

6.3 MUD REPORT

- 36" hole, 30" csg.: The 36" hole was drilled with seawater with returns to the seabed. Spotted 3.2 m³ gel prior to each connection. At T.D. the hole was displaced with viscous mud twice. Materials used in this interval were bentonite, caustic soda, soda ash, Flosal and MD detergent.
- 26" hole, 20" csg.: The 26" hole was drilled with seawater with returns to the seabed. The hole was swept every third joint with prehydrated bentonite spud mud pills. At T.D. the hole was displaced with 350 m³ prehydrated bentonite - seawater mixture at a 1:1 ratio. After a short trip to the casing shoe the hole was displaced with 56 m³ of 1.15 rd prehydrated bentonite spud mud on bottom. Materials used in this interval were barite, bentonite, caustic soda, soda ash, MD detergent, calcium chloride and XC-polymer.
- 17½" hole, 13-3/8" csg: Ran riser and BOP and drilled out of the 20" casing shoe with 1.30 rd of prehydrated bentonite/Drispac/seawater mud. Drispac was added to raise the yield point to 5 - 10 pascals. Drilled to 1478 m and increased the mud weight to 1.4 rd. Gumbo was encountered and the flow line was plugged three times. To combat this problem a 2" stream of water and Unical were added. Gumbo was gathering and unloading and not giving true mud rings. Started to add Drispac SL at 5 min/sx to raise the concentration to 2 lbs/bbl, but the solids content was too high to allow that. Seawater dilution was added to reduce viscosity and control rheology. Ran only shale shaker and mud cleaner. Dumped the sand trap but it was ineffective in this

high viscosity environment. Drilled to 1712 m, ran logs and ran the 13-3/8" casing without any problems.

Materials used in this interval were barite, bentonite, caustic soda, soda ash, MD detergent, Defoamer, Unical, sodiumbicarbonate, Drispac (reg) and Drispac (SL).

12-1/4" hole:

Drilled out of the 13-3/8" casing shoe with 1.56 rd of Ligcon / seawater / prehydrated bentonite mud. Added CMC lo-vis and Ligcon because of increasing fluid losses and high pH due to cement contamination. When drilling ahead CMC lo-vis was added to control rheology, Ligcon and Unical to control the fluid losses and the gel strength and seawater for dilution. When drilling ahead after having cut core No. 1, prehydrated bentonite was added to increase the yield point, sodium bicarbonate to reduce Ca^{++} , and seawater to keep the gel strength in line and reduce the Methylene Blue Test. After having logged at 2600 m the mud weight was reduced from 1.50 rd to 1.30 rd in two steps.

When drilling ahead seawater was added to maintain weight and reduce viscosity, and Unical was added to reduce the gel strength. Materials used in this interval were barite, bentonite, caustic soda, soda ash, Unical, Ligcon, sodiumbicarbonate, CMC lo-vis, CMC hi-vis, Drispac (reg) and Deformer.

OPERATOR : Norsk Hydro a.s			SURVEY SEC. :			CASING SIZE :			DEPTH			DRLG.DAYS			BIT SIZE										
WELL : 31/4-2			FIELD : 31/4			SURFACE : 20"			972			2			26"										
CONTRACTOR: Rowan			COUNTY: North Sea			INTERMEDIATE: 13-3/8"			1697			5			17 1/2"										
ENGINEER: Danifer/Kelly/Grant			STATE :			COUNTRY: NORWAY			PRODUCTION :																
DATE	DEPTH	R.D. WT.	VISCOSITY		PV	YP	GELS		PH	FLUID LOSS	CL	ALKALINITY			CA PPM	MG PPM	RETORT			ACTIVITY		RATIO		#BBL	
			SEC.	CPS.			0	10				100 PSI API	400 PSI 300 F HT-HP	CACL			NACL	PF	PM	MF	% OIL	% SOL	% WATER		AS
25/9	0	1.01			18	36	130	170	9.0																
26	255	1.05			16	29			9.0																30"
27	310																								
28	624	P.H.B. Sweeps - Drilling with seawater																							
29	990																								
30	990																								
1/10	990	1.30	58		18	9	3	16	9.5		13000	.3			900		0	13	87						
2	1031	1.30	40		11	3	1	15	11.0	10.4	14000	.3	1.5	.5	1200		0	14	86						
3	1242	1.30	45		17	6	2	15	9.0	11.8	14500	.2	1.3	.4	1100		0	14	86						
4	1412	1.30	57		16	8	3	28	9.0	9.7	14000	.3	1.4	.4	1200		0	15	85						
5	1700	1.40	110		17	20	30	50	9.0								0	19	81						Intro. Drispac
6	1712	1.40	75		23	10	11	35	9.0	8.0	15000	.2		.4	1000		0	18	82						
7	1712	1.40	60		19	9	10	21	9.0	9.0	14000	.3		.7	800		0	15	85						
8	1712	1.40	52		25	7	2	8	9.0	8.0	14000	.2		.5	400		0	13	87						
9	1712	1.40	50		27	10	5	12	9.5	9.0	15000	.3		.5	600		0	15	85						
10	1712	1.56	50		19	3	2	14	10.5	20.0	15000	.3		.6	800		0	19	81						
11	1969	1.56	80		26	8	12	60	10.0	9.6	16000	.2		.5	500		0	30	70						Intro. OMC
12	2038	1.56	90		28	10	15	70	10.0	9.6	15000	.3		.6	380		0	30	70						
13	2171	1.50	55		19	7	5	51	10.0	9.6	18000	.3		.9	400		0	20	80						
14	2194	1.51	52		11	4	3	24	10.0	16.2	18000	.3		.9	800		0	18	82						
15	2205	1.51	48		14	6	4	30	9.5	10.2	17000	.3		1.0	800		0	16	84						
16	2222	1.52	43		22	3	3	45	9.5	12.6	17000	.3		1.0	900		0	18	82						
17	2232	1.51	45		20	4	4	20	9.5	12.6	18000	.3		1.0	1000		0	21	79						
18	2298	1.50	52		21	8	4	24	9.5	12.2	18000	.2		.8	1200		0	19	81						
19	2365	1.50	44		15	4	5	18	10.0	12.0	14500	.3		.9	600		0	20	80						
20	2490	1.50	50		14	6	5	24	9.5	9.4	16000	.3		1.0	440		0	21	79						
21	2490	1.50	45		14	5	4	24	9.5	9.4	15500	.3		.9	440		0	20	80						
22	2490	1.50	48		14	5	4	26	9.5	9.6	16000	.2		.7	480		0	21	79						

DATE SPUD: 26/9-79

DATE T.D.: 10/11-79

B.H.T

COMPLETION FLUID TYPE:

PACKER MUD TYPE:

COST

COST:

WELL DATA SHEET

OPERATOR : Norsk Hydro a.s										SURVEY SEC.:				CASING SIZE :				DEPTH				DRLG.DAYS		BIT SIZE		
WELL : 31/4-2										FIELD : 31/4				SURFACE : 20"				972				2		26"		
CONTRACTOR: Rowan										COUNTY: North Sea				INTERMEDIATE: 13-3/8"				1697				5		17 1/2"		
ENGINEER: Dunifer/Kelly/Grant										STATE :				COUNTRY: Norway				PRODUCTION :								
DATE	DEPTH	R.D. WT.	VISCOSITY		PV	YP	GELS		PH	FLUID	LOSS	CL	ALKALINITY			CA	MG	RETORT			ACTIVITY		RATIO		#BBL	CEC
			SEC.	CPS.			0	10					100 PSI API	400 PSI 300 F HT-HP	CACL			PF	PM	MF	% OIL	% SOL	% WATER	AS		
23	2594	1.50	50		13	7	8	32	10.0	9.2	36	16000	.3		.8	360		0	21	79						
24	2600	1.49	51		14	6	7	28	9.5	9.8		16000	.2		.8	400		0	21	79						
25	2600	1.50	47		15	6	7	26	9.5	9.4		16000	.3		.8	440		0	20.5	79.5						Log
26	2608	1.40	45		14	7.5	6	28	9.0	9.6		18000	.2		.7	600		0	18	82						Log
27	2656	1.31	45		13	6	4	26	10.0	8.6	24	16500	.3		.8	360		0	15	85						
28	2686	1.30	42		13	5.5	3	22	10.0	8.4	26	16500	.3		1.1	280		0	14	86						
29	2686	1.29	43		13	6	4	24	10.0	8.8	26.8	16500	.4		1.2	300		0	14	86						WOW
30	2693	1.31	42		13	5.5	4	22	10.0	8.4	26	16500	.3		1.1	320		0	14	86						
31	2708	1.31	43		12	5.5	3	26	9.5	8.2	28	16500	.3		.8	360		0	15	85						WOW
1/11	2708	1.31	44		13	4.5	3	17	9.5	8.0	27.5	16000	.25		.8	360		0	14	86						WOW
2	2708	1.31	45		14	5.0	3	16	9.5	8.1	28	16500	.3		.8	350		0	14	86						WOW
3	2753	1.31	45		16	6.5	5	19	9.5	8.1	27	17000	.25		.8	290		0	14	86						
4	2769	1.31	47		16	6.5	6	19	9.5	8.5	26.2	17500	.25		.9	350		0	14	86						WOW
5	2769	1.31	47		16	6.5	7	17	9.5	8.3	26	19000	.25		.8	300		0	15	85						WOW
6	2769	1.31	47		17	6.5	6	19	9.5	8.5	26.5	17500	.25		.8	300		0	15	85						Pulled riser
7	2769	1.31	51		18	7.5	6	19	9.5	8.3	27	17500	.3		.8	300		0	14	86						
8	2826	1.31	45		17	7.0	5	24	10.3	7.9	26.2	17500	.4		1.0	260		0	16	84						
9	2876	1.31	45		17	6.0	6	28	10.0	7.9	25	15000	.3		.85	210		0	16	84						
10	2900	1.31	45		16	6.0	4	19	10.0	7.9	25	18000	.3		.85	250		0	16	84						
11	2900	1.31	46		17	6.5	4	19	10.0	7.8	25.2	18000	.25		.8	210		0	16	84						Log
12	2900	1.31	46		16	6.0	4	19	9.5	7.7	28	18000	.2		.8	290		0	17	83						
13	2900	1.31	46		17	6.0	5	20	9.5	7.7	28	18000	.2		.8	290		0	17	83						
												18000	.2		.8	270		0	17	83						Log

2. RFT RESULTS

The RFT program incorporated a total of 3 runs, run No 1 over the interval 2111-2170,5 mrkb, run No 2 from 2297 to 2523,5 mrkb and run No 3 from 1850-2858,5 mrkb.

No specific information could be evaluated from the first run due to tight formation or seal failures.

Gradients evaluated from run No 2 and No 3 correspond very well, and Fig. C1 shows the RFT-pressures vs. depth from run No 3. The evaluated gradient of .447 psi/ft shows no overpressures in these drilled formations. Indications of higher pressures were encountered in the Triassic formation. The explanation for the recorded overpressures is that in tight formations the overpressure due to mud invasion does not have time to be entirely released before RFT measurements are finalized.

Two samples which were taken at 2326,5 mrkb, run No 2, and at 2346 mrkb, run No 3, confirm the log interpretation.

RFT RESULTS

Well:

31/4-2

RUN 1

DEPTH (KB)	FORMATION PRESSURE
1 2111 m.	TIGHT
2 2110 m.	TIGHT
3 2049 m.	TIGHT
4 2047 m.	TIGHT
5 2170,5 m.	SEAL FAILURE
6 2170 m.	TIGHT
7 2170,4 m.	SEAL FAILURE
8 2171 m.	TIGHT
9 2170,6 m.	TIGHT
10 2170,5 m.	TIGHT

RUN 2

DEPTH (KB)	FORMATION PRESSURE
1 2297 m.	TIGHT
2 2325,5 m.	3396 PSIG
3 2327 m.	3393 PSIG
4 2346 m.	3420 PSIG
5 2352,5 m.	3426 PSIG
6 2480,5 m.	3650 PSIG
7 2484 m.	3655 PSIG
8 2492,2 m.	3664 PSIG
9 2502,5 m.	3678 PSIG
10 2523,5 m.	3718 PSIG

TOOK SEGREGATED SAMPLE AT 2326,5 m.
RECOVERED 5800 cc. GAS.

RUN 3

DEPTH (KB)	FORMATION PRESSURE
1 1850 m.	TIGHT
2 1887,5 m.	TIGHT
3 2045,5 m.	TIGHT
4 2050 m.	TIGHT
5 2063 m.	TIGHT
6 2108,5 m.	TIGHT
7 2113,2 m.	TIGHT
8 2170 m.	TIGHT
9 2197 m.	3255 PSIG
10 2202 m.	3268 PSIG
10a 2202.2 m.	3268 PSIG
11 2346 m.	3428 PSIG
12 2374,5 m.	TIGHT
12a 2374 m.	TIGHT
12b 2375 m.	TIGHT
13 2648.5 m.	3910 PSIG
14 2661 m.	SEAL FAILURE
14a 2660.5 m.	3926 PSIG
15 2681 m.	3956 PSIG
16 2697.5 m.	3980 PSIG
17 2710 m.	3998 PSIG
18 2734.5 m.	4033 PSIG
19 2760.5 m.	4070 PSIG
20 2784 m.	4103 PSIG
21 2817.7 m.	SEAL FAILURE
21a 2817.2 m.	SEAL FAILURE
21b 2818.3 m.	4166 PSIG
22 2833.3 m.	4251 PSIG
23 2846 m.	4376 PSIG
23a 2846.5 m.	4282 PSIG
24 2858.5 m.	4219 PSIG

TOOK SEGREGATED SAMPLE AT 2346 m
RECOVERED 400 cc GAS AND .5 cc OF
THICK OIL.

Checked: S.I. Leivestad
Date: 20.5.80

1. 2326,5 mrkb, (gas effect on logs)
 (Recovery: Approx. 5800 cc of gas)
 The final composition is as follows:

Component	Separator	Separator	Well Stream	
	liquid	gas	mol. %	
	<u>mol. %</u>	<u>mol. %</u>	<u>GPM</u>	<u>mol. %</u>
Hydrogren sulphide	NIL	NIL		NIL
Carbon dioxide	NIL	1.38		1.36
Nigrogen	NIL	1.33		1.31
methane	trace	80.23		79.11
ethane	trace	9.81		9.67
propane	.24	4.42	1.216	4.36
iso-butane	.42	.53	.173	0.53
n-butane	1.67	1.22	.385	1.23
iso-pentone	1.82	.27	.099	.29
n-pentane	3,63	.32	.116	.37
hexanes	8.27	.23	.094	.34
heptanes plus	<u>83.95</u>	<u>.26</u>	<u>.118</u>	<u>1.43</u>
	100.00	100.00	2.201	100.00

Properties of Heptanes plus:

API gravity:	52,3°	60°F	
Spesific gravity:	.7708	60/60°F	
Molecular weight:	<u>128</u>	<u>103</u>	<u>105</u>

Calculated separator gas gravity: .713

Primary separator gas/separator liquid ratio: 54349 SCF/STB

2. 2346 mrkb, (no gas effect on logs).

(Recovery: approx. 400 cc of gas and .500 of thick oil).

The final composition of the recovered gas is as follows:

Component	<u>Mol. %</u>	<u>GPM</u>
hydrogren sulphide	NIL	
carbon dioxide	.15	
nitrogen	15.97	
methane	62.31	
ethane	11.71	
propane	5.84	1.607
iso-butane	.63	.206
n-butane	1.44	.454
iso-pentane	.40	.146
n-pentane	.86	.312
hexanes	.52	.212
heptanes	<u>.17</u>	<u>.077</u>
	100.00	3.014

Calculated gas gravity: .807.



Norsk Hydro

Oslo - Norway

WELL 31/4-2

FORMATION PRESSURE vs DEPTH FROM THE REPEAT FORMATION TESTS.

FIG. C1

Contour interval	Interpreted by DRO.	Date 4.6.80
Scale	Drawn by BEH.	Revised
		File no.

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