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11

WELL COMPLETION REPORT

PHILLIPS 7/11-1X

PRODUCTION LICENSE 018

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Well Completion Report
Phillips 7/11-1X
Production License 018

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WELL COMPLETION REPORT

PHILLIPS 7/11-1X

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C O N T E N T S

A T T A C H M E N T S

1) Schlumberger Logs
2) Geoservices Masterlog and Chromatolog
3) Robertson Research Company Ltd. Micropaleontology and Stratigraphy Report
4) Phillips Petroleum Company Composite Log

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S U M M A R Y

Well:	Phillips 7/11-1X.
Classification:	New Field Wildcat.
Area:	Field 7, Block 11, Production License 018.
Contractor & Rig:	ODECO Norway Inc., "Ocean Viking".
Location:	Line NJV 5704, S.P. 1238, 57° 04' 15.6" N, 02° 26' 24.4" E.
Water Depth:	78 meters (257 feet) below mean sea level.
Rotary Kelly Bushing:	27 meters (90 feet) above mean sea level.
Objective:	To test the Tertiary and Mesozoic.
Results:	Tested gas and condensate from Paleocene sands.
Status:	Suspended well. New Field Discovery Wildcat.
Total Depth:	3974 meters (13,036 feet) RKB.

D R I L L I N G H I S T O R Y

Dates of Operations:

Spud:	26 February 1968
At Total Depth:	20 May 1968
Completed:	15 June 1968

Details of Operations:

Casing Program:

30-inch set at 140 meters (461 feet) RKB in 36" hole and cemented with 750 sacks cement.

20-inch set at 457 meters (1498 feet) RKB in 26" hole and cemented with 1900 sacks cement.

13-3/8-inch set at 1964 meters (6444 feet) RKB in 17-½" hole and cemented with 2400 sacks cement.

9-5/8-inch set at 3124 meters (10,248 feet) RKB in 12-1/4" hole and cemented with 1500 sacks cement.

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Mud Program:

Depth:	Weight (ppg)	Viscosity:	PV:	YP:	Water Loss:
0 - 4000 feet (0 - 1219 meters)	9.0	40	10	15	18
4000 - 6500 feet (1219 - 1981 meters)	9.5	60	20	25	12
6500 - 8100 feet (1981 - 2469 meters)	11.6	60	25	30	16
8100 - 9500 feet (2469 - 2896 meters)	12.5	50	35	40	10
9600 - 10300 feet (2926 - 3139 meters)	13.0	50	25	25	6
10300 - 13036 feet (3139 - 3974 meters)	12.0	40	20	4	8

A Drispac-Flosal-Desco mud system was used to a depth of 10,795 feet. At this depth the system was converted to a sodium chloride-saturated Drispac-Flosal-Desco system. The saltsaturated system was used to total depth.

Logging Program:

Schlumberger Tools:	Run:	Interval:
Induction Electric	1	1483 - 5066 feet
	2	4850 - 6513 "
	3	6444 -10328 "
Gamma Ray/Sonic-Caliper	1	1483 - 6503 feet Gamma Ray to subsea
	2	6444 -10230 feet
	3	10250 -13020 "
Laterolog	1	10249 -13022 feet
Microlaterolog - Caliper	1	1483 - 6513 feet
Microlaterolog/Microlog-Caliper	1	6444 -10244 feet
Microlog-Caliper	1	10250 -13023 feet
Formation Density	1	6444 -10246 feet
	2	10249 -13022 "
Neutron	1	6444 -10326 feet
Continuous Dipmeter	1	1483 - 6500 feet
	2	6444 -10320 "
	3	10252 -13018 "

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Schlumberger Tools:	Run:	Interval:
Gamma Ray - CCL	1	9000 - 10260 feet
Cement Bond Log	1	7100 - 10247 feet
Temperature Log	1	0 - 13033 feet

Drilling Problems:

Logging Surface Hole:

The only significant drilling problem encountered in well 7/11-1X was that of sloughing shale between the depths of 5500 feet and 7600 feet. It was found that a mud density of 12.0 ppg controlled the sloughing shale problem.

Hole Deviation:

Vertical deviation nil to 11,468 feet where deviation was 4.5^{o}. At the total depth of 13,000 feet deviation had increased to $11\frac{1}{2}^{o}$.

Stuck Pipe:

There was no problem with pipe sticking during the drilling of the well.

Lost Circulation:

No lost circulation problems occurred.

Coring:

Three cores were taken in the Paleocene sandstone in the following intervals:

9589 - 9622 feet, 9622 - 9678 feet, and 9688 - 9734 feet. (See Appendix 1.)

Ten sidewall cores were attempted and six were recovered between 8154 and 9923 feet. (See Appendix 2.)

Testing:

A general distinction can be made between three divisions of the Paleocene in regard to testing results. In the upper section, between 9427 - 9455 feet, 15 feet of net pay were tested. In the middle section between 9527 - 10078 feet 211 feet of net pay were tested. In the lower section between 10078 - 10388 feet which is generally tight, only minor amounts of gas were tested. No water was recovered on any of the tests. Total net pay tested was 226 feet.

Flow rates on tests of Paleocene in 7/11-1X were as follows:

Upper:

DST No. 5 (9440' - 9455'): 26/64" choke, 6.5 MMCFGD, 480 BPD 50° API oil; 2 - 1" chokes, 10.5 MMCFGD; 12/64" choke, 2.67 MMCFGD, 228 BOPD; 4.01 MMCFGD, 359 BOPD.

Middle:

DST No. 4 (9527' - 9697'): 2 - 1-1/4" chokes, 44.3 MMCFGD; on isochronal flows: 16/64" choke, 4.39 MMCFGD, 372 BPD distillate; 26/64" choke, 10.75 MMCFGD, 970 BPD distillate; 37/64", 18.00 MMCFGD, 868 BPD distillate; 48/64" choke, 25.20 MMCFGD, 850 BPD distillate; Absolute open flow potential 101 MMCFGD.

DST No. 3 (9767' - 9808'): on isochronal flows, from 1/4" through 5/8" chokes, from 4.15 to 5.88 MMCFGD and 311 to 665 BPD 54° API distillate.

Lower:

DST No. 2 (10175' - 10197'): 1½" choke, 5 MMCFGD; 1/4" choke, 121 M decreasing to 60 MMFGD, recovering 5 barrels brown to grey-green oil in water emulsion out of 30 barrels total.

DST No. 1 (10248' - 10370'): recovered ½ to 1 barrel of diesel with dark brown dissolved hydrocarbon.

Pressure data plots suggest at least three, possibly four, separate reservoirs within the total Paleocene between 9427 - 10388 feet: (See Appendix 3.)

(1) 9440 - 9455 (DST No. 5) and 9527 - 9697 (DST No. 4).

(2) 9767 - 9808 (DST No. 3)

(3) 10175 - 10197 (DST No. 2)

Additionally, (1) above may consist of two separate reservoirs on the basis of distillate gravity respectively 50° in DST No. 5 and 53.8° in DST No. 4, and by pressure plots as well.

Plugging and Abandonment.

The 9-5/8 inch casing was plugged as follows:

9325 - 9475 feet RKB: Laid a 50 sack plug across final perforations.

9289 & 4988 feet RKB: Set Baker cement retainers.

4700 - 4900 feet RKB: Laid 70 sack plug, class "A", neat cement.

500 - 650 feet RKB: Laid cement plug.

Set corrosion cap and abandoned.

S I D E W A L L C O R E S

No.	1	-	9923 - SH, gry-brn
"	2	-	9774 - NR
"	3	-	9727 - SH, gry-grn w/tr SS, gry-brn, v fg, v shly and friable
"	4	-	9670 - SS, gry-brn, v fg, v shly and friable
"	5	-	9495 - Lost
"	6	-	9457 - SH, gry, mottled
"	7	-	9440 - Lost
"	8	-	9104 - Lost
"	9	-	8288 - SH, gry-brn
"	10	-	8154 - SH, gry-brn

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G E O L O G Y

Regional Geology:

The Phillips 7/11-1X well on the Cod prospect is located in the deepest part of the Norwegian Tertiary Basin which trends north-northwesterly through Norwegian, Danish and Dutch Waters. The axis of the basin closely approximates the median line between Great Britain and Norway toward which both structural rise and stratigraphic thinning of the Tertiary occur. In the central basin in the vicinity of the well, the Tertiary section may be up to 12,000 feet in thickness. The Tertiary thins east-northeastward to a minimum at the edge of the basin and is limited by the basement high forming the west subsea escarpment of the Norwegian Channel. In regard to the Mesozoic little is known of the thickness or the limits, but total thickness may be up to 4000 - 5000 feet. Permian and older section are not yet defineable. Seismic data, however, indicate Permian Zechstein evaporite thicknesses of more than 5000 feet and distribution throughout the basin in various forms of intrusive salt structures. Most structures, if not all, including the Cod prospect, have been formed by movement of the Zechstein salt.

Prospect Geology:

The Cod 7/11-1X well was drilled on a northeast-trending anticline mapped by reflection seismic surveys in 1965-66 and in 1967. The structure is well-defined from Permian levels up through most of the Tertiary section. The size of the structure diminishes slightly with depth. On the same trend to the northeast is a similar structure (Northeast Cod) which may be linked to the Cod structure with a common closing contour. A fault due to salt movement cuts the anticline passing centrally north to northeastward and is scissored, breaking into paired radial faults on the north and south. It offsets each of three seismic mapping horizons with displacements averaging .020 milliseconds or 65 - 75 feet. Seismically mapped closure on the prospect, before drilling, was as follows:

Seismic Horizon:	Assumed Stratigraphic Horizon:	Area of Closure:	Vertical Closure at Loc.
"Green"	Near Base Tertiary - top Upper Cret. Chalk	12.3 sq.mi.	600
"Yellow"	Base Upper Cretaceous Chalk	7.0 sq.mi.	550
"Vermilion"	Top Permian Zechstein Salt	7.2 sq.mi.	1100

Geologic Objectives:

The objective of the 7/11-1X well was to test the hydrocarbon potential of the Tertiary and the Mesozoic sediments. Specific objectives were the Paleocene sandstone, the Upper Cretaceous carbonate section and the Jurassic. Other objectives conceived to be possible were sandstones in the Lower Cretaceous and Triassic.

The specific objectives were based on the results of first, the Hamilton - Teneco 30/18-1X well 50 miles to the south in British waters in which Paleocene sandstone with oil shows was encountered; and second, the Amberjack 7/11-1X well 70 miles to the north in which porous zones, without shows however, were encountered in the Upper Cretaceous chalk and in Jurassic sandstone.

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Results:

Stratigraphy:

Stratigraphic Unit:	Depth RKB Meters	Depth RKB Feet	Depth RKB Meters	Depth RKB Feet	Drilled Thickness Meters	Drilled Thickness Feet
QUATERNARY						
Recent	106	347	- 78.3	- 257		
Pleistocene					404	1327
TERTIARY						
Upper Pliocene	510	1674	- 483	-1584	105	343
Lower Pliocene	615	2017	- 587	-1927	58	192
Upper Miocene	673	2209	- 646	-2119	57	187
Middle Miocene	730	2396	- 703	-2306	803	2634
Lower Miocene						
Burdigalian	1533	5030	-1506	-4940	172	564
Aquitanian	1705	5594	-1678	-5504	264	866
Oligocene	1969	6460	-1942	-6370	697	2288
Upper-Middle Eocene	2666	8748	-2639	-8658	142	467
?Lower Eocene-						
?Paleocene	2809	9215	-2781	-9125	65	212
Upper Paleocene	2873	9427	-2846	-9337	199	651
Lower Paleocene						
Danian	3072	10078	-3044	-9988	94	310
UPPER CRETACEOUS						
Upper Maestrichtian	3166	10388	-3139	-10298	291	954
Lower Maestrichtian	3457	11342	-3430	-11252	18	58
Campanian	3475	11400	-3447	-11310	16	53
Coniacian-Turonian	3491	11453	-3463	-11363	8	27
UPPER-?LOWER CRETACEOUS						
Turonian-Cenomanian-						
?Albian	3499	11480	-3472	-11390	244	800
-unconformity-						
UPPER PERMIAN						
Zechstein Anhydrite	3743	12280	-3716	-12190	5	15
Zechstein Salt	3748	12295	-3720	-12205	226+	741+
(Total Depth)	3973	13036	-3946	-12947		

Lithology:

Quaternary:

Recent-Pleistocene undifferentiated:

Thickness 405 meters (1327 feet).

No lithology was observed to a depth of 1520 feet because the well was drilled without returns. The lower part of the unit is grey, soft, gummy, clay with abundant shell fragments.

Tertiary:

Upper Pliocene Clay Unit:

Thickness 105 meters (343 feet).

This unit is made up of grey to greyish brown, soft, gummy, slightly silty clay. Pyrite and limonite in small quantities together with thin stringers of fine grained, loose, clear sand are found toward the base of the unit.

Lower Pliocene Clay Unit:

Thickness 58 meters (192 feet).

This unit is entirely composed of dark grey clays with traces of shell fragments.

Upper Miocene Clay Unit:

Thickness 57 meters (187 feet).

This unit is composed entirely of dark grey, gummy clays which are slightly silty.

Middle Miocene Clay Unit:

Thickness 803 meters (2634 feet).

This unit is composed of dark grey, gummy clay with occasional thin stringers of very fine grained fair sorted, angular sand.

Lower Miocene Burdigalian Clay-Shale Unit:

Thickness 172 meters (564 feet).

This interval contains grey to dark brown, soft, slightly pyritic clays and shales. The upper portion contains good traces of white to grey, occasionally buff, very fine crystalline to sucrosic dolomite.

Lower Miocene Aquitanian Clay Unit:

Thickness 264 meters (866 feet).

The Aquitanian is predominantly grey to dark brown, plastic,

slightly silty clay with stringers of buff to white, fine crystalline dolomites and limestones in the lower portion.

Oligocene Shale Unit:

Thickness 697 meters (2288 feet).

This interval consists of dark grey to brown to black, slightly silty shales with soft clays interbedded. Grey to brown, hard crystalline dolomite and limestone stringers occur throughout.

Upper-Middle Eocene Shale Unit:

Thickness 142 meters (467 feet).

The unit is essentially composed of light grey to greenish, fissile to waxy shales.

?Lower Eocene-?Paleocene Shale Unit:

Thickness 65 meters (212 feet).

This unit is composed of light grey to greenish grey and occasionally purple shales. Traces of brown, hard, silty limestone are also observed.

Upper Paleocene Sandstone Unit:

Thickness 198 meters (651 feet).

The upper 100 feet is composed of light grey to greenish grey shales. The remainder of the unit is composed of interbedded light grey to brown, very fine grained, micaceous, silty, slightly calcareous sandstones and siltstones with light to medium greenish grey shales. Toward the base of the interval the sandstones become coarser, poorly sorted, and are subrounded to sub-angular.

Lower Paleocene Danian Limestone Unit:

Thickness 94 meters (310 feet).

The upper 30 feet of the unit are composed of white, chalky, soft to medium-hard limestone containing light brown, opaque chert nodules. The following 150 feet are mainly grey to buff to white, chalky to microcrystalline limestone with very occasional stringers of sandstones and shales. The lower 130 feet are made up of interbedded sandstones, shales, and limestones. The sandstone is light grey to brown, fine to medium grained, poorly sorted, and is calcareous and shaley, and the shale is grey to greenish grey. Limestone is as the upper section.

Upper Cretaceous Limestone and Chalk:

Upper Maestrichtian:

Thickness 291 meters (954 feet).

This unit is composed of white, light grey and light brown, chalky, dense, hard limestone containing traces of brown, translucent chert nodules. The lower 100 feet of the interval, in addition to the limestone, consists of stringers of light brown, medium to coarse crystalline to sucrosic dolomite with good vugular porosity.

Lower Maestrichtian:

Thickness 18 meters (58 feet).

This interval consists of light grey, microcrystalline, hard, dense limestone with traces of light brown crystalline dolomite.

Campanian:

Thickness 16 meters (53 feet).

The unit is composed of brown to white, very chalky to microcrystalline, soft to hard limestone with white to grey, soft marl in the lower part.

Coniacian-Turonian:

Thickness 8 meters (27 feet).

This interval is entirely composed of white, dense, hard limestone with abundant fractures.

Upper Cretaceous - ?Lower Cretaceous Limestone.

Turonian-Cenomanian-?Albian:

Thickness 244 meters (800 feet).

The unit is composed of white, chalky, and grey to brown, microcrystalline to fine crystalline, argillaceous, limestone with occasional chert nodules. Black carbonaceous shale stringers are prevalent toward the base of the interval. The lower 20 feet is composed of grey, fine to medium grained, poorly sorted, subangular, silty sandstone and hard, black, silty shale.

Upper Permian.

Zechstein Anhydrite:

Thickness 5 meters (15 feet).

This unit is entirely composed of white, hard, amorphous, somewhat shaley anhydrite.

Zechstein Salt:

Thickness 229+ meters (741+ feet).

This unit consists of clear, white, occasionally pink, translucent salt, with traces of hard anhydrite. The lower 100 feet are almost entirely pink, translucent salt.

C O N C L U S I O N S

Phillips 7/11-1X Cod well had five possible objective zones visualized as hydrocarbon objectives:

Lower Tertiary sandstone, Upper Cretaceous carbonate, Lower Cretaceous sandstone, Jurassic sandstone and Lower Triassic sandstone.

The Lower Tertiary objective was realized with successful testing of gas and condensate in Paleocene sandstones. There is no porosity, however, within the Upper Cretaceous limestone (Chalk equivalent) like there is in the 16/11-1X Amberjack well. Lower Cretaceous, Jurassic and Lower Triassic are absent; Upper Cretaceous limestone directly overlies the Permian Zechstein evaporite. These systems, however, are still valid objectives in flank, off-structure wells and on other prospects where salt has not penetrated as high in the stratigraphic section.

The test results of the Upper Paleocene sandstone section (9427 - 10078 feet) and Lower Paleocene Danian limestone-shale-sandstone section (10078 - 10388 feet) suggest the following conclusions:

1. No gas-water contact was established or determinable.

2. Four separate reservoirs may exist, three in the Upper Paleocene, and one in the Danian. The possibility of an oil leg or distinctly different source of oil in the Danian as opposed to the Upper Paleocene is suggested by the small recoveries of brown to grey-green oil in DST No. 2 and of dark-brown dissolved hydrocarbon in DST No. 1, both in the Danian section. Interbedded black shale is common with the Paleocene sandstones suggesting that the hydrocarbon source is within the Paleocene.

October 9, 1968

INTER-OFFICE CORRESPONDENCE / SUBJECT: PPCo. 7/11/1X, North Sea Area, Norway reservoir and accumulation continuity and/or discontinuity within the well as determined by pressure data from the well.
BARTLESVILLE, OKLAHOMA

Mr. O. D. Thomas
International Dept.

Attn: Mr. L. M. Rickards (2)
Mr. R. L. Young

OBJECTIVE

Our objective is to identify continuity or discontinuity between the hydrocarbon accumulations tested in the 7/11/1X and define the hydrocarbon-water contacts if possible. It is also our objective to identify and evaluate any abnormal formation pressures encountered.

CONCLUSIONS

1. Three separate hydrocarbon accumulations on an abnormal formation pressure gradient were tested in the subject well (see attached graph).

   The first accumulation was tested by DST #4, perforations -9445' to -9587' datum, and DST #5, perforations -9350' to -9365' datum. Although accumulation continuity may exist between these two intervals there is now a datum pressure difference from the original p_f of DST #4 of about 48 psi. The second accumulation, perforations -9680' to -9710' datum, is separated from the first accumulation by a datum pressure difference of approximately 343 psi. The third and lowest accumulation, perforations -10,085' to -10,108' datum, is separated from the second accumulation by a datum-pressure difference of approximately 449 psi.

2. Abnormally high formation pressures were measured in the subject well. They range from 5326 psi at 9564' depth, ∇p_f = .558 psi/ft. to 6177 psi @ 10,178' depth, ∇p_f = .607 psi/ft. Normal formation pressure is exceeded by approximately 1216 psi to 1831 psi respectively. See attached P-D plot. The top of the abnormally pressured section is not discernible from these data.

3. Reservoir pressure depletion is indicated to have occurred in the top pay zone during DSTs #4 and #5. The formation pressure in this zone declined from an ISIP of 5326 psi to a FSIP of 5244 psi during DST #4, and declined from 5266 psi (ISIP) to 5192 (FSIP) during DST #5. It is possible that the 5266 psi ISIP from DST #5 was influenced by the pressure depletion indicated in the zone tested by DST #4. There is still a 34 psi datum pressure discrepancy which must be explained before accumulation continuity between these two tests is clearly established.

4. The bottom, most abnormally pressured pay zone, exhibited extremely low permeability. On DST #2 the initial reservoir pressure of this zone was 6177 psi. The final unextrapolated SIP after 7 hours and 20 minutes was only 3013 psi, further suggesting a limited type reservoir. During this test gas volume rate decreased from 1.21 MCFG to 60 MCFGPD. Surface flow pressures declined from 94 psi to 60 psi.

RECOMMENDATIONS

It is recommended that these high quality pressure data from the 7/11/1X be used to help identify accumulation and/or reservoir continuity between the 7/11/1X and the presently testing 7/11/2X.

DISCUSSION AND DATA

The attached pressure-elevation graph was constructed from all useable formation pressure and fluid data presently available from the 7/11/1X well. Non-static formation pressures obtained from DST pressure build-up data were machine extrapolated to static condition. The sub-surface gas gradient of .097 psi/ft. is based on the gas gravity of .704 reported from DST #4.

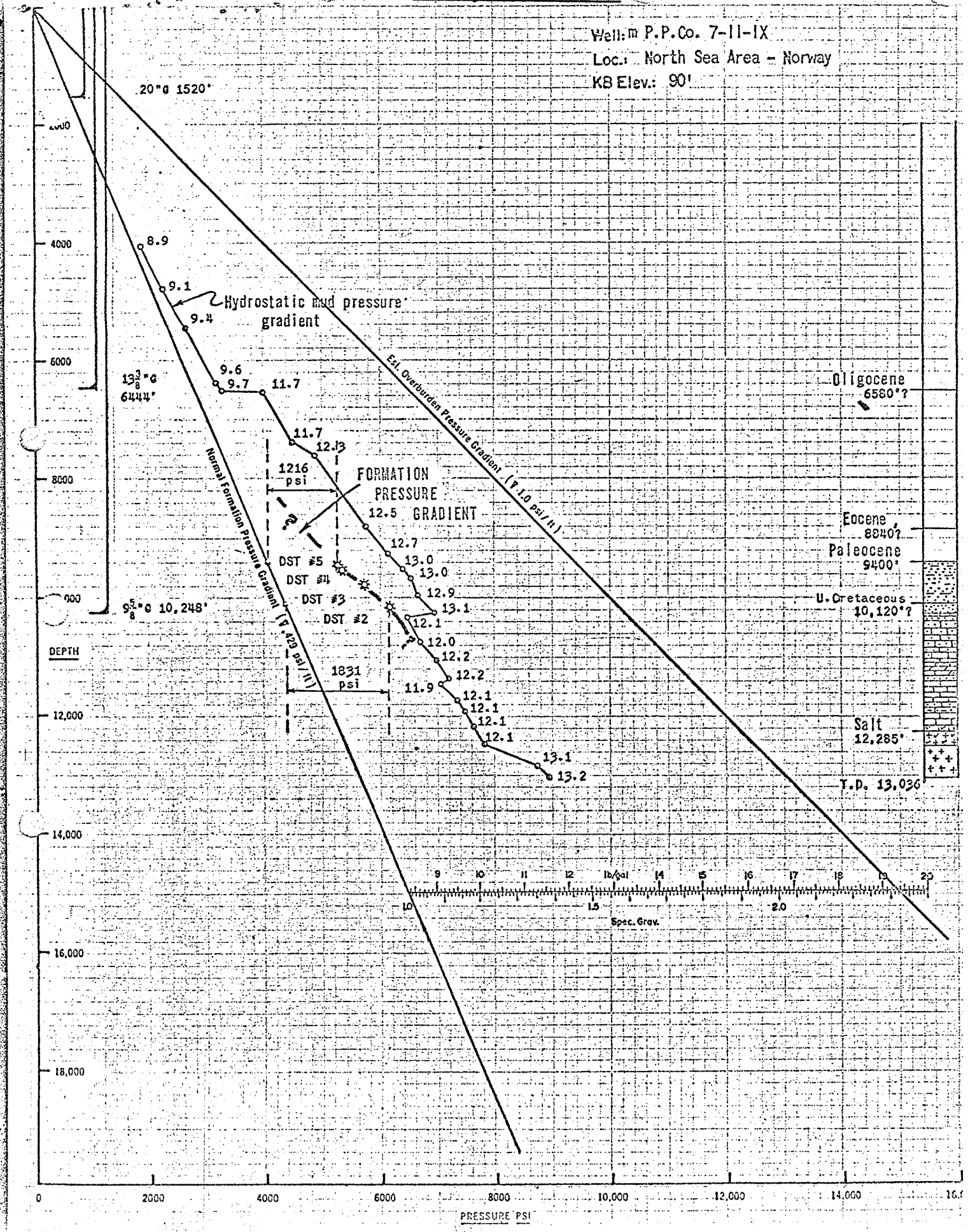
No water pressure data are available from this well so no attempt could be made to determine gas-water contact elevation.

The general overall quality of the recorded DST data from the 7/11/1X is very good for purposes of pressure-depth elevation. Most of the recorded initial shut-in pressures were static or near static. Some discrepancies were, however, noted on several of the test charts, such as gauge stylus sticking or 'stairstepping' and gauge stylus failing to zero on the pressure baseline.

Accuracy of the formation pressure data obtained from wire line tests Nos. 4 and 5 in the 7/11/1X well are questionable. The recorded HMP's on these tests are 3.9% and 8.55%, respectively, too high when compared to the HMP's calculated from the mud weight reported during the tests. On WLT #4 the SIP build-up was insufficient for reliable extrapolation, requiring a 325 psi (5.7%) extrapolation to the static condition. Formation permeability calculated from this test is less than 0.1 md. WLT #5, which was run within the interval tested by DST #4, recorded a static formation pressure of 5700 psi @ -9528'. This is approximately 370 psi higher than the static reservoir pressure adjusted to the same datum recorded by DST #4. When reduced by the indicated mud check error of 8.55%, the formation pressure recorded by WLT #5 is about 120 psi less than that recorded by DST #4. Corrected in this manner, WLT #5 more closely approximates what is indicated to be the true static reservoir pressure of the tested interval.

J. B. Marr
254 FPB, Ext. 7292

JBM:bk
Attachms.
cc w/attachms, H. M. Barrett - O. K. Bodine
A. Haig - SPG Files


Well: P.P.Co. 7-11-IX
Loc.: North Sea Area - Norway
KB Elev.: 90'
20"@ 1520'
13⅜"@ 6444'
9⅝"@ 10,248'
8.9
9.1
9.4
Hydrostatic mud pressure gradient
9.6
9.7
11.7
11.7
12.3
1216 psi
FORMATION PRESSURE GRADIENT
12.5
12.7
13.0
13.0
12.9
13.1
12.1
12.0
12.2
12.2
11.9
12.1
12.1
12.1
12.1
13.1
13.2
DST #5
DST #4
DST #3
DST #2
1831 psi
Normal Formation Pressure Gradient (.429 psi/ft)
Est. Overburden Pressure Gradient (1.0 psi/ft)
Oligocene 6580'?
Eocene 8840?
Paleocene 9400'
U. Cretaceous 10,120'?
Salt 12,285'
T.D. 13,036'
DEPTH
PRESSURE PSI
lb/gal
Spec. Grav.

APPENDIX 3 - (11)

PRESSURE – DATUM GRAPH

DATE: