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UND-ARKIVET

L.NR. 20088370049

KODE Well 31/2-6 nr 20

Returneres etter bruk

February 1982

RKER 82.010

ANALYSIS OF SOURCE ROCK PROPERTIES
OF A SUITE OF CUTTING SAMPLES
FROM WELL 31/2-6 , NORWAY

by

Geert Konert

code : 774.103

Investigation

9.12.342

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KONINKLIJKE/SHELL EXPLORATIE EN PRODUKTIE LABORATORIUM

RIJSWIJK, THE NETHERLANDS

(Shell Research B.V.)

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I INTRODUCTION

A source rock evaluation has been carried out on cutting samples from well 31/2-6 , offshore Norway.

The samples derive from two intervals , namely 1449 - 1503 m . and 1635 - 1749 m .

Source rock evaluation commonly comprises determination of:

1. the presence (or absence) of hydrocarbons source material in the rock samples;
2. the quality of the organic matter as well as the distribution of its specific constituents;
3. the degree of organic metamorphism (= level of maturity).

A source rock is identified by measuring the amount of temperature reactive ("live") organic matter present, i.e. the amount of organic matter that yields hydrocarbons upon pyrolysis. The method excludes any ("dead") organic matter such as inertinites.

In addition, the total organic carbon content can be determined which gives the sum of "live" and "dead" organic carbon. Rocks containing less than 0.5 % organic carbon are not considered to have a potential for commercial oil accumulations.

The source rock indications (SRI), which are a measure of the amount of pyrolysable organic matter, are determined on the original samples and in certain cases also after extraction with organic solvents. A systematically lower value after extraction is due to the presence of extractable hydrocarbons. These may consist of trapped oil, oil generated in situ by a source rock, or e.g. gasoil used in the drilling fluid.

In general, samples with source rock indications of 30 or less do not represent (immature or mature) source rocks. Values between 30 and 100 generally indicate marginal source rocks, while values above 100 commonly indicate good source rocks.

Intervals or samples with high source rock indications are investigated under a microscope to ensure that the high values indicate genuine source rock properties and are not due to contaminants of an organic nature such as lost circulation material.

The quality of a source rock for oil/gas generation depends on the type of organic matter present. Five categories of organic matter can be distinguished, viz.: humic, mainly humic, mixed, mainly kerogenous, kerogenous. This classification

is based on the hydrogen content of the organic matter.

Source rocks with organic matter of kerogenous, mainly kerogenous and/or mixed type generate predominantly oil. Organic matter of humic type generates gas only. Strata with organic matter of mainly humic quality generate either gas, or gas and oil.

In addition to the type and the concentration of the organic matter, the source rock quality is also characterised by the distribution of the typical organic constituents, or macerals¹, in the sediments. The maceral distribution can be used to further qualify the source rock, especially when mainly humic quality is found. For this purpose a microscopic investigation on polished rock fragments is carried out.

The maturity of source rocks is expressed in terms of degree of organic metamorphism. With increasing degree of organic metamorphism the organic matter is gradually carbonised while generating hydrocarbons. With increased carbonification the light reflectance of vitrinite, one of the coal macerals, increases. The degree of organic metamorphism can be assessed by measuring this reflectance.

- 1) maceral: an organic constituent which can be recognised with the microscope (with objectives 25x to 50 x).

II RESULTS AND DISCUSSION

The results of the analyses have been listed in Table I (source rock indications , total organic carbon content and type of organic matter) , Table II (maceral analysis) and enclosure 1 (geochemical log).

The samples under consideration have been taken from the following two intervals , namely 1449 -1503 m and 1635 - 1749 m.

a) Interval 1449 - 1503 m

Within this interval the three lowermost samples (1485 , 1494 and 1503 m) show marginal SRI-values (30 , 45 and 80 units).

In two samples (1485 ,1503 m) the total organic carbon content has been measured and was found to be 1.2 and 2.0 wt% respectively.

The type of organic matter , determined in sample 1503, revealed mainly kerogenous to mixed matter.

The results of the maceral analysis carried out in this sample , is in agreement with this observation. But since the habitat of the SOM is not favourable for oil expulsion ; this sample may be considered as a marginal source rock for gas.

b) Interval 1635 - 1750 m.

Several samples (1659 , 1668 , 1677 and 1695) show marginal SRI-values (80 , 40 , 30 and 35 units).

The total organic carbon content is measured in three samples(1659 , 1668 and 1722 m).They show respectively values as high as 1.1 , 1.1 and 0.9 wt%.

Typing (mainly kerogenous/mixed) and maceral analysis was carried out in one sample , namely 1659 m .

Especially the maceral analysis indicates that this sample should be considered as a marginal source rock for gas at the most.

III CONCLUSIONS

Intervals 1485- 1503 m, 1659- 1677 m and sample from 1695 m may be regarded as marginal source rocks for gas.

TABLE 2

CELL:

31/2-6

DEPTH	TYPE OF SAMPLE	SOURCE	SOURCE	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %
		FOCK INDICATION	FOCK INDICATION		
		BEFORE EXTP.	AFTER EXTP.		
1448	C	10	-		-
1456	C	8	-		-
1467	C	8	-		-
1476	C	8	-		-
1485	C	40	30		1.2 ✓
1494	C	50	45		-
1503	C	85	80	MK/M	2.1
1635	C	40	25		-
1641	C	10	-		-
1650	C	8	-		-
1659	C	65	80	M/MK	1.1
1668	C	38	40		1.1
1677	C	50	30		-
1686	C	25	-		-
1695	C	135	35		-
1704	C	75	25		-
1713	C	80	15		-
1722	C	65	20		.9
1731	C	50	30		-
1740	C	25	-		-
1749	C	40	15		-

TYPE OF SAMPLE C = CUTTINGS, R = CORE, S = SIDEWALL SAMPLE

CONTAMINATION: W = WALNUT FRAGMENTS OR SOME SIMILAR PRODUCT,
 H = CELLOPHANE SHEETS, F = FIBRES, P = PLASTIC OR PAINT AND
 C = CONTAMINATED BUT KIND NOT SPECIFIED

A DASH (-) INDICATES TEST NOT MADE, ASTERISKS INDICATE THE
 ORGANIC CARBON CONTENT IS THE AVERAGE FOR THE SAMPLES CONCERNED

MACERAL DESCRIPTION OF 2 SAMPLES FROM WELL 31/2-6

DEPTH IN M	SAMPLE TYPE
---------------	----------------

1503.0	CTGS
1659.0	CTGS

	ORGANIC										INORG.					
	VITA.		LIPIDINITE				ALGAL				INERT.					
SAPROBIALIC ORG. MATTER																
TELLOCOLLITE																
TELINITE																
DESMOCCOLLINITE																
SPORINITE																
CUTINITE																
RESINITE																
LIPIDOPHARINITE																
BOTRYOCOCOCCUS																
TASMANITES																
OTHER ALGAL																
MICROPLANKTON																
EXUDALINITE																
SCLEROINITE																
FUSINITE																
MACRINITE																
MICRINITE																
UNDEFINED MINERALS																
FRAMBOIDAL PYRITE																
AGGREGATES OF PYRITE																
CRYSTALS OF PYRITE																

/		/	/		/			/	/	-		/	*	/	-	/
-		-	-		-			/		-		-	*	/	-	/

COMMENT LINES

1503.0 M : Initial conversion
SOM.
Rare solid
hydrocarbons.

1659.0 M : Few solid hydrocarbons.

L E G E N D	
*	: ABUNDANT
+	: COMMON
/	: FEW
-	: RARE

TABLE II

INITIAL DISTRIBUTION

5 copies area

GEOCHEMICAL LOG

SCALE 1:5000

WELL

31/2-6

LOCATION

RÉGEO IDENTIFIER

AGE	FORMATION	DEPTH IN M	LITHOLOGY	DOM(VR)	SOURCE ROCK INDICATION OF ORIGINAL SAMPLE						TYPE OF SAMPLE	SOURCE ROCK INDICATION OF SAMPLE AFTER EXTRACTION WITH CHLOROFORM						CONTAMINATION	DEPTH IN M	ORG. CARBON (PCT. WT)	TYPE OF ORGANIC MATTER	
					100	200	300	400	500	600		100	200	300	400	500	600					
		1400														1400						
		1500														1500	1.2 2.1	MAINLY KEROGENOUS TO MIXED				
		1600														1600						
		1700														1700	1:1 0.9	MIXED TO MAINLY KEROGENOUS				
		1800														1800						
					NUMBER OF SAMPLES ANALYSED 21																	
											<p>VALUES SMALLER THAN 30 ARE CONSIDERED NOT TO BE OF SIGNIFICANCE</p> <p>MARGINAL SOURCE ROCKS FOR GAS HAVE BEEN FOUND BETWEEN 1485 - 1503 M</p> <p>MARGINAL SOURCE ROCKS FOR GAS HAVE BEEN FOUND BETWEEN 1659 AND 1695 M</p> <p>NUMBER OF SAMPLES ANALYSED 13</p>											
													<p>LEGEND</p> <p>TYPE OF SAMPLE ○ = CORE ▶ = SIDEWALL SAMPLE</p> <p>CONTAMINATION C = UNSPECIFIED W = WALNUTS E = CELLOPHANE F = FIBRES P = PLASTIC OR PAINT</p>					<p>NONINFLUENCE/WELL EXPLORATION OR PRODUCTIVE LABORATORIUM</p> <p>GEOCHEMICAL LOG OF 31/2-6 NORWAY</p>				
													<p>DATE: PER. LOG</p> <p>REP: 0010-0010 ENCL: 1 DRAW: 1</p>									