Appendix C Stina 1 well log description

G E U S

Report file no.

1785

STINA-1

Stina-1, Final well report. Vol. 2 (2) (Geology)

Copenhagen

01-09-1989

AMOCO DENMARK EXPLORATION COMPANY

5414/7-1 (STINA-1)

GEOLOGICAL WELL REPORT

Compiled by:

J. L. Roberts

September 1989

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JR/mct281

Pertinent Data

PERTINENT DATA SHEET

COUNTRY: Denmark

API NUMBER: 972050024100

WELL NAME: 5414/7-1 (Stina 1)

GEOLOGICAL PROVINCE: Ronne Graben

LOCATION: Lat: 54° 47' 19.92"N
Long: 14° 37' 43.38" E

ELEVATION: KB=36 Meters WD = 31 Meters

DATE SPUDDED: 11 June 1989

DATE REACHED T.D.: 7 July 1989

RIG RELEASE DATE: 13 July 1989

ESTIMATED FINAL COST: $4,660,329.00 Gross ($4,369,058.40 Net)

AUTHORIZED T.D.: 2736m MDRKB (2700m TVDSS)

DRILLER'S T.D.: 2518m MDRKB (2482m TVDSS)

LOG T.D.: 2510m MDRKB

P.B.T.D.: 98m MDRKB

STATUS: Plugged and Abandoned

OPERATOR: Amoco

PARTNER INTEREST:

Amoco	75%	(Paid 93.75% during exploration phase)
F. L. Smidth	5%	(Paid 6.25% during exploration phase)
Dopas	20%	(Carried during exploration)

DRILLING CONTRACTOR: Global Marine

RIG TYPE: Jack Up

RIG NAME: Glomar Moray Firth

CASING:

Size (Inches)	Depth (Meters, RKB)
30	137
20	355
13-3/8	1080

WIRELINE LOGS: See Table 1

FORMATION TOPS:		M,MD	M,S
	Quaternary	67	31
	M. Jurassic	127?	91
	L. Jurassic	304	268
	U. Triassic	555	519
	L. Triassic Bunter	1084	1048
	U. Perm. Zechstein	1635	1599
	L. Perm. Rotliegendes	1858	1822
	Silurian	2115	2079
	TD	2518	2482

CONVENTIONAL CORES: N/A

DRILLSTEM TESTS OPERATIONS SUMMARY: N/A

JR/mct281

TABLE 1: WIRELINE SURVEY SUMMARY
5414/7-1 (STINA-1)

LOG	DATE	SCALE 1:500	SCALE 1:200	TOP LOGGED INTERVAL(M)	BOTTOM LOGGED INTERVAL (M)	REMARKS
ISF-BHC-GR	16 June 89	X	X	137	363	GR to surface
BGT-BHC-GR	16 June 89	X	X	137	363	GR to surface
ISF-BHC-GR	21 June 89	X	X	355	1087	
LDL-CNL-GR-CAL	22 June 89	X	X	355	1087	
SHDT-GR	22 June 89		X	355	1087	
Computerized Cyberdip	22 June 89		X	355	1087	Processed SHDT Data
DLL-MSFL-BHC-GR	7 July 89	X	X	1080	2510	
LDL-CNL-NGL	7 July 89	X	X	1080	2510	
NGT Ratios	7 July 89	X	X	1080	2510	
SHDT-GR	8 July 89		X	1079	2510	
Check Shot Survey	8 July 89			355	2500	
CST-GR	8 July 89			1155	2498	

TABLE 2: AMOCO GROUP DANISH SECOND LICENCING ROUND

AMOCO (OPERATOR)	25%	Paid 93.75% during exploration phase.
F.L. SMIDTH	5%	Paid 6.25% during exploration phase.
DOPAS	20%	Carried during exploration.

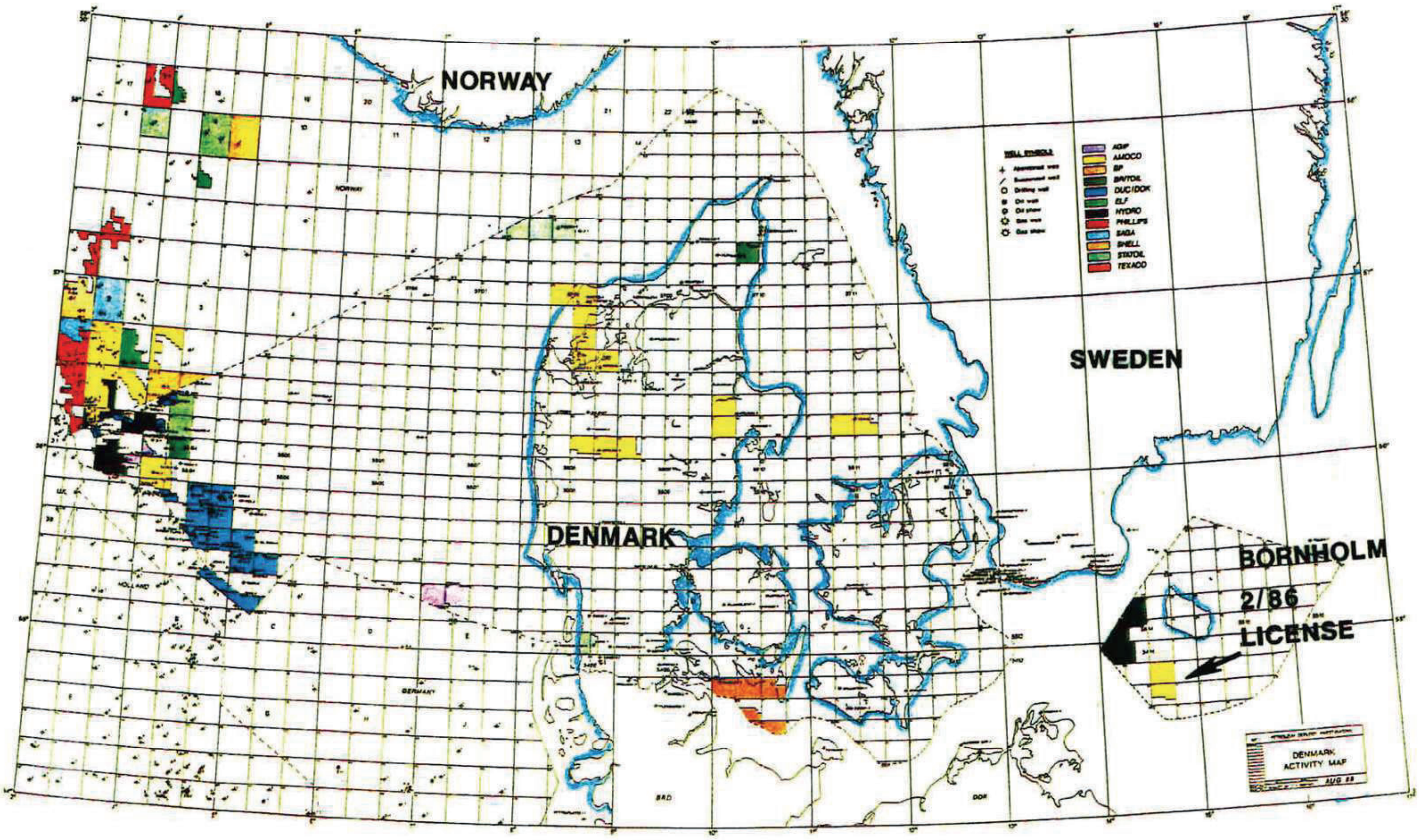
NORWAY
SWEDEN
DENMARK
BORNHOLM
2/86
LICENSE
AGIP
AMOCO
BP
BRITOIL
DUC/DOK
ELF
HYDRO
PHILLIPS
SAGA
SHELL
STATOIL
TEXACO
DENMARK
ACTIVITY MAP
AUG 88

FIGURE 1

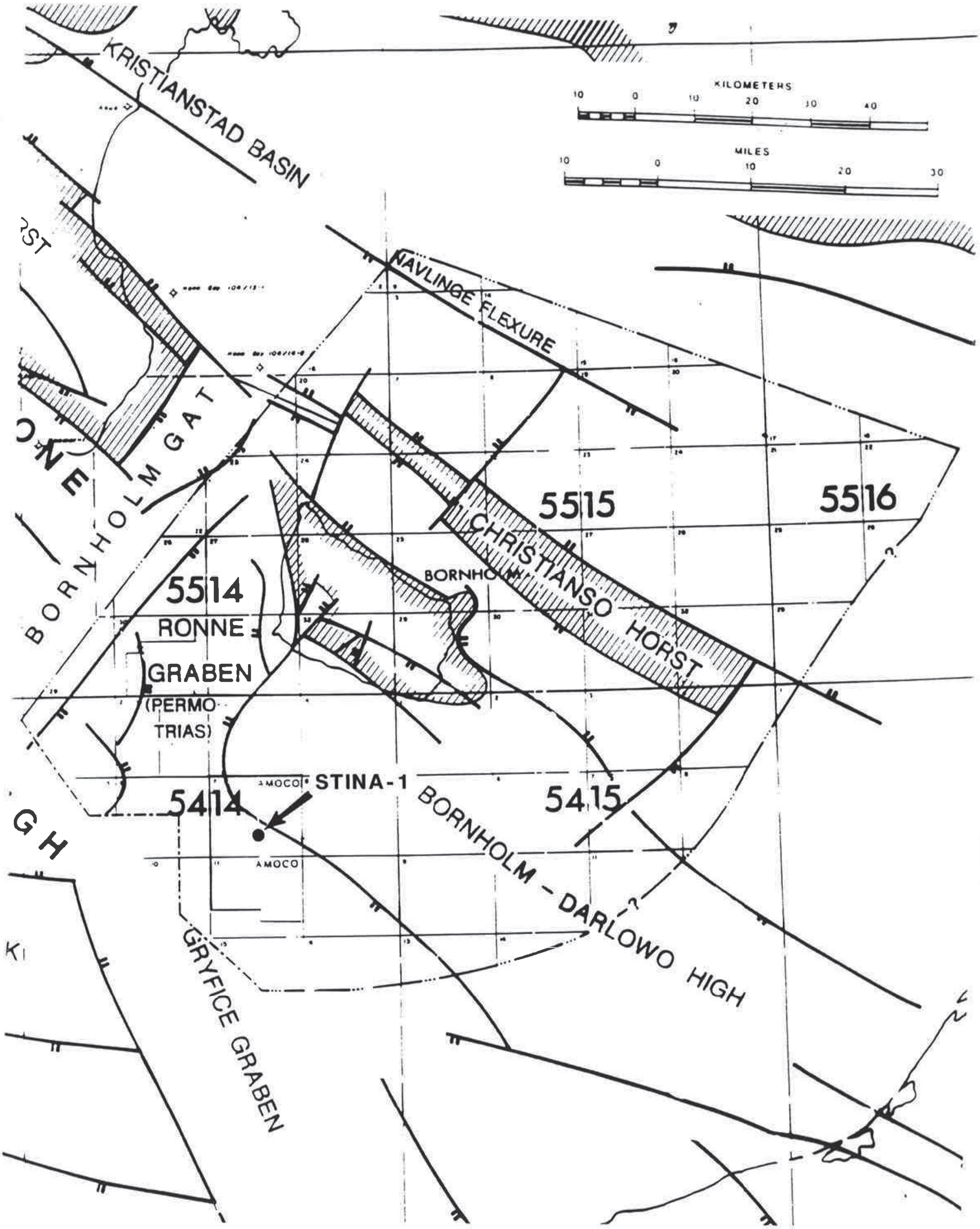

Figure 2: Bornholm Structural Elements and Location of Stina-1 Well

Geological Report

GEOLOGICAL REPORT

Introduction

The 5414/7-1 (Stina 1) well is located approximately 35 kilometers southwest of Bornholm Island, Denmark, in the Baltic Sea, at latitude 54°47'19.92"N and longitude 14°37'43.38"E (Figures 1 and 2). Amoco Denmark Exploration Company spudded the well on June 11, 1989, at shot point 394 of seismic line AM88B-05. The well reached a total depth of 2518 meters MDRKB on July 7, 1989, and was plugged and abandoned as a dry hole. The rig was released on July 13, 1989. Amoco's interest in the well was 93.75% during exploration. F. L. Smidth held the remaining 6.25%.

Wireline logs were run in the 26 inch, 17½ inch, and 12¼ inch holes (Table 1). No conventional cores were taken. Fifty of 60 sidewall cores shot were recovered. Field descriptions of sidewall cores are found in Appendix 2. RFT and drillstem tests were not conducted.

Background

The Amoco Group, Table 2, was awarded the offshore Bornholm Licence 2/86 on June 24, 1986, for a period of six years as part of the Danish Second Round of Licencing. The licence consists of block 5414/7 and part of block 5414/11 (Figures 1 and 2).

The Amoco Group's obligation on the licence was the acquisition of 450 kilometers of proprietary seismic by June 24, 1989. A decision to drill or drop the 2/86 licence block also has to be made by June 24, 1989.

Since the decision was made to drill a well on the Bornholm 2/86 licence, the remaining well obligation on the 3/84 Jutland Licence was transferred to the Bornholm licence.

The seismic option was reduced to 150 kilometers in January 1988 by the Danish Energy Agency in lieu of the Amoco Group participating in a non-exclusive shallow corehole program off the west coast of Bornholm Island. The corehole program was not sufficiently subscribed and so was not initiated. As a result, the Amoco Group withdrew support for this program.

The acquisition of 150 kilometers of proprietary seismic was completed in mid-September 1988. The Danish Energy Agency agreed to drop the remaining 300 kilometer seismic obligation if a well was drilled on Licence 2/86.

A 3000 kilometer airborne geochemical airtrace and aeromagnetic study was completed in June, 1988, over the entire Bornholm Enclave by Barringer Research, Inc., of Toronto, Canada. The purpose of the airtrace survey was to detect the presence of liquid hydrocarbons leaking to the surface from the undrilled basins around Bornholm Island. A number of hydrocarbon anomalies were detected to the northeast and west of Bornholm Island. The strongest anomaly was detected on the southwest portion of Licence 2/86. The detection of traces of liquid hydrocarbons in the air suggested that there may have been source rocks generating oil in the Bornholm area. The aeromagnetic data confirmed the configuration of basement structure as mapped from gravity data.

Regional Geological Setting

The Caledonian orogeny occurred at the end of Silurian time and involved uplift and erosion of the Paleozoic section on Bornholm Island. The west-trending Caledonian front lies to the south of Bornholm and extends from the Central Graben in the North Sea to northern Poland where it joins the Tornquist Zone. Wrenching movement along the Caledonian front is estimated to be 1600 kilometers. The Fennoscandian Border Zone formed during Caledonian time and consists of northwest trending en echelon faults which extend from Sweden to Bornholm Island. Motion along this fault system has been estimated to be 1500 kilometers of sinistral strike-slip movement.

At the end of Carboniferous time, the Variscan orogeny affected the area south of Bornholm, and the Ronne Graben was developed. It connected the Danish Subbasin in northern Denmark to the Gryfice Graben offshore northern Poland. The seaway caused by this connection permitted the deposition of Permian age sediments in the Ronne Graben. The presence of Permian Zechstein and Rotliegend sections in the recently drilled Petrobaltic K5-1 supports this hypothesis. The seaway remained until Triassic time when continental Triassic sedimentary sequences were deposited.

During Lower Jurassic time, the regional sea level rise allowed for deltaic sedimentation to extend from southern Sweden to the Bornholm area. By Middle Jurassic time, the continuing transgression was locally affected by contemporaneous uplift, tilting, and downthrowing of individual fault blocks. Local tectonics as well as minor periods of regression caused lateral variations in sediment thickness and vertical facies changes.

These included lacustrine, deltaic, and marine sediments as seen in outcrops on Bornholm Island. In comparison, it is postulated that within the Ronne Graben sediments were deposited under mostly a shallow marine influence.

During the Tertiary Alpine orogeny, regional compressive forces caused reactivation of Mesozoic age faults within the Fennoscandian Border Zone, the Tornquist Zone, the Polish Trough, and the Danish Subbasin. This compressive event is manifest by numerous inversion anticlinal features located within the Ronne Graben. The inversion anticlinal features and tilted Paleozoic fault blocks were the key structural targets for hydrocarbon exploration on the 2/86 Licence.

Reservoir Objectives

The 5414/7-1 well was designed to test the prospectivity of Lower Jurassic and Lower Triassic Sandstones, with Permian Rotliegend Sandstones as a possible third objective.

Pre-Drill Prognosis

The 5414/7-1 well was drilled to test a faulted anticline formed by wrench fault related forces which compressed and inverted the prospective sections against the northeast graben bounding basement high.

Mapping on the near base Jurassic seismic event defined the uppermost objective to posses four-way dip structural closure of 21 square kilometers

(5250 acres) areally and 100 meters of vertical relief. The structure at the near base Triassic objective exhibited three-way dip closure with fault controlled closure to the north. This structure showed areal closure of approximately 62 square kilometers (15,500 acres) at the base Triassic level and vertical relief of approximately 400 meters.

Post-Drilling Results

A comparison of prognosed and actual stratigraphy is graphically illustrated in Figure 3. The Lower Jurassic objective section was found to be 251 meters thick and 69 meters low to prognosis. The porosity of the sands was generally good, but there were no shows.

The original formation tops were revised when the Upper Triassic claystone came in 165 meters high to prognosis. The Lower Triassic objective section (Bunter Sandstone) was found to be 374 meters thick and 4 meters high to the revised prognosis. Porosity of the Bunter sands was very good in the upper and middle portions and decreased to fair with depth. There were no shows.

The Permian Rotliegendes section was found to be approximately 278 meters thick and approximately 6 meters low to the revised prognosis ("approximate" due to the highly transitional nature of the contact between the Zechstein and Rotliegendes Units). This section was expected to consist of well sorted, loosely cemented, porous sands. It was found, however, to consist of thin interbeds of claystone, siltstone, and sandstone with no significant shows.

Carboniferous-aged sediments were not present, and the total depth of 2518 meters MDRKB was reached after drilling 403 meters of Silurian claystone.

Detailed descriptions of the drill cuttings are available in Appendix 1 and are summarized graphically on the Wellsite Lithology Log (Enclosure 4).

JR/JLT277B

STINA-1 WELL STRATIGRAPHY

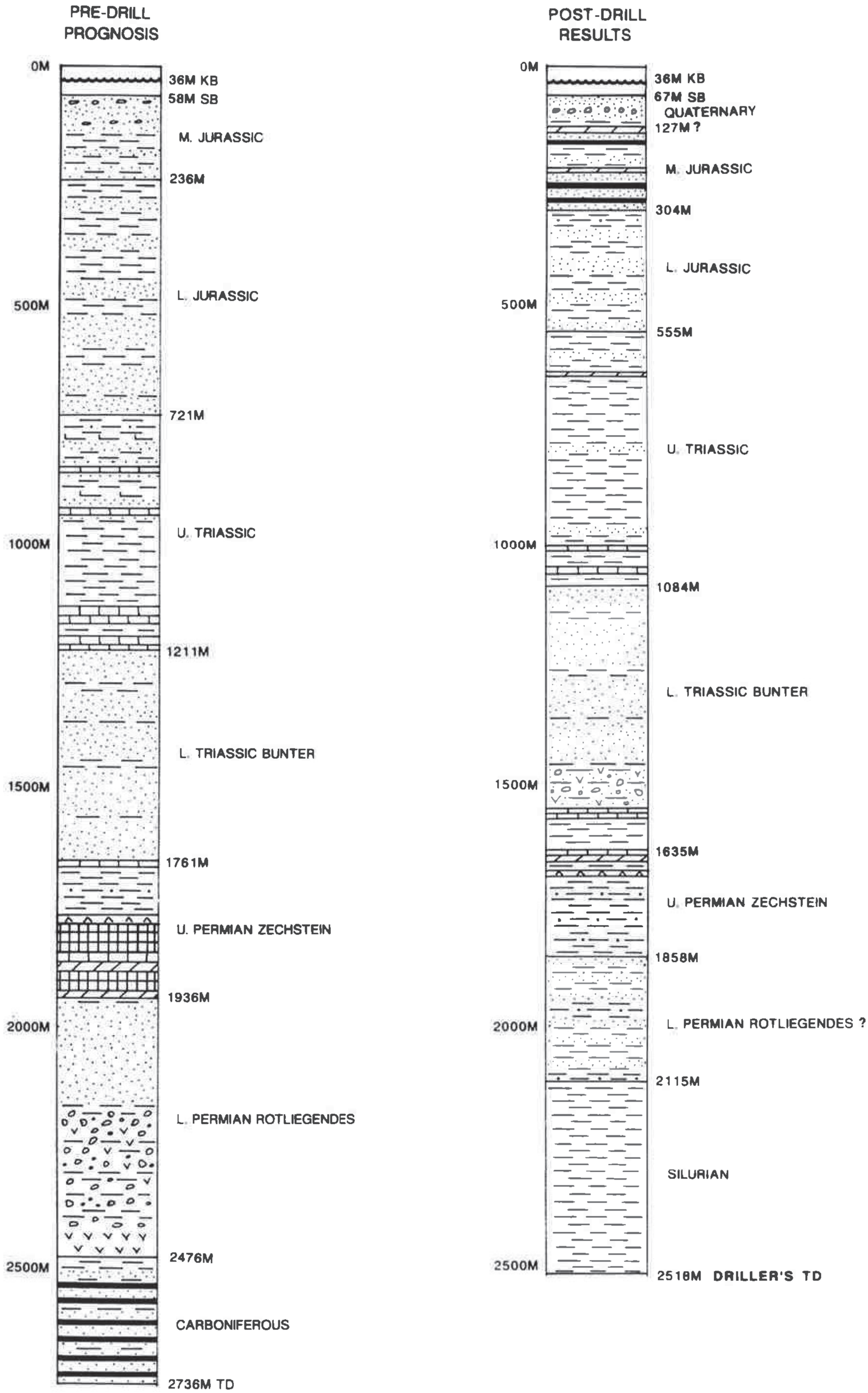

Figure 3: Stratigraphy

Formation tops are based on cuttings and log information. Tops listed are meters below RKB.

Log Analysis

<u>DENMARK 5414/7-1 (STINA-1)</u>

LOG ANALYSIS & TRIP REPORT

97-205-T8901-00

by

Robert L. Terry

July 19, 1989

Houston General Office - Exploration Technical Services

Formation Evaluation Department

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SUMMARY

The 5414/7-1 well offshore from Bornholm Island in the Baltic Sea (Figure 1) was logged during the period of July 7-8, 1989. This was the final logging run for this well and covered the interval from 1080 to 2510.7 meters. This section of the well was drilled with a salt saturated mud in anticipation of encountering salt formations in the Zechstein interval. When this did not prove to be the case, the chloride concentration was allowed to decrease to approximately 100,000 ppm. No PHPA mud was used on this well. The borehole was in fair condition with several zones exhibiting significant washout. Borehole deviation was generally less than 5 degrees, but starting at 1985 meters the hole angle began to build steadily until it reached a maximum of 24.5 degrees in the area of 2450 meters. This deviation is a result of the structural dip encountered in the Silurian shales. These shales were found (from the Dipmeter) to have a structural dip of 30 degrees to the West-Southwest. The drilling rates increased dramatically when these shales were penetrated.

The logging operations went smoothly and a detailed level-by-level analysis was performed using the Dual Water model in the PETCOM software system to produce a wellsite CPI (Computer Processed Interpretation). The CPI log is attached in the pocket at the back of this report.

The formations penetrated in the logged interval from 1080-2503 meters were the Bunter (1080-1636), the Zechstein (1636-1842), the Rotliegendes (1842-2112) and the Silurian (2112-2503). These formations are illustrated in the stratigraphic section that appears as Figure 2.

CONCLUSIONS

1) The Bunter sands in this well exhibited excellent reservoir potential (22% average porosity), but were uniformly wet. The apparent hydrocarbon shows from 1080 to 1100 meters were due to hole rugosity. Other trace shows throughout this zone can also be attributed to rugosity effects on the porosity tools and side bed effects on the resistivity devices. These generally resulted in the water saturation computation varying from 90-100%. See Table 1 for a detailed analysis by formation.

2) The Zechstein interval did not contain the anticipated salt sections. It was generally shaly with few clean porous zones. In fact, only 1.25 meters of reservoir rock was noted on the CPI log.

3) The Rotliegendes formation contained some reservoir rock (27.5 meters at 13.8% average porosity). Unfortunately, this zone was also wet, with only 1.75 meters of calculated pay which was primarily due to hole rugosity effects on the porosity devices (not real hydrocarbon shows). The hydrocarbon indication calculated in the interval from 2016-2021 meters was checked with a sidewall core sample and found to be a wet conglomerate. This pay calculation was due to an overestimation of the porosity (insufficient shale calculation...too clean for the conglomerate).

4) The lack of hydrocarbons in this well is probably related to the total absence of the Carboniferous interval (normally a source bed) below the Rotliegendes. Silurian shales lie immediately below the reservoir rocks in this well and indications from the service company personnel on site indicated similar results on the Norsk Hydro well to the North of our location.

RECOMMENDATIONS

1) No attempt should be made to test the Bunter formation and the well should be plugged and abandoned. The formation had excellent reservoir potential and given an adequate source, should be extremely productive. Further exploration using this formation as a reservoir is warranted.

2) The Zechstein formation in this area does not have adequate reservoir potential and no play should be developed based upon this zone.

3) The Rotliegendes was wet and did not have good reservoir potential. It does not appear to be a good prospect for future plays.

4) The lack of the Carboniferous coals as a source of gas resulted in this well being a dry hole. Further exploration (seismic?) to define the extent of this missing section could result in a play development elsewhere for gas in the Bunter sands.

WELLSITE OPERATIONS

The unexpected penetration of Silurian shales with their correspondingly high drilling rates resulted in the well being ready to log prior to the log analyst's arrival. The first logging run (Dual Laterolog/Micro Spherically Focused Log/Borehole Compensated Sonic) was monitored by the Amoco wellsite geologist. Subsequent logging runs were monitored by the wellsite log analyst.

Since this well was classified as a tight hole, all films, prints and data tapes were collected from the wireline service company (Schlumberger) at the completion of the job. One print of the raw Dipmeter log was provided to the Amoco drilling engineer at the wellsite to use the four arm caliper measurement in cement calculations. All other log data was removed from the wellsite. Data acquisition went very smoothly thanks in part to the presence of two Schlumberger engineers, which made it possible to have a fresh engineer at all times. The log data was transferred from the CSU (Cyber Service Unit) to the Amoco log analyst's PC, rather than the Schlumberger PC. This was done for three reasons. First, the Toshiba 5100 provided by Amoco could receive the data twice as fast as the Schlumberger PC (9600 vs. 4800 baud). Secondly, the Schlumberger PC was only equipped with floppy disk drives (no hard disk) which meant that if the data file was too large for the floppy disk, the copy operation would fail. Third, the Amoco machine had a more recent version of the Schlumberger CSU transfer program than Schlumberger's own PC (version 2.6 vs. version 2.5).

The logging services performed on this well and the pertinent borehole environmental data are as follows:

Log Heading Data and Logging Services

Date Logged	7 thru 8 July 1989
Run Number	2
Total Depth Logger	2,510.7 Meters
Bit Size	12.25 Inches
Mud Density	11.2 lbs/gallon Salt Sat.
Mud Resistivity	0.071 ohm/meters @ 78 F
Filtrate Resistivity	0.054 ohm/meters @ 75 F
Bottomhole Temperature	142 F

The following logs were run and interpreted:

DLL (1080-2506).........Dual Laterolog

MSFL (1080-2506)........Micro Spherically Focused Log

CNL (1080-2509.5).......Compensated Neutron Log

LDL (1080-2509.5).......Litho Density Log

BHC (1080-2506).........Borehole Compensated Sonic

NGL (1080-2509.5).......Natural Gamma Ray Log

SHDT (1080-2504)........Stratigraphic High Resolution Dipmeter

CST (see list)..........Chronological Sidewall Sampler

Check Shot Survey (entire borehole)

A detailed time breakdown follows for the logging operations on this well:

5414/7-1 OPERATION TIME REPORT

Date	Time	Operation
7/07	1245	Rig up Schlumberger
	1325	Start DLL-MSFL-BHC-GR
	1900	Finish DLL-MSFL-BHC-GR (data transferred to disk after logging)
	1945	Start LDL-CNL-NGL
7/08	0230	Finish LDL-CNL-NGL (data transferred to disk after logging)
	0330	Start SHDT
	0900	Finish SHDT
	0945	Start Check Shot survey
	1630	Finish Check Shot survey
	1700	Start CST (60 shots)
	2100	Finish CST
	2200	Rig down Schlumberger

The total logging time for this job was 33.25 hours. There was no lost time due to tool failure, mechanical problems or other causes.

The intention on this well was to take 60 sidewall cores. In fact, only 50 cores were recovered from the 60 shots attempted, resulting in a recovery rate of 83%. The bullets used were the old style combination bullets with 10 gram powder loads. It would be advisable in the future to use a rotary sidewall coring tool instead of the percussion bullet tools. This would improve core recovery and also allow for accurate petrophysical measurements of permeability and porosity. The results of the sidewall coring operation are as follows:

Sidewall Core Report

Depth	Formation	Lithology	Recovery	Fluorescence
2498	Silurian	Claystone	0.75"	None
2482.5	Silurian	Siltstone	0.50"	None
2467.5	Silurian	Claystone	1.00"	None
2451.3	Silurian	Siltstone	0.75"	None
2432.5	Silurian		No Recovery	
2419.5	Silurian	Claystone	0.50"	None
2404	Silurian	Claystone	0.75"	None
2390	Silurian	Claystone	0.75"	None
2369.5	Silurian	Claystone	0.75"	None
2353	Silurian	Siltstone	0.50"	None
2341.3	Silurian	Claystone	1.00"	None
2327.5	Silurian	Claystone	0.25"	None
2312.8	Silurian	Claystone	0.75"	None
2295	Silurian	Claystone	1.50"	None
2275.5	Silurian	Shale	0.50"	None
2258	Silurian	Claystone	1.00"	None
2242.5	Silurian	Claystone	0.75"	None
2227	Silurian	Clay	1.00"	None
2210	Silurian	Claystone	1.00"	None
2195	Silurian	Claystone	1.25"	None
2180	Silurian	Siltstone	1.00"	None
2169.5	Silurian	Shale	1.00"	None
2156.3	Silurian	Shale	0.75"	None
2135.3	Silurian		No Recovery	
2118	Silurian	Claystone	0.50"	None
2108.3	Rotliegend	Conglomerate	1.00"	None
2104.8	Rotliegend		No Recovery	
2100	Rotliegend	Claystone	1.25"	None
2094	Rotliegend	Claystone	1.50"	None
2091	Rotliegend		No Recovery	
2074	Rotliegend	Conglomerate	0.75"	None
2018.5	Rotliegend	Conglomerate	0.75"	None
1991	Rotliegend	Sand	0.50"	None
1983	Rotliegend	Sand	0.50"	None

Depth	Formation	Lithology	Recovery	Fluorescence
1976	Rotliegend	Sand	1.00"	None
1973	Rotliegend	Sand & Clay	1.50"	None
1962	Rotliegend	Sand	0.75"	None
1939.8	Rotliegend	Sand & Clay	0.75"	None
1927	Rotliegend	Sand	1.00"	None
1915.5	Rotliegend	Conglomerate	0.75"	None
1899	Rotliegend	Sand	0.75"	None
1898	Rotliegend	Sand	1.00"	None
1889.8	Rotliegend	Sand	0.75"	None
1867	Rotliegend		No Recovery	
1863.5	Rotliegend	Clay	0.50"	None
1687	Zechstein	Clay	0.25"	None
1640.5	Zechstein	Anhy. & Clay	0.75"	None
1637	Zechstein		No Recovery	
1547.3	Bunter	Limestone	0.25"	None
1520.5	Bunter		No Recovery	
1491.5	Bunter	Sand	0.75"	None
1465	Bunter	Sand	0.75"	None
1421	Bunter	Clay/Sand	0.75"	None
1364	Bunter		No Recovery	
1352.5	Bunter	Sand	0.50"	None
1320.5	Bunter	Sand	0.25"	None
1304	Bunter		No Recovery	
1279.3	Bunter	Sand	0.50"	None
1256.5	Bunter	Sand	1.00"	None
1155.5	Bunter		No Recovery	

A detailed description of each of the sidewall cores as performed by the wellsite geologist is included as Table 2. The sidewall cores provided excellent control on the log analysis in the conglomerate intervals, clearly indicating that the zones were wet.

ANALYSIS TECHNIQUE & INTERPRETATION

All of the logs for the well were environmentally corrected according to the published Schlumberger chart book corrections. No Tornado Chart corrections were applied to the resistivity suite (laterologs) because the rugose hole resulted in poor MSFL data. The environmentally corrected deep laterolog measurement was used as the best approximation to Rt (true formation resistivity).

The 1,423 meters of open hole encountered in this well made it necessary to break the analysis into four separate zones. Each zone corresponds to a separate geological formation and is defined by tool responses which are relatively uniform within the zone itself and different from those of the adjacent zones. The neutron, density, sonic and gamma ray clay response for each zone were defined using neutron/density and sonic/density crossplots and histograms of the selected clay points on the plots (Figures 3-6).

Pickett Plots of Rt (true formation resistivity) versus neutron/density crossplot porosity were used to determine the free water (connate water) resistivity for each zone (Figures 7-10). An RWA/Porosity crossplot was used to determine the bound water (shale associated water) resistivity in each zone (Figures 7-10).

The measurements used for the determination of clay volume in Zone 1 (2112-2503 meters) were the gamma ray and the sonic/density crossplot (see Table 3). The measurements used for the determination of clay volume in Zone 2 (1842-2112 meters) were the gamma ray and the neutron/density crossplot (see Table 4). The measurements used for the determination of clay volume in Zone 3 (1636-1842 meters) were the gamma ray and the neutron/density crossplot (see Table 5). The measurements used for the determination of clay volume in Zone 4 (1080-1636 meters) were the gamma ray and the neutron/density crossplot (see Table 6). In all of the zone analyses the rugose hole sections were discriminated out using the caliper.

All of the parameters used in the calculation of each zone in this well appear in Tables 7-10. Due to the poor borehole condition in this well, the invaded zone water saturation (Sxo) was **not** calculated from the Rxo tool readings. The sonic was used extensively for bad hole porosity control.

A CPI (computer processed interpretation) for this well is attached to this report. In addition, a detailed reservoir summary report using porosity and water saturation cutoffs as supplied by the ELAFE geologist is included as Table 1.

Technique

A Dual Water Model was used to compute effective and total porosities, water saturations and a volumetric breakdown of the main constituents of the rock (wet clay, dry clay, silt and matrix volumes). The matrix density for the formation was entered and the program calculated the neutron and density porosities using a sandstone/limestone/dolomite model. The neutron and density porosities were then corrected for clay and hydrocarbon effects. An iterative technique was used to do the hydrocarbon corrections based upon the input hydrocarbon density. If at the end of the iteration the hydrocarbon and clay corrected porosities for the neutron and density were not equal, then the program automatically adjusted input parameters to resolve the discrepancy. The adjustments were performed in the following order:

1) The input matrix density was adjusted. This option was allowed for this analysis.

2) The input clay volume was adjusted. This option was not allowed for this well.

3) If the previous adjustments did not resolve the discrepancy, the neutron or density input values were considered in error and one or the other was reduced until the discrepancy was resolved.

Between each of the aforementioned adjustments a complete set of hydrocarbon iterations was performed.

The following equations were used in the Dual Water Model analysis:

<u>Matrix corrected neutron porosity:</u>

PNC = PHIN + (PNS - PHIN)(2.71 - RHOMA)/.06

where: PHIN = Input limestone neutron porosity
PNS = Neutron sandstone porosity

<u>Matrix corrected neutron wet clay porosity:</u>

PNWCC = PNWC + (PNSWC - PNWC)(2.71 - RHOMA)/.06

where: PNWC = Input limestone neutron porosity for wet clay
PNSWC = Neutron sandstone porosity for wet clay

<u>Density calculations:</u>

PDC = (RHOMA - RHOB)/(RHOMA - RHOMF)

PDDC = (RHOMA - RHODC)/(RHOMA - RHOMF)

PDWC = (RHOMA - RHOWC)/(RHOMA - RHOMF)

where: RHOB = Input curve density
RHODC = Dry clay density
RHOWC = Wet clay density

<u>Neutron porosity for dry clay:</u>

PNDCC = 1 - (1 - PDDC)(1 - PNWCC)/(1 - PDWC)

where: PNWCC = Wet clay neutron porosity

Density and neutron clay corrections:

PDCR = PDC - VCL * PDWC

PNCR = PNC - VCL * PNWCC

where: VCL = Volume of clay

Wet clay point computation of total porosity and dry clay volume:

PTOTWC = (PDWC - PDDC)/(1 - PDDC)

VDCWCP = 1 - PTOTWC

Neutron Excavation Factor:

PHIX = PHIE + VCL * PNWCC

SWH = (PHIE(1 - SHR + SHR * PNH) + VCL * PNWCC)/PHIX

$$PNEX = (RHOMA/2.66)^2 (2*SWH*PHIX^2 + .04*PHIX)(1 - SWH)$$

where: SHR = Residual hydrocarbon saturation

Hydrocarbon corrected neutron and density porosity:

PNHC = (PNC + PNEX - VCL*PNWCC*B*SHR)/(1 - B*SHR)

PDHC = (RHOMA-RHOC+VCL*PDWC*A*SHR)/(RHOMA-RHOMF+A*SHR)

where: B = Neutron residual hydrocarbon factor
A = Density residual hydrocarbon factor

Total porosity:

PHIT = (PDHC * PNDCC - PNHC * PDDC)/(PNDCC - PDDC)

Dry clay volume and bound water saturation:

VDC = VCL * VDCWCP

SWB = (VDC * PTOTWC)/(VDCWCP * PHIT)

Effective porosity:

PHIE = PHIT(1 - SWB)

Water and hydrocarbon saturation:

$$SWT = \left[\frac{Rt*PHIT^{m}}{a} \left(\frac{1}{RwF} + \frac{SWB}{SWT} \left(\frac{1}{RwB} - \frac{1}{RwF} \right) \right) \right]^{-1/n}$$

$$SXOT = \left[\frac{RXO*PHIT^{m}}{a} \left(\frac{1}{RmfF} + \frac{SWB}{SXOT} \left(\frac{1}{RmfB} - \frac{1}{RmfF} \right) \right) \right]^{-1/n}$$

SW = (SWT - SWB)/(1 - SWB)

SXO = (SXOT - SWB)/(1 - SWB)

SHR = 1 - SXO

Volumetric calculations:

BVW = PHIE * SW

BVWSXO = PHIE * SXO

VWCLAY = VCD + SWB * PHIT

VMATRIX = PHIE(1 - PHIMAX)/PHIMAX

VSILT = 1 - PHIT -VDC -VMATRIX

LOGISTICS MAP BALTIC OPERATIONS

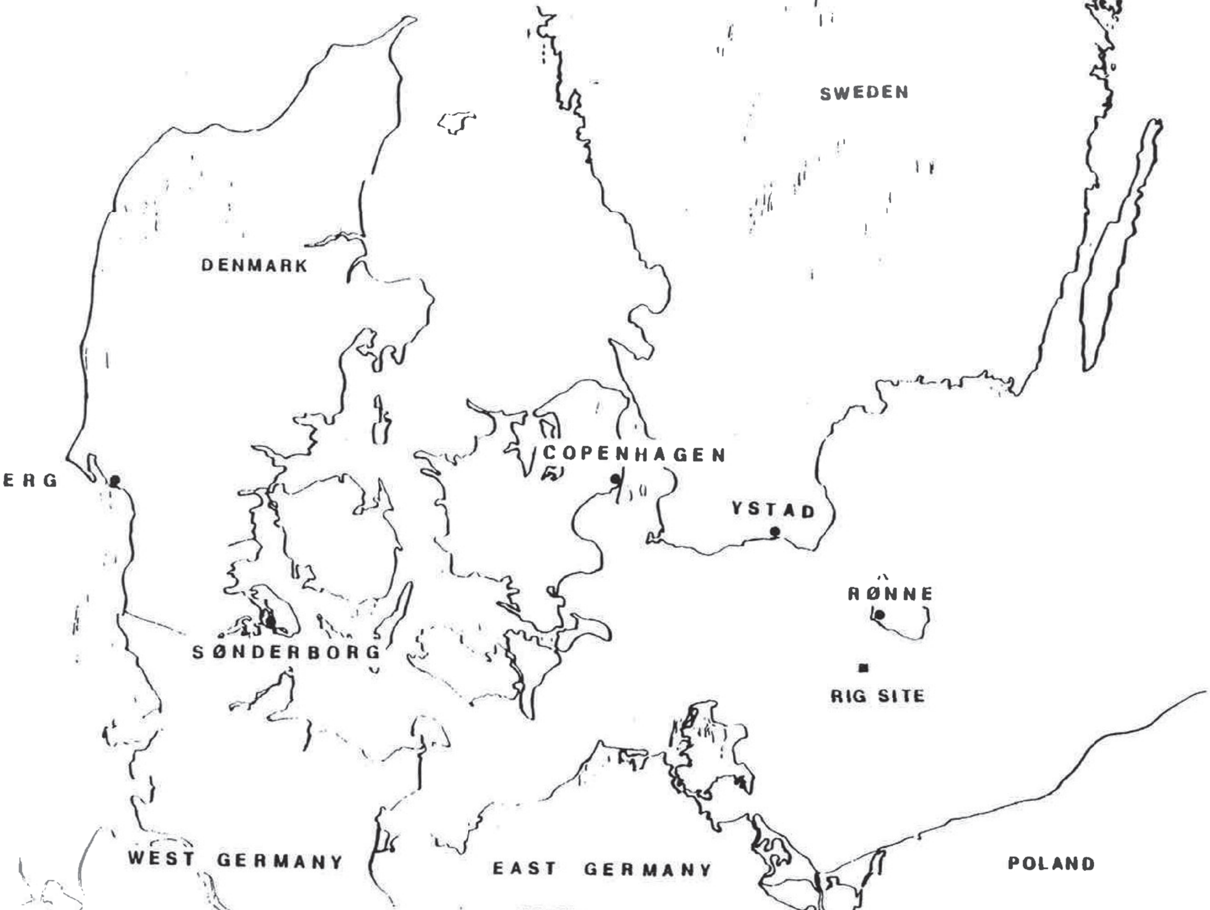


FIGURE 1

STINA-1 WELL STRATIGRAPHY

Formation tops based on cuttings and log information.
Tops listed are meters below RKB.

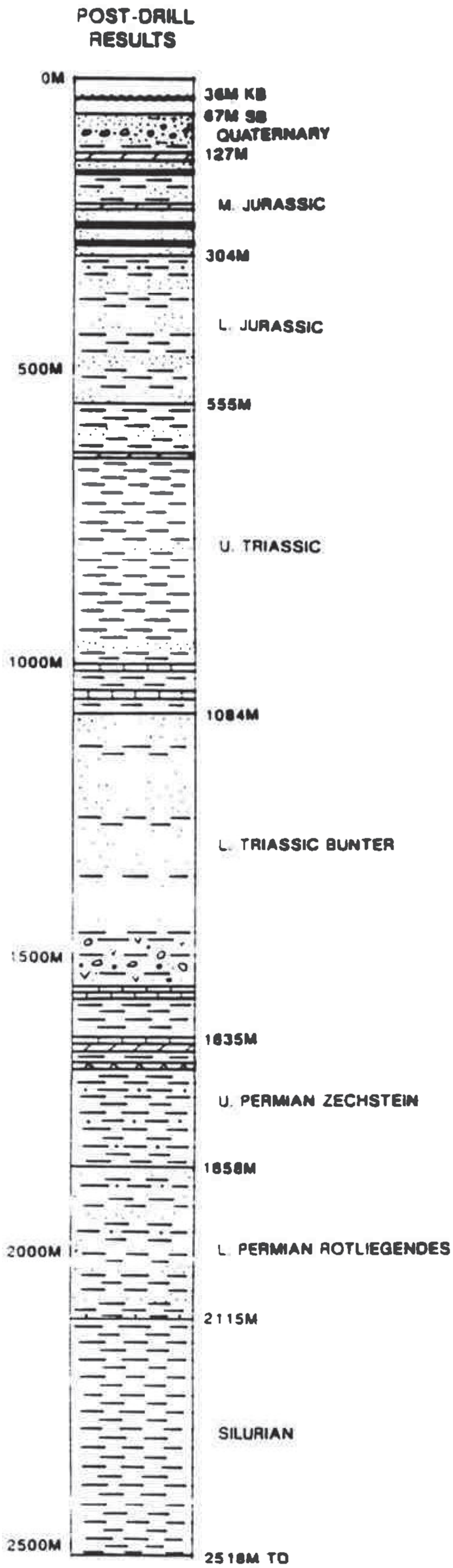
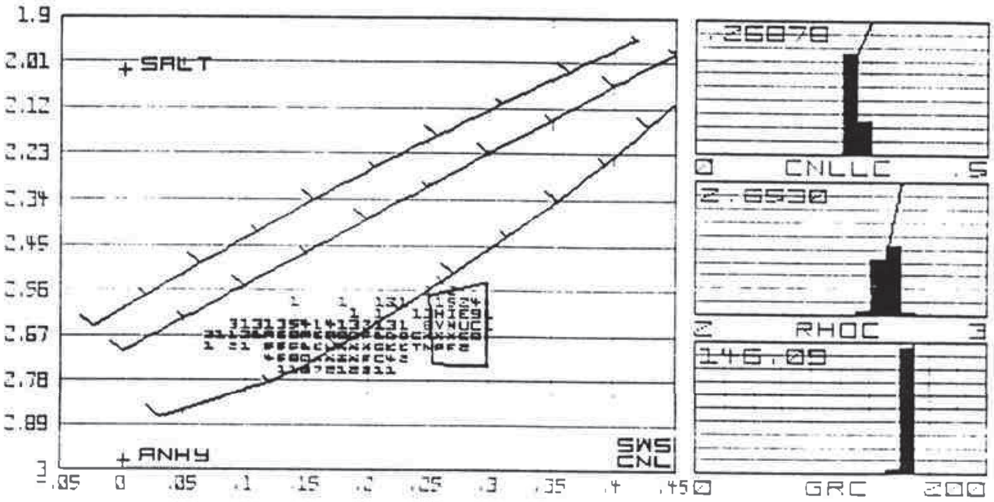


FIGURE 2

NEUTRON/DENSITY & SONIC/DENSITY CROSSPLOTS

ZONE 1

ZONE : From 2112.00 to 2503.00 M
X: CNLLC DEC Y: RHOC GM/CC Z: GRC API UNIT
Z scale: 0 25 50 75 100 125 150



ZONE : From 2112.00 to 2503.00 M
X: DTAFF MS/F Y: RHOC GM/CC Z: GRC API UNIT
Z scale: 0 25 50 75 100 125 150

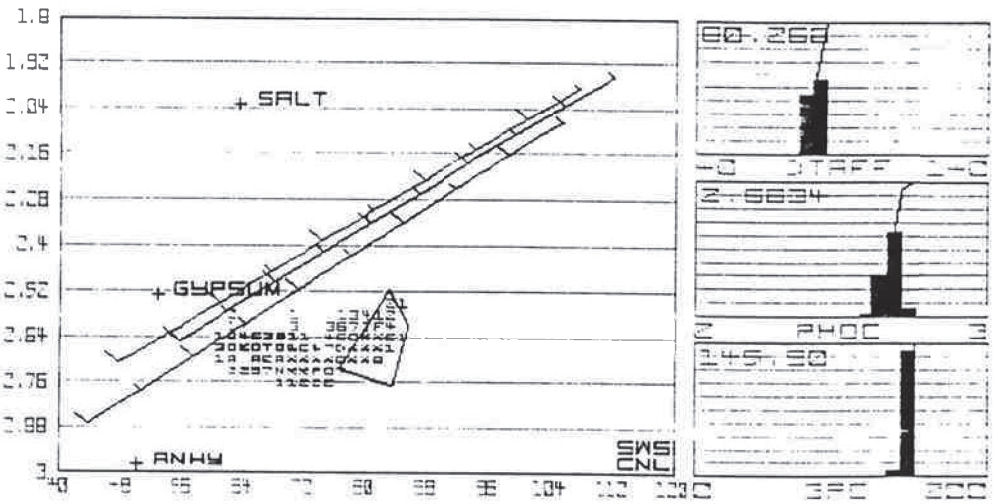
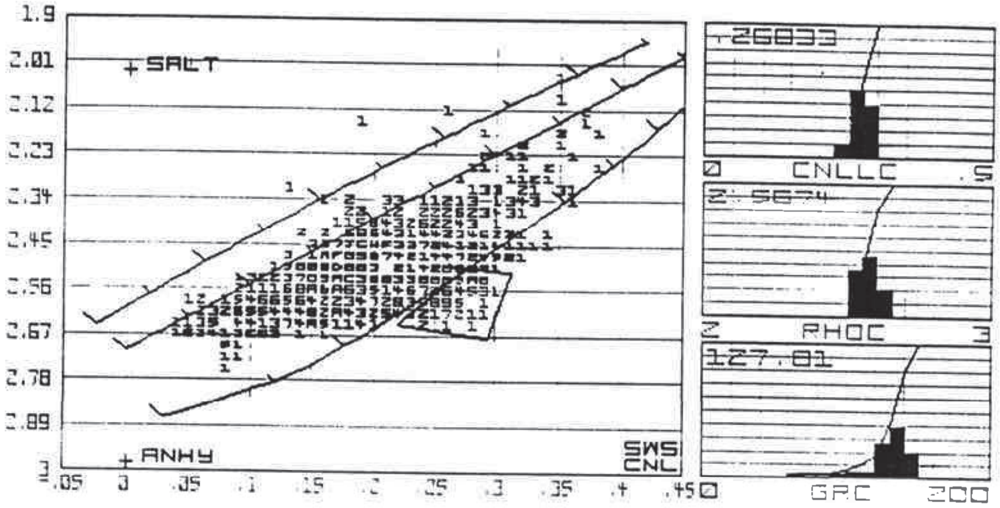


FIGURE 3

NEUTRON/DENSITY & SONIC/DENSITY CROSSPLOTS

ZONE 2

ZONE : From 1842.00 to 2112.00 M
X: CNLLC DEC Y: RHOC GM/CC Z: GRC API UNIT
Z scale: 0 25 50 75 100 125 150



ZONE : From 1842.00 to 2112.00 M
X: DTAFF MS/F Y: RHOC GM/CC Z: GRC API UNIT
Z scale: 0 25 50 75 100 125 150

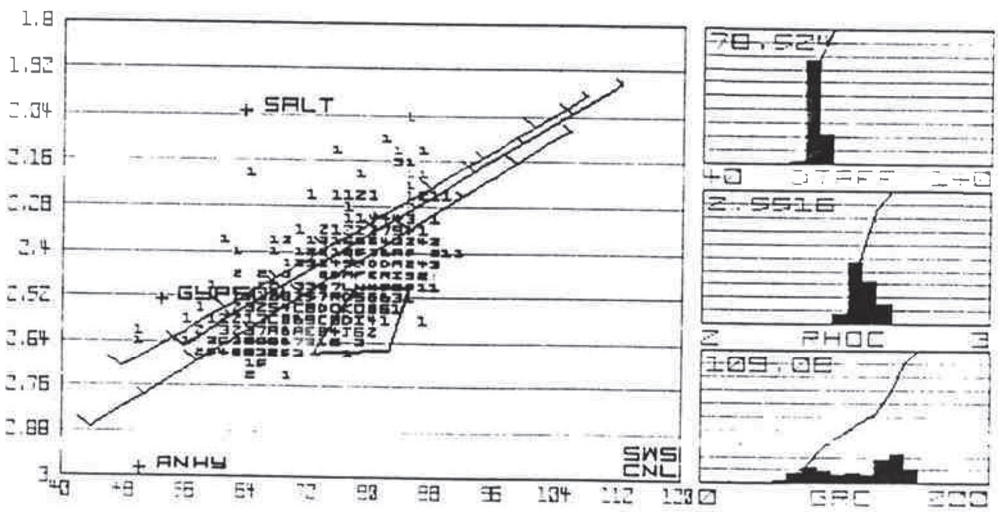
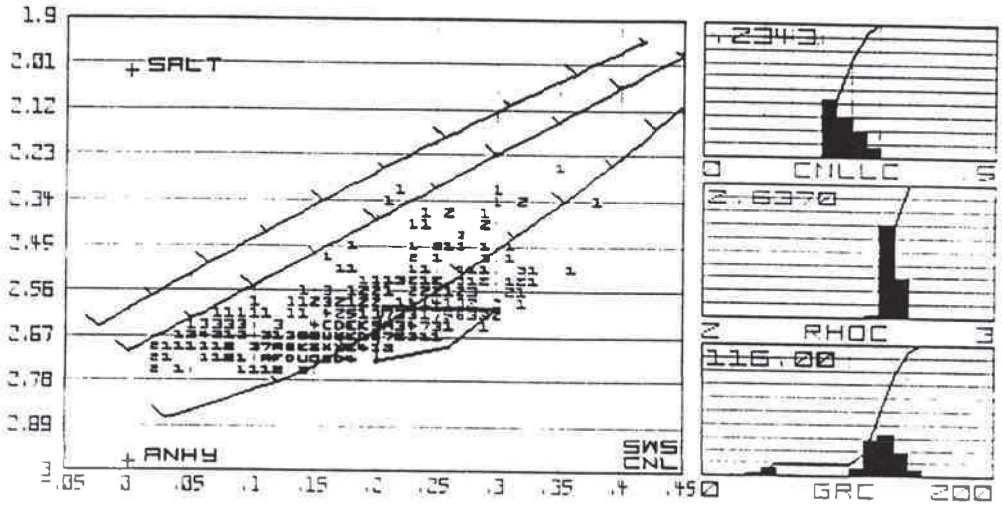


FIGURE 4

NEUTRON/DENSITY & SONIC/DENSITY CROSSPLOTS

ZONE 3

ZONE : From 1636.00 to 1842.00 M
X: CNLLC DEC Y: RHOC GM/CC Z: GRC API UNIT
Z scale: 0 25 50 75 100 125 150



ZONE : From 1636.00 to 1842.00 M
X: DTAFF MS/F Y: RHOC GM/CC Z: GRC API UNIT
Z scale: 0 25 50 75 100 125 150

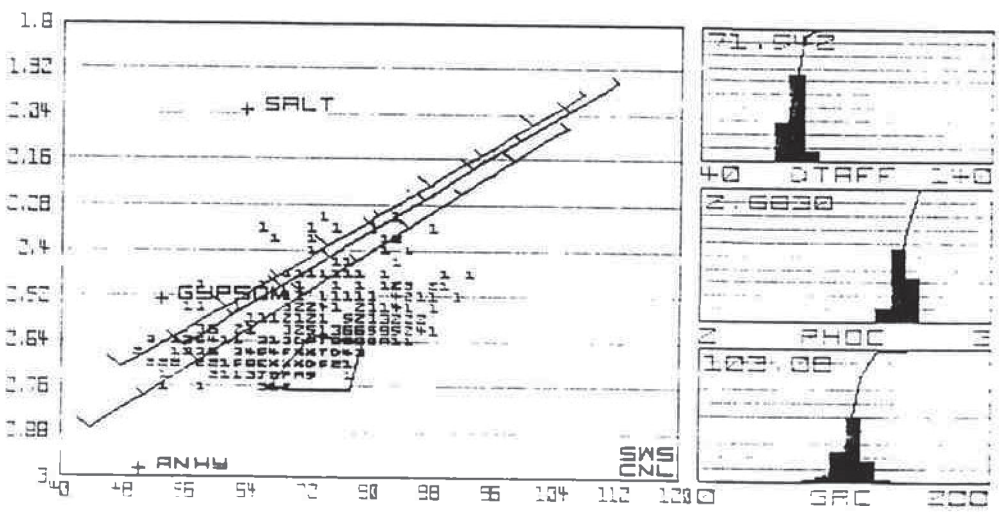
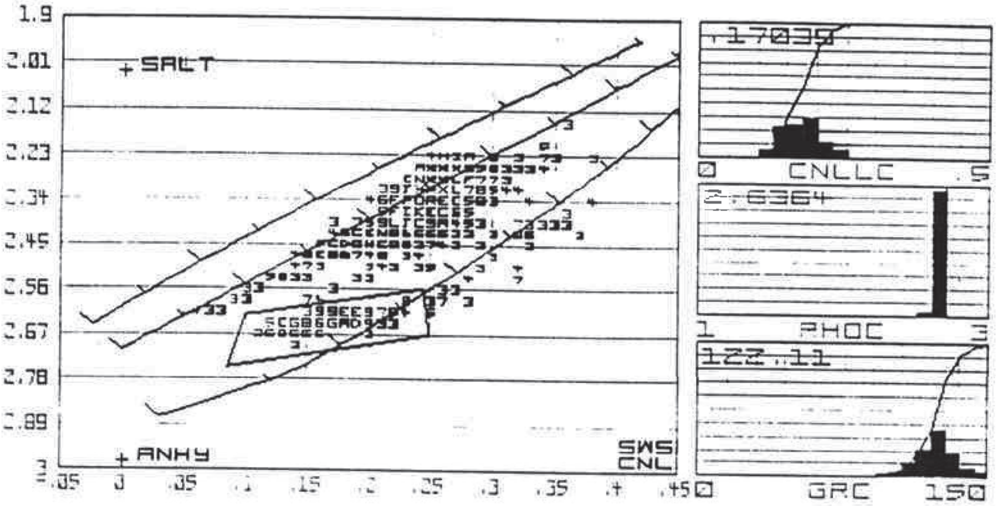


FIGURE 5

NEUTRON/DENSITY & SONIC/DENSITY CROSSPLOTS

ZONE 4

ZONE : From 1080.00 to 1636.00 M
X: CNLLC DEC Y: RHOC GM/CC Z: PEF
Z scale: 1 1.66662.33333 3.66664.33335



ZONE : From 1080.00 to 1636.00 M
X: DTAFF MS/F Y: RHOC GM/CC Z: GRC API UNIT
Z scale: 0 25 50 75 100 125 150

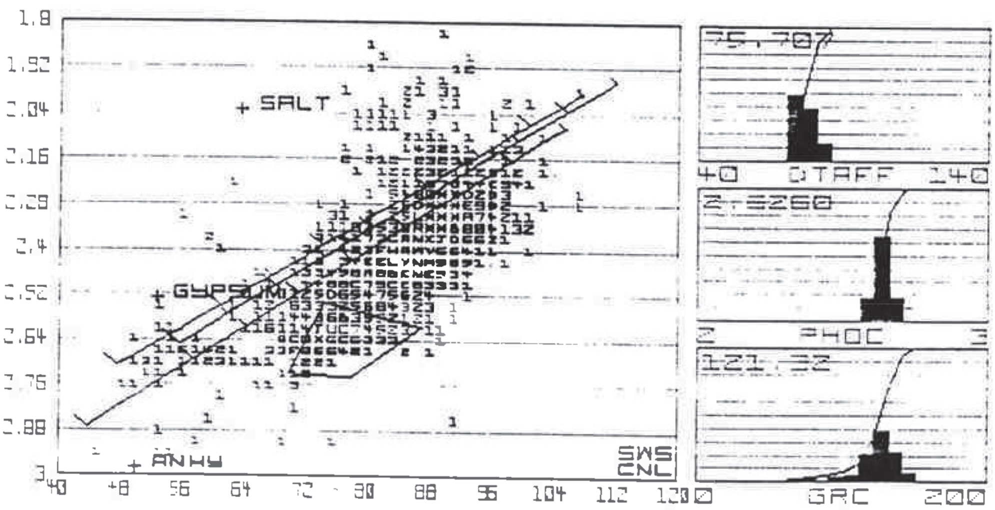
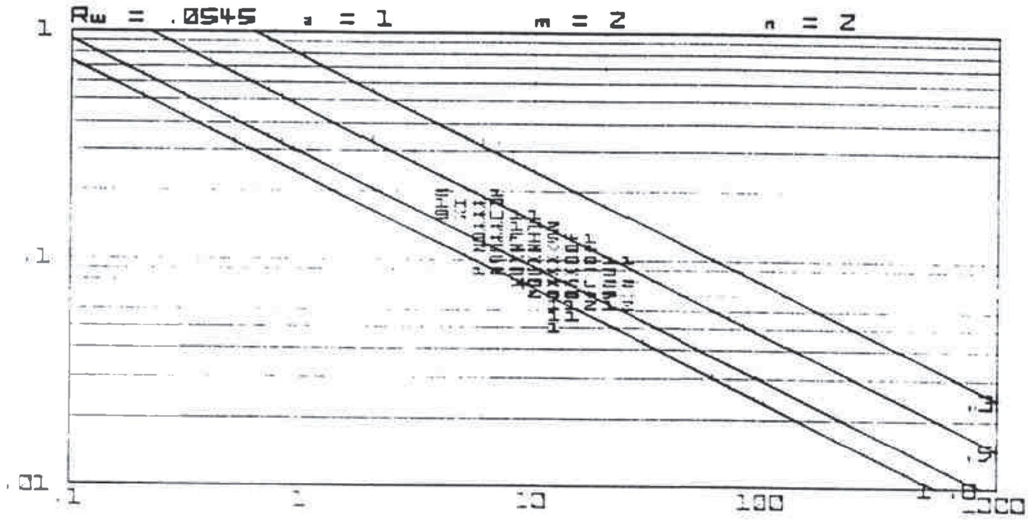


FIGURE 6

FREE WATER PICKETT PLOT & BOUND WATER PLOT

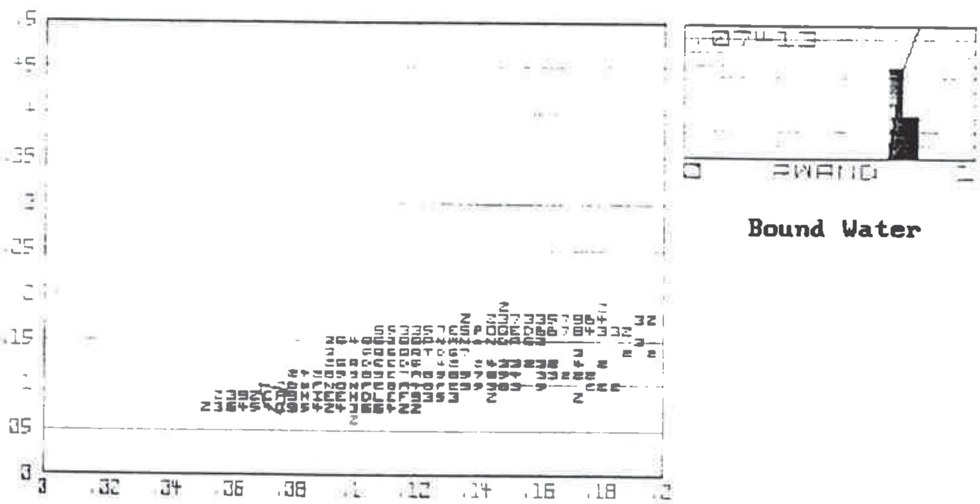
ZONE 1

ZONE : From 2112.00 to 2503.00 M
X: LLDC OHM-M Y: PND DECIMAL Z: GRC API UNIT
Z scale: 0 25 50 75 100 125 150



Free Water

ZONE : From 2112.00 to 2503.00 M
X: RWAND OHM-M Y: PND DECIMAL Z: VCL DECIMAL
Z scale: 0 .16667 .33333 .5 .66667 .833331



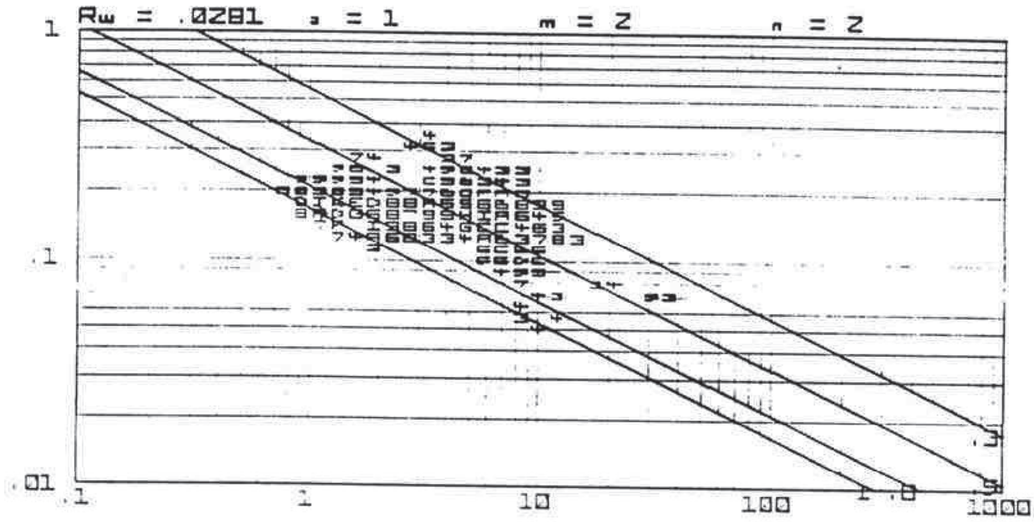
Bound Water

FIGURE 7

FREE WATER PICKETT PLOT & BOUND WATER PLOT

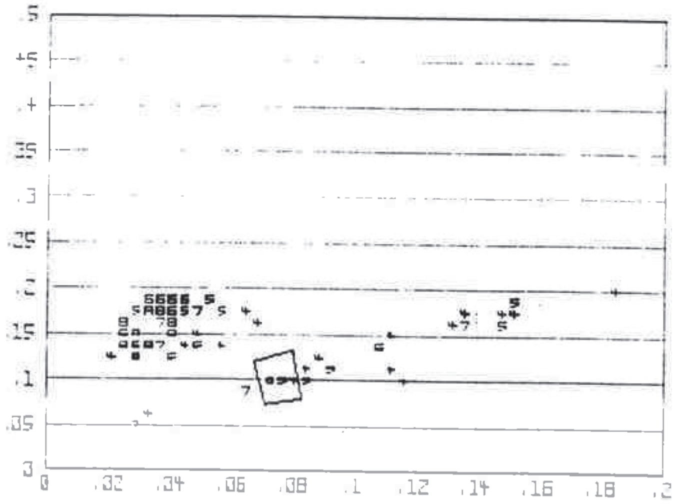
ZONE 2

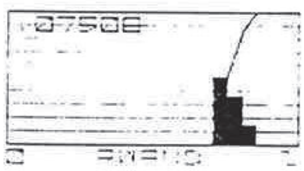
ZONE : From 1842.00 to 2112.00 M
X: LLDC OHM-M Y: PND DECIMAL Z: VCL DECIMAL
Z scale: 0 .16667 .33333 .5 .66667 .833331



Free Water

ZONE : From 1842.00 to 2112.00 M
X: RWAND OHM-M Y: PND DECIMAL Z: VCL DECIMAL
Z scale: 0 .16667 .33333 .5 .66667 .833331





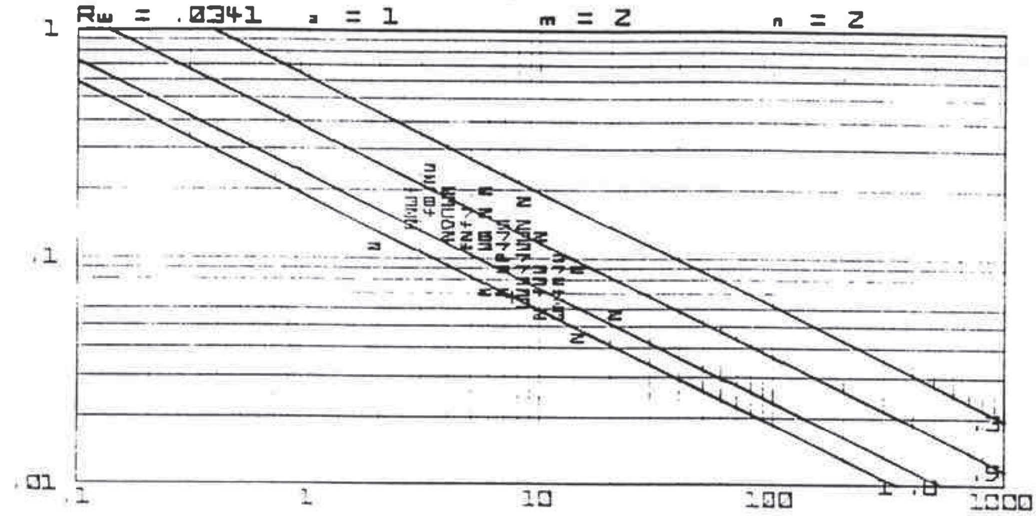
Bound Water

FIGURE 8

FREE WATER PICKETT PLOT & BOUND WATER PLOT

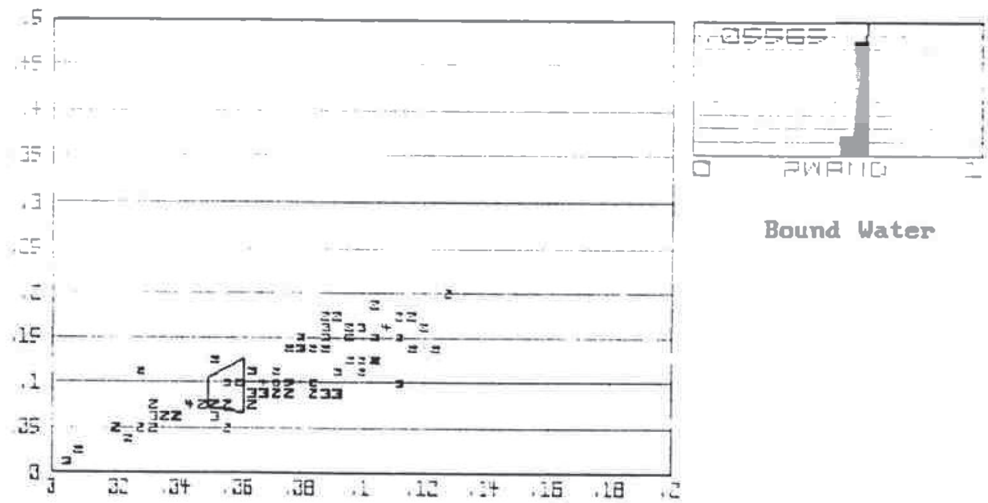
ZONE 3

ZONE : From 1636.00 to 1842.00 M
X: LLDC OHM-M Y: PND DECIMAL Z: GRC API UNIT
Z scale: 0 25 50 75 100 125 150



Free Water

ZONE : From 1636.00 to 1842.00 M
X: RWAND OHM-M Y: PND DECIMAL Z: VCL DECIMAL
Z scale: 0 .16667.33333.5 .66667.833331



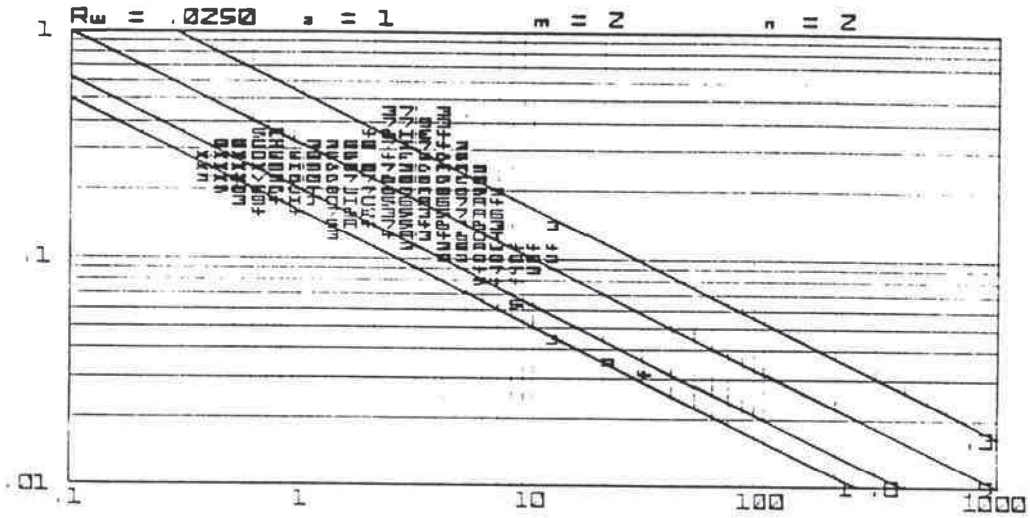
Bound Water

FIGURE 9

FREE WATER PICKETT PLOT & BOUND WATER PLOT

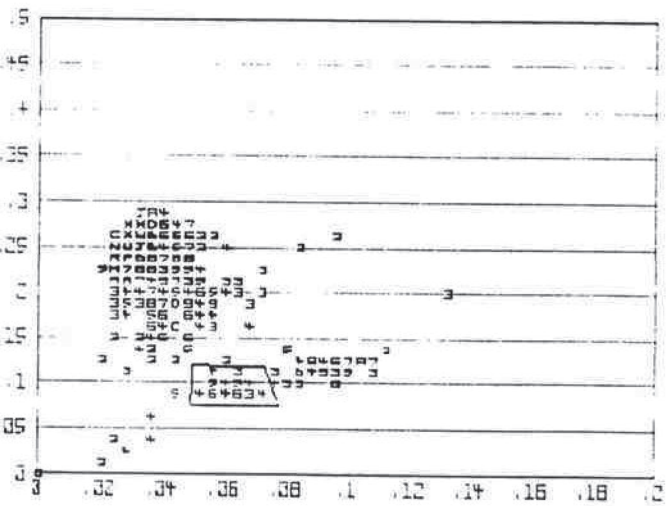
ZONE 4

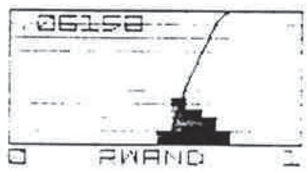
ZONE : From 1080.00 to 1636.00 M
X: LLDC OHM-M Y: PND DECIMAL Z: VCL DECIMAL
Z scale: 0 .16667 .33333 .5 .66667 .833331



Free Water

ZONE : From 1080.00 to 1636.00 M
X: RWAND OHM-M Y: PND DECIMAL Z: VCL DECIMAL
Z scale: 0 .16667 .33333 .5 .66667 .833331





Bound Water

FIGURE 10

COMPANY : AMOCO DENMARK EXPLORATION COMPANY

WELL : 5414/7-1 (STINA-1)

FIELD : WILDCAT

COUNTY : OFFSHORE

STATE : BALTIC SEA

COUNTRY : DENMARK

20-JUL-89 @ 14:43:08

CUTOFFS USED TO COMPUTE SUMMATION AVERAGES

NET PAY AVERAGES

CLAY VOLUME	<=	.350
MINIMUM POROSITY	>=	.100
MAXIMUM POROSITY	<=	(NOT USED)
WATER SATURATION	<=	.400

RESERVOIR ROCK AVERAGES

CLAY VOLUME	<=	.350
MINIMUM POROSITY	>=	.100
MAXIMUM POROSITY	<=	(NOT USED)

DISCRIMINATORS USED

8 <= CALI <= 14

ZONE : From 1080.00 to 2503.00 M

ZONE NAME	ZONE TOP	ZONE BASE	GROSS INTERVAL	NET PAY	AVG PHI	AVG Sw	AVG VCL	NET RES ROCK	AVG PHI	AVG VCL
BUNTER	1080.00	1636.00	556.25 M	.50 M	.332	.170	.111	109.75 M	.222	.273
ZECHSTEIN	1636.00	1842.00	206.25 M	.25 M	.140	.127	.324	1.25 M	.118	.073
ROTLIEGENDES	1842.00	2109.00	267.25 M	1.75 M	.183	.352	.181	27.50 M	.138	.277
SILURIAN	2109.00	2503.00	394.25 M	.00 M	.000	1.000	1.000	.25 M	.138	.000

TABLE 1

Table 2 not included in original

```
5414/7-1
 8-JUL-89 @ 00:48:16
ZONE : From  2112.00 to  2503.00


          CLAY VOLUME DETERMINATION


CROSS PLOT curves and parameters given as:
Density curve       = RHOC      clay     =     2.65
Neutron curve       = CNLLC     clay     =      .27
Sonic curve         = DTAFF     clay     =    80.00

LINES option chosen
    Density (at the point where Neutron is zero) =     2.65
    Density (at the point where Neutron is 0.20) =     2.28
    Sonic   (at the point where Density is 2.20) =    90.00
    Sonic   (at the point where Density is 2.70) =    48.00
```

TABLE 3

5414/7-1 (STINA-1)
21-JUL-89 @ 13:33:03
ZONE : From 1842.00 to 2112.00

CLAY VOLUME DETERMINATION

Gamma Ray curve	= GRC	clean	=	23.00	clay	=	127.00
Discriminator1	= CALI	minimum	=	8.00	maximum	=	14.00

CROSS PLOT curves and parameters given as:

Density curve	= RHOC	clay	=	2.57
Neutron curve	= CNLLC	clay	=	.27

LINES option chosen
Density [at the point where Neutron is zero] = 2.65
Density [at the point where Neutron is 0.20] = 2.28

TABLE 4

S41477-1
8-JUL-89 @ 00:14:17
ZONE : From 1636.00 to 1842.00

CLAY VOLUME DETERMINATION

GAMMA RAY curved
Gamma Ray curve = GRC clean = 30.00 clay = 116.00
Discriminator1 = CALI minimum = 14.00 maximum = 30.00

CROSS PLOT curves and parameters given as:
Density curve = RHOC clay = 2.64
Neutron curve = CNLLC clay = .23

LINES option chosen
Density [at the point where Neutron is zero] = 2.65
Density [at the point where Neutron is 0.20] = 2.28

TABLE 5

54147/7-1
7-JUL-89 @ 23:49:10
ZONE : From 1080.00 to 1636.00

CLAY VOLUME DETERMINATION

GAMMA RAY curved

Gamma Ray curve	= GRC	clean =	35.00	clay =	125.00
Discriminator1	= CALI	minimum =	14.00	maximum =	30.00

CROSS PLOT curves and parameters given as:

Density curve	= RHOC	clay =	2.61
Neutron curve	= CNLLC	clay =	.24

LINES option chosen

Density (at the point where Neutron is zero) = 2.65
Density (at the point where Neutron is 0.20) = 2.28

TABLE 6

5414/7-1 (STINA-1)
17-JUL-89 @ 08:00:57
ZONE : From 2112.00 to 2503.00

CONSTANTS used by DUAL WATER ANALYSIS

Input curve names are:

CNLLC	for	NEUTRON
RHOC	for	DENSITY
DTAFF	for	SONIC
VCL	for	VOLUME CLAY
CLF	for	CLAY FLAG
LLDC	for	RT
T	for	TEMPERATURE

Neutron type was CNL
Rho matrix was variable
Hydrocarbon density was fixed to the input value
Vclay was fixed to the input value
Porosity model was standard
m was variable with vclay
Discriminator for limit logic was CALI
Discriminator minimum limit = 14.000
Discriminator maximum limit = 30.000

User specified parameters

RwF	= .055	RwF Temp	= 143	RmfF	= .054
RmfF Temp	= 75	RwB	= .074	RwB Temp	= 143
RmfB	= .074	RmfB Temp	= 143	MF Density	=
P NaCl	=	HC Density	= .3	HC Den Min.	=
Neu HC Factor	=	Den HC Factor	=	Phi*Shr Limit	=
Matrix Den.	= 2.65	Wet Clay Den	= 2.653	Dry Clay Den	= 2.8
Neu Wet Clay	= .268	Phi Max	= .1	Delta Phi Max	=
Delta GD +	= .1	Delta GD -	= .03	a	= 1
m	= 2	n	= 2	Vo Clay Limit	= .35
EXP (Sxo-Sw)	= .2	IF (SW-Sxo)	= 3	Den Salt	=
Neu Salt	=	Den Coal	=	Neu Coal	=
TP Water	=	TP Clay	=	TP Hydrocarbon	=
TP Limestone	=	TP Sandstone	=	TP Dolomite	=
Min Value m	=	Max Value m	=		
Discrim. Min.	= 14	Discrim. Max.	= 30		
Bad hole logic Sonic parameters					
DT Matrix	= 55.6	DT Fluid	= 181	DT Clay	= 80
CP	= 1				

MF Density	was calculated to be	1.101
P NaCl	was calculated to be	.150

++

TABLE 7

5414/7-1 (STINA-1)
18-JUL-89 @ 08:16:21
ZONE : From 1842.00 to 2112.00

CONSTANTS used by DUAL WATER ANALYSIS

Input curve names are:
CNLLC for NEUTRON
RHOC for DENSITY
DTAFF for SONIC
VCL for VOLUME CLAY
CLF for CLAY FLAG
LLDC for RT
T for TEMPERATURE
Neutron type was CNL
Rho matrix was variable
Hydrocarbon density was fixed to the input value
Vclay was fixed to the input value
Porosity model was standard
m was variable with vclay
Discriminator for limit logic was CALI
Discriminator minimum limit = 14.000
Discriminator maximum limit = 30.000

User specified parameters

RwF	= .028	RwF Temp	= 134	RmfF	= .054
RmfF Temp	= 75	RwB	= .075	RwB Temp	= 134
RmfB	= .075	RmfB Temp	= 134	MF Density	=
P NaCl	=	HC Density	= .3	HC Den Min.	=
Neu HC Factor	=	Den HC Factor	=	Phi*Shr Limit	=
Matrix Den.	= 2.68	Wet Clay Den	= 2.567	Dry Clay Den	= 2.8
Neu Wet Clay	= .268	Phi Max	= .22	Delta Phi Max	=
Delta GD +	= .1	Delta GD -	= .03	a	= 1
m	= 2	n	= 2	Vo Clay Limit	= .35
EXP (Sxo-Sw)	= .2	IF (SW-Sxo)	= 3	Den Salt	=
Neu Salt	=	Den Coal	=	Neu Coal	=
TP Water	=	TP Clay	=	TP Hydrocarbon	=
TP Limestone	=	TP Sandstone	=	TP Dolomite	=
Min Value m	=	Max Value m	=		
Discrim. Min.	= 14	Discrim. Max.	= 30		

Bad hole logic Sonic parameters

DT Matrix	= 55.6	DT Fluid	= 181	DT Clay	= 78
CP	= 1				

MF Density was calculated to be 1.102
P NaCl was calculated to be .150

++

TABLE 8

5414/7-1 (STINA-1)
17-JUL-89 @ 07:57:30
ZONE : From 1636.00 to 1842.00

CONSTANTS used by DUAL WATER ANALYSIS

Input curve names are:

- CNLLC for NEUTRON
- RHOC for DENSITY
- DTAFF for SONIC
- VCL for VOLUME CLAY
- CLF for CLAY FLAG
- LLDC for RT
- T for TEMPERATURE

Neutron type was CNL
Rho matrix was variable
Hydrocarbon density was fixed to the input value
Vclay was fixed to the input value
Porosity model was standard
m was variable with vclay
Discriminator for limit logic was CALI
Discriminator minimum limit = 14.000
Discriminator maximum limit = 30.000

User specified parameters

RwF	= .034	RwF Temp	= 131	RmfF	= .054
RmfF Temp	= 75	RwB	= .056	RwB Temp	= 131
RmfB	= .056	RmfB Temp	= 131	MF Density	=
P NaCl	=	HC Density	= .3	HC Den Min.	=
Neu HC Factor	=	Den HC Factor	=	Phi*Shr Limit	=
Matrix Den.	= 2.65	Wet Clay Den	= 2.637	Dry Clay Den	= 2.8
Neu Wet Clay	= .234	Phi Max	= .17	Delta Phi Max	=
Delta GD +	= .1	Delta GD -	= .03	a	= 1
m	= 2	n	= 2	Vo Clay Limit	= .35
EXP (Sxo-Sw)	= .2	IF (SW-Sxo)	= 3	Den Salt	=
Neu Salt	=	Den Coal	=	Neu Coal	=
TP Water	=	TP Clay	=	TP Hydrocarbon	=
TP Limestone	=	TP Sandstone	=	TP Dolomite	=
Min Value m	=	Max Value m	=		
Discrim. Min.	= 14	Discrim. Max.	= 30		

Bad hole logic Sonic parameters

DT Matrix	= 55.6	DT Fluid	= 181	DT Clay	= 71.5
CP	= 1				

MF Density	was calculated to be	1.102
P NaCl	was calculated to be	.150

++

TABLE 9

5414/7-1 (STINA-1)
18-JUL-89 @ 08:21:24
ZONE : From 1080.00 to 1636.00

CONSTANTS used by DUAL WATER ANALYSIS

Input curve names are:

CNLLC	for	NEUTRON
RHOC	for	DENSITY
DTAFF	for	SONIC
VCL	for	VOLUME CLAY
CLF	for	CLAY FLAG
LLDC	for	RT
T	for	TEMPERATURE

Neutron type was CNL
Rho matrix was variable
Hydrocarbon density was fixed to the input value
Vclay was fixed to the input value
Porosity model was standard
m was variable with vclay
Discriminator for limit logic was CALI
Discriminator minimum limit = 14.000
Discriminator maximum limit = 30.000

User specified parameters

RwF	= .025	RwF Temp	= 128	RmfF	= .054
RmfF Temp	= 75	RwB	= .061	RwB Temp	= 128
RmfB	= .061	RmfB Temp	= 128	MF Density	=
P NaCl	=	HC Density	= .3	HC Den Min.	=
Neu HC Factor	=	Den HC Factor	=	Phi*Shr Limit	=
Matrix Den.	= 2.68	Wet Clay Den	= 2.636	Dry Clay Den	= 2.8
Neu Wet Clay	= .17	Phi Max	= .3	Delta Phi Max	=
Delta GD +	= .1	Delta GD -	= .03	a	= 1
m	= 2	n	= 2	Vo Clay Limit	= .35
EXP (Sxo-Sw)	= .2	IF (SW-Sxo)	= 3	Den Salt	=
Neu Salt	=	Den Coal	=	Neu Coal	=
TP Water	=	TP Clay	=	TP Hydrocarbon	=
TP Limestone	=	TP Sandstone	=	TP Dolomite	=
Min Value m	=	Max Value m	=		
Discrim. Min.	= 14	Discrim. Max.	= 30		

Bad hole logic Sonic parameters

DT Matrix	= 55.6	DT Fluid	= 181	DT Clay	= 75.7
CP	= 1				

MF Density was calculated to be 1.102
P NaCl was calculated to be .150

++

TABLE 10