3. TRYKKGRADIENTER

3.1 Sammenstillt trykkplott

3.1.1 Overlagringstrykk

Overlagringsgradienten er basert på tetthetslogg.

3.1.2 Poretrykk

Brønn 34/10-33B er sidesteg til brønn 34/10-33.

Gjennom det meste av Shetland Gruppen (Kritt) er poretrykket estimert til ca. 1.23 g/cm^3 ekvivalent slamvekt. I den nedre delen av Shetland Gr. ved omtrent 2800 m SVD MHN begynner trykket å øke forsiktig inntil det i bunnen av Viking Gruppen når det maksimale poretrykket i brønnen, som er lik det målte reservoartrykket.

Poretrykket fra FMT ble målt til 1.43 g/cm^3 ekvivalent slamvekt i toppen av reservoaret i brønn 34/10-33B.

3.1.3 Oppsprekkingstrykk

Oppsprekkingstrykket er beregnet fra "minifrac" tester i 34/10-33 og fra "Leak Off Tests" (LOT) i området.

Et sammenstillt trykkplott er vedlagt i Fig. 3.1.

Detaljer angående trykk og hullstabilitet finnes i egne rapporter.

3.2 Resultater fra FMT (Formation Multi Tester)

Det ble foretatt to kjøringer med FMT på borestrengen i den horisontale delen av 34/10-33B. I tillegg ble det kjørt fem CHFT (Cased Hole Formation Tester) i 9 5/8 " foringsrør. Det ble tatt en segregert prøve med FMT og to med CHFT. Prøvene (1 gal. kammer) ble sendt til land for analyse.

FMT kjøring 3C:
2 3/4 gallon kammer som ble åpnet på rigg ga 1.3 Scf gass, 1 liter vann og 8 l olje/filtrat. Trykket i kammeret var 25 bar.

CHFT kjøring 4A:
2 3/4 gal. kammer åpnet på rigg ga 112.5 Scf gass, 0.9 liter væske. Trykket i kammeret var 224 bar.

CHFT kjøring 4B:
2 3/4 gal. kammer inneholdt 84.5 Scf gass og 1.1 liter væske. Trykket i kammeret var 228 bar.

Målingene fra FMT og CHFT er listet i tabell 3.1 og plottet i figur 3.2.

Kjøring nr nr.:	Målt dyp (m MD BD)	Vert. dyp (mTVD MHN)	Form. trykk (bar)	Hydr.st.trykk (bar)	Kommentarer
3A * (FMT[1])	3894.0				Forseglingsfeil
	3892.5				=
	3887.0				=
	3880.0				=
	3857.5				=
	3856.0				=
	3844.5				=
	3818.0				=
	3763.3				=
	3741.5				=
	3738.5				=
	3719.6				=
	3701.0				=
	3668.0	3388.0	459.90	539.40	God test
	3637.0				Forseglingsfeil
	3618.0				=
	3551.0				FMT-feil feilet
3B	Mislykket kjøring				
3C *	3551.0	3369.4	-	-	Forseglingsfeil
	3618.0	3382.9	461.31	541.31	God test
	3638.0	3386.0	460.38	544.34	=
	3668.0	3388.0	459.85	542.21	=
	3738.5	3385.4	(460.8)	543.90	Supercharged
	3756.0	3384.3	456.86	538.44	God test
	3757.0	3384.2	456.91	538.51	=
	3817.5	3380.4	457.56	540.58	=
	3892.0	3376.0	457.56	540.37	Prøvetaking/God
4A (CHFT[2])	3299.5	3237.2	451.86	518.97	Prøvetaking/OK test
4B	3335.0	3263.2	452.62	524.48	Prøvetaking/Lav perm.
4C	3238.0	3188.4	449.28	513.52	Brukbar test
4D	3358.6	3279.1	452.0	530.90	=
4E	3336.1	3263.9	450.58	527.93	=

* FMT kjørt på borestrengen.

[1] FMT: Formation Multi Tester
[2] CHFT: Cased Hole Formation Tester

Tabell 3.1

DRILLING FLUID PROPERTIES RECORD | WELL NAME: 34/10-33B 12.25" HOLE | AREA: GULLFAKS SOER

WATER BASED MUD | RIG: DEEP SEA BERGEN | CONTRACTOR: O.D.C.C.

STATOIL | FLUID SYSTEM: BENTONITE/FCL | IDF MUD ENGINEERS: ROGER/PRICHARD

DATE	DEPTH M	WEIGHT S.G.	TEMP	FV	AV	PV	YP	GELS 10s	GELS 10m	FLUID API	LOSS HTHP	CAKE	pH	Pf	Mf	Pm	TOT HARD	CL- G/L	OIL %	SOLID %	SAND %	MBT	BAR Kg/M3	BAR % v/v	LGS Kg/M3	LGS % v/v	REMARKS
30/04/89	140	1.45	20	41	27.0	24	6	2	5	11.0	0.0	2	10.0	0.30	0.70	0.00	240	0.7	0	15	0.0	0.0	553.1	13.1	47.5	1.8	DRILL CEMENT
01/05/89	1822	1.45	20	41	27.0	24	6	2	5	11.0	0.0	2	10.0	0.30	0.70	0.00	240	0.7	0	15	0.0	0.0	553.1	13.1	47.5	1.8	DRG CMT/CUT CSG
02/05/89	1822	1.45	22	65	42.0	19	46	31	47	N/C	0.0	2	8.5	0.05	0.50	0.00	2520	11.0	0	16	0.0	0.0	518.7	12.3	77.3	3.0	PULL CASING
03/05/89	1822	1.45	20	65	42.0	19	46	31	47	N/C	0.0	2	8.5	0.05	0.50	0.00	2520	11.0	0	16	0.0	0.0	518.7	12.3	77.3	3.0	PULL CASING
04/05/89	1822	1.45	30	45	28.0	23	10	4	25	N/C	0.0	2	11.0	0.28	0.60	0.70	880	11.0	0	16	0.5	0.0	518.7	12.3	77.3	3.0	FIT & SQUEEZE
05/05/89	1822	1.45	20	42	22.5	18	9	3	20	N/C	0.0	2	11.0	0.20	0.50	0.60	880	11.0	0	16	0.5	0.0	518.7	12.3	77.3	3.0	DRLG CMT. DUMP WBM

DRILLING FLUID PROPERTIES RECORD | **WELL NAME:** 34/10-33B | **AREA:** GULLFAKS SOER

OIL BASED MUD | **RIG:** DEEP SEA BERGEN | **CONTRACTOR:** O.D.C.C.

STATOIL | **FLUID SYSTEM:** INTERDRILL NT | **IDF MUD ENGINEERS:** MACKIN/MCBAIN/PRICHARD

DATE	DEPTH M	WEIGHT S.G.	TEMP	FV	AV	PV	YP	GELS 10s	GELS 10m	HTHP @250	CAKE	Es	WATER %	OIL %	SOLID %	SALT %	OIL/H2O RATIO		BAR w/v	BAR %	LGS w/v	LGS %	ALK	XS LIME	MPS	Aw	REMARKS
06/05/89	1937	1.45	25	55	23.5	18	11	7	11	8.0	1	800	16	64	20	0.29	80	20	632.4	15.0	122.2	4.7	4.1	17.6	62.5	0.95	DISPLACE & DRILL
07/05/89	2124	1.45	25	55	32.0	24	16	7	11	8.8	2	720	15	63	22	0.46	81	19	534.7	12.7	230.3	8.8	3.2	13.7	100.0	0.91	DRILL AHEAD
08/05/89	2379	1.45	41	53	29.5	21	17	12	21	8.8	2	720	14	64	22	0.56	82	18	536.0	12.7	226.9	8.7	3.2	13.7	125.0	0.88	DRILL AHEAD
09/05/89	2520	1.45	0	54	29.5	22	15	11	22	5.6	2	720	13	64	23	0.88	83	17	484.5	11.5	276.6	10.6	2.7	11.6	192.2	0.78	DRILL AHEAD
10/05/89	2697	1.45	66	54	30.0	23	14	11	22	5.4	2	720	14	65	21	0.56	82	18	583.0	13.8	171.8	6.6	2.9	12.4	125.0	0.88	DRILL AHEAD
11/05/89	2902	1.5	68	54	35.5	28	15	13	22	7.0	2	770	10	67	23	0.50	87	13	646.0	15.3	186.5	7.2	2.6	11.2	150.0	0.85	DRILL AHEAD
12/05/89	2982	1.59	0	61	30.5	24	13	14	27	6.0	2	790	9	66	26	0.51	88	12	771.0	18.3	174.0	6.7	2.4	10.3	166.6	0.83	DRILL AHEAD
13/05/89	3041	1.58	61	48	31.0	24	14	14	22	5.2	2	900	8	67	26	0.52	89	11	750.5	17.8	186.4	7.2	2.9	12.4	187.4	0.79	TRIP, DRILL
14/05/89	3088	1.58	32	48	32.0	25	14	15	26	5.2	2	900	8	68	25	0.52	89	11	797.4	18.9	131.3	5.0	2.9	12.4	187.4	0.79	TRIP,DRILL,TEST BOPS
15/05/89	3178	1.58	60	48	32.0	25	14	14	23	4.9	1	980	8	67	26	0.53	90	10	753.4	17.9	184.4	7.1	3.0	12.9	199.9	0.77	TRIP, DRILL
16/05/89	3211	1.58	53	52	29.5	23	13	15	22	4.5	1	960	7	68	25	0.54	91	9	779.9	18.5	154.7	5.9	2.8	12.0	214.2	0.75	TRIP, DRILL
17/05/89	3254	1.58	62	52	28.5	22	13	13	22	4.0	1	1090	7	68	26	0.55	91	9	759.5	18.0	180.1	6.9	2.5	10.7	230.7	0.72	TRIP, DRILL
18/05/89	3314	1.58	22	68	29.0	22	14	15	26	5.0	1	1200	7	69	25	0.55	91	9	783.0	18.6	152.6	5.9	2.5	10.7	230.7	0.72	TRIP, DRILL
19/05/89	3314	1.58	20	62	28.5	22	13	16	27	5.0	1	1220	7	69	25	0.44	91	9	785.7	18.7	153.8	5.9	2.9	12.4	192.2	0.78	RIG REPAIRS
20/05/89	3409	1.58	68	48	33.5	27	13	16	27	4.4	1	1220	7	69	25	0.44	91	9	785.7	18.7	153.8	5.9	2.5	10.7	192.2	0.78	DRII AHEAD
21/05/89	3415	1.58	0	48	32.5	26	13	16	27	4.0	1	1200	7	69	25	0.44	91	9	785.7	18.7	153.8	5.9	2.6	11.2	192.2	0.78	TRIP, DRILL
22/05/89	3459	1.58	72	46	30.5	24	13	15	30	4.0	1	1280	7	69	25	0.44	91	9	785.7	18.7	153.8	5.9	3.0	12.9	192.2	0.78	DRILL, WORK ON PUMPS
23/05/89	3459	1.58	0	46	31.5	25	13	15	30	4.0	1	1400	6	69	26	0.45	92	8	765.2	18.2	179.3	6.9	3.0	12.9	208.3	0.76	LOG, WORK ON PUMPS
24/05/89	3493	1.58	73.5	46	35.0	28	14	15	30	3.8	1	1300	8	67	26	0.43	90	10	756.5	18.0	185.3	7.1	2.8	12.0	166.6	0.83	DRILL TO SEC. TD
25/05/89	3493	1.58	50	46	32.5	25	15	18	34	3.8	1	1090	7	67	26	0.43	91	9	735.8	17.5	210.9	8.1	2.9	12.4	178.5	0.81	BACKREAM, W.O.SPARES
26/05/89	3493	1.58	37	62	34.5	26	17	17	34	3.8	1	1360	7	67	26	0.43	91	9	735.8	17.5	210.9	8.1	2.6	11.2	178.5	0.81	CIRC. W.O. DRAWWORK
27/05/89	3493	1.58	28	62	31.0	24	14	17	34	3.8	1	1260	7	67	26	0.43	91	9	735.8	17.5	210.9	8.1	2.6	11.2	178.5	0.81	CIRC. W.O. DRAWWORK
28/05/89	3493	1.58	32	58	31.0	24	14	14	29	3.8	1	1220	6	68	26	0.45	92	8	741.7	17.6	206.8	7.9	2.5	10.7	208.3	0.76	REAM & SURVEY
29/05/89	3493	1.58	14	75	29.0	22	14	16	34	3.8	2	1280	6	68	26	0.42	92	8	742.3	17.6	207.1	7.9	2.4	10.3	199.9	0.77	RUN CSG
30/05/89	3493	1.58	19	78	36.0	24	24	17	31	7.2	2	620	9	67	24	0.23	88	12	826.6	19.6	107.9	4.1	2.7	11.6	83.3	0.93	RUN & CMT CSG
31/05/89	3493	1.5	15	63	28.5	23	11	13	28	3.2	2	1020	8	68	25	0.33	90	10	596.4	14.2	260.9	10.0	2.3	9.9	133.3	0.87	WOC & TEST BOPS

DRILLING FLUID PROPERTIES RECORD | WELL NAME: 34/10-338 | AREA: GULLFAKS SOER

OIL BASED MUD | RIG: DEEP SEA BERGEN | CONTRACTOR: O.D.C.C.

STATOIL | FLUID SYSTEM: INTERDRILL NT | IDF MUD ENGINEERS: WATSON/ROGER/ROBINSON

DATE	DEPTH M	WEIGHT S.G.	TEMP	FV	AV	PV	YP	GELS 10s	GELS 10m	HTHP @250	CAKE	Es	WATER %	OIL %	SOLID %	SALT %	OIL/H2O RATIO		BAR w/v	BAR %	LGS w/v	LGS %	ALK	XS LIME	MPS	An	REMARKS
01/06/89	3496	1.42	32	52	26.0	20	12	9	18	9.2	2	780	9	72	19	0.23	89	11	640.4	15.2	92.9	3.6	2.3	9.9	83.3	0.93	DRILL CMT & F.I.T
02/06/89	3496	1.42	22	53	26.5	18	17	12	21	8.8	2	920	9	72	19	0.31	89	11	636.2	15.1	93.2	3.6	3.0	12.9	111.1	0.90	MUD FAILURE, TRIP
03/06/89	3558	1.42	42	52	31.5	25	13	16	31	2.6	2	1030	8	72	21	0.32	90	10	571.0	13.6	172.4	6.6	2.4	10.3	125.0	0.88	DRILL AHEAD
04/06/89	3626	1.45	54	58	36.5	29	15	18	31	1.4	2	1200	8	72	21	0.33	91	9	629.2	14.9	149.3	5.7	3.1	13.3	133.3	0.87	TRIP, DRILL AHEAD
05/06/89	3628	1.48	27	63	37.5	29	17	19	38	1.2	2	1280	7	71	22	0.33	91	9	663.9	15.8	153.8	5.9	2.8	12.0	142.8	0.86	REAM, DRILL, POOH
06/06/89	3628	1.5	28	63	31.5	25	13	17	35	1.6	2	1260	7	72	22	0.33	91	9	740.0	17.6	93.7	3.6	2.8	12.0	142.8	0.86	REAM, DRILL, POOH
07/06/89	3628	1.5	26	63	30.0	24	12	15	30	2.2	2	1150	7	72	22	0.33	91	9	740.0	17.6	93.7	3.6	2.7	11.6	142.8	0.86	TRIPPING
08/06/89	3628	1.53	42	60	33.5	24	19	15	31	1.4	2	1180	7	72	22	0.34	92	8	797.9	18.9	70.5	2.7	2.9	12.4	157.6	0.84	REAMING
09/06/89	3628	1.56	20	61	33.0	24	18	16	31	1.2	2	1460	6	71	24	0.34	93	7	812.7	19.3	100.6	3.9	3.0	12.9	177.2	0.81	REAMING
10/06/89	3731	1.55	65	54	37.5	27	21	18	33	0.8	1	1380	6	71	24	0.32	93	7	787.0	18.7	117.1	4.5	3.0	12.9	168.1	0.82	DRILL, TRIP
11/06/89	3742	1.55	63	54	38.5	28	21	20	33	1.2	1	1310	5	72	24	0.27	94	6	771.2	18.3	141.2	5.4	2.7	11.6	172.2	0.82	DRILL, TRIP
12/06/89	3751	1.58	33	64	38.5	28	21	20	32	1.0	1	1420	6	72	23	0.33	93	7	889.1	21.1	40.6	1.6	2.7	11.6	172.7	0.82	CORING
13/06/89	3785	1.57	20	72	39.5	29	21	21	34	1.2	1	1440	5	70	25	0.30	93	7	772.7	18.4	165.4	6.3	2.5	10.7	174.9	0.81	CORING
14/06/89	3790	1.57	20	82	39.5	29	21	21	34	1.0	1	1420	6	70	25	0.34	93	7	792.1	18.8	139.5	5.4	2.5	10.7	177.2	0.81	CORING
15/06/89	3850	1.55	45	82	40.5	30	21	19	32	1.2	1	1440	6	71	24	0.33	93	7	763.2	18.1	144.6	5.5	2.3	9.9	172.7	0.82	DRILL, TRIP
16/06/89	3860	1.55	30	84	40.5	30	21	19	33	1.0	1	1480	6	70	25	0.33	93	7	739.7	17.6	172.1	6.6	2.3	9.9	172.7	0.82	CORE, TRIP
17/06/89	3942	1.56	39	58	36.0	26	20	18	39	0.8	1	1500	5	71	25	0.25	94	6	774.3	18.4	152.6	5.9	2.6	11.2	166.6	0.83	DRILL, TRIP, STUCK
18/06/89	3942	1.56	57	58	40.5	30	21	19	36	1.0	1	1500	5	71	25	0.25	94	6	774.3	18.4	152.6	5.9	2.4	10.3	166.6	0.83	REAMING
19/06/89	3942	1.6	65	53	40.0	30	20	19	38	1.0	1	1400	5	69	26	0.28	93	7	805.3	19.1	171.8	6.6	2.4	10.1	164.9	0.83	REAMING
20/06/89	3942	1.62	30	75	38.5	29	19	19	38	1.2	1	1440	4	70	27	0.24	95	5	841.8	20.0	163.3	6.3	2.4	10.1	174.9	0.81	REAMING/LOGGING
21/06/89	3942	1.61	30	75	40.0	29	22	19	40	1.0	1	1540	4	70	27	0.25	95	5	815.1	19.4	179.5	6.9	2.5	10.7	181.2	0.80	LOGGING
22/06/89	3942	1.61	14	83	44.0	33	22	20	51	1.2	1	1680	4	70	27	0.24	95	5	815.4	19.4	179.6	6.9	2.5	10.7	174.9	0.81	LOGGING
23/06/89	3942	1.61	34	61	40.5	31	19	18	41	1.0	1	1800	4	70	27	0.25	95	5	815.1	19.4	179.5	6.9	2.5	10.7	181.2	0.80	WIPER/CLEAN-UP TRIP
24/06/89	3942	1.615	27	84	38.5	30	17	18	44	1.0	1	1800	4	70	27	0.25	95	5	828.3	19.7	171.4	6.6	2.5	10.7	181.2	0.80	TRIP, LOG, TRIP
25/06/89	3942	1.615	30	65	41.5	34	15	16	40	1.4	1	1800	4	69	27	0.26	95	5	804.5	19.1	198.9	7.6	2.5	10.7	187.4	0.79	TRIP, REDAM, TRIP
26/06/89	3942	1.62	22	75	41.5	33	17	16	42	1.4	1	1800	4	69	27	0.26	95	5	817.7	19.4	190.7	7.3	2.5	10.7	187.4	0.79	TRIP, RUN LINER
27/06/89	3942	1.62	20	93	40.0	32	16	15	41	1.5	1	1800	4	69	27	0.26	95	5	817.7	19.4	190.7	7.3	2.5	10.7	187.4	0.79	RUN LINER. POOH DP
28/06/89	3942	1.62	16	112	42.5	34	17	17	43	1.5	1	1800	4	69	27	0.26	95	5	817.7	19.4	190.7	7.3	2.5	10.7	187.4	0.79	FISH, TRIP, RIH w/BIT
29/06/89	3942	1.615	53	62	39.5	32	15	15	42	0.8	1	1960	4	69	28	0.26	95	5	760.8	18.1	252.1	9.7	2.6	11.2	207.1	0.76	RIH, WASH & REAM
30/06/89	3942	1.61	43	64	39.0	31	16	16	43	0.8	1	1960	4	69	28	0.26	95	5	747.6	17.8	260.2	10.0	2.6	11.2	207.1	0.76	RIH, JAR FISH, POH

DRILLING FLUID PROPERTIES RECORD | WELL NAME: 34/10-33B | AREA: GULLFAKS SOER

OIL BASED MUD | RIG: DEEP SEA BERGEN | CONTRACTOR: O.D.C.C.

STATOIL | FLUID SYSTEM: INTERDRILL NT | IDF MUD ENGINEERS: WATSON/ROGER/ROBINSON

DATE	DEPTH M	WEIGHT S.G.	TEMP	FV	AV	PV	YP	GELS 10s	GELS 10m	HTHP @250	CAKE	Es	WATER %	OIL %	SOLID %	SALT %	OIL/H2O RATIO		BAR w/v	BAR %	LGS w/v	LGS %	ALK	XS LIME	MPS	Aw	REMARKS
01/07/89	3942	1.62	21	117	39.5	32	15	16	43	1.2	1	1970	4	69	28	0.26	95	5	798.4	18.9	216.0	8.3	2.6	11.2	207.1	0.76	RIH - FISH, TRIPPING
02/07/89	3942	1.615	27	83	41.5	33	17	18	49	1.2	1	1970	4	69	28	0.26	95	5	784.3	18.6	224.5	8.6	2.6	10.9	207.1	0.76	PLUG BACK TO 3410
03/07/89	3942	1.61	55	68	44.0	34	20	20	50	1.0	1	1860	4	69	27	0.23	95	5	792.3	18.8	207.3	8.0	2.9	12.4	168.7	0.82	CIRC OUT CEMENT PLUG
04/07/89	3942	1.61	47	68	45.0	36	18	21	50	1.2	1	1400	6	69	26	0.19	93	7	832.2	19.8	157.6	6.0	2.9	12.2	109.1	0.90	TRIP,CMT,TRIP,REAM
05/07/89	3942	1.61	45	114	42.5	33	19	21	48	1.2	1	1780	5	69	27	0.22	94	6	813.0	19.3	181.6	7.0	3.3	14.2	150.0	0.85	PLUG BACK- LEFT 19 M3
06/07/89	3942	1.61	45	80	42.5	33	19	23	56	1.6	1	1410	6	68	27	0.24	92	8	803.7	19.1	186.9	7.2	3.0	12.9	125.0	0.88	DRESS CEMENT
07/07/89	3942	1.62	14	158	44.0	35	18	22	51	1.6	1	1430	7	68	26	0.29	91	9	848.9	20.2	144.7	5.6	3.1	13.3	134.6	0.87	POOH - RIG REPAIR
08/07/89	3942	1.62	14	132	45.0	35	20	22	49	1.6	1	1480	7	68	26	0.29	91	9	848.9	20.2	144.7	5.6	3.0	12.9	134.6	0.87	RIG REPAIRS
09/07/89	3942	1.62	14	138	44.0	34	20	22	52	1.6	1	1460	7	68	26	0.29	91	9	848.9	20.2	144.7	5.6	3.0	12.9	134.6	0.87	RUN FMT'S
10/07/89	3942	1.62	0	138	45.5	36	19	22	52	1.6	1	1460	7	68	26	0.29	91	9	848.9	20.2	144.7	5.6	3.0	12.9	134.6	0.87	TRANSFER MUD TO 33-C