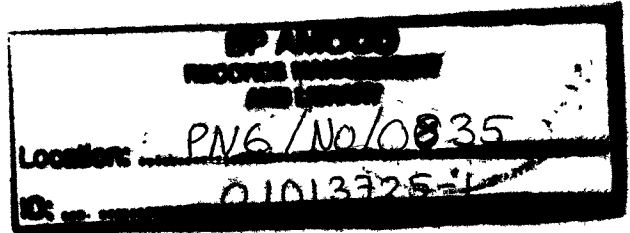




OFFER FOR
 ③ ~~1/11-2~~
 ④ LBS
 ⑤ 2/11-2

Amoco Production Company

Tulsa, Oklahoma
 March 10, 1975



File: Technical Service 9296CC
 Job 9341

Mr. K. D. Soule
 Amoco Norway Oil Company
 P. O. Box 100
 4056 Tananger, Norway

Dear Sir:

Subject: Oil Correlation Analysis - Amoco Norway 2/11-2 Well, Offshore North Sea

Results of oil correlation analyses on this oil are reported in the attached memorandum by L. M. Ross and R. L. Ames. This oil is correlative with an unaltered J(b) + J type oil, which is the same oil type recognized in the 2/8-3 well, except in the latter the oil was bacterially altered.

Very truly yours,

James A. Momper
 James A. Momper

LMR:rb
 536 217

Attachment

cc: S. A. Antoniuk - Amoco Europe
 K. A. Shepard - AIOC, Chicago
 R. R. Thompson



02320

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

Oil Correlation Analysis

1-Upper Cretaceous Oil - Amoco 2/11-2, Offshore North Sea
Norway

Geochemistry Group

L. M. Ross
R. L. Ames

Distribution: K. D. Soule - Amoco Norway
S. A. Antoniuk - Amoco Europe
K. A. Shepard - AIOC, Chicago
R. R. Thompson/J. A. Momper

Technical Service 9296CC

Job 9341

Requested by K. D. Soule

AMOCO NORWAY

"Proprietary - for the exclusive use of Amoco Production Company
and other wholly owned subsidiaries of Standard Oil Company (Indiana)."

Recd. Ames (Mar 7, 1975)
RRJ

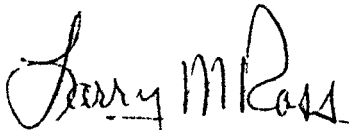
TECHNICAL SERVICE 9296CC
JOB 9341
AMOCO NORWAY

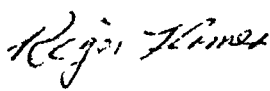
INTRODUCTION

An oil was collected from the ^{Campanian} Campanian carbonate section in Amoco Norway's 2/11-2, DST No. 2 (8670'-8745'). This oil was submitted by Amoco Norway, 2-19-75, for oil correlation. As requested by Amoco Norway, the results from this analysis are related to previous oil correlation in the area. Specifically this includes oil from the Amoco 2/11-1 (T.S. 7965CC, 11-20-70), Amoco 2/8-3 (T.S. 8554CC, 11-3-72) and Amoco 2/8-4, (T.S. 8792CC, 7-6-73).

DISCUSSION

Oil recovered from the Upper Cretaceous ^{Campanian} Campanian carbonate in the 2/11-2 well is unaltered and correlative with J(b) + J type oil. Similar type oil was recognized in the 2/8-3 well but it was bacterially altered. J type oils were identified in the Amoco 2/8-4 and 2/11-1 wells; these oils also show signs of bacterial alteration. Distinction between J and J(b) oil types is based strictly upon carbon isotope differences; this probably reflects differences within the major Jurassic source sequence.


L. M. Ross


R. L. Amos

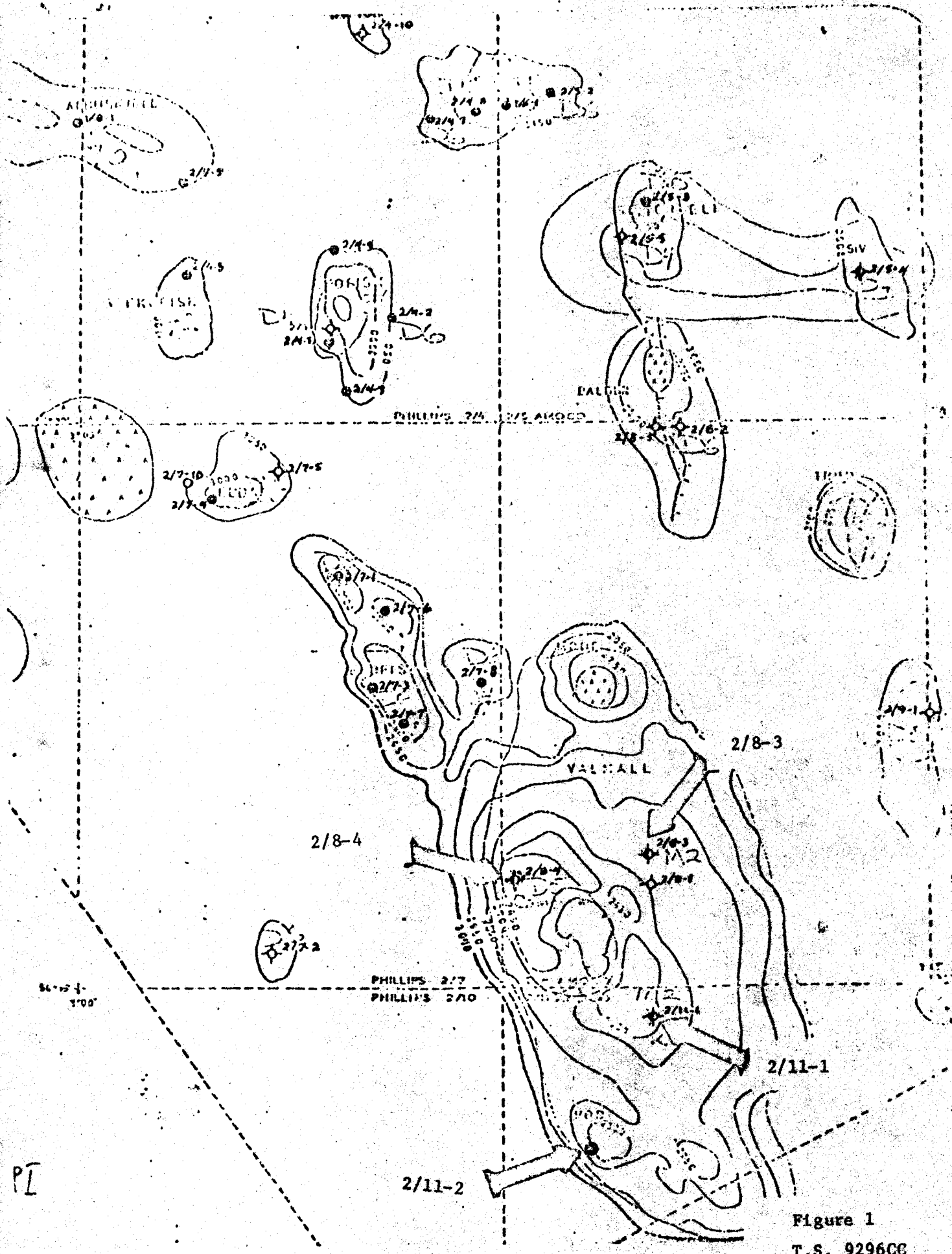
LMR/RLA:rb
536 216

OFFICE AMOCO NORWAY AREA DATE 2/27/75 AMOCO PRODUCTION COMPANY
 AUTHORIZED BY K O SMILE TECHNICAL SERVICE NUMBER 922675 RESEARCH
 STATE NORWAY COUNTY OFFSHORE WELLS LOCATION AMOCO 2/11-2 OIL CORRELATION ANALYSIS
 WELL NAME AMOCO NORWAY LEASE AMOCO 2/11-2

| SAMPLE NUMBER | TYPE | AGE | FORMATION | DEPTH | | CARBON-ISOTOPES | | OPTICAL ROTATION | API GRAVITY | I ₁ TYPE | PRISTINE/PHYTANE | I ₂ TYPE |
|---------------|------|----------|-----------|-------|--------|-----------------|---------|------------------|-------------|---------------------|------------------|---------------------|
| | | | | TOP | BOTTOM | SATURATE | WHL OIL | | | | | |
| 10 | OL | U. Cret. | | 870 | 875 | 29.9 | 29.3 | 1.02 | 36.8 | B | 1.35 | |

FOR ISOMER AND HEAVY HYDROCARBON DISTRIBUTION SEE ATTACHED FIGURES

Table 1
 T.S. 9296CC



PI

Figure 1
T.S. 9296CC

AMUCO PRODUCTION COMPANY
RESEARCH CENTER.

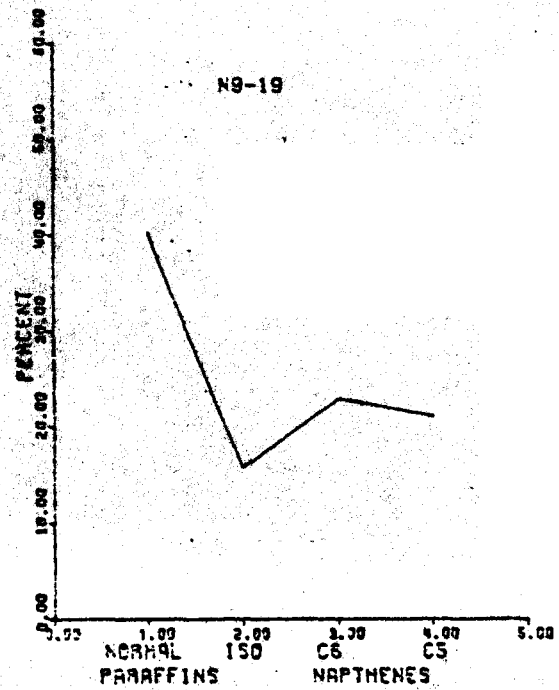


Figure 2

T.S. 9296CC

AMOCO PRODUCTION COMPANY
RESEARCH CENTER
PERCENT

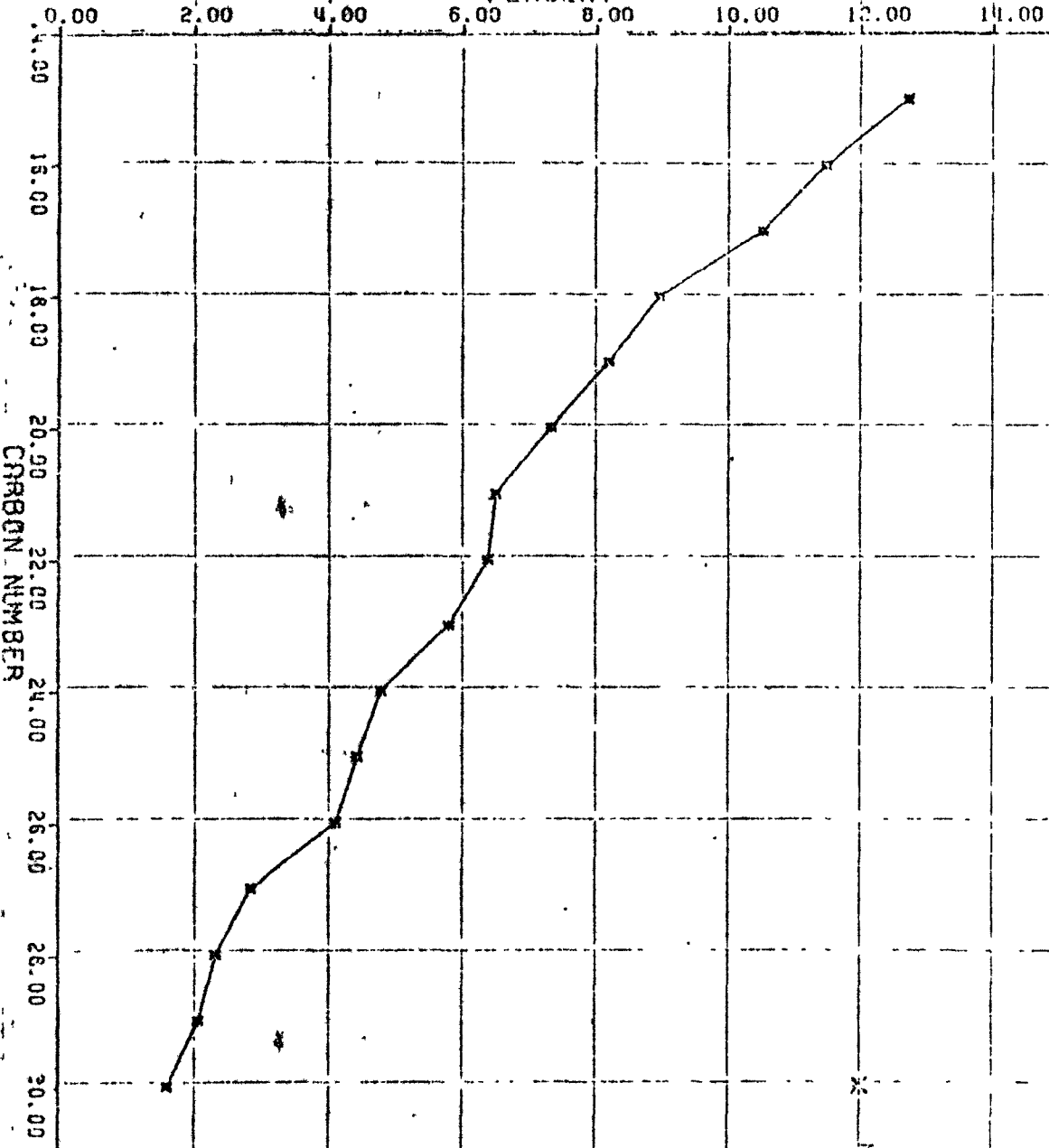


Figure 3
I.S. 9296CC

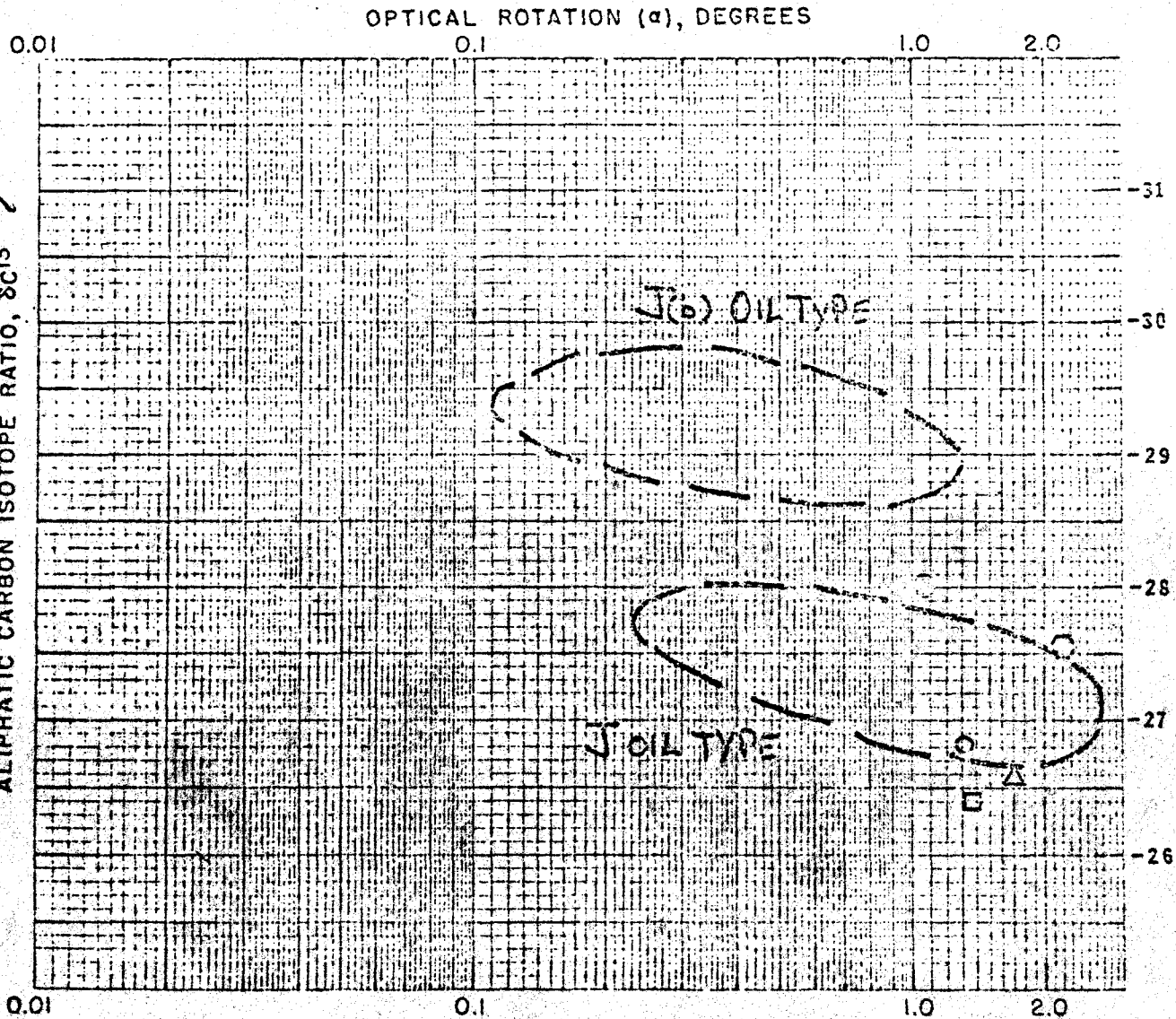
CP1
AS-19 e.i.c.c

HEAVY FRACTION
DISTRIBUTION

Amoco Production Company

RESEARCH CENTER

ALIPHATIC CARBON ISOTOPE RATIO, δC^{13}



OIL
CORRELATIONS
SEMI-LOG PLOT
 δC^{13} VS. α

North Sea - Norway

- Amoco 2/11-2 Well
- ⬡ Amoco 2/8-3 "
- △ Amoco 2/8-4 " DST.2
- Amoco 2/8-4 " DST.1
- Amoco 2/11-1 "

TECH. SERVICE 9296CC

AREA _____

DATE _____

FIGURE 4



James A. Momper
Geological Research
Director

Amoco Production Company

4502 East 41st Street
P.O. Box 591
Tulsa, Oklahoma 74102

Research Center
918-627-3400

| | | | |
|--------|---|--|------|
| R.D.S. | 1 | | |
| V.I.P. | | | |
| R.B.H. | | | |
| F.S.S. | 2 | | |
| C.L.S. | 3 | | |
| W.R.M. | 4 | | WTRM |
| R.L.D. | | | |
| I.S. | | | |
| J.W.C. | | | |
| M.S. | | | |
| P.J. | | | |

400
300.114

July 6, 1973

File: Technical Service 8792CC, Job No. 9622

K. D. Soule
Amoco Norway

Dear Sir:

Subject: Oil Correlation Analyses, Upper Cretaceous Oils,
Amoco Norway 2/8-4 Offshore Norway

Oil correlation analyses have been completed on the subject samples and are reported in the attached memorandum by L. M. Ross and R. L. Ames. The two oils are identified as bacterially altered "J" types. They are also similar to the bacterially altered Amoco Norway 2/11-1 oil.

Yours very truly,

James A. Momper
James A. Momper

LMR:el 17.07

Attachment

cc: J. V. Sexton, Amoco Europe
K. A. Shepard, AIOC Chicago
E. R. Michaelis

Distribution

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

Oil Correlation Analyses

2 Upper Cretaceous Oils - Amoco Norway 2/8-4

North Sea, Norway

Geochemistry Group

L. M. Ross
R. L. Ames

Distribution: K. D. Soule - Amoco Norway
J. V. Sexton - Chicago AIOC
K. A. Shepard - Chicago AIOC
E. R. Michaelis/J. A. Momper

Technical Service 8792CC
Job 9622
Requested by K. D. Soule
AMOCO NORWAY

Roger Ames (July 6, 1973)

AMOCO PRODUCTION COMPANY

RESEARCH CENTER

CORRELATION ANALYSES

OFFICE AMOCO NORWAY DISTRICT _____
 REQUESTED BY K. D. SOULE DATE 6-15-73
 TECHNICAL SERVICE T.S. 8792CC GEOLOGICAL PROVINCE _____
 STATE (PROVINCE) NORWAY

OIL ROCK

| SAMPLE | FIELD | COUNTY | WELL AND LOCATION | PAY | CARBON ISOTOPE $\delta^{13}C_{\text{‰}}$ | | OPTICAL ROTATION DEGREES | INFRARED SPECTRUM | ISOMER DISTRIB | HEAVY HC DISTRIB | °API AT 60°F | OIL TYPE |
|--------|-----------|--------|------------------------------------|---|--|-----------|--------------------------|-------------------|----------------|------------------|--------------|----------|
| | | | | | ALIPHATIC | WHOLE OIL | | | | | | |
| N9-11 | Block 2/8 | | Amoco Norway 2/8-4 56°17'53.7"N | Upper Cretaceous Chalk Section 8460-8490 DST.#2 | -26.6 | -26.4 | 1.67 | Mod. B | Fig. 2 | Fig. 3 | 27.7 | J (bac) |
| N9-12 | " | | 03°20'39.6"E | 8540-8604 DST.#1 | -26.4 | -26.3 | 1.38 | Mod. B | " | " | 32.6 | J (bac) |
| N9-3 | W.C. | | Amoco Norway 2/11-1 | Cretaceous 8624-8696 | -26.3 | -26.3 | 1.31 | B | | | 34.7* | J (bac) |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

REMARKS:

Oils from the Amoco Norway 2/8-4, produced from the Upper Cretaceous chalk section, are correlative to slightly bacterially altered J-type oil. The alteration was judged from the higher optical activity and lower API gravity. The use of our analytical data in Table 1 has also correlated the subject oils to the bacterially altered Amoco Norway 2/11-1 oil (T.S. 7965CC and 8554CC). The higher optical activity and lower API gravity of the shallower N9-11 (DST#2) oil indicates a greater degree of bacterial alteration than the deeper N9-12 (DST.#1) oil.

POSITIVE UNLESS OTHERWISE INDICATED;
 CANNOT USUALLY BE RUN ON ROCK EXTRACTS

Corrected API Gravity

R. L. Jones

AM Ross

ANALYST *J. Williams* DATE _____
 TABLE 1

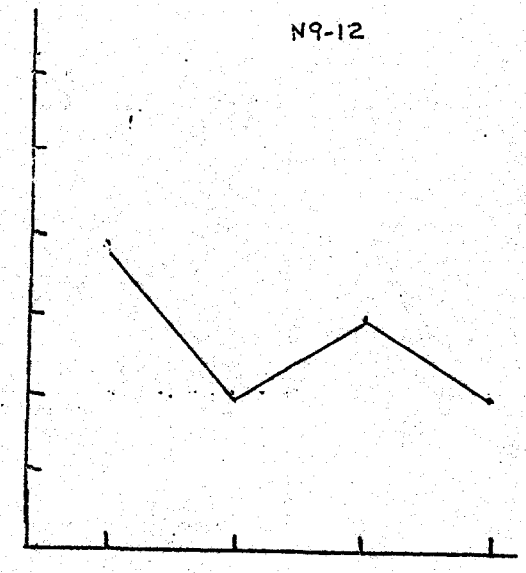
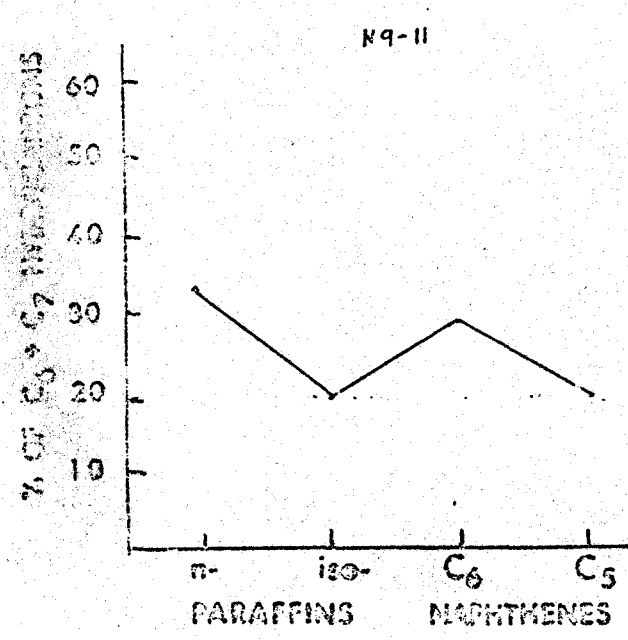


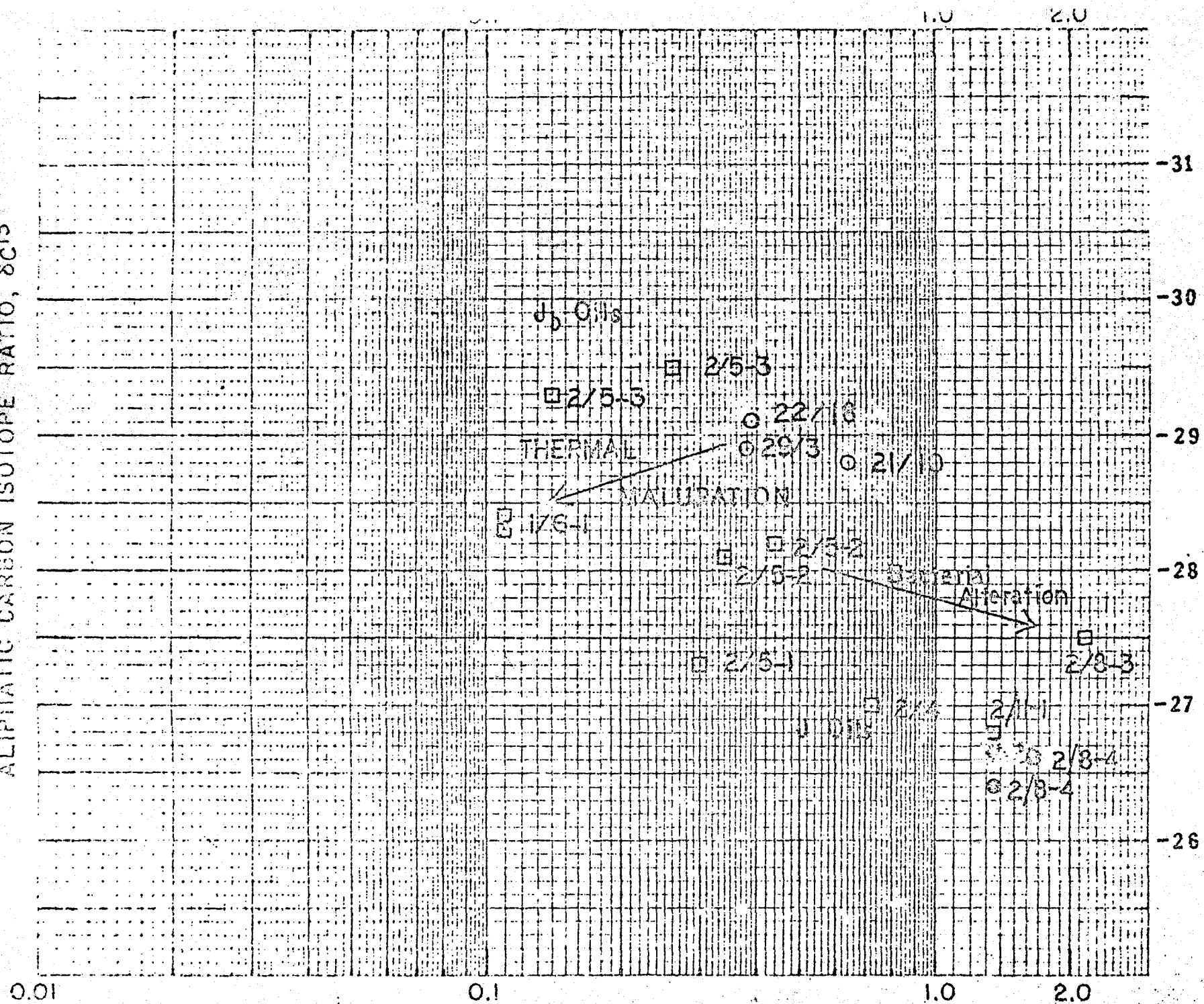
Figure 2
T.S. 8792CC
Amoco Norway

TECHNICAL SERVICE _____
AREA _____
DATE _____

OIL ROCK EXTRACT ISOMER DISTRIBUTIONS

FIGURE

ALIPHATIC CARBON ISOTOPE RATIO, δC_{13}



CORRELATION
SEMI-LOG P
 δC_{13} VS.

Offshore Norway

Subject oils

Referenced oils

Offshore United Oils

Referenced oils

TECH. SERVICE 8792

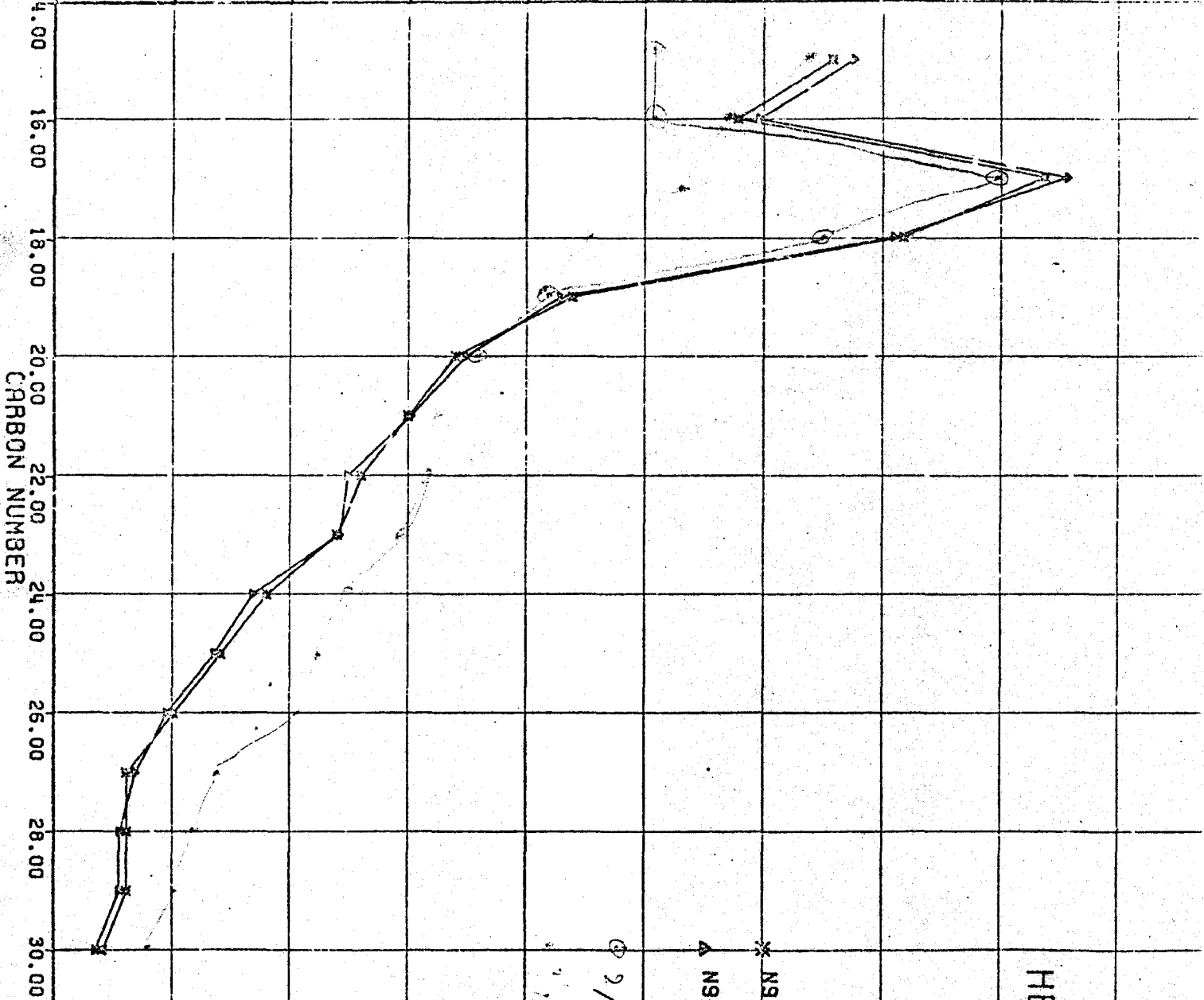
AREA Amoco Norway

DATE

FIGURE 4

AMOCO PRODUCTION COMPANY
RESEARCH CENTER
PERCENT

0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00



HEAVY HYDROCARBON
DISTRIBUTION

AMOCO NORWAY

2/8-4 & 2/11-1

CPI

* N9-11

8460-90

△ N9-12

1.11

8540-8604

⊙ 2/11-1

8624-8696

Figure 3
T.S. 8792CC
Amoco Norway

PAN AMERICAN PETROLEUM CORPORATION
RESEARCH CENTER

OIL CORRELATION ANALYSIS

- North Sea Tertiary Basin -

Geochemistry Group

J. A. Williams
R. L. Ames

Distribution: K. D. Soule, London
E. K. Waering, Amoco Norway
Attn A. J. Snyder
S. A. Antoniuk, Chicago
W. R. Walton
J. A. Momper

Technical Service 7965 CC
Amoco Europe, Incorporated
November 20, 1970

James A. Momper
11-20-70

DISCUSSION

The three subject oils from the Tertiary Basin of the North Sea are generally similar types, but they vary enough in detail to warrant some differentiation. On a gross scale, the oils have a range of 8.6 API gravity units which indicates some variability in the overall character of the oils. On a finer scale, the isomer distributions and the heavy hydrocarbon patterns (Figures 1 and 2) have only minor variations which suggests that the oils probably came from similar source bed sequences. However, the oil from Amoco 2/11-1 is classified as a subtype on the basis of its high optical rotation, high API gravity, and a slightly different infrared spectrum.

All three of the subject oils differ in both heavy hydrocarbon distribution and carbon isotope composition from the previously analyzed Paleocene oil from Amoco U.K. 22/18-1. The heavy hydrocarbon patterns from the subject oils have a prominent peak at C₁₇ and C₁₈ (Figure 2) which is not present in the 22/18-1 oil (Figure 3). The isotope difference is clearly seen in the carbon isotope-optical rotation plot of Figure 4.

Based on the aforementioned oil correlation parameters, we now believe that there are at least two major types of oil and one subtype within the Tertiary Basin of the North Sea. We have designated these oil types as: type IV - present in the Paleocene sands in Amoco U.K. 22/18-1; type V - present in the Danian limestones in the Phillips Norway 2/4-lax and Amoco Norway 2/5-1; and subtype V(a) - present in the Cretaceous limestone in Amoco Norway 2/11-1.

The different types of oil indicate that there is no common, uniform source bed for the North Sea Tertiary Basin oils. Instead, there may be either localized generation and expulsion from a widespread source bed or commingling of oils from different sources. We are attempting to identify the effective source bed(s) by analyzing organic matter in cores and cuttings from a number of wells in the Tertiary Basin.* Preliminary indications are that the Paleocene and other Tertiary shales were not the primary source for the huge in-place reserve reported in the Ekofisk Danian reservoir.

The subtle differences detected in the three oils analyzed for this study stress the need for continued thorough sampling as new fields are discovered. In this way, it should be possible to establish basic types and to determine the number of basic types. Then, the identity of each effective source sequence can be established by correlating basic types to their respective sources. The final step will be to determine the stratigraphic and geographic distribution of each oil type as an aid to exploration.

FAN AMERICAN PETROLEUM CORPORATION
RESEARCH CENTER
CORRELATION ANALYSES

OFFICE Amoco Europe AREA North Sea
AUTHORIZED BY K. D. Soule DATE 10-28-70
TECHNICAL SERVICE NUMBER 7965 CC

OIL ROCK

STATE (PROVINCE)

| SAMPLE | FIELD | COUNTY | WELL AND LOCATION | PAY SAMPLE INTERVAL | CARBON ISOTOPE $\delta^{13}C_{\text{‰}}$ | | OPTICAL ROTATION, DEGREES | INFRARED SPECTRUM TYPE | ISOMER DISTRIB. | HEAVY HC DISTRIB. | °API @ 60 °F | | OIL TYPE |
|--------|---------|--------------------|----------------------------|---------------------------|--|-------------------------|---------------------------------|------------------------------|--------------------|----------------------|-----------------|------|-------------|
| | | | | | ALIPHATIC EXTRACT | WHOLE C/L TOTAL ORG. | | | | | | | |
| E1-15 | Ekofisk | Offshore Norway | Phillips Norway 2/4-lax | Danian 10364'-10464' | -27.0 | -26.5 | 0.72 | B | Fig. 1 | Fig. 2 | 36.1 | | V |
| E1-16 | Torfelt | " | Amoco Norway 2/5-1 | Danian 9981'-10175' | -27.3 | -26.8 | 0.30 | B | " | " | 40.9 | | V |
| E1-17 | W.C. | " | Amoco Norway 2/11-1 | Cretaceous 8624'-8696' | -26.8 | -26.3 | 1.31 | Mod B | " | " | 44.7 | 34.7 | V(e) |
| E1-14* | W.C. | Offshore U.K. | Amoco 22/18-1 | Paleocene | -29.1 | -28.7 | 0.39 | C | Fig. 1 | Fig. 3 | 38.7 | | IV |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

REMARKS:

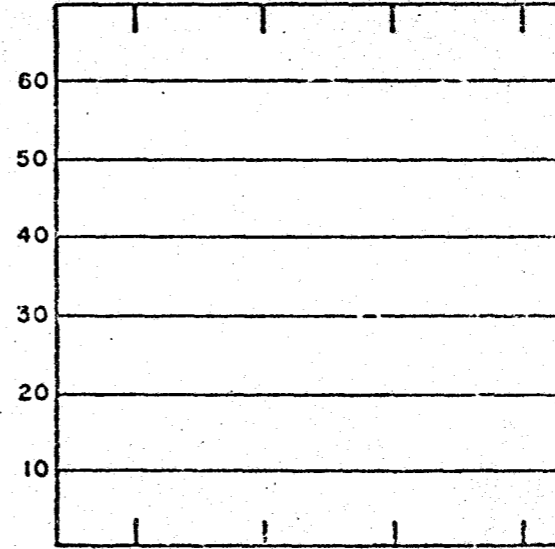
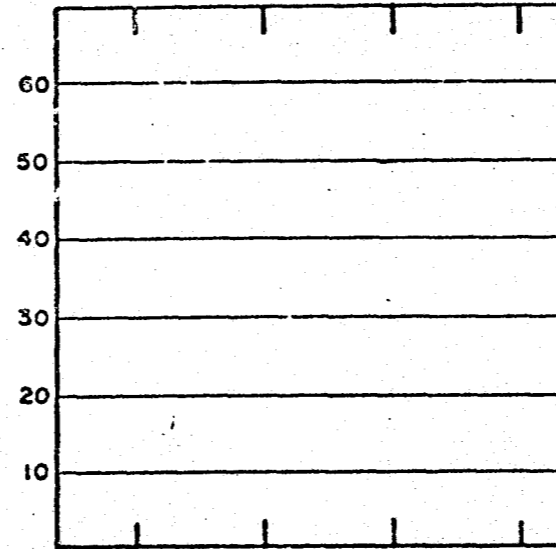
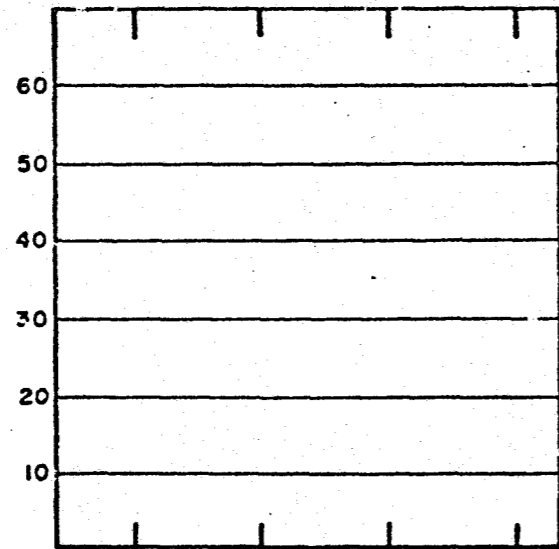
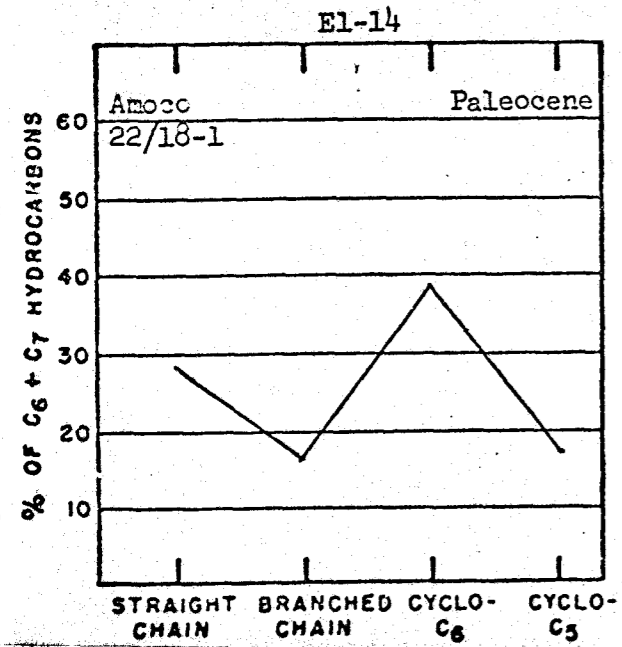
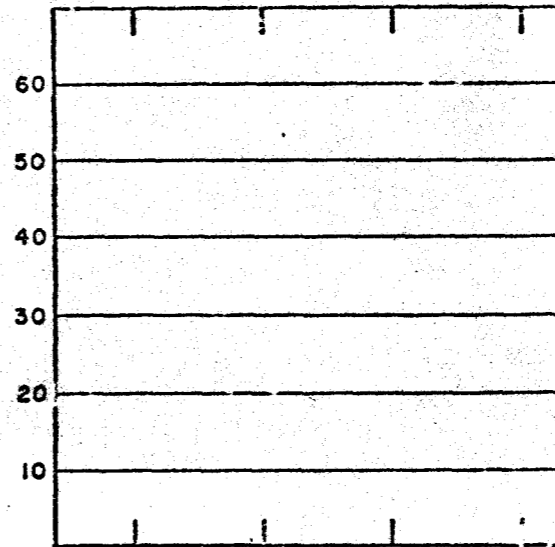
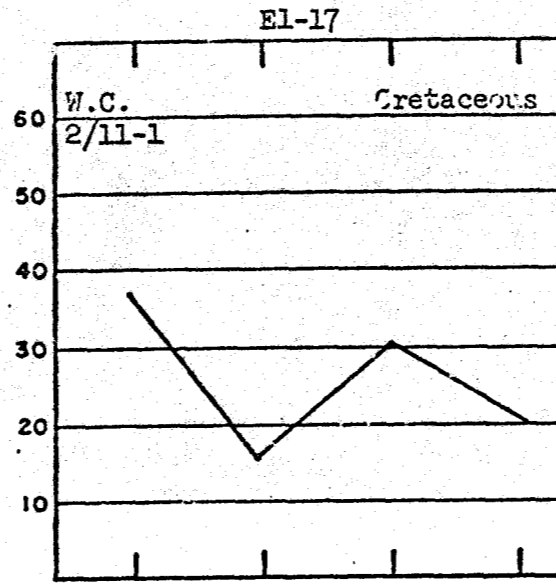
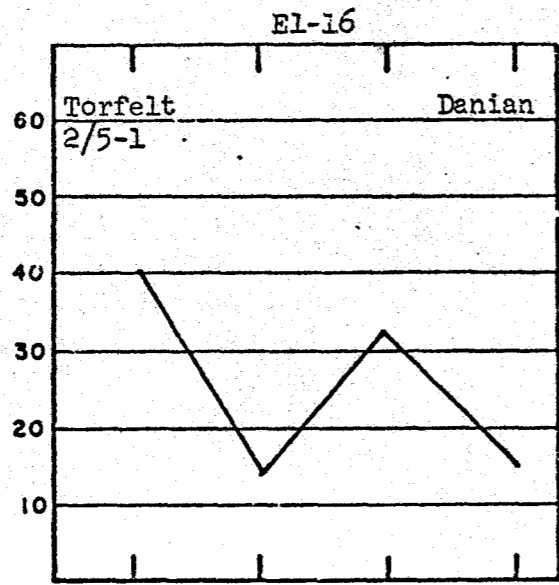
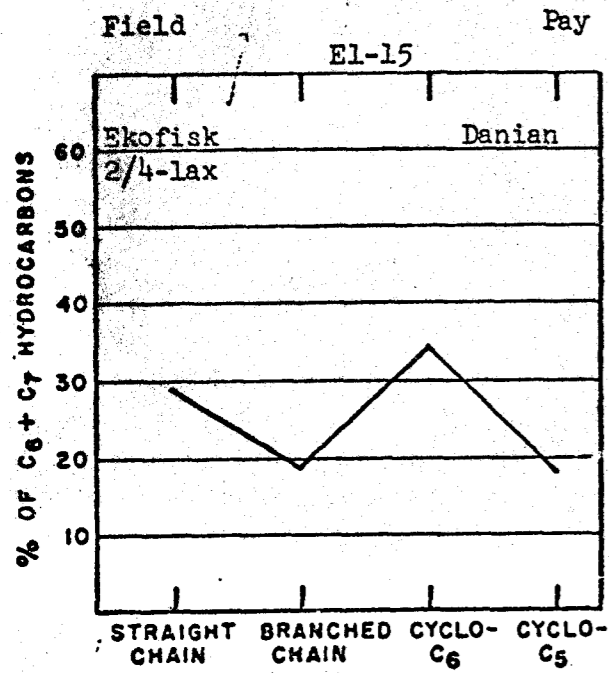
POSITIVE UNLESS OTHERWISE INDICATED; NOT RUN ON ROCK EXTRACTS

*Reported under Technical Service 7875 CC, 9-23-70.

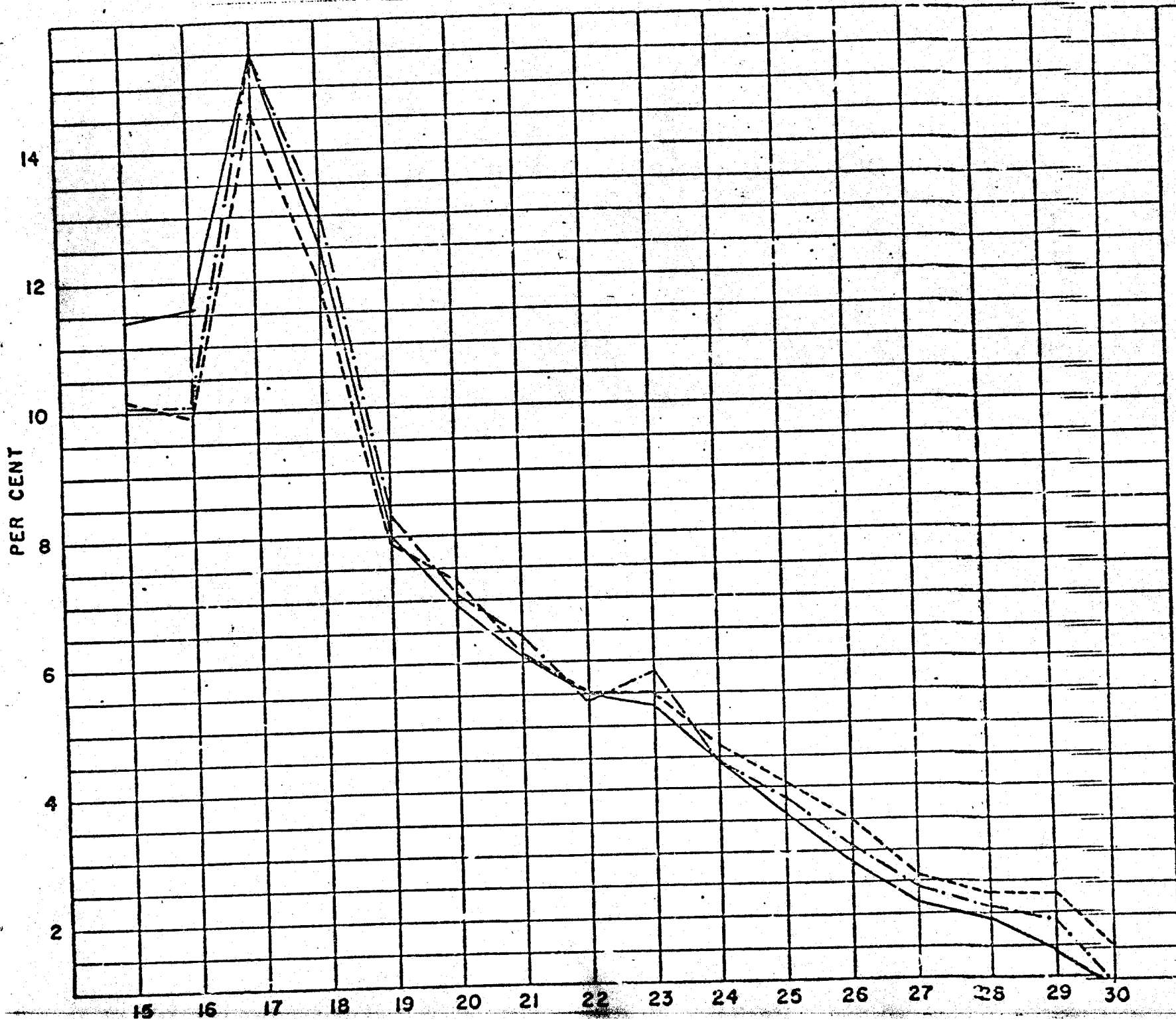
ANALYST R. Hines J. Williams DATE 11-20-70
TABLE 1

PAN AMERICAN PETROLEUM CORPORATION
RESEARCH CENTER

NORTH SEA OILS
NORWEGIAN SECTOR



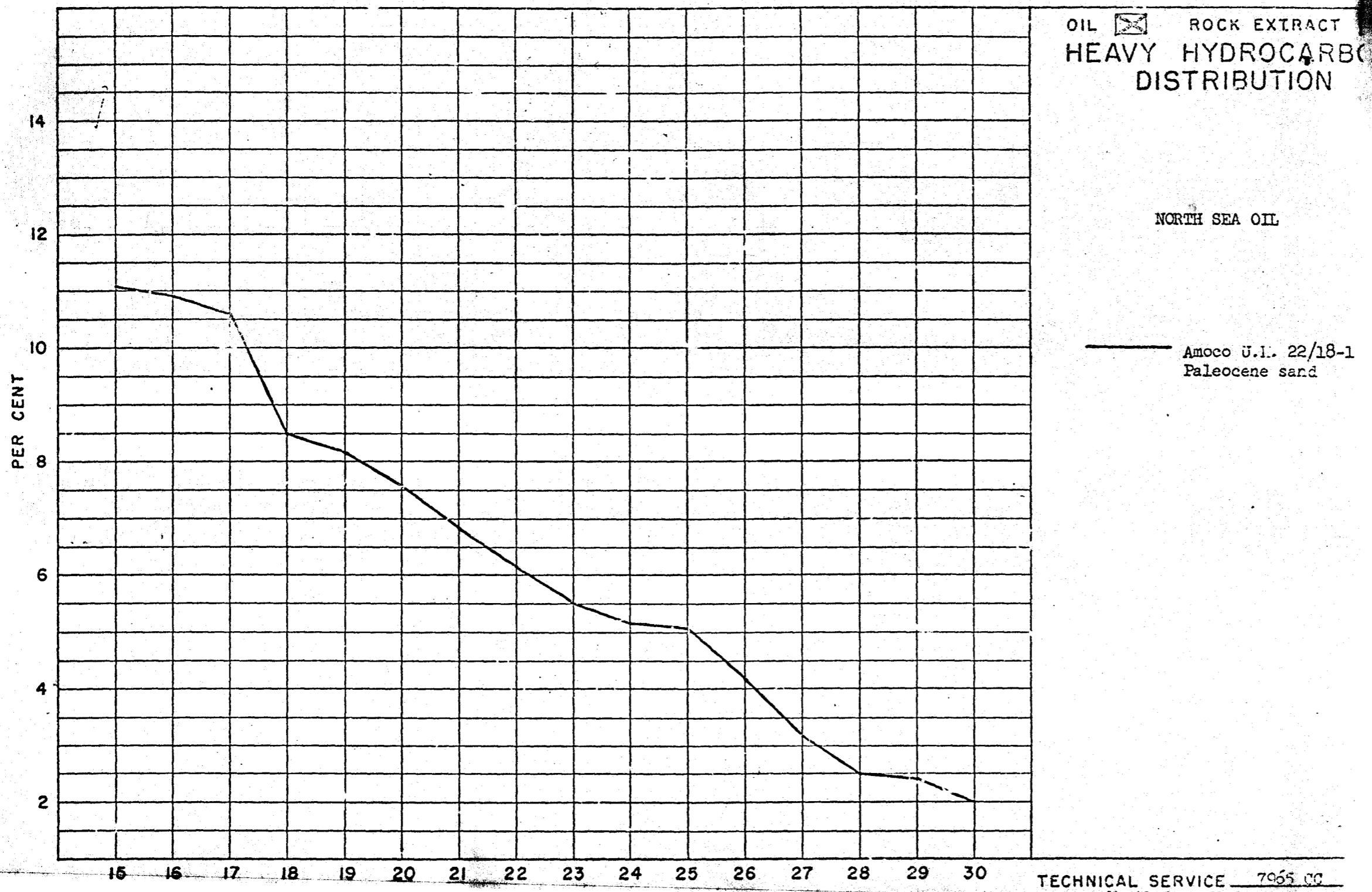
TECHNICAL SERVICE 7965 CC
AREA Amoco Europe, Inc.
DATE 11-20-70



OIL ROCK EXTRACT
HEAVY HYDROCARBON
DISTRIBUTION

NORTH SEA OILS

- El-15, Ekofisk 2/4-1a
- - - El-16, Torfvelt 2/5-1
- · - El-17, W.C. 2/11-1

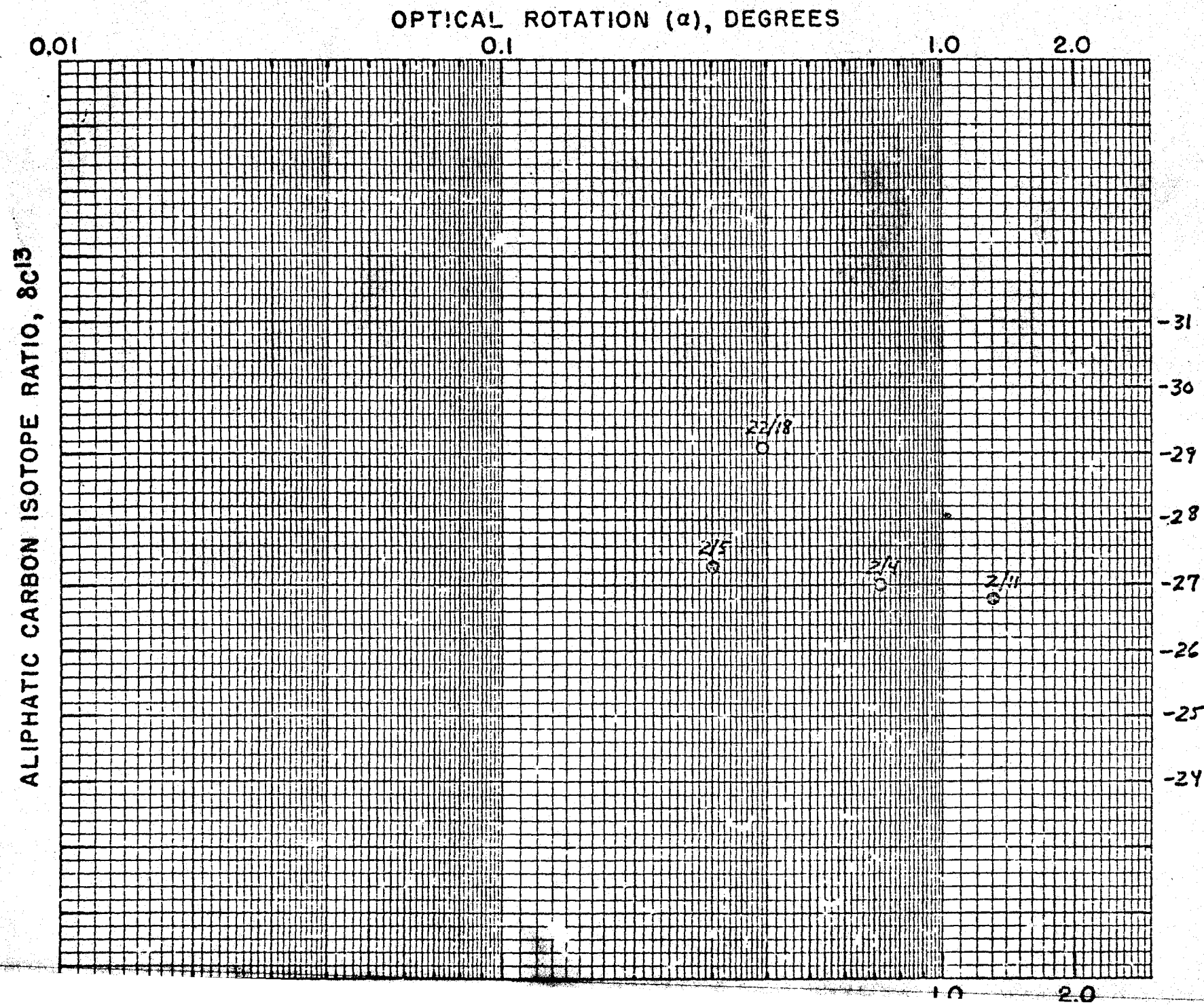


OIL ROCK EXTRACT
HEAVY HYDROCARBON
DISTRIBUTION

NORTH SEA OIL

Amoco U.I. 22/18-1
Paleocene sand

OIL
CORRELATIONS
SEMI-LOG PLOT
 δC^{13} VS. α



NORTH SEA OILS

- United Kingdom sector
22/18-1 Paleocene
- Norwegian sector
2/5-1 Torfelt Danian
2/4-lax Ekofisk Dania
2/11-1 W.C. Cretaceou

TECH. SERVICE 7965 C
AREA North Sea Tertiary
DATE 11-20-77
FIGURE 4



William R. Walton
Geological Research
Director

November 7, 1972

Mr. K. D. Soule
Amoco Norway Oil Company
Storgaten 32
Oslo 1, Norway

| AMOCO NORWAY OIL COMPANY | |
|--------------------------|-------|
| 19 NOV. 1972 | |
| INITIALS | FILE |
| P.S. | 1 |
| E.C.S. | |
| V.L.P. | |
| R.S.M. | |
| B.S. | 2 |
| C.L.R. | 4 |
| V.R.M. | 3 |
| R.L.S. | |
| J.V.C. | |
| F.J. | |
| FILE | 2/8-3 |

Amoco Production Company

4502 East 41st Street
P.O. Box 591
Tulsa, Oklahoma 74102

Research Center
918-627-3400

300.114

Dear Sir:

The attached report by R. L. Ames and L. M. Ross covers the results of oil correlation analyses on one Upper Jurassic oil sample from the Amoco Norway 2/8-3. The oil correlates with previously analyzed North Sea oils which are believed to have been generated in the Jurassic shales. However, this oil is bacterially altered and this may help explain the apparent absence of a significant oil accumulation on this large structure. This alteration indicates the influx of surface recharge waters, which is consistent with the deduction that the sea's on the oil reservoirs were breached by diapirism subsequent to accumulation, permitting escape migration to occur.

Very truly yours,

William R. Walton
WRM

Attachment

cc w/attach.: J. V. Sexton, Amoco Europe
K. A. Shepard, AIOC

Nov 3, 1972

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

OIL CORRELATION ANALYSIS

1 Upper Jurassic oil from the Amoco Norway 2/8-3
North Sea

Sample No. 1/8-3

T.S. 8554CC
Amoco Norway
North Sea

DISCUSSION

The oil from the Amoco Norway 2/8-3 wildcat, produced from the Upper Jurassic sand, is a chemically and bacterially altered J_(b) + J type oil. The alteration was judged from the higher optical activity, lower API gravity, isomer distribution, and heavy paraffin chromatogram. The use of our analytical data in Table 1, along with the hydrocarbon type mass spectral analysis, has correlated the subject oil with Torfelt, 2/5-2 (N9-5), oil (T.S. 8543CC).

Prior to the analysis of this oil the only other evidence of alteration was found in an oil from the Upper Cretaceous pay in the Amoco Norway 2/11-1, N9-3 (T.S. 7965CC). The close proximity of the subject well and 2/11-1, along with the presence of chemical and bacterial alteration in both wells, might suggest some common communication with fresh water at sometime in the past. Temperature data, sent in 1970, indicates a lower geothermal gradient in the vicinity of the 2/11-1 and 2/8-3 wells (Fig. 5). The lower temperature may be a result of communication with fresher waters, and may relate to the alteration. If bacteria were involved in the degradation of the oil, the alteration had to occur at lower temperature, or shallower depth. Bacteria can consume petroleum at temperatures up to 190°F, but the maximum consumption probably takes place below 140°F. The current reservoir temperature of approximately 220°F indicates that the alteration took place at a shallower depth.

Previous correlation analyses on oil and rock samples in the North Sea Tertiary Basin showed that the Jurassic shales are the sources of the oils (T.S. 8355CC, 3-21-72; T.S. 8207C Addendum, 4-5-72; T.S. 8361CC, 4-7-72; T.S. 8428C, 5-31-72).

Roger L. Ames

Roger L. Ames

Larry M. Ross

Larry M. Ross

RLA/LMR:glj

NOV 3 1972

Amoco Production Company

RESEARCH CENTER CORRELATION ANALYSES

FIELD Amoco Norway DISTRICT North Sea
 REQUESTED BY K. D. Soule DATE 8-17-72
 ANALYTICAL SERVICE 8554CC GEOLOGICAL PROVINCE _____

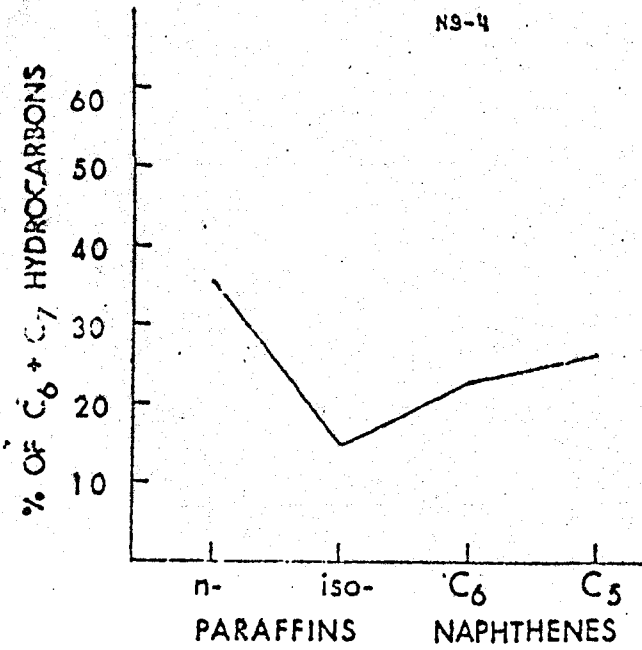
OIL ROCK

| SAMPLE | FIELD | COUNTY | WELL AND LOCATION | PAY SAMPLE INTERVAL | CARBON ISOTOPE δC ¹³ ‰ | | OPTICAL ROTATION DEGREES | INFRARED SPECTRUM | ISOMER DISTRIB | HEAVY HC DISTRIB | °API AT 60°F | OIL TYPE |
|--------|-------|------------------|--|--|-----------------------------------|------------------------|--------------------------------|----------------------|-------------------|------------------------|--------------------|-------------|
| | | | | | ALIPHATIC EXTRACT | WHOLE OIL TOTAL ORG | | | | | | |
| | W.C. | North Sea 006 | Amoco Norway 2/8-3 56°18'31"N 03°26'54"E | Upper Jurassic 11715'-11770' Temp. at 12,137' 225°F | -27.5 | -27.6 | 2.16 | B | Fig. 2 | Fig. 3 | 31.6 | J(b)† |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
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REMARKS: * POSITIVE UNLESS OTHERWISE INDICATED; NOT RUN ON ROCK EXTRACTS

ANALYST J. A. Williams DATE NOV 1 1972
 TABLE 1

AMOCO PRODUCTION COMPANY
Research Center



OIL ROCK EXTRACT ISOMER DISTRIBUTIONS

TECHNICAL SERVICE 8554CG
AREA Amoco Norway
DATE NOV 9 1972

ETC/IDE

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

PERCENT

2

4

6

8

10

12

14

HEAVY HYDROCARBON DISTRIBUTION

CPI

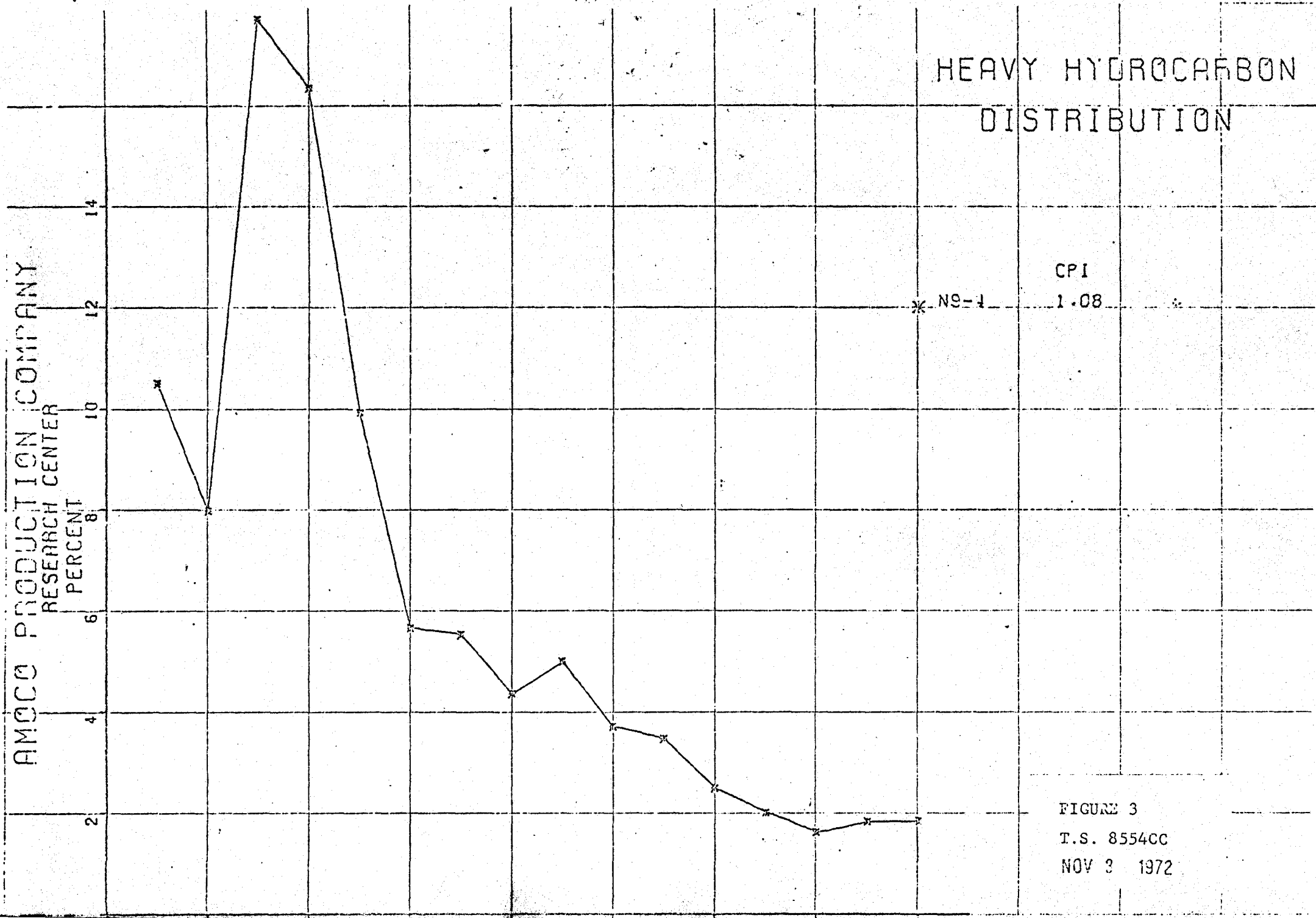
1.08

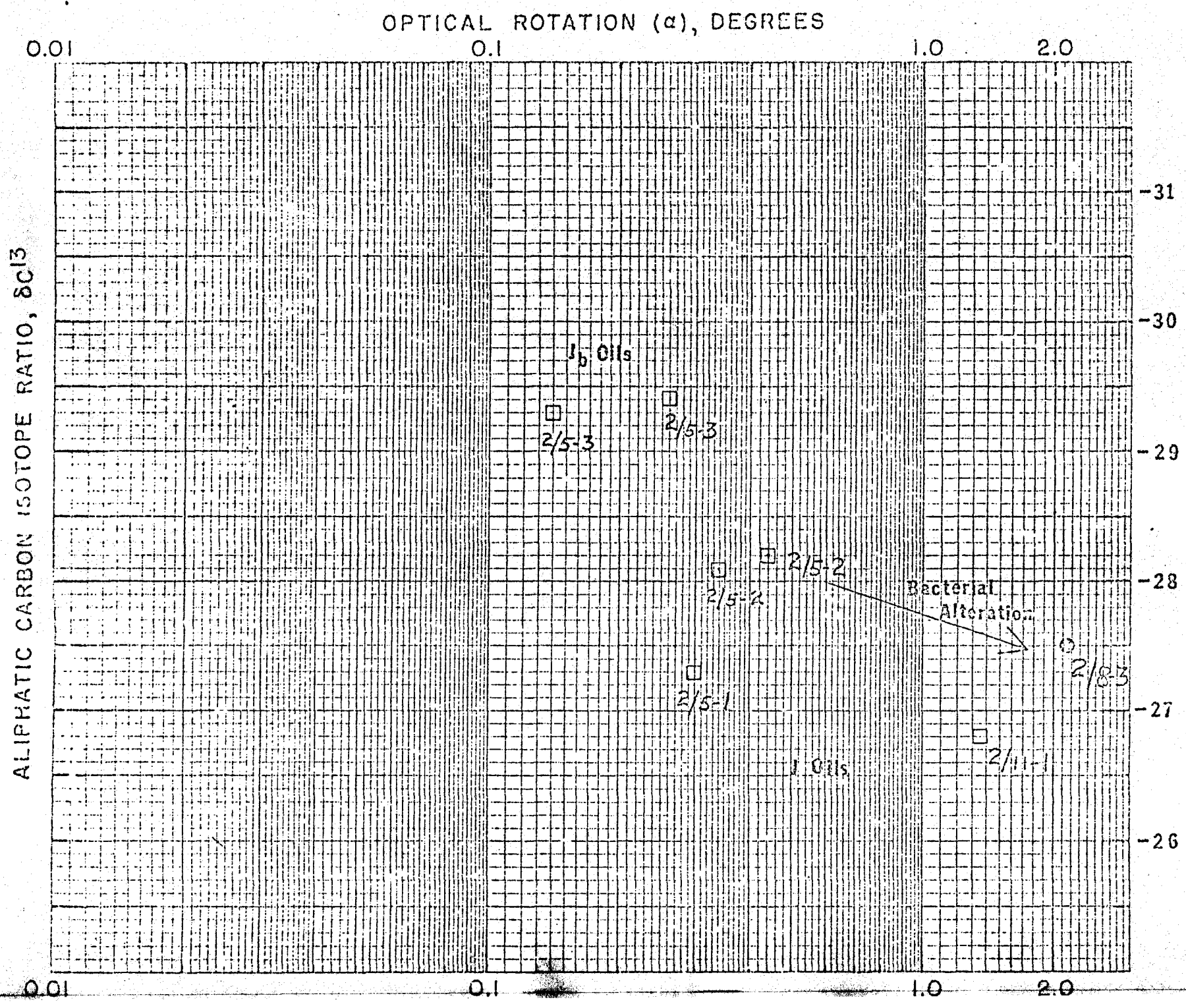
* N9-1

FIGURE 3

T.S. 8554CC

NOV 3 1972





OIL
CORRELATION
SEMI-LOG PLO
 δC^{13} VS. α

- Subject Oil N9-
- Previously analysed
T.S. 7565 CC
8543 CC

Bacterial
Alteration

TECH. SERVICE 855400
AREA Amoco Norway
DATE NOV 8 1972
FIGURE 4