

Denne rapport  
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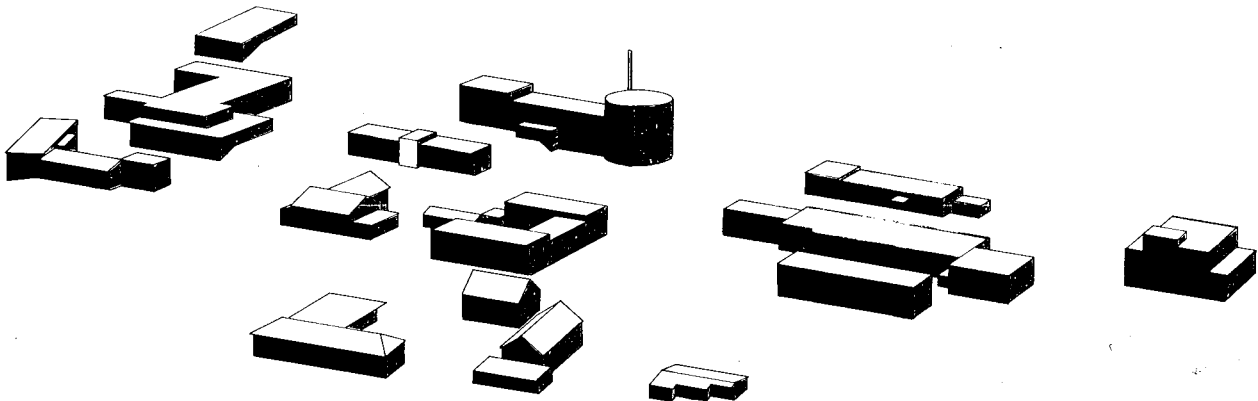
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IFE/KRF-84/111

REPORT TITLE

RESERVOIR GAS GEOCHEMISTRY ON SAMPLE FROM  
WELL 31/6-5

CLIENT  
STATOIL, NORSK HYDRO A/S, SAGA A/S



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SUMMARY				NUMBER OF ISSUES
<p>A rather heavy <math>\delta^{13}\text{C}</math> propane value together with the uncommon relationships between the <math>\delta^{13}\text{C}</math> values of propane and the butanes can in our view only be explained by effects from bacterial degradation in the reservoir.</p> <p>This in accordance with the conclusion given in the reports on well 31/3-1, 31/5-1/31/5-2, 31/6-2 and in IFE report No. IFE/KR/F-84/096.</p> <p>This biodegradation was followed by a period of renewed supply of predominantly dry gas. A crossplot between the <math>\delta^{13}\text{C}</math> methane and the <math>\delta\text{D}</math> methane values indicates that this superimposed gas was formed at rather high maturity at the end of the oil window in the condensate field.</p>				DISTRIBUTION  Oppdragsgivere, 10  Andresen, B. Berg, J.O. Brevik, E.M. Gaudernack, B. Garder, K. Råheim, A.  SUMMARY Aamodt, N-G. Project leaders Halden Dept. leaders Kjeller Library
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## ANALYTICAL PROCEDURE

The sample was received in an Al-bag. The natural gas has been separated into the different gas components by a Carlo-Erba 4200 instrument. The hydrocarbon gas components were oxydized in separate CuO-ovens, which enables us to collect several times when the concentration of a gas component is low. The combustion products CO<sub>2</sub> and H<sub>2</sub>O were frozen into collection vessels and separated. The isotopic measurements were performed on a Finnigan Mat 251 mass spectrometer. Our δ<sup>13</sup>C-value on NBS-22 is -29.77 +/- .06 ‰.

## RESULTS

The stable isotope results of the natural gas from well 31/6-5 are given in the following table :

Table 1. Isotopic composition of gas samples from well 31/6-5.

	<sup>C<sub>1</sub> δ<sup>13</sup>C   δD</sup>	C <sub>2</sub>	C <sub>3</sub>	iC <sub>4</sub>	nC <sub>4</sub>	CO <sub>2</sub> δ <sup>13</sup> C   δ <sup>18</sup> O
DST I a	-45.2   149	- 26.1	- 20.6	- 28.7	- 29.1	+ 5   - 14

The composition in % of the gas sample is given in table 2. The result has not been normalized to 100%, the rest is air.

Table 2. Composition of gas from well 31/6-5 % of C<sub>1</sub>-C<sub>4</sub>

	Sample Dist. I a
C <sub>1</sub>	72.0
C <sub>2</sub>	4.2
C <sub>3</sub>	1.0
iC <sub>4</sub>	0.4
nC <sub>4</sub>	0.2
CO <sub>2</sub>	0.1

#### INTERPRETATION

The rather heavy  $\delta^{13}\text{C}$  propane values together with the uncommon relationships between the  $\delta^{13}\text{C}$  values of propane and the butanes can in our view only be explained by effects from bacterial degradation in the reservoir.

A new, relatively dry gas has migrated into the reservoir after the bacterial degradation had stopped. The new gas mixed with the gas left after the bacterial degradation.

This makes it impossible to use Alan T. James' method \* to indicate the maturity of the source.

It is, however, likely that the methane component of the natural gas is representative for the new, relatively dry gas. This assumption is based on our experience on bacterial degradation from laboratory experiments. The carbon and hydrogen isotopic composition of the gas can therefore be plotted in a  $\delta^{13}\text{C}$  methane vs.  $\delta\text{D}$  methane plot (Schoell, 1983)\*\*, figure 1. This indicates that the superimposed gas was formed at a rather high maturity in the condensate field of the oil window. A small component of biogenic methane may be present. It should be noted, however, that Schoell's diagram is based on empirical data. This part of the diagram is not necessarily correct.

- \* James, Alan T. (1983) : Correlation of Natural Gas by Use of Carbon Isotopic Distribution Between Hydrocarbon Components, A.A.P.G. Vol. 67, No. 7, July, 1983.
  
- \*\* Schoell, M. 1983 : Genetic Characertization of Natural Gases. A.A.P.G. December, 1983.

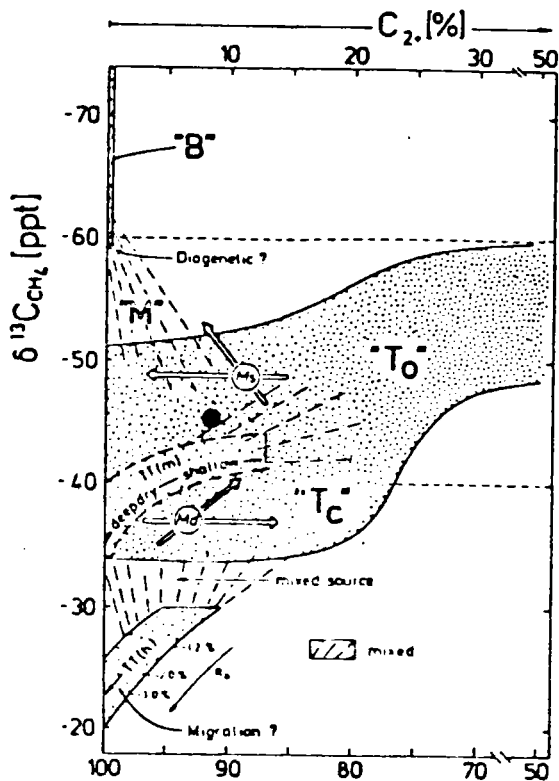


Figure 1 a. Variations of molecular composition in natural gases related to the isotope variations of methane.

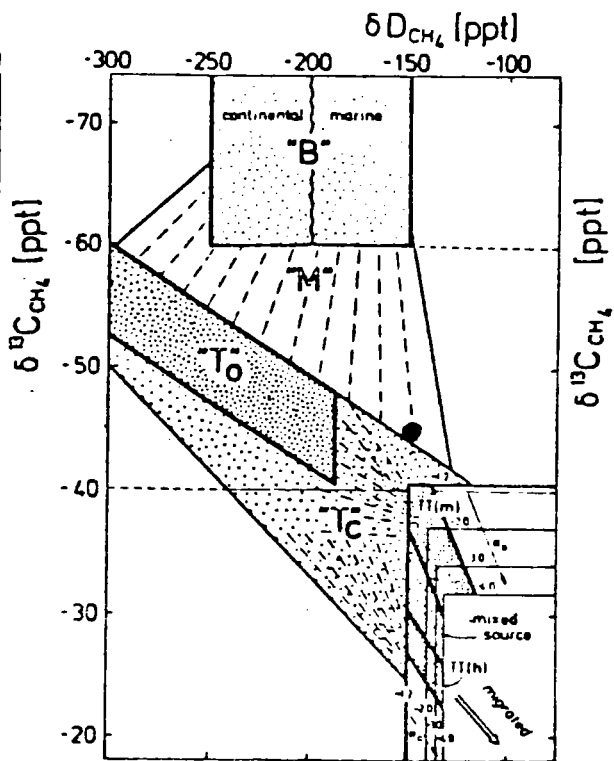


Figure 1 b. Carbon and hydrogen isotope variation in methane.

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. "T" are gases associated with petroleum in an initial phase of formation. "T<sub>c</sub>" are gases associated with condensates. (Schoell, 1983).