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<b>Title</b> GEOCHEMICAL EVALUATION OF WELL 15/12-8		BA92-294-1 11 FEB. 1992
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### 3. SAMPLES AND METHODS

The analytical work was carried out in accordance with the Statoil standards and guidelines given in "Organic geochemistry standard analytic procedure requirement and reporting guide" (1988). The work was carried out in Statoil's Geolab, with the exception of vitrinite reflectance measurements, isotope analyses and gas composition determination (IFE), and the fractionation by liquid chromatography of the deasphalted condensate (PROLAB).

The following methods were applied:

ANALYSIS	NUMBER OF SAMPLES				TOTAL
	CUTTINGS	SWC	CORE	DST	
Headspace and occluded gas					0
Lithological description	19	17	34		70
TOC	19	11			30
Rock Eval pyrolysis	10	8			18
Vitrinite reflectance	17	5			22
Kerogen description					0
Pyrolysis-GC	3	6			9
Solvent extraction	3	10			13
Deasphalting/MPLC sepn.	2	3		1	6
GC total extract/whole oil	1	7		1	9
GC of saturates	2	3		1	6
GC of aromatics	2	3		1	6
GCMS	3	9		1	13
$\delta^{13}\text{C}$ of whole oil/extract and fractions				5	5
$\delta^{13}\text{C}$ of gas (inc. composition)				1	1
Fluid density ( $^{\circ}\text{API}$ )					0
Iatroscan analysis			34		34

The precise samples analysed by each method are described in Table 1, except for those subjected to Iatroscan analysis which are listed in Table 2.

TABLE 1. SAMPLE DEPTHS AND GEOCHEMICAL ANALYSES FOR WELL 15/12-8

DEPTH mRKB	SAMPLE NO.	SAMPLE TYPE	TOC	ROCK EVAL	VIT. REF.	PY-GC	GC ANAL.	GCMS ANAL.
1000.0	S5593	CUTT	X		X			
1100.0	S5594	CUTT	X	X	X			
1220.0	S5595	CUTT	X	X	X			
1300.0	S5596	CUTT	X	X	X	X	X	X
1400.0	S5597	CUTT	X	X	X			
1500.0	S5598	CUTT	X	X	X	X	X	X
1600.0	S5599	CUTT	X	X	X			
1700.0	S5600	CUTT	X		X			
1800.0	S5601	CUTT	X	X	X			
1900.0	S5602	CUTT	X		X			
2000.0	S5603	CUTT	X	X	X			
2100.0	S5604	CUTT	X		X			
2200.0	S5605	CUTT	X		X			
2272.0	S5606	CUTT	X	X				
2277.3	S5612	SWC	X	X		X	X	X
2284.3	S5613	SWC	X	X				
2291.3	S5614	SWC	X	X		X	X	X
2295.3	S5615	SWC	X	X	X			
2315.3	S5616	SWC	X	X		X	X	X
2397.3	S5617	SWC	X		X			
2480.0	S5607	CUTT	X		X			
2640.0	S5608	CUTT	X		X			
2777.0	S5609	CUTT	X		X			
2828.0	S5610	CUTT	X					
2836.3	S5618	SWC	X	X		X	X	X
2839.3	S5619	SWC	X	X		X	X	X
2841.3	S5620	SWC	X	X		X	X	X
2849.2	S5632	SWC					X	X
2854.5	S5633	SWC					X	
2858.0	S5611	CUTT	X	X	X	X	X	X
2860.2	S5634	SWC					X	X
2861.3	S5621	SWC	X					
2877.2	S5635	SWC					X	X
2933.3	S5622	SWC	X		X			
2995.0	-	SWC			X			
3048.9	-	SWC			X			
2842.5- 2873.5		DST#1 (gas + condensate)					X	X

TABLE 2. DEPTHS OF CORE SAMPLES FROM WELL 15/12-8A FOR IATROSCAN ANALYSIS

DEPTH mRKB	SAMPLE NO.	DEPTH mRKB	SAMPLE NO.
2844.7	S5684	2858.5	S5701
2844.75	S5685	2859.5	S5702
2845.0	S5686	2860.75	S5703
2845.25	S5687	2862.1	S5704
2845.6	S5688	2862.5	S5705
2845.75	S5689	2862.75	S5706
2846.0	S5690	2863.75	S5707
2846.25	S5691	2865.0	S5708
2846.5	S5692	2866.05	S5709
2847.0	S5693	2867.1	S5710
2847.3	S5694	2868.0	S5711
2849.0	S5695	2869.0	S5712
2851.95	S5696	2870.0	S5713
2854.2	S5697	2875.0	S5714
2854.75	S5698	2880.0	S5715
2855.75	S5699	2891.1	S5716
2857.0	S5700	2902.0	S5717

TABLE 3. LITHOLOGICAL DESCRIPTION OF SAMPLES FROM WELL 15/12-8

SAMPLE NO. TYPE	Depth mRKB	LITHOLOGY: rockname, mod lith, colour, gr.size, sorting, roundness, matrix, cementation, hardness, accessories, fossils, porosity, contamination.
S5593 CUTT	1000.0	100% Clyst, olive grey-dark greenish grey, soft, occ firm, sol, stacky?, sl silty I/P occ sl blocky, micromica, sl-non calcareous TR Pyrite
S5594 CUTT	1100.0	100% Clyst, pred olive grey, v silty, else as above TR Sandstone TR Glauconite, pyrite
S5595 CUTT	1220.0	40% Clyst, dark green grey-olive grey- pred brown grey, firm, blocky, v silty, non-sl calcareous, micropyrite 60% Siltstone TR Sand, pyrite, glauconite
S5596 CUTT	1300.0	95% Clyst, brown grey, occ dusky yellow brown, firm, blocky, I/P soft and stacky, silty I/P no-sl calcareous, micropyrite 5% Siltstone
S5597 CUTT	1400.0	100% Clyst, brown grey, occ dusky yellow brown, firm, blocky, I/P soft and stacky, silty I/P, no-sl calcareous, micropyrite TR Pyrite
S5598 CUTT	1500.0	95% Clyst, olive grey, soft-occ firm, v sl stacky, non calcareous, occ micromica 5% Limestone TR foss frags
S5599 CUTT	1600.0	100% Clyst, dom olive grey, dusky yellow brown, occ. dark grey green, firm, - soft, blocky, micromica, micropyrite, mode - sl calcareous TR Siltstone, limestone
S5600 CUTT	1700.0	100% Clyst, dom olive grey, dusky yellow brown, occ. dark grey green, firm, - soft, blocky, micromica, micropyrite, mode sl calcareous TR Siltstone, limestone, pyrite
S5601 CUTT	1800.0	100% Clyst, dark green grey - olive grey, firm, blocky, sl v silty, micropyrite, calcareous TR Limestone, siltstone

TABLE 3. LITHOLOGICAL DESCRIPTION OF SAMPLES FROM WELL 15/12-8

SAMPLE NO. TYPE	Depth mRKB	LITHOLOGY: rockname, mod lith, colour, gr.size, sorting, roundness, matrix, cementation, hardness, accessories, fossils, porosity, contamination.
S5602 CUTT	1900.0	100% Sltst, yellow brown, blocky, fri, v argillous micromica, micropyrite, non calcareous TR Limestone
S5603 CUTT	2000.0	100% Clyst, green grey - brown grey, firm-mode hard non calcareous TR Limestone
S5604 CUTT	2100.0	100% Clyst, olive grey, dark green, blocky, silty, micromica, sl-mode calcareous TR Limestone, siltstone, pyrite, worms, dolomite
S5605 CUTT	2200.0	100% Clyst, grey black, olive grey, occ brown, blocky, micromica, sl silty TR Limestone
S5606 CUTT	2272.0	100% Clyst, black green, olive grey, brown, micromica, blocky, bry TR Limestone
S5612 SWC	2277.3	100% Clyst, olive black, firm, blocky - subfiss, I/P sl mica, non calcareous
S5613 SWC	2284.3	100% Clyst, olive black, firm, blocky - subfiss, I/P sl mica, non calcareous
S5614 SWC	2291.3	100% Clyst, olive black - brown black, firm, blocky - subfiss, I/P sl micromica, non calcareous
S5615 SWC	2295.3	100% Clyst, olive black, firm, blocky-subfiss, I/P sl micromica, sl calcareous
S5616 SWC	2315.3	100% Clyst, olive black, firm, blocky-subfiss, I/P sl micromica, non calcareous
S5617 SWC	2397.3	100% Clyst, olive black - olive grey, firm, blocky - subfiss, non calcareous
S5607 CUTT	2480.0	90% Clyst, green grey, mode brown - dark brown, soft, non calcareous, amorph, sl stacky, 10% Limestone

TABLE 3. LITHOLOGICAL DESCRIPTION OF SAMPLES FROM WELL 15/12-8

SAMPLE NO. TYPE	Depth mRKB	LITHOLOGY: rockname, mod lith, colour, gr.size, sorting, roundness, matrix, cementation, hardness, accessories, fossils, porosity, contamination.
S5608 CUTT	2640.0	100% Chky limestone, incr. light grey, light olive grey, pa pnk grey and argillous, occ soft - firm TR Clystone
S5609 CUTT	2777.0	70% Mrl, gen orange brown-pink brown, olive grey-light grey I/P, soft-firm, gen amorph, bcmg more argillous, ap sandy w/calcite grains, wh micromica, microglauconite 30% Calc clyst, red/brown, soft-firm, amorph, wh micromica, clr f- vf calcite grains
S5610 CUTT	2828.0	85% Mrl, gen dark red brown, mode red brown, soft-firm, amorph - blocky, occ sl micromica 10% Clyst, grey black, olive black, blocky - subfiss, non calcareous-calcareous, sl micromica 5% Arg limestone
S5618 SWC	2836.3	100% Clyst/sh, olive black - brown black, firm, subfiss-fiss, v sl micromica, non calcareous
S5619 SWC	2839.3	100% Clyst/sh, brown black - dusky yellow brown, firm, subfiss, waxy txt, I/P w/dissemin pyrite, sl micromica, non calcareous
S5620 SWC	2841.3	100% Clyst/sh, brown black - dusky yellow brown, firm, subfiss, waxy txt, I/P w/dissemin pyrite, sl micromica, non calcareous
S5632 SWC	2849.2	100% Arg sandstone, light black grey - medium light grey, clear - transported quartz, rly orng stn, vf-med, mode sorted, subangular - subrounded, abund arg matrix, calcite cemented, fri, sl micromica, pr vis por
S5633 SWC	2854.5	100% pl yellow brown, clear - v lt brown transported quartz, occ light orng stn, vf-f, rly med, mode sorted, pl yellow brown matrix, calcite cemented, fri, mica, fair vis por

TABLE 3. LITHOLOGICAL DESCRIPTION OF SAMPLES FROM WELL 15/12-8

SAMPLE NO. TYPE	Depth mRKB	LITHOLOGY: rockname, mod lith, colour, gr.size, sorting, roundness, matrix, cementation, hardness, accessories, fossils, porosity, contamination.
S5611 CUTT	2858.0	30% Sand 40% Clyst, med brown, med grey/brown, firm-hard, blocky, subfiss, ea, occ greasy, micropyrrite, occ v micropyrrite, non calcareous 20% Clyst, green grey, light green grey, firm-hard blocky, non calcareous, pyrite as ind microxls + aggs, occ silty grading to siltstone 10% Clyst, mode red brown - orange brown, blocky, hard, sl calcareous-calcareous, occ sandy w/ wh mica TR Pyrite, fib xln calcite
S5634 SWC	2860.2	100% Arg sandstone, mode brown-mode red brown, clear-transported brown quartz, vf-f, occ med, pr-mode sorted, subangular - subrounded, abund brown arg matrix, calcite cemented, fri, mica, pr vis por
S5621 SWC	2861.3	100% Clyst, silty + sandy, dark red brown, firm, subfiss, calcite, micromica, w/lams of light black grey sandstone + siltstone
S5635 SWC	2877.2	100% Sandstone, mode red brown, occ white strks, vf - f, mode sorted, subangular-subrounded, calcite/sil cemented, fair vis por
S5622 SWC	2933.3	100% Clyst, dark red brown, firm, non-sl calcite, silty, mica
S5623 SWC	2995.0	100% Clyst, dark red brown, vf, poor-mode sorted, subangular - subrounded, sil cemented, no vis por
S5624 SWC	3048.9	100% Sandstone, pa red brown, fine-coarse, occ v coarse, poor sorted, subrounded - subangular, sil/sl calcite cemented, poor-mode vis por



TABLE 4. BIOMARKER DATA FROM GCMS ANALYSIS OF SEDIMENT EXTRACTS

SAMPLE	S5596	S5598	S5612	S5614	S5616	S5618
DEPTH	1300.0	1500.0	2273.3	2291.3	2315.3	2836.3
FM.	Nord.	Hord.	Sele	Sele	Sele	Draupne
LITH.	clst	clst	clst	clst	clst	clst
%20S <sup>1</sup>	N.D.	N.D.	11	31	17	28
% $\alpha\beta\beta$ <sup>2</sup>	N.D.	N.D.	24	23	24	36
DIA27 <sup>3</sup>	N.D.	N.D.	0.4	0.5	0.7	0.7
%C27 <sup>4</sup>	N.D.	N.D.	18	19	23	35
%C28 <sup>5</sup>	N.D.	N.D.	34	28	31	32
%C29 <sup>6</sup>	N.D.	N.D.	48	53	46	33
%22S <sup>7</sup>	N.D.	N.D.	45	42	41	55
XC29 <sup>8</sup>	0	0	14	20	20	50
Ts/Tm <sup>9</sup>	0	0	33	23	32	29
HOP2930 <sup>10</sup>	1.1	0.4	0.5	0.6	0.5	0.5
28HOP <sup>11</sup>	0.0	0.0	0.0	1.1	0.4	0.0
HOPSTN <sup>12</sup>	N.D.	N.D.	5.6	2.8	4.2	1.0
SAMPLE	S5619	S5620	S5632	S5611	S5634	S5635
DEPTH	2839.3	2841.3	2849.2	2858.0	2860.2	2877.2
FM.	Draupne	Draupne	Oxford	Oxford	Triassic	Triassic
LITH.	clst	clst	sst	clst	sst	sst
%20S <sup>1</sup>	29	40	54	28	50	39
% $\alpha\beta\beta$ <sup>2</sup>	55	53	59	51	62	63
DIA27 <sup>3</sup>	0.7	0.8	0.8	0.8	1.3	1.1
%C27 <sup>4</sup>	32	31	34	31	33	36
%C28 <sup>5</sup>	38	35	29	36	31	33
%C29 <sup>6</sup>	30	34	37	33	36	32
%22S <sup>7</sup>	55	52	63	53	63	61
XC29 <sup>8</sup>	50	50	50	39	36	60
Ts/Tm <sup>9</sup>	32	34	41	27	38	41
HOP2930 <sup>10</sup>	0.5	0.5	1.0	0.5	0.9	0.5
28HOP <sup>11</sup>	0	0	0.1	0	0	0
HOPSTN <sup>12</sup>	0.8	1.1	3.2	1.0	3.9	2.8

- 1 20S/(20S+R)  $\alpha\alpha\alpha$  C29 steranes (m/z 217)
  - 2  $\alpha\beta\beta$ /( $\alpha\beta\beta$ + $\alpha\alpha\alpha$ ) 20(R+S) C29 steranes (m/z 217)
  - 3 C27  $\beta\alpha$  dia-/C27  $\alpha\alpha\alpha$  (20R+S) steranes (m/z 217)
  - 4 C27/(C27+C28+C29)  $\alpha\beta\beta$  (20R+S) steranes (m/z 218)
  - 5 C28/(C27+C28+C29)  $\alpha\beta\beta$  (20R+S) steranes (m/z 218)
  - 6 C29/(C27+C28+C29)  $\alpha\beta\beta$  (20R+S) steranes (m/z 218)
  - 7 22S/(22S+R) C32  $\alpha\beta$  hopanes (m/z 191)
  - 8 triterpane X/(triterpane X + normoretane) (m/z 191)
  - 9 Ts(Ts+Tm) (m/z 191)
  - 10 C29/C30 hopanes (m/z 191)
  - 11 C28-bisnorhopane/C30 hopane (m/z 191)
  - 12 intensity C30 hopane/intensity C29 steranes (m/z 191 and m/z 217)
- N.D. no data (samples too immature)

TABLE 5. RESULTS OF SOURCE ROCK SCREENING ANALYSES FOR WELL 15/12-8

DEPTH mRKB	SAMPLE NO.	S1	S2	TOC	HI	PP	PI	TMAX
1000,00	S5593			1,1				
1100,00	S5594	0,1	0,9	1,1	82	1,0	0,10	423
1220,00	S5595	0,2	4,8	3,2	150	5,0	0,04	425
1300,00	S5596	0,3	8,9	5,6	159	9,2	0,03	425
1400,00	S5597	0,2	7,4	4,8	154	7,6	0,03	427
1500,00	S5598	0,2	3,2	2,0	160	3,4	0,06	423
1600,00	S5599	0,1	2,6	2,0	130	2,7	0,04	424
1700,00	S5600			1,5				
1800,00	S5601	0,1	1,8	1,5	120	1,9	0,05	418
1900,00	S5602			3,0				
2000,00	S5603	0,1	3,5	2,3	152	3,6	0,03	425
2100,00	S5604			0,9				
2200,00	S5605			1,0				
2272,00	S5606	0,1	1,0	0,9	111	1,1	0,09	422
2277,30	S5612	0,2	1,7	1,0	170	1,9	0,11	427
2284,30	S5613	0,2	1,9	1,4	136	2,1	0,10	417
2291,30	S5614	0,2	1,5	1,4	107	1,7	0,12	423
2295,30	S5615	0,2	1,9	1,3	146	2,1	0,10	427
2315,30	S5616	0,2	1,1	1,1	100	1,3	0,15	421
2397,30	S5617			0,3				
2480,00	S5607			0,4				
2640,00	S5608			0,2				
2777,00	S5609			0,5				
2828,00	S5610			0,5				
2836,30	S5618	3,6	26,3	6,1	431	29,9	0,12	424
2839,30	S5619	5,4	31,9	8,1	394	37,3	0,14	422
2841,30	S5620	3,5	33,7	7,1	475	37,2	0,09	421
2858,00	S5611	0,5	6,4	2,2	291	6,9	0,07	429
2861,30	S5621			0,2				
2933,30	S5622			0,1				

S1, S2 in mg/g rock // HI as (S2/TOC)\*100  
 PP as S1+S2 // PI as S1/S1+S2 // \*) flat top

TABLE 6. QUANTITATIVE DATA FROM PYROLYSIS-GC FOR WELL 15/12-8

DEPTH (mRKB)	SAMPLE NO.	C1	C2-C5	C6-C14	C15+
1300.00	S5596	4.9	15.2	41.4	38.5
1500.00	S5598	5.0	19.1	51.6	24.3
2277.30	S5612	3.7	19.7	46.8	29.9
2291.30	S5614	3.7	20.1	49.4	26.9
2315.30	S5616	4.2	22.2	51.7	21.9
2836.30	S5618	2.5	14.6	35.3	47.7
2839.30	S5619	2.4	14.3	35.0	48.4
2841.30	S5620	2.8	15.0	34.6	47.6
2858.00	S5611	3.1	17.3	41.4	38.3

TABLE 7. CONCENTRATION OF EXTRACTABLE ORGANIC MATTER (EOM) AND CHROMATOGRAPHIC FRACTIONS (PPM), WELL 15/12-8

DEPTH (mRKB)	SAMPLE NO.	TOT EOM	HYDROCARBONS			NON HYDROCARBONS		
			SAT	ARO	TOT	ASPH	NSO	TOT
1300.00	S5596	1718	224	378	602	453	663	1116
1500.00	S5598	999						
2277.30	S5612	1224						
2291.30	S5614	1509						
2315.30	S5616	1446						
2836.30	S5618	6962	1531	1982	3513	1521	1928	3449
2839.30	S5619	9456	1722	2642	4364	2449	2642	5091
2841.30	S5620	7813	1140	2131	3271	2137	2406	4542
2849.20	S5632	620						
2854.50	S5633	1162				324		324
2858.00	S5611	3966	798	1052	1850	714	1402	2116
2860.20	S5634	602						
2877.20	S5635	481						

**TABLE 8. NORMALISED COMPONENT GROUP COMPOSITION (%) OF EXTRACTED ORGANIC MATTER (C<sub>15</sub>+), WELL 15/12-8**

DEPTH (mRKB)	SAMPLE NO.	HYDROCARBONS			NON HYDROCARBONS		
		SAT	ARO	TOT	ASPH	NSO	TOT
1300.00	S5596	13.1	22.0	35.0	26.4	38.6	65.0
2836.30	S5618	22.0	28.5	50.5	21.9	27.7	49.5
2839.30	S5619	18.2	27.9	46.2	25.9	27.9	53.8
2841.30	S5620	14.6	27.3	41.9	27.3	30.8	58.1
2854.50	S5633				27.9		27.9
2858.00	S5611	20.1	26.5	46.6	18.0	35.4	53.4

TABLE 9. GAS CHROMATOGRAPHIC DATA FROM EXTRACT FRACTIONS,  
WELL 15/12-8

DEPTH (mRKB)	SAMPLE NO.	Pr nC17 (A)	Ph nC18 (B)	A B	Pr Ph	CPI1	MPI1	Rc
1300.00	S5596	0.5	0.5	1.0	0.9	1.7		
1500.00	S5598	0.7	0.9	0.8	1.1			
2277.30	S5612	2.7	1.0	2.7	2.8			
2291.30	S5614	3.9	1.3	3.0	2.9			
2315.30	S5616	3.7	1.5	2.5	2.7	2.1		
2836.30	S5618	1.2	0.9	1.3	1.7	1.1	0.7	0.8
2839.30	S5619	0.9	0.7	1.3	1.5	1.0	0.8	0.9
2841.30	S5620	0.7	0.6	1.2	1.5	1.1		
2849.20	S5632	1.0	0.8	1.3	1.2			
2854.50	S5633	0.8	0.7	1.1	1.5	1.4		
2858.00	S5611	1.1	0.8	1.4	1.7	1.1	0.8	0.9
2860.20	S5634	1.0	0.8	1.3	1.4	1.6		
2877.20	S5635	1.4	1.3	1.1	1.2			

TABLE 10. PARAMETERS FROM THERMAL EXTRACTION-GC (S1), WELL 15/12-8

DEPTH (mRKB)	SAMPLE NO.	$\frac{\text{Pr}}{\text{nC17 (A)}}$	$\frac{\text{Ph}}{\text{nC18 (B)}}$	$\frac{\text{A}}{\text{B}}$	$\frac{\text{Pr}}{\text{Ph}}$	CPI1
2836,30	S5618	1,4	0,9	1,5	2,0	
2839,30	S5619	1,0	0,8	1,2	1,6	
2841,30	S5620	0,9	0,7	1,3	1,9	

TABLE 11. YIELDS & GROUP COMPOSITIONS FROM IATROSCAN ANALYSES OF CORE EXTRACTS FROM WELL 15/12-8A

DEPTH (mRKB)	SAMPLE NO.		SAT %	ARO %	RES %	ASPH %	TOT EOM
2844.70	S5684	CORE/SH	24.5	53.6	21.1	0.8	729
2844.75	S5685	CORE/SST	57.7	15.2	26.0	1.3	217
2845.00	S5686	"	72.4	8.2	16.0	3.5	131
2845.25	S5687	"	83.8	11.0	4.1	1.1	78
2845.60	S5688	"	84.4	6.2	7.5	2.1	205
2845.75	S5689	"	6.6	1.1	92.3	0.1	443
2846.00	S5690	"	78.0	10.6	10.3	1.2	103
2846.25	S5691	"	66.1	8.5	15.0	10.6	72
2846.50	S5692	"	81.5	10.2	5.6	2.7	68
2847.00	S5693	"	36.5	4.7	50.3	8.6	101
2847.30	S5694	"	70.6	9.7	17.2	2.5	172
2849.00	S5695	"	83.5	11.7	4.6	0.3	143
2851.95	S5696	"	84.1	11.1	4.0	0.9	145
2854.20	S5697	"	95.4	1.3	3.1	0.4	140
2854.75	S5698	"	36.1	15.7	40.0	8.3	19
2855.75	S5699	"	82.9	11.1	5.7	0.4	210
2857.00	S5700	"	71.5	16.2	11.7	0.7	76
2858.50	S5701	"	78.3	15.2	6.3	0.3	211
2859.50	S5702	"	46.7	15.0	32.8	5.7	242
2860.75	S5703	"	74.3	20.6	4.9	0.3	191
2862.10	S5704	"	64.5	23.3	8.2	4.0	395
2862.50	S5705	"	64.7	24.1	8.7	2.7	257
2862.75	S5706	"	73.6	19.3	1.6	5.6	307
2863.75	S5707	"	46.3	18.2	25.0	10.5	135
2865.00	S5708	"	60.1	26.4	11.8	1.9	87
2866.05	S5709	"	25.4	23.0	44.3	7.4	46
2867.10	S5710	"	20.5	16.3	37.4	25.8	73
2868.00	S5711	"	32.2	29.1	31.8	7.0	53
2869.00	S5712	"	80.9	13.4	5.0	0.9	138
2870.00	S5713	"	63.0	12.5	9.4	15.1	99
2875.00	S5714	"	95.1	3.2	0.9	1.0	89
2880.00	S5715	"	99.4	0.2	0.4	0.0	600
2891.10	S5716	"	99.2	0.3	0.5	0.2	46
2902.00	S5717	"	99.2	0.4	0.4	0.1	232



TABLE 12. GROUP COMPOSITION AND BIOMARKER DATA FOR CONDENSATE (DST#1) FROM WELL 15/12-8

SAMPLE NO.	S5567
%Sats <sup>a</sup>	83
%Arom <sup>a</sup>	17
%Polars <sup>b</sup>	tr.
%20S <sup>1</sup>	52
% $\alpha\beta\beta$ <sup>2</sup>	51
DIA27 <sup>3</sup>	0.7
%C27 <sup>4</sup>	45
%C28 <sup>5</sup>	32
%C29 <sup>6</sup>	23
%22S <sup>7</sup>	62
XC29 <sup>8</sup>	100
Ts/Tm <sup>9</sup>	62
HOP2930 <sup>10</sup>	0.7
28HOP <sup>11</sup>	0.0
HOPSTN <sup>12</sup>	N.D.
PR/PH <sup>13</sup>	1.5
PR/nC17 <sup>13</sup>	0.7
PH/nC18 <sup>13</sup>	0.6
nC17/(nC17+nC27) <sup>13</sup>	0.9
C28TRI/C29MONO <sup>14</sup>	1.0
TRI/MONO <sup>15</sup>	1.0
C20TRI/C28TRI <sup>16</sup>	0.84
TRI/TRI <sup>17</sup>	0.48

a from MPLC

b Polars = NSO's (from MPLC) and asphaltenes; tr = trace

1 20S/(20S+R)  $\alpha\alpha\alpha$  C29 steranes (m/z 217)

2  $\alpha\beta\beta$ /( $\alpha\beta\beta$ + $\alpha\alpha\alpha$ ) 20(R+S) C29 steranes (m/z 217)

3 C27  $\beta\alpha$  dia-/C27  $\alpha\alpha\alpha$  (20R+S) steranes (m/z 217)

4 C27/(C27+C28+C29)  $\alpha\beta\beta$  (20R+S) steranes (m/z 218)

5 C28/(C27+C28+C29)  $\alpha\beta\beta$  (20R+S) steranes (m/z 218)

6 C29/(C27+C28+C29)  $\alpha\beta\beta$  (20R+S) steranes (m/z 218)

7 22S/(22S+R) C32  $\alpha\beta$  hopanes (m/z 191)

8 triterpane X/(triterpane X + normoretane) (m/z 191)

9 Ts(Ts+Tm) (m/z 191)

10 C29/C30 hopanes (m/z 191)

11 C28-bisnorhopane/C30 hopane (m/z 191)

12 intensity C30 hopane/intensity C29 steranes (m/z 191 and m/z 217)

13 PR (pristane), PH (phytane), n-alkanes calculated from GC

14 C28 20R triaromatic sterane/(same+C29 20R monoaromatic)

15 Sum triaromatic steranes/(same+sum monoaromatic steranes)

16 C20 triaromatic sterane/(same+C28 20R triaromatic sterane)

17 C20+C21 triaromatic steranes/(same+sum C26-C28 triaromatic)

N.D. not determined

TABLE 13. SOME GAS ISOTOPIC AND COMPOSITIONAL DATA FOR WELLS FROM THE 15/9 AND 15/12 AREAS

WELL	DST#	SAMPLE TYPE	METHANE	
			$\delta^{13}C$	WT. %
15/12-8	1	Condensate	-38.3	73.2
15/12-5	?	Oil	-38.5	76.2
15/9-11	1	Condensate	-43.0	78.3
15/9-13	1	Condensate	-39.7	83.1
15/9-15	?	Condensate?	-41.0	?

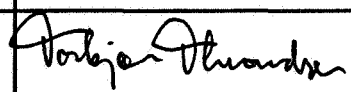
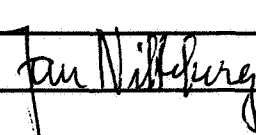
## APPENDIX 1

### VITRINITE REFLECTANCE DATA REPORT FROM IFE

#### SAMPLES ANALYSED:

DEPTH mRKB	SAMPLE NO.	SAMPLE TYPE
1000.0	S5593	CUTT
1100.0	S5594	CUTT
1220.0	S5595	CUTT
1300.0	S5596	CUTT
1400.0	S5597	CUTT
1500.0	S5598	CUTT
1600.0	S5599	CUTT
1700.0	S5600	CUTT
1800.0	S5601	CUTT
1900.0	S5602	CUTT
2000.0	S5603	CUTT
2100.0	S5604	CUTT
2200.0	S5605	CUTT
2295.3	S5615	SWC
2397.3	S5617	SWC
2480.0	S5607	CUTT
2640.0	S5608	CUTT
2777.0	S5609	CUTT
2858.0	S5611	CUTT
2933.3	S5622	SWC
2995.0	-	SWC
3048.9	-	SWC

N.B. Depths given for SWC in Appendix 1 are Loggers's.

<b>ADDRESS</b> KJELLER Box 40, N-2007 Kjeller, Norway		<b>HALDEN</b> N-1751 Halden, Norway		<b>AVAILABILITY</b> PRIVATE CONFIDENTIAL
<b>TELEPHONE</b> +47 6 806000 <b>TELEX</b> 74 573 energ n <b>TELEFAX</b> +47 6 815553		+47 9 183100 76 335 energ n		
<b>REPORT TYPE</b>  Service	<b>REPORT NO.</b> IFE/KR/F-91/136		<b>DATE</b> 1991-10-18	
	<b>REPORT TITLE</b>  VITRINITE REFLECTANCE WELL 15/12-8 OFFSHORE NORWAY		<b>DATE OF LAST REV.</b>	
			<b>REV. NO.</b>	
	<b>CLIENT</b> Statoil		<b>NUMBER OF PAGES</b>	
<b>CLIENT REF.</b> R. Patience, contract T 6269 no. 156		<b>NUMBER OF ISSUES</b> 13		
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<b>PREPARED BY</b> Torbjørn Throndsen		1991-10-18		
<b>REVIEWED BY</b>				
<b>APPROVED BY</b> Jan Nitteberg		1991-10-18		

## 1 Introduction

This report gives the result of vitrinite reflectance analyses performed on 22 samples from well 15/12-8 offshore Norway.

## 2 Material

The samples were provided from the client as pellets of bulk rock chips. 20 of the preparations consisted of claystone whereas the remaining two were siltstones. The majority of the samples were very poor in true vitrinite or even barren.

**NB!** Note that one of the supplied samples was marked 2277 whereas the depth in the accompanying sample list was 2777 mRKB. We have in the depth plots in this report assumed that the depth for this particular sample is 2777 mRKB.

## 3 Analytical techniques

The samples being were not treated with any acid prior to further preparation. Although the samples were submitted as pellets from the client they were re-impregnated at IFE. They were polished using 0.25 micron diamond paste and magnesium oxide as the two final steps. The polishing quality obtained was quite satisfactory.

The analytical equipment being used was a Zeiss MPM 03 photometer microscope equipped with an Epiplan-Neofluoar 40/0.90 oil objective. The sensitive measuring spot was about 2.5 micron in diameter, and the measurements were made through a green band pass filter (546 nm) and in oil immersion. The readings were made without a polarizer and using a stationary stage. On each sample up to 25 points were measured, and only material interpreted as true vitrinite was measured, and selectively on telocollinite if positively identified. The results are presented as arithmetic mean of all the measured spots.

## 4 Results

The vitrinite reflectance results are given in Table 1. Histograms for each sample are given in Appendix. Vitrinite reflectance versus depth plots on linear and log scales are given in Figure 1 and 2 respectively.

Table 1. Vitrinite reflectance data well 15/12-8.

Sample code IFE	Sample depth, type	Sample lithology	Vitrinite reflectance %Rm $\pm$ std ( N)	Sample quality	General comment
ST 1222	1000 cut	claystone	0.23 $\pm$ 0.03 ( 6)	-o--o	v poor/low
ST 1223	1100 cut	claystone	0.24 $\pm$ 0.03 (12)	-o--o	poor/low
ST 1224	1220 cut	claystone	0.35 $\pm$ 0.04 (25)	oooo	good
ST 1225	1300 cut	claystone	0.36 $\pm$ 0.04 (25)	oooo	good
ST 1226	1400 cut	claystone	0.35 $\pm$ 0.04 (25)	oooo	good
ST 1227	1500 cut	claystone	0.29 $\pm$ 0.04 (26)	oooo-	avg/low
ST 1228	1600 cut	claystone	0.30 $\pm$ 0.06 (17)	oooo-	avg/low
ST 1229	1700 cut	claystone	0.32 $\pm$ 0.05 ( 6)	-o--o	poor/low
ST 1230	1800 cut	claystone	0.34 $\pm$ 0.05 (26)	ooo-o	avg/low
ST 1231	1900 cut	claystone	0.36 $\pm$ 0.05 (26)	oooo	good
ST 1232	2000 cut	claystone	0.34 $\pm$ 0.07 (16)	-oo--	poor/low
ST 1233	2100 cut	claystone	0.39 $\pm$ 0.06 (18)	-oo--	poor/low
ST 1234	2200 cut	claystone	0.49 $\pm$ 0.02 ( 3)	-o+--	v poor/high
ST 1235	2290.8 swc	claystone	0.42 $\pm$ 0.03 ( 3)	-o---	v poor/low
ST 1236	2392.8 swc	claystone	barren		
ST 1237	2480 cut	claystone	barren		
ST 1238	2640 cut	claystone	0.43 $\pm$ 0.07 (10)	-oo-o	poor/low
ST 1239	2858 cut	claystone	0.48 $\pm$ 0.06 (18)	oo-oo	avg/low
ST 1240	2928.8 swc	red siltst	barren		
ST 1241	2990.5 swc	red siltst	barren		
ST 1242	3044.4 swc	red clayst	barren		
ST 1243	2777 ? cut	claystone	0.46 $\pm$ 0.07 (11)	-oo--	poor/low

## LEGEND

**Rm** : mean random reflectance in oil  
**Std**: standard deviation  
**N** : number of readings

**cut** : ditch cuttings  
**swc** : sidewall core

## CODE FOR DATA QUALITY

The sample quality is characterized by five items as follows:

ooooo

- 1 : abundance of vitrinite
- 2 : identification of vitrinite
- 3 : type of vitrinite
- 4 : particle size
- 5 : particle surface quality

+ : may give a too high vitrinite reflectance value  
o : has no effect on the resulting vitrinite reflectance  
- : may give a too low vitrinite reflectance value

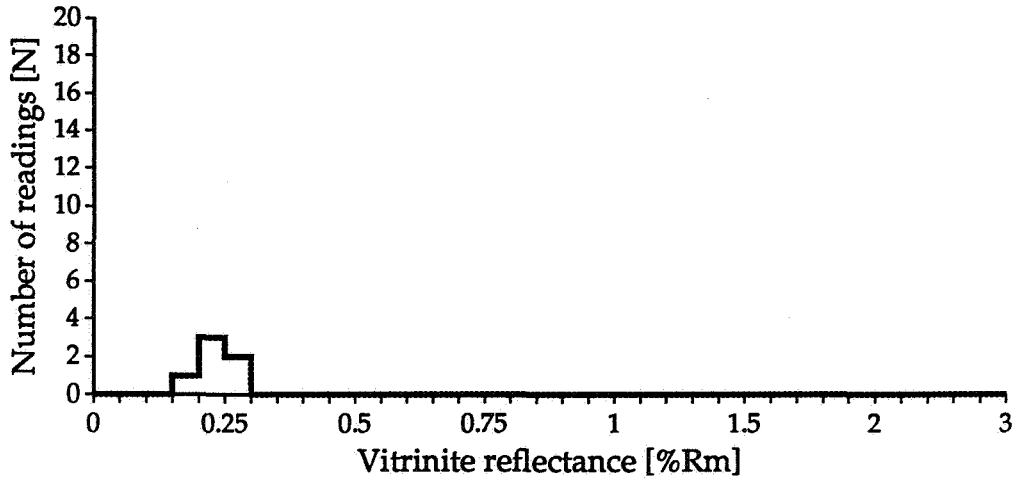
An ideal sample is characterized as follows: ooooo

IFE no.: **ST 1222**

Well: **15/12-8**  
Depth: **1000 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.23**  
Standard dev.: **0.03**  
Number of readings: **6**

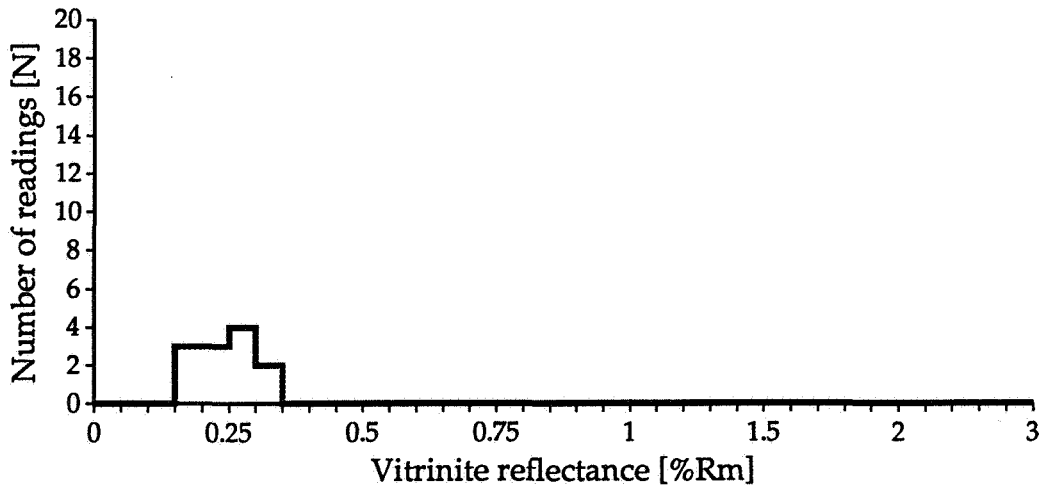


IFE no.: **ST 1223**

Well: **15/12-8**  
Depth: **1100 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.24**  
Standard dev.: **0.03**  
Number of readings: **12**



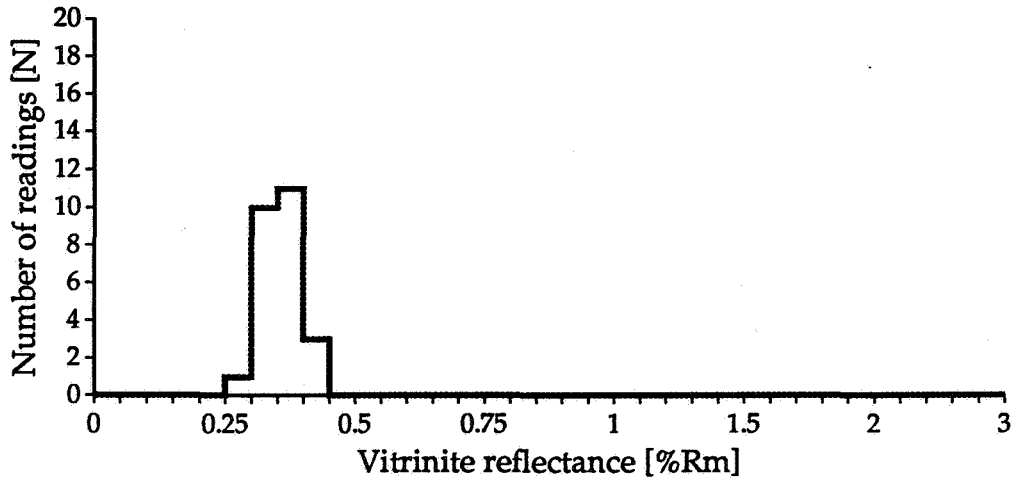


IFE no.: **ST 1224**

Well: **15/12-8**  
Depth: **1220 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.35**  
Standard dev.: **0.04**  
Number of readings: **25**

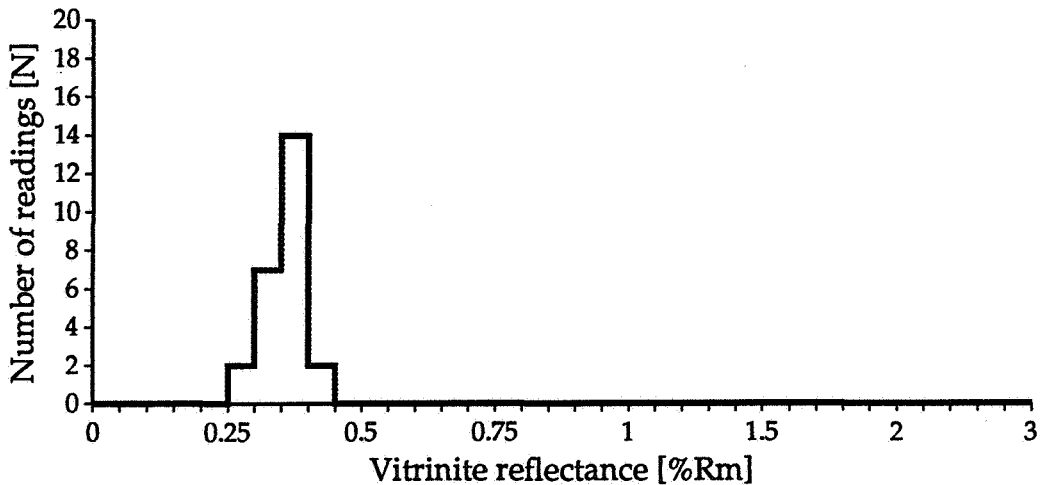


IFE no.: **ST 1225**

Well: **15/12-8**  
Depth: **1300 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.36**  
Standard dev.: **0.04**  
Number of readings: **25**

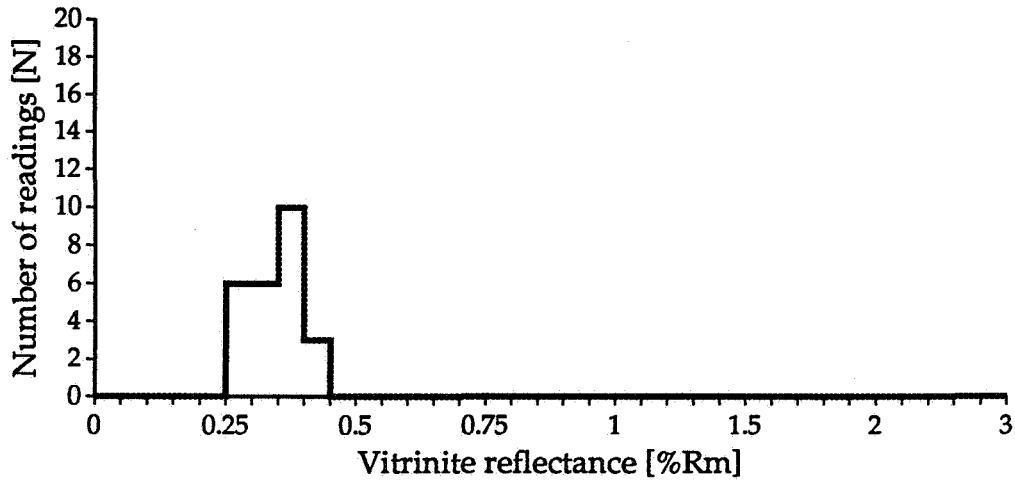


IFE no.: **ST 1226**

Well: **15/12-8**  
Depth: **1400 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.35**  
Standard dev.: **0.04**  
Number of readings: **25**

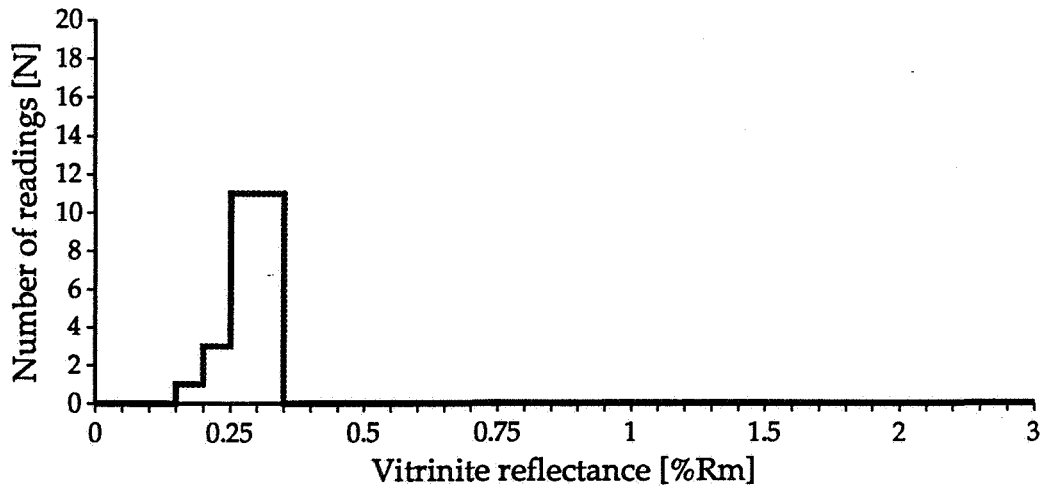


IFE no.: **ST 1227**

Well: **15/12-8**  
Depth: **1500 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.29**  
Standard dev.: **0.04**  
Number of readings: **26**

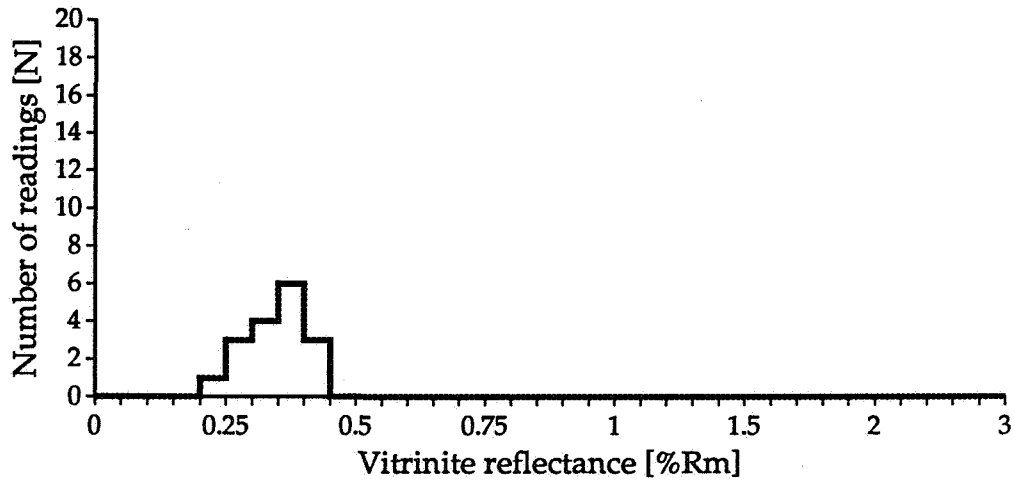


IFE no.: **ST 1228**

Well: **15/12-8**  
Depth: **1600 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.30**  
Standard dev.: **0.06**  
Number of readings: **17**

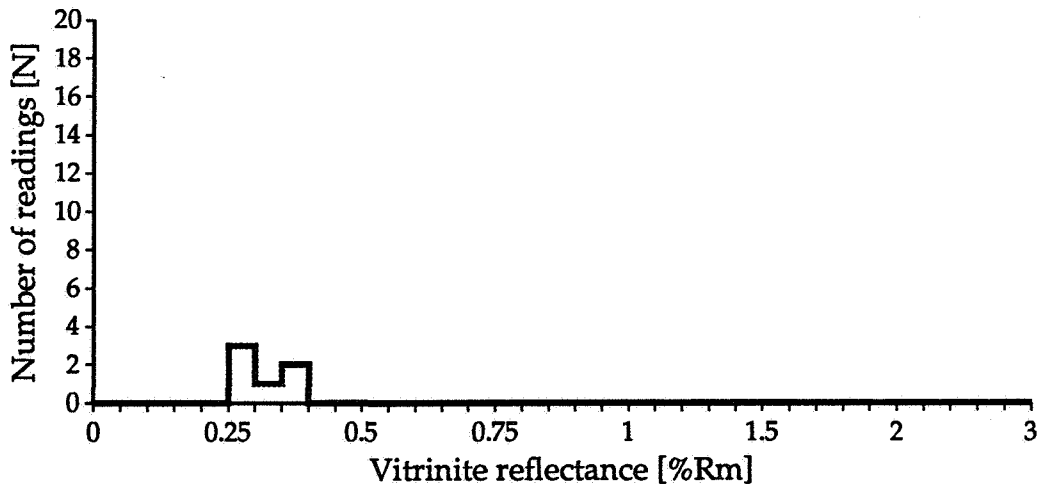


IFE no.: **ST 1229**

Well: **15/12-8**  
Depth: **1700 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.32**  
Standard dev.: **0.05**  
Number of readings: **6**

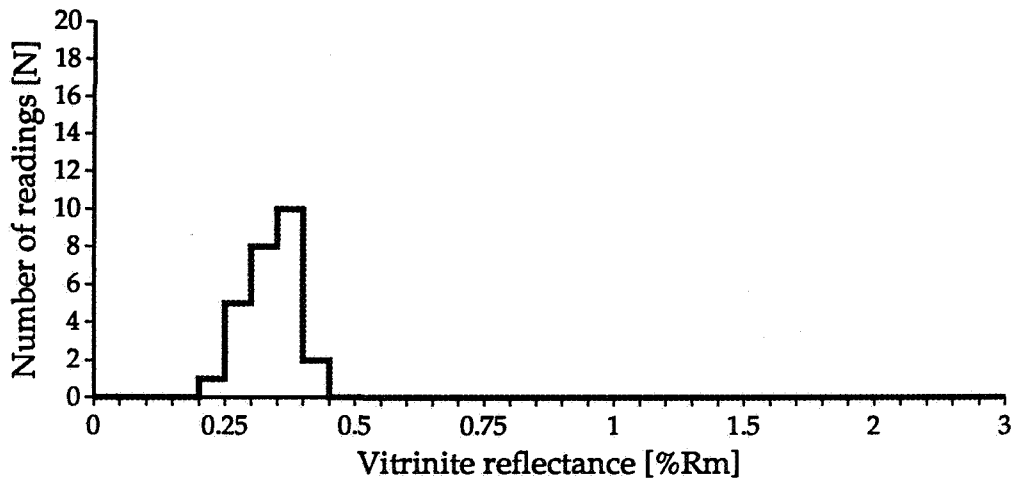


IFE no.: **ST 1230**

Well: **15/12-8**  
Depth: **1800 mRKB**  
Sample type: **cuttings**

Sample results

Mean %Rm: **0.34**  
Standard dev.: **0.05**  
Number of readings: **26**

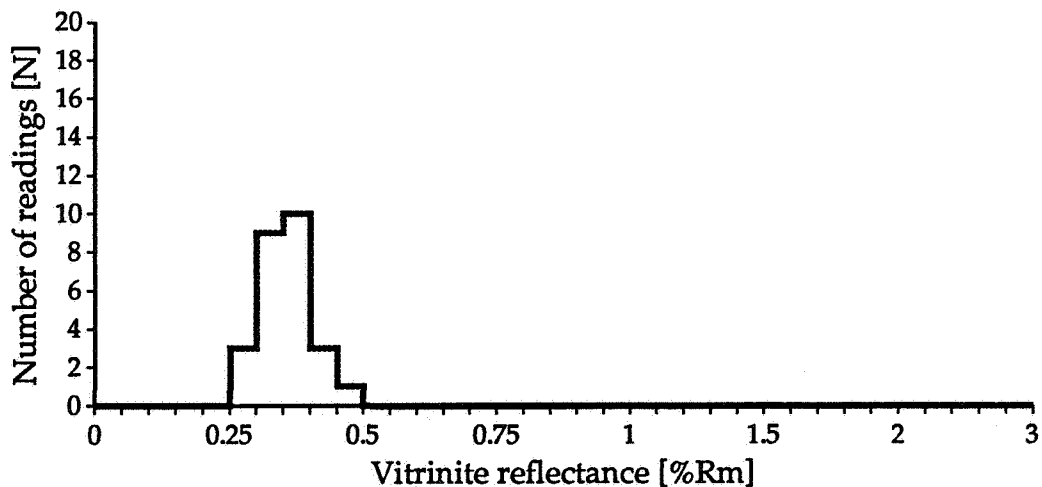


IFE no.: **ST 1231**

Well: **15/12-8**  
Depth: **1900 mRKB**  
Sample type: **cuttings**

Sample results

Mean %Rm: **0.36**  
Standard dev.: **0.05**  
Number of readings: **26**

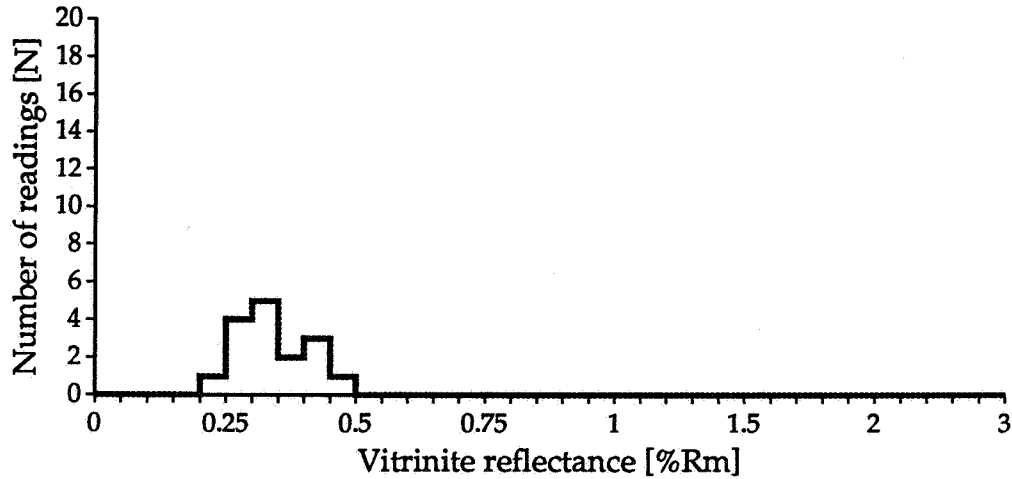


IFE no.: **ST 1232**

Well: **15/12-8**  
Depth: **2000 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.34**  
Standard dev.: **0.07**  
Number of readings: **16**

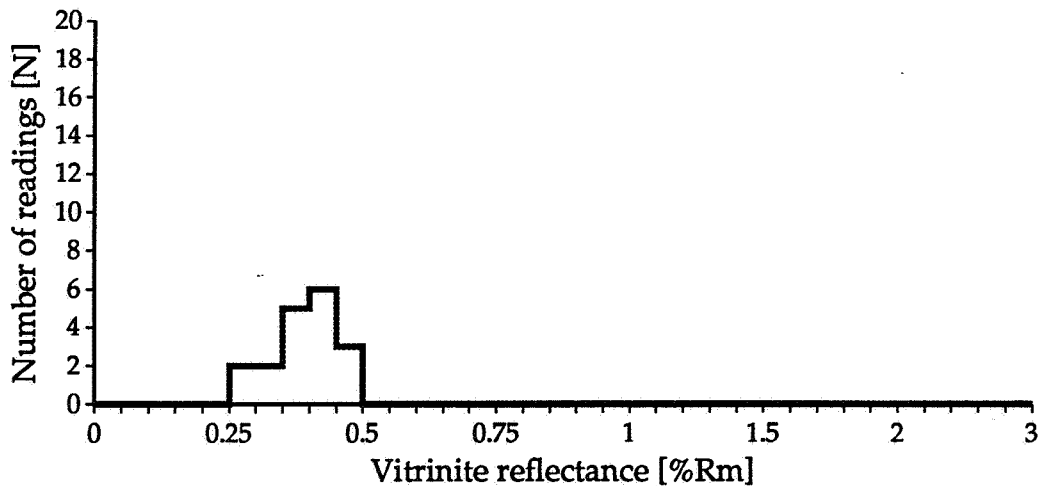


IFE no.: **ST 1233**

Well: **15/12-8**  
Depth: **2100 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.39**  
Standard dev.: **0.06**  
Number of readings: **18**

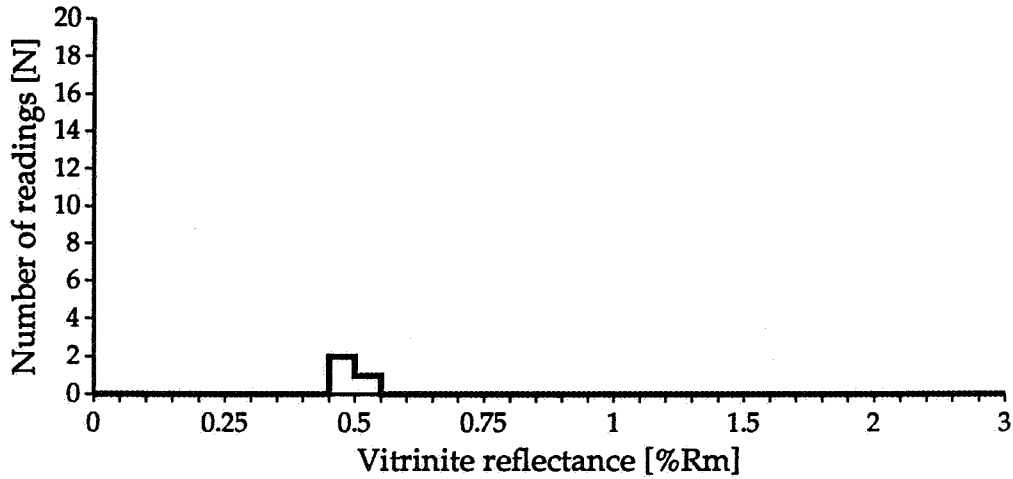


IFE no.: ST 1234

Well: 15/12-8  
Depth: 2200 mRKB  
Sample type: cuttings

Sample results

Mean %Rm: 0.49  
Standard dev.: 0.02  
Number of readings: 3

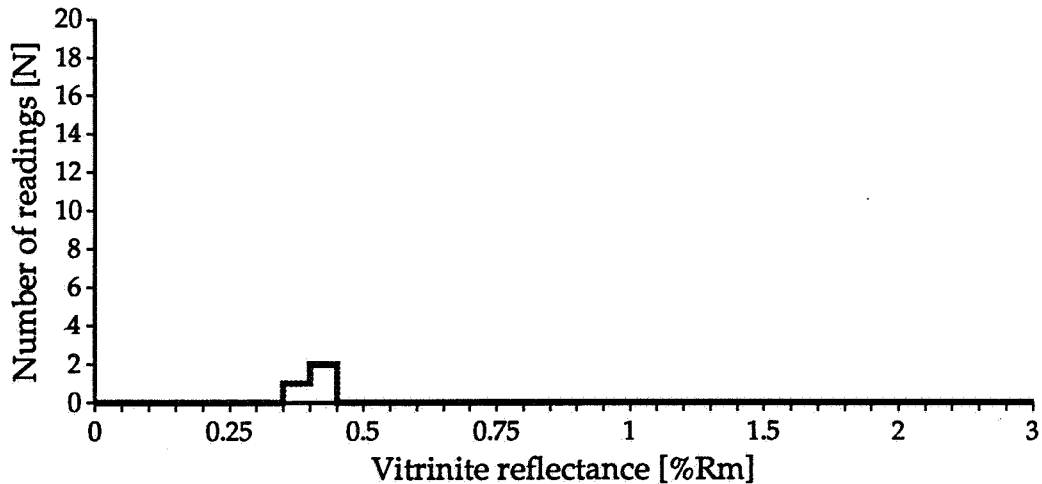


IFE no.: ST 1235

Well: 15/12-8  
Depth: 2290.8 mRKB  
Sample type: sidewall core

Sample results

Mean %Rm: 0.42  
Standard dev.: 0.03  
Number of readings: 3

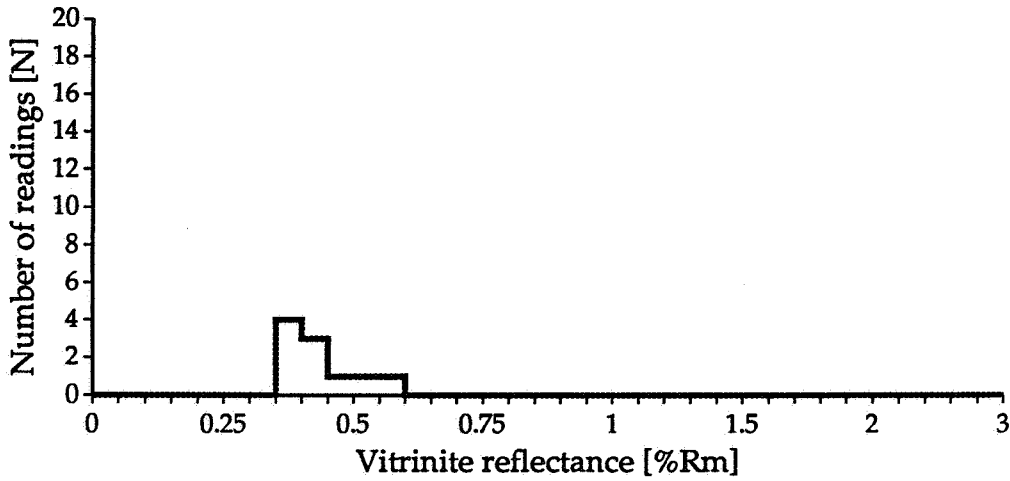


IFE no.: **ST 1238**

Well: **15/12-8**  
Depth: **2640 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.43**  
Standard dev.: **0.07**  
Number of readings: **10**

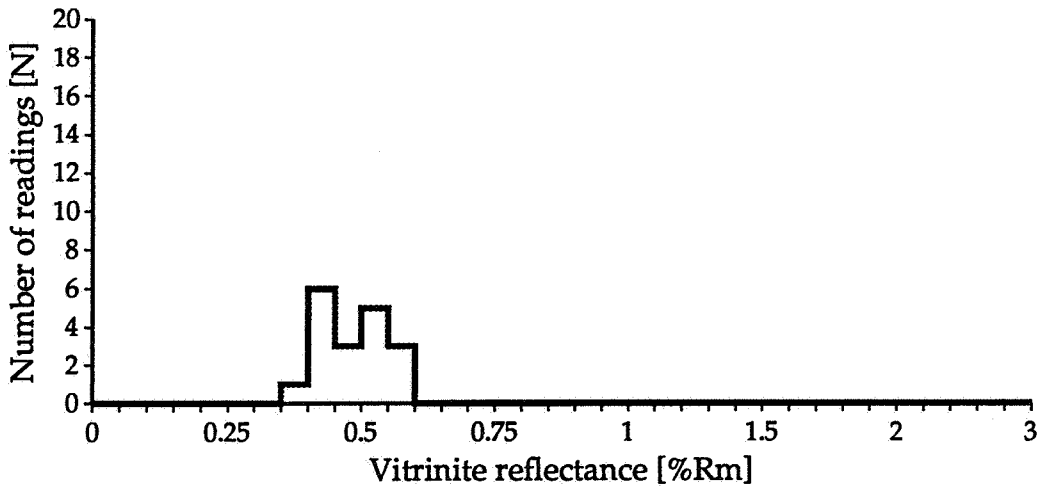


IFE no.: **ST 1239**

Well: **15/12-8**  
Depth: **2858.0 mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.48**  
Standard dev.: **0.06**  
Number of readings: **18**

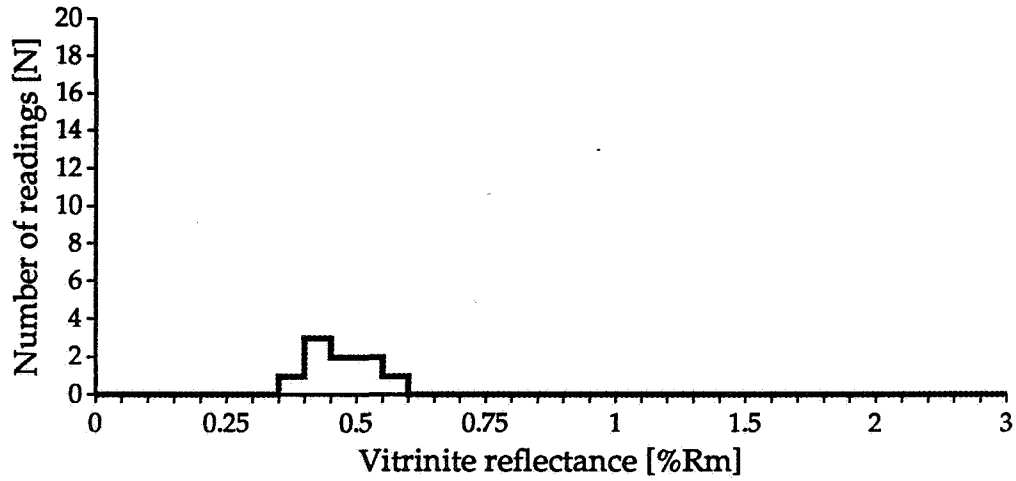


IFE no.: **ST 1243**

Well: **15/12-8**  
Depth: **2777 ? mRKB**  
Sample type: **cuttings**

**Sample results**

Mean %Rm: **0.46**  
Standard dev.: **0.07**  
Number of readings: **11**





APPENDIX 2

ISOTOPE DATA (GAS AND CONDENSATE) AND GAS COMPOSITION DATA  
- REPORT FROM IFE

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Telefax: (06) 815553  
Telex: 74 573 energ n

Vår/Our ref.:  
Dir. Line : (06) 806146

Deres/Your ref.:

Dato/Date: 1991-11-04

### Isotopanalyse brønn 15/12-8, T 6269 nr. 156

Vedlagt oversendes endelige resultater av analysene, brønn 15/12-8.

Resultatene av gassanalysen er gitt i tabell 1 og 2. Resultatene er også plottet i tolkningsdiagram, Fig. 1-4. (Schoell 1983, Faber 1987). For gassen er karbon- og hydrogenisotopverdiene forbundet med en usikkerhet på henholdsvis  $\pm 0.3\text{‰}$  PDB og  $\pm 5\text{‰}$  SMOW. IFEs verdi på NBS 22 er  $-29.77 \pm 0.06\text{‰}$  PDB.

Karbon isotopsammensetningen av fraksjonene er gitt i tabell 3. Som det går fram av tabellen har gjentatt analyse av aromat fraksjonen gitt svært forskjellige isotopverdier. Vi kan ikke forklare denne forskjellen, og desverre er det ikke mer prøvemateriale slik at analysen kan gjentas en tredje gang. Tilsvarende er det heller ikke mer prøvemateriale av NSO fraksjonen.

Faktura følger vedlagt.

Med hilsen



Bjørg Andresen

**Table 1:** Volume composition of a gas sample from well 15/12-8

Sample	IFE no	C <sub>1</sub> %	C <sub>2</sub> %	C <sub>3</sub> %	iC <sub>4</sub> %	nC <sub>4</sub> %	iC <sub>5</sub> %	nC <sub>5</sub> %	CO <sub>2</sub> %	ΣC <sub>1</sub> -C <sub>5</sub>	Wet- ness	iC <sub>4</sub> / nC <sub>4</sub>
DST#1	11122	73.2	12.1	8.2	1.3	2.2	0.85	1.2	0.90	99.1	0.26	0.57

**Table 2:** Isotopic composition of a gas sample from well 15/12-8.

Sample	IFE no	C <sub>1</sub> δ <sup>13</sup> C ‰ PDB	C <sub>1</sub> δ D ‰ SMOW	C <sub>2</sub> δ <sup>13</sup> C ‰ PDB	C <sub>3</sub> δ <sup>13</sup> C ‰ PDB	iC <sub>4</sub> δ <sup>13</sup> C ‰ PDB	nC <sub>4</sub> δ <sup>13</sup> C ‰ PDB	C <sub>5</sub> δ <sup>13</sup> C ‰ PDB	CO <sub>2</sub> δ <sup>13</sup> C ‰ PDB	CO <sub>2</sub> δ <sup>18</sup> O ‰ PDB
DST#1	11122	-38.3	-220	-27.7	-27.7	-23.8	-28.8	-28.7	10.0	-11.8

**Table 3.** Carbon isotopic composition of a condensate sample from well 15/12-8, ‰ PDB.

Sample	IFE no.	Whole condensate	SAT	ARO	NSO	ASF
S 5567	10127	-29.2	-29.0	-28.4	-28.5	-29.0
		-29.1		-29.6		-28.9

Faber, E. (1987). Zur Isotopengeochemie gasformiger Kohlenwasserstoffe. *Erdol, Erdgas, Kohle*, **103**, 210-218.

Schoell, M. (1983). Genetic characterisation of natural gases. *The American Association of Petroleum Geologists Bulletin*, **67**, 2225-2238.