



Wellbore History

GENERAL

Well 2/2-2 was located near the crest of an elongated salt-induced domal structure in the NW corner of the block. The main target was the Late Jurassic Ula Formation shallow marine sandstone. Sandstones of Middle Jurassic and Late Triassic age were possible secondary targets, having the same structural definition as the Ula sand. Secondary objectives were further represented by the Late Cretaceous chalk and a sandstone of Oligocene age.

According to the license agreement, the well should be drilled into the Triassic, salt or a maximum depth of 5000 m whatever came first. The well reached a TD of 3124 m in Permian anhydrites thus fulfilling the work commitment.

OPERATIONS AND RESULTS

Well 2/2-2 was spudded with the semi-submersible installation Dyvi Alpha on 4 April 1992 and drilled to TD at 3124 m in the Late Permian Zechstein Group. When drilling the 36" hole, the pipe stuck. After the pipe was worked free, the drilling continued. The well took a kick at 2425 m. The well was drilled with seawater and bentonite down to 715 m, with polymer/gypsum/"SST 202" mud from 715 m to 1965 m, and with lignite mud from 1965 m to TD.

The well penetrated porous layers in the Oligocene, the Cretaceous and the Jurassic. A full suit of logs was run in these sections. In the interval 1978-2057 m of the Oligocene, a bioturbated and cross-laminated very fine sandstone, interbedded with siltstone and shale was found (the Vade Formation). The upper part of the sand was found gas bearing from 1978 m down to a GWC at 2002 m. Net pay thickness was 14 metres. A segregated RFT gas sample was taken at 1996.4 m. The sand has a porosity of 24% with a shale content of 25%. A water saturation of 40% was estimated. The core analysis gave an average porosity of 27 %, but this is probably too high because the core-plugs were drilled mainly in clean silt/sandstone intervals. Below the gas water contact, a net sand thickness of 13 m with a porosity of 23% was calculated. The Cretaceous chalk, 2512 m to 2754 m, was water bearing. A net thickness of 111 m was counted with an average porosity of 22%. The chalk is clean, but large washouts indicate poor consolidation. The Middle Jurassic Sandstone, from 2909 m to 2995 m (Mandal and Bryne Formations), was found water bearing. The sand turned out to have a shale content of 27%. The porosity averaged 15%, and the net sand thickness is 16 m. Two cores were cut in the 12 1/4" section, one in the Oligocene and one in the Middle Jurassic. The RFT-measurements indicated a reservoir pressure of 431.2 bar (6254 psig) at 2959 m. This gave a gradient to surface of 0.15 bar/m (0.65 psi/ft), which shows the Middle Jurassic Sandstone to be over-pressured. The average permeability calculated from the RFT-measurements was 0.5 mD.

The well was permanently abandoned on 27 August 1982 as a gas discovery.

TESTING

The well was tested over the interval 1980 m to 1988 m in the Oligocene sand. Initial flow lasted 794 minutes. Flow-rates varied due to technical problems with the choke. Problems with plugging of the choke and hydrate build-up also occurred. A stabilized flow rate of 280-103 sm3/d (10 mm scf/d) was obtained through 9.53 mm (3/8") choke, at a drawdown of 6.3 bar (92 psi). The corresponding wellhead pressure was 178.7 bar (2541 psig). The analysis gave a reservoir pressure of 216.9 bar (3145 psia) at 1947 m and a permeability of 104 mD, which is in good agreement with the RFT-measurements. The pressure corresponds to a gradient of 0.11 bar/m (0.49 psi/m) to the surface, which is close to the hydrostatic gradient. The reservoir temperature is 82.2 deg C (180 deg F). The produced gas was very dry with a specific gravity of 0.57 (air = 1). The fourth flow period was designed to define the minimum flow-rate at which sand production occurred. Produced solids were found to be a mixture of cement and mud particles. The produced gas was very high and is now being burned off. No oil or condensate, formation water or H2S was noticed during the test.

LITHOSTRATIGRAPHY & HISTORY FOR WELL: 2/2-2