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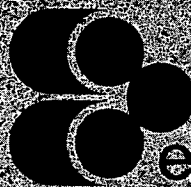
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REPORT TITLE

REPORT ON STABLE ISOTOPES ($\delta^{13}\text{C}$, δD , $\delta^{18}\text{O}$)
ON A NATURAL GAS FROM WELL 30/2-2

CLIENT

Statoil



Institute for
energy technology

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	REPORT TITLE	REPORT ON STABLE ISOTOPES ($\delta^{13}\text{C}$, δD , $\delta^{18}\text{O}$) ON A NATURAL GAS FROM WELL 30/2-2		DATE OF LAST REV.	
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SUMMARY The gas components C_1 - C_4 and CO_2 have been separated from a natural gas of well 30/2 ² -2, and the $\delta^{13}\text{C}$ values of these components have been measured. The isotopic composition of hydrogen which was made from the H_2O during the combustion of CH_4 have also been measured. The carbon isotopic distribution between the hydrocarbon gas components methane, ethane, propane and n-butane indicates together with the combined use of the carbon and hydrogen isotopic composition of methane that the gas was formed at a relatively high maturity in the oil window.				DISTRIBUTION Statoil (10) Andresen, B. Brevik, E.M. Råheim, A.	
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1. ANALYTICAL PROCEDURE

The natural gas has 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 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 mass spectrometer. Our $\delta^{13}\text{C}$ value on NBS-22 is $-29.77 \pm .06$ o/oo.

2. RESULTS

The composition of the sample is given in Table 1. The results have not been normalized to 100%. The rest is air. The stable isotope results are given in Table 2.

Our uncertainty on the $\delta^{13}\text{C}$ value is estimated to be ± 0.3 o/oo and includes all the different analysis step. The uncertainty on the δD value is likewise estimated to be ± 5 o/oo.

Table 1 Composition of a natural gas from well 30/2-2

Sample	C ₁	C ₂	C ₃ %	i-C ₄	n-C ₄	CO ₂
30/2-2 DST 3	80	7.7	3.3	0.5	0.9	6.1

Table 2 Isotopic composition of a natural gas from well 30/2-2

Sample	C ₁		C ₂		C ₃		i-C ₄		n-C ₄		CO ₂	
	$\delta^{13}\text{C}$	δD	$\delta^{13}\text{C}$	$\delta^{13}\text{C}$	$\delta^{13}\text{C}$	$\delta^{13}\text{C}$	$\delta^{13}\text{C}$	$\delta^{13}\text{C}$	$\delta^{13}\text{C}$	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	
30/2-2 DST 3	-44.8	-196	-28.0	-26.8	-26.3	-26.0	-2.4	-13.7				

3. INTERPRETATION

The gas sample has a normal trend in the relationship between the $\delta^{13}\text{C}$ values of methane, ethane, propane and n-butane. A source LOM between 12-13 is indicated when the data are plotted on the maturation diagram by James (1983) ^{*}, Figure 1, e.g. that the gas was formed at a relatively high maturity, almost in the beginning of the condensate field of the oil window.

A relative high maturity is in agreement with the combined use of the δD methane and the $\delta^{13}\text{C}$ methane values, Figure 2 (Schoell 1983) ^{**}.

4. CONCLUSION

The carbon isotopic distribution between the hydrocarbon gas components methane, ethane, propane and n-butane indicates together with the combined use of the carbon and hydrogen isotopic composition of methane that the gas was formed at a relatively high maturity in the oil window.

* James, Alan T. (1983): Correlation of Natural Gas by Use of Carbon Isotopic Distribution between Hydrocarbon Components, AAPG, Vol. 67, No. 7, July 1983.

** Schoell, M. (1983): Genetic Characterization of Natural Gases, AAPG, December 1983.

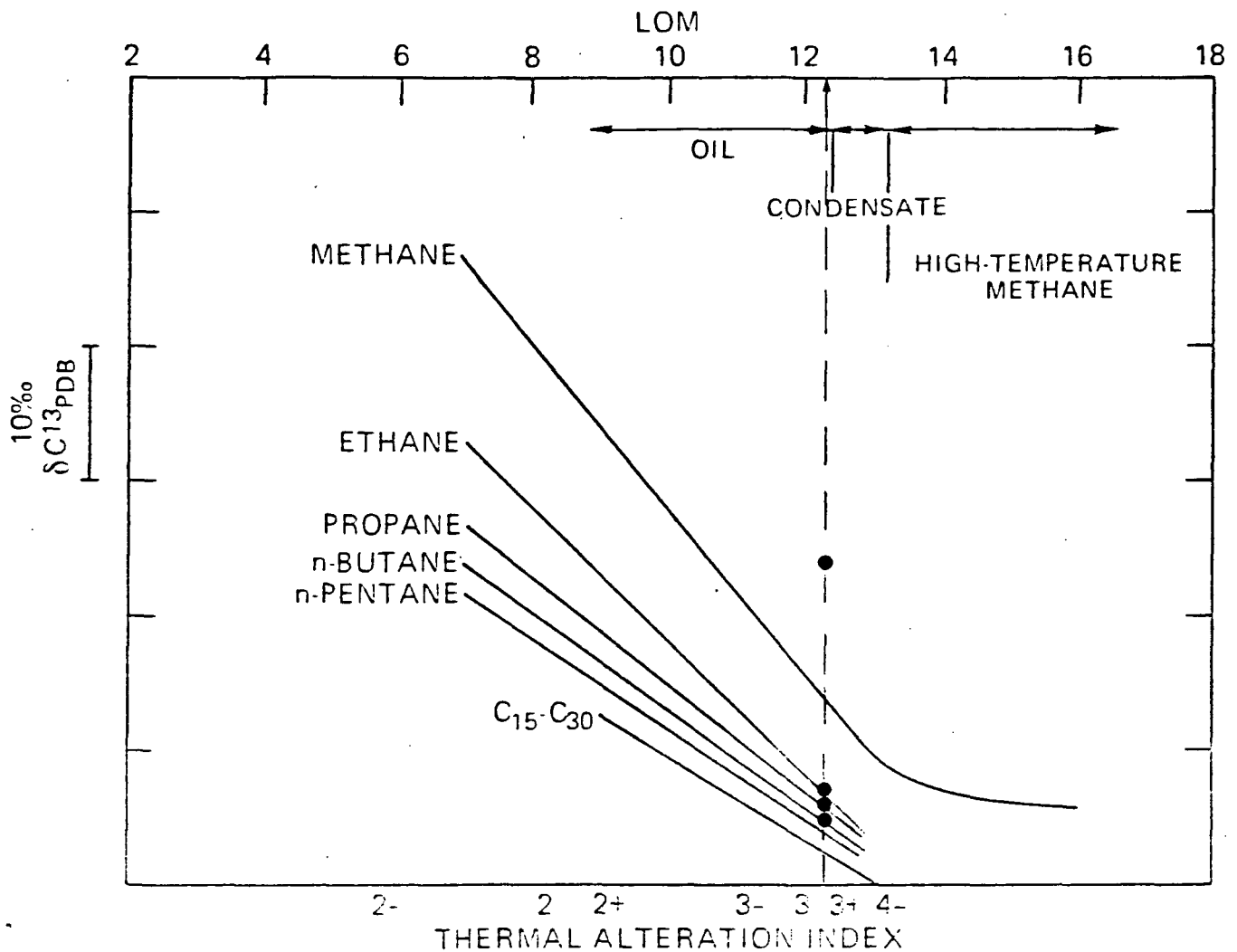


Figure 1. Carbon isotopic separations of the gas from well 30/2-2 are plotted on the maturity diagram (after James, 1983). A source LOM between 12 and 13 is indicated for the gas.

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 compositions 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.

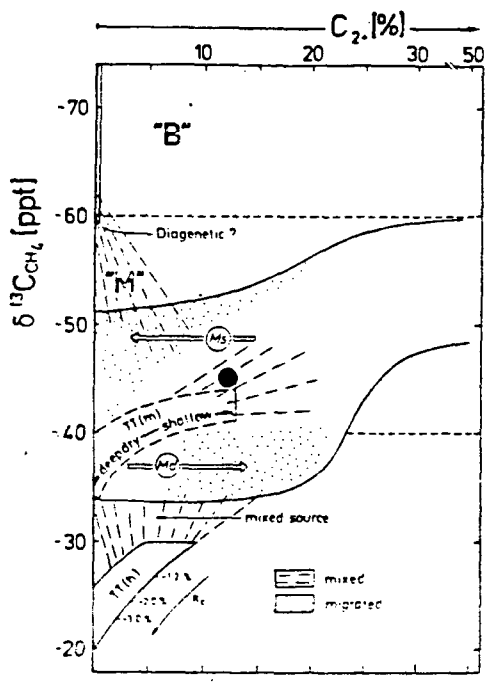


Figure 2a

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

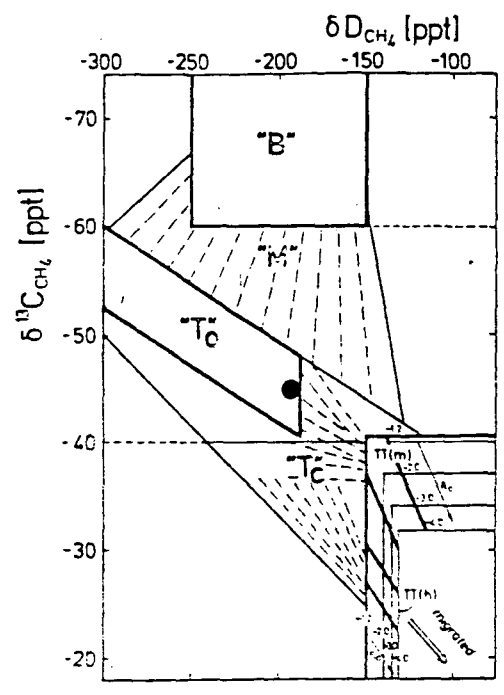


Figure 2b

Carbon and hydrogen isotope variations in methanes.

The principle for the genetic characterization of natural gases is that the 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).