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REPORT TYPE	REPORT NO. IFE/KR/F-89/129		DATE 1989-09-26
	REPORT TITLE REPORT ON STABLE ISOTOPES ($\delta^{13}\text{C}$, δD , $\delta^{18}\text{O}$) ON NATURAL GAS SAMPLES FROM WELL 34/10-T-1 AND 34/10-33		DATE OF LAST REV. 1989-10-02
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SUMMARY	The gas components C_1 - C_5 and CO_2 have been separated from natural gas samples from well 34/10-T-1; sample 84B00668 23.08.89, sample 84B00384 sep. B 29.08.89, sample 85B00665 sep. A 29.08.89, sample 86B00436 16.08.89 and from well 34/10-33 DST 2.2 (bottle A 14916) 3279 - 3307/3311.5 - 3329 m RKB. The $\delta^{13}\text{C}$ values of methane, ethane, propane, the butanes and CO_2 have been measured. The isotopic composition of hydrogen from CH_4 has also been measured.		DISTRIBUTION Statoil (10) Andresen, B. Råheim, A. Throndsen, T. File (2)
	The isotopic composition of the gas samples from well 34/10-T-1 and 34/10-33 indicates a mixed gas. The mixed gas is at least derived from two different sources with one source dominating from C_1 to C_3 and the other dominating from C_4 and higher. Gases derived from the same source but at different maturity levels is also a possibility. It is in the present case (because of the mixed gas situation) difficult to use the isotopes to indicate the maturity level of the source rocks, the data however, suggest a high maturity situation.		
KEYWORDS			
	NAME	DATE	SIGNATURE
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1 INTRODUCTION

Four gas samples from well 34/10-T-1; sample 84B00668 23.08.89, sample 84B00384 sep. B 29.08.89, sample 85B00665 sep. A 29.08.89, sample 86B00436 16.08.89 and one sample from well 34/10-33; sample DST 2.2 (bottle A 14916) 3279-3307/3311.5-3329 mRKB were received and analysed September 1989.

On the samples C₁ - C₅ and CO₂ are quantified, and the $\delta^{13}\text{C}$ value is measured on methane, ethane, propane, the butanes and CO₂. The δD value is also measured on methane.

2 ANALYTICAL PROCEDURE

The natural gas have been quantified and separated into the different gas components by a Carlo Erba 4200 instrument.

The hydrocarbon gas components were oxidized in separate CuO-ovens in order to prevent cross contamination. The combustion products CO₂ and H₂O were frozen into collection vessels and separated.

The water was reduced with zinc metal in a sealed tube to prepare hydrogen for isotopic analysis. The isotopic measurements were performed on a Finnigan Mat 251 and Finnigan Delta mass spectrometer. IFE's value on NBS 22 is $-29.77 \pm .06$ ‰ PDB.

3 RESULTS

The volume composition of the gas samples is given in table 1. The results have been normalized to 100%. The stable isotope results are given in table 2.

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

Table 1 Volume composition of a gas samples from well 34/10-T-1 and 34/10-33.

SAMPLE	IFE no.	C ₁ %	C ₂ %	C ₃ %	iC ₄ %	nC ₄ %	iC ₅ %	nC ₅ %	CO ₂ %	Σ C ₁ - C ₅	WET- NESS	iC ₄ / nC ₄
85B00668 23.08.89	8411	88.7	6.2	2.3	0.30	0.60	0.13	0.13	1.7	98.3	0.10	0.50
84B00384 sep.B 29.08.89	8412	81.4	10.5	2.7	0.33	0.73	0.18	0.18	4.0	96.0	0.15	0.46
85B00665 sep.A 29.08.89	8413	89.1	6.1	2.2	0.23	0.58	0.13	0.13	1.5	98.5	0.10	0.40
86B00436 16.08.89	8446	87.5	7.1	2.2	0.27	0.54	0.10	0.10	2.2	97.8	0.11	0.49
DST 2.2 (bottle A 14916) 3279-3307/3311.5-3329 mRKB	8445	79.6	11.7	3.0	0.36	0.79	0.15	0.15	4.3	95.7	0.17	0.46

Table 2 Isotopic composition of a gas samples from well 34/10-T-1 and 34/10-33.

SAMPLE	IFE no.	C ₁ δ ¹³ C PDB	C ₁ δ D SMOW	C ₂ δ ¹³ C PDB	C ₃ δ ¹³ C PDB	iC ₄ δ ¹³ C PDB	nC ₄ δ ¹³ C PDB	CO ₂ δ ¹³ C PDB	CO ₂ δ ¹⁸ O PDB
85B00668 23.08.89	8411	-38.7	-197	-29.1	-26.1	-25.1	-26.7	-6.7	-14.9
84B00384 sep.B 29.08.89	8412	-38.9	-201	-29.2	-26.8	-24.4	-25.3	-9.6	7.0
85B00665 sep.A 29.08.89	8413	-38.1	-194	-29.1	-26.7	-23.4	-26.8	-9.6	-10.7
86B00436 16.08.89	8446	-37.6	-192	-28.8	-26.5	-24.9	-24.4	-10.2	-12.6
DST 2.2 (bottle A 14916) 3279-3307/3311.5-3329 mRKB	8445	-38.7	-190	-29.3	-26.8	-24.0	-27.1	-7.5	-13.2

4 INTERPRETATION

As seen from table 2 the gas samples are characterized by rather heavy carbon isotopic composition of methane which may indicate a high maturity situation, an isotopically heavy source rock or a biodegraded environment.

The five gas samples from well 34/10-T-1 and 34/10-33 differs mainly in the carbon isotopic composition of n-butane.

Sample 84B00384 sep.B 29.08.89 and sample 86B00436 16.08.89 follow a general isotopic trend for unaltered gases with a smooth progression from methane to n-butane, excluding i-butane (James, 1983). A source LOM of about 11 is indicated when the $\delta^{13}\text{C}$ values of methane, ethane, propane and n-butane are plotted in James maturity diagram, fig.1 (James, 1983), e.g. at a maturity level in the middle of the oil window.

In sample 85B00668 23.08.89, sample 84B00665 sep.A 29.08.89 and sample DST 2.2 (bottle A 14916, 3279-3307/3311.5-3329 mRKB) the $\delta^{13}\text{C}$ of the n-butanenes are at the same level as or slightly lighter than the corresponding propane carbon isotopic values. This may indicate a mixed gas situation with gas at least derived from two different sources with one source dominating from C_1 to C_3 and the other dominating from C_4 and higher. Gases derived from the same source but at different maturity levels is also a possibility. The present relationship between the carbon isotopic values of n-butane and propane may also indicate a high maturity situation.

A source LOM of about 11 is indicated when the $\delta^{13}\text{C}$ values of methane, ethane and propane are plotted in James maturity diagram, fig.1 (James, 1983), e.g. at a maturity level in the middle of the oil window. Sample 85B00668 23.08.89 may seem to be slightly more immature than the two other samples (sample 85B00665 sep.B 29.08.89 and sample DST 2.2 (bottle A 14916, 3279-3307/3311.5-3329 mRKB)).

A higher maturity situation equal to the condensate field of the oil window is indicated for all five samples with the combined use of the carbon and hydrogen isotopes of methane, fig.2 (Schoell, 1983).

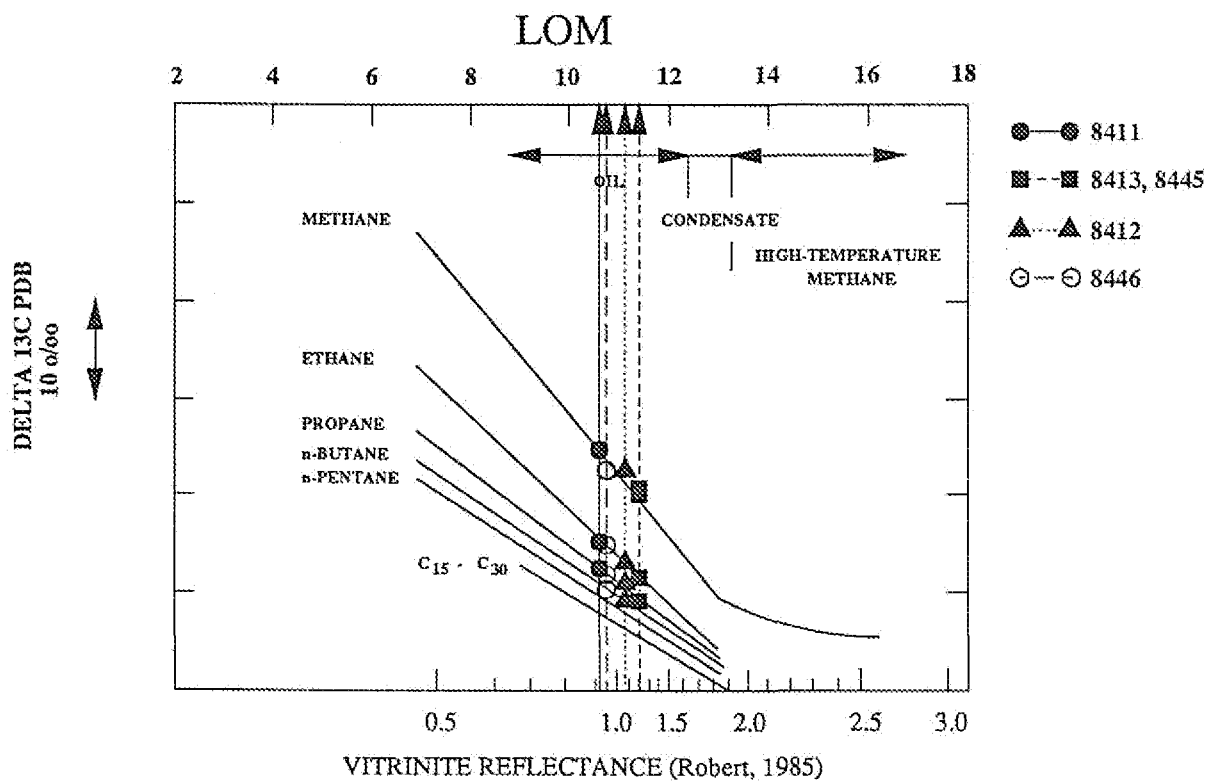
5 CONCLUSION

The isotopic composition of the gas samples from well 34/10-T-1 and well 34/10-33 indicates a mixed gas. The mixed gas is at least derived from two different sources with one source dominating from C_1 to C_3 and the other dominating from C_4 and higher. Gases derived from the same source but at different maturity levels is also a possibility.

It is in the present case (because of the mixed gas situation) difficult to use the isotopes to indicate the maturity level of the source rocks, the data however, suggest a high maturity situation.

6 LITERATURE

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8411 = 85B00668 23.08.89

8412 = 84B00384 sep.B 29.08.89

8413 = 85B00665 sep.A 29.08.89

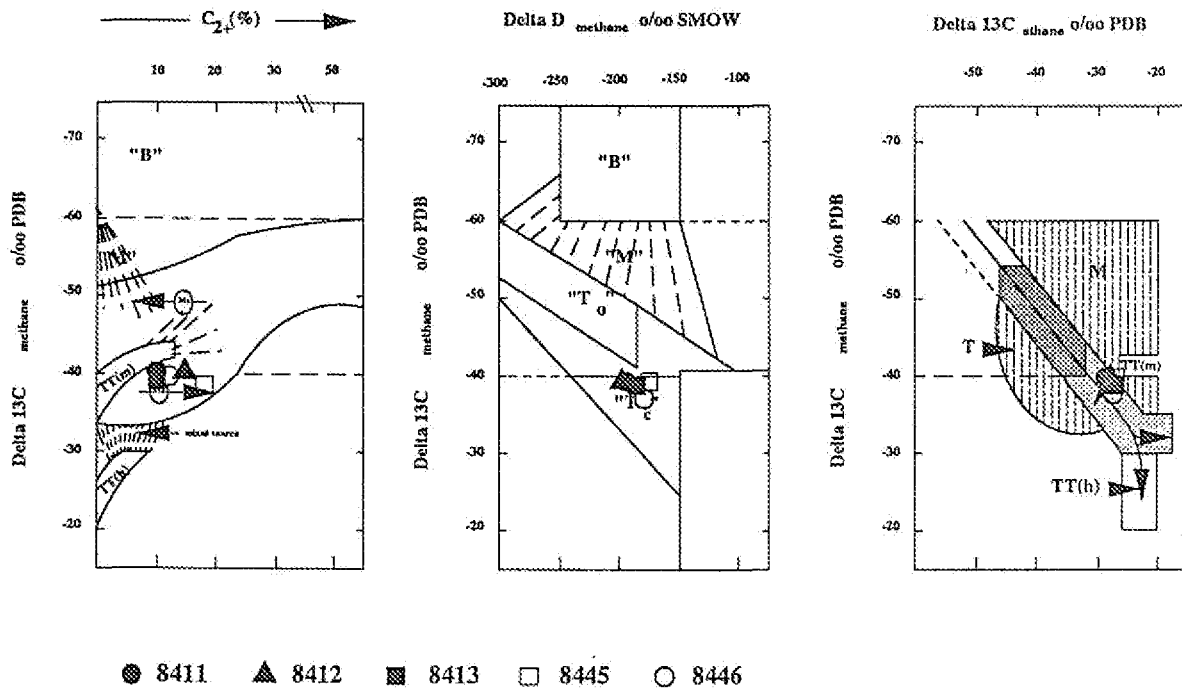
8445 = DST 2.2 (bottle A 14916) 3279-3307/3311.5-3329 mRKB

8446 = 86B00436 16.08.89

Figure 1

Carbon isotopic separation of gas samples from well 34/10-33 are plotted on the maturity diagram (after James, 1983). A source LOM of about 11 is indicated for the gas samples.

The calculated carbon isotopic separations between gas components are plotted on the vertical axis using a sliding scale that is simply the algebraic difference, in parts per mil, between the isotopic composition of the natural gas components. The scale does not possess a fixed origin, but is oriented with the more depleted $\delta^{13}\text{C}$ values at the upper end. Use of this sliding scale allows the maturity of a gas to be assessed without prior knowledge of the isotopic composition of the gas source.



8411 = 85B00668 23.08.89

8412 = 84B00384 sep.B 29.08.89

8413 = 85B00665 sep.A 29.08.89

8445 = DST 2.2 (bottle A 14916) 3279-3307/3311.5-3329 mRKB

8446 = 86B00436 16.08.89

Figure 2A

Variations of molecular composition in natural gases related to the isotope variations of methane.

Figure 2B

Carbon and hydrogen isotope variations in methane.

Figure 2C

Carbon isotope variations in ethane related to carbon isotope variations in methane.

The principle for the genetic characterization of natural gases is that primary gases (B-biogenic gas, T-associated gas, TT- non-associated gas) are defined by fields of compositional variations. These primary gases may become mixed and form various mixtures "M" of intermediate composition. "TT(m)" and "TT(h)" are non-associated gases from marine source rocks and coal gases from N.W. Germany, respectively, compositional shifts due to migration are indicated by arrows Md (deep migration) and Ms (shallow migration), respectively. "T₀" are gases associated with petroleum in an initial phase of formation. "T_c" are gases associated with condensates (Schoell, 1983).