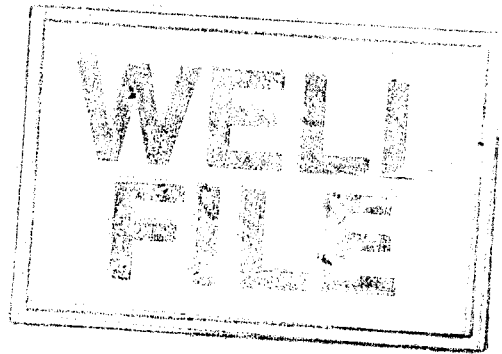


WELL FILE



N J Ø R D

(10/8-1x)

FINAL GEOLOGICAL REPORT

I. GENERAL

A. Location

Coordinates of Petronord's exploration well 10/8-1 on the Njord prospect are:

X: 57° 25' 00.009 N

Y: 5° 34' 21.706 E

i.e. shot point 7014 of seismic line 70/57 25 -

This point is located in field 10 block 8 of Norwegian waters which is included in Petronord's production licence 009.

B. Prospect geology and objectives

Njord 1 well was drilled on regular dome shaped anticline related to a salt pillow.

The structure is well defined from the Permian salt up to the upper cretaceous chalk - It has a vertical closure of 300 m for a closed area of 80 km² at a seismic horizon assumed to be the Jurassic sandstone.

A fault cuts the unconformably underlying horizons attributed to Triassic.

The specific objective of the 10/8-1 well was to test the hydrocarbon potential of the Jurassic sandstone section, estimated to be 60 m thick, with additional reservoir being furnished by the triassic sandstones immediately below.

C. Technical data

- Contractor and rig: Neptune - Pentagone 81 - Semisubmersible rig n^o 7

- <u>Dates</u> :	Spud:	December 12th 1970
	Started drilling:	December 13th 1970
	At total depth:	January 14th 1971
	Completed:	January 17th 1971

- Drilling and casing data

- Depths datum: RKB 24 m above mean sea level
(drilling and logging)

- Water depth: 81 m
- Set 30" guide at 142 m
- Drilled 17 1/2" hole to 510 m
- Set and cemented 13 3/8" casing at 508 m
- Drilled 12 1/4" hole to 1509 m
- Set and cemented 13 3/8" casing at 1504 m
- Drilled 8 1/2 hole to 2861 m (TD)

- Drilling fluids

Sea water with returns on the sea-floor was used down to 510 m ;
below, the well was drilled with a LFC - sea water system.

- Coring

Sidewall cores were taken using Schlumberger guns (see appendix 1)

- Logging (see appendix 2)

- DST's

None was taken.

- Status after completion:

Plugged and abandoned as a dry hole -

II. STRATIGRAPHY

Based on laboratory studies (Palynology and Micropaleontology) and on correlations with the surrounding wells the lithological and stratigraphical breakdown of NJORD 1 well is as follows:

1. Quaternary - Pliocene - 105 m - 569 m, thickness 464 m (sea floor)

Only bit samples were obtained down to 510 m as the well was drilled without returns -

These and the gamma-ray curve indicate mainly sands with dark-grey soft clays interbeds, and abundant shell fragments down to 406 m, clay is the main lithology down to 470 m, and the base of this unit is made up of glauconitic fine to medium grained sandstones with an argillaceous and calcareous cement.

2. Paleocene - Lower Eocene - 569 - 728 m - thickness 159 m

Two sub units.

569 - 677 m Cyclic sandstones: fine to very fine grained, with calcareous cement; some chalky, sometimes silicified, limestone stringers -

677 - 728 m (51 m) Sandy limestones: white to light brown, mudstone to wackstone sometimes silicified or marly -

Numerous foraminifera and Bryozoa some pisolithic stringers. This unit is passing gradually to:

3. Danian - 728 - 837 m - thickness 109 m

Chalky limestones white to light grey cherty and silicified with interbeds of sandy limestones (wackstone to grainstone) and greenish-black shale partings make up this unit.

4. Upper cretaceous: Cenomanian - Maestrichtian 837 - 1173 m

Massive chalky limestone, mainly mudstone to wackstone sometimes silicified, is the main lithology of this formation.

The lower 20 meters becoming more marly are very glauconitic - All the stages are represented in this chalk section and a further breakdown based on micropaleontology is as follows:

- 837 - 907 m Maestrichtian
- 907 - 1011 m Campanian (lower below 950 m)
- 1011 - 1059 m Santonian
- 1059 - 1104 m Coniacian
- 1104 - 1155 m Turonian
- 1155 - 1173 m Cenomanian

5. Lower Cretaceous Albian - Valanginian 1173 - 1338 m - thickness 195 m

This unit is composed of grey to dark grey clays and shales -

A more marly interval with green and red brown colors appears between 1217 and 1235 m -

Buff to brown microcrystalline dolomite stringers occur throughout, pyrite, lignitic fragments were observed in the lowest part, dated Neocomian below 1287 m.

6. Upper Jurassic Kimmeridgian - Oxfordian

1368 - 1504 m - thickness 136 m

This section consists of shale dark grey with some thin buff microxln. dolomite stringers, more frequent near the top. Some shell fragments and pyrite were observed in the shale.

7. Middle Jurassic ? - 1504 - 1567 m, thickness 63 m

In this interval sands and sandstones heterometric, medium to coarse, sometimes gravel-size, with subangular grains are metrically bedded with intercalations of sandy, yellow to reddish, shale -

Glauconite and lignite particles are common and the sandstones possess a whitish argillaceous and calcareous soft cement.

A few not very specific spores and pollens were recorded giving only a general Jurassic attribution to these clastic beds.

8. Triassic - 1567 - 2825 m, thickness 1258 m

A cyclic deposition of sandstones, red shales and dolomites had given birth to this thick barren section.

- The sandstones are medium to coarse with angular yellow to milky white grains and a calcareous and shaly cement.
- The dolomites are buff to tan sideritic, micro.xln - sometimes sandy
- The shales are brick to red brown sometimes light green, silty-sandy and carbonated.

These continental deposits are organised in 5 to 10 m sequences.

Some artzitic and detritic volcanic levels occur below 1935 m. The sandstones are coarser, even microconglomeratic below 2357 m.

After 2749 m red clays are becoming the dominant lithology and this section is considered to represent the lower Bunter.

Anhydrite appears in the shale at 2813 m and the last 12 m termed "Brockelshiefer" form the transistion to the following:

9. Zechstein - 2825 - 2861 m (TD), thickness 36 m.

After 10 m of shale and anhydrite interbeds had been drilled a massive salt rock section was encountered where the well was bottomed at 2861 m.

A thin potash salts stringer (2 m) is present at 2845 m and this last unit is dated Upper Permian Zechstein by palynology.

III. - PETROLEUM GEOLOGY

A) Shows

No shows were recorded but very small traces of gas (C_1 and C_2) at the base of the upper cretaceous chalk between 1010 and 1050 m.

B) Reservoirs and fluids

- The Paleocene sands outcropping and thus not sealed are water wet in this area. They are of good quality ($\phi > 30\%$) relatively thick (> 100 m) and should be a valuable objective when more buried.
- The Danian and Upper Cretaceous limestones offer good reservoir qualities down to 837 m but are related to the sands above, and water wet.
- Unfortunately the best reservoir encountered by the well, the objective Jurassic + Triassic sandstones, set, is water wet -

Its characteristics are summarized as follows:

Jurassic 1504 - 1567 m *Middle Jurassic - ?*
Gross thickness 63 m
Net thickness (h) 57,5 m
Average porosity (FDC) 22,7 %
 $\phi H = 13,05$ m
Water salinity = 50 g/l

Triassic 1567 - 2825 m
Gross thickness: 1285 m
Net thickness: 900 m

Max. and Mini. porosities: 18 % - 8 %
Decreasing with depth as compaction increases
1792 - 1919 m - 18 %
1919 - 1998 m - 14 %
1998 - 2742 m - 13 %
Average porosity: 13,5 %

$\phi H = 122$ m

IV. - CONCLUSIONS

Njord 1 well has been plugged and abandoned as a dry hole although the objectives were found at depths and with thicknesses according to previsions. The lack of shows furthermore, leaves very little hope for future finds in that part of the basin.

It should be noted that the very radioactive black jurassic shale considered one of the best mesozoic source bed is missing here.

From a stratigraphic point of view Paleocene and Danian are present under high energy border Facies with good reservoir characteristics.