New Mexico Bureau of Mines and Mineral Resources
Open-File Report No. OF-270

# CRUDE-OIL AND SOURCE ANALYSES OF THE GILA EXPLORATION CO. NO. 1 HOGAN-STATE WELL, MCKINLEY COUNTY, NEW MEXICO

By Donald G. Van Delinder
Vandeco, Inc.
Montgomery, Texas

April 10, 1986

# VANDECO, INC.

922 Lakeview, Suite 100
Montgomery, Texas 77356
(409) 582-4788

# 3435

Gila Expl. #1 Hogan 16-18N-12W McKinley Co

April 10, 1986

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

RE: Job No. 3435 - Hogan #1 Oil

Dear Robert:

We have analyzed the Hogan No.1 Oil and have solvent extracted a shale cuttings sample from the depth interval 440'-450' in the same well. This shale occurs immediately above the oil-productive sand of this well. A comparison of the geochemical character of the oil with that of the shale indicates a mismatch. We interpret that the oil is more mature than the shale and hence this shale unit, at this locality at least, did not act as the specific source of the oil. The analytical data is recorded in Tables I-VI; gc chromatograms are reproduced in Figures 1 to 3. The following observations are the basis of this conclusion:

1). The shale sample (3435-062) is immature. The T.A.I. is only 2- on GeoChem's 1-5 kerogen color alteration index and the Tmax by pyrolysis is only 434°. Whereas this shale has good total organic matter content (1.72% T.O.C.) comprised of predominant gas-prone woody (structured) kerogen and secondary amorphous-herbaceous oil-prone kerogen type, it has only realized a small percentage ($S_1/S_1 + S_2 \times 100\% = 3\%$) of its petroleum generating ability. The relatively low P-N Saturate/AROM aromatic hydrocarbon ratio (0.63) also reflects the low maturity of this shale. The oil sample (3435-001), in contrast, has the geochemical character of a moderately mature crude oil.

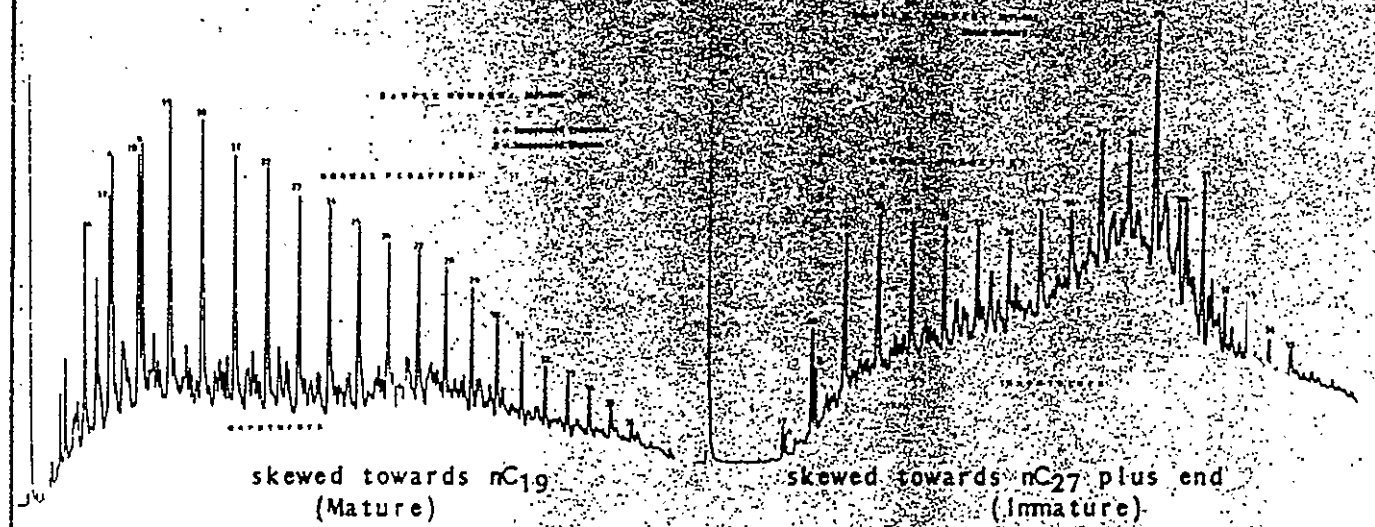
2). The oil does not resemble the bitumen in the shale. The bitumen content of the shale unit (1140'-1150') overlying the oil-productive unit in the Hogan No. 1 well does not appear to be the specific genetic parent of the oil found in the sand below it.

The oil is more mature than the shale bitumen as can be deduced from the following:

| | | Oil | Shale |
|---|---|---|---|
| (i) | P-N/AROM | 1.43 | 0.63 |

(ratio increased with maturity)

(ii) Molecular distribution of n-paraffins



skewed towards $nC_{19}$ (Mature)

skewed towards $nC_{27}$ plus end (Immature)

In addition, there are differences in molecular composition within the $C_{15+}$ P-N saturate hydrocarbon fractions as follows:

(i) The isoprenoids pristane and phytane (peaks labelled A & B) predominate over $nC_{17}$ and $nC_{18}$ in the oil, but are subordinate in the shale.

(ii) The isoparaffin peaks between $nC_{23}$ and $nC_{24}$ are larger in the shale than in the oil, and the molecular distribution of the other isoparaffins are not the same in both.

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## EXPLORATION SIGNIFICANCE

1). This work indicates that the oil at 1150'-1160' in the Hogan No.1 well is most probably geologically out-of-place. At this stage of our investigation we can only speculate where it came from and how it got to its present-day trap. Conceivable it may have been sourced in deeper (hotter) beds and migrated up a fault zone. If this is in fact the case, other sand reservoirs both above and below the oil-productive sand at 1150'-1160' may have also received oil.

2). If the oil came up a fault zone, then conceivably trace quantities may have reached the surface. If this can be [illegible] in our Hogan Surface Prospecting Pilot Study, we should be able to locate other Hogan-type accumulations bearing in mind that once we find a surface leakage, only the drill can tell us what sands will have been receivers of the leakage oil.

Yours truly,

Donald G. Van Delinder
President
VANDECO, INC.

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Enclosures

VANDECO, INC.
922 Lakeview, Suite 100
Montgomery, Texas 77356
(409) 582-4788

TABLE I

ORGANIC CARBON AND VISUAL KEROGEN ANALYSES

Total Organic Carbon Content .....1.72%. (Good)

Visual Kerogen Alteration (T.A.I.)..... $2^-$ (Immature)

| | | |
|---|---|---|
| Visual Kerogen Type | Predominant : | Woody (Gas-prone) |
| | Secondary : | Amorphous-Herbaceous (Oil-prone) |
| | Trace : | Inertinite |

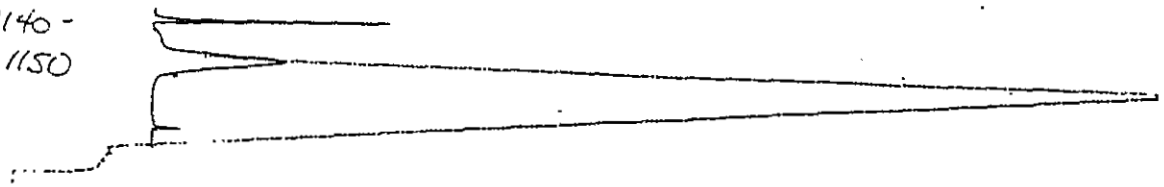
TABLE II

DATE: 04-01-86 ANALYSIS CYCLE : 4 SCALE = 1 32

INIT TEMP = 250 ISO TIME = 5 TEMP GRADIENT=25 TRAP STOP T = 390

| DEPTH | OTV | TMAX | S 1 | S 2 | S 3 | P I | S2/S3 | P C | TOC | H I | O I |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3435-0662 | 98.2 | 474 | 0.07 | 2.14 | 0.47 | 0.03 | 4.55 | 0.18 | 1.72 | 124 | 27 |

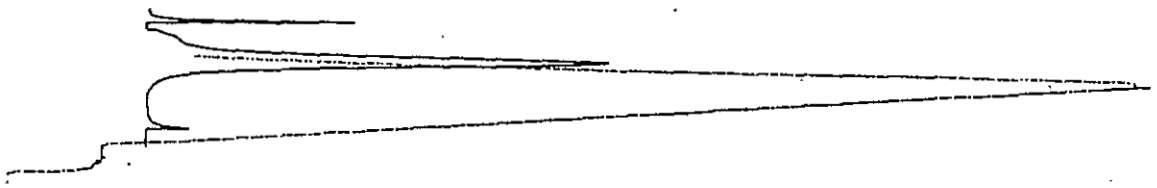
1140 - 1150



DATE: 04-01-86 ANALYSIS CYCLE : 4 SCALE = 1 32

INIT TEMP = 250 ISO TIME = 5 TEMP GRADIENT=25 TRAP STOP T = 390

| DEPTH | OTV | TMAX | S 1 | S 2 | S 3 | P I | S2/S3 | P C | TOC | H I | O I |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 111 | 100.0 | 432 | 0.21 | 6.59 | 0.44 | 0.03 | 14.97 | 0.56 | | | |



DATE: 04-01-86 BLANK CYCLE : 4 SCALE = 1 32

INIT TEMP = 250 ISO TIME = 5 TEMP GRADIENT=25 TRAP STOP T = 390

S 1 = 00000000 S 2 = 00000000 S 3 = 00000437

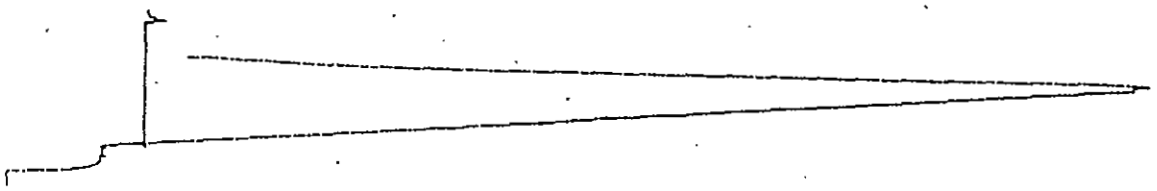


TABLE III

DETAILED C4-C7 HYDROCARBON ANALYSES

(NORMALIZED PERCENT)

| GEOCHEM SAMPLE NUMBER | 3435-001 |
|---|---|
| WELL DEPTH | - |
| ISOBUTANE | 0.4 |
| N-BUTANE | 1.1 |
| ISOPENTANE | 3.4 |
| N-PENTANE | 5.8 |
| 2,2-DIMETHYLBUTANE | 0.1 |
| CYCLOPENTANE | 1.3 |
| 2,3-DIMETHYLBUTANE | 2.0 |
| 2-METHYLPENTANE | 5.8 |
| 3-METHYLPENTANE | 4.3 |
| N-HEXANE | 10.3 |
| METHYCYCLOPENTANE | 6.9 |
| 2,2-DIMETHYLPENTANE | 0.7 |
| BENZENE | 2.6 |
| 2,4-DIMETHYLPENTANE | 0.8 |
| 2,2,3-TRIMETHYLBUTANE | 0.0 |
| CYCLOHEXANE | 9.0 |
| 3,3-DIMETHYLPENTANE | 0.1 |
| 1,1-DIMETHYLCYCLOPENTANE | 0.2 |
| 2-METHYLHEXANE | 3.8 |
| 2,3-DIMETHYLPENTANE | 1.3 |
| 1,CIS-3-DIMETHYLCYCLOPENTANE | 3.0 |
| 3-METHYLHEXANE | 4.6 |
| 1 TRANS-3-DIMETHYLCYCLOPENTANE | 2.5 |
| 1 TRANS-2-DIMETHYLCYCLOPENTANE | 3.7 |
| 3-ETHYLPENTANE | 0.6 |
| 2,2,4-TRIMETHYLPENTANE | 0.0 |
| N-HEPTANE | 8.4 |
| 1,CIS-2-DIMETHYLCYCLOPENTANE | 0.6 |
| METHYCYCLOHEXANE | 10.9 |
| 1,1,3-TRIMETHYLCYCLOPENTANE * | 1.2 |
| 2,2-DIMETHYLHEXANE | 0.3 |
| ETHYLCYCLOPENTANE | 0.6 |
| TOLUENE | 3.7 |
| C4-C7 HYDROCARBON CONTENT/PPM** | 0.2 |

| MOLECULAR RATIOS | |
|---|---|
| 2-METHYLPENTANE/3-METHYLPENTANE | 1.35 |
| ISOPENTANE/N-PENTANE | 0.59 |
| CYCLOHEXANE/METHYLCYCLOPENTANE | 1.29 |
| METHYLCYCLOPENT/METHYLCYCLOHEX | 0.64 |

* C8 COMPOUNDS

** PPM VALUES ARE EXPRESSED AS VOLUMES OF GAS PER MILLION VOLUMES OF CUTTINGS

Table IV

Summary of C15+ Soxhlet Extraction, Deasphaltening and Liquid Chromatography

A. Weights of Extracts and Chromatographic Fractions

| GeoChem Sample Number | Well Interval | Weight of Rock Extd. (grams) | Total Extract (grams) | Precipitated Asphaltenes (grams) | N-C5 Soluble (grams) | Sulfur (grams) | Paraffins-Naphthenes (grams) | Aromatics (grams) | Eluted NSO'S (grams) | Noneluted NSO'S (grams) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3435-062 | 1140 -1150 | 49.3 | 0.0578 | 0.0298 | 0.0280 | N.D. | 0.0064 | 0.0102 | 0.0085 | 0.0029 |

B. Concentration of Extracted Materials in Rock

| | | | Hydrocarbons | | | | Nonhydrocarbons | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| GeoChem Sample Number | Well Interval | Total Extract (ppm) | Paraffin-Naphthene (ppm) | Aromatic (ppm) | Total (ppm) | Sulfur (ppm) | Precipitd. Asphaltene (ppm) | Eluted NSO'S (ppm) | Noneluted NSO'S (ppm) | Total (ppm) |
| 3435-062 | 1140 -1150 | 1172 | 130 | 207 | 337 | - | 604 | 172 | 59 | 836 |

C. Composition of Extracts

| | | Hydrocarbons | | | | Nonhydrocarbons | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GeoChem Sample Number | Well Interval | Paraffin-Naphthene % | Aromatic % | PN/Arom | Sulfur % | Eluted NSO'S % | Noneluted NSO'S % | Precipitd. Asphaltene % | Asph/NSO | HC'S % | HC/Non HC |
| 3435-062 | 1140 -1150 | 11.1 | 17.6 | 0.63 | - | 14.7 | 5.0 | 51.6 | 2.61 | 28.7 | 0.40 |

Table V-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 |
|---|---|---|---|---|---|---|---|
| 3435-001 | - | 16.7 | 2.5 | 80.8 | 0.99 | 1.07 | 1.03 |
| 3435-062 | 1140 -1150 | 8.2 | 0.3 | 91.4 | 1.15 | 2.00 | 0.33 |

Table V-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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3435-001 | - | 2.6 | 5.5 | 5.7 | 6.7 | 6.4 | 6.5 | 7.5 | 7.2 | 6.3 | 6.2 | 5.4 | 5.3 | 4.8 | 4.1 | 4.0 | 3.4 | 3.1 | 2.4 | 2.0 | 1.6 | 1.4 | 1.2 | 0.8 |
| 3435-062 | 1140 -1150 | 0.1 | 0.2 | 1.6 | 1.0 | 5.1 | 3.0 | 7.7 | 7.7 | 6.7 | 6.1 | 5.0 | 4.1 | 5.0 | 3.6 | 6.2 | 4.7 | 11.8 | 3.8 | 8.1 | 2.6 | 3.0 | 1.5 | 1.2 |

TABLE VI

CRUDE OIL ANALYSIS

Gross Composition:

| | |
|---|---|
| Less than C15+ = | 35.4% |
| C15+ = | 64.6% |
| | 100% |

C15+ Composition:

| | | |
|---|---|---|
| Hydrocarbon | | |
| Paraffin-Naphthene | = | 51.6% |
| Aromatic | = | 36.0% |
| Nonhydrocarbon | | |
| Asphaltene | = | 4.1% |
| Eluted N-S-O | = | 5.2% |
| Noneluted N-S-O | = | 3.1% |
| | | 100% |

Ratios:

| | | |
|---|---|---|
| P-N/Aromatic | = | 1.43 |
| ASPH/NSO | = | 0.49 |

typical values of mature-type oil

FIGURE - 1

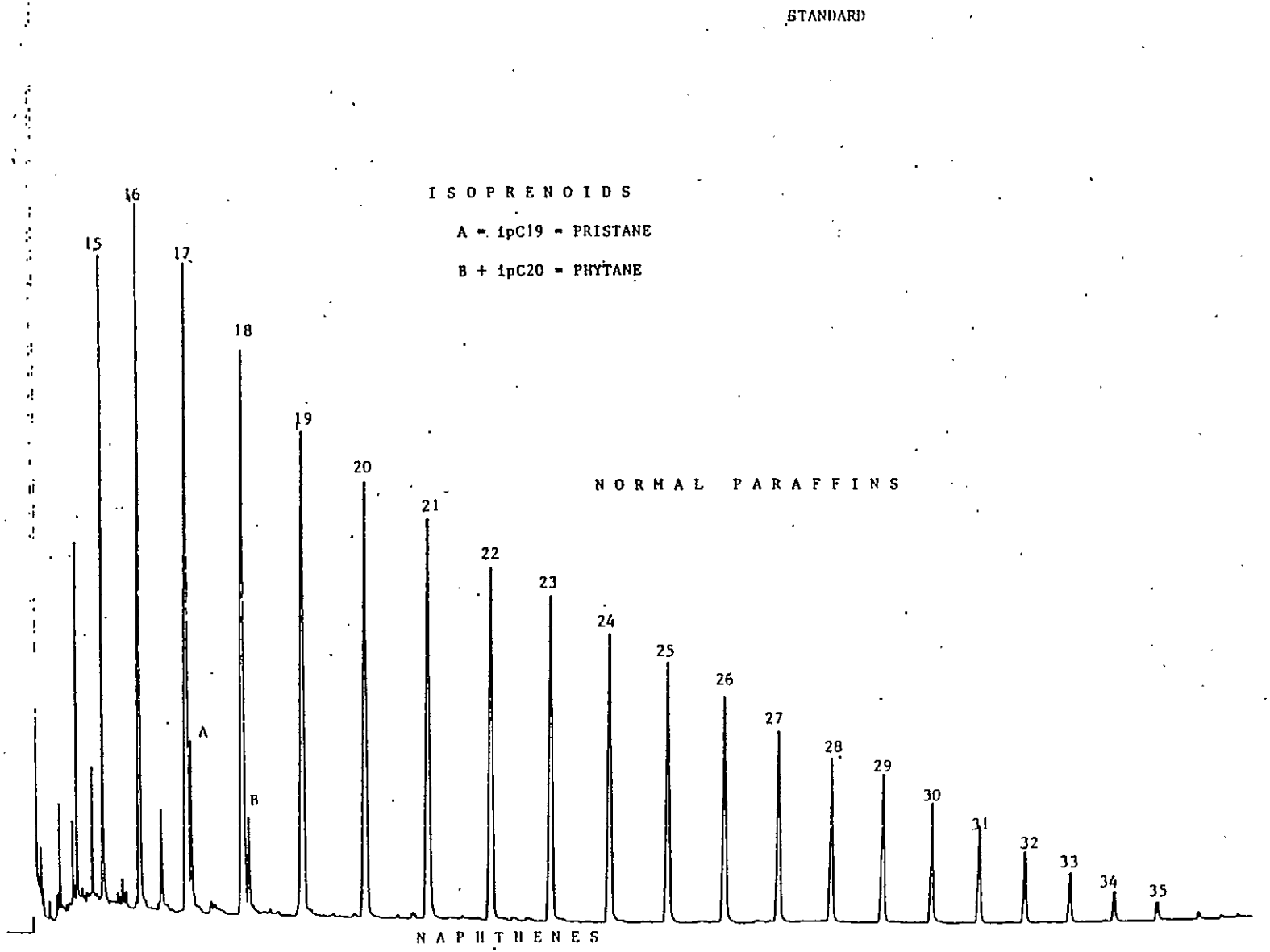

STANDARD
ISOPRENOIDS
A = ipC19 = PRISTANE
B = ipC20 = PHYTANE
NORMAL PARAFFINS
NAPHTHENES
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
A
B

FIGURE - 2

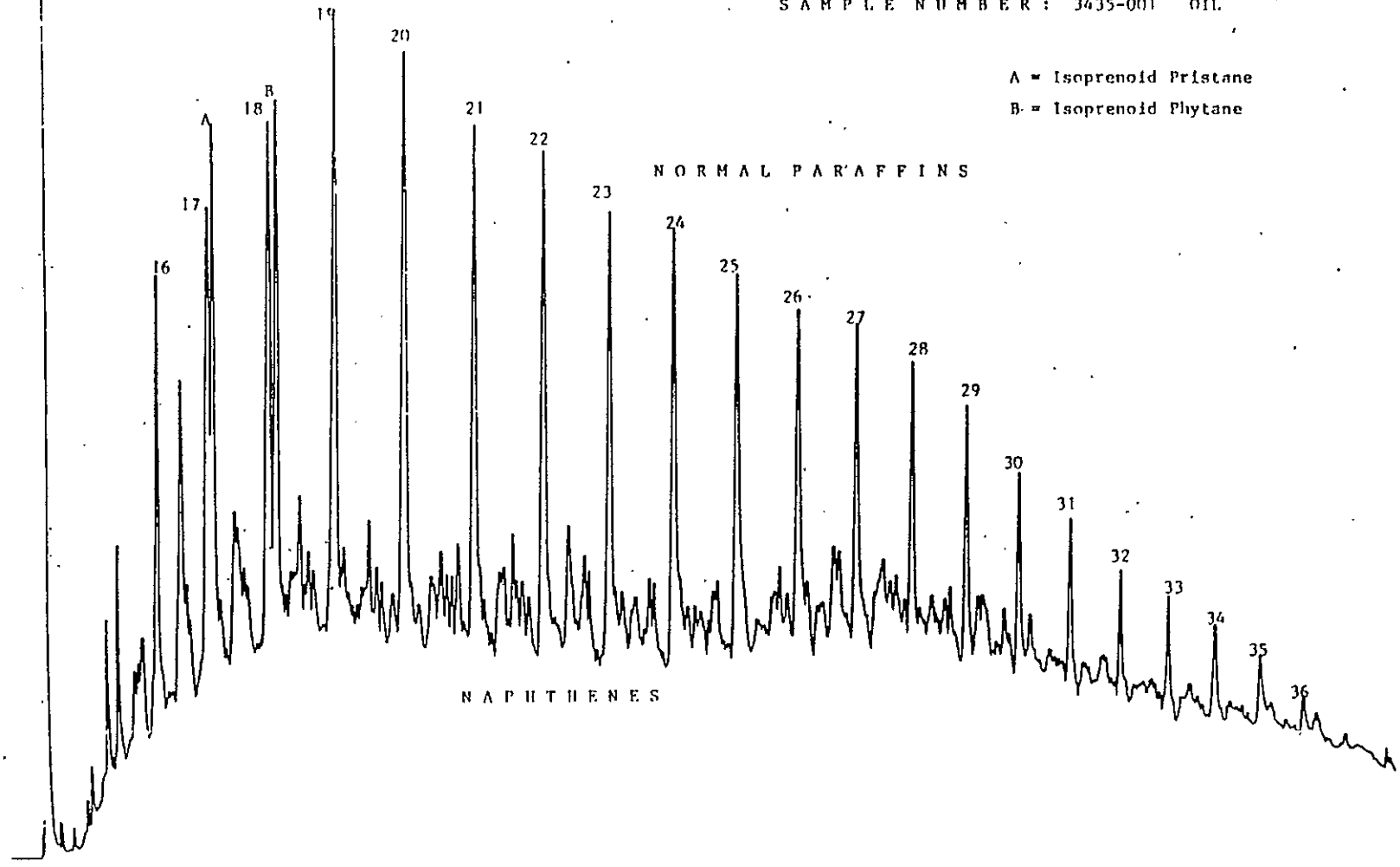
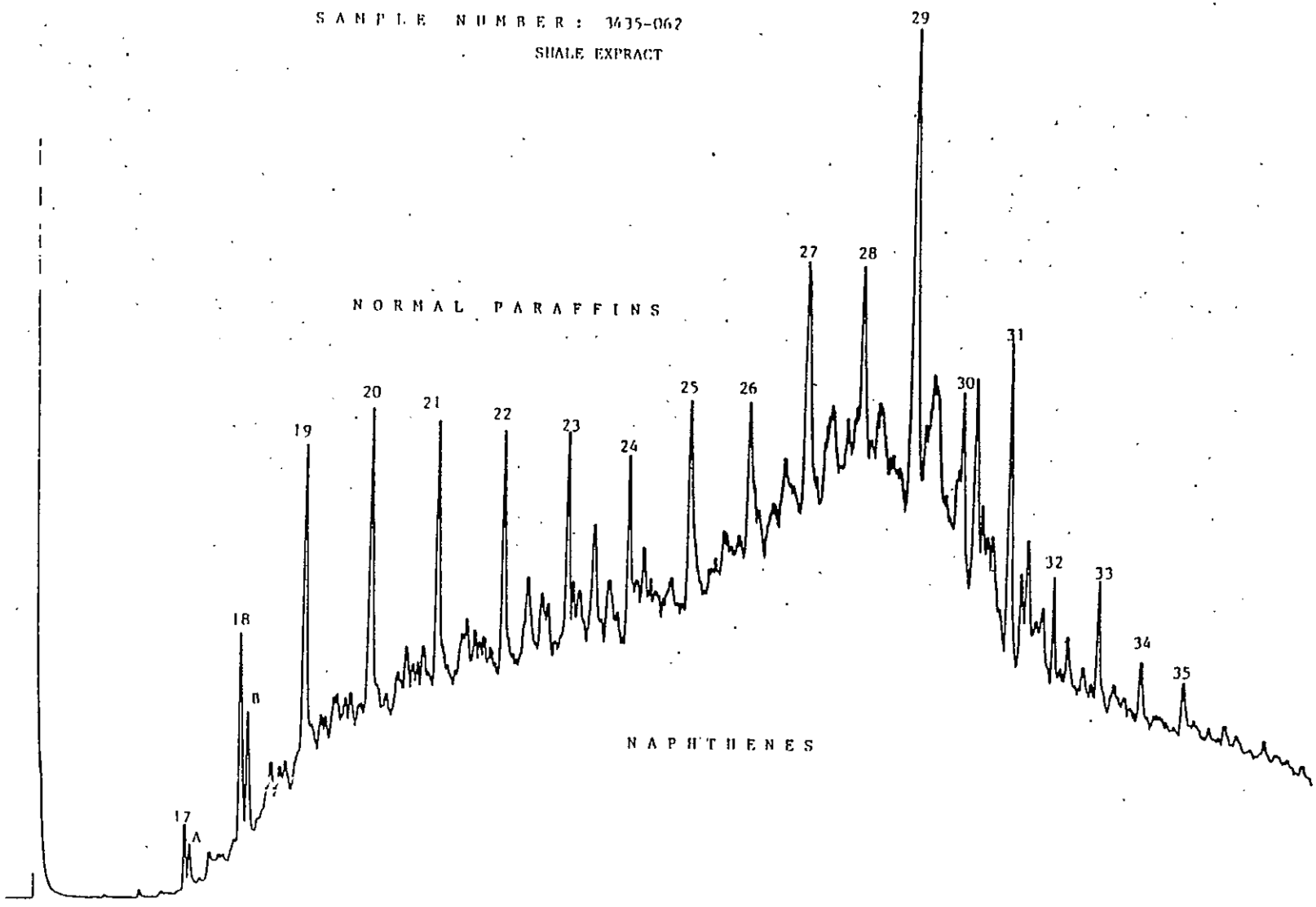

SAMPLE NUMBER : 3435-001 OIL
A = Isoprenoid Pristane
B = Isoprenoid Phytane
NORMAL PARAFFINS
NAPHTHENES
16
17
A
18
B
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

FIGURE - 1


SAMPLE NUMBER : 3435-062
SHALE EXPRACT
NORMAL PARAFFINS
NAPHTHENES
17
A
18
B
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35