

Denne rapport  
tilhører

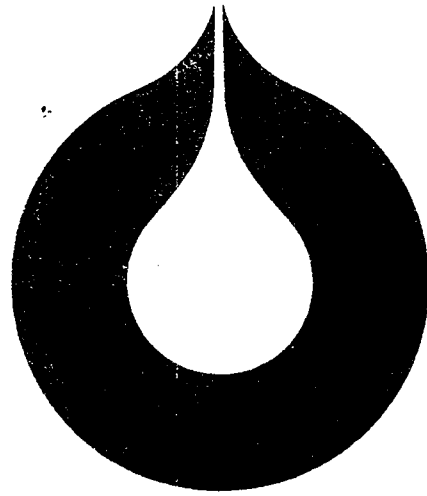


**UND DOK.SENTER**

L.NR. 12483210055

KODE Well 15/9-11 nr 19

Returneres etter bruk



**statoil**

WATER ANALYSIS

15/9-11

DST 2

STATOIL  
EXPLORATION & PRODUCTION  
LABORATORY

Aud L. Berge

APRIL 82

LAB

**Den norske stats oljeselskap a.s**

127170 ppm

63.



Classification

Requested by

Arne Singelstad - LET (SVG).

Subtitle

Water analysis from well 15/9-11 drill stem test no. 2

Co-workers

D. Malthe-Sørenssen

Title

WATER ANALYSIS  
15/9-11  
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LAB.82.12

Prepared

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## 1. INTRODUCTION

Statoil Production Laboratory (PROLAB) received two 20 l plastic containers with water from well 15/9-11 DST 2 sampled December 8th, 1981, at 1130 - 1230 and 0700 hours, at depth 2432 - 2440 m.

The water was sampled from separator after the well was shut in.

## 2. SAMPLE DESCRIPTION

The water samples contained particles and traces of an oil film, and a brown precipitate probably  $\text{Fe}(\text{OH})_3$ . A similar precipitate was formed after filtration of a sample.

## 3. METHODS OF ANALYSIS USED BY PROLAB

A sample was filtrated through a 0,45  $\mu\text{m}$  millipore filter. A brown precipitate was formed in the sample after filtration. The sample was therefore stabilized by adding concentrated nitric acid (1:1000) prior to the ion analysis.

Most of the analyses were carried out according to ASTM methods, using atomic absorption.

The following ions were determined by wet chemistry techniques:

<u>ions</u>	<u>Method</u>
$\text{SO}_4^{2-}$	ASTM D 516
$\text{Cl}^-$ (including $\text{Br}^-$ and $\text{I}^-$ )	ASTM D 512
$\text{HCO}_3^-$ , $\text{CO}_3^{2-}$ , $\text{OH}^-$	ASTM D 513 method C

Total dissolved solids was determined by drying the residue at  $120^\circ\text{C}$  over night. Density was measured by PAAR 401 densitometer. Conductivity was determined by a Philips Conductivity Meter PW 9501/01. These measurements were performed at carefully controlled temperatures.

Total organic carbon (TOC) is analysed by Carbon Determinator EC12 made by LECO Corporation.

Relativ standard deviation, RSD, was determined (experimentally and/or theoretically) on every measured value.

$$\text{RSD} = s/\bar{x} \quad \text{where} \quad \bar{x} = \frac{\sum_{i=1}^n x_i}{n}, \quad x_i \quad (i=1 \dots n)$$

is the measured values in n independent measurements

$$\text{and, } s = \left[ \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1} \right]^{1/2}$$

## 4. RESULTS

Table 1 shows the results of the formation water analyses. In table 3 is given the results of analysis of water from 15/9-11 DST 2 sampled at 8/12-81 kl. 0700.

Table 1. Results of ion analysis of water sample.

Density at 20°C, g/cm <sup>3</sup>		1.0420	
pH		6.69	
Total Dissolved solid, %		6.21	
Conductivity at 20°C, mmho/cm	80.0		63.0000 (100)
Total organic carbon, ppm	31		
<u>Ion</u>	<u>concentration (ppm)</u>	<u>eppm</u>	<u>RSD %</u>
Na <sup>+</sup>	20633.	897.5	2
K <sup>+</sup>	207.	5.3	1
Mg <sup>2+</sup>	273	22.5	1
Ca <sup>2+</sup>	2029	101.2	1.4
Ba <sup>2+</sup>	64	0.9	1.5
Sr <sup>2+</sup>	343	7.82	2
Fe <sup>n+</sup>	40.5	-	2
Li <sup>+</sup>	3.6	0.5	2
Zn <sup>2+</sup>	0.24	0.07	8
Mn <sup>n+</sup>	5.4	-	3
Si <sup>2+</sup>	9.3	1.3	4
Cr <sup>n+</sup>	<0.1	-	10
Cl <sup>-</sup> (including Br <sup>-</sup> and I <sup>-</sup> )	35495	1001.0	1
P <sub>2</sub> O <sub>5</sub> <sup>2-</sup>	0	-	1
SO <sub>4</sub> <sup>2-</sup>	15	0.4	1
CO <sub>3</sub> <sup>-</sup>	0	0	1
HCO <sub>3</sub> <sup>-</sup>	403	6.6	1
Sum ion, %	5.95		0.9
Sum anion/cation		1008.0/1037.1	1/2
Deficiency in cation		29.1	

## 5. DISCUSSION

5.1 Ion analyses

A good balance between the anions and cations was obtained as illustrated in table 1. The small difference observed is within the experimental uncertainty. The consistency in the analysis is also demonstrated by the agreement between calculated numbers for total dissolved solids (TDS). The calculated value is based on the equivalent amount (Table 2) of pure NaCl solutions found in Handbook (1).

Furthermore, there is a good agreement between TDS calculated either from the results in table 1, from the  $\text{Cl}^-$  concentration, density or conductivity.

Table 2. Comparison of calculated and measured total dissolved solid data (%).

	TDS (%)	RSD %
Residue after evaporation	6.21	1
Calculated from table 1	5.95	0.9
Calculated from $\text{Cl}^-$ ( $\text{Cl}^- \times 1.65$ )	5.86	1.0
Correlated from density	6.10	0.1
Correlated from conductivity	5.80	3
"Equivalent NaCl", from appendix 2	5.86	-

## 5.2 Comparision of water samples at kl. 0700 and kl. 1130-1230

The results of water sampled at kl. 0700 is given in table 3 and as it is seen from the table 3, the values vary little from those which where measured in the water sampled at kl. 1130-1230.

Table 3. Measured values of water sampled at kl. 0700

Density at 20°C, g/cm <sup>3</sup>	1.0422
Conductivity at 20°C, mmho/cm	81.2
<u>Ion</u>	<u>concentration (ppm)</u>
Cl <sup>-</sup>	35947

## 5.3 Comparison with mud filtrate

Unfortunately we have not been able to compare the water analysis with similar analysis on mudfiltrate.

The information we have on mudfiltrate is an extract from the mud report (appendix 1).

Table 4. Data for mud filtrate from mud report.

<u>Ion</u>	<u>Concentration (mg/l)</u>
Ca <sup>2+</sup>	160
Cl <sup>-</sup>	23000

It is seen that

Cl<sup>-</sup> sample > Cl<sup>-</sup> filtrate

Ca<sup>2+</sup> sample >> Ca<sup>2+</sup> filtrate

Cr sample < 0.1 ppm, and low content of TOC also tells that influence of filtrate is low.

## 6. CONCLUSION

It is not significant difference between the water sampled at 0.700 and water sampled at kl. 1130-1230.

The water sample from 15/9-11 DST 2 contained no or a very low amount of mud filtrate and the water should therefore be representativ for the formation.

## 7. REFERENCES

- 1) CRC Handbook of Chemistry and Physics 60th edition page D-261.
- 2) Schlumberger Log interpretationchart 1978 edition.



RECOVERY 2-3/4 GAL CHAMBER (2825.5, 2826.3, 2825.8 M RKB, RUN 1) :

- OPENING PRESSURE : 2200 PSIG
- 77 CUFT GAS
- 1 L CONDENSATE (GRAVITY = 0.712 AT 10 DEG C)

GAS ANALYSIS:

O1 : 130 000 PPM  
 O2 : 33 000 PPM  
 O3 : 26 000 PPM  
 O4 : 12000 PPM  
 CO2 : 1800 PPM

CO2 : 3.5 0/0 +/- 0.5 0/0

NO H2S

THE 1 GAL CHAMBER IS SENT ONSHORE FOR FURTHER ANALYSIS.

RECOVERY 2-3/4 GAL CHAMBER (2825.5, 2826.3, 2825.8 M RKB, RUN 2):

- OPENING PRESSURE : 50 PSIG
- 9.5 L RECOVERED WATER
- THE VOLUME OF THE RECOVERED WATER DECREASED FROM 13.5 L TO 0.5 L WHEN FLOWED OUT OF THE CHAMBER. DISSOLVED GAS GOT OUT OF SOLUTION AND THE RECOVERED WATER WHICH HAD A WHITE MILKY COLOUR BECAME BROWN. THIS MAY INDICATE A HIGH CO2 CONTENT IN THE SOLUTION GAS.

RECOVERY 1 GAL CHAMBER (2826.3, 2825.8 M RKB)

- OPENING PRESSURE : 200 PSI
- 3.0 L RECOVERED WATER.

THE RECOVERED WATER IN 1 AND 2-3/4 CHAMBERS HAD THE SAME COLOUR AND ACT SIMILAR.

LAST SAMPLE OF MUDFILTRATE (PITS) GAVE

CA++ : 160 PPM  
 CL- : 23000 PPM

RECOVERED WATER FROM THE 1 GAL CHAMBER GAVE

CA++ : 120 PPM  
 CL- : 23000 PPM

AND FROM THE 2-3/4 GAL CHAMBER:

CA++ : 900 PPM  
 CL- : 23000 PPM

NOTE: THE CA++ IS VERY SLOW REACTING.

+ ENDS +

AU  
 FFFF

RADIOTLX ROSS RIG  
 TOT 0320 UTC

## APPENDIX 2

A transformation of ionic concentrations from table 1 into "equivalent NaCl" concentration.

<u>Ion</u>	<u>Concentration (ppm)</u>	<u>Factor</u>	<u>Eq NaCl concentration</u>
NA <sup>+</sup>	20633	1.0	20633
Cl <sup>-</sup>	35495	1.0	35495
HCO <sub>3</sub> <sup>2-</sup>	403	0.21	84.6
K <sup>+</sup>	207	1.05	217.4
Mg <sup>2+</sup>	273	0.87	237.5
Ca <sup>2+</sup>	2029	0.78	1582.6
Ba <sup>2+</sup>	64	0.84	53.7
Fe <sup>n+</sup>	40.5		40.5
Sr <sup>2+</sup>	343	0.78	267.5
Li <sup>+</sup>	3.6	1.36	4.9
So <sub>4</sub> <sup>2-</sup>	15	0.37	5.6
Sum "eq NaCl" concentration %			5.86

\* See reference 2.