

Denne rapport  
tilhører



UND DOK.SENTER

L.NR. 20090414031

KODE Well 25/1-2 nr 7

Returneres etter bruk

WELLFILE

GEOLOGICAL NOTE

ON

FRIGG 2

(25/1-2x)

Elf Norge A/S  
Well 25/1-2x Frigg  
Pertinent data

- Classification: Extension well
- Area: Field 25 - Block 1 - Licence 024
- Location: x: 2° 04' 54.6" E  
y: 59° 56' 08.6" N  
i.e. SP 216 of line 69205
- Water depth: 103 m
- KB elevation: 24 m
- Objective: To test the lower tertiary sands, gas bearing in Frigg 1.
- Results: Gas and oil bearing Eocene - Paleocene sands as in Frigg 1.
- Status: Plugged and abandoned.
- Total depth: 2772 m
- Contractor/rig: Neptune "Pentagone 81" (semi-submersible)
- Date spudded: 22/7/71
- At total depth: 19/8/71
- Completed: 25/8/71

I. GENERAL

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A) Prospect geology and objectives

The Petronord 25/1-2 well is located in the tertiary graben which axis trends Northerly and approximates the median line between Scottish and Norwegian waters.

- In this area seismic reflection surveys enabled to define a large amoboïd closure at the "C1" reflector level assumed to be the top of lower tertiary sands.
- After the sucessful drilling of this structure with the Frigg 1 well, Frigg 2 was located on the Northern trend of these sand-bodies to confirm their extension, fluid contents, and check for their eventual facies variations northward. The well was to be stopped in the upper cretaceous chalk after exploring potential sandy beds and chalky stringers occuring near the top of this formation.

B) Technical data

- RKB elevation: + 24
- Water depth: 103 m

Drilling and casing data

- Drilled 36" hole to 167 m; 30" guide set at that depth.
- Drilled 17 1/2" hole to 460 m - 13 3/8 set and cemented at 452 m (454 m SPE).
- Drilled 12 1/4" hole to 1159 m, then sidetracked at 719 m down to 1159 m - 9 5/8" casing set and cemented at 1850 m.
- Drilled 8 1/2" hole to 2772 m.

Drilling fluids

A sea water-LFC system was used down to TD -

Coring

- Mechanical: none
  
- 64 sidewall cores were recovered out of 89 shot in four runs.

Logging

See 1/5000 log.

Testing

7 wire line tests were conducted:

1. 2502,5 - mechanical failure
2. 2503 - oil and filtrate
3. 1984,25 - mechanical failure
4. 2508,5 - oil and filtrate
5. 1984 - oil
6. 1986,25 - oil and filtrate
7. 1993,5 - oil and filtrate

II. STRATIGRAPHY AND LITHOLOGY

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The formations and divisions considered below are based on microfloras and microfaunas analysis as well as on petrographical and electrical correlations with surrounding wells -

1. Quaternary - Tertiary 127 - 2678 m (2551 m)

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1.1. "Lignitic series" - 127 - 755 m (628 m)

Pleistocene - Miocene

A sample recovered by divers shows that the sea bed is made of sand, fine glauconitic and micaceous, with thick shell fragments.

The well was drilled without returns down to 460 m. In this interval a lithology of sand, fine to coarse lignitic with green clays interbeds (414 - 446 m), is inferred from the gamma-ray curve and a bit sample.

Further down to 755 m this unit is composed of sand: fine to medium pyritic and micaceous with lignite, shell crags, and soft green clay intercalations -

1.2. "Brown clays group" - 755 m - 1820 m (th. 1065 m)

Oligocene - Middle Eocene

1.2.1. 755 - 910 m

Soft grey-brown, silty, sandy clays, with three very lignitic sand interbeds between 804 and 854 m make up this interval.

1.2.2. 910 - 1275 m

A very monotonous section of grey brown "gumbo" type clay follows downwards - A few tan micro-crystalline dolomite stringers and nodules occur throughout.

These two units are dated middle-lower Oligocene by palynology. (Nt V and IV zones).

1.2.3. 1275 - 1820 m

Brown soft clays are again the dominant lithology in this unit with the exception of a water-wet, fine to coarse, glauconitic sand interval between 1331 and 1349 m. These deposits were laid during Upper-Middle Eocene as indicated by their microfloras (zone Nt III).

1.3. Green shale member - 1820 - 1920 m

Light Apple Green shale marks the base of the Middle Eocene clays (base of zone Nt III) and extends downwards in the Lower Eocene (top Nt II c zone: Ypresian).

1.4. "Frigg Formation"

1.4.1. 1920 - 1949 m

Alternates of sandstones, fine to very fine with a calcareous cement - green shales and fine sands make up this unit -

Microfloras indicate a Lower Eocene (Ypresian) age for this interval (zone Nt II c).

1.4.2. 1949 - 2049 m

This exceptional reservoir section consists of 3 cyclic main sand bodies:

- a) 1949 - 1975 m
- b) 1976 - 2006 m
- c) 2009 - 2049 m

separated by minor shale stringers.

The sands are clean, light grey, with fine to medium angular- subangular grains, poorly sorted.

A few metric stringers of sandstone with a calcareous cement occur, mainly located near the base of the lower sand.

Porosities in these reservoirs are very high, in the range of - 30 %.

The dipmeter data indicates a rapid sand build-up in a shallow, high energy, environment with sediment transport from East to West.

- The upper alternates correspond with the base of palynozone Nt II c (Ypresian) and the lower clean massive sand to Lower Eocene (Nt II b - zone) - with a transgressive trend upwards -
- Dipmeter data indicate an E-W sand transport, in a shallow water, high energy environment.

1.5. Upper sand-shale member and tuffitic zone 2049 m -2221 m

1.5.1. 2049 - 2140 m (th. 91 m)

Sands and shales alternate at the top of this unit arranged in a shale-sand sequence upwards, followed by a median shale (2086 - 2114 m) and by two lignitic sand bodies in sand-shale sequence. - (2109 - 2125 m and 2134 - 2140 m).

Sediment transport was northwards in this interval dated Paleocene (Upper Nt II a zone).

1.5.2. 2140 - 2221 m (th. 81 m)

This complex lithological zone is made of grey green shale with sand interbeds, fine to medium, sandstones and volcanic ash stringers with a calcareous and grey shale cement. It corresponds to Paleocene (middle of Nt II a zone).

1.6. Cod formation 2221 - 2441 m (th. 220 m)

A cyclic deposition of sands and grey green shale, more important near the base, generates this thick reservoir.

A few sandstone stringers with a calcareous secondary cement occur at the top of the shale-sand sequences, or at the base of the sand-shale cycles - where the grains are coarser.

The sands are grey, graded in cycles from 5 to 10 m from fine to very coarse (2 mm) with angular to subrounded grains. Pyrite is common throughout. Porosities are in the 25 - 30 % range.

In these deposits, dipmeter patterns indicate a North-South trend with sediment transport reverting northwards and southwards and deposition in a low energy (50' - 300') environment. A good palynological marker is given by the appearance of *Wetziella* D 361 at the top of this reservoir, associate with other Paleocene species.

1.7. Lower sand-shale members 2441 - 2513 m (th. 72 m)

Shales, greenish-grey, are followed below 2501 m by medium sand interbeds (7 m net,  $\phi \approx 25\%$ ) where the dipmeter shows only high cross bedding of high energy deposition.

This member is dated lowermost Paleocene-Danian by palynology (Nt I b zone).



1.2. Lower shale member 2513 - 2678 m (th. 165 m)

Grey shale, silty, becoming more compacted and calcareous below 2606 m in the dominant lithology of this member.

A few metric cyclic stringers of white chalky limestones are present throughout.

In this section dated Danian (Nt I a zone) a structural dip of 5° WNW is well marked.

Reworked Upper Cretaceous microfaunas are present in the limestones. Abundant radiolaria are characteristic of the lower part of this member.

2. Upper Cretaceous - 2678 - 2772 m TD (th. >94 m)

Dark grey marls sometimes green and tan, associated with white to grey chalky limestones (mudstones) interbeds are characteristic of this interval -

A thin sand, medium to coarse grained, occurs near the top between 2684 and 2687 m, and is interpreted on the dipmeter as a distributary front trending northwards -

below 2687  
✓

Foraminifera of these strata down to TD are characteristic of Maestrichtian. ~~and~~

PTD 1701 P130001 P5. 13.04  
Well no. 25/1-2

- Location:  $59^{\circ} 56' 07''$  N  
 $02^{\circ} 05' 00''$  E
- Water depth: 103 m
- Date: July - August 1971
- Total depth: 2747,5 m (9000')
- Reference level: MSL
- Log analysis:

	G & Mc	Statoil
Porosity top	1903,4	1902,39
GOC	1948,5	1949,35
OWC		1958,39
Gross pay oil (m)		9,04
Gross pay gas (m)	53,9	47,2
Net pay (m)	39,6	46,6
$n/g=d$	0,7347	0,987
Net $\phi$	0,3018	0,290
Net $S_g$	0,9066	0,885
$\beta = d \times \phi \times S_g$	0,2010	0,253
Equivalent gas height (m)	10,834	11,804
Sand thickness (m)		208

Log analysis (Elf) Lower reservoir:

Reservoir top:	2460,75 m
OWC:	2486,75 m
Oil zone:	hg = 76 m
	hn = 5 m
	$\phi_{ave} = 26\%$
	Swave = 60%

P5.13.04

WELL NO.: 25/1-2

CUT-OFF-NO.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	MAX.O
THICKNESS M	47.2														47.2	47.2	47.2			
NET THICKNESS M	37.6														46.6	43.0	37.1			
N/G	.797														.987	.911	.786			
φG	.301														.290	.293	.303			
φN	.305														.289	.295	.311			
φN PAY	.310														.286	.292	.310			
SHY-N	.877														.859	.863	.913			
SHY-N PAY	.925														.885	.892	.925			
HYDROCARBON M	10782														11795	11204	10638			1.15

REMARKS:

INTERVAL: 1928,2 - 1975,4

Calculation made within the gas zone.

Bottom effective sand: 2048,5 m from logs and CPI.

Proper CPI-listing.