



Wellbore History

GENERAL

Well 7228/2-1 S is located on the western margin of the Nordkapp Basin close to the Nyslepp Fault Complex. It was designed to drill a large salt induced anticline that is bisected by a major north - south trending fault. Due to the large Triassic throw on the fault, the up-thrown and downthrown parts of the structure were thought to represent separate prospects. The downthrown prospect seemed to have the thickest accumulation of Triassic Anisian/Early Ladinian deposits, and was the primary objective of the well. Secondary objectives were other Middle/Upper Triassic and Jurassic sandstones. To be able to meet all obligations and at the same time test the primary objective without leaving significant potential up-dip, the well path was planned deviated at approximately 30 degrees in a northeasterly direction along seismic line MN89-603. Several reflectors in the interval 397 m to 593 m were thought to represent sand layers with possible shallow gas. The strongest amplitude anomaly was at 435 m.

OPERATIONS AND RESULTS

Wildcat well 7228/2-1 S was spudded with the semi-submersible rig Ross Rig 21 August 1989 and drilled to TD at 4300 m in the Early Triassic Havert Formation. The well was deviated from 1475 m. At 2902 m the bottom hole assembly was lost in the hole, and the well had to be sidetracked from 2700 m. The well was drilled with seawater and hi-vis pills down to 1013 m, with KCl / polymer from 1013 m to 2206 m, with lignosulphonate from 2206 m to 3663 m, and with KCl / polymer from 3663 m to TD. No shallow gas was encountered in the well.

Reservoir quality sands were found in the Jurassic and uppermost Triassic Stø, Nordmela, Tubåen, Fruholmen, and Snadd formations. Of these the Nordmela and Tubåen sands had the best properties. The Nordmela has 32.6 m of net sand but it is silty in places. Average porosity is 17% but Vsh is relatively high at 27 %. Porosity in clean sand is greater than 20 %. The Tubåen Formation has 45 m of net sand, which varies in reservoir quality from fair to excellent. The top of the sand is silty or shaly but clean high porosity sands are found at the base. Core 3 from 1384 m to 1388 m (drillers depth) has an average measured porosity of 22 %. These sands have the best reservoir quality in the entire well. Average porosity for the Tubåen is 19 %. Klinkenberg corrected permeabilities from core data are mostly between 1.5 and 2.5 Darcies. With the good porosity and permeability the sand has excellent flow potential. The sandstones of the primary objective (Kobbe Formation) were poorly developed and of poor quality.

Hydrocarbon shows in the Stø and Nordmela formations are seen in both the Core 2 and petrophysical evaluation. The shows in the petrophysical evaluation decrease as the sand quality improves. As such, both the log and core analysis shows that the oil in core 2 is probably residual. Only occasional patchy traces of residual oil were recorded below 1342 m in the Tubåen, Fruholmen and Snadd formations. Gas levels never exceeded 6 % in this section and consisted predominantly of C1 with some C2 and C3. On penetrating a friable fine grained sandstone at 3401 m (drilled depth), in the Kobbe Formation total gas rose to a maximum of 24.1% at 3423 m. The gas was composed of 190159 ppm C1, 10364 ppm C2, 2200 ppm C3, 1192 ppm IC4 and 1040 ppm NC4. No shows were seen in these samples and gas levels decreased to an average of 4.5 % below 3430 m, composed mainly of C1 with subordinate amounts of C2 and C3.

From organic geochemical analyses there appears to be a mixture of condensate and residual oil present in the Stø, Nordmela and upper Tubåen Formations. These residual oils are severely biodegraded. The Hekkingen Formation is the most significant source rock interval with TOC in the range 1 % to 8 % and type II kerogen, however also Snadd and Kobbe formations contain significant source intervals with both gas- and oil-prone kerogen.

Five conventional cores were cut on the well with good recovery in each case. Cores number 1 and 4, cut in the Late Jurassic Hekkingen and Middle Triassic Snadd Formations respectively, consisted of claystones and were taken for source and cap rock studies. Core 1 was consumed in these analyses and is no longer available from the NPD. Core 2 was cut in sandstones of the Middle Jurassic Stø Formation. The third core was cut in sandstones of the Early Jurassic Tubåen Formation and the fifth core in siltstones of the Early Triassic Havert Formation. The core-to-log shifts were significant: +3.0 m for core 1, +3.4 m for core 2, +3.8 m for core 3, +6.0 m for core 4, and +9.8 m for core 5.

LITHOSTRATIGRAPHY & HISTORY FOR WELL: 7228/2-1 S