

WELLFILE

W-02132

INTRODUCTION

Amoco Norway West Hod Field delineation well 2/11-5 was spudded on May 18, 1979 at $56^{\circ}09'57.7''N$; $03^{\circ}26'06.4''E$ in 72 m of water using the semi-submersible drilling rig "Dyvi Alpha". The well terminated in Lower Cretaceous rocks of Albian age at a total depth of 2945 m. No significant hydrocarbons were encountered and the well was plugged and abandoned as a dry hole on July 5, 1979.

OBJECTIVES

Well 2/11-5 was drilled on the western lobe of the Hod Field to test the Upper Cretaceous Chalk section. The well was located 1.8 km SSE of 2/11-2 which tested oil from a very thin Chalk section of the Lower Hod Formation. Structural interpretations were made showing a NW-SE trending graben traversing the West Hod lobe. Based on a model from East Hod, it was expected that the porous Tor Formation should be preserved below the unconformity within this structure.

The Hod Field is a structurally and stratigraphically complex area, and accurate estimates of the reserves depends largely on reliable structural definition and the presence of the porous Tor Formation. Seismic interpretation in the area has been highly speculative, however, as shallow gas above the Chalk obscures, the deeper reflectors.

As a fairly reliable estimate of reserves in East Hod can be made, the accuracy of reserve estimates in West Hod is important mainly for selecting a platform location in the Hod Field area. 2/11-5 was therefore drilled to provide information on which more refined estimates can be made.

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RESULTS

The Paleocene Ash Marker or Balder Formation was encountered at 2715 m - 105 m low to prognosis. The top of the Chalk Group was encountered at 2822 m - 117 m low to prognosis. In total, the Chalk section was found to be 98 m thick, whereas 300 m were predicted. These discrepancies reflect the effects of the shallow gas on the seismic data. The velocity corrections which were applied to the seismic were too large. As a consequence, the Chalk Group within the Graben, was found below the oil-water contact of the area and no hydrocarbons of any significance were encountered.

STRATIGRAPHY

Since a complete paleontological study was conducted on samples from Well 2/11-2, 1.8 km to the north, studies on Well 2/11-5 were only carried out from 2500 m to T.D.. Consequently, no age breakdown of the Quaternary and Middle-Upper Tertiary sediments exist. However, comparing with 2/11-2, a tentative boundary between the Nordland and Hordaland Group is set at ca. 1480 m. Below this point, there is a great increase in Fluorescence and total gas. Fluorescence increases to 100% in parts, and max total gas is 100,000 ppm (see page 6).

The upper part of the Nordland Group is mainly unconsolidated fine to medium quartz sands with both wood and shell fragments, while in the lower part, the lithology is mainly gray soft clay grading to shale. A few stringers of siltstone and limestone are encountered throughout.

The upper part of the Hordaland Group consists of dark brown to brown-gray clays and shales with some marl. From 1480 m to 1725 m total gas readings vary between 20,000 and 100,000 ppm. Fluorescence is between 20% and 100%.

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Downwards these beds pass into light gray or brown shales and clays.

Below, about 2100 m, two distinct shales are interbedded with thin stringers of oil stained dolomite. One shale is light gray to light/olive green, firm to soft, non calcareous. The other is dark brown, bituminous, organic, earthy and soft to firm. The interbedded dolomite is tan to light brown, microcrystalline with some fossil fragments preserved. It has a fair oil stain, fair to good yellow fluorescence and good cut but only poor to no visible porosity. A few fossiliferous limestones are also found in the lower part of the Hordaland Group.

The Paleocene Ash or Balder Formation was encountered at 2715 m with a thickness of 22 m. This is developed as a bluish/steel gray, friable, occ. soft, non calcareous tuff interbedded with pale, waxy non calcareous shales.

The top of the Sele Formation is put at 2737 m and the top of the Lista Formation at 2780 m. These boundaries are based partly on lithological changes partly on Gamma Ray and Sonic Log readings. The lithologies of both formations are predominantly shales, the upper Sele Formation with some interbeds of glauconitic sandstones, the lower Lista Formation with interbeds of claystone and traces of dolomite.

The intermediate Marl Unit usually found in the lower part of the Rogaland Group is also present in 2/11-5. Its boundary to the Lista Formation is not well defined, but tentatively put at 2817 m. Total thickness of the Rogaland Group is 107 m.

The top of the Chalk Group was encountered at 2822 m, being the Danian age Ekofisk Formation. This is white to light olive gray occasionally tan, firm/hard, micritic slightly argillaceous chalk. The tan chalk has dull yellow-orange fluorescence but visible porosity and cut is poor.

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Cretaceous Tor Formation is recognised from 2835 m to 2855 m. In this interval, chalk is white to light gray, soft/friable, micritic/granular, argillaceous, glauconitic and pyritic. Only poor fluorescence was observed.

The Hod Formation ranges from 2855 m to 2912 m. The chalk is white to light olive gray, but is becoming softer and more argillaceous. From 2912 m to 2915 m the Plenus Marl Formation is recognised and from 2915 m to 2920 m the Hydra Formation. In total the Chalk Group is 98 m thick.

From 2920 m to 2945 m T.D., lithology is dark gray/black shale, firm, earthy and slightly calcareous. This is recognised as Lower Cretaceous Rødby Formation.

STRUCTURE

The Hod and Valhall Fields appear to be underlain by salt and shale diapirs of probably Zechstein and Upper Jurassic/Lower Cretaceous age respectively. The huge Valhall structure and the two Hod lobes are best defined at Upper Cretaceous (or Top Chalk) level. Seismic interpretation showed a crestal graben on the West Hod Lobe similar to the one on East Hod tested by 2/11-3A. The presence of both Ekofisk and Tor Formation in well 2/11-5 suggest that the graben was developed by extension related to structural growth during Danian time. This resulted in preservation of Upper Chalk Group sediments from end Danian erosion which caused later Paleocene to rest directly on Hod Formation in structurally higher areas outside the graben. (Well 2/11-2).

BIOSTRATIGRAPHY

Micropalaeontological, palynological and stratigraphical analyses have been carried out by Robertson Research International on the interval from 2500 m to 2945 m T.D..

The Micropalaeontological breakdown is as follows:-

<u>Period</u>	<u>Age</u>	<u>Interval</u>	<u>Thickness (m)</u>
Tertiary	Early Eocene	Above 2500 -2727.5	At least 277.5
Tertiary	Palaeocene	2727.5-2810.0	82.5
Tertiary	Early Palaeocene (Danian)	2810.0-2840.0 (2835.0)*	30.0
Cretaceous (Late)	Late Maastrichtian	2840.0-2842.5 (2837.5)*	2.5
Cretaceous (Late)	Maastrichtian	2842.5-2855.0 (SWC)	12.5
Cretaceous (Late)	Late Campanian	2855.0-2857.5 (2852.5)*	2.5
Cretaceous (Late)	Early Campanian	2857.5-2860.0 (2855.0)*	2.5
Cretaceous (Late)	Santonian	2860.0-2862.5 (2857.5)*	2.5
Cretaceous (Late)	Coniacian - Turonian	2862.5-2905.0	42.5
Cretaceous (Late)	Cenomanian	2905.0-2917.5	12.5
Cretaceous (Early)	Albian	2917.5-2945.0 T.D.	27.5

* Because of discrepancies between sidewall cores and cuttings 5 meters has been added to the depths based on cuttings at 2840 m, 2842.5 m, 2857.5 m, 2860 m and 2862.5 m. The depth marked on the sample bags is indicated in paranthesis.

HYDROCARBON SHOWS

Only insignificant amounts of oil and gas were encountered through the depth of the well.

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Gas Shows

<u>Depth (m)</u>	<u>Methane (ppm)</u>	<u>Total Gas (ppm)</u>
175 - 350	less than 3,000	less than 5,000
350 - 850	1,000-22,000	2,000- 30,000
850 - 1470	1,000- 8,000	2,000- 10,000
1470 - 1700	25,000-90,000	35,000-100,000
1700 - 2400	10,000-50,000	15,000- 60,000
2400 - 2700	1,000-20,000	2,000- 22,000
2700 - 2775	12,000-30,000	13,000- 40,000
2775 - 2945 (T.D.)	1,000-20,000	2,000- 22,000

Oil Shows

<u>Depth (m)</u>	<u>Characteristics</u>	<u>Lithology</u>
1470 - 1575	Appr.100% dull yellow fluor w/slow white streaming cut, strong odour.	Marl - Claystone.
1575 - 1760	20-100% dull yellow fluor w/slow white streaming cut, large pieces bleeding gas.	Claystone w/some Siltstone and Marl.
1760 - 2050	5-20% dull yellow fluor w/slow white streaming cut.	Shale w/some Sandstones.
2050 - 2715	100% dull to golden yellow fair to good fluor. Moderate to fast streaming white cut. Fair to good oil stain.	Thin Dolomite interbeddings in bituminous Shales (less than 20% of total rock volume)
2715 - 2737	20-50%, fair dull golden fluor and fair cut.	Tuff and Shale interbeddings.
2825 - 2900	20-80%, dull yellow/orange fluor. No fair cut.	Tan stringers in generally white chalk.

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SHOW REPORTSShow Report No. 1

Interval: 1475 m - 2085 m

Lithology: Gray/brown claystone
Dark brown shale

Background gas	before	5,000	ppm
"	"	during	50,000-60,000 ppm
"	"	after	10,000-20,000 ppm

Cromatograph:	C ₁	50,000 ppm
	C ₂	5,000 ppm
	C ₃	1,000 ppm
	C ₄	-

Visible porosity: poor

Fluorescence: 20-100% dull yellow

Cut: slow streaming, bright, white

Show Report No. 2

Interval: 2825 m - 2905 m

Lithology: Limestone off white, white, tan

Background gas	before	2,000 ppm	
"	"	during	5,000 ppm
"	"	after	1,000 ppm

Cromatograph:	C ₁	4,200 ppm
	C ₂	800 ppm
	C ₃	Tr
	C ₄	-

Visible porosity: poor

Fluorescence: 80% dull occasionally
bright, yellow

Cut: moderately streaming, bright, white.

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CORES

21 sidewall cores were attempted, 17 of which had sufficient recovery.

Sidewall Core Descriptions

<u>Depth</u>	<u>Core</u>	<u>Lithological Description</u>
2830 m	21	<u>CHALK</u> . Fairly soft, friable, very light grey to light olive grey. Slightly darker argillaceous areas.
2835 m	20	<u>CHALK</u> . As 2830 m.
2840 m	19	<u>CHALK</u> . As 2830 m.
2846 m	17	<u>CHALK</u> . Fairly soft, friable, yellowish grey to light olive grey. Slightly argillaceous.
2855 m	15	<u>CHALK</u> . As 2846 m.
2859 m	14	<u>CHALK</u> . Fairly soft, weakly friable, light olive grey to olive grey. Slightly argillaceous with green ?chlorite spots.
2861 m	13	<u>CHALK</u> . Fairly soft, weakly friable, light olive grey to olive grey, slightly argillaceous.
2872 m	11	<u>CHALK</u> . Quite soft, fairly friable, very light grey to light olive grey.
2882 m	10	<u>CHALK</u> . Quite soft, fairly friable, light olive grey to olive grey. ?Slightly argillaceous.
2890 m	9	<u>CHALK</u> . Hard, olive grey.
2898 m	8	<u>CHALK</u> . As 2890 m, but slightly softer.
2907 m	7	<u>CHALK</u> . Fairly soft, friable, light olive grey to olive grey.
2914 m	6	<u>CHALK</u> . As 2907 m.
2917 m	5	<u>CHALK</u> . Fairly hard, yellowish grey to light olive grey.
2923 m	4	<u>CHALK</u> . As 2917 m.
2932 m	3	<u>CHALK</u> . As 2917 m.
2942 m	1	<u>ARGILLACEOUS CHALK</u> . Fairly soft, medium grey to light olive grey.

No conventional cores were cut in 2/11-5.