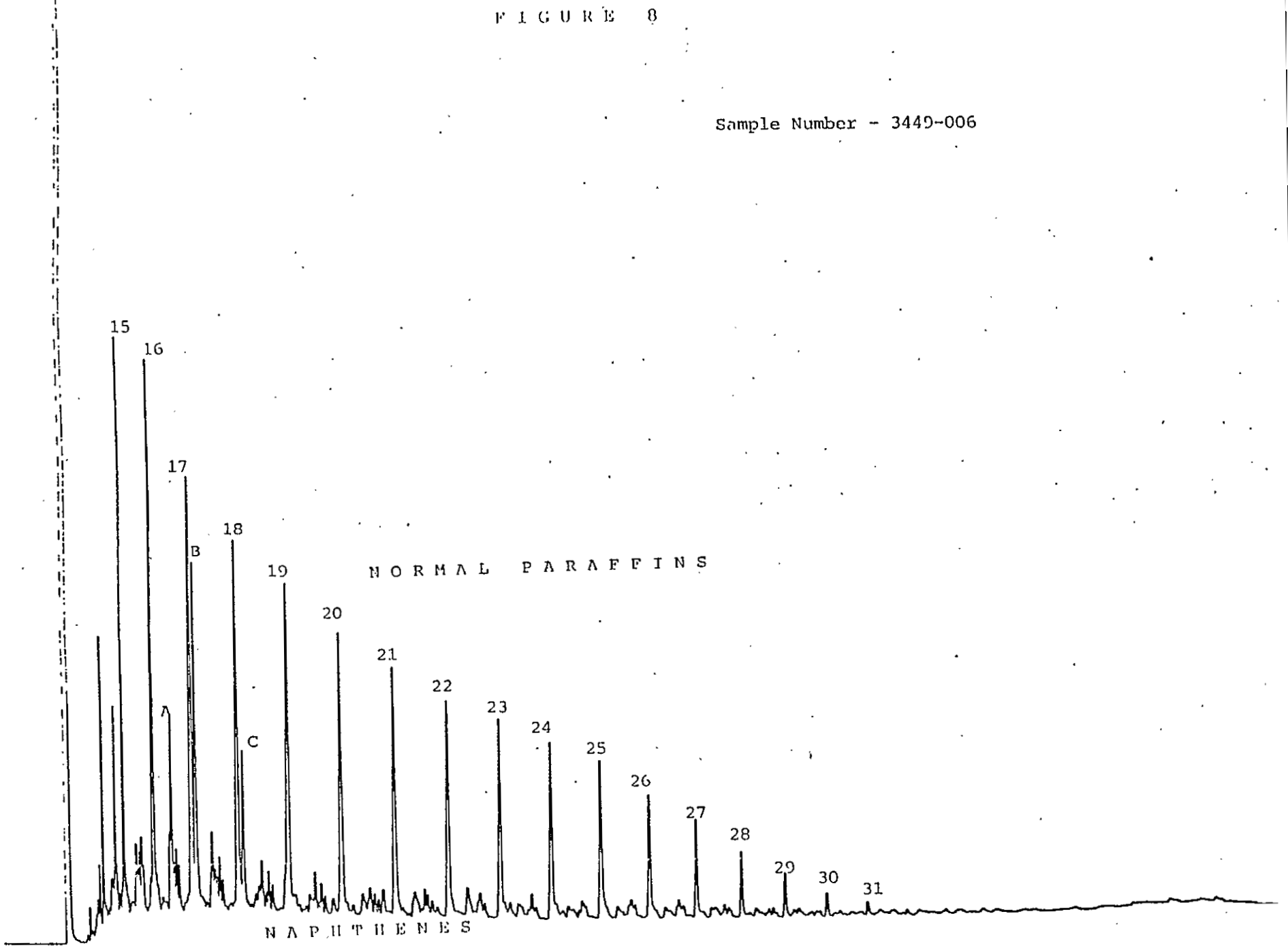


FIGURE 9

Sample Number - 3449-007

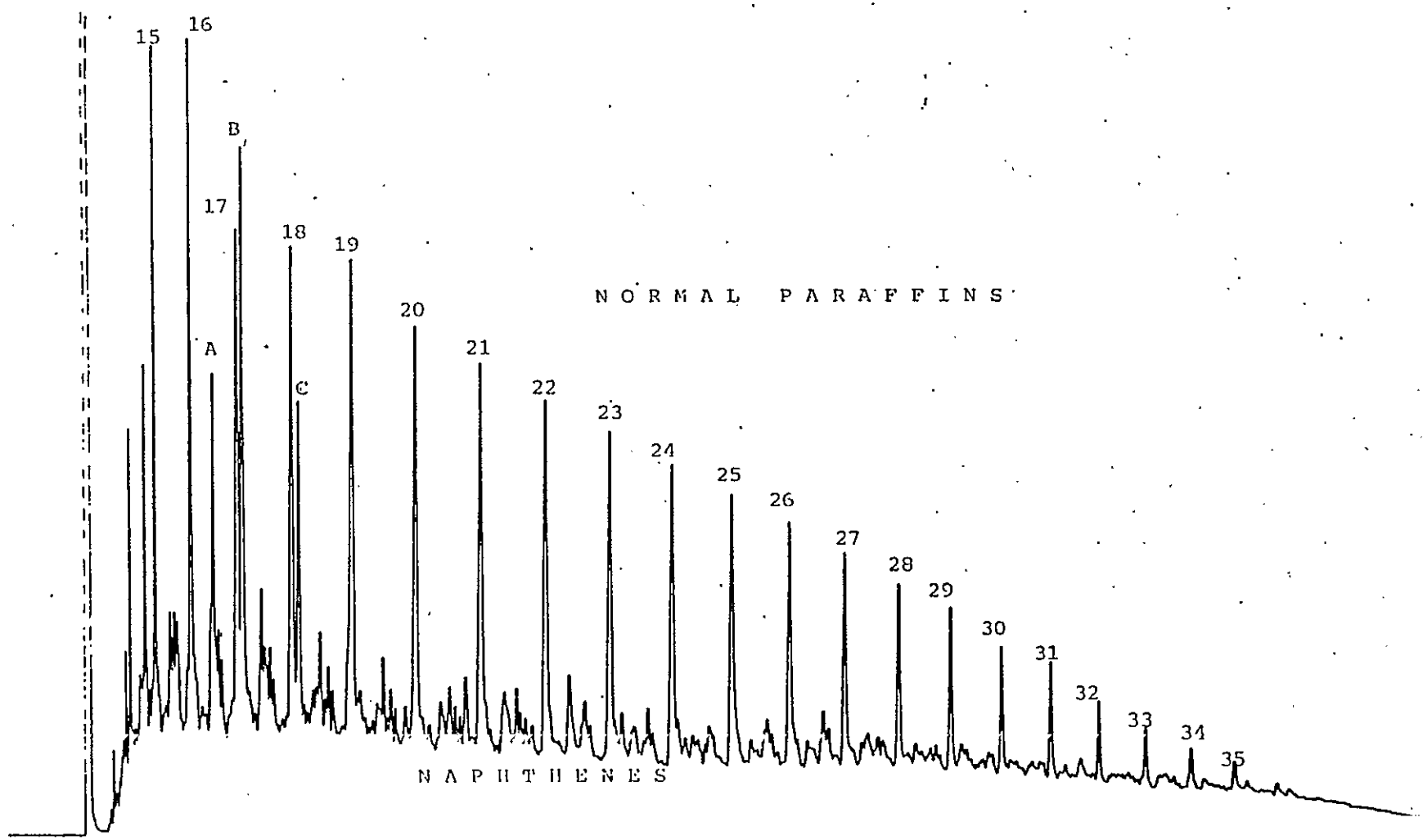
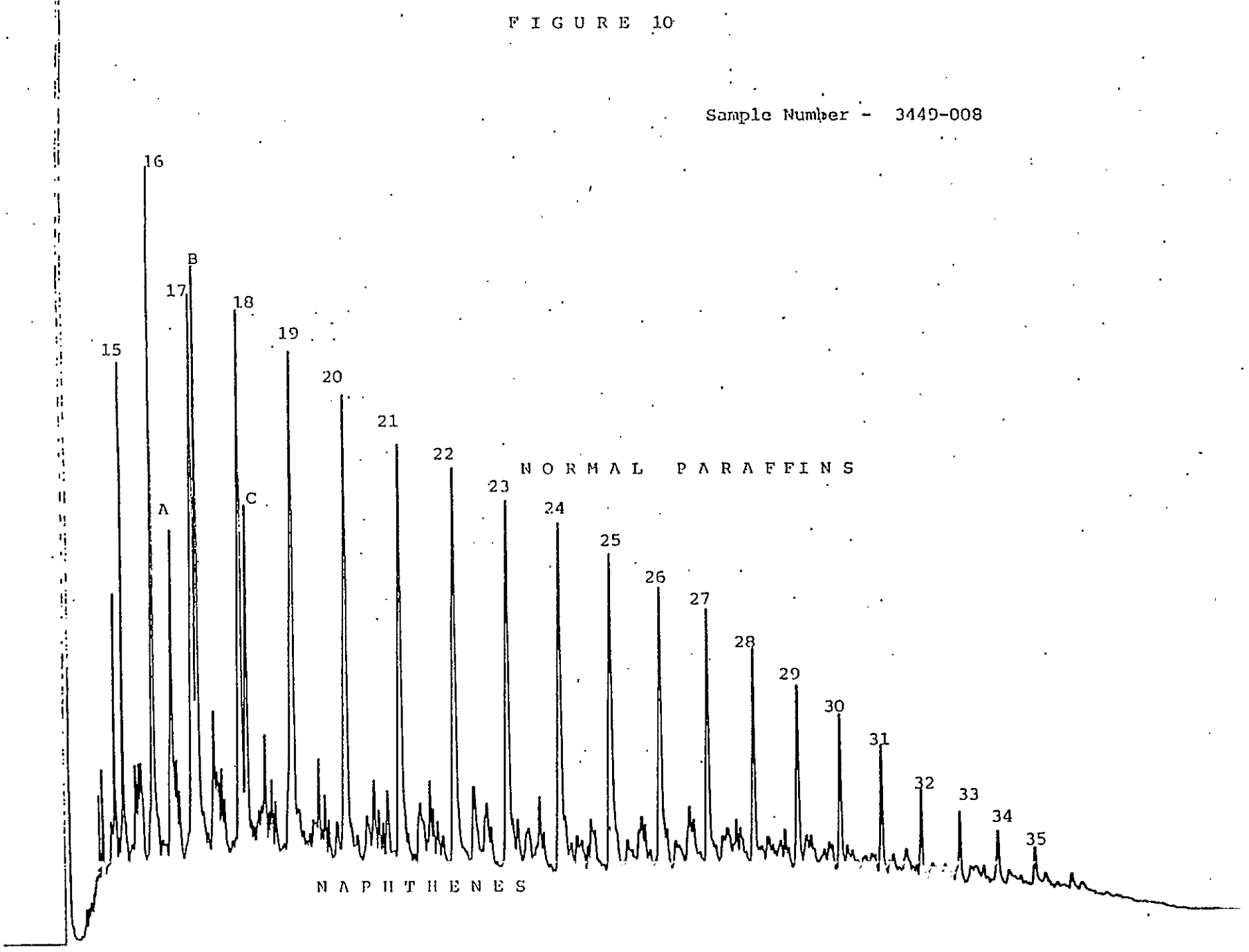


FIGURE 10


Sample Number - 3449-008
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NORMAL PARAFFINS
NAPHTHENES