DRILLING MUD SUMMARY

Table 2 below shows the types of mud that was used during the drilling phase of well 35/1-1.

Hole Section	Mud Type	Commercial Name	Producer	Base	Additives
36”	Seawater	-			Bentonite sweeps
26”	Seawater	-			Bentonite sweeps
17 ½”	Water based	Glydril	MI Anchor	Water	KCl brine w/glycol
12 ¼”	Oil based	Versaport	MI Anchor	Mineral Oil	$CaCl_2$, lime
8 ½”	Oil based	Versaport	MI Anchor	Mineral Oil	$CaCl_2$, lime

TABLE 2: DRLLING MUD SUMMARY

The mud system used in the 36” and 26” hole sewctions (seawater) did not have any effect on the data collection.
The high concentration of KCl combined with the large hole diameter in the 17 ½” hole section had an effect on the LWD resistivity readings and in particular on the shallow resistivity reading. The shallow resistivity readings from the wireline run were also effected, but these were not used for the generation of the CPI. Correction algorithms may be used to adjust these logs.
The oil based mud used in the 12 ¼” and 8 ½” hole sections had an effect on the wireline porosity determinations. This effect is normalized with the use of the correct parameters in the porosity equations.

GEOCHEMICAL REPORT ON WELL NOCS 35/1-1

Authors: Peter B. Hall

Geolab Nor A/S
Hornebergveien 5
P.O. Box 5740 Fossegrenda
7002 Trondheim
Norway

Date: November 2002

CONTENTS

Chapter 1

INTRODUCTION

1.1 General Well Information

The aim of the analytical program was to evaluate the migrated hydrocarbons, if any, present in this well. A total of 22 swc, 7 oil/oil-water samples, a Versaport mud sample and the mineral oil used in the mud were analysed by various techniques including, GHM (thermal extraction and pyrolysis-gc of swc samples), solvent extraction, liquid chromatography (MPLC), gas chromatography (saturated and aromatic hydrocarbon fractions) and GC-MS analysis. These samples covered the interval from 3970 m to 4473 m.

An oil-based mud system (Versaport) was used in drilling the well. This caused considerable problems in the interpretation of the presence or absence of migrated hydrocarbons as normal procedures for removal of these i.e. washing/solvent extraction would remove migrated hydrocarbons as well. The analyses selected were those where it was felt that there was a chance of detecting migrated hydrocarbons.

1.2 Analytical Program

The analytical program for well NOCS 35/1-1 was decided by Conoco-Phillips in consultation with Geolab Nor. The numbers of samples for the individual analyses are listed in Table 1 in Appendix 1.

Table 1a Analytical Program for NOCS 35/1-1 oils and muds

Sample Depth (m)	Sample Type	description	Bulk Sample Code	Topping	Whole Oil GC	MPLC & Deasphaltene#	Sat GC	Aro GC	Sat GCMS
Table nos.					3	4	5	6	7
4044	oil/water	MDT 7-98A MPSR 1020	W37/0023-0	x	x	x	x	x	x
4323,5	oil	MRSC 143	W37/0024-0		x				
4323,5	oil/water	MDT 9-98A MPSR 1043	W37/0025-0		x				
4323,5	oil/water	MRSC 143 3	W37/0026-0		x				
4323,5	oil/water	MDT 11-92A MPSR 168	W37/0027-0		x				
4473	oil	MRSC 165	W37/0028-0		x				
4473	oil/water/emulsion	MPSC-165	W37/0029-0		x				
	Mineral oil	EDC 95/11	W37/0030-0		x	x	x	x	
	mud	Versaport	W37/0031-0		x	x	x	x	

Table 1b Analytical Program for NOCS 35/1-1 SWC samples

Sample Depth (m)	Sample Type	description	Bulk Sample Code	Lithology Description	GHM Thermal extraction & Pyrolysis-GC
Table nos.				8a	8b-c
3970,5	swc	sandstone	W37/0001-0	x	x
3977	swc	sandstone	W37/0002-0	x	x
3982	swc	sandstone	W37/0003-0	x	x
4004,5	swc	sandstone	W37/0004-0	x	x
4013,5	swc	sandstone	W37/0005-0	x	x
4025	swc	sandstone	W37/0006-0	x	x
4032	swc	sandstone	W37/0007-0	x	x
4044	swc	sandstone	W37/0008-0	x	x
4051	swc	sandstone	W37/0009-0	x	x
4071,5	swc	sandstone	W37/0010-0	x	x
4127,5	swc	sandstone	W37/0011-0	x	x
4251	swc	sandstone	W37/0012-0	x	x
4262	swc	sandstone	W37/0013-0	x	x
4264,51	swc	sandstone	W37/0014-0	x	x
4270,5	swc	sandstone	W37/0015-0	x	x
4283,5	swc	sandstone	W37/0016-0	x	x
4299	swc	sandstone	W37/0017-0	x	x
4309	swc	sandstone	W37/0018-0	x	x
4323	swc	sandstone	W37/0019-0	x	x
4327	swc	sandstone	W37/0020-0	x	x
4448	swc	sandstone	W37/0021-0	x	x
4470,4	swc	sandstone	W37/0022-0	x	x
				22	**22**

Sample description	type	Depth (m)	Sample code
MDT 7-98A MPSR 1020	oil/water	4044	W37/0023-0
MRSC 143	oil	4323,5	W37/0024-0
MDT 9-98A MPSR 1043	oil/water	4323,5	W37/0025-0
MRSC 143 3	oil/water	4323,5	W37/0026-0
MDT 11-92A MPSR 168	oil/water	4323,5	W37/0027-0
MRSC 165	oil	4473	W37/0028-0
MPSC-165	oil/water/emulsion	4473	W37/0029-0
EDC 95/11	Mineral oil		W37/0030-0
Versaport	mud		W37/0031-0

Upper depth (m)	Lower depth (m)	Sample type	Desc.	iC4	nC4	iC5	nC5	2,2DM C4	2,3DM C4	2MC 5	3MC 5	nC6	MCyC5	Benz	CyC6	2MC 6	3MC 6	1,3ci DMCyC 5	1,3tr DMCyC 5
4044	4044	oil	7-98A,1	0	0	0	0	0,19	0,29	0	0	20,2	4,92	0,37	3,36	1,84	1,53	0,2	0,19

1,2tr DMCyC 5	nC7	MCyC6	Tol	nC8	p/m-Xyl	Sample number
0,44	1,88	3,44	1,8	2,22	1,42	W37/0023-0

Thompson Ratios	A	B	X	W	C	I	F	H	U	R	S
	0,02	0,96	0,64	1,10	3,25	4,06	0,55	14,60	0,68	1,02	106,42

Thompson ratio	Peaks in ratio
A	Benzene/nC6
B	Toluene/nC7
X	m,p-Xylene/nC8
W	Benzene*10/CyC6
C	(nC6+nC7)/(CyC6+ MCyC6)
I	(2MC6+3MC6)/(13ciDMCyC5+13trDMCyC5+12trDMCyC5)
F	nC7/MCyC6
H	nC7*100/sum CyC6 to MCyC6
U	CyC6/MCyC5
R	nC7/2MC6
S	nC6/22DMC4

Upper depth (m)	Lower depth (m)	Sample type	Desc.	oil (mg) for MPLC	Sat.	Aro.	NSO	Asph.	TOC(e)	HC	Non-HC	Sample number
		mud	Versaport	46,2	44,37	0,57	0,96	0,3	0	44,94	1,26	W37/0031-0
4044	4044	oil	7-98A,1020	46,6	44,26	1,29	0,55	0,5	0	45,55	1,05	W37/0023-0

Upper depth (m)	Lower depth (m)	Sample type	Desc	Sat/ EOM	Aro/ EOM	Asph/ EOM	NSO/ EOM	HC/ EOM	Non-HC/ EOM	Sat/ Aro	HC/Non-HC	Sample number
		mud	Versaport	96,04	1,24	0,65	2,07	97,28	2,72	77,33	35,78	W37/0031-0
4044	4044	oil	7-98A,1020	94,99	2,76	1,07	1,18	97,74	2,26	34,43	43,34	W37/0023-0

Upper depth (m)	Lower depth (m)	Sample type	Desc	nC15	nC16	Norpristane	nC17	Pristane	nC18	Phytane	nC19	nC20
		mud	Versaport	3438170	3123398	1925317	2678315	1104499	2018850	754420	1491488	954319
4044	4044	oil	7-98A,1020	3139172	2888949	1713570	2451682	917733	1857838	638363	1360046	833283

nC21	nC22	nC23	nC24	nC25	nC26	nC27	nC28	nC29	nC30	nC31	nC32	nC33	nC34	Sample number
466217	191229	78481	33233	11073	8008	0	0	0	0	0	0	0	0	W37/0031-0
411817	174477	71567	39739	20480	16668	10830	7729	7319	9851	6596	6455	0	0	W37/0023-0

Upper depth (m)	Lower depth (m)	Sample type	Desc	Prist. /nC17	Prist. /Phyt.	(Prist./nC17) /(Phyt./nC18)	CPI 1	Phytane /nC18	nC17/ (nC17+nC27)	(Pristane+Phytane)/ (nC17+nC18)	Sample number
		mud	bulk fraction	0,41	1,46	1,1	0,83	0,37	1	0,4	W37/0031-0
4044	4044	oil	7-98A,1020	0,37	1,44	1,09	0,86	0,34	1	0,36	W37/0023-0

Upper depth (m)	Lower depth (m)	Sample type	Desc	nC15	nC16	Norpristane	nC17	Pristane	nC18	Phytane	nC19	nC20	nC21	nC22	nC23	nC24	nC25	nC26
		mud	Versaport	30,8	28,0	17,2	24,0	9,9	18,1	6,8	13,4	8,5	4,2	1,7	0,7	0,3	0,1	0,1
4044	4044	oil	7-98A,1020	32,0	29,5	17,5	25,0	9,4	18,9	6,5	13,9	8,5	4,2	1,8	0,7	0,4	0,2	0,2

nC27	nC28	nC29	nC30	nC31	nC32	nC33	nC34	Sample number
0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	W37/0031-0
0,1	0,1	0,1	0,1	0,1	0,1	0,0	0,0	W37/0023-0

Upper depth (m)	Lower depth (m)	Sample type	Desc	2MN	1MN	BPh	2EN	1EN	2.6+2.7 DMN	1.6DMN	1.5DMN	1.3.7TMN	1.3.6TMN	1.3.5TMN
		mud	Versaport											
4044	4044	oil	7-98A,1020											**no data**

1.4.6+ 2.3.6 TMN	P	3MP	2MP	9MP	1MP	DBT	4MDBT	2+3 MDBT	1MDBT	Sample number
										W37/0031-0
										W37/0023-0

Table 7a GC-MS analysis Triterpane ratios (peak heights) from m/z 191 fragmentograms for NOCS 35/1-1

Conoco-Phillips

Upper depth (m)	Lower depth (m)	Sample type	Desc	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5	Ratio 6	Ratio 7	Ratio 8	Ratio 9	Ratio 10	Ratio 11	Ratio 12	Ratio 13	Ratio 14	Sample number
4044	4044	oil	7-98A,1020	10,42	0,91	0,18	0,69	0,41	0,01	0,02	0,03	0,02	0,05	0,81	0,38	0,19	58	W37/0023-0

Table 7b GC-MS analysis Sterane ratios (peak heights) from m/z 217 fragmentograms for NOCS 35/1-1

Conoco-Phillips

Upper depth (m)	Lower depth (m)	Sample type	Desc	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5	Ratio 6	Ratio 7	Ratio 8	Ratio 9	Ratio 10	Sample number
4044	4044	oil	7-98A,1020	0,26	32,47	56,39	1,09	0,67	0,19	0,14	0,39	0,48	0,96	W37/0023-0

Table 7c GC-MS analysis Triterpane peak heights from m/z 191 fragmentograms for NOCS 35/1-1

Conoco-Phillips

Upper depth (m)	Lower depth (m)	Sample type	Desc	23/3 (P)	24/3 (Q)	25/3 (R)	24/4 (S)	26/3 (T)	27Ts (A)	27Tm (B)	28ab (Z)
4044	4044	oil	7-98A,1020	31769	12710	4843,8	15337	4816,5	6722,1	70030	4404,5

Table 7c GC-MS analysis Triterpane peak heights from m/z 191 fragmentograms for NOCS 35/1-1

Conoco-Phillips

25nor30ab (Z1)	29ab (C)	29Ts (C1)	30d (X)	29ba (D)	30O	30ab (E)	30ba (F)	30G
2815,1	175467,8	7044,7	3736,7	19080	2811,1	255422,4	61818	71244

Table 7c GC-MS analysis Triterpane peak heights from m/z 191 fragmentograms for NOCS 35/1-1

Conoco-Phillips

31abS (G)	31abR (H)	31ba (I)	32abS (J1)	32abR (J2)	33abS (K1)	33abR (K2)	34abS (L1)	34abR (L2)	35abS (M1)	35abR (M2)	Sample number
41095,2	30164,4	7188	16419,4	11888	9637	6726	4601	3143	2550	1818	W37/0023-0

Table 7d GC-MS analysis Sterane peak heights from m/z 217 fragmentograms for NOCS 35/1-1

Conoco-Phillips

Upper depth (m)	Lower depth (m)	Sample type	Desc	21a (u)	22a (v)	27dbS (a)	27dbR (b)	27daR (c)	27daS (d)	28dbS (e)	28dbR (f)	28daR+ 27aaS	29dbS+ 27bbR	28daS+ 27bbS
4044	4044	oil	**7-98A,1020**	4047,9	3086,9	9132	7779,7	3348,2	1912,1	3943,7	2263,6	12041	8822,7	3858,6

Table 7d GC-MS analysis Sterane peak heights from m/z 217 fragmentograms for NOCS 35/1-1

Conoco-Phillips

27aaR (j)	29dbR (k)	29daR (l)	28aaS (m)	29daS+ 28bbR	28bbS (o)	28aaR (p)	29aaS (q)	29bbR (r)	29bbS (s)	29aaR (t)	Sample number
25391	4985,3	2201	3540,6	4247,3	5264	7943,4	6003,8	5810	6146,7	12487	W37/0023-0

Table 7e GC-MS analysis Triterpane peak heights from m/z 177 fragmentograms for NOCS 35/1-1

Conoco-Phillips

Upper depth (m)	Lower depth (m)	Sample type	Desc	25nor28ab	25nor30ab	Sample number
4044	4044	oil	**7-98A,1020**	3260,1	2506,2	W37/0023-0

Table 7f GC-MS analysis Sterane peak heights from m/z 218 fragmentograms for NOCS 35/1-1

Conoco-Phillips

Upper depth (m)	Lower depth (m)	Sample type	Desc	27bbR (h)	27bbS (i)	28bbR (n)	28bbS (o)	29bbR (r)	29bbS (s)	30bbR (x)	30bbS (y)	Sample number
4044	4044	oil	**7-98A,1020**	8022,9	5834	6611,3	7685,5	8330,7	10647	1426,8	1258,6	W37/0023-0

Biomarker ratio definition

Conoco-Phillips

	Triterpanes	**Steranes**
Ratio 1	27Tm/27Ts	27dβS/(27dβS+27ααR)
Ratio 2	27Tm/(27Tm+27Ts)	29ααS/(29ααS+29ααR)
Ratio 3	27Tm/(27Tm+30αβ+30βα)	2*(29ββR+29ββS)/(29ααS+29ααR+2*[29ββR+29ββS])
Ratio 4	29αβ/30αβ	(27dβS+27dβR+27dαR+27dαS)/(29dβS+29dβR+29dαR+29dαS)
Ratio 5	29αβ/(29αβ+30αβ)	(29ββR+29ββS)/(29ααS+29ββR+29ββS)
Ratio 6	30d/30αβ	21α+22α/(21α+22α+29ααS+29ββR+29ββS+29ααR)
Ratio 7	28αβ/30αβ	21α+22α/(21α+22α+28dαS+28ααS+29dαR+29ααS+29ββR+29ββS+29ααR)
Ratio 8	28αβ/29αβ	(29ββR+29ββS)/(29ααS+29ββR+29ββS+29ααR)
Ratio 9	28αβ/(28αβ+30αβ)	29ααS/29ααR
Ratio 10	24/3/30αβ	(29ββR+29ββS)/29ααR
Ratio 11	30αβ/(30βα+30αβ)	
Ratio 12	(29αβ+29βα)/(29αβ+29βα+30αβ+30βα)	
Ratio 13	(29βα+30βα)/(29αβ+30αβ)	
Ratio 14	32αβS/(32αβS+32αβR) %	

	Desc.

Upper depth (m)	Lower depth (m)	Sample type	Sample number
3970,5	3970,5	swc	W37/0001-0
3977	3977	swc	W37/0002-0
3982	3982	swc	W37/0003-0
4004,5	4004,5	swc	W37/0004-0
4013,5	4013,5	swc	W37/0005-0
4025	4025	swc	W37/0006-0
4032	4032	swc	W37/0007-0
4044	4044	swc	W37/0008-0
4051	4051	swc	W37/0009-0
4071,5	4071,5	swc	W37/0010-0
4127,5	4127,5	swc	W37/0011-0
4251	4251	swc	W37/0012-0
4262	4262	swc	W37/0013-0
4264,51	4264,51	swc	W37/0014-0
4270,5	4270,5	swc	W37/0015-0
4283,5	4283,5	swc	W37/0016-0
4299	4299	swc	W37/0017-0
4309	4309	swc	W37/0018-0
4323	4323	swc	W37/0019-0
4327	4327	swc	W37/0020-0
4448	4448	swc	W37/0021-0
4470,4	4470,4	swc	W37/0022-0

Table 8b Thermal extraction gas chromatography C1-C11 hydrocarbons (peak areas)
% of C_1-C_{11} and ratios for NOCS 35/1-1

Conoco-Phillips

peak areas

Upper depth (m)	Lower depth (m)	nC6	nC7	MCyC6	Toluene	nC8	ethylbenzene	m,p-Xylene	o-Xylene	nC9	nC10	Sum C1-C11
4013,5	4013,5	108053	118041	139511	289044	100938	132717	264813	101977	51053	115228	8947709
4127,5	4127,5	196135	134273	186925	229203	75630	129213	261495	64167	62329	108022	10563624
4251	4251	78714	127639	295211	229307	109650	150292	258236	66760	56601	93714	9256229
4262	4262	45891	57854	152535	142712	47822	118372	104791	128937	24998	50888	8907805

Table 8b Thermal extraction gas chromatography C1-C11 hydrocarbons (peak areas)
% of C_1-C_{11} and ratios for NOCS 35/1-1

Conoco-Phillips

		% C1-C11peak area									
Upper depth (m)	**Lower depth (m)**	**nC6**	**nC7**	**MCyC6**	**Toluene**	**nC8**	**ethyl benzene**	**m,p-Xylene**	**o-Xylene**	**nC9**	**nC10**
4013,5	4013,5	1,21	1,32	1,56	3,23	1,13	1,48	2,96	1,14	0,57	1,29
4127,5	4127,5	1,86	1,27	1,77	2,17	0,72	1,22	2,48	0,61	0,59	1,02
4251	4251	0,85	1,38	3,19	2,48	1,18	1,62	2,79	0,72	0,61	1,01
4262	4262	0,52	0,65	1,71	1,60	0,54	1,33	1,18	1,45	0,28	0,57

Table 8b Thermal extraction gas chromatography C1-C11 hydrocarbons (peak areas)
% of C_1-C_{11} and ratios for NOCS 35/1-1

Conoco-Phillips

		peak ratios		
Upper depth (m)	**Lower depth (m)**	**nC7/ MCyC6**	**Toluene/ nC7**	**m,p-Xylene/ nC8**
4013,5	4013,5	0,85	2,45	2,62
4127,5	4127,5	0,72	1,71	3,46
4251	4251	0,43	1,80	2,36
4262	4262	0,38	2,47	2,19

Upper depth (m)	Lower depth (m)	Sample type	Desc	%Lithology	C1	C2-C5	C6-C14	C15+	GORP	Sample number
3970,5	3970,5	swc	sandstone/sand	100	1,89	12,7	31,12	54,29	0,17	W37/0001-1
3977	3977	swc	sandstone/sand	100	5,22	8,82	37,23	48,73	0,16	W37/0002-1
3982	3982	swc	sandstone/sand	100	2,07	11,84	37,32	48,77	0,16	W37/0003-1
4004,5	4004,5	swc	sandstone/sand	100	3,15	14,45	46,78	35,63	0,21	W37/0004-1
4013,5	4013,5	swc	sandstone/sand	100	7,1	17,42	38,47	37,02	0,32	W37/0005-1
4025	4025	swc	sandstone/sand	100	5,32	10,82	38,01	45,85	0,19	W37/0006-1
4032	4032	swc	sandstone/sand	100	3,86	12,94	39,11	44,09	0,2	W37/0007-1
4044	4044	swc	sandstone/sand	100	5,18	8,26	35,37	51,2	0,16	W37/0008-1
4051	4051	swc	sandstone/sand	100	5,09	10,81	35,66	48,43	0,19	W37/0009-1
4071,5	4071,5	swc	sandstone/sand	100	6,14	10,99	29,82	53,05	0,21	W37/0010-1
4127,5	4127,5	swc	sandstone/sand	100	4,72	13,78	42,74	38,77	0,23	W37/0011-1
4251	4251	swc	sandstone/sand	100	10,05	23,27	49,87	16,81	0,5	W37/0012-1
4262	4262	swc	sandstone/sand	100	6,52	24,57	35,44	33,48	0,45	W37/0013-1
4264,51	4264,51	swc	sandstone/sand	100	4,84	8,58	37,91	48,67	0,16	W37/0014-1
4270,5	4270,5	swc	sandstone/sand	100	2,86	11,48	38,35	47,31	0,17	W37/0015-1
4283,5	4283,5	swc	sandstone/sand	100	4,28	14,9	41,81	39,01	0,24	W37/0016-1
4299	4299	swc	sandstone/sand	100	1,31	7,81	36,22	54,66	0,1	W37/0017-1
4309	4309	swc	sandstone/sand	100	3,44	12,6	40,01	43,94	0,19	W37/0018-1
4323	4323	swc	sandstone/sand	100	1,61	11,37	30,7	56,32	0,15	W37/0019-1
4327	4327	swc	sandstone/sand	100	0,53	6,2	16,95	76,31	0,07	W37/0020-1
4448	4448	swc	sandstone/sand	100	4	16,19	54,03	25,78	0,25	W37/0021-1
4470,4	4470,4	swc	sandstone/sand	100	1,37	12,02	32,54	54,07	0,15	W37/0022-1

GORP = gas:oil ratio