



LITHOSTRATIGRAPHY & HISTORY FOR WELL: 31/6-1

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 productivity 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 Sm3/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 Sm3 /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