MDT logging run #1A and 1B							
Date	**Log run**	**No. of pre-tests**	**Sampling depth (m MD RKB)**	**MDT Samples taken**		**Run objectives**	**Operational comments**
				Oil	**Water**		
18.09.03	1A	35	2294	SPMC:3	n/a	Pressure points and high quality hydrocarbon and water samples	The Martineau probe was used for every sampling depth. Some problems with obtaining a good seal against formation were encountered; this was probably due to unconsolidated sandstone and loose borehole. One PO failed due to plugging. Large drawdown observed due to plugging of probe inlet/filter.
			2269	SPMC:2 MRSC:1	n/a		
			2239	SPMC:3	n/a		
			2334.5	n/a	SPMC:4		
20.09.03	1B	2	2294	MRSC:2	n/a	Collect large volume hydrocarbon samples	The Martineau probe was run. Lost communication with tool and spent more than 6 hrs troubleshooting. Switched PO due to plugging. No CFA module in this run.

Table 3-3: MDT logging overview, Run 1A and 1B

3.3.1 Pressure Points

35 tests were attempted during MDT run 1A, of which 31 are considered successful, one is a dry test and three are lost seals.

Test	File	DEPTH	DEPTH	FMP	HYDB	HYDA	MOB	
		m MD RKB	mTVD MSL	BAR	BAR	BAR	mD/Cp	Comment
35	86	2238,02	2138,6	-	-	-	-	Lost seal
34	85	2240,01	2140,6	202,23	263,85	263,84	443,24	Disqualified
33	84	2242,96	2143,4	202,46	264,24	264,21	317,17	Disqualified
32	83	2245,99	2146,2	202,67	264,54	264,52	411,33	Disqualified
31	82	2250,55	2150,5	203,00	265,05	265,04	23,75	Disqualified
30	81	2252,04	2151,7	-	-	-	-	Lost seal
29	80	2253,54	2153,2	203,13	265,39	265,39	420,92	
28	79	2253,54	2153,2	-	-	-	-	Lost seal
27	78	2254,96	2154,6	203,23	265,56	265,55	827,57	
26	77	2257,00	2156,5	203,37	265,78	265,78	781,88	
25	76	2258,99	2158,4	203,52	266,01	266,00	1198,33	
24	75	2262,99	2162,1	203,80	266,47	266,44	1041,95	
23	74	2265,98	2164,9	204,02	266,79	266,77	1019,20	
22	71	2269,02	2167,7	204,22	267,13	267,13	398,02	
21	70	2272,01	2170,5	204,44	267,47	267,47	617,30	
20	69	2275,00	2173,3	204,64	267,80	267,80	741,80	
19	68	2280,01	2178,0	205,00	268,36	268,35	208,96	
18	67	2283,01	2180,8	205,24	268,75	268,69	77,06	
17	66	2286,99	2184,5	205,49	269,14	269,14	107,06	
16	61	2290,01	2187,3	205,72	269,50	269,47	83,64	
15	60	2294,01	2191,0	205,97	269,94	269,91	201,88	
14	59	2297,02	2193,8	206,17	270,34	270,24	335,55	
13	58	2300,00	2196,6	206,41	270,61	270,57	43,05	
12	57	2304,02	2200,4	206,74	271,07	271,01	84,86	
11	56	2308,49	2204,6	207,16	271,54	271,52	83,16	
10	55	2310,50	2206,4	207,38	271,76	271,75	142,95	
9	54	2312,50	2208,3	207,57	271,98	271,96	26,25	
8	53	2320,00	2215,3	208,39	272,85	272,07	18,41	Disqualified
7	52	2320,53	2215,8	208,39	272,89	272,83	13,10	Disqualified
6	51	2321,00	2216,7	-	-	-	-	Dry test
5	50	2335,03	2229,3	209,69	274,46	274,44	640,20	
4	49	2339,50	2233,5	210,11	274,94	274,92	136,43	
3	48	2346,49	2240,0	210,75	275,72	275,69	19,63	
1	46	2348,50	2241,8	210,92	275,90	275,89	51,53	
2	47	2348,50	2241,8	210,93	275,91	275,89	31,74	

Table 3-4: Listing of MDT pressure tests

3.3.2 Fluid Sampling

The main fluid sampling objective in well 25/4-9 S was to retrieve high quality oil and water sample from the Heimdal Member. Since the reservoir section was drilled with WBM, a tracer was added to the mud in order to correct for the final mud filtrate contamination in the water samples. Tritium was used as tracer.

15 fluid samples were captured during the two wireline formation sampling runs. Four of the samples are from the water zone in the Heimdal Member while rest of the samples is collected at different intervals in the oil zone.

Some operational problems were experienced during the job. Most of these problems were due to the unconsolidated Heimdal Member, i.e. formation sanding and collapse around the probe inlet. In order to handle these challenges, the following actions were taken:

- The Martineau probe was selected as the sampling probe since it has a large inlet area.
- Low, controlled pump rate was applied in order to minimize the fines/sand production.
- Selecting sample intervals where the borehole was in-gauge.

During both of the MDT sampling runs, the back-up pump-out module had to be started during the job. This was most likely due to fines/sand production hence the primary pump-out modules indicated pumping problems. Since a back-up pump was configured on both of the toolstrings, no time was lost due to switching of the pump-out modules.

During **MDT run 1A** difficulties in obtaining proper seal with the formation at several sample intervals were experienced. The unconsolidated formation may be one possible reason to this problem. Another reason may be the hole rugosity. Sampling interval 2240m MD RKB was abandoned due to repeatedly seal failures. When inspecting the caliper log, Figure 3-4, it is obvious that at this depth the hole condition is poor. Since the Martineau probe does not have the large sealing area as the standard probe, it is very sensitive to poor hole conditions. The core was cut from 2240m MD RKB, hence one should expect some wash-out at this interval which is probably the case in this well. From 2300m MD RKB the hole conditions seem to be affected by a poor drilling assembly, causing the borehole wall to be spiral-like. The result is that the MDT-probe will have difficulties to obtain a proper seal, which may be the reason for the seal failure problems at 2334.5m MD RKB.

The main objective for the **MDT run 1B** was to capture large volume oil sample for later production chemistry analysis. Two large chambers were installed in the MDT-string and the tool was run in hole. Unfortunately, the communication was lost during running in the hole, and the tool had to be pulled to surface. After some troubleshooting, the CFA-module was removed from the string and the tool was run in the hole again. Some communication problems were still experienced, but it disappeared while running in hole.

After a clean-up volume of 16 liters, the 18 gallon chamber was filled following by a 2 ¾ gallon chamber. The tool was then pulled to the surface without any problems.

3.3.3 Offshore Fluid Transfer

In this chapter only the offshore fluid transfer is described. The fluid validation and analysis is being discussed in chapter 7.

Oilphase was engaged to handle all of the fluid transfer of the 250cc SPMCs, (1 gallon) MRSC large volume sample chamber, a 2 3/4 gallon MRSC large volume sample chamber and an 18 gallon large volume chamber. The following is a summary of the Oilphase events which took place offshore. More details of the offshore fluid transfer can

be found in Ref./3/. All of the samples were shipped to the Reslab laboratory at Forus in an Oilphase container. A list of the sample bottles is found in the appendix 9.4.

MDT Run No. 1A Upon retrieval it was noted that all 12 SPMCs had successfully captured monophasic bottomhole samples. The 12 SPMC samples were heated to reservoir temperature at a pressure above reservoir pressure for minimum of 1 hours before transfer into Oilphase Single-phase Sample Bottles (SSB). The one gallon MRSC JA 047 chamber was heated and agitated for 12 hours prior to transfer to 6 x Oilphase Conventional Sample Bottles (CSB). No problems were experienced during the fluid transfer.

MDT Run No. 1B

Upon retrieval at surface it was noted that both of the large volume containers had captured fluid. The 18 gallon chamber (MRSC EC 012) was drained at ambient temperature to 6 x 11 liter IATA containers while measuring the GOR. The 2 ¾ chamber (MRSC JA 113) was heated and agitated for 12 hours prior to transfer to 11 x Oilphase Conventional Sample Bottles (CSB). The remaining fluid was drained to an 11 liter IATA container.

9.3 Sampling Operation Details – Schlumberger

SAMPLING SUMMARY

Client: Hydro
Field : Klegg
Well : 25/4-9S

Rig : Deep Sea Delta
Date: 18 sep 2003
Run : 1A

Sample	Depth	Fluid	P(form)	P(hyd)	Cleanup (l)
[1]	2294	oil	206.2	270	45
[2]	2269	oil	204.2	267	22.5
[3]	2239	oil	202.2	263.5	52
[4]	2334.5	Water	209.6	274.5	41

Details

	Chamber-Serial	Temp. (degC)	Flowing Pressure (bar)	Max. Drawdown (bar)	Shut-in Pressure (bar)	Filling Time (min)
[1a]	MS2-SPMC#121	72.8	202	4.5	280	2.5
[1b]	MS2-SPMC#150	72.9	202	4.5	280	2.5
[1c]	MS1-SPMC#045	73	202	4.5	280	2.5
[2a]	MS2-SPMC#145	71.9	200	4.2	280	3
[2b]	MS1-SPMC#137	72.1	200	4.2	280	3
[2c]	SC1-SC #47	72.3	200	4.2	280	25
[3a]	MS2-SPMC#075	71.9	199.5	3	280	2.5
[3b]	MS1-SPMC#134	70	199.5	3	280	2.5
[3c]	MS1-SPMC#123	70	199.5	3	280	2.5
[4a]	MS1-SPMC#111	75	206	3.6	280	2.5
[4b]	MS1-SPMC#90	75	206	3.6	280	2.5
[4c]	MS2-SPMC#152	75	206	3.6	280	2.5
[4d]	MS2-SPMC#153	75	206	3.6	280	2.5

9.4 Sample Bottles Overview – Schlumberger

Sample Overview MDT RUN 1A

Sample Date	Sample Number	Chamber Number	Chamber Type	Opening pressure (barg)	Sample Nature	Sample Volume (cc)	Sampling Depth (m)	Bottle Serial Number	Bottle Type
18.09.03	1.01	121	SPMC	448.2@16°C	Oil	240	2294	9833-MA	Single Phase
18.09.03	1.02	150	SPMC	448.2@16°C	Oil	240	2294	8281-MA	Single Phase
19.09.03	1.03	045	SPMC	448.2@16°C	Oil	240	2294	9845-MA	Single Phase
19.09.03	1.04	145	SPMC	448.4@16°C	Oil	239	2289	3892-MA	Single Phase
19.09.03	1.05	137	SPMC	448.2@16°C	Oil	240	2289	8285-MA	Single Phase
19.09.03	1.06	075	SPMC	448.4@16°C	Oil	236	2239	9248-MA	Single Phase
19.09.03	1.07	134	SPMC	448.2@16°C	Oil	239	2239	3062-MA	Single Phase
19.09.03	1.08	123	SPMC	448.2@16°C	Oil	239	2239	9283-MA	Single Phase
19.09.03	1.09	111	SPMC	479.2@16°C	Water	242	2334.5	8286-MA	Single Phase
19.09.03	1.10	090	SPMC	477.5@16°C	Water	241	2334.5	8491-MA	Single Phase
19.09.03	1.11	152	SPMC	479.2@16°C	Water	239	2334.5	9795-MA	Single Phase
19.09.03	1.12	153	SPMC	479.2@16°C	Water	239	2334.5	9797-MA	Single Phase
19.09.03	1.13	JA-47	MRSC	65.5@15°C	Oil	600	2289	7104-MA	Multi Phase
19.09.03	1.14	JA-47	MRSC	65.5@15°C	Oil	600	2289	6722-MA	Multi Phase
19.09.03	1.15	JA-47	MRSC	65.5@15°C	Oil	600	2289	6932-MA	Multi Phase
19.09.03	1.16	JA-47	MRSC	65.5@15°C	Oil	600	2289	7082-MA	Multi Phase
19.09.03	1.17	JA-47	MRSC	65.5@15°C	Oil	600	2289	5690-EA	Multi Phase
19.09.03	1.18	JA-47	MRSC	65.5@15°C	Oil	440	2289	6708-EA	Multi Phase
17.09.03	1.19	N/A	N/A	N/A	Mud	N/A	2238	N/A	Metal Can
17.09.03	1.20	N/A	N/A	N/A	Mud	N/A	2237	N/A	Metal Can
17.09.03	1.21	N/A	N/A	N/A	Mud	N/A	2300	N/A	Metal Can
17.09.03	1.22	N/A	N/A	N/A	Mud	N/A	2377	N/A	Metal Can

Sample Overview MDT RUN 1B

Sample Date	Sample Number	Chamber Number	Chamber Type	Opening pressure (barg)	Sample Nature	Sample Volume (cc)	Sampling Depth (m)	Apparent GOR Sm^3/m^3	Bottle Serial Number	Bottle Type
20.09.03	2.01	EC 012	MRSC	68.9 @14°C	Oil	10000	2294	449	N/A	11L. IATA
20.09.03	2.02	EC 012	MRSC	68.9 @14°C	Oil	10000	2294	449	N/A	11L. IATA
20.09.03	2.03	EC 012	MRSC	68.9 @14°C	Oil	10000	2294	449	N/A	11L. IATA
20.09.03	2.04	EC 012	MRSC	68.9 @14°C	Oil	10000	2294	449	N/A	11L. IATA
20.09.03	2.05	EC 012	MRSC	68.9 @14°C	Oil	10000	2294	449	N/A	11L. IATA
20.09.03	2.06	EC 012	MRSC	68.9 @14°C	Oil	9000	2294	449	N/A	11L. IATA
20.09.03	2.07	JA-113	MRSC	68.9 @15°C	Oil	600	2294	N/A	4544-EA	Multi Phase
20.09.03	2.08	JA-113	MRSC	68.9 @15°C	Oil	600	2294	N/A	6719-MA	Multi Phase
20.09.03	2.09	JA-113	MRSC	68.9 @15°C	Oil	600	2294	N/A	4300-EA	Multi Phase
20.09.03	2.10	JA-113	MRSC	68.9 @15°C	Oil	600	2294	N/A	7111-MA	Multi Phase
20.09.03	2.11	JA-113	MRSC	68.9 @15°C	Oil	600	2294	N/A	6662-MA	Multi Phase
20.09.03	2.12	JA-113	MRSC	68.9 @15°C	Oil	600	2294	N/A	5316-EA	Multi Phase
20.09.03	2.13	JA-113	MRSC	68.9 @15°C	Oil	600	2294	N/A	7091-MA	Multi Phase
20.09.03	2.14	JA-113	MRSC	68.9 @15°C	Oil	600	2294	N/A	7005-MA	Multi Phase
20.09.03	2.15	JA-113	MRSC	68.9 @15°C	Oil	600	2294	N/A	6660-MA	Multi Phase
20.09.03	2.16	JA-113	MRSC	68.9 @15°C	Oil	600	2294	N/A	7076-MA	Multi Phase
20.09.03	2.17	JA-113	MRSC	68.9 @15°C	Oil	600	2294	N/A	6104-MA	Multi Phase
20.09.03	2.18	JA-113	MRSC	68.9 @15°C	Oil	3000	2294	N/A	N/A	11L. IATA

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HYDRO

REPORT 2004-04-19

Title

Petroleum geochemistry, Well 25/4-9 S

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2 Introduction

This petroleum geochemical study of well 25/4-9 S includes hydrocarbon characterization of the oil column, including hydrocarbon fluid inclusions. The temperature profile is established by the vitrinite reflectance values on selected samples in the depth interval of 1130 – 2365 mRKB (TD at 2377 mRKB).

The well is drilled by an oil based mud system. Mud samples from the well are used to establish the chemical background from any mud contamination.

Well	Type	Start depth	End depth	Name	Extr. Deasph.	Iatro-scan	C5-20 HC's	Sat. HC's	Sat. Biom.	Diam. HC's	Age biom.	Aro. HC's	d13C frac.	d13C gas	Gas vol.	Ro data	OrgID
'25/4-9 S	DC	1120.00	1130.00													1	2195207
'25/4-9 S	DC	1240.00	1250.00													1	2195208
'25/4-9 S	DC	1340.00	1350.00													1	2195209
'25/4-9 S	DC	1440.00	1450.00													1	2195210
'25/4-9 S	DC	1540.00	1550.00													1	2195211
'25/4-9 S	DC	1640.00	1650.00													1	2195212
'25/4-9 S	DC	1740.00	1750.00													1	2195213
'25/4-9 S	DC	1840.00	1850.00													1	2195214
'25/4-9 S	DC	1950.00	1960.00													1	2195215
'25/4-9 S	DC	2040.00	2050.00													1	2195216
'25/4-9 S	DC	2140.00	2150.00													1	2195217
'25/4-9 S	MUD	2237.00	2237.00		1	1		1	1	1		1					2190306
'25/4-9 S	COCH	2237.60	2237.60		1	1		1	1	1		1	1				2195841
'25/4-9 S	COCH	2238.87	2238.87		1	1		1	1	1	1	1	1				2195840
'25/4-9 S	Fluid	2239.00	2239.00	1,07 3062-MA 30.10.03	1	1	1	1	1	1	1	1	1	1	1		2192873
'25/4-9 S	OIL	1.00	1.00	SEP OIL 2003-09-23	1	1	1	1	1	1		1	1				2189397
'25/4-9 S	COCH	2240.65	2240.65		1	1		1	1	1		1	1				2195839
'25/4-9 S	COCH	2242.54	2242.54		1	1		1	1	1		1	1				2195838
'25/4-9 S	COCH	2243.60	2243.60		1	1		1	1	1		1	1				2195837
'25/4-9 S	GASB	2245.00	2245.00											1	1		2189265
'25/4-9 S	COCH	2246.25	2246.25		1	1		1	1	1		1	1				2195836
'25/4-9 S	COCH	2247.50	2247.50													1	2193319
'25/4-9 S	COCH	2248.35	2248.35		1	1		1	1	1		1	1				2195835
'25/4-9 S	COCH	2249.72	2249.72		1	1		1	1	1		1	1				2195833
'25/4-9 S	GASB	2250.00	2250.00											-	1		2189267
'25/4-9 S	COCH	2251.55	2251.55		1	1		1	1	1		1	1				2195834
'25/4-9 S	COCH	2254.29	2254.29		1	1		1	1	1		1	-				2195832
'25/4-9 S	GASB	2255.00	2255.00											-	1		2189250
'25/4-9 S	GASB	2260.00	2260.00											1	1		2189260
'25/4-9 S	Fluid	2269.00	2269.00	1,04-3892 MA 31.10.03	1	1	1	1	1	1	1	1	1	1	1		2192876
'25/4-9 S	GASB	2270.00	2270.00											-	1		2189258
'25/4-9 S	GASB	2275.00	2275.00											-	1		2189269
'25/4-9 S	GASB	2280.00	2280.00											1	1		2189266
'25/4-9 S	GASB	2285.00	2285.00											1	1		2189254
'25/4-9 S	GASB	2290.00	2290.00											1	1		2189264
'25/4-9 S	DC	2285.00	2290.00													1	2195218
'25/4-9 S	Fluid	2294.00	2294.00	2.11(6662-MA) 24.10.03	1	1	1	1	1	1	1	1	1	1	1		2192225
'25/4-9 S	GASB	2295.00	2295.00											1	1		2189251
'25/4-9 S	GASB	2300.00	2300.00											-	1		2189255
'25/4-9 S	GASB	2310.00	2310.00											-	1		2189249
'25/4-9 S	GASB	2315.00	2315.00											-	1		2189253
'25/4-9 S	GASB	2330.00	2330.00											-	1		2189244
'25/4-9 S	GASB	2335.00	2335.00											-	1		2189252
'25/4-9 S	GASB	2345.00	2345.00											-	1		2189256
'25/4-9 S	GASB	2355.00	2355.00											-	1		2189247
'25/4-9 S	DC	2360.00	2365.00													1	2195219
'25/4-9 S	GASB	2375.00	2375.00											-	1		2189263
				Sum, analyses:	15	15	4	15	15	15	4	15	13	9	21	14	

Table 2.1. Sample list and analytical program. Symbol '1' indicates data, '-' indicates missing data according to plan, often caused by lean concentrations or sample amounts.

HYDRO

3 Experimental

The analytical and preparative methods employed in this study comprise geochemical characterization of gas bags, sediment extracts and MDT fluids. All chromatographic data are based on quantitative measurements.

The analytical methods are based on the guidelines in the Norwegian Industry Guide to Organic Geochemical Analyses (NIGOGA[1]). Major deviations from this guide are:

- Extract and asphaltene workup by centrifugation.
- Internal standard mixture added for quality control and quantitative measurements. GC analysis of SAT and ARO fractions by 5% phenyl methyl-silicone stationary phase.
- GC-MSD detection of the aromatic hydrocarbons (not FID).
- Report of a restricted number of compounds relative to the NIGOGA guide, due to known co-elusions or disputable identities.

Most analytical and interpretative works were carried out at the Norsk Hydro O&E Research Center in Bergen. However, IFE, Kjeller performed the gas volume and isotope measurements.

The data quality control is according to NIGOGA and defined internal laboratory procedures, available on request.

Samples that are annotated "nso1, nso2 ..." represent the internal North Sea reference oil (NGS-NSO1) and reflect the analytical repeatability.

All depths are quoted as measured depths (in mRKB).

[1] The Norwegian Industry Guide to Organic Geochemical Analyses, edition 4.0, 2000

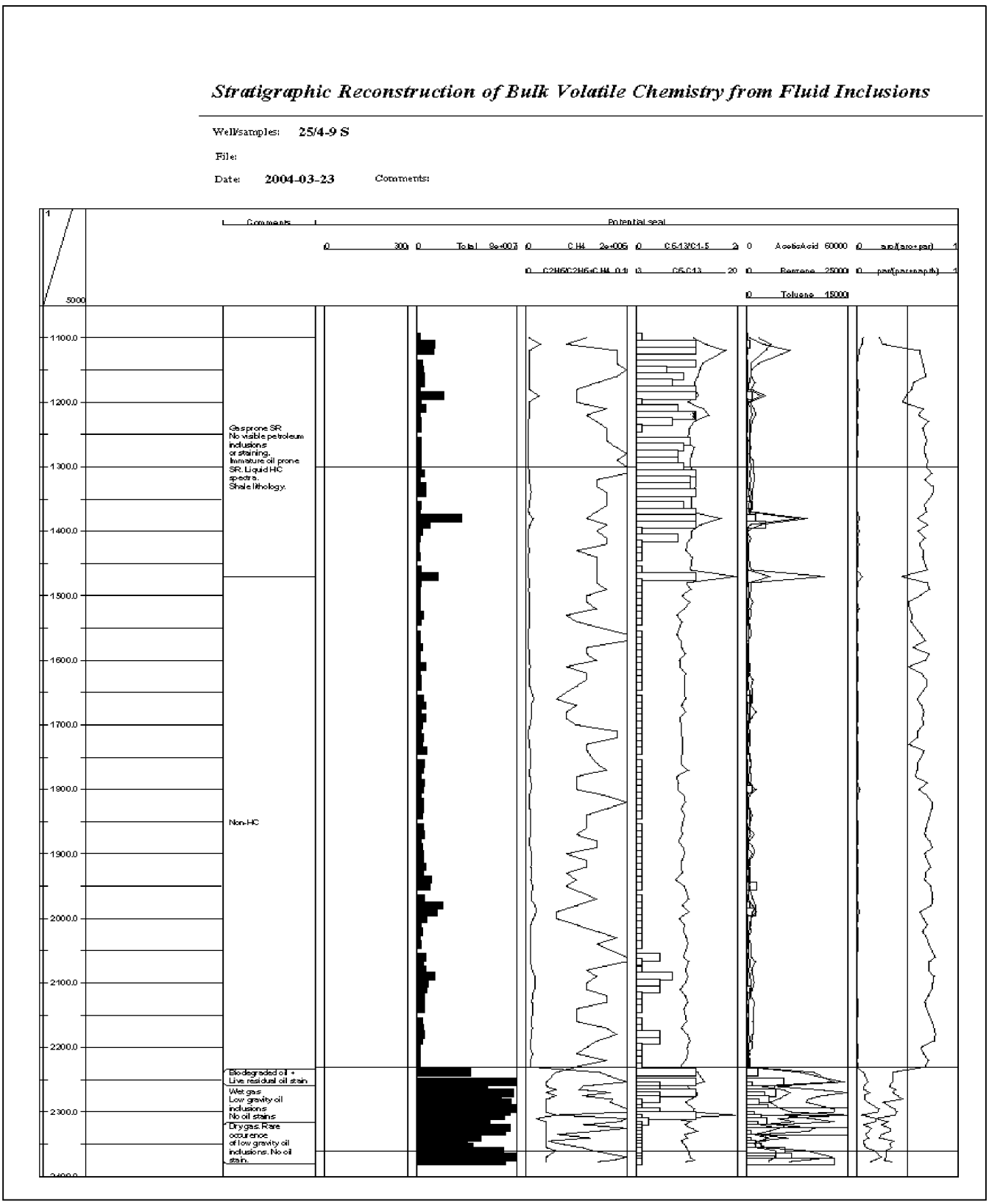

Figure 5.1. Summary FIS log, including interpretations

Lithology code		Sample quality		Sample preparation	
sst	Sandstone	G	Good	HF	Sample treatment with hydrofluoric acid prior to analysis
slst	Siltstone	M	Moderate		
clyst	Claystone	P	Poor	Bulk	Sample treated as bulk rock
sh	Shale	st	Hydrocarbon staining		
lst	Limestone				
coal	Coal				

Sample description and measurement evaluation (perfect sample characterised as: oooooo)

Sign order	Parameter	Sign	Sign legend:
1	Abundance of vitrinite	-o	- May give too low vitrinite reflectance sample value
2	Identification of vitrinite	-o+	o Reliable vitrinite reflectance sample value
3	Type of vitrinite	-o+	+ May give too high vitrinite reflectance sample value
4	Vitrinite fragment size	-o	
5	Vitrinite surface quality	-o	
6	Abundance of pyrite	o+	

Well	Sample type	Upper Depth	Lower Depth	APT ID	Sample prep.	%Lithology	%Ro	Std. dev.	No. of measurements	Quality rating	Overall quality	Comment
25/4-9 S	DC	1120	1130	19838	HF	clyst	0.23	0.03	22	ooo-o+	M	
25/4-9 S	DC	1240	1250	19839	HF	clyst	0.23	0.03	22	ooo-oo	M	
25/4-9 S	DC	1340	1350	19840	HF	clyst	0.24	0.04	23	ooo-oo	M/G	
25/4-9 S	DC	1440	1450	19841	HF	clyst	0.24	0.04	22	ooo-oo	M	
25/4-9 S	DC	1540	1550	19842	HF	clyst	0.25	0.03	20	ooo--o	M	
25/4-9 S	DC	1640	1650	19843	HF	clyst	0.24	0.03	10	-ooooo	M/P	
25/4-9 S	DC	1740	1750	19844	HF	clyst/sst	0.26	0.04	7	-oo-oo	P	
25/4-9 S	DC	1840	1850	19845	HF	clyst/sst	0.23	0.03	15	-oo--o	M	See data sheet
25/4-9 S	DC	1950	1960	19846	HF	clyst	0.26	0.02	9	-oo--o	P	
25/4-9 S	DC	2040	2050	19847	HF	clyst/sst	0.31	0.04	21	oooo-o	M/G	
25/4-9 S	DC	2140	2150	19848	HF	clyst/sst	0.28	0.03	6	-oo--o	P	
25/4-9 S	COCH	2247.50	2247.50	19849	HF	clyst	0.38	0.04	22	ooooo o	G	
25/4-9 S	DC	2285	2290	19850	HF	clyst/sst	0.33	0.05	13	-oo--o	M/P	See data sheet
25/4-9 S	DC	2360	2365	19851	HF	clyst	barren					See data sheet

Figure 6.1. Ro data, well maturity profile and analytical data.

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Appendix 1

MDT fluids and gas bags,
gas composition and carbon isotope data

Data report on molecular and isotopic composition of gas bag samples from well 25/4-9 S

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Report number APT03-527A	**Classification** Confidential
Report Title Data report on molecular and isotopic composition of gas bag samples from well 25/4-9 S	**Submitted**
Client Norsk Hydro	**Service Order** 5231099
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Distribution Norsk Hydro (1 mail) APT (1) IFE (2)	

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Approved by	Tore Haaland	2003-12-11	

CONTENTS

Table 1. Number of analyses performed

Analysis	Gas	Total
Gas composition	3	3
Stable isotopes (d13C, dD) of gas	3	3

Table 2. Gas Composition (volume-%)

Well	Sample type	Lower Depth	APT ID	C1%	C2%	C3%	iC4%	nC4%	iC5%	nC5%	CO2%	Sum C1-C5	Wetness	iC4/nC4	ppm
25/4-9 S	Gas	2239 m	19150	67.0	11.2	10.9	2.3	5.1	1.4	1.8	0.16	99.8	30.6	0.46	721344
25/4-9 S	Gas	2269 m	19151	68.3	10.7	10.3	2.3	5.0	1.4	1.9	0.14	99.9	29.3	0.45	683458
25/4-9 S	Gas	2294 m	19152	68.7	10.6	10.3	2.2	4.9	1.4	1.8	0.14	99.9	29.0	0.46	641347

Table 3. Carbon Isotopes

Well	Sample type	Lower Depth	APT ID	C1 δ13C	C2 δ13C	C3 δ13C	iC4 δ13C	nC4 δ13C
25/4-9 S	Gas	2239 m	19150	-46.9	-29.7	-28.5	-29.5	-29.6
25/4-9 S	Gas	2269 m	19151	-47.2	-29.8	-28.3	-30.1	-29.8
25/4-9 S	Gas	2294 m	19152	-44.8	-29.1	-28.4	-29.6	-29.8

Table 4. Hydrogen isotopes

Well	Sample type	Lower Depth	APT ID	C1 δD
25/4-9 S	Gas	2239 m	19150	-204
25/4-9 S	Gas	2269 m	19151	-212
25/4-9 S	Gas	2294 m	19152	-204

Experimental Procedures

All procedures follow NIGOGA, 4th Edition. Below are brief descriptions of procedures/analytical conditions.

GC analysis of gas components

Aliquots of 0.1 ml were sampled with a syringe for analysis on a Carlo Erba HRGC 5300 equipped with a Porabond Q column. The detection limit for the hydrocarbon gas components is 0.001 µl/ml using a flame ionisation detector (FID) and for CO_2 0.05 µl/ml using a thermal conductivity detector (TCD/HWD).

Stable isotope analysis of gas compounds

5-10 ml of the gas was sampled with a syringe and then separated into the different gas components by a Carlo Erba 4200 gas chromatograph. The hydrocarbon gas components were oxidised in separate CuO-ovens in order to prevent cross contamination. The combustion products CO_2 and H_2O were cryogenic separated into collection vessels. The combustion water was reduced with zinc metal in sealed quartz tubes to prepare hydrogen for isotopic analysis. The isotopic measurements were performed on a Finnigan MAT 251 and VG Optima IRMS for carbon an hydrogen isotopes respectively. The analytical procedures were tested with a laboratory gas standard mixture. Based on repeated analysis of the gas standard, the reproducibility in the $\delta^{13}C$ value is better than 0.5 ‰ PDB for all components. The reproducibility in the δD value is likewise better than 10 ‰.

Data report on molecular and isotopic composition of gas bag samples from 25/4-9S

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Approved by	Tore Haaland	2004-04-19	

CONTENTS

Table 1. Number of analyses performed

Analysis	Gas	Total
Gas composition	18	18
Stable isotopes of gas	6	6

Table 2. Gas Composition (volume-%)

Well	Sample type	Lower Depth	APT ID	C1%	C2%	C3%	iC4%	nC4%	iC5%	nC5%	CO2%	Sum C1-C5	Wetness	iC4/nC4	ppm
25/4-9 S	Gas bag	2245 m	19857	34.9	3.9	2.8	0.52	1.7	0.65	1.0	54.6	45.4	20.3	0.32	3126
25/4-9 S	Gas bag	2250 m	19858	41.6	6.6	4.7	0.92	2.9	1.2	2.1	40.0	60.0	26.7	0.32	1539
25/4-9 S	Gas bag	2255 m	19859	7.8	1.1	0.94	0.23	0.78	0.41	0.75	87.9	12.1	28.3	0.29	847
25/4-9 S	Gas bag	2260 m	19860	46.7	7.1	5.4	1.2	3.3	1.3	2.1	32.9	67.1	26.6	0.35	1887
25/4-9 S	Gas bag	2270 m	19861	46.6	7.4	5.8	1.2	3.4	1.2	2.2	32.2	67.8	27.7	0.34	1718
25/4-9 S	Gas bag	2275 m	19862	42.2	4.4	5.7	1.2	3.5	1.4	2.1	39.5	60.5	26.0	0.35	1408
25/4-9 S	Gas bag	2280 m	19863	61.5	8.9	6.6	1.4	3.8	1.4	2.0	14.4	85.6	25.2	0.37	1426
25/4-9 S	Gas bag	2285 m	19864	46.7	5.9	4.2	0.85	2.3	0.82	1.0	38.2	61.8	22.2	0.36	2084
25/4-9 S	Gas bag	2290 m	19865	52.8	6.6	4.6	0.97	2.7	0.92	1.7	29.7	70.3	22.0	0.36	2232
25/4-9 S	Gas bag	2295 m	19866	50.5	6.4	4.1	0.85	2.5	1.1	1.5	33.1	66.9	21.4	0.34	1868
25/4-9 S	Gas bag	2300 m	19867	64.9	10.9	9.0	1.9	5.8	1.8	3.8	1.9	98.1	29.9	0.32	637
25/4-9 S	Gas bag	2310 m	19868	16.7	5.3	5.3	1.5	3.8	1.6	2.5	63.4	36.6	48.8	0.40	823
25/4-9 S	Gas bag	2315 m	19869	26.2	4.4	3.4	1.0	2.6	1.1	1.9	59.3	40.7	30.5	0.39	931
25/4-9 S	Gas bag	2330 m	19870	8.8	1.7	1.7	0.00	1.3	4.8	44.2	37.6	62.4	34.6	0.00	1388
25/4-9 S	Gas bag	2335 m	19871	12.0	1.6	2.7	6.1	2.0	0.63	1.4	73.5	26.5	50.7	3.0	1038
25/4-9 S	Gas bag	2345 m	19872	10.0	1.4	2.1	0.54	1.7	0.78	1.3	82.1	17.9	36.6	0.32	735
25/4-9 S	Gas bag	2355 m	19873	2.3	0.78	1.7	4.5	1.4	0.77	1.2	87.4	12.6	78.3	3.1	783
25/4-9 S	Gas bag	2375 m	19874	4.8	0.76	0.00	0.00	0.00	0.00	0.00	94.5	5.5	13.6		570

Table 3. Gas Isotopes

Well	Sample type	Lower Depth	APT ID	C1 δ13C	C2 δ13C	C3 δ13C	iC4 δ13C	nC4 δ13C	CO2 δ13C
25/4-9 S	Gas bag	2245 m	19857	-47.0					-23.0
25/4-9 S	Gas bag	2250 m	19858						
25/4-9 S	Gas bag	2255 m	19859						
25/4-9 S	Gas bag	2260 m	19860	-45.8					-13.6
25/4-9 S	Gas bag	2270 m	19861						
25/4-9 S	Gas bag	2275 m	19862						
25/4-9 S	Gas bag	2280 m	19863	-45.6					-13.6
25/4-9 S	Gas bag	2285 m	19864	-46.4					-14.0
25/4-9 S	Gas bag	2290 m	19865	-46.6	-27.5	-27.1		-26.1	-15.5
25/4-9 S	Gas bag	2295 m	19866	-45.6					-14.3
25/4-9 S	Gas bag	2300 m	19867						
25/4-9 S	Gas bag	2310 m	19868						
25/4-9 S	Gas bag	2315 m	19869						
25/4-9 S	Gas bag	2330 m	19870						
25/4-9 S	Gas bag	2335 m	19871						
25/4-9 S	Gas bag	2345 m	19872						
25/4-9 S	Gas bag	2355 m	19873						
25/4-9 S	Gas bag	2375 m	19874						

Experimental Procedures

All procedures follow NIGOGA, 4th Edition. Below are brief descriptions of procedures/analytical conditions.

GC analysis of gas compounds
Aliquots of 0.1-1 ml were sampled with a syringe for analysis on a Carlo Erba HRGC 5300 equipped with a Porabond Q column. The detection limit for the hydrocarbon gas components is 0.001 µl/ml using a flame ionisation detector (FID) and for CO_2 0.05 µl/ml using a thermal conductivity detector (TCD/HWD).

Carbon isotope analysis of hydrocarbon compounds and CO_2
The carbon isotopic composition of the hydrocarbon gas components was determined by a GC-C-IRMS system. Aliquots were sampled with a syringe and analysed on a Trace GC2000, equipped with a Poraplot Q column, connected to a Delta plus XP IRMS. The components were burnt to CO_2 and water in a 1000 °C furnace over Cu/Ni/Pt. The water was removed by Nafion membrane separation. Repeated analyses of standards indicate that the reproducibility of $\delta^{13}C$ values is better than 1 ‰ PDB (2 sigma).

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Appendix 3

Vitrinite reflectance maturity data

Vitrinite Reflectance Analysis
14 samples from 25/4-9 S

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Report number APT03-567	**Classification** Confidential
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Approved by	Tore Haaland	2004-1-28	

CONTENTS

Table 1. Number of analyses performed

Analysis	Cuttings	Core	Total
Vitrinite reflectance	13	1	14

Table 2. Vitrinite Reflectance

Well	Sample type	Upper Depth	Lower Depth	APT ID	Sample prep.	%Lithology	%Ro	Std. dev.	No. of measurements	Quality rating	Overall quality	Comment
25/4-9 S	DC	1120	1130	19838	HF	clyst	0.23	0.03	22	ooo-o+	M	
25/4-9 S	DC	1240	1250	19839	HF	clyst	0.23	0.03	22	ooo-oo	M	
25/4-9 S	DC	1340	1350	19840	HF	clyst	0.24	0.04	23	ooo-oo	M/G	
25/4-9 S	DC	1440	1450	19841	HF	clyst	0.24	0.04	22	ooo-oo	M	
25/4-9 S	DC	1540	1550	19842	HF	clyst	0.25	0.03	20	ooo--o	M	
25/4-9 S	DC	1640	1650	19843	HF	clyst	0.24	0.03	10	-ooooo	M/P	
25/4-9 S	DC	1740	1750	19844	HF	clyst/sst	0.26	0.04	7	-oo-oo	P	
25/4-9 S	DC	1840	1850	19845	HF	clyst/sst	0.23	0.03	15	-oo--o	M	See data sheet
25/4-9 S	DC	1950	1960	19846	HF	clyst	0.26	0.02	9	-oo--o	P	
25/4-9 S	DC	2040	2050	19847	HF	clyst/sst	0.31	0.04	21	oooo-o	M/G	
25/4-9 S	DC	2140	2150	19848	HF	clyst/sst	0.28	0.03	6	-oo--o	P	
25/4-9 S	COCH	2247.50	2247.50	19849	HF	clyst	0.38	0.04	22	oooooo	G	
25/4-9 S	DC	2285	2290	19850	HF	clyst/sst	0.33	0.05	13	-oo--o	M/P	See data sheet
25/4-9 S	DC	2360	2365	19851	HF	clyst	barren					See data sheet

Legend to Vitrinite reflectance data

Lithology code		Sample quality		Sample preparation	
sst	Sandstone	G	Good	HF	Sample treatment with hydrofluoric acid prior to analysis
slst	Siltstone	M	Moderate		
clyst	Claystone	P	Poor	Bulk	Sample treated as bulk rock
sh	Shale	st	Hydrocarbon staining		
lst	Limestone				
coal	Coal				

Sample description and measurement evaluation (perfect sample characterised as: oooooo)

Sign order	Parameter	Sign	Sign legend:
1	Abundance of vitrinite	-o	- May give too low vitrinite reflectance sample value
2	Identification of vitrinite	-o+	o Reliable vitrinite reflectance sample value
3	Type of vitrinite	-o+	+ May give too high vitrinite reflectance sample value
4	Vitrinite fragment size	-o	
5	Vitrinite surface quality	-o	
6	Abundance of pyrite	o+	

Experimental Procedures

All procedures follow NIGOGA, 4th Edition. Below are brief descriptions of procedures/analytical conditions.

Sample preparation
Cuttings samples are washed in water to remove mud. When oil based mud is used, soap (Zalo) is added to the sample and the sample is washed thoroughly in warm water to remove mud and soap.

Vitrinite reflectance analysis
The samples are prepared either as "whole rock" or are treated with hydrochloric and hydrofluoric acid prior to further preparation. The aim of the acid treatment is to avoid soft and expanding mineral phases in order to ensure good polishing quality. The whole rock or the kerogen resulting from the acid treatment is embedded in an epoxy resin to make briquettes, ground flat and polished using 0.25 micron diamond paste and magnesium oxide as the two final steps.

The analytical equipment used is a Zeiss MPM 03 photometer microscope equipped with an Epiplan-Neofluar 40/0.90 oil objective. The sensitive measuring spot is kept constant for all measurements at about 2.5 micron in diameter. The measurements are made through a green band pass filter (546 nm) and in oil immersion (refractive index 1.515 at 18 °C). The readings are made without a polarizer and using a stationary stage. This procedure is called measurement of random reflectance (%Rm). The photometer is calibrated daily against a standard of known reflectance (%Rm = 0.588) and routinely (daily) checked against two other standards of significant different reflectances (%Rm = 0.879 and 1.696). A deviation from these values of less than ± 0.01 and ± 0.02 respectively is considered acceptable. The calibration is routinely checked during the course of measurements at least every hour, and a deviation of less than ± 0.005 is considered acceptable.

For each sample at least 20 points are measured if possible, and quality ratings are given to various important aspects, which may affect the measurements. These aspects are abundance of vitrinite, uncertainties in the identification of indigenous vitrinite, type of vitrinite, particle size, particle surface quality and abundance of pyrite.