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AMOCO NORWAY OIL COMPANY

FINAL WELL REPORT



AMOCO-NOCO WELL 2/11-2

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INTRODUCTIONSummary

Well 2/11-2 resulted in the discovery of oil in the Santonion and Coniacion sections of the Upper Cretaceous Limestone of the Hod structure. One hundred and sixty nine feet of pay was encountered. Initial log calculations indicate an average porosity of 27.7 percent and an average water saturation of 40.3 percent. Two production tests were conducted on the Upper Cretaceous Limestone. Log derived porosity and water saturation values are given on a foot by foot basis in Enclosure No. 1. Also shown are test intervals and results. Test No. 1 was conducted on the lower portions of the pay to determine fluid content. Although the flow rate was too low to measure due to tool plugging, water free oil was flowed from the Test No. 1 interval. The productivity of the upper portions of the pay was determined during Test No. 2. On a restricted flow, the well tested 2910 BOPD at a GOR of 1090 SCF/STB with a well head pressure of 2310 psig.

Zapata Explorer moved on location to drill exploratory well 2/11-2 on November 5, 1974 with the objective of testing the Upper Cretaceous Limestone. The well was drilled to total depth of 9207 feet RKB in 37 days without any major problems, although 10 days were lost due to waiting on water, combating lost circulation after an attempt to kill a gas kick, and waiting on a new B.O.P. stack after a leak was found on the old equipment. Schlumberger logs were run before 9 5/8-inch casing and 7-inch liner were set. A core sample was taken from 8730 to 8761 feet RKB, with a 100% recovery.

Pertinent Information

Well	:	2/11-2
Classification	:	Wildcat
Final coordinates	:	56° 10' 51.2" N 03° 25' 25.9" E
Rotary Kelly Bushing elevation	:	117 feet M.S.L. <i>35-65</i>
Water Depth	:	216 feet M.S.L. <i>65-8m</i>
Rig	:	Zapata Explorer
Objective	:	Upper Cretaceous Limestone
Result	:	Discovery Well of the Hod Field
Present status	:	Abandoned
Total depth	:	9207 feet RKB <i>2806m</i>
Date rig on location	:	November 5, 1974 (1500 hrs)
Spud date	:	November 6, 1974
Date total depth reached	:	December 12, 1974
Date abandoned	:	December 29, 1974
Date rig released	:	January 16, 1975 (2130 hrs)
Days to T.D.	:	37 days
Days from mobilization to release of rig	:	73 days
Total estimated well cost	:	\$ 3,000,976

DRILLINGHighlights of Drilling Intervals

The following is a summary of the drilling activities for each hole diameter interval in 2/11-2. See Table 1 for detailed time referenced break down of drilling activities, mud properties, bits and hydraulics, and weather conditions.

- 36-inch Hole : Spud at 0900 hrs. November 6, 1974. Drilled to 475 feet RKB using a Smith DS 17½-inch bit, 36-inch opener with a seawater, Milben saltgel mud. Drove the 36-inch casing to 489 feet. ~~RKB~~
- 26-inch Hole : Drilled from 475 to 1255 feet RKB using a Smith DS 26-inch bit. A seawater, prehydrated Milben, Flosal mud was used in this interval. Ran out of water at 1000 feet RKB, at 1122 feet RKB mud became so thick that drilling had to stop for 61.5 hrs. while waiting on water. Twenty inch * casing landed at 1211 feet RKB. Otherwise, no problems encountered during this interval. Tested formation to equivalent 13 ppg mud.
- 17½-inch Hole : Drilled from 1255 to 4250 feet RKB using first a Smith DSJ bit to drill 1147 feet when the bit locked. A Sec. S35J4 centre nozzle bit was used to drill the next 1853 feet. Mud type for this interval was Drispac, Flosal. Hole swabbed while tripping from 2397 feet RKB and well started flowing out of drill pipe in derrick. Went back in hole, circulated and observed well. Encountered mud rings at 3300 feet RKB. Dispite these problems, good drilling progress was maintained.
* Thirteen and three eights-inch casing was landed at 4208 feet RKB.
* Tested the formation to equivalent 17.4 ppg mud.
- 12 1/4-inch Hole : This interval was drilled from 4250 to 8727 feet RKB. The bits used in this interval were: a Smith V2HJ which drilled shoe and 50 feet of formation, then a Sec. S33SJ which drilled 3336 feet and a Sec. S44 which drilled the last 1089 feet of the interval. Mud type: Shale Trol until gumbo drilled, converting to Unical seawater system. Had problems with small gas kicks and lost circulation through this interval. Made good progress to 7636 feet RKB, had to change bit here and also wait for barite at this stage. Had a gas kick, attempted to kill well using 17.4 ppg mud, lost circulation. Spent five days before regained circulation and back at drilling. Ran Schlumberger logs. The nine and five-eights-inch casing was landed at 8655 feet RKB. Pay was encountered 600 feet high. BOP leaking, had to wait 2½ days for new BOP stack and adapter spool. Formation tested to equivalent * 15.5 ppg mud.
- 8½-inch Hole : Drilled from 8727 to 9207 feet RKB. A Sec M44L bit was used to drill collar, shoe cement and a rat hole for the coring. A christensen Diamond bit C22 was used for the coring

continued./.

(8730-8761 feet RKB). Then a Sec M44N bit was used to drill 446 feet to 9207 feet RKB. A Unical seawater mud was used in this interval. No problems encountered drilling this interval. Ran Schlumberger logs. Seven-inch liner set from 8355 to 8910 feet RKB.

Three tests were run before the well was abandoned on December 29th, 1974

Drilling Time Curves

Significant drilling activities are re-capped on Figure 1. The cumulative rotating hour curve shows that the rate of penetration did not significantly change over the entire footage drilled in 2/11-2. The average penetration rate was 67 foot per hour. The slight decrease in penetration rate that occurred at 7636 feet after controlling lost circulation was probably due to the effects of increased mud weight.

Time Break Down

Table 2 shows the total time break down of the drilling activities until abandonment of 2/11-2 and the time waiting until the rig could be released.

Bits, Mud and Casing

As shown on Table 3 a total of 11 bits including the Christensen Diamond bit for coring, were used. The first two bits were reruns and bits No. 1, 2 and 8 can be rerun on future wells.

A recap of mud additives is given on Table 4. A high amount of Barite were used in the 12 1/4-inch hole interval to rise mud weight and build mud, due to small gas kicks and lost circulation.

Shown in Table 5 is a summary of casing and cement data.

Well Diagram - Abandonment Program

Figure 2 shows the casing setting depth and a recap on the cement used, the test intervals and the plugs and casing cutting depth for well abandonment.

LOGS

Listed below are the logs run by Schlumberger for 2/11-2.

Logs run

<u>TYPE</u>	<u>FROM</u>	<u>TO</u>	<u>DATE</u>
	(FT. RKB)		
IES - SP	8725	4202	Dec. 3, 1974
SONIC - GR - CAL	8714	4202	Dec. 3, 1974
CNL - FDC - GR	8727	8400	Dec. 4, 1974
	6800	6500	Dec. 4, 1974
	5500	4700	Dec. 4, 1974
TEMPERATURE LOG	5500	2000	Dec. 6, 1974
	3000	310	Dec. 6, 1974
VELOCITY SURVEY	8440	1000	Dec. 7, 1974
IES - SP	9226	8650	Dec. 13, 1974
SONIC - GR - CAL	9213	8642	Dec. 13, 1974
CNL - GR	4200	300	Dec. 13, 1974
CBL - CCL - GR	8642	2000	Dec. 13, 1974
DUAL LAT. - MSFL	9216	8243	Dec. 13, 1974
CNL - FDC - GR - CAL	9208	8643	Dec. 13, 1974
CBL - CCL - GR	8836	8355	Dec. 16, 1974

Notes:

- a) On the SONIC - GR - CAL log run December 3, 1974, most of the interval from 7235 to 4993 feet had cycle shipping, due to either gas cut mud and/or fracturing.
- b) While going in hole with IES - SP on December 3, it was noted that the tool did not work as it should and a bridge plug was hit 5-10 min. later. Came out of hole and went in with D.P. and bit to clean. Schlumberger went then in hole with backup IES - SP sonde.
- c) On December 4 when trying to run the Proximity log, it was found that the arm on the sonde did not work properly, resulting in a misrun. Rxo data obtained from the micro-spherically focused log.

TEST RESULTSSummary of Tests No. 1, 2 and 3

Tests were carried out on two Chalk intervals and on a shallow shale interval. The intervals perforated were:

Test No. 1: 8767 - 8792 feet RKB
 Test No. 2: 8670 - 8745 feet RKB
 Test No. 3: 4920 - 4932, 4962 - 4978 and 4990 - 4998 feet RKB

For details of Tests No. 1, 2 and 3 see enclosure 3, 4, 5 and 6.

Test No. 1 (8767 - 8792 feet RKB)

Ran and set the RTTS packer at 8626 feet RKB. Schlumberger perforated the interval using 1 11/16-inch Unijets at 4 shots per foot 0° phasing, at 0405 hours December 17th. Otis ran Amerada wireline bombs which were unintentionally landed at 8630 feet RKB in the cross-over sub below the packer, some 63 feet above the "X"-nipple, i.e., the intended landing level. A full column water cushion was used.

IFP : 15 min started at 1352 hours.
 ISIP : 96 min
 FFP : 443 min
 FSIP : 144 min

The flow was always weak, probably due to flow restrictions between the bombs and cross-over sub. An attempt was made to measure flow rates but the rates and pressures were too low for proper separator operations. The flow ultimately died away to a weak gas flow and the test was terminated. At 0130 hours, December 18 started to bullhead fluid in drill pipe back into formation with mud.

At 0330 started reversing out.

Test No. 2 (8670 - 8745 feet RKB)

The interval was perforated using a 4-inch Casing gun with 4 shots per foot 90° phasing before running in with the test string and 2000 feet water cushion. The RTTS packer was set at 8564 feet RKB. The Halliburton bombs, run with the test string, were set at 8633 feet RKB.

1st FP : 29 min, started 0231 hrs. December 20.
 1st SIP : 73 min
 2nd FP : 230 min
 2nd SIP : 542 min

Started stimulation at 1705 hours. Did not succeed until fourth attempt. The well was flowed between the stimulation attempts. The job was finished at 1848 hours, December 21.

3rd FP : 812 min

Well was cleaned up after acid job and then flowed through separator. Due to carry over of oil into the gas meter stream, it was found necessary to restrict the maximum flow to 3000 BOPD. The well was flowed for five hours at this rate before reducing the flow to 1000 BOPD for an additional four hours.

When closing the tool on bottom for the final shut-in pressure buildup, a drill collar tool joint parted. The mud level in the annulus dropped and the well was killed. This terminated Test No. 2

Test No. 3 (4920 - 4932, 4962 - 4978, and 4990 - 4998 feet RKB)

Perforated this interval using a 4-inch casing gun with 4 shots per foot, 90° - phasing. Ran test string and bombs, RITS packer set at 4903 feet RKB with bombs set at 5003 feet RKB. The tubing was displaced with acid and water before the packer was set. Fourtyfour barrels of acid was squeezed into formation.

IFP	:	15 min started 0330 hrs. December 25.
ISIP	:	90 min
Clean up flow.	:	Some gas to surface very weak flow.
2nd SIP	:	120 min
2nd FP	:	365 min
3rd SIP	:	300 min
3rd FP	:	465 min

The flow was very weak during all the flow periods. No flow rate measured. Some oil was produced during the third flow period before the well died.

The well was killed by reverse circulation with mud.

STIMULATIONTest No. 2

Test interval was from 8670 to 8745 feet RKB. Three hundred and sixteen barrels of MOD-303 acid was pumped into formation in a three stage job. Details of stimulation job in Table 6.

When the well was back flowed between attempts to acidize, the produced fluids contained approximately 85% oil, 3% water, and 12% solids. The solids may have acted as check valves which did not allow fluid entry into the formation and may have prohibited formation breakdown.

Test No. 3

This test interval was stimulated just after the RTTS packer was set. Started pumping 2 barrels of water, then 48 barrels of acid followed by 18 barrels of water. The acid was pumped in formation at 2100 psi surface.

CORE AND FLUID SAMPLESCore Samples

A core was taken from 8730 to 8761 feet RKB, with 100% recovery.

The full core was sent to CORE LAB for routine core analysis. These data are provided in the Core Lab Report, enclosure no. 7.

Samples from the core were also sent to ROBERTSON RESEARCH for slabbing tests, splitting, and Paleontological Age Determinations.

Fluid SamplesTest No. 1

Sample 1. Mainly gas + some oil and mud
 Sample 2. Gas caught in separator
 Also 2 drums of oil from separator

Test No. 2

Recombination sample 3 (gas and oil) obtained during flow on wide choke
 Recombination sample 4 (gas and oil) obtained during flow on 24/64-inch choke
 Recombination sample 5 (gas and oil) obtained during flow on 24/64-inch choke
 REcombination sample 6 (gas and oil) obtained during flow on 16/64-inch choke
 Also 3 drums of oil from separator

Test No. 3

No samples taken

Samples sent to AMOCO RESEARCH:

Recombination samples 3, 4, 5, and 6 from Test No. 2
 5 6-inch core samples.

Laboratory analysis request:

- a) Absolute permeability determination
 - Porosity determination
 - Determination of formation factor and cementation exponent
 - Pore size distribution test
 - Water-oil steady state relative permeability test
 - Gas-oil relative permeability test
 - Test for effects of rock compressibility
 - Acoustic velocity measurement on cores.
- b) Fluid properties:
 - Recombination of combination separator oil and gas samples
 - Reservoir oil sample analysis
 - Separator efficiency calculations
 - Gas compressibility calculation.
 - Paybolt viscosity at 30, 40, 60, 100°F
 - Paraffin wax content determination
 - Gas viscosity calculations
 - Wax point determination
- c) Geology:
 - Density measurements of rock samples
 - Mineralogical analysis by X-ray methods.
 - SEM Photographs

GEOLOGICAL SUMMARYI INTRODUCTION

The primary objective of exploratory well 2/11-2 was the Danian/Upper Cretaceous "chalk" section which is the productive horizon in surrounding fields. No secondary objectives were anticipated, although the Paleocene sand/siltstone section encountered in the 2/11-1, located four miles north, encountered shows of hydrocarbons. Where the Paleocene sand is found to be well developed, it becomes a primary objective.

II STRUCTURE

Structurally, the 2/11-2 was drilled on the "Hod" anomaly which was mapped as two small individual crestal closures separated by an area of disrupted seismic reflections. The "Hod" anticline is a satellite or subsidiary feature immediately to the southwest of the large "Valhall" structure and falls within the closing contour of the larger complex. The areal extent of the Hod feature at the top of the Danian/Upper Cretaceous chalk is interpreted to cover approximately ten (10) square miles, or 6400 acres, of which more than 95% falls within Amoco's 2/11 block with possibly up to 5% of the structure extending into the Danish sector.

The trapping mechanism for the Hod anomaly is simply the domal or anticlinal situation with its seal provided, in effect, by a thick Tertiary section of more than 8600 feet of predominantly interbedded shales and clay.

The 2/11-2 encountered the "Chalk" at 8663 (-8546') correlating only 9 feet low to the 2/11-1, but 650 feet structurally higher than originally predicted from seismic interpretation due to extreme low interval velocities in the Tertiary section.

The Hod feature is characterized by a disturbed shallow gas filled zone with an interval velocity of approximately 500 ft/sec. Due to this extreme low velocity seismic events are depressed over the structures and the anticlinal crest at the chalk level is obscured. The amplitude of the chalk event on this structure is weak to non-existent due to shielding from the high amplitude shallow gas hydrocarbons within the chalk.

III STRATIGRAPHY

The stratigraphy of 2/11-2 was essentially as predicted in comparison with nearby wells. The Tertiary section consists predominantly of claystone and shales with interbedded siltstones. The Paleocene Ash marker was found to be only 8 feet thick and poorly developed, i.e., in thickness compared to surrounding chalk wells.

The Chalk section encountered has a vertical thickness of 367 feet which compares to 847 feet in the 2/11-1. The chalk in the upper 130-150 feet is generally tan to light brown mudstone, uniformly textured (i.e., homogeneous matrix), slightly friable, very light in heft, slightly argillaceous, with common to abundant fractures (Vertical and horizontal), and exhibits good oil saturation from 8660 to 8800. Below 8830 the chalk shows an increase in clay content as indicated by log interpretation and the basal 100 - 150 feet becomes marly and locally grades to marls.

Only 177 feet of the Lower Cretaceous was penetrated in the 2/11-2 and consists predominantly of interbedded and gradational marls and clays. (For a brief generalized lithological summary, please refer to page 12 and 13).

continued./.

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IV PALEONTOLOGY

Paleontological age determinations indicate that the 367 feet of chalk penetrated in the 2/11-2 are of Santonian through Cenomanian age, with the Danian, Maestrichtian and Campanian sections missing due to strong truncation and/or non-deposition.

Analysis of sample cuttings and cores also revealed evidence of solution of many individual fossil forms with some showing secondary calcite overgrowths. (For detailed age determinations, please refer to attached sheet, page 10).

V HYDROCARBON SHOWS

High gas readings were recorded from approximately 4650 to 5500 feet as indicated by the gas log, sonic-gamma ray and neutron/density logs. Free oil was also noted in the mud system during the drilling of the above interval. Log interpretation of this zone indicated very minor, but significant resistivity readings and poor reservoir characteristics from shales and very thinly bedded limestones. The zone was tested with negative results.

Good oil and gas shows were encountered in the top 140 feet of the chalk section, with matrix porosities averaging between 30-40%. Core analysis indicate permeabilities up to four (4) millidarcies.

During drill stem tests through perforations and on various choke sizes over the top 75 feet the chalk section, the well flowed water free 36° API gravity oil at rates up to 3437 BOPD, and 2.9 MMCFGD. (For detailed results of DST's - Please refer to enclosures 4 and 6.)

TABLE 4
AMOCO NOCO WELL 2 11 2
MUD MATERIALS USED

HOLE SIZE	INTERVAL	MILGEL	LIME	CAUSTIC	FLOSAL	S. W. GEL	DRISPAC	MICA	MILPLUG	MILBEN	KWICKSEAL	SODA ASH	UNICAL	BARITE	SHALE TROL	LD 7	CMC	BICARD OF SODA	NITRATE	COST PER FOOT (\$)	REMARKS
36"	0'- 475'	200	4	9	20	175	4													10,67	No problems encountered
26"	475'- 1255'			15	83	172		12	36	22	5									5,90	Dumped some mud as mud became excessively thick
17 1/2"	1255'- 4250'	37			5	35	104			45		62	23	2840						8,65	Started losing mud from about 2400 ft. circulated mud rings from 3300 ft. Small gas kicks.
12 1/4"	4250'- 8727'	182	84	259		204	37	43	70	138		1	885	28190	628	11	5			37,17	Gas kicks, had to raise mud wt. lost circulation problems.
8 1/2"	8727'- 9207'	5		5		20				10			72	300			25	3	5	8,10	Reduced mud wt. No problems
8 1/2"	Completion	25	2	6		35							14	1820			10	2			Increased mud wt to 15,3 ppg before perforations. No problems.
	TOTAL	449	90	294	108	641	145	55	106	215	5	63	994	33150	628	11	40	5	5		