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SUMMARY

The gas components C_1-C_5 and CO_2 have been separated from natural gas samples from well 34/8-3, DST 1, DST 2 DST 3, and the $\delta^{13}C$ 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.

The isotopic composition of the gas samples from well 34/8-3 indicates that the gas may be of a mixed origin derived from two or more sources or derived at different maturity levels from the same source.

DISTRIBUTION

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KEYWORDS

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1 INTRODUCTION

Three gas samples from well 34/8-3, DST 1, DST 2 and DST 3 were received and analysed August/September 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 Finnigan Delta mass spectrometer. IFE's value on NBS 22 is - 29.77 ± .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 34/8-3.

SAMPLE	IFE no.	C_1 %	C_2 %	C_3 %	iC_4 %	nC_4 %	iC_5 %	nC_5 %	CO_2 %	$\Sigma C_1 - C_5$	WET-NESS	iC_4/nC_4
DST 1	8382	85.7	7.9	2.7	0.41	0.89	0.18	0.18	2.0	98.0	0.12	0.46
DST 2	8383	89.0	5.5	2.5	0.41	0.93	0.21	0.25	1.2	98.8	0.10	0.44
DST 3	8384	87.1	6.8	2.4	0.38	0.89	0.22	0.24	2.0	98.0	0.11	0.43

Table 2. Isotopic composition of gas samples from well 34/8-3.

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 1	8382	-39.4	-158	-30.3	-28.0	-22.9	-25.6	-9.4	-9.8
DST 2	8383	-39.5	-169	-30.1	-28.0	-25.9	-25.8	-14.9	-10.8
DST 3	8384	-39.6	-167	-30.2	-28.3	-24.6	-26.2	-8.2	-12.0

4 INTERPRETATION

As seen from table 2 the gas samples from well 34/8-3 are characterized by rather heavy isotopic composition of methane.

A general isotopic trend for unaltered gases is found to be a smooth progression from methane to n-butane, excluding i-butane (James, 1983). The carbon isotopes of methane, ethane, propane and n-butane can then be used to indicate the maturity level of the gas by using James'maturity diagram (James, 1983), Figure 1. A source LOM of about 11, is then indiated, e.g. that the gas was formed at a moderate maturity level in the middle of the oil window.

The combined use of the carbon and hydrogen isotopes of methane (Schoell, 1983), Figure 2, indicate however a high maturity situation in the condensate field of the oil window. This may indicate a mixed gas situation with gas at least derived from two sources with one source dominating from C_1 and the other dominating from C_2 and higher. Gases derived from the same source but at different maturity levels is also a possibility.

5 CONCLUSION

The isotopic composition of the gas samples from well 34/8-3 indicates that the gas may be of a mixed origin derived from two or more soures or derived at different maturity levels from the same source.

6 LITERATURE

James, A.T. (1983). Correlation of natural gas by use of carbon isotopic distribution between hydrocarbon components. *American Association of Petroleum Geologists Bulletin*, 67, 1176-1191A.

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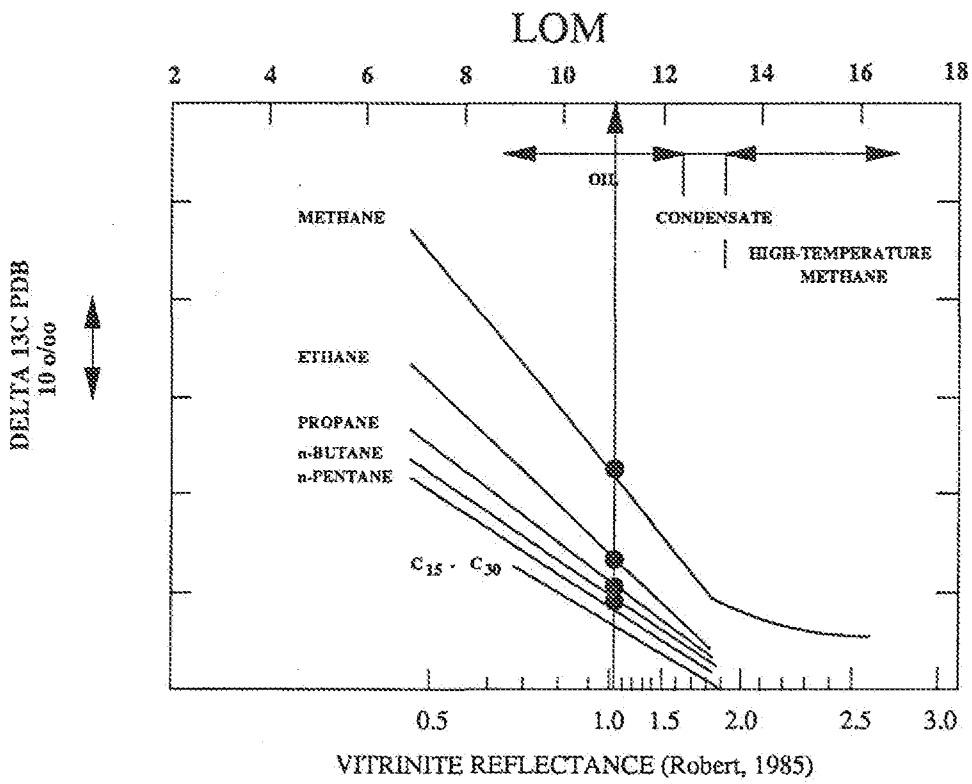

Figure 1

Carbon isotopic separation of gas samples from well 34/8-3, DST 1, DST 2 and DST 3 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 posess a fixed origin, but is oriented with the more depleted $\delta^{13}C$ 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.

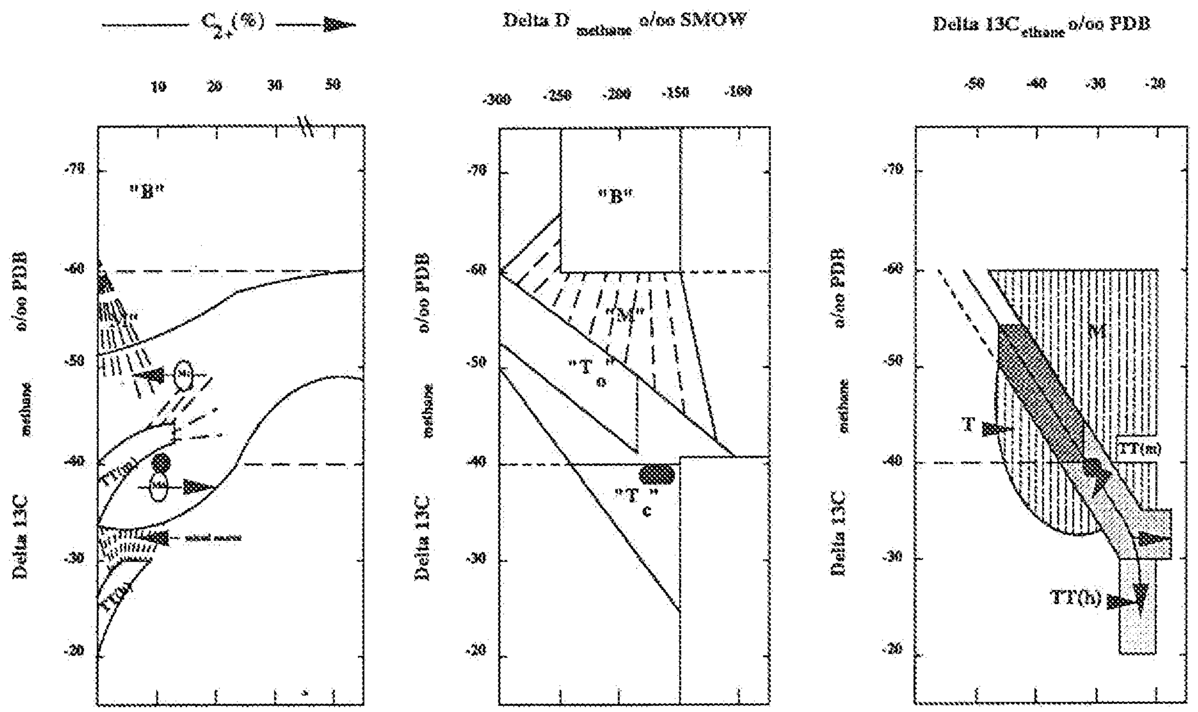

Figure 2A

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. "T_0" are gases associated with petroleum in an initial phase of formation. "T_C" are gases associated with condensates (Schoell, 1983).