

**General information**

|                                    |                                    |
|------------------------------------|------------------------------------|
| Wellbore name                      | 31/6-1                             |
| Type                               | EXPLORATION                        |
| Purpose                            | WILDCAT                            |
| Status                             | P&A                                |
| Factmaps in new window             | <a href="#">link to map</a>        |
| Main area                          | NORTH SEA                          |
| Field                              | <a href="#">TROLL</a>              |
| Discovery                          | <a href="#">31/6-1 (Troll Øst)</a> |
| Well name                          | 31/6-1                             |
| Seismic location                   | ST 8007 - 123 SP 1175              |
| Production licence                 | <a href="#">085</a>                |
| Drilling operator                  | Norsk Hydro Produksjon AS          |
| Drill permit                       | 381-L                              |
| Drilling facility                  | <a href="#">NORTRYM</a>            |
| Drilling days                      | 106                                |
| Entered date                       | 15.07.1983                         |
| Completed date                     | 28.10.1983                         |
| Release date                       | 28.10.1985                         |
| Publication date                   | 15.02.2006                         |
| Purpose - planned                  | WILDCAT                            |
| Reentry                            | NO                                 |
| Content                            | OIL/GAS                            |
| Discovery wellbore                 | YES                                |
| 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]                    | 302.0                              |
| Total depth (MD) [m RKB]           | 4070.0                             |
| Final vertical depth (TVD) [m RKB] | 4070.0                             |
| Maximum inclination [°]            | 6.25                               |
| Bottom hole temperature [°C]       | 132                                |
| Oldest penetrated age              | PRE-DEVONIAN                       |
| Oldest penetrated formation        | BASEMENT                           |
| Geodetic datum                     | ED50                               |
| NS degrees                         | 60° 38' 44.89" N                   |
| EW degrees                         | 3° 40' 52.28" E                    |



|                |            |
|----------------|------------|
| NS UTM [m]     | 6723687.94 |
| EW UTM [m]     | 537253.60  |
| UTM zone       | 31         |
| NPDID wellbore | 22         |

## Wellbore history

### General

The primary objectives of the wildcat 31/6-1 was to test Late and Middle Jurassic sandstones on the main culmination of the Troll east structure in the western part of block 31/6. Secondary objectives were Middle to Early Jurassic and Triassic sandstones and a possible sandstone reservoir of pre-Triassic age within a set of tilted fault blocks buried by Triassic strata. The Troll east structure is a large tilted fault block containing Jurassic and older strata. The closure

at Sognefjord Formation level is delineated by a flatspot covering most of the 31/6 block. The flatspot was expected to be a gas/fluid contact evident on the seismic and penetrated by nine wells in the Troll West area to the NNW in block 31/2. Planned TD of the well was 3800 m into rocks of pre-Triassic (? Devonian age).

### Operations and results

Wildcat well 31/6-1 was spudded with the semi-submersible installation Nortrym on 15 July 1983 and drilled to TD at 4070 m in pre-Devonian basement rock. Problems with getting logging tools past the 30" casing shoe occurred due to gumbo problems. Further drilling went forth without major problems. The well was drilled with spud mud down to 425 m, with seawater / prehydrated gel and hi-vis pills from 425 m to 749 m, and with KCl/polymer/PHPA mud from 749 m to TD

The total net sand in the Viking Group (1352-1805 m) found to be 424.25 m giving a net/gross ratio of 0.94 m with an average porosity of 27.5%. The Sognefjord Formation (1352-1488 m), the Heather Formation Unit B, (1488-1517.5 m) and the upper part of the Fensfjord Formation were found gas bearing from 1352 to 1571 m where the gas/oil contact was found. Below this a thin (3 m) oil zone was present with an oil/water contact at approximately 1574 m. The hydrocarbon-bearing reservoir consisted of very fine to fine grained sandstones, occasionally medium to coarse. They were generally friable to loose with a few tight calcite cemented stringers. The gross hydrocarbon column is 222 m and the net pay was calculated to be 198 m with an average porosity of 28.7% and an average water saturation of 19.1%.

Triassic rocks (Hegre Group) were encountered at 2155.5 m. The basal part of the Triassic was characterized by homogenous shales, which were easily distinguished on wire line logs by their high gamma ray (100 - 120 API units). The shales are moderate brown to red brown, micromicaceous, silty and predominantly much more calcareous than the overlying interval. This interval has been dated as Scythian to Anisian down to 3925 m, (?) Scythian to 3978 m and indeterminate down to crystalline basement rocks of indeterminate age at 4013 m. The middle to lower Jurassic and Triassic sandstones were found water bearing.

FMT pressure recordings and sampling were performed over the reservoir interval. A few pressure readings were also taken in the Cook Formation (Dunlin Group), but these were invalid and were not used for pressure gradient evaluations. The valid data gave a gas gradient of 0.012 bar/m (0.053 psi/ft) with an underlying water gradient of 0.099 bar/m (0.437 psi/ft). The interposed oil gradient is estimated to be 0.086 bar/m (0.38 psi/ft). FMT fluid samples were taken at 1371 m, (gas) 1444.6 m (gas), 1564.0 m (gas), 1564.6 m (gas), 1570.2 m (gas and water/mud filtrate), 1573.6 m (gas, 0.75 l oil, and



water/mud filtrate), and 1576.5 m (no gas, 8.9 l water/mud filtrate). A total of 20 cores were cut continuously from the Heather Formation siltstone interval below the Draupne Formation down into the Fensfjord Formation sandstones, across the OWC in core no 17. A total of 235.4 m core was recovered. One 0.3 m core (core no 20) was cut in gneiss at TD. In addition to this, 225 sidewall cores were successfully recovered.

The well was permanently abandoned on as a gas and oil discovery

### Testing

Two production tests were successfully performed over two intervals in the gas zone. Both tests were gravel pack completions. DST No 1 (1562.5 - 1567.5 m) in the Fensfjord Formation in the lower part of the gas zone, produced 842000 Sm<sup>3</sup>/day of 0.635 gravity gas (air =1) through a 22.2 mm choke (56/64"). DST No 2 (1435 - 1441 m) was performed in the lower part of the Sognefjord Formation and flowed 733000 Sm<sup>3</sup> /day of gas through a 19 mm (48/64") choke. Gas gravity was 0.650. The pore pressure at the top of the reservoir was measured to be 156.06 bar (2263.5 psi). Maximum temperature recorded during DST1 was 69.4 deg C. Maximum temperature recorded during DST 2 was 64.4 deg C. This correspond to a ca 54 deg C/km linear gradient from the sea floor (assumed at 4 deg C) to top reservoir. This is a very high gradient compared to wells outside of the Troll field.

### Cuttings at the Norwegian Offshore Directorate

| Cutting sample, top depth [m] | Cutting samples, bottom depth [m] |
|-------------------------------|-----------------------------------|
| 430.00                        | 4070.00                           |

|                                  |    |
|----------------------------------|----|
| Cuttings available for sampling? | NO |
|----------------------------------|----|

### Cores at the Norwegian Offshore Directorate

| Core sample number | Core sample - top depth | Core sample - bottom depth | Core sample depth - uom |
|--------------------|-------------------------|----------------------------|-------------------------|
| 2                  | 1349.0                  | 1350.0                     | [m ]                    |
| 3                  | 1352.5                  | 1361.0                     | [m ]                    |
| 4                  | 1361.5                  | 1370.7                     | [m ]                    |
| 5                  | 1371.0                  | 1383.0                     | [m ]                    |
| 6                  | 1389.0                  | 1407.3                     | [m ]                    |
| 7                  | 1407.5                  | 1424.2                     | [m ]                    |
| 8                  | 1425.5                  | 1440.5                     | [m ]                    |
| 9                  | 1443.5                  | 1461.5                     | [m ]                    |
| 10                 | 1461.0                  | 1477.1                     | [m ]                    |
| 11                 | 1479.5                  | 1497.8                     | [m ]                    |
| 12                 | 1498.0                  | 1514.6                     | [m ]                    |
| 13                 | 1515.5                  | 1534.0                     | [m ]                    |
| 14                 | 1534.0                  | 1542.7                     | [m ]                    |
| 15                 | 1543.0                  | 1555.8                     | [m ]                    |



|    |        |        |      |
|----|--------|--------|------|
| 16 | 1561.0 | 1561.9 | [m ] |
| 17 | 1563.0 | 1581.8 | [m ] |
| 18 | 1581.5 | 1588.5 | [m ] |
| 19 | 1588.5 | 1605.5 | [m ] |
| 20 | 4070.0 | 4070.8 | [m ] |

|                               |       |
|-------------------------------|-------|
| Total core sample length [m]  | 234.0 |
| Cores available for sampling? | YES   |

**Core photos**

1349-1350m



1352-1357m



1357-1361m



1361-1366m



1366-1370m



1371-1376m



1376-1381m



1381-1384m



1389-1394m



1394-1399m



1399-1404m



1404-1407m



1407-1412m



1412-1417m



1417-1422m



1422-1424m



1425-1430m



1430-1435m



1435-1440m



1443-1448m



1448-1453m



1453-1458m



1458-1461m



1461-1466m



1466-1471m



1471-1476m



1476-1477m



1479-1484m



1484-1489m



1489-1494m



1494-1497m



1498-1503m



1503-1508m



1508-1513m



1513-1514m



1515-1520m



1520-1525m



1525-1530m



1530-1534m



1534-1539m



1539-1542m



1543-1548m



1548-1553m



1553-1555m



1561-1562m



1563-1568m



1568-1573m



1573-1578m



1578-1581m



1581-1586m



1586-1588m



1588-1593m



1593-1598m



1598-1603m



1603-4070m

**Palynological slides at the Norwegian Offshore Directorate**

| Sample depth | Depth unit | Sample type | Laboratory |
|--------------|------------|-------------|------------|
| 440.0        | [m]        | DC          | RRI        |
| 540.0        | [m]        | DC          | RRI        |
| 640.0        | [m]        | DC          | RRI        |
| 740.0        | [m]        | DC          | RRI        |
| 840.0        | [m]        | DC          | RRI        |
| 935.0        | [m]        | DC          | RRI        |
| 1035.0       | [m]        | DC          | RRI        |
| 1135.0       | [m]        | DC          | RRI        |
| 1201.0       | [m]        | SWC         | IKU        |
| 1210.0       | [m]        | SWC         | IKU        |
| 1217.0       | [m]        | SWC         | IKU        |
| 1221.0       | [m]        | SWC         | IKU        |
| 1225.0       | [m]        | SWC         | IKU        |
| 1230.0       | [m]        | SWC         | IKU        |
| 1235.0       | [m]        | DC          | RRI        |
| 1236.0       | [m]        | SWC         | IKU        |
| 1239.0       | [m]        | SWC         | IKU        |
| 1242.0       | [m]        | SWC         | IKU        |
| 1245.0       | [m]        | SWC         | IKU        |
| 1248.0       | [m]        | SWC         | IKU        |
| 1251.0       | [m]        | SWC         | IKU        |
| 1253.0       | [m]        | SWC         | IKU        |
| 1255.0       | [m]        | SWC         | IKU        |
| 1258.0       | [m]        | SWC         | IKU        |
| 1262.0       | [m]        | SWC         | IKU        |
| 1268.0       | [m]        | SWC         | IKU        |
| 1271.0       | [m]        | SWC         | IKU        |
| 1274.0       | [m]        | SWC         | IKU        |
| 1277.0       | [m]        | SWC         | IKU        |



|        |     |     |     |
|--------|-----|-----|-----|
| 1280.0 | [m] | SWC | IKU |
| 1283.0 | [m] | SWC | IKU |
| 1289.0 | [m] | SWC | IKU |
| 1292.0 | [m] | SWC | IKU |
| 1295.0 | [m] | SWC | IKU |
| 1298.0 | [m] | SWC | IKU |
| 1301.0 | [m] | SWC | IKU |
| 1304.0 | [m] | SWC | IKU |
| 1310.0 | [m] | SWC | IKU |
| 1324.0 | [m] | SWC | IKU |
| 1329.0 | [m] | SWC | IKU |
| 1332.0 | [m] | DC  | RRI |
| 1335.0 | [m] | SWC | IKU |
| 1340.0 | [m] | SWC | IKU |
| 1346.0 | [m] | SWC | IKU |
| 1350.0 | [m] | SWC | IKU |
| 1430.2 | [m] | C   | RRI |
| 1572.4 | [m] | C   | RRI |
| 1606.0 | [m] | SWC | IKU |
| 1616.0 | [m] | SWC | IKU |
| 1625.0 | [m] | SWC | IKU |
| 1644.5 | [m] | SWC | IKU |
| 1670.0 | [m] | DC  | RRI |
| 1671.0 | [m] | SWC | IKU |
| 1681.0 | [m] | SWC | IKU |
| 1690.0 | [m] | SWC | IKU |
| 1716.0 | [m] | SWC | IKU |
| 1734.0 | [m] | SWC | IKU |
| 1787.6 | [m] | SWC | IKU |
| 1808.0 | [m] | SWC | IKU |
| 1810.0 | [m] | DC  | RRI |
| 1818.5 | [m] | SWC | IKU |
| 1836.0 | [m] | SWC | IKU |
| 1850.0 | [m] | DC  | RRI |
| 1851.0 | [m] | SWC | IKU |
| 1863.0 | [m] | SWC | IKU |
| 1870.0 | [m] | SWC | RRI |
| 1874.0 | [m] | SWC | IKU |
| 1880.0 | [m] | DC  | RRI |
| 1897.0 | [m] | SWC | IKU |



|        |     |     |     |
|--------|-----|-----|-----|
| 1900.0 | [m] | DC  | RRI |
| 1913.0 | [m] | SWC | IKU |
| 1920.0 | [m] | DC  | RRI |
| 1924.0 | [m] | SWC | IKU |
| 1930.0 | [m] | DC  | RRI |
| 1933.0 | [m] | SWC | IKU |
| 1940.5 | [m] | C   | RRI |
| 1944.0 | [m] | SWC | IKU |
| 1950.0 | [m] | DC  | RRI |
| 1956.0 | [m] | SWC | IKU |
| 1960.0 | [m] | DC  | RRI |
| 1960.7 | [m] | DC  | RRI |
| 1972.0 | [m] | SWC | IKU |
| 1980.5 | [m] | SWC | IKU |
| 2106.0 | [m] | SWC | IKU |
| 2142.0 | [m] | SWC | IKU |
| 2170.0 | [m] | DC  | RRI |
| 3552.0 | [m] | DC  | OD  |
| 3587.0 | [m] | DC  | OD  |
| 3622.0 | [m] | DC  | OD  |
| 3632.0 | [m] | DC  | OD  |
| 4047.0 | [m] | DC  | OD  |

**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       | DST1          | 1562.50          | 1567.50             | WATER       | 29.09.1983 - 00:00 | YES               |
| DST       | DST2          | 1435.00          | 1441.00             | CONDE NSATE | 18.10.1983 - 00:00 | YES               |
| DST       | DST 2         | 1441.00          | 1435.00             | CONDE NSATE | 18.10.1983 - 00:00 | YES               |

**Lithostratigraphy**

| Top depth [mMD RKB] | Lithostrat. unit             |
|---------------------|------------------------------|
| 327                 | <a href="#">NORDLAND GP</a>  |
| 531                 | <a href="#">HORDALAND GP</a> |



|      |                                  |
|------|----------------------------------|
| 531  | <a href="#">NO FORMAL NAME</a>   |
| 579  | <a href="#">NO FORMAL NAME</a>   |
| 972  | <a href="#">ROGALAND GP</a>      |
| 972  | <a href="#">BALDER FM</a>        |
| 1084 | <a href="#">SELE FM</a>          |
| 1194 | <a href="#">LISTA FM</a>         |
| 1232 | <a href="#">SHETLAND GP</a>      |
| 1232 | <a href="#">HARDRÅDE FM</a>      |
| 1236 | <a href="#">UNDIFFERENTIATED</a> |
| 1304 | <a href="#">CROMER KNOLL GP</a>  |
| 1313 | <a href="#">VIKING GP</a>        |
| 1313 | <a href="#">DRAUPNE FM</a>       |
| 1335 | <a href="#">HEATHER FM</a>       |
| 1352 | <a href="#">SOGNEFJORD FM</a>    |
| 1488 | <a href="#">HEATHER FM</a>       |
| 1518 | <a href="#">FENSFJORD FM</a>     |
| 1720 | <a href="#">KROSSFJORD FM</a>    |
| 1776 | <a href="#">HEATHER FM</a>       |
| 1805 | <a href="#">BRENT GP</a>         |
| 1835 | <a href="#">DUNLIN GP</a>        |
| 1835 | <a href="#">DRAKE FM</a>         |
| 1962 | <a href="#">COOK FM</a>          |
| 1981 | <a href="#">JOHANSEN FM</a>      |
| 2083 | <a href="#">AMUNDSEN FM</a>      |
| 2111 | <a href="#">STATFJORD GP</a>     |
| 2156 | <a href="#">HEGRE GP</a>         |
| 3978 | <a href="#">UNDEFINED GP</a>     |
| 4014 | <a href="#">BASEMENT</a>         |

**Composite logs**

| Document name      | Document format | Document size [MB] |
|--------------------|-----------------|--------------------|
| <a href="#">22</a> | pdf             | 0.63               |

**Geochemical information**





| Document name        | Document format | Document size [MB] |
|----------------------|-----------------|--------------------|
| <a href="#">22_1</a> | pdf             | 0.96               |
| <a href="#">22_2</a> | pdf             | 0.25               |
| <a href="#">22_3</a> | pdf             | 6.56               |

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

| Document name                                  | Document format | Document size [MB] |
|------------------------------------------------|-----------------|--------------------|
| <a href="#">22_01_WDSS_General_Information</a> | pdf             | 0.27               |
| <a href="#">22_02_WDSS_completion_log</a>      | pdf             | 0.39               |

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

| Document name                                                     | Document format | Document size [MB] |
|-------------------------------------------------------------------|-----------------|--------------------|
| <a href="#">22_01_31_6_1_Completion_Report_and_Completion_log</a> | pdf             | 22.24              |

**Drill stem tests (DST)**

| Test number | From depth MD [m] | To depth MD [m] | Choke size [mm] |
|-------------|-------------------|-----------------|-----------------|
| 1.0         | 1562              | 1568            | 22.2            |
| 2.0         | 1435              | 1441            | 19.0            |

| Test number | Final shut-in pressure [MPa] | Final flow pressure [MPa] | Bottom hole pressure [MPa] | Downhole temperature [°C] |
|-------------|------------------------------|---------------------------|----------------------------|---------------------------|
| 1.0         |                              |                           |                            |                           |
| 2.0         |                              |                           |                            |                           |

| Test number | Oil [Sm3/day] | Gas [Sm3/day] | Oil density [g/cm3] | Gas grav. rel.air | GOR [m3/m3] |
|-------------|---------------|---------------|---------------------|-------------------|-------------|
| 1.0         |               | 842000        |                     | 0.635             |             |
| 2.0         |               | 733000        |                     | 0.630             |             |





## Logs

| Log type                  | Log top depth [m] | Log bottom depth [m] |
|---------------------------|-------------------|----------------------|
| CBL VOL                   | 800               | 1310                 |
| CDL CNL GR CAL            | 1950              | 4067                 |
| CDL SPECTRALOG CNL GR CAL | 1295              | 1978                 |
| CFL CNL GR CAL            | 425               | 1318                 |
| CST                       | 785               | 1312                 |
| CST                       | 1313              | 1887                 |
| CST                       | 1606              | 1730                 |
| CST                       | 1729              | 1980                 |
| CST                       | 2067              | 4018                 |
| CST                       | 2142              | 3823                 |
| DIFL LSBHC GR SP          | 435               | 4070                 |
| DLL MLL                   | 1310              | 1604                 |
| FMT                       | 1338              | 1594                 |
| FMT                       | 1338              | 1594                 |
| FMT                       | 1371              | 0                    |
| FMT                       | 1444              | 0                    |
| FMT                       | 1564              | 0                    |
| FMT                       | 1564              | 0                    |
| FMT                       | 1570              | 0                    |
| FMT                       | 1573              | 0                    |
| FMT                       | 1576              | 0                    |
| HRD                       | 748               | 4069                 |
| PROLOG                    | 1300              | 1700                 |
| PROLOG                    | 1300              | 1555                 |
| VSP                       | 573               | 4070                 |

## 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                  | 424.0            | 36                | 426.0          | 0.00                     | LOT                 |
| SURF.COND.  | 20                  | 748.0            | 26                | 765.0          | 1.46                     | LOT                 |
| INTERM.     | 13 3/8              | 1310.0           | 17 1/2            | 1325.0         | 1.68                     | LOT                 |
| INTERM.     | 9 5/8               | 1967.0           | 12 1/4            | 1980.0         | 1.51                     | LOT                 |
| OPEN HOLE   |                     | 4070.0           | 8 3/8             | 4070.0         | 0.00                     | LOT                 |

**Drilling mud**

| Depth MD [m] | Mud weight [g/cm3] | Visc. [mPa.s] | Yield point [Pa] | Mud type | Date measured |
|--------------|--------------------|---------------|------------------|----------|---------------|
| 440          | 1.13               | 100.0         |                  | seawater |               |
| 500          | 1.07               | 61.0          |                  | seawater |               |
| 1000         | 1.19               | 46.0          |                  | seawater |               |
| 1200         | 1.23               | 45.0          |                  | seawater |               |
| 1340         | 1.31               | 44.0          |                  | seawater |               |
| 1980         | 1.10               | 41.0          |                  | seawater |               |
| 2400         | 1.10               | 42.0          |                  | seawater |               |
| 3100         | 1.11               | 41.0          |                  | seawater |               |
| 3800         | 1.11               | 46.0          |                  | seawater |               |
| 4070         | 1.11               | 42.0          |                  | seawater |               |

**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] |
|---------------------------------------------------------|-----------------|--------------------|
| <a href="#">22 Formation pressure (Formasjonstrykk)</a> | pdf             | 0.22               |

