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Our ref: CL 379
Your ref:

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Statoil,
Forus,
Postboks 300,
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Norway

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Gentlemen,

Electrical Resistivity Measurements - Well 34/10-4

In a letter of 21st November, 1979, we were asked to perform a series of electrical resistivity measurements on samples of core from well 34/10-4. Preliminary results have been reported by telex and we now have pleasure in presenting our final report on this work.

The opportunity to be of service is appreciated and if you have any queries concerning this report please do not hesitate to contact us.

Yours faithfully,

Jeffrey R. Hook

J.R. Hook
Chief Scientist

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COREX LABORATORIES LIMITED

ELECTRICAL RESISTIVITY MEASUREMENTS

COMPANY	STATOIL
WELL	34/10-4
LOCATION	NORTH SEA
COUNTRY	NORWAY
REPORT NO.	CL 379

CONTENTS

1. INTRODUCTION

Five plug samples from core from well 34/10-4 were received in the laboratory. The sample from depth 1836.15m was of diameter one inch and contained in a lead sleeve since the sample was unconsolidated. This size of sample was not compatible with the laboratory equipment for the required tests, so no testing was done on this sample. The remaining samples were cleaned by Soxhlet extraction using a chloroform-methanol-methylamine mixture as the refluxing solvent, dried of all solvents and the permeability to gas and helium porosity determined.

The results are given in Table 1.

TABLE 1

BASIC PROPERTIES OF SAMPLES

Company: Statoil

Well: 34/10-4

COREX SAMPLE CODE	DEPTH (m)	GAS PERM. (mD)	POROSITY (%)	GRAIN DENSITY (g cm^{-3})	LITHOLOGICAL DESCRIPTION
FN A4	1836.15	SAMPLE TOO FRIABLE TO TEST			
FN B4	1867.30	1830.	38.1	2.65	
FN C4	1869.30	2180.	38.0	2.69	
FN D4	1879.95	1440.	38.4	2.68	
FN E4	1889.48	680.	36.0	2.66	

2. ELECTRICAL RESISTIVITY MEASUREMENTS

The clean, dry samples were placed in contact with unglazed porcelain discs, mounted between end pieces in a rubber sleeve with the porcelain disc at the bottom and immersed in oil in a pressure vessel. The required hydrostatic confining pressure of 30.4 bar was applied and each sample and disc was saturated by evacuation followed by injection of a metered volume of simulated formation brine at 200 p.s.i.g. The pore pressure was then reduced to atmospheric pressure and the samples allowed to reach electrical equilibrium with the brine. The electrical resistance was then measured at five frequencies and the resistance at infinite frequency determined by extrapolation in order to correct for polarisation effects. These calculated resistances were converted to specific resistivities and the formation resistivity factor for each sample was determined by dividing by the resistivity of the brine.

The results are given in Table 2 and Figure 1.

Because of the limited range of porosity values no attempt has been made to calculate a value for the cementation exponent.

Resistivity index measurements were then made without reducing the confining pressure applied to the samples. The brine saturation of the samples was reduced by applying oil at controlled pressure to the upper end of the sample. The porcelain disc at the lower end of sample then acted as a semi-permeable diaphragm and transmitted brine but not oil so that the volume of brine expelled from the sample could be monitored and the brine saturation determined. When the volume expelled was stable the electrical resistance was measured as described above and the resistivity index determined by dividing by the sample resistance at a brine saturation of 100%. The applied oil pressure was then increased and further values of resistivity index, at a total of 6 brine saturations, obtained.

The results are given in Table 3 and Figure 2.

A least squares regression analysis of these data gave a value of 2.10 for the saturation exponent, n.

TABLE 2

FORMATION RESISTIVITY FACTOR

Company Statoil Well 34/10-4 Brine Resistivity

Net confining pressure 30.4 bar

Sample	Depth (m)	Porosity (%)	Formation Factor
FN A4	1836.15	SAMPLE TOO FRIABLE TO TEST	
FN B4	1867.30	38.1	3.31
FN C4	1869.30	38.0	4.74
FN D4	1879.95	38.4	5.27
FN E4	1889.48	36.0	6.07

FIGURE 1

FORMATION RESISTIVITY FACTOR-POROSITY CORRELATION

COMPANY Statoil FIELD

WELL 34/10-4 FORMATION

Net confining pressure: 30.4 bar

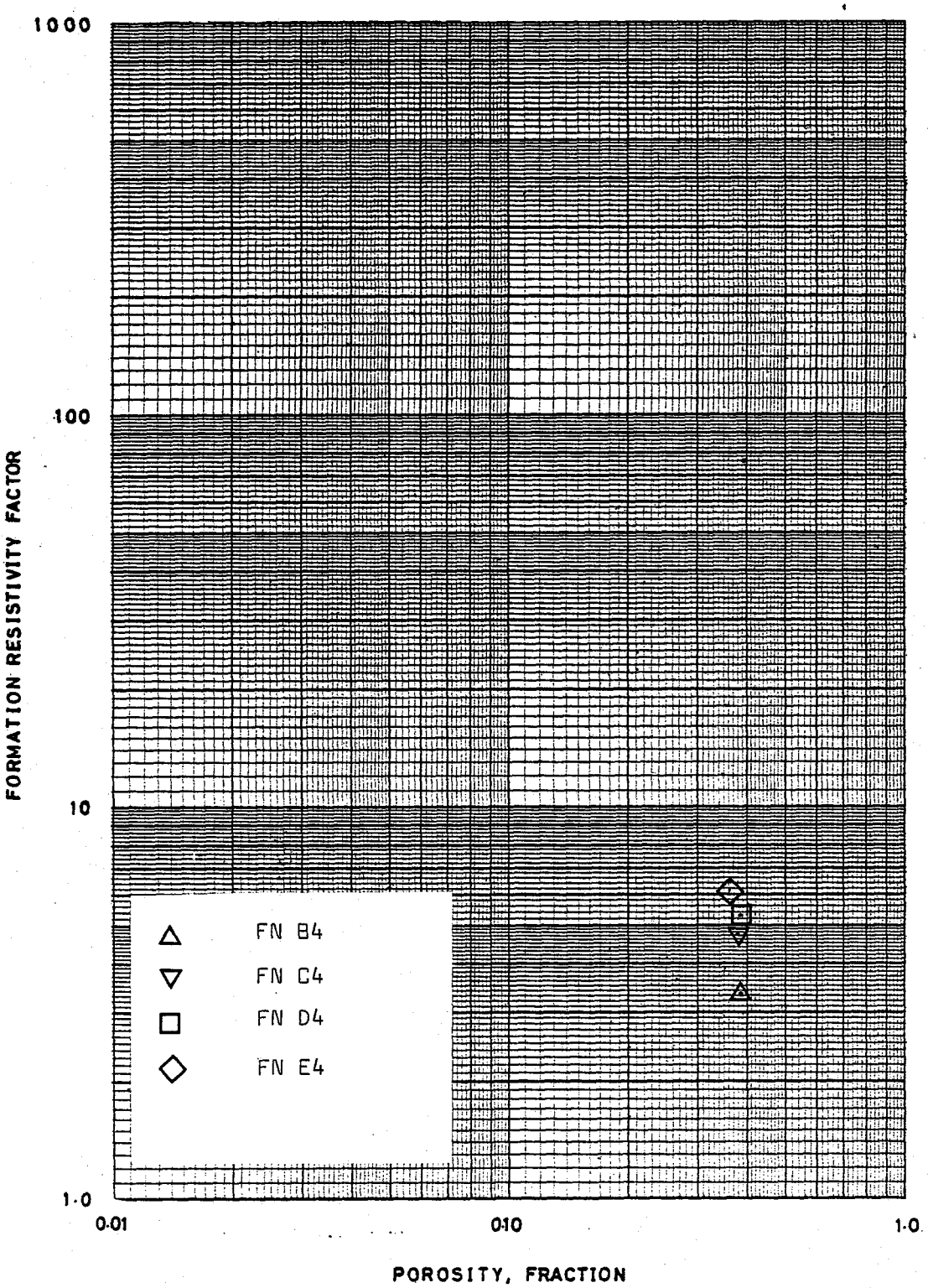

TABLE 3

RESISTIVITY INDEX

COMPANY Statoil WELL 34/10-4

NET CONFINING PRESSURE 30.4 bar

Sample	Depth(m)	Brine Saturation (%)	Resistivity Index
FN A4	1836.15	SAMPLE TOO FRIABLE TO TEST	
FN B4	1867.30	86.1	1.36
		48.2	4.48
		35.0	8.76
		29.1	12.6
		25.2	16.9
		22.5	21.8
FN C4	1869.30	66.3	2.6
		38.1	9.8
		34.4	10.3
		30.6	14.3
		25.6	23.0
		19.6	30.8
FN D4	1879.95	91.5	1.20
		67.5	2.38
		59.8	3.12
		55.2	3.67
		44.9	4.82
		33.4	7.23
FN E4	1889.48	89.0	1.36
		70.8	2.26
		54.3	3.57
		38.5	7.52
		31.2	12.7
		21.0	25.2

FIGURE 2

RESISTIVITY INDEX versus WATER SATURATION

COMPANY STATOIL FIELD

WELL 34/10-4 FORMATION

Net confining pressure: 30.4 bar