# GEOLOGICAL REPORT
# NORNE FIELD
# PL 128
# WELL 6608/10-C-4 H

Geotek Stavanger

STATOIL

# Report

| Title |
|---|
| **Geological Report**<br>**Norne Field**<br>**PL 128**<br>**Well 6608/10-C-4 H** |

| Report no.: | Contractno./Project no. | Allocated ID: | File no.: |
|---|---|---|---|
| | | | **688-6608/10-C-4H** |

| Grading: | Distribution: |
|---|---|
| **Unrestricted** | **Open distribution** |

| Distribution date: | Copy no.: |
|---|---|
| | |

| No. of pages: | No. of enclosures: | No. of copies: | Input by: |
|---|---|---|---|
| **11** | **3** | **10** | **A. K. Thorsen** |

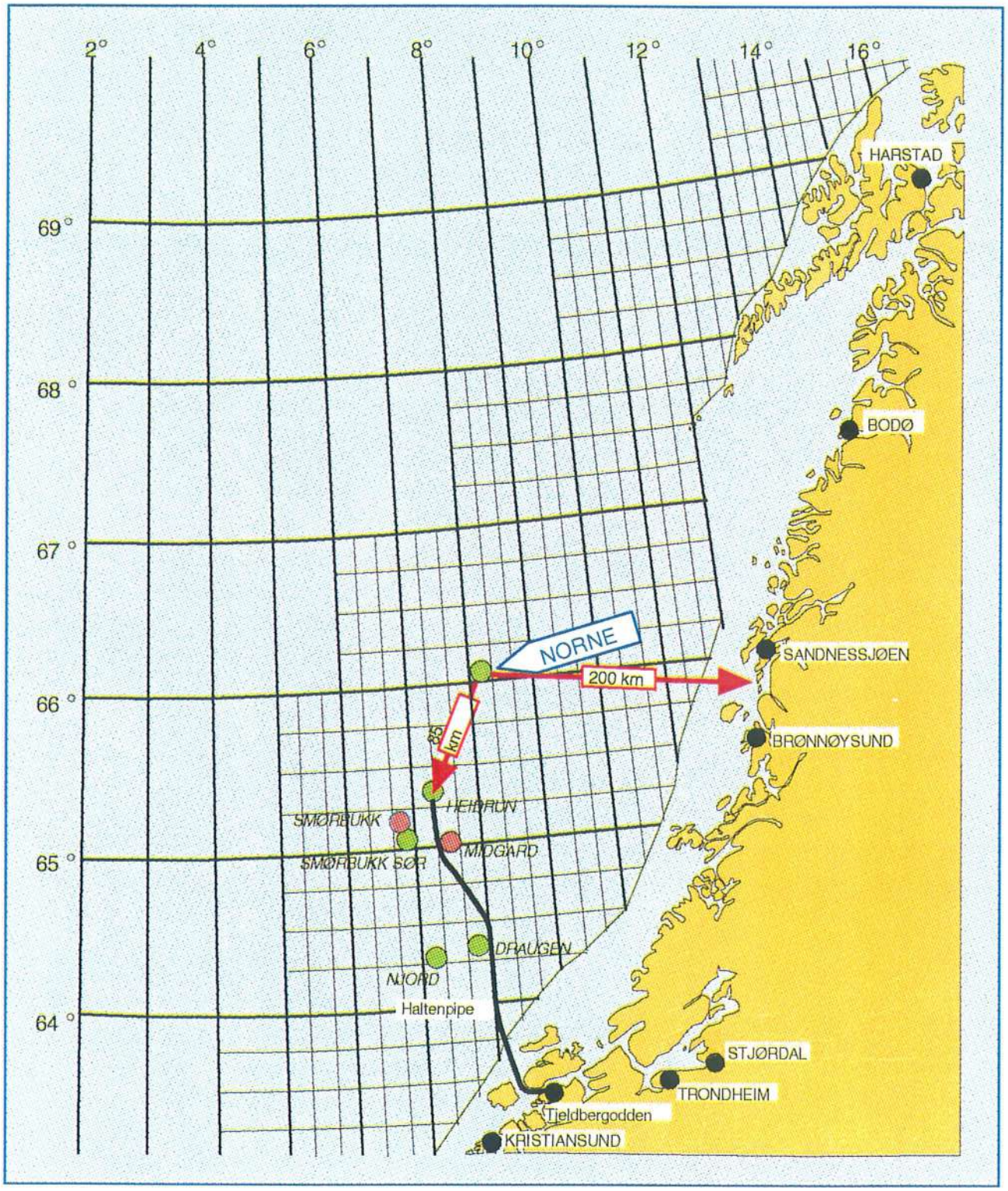

Author(s)/Source(s):
**A.K. Thorsen**


Subjects:

Drilling Results, Stratigraphic Tops, Structural Cross Section, Completion Log, Mud Log, CPI Log, Directional survey

| Drawn up by: | Name: | Date Signature |
|---|---|---|
| **Petek - Geotek** | Arve K. Thorsen | 18/8-97<br>Arve K. Thorsen |
| **Responible organization:** | **Name:** | **Date Singature:** |
| **Petek - Geotek** | John Olav Fløtre | J. Fløtre, 18.8.97 |

# NORNE FIELD
# FIELD LOCATION MAP



# CONTENTS


| | | Page |
|---|---|---|
| SUMMARY | | 1 |
| DRILLING RESULTS | | 2 |
| MWD PERFORMANCE | | 4 |
| WIRELINE PERFORMANCE | | 5 |
| PETROPHYSICAL EVALUATION | | 6 |
| STRATIGRAPHIC TOPS | | 7 |
| STRATIGRAPHIC DESCRIPTIONS | | |
| | SHETLAND GROUP | 7 |
| | CROMER KNOLL GROUP | 8 |
| | VIKING GROUP | 8 |
| | FANGST GROUP | 9 |
| | BÅT GROUP | 9 |

**FIGURES:**

| | |
|---|---|
| FIG. 1 | NORNE FIELD |
| FIG. 2 | TOP GARN DEPTH STRUCTURE MAP |
| FIG. 3 | STRUCTURAL CROSS SECTION |
| FIG. 4 | WELL INFORMATION PLOT |

**TABLES:**

| | |
|---|---|
| TABLE 1 | WELL INFORMATION SUMMARY |
| TABLE 2 | SUMMARY OF SAMPLING |
| TABLE 3 | STRATIGRAPHIC TOPS |
| TABLE 4 | RESERVOIR PROPERTIES SUMMARY |

| | |
|---|---|
| **ATTACHMENT 1:** | FINAL DIRECTIONAL SURVEY |
| **ATTACHMENT 2:** | WELLSITE CORE DESCRIPTIONS |

| | | |
|---|---|---|
| **ENCLOSURES:** | (1) | COMPLETION LOG - Hordaland Group to TD |
| | (2) | MUD LOG |
| | (3) | CPI LOG |

# SUMMARY

The well 6608/10-C-4 H was the second development well to be drilled on the Norne field. It was drilled in the north-western part of the C segment of the field. The well was planned as a Garn Formation gas injector, with a vertical trajectory through the reservoir.

The Garn Formation target was penetrated approximately 200 m north-north-west of the centre of template C.

The well is planned to be completed with a perforated cemented liner in the upper part of the Garn Formation, Garn 3.

The structural relationship of well C-4 H to other wells penetrating the Fangst Group is shown in the Top Garn Formation structure map (Figure 2). A cross section demonstrating the structure and stratigraphic sequence encountered in this well is presented in Figure 3. General well information is presented graphically in Figure 4.

Casing, logging and coring data are summarised in Table 1, Stratigraphic Tops in Table 3, and Petrophysical Parameters in Table 4. A summary of sampling is recorded in Table 2.

A full directional survey listing is included as Attachment 1. The wellsite core descriptions are enclosed as Attachment 2. A completion log covering the lower part of the Tertiary Nordland Group to TD is found as Enclosure 1. Enclosure 2 is a Mud Log, comprising geological and drilling parameter information for the entire well. The CPI log is Enclosure 3.

# DRILLING RESULTS

All depths are referred to the rotary table (RT) unless stated otherwise (RT to MSL = 25.0 m).

Both the 36" and 26" hole sections were drilled in a batch setting period prior to run the riser and start drilling the 17½" hole section.

## 36" HOLE SECTION

The 36" hole section was drilled with sea water and returns to seabed in one run from spud to 469 m. The hole was displaced to 1.40 sg mud prior to pull out to run the 30" conductor.

The 30" conductor was set and cemented at 461 m MD. The well was displaced to seawater after the cement job.

The hole was vertical throughout this section.

## 26" HOLE SECTION

The first bit run in the 26" hole section was drilled from 469 m to 777 m where an increase in pressure was detected and managed using high viscosity pills followed by displacing the hole from sea-water to 1.25 sg mud. The second bit run completed the section to 1310 m MD. Overpull and tight hole, predominantly on connections, were experienced in several places throughout the Naust Formation.

The 20" casing was set and cemented at 1301 m MD, 1281.4 m TVD RT prior to the rig being moved from slot 4.

The returns were to seabed in this section.

Below the 30" conductor the well inclination was increased from vertical to a maximum of 16.9° at 1173.3 m MD and the azimuth turned from north to between 346° and 355°. This was held until the section TD.

## 12¼" HOLE SECTION

An FIT to 1.75 Sg EMW was performed at 1281.4 m TVD RT (20" casing shoe depth).

The cement and formation were drilled with AQUACOL water based mud system. The section was drilled with a 1.40 sg mud weight to 1360 m MD, where the mud weight was increased to 1.59 Sg prior to penetrating the Kai Formation. This was a preventative measure to avoid stress relieved cavings as seen in the previous well D-1 H.

The section was drilled without any operational problems to TD at 2579 m MD in one bit run with no wiper trips. High gas readings were investigated with circulation, flow checks and correlation with MWD data and found not to be consistent with the tight, water saturated clay formations drilled. No hole instability problems were detected in this section.

The MWD data indicated an inclination of 14.2° and an azimuth of 350.6° at the 20" shoe. At the end of the drop section at 1640 m MD, the inclination had reduced to 1.64° with an azimuth of 350°. Top Melke was penetrated at 2387 m MD, 2338.1 m TVD RT with a 1.0° inclination and 235° azimuth. At section TD, 2579 m MD, the inclination was 1° and 252° azimuth.

The pore pressure was reported according to prognosis during the drilling of the section. High gas readings were detected towards the base of the section, which were inconsistent with the flow checks and MWD data available. Further investigation may call for a revision of the prognosis.

No hydrocarbon bearing formations were penetrated in this section and no shows recorded. However, gas values, in comparison to previous exploration wells, were generally high, increased by a magnitude of approximately x10.

The MWD was run by Sperry Sun. The 12¼" hole section was drilled with one bit run, GR/EWR4P/PWD/DIR. The medium phase resistivity memory data from 2265 m to 2295m MD was bad data.

The 9⁵/8" casing was set at 2572.0 m MD (2548.0 m TVD RT), 15 m MD above the Garn Formation.

## 8½" HOLE SECTION

The mud was circulated and conditioned to 1.32 sg prior to drilling out the cement, shoe track and 3m of new formation and performing a Formation Integrity Test to 1.65 sg EMW.

The top Garn Formation was penetrated at 2584.5 m MD (-2535.6 m TVD MSL). An interface core between the Melke Fomation and the Garn Foramtion.

Two cores, totalling 40 m MD were cut from 2584m to 2624 m MD, ending when the second core jammed off in the Not Formation shale.

The well was drilled vertically throughout the section and TD'd at 2900 m MD, 77 m MD into the Åre Formation.

The 7" liner was set and cemented at 2891 m MD (2867 m TVD RT) with the liner hanger at 2410 m MD (2386.1 m TVD RT)

A DGR/MLL/DLL/MAC/ZDL/CN/CHT/TTRM and Star II/DGR (Dipmeter + CBIL + GR) log was run on wireline. The caliper indicated an in-guage hole. Three hours downtime were recorded for a broken bolt on the cable drum when running in for the first log.

A preliminary STAR II/CBIL image log at the wellsite showed high quality and gave a good indication of the lithology. When processing the log in town it was found that the different resistivity buttons on the pads were reading the same resistivity, resulting in a failed STAR log.

## MWD PERFORMANCE

| Tool combination | Interval m MD | Main Stratigraphy | Log Quality | | Comment |
|---|---|---|---|---|---|
| | | | Real Time | Memory | |
| GR/EWR-P4/PWD/DIR | 1301 - 2579 | Naust → Melke | Good | Good | see A, B, C |
| DIR/PWD | 2528 - 2583 | Melke | Good | Good | see D |
| DIR/PWD | 2583 - 2584 | Melke | Good | Good | see E |
| DIR/CNP/EWR-P4/ DGR/SLD/DDS | 2584 - 2900 | Melke → Åre | Good | Good | see F |

A) REAL TIME LOG:
In the 12 1\4" hole the MWD string included a real-time pressure while drilling (PWD) sub. The well was steered from 1310m to 1670m MD to reduce angle from 14° to 0° and once achieved, the MWD tool mode was changed to increase the gamma and resistivity data transmission rate as the toolface was no longer required.

Real-time resistivity data from 2265 m to 2295 m MD (sensor depths) indicated an error code, 2000. Following a connection the sensor started to give normal readings which continued for the remainder of the section.

B) MEMORY LOG:
Memory medium phase resistivity showed bad data from 2265 to 2295 m MD (sensor depths) corresponding to the bad real time data recorded between these depths.

C) OTHER:
A stearability test was performed in the Springar Formation from 2078 m to 2088 m MD, where the tool face update was re-initialised for 10 m MD.

D) OTHER:
Milled cement, shoe & 2.5m new formation. POOH after FIT.

E) OTHER:
Milled junk and 1m of new formation. POOH for coring.

F) OTHER:
Cored interval was reamed too fast. POOH at TD.

## WIRELINE PERFORMANCE

| DATE | TIME | OPERATION |
|---|---|---|
| 06.12.96 | 12:30 | Rig up WALS (Western Atlas Logging Services), safety meeting on drill floor, problems with bottom sheave wheel. |
| | 14:50 | RIH, Log # 1: run 1A MLL/DLL/MAC/ZDL/CN/GR/TTRM/CHT |
| | 16:00 | Hung off wireline tool at 945m. Install new bolt to replace broken brake band bolt on the cable drum. |
| | 19:00 | Continue to RIH. |
| | 19:35 | Tool check at 2500 m. Caliper verification, take mark and correct for stretch. |
| | 19:50 | Stop RIH. Safety meeting on drill floor with night crew. |
| | 20:10 | Continue RIH. Record down log from 2540m to 2870m. Good quality on down log which is used as log quality check. |
| | 20:45 | Start main log from 2885m to 2669m. No repeat section on main log (confirmed OK by Operations Geologist). |
| | 22:40 | Log MAC in casing to 2150 m (200 m above Top Lyr Fm.). |
| | 23:45 | Finished main log. Verify caliper, MLL and DLL. |
| | 23:55 | Start POOH. |
| 07.12.96 | 00:30 | At surface. Remove sources, verify tools, rig down. |
| | 02:30 | End rig down log #1. Total 14 hrs, including 3 hrs down time. |
| | 02:30 | Start rig up log # 2. |
| | 03:30 | Finished rig up. Before log verification. |
| | 04:15 | RIH Log # 2: run 1A Star II/DGR (Dipmeter+CIBL+GR) |
| | 05:45 | Record tie in section 2893 - 2863m. |
| | 06:30 | Record repeat log 2880 - 2810m. |
| | 07:30 | Start main log and record from 2874 to 2569m. |
| | 09:00 | Finish main log. Verify CBIL in casing. |
| | 09:15 | Start POOH |
| | 10:00 | Tool at surface |
| | 11:30 | Finished rig down WALS. Total 9 hrs for log # 2. |

## TIME BREAKDOWN

| TOOL COMBINATION | RIG UP & DOWN hrs | OPERATING hrs | LOST TIME hrs | OTHER hrs | TOTAL hrs |
|---|---|---|---|---|---|
| MLL/DLL/MAC/ZDL/CN/GR/ CHT/TTRM. | 4.3 | 6.7 | 3.0 | - | 14.0 |
| Star II/GR (Dipmeter+CBIL+GR) | 2.5 | 6.5 | 0.0 | - | 9.0 |
| TOTAL HOURS | 6.8 | 13.2 | 3.0 | - | 23.0 |

## PETROPHYSICAL EVALUATION

The model used for the petrophysical table and the plot is as follows:

Petrophysical inputs for the Garn, Not, Ile, Ror, Tofte, and Tilje and Åre Formations.:

| | |
|---|---|
| a | 1.0 |
| m | 1.84 |
| n | 2.2 for Garn 3, Garn 2, Ile 2, Tilje 3, Tilje 2, Tilje 1.<br>2.02 for Ror, Tofte 3, Tofte 2, Tofte 1.<br>1.84 for Garn 1, Not, Ile 3, Ile 2, Åre. |
| rw | 0.054 ohmm at 98 deg. C |
| Rt | DLL |
| Rxo | MLL |

Table IV: Petrophysical parameters used in calculations, well 6608/10-C-4 H

Input logs:

| Tool Combination | Depth Interval (m) | Date |
|---|---|---|
| ZDL/GR/CHT/TTRM | 2885.0 - 2669.0 | 06.12.96 |
| DLL/MLL/MAC/ZDL/CN/GR/TTRM[1] | 2855.0 - 2150.0 | 06.12.96 |
| Star II/GR[2] | 2874.0 - 2569.0 | 07.12.96 |

[1]MAC/GR was logged inside 9 5/8" casing.
[2]Dipmeter + CBIL + GR

Table V: Logs used in petrophysical calculations, well 6608/10-C-4 H

Porosity calculations on Norne are based on a core-log correlation:

$$PHID = a + b \times RHOB.$$

Permeability is calculated from the following equation:

$$k=10 * (a+b \times PHI)$$

Water saturation is calculated using Archies equation. Rt is taken from the deep laterolog.

| | | | | | WBM[1] | |
|---|---|---|---|---|---|---|
| **Zone** | **Fluid phase** | **DEMA** | **a-perm KLOGH** | **b-perm KLOGH** | **a-por** | **b-por** |
| GARN3 | Gas | 2.67 | -3.518 | 21.69 | 1.333 | -0.4991 |
| GARN2 | Gas | 2.67 | -3.518 | 21.69 | 1.333 | -0.4991 |
| GARN1 | Gas | 2.67 | -3.518 | 21.69 | 1.333 | -0.4991 |
| | Oil | 2.67 | -3.518 | 21.69 | 1.457 | -0.5457 |
| NOT | Oil | 2.67 | -3.518 | 21.69 | 1.457 | -0.5457 |
| ILE3 | Oil | 2.67 | -3.518 | 21.69 | 1.516 | -0.5700 |
| ILE2 | Oil | 2.67 | -0.898 | 13.43 | 1.516 | -0.5700 |
| ILE1 | Oil | 2.67 | -0.898 | 13.43 | 1.516 | -0.5700 |
| ROR | Oil | 2.67 | -2.026 | 15.99 | 1.516 | -0.5700 |
| TOFTE3 | Oil | 2.65 | -4.370 | 25.07 | 1.516 | -0.5700 |
| TOFTE2 | Oil | 2.65 | -4.370 | 25.07 | 1.516 | -0.5700 |
| TOFTE1 | Oil | 2.71 | -2.415 | 19.05 | 1.391 | -0.5134 |
| | Water | 2.71 | -2.415 | 19.05 | 1.550 | -0.5719 |
| TILJE4 | Oil | 2.67 | -2.415 | 19.05 | 1.711 | -0.6338 |
| | Water | 2.67 | -2.415 | 19.05 | 1.570 | -0.5814 |
| TILJE3 | Oil | 2.67 | -2.415 | 19.05 | 1.711 | -0.6338 |
| | Water | 2.67 | -2.415 | 19.05 | 1.570 | -0.5814 |
| TILJE2 | Oil | 2.67 | -2.415 | 19.05 | 1.711 | -0.6338 |
| | Water | 2.67 | -2.415 | 19.05 | 1.570 | -0.5814 |
| TILJE1 | Oil | 2.67 | -2.415 | 19.05 | 1.711 | -0.6338 |
| | Water | 2.67 | -2.415 | 19.05 | 1.570 | -0.5814 |
| ÅRE | Water | | | | | |

[1] *From PUD*

# STRATIGRAPHIC TOPS

Principal tops and a comparison of prognosed and actual stratigraphic tops are summarised below:

| Stratigraphic Top | Predicted Depth m TVD MSL | Actual Depth m TVD MSL | Difference m TVD[1] |
|---|---|---|---|
| **Naust** | 705.0 | 693.5 | -11.5 |
| **Kai** | 1330.0 | 1322.5 | -7.5 |
| **Brygge** | 1560.0 | 1556.8 | -3.2 |
| **Brygge Tuff** | 1670.0 | 1660.2 | -9.8 |
| **Tare** | 1805.0 | 1822.2 | 17.2 |
| **Tang** | 1885.0 | 1880.7 | -4.3 |
| **Springar** | 1923.0 | 1918.2 | -4.8 |
| **Nise** | 2165.0 | 2104.6 | -60.4 |
| **Lyr** | 2318.0 | 2304.6 | -13.4 |
| **Spekk** | 2350.0 | 2330.6 | -19.4 |
| **Melke** | 2360.0 | 2338.1 | -21.9 |
| **Garn** | 2551.0 | 2535.6 | -15.4 |
| **Not** | 2585.0 | 2568.0 | -17.0 |
| **Ile** | 2593.0 | 2576.0 | -17.0 |
| **Ror** | 2634.0 | 2619.5 | -14.5 |
| **Tofte** | 2643.0 | 2628.5 | -14.5 |
| **Tilje** | 2695.0 | 2682.5 | -12.5 |
| **Åre** | 2799.0 | 2798.5 | -0.5 |
| **TD** | 2846.0 | 2851.0 | 5.0 |

[1] *- = Shallow to prognosis, no annotation = deep to prognosis*

# STRATIGRAPHIC DESCRIPTION

As there were no wellsite geologist on the rig above the Nise Formation, they were not described and therefor not implemented in his report.

## SHETLAND GROUP — 1967.0 - 2353.5 m MD, 1918.2 - 2304.6 m TVD MSL

**Nise Formation** — **2153.5 - 2353.5 m MD, 2104.6 - 2304.6 m TVD MSL**

The Nise Formation was a claystone with two distinct stringers of limestone.

The medium light grey to light grey claystone was soft to firm, subblocky, locally amorphous, slightly friable, slightly silty with local calcareous fragments. Throughout the interval traces of pyrite, glauconite, fine arenaceous material and occasional micromica were observed.

The major limestone was predominantly off white to white, locally very light grey to light grey and becoming increasingly darker where the argillaceous content increased. The limestone was soft to firm, occasionally micritic, amorphous and occasionally microcrystalline with rare traces of crystalline calcite.

The minor limestone was clean, yellow orange to light yellow brown, hard, blocky and microcrystalline to cryptocrystalline.

## CROMER KNOLL GROUP 2353.5 - 2379.5 m MD, 2304.6 - 2330.6 m TVD MSL

### Lyr Formation 2353.5 - 2379.5 m MD, 2304.6 - 2330.6 m TVD MSL

The Lyr Formation was a claystone with minor stringers of limestones and occasional sand lenses.

The PDC bit cutter action produced cuttings of a consistent amorphous texture. The claystone was medium dark grey, olive grey, amorphous, soft and predominantly non calcareous with occasional minor calcareous inclusions. Common silt and very fine arenaceous material occurred throughout with minor traces of pyrite and carbonaceous material.

The occasionally argillaceous limestone was off white to light grey, soft to occasionally firm and generally amorphous. The limestone contained traces of very fine arenaceous material and was occasionally micritic.

Minor quantities of unconsolidated quartz grains, probably washed out from the claystone were present. The grains were clear, transparent to translucent, very fine to fine grained, moderately to well sorted and subrounded to rounded.

## VIKING GROUP 2379.5 - 2584.5m MD, 2330.6 - 2535.6 m TVD MSL

### Spekk Formation 2379.5 - 2387.0m MD, 2330.6 - 2338.1 m TVD MSL

The Spekk Formation was a claystone with occasional loose quartz grains.

The claystone was brownish black, occasionally olive black, soft to very soft, amorphous with an earthy texture and abundant micromica. Throughout were traces of pyrite, carbonaceous material and rarely coal. In parts it was silty to very silty. The claystone was predominantly non calcareous.

Locally there were traces of clear, subrounded to rounded, very fine quartz grains.

### Melke Formation 2387.0 - 2584.5 m MD, 2338.1 - 2535.6 m TVD MSL

The Melke Formation was a claystone with minor limestone and occasionally very fine to fine sands towards the base. Minor sandstone beds were present in the lower Melke Formation and have been interpreted as Melke 1 through to Melke 3.

The claystone was predominantly light brown grey and locally light to medium light grey. Predominantly soft and pasty owing to the PDC bit cutter action. It was observed to be firm to amorphous, occasionally subblocky and predominantly non calcareous, although minor calcareous inclusions occurred especially in the upper part. Traces of carbonaceous material, pyrite and mica were present throughout with local horizons of abundant mica. With increasing depth the claystone became increasingly silty with increasing amounts of very fine to fine arenaceous material and grading to argillaceous siltstone.

The limestone was off white to light grey, locally light to medium grey, occasionally micritic, generally amorphous and slightly argillaceous with minor traces of fine arenaceous material.

The sand became more evident with depth and below 2509 m MD it became increasingly evident. The sand occurred as loose, clear to transparent, very fine to fine, subangular to subrounded and moderately sorted quartz grains. A medium grey argillaceous matrix was present together with traces of pyrite and mica, however, no cement was observed.

Minor traces of light grey to medium light grey siltstone were observed as subangular, firm, occasionally friable to crumbly cuttings with a slight silica cement and argillaceous matrix.

## FANGST GROUP 2584.5 - 2668.5 m MD, 2535.6 - 2619.5 m TVD MSL

The Fangst Group consists of predominantly sandstone in the Garn and Ile Formation and claystone in the thin Not Formation.

### Garn Formation 2584.5 - 2617.0 m MD, 2535.6 - 2568.0 m TVD MSL

This description is based on core chips from every 9m of core.

The Garn Formation consists of a coarsening upward sandstone sequence. The dark yellow brown sandstone in the upper section consisted of translucent and pink quartz which was coarse to very coarse and gravel size, locally fine to medium, poorly sorted and subrounded to rounded. Locally it was pyritic, cemented and very hard. The lower part of Garn 3 and Garn 2 consisted of light brown grey to light olive grey sandstone with transparent to translucent, very fine to fine, well sorted and subangular to subrounded quartz grains. It was firm and brittle with a slight argillaceous matrix, micaceous lamina and occasionally pyrite were seen. The sandstone had a fair to good visual porosity. The Garn 1 sandstones had similar characteristics to the sandstones of Garn 2 but were also firm and well consolidated with a weak calcareous cement.

The Garn Formation was in the gas zone in this well and therefore hydrocarbon shows were weak with a patchy yellow green fluorescence, slow to moderate streaming milky white cut fluorescence and yellow white to blue white residue fluorescence.

### Not Formation 2617.0 - 2625.0 m MD, 2568.0 - 2576.0 m TVD MSL

A core chip from the middle part of the Not Formation indicated an olive grey to olive black claystone which was silty, very hard, micaceous, non calcareous and locally pyritic.

### Ile Formation 2625.0 - 2668.5 m MD, 2576.0 - 2619.5 m TVD MSL

The Ile Formation consisted predominantly of a sandstone with occasional stringers of limestone and traces of pyrite and glauconite. The sand was seen in cuttings as loose transparent quartz which was occasionally pink, very fine to fine grained, subangular to subrounded and moderate to well sorted.

The limestone was white to yellow white, soft to firm and locally crystalline.

The wireline log data indicates a GOC at 2629 m MD (2580 m TVD MSL) in Ile 3.

## BÅT GROUP 2668.5 - TD @ 2900.0 m MD, 2619.5 - 2851.0 m TVD MSL

### Ror Formation 2668.5 - 2677.5 m MD, 2619.5 - 2628.5 m TVD MSL

The Ror Formation was thin, 9 m MD (9.0 m AVT). The cuttings evidence indicated a similar formation to the Ile Formation above, however, there was concern that the cuttings described may not be representative for the Ror Formation. The concern was based on the fact that there were no change in the cuttings sample from the overlying Ile Formation to the Ror Formation.

The Ror Formation consisted predominantly of a sandstone with traces of pyrite and glauconite. The sand was seen in cuttings as loose transparent quartz which was occasionally pink, very fine to fine grained, subangular to subrounded and moderate to well sorted.

**Tofte Formation** **2677.5 - 2731.5 m MD, 2628.5 - 2682.5 m TVD MSL**

The Tofte Formation consisted of a sandstone similar to the Ile Formation with thin layers of claystone and occasional limestone stringers, especially in the lower part. The sandstone had traces of pyrite and glauconite throughout. The claystone was dark grey, firm, blocky and silty.

**Tilje Formation** **2731.5 - 2847.5 m MD, 2682.5 - 2798.5 m TVD MSL**

The Tilje Formation consisted of sandstone with thin claystone interbeds and occasional limestone stringers. The sandstone was observed as loose, fine to medium grained, occasionally coarse to very coarse quartz which was subrounded to subangular, occasionally angular and moderate to poorly sorted. From approximately 2800 m MD in lower Tilje 2, the quartz was white to translucent, medium to coarse, occasionally very coarse, subangular to subrounded and moderately sorted.

The claystone was light grey to light olive grey, soft and calcareous.

The limestone was white to light olive grey, soft and argillaceous.

Provisional log data analysis indicates a tentative OWC at 2737 m MD (2688 m TVD MSL) in Tilje 4.

**Åre Formation** **2847.5 - TD @ 2900.0 m MD, 2798.5 - 2851.0 m TVD MSL**

The Åre Formation consisted of interbedded sandstone and claystone/siltstone beds with occasional limestone stringers.

The sandstone was seen in cuttings as loose quartz. These were white to translucent, medium, occasionally coarse to very coarse, subrounded to subangular, occasionally rounded and moderately sorted. Throughout were traces of pyrite, coal, mica and glauconite.

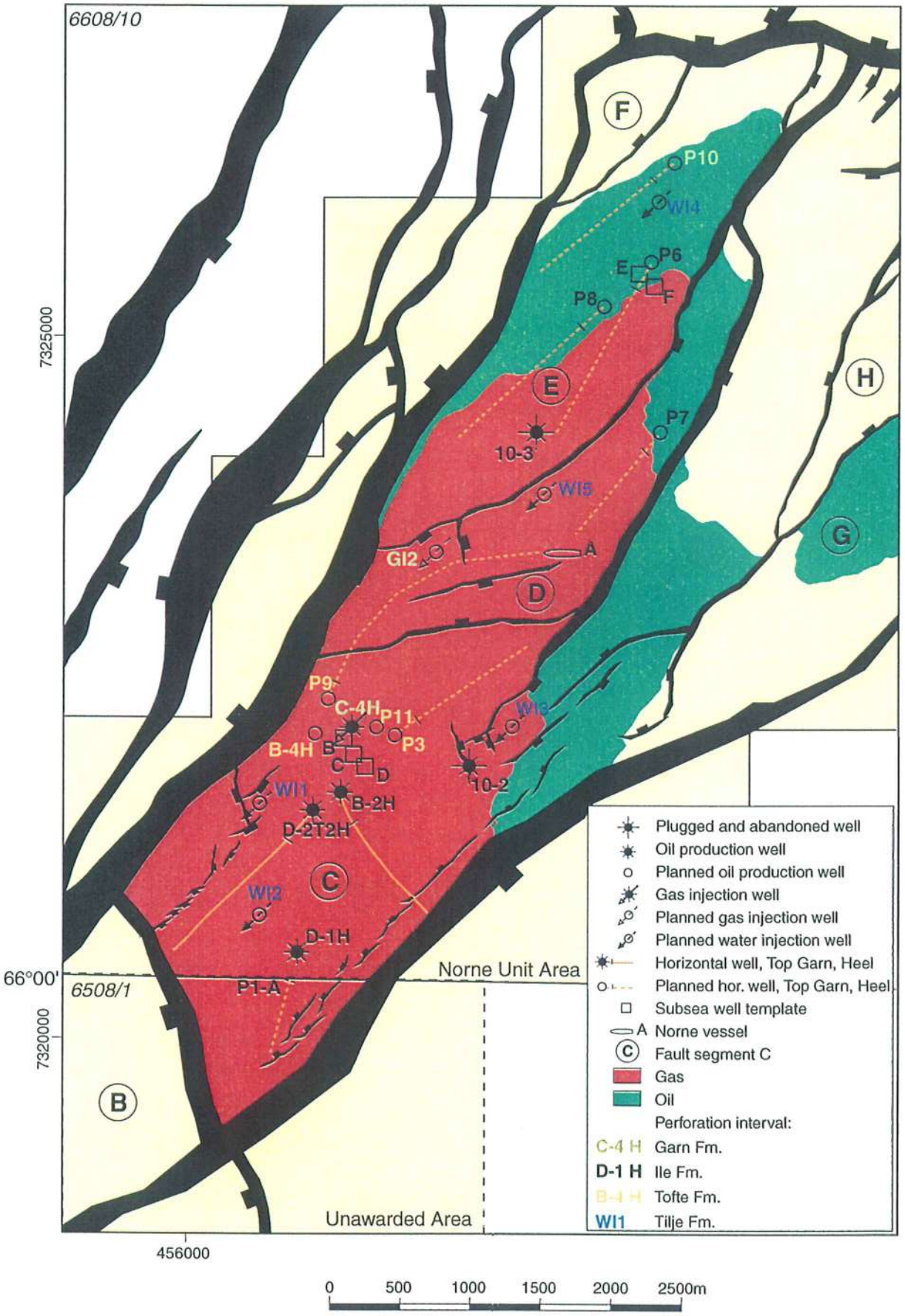
The claystone was predominately dark grey to olive grey, soft, amorphous, locally sticky, slightly calcareous and silty, locally grading to siltstone.

The limestone was white to light olive grey, soft, argillaceous and locally dolomitic.

Figure 1

# Norne Field - Top Garn Formation
## Well Locations and Hydrocarbon Area

STATOIL




HA GRS/970265/KH/23.06.97/JSE

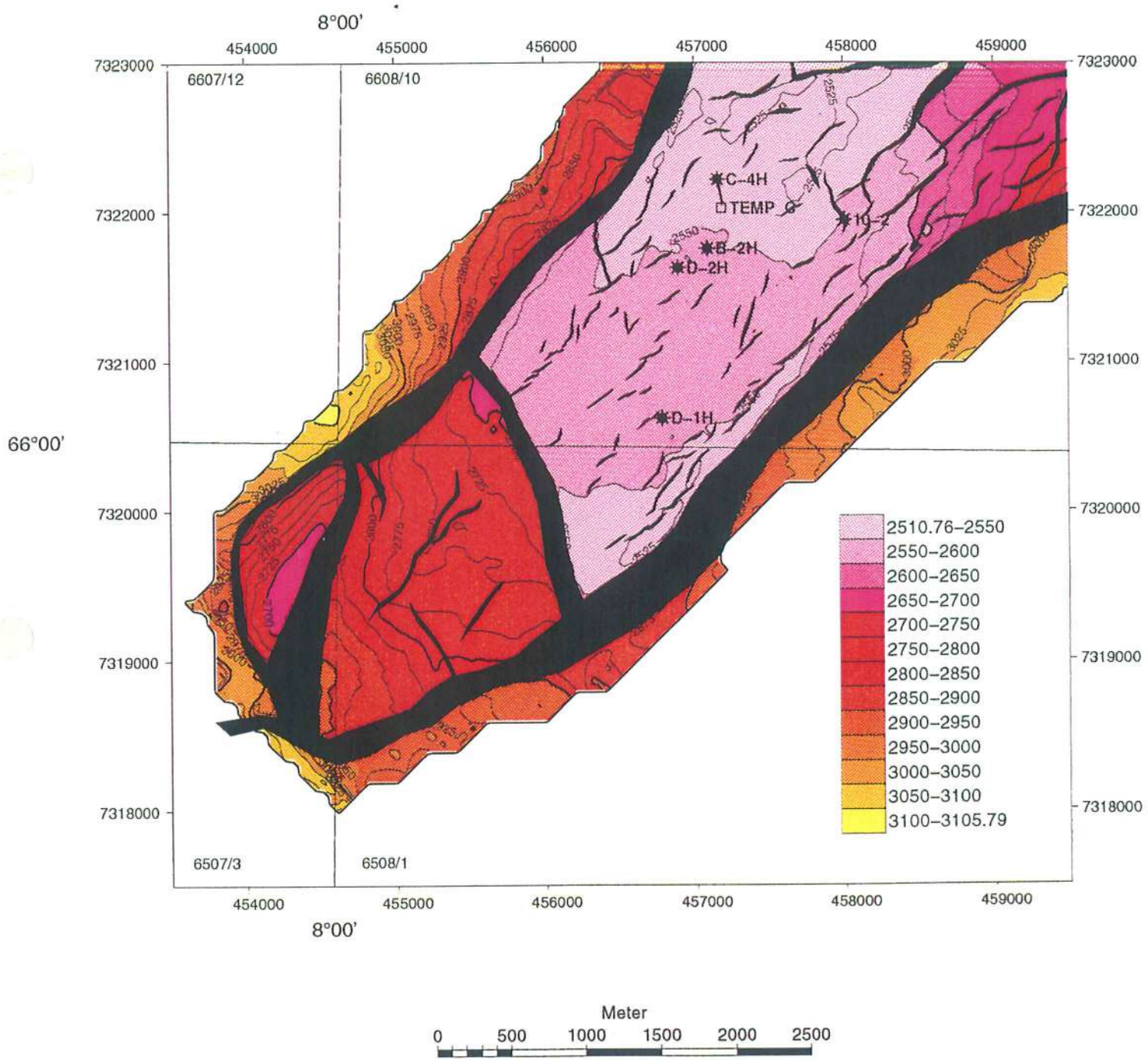
FIGURE 2

# NORNE FIELD

## Top Garn Formation – Depth structure map

## Well path 6608/10–C–4 H

STATOIL




K. Halvorsen 18–Apr–97

# STRUCTURAL CROSS SECTION
# NORNE FIELD
# WELL 6608/10-C-4 H

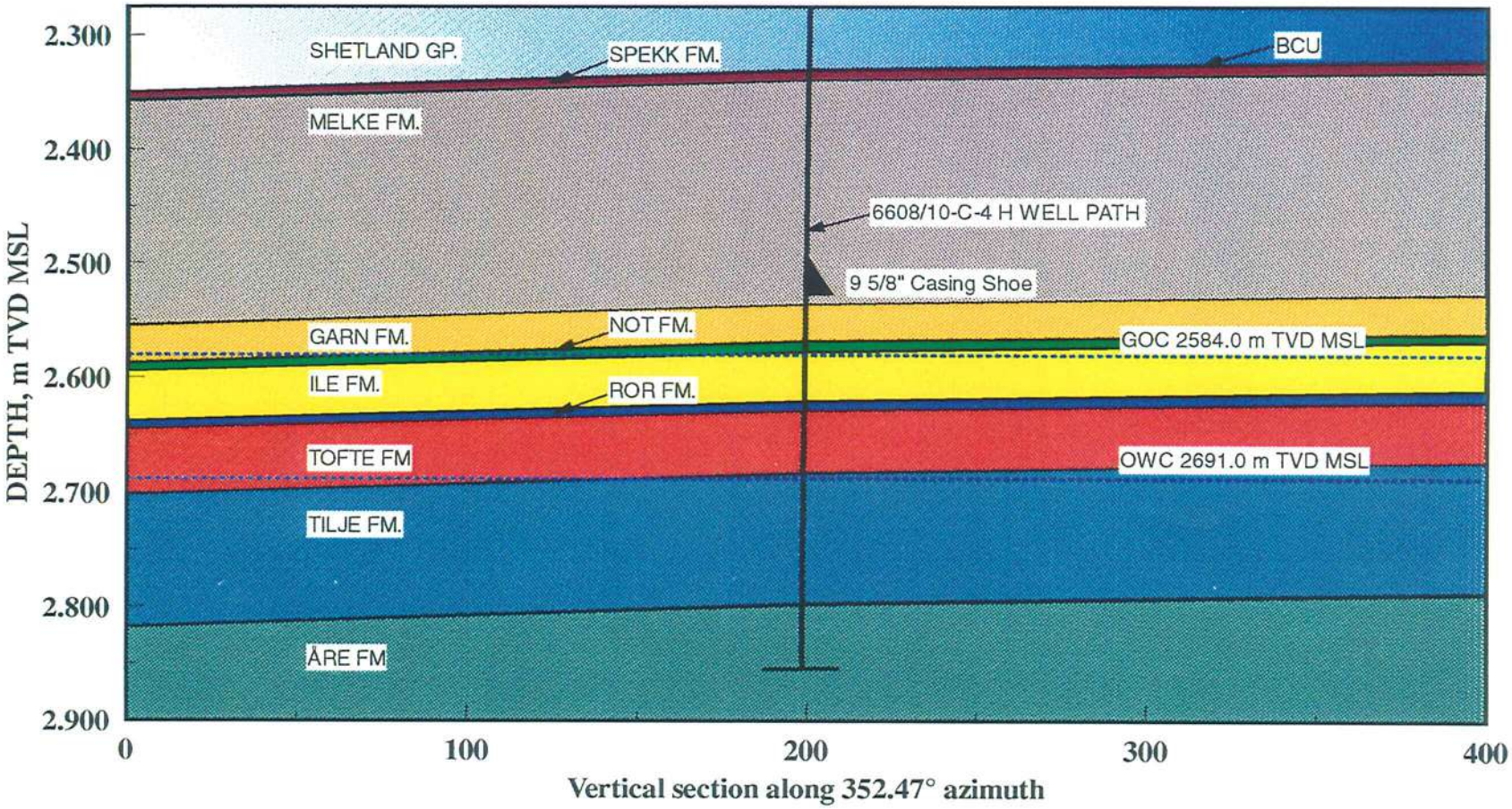



FIGURE 3

FIGURE 4

**WELL INFORMATION PLOT**
**NORNE FIELD**
**WELL 6608/10-C-4 H**

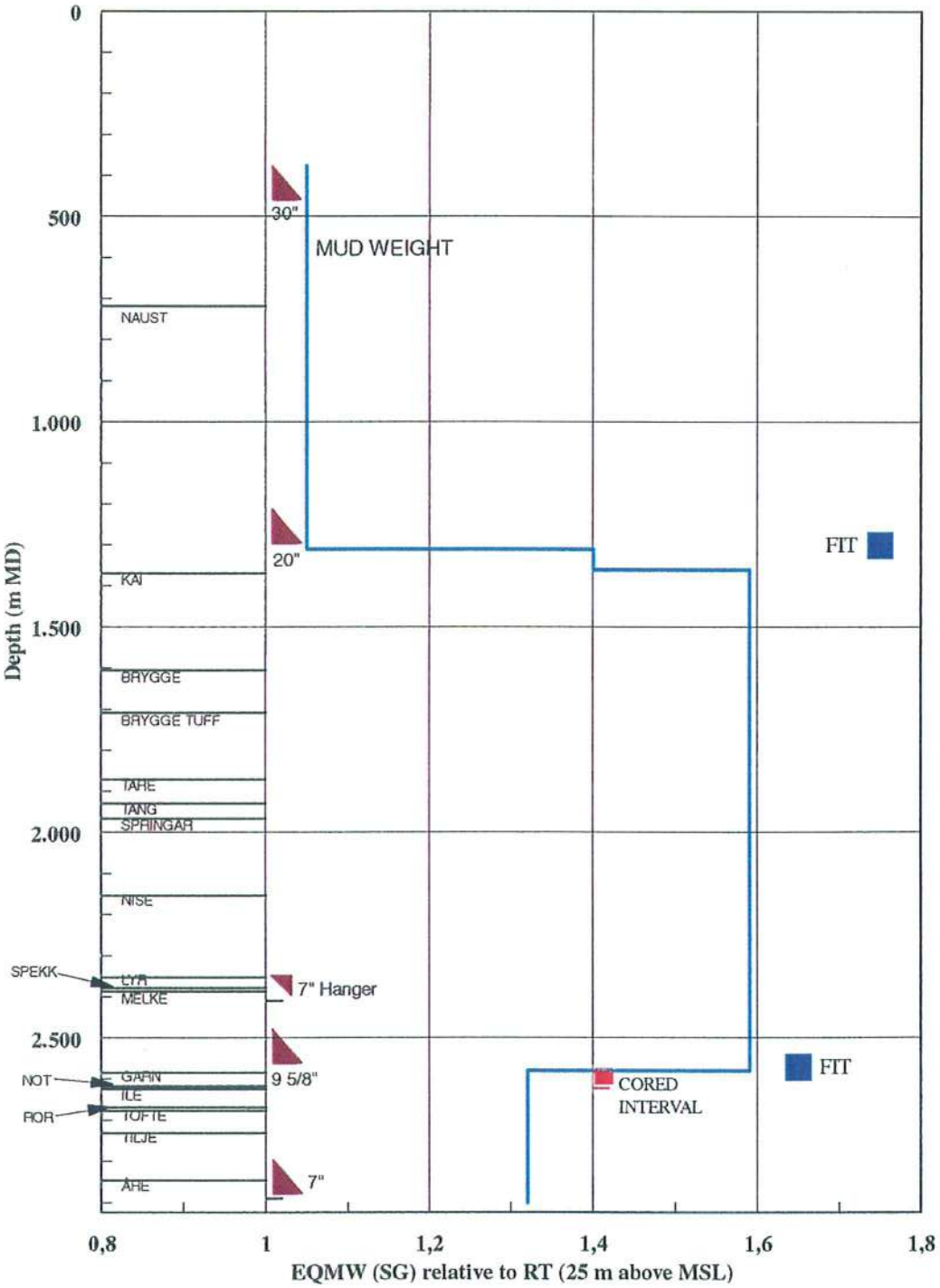
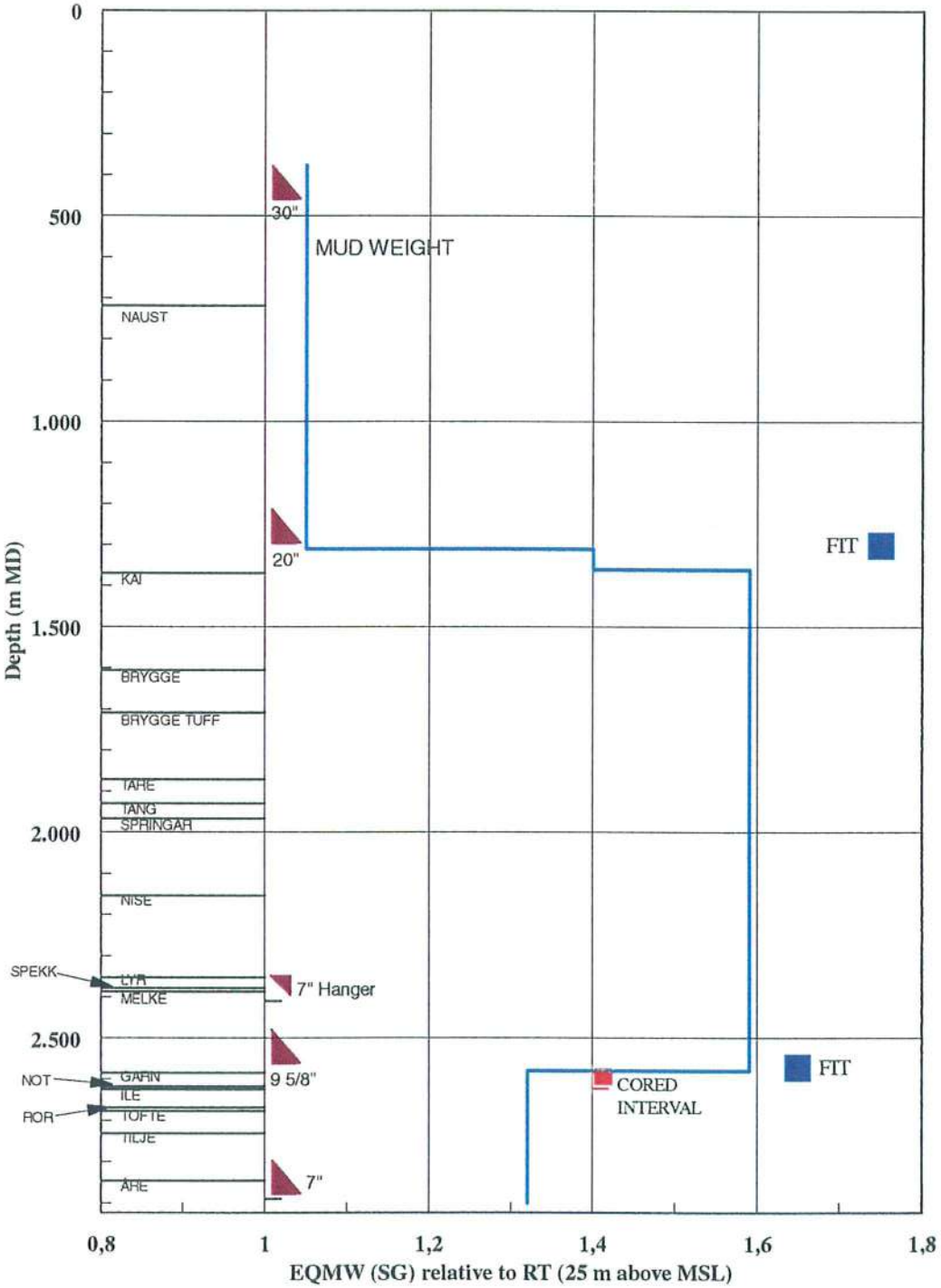


FIGURE 4

**WELL INFORMATION PLOT**
**NORNE FIELD**
**WELL 6608/10-C-4 H**



# WELL INFORMATION SUMMARY

## NORNE FIELD

## WELL 6608/10-C-4 H

| | | |
|---|---|---|
| LICENCE: | : | PL 128 |
| WELL TYPE | : | GARN GAS INJECTOR |
| TEMPLATE CENTRE | : | UTM 7 321 945.40 mN<br>457 261.50 mE |
| SLOT OFFSET: | | 7.47 mN<br>2.52 mW |
| RT - MSL | : | 25.0 m |
| WATER DEPTH | : | 376.0 m |
| SPUD DATE | : | 29.08.96. (Drill 36" section)<br>23.11.96. (Drilled out 20" casing shoe) |
| REACHED TD | : | 06.12.96. |
| TOTAL DEPTH | : | 2900.0 m MD 2851.0 m TVD MSL |
| TARGET LOCATION | : | UTM 7 322 227.6 mN 457 154.5 mE, Garn 3 |
| DISTANCE FROM WELLHEAD | : | 198.64 m (at 274.5° from wellhead) |
| CASING DEPTHS | : | 30" 461.0 m MD 461.0 m TVD RT<br>20" 1301.1 m MD 1281.4 m TVD RT<br>9 5/8" 2572.0 mMD 2548.0 m TVD RT<br>7" 2891.0 m MD 2867.0 m TVD RT<br>7" hanger 2410.0 m MD 2386.1 m TVD RT |
| CORING | : | |

| CORE | INTERVAL CUT (m MD) | | FORMATION | RECOVERY | | TOTAL RECOVERY | | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| # | FROM | TO | | m | % | m | % | |
| 1 | 2584 | 2588 | Melke/Garn | 3.30 | 82.5 | 3.30 | 82.5 | Jammed |
| 2 | 2588 | 2624 | Garn/Ile | 35.65 | 99.0 | 38.95 | 97.4 | Jammed |

TABLE 1

| OPEN HOLE LOG RUNS: | RUN # | | LOG TYPE | DATE | Interval (m) |
|---|---|---|---|---|---|
| SPERRY SUN | 1 | | GR/EWR-P4/DIR | 21.09.96 | 469 -777 |
| | 2 | | GR/EWR-P4/DIR | 26.09.96 | 777 - 1310 |
| | 3 | | GR/EWR-P4/PWD/DIR | 26.11.96 | 1301 - 2579 |
| | 4 | | PWD/DIR | 01.12.96 | 2528 - 2583 |
| | 5 | | PWD/DIR | 03.12.96 | 2583 - 2584 |
| | 6 | | PWD/DIR/CNP/EWR-P4/DGR/SLD/DDS [1] | 06.12.96 | 2584 - 2900 |
| WALS | 1A | | DGR/MLL/DLL/MAC/ZDL/CN/CHT/TTRM | 06.12.96 | 2885 - 2669 |
| | 1A | | StarII/DGR (dipmeter+CIBL+GR) | 07.12.96 | 2874 - 2569 |

[1] *Vibration sub, registers vibrations in 3 directions*

COMPLETION INTERVALS : Temporarily abandoned

HC CONTACTS :

| TYPE | DEPTH m MD | DEPTH m TVD MSL |
|---|---|---|
| TG | 2584.4 | 2535.5 |
| GOC | 2633.0 | 2584.0 |
| OWC | 2740.0 | 2691.0 |

TABLE 2

## SUMMARY OF SAMPLING

## NORNE FIELD

## WELL 6608/10-C-4 H

| TYPE | INTERVAL m MD RT | FREQUENCY m | REMARKS |
|---|---|---|---|
| WASHED LITHOLOGY | 1310 - 2364 | 10 | Samples taken for lithological descriptions, not retained |
| | 2364 - 2580 | 6 | |
| | 2583 - 2624 | 3* | |
| | 2624 - 2900 | 3 | |
| WASHED AND DRIED | 2364 - 2580 | 6 | |
| | 2583 - 2624 | 3* | |
| | 2624 - 2900 | 3 | |

* Samples during coring only caught when circulated to surface during the cutting of the core. No samples collected when lagged after trip.

TABLE 3

# STRATIGRAPHIC TOPS

## NORNE FIELD

## WELL 6608/10-C-4 H

| GROUP | FM/ZONE | Depth m MD | Depth m TVD RT | Depth m TVD MSL | Thickn m AVT | UTM east | UTM north |
|---|---|---|---|---|---|---|---|
| NORDLAND | NAUST | 719.0 | 718.5 | 693.5 | 629.0 | 457 184.8 | 7 322 031.3 |
| | KAI | 1369.0 | 1347.5 | 1322.5 | 233.8 | 457 164.3 | 7 322 191.4 |
| HORDALAND | BRYGGE | 1605.0 | 1581.8 | 1556.8 | 103.4 | 457 155.6 | 7 322 219.8 |
| | BRYGGE TUFF | 1709.0 | 1685.2 | 1660.2 | 162.0 | 457 155.8 | 7 322 222.2 |
| ROGALAND | TARE | 1871.0 | 1847.2 | 1822.2 | 58.5 | 457 159.2 | 7 322 224.1 |
| | TANG | 1929.5 | 1905.7 | 1880.7 | 37.5 | 457 160.6 | 7 322 224.6 |
| SHETLAND | SPRINGAR | 1967.0 | 1943.2 | 1918.2 | 186.5 | 457 161.5 | 7 322 224.8 |
| | NISE | 2153.5 | 2129.6 | 2104.6 | 200.0 | 457 160.3 | 7 322 221.9 |
| CROMER KNOLL | LYR | 2353.5 | 2329.6 | 2304.6 | 26.0 | 457 157.7 | 7 322 218.7 |
| VIKING | SPEKK | 2379.5 | 2355.6 | 2330.6 | 7.5 | 457 157.3 | 7 322 218.4 |
| | MELKE | 2387.0 | 2363.1 | 2338.1 | 197.5 | 457 157.2 | 7 322 218.4 |
| FANGST | GARN 3 | 2584.5 | 2560.6 | 2535.6 | 9.0 | 457 153.7 | 7 322 216.7 |
| | GARN 2 | 2593.5 | 2569.5 | 2544.5 | 10.8 | 457 153.5 | 7 322 216.7 |
| | GARN 1 | 2604.3 | 2580.3 | 2555.3 | 12.7 | 457 153.4 | 7 322 216.7 |
| | NOT | 2617.0 | 2593.0 | 2568.0 | 8.0 | 457 153.2 | 7 322 216.6 |
| | ILE 3 | 2625.0 | 2601.0 | 2576.0 | 23.0 | 457 153.1 | 7 322 216.6 |
| | ILE 2 | 2648.0 | 2624.0 | 2599.0 | 16.0 | 457 152.8 | 7 322 216.5 |
| | ILE 1 | 2664.0 | 2640.0 | 2615.0 | 4.5 | 457 152.5 | 7 322 216.4 |
| BÅT | Ø.ROR | 2668.5 | 2644.5 | 2619.5 | 9.0 | 457 152.5 | 7 322 216.4 |
| | TOFTE 3 | 2677.5 | 2653.5 | 2628.5 | 31.9 | 457 152.4 | 7 322 216.3 |
| | TOFTE 2 | 2709.4 | 2685.4 | 2660.4 | 6.3 | 457 152.0 | 7 322 216.1 |
| | TOFTE 1 | 2715.7 | 2691.7 | 2666.7 | 15.8 | 457 152.0 | 7 322 216.0 |
| | TILJE 4 | 2731.5 | 2707.5 | 2682.5 | 18.0 | 457 151.8 | 7 322 215.9 |
| | TILJE 3 | 2749.5 | 2725.6 | 2700.6 | 24.0 | 457 151.6 | 7 322 215.9 |
| | TILJE 2 | 2773.5 | 2749.6 | 2724.6 | 44.5 | 457 151.3 | 7 322 215.8 |
| | TILJE 1 | 2818.0 | 2794.0 | 2769.0 | 29.5 | 457 150.9 | 7 322 215.7 |
| | ÅRE | 2847.5 | 2823.5 | 2798.5 | 42.5 | 457 150.6 | 7 322 215.6 |
| TOTAL DEPTH | | 2900.0 | 2876.0 | 2851.0 | - | | |

TABLE 4

# RESERVOIR ROCK PROPERTIES

## NORNE FIELD

## WELL 6608/10-C-4 H

| FORMATION/ ZONE | Fluid | Top Depth m MD | Top Depth m TVD MSL | Thickn m TVD | PHIF | SW | N/G | H.PERM-A md |
|---|---|---|---|---|---|---|---|---|
| Garn 3 | Gas | 2584.5 | 2535.6 | 9.0 | 0.316 | 0.130 | 0.965 | 1243 |
| Garn 2 | Gas | 2593.5 | 2544.5 | 10.8 | 0.283 | 0.178 | 0.925 | 1667 |
| Garn 1 | Gas | 2604.3 | 2555.3 | 12.7 | 0.207 | 0.276 | 0.917 | 375 |
| Not | Gas | 2617.0 | 2568.0 | 8.0 | - | - | - | - |
| Ile 3 | Gas | 2625.0 | 2576.0 | 8.0 | 0.279 | 0.175 | 0.874 | 863 |
| | Oil | 2633.0 | 2584.0 | 15.0 | 0.252 | 0.203 | 0.949 | 154 |
| Ile 2 | Oil | 2648.0 | 2599.0 | 16.0 | 0.274 | 0.140 | 0.981 | 1143 |
| Ile 1 | Oil | 2664.0 | 2615.0 | 4.5 | 0.265 | 0.168 | 1.000 | 809 |
| Ø Ror | Oil | 2668.5 | 2619.5 | 9.0 | 0.243 | 0.249 | 0.949 | 114 |
| Tofte 3 | Oil | 2677.5 | 2628.5 | 31.9 | 0.296 | 0.151 | 1.000 | 1112 |
| Tofte 2 | Oil | 2709.4 | 2660.4 | 6.3 | 0.235 | 0.379 | 0.976 | 62 |
| Tofte 1 | Oil | 2715.7 | 2666.7 | 15.8 | 0.242 | 0.272 | 0.894 | 595 |
| Tilje 4 | Oil | 2731.5 | 2682.5 | 8.5 | 0.262 | 0.421 | 0.892 | 836 |
| | Water | 2740.0 | 2691.0 | 9.5 | 0.224 | 0.736 | 0.775 | 422 |
| Tilje 3 | Water | 2749.5 | 2700.6 | 24.0 | 0.271 | 0.696 | 0.962 | 973 |
| Tilje 2 | Water | 2773.5 | 2724.6 | 44.5 | 0.198 | 0.820 | 0.733 | 227 |
| Tilje 1 | Water | 2818.0 | 2769.0 | 29.5 | 0.275 | 0.871 | 0.897 | 2375 |
| Åre | Water | 2847.5 | 2798.5 | 42.5 | 0.256 | 0.805 | 0.264 | 1330 |

**ATTACHMENT 1**

**FINAL DIRECTIONAL SURVEY**

STATOIL
Template C (WI/GI)
slot #4
NORNE
Norwegian North Sea

# S U R V E Y  L I S T I N G

Well name : C-04h

Your ref : DEFINITIVE SURVEY C-04H

Our ref : svy6465

Date printed : 22-Jan-97
Date created : 17-Dec-96
Last revised : 20-Dec-96

Field is centred on 458667.000,7323438.000,9.00

Structure is centred on 457182.600,7322026.700,9.00

| Measured Depth | Inclin. Degrees | Azimuth Degrees | True Vert. Depth | RECTANGULAR COORDINATES | | Dogleg Deg/30m | Vert Sect | |
|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 7.47 N | 2.52 W | 0.00 | 0.00 | |
| 400.00 | 0.00 | 0.00 | 400.00 | 7.47 N | 2.52 W | 0.00 | 0.00 | SP-Sun MWD:400-1288 mMD |
| 461.00 | 0.58 | 76.72 | 461.00 | 7.54 N | 2.21 W | 0.29 | 0.03 | 30" Cond:461m MD,461 mTVD |
| 475.30 | 0.72 | 76.72 | 475.30 | 7.58 N | 2.06 W | 0.29 | 0.05 | |
| 504.40 | 1.02 | 21.53 | 504.40 | 7.86 N | 1.78 W | 0.87 | 0.29 | |
| 533.40 | 1.43 | 35.65 | 533.39 | 8.40 N | 1.48 W | 0.52 | 0.78 | |
| 562.40 | 1.40 | 36.60 | 562.38 | 8.98 N | 1.06 W | 0.04 | 1.30 | |
| 591.40 | 1.44 | 33.53 | 591.37 | 9.57 N | 0.64 W | 0.09 | 1.83 | |
| 620.50 | 3.04 | 26.70 | 620.45 | 10.56 N | 0.09 W | 1.67 | 2.74 | |
| 649.60 | 3.75 | 19.61 | 649.50 | 12.15 N | 0.57 E | 0.85 | 4.23 | |
| 678.80 | 5.64 | 11.94 | 678.60 | 14.45 N | 1.19 E | 2.04 | 6.43 | |
| 707.90 | 8.28 | 10.75 | 707.48 | 17.91 N | 1.88 E | 2.73 | 9.77 | |
| 737.00 | 9.30 | 10.39 | 736.24 | 22.28 N | 2.69 E | 1.05 | 13.99 | |
| 753.60 | 9.94 | 4.42 | 752.61 | 25.03 N | 3.04 E | 2.14 | 16.67 | |
| 766.10 | 11.27 | 5.16 | 764.89 | 27.32 N | 3.24 E | 3.21 | 18.92 | |
| 795.20 | 13.12 | 0.73 | 793.33 | 33.45 N | 3.53 E | 2.14 | 24.96 | |
| 824.20 | 15.70 | 359.73 | 821.42 | 40.67 N | 3.56 E | 2.68 | 32.11 | |
| 853.30 | 17.35 | 357.97 | 849.32 | 48.94 N | 3.39 E | 1.78 | 40.34 | |
| 882.40 | 15.65 | 353.70 | 877.22 | 57.18 N | 2.80 E | 2.15 | 48.58 | |
| 911.50 | 14.48 | 351.72 | 905.32 | 64.68 N | 1.85 E | 1.32 | 56.15 | |
| 940.60 | 13.40 | 354.13 | 933.56 | 71.64 N | 0.98 E | 1.26 | 63.15 | |
| 969.70 | 13.68 | 355.32 | 961.85 | 78.42 N | 0.35 E | 0.41 | 69.96 | |
| 998.80 | 14.33 | 355.85 | 990.09 | 85.44 N | 0.19 W | 0.68 | 76.99 | |
| 1027.80 | 13.41 | 356.91 | 1018.24 | 92.38 N | 0.63 W | 0.99 | 83.93 | |
| 1056.90 | 14.21 | 350.21 | 1046.50 | 99.27 N | 1.42 W | 1.84 | 90.86 | |
| 1086.00 | 16.54 | 346.14 | 1074.56 | 106.81 N | 3.02 W | 2.65 | 98.55 | |
| 1115.10 | 16.51 | 344.93 | 1102.46 | 114.83 N | 5.09 W | 0.36 | 106.77 | |
| 1144.20 | 16.56 | 346.58 | 1130.35 | 122.85 N | 7.12 W | 0.49 | 114.99 | |
| 1173.30 | 16.91 | 347.94 | 1158.22 | 131.03 N | 8.97 W | 0.54 | 123.33 | |
| 1202.40 | 16.53 | 348.01 | 1186.09 | 139.22 N | 10.72 W | 0.39 | 131.68 | |
| 1231.40 | 15.44 | 347.84 | 1213.97 | 147.02 N | 12.39 W | 1.13 | 139.64 | |
| 1260.60 | 14.48 | 349.97 | 1242.18 | 154.42 N | 13.84 W | 1.14 | 147.16 | |
| 1288.00 | 14.45 | 350.76 | 1268.71 | 161.17 N | 14.99 W | 0.22 | 154.00 | SP-Sun MWD:1288-2537 mMD |
| 1301.00 | 14.25 | 350.58 | 1281.31 | 164.35 N | 15.51 W | 0.47 | 157.22 | |
| 1301.10 | 14.25 | 350.58 | 1281.40 | 164.37 N | 15.51 W | 0.47 | 157.25 | 20" Csg:1301.1 mMD,1281.4 mTVD |
| 1318.00 | 13.99 | 350.34 | 1297.79 | 168.44 N | 16.20 W | 0.47 | 161.37 | |
| 1346.00 | 12.80 | 348.47 | 1325.03 | 174.81 N | 17.38 W | 1.36 | 167.84 | |
| 1376.00 | 11.85 | 349.05 | 1354.34 | 181.09 N | 18.63 W | 0.96 | 174.23 | |
| 1405.90 | 10.90 | 349.15 | 1383.65 | 186.88 N | 19.75 W | 0.95 | 180.12 | |
| 1434.20 | 10.14 | 348.29 | 1411.47 | 191.95 N | 20.76 W | 0.82 | 185.28 | |
| 1461.20 | 8.41 | 344.58 | 1438.12 | 196.18 N | 21.77 W | 2.03 | 189.60 | |
| 1494.70 | 6.59 | 340.54 | 1471.33 | 200.36 N | 23.06 W | 1.70 | 193.91 | |
| 1524.60 | 5.37 | 332.12 | 1501.07 | 203.21 N | 24.28 W | 1.50 | 196.90 | |
| 1553.40 | 4.02 | 324.53 | 1529.77 | 205.22 N | 25.50 W | 1.55 | 199.06 | |
| 1582.40 | 3.28 | 334.78 | 1558.71 | 206.80 N | 26.44 W | 1.02 | 200.75 | |
| 1610.40 | 3.54 | 333.56 | 1586.66 | 208.30 N | 27.17 W | 0.29 | 202.33 | |
| 1639.80 | 1.64 | 349.99 | 1616.03 | 209.53 N | 27.65 W | 2.06 | 203.61 | |
| 1667.60 | 1.13 | 57.56 | 1643.83 | 210.07 N | 27.48 W | 1.72 | 204.12 | |
| 1696.50 | 1.08 | 60.84 | 1672.72 | 210.35 N | 27.01 W | 0.08 | 204.34 | |
| 1725.10 | 1.30 | 61.39 | 1701.32 | 210.64 N | 26.49 W | 0.23 | 204.56 | |
| 1756.00 | 1.16 | 62.64 | 1732.21 | 210.95 N | 25.90 W | 0.14 | 204.79 | |
| 1785.80 | 1.44 | 56.77 | 1762.00 | 211.30 N | 25.32 W | 0.31 | 205.05 | |
| 1815.90 | 1.46 | 61.38 | 1792.09 | 211.69 N | 24.67 W | 0.12 | 205.35 | |
| 1845.00 | 1.51 | 67.15 | 1821.18 | 212.01 N | 23.99 W | 0.16 | 205.59 | |
| 1874.20 | 1.35 | 59.80 | 1850.37 | 212.34 N | 23.34 W | 0.25 | 205.82 | |
| 1903.70 | 1.50 | 72.68 | 1879.86 | 212.62 N | 22.67 W | 0.36 | 206.02 | |
| 1933.20 | 1.63 | 76.58 | 1909.35 | 212.84 N | 21.89 W | 0.17 | 206.13 | |
| 1961.00 | 1.30 | 79.80 | 1937.14 | 212.98 N | 21.19 W | 0.37 | 206.19 | |
| 1990.30 | 0.66 | 126.85 | 1966.44 | 212.94 N | 20.73 W | 1.00 | 206.08 | |
| 2018.50 | 0.54 | 205.50 | 1994.64 | 212.73 N | 20.66 W | 0.81 | 205.86 | |

All data is in metres unless otherwise stated
Coordinates are from structure centre and TVDs are from rkb.
Vertical section is from wellhead on azimuth 352.47 degrees.
Calculation uses the minimum curvature method.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2045.90 | 1.19 | 192.65 | 2022.03 | 212.33 N | 20.78 W | 0.74 | 205.48 | |
| 2075.80 | 1.34 | 214.47 | 2051.93 | 211.74 N | 21.04 W | 0.50 | 204.93 | |
| 2104.70 | 1.68 | 219.01 | 2080.82 | 211.13 N | 21.50 W | 0.37 | 204.39 | |
| 2134.50 | 1.51 | 219.10 | 2110.61 | 210.49 N | 22.02 W | 0.17 | 203.82 | |
| 2165.50 | 1.37 | 220.41 | 2141.60 | 209.89 N | 22.52 W | 0.14 | 203.29 | |
| 2196.60 | 1.53 | 225.51 | 2172.69 | 209.31 N | 23.06 W | 0.20 | 202.79 | |
| 2279.70 | 0.94 | 207.20 | 2255.77 | 207.93 N | 24.16 W | 0.25 | 201.57 | |
| 2369.10 | 1.05 | 233.58 | 2345.15 | 206.79 N | 25.16 W | 0.16 | 200.57 | |
| 2457.00 | 1.00 | 242.42 | 2433.04 | 205.96 N | 26.48 W | 0.06 | 199.92 | |
| 2536.90 | 1.38 | 249.41 | 2512.92 | 205.30 N | 28.00 W | 0.15 | 199.46 | SP-Sun MWD:2537-2870 mMD |
| 2572.00 | 1.07 | 252.14 | 2548.01 | 205.05 N | 28.71 W | 0.27 | 199.30 | 9 5/8" Csg:2572 mMD,2548 mTVD |
| 2581.10 | 0.99 | 253.13 | 2557.11 | 205.00 N | 28.87 W | 0.27 | 199.28 | |
| 2610.10 | 0.73 | 255.71 | 2586.11 | 204.88 N | 29.29 W | 0.27 | 199.21 | |
| 2639.30 | 0.94 | 253.02 | 2615.31 | 204.77 N | 29.69 W | 0.22 | 199.15 | |
| 2668.40 | 0.85 | 245.34 | 2644.40 | 204.61 N | 30.12 W | 0.15 | 199.05 | |
| 2697.50 | 0.71 | 226.68 | 2673.50 | 204.39 N | 30.45 W | 0.30 | 198.88 | |
| 2755.60 | 0.69 | 258.57 | 2731.60 | 204.08 N | 31.05 W | 0.20 | 198.65 | |
| 2812.60 | 0.57 | 251.63 | 2788.59 | 203.92 N | 31.66 W | 0.07 | 198.57 | |
| 2869.70 | 0.59 | 274.52 | 2845.69 | 203.85 N | 32.22 W | 0.12 | 198.58 | |
| 2891.00 | 0.59 | 274.52 | 2866.99 | 203.87 N | 32.44 W | 0.00 | 198.62 | 7" Liner:2891 mMD,2867 mTVD |
| 2900.00 | 0.59 | 274.52 | 2875.99 | 203.88 N | 32.53 W | 0.00 | 198.64 | Extrapolated to TD=2900 mMD |

## Comments in wellpath

| MD | TVD | Rectangular Coords. | | Comment |
|---|---|---|---|---|
| 400.00 | 400.00 | 7.47 N | 2.52 W | SP-Sun MWD:400-1288 mMD |
| 461.00 | 461.00 | 7.54 N | 2.21 W | 30" Cond:461m MD,461 mTVD |
| 1288.00 | 1268.71 | 161.17 N | 14.99 W | SP-Sun MWD:1288-2537 mMD |
| 1301.10 | 1281.40 | 164.37 N | 15.51 W | 20" Csg:1301.1 mMD,1281.4 mTVD |
| 2536.90 | 2512.92 | 205.30 N | 28.00 W | SP-Sun MWD:2537-2870 mMD |
| 2572.00 | 2548.01 | 205.05 N | 28.71 W | 9 5/8" Csg:2572 mMD,2548 mTVD |
| 2891.00 | 2866.99 | 203.87 N | 32.44 W | 7" Liner:2891 mMD,2867 mTVD |
| 2900.00 | 2875.99 | 203.88 N | 32.53 W | Extrapolated to TD=2900 mMD |

## Casing positions in string 'A'

| Top MD | Top TVD | Rectangular Coords. | | Shoe MD | Shoe TVD | Rectangular Coords. | | Casing |
|---|---|---|---|---|---|---|---|---|
| 399.00 | 399.00 | 7.47N | -2.52W | 461.00 | 461.00 | 7.54N | -2.21W | 30" Cond |
| 400.00 | 400.00 | 7.47N | -2.52W | 1301.10 | 1281.40 | 164.37N | -15.51W | 20" Csg |
| 399.00 | 399.00 | 7.47N | -2.52W | 2571.40 | 2547.41 | 205.05N | -28.70W | 9 5/8" Csg |
| 2410.00 | 2386.05 | 206.37N | -25.77W | 2891.00 | 2866.99 | 203.87N | -32.44W | 7" Liner |

## Targets associated with this wellpath

| Target name | Position | T.V.D. | Local rectangular coords. | | Date revised |
|---|---|---|---|---|---|
| GI-1 Tgt1 | n66 0 58.438363,e8 3 19.46338 | 2575.00 | 200.98N | 28.11W | 4-Jun-96 |

All data is in metres unless otherwise stated
Coordinates are from structure centre and TVDs are from rkb.
Vertical section is from wellhead on azimuth 352.47 degrees.
Calculation uses the minimum curvature method.

# ATTACHMENT 2

# WELLSITE CORE DESCRIPTIONS

STATOIL



# CONVENTIONAL CORE DESCRIPTION

| | | |
|---|---|---|
| **Country:** Norway | **Area:** Nordland II | **Field:** Norne |
| **Well no:** 6608/10-C-4 H | **Formation:** Melke - Garn 3 | |
| **Core no:** 1 | **Interval:** 2584 - 2588 m | **Cored:** 4.0 m **Rec:** 3.3 (82.5%) |
| **Core size:** 4 ½" | **Geologist:** S. Greve | **Date:** 04.12.96 |

| Depth (m KB) | Lithology/Grain size (cly slt vf f m c vc) | APPARENT DIP | Shows: STAIN | FLUOR | CUT | Φ: POOR | FAIR | GOOD | Lithological Description (Rock name, mod. lith., colour, grain size, sorting, roundness, matrix, cementation, hardness, sed. struct., accessories, fossils, porosity, contamination) | Remarks (Shows, etc) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2584 | m | | | | | | | | CLST: olv blk, hd, v micac, predom non calc | No Shw |
| 2586 | | | | | | | | | SST: dk yel brn, arg Mtrx, predom transl Qtz, also lt pk, crs - v crs - Grv, also v f - m, poorly srtd, sbrndd - rndd, I.P. v pyr cmt, v hd | dull yel fluor, mod strmg mlky wh cut fluor, yel wh res fluor |
| 2587.3 | | | | ■ | ■ | | ■ | | | |
| 2588 | | | | | | | | | | |

cly slt vf f m c vc

# CONVENTIONAL CORE DESCRIPTION

| | | |
|---|---|---|
| **Country:** Norway | **Area:** Nordland II | **Field:** Norne |
| **Well no:** 6608/10-C-4 H | **Formation:** Garn 3 - Not | |
| **Core no:** 2 | **Interval:** 2588 - 2624 m | **Cored:** 36.0 m **Rec:** 35.65 m (99%) |
| **Core size:** 4 ½" | **Geologist:** S. Greve | **Date:** 05.12.96 |

| Depth (m KB) | Lithology/Grain size (cly slt vf f m c vc) | Apparent Dip | Shows: STAIN | FLUOR | CUT | Φ: POOR | FAIR | GOOD | Lithological Description (Rock name, mod. lith., colour, grain size, sorting, roundness, matrix, cementation, hardness, sed. struct., accessories, fossils, porosity, contamination) | Remarks (Shows, etc) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2588 | | | | | | | | | Core shipped as 9m lengths. Core descriptions taken every 9m. | |
| 2590 | | | | | | | | | | |
| 2594 | | | | | | | | | SST: lt brn gr y -lt olv gry, transp - transl Qtz, v f - f, predom f, sbang - sbrndd, firm, brit, sl arg Mtrx, gd vis Por, non calc, wl srt | Tr wk yel fluor, slow strmg wk bl wh cut fluor, wk bl wh res |
| 2598 | | | | | | | | | | |
| 2602 | | | | | | | | | | |
| 2606 | m | | | | | | | | SST: predom a.a., mic Lam, mod - gd vis Por, occ pyr | Tr a.a., mod - slw strmg wk mlky wh cut fluor, bl wh res |
| 2610 | | | | | | | | | | |
| 2614 | m | | | | | | | | SST: lt olv gry, transl - transp Qtz, v f - f, wl srt, sbang - sbrndd, firm - mod hd, slily arg Mtrx, mic Lam, Tr Pyr, slily calc Cmt, fair - gd vis Por | dull yel gn fluor, slw strmg wh - mlky wh cut fluor, bl wh res |
| 2618 | | | | | | | | | | |
| 2622 | | | | | | | | | | |
| 2624.5 | m | | | | | | | | CLST: olv gry - olv blk, slty, v hd, mic, pyr l.P., non calc | No show |
| 2626 | | | | | | | | | | |

cly slt vf f m c vc

# NORNE FIELD
# WELL: 6608/10-C-4 H

**STATOIL**
HYDRO/SAGA/NORSK AGIP/ENTERPRISE OIL

COMPLETION LOG
BELOW 20" CASING SHOE

Scale 1 : 500

## GENERAL:

| | |
|---|---|
| Location: | PL 128 |
| Field: | NORNE |
| Well No: | 6 - Temporary 6 |
| Geographic Coord.: | 7 631 597.00 mN |
| Rig Coordinates: | 1 000 000.00 mE |
| Grid Convergence: | 1.22 mE |
| | 0.00 mN |
| Well Type: | Gas Condensate Development |
| MSL Rig: | 25.00 m |
| Water Depth: | 378.00 m |
| Kelly Bushing: | 403.00 m MSL |
| Reference Elevation: | Same |
| Date Drilling Start: | 23.10.96, From 20" Csg |
| Date on Site: | 06.02.96 |
| Logging Finished: | 07.02.96 |
| Drilling Finished: | 07.02.96 as abandoned |
| Drilling Rig: | Transocean 4 Jackup |

WELL LOCATION MAP
TOP NORTHSTOKE

WELL COMPLETION
(Not to scale)

| No. | Casing Shoe | Packer | Perforations |
|---|---|---|---|
| 1 | 2000 - 2001 | | 1911 - 1921 |
| 2 | 2000 - 2001 | | 1911 - 1921 |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |

PERFORATED INTERVALS:

Depth in Metres

CASING AND FORMATION INTEGRITY:

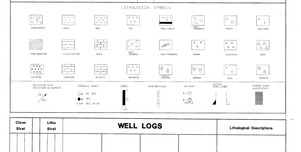
| | |
|---|---|
| 20" Casing Shoe | 27.10.96 at 2001 |
| 13 3/8" Casing Shoe | 01.11.96 at 3000 |
| 9 5/8" Casing Shoe | 17.10.96 at 4000 |
| 7" Liner Shoe | 07.11.96 at 4500 |

| | | |
|---|---|---|
| 20" Casing Shoe | 2001 | 27.10.96 |
| 13 3/8" Casing Shoe | 3000 | 01.11.96 |
| 9 5/8" Casing Shoe | 4000 | 17.10.96 |
| 7" Liner Shoe | 4500 | 07.11.96 |

FORMATION LOSING BELOW 20" CASING SHOE

| LOG TYPE | No. | DEPTH INTERV. | DATE | COMMENTS |
|---|---|---|---|---|
| DIS/CAL/GR/SP/DTC | 3 | 1200 - 2979 | 04.11.96 | BRINE/ 3.0 PVC |
| DIS/CAL/GR/SP/DTC/DSI/SLS/DSI | 3 | 2900 - 3480 | 05.11.96 | BRINE/ 3.0 PVC |
| CAL/GR/LL/MSFL/RES.CN/SON/TTRM | 4 | 3800 - 3900 | 06.11.96 | WBM |
| CAL/GR/CN/SON | 4 | 3874 - 4500 | 07.11.96 | WBM |

LITHOLOGICAL SYMBOLS




# WELL LOGS

Chron Strat | Litho Strat | Depth | Drilling Time | Gamma Ray | Caliper | Resistivity | Density | Neutron Porosion | Lithological Descriptions

TERTIARY — NEOGENE — PLIOCENE — NORDLAND — MOSER
TERTIARY — NEOGENE — MIOCENE — NORDLAND — KAI
TERTIARY — PALEOGENE — EOCENE — NORDLAND — BRYGGE
TERTIARY — PALEOGENE — EOCENE — NORDLAND — BRYGGE TUFF
TERTIARY — PALEOGENE — EOCENE — ROGALAND — TARE
TERTIARY — PALEOGENE — EOCENE — ROGALAND — TANG
CRETACEOUS — LATE CRETACEOUS — SHETLAND — SPRINGAR
CRETACEOUS — LATE CRETACEOUS — SHETLAND — HIBU
CRETACEOUS — LATE CRETACEOUS — SHETLAND — LYR
JURASSIC — MIDDLE / LATE JURASSIC — VIKING — BRENT
JURASSIC — MIDDLE JURASSIC — VIKING — BRENT
JURASSIC — EARLY JURASSIC — BAJOCIAN — TOFTE — FARSTAD
JURASSIC — EARLY JURASSIC — BAJOCIAN — TOFTE — TILJE 4
JURASSIC — EARLY JURASSIC — BAJOCIAN — TOFTE — TILJE 3
JURASSIC — EARLY JURASSIC — BAJOCIAN — TOFTE — TILJE 1
JURASSIC — EARLY JURASSIC — BAJOCIAN — BAT — ILE

Chron Strat | Litho Strat | Depth | Drilling Time | Gamma Ray | Caliper | Resistivity | Density | Neutron Porosion | Lithological Descriptions

INSITE

**sperry-sun**
DRILLING SERVICES

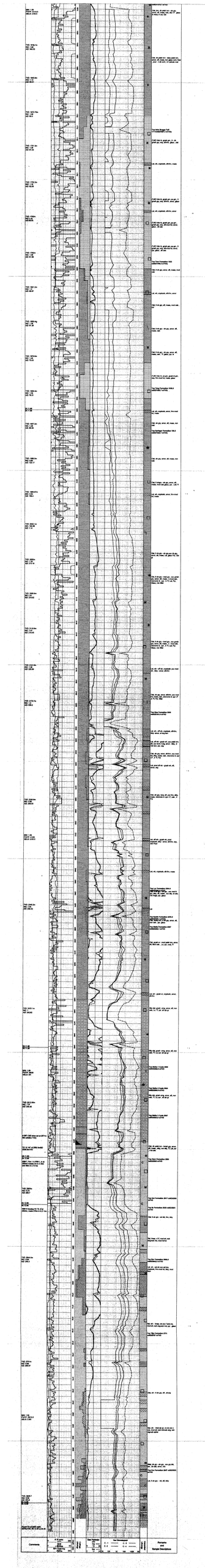
**MUDLOG** Scale 1:500

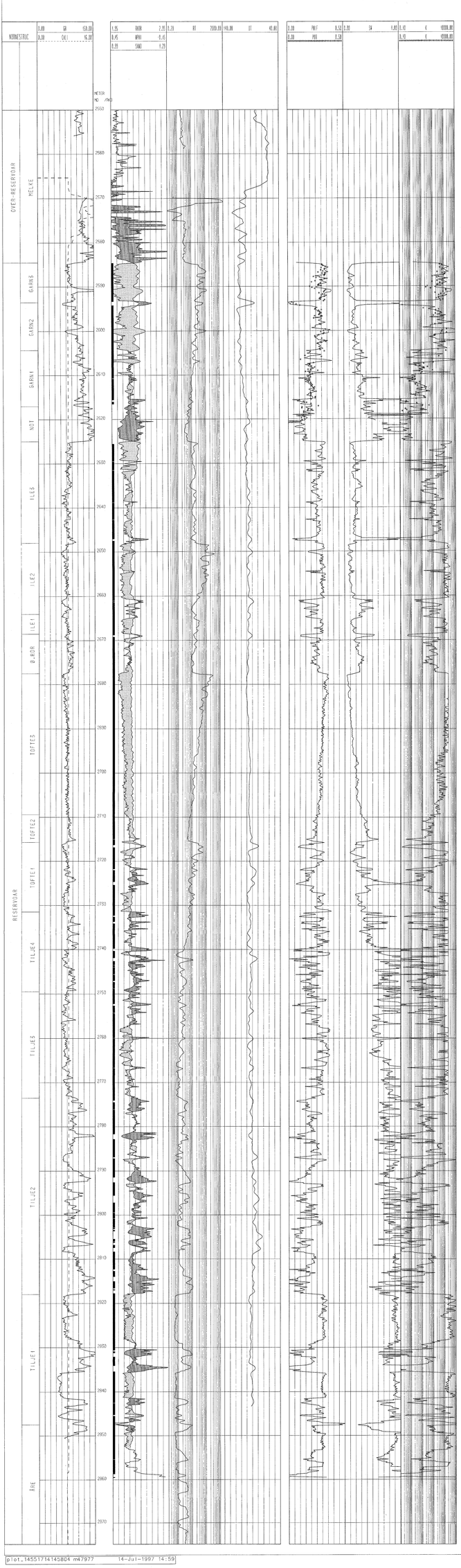
**STATOIL - NORWAY**
**Well 6608/10-C-D4H**

STATOIL

Sections | Sections | Sections | Lithology | Sonic Velocity | Wh. Gas/m | Chlorides | Pressure and Leak

| Comments | ROP (min/m) and DEPTH (MD) | Lithology | Gas Chromatograph | Formation and Sample Descriptions |
|---|---|---|---|---|
| Operation Drill, Aug 1996<br>Hole 1 Seq 0 1 127 Jetted Pilot Hole 17 1/2" with Pilot Bit and Jetting Tool. Hole size 17 1/2 in.<br>Hole 1 Seq 0 1 127 Jetted Pilot Hole 17 1/2" with Pilot Bit and Jetting Tool. Hole size 17 1/2 in. | | | | Drilled with seawater and bio-pills |
| 13" casing set at 400.00MD, 400.00TVD | | | | |
| 13" casing set at 400.00MD, 400.00TVD | | | | |
| 13" casing set at 400.00MD, 400.00TVD | | | |


Comments
Gas Indicator
Gas Chromatogram
Remarks
Sample Descriptions

STATOIL

CPI LOG 6608/10-C-4H