Institutt for energiteknikk

ADDRESS TELEPHONE TELEX TELEFAX	KJELLER Box 40, N-2007 Kjeller, Norway +47 6 806000 74 573 energ n +47 6 815553	HALDEN N-1751 Halden, Norway +47 9 183100 76 335 energ n	**AVAILABILITY** Private Confidential
REPORT TYPE	**REPORT NO.** IFE/KR/F-92/145		**DATE** 1992-10-02
	REPORT TITLE REPORT ON STABLE ISOTOPES ($\delta\ ^{13}C$, δ D) ON A GAS SAMPLE FROM WELL 34/10-36		**DATE OF LAST REV.** **REV. NO.**
	CLIENT Statoil		**NUMBER OF PAGES** 8
	CLIENT REF. T 6269/159		**NUMBER OF ISSUES** 15

SUMMARY

The gas components C_1 - C_5 and CO_2 have been separated from a gas sample from well 34/10-16, DST 1. The $\delta\ ^{13}C$ values of methane, ethane, propane, the butanes and CO_2 have been determined. The hydrogen isotopic composition of methane has also been determined.

The isotopic composition of the DST 1 sample from well 34/10-36 indicates a high maturity situation in the condensate field of the oil window.

DISTRIBUTION

Statoil (10)
Andresen, B.
Råheim, A.
Throndsen, T.
File (2)

KEYWORDS

	NAME	DATE	SIGNATURE
PREPARED BY	Bjørg Andresen	1992-10-02	Bjørg Andresen
REVIEWED BY	Torbjørn Throndsen	1992-10-02	Torbj. Throndsen
APPROVED BY	Arne Råheim	1992-10-02	Arne Råheim

1 INTRODUCTION

One gas sample from well 34/10-36; DST 1 was received and analysed September 1992.

On the sample C_1 - C_5 and CO_2 are quantified. The δ ^{13}C value is measured on methane, ethane, propane, the butanes and CO_2. In addition the δ D value is measured on the methane.

2 ANALYTICAL PROCEDURE

The natural gas sample has been quantified and separated into the different gas components by a Carlo Erba 4200 gas chromatograph.

The hydrocarbon gas components were oxidised 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 combustion water was reduced with zinc metal in a sealed quarts tube to prepare hydrogen for isotopic analysis. The isotopic measurements were performed on a Finnigan Mat 251 and Finnigan Delta mass spectrometer.
IFEs value on NBS 22 is 29.77 ± .06‰ PDB.

3 RESULTS

The volume composition of the gas sample is given in Table 1. The results have been normalised to 100%. The stable isotope results are given in Table 2.

The uncertainty on the δ ^{13}C value is estimated to be ± 0.3‰ PDB and includes all the different analytical steps. The uncertainty in the δ D value is likewise estimated to be ± 5‰.

Table 1: Volume composition of a gas sample from well 34/10-36.

Sample	IFE no	C_1 %	C_2 %	C_3 %	iC_4 %	nC_4 %	iC_5 %	nC_5 %	CO_2 %	ΣC_1-C_5	Wet-ness	iC_4/ nC_4/
DST 1	11165	85.2	7.6	3.1	0.48	0.72	0.15	0.15	2.6	97.4	0.13	0.67

Table 2: Isotopic composition of a gas sample from well 34/10-36.

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	11165	-38.5	-182	-27.7	-26.8	-26.2	-27.4	-8.8	-11.2

4 INTERPRETATION

A general isotopic trend for normal unaltered gases is found to be a smooth progression from methane to n-butane, excluding i-butane (James, 1983).

In the present DST 1 sample from well 34/10-16 the $\delta^{13}C$ propane value is enriched in the heavy isotope compared to the $\delta^{13}C$ n-butane value. This may indicate a mixed gas situation with gas at least derived from two different sources with one source dominating from the C_1 - C_3 range and the other source dominating from C_4 (and higher). Gases derived from the same source but at different maturity levels may also be the case. The present relationship between the $\delta^{13}C$ values of propane and n-butane may also be due to a high maturity situation.

A source LOM between 12 and 13 is indicated when the $\delta^{13}C$ values of methane, ethane and propane are plotted in James maturity diagram, Figure 1 (James 1983), e.g. at a high maturity level in the condensate field of the oil window.

A high maturity is in accordance with the combined use of the carbon isotope composition of methane and the gas composition (Schoell 1983), Figure 2, the carbon and hydrogen isotopes of methane (Schoell 1983), Figure 3, the combined use of the carbon isotopes of methane and ethane (Schoell 1983), Figure 4 and the combined use of the carbon isotopes of ethane and propane (Faber 1987), Figure 5.

5 CONCLUSION

The isotopic composition of the DST 1 sample from well 34/10-16 indicates a high maturity situation in the condensate field of the oil window.

6 REFERENCES

Faber, E. (1987). Zur Isotopengeochemie gasformiger Kohlenwasserstoffe. *Erdol, Erdgas, Kohle,* **103**, 210-218.

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

Robert, P. (1985). Methods and means of paleothermal analysis. *Organic Methamorphism and Geothermal History*, Elf-Aquitaine and D. Reidel Publishing Company.

Schoell, M. (1983). Genetic characterisation of natural gases. *The American Association of Petroleum Geologists Bulletin,* **67**, 2225-2238.

Institutt for energiteknikk

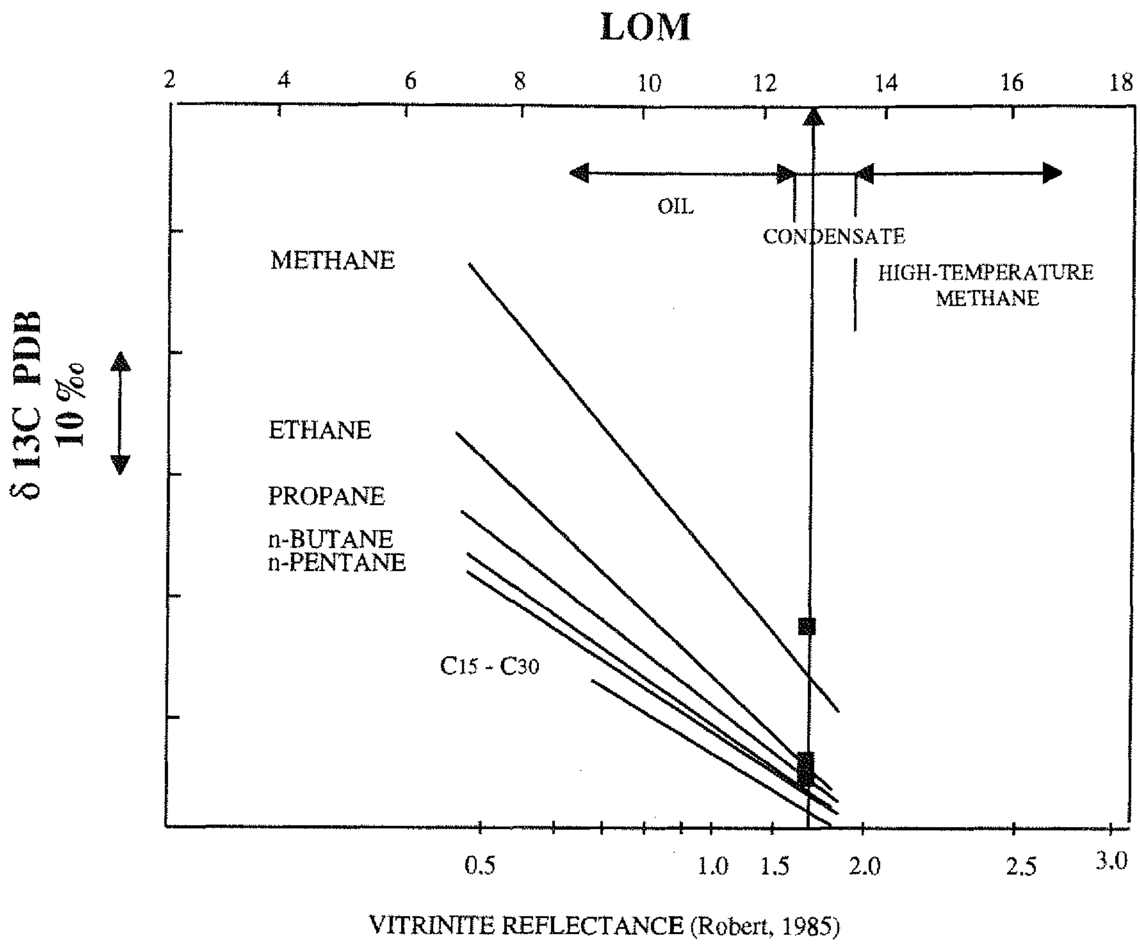

Figure 1

Carbon isotopic separation of a gas sample from well 34/10-16 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 axes 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 $\delta\ ^{13}C$ 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.

Institutt for energiteknikk

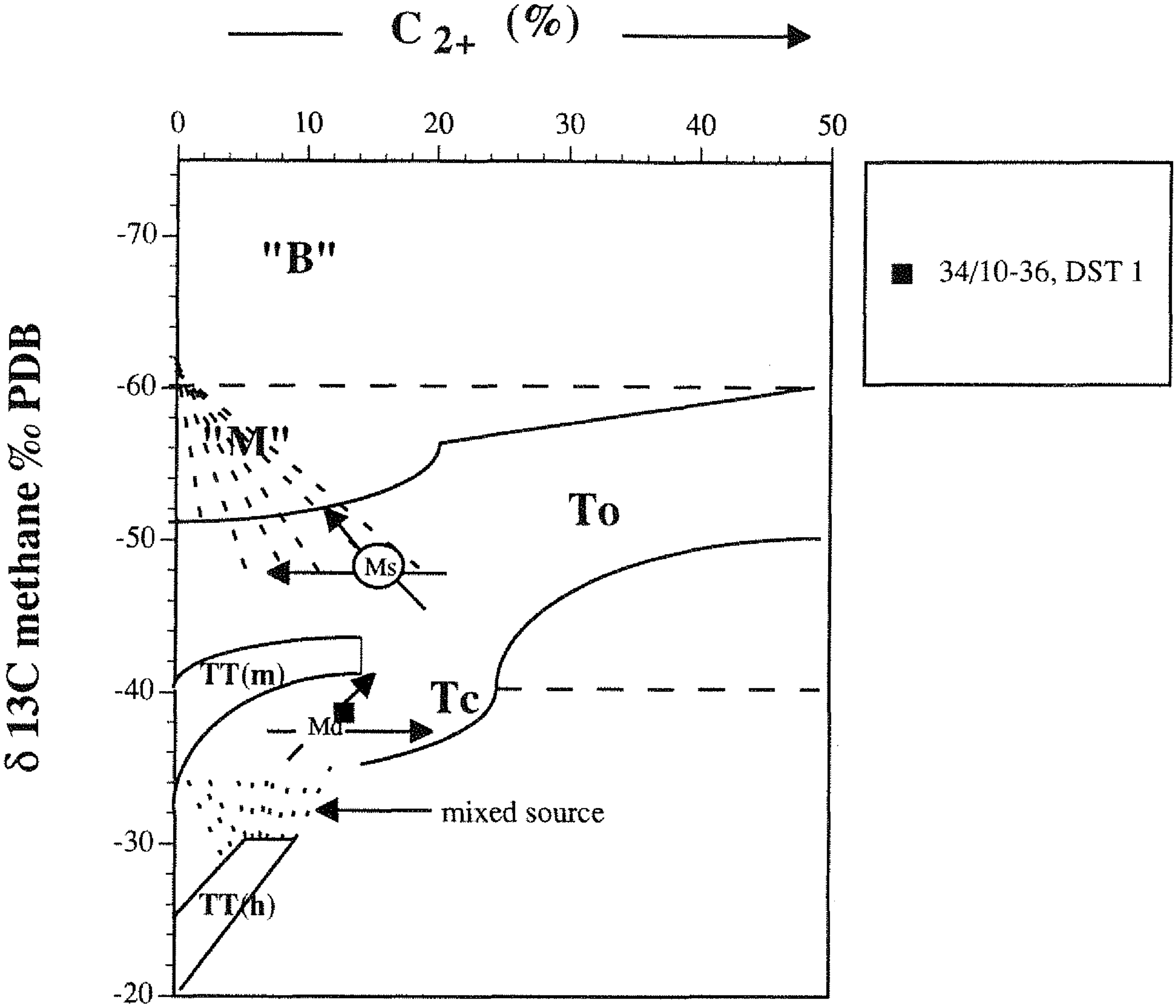

Figure 2

Variations of molecular composition in natural gases related to the isotope variations of methane in a gas sample from well 34/10-16.

The principles for the genetic characterisation 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_O" are gases associated with petroleum in an initial phase of formation. "T_C" are gases associated with condensates (Schoell, 1983).

Institutt for energiteknikk

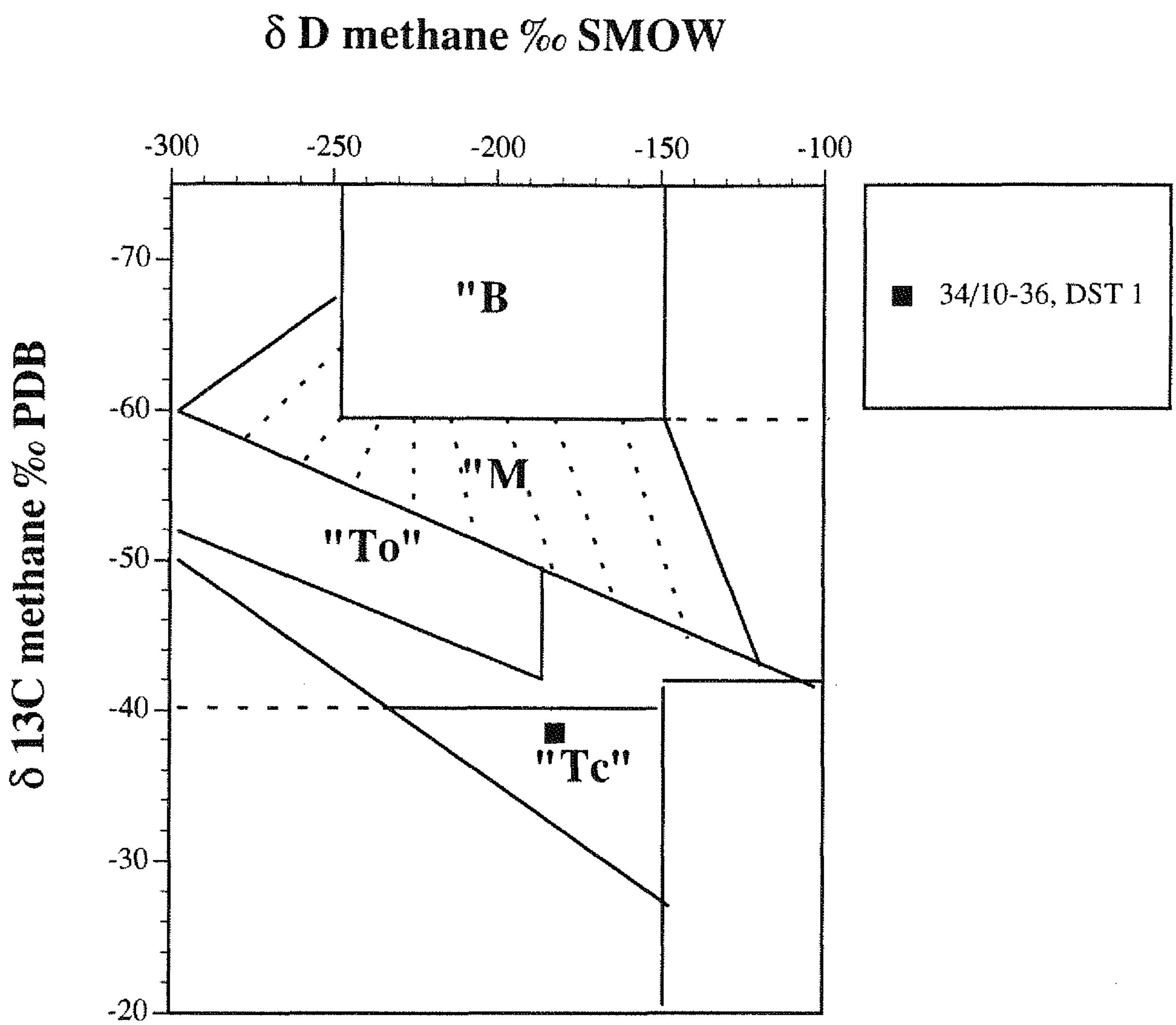

Figure 3

Carbon and hydrogen variations in methane in a gas sample from well 34/10-16.

The principles for the genetic characterisation 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_O" are gases associated with petroleum in an initial phase of formation. "T_C" are gases associated with condensates (Schoell, 1983).

Institutt for energiteknikk

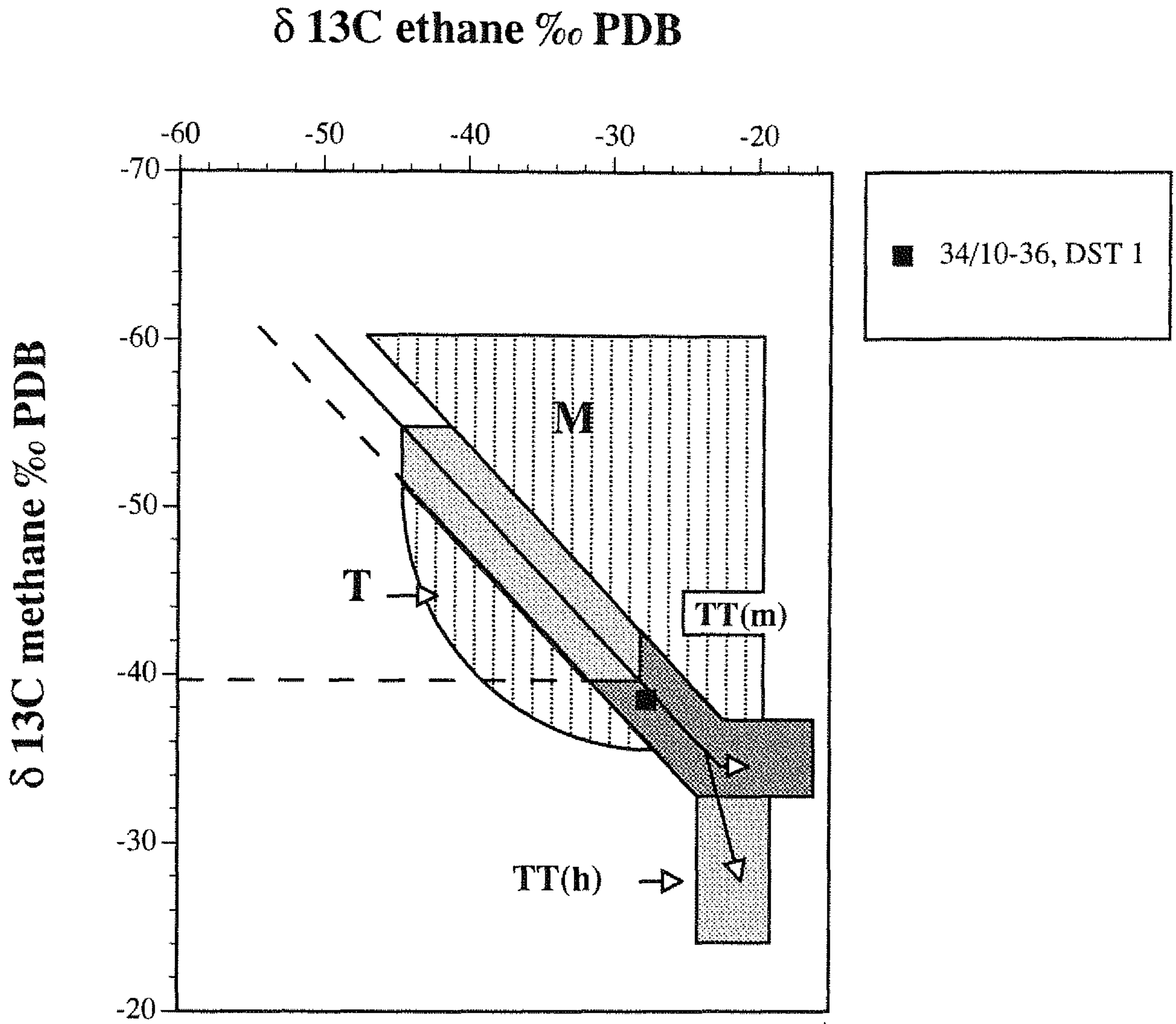

Figure 4

Carbon isotope variations in ethane related to carbon isotope variations in methane in a gas sample from well 34/10-16.

The principles for the genetic characterisation 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_O" are gases associated with petroleum in an initial phase of formation. "T_C" are gases associated with condensates (Schoell, 1983).

Institutt for energiteknikk

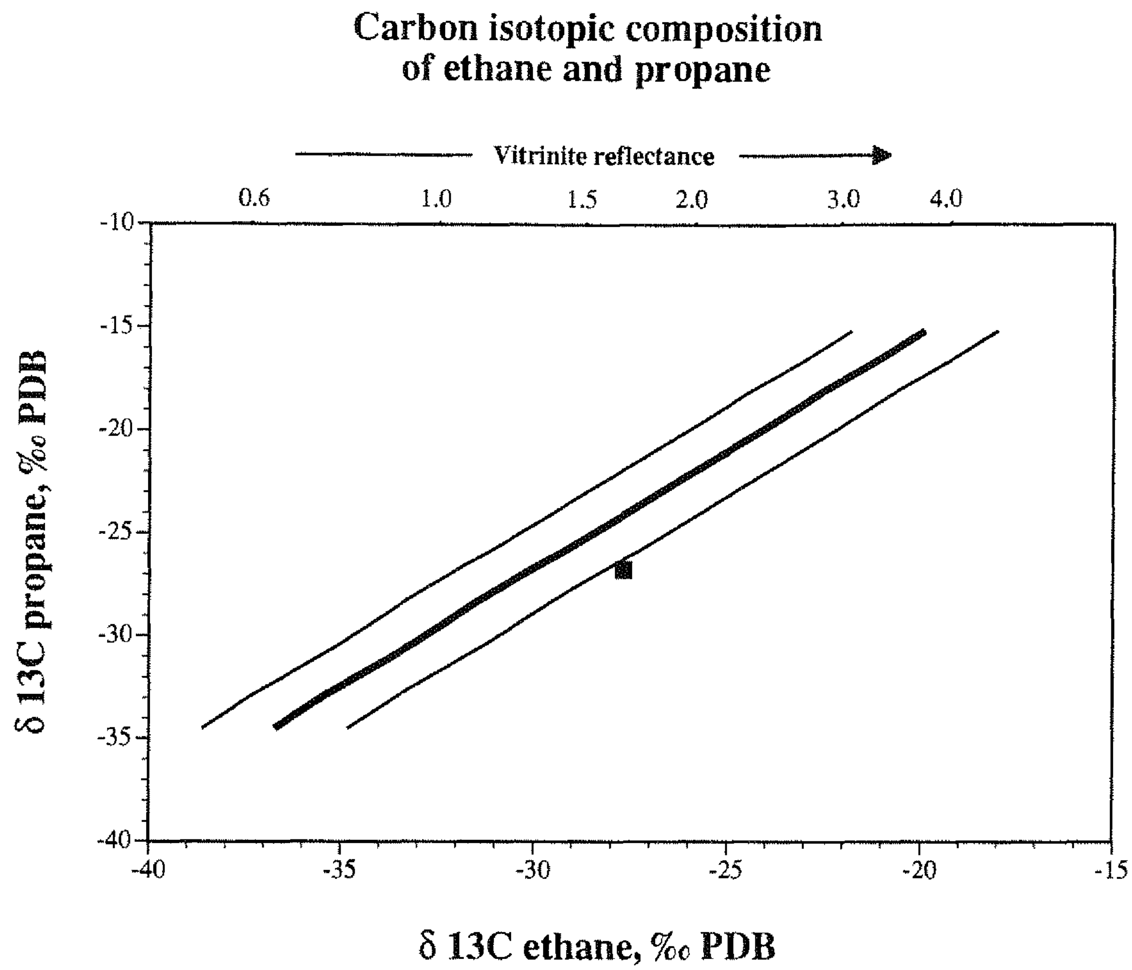

Figure 5

Carbon isotope variations in ethane related to carbon isotope variations in propane in a gas sample from well 34/10-16, in the maturity diagram described by Faber (1987).