BP AMOCO NORGE AS
6404/11-1
SCARABEO 5

GEOLOGICAL COMPLETION REPORT

6404/11-1

NORWEGIAN SEA

NORWAY

Neil Hanley

- CONFIDENTIAL -

April 2002

APPROVAL

PROSPECT:	HAVSULE
PRE-DRILL TARGETS:	EARLY EOCENE (T50) MAASTRICHTIAN (K90) CAMPANIAN (K80) LATE CENOMANIAN (K72)
LOCATION ID:	
DATE:	NOVEMBER 2001 – MARCH 2002

AUTHOR: _____

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APPROVED BY: _____

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APPROVED BY: _____

Samuel R Johnson (Licence Team Leader)

Indexing Information

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Situation:	Offshore
Region(s):	Norwegian Sea
Well name(s):	6404/11-1 (Havsule)

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Subjects:

Well Summary

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SUMMARY

GENERAL

PL 254 was awarded to a consortium comprising BP Amoco, TotalFinaElf, Norske Conoco and the SDFI (now Petoro AS) as part of the 16th Licencing Round on the 20th May 2000. BP Amoco operate the licence.

The pre-drill objective of well 6404/11-1 was to test three primary reservoir targets at T50, K90 and K80 levels and have an option to test one secondary target at K72 level in the Havsule Prospect. The prospect is a seismically defined north - south trending structural dome located in the north of the Møre Basin in the Norwegian Sea that is thought to have developed during the Tertiary Period in response to compression during opening of the North Atlantic Ocean.

OPERATIONS

BP Amoco took over the dynamically positioned (DP) semi-submersible rig, Scarabeo 5, at 19:00 hrs on 14th November 2001 with the rig arriving at the Havsule location at 15:00 hrs on the 24th November 2001. DP trials were undertaken and after the seafloor transponders were deployed, the 6404/11-1 well was spudded at 21:30 hrs on the 1st December 2001.

A 12 ¼" pilot hole was drilled from seabed to 2195 mBRT in one bit run. No indications of shallow gas or abnormal pore pressures were observed from drilling data or on LWD. After drilling to section TD the bit was pulled and the hole opened to 36" to 1629 mBRT. While repositioning one of the subsea marker buoys it was inadvertently dropped into the hole necessitating a re-spud of the well 28.6m to the north-north west of the original hole location.

The well was re-spudded at 13:30 hrs on the 6th December 2001 using a 42" x 36" hole opener assembly. 26" hole was drilled to 2175 mBRT with seawater and hi-vis sweeps. After displacing to seawater, circulating the hole clean and pulling to 1870 mBRT bubbles were seen flowing from the wellhead. Drillpipe was run to bottom and the hole was made static with 1.20sg mud. Casing was run and cemented without problem, however weather delayed running the BOP's and riser.

The 17" hole section was TD'd 15m shallow to prognosis due to concerns over increasing pore pressure. After running and cementing the 13 3/8" casing it was necessary to run a piggy-back casing hanger to allow the seal assembly to seat in the correct position.

A value of 1.38sg was obtained for the leak-off after drilling out the 13 3/8" casing and drilling 12 ¼" hole commenced. Drilling was halted at 2730 mBRT when pore pressure was seen to have reached 1.25sg and the bit was pulled into the casing shoe. In an attempt to carry on drilling an open-hole leak-off was performed that confirmed the 1.38sg value obtained earlier. Having insufficient kick tolerance to drill ahead, the decision was made to run a 9 5/8" liner. A triple-combo wireline log was run to acquire data over the drilled section.

Liner was set and a 1.47sg leak-off was obtained. Drilling commenced in 8 ½" hole. No reservoir horizons were identified and the well was TD'd at 02:45 hrs on the 20th February at a depth of 3650 mBRT. Three wireline logging runs were performed.

The 6404/11-1 well was plugged and abandoned as a dry hole at 22:00 hrs on the 10th March 2002 and the rig released to Norsk Hydro.

RESULTS

The shallowest primary target (Early Eocene T50 sandstones) was absent at the well location.

Upper Cretaceous (K90 sandstones) were absent and K80 (Nise Formation) sandstones were poorly developed.

The well was not extended to penetrate the deeper, K72 (Lysing Formation) secondary target.

SUMMARY

FIGURES

ENCLOSURES

1:500 Measured Depth Composite Log

1 WELL DATA SUMMARY

1.1 GENERAL DATA

Well Name:	6404/11-1	
Status:	P&A Dry	
Licence:	PL 254	
Drilling Permit No.	1019-L	
Operator:	BP Amoco Norge AS	35.00%
Partners:	Petoro AS	25.00%
	Norske Conoco A/S	20.00%
	TotalFinaElf Exploration Norge AS	20.00%

Original Surface Location:		**Re-spud Location:**	
Latitude	64° 10’ 10.99” N	Latitude	64° 10’ 11.91” N
Longitude	04° 21’ 36.92” E	Longitude	04° 21’ 36.65” E
Grid	7 116 809.30 mN	Grid	7 116 837.60 mN
	566 128.70 mE		566 124.40 mE

TD Location:	
Latitude	64° 10’ 12.401” N
Longitude	04° 21’ 35.455” E
Grid	7 116 852.57 mN
	566 108.00 mE

Projection:	UTM 31N; Common Meridian 03° E		
Spheroid:	ED 50, 1924 International Spheroid		
Seismic Location:	Inline: 3063, Trace 4184 (Survey RHD99 3D)		
Offset from Nearest Wells	Norsk Hydro well 6305/1-1: 62.0 kms South-east	Norsk Hydro well 6305/5-1: 85.0 kms South-east	Norsk Hydro well 6305/8-1: 92.8 kms South-east
Drilling Rig:	Scarabeo 5	**Rig Type:**	Dynamically Positioned Semi-submersible
RTE:	25 mAMSL	**Total Depth:**	3650.0 mBRT
Depth Datum:	RT	**Loggers Depth:**	3637.5 mBRT
Water Depth:	1495 m	**Max Inclination:**	Vertical
Rig on Contract:	14th November 2001	**Spud Date:**	1st December 2001
Re-Spud Date:	6th December 2001		
TD Date:	20th February 2002	**Rig Released:**	10th March 2002
Report Number:	W28.	**Author:**	Hanley, Neil

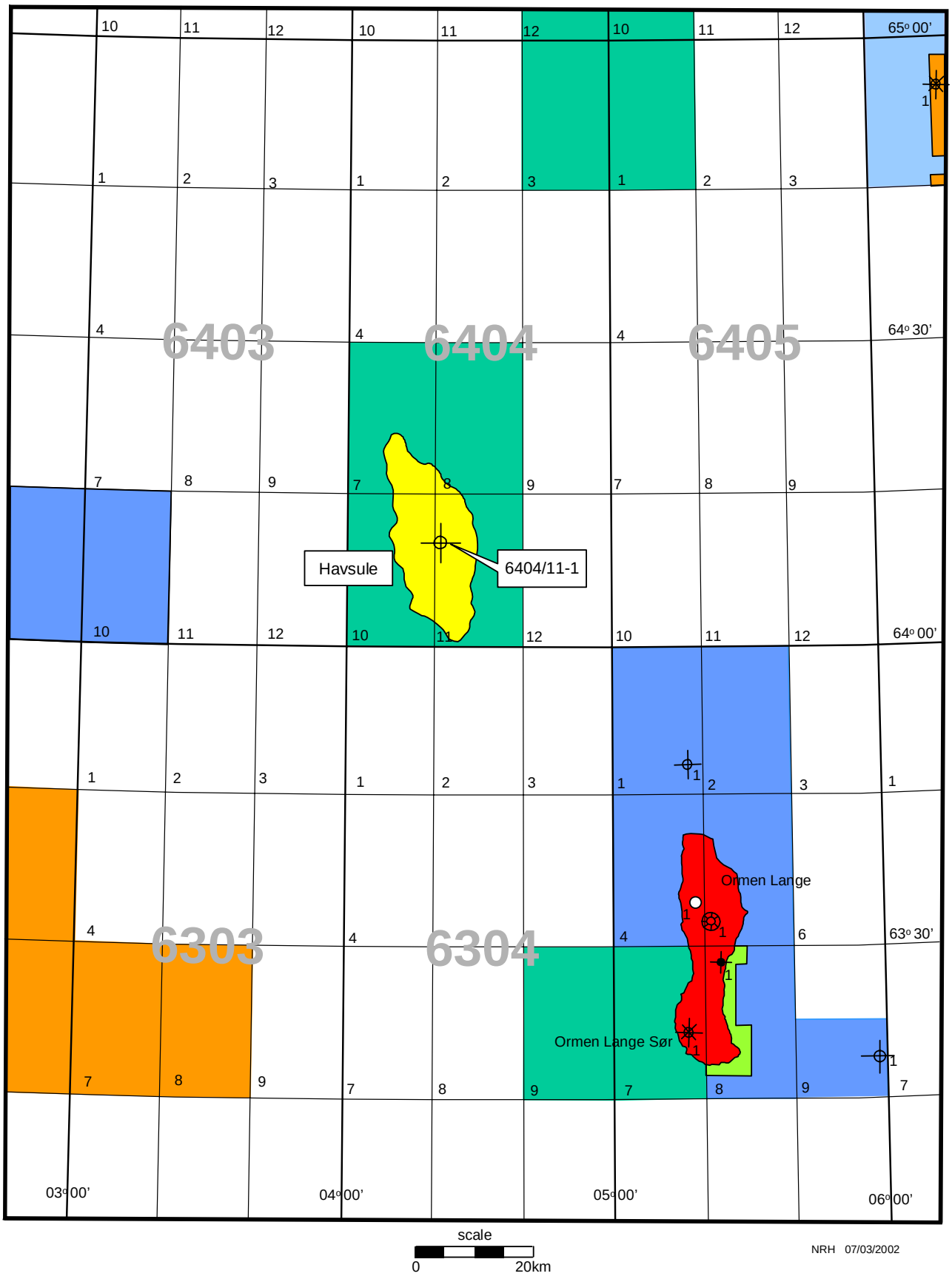

Figure 1.1: Location Map

1.2 STRATIGRAPHY

1.2.1 Summary

Chrono/Lithostratigraphy**		Tops			
		Depth mBRT	Depth mTVDBRT	Depth mTVDSS	TVT m
	Seabed	**1520.0**	**1520.0**	**1495.0**	
Recent	Storegga 2 and 1	1520.0	1520.0	1495.0	54.0
Late Pliocene – Recent	**Nordland Group**				
	Naust 'R' P. Slide 2	1574.0	1574.0	1549.0	83.0
	Naust 'R' Upper Flow	1657.0	1657.0	1632.0	25.0
	Naust 'R' Lower Flow	1682.0	1682.0	1657.0	52.0
	Naust 'S'	1734.0	1734.0	1709.0	107.0
	Naust 'U'	1841.0	1841.0	1816.0	90.5
	Naust 'W'	1931.5	1931.5	1906.5	291.1
Early Eocene – Late Oligocene	**Hordaland Group**				
	Brygge 'A'	2222.9	2222.6	2197.6	86.0
	Brygge 'C'	2308.8	2308.6	2283.6	217.5
Early Palaeocene – Earliest Eocene	**Rogaland Group**				
	Tare Fm	2525.9	2526.1	2501.1	73.6
	Tang Fm	2600.0	2599.7	2574.7	148.0
Late Santonian - Maastrichtian	**Shetland Group**				
	Springar Fm	2748.0	2747.7	2722.7	458.0
	Nise Fm	3206.0	3205.7	3180.7	>444.0

*** NOTE:** Nordland Group picks were made in the pilot hole that was drilled 28.6m from the main wellbore and have not been depth shifted to the wireline that was acquired in the respudded hole.

****NOTE:** Chronostratigraphic age interpretation is based on preliminary biostratigraphy

1.2.2 Forecast v Actual

Marker Horizon	Pre-drill Forecast			Actual		
	Depth mTVDSS	Seismic TWT msec	Error Bar m	Depth mTVDSS	VSP TWT msec	Error m
Seabed	**1495**	**2028**	**± 7.5**	**1495.0**		**0**
Storegga 2 and 1	1495	2028		1495.0		
Nordland Group	**1558**	**2091**		**1549.0**		**-9**
Naust 'R' P. Slide 2	1558	2091		1549.0		-9
Naust 'R' Upper Flow	1659	2192		1632.0		-27
Naust 'R' Lower Flow	1686	2219		1657.0		-29
Naust 'S'	1747	2281		1709.0		-38
Naust 'U'	1867	2401		1816.0		-51
Naust/Kai						
Base Pliocene	1931	2484	± 30	1907.0		-24
Hordaland Group	**2210**	**2748**	**± 40**	**2197.6**	**2717.6**	**-12.4**
Brygge Fm	2210	2748	± 40			
Rogaland Group	**2520**	**3096**	**± 50**	**2501.1**	**3065.8**	**-18.9**
Top T50 (?Tare)	2520	3096	± 50	2501.1		-18.9
Base T50	2545	3120	± 50			
Top T40b	2605	3184	± 60			
Top T10	2710	-	± 70			
Shetland Group	**2731**	**3316**	**± 70**	**2722.7**	**3272.8**	**-8.3**
Top K90 (Springar Fm)	2731	3316	± 70	2722.7		-8.3
Intra K90 Temp 3	2835	3420	± 80			
Intra K90	2970	3544	± 100			
Top K80 (Nise Fm)	3260	3772	± 120	3180.7		-79.3
Base K80?	3380	3912	± 150			
Top K76	3720	4072	± 200	NP		
Base K76?	3805	4180	± 200	NP		
Top K74	N/A			NP		
Cromer Knoll Group	**4360**	**4440**	**± 250**	**NP**		
Top K72	4360	4440	± 250	NP		
Base K72	4610	4740	± 250	NP		

Note: NP = Not penetrated

1.3 CASING

1.3.1 Summary

Casing Size	Section TD mBRT	Casing Depth mBRT	Test Depth mBRT	Lithology	Formation	Comments
36 x 30”	1628.0	1622.0	-	Mudstone	Naust Fm Nordland Gp	Surface conductor. No LOT
20”	2175.0	2171.0	2179.0	Mudstone	Naust Fm Nordland Gp	LOT: 1.37sg EMW Tested with 1.11sg mud and 812psi applied surface pressure.
13 3/8”	2449.0	2443.6	2452.0	Mudstone	Brygge Fm Hordaland Gp	LOT: 1.38 sg EMW Tested with 1.25sg mud and 295psi applied surface pressure.
9 5/8” Liner	2730.0	2729.0	2732.0	Mudstone	Tang Fm Rogaland Gp	LOT: 1.47sg EMW. Tested with 1.33sg mud and 540 psi applied surface pressure.

MINILOG

1.4 COMPARISION DRILLERS AND LOGGERS DEPTHS

1.4.1 Summary

Casing	Driller's Depth mBRT	Logger's depth mBRT
30" Conductor	1622.0	Not recorded
20" Casing	2171.4	Not recorded
13 3/8" Casing	2443.6	2440.0
9 5/8" Liner	2729.0	2729.0
TD	3650.0	3637.5

1.5 TEMPERATURE DATA

1.5.1 Summary Plot

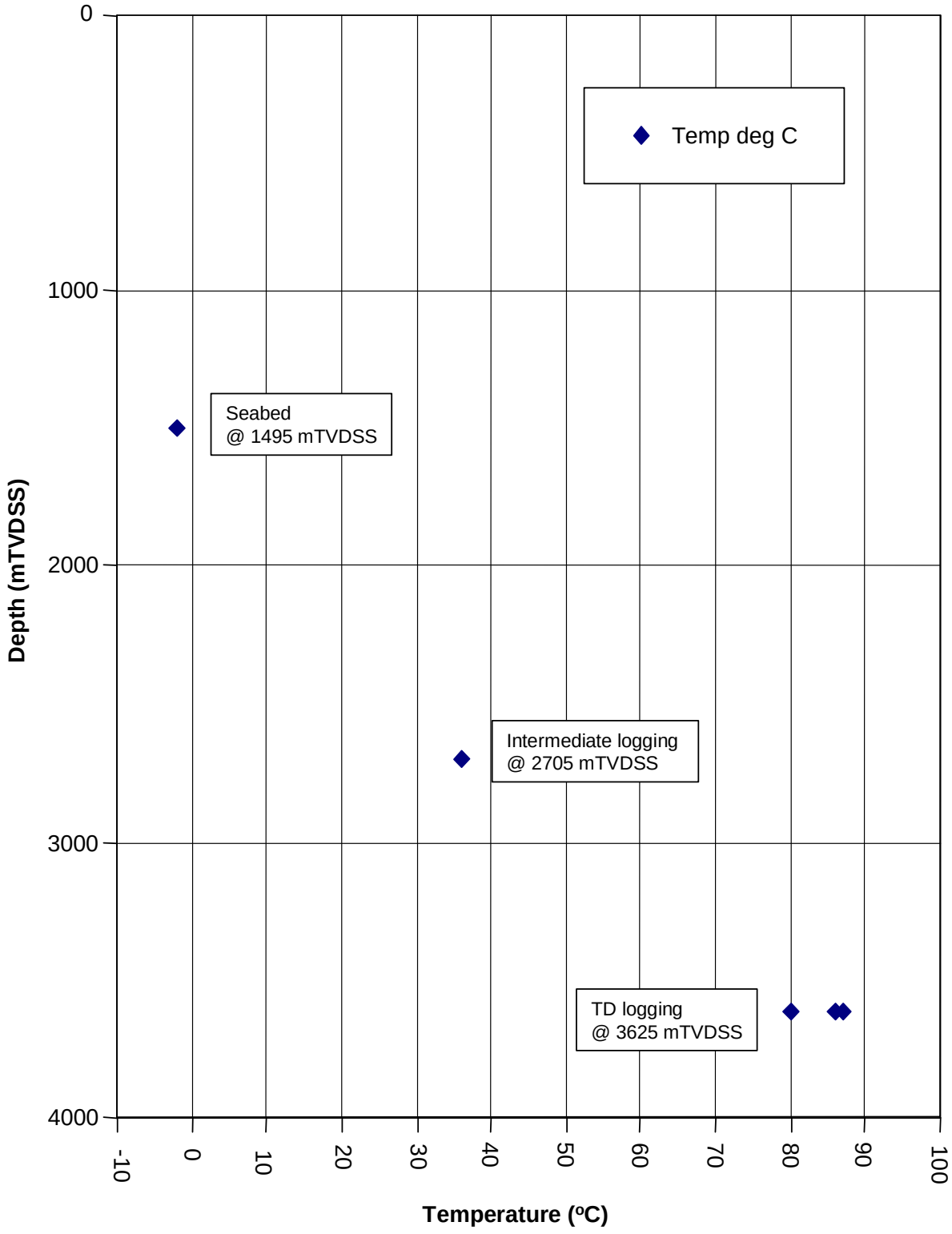

Figure 3: Temperature Plot

2 GEOLOGY

2.1 RECENT (1520.0 – 1574.0 mBRT)

2.1.1 Storegga 2 and 1 *(1520.0 –1574.0 mBRT)*

Top	1520.0 mBRT
Age	Recent
Upper boundary pick	Seabed
Lithology and shows	Returns to seabed. From drilling characteristics and logging response this section is interpreted to be composed of interbedded sands and mudstones.
Logging character	LWD gamma and resistivity data was collected in the 12 ¼" pilot hole to aid shallow gas detection and in selecting a competent lithology for setting 20" casing. LWD gamma ranged between 60 and 80 API, average 71 API. LWD resistivity between 1.5 and 2.0 ohm.ms, average 1.8 ohm.ms.
Drilling characteristics	12 ¼" pilot hole had variable rates of penetration, but averaged 30m/hr. While opening to 36" the hole appeared tight between 1554 mBRT and 1557 mBRT, this may be associated with pebbles/cobbles deposited during the Storegga Slide event. After opening the hole to 36" a subsea marker buoy was inadvertently dropped down the hole requiring the well to be re-spud. A 42 x 36" assembly with 17 ½" pilot bit was used to re-spud the well. The hole was drilled to 1628 mBRT with an average ROP of 20m/hr. Drilling fluid; seawater with hi-vis sweeps.

2.2 NORDLAND GROUP (1574.0 – 2222.9 mBRT)

2.2.1 Naust Formation (1574.0 – 2222.9 mBRT)

Top	1574.0 mBRT
Age	Late Pliocene to Recent*
Upper boundary pick	Increase in resistivity corresponding to pick on seismic.
Lithology and shows	The Naust Formation was penetrated in the pilot hole. This was drilled riserless with cuttings being circulated to seabed. In the 26" section of the re-spud hole, cuttings were collected by the ROV for headspace analysis and biostratigraphy. After installing the 20" casing, cuttings were circulated to surface from 2180 mBRT while 17" hole was being drilled. The basal Naust is composed of a grey mudstone sequence with occasional traces of sandstone and lithic gravel fragments. From drilling characteristics and logging response in the pilot hole this section is interpreted to be composed primarily of mudstones with occasional sand lenses.
Logging character	LWD logs were acquired in the 12 ¼" pilot hole. LWD gamma varies between 60 and 100 API, averaging 81 API. LWD resistivity varies between 1.0 and 2.7 ohm.ms, with an average of 1.9 ohm.ms
Drilling characteristics	Average rate of penetration in the pilot hole was 30 m/hr. Average ROP in the 26" hole was 40 m/hr. Occasional hard streaks were encountered between 1897 mBRT and 1925 mBRT. Drilling fluid; seawater with hi-vis sweeps.

* Chronostratigraphic age interpretations are based on preliminary biostratigraphy

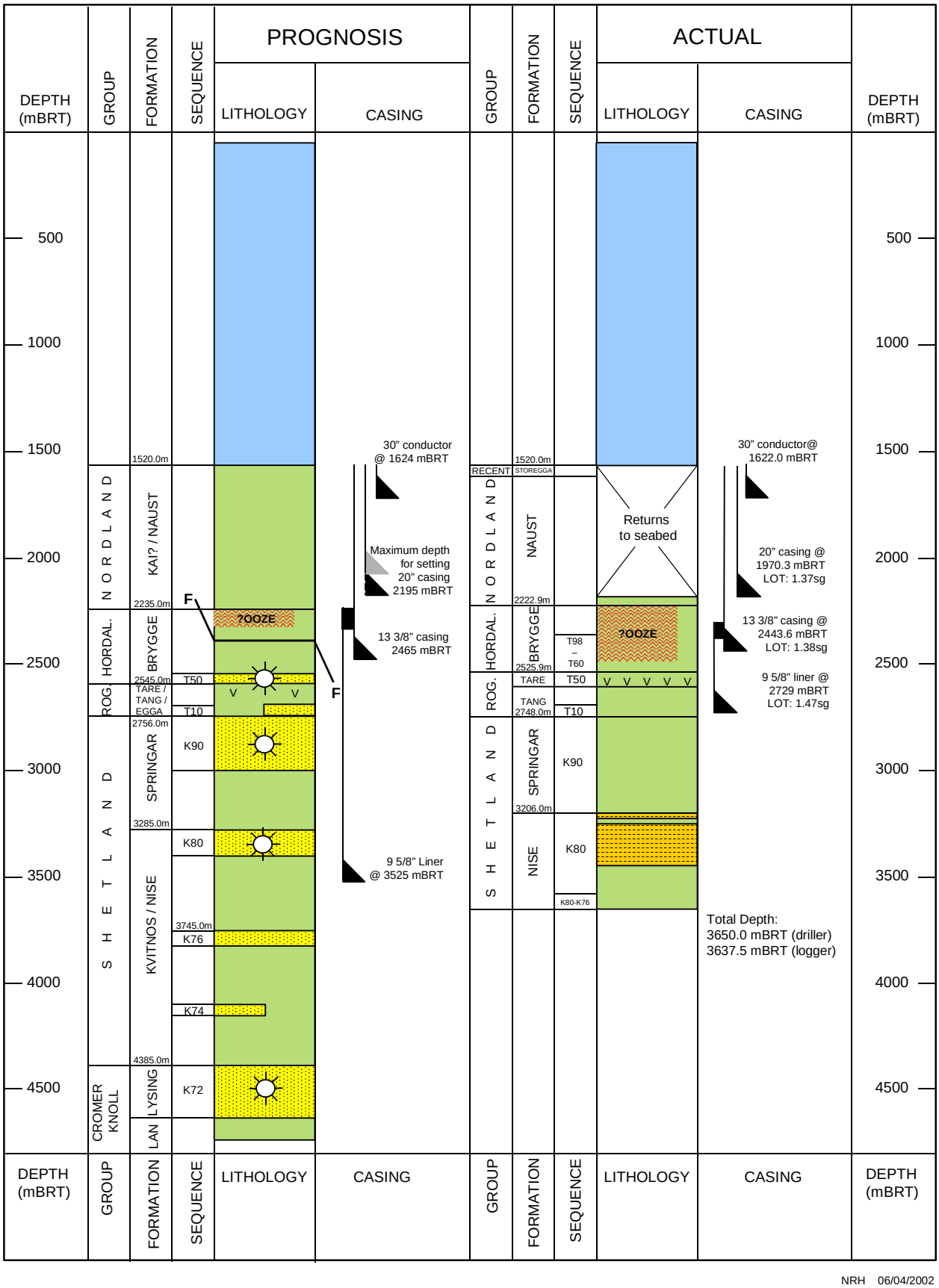

Figure 4: Prognosed versus Actual.

2.3 HORDALAND GROUP (2222.9 – 2525.9 mBRT)

2.3.1 Brygge Formation (2222.9 – 2525.9 mBRT)

Top	2222.9 mBRT
Age	Early Eocene to Late Oligocene
Upper boundary pick	Decrease in resistivity from 2.0 to 1.0 ohm.ms, slight decrease in LWD gamma from 150 to 135 API. Wireline gamma decreases from approximately 45 API to below 40 API.
Lithology and shows	The Brygge Formation comprises a thick sequence of mudstones with very rare limestone stringers. Some of the mudstones are low density ooze sediments. Two subdivisions of the Brygge Formation are recognised in the well: Brygge 'A' and Brygge 'C'. The mudstones are grey brown becoming green grey on penetration of the Brygge 'C' at 2309 mBRT. In general they are soft to moderately firm, locally micaceous with traces of glauconite and pyrite. The limestones are white to off white, crypto- to microcrystalline in texture.
Logging character	Wireline gamma averages 40 API through the Brygge 'A', with LWD gamma averaging 140 API. Some variation is noted in the LWD gamma. Resistivity is relatively characterless at 0.9 ohm.ms. Toward the base of the Brygge 'A' wireline gamma increases to over 45 API, with LWD gamma being over 150 API. From 2309 mBRT both gamma and resistivty measurements decrease. Resistivty falls to approximately 0.7 ohm.ms, with wireline gamma averaging 35 API and LWD gamma at 130 API. A 13 3/8" casing was set in the middle of the Brygge 'C', and the change in hole size affects each of the logs accordingly. Wireline gamma increases to approximately 50 API, with LWD gamma decreasing to 80 API.
Drilling characteristics	Due to the rig experiencing between 3 – 6m of heave, it proved difficult to optimise drilling parameters in the 17" hole section. Consequently, the rate of penetration varied from 10 – 60 m/hr. The 13 3/8" casing was set 102m above prognosed T50 reservoir and the 12 ¼" hole was control drilled at 15 m/hr to enable picking of the core point as per the Data Acquisition Plan. From top Brygge to 13 3/8" casing, drilled gas averaged 1.5% with 1.11sg mud and was composed of C_1 and C_2. On drilling out of the casing the mud was change to 1.25sg Aquadrill mud. Drilled gas was suppressed to 0.3% and was composed of C_1 and C_2.

2.4 ROGALAND GROUP (2525.9 – 2748.0 mBRT)

2.4.1 Tare Formation *(2525.9 – 2600.0 mBRT)*

Top	2525.9 mBRT
Age	'Earliest' Eocene
Upper boundary pick	The Tare Formation is picked at a decrease in interval transit time which corresponds to a high gamma reading at the base of the Hordaland Group. Lithology changes from mudstone to tuffaceous mudstone.
Lithology and shows	The Tare Formation consists of mudstones which are tuffaceous in the upper part. Minor limestone stringers and rare loose quartz grains are recognized. The mudstones are predominantly medium grey to grey brown, slightly silty with fine disseminated pyrite. In parts the mudstones are tuffaceous, the tuff is recognized as light to medium grey, with dark specks, it is gemerally crumbly with an ashy texture. The limestones are off white to light grey, firm subblocky, micro- to cryptocrystalline, slightly argillaceous with a mudstone texture.
Logging character	Wireline gamma varies between 30 API and 90 API with the lower values associated with occasional thin limestone stringers. LWD gamma is higher at between 60 API and 75 API. Resistivity averages less than 2.0 ohm.ms, with density averaging 2.32 g/cc and average neutron porosity values of 0.52 PU recorded. Average compressional sonic log values of 140 μsec/ft were recorded, the top 20m of the Tare Formation having an average of 180 μsec/ft. Shear sonic averages 375 μsec/ft The classic 'bell-shaped' profile of the Tare Formation logs is poorly developed at the Havsule location.
Drilling characteristics	As per the Data Acquisition Plan, drilling was controlled to less than 20 m/hr to facilitate core point selection. On penetration of the Tare Formation drilled gas increased from 0.3% to over 1.0% peaking at 5.33% at 2543 mBRT. C_1 and C_2 were present, with traces of C_3 recorded from 2563 mBRT. Connection gas was observed from each of the connections made in the Tare Formation. Maximum connection gas was 3.58% at 2560 mBRT. The Tare Formation was drilled with 1.26sg mud, however the presence of connection gas suggests that the well was close to balance throughout the Tare.

2.3.2 Tang Formation *(2600.0 – 2748.0 mBRT)*

Top	2600.0 mBRT
Age	Early to Late Palaeocene
Upper boundary pick	The Tang Formation is picked on an increase gamma ray below the Tare Formation which corresponds with a colour change in the mudstones from medium grey to brown grey.
Lithology and shows	A sequence of mudstones with limestone stringers and occasional tuff horizons. The mudstones are predominantly brown grey, soft to firm, silty with finely disseminated pyrite throughout. From 2655 mBRT the mudstones become light grey to occasionally light green grey, micromicaceous. with occasional nodular pyrite. Thin stringers of white to off white cryptocrystalline limestones occur throughout. Tuff horizons of up to 3m in thickness are recognised. These are light to medium grey, dark grey brown and mottled in appearance, occasionally purple to light purple with black specks.
Logging character	The first 130m of the Tang Formation was drilled in 12 ¼" hole, with the final 18m in 8 ½". At the TD of the 12 ¼" section a Supercombo wireline log was run, however this tool could not reach bottom after hanging up at 2718.5 mBRT and therefore wireline data from the deeper part of the hole was lost. Wireline gamma averages 45 API with occasional 'hot' sections of up to 120 API recognised. LWD gamma displays a similar profile, but ranges between 60 API and 180 API. On drilling out of the casing at 2730 mBRT a hole shale was penetrated with wireline gamma values exceeding 125 API and LWD gamma of over 200 API. Resistivity log decreases from 2.0 ohm.m to 1.0 ohm.m over the first 25m of the Tang Formation and gradually falls to 0.7 ohm.ms at the base of the formation. Density log averages 2.0 g/cc with a maximum of over 2.5g/cc associated with a limestone stringer at 2620 mBRT. Neutron log averages 0.5 PU and shows a slight increase over the bottom 18m. Both compresional and shear sonic was recorded in the Tang Formation. Average compressional sonic log values of 140 μsec/ft were recorded, with average shear sonic being 440 μsec/ft.
Drilling characteristics	Rates of penetration were held to 20 m/hr to aid core point selection. Average drilled gas was low at less than 0.7% with alkanes up to C_3 recorded. Several connection gases of over 1% were observed. These suggested that pore pressure had been increasing through the Tang Formation and that the well was close to balance. Due to concerns over increasing pore pressure, mudweight was increased from 1.26sg to 1.30sg at 2730 mBRT. A dummy connection was performed at 2730 mBRT with 1.30sg mud, this did not produce a connection gas peak. However, having insufficient kick tolerance to drill ahead, drilling was halted at this depth. A Supercombo wireline tool was rigged up and run in hole to acquire data over the 12 ¼" section and a 9 5/8" liner was run and cemented.

2.5 SHETLAND GROUP (2748.0 – 3650.0 mBRT)

2.5.1 Springar Formation *(2748.0 -3201.9 mBRT)*

Top	2748.0 mBRT
Age	Late Campanian to Late Maastrichtian
Upper boundary pick	The Springar Formation is picked on the change in lithology from light – medium grey mudstones of the Tang Formation to dark grey silty mudstone which corresponds to a decrease in gamma, increase in resistivity and increase in density log values.
Lithology and shows	The Springar Formation comprises a thick sequence on mudstones with thin limestone stringers throughout. The uppermost 50m consists of silty mudstone to argillaceous siltstone. The silty mudstone is grey to dark grey, moderately firm with traces of glauconite and micropyrite and has a silty calcareous matrix. From 2800 mBRT, the lithology becomes a grey to rarely grey brown homogenous mudstone. It is generally non to slightly calcareous, micromicaceous with traces of disseminated pyrite and carbonaceous specks. Occasional off white to pale grey argillaceous limestone stringers were penetrated throughout.
Logging character	The Springar Formation is distinguished by relatively characterless logging responses in the mudstones. Wireline gamma is stable at 70 API with LWD gamma at approximately 100 API. Resistivity averages 1.5 ohm.ms, with density and neutron porosity averaging 2.26 g/cc and 0.43 PU respectively. Compressional sonic is 136 μsec/ft with shear sonic at 347 μsec/ft. Variations in each of the logs is noted where limestone stringers are penetrated and where hole wash-outs, as indicated on the calliper log, are seen.
Drilling characteristics	The Springar Formation was drilled in 8 ½" hole. As per the Data Acquisition Plan, ROP was controlled to 20 m/hr to allow picking of the K90 core point. Once below the base of the K90 uncertainty, ROP's were allowed to increase. From 2748 mBRT to 2775 mBRT, drilled gas was over 2.0%, with a peak of 8.2% at 2755 mBRT. Below 2775 mBRT drilled gas fell to approximately 1.0% and beneath 2975 mBRT were consistently below 1.0%. Alkanes upto iC_5 were recorded throughout this section. No connection gases were observed. The interval was drilled with a mudweight of 1.33sg.

2.4.2 Nise Formation *(3206.0 - 3650.0 mBRT)*

Top	3206.0 mBRT
Age	Late Santonian to Late Campanian
Upper boundary pick	The Nise Formation is picked on the increase in gamma values associated with the change in lithology from mudstone to silty mudstone and argillaceous siltstone. This corresponds to a decrease in sonic and increase in density and resistivity log values.
Lithology and shows	The Nise Formation is predominantly composed of argillaceous siltstones with silty mudstones, occasional limestone stringers and rare thin sandstone beds. The top 100m comprises an interbedded sequence of grey to grey brown silty mudstone and argillaceous siltstones which grades to argillaceous siltstone with rare sandstones from 3300 mBRT. The argillaceous siltstones are medium dark grey, micromicaceous, with rare micropyrite and glauconite nodules. In places thin stringers of very fine grained sandstones occur. No shows were observed. Below 3500 mBRT the argillaceous content of the formation increases, the Nise being composed of silty mudstone. This is light to medium grey, non calcareous with occasional glauconite. In places a dark grey to dark olive grey silty mudstone is recognised. Thin stringers of white to off white limestones are seen throughout the sequence
Logging character	Logging response in the Nise Formation is relatively characterless, with the main responses occurring where limestones were encountered. Wireline gamma averages 65 API, with LWD gamma at 90 API. Both gamma logs decrease to 30 and 60 API respectively on penetration of the limestone stringers. Resistivity is constant at 2.5 ohm.ms, with the neutron porosity log averaging 0.32 PU and density of 2.38 g/cc. Average compressional sonic was 110 μsec/ft, with a shear sonic of 234 μsec/ft.
Drilling characteristics	In order to facilitate picking core point at top K80 reservoir, rates of penetration were maintained at approximately 20 m/hr. As the argillaceous content of the formation increased over the top 15m, drilled gas increased from 0.5% to 2.0%. By 3250 mBRT gas levels were below 1.0% and continued so for the remainder of the drilling. Alkanes up to nC_5 were recorded throughout the Nise. Due to weather, the bit was pulled at 3351 mBRT. On running back in hole to resume drilling, a trip gas of 11.9% was recorded. Below this depth connection gas was observed on every connection. Flow was reported on a connection at 3497 mBRT, the well was shut-in and mudweight was increased from 1.33sg to 1.35sg. Drilling continued with connection gases to 3650 mBRT where the well was TD'd. Average drilled gas was 0.6%, with connection gases averaging 1.0%.

3 PORE PRESSURE AND FRACTURE GRADIENT

The pore pressure in the Havsule well has been evaluated by both Knowledge Systems Inc. and by BP. These two evaluations are presented here as Interpretation 1 and Interpretation 2. The most significant differences in the two interpretations occur in the bottom 700m of the well. Due to the absence of drect measurements (eg MDT pressure points) it is not clear at present which interpretation is most realistic.

3.1 INTERPRETATION 1

3.1.1 Introduction

Realtime pore pressure evaluation was performed at the wellsite by Knowledge Systems Inc. For a detailed review see report '**Final Report - Realtime Geopressure Monitoring While Drilling - from DrillWorks/SERVICES'**, E. Doyle, 2002.

DxC Exponent, LWD, formation gases, drilling parameters and hole conditions were reviewed to provide information on formation pressure variations while drilling. Post well analysis has been carried out using wireline logs to refine the pore pressure estimation.

3.1.2 Nordland Group

A 12 ¼" pilot hole was drilled from seabed to 2195 mBRT and a normal compaction trend was established using the DxC Exponent, LWD resistivity, ECD and torque. Hole conditions were good and no evidence for hole instability were observed.

A 42 x 36" hole opening assembly was used to re-spud the well 27m to the north-north west of the original location after a subsea marker buoy was accidentally dropped into the original pilot hole. A 26" assembly was used to drill from the 30" conductor shoe to 2175 mBRT using seawater with hi-vis sweeps. No signs of abnormal pore pressure were reported. After circulating the hole clean and pulling to 1870 mBRT bubbles were seen flowing from the wellhead. Drillpipe was run to bottom and the hole displaced to 1.20sg mud after which the hole was static. Analysis of the PWD log from the 12 ¼" pilot hole indicated that the equivalent circulating density of the drilling fluid was 1.07sg. Once the hole was circulated clean and displaced to seawater, gas from the formation was able to enter the wellbore and migrate to surface.

Towards the base of the Nordland Group pore pressure had risen to slightly above normal as evidenced by the shallow water flow at the base of the 26" hole.

3.1.3 Hordaland Group

The top of the Hordaland Group is corresponds to the base of the Naust Formation. A 20" casing was run and cemented and a leak-off value of 1.37sg was obtained.

On penetration of the Hordaland Group, there is a marked cut back in resistivity from 2 to 1 ohm.ms and drilled gas increases to over 1%. Resistivity and gas remain stable suggesting pore pressure was increasing slowly with depth, reaching 1.05sg at 2312 mBRT. Below this depth resistivity decreases and gas remains high indicating that pore pressure was rising more rapidly. By 2449 mBRT pore pressure had risen to 1.15sg and was 0.03sg above the pre-drill maximum anticipated pressure for this depth. Not having the required kick tolerance to drill ahead, the decision was made to run 13 3/8" casing.

After delays setting the 13 3/8" casing, mud weight was increased to 1.25sg and a leak-off value of 1.38sg was obtained. Pore pressure continued to increase and had risen to 1.22sg at the base of the Hordaland Group.

3.1.4 Rogaland Group

Evaluation of the available data indicates that pore pressure had increased to 1.25sg by 2600 mBRT and this level was maintained through the rest of the Rogaland Group.

Connection gases were seen suggesting that the pore pressure was close to balance. Mudweight was increased to 1.30sg and an open hole leak-off was attempted in an effort to improve the kick tolerance to allow drilling into the K90 reservoir target. A value of 1.38sg was again achieved, this gave a maximum allowable pore pressure at the top of the predicted K90 reservoir of 1.27sg. However, as the maximum predicted gas-case value at top K90 was 1.31sg, the decision was made to run 9 5/8" liner. The opportunity was taken to run a Supercombo logging tool to acquire data in the 12 ¼" open hole.

After setting and cementing the casing at leak-off test was performed to 1.47sg with 1.33sg mud. Drilling commenced and pore pressure remained at 1.25sg to the base of the Rogaland Group.

3.1.5 Shetland Group

On penetration of the Shetland Group drilled gas increased from 0.1% to over 2.0%. This corresponds to an increase in the argillaceous content and therefore effective porosity of the lithology and is not thought to be pressure related. Pore pressure remained stable at approximately 1.25sg.

Both DxC Exponent and resistivity logs suggested that pore pressure had increased to 1.28sg by 3200mBRT. The uppermost 250m of the Nise Formation consist of a series of silty mudstones and siltstones, with drilled gas upto 2.4%. However, from drilling parameters and LWD logs pore pressure was interpreted to have fallen to 1.24sg at 3330 mBRT.

The bit was pulled at 3351 mBRT and the rig waited on weather for several days. On running back to bottom a trip gas of 11.9% was recorded. Connection gases were observed on every connection below this depth and possible flow was reported from a connection 3497 mBRT. Pore pressure was interpreted to have increased to 1.29sg at 3500 mBRT, and continued to increase reaching 1.32sg at the well TD.

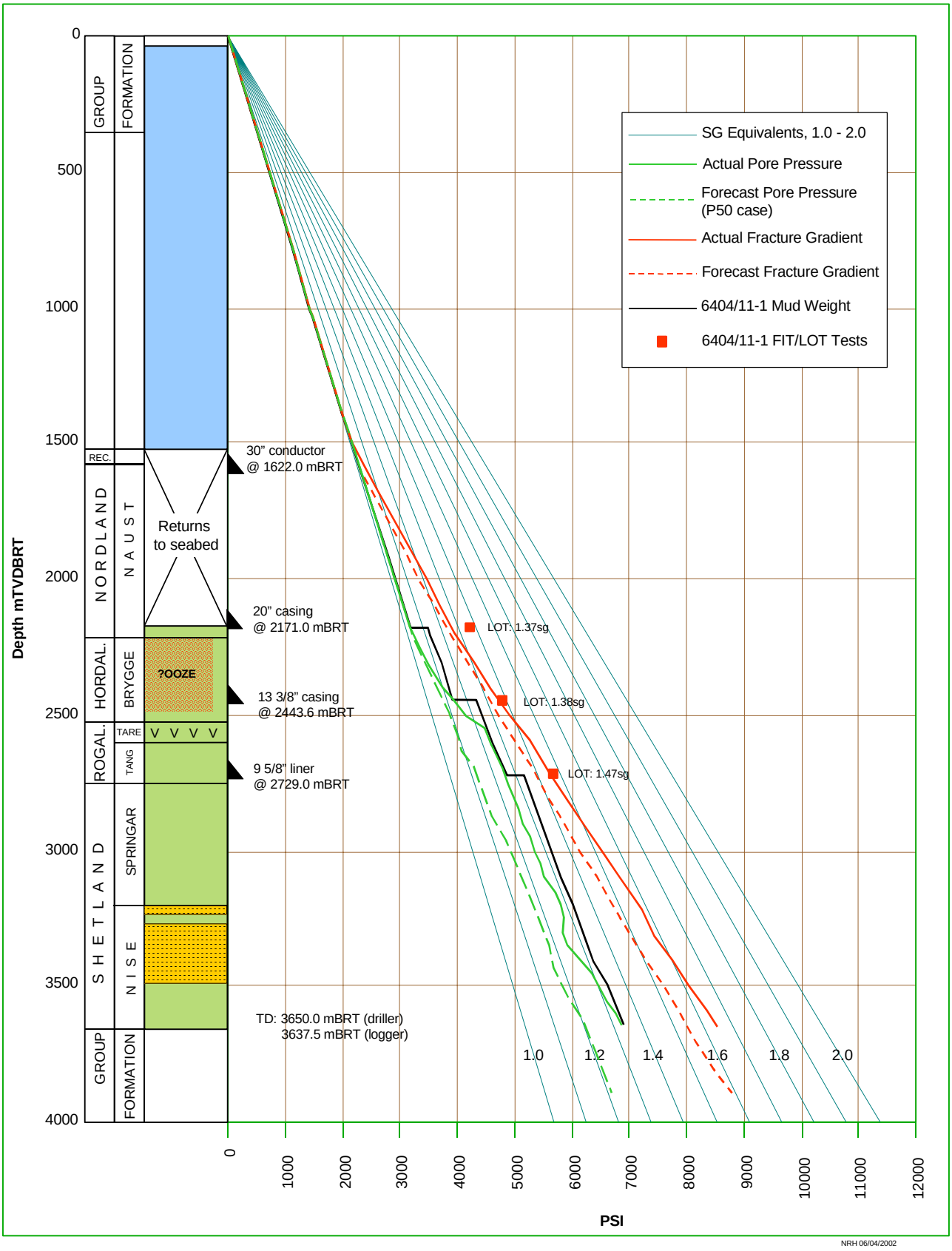

Figure 5: Formation Pressure Evaluation

3.2 INTERPRETATION 2

3.2.1 Introduction

A review of the drilling parameters used for pore pressure evaluation during drilling supports the wellsite interpretation. The offshore pore pressure evaluation was to a large degree based on the d'exponent and the gas recorded in drilling mud. However with our access to the sonic and density log an alternative evaluation is presented first using the PresGraf software. This suggests that the pore pressure gradient is decreasing from 10.4 ppg (1.25 sg) at 2730 m (as reported by Eamonn Doyle with KSI) to a bit less than 10 ppg (1.20 sg) at TD fig.6).

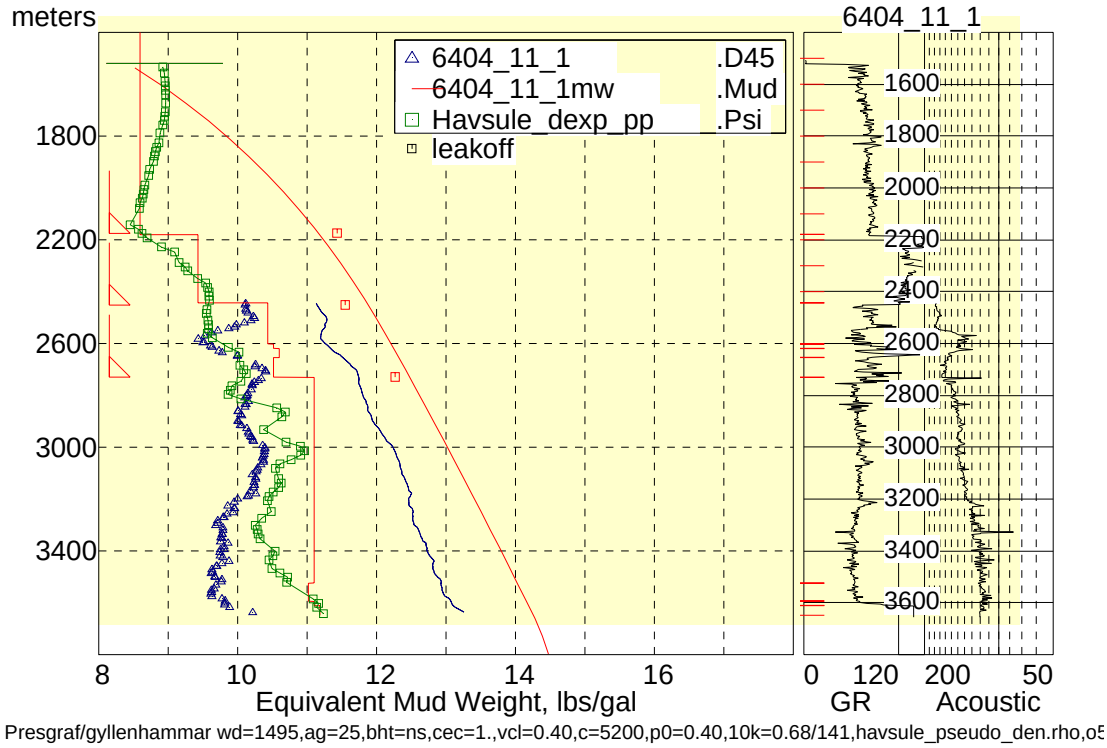

Figure 6. PresGraf plot of the pore pressure gradient profile. The D45 curve is the pore pressure gradient calculated from the shale velocity using the PresGraf New compaction trend.

3.2.2 Discussion

The following review of the drilling parameters is with the emphasis on the last few hundred meters drilled, from 3000 meters to TD.

The d'exponent shows a gradual increase with depth down to 3500 meters. This increase is less than the normal trend chosen by Eamonn. He followed a standard procedure of shifting the trend for each bit run. These shifts should ideally be parallel shifts so that the slope is kept constant. Figure 7 show the d'exp for the whole well and one can see that the upper 700 meters follow a rather steep trend. Calculating the pore pressure using the Eaton equation with parallel trend lines illustrated as normal trend 2, 3 and 4 suggests a sharp increase in pore pressure gradient, then a drop back and then an increase again. To make a smother curve, the trend was shifted parallel as well as the slope was shifted. An alternative is shown here, the normal trend 1 being adopted from the Caspian Sea. The pore pressure calculated appears reasonable. Figure 7 shows that the general slow increase in pore pressure gradient from 3000 meters down to TD is not supported by the shale velocity and not by the d'exp with the alternative normal trend. But the d'exp does show a decreasing trend from 3500 meters to TD. This is not supported by the sonic log. The gas data are inconclusive. From 2900 meters down to TD the background gas drops from 1% to 0.7% (fig. 9a and b). The gas picks on figure 9b are all but one less than 2%.

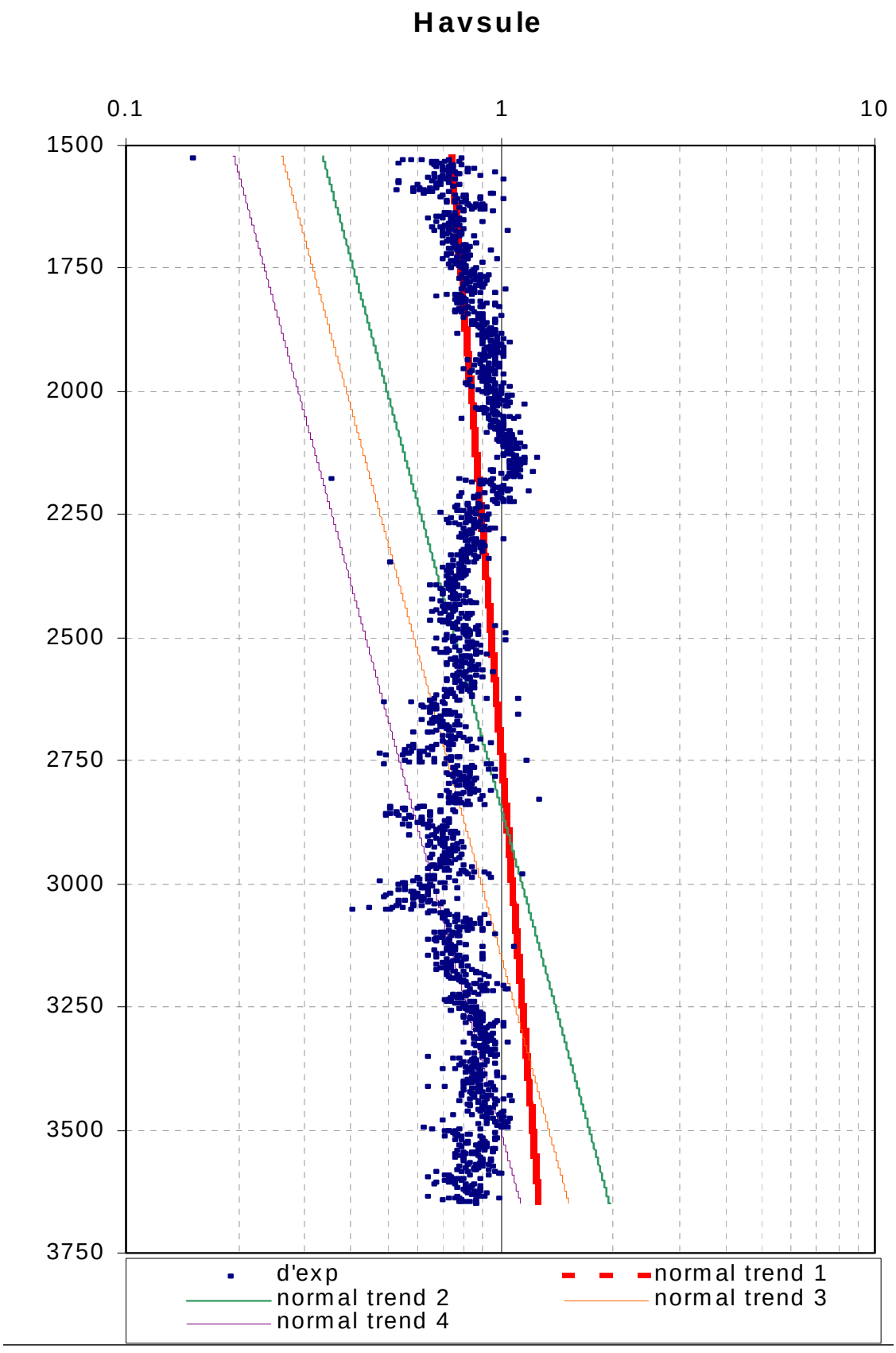

Figure 7. The d'exponent with four normal trend lines.

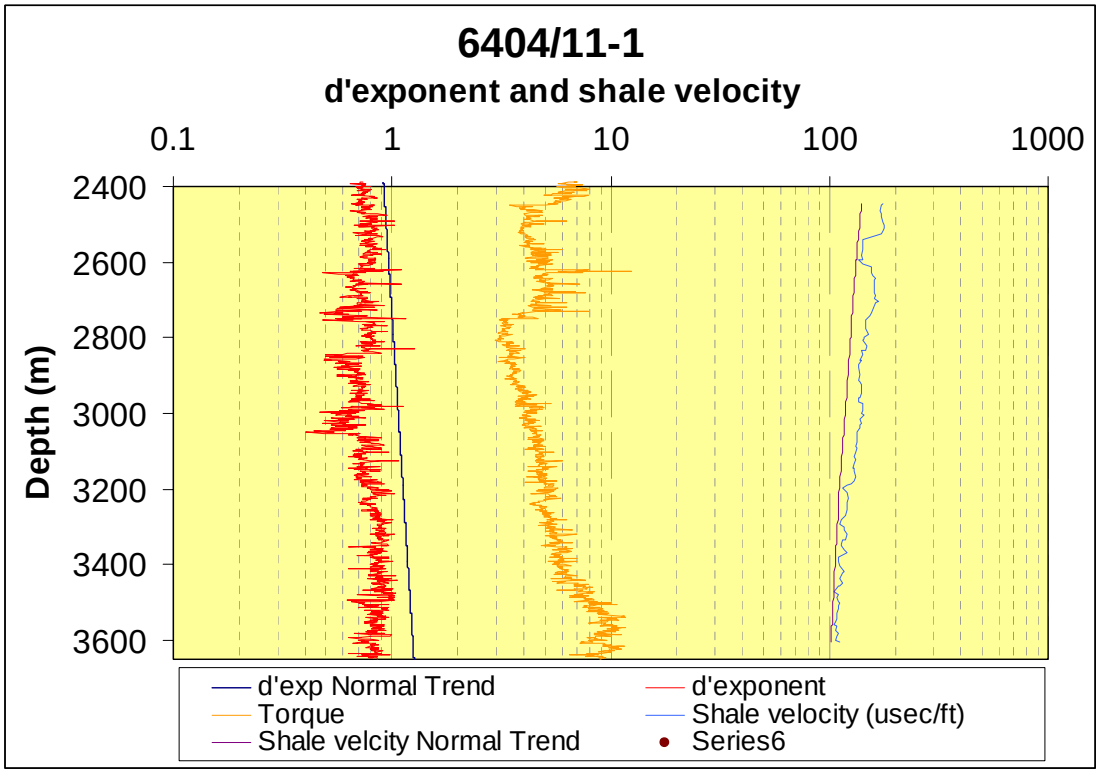

Figure 8. From left to right, d'exponent, d'exp normal trend, torque, dt normal trend and the shale sonic velocity.

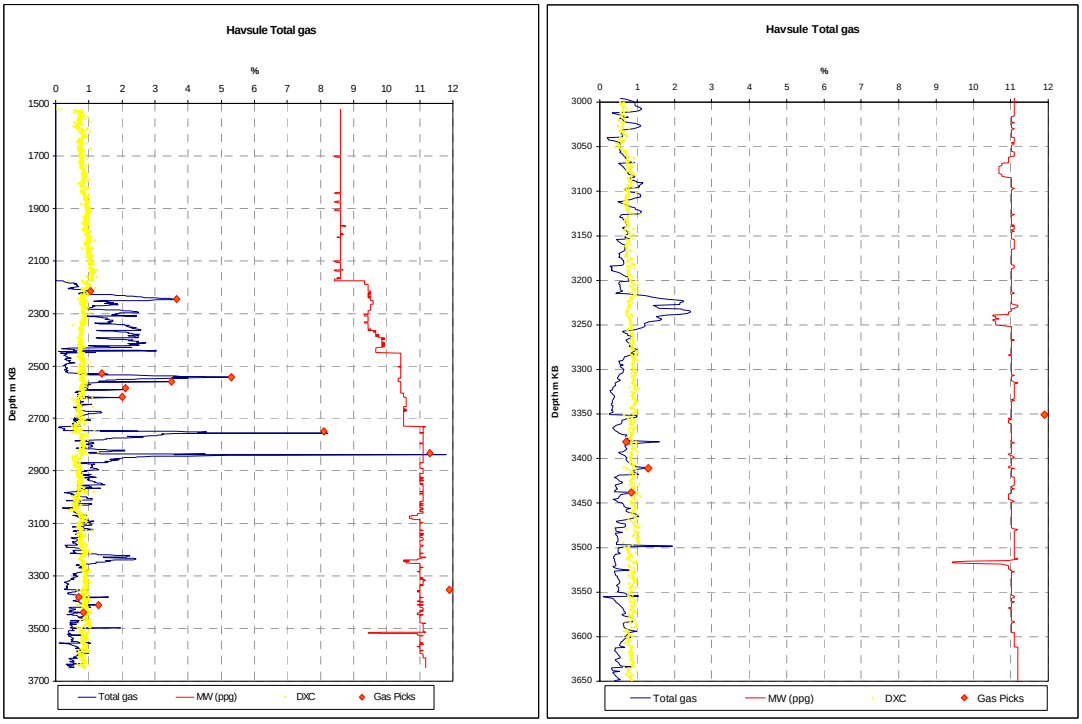

Figure 9a and b. The total gas to the left and the recorded gas picks as red diamonds.

As the d'exponent appears to be the only pore pressure indicator supporting a potential increase in the pore pressure gradient from 3500 meters to TD one may look for alternative explanations to increased drilling performance.

4 FORMATION EVALUATION

4.1 LWD LOGGING

4.1.1 Summary

Bit Run No.	LWD Run No.	LWD Tool String	Hole Size ins	Drilled interval mBRT	Drilled interval mBRT	Remarks
1	1	GR/CDR	12 ¼" Pilot Hole	1495.0	2195.0	Realtime and memory GR/CDR data was collected in the pilot hole for pore pressure monitoring, shallow gas evaluation and casing point selection. Both realtime and memory data were of good quality and no tool failures were experienced.
2	-		42 x 36"	1495.0	1629.5	Hole opening assembly. LWD not required in this hole section. Spud marker dropped in hole.
3	-		42 x 36"	1495.0	1628.0	Respud. LWD not required in this hole section.
4	2	MWD	26"	1628.0	2175.0	MWD only. LWD not required in this hole section.
5	3	GR/CDR	17"	2171.0	2449.0	Realtime GR/CDR was recorded in the 17" hole section. Data quality was good and no tool failures were experienced.
6	-		17"	-	-	Wiper/check trip
7	-		12 ¼"	-	-	13 3/8" wellhead clean out run
8	-		-	-	-	Lead impression tool.
9	4	GVR8/GR/CDR	12 ¼"	2449.0	2730.0	There was a critical requirement to have working resistivity and gamma tools to identify top reservoir. GRV8 (resistivity-at-bit) was run to allow early evaluation of the top reservoir to facilitate the coring decision. Rate of penetration was held to below 20 m/hr to enable the collection of good realtime data while drilling. The shallow, T50, target was absent at the well location and drilling continued toward the deeper, K90, level. At 2370 mBRT, drilling was halted due to concerns over increasing pore pressure.
Bit	**LWD**	**Tool String**	**Hole**	**Drilled interval**		**Remarks**

Run No.	Run No.		Size ins	mBRT	mBRT	
						Both realtime and memory data were of good quality, no tool failures were experienced.
10	-		12 ¼"	-	-	Wiper/check trip
11	-		12 ¼"	-	-	BOP test tool
12	-		12 ¼"	-	-	Wiper/check trip
13	5	ARC-5 / GR	8 ½"	2730.0	3650.0	There was a critical requirement for a working LWD tool to identify top K90 and K80 reservoirs in the 8 ½" hole. Realtime gamma readings were approximately twice as high as the anticipated levels and, as a precaution, the interval 2732 – 2748mBRT was re-logged to confirm that the tool was operating correctly. The re-logged interval confirmed that general trends were adequate for decision-making. No reservoir sands were penetrated in the 8 ½" hole and the tool was pulled at section TD at 3650mBRT. Memory data was downloaded, gamma ray memory values conformed to those expected in this section. On investigation, an error in configuring the tool was found to be the cause of the high gamma values.

4.2 WIRELINE LOGGING

4.2.1 Summary

Run No.	Date	Tool String	Hole Size ins	Logged interval		Max Temp °C	Time since circ. (hrs:min)	Opr time (hrs:min)	Lost time (hrs:min)	Remarks
				mBRT	mBRT					
1A1	01/02/02	Pex / HRLA / EMS / DSI / SP	12 ¼"	2718.5	2440.0	36	17:20	14:30	0:00	Last circulation on bottom 31/01/02 @ 20:40 hrs. Tool hung-up at 2718.5 mBRT, unable to reach hole TD of 2730 mBRT due to limestone ledge. GR to surface (1449mBRT) DSI to 2071mBRT
2A1	21/02/02	VSP/GR	8 ½"	3645.0	1700.0	80	20:20	17:40	0:00	Last circulation on bottom 20/02/02 @ 08:00 hrs. Shear pin on compensator line failed. Computer and telemetry problems encountered.
2B1	21/02/02	Pex / NGS / HRLA / DSI / SP / EMS	8 ½"	3640.5	2649.8	86	37:30	10:00	0:00	SP failed - no SP data acquired. Wireline TD at 3637.5mMD.
2C1	22/02/02	MSCT / GR	8 ½"	3593.0	2739.5	87	48:30	11:25	0:00	Cut 27, recovered 26.

4.3 SIDEWALL CORES

4.3.1 Summary

Well Number:		**6404/11-1**	**Date:**	**22-02-2002**						
Logging Witness:		**Ian Clement / Alex McNab**								
Logged Interval:		**2739.5 – 3593.2 m**	**Hole size:**	**8 ½"**						
Attempted:		**27**	**Recovered**	**26**						
Plug Depth (mMD)	**Plug Length (cm)**	**Lithology and Shows**		**Ø**			**Shows**			
				P	**F**	**G**	**T**	**P**	**F**	**G**
3593.2	4.5	Dark grey **MUDSTONE**, firm to moderately hard, occasional glauconite nodules, silty in part, micromicaceous, locally grading to silty mudstone, interbedded with light grey **SILTSTONE** to very fine **SANDSTONE** flasers and flares on a mm scale, dominately colourless clear quartz, sub angular to angular, well sorted, sub spherical, rare smokey quartz, occasional glauconite nodules, possible white to light brown feldspar, argillaceous matrix in part, well cemented, no visible porosity.								
3577.4	4.75	Dark grey **MUDSTONE** with rare lenses and flares of grey brown **SILTSTONE**, firm to moderately hard, occasional glauconite, no visible porosity.								
3558.5	4.8	Dark grey **MUDSTONE**, dominantly homogenous with very rare microlaminations of moderate grey to grey brown argillaceous **SILTSTONE** firm to moderately hard, rare micromica.								
3487.8	4.8	Dominantly medium grey brown sandy **SILTSTONE** with rare dark grey argillaceous flares and lenses of dark grey **MUDSTONE**. **SILTSTONE** moderately grey brown grading to very fine sandstone predominately silty to very fine quartz grains, sub angular to sub spherical, well sorted, glauconite, micromicaceous, well cemented in part, no visible porosity.								
3462.6	4.7	Predominately dark grey **MUDSTONE** with discontinuous lenses and flares of grey brown to medium grey, firm to moderately hard **SILTSTONE**, grading to very fine dark grey quartz **SANDSTONE**, firm to moderately hard, cemented, silty, micromicaceous, locally abundant glauconite, no visible porosity.								
3449.5	5.0	Medium grey **SILTSTONE** firm to moderately hard, well cemented, grading to very fine **SANDSTONE** in part, moderately well sorted, sub angular to dominantly angular, sub spherical, micromicaceous, glauconitic, with dark grey **MUDSTONE** laminations and lenses, no visible porosity								

Well Number:	6404/11-1	Date:	22-02-2002
Logging Witness:	Ian Clement / Alex McNab		
Logged Interval:	2739.5 – 3593.2 m	Hole size:	8 ½"
Attempted:	27	Recovered	26

Plug Depth (mMD)	Plug Length (cm)	Lithology and Shows	Ø			Shows			
			P	F	G	T	P	F	G
3442.5	5.0	Medium grey to off white **SANDSTONE** dominantly very fine quartz with rare fine grains, sub angular to angular, sub spherical, dominantly well sorted, locally moderately sorted, firm to moderately hard, cemented, locally abundant glauconite, micromicaceous in part with rare dark mica, none to very poor visible porosity, rare discontinuous lenses of dark grey **MUDSTONE**.	X						
3425.7	3.4	Medium grey to off white **SANDSTONE** dominantly very fine quartz with rare fine grains, sub angular to angular, sub spherical, dominantly well sorted, locally moderately sorted, firm to moderately hard, cemented, locally abundant glauconite, micromicaceous in part with rare dark mica, grades to **SILTSTONE** in part, no visible porosity, rare discontinuous lenses of dark grey **MUDSTONE**.							
3407.4	4.8	Dark grey **MUDSTONE** interbedded with medium grey to grey brown **SILTSTONE** as discontinous lenses and flares. **SILTSTONE** grading to very fine **SANDSTONE** in part, sub angular, sub spherical, well sorted, moderately well cemented quartz grains, no visible porosity.							
3379.1	4.7	Medium grey to grey brown **SANDSTONE** to **SILTSTONE** silty to very fine quartz, sub angular to angular, sub spherical, well sorted, micromicaceous, glauconite, moderately well cemented, rare areas of poor visible porosity. Discontinuous lenses and laminations of dark grey **MUDSTONE**. Trace of gas bubbles on core surface.	X			X			
3329.0	4.9	Dominantly dark grey, firm to moderately hard **MUDSTONE** with flares and lenses of grey brown **SILTSTONE** grading to very fine **SANDSTONE**, medium grey in part, predominately silty to very fine quartz, sub angular, sub spherical, moderately well sorted, abundant glauconite, micromicaceous, dark mica, well cemented, argillaceous matrix in part, no visible porosity.							
3296.1	4.8	Dominantly grey brown to medium grey **SILTSTONE** grading to very fine SANDSTONE, abundant argillaceous matrix, no visible porosity with lenses and flares of dark grey **MUDSTONE**.							

Logging Witness:		Ian Clement / Alex McNab									
Logged Interval:		2739.5 – 3593.2 m		Hole size:		8 ½"					
Attempted:		27		Recovered		26					
Plug Depth (mMD)	Plug Length (cm)	Lithology and Shows				Ø			Shows		
						P	F	G	T	P	F	G
3284.8	4.8	Interlaminated medium grey to grey brown **SILTSTONE** grading to very fine **SANDSTONE** with flares of dark grey **MUDSTONE**, no visible porosity.									
3277.5	3.7	Interlaminated dark grey **MUDSTONE** with medium grey to grey brown **SILTSTONE** grading to very fine **SANDSTONE**, firm to moderately hard, very fine to silty quartz, sub angular, sub spherical, well cemented, glauconite, micromicaceous, abundant argillaceous matrix, no visible porosity.									
3252.0	4.8	Dominantly medium grey to grey brown **SILTSTONE** grading to very fine **SANDSTONE** with flares and lenses of dark grey firm to moderately hard **MUDSTONE**. SILTSTONE grading to very fine **SANDSTONE** medium grey to grey brown, silty to very fine quartz, sub angular to angular, sub spherical, well to moderately well sorted, rare glauconite, micromicaceous in part, moderate to well cemented, rare poor to no visible porosity.				X					
3241.3	5.0	Grey brown **SILTSTONE**, micromicaceous, locally glauconite nodules, rare very fine quartz grains, sub angular to angular, sub spherical, moderately well sorted, argillaceous matrix, interlaminations of dark grey silty **MUDSTONE**.									
3238.1	4.8	Grey brown to medium dark grey **SILTY MUDSTONE** with lenses of dark grey **MUDSTONE**, firm to moderately hard, abundant mica, rare glauconite nodule, very rare silty quartz grains.									
3208.7	3.3	Dark grey to grey black **MUDSTONE**, homogenous, firm to moderately hard, slightly fissile, micromicaceous, grading to **SHALE**.									
3205.9		LOST									
Well Number:		6404/11-1		Date:		22-02-2002					
Logging Witness:		Ian Clement / Alex McNab									
Logged Interval:		2739.5 – 3593.2 m		Hole size:		8 ½"					

Attempted:		27	Recovered	26						
Plug Depth (mMD)	Plug Length (cm)	Lithology and Shows		Ø			Shows			
				P	F	G	T	P	F	G
3313.9	4.8	Dark grey to greyish black **MUDSTONE**, firm to moderately hard, micromicaceous, with rare micro laminations of light to medium grey argillaceous **SILTSTONE**.								
3283.6	4.5	Light to medium grey **SILTSTONE** firm to moderately hard, micromicaceous, argillaceous, very fine quartz grains, with thin dark grey to grayish black **MUDSTONE** laminations.								
3051.0	4.5	Dark grey to grey black **MUDSTONE**, firm to moderately hard, homogenous, micromicaceous, rare silty quartz grains.								
2975.5	4.8	Dark grey to grey black **MUDSTONE**, firm to moderately hard, homogenous, micromicaceous, rare silty quartz grains.								
2826.7	4.7	Dark grey to grey black **MUDSTONE**, soft to firm, micromicaceous, mm glauconite nodules, rare silty quartz grains.								
2776.5	4.7	Medium to dark grey brown, grayish green **MUDSTONE**, firm, fissile, micromicaceous, locally abundant pyrite.								
2745.8	5.0	Medium to dark grey brown, grey green **MUDSTONE**, homogenous, firm, fissile, micromicaceous.								
2739.5	4.5	Dark grey to grayish black **MUDSTONE**, homogenous, firm, micromicaceous, rare silty quartz grains.								

4.4 VSP & CHECKSHOT

4.4.1 Summary

DEPTH	T/TIME	SHOT	FIX	TIME	STACK	FILE	REMARKS
619				02:11		26	Tool evaluation Test
2500	1525.9	59-61	57-61	03:05	1	28	RIH Checkshot
2510	1520.9						
3640	2027.3	64-73	62-73	04:34	2	28	Main VSP
3630	2023.5						
3620	2019.7	74-80	74-80	04:44	3	28	
3610	2016.1						
3600	2021.2	85-91	81-91	04:56	4	28	
3590	2008.5						
3580	2004.6	94-103	92-103	05:07	5	28	
3570	2000.9						
3560	1997.3	104-111	104-111	05:15	6	28	
3550	1993.8						
3540	1989.9	113-121	112-121	05:25	7	28	
3530	1986.3						
3520	1983.3	122-129	122-129	05:33	8	28	
3510	1979.6						
3500	1975.4	131-135	130-135	05:40	9	28	
3490	1971.9						
3480	1968.6	137-141	136-141	05:47	10	28	
3470	1965.1						
3460	1961.7	142-150	142-150	05:55	11	28	
3450	1958.1						
3440	1954.1	152-156	152-156	06:02	12	28	
3430	1950.5						
3420	1946.9	157-161	157-161	06:08	13	28	
3410	1943.8						
3400	1939.3	163-167	162-167	06:14	14	28	
3390	1935.8						
3380	1932.4	168-176	168-176	06:24	15	28	
3370	1928.6						computer crash, reboot
3360	1924.8	171-175	171-175	06:40	15	33	shot numbers??/stack no 15 again??
3350	1921.4						
3340	1916.9	180-185	176-186	06:51	16	33	
3330	1913.3						
3320	1909.1	187-191	187-191	06:58	17	33	
3310	1905.3						
3300	1901.6	193-197	192-197	07:05	18	33	
3290	1897.6						
3280	1893.8	198-202	198-202	07:11	19	33	
3270	1889.9						
3260	1885.5	203-207	203-207	07:18	20	33	
3250	1881.5						
3240	1877.3	208-212	208-212	07:24	21	33	
3230	1873.1						
3220	1868.8	216-221	214-221	07:31	22	33	
3210	1864.8						
3200	1860.4	222-226	222-226	07:37	23	33	

DEPTH	T/TIME	SHOT	FIX	TIME	STACK	FILE	REMARKS
3190	1856.2						
3180	1852.1	230-234	227-234	07:45	24	33	
3170	1847.7						
3160	1843.1	235-241	235-241	07:52	25	33	
3150	1838.8						
3140	1834.9	242-247	242-247	07:58	26	33	
3130	1830.5						
3120	1825.7	248-252	248-252	08:04	27	33	
3110	1821.3						
3100	1817.2	253-257	253-257	08:10	28	33	
3090	1812.9						
3080	1808.2	263-267	258-267	08:18	29	33	
3070	1804.3						
3060	1799.8	268-272	268-272	08:24	30	33	
3050	1795.3						
3040	1790.3	274-278	273-278	08:35	31	33	
3030	1785.8						
3020	1780.2	286-293	279-293	08:47	32	33	Poor coupling
3010	1776.2						
3000	1771.7	297-301	294-301	08:55	33	33	
2990	1767.1						
2980	1762.2	302-306	302-306	09:02	34	33	
2970	1757.6						
2960	1753.6	307-314	307-314	09:12	35	33	
2950	1748.8						
2940	1744.0	317-321	317-321	09:21	36	33	
2930	1739.3						
2920	1735.1	322-327	323-327	09:31	37	33	
2910	1730.5						
2900	1725.9	328-334	330-334	09:41	38	33	
2890	1721.3						
2880	1715.4	335-340	336-340	09:49	39	33	
2870	1710.9						
2860	1706.4	341-347	341-347	09:58	40	33	
2850	1701.5						
2840	1696.2	348-357	352-357	10:13	41	33	
2830	1692.0						
2820	1686.9	358-363	359-363	10:26	42	36	Telemetry errors
2810	1682.0						
2800	1677.1	364-369	365-369	10:33	43	36	
2790	1672.2						
2780	1667.6	370-374	370-374	10:40	44	36	
2770	1662.9						
2760	1657.5	380-384	375-384	10:48	45	36	
2750	1652.6						
2740	1646.8	386-390	381-390	10:57	46	36	
2730	1642.1						
2720	1636.4	393-397	392-397	11:36	47	38	Computer crash, re-boot
2710	1631.3						
2700	1625.8	398-402	398-402	11:43	48	38	
2690	1620.5						
2680	1615.5	403-408	404-408	11:51	49	38	
2670	1610.4						
2660	1605.1	409-416	410-416	11:59	50	38	

DEPTH	T/TIME	SHOT	FIX	TIME	STACK	FILE	REMARKS
2650	1600.0						
2640	1595.2	417-421	417-421	12:14	51	38	
2630	1590.2						
2620	1586.0	422-426	422-426	12:22	52	38	
2610	1581.4						
2600	1577.0	427-431	427-431	12:28	53	38	
2590	1572.5						
2580	1568.0	433-437	432-437	12:35	54	38	
2570	1563.3						
2560	1558.4	438-442	438-442	12:40	55	38	
2550	1553.4						
2540	1549.3	443-447	443-447	12:46	56	38	
2530	1542.9						
2520	1535.2	448-452	448-452	12:51	57	38	
2510	1529.5						
2500	1523.9	453-457	453-457	12:57	58	38	
2490	1518.5						
2480	1512.4	458-462	458-462	13:03	59	38	
2470	1506.7						
2460	1502.3	463-467	463-467	13:09	60	38	
2450	1496.5						
2440	1489.4	468-472	468-472	13:15	61	38	
2430	1483.7						
2420	1476.9	473-477	473-477	13:21	62	38	
2410	1471.4						
2400	1466.8	478-482	478-482	13:27	63	38	
2390	1461.2						
2380	1455.3	483-487	483-487	13:34	64	38	
2370	1449.6						
2360	1444.5	488-492	488-492	13:40	65	38	
2350	1438.9						
2340	1432.4	493-497	493-497	13:46	66	38	
2330	1426.9						
2320	1422.3	498-502	498-502	13:52	67	38	
2310	1417.0						
2300	1410.6	503-507	503-507	14:07	68	38	
2290	1405.6						
							Broke compensator weak link
2200	1358.8	509-511	509-511	14:47	69	40	Checkshot
2180	1354.7						
2100	1316.1	512-514	512-514	14:56	70	40	
2080	1313.9						
2000	1256.5	515-520	516-520	15:05	71	40	CASING ARRIVAL
1990	1256.0						
1900	1202.4	522-524	521-524	15:12	72	40	CASING ARRIVAL
1890	1200.8						
1800	1137.9	525-527	525-527	15:20	73	40	CASING ARRIVAL
1790	1128.0						
1700	1100.3	528-530	528-530	15:27	74	40	POOH
1690	1095.9						

4.4.2 Depth v Transit Time Plot

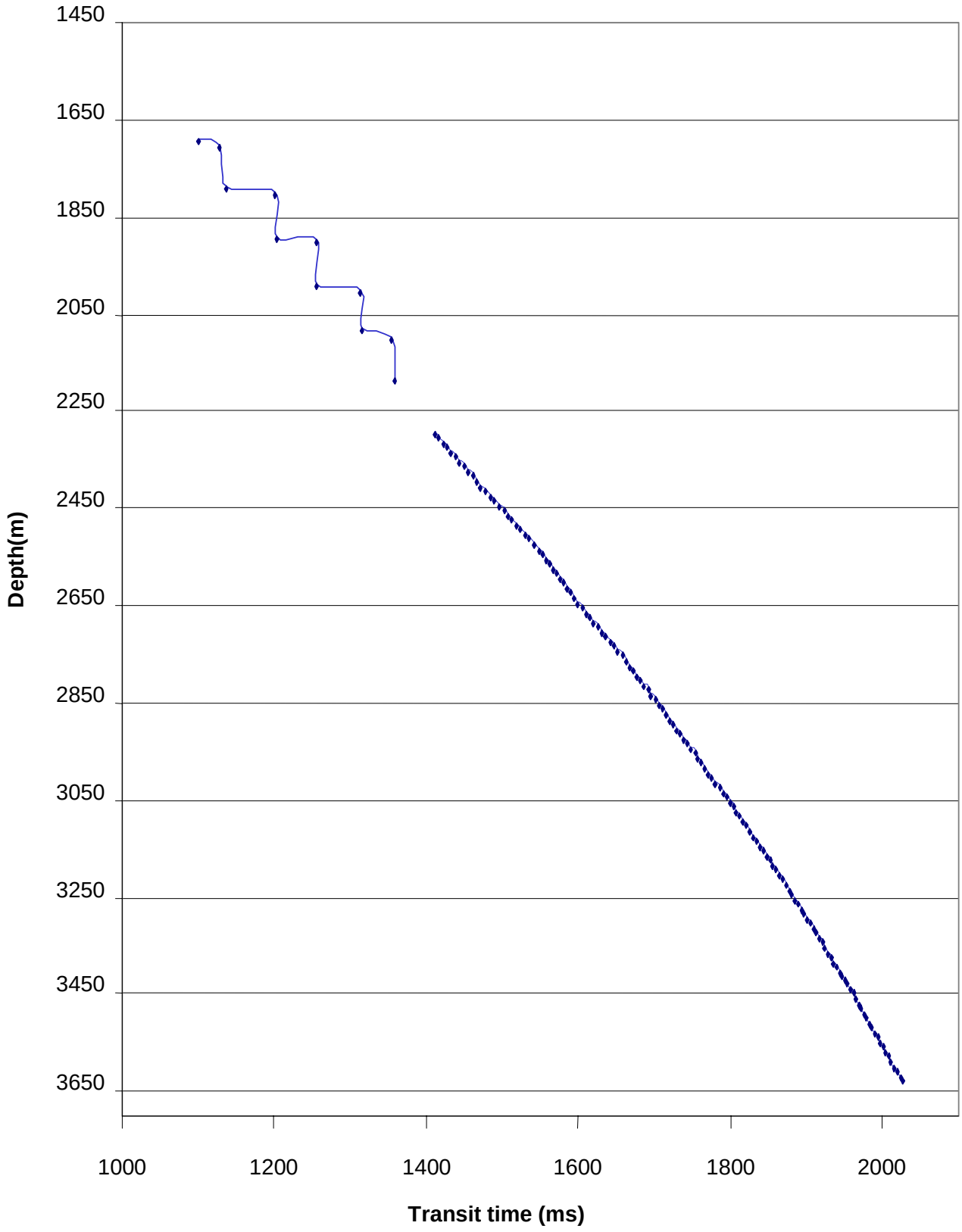

Figure 6: Depth v Transit Time

4.5 MDT DATA

4.5.1 Pressure Test Summary

No MDT tests were performed in this well.

4.5.2 Fluid Sampling Summary

No MDT samples were obtained from the well.

4.6 DST DATA

4.6.1 Summary

No drill stem tests were conducted in the well.

4.7 WIRELINE OPERATIONS SUMMARY

- Rapid mobilization of Supercombo for logging 12 ¼" hole. Some problems with tool telemetry while rigging up quickly mitigated by Schlumberger crew. Logging commenced from 2718.5 mBRT as tool couldn't reach bottom due to hanging up on limestone ledge.
- Computer and telemetry problems on VSP run
- Shear pin on rig compensator line failed
- SP log not acquired during 8 ½" Pex run
- No downtime
- Good hole conditions – no tool sticking
- Excellent pre-job planning
- Lead wireline engineer highly experienced and very competent. Involved in planning phase, built the logging programme. Motivated crew to perform to a high level.

4.8 CUTTINGS SAMPLING PROGRAMME

4.8.1 Mudlogging Programme

Hole Section		Depth Interval (mBRT)	Frequency	Description
12 ¼" Pilot Hole	42x36"	1520 1628		No samples required
	26"	1628 2175	Every connection	Samples collected by ROV. See table 4.8.2
17"		2175 2449	10m	**Wet Samples:** 1 x 5 litre bulk per sample depth
			10m	**Dry Samples:** 1 x 250g per sample depth
			30m	**Geochemistry:** 2 x 1 litre tin per sample depth
			Start, end of section	**Mud Samples:** 2 x 1 litre mud sample
12 ¼"		2449 2730	3m	**Wet Samples:** 1 x 5 litre bulk per sample depth
			3m	**Dry Samples:** 1 x 250g per sample depth
			30m	**Geochemistry:** 2 x 1 litre tin per sample depth
			Start, end of section	**Mud Samples:** 2 x 1 litre mud sample
8 ½"		2730 3650	3m	**Wet Samples:** 1 x 5 litre bulk per sample depth
			3m	**Dry Samples:** 1 x 250g per sample depth
			30m	**Geochemistry:** 2 x 1 litre tin per sample depth
			Start, end of section	**Mud Samples:** 2 x 1 litre mud sample

4.8.2 ROV Samples

Samples collected by ROV.

Sample Number	Depth (mBRT)	Lag depth (mBRT)	Comment
1	1637	1634 – 1652	Empty
2	1652	1652 – 1677	Empty
3	1681	1677 – 1704	Empty
4	1710	1704 – 1731	Skipped sample (poor visibility)
5	1739	1731 – 1764	Lost sample pod
6	1768	1764 – 1792	Empty
7	1797	1792 – 1816	Empty
8	1826	1816 – 1836	Lost sample pod
9	1852	1836 – 1860	Empty
10	1881	1860 – 1892	Skipped sample (poor visibility)
11	1909	1892 – 1922	Empty
12	1938	1922 – 1942	Empty
13	1966	1942 – 1989	Empty
14	1995	1989 – 2000	Empty
15	2024	2000 – 2026	Empty
16	2052	2026 – 2052	Sample collected from cuttings pile around conductor
17	2081	2052 – 2088	Skipped sample (poor visibility)
18	2110	2088 – 2129	Skipped sample (poor visibility)
19	2140	2129 – 2153	Empty
20	2167	2153 – 2175	Empty
21	2175		Sample collected from cuttings pile around conductor
22	2175		Empty
23	2175		Sample collected from cuttings pile around conductor
24	2175		Sample collected from cuttings pile around conductor

4.8.3 Gas Samples

Hole Section	Depth (mBRT)	Gas peak (%)	Background Gas (%)	Description
17” section	2214 2238 2440	1.0% 2.6% 3.0%	0.6% 0.6% 1.3%	1 x 1 litre samples collected in Teflon bags per sample depth
12 ¼” section	2730	3.2%	0.7%	1 x 1 litre samples collected in Teflon bags per sample depth
8 ½” section	2747 2748 2751 2838 3235 3351	2.5% 2.7% 4.4% 1.8% 2.4% 9.8%	0.1 – 0.4% 0.1 – 0.4% 1.2 – 3.0% 0.5 – 0.9% 0.25 – 0.6% 0.25 – 0.6%	1 x 1 litre samples collected in Teflon bags per sample depth

REFERENCES

6404/11-1 Drilling Programme	BP Amoco Norge AS, September 2001
6404/11-1 Data Acquisition Plan	BP Amoco Norge AS, August 2001
Shallow Geoharzard Assessment	BP, May 2001
A lithostratigraphic scheme for the Mesozoic and Cenozoic succession offshore mid- and northern Norway	NPD Bulletin No. 4, Edited by A. Dalland, D. Worsley, and K. Ofstad

APPENDIX 1: WIRELINE OPERATIONS ACTIVITY SUMMARY

Run Number	Time/Date	Comments/Activities
	01/02/02	
	01:00	Tools lifted onboard from Far Swan.
	03:00	Tools lifted to Catwalk.
1A1	**01/02/02**	**PEX-HRLA-EMS-DSI-SP**
	06:00	Tool Box talk on drill floor
	06:15	Rigged up compensator and sheaves.
	06:45	Handover, started to rig up tools.
	09:00	Toolstring rigged up. Checked toolstring.
	09:15	Changed EMS position to under HRLA
	09:30	Started before calibrations
	10:00	Standby for drillfloor work.
	10:15	Continued calibrations and prejob checks.
	10:50	Held safety meeting regarding loading of radioactive sources in Doghouse.
	11:20	Loaded radioactive sources
	11:40	RIH.
	11:55	Compensator on. Checked surface rig up length 74.5m (L1)
	12:00	At 370m, hoses rubbing wireline. Wait while hoses are tied back.
	12:30	Continued to RIH
	13:05	At BOP's continued to RIH.
	13:30	At 2400m. RIH and checked Surface rig up length (74.4m - +0.1m correction). Took up and down weights (2800lbs up, 3200lbs down - stretch correction +0.6m. Tide correction of –1.2m.
	13:35	Pull back into shoe.
	13:40	At 2420m. Start down log (3500 ft/hr).
	13:45	At shoe (depth 2440m).
	14:00	Slowed logging speed as approached bottom. Tagged bottom early at 2718.5m. Pulled up to 2713m and RIH to check TD stood up at same depth (possibly standing up on a Limestone ledge off bottom).
	14:05	Slacked off to 2722m and picked up slowly, opened callipers and started main log (1750 ft/hr).
	14:45	At shoe, calibrate callipers to casing ID (12.347"). Check depth (+0.2m correction).
	14:55	RIH to 2670m for repeat section, while replaying mainlog on depth.
	15:30	At 2670m, pull up slowly while opened callipers and start repeat section.
	15:55	At 2530m, stopped repeat section. Continued to POOH to shoe.
	16:00	At 2500m. Start logging up with GR and DSI in casing.
	16:15	At shoe continued up log at 1750 ft/hr. Cement not good at shoe, better 2425 to 2405m and 2315 to 2285m. Change in character at 2220m.
	17:08	Stop log at 2071m. RIH to 2150m.
	17:12	Log up with GR only at 3500 ft/hr to surface at 1499m.
	17:45	At BOP's
	17:50	Tools through BOP's increase speed and POOH to suface.
	18:40	Out of hole. (Maximum Temp 2x36°C, 1 failed).
	18:55	Unloading Radioactive sources complete, performed after calibrations.
	19:25	After calibrations completed. Started rigging down
	20:30	Rig down complete floor to Saipem.
		Total time run 1A1 = 14 hours 30 minutes
2A1	**21/02/02**	**VSP - GR**

Run Number	Time/Date	Comments/Activities
	00:05	Safety meeting with drill crew on drill floor.
	00:20	Start rigging up compensator and sheaves.
	00:45	Pick up tools.
	00:55	Check tool telemetry.
	01:15	Function test arms.
	01:20	RIH to 100m.
	01:25	Move air hoist cable away from sheaves in derrick and charge compensator.
	01:45	Compensator on. Check rig up length L1 = 75.8m
	01:50	RIH to 620m.
	02:00	Tool evaluation tests.
	02:15	RIH
	02:35	1556m start gamma down log. Test guns and adjust tuning to 70 msec
	02:50	2500m check-shot. Fine tune hydrophones.
	03:05	RIH to 2628m. Check rig up length. L2 = 75.4m (+0.4m)
		-1.0m deep on gamma correlation to PEX log for 12 ¼" hole.
	03:20	In open hole.
		2744m hanging up, pull back into shoe and run down at 10,00m/hr to get through, continue RIH.
	03:50	3320m hanging up.
		3335m hanging up.
		3343m hanging up.
		Loss of tension builds slowly suggesting accumulated drag rather than ledges.
	04:00	RIH OK at 6000m/hr.
		3440m hanging up, pick up, no sticking.
	04:05	3600m, do tensions, Down 2300 lbs, Up 3200 lbs, +1.45 stretch correction.
		L1-L2 = +0.4m, Tidal correction –0.35m, Correlation –1.0m, Final correction +0.5m
	04:15	Tagged at 3648.8m, picked up tension at 3645m. TD 3645m
	04:20	Log gamma up. 3640m first station. Fine tune geophones.
	04:30	Continue out of hole at 20m intervals with VSP log, two geophones at 10m spacing.
	07:35	At 3180m – also seeing signs of tool telemetry problem, but no impact on operations.
	10:10	2820m- restart surface systems due to erratic tool responses (both GR and CSATs) causing surface systems to lock up. Probable cause erratic tool telemetry.
	10:15	Continue from 2820m
	11:00	At 2720m (inside shoe). Repeated tool telemetry problems cause surface systems to lock up; reboot PC's and power down complete system. Possible ACTS (cable head tension) or tool head problem.
	11:25	Continue from 2720m.
	13:55	At 2300m. Last VSP survey station.
	14:03	VSP complete. Pull up for check-shots.
	14:10	Shear pin breaks in rig compensator line. Wait for Saipem to replace.
	14:40	Start check-shots at 2200m
	15:27	1700m - stop check shots due to signal loss. POOH
	16:35	At surface, start rig down. Trouble shoot telemetry problem; found to be electrical connection between TCC and ACTS (ie. ACTS and tool head OK for re-use)
	17:45	Rig down complete
		Thermometers 80, 80, 80 Deg C
		Total time run 2A1 = 17 hours 40 minutes
2B1	**21/02/02**	**NGS-PEX-HRLA-FMS-DSI-SP**
	17:45	Start rig up

Run Number	Time/Date	Comments/Activities
	18:35	Safety meeting on drill floor
	18:45	Load radioactive sources
	18:55	Rig up compensator
	19:10	Compensator on, check surface length. L1 = 76.9m
	19:18	RIH
	20:05	2600m; measure rig up length 2. L2 = 76.9m
		Tension down 2500 lbs, tension up 3700 lbs, correlation with 12 ¼" gamma 1.0m deep.
	20:20	In open hole, down-log not corrected 1m deep. Casing shoe at 2731m.
	21:25	Tagged bottom, no overpull picking off bottom, stretch correction 2.92m, Tide +0.1m
		Loggers TD 3645m
	21:30	Start up log at 2000 ft/hr
	23:50	Back in casing at 2731m
	24:00	Stopped log at 2644m
		Prepare rush data 1m off depth for transfer to office
		Playback to correct depth whilst running in for repeat
	00:10	RIH to 3275m, open calipers
	00:35	Log up on repeat from 3275m
	00:55	Stop repeat at 3145m, close calipers, POOH
	02:30	On surface, Remove sources and rig down tools.
	03:45	Tools rigged down.
		Thermometers 86, 86, 85 Deg C
		Total time run 2B1 = 10 hours 00 minutes
2C1	**22/02/02**	**MSCT**
	03:55	Pick up tools
	04:20	Change logging head
	05:00	Test tools
	05:15	Install protector – zero tools
	05:25	Compensator
	05:30	RIH
	05:35	Top Drive hoses rubbing line – tie back
	05:47	Continue RIH
	06:15	Test telemetry at 1700m
	06:40	Test at shoe 2710mMD. Very slow hydraulic pressure increase – oil thick due to cold temp. in riser – wait for oil to warm up.
	07:00	Continue RIH
	07:30	Start depth correlation at 3620mMD
	07:40	Stop correlation log. Poor log character
	07:45	Try another correlation log interval from 3490-3424mRT. Add 0.3m
	08:00	Relog to verify depth correlation. Subtract 0.2m. Now on depth to Pex log
	08:30	Start core programme at 3593m, going up hole for priority 1 depths.
	09:05	Gamma log confirm depth control at 3475m. Continue core programme.
	09:08	Problem with Limit Switch-indicates core arm not fully deployed. However core head rotation indicates core bit able to rotate and therefore core arm must actually be deployed. Override limit switch and continue manually. Core OK
	09:15	Continue core programme, no more limit switch problems.
	09:27	Add 0.3 m to depth after correlation log at 3427m.
	09:33	Continue core programme
	10:12	Verify depth control OK at 3283m
	10:50	Complete up hole priority 1 points at 3208.7m. RIH to deeper priority 2 points.
	10:55	Gamma correlation over 3325m area. Add 0.2 m. Relog and subtract 0.1m.
	11:10	At 3313.9m. Limit switch problem again – override and core using manual control. OK

Run Number	Time/Date	Comments/Activities
	11:15	Continue core programme for priority 2 points, logging uphole. No more limit switch problems.
	12:10	Verify depth at 2826.7m and continue.
	12:35	Cut last core at 2739.5m
	12:40	POOH
	14:10	Deactivate heave compensator
	14:20	Tools at surface. Start rig down. Recovered 26 cores out of 27 cut attempted.
	15:20	Rig down complete. Hand rig floor back to Saipem.
		Thermometers 87, 87 Deg C
		Total time run 2C1 = 11 hours 25 minutes