

**General information**

Wellbore name	6406/9-1
Type	EXPLORATION
Purpose	WILDCAT
Status	P&A
Press release	link to press release
Factmaps in new window	link to map
Main area	NORWEGIAN SEA
Discovery	6406/9-1 Linnorm
Well name	6406/9-1
Seismic location	HWE95m:inline 4340 & xline 1541.6
Production licence	255
Drilling operator	A/S Norske Shell
Drill permit	1077-L
Drilling facility	TRANSOCEAN LEADER
Drilling days	353
Entered date	15.06.2004
Completed date	02.06.2005
Release date	02.06.2007
Publication date	21.12.2007
Purpose - planned	WILDCAT
Reentry	NO
Content	GAS
Discovery wellbore	YES
1st level with HC, age	MIDDLE JURASSIC
1st level with HC, formation	ILE FM
2nd level with HC, age	EARLY JURASSIC
2nd level with HC, formation	TOFTE FM
3rd level with HC, age	EARLY JURASSIC
3rd level with HC, formation	TILJE FM
Kelly bushing elevation [m]	23.5
Water depth [m]	308.0
Total depth (MD) [m RKB]	5080.0
Final vertical depth (TVD) [m RKB]	5077.0
Maximum inclination [°]	7
Bottom hole temperature [°C]	184
Oldest penetrated age	EARLY JURASSIC
Oldest penetrated formation	ÅRE FM
Geodetic datum	ED50



NS degrees	64° 26' 46.85" N
EW degrees	6° 48' 55.23" E
NS UTM [m]	7148739.49
EW UTM [m]	394862.07
UTM zone	32
NPDID wellbore	4927

Wellbore history

**General**

Well 6406/9-1 is located in the southern Haltenbanken area, offshore Mid Norway. The well was drilled near the crest of the prospect structure, a rotated fault block. The primary objective of well 6406/9-1 was to test the hydrocarbon potential in the Middle to Early Jurassic reservoirs of the Garn, Ile, Ror/Tofte and Tilje Formations, and to production test possible hydrocarbon occurrences.

Operations and results

Wildcat well 6406/9-1 was spudded with the semi-submersible installation Transocean Leader on 15 June 2004 and drilled to TD at 5080 m in Early Jurassic sediments of the Åre Formation. The well was a high temperature / high pressure well, with a formation temperature of ca 184 deg C at TD, according to DST and wire line measurements. The well was drilled with seawater and bentonite sweeps down to 1375 m, with Glydril mud from 1375 m to 2893 m, and with Paratherm oil based (paraffin base) mud from 2893 m to TD. Shallow gas was neither predicted nor encountered. Due to labour disputes and bad weather the well was not terminated until 2 June 2005.

The Jurassic Ile, Tofte, Tilje and Åre Formations were all found to be entirely gas bearing. The Garn Formation, a reservoir interval in some of the neighbouring wells, was found to be shaled out here. The presence of hydrocarbons was confirmed by RCI samples in the Ile, Tofte and Tilje. The discovery appeared to be a stacked reservoir sequence with up to 5 different compartments with small pressure differences between the formations. All reservoirs were intersected in Gas-Down-To situations. The total hydrocarbon column in-well was 492.5 m. The gas was significantly drier than expected when compared to other accumulations in the area. Reservoir quality was very variable with large sections of low/medium permeability, but also two distinct sands of exceedingly high quality.

A total of four cores were taken from the Early and Middle Jurassic intervals. The first core was taken from the upper part of the Ile Formation and is 13.44 m long. Operations were cut short because of jamming of the core, possibly due to junk in the hole. The second core was taken from the lower part of the Ile Formation and is 27.7 m long. A 26 m core was taken from the Tofte Formation as well as a 28.47 m core from the Lower Ror Formation. The RCI fluid samples sampled gas from four depths: 4625.5 m (Ile), 4682.1 m (Tofte), 4908.5 m (upper Tilje), and 5021.9 m (Tilje).

The well was permanently abandoned on 2 June 2005 as a gas discovery.

Testing

Two full well tests were performed aimed at the most promising Formations: the lower Tilje and the lower Ile. The perforation intervals were limited and selected to include the two high quality sands.

DST 1 tested the interval 4989.2 - 5029.75 m in the lower Tilje Formation. It produced gas at a rate of 1410000 Sm³/day and with a condensate/gas ratio of less than 1.0E-6 Sm³/Sm³ (GOR > 1000000 Sm³/Sm³). The CO₂ content was 7-8% (vol) and the H₂S content was 20 - 30 ppm on average. DST 2 tested the interval 4619 - 4633.7 m in the lower Ile Formation. It produced gas at a rate of 770000 Sm³/day and with a condensate/gas ratio of ca 25E-6 Sm³/Sm³ (GOR ca 40000 Sm³/Sm³). The CO₂ content was 7-8% (vol), and the H₂S content was 15-18 ppm on average.

Maximum temperatures recorded were 182 and 172 deg C in DST 1 and DST 2, respectively.

**Cuttings at the Norwegian Offshore Directorate**

Cutting sample, top depth [m]	Cutting samples, bottom depth [m]
1390.00	5079.00

Cuttings available for sampling?	YES
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Cores at the Norwegian Offshore Directorate

Core sample number	Core sample - top depth	Core sample - bottom depth	Core sample depth - uom
1	4546.5	4559.9	[m]
2	4591.0	4618.8	[m]
3	4684.0	4710.1	[m]
4	4784.0	4812.5	[m]

Total core sample length [m]	95.8
Cores available for sampling?	YES

Palynological slides at the Norwegian Offshore Directorate

Sample depth	Depth unit	Sample type	Laboratory
1390.0	[m]	DC	ICHRON
1430.0	[m]	DC	ICHRON
1490.0	[m]	DC	ICHRON
1530.0	[m]	DC	ICHRON
1560.0	[m]	DC	ICHRON
1600.0	[m]	DC	ICHRON
1660.0	[m]	DC	ICHRON
1680.0	[m]	DC	ICHRON
1720.0	[m]	DC	ICHRON
1780.0	[m]	DC	ICHRON
1800.0	[m]	DC	ICHRON
1840.0	[m]	DC	ICHRON
1880.0	[m]	DC	ICHRON
1910.0	[m]	DC	ICHRON
1940.0	[m]	DC	ICHRON
1990.0	[m]	DC	ICHRON
2020.0	[m]	DC	ICHRON
2050.0	[m]	DC	ICHRON
2080.0	[m]	DC	ICHRON



2110.0	[m]	DC	ICHRON
2140.0	[m]	DC	ICHRON
2180.0	[m]	DC	ICHRON
2200.0	[m]	DC	ICHRON
2220.0	[m]	DC	ICHRON
2250.0	[m]	DC	ICHRON
2265.0	[m]	DC	ICHRON
2275.0	[m]	DC	ICHRON
2280.0	[m]	DC	ICHRON
2295.0	[m]	DC	ICHRON
2305.0	[m]	DC	ICHRON
2315.0	[m]	DC	ICHRON
2320.0	[m]	DC	ICHRON
2325.0	[m]	DC	ICHRON
2335.0	[m]	DC	ICHRON
2340.0	[m]	DC	ICHRON
2350.0	[m]	DC	ICHRON
2360.0	[m]	DC	ICHRON
2365.0	[m]	DC	ICHRON
2370.0	[m]	DC	ICHRON
2375.0	[m]	DC	ICHRON
2380.0	[m]	DC	ICHRON
2385.0	[m]	DC	ICHRON
2390.0	[m]	DC	ICHRON
2395.0	[m]	DC	ICHRON
2400.0	[m]	DC	ICHRON
3155.0	[m]	DC	ICHRON
3180.0	[m]	DC	ICHRON
3285.0	[m]	DC	ICHRON
3320.0	[m]	DC	ICHRON
3330.0	[m]	DC	ICHRON
3350.0	[m]	DC	ICHRON
3400.0	[m]	DC	ICHRON
3420.0	[m]	DC	ICHRON
3460.0	[m]	DC	ICHRON
3490.0	[m]	DC	ICHRON
3530.0	[m]	DC	ICHRON
3550.0	[m]	DC	ICHRON
3570.0	[m]	DC	ICHRON
3780.0	[m]	DC	ICHRON



3790.0	[m]	DC	ICHRON
3805.0	[m]	DC	ICHRON
3820.0	[m]	DC	ICHRON
3850.0	[m]	DC	ICHRON
3865.0	[m]	DC	ICHRON
3875.0	[m]	DC	ICHRON
3890.0	[m]	DC	ICHRON
3905.0	[m]	DC	ICHRON
3930.0	[m]	DC	ICHRON
3940.0	[m]	DC	ICHRON
4068.0	[m]	DC	ICHRON
4071.0	[m]	DC	ICHRON
4080.0	[m]	DC	ICHRON
4095.0	[m]	DC	ICHRON
4107.0	[m]	DC	ICHRON
4125.0	[m]	DC	ICHRON
4131.0	[m]	DC	ICHRON
4137.0	[m]	DC	ICHRON
4143.0	[m]	DC	ICHRON
4155.0	[m]	DC	ICHRON
4161.0	[m]	DC	ICHRON
4173.0	[m]	DC	ICHRON
4185.0	[m]	DC	ICHRON
4197.0	[m]	DC	ICHRON
4203.0	[m]	DC	ICHRON
4209.0	[m]	DC	ICHRON
4215.0	[m]	DC	ICHRON
4221.0	[m]	DC	ICHRON
4227.0	[m]	DC	ICHRON
4233.0	[m]	DC	ICHRON
4239.0	[m]	DC	ICHRON
4242.0	[m]	DC	ICHRON
4248.0	[m]	DC	ICHRON
4251.0	[m]	DC	ICHRON
4254.0	[m]	DC	ICHRON
4263.0	[m]	DC	ICHRON
4266.0	[m]	DC	ICHRON
4269.0	[m]	DC	ICHRON
4272.0	[m]	DC	ICHRON
4281.0	[m]	DC	ICHRON



4290.0 [m]	DC	ICHRON
4296.0 [m]	DC	ICHRON
4335.0 [m]	DC	ICHRON
4374.0 [m]	DC	ICHRON
4398.0 [m]	DC	ICHRON
4419.0 [m]	DC	ICHRON
4422.0 [m]	DC	ICHRON
4428.0 [m]	DC	ICHRON
4434.0 [m]	DC	ICHRON
4437.0 [m]	DC	ICHRON
4443.0 [m]	DC	ICHRON
4449.0 [m]	DC	ICHRON
4455.0 [m]	DC	ICHRON
4461.0 [m]	DC	ICHRON
4470.0 [m]	DC	ICHRON
4476.0 [m]	DC	ICHRON
4488.0 [m]	DC	ICHRON
4506.0 [m]	DC	ICHRON
4527.0 [m]	DC	ICHRON
4536.0 [m]	DC	ICHRON
4542.0 [m]	DC	ICHRON
4550.3 [m]	C	ICHRON
4556.8 [m]	C	ICHRON
4559.3 [m]	C	ICHRON
4569.0 [m]	DC	ICHRON
4579.7 [m]	C	ICHRON
4591.2 [m]	C	ICHRON
4595.2 [m]	C	ICHRON
4601.5 [m]	C	ICHRON
4605.4 [m]	C	ICHRON
4608.3 [m]	C	ICHRON
4614.8 [m]	C	ICHRON
4685.3 [m]	C	ICHRON
4692.7 [m]	C	ICHRON
4698.7 [m]	C	ICHRON
4702.4 [m]	C	ICHRON
4706.5 [m]	C	ICHRON
4785.3 [m]	C	ICHRON
4788.5 [m]	C	ICHRON
4792.6 [m]	C	ICHRON



4794.6	[m]	C	ICHRON
4798.5	[m]	C	ICHRON
4803.5	[m]	C	ICHRON
4807.5	[m]	C	ICHRON
4808.5	[m]	C	ICHRON
4812.3	[m]	C	ICHRON

Oil samples at the Norwegian Offshore Directorate

Test type	Bottle number	Top depth MD [m]	Bottom depth MD [m]	Fluid type	Test time	Samples available
DST		0.00	0.00	CONDE NSATE	30.04.2005 - 09:00	YES

Lithostratigraphy

Top depth [mMD RKB]	Lithostrat. unit
333	NORDLAND GP
333	NAUST FM
1191	KAI FM
1655	HORDALAND GP
1655	BRYGGE FM
2247	ROGALAND GP
2247	TARE FM
2333	TANG FM
2405	SHETLAND GP
2405	SPRINGAR FM
2516	NISE FM
2732	KVITNOS FM
2928	CROMER KNOLL GP
2928	LYSING FM
3405	LANGE FM
4229	LYR FM
4254	VIKING GP
4254	SPEKK FM
4269	MELKE FM
4415	FANGST GP
4415	GARN FM



4472	NOT FM
4533	ILE FM
4634	BÅT GP
4634	ROR FM
4681	TOFTE FM
4721	ROR FM
4826	TILJE FM
5024	ÅRE FM

Drill stem tests (DST)

Test number	From depth MD [m]	To depth MD [m]	Choke size [mm]
1.0	4964	5004	22.0
2.0	4619	4634	19.0

Test number	Final shut-in pressure [MPa]	Final flow pressure [MPa]	Bottom hole pressure [MPa]	Downhole temperature [°C]
1.0			23.000	43
2.0			28.000	49

Test number	Oil [Sm ³ /day]	Gas [Sm ³ /day]	Oil density [g/cm ³]	Gas grav. rel.air	GOR [m ³ /m ³]
1.0		1410000			
2.0		1440000			

Logs

Log type	Log top depth [m]	Log bottom depth [m]
AIT DSI IS EMS GR ACTS GPIT	2777	4308
AIT DSI IS EMS GR ACTS GPIT	4291	5058
CBL	3096	3813
CBL	3510	5047
CMR LDS APS ECS HGNS ACTS ECRD	4291	5058
EARTH IMAGER	4300	5075
LDS APS HGNS ACTS ECRD	2777	4308
MFC READ	326	4184



MFC READ	4100	5020
MWD LWD - ARC	1367	4291
MWD LWD - ARC	4541	4591
MWD LWD - ARC	4865	5068
MWD LWD - ARC TST6 STETO	4289	4541
MWD LWD - DVD ECOSCOPE	4291	4878
MWD LWD - GR	346	1363
RCI MINI DST	4522	4620
RCI MINI DST	4563	4684
RCI MINI DST	4908	4909
RCI MINI DST	5007	5022
RCI PRESSURE	4500	5024
RCI SAMPLE	4625	5022
RCOR	4684	5023
VSP	1500	5075

Casing and leak-off tests

Casing type	Casing diam. [inch]	Casing depth [m]	Hole diam. [inch]	Hole depth [m]	LOT/FIT mud eqv. [g/cm3]	Formation test type
CONDUCTOR	30	417.0	36	417.0	0.00	LOT
SURF.COND.	20	1375.0	26	1375.0	1.74	LOT
INTERM.	16	2243.0	17 1/2	2244.0	1.89	LOT
INTERM.	13 3/8	2873.0	14 7/8	2873.0	1.95	LOT
INTERM.	9 5/8	4365.0	12 1/4	4365.0	2.13	LOT
LINER	7	5080.0	8 1/2	5080.0	0.00	LOT

Drilling mud

Depth MD [m]	Mud weight [g/cm3]	Visc. [mPa.s]	Yield point [Pa]	Mud type	Date measured
405	1.05			SPUD MUD	
644	1.05			SPUD MUD	
1381	1.55	19.0		GLYDRIL MUD	
1820	1.82	21.0		GLYDRILL WBM	
2248	1.70	30.0		GLYDRIL MUD	
2793	1.75	32.0		GLYDRIL MUD	
3251	1.77	30.0		PHARATERM	
3544	1.79	32.0		PHARATERM	



4075	1.87	40.0		PARATHERM	
4306	1.87	38.0		PARATHERM	
4546	1.89	32.0		PARATHERM	
4591	1.88	36.0		PARATHERM	
4710	1.90	40.0		PARATHERM	
4718	1.89	40.0		PARATHERM	
4880	1.88	40.0		PARATHERM	
5063	1.89	43.0		PARATHERM	
5080	1.88	49.0		PARATHERM	

Pressure plots

The pore pressure data is sourced from well logs if no other source is specified. In some wells where pore pressure logs do not exist, information from Drill stem tests and kicks have been used. The data has been reported to the NPD, and further processed and quality controlled by IHS Markit.

Document name	Document format	Document size [MB]
4927 Formation pressure (Formasjonstrykk)	pdf	0.29

