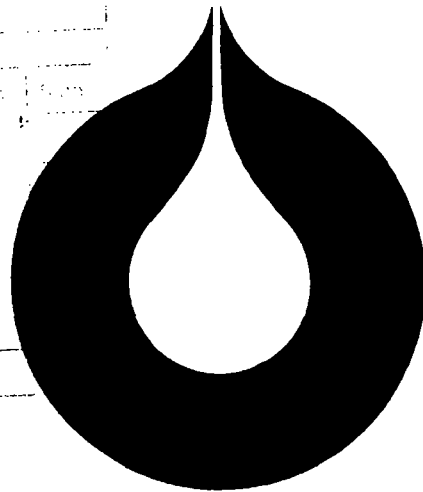


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statoil

Comments on Robertson Research
 spesial core analysis study for Statoil

Well 15/9-11

STATOIL
 EXPLORATION & PRODUCTION
 LABORATORY

Jon K. Ringen

Den norske stats oljeselskap a.s



Classification

12484110006
15/9-11 Kjernerapport

Requested by

Ø. Reinertsen, Sleipner

Subtitle

Co-workers

Title

Comments on Robertson Research
spesial core analysis study for Statoil

Well 15/9-11

STATOIL
EXPLORATION & PRODUCTION
LABORATORY

Jon K. Ringen

Prepared

12/5-82

Jon K. Ringen

Jon K. Ringen

Approved

[Signature]

Comments on Robertson Research's special core analysis study for Statoil on well 15/9-11.

Robertson Research received seven untrimmed 1 1/2" plug samples from us in Nov. -81. The request was to measure Helium porosity , gas-permeability with Klinkenberg correction, capillary pressure curves with gas-water system, the formation factors at room condition and the saturation exponents. On 4 of the samples we wanted the residual gas saturation after a waterflood to be determined.

All the requested analyses have been made and reported. The report is generally good, with the procedures described in detail, only a few comments will be made.

Brine composition

At the time this study was started, the only formation water analysis available from the 15/9 area was that from 15/9-7, Sleipner formation. Well 15/9-11 is on the Heimdal formation which has a different brine composition. We believe, however, that due to the high salinity of this brine the effect of brine composition will not influence the electrical properties or the waterfloods.

Porosity and permeability

The measured porosities and permeabilities are much as was expected when comparing with routine analysis, except sample 21A which has a very high porosity. In their table of the K and ϕ data Rob. Res. fail to list the measured gas permeabilities at the three mean pressures. Rob. Res. have reported the missing data in a telex of preliminary results. This has been included in the table enclosed here, together with the calculated KA.

Capillary pressure data

The capillary pressure curves are as can be expected, except for sample 21A. Because quick results was the priority in this study only 6 pressure points were taken. A saturation value at $P = 3$ bar would have been useful for drawing the capillary pressure curve. A plot of S_{wi} , the last saturation point, versus $\log K_L$ is enclosed here, and a linear regression analysis gives the equation:

$$S_{wi} = .446 - .092 \log K_L$$

Sample 21A was not included in the linear regression.

The high S_{wi} of sample 21A is to be expected; it has a high porosity when compared to the permeability, and hence a larger portion of small pores than the other samples in the study.

Electrical measurements

The formation factors compare well with the formation factors measured by Geco on another set of 1 1/2" plugs from 15/9-11, Evaluation of core data. The results are compared on the figure enclosed here and this shows a good agreement between the two analyses. Linear regression on the composite plot gives:

$$FF = 1.91 \phi^{-1.33}, \quad R^2 = .72$$

and, when forced through point (1,1):

$$FF = \phi^{-1.80}$$

The Geco report showed that the last equation is virtually constant with overburden pressure.

One should be very careful when doing and using the linear regression analyses on these sets of data. The distribution in porosity is limited.

The saturation exponents calculated by Rob. Res. are almost identical. averaging at $n = 2.22$. Only sample 21A differs from this, $n = 1.94$.



COMPANY: STATOIL FORMATION:
WELL: 15/9-11 LOCATION: NORTH SEA
FIELD: COUNTRY: NORWAY

HELIUM POROSITY AND KLINKENBERG PERMEABILITY

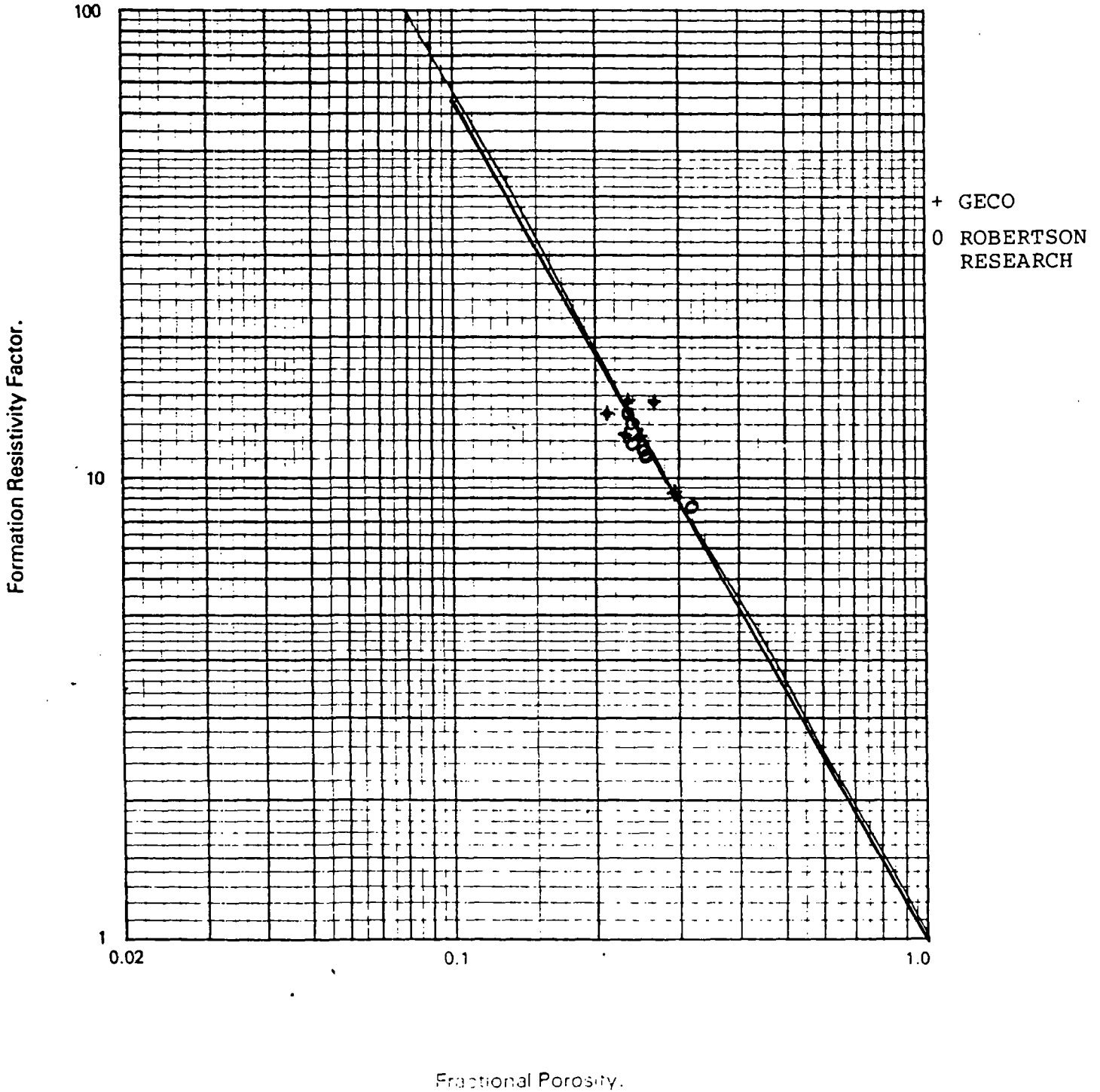
SAMPLE NUMBER	DEPTH (METRES)	POROSITY (PERCENT)	MEAN PRESSURE		KLINKENBERG PERMEABILITY	
			Bar.	K _v , md	KL (md)	Ka, md
1A	2395.25	23.8	1.023	208	189	208
			2.018	199		
			3.400	195		
2A	2395.85	23.3	1.023	156	149	156
			2.251	152		
			3.388	151		
8A	2403.45	25.3	1.023	629	596	629
			2.010	620		
			3.388	610		
12A	2413.90	25.0	1.023	585	553	585
			1.470	575		
			3.051	564		
15A	2419.80	24.0	1.468	292	269	305
			2.010	286		
			3.042	277		
18A	2422.50	25.0	1.023	177	150	177
			1.464	169		
			3.052	159		
21A	2445.90	31.8	1.466	214	198	221
			2.133	209		
			3.388	205		

Formation Factor versus Porosity

Company Statoil

Well 15/9-11 Room Condition

GECO	ROBERTSON RES.	COMPOSITE
FF = $1.00\phi^{-1.82}$, $R^2 = .55$	FF = $1.00\phi^{-1.78}$, $R^2 = .83$	FF = $1.00\phi^{-1.80}$
FF = $2.00\phi^{-1.31}$, $R^2 = .64$	FF = $1.77\phi^{-1.37}$, $R^2 = .91$	FF = $1.91\phi^{-1.33}$, $R^2 = .72$



Plot of S_{wi} versus $\log K_L$
Robertson Research data
Well 15/9-11

