Final Well Report (Exploration)
34/10-47 S/ST2
34/10-47 A

Contents

1 Introduction

1.1 Well data record

Well name:	34/10-47 S / ST2	
Well type:	Exploration well	
Prospect / Field:	Aurora and Dolly (N7)	
Area:	Tampen Spur	
Country:	Norway	
License Number:	PL 050 / PL 050B	
Licences:	Statoil (operator)	61 %
	Petoro	30 %
	Hydro	9 %
Drilling rig:	Deepsea Trym	
Rig type:	Semi-submersible	
Drilling contractor:	Odfjell Drilling	
Water depth / air gap:	140.0 m MSL / 25.0 m RKB	
TD:	4027 m MD RKB (2445,2 m TVD RKB)	
Formation at TD:	Shetland Group	
Surface co-ordinates:	Latitude:	N 61º 10` 52,5"
	Longitude:	E 02º 03` 11,1"
	UTM:	N 6 783506
		E 449076
Top reservoir co-ordinates:	Latitude:	N 61º 10`50,1
(Rannoch N7)	Longitude:	E 02º 02`19,4
	UTM:	N 6 783442
		E 448302
Seimic reference:	Seimic survey ST9607	
	Inline 2401,89 CDP 2056,53	
	(Closest line/CDP: 2402/2057)	

Well name:	34/10–47 A (sidetracked from 34/10-47 S)	
Well type:	Exploration well	
Prospect / Field:	Statfjord (N7)	
Area:	Tampen Spur	
Country:	Norway	
License Number:	PL 050 / PL 050B	
Licences:	Statoil (operator)	61 %
	Petoro	30 %
	Hydro	9 %
Drilling rig:	Deepsea Trym	
Rig type:	Semi-submersible	
Drilling contractor:	Odfjell Drilling	
Water depth / air gap:	140.0 m MSL / 25.0 m RKB	
TD:	3020 m MD RKB (2924,8 m TVD RKB)	
Formation at TD:	Statfjord Formation	
Surface co-ordinates:	Latitude:	N 61º 10` 52,5"
(-47 S)	Longitude:	E 02º 03` 11,1"
	UTM:	N 6 783 506
		E 449 076
Top reservoir co-ordinates:	Latitude:	N 61º 10`50,0"
(Top Statfjord)	Longitude:	E 02º 02`40,8"
	UTM:	N 6 783 435
		E 448 662
Seimic reference:	Seimic survey ST9607	
	Inline 2401,89 CDP 2056,53	
	(Closest line/CDP: 2402/2057	

All depths in this program are related to m MD RKB, unless otherwise stated.

1.2 Well objectives

The main objective of well 34/10-47 S was to investigate the hydrocarbon potential in sandstones in the Upper Jurassic, prospect Aurora and secondary to investigate the hydrocarbon potential of the Middle Jurassic Brent Group in segment N7. The optional third objective was to sidetrack into the Statfjord Formation to investigate the hydrocarbon potential there.

1.3 Result of the well

The main target of the well 34/10-47 S, the Aurora prospect, proved to be non-existing. Well 34/10-47 S/ -ST2 continued and drilled into the Brent prospect (secondary objective) in the N7 segment and penetrated a 65 m thick hydrocarbon column in the Brent Group. The discovery was oil and it was documented different oil-water contacts in the upper and lower Brent Group. Total hydrocarbon column are estimated to be 150 m TVD, whereas only 20% of the reservoir lies shallower than the well level. 5/6 of the hydrocarbons in place are within a good reservoir unit (Tarbert Fm.) with excellent reservoir properties and expectations. TD was set in the Shetland Group at 4027 m MD / 2445.2 m TVD RKB.

MDT-fluid samples were carried out in the oil zone. The average oil density (reservoir conditions) measured on oil samples with "SmartLab" was 0.688 g/ccm and average Bo was 1.383. In the Tarbert Fm. the formation pressure points gives a gradient of 0.0664 bar/m i.e. an oil density at reservoir conditions of 0.677 g/cm^3. Estimated resources in well 34/10-47 S/ -ST2 after the discovery are approximately 10,1 x 10^6 Sm^3 STOIIP and approx. 1,2 x 10^9 Sm^3 GIIP.

Sidetrack 34/10-47 A was drilled to clarify the resources in the Statfjord Formation in segment N7 and the resources of the Tarbert Fm. in segment O7. Well 34/10-47 A was found to be dry and TD was set in the Statfjord Formation, Nansen Member at 3020 m MD / 2924,8 m TVD RKB.

1.4 Drilling summary

1.4.1 Casings

Well 34/10-47 S & -47 A

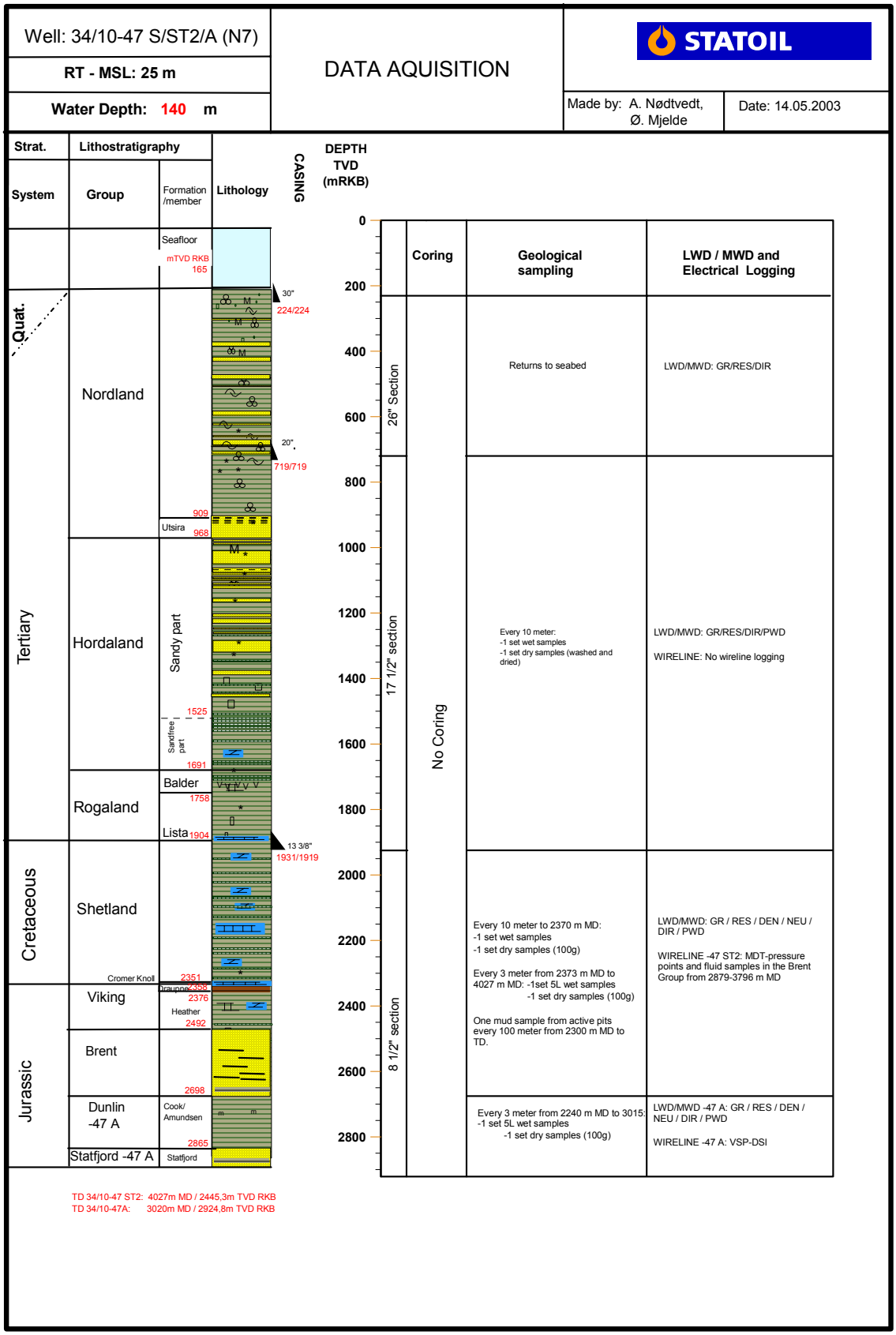
Casing size	Casing depth m MD RKB/ m TVD RKB	Hole depth m MD RKB / m TVD RKB	Test pressure/ mud weight/ mud type	Result g/cm^3
30"	223,7 / 223,7	227 / 227		
20"	719,3 / 718,7	725 / 724	95 Bar / 1,03 g/cm^3	1,63 (LOT)
13 3/8"	1931,2 / 1918,7	1939 / 1926	270 Bar / 1,40 g/cm^3	1,76 (FIT)

1.4.2 Drilling fluids

CMC/seawater above 26" hole / 20" casing.
The 17 ½" section was drilled with Glydril – Formulation #12 WBM.
Versavert – Formulation #41 OBM was used in the 12 ¼" and 8 ½" sections.

Conduit	Fluid present	Fluid properties
13 3/8" x 20" annulus	36 m^3 treated fresh water 64 m^3 Glydril #12 WBM	1,03 g/cm^3 1,40 g/cm^3

1.5 Data acquisition summary



2 Exemptions and non-conformances

Exemption from “Forskrift om ressursforvaltning i petroleumsvirksomheten”, chapter 3, §9:

- Even if the Brent Group is hydrocarbon filled, no coring is planned. The well is situated close to the exploration well 34/10-17, in which it was done extensive coring in the Brent Group.

Even if the Statfjord Formation is hydrocarbon filled, no coring is planned. The well is situated close to the Gullveig well 34/10-K-2H, in which it was done extensive coring in the Statfjord Formation.

3 Health, safety, environment and quality (HSE&Q)

3.1 Experience summary

See appendix G, other reports.

3.2 Time distribution

Table 3.1 Time distribution for well 34/10-47 S /-47ST2 and sidetrack 34/10-47 A

Drilling			
Planned duration (days)	Actual Duration (days)	Planned cost (mill NOK)	Effec. Cost (mill NOK)
45,7	53,7	119 (case with a dry well and without sidetrack)	143

See appendix G, other reports, for a time distribution plot.

4 Geology and formation data report

4.1 Geological setting and results

Well 34/10-47 S is drilled in the southeastern part of the Tampen Spur area and it is drilled on a protrusion of the main fault 3-4 km north of the Gullveig Field. The N7 segment is a rotated fault block and the trap is defined by a protrusion on the main fault that makes up a closure. There were moderately expectations of finding oil bearing sandstones in the interpreted Aurora sandlobe in Upper Jurassic. The expectations were not fulfilled as no sandstone was found in Upper Jurassic, which was the target with highest potential in the well. The geological time model was correct for the rest of the Jurassic section. The Brent prospect in segment N7 had higher probability of discovery, but lower potential and proved oil filled. The Jurassic succession was found to be approximately 20 m deeper in segment O7 and 20-30 m shallower in segment N7 than prognosed. Geological cross-section and wellpath before and after drilling of well 34/10-47 S/ST2 and sidetrack 34/10-47 A is shown in figure 4.1. See also figure 4.2 over the prognosed and observed litostratigraphy.

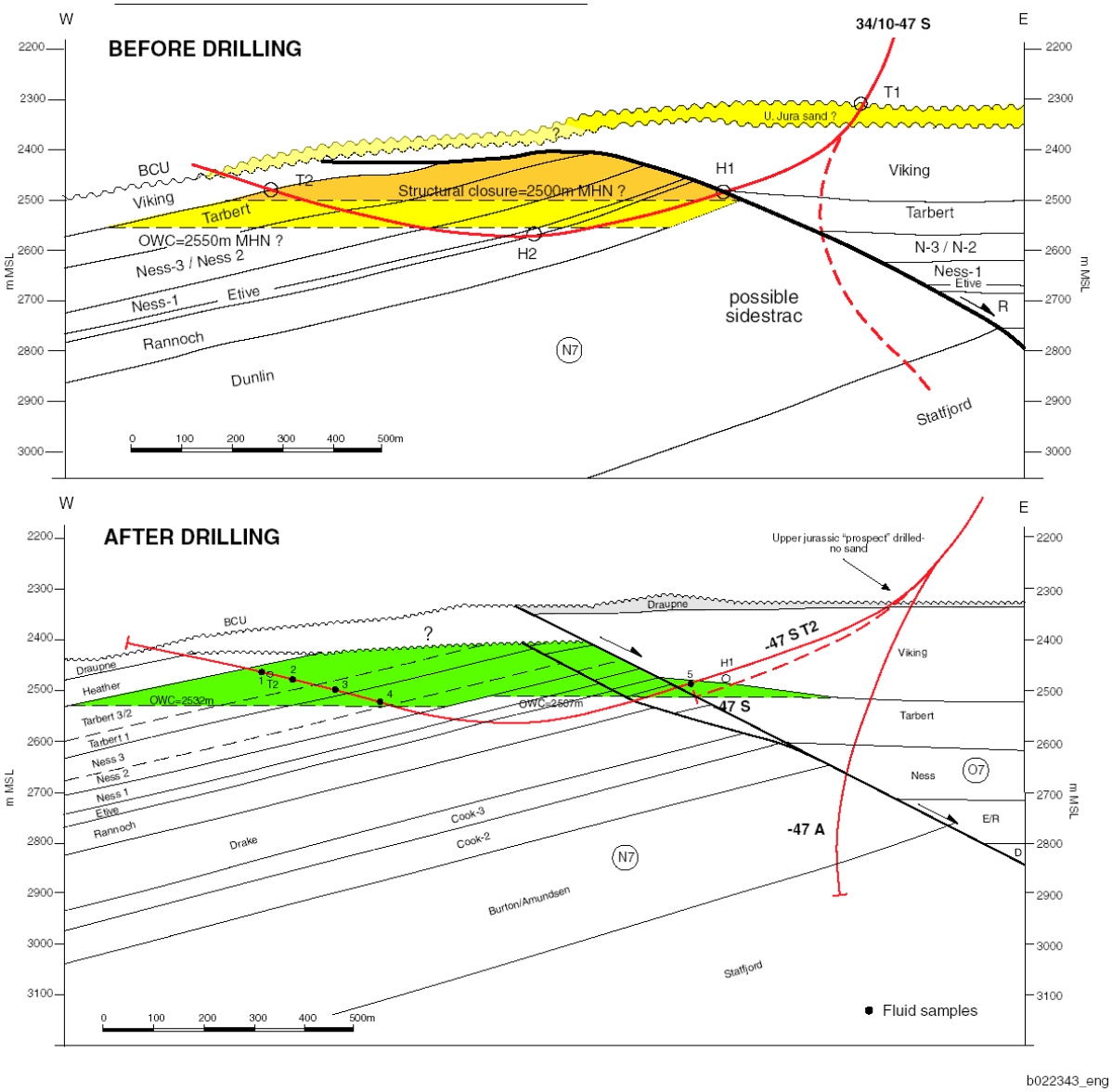


Figure 4.1 Geological cross-section and wellpath before and after drilling of well 34/10-47 S/ST2 and the sidetrack 34/10-47 A.

4.2 Shallow gas results

No shallow gas was registered neither on gas readings or resistivity logs. First gas responses were observed between 750-1250 m MD with maximum gas values of 6 %.

4.3 Stratigraphy

The stratigraphic zonation is based on previous logs from near-situated wells and Statoils own interpretation.

4.3.1 Table of chronostratigraphy

Chronostratigraphic investigations were not performed in this well.

4.3.2 Table of lithostratigraphy

Table 4.1 Litostratigraphy of Well 34/10-47 S*

LITOSTRATIGRAPHIC TOPS	DEPTH MD (m RKB)	DEPTH (m RKB)	TVD (m MSL)	THICKNESS (m TVD)	Deviation from prognosis m +/-
NORDLAND GROUP	165	165	140	802	
Utsira Formation	910	909	884	58	
HORDALAND GROUP	968	967	942	724,4	
Sandy Hordaland	968	967	942	557,5	
Sandfree Hordaland	1529	1524,5	1499,5	166,9	
ROGALAND GROUP	1698	1691,4	1666,4	213	
Balder Formation	1698	1691,4	1666,4	66,7	
Lista Formation	1765	1758,1	1733,1	146,3	
SHETLAND GROUP	1916	1904,4	1879,4	454,9	
CROMER KNOLL GROUP	2443,5	2350,4	2325,4	8,9	
VIKING GROUP	2458	2359,3	2334,3	189,0	+ 22,3
Draupne Formation	2458	2359,3	2334,3	20,3	+ 22,3
Heather Formation	2488	2377,1	2352,1	168,7	+ 4,1
BRENT GROUP	2806	2515,9	2490,9	31,8	+ 5,9
Tarbert Formation	2806	2515,9	2490,9	31,8	+ 5,9
TD	2880	2540,3	2515,3		

*34/10-47 S: The well was lost due to stuck pipe situation a few meters into the Brent reservoir at 2880 m MD.

Table 4.2 Litostratigraphy of Well 34/10-47 ST2*

LITOSTRATIGRAPHIC TOPS	DEPTH MD (m RKB)	DEPTH (m RKB)	TVD (m MSL)	THICKNESS (m TVD)	Deviation from prognosis m +/-
CROMER KNOLL GROUP	2443,5	2349,7	3224,8		
VIKING GP.	2458	2357,9	2332,9	155,3	+ 20,9
Draupne Formation	2458	2357,9	2332,9	16,6	+ 20,9
Heather Formation	2489	2374,5	2349,5	138,7	+ 1,5
BRENT GP. (segment O7)	2876	2513,2	2488,2	10,0	
Tarbert Formation	2876	2513,2	2488,2	10,0	
BRENT GP. (segment N7)	2910	2523,2	2498,2	135,4	+ 13,2
Rannoch Formation	2910	2523,2	2498,2	72,2	+ 13,2
Etive Formation Base	3285	2595,4	2570,4	5,9	+ 0,4
Etive Formation Top	3355	2589,5	2564,5		
Ness-1 Formation	3401,5	2582,9	2557,9	16,4	+ 11,9
Ness-2/Ness-3 Fm.	3491,5	2563,1	2538,1	80,9	+ 29,1
Tarbert Formation	3804	2491,7	2466,7	93,53	+ 9,3
VIKING GP.	3963,5	2460,0	2435,0	31,64	- 10,0
Draupne Formation	3963,5	2460,0	2435,0	8,87	
Heather Formation	3923,0	2468,9	2443,9	22,77	
SHETLAND GP. Base	3963,5	2460,0	2435,0		
TD	4027	2445,3	2420,3		

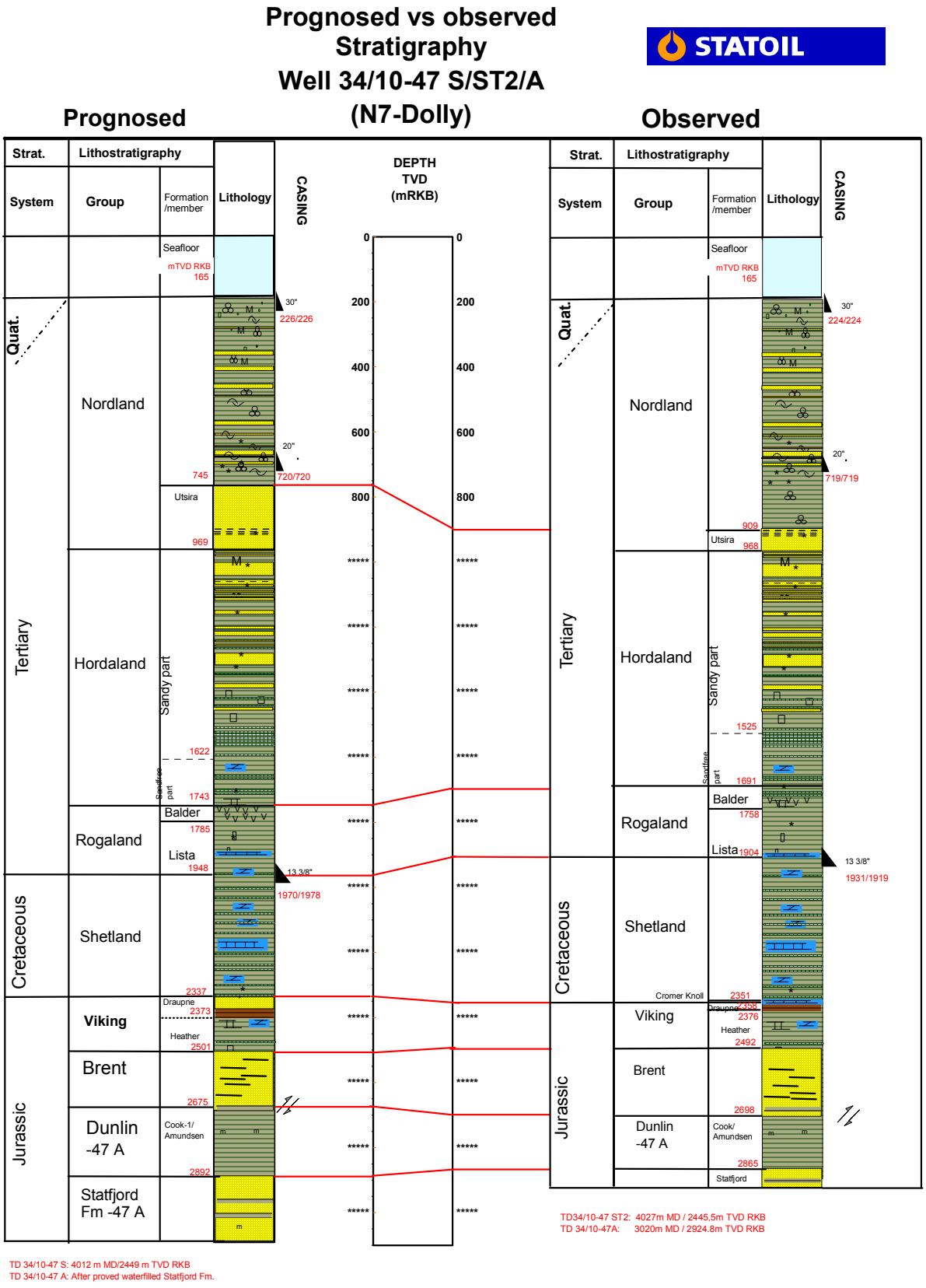
*34/10-47 ST2: Technical sidetrack performed from well 34/10-47 S at 2428 m MD in the lower part of the Shetland Group.

Table 4.3 Litostratigraphy of well 34/10-47 A*

LITOSTRATIGRAPHIC TOPS	DEPTH MD (m RKB)	DEPTH (m RKB)	TVD (m MSL)	THICKNESS (m TVD)	Deviation from prognosis m +/-
CROMER KNOLL GROUP	2404	2345,4	2320,4	8,7	
VIKING GP.	2414	2354,1	2329,1	193,7	+ 17,1
Draupne Formation	2414	2354,1	2329,1	14,7	+ 17,1
Heather Formation	2431	2368,8	2343,8	179,0	- 4,2
BRENT GP.	2631,5	2547,8	2522,8	151,1	+ 26,8
Tarbert Formation	2631,5	2547,8	2522,8	89,9	+ 26,8
Ness Formation	2729	2637,7	2612,7	61,20	+ 51,7
Ness-3 Formation	2729	2637,7	2612,7	35,2	+ 51,7
Ness-2 Formation	2766	2672,9	2647,9	26,0	
DUNLIN GP. / FAULT	2793	2698,9	2673,9	165,5	+ 33
Burton Formation	2793	2698,9	2673,9	24,4	+ 33
Amundsen Formation	2818	2723,3	2698,3	142,9	
Statfjord Fm.	2964	2868,8	2843,8	56	+ 18,7
Nansen Member	2964	2868,8	2843,8	56	+ 18,7
TD	3020	2924,8	2899,8		

*34/10-47 A: Sidetracked from well 34/10-47 ST2 at 2215 m MD in the lower part of the Shetland Group.

Figure 4.2 Listostratigraphy for Well 34/10-47 S / ST2 / A prognosed and observed.



4.4 Lithostratigraphic description

General Information

System, Series and Stage: Based on log interpretation and correlation.

Lithology: The lithological description is based on cuttings description.

The dephts are in meters with drillfloor as datum unless otherwise stated.

Geological summary

Well 34/10-47 S

NORDLAND GROUP 165 – 968 m MD (165 – 967 m TVD)

The upper part of the Nordland Group was drilled with returns to seafloor and logged with MWD (GR/RES/DIR). Log interpretation suggests mostly clay/claystone with some thin sand layers.

No shallow gas was recorded in the sands.

Utsira Formation 910 – 968 m MD (909 – 967 m TVD)

The formation consists of sand/sandstone, predominantly loose quartz grains, clear to translucient, fine to medium, occasional very fine, moderately to poor sorted, subangular to subrounded, occasional rounded.

HORDALAND GROUP 968 – 1698 m MD (967 – 1692 m TVD)

The Hordaland Group consists of claystone with beds of sandstone. The sandstone/sand consists predominantly of clear to translucent quartz grains, very fine to fine, occasional medium, subangular to subrounded, well rounded, well sorted and dominantly loose.

The claystone seen in samples are greenish grey, occasional dark grey. The claystone are generally firm to hard, blocky and non calcareous.

ROGALAND GROUP 1698 – 1916 m MD (1692 – 1905 m TVD)

In this well the Rogaland Group consists of the Balder Formation and Lista Formation.

Balder Formation **1698 – 1765 m MD (1692 – 1758 m TVD)**

The Balder Formation is recognized on the MWD logs by the characteristic gamma ray and resistivity curves.

The Balder Formation consists of interbedded claystone and tuff.

The claystone varies in colour from medium grey, olive grey to greenish grey and dark greenish grey. It is firm to hard, subblocky to blocky, micropyritic in parts and non calcareous.

The claystone is tuffaceous in parts, and grades from dark greenish grey to medium blusish grey tuff. The tuffaceous claystone is firm and subblocky.

Lista Formation **1765 – 1916 m MD (1758 – 1905 m TVD)**

The Lista Formation consists of claystone with layers of limestone and minor sandstone.

The claystone is dominantly medium grey to medium dark grey and greenish grey, firm, blocky and occasional silty. The claystone is in places very calcareous, grading to marl.

The limestone is milky white to very light grey, soft-firm, occasional hard, subblocky, argillaceous and grading to marl.

SHETLAND GROUP **1916 – 2444 m MD (1905– 2350 m TVD)**

The Shetland Group consists of claystone with marl/limestone beds.

The claystones is generally medium grey, also greenish/bluish grey, soft, subblocky, non to very calcareous.

The limestone is light grey to tan to white, firm to moderately hard, occasional hard, microcrystallin.

The marl is white to light grey, soft to firm and silty in places.

CROMER KNOLL GROUP **2444-2458 m MD (2350-2359,3 m TVD)**

The Cromer Knoll Group consists of marl/claystone and limestone.

The claystone is grading to marl and is generally olive grey to light olive grey, occasional olive black, soft, occasional medium hard, sticky, calcareous and micropyritic.

The limestone is yellow white to light grey, medium hard to hard, blocky, chalky, occasional argillaceous.

VIKING GROUP 2458 – 2806 m MD (2359,3 – 2515,9 m TVD)

The top of the Viking Group and the Draupne Formation was picked at the abrupt increase in the gamma ray. The Viking Group is presented by the Draupne Formation and the Heather Formation and consists of carbonaceous claystone with limestone beds.

Draupne Formation 2458 – 2488 m MD (2359,3 – 2377,1 m TVD)

The Draupne claystone is predominantly dark grey to grayish black, soft to moderately hard, occasional firm, subblocky, calcareous, trace micropyrite, trace carbonaceous material.

Heather Formation 2488 – 2806 m MD (2377,1 – 2515,9 m TVD)

The Heather Formation consists of claystones with limestone beds.

The claystone seen in samples is predominantly dark grey, grayish black to olive black, soft to moderately hard, subblocky, non to slightly calcareous with trace of micropyrite and trace of carbonaceous material.

The limestone is described as white to plain yellowish brown, hard and cryptocrystallin.

BRENT GROUP 2806 – 2880 m MD (TD –47 S) (2515,9 – 2539,7 m TVD)

The Brent Group in Well 34/10-47 S compromise the upper part of the Tarbert Formation in segment O7. Well 34/10-47 S got stuck at 2880 m MD in the Tarbert Fm close to the main fault between segment O7 and N7. Sidetrack 34/10-47 ST2 was kicked off from well 34/10-47 S at 2428 m MD in the lower part of the Shetland Group.

Tarbert Formation 2806 – 2880 m MD (TD –47 S)(2515,9 – 2539,7 m TVD)

The Tarbert Formation is composed of sandstone interbedded with shale, siltstone and coal.

The sandstone is mainly composed of clear to translucient quarts grains, predominantly medium, occasional coarse, occasional fine, moderately to good sorted, subangular to subrounded. The sandstone is calcareous cemented and also contain loose quartz grains.

The claystone is predominantly medium grey, also grayish black to olive black, subblocky, soft to moderately hard, non to slightly calcareous. Trace of micropyrite and carbonaceous materiale.

The coal is black, hard and blocky.

Well 34/10-47 ST2

SHETLAND GROUP 2428(KOP)–2444 m MD (2340-2350 m TVD)

The Shetland Group consists of claystone with minor beds of limestone and marl.

The claystones is generally medium grey, also greenish grey, soft to firm, blocky, occasional subfissile, non to very calcareous.

The limestone is milky white to tan, also very light grey, firm to moderately hard, occasional hard, microcrystallin.

The marl is light grey to tan and white, soft to firm and slightly silty.

CROMER KNOLL GROUP 2444-2458 m MD (2350-2358 m TVD)

The Cromer Knoll Group consists of marl/claystone and limestone.

The claystone is grading to marl and is generally olive grey to light olive grey, occasional olive black, soft, occasional medium hard, sticky, calcareous and micropyritic.

The limestone is yellow white to light grey, medium hard to hard, blocky, chalky, occasional argillaceous.

VIKING GROUP 2458 – 2876 m MD (2357,9– 2513,2m TVD)

The Viking Group is presented by the Draupne Formation and the Heather Formation and consists of carbonaceous claystone with limestone beds.

Draupne Formation 2458 – 2489 m MD (2357,9–2374,5m TVD)

The Draupne claystone is predominantly dark grey to grayish black, soft to moderately hard, occasional firm, subblocky, calcareous, trace micropyrite, trace carbonaceous material.

Heather Formation 2489 – 2876 m MD (2374,5- 2513,2 m TVD)

The Heather Formation consists of claystones with minor limestone stringers.

The claystone seen in samples is predominantly dark grey, greyish black to olive black, soft to moderately hard, subblocky, none to slightly calcareous. Trace of micropyrite and trace of carbonaceous material.

The limestone is described as white to plain yellowish brown, hard and cryptocrystallin.

BRENT GROUP 2876 – 3804 m MD (2513,2 – 2491,7m TVD)(-47 ST2)

The Brent Group in well 34/10-47 S/-47 ST2 comprises partly the Tarbert, Rannoch and Etive Formations and a complete Ness and Tarbert Formations in the N7 segment. The Tarbert Group and the upper part of the Ness Group proved to be hydrocarbon bearing. Background gas was very low (0,1-0,7%) through the whole 8 ½" section in the Shetland and Viking Groups with maximum gas values (1,2-11,5%) reached from hydrocarbon filled sands in the Tarbert and Ness Formations.

Tarbert Formation (O7-segment) 2876 – 2910 m MD (2513,2 – 2523,2 m TVD)

The Tarbert Formation consists dominantly of sandstone, but it is occasionally interbedded with shale, siltstone and coal.

The sandstone is mainly composed of clear to translucent quarts grains, predominantly medium, occasional coarse, occasional fine, moderately to good sorted, subangular to subrounded. The sandstone is calcareous cemented and also contain loose quartz grains.

The claystone is predominantly medium grey, also grayish black to olive black, subblocky, soft to moderately hard, non to slightly calcareous. Trace of micropyrite and carbonaceous material.

The coal is black, hard and blocky.

Fault O7/N7 segments 2910 m MD (2523,2 m TVD)
Rannoch Formation (N7-segment) 2910– 3285 m MD (2523,2-2595,4m TVD)

The Rannoch Formation is composed of sandstone with minor claystone beds.

The sandstone/siltstone is medium grey to yellowish white, clear to translucent quarts grains, predominantly fine, occasional very fine, good sorting, subangular to subrounded, loose quarts grains.

The claystone is grayish black to olive black, moderately hard, subblocky, none calcareous with trace of micropyrite and carbonaceous material.

Etive Formation 3285 – 3355 m MD (2595,4– 2589,5m TVD)

The Etive Formation is composed of sandstone with claystone and limestone/dolomite stringers.

The sandstone is dusky yellowish brown to light olive grey with argillaceous or silty matrix. Clear to translucent quartz grains, locally milky white, silty to fine grained, predominantly very fine, later predominantly very fine to medium, rare coarse to very coarse. The sand is moderately to well sorted, becoming generally poor to moderately well sorted, firm to friable, subangular, locally subrounded to subangular, non calcareous, generally poor inferred porosity, locally good inferred porosity.

The claystone is dark olive grey to olive black, later generally greenish black to black, subblocky to blocky, moderately hard to hard, generally micromicaceous, locally micropyritic, non calcareous.

Ness Formation **3355 –3581 m MD (2589,5– 2538,9m TVD)**

The Ness Formation is composed of sandstone, claystone and coal.

The sandstone has a dusky yellowish argillaceous matrix. The loose sand grains are clear to translucent with trace of milky white quartz grains. The sandstone is predominantly fine to medium, occasional coarse to very coarse, moderately to well sorted, subangular to subrounded with a slightly argillaceous matrix, locally clean. The sandstone is none calcareous with good to fine inferred porosity.

The claystone is medium dark gray to olive gray, olive black to black, firm to moderately hard, predominantly blocky, locally subblocky, predominantly none silty, predominantly very carbonaceous grading to coal. The claystone is brittle and flaky, micropyritic and non calcareous.

Tarbert Formation **3581 – 3804 m MD (2538,9– 2491,7 m TVD)**

The Tarbert Formation is composed of sandstone with minor claystone beds.
The sandstone is medium gray to gray and yellowish white and is mainly composed of clear to translucient quarts grains, predominantly medium, occasional fine and coarse, moderate to good sorting, subangular to subrounded. The sandstone has some silty/argillaceous matrix.

The claystone is predominantly dark gray, grayish black to olive black, soft to moderately hard, subblocky, none to slightly calcareous with trace of micropyrite and carbonaceous material.

VIKING GROUP **3804 – 3963 m MD (2491,7 – 2460,0 m TVD)**

The Viking Group is presented by the Draupne Formation and the Heather Formation and consists of carbonaceous claystone with minor limestone beds and marl.

The claystone seen in samples is predominantly dark greenish gray to greenish black, blocky, firm to moderately hard, none calcareous, uniform, with trace of glauconite and micropyrite.

The limestone is milky white to yellowish brown, very light gray, firm to moderately hard, microcrystallin.

The marl is light gray, tan to white, soft to firm, slightly silty.

SHETLAND GROUP **3963 – 4027 m MD (2460,0– 2445,2 m TVD)**

The Shetland Group consists of claystone with marl/limestone beds.

The claystones is generally dark greenish gray to greenish black, blocky, firm to moderately hard, non silty, non calcareous, uniform with trace of glauconite and micropyrite.

The limestone is milky white to yellowish brown, very light gray, firm to moderately hard, microcrystallin.

The marl is light gray to tan and white, soft to firm and silty in places.

Well 34/10-47 A

SHETLAND GROUP **2215 (KOP) – 2404 m MD (2180,9 - 2345,4 m TVD)**

The lower part of the Shetland Group that this sidetrack was kicked off in consists of claystone with minor beds of limestone and marl.

The claystone is medium gray and greenish gray, soft, subblocky and none to very calcareous.

The limestone is light gray to tan and white, firm to moderately hard, occasional hard, microcrystallin.

The marl is white to light gray, firm to moderately hard, occasional hard, microcrystallin.

CROMER KNOLL GP. **2404 – 2414 m MD (2345,4 – 2354,1 m TVD)**

The Cromer Knoll Gp. consists of marl with layers of limestone.

The marl seen in Cromer Knoll is white to light gray, soft to firm and silty in places.

The limestone is light gray to tan and white, firm to moderately hard, occasional hard, microcrystallin.

VIKING GROUP **2414 – 2632 m MD (2354,1 – 2547,8 m TVD)**

The Viking Group is presented by the Draupne Formation and the Heather Formation and consists of carbonaceous claystone with minor limestone stringers.

Draupne Formation **2414 – 2431 m MD (2354,1 – 2368,8 m TVD)**

The Draupne claystone is grayish black, brownish black and olive black, firm to moderately hard, non calcareous, subblocky, micropyritic.

The limestone is light gray to tan and white, firm to moderately hard, occasional hard, microcrystallin.

Heather Formation **2431 – 2632 m MD (2368,8-2547,8 m TVD)**

The Heather Formation consists of claystones with thin layers of limestone.

The claystone seen in samples is predominantly grayish black, brownish black and olive black, firm to moderately hard, none calcareous, subblocky and micropyritic.

The limestone is described as light gray to tan and white, firm to moderately hard, occasional hard and microcrystallin.

BRENT GROUP **2632 – 2793 m MD (2547,8 – 2698,9 m TVD)**

The Brent Group in well 34/10-47 A comprises the whole the Tarbert Fm. and the upper part of the Ness Fm. Background gas was very low through the whole 8 ½" section in this sidetrack with maximum gas values as low as 0,7-0,8% registered in the water filled sands of the Tarbert Formation.

Tarbert Formation **2632 – 2729 m MD (2547,8 – 2637,7 m TVD)**

The Tarbert Formation is composed of sandstone interbedded with shale, siltstone and coal.

The sandstone is mainly composed of clear to translucent quarts grains, fine to medium, occasional coarse, subrounded to subangular. The sandstone is non calcareous, moderately cemented and predominantly loose, occasional occurrence of calcite cemented aggregates.

The claystone is medium to dark gray and brownish gray, olive gray, firm to moderately hard, non calcareous, subblocky, micropyritic.

The coal is black, brittle and firm.

Ness Formation **2729 – 2793 m MD (2637,7-2698,9 m TVD)**

The Ness Formation is composed of sandstone interbedded with claystone, coal and calcite cementation.

The sandstone is clear to translucent and milky white quarts grains, fine to medium, subrounded to subangular, loose, occasional calcite cemented aggregates.

The claystone is medium dark gray to brownish gray, olive gray, firm to moderately hard, subblocky, non calcareous and micropyritic.

The coal is black, brittle and firm.

DUNLIN GROUP **2793 – 2964 m MD (2698,9 – 2868,8 m TVD)**

The Dunlin Group consists predominantly of claystone/shale and siltstone, with some laminations of limestone and sandstone. Well 34/10-47 A compromises only parts of the Dunlin Group with parts of the Burton and the Amundsen Formations present.

Burton Formation **2793-2818 m MD (2698,9 – 2723,3 m TVD)**

The Burton Formation consists of claystone. Well 34/10-47A compromises only the lower parts of the Burton Formation due to a fault that separates the O7 from the N7 segment, where the Burton Formation belongs to the latter segment.

Amundsen Formation **2818 – 2964 m MD (2723,3 – 2868,8 m TVD)**

Amundsen Formation consists predominantly of sandstone with claystone layers and minor calcite cementation.

The sandstone consists of clear to translucent and milky white quarts grains, fine to medium, subrounded to subangular, loose, occasional occurrence of calcite cemented aggregates.

The claystone is medium dark gray to brownish gray, olive gray, firm to moderately hard, subblocky, non calcareous, micropyritic.

Statfjord Formation **2964 – 3020 m MD (TD), (2868,8 – 2924,8 m TVD MSL)**

TD was set in the Statfjord Formation, Nansen Member.

The top of the Statfjord Formation is clearly recognized by a lithological transition from the silty shale of the Amundsen Formation toward a clean sandstone of the Statfjord Formation. The logs exhibit a sharp drop in the gamma ray readings.

The Statfjord Formation consists of sandstone with layers of claystone and minor calcite cementation.

The sandstone consists of clear to translucent and milky white quarts grains, fine to medium, occasional coarse, subrounded to subangular, loose, occasional calcite cemented aggregates.

The claystone is medium dark gray to brownish gray and olive gray, firm to moderately hard, subblocky, non calcareous, micropyritic.

4.5 Hydrocarbon indications

Background gas was very low during drilling of the Shetland Group, varying between 0,25-1%. There was a gas response while drilling into the Draupne Formation and the gas increased further to 6 % when drilling into hydrocarbon filled Brent Group in well 34/10-47 S. The gas response was similar, although a bit lower, 2,0 % while drilling into the Brent Group in track –47 ST2. The background gas was varying between 0,6-1,0 % during further drilling in Rannoch Fm. and Etive Fm. In the Ness Fm. background gas were low; 0,5-1,5 % and there were gas peaks varying between 0,5-1,5 % in coal stringers. Background gas increased considerable after passing the oil-water contact and gas peaks up to 11,45 % was registered in the oilbearing zone. Lag gas gave high background gases while drilling stratigraphic upwards into the Viking Group and Shetland Group (1,7 –0,4 %).

Background gas was very low during drilling of the sidetrack 34/10-47 A, due to relatively high overbalance while drilling the well and water filled reservoirs.

Table 4.4 Gas peak list for well 34/10-47 S / -47ST2

Depth m MD	Depth m TVD	Gas peak %	BG	C1	C2	C3	iC4	nC4	Gas type
34/10-	**47 S**								
2809	2517,5	6,08	1,5	68034	3403	1215	172	240	FG
34/10-	**47 ST2**								
2882	2516,2	2,03	0,5	16099	922	340	47	69	FG
2908	2523	2,65	0,6	22264	1157	442	65	95	FG
3513	2557,5	3,1	0,47	30077	1471	469	56	87	FG
3657	2520,3	7,9	1,5	84087	4586	1750	244	356	FG
3670	2517,3	6,4	0,4	74593	7178	1529	208	305	FG
3680	2515,1	7,9	2,16	84253	4870	1882	260	379	FG
3702	2511	11	3,8	140636	6148	2105	274	404	FG
3733	2504	11,45	6,2	109917	6063	2358	338	492	FG
3773	2497	8,77	2,4	80342	4730	1894	281	416	FG

Table 4.5 Gas peak list for well 34/10-47 A

Depth m MD	Depth m TVD	Gas peak %	BG	C1	C2	C3	iC4	nC4	Gas type
2679	2591	0,7	0,2	4836	286	79			FG
2768	2674,7	0,8	0,3	5552	369	122			FG

4.6 Geophysical results

The Jurassic succession came in approximately 20 m deeper in segment O7 and 20-30 m shallower than prognosed in segment N7. As a consequence, the velocity model had to be adjusted to obtain the correct depths.

Drilling of the well 34/10-47 S/ST2 and sidetrack 34/10-47 A proved the geophysical interpretation of the area to be correct for the Middle Jurassic Brent Group and the lower Jurassic Dunlin Group. However, the interpreted Upper Jurassic sandlobe (Aurora prospect) proved to be non-existing.

The final geophysical results of the area are shown in appendix F.

4.7 Data acquisition

4.7.1 Cuttings and mud samples

One set of washed sample and one set of dried sample (100 g) was collected every 10 m from start of the 17 ½" section and down to 2370 m MD. One set of dried sample (100g) and one set of 5L wet samples were collected from 2370m MD to TD of Well 34/10-47 ST2. One mud sample was collected from the active pits every 100 m from 2300 m TVD to TD. Extra mud samples were collected while drilling through hydrocarbon filled Brent Group.

In well 34/10-47 A one set of 5L wet sample and one set of dried sample (100 g) was collected every 3 m from start of the sidetrack and the sample interval was maintained to TD of Well 34/10-47 A.

4.7.2 Conventional coring

Baker Hughes INTEQ had the coring contract on this well. Cores were planned to be taken in an eventually reservoir sandstone in Upper Jurassic (Draupne Formation, Viking Group) and the Krans Member in the Shetland Group. No reservoir sandstones were detected in these stratigraphic levels and consequently no coring was carried out.

4.7.3 MWD/LWD

Schlumberger D&M had the MWD/LWD service on this well. The 26" hole section was logged with CDR-Gr/Res/Pwd and D&I. The logs were fairly good even though the ROP was very high at times and the fact that it is a 9 ½" tool in a 26" hole. The 17 ½" section was logged with CDR-Gr/Res/Pwd and D&I. There are some questions raised by the geologist regarding the Gamma Ray curve, whether the steering is influencing the tool. No 12 ¼" section was drilled (only 5 meters 12 ½" clean up hole below 13 3/8" casing shoe).
The 8 ½" sections (-47 S & -47 ST2) were logged with Vision 675/VADN/APWD.

Sidetrack 34/10-47 A was drilled in one 8 ½" section and the section was logged with Vision 675/VADN.

Table 4.6 LWD Run summary 34/10-47 S/ST2

LWD Run Summary 34/10-47 S/ST2						
Contractor: Anadrill, Schlumberger D&M						
Run	**Logging Service** (tool combination)	**Pass**	**Pass direct.**	**Log speed**	**Interval [m MD]**	**Pass remark**
Well 34/10-47 S						
36" Section						
1	Powerpulse	Drilling	Down	ROP	165-227	
Section 26"						
2	CDR/PWD	Drilling	Down	ROP	224-725	
Section 17 ½"						
3	CDR/PWD	Drilling	Down	ROP	725-730	No signals from CDR, damaged threads on MWD
4	CDR/PWD	Drilling	Down	ROP	730-1939	
Section 8 ½"						
5		Drilling	Down	ROP	1939-1944	12 ¼" clean out BHA
6	Vision 675/VADN/APWD	Drilling	Down	ROP	1944 - 2880	The tool string got stuck at 2880 m MD. The tool string had to be shot free.
Well 34/10-47 ST2						
1	Vision 675	Drilling	Down	ROP	2428 - 2450	Kick off motor assembly
2	Vision 675/ VADN/APWD	Drilling	Down	ROP	2450 - 4027	

Table 4.7 MWD/LWD Data acquisition for well 34/10-47 S / -47 ST2 and sidetrack 34/10-47 A

Section Run #	Contractor	Equipment	Failure & problems	Interval	Date	Lost time
	34/10-47 S					
1	Anadrill	CDR/PWD		224-725	25-27.09.02	
2						
3	Anadrill	CDR/PWD		725-730	29.09.02	
4	Anadrill	CDR/PWD		730-1939	30.09-05.10.02	
5						
6	SLB D&M	Vision 675/AND/PWD	ECD	1944 - 2880	07-11.10.02	-
	33/12-47 S T2					
1	SLB D&M	Vision 675		2428 - 2450	15-16.10.02	
2	SLB D&M	Vision 675/ ADN/PWD		2450 - 4027	15-23.10.02	
	34/10-47 A					
1	SLB D&M	Vision 675/VADN		2180 - 3016	02-06.11.02	

Table 4.8 Problems and comments to logging while drilling

Problems and comments to logging while drilling
17 ½" section: Realtime log had some missing parts due to high ROP. Operation geologist approved to keep a high ROP as long as one measurement pr. foot was performed. Gamma ray values are 5-6 times higher than expected due to the influence from the KCl-mud. In some intervals the GR reads lower values, one possibility is that during steering intervals the mud between the tool and hole is being squeezed away, giving lower GR readings because of less influence from the KCl-mud. **12 ¼" section:** A five meter clean out 12 ¼" section (1939-1944 m MD) was drilled without MWD/LWD tools. **34/10-47 S 8 ½" section:** The logs were fairly good even though the ROP was very high at times. The tool string got stuck at 2880 m MD and had to be shot free. Prior to the shooting, the radioactive sources were retrived through the drill pipe. Unfortunately it was not given time to download the memory data from the tool. Due to the high ROP and the LWD sample data used, the realtime data has values at approx. every 70-80 cm. The well operation continued on technical sidetrack 34/10-47 ST2. **34/10-47 ST2 8 ½" section:** Very good transmission of realtime data. To high TNPH values due to wrong calibration of the tool on land. The TNPH data had to be processed afterwards. **34/10-47 A 8 ½" section:** Very good transmission of real time data.

Table 4.9 LWD Run summary 34/10-47 A

LWD Run Summary 34/10-47 A						
Section: 8 ½" Contractor: Schlumberger D&M						
Run	**Logging Service** (tool combination)	**Pass**	**Pass direct.**	**Log speed**	**Interval [m MD]**	**Pass remark**
1	Vision 675/VADN	Drilling	Down	ROP	2260-3017	Kicking off @ 2215 mMD
Run Remark.						

4.7.4 Wireline logging

Schlumberger WL performed electrical wireline logging. One run in 34/10-47 ST2 to acquire formation pressure and fluid samples was conducted. A VSP (vertical seismic profile) and DSI (sonic) log was run in one run with two passes in 34/10-47 A. The VSP was intended to provide the time/depth relations for sonic log calibration and depth conversion.

Table 4.10 Wireline logging in well 34/10-47 ST2

34/10-47 ST2 Section: 8 ½" Contractor: Schlumberger					
Run	**Logging Service** (tool combination)	**Pass**	**Pass direct.**	**Log speed**	**Interval [m MD]**
1A	GR/MDT	Main	Down	N.A.	2879-3775
1A	GR/MDT	Main	Up	N.A.	2879-3775
Run remark: Telemetry problems. Changed chambers.					

Table 4.11 Wireline logging in well 34/10-47 A

34/10-47 A Section: 8 ½" Contractor: Schlumberger					
Run	**Logging Service** (tool combination)	**Pass**	**Pass direct.**	**Log speed**	**Interval [m MD]**
1A	DSI/VSP	Main	Up	N.A.	2970-730
1A	DSI/VSP	Main	Up	900 ft/h	3020-1388
1A	DSI/VSP	repeat	Up	900 ft/h	2052-1920
Run remark: DSI were run in cross dipole mode and monopole mode. VSP was run with a rig source.					

Table 4.12 Wireline time distribution in sidetrack 34/10-47 A

Time Distribution			
Run	**Operation time [Hours]**	**Lost Time [Hours]**	**Comments**
1A, DSI/VSP	22.5	0.5	6 armed caliper for DSI did not worked when checked inside casing at approx. 1700 m MD when RIH. Tried fault finding for 50 minutes without result. Pressure on lower limit when logging CSI at 1985 m MD. The pressure had been dropping slightly when logging from bottom to 1985 m MD. Managed to get the compressors giving a slightly higher and more stable pressure supply. The minor pressure drop should not affect the VSP data quality.
Total	22.5	0.5	

Table 4.13 Problems and comments Wireline logging 34/10-47 ST2

Problems and comments Wireline logging 34/10-47 ST2
8 ½" section: The MDT probe was retracted during operation due to lost power supply, first time at bottle 3775 m MD. The feedback from Petrotech was that this sample seems to be OK. The next two samples was @2879 m MD. These two samples were lost due to MDT-tool failure. One of the bottles was also prepared for water sample. The final objective of the fluid sampling was oil samples only. Mis-communication by Schlumberger resulted in that two of the 450cc sample chambers and the 1 gallon chamber were prepared for water samples. However, Schlumberger also set up the 1 gallon chamber as an throttling chamber. This is an old technique, not commonly used, which sampled with no back-pressure i.e. sampling into a chamber with atmospheric pressure. The 1 gallon oil sample is therefore not useful for lab-analysis.

Table 4.14 Problems and comments Wireline logging 34/10-47 A

Problems and comments Wireline logging 34/10-47 A
8 ½" section: Could not open the 6-armed caliper when checking at approx. 1700 m MD when RIH with DSI/VSP. Tried fault finding for 30 minutes without result. Conclusion: the calipers had to be repaired or shifted out. Problem: did not have backup 6-armed caliper on the rig in case repair did not succeed. It was then decided to continue to RIH to TD to start VSP (vertical seimic profile) logging instead. Low pressure was observed when logging CSI at 1985 m MD. After a 20 minutes break the rig was able to get the rig compressors going at a higher rate and provide a higher and more stable pressure than before. It was observed that the pressure had been dropping slightly from start of VSP at 2970m to 1985m MD. The minor pressure drop should not affect the data quality. Continued VSP with a constant pressure of 2000 PSI. The original plan was to provide pressure to the guns by gas bottles sent out from base and not to be dependent on the more unstable compressor system at the rig. However, the gas bottles did not get on the boat they were planned for and was not here when rigging up the VSP equipment. Because of large difference between upper- and lower dipole data in 34/10-B42 B, it was high focus on the DSI job in this well. It was highly recommended to run the DSI with a caliper and orientation tool to know for certain which sensor that was oriented at low side and which at high side. When the caliper failed, the decision from town was to run the DSI without the caliper. Schlumberger WL felt confident that the tool was centralized, and recommended go ahead and log DSI in BCR mode (cross-dipole mode). Caliper is required for dispersion correction of the flextural (Shear) wave to get accurate DT-Shear, but if the hole is good, they could use bit size for dispersion correction.

4.7.5 Data quality

Experienced gamma ray values 5-6 times higher than expected due to the influence from the KCl-mud in the 17 ½" section. For further details see section 4.7.3.

The 6-armed caliper failed before start logging in the 8 ½" section. Missing caliper data could cause problems for dispersion correction of the flexural (Shear) wave to get the accurate DT-shear. For further details see section 4.7.3.

See also section 4.7.3-4.7.4.

4.8 Formation pressure

The final pore pressure figure is mainly based on information gained while drilling this well. Moreover, experience and information from the closest exploration wells in this area (well 34/10-39 S, 34/10-37, 34/10-43 S and 33/12-8 S) are also taken into consideration. In the Brent reservoir, in well 34/10-47 ST2, pore pressure is based on MDT pressure results.

The final pore pressure, fracture pressure and overburden gradient for well 34/10-47 S / -47 ST2 and sidetrack 34/10-47 A are graphically presented in fig. 4.3.

The pore pressure was experienced to be hydrostatic down to sandfree Hordaland Group at approximately 1605 m TVD RKB, where it is equal to 1,02 g/cm^3 EMW. From this depth a weak pressure buildup is seen and the pore pressure at the top of the Balder Formation (1691 m TVD RKB) is indicated to be 1,07 g/cm^3 EMW based on drilling data, gas values and realtime logs. Pore pressure at top of the Lista Formation (1758 m TVD RKB) is estimated to be 1,15 g/cm^3. Top Shetland Group (1904 m TVD RKB) has a pore pressure estimation of 1,22 g/cm^3 EMW. The pore pressure interpretation based on logs and drilling data correspond seemingly well with the prognosis.

The segment N7 has the same pressure regime in the water zone as the neighbouring fields (Gullfaks Vest, Tordis and Rimfaks). It was therefore assumed depletion in the Brent Reservoir via the water zone as a result of production in adjacent reservoirs. Pressure testing showed that the hydrocarbon filled part of the Brent reservoir in well 34/10-47 S / ST2 (segment O7 and N7) is depleted with 29-57 Bars, approximately as expected. The channel sands in the Ness Formation seems to be partly isolated systems with a pressure depletion varying between 29-52 Bars. The pressure depletion in the other Brent Formations that was logged was varying between 49-57 Bars (Tarbert Fm., Rannoch Fm., Etive Fm.).

No pressure tests were taken in the Statfjord Formation in sidetrack 34/10-47 A. The mudweight was kept well above the prognosed pore pressure while drilling the sidetrack and there were no evidence for higher pressures than prognosed. Pressure at the top of the Statfjord prospect (2840 TVD MSL) is prognosed to be 408 Bars (initial pressure), corresponding to 1,45 g/cm^3 in EMW.

4.8.1 Reservoir pressure summary

The Brent segment was expected to be in communication with the Gullveig Field, the Tordis Field and the Gullfaks West Field via the water basin. The Brent reservoir turned out to be depleted with 29-57 Bars as expected. The Brent reservoir was most depleted in the Tarbert Fm., the Rannoch Fm. and the Etive Fm. The channel sands of the Ness Formation were least depleted, varying between 29-52 Bars depletion.

Figure 4.3 Final Pore Pressure curve for well 34/10-47 S/ST2/A

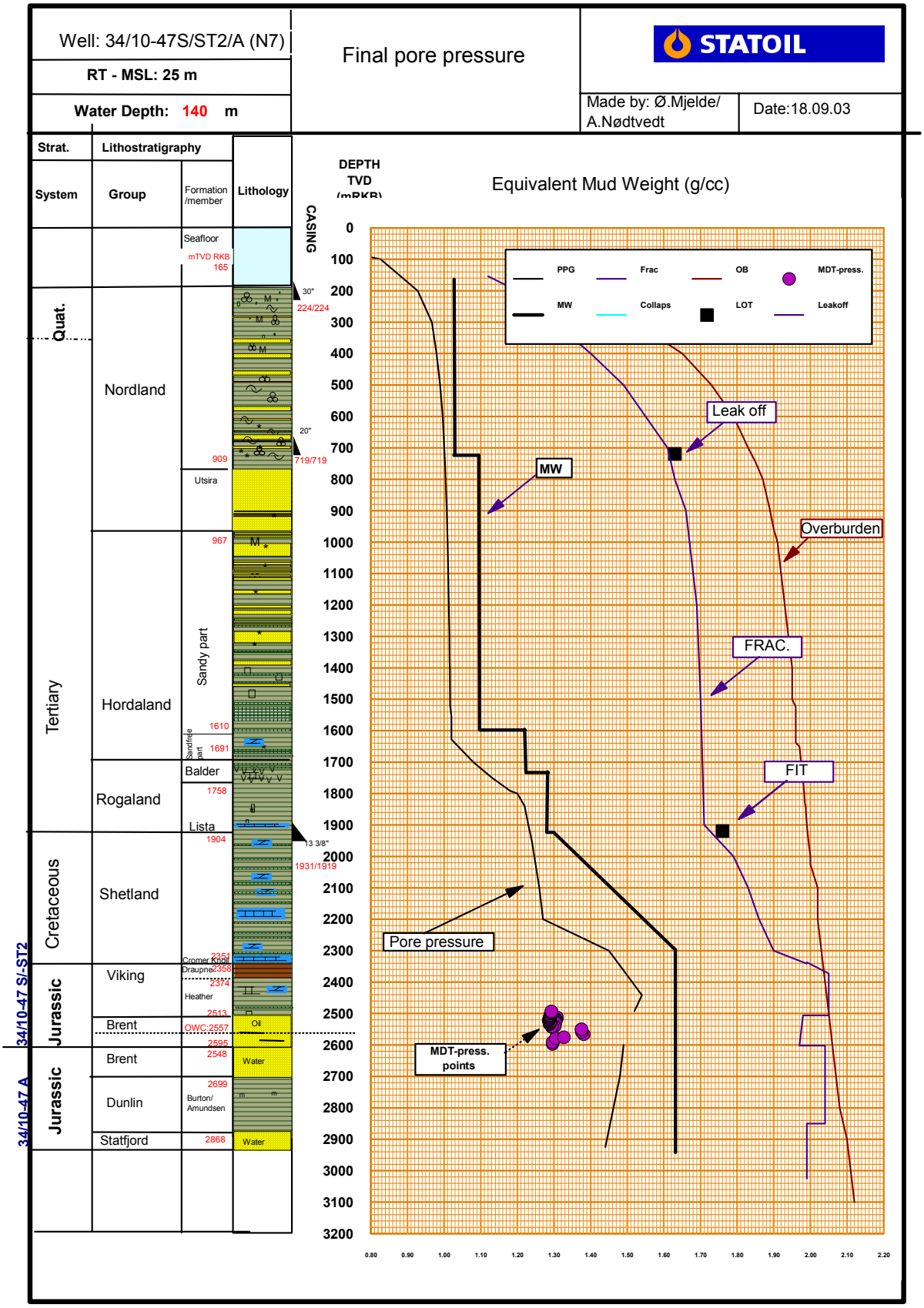
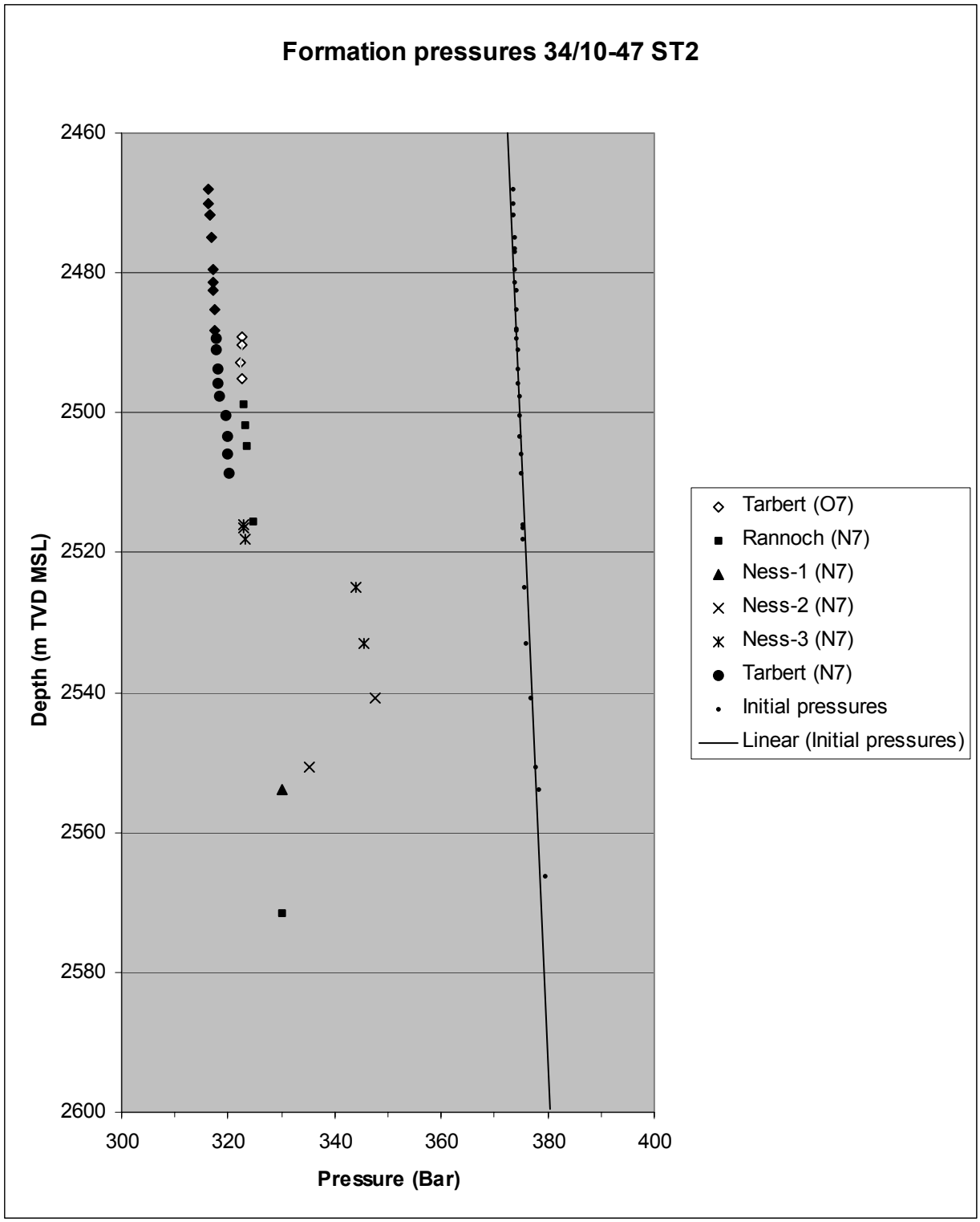


Figure 4.4 Formation pressures in well 34/10-47 ST2



4.9 Reservoir fluid sampling

Table 4.15 WFS sample list for 34/10-47 S/ -ST2

Sample List (WFS)

K-no:	55249
Operator:	Statoil
Rig:	Deep Sea Trym
Well:	34/10-47S

Sample no.	Date	Run no.	Chamber no.	Bottle no.	Sample type	Depth mRKb	Reservoir temp	Volume ml	P.Res bar	Comments
1,1	25.10.2002	1	MRSC-203	TS-47402	Oil/Gas	2550,0	94,2	3400	344,042	Chamber prepared for wtr. sample
1,2	25.10.2002	1	MPSR-37	PT-1081	Oil	3775,0	93,1	390	316,5	
1,3	25.10.2002	1	MPSR-694	PT-5606	Oil	2522,6	93,6	400	318,196	Analysed offshore
1,4	25.10.2002	1	MPSR-776	PT-1020	Oil	3722,0	93,8	380	317,137	Analysed offshore
1,5	25.10.2002	1	MPSR-134	PT-1045	Oil	3775,0	93,1	380	316,5	
1,6	25.10.2002	1	MPSR-168	PT-1048	Oil	3775,0	93,1	390	316,5	Analysed offshore
1,7	25.10.2002	1	MPSR-795	PT-1065	Oil	3646,0	93,6	390	318,196	
1,8	25.10.2002	1	MPSR-852	PT-1015	Oil	3539,0	94,2	390	344,042	Analysed offshore
1,9	25.10.2002	1	MPSR-855	PT-1023	Oil	3539,0	94,2	385	344,042	
1,10	25.10.2002	1	MPSR-927	PT-1063	Oil	2879,0	91,6	390	322,585	
1,11	25.10.2002	1	MPSR-173	PT-1040	Oil	3722	93,8	390	317,137	

Remarks: Sample no. 1.1 is not representative, the sample chamber was not prepared for low chock sampling.

4.10 Formation temperature

Formation temperatures were measured while logging MDT on TLC in the reservoir section in well 34/10-47 ST2 and are shown in figure 4.5.

Figure 4.5 Formation temperatures measured in the reservoir section in well 34/10-47 ST2 while logging MDT on TLC.

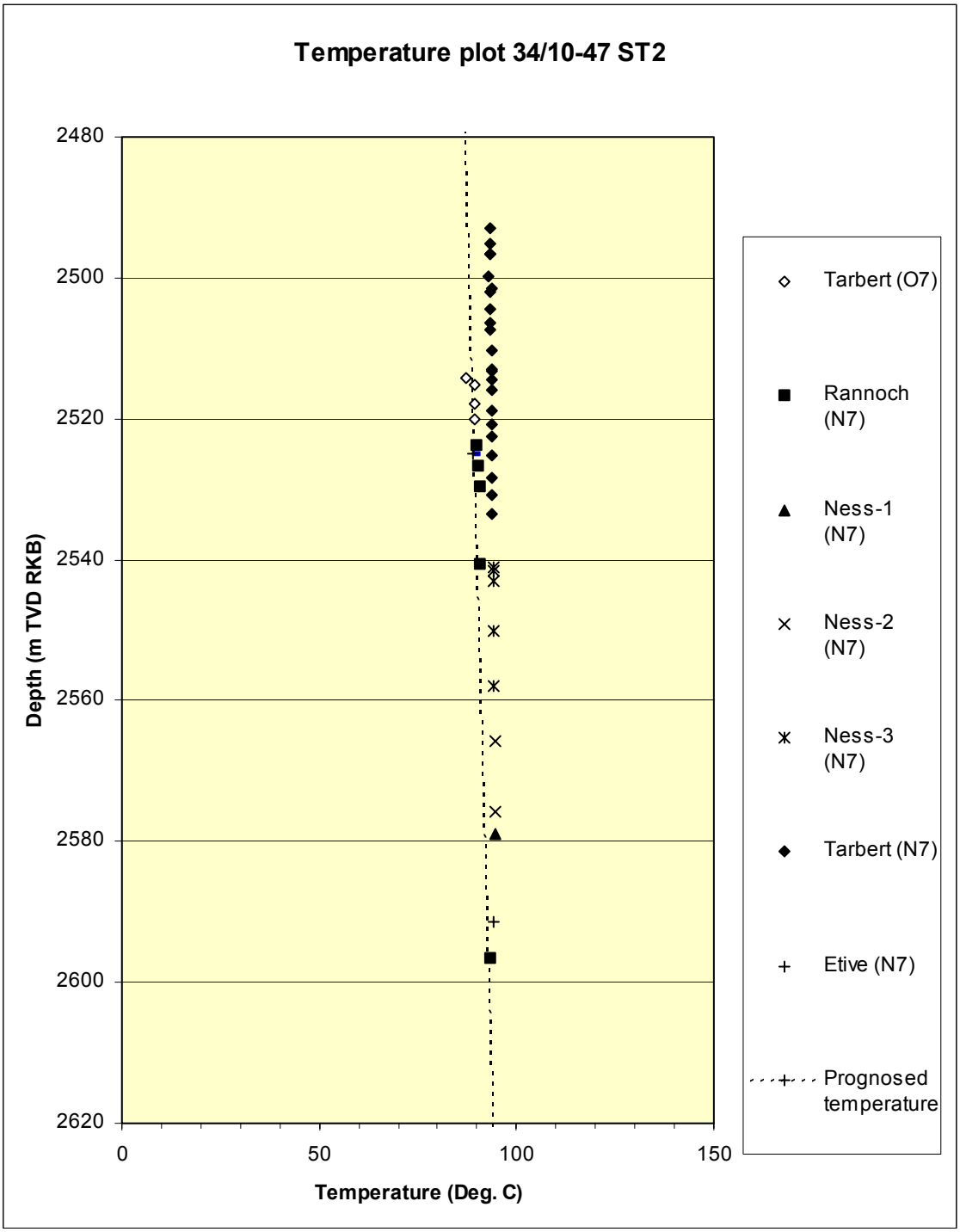


Table 4.16 Measured temperatures in well 34/10-47 ST2.

ZONE NAME	Test no.	Depth m MD RKB	Depth m TVD RKB	Depth M TVD MSL	Temp. Deg. C
SEGMENT O7					
Tarbert	1	2879	2514.1	2489.1	87.4
Tarbert	2	2883	2515.2	2490.2	89.3
Tarbert	3	2892	2517.9	2492.9	89.3
Tarbert	4	2899.5	2520.1	2495.1	89.5
SEGMENT N7					
Rannoch	5	2912	2523.8	2498.8	89.9
Rannoch	6	2922	2526.7	2501.7	90.2
Rannoch	7	2932	2529.7	2504.7	90.5
Rannoch	8	2967	2540.6	2515.6	90.9
Rannoch	9	3253	2596.6	2571.6	93.2
Etive	10	3339	2591.3	2566.3	94.1
Ness-1	11	3424	2578.9	2553.9	94.5
Ness-2	12	3440	2575.7	2550.7	94.6
Ness-2	13	3482	2565.7	2540.7	94.5
Ness-3	14	3510	2558	2533	94.4
Ness-3	15	3539	2550	2525	94.3
Ness-3	16	3565	2543.1	2518.1	94.1
Ness-3	17	3571	2541.5	2516.5	94
Ness-3	18	3575	2541	2516	94.1
Tarbert	19	3602.5	2533.6	2508.6	93.9
Tarbert	20	3612	2530.9	2505.9	93.9
Tarbert	21	3622.5	2528.3	2503.3	93.8
Tarbert	22	3634.5	2525.3	2500.3	93.8
Tarbert	23	3646	2522.6	2497.6	93.8
Tarbert	24	3654	2520.7	2495.7	93.7
Tarbert	25	3662	2518.8	2493.8	93.7
Tarbert	26	3675	2515.9	2490.9	93.7
Tarbert	27	3682	2514.4	2489.4	93.7
Tarbert	28	3689	2512.9	2487.9	93.8
Tarbert	29	3687	2513.3	2488.3	93.6
Tarbert	30	3702	2510.2	2485.2	93.7
Tarbert	31	3716	2507.4	2482.4	93.4
Tarbert	32	3722	2506.3	2481.3	93.4
Tarbert	33	3731.5	2504.5	2479.5	93.4
Tarbert	34	3748	2501.5	2476.5	93.6
Tarbert	35	3746	2501.9	2476.9	93.4
Tarbert	36	3757	2499.9	2474.9	93
Tarbert	37	3775	2496.7	2471.7	93.3
Tarbert	38	3775	2496.7	2471.7	93.3
Tarbert	39	3784	2495.1	2470.1	93.3
Tarbert	40	3796	2493	2468	93.3

4.11 Experiences / recommendations

MWD/LWD data, MDT pressure and fluid samples, sonic logs and vertical seismic profile (VSP) executed in Well 34/10-47 S/ST2/A have contributed to a better understanding of the geophysical model, pressure regime and the geological time model of the area.

5 Drilling operations report

5.1 Rig move and anchor handling

Deepsea Trym was moved from 34/10-D-3 to 34/10-47 S well location in 5 hrs. The anchor handling was performed in 22 hrs.

5.2 Comparison final / original well design

Well 34/10-47 S was drilled mainly as planned after the well programme. Track 2 was adjusted up a few meters due to experience from well –47 S where Top Brent came in a few meters deeper than prognosed before the stuck pipe incident. After getting stuck close to the main fault one had to perform a technical sidetrack (-47 ST2), which was kicked off in the lower part of the Shetland Group (See figure 4.1). Track 2 was drilled without any steering problems.

The planned sidetrack 34/10–47 A was drilled with a more gentle curve and lower doglegs than the original well-path for well –47 A (see Figure 4.1). Change in the original well-path was done to ensure that the well could be easily drilled without any steering-problems related to reaching Target 1; Top Statfjord Formation. Schlumberger could not guarantee that Target 1 could be reached, by use of the Powerdrive, if the planned well-path had doglegs higher than 3.5 degrees every 30/m as in the original plan.

5.3 Drilling top hole section

5.3.1 36" hole section

Drilling

- Drilled 36" hole from seabed, 165 m MD to 227 m MD in one run. Reamed hole in order to get inclination below 0,75°. Achieved less than 0,6° in entire section.
- Had indications of boulders during drilling; reaming was necessary both during drilling and after reaching TD.

Bit run

- From 165 m MD to 227 m MD.
- Run #1: 17 ½" x 26" x 36" hole opener assembly.
  Hole opener: Smith Red Baron 26" x 36"
  Bit: 17 ½" Smith MGSSH+ODC.

MWD/BHA

- Schlumberger Anadrill MWD
- Hole opener assembly

MUD

The section was drilled with seawater. Several HiVis pills were swept during drilling. At TD the well was swept with 20 m^3 HiVis and the hole displaced to 1,40 g/cm^3 EMW WBM before pulling out of hole.

30" conductor

- Housing: 0,10°
- Shoe is set at 223,7 m MD / 223,7 m TVD.

Cement job

- Lead slurry: 28,0 m^3, 1,56 g/cm^3 EMW
- Tail slurry: 15,0 m^3, 1,95 g/cm^3 EMW
- Did not observe cement returns at seabed. Was able to RIH outside conductor to 171 m MD when stabbing cement stinger through RGB funnel.
- Performed grouting job with 15,0 m^3, 1,95 g/cm^3 EMW slurry and observed cement return at seabed.

5.4 Drilling intermediate sections

5.4.1 26" hole section (227 m to 725 m MD)

Drilling

- Drilled 26" hole from 227 m MD to 725 m MD in one run.
  At 482 m MD a hydrocarbon bearing sandstone was indicated on the MWD. A flowcheck indicated stable well, and drilling was continued to TD.

- Well profile:

Inclination:	Start	0,8°	End:	4,75°
Azimuth:	Start:	314°	End:	291°

Bit run

- From 227 m MD to 725 m MD.
- Run #2: 26” Security XT02.

MWD/BHA

- Schlumberger Anadrill MWD and CDR.
- The BHA was designed to be stiff, with no motor included. This lead well path to drift away from vertical causing time consuming steering in 17 ½" section.
- Due to this, it is recommended to include motor in 26" BHA on GF satellittes.
- **Comment**; the purpose of this section was to drill a vertical hole to TD.

MUD

- The section was drilled with seawater. HiVis pills were swept during drilling. At TD the well was swept with 20 m^3 HiVis and the hole displaced to 1,20 g/cm^3 EMW WBM before pulling out of hole.

20" casing

- Shoe is set at 719,3 m MD / 718,7 m TVD.

Cement job

- Lead slurry: 89,0 m^3, 1,65 g/cm^3 EMW
- Tail slurry: 31,0 m^3, 1,90 g/cm^3 EMW

LOT

Performed LOT equivalent to 1,63 g/cm^3 EMW

5.4.2 17 ½" hole section (725 m to 1939 m MD)

Drilling

- Drilled 17 ½" hole from 725 m MD to 730 m MD. POOH to change MWD.
- Drilled 17 ½" hole from 730 m MD to 1939 m MD.

- **Well profile:**
  Inclination: Start 4,75° End: 19,39°
  Azimuth: Start: 291° End: 253°

Bit run

- The section was drilled with one bit.
- Run #3: From 725 m MD to 730 m MD. 17 ½" Hughes Christensen MX03DDT.
- Run #4: From 730 m MD to 1939 m MD. 17 ½" Hughes Christensen MX03DDT.

MWD/BHA

- Schlumberger Anadrill's MWD/PWD and CDR sensors were incorporated in the BHA for the 17 ½" section. BHI's Navidrill DTU motor with 0,8° bend was used.

MUD

- 1,20 – 1,40 g/cm^3 EMW Glydrill Formulation #12 WBM was used.

13 3/8" casing

- Shoe is set at 1939,0 m MD / 1926,1 m TVD.

Cement job

- Slurry: 21,4 m^3 , 1,90 g/cm^3 EMW

FIT

- Performed FIT equivalent to 1,76 g/cm^3 EMW

5.4.3 12 ¼" hole section (1939 m to 1944 m MD)

Drilling

- Drilled cement, cleaned out casing shoe and drilled 12 ¼" hole from 1939 m MD to 1944 m MD.

Bit run

- Run #5: From 1939 m MD to 1944 m MD. 12 ¼" Reed Hycalog MHT13GK (used bit).

MUD

- 1,50 g/cm^3 EMW Versavert Formulation #41 OBM was used.

5.5 Drilling reservoir sections

5.5.1 8 ½" hole section –47 S (1944 m to 2880 m MD)

Drilling

- Drilled 8 ½" hole from 1944 m MD to 2880 m MD and got stuck. Cutted drillpipe and cemented the hole back to 2315 m MD.
- Kicked off on cement plug at 2428 m MD with motor assembly and drilled 8 ½" hole to 2450 m MD.

- **Well profile:**
  Inclination: Start 19,39° End: 71°
  Azimuth: Start: 253° End: 271°

Bit run

- Run #6: From 1944 m MD to 2880 m MD. 8 ½" Lyng LD575PDG.
- Run #7: From 2428m MD to 2450 m MD. 8 ½" Smith MFDGH.

MWD/BHA

- Schlumberger Anadrill's MWD/PWD, Vision and ADN sensors were incorporated in the BHA for bit run #6. The PD675Xtra 3D rotary steerable system was used.
- Schlumberger Anadrill's MWD/PWD and Vision sensors were incorporated in the BHA for bit run #7. The Power Pack motor with 1,5° bend was used for kick-off on cement plug on bitrun #7.

MUD

- 1,63 g/cm^3 EMW Versavert Formulation #41 OBM was used.

Plug back cement job

Cement plug interval: 2730 m MD – 2480 m MD; 13,5 m^3 , 2,05 g/cm^3 EMW
Kick-off plug for sidetrack.

See well schematic in appendix for further details.

5.5.2 8 ½" hole section –47 ST2 (2450 m to 4027 m MD)

Drilling

- Drilled 8 ½" hole from 2450 m MD to 4027 m MD.
- Kicked off on cement plug from 2167m MD to 2215 m MD.

- **Well profile:**
  Inclination: Start 57,55° End: 103,7°
  Azimuth: Start: 274° End: 266°

Bit run

- Run #1: Continued from run #7 above.
- Run #2: From 2450m MD to 4027 m MD. 8 ½" Reed Hycalog RSX162HDW.
- Run #3: BHA pulled while RIH due to cement plugging of BHA.

- Run #4: Kick-off from 2167m MD to 2215 m MD. 8 ½" Reed Hycalog RSX162HDW.

MWD/BHA

- Schlumberger Anadrill's MWD/PWD, Vision and ADN sensors were incorporated in the BHA for bit run #2, 3 & 4. The PD675Xtra 3D rotary steerable system was used.

MUD

- 1,63 g/cm^3 EMW Versavert Formulation #41 OBM was used.

Plug back cement job

The HC bearing intervals were plugged back, and a kick-off plug set with top at 2160 m MD. Cement plug intervals:

Plug #1:	3470 m MD - 3120 m MD;	16,0 m^3 , 1,90 g/cm^3 EMW
Plug #2:	2990 m MD - 2640 m MD;	16,0 m^3 , 1,90 g/cm^3 EMW
Plug #3:	2410 m MD - 2160 m MD;	14,0 m^3 , 1,90 g/cm^3 EMW
	Kick-off plug for sidetrack.	

Got losses to formation while circulating at 3677 m MD prior to cement job. Decreased mudweigth to 1,60 sg EMW and pulled into casing shoe. With well stable, started running in hole again with cement stinger. Had sligth losses while running in hole to 3470 m MD. Spotted a LCM pill and cemented. After cement plug #1 was set, the well was stable.

Discussion:
As this wellpath ends at 103,7°, it was decided to circulate bottoms up to ensure that there was no gas in the wellbore prior to setting cement plugs. The cirulation was performed at 2000 lpm / 240 bar, with an ECD of 1,73 – 1,75 sg EMW. At end of circulation, the annular preventer was closed and SCR taken. Then circulation was resumed up choke line. Losses occurred at 820 liter pr. minute.

It is most likely that during these operations, the wellbore was exposed to ECD values in excess of formation strength, leading to the loss situation.

5.5.3 8 ½" hole section –47 A (2215 m to 3016 m MD)

Drilling

- Drilled 8 ½" hole from 2215 m MD to 3016 m MD. Schlumberger Anadrill's MWD/PWD, Vision and ADN sensors were incorporated in the BHA. The PD675Xtra 3D rotary steerable system was used.

- **Well profile:**

Inclination:	Start	25,56°	End:	0°
Azimuth:	Start:	288°	End:	54°

Bit run

- Run #1: From 2215m MD to 3016 m MD. 8 ½" Reed Hycalog RSX162HDW.

MWD/BHA

- Schlumberger Anadrill's MWD/PWD, Vision and ADN sensors were incorporated in the BHA. The PD675Xtra 3D rotary steerable system was used.

MUD

- 1,63 g/cm^3 EMW Versavert Formulation #41 OBM was used.

P&A

The reservoir sections were plugged back, and a cement plug was set into 13 3/8" casing with top at 1850 m MD. A scraper run was performed, and the cement plug was weigth tested with 10 ton, and pressure tested to 92 bar with 1,63 sg EMW mud.
A retrievable Halliburton HE-3 plug w/ junk catcher was installed at 754 m MD.
Cement plug intervals:

Plug #1:	3016 m MD - 2716 m MD;	13,7 m^3, 1,90 g/cm^3 EMW
Plug #2:	2706 m MD - 2406 m MD;	13,7 m^3, 1,90 g/cm^3 EMW
Plug #3:	2131 m MD - 1850 m MD;	16,9 m^3 , 1,90 g/cm^3 EMW

P&A plug into 13 3/8" casing.

6 Appendix