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*Sent to Scriber
to Geologists
File in
SOURCE ROCK
CRUDE OIL
CHARACTERIZATION
August 13*

MGR.	<i>VW</i>
EXEC. ASST.	<i>VW</i>
CH. GEOL.	<i>VW</i>
1974	<i>7H CK</i>
GEOGR.	
Er-140-74	

Received by:
Phillips Pet. Co. Norway
20 AUG. 1974

9

INTER-OFFICE CORRESPONDENCE / SUBJECT:
BARTLESVILLE, OKLAHOMA

North Sea, Norwegian Sector
Well 2/7-2X; Source Rock-Crude Oil
Characterization

C. P. Kaiser, Manager
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Attention: C. S. Sanders

Geochemical characterization has been completed on the nineteen sidewall cores taken from the 2746 to 2961 meter (9008-9715 foot) interval in the Tertiary, and a companion gas-liquid set recovered further down-hole in DST-1 which tested the lower Danian carbonate at a depth between 3005-3018 meters (9860-9900 feet) in the 2/7-2X well, Norwegian Sector, North Sea.

Conclusions and interpretations resulting from this study are as follows:

1. Overall the shale section between 2746 and 2961 meters (9008-9715 feet) has been a good source of petroleum, much of which has migrated out of the section. As at Ekofisk the productivity varies throughout the section and reflects both changes in environment and conditions of deposition. Some of the oil generated in the finer grained intervals has accumulated in coarser grained strata along with indigenous oil.
2. Most of the samples accumulated in an open marine environment with only minor amounts of terrigenous material reaching the depositional site. Exceptions are samples near the middle of the sample sequence which represent a brackish environment. This slight influx of terrigenous material could result from proximity to land during a temporary lowering of sea level; however, the anomalous position in an otherwise marine section is probably due to further seaward transportation of continental matter opposite the mouths of swollen rivers.
3. The crude oil is paraffinic with a density of 0.8050 (44.22 API gravity), 0.12 weight per cent sulfur, 0.08 weight per cent nitrogen, and an asphaltic fraction of 1.8 weight per cent. In overall properties the oil is similar to the other low sulfur-paraffinic productions from the Danian in the North Sea.

These conclusions and interpretations are based on data presented in Tables I-III and Figures 1 and 2.

J. Gordon Erdman

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JGE/JBF:gml

Attachments: Tables I-III
Figures 1-2

TABLE 1
SOURCE ROCK EVALUATION DATA
Well 2/7-2X, North Sea, Norway

GEOCHEMISTRY BRANCH CODE	DEPTH		CARBONATE CARBON, WT %	ORGANIC CARBON, WT %	RATIO SOLUBLE / TOTAL CARBON	SOLUBLE ORGANIC MATTER								ODD-EVEN PREDOMINANCE OEP
	METERS	FEET				TOTAL		SATURATES		AROMATICS		ASPHALTICS		
						WT %	δ^{13} PDB	WT %	δ^{13} PDB	WT %	δ^{13} PDB	WT %	δ^{13} PDB	
HHV	2746	9008	0.02	0.59	0.071	0.052	-	55.6	-27.5	28.4	-26.5	16.0	-26.6	1.39
HHU	2764	9069	0.02	0.41	0.114	0.058	-27.3	46.7	-	36.0	-26.5	17.3	-26.3	1.97
HHT	2774	9100	0.21	0.63	0.051	0.040	-26.8	16.7	-	55.5	-27.4	27.8	-26.3	-
HHS	2787	9144	0.24	1.68	0.060	0.127	-26.9	21.8	-28.3	61.1	-26.4	17.1	-26.3	1.37
HHR	2795	9171	0.05	0.89	0.055	0.061	-27.1	47.4	-	31.3	-26.6	21.3	-26.4	1.20
HHQ	2814	9232	0.60	0.41	0.122	0.050	-27.8	19.2	-	28.6	-26.4	52.2	-26.3	-
HHP	2830	9286	0.05	0.90	0.462	0.520	-	66.9	-32.2	27.3	-27.6	5.8	-27.1	1.06
HHO	2842	9324	0.04	1.38	0.189	0.326	-27.1	66.7	-27.6	23.3	-26.9	10.1	-26.6	1.09
HHN	2850	9351	0.02	0.83	0.202	0.210	-29.7	56.7	-30.4	34.2	-30.2	9.2	-29.3	0.98
HHM	2872	9422	1.87	0.71	0.073	0.065	-26.7	33.8	-27.3	59.3	-26.7	6.8	-26.1	1.35
HHL	2881	9452	0.14	2.64	0.411	1.357	-27.0	49.4	-27.7	41.1	-27.2	9.6	-27.0	1.14
HHK	2898	9507	0.13	0.45	0.106	0.059	-30.1	29.6	-	49.2	-27.0	21.2	-26.3	-
HHJ	2907	9537	0.35	1.10	0.106	0.145	-	42.3	-26.6	45.6	-27.3	12.2	-	-
HHI	2914	9560	0.22	1.05	0.144	0.189	-27.0	66.2	-27.0	27.8	-27.1	5.9	-26.4	1.49
HHG	2934	9625	3.51	0.33	0.056	0.023	-26.8	-	-	-	-	-	-	-
HHH	2938	9640	2.20	0.11	0.250	0.034	-27.0	-	-	-	-	-	-	-
HHF	2942	9653	2.14	0.09	0.275	0.032	-26.8	-	-	-	-	-	-	-
HHE	2953	9688	3.68	0.39	0.157	0.076	-26.7	72.6	-	15.9	-26.9	11.5	-26.1	1.23
HHD	2961	9715	3.03	0.17	0.889	0.189	-26.8	76.3	-27.2	17.0	-27.3	6.7	-26.2	1.18

TABLE II

CHARACTERIZATION OF CRUDE OIL
WELL 2/7-2X, NORTH SEA, NORWAY

GEOCHEMISTRY BRANCH CODE	KHL
Depth	
Meters	3005-3018
Feet	9860-9900
DENSITY	0.8050
API Gravity	44.2
<u>HETEROELEMENTS</u>	
Sulfur, wt %	0.12
Nitrogen, wt %	0.08
Vanadium, ppm	0.59
Nickel, ppm	1.03
<u>MAJOR FRACTIONS</u>	
Saturates, wt %	75.4
Aromatics, wt %	22.8
Asphaltics, wt %	1.8
<u>CARBON ISOTOPIC COMPOSITION δC^{13} FDB</u>	
Whole Crude	-26.7
Saturates	-27.2
Aromatics	-26.2
Asphaltics	-26.2
AVERAGE ODD-EVEN PREDOMINANCE	1.03

COMPONENT	WELL #1 3005-1018 m. (2860-2900 ft.)	WT PERCENT OF SAMPLE		
		0.0	0.5	1.0
HELIUM	0.000			
HYDROGEN SULFIDE	0.000			
OXYGEN + ARSEN	0.000			
NITROGEN	0.230			
CARBON DIOXIDE	1.392			
METHANE	5.128			
ETHANE	3.999			
PROPANE	5.386			
ISOBUTANE	1.292			
N-BUTANE	4.310			
ISOPENTANE	1.583			
N-PENTANE	2.216			
NEOPENTANE	0.068			
CYCLOPENTANE	0.308			
1,3-DIMETHYLPENTANE	0.315			
2-METHYLPENTANE	0.583			
3-METHYLPENTANE	0.560			
N-HEXANE	1.070			
METHYLCYCLOPENTANE + 2,3-DIMETHYLPENTANE	0.835			
1,4-DIMETHYLPENTANE	0.282			
BENZENE + 1,2,3-TRIMETHYLPENTANE	0.283			
CYCLOHEXANE + 2,3-DIMETHYLPENTANE	0.809			
2-METHYLHEXANE	0.393			
2,3-DIMETHYLPENTANE + 1,1-DIMETHYLCYCLOPENTANE	0.312			
3-METHYLHEXANE	0.854			
1-CIS-2-DIMETHYLCYCLOPENTANE	0.281			
1-TRANS-2-DIMETHYLPENTANE + 2-ETHYLPENTANE	0.171			
1-TRANS-2-DIMETHYLCYCLOPENTANE	0.306			
N-HEPTANE	2.081			
1-CIS-2-DIMETHYLCYCLOPENTANE	0.095			
HEPTANE + 2,3-DIMETHYL + 1,2,3-TRIMETHYL	1.848			
2,3-DIMETHYLHEXANE	0.127			
2,4-DIMETHYLHEXANE + ETHYLCYCLOPENTANE	0.213			
2,2,3-TRIMETHYLHEXANE	0.080			
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.084			
1,3-DIMETHYLHEXANE	0.036			
TOLUENE	0.592			
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.001			
2,2,4-TRIMETHYLHEXANE	0.257			
1,2-DIMETHYL + 2,2,3-TRIMETHYL + 3-METHYLHEPTANE	0.121			
2-METHYLHEPTANE + 4-METHYLHEPTANE	0.682			
2,3-DIMETHYL + 1-CIS-2-TRANS-4-TRIMETHYL	0.279			
3-ETHYLHEXANE	0.077			
3-METHYLHEPTANE + 3-METHYL-2-ETHYLHEPTANE	0.567			
2,2,3-TRIMETHYL + 1,1,3-TRIMETHYL	0.023			
1-CIS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.022			
1-TRANS-4 + 1-CIS-2 + 1,1-DIMETHYLHEXANE	0.877			
1-METHYL-2-ETHYLHEPTANE + 2,2,4-TRIMETHYLHEXANE	0.068			
1-METHYL-TRANS-2 + 1-METHYL-2-ETHYLHEPTANE	0.110			
CYCLOHEPTANE	0.022			
N-OCTANE + 1-TRANS-2-DIMETHYLCYCLOHEXANE	2.654			
1-CIS-2-DIMETHYLCYCLOHEXANE	0.219			
1-TRANS-2-DIMETHYLCYCLOHEXANE	0.158			
2,2,4-TRIMETHYLHEXANE + 1-ETHYLCYCLOPENTANE	0.011			
2,2,3-TRIMETHYLHEXANE + 2,3-DIMETHYLHEPTANE	0.028			
1-METHYL-2-CIS-3-ETHYLCYCLOPENTANE	0.071			
2,4-DIMETHYLHEPTANE + 2,2,3-TRIMETHYLHEXANE	0.262			
2,4-DIMETHYLHEPTANE + 1-CIS-2-METHYLHEXANE	0.022			
METHYLCYCLOHEPTANE + 2,3- + 2,4-DIMETHYLHEPTANE	0.198			
ETHYLCYCLOHEXANE	0.452			
ETHYLBENZENE	0.137			
1,3-DIMETHYLHEPTANE + 1,1,3-TRIMETHYLHEXANE	0.220			
2,2,3-TRIMETHYLHEXANE	0.066			
2-METHYL-3-ETHYLHEXANE	0.018			
P-TOLUENE	0.067			
M-TOLUENE + 2,2,3-TRIMETHYLHEXANE	0.286			
2,3- + 1,4-DIMETHYLHEPTANE	0.135			
4-METHYLOCTANE	0.287			
3-METHYLOCTANE	0.273			
3-ETHYLHEPTANE	0.066			
3-METHYLOCTANE	0.235			
NONANE (w/ C-10 ALKANES)	0.251			
2,2,4-TRIMETHYLHEPTANE	0.060			
2,2,3-TRIMETHYLHEPTANE	0.036			
2,2,4-TRIMETHYLHEPTANE	0.003			
NONANE	0.095			
2,2,3-TRIMETHYLHEPTANE	0.000			
2,2,4-TRIMETHYLHEPTANE	0.021			
C-9 NAPHTHENE	0.255			
10-NAPHTHENE	0.000			
C-9 NAPHTHENE + C-10 ALKANES	1.612			
10-NAPHTHENE	0.000			
1-METHYL-3-ETHYLBENZENE	0.150			
1-METHYL-2-ETHYLBENZENE	0.154			
1-METHYL-2-ETHYLBENZENE	0.267			
1,2,3-TRIMETHYLBENZENE	0.237			
1,2,4-TRIMETHYLBENZENE	0.613			
1,2,3-TRIMETHYLBENZENE	0.027			
N-DECANE	1.665			
UNSATURATED AND HEAVIER	66.172			

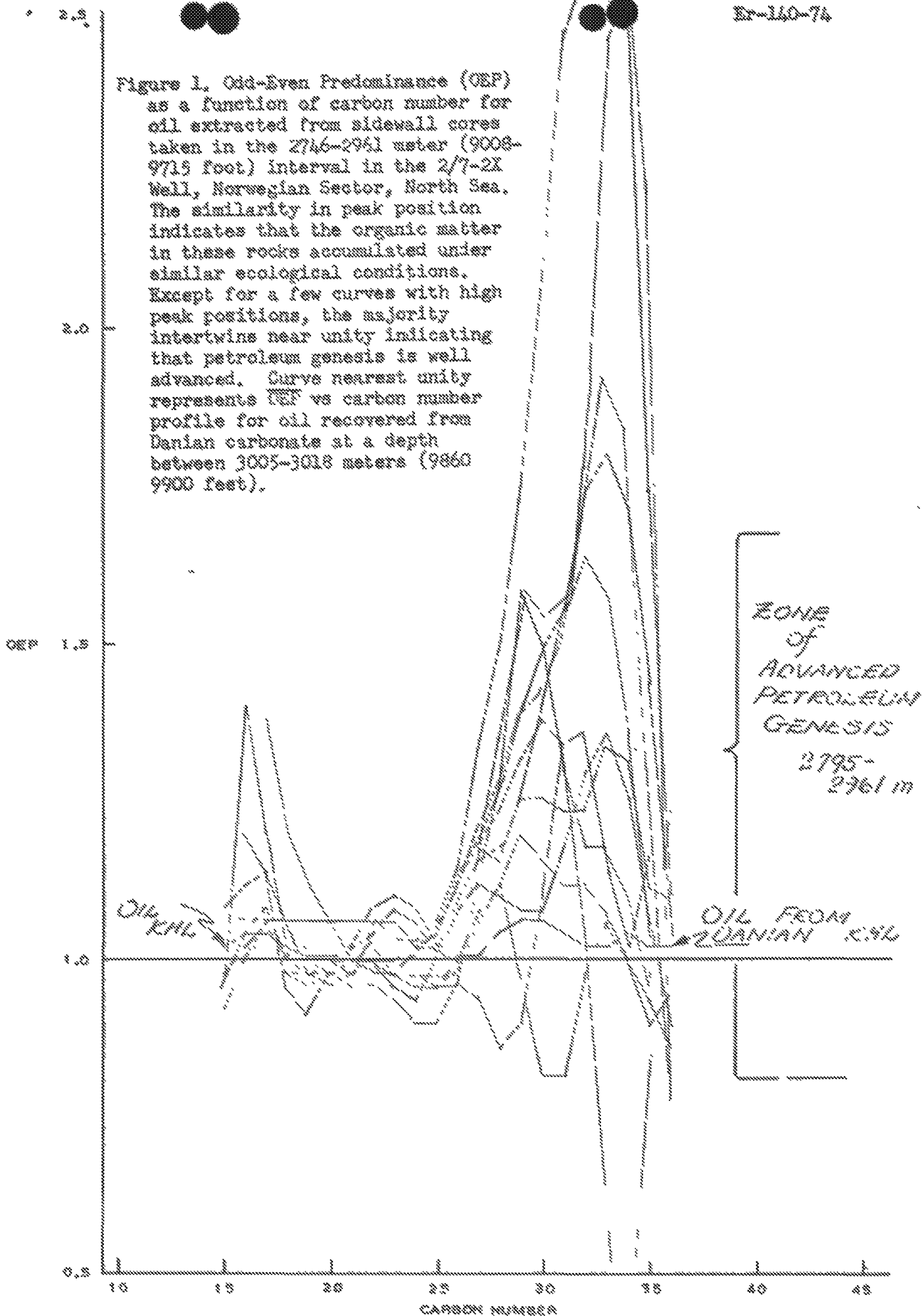
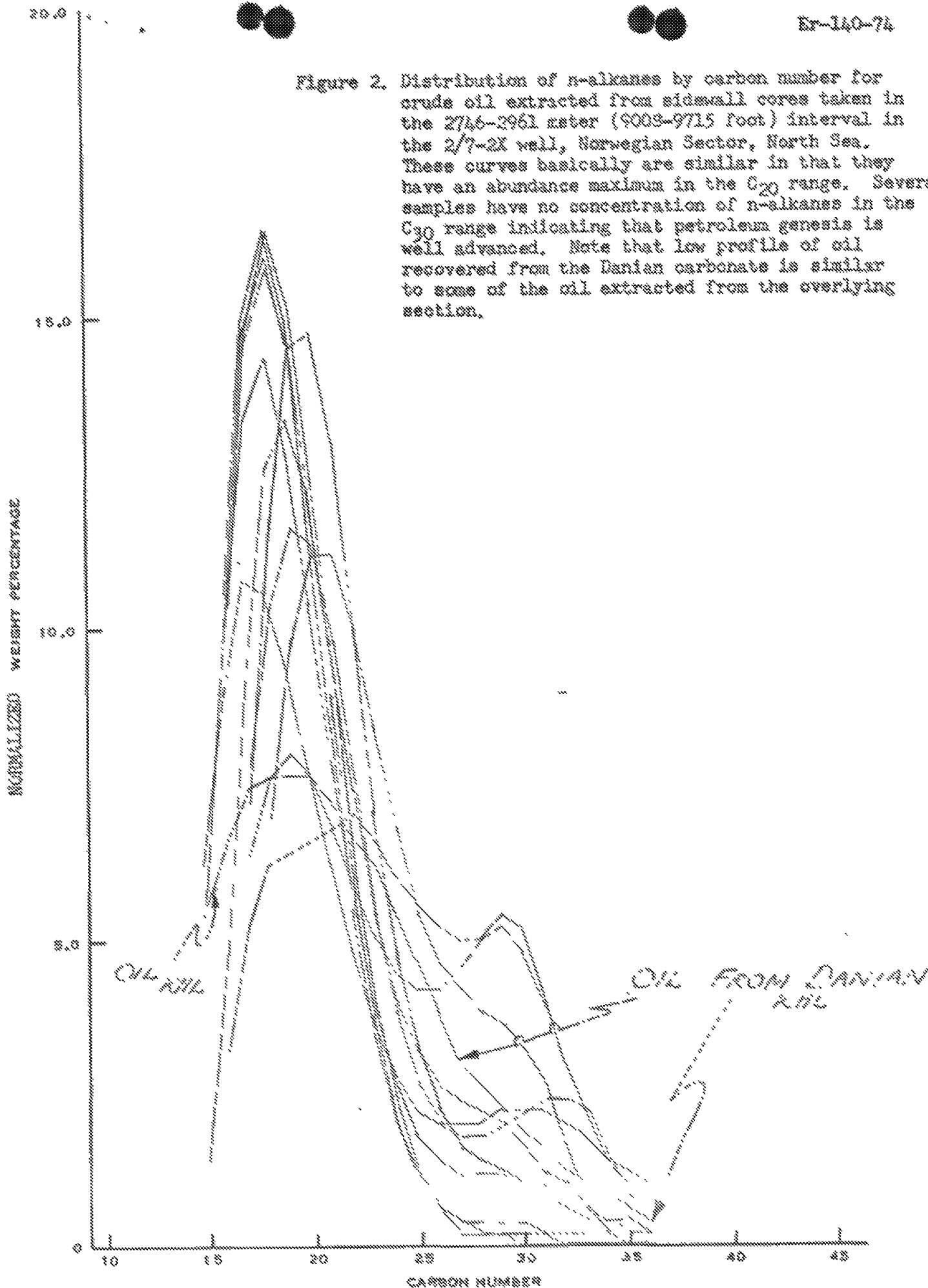


Figure 2. Distribution of n-alkanes by carbon number for crude oil extracted from sidewall cores taken in the 2746-2961 meter (9003-9715 foot) interval in the 2/7-2X well, Norwegian Sector, North Sea. These curves basically are similar in that they have an abundance maximum in the C_{20} range. Several samples have no concentration of n-alkanes in the C_{30} range indicating that petroleum genesis is well advanced. Note that low profile of oil recovered from the Danian carbonate is similar to some of the oil extracted from the overlying section.



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Norway/Wells/ 2/7-2X Eel
CDW
220



INTER-OFFICE CORRESPONDENCE / SUBJECT:
BARTLESVILLE, OKLAHOMA

North Sea, Norwegian Sector, 2/7-2X(Eel) Well
Characterization of Fluids From DST #1
Er-370-72

December 14, 1972

O. J. Koop (2)
International Department

As part of our continuing geochemical characterization of petroleum samples from the North Sea Tertiary Basin in support of current and future exploration, we have compositionally characterized the companion gas-liquid sample from DST 1 which tested the 9860-9900 foot interval in the 2/7-2X well. Additional geochemical data on this sample will be provided later.

This, as well as the other samples we are characterizing from the basin, will permit us to detect and map variations in petroleum composition which may exist in the Danian. This information is expected to be useful in establishing migration patterns within the basin.

Upon conclusion of the characterization of this sample, a geochemical interpretation will be prepared integrating these data with other relevant data from the Tertiary Basin.

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JGE/DAM:gml

Attachment: Table I
Figure 1

TABLE I

COMPONENT COMPOSITION OF GAS, LIQUID AND COMBINED STREAM
 FROM THE EEL 2/7-2X WELL, DST 1, 9860-9900 FEET

CODE LETTERS OF LIQUID SAMPLE = AKHL L
 CODE LETTERS OF GAS SAMPLE = AKHK G

TIME - 16:38:14

DATE - 11/13/1972

COMPONENT	GAS SAMPLE		LIQUID SAMPLE		COMBINED STREAM	
	WT PCT.	MDL PCT	WT PCT.	MDL PCT	WT PCT.	MDL PCT
HELIUM	0.000	0.000	0.000	0.000	0.000	0.000
HYDROGEN SULFIDE	0.000	0.000	0.000	0.000	0.000	0.000
NOXYGEN + ARGON	0.000	0.000	0.000	0.000	0.000	0.000
NITROGEN	1.114	1.079	0.037	0.194	0.230	0.635
CARBON DIOXIDE	8.409	5.188	0.126	0.413	1.592	2.789
ETHANE	33.439	56.606	0.283	2.536	6.124	29.437
PROPANE	19.344	17.471	0.651	3.111	3.999	10.255
ISOBUTANE	18.516	11.403	2.073	6.756	5.186	9.068
N-BUTANE	4.601	2.149	1.053	2.603	1.792	2.377
ISOPENTANE	6.616	4.025	2.884	7.129	4.210	5.585
N-PENTANE	1.773	0.667	1.338	2.664	1.563	1.671
ISOHXANE	1.876	0.706	1.934	3.852	2.140	2.287
CYCLOPENTANE	0.029	0.009	0.044	0.074	0.046	0.041
2,3-DIMETHYLBUTANE	0.058	0.022	0.105	0.215	0.108	0.119
2-METHYLPENTANE	0.048	0.015	0.114	0.190	0.115	0.103
3-METHYLPENTANE	0.385	0.121	0.958	1.598	0.965	0.863
2,2-DIMETHYLPENTANE	0.193	0.060	0.562	0.937	0.560	0.501
2,2,3-TRIMETHYLBUTANE	0.547	0.172	2.002	3.337	1.970	1.763
ETHYLCYCLOPENTANE + 2,2-DIMETHYLPENTANE	0.142	0.045	0.693	1.114	0.636	0.583
2,4-DIMETHYLPENTANE	0.023	0.006	0.126	0.180	0.122	0.094
2,2,3-TRIMETHYLBUTANE	0.058	0.020	0.291	0.535	0.283	0.270
CYCLOHEXANE + 3,3-DIMETHYLPENTANE	0.133	0.043	0.903	1.542	0.869	0.869
2-METHYLHEXANE	0.071	0.019	0.620	0.889	0.593	0.456
2,3-DIMETHYLPENTANE + 1,1-DIMETHYLCYCLOPENT.	0.037	0.010	0.326	0.468	0.312	0.240
2-METHYLHEXANE	0.069	0.018	0.676	0.970	0.645	0.496
CIS-3-DIMETHYLCYCLOPENTANE	0.019	0.005	0.190	0.278	0.181	0.142
TRANS-3-DIMETHYLCYCLOPENTANE + 3-ETHYLPENTANE	0.018	0.004	0.180	0.263	0.171	0.134
TRANS-2-DIMETHYLCYCLOPENTANE	0.029	0.008	0.322	0.471	0.306	0.241
HEPTANE	0.155	0.042	2.151	3.085	2.041	1.571
CIS-2-DIMETHYLCYCLOPENTANE	0.000	0.000	0.102	0.149	0.095	0.075
CYCLOHEX + 2,2-DIMETHYLCYCLOPENT + 1,1,3-TRIMETHYLPENT	0.120	0.033	1.951	2.855	1.848	1.451
2,5-DIMETHYLHEXANE	0.005	0.001	0.135	0.170	0.127	0.086
2,4-DIMETHYLHEXANE + ETHYLCYCLOPENTANE	0.008	0.002	0.225	0.283	0.212	0.143
2,3-TRIMETHYLPENTANE	0.000	0.000	0.000	0.000	0.000	0.000
TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.000	0.000	0.089	0.114	0.084	0.057

TABLE I (continued - 2)

1,3-DIMETHYLHEXANE	0.000	0.000	0.027	0.035	0.026	0.017
BENZENE	0.025	0.007	0.627	0.979	0.592	0.495
-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.006	0.001	0.000	0.000	0.001	0.000
1,3,4-TRIMETHYLPENTANE	0.000	0.000	0.061	0.077	0.057	0.038
1,3-DIMEHEX+2,3,3-TRIMEPENT+2-ME3-ETPENT	0.000	0.000	0.130	0.163	0.121	0.082
-METHYLHEPTANE + 4-METHYLHEPTANE	0.018	0.004	0.725	0.912	0.682	0.460
1,4-DIMEHEX + 1-CIS-2-TRAN-4-TRIMECYPENT	0.006	0.001	0.297	0.374	0.279	0.188
-ETHYLHEXANE	0.000	0.000	0.039	0.049	0.037	0.025
-METHYLHEPTANE + 3-ME-3-ETHYLPENTANE	0.012	0.003	0.603	0.759	0.567	0.382
1,2,5-TRIMEHEX+1,1,3-TR-4-TETRAMECYPENT.	0.000	0.000	0.014	0.015	0.013	0.008
-CIS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.000	0.000	0.024	0.031	0.022	0.015
-TRANS-4 + 1-CIS-3 + 1,1-DIMECYHEXANE	0.018	0.004	0.720	0.922	0.677	0.465
-ME-3-ETHCYPENT + 2,2,4-TRIMETHYLHEXANE	0.000	0.000	0.073	0.093	0.068	0.047
-ME-TRANS-2 + 1-ME-CIS-3-ETHYLCYPENTANE	0.000	0.000	0.117	0.151	0.110	0.075
CYCLOHEPTANE	0.000	0.000	0.024	0.035	0.022	0.018
-OCTANE + 1-TRANS-2-DIMETHYLCYCLOHEXANE	0.028	0.006	1.764	2.218	1.656	1.118
-CIS-4-DIMETHYLCYCLOHEXANE	0.005	0.001	0.340	0.435	0.319	0.219
-TRANS-3-DIMETHYLCYCLOHEXANE	0.000	0.000	0.168	0.216	0.158	0.108
1,2,4-TRIMEHEXANE + ISOPROPYLCYCLOPENT.	0.000	0.000	0.015	0.016	0.014	0.008
1,3,5-TRIMEHEXANE + 2,2-DIMETHYLHEPTANE	0.000	0.000	0.030	0.033	0.028	0.016
-METHYL-CIS-2-ETHYLCYCLOPENTANE	0.000	0.000	0.076	0.098	0.071	0.049
1,4-DIMEHEPTANE + 2,2,3-TRIMETHYLHEXANE	0.000	0.000	0.259	0.290	0.242	0.146
1,6-DIMEHEPTANE + 1-CIS-2-DIMECYHEXANE	0.000	0.000	0.043	0.049	0.041	0.024
-PROPYLCYPENT + 2,5- + 3,5-DIMEHEPTANE	0.000	0.000	0.212	0.271	0.198	0.136
THYLCYCLOHEXANE	0.000	0.000	0.483	0.619	0.452	0.311
THYLBENZENE	0.006	0.001	0.145	0.197	0.137	0.100
1,3-DIMETHYLHEPTANE + 1,1,3-TRIMECYHEXANE	0.000	0.000	0.235	0.263	0.220	0.132
1,3,3-TRIMETHYLHEXANE	0.000	0.000	0.049	0.055	0.046	0.027
-METHYL-3-ETHYLHEXANE	0.000	0.000	0.019	0.021	0.018	0.010
-XYLENE	0.000	0.000	0.072	0.098	0.067	0.049
-XYLENE + 2,3,4-TRIMETHYLHEXANE	0.000	0.000	0.840	1.136	0.786	0.571
1,3- + 3,4-DIMETHYLHEPTANE	0.000	0.000	0.145	0.162	0.135	0.081
-METHYLOCTANE	0.007	0.001	0.316	0.354	0.297	0.179
-METHYLOCTANE	0.000	0.000	0.399	0.446	0.373	0.244
-ETHYLHEPTANE	0.000	0.000	0.071	0.079	0.066	0.040
-METHYLOCTANE	0.000	0.000	0.358	0.401	0.335	0.201
-XYLENE (+ A C-10 ALKANE)	0.000	0.000	0.311	0.420	0.291	0.211
1,2,4-TRIMETHYLHEPTANE	0.000	0.000	0.000	0.000	0.000	0.000
1,2,5-TRIMETHYLHEPTANE	0.000	0.000	0.039	0.039	0.036	0.019
1,2,6-TRIMETHYLHEPTANE	0.000	0.000	0.000	0.000	0.000	0.000
** UNKNOWN **	0.000	0.000	0.101	0.102	0.095	0.051
1,5,5-TRIMETHYLHEPTANE	0.000	0.000	0.000	0.000	0.000	0.000
1,4,4-TRIMETHYLHEPTANE	0.000	0.000	0.079	0.079	0.074	0.040

TABLE I (concluded)

*** A C-9 NAPHTHENE ***	0.000	0.000	0.272	0.310	0.255	0.155
ISOPROPYLBENZENE	0.000	0.000	0.000	0.000	0.000	0.000
1-NONANE	0.007	0.001	1.742	1.951	1.632	0.981
C-9 NAPHTHENES + C-10 ALKANES	0.009	0.002	2.607	2.967	2.443	1.492
1-PROPENYL-BENZENE	0.000	0.000	0.000	0.000	0.000	0.000
1-METHYL-3-ETHYLBENZENE	0.000	0.000	0.193	0.230	0.180	0.115
1-METHYL-4-ETHYLBENZENE	0.000	0.000	0.164	0.197	0.154	0.099
1-METHYL-2-ETHYLBENZENE	0.000	0.000	0.285	0.341	0.267	0.171
1,3,5-TRIMETHYLBENZENE	0.000	0.000	0.424	0.506	0.397	0.254
1,2,4-TRIMETHYLBENZENE	0.000	0.000	0.441	0.527	0.413	0.275
1,2,3-TRIMETHYLBENZENE	0.000	0.000	0.029	0.035	0.027	0.017
1-DECANE	0.000	0.000	1.565	1.580	1.465	0.794
UNDECANES AND HEAVIER	0.000	0.000	59.087	29.647	44.172	14.897

TOTAL PERCENT C6'S = 5.051

TOTAL PERCENT C7+ = 30.841

Figure 1
 COMPONENT COMPOSITION OF COMBINED STREAM
 THRU N-DECANE, BP = 345.4F (= 174.1C)
 2/7-2X (EEL) WELL, NORTH SEA, NORWEGIAN SECTOR

Er- 370-72

