

**General information**

Wellbore name	6406/2-4 SR
Type	EXPLORATION
Purpose	APPRAISAL
Status	P&A
Factmaps in new window	link to map
Main area	NORWEGIAN SEA
Field	KRISTIN
Discovery	6406/2-1 Lavrans
Well name	6406/2-4
Seismic location	HWM94- INLINE 1500 & CROSSLINE 2063
Production licence	199
Drilling operator	Saga Petroleum ASA
Drill permit	876-L2
Drilling facility	DEEPSEA BERGEN
Drilling days	96
Entered date	12.11.1998
Completed date	15.02.1999
Plugged and abandon date	15.02.1999
Release date	15.02.2001
Publication date	11.04.2003
Purpose - planned	APPRAISAL
Reentry	YES
Reentry activity	DRILLING
Content	GAS/CONDENSATE
Discovery wellbore	NO
1st level with HC, age	MIDDLE JURASSIC
1st level with HC, formation	GARN FM
2nd level with HC, age	EARLY JURASSIC
2nd level with HC, formation	BÅT GP
Kelly bushing elevation [m]	23.0
Water depth [m]	273.5
Total depth (MD) [m RKB]	5080.0
Final vertical depth (TVD) [m RKB]	4969.6
Maximum inclination [°]	25.1
Bottom hole temperature [°C]	177
Oldest penetrated age	EARLY JURASSIC
Oldest penetrated formation	ÅRE FM
Geodetic datum	ED50



NS degrees	64° 47' 58.34" N
EW degrees	6° 32' 29.26" E
NS UTM [m]	7188560.78
EW UTM [m]	383212.30
UTM zone	32
NPDID wellbore	3627

Wellbore history

General

Appraisal well 6406/2-4 S was drilled on the southern part of the Lavrans structure in the eastern part of block 6406/2, south of the Sørbukk Field and west of the Trestakk Field on Haltenbanken. The Lavrans structure is a rotated fault block west of the Trestakk Fault on the Halten Terrace. The purpose of the well was to appraise the southward extension of hydrocarbons in the Garn, Ile and Tofte Formations in the Lavrans structure, and to test separate closures in the Tilje and Åre formations. In addition, the well was planned to test the productivity improvement achievable by hydraulic stimulation. The well should also penetrate two sandy zones of Turonian (Lysing Formation) and Cenomanian/Albian age (Intra Lange sandstone).

Operations and results

The deviated appraisal well 6406/2-4 S was spudded 18 January 1997 with the semi-submersible installation "Deepsea Bergen". It was drilled to 4546 m (4457 m TVD) in the Melke Formation. Mainly because of the weather conditions (41 days of WOW and weather-related problems) drilling of 6406/2-4 S was significantly delayed. Due to environmental restrictions in the area the well had to be suspended on April 5 1997 before the well targets had been reached. Well 6406/2-4 S R was re-entered 12 November at depth 4534 m (4446 m TVD), below the 9 5/8" casing shoe in the initial well, and drilled to final TD at 5080 m (4969 m TVD) in Early Jurassic Åre Formation sediments. The well bores were drilled with KCl mud / spud mud down to 1110 m, with KCl mud and "ANCO 208" glycol from 1110 m to 2260 m, and with oil based "ANCOVERT" mud from 2260 m to final TD.

Down to Base Cretaceous Unconformity the stratigraphy was as expected, the prognosis matched the experienced stratigraphy well. Below ECU, 154 meters of Upper Jurassic shales were penetrated before the drilling had to be stopped. Prognosed thickness of the Upper Jurassic shales was 44 m TVD. High total gas was observed when drilling through the Cretaceous sandy intervals, the Lysing and Lange Formations, but shows were not described in the cuttings.

Well 6406/2-4 S R proved gas/condensate bearing sandstones in the Garn, Tofte and Tilje formations in hydrocarbon-down-to situations. The well penetrated a large fault within the Garn Formation, so that the Ile Formation along with parts of the Garn, most of the Not, the entire Upper Ror and the upper part of the Tofte Formation were faulted out. This fault came on depth as prognosed, but it had considerably larger throw than expected. In addition to this large fault, two smaller faults were penetrated in the Tilje Formation. The quality of the reservoir formations was somewhat lower than expected due to the tectonic influence. In the Tofte Formation, the proximity to the fault has reduced reservoir quality due to fractures and higher degree of cementation. In the Tilje Formation, the best-developed reservoir zones were either fractured or faulted out. The Garn Formation was intensively brecciated and fractured. Disregarding the faults, thickness of the formations approximates those of the neighbouring wells on Lavrans. The Åre Formation gave some gas readings during drilling but was regarded to be



without hydrocarbons. No cores were cut and no wire line samples taken in well bore 6406/2-4 S. In the re-entry a total of ten conventional cores with a total length of 325.1 m were drilled, of which 322.8 m (99.3 %) were recovered. The cores were cut in the Middle Jurassic.

A total of seven fluid samples were acquired in 6406/2-4 S R. Two hydrocarbon samples were taken in the Tofte Formation at 4701 m, four hydrocarbon samples were taken in the Tilje Formation at 4945.2 m and 4881.0 m, and one water sample was acquired in the Tilje Formation at 4835 m. The mud contamination from base oil in the MDT hydrocarbon samples were analysed to be from 25 to 71 % by weight. Well 6406/2-4 S R was permanently abandoned on 15 February 1999 as a gas and condensate appraisal well.

Testing

The Tilje (4874 m - 4904 m) and Tofte (4684 m - 4704 m) formations were production tested. Test 1 in the Tilje Formation produced 237000 m³ gas/day and 93 m³ condensate/day through a 9.53 mm choke. Test 2 in the Tofte Formation produced 42855 m³ gas/day and 18.1 m³ condensate/day through a 7.94 mm choke. The flow capacity of the test was severely influenced by fractures.

Cores at the Norwegian Offshore Directorate

Core sample number	Core sample - top depth	Core sample - bottom depth	Core sample depth - uom
1	4615.0	4619.4	[m]
2	4620.0	4627.9	[m]
3	4692.0	4719.0	[m]
4	4762.0	4818.2	[m]
5	4818.5	4838.2	[m]
6	4838.5	4857.2	[m]
7	4857.2	4898.4	[m]
8	4898.5	4936.1	[m]
9	4939.1	4992.2	[m]
10	4992.2	5046.5	[m]

Total core sample length [m]	320.0
Cores available for sampling?	YES

Core photos



4615-4619m



4620-4625m



4625-4694m



4694-4699m



4699-4704m



4704-4709m



4709-4714m



4714-4719m



4762-4767m



4767-4772m



4772-4777m



4777-4782m



4782-4787m



4787-4792m



4792-4797m



4797-4802m



3802-4807m



4807-4812m



4812-4817m



4817-4821m



3821-4826m



4826-4831m



4831-4836m



4836-4840m



4840-4845m



4845-4850m



4850-4855m



4855-4859m



4859-4864m



4864-4869m



4869-4874m



4874-4879m



4879-4884m



4884-4889m



4889-4894m



4894-4898m



4898-4903m



4903-4908m



4908-4913m



4913-4918m



4918-4923m



4923-4928m



4928-4933m



4933-4937m



4937-4942m



4942-4947m



4947-4952m



4952-4957m



4957-4962m



4962-4967m



4967-4872m



4972-4977m



4977-4982m



4982-4987m



4987-4992m



4992-4996m



4996-5001m



5001-5006m



5006-5011m



5011-5016m



5016-5021m



5021-5026m



5026-5031m



5031-5036m



5036-5041m



5041-5046m



5046-5047m

Lithostratigraphy

Top depth [mMD RKB]	Lithostrat. unit
296	NORDLAND GP
296	NAUST FM
1576	KAI FM
1946	HORDALAND GP
1946	BRYGGE FM
2462	ROGALAND GP
2462	TARE FM
2528	TANG FM
2589	SHETLAND GP
2589	SPRINGAR FM
2725	NISE FM
2913	KVITNOS FM
3485	CROMER KNOLL GP
3485	LYSING FM
3502	LANGE FM
3565	NO FORMAL NAME
3623	LANGE FM
4372	LYR FM
4388	VIKING GP
4388	SPEKK FM
4406	MELKE FM
4612	FANGST GP
4612	GARN FM
4667	NOT FM
4671	BÅT GP
4671	TOFTE FM
4755	TILJE FM
4950	ÅRE FM



Composite logs

Document name	Document format	Document size [MB]
3627	pdf	0.45

Geochemical information

Document name	Document format	Document size [MB]
3627_1	pdf	1.93
3627_2	pdf	0.68

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

Document name	Document format	Document size [MB]
3627_6406_2_4_R_COMPLETION_REPORT	.pdf	32.80

Drill stem tests (DST)

Test number	From depth MD [m]	To depth MD [m]	Choke size [mm]
1.0	4905	4874	9.5
2.0	4704	4684	7.9

Test number	Final shut-in pressure [MPa]	Final flow pressure [MPa]	Bottom hole pressure [MPa]	Downhole temperature [°C]
1.0	44.000	31.000	52.000	
2.0	50.000	12.000	51.000	

Test number	Oil [Sm3/day]	Gas [Sm3/day]	Oil density [g/cm3]	Gas grav. rel.air	GOR [m3/m3]
1.0	93	237000	0.773	0.780	2925
2.0	18	42855	0.789	0.743	2300





Logs

Log type	Log top depth [m]	Log bottom depth [m]
AIT IPLT	4534	5081
CMR ECS HNGS	4534	5060
MDT	4619	5008
MDT	4643	4988
MDT	4945	4945
MSCT	4610	4764
MWD - GR RES DIR	4534	5080
UBI DSI	4534	5060
VSP	4400	5080

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.	9 5/8	4534.0	12 1/4	4534.0	1.87	LOT
LINER	7	5080.0	8 1/2	5080.0	0.00	LOT

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]
3627 Formation pressure (Formasjonstrykk)	pdf	0.28

