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	REPORT TITLE REPORT ON STABLE ISOTOPES ($\delta^{13}\text{C}$, δD , $\delta^{18}\text{O}$) ON NATURAL GAS SAMPLES FROM WELL 30/9-8, DST 1, AND DST 2B.		DATE OF LAST REV. REV. NO.
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SUMMARY		DISTRIBUTION	
<p>The gas components C_1-C_5 and CO_2 have been separated from natural gas samples from well 30/9-8, DST 1 and DST 2B, and 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.</p> <p>The isotopic composition of sample DST 2B from well 30/9-8 indicates a high maturity situation.</p> <p>The isotopic composition of the DST 1 sample indicates however a mixed gas. The mixed gas is possibly derived from two sources with one source dominating the contribution to the C_1 to C_3 range and the other source dominating the contribution to the butanes. Gases derived from the same source but at different maturity levels is also a possibility.</p> <p>It is in the present case (because of the mixed gas) difficult to use the isotopes to indicate the maturity level of the source rocks, the data however, suggest a high maturity source rock situation.</p>		<p>Hydro (15) Andresen, B. Råheim, A. Thronsen, T. File (2)</p>	
KEYWORDS			
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1 INTRODUCTION

Two gas samples from well 30/9-8, DST 1 and DST 2B were received and analysed December 1989.

On the samples $C_1 - C_5$ and CO_2 are quantified, and the $\delta^{13}C$ value is measured on methane, ethane, propane, the butanes and CO_2 . The δD value is also measured on methane.

2 ANALYTICAL PROCEDURE

The natural gas has 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 CO_2 and H_2O were frozen into collection vessels and separated.

The water was reduced with zinc metal in sealed tubes to prepare hydrogen for isotopic analysis. The isotopic measurements were performed on a Finnigan Mat 251 and a 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 $\delta^{13}C$ 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 gas samples from well 30/9-8.

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
DST 1	8576	82.4	3.3	1.2	0.07	0.09	0.02	0.01	12.9	87.1	0.05	0.78
DST 2	8577	77.5	11.0	6.5	0.81	1.5	0.41	0.43	1.9	98.1	0.21	0.56

Table 2 Isotopic composition of gas samples from well 30/9-8.

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
DST 1	8576	-43.3	-196	-29.7	-29.3	-28.1	-29.9	-11.5	-7.0
DST 2B	8577	-43.3	-188	-29.2	-27.8	-27.1	-26.8	-12.1	-10.2

4 INTERPRETATION

The two gas samples from well 30/9-8 (DST 1 and DST 2B) differ mainly in the volume composition as shown in table 1. The DST 2B sample contains a higher concentration of the wetter components and a lower CO₂ concentration than the DST 1 sample. In addition the two samples differ in the isotopic composition of the higher hydrocarbon gas components C₃ and C₄.

A general isotopic trend for unaltered gases is found to be a smooth progression from methane to n-butane, excluding i-butane (James, 1983). This is the case with the DST 2B sample. A source LOM of about 12 is indicated when the δ¹³C values of methane, ethane, propane and n-butane are plotted in James maturity diagram, fig.1 (James, 1983), e.g. at a high maturity level almost in the condensate field of the oil window. This is in accordance with the combined use of the hydrogen and carbon isotopic composition of methane as indicated in fig. 2 (Schoell, 1983).

The DST 1 sample is characterized by a δ¹³C n-butane value lighter than or at the same level as the corresponding ethane and propane values. This relationship between the δ¹³C ethane, propane and n-butane values may indicate a mixed gas situation with gas at least derived from two sources with one source dominating from C₁ to C₃ and the other dominating from

C₄ 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 ethane, propane and n-butane may also indicate a high maturity situation.

A source LOM of about 13 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 high maturity level in the condensate field of the oil window.

A high maturity level is also indicated with the combined use of the carbon and hydrogen isotopes of methane, fig.2 (Schoell, 1983).

5 CONCLUSION

The isotopic composition of sample DST 2B from well 30/9-8 indicates a high maturity situation.

The isotopic composition of the DST 1 sample indicates however a mixed gas. The mixed gas is possibly derived from two sources with one source dominating the contribution to the C₁ to C₃ range and the other source dominating the contribution to the butanes. 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) difficult to use the isotopes to indicate the maturity level of the source rocks, the data however, suggest a high maturity source rock situation.

6 LITERATURE

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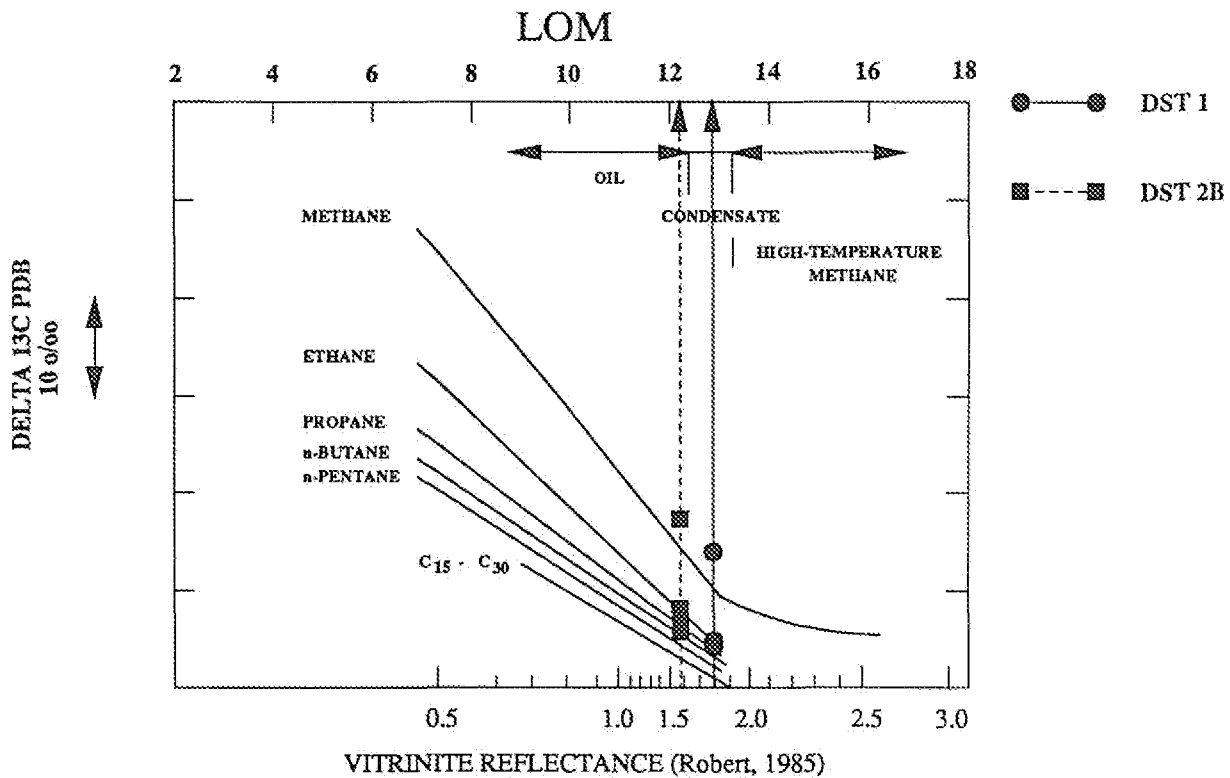


Figure 1

Carbon isotopic separation of gas samples from well 30/9-8, DST 1 and DST 2B are plotted on the maturity diagram (after James, 1983). A source LOM of about 12 to 13 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.

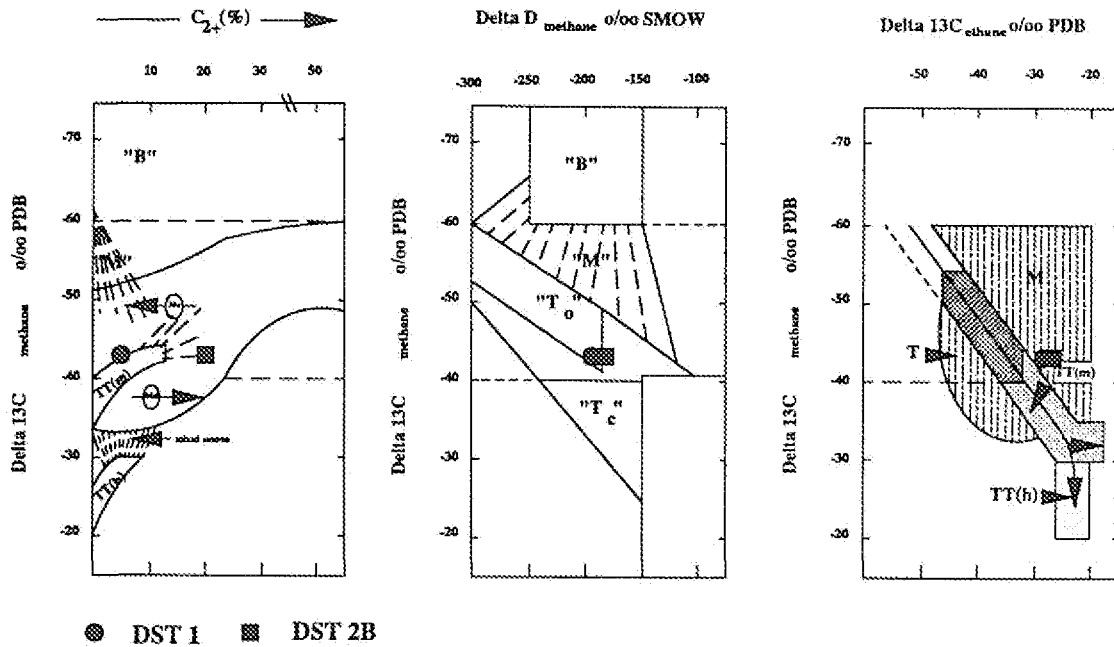


Figure 2A

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).