App D MDT pressure measurements

Table 4.7: MDT-GR Run 3A

Test no	Formation	Depth m MD RKB	Depth m TVD SS	Hydrost. Pressure Before bar	Formation Pressure bar	Hydrost. Pressure After bar	Mobility md/cp	Temp DegC	Gradient g/cc	Comments
1	Danian SS	3902.2	3877.0	602.45	557.48	601.986	2.2	79.2	1.466	Good
2	Danian SS	3905.9	3880.7	602.53	-	602.48	-	81.1	-	No seal
3	Danian SS	3905.99	3880.8	602.52	-		-	80.8	-	Tight
4	Danian SS	3906.9	3881.7	602.54	557.43	602.31	26.4	80.7	1.464	Good
5	Danian SS	3914.1	3888.9	604.08	-	603.62	-		-	Tight
6	Danian SS	3920.9	3895.7	605.25	-		-		-	Tight
7	Danian SS	3920.9	3895.7	604.60	540.49	604.381	0.02	82.8	1.414	Unstable
8	Danian SS	3922.2	3897.0	604.89	558.11	604.542	1.9	83.0	1.460	Good
9	Danian SS	3927.8	3902.6	605.96	558.61	605.508	4.5	83.0	1.459	Good
10	Danian SS	3937	3911.8	607.60	559.50	607.087	11.6	83.4	1.458	Good
11	Danian SS	3952.5	3927.3	609.10	561.14	609.662	48.8	84.3	1.456	Good
12	Danian SS	3967.8	3942.6	612.38	562.45	611.93	9.3	85.6	1.454	Good
13	Danian SS	3972.6	3947.4	613.05	562.93	612.49	129.90	86.50	1.454	Good
14	Danian SS	3978.4	3953.2	613.30	-	613.17	0.9	87.6	-	Tight
15	Danian SS	3981.4	3956.2	613.88	-	613.73	1.9	87.8	-	Tight
16	Danian SS	3995.5	3970.3	616.61	-	616.37	2.9	87.9	-	Tight
17	Danian SS	3995.7	3970.5	616.24	574.00	615.89	0.3	88.4	1.474	Supercharged
18	Danian SS	3997	3971.8	616.24	565.41	615.86	25	88.7	1.451	Good
19	Danian SS	4018.1	3992.9	620.36	-	620.06	-	88.4	-	Tight
20	Danian SS	4064.1	4038.9	626.36	-	626.25	-	91.6	-	Tight
21	Danian SS	4070.2	4045.0	627.71	573.00	627.35	2.9	92.7	1.444	Tight
22	SHETLAND GP	4076.5	4051.3	628.85	-	629.56	-	92.7	-	Tight
23	SHETLAND GP	4078.5	4053.3	628.98	-	628.78	-	92.9	-	Tight
24	SHETLAND GP	4097	4071.8	632.36	-	632.08	-	93.3	-	Tight
25	SHETLAND GP	4111.5	4086.3	634.87	-	634.53	-	93.9	-	Tight
26	SHETLAND GP	4122	4096.8	636.45	-	636.18	-	94.7	-	Tight
27	SHETLAND GP	4127	4101.8	637.12	-	636.93	-	95.3	-	Tight
28	SHETLAND GP	4139.5	4114.3	639.27	-	639.02	-	95.7	-	Tight
29	SHETLAND GP	4140.5	4115.3	639.06	-	638.59	-	96.7	-	Tight
30	Danian SS	4070.2	4045.0	573.06	573.06		0.7	95.8	1.444	Good? Repeated test reading same
Sampling										
31	Danian SS	3921.9	3896.7	604.62	-		13.9		-	Looking for sample point
32	Danian SS	3920.9	3895.7		-				-	Abandoned too tight for sampling
33	Danian SS	3920.7	3895.5		-				-	Abandoned too tight for sampling
34	Danian SS	3921.8	3896.6	604.56	-		3.2		-	Abandoned too tight for sampling
35	Danian SS	3921.9	3896.7		-		1.3		-	Abandoned too tight for sampling
36	Danian SS	3922.0	3896.8		-				-	Abandoned too tight for sampling
37	Danian SS	3921.9	3896.7		558.09		3.1		1.460	Abandoned too tight for sampling
38	Danian SS	3952.2	3927.0		561.088		16.1	91.3	1.456	Sampling
39	Danian SS	3952.2	3927.0		561.091		14.9		1.456	Pretest after sampling
40	Danian SS	3902.2	3877.0		557.259		7.7		1.465	Abandoned too tight for sampling
41	Danian SS	3902.1	3876.9		557.295		2.3		1.465	Abandoned too tight for sampling
42	Danian SS	3902.0	3876.8		557.348		1.8		1.465	Abandoned too tight for sampling
43	Danian SS	3903.0	3877.8		557.281		284.3	84.2	1.465	Good, pretest before sampling

Table 4.8 MDT-GR Run 3B

Test no	Formation	Depth m MD RKB	Depth m TVD SS	Hydrost. Pressure Before bar	Formation Pressure bar	Hydrost. Pressure After bar	Mobility md/cp	Temp DegC	Gradient g/cc	Comments
1	Danian SS	3937.1	3937.1	606.36	-				-	Abandoned too tight for sampling
2	Danian SS	3937.1	3937.1	606.98	559.607		9.7		1.449	Abandoned too tight for sampling
3	Danian SS	3937.0	3937.0		559.717		65.7		1.449	Sampling

Table 4.9 MDT-GR Run 3C

Test no	Formation	Depth m MD RKB	Depth m TVD SS	Hydrost. Pressure Before bar	Formation Pressure bar	Hydrost. Pressure After bar	Mobility md/cp	Temp DegC	Gradient g/cc	Comments
1	Danian SS	3920.8	3895.6						-	Sampling with DP.
2	Danian SS	3968.0	3942.8	609.83	562.44		13.7		1.454	Pretest before scanning
3	Danian SS	3967.9	3942.7	609.63	562.41		83.4	99.2	1.454	Fluid scanning
4	Danian SS	3955.0	3929.8	607.71			2.6		0.000	Good, Pretest before scanning
5	Danian SS	3954.9	3929.7	607.68			2.1		0.000	Good, Pretest before scanning
6	Danian SS	3954.8	3929.6	607.68					0.000	Lost seal
7	Danian SS	3954.7	3929.5	607.66					0.000	Good, Pretest before scanning
8	Danian SS	3954.9	3929.7	607.67	561.22		19.6		1.456	Scanning
9	Danian SS	3934.1	3908.9	604.33				98.9	-	Pretest before scanning, tight
10	Danian SS	3934.0	3908.8	604.37	559.21		13.9	98.4	1.458	Good
11	Danian SS	3934.1	3908.9	604.32				98.0	-	Pretest before scanning, tight.
12	Danian SS	3933.9	3908.7	604.30					-	Lost seal
13	Danian SS	3933.9	3908.7	604.30					-	Lost seal
14	Danian SS	3934.0	3908.8	604.30					-	Lost seal
15	Danian SS	3933.8	3908.6	604.34					-	Tight
16	Danian SS	3934.0	3908.8	604.21					-	Tight
17	Danian SS	3933.9	3908.7	604.14					-	Tight
18	Danian SS	3934.0	3908.8	604.23					-	Tight
19	Danian SS	3934.0	3908.8	604.23					-	Tight

4.9 Reservoir fluid sampling

Samples were collected in the Danian Sandstone. Gas samples were encountered at depth 3903 and 3952.2 m. The other two samples at 3937 and 3920.8 m proved formation water.

Table 4.8 Reservoir fluid samples

Sample depth (m MD)	Run No.	Chamber (volume)	Drawdown (bar)	Formation Pressure (bar)	Pump Volume* (litres)	Dead volume cc	Opening pressure (bar)	Remarks
3952.2	3A	1 Gal	25.1	561.088	70	-	482.63	+Geochemical 8395-2
3952.2	3A	420 cc	24.8	561.088	76	16.2	482.63	
3952.2	3A	420 cc	24.5	561.088	82	15.7	506.76	
3952.2	3A	420 cc	24.1	561.088	87.3	14.8	482.63	Used offshore
3903.0	3A	1 Gal	13.7	557.281	163	-	503.32	+ Geochemical B-319
3903.0	3A	420 cc	1.6	557.281	67*	10.9	506.76	
3903.0	3A	420 cc	1.5	557.281	75*	13.9	489.53	
3903.0	3A	420 cc	1.9	557.281	83.4*	14	496.42	
3937.0	3B	420 cc	140	559.717	15	14	44.2	Mud filtrate
3937.0	3B	1 Gal	240	559.717	78	-	91.8	Emptied offshore
3937.0	3B	1 Gal	211	559.717	88	-	62	
3920.8	3C	420 cc	60	358	275	16.2	112	
3920.8	3C	420 cc	40	358	363	15.7	116	
3920.8	3C	420 cc	39	358	378	13.9	126	
3920.8	3C	1 Gal	40	358	435	-	129	100 ml used in analysis

1.4 Drilling summary

1.4.1 Casing

Table 1.1 Casing programme summary

Casing	Shoe depth [mMD, drillers depth]	LOT / FIT [Equivalent mud weight]
Well 6302/6-U-1		
30"	1363	N/A
20"	2116	N/A
Well 6302/6 -1		
30"	1363	N/A
20"	1960	FIT: 1.29 sg
16"	2380	LOT: 1.60 sg + 1.46 sg
13 3/8"	3035	FIT: 1.49 sg
9 5/8"	3840	LOT: 1.72 sg

1.4.2 Drilling fluids

Table 1.2 Drilling fluids summary

Section	Section TD [m MD, drillers dpth]	Max mud weight [g/cm³]	Mud type
Well 6302/6-U-1			
36"	1366	1.03	Seawater / high visc. Sweeps
26"	2122	1.03	Seawater / high visc. Sweeps
Killmud #1	2122	1.40	WBM mix of Glydrill, Bentonite and CMC
Killmud #2	2122	1.45	WBM with prehydrated Bentonite
Killmud #3	2122	1.47	Glydrill (KCl brine, Glycol and Polymers)
Well 6302/6 -1			
36"	1366.5	1.03	Seawater / high visc. Sweeps
26"	1965	1.03	Seawater / high visc. Sweeps
17"	2390	1.23	Glydrill Deepwater
12 ¼"	3842	1.40	Glydrill Deepwater
8 ½"	4230	1.56	Glydrill Deepwater

5.11.6 Drilling fluids

Figure 5.5 Summary of Drilling fluids program

Well: 6302/6-1
Field: PL 251, Tulipan
Rig: Eirik Raude

DRILLING FLUIDS PROGRAMME

Rev. 2 - 08.12.2005

HOLE SIZE	HOLE TVD MD	CASING SIZE	CASING TVD MD	MUD TYPE	MW [SG]	LGS [KG/m³]	10 sec. [Pa]	10 min. [Pa]	Fann 100 rpm	Fann 3 rpm	FV [sec]	PV [mPa]	API FL [ml]	pH	MBT [KG/m³]	NaCl (WPS)	Kcl (WPS)	Gluc. [%]	MEG %	Ca++ mg/l	Total volume / Old volume / New volume / Usage [m³]
42"x 36"	1366,5 1366,5	30"	1363 1363	Sea Water High vis. Swweps Bentonite Displ.fluid	1,03 - 1,35						200		<12								419 318 101 240
				COMMENTS: The section was drilled by using sea water - pumping hivis sweeps. Rec. 318 m3 Bentonite spud mud from well: 6302/6-U-1, 26" section. Built 101 m3 Bentonite spud mud and transferred the remaining 179 m3 over to the next section. Built 101 m3 Bentonite spud mud and transferred the remaining 179 m3 over to the next section. The system performed as expected, no need for changes																
26"	1965 1965	20"	1959,8 1959,8	Sea Water High vis. sweeps KCl/PAC Displ.fluid	1,03 - 1,35 -						122 - 127			8 - 9							1254 385 869 1254
				COMMENTS: The 26" section was drilled using seaweater and CMC hivis sweeps due to MWD readings. The system performed as expected and no changes required. Rec. 179 m3 spud mud from 36" section and 206 m3 1,47 sg Glydril mud from well: 6302/6-U-1, 26" section.																
17"x 20" (optional)	2390 2390	16"	2380,3 2380,3	Glydril DW	1,21 - 1,25	7 - 127	4 - 6	6 - 11	<30	7 - 11		13 - 18	2 - 3,8	8,2 - 11,6	<60	108 - 251	49 - 93	4 - 5,5	13 - 14,5	460 - 900	1950 1698 252 1018
				COMMENTS:The section was drilled by use of Glydril DW. Ran 16" liner.Unable to set it. Cemented as per programme. Tested liner without success. Squeezed 7.2m3 cement into liner lap. 6.8m3 + 14 m3 1.60 SG spacer left in hole. PO and circulated. Dumped approx. 140m3 due to heavy cement contamination, pH >11 and high MW from blended 1.60sg spacer. RIH with 17 ½" clean out assy. Drilled cement and cleaned out to the liner lap. 86m3 mud was dumped due to cement contamination. RIH with 14 ¾" assy. Tagged TOC at 2307 and drilled cement to 2352. At this stage mud was so badly contaminated that it was decided to displace to new mud. A total of 691 m3 Glydril DW was discharged due to heavy contam. The first premixes made in (1100 m3) Kristiansund gave a total of 223 kg/m3 of NaCl in the waterphase and 100 kg/m3 of KCl in the waterphase .Testing on the rig showed that some of the salt had crystallized out of the premix due to oversaturation of the premix. It is recommended to use no more than 60 kg/m3 KCl because too much KCl may lead to precipitation of salt, mostly NaCl. In agreement with Statoil started the section with the mud outside spec. on the NaCl concentration.																

17 1/2"	3046 3046	**13 3/8"**	3035 3035	Glydril DW	1,20 - 1,42	28 - 107	4 - 5	6 - 8	<30	8 - 10		19 - 24	1,7 - 2	8,5 - 9,7	<60	200 - 220	63 - 84	4,8 - 5,6	14,5 - 15	400 - 600	1481 1332 149 352
	COMMENTS: The section was drilled by use of Glydril DW. Not able to pass through 16" liner due to clay on liner wall. POOH with logging tool. M/U 17 ½" underreamer assembly and RIH. Drilled 17 ½" hole to 3046m. Circulated two times BU. Backreamed to 16"liner shoe and circulated 1xBU. Cleanup up inside 16" liner using underreamer and maximum obtained flowrate of 1000lpm. Circulated at full rate when inside 20" casing. A lot of cuttings over the shaker. Heavy losses during last metres of casing running and lost 500-1500ltr/min at pumprate 1000/2500 ltr/min during displacement. Not able to pass with Wire line tool through 16" liner due to clay on liner wall. Defoam AL showed to be very effective even in small amounts using Glydril DW mud. If signs of air in active mud, punch a small hole in a 25ltr can, place on grating between shakers and let it drip into mudflow to process pits. 1-2 cans per shift were used while drilling.																					
12 1/4"	3842 3842	**9 5/8"**	3840 3840	Glydril DW	1,40 - 1,41	2 - 41	4,5 - 6	7 - 11	<30	8 - 10		15 - 26	1,9 - 2,5	8,2 - 9	21 - 24	190 - 228	82 - 86	5 - 6,5	14,8 - 16	320 - 480	1190 1132 58 92
	COMMENTS: The section was drilled by use of Glydril DW. Drilled 12 ¼" hole to 3151 m while adding 25kg/m3 LCM material to the active system (2kg/m3 CaCO3 M, 10kg CaCO3 C, 3kg/m3 G-Seal F and 10kg/m3 G-Seal). This concentration was maintained until drilling past Ooze formation. Pulled back into casing shoe, experienced tight hole. RIH and drilled ahead, experienced high ECD readings from MWD. Pumped a hivis pill with 110kg/m3 Nutplug M to clean out BHA. Drilled 12 ½" hole to TD at 3839 m. Circulated hole clean and backreamed out to shoe due to tight hole. Circulated BU, RIH and performed wipertrip. Drilled 12 ¼" to 3842 m. Circulated hole clean and POOH. RIH with logging tool, couldn't pass tight spot in 13 3/8" csg at 2680. POOH. Ran wiper trip and increased glydril MC conc from 5 to 6.5%. No tight spots on second attempt. 'After the cementjob, a 85 m3 high pH returns from cement contamination was isolatedin a reserve pit and treated with S. Bicarb and C. Acid. The rest of the system was also contaminated in various amounts and was also treated back to spec. The long riser is stretching out contaminated returns to almost the hole 500 m3 system.																					
8 1/2"	4230 4230	**N/A**		Glydril DW	1,47 - 1,56	52 - 148	3,5 - 6	9 - 12	<30	8 - 10		23 - 30	2,1 - 3,2	8 - 10,4	20 - 43	190 - 205	70 - 86	4,8 - 6	15 - 15,4	200 - 560	1447 1098 349 631
	COMMENTS: The section was drilled by use of Glydril DW. Started out section with 1,47sg mudweight and weighted up in steps to 1,56sg as hole dictated.Bit balling occurred on the three first coring runs due to mainly shale/clay formations (thin layers of sand in between. When drilling hard formation (Shale, limestone and sand) at the last 300 m of the 8 ½" section a drop in MEG content was observed. Replaced with total additions of 2.5% MEG. There were now changes in the NaCl (WPS) when adding NaCl powder, see recommendations under 17 X 20" section above. At 3918 m decided to replace ~20% of the active volume with weighted NaCl premix (WPS saturated with NaCl) to raise the NaCl-level, managed to raise it from 187 to ~200 kg/m3. The KCl-level dropped from 83 to 70 kg/m3.																					