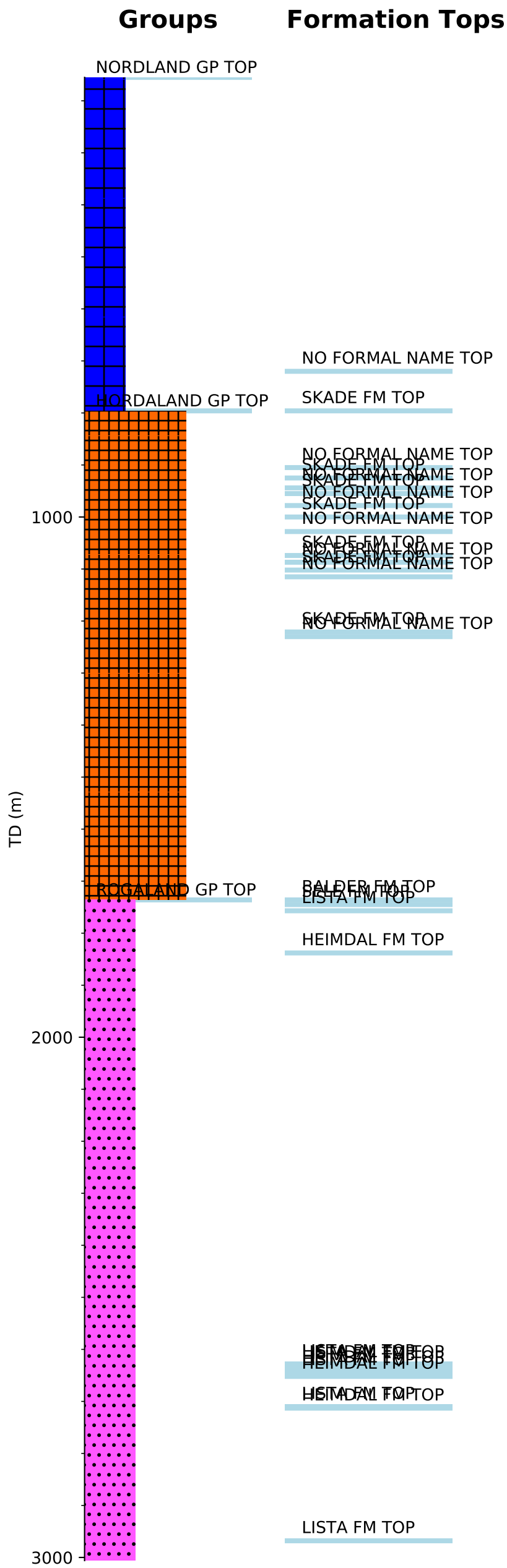

LITHOSTRATIGRAPHY & HISTORY FOR WELL: 25/11-21 A

Wellbore History

GENERAL

Well 25/11-21 S was drilled on the Grane Field. The primary objectives of well 25/11-21 S were to calibrate the depth conversion model with reference to top and base of the Grane reservoir and the oil-water contact, and to investigate horizontal and vertical reservoir barriers and reservoir heterogeneities. The secondary objectives of well 25/11-21 S were to obtain reservoir and fluid data and to investigate uncontaminated initial water saturation values in the oil zone. The well location was selected to allow building up hole angle for later drilling of a horizontal section (25/11-21 A) at the required depth and coordinates and at the same time to provide an accurate seismic tie, i.e. an area with minimal compaction effects and away from faults, in an area where there are indications of a thick sand on the seismic data.

Sidetrack well 25/11 -21 A was drilled to obtain 600 m to 900 m of horizontal reservoir information. The objectives were to appraise the reservoir in terms of reservoir quality and to confirm the structural top and base reservoir maps; to obtain lateral velocity information for calibration of the depth conversion model; to identify possible reservoir heterogeneities indicated on seismic; and finally to perform an extended test production in the horizontal section of the well.

OPERATIONS AND RESULTS

Appraisal well 25/11-21 S was spudded with the semi-submersible installation "Treasure Saga" on 23 October 1995 and drilled to TD at 1957 m (1863.5 m TVD MSL) in Late Cretaceous Hod Formation. The well was drilled with seawater and hi-vis bentonite sweeps down to 1270 m and with KCl / Polymer mud from 1270 m to TD.

Heimdal Formation sand was penetrated at 1788 m (1711.5 m TVD MSL). A reservoir thickness of 88 m (79.5 m TVD) was defined, giving a net pay of 57.9 m. The pressure data from the Heimdal Formation indicates a 0.4 bar pressure difference to well 25/11-18 T2 and 1.7 bar difference to well 25/11-15 based on HP gauge measurements. The oil-water contact (FWL) in the well was found at 1765 m TVD MSL, i.e. more or less the same as in well 25/11-18-T2 and 2.5 meters deeper than in well 25/11-15. No free gas cap was found.& Both the top and base reservoir seismic reflectors and the depth conversion model were proven to be correct in the area, and the reservoir characteristics as found in wells 25/11-15 and 25/11-18 T2 were confirmed. A walk away VSP and walk away AVO VSP were acquired in well 25/11-21 S yielding good qualify high resolution data. The entire reservoir section was cored from 1778 m to 1880.5 m. The wire line logging programme was followed successfully except for an operational failure of the GHMT-tool. MDT Oil samples were taken at 1790 m (1713.09 m TVD MSL), 1796 m (1718.6 m TVD MSL), 1813 m (1734 m TVD MSL), 1828 m (1747.4 m TVD MSL), 1830 m (1749.4 m TVD MSL), 1837.5 m (1756.2 m TVD MSL), and 1845 m (1763 m TVD MSL). MDT water samples were taken at 1850 m (1767.5 m TVD MSL), 1855 m (1772.1 m TVD MSL), 1861.5 m (1777.9 m TVD MSL), and 1874 m (1789.2 m TVD MSL). Well 25/11-21 S was plugged back to the 13 3/8" casing shoe and suspended as an oil appraisal on 14 November 1995.

The well was re-entered with the semi-submersible installation "Treasure Saga" on 15 May 1996. Well 25/11-21 A was kicked of at 1262 m and drilled down to 1973 m in the Heimdal Formation. The hole was drilled with a too low angle to reach the 10 3/4" casing point within acceptable tolerances. Thus the hole was plugged back from 1973 m, and a technical sidetrack, 25/11-21 A T2, was drilled from 1783 m, continued inclined to horizontal, and drilled to TD at 3006 m (1801.4 m TVD MSL) in the Late Paleocene Lista Formation. The sidetrack was drilled water based with KCl / Polymer mud from kick off to 2448 m and with CaCO3 / NaCl mud from 2448 m to TD. In well 25/11-21 A T2, the top of the Heimdal Formation sand was penetrated at 1837.5 m (1705.7 m TVD MSL). At a depth of 1749 m TVD MSL a 820 m horizontal section was drilled. Here a 3 m thick calcite cemented layer, corresponding to an intra reservoir reflector, was penetrated at 2514.5 m. A deformed shaly zone, penetrated at 2627.5 - 2652 was probably due to drilling very close to top reservoir in this area. The base of the Heimdal Formation was reached at 1765.7 m TVD MSL. The reservoir quality of the Heimdal sand is good, showing average porosities of 33%, and a general porosity increase from the SW towards the NE along the well path. The net to gross ratio of the Heimdal Formation is 0.98, due to the penetrated cemented and shaly zones. The oil-water contact (FWL) was found at 1765.6 m TVD MSL, confirming the results from the wells 25/11-21 S and 25/11-18 T2. The average oil saturation within the oil zone is 90%. Only MWD logs were obtained in the sidetrack. No wire line logs were run; consequently no fluid samples