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BA 84-6058-1

REPORT ON STABLE ISOTOPES ($\delta^{13}C$ AND δD) ON TEST GAS SAMPLES FROM 6406/3-1

COMMENTS FROM STATOIL

The well coded XX-1 in the following report is 6406/3-1.
The samples used are as follows:

1156 Al bag is from DST no. 1, depth 3782.5 - 3783.5 m.
This sample was collected in an aluminium bag.

b95 is also from DST no. 1, depth 3782.5 - 3783.5 m but the sample was taken in a pressurised gas flask.

The values obtained compare very well except for δD_{smow} and $\delta^{13}C$ for i C_4. The discrepancy in δD is most likely due to leakage or biodegradation in the aluminium bag.
The fact that δD, $\delta^{13}C(iC_4)$, $\delta^{13}C(nC_4)$, $\delta^{13}C(CO_2)$ and $\delta^{18}O(CO_2)$ are all heavier in the aluminium bag suggests strongly that the effect is due to slight leakage from the aluminium bag.
The most reliable result is therefore believed to be that for b95.

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SUMMARY

The gas components CH_4, C_2H_6, C_3H_8, iC_4H_{10}, nC_4H_{10} and CO_2 have been separated from natural gases of well XX-1, and the $\delta^{13}C$-values of these components have been measured. The δD methane value have also been determined.

The distribution of $\delta^{13}C$ values of the different gas component of the gases and the combined use of $\delta^{13}C$ methane value and the δD methane value of the gases suggest that both samples were formed at relatively high maturity. Sample "1156 Al-bag" appear to be oil associated, while sample "b 95" appear to be condensate associated.

DISTRIBUTION

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SUMMARY
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ANALYTICAL PROCEDURE

The samples were received in an aluminium bag (1156) and in a pressurized gas bottle (b 95). The natural gases were 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_2 and H_2O were frozen into collection vessels and separated. The isotopic measurements were performed on a Finnigan Mat 251 mass spectrometer. Our $\delta^{13}C$-value on NBS-22 is -29.77 ± .06 $^0/oo$.

RESULTS

The stable isotope results of the natural gases from well xx-1 are given in the following table.

Table 1. Isotopic composition of gas samples from well xx-1.

Sample xx-1	C_1 $\delta^{13}C$	δD_{SMOW}	C_2	C_3	iC_4	nC_4	CO_2 $\delta^{13}C$	$\delta^{18}O_{PDB}$
1156 Al bag	-42.1	-197	-31.2	-30.3	-24.3	-29.1	-14.7	-12.2
b 95	-42.0	-231	-31.5	-31.1	-26.8	-30.0	-16.2	-16.0

Our uncertainty on the $\delta^{13}C$-value is estimated to be ± 0.3 $^0/oo$ and includes all the different analysis steps. The uncertainty on the δD-value is estimated to be ± 5 $^0/oo$.

The composition of the gas samples are given in table 2. The results have not been normalized to 100 %. The rest is air.

Table 2. Composition of gases from well xx-1. (%)

	1156 Al bag	b 95
C_1	66.0	74.0
C_2	.8	2.1
C_3	.4	.4
iC_4	.02	.02
nC_4	.05	.05
CO_2	10.0	13.0

INTERPRETATION

The δ^{13}C-values of methane, ethane, propane and n-butane for the two samples have been plotted on the maturity diagram by James (1983)* figure 1. A high maturity is indicated for both samples. Sample, 1156 Al-bag, however appear to be oil-associated, while sample, b 95, appear to have formed at somewhat higher maturity in the condensate field of the oil window. The same conclusion is derived when the samples are plotted in a δ^{13}C methane vs δD methane cross plot (Schoell, 1983)** fig. 2. Sample, 1156 Al bag, appear to be oil associated while sample, b 95, appear to be condensate associated.

The relationship of the two samples from well xx-1 is not known to us. The more negative δ^{13}C Co_2 value of sample b 95 suggests, however, that this sample is collected closest to the source. The δ^{18}O CO_2 value of sample b 95 indicate a higher collection site temperature than sample 1156 Al-bag.

CONCLUSION

Both samples from well xx-1 appear to have formed at relatively high maturity in the oil window. Sample 1156 Al-bag appear to be oil associated while sample b 95 appear to be condensate associated.

* James Alan T. (1983): Correlation of Natural Gas by Use of Carbon Isotopic Distribution Between Hydro carbon Components. A.A.B.G. Vol 67, No. 7. July 1983.

** Scholl, M. (1983): Genetic Characterization of Natural Gases. A.A.P.G. Vol 67, No. 12. Dec, 1983.

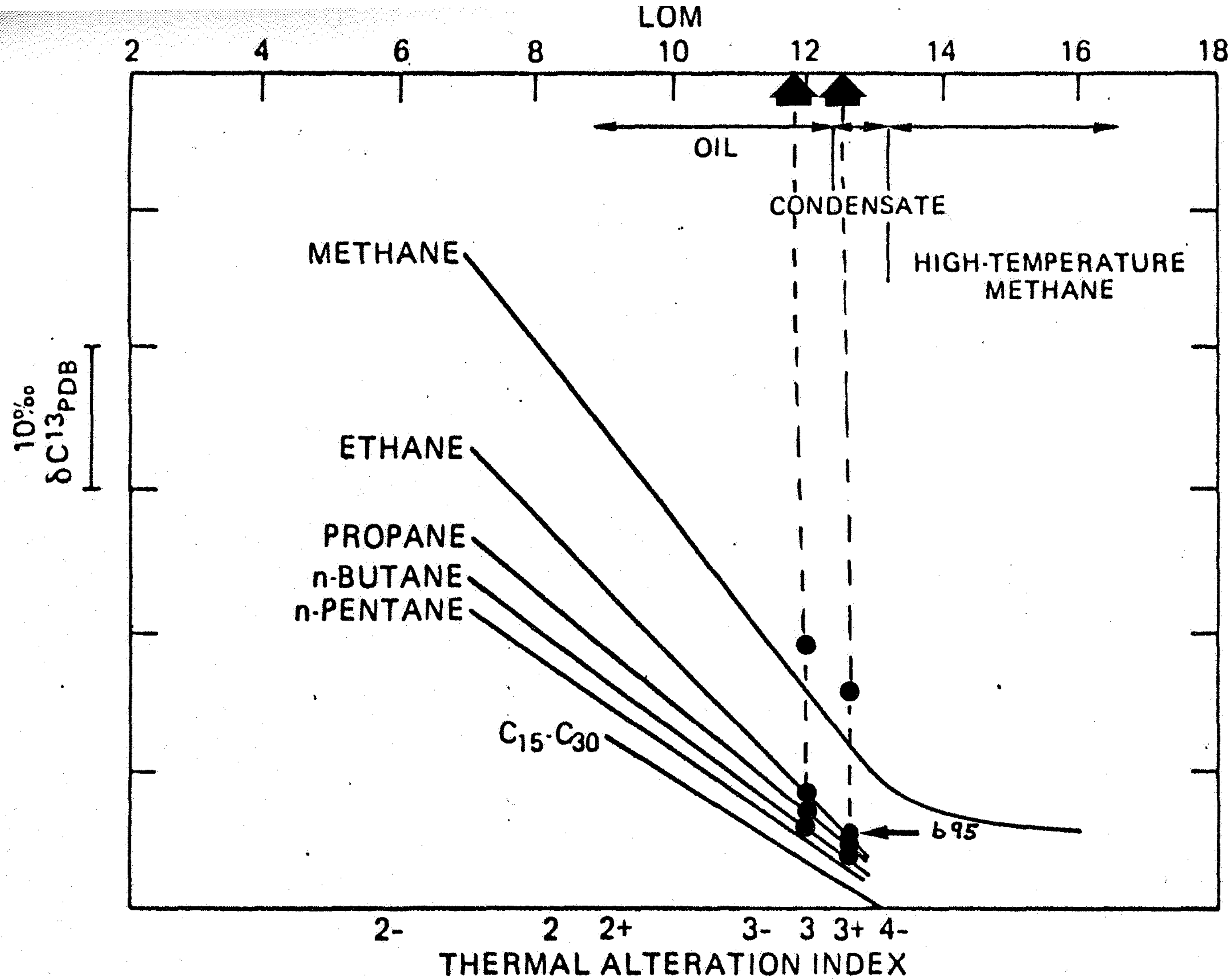

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Figure 1. Carbon isotopic separations of the gas from well XX-1 is plotted on the maturity diagram (after James, 1983).

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 $\delta^{13}C$ 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.

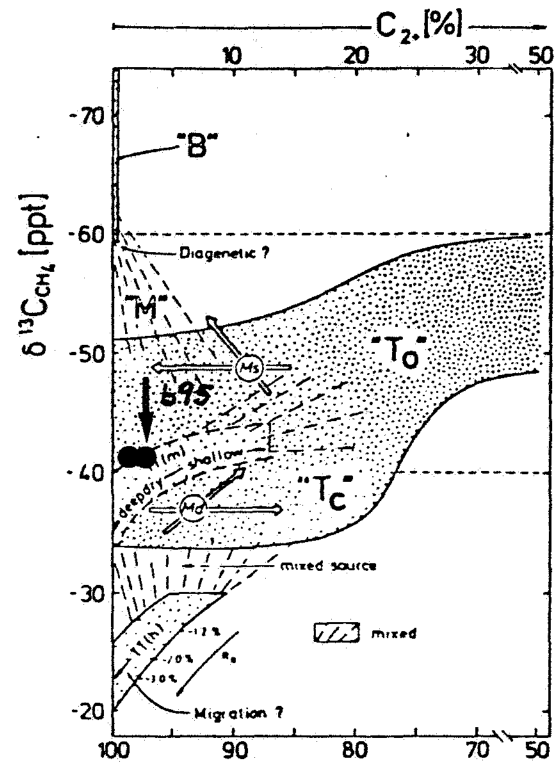

Figure 2 a. Variations of molecular composition in natural gases related to the isotope variations of methane.

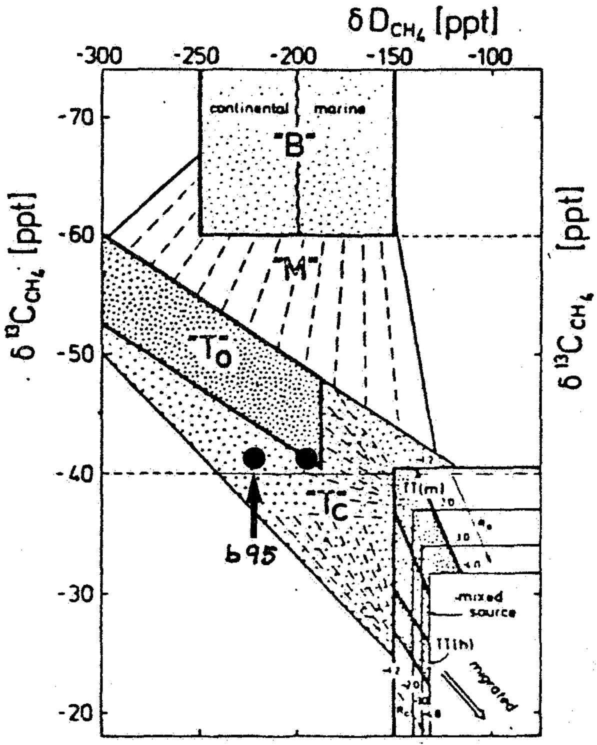

Figure 2 b. Carbon and hydrogen isotope variations in methanes.

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