GAS AND FUEL EXPLORATION N.L.

PEP 104

OTWAY BASIN

VICTORIA

BOGGY CREEK No.1

WELL COMPLETION REPORT

WCR vol.1, Boggy Creek, (W1053).

V.AKBARI

OCTOBER, 1992

VOLUME – 1

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BOGGY CREEK - 1

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SUMMARY

Boggy Creek No.1 was drilled as a wildcat exploration well in PEP104, Otway Basin, Victoria.

The participants in this well were:-

Gas and Fuel Exploration N.L. (Operator)

Bridge Oil Limited

Beach Petroleum N.L.

The well is located 35 kilometres east of Warrnambool and 10 kilometres northeast of Peterborough.

The prospect which is situated on the upthrown side of the Boggy Creek Fault is a seismically defined tilted horst block that forms part of a larger faulted complex (Boggy Creek-Schomberg structure). The complex is the most prominent of several high structures which align in a northeast-southwest direction from Westgate-1A to Curdievale-1.

The primary objective of the well was the sandstone of the Basal Late Cretaceous Waarre Formation. The secondary objectives were the Tertiary/Late Cretaceous Pebble Point Formation and the Late Cretaceous Nullawarre Greensand.

Drilling commenced at 1100 hours on 21 December 1991.

At the depth of 1673m, DST-1 was carried out over the interval 1662m-1673m which resulted in non-combustible gas flowing to the surface.

Following DST-1, core No.1 was cut from 1673m-1682.26m with 95% recovery.

Drilling continued to a total depth of 1900m reached at 1730 hours on 4 January, 1992.

At total depth the following Wireline logs were run:

Dual Laterolog, microlog, Caliper, Sonic, gamma ray log (DLS/MLL/CSS/GR)

Photodensity, neutron, Caliper, gamma ray log (PDS/CNL/GR)

Real time dipmeter, gamma ray log (PSD/CR)

Repeat formation sampler, gamma ray log (RFS/GR)

Velocity Survey

Sidewall Core (SCG).

The hole was conditioned and 7-in. casing was run and cemented with the shoe at 1898.45m.

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

$2^{7}/_{8}$-in tubing was run and the hole was displaced with brine and inhibitor.

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

The level of detected gas was not significant down to 1670m. Below this depth the first major gas peak of 13 units consisting mainly C_1 was encountered and reached to a maximum of 65 units between 1785-1790m.

Boggy Creek No.1 was suspended as a potential CO_2 producing well and the rig was released at 1500 hours on 12 January, 1992.

Figure 1 is the Summary Sheet of Boggy Creek No.1.

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OTWAY BASIN

BOGGY CREEK NO. 1

GAS AND FUEL EXPLORATION N.L.

STATUS:	SUSPENDED CO_2 PRODUCER	LOCATION:	Lat.: 38° 31' 34.1" S Long: 142° 49' 28.1" E
HOLE SIZE:	$12^1/_4$" 318m $8^1/_2$" to 1900m	SEISMIC: ELEVATION:	VP380 Line HA90-17 GL:30 KB:34.95 A.S.L.
CASING	$9^5/_8$" at 316m 7" at 1898.45m $2^7/_8$" Tubing at 1658m	SPUDDED: REACHED T.D.: RIG RELEASED: TOTAL DAYS DRILLING: TOTAL DAYS ON WELL:	21-12-91 4-1-92 12-1-92 15 22

ROCK UNIT	KB(M)	SUBSEA(m)	THICKNESS(M)
Heytesbury Group	*4.95*	*+30.0*	*456*
Port Campbell Lst	4.95	+30.0	144
Gellibrand Marl	149	-114.05	292
Clifton Formation	441	-406.05	20
Nirranda Group	*461*	*-426.05*	*110*
Narrawaturk Marl	461	-426.05	79
Mepunga Formation	540	-505.05	31
Wangerrip Group	*571*	*-536.05*	*395*
Dilwyn Formation	571	-536.05	282
Pember Mudstone	853	-818.05	52.5
Pebble Point Formation	905.5	-870.55	60.5
Sherbrook Group	*966*	*-931.05*	*775.5*
Paaratte Formation	966	-931.05	516
Belfast Mudstone	1482	-1447.05	176
Waarre Formation	1658	-1623.05	83.5

Unit -D (Flaxman Mbr)	1658	-1623.05	11.5
Unit -C	1669.5	-1634.55	19.0
Unit -B	1688.5	-1653.55	18.5
Unit -A	1707	-1672.05	34.5
Otway Group	*1741.5*	*-1706.55*	*158.5*
Eumeralla Formation	1741.5	-1706.55	158.5
Total Depth (Driller)	1900	-1865.05	
Total Depth (Logger)	1899	-1864.05	
P.B. TD	1865	-1830.05	

LOGS: DLS/MLL/CSS/GR, PDS/CNL/GR, PSD/GR, RFS, Velocity Survey, SCG, CBL/CCL/GR

TEST: DST-1 (1662-1673m) Flowed non-combustible gas at an estimated rate of 4.5 MMCFD.

CORE: one core was cut from 1673m-1682.26m with 95% recovery

SIDEWALL CORE: Number of Shot: 24 Recovered: 22

RFS: 18 pressure test over the interval 1673-1872m plus a segregated sample from 1720.1m.

GAS AND FUEL EXPLORATION N.L.

PEP 104 – OTWAY BASIN

BOGGY CREEK NO.1

WELL SUMMARY

SPUDDED : 21-12-91	OBJECTIVE : WAARRE FMN.	KBE : 34.95 A.M.S.L.
COMPLETED : 12-01-92	STATUS : CO_2 PRODUCER	LAT : 38°31'34.1"S LONG : 142°49'28.1"E

REMARKS AND TEST INFORMATION

DST – 1
1662.0 – 1673.0m
FLOWED NON-COMBUSTIBLE
(93.25% CO2) GAS TO SURFACE
AT AN ESTIMATED RATE
OF 4.5 MMCFD
FWHP : 1100 PSI ON 1/2" CHOKE
BHT : 68.33°C AT 1672.0m

CORE No. 1

INTERVAL 1673.0 – 1682.26m

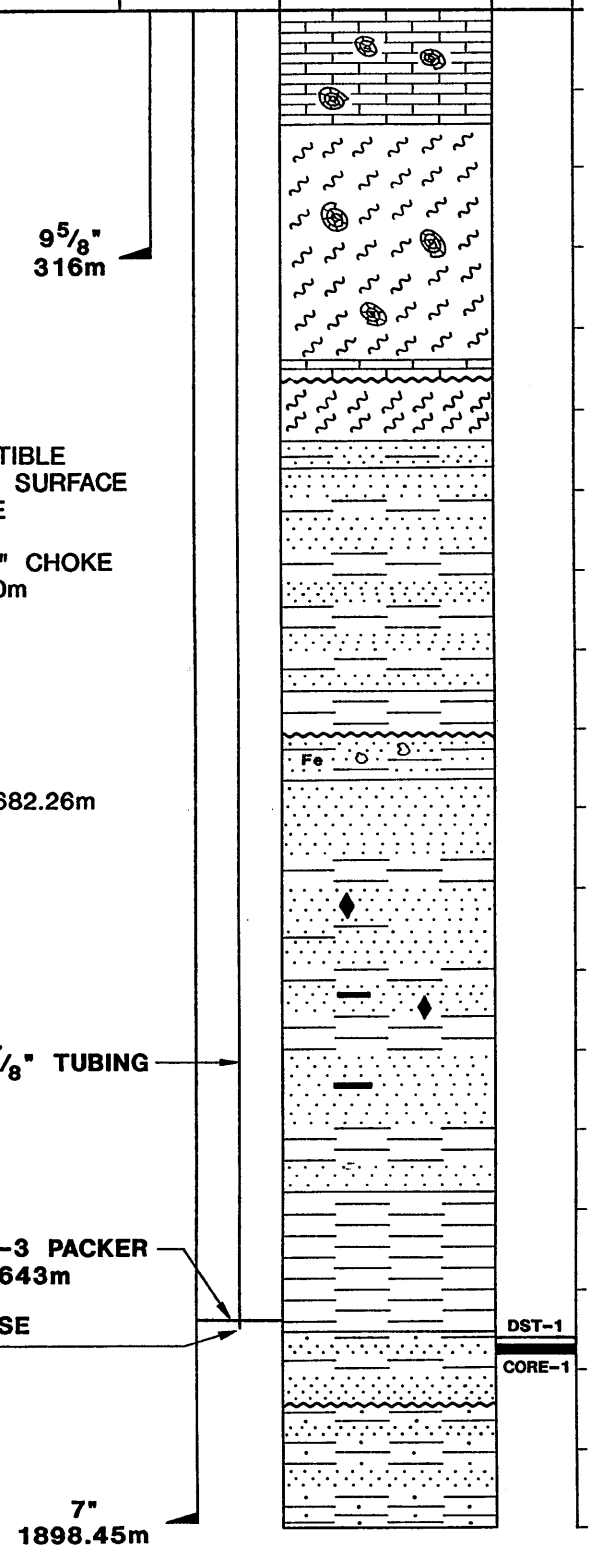
CUT / REC. 9.26 / 8.8

REC % 95

SIDEWALL CORES

No. OF SHOT : 24

RECOVERY : 22



FORMATION TOPS
Depths mKB (MSS)

- PORT CAMPBELL LIMESTONE 4.95m (+34.95m)
- GELLIBRAND MARL 149m (-114.05m)
- CLIFTON FORMATION 441m (-406.05m)
- NARRAWATURK MARL 461m (-426.05m)
- MEPUNGA FORMATION 540m (-505.05m)
- DILWYN FORMATION 571m (-536.05m)
- PEMBER MUDSTONE 853m (-818.05m)
- PEBBLE POINT FORMATION 905 m (-870.25m)
- PAARATTE FORMATION 966m (-931.05m)
- BELFAST MUDSTONE 1482m (-1447.05m)
- WAARRE FORMATION 1658m (-1623.05m)
- EUMERALLA FORMATION 1741.5m (-1706.55m)

TOTAL DEPTH 1900m (-1865.05m)

FIG. 1

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CONCLUSION

1. The primary objective of the well, the Waarre Formation, was successfully evaluated.

2. Good reservoir quality sand was found in the basal Pebble Point Formation but it was water saturated.

3. All formations within the Tertiary were encountered between 11-73m lower than forecast. These discrepancies are mainly due to errors in the predicted interval velocities.

4. The Skull Creek Mudstone and Nullawarre Greensand were not recognised. They were possibly not deposited over the Boggy Creek structure.

5. As predicted, sand with good reservoir quality was found in the Waarre Formation.

6. Seismic and dipmeter data suggest that the well may have entered a fault at around 1540m within the Belfast Mudstone with the Boggy Creek structure forming the footwall of the fault.

7. The Waarre Formation was 20 metres thinner than forecast, and was found to have good reservoir quality sand. Porosities of 15-25% and permeabilities of up to 10103 mD were measured in the core cut from within the upper part of the Waarre Formation.

8. No gas-water contact was established by logs or from RFS results.

9. The geothermal gradient was found to be low (1.56^{o}C/100m) down to 1600m (postulated fault within the Belfast Mudstone) below which depth it increased to 3.1^{o}C/100 (which is identical to that of Curdie No.1, 3 kilometres to the south of the Boggy Creek-1).

1. INTRODUCTION

Boggy Creek No.1 was drilled on the southern part of Port Campbell Embayment of the Otway Basin, Victoria.

The Otway Basin in southeast Australia formed during the early stages of continental rifting between Australia and Antarctica. It is an intracratonic east-west trending sedimentary basin that developed during the Late Jurassic - Late Cretaceous time. The basin contains up to 8000 metres of Mesozoic to Cainozoic sedimentary sequences and has an aerial extent of approximately 105,000 square kilometres extending from the Cape Otway - King Island high in Victoria to west of Kingston and Cape Jaffa in South Australia.

The Boggy Creek prospect was delineated as the result of the Peterborough Seismic Survey (1989) and the Halladale (1990) Seismic Survey. It is a tilted fault block that forms part of a larger faulted complex which includes the Schomberg structure north of the Boggy Creek block. The complex is the most prominent of several high structures, which align in a northeast-southwest direction from the Westgate -1A to Curdievale -1.

Within the Boggy Creek structure, the Waarre Formation is both overlain by Belfast Mudstone and juxtposed against Belfast Mudstone across the southern boundary fault. It abuts Eumeralla Formation sediments across the northern boundary fault.

The Boggy Creek structure was originally thought to be ideally located to trap hydrocarbons sourced from the sediments deposited within the Curdie Trough both to south and to the west. It was also thought that the zone of high structures of which Boggy Creek is one would form a preferential conduit for hydrocarbons migrating out of the Curdie Trough.

The well was designed to test as a primary objective, the nature of the fluid content in the sandy reservoirs of the basal Late Cretaceous Waarre Formation. The secondary objectives were the Pebble Point Formation and Nullawarre Greensand immediately underlying the Skull Creek Mudstone.

Geochemical and source rock studies in the Port Campbell Embayment (A. Buffin, 1987) indicate that the Eumeralla Formation and possibly the Belfast Mudstone contain mature source rocks particularly on the downthrown side of the Boggy Creek and Port Campbell fault zones.

2. WELL HISTORY

2.1 Location (see figures 2 and 3)

Co-ordinates:	Latitude : 38° 31' 34.1"S
	Longitude : 142° 49' 28.1"E
Geophysical:	VP : 380
	Seismic Line : HA90-17
Real Property Description:	Crown Allotment : 94
	County of Heytesbury
	Parish of Nirranda
	Shire of Warrnambool

2.2 General Data

Well Name:	Boggy Creek No. 1
Operator:	Gas and Fuel Exploration N.L.
	11th Floor, 151 Flinders Street
	MELBOURNE, VIC. 3000.
Participants:	Bridge Oil Limited
	Level 9, 255 Elizabeth Street
	SYDNEY, NSW. 2000

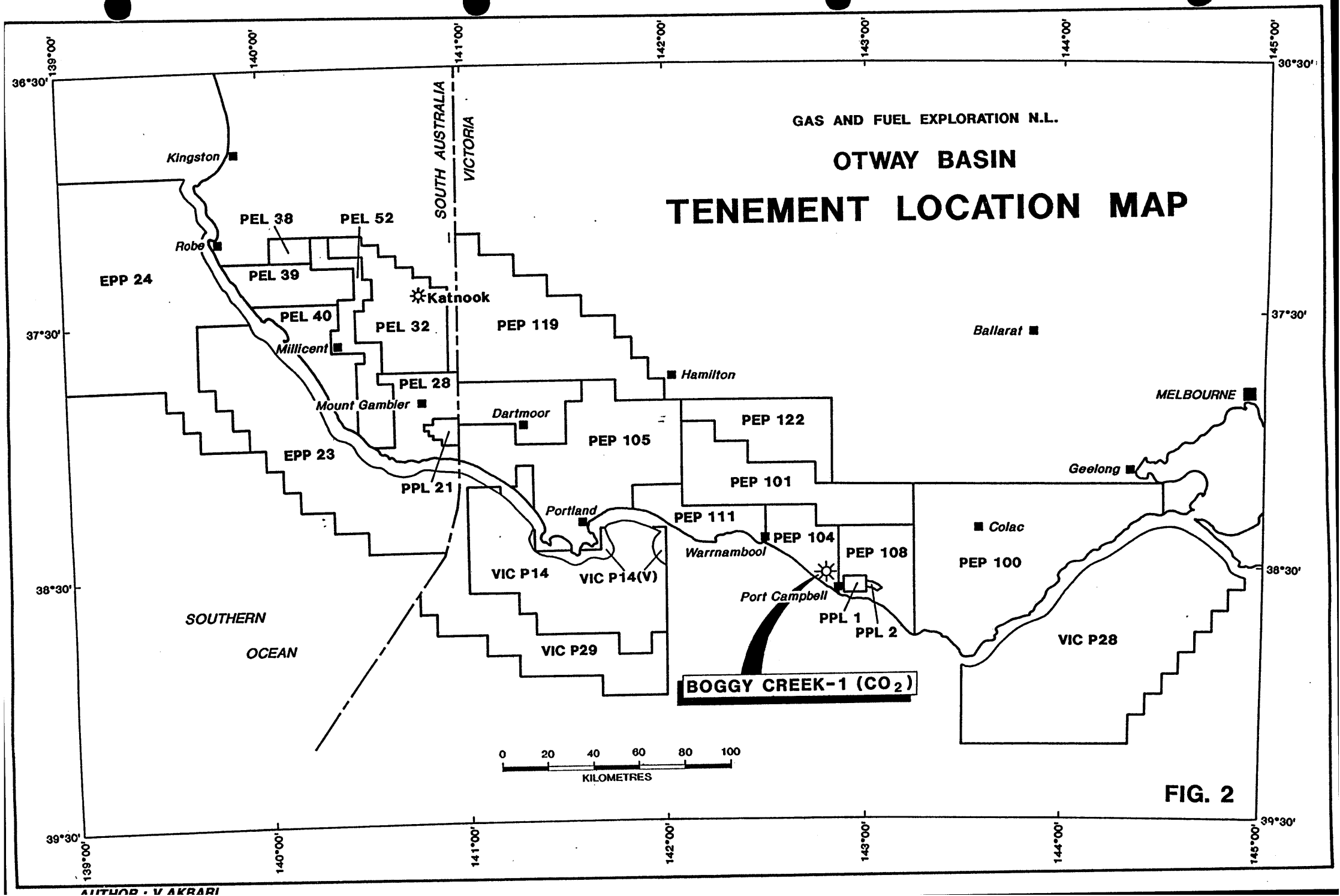

FIG. 2

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LOCATION MAP

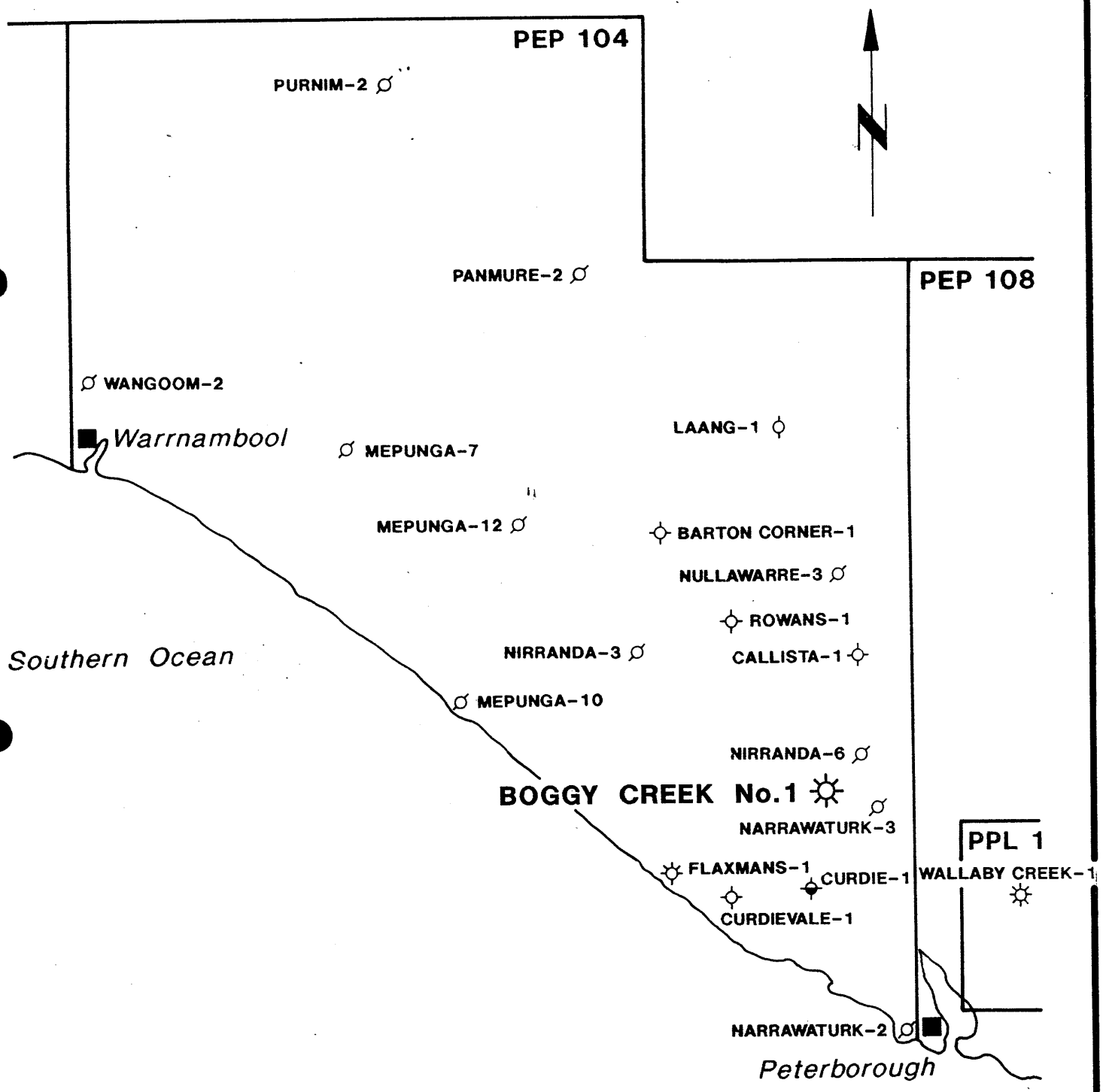

FIGURE 3

	Beach Petroleum N.L. Level 7, 345 George Street SYDNEY, NSW. 2000
Elevation:	Ground level : 30.0m ASL Kelly Bushing: 34.95m ASL (Unless otherwise stated, all depths refer to K.B.)
Total depth:	Driller: 1900m Wireline Logger: 1899m P.B. T.D. 1865m
Drilling Commencement:	21 December 1991 @ 1100 hours
Total Depth Reached:	4 January 1992 @ 1730 hours
Rig Released:	12 January 1992 @ 1500 hours
Drilling Time to T.D.:	15 days
Rig Days:	23 days
Status:	Suspended CO_2 producer.

2.3 Drilling Data:

2.3.1 *Drilling Contractor*

Gearhart Drilling Services

2.3.2 *Drilling Rig*

G.D.S. Rig 2.

2.3.3 *Casing and Cementing Details*

A 16" Conductor Pipe was set at 10.0m prior to rig up.

Surface Casing

Size:	$9^5/_8$"
Weight and Grade:	5/KSS - 36lb/ft, R3 LTC 8 round
Centralisers:	303.7m, 291.4m, 279.5m 267.6m, 267.1m & 36.2m
Float Collar:	303.2m
Shoe:	316m (Logger)
Cement:	261 sacks Class "A" cement with 2% Prehydrated bentonite followed by 202 sacks Class "A" neat cement
Method:	Single plug displacement (top plug only)
Equipment:	Halliburton Services

Production Casing

Size:	7-in.
Weight and grade:	J/KSS - 26 lb/ft R_3 8 round LTC
Centralisers:	1886.3m, 1873.9m, 1861.9m 1838m, 1814.1m, 1790.4m, 1766.6m, 1742.6m, 1718.5m 1694.7m, 1670.9m, 1658.8m, 1647.0m, 1635.0m, 1611.1m, 1574.9m, 1551.2m, 1515.4m, 1420.9m,

	1301.7m, 1183.1m, 1099.0m, 308.2m, 248.8m, and 131.4m
Float Collar:	1885.83m
Shoe:	1898.45

Tubing

Size:	$2^{7}/_{8}$"
Grade & Weight:	EU 'AB' 6 lb/ft
Depth:	1658m to surface
Packer:	1643m
Cement:	116 sacks of Class "G" cement mixed with 2.5% prehydrated gel and followed by 276 sacks Class "G" mixed with 1% Halad 322.
Method:	single plug displacement
Equipment:	Halliburton Services

2.3.4 *Drilling Fluid*

The well was spudded using fresh-water flocculated AQUAGEL in order to prevent wash-out around the conductor pipe as it had not been properly cemented. Wash out was nevertheless encountered while drilling at 145m with returns to the cellar.

Flocculated gel mud was in use while drilling $8^{1}/_{2}$" hole down to the Top of Dilwyn Formation where the gel mud system was converted to KCl/EZ mud system for

preventing clay dispersion and thus controlling solid content of the mud.

Mud losses of up to 40 bbl./hr. (averaging 10 bbl./hr.) were encountered while drilling the Paaratte Formation. The mud losses however were reduced to less than 5bbl./hr. without having to use loss circulation materials.

The mud weight and viscosity were maintained within the range of 8.8-9.3 ppg and 40-43 secs. respectively.

2.3.5 *Water Supply*

Drilling water was provided by the land owner and the water was pumped from his local dam built only a few hundred metres from the rig.

2.3.6 *Hole Conditions*

Tight hole conditions were experienced while making a bit trip at 1076m. This was due to the addition of a stabilizer to the bottom hole assembly and the hole had to be reamed from 538m to bottom. Tight hole condition was again experienced while attempting to cut a core at 1673m. A 60 ft. core barrel was run in the hole and after considerable washing and reaming, the core barrel was replaced by a 30 ft core barrel.

Minor tight hole conditions were experienced whilst logging at total depth however no major problems were encountered in making wiper trips prior to logging operations and running the 7-in. casing.

Caliper logs show various degrees of wash-out below the $9^5/_8$-in. casing shoe (316m). The wash-out zones can be generalized as follows:-

316m - 1500m	Minor wash-out with hole size for the most part being 9-10 inches. There are a few erratic washed-out spots particularly in the shaly sections between 557-570m where the hole size is up to 15 inches.
1500m - 1575m	Moderate wash-out with the hole size being up to 14 inches.
1575m - 1660m	Minor wash-out with the overall hole size being 10 inches.
1660m - 1900m(T.D.)	Very minor wash-outs with the hole size for most part being in-gauge to slightly under-gauge.

For details of the drilling fluid see Appendix 3.

2.4 Formation Sampling and Testing

2.4.1 Cuttings

No cuttings samples were collected from the surface to 18m.

Cuttings samples were collected at 10m intervals to 316m ($9^5/_8$-in. casing point) and at 5 metres intervals from 316m to the T.D. Spot samples were occasionally collected at 2 and 1 m intervals particularly during circulation for show evaluation. Each sample was washed, dried, and divided into five (5) splits, four (4) of which were stored in labelled polythene bags and the fifth one was stored in plastic sample trays. One set of washed and dried samples was distributed to the Department of Manufacturing & Industry Development (DMID). Joint Ventures other than GFE did not require any samples.

2.4.2 Cores

2.4.2.1. Conventional Core

One conventional core was cut from 1673 to 1682.26 with 95% recovery.

The core was cut using $8^1/_2$" Christenson diamond core bit.

After initial preliminary core orientation and description at the wellsite, the core was dispatched to Amdel Core Services. The following conventional core analyses were carried out.

- Continuous gamma radiation detection.

- Porosity, permeability and apparent grain densities were determined at ambient conditions on $1^1/_2$" diameter plugs taken in sandstone sections of the core at 25cm intervals.

- Log depth to core depth correlation was established by plotting core gamma ray, porosity and density values against the relevant log data correcting the grain density values for porosity and fluid content. A three metre discrepancy seems to exist between core depth and log depth and best correlation is achieved by shifting the core 3 metre low. See figures 4, 4a and 5, 5a.

GAS AND FUEL EXPLORATION N.L.

BOGGY CREEK No.1

AMBIENT GRAIN DENSITY AND POROSITY Vs LOG DATA

(NO DEPTH ADJUSTMENT)

——— Core
- - - - Log

CORE
Interval :
Recovery :

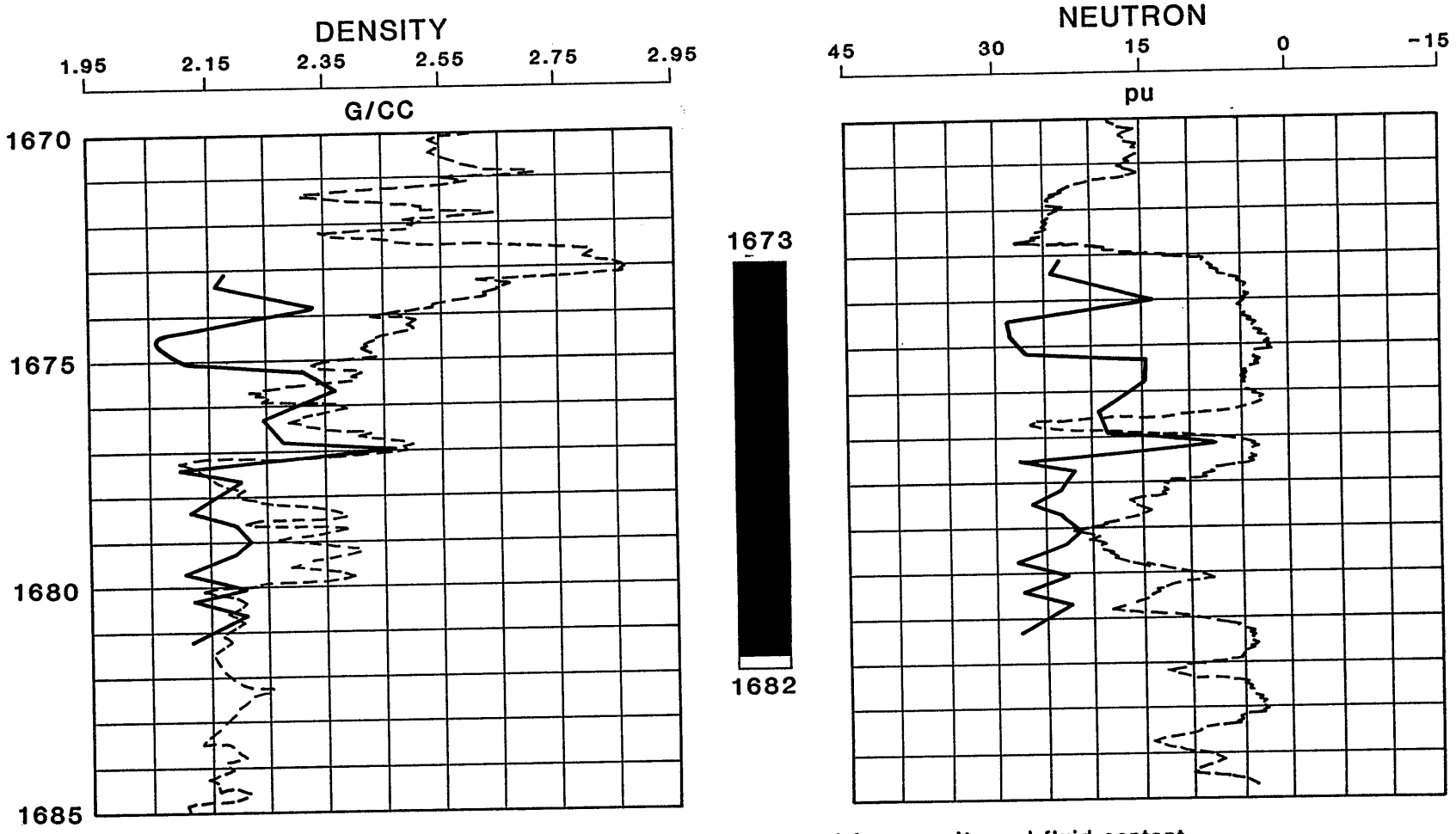

FIG. 4

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NOTE: Grain density values are corrected for porosity and fluid content

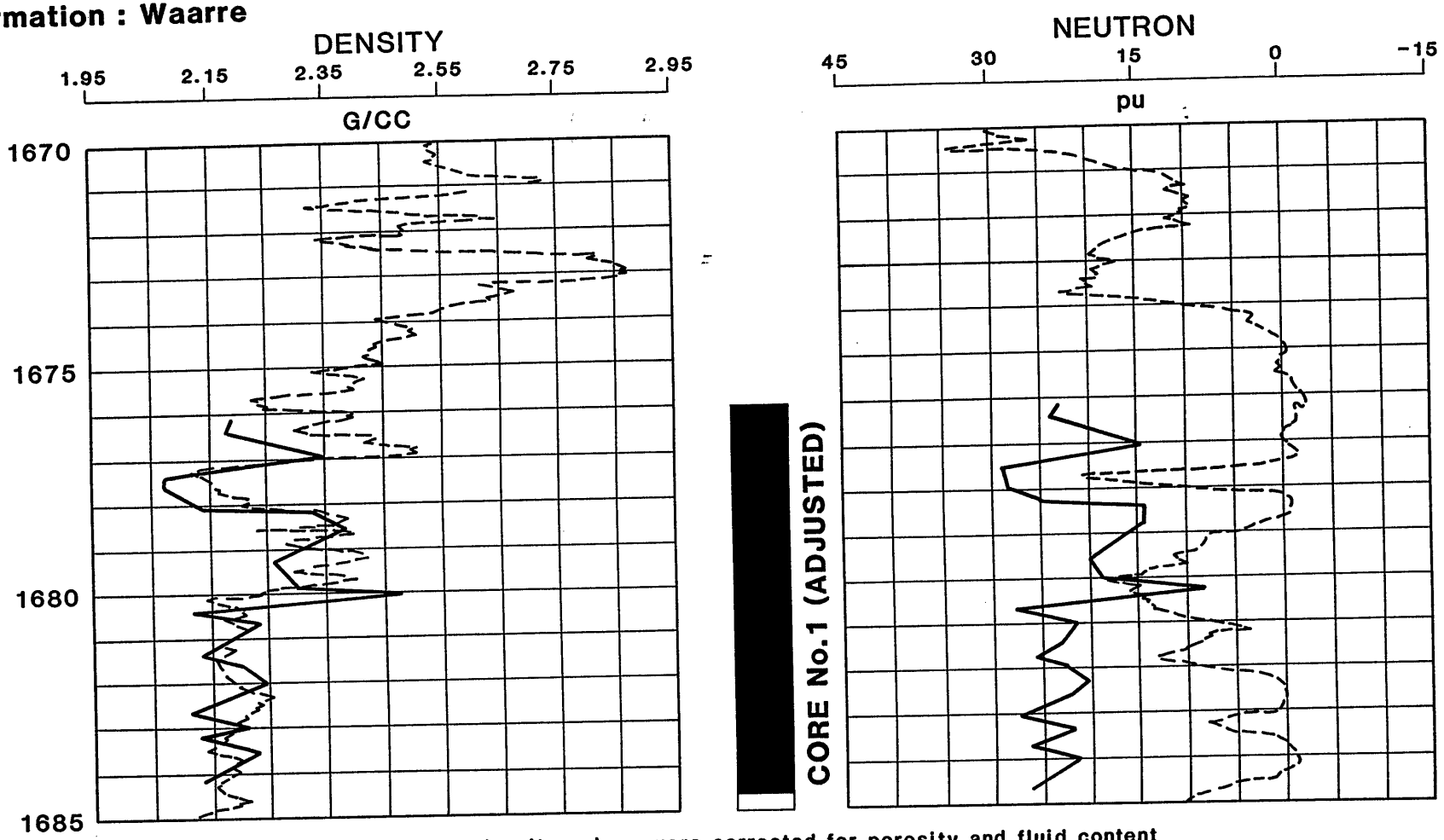
GAS AND FUEL EXPLORATION N.L.

BOGGY CREEK No.1

AMBIENT GRAIN DENSITY AND POROSITY Vs LOG DATA

(DEPTH ADJUSTED)

CORE No.1
Interval : 1673m-1682m
Recovery : 96.7%
Formation : Waarre



NOTE: Grain density values were corrected for porosity and fluid content

FIG. 4A

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GAS AND FUEL EXPLORATION N.L.

BOGGY CREEK No.1

CORE GAMMA RAY Vs LOG GAMMA RAY (DEPTH UNADJUSTED)

CORE
Interval :
Recovery :

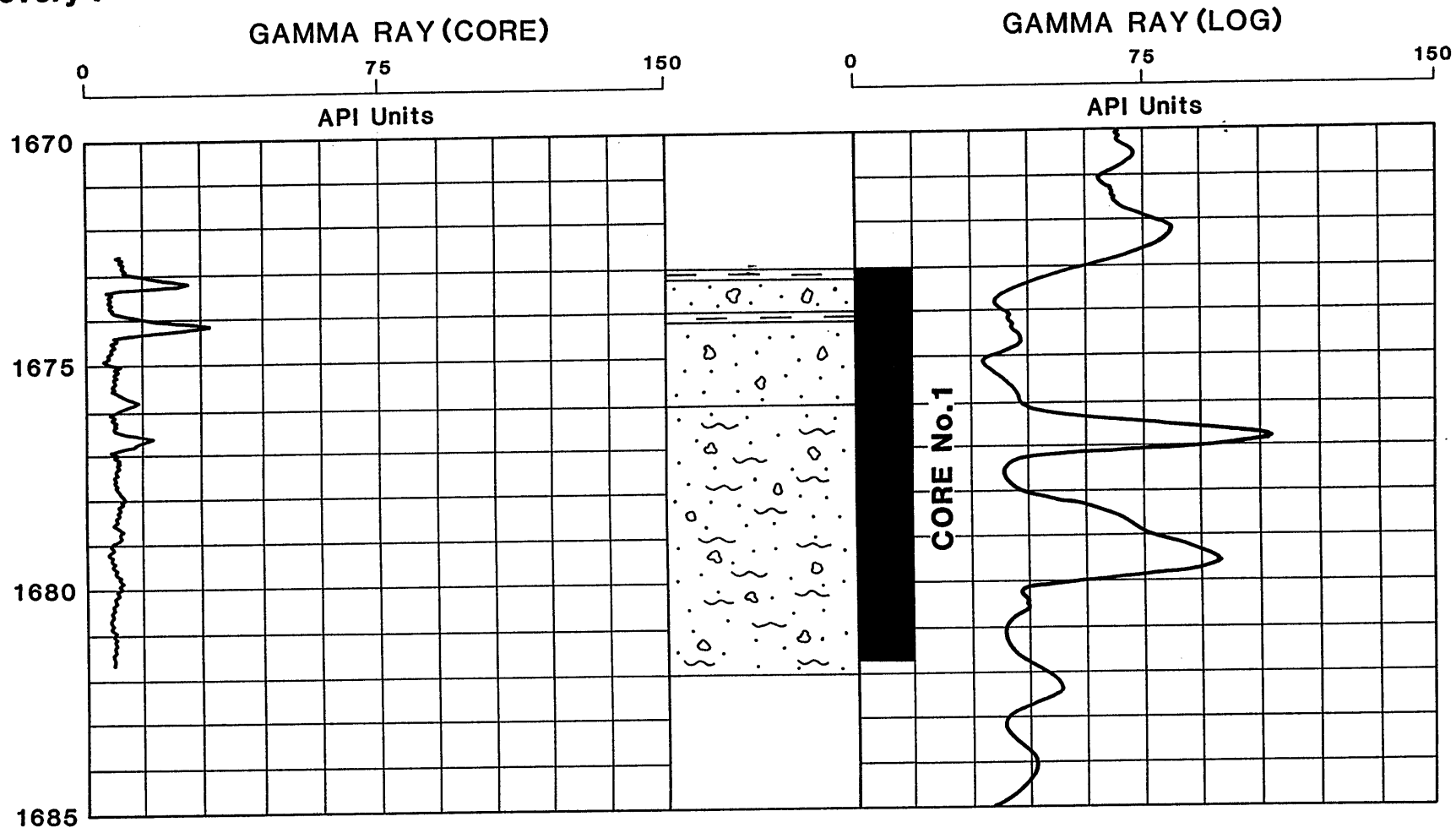

FIG. 5

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GAS AND FUEL EXPLORATION N.L.

BOGGY CREEK No.1

CORE GAMMA RAY Vs LOG GAMMA RAY (DEPTH ADJUSTED)

CORE No.1
Interval : 1676-1685
Recovery : 96.7%
Formation : WAARRE

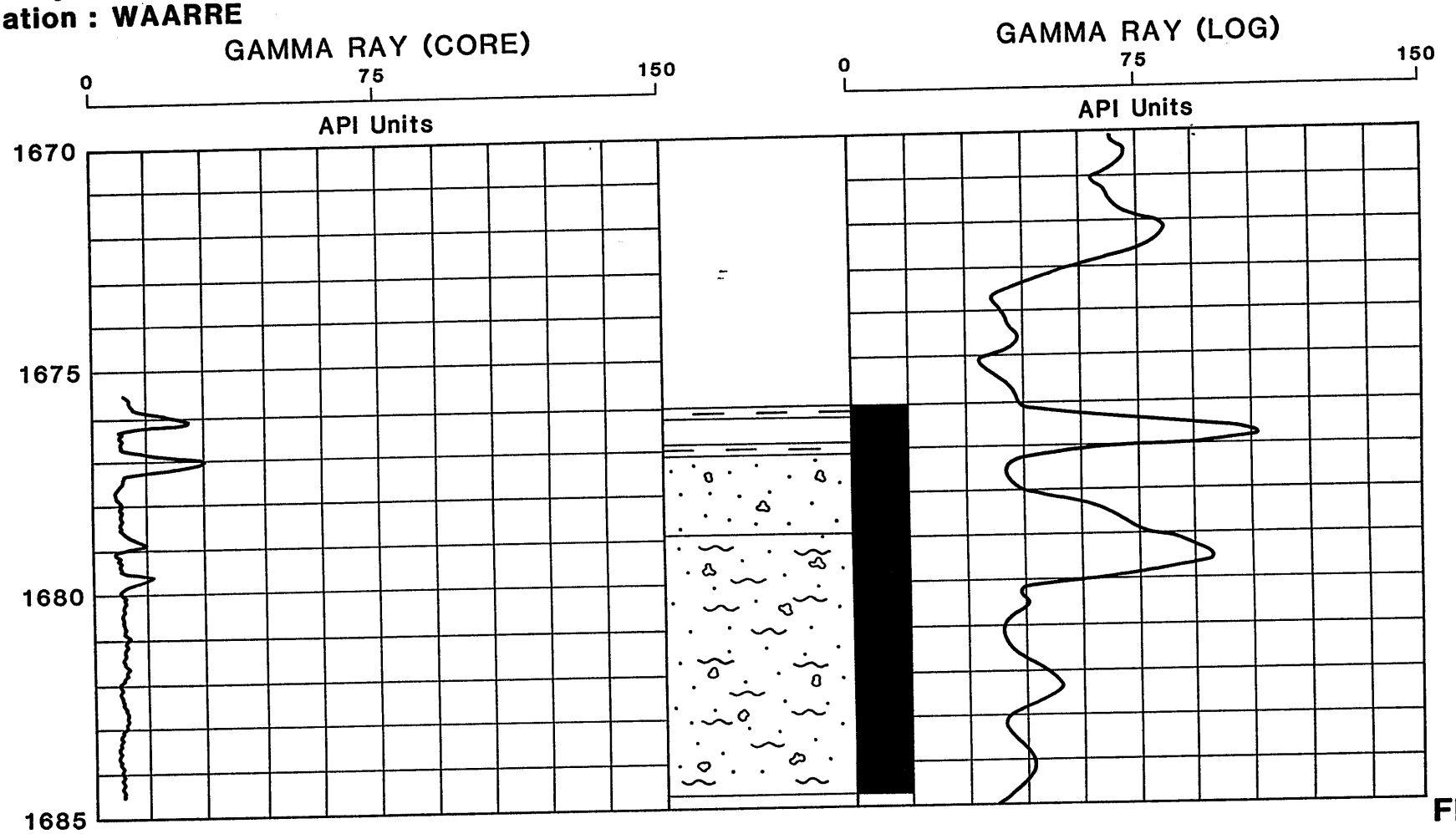

FIG. 5A

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- The core was slabbed and subsequently described. The core description is presented in Fig. 6 and Appendix 5.

- Special core analysis were also carried out for the measurement of the fluid and cementation exponent as well as porosity measurement at overburden condition. The results are included in Appendix 5.

2.4.2.2. *Sidewall Cores*

Twenty four (24) sidewall cores were shot of which 22 were recovered.

Sidewall core samples were sent to the following consultants:-

- Michael Macphail consultant palynologist for palynology and age dating.

- Amdel Core Services for petrography, X-Ray diffraction, and source rock evaluation.

GAS AND FUEL EXPLORATION N.L.

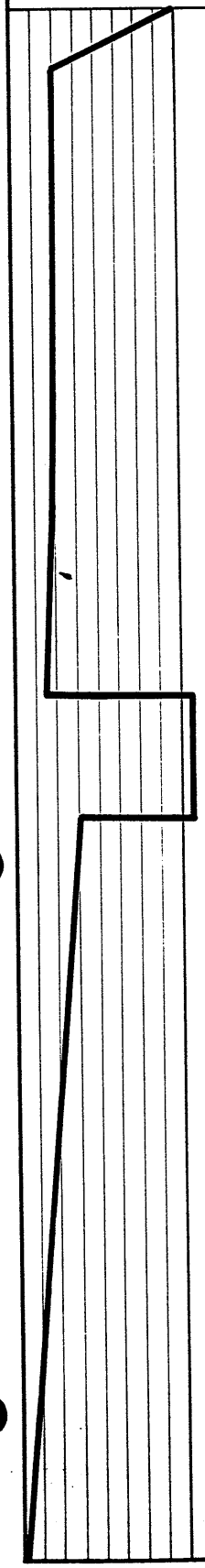
CORE DESCRIPTION

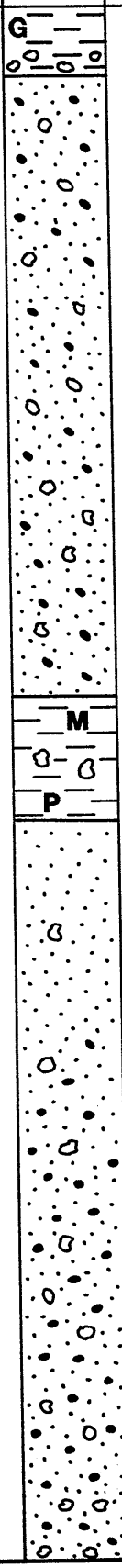
WELL : **BOGGY CREEK No.1** CORE No.: **1** PAGE **1** OF **4**

DATE : **27 – 4 – 1992** INTERVAL : **1673m – 1682m**

FORMATION : **WAARRE** RECOVERY : **96.7 %**

GEOLOGIST : **V.AKBARI** **FIGURE No. 6**





DEPTH (DRILLERS)	(MEASURED) Ø %	(MEASURED) k mD	DESCRIPTION
1673.00	22.9	7058	**SHALE, dark greyish green, abd. fine – med. glauconite pellets, micro – micaceous, becoming sandy common carbonaceous material.**
1673.20			
1673.40	23.5	3950	**SANDSTONE, off white – very light grey, v. fine – v. crs., dom. crs., becoming pebbly with depth, poorly sorted subang – subrndd., dom. subang. qtz. common pyrite com. altered feldspar abd. argil. matrix., hard, good visual porosity.**
1673.50			
1673.95	14.5		
1674.00			**SHALE, dark grey, very finely micro micaceous, carbonaceous pyritic, common fine – medium, occ. crs finely crystalline nodules.**
1674.50	28.2	6530	
1674.78	27.8	6245	**SANDSTONE, off white – greyish – translucent fine – crs., dom. m medium grained, moderately sorted, subang. – subrndd, dom. subrndd. qtz, rare. carb. detritus rarely pyritic common white altered feldspar. common argillaceous matrix, firm – friable good visual porosity, becoming very crs. with depth and pebbly at 1675.25 m and grades in**
1675.00			
1675.10	25.6	5857	
1675.25			

GAS AND FUEL EXPLORATION N.L.

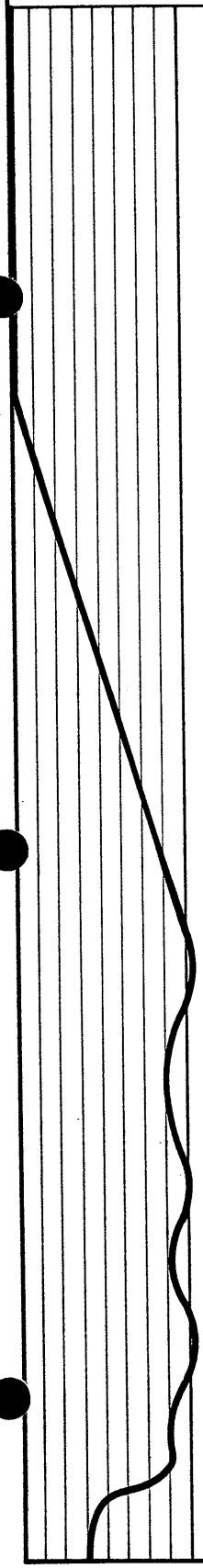
CORE DESCRIPTION

WELL : **BOGGY CREEK No.1** CORE No.: **1** PAGE **2** OF **4**

DATE : **27 – 4 – 1992** INTERVAL : **1673m – 1682m**

FORMATION : **WAARRE** RECOVERY : **96.7 %**

GEOLOGIST : **V.AKBARI** **FIGURE No. 6**



GAS AND FUEL EXPLORATION N.L.

CORE DESCRIPTION

WELL : **BOGGY CREEK No.1** CORE No.: **1**

DATE : **27 – 4 – 1992** INTERVAL : **1673m – 1682m**

FORMATION : **WAARRE** RECOVERY : **96.7 %**

GEOLOGIST : **V.AKBARI** **FIGURE No. 6**

GRAINSIZE AND STRUCTURES (P G VC C M F VF Slt Clay)	Lithology	DIPS	DEPTH (DRILLERS)	(MEASURED) Ø %	(MEASURED) k mD	DESCRIPTION
			1677.80	20.5	1363	translucent, fine – v. crs., dom. crs grained, mod. sorted, subang – subrndd., dom. subang. quartz, rare pyrite, com. carb. detritus rare alt. fspr. com. argil. matrix firm – friable, good vis. and intergranular porosity, becoming very crs with depth, with minor thin laminae of dark grey carb. siltstone.
			1678.00			
			1678.15	22.2	4265	
			1678.45	25.0	6901	
			1678.50			
			1678.78	22.4	5860	
			1679.00			
			1679.22	20.0	6574	
			1679.42	21.3	4639	
			1679.50			

GAS AND FUEL EXPLORATION N.L.

CORE DESCRIPTION

WELL : **BOGGY CREEK No.1** CORE No.: **1** PAGE **4** OF **4**

DATE : **27 – 4 – 1992** INTERVAL : **1673m – 1682m**

FORMATION : **WAARRE** RECOVERY : **96.7 %**

GEOLOGIST : **V.AKBARI** **FIGURE No. 6**

GRAINSIZE AND STRUCTURES (P G VC C M F VF Silt Clay)	Lithology	DIPS	DEPTH (DRILLERS)	(MEASURED) Ø %	(MEASURED) k mD	DESCRIPTION
			1679.80	26.4	9659	
			1680.00			
			1680.05	21.5	7792	Massive, dominantly crs. grained SANDSTONE as above with few scattered laminae of carbonaceous material.
			1680.40	26.2	10103	
			1680.50			
			1680.70	20.9	5751	
			1680.98	24.2	86.73	SANDSTONE, off white – lt. grey, very fine – crs, in part pebbly, dom. v. crs. grained, poorly – mod. sorted subang – subrndd., dom. subang. quartz rare colored lithics rare – com. pyrite, rare – com. carbonaceous detritus com. siliceous matrix firm – friable, good visual and intergranular porosity.
			1681.00			
	G		1681.30	25.4	4729	
			1681.50			
						1681.70 Bottom Core
			1682.00			1682.00 Bottom Cored Interval.

- Keiraville Konsultants for vitrinite reflectance measurement.

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

2.4.3 *Testing*

One drill stem test was carried out as follows:-

DST No.1 (31/12/91)

a: Reason for Testing

While drilling at 1670m, a change in the rate of penetration rate (from 13m/hr to 33m/hr) was encountered which was associated with a lithology change from siltstone to fine grained sandstone. No oil shows or fluorescence were noted. However the total gas increased from 1.1 unit to 13 units with C_1, C_2, C_3 and C_4+ being 95%, 32%, 1% and 0.1% respectively. Drilling continued to 1673m in the same lithology whereupon a decision was made to carry out a drill stem test.

(Ref:23/VA:cw/W1798)

GAS AND FUEL EXPLORATION N.L.

LIST OF SIDEWALL CORES

WELL NAME: BOGGY CREEK

GEOLOGIST: A. TABASSI

DATE: 07-02-92

CORE TAKEN BY: BPB

NO.	DEPTH (METRES)	REC (CM)	FORMATION	LITHOLOGY	PALY.	TOC	SOURCE ROCK EVAL.	Ro	XRD
1	1878	-	EUMERALLA		NO RECOVERY				
2	1856	1.7	EUMERALLA	SILT		*		*	*
3	1836	1.5	EUMERALLA	CLAY	*	*	*	*	
4	1826	3.5	EUMERALLA	SAND					*
5	1816	2.5	EUMERALLA	SILT		*	*	*	
6	1772	2.5	EUMERALLA	SILT	*	*	*	*	
7	1722.5	3.5	WAARRE	CLAY	*	*	*	*	*
8	1715	1.5	WAARRE	SILT	*				*
9	1693	2.2	WAARRE	SAND					*
10	1683	-	WAARRE		NO RECOVERY				
11	1675	2.0	WAARRE	SAND					*
12	1668	0.5	WAARRE	SAND	*	(RECOVERY NOT ACCEPTED)			
13	1579	2.7	BELFAST	CLAY	*	*	*	*	*
14	1487	2.5	BELFAST	CLAY	*	*	*	*	
15	1343	2.5	PAARATTE	SAND					*
16	1247	3.0	PAARATTE	SAND					
17	1193	3.5	PAARATTE	SAND					
18	1109	2.2	PAARATTE	CLAY		*	*	*	*
19	981.5	3.5	PAARATTE	CLAY	*	*		*	
20	939.5	2.7	PEBBLE PT.	SAND	*				*
21	931	3.2	PEBBLE PT.	SAND					
22	914.5	3.5	PEBBLE PT.	PEBBLY CLAY		*	*	*	*
23	857.5	4.0	PEMBER	CLAY		*	*	*	*
24	753	4.0	DILWYN	CLAY		*		*	

TABLE 1

b: Data

Test Interval:	1662m-1673m	
Formation:	Waarre	
Cushion:	None	
Type of test:	Conventional off bottom straddle	
Packers Depth:	Top:	1659.6m
	Bottom:	1662m
Choke Size:	Top:	1/2"
	Bottom:	3/4"
Flow Periods:	Two	

c: Test

The test consisted of two flow periods. During the first pre-flow period, the string slipped and the tool was closed. The packers were reset and the tool was opened for 15 min. during which a very weak blow was observed. The tool was re-opened after 30 mins. during which time the initial shut-in pressure was established. The second flow period began with a very strong blow of non-combustible gas which reached the surface one min. after opening the tool. The tool was left open on 1/2" choke for a period of 57 min. during which time the flowing wellhead pressure rapidly increased and finally reached 1100 psi. at the end of the flowing period. A flow rate of 4.5 MMCFD was estimated prior to closing the tool for recording the final shut-in pressure.

d: Pressures

The following pressures were recorded:

Recorders Depth	1648.7m	1655m	1672m
Initial Hydrostatic	-	2650.73	2673.73
Start Draw-Down	14.66	196.06	2441.54
End-Draw Down	87.98	470.01	2447.75
Start Build-Up	87.98	470.01	2447.75
End Build-Up	67.75	3023.59	2988.22
Start Draw-Down	67.75	504.91	2117.95
End Draw-Down	1759.28	1765.10	2382.54
Start Build-Up	1759.28	1765.10	2382.54
End Build-Up	1076.39	2448.82	2449.55
Final Hydrostatic	-	2645.98	2668.40

NOTE: All pressures are in PSIA

Bottom Hole Temperature: 68.3^{o}C/155^{o}F.

e: Gas Components

Two gas samples were collected from the surface manifold during the second flowing period and were subsequently analysed by the Scientific Service Department of the Gas & Fuel Corporation of Victoria. The results of the gas analyses are listed in Table -2.

Figure - 7 is a graphical presentation of DST -1.

GAS ANALYSES, BOGGY CREEK-1

7/1/92

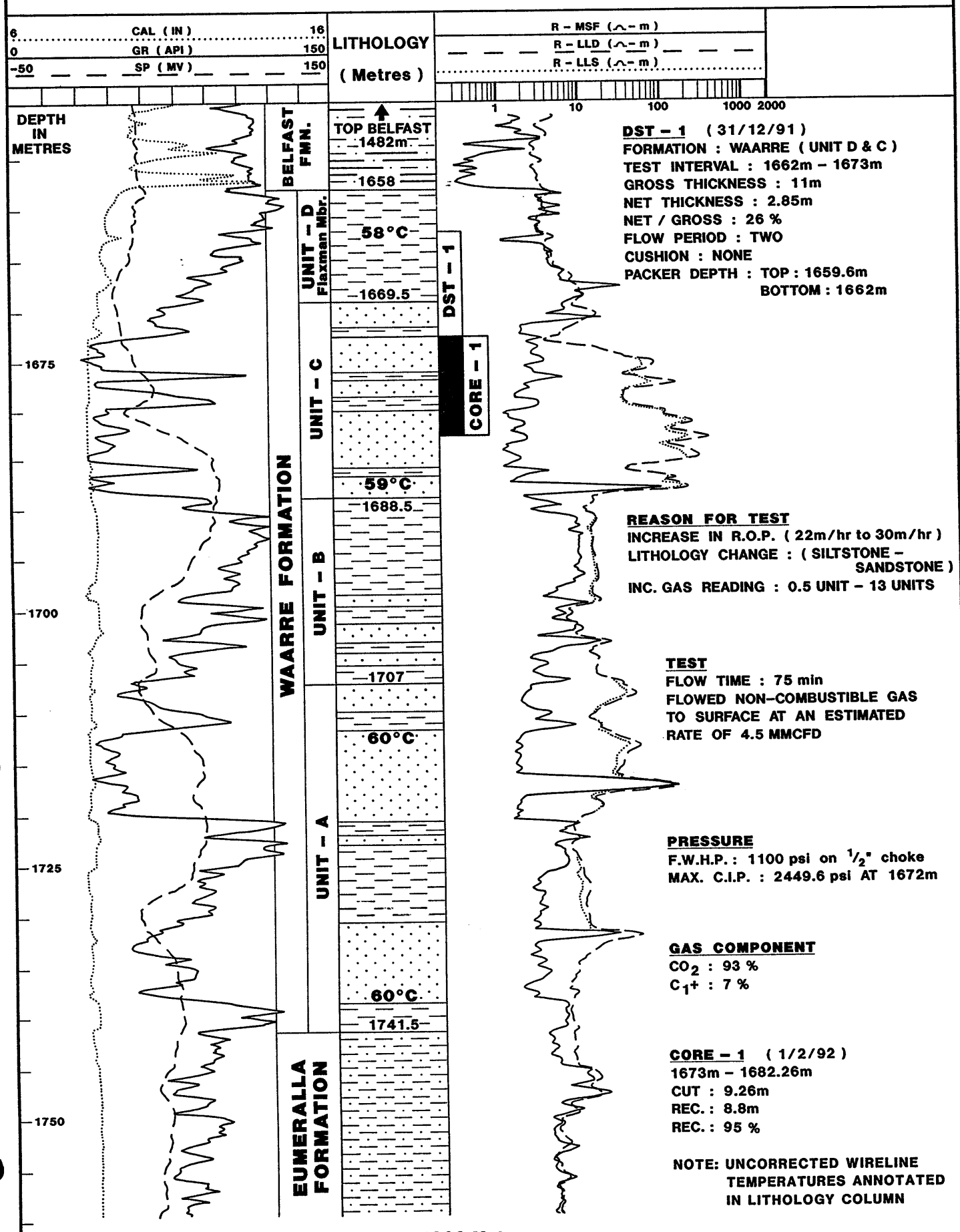
	WITH AIR				WITHOUT AIR			
	DST #1		RFS (1720m)		DST #1		RFS (1720m)	
	SAMPLE #1	SAMPLE #2	LARGE	SMALL	SAMPLE #1	SAMPLE #2	LARGE	SMALL
CO2	91.617	91.752	88.700	86.100	93.252	93.024	90.498	88.476
Methane	6.353	6.602	9.030	10.900	6.466	6.694	9.213	11.201
Ethane	0.159	0.162	0.140	0.150	0.162	0.164	0.143	0.154
Propane	0.047	0.047	0.030	0.030	0.048	0.048	0.031	0.031
i-Butane	0.008	0.007	0.004	0.003	0.008	0.007	0.004	0.003
n-Butane	0.010	0.010	0.006	0.004	0.010	0.010	0.006	0.004
i-Pentane	0.003	0.002	0.001	0.001	0.003	0.002	0.001	0.001
n-Pentane	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.001
Hexanes	0.006	0.005	0.003	0.001	0.006	0.005	0.003	0.001
Heptanes+	0.011	0.010	0.008	0.005	0.012	0.010	0.008	0.005
O2/Ar/N	1.753	1.366	2.000	2.600	0.000	0.000	0.000	0.000
Helium	0.030	0.034	0.090	0.120	0.031	0.035	0.092	0.123
	100.000	99.999	100.013	99.915	100.000	100.000	100.000	100.000

TABLE – 2

GAS AND FUEL EXPLORATION N.L.

BOGGY CREEK NO.1

DST No.1



DST - 1 (31/12/91)
FORMATION : WAARRE (UNIT D & C)
TEST INTERVAL : 1662m - 1673m
GROSS THICKNESS : 11m
NET THICKNESS : 2.85m
NET / GROSS : 26 %
FLOW PERIOD : TWO
CUSHION : NONE
PACKER DEPTH : TOP : 1659.6m
BOTTOM : 1662m

REASON FOR TEST
INCREASE IN R.O.P. (22m/hr to 30m/hr)
LITHOLOGY CHANGE : (SILTSTONE - SANDSTONE)
INC. GAS READING : 0.5 UNIT - 13 UNITS

TEST
FLOW TIME : 75 min
FLOWED NON-COMBUSTIBLE GAS TO SURFACE AT AN ESTIMATED RATE OF 4.5 MMCFD

PRESSURE
F.W.H.P. : 1100 psi on $^1/_2$" choke
MAX. C.I.P. : 2449.6 psi AT 1672m

GAS COMPONENT
CO_2 : 93 %
C_1+ : 7 %

CORE - 1 (1/2/92)
1673m - 1682.26m
CUT : 9.26m
REC. : 8.8m
REC. : 95 %

NOTE: UNCORRECTED WIRELINE TEMPERATURES ANNOTATED IN LITHOLOGY COLUMN

TOTAL DEPTH : 1900 Metres

FIG. 7

AUTHOR : V.AKBARI

2.5 Logging and Surveys

2.5.1 *Mud Logging*

A standard skid-mounted Exlog unit was used. The unit was equipped for continuous recording of the penetration rate, mud gas, pumping rate, mud volume data, and intermittent mud and cuttings gas analysis.

The mud log is included as Enclosure 2.

2.5.2 *Wireline Logging*

Wireline logging was performed by BPB Wireline Services using a truck-mounted unit. One logging suite was carried out at the total depth which consisted of the following logs.

Logging Suite	Interval (m)
Dual Laterolog Sond Micro Log Sond/Compensated Sonic Sond/Gamma Ray (DLS-MLL-CSS-GR)	1897 - 318 with GR to surface
Photodensity Sond/ Compensated Neutron Sond Gamma Ray/Caliper (PDS/CNL/GR/CAL)	1897 - 875

Precision Strata Dipmeter (PSD)	1896 - 1300
Velocity Survey	No. of shot: 26
	No. of level: 22
Repeat Formation Sampler	No. of sampling
(RFS)	Points: 14
Sidewall Core Gun (SCG)	No. of shot: 24
	Recovery: 22
Cement Bond Log	1869.5 - 950
CBL/CCL/GR	

2.5.3 *Repeat Formation Sampler (RFS)*

Repeat Formation Sampler (RFS) pressure measurements were recorded at 19 levels. A gas sample was collected in the course of repeat formation sampling.

2.5.4 *Deviation Surveys*

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

Depth (m)	Deviation (Deg.)
80	0.50
147	0.50
316	0.75
563	0.75
861	1.0
1064	0.75
1273	0.50
1472	2.50
1567	3.5
1595	4.0
1610	3.75
1626	3.0
1633	2.75
1645	2.75
1660	2.25
1710	1.50
1764	1.25
1897	1.00

2.5.5 *Velocity Survey*

A velocity survey was carried out by Velocity Data Pty Ltd. The result of which is included in Appendix - 7.

3. RESULTS OF DRILLING

3.1 Stratigraphy

The following stratigraphic intervals have been delineated using penetration rate, cuttings analyses, wireline log interpretation, palynology and clay analyses. (See Figures 8 & 9 and Appendices 4, 9 & 12).

ROCK UNIT	DEPTH (m) KB	SS (m)	THICKNESS (m)
Heytesbury Group	*Surface*	*+30.0*	*456.0*
Port Campbell Limestone	Surface	30.0	144.0
Gellibrand Marl.	149	-114.05	292.0
Clifton Formation	441	-406.05	20.0
Nirranda Group	*461*	*-426.05*	*110.0*
Narrawaturk Marl.	461	-426.05	79.0
Mepunga Formation	540	-505.05	31.0
Wangerrip Group	*571*	*-536.05*	*395.0*
Dilwyn Formation	571	-536.05	282.0
Pember Mudstone	853	-818.05	52.5
Pebble Point Formation	905.5	-870.55	60.5

Sherbrook Group	*966*	*-931.05*	*775.5*
Paaratte Formation	966	-931.05	516
Belfast Mudstone	1482	-1447.05	176
Fault	1540	-1505.05	-
Waarre Formation	1658.0	-1623.05	83.5
Unit -D (Flaxman Mbr.)	1658.0	-1623.05	11.5
Unit -C	1669.5	-1634.55	19.0
Unit -B	1688.5	-1653.55	18.5
Unit -A	1707.0	-1672.05	34.5
Otway Group	*1741.5*	*-1706.55*	*158.5*
Eumeralla Formation	1741.5	-1706.55	158.5(T.D.)
Total Depth (Driller)	*1900.0*	*-1865.05*	
Total Depth (Logger)	*1899.0*	*-1864.05*	
P.B. TD	*1865.0*	*-1830.05*	

3.2 Lithological Description

3.2.1 *Heytesbury Group* *(Surface - 461.0m)*

Port Campbell Limestone surface - 149m

CALCARENITE, off white, light yellowish brown; medium - coarse, sub-rounded to rounded; abundant fossil fragments coral, bryozoa, forams, crinoids, shell fragments; rare - common glauconite, rare pytite, friable - very poorly cemented.

Gellibrand Marl. **149 - 441m**

CALCILUTITE, medium - dark grey, dark brown; rare glauconite; rare - common iron oxide fragments, rare pyrite, commonly carbonaceous and fossiliferous soft and sticky

Clifton Formation **441 - 461m**

CALCARENITE, reddish - brown - orange, some white - pinkish; common iron oxide staining, rare iron oxide nodules, very fossiliferous, poorly consolidated.

3.2.2 *Nirranda Group* *461m - 571m*

Narrawaturk Marl. **461m - 540m**

MARL, dark grey, olive grey; slightly silty; common fossil fragments; very soft and dispersive.

Mepunga Formation 540m - 571m

SANDSTONE off white - translucent; fine - coarse grained; dominantly coarse grained; poorly sorted; rounded to sub - rounded; dominantly sub - rounded quartz; rare lithics; loose - very poorly cemented; very good intergranular porosity; and MARL, dark brown - reddish brown; very glauconitic with abundant dark green glauconite nodules; common fossil fragments; rare pyrite; soft and dispersive.

3.2.3 *Wangerrip Group* *571m - 966m*

Dilwyn Formation 571m - 853m

SANDSTONE off-white - translucent, occasionally brownish; medium - very coarse, dominantly coarse grained; moderately sorted; rounded - sub-rounded, dominantly sub-rounded quartz; trace mica flakes, rare pyrite: friable - very poorly cemented; good intergranular porosity, interbedded with SILTSTONE, dark grey; argillaceous, carbonaceous, rare pyrite, rare glauconite; soft and dispersive, and minor CLAYSTONE, dark grey; silty, carbonaceous; soft and dispersive.

Pember Mudstone 853m - 905.5m

CLAYSTONE medium - dark brown, occasionally dark grey - olive grey; silty, slightly - commonly carbonaceous, rarely pyritic, very glauconitic (900-905m) with abundant dark green glauconite nodules; very soft and dispersive.

Pebble Point Formation **905.5m - 966m**

SANDSTONE dark brown - dark greyish - brown; medium - coarse, dominantly coarse; poorly sorted; rounded - sub-rounded, dominantly sub-rounded iron stained quartz; abundant medium - pebble size iron oxide pellets, very argillaceous with abundant chamositic, limonitic clay matrix, nil - very poor porosity, interbedded with CLAYSTONE medium - dark brown, in part grey; rarely carbonaceous and micaceous; blocky, firm, moderately silty, in part grading to SILTSTONE, light grey; minor clay matrix; friable - firm, poor porosity.

3.2.4 Sherbrook Group *966m - 1741.5*

Paaratte Formation **966m - 1482m**

SANDSTONE off-white - very light tan - translucent; medium - coarse grained, dominantly coarse grained; moderately sorted; sub-angular - sub-rounded dominantly sub-angular quartz; rare desiminated crypto-crystalline pyrite, rare mica and carbonaceous flakes, rare dispersive argillaceous matrix; good intergranular porosity, and CLAYSTONE, dark brown, dark green - grey; rarely - moderately silty and arenaceous, rare mica, rare dark green - grey lithics, rarely carbonaceous; blocky in part, firm, and minor SANDSTONE, off white -

very light yellow - orange; fine - medium; well sorted; sub-angular to sub-rounded quartz; well - cemented with abundant calcareous clay matrix; hard; good porosity, interbedded with SILTSTONE, medium - dark grey; rare lithics, very calcareous; hard - very hard.

Belfast Mudstone 1482m - 1658m

CLAYSTONE medium - dark grey, brownish; silty, common carbonaceous flakes, trace - common dark green glauconite, trace mica, rare - trace dolomite fragment, occasionally very arenaceous grading to very fine sandstone; moderately firm - dispersive, with minor SANDSTONE, off white; very fine; well sorted; sub-angular quartz; well cemented with abundant argillaceous matrix grading into claystone, friable with no visual porosity.

Waarre Formation 1658m - 1741.5m

(See Figure 10)

Unit - D (Flaxman Member) 1658m - 1669.5m

SILTSTONE dark grey - greenish; trace glauconite increasing with depth, rarely pyritic; blocky to sub-fissile; moderately hard, grading into fine grained SANDSTONE with depth.

Unit - C 1669.5m - 1688.5m

SANDSTONE, off white - light grey, translucent; very fine - coarse, dominantly very fine; poorly sorted; sub-angular to sub-rounded, dominantly sub-rounded quartz; rare pyrite, trace glauconite, trace carbonaceous detritus; well cemented, with abundant, argillaceous slightly calcareous cement; friable; poor visual porosity, with minor CLAYSTONE dark grey, brownish; silty, rarely glauconitic; blocky - sub-fissile; soft.

Unit - B 1688.4m - 1707m

SILTSTONE medium grey - medium brownish grey; common very fine sand, trace fine mica, occasionally very carbonaceous, trace blocky coal particles, trace pyrite, very argillaceous; firm - sub fissile, interlaminated with minor SANDSTONE light grey - light brown; very fine to very coarse, dominantly medium; poorly sorted; sub-angular quartz grains; trace lithics, common white argillaceous matrix, moderately calcareous: friable - moderately hard; poor visual porosity.

Unit - A 1707 - 1741.5m

SANDSTONE light grey - light brownish grey; very fine - coarse, dominantly medium; poorly sorted; sub-angular - sub-rounded quartz; common black coal particles, trace dolomite and silica cement, common white argillaceous matrix; friable - moderately hard; poor visual porosity, interbedded with SILTSTONE medium grey, medium brownish grey; common very fine sand, trace fine mica, occasionally carbonaceous, trace black coal particles, trace pyrite, argillaceous; firm - sub fissile.

3.2.5 *Otway Group* *1741.5m - 1900m*

Eumeralla Formation **1741.5m - 1900m**

SANDSTONE off white - light greenish - grey; fine - medium; moderately sorted; angular - sub-angular quartz and multi-coloured volcanogenic lithics; trace partially altered feldspars, rare pyrite and carbonaceous detritus, abundant kaolinitic clay matrix, common - weak calcareous cement; very poor - poor visual porosity, interbedded with CLAYSTONE, light - medium brown in part grey - olive grey; trace - common multi-coloured lithics, rare carbonaceous detritus; soft-firm, in part dispersive, in part blocky.

GAS AND FUEL EXPLORATION N.L.

PEP 104 AND ENVIRONMENTS – OTWAY BASIN

STRATIGRAPHIC TABLE

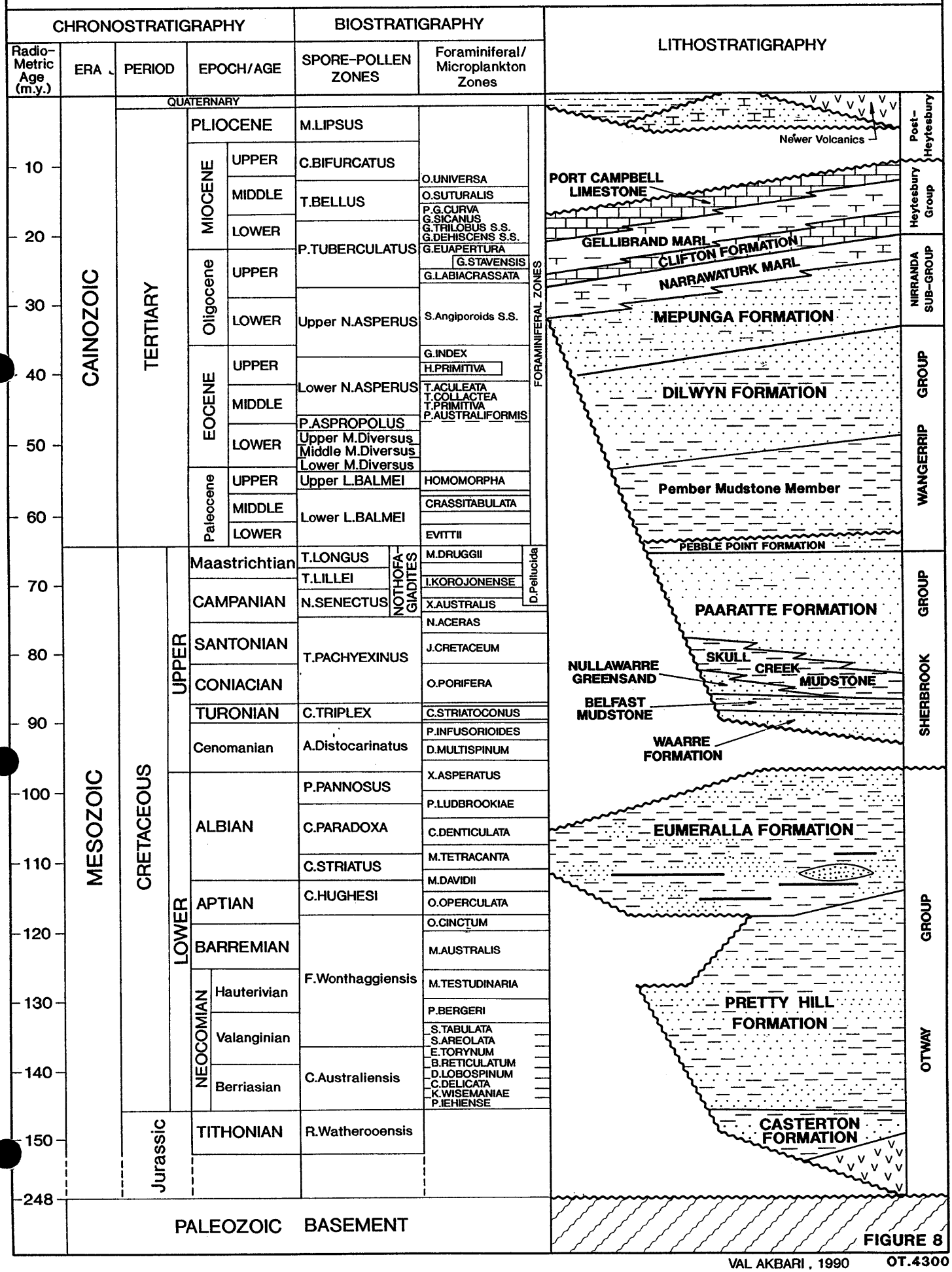


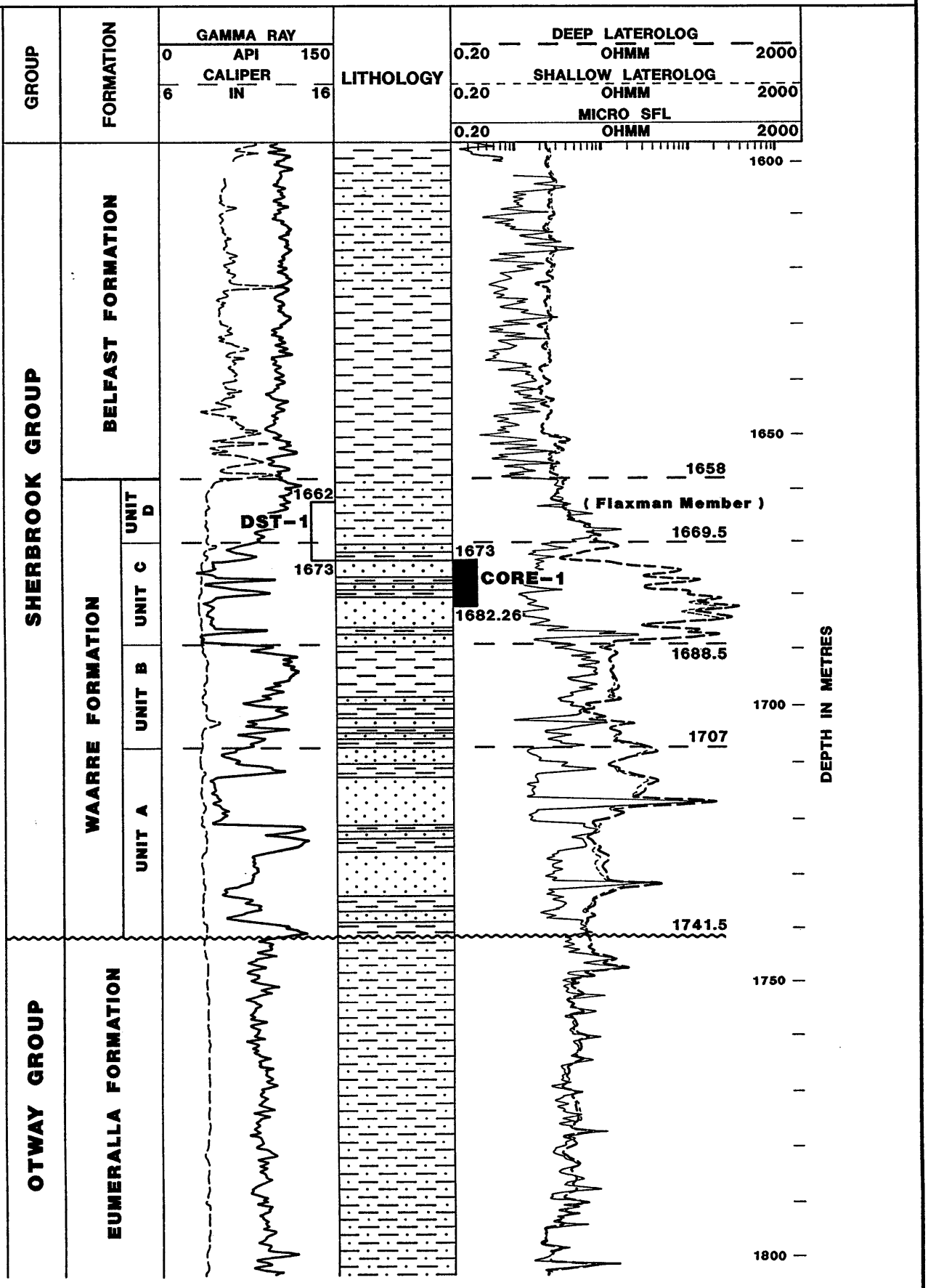
FIGURE 8

VAL AKBARI, 1990 OT.4300

GAS AND FUEL EXPLORATION N.L.

BOGGY CREEK No.1

WAARRE FORMATION



AUTHOR : V.AKBARI

FIGURE 10

3.2 Lithological Description

(Surface - 461.0m)

surface - 149m

CALCARENITE, off white, light yellowish brown; medium - coarse, sub-rounded to rounded; abundant fossil fragments coral, bryozoa, forams, crinoids, shell fragments; rare - common glauconite, rare pytite, friable - very poorly cemented.

149 - 441m

CALCILUTITE, medium - dark grey, dark brown; rare glauconite; rare - common iron oxide fragments, rare pyrite, commonly carbonaceous and fossiliferous soft and sticky

441 - 461m

CALCARENITE, reddish - brown - orange, some white - pinkish; common iron oxide staining, rare iron oxide nodules, very fossiliferous, poorly consolidated.

461m - 571m

Narrawaturk Marl. 461m - 540m

MARL, dark grey, olive grey; slightly silty; common fossil fragments; very soft and dispersive.

540m - 571m

SANDSTONE off white - translucent; fine - coarse grained; dominantly coarse grained; poorly sorted; rounded to sub - rounded; dominantly sub - rounded quartz; rare lithics; loose - very poorly cemented; very good intergranular porosity; and MARL, dark brown - reddish brown; very glauconitic with abundant dark green glauconite nodules; common fossil fragments; rare pyrite; soft and dispersive.

571m - 966m

571m - 853m

SANDSTONE off-white - translucent, occasionally brownish; medium - very coarse, dominantly coarse grained; moderately sorted; rounded - sub-rounded, dominantly sub-rounded quartz; trace mica flakes, rare pyrite: friable - very poorly cemented; good intergranular porosity, interbedded with SILTSTONE, dark grey; argillaceous, carbonaceous, rare pyrite, rare glauconite; soft and dispersive, and minor CLAYSTONE, dark grey; silty, carbonaceous; soft and dispersive.

853m - 905.5m

CLAYSTONE medium - dark brown, occasionally dark grey - olive grey; silty, slightly - commonly carbonaceous, rarely pyritic, very glauconitic (900-905m) with abundant dark green glauconite nodules; very soft and dispersive.

905.5m - 966m

SANDSTONE dark brown - dark greyish - brown; medium - coarse, dominantly coarse; poorly sorted; rounded - sub-rounded, dominantly sub-rounded iron stained quartz; abundant medium - pebble size iron oxide pellets, very argillaceous with abundant chamositic, limonitic clay matrix, nil - very poor porosity, interbedded with CLAYSTONE medium - dark brown, in part grey; rarely carbonaceous and micaceous; blocky, firm, moderately silty, in part grading to SILTSTONE, light grey; minor clay matrix; friable - firm, poor porosity.

966m - 1741.5

966m - 1482m

SANDSTONE off-white - very light tan - translucent; medium - coarse grained, dominantly coarse grained; moderately sorted; sub-angular - sub-rounded dominantly sub-angular quartz; rare desiminated crypto-crystalline pyrite, rare mica and carbonaceous flakes, rare dispersive argillaceous matrix; good intergranular porosity, and CLAYSTONE, dark brown, dark green - grey; rarely - moderately silty and arenaceous, rare mica, rare dark green - grey lithics, rarely carbonaceous; blocky in part, firm, and minor SANDSTONE, off white -

very light yellow - orange; fine - medium; well sorted; sub-angular to sub-rounded quartz; well - cemented with abundant calcareous clay matrix; hard; good porosity, interbedded with SILTSTONE, medium - dark grey; rare lithics, very calcareous; hard - very hard.

1482m - 1658m

CLAYSTONE medium - dark grey, brownish; silty, common carbonaceous flakes, trace - common dark green glauconite, trace mica, rare - trace dolomite fragment, occasionally very arenaceous grading to very fine sandstone; moderately firm - dispersive, with minor SANDSTONE, off white; very fine; well sorted; sub-angular quartz; well cemented with abundant argillaceous matrix grading into claystone, friable with no visual porosity.

1658m - 1741.5m

1658m - 1669.5m

SILTSTONE dark grey - greenish; trace glauconite increasing with depth, rarely pyritic; blocky to sub-fissile; moderately hard, grading into fine grained SANDSTONE with depth.

1669.5m - 1688.5m

SANDSTONE, off white - light grey, translucent; very fine - coarse, dominantly very fine; poorly sorted; sub-angular to sub-rounded, dominantly sub-rounded quartz; rare pyrite, trace glauconite, trace carbonaceous detritus; well cemented, with abundant, argillaceous slightly calcareous cement; friable; poor visual porosity, with minor CLAYSTONE dark grey, brownish; silty, rarely glauconitic; blocky - sub-fissile; soft.

1688.4m - 1707m

SILTSTONE medium grey - medium brownish grey; common very fine sand, trace fine mica, occasionally very carbonaceous, trace blocky coal particles, trace pyrite, very argillaceous; firm - sub fissile, interlaminated with minor SANDSTONE light grey - light brown; very fine to very coarse, dominantly medium; poorly sorted; sub-angular quartz grains; trace lithics, common white argillaceous matrix, moderately calcareous: friable - moderately hard; poor visual porosity.

1707 - 1741.5m

SANDSTONE light grey - light brownish grey; very fine - coarse, dominantly medium; poorly sorted; sub-angular - sub-rounded quartz; common black coal particles, trace dolomite and silica cement, common white argillaceous matrix; friable - moderately hard; poor visual porosity, interbedded with SILTSTONE medium grey, medium brownish grey; common very fine sand, trace fine mica, occasionally carbonaceous, trace black coal particles, trace pyrite, argillaceous; firm - sub fissile.

1741.5m - 1900m

1741.5m - 1900m

SANDSTONE off white - light greenish - grey; fine - medium; moderately sorted; angular - sub-angular quartz and multi-coloured volcanogenic lithics; trace partially altered feldspars, rare pyrite and carbonaceous detritus, abundant kaolinitic clay matrix, common - weak calcareous cement; very poor - poor visual porosity, interbedded with CLAYSTONE, light - medium brown in part grey - olive grey; trace - common multi-coloured lithics, rare carbonaceous detritus; soft-firm, in part dispersive, in part blocky.

3.3 Hydrocarbon Indications

3.3.1 *Mud Gas Reading*

The mud gas detecting equipment was operational from 19m (9m below the 16" conductor depth) to 1900m (total depth).

Levels of gas in the drilling mud were below the detection capabilities of the system from the start to a depth of 1450m near the top of Belfast Mudstone. (Top Belfast at 1485m)

From 1485m to 1669m, the level of detected gas ranged from trace to 3.5 units being mainly methane.

From 1669m to 1810m the level of detected gas generally fluctuated between 4 - 60 units averaging 10 - 30 units. A maximum of 65 units of gas was detected between 1785 - 1790m consisting of C1: 10206 ppm, C2: 522 ppm, C3: 211 ppm and C4: 30 ppm.

From 1810 m to 1870 m the level of detected gas decreased to 5 - 10 units with a few gas peaks of up to 37 units.

From 1870 to total depth the level of gas readings continuously decreased and at total depth the level of detected gas was less than one unit.

No CO_2 detecting instrument was used and no changes in mud properties related to the presence of CO_2 were reported.

3.3.2 *Sample Fluorescence*

Cuttings samples were routinely inspected for shows and fluorescence at 10m intervals from 20m to 320m and at 5m intervals from 320m to 1900m (total depth). Occasional spot samples as well as sidewall cores were also checked for shows and fluorescence.

No fluorescence or oil staining was reported either in cuttings samples or sidewall cores.

3.3.3 *Blender Gas*

As part of the show evaluation programme, cuttings gases were evaluated after each prospective drilling break using a blender connected to gas detecting instruments.

4. GEOLOGY

4.1 Structure

4.1.1 Seismic

The Boggy Creek prospect was delineated as the result of the Peterborough Seismic Survey (1989) and Halladale Seismic Survey (1990).

The structure is situated adjacent to the northeastern side of the Curdie Trough and consists of a tilted fault block located on the immediate upthrown side of the Boggy Creek fault. To the northeast, it is bounded by a fault which forms the boundary of the structurally higher Schomberg horst.

The two structures are components of a larger fault complex (Boggy Creek-Schomberg Structure) which is bounded further to the north by the Skull Creek Low and is the most prominent of the several highs which align in a northeast-southwest direction from Westgate-1A to Curdievale-1.

The well encountered the top of the Belfast Mudstone in the hanging wall (downthrown) block at much higher level than predicted. The implication is that the Belfast could therefore be thicker than previously interpreted over the Boggy Creek block. (See Figure 11).

The Boggy Creek prospect was mapped on the following horizons:-

Top Pebble Point Formation

Top Waarre Formation (pre and post drilling)

See Figures 12, 13 and 14, and 15.

The formations within the Tertiary Group were encountered significantly lower than forecast. This was due to the uncertainty in the velocity data prior to drilling as well as incorrect interpretation of the seismic horizons.

The well is believed to have achieved its main target in testing the structure near its culmination.

At the well location, sediments within the Waarre Formation are nearly horizontal.

The dips within the underlying Eumeralla Formation are generally higher than those in the Waarre. However no clear dip direction is evident suggesting that they largely represent depositional rather than structural dips.

GAS AND FUEL EXPLORATION N.L.

PEP 104 – OTWAY BASIN

BOGGY CREEK NO.1

PROPOSED AND ACTUAL STRATIGRAPHY

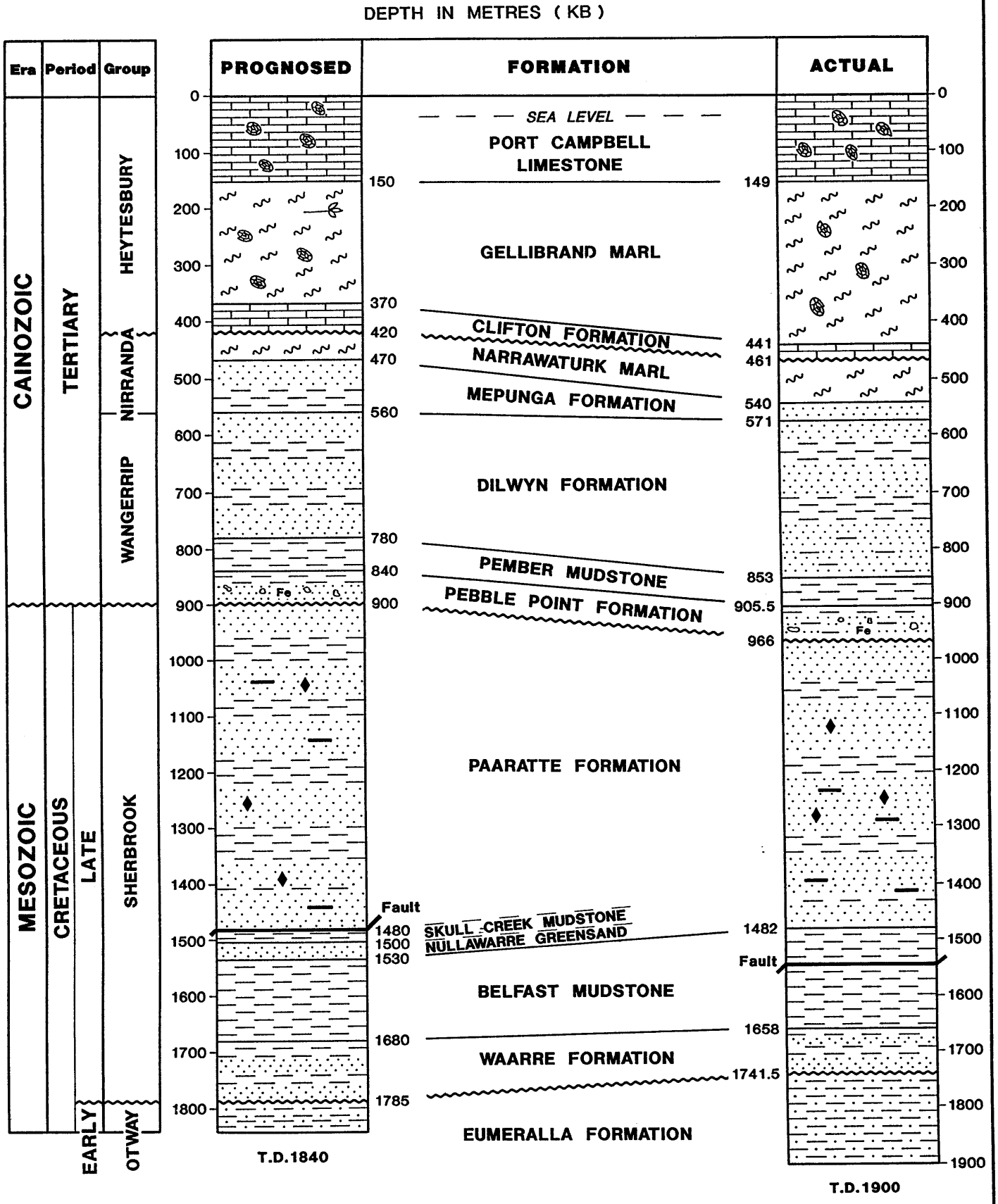


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FIG. 9

GAS AND FUEL EXPLORATION N.L.

PEP 104 - OTWAY BASIN

SCHEMATIC SECTION THROUGH BOGGY CREEK

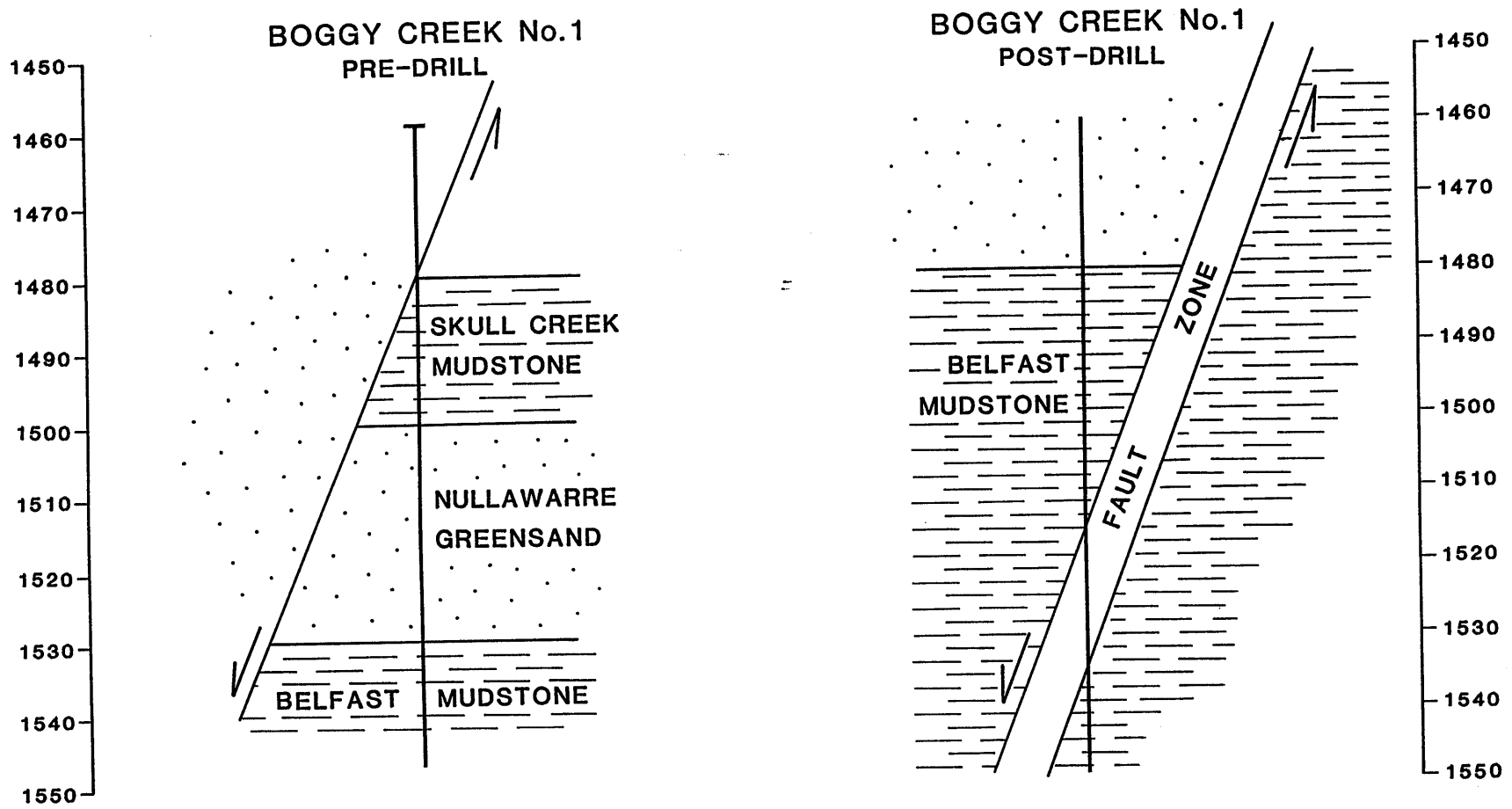

FIG. 11

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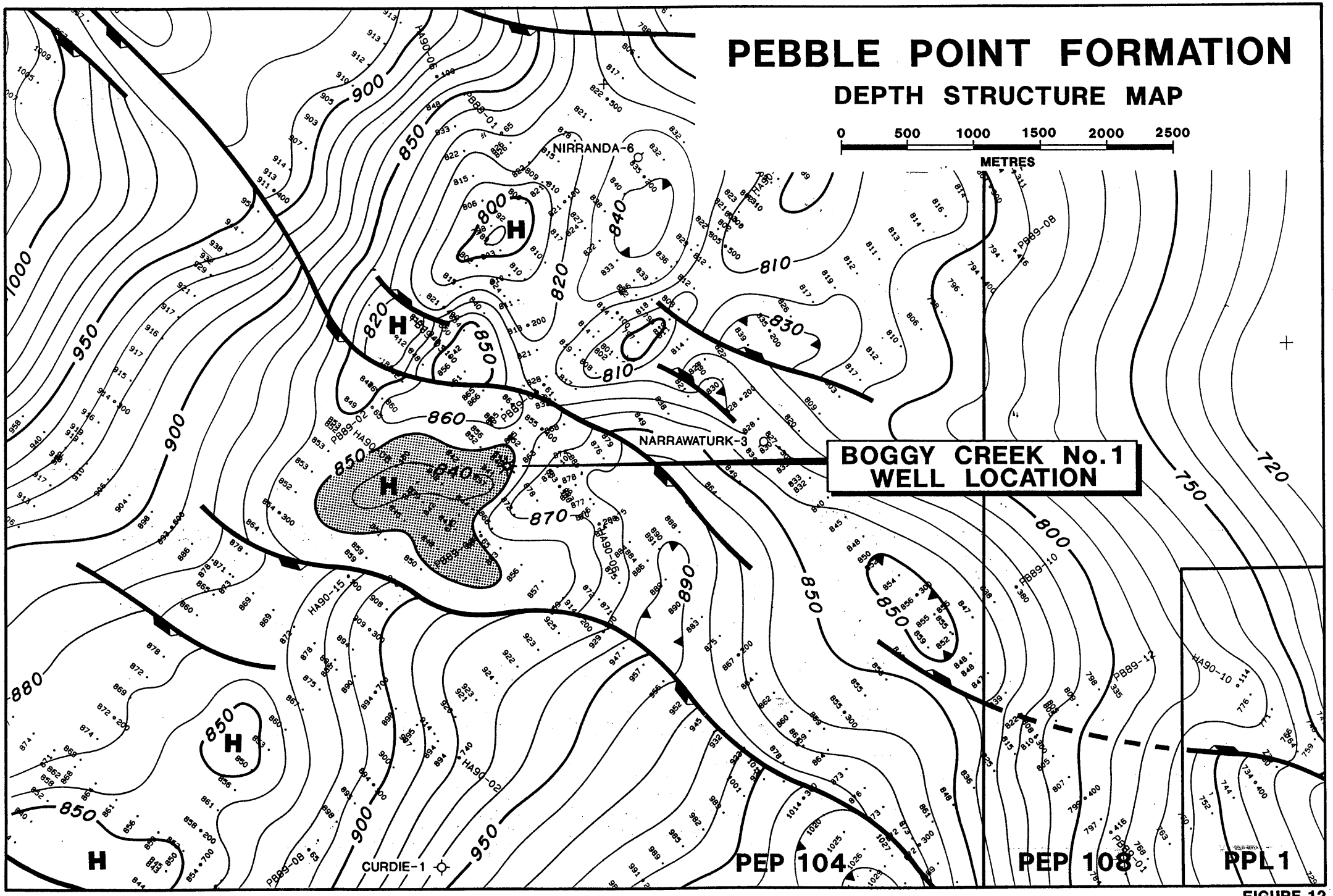
PEBBLE POINT FORMATION
DEPTH STRUCTURE MAP
0 500 1000 1500 2000 2500
METRES
NIRRANDA-6
NARRAWATURK-3
BOGGY CREEK No.1
WELL LOCATION
CURDIE-1
PEP 104
PEP 108
PPL 1

FIGURE 12

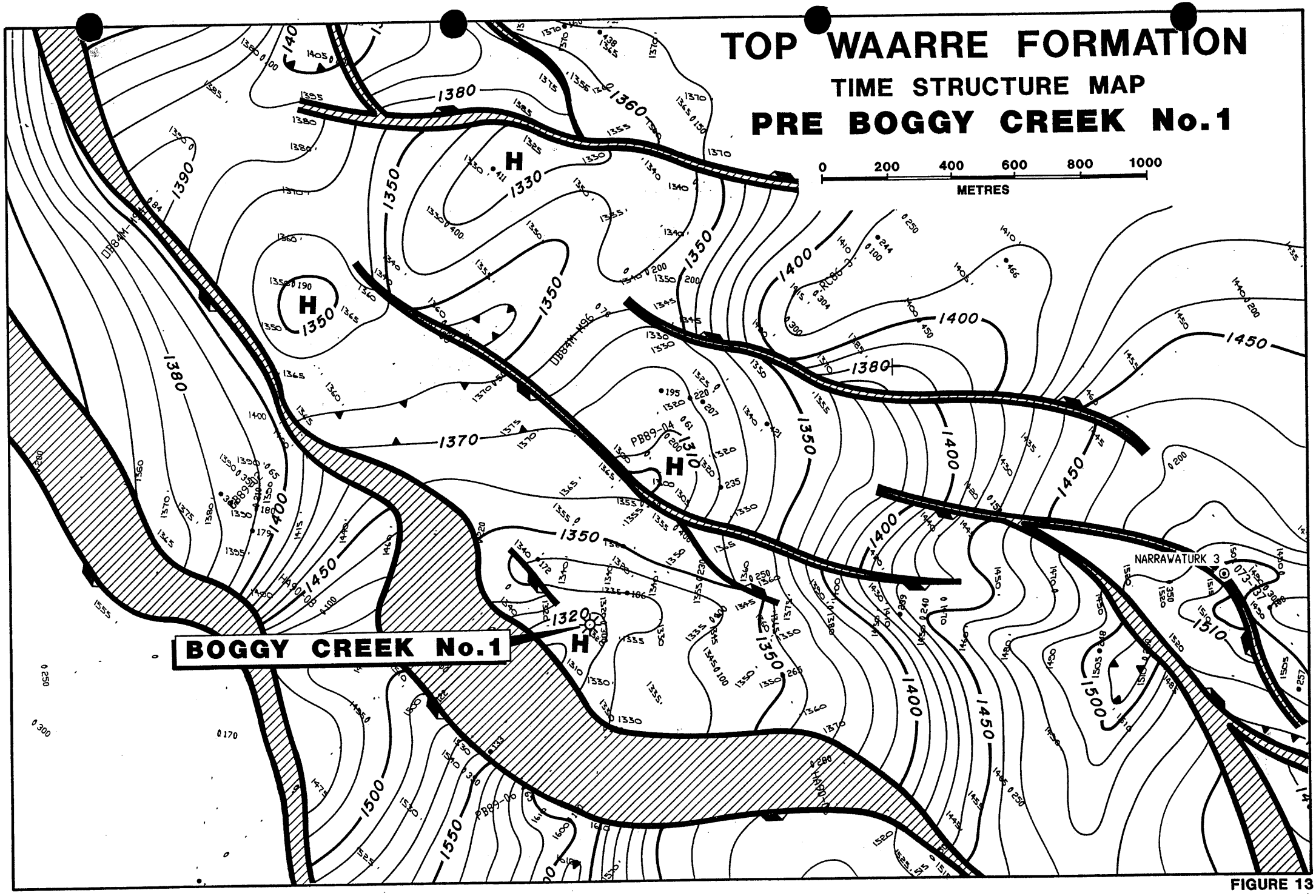
TOP WAARRE FORMATION
TIME STRUCTURE MAP
PRE BOGGY CREEK No.1
0 200 400 600 800 1000
METRES
BOGGY CREEK No.1
NARRAWATURK 3

FIGURE 13

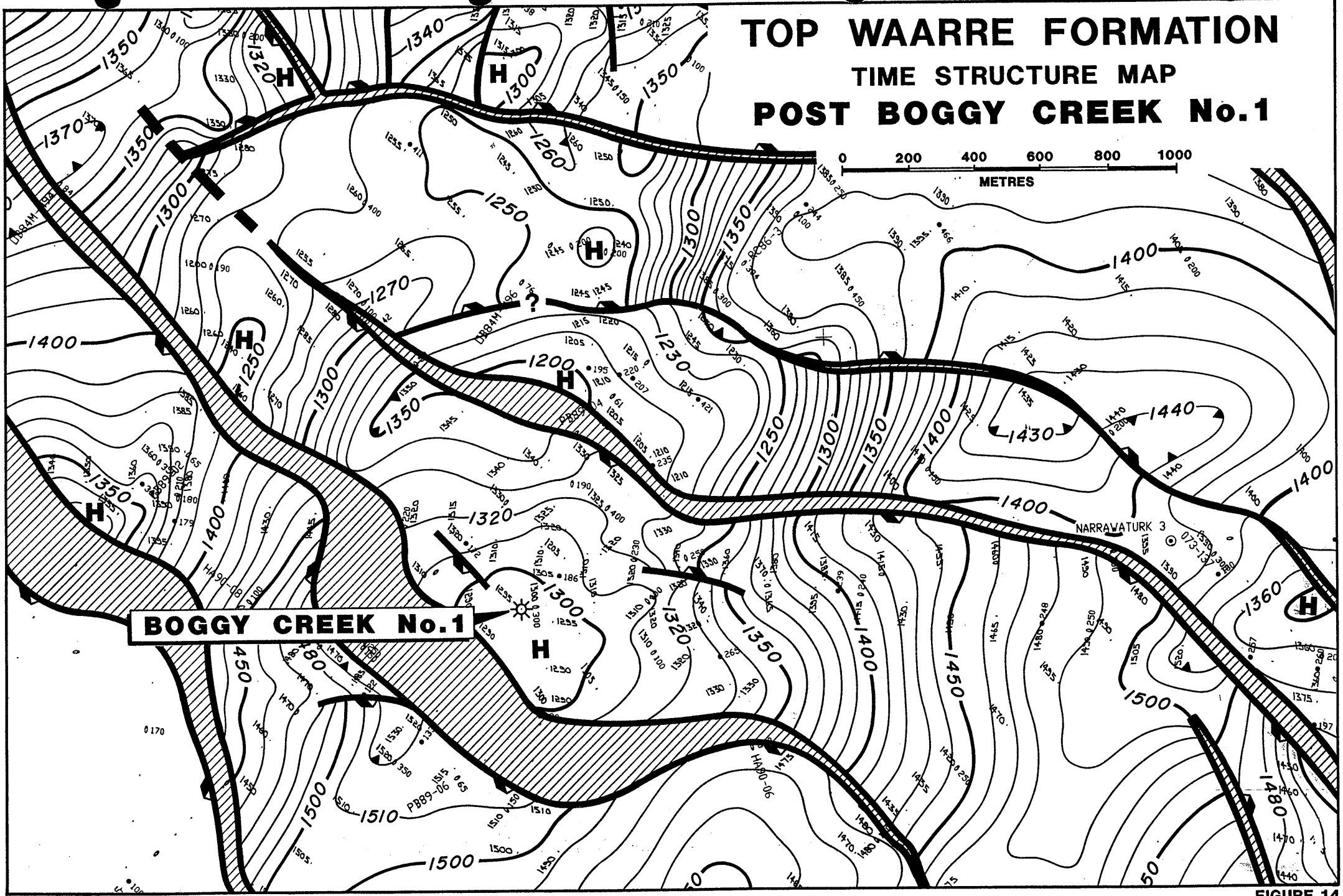
TOP WAARRE FORMATION
TIME STRUCTURE MAP
POST BOGGY CREEK No.1
0 200 400 600 800 1000
METRES
BOGGY CREEK No.1
NARRAWATURK 3
DRB4M
PB89-06
HA90-06
PB86-2

FIGURE 14

4.1.2 *Dipmeter Data*

A Precision Strata Dipmeter (PSD) log was run from 1894 to 1632m and from 1570m to 1301m. The results can be summarized as follows:-

1301m - 1390m

The dip vectors in the interbedded sandstone and claystone sequence of the Paaratte Formation generally have high confidence. The dip angles generally range from 4 to 10 degrees with the occassional dip value greater than 10 degrees. The dips in general trend northeast indicating a northwest-southeast structural strike. The rather low dip angles are consistent with the generally flat strata interpreted on the seismic. Minor changes in dip angles and directions are believed to be related to the sedimentary features.

1390m - 1470m

The dips in this section of the lower part of the Paaratte Formation have high confidence and are fairly consistent (green pattern). The dip magnitudes range from 10-12 degrees and are generally due northeast. The consistency of dip attitude is indicative of true structural dip.

1470m - 1482m

In this basal Paaratte interval, the dips are randomly oriented (yellow pattern) with dip angles ranging from 4 to 34 degrees. The sediment consists of fine-coarse, poorly sorted sandstone exhibiting randomly oriented dips which are possibly due to sedimentary facies.

1482m - 1570m

This interval covers the upper part of Belfast Mudstone. Despite the shale lithology in which the dip confidence and frequency was expected to be high, the number of measured dips and their reliability are rather low. The dip magnitudes and directions down to 1516m are consistent (green pattern) ranging from 10-15 degrees suggesting structural dip. From 1516 to 1535m the dips are randomly oriented and are of low confidence. From 1535 to 1570m, a slight change in both magnitude and attitude of the dips from 10-15 degrees northeast to generally 5-18 degrees to the east-north-east suggests that the well might have encountered a fault between 1516-1535m. A fault within the interval 1516m - 1535m can also be seen on seismic line HA90-17. (Figure No.16 shows the dipmeter log and the possible fault zone in the Belfast Mudstone.)

1632M-1658m

The confidence and frequency of the dips in this interval which covers the lower part of Belfast Mudstone are low. The dips are randomly oriented and ranging in values from 4-45 degrees.

1658m - 1742m

This interval covers the Waarre Formation. The dip frequencies and their level of confidence are generally good. The magnitude of the dips throughout the entire interval is rather low ranging from 2 to 10 degrees. The direction and magnitude of the dips with this interval change abruptly indicating a shift in the direction of the depositional channel. The upward fining sequence of dark grey claystone of unit - D (Flaxman Member) with common to abundant glauconite is indicative of a marine environment (see Figure 17).

1742m - 1894m

The dips within this interval which covers the drilled section of Eumeralla Formation show a moderate degree of confidence. However dips of low confidence are also observed in some intervals. The dips appear randomly oriented throughout the entire interval and range in magnitude from 2-40 degrees. The random dip pattern associated with poorly sorted volcanogenic rich sediments, suggest slumping and rapid sedimentation.

GAS AND FUEL EXPLORATION N.L.

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BOGGY CREEK NO.1

DIPMETER LOG SHOWING POSSIBLE FAULT ZONE

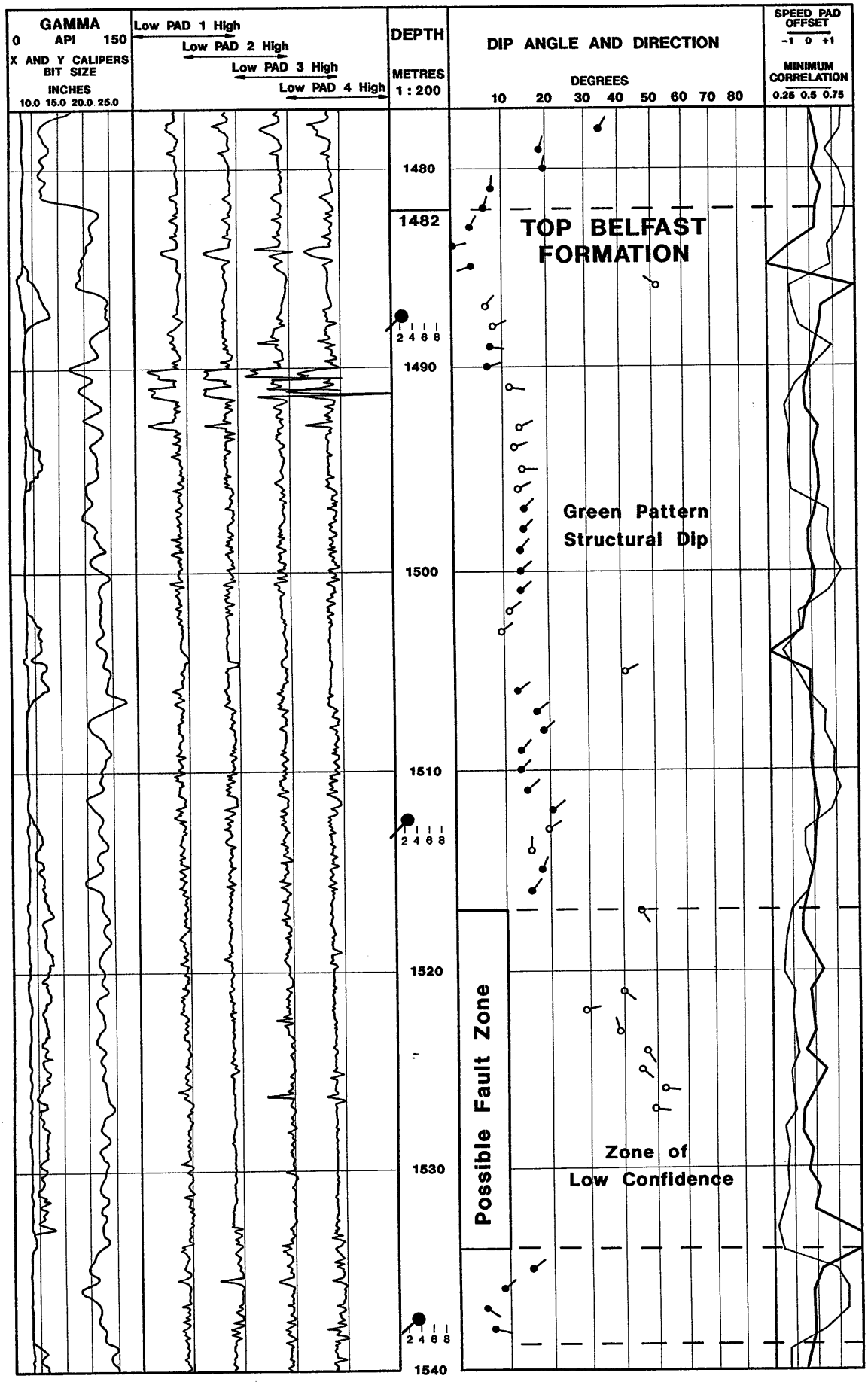

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FIGURE 16

GAS AND FUEL EXPLORATION N.L.

PEP 104 – OTWAY BASIN

BOGGY CREEK No.1

WAARRE FORMATION DIPMETER LOG AND SEDIMENTARY ENVIRONMENTS

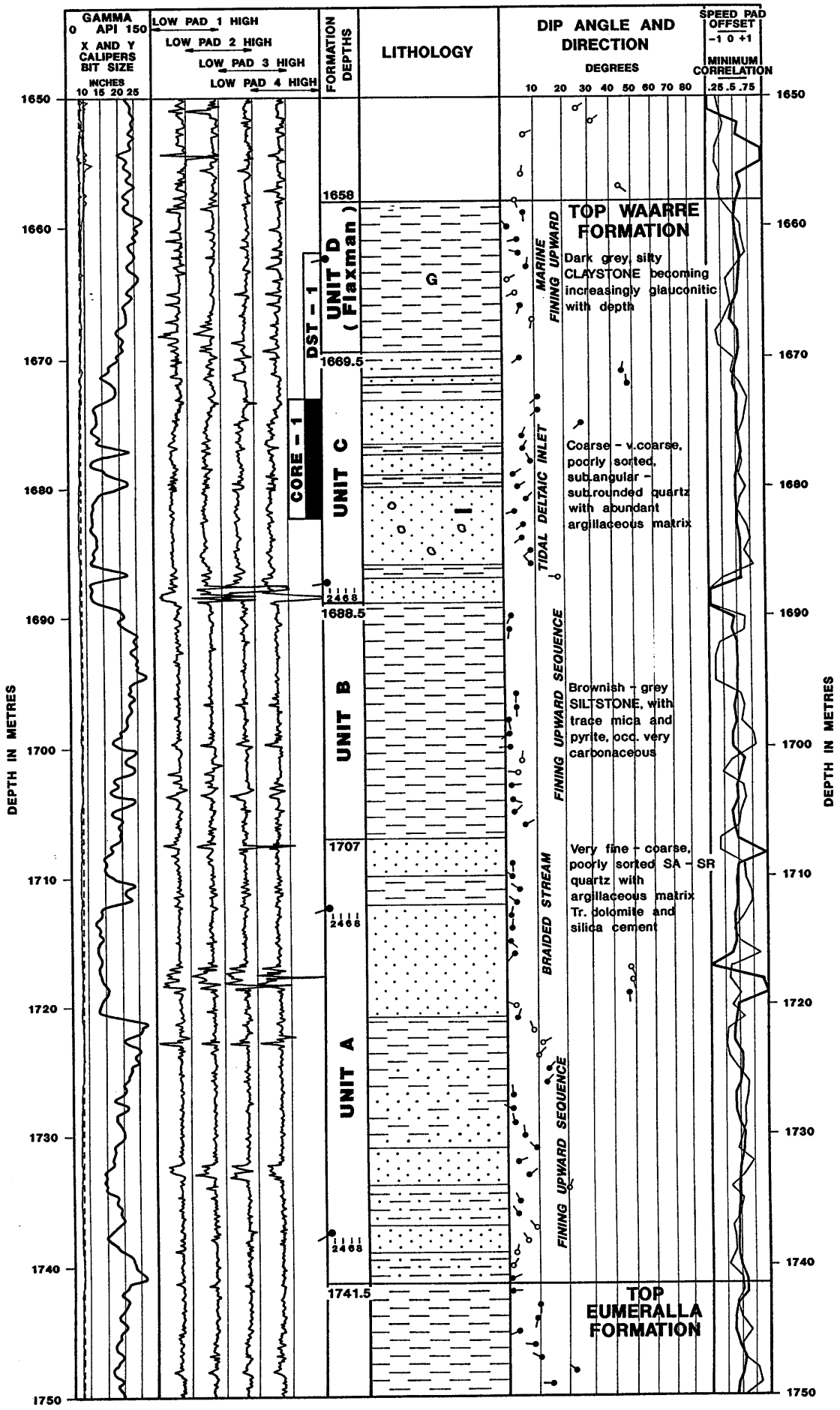

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FIGURE 17

PE600839

This is an enclosure indicator page.
The enclosure PE600839 is enclosed within the container PE902050 at this location in this document.

The enclosure PE600839 has the following characteristics:

ITEM_BARCODE	= PE600839
CONTAINER_BARCODE	= PE902050
NAME	= Seismic Interpretation Section
BASIN	= OTWAY
PERMIT	= PEP 104
TYPE	= SEISMIC
SUBTYPE	= SECTION
DESCRIPTION	= Seismic Line HA90-17, Migrated Stack with Interpretaion (enclosure from WCR vol.1) for Boggy Creek-1
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	= 14/01/93
W_NO	= W1053
WELL_NAME	= Boggy Creek-1
CONTRACTOR	=
CLIENT_OP_CO	= Gas & Fuel Exploration

(Inserted by DNRE - Vic Govt Mines Dept)

4.2 Porosity and Water Saturation

The following two zones covering the primary and secondary objectives of the well were selected for log analysis using the Crocker Data Processing (CDP) Petrology Log Computer programme (Table 3).

Zone-1 905 - 968m

The zone covers the Pebble Point Formation which was a secondary objective. The upper section of this zone (905m-932m) consists of interbedded pebbly argillaceous sandstone and claystone characterized by slight resistivity and separation between deep and shallow resistivity curves. The sand within this section exhibits over 20% effective log porosity and 100% water saturation. During the course of drilling no fluorescence or stain was observed and the total gas remained below the level of detection.

The lower part of zone 1 (932-968m) represents a relatively clean part of the Pebble Point Formation. The section becomes increasingly fine and slightly shaly with depth. The range of effective porosity and water saturation as indicated by logs are 10-25 and 95-100 percent respectively.

Zone-2 1650 - 1760m

This zone covers the Waarre Formation and consists of the following intervals:

(a) 1658-1669.5m (Unit - D, Flaxman Member)

This interval as indicated in the log is a fining upward sequence with clay content decreasing with depth. The effective porosity for the most part is less than 5%. The bottom 7.5 m of this interval which was included in the DST -1, is very tight and is not believed to have contributed significantly to CO_2 gas flowed during the test. No fluorescence or staining were observed while drilling and the total gas was 1.1 units with C1, C2, C3 and C4 concentrations being 150, 18, 10 and 3 ppm respectively.

(b) 1669.5-1688.5m (Unit C)

This interval covers the upper arenaceous part of the Waarre Formation and is characterized by low gamma ray and a sharp increase in the resistivity compared to the overlying interval. The average V-shale content of the sand is about 10%. The interval as indicated on the logs shows effective porosity values in the range 20-25% with gas saturations of up to 95%. The relatively high water saturation in the top three meters of this zone is probably due to the relatively high clay content. The water seems to be irreducible and was not produced during the course of DST No. 1 which covered this interval. No fluorescence or staining were observed while drilling and the total gas was reached a maximum of 22 units comprising of C1;4065 ppm, C;100 ppm, C3: 25 ppm and C4 18 ppm.

(c) 1688.5-1707m (Unit -B)

This interval represents a shale unit between the two sandy units A and C. It is an upward fining sequence and both gamma ray and the V-clay curve decrease with depth. The range of effective porosity is nil-5 percent. This unit does not appear to be an effective seal between Unit C and the underlying basal sand unit. Pressure data confirm that the sands above and below this unit are in communication. No fluorescence and staining were observed in the cuttings samples. The maximum total gas was 20 units with C1, C2, C3 and C4 concentrations being 2600, 100, 25 and 9 ppm respectively.

(d) 1707-1741.5m (Unit-A)

This interval covers the basal sandy section of the Waarre Formation. The upper part of this section consists of clean sand characterized by low gamma ray and low shale content. The effective porosity and gas saturation values in this part are 25-30% and 75-80% respectively.

The lower part of this section is an upward fining sequence. Both gamma ray and shalyness decrease with depth. The range of effective log porosity and gas saturation are 10-22% and 40-60% respectively. No fluorescence, staining or cut were observed in cuttings samples or drilling mud. The total gas reached a maximum of 62 unit (1720-1725m) consisting of C1, C2, C3 and C4 concentration being at 11718, 268, 72 and 25 ppm respectively.

(e) 1741.5-1760m (Eumeralla Formation)

The high gamma ray and V-clay are indications of low reservoir potential in this interval. No fluorescence, cut, or staining were observed. A maximum total gas of 37 units was reported between 1845m-50m comprising C1:6770 ppm, C2:240 ppm, C3:35 ppm and C4:17 ppm.

The total gas gradually diminished below 1760 m and at total depth (1900m) reached a minimum of 1.7 units comprising of C1:264, C2:15, C3:10 and C4:5 ppm.

Log interpretation was performed in two stages:

(a) Pre-interpretation and quality control (first pass) which included the following procedures:-

- Depth matching of the poorly matched logs
- Bad data readings were set to missing
- Data input
- Environmental correction
- Subdivision into zones
- Computation of the pre-interpretation results

(b) Final interpretation and computation (second pass) which consisted of the following procedures:-

- Complex lithology model utilizing Indonesian Equation for Complex Lithology.
- Generating crossplots
- Computing RW, RT, and ROHO (density of hydrocarbon)
- Generating graphic results.

Table 3 summarizes the result of the log analysis and a complete data set of the log interpretation results and logs are included in Appendix 13.

4.3 Relevance to the Occurrence of Hydrocarbons

Boggy Creek No.1 was drilled on one several high structures aligning in a northeast - southwest direction from Westgate - 1A to Curdievale -1.

Prior to drilling the well, and based on a regional depositional model constructed for the Waarre Formation, it was postulated that the reservoir sands such as were encountered in the Waarre Formation in the Iona Gas Field, would be developed in the Boggy Creek area. These sands exhibit excellent reservoir qualities

The seismic interpretation added significantly to the prospectivity of the area as it revealed the Boggy Creek to be ideally located to trap hydrocarbon generated from the sediments deposited within the Curdie Trough and migrated up dip from both south and west. Gas and oil shows encountered in the wells drilled in the vicinity of the Boggy Creek such as Flaxman No.1, Curdie No.1, and Wallaby Creek No.1 were further encouragement towards the prospectivity of the area. As to the secondary objectives, the Pebble Point Formation and the Nullawarre Greensand sealed with Pember and Skull Creek mudstones were thought to have good reservoir potentials

GAS AND FUEL EXPLORATION N.L.

PEP 104 - OTWAY BASIN

BOGGY CREEK NO.1

FORMATION EVALUATION

Formation		INTERVAL (Metres)	Nett / Gross %	SHOW	Ø E LOG %	AV. SW %
PEBBLE POINT FORMATION (Secondary Objective)		905 - 932 INTERBEDDED CLAYEY SANDSTONE AND CLAYSTONE	44	NIL	> 20	100
		932 - 966 ARGILLACEOUS SANDSTONE	100	NIL	10 - 25	95-100
WAARRE FORMATION (Primary Objective)	UNIT - D (Flaxman)	1658 - 1669.5 UPWARD FINING SILTSTONE	0	TOTAL GAS : 1.1 UNIT C1 : 150 ppm C2 : 18 ppm C3 : 10 ppm C4 : 3 ppm	< 5	-
	UNIT - C	1669.5 - 1688.5 MEDIUM - C.GRAINED SANDSTONE WITH MINOR CLAY	76	TOTAL GAS : 20 UNITS C1 : 2,600 ppm C2 : 100 ppm C3 : 25 ppm C4 : 9 ppm	20 - 25	5
	UNIT - B	1688.5 - 1707 UPWARD FINING CLAYSTONE, SILTSTONE AND MINOR SANDSTONE	22	TOTAL GAS : 20 UNITS DIMINISHING TO 4 UNITS C1 : From 2,600 to 760 ppm C2 : From 100 to 27 ppm C3 : From 25 to 11 ppm C4 : From 9 to 2 ppm	0 - 5	-
	UNIT - A	1707 - 1741.5 SANDSTONE AT THE TOP AND UPWARD FINING SAND AND SILT IN LOWER PART	48	TOTAL GAS : 62 UNITS C1 : 11,718 ppm C2 : 268 ppm C3 : 72 ppm C4 : 25 ppm	25 - 30	40 - 50
EUMERALLA FORMATION		1741.5 - 1760 SILTSTONE / CLAYSTONE	0	TOTAL GAS : 8.7 UNITS C1 : 1417 ppm C3 : 27 ppm C2 : 56 ppm C4 : 5 ppm	< 10	⩾ 90

TABLE 3

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Post drilling data however indicated that:

- Good reservoir quality sand existed in the lower part of the Pebble Point and Paaratte Formations. The sands however were found to be water saturated.

- The Skull Creek Mudstone and Nullawarre Greensand were not present. It is believed that these formations have been pinched out against the Boggy Creek - Schomberg High.

- The Belfast Mudstone although entered in the low side of the fault was found to be thicker than originally prognosed. This would indicate the existence of a thick and hence a more effective seal for the Waarre reservoir in the area.

- Good reservoir quality sands were found to have been developed in the unit C and A of the Waarre Formation.

4.3.1 *Total Organic Carbon (TOC)*

A total of ten (10) sidewall core samples were selected for TOC's measurement and source rock evaluation. The measured TOC's ranged from 0.09 to 2.0 percent and generally decreased with depth. An exception was sidewall core No. 7 taken at 1722.5m which had TOC of 5.85%.

GAS AND FUEL EXPLORATION N.L.

BOGGY CREEK 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	857	422	IMMATURE	0.17	POOR	1.24		1.68	1.41	POOR – MARGINAL	0.12	OIL WINDOW	0.73	0.11	2.00	FAIR – GOOD	62	84
	914.5	327		0.14		0.00		1.35	0.14		1.00		0.00	0.01	0.54		0	250
	1109	333		0.14		0.27		0.60	0.41		0.35		0.45	0.03	1.25		21	48
BELFAST	1487	429		0.29		1.41		0.96	1.70		0.17		1.45	0.14	1.82		77	52
	1579	400		0.17		0.54		0.41	0.71		0.24		1.31	0.05	1.44	EXCELLENT	37	28
WAARRE	1722.5	420		0.64	GOOD	7.06		1.03	7.70	GOOD	0.08		6.85	0.64	5.85		120	17
EUMERALLA	1772	319		0.20	POOR	0.63		0.21	0.88	POOR	0.28		3.00	0.07	0.09		143	47
	1816														0.44	POOR		
	1836														0.26			
	1856														0.20			

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 4 OT.

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GAS AND FUEL EXPLORATION N.L.

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BOGGY CREEK NO.1

VITRINITE REFLECTANCE PROFILE

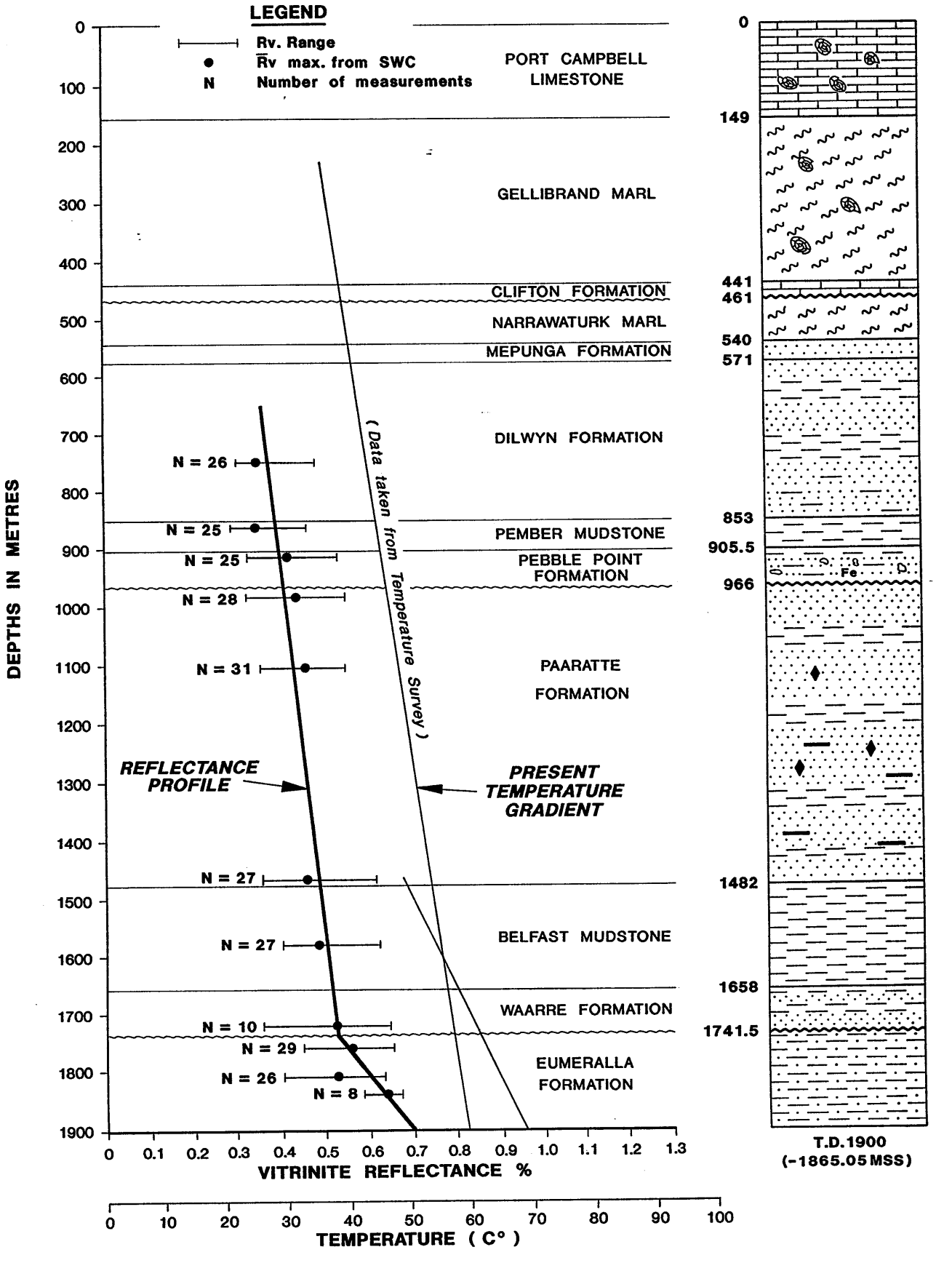

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FIGURE 18

BOGGY CREEK NO.1
MATURITY PROFILE

PEP 104

Oct 7, 1992
12:04 pm

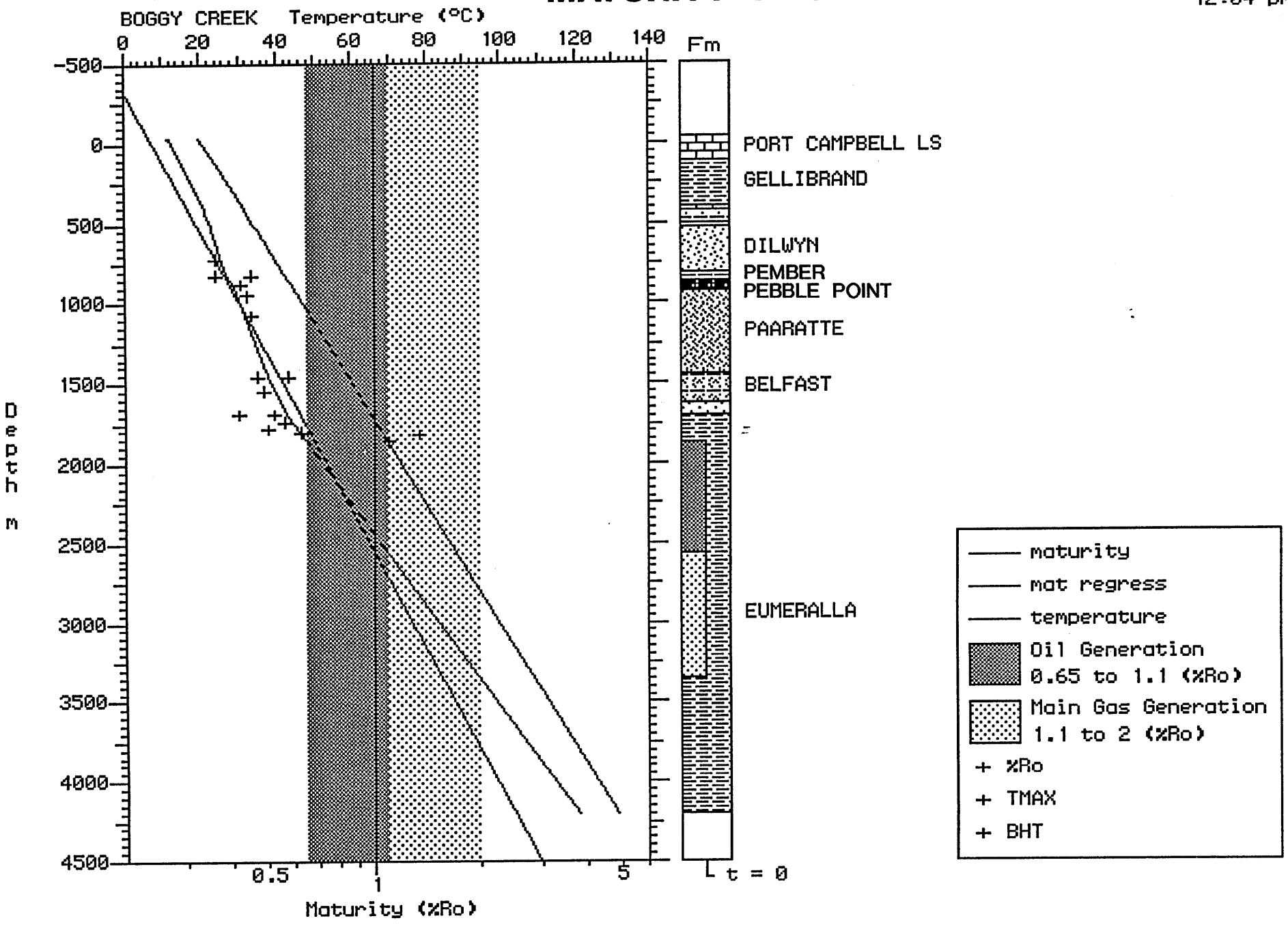


FIGURE 21

PEP 104
BOGGY CREEK

BOGGY CREEK No.1
DEPOSITIONAL AND TECTONIC HISTORY

Oct 7, 1992
12:00 pm

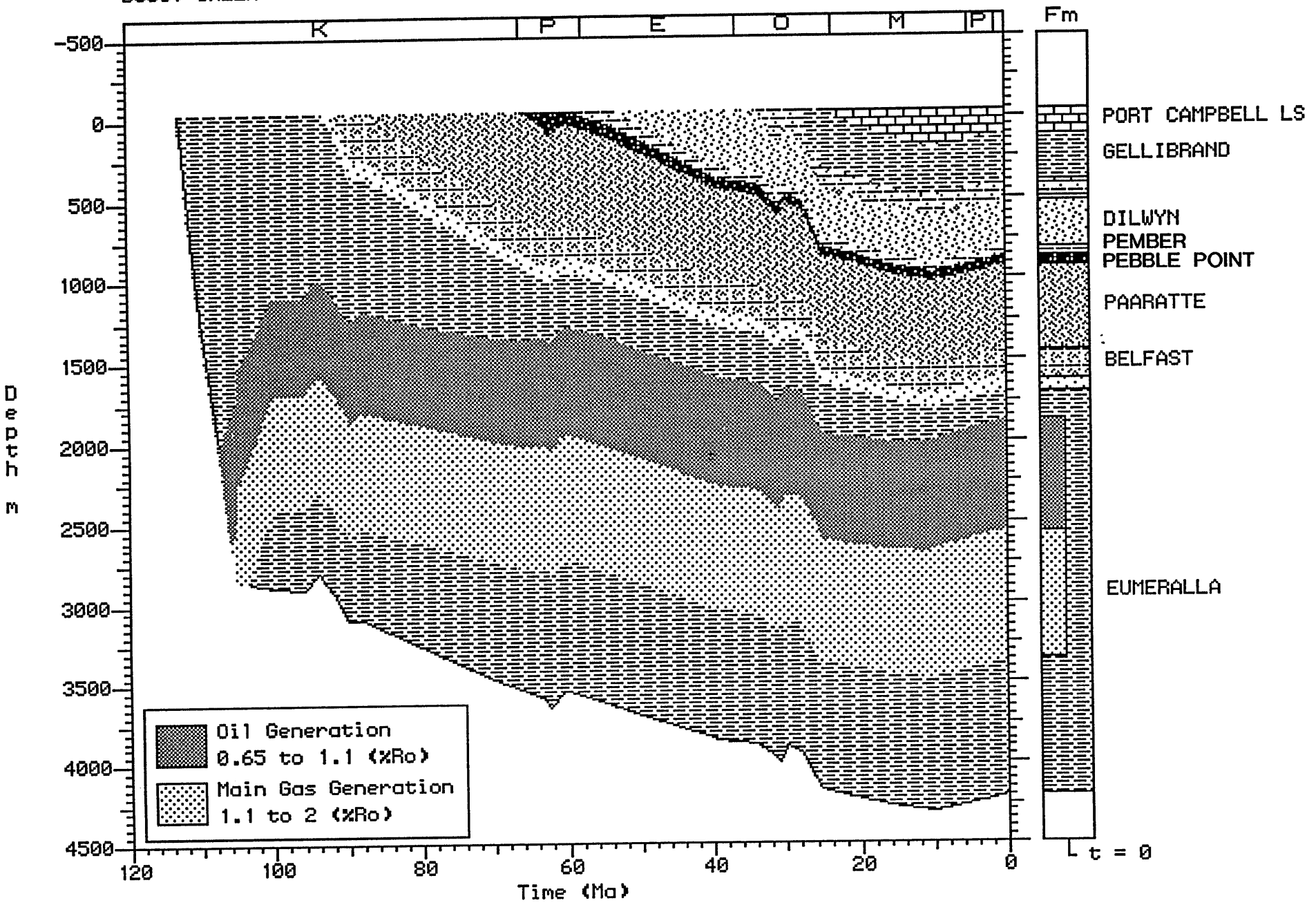


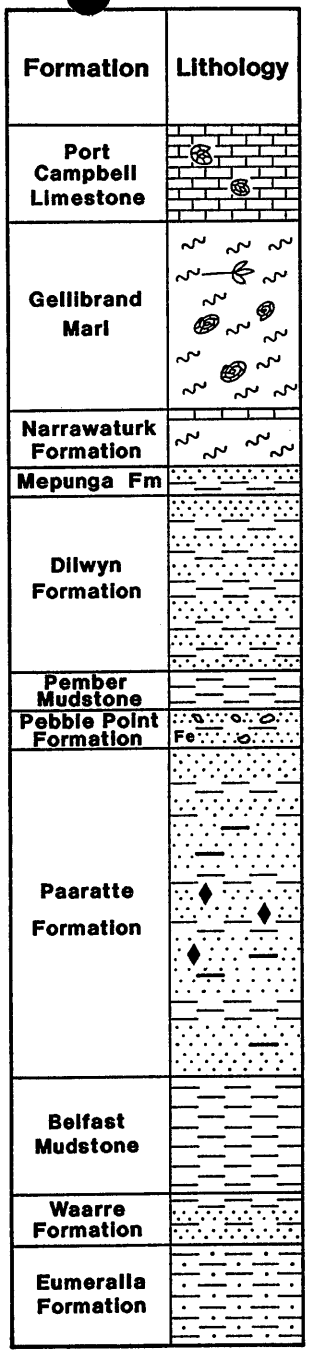
FIGURE 20

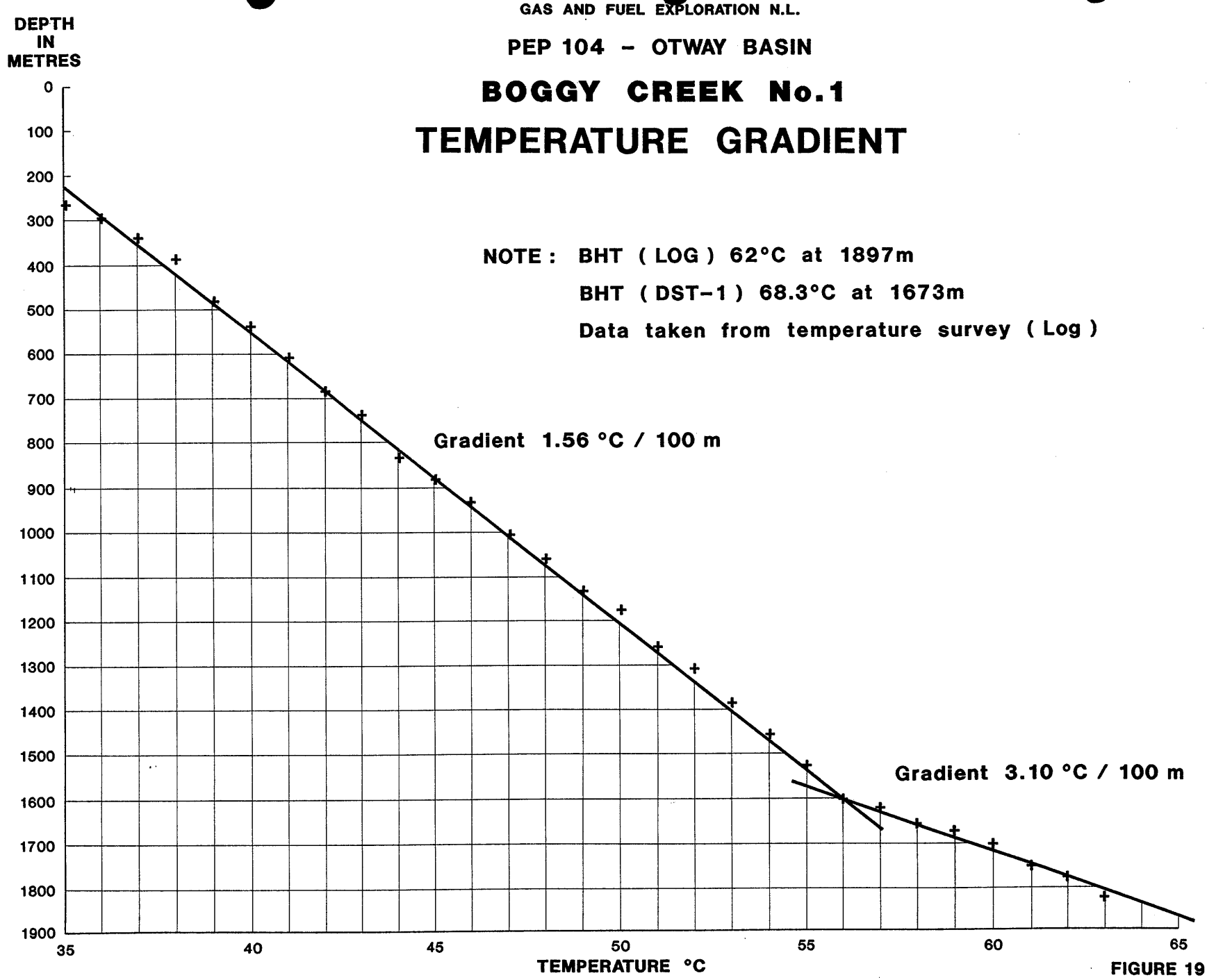
GAS AND FUEL EXPLORATION N.L.

PEP 104 - OTWAY BASIN

BOGGY CREEK No.1

TEMPERATURE GRADIENT





NOTE : BHT (LOG) 62°C at 1897m

BHT (DST-1) 68.3°C at 1673m

Data taken from temperature survey (Log)

AUTHOR : V.AKBARI

FIGURE 19

The organic matter mainly consisted of inertinite with both vitrinite and liptinite being common to sparse. Dispersed organic matter (DOM) was common to abundant in most samples. The results of the pyrolysis confirm the type of kerogen to be predominantly of type III and that the entire sequence penetrated, including the Belfast and Eumeralla Formations, is thermally immature. The highest T max was 422°C at 857 m.

The complete geochemical results are contained in Appendix -11. Table 4 also summarizes the result of the source rock assessment.

4.3.2 *Vitrinite Reflectance*

A total of twelve (12) sidewall core samples were selected for vitrinite reflectance measurements. The reflectance values are less than 0.55% down to the base of the Waarre confirming the thermal immaturity of the sequence.

A shift in vitrinite reflectance profile is clearly evident below the Waarre Formation (See Figure 18).

4.3.3 *Bottom Hole Temperature*

A temperature survey was carried out during the course of the wireline logging by measuring and recording temperature every 25-30 m intervals.

The temperature gradient profile (Figure 19) indicates a rather low gradient of 1.56°C per 100 metres down to a depth of about 1600 m close to the faulted zone in the Belfast Mudstone. Below this depth, the geothermal gradient increased to 3.10°C per 100 meters.

Maximum bottom hole temperatures of 62°C at 1899m and 68.3°C at 1672m were recorded during the wireline logging and formation testing respectively.

5. BASIN MODELLING

5.1 Introduction

Two steps are generally involved in any basin modelling:

- Re-construction of the depositional and tectonic history by means of plotting the depth of burial versus geological time.

- Integration of present or paleo-thermal data into the thermal maturation calculations.

Other factors such as sea level changes throughout geological time, lithology, compaction, heat flow/conductivity data, vitrinite reflectance values and kerogen type are also incorporated in order to generate a more complete and realistic model. The integrity of the generated model is verified by comparing the measured and calculated maturity profile.

5.2 Boggy Creek Modelling

A computer programme (Modular Basin Modelling System) was used to generate a model for depositional, tectonic and source maturation history of the Boggy Creek prospect (Figures 20 & 21). The generated model reveals the following points:-

- The overall subsidence of the area is characterized by a rapid subsidence followed by a period of brief uplift and erosion during the Albain time and thereafter the subsidence continued gradually and at much slower rate.

- The maximum subsidence encountered during the Miocen time when carbonate and calcareous marl became prevailed.

- The upper and middle part of the Eumeralla were potentially mature for hydrocarbon generation prior to the deposition of the Waarre Formation.

- The present day oil and gas windows occur at the depth of 1850 and 2550 metres respectively.

- The lower part of the Eumeralla Formation which is generally expected to be richer in organic content than the upper and middle part, is thermally post mature due to the deep burial depth.

6. PRESENCE AND ORIGIN OF CARBON DIOXIDE

6.1 Presence of CO_2

The presence in the subsurface of carbon dioxide in high concentrations is widespread throughout the Otway Basin. However its occurrence in terms of reservoir type, reservoir age, quantity and purity is very diverse. Although CO_2 is a common component of natural gas, its occurrence in a commercial amount is relatively rare. The presence of CO_2 in significant quantity has been reported in the following wells:-

Well Name	Formation	Depth (m)	% CO_2	Flow Rate
Boggy Creek -1	Waarre	1662	92	4.5 MMCFD
Caroline -1	Waarre	2500	98.9	2.7 MMCFD
Garvoc -1	Pretty Hill	1365	96.3	Gas-cut water
Grumby -1	Waarre	1664.5	51.7	2.3 MMCFD
Kalangadoo -1	Otway/Basement	2112	96.27	2.8 MMCFD
Pine Lodge -1	Belfast	1940	96.9	4.0 MMCFD

6.2 Origin of the Carbon Dioxide

Several diverse sources for the subsurface accumulation of CO_2 have been proposed by various authors which could be summarised as follows:-

6.2.1 *Inorganic Origin*

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 and thermally immature leading to the belief of an inorganic sources for CO_2. In the absence of the organic materials the CO_2 can be evolved under the following conditions.

- Several significant occurrences of CO_2 reservoirs have been reported in regions where carbonates are in close proximity to the volcanism. These reservoirs show a random distribution with regard to the age and nature of the host sediment. Farmarer (1965) concluded that most of the carbon dioxide found in relatively large quantities had its origins 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 been shown to be capable of generating significant quantities of carbon dioxide.

Dissolution of carbonates by very low PH ground water could also be important in generating CO_2.

6.2.2 Organic Origin

Thermal degradation of organic matter may lead to generation of carbon dioxide. During initial degradation at relatively low pressure and temperature (<80°C), high microbial activities lead to the formation of CO_2 as a component of natural gas. At vastly increased pressure and temperature breakdown of organic matter, including hydrocarbon generated during diagensis - catagenesis processes, can lead to the liberation of carbon and hence formation of carbon dioxide.

Oxidation of hydrocarbon by mineralized water has also been suggested as the source of carbon dioxide.

The data from the Isotopic analysis suggests the following points:-

- The carbon dioxide gas in the Boggy Creek, has its origin from either volcanic activities and/or non-biogenic decomposition of carbonates. (Isotopic values in the order of 0.03% would be anticipated if its origin was due to organic maturation)

- The carbon dioxide and hydrocarbon components of the gas have been generated from different sources. By inference they have migrated independently into the structure.

- The Isotopic values of the hydrocarbon components indicate a source having a maturity level of approximately 0.84-0.85% V_{Ro}. Such a level is expected to be easily attained deeper within the Eumeralla Formation.

- The relative concentration of C_2-C_4 in the total hydrocarbon is an indication of a relatively wet gas coming from a source being capable of generating liquid hydrocarbon. This is further confirmed by the existence of heavier components i.e. C_6 and C_7. The presence of the latter components would also point to a low level of biodegradation if any at all.

6.3 Significant Features of CO_2 Accumulations in the Otway Basin

J. Mulready (1971) summarised the distinguishing features of the major CO_2 accumulations within the Otway Basin to be as follows:

- High purity of CO_2 (up to 98.9% in Caroline No. 1).
- Differing reservoir depths.
- Lack of a significant carbonate sequence in close vertical proximity to the reservoir beds.
- Lack of a high percentage of the organic material in the host sediment.
- The association of the CO_2 reservoirs with horizons of different age and lithology.
- The association of the CO_2 reservoirs with areas of recent volcanic activities.
- Accumulation in fault controlled structures.

6.3.1 *Isotopic Analysis of C02 and Hydrocarbon Gases*

Two gas samples collected during the course of DST-1 were sent to CSIRO's Division of Exploration Geosciences for Isotopic analysis of both the CO_2 component and the hydrocarbon gases. Both samples were characterised by high CO_2 contents. The C_3 - C_4 hydrocarbons were concentrated prior to the measurement of their Isotopic values by removal of CO_2 with potassium hydroxide.

APPENDIX – 1

DETAIL OF DRILLING PLANT

RIG SPECIFICATION

CONTRACTOR: GEARHART DRILLING SERVICES

RIG NO.: GDS-2

RIG MODEL: SUPERIOR 700E SCR

CAPACITY: 3350M (11,000FT.) NOMINAL

Drawworks

One superior model 700E SCR electric driven drawworks complete with auxiliary brake and sandreel. Maximum input H.P.1000. Driven by EMD motor.

One Foster model 37 make-up spinning cathead. Mounted on drillers side.

One Foster model 24 Break-out cathead. Mounted off drillers side.

Transmission - 2 speed transmission with high chain $1^1/_4$" triple 26T to 24T. Twin disc PO218 air clutch. Low chain $1^1/_4$" triple 20T to 39T twin disc PO218 air clutch.

Engines

Four caterpillar model 3412 PCTA diesel engines.

Mast

Floor mounted cantilever mast Dreco - model No.: M12713-510 designed in accordance with A.P.I. specification 4E 'drilling and well servicing structures'.

Clear working height - 127'
Base width - 13'6"
Hook load
Gross nominal capacity - 510,000 lbs
Hook load capacity with:

10 lines strung	410,000 lbs
8 lines strung	365,000 lbs
6 lines strung	340,000 lbs
4 lines string	306,000 lbs

Maximum wind load 100 MPH - no setback
Maximum wind load 84 MPH - rated setback.

Adjustable racking board with capacity for 108 stands of $4^1/_2$" drill pipe, 10 stands of $6^1/_2$" drill collars, 3 stands of 8" drill collars designed to withstand an A.P.I. windload of 84 MPH with pipe racked.

2/....

Crown Block

215 ton with five 36" sheaves, and one 36" fastline sheave grooved $1^1/8$"/

Substructure

One piece substructure. 14' H x 13'6" W X 50'L W/12' BOP clearance.
Set-back - 200,000 lbs - casing = 210,000 lbs.

Rig Lighting

Explosion proof fluorescent.

Travelling Block

One 667 Crosby McKissick 250 ton combination block hook Web Wilson 250 ton hydra-hook unit 5 - 36" sheaves.

Kelly Drive

One 20 HDP Varco Kelly drive bushing

Kelly

One square kelly drive $4^1/4$" X 40' complete with scabbard.

Swivel

One oilwell pc-300 ton swivel.

Rotary Table

One oilwell a 20 $^1/_2$" rotary table torque tube driven from drawworks.

Air Compressors & Receivers

Two Leroi Dresser model 660A air compressor packages C/W 10 H.P. motors rated at 600 volt 60 HZ 3 phase. Receivers each 120 gallon capacity and fitted with relief valves.

Instrumentation

One (1) 6 pen drill sentry recorder to record:

Weight (D) 1-Martin Decker Sealtite
1 Cameron deadline type
Penetration (feet)
Pump Pressure (0-6000 P.S.I.)
Electric Rotary Torgue
Rotary speed (R.P.M.)
Pump S.P.M. (with selector switch)
One (1) drillers console including the following equipment:
Martin Decker weight indicator type 'D' electric rotary torque gauge.
Pit scan.
S.P.M. gauge (2 per console).
Rotary R.P.M. gauge.
One set of 'double shot'.
Deviation instrument 'TOTCO'.
One set of mud testing laboratory standard kit (Baroid).

3/.....

Drilling Line

5000' of $1\frac{1}{8}$" - Tiger brand.

Mud Pumps

Two Gardner Denver mud pumps model No.: PZHVE 750 each driven by 800 HP EMD motor.

Generator

Four brown Boveri 600 volt 3 phase 60 HZ AC generators. Powered by four cat 3412 PCTA diesel engines.

B.O.P's and Accumulator

One hydril 13 $\frac{5}{8}$" X 3000 P.S.I. spherical annular B.O.P., studded top and flanged bottom. Height 14".
One hydril 13 $\frac{5}{8}$" X 5000 P.S.I. flanged double gate B.O.P.
One Galaxie 13 $\frac{5}{8}$" X 5000 P.S.I. double studded adaptor flanges complete with studs and nuts.
One cup tester, gray C/W test cups for 9 $\frac{5}{8}$" and 13 $\frac{3}{8}$".
One Wagner model 130 - 160 3 BND 160 gallon accumulator consisting of:

Sixteen 11 gallon bladder type bottles.
One 20 H.P. electric driven triplex pump 600 volt 60 HZ 3 phase motor and controls
One Wagner model A - 60 auxiliary air pump 4.5 gals/minute.
One Wagner model UM2SCB5S mounted hydraulic control panel with five (5) 1" stainless steel fitted selector valves and two (2) stripping controls and pressure reducing valves: three (3) 4" hydraulic readout gauges:

- one for annular pressure
- one for accumulator pressure
- one for manifold pressure.

One Wagner model GMSB - 5A 5 station remote drillers control with three pressure readback gauges, increase and decrease control for annular pressure.

Spools

One set flanged adaptor spools to mate 13 $\frac{5}{8}$" lot X 5000 P.S.I. A.P.I. B.O.P. flange to following wellhead flanges:

12" X 900 series, Height 14"
10" x 900 series, " "
8" X 900 series, " "
B.O.P. spacer, flange 12" 3000 R57 studded X 6" 3000 R45 flange, height 16"
B.O.P. spacer spool (drilling spool) 12" 5000 BX160, Height 14".

4/.....

Kelly Cocks

One Griffith lower kelly cock 6 1/2" O.D. with 4 1/2" X H connections.
One Griffith upper kelly cock 7 3/4" with 6 5/8" A.P.I. connections.

Drill Pipe Safety Valve

One Griffith 6 1/2" inside blowout preventors (4 1/2" X H)
One Griffith 6 1/2" stabbing valve (4 1/2" x H)

Choke Manifold

One McEvoy choke and kill manifold 3" - 5000 P.S.I.

Mud System

One pill tank capacity 25 bbls.
Two mix tanks capacity 108 bbls. (each)
One reserve tank capacity 120 bbls.
One desilt tank capacity 120 bbls.
One desand tank capacity 120 bbls.
One sand trap capacity 15 bbls.

Fuel Tank

One 140 bbls.
One 6000 gals - 30,000 litres.

Water Tanks

One 400 bbls.

Mixing Pumps

Five mission magnum 5' x 6' x 14" centrifugal pumps complete with 50 H.P. 600 volt HZ3 PH explosion proof electric motors.

Trip Tank Pump

One mission magnum 2" x 3" cemplete with 20 H.P. 600 volt 60 HZ3 PH explosion proof motors.

Water Transfer Pumps

Three mission magnum 2" x 3" centrifugal pumps C/W 20 H.P. 600 volt 60 HZ3 PH explosion proof motors.

Mud Agitators

Six geolograph/pioneer 40 TD - 15" 'Pitbull' mud agitators with 15 H.P. 600 volt 60 HZ3 PH electric motors.

Shale shaker

One Brandt-dual tandem shale shaker.

Desander

One Pioneer T8-6 'sandmaster' desander

Desilter

One Pioneer T12-4 "Siltmaster" desilter

Drill Pipe

10000 Ft of 4 1/2" grade 'E' 16.60 lbs/ft hard banded drill pipe 326 joints.

Drill Collars

1 - 6 1/2" OD drill collar (short) 15'.
27 - 6 1/2" OD drill collars.
3 Actual 8" OD drill collars.
9 Actual joints of 4 1/2" hevi-wate drill pipe.

Two (2) bit subs - 6 5/8" reg DBL box
Two (2) bit subs - 4 1/2" reg x 4 1/2" XH DBL box
One (1) XO sub - 7 5/8" reg x 6 5/8" reg DBL box
One (1) XO sub - 4 1/2" XH Box X 4 1/2" IF pin
One (1) XO sub - 4 1/2" reg x 4 1/2" XH DBL pin
Two (2) XO sub - 6 5/8" reg pin x 4 1/2" XH box
One (1) junk sub - 6 5/8" reg pin x 6 5/8" reg box
One (1) junk sub - 4 1/2" reg box x 4 1/2" reg pin
One (1) junk sub - 4 1/2" reg box x 4 1/2" XH box
Two (2) kelly saver sub s/w rubber 4 1/2" XH PXB
Two (2) circular subs - 4 1/2" XH X 1502 HAMMR Union
Two (2) 12 1/4" EZI change S/Stab 6 5/8" reg PXB
Two (2) 8 1/2" Integral blade stabilizers 4 1/2" XH PXB

Elevators

One (1) 4 1/2" BJ250 Ton 18 degree taper D/P elevators
One (1) 2 7/8" IUS 100 Ton tubing elevators
One (1) 2 7/8" EUI 100 Ton tubing elevators
One (1) 13 3/8" BAASH ROSS 150 Ton s/door elevators
One (1) 13 3/8" S/Joint P.U. Elevators
One (1) 9 5/8" Webb Wilson 150 Ton s/door elevators
One (1) 9 5/8" S/joint P.U. Elevators
One (1) 7" BJ 200 Ton s/door elevators
One (1) 7" S/joint P.U. Elevators
All P.U. elevators c/w slings and swivel

One (1) 8" Webb Wilson 150 Ton s/door elevators D/C
One (1) 5 3/4" Webb Wilson 150 Ton s/door electors D/C
Above c/w lift nubbing and bails

Rotary Slips D/P Tubing

Two (2) 4 1/2" VARCO SDML D/P slips
One (1) 3 1/2" VARCO SDML Tubing slips
Two (2) 8" - 6 1/2" DCS-R drill collar slips

Rotary Tongs

One (1) BJ type 'B'C/W latch & lugjaws 13 3/8" - 3 1/2"

Casing Slips

Three (3) 13 3/8" - 9 5/8" - 7" VARCO CSML casing slips

Bit Breakers

Four (4) 17 1/2" - 12 1/4" - 8 1/2" - 6"

Fishing Tools

One (1) 8 1/8" Bowen series 150 F.S. O/Shot
One (1) 10 5/8" Bowen series 150 F.S. O/Shot
C/W grapples and packoofs to fish contractors down hole equipment
One (1) 8 O.D. fishing magnet 4 1/2" reg pin
One (1) Reverse circ junk basket 4 1/2" XH box
One (1) Junk basket mill type c/w mill shoe 4 1/2" reg pin
One (1) Jars 6 1/2" O.D. Griffiths fishing 4 1/2" XH PXB
One (1) Jar accelerator Griffiths fishing 6 1/2" O.D. 4 1/2" XH PXB
One (1) Bumper sub 6 1/2" O.D. fishing 4 1/2" XH PXB
One (1) 12" Junk Mill 6 5/8" reg pin
One (1) 8" Junk Mill 4 1/2" reg pin

Rotary Reamers

One (1) 6 1/2" O.D. Drilco N.B. roller reamer C/W type K cutters 8 1/2" hole

PUP Joints

Three (3) 5' - 10;- 15; 4 1/2" O.D. grade 'G' PUP joints

Auger

One (1) 27 1/2" Auger 4 1/2" XH box

Rathole Digger

One (1) fabricated rotary table chain driven

Power Tong

One (1) Farr 13 5/8" - 5 1/2" hydraulic power tons
C/W hyd. power pack and hoses and torgue gauge assy.

APPENDIX – 2

BOGGY CREEEK–1 DRILLING AND COMPLETION REVIEW

BOGGY CREEK - 1 : DRILLING AND COMPLETION REVIEW

Rig Move

Start: 15 December, 1991

Finish: 21 December, 1991

The GFE drilling supervisor Gerard Nicot was on location for the whole rig move. Gearhart Drilling Services (GDS) had programmed two days for repairs to the drawworks. This was completed on time. There was some delay due to difficulty starting the rig engines and a breakdown of a portable hot air blower. (The blower is used to dry the moisture out of the SCR unit).

Generally, the rig up was performed slower than anticipated. The inexperience of the crew partly caused this.

Drilling

Spud	:	1100 hours 21 December 1991
Complete Logging	:	0300 hours 7 January 1991
Estimated Total Time	:	24.0 days
Actual Total Time	:	16.67 days

The drilling of the $12^{1}/_{4}$ inch surface hole and the running cementing of the $9^{5}/_{8}$ inch casing was performed without problems and there was no deviation in time from the prognosed times.

The $8^{1}/_{2}$ inch hole drilled at a considerably faster rate than anticipated. This was mainly due to a better than expected run through the Paaratte Formation and the inhibiting and hole cleaning characteristics of the PHPA mud. Nearby wells which were drilled in the early 1980's and did not use PHPA mud penetrated similar sections at considerably slower rates.

The hole deviated out to a maximum of 4 degrees (1595m KB) after drilling through the fault at approximately 1484 m KB at the base of the Paaratte Formation. This was corrected by decreasing the weight on bit and increasing the bit revolutions per minute.

The replacement of an out of gauge string stabiliser helped overcome the tight sections at 1000-1060m KB, 1230-1260m KB and 1315-1470m KB. DST No.1 was successfully run over the interval 1654-1673m KB. A flow rate of 4.5 MMscf/d of Carbon Dioxide was recorded. After the DST, the 60 foot core barrel was run to cut a core in the top of the Waarre, however it failed to reach bottom due to the tightness of the hole. A stiff BHA (near bit stabiliser and string stabiliser at 30 feet) was run to ream the hole and clean to bottom. A 30 foot core barrel was then successfully run to bottom and core No.1 cut.

There were no other significant incidents in drilling to 1900 m KB total depth or during the logging of the well prior to completion.

Completion

The well was completed with $2^{7}/_{8}$ inch EU-AB modified 6.5 lb/ft J55 tubing with a Baker SB-3 permanent packer set at 1643m KB and the wireline re-entry guide at 1658m KB. The full completion string is illustrated on Figure 22.

A 3000 psi stainless steel trim wellhead has been installed.

The well is awaiting perforation and further testing.

The completion took 1.5 days longer than estimated, due mainly to problems with cleaning and drifting the tubing. The variances are itemized and discussed as attached.

Figure 23 shows the proposed and actual drilling time.

GAS AND FUEL EXPLORATION N.L.

BOGGY CREEK No.1

WELL COMPLETION DIAGRAM

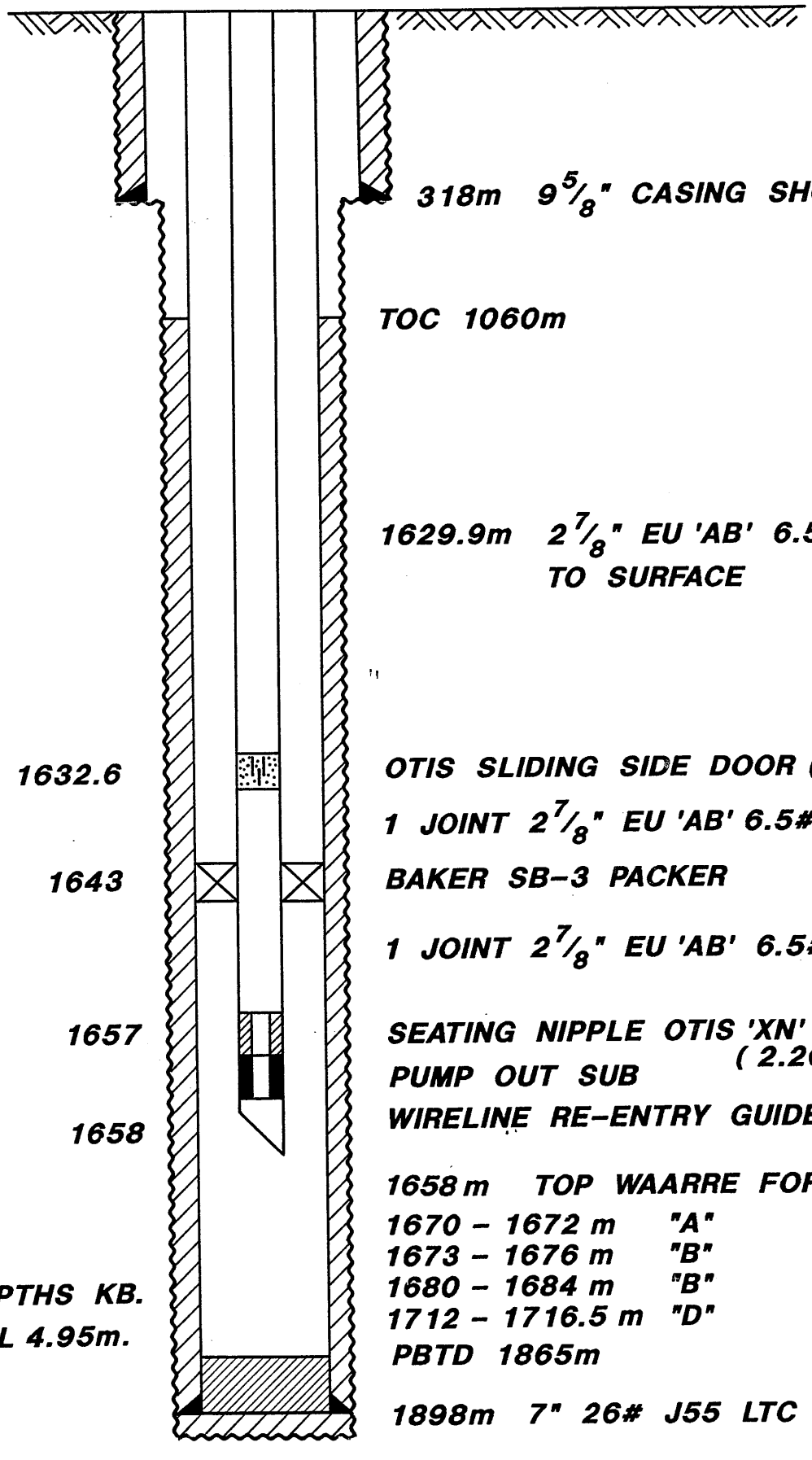


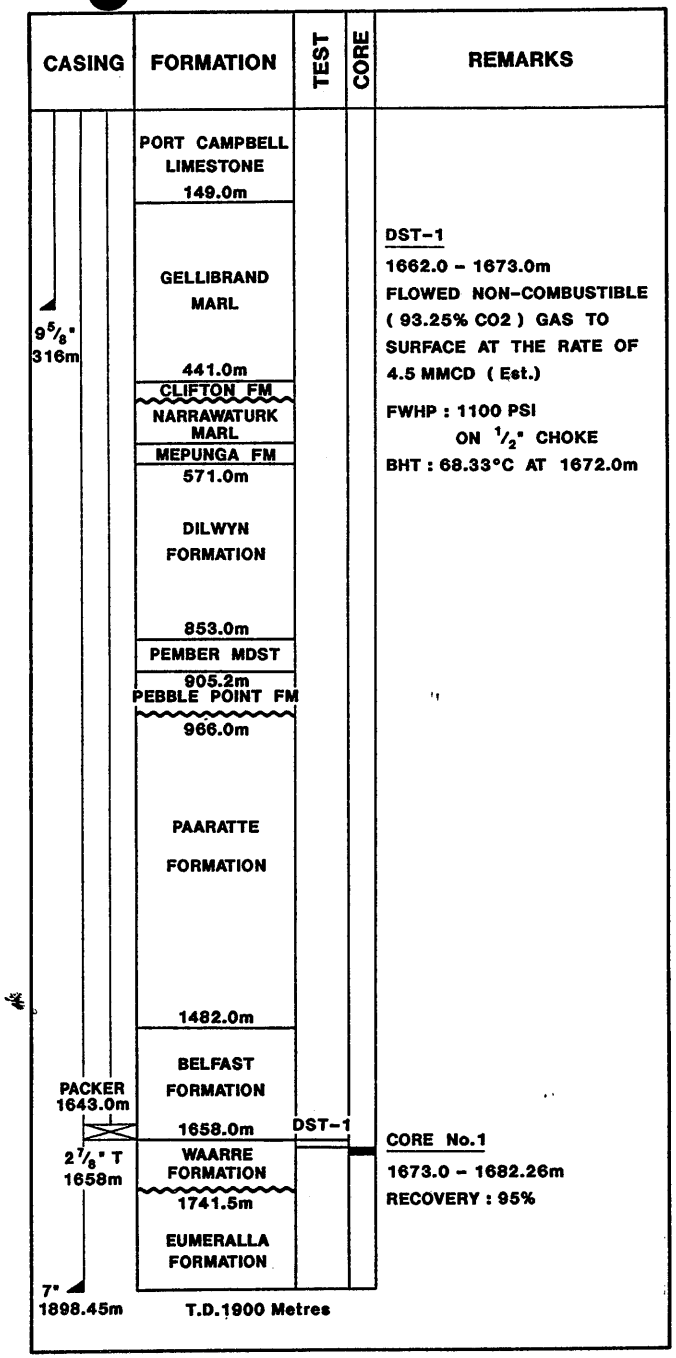
FIGURE 22

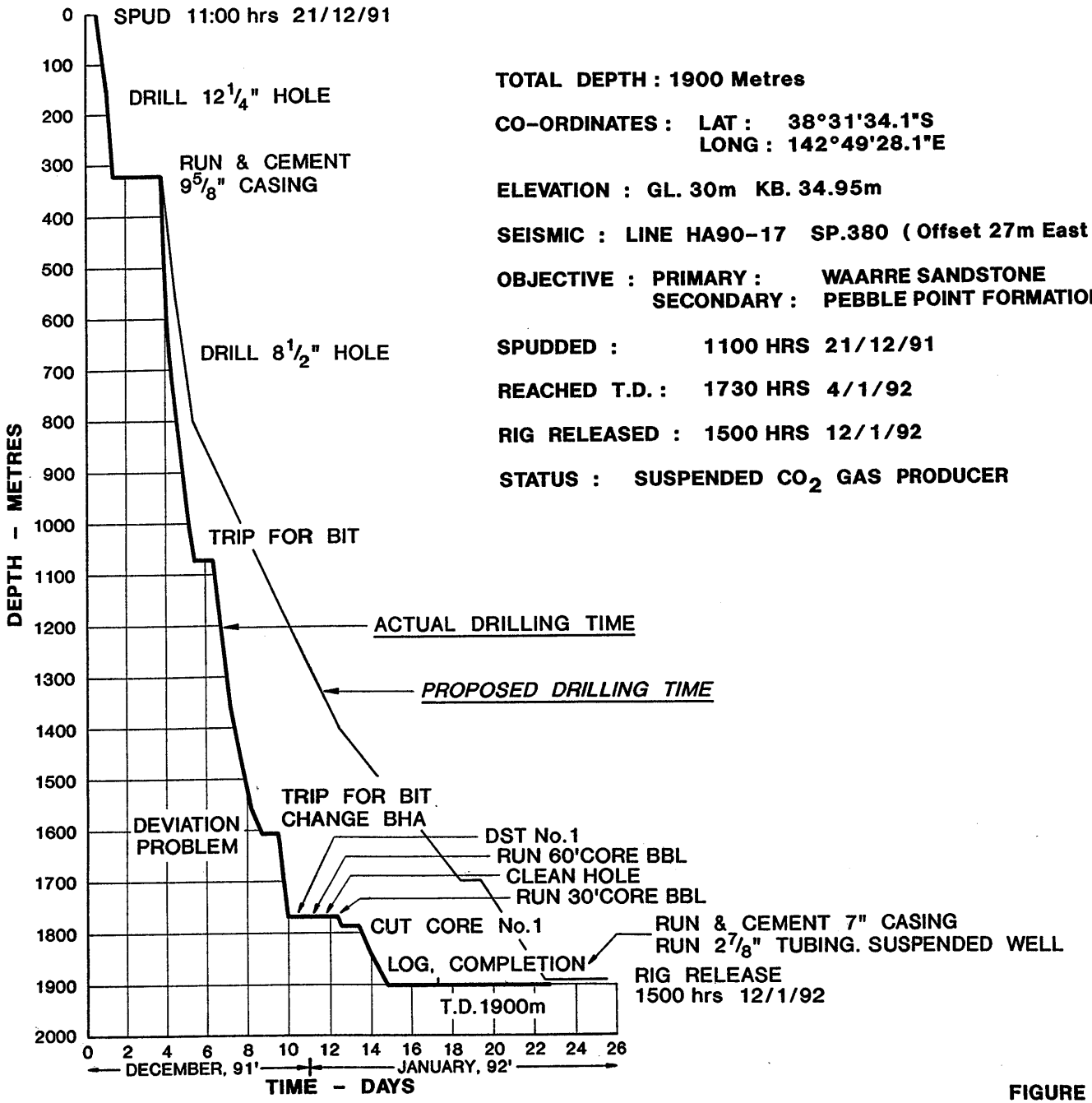
AUTHOR : V.AKBARI

GAS AND FUEL EXPLORATION N.L.

BOGGY CREEK No.1

PROPOSED AND ACTUAL DRILLING TIMES





TOTAL DEPTH : 1900 Metres

CO-ORDINATES : LAT : 38°31'34.1"S
LONG : 142°49'28.1"E

ELEVATION : GL. 30m KB. 34.95m

SEISMIC : LINE HA90-17 SP.380 (Offset 27m East)

OBJECTIVE : PRIMARY : WAARRE SANDSTONE
SECONDARY : PEBBLE POINT FORMATION

SPUDDED : 1100 HRS 21/12/91

REACHED T.D. : 1730 HRS 4/1/92

RIG RELEASED : 1500 HRS 12/1/92

STATUS : SUSPENDED CO_2 GAS PRODUCER

AUTHOR : ROD HARRIS

FIGURE 23

BIT RECORD
BOGGY CREEK-1
==========

PEP 104 OPERATER: GFE
COTRACTOR: GEARHART D.S. RIG: #2

PUMP 1GD PZ8
PUMP 2GD PZ8

GFE REP: G. NICOT
TOOLPUSHER: I. SEPERIC

No.	SIZE IN	MAKE	TYPE	JET SIZE	SERIAL	DEPTH OUT	m DRILLED	HOURS	ACCUM. HOURS	DRLG RATE m/hr	DULL COND	No. of D.C.	Wt 1000 lbs	R.P.M.	VERT. DEV.	PUMP PRESS	No.1 spm	Liner	No.2 spm	Liner	MUD Wt	Vis	pH	WL	DATE
								19	19	16.32	2 2 IN	2X8",15X6.25"	5-15	110/120	0.75	650	120	6"		6"	8.8	36	8.5		23-12-91
1	12-1/4	SEC	S33F	3 X 16	554660	323	310	34.5	53.5	21.83	7 2 1/8	15 x 6-1/2"	20	120	0.75	900	100	6"		6"	8.9	43	8.5	8.4	27-12-91
2	8-1/2	SEC	S33F	11/11/13	543673	1076	753	52	105.5	10.29	4 3 3/16	15 x 6-1/2"	10-20	100-130	0.5-4	880	88	6"		6"	9.2	46	9.0	7.2	30-12-91
3	8-1/2	SEC	S82F	11/11/13	560575	1611	535	7.5	113	8.27		15 x 6-1/2"	15-20	100-130	3-2.25	1000	90	6"		6"	9.3	42	9.0	6.2	31-12-91
4	8-1/2	SEC	S446F	3 X 11	532778	1673	62	4.5	117.5	2.00	60 %	15 x 6-1/2"	12-18	80		550	70	6"		6"	9.2	41	9.0	7.0	03-01-92
5	8-1/2	CHRIST	CG		651857F	1682	9	26	143.5	8.38	3 3 IN	14 x 6-1/2"	20	110	1	950	90	6"		6"	9.3	41	9.5	6.4	05-01-92
6	8-1/2	SEC	S82F	3 X 11	560580	1900	218																		

TABLE – 5