

U-16

AMOCO PRODUCTION COMPANY
RESEARCH CENTER

SOURCE ROCK EVALUATION

- Amoco Norway 2/8-2 -

Geochemistry Group

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REGISTRERT
OLJEDIREKTORATET

Technical Service 7890CC (Addendum)
Amoco Norway Oil Company

James A. Momper
10-14-71

Fourteen cuttings samples from the Amoco Norway 2/8-2 well were processed for source rock evaluation and organic diagenesis determination. The samples were unwashed and partially dried when received, and it was not possible to separate the cuttings from the drilling mud. As a consequence, all of the samples are contaminated by diesel oil used in the drilling mud. This contamination is shown by the extraordinarily large volumes of extractables (Table 1), a dominance of C₂₂ paraffins on the heavy hydrocarbon distribution (Figure 1), and by the small range of carbon isotope values. The heavy hydrocarbon patterns are nearly identical for all the samples, regardless of the quantity of extractable hydrocarbons.

Similar source rock analyses on sidewall cores from this well, reported in T.S. 7890CC, 12/8/70, yielded approximately one-tenth as much extractable organic matter as the cuttings. On the other hand, both cuttings and cores demonstrate that the Tertiary shales have fair to very good source rock potential based on the weight percent organic carbon.

Organic diagenesis of the kerogen is more systematic in the sidewall cores than in the cuttings (Figure 2). For example, the percent carbon increases progressively with depth in the cores and attains peak stage of hydrocarbon generation at about 8000-9000 feet. The percent carbon increases sporadically in the cuttings and never reaches the peak hydrocarbon generating stage (Table 2). Sidewall cores showed hydrogen depletion at about 8000 feet, indicating this to be the top of the zone of significant hydrocarbon generation. On the other hand, cuttings show hydrogen enrichment to about 7000 feet, and then insignificant change at greater depths. Thus, the contamination in the cuttings samples garbles the elemental analysis results for the kerogen and obscures the diagenetic patterns.

In summary, the cuttings samples from Amoco Norway 2/8-2 are badly contaminated by diesel oil. The total organic carbon is the only reliable measurement obtained, and it shows that most of the Tertiary shales have fair to very good source rock potential. Gas and gas condensate liquids would be the type of hydrocarbon formed from the organic matter in the Tertiary shales.

Walter J. Allen

RLA/JAW:prj

Amoco Norway
 ED BY E. K. Waering AREA North Sea
 DATE 8-5-70
 WELL SERVICE NUMBER 7890CC (Addendum)
 PROVINCE) Norwegian Sector COUNTY _____

AMOCO PRODUCTION COMPANY
RESEARCH CENTER
SOURCE ROCK EVALUATIONS

WELL LOCATION Amoco Norway 2/8-2

DEPTH	FORMATION	LITHOLOGY	DEPTH	INSOLUBLE RESIDUE %	ORGANIC CARBON WT. %	EXTRACTABLE ORGANIC Bbl/ACRE FT.	EXTRACT. HYDROCARBON Bbl/ACRE FT.	EXTRACT. ORG. TOTAL ORG.	RATING	$\delta^{13}C_{12}$ Extracted HCB
2000-2030	Pliocene	gry sh.	2000-2030	81.5	0.72	62.6*	47.1*	0.25	fair	-27.6
2090-2120			2090-2120							
2990-3020	Miocene	"	2990-3020	79.0	.94	113.7*	90.7*	.31	fair	-27.0
3080-3110			3080-3110							
3980-4010	"	"	3980-4010	81.0	.78	49.3*	35.6*	.20	fair	-27.1
4970-5000	"	"	4970-5000	79.0	.88	43.8*	30.2*	.16	fair	-27.1
5470-5500	"	"	5470-5500	79.0	1.82	123.2*	70.0*	.21	very good	-27.5
5970-6000	Oligocene	gry, brn sh.	5970-6000	84.0	1.81	92.0*	60.9*	.16	very good	-27.4
6480-6510			6480-6510							
6990-7020	"	"	6990-7020	78.0	2.40	116.4*	75.5*	.16	very good	-27.1
7470-7500	"	"	7470-7500	84.5	1.24	115.3*	76.7*	.26	good	-27.0
7980-8000	"	"	7980-8000	78.0	1.27	79.1*	51.7*	.19	good	-27.0
7980-8000	"	"	7980-8000	78.5	1.30	63.9*	41.1*	.16	good	-27.3
8480-8500	Lower Eocene	gry-grn sh.	8480-8500	77.5	.98	82.0*	58.3*	.24	fair	-27.3
8580-8600			8580-8600							
8980-9000	"	"	8980-9000	79.0	.85	54.1*	41.8*	.20	fair	-27.5
9490-9500	Paleocene	gry sh.	9490-9500	78.5	1.04	41.8*	26.9*	.13	good	-27.6
9695-9700	Danian (?)	"	9695-9700	63.4	.71	22.4*	15.0*	.11	fair	-27.6

Ref. 7890CC, 12-2-70

Log temp: 137°F @ 5081'
 192°F @ 9717'
 206°F @ 10,654'

*Contaminated

ANALYST J. Williams

DATE OCT 14 1971

TABLE 1

AMOCO Norway
 AREA North Sea
 ED BY E. K. Waering DATE 8-5-70
 SERVICE NUMBER 7890CC (Addendum)
 PROVINCE) Norwegian Sector COUNTY WELL LOCATION Amoco Norway 2/8-2

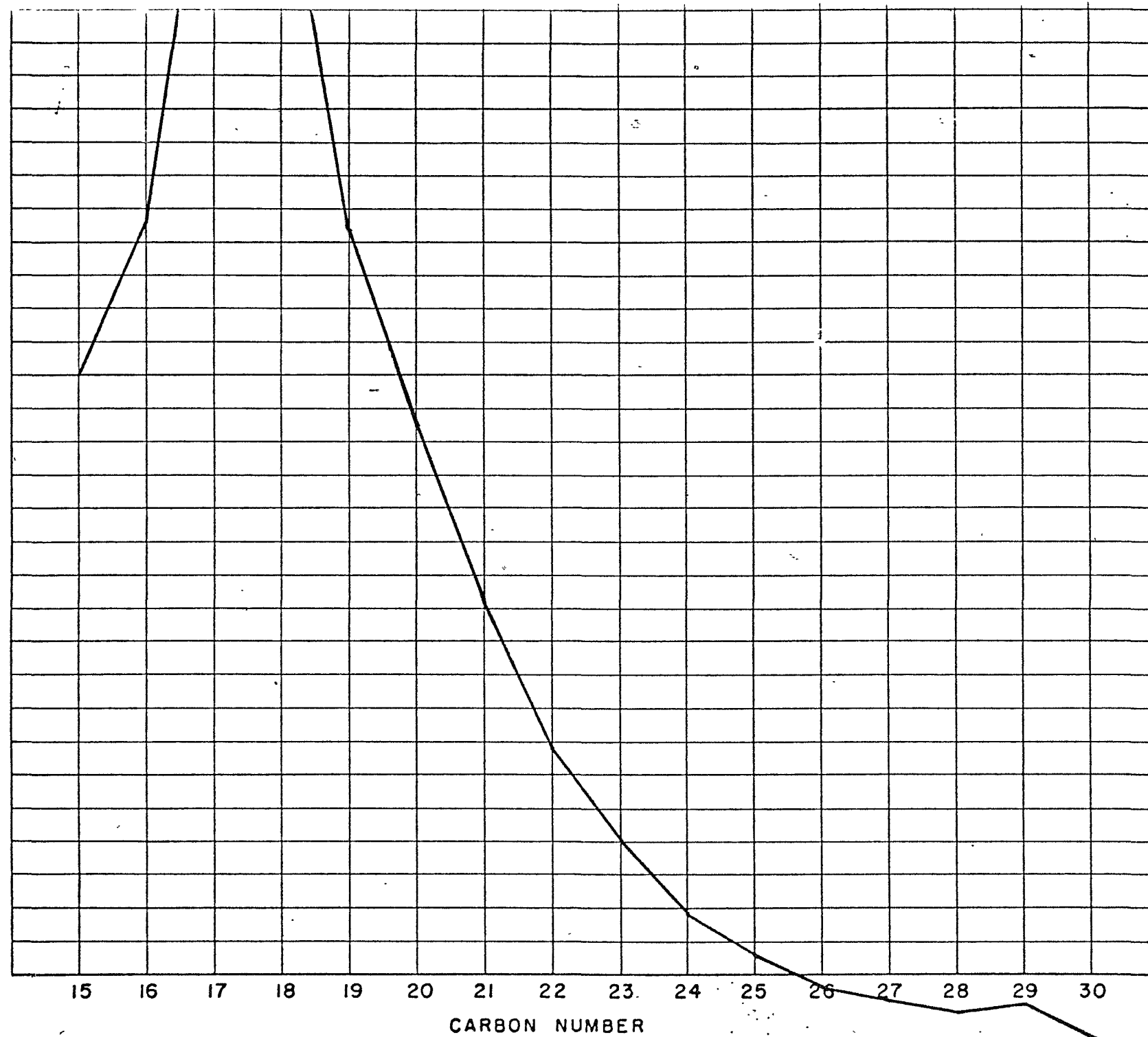
AMOCO PRODUCTION COMPANY
 RESEARCH CENTER
 ORGANIC DIAGENESIS DATA

DEPTH	QUALITY	FORMATION	LITHOLOGY	DEPTH	ELEMENTAL ANALYSIS, PERCENT				RATIO H/C	STATE OF DIAGENESIS	HYDROCARBON TYPE BY	
					CARBON	HYDROGEN	OXYGEN	NITROGEN			% HYDROGEN	PYROLYSIS
2000-2030	poor	Pliocene	gry sh	2090-2120	66.80	5.61	25.46	2.13	1.01	*	gas	
2990-3020	"	Miocene	"	3080-3110	64.31	5.65	27.49	2.54	1.05	"	gas	
3980-4010	"	"	"		67.38	5.99	23.85	2.78	1.07	"	gas - cond	
4970-5000	"	"	"		67.09	6.37	24.01	2.53	1.14	"	gas - cond	
5470-5500	"	"	"		70.89	7.28	19.28	2.56	1.23	"	oil	
5970-6000	"	Oligocene	gry, brn sh.		72.39	6.74	18.48	2.39	1.12	"	gas - cond.	
6480-6510	"	"	"		71.68	6.21	19.87	2.23	1.04	"	"	
6990-7020	"	"	"		70.53	6.50	20.83	2.15	1.11	"	"	
7470-7500	"	"	"		70.63	6.45	20.54	2.37	1.10	"	"	
7980-8000	"	"	"		70.60	6.47	20.57	2.36	1.10	"	"	
8480-8500	"	Lower Eocene	gry-brn sh.	8580-8600	70.87	6.39	20.50	2.23	1.08	"	"	
8980-9000	"	"	"		74.08	6.46	17.04	2.42	1.05	"	"	
9490-9500	"	Paleocene	gry sh		71.26	6.40	20.03	2.31	1.08	"	"	
9695-9700	"	Danian (?)	gry sh		67.69	5.94	24.30	2.07	1.05	"	"	

*State of diagenesis cannot be determined because of contamination.

ANALYST R. P. LaPlante DATE OCT 14 1971
 TABLE 2

HEAVY HYDROCARBON DISTRIBUTION



Amoco Norway 2/8-2

ANO-15 Pliocene shale 2000-2030
2090-2120

Virtually identical patterns were obtained for all samples, indicating contamination from the drilling mud.

TECHNICAL SERVICE 7890CC (Addendum)
AREA North Sea
DATE OCT 14 1971 FIGURE 1

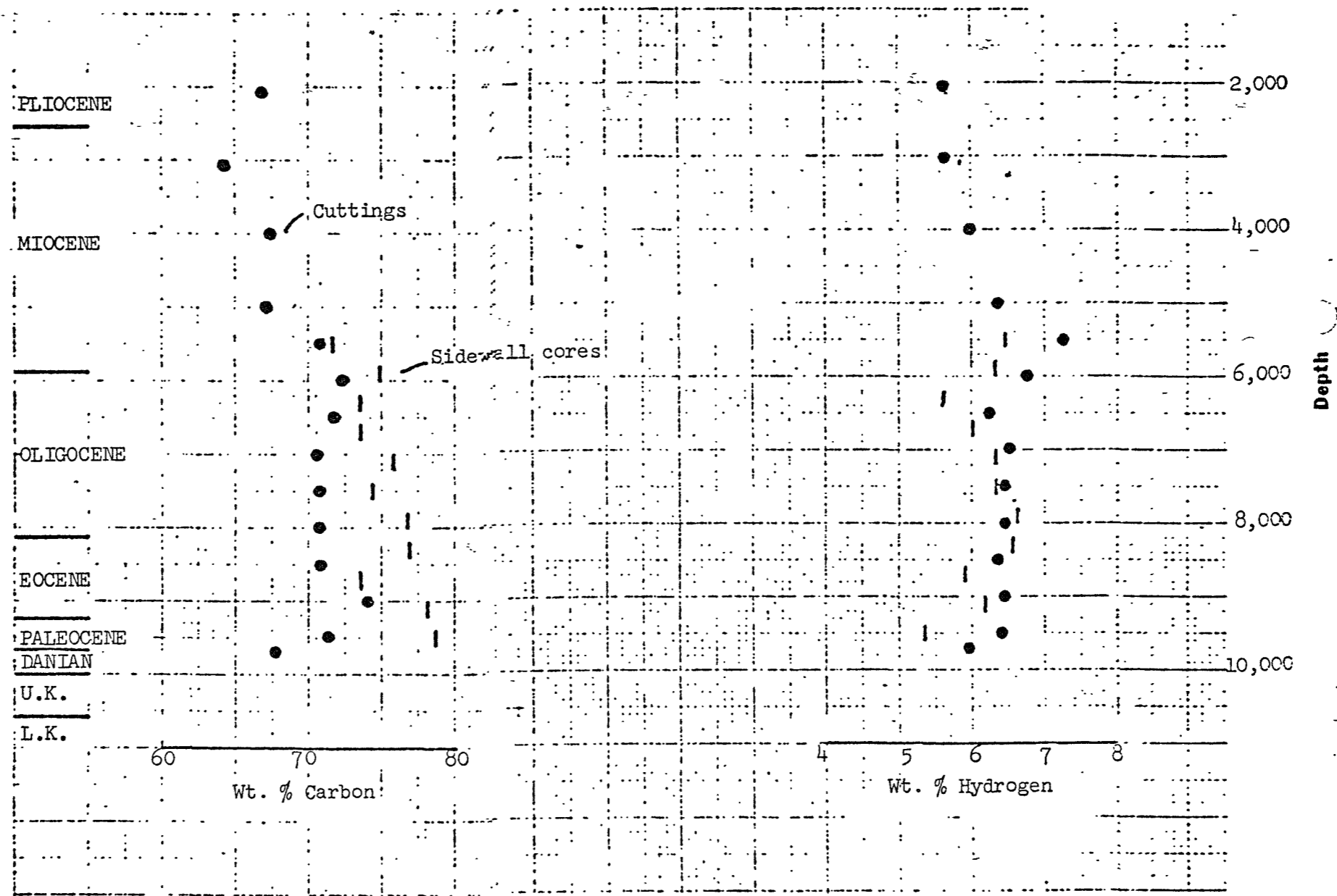


FIGURE 2 - ELEMENTAL COMPOSITION OF RESIDUAL ORGANIC MATTER
Amoco Norway 2/8-2

T.S. 7890CC (Addendum)
OCT 14 1971

47-2
Jurassic
Mid.

SUMMARY

Minor quantities of residual organic matter were recovered from three composite samples of a Jurassic sandstone section in the Phillips Norway 2/7-2 well. Elemental analysis suggests that this organic matter is more similar to detrital coaly material than to asphaltenes or pyrobitumens derived from crude oils. The diagenetic level of the organic matter is equivalent to peak hydrocarbon generation which indicates a relatively low thermal history. All three extracts resemble condensate-like oils.

INTRODUCTION

Three composite samples of Middle Jurassic sandstone in the Phillips Norway 2/7-2 well (Figure 1), containing residual asphaltic (?) material, were submitted for analysis. Some sections of the sandstone are described on the lithologic log as containing abundant asphaltic material; however, binocular microscope examination revealed only trace amounts of asphalt. The purpose of the analysis is to determine, if possible, whether the residual material represents asphalt precipitated by solution of gas into an oil accumulation, or whether it represents pyrobitumen generated by cracking reactions during thermal maturation.

DISCUSSION

The organic content of the sandstone cuttings is small, ranging from 0.05 to 0.06 weight percent (Table 1). These low values agree with the trace amounts of residual organic matter observed by microscopic examination.

Because of the small amount of organic matter, the three samples had to be combined for elemental analysis. The single analysis in Table 2 suggests that the organic matter in the Phillips well resembles coaly type kerogen rather than an asphaltic precipitate from crude oil. The subject organic matter has an appreciably lower H/C ratio than the average value for seven petroleum asphaltenes, and it has a higher H/C ratio than the average values for thermal matured asphaltenes in the Smackover dolomite. It would not be possible to attain the H/C ratio of the residue from the Phillips well, at such a low carbonization, from a petroleum asphaltene source. It is concluded that this

material is a coaly type of sedimentary organic matter. This interpretation is supported by the presence of common wood and charcoal debris in the organic residue (Table 3).

Both elemental and microscopic kerogen analysis indicate a peak generation stage of organic diagenesis. By comparison, organic matter in Jurassic shales between 12,140-12,940 feet in the Phillips Norway 2/7-1x well had attained carbonization levels of 83.1 and 85.2% (T.S. 8355CC). The lower carbonization level in the 2/7-2 well indicates a lower thermal history, which is supporting evidence for an extrusive origin of the underlying igneous rocks.

The high ratios of extract to organic carbon (> 0.16) show that non-indigenous oil is present in these samples. Based on the reported oil shows (lithologic log) the extracts probably represent small amounts of migrated oil.

The extracts are a mature condensate-like oil based on the predominance of $C_{17}-C_{22}$ paraffins in the heavy hydrocarbon fraction (Figure 2).

R. L. Ames

R. L. Ames

RLA:ck/uw

The residual material in 2/7-2 is about 0.2 atoms carbon, based on the elemental analysis.

CO Norway _____ AREA Offshore Norway
 BY K. D. Soule DATE 11-3-72
 SERVICE NUMBER 8615CC
 COUNTY _____

AMOCO PRODUCTION COMPANY
 RESEARCH CENTER
 SOURCE ROCK EVALUATION

TYPE	FORMATION	AGE	LITHOLOGY	DEPTH FT	INSOLUBLE RESIDUE %	TOTAL ORGANIC CARBON WT. %	EXTRACTABLE ORGANIC BBL/ACRE FT.	EXTRACTABLE HYDROCARBON BBL/ACRE FT.	EXTRACT. HYDROCARBON EXT. ORG.	EXTRACT. ORGANIC TOTAL ORG.	RATING	Remarks
	IPS NO. 217-2	O.				*						Non-
CUTT A		JUR	SS w/trace asphalt	12800-12850	80.5	0.06	17.7	8.3	0.46	0.51	NON	nous
CUTT A		JUR	AA	12850-12900	78.5	0.06	28.6	17.3	0.60	0.64	NON	"
CUTT A		JUR	AA	12900-12925	80.0	0.05	16.8	7.1	0.42	0.53	NON	"

Core data available at Research Center
 Non-extractable organic carbon
 Probably migrated oil (see Discussion Section)

J. D. Soule

Table 1

OFFICE Amoco Norway AREA Offshore Norway
 AUTHORIZED BY K. D. Soule DATE 11-3-72
 TECHNICAL SERVICE NUMBER 8615CC
 STATE (PROVINCE) _____ COUNTY _____ WELL LOCATION _____

Amoco Production Company
RESEARCH CENTER
ORGANIC DIAGENESIS DATA

SAMPLE			FORMATION	LITHOLOGY	DEPTH	ELEMENTAL ANALYSIS, PERCENT				RATIO H/C	STATE OF DIAGENESIS	HYDROCARBON TYPE BY	
NUMBER	TYPE	QUALITY				CARBON	HYDROGEN	OXYGEN	NITROGEN			% HYDROGEN	PYROLYSIS
ODB C-98-100	Geot.		Mid. Jur. Kimmeridge	Qtz. ss with minor shale	12,800-925'	80.6	5.8	11.3	2.3	0.86	Early gas generation	Gas	
						5.75	5.5	0.70	1.10				
			Montcrief Field, Franklin Co., Texas (average of eight samples)										
			Smackover (Jur.)	dolomite	12,045-412'	86.6	3.8	8.2	1.5	0.52			
			Braley Field, Webster Parish, Louisiana (average of two samples)										
			Smackover (Jur.)	dolomite	11,016-299'	87.8	4.1	7.0	1.0	0.56			
			Petroleum asphaltenes (average of seven samples)										
						83.7	8.1	1.4	1.4	1.16	* also contains	5.0% sulfur	

REMARKS: References:
 T.S. 8151CM, 8-2-71
 T.S. 8131C, 9-7-71
 T.S. 8355CC, 3-21-72
 Witherspoon, P. A. and Winniford, 1967, The Asphaltic Components
 of Petroleum, in Fundamental Aspects of Petroleum Geochemistry,

ANALYST Roque E. LaPlante DATE _____
 TABLE 2

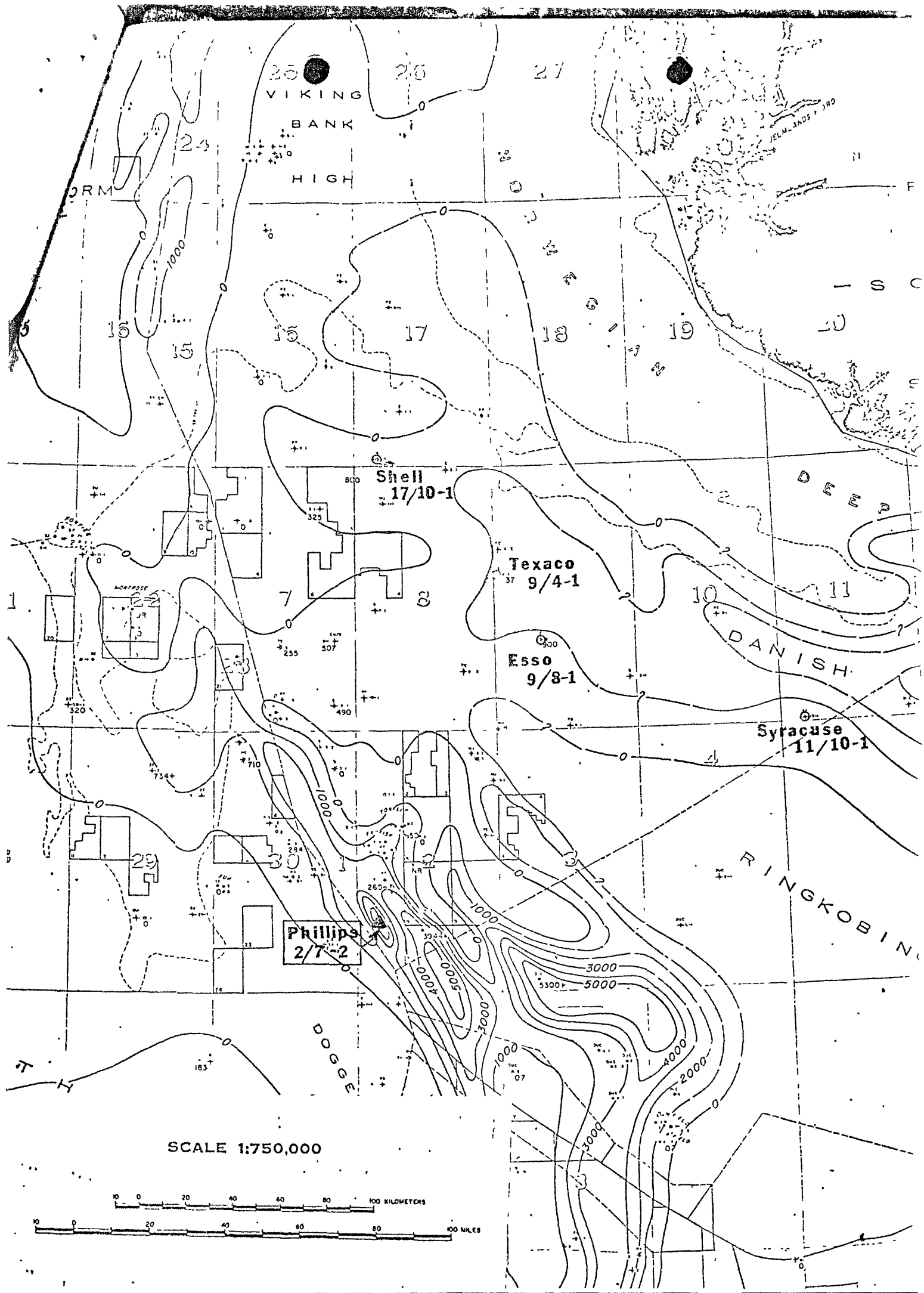
MICROSCOPIC KEROGEN ANALYSIS

<u>SRA No.</u>	<u>Depth (ft)</u>	<u>Color</u>	<u>Description</u>	<u>Remarks</u>
C-93	12,800-12,850 Mid Jurassic ?	Medium Brown	Stage 2 Early generation Gas generating	* Abundant grains of charcoal mineral matter. Fairly common wood fragments. Rare palynomorphs - medium brown. Common abundant clay mineral.
C-93	12,850-12,900 Mid Jurassic ?	Medium Brown	Stage 2 Early generation Gas generating	Common grains of charcoal mineral matter. Common wood fragments. Rare palynomorphs - light brown.
C-100	12,900-12,925 Mid Jurassic ?	Brown	Stage 2 Early generation Gas generating	Common grains of charcoal mineral matter. Fairly common wood fragments. Rare palynomorphs - medium brown. Abundant clay mineral

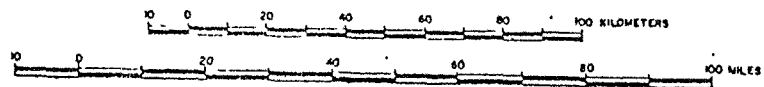
Sample quantity and quality was very poor.
Not enough kerogen for elemental analysis.

T.S. 8615CC

Table 3



SCALE 1:750,000



HEAVY HYDROCARBON DISTRIBUTION

INDUCED PRODUCT CENTER PERCENT

PERCENT CENTER PERCENT

	CPI
* C-98	1.02
△ C-99	1.06
□ C-100	1.02

