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**Geochemical investigation of a gas from sample from
Benbecula, 154/1-1, UK**

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1.0 INTRODUCTION

A geochemical investigation has been carried out on a gas sample from 2861 m (S217038/1, Palaeocene Vaila Sst Fm.) in well 154/1-1 (Benbecula), UK.

The objective was a full typing a comparison with previous contractor analysis.

The geochemical parameters are shown on pages 2 to 6, the analysis results are presented on the yellow pages.

2.0 RESULTS

2.1 Transformation processes

The gas sample shows no indication of bacterial degradation (gas composition).

However, the deviating carbon isotope of methane (-32.5 ‰) suggests leakage of the gas cylinder.

2.2 Maturity

The molarogram of the gas is of type B, suggesting a relatively high maturity.

2.3 Type of organic matter

The gas classification diagram indicates a thermal origin, presumably derived from a type II kerogenous source rock. The compound specific isotopes do not indicate admixture of a gas from another source.

The carbon isotopes do not correlate with a Carboniferous source, an Upper Jurassic source could be possible.

2.4 Correlation

A comparison has been made with previous analysis results of two gases from the same well (see Table page 6).

These data indicate that, in general, the data are good comparable.

However, relatively large differences can be found in:

- the amounts of nitrogen (3.23 and 2.66 % versus Shell data 0.61%); this difference is difficult to explain. It could be that the sample that was analysed by the contractor contained some air and that the reported values have not been corrected for air. The sample that was analysed by Shell did not contain air, besides that, Shell data are air corrected.
- the amounts of C6+ hydrocarbons (not measured versus Shell data 0.18%);
- the carbon isotopes of n-butane (-28.97 and -28.85 ‰ versus Shell data -30.1 ‰); an explanation for the differences might be that the contractor data become more unreliable when concentrations are low (0.10-0.12%; isotopes on lower concentrations have not been measured by the contractor). The carbon isotopes on methane, ethane and propane, all with concentrations higher than 0.54%, are very similar to the Shell data.

Furthermore, no deuterium, no iso-butane and no iso- and n-pentane isotopes were reported in the contractor report. These compound specific isotopes are important for the assessment of possible gas mixing and reservoir continuity.

Country: *United Kingdom*
Well: *154/01-01*
Depth: *2861.0m*
Type: *Gas*

Composition Total Gas (Mole%, air corrected)

methane:	96.40
ethane:	2.10
propane:	0.43
iso-butane:	0.06
normal-butane:	0.09
iso-pentane:	0.03
normal-pentane:	0.03
C6+ hydrocarbons:	0.18
nitrogen:	0.61
carbon dioxide:	0.03
hydrogen sulphide:	n.d.

Gas ratios

Methane/Ethane	45.9
Iso Butane / Normal Butane	0.7

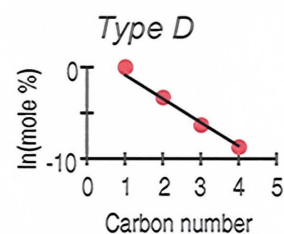
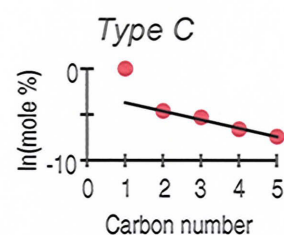
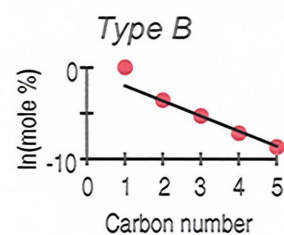
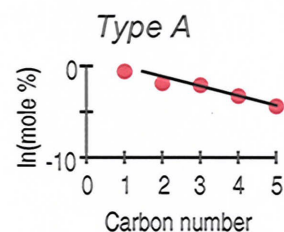
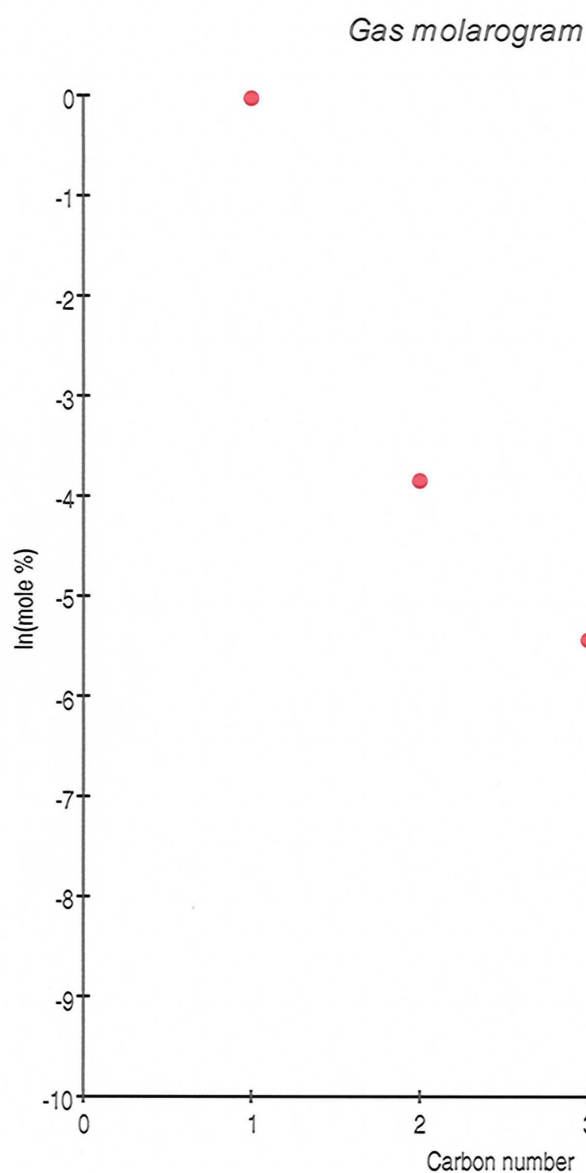
Isotope Ratios (MS)

methane (C13):	-32.5
ethane (C13):	-37.1
carbon dioxide (C13):	n.d.
carbon dioxide (O18):	n.d.
Nitrogen (N15):	n.d.

Compound Specific Isotope Analysis (GC-MS)

methane:	-32.5
ethane:	-37.1
propane:	-31.7
iso-butane:	-29.7
normal-butane:	-30.1
iso-pentane:	-27.2
normal-pentane:	-27.1

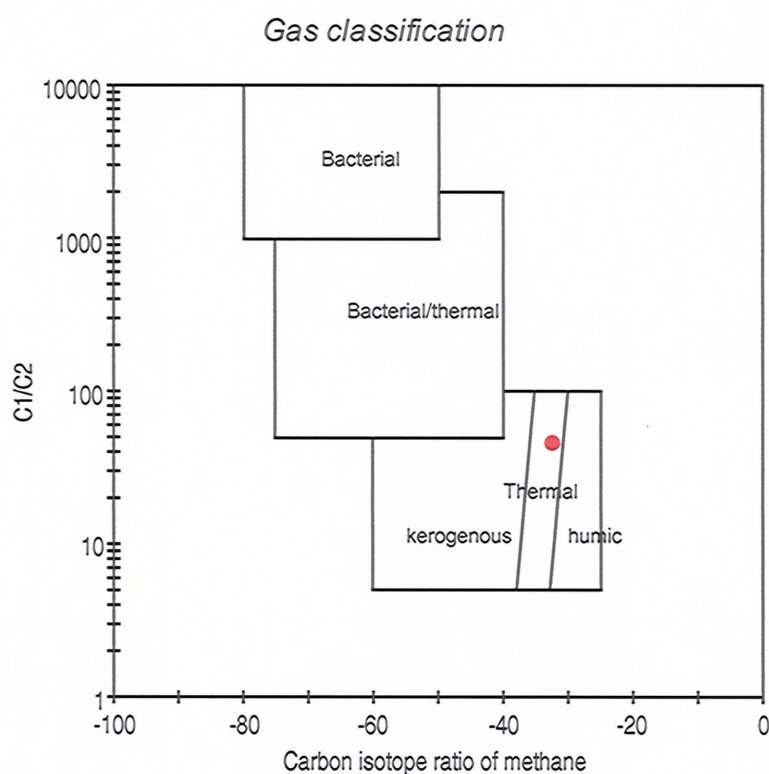
Country: United Kingdom
Well: 154/01-01
Depth: 2861.0m
Type: Gas



Molarogram types
A: low mature
B: high mature, thermal
C: thermal + bacterial
D: bacterially degraded

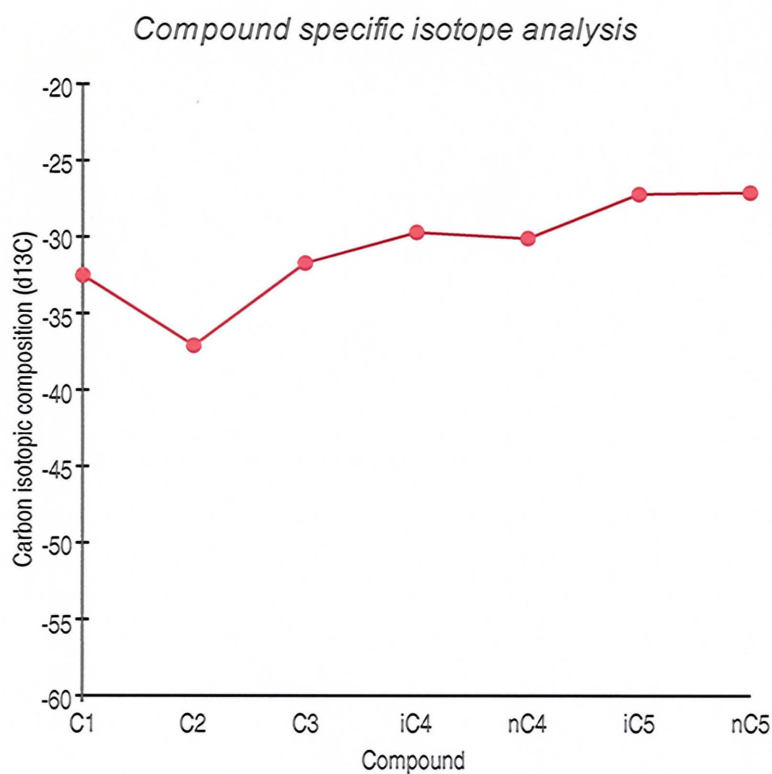
Conclusions:

Country: United Kingdom
Well: 154/01-01
Depth: 2861.0m
Type: Gas



Isotope ratios

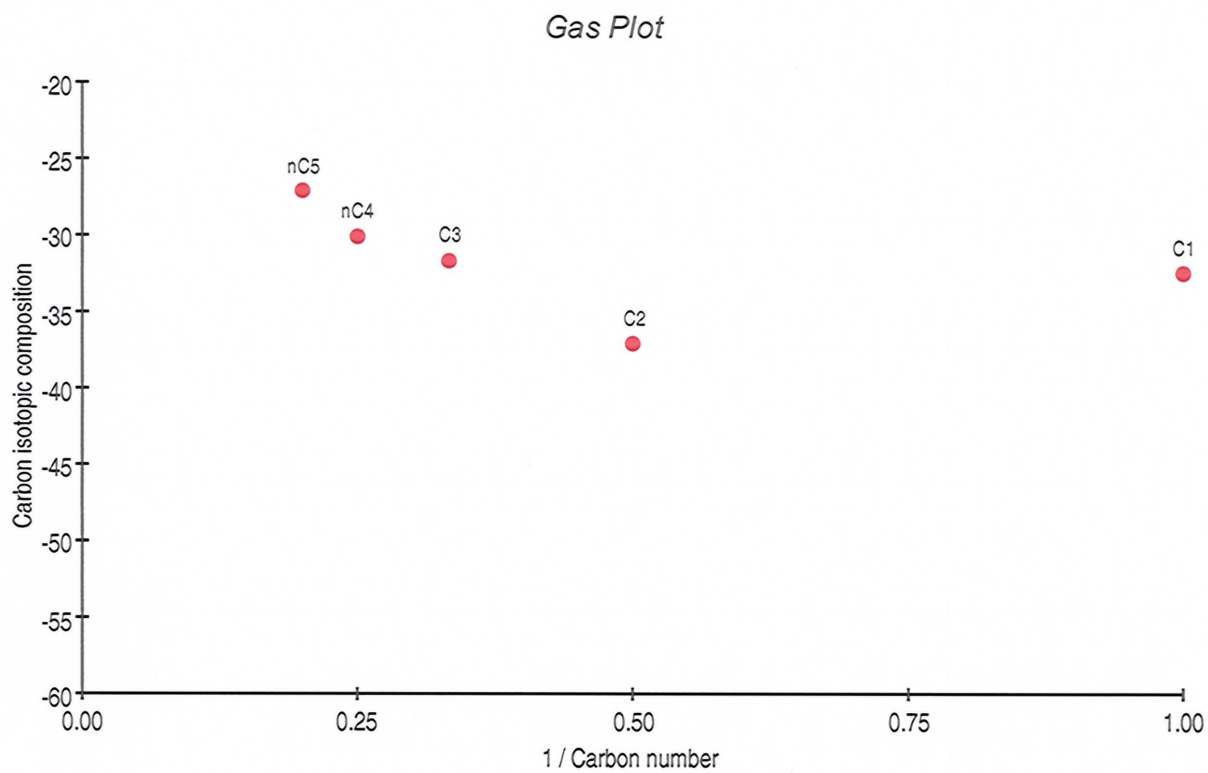
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ethane (C13):	-37.1
carbon dioxide (C13):	n.d.
carbon dioxide (O18):	n.d.
Nitrogen (N15):	n.d.



Compound specific isotope ratios

methane:	-32.5
ethane:	-37.1
propane:	-31.7
iso-butane:	-29.7
normal-butane:	-30.1
iso-pentane:	-27.2
normal-pentane:	-27.1

Country: United Kingdom
 Well: 154/01-01
 Depth: 2861.0m
 Type: Gas



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154/1-1	RCI 184312 isotopes	%	RCI 185635 isotopes	%	Shell sample isotopes	%
Methane	-32.16	93.08	-32.75	93.91	-32.5	96.4
Ethane	-36.98	2.97	-37.56	2.53	-37.1	2.1
Propane	-31.32	0.56	-32.15	0.54	-31.7	0.43
Iso-Butane	ND	0.06	ND	0.09	-29.7	0.06
N-Butane	-28.97	0.1	-28.85	0.12	-30.1	0.09
Iso-Pentane	ND	0	ND	0.04	-27.2	0.03
N-Pentane	ND	0	ND	0.04	-27.1	0.03
C6+ hydrocarbons						0.18
CO2	ND	0	ND	0.08	ND	0.03
Nitrogen		3.23		2.66		0.61
Methane (H)						-148

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