

**CORE LABORATORIES UK LTD.**  
*Petroleum Reservoir Engineering*  
**ABERDEEN, SCOTLAND**

Water Analysis  
For  
Statoil A/S  
Well: 34/10-3  
and Statfjord 'A' Platform

**CORE LABORATORIES UK LTD.**  
*Petroleum Reservoir Engineering*  
**ABERDEEN, SCOTLAND**

7th October, 1980

Statoil A/S,  
P.O. Box 300,  
4001 Stavanger,  
Norway.

Attention: Peter Read

Dear Sirs,

Enclosed is our report Ref: SCL 152/1 concerning the analysis of formation water from Well 34/10-3 and seawater from Statfjord 'A'. The compatibility of the two waters was also studied.

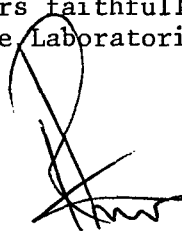
Upon receipt in the laboratory the formation water was found to contain a white precipitate. This was isolated and semi-quantitatively analysed, showing it to consist predominantly of calcium and barium ions. Thus the sample analysed was not truly representative of the formation.

Despite the fact that the formation water sample was not representative it was agreed with Statoil to perform a compatibility study. This showed the formation water and the seawater to be incompatible, the major precipitant being barium sulphate. Trace precipitation of calcium sulphate and strontium sulphate was also observed, the latter increasing as the seawater concentration increased.

Whilst the incompatibility observed was of a low order, had the test been performed with true formation water considerably more precipitation would have occurred. For example a barium concentration of 50 mg/l would produce at least 64 mg/l of precipitated salts for a solution containing 25% seawater.

We trust that this report meets with your approval and look forward to being of service in the future.

Yours faithfully,  
Core Laboratories U.K. Ltd.,



Roger J. Inns,  
Laboratory Supervisor

RJI/HG  
7 cc addressee

CORE LABORATORIES UK LTD.  
ABERDEEN, SCOTLAND

WATER ANALYSIS

COMPANY: Statoil  
SAMPLE NUMBER: 1A  
DEPTH: 71 m below sea level  
LOCATION: Offshore  
COUNTY: North Sea  
DATE SAMPLED: 5.8.80  
ANALYST: DB

WELL NUMBER:  
FORMATION:  
SAMPLED FROM: Statfjord 'A' Platform  
FIELD:  
STATE: Norway  
DATE ANALYSED: 11.8.80  
OUR FILE NUMBER: SCL 152/1

APPEARANCE BEFORE FILTRATION: Clear colourless seawater

APPEARANCE AFTER FILTRATION: Clear colourless seawater

TOTAL DISSOLVED SOLIDS MG/L (CALCULATED): 36680

SPECIFIC GRAVITY AT 60/60° F: 1.026

RESISTIVITY, OHM-METERS AT 60° F. (DETERMINED): 0.236

HYDROGEN SULPHIDE: None detected

pH: 7.9

<u>CONSTITUENTS:</u>	<u>Mg/L:</u>	<u>Meq/L:</u>
<u>CATIONS:</u>		
SODIUM	11150	485.03
POTASSIUM	420	10.74
CALCIUM	435	21.71
MAGNESIUM	1410	115.99
BARIUM	0.1	10.01
STRONTIUM	6.6	0.15
TOTAL IRON	1.9	-
DISSOLVED IRON	10.1	10.01
<u>ANIONS:</u>		
CHLORIDE	20310	572.95
SULPHATE	2800	58.30
BICARBONATE	150	2.46
CARBONATE	NIL	-
HYDROXIDE	NIL	-

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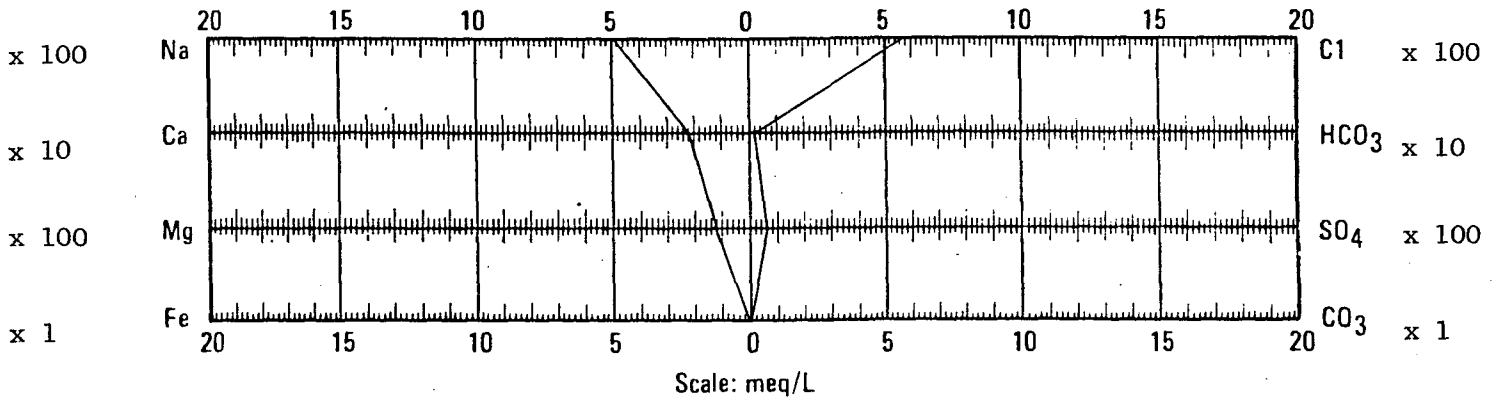
**WATER ANALYSIS**

**STIFF DIAGRAM**

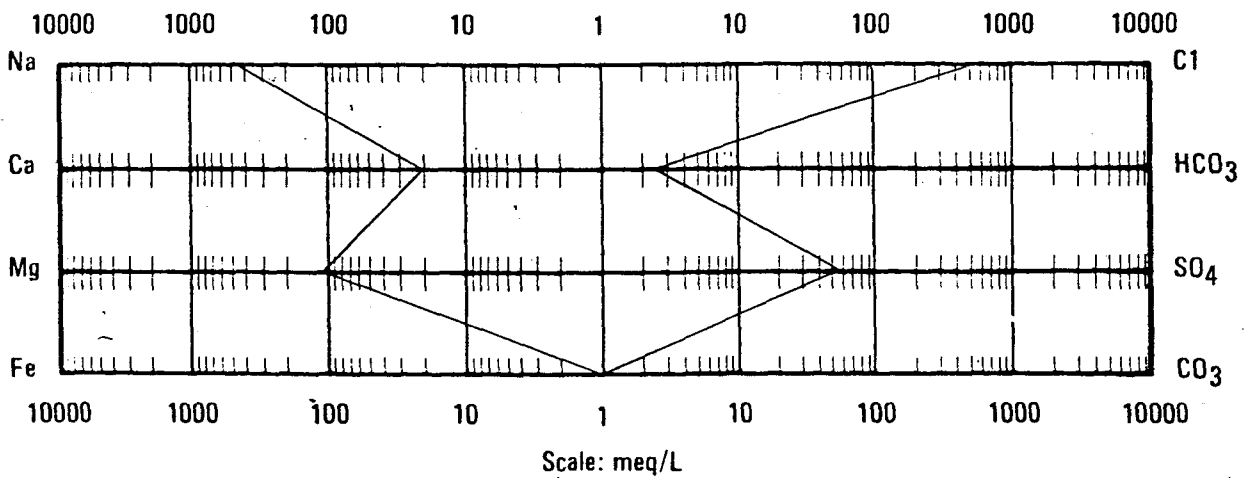
COMPANY: Statoil  
SAMPLE NO: 1A  
DEPTH: 71 m below sea level  
LOCATION: Offshore  
COUNTY: North Sea  
DATE SAMPLED: 5.8.80  
ANALYST: DB

WELL NAME:  
FORMATION:  
SAMPLED FROM: Statfjord 'A'  
FIELD: Platform  
STATE: Norway  
DATE ANALYSED: 11.8.80  
FILE: SCL 152/1

**LINEAR PLOT**



**LOGARITHMIC PLOT**



**ALL ANALYSES PERFORMED ON A FILTERED SAMPLE**

CORE LABORATORIES UK LTD.  
ABERDEEN, SCOTLAND

WATER ANALYSIS

COMPANY: Statoil  
SAMPLE NUMBER:  
DEPTH:  
LOCATION: Offshore  
COUNTY: North Sea  
DATE SAMPLED:  
ANALYST: RJS

WELL NUMBER: 34/10-3  
FORMATION:  
SAMPLED FROM:  
FIELD:  
STATE: Norway  
DATE ANALYSED: 14.8.80  
OUR FILE NUMBER: SCL 152/1

APPEARANCE BEFORE FILTRATION: Pale orange water with white precipitate

APPEARANCE AFTER FILTRATION: Clear colourless water

TOTAL DISSOLVED SOLIDS MG/L (CALCULATED): 42310

SPECIFIC GRAVITY AT 60/60° F: 1.029

RESISTIVITY, OHM-METERS AT 60° F. (DETERMINED): 0.193

HYDROGEN SULPHIDE: None detected

pH: 7.4

CONSTITUENTS:

	<u>Mg/L:</u>	<u>Meq/L:</u>
<u>CATIONS:</u>		
SODIUM	14570	633.80
POTASSIUM	330	8.44
CALCIUM	1040	51.90
MAGNESIUM	305	25.09
BARIUM	19	0.28
STRONTIUM	260	5.94
TOTAL IRON	18	-
DISSOLVED IRON	10.1	10.01
<u>ANIONS:</u>		
CHLORIDE	25600	722.18
SULPHATE	31	0.65
BICARBONATE	150	2.46
CARBONATE	NIL	NIL
HYDROXIDE	NIL	NIL

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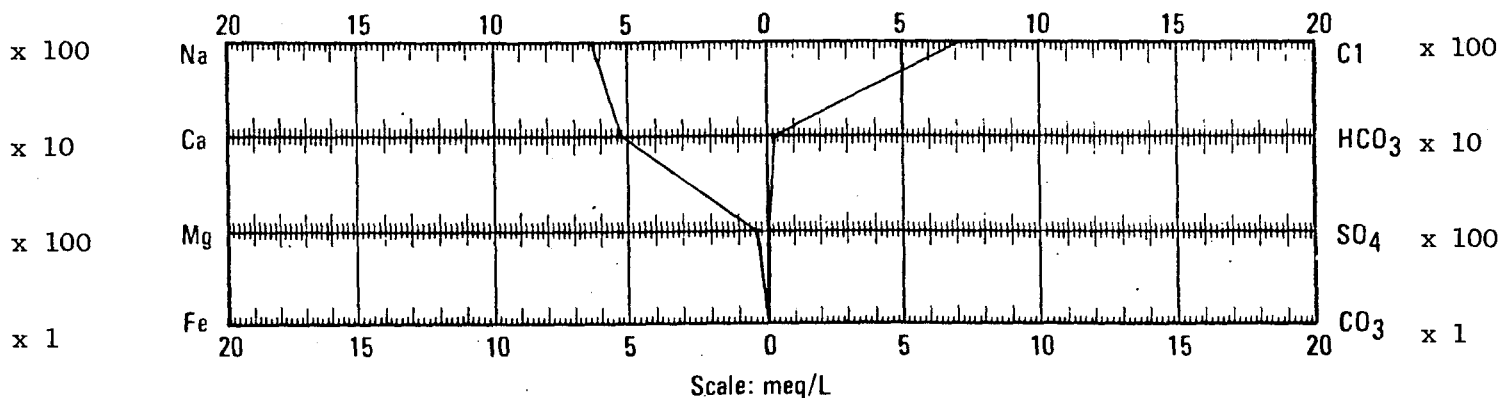
**WATER ANALYSIS**

**STIFF DIAGRAM**

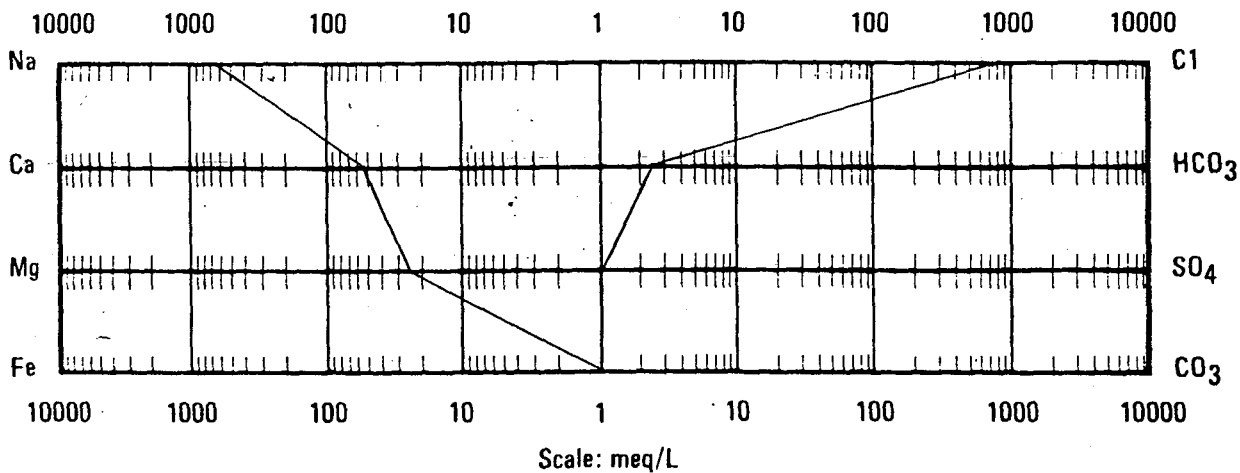
COMPANY: Statoil  
SAMPLE NO:  
DEPTH:  
LOCATION: Offshore  
COUNTY: North Sea  
DATE SAMPLED:  
ANALYST: RJS

WELL NAME: 34/10-3  
FORMATION:  
SAMPLED FROM:  
FIELD:  
STATE: Norway  
DATE ANALYSED: 14.8.80  
FILE: SCL 152/1

**LINEAR PLOT**



**LOGARITHMIC PLOT**



**ALL ANALYSES PERFORMED ON A FILTERED SAMPLE**

**CORE LABORATORIES UK LTD.**  
*Petroleum Reservoir Engineering*  
**ABERDEEN, SCOTLAND**

COMPATABILITY STUDY

COMPANY: Statoil  
WELL NO: 34/10-3  
LOCATION: Offshore  
COUNTY: North Sea  
STATE: Norway  
FILE NO: SCL 152/1

The compatability of formation water from Well 34/10-3 with seawater collected from Statfjord 'A' was assessed by mixing together varying proportions of the two waters. Prior to mixing, the samples were filtered through 0.45 micron Millipore filters thus removing any suspended matter.

Four blends were prepared, these being as follows:

Blend 1	5% seawater	95% formation water
Blend 2	10% seawater	90% formation water
Blend 3	25% seawater	75% formation water
Blend 4	50% seawater	50% formation water

Immediately after mixing, the pH of each blend was measured and the samples then sealed. Each blend was then allowed to stand undisturbed for three days when a visual appearance was recorded. The blends were then conditioned at reservoir temperature for a further twenty-four hours.

After recording the appearance, each blend was filtered through 0.45 micron Millipore filters and the concentration of precipitated salts measured. An analysis of the filtrate and precipitated salts was then performed.

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COMPANY: Statoil  
FILE NUMBER: SCL 152/1  
SUBJECT: Compatability Study

BLEND NUMBER: 1

5% SEAWATER 95% FORMATION WATER

THEORETICAL COMPOSITION:

SODIUM	14400 mg/1
POTASSIUM	335 mg/1
CALCIUM	1010 mg/1
MAGNESIUM	360 mg/1
BARIUM	18 mg/1
STRONTIUM	247 mg/1
IRON	10.1 mg/1
CHLORIDE	25335 mg/1
SULPHATE	169 mg/1
CARBONATE	NIL mg/1
BICARBONATE	150 mg/1

ANALYSIS:

pH of Blend	7.6
APPEARANCE (1) ROOM TEMPERATURE	Clear colourless water
(2) RESERVOIR TEMPERATURE	Slight precipitation, colourless
PRECIPITATED SALTS	13.5 mg/1

COMPOSITION OF PRECIPITATED SALTS:

CALCIUM	0.52 mg/1
MAGNESIUM	0.03 mg/1
STRONTIUM	0.08 mg/1
IRON	10.01 mg/1
BARIUM	6.5 mg/1
SULPHATE	5 mg/1
BARIUM CONTENT OF FILTRATE	11 mg/1



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COMPANY: Statoil  
FILE NUMBER: SCL 152/1  
SUBJECT: Compatability Study

BLEND NUMBER: 2

10% SEAWATER 90% FORMATION WATER

THEORETICAL COMPOSITION:

SODIUM	14230 mg/l
POTASSIUM	339 mg/l
CALCIUM	980 mg/l
MAGNESIUM	416 mg/l
BARIUM	17 mg/l
STRONTIUM	235 mg/l
IRON	10.1 mg/l
CHLORIDE	25070 mg/l
SULPHATE	308 mg/l
CARBONATE	NIL mg/l
BICARBONATE	150 mg/l

ANALYSIS:

pH of Blend	7.7
APPEARANCE (1) ROOM TEMPERATURE	Slight precipitation, colourless
(2) RESERVOIR TEMPERATURE	Slight precipitation, colourless
PRECIPITATED SALTS	23 mg/l

COMPOSITION OF PRECIPITATED SALTS:

CALCIUM	0.43 mg/l
MAGNESIUM	0.02 mg/l
STRONTIUM	0.42 mg/l
IRON	10.01 mg/l
BARIUM	11 mg/l
SULPHATE	10 mg/l
BARIUM CONTENT OF FILTRATE	4.5 mg/l

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COMPANY: Statoil  
FILE NUMBER: SCL 152/1  
SUBJECT: Compatability Study

BLEND NUMBER: 3

25% SEAWATER 75% FORMATION WATER

THEORETICAL COMPOSITION:

SODIUM	13715 mg/l
POTASSIUM	353 mg/l
CALCIUM	889 mg/l
MAGNESIUM	581 mg/l
BARIUM	14 mg/l
STRONTIUM	197 mg/l
IRON	10.1 mg/l
CHLORIDE	24280 mg/l
SULPHATE	708 mg/l
CARBONATE	NIL mg/l
BICARBONATE	150 mg/l

ANALYSIS:

pH of Blend	7.7
APPEARANCE (1) ROOM TEMPERATURE	Trace precipitation, colourless
(2) RESERVOIR TEMPERATURE	Trace precipitation, colourless
PRECIPITATED SALTS	24.5 mg/l
COMPOSITION OF PRECIPITATED SALTS:	
CALCIUM	0.34 mg/l
MAGNESIUM	0.03 mg/l
STRONTIUM	0.51 mg/l
IRON	10.01 mg/l
BARIUM	14 mg/l
SULPHATE	10 mg/l
BARIUM CONTENT OF FILTRATE	0.8 mg/l

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COMPANY: Statoil  
FILE NUMBER: SCL 152/1  
SUBJECT: Compatability Study

BLEND NUMBER: 4

50% SEAWATER 50% FORMATION WATER

THEORETICAL COMPOSITION:

SODIUM	12860 mg/l
POTASSIUM	375 mg/l
CALCIUM	738 mg/l
MAGNESIUM	858 mg/l
BARIUM	9.5 mg/l
STRONTIUM	133 mg/l
IRON	10.1 mg/l
CHLORIDE	22955 mg/l
SULPHATE	1416 mg/l
CARBONATE	NIL mg/l
BICARBONATE	150 mg/l

ANALYSIS:

pH of Blend	7.7
APPEARANCE (1) ROOM TEMPERATURE	Slight precipitation, colourless
(2) RESERVOIR TEMPERATURE	Slight precipitation, colourless
PRECIPITATED SALTS	21 mg/l

COMPOSITION OF PRECIPITATED SALTS:

CALCIUM	0.45 mg/l
MAGNESIUM	0.02 mg/l
STRONTIUM	2.7 mg/l
IRON	10.01 mg/l
BARIUM	8.5 mg/l
SULPHATE	10 mg/l
BARIUM CONTENT OF FILTRATE	0.4 mg/l

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Statoil A/S  
SCL 152/1

Core Laboratories U.K. Ltd.,  
Chemistry Division,



Roger J. Inns,  
Laboratory Supervisor