General information

Wellbore name	6406/2-1 R
Type	EXPLORATION
Purpose	WILDCAT
Status	P&A
Factmaps in new window	link to map
Main area	NORWEGIAN SEA
Field	KRISTIN
Discovery	6406/2-1 Lavrans
Well name	6406/2-1
Seismic location	SG 9312 3D- ROW 1396 & COLUMN 1975
Production licence	199
Drilling operator	Saga Petroleum ASA
Drill permit	798-L2
Drilling facility	ROSS ISLE
Drilling days	140
Entered date	21.08.1995
Completed date	07.01.1996
Release date	07.01.1998
Publication date	29.05.2002
Purpose - planned	WILDCAT
Reentry	YES
Reentry activity	TESTING
Content	GAS/CONDENSATE
Discovery wellbore	NO
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]	22.0
Water depth [m]	278.0
Total depth (MD) [m RKB]	5892.0
Final vertical depth (TVD) [m RKB]	5790.0
Maximum inclination [°]	38.1
Bottom hole temperature [°C]	194
Oldest penetrated age	LATE TRIASSIC
Oldest penetrated formation	ÅRE FM
Geodetic datum	ED50
NS degrees	64° 52' 15.19'' N

EW degrees	6° 36' 21.35'' E
NS UTM [m]	7196390.67
EW UTM [m]	386574.36
UTM zone	32
NPDID wellbore	2642

Wellbore history

General

Exploration well 6406/2-1 was drilled on the B-prospect east in the block 6406/2, south of the Smørbukk Field and west of the Trestakk Field on Haltenbanken. The main purpose was to test the B-prospect sandstones of Middle to Early Jurassic age and the presence of hydrocarbons. Further, the reservoir quality at great depth (prognosed TD 5200 m) was to be tested. The main reservoir zones were prognosed to be the Ile and Tilje Formations, both prognosed to consist of mica-bearing sandstones with thin shale layers. The Garn and Tofte Formations, expected to be purer quartz-sandstones and more susceptible to diagenetic quartz cementation, were considered as additional potential.
Possible sandstones were also prognosed at three different levels within the Cromer Knoll Group (in the Lysing and Lange Formations, of Turonian and Cenomanian age), and the well 6406/2-1 was aimed to test these levels within structural closure.

Operations and results

Well 6406/2-1 was spudded on 31 October 1994 with the semi-submersible "Ross Rig" . Due to environmental restrictions in the area, the drilling operations was stopped on 1 April 1995, and the well was temporarily plugged and abandoned on 9 April 1995 at a preliminary TD of 5295 m. Total non-productive time (NPT) for the well was 49,3 days. The reasons for lost time were mainly:
- Core barrel stuck when attempting to pull out of hole with core no. 7
- Leakages on hose between yellow pod and shuttle valve for MPR
- Stuck with 2 radioactive logging tools
- Unsuccessful attempts to log with RCI / FMT tools

The well 6406/2-1 R was reentered 21 August 1995 and reached TD 20 September at 5892 m (5790 mTVD). The production testing of seven Jurassic reservoir levels was started 28 September 1995, and was completed 1 January 1996. The planned TD for the reentry was changed during drilling to 5800 m or 100 m below the Intra Åre Coal Sequence, in order to investigate the reservoir potential of the underlying sandstones.

Well 6406/2-1 was drilled with a spud mud down to 1236 m and KCl mud with ANCO 208 glycols to 5295 m. The 6406/2-1 Re-entry (5295 m - 5892 m) was drilled water based without ANCO 208.

The combined well bore 6406/2-1 + 6406/2-1 R was a record well on the Norwegian sector both as the deepest TD to date and with the longest cored section to date (692.5 m gross, 625 m recovered).

In the Nordland and Hordaland Groups, the well penetrated mainly clay/claystones with some thin sand beds, predominantly non-calcareous. The Rogaland Group comprised tuffaceous claystones with local carbonate cement in the upper part (Tare Formation), and claystones with thin limestone beds in the lower part (Tang Formation). In the Shetland Group, silty claystones with occasional thin beds of sandstone and limestone were drilled in the Springar Formation, whereas the Nise and Kvitnos Formations consisted of silty and sandy claystones with thin beds of sandstone and limestone.
In the Cromer Knoll Group, two of the prognosed sandy intervals were identified; the

Lysing Formation of Late Turonian age and an Intra Lange Sandstone close to the Cenomanian - Albian boundary. Weak oil stain as well as hydrocarbon fluorescence and cut reactions could be traced in cuttings and sidewall cores within these two sandstone intervals. However, the individual sand beds are too thin to constitute any significant reservoir. In addition a sandy interval (Intra Lange Sandstone) was identified in Upper Cenomanian - Lower Turonian sediments. No shows were observed in this interval.
The Upper Jurassic Viking Group was penetrated at 4371 m. It consisted of dark shales, rich in organic content typical for the Spekk Formation, and paler gray mudstones of the Melke Formation
The well proved good reservoir quality in mica-bearing sandstones of the Ile, Tofte, Tilje and the upper part of the Åre Formations, and marginal porosities in the Garn Formation which contained more quartz rich, mature sand. Hydrocarbons were discovered in all reservoir units, and no hydrocarbon contacts were encountered.
Pressure points were measured in the Garn, Ile and Tofte Formations. The formation pressures were slightly higher than hydrostatic. An FMT fluid sample was collected from 4435 m in the Garn Formation. It contained only filtrate and some gas. Two FMT- fluid samples were collected at 4687 m and 4700 m in the Ile Formation. Both contained gas and oil in addition to filtrate. No FMT results were obtained from the Tilje and Åre Formations.

In well 6406/2-1 684.5 m was cored (616.6 m recovered) in the Middle and Lower Jurassic. One core was sampled in well 6406/2-1 R in the lower part of the Åre Formation at 5643-5651,65 m (later log-shifted 11 m downwards). The well was suspended at TD as a gas/condensate discovery.

Testing

Seven drill stem tests were performed.
The test intervals 4,5 and 6 in the Tilje, Tofte and Ile Formations produced gas and condensate. The test intervals 3 and 7 in the middle of the Tilje Formation and the Garn Formation, respectively, produced both gas/condensate and formation water, indicating hydrocarbon contacts within interval 3 (5024-5041 m) and interval 7 (4427-4495 m). The test interval 1 in the upper Åre Formation and test interval 2 in the lower Tilje Formation produced water.

Cores at the Norwegian Offshore Directorate

Core sample number	Core sample - top depth	Core sample - bottom depth	Core sample depth - uom
1	5643.0	5651.7	[m]

Total core sample length [m]	8.7
Cores available for sampling?	YES

Core photos


5643-5648m 5648-5652m

Lithostratigraphy

Top depth [mMD RKB]	Lithostrat. unit
300	NORDLAND GP
300	NAUST FM
1531	KAI FM
1942	HORDALAND GP
1942	BRYGGE FM
2384	ROGALAND GP
2384	TARE FM
2436	TANG FM
2501	SHETLAND GP
2501	SPRINGAR FM
2670	NISE FM
2846	KVITNOS FM
3413	CROMER KNOLL GP
3413	LYSING FM
3440	LANGE FM
3450	LYR FM
4369	VIKING GP
4369	SPEKK FM
4379	MELKE FM
4415	FANGST GP
4415	GARN FM
4554	NOT FM
4599	ILE FM
4706	BÅT GP
4706	ROR FM
4815	TOFTE FM
4858	ROR FM
4908	TILJE FM
5186	ÅRE FM

Composite logs

Document name	Document format	Document size [MB]
2642	pdf	0.77

Geochemical information

Document name	Document format	Document size [MB]
2642_1	pdf	0.70
2642_2	pdf	1.96
2642_3	pdf	0.50

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

Document name	Document format	Document size [MB]
2642_6406_2_1_R_COMPLETION_REPORT_AND_LOG	pdf	40.87

Drill stem tests (DST)

Test number	From depth MD [m]	To depth MD [m]	Choke size [mm]
1.0	5227	5201	6.4
2.0	5170	5099	20.6
3.0	5041	5021	12.7
4.0	4924	4910	12.7
5.0	4858	4816	28.6
6.0	4704	4645	28.6
7.0	4495	4427	25.4

Test number	Final shut-in pressure [MPa]	Final flow pressure [MPa]	Bottom hole pressure [MPa]	Downhole temperature [°C]
1.0	51.000	45.000	51.000	175
2.0	51.000	49.000	51.000	173
3.0	48.000	13.000	53.000	157
4.0	48.000	28.000	52.000	169
5.0	50.000	26.000	52.000	167
6.0	38.000	22.000	51.000	158
7.0	38.000	19.000		157

Test number	Oil [Sm3/day]	Gas [Sm3/day]	Oil density [g/cm3]	Gas grav. rel.air	GOR [m3/m3]
1.0					
2.0					
3.0	22	88000	0.796	0.770	4000
4.0	69	289000	0.783	0.770	4200
5.0	273	788000	0.803	0.770	2700
6.0	247	716300	0.798	0.730	2900
7.0	4		0.800	0.730	

Logs

Log type	Log top depth [m]	Log bottom depth [m]
DLL ZDL CN DGR	5248	5820
DPIL MAC DSL	5250	5880
FMT	5300	5641
VSP	3060	3400
VSP	5170	5755

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
INTERM.	7	5892.0	5 7/8	5892.0	0.00	LOT

Drilling mud

Depth MD [m]	Mud weight [g/cm3]	Visc. [mPa.s]	Yield point [Pa]	Mud type	Date measured
5295	1.25	13.0	10.0	WATER BASED	28.08.1995
5295	1.25	13.0	11.0	WATER BASED	29.08.1995
5298	1.25	12.0	10.0	WATER BASED	30.08.1995
5324	1.25	26.0	12.0	WATER BASED	01.09.1995
5374	1.25	15.0	9.0	WATER BASED	04.09.1995
5393	1.25	16.0	7.0	WATER BASED	06.09.1995
5431	1.25	18.0	10.0	WATER BASED	06.09.1995
5440	1.25	17.0	10.0	WATER BASED	06.09.1995

5461	1.25	19.0	13.0	WATER BASED	06.09.1995
5461	1.25	18.0	13.0	WATER BASED	06.09.1995
5521	1.25	22.0	20.0	WATER BASED	07.09.1995
5580	1.25	23.0	13.0	WATER BASED	08.09.1995
5637	1.25	23.0	13.0	WATER BASED	11.09.1995
5637	1.25	23.0	13.0	WATER BASED	11.09.1995
5653	1.25	21.0	10.0	WATER BASED	11.09.1995
5654	1.25	19.0	7.0	WATER BASED	12.09.1995
5682	1.30	19.0	7.0	WATER BASED	13.09.1995
5684	1.30	24.0	10.0	WATER BASED	14.09.1995

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]
2642_Formation_pressure_(Formasjonstrykk)	pdf	0.28