BP AMOCO NORGE AS
6507/5-4A
STENA DEE

GEOLOGICAL AND PETROLEUM ENGINEERING COMPLETION REPORT

6507/5-4A

NORWEGIAN SEA

NORWAY

Inge H. H. Eikelmann

December 2001

GCR APPROVAL

PROSPECT: SKARV

TARGET: LOWER TO MIDDLE JURASSIC GARN AND ILE FORMATIONS.

LOCATION ID:

DATE: DECEMBER 2001

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Indexing Information

Country(s):	**NORWAY**
Situation:	Offshore
Region(s):	Norwegian Sea
Well name(s):	6507/5-4A

Regional Reports:

Well report subject code:	Geological Completion Report W28.48
File name:	6507_5_4A_W28 Geol comp.report.doc
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Subjects:

Well Summary

Geology/Lithology

Pore Pressure/Fracture Gradient

Wireline Operations

CONTEXT, WELL OBJECTIVE AND RESULT

Technical Well Objective

To explore for a deeper OWC in the Garn Formation of the C segment, as indicated by a structurally conforming amplitude anomaly.

Well location objectives:

- Penetrate sufficient reservoir to measure accurate pressure gradient(s) in order to establish the Garn oil/water contact.
- Be in an area with good seismic quality within the defined high amplitude anomaly.
- Avoid faults

Strategic Well Objective

Gather the data required to allow confident resource evaluation of the Skarv discovery liquids. The aim is to make well 6507/5-4 A the last appraisal well on the Skarv structure and enable decisions on potential fast tracking of a Skarv area development.

Timing:

Well 6507/5-4A was drilled with the rig Stena Dee. The rig was initially on contract for the 6507/5-4 well, from 2nd February 2001 (19:00 hrs). Sidetrack well operations for 6507/5-4A were initiated on 4th April 2001 (09:30 hrs). After problems with cutting and retrieving the 9 5/8" casing in the original wellbore, the well was successfully kicked off on 17th April 2001 (10:45 hrs). TD was reached on the 13th May 2001 (22:00 hrs), at a depth of 3883 mBRT. After logging operations, the well was temporarily abandoned for testing at a later date. The rig was off contract on 3rd June 2001 (24:00 hrs).

Well Result

Well 6507/5-4A completed a shorter logging programme across the Jurassic targets in the 8 ½" hole than planned. This was due to hole instability problems in the lower part of Melke Formation caused by stuck casing 21m above planned setting depth for the 9 5/8" casing. An oil down to scenario was proven in the primary Garn reservoir. In addition, hydrocarbons shows was detected in the thin Lysing Formation and in poor quality Cretaceous Lange sands in the 12 ¼" hole.

Previous Drilling

Block 6507/6 was previously operated by Saga in the PL123 Licence. Two exploration wells were drilled by Saga in the period 1986 to 1991: 6507/6-1 and 6507/6-2. Both wells were plugged and abandoned as dry wells with shows. The Amoco operated exploration well 6507/5-1 well was completed in 1998 and was suspended as an oil and gas discovery in the Jurassic and Cretaceous. The Jurassic discovery was named Skarv and the Cretacous discovery Gråsel. In 1999, well 6507/5-2 was drilled by BP Amoco to appraise Skarv. The well was plugged and abandoned as a gas well. The Snadd structure was explored by the 6507/5-3 well in June 2000 and plugged and abandoned as a gas discovery.
Well 6507/5-4, drilled within the C segment, successfully completed a logging program across Cretaceous secondary targets in the 12.25" hole, and a logging and coring programme of the primary Jurassic targets in 8.5" hole. Oil and gas were discovered in the primary Garn reservoir target, while Ile and Tilje were water-wet. In addition, oil was discovered in poor quality Cretaceous Lange sands. The thin Lysing Formation were tight without shows.

Regional Setting

The Skarv structure is a Jurassic tilted fault block located to the west of the Nordland Ridge at the eastern edge of the Dønna Terrace. Play concept is similar to the existing fields in the Mid Norway area, e.g. Heidrun, Norne and Smørbukk. The main structural events to create these traps occurred during Late Jurassic rifting.

Mapping and Trap Definition

The Skarv structure is mapped on the ANO9701 3D survey, with recent fault map updates from the reprocessing fast track cube (PL212 seisworks project). The structure is a tilted fault block bounded to the northwest by a major normal fault down-throwing to the northwest. The remaining part of the structure is dip-closed. Skarv is split into three main segments, A, B and C, by two normal faults, which trend northwest - southeast. Well 6507/5-4 was located in segment C, as is well 6507/5-4A.
Seismic quality over Skarv is of fair to good quality. The Jurassic targets can be tied and mapped with high confidence, but a relative large uncertainty is attached to the depth conversion. Amplitude anomalies are identified and show good structural conformance over the three fault segments of Skarv. The seismic is not of sufficient quality to enable hydrocarbon phase prediction. In addition to the Jurassic primary targets, relatively high risk secondary targets have been identified in the Cretaceous Lysing and Lange Formations.

Reservoir

The main reservoir target in the 6507/5-4A well was the Middle Jurassic sandstones of the Fangst Group (Garn and Ile Formations). The Top Garn reflector was tied to the 6507/5-4 well, which had in turn been tied in to the 6507/6-2, 6507/5-1 and 6507/5-2 wells.

FIGURES

Enclosures

1/500 Measured Depth Composite Log

1 WELL DATA SUMMARY

1.1 GENERAL DATA

Well Name	6507/5-4A	
Status	Suspended, Oil Discovery	
Licence	PL 212	
Operator	**BP Amoco**	**30.00%**
Partners	Statoil	30.00%
	Enterprise	25.00%
	Mobil	15.00%

Surface Location		**TD Location**	
Latitude	65° 41’ 44.773” N	**Latitude**	65° 41’ 24.017” N
Longitude	07° 34’ 13.618” E	**Longitude**	07° 33’ 53.753” E
Grid	7 286 930.74 mN	**Grid**	7 286 294.0 mN
	434 346.75 mE		434 078.7 mE

Projection	UTM 32N; Common Meridian 09° E
Spheroid	ED 50, 1924 International
Seismic Location	Inline: 1157, Xline: 1865 (Surface location) (Survey AN09701M)

Offset from Nearest Wells	BP Amoco well 6507/5-2: 3.9 kms North-east	Amoco well 6507/5-1: 6.5 kms North-east	Saga well 6507/6-2: 7.3 kms North-east
Drilling Rig:	Stena Dee	**Rig Type:**	Semi-submersible.
RTE	25 m MSL	**Total Depth**	3883 mBRT
Depth Datum	RT	**Loggers Depth**	n.a. mBRT
Water Depth	421 m	**Maximum Inclination**	19.2° @ 1789 mBRT
Rig on Contract	2nd February 2001 (for the 6507/5-4 well)	**Spud Date**	17th April 2001 (kick-off from 6507/5-4)
TD Date	13th May 2001	**Rig Released:**	04th June 2001
Report Number	W28.48		
Authors	Inge H. H. Eikelmann		

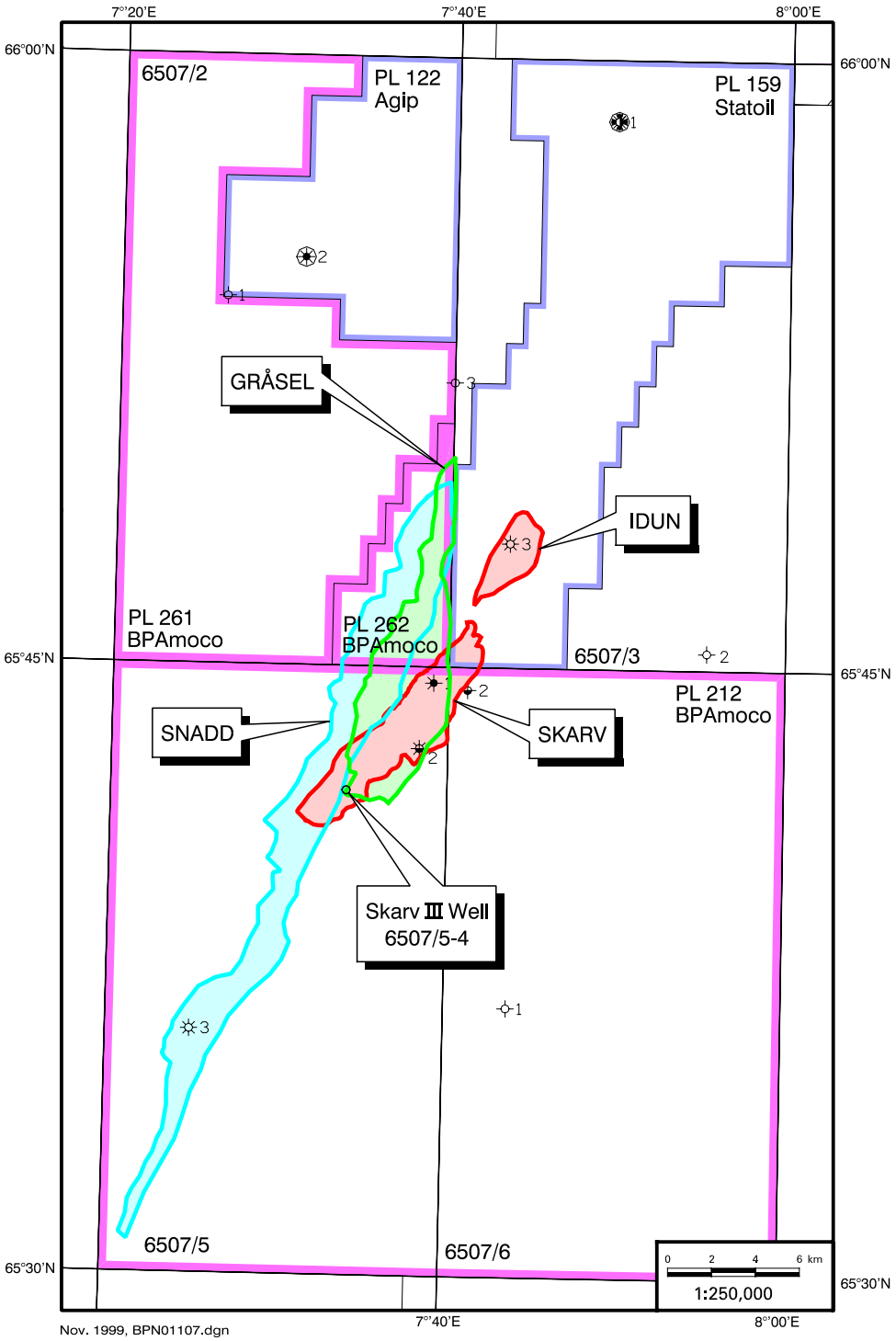

Figure 1: Location Map

1.2 STRATIGRAPHY

Chrono/Lithostratigraphy		Tops			
		Depth	**Depth**	**Depth**	**Thickness**
		mMDBRT	mTVDBRT	mTVDSS	m
Middle Miocene - Recent	**Nordland Group**				
	Quaternary	446	446	421	199.8
	Naust Fm	645.8	645.8	620.8	752.3
	Kai Fm	1398.2	1398.1	1373.1	417.5
Well sidetracked at 1480 mMD (intra Kai Fm). Tops above 1480 mMDBRT taken from well 6507/5-4.					
Late Palaeocene – Late Oligocene	**Hordaland Group**				
	Brygge Fm	1822.8	1815.6	1790.6	184
Late Campanian - Late Palaeocene	**Rogaland Group**				
	Tare Fm	2016	1999.6	1974.6	45.9
	Tang Fm	2064.2	2045.5	2020.5	57.7
Coniacian – Late Campanian	**Shetland Group**				
	Nise Fm	2124.8	2103.2	2078.2	477.4
	Kvitnos Fm	2626.0	2580.6	2555.6	205.9
Early Hauterivian - Late Turonian	**Cromer Knoll Group**				
	Lysing m	2842	2786.5	2761.5	5.4
	Lange Fm	2848	2791.9	2766.9	278.2
	Upper intra Lange Sandstone	3140	3070.1	3045.1	79.5
	Upper intra Lange Sst. base	3223.5	3149.6	3124.6	
	Lower intra Lange Sandstone	3311	3233.1	3208.1	40.4
	Lower intra Lange Sst. base	3353.7	3273.5	3248.5	
	Lyr Fm.	3461.0	3375.5	3350.5	13
Latest early –late Bajocian - Middle Kimmeridgian	**Viking Group**				
	Spekk Fm	3474.0	3388.1	3363.1	15.5
	Melke Fm	3490.5	3403.6	3378.6	218
Aalenian	**Fangst Group**				
	Garn Fm	3719.5	3621.5	3596.5	69.9
	Not Fm	3793	3691.4	3666.4	26.2
	Ile Fm	3820.5	3717.6	3692.6	25.4
Late/Middle Toarcian	**Båt Group**				
	Ror Fm	3847	3743	3718	38.5+

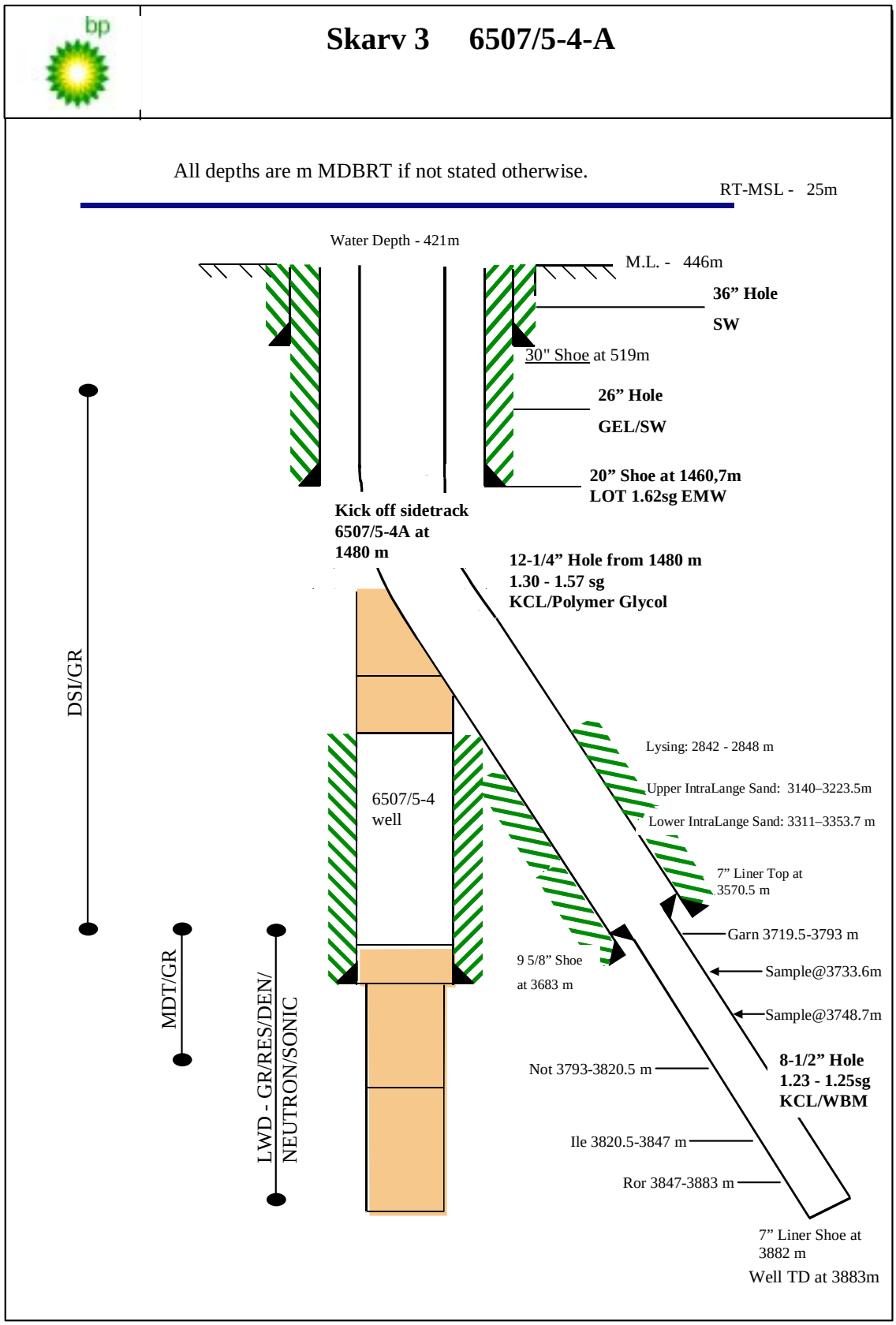

Figure 2. Well summary

1.3 CASING

Casing Size	Section TD mBRT	Casing Depth mBRT	Test Depth mBRT	Lithology	Formation	Comments
30" (from 6507/5-4 well)	522.0	519.0	-	Mudstone	Undifferentiated Quaternary	Surface conductor. No LOT
20" (from 6507/5-4 well)	1466.0	1460.66	-	Mudstone	Kai Formation	LOT: 1.62sg EMW taken in 6507/5-4 well at 1469 mBRT. Tested with 1.40sg mud and 710 psi applied surface pressure.
9 5/8"	3709	3683	-	Mudstone	Melke Formation	FIT: 2.01sg EMW taken in 6507/5-4 well at 3501.5 mBRT. Tested with 1.25 sg mud and 3800 psi applied surface pressure.
7"	3883	3882	-	Mudstone	Ror Formation	Top of liner set at 3570.5 mBRT

1.4 SHOWS

Interval (m BRT)	Lithology	Formation /sequence	Background Gas	Gas Show	Oil Show Description
2842 –2846.5	Sandstone	Lysing Formation	0.1 %	1.4 %	Drilled cuttings: Poor shows - trace spotty very dull to rare bright yellow white direct fluorescence, trace very slow blooming very dull bluish white crush cut fluorescence?
3110 – 3224	Sandstone	Upper Intra Lange Sst.	0.2 %	0.5 %	Drilled cuttings: pinpoint dull yellow-white direct fluorescence, direct cut, poor blue-white crush cut fluorescence, rare bright blue-white residual ring fluorescence.
3311 -3353	Sandstone	Lower Intra Lange Sst.	0.55 %	1.4 %	Drilled cuttings: traces pinpoint dull-bright yellow-white direct fluorescence, slow blooming bluish-white cut, improved with crushing, weak very dull blueish white residual fluorescent ring.
3719.5 - 3793	Sandstone	Garn	0.4 %	3.4 %	Drilled cuttings: bright yellow/white-yellow/gold direct fluorescence, slow-moderately fast blooming-slow streaming

					milky white-bluish white cut, milky white-dull bluish white crush cut, pale yellowish white residual ring, dull yellow residual ring.
3793 - 3820	Sandstone	Not	0.2 %	0.2 %	Drilled cuttings: yellow-yellowish gold direct fluorescence, slow-moderately fast blooming, bluish white cut, milky white-dull bluish white crush cut, pale yellowish white residual ring, locally with traces of light brown oil staining, dull yell residue ring.
3820 - 3847	Sandstone	Ile	0.1 %	0.4 %	Drilled cuttings: yellow-yellowish gold direct fluorescence, moderately fast streaming-blooming yellow white cut, milky white residual ring.

1.5 TESTS

1.5.1 MDT PRESSURE TEST DATA

Test	Depth mMDBRT	Depth mTVDSS	Mud Hydrostatic (psia)		Formation Pressure (psia)	Comment
			Before	After		
1	3721	3597.8	6358.30	6358.80	5424.88	Good Test
2	3723.2	3599.9	6361.00	6360.70	5426.70	Good Test
3	3725.3	3601.9	6364.10	6364.20	5428.46	Good Test
4	3727.2	3603.7	6366.20	6367.40	5430.59	Good Test
5	3730.1	3606.5	6372.20	63.71.8	5432.70	Good Test
6	3733.6	3609.8	6377.17	6376.40	5435.43	Good Test
7	3736.9	3612.9	6382.30	6383.20	5438.58	Good Test
8	3740.3	3616.2	6388.40	6387.80	5441.46	Good Test
9	3743.3	3619.0	6392.60	6392.50	5444.40	Good Test
10	3749	3624.4	6401.20	6402.20	5449.15	Good Test
11	3751.9	3627.2	6406.80	6406.55	5452.07	Good Test
12	3754.6	3629.8	6411.00	6410.80	5454.21	Good Test
13	3757.8	3632.8	6416.10	6416.10	5457.18	Good Test
14	3763	3637.8	6424.80	6424.30	-	Supercharged
	3763	3637.8	6424.00	6423.90	5461.27	Good Test (Retry point. +0.7 m added after correlation)
15	3765.7	3640.3	6428.80	6428.40	5463.77	Good Test
16	3769	3643.5	6433.40	6433.20	5466.78	Good Test
17	3772.4	3646.7	6439.40	6439.60	5469.86	Good Test
18	3781	3654.9	6454.30	6453.90	-	Tight
19	3784	3657.7	6458.90	5458.60	-	Supercharged.
20	3788.5	3662.0	6465.00	-	-	Supercharged
21	3790.5	3663.9	6468.20	-	-	Supercharged
22	3799	3672.0	6482.90	-	-	Tight

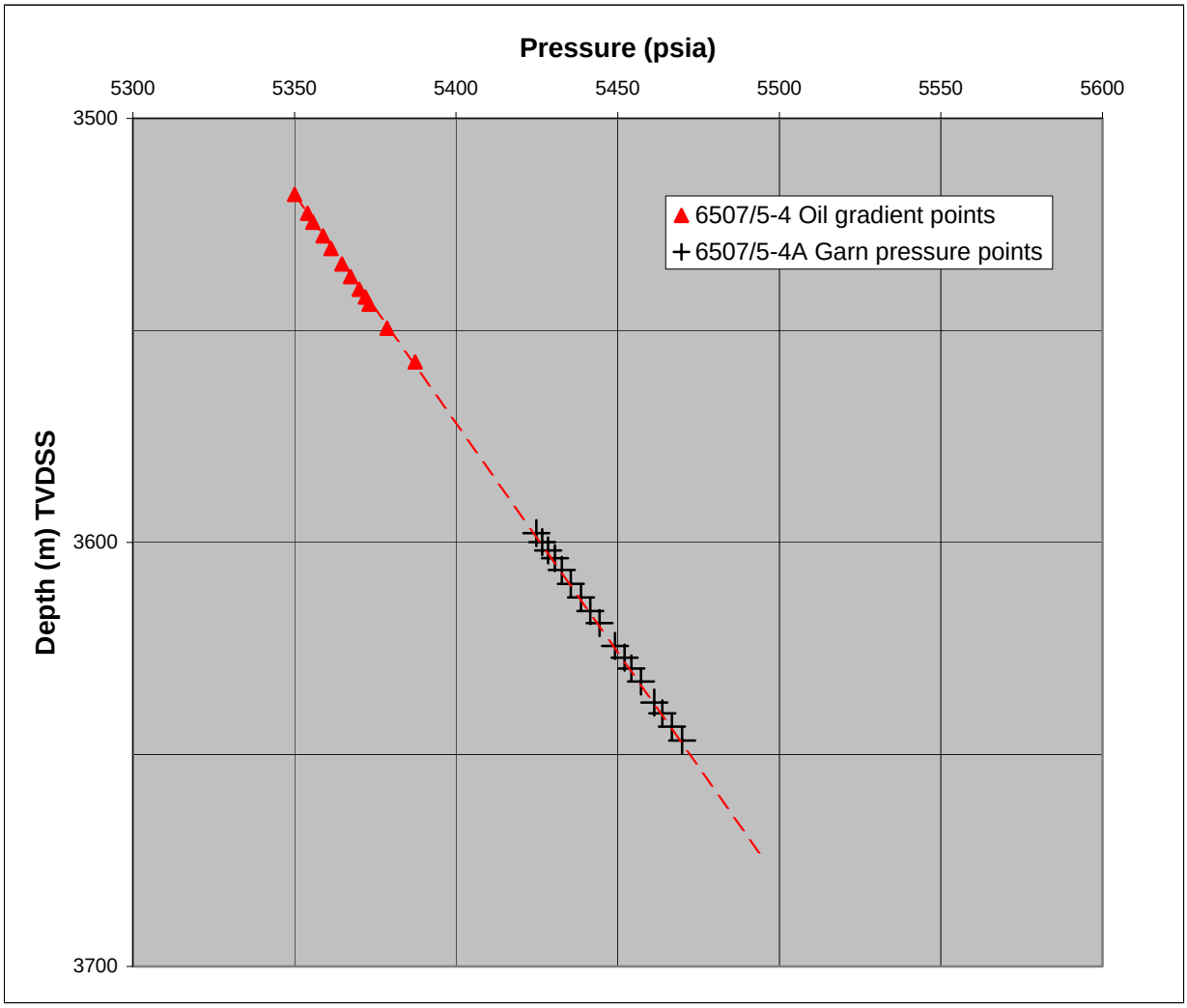

Figure 3: MDT Pressure Data plot

1.5.2 MDT SAMPLING DATA

Tool Set	Depth mBRT	Depth mTVDSS	Mobility Md/cp	Hydrostatic psia	Initial Pressure psia	Flowing Pressure psia	Shutin Pressure psia	Volume cm^3	Comments
1	3733.6	3609.8	320	6365.8	5435.67	5400	10859	1 Gal	T 116.7º C, dd 35.7
2	3733.6	3609.8	320	6365.8	5435.67	5403	10859	1 Gal	T 116.6 º C, dd 32.7
3	3733.6	3609.8	320	6365.8	5435.67	5405	10859	1 Gal	T 116.7 º C, dd 30.7
4	3733.6	3609.8	320	6365.8	5435.67	5405	10859	1 Gal	T 116.6 º C, dd 30.7
5	3733.6	3609.8	320	6365.8	5435.67	5405	10859	250	T 116.8 º C, dd 30.7
6	3733.6	3609.8	320	6365.8	5435.67	5405	10859	250	T 116.8 º C, dd 30.7
7	3748.7	3624.2	115	6388	5448.79	4720	10881	450	T 116.5 º C, dd 728.8
8	3748.7	3624.2	115	6388	5448.79	4631	10881	450	T 117.2 º C, dd 817.8

1.5.3 DST PRESSURE TEST DATA

The well was temporarily abandoned, with a contingent DST planned for a later date.

1.6 TEMPERATURE PLOT

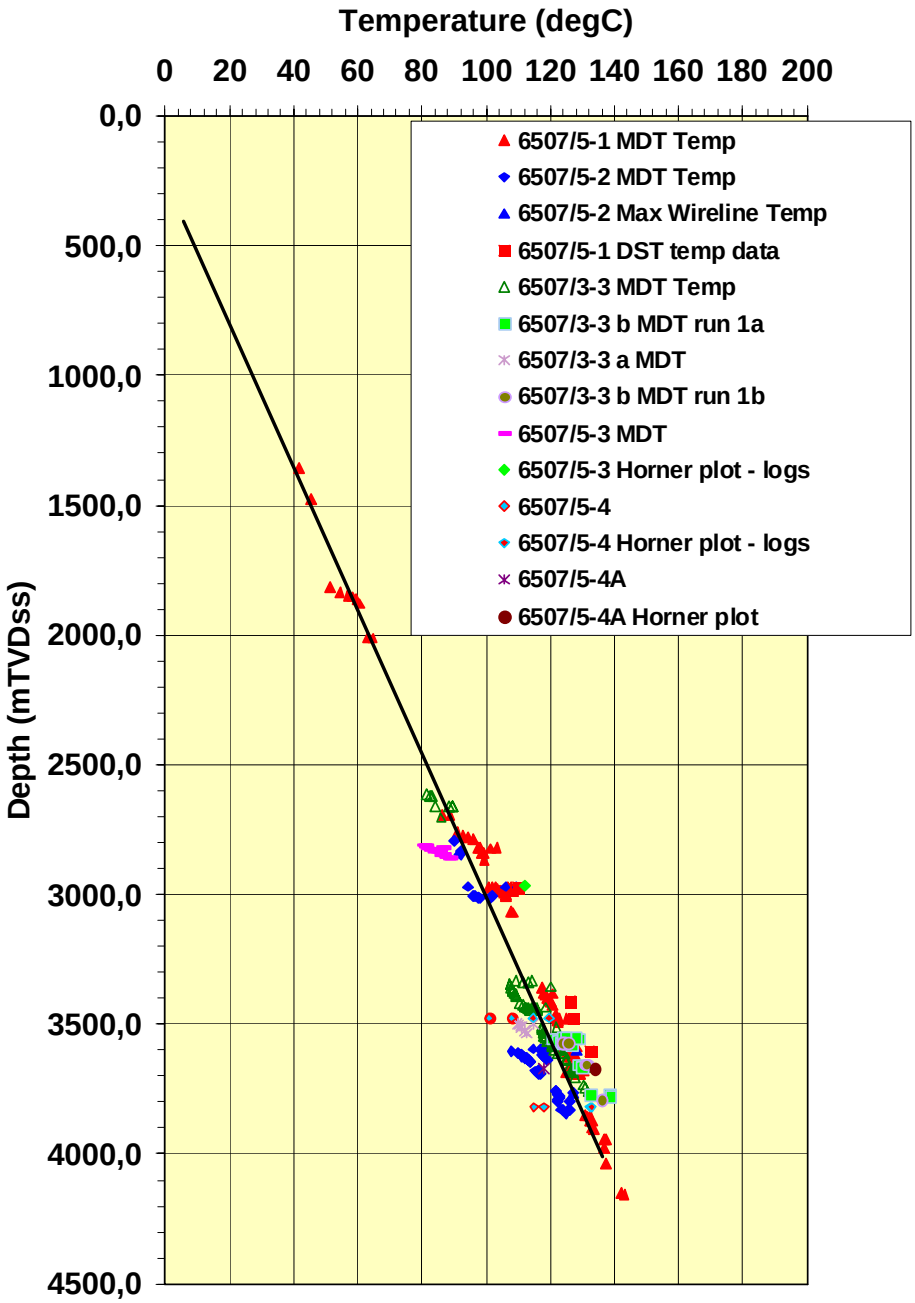

Figure 4: Temperature plot

See Section 4.2 for Formation Temperature Summary table

2 GEOLOGY

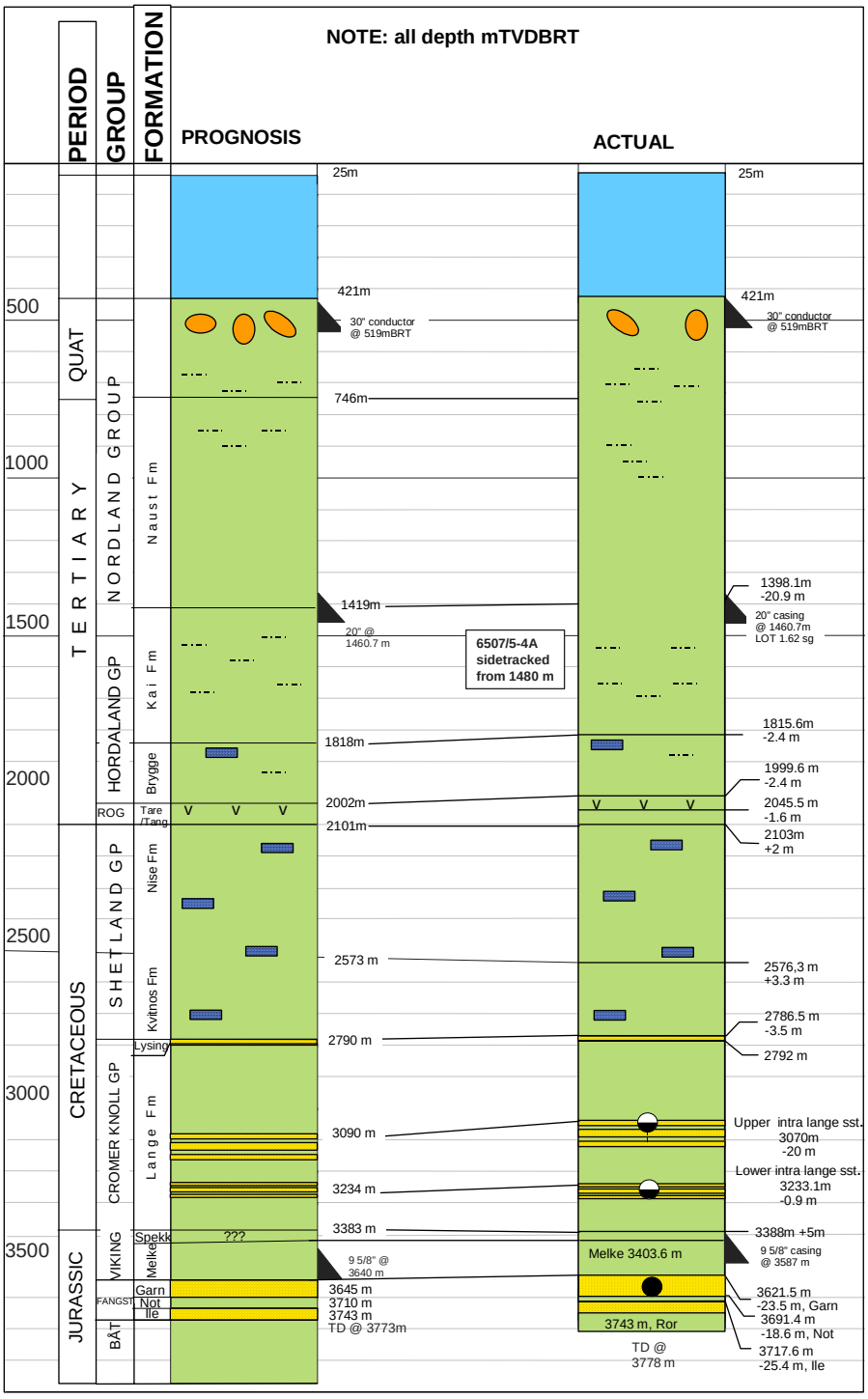

Figure 5: Prognosed versus Actual Stratigraphy.

2.1 NORDLAND GROUP (1480.0 – 1822.8 mBRT)

2.1.1 KAI FORMATION (1480 – 1822.8 mBRT)

Well 6507/5-4A was sidetracked from original 6507/5-4 wellbore at 1480 mBRT, within upper the Kai Formation.

Top	1398.2 mBRT (from 6507/5-4)
Age	Middle Miocene to Early Pliocene
Upper boundary pick	Slight drop in the resistivity from 2 to1.5 ohmm and a increasing GR from 75 to 80 API.
Lithology and shows	- well kicked off a cement plug at 1480 mBRT - thick silty mudstone sequence with common siltstones and sandstones. Mudstone: generally light to medium green grey, grading to grey, moderately soft, subblocky to blocky, commonly sticky and amorphous, micromicaceous, occasional black carbonaceous specks, hygroturgid, grading to slightly calcareous siltstone with, traces of very fine, clear and angular quartz sand. Siltstone: pale grey to grey brown, moderately soft, subblocky to crumbly, calcareous matrix, grading to silty quartz: clear, colourless, translucent off white to pale grey, yellow, subangular to rarely subrounded, subelongate, no visible cement/matrix, occasional very fine sandstone. No shows.
Logging tools	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.
Drilling characteristics	Average ROP: 50.0 m/hr Gas readings from 1480m BRT: -drilled gas averages 0.5% -maximum of 7.1 % at 1663 mBRT. - Alkanes up to iC_5 were recorded. -drilled out with 1.3 sg mud. -increased the mudweight to 1.43 sg during the interval.

2.2 HORDALAND GROUP (1822.8 – 2016.0 mBRT)

2.2.1 BRYGGE FORMATION (1822.8 – 2016.0 mBRT)

Top	1822.8 mBRT
Age	Late Palaeocene to Late Oligocene
Upper boundary pick	A small gamma ray "peak" and a small decrease in resistivity corresponding with a change in lithology from more greyish mudstone to more brownish silty mudstone.
Lithology and shows	Top: predominantly siltstone with interbedded mudstone and some minor limestone stringers and traces of sand. Middle: transition from silty mudstone to predominantly cleaner mudstone with minor limestone stringers. Base: predominantly mudstone where occasional tuffaceous beds occur. Siltstone: brown, greyish brown, rarely green, subblocky to crumbly occasional amorphous. Slightly calcareous and highly carbonaceous. Argillaceous and glauconitic. Mudstones: light to medium grey, greenish grey, occasional pale green, occasional greyish brown to reddish, soft to moderate firm with traces of glauconite, micropyrite, micromica. Non calcareous and rarely silty in parts. Limestone: off white, light grey, rarely yellow brown to cream, firm, blocky, and microcrystalline. Locally slightly argillaceous. Tuff: mottled light grey, white to off with, soft. No visual shows
Logging character	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.
Drilling characteristics	Average ROP: 60 m/hr Gas readings : -drilled gas averages 0.1 – 0.2% -maximum of 0.5 % at 1826 mBRT. - C_1, C_2 and C_3 were recorded throughout, with C_4 and C_5 in some narrow intervals. -continued to raise the mudweight to maximum 1.45 sg .

2.3 ROGALAND GROUP (2016.0 - 2124.8 mBRT)

2.3.1 TARE FORMATION (2016.0 – 2064.2 mBRT)

Top	2016.0 mBRT
Age	Late Palaeocene
Upper boundary pick	The Top Tare is picked at a slight increase in resistivity and gamma ray signature.
Lithology and shows	Mudstones with tuffaceous interbeds. Traces of limestone. Mudstones: light medium grey to greyish grey, pale green, occasionally reddish brown. Soft to firm. Traces glauconite and micropyrite. Non calcareous. Tuff: metallic grey, light grey, mottled, fine specks. Occurs as thin stringers. Trace Limestone: light grey, off white, amorphous and cryptocrystaline. No shows.
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.
Drilling characteristics	Average ROP: 68 m/hr Gas readings : -drilled gas averages 0.1% -no peaks recorded - C_1, C_2 and C_3 were recorded throughout, with C_4 and C_5 in some narrow intervals. -mudweight was 1.45 sg .

2.3.2 TANG FORMATION (2064.2 – 2124.8 mBRT)

Top	2064.2 mBRT
Age	Late Campanian to Late Palaeocene
Upper boundary pick	Slight decrease in resistivity below the Tare Formation and gamma ray signature.
Lithology and shows	Mudstone with a tuffaceous interval in the top part. Mudstones: dark greenish grey, greenish/greyish black, occasional olive grey. Moderately hard, abundant glauconite nodules and non to slightly calcareous. Tuffaceous in top part. Tuff: light to moderate grey, commonly bluish grey, brownish grey, speckled. Firm, glauconitic and non to slightly calcareous. No shows.
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.

Drilling characteristics

Average ROP: 75 m/hr

Gas readings : -drilled gas averages 0.1%
-no peaks recorded.
- C_1, C_2 and C_3 were recorded throughout, with C_4 and C_5 in some narrow intervals.

-mudweight was maintained at 1.45 sg .

2.4 SHETLAND GROUP (2124.8 – 2842 mBRT)

2.4.1 NISE FORMATION (2124.8 – 2626 mBRT)

Top	2124.8 mBRT
Age	Late Santonian to Late Campanian
Upper boundary pick	Slight increase in resistivity corresponding to a interval with several small gamma peaks
Lithology and shows	Thick sequence of mudstones with limestone stringers throughout. Mudstone becoming more silty with depth and traces of sand observed in the base of the formation. Mudstone: light to medium grey, greenish grey, becoming darker with depth; medium dark grey, medium dark greenish grey, dark olive grey,. Generally firm, with traces of micromica, microcarbonaceous fragments and micropyrite. Predominantly non calcareous. Increasing traces of silt towards base, grading to very fine grained quartz at the very base. Limestone: off with, white to pale yellow, occasional cream. Soft to firm, argillaceous and microcrystalline. Dolomitic in part. No shows.
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.
Drilling characteristics	Average ROP: 40.0 m/hr Gas readings: -drilled gas averages 0.1% -maximum of 1.15% at 2494 mBRT. -C_1, C_2 and C_3 were recorded throughout, with C_4 and C_5 in some narrow intervals. In this interval the mudweight was continually raised to1.55sg.

2.4.2 KVITNOS FORMATION (2626 – 2842 mBRT)

Top	2626 mBRT
Age	Early Coniacian to Late Santonian
Upper boundary pick	Gamma ray spike marks the base of the Nise Formation

Lithology and shows	Thick mudstone sequence interbedded with limestone stringers, commonly dolomitic and argillaceous. Mudstones: medium dark grey, rarely greyish brown, rarely greenish grey, predominantly moderate firm. Traces of mica, carbonaceous material and micropyrite. Non to slightly calcareous, rarely silty in part. Limestone: white to off white, very pale orange grey to pale cream. Soft to firm and microcrystalline. At base grades to calcareous sandstone. No shows.
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.
Drilling characteristics	Average ROP: 13 m/hr -ROP reduced due to suspected bit balling problems. Gas readings: -drilled gas averages 0.05 – 0.1% - no gas peaks recorded -C_1, C_2 and C_3 were recorded throughout, with C_4 and C_5 in some narrow intervals. Mudweight was maintained at 1.55 sg in this interval.

2.5 CROMER KNOLL GROUP (2842 – 3474 mBRT)

2.5.1 LYSING FORMATION (2842 – 2848 mBRT)

Top	2842 mBRT
Age	Coniacian
Upper boundary pick	Distinct change in lithology from mudstone to sandstone. Gamma ray decrease correspond to a resestivity peak.
Lithology and shows	Comprises of calcareous sandstone. Sandstone: predominantly loose quartz, rarely consolidated, clear to translucent, colourless to very pale yellow, very fine to medium grained, predominantly fine to medium grained, subangular, occasionally subrounded, subspherical to subelongate, occasionally calcite cemented, common to abundant calcite rock flour, no to very poor visible porosity. Shows: trace spotty very dull to rare bright yellow-white direct fluorescence, trace very slow blooming very dull bluish white crush cut fluorescence
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.
Drilling characteristics	Average ROP: 8 m/hr ROP possibly affected by bit balling Gas readings: -drilled gas average 0.5% -maximum of 1.4% at 2842 mBRT. -C_1, C_2, C_3, and C_4 were recorded throughout, with C_5 in some narrow intervals. Mudweight was maintained at 1.55sg.

2.5.2 LANGE FORMATION (2848.0 – 3474 mBRT)

Top	2848.0 mBRT
Age	Late/Middle Albian to Early Coniacian
Upper boundary pick	Change in lithology from sandstone (Lysing Formation) to mudstone with corresponding increase in gamma ray level

Lithology and shows	Mudstone with occasional limestone and sandstone stringers. Two major sandstone packages occur within the Lange Formation, the Upper and Lower Intra Lange Sandstones, described separately. Mudstone: medium grey to moderate dark grey, occasional greyish brown, occasional olive grey, rarely greenish grey, soft to firm. Micromicaceous, generally non calcareous but towards the base calcareous interval grading to argillaceous marl. Silt in parts. Traces of microcarbonaceous material, micromica and micropyrite was seen throughout the formation. Limestone: off-white to white, light moderate grey, yellow brown to pale orange brown, soft to firm, microcrystalline and argillaceous. Sandstone : clear to translucent, colourless, occasional pale yellowish brown, occasional milky white, predominantly fine to medium loose quartz grains. Predominantly well sorted subangular to subrounded grains. Calcareous rock flour. Shows: No
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.
Drilling characteristics	Average ROP: 10.0 m/hr between 2848 – 3140 mBRT 11.0 m/hr between 3223.5 – 3311 mBRT 8.0 m/hr between 3353.7 – 3474 mBRT ROP values were affected by bit balling problems encountered in these sections. Gas readings: -drilled gas averages of 0.1% between 2848 – 3140 mBRT. -maximum of 0.5% at 2920 and 3110 mBRT. -drilled gas averages of 0.1% between 3223.5 – 3284 mBRT, increasing to 0.35% from 3284 mBRT. -maximum of 0.8% at 3302.0 mBRT. -drilled gas averages of 0.2% between 3353.7 – 3474 mBRT. -maximum of 0.4% at 3361.0 mBRT. -C_1, C_2 , C_3 and C_4 were recorded throughout and C5 notably increasing from 3284-3400 mBRT. Mudweight was maintained at 1.55sg through most of the section, rising to 1.57 sg toward the very base.

2.5.3 UPPER INTRA LANGE SANDSTONE SEQUENCE (3140 – 3223.5 mBRT)

Top	3140 mBRT
Age	Early/Middle Turonian
Upper boundary pick	Change in lithology from typical Lange mudstone to sandstone with interbedded mudstone. Slight decrease in gamma ray and sonic values correspond with increasing spiky resistivity values.

Lithology and shows	Sandstone with mudstone interbeds and minor limestone stringers. Sandstone: clear to translucent, colourless to grey and pale yellowish brown quartz grains. Predominantly fine, occasional very fine medium. Coarser grains more common towards the base of formation. Moderate to well sorted subangular to subrounded grains. Calcareous cement and calcareous Rock Flour. Traces of glauconite, mica, pyrite and carbonaceous material. Commonly no visible porosity. Mudstone: light to medium grey, occasional medium dark grey to olive grey, soft to firm. Predominantly non calcareous. Traces of micropyrite and microcarbonaceous material. Limestone: off white to pale yellow orange/brown, soft to moderate hard, microcrystalline and slightly argillaceous in part Shows: trace spotty very dull yellow to white direct fluorescence, slow white cut, faint bright blue to white residue.
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.
Drilling characteristics	Average ROP: 25.0 m/hr. ROP values were affected by bit balling problems encountered in these sections. Gas readings: -drilled gas average of 0.25% -maximum of 0.4% at 3160.0 mBRT -C_1, C_2 , C_3, and C_4 were recorded throughout, C_5 in a few places. Mudweight was maintained at 1.55sg.

2.5.4 LOWER INTRA LANGE SANDSTONE SEQUENCE (GRÅSEL EQUIVALENT) (3311.0 – 3353.7 mBRT)

Top	3311.0 mBRT
Age	Early Turonian
Upper boundary pick	Change in lithology from typical Lange mudstone to sandstone with interbedded mudstone. Slight decrease in gamma ray and sonic values correspond with increasing spiky resistivity values.
Lithology and shows	Sandstone with mudstone interbeds. Sandstone: clear to colourless, occasional pale grey to pale yellowish brown quartz grains. Predominantly very fine to fine, occasional medium. Abundant micaceous and carbonaceous material. Moderate to well calcareous cemented and poor visible porosity observed. Mudstone: medium dark grey, olive grey. Firm. Microcarbonaceous, micromicaceous and non calcareous. Shows: traces spotty pinpoint dull to bright yellow withe direct fluorescence, very slow dull bluish white blooming crush cut, faint white residue.
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.

Drilling characteristics	Average ROP: 16.3 m/hr. ROP values were affected by bit balling problems encountered in these sections. Gas readings: -drilled gas averages of 0.5%. -maximum of 1.4% at 3345.0. -C_1, C_2, C_3, C_4 and C_5 were recorded throughout. Mudweight was maintained at 1.55sg.

2.5.4 LYR FORMATION (3461 – 3474 mBRT)

Top	3461 mBRT
Age	Early Hauterivian
Upper boundary pick	This formation pick was based on biostratigraphy.
Lithology and shows	Mudstone. Mudstone: brownish black to dark grey brown, commonly dark dusky yellowish brown. Firm. Non calcareous. Locally slightly silty and commonly with micropyrite and carbonaceous speck. Trace micromica. Shows: none.
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.
Drilling characteristics	Average ROP: 16.5 m/hr. Gas readings: -drilled gas averages of 0.1%. -maximum of 0.2% at 3468.0 mBRT. -C_1, C_2, C_3, and C_4 were recorded throughout, minor C_5 was seen locally. Mudweight was maintained at 1.57sg.

2.6 VIKING GROUP (3474 – 3719.5 mBRT)

2.6.1 SPEKK FORMATION (3474 – 3490.5 mBRT)

Top	3474.0 mBRT
Age	Middle Kimmeridgian
Upper boundary pick	Gamma ray peak (hot shale), corresponding to an decreasing sonic velocity.
Lithology and shows	Mudstone. Mudstone: brownish black to dark grey brown, commonly dark dusky yellowish brown. Firm. Non calcareous. Slightly silty and commonly with micropyrite and carbonaceous speck. Trace micromica. Shows: none.
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.
Drilling characteristics	Average ROP: 16.5 m/hr. Gas readings: -drilled gas averages of 0.25%. -maximum of 1.0% at 3484.0 mBRT. -C_1, C_2 , C_3, and C_4 were recorded throughout, minor C_5 was seen locally. Mudweight was maintained at 1.57sg.

2.6.2 MELKE FORMATION (3490.5 – 3719.5 mBRT)

Top	3490.5 mBRT
Age	Bajocian to Late/Middle Oxfordian
Upper boundary pick	High gamma Spekk formation overlying the Melke formation. Decreasing gamma ray corresponding to an increase in the sonic velocity.
Lithology and shows	Mudstone with limestone stringers. Siltstone at the very base. Mudstone: brownish black to dark brown, medium grey, commonly dark dusky yellowish brown (increases towards the base), greyish black, olive black. Soft to moderate hard. Generally non calcareous Silty and micromicaeous in parts. Limestone: pale yellow brown , white, off-white to light grey, soft to firm, locally argillaceous. Shows: none.
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.

Drilling characteristics

Average ROP: 13.2 m/hr.

Gas readings: -drilled gas averages of 0.25%.
-maximum of 1.6% at 3505.0 mBRT.

-C_1, C_2 , C_3, C_4 and C_5 were recorded throughout.

Mudweight was maintained at 1.57sg.

2.7 FANGST GROUP (3719.5 – 3847 mBRT)

2.7.1 GARN FORMATION (3719.5 – 3793 mBRT)

Top	3719.5 mBRT
Age	Aalenian
Upper boundary pick	Clear change in lithology from siltstone to sandstone with corresponding rapid decrease in gamma ray and cross-over of density – neutron curves.
Lithology and shows	Sandstone. Sandstone: clear, colourless, translucent, milky white to occasional yellow brown, rarely rose pink, very fine to coarse, predominantly fine to medium. Moderate to well sorted, subangular to subrounded grains. Silica cemented in parts, generally non calcareous, rarely clay matrix and trace carbonaceous material. Moderate visible porosity. Shows: even bright yellow white/yellow gold direct fluorescence. Slow blue/white blooming, occasionalmoderate to slow streamingbright yellow/white cut, dull yellow, occasional green white residue.
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.
Drilling characteristics	Average ROP: 9.5 m/hr. Gas readings: -drilled gas averages of 0.8%. -maximum of 3.4% at 3775.0 mBRT -C_1, C_2 , C_3, C_4 and C_5 were recorded throughout. Mudweight was lowered to 1.25 sg before entering the reservoir section.

2.7.2 NOT FORMATION (3793 – 3820.5 mBRT)

Top	3793 mBRT
Age	Aalenian
Upper boundary pick	Change in lithology from sandstone to siltstone with corresponding increase in gamma and density values.
Lithology and shows	Siltstone with some sandy interbeds. Siltstone: dark grey greyish brown/black, hard and none calcareous. Siliceous cement/matrix. Abundant micropyrite towards the base. Grading to silty sandstone Shows: None.
Logging	LWD: gamma ray and resistivity tool Wireline: DSI/GR logged through casing.

Drilling characteristics	Average ROP: 11.0 m/hr.
	Gas readings: -drilled gas averages of 0.1%. -no gas peaks recorded
	-C_1, C_2 , C_3, and C_4 were recorded throughout, minor C_5 intermittantly
	Mudweight was maintained at 1.25 sg .

2.7.3 ILE FORMATION (3820.5 – 3847 mBRT)

Top	3820.5 mBRT
Age	Aalenian
Upper boundary pick	Change in lithology from siltstone to sandstone with corresponding decrease in gamma ray and density.
Lithology and shows	Sandstone with interbedded siltstone in the top of the formation.
	Sandstone: clear to translucent, colourless, rarely yellowish brown, rarely grey. Very fine to fine, often medium. Good siliceous cement, locally dolomittic cement. Slightly argillaceous matrix. Locally carbonaceous, micropyritic and micaceous. Poor visible porosity. Shows: yellow to yellow/gold direct fluorescence, moderate to fast streaming/blooming yellow/white cut and yellow blue/white crus cut, white residual ring.
Logging	LWD: gamma ray , resistivity, sonic and density/neutron tool Wireline: MDT.
Drilling characteristics	Average ROP: 12.0 m/hr.
	Gas readings: -drilled gas averages of 0.2%. -maximum of 0.3% at 3830.0 mBRT
	-C_1, C_2 , C_3, C_4 and C_5 were recorded throughout.
	Mudweight was maintained at 1.25 sg .

2.8 BÅT GROUP (3847 – TD 3883.0 mBRT)

2.8.1 ROR FORMATION (3847 – TD 3883 mBRT)

Top	3847 mBRT
Age	Late/Middle Toarcian
Upper boundary pick	Change in lithology from sandstone to silty mudstone with corresponding increase in gamma and density values.
Lithology and shows	Silty mudstone. Silty mudstone: dark brownish grey to brownish black. Moderate hard to hard with patchy microcrystalline pyrite. Common glauconitic and non calcareous, Locally abundant mica.
Logging	LWD: gamma ray , resistivity, sonic and density/neutron tool Wireline: MDT.
Drilling characteristics	Average ROP: 7.2 m/hr. Gas readings: -drilled gas average of 0.05%. -no gas peaks recorded. -C_1, C_2 , C_3, C_4 and C_5 were recorded throughout down to 3860 mBRT. C_5 decreased to zero generally from 3860 mBRT, with only rare occurrences. Mudweight was maintained at 1.25 sg .

3.0 PORE PRESSURE AND FRACTURE GRADIENT

3.1 INTRODUCTION

A pore pressure evaluation has been undertaken together for the 6507/5-4 and the sidetrack 6507/5-4A well. DxC Exponent, realtime LWD, formation gases and hole conditions were reviewed to provide information on formation pressure variations while drilling. Post well analysis has been carried out using wireline logs and information acquired from pressure tests using MDT to refine the pore pressure estimation in both 6507/5-4 and the sidetrack 5-4A.

Summary of Work Processes

Data analysis for Pore Pressure
The direct pressure measurement data were used to calibrate the semi-quantitative indications from Corrected Drilling Exponent (Dxc), Sonic and Resistivity data

Drilling exponent:

The pore pressure from Dxc for Skarv-3 was calibrated using the MDT values from both 6507/5-4 and 5-4A, and compares well with equivalents from sonic and resistivity, except for the section between 1800m and 2200m.

Sonic:

In the 6507/5-4A well sonic data was just available through casing in the 12 ¼”(1480 to 3709M BRT) section and from LWD tool in the 8 ½” section Pore pressure dataset – ‘PP dt e3’ was created from the ‘DT shale’ dataset plus its NCT, calibrated with the MDT data from both 6507/5-4 and 5-4A (8 /2” section).

Resistivity:

The pore pressure curve calculated from the shale resistivity dataset for Skarv-3, and calibrated using the MDT data, compares very well to the sonic equivalent.

Gas:

All reported gas peak values were extracted from the daily geological reports and included in the project, together with total gas and chromatograph data. No confirmed CG peaks were reported.

Caliper and Hole Condition:

No calliper logs was ran in the in the 12 ¼”section of the sidetrack 5-4A. The 9 5/8” casing went stuck 22m higher (3683m BRT) than planned setting depth. This resulted in a serious wash out (out of caliper range) in the interval between the 9 5/8” shoe and the top of the 8 ½” hole. The wireline logging tools failed to pass into the 8 ½” hole (except for the last MDT run) and many instances of tight hole and drag in the 8 ½” hole was believed to be a result of this.

3.2 OVERBURDEN GRADIENT

An OBG curve had been created previously for the Dønna Terrace and used in the PP prognosis for the Skarv-3 wells. The RHOB from Skarv-3 was used to calculate a new OBG, using an average sediment density of 2.25g/cc between seabed and top of good RHOB data at 1500m. This new OBG compared well with the Dønna Terrace average OBG and is used for this PP evaluation.

3.3 PORE PRESSURE

Pore pressure indicators are calibrated using the good coverage of direct measurements, particularly in the Cretaceous. Main features of the final pore pressure profile are:

- Normal hydrostatic pressure from seabed to 1600mTVD BRT

- Steady increase in PP from 1600m to 1.48sg at 2300m, within the Shetland group.

- Measured pressure of 1.36sg in the Lysing Formation at top Cromer Knoll group in the 6507/5-4 well represents the likely minimum pore pressure of the Cretaceous.

- Pressure increase from 1.36sg at 2780m to a maximum of 1.54g at 3400m in the base of the Cretaceous. The maximum pressure measured in the 6507/5-4 well was 1.50sg at 3244mRKB. However, the calibrated log responses from Sonic and Resisitivity indicate that shale porosity, and thus pore pressure, were higher in base Cretaceous than in the immediate vicinity of the Lange Sandstone, in which the 1.50sg pressure was measured.

- Pressure then drops from the top of Upper Jurassic Viking group. Experience puts the main decrease in the lower part of the Viking but here the sonic log indicates that the drop starts right at top of Viking, and continues throughout the Viking. The final PP curve tries to take account of both these features.

- Maximum measured pressure in Fangst group was 1.054sg at 3721mRKB in the sidetrack 5-4A.

3.4 FRACTURE GRADIENT

The final fracture gradient curve was calculated using the Pilkington method, in which the shallowest good LOT is used as a 'calibration' point. It represents in reality a minimum set of values for formation strength in the well, with the curve shifted to fit the LOT taken in Skarv-3.

This FG indicates minimum formation strengths of 1.43sg in the Kai Formation, 1.69sg in the top of Brygge Formation, and 1.94sg in the base of Cretaceous.

3.5 CONCLUSIONS

The well OBG is very similar to the average OBG for Dønna terrace.

The pore pressure prognosed for the well before drilling is actually very similar to the final pressure profile, although the maximum prognosed pressure was expected at 1.49sg in the Lange formation, not in the base Cretaceous shales. The difference in the 6507/5-4 well, between prognosed 1.49sg and actual 1.50sg in the Lange (c.100psi) is minimal, and could just be a function of the lack of detail at the pre-drill stage about expected Lange formation top depths, and the difference between prognosed and actual top Lange.

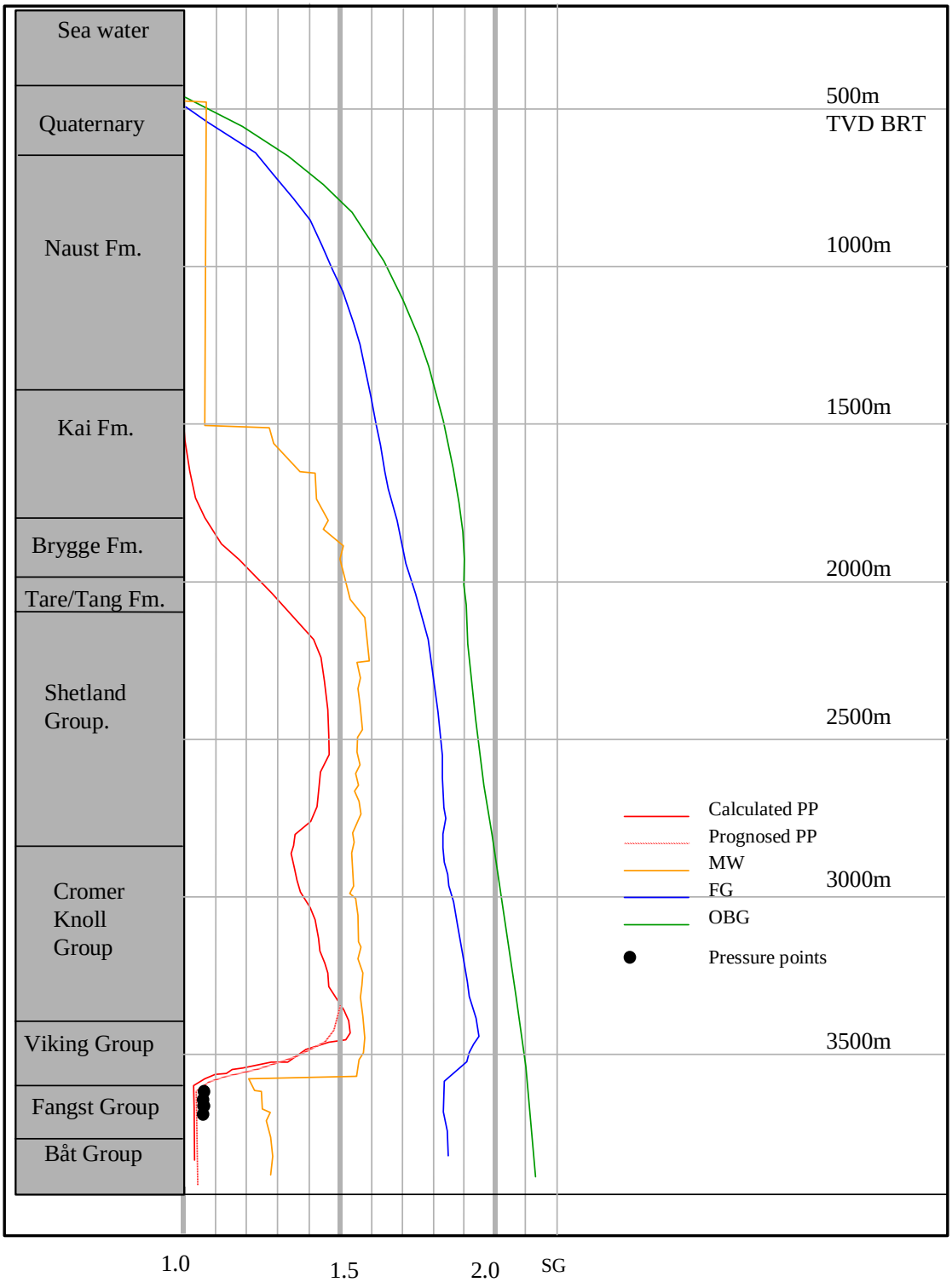

Figure 6: Formation Pressure Evaluation

4.0 FORMATION EVALUATION

4.1 WIRELINE LOGGING

Run No.	Date	Tool String	Hole Size ins	Max Temp (°C)	Time since circ. (hrs:min)	Logged interval mBRT	Logged interval mBRT	Remarks
1a1	14/05/01	HRLA-DSI-GR-SP-EMS-GPIT	8.5	98	17:55*	3709	1385	Failed to pass into 8.5" hole section Logged DSI and GR in casing
1a2	15/05/01	HRLA-DSI-GR-EMS-GPIT	8.5	-	23:30*	3709	3709	Failed to pass into 8.5" hole section
1b1	15/05/01	IPLT-GR	8.5	-	29:00*	3709	3683	Failed to pass into 8.5" hole section. Logged caliper.
1c1	15/05/01	MDT-GR	8.5	105	36:40*	3709	3709	Failed to pass into 8.5" hole section. Make wiper trip.
1c2	16-17/05/01	MDT-GR	8.5	120	85:75#	3721	3799	Tool problems, also unable to pass 3810 m. Took 2 sample depths. Tool stuck at 3748.9m

*Last circulation on bottom: 14/05/01 @ 04:00 hrs
#Last circulation on bottom: 16/05/01 @ 04:30 hrs

4.2 FORMATION TEMPERATURE SUMMARY TABLE

(see Figure 4 for temperature plot – Section 1.8)

Run	Loggers TD (mBRT)	Date/Time on TD	Date/Time of last circulation	Mud Density (sg)	Rm (Ohmm)	Rmf (Ohmm)	Rmc (Ohmm)	BHT (deg C)
1C2	3799	00:50 17/05/01	11:30 16/05/01	1.23	0.069 @ 21 deg C	0.060 @ 21 deg C	0.174 @ 21 deg C	118

4.3 WIRELINE OPERATIONS SUMMARY

The hole was handed over to Schlumberger at 17:00 on May 14th 2001.
Toolbox talks rig up and run in hole with DSI-HRLA-EMS-GPIT-SP-GR. However, the toolstring was unable to pass into the 8 ½" hole, hanging up in the 12 ¼" rathole below the 9 5/8" casing shoe. After several attempts to enter the 8 ½" hole, at 22:05 the tools were pulled out, while logging the DSI and GR through casing.
The tools reached surface at 00:40 on the 15th May 2001 and the toolstring was modified, with the SP removed and stand-offs and a hole finder added. Commenced running in hole at 01:50 and reached the top of the 8 ½" hole at 02:55; again , after repeated attempts to unsuccessfully enter the 8 ½" hole, the tools were pulled out of hole at 03:30. The tools reached surface at 04:50 and were rigged down by 06:00.

It was decided to pick-up the IPLT-GR toolstring, but without sources, as a test run to see if another toolstring configuration would be able to enter the 8 ½" hole. Rig up commenced at 06:00 and the tools were run in hole at 07:15. At 08:43 the IPLT-GR tool was at the casing shoe, but once again the tools were not able to pass 3709 mBRT. After logging up with the IPLT caliper over the 12 ¼" rathole into the casing shoe, the string was pulled out at 09:05 and was at surface by 10:52. The IPLT-GR was rigged down by 12:00, when the rig up of an MDT-GR string commenced. The IPLT caliper indicated extreme wash-out in the 12 ¼" rathole, below the casing shoe.

Rig up of the MDT tools was completed by 14:35 and the string was run in hole, with a brief delay while the heave compensator line was repaired. At 15:53 a brief correlation log was run through casing of the Spekk Formation and by 16:10 the string was down at the 9 5/8" casing shoe. Once again, the wireline tools were not able to pass into the 8 ½" hole and at 16:40 the tools were pulled out of hole. By 18:00, the tools were at surface and by 19:15 Schlumberger had completed the rig down off all wireline equipment. The drill floor was then handed back to Stena Drilling, in order to make a remedial wiper trip prior to any further wireline operations.

On 16th May 2001 at 21:00, the drill floor was once again handed over to Schlumberger. Rig up of an MDT-GR toolstring was completed by 22:46 and commenced running in hole. At 00:35 on 17th May 2001 a GR correlation log was commenced and at 00;45 the tools were able to pass into the 8½" hole. At 00:50 the tool hung up at 3810 mBRT and after attempts to pass through an uplog was started at 01:00. After making a correlation pass, at 01:35 the MDT was on the first station at 3721m and pretests commenced. At 05:05 it became impossible to set the probe used in MRPS 1.Tried swapping to MRPS 2 (probe 2) but it was still unable to set the probe – a hydraulic leak was suspected and at 05:25 the tools were run in hole to attempt to pass the restriction at 3810m MD; however this was still not possible and at 05:30 the tools were begun to be pulled out of hole. However at 06:34 at 3400 mBRT, the pump problem was solved by increasing pump rate and the tools were run back in hole.
A correlation log was made at 06:57, after which at 07:15 pressure tests were restarted at 3788.5 mBRT and below - all tests were tight/supercharged. At 07:45 it was found to be impossible to pass 3805 mBRT and at 07:55 the tools were pulled up to take the first sample. After a correlation gamma log over the upper Garn (on depth), the tools were on station at 08:45, at a depth of 3733.6 mBRT. After setting the probe and doing a pressure test, pumping out commenced at 09:00. At 11:20, pumping out was completed and the first sample attempted; however, it was unable to build pressure in the flowline. After troubleshooting, a leak in flowline somewhere was diagnosed and at 12:03 the pump was stopped and at 12:05 the toolstring was pulled out for investigation at surface. The tools reached surface at 13:30 and a flowline plug seal was found to have failed on a 1 gal MRSC (presumed to be due to damage inflicted during rig-up). This caused the pressure loss in the flow line. Checked all the other seals and valves – and found the upper seal valve glide ring had also failed. This would not have affected the flowline pressure but would have caused inconvenience when sampling the multisampler. Replaced all faulty parts. Also changed out the OFA as a precaution (this had been giving minor low level gas indications throughout, although this was thought to be a software related fault). At 14:40, the tools were run back in hole again. At 15:37 a correlation run over top Garn was made (subtract 0.5m) and at 15:55 the MDT was back on station at 3733.6 mBRT. At 16:00, after a pressure test, initiated pumping out for clean up. At 17:45, stopped the clean up (total 92.3

litres pumped through) and sampling started. Sampling of 4x1 gal MRSC and 2x250cc SPMC chambers was completed at 18:40. The tool was run in hole to 3752 mBRT, with some slight hanging up at 3752 mBRT and a correlation pass made. At 19:04 the MDT was on station at 3752.0 mBRT and pumping out began. At 20:27, pumping out was stopped due to very slow clean up and the tool moved down to 3752.8 mBRT. Pumping out at started at 20:45, but although clean up was quicker than the previous point, the drawdown pressure was too high (150-200 psi) and at 22:18 pumping stopped. Between 22:18 and 00:45 on the 18th May 2001, sample points at 3748.2, 3754.4, 3759.8, 3762.8, 3748.7, and 3748.3 mBRT were attempted, but the drawdown pressures or mobilities were poor in all cases and the pump outs aborted. At 00:50, the MDT was set again at 3748.7 mBRT and pumping out commenced at 01:05. This time the pump out was more successful and between 03:40 and 04:14 2x450cc MPSR samples were taken. At 04:20, while attempting to come away from the wellbore wall, the MDT tool was unable to be freed and the tool was stuck.

At 08:00 the wireline cable was cut at surface and cut and strip fishing operations commenced. When at 3665 mBRT with the drillpipe, at 19:30 on the 19th May 2001, Schlumberger electrically reconnected the wireline cable, but received no telemetry from the tool; this was thought to be the result of damage to the cable when trying to initially pull the tool free. At 04:15 on the 20th May 2001, the MDT tool was washed over with the fishing assembly and the fish engaged. At 04:30 the fish had been pulled back inside the casing shoe, but attempts to electrically fire the wireline weakpoint failed. After several more attempts to electrically fire the weakpoint, discussion with town and safety assessments, it was attempted to mechanically pull the weakpoint using the Top Drive at 10:15. This also failed and at 12:30 the wireline cable was cut at the drill floor. At 12:45 tripping out commenced, cutting the wireline cable at every stand. At 20:40 the MDT tool was at surface and the sample chambers from the MDT retrieved.

At 22:15 on the 20th May 2001, final rig down of the wireline equipment was completed.

4.4 COMPARISION LOGGERS AND DRILLERS DEPTHS

Casing	Driller's Depth	Logger's depth
	mBRT	mBRT
9 5/8" Casing	3683	3686.5
TD	3883	N/A

4.5 TIME BREAKDOWN

Run No.	Date	Tool String	Logged interval		Opr. Time	Lost time
			mBRT	mBRT	(hrs:min)	(hrs:min)
1a1	14/05/01	HRLA-DSI-GR-SP -EMS-GPIT	3709	1385 (with DSI)	06:55	
1a2	15/05/01	HRLA-DSI-GR-EMS-GPIT	3709	-	05:20	
1b1	15/05/01	IPLT-GR	3709	Caliper into 9 5/8" casing	06:00	
1c1	15/05/01	MDT-GR	3709	-	07:15	
1c2	16-17/05/01	MDT-GR	3721	3799	31:20	06:50

4.6 LWD LOGS RUN

12 ½" Section

Run No.	Tool String	Hole Size ins	Logged interval (relative to GR)		Remarks
			mBRT	mBRT	
1	MPR/GR (Baker Hughes Inteq)	12 ¼"	1445	1620	Drilled cement plug and performed kick-off. Assembly pulled once surveys without magnetic interference obtained. Realtime data lost from 1535 – 1592 mBRT due to loss of BHI depth line. Problems with realtime decoding, especially when taking surveys off bottom.
2	AutoTrak (Baker Hughes Inteq)	12 ¼"	1620	2970	No ROP restrictions for data density, hence realtime data poor. Memory fine. KCL added continually to increase MW affected GR readings. Bit pulled due to suspected bit-balling.
3	AutoTrak (Baker Hughes Inteq)	12 ¼"	2970	2995	Same tool. Bit pulled due to bit-balling. Memory download took approx. 90 minutes – longer than normal due to the laptop used freezing up during the initial download – had to reboot and start the process over again.
4	AutoTrak (Baker Hughes Inteq)	12 ¼"	2995	3359	New tool used due to hours used on the previous tool. Bit pulled due to bit-balling. Memory dumped at surface, again this took an un-exceptable amount of download due to computer problems.
5	AutoTrak (Baker Hughes Inteq)	12 ¼"	3359	3704	Assembly reached casing point.Pressure While Drilling sub failed at 3565 mBRT.

8 ½" Section

Run No.	Tool String	Hole Size ins	Logged interval (relative to GR)		Remarks
			mBRT	mBRT	
6	MPR/GR (Baker Hughes Inteq)	8 ½"	3704	3882	Drilled cement, shoe and new formation to TD. While drilling out cement/shoetrack and subsequent new formation, realtime decoding was very poor A change of data transmission type, from Combinatorial to Split-Phase, was required in order to provide a more robust realtime signal.
7	MPR/GR/ORD/ CCN (Baker Hughes Inteq) SONIC (Pathfinder)	8 ½"	3704	3882	Due to failure to get wireline tools into the 8 ½" hole, LWD logs run. Pathfinder tool run in memory only mode. Good sonic log downloaded at surface. BHI tools failed to transmit realtime data during the run and at surface the memory data was found to be intermittently recorded and therefore inadequate.
8	MPR/GR/ORD/ CCN (Baker Hughes Inteq)	8 ½"	3704	3882	New BHI tools used. Lost realtime neutron data between 3761 – 3820 mBRT. Neutron sensor failed intermittently; however, the data was later reprocessed onshore and a full neutron log produced.

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Final Pore Pressure Evaluation 6507/5-4 and –4A, Skarv 3	Eamonn Doyle Knowledge System Inc. September 2001

APPENDIX 1: WIRELINE OPERATIONS TIME BREAKDOWN

Run Number	Time/Date	Comments/Activities
1a1	**14/05/01**	**HRLA-DSI-SP-GR-EMS-GPIT**
	17:00	Tool Box talk on drill floor
	17:45	Rigged up compensator and sheaves.
	17:55	Check tools.
	19:10	Checks OK, winch OK
	19:15	Zero tools, start running in hole.
	19:22	RULS check (rig-up-length-surface check of cable from wireline unit thru' sheaves to drillfloor)
	19:25	Engage Heave Compensator
	19:30	Compensator engaged, re-zero tools. Drill crew tie off mudline in derrick to keep wireline cable clear.
	19:55	Run in hole from 109.8m
	21:15	RULB checks at 3578m
	21:30	Run in hole from 3578m, start downlog.
	21:37	Pass out of shoe to open hole.
	21:45	At 12 ¼" rathole / 8 ½" hole junction. Difficulty passing into 8 ½" hole.
	22:05	No success, Pull out and log sonic and Gamma Ray through casing.
	23:55	Finished DSI log, POOH to surface.
	15/05/01	
	00:40	Out of hole. Temp 3x 98degC. Rig down SP/make up stand-offs & hole finder.
		Total time run 1a1 = 6 hours 55 minutes
	01:30	Check re-configured string.
1a2	01:50	Compensator on, start RIH
	02:55	At 3709m, attempt transit from 12 ¼" rathole into 8 ½" hole. No success despite repeated attempts at different running speeds. Also opened caliper inside casing to attempt to change position of bottom of tool wrt hole, closed caliper and ran down, still obstructed.
	03:30	POOH to surface.
	04:40	Disengage compensator.
	04:50	At surface. Rig down logging tools
	06:00	Rig down complete. Start rig up for dummy IPLT run.
		Total time run 1a2 = 5 hours 20 minutes
1b1		**IPLT-GR (no sources, dummy run)**
	06:00	Start rig up tool, minus sources
	07:10	Test tools – okay
	07:10	Start RIH, zero depth
	07:15	Put on compensator. RULS check 78.5 m. Continue RIH
	08:35	RULB check at 3578m
	08:43	At shoe. Attempt to enter 8.5" hole at 3709m, still no go after several attempts
	09:00	Log up from deepest point to get caliper log over rathole.
	09:05	Inside shoe. Close caliper.
	09:07	POOH
	10:52	At 100m, remove compensator. Start rig down tools
	12:00	Tools rigged down. Start rig up for MDT-GR.
		Total time run 1a2 = 6 hours 00 minutes
1c1		**MDT-GR**
	12:00	Start rig up.
	13:55	Power up tools and test string

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	14:15	RIH to 100m. Put on compensator.
	14:21	Compensator weak point broke. Wait while fixed.
	14:35	RIH
	15:53	Log up over Speck Formation for correlation.
	16:00	Finish uplog and RIH. 5m stretch indicated.
	16:10	At shoe.
	16:15	Hung up at 3709 mMD. Made several attempts to pass at varying speeds, all attempts stopping at the same point.
	16:40	POOH.
	18:00	At Surface, disengage compensator.
	19:15	Fully rigged down, drillfloor back to Stena.
		Total time run 1c1 = 7 hours 15 minutes
	16/05/01	
1c2		**MDT-GR**
	21:00	Start rigging up sheaves
	21:10	Held safety meeting
	21:20	Start rigging up wireline run 1c2 MDT-GR
	22:20	Check tools
	22:46	RIH
	23:00	Compensator on and continue to RIH.
	17/05/01	
	00:30	Stopped at 3418m MD. Reboot PC's and let tools temperature stabilize.
	00:35	Log down with GR (6m deeper than LWD) while RIH.
	00:45	Into 8½" hole
	00:50	At 3810m MD tool hung up, pull up and tried to work past. Unable to pass.
	01:00	Started uplog.
	01:15	Made correlation pass +0.2m correction.
	01:35	On station at 3721m and commence pretests.
	03:55	At 3763m MD, supercharged, suspected off depth. Made correlation pass +0.7m correction.
	04:11	On station at 3763m MD continued pretests
	05:05	Unable to set MRPS 1 (probe 1), tried swapping to MRPS 2 (probe 2), still unable to set probe, suspect hydraulic leak. Try isolating probe 2 and retry probe 1 still no go**. (lost time starts)**
	05:25	RIH and attempted to pass restriction at 3810m MD still unable to pass.
	05:30	POOH with MDT-GR.
	06:34	At 3400 mMD. Pump problem solved by increasing pump rate. RIH
	06:57	Correlation log
	07:15	Start attempting pressure tests at 3788.5 m loggers depth. All tests tight/supercharged **(lost time ends – lost time 2hrs 10mins)**
	07:45	Attempt to pass 3805m; no go.
	07:55	POOH to take first sample
	08:40	Correlate gamma log over upper Garn. On depth.
	08:45	At sample point – 3733.6mMD.
	08:52	Set probe and do pressure test
	09:00	Start pumping out to clean up. Indications of good clean flow and monophase sample. The OFA gas detector however showed a consistant low gas indication,even while flowing mud; this did not reflect actual fluid phase and was possibly a software related fault (?).
	11:20	Clean out complete-attempt to sample; unable to build pressure in flowline to sample. Troubleshoot – leak in flowline somewhere, unable to determine where. **(lost time starts)**
	12:03	Stop pump.
	12:05	POOH. Pulled clear of hole side without any problem.

Run Number	Time/Date	Comments/Activities
	13:05	Remove Heave compensator
	13:30	At surface. Found flowline plug seal had failed on a 1 gal MRSC (presumed to be due to damage inflicted during rig-up). This caused the pressure loss in the flow line. Checked all other seals and valve – found the upper seal valve glide ring had also failed. This would not have affected the flowline pressure but would have caused inconvenience when sampling the multisampler. Replaced all faulty parts. Also changed out OFA as a precaution. Probe pump hydraulic leak felt to not require change out as it represented no potential impact on operations.
	14:40	Heave compensation on, RIH.
	15:37	Correlation run over top Garn, subtract 0.5m
	15:55	At 3733.6 m, take Pressure Test
	16:00	Start pumping out for clean up. Still have low gas indication from the OFA gas detector-software bug thought to be the cause.
		Stop clean up, take first 1 gal sample **(lost time ends, lost time 4 hr 40 min)**
	17:45	Ready to start sampling (clean up volume 92.3 L). Open MRSC #1
	17:50	MRSC #1 closed.
	17:55	MRSC #2 open
	18:00	MRSC #2 closed
	18:02	MRSC #3 open
	18:07	MRSC #3 closed
	18:10	MRSC #4 open
	18:15	MRSC #4 closed
	18:21	SPMC #1 open
	18:27	MRMS valve open again
	18:31	SPMC #2 open
	18:37	MRMS valve open again
	18:40	Pumping stopped and retracted probe.
	18:42	RIH to 3752m hanging up, pulled up (max O/P 2500 lbs)
		POOH to make correlation pass – on depth
	18:52	On station at 3752m
	19:04	Started pumping out, very slow clean up only 5-10% oil after nearly 1½ hours.
	20:27	Stopped pumping
	20:30	Moved down to 3752.8m.
	20:35	On station at 3752.8m, mobility better.
	20:45	Started pumping out, clean up quicker, but minimum acheivable drawdown was 150-200 psi, (need less than 100 psi for PVT quality sample).
	22:18	Stopped pumping and retracted probe.
	22:20	Moved off wall dropped down, then POOH and run in again to recorrelate – added 0.2m depth correction.
	22:25	Continued to RIH to 3748.7m
	22:30	Set probe at 3748.7m, better mobility 170md
	22:40	Start pumping out, minimum achievable drawdown was 150-180 psi, too high.
	22:48	Stopped pumping and retracted probe.
	22:50	At 3754.4m set probe.
	23:00	Started pumping out, minimum achievable drawdown was 250-280 psi, too high.
	23:24	Stopped pumping and retracted probe.
	23:28	RIH to 3759.8m and set probe
	23:37	Started pumping out, minimum achievable drawdown was 200-250 psi, too high.
	23:45	Stopped pumping and retracted probe and RIH
	23:55	At 3762.8m
	18/05/01	
		Started pumping out, minimum achievable drawdown was 200-250 psi, too high.
		Stopped pumping and retracted probe. Decided to go for best point so far at 3748.7m. Pull

Run Number	Time/Date	Comments/Activities
		up and RIH to recorrelate – no depth correction
	00:35	At 3748.7m set probe, formation pressure a little high and mobility a little low, suspect slightly low on depth.
	00:45	Picked up to to 3748.3m and retest. Still not quite right.
	00:50	Picked up and recorrelated – no depth correction. RIH to 3748.7m, mobility better.
	01:05	Start pumping out.
	03:40	Open MPSR 1 (#800)
	03:55	Closed MPSR 1 (#800)
	04:05	Opened MPSR 2 (#928)
	04:11	Closed MPSR 2 (#928)
	04:14	Stopped pumping
	04:20	Attempted to come off wall, unable to unseat tool. Stuck at 3748.7m. Pulled to 9500lbs cable tension (9700lb max allowable) and 4300 lbs CHT (8000lbs max allowable). Unable to move up or down. Able to slack off cable (ie tool, not cable stuck). Once established tool unable to move, keep line under 9500 lbs tension. Prepare fishing equipment. **Time allocated to wireline operations stops?**
	07:30	Found that 50v MDT power line causes interference on telemetry signal. Presumable due to damage to cable while pulling. Telemetry unreliable.
	08:00	Slack-off cable tension to 2900 lbs. Attached T bar at rotary, cut wire and made up rope socket and prepared fishing equipment.
	09:45	Removed ropes from mud hoses. Rigged down sheaves and changed elevators.
	10:45	Held Tool Box Talk and installed Schlumberger top sheave assembly at crown.
	13:15	Held Tool Box Talk and made up wireline fishing assembly to a stand of 5” drillpipe and checked rigup.
	14:30	Removed torque wrench from topdrive. Welded on wear bars to DDM. Rigged up hold back sheave.
	17:15	Stripped into hole over cable with 5” drillpipe.
	18:00	Held Tool Box Talk at Schlumberger shift change.
	18:15	Continued to strip into hole over cable. Float through BOP and wellhead.
	20:00	Welded on protection strip to DDM.
	20:15	Continued to strip into hole over cable, checking wire and bumper plates on DDM every 10 stands.
	19/05/01	
	00:00	Held Tool Box Talk at drill crew shift change.
	00:15	Continued to strip into hole over cable, checking wire and bumper plates on DDM every 10 stands.
	02:00	Changed out to 5½” handling gear. Made up crossover to Schlumberger kick sub.
	02:30	Investigated electrical cable arcing over at bottom of upper racking arm cabin. Electrician traced fault and made safe.
	03:00	Continued to strip into hole over cable, checking wire and bumper plates on DDM every 10 stands.
	14:00	Extended cable bar protection on DDM.
	14:15	Continued to strip into hole over cable, checking wire and bumper plates on DDM every 10 stands.
	15:45	Changed to 5” handling equipment and continued to strip into hole to 3665m
	19:30	Held tool box talk. Schlumberger reterminated cable ends and reconnected cable with torpedo – no telemetry from MDT tool. Installed side entry sub.
	20/05/01	
	00:15	Installed DDM torque wrench and function tested.
	02:00	Held tool box talk to discuss fishing operations.
	02:30	Made up a stand of drillpipe to DDM, removed clamp from wireline and RIH laying out the top single.
	03:15	RIH at controlled speed to 3714m. Took up and down wieghts and circulated at 43 SPM =

Run Number	Time/Date	Comments/Activities
		500 psi.
	04:15	Washed down from 3714m and tagged top of fish at 3731m. Observed pressure increase to 650 psi, switched off pumps. Continued to RIH to 3737m. Good indications on surface tension of fish engaged.
	04:30	POOH with 5" drillpipe inside shoe and attempted to fire weakpoint – no go.
	05:15	Held tool box talk on the drillfloor. Made up single of drillpipe and racked back stand above side entry sub. Attempted to fire weak point – no go. Pulled 9700 lbs on cable to see if free.
	07:00	Clamped cable, opened up torpedo and check electrical continuity in cable. Again attempted to fire weakpoint – no go.
	09:00	Laid out side entry sub. Installed T bar and rigged up to pull weak point on elevator.
	10:15	Held tool box talk on drillfloor. Attempted to pull cable weak point with maximum 17000 lbs – no go.
	12:30	Flow checked well – negative. Meanwhile cut Schlumberger cable at surface and prepared to POOH with fish.
	12:45	POOH with fish to 2800m. Changed to 5½" drillpipe handling equipment.
	14:45	Pumped slug.
	15:15	Continued POOH with fish, secured same in rotary, pulled compensated and at controlled rate through 9 5/8" casing patch and BOP. Flow checked well prior to pulling through BOP – negative. Had to use manual rig tongs to break out some drillpipe connections (up to 70,000 lbs to break).
	20:40	Fish at surface. Laid down MDT tool string and overshot assembly. No obvious damage to MDT toolstring, all bulk chambers and the 2x MPSR bottoles showed indications of being full.
	22:15	Held toolbox talks on the drillfloor. Rigged down Schlumberger sheaves from derrick and cleared and tidied rigfloor.
		Total time run 1c2 = 31 hours 20 minutes LOST TIME 1c2 = 6 hours 50 minutes