

**General information**

Wellbore name	6406/2-3
Type	EXPLORATION
Purpose	WILDCAT
Status	P&A
Factmaps in new window	link to map
Main area	NORWEGIAN SEA
Field	KRISTIN
Discovery	6406/2-3 Kristin
Well name	6406/2-3
Seismic location	HWM94-row 2802 & col 1022
Production licence	199
Drilling operator	Saga Petroleum ASA
Drill permit	851-L
Drilling facility	TRANSOCEAN ARCTIC
Drilling days	235
Entered date	24.08.1996
Completed date	15.04.1997
Release date	15.04.1999
Publication date	29.05.2002
Purpose - planned	WILDCAT
Reentry	NO
Content	GAS/CONDENSATE
Discovery wellbore	YES
1st level with HC, age	MIDDLE JURASSIC
1st level with HC, formation	FANGST GP
2nd level with HC, age	EARLY JURASSIC
2nd level with HC, formation	BÅT GP
Kelly bushing elevation [m]	24.0
Water depth [m]	372.0
Total depth (MD) [m RKB]	5258.0
Final vertical depth (TVD) [m RKB]	5255.9
Maximum inclination [°]	6.4
Bottom hole temperature [°C]	188
Oldest penetrated age	EARLY JURASSIC
Oldest penetrated formation	ÅRE FM
Geodetic datum	ED50
NS degrees	64° 58' 40.8" N
EW degrees	6° 24' 37.71" E



NS UTM [m]	7208685.60
EW UTM [m]	377806.71
UTM zone	32
NPDID wellbore	2849

Wellbore history

General

The main objective of well 6406/2-3 was to test the hydrocarbon potential of the Kristin structure with respect to Middle and Lower Jurassic sandstones, and to test the reservoir qualities at great depths (prognosed TD 5600 m). The secondary target for the well was the seismically prognosed Aptian sandstone, which was interpreted to form either a stratigraphic trap or a structural closure above the crest of the Kristin structure. The Kristin structure is a fault bounded horst block, somewhat eroded in the western part, with only minor internal faulting. The Kristin structure extends into PL 134 area, and the well location was agreed between PL 199 and PL 134. PL 134 contributed with 20% of the expenses to the joint well. Hydrocarbon leakage due to the prognosed high pore pressure in the Kristin structure was regarded the primary risk for the trap, knowing that all high pressured wells drilled in this area had been dry.

Operations and results

Wildcat well 6406/2-3 was spudded 24 August 1996 with the semi-submersible rig "Transocean Arctic", and reached TD 47 m into the Åre Formation at 5258 m on 26 January 1997. Due to well control problems starting 23 September a technical side-track was started 23 October from the 13 3/8" casing shoe at 2834 m, and the suffix T2 was added to the well designation (6406/2-3T2). During intermediate logging in 8 1/2" section a FMT tool got stuck, and a second sidetrack had to be done from the 9 5/8" casing shoe at 4538 m. The second sidetrack, 6406/2-3T3, was started 6 December 1996. Shallow gas caused no operational problems. The well was drilled with seawater swept with high viscosity mud down to 1413 m. ANCO 2000 water based mud with ANCO 208 glycol additive was used from 1413 to 2848 m, while ANCOVERT oil based mud was used from 2848 m to TD.

The main result of well 6406/2-3 was the discovery of gas/condensate in Garn and Ile Formations as proven by production tests, fluid samples, cores and logs. Both Garn and Ile Formations were filled with gas/condensate throughout the units in the well position. Tofte, Tilje and Åre Formations were water bearing, except for a possible hydrocarbon-water transition zone in the uppermost parts of the Tofte Formation. The prognosed Lower Cretaceous Aptian sandstone was not encountered in the well. The well also penetrated Cretaceous sandstones (Lysing and Lange sandstones) that were interpreted to be water bearing with some shows and with poor reservoir qualities.

Reservoir qualities of the Middle Jurassic sandstones of the Garn and Ile Formations are in general very good, ranging from fair to excellent. The reservoir properties of the Garn Formation are best in the upper part, with porosities up to 20% and permeabilities up to 1 Darcy. The properties of the Ile Formation are best in the lower part and in one central zone of the unit, with porosities up to 30% and permeabilities up to 12 Darcy. The reservoir qualities of the Tofte, Tilje and Åre Formations are more variable, with Tofte Formation ranging from fair to good, Tilje Formation ranging from poor to good, and Åre Formation having poor reservoir qualities.

Pore pressures of the Jurassic units were very high, reaching a maximum gradient of 1.97 g/cc EMW in upper part of the Garn Formation.

Ten cores were cut from Lange, Garn, Ile, Tofte and Tilje Formations, totaling 202.95 m,



with a recovery of 198.35 m. Two cores were cut in the Cretaceous Lange Formation. Fluid samples containing gas and condensate were collected in the Garn and Ile Formations, whilst water samples were collected in the Tofte, Tilje and Åre Formations. The well was plugged and abandoned as a gas/condensate discovery.

Testing

Two zones in the well were successfully production tested. Test # 1 in lower Ile Formation (4806 - 4832 m) produced 892 000 Sm³/D gas and 890 Sm³/D condensate (GOR: 1003 Sm³/Sm³). Test # 2 in upper Garn Formation (4629 - 4654.4 m) produced 777 000 Sm³/D gas and 1048 Sm³/D condensate (GOR: 744 Sm³/Sm³).

Cuttings at the Norwegian Offshore Directorate

Cutting sample, top depth [m]	Cutting samples, bottom depth [m]
1420.00	5256.00

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	4380.0	4401.5	[m]
2	4402.0	4425.5	[m]
3	4633.0	4639.0	[m]
4	4642.0	4650.8	[m]
5	4651.5	4661.5	[m]
6	4661.5	4671.0	[m]
7	4671.0	4699.4	[m]
8	4699.3	4727.8	[m]
9	4754.0	4777.5	[m]
10	4777.5	4806.1	[m]
11	4898.0	4925.4	[m]
12	5038.0	5064.9	[m]

Total core sample length [m]	242.6
Cores available for sampling?	YES

Core photos



4380-4385m



4385-4390m



4390-4395m



4395-4400m



4400-4401m



4402-4407m



4407-4412m



4412-4417m



4417-4422m



4422-4423m



4633-4638m



4638-4640m



4642-4647m



4647-4650m



4651-4656m



4656-4661m



4661-4662m



4661-4666m



4666-4671m



4676-4681m



4681-4686m



4686-4691m



4691-4696m



4696-4699m



4699-4704m



4704-4709m



4709-4714m



4714-4719m



4719-4724m



4724-4727m



4754-4759m



4759-4764m



4764-4769m



4769-4774m



4774-4777m



4777-4782m



4782-4787m



4787-4792m



4792-4797m



4797-4802m



4802-4806m



4898-4903m



4903-4908m



4908-4913m



4913-4918m



4918-4923m



4923-4925m



5038-5043m



5043-5048m



5048-5053m



5053-5058m



5058-5063m



5063-5065m

Palynological slides at the Norwegian Offshore Directorate

Sample depth	Depth unit	Sample type	Laboratory
1430.0	[m]	DC	STRAT
1450.0	[m]	DC	STRAT
1470.0	[m]	DC	STRAT



1490.0	[m]	DC	STRAT
1510.0	[m]	DC	STRAT
1530.0	[m]	DC	STRAT
1550.0	[m]	DC	STRAT
1570.0	[m]	DC	STRAT
1590.0	[m]	DC	STRAT
1610.0	[m]	DC	STRAT
1630.0	[m]	DC	STRAT
1650.0	[m]	DC	STRAT
1670.0	[m]	DC	STRAT
1690.0	[m]	DC	STRAT
1710.0	[m]	DC	STRAT
1730.0	[m]	DC	STRAT
1750.0	[m]	DC	STRAT
1770.0	[m]	DC	STRAT
1790.0	[m]	DC	STRAT
1810.0	[m]	DC	STRAT
1830.0	[m]	DC	STRAT
1850.0	[m]	DC	STRAT
1870.0	[m]	DC	STRAT
1890.0	[m]	DC	STRAT
1910.0	[m]	DC	STRAT
1930.0	[m]	DC	STRAT
1950.0	[m]	DC	STRAT
1970.0	[m]	DC	STRAT
1990.0	[m]	DC	STRAT
2010.0	[m]	DC	STRAT
2030.0	[m]	DC	STRAT
2050.0	[m]	DC	STRAT
2070.0	[m]	DC	STRAT
2090.0	[m]	DC	STRAT
2110.0	[m]	DC	STRAT
2130.0	[m]	DC	STRAT
2150.0	[m]	DC	STRAT
2170.0	[m]	DC	STRAT
2270.0	[m]	DC	STRAT
2290.0	[m]	DC	STRAT
2310.0	[m]	DC	STRAT
2330.0	[m]	DC	STRAT
2350.0	[m]	DC	STRAT



2370.0	[m]	DC	STRAT
2410.0	[m]	DC	STRAT
2430.0	[m]	DC	STRAT
2470.0	[m]	DC	STRAT
2510.0	[m]	DC	STRAT
2530.0	[m]	DC	STRAT
2550.0	[m]	DC	STRAT
2570.0	[m]	DC	STRAT
2590.0	[m]	DC	STRAT
2610.0	[m]	DC	STRAT
2630.0	[m]	DC	STRAT
2650.0	[m]	DC	STRAT
2670.0	[m]	DC	STRAT
2690.0	[m]	DC	STRAT
2710.0	[m]	DC	STRAT
2730.0	[m]	DC	STRAT
2750.0	[m]	DC	STRAT
2770.0	[m]	DC	STRAT
2790.0	[m]	DC	STRAT
2810.0	[m]	DC	STRAT
2830.0	[m]	DC	STRAT
2850.0	[m]	DC	STRAT
2870.0	[m]	DC	STRAT
2900.0	[m]	DC	STRAT
3000.0	[m]	DC	STRAT
3100.0	[m]	DC	STRAT
3200.0	[m]	DC	STRAT
3300.0	[m]	DC	STRAT
3400.0	[m]	DC	STRAT
3500.0	[m]	DC	STRAT
3600.0	[m]	DC	STRAT
3700.0	[m]	DC	STRAT
3800.0	[m]	DC	STRAT
3900.0	[m]	DC	STRAT
4000.0	[m]	DC	STRAT
4099.0	[m]	DC	STRAT
4201.0	[m]	DC	STRAT
4300.0	[m]	DC	STRAT
4399.0	[m]	DC	STRAT
4501.0	[m]	DC	STRAT



4575.0	[m]	DC	STRAT
4635.0	[m]	DC	STRAT

Lithostratigraphy

Top depth [mMD RKB]	Lithostrat. unit
396	NORDLAND GP
396	NAUST FM
1518	KAI FM
1954	HORDALAND GP
1954	BRYGGE FM
2300	ROGALAND GP
2300	TARE FM
2364	TANG FM
2425	SHETLAND GP
2425	SPRINGAR FM
2549	NISE FM
2838	KVITNOS FM
3429	CROMER KNOLL GP
3429	LYSING FM
3440	LANGE FM
4620	LYR FM
4629	FANGST GP
4629	GARN FM
4716	NOT FM
4751	ILE FM
4837	BÅT GP
4837	ROR FM
4877	TOFTE FM
5028	TILJE FM
5210	ÅRE FM

Composite logs

Document name	Document format	Document size [MB]
2849	pdf	0.77





Geochemical information

Document name	Document format	Document size [MB]
2849_1	pdf	1.68
2849_10	pdf	0.98
2849_2	pdf	1.94
2849_3	pdf	1.99
2849_4	pdf	1.88
2849_5	pdf	1.91
2849_6	pdf	1.87
2849_7	pdf	1.88
2849_8	pdf	1.78
2849_9	pdf	1.46

Documents - reported by the production licence (period for duty of secrecy expired)

Document name	Document format	Document size [MB]
2849_6406_2_3_COMPLETION_LOG	pdf	11.09
2849_6406_2_3_COMPLETION_REPORT	pdf	47.22

Drill stem tests (DST)

Test number	From depth MD [m]	To depth MD [m]	Choke size [mm]
1.0	4832	4806	17.0
2.0	4654	4629	17.5

Test number	Final shut-in pressure [MPa]	Final flow pressure [MPa]	Bottom hole pressure [MPa]	Downhole temperature [°C]
1.0	90.000	89.000	91.000	167
2.0	88.000	81.000	89.000	166

Test number	Oil [Sm3/day]	Gas [Sm3/day]	Oil density [g/cm3]	Gas grav. rel.air	GOR [m3/m3]
1.0	890	892000	0.791	0.720	1003
2.0	1048	777000	0.792	0.720	744





Logs

Log type	Log top depth [m]	Log bottom depth [m]
DPIL MAC DSL	4537	4928
DPIL MAC GR	2833	4545
DPIL MAC GR	4875	5255
DPIL MAC ZDL GR	1405	2845
DPIL ZDL GR	4512	4654
FMT GR	3430	4405
FMT GR	4626	5257
HEXDIP CBIL GR	4537	5243
MRIL GR	4550	5255
MWD - DIR	395	487
MWD - GR RES DIR	487	5258
RCOR GR	3430	4504
SWC GR	4578	4957
ZDL CN DSL	4537	5257
ZDL CN GR	2833	4926

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	482.0	36	484.0	0.00	LOT
INTERM.	18 5/8	1405.0	20	1407.0	1.80	LOT
INTERM.	13 3/8	2834.0	17 1/2	2835.0	1.96	LOT
INTERM.	9 5/8	4538.0	12 1/4	4540.0	2.20	LOT
LINER	7	5258.0	8 1/2	5258.0	0.00	LOT

Drilling mud

Depth MD [m]	Mud weight [g/cm3]	Visc. [mPa.s]	Yield point [Pa]	Mud type	Date measured
680	1.03	16.0		SPUD MUD	
900	1.03	16.0		SPUD MUD	
1413	1.20	18.0		SPUD MUD	
1549	1.30	20.0		KCL MUD	
2060	1.45	27.0		KCL MUD	



2525	1.72	38.0		KCL MUD	
2570	1.72	46.0		KCL MUD	
2848	1.72	44.0		KCL MUD	
2860	1.82	53.0		OIL BASED	
2872	1.82	51.0		OIL BASED	
3170	1.80	47.0		OIL BASED	
3389	1.50	44.0		OIL BASED	
3490	1.80	45.0		OIL BASED	
3580	1.57	41.0		OIL BASED	
3591	1.80	43.0		OIL BASED	
3689	1.57	47.0		OIL BASED	
3753	1.80	41.0		OIL BASED	
3802	1.82	53.0		OIL BASED	
3971	1.64	55.0		OIL BASED	
3975	1.67	54.0		OIL BASED	
4017	1.67	50.0		OIL BASED	
4050	1.67	45.0		OIL BASED	
4054	1.67	55.0		OIL BASED	
4070	1.67	44.0		OIL BASED	
4080	1.80	47.0		OIL BASED	
4087	1.81	43.0		OIL BASED	
4180	1.78	54.0		OIL BASED	
4276	1.80	45.0		OIL BASED	
4378	1.80	50.0		OIL BASED	
4402	1.80	51.0		OIL BASED	
4424	1.80	50.0		OIL BASED	
4448	1.81	48.0		OIL BASED	
4460	1.78	54.0		OIL BASED	
4527	1.81	50.0		OIL BASED	
4550	1.81	48.0		OIL BASED	
4554	1.89	52.0		OIL BASED	
4580	2.00	66.0		OIL BASED	
4593	1.82	55.0		OIL BASED	
4596	1.82	67.0		OIL BASED	
4597	2.00	61.0		OIL BASED	
4598	2.00	64.0		OIL BASED	
4603	2.00	65.0		OIL BASED	
4614	2.00	66.0		OIL BASED	
4626	2.06	80.0		OIL BASED	
4632	2.00	64.0		OIL BASED	



4634	2.00	59.0		OIL BASED	
4635	2.00	69.0		OIL BASED	
4661	2.00	57.0		OIL BASED	
4662	2.06	65.0		OIL BASED	
4671	2.06	69.0		OIL BASED	
4699	2.06	62.0		OIL BASED	
4719	2.06	65.0		OIL BASED	
4728	2.06	66.0		OIL BASED	
4742	2.06	65.0		OIL BASED	
4754	2.06	65.0		OIL BASED	
4777	2.06	66.0		OIL BASED	
4778	2.06	66.0		OIL BASED	
4806	2.06	66.0		OIL BASED	
4806	2.06	65.0		OIL BASED	
4843	2.06	64.0		OIL BASED	
4897	2.06	67.0		OIL BASED	
4926	2.06	65.0		OIL BASED	
4976	2.06	63.0		OIL BASED	
5000	2.06	64.0		OIL BASED	
5020	2.06	63.0		OIL BASED	
5038	2.06	65.0		OIL BASED	
5063	2.06	63.0		OIL BASED	
5066	2.06	65.0		OIL BASED	
5081	2.06	63.0		OIL BASED	
5123	2.06	63.0		OIL BASED	
5169	2.06	71.0		OIL BASED	
5258	2.06	66.0		OIL BASED	
5258	2.06	76.0		OIL BASED	

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]
2849 Formation pressure (Formasjonstrykk)	PDF	0.22
2849 T2 Formation pressure (Formasjonstrykk)	PDF	0.27

