

**General information**

Wellbore name	31/2-4 R
Type	EXPLORATION
Purpose	APPRAISAL
Status	SUSPENDED
Factmaps in new window	link to map
Main area	NORTH SEA
Field	TROLL
Discovery	31/2-1 (Troll Vest)
Well name	31/2-4
Seismic location	624445 SP: 195
Production licence	054
Drilling operator	A/S Norske Shell
Drill permit	261-L2
Drilling facility	BORGNY DOLPHIN
Drilling days	180
Entered date	09.10.1980
Completed date	06.04.1981
Release date	06.04.1983
Publication date	15.02.2006
Purpose - planned	WILDCAT
Reentry	YES
Reentry activity	DRILLING
Content	OIL/GAS
Discovery wellbore	NO
1st level with HC, age	LATE JURASSIC
1st level with HC, formation	SOGNEFJORD FM
2nd level with HC, age	MIDDLE JURASSIC
2nd level with HC, formation	FENSFJORD FM
Kelly bushing elevation [m]	25.0
Water depth [m]	336.0
Total depth (MD) [m RKB]	5035.0
Final vertical depth (TVD) [m RKB]	5035.0
Maximum inclination [°]	4
Bottom hole temperature [°C]	141
Oldest penetrated age	EARLY TRIASSIC
Oldest penetrated formation	HEGRE GP
Geodetic datum	ED50
NS degrees	60° 51' 23.57" N



EW degrees	3° 30' 44.33" E
NS UTM [m]	6747077.42
EW UTM [m]	527835.00
UTM zone	31
NPDID wellbore	502

Wellbore history

General

Well 31/2-4 is located some 10 km NNW of the discovery well 31/2-1 in a separate fault compartment near the crest of the Jurassic gas accumulation. This crestal area appeared also to coincide with the culminations of all deeper horizons that could be mapped. The well had two main objectives. The first was to appraise the Jurassic gas accumulation in the 31/2-1 Troll Discovery in a location with nearly maximum gross hydrocarbon column. The well should test lateral variations in this reservoir. The second major objective was to explore deeper Triassic/Palaeozoic Formations. The well would test possible hydrocarbon accumulations under the Late Jurassic Troll reservoir, explore possible pre-Jurassic source rocks, and provide geological ages for deep horizons and thus improve the regional geological setting.

TD of the well was proposed to be 5000 m below sea level or in Palaeozoic formations whatever came first.

Well 31/2-4 was originally drilled with Borgny Dolphin down to 815 m in 1980. The well was however suspended on 13 September 1980 due to a blow out on 34/10-10, where Borgny Dolphin's services were immediately required.

Operations and results

Well 31/2-4 was re-entered (31/2-4 R) with the semi-submersible installation Borgny Dolphin on 9 October 1980 and drilled to TD at 5035 m in Early Triassic sediments of the Hegre Group. The well bore deviation did not exceed 4 deg and at 4693 m, the deepest survey point reported, there was only 2 m difference between drilled and true vertical depth. The top hole down to 815 m had previously been drilled with seawater and hi-vis pills. From 815 m to 1280 m the well was drilled with KC/polymer mud, from 1280 m to 1951 m it was drilled with KCl/polymer converting to gel/lignosulphonate, from 1951 m to 4029 m it was drilled with seawater/gel/dispersed lignosulphonate, and from 4029 m to TD it was drilled with a gypsum/lignosulphonate mud.

The top of the gas-bearing reservoir was found at 1364.5 m. The accurate pick of the GOC from logs was hampered severely by lithology effects placing the GOC somewhere between 1567 and 1573 m, with 1568 m as a likely place. A depth of 1572 m is however, more consistent with other wells in the field. OWC was found at 1580 m.

Lithologically, the reservoir sequence in 31/2-4 R is similar to that encountered in earlier wells in the block. A largely unconsolidated high porosity - high permeability sand occurred in the top part of the reservoir (Sognefjord Formation). This was underlain by a finer grained, better consolidated, but strongly micaceous sandstone (Heather Formation), in which porosity was somewhat reduced and permeability was low. Beneath this micaceous interval was a zone of more variable lithology, comprising interbeds of fine, micaceous sands and coarser cleaner sands (Fensfjord Formation). Thin (generally less than 1 m thick) carbonate cemented bands occurred throughout the reservoir and formed very low porosity - permeability horizons. Carbonate cementation did not appear to be restricted to any one particular litho-type, and the individual bands were not believed to be of significant lateral extent, (lateral contacts between cemented and non-



cemented lithologies have been cored).

The seal in 31/2-4 is formed by a thick sequence of Palaeocene claystones. Reworked Late Cretaceous fauna occur in these claystones immediately above the reservoir.

No significant hydrocarbon indications were seen in the section below the main Jurassic accumulation. The well drilled Triassic sediments from 2422 m (Hegre Group) to TD. The upper section down to 3345 m was dominantly claystones/siltstones with interbedded sandstones. The lithology below 3345 was dominantly sandstone. One RFT run acquired pressure data points over the Jurassic reservoir section and two more runs acquired twelve good pressure points from the Early Jurassic to Triassic formations from 2142 m to 4969 m. The latter two runs showed two hydrostatic water gradients with a break somewhere between 2713 m and 3262 m. The break towards a higher gradient could represent a more saline water in the deeper section. An RFT gas sample was taken at 1566 m, just above the anticipated GOC. An extensive coring programme was carried out with a total of 29 recovered cores. Top coring point was in the Paleocene cap rock above the reservoir, and coring continued over the entire hydrocarbon bearing Late/Middle Jurassic reservoir section. A bottom hole core (core no 29) was taken at TD in the well.

After Logging at TD the rig went on hire to Shell UK Exploration and Production. The well was suspended on 6 April 1981 for possible testing and abandonment at a later stage. The well was classified as a gas and oil appraisal well. **Testing**

No drill stem test was performed.

Cores at the Norwegian Offshore Directorate

Core sample number	Core sample - top depth	Core sample - bottom depth	Core sample depth - uom
1	1320.0	1325.7	[m]
2	1326.0	1326.5	[m]
3	1338.0	1347.0	[m]
4	1347.0	1357.0	[m]
5	1365.0	1378.0	[m]
6	1379.0	1397.0	[m]
7	1397.0	1410.0	[m]
8	1410.0	1415.0	[m]
9	1415.0	1425.0	[m]
10	1426.5	1426.7	[m]
11	1443.5	1452.5	[m]
12	1452.5	1454.2	[m]
13	1454.5	1468.3	[m]
14	1472.5	1479.5	[m]
15	1482.5	1483.2	[m]
16	1484.5	1490.0	[m]
17	1490.0	1506.8	[m]
18	1508.0	1524.6	[m]



19	1526.0	1543.3	[m]
20	1544.0	1562.0	[m]
21	1562.0	1566.9	[m]
22	1567.0	1582.8	[m]
23	1585.0	1599.2	[m]
24	1603.0	1606.6	[m]
25	1607.0	1621.0	[m]
26	1621.0	1626.1	[m]
27	1627.0	1644.4	[m]
28	1645.0	1662.9	[m]
29	5025.0	5033.4	[m]

Total core sample length [m]	291.8
Cores available for sampling?	YES

Core photos



1320-1323m



1323-1325m



1325-1326m



1326-1327m



1338-1340m



1340-1343m



1343-1346m



1346-1347m



1347-1349m



1349-1352m



1352-1355m



1355-1357m



1365-1367m



1367-1370m



1370-1373m



1373-1375m



1375-1378m



1379-1381m



1381-1384m



1384-1387m



1387-1389m



1389-1392m



1392-1395m



1395-1397m



1397-1399m



1399-1402m



1402-1405m



1405-1407m



1410-1412m



1412-1415m



1415-1418m



1418-1420m



1420-1423m



1423-1425m



1426-1427m



1443-1446m



1446-1448m



1448-1451m



1451-1452m



1452-1454m



1454-1457m



1457-1459m



1459-1462m



1462-1465m



1465-1468m



1468-1468m



1472-1475m



1475-1477m



1477-1479m



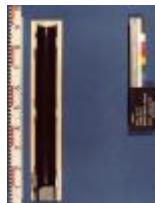
1482-1483m



1484-1487m



1487-1489m



1489-1489m



1490-1492m



1492-1495m



1495-1498m



1498-1500m



1500-1503m



1503-1506m



1506-1506m



1508-1510m



1510-1513m



1508-1516m



1516-1518m



1518-1521m



1521-1524m



1521-1524m



1524-1525m



1526-1528m



1528-1531m



1531-1534m



1534-1536m



1536-1539m



1539-1542m



1542-1543m



1544-1546m



1546-1549m



1549-1552m



1552-1554m



1554-1557m



1557-1560m



1560-1562m



1562-1564m



1564-1566m



1567-1569m



1569-1572m



1572-1575m



1575-1577m



1577-1580m



1580-1582m



1585-1587m



1587-1590m



1590-1593m



1593-1595m



1595-1598m



1598-1599m



1603-1605m



1605-1606m



1607-1609m



1609-1612m



1612-1615m



1615-1617m



1617-1620m



1620-1621m



1621-1623m



1623-1626m



1627-1629m



1629-1632m



1632-1635m



1635-1637m



1637-1640m



1640-1643m



1643-1644m



1647-1650m



1650-1653m



1653-1655m



1655-1658m



1658-1661m



1661-1662m



5025-5027m



5027-5030m



5030-5033m



5033-5034m

Lithostratigraphy

Top depth [mMD RKB]	Lithostrat. unit
361	NORDLAND GP
494	NO FORMAL NAME
528	NO FORMAL NAME
724	HORDALAND GP
1203	ROGALAND GP
1203	BALDER FM
1234	SELE FM
1256	LISTA FM
1357	VÅLE FM



1365	VIKING GP
1365	SOGNEFJORD FM
1460	HEATHER FM
1520	FENSFJORD FM
1625	KROSSFJORD FM
1710	HEATHER FM
1784	BRENT GP
1902	DUNLIN GP
1902	DRAKE FM
2008	COOK FM
2107	AMUNDSEN FM
2126	JOHANSEN FM
2241	AMUNDSEN FM
2256	STATFJORD GP
2422	HEGRE GP

Composite logs

Document name	Document format	Document size [MB]
502	pdf	1.04

Documents - older Norwegian Offshore Directorate WDSS reports and other related documents

Document name	Document format	Document size [MB]
502 01 WDSS General Information	pdf	0.09

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	446.0	36	450.0	0.00	LOT
SURF.COND.	20	807.0	26	815.0	1.71	LOT
LINER	16	1272.0	22	1280.0	1.71	LOT
INTERM.	13 3/8	1927.0	15 3/4	1946.0	0.00	LOT
INTERM.	9 5/8	3982.0	12 1/4	4029.0	0.00	LOT
OPEN HOLE		5035.0	8 1/2	5035.0	0.00	LOT



**Drilling mud**

Depth MD [m]	Mud weight [g/cm ³]	Visc. [mPa.s]	Yield point [Pa]	Mud type	Date measured
820	1.56			seawater	
1665	1.62			seawater	
2000	1.46			seawater	
2310	1.46			seawater	
3480	1.46			seawater	
3640	1.44			seawater	