REPORT TITLE

SOURCE ROCK ANALYSES OF WELL 34/10-7 PART II.

CLIENT

Statoil

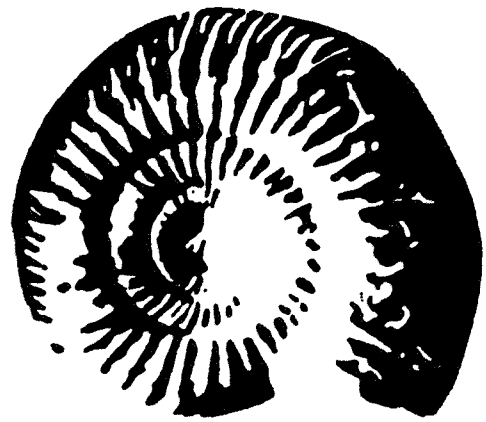
CLIENT's REF.:

Bjørn Rasmussen

REPORT NO.:

1 -270/3/80

IKU



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AUTHOR (S):

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DEPARTMENT:

Organic Geochemistry

RESPONSIBLE SCIENTIST:

Malvin Bjorøy

SUMMARY:

The sequence from 1600 - 1690 m was analysed and the limestone 1660 - 1690 m was found to have a fair/good potential as a source rock for oil and gas.

KEY WORDS

Source rock

Experimental: See report /-270/1/80.

RESULTS AND DISCUSSION

With background in the results from the analyses of the sequence 1690-100 m, (Report 0-270/1/80) it was decided to look at the samples from 1600 - 1690 m, with special interest in the limestone.

Total Organic Carbon.

Most of the samples contained claystone and limestone. The claystone has rather low TOC values, 0.5 - 0.8%. The limestone down to 1645 m is also found to have low TOC values, while the limestone from 1645 - 1690 m has high TOC values, 0.6 - 2.2%. These three samples were analysed further.

Extraction and Chromatographic Separation.

Two samples, 1660-75 m and 1675-90 m were analysed and both found to have rich abundance of extractable hydrocarbons. The hydrocarbon/organic carbon ratio (HC/TOC) is, however, high for both samples which indicate that the samples are contaminated by migrated hydrocarbons. The gas chromatograms of the saturated hydrocarbon fractions both show a large unresolved envelope typical for biodegraded hydrocarbons. Pristane, phytane and n-alkanes can not be recognized from the gas chromatograms.

Visual Kerogen Analyses.

Three samples were investigated and yielded acid resistant residues poor in organic material, and relatively rich in minerals, both single crystals and amorphous compounds.

All of the organic residues are mainly composed of small to medium sized particles. The terrestrial remains which dominate the samples include dark woody fragments and indeterminate herbaceous matter.

The tendency of organic material as well as minerals to appear in aggregates makes disttinction somewhat arbitrary.

Appearently there is a development downhole towards relatively smaller organic residues and coarser material.

The colour may be controlled by the lithology, which is rich in limestone. The colour index may therefore be too high as a maturation parameter.

Rock-Eval Pyrolyses.

The three samples from 1645-1690 m were analysed. The uppermost sample shows a very high oxygen index which could be due to decomposition of carbonates. The S_1 peaks increases with increasing depth and is very high for the two lowermost samples, indicating free hydrocarbons in these samples. The T_{max} for all three samples are low indicating immature samples.

The hydrogen index is low for the uppermost sample while it is higher (approximately 250) for the two lowermost samples. This is still low for kerogen type II for immature samples, but high for kerogen type III. It is therefore believed that both these samples contains a mixture of kerogen type II and III.

CONCLUSION.

Based on the available data the limestone in the interval 1660-1690 m has a fair to good potential as a source rock for oil and gas. The limestone contains migrated biodegraded hydrocarbons. These are different from the hydrocarbons found in the extracts further down in the well (Report 0-270/1/80) and the oil found in the well (Report 0-270/2/80.

prove nr

TABLE I

IKU No.	Depth	TOC	Lithology
K 4157	1600-15	0,56 0,25	85% Claystone, grey, light grey, green. 15% Limestone, grey to dark grey, hard, slightly brownish, some light grey/white. Sm.am. Sand, angular-subangular, medium to coarse, obs. subrounded; ? clear amorphous silika/chert; secondary Calcite, partly fibrous, clear; ? dark grey volcanic glass.
K 4158	1615-30	0,56	100% Claystone, grey (some light), greenish to green. Sm.am. Limestone, as above.
K 4159	1630-45	0,83 0,39	15% Claystone, as above. 50% Limestone, to silty Marl, light grey (brownish), grey, white. 15% Sand, fine to coarse, clear, angular/sub-angular; Siltstone. 20% Mica (additive) and cement. Sm.am. Pyrite; ? clear Chert.
K 4160	1645-60	0,62	65% Limestone, white (brittle), grey (hard), light brown. 20% Sand, as above. 10% Additives (Mica, nut shells). 5% Claystone.
K 4161	1660-75	1,07	90% Limestone, white to light grey, some grey. 10% Mica (additive). Sm.am. Claystone; Sand.
K 4162	1675-90	2,21	75% Additives (Nut shells, Mica, Coal). 20% Limestone, as above. 5% Claystone, grey, greenish.

IKU

T A B L E : II

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKU-No	DEPTH (m)	Rock Extr. (g)	EOM (mg)	Sat. (mg)	Aro. (mg)	HC (mg)	Non HC (mg)	TOC (%)
K-4161	1660	49.1	473.0	157.0	90.7	247.7	225.3	1.1
K-4162	1675	48.3	280.2	90.2	53.2	143.4	136.8	2.2

T A B L E : III

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
K-4161	1660	9633	3198	1847	5045	4589
K-4162	1675	5801	1867	1101	2969	2832

T A B L E : IV

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
K-4161	1660	900.3	298.8	172.6	471.5	428.8
K-4162	1675	262.5	84.5	49.8	134.3	128.2

T A B L E : V

COMPOSITION IN % OF THE MATERIAL EXTRACTED FROM THE ROCK

IKU-No	DEPTH (m)	Sat / EOM	Aro / EOM	HC / EOM	Sat / Aro	Non HC / EOM	HC / Non HC
K-4161	1660	33.2	19.2	52.4	173.1	47.6	109.9
K-4162	1675	32.2	19.0	51.2	169.5	48.8	104.8

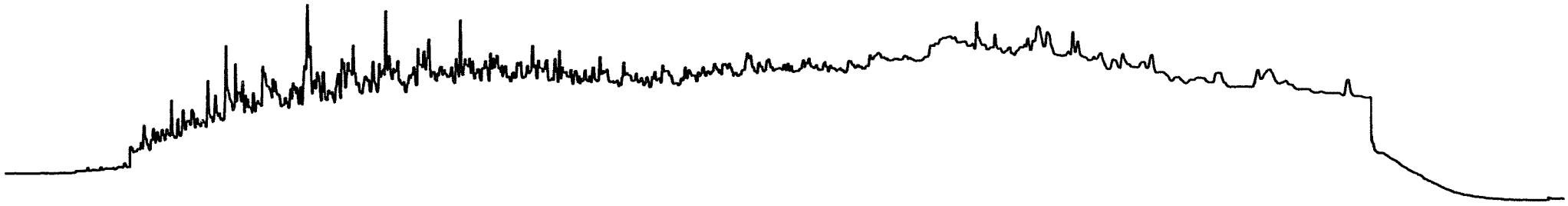
Table VI

IKU 34/10-7 Code number		VISUAL KEROGEN ANALYSIS				
		Composition of residue	Particle size	Preservation -palynomorphs	Thermal maturation index	Remarks (Trondheim 1980)
K 4160	1645-60	Am, W (coaly), He, W	FM	poor	-2/2	The samples contain woody, reworked/or oxidized particles.
K 4161	1660-75	Am, W (coaly), He, W	FM	poor,fair,good	-2/2	
K 4162	1675-90	Am, W (coaly), He	F, M	fair	-2/2	The maturation index may be controlled by the lithology and too high as a maturation parameter.
		Am amorphous W woody He herbaceous	F fine M medium			

Table VII

Sample	Depth	S_1	S_2	S_3	C_{org}	Hydrogen Index	Oxygen Index	Oil of gas content ($S_1 + S_2$)	Production Index $\frac{S_1}{S_1 + S_2}$	T_{max} °C
K 4160	1645-60	1,42	0,64	3,53	0,62	103,23	569,35	2,06	0,69	411°
K 4161	1660-75	5,30	2,76	1,39	1,07	257,94	129,91	8,06	0,66	416°
K 4162	1675-90	15,63	5,57	1,98	2,21	252,04	89,59	21,20	0,74	423°

K-4161 1660-75



K-4162 1675-90