GAS AND FUEL EXPLORATION N.L.

PEP 105

OTWAY BASIN

VICTORIA

PINE LODGE No.1

WELL COMPLETION REPORT

W1034

V.AKBARI

JUNE, 1991

VOLUME 1

W1034

GAS AND FUEL EXPLORATION N.L.

PEP 105

OTWAY BASIN

VICTORIA

PINE LODGE No.1

WELL COMPLETION REPORT

V.AKBARI

JUNE, 1991

PINE LODGE

CONTENTS

FIGURES

APPENDICES

1. Details of drilling plant
2. Summary of wellsite operations
3. Drilling fluid recap
4. Sample description
5. Core description
6. Sidewall core description
7. Velocity survey
8. Synthetic Seismograms
9. X-Ray diffraction analysis
10. Vitrinite Reflectance
11. Geochemical analysis
12. Palynology
13. Formation Testing DST-1
14. " " DST-2
15. " " DST-3 & 4
16. " " DST-5 & 6
17. " " DST-7
18. Questa Report on DST-1
19. Questa Report on DST-3 & 4.

ENCLOSURES

		Scale
1.	Composite Well Log	1:1000
2.	Gearhart Mud Log	1:500
3.	Halliburton Wireless Log	
	DLL/MSFL/GR	1:200 & 1:500
	BCS/GR	1:200 & 1:500
	SLD/CNS/GR	1:200 & 1:500
	FED/GR	1:200
	NEXUS/Dipmeter	1:200
	Well Evaluation Log	1:200
	CBL/CCL	1:200
4.	Log Analysis	

TABLES

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1

PEP 105

SPUDDED : 27-7-90	OBJECTIVE : WAARRE FM.	KBE : 57.3 A.M.S.L.
COMPLETED : 9-9-1990	STATUS : SUSPENDED CO_2	LAT : 37°58'25.44"S LONG : 141°12'41.60"E

DST-1
1939.9m - 1967.13m
Flowed non-combustible (97% CO_2) gas to surface at the rate of 3.55 MMCFD
FWHP : 880 psi on $^1/_2$" choke

DST-2
2018m - 2094m
Mis-run (packer failure)

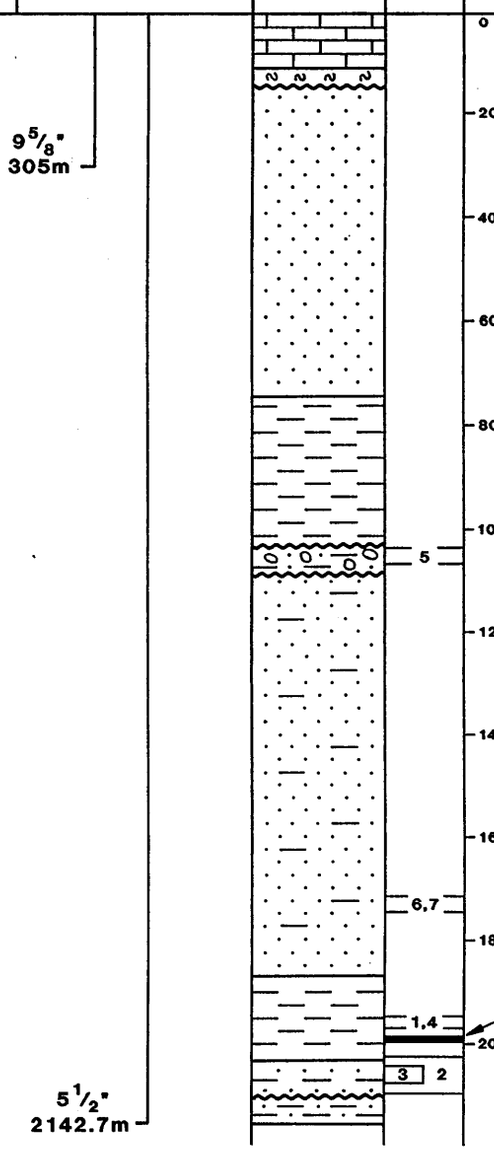
DST-3
2043m - 2070m
Rec : Drilling fluid

DST-4
1940m - 1967m
Flowed non-combustible gas to surface at the rate of 4 MMCFPD
FWHP : 850 psi dropped to 810 psi at the end of flow

DST-5
1032m - 1059m
Rec : Minor amount of drilling fluid

DST-6
1709m - 1736m
Test mis-run (packer failure)

DST-7
1709m - 1736m
Rec : Formation water slightly cut by CO_2
Cl : 18000 ppm
RW : 0.2 ohmm at 65°F



PORT CAMPBELL LIMESTONE
SURFACE (+57.3m)
GELLIBRAND MARL
109m (-51.7m)
DILWYN FORMATION
138m (-80.7m)
PEMBER MUDSTONE
741.5m (-684.2m)
PEBBLE POINT FORMATION
1031m (-973.7m)
PAARATTE FORMATION
1082.5m (-1025.2m)
BELFAST FORMATION
1868.5m (-1811.2)
CORE-1
WAARRE FORMATION
2032.5 (-1975.2)
EUMERALLA FORMATION
2106.5m (-2049.2m)

TOTAL DEPTH 2149.6 (-2092.3)

CORE No.	INT.	CUT / REC.	%
1	1975m - 1984.14m	9.14 / 9.14	100

FIGURE 1

OT.4336

SUMMARY

Pine Lodge No.1 was drilled as a wildcat exploration well in PEP 105, Otway Basin, Victoria.

Participants in this well were:-

Gas and Fuel Exploration N.L. (Operator)
Crusader Resources N.L.
Australian Hydrocarbon N.L.
Mosaic Oil N.L.
VIP N.L.
Beach Petroleum N.L.

The well is located 42km southeast of Mt. Gambier, 54km northwest of Portland and 8km southwest of Dartmoor.

The prospect which is situated on the northern side of Portland trough is a seismically defined tilted fault block bounded to the north by the Tartwarp fault and to the south by the Wanwin fault with a pronounced rollover being evident along the northwest-southeast structural trend.

The primary objective of the well was the sandstones of basal Upper Cretaceous Waarre Formation. The secondary objectives were the basal Tertiary Pebble Point Formation and the immediately underlying Paaratte Formation.

Drilling commenced at 2030 hrs. on 27th July, 1990.

At the depth of 1975m, DST-1 was carried out over the interval 1939.90m-1967.13m and flowed non-combustible gas to surface.

Following DST-1, core No.1 was cut from 1975m to 1984.14m with 100 percent recovery.

Drilling continued to a total depth of 2149.6m reached at 0800hrs on 27th August, 1990.

At total depth the following wireline logs were run:

Bore hole compensated sonic gamma ray
Dual laterolog microspherically focused log - gamma ray
Four electrode dipmeter gamma ray
Spectral litho-density compensated neutron log - gamma ray
Check shot survey
Sidewall core

The hole was conditioned and six (6) drill stem tests were carried out over the following interval using inflatable straddle packers.

DST NO.	*INTERVAL (m)*
2	2018-2094
3	2043-2070
4	1940-1967
5	1032-1059
6	1709-1736
7	1709-1736

The $5^1/_2$" casing was run and cemented with the shoe at 2142.7m.

The hole was cleaned out prior to running cement bond log.

$2^7/_8$" tubing was run to 2113.2m prior to displacing the hole with brine. The tubing was then removed.

No significant hydrocarbon shows were noted in the cuttings, drilling mud, core or sidewall cores.

A maximum of 3500 PPM gas being mainly C_1 with trace C_3 between the interval 2055-2060m was recorded.

Pine Lodge No.1 was suspended as a CO_2 producing well and the rig was released at 2400hrs on 9th September, 1990.

Figure - 1 is the summary sheet of Pine Lodge No.1.

PEP 105 — PINE LODGE NO. 1.

OTWAY BASIN — GAS AND FUEL EXPLORATION N.L.

STATUS:	Suspended C_{02} producer	Location:	Lat. 37° 58' 25.55" S Long. 141° 12' 41.60" E
HOLE SIZE:	$12^1/_4$" to 305m $8^1/_2$" to 2149m	Seismic: Elevation:	CDP 233 line WGD85-350 50mGL. 57.39mKB A.S.L.
CASING SHOE:	$9^5/_8$" at 305m $5^1/_2$" at 2149m	Spudded: Rig Released:	27-7-1990 9-9-1990

ROCK UNIT	KB(m)	SUBSEA(m)	THICKNESS(m)
Heytesbury Group			
Port Campbell Lst.	Surface	+ 57.3	109
Gellibrand Marl	109.0	- 51.7	29
Wangerrip Group			
Dilwyn Formation	138.0	- 80.7	603.5
Pember Mudstone	741.5	- 684.2	289.5
Pebble Point Formation	1031.0	- 973.7	51.5
Sherbrook Group			
Paaratte Formation	1082.5	-1025.2	786

ROCK UNIT	KB(m)	SUBSEA	THICKNESS (m)
Sherbrook Group Cont'd.			
Belfast Formation	1868.5	-1811.2	157
Waarre Formation	2032.5	-1975.2	74
Otway Group			
Eumeralla Formation	2106.5	-2049.2	43.1
Total Depth (Driller)	2149.6	-2092.3	
Total Depth (Logger)	2148.7	-2091.4	

LOGS: DLL/MSFL/GR, BCS/GR, SLD/CNS/GR, FED/GR, SWC, VELOCITY SURVEY, MUD LOG, CBL/CCL/GR.

TEST: DST-1 (1939.9-1967.13m) flowed non-combustible gas at the rate of approximately 3.55MMCFD.

DST-2 (2018-2094) misrun (packer failure).

DST-3 (2043-2070m) recovered drilling fluids.

DST-4 (1940-1967m) flowed non-combustible gas at the rate of approximately 4 MMCFD.

TEST Cont'd.:

DST-5 (1032-1059m) recovered minor amount of drilling fluid.

DST-6 (1709-1736m) test misrun (packer failure).

DST-7 (1709-1736m) recovered slightly CO_2 cut formation water

Rw: 0.2 ohm.m. at 65^{o}F.

CORE: One core was cut from 1975-1984.14 with 100% recovery.

SIDEWALL CORES: Shot 48. Recovery 42.

CONCLUSIONS

1. The primary and secondary objectives of the well were successfully evaluated.

2. The well entered into the Belfast Formation, Waarre Formation and Otway Group significantly lower than forecast. This is due to uncertaintly of velocity data and incorrect pre-drill interpretation of the seismic horizons. However it is believed that the well achieved its target in testing the structural culmination.

3. Seismic and dipmetr data suggest that a minor, local fault cuts through Waarre section at the well location. This is further confirmed by a major shift in vitrinite reflectance profile at about that level.

4. The CO_2 zone was found to be within a local faulted zone within the Belfast Formation and which cannot be resolved on the seismic. This makes mapping rather unreliable.

5. The Waarre Formation as well as top Otway Group do not show continuity in seismic signature. Better quality dats is required for reliable mapping.

Conclusions Cont'd.

6. It is not clear as to whether or not a true thickness of Waarre has been penetrated.

7. The Waarre Formation was found to be very shaly with poor reservoir properties.

8. The reservoir potential of the Pebble Point was found to be very limited. The upper sandy section as seen in Wilson - 1 is missing.

9. Production data suggests that a limited CO_2 reserve exists in the Basal Belfast Sand.

10. The in-place estimation of CO_2 gas is not realistically possible as mapping the zone with current data is highly unreliable.

11. The origin of CO_2 is not clear. Available data suggest that it may have been sourced from basement.

Conclusions Cont'd.

12. The Tertiary - Upper Cretaceous Section although reasonably rich in organic content are immature.

13. The limited data within Eumeralla indicate the formation to have good source potential that may be marginally mature.

1. INTRODUCTION

Pine Lodge No.1 was drilled on the northern side of the northwest-southwest trending Portland Trough of the Otway Basin, Victoria.

The Otway Basin is an east-west trending sedimentary basin that has developed in the Late Jurassic - Early Cretaceous along the southern margin of Australia. The basin contains up to 8000 metres of Mesosoic to Cainozoic sedimentary sequence and has an aerial extent of approximately 105,000 square kilometers. It is situated west of Gippsland Basin which is Australia's major oil producing basin.

Pine Lodge prospect was defined following the reprocessing project (1988) of Wanwin Gorae (1984) and Wanwin Gorea Detail (1985) and the Crawford River Seismic Survey (1988). It is a tilted fault block bounded to the north by the Tartwaup fault and to the south by the Wanwin fault. The structure is closed to the north on the low side of the Tartwaup fault where the Waarre Formation is juxtaposed against the Eumeralla Formation of the Otway Group.

The well was designed to test as a primary objective, the nature of the fluid content in the sand reservoirs of the basal Upper Cretaceous Waarre Formation. The secondary objectives were the basal Tertiary Pebble Point Formation and the immediately underlying Paaratte Formation.

Geochemical data from the wells drilled in the proximity of the prospect suggest that the Portland Trough contains sediments of good source potential. Of particular significance was Wilson No.1 situated 6 kilometers northwest of the prospect where oil of marine source was recovered from the Pebble Point Formation. Very encouraging hydrocarbon shows were also encountered in the area at the Pebble Point level in Fahley No.1 and at Waarre level in Najaba No.1.

Prior to drilling Pine Lodge No.1 it was thought that:-

- Sufficient source rock, reservoir, and seal were present for the generation and accumulation of hydrocarbons.

- Vertical seals for the primary and secondary objectives were to be provided by the Belfast Mudstone and Pember Mudstone respectively.

- The prospect is structurally higher than Wilson - 1, Fahley -1 & -2, and Najaba 1A at Pebble Point level and possibly at Waarre level and thus is ideally located to trap any generated hydrocarbons migrating updip from these neighbouring low areas.

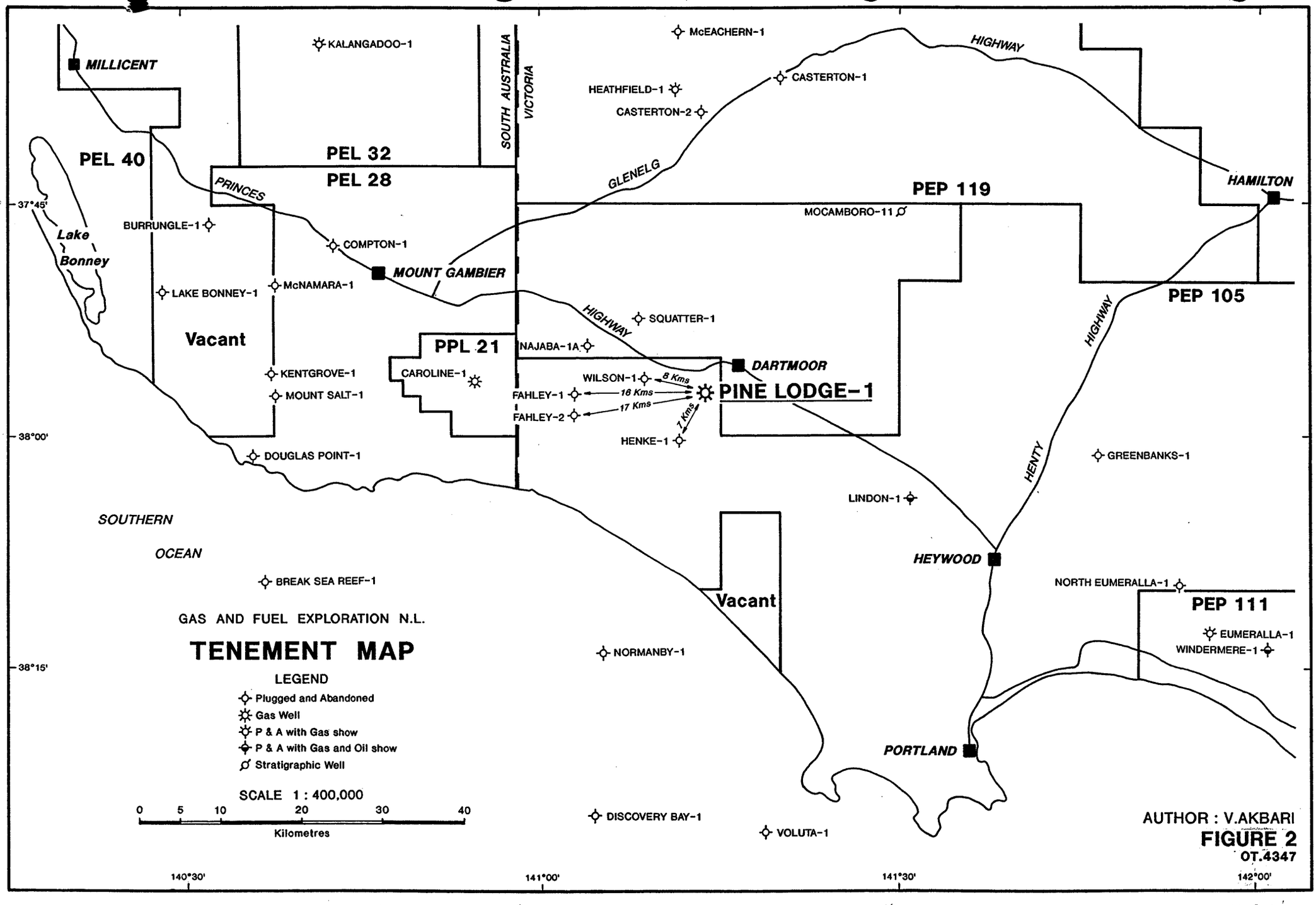
2. WELL HISTORY

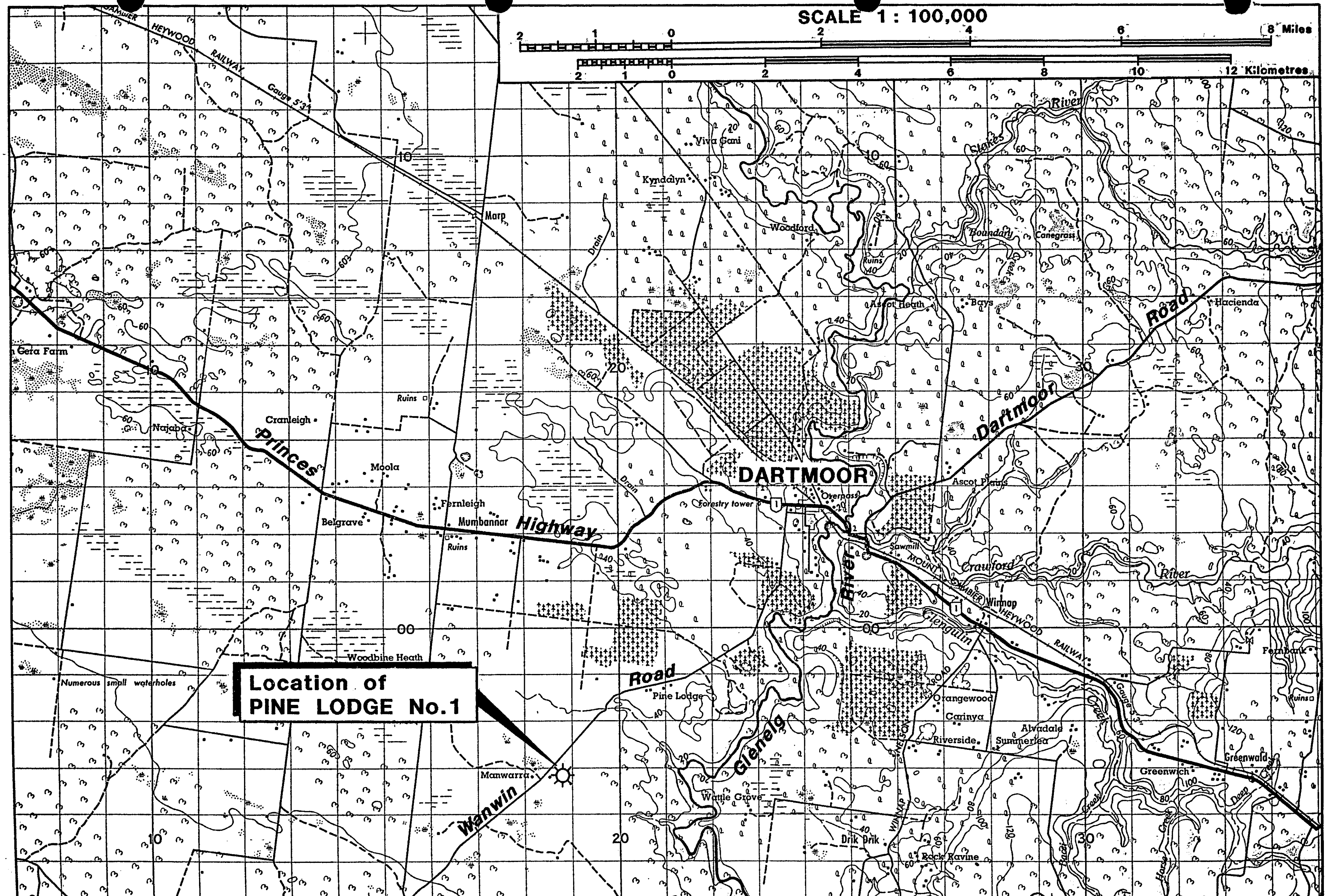
2.1 Location (See Figures 2 and 3)

Co-ordinates:	Latitude: 37° 58' 25.44" S
	Longitude:141° 12' 41.60" E
Geophysical Control	CDP : 233
	Seismic Line: WGD 85-350
Real property Description:	County of Follett
	Parish of Dartmoor
	Shire of Portland
Property owner:	F. & M. Salmic
	Wanwin Road, Dartmoor

2.2 General Data

Well Name:	Pine Lodge No.1
Operator:	Gas & Fuel Exploration N.L.
	Level 11, 151 Flinders Street
	MELBOURNE, VIC. 3000
Participants	Crusader Resources N.L.
	27th Floor, 12 Creek Street
	BRISBANE, Q'LD. 4000


MILLICENT
KALANGADOO-1
SOUTH AUSTRALIA
VICTORIA
McEACHERN-1
HIGHWAY
CASTERTON-1
HEATHFIELD-1
CASTERTON-2
PEL 40
PEL 32
PEL 28
PRINCES
GLENELG
HAMILTON
PEP 119
37°45'
Lake Bonney
BURRUNGLE-1
COMPTON-1
MOCAMBORO-11
MOUNT GAMBIER
LAKE BONNEY-1
McNAMARA-1
PEP 105
HIGHWAY
SQUATTER-1
Vacant
PPL 21
NAJABA-1A
DARTMOOR
KENTGROVE-1
CAROLINE-1
WILSON-1
8 Kms
FAHLEY-1
16 Kms
PINE LODGE-1
MOUNT SALT-1
17 Kms
FAHLEY-2
7 Kms
HENKE-1
38°00'
DOUGLAS POINT-1
HENTY
GREENBANKS-1
LINDON-1
SOUTHERN
OCEAN
HEYWOOD
BREAK SEA REEF-1
NORTH EUMERALLA-1
Vacant
PEP 111
EUMERALLA-1
WINDERMERE-1
GAS AND FUEL EXPLORATION N.L.
TENEMENT MAP
NORMANBY-1
38°15'
LEGEND
Plugged and Abandoned
Gas Well
P & A with Gas show
P & A with Gas and Oil show
Stratigraphic Well
PORTLAND
SCALE 1 : 400,000
0 5 10 20 30 40
Kilometres
DISCOVERY BAY-1
VOLUTA-1
AUTHOR : V.AKBARI
FIGURE 2
OT.4347
140°30'
141°00'
141°30'
142°00'



SCALE 1 : 100,000
Miles
Kilometres
Location of
PINE LODGE No.1
DARTMOOR
Princes
Highway
Dartmoor
Road
Wanwin
Road
Glenelg
River
Stokes
River
Crawford
River
MOUNT GAMBIER HEYWOOD RAILWAY
Gauge 5'3"
Marp
Viva Gani
Kyndalyn
Woodford
Ascot Heath
Bays
Hacienda
Boundary
Canegrass
Cranleigh
Najaba
Moola
Fernleigh
Belgrave
Mumbannar
Ruins
Forestry tower
Overpass
Ascot Plains
Sawmill
Winnap
Glenaulin
Woodbine Heath
Numerous small waterholes
Pine Lodge
Manwarra
Orangewood
Carinya
Riverside
Alvadale
Summerlea
Wattle Grove
Drik Drik
Rock Ravine
Greenwich
Greenwald
Fernbank
Drain

FIGURE 3

2.2 General Data Cont'd.

Mosaic Oil N.L.
Level 2, Export House
22-24 Pitt Street
SYDNEY, N.S.W. 2000

Beach Petroleum N.L.
Level 7
345 George Street
SYDNEY, N.S.W. 2000

Australian Hydrocarbon N.L.
Level 31
12 Creek Street
BRISBANE, Q'LD. 4000

Victorian International
Petroleum N.L.
4th Floor, Griffin Centre
28 The Esplanade
PERTH, W.A. 6000

Elevation: Ground Level: 50m ASL
Kelly Bushing: 57.39m ASL
(unless otherwise stated, all depths refer to K.B.)

Total Depth:

Driller	2149.6m
Logger	2148.7m

2.2 General Data Cont'd

Drilling commencement:	27th July 1990	@ 2030Hrs.
Total depth reached:	27th August 1990	@ 0800Hrs.
Rig released:	9th September 1990	@ 2400Hrs.
Drilling time to T.D.:	31 days	
Status:	Suspended CO_2 producer	

2.3 Drilling Data (see also Appendices 1 & 2)

2.3.1 *Drilling Contractor*

ATCO-APM Drilling Pty. Ltd.

2.3.2 *Drilling Rig*

ATCO Rig-2

2.3.3 *Casing and Cementing Details*

A 16" conducter pipe was set at 9.9m prior to rig up

Drilling Data Cont'd.

Surface Casing

Size	: $9^5/_8$"
Weigh and Grade	: 36 lb/ft J55 S.T. & C 8 round
Centraliser	: 307m, 291m, 279m, 269m and 257m.
Float collar	: 292.0m
Shoe	: 305.7m
Cement	: 282 sack class "A" cement with 2% prehydrated gel and 162 sacks class "A" neat.
Method	: Single plug dispacement (Top plug only)
Equipment	: Halliburton Services

Production Casing

Size	: $5^1/_2$"
Weigh and Grade	: J-55
Centralisers	:
Float Collar	:
Shoe	: 2142.7m

2.3.3 ***Casing and Cementing Details Cont'd.***

Cement	: 440 sacks class "A" with 2.5% prehydrated gel and 530 sacks class "G" with 1% Hallad 323
Method	:
Equipment	: Halliburton Services

Cement Plugs

None

2.3.4 ***Drilling Fluid***

The hole was spudded using prehydrated Aquagel flocculated with lime in order to prevent conductor wash-out. Drilling continued uneventfully to $9^5/_8$-in casing point using fresh water.

Fresh water/gel/polymer mud was in use while drilling $8^1/_2$-in hole down to total depth. Tight hole conditions were experienced below the depth of 1122m and a total of $40^1/_2$ hours were spent on reaming tight spots and conditioning hole.

Wireline logging was carried out at total depth with no major incident.

Caliper log shows various degrees of wash-out below the $9^5/_8$-in casing shoe (305.7m) which can be generalized as following:

305.7 - 335m	Moderate-heavy wash-out hole size up to 17 inches
335-655m	Moderate-minor wash-out with hole size being up to 11 inches
655-740m	Heavy wash-out with hole size for the most part being up to 16 inches
740-930m	Moderate-minor irregular wash-out with hole size being up to 11 inches
930-1030m	Moderate-heavy wash-out with hole size being up to 14 inches
1030-T.D.	Very minor wash-out with hole being in-gauge to slightly under-gauge for most part.

For details of drilling fluid see Appendix-3.

2.3.5 ***Water Supply***

Drilling water was obtained and transported from the Glenelg River some 8 kilometers from the well location.

2.4 Formation Sampling and Testing

2.4.1 ***Cuttings***

No cuttings samples were collected from the surface to 40 metres.

Cuttings samples were collected at 10m intervals to 310m ($9^5/_8$-in casing point) and at 5m intervals from 310m to the T.D. Spot samples were occasionally collected at 2 & 1m intervals. Each sample was washed, air dried and divided into five splits, four of which were stored in labelled polythene bags and fifth one was stored in plastic sample trays. The washed and dried samples in polythene bags were distributed to the following:

- Crusader Resources/Australian Hydrocarbons
- Mosaic Oil
- Victorian International Petroleum
- D.I.T.R. (Director of Petroleum)

The Operator retained one set of washed and dried cutting in polythene bags and another in plastic trays.

In addition from 40m to T.D. unwashed samples were collected at 10m intervals. These samples were stored in labelled cloth bags, air dried and retained by the Operator.

2.4.2 ***Cores***

(i) Conventional Core

One conventional core was cut from 1975-1984.4 with 100% recovery. The core was cut using fiber glass sleeve and Christenson diamond core bit.

After initial preliminary core orientation and description at wellsite, the core was dispatched to Amdel Core Services for conventional core analysis (Appendic - 5).

- Continuous gamma radiation detection wa carried out through a lead tunnel.
- Ambient core parameters: porosity, permeability, and apparent grain densities were determined in $1^1/_2$" diameter plugs taken in sandstone sections of the core and 25cm intervals.
- The porosity and density readings were plotted against the relevant wireline

logs to establish a log depth to core depth correlation. The discrepancy was found to be very minor and negligable. See Figure 4.

- The core was slabbed and major part of it was retained in its original state. This was subsequently described and presented in Figure 5 as a detail core description.

Selected samples from the core were also sent to Dr. Roger Morgan for palynology and age dating.

(ii) <u>Sidewall Cores</u>

Forty eight sidewall cores were attempted of which forty two were recovered.

Samples from selected sidewall cores were sent to the following consultants:

- Keiraville Konsultants for vitrinite reflectance
- Dr. Roger Morgan for palynology and age dating
- Amdel Core Services for petrography and X-ray diffraction, T.O.C. measurement and source rock analysis.

Note:

The following samples were taken from the wellsite and air freighted to Adelaide for palynology and age determination.

Depth	Sample
1885	Cuttings
1890	"
1894	"
1982	Core
2033	Cuttings
2085	"
2132	"

The depth, recovery, and analyses carried out on sidewall cores are listed in table 1.

2.4.3 ***Testing***

A total of seven (7) conventional drill stem tests were carried out as follows:-
(See Figures 6,7,8,9)

DST-1 (19.08.90)

a: Reason for testing

While drilling at 1946.7m, a change in rate of penetration (1.5m/hr to 10m/hr) was

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1

AMBIENT BULK DENSITY AND POROSITY Vs LOG DATA

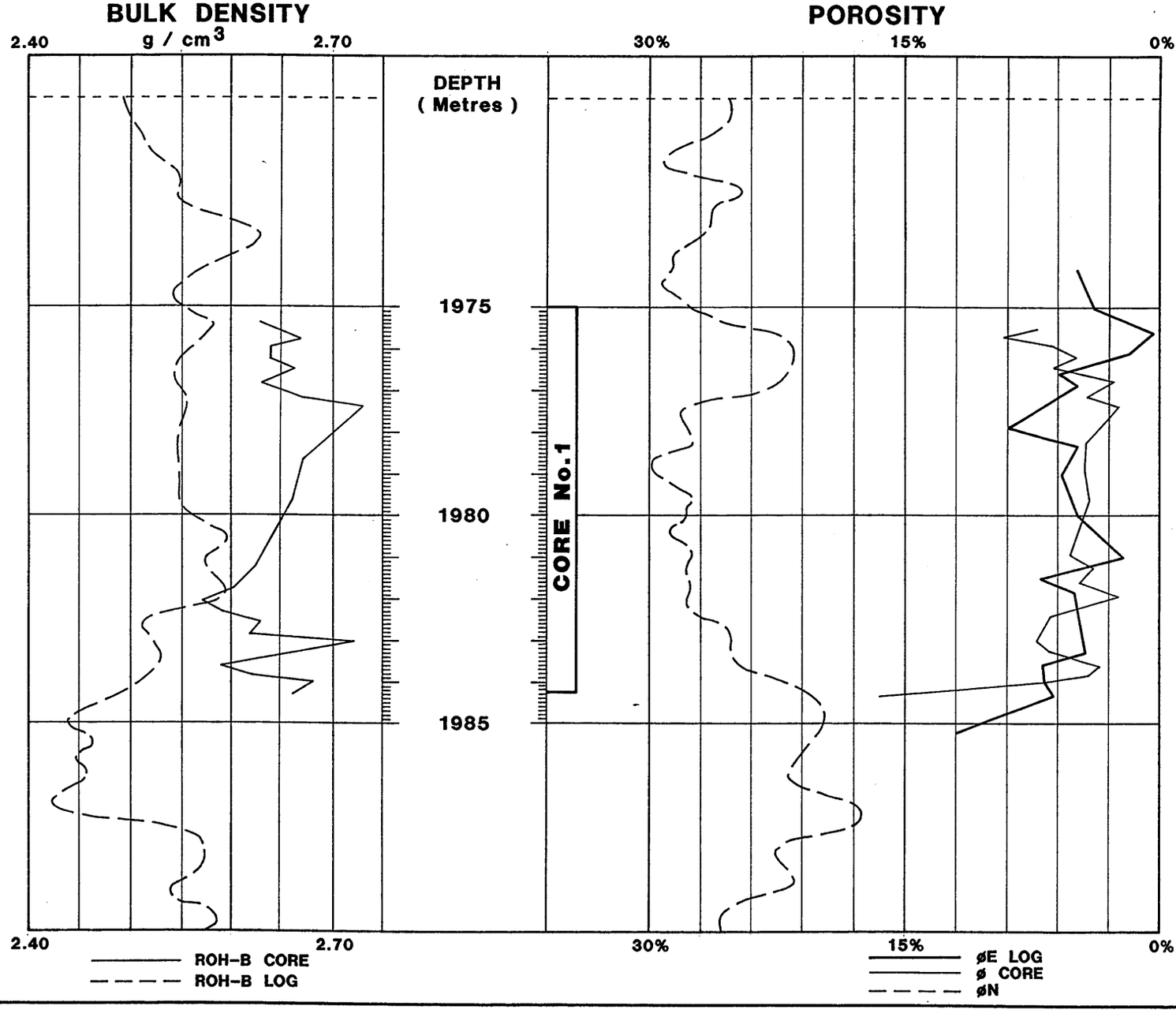


FIGURE 4

AUTHOR : V.AKBARI

GAS AND FUEL EXPLORATION N.L.

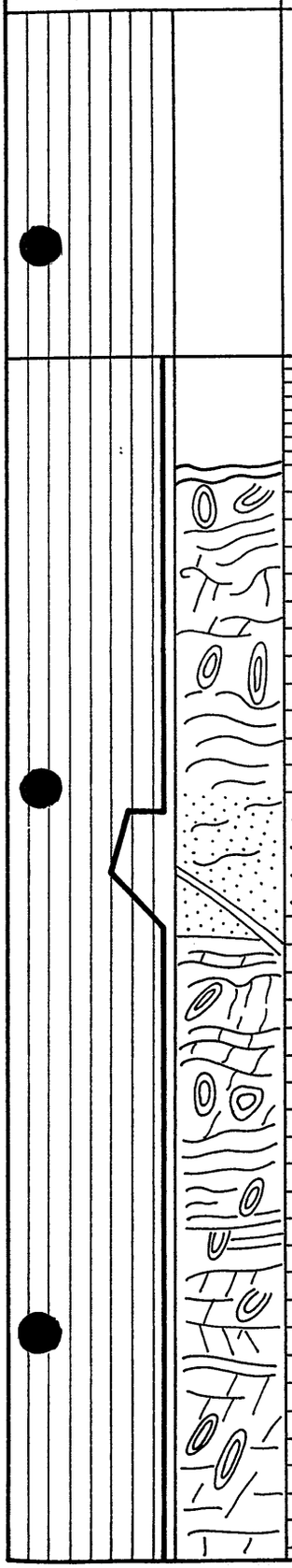
CORE DESCRIPTION

WELL : **PINE LODGE No.1** CORE No.: **1** PAGE **1** OF **3**

DATE : **12 – 4 – 1991** INTERVAL : **1975 – 1984.24m**

FORMATION : **BELFAST** RECOVERY : **100%**

GEOLOGIST : **V.AKBARI** **FIGURE No. 5**



DEPTH (DRILLERS)	(MEASURED) Ø %	(MEASURED) k mD	DESCRIPTION
1975			
			Dark grey, carbonaceous shale. Rubble, com. vertical–subvertical burrows.
1975.45	7.6	0.36	
			Siltstone, bio–turbited vertical–subvertical burrows and hairline vertical fracture open–partially opened abd. lithics
1975.70	9.2	0.35	
1975.95	6.6	0.30	
1976			
1976.21	4.9	0.15	
			Fine grained sandstone becoming finer–siltsize toward base. Nearly vertical filled–partially filled fractures.
1976.45	6.2	0.03	
1976.85	2.9	0.77	
1977			Siltstone, dark grey, bioturbated common small–medium, rare large vertical–subvertical burrows.
1977.10	4.5	0.23	
1977.35	2.6	0.01	
1977.70	4.6	<0.01	
1978			

GAS AND FUEL EXPLORATION N.L.

CORE DESCRIPTION

WELL : **PINE LODGE No.1** CORE No.: **1** PAGE **2** OF **3**

DATE : **12 – 4 – 1991** INTERVAL : **1975 – 1984.24m**

FORMATION : **BELFAST** RECOVERY : **100%**

GEOLOGIST : **V.AKBARI** **FIGURE No. 5**

Lithology	DIPS	DEPTH (DRILLERS)	(MEASURED) Ø %	(MEASURED) k mD	DESCRIPTION
		1979			Dark grey, bioturbated siltstone.
		1979.75	4.4	0.11	
		1980			
		1981			
		1981.25	5.2	0.06	Horizontal thin band (1cm) of fragmented coal cemented with pyrite and brownish–red hematite.
		1981.50	4.0	0.14	
		1981.75	4.8	0.03	
		1982	2.4	0.14	
		1982.25	3.9	0.08	
		1982.50	6.2	0.03	Brownish–grey fine–very fine sand.
		1982.75	6.8	0.03	
		1982.95	7.1	2.8	

GAS AND FUEL EXPLORATION N.L.

CORE DESCRIPTION

WELL : **PINE LODGE No.1** CORE No.: **1** PAGE **3** OF **3**

DATE : **12 – 4 – 1991** INTERVAL : **1975 – 1984.24m**

FORMATION : **BELFAST** RECOVERY : **100%**

GEOLOGIST : **V.AKBARI** **FIGURE No. 5**

GRAINSIZE AND STRUCTURES (P G VC C M F VF Silt Clay)	Lithology	DIPS	DEPTH (DRILLERS)	(MEASURED) Ø %	(MEASURED) k mD	DESCRIPTION
			1983			
			1983.20	6.7	0.09	Bioturbated siltstone grading to very fine grained sandstone.
			1983.50	3.6	0.07	
			1983.75	4.2	0.01	Medium–coarse grained sandstone with good visual and inter–granular porosity.
			1983.95	7.7	0.17	
			1984			
			1984.20	17.3	94	BOTTOM OF CORE 1984.24m
			1985			

***Testing* Cont'd.**

associated with a lithology change from siltstone to sandstone. No fluorescence was noted in the samples, however total gas increased to a maximum of 4.6 units (diminishing) against the background gas of 0.29 units. To assess the diminishing gas kick, drilling continued intermittently to 1915m where a decision was made to carry out a one flow period test. (Sole Risk decision of Crusader)

b: **Data**

Test Interval	1939.90 - 1967.13m
Formation	Intra-Belfast sand
Cushion	None
Type of test	Conventionally off bottom straddle
Choke size	Top $^1/_2$"; Bottom $^3/_4$"
Flow period	One (90min.)

c: **Test**

The test consisted of a one period flow which started with a moderate blow and increased to strong blow in one minute with very wet gas reaching the surface in three minutes. The

Testing Cont'd.

tool was left open for a total of 87 minutes during which non-combustible gas was flowed at an approximate rate of 3.55 MMCFPD. The flowing well-head pressure started with 12 psi 2 minutes after opening the tool and increased to a maximum stabilized pressure of 880 psi 48 min. after the start of the flow. A final build-up pressure was taken by closing the tool for 180 minutes prior to reverse circulating and pulling out with test tool.

d: **Pressure**

Recorder Depths (m)

Description	1930.7	1933.6	1946.0	1974.5
Initial				
Hydrostatic	3091.04	3082.57	3138.04	3139.32
Start draw-down	1186.07	1143.67	1520.45	3143.33
End draw-down	1792.87	1780.75	1874.67	3148.74
Start build-up	1792.87	1780.75	1874.67	3148.74
End build-up	2671.14	2055.28	2692.32	3155.53
Final				
Hydrostatic	3090.72	3082.16	3126.01	3144.73

Note

All pressures are in PSIA

Bottom Hole Temperature : 165^{O}F

Testing Cont'd.

e: Gas Components

The gas samples taken from the surface choke manifold were analysed by the Scientific Service Department of Gas and Fuel Corporation and the results are listed as follows:

	Mole% Concentration	
Component	10.40 am	11.30 am
Methane	2.450	2.770
Ethane	0.106	0.113
Propane	0.038	0.040
Iso Butane	0.007	0.007
Normal Butane	0.010	0.009
Iso Pentane	0.005	0.003
N Pentane	0.004	0.002
Hexanes	0.020	0.006
Heptane +	0.075	0.034
Helium	0.009	0.009
Oxygen & Argon	0.004	0.009
Nitrogen	0.305	0.347
Carbon dioxide	97.000	96.700

2.4.3 ***Testing Cont'd.***

The test data were sent to Questa Australia Pty. Ltd. for review and comments on the discovery (for details see Appendix 12 and Appendix 17).

Following wireline logging at total depths, six (6) conventional drill stem tests were carried out as follows:-

DST-2 (31-8-30)

a: **Data**

Test Interval:	2018-2094
Formation:	Waarre
Cushion:	None
Type of test:	Hydroflatable straddle
Choke size:	Top $^1/_2$", Bottom $^3/_4$"

b: **Test**

The test was misrun.

***Testing* Cont'd.**

Two attempts to set the packers failed.
The tool was then pulled out of hole.

DST-3

Test Interval	2043m-2070m
Formation :	Waarre
Cushion :	None
Type of test :	Hydroflatable straddle
Choke size :	Top $^1/_2$" Bottom $^3/_4$"
Flow period :	Two (5 min. & 96 min.)

b: Test

The tool was opened for 5min. (pre-flow) during which a very weak blow was observed. After taking 60min. initial closed in pressure, the tool was opened for 120min. during which time a very weak blow was observed. After closing the tool for 126min., the packers were pulled free and the test tool was pulled up (8 stands) prior to carrying out DST-4.

***Testing** Cont'd.*

c: **Recovery**

The recovery was consisted of a minor amount of drilling fluid recovered during the course of DST-4.

d: **Pressure**

	Recorder Depths (m)			
Description	2013.1	2018.0	2018.	2070.3
1st Period				
Initial Hydrostatic	-	3239.99	3100.74	3010.22
Start draw-down	13.94	57.38	71.34	138.84
End draw-down	57.04	78.83	77.71	136.14
Start build-up	57.04	78.83	77.71	136.14
End build-up	59.79	1884.88	1907.35	1948.04
2nd Period				
Start draw-down	59.79	158.32	160.25	168.50
End draw-down	151.15	173.81	174.62	226.24

Testing Cont'd.

Start build-up	151.15	173.81	174.62	226.24
End build-up	153.09	1324.66	1344.53	1382.48
Final Hydrostatic				3283.09

Note

- All pressures are Psia.
- Max. temperature 170^{o}F at 2018m.

DST-4 (31.8.1990)

a: Data

Test Interval	1940-1967m.
Formation	Belfast
Cushion	Minor amount of drilling fluid
Type of Test	Hydroflatable straddle
Choke Size	Top $^{1}/_{2}$", Bottom $^{3}/_{4}$"
Flow Period	Two: (5min. and (178min.)

b: Test

***Testing** Cont'd.*

The tool was opened for 5 min. pre-flow during which time a strong blow was observed. The flowing wellhead pressure reached 50psi in one minute and increased to 200psi at the end of the first flow period. During the second period non-combustible gas reached surface almost immediately after opening the tool. The well was flowed for 178min. during which the flowing wellhead pressure which started with 260psi, increased to a maximum of 850psi in 53min. and then stabilized at 810psi for the remaining flow period. The tool was closed for 188 minutes before the packers were pulled free for reverse circulation.

to a maximum of 850psi in 53min. and then stabilized at 810psi for the remaining flow period. The tool was closed for 188 minutes before the packers were pulled free for reverse circulation.

***Testing** Cont'd.*

c: **Pressure**

	Recorder Depths (m)			
DESCRIPTION	1910.1	1915.1	1915.4	1967.2
1st Period				
Initial				
Hydrostatic				
Start draw-down		763.05	765.95	
End draw-down		908.16	911.50	
Start build-up		908.16	911.50	
End build-up		2734.97	2723.44	
2nd Period				
Start draw-down		1276.82	1279.71	
End draw-down		1597.23	1601.69	
Start build-up		1597.23	1601.69	
End build-up		2568.33	2518.20	
Final Hydrostatic		3078.82		

Note:

- All pressures are absolute pressures psia
- A maximum temperature of 170^{o}F recorded at
- 1967.2m

***Note** Cont'd.*

- The pressures on recorder - 1 (1910.1m) and recorder and (1967.2m) were not recorded due to clock failure.

d. **Gas Composition**

The Gas samples taken from the surface choke manifold were analysed by the Scientific Service Department of Gas and Fuel Corporation and the results are as follows:

	Mole % Concentration	
Component	18.26 Hr.	19.57 Hr.
Methane	2.560	2.580
Ethane	0.115	0.115
Propane	0.041	0.042
Iso-Butane	0.007	0.007
Normal Butane	0.010	0.010
Iso-Pentane	0.003	0.003
Normal Pentane	0.002	0.002
Hexane	0.006	0.005
Heptanes +	0.016	0.018
Oxygen + Argon	0.010	0.010
Nitrogene	0.330	0.034
Carbon dioxide	96.900	96.900

2.4.3 ***Testing (Cont'd)***

DST-5 (02.9.1990)

a: **Data**

Test Interval	:	1032-1059m
Formation	:	Pebble Point
Cushion	:	None
Type of test	:	Hydroflatable straddle
Choice Size	:	Top $^1/_2$" Bottom $^3/_4$"
Flow period	:	Two (5min and 18min.)

b: **Test**

No blows were observed during the first or second flowing periods. The time for initial and final build-up pressure were 33 and 30 minutes respectively.

c: **Recovery**

The recovery consisted of minor amounts of drilling fluid.

2.4.3 ***Testing (Cont'd.)***

d: **Pressure**

	Recorders Depth (m)			
Description	1001.7	1005.1	1007.3	1121.9
Initial				
Hydrostatic	-	1641.20	1643.52	1713.64
Start draw-down	13.53	28.63	54.20	131.03
End draw-down	26.96	37.38	52.82	123.88
Start build-up	26.96	37.38	52.82	123.88
End build-up	27.76	271.64	1260.77	1336.88
Start draw-down	28.90	42.48	72.30	140.07
End draw-down	54.77	65.98	76.09	143.73
Start build-up	54.77	65.98	76.09	143.73
End build-up	56.06	1084.23	1087.35	1150.91
Final Hydrostatic	-	1619.93	1625.36	1703.47

Note:

- Pressures are in Psia
- Bottom Hole Temperature 119^{O}F.

DST-6 (02.9.1990)

a: Data

Test interval: 1709-1736m

Formation : Paaratte

2.4.3 ***Testing** (Cont'd.)*

Cushion : None

Type of test : Hydroflatable straddle

Choke size : Top $^1/_2$"
Bottom $^3/_4$"

b: Test

Two attempts to open the hydrospring by setting weight on the tool failed. The string was subsequently pulled out of hole and the test considered to be a misrun.

***DST-7** (3.9.1990)*

a: Data

Test Interval: 1709-1736m

Formation : Paaratte

Cushion : None

Type of test : Hydroflatable straddle

Choke size : Top $^1/_2$"
Bottom $^3/_4$"

Flow period : Two (6 min. and 5min.)

2.4.3 ***Testing (Cont'd.)***

b: Test

Strong blow was observed during 5 minutes pre-flow period. After taking 60 minutes initial build-up, attempt to re-open the tool failed and the test tool became stuck above the hydrospring. The string was worked free resulting in initial build-up time being prolonged to almost 97min. To minimize the risk of string becoming stuck again, the second flow period was shortened to only five minutes during which a weak blow was observed. A wet string was pulled out after taking 62min. for final buildup.

c: Recovery

The recovery consisted of 5.97 bbls. of water cut mud and 64.50 bbls of clean, brownish, slightly CO_2 cut formation water with the following field analysis.

CO_2	>5%
Cl^-	18000 ppm
Rw	0.2 ohmm at 65°F

d: Pressure

2.4.3 ***Testing (Cond.)***

	Recorders Depth (m)			
Description	1678.8	1684.1	1684.4	1737.9
Initial				
Hydrostatic	-	2735.42		2812.69
Start draw-down	13.81	1654.83		2239.12
End draw down	1034.14	1591.07		2210.25
Start build-up	1034.14	1591.07		2210.25
End build-up	1035.11	2353.91		2418.64
Start draw-down	1036.57	1687.17		2290.36
End draw-down	1465.99	1919.30		2272.91
Start build-up	1465.99	1919.30		2272.91
End build-up	2269.82	2332.62		2398.98
Final				
Hydrostatic	2278.04	2717.53		2785.63

Note:

- All pressure are in Psia

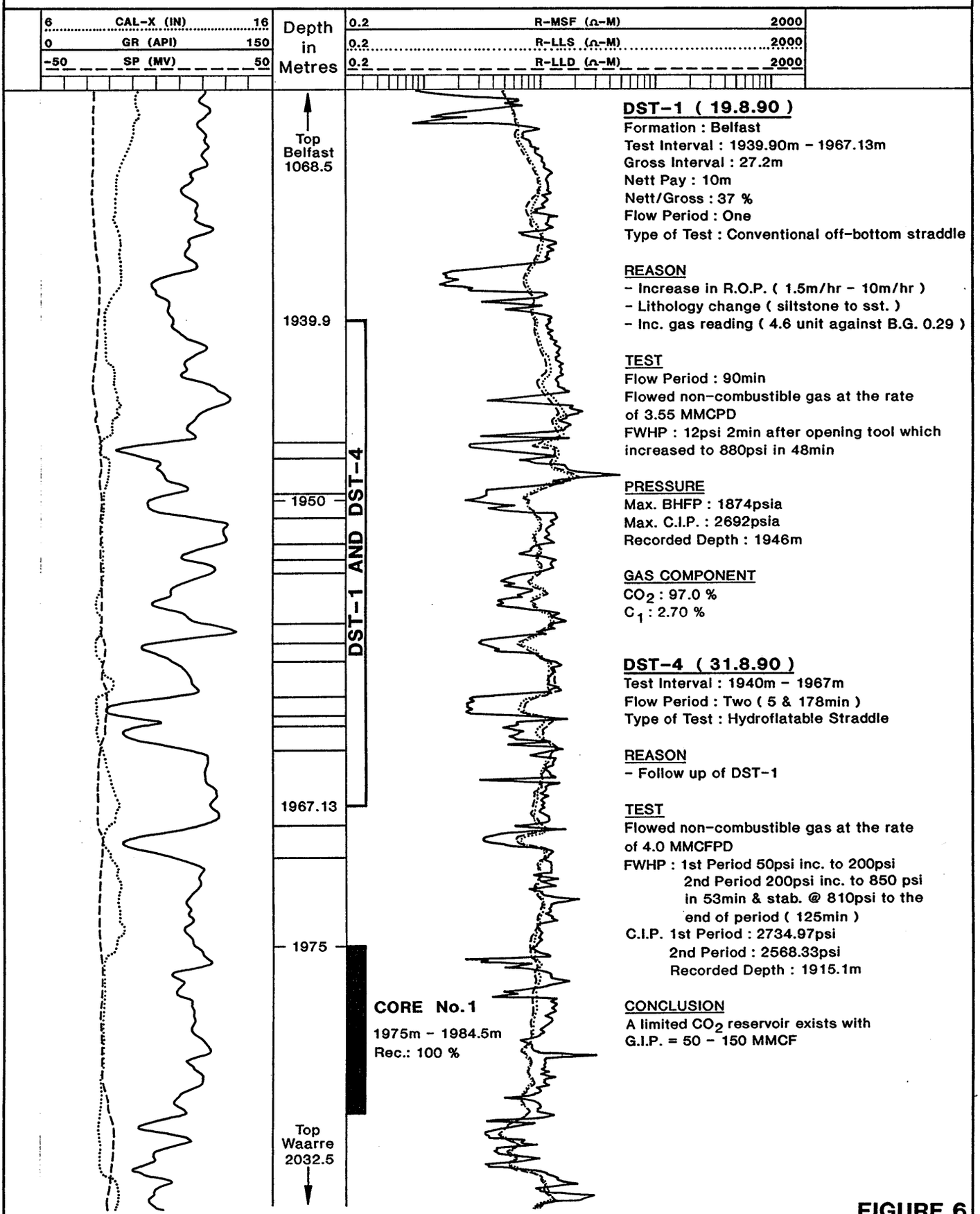
- Bottom Hole temperature: 153^{O}F.

- The clock on recorder 3 (1624.4m) did not operate.

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1 - PEP 105

DST-1 AND DST-4



DST-1 (19.8.90)
Formation : Belfast
Test Interval : 1939.90m - 1967.13m
Gross Interval : 27.2m
Nett Pay : 10m
Nett/Gross : 37 %
Flow Period : One
Type of Test : Conventional off-bottom straddle

REASON
- Increase in R.O.P. (1.5m/hr - 10m/hr)
- Lithology change (siltstone to sst.)
- Inc. gas reading (4.6 unit against B.G. 0.29)

TEST
Flow Period : 90min
Flowed non-combustible gas at the rate of 3.55 MMCPD
FWHP : 12psi 2min after opening tool which increased to 880psi in 48min

PRESSURE
Max. BHFP : 1874psia
Max. C.I.P. : 2692psia
Recorded Depth : 1946m

GAS COMPONENT
CO_2 : 97.0 %
C_1 : 2.70 %

DST-4 (31.8.90)
Test Interval : 1940m - 1967m
Flow Period : Two (5 & 178min)
Type of Test : Hydroflatable Straddle

REASON
- Follow up of DST-1

TEST
Flowed non-combustible gas at the rate of 4.0 MMCFPD
FWHP : 1st Period 50psi inc. to 200psi
2nd Period 200psi inc. to 850 psi in 53min & stab. @ 810psi to the end of period (125min)
C.I.P. 1st Period : 2734.97psi
2nd Period : 2568.33psi
Recorded Depth : 1915.1m

CONCLUSION
A limited CO_2 reservoir exists with G.I.P. = 50 - 150 MMCF

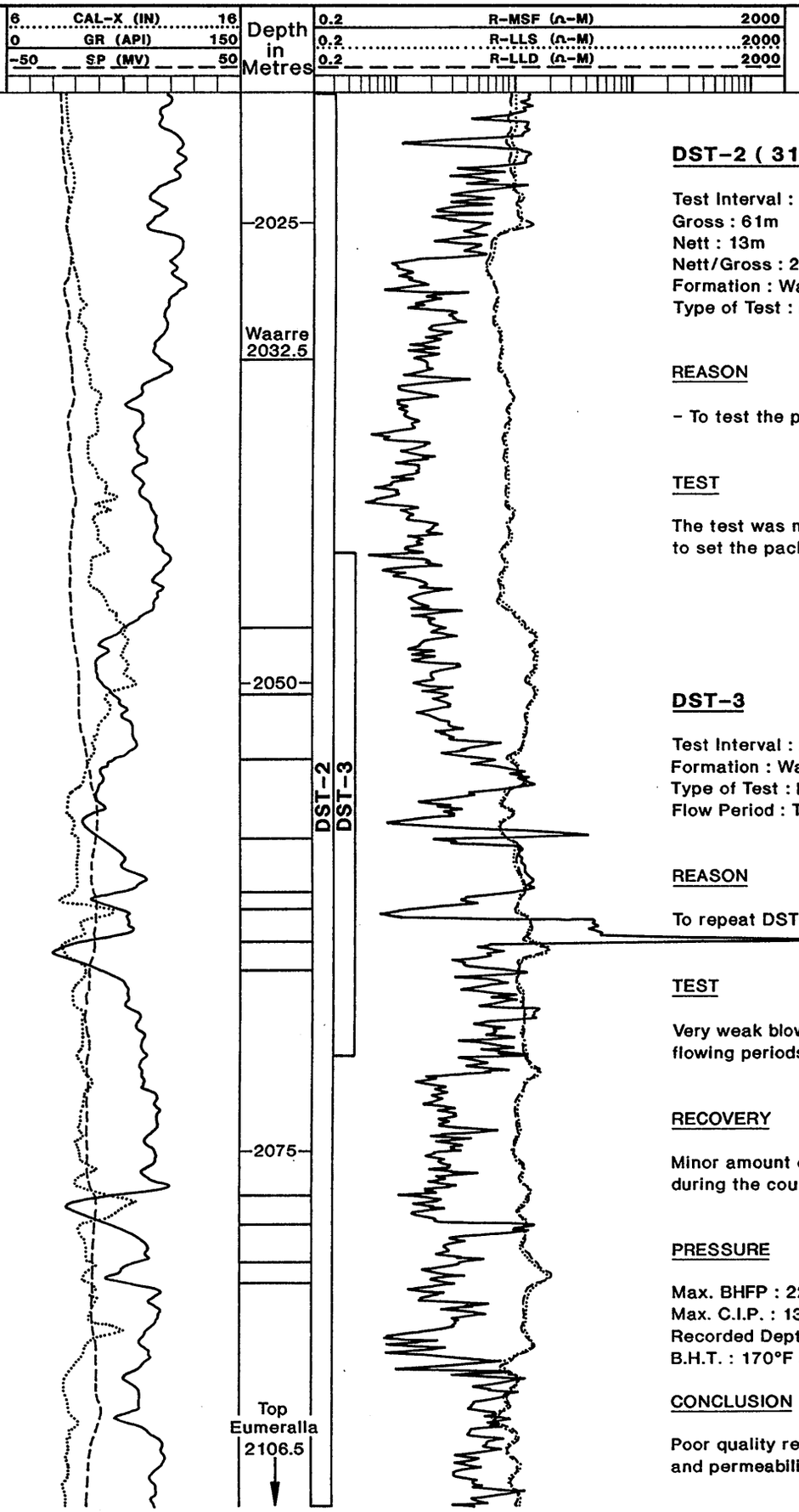
FIGURE 6
OT.4354

AUTHOR : V.AKBARI

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1 - PEP 105

DST-2 AND DST-3



DST-2 (31.8.90)

Test Interval : 2018m - 2099m
Gross : 61m
Nett : 13m
Nett/Gross : 21%
Formation : Waarre
Type of Test : Hydroflatable Straddle

REASON

- To test the primary objective of the well

TEST

The test was misrun - Two attempts to set the packers were failed

DST-3

Test Interval : 2043m - 2070m
Formation : Waarre
Type of Test : Hydroflatable Straddle
Flow Period : Two (5 & 120min)

REASON

To repeat DST-2

TEST

Very weak blow observed in both flowing periods

RECOVERY

Minor amount of drilling fluid recovered during the course of DST-4

PRESSURE

Max. BHFP : 226.24psia
Max. C.I.P. : 1332.48psia
Recorded Depth : 2070.3m
B.H.T. : 170°F at 2018m

CONCLUSION

Poor quality reservoir with poor porosity and permeability

FIGURE 7

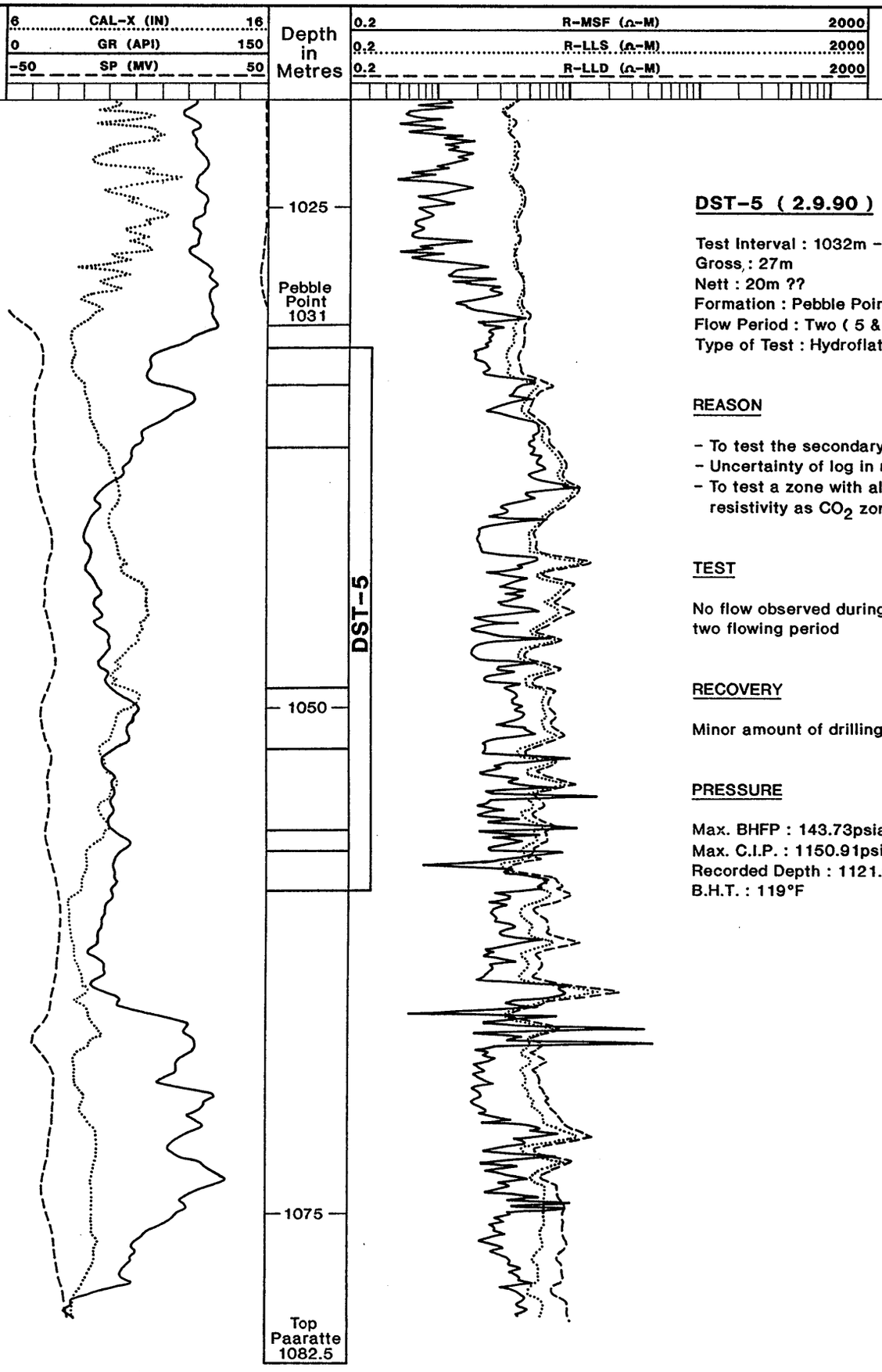
OT.4355

AUTHOR : V.AKBARI

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1 - PEP 105

DST-5



DST-5 (2.9.90)

Test Interval : 1032m - 1059m
Gross : 27m
Nett : 20m ??
Formation : Pebble Point
Flow Period : Two (5 & 18min)
Type of Test : Hydroflatable Straddle

REASON

- To test the secondary objective
- Uncertainty of log in regard to lithology
- To test a zone with almost similar resistivity as CO_2 zone

TEST

No flow observed during the two flowing period

RECOVERY

Minor amount of drilling fluid

PRESSURE

Max. BHFP : 143.73psia
Max. C.I.P. : 1150.91psia
Recorded Depth : 1121.9m
B.H.T. : 119°F

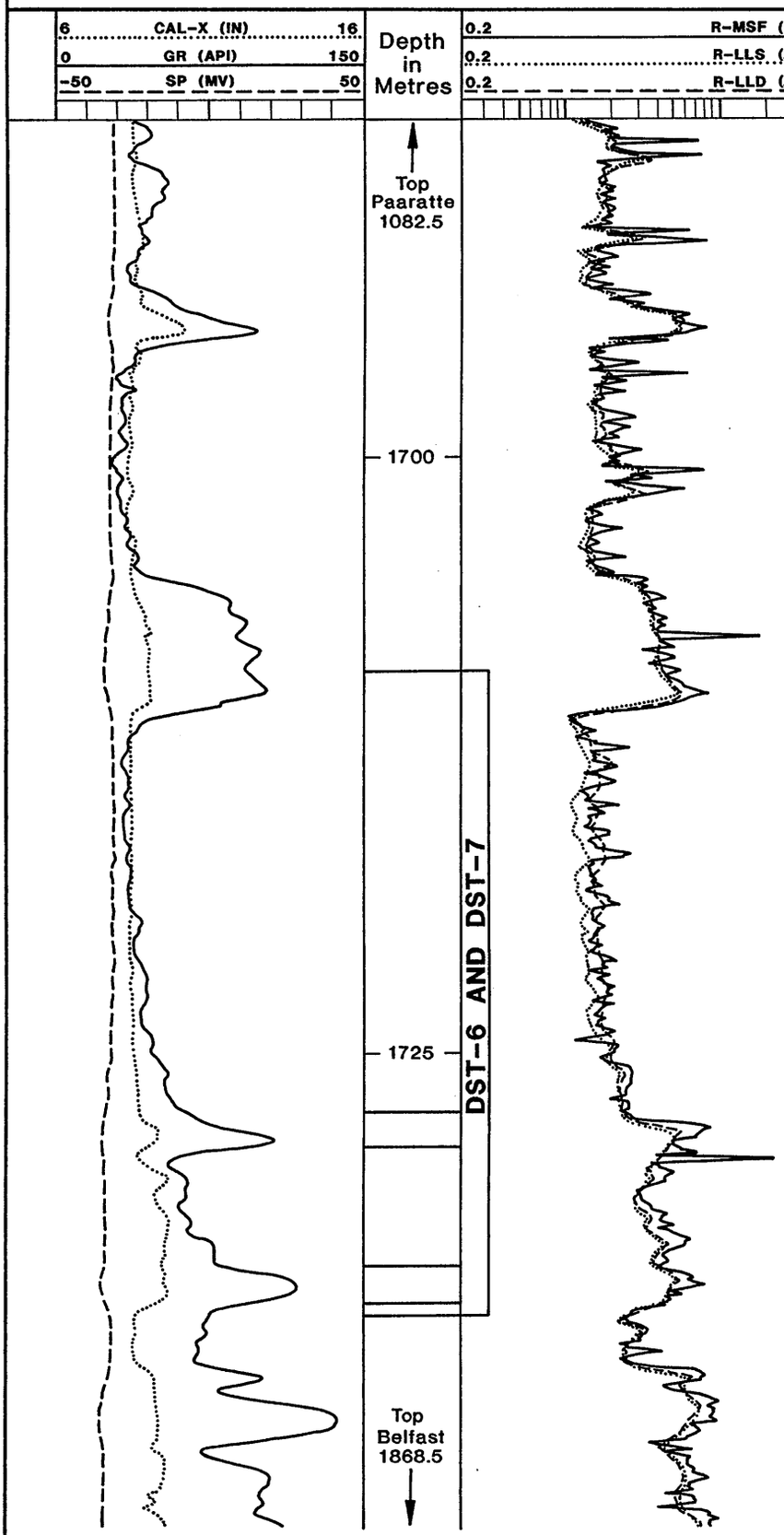
AUTHOR : V.AKBARI

FIGURE 8
OT.4356

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1 - PEP 105

DST-6 AND DST-7



DST-6 (2.9.90)

Formation : Paaratte
Test Interval : 1709m - 1736m
Gross Interval : 27m
Nett Pay : 24m
Nett Gross : 89%
Type of Test : Hydroflatable Straddle

REASON

- Uncertainty of logs response to CO2
- To test the porous zone within Paaratte

TEST

The test was not mechanically successful.
Two attempts to open the tool were failed

DST-7 (3.9.90)

Test Interval : Same as DST-6
Flow Period : Two (5 & 5min)

TEST

Strong blow observed during pre-flow.
In attempting to re-open the tool the string became stuck and then was worked free.
A short second flow and build up period was carried out to minimize the pipe from becoming stuck.

RECOVERY

- 5.97bbls of water cut mud
- 64bbls clear, brownish slightly CO_2 cut formation water

WATER ANALYSIS

CO2 : > 5%
Cl^- : 18000ppm
Rw : 0.2ohmm at 65°F

PRESSURE

Max. BHFP : 2398.98psia
Max. C.I.P. : 2785.63psia
Recorded Depth : 1737.9m
B.H.T. : 153°F

AUTHOR : V.AKBARI

FIGURE 9
OT.4357

2.5 Logging and Surveys

2.5.1 *Mud Logging*

A standard skid-mounted Halliburton (Geodata Division) unit was used. This was equiped for continuous recording of pentetration rate, mud gas, monitoring pump rate, mud volume data and intermittent mud and cutting gas analysis. The unit was also equipped with a special instrument for continuous detection of carbon dioxide of up to a concentration of 5% CO_2. The mud log is included as Enclosure 2.

2.5.2 *Wireline Logging*

Wireline logging was performed by Halliburton Logging Services Pty. Ltd. using a standard truck-mounted unit. One logging suite was carried out at total depth consisting of the following logs:

Log	Interval (m)
Dual Laterolog/Microspherically Focused Resistivity/Gamma Ray Log (DLL-MSFL-GR)	2148.7-305.3
Borehole Compensated Sonic/ Gamma Ray (BCS-GR)	2145-18.7
Spectral Litho-Density/Compensated Neutron Log/Gamma Ray (SLD-CNS-GR)	2148.4-1000

Four Electrode Dip Meter/ Gamma Ray (FED-GR)	2147.5-1280
Well Evaluation Log (WEL)	1925-2095
Cement Bond Log/Casing Collar Locator/Gamma Ray (CBL-CCL-GR)	2114-900

2.5.3 ***Deviation Surveys***

Totco deviation surveys were carried out regularly with the following results:

Depth (m)	Deviation (Deg.)
33.9	1.50
80.5	2.00
99.2	0.00
127.4	0.50
202.2	0.25
303.0	0.00
511.0	1.50
540.0	2.00
587.0	2.00
606.0	1.75
701.0	1.50
768.0	1.50
806.0	1.50
865.0	1.00
931.0	Misrun
940.0	1.00

2.5.3 Deviation Surveys (Cont'd.)

Depth (m)	Deviation (Deg.)
1151.0	1.50
1225.0	2.00
1294.0	2.00
1390.0	2.00
1457.0	1.75
1533.0	2.25
1668.0	2.00
1770.0	1.75
1866.0	Misrun
1878.0	2.25
1964.0	2.25
2040.0	4.00
2087.0	3.00
2149.0	1.75

2.5.4 ***Velocity Survey***

A velocity survey was carried out by Velocity Data Pty. Ltd. the result of which is included as Appendix - 5.

3. RESULTS OF DRILLING

3.1 *Stratigraphy*

The following stratigraphic intervals have been delineated using penetration rate, cutting analysis, wireline log interpretation, palynology, and clay analysis. (See figures 10, 11 and Appendices 8, 9).

Rock Unit	Depth K.B.(M)		Depth S.S.(M)	Thickness (M)
Heytesbury Group				
Port Campbell Lst	Surface	+	57.3	109
Gellibrand Marl	109.0	-	51.7	29
Wangerrip Group				
Dilwyn Formation	138.0	-	80.7	603.5
Pember Mudstone	741.5	-	684.2	289.5
Pebble Point Formation	1031.0	-	973.7	51.5
Sherbrook Group				
Paaratte Formation	1082.5	-	1025.2	786
Belfast Formation	1868.5	-	1811.2	157
Waarre Formation	2032.5	-	1975.2	74

Otway Group

Eumeralla Formation	2106.5	- 2049.2	43.1
Total Depth (Driller)	2149.6	- 2092.3	
Total Depth (Logger)	2148.7	- 2091.4	

3.2 Lithological Description

3.2.1 *Heytesbury Group (Surface - 138m)*

Port Campbell Limestone Surface - 109m.

Calcarenite, off white, light yellowish brown; medium-coarse, sub-rounded to rounded; abundant fossil fragments, coral, bryozoa, forams, crinoids, and shell fragments; rare to common glauconite; rare pyrite.

Gellibrand Marl 109m-138m.

Calcilutite, medium-dark grey, dark brown-black; firm to soft, in part sticky; commonly carbonaceous and fossilferous.

3.2.2 ***Wangerrip Group (138m-1082.5m)***

Dilwyn Formation 138-741.5m.

SANDSTONE, off white-translucent, frosty, light-medium grey; fine to coarse grained dominantly medium-coarse grained, angular to sub-angular to sub-rounded, dominantly sub-rounded, moderately to poorly sorted quartz; rare-common mica; rare lithics; common pyrite; interbedded with SILTSTONE, dark grey-black, dark brownish grey; rare to common carbonaceous detritus; common siliceous cement; firm to hard, dominantly hard; and minor CLAYSTONE, dark grey, brownish; carbonaceous; very soft, dominantly dispersive; interlaminated with COAL, very dark grey-black, brownish; in part silty; rarely pyritic; moderately firm with concoidal fracture.

Pember Mudstone Member 741.5m-1031m.

CLAYSTONE, dark greyish brown, dark grey green; silty in part grading to siltstone; carbonaceous; rare pyrite; firm to soft, dominantly soft and dispersive; interbedded with minor SANDSTONE, light brown-tan; fine to medium grained, dominantly medium grained, well sorted, sub-angular to sub-rounded, dominantly sub-rounded quartz; rare glauconite; rare pyrite; rare colored lithics; common calcareous cement; soft to hard, dominantly hard; poor to no visual porosity.

Pebble Point Formation 1031m-1082.5m.

SANDSTONE, light brown to tan, in part medium-dark brownish-greenish grey; fine-coarse grained, in part fine to pebble size, poorly sorted, sub-angular to sub-rounded to rounded, dominantly rounded quartz; common medium to dark green glauconite nodules; common reddish-brown iron

oxide; common medium-brownish grey dispersive clay matrix interbedded; with CONGLOMERATIC SANDSTONE, very dark grey to black, spots of white color where quartz pebbles are shattered; fine - pebble size grains, poorly sorted, fine grains and pebbles are rounded - well rounded, fine to medium grains are angular (possibly crushed pebbles), medium-coarse grains are sub-angular to sub-rounded quartz; trace to common cryptocrystalline pyrite; abundant very dark grey to black argillaceous matrix; firm to hard, in parts friable; very poor to no visual porosity; minor CLAYSTONE, dark brownish-grey; slightly silty; fissile - sub-fissile; micromicaceous; carbonaceous; slightly calcareous.

3.2.3 *Sherbrook Group 1082.5m - 2106.5m*

Paaratte Formation 1082.5m-1868.5m

SANDSTONE, off white - light yellowish brown, dominantly off white and translucent; fine to very coarse, dominantly coarse grained, poorly to moderately, dominantly poor sorting, angular to sub-angular dominantly sub-angular quartz; rarely to commonly micaceous; rare multi-color lithics; rare - common pyrite increasing with depth, minor to abundant, very dispersive clay matrix; in places well cemented with abundant white dolomitic cement; soft except for well cemented sandstones which are firm to hard and generally have poor to no visual porosity; interbedded with minor SILTSTONE, light greyish-brown; abundant quartz; common to rare dark color lithics; micro-micaceous; hard-firm, dominantly firm; and CLAYSTONE, light-dark, dominantly dark greyish-brown; in part silty and sandy; in part carbonaceous, soft and dispersive; and minor COAL, dark brown-black; firm with concoidal fractures.

Belfast Mudstone 1868.5m - 2025.5m.

CLAYSTONE, dark grey; micro-micaceous; carbonaceous; silty, occasionally grading to siltstone; firm-soft, dominantly soft and dispersive; interbedded with SILTSTONE, medium-dark grey, occasionally light grey-off white; very argillaceous; very carbonaceous, common black coal and carbonaceous material; blocky to sub-fissile; firm to hard, dominantly firm; and minor SANDSTONE, off white to light brownish-tan; fine-medium grained, dominantly medium; good-fair sorting; sub-angular to sub-rounded, dominantly sub-rounded quartz; rare lithics; rarely glauconitic; well cemented, abundant siliceous cement; hard; very poor to no visual porosity.

Waarre Formation 2032.5 - 2106.5m.

SANDSTONE, clear to off white to very light grey; medium to very coarse grained, dominantly coarse grained; poorly sorted; angular to sub-rounded, dominantly sub-rounded quartz; trace medium-dark green

lithics (glauconite); trace silica cement; rare pyrite cement and nodules; trace dolomite; common medium-dark grey argillaceous matrix; poor-occasionally fair visual porosity interbedded with SILTSTONE light grey-light brown, occasionally off-white; blocky in part;.moderately argillaceous in part; trace light grey lithics; trace carbonaceous detritus occassionally grading to SANDSTONE as above.

3.2.4 ***Otway Group 2106m. - 2149.6m.***

Eumeralla Formation 2106.5m - 2149.6m.

CLAYSTONE light-medium green-grey, light-medium brown-grey, occ. off-white - pale grey in part; soft-firm, dispersive in part, in part blocky; silty in part; rare partially altered feldspar, rarely carbonaceous; rare very fine mica interbedded with SANDSTONE light-medium green-gray, med. brown grey mottled in part; very fine-fine, often medium; sub-angular - sub-rounded; poorly sorted quartz; abundant volcanogenic, green-grey, brown, red, and very rare pinkish lithics;

GAS AND FUEL EXPLORATION N.L.

LIST OF SIDEWALL CORES

WELL NAME : PINE LODGE - 1

DATE : 29-8-1990

WELLSITE GEOLOGIST : A. TABASSI

CORE TAKEN BY: HALLIBURTON LOGGING SERVICES

NO.	DEPTH (m)	RCC Cm	FORMATION	LITHO LOGY	PALY.	TOC	SOURCE ROCK EVAL.	VITRI-NITE REF.	XRD
1	2135.0	2.0	EUMERALLA	Clay	*	*	*	*	
2	2121.5	2.5	"	Coal		*	*	*	
3	2109.0	1.0	"	Clay	*	*	*		*
4	2095.0	0	WAARRE		NO	RECOVERY			
5	2091.0	1.5	"	Silt				*	
6	2087.0	2.0	"	Silt	*				*
7	2076.5	2.5	"	Silt	*	*	*		
8	2072.0	2.5	"	Silt	*				
9	2064.5	2.5	"	Sand				*	
10	2059.0	2.0	"	Sand					
11	2055.5	1.5	"	Clay					
12	2052.5	2.0	"	Clay	*	*	*	*	
13	2045.0	2.0	"	Clay					
14	2041.0	2.5	"	Clay	*				
15	2030.0	2.0	"	Clay	*	*	*	*	
16	2024.0	0.5	"	Clay	*				
17	2014.0	2.0	BELFAST	Silt	*				*
18	2007.0	0.5	"	Silt		*	*	*	
19	1969.0	2.5	"	Sand					*
20	1961.5	2.0	"	Sand					*

GAS AND FUEL EXPLORATION N.L.

LIST OF SIDEWALL CORES

WELL NAME : PINE LODGE - 1 **PAGE** 2 OF 3

DATE : 29.8.1990 **CORE TAKEN BY:** HALLIBURTON LOGGING SERVICES

WELLSITE GEOLOGIST : A. TABASSI

NO.	DEPTH (m)	RCC Cm	FORMATION	LITHO	PALY.	TOC	SOURCE ROCK EVAL.	VITRI-NITE REF.	XRD
21	1931.0	2.0	BELFAST	Clay	*	*	*	*	
22	1898.0	2.5	"	Clay		*	*	*	
23	1886.5	1.5	"	Silt	*				
24	1874.0	0		NO	RECOVERY				
25	1868.0	0.5	"	Sand					*
26	1860.0	0	PAARATTE	NO	RECOVERY				
27	1815.0	2.0	"	Silt		*	*	*	
28	1787.0	2.0	"	Clay	*	*	*	*	
29	1709.0	2.0	"	Sand					*
30	1624.0	2.5	"	Silt	*			*	
31	1400.0	2.5	"	Sand					*
32	1376.0	3	"	Sand					
33	1300.0	3.5	"	Silt	*			*	*
34	1123.5	1.5	"	Silt	*			*	
35	1087.5	2.5	"	Sand					
36	1085.0	0	"	NO	RECOVERY				
37	1081.5	2.0	PEBBLE PT.	Clay					*
38	1079.5	2.5	"	Cong. Sand	*				
39	1077.0	3.5	"	"				*	*
40	1072.0	0		NO	RECOVERY				

GAS AND FUEL EXPLORATION N.L.

LIST OF SIDEWALL CORES

WELL NAME : PINE LODGE - 1 **PAGE** 3 OF 3

DATE : 29.8.1990 **CORE TAKEN BY** :

HALLIBURTON LOGGING SERVICES

WELLSITE GEOLOGIST : A. TABASSI

NO.	DEPTH (m)	RCC Cm.	FORMATION	LITHO LOGY	PALY.	TOC	SOURCE ROCK EVAL.	VITRI-NITE REF.	XRD
41	1068.0	2.0	"	Sand					*
42	1060.0	2.5	"	Sand					*
43	1048.0	3.5	"	Sand					
44	1039.5	3.0	"	Sand					*
45	1030.0	3.5	PEMBER	Clay	*			*	*
46	925.0	0	"	NO	RECOVERY				
47	750.0	3.5	"	SILT				*	
48	506	0	DILWYN	NO	RECOVERY				

GAS AND FUEL EXPLORATION N.L.

PEP 105/118 AND ENVIRONMENTS - OTWAY BASIN

STRATIGRAPHIC TABLE

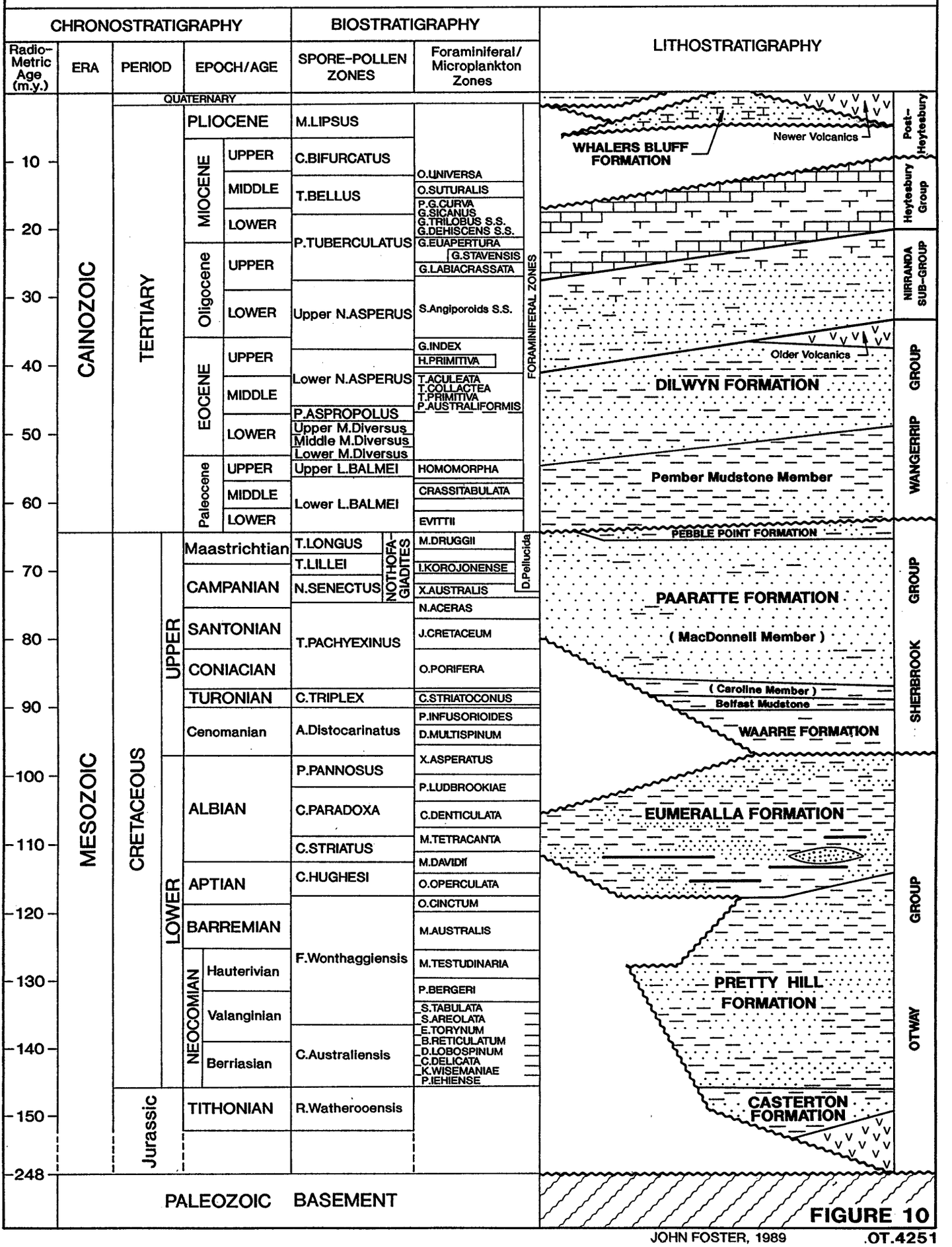


FIGURE 10

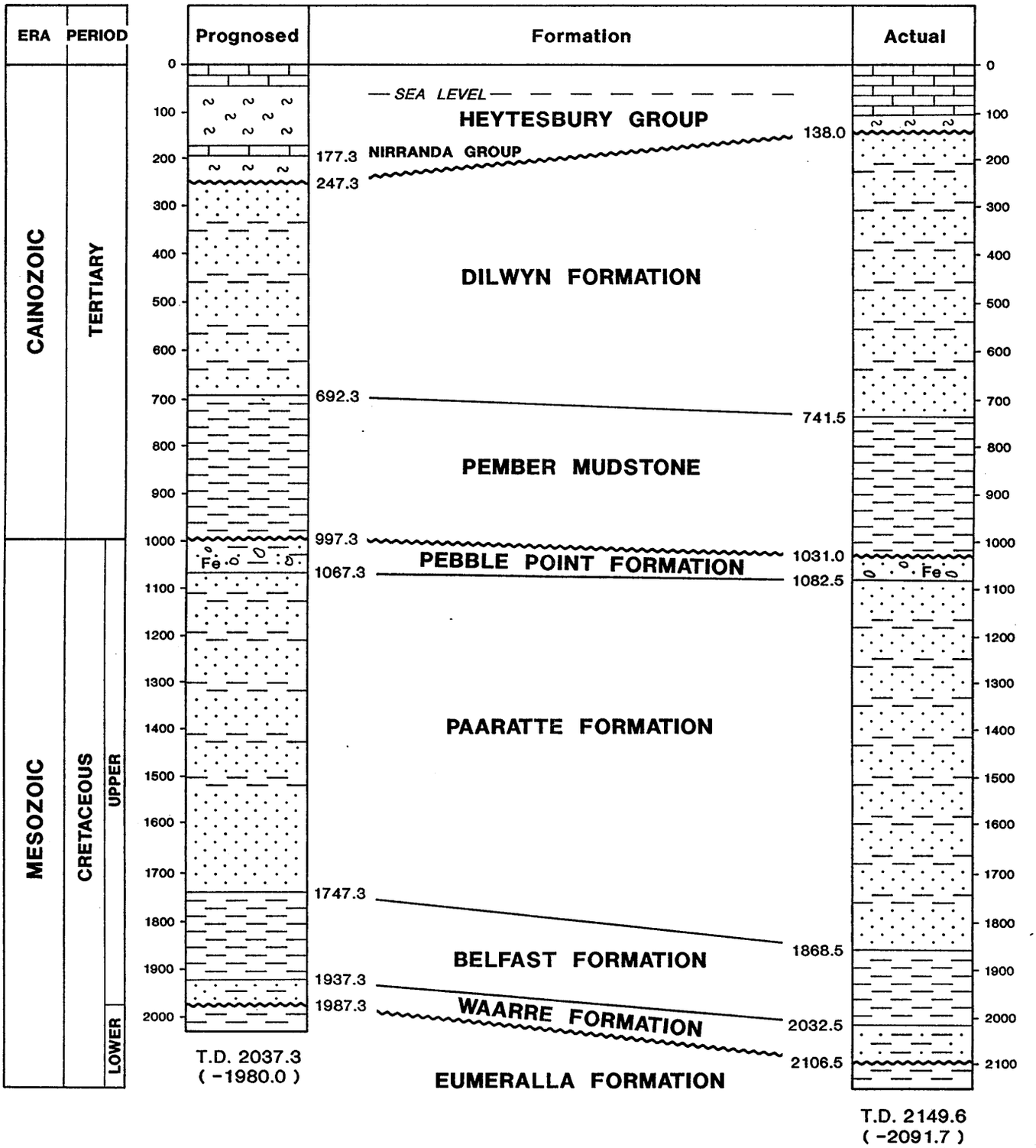
JOHN FOSTER, 1989 .OT.4251

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1

PROGNOSED AND ACTUAL STRATIGRAPHY

DEPTHS IN METRES (KB)



AUTHOR : V.AKBARI

FIGURE 11
OT.4352

trace partially altered feldspar; trace - common chloritic and minor kaolinitic argillaceous matrix; trace, fine carbonaceous detritus; friable - firm, rarely hard; very poor visual porosity.

3.3 Hydrocarbon Indications

3.3.1 *Mud Gas Reading:*

The mud gas and CO_2 detecting equipment were operational from 40m (30 meter below the 16" conductor depth) to 2149.6m (total depth).

Levels of gas in the drilling mud were below the detection capabilities of the system from the start to a depth of approximately 1040m.

From 1040m to 1085m, the level of gas ranged from 50-150 ppm being mainly methane.

From 1085m to 1942m the levels of gas in the drilling fluid were again below the detection capabilities of the system.

From 1942m to total depth the levels of gas generally fluctuated between 50 to 500ppm being mainly C_1 with occassional traces of C_3.

A maximum gas level of 3500ppm was recorded between 2055-2060m being mainly C_1 with trace of C_3. The gas was liberated after encountering a drilling break.

3.3.2 *Sample Fluorescence*

Cutting samples were rountinely inspected for shows and fluorescence at 10m intervals from 40m to 310m and at 5 metre interval from 310m to 2149.6m (T.D.) Occassional spot samples as well as sidewall cores were also checked for shows and fluorescence.

No fluroescence or oil staining were reported either in cuttings samples or sidewall cores.

3.3.3 *Cuttings Gas*

As part of the show evaluation programme, cuttings gases were evaluated using a blender after prospective drilling break.

4. GEOLOGY

4.1 Structure

4.1.1 *Seismic*

Pine Lodge prospect was defined as the results of Wanwin-Gorae (1984) and Wanwin Gorae Detail (1985) Seismic Surveys and following the reprocessing project of 1988. In addition two lines of Crawford River Seismic Survey were used.

The prospect which is located on the northern side of the Portland Trough was interpreted as a tilted fault block bounded to the north by the Tartwaup Fault and to the south by the Wanwin Fault. Both faults are normal listric faults trending south-eastward and merging to the southeast of the prospect.

The structure was thought to be closed to north against the Tartwaup Fault where the Waarre Formation was expected to be juxtaposed against the Eumeralla

Formation of the Otway Group.

Pronounced rollover was also evident along northwest-southeast trending strike lines.

The structure was mapped on the following horizons:

- Near Top Pember Mudstone
- Top Pebble Point Formation
- Near Top Belfast Formation
- Near Top Otway Group

See figures 12, 13. 14, 15 and 16.

Post drilling data suggest the following structural points:

- The CO_2 producing zone (1939.9-1967.9m) is believed to be within a local faulted zone. The zone does not show a clear seismic signature which makes its mapping rather unreliable.

PE906558

This is an enclosure indicator page.
The enclosure PE906558 is enclosed within the container PE902068 at this location in this document.

The enclosure PE906558 has the following characteristics:

ITEM_BARCODE	= PE906558
CONTAINER_BARCODE	= PE902068
NAME	= Time Depth Curve
BASIN	= OTWAY
PERMIT	= PEP105
TYPE	= WELL
SUBTYPE	= VELOCITY_CHART
DESCRIPTION	= Time Depth Curve and Seismic Section, Pine Lodge-1
REMARKS	=
DATE_CREATED	= 30/06/1991
DATE_RECEIVED	= 05/12/1991
W_NO	= W1034
WELL_NAME	= PINE LODGE-1
CONTRACTOR	=
CLIENT_OP_CO	= GAS AND FUEL EXPLORATION NL

(Inserted by DNRE - Vic Govt Mines Dept)

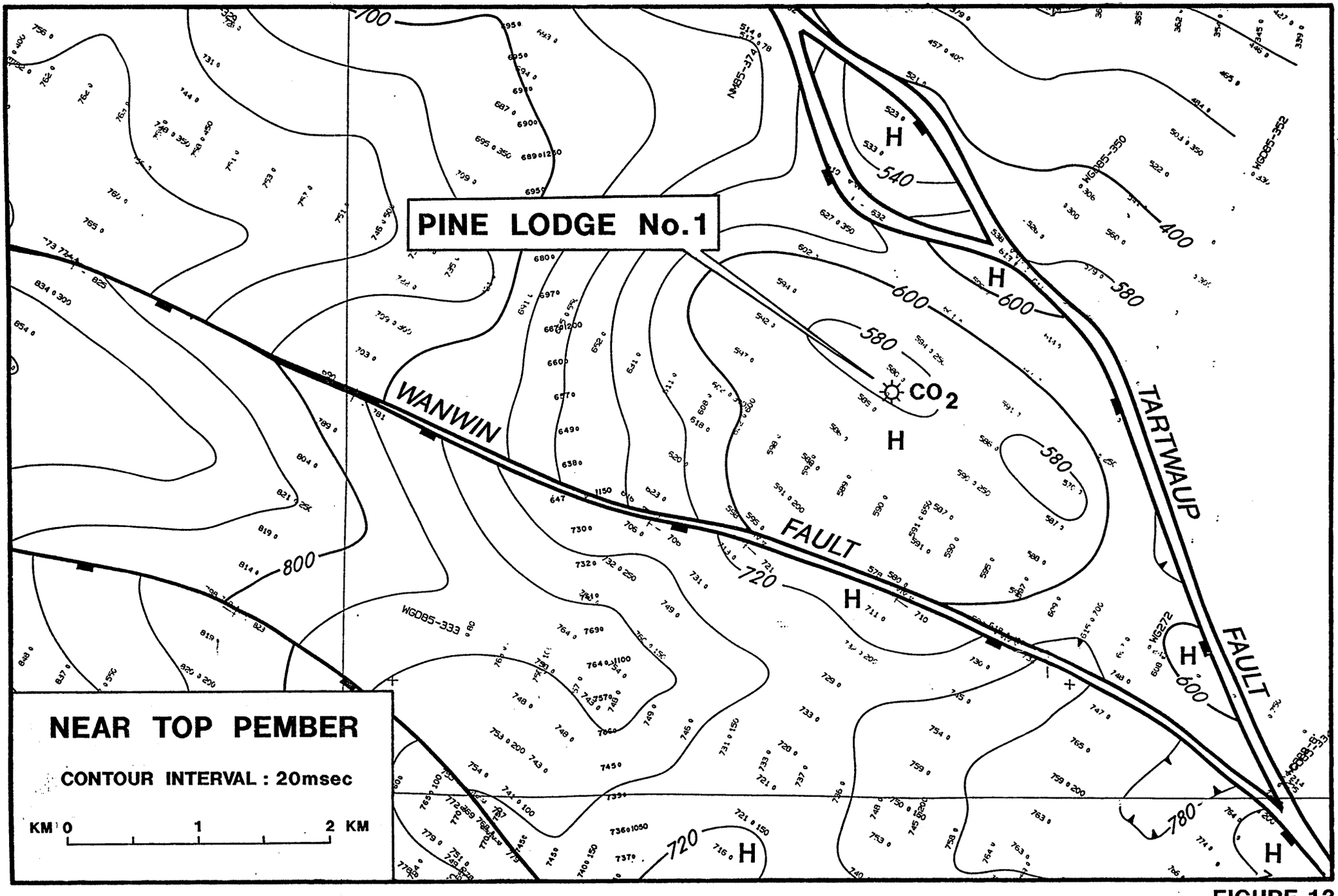

PINE LODGE No.1
WANWIN
FAULT
TARTWAUP
FAULT
CO2
NEAR TOP PEMBER
CONTOUR INTERVAL : 20msec
KM 0 1 2 KM
700
800
720
540
400
580
600
780
WGDB5-333
WGDB5-374
WGDB5-350
WGDB5-352
WG272

FIGURE 13

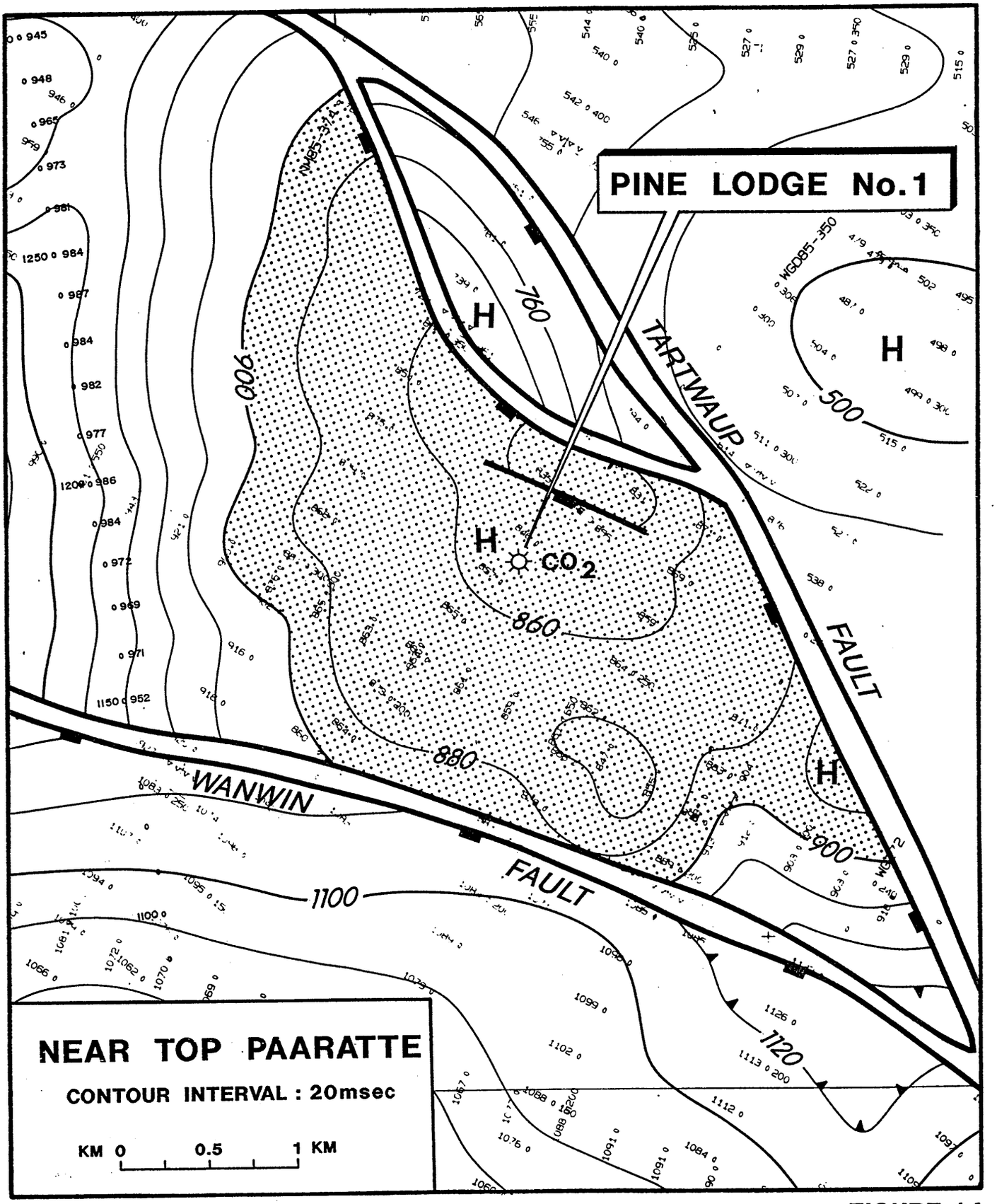

PINE LODGE No.1
TARTWAUP
FAULT
WANWIN
FAULT
760
806
860
880
900
1100
1120
500
H
H
H
H
CO 2
NEAR TOP PAARATTE
CONTOUR INTERVAL : 20msec
KM 0 0.5 1 KM

FIGURE 14

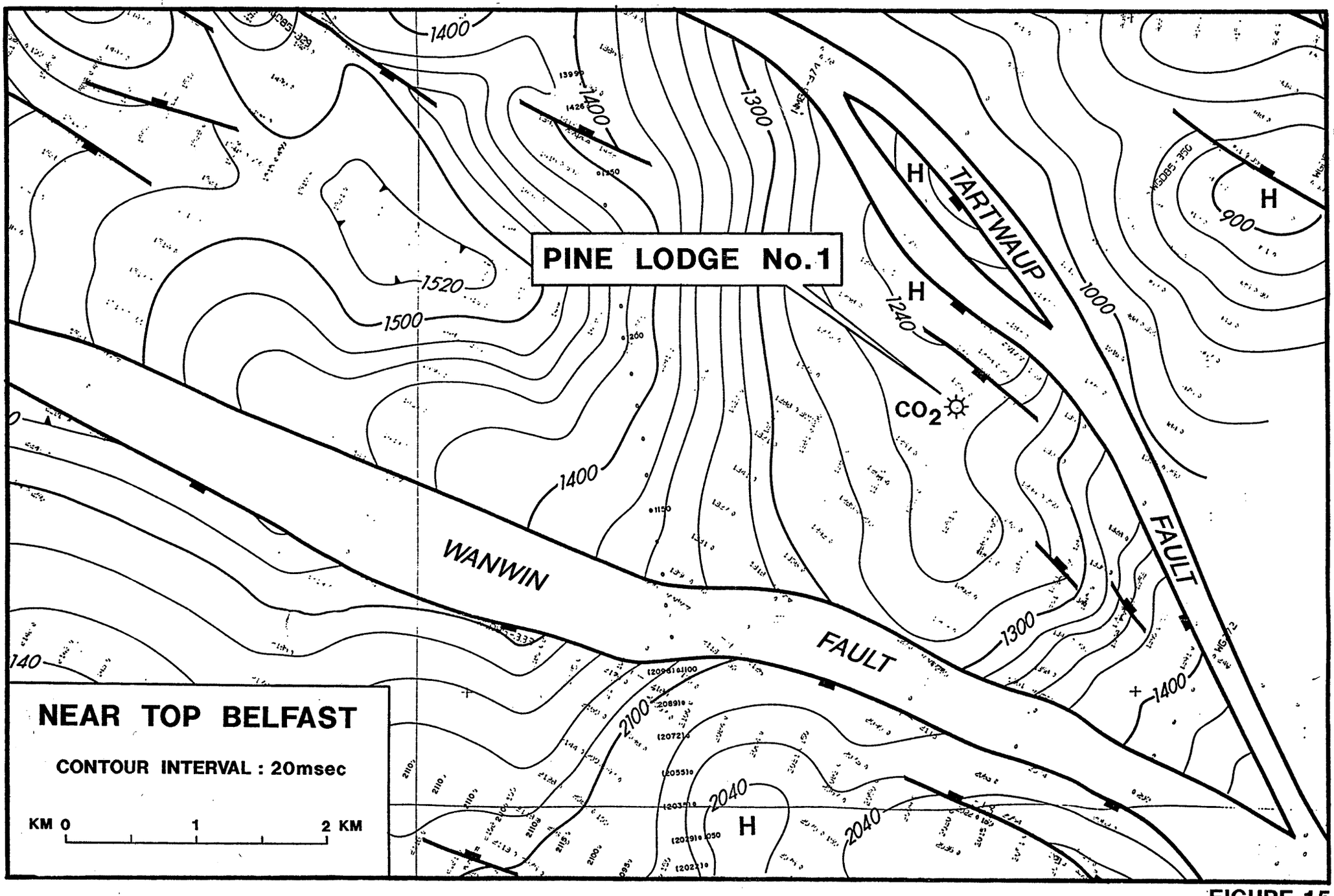

PINE LODGE No.1
TARTWAUP
WANWIN
FAULT
FAULT
H
H
H
H
1400
1300
1400
1520
1500
1400
1240
1000
900
1300
1400
2100
2040
2040
CO_2
NEAR TOP BELFAST
CONTOUR INTERVAL : 20msec
KM 0
1
2 KM

FIGURE 15

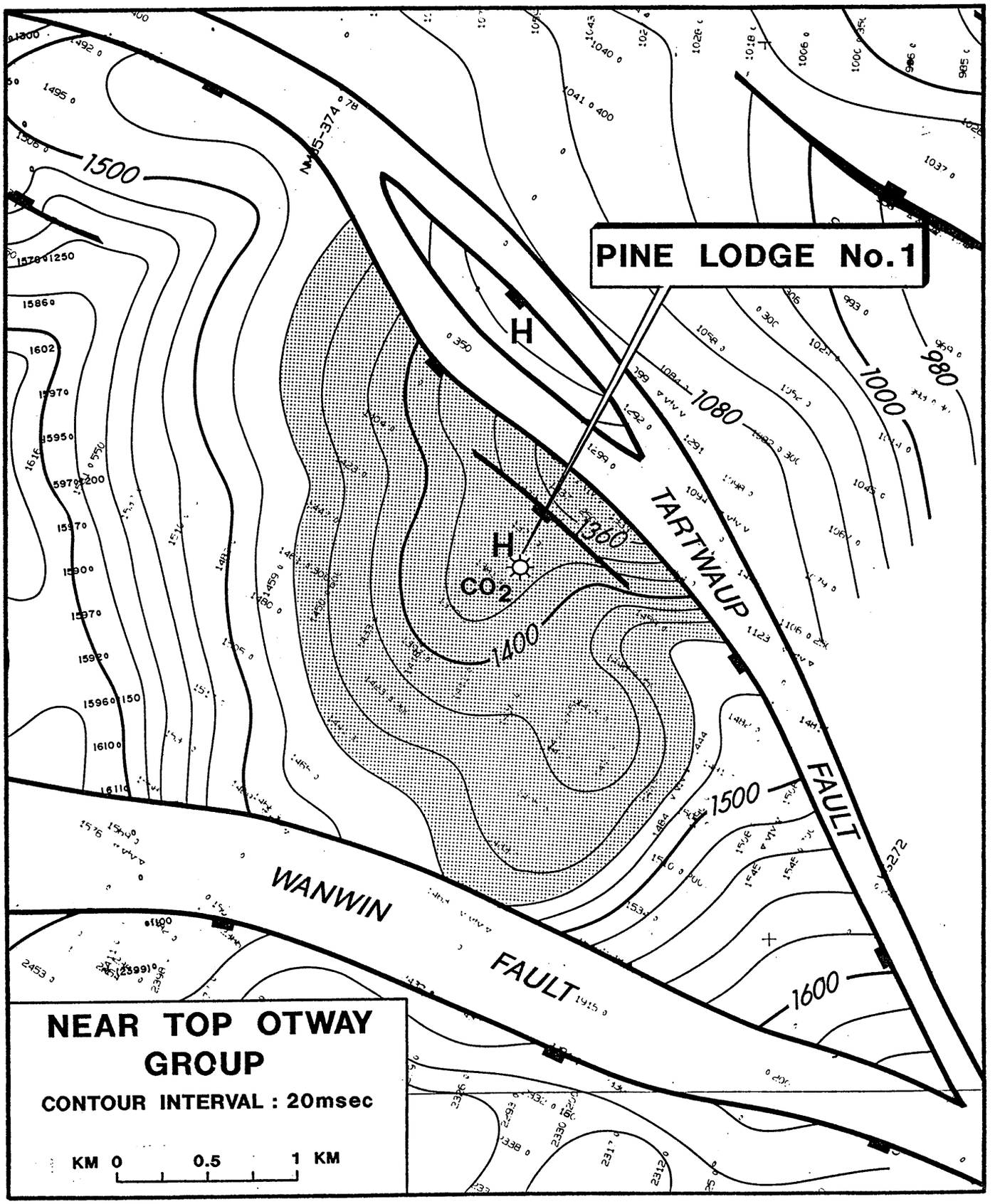

PINE LODGE No.1
TARTWAUP FAULT
WANWIN FAULT
1500
1400
1360
1080
1000
980
1600
H
H
CO_2
NEAR TOP OTWAY GROUP
CONTOUR INTERVAL : 20msec
KM 0 0.5 1 KM

FIGURE 16

- A local fault is also believed to have cut
- through the Waarre Formation at the well location. It is therefore not clear as to whether or not a true thickness of the Waarre has been penetrated.

- The well entered into the Belfast, Waarre, and Otway Group significantly lower than forecast. This was due to the uncertainty of the velocity data and incorrect interpretation of the seismic horizons. The well however is thought to have achieved its target of testing the structure near its culmination.

4.1.2 ***Dipmeter Data***

A Four Electrode Dipmeter (FED) was run by Halliburton Logging Services over the intervals 2148.5 to 1710m and from 1434.7m to 1289m. The results can be summarised as follows:

1434.7-1279m

The dips in the interbedded sandstone and claystone sequence of Paaratte Formation

are generally good with a few short intervals showing less reliable dip values. The low angle, fairly consistent (green pattern) dips ranging from 4 degrees increasing with depth to about 8^{o} and a hole deviation of less than 2^{o} would indicate the well is located in the area of the structural culmination. The dips in general trend north-northeast indicating a northwest - southeast strike. Some minor dip anomalies are seen in the interval from 1350 - 1360m which may indicate a change in the depositional environment.

2148.5-1705m

The dips in the sections composed of predominantly claystone and siltstone interbedded with minor sandstone are fair to good.

In the lower part of the Paaratte Formation and down to a depth of approximately 1800m the structural dips are irregular and to some extent of low confidence. Between 1800m and the top of Belfast, the dips are remarkably consistent and reliable. The dips which

are generally of a "green" type pattern are due east-southeast ranging from 10 to 14 degrees.

In the Belfast Formation, down to 1938m the dips are rather irregular. Apart from a small normal fault in the interval 1940-1970m [CO_2 zone] no other structural pattern could be identified (figure 17).

Below 1938m, the dips range from 10^{o}-26^{o} generally northeast and consist predominantly of "red" and "blue" patterns.

In the Waarre Formation (2025-2106.5m the dips are both very irregular ("Bag of Nails") and of low confidence. However, a sharp change in dip values from 20^{o} NE to almost 50^{o} SE at 2025.5 (figure 18) is thought to be due to a normal fault cutting through the top of the Formation.

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1

DIPMETER LOG SHOWING FAULT

IN CO2 PRODUCING ZONE

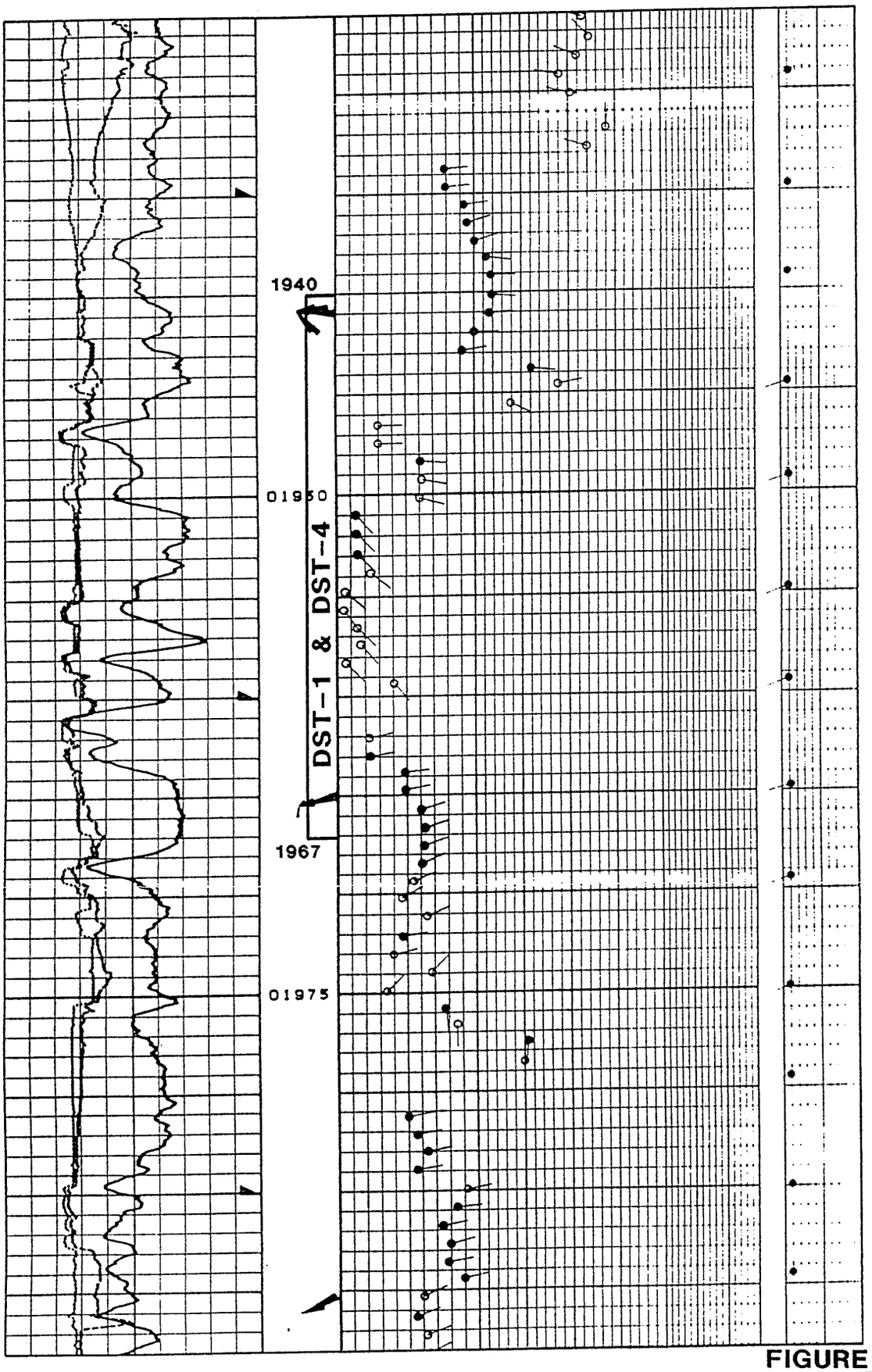


FIGURE 17

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1

DIPMETER LOG SHOWING POSSIBLE FAULT IN WAARRE FORMATION

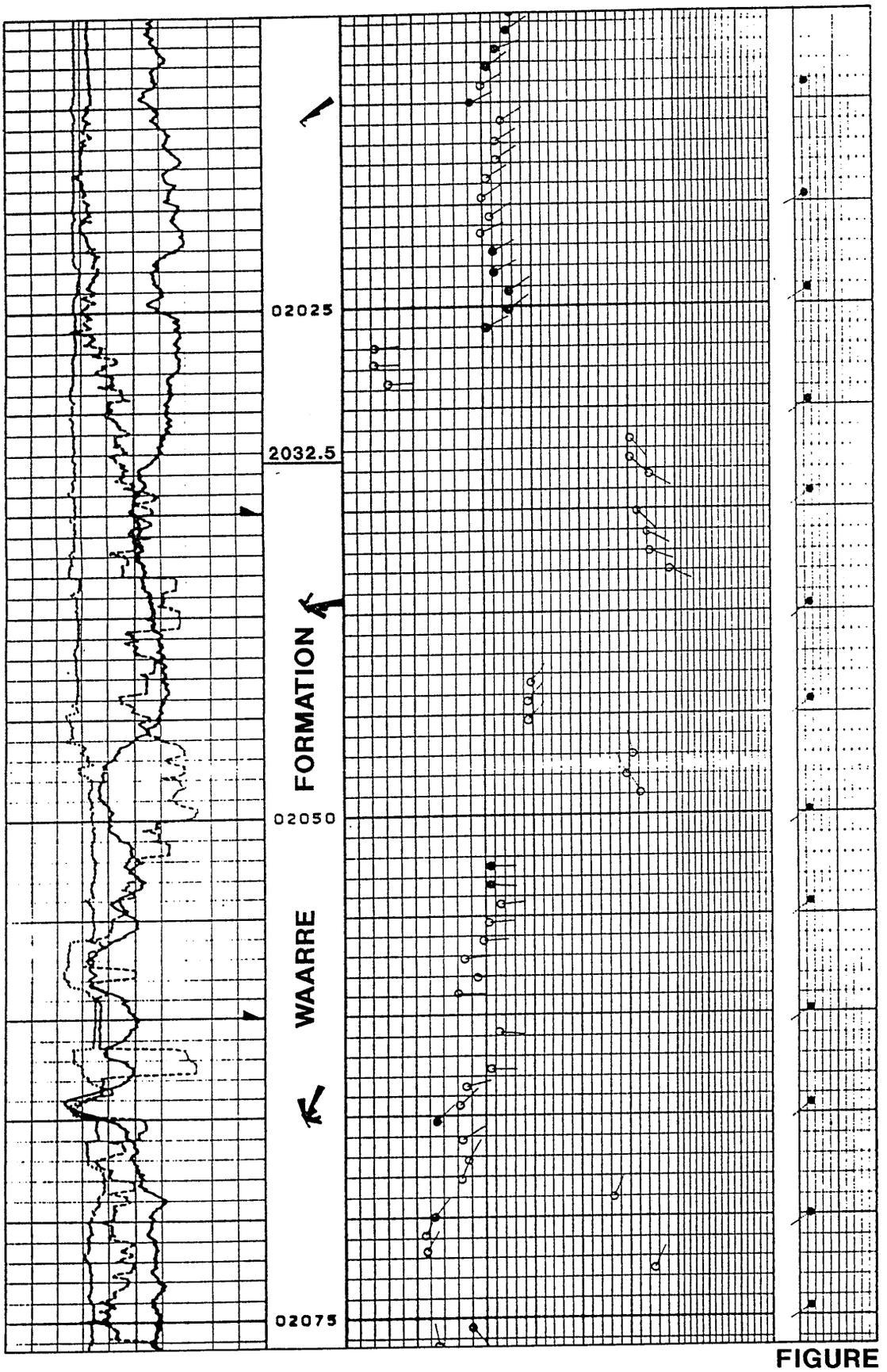


FIGURE 18

In the siltstone and claystone sequences of the Eumeralla Formation, the dips are more consistent and reliable ranging from 20° to 40° due southeast. A sharp change in dip angle and direction at 2106.5m marks the angular unconformity separating Waarre from Eumeralla. Figure 19.

4.2 Porosity and Water Saturation

The following four zones covering the primary and secondary objectives of the well, were selected for log analysis using the Crocker Data processing (CDP) petrology log package. Table 2.

Zone-1, 1031-1085m

Represents an arenaceous section of the Pebble Point Formation which was a secondary objective in the well. The zone includes a rather massive and relatively clean sandstone characterized by an increase in resistivity and slight separation between the deep and shallow resistivity curves. During the course of drilling this zone, no fluorescence or stain was observed and the total gas reached only 1.4 units.

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1

DIPMETER LOG SHOWING UNCONFORMITY ON TOP OTWAY

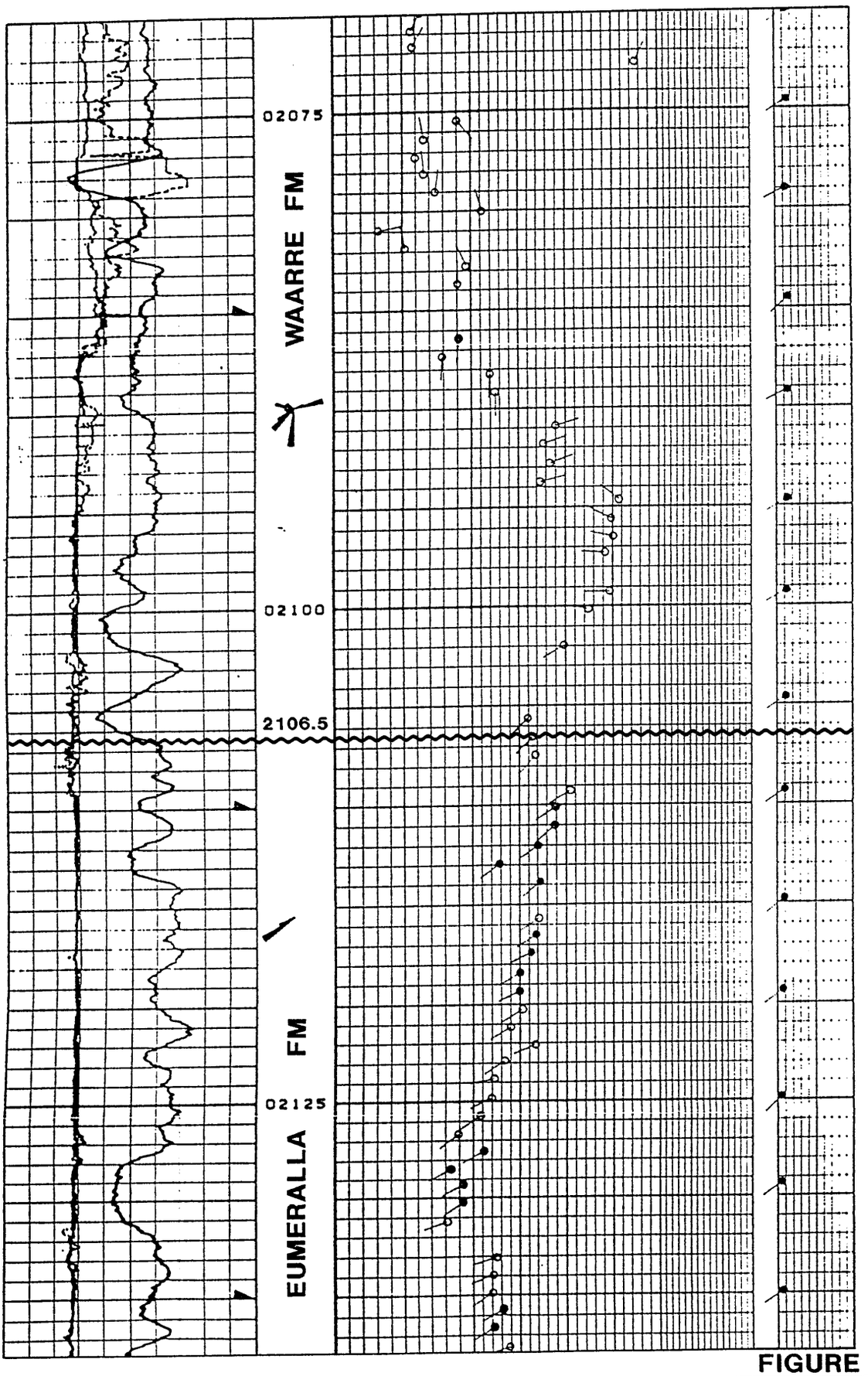


FIGURE 19

Zone - 2

The Zone consists of two intervals:

a. 1400-1470m

This interval comprises two massive porous sandstones within the Paaratte Formation and is characterised by low gamma ray, a rather in gauge hole and good separation between the two resistivity curves. While drilling this zone, no fluorescence was observed and the total gas reached only a trace.

b. 1800-1870m

This interval represents the basal part of the Paaratte Formation and corresponds to a series of sandstones interbedded with shale. No fluorescence was observed while drilling and the total gas reached only to 0.1 unit.

Zone-3, 1932-1967m

The Zone is within the Belfast Formation and consists of a series of thin, fine grained sandstones interbedded with silt and claystone. While drilling this interval, no

fluorescence was observed but a gas kick of 4.6 units was encountered from 1940-1947. Total gas decreased to 0.8 unit at 1970m.

Zone 4, 2032.5-2106.5m

This zone represents the Waarre Formation and was considered as the primary objective of the well. Cuttings which were predominantly siltstone and claystone with minor sandstone displayed no visual porosities. The logs over this interval indicate a dense and shaly formation. No fluorescence was observed while drilling but a maximum gas reading of 17.5 units was recorded from 2056-2059m against the background gas of 0.4 unit.

Prior to log analysis the following log data processing was carried out.

- Depth matching of poorly matched logs. Data were matched to the resistivity log.

- Bad data readings were set to missing.

- Some readings were set to missing from surface to 305m (re-casing reading).

- An SP drift correction was effected.

Log interpretation was performed in two stages:

1. Pre interpretation (1st pass)/preinterpretation cross-plots.
2. Complex Lithology (2nd pass) utilizing the Indonesian Equation/Complex Lithology cross-plots.

A complete data set of log interpretaion results and logs are contained in Appendix-13, however table 2 summarises the results of the log analysis.

4.3 Relevance to the occurence of Hydrocarbons

Pine Lodge No.1 was drilled to test a structure in close proximity to the Portland Trough which is considered to be a potential hydrocarbon kitchen. Before drilling it was postulated that hydrocarbons generated in the Trough would accumulate in Upper Cretaceous reservoirs. In support of this postulation, Wilson No.1 situated 6km northwest of the prospect was of particular encouragement as oil from a marine source was

GAS AND FUEL EXPLORATION N.L.

PEP 105

PINE LODGE No.1

FORMATION EVALUATION

ZONE	INTERVAL (Metres)	NETT / GROSS %	SHOW	AV. ø E %	AV. Sw %
1	1030m - 1085m DST-5 (1032.5m - 1059m) **(Pebble Point)**	71	No Fluor. Total gas up to 1.4 unit	20	95
2	1400m - 1470m 1800m - 1870m **(Paaratte)**	78 49.3	No Fluor T.G.: Tr. No Fluor T.G.: 0.1	15-25 15-20	>95 >95
3	1932m - 1970m 1940m - 1967m (DST-1, DST-4) **(Intra Belfast)**	34	No Fluor. Max. T.G.: 4.6 unit dec. to 0.8 at 1970m	5-10 15-20 5-10	100 50-100 80
4	2032.5m - 2106.5m **(Waarre)**	13.5	No Fluor T.G.: 0.4 - 1.3 Max. 17.5 2056m - 2059m	5-10 5-10	100 100

AUTHOR : V.AKBARI

TABLE 2
OT.4351

recovered from the Pebble Point Formation. Hydrocarbon shows were also encountered in the Pebble Point in Fahley No.1 and in the Waarre in Najaba No.1. Post drilling data however indicated that:

- The existance of reservoir quality sand in the Pebble Point and Paaratte Formations.

  The Sands however were found to be water saturated and tight in the Pebble Point.

- The existance of a non-combustible gas reservoir in intra-Belfast sandstones the extents of which are thought to be limited.

- The presence of the Waarre Formation was confirmed, however intraformational sandstones were found to be of very poor quality and limited in development.

4.3.1 ***Total Organic Carbon***

A total of eleven (11) sidewall core samples were selected for TOC measurement and source rock evaluation. The measured TOC ranged from 1-2 percent and consisting mainly of vitrinite and inertinite with sparse to rarely common liptinite The result of pyrolysis however indicated that:

- The type of the Kerogens were predominantly of type III with gas generating potential if mature. Figure 20.

- The organic matter is not thermally mature down to at least 2100m below which depth it becomes only marginally mature for gas. This is confirmed by yellow-light brown spore colour.

- The sidewall core taken at 2121.5m (Eumeralla Formation) was particularly unusual being a bituminous coal (cannel coal) with measured TOC of 46% and consisting of liptinite, vitrinite and inertinite, (60%, 31% and 9% respectively). The vitrinite reflectance value however was only 0.4%. Such high liptinite coals have not been previously observed in the Eumeralla Formation and if sufficiently mature such a rock could be a significant oil source.
  The complete geochemical analysis results are contained in appendix 10. Table 3 summarises the result of the source rock assessment.

4.3.2 *Vitrinite Reflectance*

A total of seventeen sidewall core samples were selected for vitrinite reflectance measurements Fig. 21. The reflectance values however do not reach beyond 0.5% indicating thermal immaturity of the sequence.

A shift in vitrinite reflectance valves is clearly evident near the top of Waarre Formation and appears to confirm the existance of a minor local fault.

4.3.3 *Bottom Hole Temperature*

The following Bottom Hole Temperatures were measured during the wireline logging.

Depth	Max T(^{o}F)	Log
2189.3	154	DLL/MSFL/GR
2148.4	162	SLD/CNS/GR
2145	168	BHC/GR
2147.5	170	FED/GR

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1

HYDROGEN INDEX vs T max

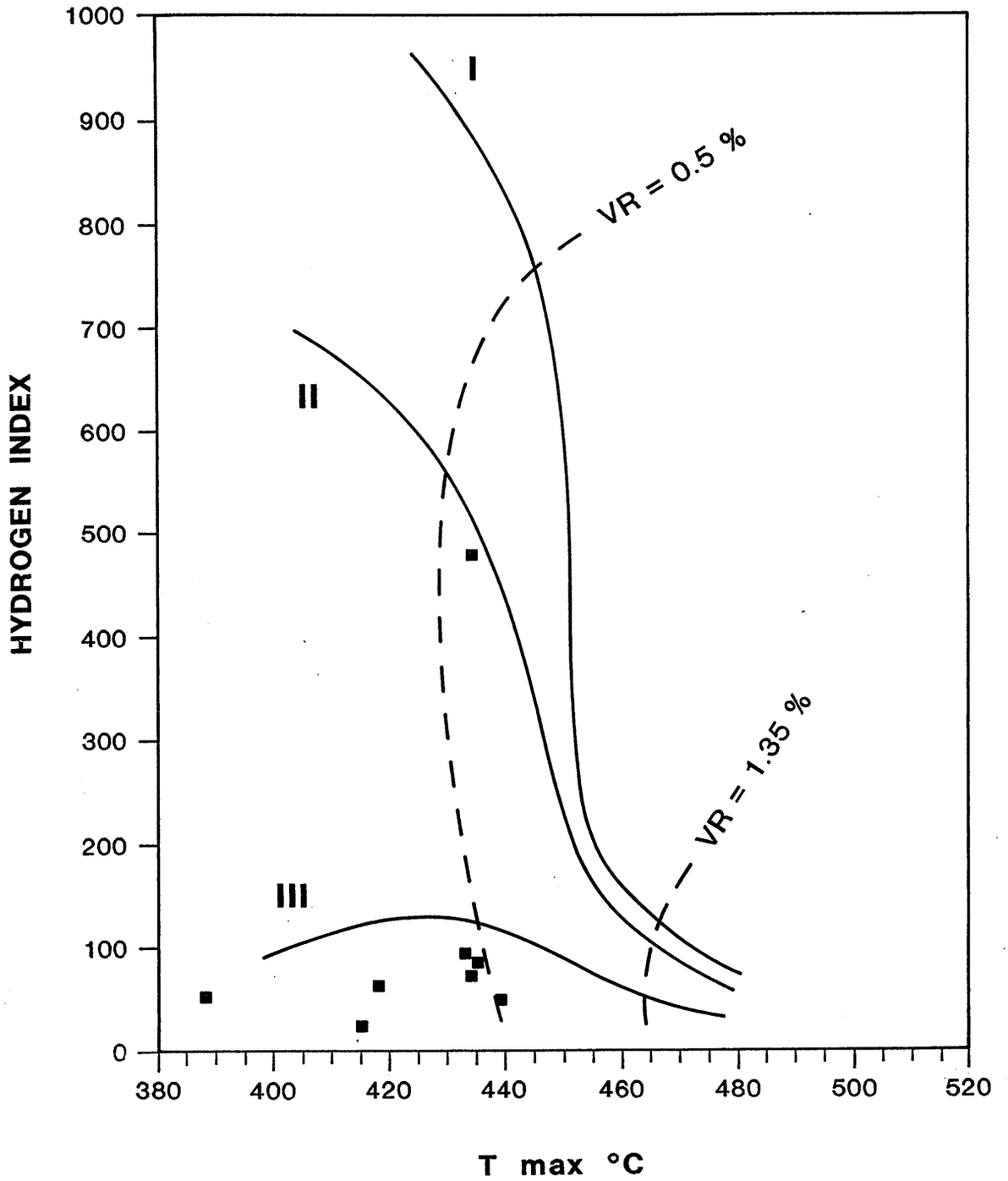
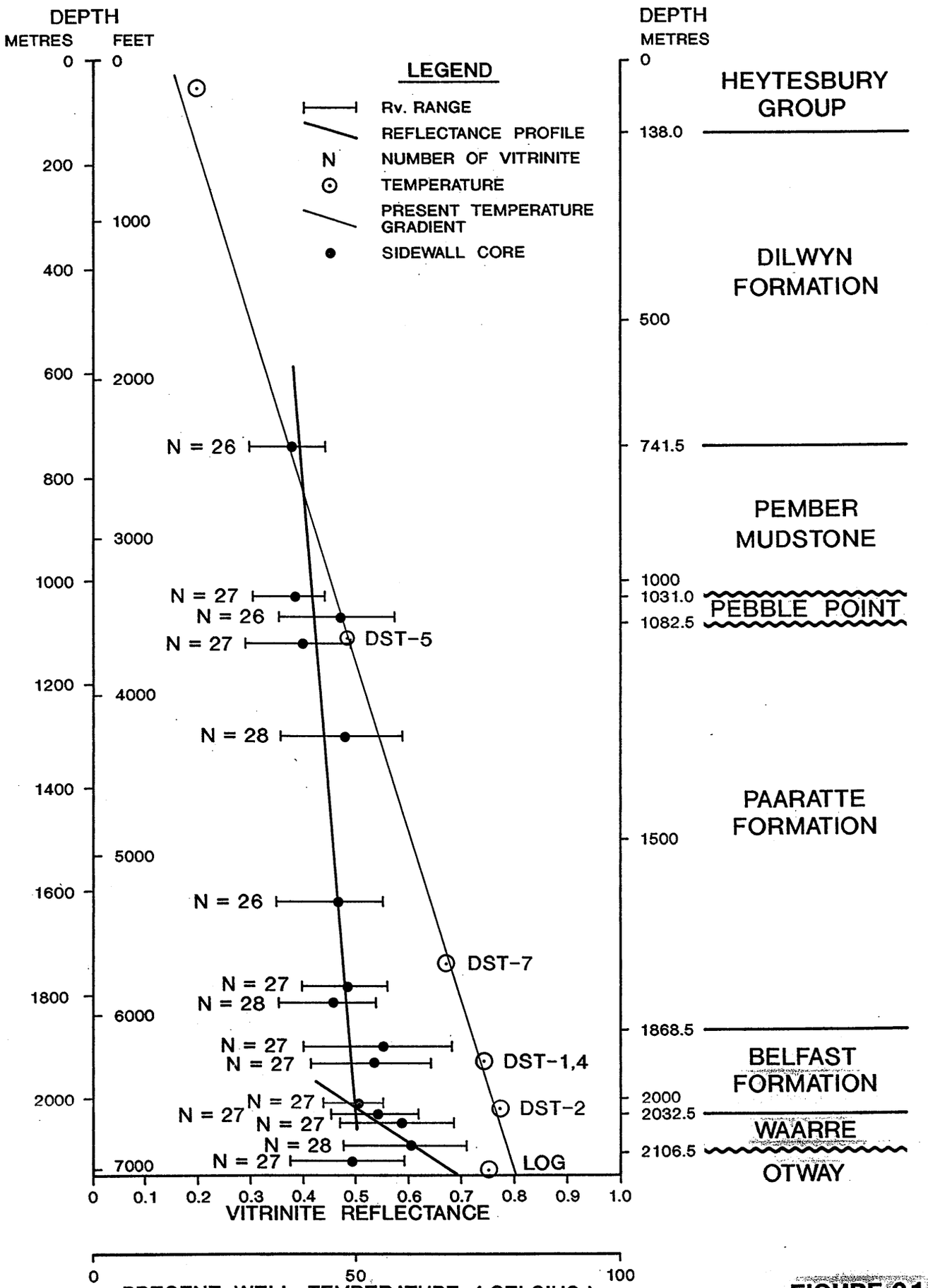


FIGURE 20
OT.4349

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1

VITRINITE REFLECTANCE PROFILE



AUTHOR : V.AKBARI

FIGURE 21
OT.4348

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1

SOURCE ROCK ANALYSIS

FORMATION	DEPTH (Metres)	T Max		S1		S2	S3	Richness S1 + S2		S1/S1+S2 P1		S2/ S3	PC	TOC		HI	OI
PAARATTE	1787	415	IMMATURE	0.07	POOR	0.68	0.77	0.75	POOR	0.09	IMMATURE	0.88	0.06	2.98	GOOD	22	25
	1815	350		0.11		0.57	0.72	0.68		0.16		0.79	0.05	1.38		41	52
BELFAST	1898	388		0.11		0.89	1.50	1.00		0.11		0.59	0.08	1.70		52	88
	1931	369		0.10		0.77	0.66	0.87		0.12		1.16	0.07	1.56		49	42
	2007	228		0.12		0.82	0.78	0.94		0.13		1.05	0.08	1.58		52	49
WAARRE	2030	435	IMMATURE / MARGINALLY MATURE	0.12		1.85	0.80	1.97		0.06		2.31	0.16	2.17		85	36
EUMERALLA	2052	418		0.17		0.75	0.89	0.92	MARGINAL	0.18		0.84	0.07	1.21		61	73
	2076	434		0.13		1.28	0.52	1.41		0.09		2.46	0.11	1.80		71	28
	2091	433		0.15		1.02	0.40	1.17		0.13		2.55	0.09	1.10		92	36
	2121	434		8.59		219.7	1.65	228.3		0.04		133.12	19.02	46.00		477	3
	2135	439		0.11		1.05	0.30	1.16		0.09		3.50	0.09	2.18		48	13

S1	CLASS
0.0 – 0.2	POOR
0.2 – 0.4	FAIR
0.4 – 0.8	GOOD
0.8 – 1.6	EXCELLENT

S1 + S2	CLASS
0.00 – 1.00	POOR
1 – 2	MARGINAL
2 – 6	MODERATE
6 – 10	GOOD
10 – 20	VERY GOOD
> 20	EXCELLENT

PI	CLASS
< 0.1	IMMATURE
0.1 – 0.4	OIL WINDOW
> 0.4	OVER MATURE

T.Max.C°	CLASS
< 435	IMMATURE
435 – 450	OIL
450 – 470	GAS GEN.
> 470	OVER MATURE

T.O.C.	CLASS
0.0 – 0.5	POOR
0.5 – 1.0	FAIR
1 – 2	GOOD
2 – 4	VERY GOOD
> 4	EXCELLENT

TABLE 3 OT.4350

A Formation temperature of 172.6°F (78.1°C) was extrapolated from a Horner - type plot. Figure 22.

Assuming a surface temperature of 20°C, the average temperature gradient is 2.7°C/100m.

5. BASIN MODELING

5.1 Introduction

Two steps are generally involved in any basin modeling. The first step is the reconstruction of the depositional and tectonic history. This can best be accomplished by plotting depth of burial versus geological time.

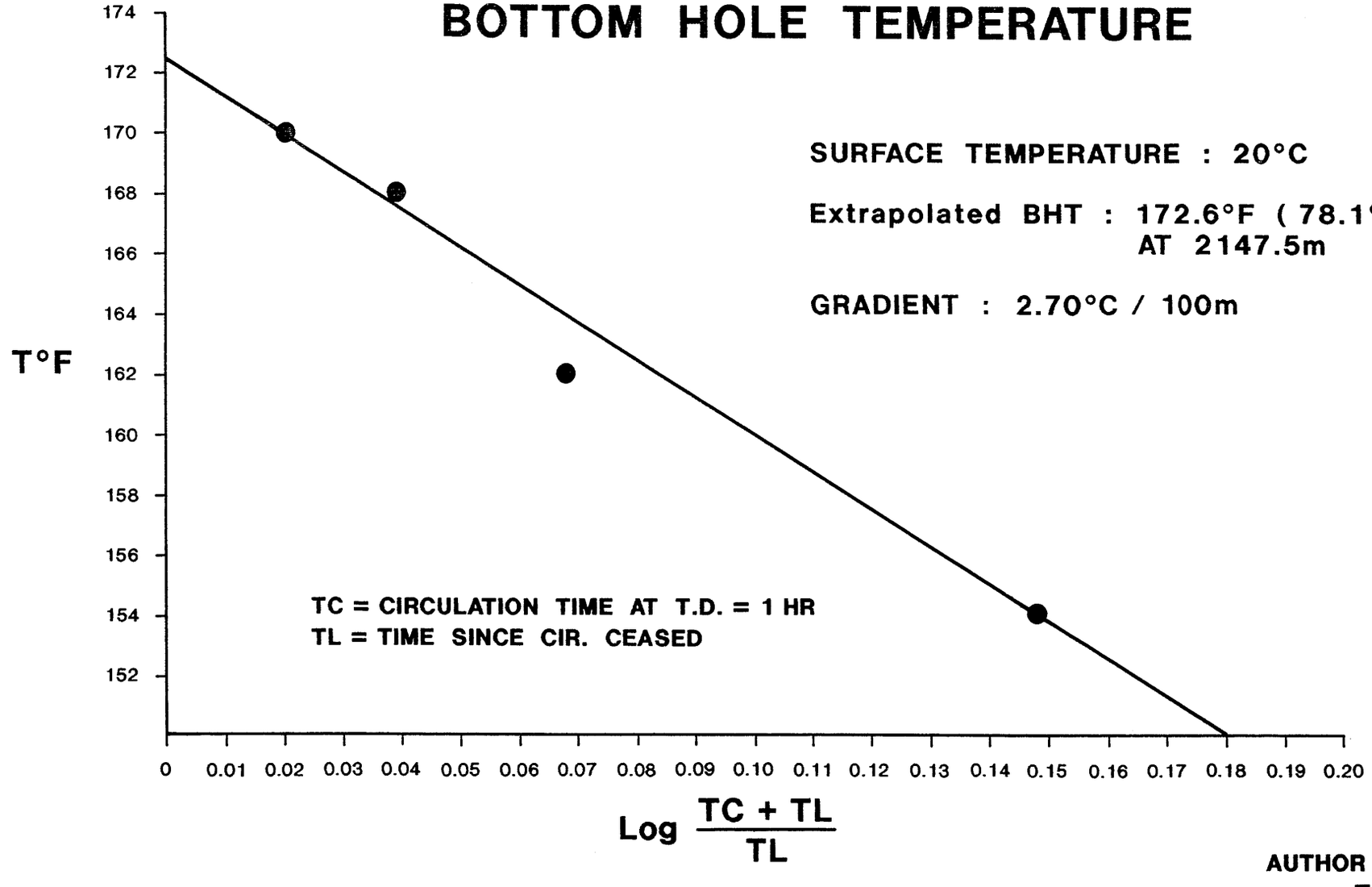
The second step is the application of the present or paleo-thermal history. Other factors such as sea level charges through geological time, lithology, compaction, heat flow/conductivity, vitrinite reflectance and type of kerogen are also incorporated. The integrity of the model is verified by the comparison of the measured and calculated maturity profiles.

5.2 *Pine Lodge Modeling*

A computer programme (Modular Basin Modeling System) was used for generatng a model i.e. figure 23, the data base for which is

PINE LODGE No.1

HORNER – TYPE PLOT FOR TRUE BOTTOM HOLE TEMPERATURE



AUTHOR : V.AKBARI

FIGURE 22

set out in Table 4.

The accuracy of the generated model is believed to be good as indicated by the very close match between the measured and calculated maturity cures. Figure 24.

Figures 23 and 24 reveal the following points:-

- A rather gradual subsidence with few short periods of interuption.
- The Tertiary and Upper Cretaceous sequences are not thermally mature.
- The basal Eumeralla Formation entered early maturity some 30M.Y.A. at the depth of 2200 meters.

PERMIT: PEP 105 **NAME:** PINE LODGE-1 **PAGE NO.:** 1 OF 2

PORTLAND TROUGH DATA BASE **TABLE NO.:** 4

FORMATION	TYPE	BEGIN AGE (M.Y.)	WELL TOP (m)	PRESENT Thickness (m)	MISSING Thickness (m)	LITHOLOGY					V_{Ro}		TEMPERATURE		GEOLOGICAL TIME
						LST	CLAY	SST	SLST	COAL	DEPTH	V_{Ro}	DEPTH	T C°	
EROSION - 1	E	20			-300						740	0.36	1005	49	
MIS.P.C. LS.	D	22			250						1030	0.37	1684	67.3	
P.C. LS	F	25.2	0	109		100					1070	0.45	1918	74	
GELLIBRAND ML	F	30	109	24			100				1123.5	0.37	1933.6	76.2	
EROSION - 2	E	36			-400						1300	0.45	2148	78.1	
MIS. DILWYN	D	40			350		28	70		2	1624	0.44			
DILWYN	F	54	133	608.5			28	70		2	1787	0.47	GRADIENT		
PEMBER	F	60.2	741.5	289.5			96	4			1815	0.45	0	2.9	
EROSION - 3	E	62.5			-100						1898	0.54	1005	2.8	
MIS.P. PT	D	63			80		36	64			1931	0.53	1684	2.7	
PEBBLE POINT	F	66.5	1031	51.5			36	64			2007	0.50	1918	2.6	
PAARATTE	F	89	1082.5	786			42	47.5	9	1.5	2030	0.57			
BELFAST	F	92	1868.5	157				8	92		2052.5	0.57			
WAARRE	F	96	2025.5	81				22	78		2076.5	0.59			
EROSION - 4	E	100									2091	0.63			
MIS EUMERALLA	D	105			80			22	78		2121.5	0.47			

PORTLAND TROUGH DEPOSITIONAL AND TECTONIC HISTORY

PINELODGE 1

May 17, 1991
9:22 am

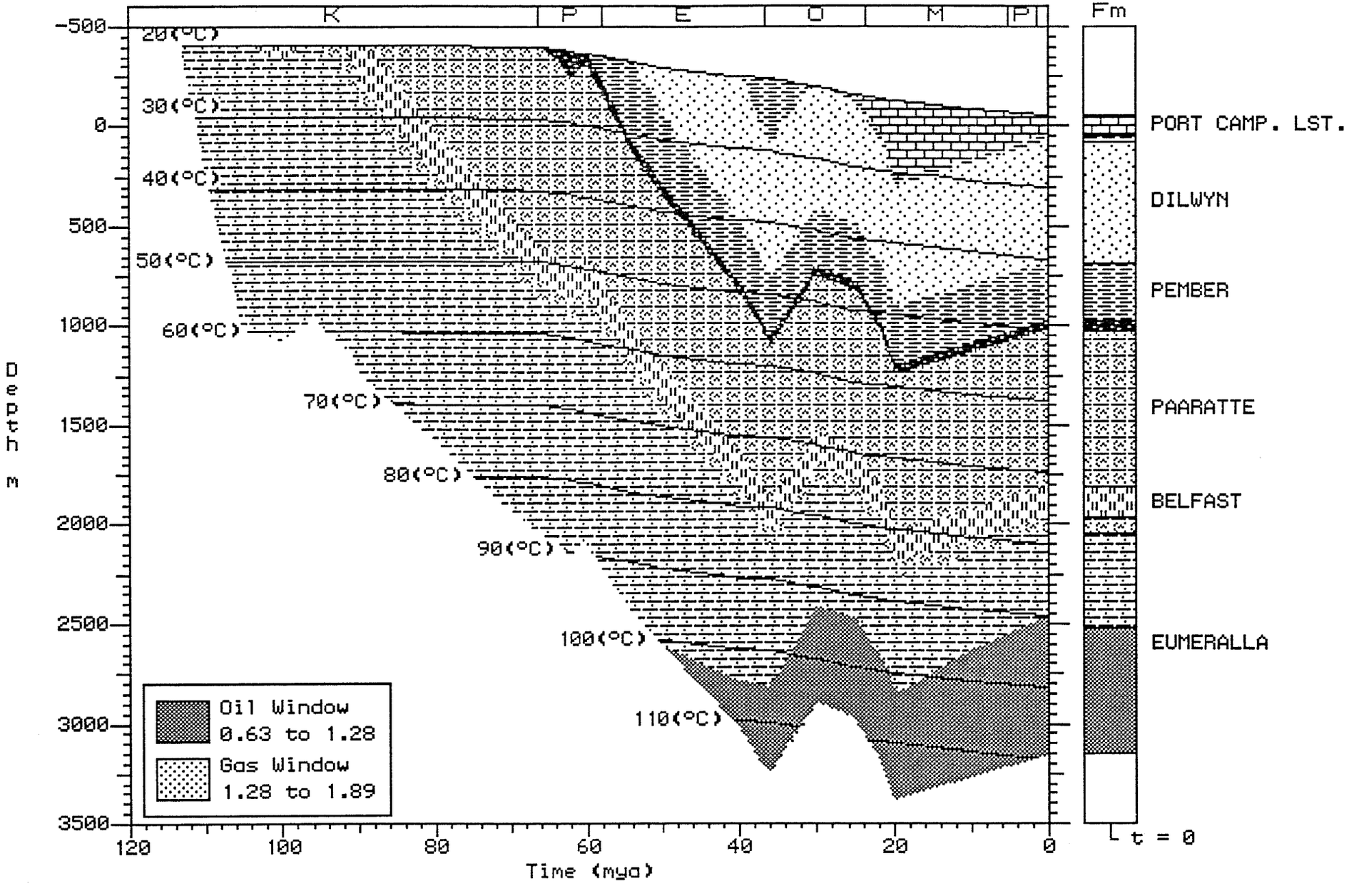


FIGURE 23

PORTLAND TROUGH

PINELODGE 1

MATURITY PROFILE

May 17, 1991
9:41 am

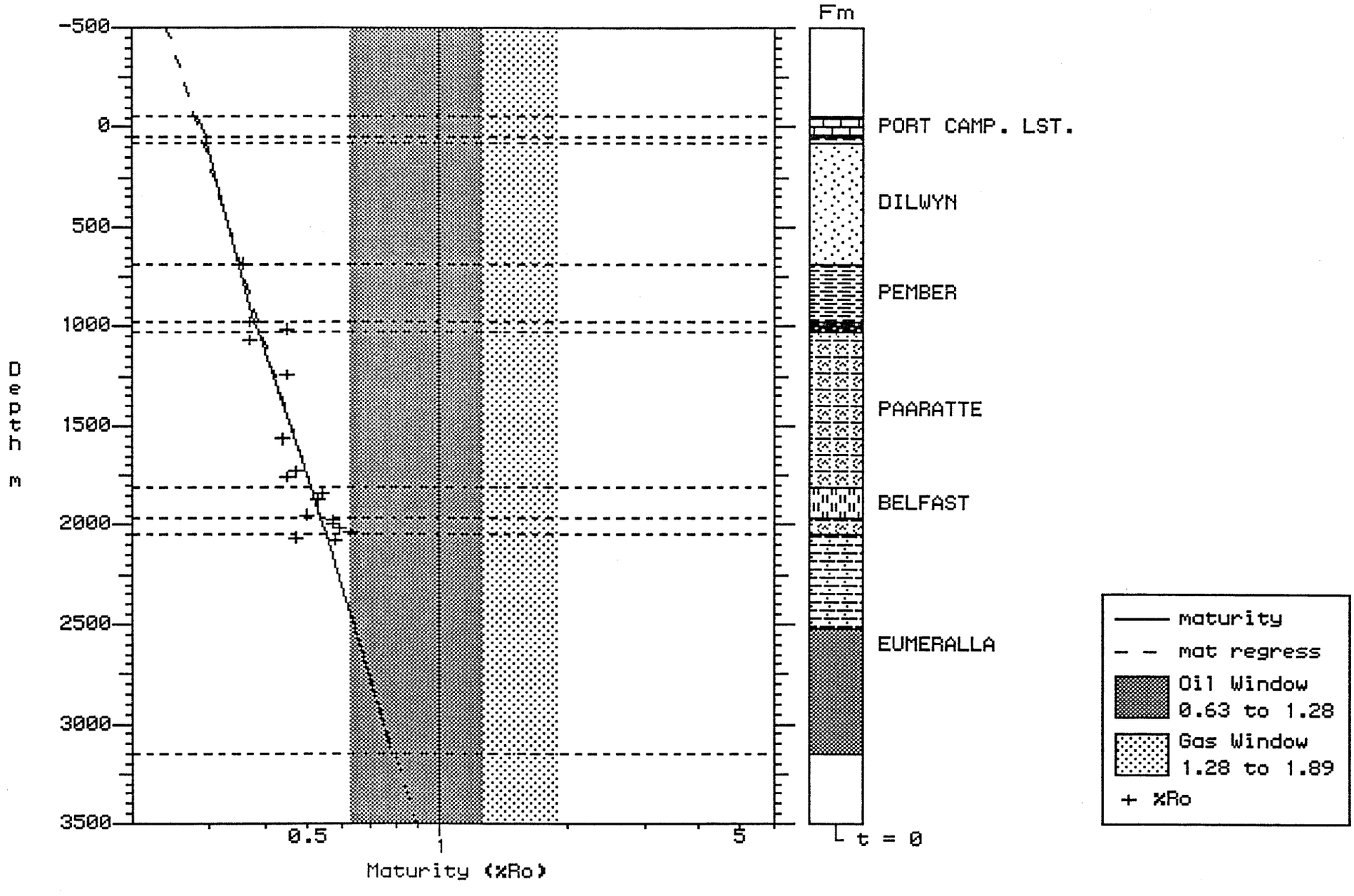


FIGURE 24

6. PRESENCE AND ORIGINS OF CARBON DIOXIDE.

6.1 Presence of the CO_2

The presence of natural carbon dioxide is geographically wide spread throughout the Otway Basin. It's occurrence however is very diverse in terms of locality, formation, geological age, quantity, and concentration. Although CO_2 is common as a component of natural gas, occurrences of high purity gas in commercial amounts is relatively rare. The presence of CO_2 in significant quantities have been reported in the following wells:

Well Name	Formation	$\%CO_2$	Occurrence
Caroline No.1	Waarre	98.9	Gas flow 2.7MMCFD
Garvoc No.1	Pretty Hill	96.3	Gas-cut to water
Grumby No.1	Waarre	51.7	Gas flow 2.3MMCFD
Kalangadoo No.1	Otway	96.27	Gas flow 2.8MMCD
Pine Lodge No.1	Belfast	96.9	Gas flow 4MMCFD

6.2 Origin of the CO_2

Several diverse sources of subsurface CO_2 accumulation have been proposed by various authors and are summarized as follows:

6.2.1 *Inorganic Origin of CO_2*

Carbon dioxide has been found in large quantities in the areas where the host rocks have been found to be very poor in organic content leading to the belief of an inorganic source for CO_2. In the absence of organic materials, the CO_2 can be evolved under the following conditions:

Metamorphism of Carbonate

Farmer (1961) concluded that most of the carbon dioxide found in relatively large accumulations, had its origin in the breakdown of impure limestone and dolomite under the heat generated by igneous intrusion. This theory was also used by Gulf (1971) to attribute inorganic origins to

natural gas in areas where high temperature magmas had intruded carbon bearing sediments. Granite and metamorphic rocks have also been shown to be capable of generating significant quantities of carbon dioxide.
Disolution of carbonates by very low pH ground water could also be important in generating CO_2.

6.2.2 *Organic Origin*

Decay of Organic matter

Thermal degradation of organic matter results in generation of carbon dioxide. During initial degradation at relatively low pressures and temperatures ($<80^{C}$) high microbial activity lead to the formation of CO_2 as a component of natural gas. At vastly increased temperature and pressures, breakdown of organic matter, including hydrocarbons generated during diagenesis - catagenesis, can lead to the liberation of carbon and formation of CO_2.

Oxidation of hydrocarbon

Oxidation of hydrocarbon by mineralised waters has also been suggested as the source of carbon dioxide.

6.3 Significant Features of Otway CO_2 accumulation

J. Mulready (1971) summarized the distinguishing features of the major CO_2 accumulations within Otway Basin as follows:-

- High purity of CO_2
- Different depths of burial
- The lack of any significant carbonate sequence in close vertical proximity to the reservoir beds.
- The lack of a significant percentage of the organic material in the host sediments.
- Their association with horizons of different lithology and age.

- Their association with areas of recent volcanic activities.
- Association with faulting and fault controlled structures.

Many of these features are consistent with the Pine Lodge occurrence except that no volcanics were encountered in Pine Lodge - 1 or surrounding wells, and surface volcanics are restricted to areas further eastwards from the Pine Lodge locality. The absence of significant quantities of hydrocarbons implies that an origin attributable in-situ biogenic degradation of entrapped hydrocarbons is highly unlikely; and the low thermal maturity of the Belfast, Waarre and upper Eumeralla Formations mitigates against sourcing from organic rich sediments undergoing normal maturation with burial in these intervals.

Therefore a theory involving the migration of CO_2 into Pine Lodge seems more befitting in which case the question remains as to the ultimate source of the migrated carbon dioxide.

Recent work on the generation of carbon dioxide and methane has utilised isotopic ratio measurements in an attempt to identify the source of carbon. Oxygen isotope studies may be required to throw further light on the origin of the CO_2.

APPENDIX 1

APPENDIX -1

DETAILS OF DRILLING PLANT

ATCO-APM RIG 2

Drawworks

MidContinent U-36-A Single Drum Drawworks

Horsepower Rating	:	1000 Input, 600 Continuous
Hoisting Speeds	:	2
Rotary Speed	:	1
Catheads	:	Kelco Model 16-L
Hydromatic	:	Parmac 281
Drive	:	GE 752 DC traction motor with 10 hp electric blower
Crown Saver	:	Barber

Rigpower

SCR	:	GE AMP Supply 600 Volts, 3 phase, 3 wire, 60 Hz, 2300 AMP. Power converter rating 750 VDC 1000 AMP DC complete with interface panel for 4 - 500 KW generators and SCR power converters.
Generators	:	4 x Brushless Synchronous Alternator powered by 4 - D353 Turbo charged diesel engines complete with Barber Rig Savers

Derrick

Mast	:	131' Modified Lee C Moore Mast Leg Spread 18 ft GNC 450,000 lbs Max Hook Load 10 lines - 450,000 lb
Crown Blocks	:	Cross Sheave-5-36" Grooved 1-$1/8$" Fast Sheave -1-36" Grooved 1-$1/8$" Dead Sheave -1-36" Grooved 1-$1/8$"

Sub Structure

: Dreco Four Section Box Style
Max Pipe Set Back Capacity-330,000 lbs
Max Rotary Table Capacity-475,000 lbs
Overall Size - 7'2"W x 39'6"L x 16'H

Swabbing Unit	:	Type "H-25" Ideco. 9000' x $9/16$" line. Powered by GM 6-71 diesel motor, complete with 1-10' x 1 $3/4$" sinker bars 1-$9/16$" swivel rope socket 1-$2\,3/8$" swabbing mandril 1-$2\,7/8$" swabbing mandril
Miscellaneous	:	1 - High pressure water blaster

Safety Equipment : Includes stretcher, safety belts, first aid kits, general TGC 30 lb. fire extinguishers, inflatable air splints, chemical goggles, geronimo safety slide, face shields, vest type safety harnesses, lift harnesses

Vehicles : 1-4 Wheel Drive Forklift complete with bucket and forks
1 Toolpusher Ute
1 Crew Wagon

Toolpusher Unit : 15 m x 3 m Unit comprising of 2 bedrooms, 2 offices and ablution area - fully furnished

Camp and Equipment : 1 - Fully furnished and air conditioned 30 man camp (18 m x 18 m) including kitchen and ablutions 1-12 m x 3 m Camp Support Unit comprising generators, fuel and water tanks, and camp storage. 1-12 m x 3 m cooler, freezer and store.

Spools and Valves : 1-13 5/8" 5000 psi x 11" 5000 psi cross-over spool
1-13 5/8" 5000 psi x 7 1/6" 5000 psi double studded adaptor

Handling Tools : Back-up set of 4 1/2" drill pipe elevators and slips

Dog House : Size 10'W x 25'L x 8'5"H

Contents: knowledge box, lockers, outside tool board, first aid kit, fold-away metal table, steel bench, double-door parts cabinet

Pump House 1 : Size: 10'W x 30'L x 9'H

Pump House 2 : Size: 10'W x 30'L x 9'H

Accumulator/Storage Room : Size: 10'W x 40'L x 8'8"H

Storage Tanks

Water Tank : Size: 12'W x 36'3" x 8'6"H
Total Capacity: 550 barrels.

Water Circulating Pump : No. 1 and No 2: Mission 2 x 3R Centrifugal pumps driven by 10 hp electric motors

Fuel Tank : Size: 7' dia x 30'L
Total Capacity: 32,000 litres

Fuel Transfer Pump : 2 - 1" x 1" fuel transfer pumps driven by 1 hp electric motors

Additional Equipment

Catwalk and Pipe Racks	:	1 - 7'8"W x 40'L x 3'6"H Catwalk 5-3'6"H x 30'L sets of tumble pipe racks.
Subs	:	All subs required for Contractor's tubulars
Hole Stabilizing	:	2 - Drilco 6 3/4" OD x 4 IF Pin and box stabilizer body for $8\frac{1}{2}$" hole 1 - Drilco Model 60 $8\frac{1}{2}$" near bit reamer 1 - Drilco 8" OD x $6\frac{5}{8}$" Pin and box connections for $12\frac{1}{4}$" and $17\frac{1}{2}$" hole
Casing and Tubing	:	Farr Model "LW" Hi-Torque casing tongs with torque gauge assembly, complete with: $5\frac{1}{2}$", 7", $9\frac{5}{8}$", and $13\frac{3}{8}$" casing jaws Casing elevators and slips for: $5\frac{1}{2}$", 7", $9\frac{5}{8}$" and $13\frac{3}{8}$"
Fishing Equipment	:	To suit all Contractor's tubulars
Kelly, Kelly		1-$4\frac{1}{4}$" x 40' square kelly with $6\frac{5}{8}$" Reg connection
Bushing, Kelly, Cock and Stabbing Valve	:	1 - Foster Type "77-1" kelly spinner 1 - Roller driver kelly bushing 1 - upper kelly cock with $6\frac{5}{8}$" Reg connections 1 - lower kelly cock with 4" XH connections 1 - Griffith stabbing valve

Handling Tools

Slips, Spider & Safety Clamps	:	1-Varco $4\frac{1}{2}$" drill pipe slips 1-Varco 5" drill pipe slips 1-Varco 7" drill collar slips 1-Varco 9" drill collar slips
Rotary Tongs	:	1 Set Wooley rotary tongs complete with jaws $2\frac{3}{8}$" - 17" with Tugger pull back
Elevators & Links	:	$2\frac{1}{4}$" x 108" Weldless elevator inks $4\frac{1}{2}$" "GG" centre latch 18 degree, drill pipe elevators 7" - $13\frac{3}{8}$" casing elevators

Winches & Floorlines : Curtis hoover hydraulic power system driven by a 50 hp electric motor (mounted in substructure)
1-Gearmatic hydraulic tugger winch complete with 250' of $\frac{5}{8}$" steel cable
1-Wireline survey unit with 10,000' of .092 plow steel line

Instrumentation :

1-Geolograph remote pump pressure gauge
1-Geolograph rotary torque system panel mount with 6" gauge
1-Geolograph RPM Tach Drive Assembly
1-SPM Tach Drive Assembly
1-Geolograph Tong Line Pull Assembly
1-M/D indicator complete with diaphram
1-Weight indicator transmitter
1-Geodrill Bit Sentry automatic drilling control
1-Geolograph Drill-Sentry 6 Pen Recorder
1-Cameron Type "C" mechanical deadline anchor type weight indicator
2-mud pressure gauges - floshow, pump stroke counter, pitograph
1-Single shot dual short deviation record 7° and 14°

Buildings

Generator Building 1 : Size 10'W x 38'L x 10'H (for Generators Nos 2 and 3)

Generator Building 2 : Size 10'W x 38'L x 10'H (for Generators Nos 2 and 3)

Tool House : Size 10'W x 30'L x 9'H

Desilter : 10-100 mm (5") cones related 2,250 lt/min (500 gal/min), driven by a Mission Magnum 5"x6"x11" pump, powered by a 50 hp electric motor

Blowout Preventers

Annular : Shaffer "Spherical" 346 mm - 34,470 kPa

Rams : ($13\frac{5}{8}$" - 5,000 psi)
2 - Shaffer "SL-SGL" 346 mm - 34,470 kPa ($13\frac{5}{8}$" - 5,000 psi) single gate ram preventers

Additional Blocks : 1 set each of the following
Tubing - $2\frac{3}{8}$", $2\frac{7}{8}$" and $3\frac{1}{2}$
Casing - $5\frac{1}{2}$", 7" and $9\frac{5}{8}$

Spools and Valves : 1-$13\frac{5}{8}$" x 12" 900 Series Adaptor Spool with 3" 5,000 psi flanged outlets
1-$13\frac{5}{8}$" x $13\frac{5}{8}$" 900 Series Adaptor Spool with 3" 5,000 psi flanged outlets
5-McEvoy automatic self sealing gate values
3" Fig 120 API full port RM-12 Trim 5,000 psi
1-McEvoy HP check valve, 3" 5,000 psi full port
1-$13\frac{5}{8}$" 5,000 x 11" 3,000 psi cross-over spool

Hydraulic Fluid Accumulator	:	Wagner Model 20-120-3BNH Accumulator 120 gallon Capacity, 5 station control valves, Nitrogen Bottle Backup System Triplex Pump with 20 hp Electric motor Remote Drillers Control Panel
Well Control Manifold	:	McEvoy automatic self sealing gate valves, 3" Fig 29, fullport RM-12 trim 5,000 psi 2-Willis M-3 Multi-Orifice Chokes 550 ft. Flare line, $2^{7}/_{8}$" tubing 120 ft. Degasser Line, 4" tubing 1-16" Flow Nipple
Drill Pipe	:	10-Jnts $4^{1}/_{2}$" OD "HEVI WATE" with 4 IF connections 200-Jnts $4^{1}/_{2}$" OD Grade "E" drill pipe, 16.60 # with 4 IF connections, internal coated and hard banded 200-Jnts $4^{1}/_{2}$" OD Grade "G" drill pipe, 16.60 # with 4 IF connections, internal coated and hard banded
Drill Collars	:	25-$6^{1}/_{2}$" OD with 4 IF connections 8-8" OD with $6^{5}/_{8}$" regular connections
Rotary Table	:	National Model MS205, Size-$20^{1}/_{2}$", Complete with Split Master Bushings
Travelling Block	:	Model 542 E 200 National Block and Hook Combination with 5-42" Diameter Sheaves Capacity-200 tons
Swivel	:	National Model n-69 Swivel, complete with support for Foster Kelly. Capacity-300 tons
Mud Pumps		
No.: 1	:	National 8P80 triplex $6^{1}/_{4}$" x $8^{1}/_{2}$" Hydril K-20 pulsation dampener Discharge strainer cross 2" Cameron safety relief valve 1 GE752 DC traction motor rated to 800 hp
No.: 2	:	National K500A Duplex $7^{1}/_{4}$" x 15" Hydril K10 pulsation dampener Discharge strainer cross 2" Cameron safety relief valve 1 GE752 DC traction motor rates to 550 hp 1 x Mission magnum 5" x 6" x 14" mud mixing pump powered by 60 hp electric motor

Mud Tanks	:	Total Capacity - 870 bbls
Tank No. 1	:	Four compartment tank with sand trap Overall size - 9'W x 50'L x 6'H Four subsurface guns Swaco vacuum degasser
Tank No. 2	:	Three Compartment Tank Overall Size - 9'W x 50'L x 6'H 2 agitators powered by 10 hp electric motors 1 agitator powered by 5 hp electric motor
Shale Shakers	:	2-Brandt dual tandem shale shakers each driven by a 5 hp electric motor
Desander	:	4 x 160 mm (6") cones driven by a Mission Magnum "I" 6" x 5" x 14" pump powered by a 60 hp electric motor

APPENDIX 2

APPENDIX 2

SUMMARY OF WELLSITE OPERATIONS

The Pine Lodge No.1 wellsite was prepared by the Mt. Gambier Earthmovers Pty. Ltd.

A 16" conductor pipe was installed and cemented at 9.9m.

The ATCO-APM Rig No.2 was rigged up and Pine Lodge No.1 was spudded at 2030 Hrs on 27th July, 1990.

Drilling $12^1/_2$" hole continued to 309.83m where $9^5/_8$" casing was run and cemented with the float at 292.97m and the shoe at 305.7m.

The blow out preventors, choke manifold, flare line and kill lines were installed and successfully tested to 1500 psi.

The float, cement and shoe were drilled out and after drilling 5 metres of new hole, a Formation Integrity Test was undertaken with 8.9 ppg mud in the hole. The formation held 220 psi in addition to the hydrostatic mud pressure this being equivalent to a mud weight of 13.00 ppg.

Drilling $8^1/_2$ in. hole continued uneventfully to 1902m with bit changes at 818, 943, 1225, 1382, 1463, 1541, 1722, 1809, and 1866 metres respectively.

At the depth of 1942m, a total of $16^1/_2$ hours were lost waiting on repairs to the Hydromatic.

The $8^1/_2$" hole was deepened to 1975 metres where DST-1 was conducted over the interval 1939.9 - 1967.13 metres using conventional off-bottom open hole straddle packers. The top and bottom packers were set at 1937.5, 1939.9 m and 1967.13, 1971.42 m respectively.

Following DST 1, the hole was conditioned and core No.1 was cut from 1975-1984.14 m (9.14 m) with 100% recovery.

Drilling $8^1/_2$" hole continued until a total depth of 2149.6m (DD) at 0930 hours on 27 August, 1990 with bit changes at 1942, 1975, 1985, 2044.1 and 2087 metres respectively.

At total depth the hole was conditioned and the following logs were run by Halliburton Logging Services.

GRS

DLL/MSFL/GR

SLDT/CNT/GR

FED/GR

SWC

Velocity Survey

Following logging, the hole was conditioned and the following DSTs were carried out:

DST NO.	INTERVAL
2	2018 - 2094 (misrun)
3	2043 - 2070
4	1940 - 1967
5	1032 - 1059
6	1709 - 1736
7	1709 - 1736

The hole was conditioned and $5^1/_2$" casing was run and cemented with the shoe at 2142.7m.

A 10" x 6" tubing spool complete with $5^1/_2$ in casing pack-off adapter was installed. Figure 25.

A total of 250 barrels of 9.2 ppg sodium chloride brine containing Baracor A (B 1400) inhibitor/microbiostat with a pH of 10.5 was mixed.

A casing scraper was run on tubing and after displacing the casing with the sodium chloride brine, the tubing was pulled out.

A plate was installed on top of tubing spool.

The rig was released out 2400 hrs on 9th September, 1990.

Figure 26 shows the proposed and the actual drilling time.

GAS AND FUEL EXPLORATION N.L.

PINE LODGE No.1

WELL SUSPENSION DIAGRAM

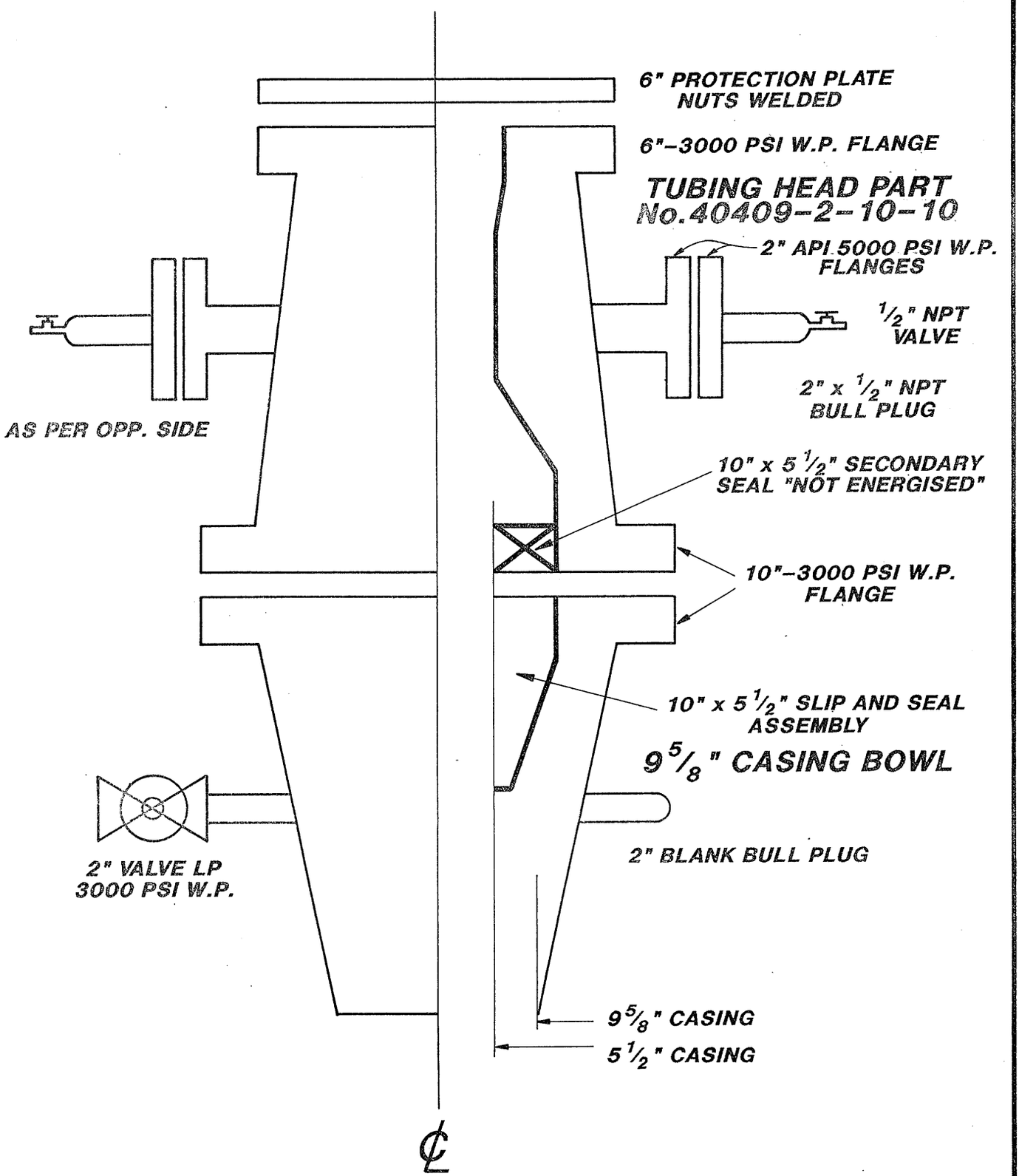
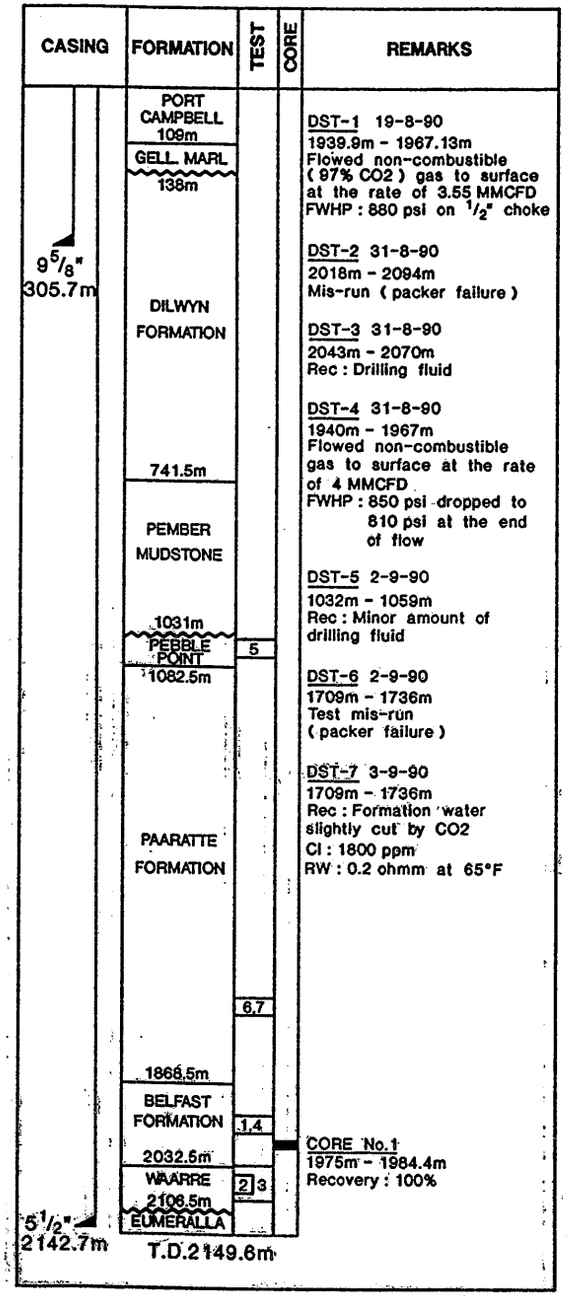


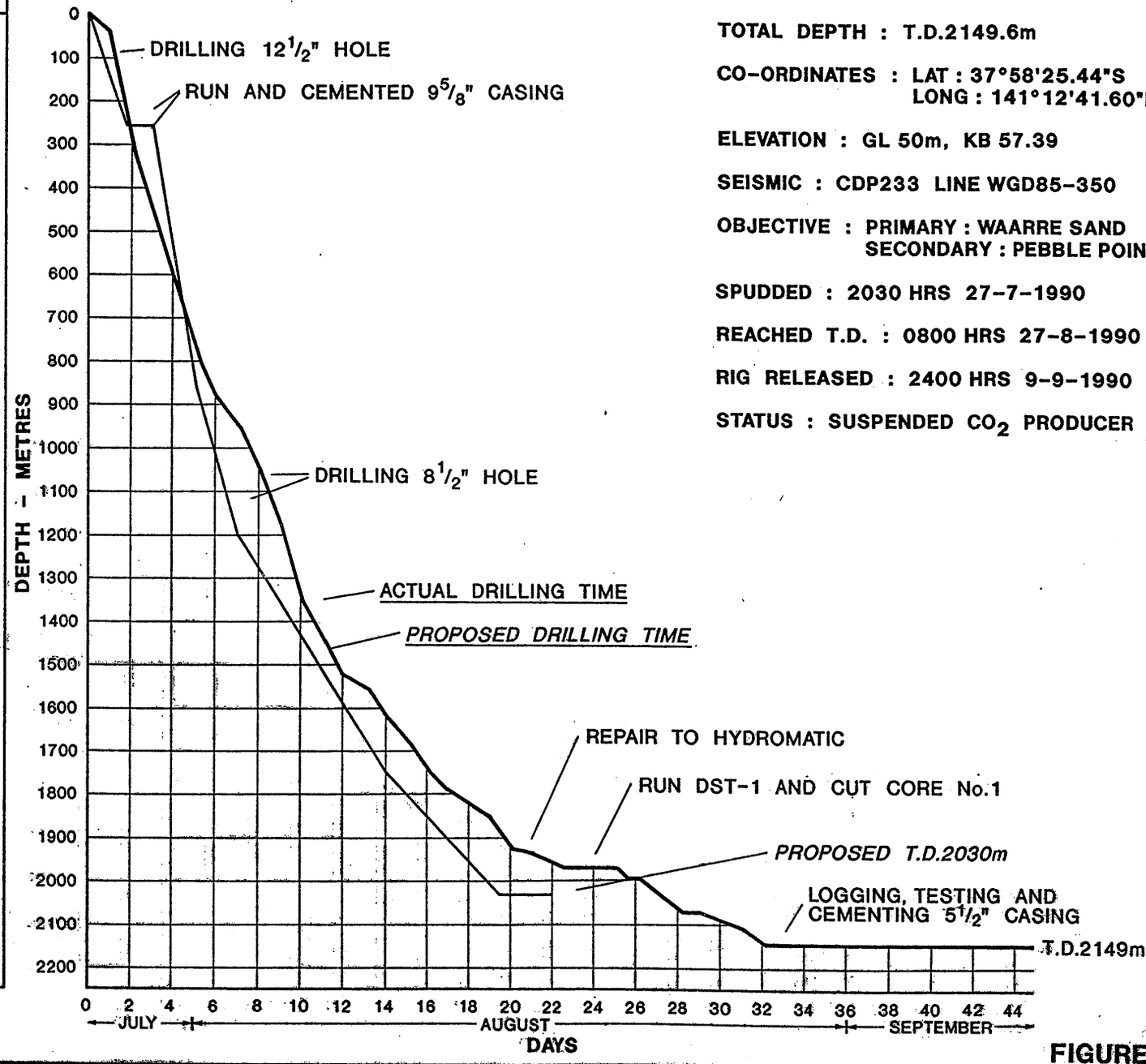
FIGURE No.25

GAS AND FUEL EXPL[illegible] ON N.L.

PINE LODGE No.1

PROPOSED AND ACTUAL DRILLING TIMES





TOTAL DEPTH : T.D.2149.6m

CO-ORDINATES : LAT : 37°58'25.44"S
LONG : 141°12'41.60"E

ELEVATION : GL 50m, KB 57.39

SEISMIC : CDP233 LINE WGD85-350

OBJECTIVE : PRIMARY : WAARRE SAND
SECONDARY : PEBBLE POINT

SPUDDED : 2030 HRS 27-7-1990

REACHED T.D. : 0800 HRS 27-8-1990

RIG RELEASED : 2400 HRS 9-9-1990

STATUS : SUSPENDED CO_2 PRODUCER

AUTHOR : V.AKBARI

26

FIGURE 25

BLANK PAGE

END OF VOLUME ONE