5 PRESSURE AND LOG SUMMARY

5.1 Petrophysical evaluation 15/12-4

Cretaceous Fm

The Cretaceous formation was logged with the following tools:

1. DIFL/BHC ACOUSTIC-SP-GR-CAL
2. CDL/CNL-GR
3. DLL/MLL-GR
4. FMT
5. HR DIPLOG
6. COREGUN

A petrophysical evaluation has been done with the following input parameters:

Interval, m RKB:	2475 - 2676
Formation temp. ^{o}C:	99
R fm at 99^{o}C, ohm m:	0.078
R_w, ohm m:	0.040
R_{sh}, ohm m:	1.80
$PHIN_{ma}$, fraction:	0.00
$PHIN_{sh}$, fraction:	0.23
$RHOB_{ma}$, g/cc:	2.71
RHOBsh, g/cc:	2.50
$RHOB_{fl}$, g/cc:	1.01
GR_{max}:	68
GR_{min}:	4
m:	2
n:	2
a:	1
Shale exp:	1.6

Hydrocarbon corr. factor: 0.1

A shaly sand model with the GR log as shale indicator was used in the evaluation. The porosities are determined from the CDL and CNL logs corrected for shale and hydrocarbons.

Water saturation was calculated using the North Sea equation.

From logs and cores hydrocarbons were seen in the uppermost part of the Cretaceous chalk. Core analysis and log analysis indicates very poor reservoir properties in this chalk. The water saturation is high (60 - 80 %) and the permeability is extremely low (0.01 - 0.5 md).

The results from the log analysis are listed below:

Interval evaluated, m RKB:	2475 - 2675
Top oil zone, m RKB:	2491.5
High oil zone, m*:	9.5
Av. porosity*:	0.15
Av. water saturation*:	0.74
Av. shale content*:	0.11

* The results are taken from the hydrocarbon interval 2491.5 - 2501 m RKB with not cut off values for Fw and Ø.

Jurassic_Fm

The Jurassic formation was logged with the following tools:

1. DIFL/BHC-GR-SP-CAL
2. CDL/CNL-GR
3. DLL/MLL-GR
4. FMT
5. HR DIPLOG
6. COREGUN
7. VSP

A petrophysical evaluation has been done with the following input parameters:

Interval, m RKB	2875-2911	2911-2951	2951-3075
Formation temp.^{o}C:	120	120	120
Rmf at 99^{o}C, ohm m:	0.047	0.047	0.047

R_w, ohm m:	0.0145	0.0145	0.0145
R_{sh}, ohm m:	2.0	2.0	2.0
$PHIN_{ma}$, fraction:	0.035	0.035	0.035
$PHIN_{sh}$, fraction:	0.23	0.23	0.23
$RHOB_{ma}$, g/cc:	2.68	2.65	2.65
$RHOB_{sh}$, g/cc:	2.50	2.50	2.50
$RHOB_{fl}$, g/cc:	1.01	1.01	1.01
GR_{max}:	100	100	100
GR_{min}:	35	32	12
m:	2	2	2
n:	2	2	2
a:	1	1	1
Shale exp:	1.6	1.6	1.6

Hydrocarbon corr. factor: 0.1

A shaly sand model with the GR log as shale indicator was used in the evaluation. The porosities are determined from the CDL and CNL logs corrected for shale and hydrocarbons.

Water saturation was calculated using the North Sea equation.

A 1.5 meter oil leg was seen in the Jurassic sandstone. The calculated water saturation is probably too high because the thinness of the oil and bed effects are affecting the resistivity logs. No water was produced back when taking a segregated oil sample at 2912 m RKB.

On the logs and oil/water contact is seen at 2913 m RKB with a transition zone down to 2915.5 m RKB. This is confirmed by the FMT log were an oil sample were taken at 2912 m RKB and a water sample, containing some small amounts of oil, at 2913.5 m RKB.

The results from the log evaluation are listed below:

Top reservoir:	2911.5	
Oil/water contact, m RKB:	2913	
Interval evaluated:	2875-2911.5	2911.5-3075

Net pay, m:	0	1.50
Net sand, m:	3.75	160.5
Av. porosity, net pay:	-	0.25
Av. porosity, net sand:	0.13	0.23
Av. shale content, net pay:	-	0.04
Av. shale content, net sand:	0.25	0.10
Av. water saturation, net pay:	-	0.56

Cut off values applied: $V_{sh} > 0.40$
$\emptyset < 0.10$
$Sw > 0.70$

5.2 FMT summary

Cretaceous Fm

One FMT run was made in the Cretaceous formation. No pressure points out of 19 attempts were successful due to seal failure and very low permeability in the formation. One attempt to get sample at 2439.5 m RKB failed due to tight formation. The sample chamber showed to be empty.

Uncorrected pressure readings are listed below:

Test no.	Depth (m RKB)	Formation pressure (KPa)	Remarks
1	2482.5	-	Tight formation
2	2484.5	-	No seal
3	2483	-	No seal
4	2489	-	No seal
5	2494.5	-	No seal
6	2498	-	No seal
7	2324.5	29619	Supercharge
8	2483	-	No seal
9	2505	1315	Low permeability, press. incr. very slow.
10	2538	32819	Supercharge

11	2560	-	No seal
12	2570.5	-	No seal
13	2604.9	791	Very low perm., press. increasing very slow
14	2633	977	Very low perm., press. increasing very slow
15	2653.5	1660	Very low perm., press. increasing very slow
16	2666	-	No seal
17	2488.5	998	Very low perm., press. increasing very slow
18	2483	32350	Supercharge, attempt to get sample
19	2438.5	2860	Very low perm., press. increasing very slow

Jurassic Fm

Four FMT runs were made in the Jurassic formation.

Run no. 1:

17 out of 23 attempts to get pressure points were successful. One segregated oil sample was taken at 2912 m RKB. Some pressure was lost on the 2 3/4 gallon chamber due to a leaking o-ring.

The 2 3/4 gallon chamber was drained offshore:

Opening pressure:	1480 KPa
H_2S:	0 %
Recovery, Gas:	0.06 Sm^3
Oil:	5800 cc (SG = 0.847 g/cc)
Water	0 cc

The one gallon chamber was sent to Statoil PVT lab. for analysis.

Opening pressure offshore:	12860 KPa
Opening pressure onshore:	11136 KPa at 13°C

Run no. 2:

3 out of 5 attempts to get pressure points were successful. An attempt to get a sample at 2913.6 m RKB failed due to a shorted conductor. This conductor is used to operate tool valves for sample chambers.

Run no. 3:

It was not possible to get pressure points during this run due to seal failures (misrun).

Run no. 4:

1 out of 2 attempts to get pressure points were successful. One segregated sample was taken at 2113.5 m RKB.

2 3/4 gallon chamber was drained offshore:

Opening pressure:		6998 KPa
Recovery:	Gas:	0.33 Sm^3
	Oil:	500 cc
	Mudfiltrate/water:	9000 cc

1 gallon chamber was drained onshore:

Opening pressure offshore:	5274 KPa
Opening pressure onshore:	3205 KPa at 13°C
Recovery:	Water with traces of oil

Data summary from PVT report:

Bubble point at res. temp. (120°C): 356 bar

Single flash GOR:	150 Sm^3/Sm^3
Flash volume factor:	1.445 m/Sm^3 STO
Viscosity at bubble point:	0.368 cp
Viscosity at res. press:	0.400 cp
Density at bubble point:	0.700 g/cm^3
Density of STO:	0.0854 g/cm^3

Composition of reservoir fluid:

	Mol %
Nitrogen	0.65
Carbondioxide	2.11
Methane	43.18
Ethane	7.30
Propane	4.78
i-Butane	0.74
n-Butane	2.10
i-Pentane	0.76
n-Pentane	1.22
Hexanes	1.78
Heptanes	3.56
Octanes	3.96
Nonanes	2.80
Decan plus	25.06

Corrected pressure readings from the various runs are listed below and plotted in Fig. 5.1.

Run no.	Depth (m RKB)	Formation press (KPa)	Comments
1	2901	3894	Supercharge
	2902.5	38522	Supercharge
	2904	-	Tight formation
	2906	-	Tight formation
	2908.4	-	Tight formation
	2910	35329	Very low perm.
	2912	34788	Very good perm., sample
	2914	34788	Very good perm.
	2916	34829	Very good perm.
	2918	34850	Very good perm.
	2924	34915	Very good perm.
	2935	35088	Very good perm.
	2946	35215	Very good perm.
	2955	35263	Very good perm.
	2971	35481	Very good perm.
	2986	35584	Very good perm.

	2994	35681	Very good perm.
	3003	35774	Very good perm.
	3023.5	35998	Very good perm.
	3043.5	36212	Very good perm.
	3097	36770	Very good perm.
	3119.5	37001	Very good perm.
	3146	37843	Very good perm.
2	2911.5	-	Tight formation
	2911.9	-	Tight formation
	2912	34936	Very good perm.
	2912.6	34915	Very good perm.
	2913.6	34936	Very good perm.
4	2913.4	-	Lost seal
	2913.5	34812	Very good perm., sample

The pressure points indicate a water gradient of 10.73 KPa/m (SG = 1.10 g/cc).

It was not possible to establish any oil gradient because the thinness of the oil zone (1.5 m).

From the sampling results it is proved that the oil/water contact must be between 2912 and 2913.5 m RKB.

OPERATING AREA

MATERIALS USED PER CASING INTERVAL

36" HOLE 30" CONDUCTOR

MATERIAL	UNIT	QTY	COST	ESTIMATED USE	TOTAL COST $
BARITE	-	-	-	35	3,500.00
BENTONITE	MT	30	7,500.00	23	5,750.00
CAUSTIC		33	371.25		
CMC Extra Hi vis	25 KG.	14	612.50		
SODA ASH	50 KG.	11	223.52		
TOTAL MATERIAL COST			8707.27		9,250.00

COST PER METER DRILLED	61.43	ESTIMATED	142.31
COST PER CUBIC METER	18.97	ESTIMATED	30.53
COST PER BARREL	3.02	ESTIMATED	4.87

OPERATING AREA STATOIL Well No. 15/12-4.

MATERIALS USED PER CASING INTERVAL

26" HOLE 20" CASING

MATERIAL	UNIT	QTY	COST	ESTIMATED USE	TOTAL COST $
BARITE	MT	82	8,2000.00	152	15,200.00
BENTONITE	MT	18	4,500.00	50	12,500.00
CAUSTIC	25 KG.	37	416.25		
CMC Extra Hi vis	25 KG.	12	525.00		
LIGNOSULFONATE	25 KG.	12	159.00		
STAFLO	25 KG.	3	322.35		
SODA ASH	50 KG.	9	182.88		
XCD POLYMER	25 KG.	1	359.60		
TOTAL MATERIAL COST			14,665.08		27,700.00

COST PER METER DRILLED (345)	56.53	ESTIMATED (340)	81.47
COST PER CUBIC METER (1,147	17.00	ESTIMATED (779)	35.56
COST PER BARREL (7,213)	2.70	ESTIMATED (4900)	5.56

OPERATING AREA STATOIL Well No. 15/12-4.

MATERIALS USED PER CASING INTERVAL

17 1/2 HOLE 13 3/8 CASING

MATERIAL	UNIT	QTY	COST	ESTIMATED USE	TOTAL COST $
BARITE	MT	43	4,300.00	61	6,100.00
BENTONITE	MT	4	1,000.00	81	20,250.00
CAUSTIC	25 KG.	170	1,912.50	217	2,441.25
CMC Lo vis	25 KG.	118	4,336.50	248	9,114.00
CMC Hi vis	25 KG.	12	441.00		
CMC Extra Hi vis	25 KG.	3	131.25		
DEXTRID	50 LB.	293	17,392.48	344	20,419.84
GYPSUM	40 KG.	740	5,505.60	707(50KG.)	6,575.10
LIME	25 KG.	13	79.30		
LIGNOSULFONATE	25 KG.	-	-	155	2,053.75
SODA ASH	50 KG.	-	-	24	487.68
XCD POLYMER	25 KG.	85	30,566.00	144	51,782.40
TOTAL MATERIAL COST			65,664.63		119,224.02

COST PER METER DRILLED (1,100)	43.67	ESTIMATED (1100)	108.38
COST PER CUBIC METER (1,222)	53.74	ESTIMATED (1086)	109.78
COST PER BARREL (7,685)	8.55	ESTIMATED (6830)	17.47

OPERATING AREA STATOIL Well No. 15/12-4.

MATERIALS USED PER CASING INTERVAL

12 1/4 HOLE 9 5/8 CASING

MATERIAL	UNIT	QTY	COST	ESTIMATED USE	TOTAL COST $
BARITE	MT	112	11,200.00	283	28,300.00
BENTONITE	MT	2	500.00	18	4,500.00
CAUSTIC	25 KG.	103	1,158.75	131	1,473.75
CMC Lo vis	25 KG.	89	3,270.75	154	5,659.50
DEXDRID	50 LB.	247	14,661.92	216	12,821.76
DRISPAC (reg)	50 LB.	6	585.00	-	-
GYPSUM	40 KG.	345	2,566.80	327 (50KG)	3,041.10
LIGNOSULFONATE	25 KG.	40	530.00	27	357.75
SODA ASH	50 KG.	1	20.32	-	-
SODIUM BICARB	50 KG.	12	259.20	13	280.80
STAFLO	-	12	1,289.40	-	-
XCD POLYMER	-	24	8,630.40	36	12,945.60
TOTAL MATERIAL COST			44,715.24		69,380.26

COST PER METER DRILLED (1,060)	37.25	ESTIMATED (1,120)	61.95
COST PER CUBIC METER (870)	71.66	ESTIMATED (573)	121.08
COST PER BARREL (5,471)	11.39	ESTIMATED (3,600)	19.27

OPERATING AREA

STATOIL Well No. 15/12-4.

MATERIALS USED PER CASING INTERVAL

8 1/2 HOLE

MATERIAL	UNIT	QTY	COST	ESTIMATED USE	TOTAL COST $
BARITE	MT	56	5,600.00	216	21,600.00
BENTONITE	MT	11	2,750.00	25	6,250.00
CAUSTIC SODA	25 KG.	73	821.25	132	1,485.00
CC1b	50 LB.	265	4,505.00	362	5,592.90
CMC Lo vis	25 KG.	203	7,460.25	185	6,798.75
CMC Hi vis	25 KG.	3	110.25	-	-
DEXTRID	50 LB.	18	1,068.48	-	-
LIGNOSULFONATE	25 KG.	110	1,457.50	444	5,883.00
SODA ASH	50 KG.	9	182.88	9	182.88
SODIUM BICARB	50 KG.	5	108.00	12	258.20
TOTAL MATERIAL COST			24,179.51		48,051.73

COST PER METER DRILLED	(529)	87.65	ESTIMATED (1,120)	61.95
COST PER CUBIC METER	(432)	107.33	ESTIMATED (318)	151.11
COST PER BARREL	(2,717)	17.07	ESTIMATED (2,000)	24.03

NORSK PETROLEUM nps SERVICES I

OPERATOR STATOIL

WELL NAME/No. 15/12-4.

CONTRACTOR O.D.C.C.

RIG DEEP SEA BERGEN

BAROID ENGINEERS CHRIS MADLEY - HOLLIS CLUCK

T.D. 3157 m.

HOLE SIZE	CASING SIZE	CASING SET AT	MUD TYPE	MUD COST	DRILLING DAYS
36"	30"	171	GEL-SEAWATER	3,869.92	0.6
26"	20"	505	GEL-SEAWATER	19,502.43	2.1
17 1/2	13 3/8	1601	GYP-POLYMER	48,039.43	2.9
12 1/4	9 5/8	2666	GYP-POLYMER	39,480.90	4.5
8 1/2	-	3157	LIGNITE-LIGNOSULFONATE	46,365.73	5.3