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HEADSPACE GAS GEOCHEMISTRY ON SAMPLES FROM WELL 31/3-1

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SUMMARY

The gas components C_1-C_4 from 10 headspace cans are quantified and the $\delta^{13}C$ value is measured when possible on the methane, ethane, propane and the butanes.

Migrated thermogenic methane is mixed with biogenic methane at least to about the 1000 m level. The rather heavy $\delta^{13}C$ values of ethane and propane (a typical signature of the Troll gases) at the 1260-75 m level suggest migration of reservoired gas to this level.

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1 INTRODUCTION

Headspace cans from well 31/3-1 were received early March 1985.

At the arrival some of the cans (sample depth 1290-05, 1350-65, 1365-80, 1425-40, 1510-25 m) were completely corroded with no possibility for headspace gas analysis. A total of 10 headspace cans are quantified and when possible the $\delta^{13}C$ value is measured on methane, ethane, propane and the butanes. Due to low concentration we were not able to measure the δD value on methane.

2 ANALYTICAL PROCEDURE

The headspace gas was quantified by a Carlo Erba HRGC 5300 gas chromatograph equipped with a FID detector. To be able to do the isotopic measurements the gases have been separated into the different gas components by a Carlo Erba 4200 instrument. This gas chromatograph is equipped with a special injection loop in order to concentrate the samples, in the case of low concentration of the gas components. The hydrocarbon gas components were oxidized 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 isotopic measurements were performed on a Finnigan Mat 251 mass spectrometer. Our $\delta^{13}C$ value on NBS 22 is -29.77 $\pm$ 0.06 o/oo.

3 RESULTS

The composition of the headspace gas are given in Table 1. The results have not been normalized to 100%. The rest is air. The stable isotope results from the headspace gas are given in Table 2. Our uncertainty on the $\delta^{13}C$ value is estimated to be $\pm$ 0.3 o/oo and includes all the different analysis step. The results are also shown graphically in Figure 1 together with the results of the mud and reservoir gas

geochemistry from the same well (report No. IFE/KR/F-84/003 and IFE/KR/F-84/096). Note that the small squares represent the data from the headspace analysis and likewise that the concentration scale of the abundance is shown at the bottom of the figure.

4 INTERPRETATION

As seen from Table 2, thermogenic methane migrated and was mixed with biogenic methane at least to about the 1000 m level. The sealing efficiency of the cap rock may therefore not be complete with respect to methane.

The sample from the 1395-10 m level shows a rather heavy $\delta^{13}C$ methane value which is most likely due to bacterial degradation in the can. We suspect that no or insufficient bacterizide has been added.

The sample from the 1260-75 m level has a normal trend in the distribution of the $\delta^{13}C$ value of methane, ethane and propane but with rather heavy $\delta^{13}C$ values of ethane and propane. Compared with the isotope values of the reservoired gases of well 31/3-1 (IFE/KR/F-84/003) this suggests a mixing of reservoired gas and a gas of different origin at the 1260-75 m level.

5 CONCLUSION

Migrated thermogenic methane is mixed with biogenic methane at least to about the 1000 m level. The rather heavy $\delta^{13}C$ values of ethane and propane (a typical signature of the Troll gases) at the 1250-75 m level suggest migration of reservoired gas to this level.

Table 1 Composition of Headspace Gas from Well 31/3-1

Sample	C_1 %	C_2 %	C_3 %	iC_4 %	nC_4 %	Abundance $\Sigma C_1 - C_4$ %	Abundance $\Sigma C_2 - C_4$ %	Wetness	$\frac{iC_4}{nC_4}$
855-70 m	4.1	0.14	0.004	0.0011	0.0009	4.25	0.15	0.03	1.2
900-15 m	1.8	0.08	0.007	0.0013	0.0017	1.89	0.09	0.05	0.8
975-90 m	3.0	0.04	0.003	0.0006	0.0006	3.04	0.04	0.01	1.0
1065-80 m	1.8	0.12	0.009	0.0011	0.0014	1.93	0.13	0.07	0.8
1125-40 m	0.6	0.03	0.012	0.0008	0.0009	0.64	0.04	0.07	0.9
1200-15 m	1.0	0.06	0.026	0.0042	0.0046	1.09	0.09	0.09	0.9
1260-75 m	0.5	0.16	0.111	0.0240	0.0190	0.81	0.31	0.39	1.3
1305-20 m	0.02	0.01	0.003	0.0040	0.0031	0.04	0.02	0.45	1.3
1395-10 m	0.3	0.07	0.053	0.0420	0.0210	0.49	0.19	0.38	2.0
1455-70 m	0.01	0.002	0.006	0.0630	0.0520	0.03	0.02	0.63	1.2

Table 2 Isotopic Composition of Headspace Gas from Well 31/3-1

Sample	C_1 $\delta^{13}C$	C_2 $\delta^{13}C$	C_3 $\delta^{13}C$	iC_4 $\delta^{13}C$	nC_4 $\delta^{13}C$
855-70 m	-61.0	-32.0			
900-15 m	-56.7				
975-90 m	-53.5	-32.8			
1065-80 m	-50.5				
1125-40 m	-47.7				
1200-15 m	-42.3				
1260-75 m	-42.0	-25.0	-22.3		
1395-10 m	-31.4	-21.2	-20.0	-18.7	-19.9

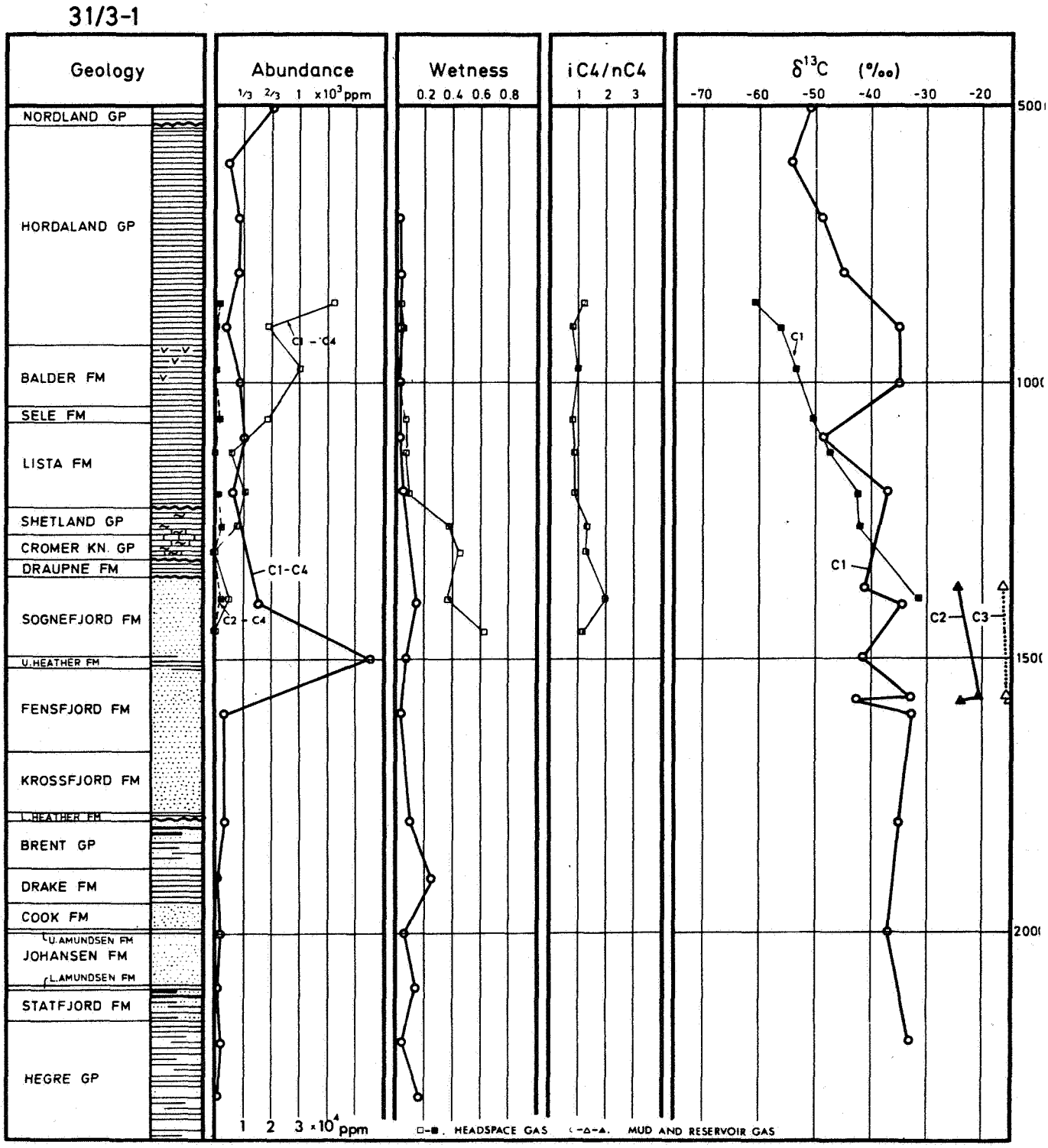

Figure 1 Composition of Gas from well 31/3-1