SIEP External Report March 1997

SIEP-97-5412

Geochemical investigation of an extract from well 03/07-06, Norway

by

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Geochemical investigation of an extract from well 03/07-06, Norway

1.0 Introduction

A geochemical investigation has been carried out on a source rock extract from well 03/07-06, Norway:

- 03/07-06, Spekkhugger-1, 3640.02 m, Core chips, S185669/2;

In addition a water sample from the same well was analysed for its organic constituents as there appeared to be an oil film floating on the water:

- 03/07-06, Spekkhugger-1, 3478 m, RFT/MDT run 1A, combined sample from Chambers 1, 2 and 3, S185670/2.

The geochemical parameters are shown on pages 2 to 7, analysis results are presented on the yellow pages.

2.0 Conclusions

2.2 Water sample

The mass spectra of the organic compounds present in the water sample indicate that they are a homologues series of alcoholethoxylates, Shell's brand name Dobanol, general molecular formula CnH2n+1O-(C2H5O)-H (n is usually equal to 4), that are used in enhanced oil recovery.

Summary of the geochemical data of the extract from well 03/07-06 (3640 m), Norway

Gravity and Gross Composition

% Extract :	0.31
% TOC after extract :	0.1
Extract/TOC :	3.10
Gross Composition (wt%)	
Saturates :	50
Aromatics :	37
Heterocompounds :	9
Rest (high molecular) :	4
Sulphur (%) :	no data
Vanadium (ppm) :	no data
Nickel (ppm) :	no data

Saturates Distribution

(Gas Chromatography)

Pristane / Phytane :	1.17
Pristane / n-C17 :	1.30
Phytane / n-C18 :	1.08
ACI :	12
Corr. Coeff. :	-0.9711

C7 Distribution

(Gas Chromatography)

C7 Alkanes (%)	
Normal C7 :	no data
Monobranched :	
Polybranched :	
C7 Alkanes / Cycloalkanes (%)	
Normal C7 :	no data
Cycloalkanes :	
Branched Alkanes :	
C7 Alkanes / Aromatics (%)	
Alkanes :	no data
Cycloalkanes :	
Aromatics :	

Biomarkers Distribution

(Gas Chromatography / Mass Spectrometry)

Steranes/Triterpanes (%)	
Iso Steranes :	26
Rearranged Steranes :	65
Triterpanes :	9
Sterane Conversion (%)	
Iso Steranes :	19
Rearranged Steranes :	32
Normal Steranes :	49
Steranes Carbon Numbers (%)	
C27 :	35
C28 :	30
C29 :	35
Triterpanes (%)	
C30 Hopane :	100
Oleanane (α+ β) :	0
W + T :	0
C29 Sterane Ratios	
20S / (20R + 20S) :	0.34
Iso / (Iso + Normal) :	0.33
Triterpane Ratios	
Ts / Tm :	0.52
Ts / (Ts + Tm) :	0.34
3R / (3R + 5R) :	0.05

Aromatics Distribution

(Gas Chromatography / Mass Spectrometry)

Monoaromatic Steroids (%)	
C27 :	32
C28 :	43
C29 :	25
Phenanthrene Ratios	
MPI-1 :	0.46
F-1 :	0.41
F-2 :	0.21

Carbon Isotope Ratios

(Mass Spectrometry)

Total Oil (topped) :	-29.0
Saturates :	-29.5
Aromatics :	-28.8

S18566902

GC/MS data of the aromatic fraction from well 03/07-06 (3640 m), Norway

Standard used for calculations: PDP
Discrimination factor : 0.47

I) NAPHTHALENES

a) Concentrations (ppm)		
2-MN		96
1-MN		91
2,6+2,7-DMN		75
1,6-DMN		107
1,5-DMN		56
1,3,5+1,4,6-TMN		70
2,3,6-TMN		46
1,2,5-TMN		57
C4-NAPH		40
THN		106
CAD		0
Total Naphthalenes		744

b) Parameters		
2-MN/1-MN	(MNR)	1.06
2,6+2,7-DMN/1,5-DMN	(DNR-1	1.35
2,3,6-TMN/1,3,5+1,4,6-TMN	(TNR-1	0.65
2,3,6-TMN/1,2,5-TMN	(TNR-2	0.81
2,3,6-TMN/THN		0.43
2,3,6-TMN/Cadelene		125.95

II) PHENANTHRENES

a) Concentrations (ppm)		
P		313
3-MP		83
2-MP		88
9-MP		137
1-MP		113
Total Phenantrenes		734

b) Parameters		
2-MP/1-MP		0.78
1.5*(2+3-MP/(P+1+9-MP))	(MPI-1	0.46
3*(2-MP/(P+1+9-MP))	(MPI-2	0.47
2+3-MP/1+9-MP		0.68
2+3-MP/1+9+2+3-MP		0.41

III) DIBENZOTHIOPHENES

a) Concentrations (ppm)	
DBT	34
4-MDBT	29
2+3-MDBT	18
1-MDBT	29
Total Dibenzothiophenes	110

b) Parameters	
4-MDBT/2+3-MDBT	1.58
4-MDBT/1-MDBT	1.02
2+3-MDBT/1-MDBT	0.64
4-MDBT/DBT	0.86
2+3-MDBT/DBT	0.54
1-MDBT/DBT	0.85

IV) BIPHENYLS

a) Concentrations (ppm)	
BP	13
2-MBP	2
3-MBP	21
4-MBP	5
Total Biphenyls	41

b) Parameters	
3-MBP/BP	1.66
3-MBP/4-MBP	4.30
3-MBP/2-MBP	9.01

V) DIBENZOFURANS

a) Concentrations (ppm)	
DBF	18
4-MDBF	30
2+3-MDBF	33
1-MDBF	12
Total Dibenzofurans	93

b) Parameters	
4-MDBF/2+3-MDBF	0.91
4-MDBF/1-MDBF	2.46
2+3-MDBF/1-MDBF	2.71
4-MDBF/DBF	1.69
2+3-MDBF/DBF	1.86
1-MDBF/DBF	0.69

VI) OVERALL RATIOS

Biphenyls/NAPH*	0.17
Dibenzothiophenes/NAP	0.45
Dibenzofurans/NAPH*	0.37

MN = methylnaphthalene
DMN = dimethylnaphthalene
TMN = trimethylnaphthalene
THN = tetrahyronaphthalene
DBF = methyldibenzofuran
MDBF= methyldibenzofuran
P = phenanthrene
MP = methylphenanthrene
DBT = dibenzothiophene
MDBT= methyldibenzothiophene
BP = biphenyl
MBP = methylbiphenyl
NAPH*= 2,6+2,7-DMN + 1,5-DMN + 1,4,6+1,3,5-TMN + 2,3,6-TMN

S18566902

GC/MS data of the aromatic fraction from well 03/07-06 (3640 m), Norway

VII) Misc. NAPHTHALENES

a) Concentrations (ppm)

2,6-DMN	29	4,5-DMP	11
2,7-DMN	46	2,6+3,6-DMP	36
1,3+1,7-DMN	125	3,5-DMP	20
1,6-DMN	107	2,7-DMP	13
1,4-DMN	n.d.	3,9-DMP	95
2,3-DMN	42	1,6+2,5+2,9-DMP	54
1,5-DMN	56	1,7-DMP	62
1,2-DMN	38	1,9+4,9-DMP	53
1,4+2,3-DMN	42	1,5-DMP	n.d.
		1,8-DMP	11
		1,2-DMP	13
		9,10-DMP	n.d.
1,3,7-TMN	37	1,2,6-TMP	4
1,3,6-TMN	66	1,2,5-TMP	6
1,3,5+1,4,6-TMN	70	1,2,9-TMP	7
2,3,6-TMN	46	1,2,7-TMP	n.d.
1,2,7-TMN	29	1,2,8-TMP	22
1,6,7-TMN	92		
1,2,6-TMN	4		
1,2,4-TMN	17		
1,2,5-TMN	57		
1,3,5,7-TeMN	28		
1,3,6,7-TeMN	26		
1,2,4,7-TeMN	43		
1,2,5,7-TeMN	22		
2,3,6,7-TeMN	16		
1,2,6,7-TeMN	23		
1,2,5,6-TeMN (C4-NAPH)	40		

b) Parameters

1,2,5-TMN/1,3,6-TMN	0.85
1,2,7-TMN/1,3,7-TMN	0.80

The assignment of some of these peaks is tentative

S18566902

GC/MS data of the aromatic steroids from well 03/07-06 (3640 m), Norway

I) Monoaromatic steroids
Intensities (arbitrary units)

MA C21 a ?	116
MA C21 b ?	40
MA C22 a ?	100
MA C22 b ??	49
MA C23 a ?	41
MA C23 b ?	26
MA C27 I 20S	110
MA C27 V 20S	342
MA C27 I 20R + MA C27 V 20R	353
MA C27 II 20S	168
MA C28 I 20S	616
MA C28 V 20S	58
MA C27 II 20R	120
MA C28 II 20S	176
MA C28 I 20R + MA C28 V 20R	451
MA C29 I 20S + MA C29 V 20S	407
MA C29 II 20S	13
MA C28 II 20R	183
MA C29 I 20R + MA C29 V 20R	295
MA C29 II 20R	146

II) Triaromatic steroids
Intensities (arbitrary units)

TA C20	71
TA C21	63
TA C22 20S	20
TA C22 20R	18
TA C26 20S	290
TA C26 20R + TA C27 20S	721
TA C28 20S	288
TA C28 20S	n.d.
TA C27 20R	332
TA C29 20S	58
TA C29 20S	25
TA C28 20R	224
TA C29 20R	43

III) Methylated Triaromatic steroids
Intensities (arbitrary units)

1Me TA C21 ?	6
3Me TA C21	12
6Me TA C21 ?	7
4Me TA C21	39
3Me TA C22	6
4Me TA C22	20
3Me TA C27 20S	33
4Me TA C27 20S	60
2Me TA C28 20S	6
3Me TA (C27 + C28) 20S	81
4Me TA (C27 + C28) 20S ?	189
4Me TA (C27 + C28) 20S ?	n.d.
2Me TA C29 20S	8
TA dinosteroid D1	48
3Me TA C29 20S	25
TA dinosteroid D2	119
2Me TA C28 20R	65
4Me TA C29 20S	n.d.
3Me TA C28 20R	45
4Me TA C28 20R	99
TA dinosteroid D3	100
TA dinosteroid D4	130
2Me TA C29 20R	7
3Me TA C29 20R	30
TA dinosteroid D5	108
4Me TA C29 20R	43
TA dinosteroid D6	178

IV) Parameters

% MA C27	32.33
% MA C28	42.22
% MA C29	25.45
TA C28/(MA C29 + TA C28)	0.37
MA(I)/MA(I+II)	0.08
TA(I)/TA(I+II)	0.06
MA C27 V 20S/(MA C27 (I+V) 2	0.76
TA C26 20S/TA C28 20S	1.01
TA C27 20R/TA C28 20R	1.48
3Me TA C28 20R/3Me TA C29 20	1.50
3Me TA C29 20R/(3+4)Me TA C2	0.41
TA (3+4)Me C27 20S/(3+4)Me C	3.69
TA (3+4)Me C28 20R/(3+4)Me C	1.97

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