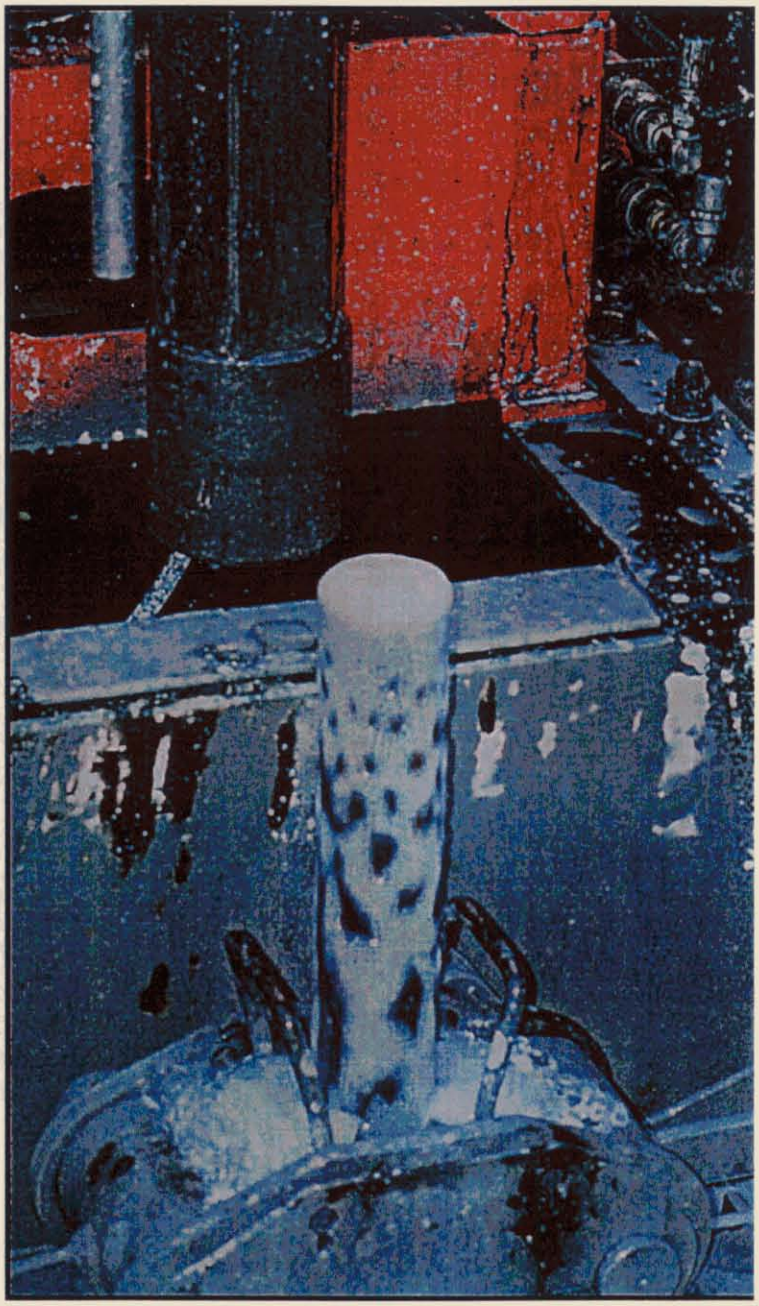
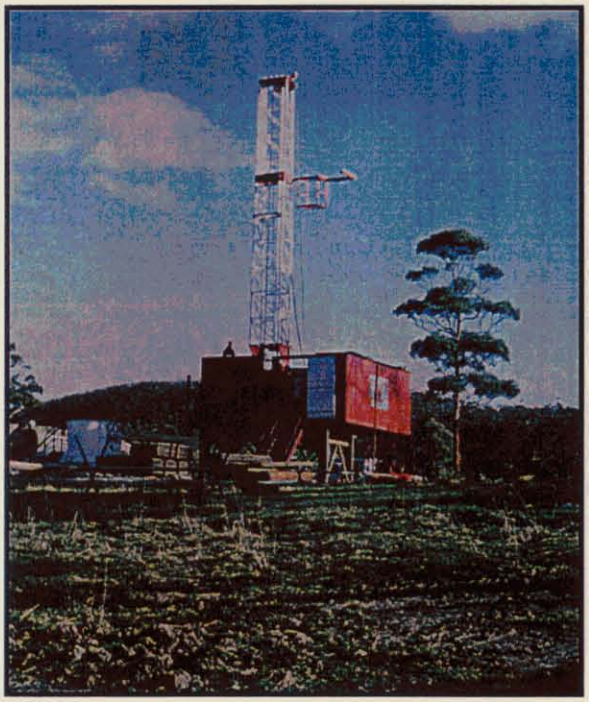
GREAT SOUTH LAND MINERALS PTY LTD.

ACN 068 650 386

Report from the Shittim #1 Well March 1997

By Dr. Clive Burrett





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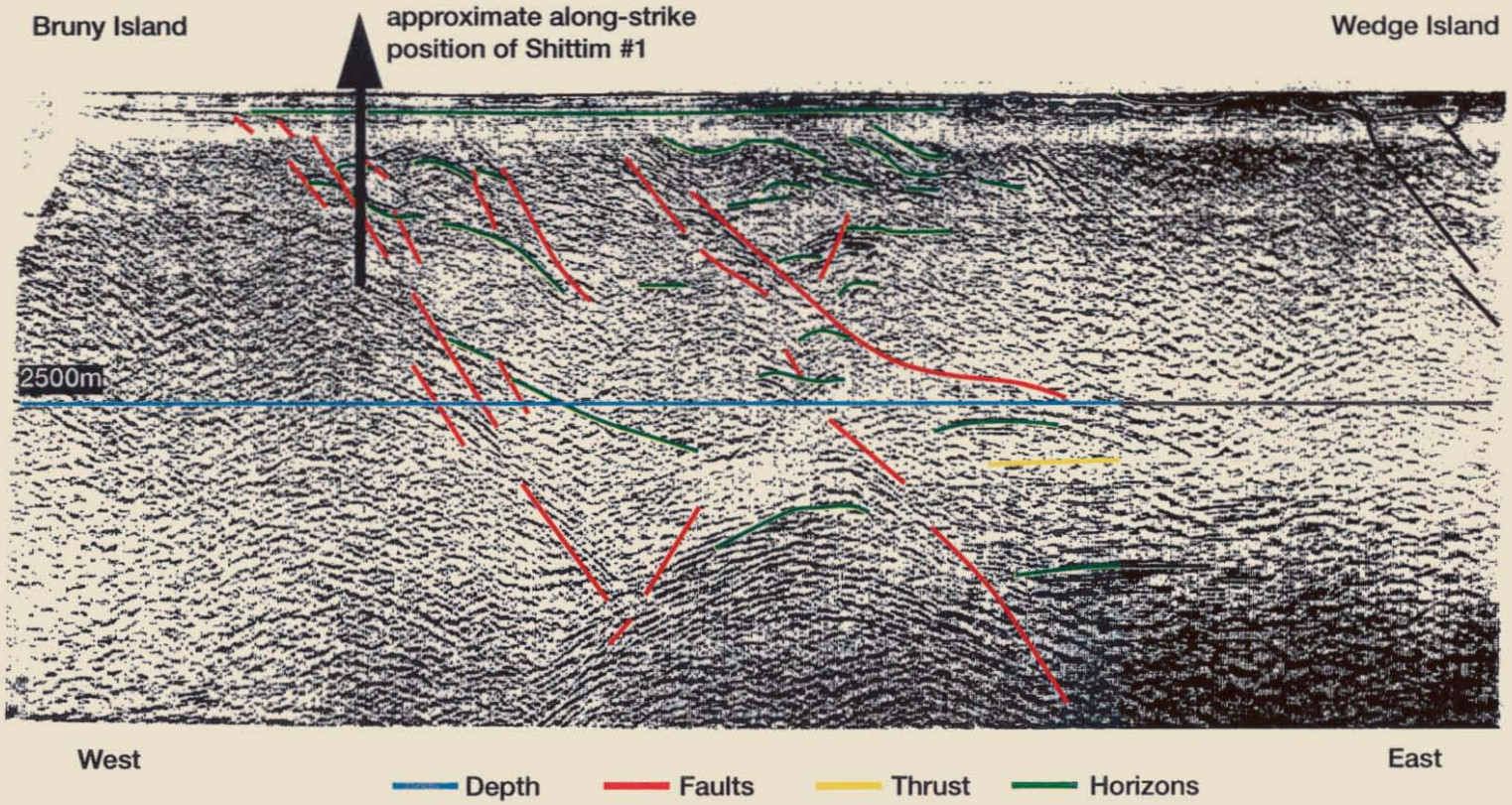
Seismic Section across Storm Bay, Southern Tasmania

A Preliminary Interpretation



Interpretation by Leaman

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Figure 1

REPORT FROM THE SHITTIM HOLE ON BRUNY ISLAND

INTRODUCTION

A stratigraphic drillhole on north Bruny Island was planned in 1994 to test structures identified on nearby seismic, gravity and magnetics and on marine seismic lines across Storm Bay (Fig. 1). The hole, known as Shittim #1, was suspended at 1751m. and a full analysis of the geochemical results to date are included herein. A dipmeter survey showed that the hole did not deviate from the vertical by more than 5 degrees. The fully cored stratigraphic succession is summarised in Fig. 2.

A comparison can be made with a precollar hole (Jericho) drilled some 2.5 km west of Shittim, in which quantities of gas, including hydrogen, were found at shallow depth. This gas was not tested for helium (see Fig. 2A). The rig is presently operational at this site.

Notes on the method of collection of samples and on the collection of data are included at the end of this document.

STRATIGRAPHY

The Lower Parmeener Supergroup (Upper Carboniferous-Permian) in Shittim #1 has been intruded by two major dolerite sills - an upper sill which is 580m thick and a lower sill which is 250m thick. In addition there are thinner sills with one minor sill being 3m thick.

All of the sedimentary succession in Shittim #1 has been contact metamorphosed (heated) by one or both of the thick dolerite sills. Details of the mineralogy of the contact metamorphics and of the metallic minerals in the dolerite can be found in Bottrill (1995) and Woods (1995). Metamorphic assemblages and vitrinite reflectance data, which are indicators of the level of heating, show that all of the Parmeener metasedimentary rocks have experienced temperatures of 300-500^{0}C.

The formations however, are easily recognised (Forsyth 1995) and are summarised in the attached log. The uppermost formation cored is the Deep Bay Fm, followed by the Bundella Fm (and its several members), then by the Woody Island Fm and Truro Tillite.

There are no surprises in the stratigraphy of the Lower Parmeener Supergroup and even the very thin formations (probably best regarded as members) erected on Satellite Island (previously Woody Island) by Banks *et al* (1955) can be readily identified. The Truro Tillite at slightly over 400m is thicker than in most other Tasmanian sections. The Truro Fm also contains minor conglomerate, sandstone, shale and limestone interbeds, all of which have been recorded in other Tasmanian sections of the Truro Fm.

Shittim #1 Well Log, North Bruny Island

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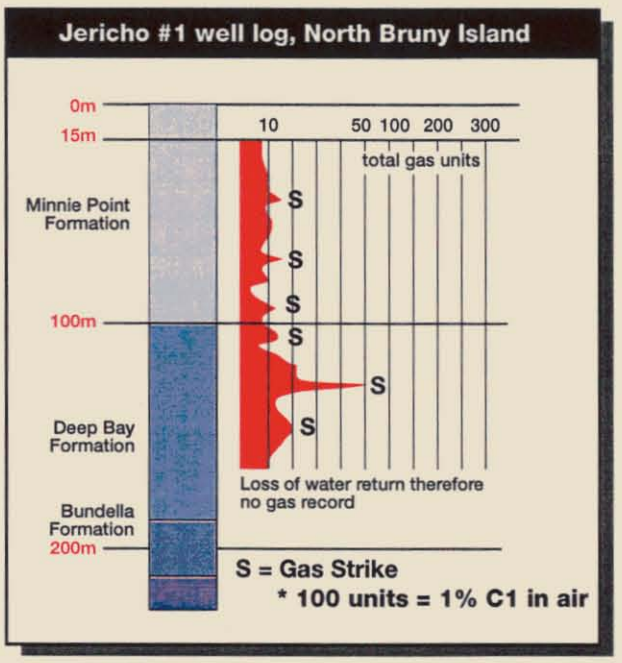

Figure 2A

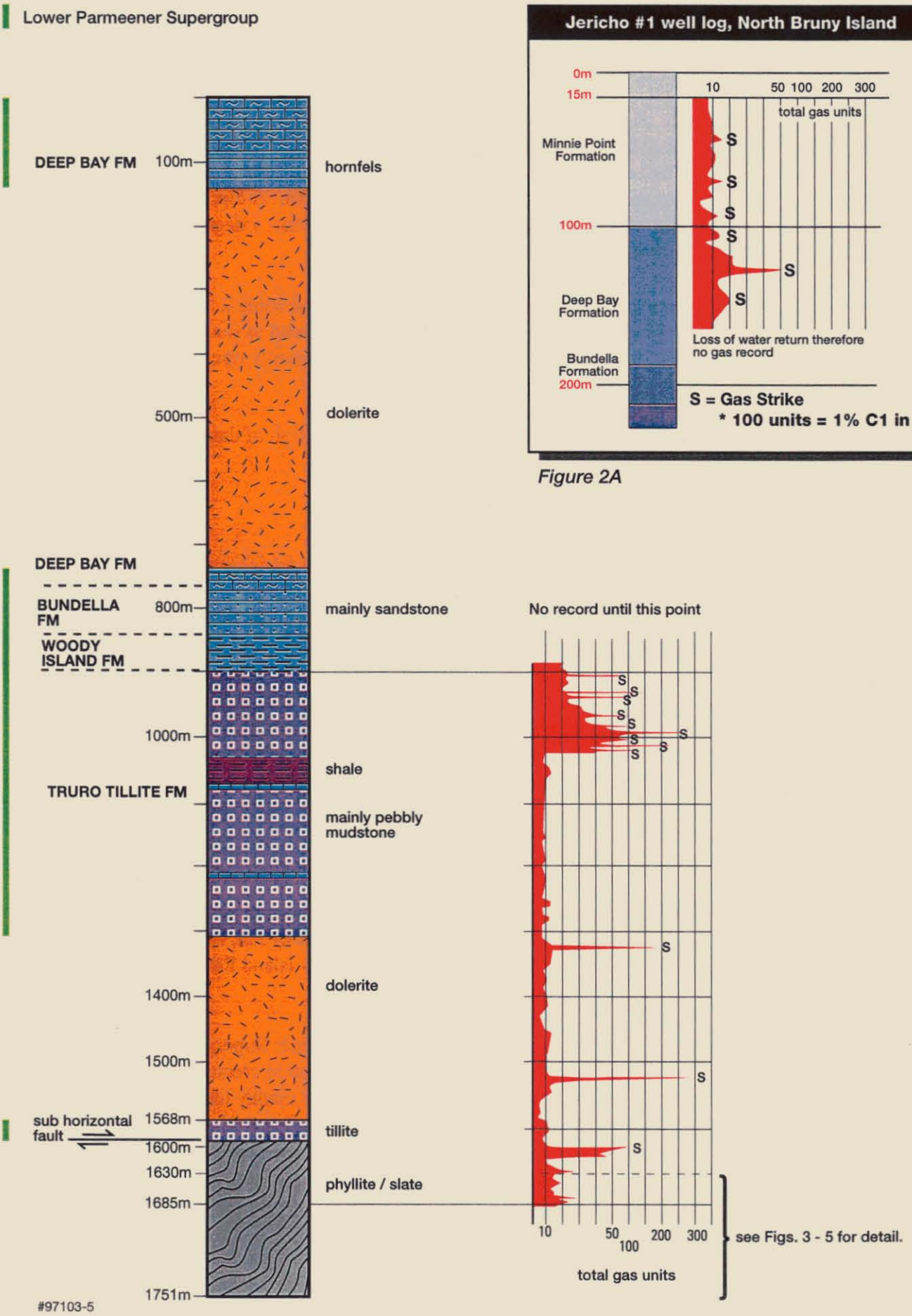

Figure 2

STRUCTURE

The section is jointed throughout, is cut by several small faults and the more ductile Woody Island Formation is deformed. Horizontal fracturing in the Woody Island Fm may indicate low angle faulting.

The lower dolerite sill is underlain at 1568m by 33cm of metatillite. At 1568.3m there is a 10cm wide, horizontally striated fault zone and beneath the fault is 183m core thickness of highly deformed slates and phyllites with very minor marble (dolomite + calcite) beds. Spotting in the phyllite/slate rocks decreases away from the fault suggesting that this low angle fault is pre-dolerite in age.

A low angle, probably listric, fault was identified on a seismic line from nearby in Storm Bay by Leaman in 1987.

POROSITY AND PERMEABILITY

Porosity measurements were carried out on the sandstones of the Bundella Fm. Woods (1995) found a relationship between both porosity and permeability and distance from the upper dolerite sill. Porosities range from 7.5% to 12% and permeabilities from 0.1 to 9.8 md.

Porosity has probably been enhanced by decarboxylation. The potential reservoirs intersected are few and include a few metres of porous sandstones in the Bundella Fm. This is the distal facies equivalent of the thicker glacifluvial sandstones of the Liffey and Faulkner Groups that do not occur on Bruny Island but are attractive reservoir targets on the mainland of Tasmania (Maynard 1996).

Fracture porosity may be present in several of the formations but is most obvious in the Woody Island Fm. Fracture porosity is difficult to measure and it is not possible to say whether or not a potential reservoir exists in the Shittim #1 area based solely on fracture porosity. Elevated levels of wet gas and helium occur within fractured and veined sections of the phyllite/slate complex between 1700 and 1730m (Figs. 3, 4, 5).

PRE-PARMEENER METAMORPHICS

A total of 183m of pre-Parmeener metamorphics has been drilled. These grey to black metamorphics vary from phyllite to slate and all have an intense, closely spaced cleavage. The cleavage maintains a high angle to the core and the bedding, where identifiable, is usually (but not always) at a low angle of about 10-15 degrees.

At least two thin (15cm) beds of highly deformed dolomitic marble are present. There is a suggestion of a stromatolitic texture in one of these beds.

Gas Analysis for Shittim #1C

Cuttings gas analysis (air, nitrogen and CO_2 corrected)
(AMDEL Laboratories, Adelaide)

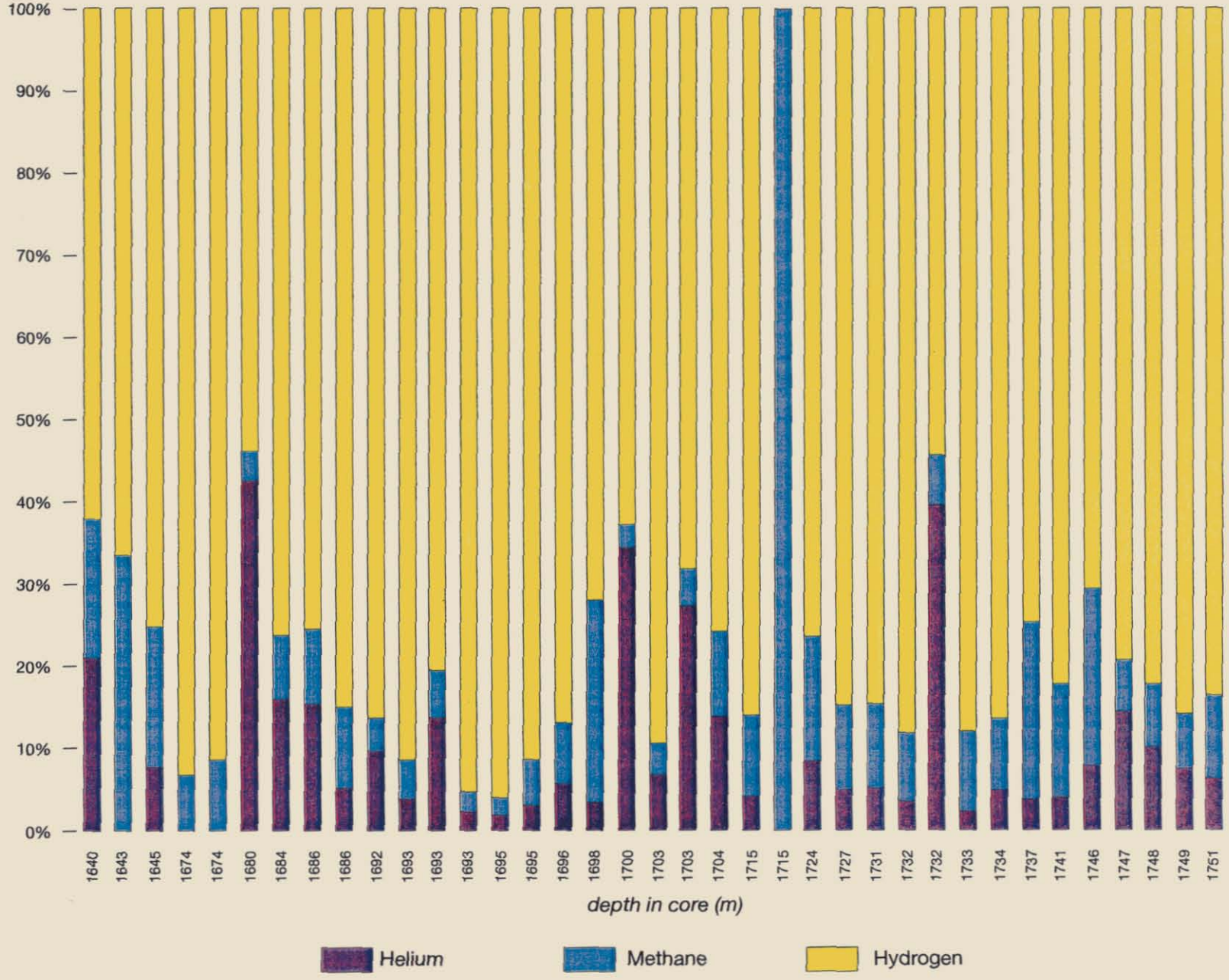

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Figure 3

These phyllites and slates are lithologically reminiscent of some parts of the Ordovician -Devonian Mathinna Group (particularly near granites), of some highly deformed pelitic areas of the Ordovician to Devonian Eldon Group and of some parts of the Upper Proterozoic metamorphics of Tasmania such as the Oonah Fm.

The dolomitic limestones probably suggest that the greatest similarity is to the Late Proterozoic (Precambrian) metamorphics of Tasmania.

NATURAL GAS AND OIL

Although Shittim #1 was designed as a stratigraphic hole, the discovery of hydrocarbons was not totally unexpected, as oil and gas had been reported in a nearby shallow hole at Johnson's Well in 1929.

Gas was reported by the drillers at shallow depths and high pressures were reported in porous sandstones within the Bundella Fm correlate under the first thick dolerite sill at about 800m. This necessitated the installation of a hotwire below this level.

Total gas units from 875m to 1685m are shown in Figure 2. A more sensitive gas chromatograph was installed at 1021m which could detect total gas, hydrogen, methane and C_2+ separately. Generation of hydrogen caused by acid-water reaction with drill rods was prevented by increasing the pH of the drilling fluids.

However, hydrogen occured in all samples and ranges from 0.45% to 8.49% (air corrected). The reactivity of hydrogen makes air-corrections based on oxygen unreliable due to the probable removal of free oxygen by hydrogen to form water. Air-corrected values of hydrocarbons cited here are probably underestimates due to this effect.

The uncertainties for air correction also make it difficult to be sure of the nitrogen composition of the gas. Values range from 55 - 98% and suggest that nitrogen is a major component of the gas. The analyses show that from 1630-1686m there is a decrease in hydrogen, an increase in nitrogen and a decrease in carbon dioxide to zero.

Methane (C_1) was recorded continuously from about 800m to 1686m and samples were collected at regular intervals from 1686m to 1751m and sent to AMDEL for analysis. Methane levels increased below the lower dolerite sill on entering the phyllite/slate complex at 1568m.

Background methane for most of the section ranged from a few hundred to a few thousand parts per million. The highest value (air corrected) is 31% at 1715m. The carbon isotope values of the methane ranged from -50 to -59 parts per thousand PDB, placing it firmly in the middle of the "gas associated with oil generation" range (, 1977). These figures overlap with the carbon isotope values (-55 and -56) from methane collected from thye surface at nearby Johnson's Well and the Saw Pit (Revill and Volkman 1994).

Gas Analysis for Shittim #1C

Hydrocarbon results (air, nitrogen, and CO_2 corrected)

(AMDEL Laboratories, Adelaide)

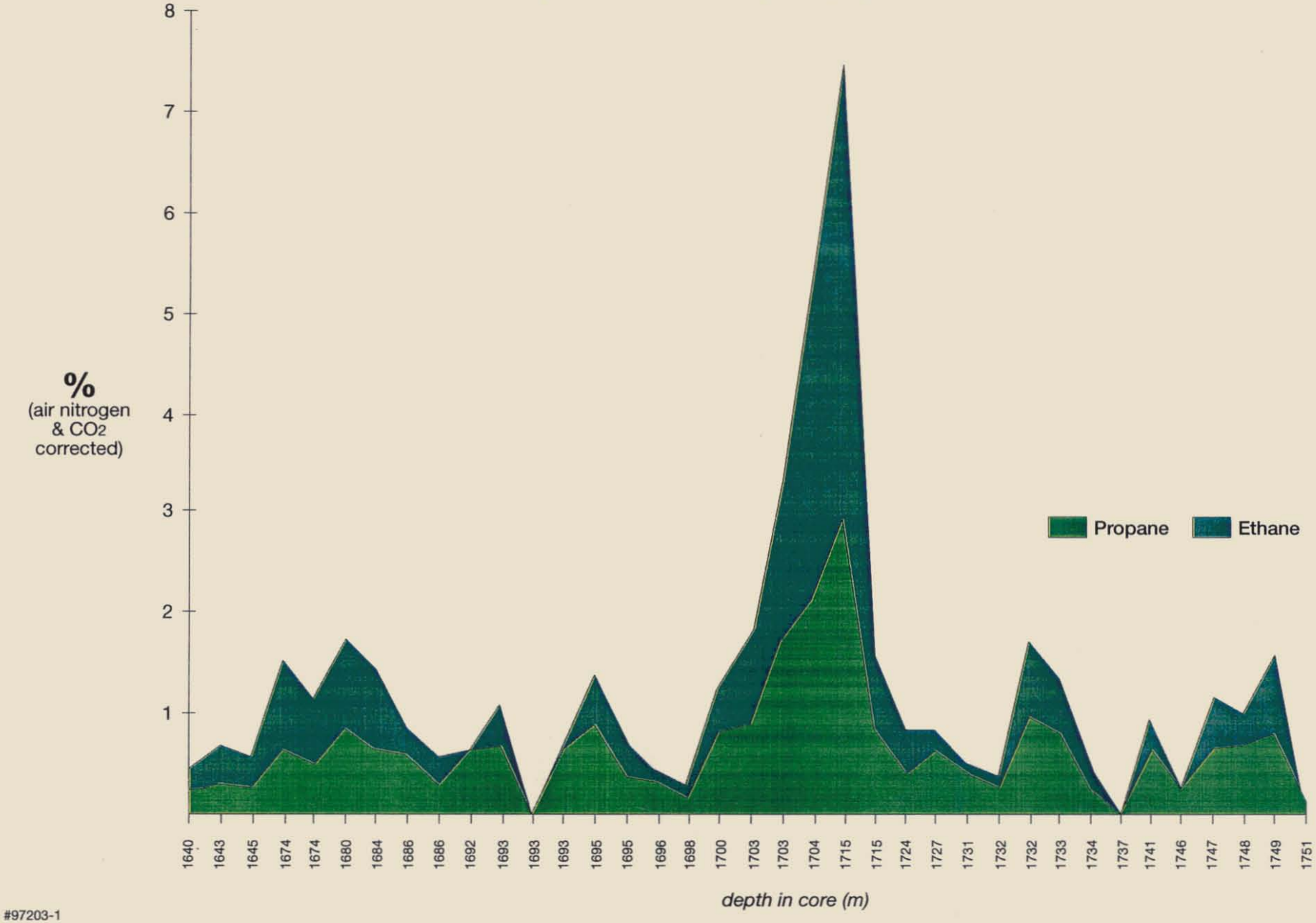

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Figure 6

Gas Analysis for Shittim #1C

Values of nitrogen, helium, methane and CO_2 (Air corrected)

(AMDEL Laboratories, Adelaide)

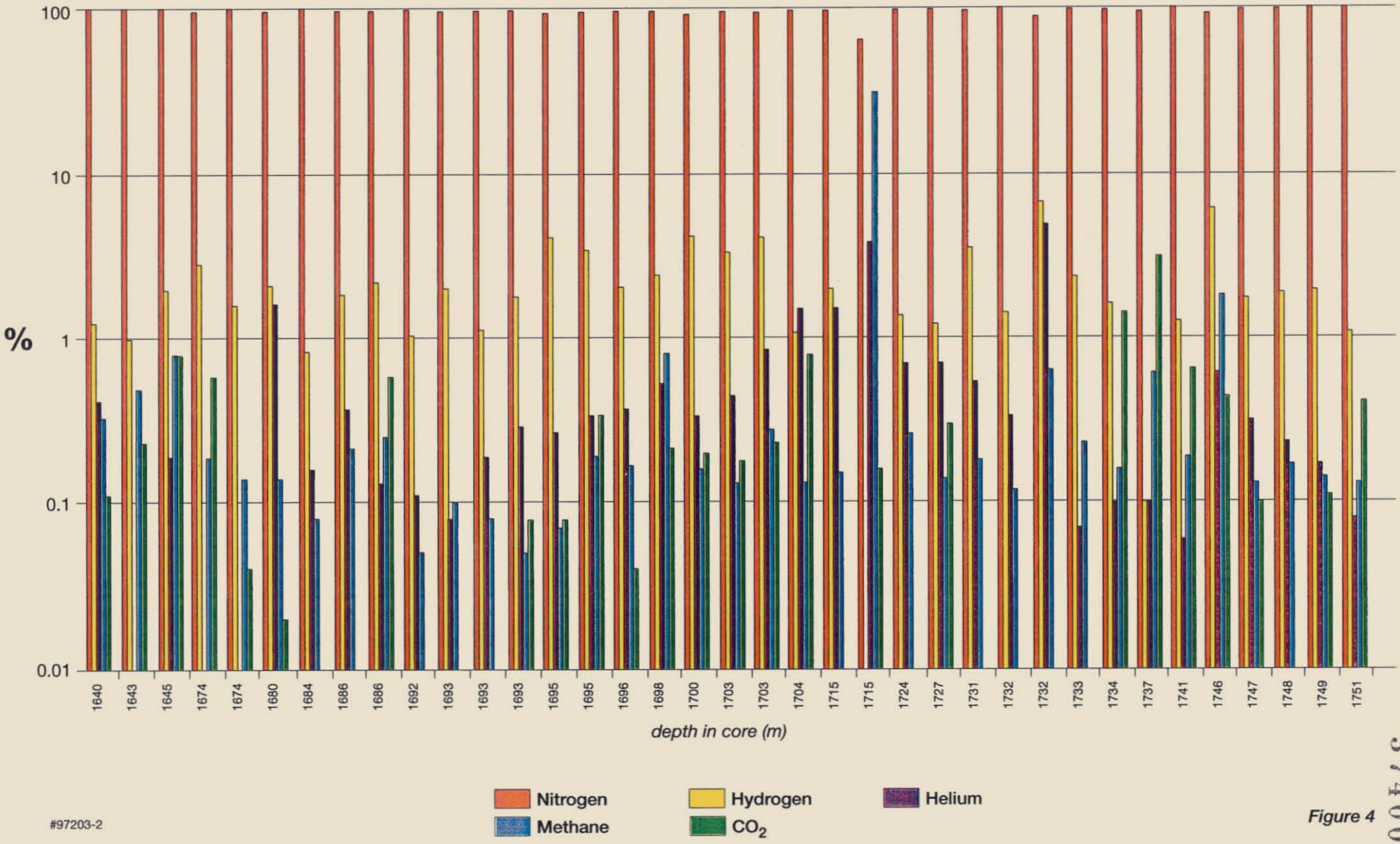

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Figure 4

Gas Analysis for Shittim #1C

Hydrocarbon results (air, nitrogen, and CO_2 corrected)
(AMDEL Laboratories, Adelaide)

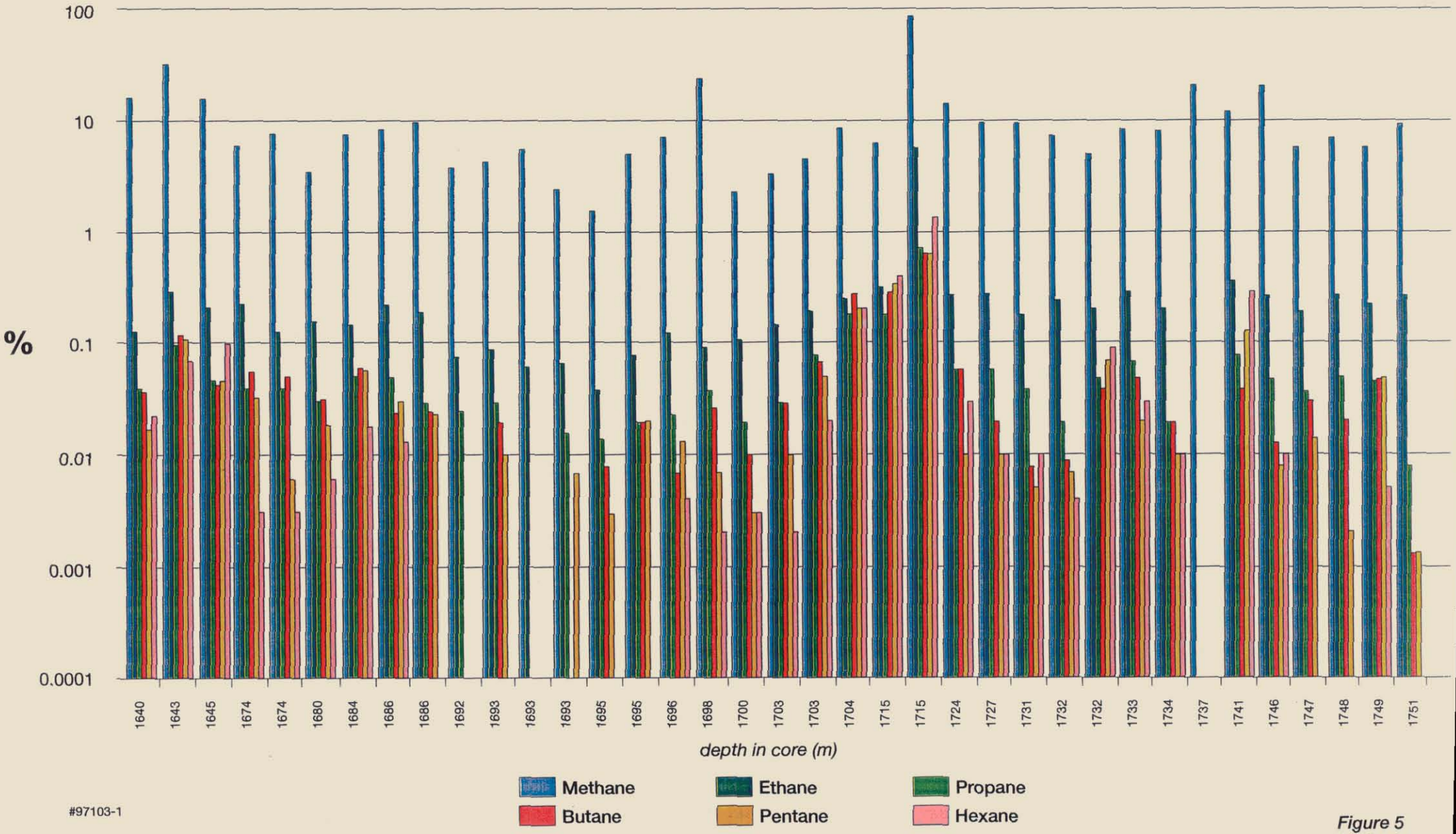

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Figure 5

Ethane (C_2) was first detected at low levels in four samples collected from trip gas at 1528m (Davies 1996). Samples collected from the phyllite/slate complex from 1630 to 1751m show generally increasing though fluctuating levels of wet gas (Figs. 3 - 5). The highest level of wet gas was recorded at 1715m (Fig. 6) and consisted of 88% methane, 6% ethane, 0.75% propane, 0.67% butane, 0.63% pentane, 1.38% hexane, 1.18% heptane, 1.24% octanes and higher, and helium 0.1% (air, nitrogen and CO_2 corrected).

A graph of the ratios of C_2 to C_3 show that the gas is typical of 'gas associated with oil and gas provinces' (Fig. 7) and is unlike that from 'non-associated gases' (Nikonov 1972).

A core sample of black slate with a TOC of 0.12 from 1676m was crushed at AMDEL laboratories in Adelaide and traces of an oil were analysed (see Fig.8). This oil has the characteristics of an algal-derived oil and the unusual predominance of C_{18} and the pristane/phytane ratio of around 1 is very similar to a sample from the Ordovician Gordon Limestone at Bender's Quarry, at Lune River in SW Tasmania (Volkman, 1990).

As the rocks containing the oils and wet-gas are low grade regional metamorphics and are most unlikely to be sources for the hydrocarbons, then both the oil and gas must have migrated in either laterally or from depth. A deep crustal or even mantle origin is likely for the helium.

HELIUM

Helium is present in eight samples with concentrations ranging from air-corrected values of 0 to 4.83%. Several samples have greater values than the economic cut-off value of 0.3% (Figs.3, 4)

A sample from 1680m contains 0.18% (air-corrected) (see Fig.4) and 42% (air and nitrogen corrected)(see Fig. 3). A sample taken from the choke manifold at 1635m, is probably the least contaminated by air and has an uncorrected helium value of 0.9% and an air, nitrogen and carbon dioxide corrected helium value of 1.2%. A sample from 1732.8m contains 4.83% (air corrected) and 39.57% (air, nitrrogen and CO_2 corrected).

Nikonov (1973) has shown that the majority of high helium-bearing gases are found in oil and gas fields, with high (mode of 22%) nitrogen and "hydrocarbons (up to C_6) are nearly always present in nitrogen helium-bearing gases. In nitrogen gases with 1% or more helium the C_2 divided by the sum of the heavy hydrocarbons is less than 1.5", and this value is characteristic of the gases of oil-gas and oil deposits.

The average value of the gas from the Shittim hole is 1.286.

These results strongly suggest the possibility of economic quantities of helium on Bruny Island. It should be recognised that helium is already some 30 times more

Natural Gas Analysis (*from Nikonov 1972*)

A comparison with the Shittim #1C data

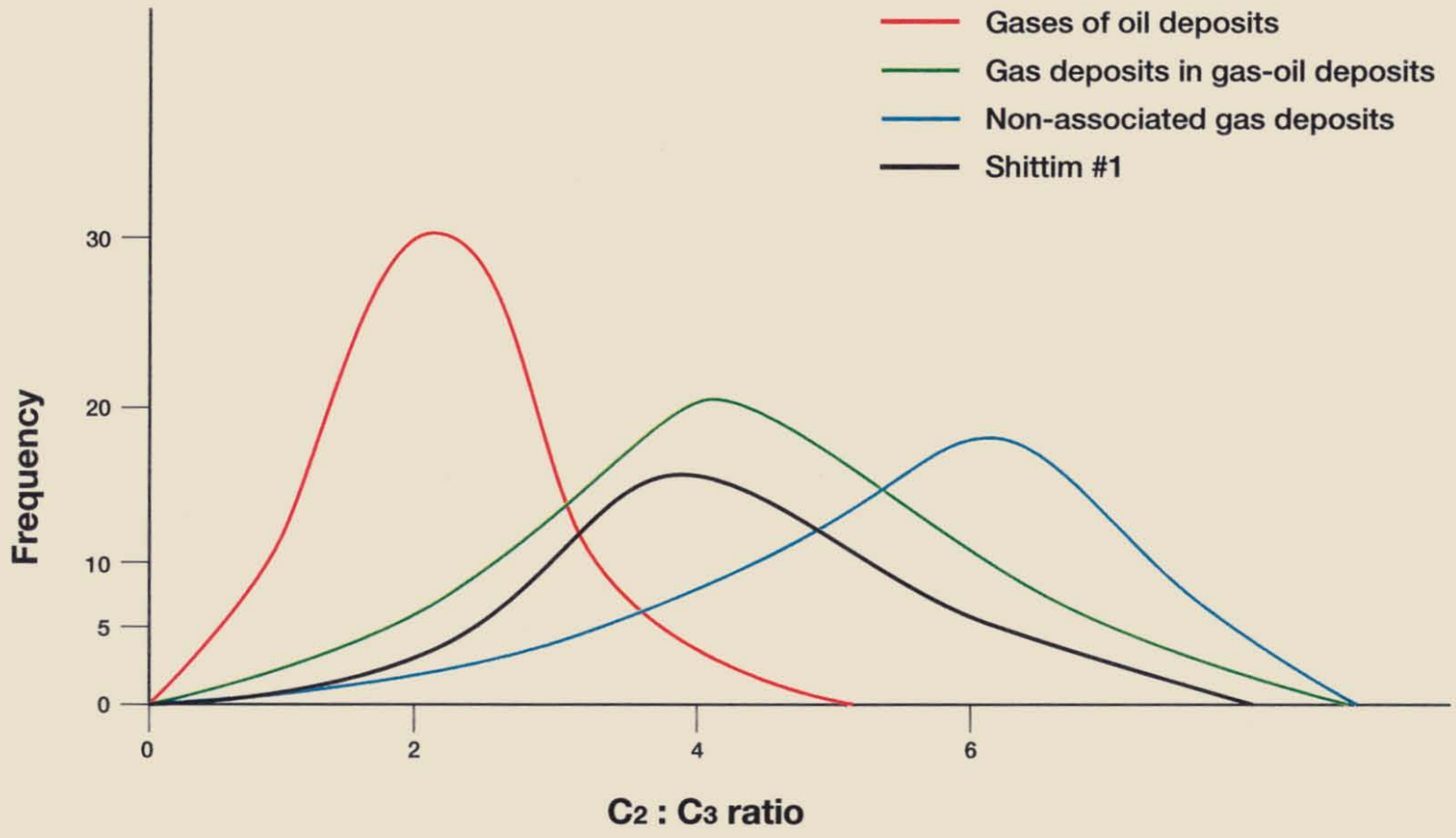

Figure 7

valuable than petroleum gas, and it is recognised that by the end of the century, most of the helium-rich natural gas fields currently supplying helium will be exhausted.

CONCLUSIONS

The results of gas and trace oil show that the Shittim #1 stratigraphic hole is 'live' with respect to hydrocarbons. The levels of wet gas with hydrocarbons of C8 and above are encouraging. If good flow rates are encountered, then the levels of helium already sampled are probably economic.

Results from Shittim #1 have been reviewed by independent, international, petroleum consultant Mr Gerald Carne. In a report to the company dated January 1997, he notes *inter alia* that:

- Shittim was drilled for stratigraphic purposes
- the shows are significant and demonstrate that gas, condensate and oil have been generated in the north Bruny Island area
- the identification of gas, condensate, oil, hydrogen and helium provides considerable optimism towards the future of the onshore petroleum industry in Tasmania.

DATA COLLECTION

A hotwire (readings taken by Mr E. McNally) was used to record hydrocarbons from 880m to 1025m. A gas chromatograph supplied by Colin Higgins and Associates Pty Ltd and operated by Mr M. Purvins under the direction of Mr Higgins was used to measure and plot total gas, hydrogen and C_1 to C_5 from 1025m to 1650m.

Hydrocarbon samples were collected by Mr M. Purvins, Dr C. Burrett and M. Bendall, using glass and metal gas collecting containers provided by CSL and AMDEL and analyses were carried out by Dr N. Davies at the Central Science Laboratory (CSL) of the University of Tasmania and by AMDEL Laboratories in Adelaide.

Geological logging was carried out by Mr M. Purvins (Colin Higgins and Associates), by Mr T.Woods, Ms Cheryl-Lee Randell and Dr C.Burrett of the Geology Department, University of Tasmania and Mr S. Forsyth (Mines Department).

XRD analyses were carried out by the Mines Department and porosity and permeability determinations by ACS Laboratories in Brisbane.

Analysis of Oil Samples

Core Sample, 1676m Total GC of Saturates Fraction in Shittim #1C Comparison with GC from rock at Benders Quarry

The dominance of n-C_{18} and the Pr/Ph ratio is very similar to the sample from Benders Quarry in Ordovician Gordon Gp. Limestone from Lune River.

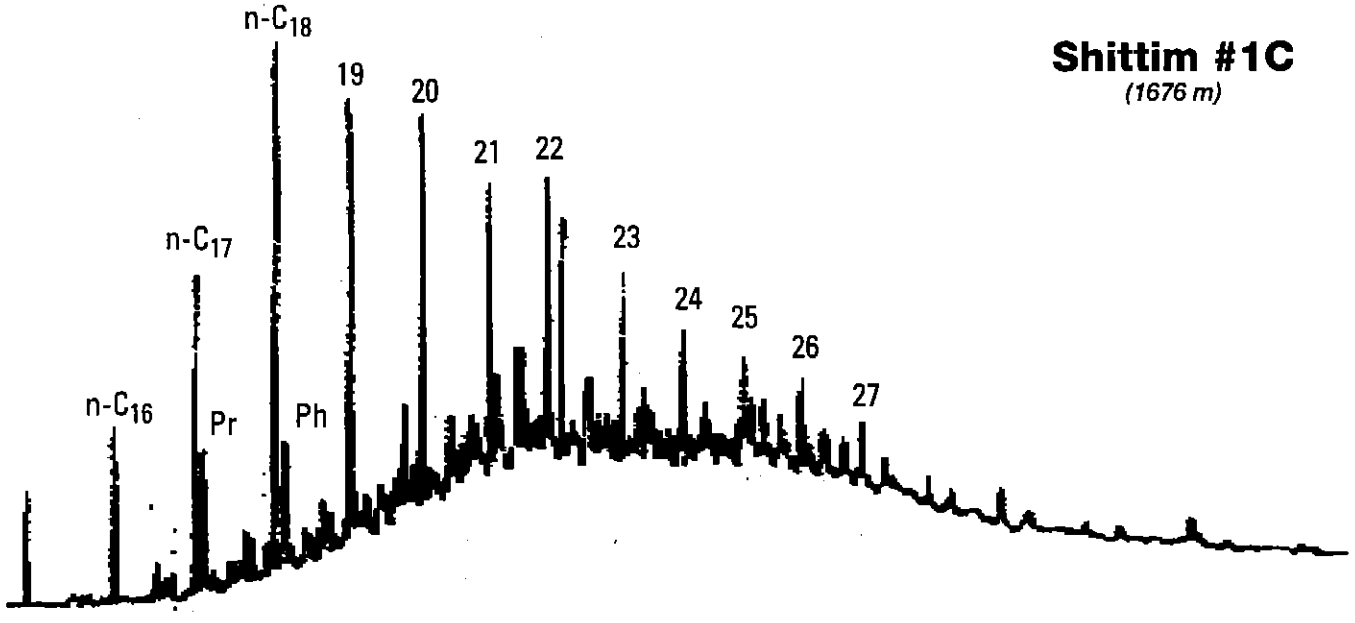

Figure 8A

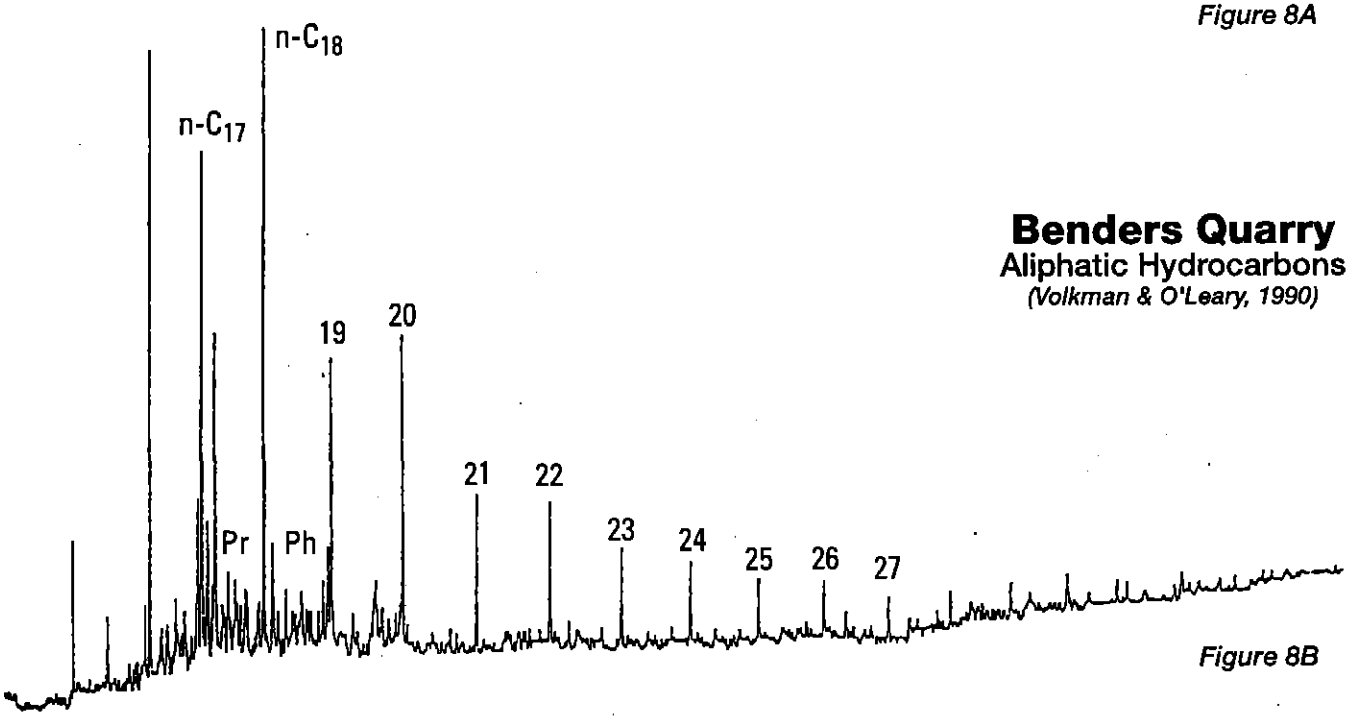

Figure 8B

Figure 8

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