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KONINKLIJKE / SHELL EXPLORATIE EN PRODUKTIE LABORATORIUM

RIJSWIJK, THE NETHERLANDS

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SOURCE ROCK ANALYSIS OF CORES FROM
INTERVAL 1575.7 TO 1592.0 M OF THE
KIMMERIDGE CLAY FM. FROM WELL 31/2-10,
NORWAY

by
J.M.J.Terken and L.Hermans
code: 774.10300

in co-operation with

J.E.A.M.Dielwart

R.F.M.Hofland

P.J.van der Vet

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REGISTRERT
LABORATORIUM

Investigation

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RIJSWIJK, THE NETHERLANDS
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Table II Maceral description, comment lines

Enclosure 1 Geochemical log

1.0 INTRODUCTION

A source rock evaluation has been carried out on cores from well 31/2-10, NORWAY. The approximate location is shown in Figure 1.

The samples are taken from interval 1575.7 to 1592.0 m of the Kimmeridge Clay Fm, i.e. Portlandian, Upper Jurassic. Total depth was reached at 1833 m.b.d.f..

The purpose of the investigation was:

1. to detect the presence (or absence) of source rocks in the samples
2. to determine the quality of the organic matter, as well as its distribution.
3. to establish 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%wt 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 macerals(1), 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 increasing 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 50x)

2.0 RESULTS

The results are listed in Table I (source rock indication values, total organic carbon content, type of organic matter) and Table II (maceral description, comment lines). All chemically obtained results are summarised in Enclosure 1 (Geochemical log).

3.0 DISCUSSION

3.1 Interval 1575.7 to 1592.0 m (Kimmeridge Clay Fm.)

All samples of this interval show predominantly fairly good to good source rock indication (SRI) values, together with organic carbon contents in the range of 2 to 6 %wt.

Based on the maceral descriptions (Table 2) a partition can be made into:

- a) a top and bottom part containing "common" sapropelic organic matter (SOM) in a distribution, rather favourable for oil expulsion, and
- b) a middle part (1585.0 to 1589.0 m) with less ("few") SOM (in a distribution, unfavourable for oil expulsion).

In addition to the SOM, which shows initial micrinisation, in all samples liptinites, microplankton and varying amounts of micrinite are present.

The type of organic matter, "mainly kerogenous" and "kerogenous", is in agreement with the maceral descriptions.

Consequently it is concluded that the top and bottom parts (1575.7-1580.7 m and 1590.0-1592 m) of the investigated interval can be regarded as fairly good to good source rock for oil and gas, whereas the middle part can be regarded as fairly good source rock for gas only.

4.0 CONCLUSION

Intervals 1575.7 to 1580.7 m and 1590.0 to 1592.0 m can be regarded as fairly good to good source rocks for oil and gas.

Interval 1585.0 to 1589.0 m can be regarded as a fairly good source rock for gas only.

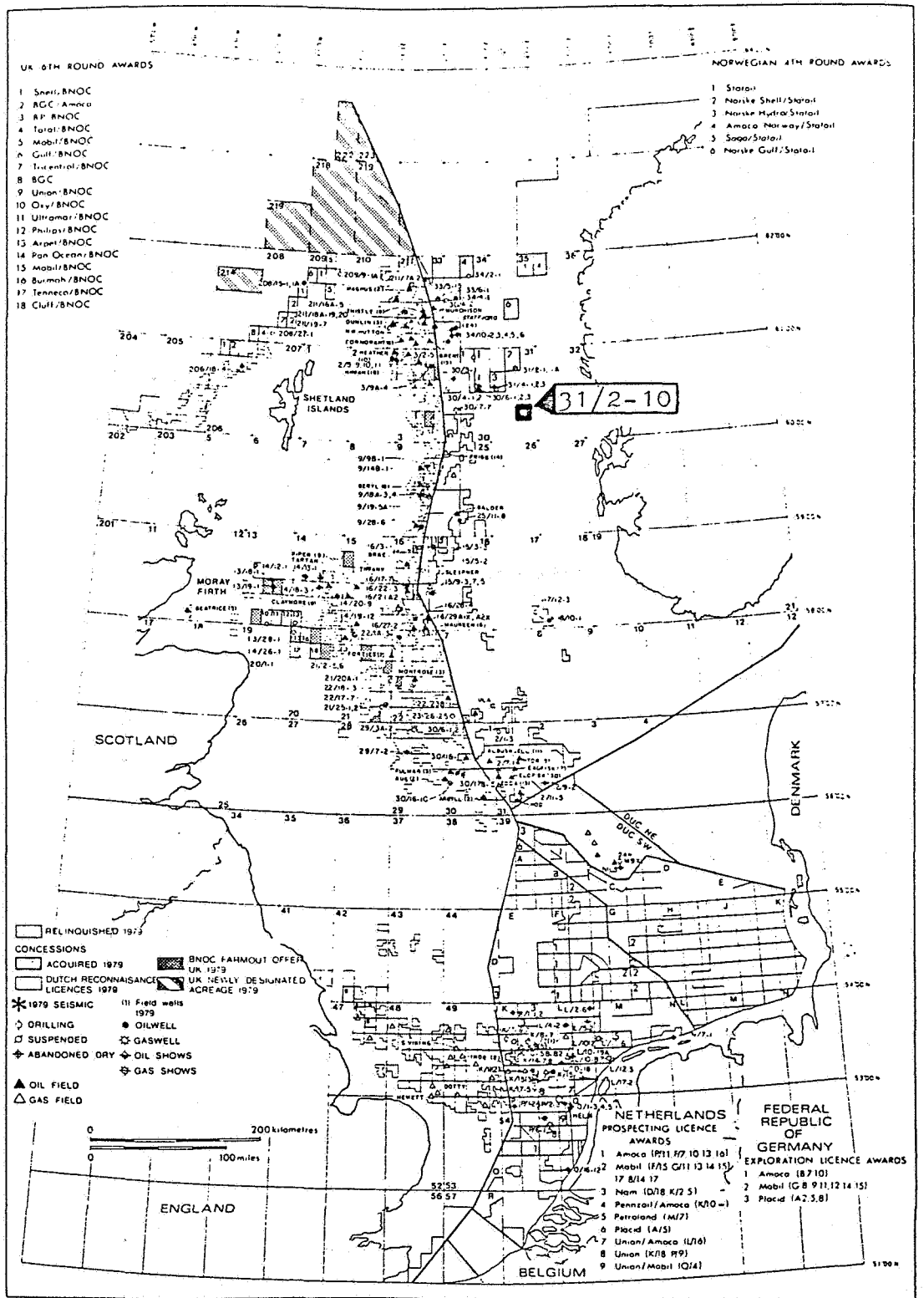


FIGURE 1: LOCATION MAP

GEOCHEMICAL SOURCE ROCK DATA

TABLL 1

WELL: 31/2-10

DEPTH	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.	SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
1575.70	R	285	285	K	2.4
1576.70	R	655	570	K	6.1/60
1577.70	R	470	440	K	5.1
1578.70	R	415	425	K	4.5
1579.80	R	385	340	K	4.4
1580.70	R	470	425	K	5.5
1585	R	145	150	K	2.5
1586	R	205	150	K	2.6
1586.90	R	185	195	K	2.9
1588	R	145	135	MK	2.3
1589	R	115	115	MK/K	2.2
1590	R	155	160	MK	3.0
1590.90	R	225	240	MK	4.0
1592	R	300	260	K	3.7

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

CONTAMINATION : W = WALNUT FRAGMENTS OR SOME SIMILAR PRODUCT, E = CELLOPHANE SHREDS, 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 14 SAMPLES FROM WELL 31/2-10

DEPTH IN M	SAMPLE TYPE
1575.7	CORE
1576.7	CORE
1577.7	CORE
1578.7	CORE
1579.8	CORE
1580.7	CORE
1585.0	CORE
1586.0	CORE
1586.9	CORE
1588.0	CORE
1589.0	CORE
1590.0	CORE
1590.9	CORE
1592.0	CORE

	ORGANIC											INORG.					
	SAPROPELIC ORG. MATTER	TELOCOLLINITE	TELINITE	LIPTINITE				MICROPLANKTON	EXUDATINITE	SCLEROTINITE	FUSINITE	MACRINITE	MICRINITE	UNDEFINED MINERALS	FRAGMENTAL PYRITE	AGGREGATES OF PYRITE	CRYSTALS OF PYRITE
				VITR.	ALGAE												

+		-	/		+	/		+		-		+	*	+	/	-
+		-	/		+	/		+		-		+	*	+	/	-
+		-	/		+	/		+		-		/	*	/	/	-
+		-	-		+	-		+		-		/	*	/	-	-
+		/	/		+	/		+		-		/	*	/	-	-
+		-	/		+	-		+		-		+	*	/	/	-
/		/	-		+	-		+		-		-	*	/	-	-
/		/	-		+	-		/		-		-	*	/	/	-
/		/	-		+	-		/		-		-	*	/	/	-
+		/	-		+	-		/		/		+	*	+	/	/
+		-	-		+	-		/		-		+	*	+	+	/
+		/	/		+	-		+		/		+	*	/	/	-

LEGEND	
*	: ABUNDANT
+	: COMMON
/	: FEW
-	: RARE

TABLE II (part 2)
COMMENT LINES FROM WELL/OUTCROP : 31/2-10

1575.7 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED
FOSSIL REMAINS

1576.7 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED

1577.7 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED
FOSSIL REMAINS

1578.7 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED

1579.8 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED

1580.7 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED

1585.0 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED

1586.0 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED

1586.9 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED

1588.0 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED
TASMANITES ARE OXIDISED

1589.0 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED

1590.0 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED

1590.9 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED

1592.0 M : INITIAL .CONVERSION S.O.M.
SAMPLE SLIGHTLY OXIDISED

INITIAL DISTRIBUTION

5 copies area

GEOCHEMICAL LOG

SCALE 1:200

WELL 31/2-10

LOCATION

REGEO 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												
	KIMMERIDGE CLAY FM.	1570															1570												
			1575															1575	2.4	KEROGENOUS									
																			6.0	6.1	KEROGENOUS								
																			5.1		KEROGENOUS								
																			4.5		KEROGENOUS								
			1580															1580	4.4		KEROGENOUS								
																			5.5		KEROGENOUS								
			1585															1585	2.5		KEROGENOUS								
																			2.6		KEROGENOUS								
																			2.9		KEROGENOUS								
																			2.3		MAINLY KEROGENOUS								
																			2.2		MAINLY KEROGENOUS TO KEROGENOUS								
			1590															1590	3.0		MAINLY KEROGENOUS								
																			4.0		MAINLY KEROGENOUS								
																			3.7		KEROGENOUS								
		1595															1595												
		1600															1600												
					NUMBER OF SAMPLES ANALYSED 15												NUMBER OF SAMPLES ANALYSED 15												
										<p>VALUES SMALLER THAN 30 ARE CONSIDERED NOT TO BE OF SIGNIFICANCE</p>																			
										<p>INTERVALS 1575.7-1580.7 M AND 1590.0-1592.0 M CAN BE REGARDED AS FAIRLY GOOD TO GOOD SOURCE ROCKS FOR OIL AND GAS</p> <p>INTERVAL 1585.0-1589.0 M CAN BE REGARDED AS A FAIRLY GOOD SOURCE ROCK FOR GAS ONLY.</p>																			
										<p>LEGEND</p> <p>TYPE OF SAMPLE G = CORE P = SIDEWALL SAMPLE</p> <p>CONTAMINATION C = UNSPECIFIED W = WALNUTS E = CELLOPHANE F = FIBRES P = PLASTIC OR PAINT</p>																			
																				<p>NONINLYKE/SHELL EXPLORATIE EN PRODUCTIE LABORATORIUM</p> <p>GEOCHEMICAL LOG</p> <p>COUNTRY : NORWAY WELL : 31/2-10 INTERVAL : 1570 - 1600 M. SCALE 1:200</p>									
																				<p>AUTHOR: TERKEN DATE: MAY 1983</p> <p>REP: 63-126/096 ENCL: 1 DRAW. NO:</p>									