(((
(ooo) HYDRO

FORMATION FLUID SAMPLING

Well : 30/9-13S

Rig : Vildkat Explorer

Pretest No. : 22	Sample Depth : 3097.1m	Witnesses : Gundeso/Bryn

Run No. :2A	Sample No. : 22	1st Chamber	2nd Chamber	3rd Chamber
Chamber volume (gals/litres)		2-3/4 gal	1 gal	
Chamber No.		RFS BB 1306	RFS AB 1195	
Filling time (mins.)		17	9	
Shut in press. (bar)/T oC		313.61 / 99.6	313.61 / 99.6	/
Chamber press. (surf bar)/T oC		20.7 / 12	6.9 / 12	/
Gas volume (SCF/Sm3)		1.0 / 0.03	0.25 / 0.0071	
Oil volume (litres)		0	0	
Filtrate gravity (gm/cc)		1.05	1.05	
Water / Filtrate (litres)		10.1	3.75	
Water / Filtrate PPM CL-		33,000	33,000	
Water filtrate pH/pF/Ca++ ppm		7.2 / 0 /280	7.3 / 0 / 270	/ /
Mud filtrate PPM CL-		36,000	36,000	
Mud filtrate pH/pF/Ca++		8.2 / 0 / 400	8.2 / 0 / 400	/ /
Gas composition %	C1	278290	239258	
	C2	50441	45818	
	C3	5037	9958	
	IC4	606	1961	
	NC4	81	3626	
	H2S			
	CO2			

Remarks :

Gas ratio: 4.95.
A hydrocarbon-like skim was observed on the surface of both samples.

(((
(ooo) HYDRO

FORMATION FLUID SAMPLING

Well : 30/9-13S

Rig : Vildkat Explorer

Pretest No. : 23	Sample Depth : 3025.6 m	Witnesses : Gundeso/Bulman

Run No. : 2B	Sample No. :	1st Chamber	2nd Chamber	3rd Chamber
Chamber volume (gals)		2 3/4	1	
Chamber No.		RFSBB 1306	RFSAB 1195	
Filling time (mins.)		9	8	
Shut in press. (bar)/T deg C		309.2 / 100.2	309.1 / 100.2	/
Chamber press. (surf bar)/T		34.5 / 11	/	/
Gas volume (SCF/Sm3)		1 / 0.03		
Oil volume (litres)		0.05		
Oil gravity (API/gm/cc)		Not measurable		
Water / Filtrate (litres)		9.95		
Water / Filtrate PPM CL-		21300		
Water filtrate pH/pF/Ca++		6.6 / 0 / 380	/ /	/ /
Mud filtrate PPM CL-		36000		
Mud filtrate pH/pF/Ca++		7.9 / 0 / 400	/ /	/ /
Gas composition	C1	264275		
	C2	83130		
	C3	20410		
	IC4	3705		
	NC4	7335		
	H2S			
	CO2			

Remarks :

Oil film on 2 3/4 gal sample. Bright yellow-white direct fluorescence.

Gas ratio: 2.3
Filtrate density 1.03 g/cc

(((
(ooo)
HYDRO

FORMATION FLUID SAMPLING

Well : 30/9-13S

Rig : Vildkat Explorer

Pretest No. : 10	Sample Depth : 3997.1m	Witnesses : Tammemagi / Stump

Run No. :3D	Sample No. : 1	1st Chamber	2nd Chamber	3rd Chamber
Chamber volume (gals/litres)		2-3/4 gal	1 gal	
Chamber No.		RFS-BB1342	RFS-AB1170	
Filling time (mins.)		43	20	
Shut in press. (bar)/T °C		467.9 / N/A	467.8 / N/A	/
Chamber press. (surf bar)/T °C		34.5 / 17	31.0 / 17	/
Gas volume (SCF/Sm^3)		2.0 / 0.06	0.4 / 0.01	
Oil volume (litres)		0	0	
Filtrate gravity (gm/cc)		1.03	1.04	
Water / Filtrate (litres)		9.2	3.2	
Water / Filtrate PPM CL-		29,000	32,000	
Water filtrate pH/pF/Ca++ ppm		6.4 / 0 / 1080	6.0 / 0 / 1680	/ /
Mud filtrate PPM CL-		25,000	25,000	
Mud filtrate pH/pF/Ca++		8.5 / 0.1 / 300	8.5 / 0.1 / 300	/ /
Gas composition %	C_1	216,567	209,945	
	C_2	21,757	17,667	
	C_3	2,473	1,878	
	IC_4	385	227	
	NC_4	213	85	
	H_2S	0	0	
	CO_2	0	0	

Remarks :

- Sample taken after it was accertained that the RFT was malfunctioning.
- Pressures unreliable and temperature failed.
- Pressure dropped to zero immediately upon opening each chamber.
- Gas composition averaged from three analyses of each chamber.
- Cl- of mud filtrate from last circulation before RFT. Cl- on 28/08/91 whilst drilling was 29,000 ppm. It was 32,000 ppm whilst drilling to 3650m and then decreased slowly.

(((
(ooo)
HYDRO

FORMATION FLUID SAMPLING

Well : 30/9-13S

Rig : Vildkat Explorer

Pretest No. : 10	Sample Depth : 4012.8 m	Witnesses : Tammemagi/Henderson

Run No. : 3E	Sample No. : 1	1st Chamber	2nd Chamber	3rd Chamber
Chamber volume (gals)		2 3/4	1	
Chamber No.		RFS-BB 1342	RFS-AB 1170	
Filling time (mins.)		** 32		
Shut in press. (bar)/T deg C		470.29		
Chamber press. (surf bar)/T		0		
Gas volume (SCF/Sm3)		0		
Oil volume (litres)		0		
Oil gravity (API/gm/cc)		-		
Water / Filtrate (litres)		1.75		
Water / Filtrate PPM CL-		25000		
Water filtrate pH/pF/Ca++		7.4/0.00/440		
Mud filtrate PPM CL-		25000		
Mud filtrate pH/pF/Ca++		8.4/0.05/300		
Gas composition	C1	-		
	C2	-		
	C3	-		
	IC4	-		
	NC4	-		
	H2S	-		
	CO2	-		

Remarks :

**Chamber not filled - sampling aborted due to low sampling pressure.

HYDRO WELL TEST RESULT

WELL: 30/9-13S

TEST NO.	1	2	3
PERFORATED INTERVAL	3086.5-3094.5 m MD RKB	3023.9-3072.9 m MD RKB	2958.1-2986.1 m MD RKB
CHOKE SIZE (mm)	19.05	19.05	28.575
OIL/COND. FLOW RATE /Sm^3/D)	792	535	90
GAS FLOW RATE (Sm^3/D)	120983	107458	459522
GOR (Sm^3/Sm^3)	153	201	5099
OIL/COND. GRAVITY (g/cc) @ 15°C	0.85	0.84	0.780
GAS GRAVITY (air=1)	0.73	0.76	0.720
FWHP (bar)	84.1	61.3	51.9
SIWHP(bar) (DST # 3 : Surface shut in)	79.8	73.3	221.2
FWHT (deg C)	63.6	52.4	43.4
BHFT (deg C)	114.2	110.7	86.3
BHFP (bar)	252.4	185.6	100.5
BHSIP (bar)	304.2	304.7	300.1
BS&W (%)	Trace	0.0	6.0
CO2 (%) (Max)	2.8	2.5	2.0
H2S (ppm) (Max)	2.3	2.5	1.4
K (mD)	356	19	*
S (%)	+ 9.2	+ 11.5	*
PI (SM^3/D/BAR))	4.75	4.35	*
Gauge: HMR-205/Read-04/HMR-211	3041.84	2977.19	2902.470
DEPTH OF BH MEASUREMENTS	m MD RKB	m MD RKB	m MD RKB

Note: All flowing data from end of Main Flow Period!

* Details will be issued in the test report

Daily mud properties — Date 25/2-1992

System : BORE

Well: 30/9-13S

Mud Contractor: BAROID

Data: "Mid depth" from table 3, otherwise from table 14.

Date	Mid. depth m,MD	Mud Dens. (SG)	PV cp	YP Pa	GEL 0 Pa	GEL 10 Pa	pH	100 psi (cc)	HP/HT (cc)	Cl- inn/out mg/l	Alkalinity Pf	Alkalinity Pm	Alkalinity Mf	Ca++ inn/out mg/l	Oil %	Sol %	H2O %	V.G. meter at 115 gr. F 600 rpm	300 rpm	200 rpm	100 rpm	6 rpm	3 rpm	Mud Type
910705	217	1.05	0	0			9.5																	SPUD
910708	1030	1.20	0	0																				SPUD
910709	1030	1.20	0	0																				SPUD
910710	1030	1.10	11	7	3	4	9.5	12.0			0.10		0.50		0			35	24	19	13	4	3	KCL
910711	1052	1.10	11	9	2	0	9.2	8.0		51000/51000	0.10		0.40	200/200	6			40	29	20	15	4	3	KCL
910712	1205	1.12	14	14	2	2	8.1	6.4		60000/60000	0.10		0.40	200/200	0	3	97	44	30	23	16	5	3	KCL
910713	1486	1.20	16	11	2	3	8.7	5.2		78000/78000	0.10		0.30	320/320	0	7	93	53	37	20	21	5	4	KCL
910714	1492	1.20	16	11	2	3	8.5	5.0		76000/76000	0.10		0.30	280/280	0	7	93	53	37	30	21	5	4	KCL
910715	1685	1.32	20	12	3	3	8.1	4.4		71000/71000			0.40			8		64	44	34	24	6	4	KCL
910716	1822	1.33	20	11	2	3	8.1	4.5		69000/69000	0.10		0.30	360/360		11		62	42	33	22	5	4	POLYMER
910717	1960	1.33	22	13	3	4	7.9	4.2		64000/64000	0.10		0.40	560/560		12		69	47	36	24	6	5	KCL
910718	2135	1.32	23	14	3	4	8.2	3.8		62000/62000	0.40		0.80	520/520		12		74	51	40	27	7	5	KCL
910719	2249	1.32	22	16	3	4	8.0	3.8		61000/61000	0.03		0.75	460/460	0	11	89	81	56	44	29	6	5	KCL
910720	2498	1.31	23	15	3	4	8.0	3.8		62000/62000	0.03		0.80	520/520	0	11	89	81	56	44	28	7	3	KCL
910721	2498	1.32	24	13	3	4	8.0	3.8		62000/62000	0.30		1.50	520/520	0	11	89	73	49	39	26	7	5	KCL
910722	2521	1.32	22	11	2	4	8.3	3.8		62000/62000	0.10		0.60	500/500	0	11	89	66	44	24	23	6	4	KCL
910723	2579	1.32	19	10	2	3	79.0	35.0		70000/70000	0.10		0.50	400/400				58	39	30	19	5	4	KCL
910724	2605	1.32	20	10	2	3	8.2	3.8		65000/65000	0.10		0.50	580/580		13		60	40	31	22	6	5	KCL
910725	2610	1.33	18	10	2	3	8.0	3.9		65000/65000	0.10		0.50	620/620		12		56	38	30	21	6	4	KCL
910726	2675	1.35	19	10	3	4	8.0	4.1		67000/67000	0.10		0.50	680/680		12		58	39	31	21	6	4	KCL
910727	2783	1.35	19	9	3	7	8.0	4.5		67000/67000	0.10		0.70	400/400		12		56	37	28	20	6	4	KCL
910728	2851	1.35	20	9	3	8	7.9	4.5		65000/65000	0.10		0.70	500/500		13		58	38	30	20	5	4	KCL
910729	2963	1.35	23	12	3	7	7.9	4.5		65000/65000	0.10		0.70	400/400		13		70	47	36	25	7	6	KCL
910730	3031	1.35	21	9	2	8	7.9	4.4		66000/66000	0.10		0.50	600/600		13		60	39	31	21	6	4	KCL
910731	3031	1.35	20	9	2	8	7.9	4.5		66000/66000	0.10		0.50	580/580	0	13	87	58	38	29	19	5	4	KCL
910801	2880	1.35	21	11	3	8	7.9	4.8		66000/66000	0.50		0.50	600/600	0	13	87	63	42	33	23	6	5	KCL
910802	2890	1.35	20	11	3	9	8.3	5.2		66000/66000	0.10		0.50	620/620	0	13	87	62	42	33	23	6	4	KCL
910803	2890	1.22	12	7	5	1	9.3	4.0		42000/42000	1.50	0.30	1.20	200/200	0	10	90	38	26	20	12	4	3	LIGNO
910804	2921	1.22	14	9	5	3	9.0	4.0	12.0	50000/50000	0.30	0.50	0.90	600/600	0	10	90	46	32	26	18	5	4	KCL
910805	2975	1.23	15	8	2	2	8.0	5.0	14.0	39000/39000	0.50	0.50	1.10	680/680	0	12	88	45	30	24	16	4	3	KCL
910806	2993	1.22	15	8	2	2	8.0	4.0	12.0	39000/39000	0.50		1.10	660/660	0	12	88	45	30	27	15	4	3	KCL
910807	3033	1.22	20	7	5	2	8.0	3.0	12.0	41000/41000	0.10		1.40	600/600	0	12	88	53	33	26	17	4	3	KCL
910808	3067	1.22	15	6	1	2	8.2	4.0	15.0	43000/43000	0.10		1.20	600/600	0	12	88	41	26	20	14	3	2	KCL
910809	3095	1.22	12	6	1	2	8.1	3.0	16.0	37000/37000	0.10		1.20	600/600	0	12	88	36	24	18	12	3	2	KCL
910810	3122	1.22	14	7	2	3	8.3	4.0	17.2	40000/40000	0.10		1.70	520/520	0	12	88	41	27	21	13	4	3	KCL
910811	3164	1.22	12	7	2	3	8.4	3.4	13.0	36000/36000	0.10	0.10	1.50	440/440	0	15	85	37	25	19	13	3	3	KCL
910812	3194	1.22	14	8	2	4	8.5	3.6	15.2	38000/38000	0.10	0.10	1.70	440/440	0	12	88	43	29	23	16	4	3	THERMA
910813	3223	1.22	13	7	2	4	8.4	4.0	15.5	35000/35000	0.10		1.50	440/440	0	12	88	39	26	21	15	4	3	THERMA
910814	3316	1.22	12	7	2	4	8.1	4.3	15.4	36000/36000	0.10		1.50	400/400	0	12	88	39	25	20	13	3	3	THERMA
910815	3385	1.26	16	7	2	6	8.3	3.5	15.0	37000/37000	0.10	0.10	1.60	400/400	0	16	84	45	29	22	15	3	3	THERMA
910816	3396	1.26	15	7	2	6	8.2	3.9	14.0	31000/31000	0.00	0.00	1.10	400/400	0	14	86	43	28	23	16	3	3	THERMA
910817	3396	1.26	15	7	2	6	8.2	3.9	14.0	31000/31000	0.00	0.00	1.10	400/400	0	14	86	43	28	23	16	3	3	THERMA
910818	3396	1.26	15	6	2	6	8.2	3.8	14.0	37000/37000	0.00	0.00	1.10	400/400	0	14	86	41	27	21	14	3	3	THERMA

Table B-10 Daily mud properties

(((
(ooo)
Norsk Hydro

Daily mud properties — Da 25/2

Date 25/2-1992

System : BORE

Well: 30/9-13S
Mud Contractor: BAROID
Data: "Mid depth" from table 3, otherwise from table 14. 14. 4

Date	Mid. depth m,MD	Mud Dens. (SG)	PV cp	YP Pa	GEL 0 Pa	GEL 10 Pa	pH	100 psi (cc)	HP/HT (cc)	Cl- inn/out mg/l	Alkalinity Pf	Pm	Mf	Ca++ inn/out mg/l	Oil %	Sol %	H2O %	V.G. meter at 115 gr. F 600 rpm	300 rpm	200 rpm	100 rpm	6 rpm	3 rpm	Mud Type
910819	3396	1.26	14	6	1	6	7.9	3.9	14.0	36000/36000	0.00	0.00	1.80	480/480	0	14	86	40	26	19	13	3	2	LIGNO
910820	3396	1.26	13	5	1	4	7.9	3.9	15.0	36000/36000	0.00	0.00	1.70	400/400	0	14	86	36	23	17	12	3	2	LIGNO
910821	3399	1.26	15	7	2	7	8.3	3.9	15.0	35000/35000	0.10	0.00	1.70	400/400	0	15	85	44	29	21	15	3	3	LIGNO
910822	3425	1.26	16	7	2	9	8.0	3.9	14.6	35000/35000		0.00	1.90	380/380	0	15	85	46	30	23	16	4	3	TERMADRILL
910823	3544	1.26	16	7	2	10	8.5	4.2	15.0	33000/33000	0.10	0.00	2.10	320/320	0	16	84	46	30	23	16	5	3	TERMADRILL
910824	3597	1.26	15	6	2	11	8.1	4.1	14.0	32000/32000	0.10	0.00	1.90	380/380	0	16	84	42	27	21	14	4	3	TERMADRILL
910825	3757	1.26	20	8	3	12	8.7	4.1	13.8	30000/30000	0.10	0.10	2.40	260/260	0	18	82	55	35	26	18	4	3	TERMADRILL
910826	3860	1.26	18	7	2	11	8.5	4.3	15.0	29000/29000	0.10	0.10	2.30	300/300	0	16	84	49	31	23	15	3	8	LIGNO
910827	3963	1.26	22	8	3	13	8.5	4.5	15.8	28000/28000	0.10		2.40	260/260	0	16	84	60	38	30	20	6	4	LIGNO
910828	3991	1.26	20	8	3	11	9.0	3.8	14.4	29000/29000	0.30	0.10	2.80	200/200	0	16	84	55	35	26	17	5	4	LIGNO
910829	4027	1.26	18	6	2	10	9.1	3.8	15.0	26000/26000	0.30	0.40	2.60	320/320	0	15	85	48	30	22	15	4	3	LIGNO
910830	4027	1.26	19	7	2	11	9.1	3.8	14.8	26000/26000	0.30	0.40	2.60	300/300	0	15	85	52	33	25	17	5	4	LIGNO
910831	4027	1.26	20	6	2	10	8.5	3.5	13.8	26000/26000	0.10		2.50	300/300	0	15	85	52	32	24	16	4	3	LIGNO
910901	4027	1.25	19	8	3	13	8.5	3.7	14.6	25000/25000	0.10		2.50	300/300	0	15	85	54	35	27	19	5	4	LIGNO
910902	4027	1.25	19	8	3	13	8.5	3.7	14.6	25000/25000	0.10	0.10	2.50	300/300	0	14	86	54	35	27	19	5	4	THERMADRILL
910903	4027	1.27	20	8	3	13	8.3	3.9	15.0	25000/25000	0.10		2.40	300/300	0	14	86	56	36	27	20	5	4	THERMADRILL
910905	4027	1.27	14	8	4	15	8.0	3.1	12.2	25000/25000	0.10		2.50	440/440	0	14	86	43	29	24	17	11	9	THERMADRILL
910906	3328	1.26	12	7	4	12	8.0	3.2	11.6	22000/22000	0.00	0.00	2.00	440/440	0	14	86	37	25	21	16	9	9	THERMADRILL
910907	3328	1.26	11	7	4	17	8.3	3.6	11.8	22000/22000	0.00	0.20	2.00	440/440	0	14	86	36	35	21	16	8	8	THERMADRILL
910908	3328	1.26	11	5	3	11	8.4	3.6	11.4	22000/22000	0.10	0.50	2.00	480/480	0	14	86	32	21	17	14	7	6	THERMADRILL
910909	3328	1.26	11	5	3	11	8.5	3.6	11.4	21000/21000	0.10	0.30	2.00	480/480	0	14	86	32	21	17	14	7	6	THERMADRILL
910910	3328	1.26	11	5	3	11	8.5	3.6	11.5	22000/22000	0.10	0.30	2.00	440/440	0	14	86	32	21	17	14	7	6	THERMADRILL
910911	3328	1.26	10	5	1	6	9.3	4.1		22000/22000	0.10	0.30	2.30	540/540	0	14	86	30	20	12	6	2	2	THERMADRILL
910912	3328	1.26	10	4	1	5	9.1	4.1		20000/20000	0.10	0.30	2.20	540/540	0	14	86	28	18	12	7	2	2	THERMADRILL
910913	3328	1.26	11	5	2	6	9.1	4.1		20000/20000	0.10	0.30	2.40	540/540	0	14	86	37	21	14	7	3	3	THERMADRILL
910914	3328	1.26	12	7	2	7	9.0	4.1		20000/20000	0.10	0.30	2.40	540/540	0	14	86	38	26	17	10	4	3	THERMADRILL
910915	3328	1.26	8	6	2	4	7.5	4.4		13000/13000			0.40	600/600	0	9	91	27	19	16	12	4	3	THERMADRILL
910916	3328	1.26	8	6	2	4	7.6	4.4		13000/13000			0.40	600/600	0	10	90	27	19	16	12	4	3	THERMADRILL
910917	3328	1.26	12	7	3	9	8.4	4.3					2.00		0	14	86	38	26	22	16	7	6	THERMADRILL
910918	3328	1.26	12	7	3	9	8.3	4.2		18000/18000			1.90	660/660		14		38	26	22	15	6	5	THERMADRILL
910919	3328	1.26	8	8	3	8	8.3	4.3		18000/18000			1.90	660/660		13		35	25	21	16	6	5	THERMADRILL
910920	3328	1.26	10	6	2	3	8.0	4.6		16000/16000			1.80	640/640		13		32	22	17	14	5	3	THERMADRILL
910921	3328	1.26	9	6	3	11	8.0	4.9		13000/13000			2.20	760/760		14		30	21	16	13	7	5	THERMADRILL
910922	3083	1.26	8	6	4	11	8.0	4.8		13000/13000			2.30	380/380		14		28	20	17	13	7	6	THERMADRILL
910923	3083	1.26	7	7	4	11	8.0	4.8		13000/13000			2.30	380/380		14		28	21	17	13	7	6	THERMADRILL
910924	3083	1.26	8	6	4	11	8.0	4.8		13000/13000			2.30	380/380		14		28	20	17	13	7	6	THERMADRILL
910925	3083	1.26	8	8	5	12	7.9	4.7		14000/14000			2.30	420/420		14		32	24	21	18	12	10	THERMADRILL
910926	3083	1.26	8	8	5	12	7.9	4.8		14000/14000			2.30	440/440		14		32	24	21	18	12	10	THERMADRILL
910927	3083	1.26	8	7	4	7	8.2	4.5		14000/14000								29	21	17	13	7	6	THERMADRILL
910928	3000	1.26	10	8	4	11	8.0	4.6		15000/15000			2.60	240/240		14		36	26	22	16	8	7	THERMADRILL
910929	3009	1.27	10	8	3	11	9.0	4.8		14000/14000	0.20	0.30	2.60	260/260		14		36	26	22	16	9	6	THERMADRILL
910930	3009	1.27	9	9	4	11	9.0	4.8		15000/15000	0.20	0.30	0.30	280/280		14		35	26	23	16	9	6	THERMADRILL

Daily mud properties — Da 25/2 — Date 25/2-1992

(((
(ooo)
Norsk Hydro

System : BORE

Well: 30/9-13S
Mud Contractor: BAROID
Data: "Mid depth" from table 3, otherwise from table 14. 14. 4

Date	Mid. depth m,MD	Mud Dens. (SG)	PV cp	YP Pa	GEL 0 Pa	GEL 10 Pa	pH	100 psi (cc)	HP/HT (cc)	Cl- inn/out mg/l	Alkalinity Pf	Alkalinity Pm	Alkalinity Mf	Ca++ inn/out mg/l	Oil %	Sol %	H2O %	V.G. meter at 115 gr. F 600 rpm	300 rpm	200 rpm	100 rpm	6 rpm	3 rpm	Mud Type
911001	3009	1.29	4	7	4	8	8.0	4.6		13000/13000	0.10		0.20	360/360		13		28	21	17	13	9	8	THERMADRILL
911002	3009	1.27	4	7	4	8	8.1	4.6		13000/13000	0.10		2.20	380/380		13		27	20	17	13	9	8	THERMADRILL
911003	3009	1.27	8	6	3	9	8.5	4.0		13000/13000	0.20	0.30	2.20	400/400		13		28	20	16	13	9	8	THERMADRILL
911004	3009	1.27	9	6	3	8	8.5	4.0		13000/13000	0.20	0.30	2.20	400/400		13		30	21	17	13	9	8	THERMADRILL
911005	3009	1.26	6	4	3	6	8.9	4.4		14000/14000	0.20	0.50	2.20	400/400		14		20	14	12	9	6	5	THERMADRILL
911006	3009	1.26	7	7	4	8	8.3	4.4		14000/14000	0.10	0.20	2.20	380/380		14		28	21	17	14	9	8	THERMADRILL
911007	3009	1.26	7	7	4	7	8.5	4.4		14000/14000	0.10	0.30	2.20	400/400		14		28	21	17	14	9	8	THERMADRILL
911008	3009	1.27	11	8	8	18	10.1																	THERMADRILL
911009	2786	1.27	11	8	8	18	10.1																	THERMADRILL

Table B-11 Mud material consumption

Figures based on service company's end of well report

((((ooo) Norsk Hydro	Mud consumption System : BORE Well: 30/9-13S Mud company: BAROID	Date 24/2-1992 13

		Actual used
Drilling of 36 " hole		
BARITE	Kg	38000
BENTONITE	Kg	16000
CAUSTIC SODA	Kg	375
SODA ASH	Kg	375
Drilling of 17 1/2" hole		
BARITE	Kg	82000
BENTONITE	Kg	22000
CAUSTIC SODA	Kg	550
LIME	Kg	175
SODA ASH	Kg	550
Drilling of 12 1/4" hole		
BARASCAV-D	Kg	3125
BARITE	Kg	504000
BENTONITE	Kg	2000
CAUSTIC SODA	Kg	50
EZ MUD	Kg	2220
EZ MUD DP	Kg	4375
KCL	Kg	33000
KOH	Kg	700
PAC-L	Kg	6515
PAC-R	Kg	2416
SODA ASH	Kg	100
SODIUM BICARB	Kg	1375
XCD POLYMER	Kg	3000
KCL BRINE	l	515000
Drilling of 8 1/2" hole		
BARACOR 95	Kg	800
BARANEX	Kg	10886
BARASCAV-D	Kg	2250
BARITE	Kg	163000
BENTONITE	Kg	4000
CARBONOX	Kg	4600
CITRIC ACID	Kg	200
KOH	Kg	675
LIME	Kg	1115
PAC-L	Kg	1625
PAC-R	Kg	775
SODA ASH	Kg	200
SODIUM BICARB	Kg	425
THERMA THIN	Kg	2625
XCD POLYMER	Kg	1125
BARADEFOAM W300	l	208

(((
(ooo)
Norsk Hydro

Mud consumption

System : BORE

Date 24/2-1992

Well: 30/9-13S
Mud company: BAROID

13

	Actual used
CONDET 1	208
Test no. 1	
BARACOR 95 Kg	200
BARASCAV-D Kg	775
BARITE Kg	70000
BENTONITE Kg	5000
CAUSTIC SODA Kg	650
CITRIC ACID Kg	25
PAC-R Kg	145
SODA ASH Kg	450
SODIUM BICARB Kg	25
XCD POLYMER Kg	1200

V-600

HYDRO

Document frontpage
Exploration and Production

Norsk Hydro a.s Bergen
E&P Research Centre

Doc. type: ☐ Agreement ☐ Amendment ☒ Report

Storage: ☐ 2 years ☐ 5 years ☒ Permanent archives

Grading: ☐ Open ☐ Internal ☒ Confidential ☐ Very conf. ☐ Strictly conf.

Doc. id: R-054103
Copy no.:

Distribution
Agip (2)
DNO (2)
Saga (2)
Conoco (2)
Statoil (2)
NPD (2)
Hydro (3)

BA92-450-1

Title

PETROLEUM GEOCHEMISTRY

WELL: 30/9-13S

Summary/Conclusion//Recommendation

Keywords
Source rocks, migrated hydrocarbons, biomarkers, maturity, oil-correlations

Pages-appendix	Amendment no.	Revision no.	Revision date
20 + app.			
Quadrant/Block-well	**Project no.**	**Licens no.**	**Date**
30/9-13S	214721/215581	PL104	16.01.92
Department	BASIN MODELLING/PETROLEUM GEOCHEMISTRY		
Section	GEOSECTION		
Authors	L. AAKVAAG, A. STEEN AND T. HANESAND 03.02.92 Trond Hanesand		
Controlled	Birgit Sahl		
Accepted	Ivar A. Sandø		
Approved			

Postal Address: P.O.Box 4313, 5028 Nygårdstangen, Norway
Office Address: Lars Hilliesgt. 30, 5008 Bergen, Norway
Phone: National: (05) 99 50 00, Internat.: +47 5 99 50 00
Telefax: National: (05) 99 61 96, Internat.: +47 5 99 61 96
Telex: 40920 hydro n

HYDRO

TABLE OF CONTENTS

1. INTRODUCTION

This report comprises the results from the organic geochemical study on 72 samples (68 sediment samples and 4 fluid samples) from the well. The aims of the study were determination of source rock potential, fluid correlations and estimation of the thermal maturity of the penetrated strata in well 30/9-13S.

TABLE 1.2 List of fluid samples analysed

TYPE	ID	DEPTH
GAS	DST # 3	2958.1 - 2986.1 mRKB
OIL	RFT-1195	3025.6 mRKB
OIL	DST # 2	3024.0 - 3073.0 mRKB
OIL	DST # 1	3086.5 - 3094.5 mRKB

Vitrinite reflectance was measured on 27 samples from the interval 1060 m (Hordaland Group) - 4005 m by Geo-Optics, Newcastle, U.K. The report from Geo-Optics is included as Appendix IV to this report. Spore colouration and visual kerogen description of 41 samples in the interval 1040 m (Hordaland Group) - 4002 m were performed by The Robertson Group, Gwynedd, U.K. (Appendix V). The isotopic composition of the gas sample (DST # 3) was determined by Institutt for energiteknikk, Kjeller, Norway (Appendix VI). The stable isotopic composition of the 3 oils and 11 sediment samples was measured by GeolabNor, Trondheim, Norway (Appendix VII). All other geochemical analyses together with the compilation and interpretation presented in this report were undertaken by Norsk Hydro Research Centre, Bergen, Norway.

The sample type abbreviations SWC (sidewall core), COCH (core chip, A-cut), DCW (drill cuttings, received wet) and DCD (drill cuttings, received washed and dried) are used throughout this report.

The lithostratigraphic division listed in Table 1.1 is based on the version of October 29th 1991 and may be subject to later revision.

All reported depths are in meters relative to rotary kelly bushing (m MD RKB), driller's depth.

Table 2.1 **VITRINITE REFLECTANCE DATA WELL 30/9-13S**
Average values

Petroleum Geochemistry Group
Research Centre Bergen
HYDRO

Depth	%	Lithology	Type	Population I	Population II	Population III	SCI
1060.00	100	SH	DC	0.31 (20)			
1220.00	100	SH/SST	DC	0.34 (20)			
1390.00	100	SST	DC	0.38 (4)			
1520.00	80	SLTY.SH	DC	0.38 (20)			
1640.00	80	SH	DC	0.35 (20)			
1760.00	100	SH	DC	0.44 (20)			
1880.00	100	SH	DC	0.40 (7)			
2000.00	100	SH	DC	0.00			
2100.00	100	SH	DC	0.46 (8)			
2200.00	100	SH	DC	0.44 (4)			
2300.00	100	SH	DC	0.46 (20)			
2405.00	100	SH	DC	0.53 (4)			
2500.00	70	SH	DC	0.45 (13)			
2605.00	60	SH	DC	0.44 (6)			
2700.00	100	SH	DC	0.45 (7)			
2805.00	100	CLYST	DC	0.43 (7)			
2900.00	100	SH	DC	0.00			
2947.00	100	CLYST	DC	0.43 (9)			

Table 2.1 **VITRINITE REFLECTANCE DATA WELL 30/9-13S** (cont'd)
Average values

Depth	%	Lithology	Type	Population I	Population II	Population III	SCI
2997.00	50	SH	DC	0.45 (6)			
3060.00	100	ROCK FLOUR	DC	0.00			
3130.00	70	SST	DC	0.48 (20)			
3205.00	80	SST	DC	0.47 (2)	0.67 (21)		
3300.00	100	SH	DC	0.67 (20)			
3407.00	100	SH	DC	0.73 (22)			
3502.00	100	SLTY.SH	DC	0.68 (7)			
3610.00	100	SH	DC	0.53 (4)			
3707.00	100	SH	DC	0.57 (13)			
3807.00	70	SH	DC	0.33 (11)	0.72 (11)		
3922.00	100	SH/SLST	DC	0.69 (5)			
4005.00	90	SST	DC	0.72 (5)			

TABLE 2.2 SPORE COLOURATION AND VISUAL KEROGEN DATA

COMPANY: NORSK HYDRO **WELL: 30/9-13S** **LOCATION: NORWEGIAN NORTH SEA**

Depth (m)	SCI (1-10)	Kerogen Type (%)				
		Inertinite	Vitrinite (Structured)	Vitrinite (Amorphous)	Liptinite (Amorphous)	Liptinite (Structured)
1040	2.5-3.0	5	20	70	*	5 Sp,Di
1200	2.5	5	20	70	*	5 Sp,Di
1380	2.5-3.0	10	15	60	10	5 Sp,Di
1510	2.5	10	15	65	*	10 Sp,Di
1620	2.5	10	15	65	*	10 Sp,Di
1740	2.5	10	15	65	*	10 Sp,Di
1860	3.0	5	10	75	*	10 Sp,Di
1980	3.0-3.5	10	5	70	*	15 Sp,Di
2080	3.0	10	40	40	*	10 Di
2180	3.5	20	10	65	*	5 Di,Sp
2280	2.5	10	5	25	40	20 Sp
2380	3.0-3.5	20	20	15	20	25 Sp
2495	3.0	25	10	55	*	10 Sp
2595	3.0-3.5	25	10	55	*	10 Sp
2695	3.5	15	10	70	*	5 Sp,Di
2795	4.0-4.5	Mnr	10	90	*	*
2895	3.5-4.0	20	Mnr	80	*	*
2944.0		5	5	*	60	30 Sp,Di
2945.3		65	5	*	20	10 Sp,Di,Al
2947.0		5	Mnr	*	75	20 Sp,Di,Al
2950		20	10	*	50	20 Sp,Di
2951.0		10	Mnr	*	70	20 Sp,Di,Al
2952	4.5	20	30	20	20	10 Sp
2955		10	Mnr	*	70	20 Sp,Di,Al
2955.0		15	5	*	60	20 Sp,Di,Al
2957.00		15	5	*	60	20 Sp,Di,Al
2957.75		15	5	*	50	30 Sp,Di,Al
2958.50		10	5	*	65	20 Sp,Di,Al
2959.50		15	5	*	50	30 Sp,Di,Al
2995	3.5-4.0?	40	20	30	10	Mnr Sp
3057	4.0-4.5	10	10	80	*	*
3127	4.5	20	60	20	*	*
3202	4.0-4.5	25	20	55	*	Mnr Sp
3302	4.0-4.5? 6.0-7.0?	25	20	55	*	Mnr Sp
3405	4.5-5.0	40	20	40	*	Mnr Sp
3500	6.0	10	70	20	*	Mnr Sp
3607	6.0	40	10	50	*	*
3705	7.0-7.5	40	10	50	*	*
3805	*	10	20	70	*	*
3920	8.0-8.5	30	10	60	*	*
4002	8.0	30	10	60	*	*

Table 3.1 **SOURCE ROCK SCREENING DATA WELL 30/9-13S**

Petroleum Geochemistry Group
Research Centre Bergen
HYDRO

Depth (m)	%	Lithology	Type	S1 kg/t	S2 kg/t	TOC %	HI	PI	Tmax DegC	Company
2944.00		SLST	SWC	0.78	4.96	3.1	160	0.14	427	
2945.30		CLYST	SWC	1.81	9.18	10.2	90	0.16	430	
2947.00		CLYST	SWC	0.44	5.16	2.5	206	0.08	433	
2950.00			DCW	0.33	3.20	2.1	152	0.09	428	F-BERGEN
2951.00		CLYST	SWC	1.53	14.17	3.4	417	0.10	430	
2955.00		CLYST	SWC	0.49	4.21	1.7	248	0.10	436	
2955.00			DCW	0.48	7.71	2.6	297	0.06	429	F-BERGEN
2957.00			COCH	2.27	28.76	4.7	612	0.07	432	F-BERGEN
2957.75			COCH	1.07	15.31	3.0	510	0.07	432	F-BERGEN
2958.50			COCH	0.88	9.80	2.4	408	0.08	433	F-BERGEN
2959.50			COCH	0.59	8.03	2.4	335	0.07	436	F-BERGEN

Table 3.2 **SOURCE ROCK EXTRACTION DATA WELL 30/9-13S**

Petroleum Geochemistry Group
Research Centre Bergen

HYDRO

Depth (m)	%	Lithology	Type	EOM(mg)	EOM(%)	Hydrocarbons SAT(%)	Hydrocarbons ARO(%)	Hydrocarbons TOTAL(%)	Non Hydrocarbons NSO(%)	Non Hydrocarbons ASPH(%)	Non Hydrocarbons TOTAL(%)
2944.00		SLST	SWC		0.10	6.30	12.90	19.20	58.50	22.30	80.80
2945.30		CLYST	SWC		0.10	6.60	11.70	18.30	57.80	23.90	81.70
2947.00		CLYST	SWC		0.10	6.60	17.10	23.70	53.10	23.20	76.30
2950.00			DCW		0.10	4.20	11.20	15.40	62.80	21.80	84.60
2951.00		CLYST	SWC		0.10	15.60	29.90	45.50	38.80	15.70	54.50
2955.00		CLYST	SWC		0.10	5.50	13.00	18.50	62.30	19.20	81.50
2955.00			DCW		0.10	3.40	15.60	19.00	51.40	29.60	81.00
2957.00			COCH		0.10	11.60	24.50	36.10	49.40	14.50	63.90
2957.75			COCH		0.10	10.70	17.10	27.80	56.20	16.00	72.20
2958.50			COCH		0.10	9.70	23.10	32.80	51.10	16.10	67.20
2959.50			COCH		0.10	6.90	22.50	29.40	53.40	17.20	70.60

Table 3.3 **SOURCE ROCK EXTRACTION DATA WELL 30/9-13S**

Petroleum Geochemistry Group
Research Centre Bergen
HYDRO

Depth	%	Lithology	Type	TOC (%)	EOM(%)/TOC(%)	SAT(%)/TOC(%)	SAT(%)/ARO(%)	HC/Non HC
2944.00		SLST	SWC	3.10	0.03	2.03	0.49	0.24
2945.30		CLYST	SWC	10.20	0.01	0.65	0.56	0.22
2947.00		CLYST	SWC	2.50	0.04	2.64	0.39	0.31
2950.00			DCW	2.10	0.05	2.00	0.38	0.18
2951.00		CLYST	SWC	3.40	0.03	4.59	0.52	0.83
2955.00		CLYST	SWC	1.70	0.06	3.24	0.42	0.23
2955.00			DCW	2.60	0.04	1.31	0.22	0.23
2957.00			COCH	4.70	0.02	2.47	0.47	0.56
2957.75			COCH	3.00	0.03	3.57	0.63	0.39
2958.50			COCH	2.40	0.04	4.04	0.42	0.49
2959.50			COCH	2.40	0.04	2.88	0.31	0.42

Table 3.4 **SATURATED FRACTION MOLECULAR RATIOS WELL 30/9-13S**

Depth	%	Lithology	Type	Pristane / nC17	Pristane / Phytane	CPI-I	CPI-II	nC15+ / Total	nC20 / nC25
2944.00		SLST	SWC	2.06	3.05	1.31	1.11		
2945.30		CLYST	SWC	3.77	3.73	1.34	1.16		
2947.00		CLYST	SWC	1.52	4.14	1.33	1.28		
2950.00			DCW	2.08	4.18	1.38	1.25		
2951.00		CLYST	SWC	1.13	2.75	1.25	1.24		
2955.00		CLYST	SWC	1.54	3.22	1.30	1.26		
2955.00			DCW	0.59	2.91	1.38	1.36		
2957.00			COCH	0.99	2.59	1.22	1.18		
2957.75			COCH	0.90	2.65	1.24	1.22		
2958.50			COCH	1.10	3.66	1.20	1.17		
2959.50			COCH	0.93	3.08	1.35	1.34		

TABLE 3.5

TRITERPANE ISOMERISATION
SEDIMENT EXTRACTS WELL 30/9-13S

Depth start int	Depth end int.	Sample type	Ts/Tm	NOR/ NOR+HOP	BNOR/ BNOR+NOR	MORETAN/ HOPAN	% 22S BISHOMOHOP
2944.00	2944.00	SWC	0.14	0.44	0.00	0.18	59.9
2945.30	2945.30	SWC	0.15	0.42	0.00	0.16	58.5
2947.00	2947.00	SWC	0.27	0.44	0.00	0.20	57.3
2947.00	2950.00	DCW	0.19	0.43	0.02	0.20	56.6
2951.00	2951.00	SWC	0.63	0.43	0.00	0.13	56.6
2952.00	2955.00	DCW	0.38	0.40	0.01	0.11	57.0
2955.00	2955.00	SWC	0.35	0.40	0.01	0.17	57.1
2957.00	2957.00	COCH	0.64	0.42	0.01	0.13	56.8
2957.75	2957.75	COCH	0.52	0.43	0.00	0.14	56.3
2958.50	2958.50	COCH	0.47	0.43	0.01	0.15	56.8
2959.50	2959.50	COCH	0.51	0.41	0.00	0.16	56.1
BIOM.STD.			1.24	0.32	0.33	0.04	62.0
BIOM.STD.			1.37	0.27	0.38	0.05	59.6

STERANE ISOMERISATION
SEDIMENT EXTRACTS WELL 30/9-13S

Depth start int	Depth end int	Sample type	C-29 20S % aaa	C-29 20S+R % abb
2944.00	2944.00	SWC	42.2	35.1
2945.30	2945.30	SWC	39.7	28.4
2947.00	2947.00	SWC	40.7	29.6
2947.00	2950.00	DCW	40.5	28.5
2951.00	2951.00	SWC	37.4	25.8
2952.00	2955.00	DCW	34.5	28.7
2955.00	2955.00	SWC	39.0	27.6
2957.00	2957.00	COCH	37.4	26.5
2957.75	2957.75	COCH	36.2	27.3
2958.50	2958.50	COCH	39.1	27.6
2959.50	2959.50	COCH	36.8	26.6
BIOM.STD.	BIOM.STD		42.9	62.4
BIOM.STD.	BIOM.STD		43.8	59.5

TABLE 3.6: **Tabulation of carbon isotope data for EOM/EOM - fractions or Oils for well WELL 30/9-13S,NORSK HYDRO**

Depth unit of measure: m

Depth	Typ	Lithology	EOM/Oil	Saturated	Aromatic	NSO	Asphaltenes	Kerogen	Sample
2944.00	swc		-	-27.74	-25.82	-25.37	-24.21	-	0001-0B
2945.30	swc		-	-27.22	-25.20	-24.92	-23.73	-	0002-0B
2947.00	swc		-	-27.59	-26.18	-25.82	-24.58	-	0003-0B
2950.00	dcw		-	-27.72	-25.83	-25.66	-24.35	-	0010-0B
2951.00	swc		-	-29.94	-28.04	-27.90	-26.40	-	0004-0B
2955.00	swc		-	-28.23	-26.61	-26.07	-24.85	-	0005-0B
2955.00	dcw		-	-27.77	-26.20	-26.07	-24.74	-	0011-0B
2957.00	coc		-	-29.95	-28.37	-27.91	-26.90	-	0006-0B
2957.75	coc		-	-29.26	-27.76	-27.37	-25.99	-	0007-0B
2958.50	coc		-	-29.12	-27.38	-27.04	-25.81	-	0008-0B
2959.50	coc		-	-28.28	-26.75	-26.46	-25.19	-	0009-0B

TABLE 4.5 **Tabulation of carbon isotope data for** oils from well 30/9-13S

Depth unit of measure: m

Well	EOM/Oil	Saturated	Aromatic	NSO	Asphaltenes	Kerogen	Sample
	-					-	0001-0B
30/9-13S DST 1	-	-28.60	-27.67	-27.20	-27.65	-	0002-0B
30/9-13S DST 2	-	-28.55	-27.67	-27.38	-27.61	-	0003-0B
30/9-13S RFT	-	-28.58	-27.68	-27.55	-27.75	-	0004-0B
	-					-	0005-0B
	-					-	0006-0B
	-					-	0007-0B
	-					-	0008-0B

THE ROBERTSON GROUP plc

REPORT NO. 7032/Ic

SPORE COLOURATION AND KEROGEN TYPING STUDY OF THE NORSK HYDRO 30/9-13S WELL, INTERVAL 1040m TO 4002m, NORWEGIAN SECTOR, NORTH SEA

by

A G COLLINS

PROJECT NO. Ic/21272

Prepared by:

The Robertson Group plc
Petroleum and Minerals Division
Llandudno
Gwynedd LL30 1SA
United Kingdom

Prepared for:

Norsk Hydro as
Lars Hillesgt 30
N-5008 Bergen
Norway

NOVEMBER 1991

2 INTRODUCTION

This report presents the results of spore colouration and kerogen typing studies carried out on 5 sidewall core, 32 ditch cuttings samples and 4 conventional core samples from the interval 1040m to 4002m in the Norsk Hydro 30/9-13S Norwegian North Sea well. Norsk Hydro provided prepared sieved kerogen, total kerogen and palynological (oxidised) slide mounts for 11 of the samples in the interval 2944.0m to 2959.5m, which were analysed for kerogen type only; sieved kerogen and total kerogen slide mounts for the remaining ditch cuttings were prepared from washed, dried sample material at The Robertson Group's North Wales laboratories. The numbers of analyses carried out are as follows:

	No. of samples
Preparation of kerogen and slides	30
Spore colouration	30
Kerogen typing	41

The cuttings samples were received at The Robertson Group's North Wales laboratories on 3 October 1991, the slides on 22 October and preliminary results were despatched to Lotte Aakvaag and Arne Steen, our contacts at Norsk Hydro in Bergen, between 17 October and 4 November 1991. The work was carried out in accordance with Norsk Hydro Purchase Order No. NHO 571928 of 24 October 1991.

RG personnel involved in the study were:

Alan Collins - Project co-ordination, spore colour microscopy and report preparation
Malcolm Jones - Supervision of kerogen preparation

The stratigraphic information used in this report was taken from the preliminary formation tops listing (version 29 October 1991) produced for Norsk Hydro by The Robertson Group's biostratigraphic department.

3 RESULTS AND INTERPRETATION

3.1 METHODS

Sidewall core, conventional core and two ditch cuttings samples (interval 2944.0m to 2959.5m) were received as prepared kerogen slides. The remaining ditch cuttings samples (interval 1040m to 4002m) were received as washed, dried material and were processed to give total and 10 μm sieved kerogen by standard palynological methods, omitting any oxidation procedures. Spore colour index (SCI) values were assigned with reference to the set of SCI standards kept at RG laboratories in North Wales. Kerogen identification follows the system outlined in Appendix 2. Table 1 gives a summary of kerogen proportions in terms of oil-prone (sapropel), gas-prone (vitrinite) and non-source (inertinite) while, in Table 2, a more detailed breakdown to conform to NPD standard format is given.

COMPANY: NORSK HYDRO WELL: 30/9-13S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			MATURITY DATA		KEROGEN COMPOSITION DATA						
SAMPLE DEPTH (Metres)	SAMPLE TYPE	ANALYSED LITHOLOGY	SPORE COLOUR INDEX	VITR. REFL. R oil av %	% (Visual, from microscopy)			% (Calculated)			
					INERTINITE	VITRINITE	SAPROPEL	INERT	VIT	ALG SAP	WXY SAP
1040	Ctgs	No liths available	2.5-3.0		5	90	5				
1200	Ctgs	No liths available	2.5		5	90	5				
1380	Ctgs	No liths available	2.5-3.0		10	75	15				
1510	Ctgs	No liths available	2.5		10	80	10				
1620	Ctgs	No liths available	2.5		10	80	10				
1740	Ctgs	No liths available	2.5		10	80	10				
860	Ctgs	No liths available	3.0		5	85	10				
1980	Ctgs	No liths available	3.0-3.5		10	75	15				
2080	Ctgs	No liths available	3.0		10	80	10				
2180	Ctgs	No liths available	3.5		20	75	5				
2280	Ctgs	No liths available	2.5		10	30	60				
2380	Ctgs	No liths available	3.0-3.5		20	35	45				
2495	Ctgs	No liths available	3.0		25	65	10				
2595	Ctgs	No liths available	3.0-3.5		25	65	10				
2695	Ctgs	No liths available	3.5		15	80	5				
2795	Ctgs	No liths available	4.0-4.5		Mnr	100	*				
2895	Ctgs	No liths available	3.5-4.0		20	80	*				
2944.0	Swc	No liths available			5	5	90				
2945.3	Swc	No liths available			65	5	30				
2947.0	Swc	No liths available			5	Mnr	95				
2950	Ctgs	No liths available			20	10	70				
2951.0	Swc	No liths available			10	Mnr	90				
2952	Ctgs	No liths available	4.5		20	50	30				
2955	Ctgs	No liths available			10	Mnr	90				
2955.0	Swc	No liths available			15	5	80				
2957.00	Core	No liths available			15	5	80				
2957.75	Core	No liths available			15	5	80				

MATURITY AND KEROGEN COMPOSITION DATA

TABLE : 1A

COMPANY: NORSK HYDRO WELL: 30/9-13S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			MATURITY DATA		KEROGEN COMPOSITION DATA						
SAMPLE DEPTH (Metres)	SAMPLE TYPE	ANALYSED LITHOLOGY	SPORE COLOUR INDEX	VITR. REFL. R oil av %	% (Visual, from microscopy)			% (Calculated)			
					INERTINITE	VITRINITE	SAPROPEL	INERT	VIT	ALG SAP	WXY SAP
2958.50	Core	No liths available			10	5	85				
2959.50	Core	No liths available			15	5	80				
2995	Ctgs	No liths available	3.5-4.0?		40	50	10				
3057	Ctgs	No liths available	4.0-4.5		10	90	*				
3127	Ctgs	No liths available	4.5		20	80	*				
3202	Ctgs	No liths available	4.0-4.5		25	75	Mnr				
3302	Ctgs	No liths available	4.0-4.5? 6.0-7.0?		25	75	Mnr				
>405	Ctgs	No liths available	4.5-5.0		40	60	Mnr				
3500	Ctgs	No liths available	6.0		10	90	Mnr				
3607	Ctgs	No liths available	6.0		40	60	*				
3705	Ctgs	No liths available	7.0-7.5		40	60	-				
3805	Ctgs	No liths available	*		10	90	-				
3920	Ctgs	No liths available	8.0-8.5		30	70	-				
4002	Ctgs	No liths available	8.0		30	70	-				

MATURITY AND KEROGEN COMPOSITION DATA

TABLE : 1B

COMPANY: NORSK HYDRO WELL: 30/9-13S LOCATION: NORWEGIAN NORTH SEA

Depth (m)	SCI (1-10)	Kerogen Type (%)				
		Inertinite	Vitrinite (Structured)	Vitrinite (Amorphous)	Liptinite (Amorphous)	Liptinite (Structured)
1040	2.5-3.0	5	20	70	*	5 Sp,Di
1200	2.5	5	20	70	*	5 Sp,Di
1380	2.5-3.0	10	15	60	10	5 Sp,Di
1510	2.5	10	15	65	*	10 Sp,Di
1620	2.5	10	15	65	*	10 Sp,Di
1740	2.5	10	15	65	*	10 Sp,Di
1860	3.0	5	10	75	*	10 Sp,Di
1980	3.0-3.5	10	5	70	*	15 Sp,Di
2080	3.0	10	40	40	*	10 Di
2180	3.5	20	10	65	*	5 Di,Sp
2280	2.5	10	5	25	40	20 Sp
2380	3.0-3.5	20	20	15	20	25 Sp
2495	3.0	25	10	55	*	10 Sp
2595	3.0-3.5	25	10	55	*	10 Sp
2695	3.5	15	10	70	*	5 Sp,Di
2795	4.0-4.5	Mnr	10	90	*	*
2895	3.5-4.0	20	Mnr	80	*	*
2944.0		5	5	*	60	30 Sp,Di
2945.3		65	5	*	20	10 Sp,Di,Al
2947.0		5	Mnr	*	75	20 Sp,Di,Al
2950		20	10	*	50	20 Sp,Di
2951.0		10	Mnr	*	70	20 Sp,Di,Al
2952	4.5	20	30	20	20	10 Sp
2955		10	Mnr	*	70	20 Sp,Di,Al
2955.0		15	5	*	60	20 Sp,Di,Al
2957.00		15	5	*	60	20 Sp,Di,Al
2957.75		15	5	*	50	30 Sp,Di,Al
2958.50		10	5	*	65	20 Sp,Di,Al
2959.50		15	5	*	50	30 Sp,Di,Al
2995	3.5-4.0?	40	20	30	10	Mnr Sp
3057	4.0-4.5	10	10	80	*	*
3127	4.5	20	60	20	*	*
3202	4.0-4.5	25	20	55	*	Mnr Sp
3302	4.0-4.5? 6.0-7.0?	25	20	55	*	Mnr Sp
3405	4.5-5.0	40	20	40	*	Mnr Sp
3500	6.0	10	70	20	*	Mnr Sp
3607	6.0	40	10	50	*	*
3705	7.0-7.5	40	10	50	*	*
3805	*	10	20	70	*	*
3920	8.0-8.5	30	10	60	*	*
4002	8.0	30	10	60	*	*

Table 2 Detailed kerogen typing data

Institutt for energiteknikk

	KJELLER	HALDEN
ADDRESS	Box 40, N-2007 Kjeller, Norway	N-1751 Halden, Norway
TELEPHONE	+47 6 806000	+47 9 183100
TELEX	74 573 energ n	76 335 energ n
TELEFAX	+47 6 815553	

AVAILABILITY
Private
Confidential

REPORT TYPE

REPORT NO.
IFE/KR/F-91/146

DATE
1991-11-18

REPORT TITLE
REPORT ON STABLE ISOTOPES ($\delta\,^{13}C$, $\delta\,D$, $\delta\,^{18}O$) ON A NATURAL GAS FROM WELL 30/9-13S, DST 3, 2958.1 - 2986.1 m.

DATE OF LAST REV.

REV. NO.

CLIENT
Norsk Hydro a.s.

NUMBER OF PAGES
8

CLIENT REF.
Bestilling nr F 10562

NUMBER OF ISSUES
15

SUMMARY

The gas components C_1 - C_5 have been separated from a gas sample from well 30/9-13S, DST 3, 2958.1 - 2986.1 m, and the $\delta\,^{13}C$ values of methane, ethane, propane, the butanes and CO_2 have been measured. The hydrogen isotopic composition of methane has also been determined.

DISTRIBUTION
Norsk Hydro a.s (10)
Andresen, B.
Råheim, A.
Throndsen, T.
File (2)

KEYWORDS

	NAME	DATE	SIGNATURE
PREPARED BY	Bjørg Andresen	1991-11-18	Bjørg Andresen
REVIEWED BY	Torbjørn Throndsen	1991-11-18	Torbjørn Throndsen
APPROVED BY	Arne Råheim	1991-11-18	Arne Råheim

1 INTRODUCTION

One gas sample from well 30/9-13S, DST 3, 2958.1 - 2986.1 m, was received and analysed October/November 1991.

On the sample C_1 - C_5 and CO_2 are quantified. The $\delta\ ^{13}C$ value is measured on methane, ethane, propane, the butanes and CO_2. In addition the δ D value is measured on methane.

2 ANALYTICAL PROCEDURE

The natural gas sample has been quantified and separated into the different gas components by a Carlo Erba 4200 gas chromatograph.

The hydrocarbon gas components were oxidised in separate CuO-ovens in order to prevent cross contamination. The combustion products CO_2 and H_2O were frozen into collection vessels and separated.

The combustion water was reduced with zinc metal in a sealed quarts tube to prepare hydrogen for isotopic analysis. The isotopic measurements were performed on a Finnigan Mat 251 and Finnigan Delta mass spectrometer.
IFEs value on NBS 22 is 29.77 ± .06‰ PDB.

3 RESULTS

The volume composition of the gas sample is given in Table 1. The results have been normalised to 100%. The stable isotope results are given in Table 2.

The uncertainty on the $\delta\ ^{13}C$ value is estimated to be ± 0.3‰ PDB and includes all the different analytical steps. The uncertainty in the δ D value is likewise estimated to be ± 5‰.

Table 1: Volume composition of a gas sample from well 30/9-13S.

Sample	IFE no	C_1 %	C_2 %	C_3 %	iC_4 %	nC_4 %	iC_5 %	nC_5 %	CO_2 %	ΣC_1-C_5	Wet-ness	iC_4/ nC_4/
DST 3, 2958.1 - 2986.1 m	10148	84.1	7.9	3.8	0.57	1.2	0.37	0.42	1.8	98.2	0.14	0.49

Table 2: Isotopic composition of gas samples from well 30/9-13S.

Sample	IFE no	C_1 $\delta^{13}C$ ‰ PDB	C_1 δD ‰ SMOW	C_2 $\delta^{13}C$ ‰ PDB	C_3 $\delta^{13}C$ ‰ PDB	iC_4 $\delta^{13}C$ ‰ PDB	nC_4 $\delta^{13}C$ ‰ PDB	CO_2 $\delta^{13}C$ ‰ PDB	CO_2 $\delta^{18}O$ ‰ PDB
DST 3, 2958.1 - 2986.1 m	10148	-40.8	-197	-28.5	-26.8	-25.2	-26.9	-16.6	-10.0

GEOLAB NOR

REPORT:	DATARAPPORT Gruppetypeseparasjon og isotopanalyse av 30/9-13S
CLIENT(S):	NORSK HYDRO Arne Steen Lotte Aakvaag
RESPONSIBLE SCIENTIST:	Kirsti L. Andersen
AUTHORS:	Tone Haugen Rita Moe
DATE: 11.11.91	**GEOLAB PROJECT:** 526183 **CLIENTS REF:** F 10557

EXPERIMENTAL PROCEDURES

Separation of Asphaltenes

The EOM is dissolved in 1:3 (w:v) tetrahydrofuran in an tared flask and pentane added to precipitate asphaltenes. A minimum of 40 volumes of pentane per 1 volume of THF/EOM is used and the solution allowed to stand 8 h at room temperature in the dark. The solution is filtered and the precipitated asphaltenes returned to the original flask by dissolution in methanol (7% v/v)/dichloromethane. The asphaltene solution is evaporated to constant weight.

Liquid chromatographic separation

Chromatographic separation is performed using an MPLC system developed by the company. The EOM (after removal of asphaltenes) is injected into the MPLC and chromatographed using hexane as eluent. This effects a separation into saturated and aromatic fractions which are collected and concentrated on a rotary evaporator, at 35°C and 200 mB, to remove the bulk of the hexane. The fractions are then transferred to small tared vials and evaporated to dryness in a stream of nitrogen. The vials are re-weighed to obtain the weights of both fractions. The weight of the NSO fraction, which is retained on the chromatography column, is obtained by difference.

EXPERIMENTAL

Isotope Ratio Mass Spectrometry

The isotope analysis were performed on a dual inlet VG SIRA 10 instrument. The combustion of the samples were done by a Carlo Erba EA 1108 element analyser directly connected to the inlet system of the mass spectrometer.

The combustion temperature was 1020°C and the carries gas used was Helium. After the combustion H_2O and CO_2 were trapped in different cool traps. The CO_2 gas was then heated up before it was admitted to the mass spectrometer. The whole operation was controlled by a IBM PC50 computer system.

δ-values

The isotope ratios are given as δ-values in $^{o}/_{oo}$ versus the PDB-standard:

$$\delta^{13}C = (R \text{ sample} - R \text{ standard} / R \text{ standard}) * 1000$$

$$R = {}^{13}C / {}^{12}C$$

The PDB standard (a marine chalk of the Pee Dee-formation, USA) was created by Craig 1957. All results of ^{13}C / ^{12}C - analysis of organic matter today are calculated (Craig correction) against this international standard.

Reproducebility

The presision of the combustion system and the mass spectrometer is controlled by determinations of an international calibrated standard, NBS22 oil and a house standard of carbon.

Double analysis on samples are also done.

Table 1 a: Weight of EOM and Chromatographic Fraction for well WELL 30/9-13S,NORSK HYDRO

Depth unit of measure: m

Depth	Typ	Lithology	Rock Extracted (g)	EOM (mg)	Sat (mg)	Aro (mg)	Asph (mg)	NSO (mg)	HC (mg)	Non-HC (mg)	TOC(e) (%)	Sample
2944.00	swc	bulk	-	12.1	1.2	1.5	6.0	3.4	2.7	9.4	-	0001-0B
2945.30	swc	bulk	-	11.1	0.9	1.8	4.0	4.4	2.7	8.4	-	0002-0B
2947.00	swc	bulk	-	13.8	1.2	2.4	5.3	4.9	3.6	10.2	-	0003-0B
2950.00	dcw	bulk	-	21.1	1.5	3.0	10.7	5.9	4.5	16.6	-	0010-0B
2955.00	swc	bulk	-	40.3	4.8	8.3	12.3	14.9	13.1	27.2	-	0005-0B
2955.00	dcw	bulk	-	11.7	0.5	1.7	5.5	4.0	2.2	9.5	-	0011-0B
2957.00	coc	bulk	-	42.6	7.7	11.0	6.7	17.2	18.7	23.9	-	0006-0B
2957.75	coc	bulk	-	29.0	4.8	7.4	6.1	10.7	12.2	16.8	-	0007-0B
2958.50	coc	bulk	-	46.5	6.0	11.3	11.8	17.4	17.3	29.2	-	0008-0B
2959.50	coc	bulk	-	31.8	3.8	7.8	9.7	10.5	11.6	20.2	-	0009-0B

Table 1 b: Composition of material extracted from the rock (%) for well WELL 30/9-13S,NORSK HYDRO

Depth unit of measure: m

Depth	Typ	Lithology	Sat / EOM	Aro / EOM	Asph / EOM	NSO / EOM	HC / EOM	Non-HC / EOM	Sat / Aro	HC / Non-HC	Sample
2944.00	swc	bulk	9.92	12.40	49.59	28.10	22.31	77.69	80.00	28.72	0001-0B
2945.30	swc	bulk	8.11	16.22	36.04	39.64	24.32	75.68	50.00	32.14	0002-0B
2947.00	swc	bulk	8.70	17.39	38.41	35.51	26.09	73.91	50.00	35.29	0003-0B
2950.00	dcw	bulk	7.11	14.22	50.71	27.96	21.33	78.67	50.00	27.11	0010-0B
2955.00	swc	bulk	11.91	20.60	30.52	36.97	32.51	67.49	57.83	48.16	0005-0B
2955.00	dcw	bulk	4.27	14.53	47.01	34.19	18.80	81.20	29.41	23.16	0011-0B
2957.00	coc	bulk	18.08	25.82	15.73	40.38	43.90	56.10	70.00	78.24	0006-0B
2957.75	coc	bulk	16.55	25.52	21.03	36.90	42.07	57.93	64.86	72.62	0007-0B
2958.50	coc	bulk	12.90	24.30	25.38	37.42	37.20	62.80	53.10	59.25	0008-0B
2959.50	coc	bulk	11.95	24.53	30.50	33.02	36.48	63.52	48.72	57.43	0009-0B

Table 2a : Tabulation of carbon isotope data for EOM/EOM - fractions or Oils for well WELL 30/9-13S,NORSK HYDRO

Depth_unit of measure: m

Depth	Typ	Lithology	EOM/Oil	Saturated	Aromatic	NSO	Asphaltenes	Kerogen	Sample
2944.00	swc		-	-27.74	-25.82	-25.37	-24.21	-	0001-0B
2945.30	swc		-	-27.22	-25.20	-24.92	-23.73	-	0002-0B
2947.00	swc		-	-27.59	-26.18	-25.82	-24.58	-	0003-0B
2950.00	dcw		-	-27.72	-25.83	-25.66	-24.35	-	0010-0B
2951.00	swc		-	-29.94	-28.04	-27.90	-26.40	-	0004-0B
2955.00	swc		-	-28.23	-26.61	-26.07	-24.85	-	0005-0B
2955.00	dcw		-	-27.77	-26.20	-26.07	-24.74	-	0011-0B
2957.00	coc		-	-29.95	-28.37	-27.91	-26.90	-	0006-0B
2957.75	coc		-	-29.26	-27.76	-27.37	-25.99	-	0007-0B
2958.50	coc		-	-29.12	-27.38	-27.04	-25.81	-	0008-0B
2959.50	coc		-	-28.28	-26.75	-26.46	-25.19	-	0009-0B

Table 2a : Tabulation of carbon isotope data for EOM/EOM - fractions or Oils for well 8 OLJER FOR SEP/ISOTOP

Depth unit of measure: m

Well	EOM/Oil	Saturated	Aromatic	NSO	Asphaltenes	Kerogen	Sample
	-					-	0001-0B
30/9-13S DST 1	-	-28.60	-27.67	-27.20	-27.65	-	0002-0B
30/9-13S DST 2	-	-28.55	-27.67	-27.38	-27.61	-	0003-0B
30/9-13S RFT	-	-28.58	-27.68	-27.55	-27.75	-	0004-0B
	-					-	0005-0B
	-					-	0006-0B
	-					-	0007-0B
	-					-	0008-0B

Table 2b : Tabulation of cv values from carbon isotope data for well WELL 30/9-13S,NORSK HYDRO

Depth unit of measure: m

Depth	Typ	Lithology	Saturated	Aromatic	cv value	Sample
2944.00	swc		-27.74	-25.82	1.21	0001-0B
2945.30	swc		-27.22	-25.20	1.27	0002-0B
2947.00	swc		-27.59	-26.18	0.03	0003-0B
2950.00	dcw		-27.72	-25.83	1.14	0010-0B
2951.00	swc		-29.94	-28.04	1.85	0004-0B
2955.00	swc		-28.23	-26.61	0.70	0005-0B
2955.00	dcw		-27.77	-26.20	0.44	0011-0B
2957.00	coc		-29.95	-28.37	1.14	0006-0B
2957.75	coc		-29.26	-27.76	0.75	0007-0B
2958.50	coc		-29.12	-27.38	1.24	0008-0B
2959.50	coc		-28.28	-26.75	0.51	0009-0B

Table 2b : Tabulation of cv values from carbon isotope data for well 8 OLJER FOR SEP/ISOTOP

Depth unit of measure: m

Well		Saturated	Aromatic	cv value	Sample
					0001-0B
30/9-13S DST 1		-28.60	-27.67	-0.72	0002-0B
30/9-13S DST 2		-28.55	-27.67	-0.85	0003-0B
30/9-13S RFT		-28.58	-27.68	-0.79	0004-0B
					0005-0B
					0006-0B
					0007-0B
					0008-0B