NANA-1XP

Conventional Core Analysis for Mærsk Olie og Gas A/S . Well: Nana-1XP

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Conventional Core Analysis for Mærsk Olie og Gas A/S

Well: Nana-1XP

Core Laboratory
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GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
MINISTRY OF ENVIRONMENT AND ENERGY

GEUS

Contents

1. Introduction

By request of Mærsk Olie & Gas A/S, GEUS Core Laboratory has carried out conventional and special core analysis on the well Nana-1XP from the Halfdan Field.

The experimental programme was specified in facsimile messages from Ms. Pia Hansen, dated March 24 and April 26, 1999. The following analytical programme has been carried out:

- Conventional plug analysis
- Fluid saturation measurements
- Stepwise relative gas permeability
- Formation water analysis
- Lithological description of plugs

This study is carried out under contract GSC 1418, CWO's 163 and 165, covering the formation water and conventional core analysis study respectively. Several preliminary reports have been forwarded to Mærsk Olie & Gas A/S in the time period June - October 1999.

2. Sampling and analytical procedure

GEUS Core Laboratory received a total of 318 plugs for conventional analysis + 4 plugs for formation water analysis covering the interval 6918 – 7247 feet measured depth in the Nana-1XP well. Plugs were received from Mærsk Laboratory during the period mid April to late May 1999.

2.1 Fluid saturation

The following densities were used for the calculation of fluid saturation: 1.037 g/ml for the brine and 0.850 g/ml for the oil.

2.2 Hot Soxhlet cleaning

The plugs were cleaned in methanol and toluene and then dried at 110 ^{0}C.

2.3 Conventional core analysis

Conventional core analysis including He-porosity, grain density, gas permeability and Klinkenberg permeability was performed. The permeability was measured using a sleeve pressure of 800 psi.

2.4 Stepwise relative gas permeability

The relative permeability to gas was measured on 5 plug. The plugs were fully saturated with brine and then drained to S_w values of 0.8, 0.6, 0.4, 0.2 and 0. At each step a routine gas permeability was measured. Two plugs were measured for Klinkenberg permeability as well. The permeability was measured using a sleeve pressure of 800 psi.

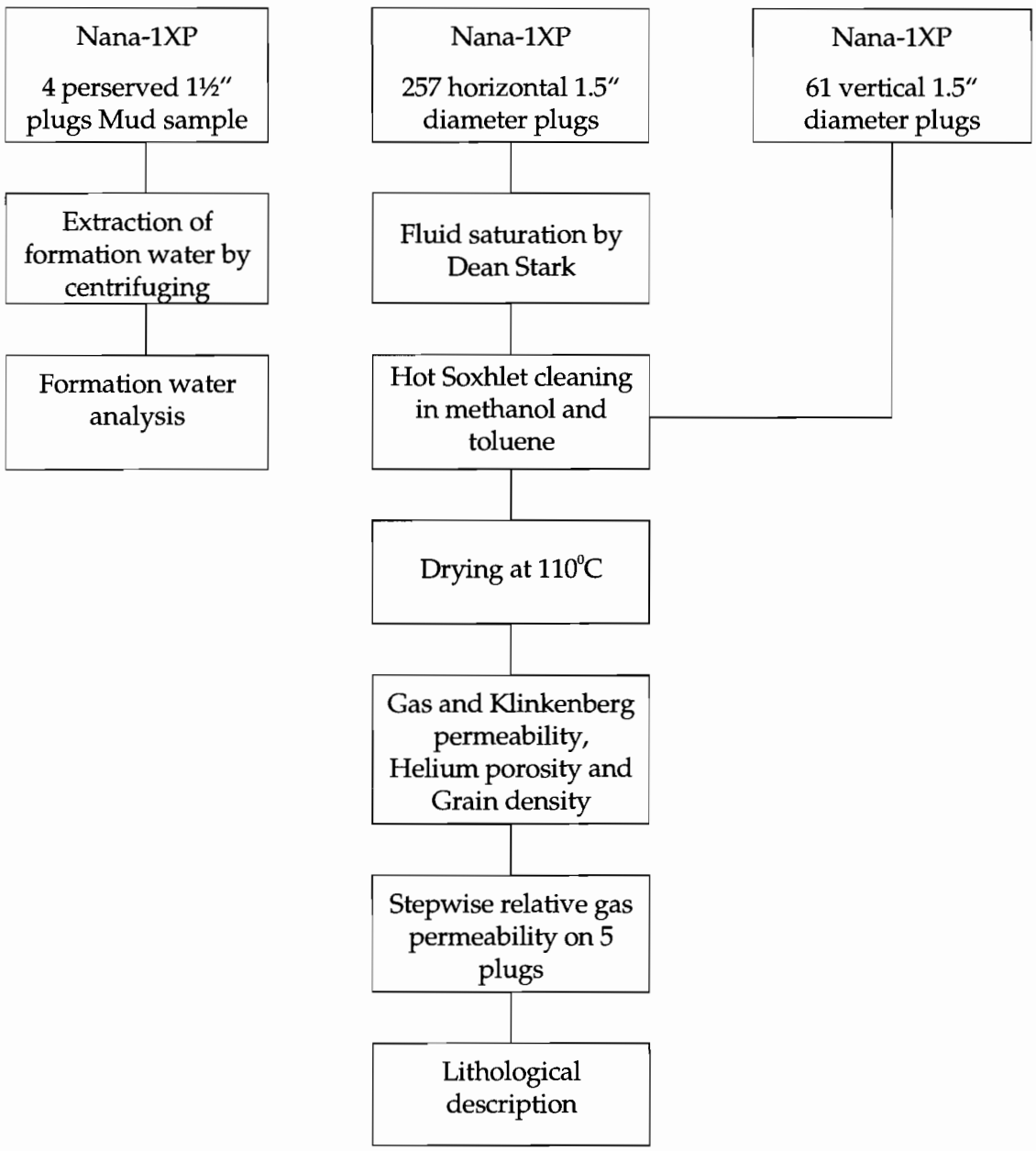
2.5 Formation water analysis

The formation water analysis was performed by The British Geological Survey and their report is attached at the end of the present report

2.6 Lithological description

The plugs were lithologically described according to the JCR nomenclature, and the description is included with the results in section 5.4.

3. Flow chart of the analytical procedure



4. Analytical methods

The following is a short description of the methods used by the GEUS Core Laboratory. For a more detailed description of methods, instrumentation and principles of calculation the reader is referred to API recommended practice for core analysis procedure (API RP 40, 1998).

4.1 Conventional cleaning and drying

The samples are placed in a Soxhlet extractor, which continuously soaks and washes the samples with methanol. This process removes water and dissolves salt precipitated in the pore space of the rock. Extraction is terminated when no chloride ions are present in the methanol. Samples containing hydrocarbons are then cleaned in toluene until a clear solution is obtained. Samples are vacuum dried at 90 °C or 110 °C, or they are humidity dried at 60 °C and 40% relative humidity until constant weight occurs, depending on the requirements of the client.

4.2 Gas permeability

The plug is mounted in a Hassler core holder, and a confining pressure of 800 psi applied to the sleeve. The specific permeability to gas is measured by flowing nitrogen gas through a plug of known dimensions at differential pressures between 0 and 1 bar. No back pressure is applied. The readings of the digital gas permeameter are checked regularly by routine measurement of permeable steel reference plugs.

4.3 Klinkenberg permeability (steady state instrument)

The Klinkenberg corrected gas permeability, sometimes termed the equivalent liquid permeability, is calculated from gas permeability measurements performed at 3 different mean pressures in the plug sample.

The plug is mounted in a Hassler core holder, and a confining pressure of 800 psi is applied to the sleeve. Nitrogen gas pressures of 3, 5 and 8 atm. (abs.) are applied at the upstream end of the plug, and the downstream pressure is regulated until a suitable flow is obtained. The differential pressure is kept approx. constant in order to maintain a similar flow regime during the 3 measurements. When a steady state is reached, the upstream pressure, the differential pressure across the plug and the flow reading is recorded. A linear regression of permeability on inverse mean pressure is performed for the 3 measurements, and the intercept on the permeability axis is the Klinkenberg corrected gas permeability. To ensure compatibility with plug data which do not include Klinkenberg corrected gas permeability, a permeability value pertaining to a mean pressure of 1.5 atm. (abs) is calculated from the Klinkenberg regression coefficients. This value is reported as "1.5 P-M permeability" in the core analysis tabulation, and should be comparable to the conventional gas permeability which is measured at the same mean pressure.

Klinkenberg corrected gas permeabilities are only reported down to approx. 0.1 mD on normal routine terms. However, on request measurements can be carried out to a lower limit of 0.01 mD. The performance of the digital gaspermeameter is checked regularly by routine measurements of permeable steel reference plugs.

4.4 He-porosity and grain density

The porosity is measured on cleaned and dried samples. The porosity is determined by subtraction of the measured grain volume and the measured bulk volume. The Helium technique, employing Boyle's Law, is used for grain volume determination, applying a double chambered Helium porosimeter with digital readout, whereas bulk volume is measured by submersion of the plug in a mercury bath using Archimedes principle. Grain density is calculated from the grain volume measurement and the weight of the cleaned and dried sample.

4.5 Fluid saturation determination

The water content of a plug is extracted by Dean Stark distillation with toluene. The water is retained by a condenser, and the amount is directly measured in a calibrated trap. The oil content of the plug is dissolved in the toluene. The quantity of oil is calculated as the difference between the original sample weight and the weight after extraction, corrected for the amount of water recovered. The plug is finally Soxhlet cleaned to remove salt precipitated in the pore space. The porosity is then measured as described above.

The calculation of fluid saturation presumes that the water and oil density is known. If it is unknown, a value is assumed in the final calculation, usually 1.0 g/ml for the brine and 0.85 g/ml for the oil. The percentage of the plug pore volume which is not occupied by either water or oil is the gas saturation.

4.6 Precision of analytical data

The table below gives the precision (= reproducibility) at the 68% level of confidence (+/- 1 standard deviation) for routine core analysis measurements performed at the GEUS Core Laboratory.

Measurement	Range, mD	Precision
Grain density		0.003 g/cc
Porosity		0.1 porosity-%
Gas Permeability	0.001-0.01 0.01-0.1 > 0.1	25% 15% 4%

The precision of the fluid saturation determination depends on the pore volume of the plug. The greater the plug and the greater the porosity of the plug, the better precision is obtained. The following table gives the precision in absolute percent-point.

Porosity	1" x 1.5" plugs	1.5" x 3" plugs
> 20%	5%	1%
10-20%	10%	2%
5-10%	20%	5%
< 5%	> 20%	> 5%

Certain factors might alter the stated precision of the fluid saturation determination. Loss of material during handling of the plug will result in an increase in the calculated oil saturation, and a similar decrease in the calculated gas saturation. This may occur for fragile for loosely consolidated rocks or if the rock contains dissolvable matters like halite. As the lost material usually has a greater density than oil, it may happen that the estimated volume of oil and the measured volume of water all together take up more space than the actual pore volume after cleaning.

5. Results

The results are presented as followed:

- Listed conventional core analysis data.
- Frequency of porosity, grain density, gas permeability, klinkenberg permeability, water– oil– and gas- saturation.
- Crossplot of porosity vs. gas permeability and Klinkenberg permeability.
- Crossplot of Klinkenberg permeability vs. gas permeability.
- Stepwise relative gas permeability data
- Lithological description.
- Formation water analysis data from The British Geological Survey
- Attached corelog plotting gas permeability, 1.5 P-M permeability, Klinkenberg permeability, porosity, grain density, oil- water- and gas saturation vs. depth.
- All measured data is also included on a diskette.

Based on plug data and after contact with Mærsk, the core has been divided into two formations:

Well: Nana-1XP Formation	Measured depth feet			Horizontal Plug no.	Vertical Plug no.
Danian	6918	→	7005	1 – 70	1V – 16V
Mastrichtian	7005	→	7247	71 – 257	17V – 61V

Frequency plots and crossplots are included for each formation.

5.1 Conventional core analysis data

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

GEUS CORE LABORATORY

CORE ANALYSIS TABULATION

Final report

Compiled by C.Hoier

WELL : Nana-1XP

CORE : 1,2,3 & 4

Printed : 15-DEC-99

GENERAL INFORMATION ON THE ANALYSIS

COMPANY : MAERSK OLIE OG GAS	LOCATION : Danish North Sea
DEPTH INTERVAL : 6918.50 - 7247.00	CORE NO.'S : 1,2,3 & 4
DEPTHS ARE MEASURED FROM KB	ANALYSTS : MJ, HJL, CH
DEPTHS ARE IN FEET	DATE : 221299
PROGRAM POPE V.5.9	FILE : NANA1XP

REMARKS :

Plugs have been Dean Starked, Soxhlet cleaned in methanol and toluene and dried at 110 C. He-porosity was measured unconfined, gas permeability was measured at 800 psi confining sleeve pressure.

MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
1	6918.50	HOR	0.530	0.501	0.206	1.000	28.26	2.706	38	12	50	
1V	6918.67	VERT	0.504	0.492	0.187	0.996	28.69	2.704				
2	6919.50	HOR	1.04	1.04	0.475	1.000	33.12	2.709	37	13	50	
3	6920.67	HOR	2.33	2.25	1.17	1.000	38.41	2.711	43	8	49	
4	6921.67	HOR	0.734	0.710	0.297	1.000	32.21	2.707	45	14	42	
2V	6922.67	VERT	0.842	0.850	0.311	0.997	33.05	2.702				
5	6922.92	HOR	1.02	0.979	0.426	1.000	33.34	2.703	57	-2	45	
6	6924.08	HOR	1.13	1.11	0.455	1.000	34.43	2.704	39	22	38	
7	6925.83	HOR	0.899	0.862	0.377	1.000	32.79	2.707	37	11	52	
8	6926.83	HOR	1.04	1.01	0.449	1.000	33.51	2.710	43	13	44	
9	6928.17	HOR	1.35	1.30	0.635	1.000	34.12	2.708	38	13	49	
10	6929.00	HOR	1.75	1.70	0.817	1.000	36.56	2.709	35	16	49	
3V	6929.25	VERT	1.17	1.10	0.509	1.000	34.79	2.706				
11	6931.83	HOR	1.80	1.68	0.862	0.997	36.89	2.710	19	24	58	
12	6932.00	HOR	1.28	1.19	0.589	0.998	33.50	2.705	32	26	42	
13	6932.83	HOR	1.52	1.49	0.707	0.999	34.79	2.706	29	28	43	
14	6942.42	HOR	1.12	1.12	0.467	1.000	33.68	2.707	43	34	23	
15	6943.00	HOR	1.04	1.01	0.468	0.999	32.00	2.707	47	40	13	
4V	6943.25	VERT	1.30	1.05	0.517	1.000	31.48	2.706				
16	6944.92	HOR	1.21	1.20	0.512	1.000	33.99	2.710	33	44	22	
17	6946.50	HOR	0.508	0.501	0.201	0.995	28.70	2.711	28	38	34	
18	6947.50	HOR	1.06	1.03	0.477	1.000	32.22	2.709	22	40	37	

MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
5V	6948.17	VERT	0.370	0.365	0.139	0.996	26.93	2.707				
19	6948.50	HOR	1.09	1.06	0.517	0.999	31.71	2.710	24	39	37	
20	6949.50	HOR	0.707	0.689	0.314	0.999	28.05	2.708	27	38	35	
21	6950.50	HOR	1.03	1.02	0.513	1.000	28.05	2.705	15	40	45	
22	6951.50	HOR	1.37	1.34	0.665	0.999	33.53	2.702	31	39	30	
23	6952.50	HOR	1.21	1.19	0.559	1.000	31.69	2.716	19	34	47	
6V	6953.25	VERT	0.215	0.212	0.059	0.997	25.66	2.706				
24	6953.50	HOR	0.489	0.482	0.185	1.000	28.70	2.705	26	33	41	
25	6954.50	HOR	0.569	0.550	0.235	1.000	27.95	2.704	33	36	31	
26	6955.50	HOR	0.588	0.583	0.226	1.000	29.01	2.703	28	33	39	
27	6957.25	HOR	1.23	1.22	0.527	1.000	33.94	2.699	39	34	27	
28	6958.17	HOR	1.15	1.12	0.489	0.999	34.83	2.697	36	33	31	
7V	6958.42	VERT	0.410	0.421	0.132	0.999	29.55	2.701				
29	6959.17	HOR	0.706	0.700	0.269	1.000	31.06	2.700	28	34	37	
30	6960.25	HOR	1.22	1.19	0.555	0.999	32.09	2.699	26	36	38	
31	6961.25	HOR	0.796	0.775	0.314	1.000	32.05	2.698	31	33	36	
32	6962.25	HOR	0.608	0.600	0.240	0.997	29.33	2.699	30	34	36	
8V	6962.42	VERT	0.401	0.400	0.148	1.000	28.38	2.698				
33	6963.25	HOR	1.03	0.940	0.442	0.999	34.71	2.694	30	36	35	
34	6964.25	HOR	0.745	0.726	0.274	0.999	33.30	2.708	34	34	32	
35	6965.25	HOR	0.548	0.512	0.212	1.000	29.67	2.705	22	31	46	
36	6966.92	HOR	0.130				20.07	2.704	47	12	42	

MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
9V	6967.42	VERT	0.000				20.82	2.702				
37	6967.92	HOR	0.177				22.27	2.699	47	17	36	
38	6968.92	HOR	0.199				22.66	2.705	36	22	42	
39	6970.00	HOR	0.177				24.16	2.709	49	11	40	
40	6971.00	HOR	0.308	0.260	0.111	0.997	28.21	2.706	42	15	43	
41	6972.00	HOR	0.356	0.327	0.132	1.000	27.67	2.701	49	26	25	
10V	6972.75	VERT	0.533	0.507	0.200	0.996	31.43	2.694				
42	6973.17	HOR	0.383	0.382	0.134	1.000	28.41	2.700	56	25	19	
43	6974.17	HOR	0.339	0.387	0.089	0.994	28.97	2.700	52	2	45	
44	6975.17	HOR	0.344	0.362	0.118	0.997	29.24	2.705	55	23	22	
45	6976.25	HOR	0.181				23.89	2.701	66	9	25	
11V	6977.83	VERT	0.055				20.70	2.703				
46	6978.00	HOR	0.166				24.36	2.700	64	12	25	
47	6979.00	HOR	0.115				19.24	2.706	77	8	15	
48	6980.00	HOR	0.115				19.25	2.704	63	11	26	
49	6981.00	HOR	0.175				22.77	2.692	46	13	41	
50	6982.17	HOR	0.137				18.72	2.695	52	19	29	
12V	6982.58	VERT	0.014				14.78	2.703				
51	6983.17	HOR	0.095				16.93	2.700	49	15	36	
52	6984.25	HOR	0.300	0.301	0.132	1.000	24.40	2.661	45	24	31	
53	6985.25	HOR	0.067	0.063	0.015	0.973	18.78	2.705	69	13	18	
54	6987.25	HOR	0.195				14.75	2.715	66	8	25	

MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
13V	6987.33	VERT	0.020				15.87	2.714				
55	6988.17	HOR	0.527	0.512	0.241	1.000	30.11	2.703	13	45	42	
56	6989.17	HOR	0.166				23.65	2.703	48	23	28	
57	6990.17	HOR	0.306	0.200	0.073	1.000	29.07	2.701	36	42	23	
58	6991.17	HOR	0.553	0.366	0.152	1.000	29.85	2.695	40	40	19	
59	6992.17	HOR	0.172				25.35	2.701	29	28	43	
14V	6992.58	VERT	0.096	0.135	0.018	0.868	21.62	2.705				
60	6993.17	HOR	0.184				19.35	2.710	57	24	19	
61	6994.25	HOR	0.129				23.58	2.711	39	49	12	
62	6995.33	HOR	0.160				24.82	2.703	43	31	27	
63	6997.25	HOR	0.364	0.233	0.088	1.000	29.74	2.702	23	55	22	
15V	6997.50	VERT	0.117				25.68	2.713				
64	6998.25	HOR	0.407	0.393	0.159	0.999	27.87	2.706	26	30	44	
65	6999.25	HOR	0.159				24.23	2.709	29	62	9	
66	7000.33	HOR	0.223				27.92	2.711	41	53	6	
67	7001.25	HOR	0.346	0.338	0.183	0.993	21.13	2.712	61	30	9	
16V	7002.17	VERT	0.291				30.07	2.706				
68	7002.25	HOR	0.343	0.380	0.096	0.990	28.92	2.712	37	21	42	
69	7003.25	HOR	0.206				23.16	2.714	38	46	15	
70	7004.25	HOR	0.379	0.385	0.182	1.000	24.41	2.706	35	12	54	
71	7005.25	HOR	0.527	0.529	0.300	0.995	18.75	2.714	19	38	43	
72	7006.25	HOR	1.11	1.10	0.651	1.000	21.24	2.714	13	42	45	

MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
73	7008.50	HOR	0.739	0.702	0.403	1.000	19.15	2.712	19	41	40	
17V	7009.42	VERT	0.983	0.967	0.518	1.000	24.38	2.706				
74	7009.58	HOR	1.19	1.16	0.646	1.000	25.00	2.711	20	43	38	
75	7010.75	HOR	2.01	1.94	1.26	0.999	24.29	2.712	33	40	27	
76	7011.75	HOR	2.09	2.08	1.33	0.997	22.29	2.710	32	49	18	
77	7012.67	HOR	0.902	0.912	0.524	1.000	20.69	2.710	27	43	30	
78	7013.67	HOR	1.41	1.36	0.875	0.999	25.96	2.709	31	49	20	
18V	7014.42	VERT	1.06	1.04	0.540	0.998	26.40	2.707				
79	7014.75	HOR	0.907	0.874	0.482	1.000	25.30	2.713	34	45	22	
80	7015.92	HOR	1.27	1.26	0.651	0.999	27.95	2.714	25	48	27	
81	7016.92	HOR	0.816	0.787	0.429	0.994	21.29	2.714	49	28	23	
82	7018.25	HOR	2.40	2.31	1.69	0.999	24.71	2.714	27	48	26	
83	7019.42	HOR	1.07	1.06	0.542	0.998	26.55	2.713	33	45	22	
19V	7019.67	VERT	0.983	0.940	0.500	0.997	27.87	2.707				
84	7020.42	HOR	1.15	1.13	0.577	1.000	26.20	2.701	29	48	23	
85	7021.58	HOR	1.13	1.18	0.556	1.000	26.98	2.712	27	51	22	
86	7022.92	HOR					22.64	2.714	27	58	14	
87	7024.00	HOR	6.34	6.83	4.77	0.992	23.71	2.716	29	59	12	Frac. perm
20V	7024.83	VERT	0.564	0.561	0.255	1.000	25.15	2.713				
88	7025.00	HOR	0.697	0.710	0.322	1.000	25.10	2.710	38	38	24	
89	7026.00	HOR	1.41	1.33	0.830	0.995	26.03	2.713	32	50	18	
90	7027.00	HOR	1.86	2.21	0.979	1.000	25.80	2.713	30	52	18	

MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
91	7033.42	HOR	0.961	0.947	0.459	1.000	27.32	2.710	34	42	24	
21V	7033.58	VERT	1.63	1.63	0.849	1.000	26.02	2.710				
92	7035.17	HOR	3.48	3.57	2.34	0.987	28.40	2.710	28	57	15	
93	7036.25	HOR	1.55	1.56	0.823	0.994	27.75	2.711	33	46	21	
94	7037.17	HOR	1.47	1.36	0.771	1.000	29.53	2.712	32	52	16	
22V	7038.58	VERT	3.89	3.78	2.30	1.000	36.18	2.709				
95	7042.92	HOR	4.56	4.45	2.80	1.000	35.73	2.712				
23V	7043.42	VERT	0.841	0.823	0.420	0.998	24.23	2.711				
96	7044.08	HOR	2.28	2.11	1.37	0.998	29.70	2.713	18	58	24	
97	7045.58	HOR	2.14	2.06	1.29	0.993	28.89	2.709	23	58	19	
98	7046.67	HOR	3.23	3.00	2.17	1.000	29.19	2.710	27	53	20	
99	7047.58	HOR	1.95	1.90	1.10	0.974	30.57	2.711	26	60	13	
24V	7048.42	VERT	2.59	2.58	1.45	0.998	32.68	2.709				
100	7048.75	HOR	1.94	1.92	1.02	0.999	30.95	2.714	37	47	16	
101	7050.75	HOR	0.753	0.747	0.392	0.999	23.53	2.714	35	42	23	
102	7051.67	HOR	1.32	1.30	0.696	1.000	27.85	2.716	36	48	16	
103	7052.67	HOR	1.48	1.45	0.810	0.999	27.77	2.716	33	50	17	
25V	7053.00	VERT	1.81	1.80	0.972	1.000	27.65	2.712				
104	7066.08	HOR	1.26	1.22	0.726	0.995	24.40	2.718	44	31	25	
26V	7066.25	VERT	1.08	1.07	0.560	1.000	24.53	2.718				
105	7067.00	HOR	2.06	1.99	1.16	0.999	27.91	2.721	43	33	24	
106	7068.00	HOR	1.95	1.86	1.18	0.992	26.78	2.720	31	52	18	

MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
107	7069.00	HOR	1.98	1.80	1.15	1.000	29.53	2.717	36	51	13	
108	7071.00	HOR					26.48	2.715	33	64	3	
27V	7071.25	VERT	1.68	1.62	0.965	0.995	27.07	2.715				
109	7072.00	HOR	3.27	3.17	2.06	0.996	27.66	2.715	32	49	19	
110	7073.42	HOR	2.38	2.25	1.55	1.000	27.77	2.715	34	58	8	
111	7074.83	HOR	1.39	1.36	0.722	0.997	27.41	2.712	40	53	7	
112	7076.67	HOR	1.13	1.04	0.594	1.000	25.09	2.713	48	27	25	
28V	7077.00	VERT	0.943	0.943	0.485	0.999	25.65	2.714				
113	7077.92	HOR	1.57	1.58	0.893	0.997	25.94	2.712	43	41	15	
114	7079.17	HOR	1.38	1.32	0.790	0.996	26.14	2.714	46	18	36	
115	7080.58	HOR	1.82	1.73	1.03	1.000	29.02	2.712	28	45	27	
116	7081.83	HOR	0.807	0.706	0.443	0.987	23.98	2.713	55	29	16	
117	7082.83	HOR	1.66	1.63	0.894	0.998	28.07	2.713	43	26	31	
29V	7083.17	VERT	1.44	1.41	0.786	1.000	26.74	2.711				
118	7083.83	HOR	3.06	2.96	1.79	0.991	26.58	2.713	43	32	25	
119	7084.83	HOR					27.11	2.710	45	33	21	
120	7085.92	HOR	2.03	1.92	1.11	0.998	30.31	2.714	40	26	34	
121	7086.92	HOR	1.25	1.22	0.633	1.000	25.93	2.714	47	29	25	
122	7087.92	HOR	2.05	1.98	1.13	1.000	28.93	2.713	45	37	18	
30V	7088.25	VERT	2.10	2.07	1.18	0.998	29.09	2.713				
123	7089.58	HOR	2.31	2.20	1.31	1.000	28.60	2.715	39	17	43	
124	7091.33	HOR	2.71	2.55	1.52	1.000	30.35	2.713	27	33	40	

MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
125	7093.00	HOR	1.67	1.63	0.898	0.999	27.37	2.712	48	35	16	
31V	7093.25	VERT	1.66	1.62	0.892	1.000	27.58	2.713				
126	7094.42	HOR	1.71	1.62	0.925	0.999	26.84	2.716	44	32	24	
127	7095.50	HOR	2.80	2.57	1.74	1.000	27.18	2.715	47	37	15	
128	7096.50	HOR	2.30	2.20	1.32	0.996	29.42	2.712	49	38	12	
129	7097.67	HOR	2.09	2.02	1.16	0.999	28.16	2.714	40	51	10	
32V	7099.75	VERT	1.29	1.27	0.624	1.000	28.39	2.711				
130	7099.92	HOR	2.75	2.69	1.79	0.998	22.67	2.710				
131	7101.67	HOR	1.91	1.88	1.14	0.993	28.21	2.716	30	51	19	
132	7102.83	HOR	7.64	7.60	5.42	0.992	31.46	2.714	26	55	20	Frc. perm.
133	7103.83	HOR	5.26				31.43	2.716	29	56	14	
134	7105.00	HOR	2.51	2.51	1.46	0.998	29.71	2.714	40	50	10	
33V	7105.25	VERT	2.22	2.08	1.26	1.000	30.97	2.708				
135	7106.17	HOR	1.86	1.77	1.01	0.997	29.12	2.712	40	48	12	
136	7107.25	HOR	3.97	3.73	2.58	1.000	31.00	2.715	39	51	9	
137	7108.17	HOR	2.01	2.55	1.37	1.000	30.55	2.718	39	51	10	
138	7109.08	HOR	2.43	2.30	1.36	0.965	32.38	2.714	37	42	21	
34V	7109.83	VERT	2.21	2.08	1.26	1.000	31.75	2.710				
139	7110.25	HOR	1.63	1.92	0.756	0.992	29.38	2.722	28	41	31	
140	7111.25	HOR	1.65	1.61	0.857	1.000	28.26	2.715	42	48	10	
141	7112.58	HOR	2.98	2.87	1.82	0.999	30.97	2.715	25	58	17	
142	7113.75	HOR	3.19	3.08	1.91	1.000	32.58	2.716	25	57	18	

MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
35V	7114.50	VERT	2.86	2.87	1.65	0.997	32.95	2.707				
143	7114.75	HOR	3.25	3.21	1.88	0.998	33.81	2.717	22	47	31	
144	7116.00	HOR	2.76	2.49	1.69	1.000	31.39	2.716	30	49	22	
145	7116.92	HOR	1.98	1.90	1.13	0.997	29.74	2.714	33	48	19	
146	7118.00	HOR	1.77	1.84	0.958	0.992	28.93	2.715	29	53	19	
147	7119.00	HOR	3.29	2.99	2.17	0.999	31.50	2.716	27	57	16	
36V	7119.42	VERT	3.56	3.58	2.07	1.000	33.11	2.712				
148	7120.42	HOR	2.81	2.74	1.58	1.000	31.73	2.717	27	50	23	
149	7121.58	HOR	2.57	2.46	1.68	0.955	27.90	2.720	35	46	19	
150	7124.17	HOR	3.79	3.57	2.17	1.000	36.02	2.707	26	51	23	
37V	7124.42	VERT					31.34	2.711				
151	7125.08	HOR	3.41	3.27	2.00	0.999	34.32	2.708	24	43	33	
152	7126.08	HOR	2.11	2.05	1.24	0.995	29.00	2.711	30	53	17	
153	7127.08	HOR	2.34	2.20	1.38	0.998	31.21	2.712	26	40	34	
154	7128.17	HOR	2.59	2.30	1.59	0.987	29.78	2.706	25	46	30	
38V	7128.83	VERT	1.41	1.24	0.695	0.994	26.81	2.713				
155	7129.17	HOR	2.50	2.34	1.61	1.000	26.66	2.710	25	48	27	
156	7130.42	HOR	1.51	1.47	0.813	1.000	27.65	2.712	28	48	24	
157	7131.42	HOR	1.75	1.70	0.961	1.000	28.08	2.711	37	44	19	
158	7132.42	HOR	1.94	1.86	1.13	1.000	27.51	2.711	31	48	20	
159	7133.42	HOR	1.46	1.46	0.751	0.999	27.76	2.713	34	44	23	
39V	7134.08	VERT	1.88	1.84	1.05	0.998	28.62	2.710				

MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
160	7134.33	HOR	1.56	1.50	0.844	1.000	27.90	2.711	32	48	19	
161	7135.50	HOR	1.34	1.28	0.743	0.998	25.95	2.711	47	38	15	
162	7136.58	HOR	1.55	1.44	0.846	1.000	27.36	2.711	33	47	20	
163	7137.67	HOR	1.32	1.29	0.734	0.999	26.17	2.711	35	48	17	
40V	7138.08	VERT	1.37	1.33	0.707	0.998	27.12	2.721				
164	7138.50	HOR	2.38	2.32	1.45	0.997	27.29	2.710	37	49	14	
165	7139.50	HOR	0.508	0.496	0.241	1.000	21.62	2.714	47	26	27	
166	7140.42	HOR	2.41	2.22	1.57	0.967	27.80	2.711	42	47	11	
167	7141.42	HOR	1.85	1.83	1.02	1.000	28.75	2.711	32	51	17	
168	7142.83	HOR	1.49	1.40	0.854	1.000	26.80	2.713	44	41	15	
41V	7143.00	VERT	1.18	1.16	0.614	1.000	26.45	2.713				
169	7143.83	HOR	1.52	1.42	0.942	0.998	24.40	2.713	45	35	20	
170	7145.00	HOR	2.45	2.44	1.60	0.973	27.00	2.712	39	48	14	
171	7146.00	HOR	1.33	1.32	0.683	1.000	27.40	2.713	35	38	27	
172	7147.25	HOR	1.63	1.56	0.927	1.000	26.54	2.711	41	49	10	
173	7148.25	HOR	1.94	1.91	1.11	0.999	28.94	2.712	37	45	19	
42V	7148.67	VERT	2.31	2.11	1.32	0.999	28.99	2.711				
174	7149.25	HOR	1.43	1.42	0.757	0.999	27.27	2.713	36	41	24	
175	7150.25	HOR	2.96	2.81	1.87	0.996	29.57	2.710	42	52	6	
176	7151.25	HOR	1.57	1.55	0.811	0.999	27.43	2.711	48	38	14	
177	7152.25	HOR	1.92	1.84	1.12	0.998	27.71	2.713	35	49	15	
178	7153.17	HOR	3.02	2.96	1.95	0.999	26.23	2.713	37	53	10	

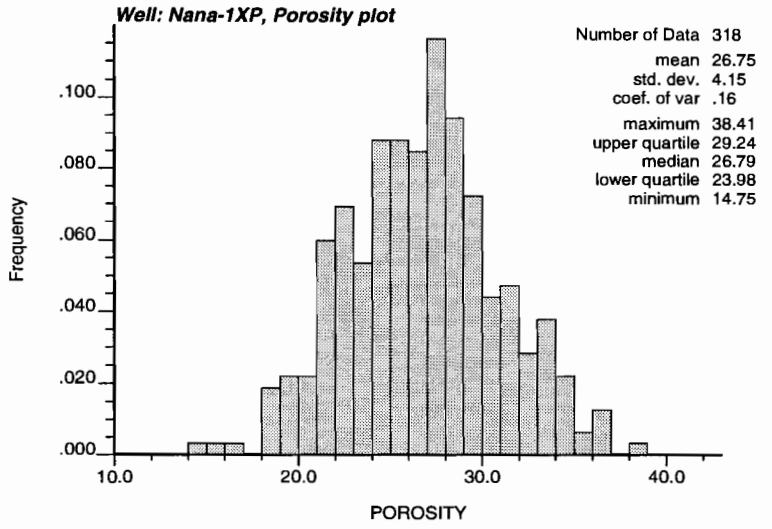
MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
179	7158.33	HOR	1.37	1.35	0.740	0.982	26.56	2.717	48	33	19	
43V	7158.75	VERT	1.21	1.18	0.593	1.000	25.37	2.712				
180	7159.42	HOR	1.35	1.31	0.703	1.000	25.23	2.663	43	38	20	
181	7160.58	HOR	1.90	1.83	1.05	1.000	27.23	2.713	40	47	13	
182	7161.58	HOR	1.37	1.30	0.728	0.999	26.65	2.714	38	43	19	
183	7162.58	HOR	1.15	1.02	0.548	1.000	24.67	2.711	40	40	20	
184	7163.58	HOR	1.28	1.22	0.651	1.000	24.97	2.713	53	36	11	
44V	7163.92	VERT	1.70	1.65	0.894	0.995	25.47	2.713				
185	7164.75	HOR	1.10	1.04	0.578	1.000	24.96	2.712	47	43	10	
186	7166.75	HOR	1.10	1.04	0.585	1.000	24.45	2.713	43	41	16	
187	7167.83	HOR	1.09	1.08	0.570	1.000	25.30	2.712	39	43	18	
188	7168.83	HOR	1.20	1.11	0.663	0.999	25.68	2.714	39	37	24	
45V	7168.92	VERT	1.20	1.18	0.644	0.999	25.41	2.714				
189	7169.92	HOR	1.36	1.31	0.750	0.999	26.19	2.712	41	37	21	
190	7171.42	HOR	2.29	2.13	1.84	0.990	19.40	2.713	47	43	10	
191	7172.42	HOR	0.669	0.615	0.331	1.000	21.96	2.709	36	34	31	
192	7173.50	HOR					22.46	2.710	42	37	21	
46V	7173.92	VERT	0.821	0.815	0.417	0.999	23.48	2.714				
193	7174.42	HOR	0.777	0.746	0.382	0.995	21.24	2.710	51	34	15	
194	7175.50	HOR	0.758	0.742	0.386	1.000	21.89	2.712	39	36	24	
195	7176.42	HOR	0.827	0.791	0.421	1.000	23.19	2.711	42	37	21	
196	7177.42	HOR	1.11	1.05	0.600	1.000	24.72	2.706	37	37	26	

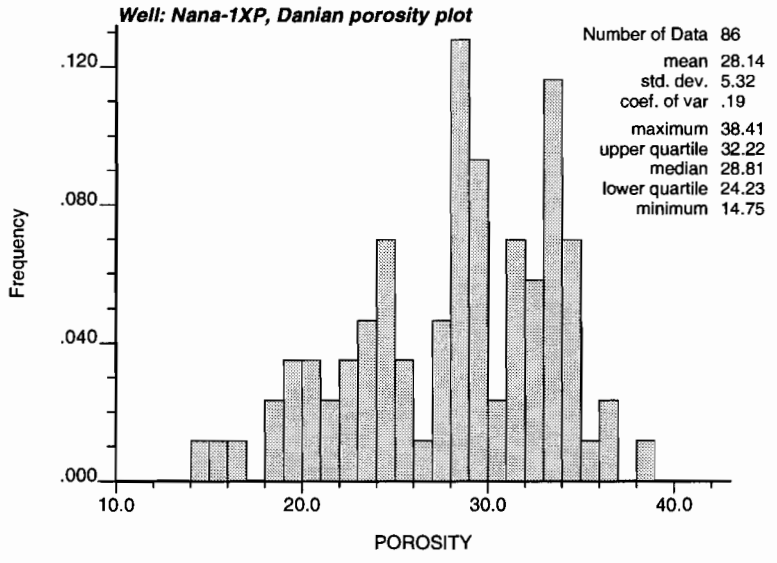
MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
197	7178.58	HOR	0.711	0.671	0.356	1.000	22.55	2.708	36	30	33	
47V	7178.92	VERT	0.549	0.557	0.257	1.000	21.43	2.713				
198	7179.50	HOR	0.497	0.481	0.262	1.000	18.46	2.710	65	21	14	
199	7180.42	HOR	1.37	1.33	0.795	0.997	22.95	2.704	38	36	25	
200	7181.67	HOR	0.897	0.873	0.451	1.000	22.86	2.703	39	33	28	
201	7182.67	HOR	0.573	0.601	0.288	0.998	18.35	2.709	41	45	15	
48V	7183.17	VERT	0.438	0.441	0.190	1.000	21.30	2.710				
202	7185.67	HOR	1.05	1.01	0.574	1.000	21.16	2.725	36	25	39	
203	7187.17	HOR	1.54	1.49	0.898	0.998	25.89	2.704	38	36	26	
49V	7188.00	VERT	0.665	0.662	0.306	1.000	23.90	2.709				
204	7188.17	HOR	0.798	0.755	0.420	1.000	23.26	2.704	41	31	28	
205	7189.33	HOR	1.09	1.02	0.662	0.998	22.85	2.708	35	34	32	
206	7190.25	HOR	0.635	0.599	0.313	0.998	22.13	2.705	42	33	25	
207	7191.75	HOR	0.798	0.755	0.434	1.000	24.45	2.707	26	37	36	
50V	7192.08	VERT	0.715	0.717	0.356	0.997	22.89	2.708				
208	7192.75	HOR	0.925	0.892	0.474	1.000	24.13	2.707	42	38	21	
209	7193.75	HOR	1.57	1.50	0.874	1.000	27.89	2.703	46	34	20	
210	7194.75	HOR	1.26	1.22	0.685	1.000	25.62	2.708	40	33	27	
211	7195.75	HOR	1.13	1.10	0.595	0.999	25.35	2.710	36	35	29	
212	7196.75	HOR	0.913	0.872	0.480	0.999	24.46	2.709	41	34	26	
51V	7197.33	VERT	0.819	0.789	0.378	1.000	24.13	2.715				
213	7197.75	HOR	1.04	1.00	0.582	0.999	21.22	2.711	48	29	24	

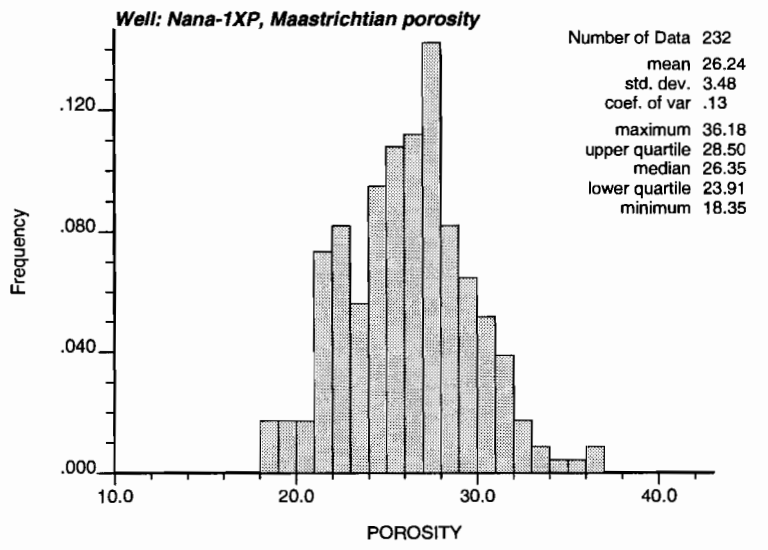
MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
214	7198.75	HOR	1.83	1.78	1.07	1.000	23.21	2.711	43	29	27	
215	7200.58	HOR	0.451	0.437	0.214	0.999	21.03	2.715	36	24	40	
216	7201.58	HOR	0.640	0.610	0.337	1.000	21.02	2.712	55	22	23	
217	7202.67	HOR	1.95	1.89	1.26	0.994	24.88	2.710	46	32	22	
52V	7202.67	VERT	0.964	0.930	0.466	1.000	25.67	2.714				
218	7203.67	HOR	0.966	0.948	0.485	0.999	24.81	2.712	43	31	26	
219	7204.67	HOR	1.78	1.71	1.09	0.996	26.31	2.711	56	32	12	
220	7205.67	HOR	5.46	5.50	3.62	0.993	28.84	2.709	54	29	17	
221	7206.67	HOR	1.51	1.48	0.729	1.000	30.09	2.713	51	33	16	
222	7207.83	HOR	1.76	1.72	0.900	0.999	30.48	2.711	50	31	19	
53V	7207.92	VERT	1.91	1.73	1.10	0.999	31.76	2.715				
223	7208.83	HOR	0.835	0.805	0.420	1.000	24.68	2.713	49	28	22	
224	7209.83	HOR	0.649	0.632	0.296	1.000	23.86	2.718	45	23	32	
225	7211.25	HOR	3.38	3.33	2.20	0.998	25.74	2.712	41	29	30	
226	7212.58	HOR	2.16	2.10	1.50	0.999	22.83	2.713	48	27	24	
227	7213.58	HOR	0.298	0.289	0.121	1.000	18.95	2.722	58	18	24	
54V	7213.92	VERT	0.398	0.395	0.166	0.999	20.39	2.715				
228	7214.58	HOR	1.58	1.56	1.02	0.998	23.91	2.718	34	30	36	
229	7216.33	HOR	0.739	0.730	0.366	1.000	22.43	2.717	39	20	41	
230	7217.33	HOR	0.483	0.478	0.239	0.999	19.26	2.716	74	8	18	
55V	7218.08	VERT	1.04	1.02	0.513	1.000	26.46	2.712				
231	7218.33	HOR	1.24	1.21	0.669	1.000	25.67	2.710	37	30	33	

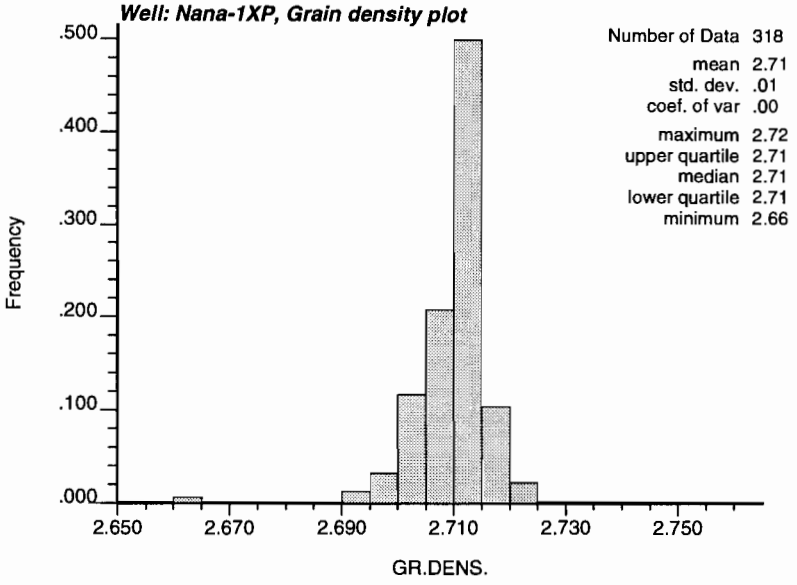
MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
232	7219.33	HOR	1.63	1.60	0.915	0.997	26.70	2.707	43	30	27	
233	7220.33	HOR	1.61	1.58	0.885	1.000	28.91	2.707	19	55	26	
234	7221.33	HOR	0.654	0.627	0.339	1.000	21.06	2.711	58	23	19	
56V	7222.08	VERT	1.35	1.32	0.688	0.999	27.79	2.712				
235	7222.42	HOR	1.63	1.56	0.861	0.998	28.62	2.705	42	28	30	
236	7223.42	HOR	1.81	1.78	1.06	0.999	26.44	2.707	44	29	27	
237	7224.58	HOR	0.707	0.683	0.399	1.000	20.00	2.712	63	9	28	
238	7225.58	HOR	0.437	0.412	0.212	0.997	20.65	2.711	64	9	27	
239	7226.58	HOR	0.742	0.726	0.372	1.000	22.48	2.711	50	22	27	
57V	7227.25	VERT	1.58	1.54	0.818	1.000	29.13	2.712				
240	7227.58	HOR	2.34	2.18	1.35	0.998	30.60	2.705	40	31	30	
241	7228.58	HOR	1.08	1.05	0.546	1.000	25.76	2.709	53	26	21	
242	7229.58	HOR	1.19	1.15	0.738	1.000	23.19	2.712	55	17	28	
243	7230.58	HOR	0.803	0.765	0.434	1.000	21.62	2.714	60	12	28	
244	7231.58	HOR	0.821	0.778	0.443	0.999	20.78	2.714	64	12	24	
58V	7232.42	VERT	0.653	0.629	0.309	1.000	22.58	2.714				
245	7232.58	HOR	0.873	0.830	0.476	1.000	22.07	2.713	45	23	32	
246	7233.42	HOR	0.902	0.886	0.482	1.000	22.37	2.711	53	20	27	
247	7234.58	HOR	0.752	0.717	0.357	0.999	23.59	2.722	46	22	32	
248	7235.58	HOR	0.892	0.850	0.464	0.996	23.99	2.712	43	28	29	
249	7236.58	HOR	1.15	1.07	0.686	1.000	22.08	2.711	59	16	25	
59V	7237.08	VERT	0.527	0.515	0.231	1.000	21.32	2.714				

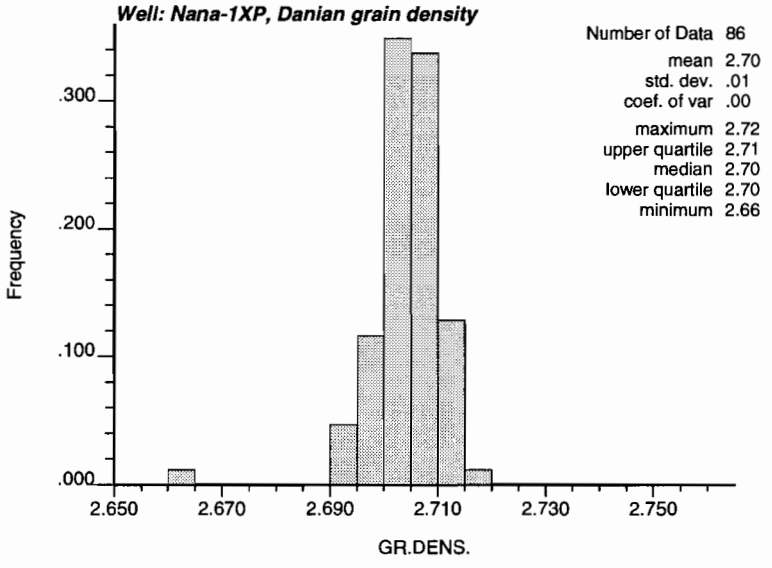
MPLE NO.	DEPTH FEET	PLUG TYPE	GAS PERM mD	1.5 P-M PERM mD	KLINK PERM mD	KLINK CORR. COEF.	POROSITY %	GRAIN DENS. G/CCM	WATER SATUR. %	OIL SATUR. %	GAS SATUR. %	COMMENT
250	7237.83	HOR	0.579	0.558	0.283	1.000	21.58	2.716	60	12	28	
251	7238.83	HOR	0.683	0.653	0.327	1.000	22.38	2.716	85	-2	17	
252	7239.83	HOR	1.18	1.15	0.657	1.000	21.27	2.717	71	7	22	
253	7240.83	HOR	0.803	0.770	0.385	1.000	22.36	2.723	59	10	31	
254	7242.17	HOR	1.02	0.959	0.531	1.000	25.91	2.717	50	18	31	
60V	7242.42	VERT	0.780	0.756	0.364	0.999	25.98	2.715				
255	7243.75	HOR	1.20	1.15	0.649	1.000	24.59	2.718	29	23	49	
256	7244.75	HOR	1.40	1.32	0.814	1.000	24.82	2.719	30	24	46	
257	7246.00	HOR	2.07	1.93	1.18	1.000	30.28	2.714	29	33	38	
61V	7247.00	VERT	1.50	1.49	0.752	0.999	29.74	2.712				

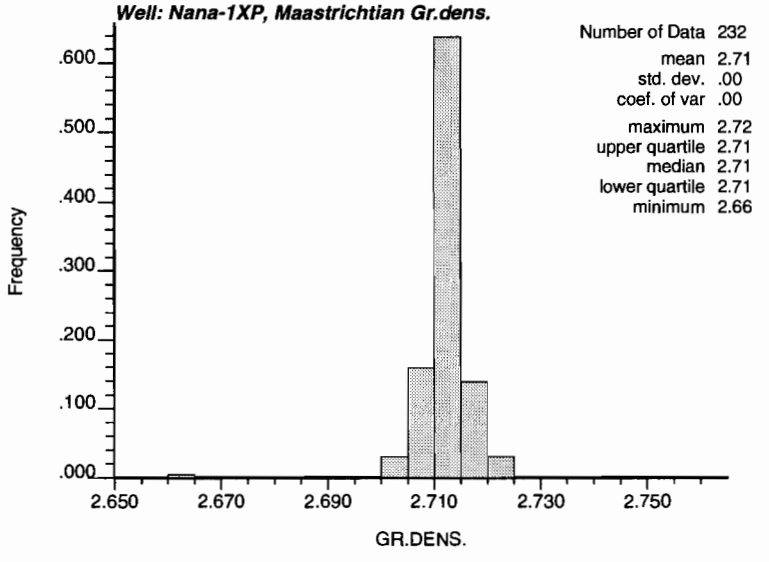

Well: Nana-1XP, Porosity plot
Number of Data 318
mean 26.75
std. dev. 4.15
coef. of var .16
maximum 38.41
upper quartile 29.24
median 26.79
lower quartile 23.98
minimum 14.75
Frequency
.100
.080
.060
.040
.020
.000
10.0
20.0
30.0
40.0
POROSITY

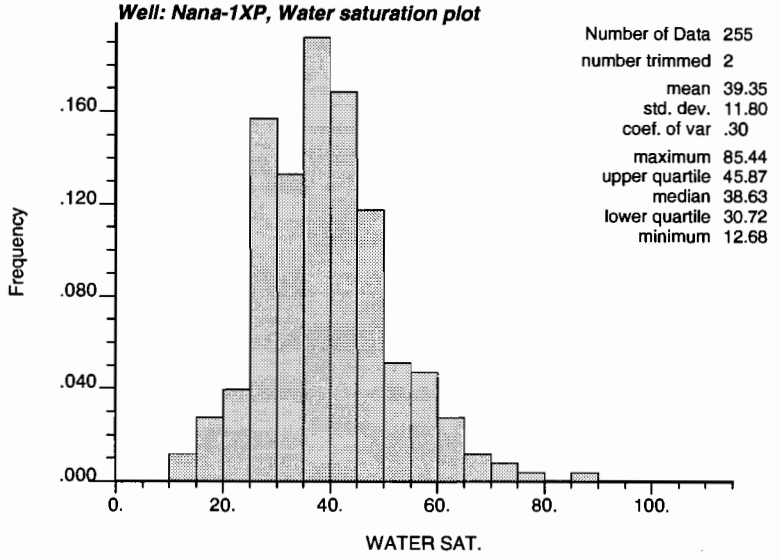

Well: Nana-1XP, Danian porosity plot
Number of Data 86
mean 28.14
std. dev. 5.32
coef. of var .19
maximum 38.41
upper quartile 32.22
median 28.81
lower quartile 24.23
minimum 14.75
Frequency
.120
.080
.040
.000
10.0
20.0
30.0
40.0
POROSITY

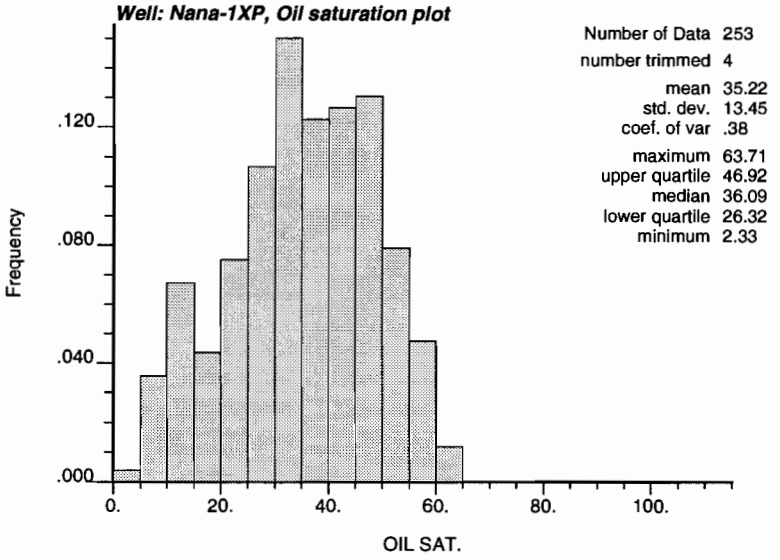

Well: Nana-1XP, Maastrichtian porosity
Number of Data 232
mean 26.24
std. dev. 3.48
coef. of var .13
maximum 36.18
upper quartile 28.50
median 26.35
lower quartile 23.91
minimum 18.35
Frequency
.120
.080
.040
.000
10.0
20.0
30.0
40.0
POROSITY

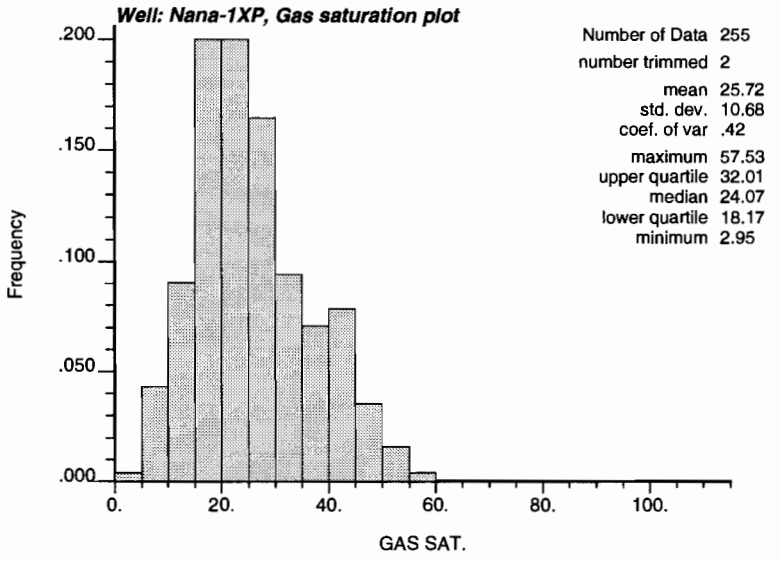

Well: Nana-1XP, Grain density plot
Number of Data 318
mean 2.71
std. dev. .01
coef. of var .00
maximum 2.72
upper quartile 2.71
median 2.71
lower quartile 2.71
minimum 2.66
Frequency
.500
.400
.300
.200
.100
.000
2.650
2.670
2.690
2.710
2.730
2.750
GR.DENS.

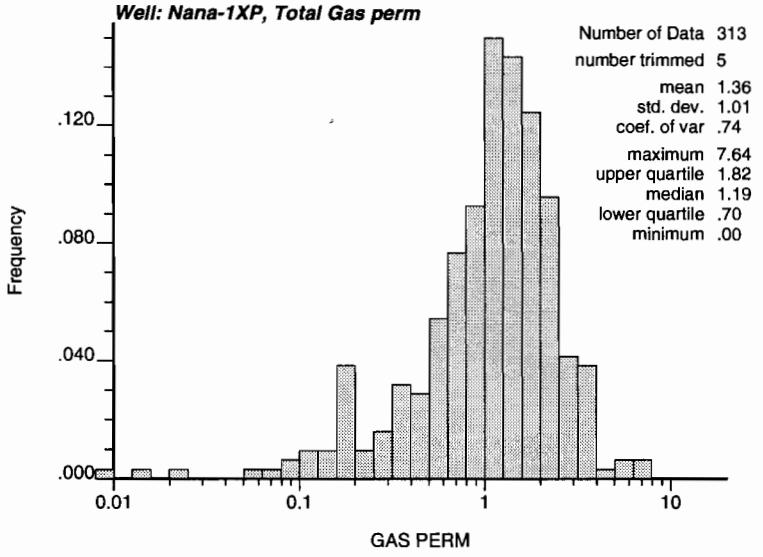

Well: Nana-1XP, Danian grain density
Number of Data 86
mean 2.70
std. dev. .01
coef. of var .00
maximum 2.72
upper quartile 2.71
median 2.70
lower quartile 2.70
minimum 2.66
Frequency
.300
.200
.100
.000
2.650
2.670
2.690
2.710
2.730
2.750
GR.DENS.

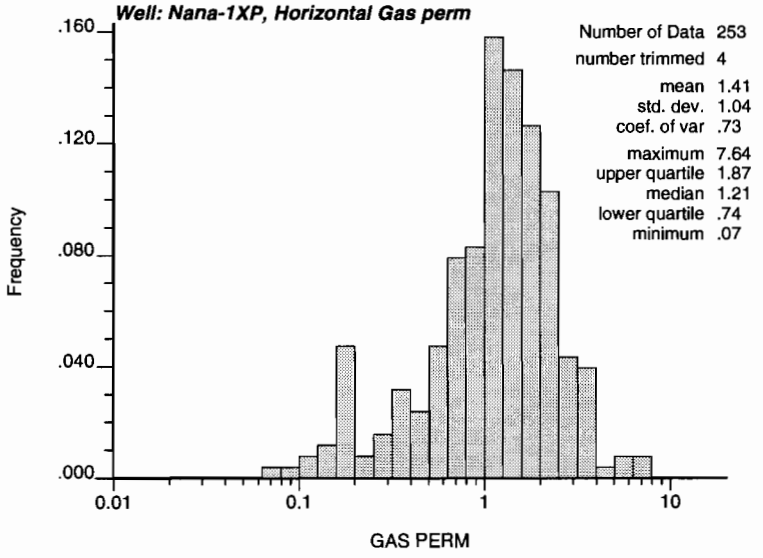

Well: Nana-1XP, Maastrichtian Gr.dens.
Number of Data 232
mean 2.71
std. dev. .00
coef. of var .00
maximum 2.72
upper quartile 2.71
median 2.71
lower quartile 2.71
minimum 2.66
Frequency
.600
.500
.400
.300
.200
.100
.000
2.650
2.670
2.690
2.710
2.730
2.750
GR.DENS.

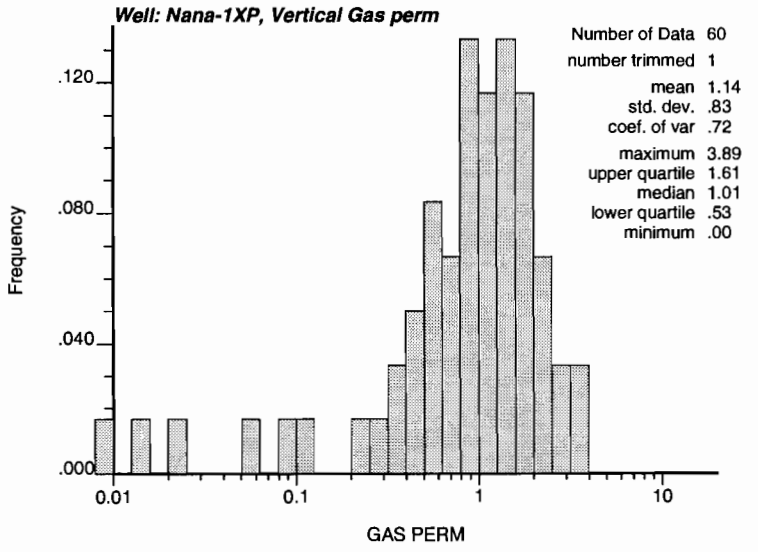

Well: Nana-1XP, Water saturation plot
Number of Data 255
number trimmed 2
mean 39.35
std. dev. 11.80
coef. of var .30
maximum 85.44
upper quartile 45.87
median 38.63
lower quartile 30.72
minimum 12.68
Frequency
.160
.120
.080
.040
.000
0.
20.
40.
60.
80.
100.
WATER SAT.

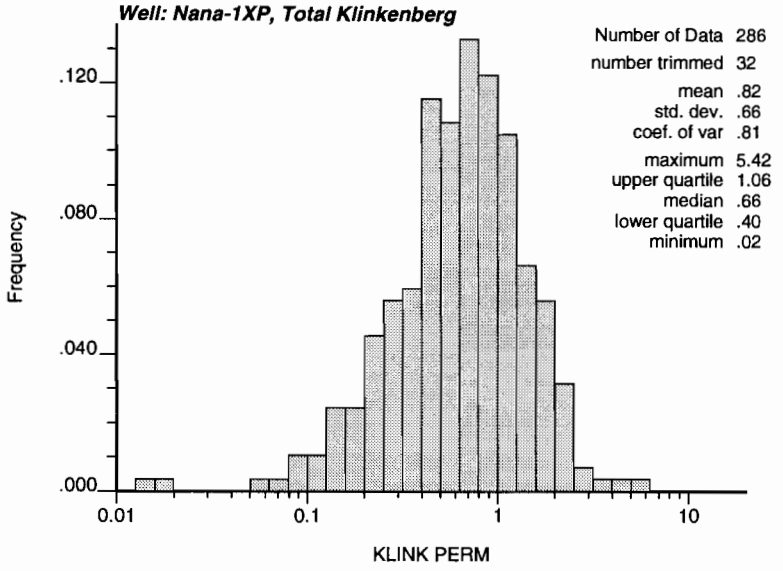

Well: Nana-1XP, Oil saturation plot
Number of Data 253
number trimmed 4
mean 35.22
std. dev. 13.45
coef. of var .38
maximum 63.71
upper quartile 46.92
median 36.09
lower quartile 26.32
minimum 2.33
Frequency
.120
.080
.040
.000
0.
20.
40.
60.
80.
100.
OIL SAT.

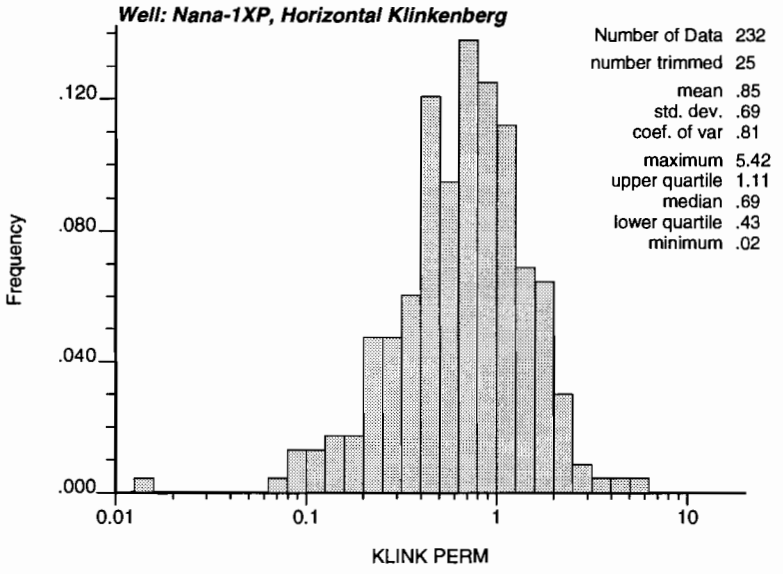

Well: Nana-1XP, Gas saturation plot
Number of Data 255
number trimmed 2
mean 25.72
std. dev. 10.68
coef. of var .42
maximum 57.53
upper quartile 32.01
median 24.07
lower quartile 18.17
minimum 2.95
Frequency
.200
.150
.100
.050
.000
0.
20.
40.
60.
80.
100.
GAS SAT.

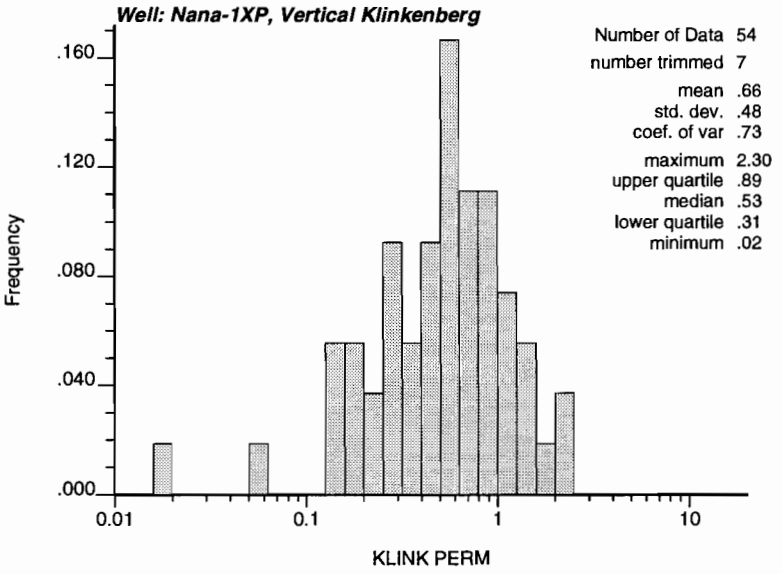

Well: Nana-1XP, Total Gas perm
Number of Data 313
number trimmed 5
mean 1.36
std. dev. 1.01
coef. of var .74
maximum 7.64
upper quartile 1.82
median 1.19
lower quartile .70
minimum .00
Frequency
.120
.080
.040
.000
0.01
0.1
1
10
GAS PERM

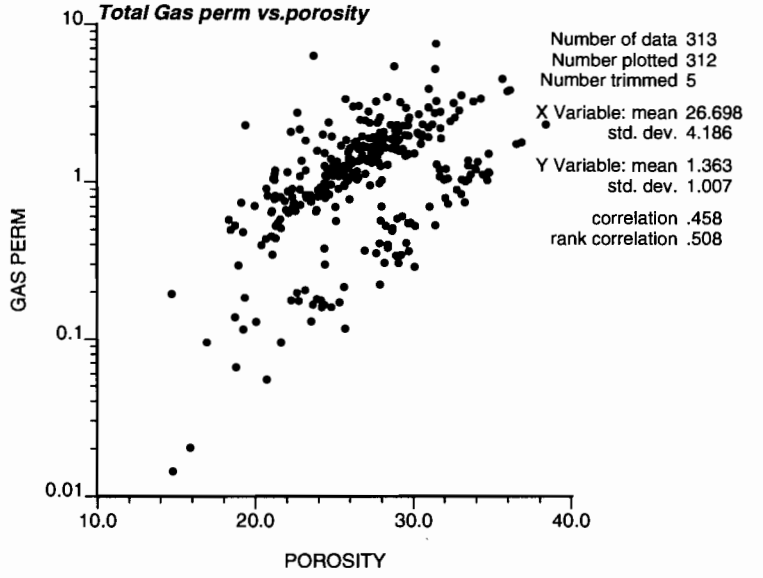

Well: Nana-1XP, Horizontal Gas perm
Number of Data 253
number trimmed 4
mean 1.41
std. dev. 1.04
coef. of var .73
maximum 7.64
upper quartile 1.87
median 1.21
lower quartile .74
minimum .07
Frequency
.160
.120
.080
.040
.000
0.01
0.1
1
10
GAS PERM

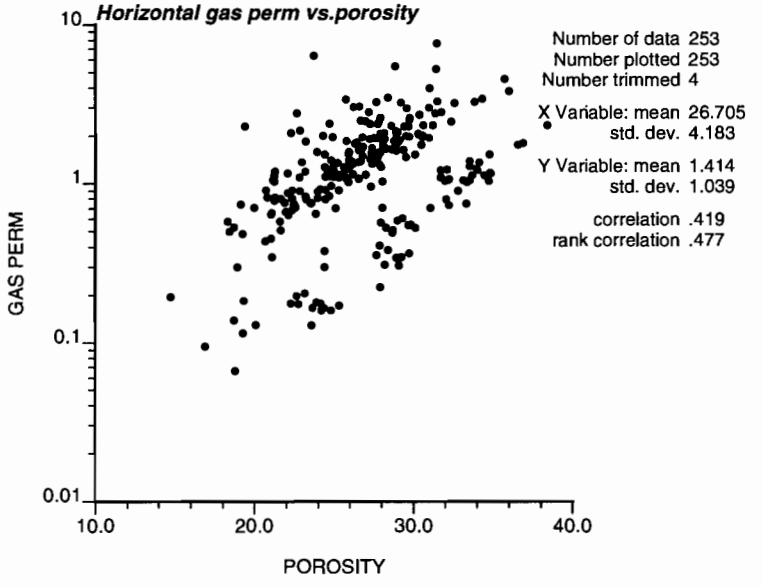

Well: Nana-1XP, Vertical Gas perm
Number of Data 60
number trimmed 1
mean 1.14
std. dev. .83
coef. of var .72
maximum 3.89
upper quartile 1.61
median 1.01
lower quartile .53
minimum .00
Frequency
.120
.080
.040
.000
0.01
0.1
1
10
GAS PERM

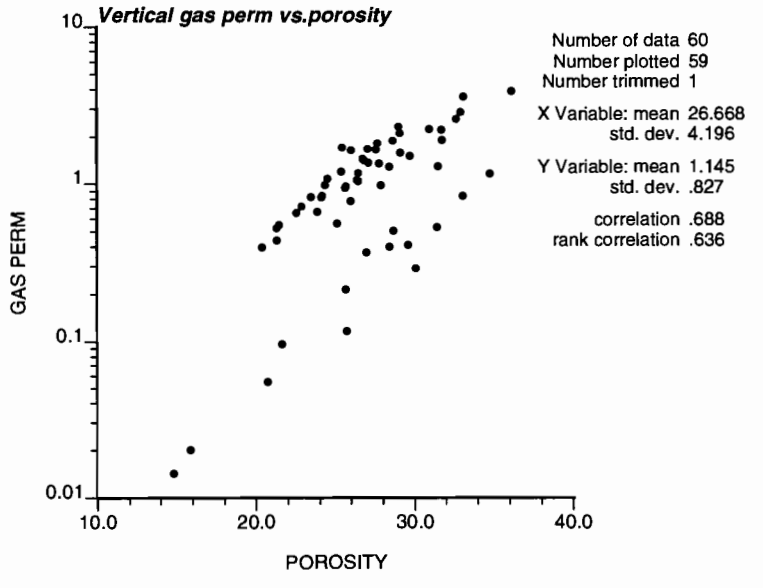

Well: Nana-1XP, Total Klinkenberg
Number of Data 286
number trimmed 32
mean .82
std. dev. .66
coef. of var .81
maximum 5.42
upper quartile 1.06
median .66
lower quartile .40
minimum .02
Frequency
.120
.080
.040
.000
0.01
0.1
1
10
KLINK PERM


Well: Nana-1XP, Horizontal Klinkenberg
Number of Data 232
number trimmed 25
mean .85
std. dev. .69
coef. of var .81
maximum 5.42
upper quartile 1.11
median .69
lower quartile .43
minimum .02
Frequency
.120
.080
.040
.000
0.01
0.1
1
10
KLINK PERM


Well: Nana-1XP, Vertical Klinkenberg
Number of Data 54
number trimmed 7
mean .66
std. dev. .48
coef. of var .73
maximum 2.30
upper quartile .89
median .53
lower quartile .31
minimum .02
Frequency
.160
.120
.080
.040
.000
0.01
0.1
1
10
KLINK PERM

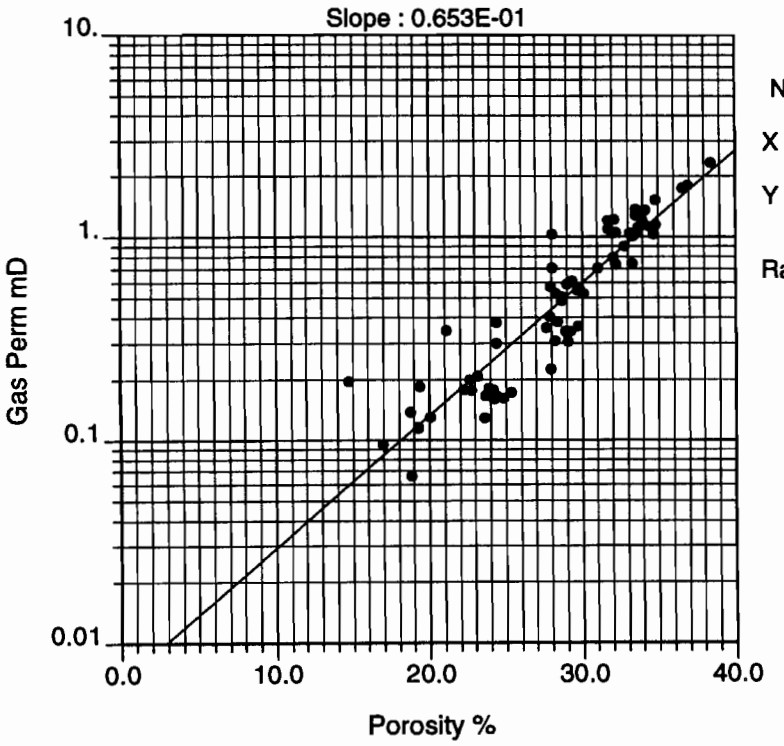

Total Gas perm vs.porosity
Number of data 313
Number plotted 312
Number trimmed 5
X Variable: mean 26.698
std. dev. 4.186
Y Variable: mean 1.363
std. dev. 1.007
correlation .458
rank correlation .508
GAS PERM
10
1
0.1
0.01
10.0
20.0
30.0
40.0
POROSITY


Horizontal gas perm vs.porosity
Number of data 253
Number plotted 253
Number trimmed 4
X Variable: mean 26.705
std. dev. 4.183
Y Variable: mean 1.414
std. dev. 1.039
correlation .419
rank correlation .477
GAS PERM
10
1
0.1
0.01
10.0
20.0
30.0
40.0
POROSITY


Vertical gas perm vs.porosity
Number of data 60
Number plotted 59
Number trimmed 1
X Variable: mean 26.668
std. dev. 4.196
Y Variable: mean 1.145
std. dev. .827
correlation .688
rank correlation .636
GAS PERM
10
1
0.1
0.01
10.0
20.0
30.0
40.0
POROSITY

Gas Permeability vs. Porosity

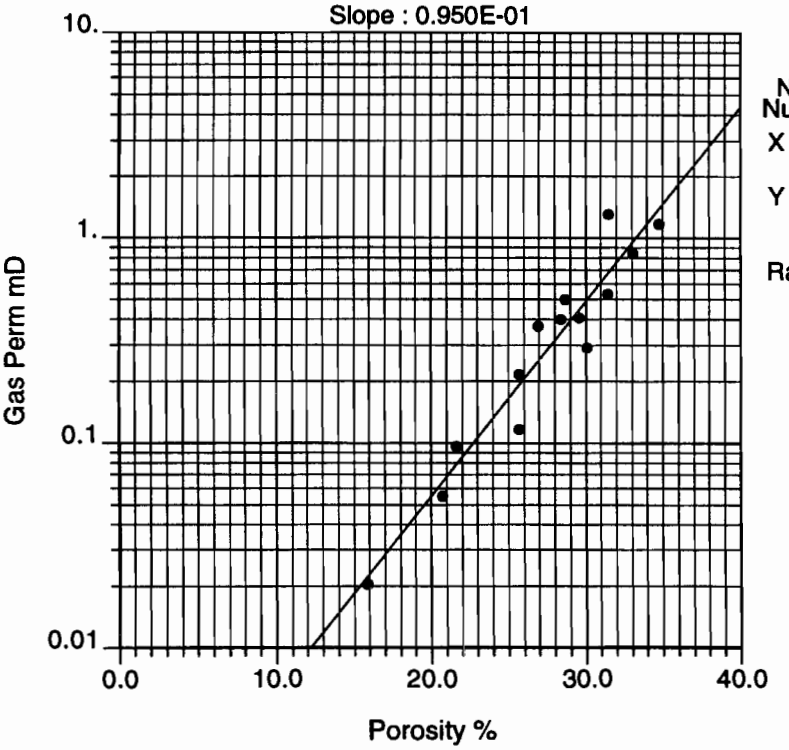
Danian, horizontal plugs



Number of data	70
X variable mean	28.287
std. dev.	5.313
Y variable mean	0.459
std. dev.	2.383
Correlation	0.921
Rank correlation	0.919
Regression a	-2.186
Regression b	0.065

Gas Permeability vs. Porosity

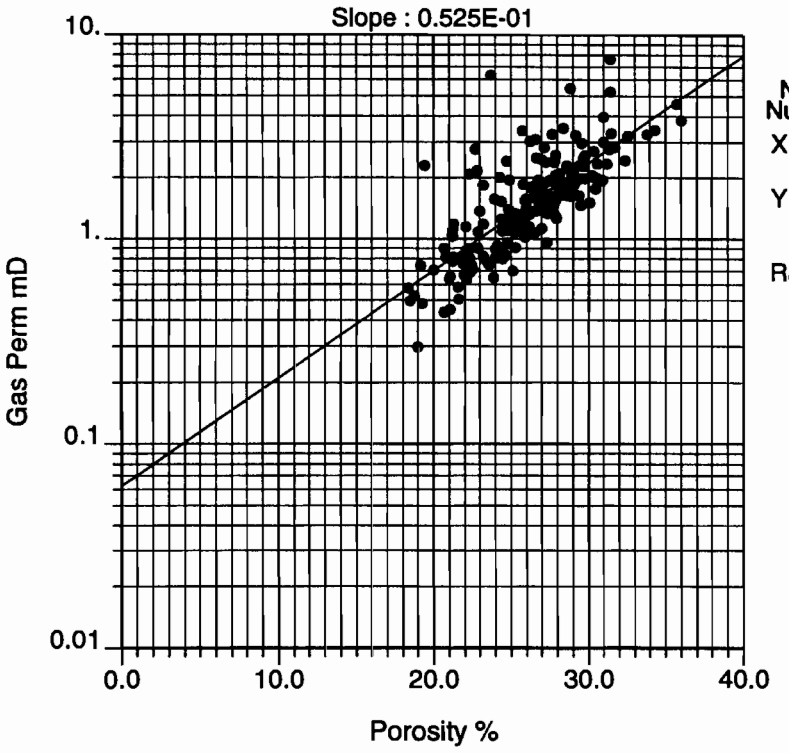
Danian, vertical plugs



Number of data	14
Number trimmed	1
X variable mean	27.422
std. dev.	5.010
Y variable mean	0.278
std. dev.	3.132
Correlation	0.960
Rank correlation	0.934
Regression a	-3.163
Regression b	0.095

Gas Permeability vs. Porosity

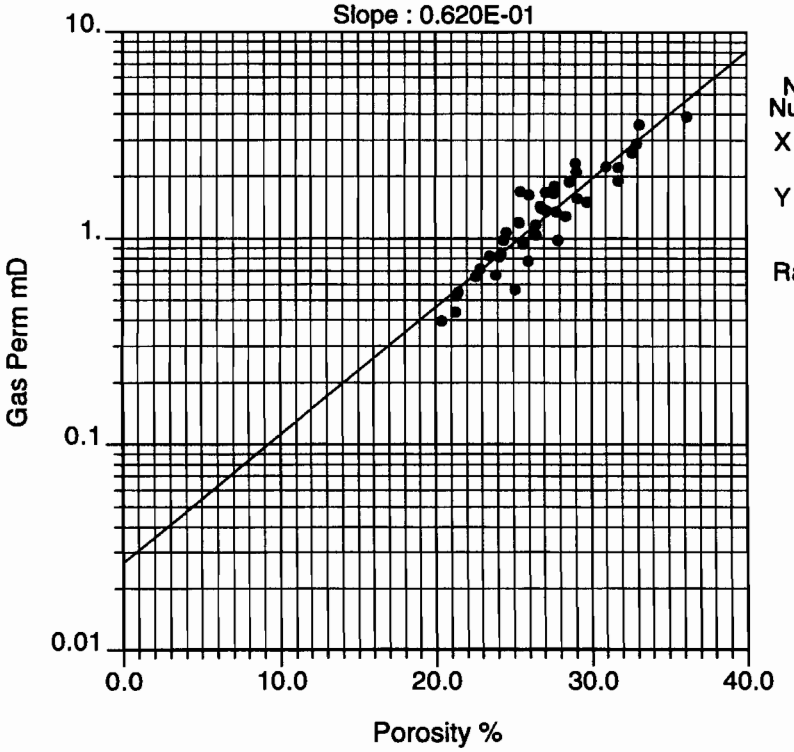
Maastrichtian, horizontal plugs



Number of data	183
Number trimmed	4
X variable mean	26.100
std. dev.	3.474
Y variable mean	1.468
std. dev.	1.732
Correlation	0.765
Rank correlation	0.771
Regression a	-1.203
Regression b	0.052

Gas Permeability vs. Porosity

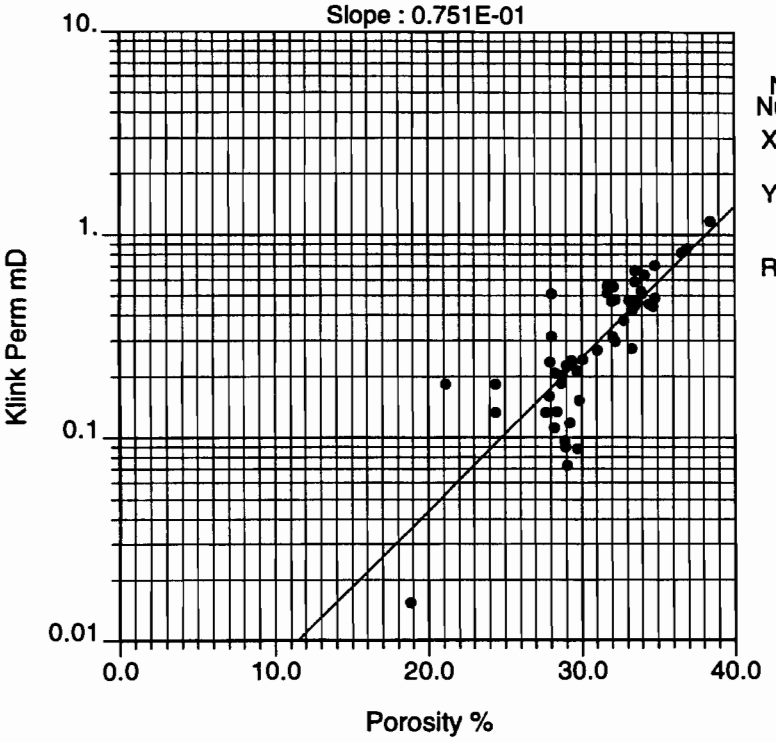
Maastrichtian, vertical plugs



Number of data	44
Number trimmed	1
X variable mean	26.832
std. dev.	3.440
Y variable mean	1.232
std. dev.	1.705
Correlation	0.920
Rank correlation	0.895
Regression a	-1.572
Regression b	0.062

Klinkenberg Permeability vs. Porosity

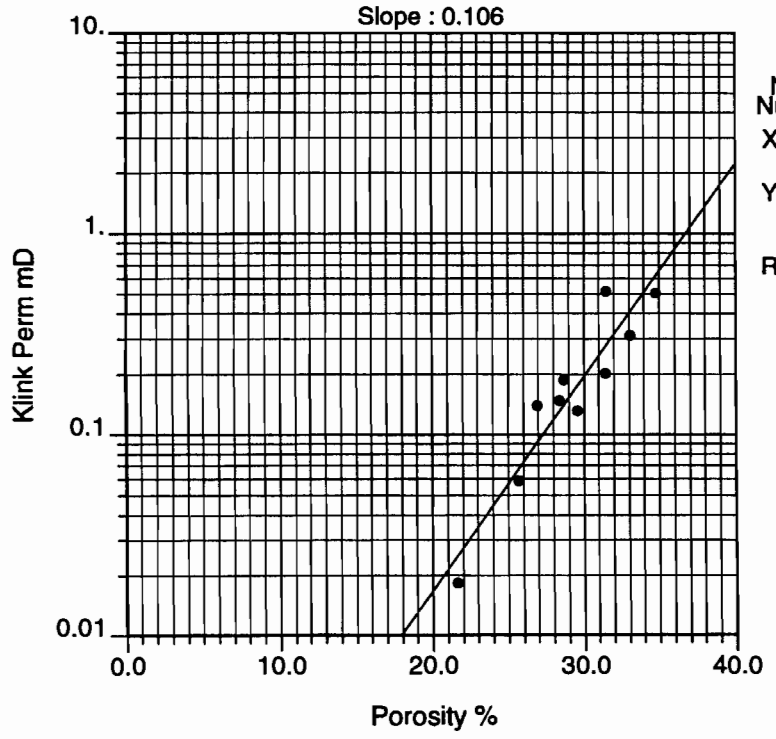
Danian, horizontal plugs



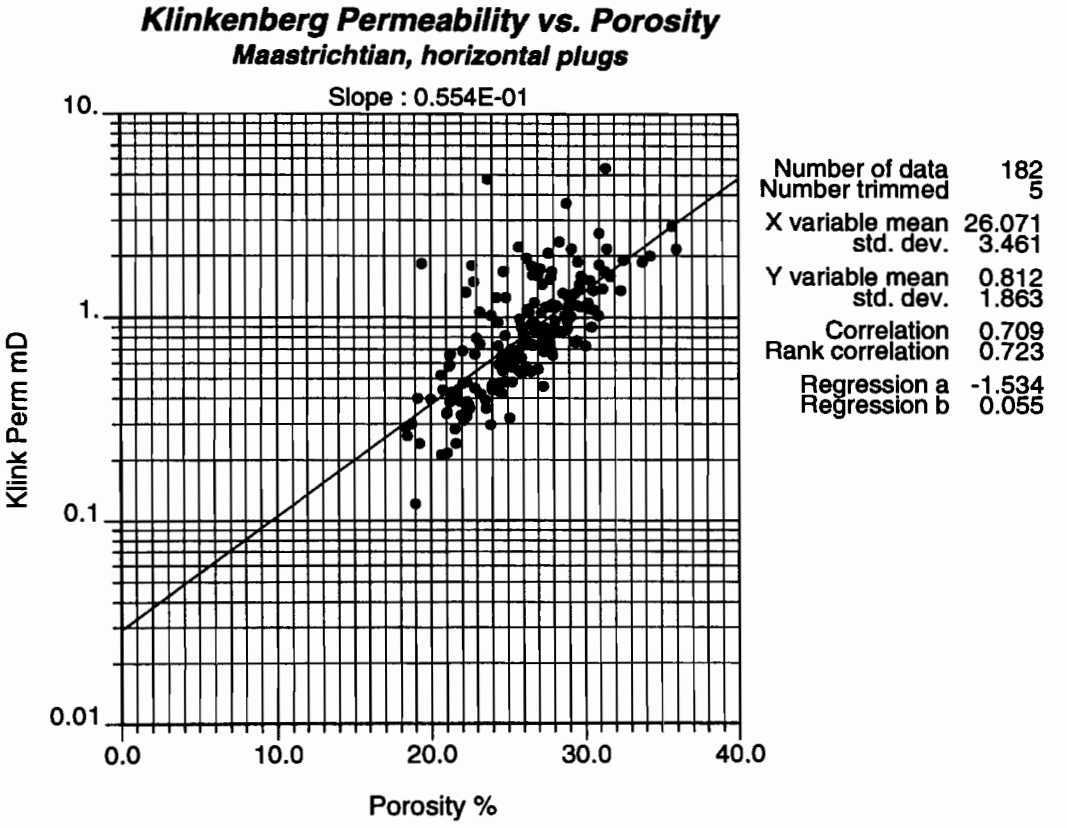
Number of data	50
Number trimmed	20
X variable mean	30.779
std. dev.	3.723
Y variable mean	0.281
std. dev.	2.198
Correlation	0.817
Rank correlation	0.784
Regression a	-2.863
Regression b	0.075

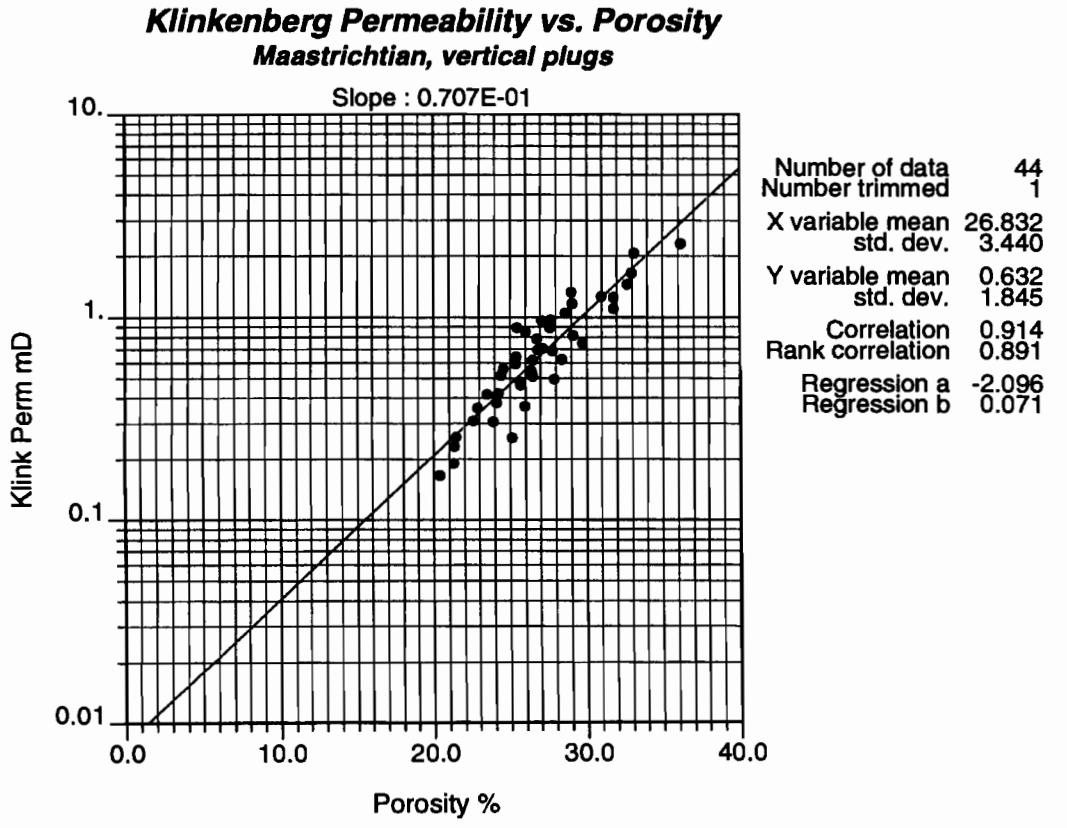
Klinkenberg Permeability vs. Porosity

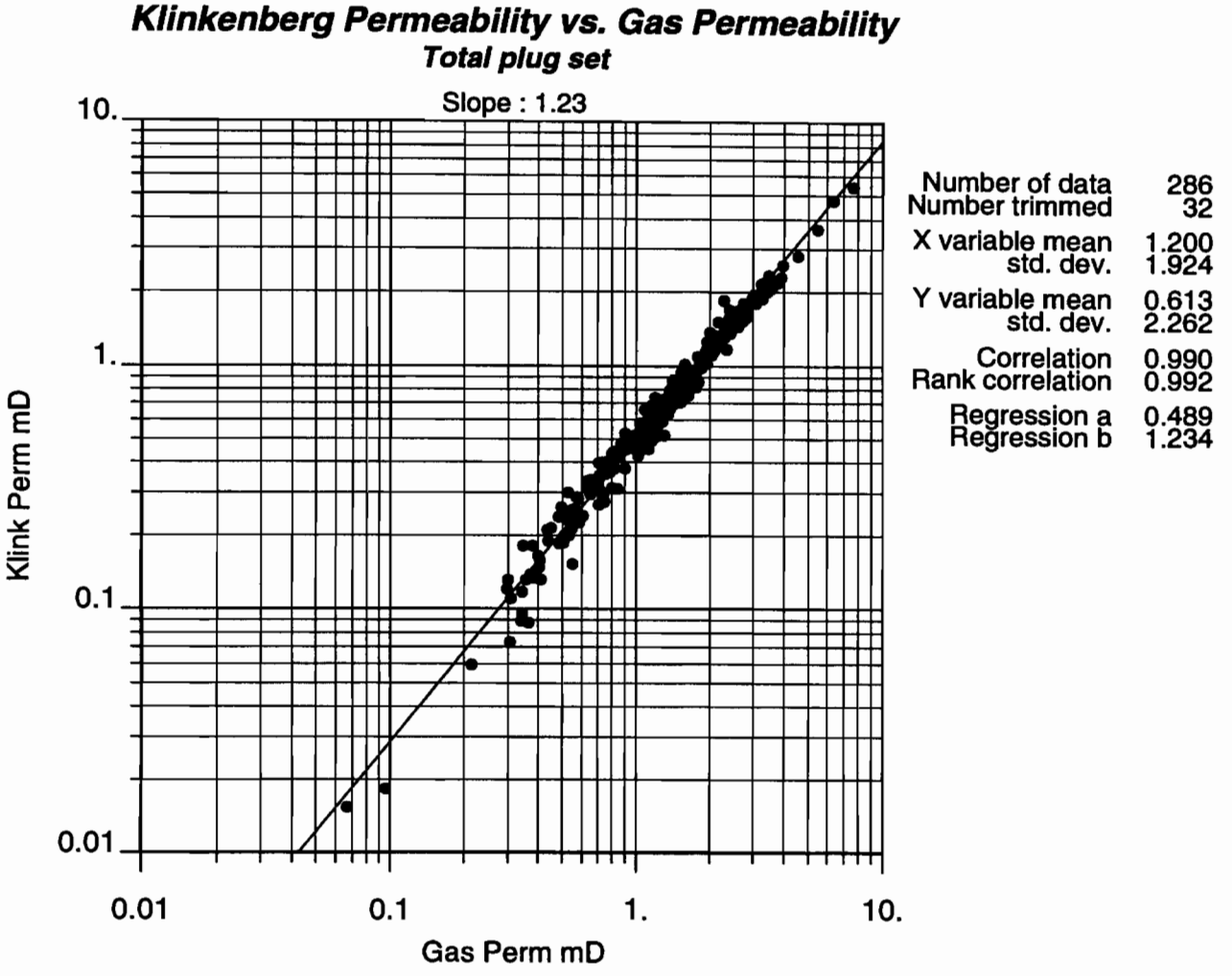
Danian, vertical plugs



Number of data	10
Number trimmed	5
X variable mean	29.158
std. dev.	3.639
Y variable mean	0.157
std. dev.	2.580
Correlation	0.939
Rank correlation	0.891
Regression a	-3.901
Regression b	0.106


Klinkenberg Permeability vs. Porosity
Maastrichtian, horizontal plugs
Slope : 0.554E-01
10.
1.
0.1
0.01
Klink Perm mD
0.0
10.0
20.0
30.0
40.0
Porosity %
Number of data 182
Number trimmed 5
X variable mean 26.071
std. dev. 3.461
Y variable mean 0.812
std. dev. 1.863
Correlation 0.709
Rank correlation 0.723
Regression a -1.534
Regression b 0.055


Klinkenberg Permeability vs. Porosity
Maastrichtian, vertical plugs
Slope : 0.707E-01
10.
1.
0.1
0.01
Klink Perm mD
0.0
10.0
20.0
30.0
40.0
Porosity %
Number of data 44
Number trimmed 1
X variable mean 26.832
std. dev. 3.440
Y variable mean 0.632
std. dev. 1.845
Correlation 0.914
Rank correlation 0.891
Regression a -2.096
Regression b 0.071


Klinkenberg Permeability vs. Gas Permeability
Total plug set
Slope : 1.23
10.
1.
0.1
0.01
Klink Perm mD
0.01
0.1
1.
10.
Gas Perm mD
Number of data 286
Number trimmed 32
X variable mean 1.200
std. dev. 1.924
Y variable mean 0.613
std. dev. 2.262
Correlation 0.990
Rank correlation 0.992
Regression a 0.489
Regression b 1.234

5.2 Stepwise relative gas permeability data

Table 5.1 Gas permeability at various water saturation.

Plug id	Depth	Sw	Gas perm	Sw	Gas perm	Sw	Gas perm	Sw	Gas perm	Sw	Gas perm
	Feet	%	mD	%	mD	%	mD	%	mD	%	mD
5	6922.92	81.0	0.01	59.1	0.08	38.6	0.29	19.8	0.67	0.0	1.18
6	6924.08	81.8	0.00	59.2	0.11	38.2	0.33	20.0	0.70	0.0	1.30
7	6925.83	80.1	0.01	55.8	0.04	38.2	0.26	20.0	0.59	0.0	1.04
20	6949.50	74.7	0.02	58.7	0.03	39.2	0.19	19.5	0.42	0.0	0.75
24	6953.50	74.4	0.01	58.0	0.02	40.2	0.11	19.8	0.28	0.0	0.55

Table 5.2 Relative gas permeability k_{rg} at various water saturations (Base = Gas perm.@S_w=0).

Plug id	Depth	Sw	Krg	Sw	Krg	Sw	Krg	Sw	Krg	Sw	Krg
	Feet	%		%		%		%		%	
5	6922.92	81.0	0.01	59.1	0.07	38.6	0.25	19.8	0.57	0.0	1.00
6	6924.08	81.8	0.00	59.2	0.08	38.2	0.25	20.0	0.54	0.0	1.00
7	6925.83	80.1	0.01	55.8	0.04	38.2	0.25	20.0	0.57	0.0	1.00
20	6949.50	74.7	0.03	58.7	0.04	39.2	0.25	19.5	0.56	0.0	1.00
24	6953.50	74.4	0.02	58.0	0.04	40.2	0.20	19.8	0.51	0.0	1.00

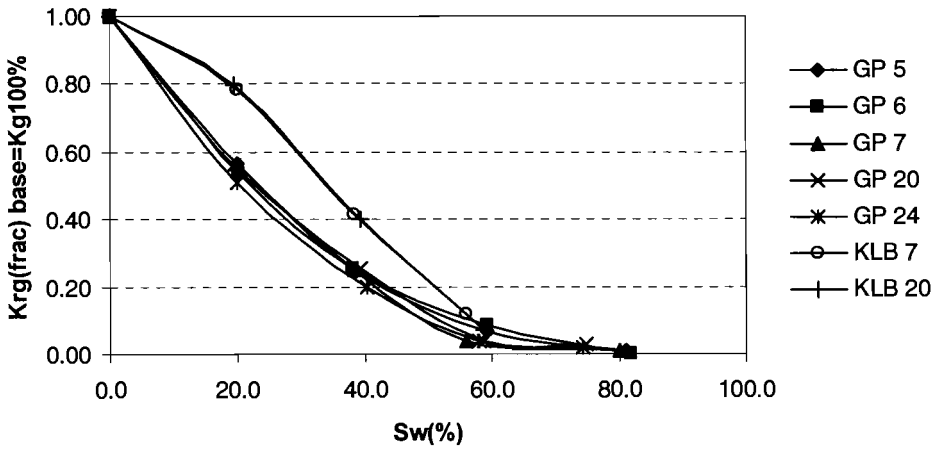
Table 5.3: Klinkenberg permeability at various water saturations.

Plug id	Depth	Sw	Klinkenb.	Sw	Klinkenb.	Sw	Klinkenb.	Sw	Klinkenb.	Sw	Klinkenb.
	Feet	%	mD	%	mD	%	mD	%	mD	%	mD
7	6925.83	80.1	-	55.8	0.05	38.2	0.16	20.0	0.30	0.0	0.38
20	6949.50	74.7	-	58.7	0.02	39.2	0.12	19.5	0.23	0.0	0.29

Table 5.4: Relative Klinkenberg permeability k_{rg} at various water saturations (Base = Klink perm.@S_w=0).

Plug id	Depth	Sw	Krg	Sw	Krg	Sw	Krg	Sw	Krg	Sw	Krg
	Feet	%		%		%		%		%	
7	6925.83	80.1	-	55.8	0.12	38.2	0.41	20.0	0.79	0.0	1.00
20	6949.50	74.7	-	58.7	0.07	39.2	0.40	19.5	0.80	0.0	1.00

Figure 5.1: Relative Klinkenberg and gas permeability plot



5.3 Lithological description

The plug description sheet is made in accordance with the description system given in:
Crabtree, B., Fritsen, A., Mandzuich, K., Moe, Aa., Rasmussen, F.O., Siemers, T. Søiland, G. & Tirsgaard, H., 1996: Description and Classification of Chalks – North Sea Central Graben. Joint Chalk Research Phase IV, July 1996. Norwegian Petroleum Directorate (NPD), Stavanger.

The following additional abbreviations are intended to be used in the comment column of the plug description sheet.

Rock colour

blk	=	black
br	=	brown
gn	=	green
gy	=	grey
ol	=	olive
rd	=	red
wh	=	white
owh	=	off-white
vl-	=	very light
l-	=	light, e.g. lgy = light grey
ml-	=	medium light
m-	=	medium
md-	=	medium dark
d-	=	dark
-sh	=	-ish, e.g. brsh = brownish
var	=	varicoloured

Miscellaneous

amp	=	amplitude of stylolite
art	=	artificial(-ly)
art F	=	artificially induced fracture
bio tex	=	bioturbate texture
Btn	=	thin-bedded
Cl	=	low consolidation
Cm	=	medium consolidation
Chi	=	high degree of consolidation
Ggl	=	glauconite grains
GIn	=	*Inoceramus* fragments
Gph	=	phosphorite grains
ids	=	indistinct(-ly)
ira	=	insoluble residue accumulation
leo	=	leopard structure
mic	=	micro
mic S	=	microstylolite, almost invisible with the naked eye
mou	=	mould(-s) from Gsk
mot	=	mottled
rep	=	replaced by
S	=	stylolite
slg	=	slight(-ly)
Ss	=	solution seam
Ssh	=	high density of solution seams
Ssl	=	low density of solution seams
TCh	=	*Chondrites* trace fossil
TPl	=	*Planolites* trace fossil
TTe	=	*Teichichnus* trace fossil
TTh	=	*Thalassinoides* trace fossil
TTr	=	*Trichichnus* trace fossil
TZo	=	*Zoophycos* trace fossil

JCR plug description scheme

Well: Nana-1XP | Field: Halfdan | Sheet no.: 1 | Geologist: Nis

Plug size Ø = 1½"

			Depositional fabric									Composition									Stratification									Deformation structures						Bioturbation				Hardness					Stylolites				Secondary minerals						Fractures							Comments
			Rock type									Matrix			Grains						Bedding				Lamination											Trace fossils																								
Plug	Core depth	Lithotype	M	Mf	Mc	Wf	Wc	Pf	Pc	Gf	Gc	Ch	Arl	Arh	Gn	Gsh	Gch	Gsk	Gct	Go	Bn	Btn	Bm	Btk	Ln	Lpl	Lun	Lx	Lg	Dn	Dfl	Dfh	Dcl	Dch	Ds	Tn	Tl	Tm	Th	Hvs	Hs	Hm	Hh	Hvh	Sn	Sl	Sm	Sh	Mn	Mca	Mpy	Mdo	Msi	Mo	Fn	Fo	Fm	Fhl	Fhh	Fs	Plug	
no.	m/ft.		1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6	no.	
1	6918.50	MaMu	1									1			1						1				1					1						1						3			1				1									4			1	owh
1V	6918.67	MaMu	1									1					3	4			1				1					1						1						3			1				1									4			1V	owh
2	6919.50	MaMu	1									1			1						1				1					1						1						3				2					3							4			2	owh, 1S
3	6920.67	MaMu	1									1			1						1				1					1						1					2				1				1						1						3	owh
4	6921.67	MaMu	1									1			1						1				1					1						1						3				2					3				1						4	owh, 1 mic S
2V	6922.67	LaMu	1									1			1						1					2				1						1						3			1						3							4			2V	owh
5	6922.92	MaPeMu			3							1					3				1				1					1						1						3			1				1									4			5	owh
6	6924.08	MaMu	1									1			1						1				1					1						1						3			1				1									4			6	owh
7	6925.83	MaMu	1									1			1						1				1					1						1						3			1				1						1						7	owh
8	6926.83	MaMu	1									1						4			1				1					1						1						3				2			1						1						8	owh, 2 mic S
9	6928.17	MaMu	1									1						4			1				1					1						1						3			1				1						1						9	owh
10	6929.00	MaMu	1									1			1						1				1					1						1						3			1				1						1						10	owh
3V	6929.25	MaMu	1									1						4			1				1					1						1						3			1				1									4			3V	owh
11	6931.83	MaMu	1									1					3				1				1					1						1						3			1						3							4			11	owh
12	6932.00	MaMu	1									1			1						1				1					1						1						3			1						3				1						12	owh
13	6932.83	MaMu	1									1					3				1				1					1						1						3			1				1						1						13	owh
14	6942.42	MaMu	1									1			1						1				1					1						1						3				2			1									4			14	owh, 1 mic S
15	6943.00	MaMu	1									1			1						1				1					1						1						3			1				1									4			15	owh
4V	6943.25	MaMu	1									1						4			1				1					1						1						3			1						3								5		4V	owh, art F
16	6944.92	MaPeMu			3							1					3				1				1					1						1						3				2					3				1						16	owh, 1 mic S
17	6946.50	MaMu	1									1						4			1				1					1							2						4		1				1									4			17	owh
18	6947.50	MaMu	1									1			1						1				1					1						1							4		1				1									4			18	owh
5V	6948.17	MaMu	1									1			1						1				1					1						1							4		1				1									4			5V	owh, mot
19	6948.50	MaMu	1									1			1						1				1					1							2						4			2					3							4			19	owh, 1 S
20	6949.50	MaMu	1									1			1						1				1					1						1							4		1				1									4			20	owh, mot
21	6950.50	MaMu	1									1			1						1				1					1						1							4		1						3							4			21	owh, mot
22	6951.50	MaMu	1									1			1						1				1					1							2						4		1				1						1						22	owh, TZo
23	6952.50	MaMu	1									1			1							2			1					1						1							4			2					3								5		23	owh, 1 mic S
6V	6953.25	MaMu	1									1			1						1				1					1						1							4			2			1						1						6V	owh, 2 S
24	6953.50	MaMu	1									1			1						1				1					1						1							4		1				1									4			24	owh
25	6954.50	MaMu	1									1			1						1				1					1						1							4		1				1									4			25	owh
26	6955.50	MaMu	1									1			1						1				1					1						1							4			2					3							4			26	owh, 3 mic S
27	6957.25	MaMu	1									1			1						1				1					1							2						4		1				1						1						27	owh, TZo
28	6958.17	MaMu	1									1			1						1				1					1							2						4		1				1									4			28	owh, TCh

JCR plug description scheme

Well: Nana-1XP | Field: Halfdan | Plug size Ø = 1½" | Sheet no.: 2 | Geologist: Nis

Plug	Core depth	Lithotype	Depositional fabric									Composition								
			Rock type									Matrix			Grains					
Plug	Core depth	Lithotype	M	Mf	Mc	Wf	Wc	Pf	Pc	Gf	Gc	Ch	Arl	Arh	Gn	Gsh	Gch	Gsk	Gct	Go
no.	m/ft.		1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6
7V	6958.42	MaMu	1									1			1					
29	6959.17	MaMu	1									1			1					
30	6960.25	MaMu	1									1						4		
31	6961.25	LaMu	1									1			1					
32	6962.25	LaMu	1									1			1					
8V	6962.42	LaMu	1									1			1					
33	6963.25	MaMu	1									1			1					
34	6964.25	MaMu	1									1			1					
35	6965.25	LaMu	1									1			1					
36	6966.92	MaMu	1									1			1					
9V	6967.42	MaMu	1									1			1					
37	6967.92	MaMu	1									1						4		
38	6968.92	MaMu	1									1			1					
39	6970.00	MaMu	1									1						4		
40	6971.00	MaMu	1									1			1					
41	6972.00	MaMu	1									1			1					
10V	6972.75	MaMu	1									1						4		
42	6973.17	MaMu	1									1			1					
43	6974.17	MaMu	1									1			1					
44	6975.17	MaMu	1									1			1					
45	6976.25	MaMu	1									1						4		
11V	6977.83	LaArMu	1										2		1					
46	6978.00	MaMu	1									1					3			
47	6979.00	MaPeMu			3							1					3			
48	6980.00	MaPeMu		2	3							1					3			
49	6981.00	MaMu	1									1			1					
50	6982.17	MaMu	1									1			1					
12V	6982.58	LaArMu	1										2		1					
51	6983.17	LaMu	1									1			1					
52	6984.25	LaMu	1									1						4		
53	6985.25	LaArMu	1										2		1					
54	6987.25	LarArMu	1										2		1					
13V	6987.33	LaArMu	1										2					4		
55	6988.17	MaMu	1									1						4		

Plug	Stratification									Deformation structures						Bioturbation			
	Bedding				Lamination											Trace fossils			
Plug	Bn	Btn	Bm	Btk	Ln	Lpl	Lun	Lx	Lg	Dn	Dfl	Dfh	Dcl	Dch	Ds	Tn	Tl	Tm	Th
no.	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4
7V	1				1					1						1			
29	1				1					1						1			
30	1				1					1						1			
31	1					2				1						1			
32	1					2				1						1			
8V	1					2				1						1			
33	1				1					1							2		
34	1				1					1						1			
35	1					2				1						1			
36	1				1					1						1			
9V	1				1					1						1			
37	1				1					1						1			
38	1				1					1							2		
39	1				1					1						1			
40	1				1					1							2		
41	1				1					1						1			
10V	1				1					1						1			
42	1				1					1							2		
43	1				1					1						1			
44	1				1					1							2		
45	1				1					1						1			
11V	1						3			1						1			
46	1				1					1						1			
47	1				1					1						1			
48	1				1					1						1			
49	1				1					1						1			
50	1				1					1						1			
12V	1						3			1						1			
51	1						3			1						1			
52	1						3			1						1			
53	1						3			1						1			
54	1						3			1						1			
13V	1						3			1						1			
55	1				1					1							2		

Plug	Hardness					Stylolites				Secondary minerals						Fractures						Plug	Comments
Plug	Hvs	Hs	Hm	Hh	Hvh	Sn	Sl	Sm	Sh	Mn	Mca	Mpy	Mdo	Msi	Mo	Fn	Fo	Fm	Fhl	Fhh	Fs	Plug	
no.	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6	no.	
7V				4			2					3							4			7V	owh, 1S
29				4		1				1						1						29	owh
30			3			1				1									4			30	owh
31			3			1				1									4			31	owh, ids Lpl
32				4			2			1									4			32	owh, ids Lpl
8V				4		1						3				1						8V	owh, ids Lpl
33				4		1				1										5		33	owh, TZo
34				4		1				1									4			34	owh
35				4		1				1						1						35	owh, ids Lpl
36				4		1						3				1						36	owh-lgy, Ss
9V				4		1				1						1						9V	owh-lgy, Ss
37				4		1				1									4			37	owh
38				4		1						3				1						38	owh
39				4		1				1									4			39	owh
40				4		1				1						1						40	owh
41				4		1						3							4			41	owh, Ss
10V				4		1				1									4			10V	owh
42				4		1				1						1						42	owh, ids Ss
43				4		1				1									4			43	owh, Ss
44				4		1				1									4			44	owh, TCh, Ss
45				4		1				1										5		45	owh
11V				4		1				1						1						11V	Lgy, Ss
46				4		1				1						1						46	owh-lgy, Ss
47					5	1						3							4			47	owh-lgy, ids Ss
48					5	1				1						1						48	owh-lgy, ids Ss
49				4		1				1						1						49	owh, Ss ?
50					5	1						3				1						50	owh-lgy, ids Ss
12V					5	1						3				1						12V	Lgy, Ss, art F
51					5	1						3				1						51	Lgy, Ss
52					5	1						3		5		1						52	Lgy, Ss
53					5	1						3				1						53	Lgy, Ss
54					5	1						3		5		1						54	Lgy, Ss
13V					5	1						3				1						13V	Lgy, Ss
55				4		1				1						1						55	owh, TZo, Ss

JCR plug description scheme

Well: Nana-1XP | Field: Halfdan

Sheet no.: 3

Geologist: Nis

Plug size Ø = 1½"			Depositional fabric									Composition									Stratification									Deformation structures						Bioturbation				Hardness					Stylolites				Secondary minerals						Fractures							Comments
			Rock type									Matrix			Grains						Bedding				Lamination											Trace fossils																										
Plug	Core depth	Lithotype	M	Mf	Mc	Wf	Wc	Pf	Pc	Gf	Gc	Ch	Arl	Arh	Gn	Gsh	Gch	Gsk	Gct	Go	Bn	Btn	Bm	Btk	Ln	Lpl	Lun	Lx	Lg	Dn	Dfl	Dfh	Dcl	Dch	Ds	Tn	Tl	Tm	Th	Hvs	Hs	Hm	Hh	Hvh	Sn	Sl	Sm	Sh	Mn	Mca	Mpy	Mdo	Msi	Mo	Fn	Fo	Fm	Fhl	Fhh	Fs	Plug	
no.	m/ft.		1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6	no.	
56	6989.17	MaMu	1									1					3				1				1					1						1							4		1						3				1						56	owh-lgy, Ss
57	6990.17	MaMu	1									1			1						1				1					1						1							4		1				1						1						57	owh-lgy, Ss
58	6991.17	MaMu	1									1					3	4			1				1					1							2						4		1						3		5		1						58	owh-lgy, Ss
59	6992.17	MaMu	1									1						4			1				1					1						1							4		1						3							4			59	owh, Ss
14V	6992.58	LaMu	1									1					3				1						3			1						1							4		1						3				1						14V	owh-lgy, Ss
60	6993.17	LaMu	1									1			1						1						3			1						1							4		1						3				1						60	owh-lgy, Ss
61	6994.25	MaMu	1									1			1						1				1					1						1							4		1						3				1						61	owh, Ss
62	6995.33	MaMu	1									1			1						1				1					1							2						4			2					3				1						62	owh, mic S, Ss
63	6997.25	MaMu	1									1					3				1				1					1						1							4		1						3				1						63	owh, Ss
15V	6997.50	MaWa				4	5					1					3				1				1					1						1							4					4			3								5		15V	owh, mic S
64	6998.25	MaMu	1									1					3				1				1					1						1							4		1						3							4			64	owh, Ss
65	6999.25	MaMu	1									1			1						1				1					1						1							4		1						3							4			65	owh, Ss
66	7000.33	MaMu	1									1			1						1				1					1							2						4					4			3							4			66	owh, mic S
67	7001.25	MaMu	1									1					3				1				1					1						1							4		1						3							4			67	owh-lgy, Ss
16V	7002.17	MaMu	1									1			1						1				1					1						1							4					4			3							4			16V	owh, mic S
68	7002.25	MaMu	1									1					3				1				1					1							2						4		1				1									4			68	owh, TZo
69	7003.25	MaMu	1									1			1						1				1					1						1							4		1						3		5		1						69	owh, Ss
70	7004.25	MaMu	1									1			1						1				1					1							2						4					4			3				1						70	owh-lgy, mic S
71	7005.25	MaMu	1									1						4			1				1					1						1								5		2					3						3				71	owh, mic S
72	7006.25	MaMu	1									1			1						1				1					1							2						4		1				1						1						72	owh
73	7008.5	MaMu	1									1						4			1				1					1						1							4		1				1									4			73	owh
17V	7009.42	MaMu	1									1			1						1				1					1						1							4			2			1						1						17V	owh, 2S
74	7009.58	MaMu	1									1			1						1				1					1						1							4			2			1						1						74	owh, 1S
75	7010.75	MaMu	1									1			1						1				1					1						1							4				3		1										5	6	75	owh, 3S
76	7011.75	MaMu	1									1			1						1				1					1						1							4			2			1									4		6	76	owh, 2 mic S
77	7012.67	LaMu	1									1			1						1					2				1						1							4				3		1										5		77	owh, ids Lpl
78	7013.67	MaMu	1									1			1						1				1					1						1							4			2			1									4			78	owh, 2 mic S
18V	7014.42	MaMu	1									1			1						1				1					1						1							4		1				1									4			18V	owh
79	7014.75	MaMu	1									1			1						1				1					1						1							4			2			1										5		79	owh, 1S
80	7015.92	MaMu	1									1			1						1				1					1						1							4		1				1										5		80	owh
81	7016.92	BuMaMu	1									1			1						1				1					1									4				4			2			1										5		81	owh-lgy, 2S
82	7018.25	BuMaMu	1									1			1						1				1					1									4				4				3		1									4			82	owh-lgy, 3S
83	7019.42	MaMu	1									1			1						1				1					1						1							4		1				1									4			83	owh
19V	7019.67	MaMu	1									1			1						1				1					1							2						4			2			1									4			19V	owh, 1S

JCR plug description scheme

Well: Nana-1XP | Field: Halfdan | Sheet no.: 4

Geologist: Nis

Plug size Ø = 1½"

			Depositional fabric									Composition									Stratification									Deformation structures						Bioturbation				Hardness					Stylolites				Secondary minerals						Fractures							Comments
			Rock type									Matrix			Grains						Bedding				Lamination											Trace fossils																										
Plug	Core depth	Lithotype	M	Mf	Mc	Wf	Wc	Pf	Pc	Gf	Gc	Ch	Arl	Arh	Gn	Gsh	Gch	Gsk	Gct	Go	Bn	Btn	Bm	Btk	Ln	Lpl	Lun	Lx	Lg	Dn	Dfl	Dfh	Dcl	Dch	Ds	Tn	Tl	Tm	Th	Hvs	Hs	Hm	Hh	Hvh	Sn	Sl	Sm	Sh	Mn	Mca	Mpy	Mdo	Msi	Mo	Fn	Fo	Fm	Fhl	Fhh	Fs	Plug	
no.	m/ft.		1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6	no.	
84	7020.42	MaMu	1									1			1						1				1					1								3					4		1				1									4			84	owh
85	7021.58	MaMu	1									1			1						1				1					1							2						4		1				1						1						85	owh
86	7022.92	MaMu	1									1			1						1				1					1							2						4			2			1									4			86	owh, 1S
87	7024.00	MaMu	1									1			1						1				1					1							2						4			2			1						1						87	owh, 1S, 1 art F
20V	7024.83	MaMu	1									1			1						1				1					1							2						4			2			1										5		20V	owh, 2S
88	7025.00	MaMu	1									1			1						1				1					1							2						4			2					3								5		88	owh, 2 mic S
89	7026.00	MaMu	1									1			1						1				1					1							2						4				3		1									4			89	owh, 3S
90	7027.00	MaMu	1									1						4			1				1					1							2						4			2			1										5		90	owh, 1S
91	7033.42	MaMu	1									1			1						1				1					1						1							4			2			1										5		91	owh, 1S
21V	7033.58	BuMaMu	1									1					3				1				1					1									4				4			2			1										5		21V	owh-lgy, 2S
92	7035.17	BuMaMu	1									1			1						1				1					1									4				4		1				1									4			92	owh-lgy
93	7036.25	MaMu	1									1			1						1				1					1							2						4		1				1									4			93	owh
94	7037.17	MaMu	1									1			1						1				1					1							2						4			2			1									4			94	owh, 1S
22V	7038.58	MaMu	1									1			1						1				1					1							2						4		1				1										5		22V	owh
95	7042.92	MaMu	1									1			1						1				1					1							2					3	4		1				1									4			95	owh
23V	7043.42	MaMu	1									1			1						1				1					1						1							4		1						3								5		23V	owh-lgy
96	7044.08	MaMu	1									1			1						1				1					1							2						4			2			1						1						96	owh, 1S
97	7045.58	MaMu	1									1			1						1				1					1							2						4			2			1									4			97	owh, 1S
98	7046.67	MaMu	1									1			1						1				1					1						1							4			2					3							4			98	owh, 2S
99	7047.58	MaMu	1									1			1						1				1					1							2					3	4			2			1										5		99	owh, 2S
24V	7048.42	MaMu	1									1			1						1				1					1							2					3			1						3								5		24V	owh, TCh
100	7048.75	MaMu	1									1			1						1				1					1							2					3	4		1				1										5		100	owh-lgy
101	7050.75	MaMu	1									1			1						1				1					1							2						4				3		1										5		101	owh, 3S
102	7051.67	MaMu	1									1			1						1				1					1							2					3	4			2			1										5		102	owh, 1S
103	7052.67	MaMu	1									1			1						1				1					1							2						4			2			1										5		103	owh, 1S
25V	7053.00	MaMu	1									1			1						1				1					1							2						4			2			1										5		25V	owh, 2S
104	7066.08	MaMu	1									1			1						1				1					1							2						4			2			1										5		104	owh, 1S
26V	7066.25	MaMu	1									1			1						1				1					1							2						4	5	1						3								5		26V	owh
105	7067.00	MaMu	1									1			1						1				1					1							2						4		1						3							4			105	owh
106	7068.00	MaMu	1									1			1						1				1					1						1							4			2			1									4			106	owh, 2S
107	7069.00	MaMu	1									1			1						1				1					1							2						4		1						3							4			107	owh
108	7071.00	MaMu	1									1			1						1				1					1						1							4			2			1										5		108	owh, 2S
27V	7071.25	MaMu	1									1			1						1				1					1						1							4			2					3								5		27V	owh, 2S
109	7072.00	MaMu	1									1			1						1				1					1						1							4		1						3								5		109	owh

JCR plug description scheme																																																												Sheet no.: 5
Well: Nana-1XP	Field: Halfdan																																																													Geologist: Nis
Plug size Ø = 1½"			Depositional fabric												Composition						Stratification									Deformation structures						Bioturbation				Hardness					Stylolites				Secondary minerals						Fractures							Comments
			Rock type									Matrix			Grains						Bedding				Lamination											Trace fossils																											
Plug	Core depth	Lithotype	M	Mf	Mc	Wf	Wc	Pf	Pc	Gf	Gc	Ch	Arl	Arh	Gn	Gsh	Gch	Gsk	Gct	Go	Bn	Btn	Bm	Btk	Ln	Lpl	Lun	Lx	Lg	Dn	Dfl	Dfh	Dcl	Dch	Ds	Tn	Tl	Tm	Th	Hvs	Hs	Hm	Hh	Hvh	Sn	Sl	Sm	Sh	Mn	Mca	Mpy	Mdo	Msi	Mo	Fn	Fo	Fm	Fhl	Fhh	Fs	Plug	
no.	m/ft.		1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6	no.	
110	7073.42	MaMu	1									1			1						1				1					1						1							4			2			1											6	110	owh
111	7074.83	MaMu	1									1			1						1				1					1							2						4	5	1				1									4			111	owh
112	7076.67	MaMu	1									1			1						1				1					1							2						4	5		2			1									4			112	owh, 1S
28V	7077.00	MaMu	1									1			1						1				1					1							2						4	5			3		1										5		28V	owh, 3S
113	7077.92	MaMu	1									1			1						1				1					1						1							4	5	1						3							4			113	owh
114	7079.17	LaMu	1									1			1						1					2				1							2						4	5		2			1										5		114	owh, 1S, TCh
115	7080.58	MaMu	1									1			1						1				1					1							2						4		1				1									4			115	owh, TCh
116	7081.83	MaMu	1									1			1						1				1					1							2						4			2			1									4			116	owh, TCh
117	7082.83	MaMu	1									1						4			1				1					1						1							4		1				1										5		117	owh
29V	7083.17	MaMu	1									1						4			1				1					1						1							4		1				1										5		29V	owh
118	7083.83	LaMu	1									1			1						1					2				1						1							4			2			1										5		118	owh, 1 mic S
119	7084.83	MaMu	1									1			1						1				1					1						1							4		1				1										5		119	owh, art F
120	7085.92	MaMu	1									1			1						1				1					1							2						4		1				1									4			120	owh, TZo
121	7086.92	MaMu	1									1			1						1				1					1							2							5	1				1										5		121	owh, TZo, TCh
122	7087.92	MaMu	1									1			1						1				1					1							2						4	5	1						3								5		122	owh
30V	7088.25	MaMu	1									1			1						1				1					1							2							5		2			1										5		30V	owh, 1S
123	7089.58	MaMu	1									1			1						1				1					1							2						4	5	1				1									4			123	owh
124	7091.33	MaMu	1									1			1						1				1					1						1							4		1				1										5		124	owh, mot
125	7093.00	MaMu	1									1			1						1				1					1						1							4		1						3							4			125	owh
31V	7093.25	MaMu	1									1			1						1				1	2				1						1							4			2			1										5		31V	owh, ids Lpl, 2S
126	7094.42	MaMu	1									1			1						1				1					1						1							4	5	1						3								5		126	owh
127	7095.50	MaMu	1									1						4			1				1					1						1							4	5		2			1									4			127	owh, 2S
128	7096.50	MaMu	1									1			1						1				1	2				1							2						4			2			1										5		128	owh, 2S
129	7097.67	BuMaMu	1									1			1						1				1	2				1								3					4	5	1				1									4			129	owh
32V	7099.75	LaMu	1									1						4			1				1	2				1							2						4			2			1										5		32V	owh, ids Lpl, 1S
130	7099.92	MaMu	1									1			1						1				1					1							2						4			2			1									4			130	owh, 2S
131	7101.67	MaMu	1									1			1						1				1					1							2						4			2			1									4			131	owh, 1S
132	7102.83	MaMu	1									1			1						1				1					1							2						4			2			1						1						132	owh, TCh, 2S
133	7103.83	MaMu	1									1						4			1				1					1						1							4		1				1						1						133	owh
134	7105.00	MaMu	1									1			1						1				1					1							2						4			2			1										5		134	owh, 1 mic S
33V	7105.25	MaMu	1									1			1						1				1					1							2						4		1				1										5		33V	owh
135	7106.17	MaMu	1									1			1						1				1					1							2						4			2			1									4			135	owh, 2S
136	7107.25	MaMu	1									1			1						1				1					1							2						4			2			1									4			136	owh, 1S
137	7108.17	LaMu	1									1			1						1					2				1							2						4			2			1										5		137	owh, ids Lpl, 2S

JCR plug description scheme																																																													Sheet no.: 6	
Well: Nana-1XP		Field: Halfdan																																																										Geologist: Nis	
Plug size Ø = 1½"			Depositional fabric									Composition									Stratification									Deformation structures						Bioturbation				Hardness					Stylolites				Secondary minerals						Fractures							Comments
			Rock type									Matrix			Grains						Bedding				Lamination											Trace fossils																										
Plug	Core depth	Lithotype	M	Mf	Mc	Wf	Wc	Pf	Pc	Gf	Gc	Ch	Arl	Arh	Gn	Gsh	Gch	Gsk	Gct	Go	Bn	Btn	Brn	Btk	Ln	Lpl	Lun	Lx	Lg	Dn	Dfl	Dfh	Dcl	Dch	Ds	Tn	Tl	Tm	Th	Hvs	Hs	Hm	Hh	Hvh	Sn	Sl	Sm	Sh	Mn	Mca	Mpy	Mdo	Msi	Mo	Fn	Fo	Fm	Fhl	Fhh	Fs	Plug	
no.	m/ft.		1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6	no.	
138	7109.08	MaMu	1									1			1						1				1					1							2	3					4		1				1									4			138	owh
34V	7109.83	MaMu	1									1			1						1				1					1							2						4		1				1										5		34V	owh
139	7110.25	MaMu	1									1			1						1				1					1						1							4			2					3							4			139	owh, 1S
140	7111.25	LaMu	1									1			1						1					2				1							2						4		1				1									4			140	owh, ids Lpl
141	7112.58	LaMu	1									1			1						1					2				1							2						4			2			1									4			141	owh, ids Lpl
142	7113.75	MaMu	1									1			1						1				1					1							2						4			2			1						1						142	owh, 1S
35V	7114.50	MaMu	1									1			1						1				1					1							2						4		1						3							4			35V	owh, TCh
143	7114.75	LaMu	1									1			1						1					2				1							2						4		1				1									4			143	owh, TCh
144	7116.00	LaMu	1									1			1						1					2				1						1							4		1				1										5		144	owh, ids Lpl
145	7116.92	LaMu	1									1			1						1					2				1							2						4		1				1									4			145	owh, ids Lpl
146	7118.00	LaMu	1									1			1						1					2				1							2						4			2			1									4			146	owh, 2 mic S
147	7119.00	MaMu	1									1			1						1				1					1							2						4			2			1									4			147	owh, 1S
36V	7119.42	MaMu	1									1						4			1				1					1						1							4			2			1									4			36V	owh, 1S
148	7120.42	LaMu	1									1			1						1					2				1							2						4		1				1									4			148	owh, TCh
149	7121.58	MaMu	1									1			1						1				1					1							2						4			2			1									4			149	owh,TZo, 1S
150	7124.17	MaMu	1									1			1						1				1					1							2						4		1				1									4			150	owh
37V	7124.42	MaMu	1									1			1						1				1					1						1							4			2			1										5		37V	owh, 1S
151	7125.08	MaMu	1									1			1						1				1					1							2						4			2			1									4			151	owh, 1S
152	7126.08	MaMu	1									1			1						1				1					1							2						4			2			1									4			152	owh, 2S
153	7127.08	MaMu	1									1			1						1				1					1							2						4		1				1									4			153	owh, TCh
154	7128.17	LaMu	1									1			1						1					2				1						1							4			2			1										5		154	owh, 1S
38V	7128.83	MaMu	1									1			1						1				1					1						1							4	5	1						3							4			38V	owh, biotex
155	7129.17	MaMu	1									1			1						1				1					1							2						4	5		2					3							4			155	owh, TCh, 2S
156	7130.42	MaMu	1									1			1						1				1	2				1							2						4			2			1									4			156	owh, TCh, 1S
157	7131.42	MaMu	1									1			1						1				1					1							2						4		1				1									4			157	owh
158	7132.42	MaMu	1									1			1						1				1					1						1							4			2			1									4			158	owh, 2S, 1 mic S
159	7133.42	MaMu	1									1			1						1				1					1						1							4			2					3							4			159	owh, 1S
39V	7134.08	MaMu	1									1			1						1				1					1							2						4			2			1									4			39V	owh, 1S
160	7134.33	MaMu	1									1			1						1				1					1							2						4	5	1				1									4			160	owh
161	7135.50	MaMu	1									1			1						1				1					1							2						4	5	1				1										5		161	owh
162	7136.58	MaMu	1									1						4			1				1					1						1							4	5	1				1									4			162	owh
163	7137.67	MaMu	1									1			1						1				1					1							2						4	5		2			1									4			163	owh. 1S
40V	7138.08	MaMu	1									1			1						1				1					1							2						4	5		2			1									4			40V	owh, 1 mic S
164	7138.50	MaMu	1									1						4			1				1	2				1							2						4	5	1				1									4			164	owh, TCh

JCR plug description scheme

Well: Nana-1XP | Field: Halfdan | Sheet no.: 7 | Geologist: Nis

Plug size Ø = 1½"

Plug	Core depth	Lithotype	Depositional fabric									Composition									Stratification									Deformation structures						Bioturbation				Hardness					Stylolites				Secondary minerals						Fractures						Plug	Comments
			Rock type									Matrix			Grains						Bedding				Lamination											Trace fossils																										
Plug	Core depth	Lithotype	M	Mf	Mc	Wf	Wc	Pf	Pc	Gf	Gc	Ch	Arl	Arh	Gn	Gsh	Gch	Gsk	Gct	Go	Bn	Btn	Bm	Btk	Ln	Lpl	Lun	Lx	Lg	Dn	Dfl	Dfh	Dcl	Dch	Ds	Tn	Tl	Tm	Th	Hvs	Hs	Hm	Hh	Hvh	Sn	Sl	Sm	Sh	Mn	Mca	Mpy	Mdo	Msi	Mo	Fn	Fo	Fm	Fhl	Fhh	Fs	Plug	
no.	m/ft.		1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6	no.	
165	7139.50	MaMu	1									1			1						1				1					1							2							5		2			1									4			165	owh, 1S
166	7140.42	MaMu	1									1						4			1				1					1						1								5		2			1									4			166	owh, 2S, art F
167	7141.42	MaMu	1									1			1						1				1					1						1								5		2			1									4			167	owh, 1S
168	7142.83	MaMu	1									1			1						1				1					1							2							5	1				1									4			168	owh, TCh
41V	7143.00	MaMu	1									1			1						1				1					1						1							4	5		2					3							4			41V	owh, 2S
169	7143.83	MaMu	1									1			1						1				1					1						1								5			3		1										5		169	owh, 3S
170	7145.00	MaMu	1									1			1						1				1					1							2							5		2					3				1						170	owh, TZo, 2S
171	7146.00	MaMu	1									1			1						1				1					1							2							5	1				1									4			171	owh
172	7147.25	LaMu	1									1			1						1					2				1						1								5				4	1									4			172	owh, ids Lpl, 4S
173	7148.25	MaMu	1									1			1						1				1					1							2						4	5	1						3							4			173	owh
42V	7148.67	MaMu	1									1			1						1				1					1							2						4			2			1									4			42V	owh, 2S
174	7149.25	MaMu	1									1						4			1				1					1						1							4		1				1									4			174	owh
175	7150.25	MaMu	1									1						4			1				1					1							2						4			2			1									4			175	owh, 1S, 1 mic S
176	7151.25	MaMu	1									1						4			1				1	2				1							2						4		1				1									4			176	owh, ids Lpl
177	7152.25	MaMu	1									1			1						1				1					1							2						4			2			1									4			177	owh, 2S
178	7153.17	LaMu	1									1			1						1					2				1						1							4			2			1									4			178	owh, 1 mic S
179	7158.00	MaMu	1									1			1						1				1					1						1								5		2			1									4			179	owh, 1S
43V	7158.75	MaMu	1									1			1						1				1					1						1								5			3		1									4			43V	owh, 3S
180	7159.42	MaMu	1									1			1						1				1					1						1								5	1						3							4			180	owh
181	7160.58	MaMu	1									1			1						1				1					1						1								5	1				1						1						181	owh
182	7161.58	LaMu	1									1			1						1					2				1						1								5		2			1									4			182	owh, ids Lpl, 1S
183	7162.58	MaMu	1									1			1						1				1					1						1								5		2			1									4			183	owh, 1 mic S
184	7163.58	MaMu	1									1			1						1				1					1						1								5	1				1									4			184	owh, art F
44V	7163.92	MaMu	1									1						4			1				1					1						1								5		2			1									4			44V	owh, 1 mic S
185	7164.75	MaMu	1									1			1						1				1					1							2							5		2					3							4			185	owh, TZo, 1S
186	7166.75	MaMu	1									1			1						1				1					1						1								5		2			1									4			186	owh, 1S
187	7167.83	MaMu	1									1						4			1				1					1						1								5	1				1									4			187	owh
188	7168.83	MaMu	1									1						4			1				1					1						1								5	1				1									4			188	owh
45V	7168.92	MaMu	1									1			1						1				1					1						1								5		2					3							4			45V	owh, 1S
189	7169.92	LaMu	1									1						4			1					2				1							2							5	1				1									4			189	owh, ids Lpl
190	7171.42	MaMu	1									1			1						1				1					1						1								5		2			1									4			190	owh, 2S
191	7172.42	MaMu	1									1						4			1				1					1						1								5		2					3				1						191	owh, 2 mic S
192	7173.50	MaMu	1									1						4			1				1					1						1								5		2			1										5		192	owh, 2 mic S
46V	7173.92	MaMu	1									1						4			1				1	2				1						1								5	1				1										5		46V	owh, ids Lpl

JCR plug description scheme

Well: Nana-1XP | Field: Halfdan | Sheet no.: 8

Plug size Ø = 1½" | Geologist: Nis

Plug	Core depth	Lithotype	Depositional fabric – Rock type									Composition – Matrix			Composition – Grains						Stratification – Bedding				Stratification – Lamination					Deformation structures						Bioturbation – Trace fossils				Hardness					Stylolites				Secondary minerals						Fractures						Plug	Comments
no.	m/ft.		M	Mf	Mc	Wf	Wc	Pf	Pc	Gf	Gc	Ch	Arl	Arh	Gn	Gsh	Gch	Gsk	Gct	Go	Bn	Btn	Bm	Btk	Ln	Lpl	Lun	Lx	Lg	Dn	Dfl	Dfh	Dcl	Dch	Ds	Tn	Tl	Tm	Th	Hvs	Hs	Hm	Hh	Hvh	Sn	Sl	Sm	Sh	Mn	Mca	Mpy	Mdo	Msi	Mo	Fn	Fo	Fm	Fhl	Fhh	Fs	no.	
			1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6		
193	7174.42	LaMu	1									1						4			1					2				1							2							5		2			1									4			193	owh, idsLpl, 2 mic S
194	7175.50	LaMu	1									1			1						1					2				1							2							5			3		1										5		194	owh, ids Lpl, 3S
195	7176.42	LaMu	1									1			1						1					2				1						1								5		2			1									4			195	owh, ids Lpl, 2S
196	7177.42	MaMu	1									1			1						1				1					1							2							5	1				1									4			196	owh
197	7178.58	MaMu	1									1						4			1				1					1							2							5	1				1										5		197	owh
47V	7178.92	LaMu	1									1			1						1					2				1						1								5				4	1										5		47V	owh, ids Lpl, 4S
198	7179.50	MaMu	1									1						4			1				1					1						1								5				4			3				1						198	owh-lgy, 6S
199	7180.42	LaMu	1									1						4			1					2				1						1								5				4			3				1						199	owh, ids Lpl, 4S
200	7181.67	MaMu		2								1						4			1				1	2				1						1								5	1				1						1						200	owh, Gln
201	7182.67	MaMu	1									1			1						1				1					1						1								5		2			1									4			201	owh, 2S
48V	7183.17	LaMu	1									1			1						1					2				1						1								5		2			1									4			48V	owh, ids Lpl, 1S
202	7185.67	LaMu	1									1			1						1					2				1						1								5		2					3								5		202	owh, ids Lpl, 2S
203	7187.17	LaMu	1									1			1						1					2				1						1								5		2			1									4			203	owh, ids Lpl, 2S
49V	7188.00	LaMu	1									1						4			1					2				1						1								5		2					3							4			49V	owh, ids Lpl, 1S
204	7188.17	MaMu	1									1						4			1				1					1						1								5			3		1									4			204	owh, 3S
205	7189.33	MaMu	1									1						4			1				1					1							2							5			3		1									4			205	owh, Gln, 3S
206	7190.25	LaMu	1									1						4			1					2				1						1								5				4	1									4			206	owh, Gln, 4S
207	7191.75	MaMu		2								1						4			1				1					1						1								5	1				1						1						207	owh, Gln
50V	7192.08	MaMu	1									1						4			1				1	2				1							2							5				4	1						1						50V	owh, Gln, 5S
208	7192.75	MaMu	1									1						4			1				1					1						1								5		2			1									4			208	owh, 1S
209	7193.75	LaMu	1									1						4			1					2				1						1								5	1				1						1						209	owh, ids Lpl
210	7194.75	LaMu	1									1						4			1					2				1							2							5		2			1									4			210	owh, ids Lpl, 2S
211	7195.75	MaMu	1									1						4			1				1					1							2							5	1				1									4			211	owh, TZo, TCh
212	7196.75	MaMu	1									1			1						1				1					1								3						5		2			1									4			212	owh, TZo, 1S
51V	7197.33	MaMu	1									1						4			1				1					1							2							5		2			1										5		51V	owh, Gln, 2 mic S
213	7197.75	MaMu	1									1						4			1				1					1							2							5				4	1									4			213	owh, Gln, 4S
214	7198.75	BuMaMu	1									1			1						1				1					1									4					5			3				3								5		214	owh-lgy, 3S
215	7200.58	MaMu	1									1						4			1				1					1							2							5	1						3								5		215	owh
216	7201.58	MaMu	1									1			1						1				1					1						1								5			3				3							4			216	owh, 3S
217	7202.67	MaMu	1									1						4			1				1					1							2							5		2			1									4			217	owh, TZo, 2S
52V	7202.67	LaMu	1									1						4			1					2				1		3					2							5		2					3							4			52V	owh, ids Lpl, 2S
218	7203.67	LaMu		2								1						4			1					2				1						1								5		2			1									4			218	owh, Gln, ids Lpl, 2S
219	7204.67	MaMu	1									1			1						1				1					1							2							5			3		1									4			219	owh, 3S
220	7205.67	MaMu	1									1			1						1				1					1							2						4	5		2			1									4			220	owh-lgy, 2S

JCR plug description scheme

Sheet no.: 9

Well: Nana-1XP | Field: Halfdan | Geologist: Nis

Plug size Ø = 1½"

			Depositional fabric									Composition									Stratification									Deformation structures						Bioturbation				Hardness					Stylolites				Secondary minerals						Fractures							Comments
			Rock type									Matrix			Grains						Bedding				Lamination											Trace fossils																										
Plug	Core depth	Lithotype	M	Mf	Mc	Wf	Wc	Pf	Pc	Gf	Gc	Ch	Arl	Arh	Gn	Gsh	Gch	Gsk	Gct	Go	Bn	Btn	Bm	Btk	Ln	Lpl	Lun	Lx	Lg	Dn	Dfl	Dfh	Dcl	Dch	Ds	Tn	Tl	Tm	Th	Hvs	Hs	Hm	Hh	Hvh	Sn	Sl	Sm	Sh	Mn	Mca	Mpy	Mdo	Msi	Mo	Fn	Fo	Fm	Fhl	Fhh	Fs	Plug	
no.	m/ft.		1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6	no.	
221	7206.67	LaMu	1									1						4			1					2				1						1							4	5	1						3								5		221	owh, ids Lpl
222	7207.83	MaMu	1									1			1						1				1					1							2						4		1						3							4			222	owh-lgy
53V	7207.92	MaMu	1									1			1						1				1	2				1							2						4			2			1									4			53V	owh, TCh , 2S
223	7208.83	MaMu	1									1			1						1				1					1						1								5			3		1									4			223	owh, 3S
224	7209.83	MaMu	1									1			1						1				1					1						1								5				4	1									4			224	owh, 4S
225	7211.25	MaMu	1									1			1						1				1					1							2							5		2			1						1						225	owh, TZo, 2S
226	7212.58	MaMu	1									1			1						1				1					1							2							5		2			1										5		226	owh, TZo, 1S
227	7213.58	MaMu	1									1			1						1				1					1							2							5	1				1									4			227	owh, TCh
54V	7213.92	MaMu	1									1			1						1				1					1						1								5		2					3							4			54V	owh, 1 mic S
228	7214.58	MaMu	1									1			1						1				1					1							2							5				4			3				1						228	owh, 4S
229	7216.33	MaMu	1									1			1						1				1					1							2							5		2			1									4			229	owh, TCh, 2S
230	7217.33	MaMu	1									1			1						1				1					1						1								5				4	1									4			230	owh, 5S
55V	7218.08	MaMu	1									1			1						1				1					1						1								5	1				1										5		55V	owh
231	7218.33	MaMu	1									1			1						1				1					1							2							5		2			1									4			231	owh, 1S, 1 mic S
232	7219.33	MaMu	1									1			1						1				1					1							2							5		2			1						1						232	owh, 1 mic S
233	7220.33	MaMu	1									1			1						1				1					1							2							5	1						3							4			233	owh, TCh ?
234	7221.33	MaMu	1									1			1						1				1					1							2							5				4	1						1						234	owh, TZo, 5S
56V	7222.08	MaMu	1									1			1						1				1	2				1						1							4	5	1				1									4			56V	owh
235	7222.42	MaMu	1									1			1						1				1					1							2						4	5	1				1									4			235	owh
236	7223.43	MaMu	1									1			1						1				1					1						1							4	5			3		1									4			236	owh, 3 mic S
237	7224.58	MaMu	1									1			1						1				1					1							2							5				4	1									4			237	owh, 1S, 3 mic S
238	7225.58	MaMu	1									1			1						1				1					1						1								5		2			1									4			238	owh, 1S, 1 mic S
239	7226.58	MaMu	1									1			1						1				1					1						1								5		2			1						1						239	owh, 2S
57V	7227.25	MaMu	1									1						4			1				1					1							2							5		2			1									4			57V	owh, 1 mic S
240	7227.58	MaMu	1									1			1						1				1					1							2						4		1				1						1						240	owh, TZo ?
241	7228.58	MaMu	1									1			1						1				1					1						1							4	5		2					3							4			241	owh, 1S
242	7229.58	MaMu	1									1			1						1				1					1							2							5			3		1						1						242	owh, 3S
243	7230.58	MaMu	1									1			1						1				1	2				1						1								5			3		1									4			243	owh, 1S, 2 mic S
244	7231.58	MaMu	1									1			1						1				1					1						1								5				4			3							4			244	owh, 4S
58V	7232.42	MaMu	1									1			1						1				1					1						1								5		2			1						1						58V	owh, 1S
245	7232.58	MaMu	1									1			1						1				1					1						1								5		2			1						1						245	owh, 1S
246	7233.42	MaMu	1									1			1						1				1					1						1								5		2					3							4			246	owh, 1S
247	7234.58	MaMu	1									1			1						1				1					1						1								5		2					3							4			247	owh, 2S
248	7235.58	MaMu	1									1			1						1				1					1						1								5		2			1						1						248	owh, 1S

JCR plug description scheme																																																														Sheet no.: 10
Well: Nana-1XP		Field: Halfdan																																																											Geologist: Nis
Plug size Ø = 1½"			Depositional fabric									Composition									Stratification									Deformation structures						Bioturbation				Hardness					Stylolites				Secondary minerals						Fractures							Comments
			Rock type									Matrix			Grains						Bedding				Lamination											Trace fossils																										
Plug	Core depth	Lithotype	M	Mf	Mc	Wf	Wc	Pf	Pc	Gf	Gc	Ch	Arl	Arh	Gn	Gsh	Gch	Gsk	Gct	Go	Bn	Btn	Bm	Btk	Ln	Lpl	Lun	Lx	Lg	Dn	Dfl	Dfh	Dcl	Dch	Ds	Tn	Tl	Tm	Th	Hvs	Hs	Hm	Hh	Hvh	Sn	Sl	Sm	Sh	Mn	Mca	Mpy	Mdo	Msi	Mo	Fn	Fo	Fm	Fhl	Fhh	Fs	Plug	
no.	m/ft.		1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6	no.	
249	7236.58	MaMu	1									1			1						1				1					1							2							5		2					3							4			249	owh, 2S
59V	7237.08	MaMu	1									1			1						1				1					1						1								5			3				3							4			59V	owh, 3S
250	7237.83	MaMu	1									1			1						1				1					1							2							5				4	1									4			250	owh, 4S
251	7238.83	MaMu	1									1			1						1				1					1						1								5			3		1									4			251	owh, 2S, 1 mic S
252	7239.83	MaMu	1									1						4			1				1					1						1								5		2			1									4			252	owh, Gln, 2S
253	7240.83	MaMu		2	3							1					3	4			1				1					1							2							5		2			1						1						253	owh, 2S
254	7242.17	MaMu	1									1						4			1				1					1						1								5	1				1									4			254	owh
60V	7242.42	MaMu	1									1			1						1				1					1							2							5		2					3							4			60V	owh, 1S
255	7243.75	MaMu	1									1			1						1				1					1							2							5		2					3							4			255	owh, 1S, 1 mic S
256	7244.75	MaMu	1									1			1						1				1					1							2							5			3				3							4			256	owh, 2S, 1 mic S
257	7246.00	MaMu	1									1			1						1				1					1								3					4	5	1				1									4			257	owh, biotex
61V	7247.00	MaMu	1									1			1						1				1					1							2						4	5	1						3							4			61V	owh

5.4 Formation water analysis data

Mærsk Laboratory forwarded 4 plugs for formation water analysis and one sample of drilling mud as well. 2 plugs were drilled from the Danian section and 2 plugs from the Maastrichtian section of the cores with the objective to test for differences in formation water composition between the chalk units. The plugs were drilled from the center of the cores parallel to the axis of the full core to obtain the least contaminated material. Mærsk Lab used compressed air as a coolant during cutting of the plugs. GEUS Core Lab stored the samples for approx. one month in a refrigerator, and then forwarded the samples to the British Geological Survey (BGS) for analysis. Analytical results are presented in table 5.5.

Observations:

- From table 5.5 it is obvious that the extracted formation water is heavily contaminated by drilling mud. Considering the care excersised by the involved laboratories this contamination must have occurred downhole during the drilling operation due to invasion/ imbibition.

- The drilling mud do not contain much Ca and Sr; therefore the Sr/Ca ratio can be used as one parameter for detecting differences in formation water composition between the Danian and Maastrichtian plugs. Although the number of samples are a minimum there do not seem to be a significant difference between the formation water in the two chalk units.

- The drilling mud contamination is so heavy that a correction must be regarded with some uncertainty. A best estimate based on an assumed fraction of contaminating drilling mud is given in table 5.6

Analysis report cover notes from BGS

The sealed core samples were cut open and crushed to ca 5mm fragments. The crushed samples (ca. 130 g subsamples) were centrifuged in pore-water extraction cups at 16000 rpm for 60 min at 10°C in a Beckman J2-21 centrifuge. To obtain sufficient pore-water for chemical analysis three extractions, on separate batches of crushed core, were carried out for core samples 1 and 2 and two extractions for core samples 3 and 4. The pore-waters obtained for each sample from each extraction were combined to give a composite sample. The volumes of pore-water extracted were as follows:

Core Sample	Depth (feet)	Extracted pore water (g)	Comments
GEUS1	6923.70	6.17	Colourless water with slight methanolic smell
GEUS2	6924.45	4.30	Colourless water with slight methanolic smell
GEUS3	7012.45	1.00	Strong methanolic smell with ca 50% thick brown oil and ca 50 % colourless water
GEUS4	7012.96	0.99	Strong methanolic smell with ca 10 % light brown oil and ca 80 % colourless water

An aliquot of each pore-water (ca 0.5 ml) was extracted with hexane in a separating funnel. The aqueous fraction, was diluted with deionised water to facilitate sample handling when separating it from the organic fraction. The Nana-1X separator water and mud filtrate and the Nana separator water were extracted in hexane in a similar manner.

For pore-water from core samples 1,2 and 4 there was sufficient sample to carry out a chemical analysis of the untreated pore-water. The high oil/organic content in sample 3 and in the separator and mud filtrate samples made it necessary to digest these sample before analysis could be carried out. The Nana-1X separator water and mud filtrate and the Nana separator water were digested in a mixture of nitric acid and hydrogen peroxide. For sample 3, however, the thick brown oil content proved more difficult to digest and required the additional use of sulphuric acid to complete the mineralisation.

Data are reported for reagent blank corrected analyses of the untreated pore-waters, the hexane extracted pore-waters and sample digests.

Table 5.5 Nana formation water analysis. Data supplied by BGS in report no. 06282/2, 1999.

Sample ID	Comments	pH	Ca	Mg	Na	K	HCO3	Cl	SO4	Br	Total S	Sr	Sr/Ca	TDS
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		mg/l
GEUS core 1	Bulk Pore-water	7.28	1074	472	26214	19967	nep	63953	1040	179	420	144	0.134	
GEUS core 2	Bulk Pore-water	7.33	938	319	24854	19926	nep	60441	928	160	343	140	0.149	
GEUS core 3	Bulk Pore-water	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
GEUS core 4	Bulk Pore-water	n/a	1484	309	32075	19937	n/a	69444	801	187	324	205	0.138	
Nana-1X mud filtrate		9.10	n/a	n/a	n/a	n/a	333	n/a	n/a	n/a	n/a	n/a		
Nana-1X separator water		4.31	n/a	n/a	n/a	n/a	nep	n/a	n/a	n/a	n/a	n/a		
Nana-1X separator water		4.13	n/a	n/a	n/a	n/a	nep	n/a	n/a	n/a	n/a	n/a		
GEUS core 1	Organic Free	n/a	626	254	21366	18904	<447	63641	1036	172	316	119		106118
GEUS core 2	Organic Free	n/a	671	232	20619	18901	<449	60367	944	163	252	120		102019
GEUS core 3	Organic Free	n/a	1027	236	25419	18656	<448	64132	934	176	364	156		110737
GEUS core 4	Organic Free	n/a	942	213	24041	18745	<448	61333	752	170	231	153		106349
Nana-1X mud filtrate	Organic Free	n/a	7.1	5.4	12496	65122	1609	82855	1758	241	669	0.6		162485
Nana-1X separator water	Organic Free	n/a	55751	910	8901	1292	<455	98356	965	9715	285	167		176056
Nana-1X separator water	Organic Free	n/a	56526	890	8989	1328	1516	98856	631	9714	199	168		177103
GEUS core 3	Digests	n/a	1247	180	18912	12618	n/a	n/a	n/a	n/a	n/a	114		
Nana-1X mud filtrate	Digests	n/a	15.2	7.02	14827	54247	n/a	n/a	n/a	n/a	1101	1.49		
Nana-1X separator water	Digests	n/a	53216	1117	9894	1223	n/a	n/a	n/a	n/a	358	186		
Nana-1X separator water	Digests	n/a	70802	1324	10751	1122	n/a	n/a	n/a	n/a	397	223		

n/a – not analyzed
nep – no end point observed

Determinands	Test Method	Notes
pH and alkalinity	Potentiometric titration	
Ca, Mg, Na, K, Sr, and S	ICP-AES	
Cl, SO_4, and Br	Ion chromatography	

There was not sufficient sample volume to measure the pH on core pore-water samples 3 and 4. pH was not measured on the hexane extracted samples because the samples had been diluted with deionised water.

Because of the acid matrix used to mineralise the Nana-1X separator water and mud filtrate, the Nana separator water and the core 3 pore-water anion analysis could not be carried out on the digested samples.

The total sulphur data give values consistently higher than those accounted for by the sulphate and suggests the presence of non-sulphate sulphur species.

The alkalinity data should be treated with some caution as the titration curves showed that bicarbonate was not the only titratable species present and, in some samples, no titration end point was observed.

Table 5.6 Measured and calculated chemical composition of Nana pore and formation water. After correction, the formation water composition for Nana falls along the general formation water trend fig. 5.2.2.

Chemical Composition of Mud Filtrate and pore water, Nana-1X

Sample	pH	Cl	SO4	HCO3	Na	K	Ca	Mg	Sr
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Mud filtrate	9.1	82855	1758	333	12496	65122	7.1	5.4	0.6
GEUS core 1	7.28	63953	1040		26214	19967	1074	472	144
GEUS core 4		69444	801		32075	19937	1484	309	205

Calculated Chemical Composition of Formation Water, Nana-1X
Assumed Maximum and Minimum - based on GEUS core 1

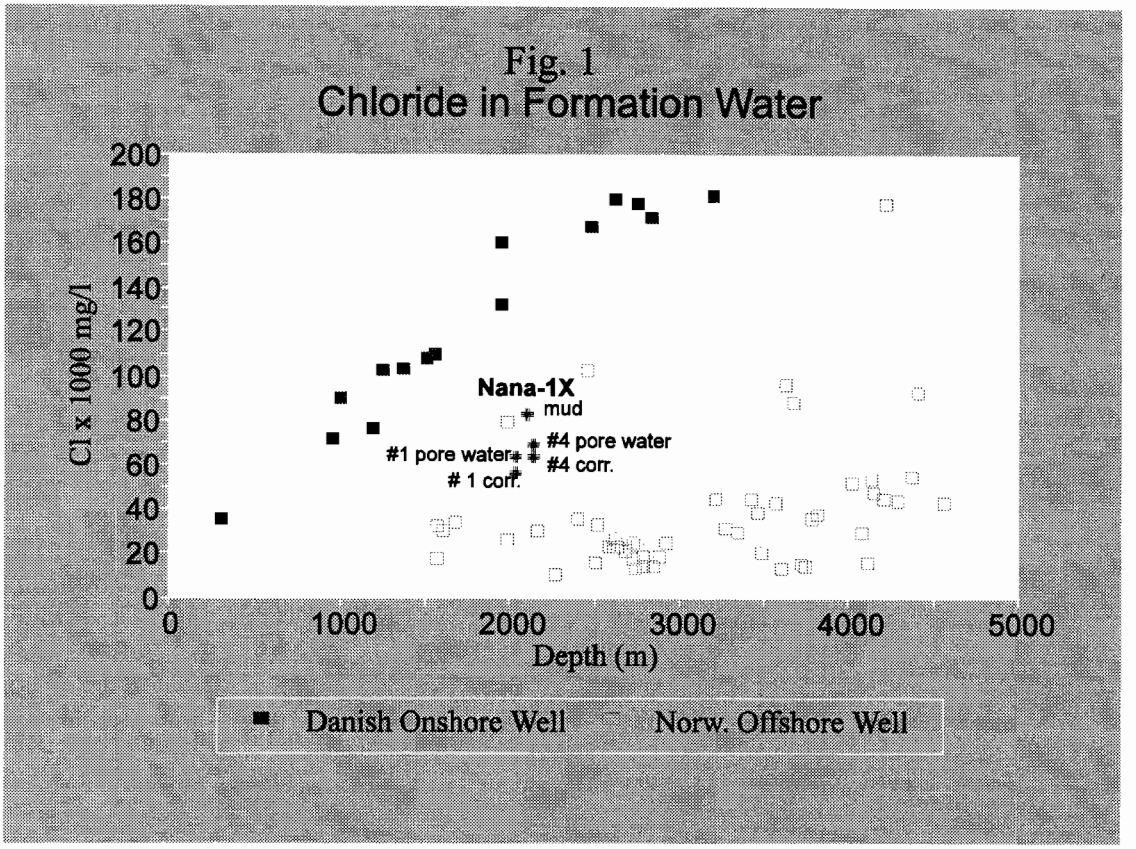
X	K/Cl	K/Cl	Cl	SO4	Na	K	Ca	Mg	Sr
	mg/mg	mol/mol	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
0.30	0.011	0.01	55850	730	37450	819	1530	670	205
0.29	0.027	0.024	56230	750	36900	1520	1510	660	203

X = fraction of mudfiltrate in the porewater

Calculated Chemical Composition of Formation Water, Nana-1X
Assumed Maximum and Minimum - based on GEUS core 4

X	K/Cl	K/Cl	Cl	SO4	Na	K	Ca	Mg	Sr
	mg/mg	mol/mol	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
0.30	0.009	0.008	63700	390	40450	572	2120	440	293
0.29	0.023	0.021	63700	410	40100	1480	2090	430	288

X = fraction of mudfiltrate in the porewater



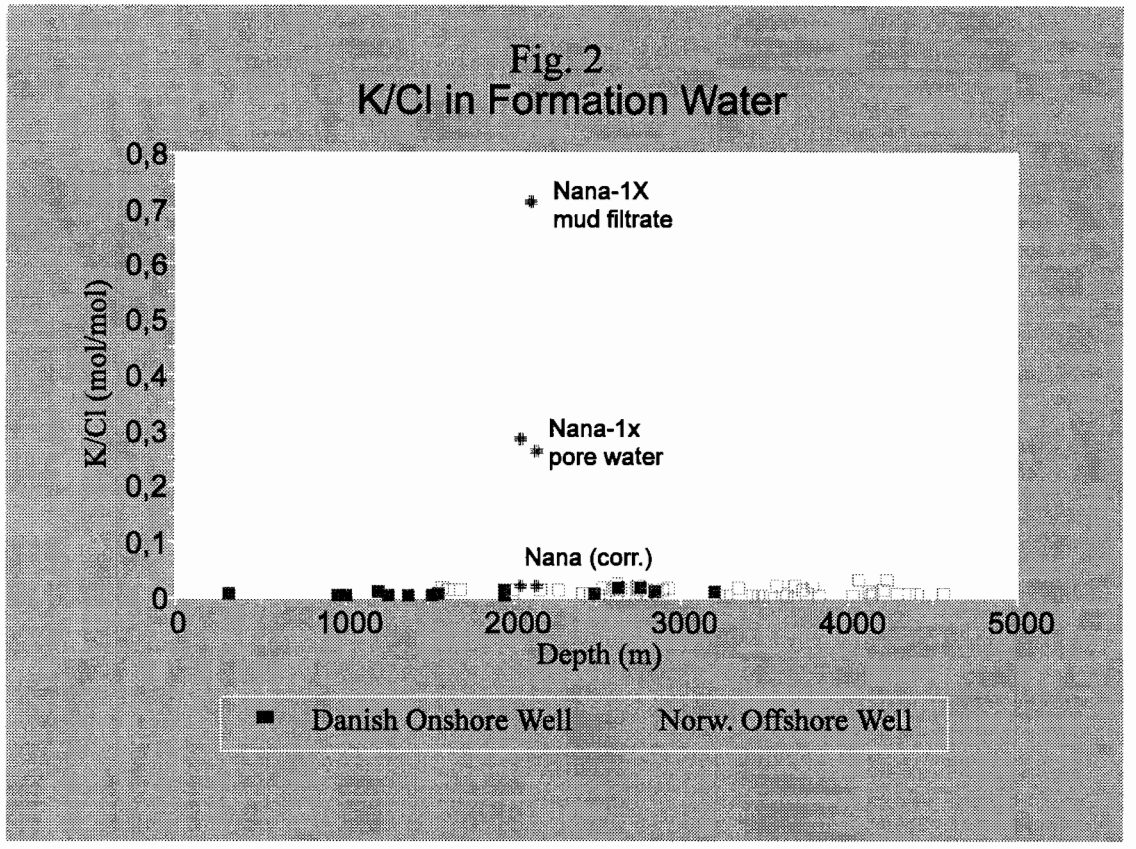


Fig. 5.2.1 and 5.2.2. The position of Nana mud and extracted pore water relative to the North Sea and Danish onshore trends. Nana formation water (corrected) is shown as well.