GORDON 1

WCR

W1191

Well Completion Report

Santos

GORDON 1

Well Completion Report

WCR
GORDON - 1
W1191

Santos
A.C.N. 007 550 923

PEP119, OTWAY BASIN
VICTORIA

WCR

Gordon

(W1191)

GORDON-1
WELL COMPLETION REPORT

COMPILED FOR

TMOC PTY LTD

Prepared By:
J. A. WATT
D.HORNER
JUNE, 1997

GORDON-1

TABLE OF CONTENTS

<u>**LOCATION MAP**</u>

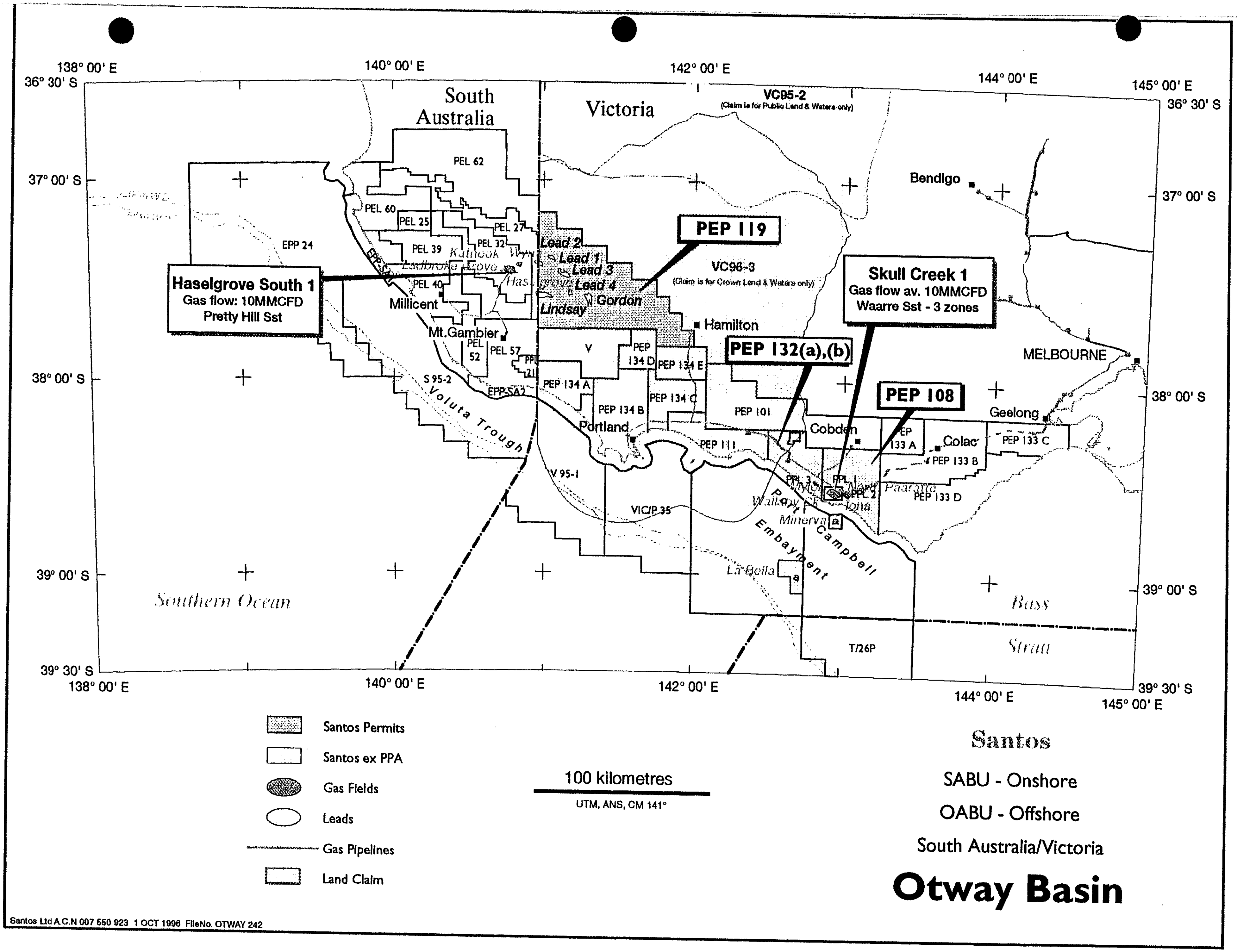
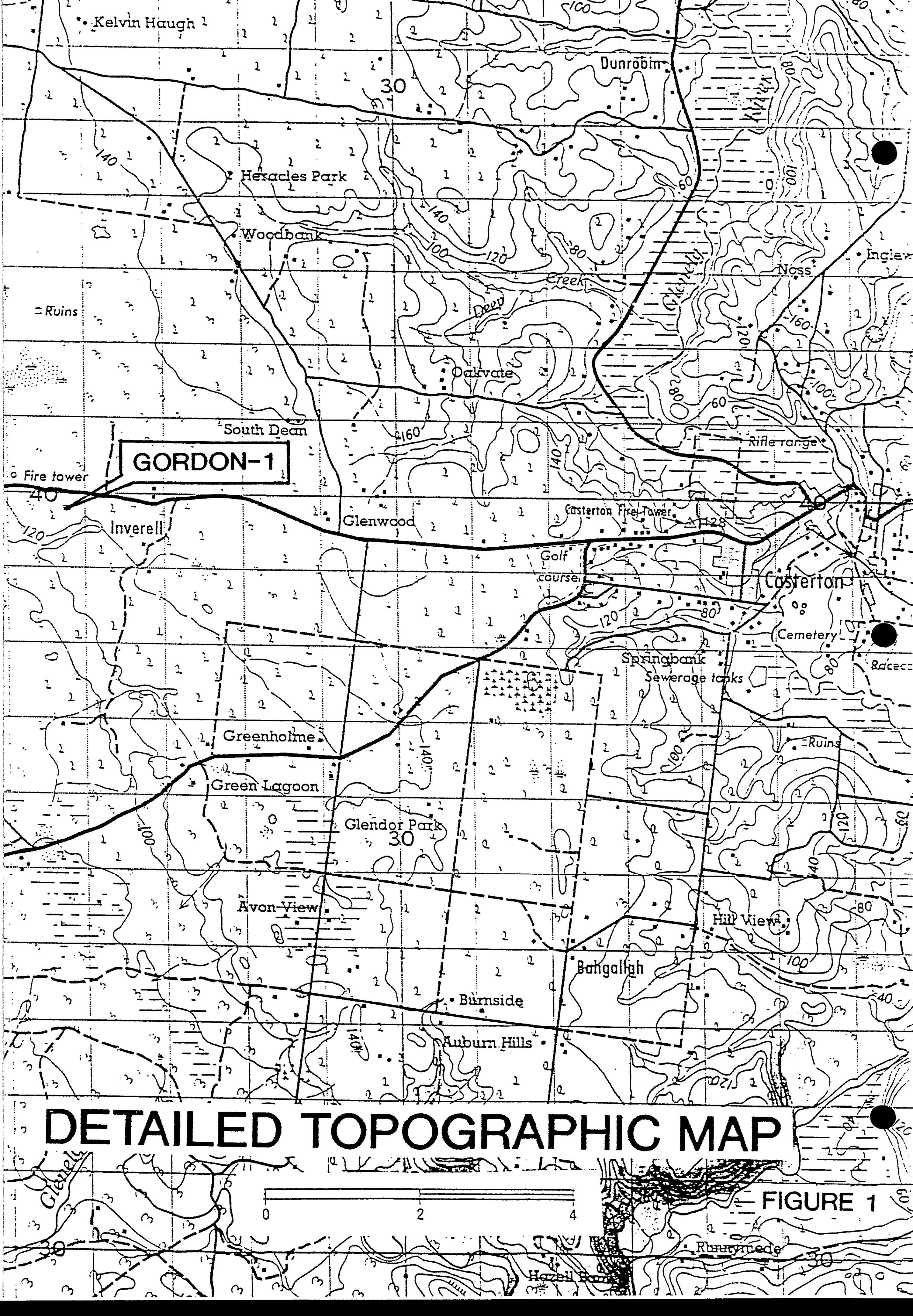
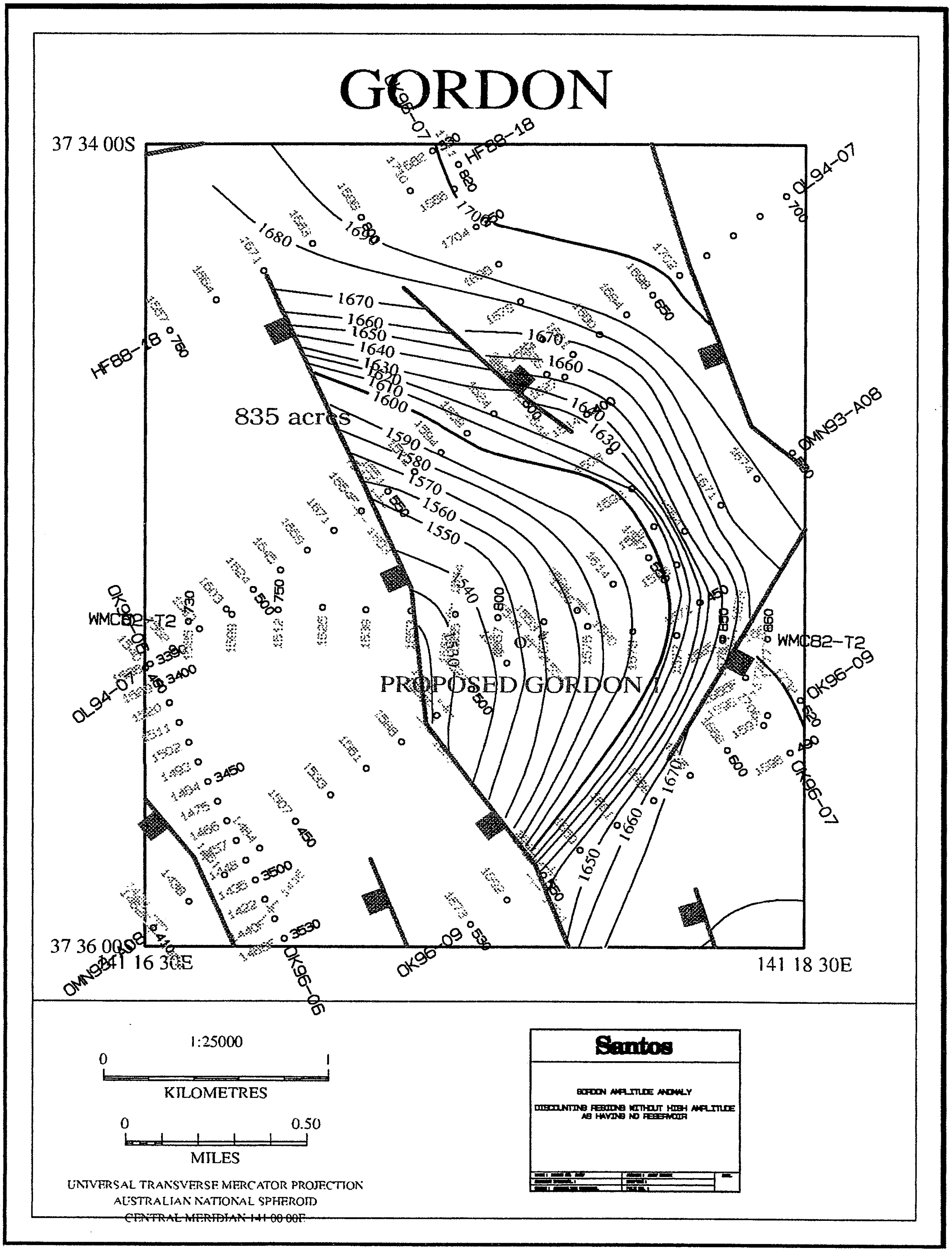

Otway Basin
South Australia/Victoria
SABU - Onshore
OABU - Offshore
Santos
Haselgrove South 1
Gas flow: 10MMCFD
Pretty Hill Sst
Skull Creek 1
Gas flow av. 10MMCFD
Waarre Sst - 3 zones
PEP 119
PEP 132(a),(b)
PEP 108
South Australia
Victoria
VC95-2
(Claim is for Public Land & Waters only)
VC96-3
(Claim is for Crown Land & Waters only)
Lead 1
Lead 2
Lead 3
Lead 4
Gordon
Lindsay
Bendigo
Hamilton
Melbourne
Geelong
Colac
Cobden
Portland
Millicent
Mt.Gambier
PEL 62
PEL 60
PEL 25
PEL 27
PEL 32
PEL 39
PEL 40
PEL 52
PEL 57
EPP 24
PEP 134 A
PEP 134 B
PEP 134 C
PEP 134 D
PEP 134 E
PEP 101
PEP 111
PEP 133 A
PEP 133 B
PEP 133 C
PEP 133 D
V 95-1
VIC/P 35
S 95-2
T/26P
Voluta Trough
Port Campbell Embayment
La Bella
Minerva
Southern Ocean
Bass Strait
138° 00' E
140° 00' E
142° 00' E
144° 00' E
145° 00' E
36° 30' S
37° 00' S
38° 00' S
39° 00' S
39° 30' S
Santos Permits
Santos ex PPA
Gas Fields
Leads
Gas Pipelines
Land Claim
100 kilometres
UTM, ANS, CM 141°
Santos Ltd A.C.N 007 550 923 1 OCT 1996 FileNo. OTWAY 242

FIGURE 1



DETAILED TOPOGRAPHIC MAP

FIGURE 1


GORDON
37 34 00S
37 36 00S
141 16 30E
141 18 30E
835 acres
PROPOSED GORDON 1
HF88-18
OL94-07
OMN93-A08
WMC82-T2
OK96-09
OK96-07
OK96-06
1:25000
KILOMETRES
0
0.50
MILES
UNIVERSAL TRANSVERSE MERCATOR PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN 141 00 00E
Santos
GORDON AMPLITUDE ANOMALY
DISCOUNTING REGIONS WITHOUT HIGH AMPLITUDE
AS HAVING NO RESERVOIR

WELL CARD

WELL: Gordon-1	WELL CATEGORY: Wildcat (WCNF) WELL INTENT: Gas in the McEachern Sandstone	SPUD: 15/04/97, 23:00hrs TD REACHED: 27/04/97, 21:30hrs
		RIG RELEASED: 3/05/97, 22:00hrs CMPLT:
		RIG: ODE Rig 30 (IDECO H725)
LAT: 37 deg 35' 14.5" S	LONG: 141 deg 17' 38.4" E	STATUS: Plugged and Suspended well (PSO)
SEISMIC STATION: Offline 36m NW of CDP827 (SP515) line OMN 93-08		REMARKS: Suspended for possible re-entry. Sidetrack for potential oil in fractured basement.
ELEVATION GND: 124.89m amsl	RT: 129.59m	
BLOCK/LICENCE: PEP 119, Onshore Otway Basin, Victoria		
TD : 2303m (Logr Ext) ; 2505m (Drlr)		

PBTD M (Logr) M (Drlr)	CASING SIZE	SHOE DEPTH	TYPE
TYPE STRUCTURE: Tilted fault block	16"	10m	Conductor
TYPE COMPLETION: Plugged and Suspended	9.625" (244mm)	653.3m (D)	K55 - 36lb
ZONE(S): Basement		652m (L)	

AGE	FORMATION OR ZONE TOPS	DEPTH (M) LOGGERS	DEPTH (M) SUBSEA	THICKNESS (m)	HIGH (H) LOW (L)
	Tertiary (undifferentiated)	4.7 sfc	+124.9	35	
	Otway Group				
Early Cretaceous (Aptian-Albian)	Eumeralla Formation	40.0	+89.6	1110	2.6 (H)
	Crayfish Group				
E. Cret. (Valanginian-Hauterivian)	Laira Formation	1150	-1020.4	367	3.4 (L)
E. Cret. (Berriasian-Valanginian)	Pretty Hill Formation	1517.0	-1387.4	601	143.6 (H)
	McEachern Sandstone	Not	Present		---
L. Jur.-E.Cret.(Kimmeridgian-Berriasian)	Casterton Formation	2118.0	-1988.4	243	269.6 (H)
Palaeozoic	Basement	2361.0	-2231.4	130+	89.6 (H)
	T.D.	2503.0	-2373.4		7.7 (L)
*(ages from APG Consultants, 1997)					

LOG INTERPRETATION (Interval Averages)

	Ø %	SW %	INTERVAL(ft)	Ø %	SW %

PERFORATIONS (4 shots/ft)

FORMATION	INTERVAL
None	

CORES

FORM	NO.	INTERVAL	CUT	REC
None				

LOG	SUITE/ RUN	INTERVAL (M)	BHT/TIME/REMARKS Degrees C	LOG	SUITE/ RUN	INTERVAL (M)	BHT/TIME/REMARKS Degrees C
SP-AR	1/1	2473-652		DT	1/1	2485-652	
ECGR	1/1	2490-560	97°C/8Hrs 17 Mins	DTL	1/1	"	
HCAL	1/1	2496-652	"	DTLN	1/1	"	
RXO8	1/1	"	"	DTLF	1/1	"	
HRLD	1/1	2499-652	"	A/S	1/1	2485-2100	
HRLS	1/1	"	"	CST	1/2		99°C/16Hrs 23Mins, Cut 60, Rec 56 (1 lost, 3 empty) 29/04/97
TNPH	1/1	2492-652	"	FMI	1/3	2498-2170.4	96°C/6 Hrs 30Mins, 29/04/97
RHO8	1/1	2496-652	"				

FORMATION TESTS

NO.	INTERVAL (m)	FORMATION	FLOW (mins)	SHUT IN (mins)	BOTTOM GAUGE IP/FP (psia)	SIP	MAX SURF PRESS (psia)	FLUID TO SURF (mins)	TC/ BC	REMARKS
1 CS	2390-2461 (D) 2388-2459 (L)	Basement	15 17	42	115.1 181 220.1	2054			0.5"/ 0.75"	Packer failed 17 mins into 2nd flow. NFTS. Rec 6bbls oil cut rathole mud. API 38° @ 60° F., Pr Pt 36° C.
2 CS	2389.5-2461 (D) 2387.5-2459 (L)	Basement	216	154	158.2 474.7	2773			0.5"/ 0.75"	Packers failed after 216 mins. Rec 1bbl oil cut mud + 7bbls muddy water.

SUMMARY:

The Gordon-1 well was drilled during the months April and May, 1997, in PEP 119, situated in southwestern Victoria, approximately 25km east of the border of South Australia. The well was proposed as an exploration well for gas, in the Penola Trough, within the Victorian Otway Basin. Gordon-1 lies about 5km west of the town of Casterton, 9.5km SSE of McEachern-1, 30km E of the Katnook gas pipeline and approximately 50km W of the Victorian gas pipeline at Hamilton.

The Gordon structure is a tilted fault block located on the northeastern flank of the Penola Trough. The primary objective was the McEachern Sandstone, a member of the Pretty Hill Formation, within the Crayfish Group, overlying the Casterton Formation. The McEachern Sandstone was not recognized in the well, presumably pinched out, and the well bottomed in metasiltstone basement at 2505mKB. There were shows both in Early Cretaceous and Late Jurassic sediments, as well as in the Palaeozoic basement. Within the Pretty Hill Sandstone, at 1642-44m, and 1771-75m there were trace residual oil shows, and in the basal section of the Casterton Formation at 2345-63m there were gas shows associated with coals. Underlying the Casterton, in light to dark greenish-grey metasiltstones at 2400-60m, trace to fair oil shows, with moderately bright to bright yellowish-white fluorescence, a milky white crush cut, and a thin ring residue were recorded, associated with fractures in the Palaeozoic basement. A Formation Microscanner Imager Log (FMI) was run to elucidate the fracture system, and it indicated a high density of open fractures across the interval containing the oil shows.

Two drill stem tests were conducted to evaluate the fractured interval intersected at the top of the basement. The first, DST #1, was conducted as a conventional straddle test between 2390-2461m. It lost its packer seat 17 minutes into the second flow, but recovered 6 bbls of oil cut rathole mud. The second test, DST #2, was run over the same interval, however, it too had a packer failure after 216 minutes. Recovery was 1 bbl of oil cut water and 15 bbls of muddy water. The flow rate was calculated to be 47 bbls a day, and the API gravity of the oil was analyzed to be 38° at 60° F.

The Gordon-1 well was plugged and suspended for possible re-entry and the ODE Rig 30 was released on May 3rd, 1997 at 22h00.

AUTHOR: D. Horner, A. Pietsch **DATE: Sept. 1997**

<u>WELL HISTORY</u>

1. GENERAL DATA

Well Name:	Gordon-1	
Well Classification:	Exploration (WCNF)	
Interest Holders:	TMOC Pty Ltd Basin Oil NL	60.00% 40.00%
Participating Interests:	TMOC Pty Ltd Basin Oil NL	60.00% 40.00%
Operator:	SANTOS	
Block/Licence:	PEP 119, Onshore Otway Basin, Victoria	
Surface Location:	Latitude: 37^{O} 35' 14.5" South Longitude: 141^{O} 17' 38.4" East	
Surveyed Elevation:	Ground Level: 124.89m Rotary Table: 129.59m	
Seismic Survey:	Kanawinka Seismic Survey	
Seismic Location:	Offline 36m NW of CDP827 (SP515) line OMN 93-08	
Total Depth:	Driller: 2305m Logger: 2303m	
Completion:	Not Completed	
PBTD:	Well plugged and suspended.	
Status:	Suspended Oil Well.	

2. DRILLING DATA

Date Drilling Commenced:	2300 hours, 15th April, 1997
Date Drilling Completed:	2130 hours, 27th April, 1997
Date Rig Released:	2200 hours, 3rd May, 1997
Contractor:	Oil Drilling and Exploration Pty. Ltd. (ODE)
Rig:	ODE Rig #30
Rig Specifications:	(Refer to Appendix XI)

3. DRILLING SUMMARY

(a) Drilling Summary (All Depths Driller's KB)

Gordon-1 was spudded at 2300 hours on the 15th of April, 1997.

Tables I and II summarize the major drilling operations in this hole. A more comprehensive summary is appended to this report (Appendix X: Drilling, Casing, and Abandonment Summary).

TABLE I: CASING, HOLE, AND CEMENT DETAILS

BIT SIZE	DEPTH	CSG SIZE	CSG DEPTH	JNTS	CSG TYPE	CEMENT
12.25" 301mm	656m	9 5/8" 244mm	653.3m	52	36ppf, K55 LTC	437sx Class "G" cmt with 112.4bbl water + 2.5%PHG @ 12.8ppg; plus 127sx "G" cmt with 15bbl water + 1.2% CaCl2 @ 15.8ppg plus 130sx, 27bbls "G" tail , with 2%CaCl; top-up with 26sx "G" with 3bbl water + 2% CaCl2 @ 15.8 ppg.

TABLE II: SUMMARY OF MUD SYSTEMS

MUD TYPE	INTERVAL (m)
Spud Mud (Gel/Water)	Surface - 656
KCL/PHPA	656 - 2505

(b) Lost Time

Lost time at Gordon-1 – This section will be forwarded when available, and appear as part of Appendix X : Drilling , Casing and Abandonment Summary.

(c) Water Supply

Make up water (Chlorides 800 mg/l, hardness 140 mg/l, pH 7.3, Pf/Mf 0/0.05) was hauled from the mains.

(d) Mudlogging

Mudlogging services were provided by Halliburton Australia Pty Ltd. (Unit 27). Samples were collected, washed, and described at 10m intervals from the surface to 9 5/8" casing point, 656m, then at 5m intervals from 9 5/8" casing shoe to 1300m, and then at 3m intervals to total depth at 2505m. All samples were checked for oil shows using ultraviolet fluorescence. Gas levels were monitored from the surface casing shoe to TD using a total gas detector and other parameters monitored included rate of penetration, weight on hook and mud pit levels.

(e) Testing

The following table summarizes the two Drill Stem Tests (DSTs):

TABLE III: SUMMARY OF DRILL STEM TESTS

DST	INTERVAL	TYPE	TESTING CO	RESULTS
1	Basement 2390-2461m (D) 2388-2459m (L)	Conv. Off Bottom Straddle	Halliburton	Packer failed 17mins into 2nd Flow; NFTS; Rec. 6bbls oil cut rathole mud, @ 38° API, Pr. Pt. 36° C.
2	Basement. 2389-2461m (D) 2387.5-2459m (L)	Conv. Off Bottom Straddle	Halliburton	Packers failed after 216mins. Rec. 1bbl oil cut water + 7bbls muddy water.

(f) Coring

No cores were cut in the Gordon-1 well.

(g) Electric Logging

One suite of electric logs was run in Gordon-1, as detailed below:-

TABLE IV: ELECTRIC LOG SUMMARY

TYPE OF LOG	SUITE/RUN	INTERVAL	BHT/TIME
GR (ECGR) CAL (HCAL) SP (SPAR) Sonic (DTLF, DTLN, DTL, DT) Resistivity (RX08, HRLS, HRLD) TNPH A/S	1/1	2490-560m 2496-652m 2473-652m 2485-652m 2499-652m 2492-652m 2485-2100m	97° C/ 8.2 hrs
CST	1/2	2485-1035m	99° C/ 16.2 hrs; Cut 60, Rec. 56
FMI	1/3	2498-2270.4	96° C/ 6.3 hrs.
*__Note__: Wireline logging contractor: SCHLUMBERGER			

(h) Geothermal Gradient

A static bottom hole temperature of 102°C is calculated. This gives a geothermal gradient of 3.27°C/100m. An ambient temperature of 21 °C was employed. Data used for calculations is as follows:-

97 °C at 2499m after 8.2 hours from Run 1, Suite 1, with the SP, GR, Resisivity, Sonic etc.

99 °C at 2485m after 16.3 hours from Run 2, Suite 1, with the sidewall cores.

96 °C at 2498m after 6.5 hours, from Run 3, with the FMI log, following last wiper trip.

Note: See Appendix VIII for more detail.

(i) Hole Deviation

The Gordon-1 well was not deviated at all.

j) Velocity Survey

No velocity survey was run in Gordon-1.

(k) Completion Summary

Gordon-1 was cased and suspended for possible re-entry and to sidetrack the well in the future.

GEOLOGY

1. PRE-DRILLING SUMMARY (after Well Proposal)

Gordon-1 was proposed as a wildcat, exploration well for gas, located on Offline 36m northwest of CDP827 (SP 515), line OMN 93-08, in PEP 119, in the western part of the Otway Basin of Victoria, very close to the border of South Australia. The structure is a tilted, normal fault block closure, dipping gently to the northeast, on the northern terrace of the northwest-southest trending Penola Trough. It was calculated to have a mapped area of 1050 acres, which it was thought may extend to 4400 acres if lowside closure and evidence of a minor AVO was included.

The primary objective of Gordon-1 was clean, loose sandstones of the early Early Cretaceous McEachern Sandstone, of the Pretty Hill Formation, Crayfish Group. A relatively thick section of the sandstone was predicted, with a mean net pay estimated to be 21m. Nearby, in the McEachern-1 well, (drilled in Dec. 1989/Jan. 1990 by GFE), 250m of the sand was encountered, with a net sand of 144m, with average log porosity of 20%. The sandstone is of good reservoir quality, with a low amount of finer-grained interbeds, however, most of the McEachern is dominated by the grain supported quartzarenites.

In the Otway Basin, especially in the western portion lying in South Australia, sandstones occurring in the Pretty Hill Formation have had encouraging hydrocarbon shows, and exhibit excellent reservoir characteristics. Seal is provided by overlying shales in the upper portion of the Pretty Hill and by the Eumeralla Formation which acts as a regional seal. The underlying Late Jurassic to Early Cretaceous Casterton Formation has been analyzed and proved to be an excellent, mature, source rock capable of generating hydrocarbons. The presence of oil at Gordon-1 was not discounted, due to recovery of oil (thought to have been sourced from the Casterton) from Wynn-1 and Sawpit-1 also located on the flank of the Penola Trough. Thus, prior to the drilling of Gordon-1, it was thought that all the necessary ingredients were in place for the presence of hydrocarbons in the structure.

The critical risks were identified as being fault seal for the gas target and oil charge into the reservoir. Reservoir is also considered as a significant risk in the central Penola Trough.

2. DRILLING RATIONALE (after Well Proposal)

Gordon-1 is located in the far western corner of PEP 119, which lies at the western boundary of the State of Victoria. The well is approximately 5 km west of the small town of Casterton, 9.5km south southeast of the McEachern well, 30km east of the Katnook gas pipeline in South Australia, and about 50km west of the Victorian gas pipeline at Hamilton, Victoria.

The Gordon structure, a tilted fault block, is situated on the northeastern flank of the Penola Trough, occurring in the western portion of the Otway Basin.

The well was planned to drill and evaluate the McEachern Sandstone, a member of the Early Cretaceous Pretty Hill Formation (Lavin and Muscatello, 1997). This good quality reservoir sandstone was first intersected in the McEachern-1 well, drilled in 1990, to a total depth of 2384mKB. One drill stem test was conducted in the Pretty Hill and produced 41bbls of salty, gassy water and 9bbls of slightly muddy, gassy water. The Pretty Hill Formation contains several sandstone reservoir units, one of which is the McEachern, that in the well completion report was named the "basal Pretty Hill Sandstone". In the original well it consists of a clear, off-white to very light brownish-grey, coarse-grained sandstone, minor lithic fragments, poor to moderate sorting, and very good porosity, and is interbedded with minor claystone. A section of 250m was encountered in the well, with a net sand of 144m exhibiting a porosity of 20-25% immediately above the Casterton Formation. In the Gordon well, the McEachern was expected to have a mean net pay of a 21m thick, mature, well developed, potential reservoir sandstone.

Geophysical mapping, incorporating seismic data of mixed vintage (1993-1996), indicated that Gordon had strong dip reversal to the northeast, against the monoclinal, southwesterly dip, which is pervasive throughout the Penola Trough. Closure to the south is against a major east-west trending fault, with cross fault seal provided by shales in the Pretty Hill Formation (McGee, 1996). Vertical seal was also expected to have been provided by the overlying thick shale sequence of the Laira Formation of the Crayfish Group. It does, however, contain abundant interbedded sandstones and great lateral variation of lithology, thus there may exist a risk of cross fault leakage (Lavin and Muscatello, 1997), at that level.

[It should be noted that the McEachern Sandstone is not recognized formally in the literature or industry as a subdivision of the Pretty Hill Formation. Lovibond *et al.* (1995) proposed the breakdown of the formation into four units, utilizing the same name for members as the enclosing formation, however, as such they do not meet the criteria of the International Stratigraphic Code of Nomenclature. See Morton *et al* (1995), p.59, in the Petroleum Geology of South Australia, Volume 1: Otway Basin, for more information.]

Unfortunately it was discovered during the drilling of the Pretty Hill Formation, that the McEachern Sandstone was not present. The reasons are presumably because of pinchout of the clean, mature sands, resulting in a more fine-grained section being intersected. The objective was predicted to occur at 2278.3m RT or 2149m SS, and to be 109m thick. At this level in the well, silty claystone grading to minor argillaceous siltstone and a trace of siliceous, argillaceous sandstone was intersected.

3. RESULTS OF DRILLING

(a) Stratigraphy

The following table lists the formations intersected in Gordon-1, together with subsea elevations and thicknesses. All depths are Logger's Depths.

TABLE VI: STRATIGRAPHY IN THE GORDON-1 WELL

AGE	FORMATIONS (S)	DEPTH (m)	ELEV (m)	THICK (m)
Tertiary	Heytesbury Group undifferentiated	4.7(sfc	+124.9	35
	Otway Group			
E. Cret. (Aptian-Albian)	Eumeralla Formation	40.0	+89.6	1110
E. Cret. (Berriasian-Barremian)	Crayfish Group			
E. Cret. (Valanginian-Barr.)	Laira Formation	1150.0	-1020.4	367
E. Cret. (Berr.-Valanginian)	Pretty Hill Formation	1517.0	-1387.4	601
(not present)	McEachern sst	*Not*	*present*	*in the well*
L. Jur. to E. Cret. (Kimm. to Berr.)	Casterton Formation	2118.0	-1988.4	243
Palaeozoic	Basement	2361.0	-2231.4	142+
	Total Depth	2503.0	-2373.4	

Cuttings samples were collected, washed, and described at 10m intervals from the surface to 9 5/8" csg pt. (656m), thereafter at 5m intervals from 656m to 1300m and at 3m intervals from 1300m to the total depth of 2505m.

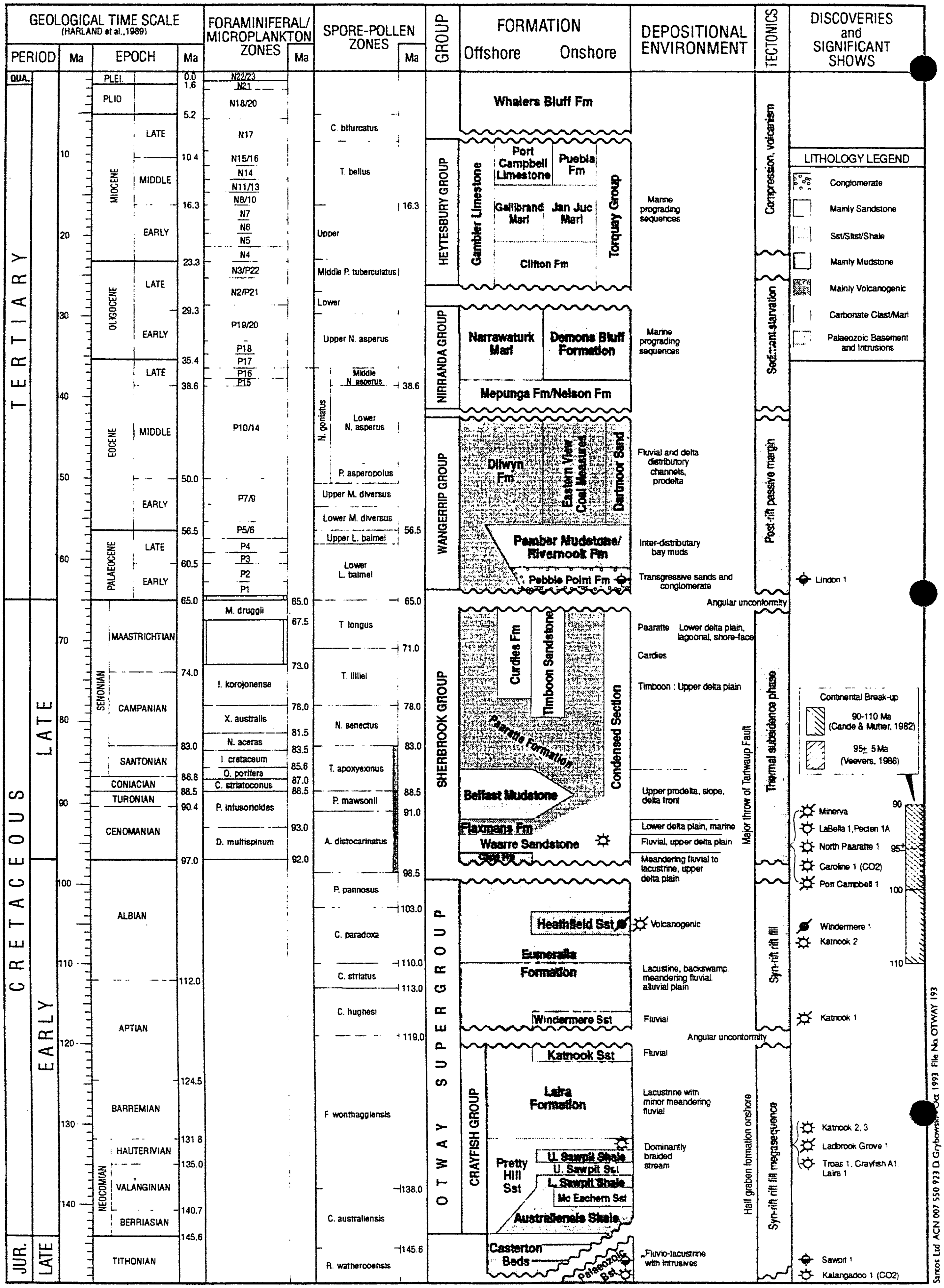
STRATIGRAPHY

A brief summary of the formations penetrated in Gordon-1 and their interpreted environments of deposition follows:- (For more detailed lithological descriptions from the wellsite, please refer to **Appendix I, Part a and Part b).**

Total depth for Gordon-1 was reached at 2505m (D) or -2375.4m ss, in the **Palaeozoic basement**. The well intersected 139m of metasiltstones, interpreted as the basement, before declaring total depth. The weathered, white, very light grey to light green metasiltstone was drilled into at 2361m (-2231.4m ss). With depth, it became medium to dark greenish-grey with fine to medium-grained brown to black inclusions with diffuse grain boundaries. It was very siliceous, slightly to moderately calcareous, with very coarsely crystalline vein quartz in places, abundant micromica, a trace of pyrite, and was hard and fissile. From 2411m to 2505m, the colour became more olive grey, had a siliceous to microcrystalline texture, was slightly to moderately calcareous and ankeritic, had minor increasing to common slickensides (with ankeritic lining), and minor increasing to common, coarsely crystalline quartz infilling fractures, both of which increased with depth. In the last 70m there was common disseminated and nodular pyrite.

OTWAY BASIN STRATIGRAPHIC COLUMN

Santos



A live oil show was encountered in the fractured basement between 2401-2410m. The fluorescence was associated with the quartz veining, the adjacent host rock and in part with the slickensides. It was a trace to 2% moderately bright to bright patchy yellowish-white fluorescence, with a dull milky white crush cut forming a thin ring residue. In the three intervals below exhibiting oil shows, at 2411-2436m, 2436-2443m and 2457-2460m the fluorescence became a trace, and slightly weaker, though still bright patchy pale yellow, with also a lesser degree of fracturing in the metasiltstones.

Two drill stem tests were conducted over the fractured interval displaying the shows. The first, DST #1, from 2390-2461m, although it had a packer failure, recovered 6bbls of oil cut mud. The second, DST #2, was run over the same section, recovering 1bbl of oil cut water and 7bbls of muddy water, however, it also lost its packer seat.

[In Sawpit-1, good oil shows were recorded within fracture porosity in metasedimentary, phyllitic basement. A drillstem test recovered 1.5bbl of 32°-35° API oil, with the Casterton interpreted to provide the source of the oil. Also at Kalangadoo-1, carbon dioxide rich gas flowed at a rate of 1.5mmcfd, from fractured basement (from Lovibond *et al.*, 1995).]

The Otway Basin is a Late Jurassic to Recent basin on the southern margin of Australia, straddling the states of South Australia and Victoria. It was formed by the rifting and continental break-up of Australia and Antarctica. The Pre-Mesozoic basement rocks consist of Palaeozoic intrusives and metasediments associated with the Lachlan Fold Belt. The basement reflector is a high amplitude, low frequency event showing strong angular unconformity onto an erosional or faulted surface (Cockshell *et al.*, 1994). The Otway Basin was initiated as a series of half grabens (Sprigg, 1986), separated by basement highs. Many of these grabens such as the Penola Trough in which Gordon is situated, are bounded to the south by large, north-dipping faults. Some of the intervening half-grabens have southerly dipping, north bounding faults (Cockshell *et al.*, 1994). The basement topography and geometry of the half grabens has clearly affected, and thus controlled, the distribution and thickness of the overlying sediments of the Casterton Formation and the Crayfish Group.

Overlying basement at Gordon-1 is the Late Jurassic to Early Cretaceous **Casterton Formation**. The top of the Casterton came in at 2118m, or -1988.4m ss, 269.6m high to prognosis, and is 243m thick. The top 82m to 2200m(L), consists of medium brownish-grey siltstone grading to and in part laminated with off-white to medium brownish-grey and medium grey sandstone, making up the coarsest grained interval of the formation. From 2160m(L) the sediments display several fining-up sequences of 3 to 4m in thickness, and at 2190m(L) a small 3m blocky channel sand is present. A 30m thick interval of medium to dark brown to dark grey silty claystone, more characteristic of the type Casterton occurs below, to 2230m(L). From 2230m to 2274m(L) a finer-grained section dominantly consisting of dark brownish-grey to dark grey, moderately carbonaceous silty claystone is present, with the Gamma Ray showing a fairly expressionless, straight line. In lithological descriptions in contrast, is described claystone grading to argillaceous siltstone and trace sandstone (probably cavings). Below, from 2274m to 2351m (L) grain size increases, with more argillaceous siltstone appearing, moderately carbonaceous, with common black carbonaceous flecks and trace black coaly detritus. At 2351m(L), black to very dark grey coal is present, making up 25% of the samples, with the remainder carbonaceous, silty claystone and argillaceous siltstone, with a trace of very fine sandstone. This basal section is approximately 10m thick, lying above basement. Throughout the formation the argillaceous siltstone and minor sandstone contain abundant very fine partially altered feldspar grains and common grey, greyish-green and brown lithics.

No volcanics, basalts or tuff were described in the samples by the wellsite geologist at this location. The Casterton Formation is known to contain volcanics in eastern Victoria especially, including the Casterton well nearby, however, none have been confirmed within the formation in South Australia (Morton *et al.*, 1995).

The contact with the underlying low grade metasedimentary basement is a low angle unconformity. Distribution and thickness of the formation was fault controlled, and was determined by the underlying topography of the basement. On seismic sections it shows a low angle onlap on to the basement highs. The Casterton has been interpreted to have been deposited in a non-marine lacustrine to swampy environment, with fluvial systems present in the adjacent highlands (from Lavin, 1997). It has been suggested that deposition may have preceded rifting, following seismic work carried out by the Geological Survey of Victoria (Morton *et al*, 1994, *in* Finlayson *et al.*, 1994). It is also thought (Lovibond *et al., 1995)* that the Casterton represents the earliest synrift fill in the Penola Trough.

The Casterton Formation is considered to be Late Jurassic to Early Cretaceous, belonging to the *Retitriletes watherooensis* to lower *Cicatricosisporites australiensis* zones, *ie* Tithonian to Berrasian in age (Morton *et al.,* 1995). Twelve sidewall core samples were analyzed for biostratigraphic purposes, from 2126m to 2356.25m, encompassing the whole of the Casterton intersected in the well. The ages ranged from Berriasian (Early Cretaceous) at the top to Kimmeridgian (Late Jurassic) at the base. Most of the cores were siltstone of a varying shade of grey to brownish-grey, some with very fine to fine-grained sandstone laminations. The environments of deposition switched between fluvial at the top, to lacustrine, back to fluvial, then lacustrine and remained fluvial until the 2337.5m sample, #14, which was lacustrine again. The final sample at 2356.25m, #11, was identified as being from a peat bog (possibly flanking a lacustrine system), as it was a black, subvitreous coal, containing dominant fern spores. It was indicated to have been derived from the Casterton coal palynofacies (APG Consultants, 1997). The varying palaeoenvironments may have been a result of a general transgressive lacustrine system, intercalated with regressions, thus forming river and alluvial systems on the outer fringes. It was suggested by Lavin (1997) that as the topographic low was created by syn-depositional faulting, the lake deepened, and depositional energy levels decreased. As extensional faulting ceased for a time, or slowed, regression would take place, with deltas and fans becoming more prominent.

Analyses were not carried out on the sidewall cores for maturity, total organic carbon (TOC), or kerogen content, spore colour or TAI indices, thus statements cannot be made as to the source potential of the Casterton at Gordon-1. In general, the formation has a fairly good potential, containing rich organic material. The TOC values commonly exceed 1.5%, but values vary considerably. In the McEachern-1 well, the average TOC measured 1.1%. At Casterton-1 nearby, the formation is a locally excellent source, with maximum TOC=45.90%, though the average was 4.9%, and S1+S2=100.86. These intervals, though thin are capable of generating significant quantities of oil where mature. It has been discovered that the richest source intervals occur towards the base of the unit, possibly reflecting high concentrations of terrestrial detritus in localized rift lakes (from Hill, 1997).

An unconformity separates the Casterton Formation and the overlying **Crayfish Group**. At some locations this is an angular contact (Morton *et al.*, 1994, *in* Finlayson *et al.*, 1994), at others it has proved to be difficult to map reliably on seismic and its identification by palynology and on logs is interpretive, and in addition its distribution is poorly understood (Lovibond *et al.*, 1995).

The Crayfish Group has been divided into three formations, the **Pretty Hill Formation, Laira Formation** and the **Katnook Sandstone**, by Morton *et al*., (1994, *in* Finlayson *et al*., 1994). They stated nevertheless that regional correlation shows the Katnook Sandstone and Laira Formation can be lateral facies variations of each other, but that the top of the Pretty Hill Formation is probably reasonably synchronous. Seismic mapping of these units is therefore quite difficult. The group is best known from the Penola Trough.

The **Pretty Hill Formation** which overlies the Casterton Formation unconformably, was intersected at Gordon-1 at 1517m (L) or 1387.4m ss, coming in 143.6m high to prognosis. It was 601m thick in this well. The formation has been subdivided in the past by several authors although they have not been recognized formally (Morton *et al*., 1995). With additional drilling in the western Otway and further geophysical, geochemical and biostratigraphic work, the members could be formally defined in the near future. Lovibond *et al*. (1995) informally subdivided the formation into four members:- 'Pretty Hill sandstone', 'Sawpit sandstone', 'Sawpit shale' and 'McEachern sandstone'. The **McEachern sandstone** was expected to occur at this location and was designated the primary objective in the Gordon-1 well, predicted to come in at 2278.3m or -2149m ss, and be 109m thick. It has been determined that the sandstone was not present in the well.

At the wellsite, the Pretty Hill was not designated into members, thus the present author will deal with the formation as a whole. On logs it appears the formation consists to a high degree of sandstone, with a minority of silty claystone (from 5% to 25%, in the lower portion of the Pretty Hill), with siltstone (5%) and claystone (5%) in the following 200m, and in the top 32m, sandstone makes up 60%, claystone 30%, and siltstone 10%.

In the basal 128m, from 1990-2118m, the sandstone is off-white to light grey, dominantly fine-grained, although ranges from very fine to coarse, poorly sorted, with moderate to strong silica and weak calcareous cement. There is common white argillaceous matrix, trace to common pink to red garnet, common grey to green phyllitic and volcanic lithics, increasing with depth, and a trace of black coaly detritus. The sandstone is moderately hard to hard, has a poor to fair visible porosity, and no fluorescence. It is interbedded and laminated with medium brown to medium grey silty claystone, that is in part dark grey and shaly. It contains a trace of very fine off-white partially altered feldspar grains in part, trace to common black carbonaceous flecks and coaly detritus, is moderately hard, very dispersive and subfissile.

The next section, from 1751-1990m, is made up of a majority of off-white to light grey, medium-grained, poorly sorted sandstone. Generally the description for the sandstone in this interval is the same as the underlying one. There is moderate silica, weak to moderate calcareous and a trace of strong brown dolomite cement. It is interbedded and in part laminated with silty claystone as above. The basal 20m is silty claystone, overlain by a thin sandstone lens with a sharp contact, which fines upwards. This is followed by a 55m thick sandstone with a trace of claystone, which fines up slowly through 10m to a 5m thick silty claystone. The overlying interval, from 1751m-1808m consists of more thickly interbedded sandstone and silty claystone. The sandy sections generally have a blocky character, except between 1783m and 1776m, where a 3m sand, fining upwards, is immediately overlain by another 3m sand, coarsening upwards. The overlying section (1549m-1751m) is composed of 90% sandstone, dominantly off-white with very light grey to light brown and medium-grained, with common white to light brown argillaceous matrix, common pink to red garnets and only a trace of cherty, volcanogenic and phyllitic lithics, and poor to fair visible porosity, which is interbedded and laminated with 5% siltstone and 5% claystone. The topmost section, from 1517m to 1549m, has 30% claystone and 10% siltstone, overlain by a 15m thick, off-white, fine to medium sand with very poor to fair porosity (inferred), comprising 60%. This sand contains moderate silica and calcareous cements, has common to abundant white argillaceous matrix and only a trace of greyish-green and reddish-brown lithics, a trace of garnet and black to dark brown coaly detritus.

The environments of deposition postulated for the Pretty Hill Formation are related to rapid subsidence and thus ensuing high sedimentation rates in a syn-rift basin. The formation is best known from the Penola Trough. The Gordon-1 well is situated on the far eastern edge of the trough, on its flanks, and therefore will not exhibit all the features that are represented in the Katnook wells, for example. In the axial position of the half graben, Morton *et al.* (1995) suggests that parts of the Pretty Hill have characteristics of a high sinuosity fluvial system, and parts, a low sinuosity system. Flood-basin deposits, silty flood plain with crevasse-splay and sheet-flood sandstone interbeds are thought to have formed adjacent to the main channel. In the case of Gordon-1, where there is a predominance of sandstone, with thin interbedded siltstones and shales, it appears that it is located in the vicinity of a braided, fluvial channel system. A westerly palaeocurrent flow has been interpreted from dipmeter data for the Pretty Hill (Morton *et al.*, 1995) probably sourced from erosion of local basement highs.

The age of the Pretty Hill Formation is Early Cretaceous [Berrasian to Valanginian Stages (140-133Ma)], falling into the upper part of the *Cicatricosisporites australiensis*, and lower part of the *Foraminisisporis wonthaggiensis* palynozones (Morgan *et al.*, 1995). The samples all yielded inaperturate and saccate pollen and fern and lycopod spores, though some were sparse and restricted in diversity. Six sidewall core samples were examined for their spore and pollen content in the Pretty Hill Formation. These were #47—1536m, #44—1593.25m, #43—1614m,#40—1761m, #39—1768m and #36—1882m. The first three, dark grey claystone and light to medium greyish-brown siltstone, were identified as being fluvial in origin, then there was a gap in samples represented by a sandy section, then #40 was a siltstone and thought to be paralic coastal plain, the next #39, a claystone, is lacustrine with algal forms notable, and the final one, #36 a siltstone, is paralic lagoonal. (See APG Consultants Biostratigraphic Report). The base of the formation was not examined, being a thick sandy interval.

Overlying the Pretty Hill Formation is the **Laira Formation**, forming the top of the Crayfish Group at this location. The contact appears to be gradational, and fairly transitional with the underlying 15m thick sand at the top of the Pretty Hill. The top of the Laira was intersected at 1150m, or -1020.4m ss, and is 367m thick. It was predicted to occur at 1017m ss, thus was only 3.4m low to prognosis.

The Laira Formation is composed to a great extent of shale (claystone, in lithological descriptions), with thin interbeds of siltstone making up 20-30% of the samples and sandstone, only 10%. These interbeds measure from 1m to 5m in thickness.

From 1350m to 1517m, the claystone is light to medium brownish-grey to medium grey and olive grey, and in parts very silty. It contains a trace of black carbonaceous flecks and micromica, and common, in part, abundant dark brown to black coaly material. It is firm to moderately hard and subfissile. The claystone grades to a minor argillaceous siltstone of the same colour, in part finely arenaceous with partially altered feldspar grains with similar carbonaceous material. The sandstone lenses are off-white, very fine, subangular, moderately sorted, with moderate to strong silica and calcareous cements, common to abundant white argillaceous matrix, trace greyish-green and reddish-brown lithics and garnet, and trace to common coaly detritus. It is friable to hard, has no, to poor, porosity (inferred), and no fluorescence. The thickest sand, from 1419m to 1426m, has a sharp base and fines upwards.

The overlying interval, between 1150m and 1350m, appears very similar in log character to the one below, perhaps more shaly, though was described as having a greater percentage of siltstone. One sand lens, (2m), at 1288m has a sharp top, and fines downwards, while the others, no more than 1-1.5m are merely gradational interbeds and laminations. All were expressed as having no visible porosity.

The Laira Formation appears to represent a fluvial flood plain environment, at least at the base of the formation, with its dominance of shale, and the sandstone lenses overbank deposits, or perhaps sheet-flood sediments. In the sidewall core sample (#48) at 1510m *Microfasta evansii* is described as being notable. It does not appear again until at 1369m (#52), where it is denoted as isolated, and at 1275m (#53) it is notable. *M. evansii* is an algal acritarch and is taken to indicate a lacustrine environment. Below 1369m, the preservation and organic yield are poor to very poor which may point to a higher energy fluvial setting, whereas the cores above contain fair to fresh palynomorphs, and other aquatic forms (from APG Consultants, 1997—see Biostratigraphic Analysis), and therefore likely to be lacustrine dominated.

The age attributed to the Laira is Early Cretaceous, in the Valanginian to Hauterivian Stages (136-125Ma), belonging to the lower to upper *Foraminisisporis wonthaggiensis* palynozone (Morgan *et al.,* 1995).

In the Gordon-1 well the Katnook Formation is not present. According to Morgan *et al.*, (1995) it has not yet been mapped in Victoria, and there are difficulties in correlating the unit away from the type section in the Katnook field, as it is absent due to erosion or facies change elsewhere within the Penola Trough.

Overlying the Laira Formation, therefore, at the well site, is the **Eumeralla Formation**, considered to be the basal, oldest formation of the **Otway Group**. It rests unconformably upon the Crayfish Group, Laira Formation in this case. The Eumeralla Formation was intersected at 40.0m, or +89.6m ss, and was expected to be at 42.6m, thus only 2.6m high to that predicted. The formation is 1110m thick at Gordon, and about 1500m in the Penola Trough, though is thought to be possibly greater than 4000m in the eastern Otway (Lavin, 1997). On the wireline logs there is no distinct boundary between the shales of the Laira Formation and the Eumeralla above, although the gamma ray appears slightly higher in the Laira.

The Eumeralla lithology is primarily composed of carbonaceous silty claystone with very fine-grained feldspathic sandstone interbeds, measuring from less than a metre to 4m in thickness. (Note: Wireline logs were not run over the top hole, prior to setting casing at 653.3m, and as a result the lithological descriptions cannot be correlated and compared uphole, except for verifying with the mudlog, for ROP and their lithology column).

From a depth of 955m, in sample descriptions, claystone makes up the bulk of the samples, at 50-60%. It varies from a light to medium olive grey to light to medium grey, (and off-white to medium brown between 1027-1092m), very silty in part, contains a trace to, in part, abundant black carbonaceous flecks and detritus, trace micromica and is firm to moderately hard and slightly subfissile to subfissile. Coal is expressed as 10% of the cuttings samples between 1027-1092m and a trace between 955-1027m, where it is black, blocky fracture, earthy to subvitreous lustre, dark brown and very argillacous in part, hard and brittle. On logs, coal/carbonaceous shale is present mainly around 1041-1044m.

A third of the samples is made up of interbedded off-white to light brown to medium grey to medium olive grey siltstone. It is very argillaceous, and in part very finely arenaceous with partially altered feldspar and quartz grains, with a trace to, in part, abundant black carbonaceous flecks and detritus, firm and slightly subfissile.

Sandstone is fairly minor (10%), grading to, and interbedded with siltstone. It is off-white to medium brownish-grey and light brown, very fine to fine-grained, (in the basal 60m appear rare, clear, medium to very coarse quartz grains), angular to subrounded, moderately sorted, strong calcareous cement (in the basal 60m also moderate to strong silica, and trace strong dolomite, cement), abundant white argillaceous matrix in part (abundant medium grey silt matrix between 955-1027m), with common green-grey and trace red lithics, trace coal detritus from 1092-1150m and becomes more common above. It is moderately hard to hard, has no visible porosity or fluorescence.

The gamma ray curve from 790m-955m is fairly expressionless, hovering around 100 units, indicating a sequence dominated by a silty, partly finely arenaceous and carbonaceous claystone, with very thin interbeds of siltstone and fine-grained sandstone. The samples, however, are almost equally divided between claystone, siltstone and sandstone with descriptions very similar to the previous interval below.

The upper section of the Eumeralla in the well has a more varied expression. At the base, from 775m to 790m, two stacked 3-4m thick sands are present. They appear fairly clean, and are described as off-white to medium brownish-grey, very fine, moderately sorted, with some white argillaceous, and grey silty, matrix, common greenish-grey and red lithics, common black carbonaceous matter, moderately hard, and no visible porosity or fluorescence. The upper sand displays two small fining-up cycles, whereas the lower is more blocky. Two 1m thick sands just above, at 764m and 767m contain more argillaceous matrix and have strong calcareous cement.

The remainder of the sequence above, to 656m just below casing point, and that above from 92m to 656m, is quite shaly (60%) with very silty sections, and the siltstone (30%) described as being very argillaceous. Both contain common black carbonaceous detritus and flecks. After setting casing, a 3m thick fine-grained, very calcareous, argillaceous sand, with no visible porosity, was drilled into. Another, merely 1m thick, at 674m, was encountered.

The interval from 40m to 92m, the top of the Eumeralla, consists of a greater percentage of claystone (90%), medium olive-grey to medium greenish-grey, light to medium brownish-grey and in part, dark greenish-grey, slightly to very silty, finely interbedded and laminated with medium grey to medium greenish-grey fine-grained sandstone (10%).

A number of types of depositional environments have been interpreted for the Eumeralla Formation in South Australia and Victoria. They range from high energy fluvial channels and flood basin deposits, with lenticular channel sands, and minor sheet-flood sands with overbank coals and silts, and also lacustrine deposits.

In the Gordon-1 well, the Eumeralla Formation appears to represent more of an overbank and back swamp facies, with very minor sheet-flood sands, due to the low frequency of sandy horizons. Both the Windermere and Heathfield Members appear to be absent. Coals are not common as such, although many samples contain common carbonaceous material. The only mention of coaly horizons are between 1027-1092m, and trace between 955-1027m in cuttings, and on logs at 1041-1044m.

Only the basal section was sampled and analyzed for biostratigraphic purposes, from 1035m to 1118m, that is SWC# 60, 59, 58, and 57. The spores and pollen present indicated a diverse fern association, existing in swampy conditions, with saccate pollens dominating the 1063m and 1105m samples (#59 and #58), thus a definite non-marine environment. At 1063m (#59), *Schizosporis reticulatus* was notable, an algal acritarch, which points to a minor lacustrine influence.

It appears that this section sampled is from the lower to middle Eumeralla Formation, and the zones identified in the preliminary biostratigraphy report, indicate an oldest age of Aptian, though the basal 32m was not age dated. The upper portion of the formation that was not analyzed and dated is most likely Aptian to Albian in age (125-97 Ma, *ie*. for the whole formation; Morgan *et al*., 1995).

Overlying the Eumeralla at the well site, is 40m of an orangey-brown medium-grained, with fine to in part very coarse to grit size grains, poorly to moderately sorted sandstone. At the wellsite, this section was designated as ***undifferentiated Heytsbury Group**. The sandstone has common light orange to dark brown argillaceous and silt matrix in part, clear and in part orange quartz grains, trace and, in part common, muscovite flakes, trace black to dark brown, fibrous, carbonaceous flakes, unconsolidated to, in part, hard, very good porosity (inferred), and no fluorescence. It has minor interbedded dark brown, very soft claystone. It was intersected from spudding the well to a depth of 40m (+130m to +89.6m ss). The sandstone overlies the Eumeralla unconformably, though on seismic, apparently not with a great angularity (OMN93-08R).

***Note**: In Victoria and South Australia, the Heytsbury typically contains marine sediments including limestone and marl, though assigned slightly different formation and member names, according to varying lithologies in the two states. The present author questions this assignment. In the McEachern-1 well, the top 130m were included in the Heytsbury, however, and the sample descriptions are similar, though the sandstone was very light grey and light brown.

For further details concerning the lithology, cuttings and sidewall core descriptions of the formations encountered in Gordon-1, refer to **Appendix I**, **Part a**: **Cuttings,** and **Part b**: **Sidewall Cores**, of this report.

(b) Stratigraphic Prognosis (after Well Proposal)

The Gordon-1 well is situated within a tilted fault block on the northeastern flank of the Penola Trough. This structure forms a typical type of play found in the Otway Basin, the successes being located in high side, tilted fault and horst blocks. The structure was identified following mapping and interpretation of an approximately 1km x 4km seismic grid, of mixed vintage derived from 1993 to 1996. A total of five seismic events were interpreted, using seismic ties from six offset wells, including Casterton-1 and -2, McEachern-1, Bus Swamp-1, Tullich-1, and Heathfield-1.

All formations were encountered as predicted on prognosis, excepting the primary objective, the McEachern sandstone, at the base of the Pretty Hill Formation, in the Crayfish Group. During and subsequent to the drilling of Gordon-1, it was deduced that the sandstone was absent at this location.

The well was spudded into an orangey-brown sandstone declared to be undifferentiated Heytsbury Group, though this assignment may be questioned. Forty metres below, the Eumeralla Formation, of the Otway Group, was intersected only 2.6m low to prognosis. The Eumeralla consisted dominantly of claystone, with varying percentages of siltstone (5-40%) and minor (5-30%) sandstone, and was 1110m thick. The Laira Formation of the Crayfish Group was found to underlie the Eumeralla, and came in at 1150mRT, merely 3.4m low to that expected. Claystone (60-70%) again predominates the lithology, with siltstone 20-30%, and sandstone (10%). Below was the Pretty Hill Formation, with its top at 1517mRT, 143.6m high to prognosis. Sandstone makes up the bulk of the samples, up to 95%, with siltstone and claystone ranging from 5% to 30%.

The McEachern sandstone, an informal member of the Pretty Hill Formation, the target of the Gordon-1 well, was expected to occur at 2278m, or -2149m ss. It was deemed not to be present. Underlying the Pretty Hill is the Casterton Formation, intersected at 2118m, or -1988m ss, 269.6m high to prognosis. It is 243m thick at Gordon, overlying the Palaeozoic basement, which was drilled into at 2361m (-2373m ss), but was expected at 2450m, thus 89.6m high. The basement, a fractured metasiltsone, was found to contain live oil, throughout an approximate 40m column, from 2401-2443m, plus an additional 3m section from 2457-2460m. These shows precipitated the two drill stem tests, neither of which was entirely successful, due to packer seat failures, though there were recoveries of oil cut rathole mud.

Actual versus the predicted subsea formation tops plus thicknesses for Gordon-1 are tabled below (all depths quoted are Logger's Depths):

TABLE VIII: ACTUAL VERSUS PREDICTED DEPTHS AND THICKNESSES GORDON-1

FORMATION	PROG SS DEPTH	ACTUAL SS DEPTH	DEPTH DIFF	PROG THICK	ACTUAL THICK	THICK DIFF
undiff. Tertiary/L. Cret	+125m	+124.9m		38m	35m	-3m
Eumeralla Fm	+87m	+89.6m	2.6mH	1104m	1110m	+6m
Laira Fm.	-1017m	-1020.4m	3.4mL	514m	367m	-147m
Pretty Hill Fm	-1531m	-1387.4m	143.6mH	618m	601m	-17m
McEachern sst	-2149m	*No*	*present*	109m	0m	
Casterton Fm	-2258m	-1988.4m	269.6mH	63m	243m	+180m
Basement	-2321m	-2231.4m	89.6mH	45+m	142+m	
Total Depth	-2366m	-2373.4m				

(c) Hydrocarbon Summary

Total gas was recorded from the surface to total depth (2505m KB) using an FID total gas detector run by Halliburton Services, Unit No. 27. One unit of gas is equal to 200 ppm methane equivalent. Chromatographic analysis was determined using an FID chromatograph and these values are quoted as percentages (C1 - C4). Ditch cuttings were collected at 10m intervals from the surface to 9 5/8" casing point, at 653.3m, at 5m intervals to 1300m, and then at 3m intervals from there to T.D. at 2505m. All samples were washed, described and checked for fluorescence using ultraviolet light.

Surface to top Pretty Hill Formation (spud to 1517m)

No shows were recorded through the top undifferentiated section, Eumeralla Formation or Laira Formation. Throughout these formations no gas was detected, until at 600m, in the Eumeralla, where total gas was 0.1 units, and maximum was 0.2, with C1 at 100%. Levels remained low, increasing to maximum of 75 units, from coal, with C1--98%, C2--2%, C3&4-- trace between 1027-1092m, dropping back to a maximum of 12 units at the base of the Eumeralla. In the underlying Laira Formation, background gas was still low, with a maximum of 6-7 units, until a maximum of 45 units (on the mudlog it was only 20 units), again associated with a coal, between 1350-55m. On the mudlog, however, a few peaks were recorded, ranging from 20-42 units approximately, but C1 remained at 95-97%, with C2 at 3-4%. No hydrocarbon fluorescence in the drill cuttings were recorded within these formations.

Pretty Hill Formation (1517 - 2118m)

Background total gas within the Pretty Hill was low, with virtually no peaks (with a range of less than one to a maximum of about 18 units) in the curve. C1 values were between 94-99%, with C2--1-5%. Sandstone at 1641m to 1645m displayed a trace of patchy, moderately bright yellowish-white fluorescence, a moderately bright milky white crush cut and a thin film residue. At the wellsite, it was determined that the oil show was of a residual nature and confined to tighter aggregates only. The sand was off-white to light brown, medium-grained, with moderately strong silica, moderate dolomite and weak calcareous cements, with a poor to fair visible porosity. There was no associated gas peak.

Another thin sandstone, off-white to light grey, with poor to fair visible porosity, at 1771-1775m, also had a trace of patchy moderately bright yellowish-white fluorescence, with a dull to moderately bright milky white crush cut and a trace of residue. This was again thought to be of a residual nature. It had a small associated gas peak of about 10 units.

The primary objective in the Gordon-1 well was the McEachern sandstone member of the Pretty Hill Formation. During the drilling, it was deduced that the member was not present at this location, perhaps due to pinchout or merely lateral facies variation.

Casterton Formation (2118 - 2361m)

Total gas within the formation was low prior to 2325m when it rose to a maximum of about 150 units (see Mudlog for more detail). C1 values dropped from 94% to 77%, and C2 increased from 4 to 12%, with the highest C3 of 10%, C4 of 11%, and C5 of 1%. Black to dark brownish-black coal was noted in the cuttings descriptions, from 2345m to 2364m, immediately above basement, with associated gas peaking between 60 to 150 units.

An off-white to light brown, fine-grained sandstone with very poor porosity at 2195-2212m, displayed a trace to 1% moderately bright, patchy, light yellow fluorescence, with a dull pale yellowish-white crush cut and a thin ring residue. The wellsite assesment was that it was a live oil show, and contained only within aggregates where slightly better porosity existed. No significant gas peaks were recorded over the interval.

Basement (2361 - T.D. of 2505m KB)

The level of background total gas remained fairly low with a straight trace, with 5 very minor peaks to total depth, within the basement. The C1 readings ranged from 77-86%, C2 from 6-9, C3 from 5-9, C4 from 1-5 and C5 from trace to 2%. Each of the peaks in total gas was associated with an oil show in the cuttings.

From a depth of 2400m there was an almost continuous live oil show within the metasiltstone to a depth of 2443m. The fluorescence was associated with quartz veining, and was also in the adjacent host metasediments. It appeared as a trace, to 2%, moderately bright to bright patchy yellowish-white, and pale yellow fluorescence with dull milky white crush cut and a thin ring residue. The first show was detected at 2401-2410m and was thought to be associated a fracture system at that depth, and was infilled by coarsely crystalline quartz. The second show interval, at 2411m - 2436m appeared to be weaker and tighter than for the one above, with the degree of fracturing of the metasiltstones far lower. The third interval, from 2436m-2443m, was again seen with the vein quartz and juxtaposed host rock, and also to a minor degree with the slickensiding. It too was weaker than the first interval.

There was a final show seen from 2457m to 2460m, that had a trace patchy pale yellow fluorescence, dull milky yellowish-white crush cut and thick ring residue. (Gas values were as follows:- total gas maximum was 21 units, and C = 77/8/9/5/1).

The wireline logs were analyzed over the interval 2300-2400m. No pay was identified in this section, which included the basal 60m approximately of the Casterton Formation, plus 40m into the fractured metasediments forming the basement.

Two drill stem tests were conducted, the first from 2390-2461m, the second a re-run of the first, as a result of packer failure, from 2389.5-2461m, in the basement. From DST #1 there was a recovery of 6bbls of oil cut rathole and annulus mud, and from DST #2 1bbl of oil cut water plus 15bbls of muddy water. The flow rate calculated from recovery charts was 47bbls a day.

The Gordon-1 well had been classed as a wildcat gas exploration well, and following drill stem tests was plugged and suspended for possible re-entry, and sidetrack for potential oil in the fractured basement.

4. SUMMARY

Gordon-1 was drilled as a (WCNF) gas exploration well within PEP 119, situated near the western border of Victoria. The well is situated on the northeastern flank of the Penola Trough, within the Otway Basin. Gordon was spudded on April 15th, total depth of 2505m RT reached on April 27th , and the ODE Rig #30 released on May 3rd, 1997.

The well was a technical success, drilled and completed in a matter of 18 days, including wireline logging and two drill stem tests.

The primary target of the Early Cretaceous McEachern sandstone, at the base of the Pretty Hill Formation, was deduced not to have been present in the well. The sandstone was predicted to occur at 2278.3m RT, and to be 109m in thickness. This sand unit was penetrated by the McEachern-1 nearby, 9.5km south southeast of Gordon, but probably has only a limited lateral extent, and there appear to be many facies changes between wells within the Pretty Hill Formation. Correlation from well to well in this part of the Penola Trough, in western Victoria, is difficult and somewhat tenuous due to the low density of wells.

Reservoir is a significant risk in the central part of the Penola Trough. It has been discovered that sand development within the Crayfish Group is to some degree localized and cannot be mapped accurately, either geophysically or geologically over any great distance (McGee, 1996).

All the remaining formations were intersected as on prognosis, though the older units were high to that predicted. The Eumeralla and Laira formations, however, were merely 2.6m high and 3.4m low, respectively. The underlying formations, the Pretty Hill, was 143.6m high, and the Casterton 269.6m high. Basement at Gordon was intersected high, at 2361m RT, but expected lower at 2450m, thus there was an 89.6m difference.

During the drilling of the well, no significant gas shows or peaks were recorded, until within the Pretty Hill Formation, at 1641m and again at 1771m, where thin, 4m, sandstone beds exhibited trace, patchy fluorescence. These were both assessed at the wellsite to be oil shows of a residual nature. In the underlying Casterton Formation, between 2195-2212m, in a 17m thick section of fine-grained sandstone with very low porosity, was a live oil show, with a trace to 1% patchy fluorescence.

Basement, a greenish-grey metasiltstone, was drilled into at 2361m RT. Forty metres below, live oil shows were recorded, associated with fracturing, quartz veining and the adjacent host metasediments, from 2401-2410m. An almost continuous show was documented down to 2443m, then again from 2457-2460m. The first 10m displayed the strongest fluorescence and cut, and below became weaker and more tight, with the degree of fracturing of the host rock far lower. This interval was deemed to be of sufficient interest to be tested. Following wireline logging, including running sidewall cores (2485m-1035m) and Formation Microscanner Image (FMI) over the zone of interest, DST #1 was conducted over the interval 2388-2459m(L). The packer failed after 17 minutes into the second flow, with no flow to surface, but there was a recovery of 6bbls of oil cut mud. A second test, DST #2, was tried over the same section, but once again there was packer seat failure, this time after 216 minutes. Recovery was 1bbl of oil cut mud and 7bbls of muddy water. A sample from the first test was analyzed to be crude oil with an API of 38° API, at 60°F, with a pour point of 36°.

As a result of the oil discovered in the fractured basement, the Gordon-1 well was plugged and suspended. According to future market demand, financial viability and oil pricing, plus additional rigorous reservoir studies, this well could possibly be re-entered and sidetracked for the potential oil.

5. REFERENCES

Akbari, V. 1990 McEachern-1 Well Completion Report, Volume 1. Gas and Fuel Exploration N.L., PEP 119, Otway Basin. May, 1990. Unpublished Report.

APG Consultants, 1997 Biostratigraphic Report for the Gordon-1 well. Unpublished Report.

Cockshell, C.D., Perincek, D., Finlayson, D.M., Pettifer, G.R., and Hill, K.A., 1994 Key horizon mapping and spatial basin evolution. *In* Finlayson , D.M. (compiler), 1994. NGMA/PESA Otway Basin Symposium, Melbourne, 20 April, 1994: extended abstracts. AGSO Record 1994/14. pp. 19-26

Finlayson, D. M. (compiler), 1994 NGMA/PESA Otway Basin Symposium, Melbourne, 20 April 1994: extended abstracts. AGSO, Record 1994/14.

Hill, A. J., 1995 Source Rock Distribution and Mature Modelling, *in* Petroleum Geology of South Australia, Chapter 7, Volume 1: Otway Basin. Mines and Energy, South Australia. Morton, J.G.G., and Drexel, J.F., (eds) pp. 103-125.

Lavin, C., 1997 A Review of the Prospectivity of the Crayfish Group in the Victorian Otway Basin. APPEA JOURNAL 1997, Volume 37, Part 1; pp. 232-244.

Lavin, C., and Muscatello, 1997 Petroleum Prospectivity - The Casterton Petroleum System. VIMP REPORT 41, pp. 24-27

Lovibond, R., Suttill, R.J., Skinner, J.E., and Aburas, A.N., 1995 The Hydrocarbon Potential of the Penola Trough, Otway Basin. APEA JOURNAL 1995, Volume 35, Part 1; pp.358-371.

McGee, A., 1996 Gordon-1 Well Proposal. Exploration and Development - S.A., Otway Team Santos Ltd. (TMOC). Unpublished Report.

Morton, J.G.G., Hill, A.J., Parker, G., and Tabassi, A., 1994 Towards a Unified Stratigraphy for the Otway Basin. Extended Abstracts, NGMA/PESA Otway Basin Symposium, AGSO Record 1994/14 pp. 7-12

Morton, J.G.G., Alexander, E.M., Hill, A.J. and White, M.R., 1995 Lithostratigraphy and Environments of Deposition. *In* Petroleum Geology of South Australia, Volume 1, Otway Basin. (eds.) J.G.G. Morton and Drexel, J. F. pp. 47-94

Pietsch, A.P. and Horner, D., 1997 Gordon-1 Raw Data Report. Santos Ltd. - Cultus Petroleum N.L. July 1997. Unpublished Report.

Richardson, B., 1997 Gordon-1 Drilling and Evaluation Programme. March 1997. TMOC Exploration Ltd.,--Cultus Petroleum N.L. 1997 Unpublished Report.

Sprigg, R.C., 1986 A history of the search for commercial hydrocarbons in the Otway Basin complex. *In* Glenie, R.C. (ed.) 2nd South-eastern Australia Oil Exploration Symposium, Melbourne, 1985. Technical papers. PESA pp. 173-200

APPENDIX I: PART 1: LITHOLOGICAL DESCRIPTIONS

Ditch cuttings were collected, washed, described, and checked for fluorescence at 10m intervals from the surface to 9 5/8" casing point at 656m, thereafter at 5m intervals from the casing shoe to 1300m, and then at 3m intervals to total depth at 2505m.

HEYTSBURY GROUP

Undifferentiated Tertiary

(35m thick)

Spud-40m SANDSTONE: (100%) orange brown, very fine to coarse, dominantly medium, occasional very coarse to grit size grains, angular to subangular, poor to moderately sorted, strong orange iron oxide cement in part - decreasing with depth, common light orange to dark brown argillaceous and silt matrix in part, clear to occasionally orange quartz grains, trace to common coarse muscovite flakes, trace black to dark brown fibrous carbonaceous matter, unconsolidated to occasionally hard, very good inferred porosity, no oil fluorescence, With minor interbedded: CLAYSTONE: (trace) dark brown, minor dispersed very fine to medium quartz sand grains, trace to common black fibrous carbonaceous matter, very soft, very dispersive, non fissile.

40-1150m **OTWAY GROUP**

Eumeralla Formation (Early Cretaceous - *i.e* Aptian to Albian)

(1110m thick)

40-92m CLAYSTONE: (95%) medium olive grey to medium green grey, light to medium brown grey, occasionally dark green grey, slightly to occasionally very silty, common very fine partially altered feldspar grains in part, trace black carbonaceous detritus, trace micromica, soft, non fissile,

Finely interbedded and laminated in part with:

SANDSTONE: (5%) medium grey to medium green grey, very fine to dominantly fine, angular to subrounded, dominantly subangular, moderately sorted, weak to moderate silica cement, weak calcareous cement in part, abundant medium olive grey argillaceous and silt matrix, abundant altered feldspar grains, common to abundant grey green and red lithics, trace black coaly detritus, trace mica flakes, friable, no visible porosity, no oil fluorescence

92-476m CLAYSTONE: (90%) medium green grey to medium olive grey, medium brown, very silty in part, common very fine altered feldspar grains where silty, trace black carbonaceous flecks and detritus, trace coarse brown and green mica flakes, trace to common micromica, trace pyrite, firm, non fissile,

In part grading to:

SILTSTONE: light to medium grey, light to medium olive grey, very argillaceous, often very finely arenaceous and grading to silty sandstone, trace to common black carbonaceous detritus and flecks, slightly calcareous in part, trace micromica, soft to firm, non fissile,

Finely interbedded with, laminated with and in part grading to:

SANDSTONE: (10%) medium green grey, very fine to medium, dominantly fine, angular to subangular, moderately sorted, moderate silica and calcareous cements, common green white argillaceous matrix, common to abundant altered feldspar grains, abundant green grey lithics, trace black carbonaceous detritus often with associated pyrite, trace coarse brown and green mica flakes, trace pyrite, moderately hard, no visible porosity, no oil fluorescence.

476-656m (csg pt.) CLAYSTONE: (60%) medium olive grey to medium grey, occasionally light to medium brown, occasionally medium green grey, very silty in part, trace black carbonaceous flecks and detritus, trace pyrite, trace micromica, firm, slightly subfissile,

Grading to:

SILTSTONE: (30%) light to medium grey, light to medium olive grey, often very finely arenaceous with quartz, altered feldspar and grey green and red lithics, trace black carbonaceous detritus, trace micromica, firm, slightly subfissile,

Grading to, laminated and interbedded with:

SANDSTONE: (10%) light brown to light to medium green grey to medium grey, very fine to dominantly fine, rarely medium, angular to subrounded, moderately sorted, strong silica and calcareous cements in part, abundant medium olive grey argillaceous and silt matrix in part, abundant altered feldspar, abundant grey green and red lithics, trace to common black coaly detritus, trace mica flakes, friable to hard, no visible porosity, no oil fluorescence.

656-659m SANDSTONE: (100%) off white to medium brown grey, very fine - rarely fine, angular to subrounded, moderately sorted, strong calcareous cement, abundant white argillaceous matrix in part, abundant medium grey silt matrix in part, common green grey and red lithics, common black carbonaceous matter, trace micromica, moderately hard, no visible porosity, no oil fluorescence.

659-790m CLAYSTONE: (60%) medium olive grey to medium grey to medium brown grey, very silty in part, common black carbonaceous detritus, trace micromica, firm, slightly subfissile,

Grading to:

SILTSTONE: (30%) medium grey to medium brown grey, very argillaceous, often very finely arenaceous, common partially altered feldspar grains in part, common black carbonaceous detritus and flecks, firm, slightly subfissile,

Grading in part to and occasionally interbedded with:

SANDSTONE: (100%) off white to medium brown grey, very fine to rarely fine, angular to subrounded, moderately sorted, strong calcareous cement, abundant white argillaceous matrix in part, abundant medium grey silt matrix in part, common green grey and red lithics, common black carbonaceous matter, trace micromica, moderately hard, no visible porosity, no oil fluorescence

790-835m CLAYSTONE: (30%) medium olive grey, light to medium grey, light to medium brown grey, very silty in part, common black carbonaceous flecks and detritus, trace micromica, firm, slightly subfissile,

Grading to:

SILTSTONE: (40%) medium grey to medium brown grey, very argillaceous, often very finely arenaceous, common partially altered feldspar grains in part, common black carbonaceous detritus and flecks, firm, slightly subfissile,

Grading in part to and interbedded with:

SANDSTONE: (30%) off white to light grey, very fine to fine, in part with abundant coarse to very coarse quartz grains, angular to subrounded, dominantly subangular, poor to moderately sorted, moderate to strong silica and calcareous cements, abundant white argillaceous matrix, occasionally abundant medium grey argillaceous and silt matrix, common grey green lithics, trace red brown lithics, trace black carbonaceous matter, friable to hard, no to very poor inferred porosity, no oil fluorescence.

835-955m CLAYSTONE: (40%) light green to medium olive grey, light to medium grey, light to medium brown grey, very silty in part, common black carbonaceous flecks and detritus, trace micromica, firm, slightly subfissile,

Grading to:

SILTSTONE: (40%) medium grey to medium brown grey, very argillaceous, often very finely arenaceous with partially altered feldspar and quartz grains, common black carbonaceous detritus and flecks, firm, slightly subfissile,

Grading in part to and interbedded with:

SANDSTONE: (20%) off white to medium brown grey, very fine to rarely fine, angular to subrounded, moderately sorted, strong calcareous cement, abundant white argillaceous matrix in part, abundant medium grey silt matrix in part, common green grey and red lithics, common black carbonaceous matter, trace micromica, moderately hard, no visible porosity, no oil fluorescence

955-1027m CLAYSTONE: (60%) medium olive grey to medium grey to light to medium brown grey, very silty in part, trace to occasionally abundant black carbonaceous flecks and detritus, trace micromica, firm, slightly subfissile,

Grading to:

SILTSTONE: (30%) medium grey to medium brown grey, very argillaceous, often very finely arenaceous with partially altered feldspar and quartz grains, trace to occasionally abundant black carbonaceous detritus and flecks, firm, slightly subfissile,

Grading in part to and interbedded with:

SANDSTONE: (10%) off white to medium brown grey, very fine to fine, angular to subrounded, moderately sorted, strong calcareous cement, abundant white argillaceous matrix in part, abundant medium grey silt matrix in part, common green grey and red lithics, common black carbonaceous matter, trace micromica, moderately hard to hard, no visual porosity, no oil fluorescence,

With minor laminated and thinly interbedded:

COAL: (trace) black, blocky fracture, earthy to subvitreous lustre, dark brown and very argillaceous in part, hard, brittle

1027-1092m CLAYSTONE: (50%) off white to medium brown, medium olive grey to medium grey, very silty in part, trace to occasionally abundant black carbonaceous flecks and detritus, trace micromica, firm, slightly subfissile,

Grading to:

SILTSTONE: (30%) off white to medium brown to medium grey, very argillaceous, often very finely arenaceous with partially altered feldspar and quartz grains, trace to occasionally abundant black carbonaceous detritus and flecks, firm, slightly subfissile,

Grading in part to and interbedded with:

SANDSTONE: (10%) off white to light brown, very fine to fine, angular to subrounded, moderately sorted, strong calcareous cement, abundant white argillaceous matrix in part, common green grey and trace red lithics, common black carbonaceous matter, trace micromica, moderately hard to hard, no visible porosity, no oil fluorescence,

With occasional laminated and thinly interbedded:

COAL: (10%) black, blocky fracture, earthy to subvitreous lustre, dark brown and very argillaceous in part, hard, brittle micromica, moderately hard to hard, no visible porosity, no oil fluorescence,

With occasional laminated and thinly interbedded:

COAL: (10%) black, blocky fracture, earthy to subvitreous lustre, dark brown and very argillaceous in part, hard, brittle.

1092-1150m CLAYSTONE: (60%) light to medium olive grey, light to medium brown grey, very silty in part, trace black carbonaceous flecks, common black coal detritus in part, trace micromica, firm to moderately hard, subfissile,

Grading to:

SILTSTONE: (30%) off white to light brown to medium grey to medium olive grey, very argillaceous, often very finely arenaceous with partially altered feldspar grains, trace black carbonaceous flecks, trace to common black coal detritus, trace micromica, firm to moderately hard, subfissile,

Grading to, laminated with and finely interbedded with:

SANDSTONE: (10%) off white to light brown, very fine to fine, dominantly very fine, rare clear medium to very coarse quartz grains, angular to subrounded, dominantly subangular, moderately sorted, moderate to strong silica and calcareous cements, trace strong dolomite cement, abundant white argillaceous matrix, common grey green lithics, trace red brown lithics, common to abundant off white partially altered feldspar grains, trace coal detritus, hard, no visible porosity, no oil fluorescence.

1150-2118m **<u>CRAYFISH GROUP</u>**

1150-1517m **<u>Laira Formation (E. Cret.—*i.e.* Valanginian - Hauterivian)</u>**

(367m thick)

1150-1350m CLAYSTONE: (60%) medium brown grey to medium olive grey to medium grey, very silty in part, trace black carbonaceous flecks and coal detritus, trace micromica, firm to moderately hard, subfissile,

Grading to:

SILTSTONE: (30%) medium brown grey to medium olive grey to medium grey, very argillaceous, often very finely arenaceous with partially altered feldspar grains, trace black carbonaceous flecks and coal detritus, trace micromica, firm to moderately hard, subfissile,

Grading to, laminated with and finely interbedded with

SANDSTONE: (10%) off white to light brown, very fine to fine, dominantly very fine, rare clear medium to very coarse quartz grains, angular to subrounded, dominantly subangular, moderately sorted, moderate to strong silica and calcareous cements, trace strong dolomite cement, abundant white argillaceous matrix, common grey green lithics, trace red brown lithics, common to abundant off white partially altered feldspar grains, trace coal detritus, hard, no visible porosity, no oil fluorescence.

1350-1517m CLAYSTONE: (70%) light to medium brown grey to medium grey to medium olive grey, occasionally very silty, trace black carbonaceous flecks, common to occasionally abundant dark brown to black coaly material, trace micromica, firm to moderately hard, subfissile,

Grading to:

SILTSTONE: (20%) medium brown grey to medium grey to medium olive grey, very argillaceous, occasionally very finely arenaceous with partially altered feldspar grains, trace black carbonaceous flecks, common dark brown to black coaly material, trace micromica, firm to moderately hard, subfissile,

Grading in part to, laminated with and finely interbedded with:

SANDSTONE: (10%) off white, very fine to occasionally medium, dominantly very fine, angular to subrounded, dominantly subangular, moderately sorted, moderate to strong silica and calcareous cements, common to abundant white argillaceous matrix, trace grey green and red brown lithics, trace garnet, trace to common coaly detritus, friable to hard, no to poor inferred porosity, no oil fluorescence.

1517-2118m **Pretty Hill Formation (E. Cret.—*i.e.* Berriasian to Valanginian) (601m thick)**

1517-1549m CLAYSTONE: (30%) light to medium brown grey to medium grey to medium olive grey, occasionally very silty, trace black carbonaceous flecks, common to occasionally abundant dark brown to black coaly material, trace micromica, firm to moderately hard, subfissile,

Grading to:

SILTSTONE: (10%) medium brown grey to medium grey to medium olive grey, very argillaceous, occasionally very finely arenaceous with partially altered feldspar grains, trace black carbonaceous flecks, common dark brown to black coaly material, trace micromica, firm to moderately hard, subfissile,

Grading in part to, laminated with and finely interbedded with:

SANDSTONE: (60%) off white, very fine to coarse, dominantly fine to medium, angular to subrounded, dominantly subangular, moderately sorted, moderate silica and calcareous cements, common to abundant white argillaceous matrix, trace grey green and red brown lithics, trace garnet, trace black to dark brown coaly detritus, friable to moderately hard, very poor to fair inferred porosity, no oil fluorescence.

1549-1751m SANDSTONE: (90%) off white to very light grey to light brown, dominantly off white, very fine to coarse, dominantly medium, trace very coarse to grit sized grains in part, angular to subangular, moderate to strong silica cement, weak calcareous cement, occasionally moderate dolomite cement, common white to occasionally light brown argillaceous matrix, clear to opaque quartz grains, common pink to red garnet, trace green grey cherty lithics, trace medium green volcanogenic lithics, trace medium grey phyllitic lithics, trace black coal detritus, moderately hard, poor to dominantly fair visible porosity,

Interbedded and laminated with:

SILTSTONE: (5%) medium grey to medium brown grey, moderately to very argillaceous, common very fine off white partially altered feldspar grains in part, trace black carbonaceous flecks, common micromica, moderately hard, very dispersive, subfissile

Grading in part to

CLAYSTONE: (5%) medium grey to medium brown grey, moderately to very silty, trace black carbonaceous flecks, common micromica, moderately hard, very dispersive, subfissile.

1751-1839m SANDSTONE: (80%) off white to light grey, very fine to very coarse, dominantly medium, angular to subangular, poorly sorted, moderate silica cement, weak to moderate calcareous cement, trace strong brown dolomite cement, common white argillaceous matrix, common pink to red garnet, trace to common grey to green phyllitic and volcanogenic lithics, trace black coaly detritus, moderately hard, poor to fair visible porosity,

Interbedded and in part laminated with:

SILTY CLAYSTONE: (20%) medium brown grey to medium grey, occasionally dark grey and shaley, trace very fine off white partially altered feldspar grains in part, trace to common black carbonaceous flecks and coaly detritus, common micromica, firm to moderately hard, very dispersive, subfissile.

1839-1990m SANDSTONE: (75%) off white to light grey, very fine to very coarse, dominantly fine, angular to subangular, very poorly sorted, moderate to strong silica cement, weak calcareous cement, trace strong brown dolomite cement, common to occasionally abundant white argillaceous matrix, trace to common pink to red garnet, common grey to green phyllitic and volcanogenic lithics, trace brown mica flakes, trace black coaly detritus, moderately hard to hard, very poor to fair visible porosity,

Interbedded and laminated with:

SILTY CLAYSTONE: (25%) medium brown to medium grey, occasionally dark grey and shaley, occasionally dark brown and very carbonaceous, trace very fine off white partially altered feldspar grains in part, trace to common black carbonaceous flecks and coaly detritus, trace fine brown mica flakes, common micromica, firm to moderately hard, very dispersive, subfissile.

1990-2118m SANDSTONE: (95%) off white to light grey, very fine to very coarse, dominantly fine, angular to subangular, poorly sorted, moderate to strong silica cement, weak calcareous cement, common white argillaceous matrix, trace to common pink to red garnet, common grey to green phyllitic and volcanogenic lithics in general increasing with depth, trace black coaly detritus, moderately hard to hard, poor to fair visible porosity, no oil fluorescence,

Interbedded and laminated with:

SILTY CLAYSTONE: (5%) medium brown to medium grey, occasionally dark grey and shaley, trace very fine off white partially altered feldspar grains in part, trace to common black carbonaceous flecks and coaly detritus, trace fine brown mica flakes, common micromica, moderately hard, very dispersive, subfissile.

2118-2361m **Casterton Formation (Late Jurassic to E. Cret.—*i.e.* Kimmeridgian to Berriasian) (243m thick)**

2118-2212m SILTSTONE: (75%) medium brown grey to dominantly dark grey, slightly to moderately argillaceous, common to abundant off white very fine partially altered feldspar grains in part, common black carbonaceous flecks, trace black coaly laminae, common micromica, moderately hard, subfissile,

Grading to and in part laminated with:

SANDSTONE: (25%) off white to medium brown grey to medium grey, silty to very fine, angular to subangular, moderately sorted, strong silica cement, weak to occasionally moderate calcareous cement, common off white argillaceous matrix, abundant medium grey silty matrix in part, abundant off white very fine partially altered feldspar grains, common fine clear to brown mica flakes, common very fine grey to brown lithics, common very fine black carbonaceous grains and detritus, hard, no to occasionally very poor visible porosity.

2212-2230m SILTY CLAYSTONE: (100%) medium to dark brown to medium to dark grey, very silty grading in part to siltstone, common very fine partially altered feldspar grains where very silty, common very fine brown and clear mica flakes, moderately carbonaceous, common black carbonaceous flecks and coaly detritus, moderately hard, subfissile.

2230-2343m	SILTY CLAYSTONE: (70%) dark brown grey to dark grey, moderately carbonaceous, common black carbonaceous flecks, trace black coaly detritus, common micromica, moderately hard, subfissile, Grading to: ARGILLACEOUS SILTSTONE: (28%) medium to dark brown grey to dark grey, moderately carbonaceous, common black carbonaceous flecks, trace black coaly detritus, abundant off white very fine partially altered feldspar and quartz grains in part, common micromica, moderately hard, subfissile, Grading to and laminated with: SANDSTONE: (2%) light to medium brown grey, silty to very fine, angular to subangular, moderately sorted, strong silica cement, common to abundant white to dark brown grey argillaceous and silt matrix, abundant very fine partially altered feldspar grains, common grey green and brown lithics, common very fine to fine brown and clear mica flakes, hard, no visible porosity, no oil fluorescence.
2343-2361m	COAL: (25%) black to very dark grey, very argillaceous and silty in part, subconchoidal to platy fracture, subvitreous lustre where pure, earthy where argillaceous, hard, brittle, Interbedded and laminated with and grading to: SILTY CLAYSTONE: (55%) dark brown grey to dark grey to grey black, moderately to very carbonaceous, common black carbonaceous flecks, common micromica, moderately hard, subfissile, Grading to: ARGILLACEOUS SILTSTONE: (20%) medium to dark brown grey to grey black, moderately to very carbonaceous, common black carbonaceous flecks, abundant off white very fine partially altered feldspar and quartz grains in part, common micromica, moderately hard, subfissile, Grading to and in part laminated with: SANDSTONE: (trace) light to medium brown grey, silty to very fine, angular to subangular, moderately sorted, strong silica cement, common to abundant white to dark brown grey argillaceous and silt matrix, abundant very fine partially altered feldspar grains, common grey green and brown lithics, common very fine to fine brown and clear mica flakes, hard, no visible porosity, no oil fluorescence
2361-2505m T.D.	**Metamorphic Basement (Palaeozoic)** **(144m thick)**
2361-2411m	METASILTSTONE: (100%) weathered in part at top to white clay, very light grey to light green, becoming medium to dark green grey with depth, often with fine to medium grained brown to black inclusions with diffuse grain boundaries, very siliceous, slightly to occasionally moderately calcareous, nil to occasionally common very coarsely crystalline vein quartz, trace pyrite, abundant micromica, hard, fissile.
2411-2436m	METASILTSTONE: (100%) light to dark olive grey, dominantly medium olive grey, siliceous, slightly calcareous and ankeritic, trace fine to medium brown mineral regrowth inclusions with diffuse grain boundaries, minor coarsely crystalline vein quartz, common pyrite, common micromica, earthy to often phyllitic sheen, minor slickensides, hard, fissile.

2436-2505m T.D.

METASILTSTONE: (100%) medium grey to medium olive grey, siliceous to microcrystalline texture, trace diffuse brown micaceous mineral growths, slightly to moderately calcareous and ankeritic, common slickensides often with ankeritic lining, common coarsely crystalline quartz fracture and vein infilling, common disseminated and nodular pyrite, common micromica, hard, fissile.

Note: See Hydrocarbon Show Summary for fluorescence in metasediments.

APPENDIX II : SIDEWALL CORE DESCRIPTIONS

SANTOS LIMITED

SIDEWALL CORE DESCRIPTION

WELL: GORDON-1 **DATE:** 29th April 1997 **PAGE:** 1 of 3

GUN NOs.: 1 & 2 **SHOTS FIRED:** 60 **SHOTS BOUGHT:** 56

GEOLOGIST: David Horner

CORE NO.	DEPTH	REC. mm	PALYN. EVAL. REJECT	LITH.	COLOUR	GRAIN SIZE	HYDR. INDIC. (Y/N)	SUPPLEMENTARY INFORMATION
1	2485.0	-						Empty
2	2465.0	19		Metaslt	Lt-m gy	Slt-vf	n	Lt-m gy,slt-vf xln text,v calc,hd
3	2452.0	-	Eval					Empty
4	2446.75	18	Eval	Metaslt	Lt-m gy	Slt-vf	n	Lt gy-m blu gy,slt-vf xln text,abt mmic,m calc,wh flks,hd
5	2429.25	13	Eval	Metaslt	Lt-m gy	Slt-vf	n	Lt gy-m blu gy,slt-vf xln text,abt mmic,sl calc,wh flks,hd
6	2426.5	-	Eval					Empty
7	2400.0	20	Eval	Metaslt	Lt-m blu gu,lt brn	Slt-vf	n	Lt-m blu gy,lt brn,slt-vf xln text,wk-m calc,com mmic,hd
8	2380.0	22		Metaslt	Lt-m blu gu,lt brn	Slt-vf	n	Lt-m blu gy,lt brn,slt-vf xln text,wk-m calc,com mmic,hd
9	2370.0	27		Metaslt	Lt-m blu gy,lt brn	Slt-vf	n	Lt blu grn,lt-m blu gy,lt brn,slt-vf xln text,non calc,tr mmic,hd
10	2359.0	38	Coal Mark	Carb sltst	Dk brn-brn bk	Slt-cly	n	m-dk brn,frm,v carb,v arg,v slty,com mmic,frm,sbfis
11	2356.25	36	Eval	Carb sltst	Brn bk	Slt-cly	n	Brn bk,v carb & coaly,tr mmic,non calc,tr wh veins,frm,sbfis
12	2350.0	40	Eval	Arg sltst	Dk brn	Slt-cly	n	Dk-v dk brn,mod carb,tr mmic,non calc,frm,sbfis
13	2345.25	26		Arg sltst	M gy-m brn	Slt-cly	n	M gy-m brn,off wh i/p,mod carb,sft-frm,tr mmic,sl sbfis
14	2337.5	22	Eval	Arg sltst	M-dk brn	Slt-cly	n	m-dk brn,v arg,mod carb,tr-v mmic,frm,sbfis
15	2325.0	25		Arg sltst	m brn	Slt-cly	n	m-dk brn,v arg,mod carb,tr-v mmic,frm,sbfis
16	2295.5	21		Sst/ sltst	Wh,m-dk brn	Slt-vf	n	Wh,m-dk brn,slt-vf,a-sa,m srt,wk sil cmt,non calc,frm,no vis por
17	2270.0	22		Arg sltst	Dk brn	Slt-cly	n	Dk brn,v arg grdg to clyst,non calc,com mmic,sft-frm,sl sbfis
18	2235.0	22		Arg sltst	Dk brn	Slt-cly	n	Dk brn,v arg grdg to clyst,non calc,com mmic,sft-frm,sl sbfis
19	2215.0	19		Sltst/ sst	Lt-m brn	Slt-vf	n	Lt-m brn,slt-vf,a-sa,m srt,wk sil cmt,non calc,v arg i/p,sft-frm,com mmic,sl sbfis
20	2205.0	15		Sltst/ sst	Lt-m brn	Slt-vf	n	Lt-m brn,slt-vf,a-sa,m srt,wk sil cmt,non calc,v arg i/p,sft-frm,com mmic,sl sbfis
21	2196.6	33	Eval	Sst	Off wh-lt gy	Vf-f	n	Off wh-lt gy,vf-f,w srt,sa-sr,wk calc cmt,mod sil cmt,abt wh arg mtx,fri,v pr vis por
22	2195.25	28	Eval	Sst	Off wh-lt gy	Vf-f	n	Off wh-lt gy,vf-f,w srt,sa-sr,wk calc cmt,mod sil cmt,abt wh arg mtx,abt med-dk gy arg & slt mtx, tr multicolor liths, tr mmic,fri,v pr vis por
23	2197.75	16	Eval	Sst	Off wh-lt gy	Vf-f	n	Off wh-lt gy,vf-f,w srt,sa-sr,wk calc cmt,mod sil cmt,abt wh arg mtx,abt med-dk gy arg & slt mtx, tr multicolor liths, tr mmic,fri,v pr vis por

WELL: GORDON-1 **DATE:** 29^{th} April 1997 **PAGE:** 2of 3

GUN NOs.: 1 & 2 **SHOTS FIRED:** 60 **SHOTS BOUGHT:** 56

GEOLOGIST: David Horner

CORE NO.	DEPTH	REC. mm	PALYN. EVAL. REJECT	LITH.	COLOUR	GRAIN SIZE	HYDR. INDIC. (Y/N)	SUPPLEMENTARY INFORMATION
24	2187.5	21		Sst	Off wh-lt gy	Vf-f	n	Off wh-lt gy,vf-f,w srt,sa-sr,wk calc cmt,mod sil cmt,abt wh arg mtx,abt med-dk gy arg & slt mtx, tr multicolor liths, tr mmic,fri,v pr vis por
25	2160.25	24		Sltst	Lt-m brn gy	Slt-vf	n	Lt-m gy brn,vf aren grdg to vf sst,tr mmic,frm,sbfis
26	2128.5	18		Sltst	Lt-m brn gy	Slt-vf	n	Lt-m gy brn,vf aren grdg to vf sst,tr mmic,frm,sbfis
27	2126.0	24		Sltst	Lt-m brn gy	Slt-cly	n	Lt-m gy brn,v arg grdg to clyst,tr mmic,frm,sbfis
28	2076.5	12		Sst	Off wh	f-m	n	Wh,clr-trnsl qtz,sa-sr,m srt,m sil cmt,tr wh arg mtx,fri,fr vis por
29	2057.5	22		Sst	Off wh-lt gy-lt brn	f-m	n	Wh,clr-trnsl qtz,sa-sr,m srt,m sil cmt,tr-com wh & brn arg mtx,fri,fr vis por
30	2030.75	19		Sst	Off wh	f-m	n	Wh,clr-trnsl qtz,sa-sr,m srt,m sil cmt,wk calc cmt, tr wh arg mtx,fri,fr vis por
31	2008.75	25		Sst	Wh-lt gy	f-c	n	Wh-lt gy,f-c,dom m,m-w srt,a-sa,wk calc cmt,com wh arg mtx,fri,pr vis por
32	1989.5	35		Sst	Wh-lt gy	f-c	n	Wh-lt gy,f-c,dom m,m-w srt,a-sa,wk calc cmt,com wh arg mtx, tr dk gy slt incl, tr liths,pr vis por
33	1920.5	41		Sst	Wh-lt gy	f-c	n	Wh-lt gy,f-c,dom m,m-w srt,a-sa,wk ca[illegible] cmt,com wh arg mtx, tr dk gy slt incl, tr liths,pr vis por
34	1899.0	25		Sst	Wh-lt gy	vf-c	n	Wh-lt gy,vf-c,dom f-m,sa-r,pr srt,str calc cmt,com wh arg mtx,tr liths,clr qtz grs,fri,pr vis por
35	1895.0	31		Sst	Lt-m gy	Vf-c	n	Lt-m gy,vf-c,dom m,sa-sr,m-w srt,wk calc cmt,mod sil cmt,abt wh arg mtx,fri,pr vis por
36	1882.0	37		Sltst	m-dk brn	Cly-vf	n	m-dk brn,vf aren i/p,v arg i/p,frm,sl sbfis
37	1871.5	29		Sst	Lt-m gy	Vf-c	n	Lt-m gy,vf-c,dom m,sa-sr,m-w srt,wk calc cmt,mod sil cmt,com wh arg mtx,com m brn gy arg & slt mtx, fri,pr vis por
38	1810.0	26		Sst/Cly	Lt-m gy	Vf-c	n	Lt-m gy,vf-c,dom m,sa-sr,m-w srt,wk calc cmt,mod sil cmt,com wh arg mtx,abt m brn gy arg & slt mtx grdg to clyst, fri,pr vis por
39	1768.0	39		Clyst	Lt-dk gy	Cly-vf	n	Lt-dk gy,vf aren i/p grdg to vf sst,frm-hd,non fis
40	1761.0	38		Sltst/ sst	Lt-m brn gy	Cly-vf	n	Lt-m gy brn, vf aren i/p grdg to vf sst,frm-hd,non fis
41	1749.5	-						Lost Bullet
42	1680.0	28		Sst	Wh-lt gy	Vf-m	n	Wh-lt gy,vf-m,dom f,sa-sr,pr srt,mod sil cmt,abt wh arg mtx,mod hd,v pr vis por
43	1614.0	36		Sltst	Lt-m brn gy	Slt-vf	n	Lt-m gy brn,vf aren grdg to slty sst,com mmic,frm,sl sbfis
44	1593.25	38		Sltst	M brn-m gy	Cly-vf	n	M brn,m gy,wh,v arg i/p,vf aren i/p grd[illegible] to vf sst,(laminated),frm,non fis
45	1558.0	30	Eval mark	Sst	Wh	m	n	Wh,m,sa-sr,w srt,mod sil cmt,tr wh mtx,clr qtz grs,tr garn,fri-hd,gd vis por
46	1549.0	32		Sltst/ sst	Lt-m gy brn	Cly-vf	n	Lt-m gy brn,v arg,vf aren grdg to sst,frm,sl sbfis
47	1536.0	31		Sltst	m-dk brn, dk gy	Cly-sst	n	m-dk brn,dk gy,v arg,vf aren grdg to sst,sft-frm,sl sbfis

WELL:	GORDON-1	**DATE:**	29th April 1997	**PAGE:**	3of 3
GUN NOs.:	1 & 2	**SHOTS FIRED:**	60	**SHOTS BOUGHT:**	56
		GEOLOGIST:	David Horner		

CORE NO.	DEPTH	REC. mm	PALYN. EVAL. REJECT	LITH.	COLOUR	GRAIN SIZE	HYDR. INDIC. (Y/N)	SUPPLEMENTARY INFORMATION
48	1510.0	32		Sltst	m-dk brn, dk gy	Cly-sst	n	m-dk brn,dk gy,v arg,vf aren grdg to sst,sft-frm,sl sbfis
49	1482.5	40		Sltst	Lt-m gy	Cly-vf	n	Lt-m gy,v arg,vf aren grdg to vf sst,frm,sl sbfis
50	1428.0	46		Sltst	Lt-m brn gy	Cly-vf	n	Lt-m gy,v arg,vf aren grdg to vf sst,frm,sl sbfis
51	1413.5	37		Sltst	Lt-m gy	Cly-vf	n	Lt-m gy,mod arg,vf aren grdg to vf sst,frm,sl sbfis
52	1369.0	33		Sltst	Lt-m gy	Cly-vf	n	Lt-m gy,v arg,vf aren grdg to vf sst,frm,sl sbfis
53	1275.0	33		Sltst	Lt-m brn gy	Cly-vf	n	Lt-m gy brn,v arg,vf aren grdg to slty sst,frm,sl sbfis
54	1211.0	41		Sltst/ clyst	Lt-dk gy,m brn	Cly-slt	n	Lt-dk gy,m brn,v arg grdg to clyst,sl calc,frm,sl sbfis
55	1184.5	32		Clyst	M gy brn	Cly-slt	n	M gy brn,v slty grdg to sltst,com mmic,frm,sl sbfis
56	1149.5	26		Sst	Lt-m gy, med brn	vf	n	Lt-m gy,m brn,a-sr,w srt,wk sil cmt,abt arg & slt mtx grdg to sltst,tr carb flks,fri,v pr vis por
57	1118.0	35		Sltst	Lt-m gy	Cly-vf	n	Lt-m gy,vf aren grdg to vf slty sst,mod arg,abt mmic,frm,sl sbfis
58	1105.0	32		Sltst	Dk brn -occ bk	Cly-vf	n	Dk brn-occ bk,v carb grdg to v slty coal,occ vf sst lam,frm-hd,non fis
59	1063.0	32		Clyst	Lt-m gy	cly	n	Lt-m gy,frm,non fis
60	1035.0	30		Sst/ clyst	Wh-lt gy, med brn	Cly-vf	n	Wh,lt gy,med brn,vf gr,v arg i/p grdg to clyst,fri-frm,non fis,no vis por

COMMENTS:

Of Note: with a second look at these sidewall cores, the description of some were different from the first look, depending on where the flake of sample to look at was taken from, and from which end, even though to look externally at the core there was no difference due to a smeared coating on the outside of the core from the bullet entry. Wonder if this is always the case, and what can be done to avoid incorrect descriptions apart from destroying the sidewall core in the process?

APPENDIX II: OIL SHOW EVALUATION REPORTS

SANTOS LIMITED

OIL SHOW EVALUATION REPORT

WELL: Gordon 1

INTERVAL 1641m - 1645m

FM: Pretty Hill Sst.

GEOLOGIST: David Horner

DATE: 21/04/97

C1 ppm	5k	10k	20k	30k	40k	50k	100k	150k	200k	>250k
C2+ ppm	500	750	1k	2k	3k	4k	5k	7.5k	10k	>15k
Porosity Ø	tight			poor		fair		good		
% with fluorescence	trace	10	20	30	40	50	60	70	80	>90
Fluorescence appearance	trace		spotted			streaked		patchy		solid
Brightness of fluorescence	v. dull		dull		dim		moderate bright	bright	v. bright	glowing
Type of cut	trace	v. slow crush cut	crush cut	instant crush cut	v. slow streaming cut	slow stream	moderate streaming	streaming	fast streaming	instant
Residue on spot plate	trace	heavy trace	v. thin ring	thin ring	thick ring	v. thick ring	thin film	thin film	thick film	solid
Show rating	trace		poor		Fair		good			
Comments:										

SANTOS LIMITED

OIL SHOW EVALUATION REPORT

WELL: Gordon 1

INTERVAL 1771m - 1775m

FM: Pretty Hill Sst.

GEOLOGIST: David Horner

DATE: 22/04/97

C1 ppm	5k	10k	20k	30k	40k	50k	100k	150k	200k	>250k
C2+ ppm	500	750	1k	2k	3k	4k	5k	7.5k	10k	>15k
Porosity Ø	tight			poor		fair		good		
% with fluorescence	trace	10	20	30	40	50	60	70	80	>90
Fluorescence appearance	trace		spotted			streaked		patchy		solid
Brightness of fluorescence	v. dull		dull		dim		moderate bright	bright	v. bright	glowing
Type of cut	trace	v. slow crush cut	crush cut	instant crush cut	v. slow streaming cut	slow stream	moderate streaming	streaming	fast streaming	instant
Residue on spot plate	trace	heavy trace	v. thin ring	thin ring	thick ring	v. thick ring	thin film	thin film	thick film	solid
Show rating	trace		poor		Fair		good			
Comments:										

SANTOS LIMITED

OIL SHOW EVALUATION REPORT

WELL: Gordon 1
INTERVAL: 2195m - 2212m
FM: Casterton Fm.

GEOLOGIST: David Horner
DATE: 24/04/97

C1 ppm	5k	10k	20k	30k	40k	50k	100k	150k	200k	>250k
C2+ ppm	500	750	1k	2k	3k	4k	5k	7.5k	10k	>15k
Porosity Ø	tight			poor		fair		good		
% with fluorescence	trace	10	20	30	40	50	60	70	80	>90
Fluorescence appearance	trace		spotted			streaked		patchy		solid
Brightness of fluorescence	v. dull		dull		dim		moderate bright	bright	v. bright	glowing
Type of cut	trace	v. slow crush cut	crush cut	instant crush cut	v. slow streaming cut	slow stream	moderate streaming	streaming	fast streaming	instant
Residue on spot plate	trace	heavy trace	v. thin ring	thin ring	thick ring	v. thick ring	thin film	thin film	thick film	solid
Show rating	trace		poor		Fair		good			
Comments:	Oil only in aggregates where there is some visual ∅.									

SANTOS LIMITED

OIL SHOW EVALUATION REPORT

WELL: Gordon 1

INTERVAL 2401m - 2410m

FM: Basement

GEOLOGIST: David Horner

DATE: 25/04/97

C1 ppm	5k	10k	20k	30k	40k	50k	100k	150k	200k	>250k
C2+ ppm	500	750	1k	2k	3k	4k	5k	7.5k	10k	>15k
Porosity Ø	tight			poor		fair		good		
% with fluorescence	trace	10	20	30	40	50	60	70	80	>90
Fluorescence appearance	trace		spotted			streaked		patchy		solid
Brightness of fluorescence	v. dull		dull		dim			bright	v. bright	glowing
Type of cut	trace	v. slow crush cut	crush cut	instant crush cut	v. slow streaming cut	slow stream	moderate streaming	streaming	fast streaming	instant
Residue on spot plate	trace	heavy trace	v. thin ring	thin ring	thick ring	v. thick ring	thin film	thin film	thick film	solid
Show rating	trace		poor		Fair		good			
Comments:	Associated with fractures and quartz veining.									

SANTOS LIMITED

OIL SHOW EVALUATION REPORT

WELL: Gordon 1
INTERVAL 2411m - 2436m
FM: Basement

GEOLOGIST: David Horner
DATE: 26/04/97

C1 ppm	5k	10k	20k	30k	40k	50k	100k	150k	200k	>250k
C2+ ppm	500	750	1k	2k	3k	4k	5k	7.5k	10k	>15k
Porosity Ø	tight			poor		fair		good		
% with fluorescence	trace	10	20	30	40	50	60	70	80	>90
Fluorescence appearance	trace		spotted			streaked		patchy		solid
Brightness of fluorescence	v. dull		dull		dim			bright	v. bright	glowing
Type of cut	trace	v. slow crush cut	crush cut	instant crush cut	v. slow streaming cut	slow stream	moderate streaming	streaming	fast streaming	instant
Residue on spot plate	trace	heavy trace	v. thin ring	thin ring	thick ring	v. thick ring	thin film	thin film	thick film	solid
Show rating	trace		poor		Fair		good			
Comments:	Weaker show than for 2401 - 2410m.									

SANTOS LIMITED

OIL SHOW EVALUATION REPORT

WELL: Gordon 1

INTERVAL 2436m - 2443m

FM: Basement

GEOLOGIST: David Horner

DATE: 27/04/97

C1 ppm	5k	10k	20k	30k	40k	50k	100k	150k	200k	>250k
C2+ ppm	500	750	1k	2k	3k	4k	5k	7.5k	10k	>15k
Porosity Ø	tight			poor		fair		good		
% with fluorescence	trace	10	20	30	40	50	60	70	80	>90
Fluorescence appearance	trace		spotted			streaked		patchy		solid
Brightness of fluorescence	v. dull		dull		dim			bright	v. bright	glowing
Type of cut	trace	v. slow crush cut	crush cut	instant crush cut	v. slow streaming cut	slow stream	moderate streaming	streaming	fast streaming	instant
Residue on spot plate	trace	heavy trace	v. thin ring	thin ring	thick ring	v. thick ring	thin film	thin film	thick film	solid
Show rating	trace		poor		Fair		good			
Comments:	Weaker show than preceding basement shows due to less Basement Fractures.									

APPENDIX III : LOG EVALUATION

GORDON 1 - LOG ANALYSIS

Gordon 1 wireline logs were analysed over the interval 2300-2400m. No pay was identified and the well was plugged and suspended with oil shows in fractured basement.

A 12 1/4" surface hole was drilled to 656m and 9 5/8" casing set at 652m. An 8 1/2" production hole was drilled to 2505m without any significant problems. Two DST's over the intervals 2390-2461m and 2389.5-2361m tested the fractured basement and recovered 6 bbls and 1 bbl of oil respectively.

Logs Acquired

PEX-AS (Res)	2501- 652m (GR to surface)
(Nuclear)	2501- 652m (High res 2501-2100m)
FMI	2499- 2270m
CST	60 shot (56 recovered)

Mud Parameters

Mud Type	KCl/PHPA
Mud Density	1.107 gm/cc
Rm	0.195 ohmm @ 17 °C
Rmf	0.148 ohmm @ 20 °C
Rmc	0.321 ohmm @ 16 °C
BHT	99 °C

Log Processing

- Hole conditions were excellent and all logs were of an acceptable quality.
- An invasion corrected Rt curve was derived from the DLL
- DT was estimated from the median of the four sonic transit time curves.
- No other environmental corrections, other than those applied real - time in the field, were considered necessary

Interpretation Procedures and Parameters

An interpretation was made using a density-neutron derived Vshale. Water saturations were calculated using the Simandoux equation.

- Total porosity was calculated from the LDL density log:

  PHID = (2.65 - RHOB) / (RHOG - RHOF)

  where:
  RHOB = Bulk density from log
  RHOG = 2.65 gm/cc
  RHOF = 1.00 gm/cc

- Effective porosity was calculated as follows:

  PHIE = PHID - (VSH * PHISH)

  where:
  PHISH = 0.1 (apparent shale porosity)

Formation water resistivity was derived from regional salinity data.

Parameters used for the interpretation are detailed in Table 1.

Conclusions

1. FMI data identified fractures within basement rock at Gordon 1.

2. Gordon 1 recovered oil from basement fractures.

3. Gordon 1 was plugged and suspended.

4. Quantitative water saturation and porosity values were not calculated due to the fractured nature of the basement.

TABLE 1

Log Analysis Parameters

PARAMETERS	MACEACHERN	BASEMENT
Rw (ohmm) @ 25°C	0.5	0.5
a	1	1
m	2	2
n	2	2
Rt Sh (ohmm)	30	30
Neut Sh (v/v)	0.2	0.2
Rhob Sh (gm/cc)	2.65	2.65
Rhob Coal (ms/ft)	2.35	2.35

PE604425

This is an enclosure indicator page.
The enclosure PE604425 is enclosed within the container PE905781 at this location in this document.

The enclosure PE604425 has the following characteristics:

```
     ITEM_BARCODE = PE604425
CONTAINER_BARCODE = PE905781
             NAME = Well Evaluation Summary for Gordon-1
            BASIN = OTWAY BASIN
           PERMIT = PEP/119
             TYPE = WELL
          SUBTYPE = WELL_LOG
      DESCRIPTION = Well Evaluation Summary (from WCR) for
                    Gordon-1
          REMARKS =
     DATE_CREATED = 31/08/97
    DATE_RECEIVED =
             W_NO = W1191
        WELL_NAME = GORDON-1
       CONTRACTOR = SANTOS
     CLIENT_OP_CO = SANTOS LTD
```

(Inserted by DNRE - Vic Govt Mines Dept)

APPENDIX IV: DRILL STEM TEST DATA

The Service Company Reports will be forwarded when available

REVISION 1 (11/11/96)

Santos

A.C.N. 007 550 923

DRILL STEM TEST REPORT

WELL:	Gordon-1	**DST NO:** 1		**DATE:**	30th April, 1997
INTERVAL:	2390 - 2461m (2.5m fill)	**FORMATION:**		Basement	
TEST TYPE:	On bottom straddle	**Separator:**	No	**Type:**	
CUSHION:	No	**Rmf:**	0.20 at 72 F		
		Rw:			
GEOLOGIST:	David Horner	**Tracer:**			

REMARKS

ELAPSED TIME (MIN)	REMARKS/ PRESSURES	ELAPSED TIME (MIN)	REMARKS/ PRESSURES	ELAPSED TIME (MIN)	REMARKS/ PRESSURES
0 IF	No blow	57 FF	No blow		
2	No blow	58	No blow		
4	No blow	59	Very weak bubble		
6	No blow	61	Very weak -increasing		
8	Very weak bubble	64	1" in bucket		
9	Weak bubble	67	2" in bucket		
10	5" in bucket	69	3" in bucket		
11	6" in bucket	71	4" in bucket		
12	7" in bucket	74	5" in bucket		
13	10" in bucket	Lost seat	Annulus dropping		
14	11" in bucket		Strong blow to bottom		
15 ISI	12" in bucket	84	Abort test		

SURFACE FLOW SUMMARY

CHOKE SIZE (IN) SEPARATOR	FLUID TO SURFACE (MIN)	FLOWING TIME	MAXIMUM SURFACE PRESSURE	FINAL GAS RATE (MMCFD)	FINAL LIQUIDS RATE	FIELD GAS ANALYSIS	FIELD LIQUIDS ANALYSIS
-	-	-	-	-	-	-	-

FIELD DOWNHOLE PRESSURE DATA

		BOTTOM ELECTONIC	BOTTOM	TOP ELEC	TOP	TIMES
DEPTH	m	2403.8	2400.5	2385.4	2382.6	
INITIAL HYDROSTATIC	psig	3838.5	3050.5	3826.2	3833.7	15min
1ST - INITIAL FLOW	psig	115.1	186.3	85.8	88.5	
1ST - FINAL FLOW	psig	181.0	-	155.5	-	
1ST - CLOSED IN	psig	2054.6	2007.8	2035.2	207.2	42 min
2ND - INITIAL FLOW	psig	220.1	279.5	194.4	215.9	17 min
2ND - FINAL FLOW	psig	-	-	-	-	Lost
2ND - CLOSED IN	psig	-	-	-	-	seat
FINAL HYDROSTATIC	psig	3838.4	3850.5	3827.6	3833.7	
TEMPERATURE	F	211.37		210		

WELL: Gordon-1 **DST NO:** 1 **DATE:** 30/4/97

RECOVERY

REVERSE CIRCULATED	
PULLED	Y

RECOVERY: 6 bbls oil cut rathole and annulus mud

SAMPLE DATA

GAS/CONDENSATE

SAMPLE NO	BOMB NO	TYPE	SOURCE	PRESS/TEMP
NIL				

OIL/CONDENSATE FILTRATE

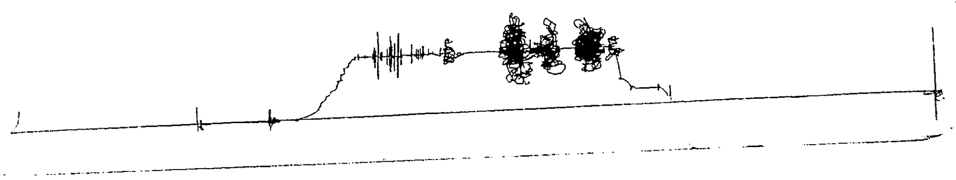
SAMPLE NO	TYPE	SAMPLE	RMF	TRACER	CL (PPM)
1	TIN	OIL			
3	PHIAL	Mud Filtrate	0.20 at 72F		

WATER

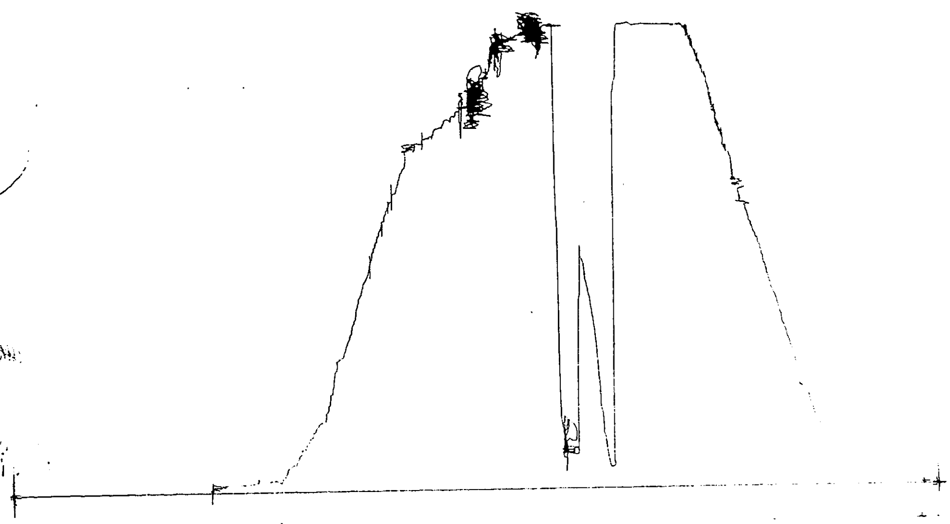
SAMPLE NO	TYPE	RW	REMARKS
2	Make-up water	>10 at 80F	

REMARKS:
Packers failed partway into final flow period. Lower top packer and both bottom packers ruptured.
Fluid before packer seat failure = 129 PSI (= 275ft at 9.0 lb/gal mud weight eq.)
Oil Pour Point 23 degrees C.

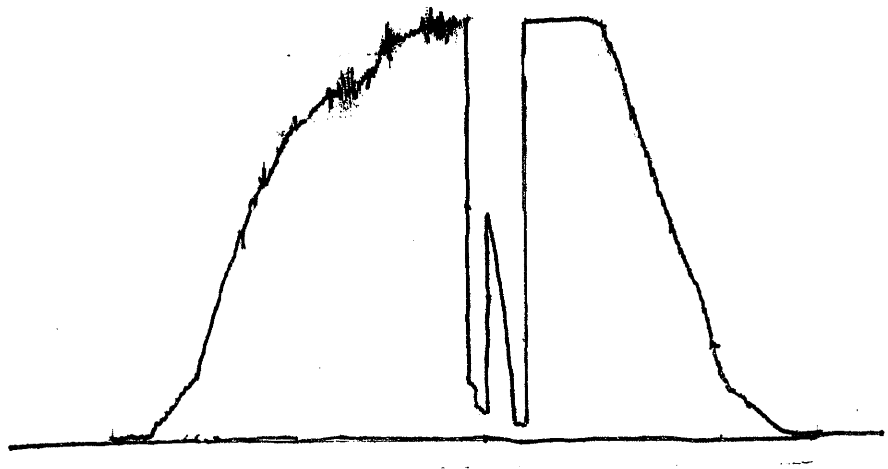
GORDON #1 DST#1 REC 22199 2390-2460m ABOVE



GORDON #1 DST #1 REC 22200 2395-2460m OUTSIDE



GORDON #1 DST #1 REC 10335 2390-2461m INSIDE



GORDON #1 DST #1 REC 10335 2390-2461m
INSIDE

FILE

COMPANY SANTOS LIMITED STATE VICTORIA DATE 30-4-97

Well Name GORDON #1 KB Elv. 129.59 m ~~ft.~~ Ticket No. ____ DST No. ONE

Well Location PEP119, ONSHORE OTWAY BASIN VIC. 141° 17' 38.4" E 37° 35' 14.5" S GR Elv. 124.89 m ~~ft.~~ Formation BASEMENT

Interval 2390-2461 m T.D. 2505 m ~~ft.~~ Net Pay ____ ft. Type of Test CONVENTIONAL BY-PASS STRADDLE

API Gravity ____ W.S. ____ Average Porosity ____

RECORDER DATA

Mins. ____

PF ____	Rec. # 22199	#10335	#522	#22200	#526
SI ____	Range 6325 lbs.	6900	5000	6250	5000
SF ____	Clock 24 hrs.	24	BATTERY	24	BATTERY
FS ____	Depth 2376 m	2382.6	2385.4	2400.5	2403.8
		PSI	PSI	PSI	PSI
A. Init. Hyd.		3833.7	3826.2	3850.5	3838.5
B. First Flow		88.5	85.8	186.3	115.1
B1 Final Flow	64		155.5		181.0
C. In. Shut-In		2072.2	2035.2	2007.8	2054.6
D. Init. Flow		215.9	194.4	279.5	220.1
E. Final Flow	129				
F. Fl. Shut-in					
G. Final Hyd.		3833.7	3827.6	3850.5	3838.4
Inside/Outside	ABOVE	(IN)	(IN)	(OUT)	(OUT)

TIME DATA

PF Fr. 0656 to 0711 hr.

IS Fr. 0711 to 0753 hr.

SF Fr. 0753 to 0810 hr.

FS Fr. ____ to ____ hr.

T. STARTED 2145 29.4.97 hr.

T. ON BOTM. 0510 hr.

T. OPEN 0656 hr.

T. PULLED 0820 hr.

T. OUT 1800 hr.

TOOL DATA

Tool Wt. 15.000 lbs.

Wt. Set on Packer 30.000 lbs.

Wt. Pulled Loose 40.000 lbs.

Initial Str. Wt. 140.000 lbs.

Unseated Str. Wt. 150.000 lbs.

Bot. Choke 3/4 in.

Hole Size 8½ in.

D. Col. I.D. 2 13/16 in.

D. Pipe I.D. 3.826 in.

D.C. Leng. 150.09 m ~~ft.~~

D.P. Leng. 2145.9 m ~~ft.~~

HWDP 83.38

RECOVERY

Total Fluid 6 bbls ft. of ____ ft. in D.C. and ____ ft. in D.P.

6 bbls (315 m) ~~ft.~~ of OIL CUT MUD

____ ft. of ____

____ ft. of ____

____ ft. of ____

GAS RECOVERY MEASURED WITH

	Time Mins.	Orifice inches	Pressure PSI	H_2O inches	Rate mcf/d
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

SURFACE CHOKE SIZE: ____

MUD DATA

Mud type KCL PHPA

Weight 9.3

Vis. 42

W.L. 5.5

F.C. 1 in.

Mud Drop YES

GENERAL DATA

Amt. of fill 2.5 m ~~ft.~~

Btm. H. Temp. 211.37 °F

Hole Cond. FAIR

Packer Size 7½ x 30 in.

No. of Packers 4

Cushion Amt. — ft.

Cushion Type —

Reversed Out NO

Tool Chased NO

Tester J SILVESTER

Co. Rep. A. BRADLEY

Contractor OD+E

Rig No. 30

BLOW DESCRIPTION: ... NIL AIR ... [illegible]

Reversed Out: NO

Tool Chased: NO

Tester: J. SILVESTER

Co. Rep.: A. BRADLEY

Contractor: OD+E

Rig No.: 30

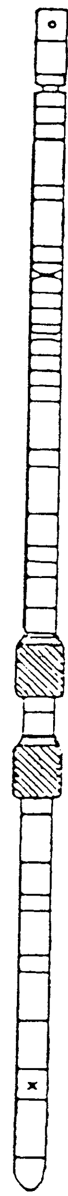
BLOW DESCRIPTION 1st FLOW: NIL AIR BLOW FOR 8mins THEN V.W.A.B INCREASING TO WEAK AT END OF FLOW.

BLOW DESCRIPTION 2nd FLOW: NIL AIR BLOW FOR 2mins THEN V.W.A.B AND INCREASING

REMARKS: MUD STARTED TO DROP VERY SLOWLY AT 0810HRS. VERY LITTLE WEIGHT ON TOOL. APPEARED TO SKID THRU FILL. CHASED TOOL APPROX 1½m TO KEEP 25000 ON TOOL. MUD STILL DROPPED SLOWLY P.O.O.H.

			LENGTH
TOTAL TOOL TO BOTTOM TOP PACKERS			15·36
INTERVAL TOOL			14·77
Bottom PACKER + ANCHOR			44·06
TOTAL TOOL			74·19
DRILL COLLAR ANCHOR IN INTERVAL			56·13
DRILL COLLARS ABOVE TOOLS	Stands	Total	150·09
DRILL PIPE ABOVE TOOLS	Stands	Total	2145·9
H. W. PIPE ABOVE TOOLS	Stands	Total	83·35
OTHER ABOVE TOOL		Total	
TOTAL DRILL COLLARS DRILL PIPE AND TOOLS			2509·69
TOTAL DEPTH			2505
TOTAL DRILL PIPE ABOVE K.B.			4·69

REMARKS:



	LENGTH
BO SUB	
P.O. SUB	
C.O. SUB	
SHUT-IN TOOL	
HMV	
JARS	
SAFETY JOINT	
PACKER	
PACKER	
DEPTH	
STUBB	
ANCHOR	
BULLNOSE	
T.D.	

SANTOS LIMITED

WELL NAME: GORDON #1 **DST #1** **DATE: 30/04/97**

FORMATION: BASEMENT **TESTER:** J.SILVESTER

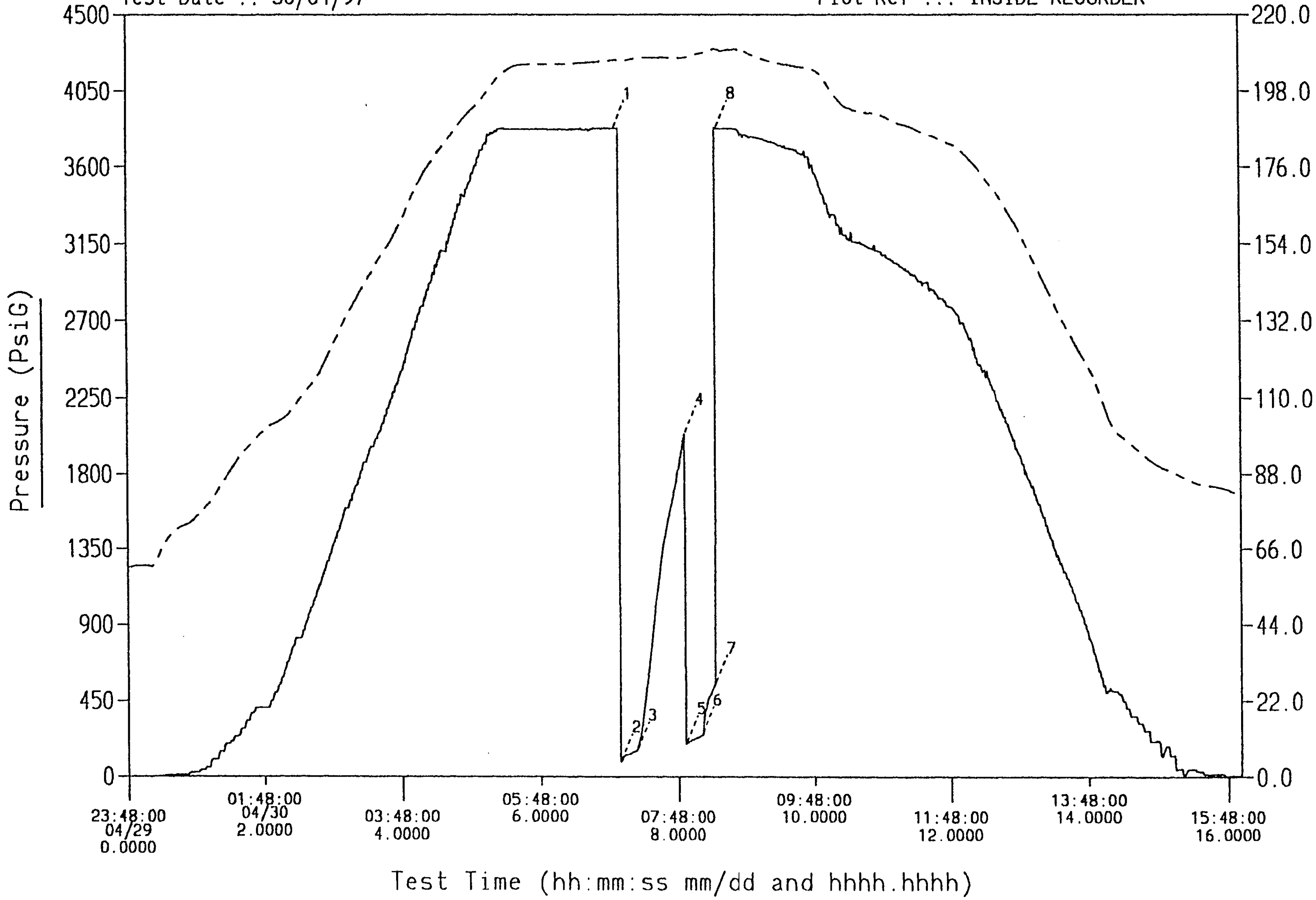
TOTAL TOOL TO BOTTOM TOP PACKEF	15.36
TOOL INTERVAL	14.77
BOTTOM PACKER AND ANCHOR	44.06
TOTAL TOOL	74.19
DRILL COLLARS IN INTERVAL	56.13

STICK UP	**-4.69**		
DRILL PIPE	2145.9	-4.69	75STDS+SGL+PUP
H.W.DRILL PIPE	83.38	2141.21	3 STANDS
DRILL COLLARS	131.42	2224.59	5 STANDS+JARS
PUMP OUT SUB	0.41	2356.01	
DRILL COLLARS	9.28	2356.42	1 SGL
DROP BAR SUB	0.3	2365.7	
DRILL COLLARS	9.39	2366	1 SGL
CROSS OVER	0.31	2375.39	
RECORDER CARRIER	1.52	2375.7	
SHUT-IN TOOL	1.71	2377.22	
SAMPLER	1.02	2378.93	
TRAVEL SUB	0.46	2379.95	
HYD TOOL	1.68	2380.41	
RECORDER CARRIER	1.52	2382.09	
RECORDER CARRIER EMP	1.83	2383.61	
HANGER SUB	0.31	2385.44	
SAFETY JOINT	0.66	2385.75	
PACKER	2.34	2386.41	
PACKER	1.29	2388.75	
DEPTH	**2390.04**	2390.04	
STICK DOWN	1.05	2390.04	
PERF	8.82	2391.09	
RECEIVER SUB	0.31	2399.91	
RECORDER CARRIER	1.52	2400.22	
RECORDER CARRIER EMP	2.05	2401.74	
CROSS OVER	0.31	2403.79	
DRILL COLLARS	56.13	2404.1	2 STANDS
CROSS OVER	0.31	2460.23	
STICK UP	0.4	2460.54	
DEPTH	**2460.94**	2460.94	
PACKER	1.94	2460.94	
PACKER	2.34	2462.88	
CROSS OVER	0.31	2465.22	
DRILL PIPE	38.23	2465.53	4 DRILL PIPE
CROSS OVER	0.31	2503.76	
PERF	0.31	2504.07	
BULLNOSE	0.62	2504.38	
TOTAL DEPTH	**2505**		

97/04/30
22:37:00

Company .... SANTOS LIMITED
Well .... GORDON #1 PEP119 ONSHORE OTWAY BASIN VICTORIA
Test Date .. 30/04/97

EMP S/N 080-522
File Ref ... G01DST1
Plot Ref ... INSIDE RECORDER

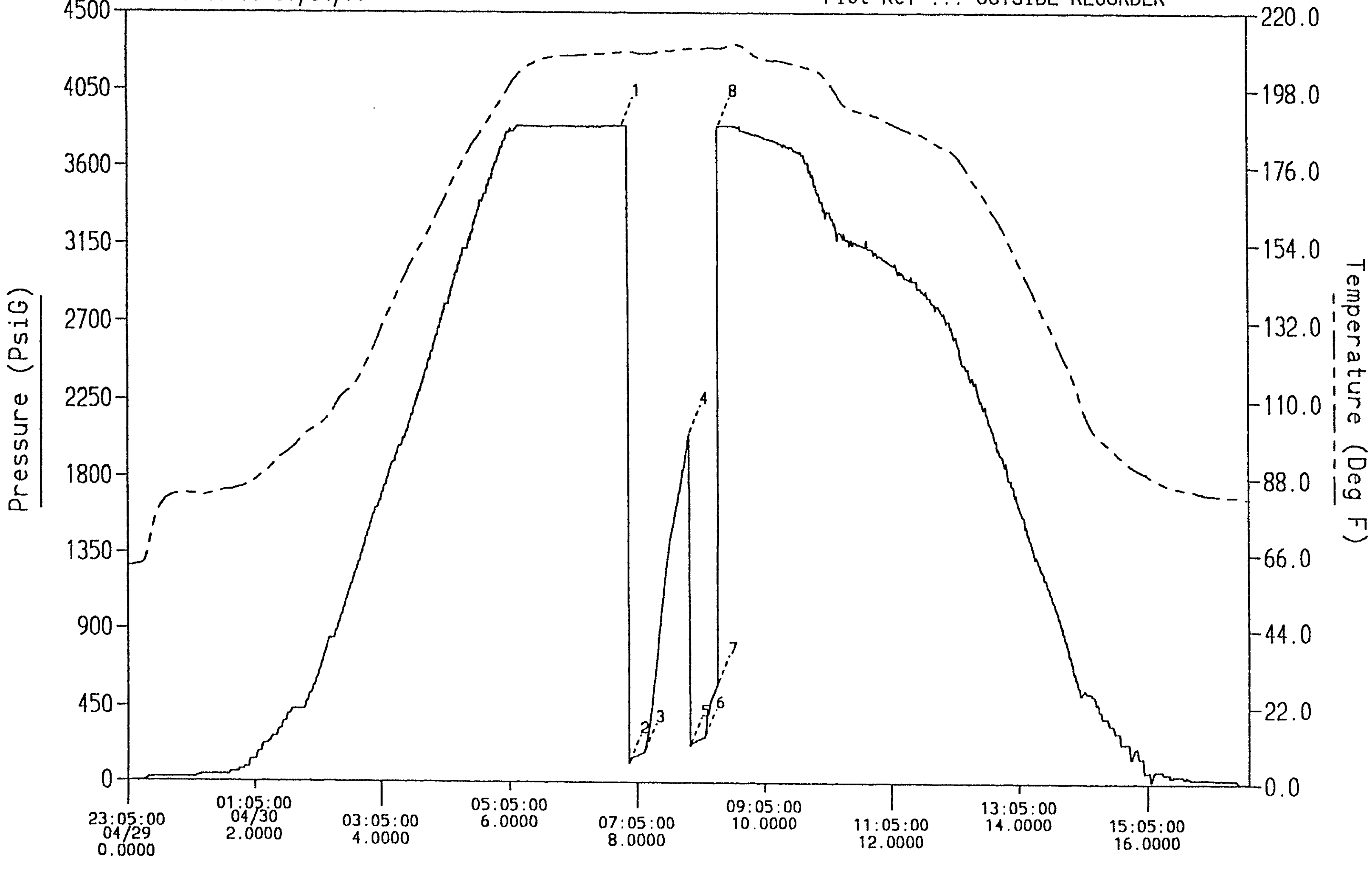


1 - INITIAL HYDROSTATIC; t=7.0678; P=3826.2
2 - INITIAL PREFLOW; t=7.1511; P=85.8
3 - FINAL PREFLOW; t=7.3844; P=155.5
4 - INITIAL SHUTIN; t=8.0844; P=2035.2
5 - INITIAL FLOW; t=8.1011; P=194.4
6 - LOST PACKER SEAT; t=8.3344; P=246.6
7 - PULL FREE; t=8.5344; P=552.7
8 - FINAL HYDROSTATIC; t=8.5678; P=3827.6

97/04/30
22:11:58

Company .... SANTOS LIMITED
Well .... GORDON #1 PEP119 ONSHORE OTWAY BASIN VICTORIA
Test Date .. 30/04/97

EMP S/N 080-526
File Ref ... GOR1DST1
Plot Ref ... OUTSIDE RECORDER



1 - INITIAL HYDROSTATIC; t=7.7678; P=3838.5
2 - INITIAL PREFLOW; t=7.8678; P=115.1
3 - FINAL PREFLOW; t=8.1011; P=181.0
4 - INITIAL SHUTIN; t=8.8011; P=2054.6
5 - INITIAL FLOW; t=8.8178; P=220.1
6 - LOST PACKER SEAT; t=9.0511; P=271.0
7 - PULLFREE; t=9.2511; P=584.5
8 - FINAL HYDROSTATIC; t=9.2844; P=3838.4

Santos

A.C.N. 007 550 923

DRILL STEM TEST REPORT

WELL:	Gordon-1	**DST NO:**	2	**DATE:**	1st May, 1997
INTERVAL:	2389.5-2461m	**FORMATION:**	Basement		
TEST TYPE:	CS	**Separator:**	Yes/No	**Type:**	
CUSHION:	52m (0.8bbls)	**Rmf:**	0.20 at 72F		
		Rw:	>10 at 80 F		
GEOLOGIST:	David Horner	**Tracer:**	Nil		

REMARKS

ELAPSED TIME (MIN)	REMARKS/ PRESSURES	ELAPSED TIME (MIN)	REMARKS/ PRESSURES	ELAPSED TIME (MIN)	REMARKS/ PRESSURES
0 open tool	No blow	125	4 1/4" in bucket		
11	No blow	140	5" in bucket		
12	2 bubbles	155	5.5" in bucket		
13	Occasional bubbles	170	5 3/4" in bucket		
20	Continuous bubbles	185	6.25" in bucket		
25	Weak at surface	200	6.25" in bucket		
35	1" in bucket	215	6.75" in bucket		
50	1 5/8" in bucket	216	Lost packer seat		
65	1 3/4" in bucket	ISI	Tool closed in		
80	2 3/4" in bucket	470	Pull tool free		
95	3" in bucket				
110	4" in bucket				

SURFACE FLOW SUMMARY

CHOKE SIZE (IN) SEPARATOR	FLUID TO SURFACE (MIN)	FLOWING TIME	MAXIMUM SURFACE PRESSURE	FINAL GAS RATE (MMCFD)	FINAL LIQUIDS RATE	FIELD GAS ANALYSIS	FIELD LIQUIDS ANALYSIS

FIELD DOWNHOLE PRESSURE DATA

		BOTTOM EMP	BOTTOM	TOP EMP	INTERNAL	TIMES
DEPTH	m	2403.8	2400.5	2382.9	2379.8	
INITIAL HYDROSTATIC	psig	3813.1	3803.7	3794.8	3880.9	219min
1ST - INITIAL FLOW	psig	158.2	186.3	126.1	210.4	
1ST - FINAL FLOW	psig	474.7	465.8	448.6	485.4	
1ST - CLOSED IN	psig	2773.0	2743.7	2754.1	2815.0	150min
2ND - INITIAL FLOW	psig	-	-	-	-	
2ND - FINAL FLOW	psig	-	-	-	-	
2ND - CLOSED IN	psig	-	-	-	-	
FINAL HYDROSTATIC	psig	3809.9	3803.7	3793.8	3880.9	
TEMPERATURE	F	211.37		208		

WELL: Gordon-1 **DST NO:** 2 **DATE:** 1st May, 1997

RECOVERY

REVERSE CIRCULATED	Y
PULLED	Y

RECOVERY: Pulled to shoe, then reverse circulated.
Recovered 1 bbl oil cut water, 15 bbls muddy water.
Flow rate calculated from recovery charts at 47 barrels per day.

SAMPLE DATA

GAS/CONDENSATE

SAMPLE NO	BOMB NO	TYPE	SOURCE	PRESS/TEMP
NIL				

OIL/CONDENSATE

SAMPLE NO	TYPE	SAMPLE	API	PP	POSITION
1	1 gal tin	Oil/water	-	23C	Top of recovery
2	1 gal tin	Oil/water	-	23C	Top of recovery

MAKEUP WATER/ FILTRATE

SAMPLE NO	TYPE	SAMPLE	RMF	TRACER	CL (PPM)
13	Glass phial	Mud filtrate	0.20 at 72F	-	25,000
14	Plastic bottle	Makeup water	>10 at 70F	-	Trace

WATER

SAMPLE NO	TYPE	RW	REMARKS
3 Muddy water	0 strokes	0.30 at 70F	Strokes measured from start of fluid recovery which was 49 into a recovery with a Total theoretical recovery Of 284 strokes ie. Total Strokes of fluid recovery Is 235 strokes.
4 Muddy water	31 strokes	0.28 at 70F	
5 Muddy water	67 strokes	0.30 at 70F	
6 Muddy water	104 strokes	0.28 at 70F	
7 Muddy water	141 strokes	0.22 at 70F	
8 Watery Mud	170 strokes	0.22 at 70F	
9 Watery mud	245 strokes	0.20 at 70F	
10 Dirty water	Top of sample chamber		
11 Dirty water	Bottom of sample chamber		
12 Dirty water	Bottom of sample chamber		

REMARKS:
IF 216 mins before packer seat failure. Tool closed in for 154 mins. Sample chamber closed prior to pulling tool free.

COMPANY Santos Limited STATE Victoria DATE 1.5.97

Well Name Gordon #1 KB Elv. 129.59 m ~~ft.~~ Ticket No. 055 DST No 2

Well Location PEP119 Onshore Otway Basin Vic GR Elv. 124.89 m ~~ft.~~ Formation Basement

Interval 2389.5 – 2461 m T.D. 2505 m ~~ft.~~ Net Pay ______ ft. Type of Test Conventional

API Gravity ______ W.S. ______ Average Porosity ______ By Pass Straddle

RECORDER DATA

Mins.					
PF ___ Rec. #	10339	#22199	# 522	# 22200	# 526
SI ___ Range	6325 lbs.	6900	5000	6250	5000
SF ___ Clock	24 hrs.	24	Battery	24	Battery
FS ___ Depth	2373.5 ~~ft.~~ m	2379.8	2382.9	2400.5	2403.8
		PSI	PSI	PSI	PSI
A. Init. Hyd.		3880.9	3794.8	3803.7	3813.1
B. First Flow	159.3	210.4	126.1	186.3	158.2
Final Flow	442.5	485.4	448.6	465.8	474.7
C. In. Shut-In		2815.0	2754.1	2743.7	2773.0
D. Init. Flow					
E. Final Flow					
F. Fl. Shut-in					
G. Final Hyd.		3880.9	3793.8	3803.7	3809.9
Inside/Outside	Above	(Inside	(Inside)	(Outside	(Outside

TIME DATA

PF Fr. 1710 to 2049 hr.

IS Fr. 2049 to 2322 hr.

SF Fr. ______ to ______ hr.

FS Fr. ______ to ______ hr.

T. STARTED 0930 hr.

T. ON BOTM. 1545 hr.

T. OPEN 1710 hr.

T. PULLED 2222 hr.

T. OUT ______ hr.

TOOL DATA

Tool Wt. 16.000 lbs.

Wt. Set on Packer 55.000 lbs.

Wt. Pulled Loose 135.000 lbs.

Initial Str. Wt. 135.000 lbs.

Unseated Str. Wt. ______ lbs.

Bot. Choke 3/4 in.

Hole Size 8½ in.

D. Col. I.D. 2 13/16 in.

D. Pipe I.D. 3.826 in.

D.C. Leng. 121.55 m ~~ft.~~

D.P. Leng. 2170.92 m ~~ft.~~

HWDP 83.38 m

MUD DATA

Mud type KCL PHPA

Weight 9.2

Vis. 39

W.L. 5.8

F.C. 1 in.

Mud Drop ______

RECOVERY

Total Fluid ______ ft. of ______ ft. in D.C. and ______ ft. in D.P.

1 bbl ~~ft.~~ of Oil Cut Water

15 Bbls ~~ft.~~ of Muddy Water

______ ft. of ______

______ ft. of ______

GAS RECOVERY MEASURED WITH

	Time Mins.	Orifice inches	Pressure PSI	H_2O inches	Rate mcf/d
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

SURFACE CHOKE SIZE: ______

Flow Rate Calculated 47 bbls/day

GENERAL DATA

Amt. of fill 1.5 m ~~ft.~~

Btm. H. Temp. 211.37 °F

Hole Cond. Fair

Packer Size 7½ x 30 in.

No. of Packers 4

Cushion Amt. 52 m ~~ft.~~

Cushion Type Water

Reversed Out Yes.

Tool Chased Yes. At 2046 hrs

Tester J. Silvester & C. McGuinn

Co. Rep. A Bradley / B Richardson.

Contractor OD & E

Rig No. 30

FLOW RATE CALCULATIONS ...

Reversed Out: YES
Tool Chased: YES. AT 2046 HRS
Tester: J. SILVESTER & C. McGUINN
Co. Rep.: A. BRADLEY/B RICHARDSO
Contractor: OD & E
Rig No.: 30

BLOW DESCRIPTION 1st FLOW: NIL AIR BLOW FOR 12 MINS THEN OCCASIONAL BUBBLES INCREASING TO WEAK BLOW AT END OF FLOW. (BUBBLE HOSE 6¾" INTO BUCKET)

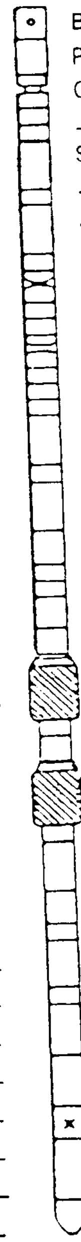
BLOW DESCRIPTION 2nd FLOW:

REMARKS: MUD DROPPED AT 2046. SHUT IN AT 2049

AFTER 2½ HR SHUT IN. ROTATING SHUT IN TOOL WAS TURNED THRU THE OPEN POSITION INTO THE CLOSED POSITION TO CLOSE THE SAMPLE CHAMBER PRIOR TO PULLING FREE AND P.O.O.H.

			LENGTH
TOTAL TOOL TO BOTTOM TOP PACKERS			17.29
INTERVAL TOOL			15.38
Bottom PACKER + ANCHOR			44.06
TOTAL TOOL			76.73
DRILL COLLAR ANCHOR IN INTERVAL			56.13
DRILL COLLARS ABOVE TOOLS	Stands	Total	121.55
DRILL PIPE ABOVE TOOLS	Stands	Total	2170.92
H. W. PIPE ABOVE TOOLS	Stands	Total	83.38
OTHER ABOVE TOOL		Total	
TOTAL DRILL COLLARS DRILL PIPE AND TOOLS			2508.71
TOTAL DEPTH			2505
TOTAL DRILL PIPE ABOVE K.B.			3.71m

REMARKS:



	LENGTH
BO SUB	
P.O. SUB	
C.O. SUB	
SHUT-IN TOOL	
HMV	
JARS	
SAFETY JOINT	
PACKER	
PACKER	
DEPTH	
STUBB	
ANCHOR	
BULLNOSE	
T.D.	

FILE

SANTOS LIMITED

WELL NAME: GORDON #1 **DST#2** **DATE:1/5/97**

FORMATION: BASEMENT **TESTER : J.SILVESTER**
C.Mc GUINN

TOTAL TOOL TO BOTTOM TOP PACKEF	17.29
TOOL INTERVAL	15.38
BOTTOM PACKER AND ANCHOR	44.06
TOTAL TOOL	76.73
DRILL COLLARS IN INTERVAL	56.13

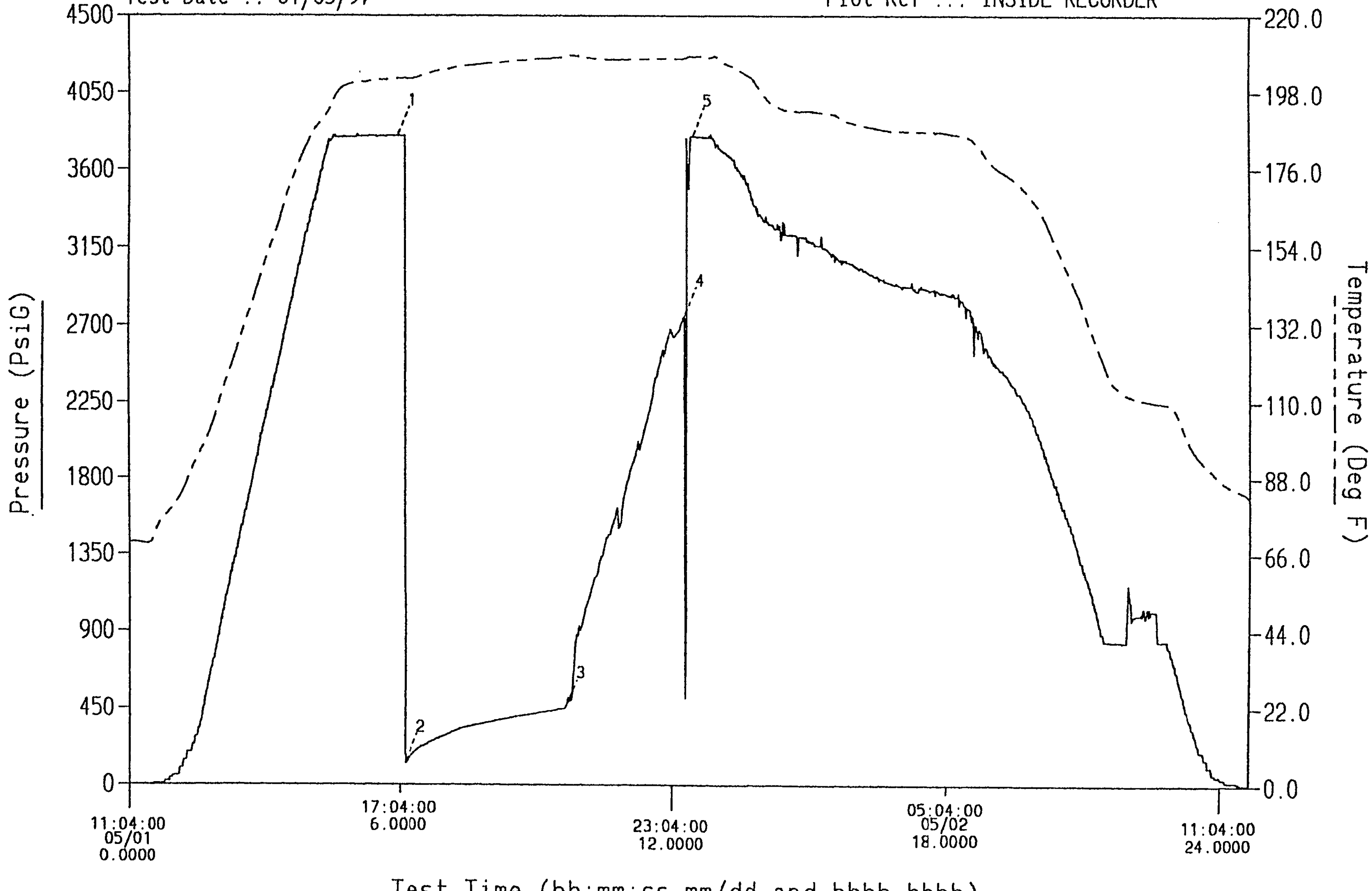
STICK UP	**3.71**		
DRILL PIPE	2170.92	-3.71	76 STDS+ 1 SG
H.W.DRILL PIPE	83.38	2167.21	3STDS
DRILL COLLARS	102.88	2250.59	3STDS+DBL
PUMP OUT SUB	0.41	2353.47	
DRILL COLLARS	9.28	2353.88	1 SGL
DROP BAR SUB	0.3	2363.16	
DRILL COLLARS	9.39	2363.46	1SGL
CROSS OVER	0.31	2372.85	
RECORDER CARRIER	1.52	2373.16	
SHUT-IN TOOL	1.71	2374.68	
SAMPLER	1.02	2376.39	
TRAVEL SUB	0.46	2377.41	
HYD TOOL	1.68	2377.87	
RECORDER CARRIER	1.52	2379.55	
RECORDER CARRIER EMP	1.83	2381.07	
JARS	1.93	2382.9	
HANGER SUB	0.31	2384.83	
SAFETY JOINT	0.66	2385.14	
PACKER	2.34	2385.8	
PACKER	1.29	2388.14	
DEPTH		**2389.43**	
STICK DOWN	1.05	2389.43	
PERF	9.43	2390.48	
RECEIVER SUB	0.31	2399.91	
RECORDER CARRIER	1.52	2400.22	
RECORDER CARRIER EMP	2.05	2401.74	
CROSS OVER	0.31	2403.79	
DRILL COLLARS	56.13	2404.1	2 STDS
CROSS OVER	0.31	2460.23	
STICK UP	0.4	2460.54	
DEPTH		**2460.94**	
PACKER	1.94	2460.94	
PACKER	2.34	2462.88	
CROSS OVER	0.31	2465.22	
DRILL PIPE	38.23	2465.53	
CROSS OVER	0.31	2503.76	
PERF	0.31	2504.07	
BULLNOSE	0.62	2504.38	
TOTAL DEPTH		**2505**	

AUSTRALIAN D.S.T. (AUSTRALASIA)

97/05/02
16:10:58

Company .... SANTOS LIMITED
Well .... GORDON #1 PEP119 ONSHORE OTWAY BASIN VICTORIA
Test Date .. 01/05/97

EMP S/N 080-522
File Ref ... G01DST2
Plot Ref ... INSIDE RECORDER

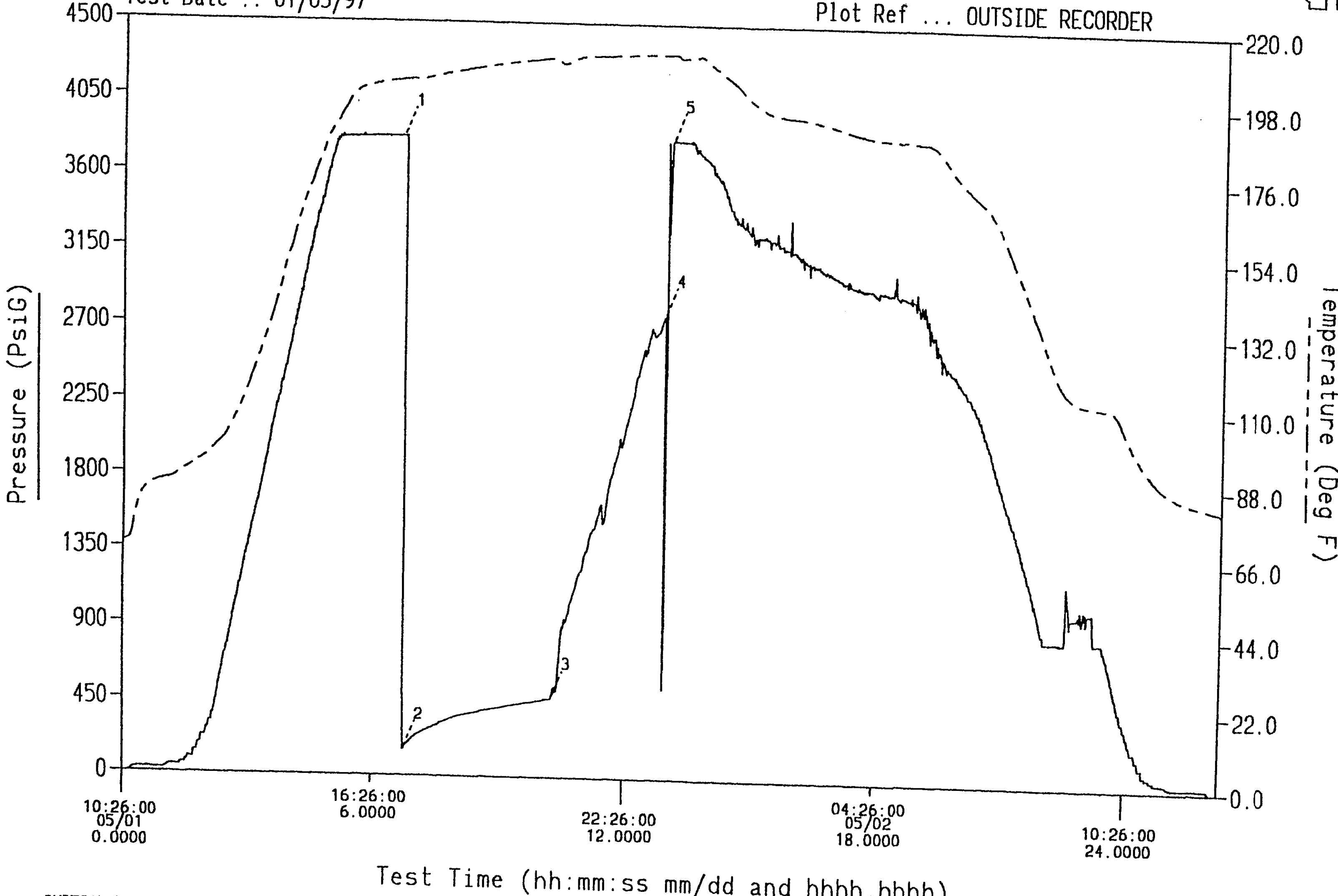


1 - INITIAL HYDROSTATIC; t=5.9344; P=3794.8
2 - INITIAL FLOW; t=6.1178; P=126.1
3 - FINAL FLOW; t=9.6344; P=448.6
4 - FINAL SHUTIN; t=12.2678; P=2754.1
5 - FINAL HYDROSTATIC; t=12.4511; P=3793.8

97/05/02
15:46:58

Company .... SANTOS LIMITED
Well .... GORDON #1 PEP119 ONSHORE OTWAY BASIN VICTORIA
Test Date .. 01/05/97

EMP S/N 080-526
File Ref ... GOR1DST2
Plot Ref ... OUTSIDE RECORDER



1 - INITIAL HYDROSTATIC; t=6.6511; P=3813.1
2 - INITIAL FLOW; t=6.7511; P=158.2
3 - FINAL FLOW; t=10.2678; P=474.7
4 - FINAL SHUTIN; t=12.9011; P=2773.0
5 - FINAL HYDROSTATIC; t=13.0511; P=3809.9

APPENDIX V: HYDROCARBON ANALYSIS

amdel

Amdel Limited
A.C.N. 008 127 802

Petroleum Services
PO Box 338
Torrensville Plaza SA 5031

Telephone: (08) 8416 5240
Facsimile: (08) 8234 2933

16 June, 1997

Santos Limited
GPO Box 2319
ADELAIDE SA 5001

Attention: A. Pietsch

REPORT LQ5871 - Part 1

CLIENT REFERENCE: C18994

WELL NAME/RE: Gordon-1, DST-1

MATERIAL: Crude Oil

WORK REQUIRED: Liquid Composition and Physical Tests

Please direct technical enquiries regarding this work to the signatory below under whose supervision the work was carried out. This report relates specifically to the sample or samples submitted for testing.

Brian L. Watson
Manager
Petroleum Services

PHYSICAL PROPERTIES

Client: SANTOS Ltd. Report: LQ5871

Sample: GORDON-1
DST-1
DATE : 30/04/97

Method		Description		Units	GORDON-1 DST-1
IP2	ASTM D611	Aniline Point		°C	-
IP143		Asphaltenes		% wt	-
IP364	ASTM D976	Calculated Cetane Index			-
IP219	ASTM D2500	Cloud Point		°C	-
IP17		Colour by Lovibond Tintometer			-
IP274	ASTM D2624	Conductivity of Fuels		pS/m	-
IP13	ASTM D189	Conradson C Residue on 10% Dis Residue		% wt	-
IP154	ASTM D130	Copper Corrosion			-
IP365	ASTM D4052	Density @ 15°C		g/mL	0.8341
IP21		Diesel Index			-
IP123	ASTM D86	Distillation			
			IBP	°C	-
			10% Rec	°C	-
			20% Rec	°C	-
			30% Rec	°C	-
			40% Rec	°C	-
			50% Rec	°C	-
			60% Rec	°C	-
			70% Rec	°C	-
			80% Rec	°C	-
			90% Rec	°C	-
			95% Rec	°C	-
			Decomposition Point	°C	-
			Residue	% vol	-
			Loss	% vol	-
		Evaporated @ 75°C, 105°C, 135°C		% vol	-
IP131	ASTM D381	Existent Gum by Evaporation		mg/100mL	-
IP170		Flash Point Abel Closed Cup		°C	-
IP34	ASTM D93	Flash Point Pensky Martens Closed Cup		°C	-
IP156	ASTM D1319	Fluorescent Indicator Absorption Aromatics		% vol	-
IP16	ASTM D2386	Freezing Point		°C	-
IP71	ASTM D445	Kinematic Viscosity @ 40°C		cSt	9.697
IP71	ASTM D445	Kinematic Viscosity @ 100°C		cSt	-
IP15	ASTM D97	Pour Point		°C	36
	ASTM D5185	Aluminium		mg/kg	-
	ASTM D5185	Vanadium		mg/kg	-
	ASTM D5185	Sodium		mg/kg	-
IP365	ASTM D4052	Specific Gravity @ 60/60°F			0.8345
IP354	ASTM D3242	Total Acidity in Aviation Fuel		mgKOH/g	-
IP216		Total Contaminant		mg/L	-
	ASTM D2270	Viscosity Index			-
IP289	ASTM D1094	Water Reaction	Interface Rating		-
			Separation		-
	ASTM D96	Water		% vol	-
	ASTM D96	Mud		% vol	99.0
IP160		API Gravity		degrees	38.06

\- = not determined

Approved Signatory: [signature]
Mohammad Massoumi

Date: 06/06/97 Registration No: 2013

This report relates specifically to the sample submitted for testing.

amdel

PETROLEUM SERVICES LIQUID ANALYSIS   Method GL-02-01

Client: SANTOS Ltd   Report # LQ5871

Sample: GORDON-1
DST-1
30/04/97

Boiling Point Range (Deg.C)	Component	Weight%	Mol%
-88.6	ETHANE	0.04	0.24
-42.1	PROPANE	0.18	0.77
-11.7	I-BUTANE	0.27	0.89
-0.5	N-BUTANE	0.49	1.62
27.9	I-PENTANE	0.99	2.63
36.1	N-PENTANE	0.69	1.83
36.1-68.9	HEXANE, C-6	2.56	5.68
80.0	BENZENE	0.03	0.07
68.9-98.3	HEPTANE,C-7	3.50	6.70
100.9	METHYLCYCLOHEXANE	1.69	3.29
110.6	TOLUENE	0.07	0.14
98.3-125.6	OCTANE, C-8	4.01	6.72
136.1-144.4	ETHYLBZ+XYLENES	0.66	1.19
125.6-150.6	C-9	3.79	5.66
150.6-173.9	C-10	4.62	6.23
173.9-196.1	C-11	4.23	5.19
196.1-215.0	C-12	3.73	4.19
215.0-235.0	C-13	4.31	4.47
235.0-252.2	C-14	4.16	4.02
252.2-270.6	C-15	5.13	4.63
270.6-287.8	C-16	3.85	3.26
287.8-302.8	C-17	3.36	2.68
302.8-317.2	C-18	4.27	3.21
317.2-330.0	C-19	3.97	2.83
330.0-344.4	C-20	3.01	2.04
344.4-357.2	C-21	3.69	2.38
357.2-369.4	C-22	3.49	2.15
369.4-380.0	C-23	3.52	2.08
380.0-391.1	C-24	3.99	2.26
391.1-401.7	C-25	3.80	2.07
401.7-412.2	C-26	3.37	1.76
412.2-422.2	C-27	3.39	1.71
>422.2	C-28+	11.14	5.41
	Total	100.00	100.00

(0.00 = LESS THAN 0.01%)

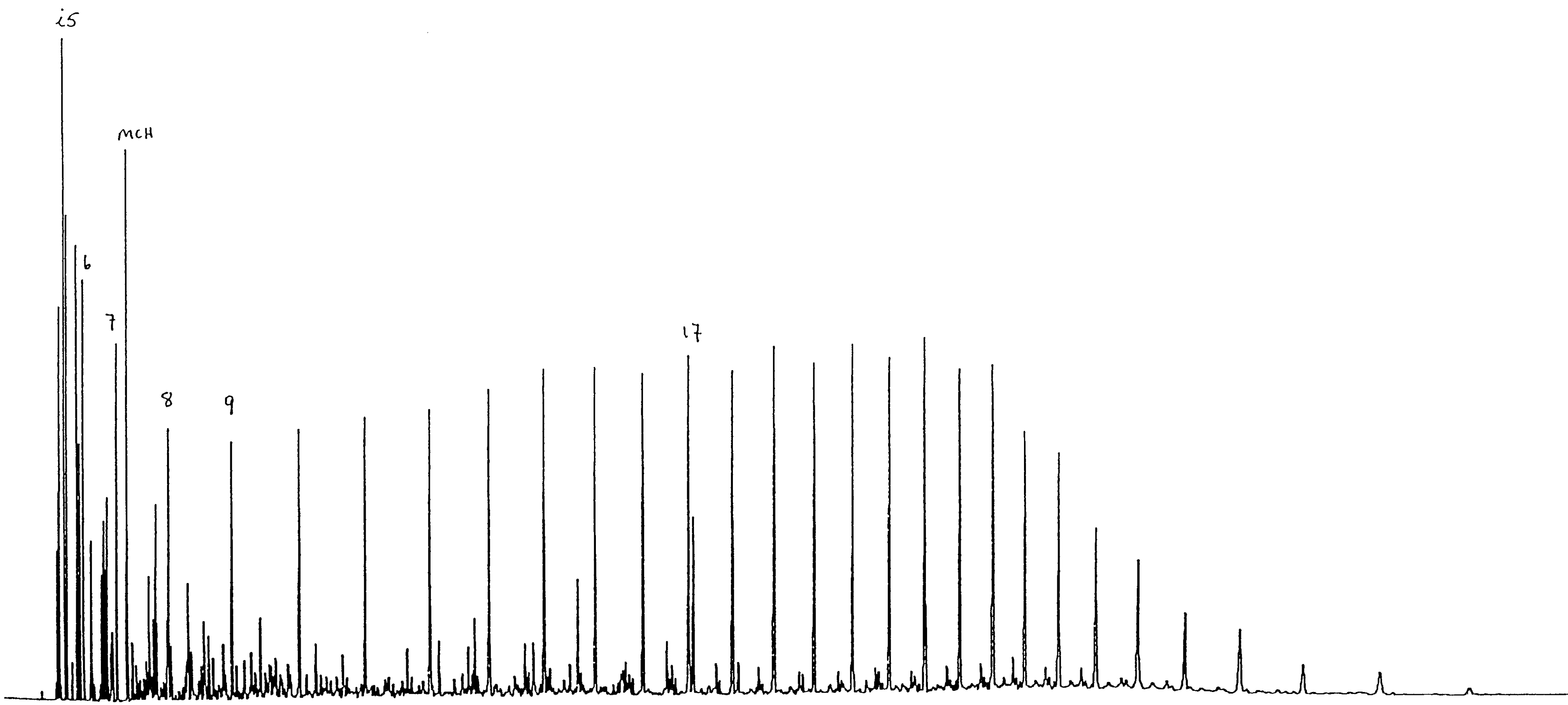
The above boiling point ranges refer to the normal paraffin hydrocarbon boiling in that range. Aromatics, branched hydrocarbons, naphthenes and olefins may have higher or lower carbon numbers but are grouped and reported according to their boiling points.

Average molecular weight of C-8 plus fraction (calc) = 220 g/mol

This report relates specifically to the sample submitted for analysis.

Approved Signatory: Diane Cass
Registration No: 2013
Date: 03-Jun-97

Gordon-1, DST-1
30/04/97



APPENDIX VI: WATER ANALYSIS

APPENDIX VI: WATER ANALYSIS

Three samples were forwarded to Amdel for analysis.

Sample	Origin	Type	Collection Point
1	DST 2	Water	Top of sample chamber
2	DST 2	Water	Bottom of sample chamber
3	DST 1	Mud Filtrate	Pits

amdel

Amdel Limited
A.C.N. 008 127 802

Petroleum Services
PO Box 338
Torrensville Plaza SA 5031

Telephone: (08) 8416 5240
Facsimile: (08) 8234 2933

25 July, 1997

Santos Limited
GPO Box 2319
ADELAIDE SA 5001

Attention: A. Pietsch

REPORT LQ6104

CLIENT REFERENCE: C24144

WELL NAME/RE: Gordon-1

MATERIAL: Water Samples

WORK REQUIRED: Water Analysis

Please direct technical enquiries regarding this work to the signatory below under whose supervision the work was carried out. This report relates specifically to the sample or samples submitted for testing.

Brian L. Watson
Manager
Petroleum Services

1. INTRODUCTION AND RESULTS

Two (2) samples were received for standard water analysis (WA-10-01). All analyses were performed according to APHA methods (19th Edition). Results are presented on the following pages.

amdel
Petroleum Services

TABLE 1 - WATER ANALYSIS **JOB NUMBER: LQ6104**

WELL / ID: Gordon-1,DST-2 (Sample 10)
SAMPLE TYPE: Water
SAMPLE POINT: Top Of Sample Chamber
DATE COLLECTED -
DATE RECEIVED: 24/07/97

FORMATION: -
INTERVAL: -
COLLECTED BY: Client

PROPERTIES:

pH (measured) = 6.85
Resistivity (Ohm.M @ 25°C) = 0.18
Electrical Conductivity (μS/cm @ 25°C) = 54300
Specific Gravity (S.G. @ 20°C) = na
Measured Total Dissolved Solids(Evap@180°C) mg/L = na
Measured Total Suspended Solids mg/L = na

CHEMICAL COMPOSITION

CATIONS		mg/L	meq/L	ANIONS		mg/L	meq/L
Ammonium	as NH_4	na	na	Bromide	as Br	na	na
Potassium	as K	9571	244.78	Chloride	as Cl	16998	478.82
Sodium	as Na	4749	206.57	Fluoride	as F	na	na
Barium	as Ba	na	na	Hydroxide	as OH	nd	nd
Calcium	as Ca	154	7.68	Nitrite	as NO_2	na	na
Iron	as Fe	na	na	Nitrate	as NO_3	nd	nd
Magnesium	as Mg	35	2.88	Sulphide	as S	na	na
Strontium	as Sr	na	na	Bicarbonate	as HCO_3	1013	16.61
Boron	as B	na	na	Carbonate	as CO_3	nd	nd
				Sulphite	as SO_3	na	na
				Sulphate	as SO_4	479	9.97
Total Cations		14509	461.92	**Total Anions**		18490	505.40

DERIVED PARAMETERS

a) Ion Balance (Diff*100/Sum) (%) = 4.49
b) Total Alkalinity (calc as $CaCO_3$) (mg/L) = 830
c) Total of Cations + Anions = 32999
(measured dissolved salts)

d) Theoretical Total dissolved salts = 34752
(From Electrical Conductivity)

QUALITY CONTROL COMMENTS

Item	Actual Value	Acceptance Criteria	Satisfactory? (Yes/No)
Ion Balance (%) =	4.49	5%	Yes
Undetected ions % =	5.04	10%	Yes
(from comparison of measured vs theoretical salts derived from measured conductivity)			
Expected pH range		< 8.3	Yes
% difference between measured total dissolved solids and calc total dissolved salts (from ionic comp) =	na	5%	na

na = not applicable
nd = not detected
is = insufficent sample

If No - what action is recommended by Amdel

amdel
Petroleum Services

TABLE 1 - WATER ANALYSIS

JOB NUMBER: LQ6104

WELL / ID: Gordon-1,DST-2 (Sample 12)
SAMPLE TYPE: Water
SAMPLE POINT: Bottom Of Sample Chamber
DATE COLLECTED -
DATE RECEIVED: 24/07/97

FORMATION: -
INTERVAL: -
COLLECTED BY: Client

PROPERTIES:

pH (measured) = 6.87
Resistivity (Ohm.M @ 25°C) = 0.18
Electrical Conductivity (μS/cm @ 25°C) = 54300
Specific Gravity (S.G. @ 20°C) = na
Measured Total Dissolved Solids(Evap@180°C) mg/L = na
Measured Total Suspended Solids mg/L = na

CHEMICAL COMPOSITION

CATIONS		mg/L	meq/L	ANIONS		mg/L	meq/L
Ammonium	as NH_4	na	na	Bromide	as Br	na	na
Potassium	as K	9848	251.87	Chloride	as Cl	17484	492.51
Sodium	as Na	5136	223.40	Fluoride	as F	na	na
Barium	as Ba	na	na	Hydroxide	as OH	nd	nd
Calcium	as Ca	166	8.28	Nitrite	as NO_2	na	na
Iron	as Fe	na	na	Nitrate	as NO_3	nd	nd
Magnesium	as Mg	39	3.21	Sulphide	as S	na	na
Strontium	as Sr	na	na	Bicarbonate	as HCO_3	1132	18.56
Boron	as B	na	na	Carbonate	as CO_3	nd	nd
				Sulphite	as SO_3	na	na
				Sulphate	as SO_4	482	10.04
Total Cations		15189	486.76	**Total Anions**		19098	521.10

DERIVED PARAMETERS

a) Ion Balance (Diff*100/Sum) (%) = 3.41
b) Total Alkalinity (calc as $CaCO_3$) (mg/L) = 928
c) Total of Cations + Anions = 34287
(measured dissolved salts)

d) Theoretical Total dissolved salts = 34752
(From Electrical Conductivity)

QUALITY CONTROL COMMENTS

Item	Actual Value	Acceptance Criteria	Satisfactory? (Yes/No)
Ion Balance (%) =	3.41	5%	Yes
Undetected ions % =	1.34	10%	Yes
(from comparison of measured vs theoretical salts derived from measured conductivity)			
Expected pH range		< 8.3	Yes
% difference between measured total dissolved solids and calc total dissolved salts (from ionic comp) =	na	5%	na

na = not applicable
nd = not detected
is = insufficent sample

If No - what action is recommended by Amdel

amdel

Amdel Limited
A.C.N. 008 127 802

Petroleum Services
PO Box 338
Torrensville Plaza SA 5031

Telephone: (08) 8416 5240
Facsimile: (08) 8234 2933

22 May, 1997

Santos Limited
GPO Box 2319
ADELAIDE SA 5001

Attention: A. Pietsch

REPORT LQ5871 - Part 2

CLIENT REFERENCE: C18994

WELL NAME/RE: Gordon-1

MATERIAL: Mud Filtrate

WORK REQUIRED: Water Analysis

Please direct technical enquiries regarding this work to the signatory below under whose supervision the work was carried out. This report relates specifically to the sample or samples submitted for testing.

Brian L. Watson
Manager
Petroleum Services

1. INTRODUCTION AND RESULTS

One (1) sample was received for standard water analysis (WA-10-01). All analyses were performed according to APHA methods (19th Edition). Results are presented on the following page.

amdel
Petroleum Services

TABLE 1 - WATER ANALYSIS

JOB NUMBER: **LQ5871 - Part 2**

WELL / ID: Gordon-1, DST-1 (Sample 3)
SAMPLE TYPE: Mud Filtrate
SAMPLE POINT: -
DATE COLLECTED: 29/04/97, 2400 h
DATE RECEIVED: 20/05/97

FORMATION: -
INTERVAL: -
COLLECTED BY: Client

PROPERTIES:

pH (measured) = 9.15
Resistivity (Ohm.M @ 25°C) = 0.14
Electrical Conductivity (µS/cm @ 25°C) = 74000
Specific Gravity (S.G. @ 20°C) = na
Measured Total Dissolved Solids(Evap@180°C) mg/L = na
Measured Total Suspended Solids mg L = na

CHEMICAL COMPOSITION

CATIONS		mg/L	meq/L	ANIONS		mg/L	meq/L
Ammonium	as NH_4	na	na	Bromide	as Br	na	na
Potassium	as K	25592	654.53	Chloride	as Cl	25646	722.42
Sodium	as Na	2566	111.61	Fluoride	as F	na	na
Barium	as Ba	na	na	Hydroxide	as OH	nd	nd
Calcium	as Ca	nd	nd	Nitrite	as NO_2	na	na
Iron	as Fe	na	na	Nitrate	as NO_3	nd	nd
Magnesium	as Mg	nd	nd	Sulphide	as S	na	na
Strontium	as Sr	na	na	Bicarbonate	as HCO_3	397	6.51
Boron	as B	na	na	Carbonate	as CO_3	195	6.50
				Sulphite	as SO_3	na	na
				Sulphate	as SO_4	932	19.40
Total Cations		28158	766.14	**Total Anions**		27170	754.84

DERIVED PARAMETERS

a) Ion Balance (Diff*100/Sum) (%) = 0.74
b) Total Alkalinity (calc as $CaCO_3$) (mg/L) = 651
c) Total of Cations + Anions = 55328
(measured dissolved salts)

d) Theoretical Result of Evaporation Test = 47360
(From Electrical Conductivity)
e) 0.6 x Concentration of Bicarbonate ion* = 238.2
f) Theoretical Total Dissolved Salts d) + e) = 47598.2

QUALITY CONTROL COMMENTS

Item	Actual Value	Acceptance Criteria	Satisfactory? (Yes/No)
Ion Balance (%) =	0.74	5%	Yes
Undetected ions % =	-16.24	10%	Yes
(from comparison of measured vs theoretical salts derived from measured conductivity)			
Expected pH range		< 8.3	Yes
% difference between measured total dissolved solids and calc total dissolved salts (from ionic comp) =	na	5%	na

na = not applicable
nd = not detected
is = insufficent sample

If No - what action is recommended by Amdel

APPENDIX VII : PALYNOLOGICAL ANALYSIS

APG Consultants

Report 640/05
SANTOS File 1997/20

Palynostratigraphy of SANTOS Gordon # 1 Otway Basin, Victoria

for
SANTOS Ltd

P.L. Price
30 October, 1997

APG Consultants PO Box 682, Kenmore, Qld 4069 Australia Phone +61 7 3878 1862 Fax +61 7 3878 1881

Gordon #1

Table of Contents

Gordon #1

Summary of Conclusions

Biostratigraphy

1035.0m - 1118.0m	APK321	lower Eumeralla Formation
1118.0m - 1184.0m	Unconformity	
1184.0m - 1275.0m	APK212	upper Laira Formation
1369.0m - 1510.0m	APK21	Laira Formation
1536.0m - 1761.0m	APK122	upper Pretty Hill Formation
1768.0m - 1882.0m	APK12	Pretty Hill Formation
2126.0m - 2356.25m	APK11	Casterton Formation

Depositional Environment

(from the perspective of the sampled sediments only)

1035.0m	Fluvial, overbank & billabong
1063.0m - 1118.0m	Fluvial to shallow lacustrine
1184.0m - 1882.0m	Fluvial, overbank & billabong; paralic coastal plain
2126.0m - 2205.0m	Lacustrine
2215.0m - 2325.0m	Fluvial, overbank & billabong
2337.5m - 2350.0m	Lacustrine
2356.25m	Peat Bog

Maturity

(from a cursory examination only)

1035.0m - 1118.0m	Immature Dry Gas Zone
1184.0m - 2356.25m	Early Mature; upper "Oil Window"

Hydrocarbon Source Potential

(based on a cursory examination and from the perspective of the sampled sediments only)

1035.0m - 1063.0m	Not a source rock
1105.0m	Moderate gas source with some oil potential
1118.0m - 1184.0m	Not a source rock
1211.0m	Moderate gas source with some oil potential
1275.0m - 1882.0	Not a source rock
2126.0m - 2160.0m	Meagre potential for mostly gas
2205.0m - 2325.0m	Moderate gas source with some oil potential
2337.0m - 2356.25m	Rich gas and oil source

Gordon #1

Introduction

Thirty sidewall core samples from Gordon #1 representing the lower part (Early Cretaceous to latest Jurassic) of the Otway Basin section sequence penetrated by Gordon #1 were submitted for palynological examination. The study was directed primarily towards establishing the biostratigraphic succession and age relationships of the sampled section.

The samples were examined in detail from unoxidized +20μm fraction, +20μm -80μm oxidised 1.65sg floats fraction and +80μm oxidised 1.65sg floats fraction to determine their palynomorph assemblage characteristics; species lists were compiled from these examinations. The deposition environment, palynofacies - organic facies characteristics and level of thermal alteration of the sampled section were established only in general terms; neither statistical assemblage data nor detail transmitted light - fluorescent examination of the unoxidized total organic fraction required for such studies was undertaken.

The biostratigraphic and broad qualitative palynofacies and environmental data for Gordon #1 are tabulated on the appended Palynostratigraphical Data Table; the text provides an overview of the results supplementing the sample by sample descriptions set out in the Data Tables. The distribution of all taxa identified is presented in the appended charts as alphabetical check lists and oldest occurrence lists for the Early Cretaceous to Late Jurassic palynofloras; the distribution of a subset including the index taxa is given on Page 12. Graphical presentations of palynomorph species diversity within various morphological and presumed phylogenetic groups are appended also.

Palynostratigraphy

Otway Basin Palynostratigraphic Nomenclature

The biostratigraphic nomenclature adopted for this study is based upon that of Price *et al*, 1985 and Filatoff & Price, 1988 developed primarily for the Surat and Eromanga Basin sections but adapted for the Otway Basin by Price, 1993, 1995, 1996. The units and their relationship to the nomenclatures of Morgan, 1985 and 1992, Dettmann, 1986 and Dettmann and Playford, 1969 and Morgan *et al*, 1995 are summarised on Page 9 and the relationship of the palynostratigraphic units to the Otway Basin lithostratigraphy is presented on Page 10. The lithostratigraphical conventions of Morton *et al* 1995 have been adopted (with slight modification). However, the evidence for an unconformity between the Casterton Formation and the lower Crayfish Sub Group (hence the exclusion of the Casterton Formation from the Otway Group) is questioned and there seems to be a need for revision and formal definition of the various lithofacies of the Pretty Hill Formation.

The units of Dettmann, 1963 and 1986, Dettmann and Playford, 1969, Morgan, 1985, 1988, 1989 and 1992 have been used widely in Otway Basin studies. These nomenclatures however, have been applied in different ways in the various well sections giving some confusion as to what is represented by a particular unit in any given study. Further, there is no consensus as to the precise order of appearance of certain of the Early Cretaceous index taxa in the Otway Basin as their introduction is blurred by the extent of the base Eumeralla unconformity, facies constraints and, possibly, floral migration.

Morgan *et a*l, 1995 reviewed and revised the Otway Basin palynostratigraphy as part of the comprehensive stratigraphic review of the western Otway Basin by MESA (Morton and Drexel Eds., 1995). Although the revised nomenclature of Morgan *et al*, 1995 gives some stability to the Otway Basin palynostratigraphy, the units of Price *et al*, 1985 and Price, 1993, 1995, 1996 have been used in this study in an attempt to increase the biostratigraphic resolution and to lessen any possible ambiguity with the earlier nomenclatures arising from differences of interpretation as to the order of entry of certain index taxa. The equivalent units of Morgan *et al*, 1995 however, are given also in the text to assist in relating the results of this study to the stratigraphic interpretation given in the 1995 MESA compilation; reference should be made to Page 9 if there is a need to relate an earlier nomenclature to this study.

In relating this study to earlier subdivisions, particular care should be taken with the *F. wonthaggiensis* Zone, the *C. hughesii* Zone and their stratigraphic relationship as their definition and application have varied from study to study (see Page 9). This variation in interpretation reflects their development as reliable Otway Basin palynostratigraphic units with additional data becoming available and relates also to regional differences between the Early Cretaceous palynofloras of the Otway Basin and other basins (see Dettmann, 1986 and Dettmann *et al*, 1991); certain of the "index" species prominent in areas such as the Surat/Eromanga Basins, are very scarce and sporadic in their distribution within the Otway Basin.

Dettmann, 1986 and Dettmann *et al*, 1991 also consider the time taken for migration of the parent plants from their point of evolution to the various basins as being discernible and resulted in different order of appearances for the index forms in these basins. The recent well section studies (eg Morgan, 1989, 1990, 1991, 1992, 1993, 1993; Price, 1993; Morgan *et al*, 1995) however, record a similar order of appearance of the index forms in the Otway Basin as Price *et al*, 1985 and Filatoff and Price, 1988 do for the Eromanga Basin. It is likely that facies and environmental variations (giving rise to more subtle and less systematic differences in the distribution of the index forms) are at least as significant as the migration processes suggested by Dettmann, 1986 and Dettmann *et al*, 1991. The application of the Early Cretaceous and Late Jurassic palynostratigraphic units in the Otway Basin, as in other basins, requires the recognition of the facies and preservational constraints upon the distribution of "marker" taxa in order to achieve a reliable biostratigraphic correlation; these factors are still not well understood. Thus, the down hole logging of the various "index" taxa must be tempered by palynofacies considerations before a palynostratigraphic unit is assigned.

The Laira Shale/Pretty Hill section palynofloras seem less diverse than the equivalent Cadna-Owie/Murta/Namur Eromanga Basin section perhaps reflecting a more restricted range of environments within the Otway Basin catchment. Ferns, although prominent, are less diverse in the Crayfish Sub Group than they are in the Eromanga Basin. For example the fern derived index group *Cicatricosisporites spp* is scarce in the APK2 and APK1 (*Foraminisporis wonthaggiensis* Zone and *C. australiensis* Zone) assemblages such that the distribution of *Cicatricosisporites australiensis* may be too sporadic in many of the Otway sections to be a reliable biostratigraphic marker; however, this seemed not to be a problem in Gordon #1. It is worth noting that, in certain facies within the Surat and Eromanga Basins, the distribution of *Cicatricosisporites* can be erratic also. Considerable reservation is held for the biostratigraphic utility of presumed bryophyte form *Foraminisporis wonthaggiensis* within APK21; although a reliable marker in the Surat and Eromanga Basins, it has proved to be too elusive to be of any value in the resolution of the Crayfish Sub Group.

The relationship of the oldest occurrence of *Pilosisporites notensis* to that of *Foraminisporis asymmetricus* and the *P. notensis* Zone - *F. wonthaggiensis* Zone boundary (base APK22) and the unconformable boundary between the Eumeralla and the Katnook Sandstone - Laira Formation is perhaps blurred by differing applications of the earlier nomenclatures. In Katnook 2 (which seems to represent the most complete section at the basal Eumeralla Formation - Katnook Sandstone - Laira Formation interval) Morgan, 1989 placed the base of the "lower *C. hughesii* Zone" near the base of the Eumeralla Formation at 1896.5m but records *F. asymmetricus* down to 1925m (within the Windermere Sandstone or the top of the Katnook Sandstone, depending upon interpretation) and *P. notensis* at 2103m (within the uppermost Laira Formation just below the Katnook Sandstone); both taxa are recorded from SWC samples and therefore, should not represent contamination.

Thus, while the MESA correlations (Morton *et al* 1995) show the *P. notensis* Zone to be equivalent to the "*C. hughesii* Zone", their extent is restricted to the base of the Eumeralla Formation. Such a correlation seems to overlook the distribution of *P. notensis* (and perhaps *F. asymmetricus*) in Katnook 2 which suggests that the *P. notensis* Zone (as with APK22) should extend into the Crayfish Group. In most other areas (eg Sawpit #1 and Zema #1), lithological and seismic evidence suggests there is an erosional break between the Eumeralla Formation and Crayfish Sub Group. Thus, it is acknowledged that the *P. notensis* Zone is restricted to the Eumeralla Formation in such section, but it is a result of the loss of the lower part of the *P. notensis* Zone (equivalent to the APK22) with the erosion the top of the Crayfish Sub Group.

A further complication to the resolution of the *C. hughesii* - *F. wonthaggiensis* Zone boundary is a difficulty in the identification of *Foraminisporis asymmetricus*. Certain of the morphological variants within an undescribed complex (including *"Verrucosasporites" "pseudoasymmetricus"* 1410) in APK32 to APJ6 palynofloras can resemble *F. asymmetricus* and may have blurred the distribution of *F. asymmetricus* with respect to the base Eumeralla Formation unconformity. Similarly, morphological variation within the *Cooksonites variabilis* complex may account for some of the records of *Coptospora paradoxa* in APK3 and APK2 associations.

The occurrence of *Microfasta evansii* as a means of distinguishing the upper Crayfish Sub Group from the Eumeralla Formation (Morgan *et al* 1995) can no longer be relied upon as this form has been recovered from a number of sections within the lower Eumeralla Formation both in the Robe Trough and the Penola Trough; its occurrence in APK3 associations is proving to be the rule rather than the exception in the western Victorian region where Gordon was drilled. The upwards extension of *M. evansii's* range into APK32 is consistent with its distribution in other basins and the APK32 occurrences in the Otway Basin seem too numerous and with too wide a geographic distribution for them to be dismissed as reworking from the underlying Crayfish Sub Group.

Reliance on the extinction (youngest occurrence) of *Cyclosporites hughesii* as an indication of the top of the *P. notensis* Zone - base of the *C. striatus* Zone boundary (base APK4) in the Otway Basin should be accepted with caution as *C. hughesii* is known to persist up through the *C. paradoxa* Zone (APK5) in the Eromanga Basin; the data from Digby #1 suggests that it may do the same in parts of the Otway Basin.

Notwithstanding these differences of interpretation, certain of the marker species have a regional consistency recognised by most students of the Otway and Eromanga palynology and these have been given greater emphasis in this study. These include the oldest (initial) occurrence of *Pilosisporites parvispinosus* (base APK321), *Pilosisporites notensis* (base APK22), *Dictyotosporites speciosus* (base APK122), *Cyclosporites hughesii* (base APK121).

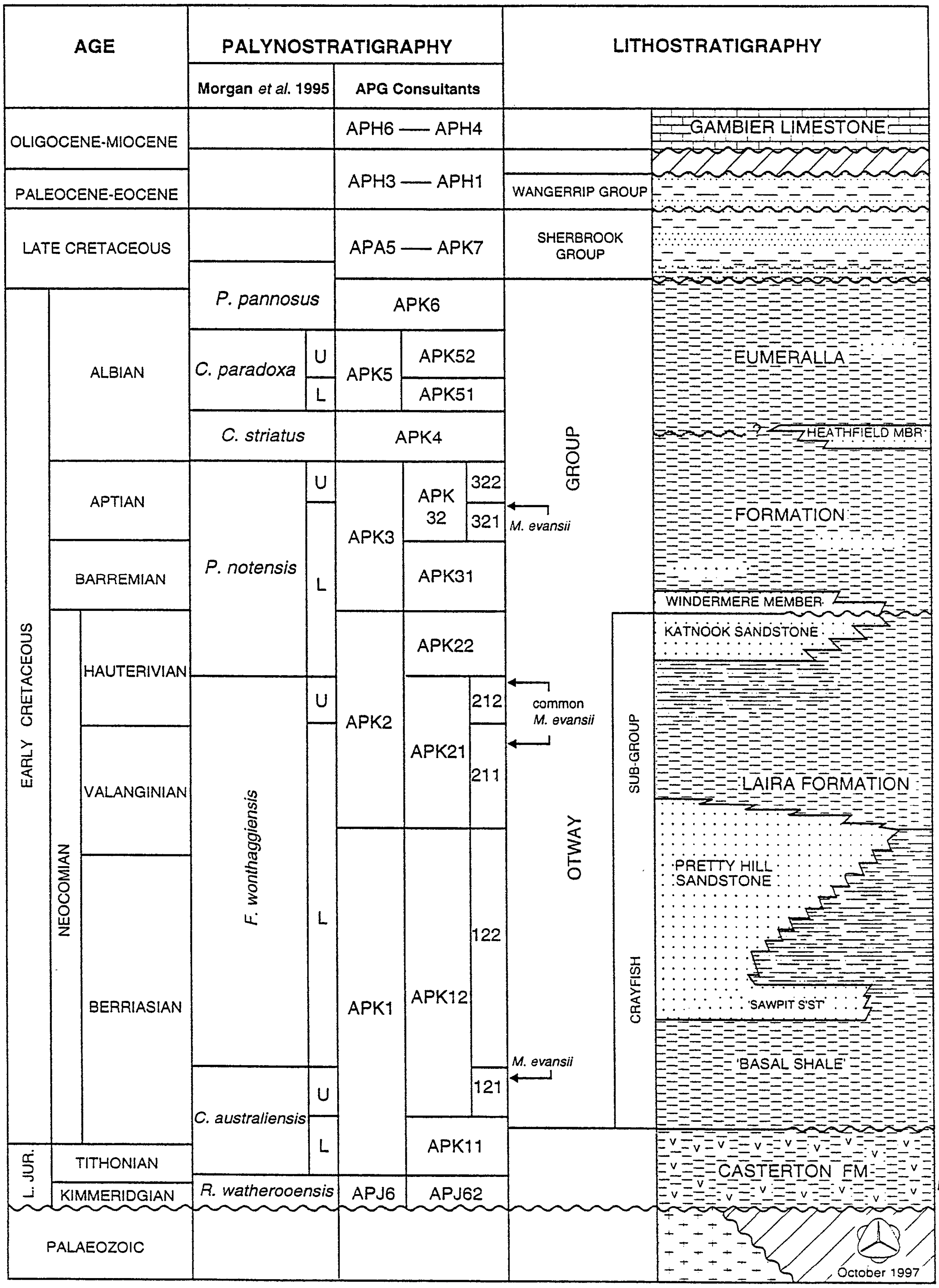
Of particular interest in terms of increased reliability of unit APK321 (uppermost part of the Lower *P. notensis Zone*) is the presence of the distinctive undescribed species *Foraminisporis wonthaggiensis "lunaris"* sp 1519 (?=*F. "reticulowonthaggiensis"* of Morgan). This form has a restricted range in both the Otway and Eromanga Basins being confined to about the introduction of *Pilosisporites parvispinosus* and not extending up the section much beyond the top of APK3. The presence of *F. wonthaggiensis "lunaris"* within APK321 (upper Lower *P. notensis* Zone) is a consistent feature of many Otway Basin wells and enhances the *P. parvispinosus* oldest occurrence datum as a reliable correlatable event.

OTWAY BASIN NOMENCLATURE

Dettman & Playford, 1969	Dettman 1986	Morgan, 1985 (Otway Basin Review)	Morgan, 1992 (Zema 1)	Morgan *et al*; 1995 (MESA Otway Volume)	APG Consultants			Events
								┘ *Phyllocladidites mawsonii*
A. distocarinatus	*A. distocarinatus*	*A. distocarinatus*	*A. distocarinatus*	*A. distocarinatus*	APK7			┐ *C. paradoxa*; ┘ *Crybelosporites* sp. cf. *C. brenner* (sp. 1255)
P. pannosus	*P. pannosus*	*P. pannosus*	*P. pannosus*	*P. pannosus*	APK6			┘ *Phimopollenites pannosus*
C. paradoxa	*C. paradoxa* U	*C. paradoxa* U	*C. paradoxa* U	*C. paradoxa* U	APK5	APK52		┘ *Pilosisporites grandis*
C. paradoxa	*C. paradoxa* L	*C. paradoxa* L	*C. paradoxa* L	*C. paradoxa* L	APK5	APK51		┘ *Coptospora paradoxa*
D. speciosus – *C. striatus*	*D. speciosus* – *C. striatus*	*C. striatus*	*C. striatus*	*C. striatus*	APK4			┘ *Crybelosporites striatus*
D. speciosus – *C. hughesii*	*D. speciosus* – *C. hughesii* Upper	*C. hughesii* U	*C. hughesii* U	*P. notensis* U	APK3	APK32	APK322	┐ *Cooksonites variabilis*; ┐ *M. evansii*
D. speciosus – *C. hughesii*	*D. speciosus* – *C. hughesii* Upper	*C. hughesii* U	*C. hughesii* U	*P. notensis* U	APK3	APK32	APK321	┘ *Pilosisporites parvispinosus*; ┘ *F. wonthaggiensis lunaris*
D. speciosus – *C. hughesii*	*D. speciosus* – *C. hughesii* Mid.	*C. hughesii* M	*C. hughesii* L	*P. notensis* L	APK3	APK31		┘ *Foraminisporis asymmetricus*
D. speciosus – *C. hughesii*	*D. speciosus* – *C. hughesii* Lower	*C. hughesii* M	*C. hughesii* L	*P. notensis* L	APK2	APK22		┘ *Pilosisporites notensis*; ┐ *M. evansii* consistent to frequent
D. speciosus – *C. hughesii* / *C. stylosus*	*D. speciosus* – *C. hughesii* / *C. stylosus*	*C. hughesii* L	*F. wonthaggiensis* U	*F. wonthaggiensis* U	APK2	APK21	APK212	┘ *Triporoletes reticulatus*; ┘ *M. evansii* consistent to frequent
D. speciosus – *C. hughesii* / *C. stylosus*	*D. speciosus* – *C. hughesii* / *C. stylosus*	*C. hughesii* L	*F. wonthaggiensis* L	*F. wonthaggiensis* L	APK2	APK21	APK211	┘ *Foraminisporis wonthaggiensis*
C. stylosus	*C. stylosus*	*C. hughesii* L	*F. wonthaggiensis* L	*F. wonthaggiensis* L	APK1	APK12	APK122	┘ *Dictyotosporites speciosus*; ┘ *M. evansii*
C. stylosus	*C. stylosus*	*C. stylosus*	*C. australiensis*	*C. australiensis* U	APK1	APK12	APK121	┘ *Cyclosporites hughesii*
C. stylosus	*C. stylosus*	*C. stylosus*	*C. australiensis*	*C. australiensis* L	APK1	APK11		┘ *Cicatricosisporites* spp.
C. stylosus	*C. stylosus*		*R. watherooensis*	*R. watherooensis*	APJ6	APJ62	APJ622	┘ *Foraminisporis dailyi*
C. stylosus	*C. stylosus*		*R. watherooensis*	*R. watherooensis*	APJ6	APJ62	APJ621	┘ *Ceratosporites equalis*
			R. watherooensis	*R. watherooensis*	APJ6	APJ61		┘ *Retitriletes watherooensis*
					APJ5			┘ *Murospora florida*

April 1996

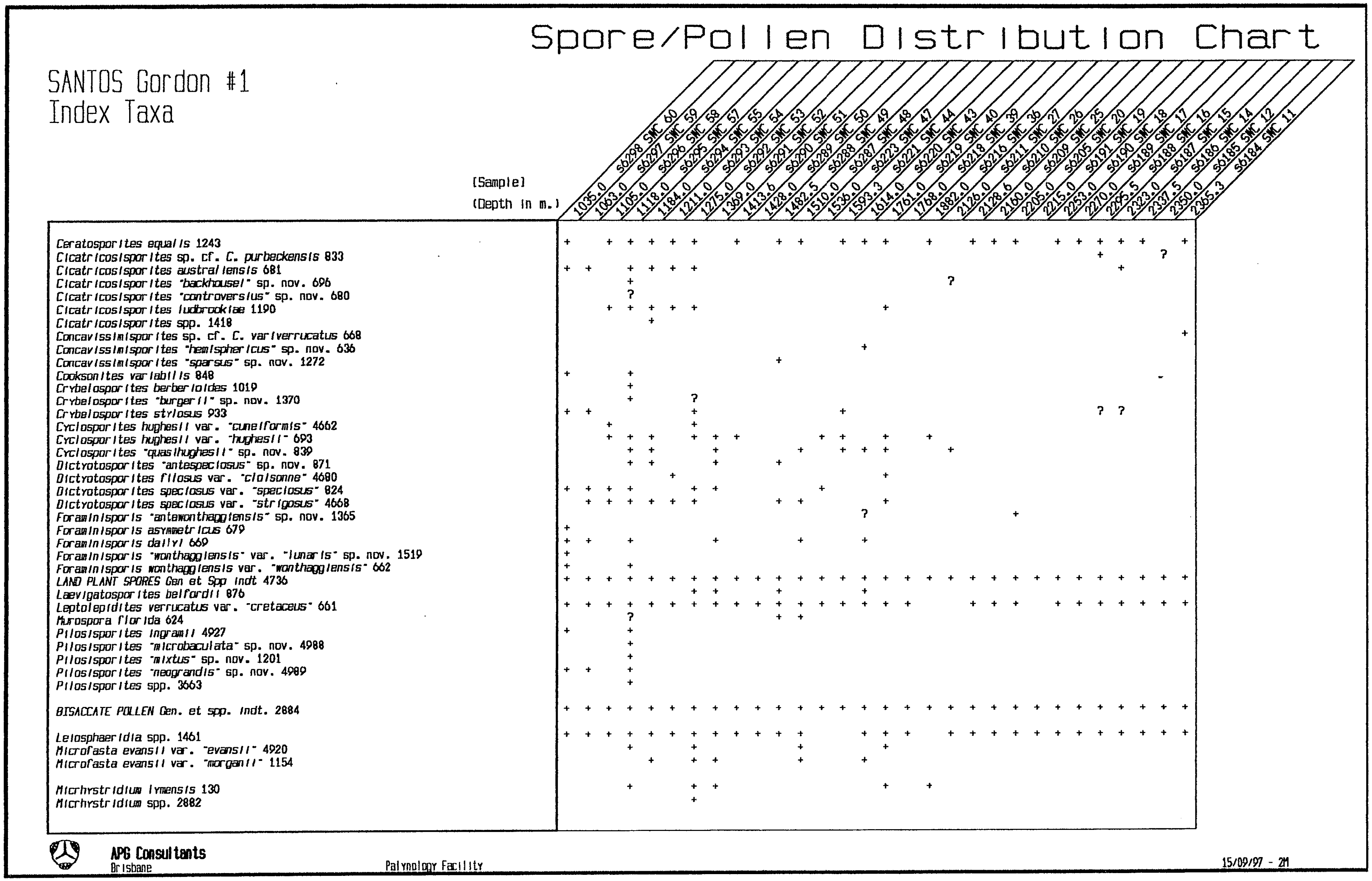
STRATIGRAPHIC NOMENCLATURE



Sample Reliability and Biostratigraphic Resolution

Although the section between 1000m and 2500m (spanning from within the lower part of the Eumeralla Formation to within the basement rocks at the well's total depth) was sampled by sixty SWC samples, only some thirty were suitable for palynological study. Most of the samples from within the Pretty Hill Sandstone section and the basal nine SWCs shot in the metamorphic basement were excluded. The basal Eumeralla unconformity was not closely defined because of the unsuitability of SWC56 1149.5m (a sandstone) and a degree of ambiguity of the assemblages from 1184.m and 1211m (unusual palynofacies). The sample coverage in the Laira was a little sparse given the difficulty in recovering diagnostic assemblages from this interval in other wells. Although covered by a high sample density, the Pretty Hill section included very few shale intervals and thus its age relations to the Laira Shale and the Casterton Formation in this part of the Otway Basin remains somewhat enigmatic. The Casterton was closely sampled giving a clearer understanding of the age of the Casterton than has been achieved in previous intersections.

The majority of the SWC samples were sufficiently coherent to permit removal of the drilling mud. Only in one or two samples was contamination observed and this was extremely minor and had no influence on the biostratigraphic interpretation or resolution. The preservation of the recovered palynofloras was better than is generally achieved in the Crayfish Sub Group or the Casterton Formation. The local intrusions that affected the preservation of the Digby #1 palynofloras seemed not to be an influence in the Gordon section.


Spore/Pollen Distribution Chart
SANTOS Gordon #1
Index Taxa
[Sample]
(Depth in m.)
1035.0 56298 SWC 60
1063.0 56297 SWC 59
1105.0 56296 SWC 58
1118.0 56295 SWC 57
1184.0 56294 SWC 55
1211.0 56293 SWC 54
1275.0 56292 SWC 53
1369.0 56291 SWC 52
1413.6 56290 SWC 51
1428.0 56289 SWC 50
1482.5 56288 SWC 49
1510.0 56287 SWC 48
1536.0 56223 SWC 47
1593.3 56221 SWC 44
1614.0 56220 SWC 43
1761.0 56219 SWC 40
1768.0 56218 SWC 39
1882.0 56216 SWC 36
2126.0 56211 SWC 27
2128.6 56210 SWC 26
2160.0 56209 SWC 25
2205.0 56205 SWC 20
2215.0 56191 SWC 19
2253.0 56190 SWC 18
2270.0 56189 SWC 17
2295.5 56188 SWC 16
2323.0 56187 SWC 15
2337.5 56186 SWC 14
2350.0 56185 SWC 12
2365.3 56184 SWC 11
Ceratosporites equalis 1243
Cicatricosisporites sp. cf. C. purbeckensis 833
Cicatricosisporites australiensis 681
Cicatricosisporites "backhousei" sp. nov. 696
Cicatricosisporites "controversius" sp. nov. 680
Cicatricosisporites ludbrookiae 1190
Cicatricosisporites spp. 1418
Concavissimisporites sp. cf. C. variverrucatus 668
Concavissimisporites "hemisphericus" sp. nov. 636
Concavissimisporites "sparsus" sp. nov. 1272
Cooksonites variabilis 848
Crybelosporites berberioides 1019
Crybelosporites "burgerii" sp. nov. 1370
Crybelosporites stylosus 933
Cyclosporites hughesii var. "cuneiformis" 4662
Cyclosporites hughesii var. "hughesii" 693
Cyclosporites "quasihughesii" sp. nov. 839
Dictyotosporites "antespeciosus" sp. nov. 871
Dictyotosporites filosus var. "cloisonne" 4680
Dictyotosporites speciosus var. "speciosus" 824
Dictyotosporites speciosus var. "strigosus" 4668
Foraminisporis "antewonthaggiensis" sp. nov. 1365
Foraminisporis asymmetricus 679
Foraminisporis dailyi 669
Foraminisporis "wonthaggiensis" var. "lunaris" sp. nov. 1519
Foraminisporis wonthaggiensis var. "wonthaggiensis" 662
LAND PLANT SPORES Gen et Spp indt 4736
Laevigatosporites belfordii 876
Leptolepidites verrucatus var. "cretaceus" 661
Murospora florida 624
Pilosisporites ingramii 4927
Pilosisporites "microbaculata" sp. nov. 4988
Pilosisporites "mixtus" sp. nov. 1201
Pilosisporites "neograndis" sp. nov. 4989
Pilosisporites spp. 3663
BISACCATE POLLEN Gen. et spp. indt. 2884
Leiosphaeridia spp. 1461
Microfasta evansii var. "evansii" 4920
Microfasta evansii var. "morganii" 1154
Micrhystridium lymensis 130
Micrhystridium spp. 2882
APG Consultants
Brisbane
Palynology Facility
15/09/97 - 2M

Gordon #1 Palynostratigraphy

Unit APK321; lower Eumeralla Formation

The diverse fern associations recovered from SWC60 1035m which included *Cooksonites variabilis, Pilosisporites notensis, P. parvispinosus, Cyclosporites hughesii* and *Foraminisporis wonthaggiensis "lunaris"*; *Cicatricosisporites spp* was a notable component. Such associations are typical of APK321 (lower *C. hughesii* Zone) palynofloras though out eastern Australia including those from the lower Eumeralla Formation. SWC 59 1063m yielded a more restricted palynoflora but the presence of *Pilosisporites notensis* and *P. parvispinosus* clearly indicate its affinities with APK32. The diverse palynoflora from SWC57 1118m is also assignable to APK321 although *Foraminisporis wonthaggiensis "lunaris"* was absent and *Pilosisporites* were represented by a slightly different suite including *P. ingramii* and with *P. parvispinosus* extremely rare; perhaps it is representative of the basal part of APK321.

The association recovered from SWC58 1105m was restricted, bearing some similarity with certain of the bland Crayfish Sub Group palynofloras from lower in the section; thus, apart form lying between typical APK321 palynofloras, there was little to associate it with APK3. The contrast in palynofacies in the lower Eumeralla Formation is a reflection of lithofacies variation and emphasis the need for close sampling of the section to achieve reliable biostratigraphic resolution of the mid Otway Group unconformity.

Unit APK21; Laira Formation

The restricted associations recovered from 1184m to 1510m included *Dictyotosporites speciosus* but lacked both the APK3 forms typical of the overlying Eumeralla assemblages and *Pilosisporites notensis*; as such, they are referable to Unit APK21 or APK122. The occurrence of *Microfasta evansii* through out the interval (deepest occurrence in notable numbers at 1510m) and the tentative identification of *Triporoletes reticulatus* at 1275m suggests APK212 may extend down to 1275m and

APK21 may be represented to 1510m; however, as is usually the case in APK211 palynofloras from the Otway Basin, the index taxa, *Foraminisporis wonthaggiensis*, was not recorded.

The upper two of the associations referred to APK21 (SWC55 1184m and SWC54 1211m) are not typical of APK21 and their assignment should be accepted with some caution. These associations were very restricted in species diversity, dominated by *Cyathidites spp* and included a prominence of *Cicatricosisporites spp.*. The abundance of this latter form is a little perplexing in that, although it extends down to the base of the succeeding palynostratigraphic unit (APK1), it has proved to be a scarce, intermittent component of the Crayfish Sub Group in other parts of the Otway Basin; however, in contrast, it is usually prominent in the overlying Eumeralla Formation palynofloras. Additionally, the prominence of the *Cooksonites variabilis* complex representatives perhaps is more in keeping with the lower Eumeralla than the upper Crayfish palynofloras. Thus, it is possible that these two associations may represent a restricted (specialised sand facies) Eumeralla Formation palynoflora similar to that at 1105m. Nevertheless, weight has been given to the absence of the APK3 index taxa in giving a tentative APK2 assignment and referring the section at 1184m and 1211m to the Crayfish Sub Group pending a regional review of the base Eumeralla - upper Crayfish interval in adjacent well sections.

Unit APK12; Pretty Hill Sandstone

The associations from the Pretty Hill Sandstone (1536m - 1882m) were mostly poorly reserved and restricted; *Cyclosporites hughesii* was present to the base of the sampled interval with *Dictyotosporites speciosus* extending to 1761m; *Microfasta evansii* occurred sporadically as only isolated specimens to 1761m. On the basis of these associations, the section to 1761m is considered to be no older than APK122 (lower *Foraminisporis wonthaggiensis* zone of Morgan *et al* 1995) with the section to 1882m being at least unit APK12 (upper *C. australiensis* zone). The possibility that the upper part may be as young as APK211 can not be excluded given the poor palynomorph recoveries from this section.

The lower Pretty Hill Sandstone (approximately 1885m to 2120m), in common with the adjacent well section, was a almost entirely arenaceous retuning no argillaceous samples suitable for palynological examination.

APK11; Casterton Formation

The high to moderate palynomorph yields recovered from the samples spanning 2126m to 2356.25m together with the prominence of inaperturate pollen and thin walled leiospheres, sparse restricted land plant spore component and restricted saccate pollen component (including few representatives of the trisaccate form *Microcachryidites antarcticus*) are characteristics of the Casterton Formation palynofacies. The diffuse translucent nature of the palynodebris is also characteristic although this aspect of the organic facies was not studied in any detail in this well. The sporadic occurrence of *Cicatricosisporites spp* almost to basement and the consistent occurrence of *Ceratosporites equalis* indicate the section is assignable to APK1 and the presence of *Cyclosporites sp cf C. hughesii* at 2126m suggests proximity to unit APK12 at the top of the Casterton section.

The bulk of the Casterton Formation has been suspected of being somewhat older than APK1, perhaps representative of the Late Jurassic unit APJ6. However, the present data (based upon the most comprehensively sampled section with some of the best preserved Casterton palynofloras recovered to date) suggests the "Jurassic" character of the Casterton assemblages (few *M. antarcticus,* prominence of inaperturate pollen, restricted land plant spore component sometimes with *Contignisporites spp* notable) is more a reflection of the specialised aquatic depositional environment associated with the initial rift development, than its previously supposed antiquity.

Correlation with Adjacent Well Sections

Introduction

In considering the palynostratigraphic data from Gordon #1, data from Digby #1 (Price, 1994), Bus Swamp #1 (Morgan, 1993; Alley, 1993; Burger, 1993), Mocamboro #11 (Morgan, 1991), Casterton #1 (Morgan,1986) and McEachern #1 (Morgan, 1990) were reviewed. It should be noted that no taxa distribution data were available for Casterton #1.

The data from Mocamboro #11 is a little ambiguous in that, if the available taxa distribution data is taken at face value, there is evidence of contamination (eg downward extension *Coptospora paradoxa* into APK2 associations) even though the study was based upon conventional cores and side wall cores. Alternatively, it is possible there is some confusion over the identity of certain *Cooksonites variabilis* complex representatives. If the former is accepted, then the down ward extension of APK3 to the top of the Pretty Hill sand may be attributed to contamination but if forms such as *C. paradoxa* and *Foraminisporis asymmetricus* have been confused with the some similarly constructed forms known to occur in APK2 associations (and thus, there is no contamination problem), then the downward extension of *P. notensis* (and hence APK22) would suggest the facies relation of the Laira and Pretty Hill and the position of the Eumeralla unconformity relative to the other wells seems to be rather complex. Clearly there is a need to reprocess core samples from Bus Swamp #1, Casterton #1 and Mocamboro #11 and reconsider the palynostratigraphy and lithostratigraphy of the basal Eumeralla - Crayfish Sud Group transition in all the bores from this region.

Basal Eumeralla Formation

The APK321 association from SWC60 1035mis representative of the lower Eumeralla Formation in other wells in the Otway Basin. However, from data in the Katnook region, it seems not to be the basal unit as APK31 is considered to be the oldest Eumeralla association with APK22 being representative of the uppermost Crayfish Sub Group were that unit is fully developed. Unit APK321 is perhaps the most consistent of the lower Eumeralla Formation and Crayfish Sub Group palynofloras in terms of its ease of recognition and lateral distribution in the lower Otway Basin sequence. In this respect, it seems to be a reliable datum from which to start to unravel the subtlety of the mid Otway Group unconformity.

APK321 is represented in Gordon #1 (1035m - 1118m) Digby #1 (1096m),Bus Swamp #1 (?830m - 862m) and Mocamboro #11 (?557.2m - 777.8m). However, the distinction of APK22 and APK31 from APK321 can be difficult to establish in individual samples as several of the index can be somewhat sporadic in their distribution particularly within the more arenaceous intervals. For example, in Gordon #1, had SWC57 not been available, the placement of the restricted association from SWC58 1105m would have been a problem as it may have been taken to be as old as APK122 or APK2. Clearly, a high sample density and a comparison of adjacent well sections assists in the amelioration of the vagaries of facies upon the biostratigraphic resolution.

In Gordon #1 and Digby #1 APK321 seems to be represented the basal of Eumeralla while in Casterton #1 and Mocamboro #11 it is possible the basal Eumeralla section is marginally older being represented by APK31. However, the possibility that the APK31 associations are an impoverished APK321 palynoflora can not be eliminated on present data. It is of interest to note that in Casterton #1, Digby #1 and Gordon #1 *Microfasta evansii* is present in the APK3 associations emphasising the problems of relying upon this taxon as an indicator species confined to the Crayfish Sub Group in the Otway Basin.

Upper Laira Shale

The downward extension of *Pilosisporites notensis* into Crayfish Sub Group-like palynofloras is difficult to interpret in individual sections; the dilemma lies in the discrimination of impoverished APK3 Eumeralla associations from older APK22

Laira palynofloras. Such associations have been recovered from Digby #1 (1220.8m), Bus Swamp #1 (886m), McEachern #1 (1048m) and possibly Mocamboro #11 (965m) and are difficult to reconcile with a consistent lithological correlation of the section lying between the base of APK321 and the top of the Pretty Hill sand. If an extensive APK22 section is accepted (suggesting that the top of the Crayfish Sub Group is young as that at Katnook #2 section) then the possibility of an unconformity within the Crayfish Sub Group should be considered particularly if the antiquity of the Pretty Hill Sandstone is accepted.

Lower Laira Shale - Pretty Hill Sandstone

With the possible exception of the of Mocamboro #11, the lower Laira Formation seems to be assignable to APK21, with APK122 (lower *F. wonthaggiensis* zone of Morgan *et al* 1995) extending into the upper half of the Pretty Hill sand. In some other parts of the western Otway Basin, unit APK21 extends into the upper part of the Pretty Hill sand facies. The base of the Crayfish sand facies in the Gordon region is probably APK121 (upper *C. australiensis* zone of Morgan *et al* 1995) although the lower Pretty Hill has relatively few palynologically productive samples.

Casterton Formation

The Casterton Formation palynofloras are distinctive reflecting specialised palynofacies of a lacustrine depositional setting. As a the association are restricted in species diversity, they have given an impression of greater antiquity in the poorly preserved assemblages from sections sampled prior to the drilling of Gordon #1. On present data it seems probable that the Casterton in western Victoria and eastern South Australia is confined to APK11 (with a slight possibly of being as young as APK121 at the top). In this region of the Otway, there is little palynological evidence of a depositional break between Casterton Formation and the Pretty Hill Sandstone, particularly when considered in conjunction with the Sawpit #1 data. On this basis, there seems to be little justification for excluding the Casterton Formation from either the Otway Group or the Crayfish Sub Group.

References

Alley, N.F., 1993. Palynological dating and correlation of samples from Bus Swamp #1, Otway Basin, South Australia. MESA Report Book 93/43.

Burger, D., 1993. Palynological examination of DEM Bus Swamp 1 stratigraphic hole, Otway Basin, Victoria. In Abele, C., Bus Swamp Report Appendix 9.

Dettmann, M.E. 1963. Upper Mesozoic microfloras from south eastern Australia. *Proceedings of the Royal Society of Victoria, 77*, 1-148.

Dettmann, M.E. 1986. Early Cretaceous palynofloras of subsurface strata correlative with the Koonwarra Fossil Bed, Victoria. *Memoirs of the Association of Australasian Palaeontologists, 3*, 79-110.

Dettmann, M.E. & Playford, G. 1969. Palynology of the Australian Cretaceous: a review. In *Stratigraphy and palaeontology: essays in honour of Dorothy Hill* (ed. Campbell, K.S.W.), pp 174-210 (Australian National University Press, Canberra).

Filatoff, J. and Price, P.L. 1988. A pteridacean spore lineage in the Australian Mesozoic. *Mem. Assoc. Australas. Palaeontol., 5*, 89-124.

Morgan, R. 1980. Palynostratigraphy of the Australian Early and Middle Cretaceous. *Mem. Geol. Surv. N.S.W., Palaeont., 18*, 1-153.

Morgan, R. 1985. Palynology review of 13 Otway Basin (South Australia) wells. *Unpublished Report.*

Morgan, R., 1986. Palynology data sheet on Casterton #1. Palynology Rept.

Morgan, R., 1990. Palynology of Gas and Fuel M[c]Eachern #1, Otway Basin, Australia. Morgan Palaeo Associates Report.

Morgan, R., 1991. Palynology of Victorian Geological Survey Mocamboro #11, Otway Basin, Victoria. Morgan Palaeo Associates Report.

Morgan, R., 1992. Palynology of Ultramar Zema 1, Otway Basin, South Australia. Morgan Palaeo Associates Report for SAGASCO/Ultramar

Morgan, R., 1993. Updated Palynology of Bus Swamp #1, Otway Basin, Victoria, Australia. Morgan Palaeo Associates Report.

Morgan, R., 1993. New palynology of the Laira Shale in the Katnook 1, 2 & 3, Banyula 1, Laira 1, Ladbroke Grove 1 and Kalangadoo 1 Otway Basin, South Australia. Morgan Palaeo Associates Report for SAGASCO

Morgan, R., Alley, N.F., Rowett, A.I. and White, M.R., 1995. Chapter 6; Biostratigraphy. **In** Morton and Drexel Eds *Petroleum Geology of South Australia. Volume 1: Otway Basin.* Mines and Energy South Australia **Report Book 95/12** 95-101

Morton, J.G.G., Alexander, E.M., Hill, A.J. & White, M.R., 1995. Lithostratigraphy and environments of deposition. **In** Morton and Drexel Eds *Petroleum Geology of South Australia. Volume 1: Otway Basin.* Mines and Energy South Australia **Report Book 95/12** 95-101

Morton, J.G.G. & Drexel, J.F., (Eds) 1995. *Petroleum Geology of South Australia. Volume 1: Otway Basin.* Mines and Energy South Australia **Report Book 95/12.**

Price, P.L., 1993. Palynostratigraphy, Organic Facies and Geochemistry of Sawpit #1, Otway Basin. APG Consultants Report 264/13 for Oil Company of Australia.

Price, P.L., 1996. A review of the Palynostratigraphy of some Otway Basin Wells. APG Consultants Report 264/24

Price, P.L. & Filatoff, J. 1990. Applications of morphological lineages in Australian palynostratigraphy. *Review of Palaeobotany and Palynology, 65*, 195-207.

Price, P.L., Filatoff, J., Williams, A.J., Pickering, S.A., & Wood, G.R. 1985. Late Palaeozoic and Mesozoic palynostratigraphical units. *CSR Oil and Gas Div., Palynol. Facil. Rep., 274/25*, 1-20 (Queensland Dep. Mines Open File Rep. 14012).

Appendix 1

Palynostratigraphical Data
Table

Gordon #1

APG Consultants, PO Box 682, Kenmore Q'ld 4069
Phone (07)3878 1862; Fax (07) 3878 1881

Sample Sample number Depth Preparation Num.	Palynostratigraphic Unit Age [*Index taxa*]	Inferred Lithostratigraphic Unit *(Log Interpreted Unit)*	*Inferred Deposition Environment* (Lithology)	Palynomorph Preservation	Palynomorph Yield (*Org. Yield*)	Palynomorph Diversity	Remarks
SWC 60 s6298 1035.0m P19271	APK321 Aptian [*P. notensis, P. parvispinosus, C. variabilis, F. asymmetricus F. wonthaggiensis lunaris, C. hughesii*]	Eumeralla Formation (*Eumeralla Formation*)	Fluvial Sandstone, f. grained; & Claystone, slightly carbonaceous.	Fair	High [*Extremely low*]	Moderate	Land plant spores and pollen dominant. Bisaccate and trisaccate pollen remnants prominent; inaperturate pollen notable. Fern spores prominent; mostly *Cyathidites*; *Pilosisporites* notable and diverse. Lycopod spores conspicuous; mostly *Retitriletes.* Bryophyte spores notable and moderately diverge; mostly *Cooksonites* and *Foraminisporis*. Algal forms scarce.
SWC 59 s6297 1063.0m P19270	APK32 possibly APK321 Aptian [*P. notensis, P. parvispinosus, D. speciosus*]	Eumeralla Formation (*Eumeralla Formation*)	Fluvial lacustrine Siltstone, mid grey, carbonaceous flecks	Fair [Thin; over oxidised]	Moderate [*Extremely low*]	Low	Land plant spores and pollen dominant. Bisaccate pollen remnants prominent; inaperturate pollen notable. Fern spores prominent but restricted in diversity; mostly *Cyathidites*. Lycopod spores conspicuous; mostly *Retitriletes.* Leiospheres and *S. reticulatus* notable
SWC 58 s6296 1105.0m P19269	APK122 - APK3 tentatively APK3 Aptian [*C. hughesii, D. speciosus*]	Eumeralla Formation (*Eumeralla Formation*)	Fluvial - swamp Siltstone, brownish black; carbonaceous laminations.	Poor [thin, corroded, fragmented]	High [*High*]	Low	Palynoflora dominated by saccate pollen, ?inaperturate pollen and cuticle remnants (mostly unidentifiable); cheirolepidiacean pollen prominent. Spores prominent but restricted in diversity; *Cyathidites minor, Retitriletes* and *Neoraistrickia* conspicuous. Almost no bryophyte spores present. Algal forms scarce. [The prominence of Cheirolepidiacean pollen, the scarcity of *Cicatricosisporites* and the absence of *Pilosisporites* and *Foraminisporis* are unusual in the Eumeralla]
SWC 57 s6295 1118.0m P19268	APK321 Aptian [*P. notensis, P. ingramii, P. parvispinosus, C. variabilis, C. hughesii, Crybelosporites 'burgeri' M. evansii*]	Eumeralla Formation (*Eumeralla Formation*)	Paralic lagoonal Siltstone, mid dark olive grey, carbonaceous flecks	Fair	Moderate [*Extremely low*]	High	Palynoflora dominated by land plant spores; diverse fern association; *Cyathidites* dominant (mostly *C. minor* but with *C. punctatus* conspicuous); *Osmundacidites* and *Cicatricosisporites* prominent; *Pilosisporites* notable. Bryophyte spores notable and relatively diverse; *Aequitriradites* and *Cooksonites - Verrucosisporites* conspicuous; *Foraminisporis* group and sphagnaceous forms scarce. Lycopod spores sparse but moderately diverse. Conifer pollen prominent; *M. antarcticus* conspicuous. Algal forms notable; mostly *Sigmopollis* and leiospheres; isolated *M. evansii* and spinose acritarch.

Sample Sample number Depth Preparation Num.	Palynostratigraphic Unit Age [*Index taxa*]	Inferred Lithostratigraphic Unit *(Log Interpreted Unit)*	*Inferred Deposition Environment* (Lithology)	Palynomorph Preservation	Palynomorph Yield (*Org. Yield*)	Palynomorph Diversity	Remarks
Between 1118m and1275m probably between 1118m and 1184m) (or a much less likely alternative of between 1211m and 1275m)		Eumeralla - Crayfish Group Unconformity					The tentative alternative position (between 1211 & 1275m) of the unconformity reflects a possible assignment of the associations at 1184m and 1211m to APP3 based on the rather uncertain assemblage criterion of *Cicatricosisporites australiensis* being a significant component of these associations; it is usually extremely rare in the Crayfish Sub Group. There are exceptions to this assemblage trend and acceptance of the lower (between 1211m and 1275m) position should be considered only if there were compelling lithostratigraphic or seismic evidence.
SWC 55 1184.0m s6294 P19239	APK122 - APK31 probably APK212 - APK22 tentatively APK212 Hauterivian [*D. speciosus, Crybelosporites berberioides, M. evansii*]	Laira Shale (*Laira Formation*)	Fluvial Claystone, mid grey, silty	Fair - poor	Moderate [*Very low*]	Low	Restricted (?specialised) fern spore dominated palynoflora; mostly *Cyathidites minor*; *Osmundacidites* prominent; *Cicatricosisporites* notable. Bryophyte spores notable; mostly *Aequitriradites*. Fragmented saccate pollen, inaperturate pollen and corroded cuticle sheets conspicuous. Few leiospheres and *S. reticulatus*
SWC 54 1211.0m s6293 P19240	APK122 - APK31 possibly APK212 - APK22 extremely tentatively APK212 Hauterivian [*D. speciosus, C. hughesii*]	Laira Shale (*Laira Formation*)	Fluvial - lacustrine Siltstone, dark grey - black, argillaceous in part.	Fair to fresh	Moderate [*High*]	Low	Restricted (?specialised) fern spore dominated palynoflora; mostly *Cyathidites minor*; *Osmundacidites* conspicuous; *Cicatricosisporites* notable. Saccate and inaperturate pollen scarce. Few aquatic forms; *S. reticulatus* and leiospheres notable
SWC 53 1275.0 s6292 P19241	APK21 - APK22 possibly APK21 tentatively APK212 Hauterivian [*D. speciosus, C. hughesii, M. florida, ?T. reticulatus, C. stylosus, M. evansii*]	Laira Shale (*Laira Formation*)	Paralic coastal plain Claystone, mid lt grey; v. fine sandstone in part	Fair	Moderate [*Very low*]	Moderate	Palynoflora dominated by land plant spores. Fragmented saccate pollen prominent; mostly bisaccate but trisaccate pollen notable. Cheirolepidiacean pollen notable. Fern pores subdominant but somewhat restricted in diversity; *Osmundacidites* prominent; *Cyathidites* conspicuous. Small leiospheres and *M. evansii* notable; few *S. reticulatus* and *Micrhystridium* present.
Between 1275m & 1369m	**94m sample gap**						

Sample Sample number Depth Preparation Num.	Palynostratigraphic Unit Age *[Index taxa]*	Inferred Lithostratigraphic Unit *(Log Interpreted Unit)*	*Inferred Deposition Environment* (Lithology)	Palynomorph Preservation	 Yield *(Org. Yield)*	 Diversity	Remarks
SWC 52 1369.0m s6291 P19242	APK122 - APK22 very tentatively APK21 Hauterivian - Valanginian *[D. speciosus, C. hughesii, F. dailyi M. evansii]*	Laira Formation *(Laira formation)*	Paralic coastal plain Mudstone, mid grey, arenaceous	Fair	Moderate *[Extremely low]*	Moderate	Palynoflora dominated by spores; mostly *Osmundacidites*; *Cyathidites* prominent; *C. equalis* and *L. verrucatus* notable; Saccate pollen remnants subdominant. Few leiospheres; few *M. evansii*; isolated *S. reticulatus* and *Micrhystridium* present.
SWC 51 1413.0m s6290 P19243	APK12 - APK2 very tentatively APK21 Hauterivian - Valanginian *[C. australiensis, C. equalis, C. hughesii]*	Crayfish Group *(Laira Formation)*	Fluvial Mudstone, dark grey, arenaceous in part.	Very poor strongly corroded	Very low *[Extremely low]*	Low	Sparse palynoflora of mostly spore remnants with only the more robust forms identifiable: *Cyathidites, Ceratosporites equalis, Leptolepidites major* and *Retitriletes* conspicuous. Fragmented saccate pollen remnants conspicuous.
SWC 50 1428.0m s6289 P19244	APJ2 - APK2 *[L. verrucatus]*	Crayfish Group *(Laira Formation)*	Fluvial - lacustrine Claystone, dark grey	Very poor thin, corroded	Very low *[Extremely low]*	Very low	Sparse palynoflora of mostly unidentifiable saccate pollen, cuticle and spore remnants: *Cyathidites, Leptolepidites verrucatus* and *Retitriletes* conspicuous. Small leiospheres notable
SWC 49 1482.5m s6288 P19245	APK122 - APK2 very tentatively APK211 Valanginian *[D. speciosus, C. equalis, L. belfordii Concavissimisporites "sparsus"]*	lower Laira Formation or upper Pretty Hill Sandstone *(Laira Formation)*	Fluvial Claystone, mid dark grey, arenaceous in part	Poor corroded	Moderate *[Extremely low]*	Moderate	Restricted palynoflora of mostly spores; *Cyathidites* and *Retitriletes* conspicuous; *L. belfordii, B. spectabilis, Klukisporites, Leptolepidites* and *Neoraistrickia* notable. Saccate pollen prominent; mostly unidentifiable remnants. Very few aquatic forms.
SWC 48 1510.0m s6287 P19246	APK122 - APK2 very tentatively APK211 Valanginian *[D. speciosus, C. hughesii, M. evansii*	lower Laira Formation or upper Pretty Hill Sandstone *(Laira Formation)*	Fluvial - lacustrine Mudstone, mid brown grey, grading to v. fine sandstone in part	Poor	Moderate *[Very low]*	Moderate	Palynoflora dominated by land plant spores; mostly *Retitriletes* and *Osmundacidites*; *Cyathidites*; *Leptolepidites* conspicuous. Bisaccate pollen prominent. Leiospheres and *M. evansii* notable

Sample Sample number Depth Preparation Num.	Palynostratigraphic Unit Age *[Index taxa]*	Inferred Lithostratigraphic Unit *(Log Interpreted Unit)*	*Inferred Deposition Environment* (Lithology)	Palynomorph: Preservation	Palynomorph: Yield *(Org. Yield)*	Palynomorph: Diversity	Remarks
SWC 47 1536.0m s6223 P19247	APK122 - APK2 tentatively APK122 Valanginian - Berriasian *[D. speciosus, C. hughesii, C. equalis. Converrucosisporites. cf C. exquisitus 631]*	lower Laira Formation or Pretty Hill Sandstone *(Pretty Hill Sandstone)*	Fluvial Claystone, dark grey	Fair	Moderate *[Low]*	Low	Palynoflora dominated by land plant spore and pollen remnants. Fern spores subdominant but restricted in diversity; mostly *Osmundacidites spp* with *Cyathidites minor, C. equalis* and *L. verrucatus* notable. Lycopod spores notable but relatively diverse; mostly *Retitriletes spp* . Bryophytes very scarce. Almost no aquatic forms noted. Cuticle sheets prominent in oxidised residue. [Absence of *F. wonthaggiensis* not reliable in view of low Bryophyte association]
SWC 46 1549.0m s6222 P19248	Not examined		Siltstone, mid dark grey				Very low organic recovery
SWC 44 1593.25m s6221 P19249	APK1 - APK2 tentatively APK1 Valanginian - Berriasian - Tithonian *[C. hughesii, C. stylosus]*	lower Laira Formation or Pretty Hill Sandstone *(Pretty Hill Sandstone)*	Fluvial Laminite, dark grey siltstone & v. fine off white sandstone,	Poor corroded fragmented	Moderate *[Low]*	Low	Palynoflora dominated by inaperturate pollen and saccate pollen. Fern spores conspicuous; mostly *Cyathidites* and *Osmundacidites.* Lycopod spores notable; mostly *Retitriletes* and *Kekryphalospora.* Bryophytes scarce. Almost no aquatic forms noted.
SWC 43 1614.0m s6220 P19250	APJ6 - APK2 tentatively APK12 Valanginian - Berriasian *[C. equalis, M. evansii, C. "hemisphericus"]*	lower Laira Formation or Pretty Hill Sandstone *(Pretty Hill Sandstone)*	Fluvial Siltstone, lt - mid grey brown; v. fine sandstone in part	Poor thin corroded	Low - Moderate *[Very low]*	Moderate	Palynoflora mostly unidentifiable saccate pollen, inaperturate pollen and cuticle remnants. Spores restricted in diversity; *Osmundacidites* prominent; *Cyathidites* and *Retitriletes* conspicuous. Few leiospheres; isolated *M. evansii.*
Between 1614m & 1761m	**147m sample gap**						Sandy section; additional samples from this section unlikely to yield definitive palynomorph associations.

Sample Sample number Depth Preparation Num.	**Palynostratigraphic Unit** Age *[Index taxa]*	**Inferred Lithostratigraphic Unit** *(Log Interpreted Unit)*	***Inferred Deposition Environment*** (Lithology)	**Palynomorph** Preservation	Yield *(Org. Yield)*	Diversity	**Remarks**
SWC 40 1761.0m s6219 P19251	APK122 - APK2 possibly APK122 Valanginian - Berriasian [*D. filosus cloisonne, D. speciosus, C. hughesii, C. ludbrookiae, M. evansii*]	lower Laira Formation or Pretty Hill Sandstone *(Pretty Hill Sandstone)*	Paralic coastal plain Siltstone, mid - mid dark grey	Poor thin corroded	Low [*Very low*]	Low	Palynoflora mostly unidentifiable spore, saccate pollen and cuticle remnants. Spores prominent but restricted in diversity; *Osmundacidites* and *Retitriletes* conspicuous. Algal forms scarce; isolated *M. evansii* and *Micrhystridium*.
SWC 39 1768.0m s6218 P19252	APJ2 - APK3 very tentatively APK1 Valanginian - Berriasian - Tithonian [*L. verrucatus,*]	lower Laira Formation or Pretty Hill Sandstone *(Pretty Hill Sandstone)*	Lacustrine Claystone, mid grey	Very poor	Very low [*Extremely low*]	Very low	Sparse restricted palynoflora of mostly unidentifiable fragmented saccate pollen and cuticle remnants. Spore fragments subdominant; *Cyathidites* and *Retitriletes* conspicuous. Algal forms notable; mostly leiospheres.
SWC 38 1810.0m s6217 P19253	Not examined	*(Pretty Hill Sandstone)*	Mudstone, mid greenish grey, sandstone in part; calcite veins				Very low organic recovery
SWC 36 1882.0m s6216 P19254	APK1 - APK2 possibly APK12 Valanginian - Berriasian [*C. equalis, C. hughesii*]	lower Laira Formation or Pretty Hill Sandstone *(Pretty Hill Sandstone)*	Paralic lagoonal Siltstone, mid - dark grey.	Very poor	Low [*Extremely low*]	Low	Palynoflora mostly unidentifiable saccate pollen and cuticle remnants; inaperturate pollen notable. Spores fragments subdominant but restricted in diversity; *Osmundacidites* conspicuous. Leiospheres notable, few *Micrhystridium*.
Between 1882m & 2126m	**244m sample gap**						Sandy section; additional samples from this section unlikely to yield definitive palynomorph associations.
SWC27 2126.0m s6211 P19255	APK1 very tentatively APK11 Berriasian - Tithonian [*C. 'quasihughesii', ?C. 'backhousei'*] [Casterton palynofacies]	Casterton Formation *(Casterton Formation)*	Fluvial Siltstone, dark grey	Very poor diffuse, corroded & fragmented	Moderate [*Very low*]	Very low	Palynoflora of mostly corroded and fragmented inaperturate pollen remnants (often difficult to distinguish from the abundant very fragmented and corroded cuticle remnants): very few forms could be identifies; few recognisable saccate pollen.. Spores scarce and very restricted in diversity. Few aquatic algal spores; almost entirely leiospheres.

Sample Sample number Depth Preparation Num.	Palynostratigraphic Unit Age [*Index taxa*]	Inferred Lithostratigraphic Unit *(Log Interpreted Unit)*	*Inferred Deposition Environment* (Lithology)	Palynomorph Preservation	 Yield *(Org. Yield)*	 Diversity	Remarks
SWC 26 2128.6m s6210 P19256	APJ62 - APK2 very tentatively APK11 Berriasian - Tithonian [*C. equalis*] [Casterton aquatic palynofacies]	Casterton Formation *(Casterton Formation)*	Lacustrine Siltstone, mid dark grey brown	Pollen: very poor diffuse, corroded & fragmented Acritarchs: fair - fresh.	High [*Low*]	Very low	Palynoflora of mostly strongly corroded inaperturate pollen fragments (mostly difficult to distinguish from the abundant very fragmented and corroded cuticle remnants); very few forms could be identifies. Few recognisable saccate pollen. Aquatic algal spores subdominant to co dominant; almost entirely thin and moderately thick walled leiospheres. Spores very scarce and extremely restricted in diversity.
SWC 25 2160.0m s6209 P19257	APJ62 - APK2 very tentatively APK11 Berriasian - Tithonian [*C. equalis*] [Casterton palynofacies]	Casterton Formation *(Casterton Formation)*	Fluvial Siltstone, mid grey brown; v. fine sandstone in part	Extremely poor diffuse, corroded & fragmented	Moderate [*Low*]	Very low	Palynoflora mostly strongly corroded thin ?inaperturate pollen, ?saccate pollen and cuticle fragments; few forms could br recognised. Spores extremely scarce and restricted in diversity. Isolated algal spores present.
SWC 20 2205.0m s6208 P19258	APJ6 - APK2 very tentatively APK11 Berriasian - Tithonian [*C. equalis*] [Casterton aquatic palynofacies]	Casterton Formation *(Casterton Formation)*	Lacustrine Siltstone, light mid brownish grey; off white sandstone laminations	Pollen: extrm. poor diffuse, corroded & fragmented Algae; fair	Moderate [*Moderate*]	Very low	Palynoflora mostly strongly corroded thin inaperturate pollen remnants together with cuticle fragments; very few forms could br identifies; few recognisable saccate pollen. Spores very scarce and restricted in diversity. Algal spores conspicuous; mostly thin walled and small leiospheres.
SWC 19 2215.0m s6191 P19259	APJ6 - APK2 very tentatively APK11 Berriasian - Tithonian [Casterton palynofacies]	Casterton Formation *(Casterton Formation)*	Fluvial Siltstone, mid brown; fine sandstone in part.	Extremely poor diffuse, corroded & fragmented	Moderate [*Moderate*]	Extremely low	Palynoflora mostly strongly corroded thin ?inaperturate pollen remnants and cuticle fragments; very few forms could br identifies; few recognisable saccate pollen. Spores extremely scarce and restricted in diversity. Few algal spores (mostly leiospheres) present.
SWC 18 2235.0m s6190 P19260	APJ62 - APK2 very tentatively APK11 Berriasian - Tithonian [*C. equalis*] [Casterton palynofacies	Casterton Formation *(Casterton Formation)*	Fluvial Siltstone, dark brown black, claystone in part	Very poor diffuse, corroded & fragmented	High [*Moderate*]	Low	Palynoflora dominated by corroded inaperturate pollen remnants and cuticle fragments; few recognisable saccate pollen. Spores sparse and restricted in diversity; *Osmundacidites* and *Ceratosporites equalis* notable; *Contignisporites cooksoniae* represented by several specimens. Algal spores very rare; mostly leiospheres.

Sample Sample number Depth Preparation Num.	Palynostratigraphic Unit Age [*Index taxa*]	Inferred Lithostratigraphic Unit *(Log Interpreted Unit)*	*Inferred Deposition Environment* (Lithology)	Palynomorph Preservation	Palynomorph Yield (*Org. Yield*)	Palynomorph Diversity	Remarks
SWC 17 2270.0m s6189 P19261	APJ62 - APK2 very tentatively APK11 Berriasian - Tithonian [*C. equalis, C. glebulentus*] [Casterton palynofacies]	Casterton Formation (*Casterton Formation*)	Fluvial Siltstone, dark brown black, claystone in part	Very poor diffuse, corroded & fragmented	Moderate [*Moderate*]	Very low	Palynoflora dominated by thin corroded inaperturate pollen remnants and cuticle fragments; few recognisable saccate pollen; pollen and cuticle remnants often difficult to distinguish. Spores very sparse and restricted in diversity; *Osmundacidites* and *Cyathidites* notable. Algal spores extremely rare; mostly leiospheres.
SWC 16 2295.5m s6188 P19262	APK1 tentatively APK11 Berriasian - Tithonian [*C. equalis, Cicatricosisporites purbeckensis*] [sand palynofacies]	Casterton Formation (*Casterton Formation*)	Fluvial Siltstone, mid dark brown	Very poor corroded fragmented	Low [*Low*]	Very low	Sparse palynoflora of mostly unidentifiable remnants. Land plant spores dominant; Lycopods (mostly *Retitriletes* and *Kekryphalospora*) prominent and moderately diverse. Few recognisable inaperturate or saccate pollen. Few possible algal spores.
SWC 15 2325.0m s6187 P19263	APK1 tentatively APK11 Berriasian - Tithonian [*C. australiensis, C. equalis*] [Casterton palynofacies	Casterton Formation (*Casterton Formation*)	Fluvial Siltstone, mid dark brown, carbonaceous	Very poor diffuse, stained corroded & fragmented	Moderate [*Moderate*]	Very low	Palynoflora dominated by thin strongly corroded ?inaperturate pollen remnants and cuticle fragments; few recognisable saccate pollen; pollen and cuticle remnants often difficult to distinguish. Spores very sparse and restricted in diversity; *Retitriletes* and *Kekryphalospora* notable. Algal spores extremely rare; mostly leiospheres.
SWC 14 2337.5m s6186 P19264	APJ62 - APK1 tentatively APK11 Berriasian - Tithonian - Kimmeridgian [*C. equalis*] [Casterton palynofacies]	Casterton Formation (*Casterton Formation*)	Lacustrine Siltstone mid dark brown, carbonaceous	Ext poor diffuse, stained corroded & fragmented	Very high [*Very high*]	Extremely low	Palynoflora consists almost entirely of thin strongly corroded inaperturate pollen, thin ?leiospheres and cuticle tissue fragments; few forms could be identified. Some humic staining but less than the section 2295 - 2325m. Land plant spores extremely scarce.

Sample Sample number Depth Preparation Num.	Palynostratigraphic Unit Age [Index taxa]	Inferred Lithostratigraphic Unit *(Log Interpreted Unit)*	*Inferred Deposition Environment* (Lithology)	Palynomorph Preservation	 Yield *(Org. Yield)*	 Diversity	Remarks
SWC 12 2350.0m s6185 P19265	APJ6 - APK1 tentatively APK11 Berriasian - Tithonian [*?C. purbeckensis, ?R. watherooensis*] [Casterton oil shale aquatic palynofacies]	Casterton Formation *(Casterton Formation)*	Lacustrine Siltstone, dark brownish grey, carbonaceous	Pollen: fair - poor Spores: very poor Algae; fair - fresh	Very high *[Very high]*	Very low	Palynoflora dominated by somewhat corroded but mostly entire inaperturate pollen; bisaccate pollen notable. Cuticle tissue highly corroded, diffuse and finely divided; less humic staining than at 2295 - 2337.5m. Land plant spores extremely scarce and restricted in diversity. Algal spores prominent; mostly thin walled and small leiospheres including *Granodiscus minutia.* [Palynoflora seem similar to the section from 2105m - 2270m but Inaperturate pollen better preserved; spore association differs in that *C. equalis* absent but doubt that it is significantly older. Very few forms free of the granular-fibrous matrix in unoxidized +20μm fraction]
SWC 11 2356.25m s6184 P19266	APJ62 - APK1 very tentatively APK11 Berriasian - Tithonian - Kimmeridgian [*C. equalis*] [Casterton Coal palynofacies]	Casterton Formation *(Casterton Formation)*	Peat Bog Coal, black sub vitreous	Poor	Moderate *[Very high]*	Low	Fern spores dominate but restricted in diversity; mostly *Osmundacidites*; *Klukisporites* notable. Inaperturate pollen remnants conspicuous. Few bisaccate pollen. Lycopod spores scarce; *Dictyotosporites* notable. Isolated algal spores. [Palynomorphs thin with humic staining; *cf* assemblage above. Few palynomorphs free of humic matrix in +20μm unoxidized fraction]

APG CONSULTANTS

Appendix 2

Species Distribution Lists

Gordon #1

APG Consultants, PO Box 682, Kenmore Q'ld 4069
Phone (07)3878 1862; Fax (07) 3878 1881

PE905777

This is an enclosure indicator page.
The enclosure PE905777 is enclosed within the container PE905781 at this location in this document.

The enclosure PE905777 has the following characteristics:

ITEM_BARCODE = PE905777
CONTAINER_BARCODE = PE905781
NAME = Spore/Pollen Distribution Chart showing Species Check List
BASIN = OTWAY BASIN
PERMIT = PEP/119
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Pollen Distribution Chart showing Species Check List (from WCR) for Gordon-1
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W1191
WELL_NAME = GORDON-1
CONTRACTOR =
CLIENT_OP_CO =

(Inserted by DNRE - Vic Govt Mines Dept)

PE905774

This is an enclosure indicator page.
The enclosure PE905774 is enclosed within the container PE905781 at this location in this document.

The enclosure PE905774 has the following characteristics:

ITEM_BARCODE = PE905774
CONTAINER_BARCODE = PE905781
NAME = Spore/Pollen Distribution Chart showing Oldest Occurence Species List
BASIN = OTWAY BASIN
PERMIT = PEP/119
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Pollen Distribution Chart showing Oldest Occurence Species List (from WCR) for Gordon-1
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W1191
WELL_NAME = GORDON-1
CONTRACTOR =
CLIENT_OP_CO =

(Inserted by DNRE - Vic Govt Mines Dept)

Appendix 3

Group Diversity Charts

Gordon #1

APG Consultants, PO Box 682, Kenmore Q'ld 4069
Phone (07)3878 1862; Fax (07) 3878 1881

PE905775

This is an enclosure indicator page.
The enclosure PE905775 is enclosed within the container PE905781 at this location in this document.

The enclosure PE905775 has the following characteristics:

ITEM_BARCODE = PE905775
CONTAINER_BARCODE = PE905781
NAME = Spore/Pollen Distribution Chart showing Morpho-Group Diversity
BASIN = OTWAY BASIN
PERMIT = PEP/119
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Pollen Distribution Chart showing Morpho-Group Diversity (from WCR) for Gordon-1
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W1191
WELL_NAME = GORDON-1
CONTRACTOR =
CLIENT_OP_CO =

(Inserted by DNRE - Vic Govt Mines Dept)

PE905776

This is an enclosure indicator page.
The enclosure PE905776 is enclosed within the container PE905781 at this location in this document.

The enclosure PE905776 has the following characteristics:

```
     ITEM_BARCODE = PE905776
CONTAINER_BARCODE = PE905781
             NAME = Spore/Pollen Distribution Chart showing
                    Phylo-Group Diversity
            BASIN = OTWAY BASIN
           PERMIT = PEP/119
             TYPE = WELL
          SUBTYPE = DIAGRAM
      DESCRIPTION = Pollen Distribution Chart showing
                    Phylo-Group Diversity (from WCR) for
                    Gordon-1
          REMARKS =
     DATE_CREATED =
    DATE_RECEIVED =
             W_NO = W1191
        WELL_NAME = GORDON-1
       CONTRACTOR =
     CLIENT_OP_CO =
```

(Inserted by DNRE - Vic Govt Mines Dept)

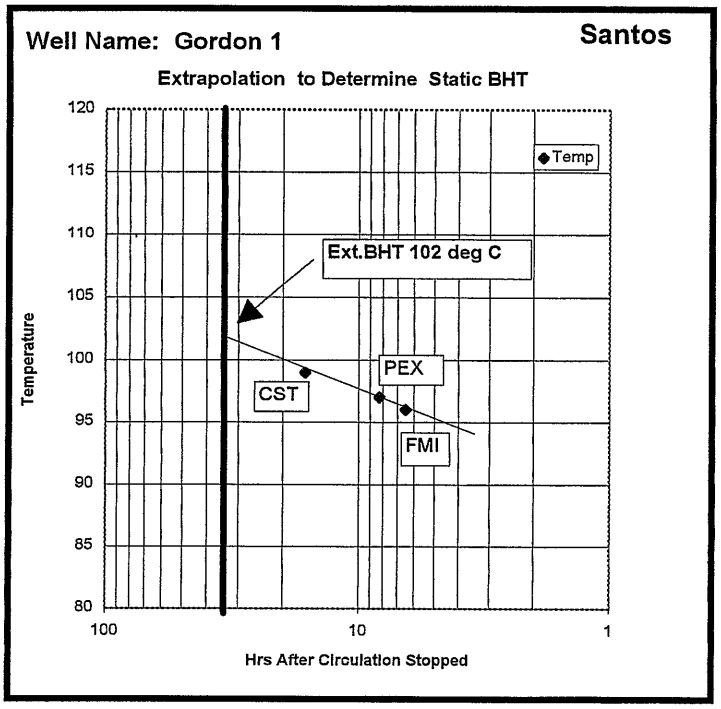
APPENDIX VIII: GEOTHERMAL GRADIENT

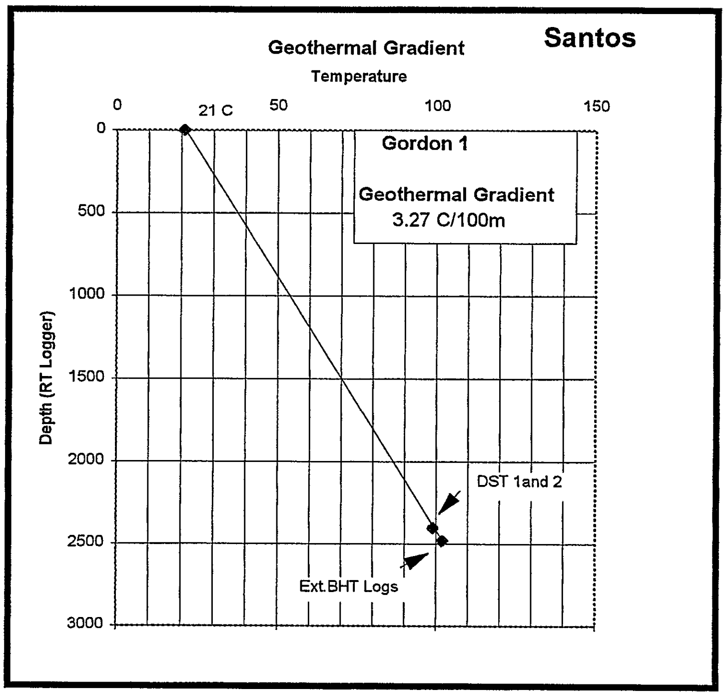
Information for the geothermal gradient may be taken from the following data:-

97 °C at 2499m after 8.2 hours from Run 1, Suite 1, with the SP, GR, Resisivity, Sonic etc.

99 °C at 2485m after 16.3 hours from Run 2, Suite 1, with the sidewall cores.

96 °C at 2498m after 6.5 hours, from Run 3, with the FMI log, following last wiper trip.


Well Name: Gordon 1
Santos
Extrapolation to Determine Static BHT
Temp
Ext.BHT 102 deg C
CST
PEX
FMI
Temperature
120
115
110
105
100
95
90
85
80
100
10
1
Hrs After Circulation Stopped


Geothermal Gradient
Santos
Temperature
0
21 C
50
100
150
Gordon 1
Geothermal Gradient
3.27 C/100m
Depth (RT Logger)
0
500
1000
1500
2000
2500
3000
DST 1and 2
Ext.BHT Logs

APPENDIX IX: WELL LOCATION SURVEY

Santos Ltd
A.C.N. 007 550 923
39 Grenfell Street
Adelaide SA 5000
GPO Box 2319
Adelaide SA 5001
Telephone: (08) 218 5111
Geology Operations
Facsimile: (08) 224 7962
Telephone: (08) 224 7957

Santos

Facsimile

To: Cultus **Attn:** Mr. V. Dauzacker

CC: Department of Natural Resources & Environment - Petroleum Branch **Attn:** Mr. K. Mehin

From: A.P. Pietsch

Date: 15th April, 1997

Subject: *Gordon 1*

No of pages: (incl. this one) 1

(*IF INCOMPLETE TRANSMISSION RECEIVED PLEASE PHONE: (08) 224 7967*)

Ground Elevation and Co-ordinates after lease preparation are as follows:

Ground Level:	124.89m	141°	17'	38.4" E
Rotary Table:	129.59m	37°	35'	14.5" S

Please amend your records accordingly.

A.P. PIETSCH
CHIEF OPERATIONS GEOLOGIST

APP:ap

cc: A. McGee
Ops Geologist
Wellsite Geologist
Peter Davidson

APPENDIX X: DRILLING, CASING, AND ABANDONMENT SUMMARY

Note: This appendix will be forwarded when it becomes available.

APPENDIX XI: RIG SPECIFICATIONS

ODE RIG #30 SPECIFICATIONS

CONTRACTOR'S EQUIPMENT

CONTRACTOR'S RIG	:	Rig #30 - rated to 11,000 ft. with 4.1/2," drill pipe
DRAWWORKS	:	Ideco H725 Hydrair, driven by EMD D79 electric motor. Maximum input 900 hp Parmac V-80 Hydromatic brake. Transmission - 3 speed transmission with Fawick 40CB525 air clutch.
ENGINES	:	Four (4) Caterpillar Model 3412 PCTA diesel engines.
SUBSTRUCTURE	:	One piece substructure 14' high x 13'6" wide x 50' long with 12' BOP clearance. Setback area loading:250,000 lbs Casing area loading:275,000 lbs
MAST	:	Dreco Model #: M12713-510 Floor Mounted Cantilever Mast designed in accordance with API Specification 4E Drilling & Well Servicing Structures. Hook load Gross Nominal Capacity - 510,000 lbs with:- 10 lines strung-365,000 lbs 8 lines strung-340,000 Lbs Clew working height of 127' Base width of 13'6". Adjustable racking board with capacity for:- i) 108 stands of 4.1/2" drill pipe, ii) 10 stands of 6.1/2" drill collars, iii) 3 stands of 8" drill collars Designed to withstand an API windload of 84 mph with pipe racked and 100 mph with no pipe racked.
CATHEADS	:	One (1) Foster Model 37 make-up spinning cathead mounted on drillers side. One (1) Foster Model 24 break-out cathead mounted off drillers side.
CROWN BLOCK	:	215 ton with five (5) 36" sheaves and one (1) 36" fastline sheave grooved 1.1/8".
TRAVELLING BLOCK	:	One (1) 667 Crosby McKissick 250 ton combination block hook Web Wilson. 250 ton Hydra hook Unit 5 - 36" sheaves.
SWIVEL	:	One (1) Oilwell PC-300 ton swivel. 192 tons API bearing rating at 100 rpm.
RIG LIGHTING	:	Explosive proof fluorescent. As per approved State Specifications.

MUD PUMPS : Two (2) Gardner Denver mud pumps Model PZ-8 each driven by 800 HP EMD motors. 8" stroke with liner size 6".

MIXING PUMPS : Five (5) Mission Magnum 5" x 6" x 14" centrifugal pumps complete with 50 HP, 600 Volt, 60 Hz, 3 phase explosion proof electric motors.

MUD AGITATORS : Six (6) Geolograph/Pioneer 40TD - 15" 'Pitbull' mud agitators with 15 HP, 60 Volt, 60 HZ, 3 phase electric motors.

SHALESHAKER : Two (2) DFE SCR-01 Linear motion shale shakers.
Adjustable screen deck - 1° to + 5°.

DEGASSER : One (1) Drilco See-Flo.

DESILTER : One (1) Pioneer T12-4 'Siltmaster' desilter.
12 x 4" cones. Approximate output of 2,250 litres per minute.

DESANDER : Harrisburg DSN-1000 unit with 2 x 10" cones. Approximate output of 3,600 litres per minute.

GENERATORS : Four (4) Brown Boveri 600 Volt, 600 kw 3 phase, 60 HZ AC generators. Powered by four (4) Cat 3412 PCTA diesel engines.

B.O.P.'s : One (1) Hydril 13.5/8" x 3,000 psi spherical annular BOP, studded top and flanged bottom.
One (1) Hydril 13.5/8" x 5,000 psi flanged double gate BOP.

SPOOLS : Double studded adaptor, 4.1/2" H 13.5/8" 5000 BXI60 x 13.518" 3000 RX57.
Double studded adaptor, 4.1/2" H 13.5/8" 5000 BXI60 x 7.1/16" 5000 R46.
Double studded adaptor, 5.1/2" H 13.5/8" 5000 BXI60 x 7.1/16" 3000 R45.
BOP spacer spool (drilling spool), 17" H 13.5/8" 5000 BXI60 x 13.5/8" 5000 BXI60.
BOP spacer spool (drilling spool), 14.1/2," H 13.5/8" 3000 R57 x 13.5/8" 3000 R57.
BOP adaptor spool, 18" H 13.5/8" 5000 BXI60 x 11" 3000 R53.

ACCUMULATOR : One (1) Wagner Model 130-160 3 BND 160 gallon accumulator consisting of:-

- Sixteen (16) 11 gallon bladder type bottles.
- One (1) 20 HP electric driven triplex pump 600 volts, 60 HZ, 3 phase motor and controls.
- One (1) Wagner Model A - 60 auxiliary air pump 4.5 gals/minute.

- One (1) 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 (1) Wagner Model GMSB - 5A 5 station remote drillers control with three pressure gauges, increase and decrease control for annular pressure.

DRILL PIPE SAFETY VALVE : One (1) 4" IF inside BOP.
One (1) 4" IF Stabbing Valve.

AIR COMPRESSORS & RECEIVERS : Two (2) LeRoi Dresser Model 660A air compressor packages c/w 10 HP motors rated at 600 Volts, 60 HZ, 3 phase. Receivers each 120 gallon capacity and fitted with relief valves.

AIR WINCH : One (1) Ingersol Rand HU-40 with 5/8" wireline. Capacity 2,000 lb.

POWER TONGS : One (1) Farr 13.5/8" - 5.1/2" hydraulic casing tongs c/w hydraulic power pack and hoses and torque gauge assembly.
One (1) Farr Model LW5500 5.1/2" high torque hydraulic power tong complete w/- 3.1/2" rotating assembly.
One (1) Foster hydraulic kelly spinner with 6.5/8" LH connections.
One (1) Varco SSW-30 hydraulic spinning wench. Self adjusting 2.7/8" through to 7" OD pipe.

ROTARY TABLE : One (1) Ideco 23" rotary table shaft driven from drawworks.

MUD TANKS (SHAKER) : One (1) Shaker tank total 236 bbls

- trip tank - 24 bbls
- sand trap - 92 bbls
- settling tank - 120 bbls

(INTERMEDIATE) : One (1) Intermediate tank total 337 bbls.

- with desilter tank - 113bbls
- with desander tank - 112bbls
- with reserve tank - 112bbls

(SUCTION) : One (1) Suction tank total 222 bbls.

- with pill tank - 23 bbls
- with two (2) suction tanks - 100 bbls each

Total system: 795 bbls

TRIP TANK PUMP : One (1) Mission Magnum 2" x 3" centrifugal pump complete with 20 HP, 600 Volts, 60 HZ, 3 phase explosion proof motors.

CHOKE MANIFOLD : One (1) Choke manifold, complete with Cameron type 'FL' 3" 5000 psi valves and Hydraulic Swaco "super" choke.

DRILL PIPE :
2,280m - 4.1/2" OD 16.60 lb/ft Grade "G" drill pipe.
465m - 4.1/2" OD 16.60 lb/ft Grade "E" drill pipe.
2,500m - 3.1/2" OD 13.30 lb/ft Grade "G" drill pipe.

PUP JOINTS :
One (1) - 5' 4.1/2" OD Grade 'G'.
One (1) - 5' 3.1/2" OD Grade 'G'.
One (1) - 10' 4.1/2" OD Grade 'G'.
One (1) - 10' 3.1/2" OD Grade 'G'.
One (1) - 15' 4.1/2" OD Grade 'G'.

HEVI-WATE DRILL PIPE :
142m (15 jts) of 4.1/2" H.W.D.P.
142m (15 jts) of 3.1/2" H.W.D.P.

DRILL COLLARS :
60m - 8" OD drill collars
230m - 6.1/4" OD drill collars
285m - 4.3/4" OD drill collars

KELLY :
One (1) Square Kelly drive 4.1/4" x 40' complete with Scabbard - 4" IF pin connection.
One (1) Hex Kelly drive 3.1/2" x 40' complete with Scabbard. 3.1/2" IF pin connection.

KELLY DRIVE : One (1) 20 HDP Varco kelly drive bushing to suit 4.1/4" square kelly and changeable rollers to suit 3.1/2" Hex Kelly.

KELLY COCK (UPPER) : One (1) Griffith Upper Kelly Cock 7.3/4" with 6.5/8" API connections.

KELLY COCK (LOWER) :
One (1) Griffith Lower Kelly Cock 6.1/2" OD with 4" IF connections.
One (1) Griffith Lower Kelly Cock 4.3/4" OD with 3.1/2," IF connections.

FISHING TOOLS :
One (1) only 10.5/8" Bowen series 150 FS overshot c/w grapples md packoffs to fish Contractors downhole equipment.
One (1) only 8.1/8" Bowen series 150 FS overshot c/w grapples and packoffs to fish Contractors downhole equipment.
One (1) only 5.3/4" Bowen series 150 FS overshot c/w grapples & packoffs to fish Contractors downhole equipment.
One (l) only 8" OD fishing magnet 4.1/2" reg pin.
One (l) only Reverse circulating junk basket 4" IF box.
One (1) only Fishing Jar 6.1/2" OD 4" IF pin & box.

One (1) only Fishing Jar 4.3/4" OD 3.1/2" IF pin & box.
One (1) only 12" Junk Mill - 6.5/8" reg pin.
One (1) only 8" Junk Mill - **4.Y2"** reg pin

SUBSTITUTES : Two (2) Bit Subs - 6.5/8" reg double box.
Two (2) Bit Subs - 4.1/2" reg x 4" IF double box.
Two (2) Bit Subs - 3.1/2" reg x 3.1/2" IF double box.
One (1) XO Sub - 7.5/8" reg x 6.5/8" reg double box.
One (1) XO Sub - 4" IF box x 4.1/2" IF pin.
One (1) XO Sub - 3.1/2" IF box x 4" IF pin.
Two (2) XO Sub - 6.5/8" reg pin x 4" IF box.
One (1) Junk Sub - 6.5/8" reg pin x 6.5/8" reg box.
Two (2) Kelly Saver Subs 4" IF pin & box.
One (1) Kelly Saver Subs 3.1/2" IF pin & box.
Two (2) Circulating Subs - 4" IF x 2" 1502 hammer union.
One (1) 6.5/8" reg. x 4.1/2" IF double box.
One (1) 4" IF Box x 4" FH pin.
Two (2) 4" IF Box x 4.1/2" IF pin.
Two (2) 4" IF x 4.1/2" IF double box
Two (2) 4.1/2" IF Box x 4" IF pin.
One (1) 3.1/2" IF Pin x 4.1/2" IF box.
One (1) 2.7/8" Pin x 2.3/8" IF pin.
One (1) 3.1/2" IF x 2.7/8" IF pin.

HANDLING TOOLS : 1 only 13.3/8" Baash Ross 150 ton side door elevator.
1 only 13.3/8" single joint P.U. elevators.
1 only 9.5/8" Webb Wilson 150 ton side door elevators.
1 only 9.5/8 single joint P.U. elevator.
1 only 7" BJ 200 ton side door elevators.
1 only 7" single joint P.U. elevators.
1 only 5./2" BJ 200 ton side door elevator
1 only 3.1/2" BJ 150 ton 18 degree taper D/P elevators.
2·only 4.1/2" BJ 250 ton 18 degree taper D/P elevators.
1·only 3.1/2" 100 ton tubing elevator.
1·only 2.7/8" 100 ton tubing elevator.
1 only 2.3/8" - 3.1/2" YT slip type tubing elevator.
1 only 8" Webb Wilson 150 ton single door elevator D/C.
1 only 6.1/2" Webb Wilson 150 ton single door elevator D/C.
1 only 13.3/8" Varco CMS-XL casing slips.
1 only 9.5/8" Varco CMS-XL casing slips.
1 only 7" Varco CMS-XL casing slips.
1 only 5.1/2" Varco SDXL casing slips.
2·only 4.1/2" Varco SDXL D/P slips.
1·only 3.1/2" Varco SDML tubing slips.
1·only 2.7/8" Varco SDML tubing slips.
2·only 8" - 6.1/2" DCS-R drill collar slips.
2·only 3.1/2" Varco type SDML DP slips.
2·only 4.3/4" DCS drill collar slips.

ROTARY TONG	:	One set Web Wilson type 'AAX' c/w latch & lug jaws 13.3/8" - 3.1/2".
BIT BREAKERS	:	One (1) each 17.1/2", 12.1/4", 8.1/2", 6".
FUEL TANK	:	1 only 25,000 litres. 1 only 30,000 litres.
WATERTANK	:	1 only 400 bbls.
DRILLING RATE RECORDER	:	1 only 6 pen drill sentry recorder to record: • weight (D) • penetration (feet) • pump pressure (0-6,000 psi) • electric rotary torque • rotary speed (rpm) • pump spm (with selector switch)
DEVIATION INSTRUMENT	:	1 set Totco 'Double Shot' deviation instrument 0^{o}-8^{o}.
INSTRUMENTS & INDICATORS	:	1 only Martin Deck Type 'D' weight gauge. 1 only National Type 'D 'dead man anchor. • Electric rotary torque gauge • Pit scan • SPM gauge (2 per console) • Rotary rpm gauge
MUD TESTING	:	1 set Baroid mud testing laboratory (standard kit).
RATHOLE DRILLER	:	One (1) fabricated rotary table chain driven.
WATER PUMPS	:	Three (3) Mission Magnum 2" x 3" centrifugal pumps c/w 20 HP, 600 Volts, 60 HZ, 3 phase explosion proof motors.
CUP TESTER	:	One (1) Grey Cup Tester c/w test cups for 9.5/8" & 133/8".
DRILLING LINE	:	5,000' 1.1/8" - E.I.P.S.

TRANSPORT EQUIPMENT AND MOTOR VEHICLES

International 530 Forklift

1 Tray Top Utility - 4WD
1 Crew Wagon - 8 perso

CAMP EQUIPMENT

4 - 8 - Man Bunkhouses
1 - Recreation/Canteen unit
1 - Ablution/Laundry/Freezer unit
1 - Kitchen/Cooler/Diner unit
2 - Toolpusher units
1 - Combined Water/Fuel Tank unit
2·- CAT 3304PC generator sets each 106 Kva, 86 KW, 50 HZ.

Note: **At Contractor's discretion any of the foregoing items may be replaced by equipment of equivalent or greater capacity.**

SAFETY EQUIPMENT

General Safety Equipment to be provided By the drilling Contractor	
Wet weather gear Safety glasses Safety hats Safety footwear Safety belts c/wlines Ear protection -grade 4 Leather gloves Rubber gloves Rubber aprons Fullface visors Eye shields (for grinding machines, etc)	Sufficient personal protective equipment will be available at all times. All equipment will comply with International standards.
Dust masks Rubber gloves - elbow length for chemical handling "No-Smoking" signs "Hard-Hat" signs	Pictographic signs will be displayed in prominent locations around the Rig giving wanting to a specific hazard.
Eye Wash Stations	
Quantity	3
Make/model	1 x Enware eye wash Deluge shower. 2 x Protector eye wash station
Located at	Intermediate tank Dog House Mud Hopper
Derrick Safety Equipment	
Derrick escape (Geronimo)	Geronimo
Derrick safety belts	Lewis Type SC
Derrick Climbing Assist	
Make	R.T.C.
Fire Extinguishers	
Make	
Type: 1. Dry Chemical	Quell or equivalent 10 x 9kg
2. Other	2 x 11.5 BCF

First Aid Equipment

First Aid Kits	
Quantity	2
Located at office	Dog House, Toolpushers Office
Bum Kits/Fire Blankets	
Quantity	2 - H2O GEL blanket
Located at office	Toolpushers office (1), Dog House (1)
Stretchers	
Quantity	2
Type	1 MSA Stokes 1 MSA Stokes Fold canvas
Located at	Dog House/Offices

APPENDIX XII: FMI INTERPRETATION

GORDON-1 FMI*
IMAGE INTERPRETATION
NOVEMBER 1997

Summary

An interpretation was made on scaled FMI* images recorded in Gordon-1 from within the Casterton Formation and 'Basement Unit'. The Casterton Formation has a structural dip of 8° to the ENE with common drilling induced fracture and borehole breakout striking NW-SE and NE-SW respectively. The 'Basement Unit' contained numerous natural open and healed continuous and discontinuous fractures. Detailed interpretation focused on natural open fractures which were classified into the following classes: 'Vertical' fractures (70°-90°), 'High' angle (70°-20°) or low angle (0°-20°).

The High angle fractures were the most numerous fracture set identified and had a polymodal distribution with a dominant N-S trend. Hydrocarbon shows from the mudlog show an approximate correlation to increases in high angle fracture density such as seen at 2398m-2408m, 2421-2429m and 2449-2460m . Vertical fractures were rare and irregularly spaced with a dominant NE-SW strike orientation. Resistive fractures were rare and have a N-S strike orientations, similar to the orientation of the High Angle fractures.

A number of open natural fractures with dip magnitudes lower than 20° were observed with a polymodal strike distribution. The genesis of these fractures is not known.

Mean drilling induced fracture and borehole breakout orientation was 144°-324° and 052°-232°. This implies a maximum horizontal stress orientation of NW-SE (144°-324° and a minimum horizontal stress orientation of NE-SW (052°-232°).

Introduction

An FMI* (FBST-B) log was acquired in Gordon-1 (28/4/1997) from 2501.5m-2270m in 8.5" hole (78% borehole coverage). This interval covered the 'Basement Unit' and Casterton Formation. An interpretation was made by S.Horan (Schlumberger) and Siew Looi at the Santos DCC in Adelaide. The aim of the interpretation was to determine the fracture attributes from the 'Basement Unit' .

FMI images were calibrated to the PEX* shallow resistivity measurement recorded in the same logging suite as the FMI* . The resultant scaled FMI images were then interpreted on Borview, the image log interpretation package on Schlumberger's GeoFrame Software System.

A data quality check was made on the data prior to interpretation and is discussed in a separate report 'Borehole Electrical Image Log Quality Check - Gordon-1 FMI*, November 1997'. A main log pass was made first from 2500m-2270m followed by a repeat section from 2493m-2377m. During the main pass from 2498m-2443m the calipers did not open more than 8" which did not agree with the caliper from the PEX*. However the caliper data from the repeat section agrees with the PEX* caliper and is considered to be valid. Interpretation then focused on the repeat section and on the upper section of the main log from 2377-2270m considered to have a valid caliper..

Formation tops were provided by Graham Parsons and refer to meters beneath the drill floor.

Interpretation Methodology

Image Calibration

Electrical dipmeter (e.g. SHDT*) and imaging tools (e.g. FMS* & FMI*) record the conductance of a formation from a number of microresistivity button electrodes. In order to achieve resolutions of 0.2"-0.3" required for detailed stratigraphic analysis these buttons have had to be designed so that they are un-calibrated and un-focused. This is in contrast to resistivity tools such as the Dual Laterlog Tool* (DLT) which is designed to record a focused and calibrated resistivity measurement but has a vertical resolution of only 32".

In order to measure fracture attributes such as fracture aperture and porosity FMI* data has to be scaled to give a measurement "resembling" the formation conductivity as measured by a true resistivity tool. This is done by cross-plotting FMI* conductivity data against a shallow resisitivity device such as the LLS and checking for a correlation between the two data sets. It has been found that in relatively thick and homogeneous beds the button focusing is unimportant and FMI* data can be calibrated to read true formation conductivity.

The final processing step in image calibration is entering temperature corrected mud resistivity. Open fractures are assumed to filled with mud and hence the boundaries of each open fracture is defined by the mud resistivity.

Fracture and Dip Classification

Formation Micro-Imager images were interpreted with fracture and bedding features classified into the following classes:

Bed Boundaries:	bedding planes from claystones and siltstones which provide a good estimate of structural dip,
Drilling Induced Fractures:	Induced hydraulic fractures due to tensile failure of the borehole wall. Drilling induced fractures appear as vertical to sub-vertical open fractures that don't cross the borehole. They form parallel to the maximum horizontal stress and perpendicular to the minimum horizontal stress (breakout

orientation).

Borehole Breakout: abrupt ovalization of the borehole due to the presence of anisotrophic stress fields surrounding the borehole. If the difference between these two horizontal stresses reaches a certain threshold the area around the well bore will undergo compressive shear failure orientated parallel to the minimum horizontal stress (Bell 1990). This resulting in spalling and caving of the borehole wall and the formation of breakouts.

Low angle Fracture: open natural fractures with dip magnitudes less than 20°.

HACC Fractures: open high angle natural fractures that dip between 20° and 70°.

VCC Fractures: open vertical natural fractures that dip at greater than 70°.

Resistive Fractures:. Healed natural fractures.

Fracture Attributes

The following fracture attribute curves were computed after interpretation of scaled images:

FVDC Corrected Fracture Density in number of fractures per meter of borehole. A correction is applied for orientational bias (i.e. angle between planar fracture and borehole axis) of: 1 / ((cos(Dip°)) + Borehole Size" x ((sin(Dip°)).

FCNB Cumulative number of fractures in the uphole direction.

PVPA Apparent Electrical Fracture Porosity in porosity units. This is calculated as ratio of two areas: the area of fracture seen on the borehole wall, and the borehole wall.

HA Hydraulic aperture is the square root of the sum of aperture length multiplied by the cube width of the aperture, all divided by the sum off the aperture length.Hydraulic aperture has been shown to be proportional to flow rate of fluids throw smooth walled fractures (Brown 1987; Jones et al 1988).

Results

Enclosures 1 and 2 show 1:20 scaled images interpretation from the repeat log (2493m-2377m) and for the main log (2498m-2270m). Enclosures 3 and 4 show corrected fracture density (FVDC), apparent electrical fracture porosity (PVPA) and cumulative number of fractures for the HACC (red curves) and VCC (green curves).

Interpretation of the FMI images was initially undertaken in the Casterton Formation to determine structural dip, borehole breakout and drilling induced fracture orientation in an interval with relatively few fractures. Borehole breakout and drilling induced fractures were clearly identified and strike NE-SW and NW-SE respectively (Enclosure 2). Claystones were finely bedded on a 10s cm scale and dipped to the E (071°) at 8° (Fig. G1-2).

Figure G1-1 shows the borehole breakout and drilling induced fractures strike orientation for the Casterton Formation and Basement 'Unit' which strike 052°-232° and 144°-324° respectively.

Basement Fracture Attributes.

Continuous fractures were classified as per the scheme outlined above. Strike orientations for HACC, VCC , low angle natural fractures and resistive fractures is shown in Figures G1-3, -4, -5, -6.. HACC fractures were the most common (n=266) which had a dominant N-S orientation (Fig G1-3) which is similar in orientation to resistive fractures (Fig G1-5). VCC fractures have a dominant NE-SW trend with a minor NNE-SSW trend also (Fig. G1-4).

Low angle natural open fracture show a polymodal strike distribution (Fig G1-6). These fractures are problematical as they are interpreted as open fractures based on there resistivity image however with dip magnitudes less than 20° it is difficult to imagine them staying open at there present depth without a significant horizontal compressive stress being applied

Tables 1 and 2 below list a summary of some of the fracture attributes calculated for the HACC and VCC fractures. Vertical fractures were not common and were irregularly spaced so a mean fracture porosity was not calculated. Fracture porosity is shown on Enclosure 4 but should be interpreted with caution given the small amount and irregular spacing.

High Angle Fractures (HACC)	**n = 266**
Minimum-Maximum Depth	**2378m-2492m**
Mean Hydraulic Aperture	**0.001377 cm**
Mean Dip Spacing	**0.43 m**
Mean Trace Length	**22.28cm**
Minimum-Maximum Fracture Porosity	**0-0.000181 m^3/m^3**
Mean Fracture Porosity	**0.0000144 m^3/m^3**

Table 1. Summary of HACC fracture attributes.

Vertical Fractures (VCC)	**n = 20**
Minimum-Maximum Depth	**2393m-2477m**
Mean Hydraulic Aperture	**0.000657 cm**
Mean Dip Spacing	**4.35 m**
Mean Trace Length	**49.13 cm**

Table 2. Summary of VCC fracture attributes.

Hydrocarbon shows from the mudlog show an approximate correlation to the High angle fracture density. For instance fracture densities of 10 or more per meter were seen from 2398m-2408m, 2421-2429m and 2449-2460m which equate to increases in ditch cuttings and presence of fluorescence.

Numerous open and healed discontinuous fractures were observed (Enclosure 1 & 2) but no attempt was made to determine there orientation due to the large numbers

Simon Horan
Division Geologist
Schlumberger Wireline & Testing

* Mark of Schlumberger

References.

Bell, J.S. . 1990. Investigating stress regimes in sedimentary basins using information from oil industry wireline logs and drilling records. Geological Applications of Wireline Logs - Geological Society Special Publication No.48, pp305-325.

Brown,S.R. 1987. Fluid flow through rock joints: the effect of surface roughness. Journal of Geophysical Research. 92, p1337-1347.

Jones,T.A., Wooten,S.A., Kaluza,T.J., 1988. Single-phase fluid flow through natural fractures: Proceeding Annual Conference Society Petroleum Engineers. Formation evaluation and reservoir geology, p687-696.

PE905778

This is an enclosure indicator page.
The enclosure PE905778 is enclosed within the container PE905781 at this location in this document.

The enclosure PE905778 has the following characteristics:

ITEM_BARCODE = PE905778
CONTAINER_BARCODE = PE905781
NAME = Fracture Strike Plot, sheet 1 of 3, for Gordon-1
BASIN = OTWAY BASIN
PERMIT = PEP/119
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Fracture Strike Plot, 1of 3, (from WCR) for Gordon-1
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W1191
WELL_NAME = GORDON-1
CONTRACTOR =
CLIENT_OP_CO =

(Inserted by DNRE - Vic Govt Mines Dept)

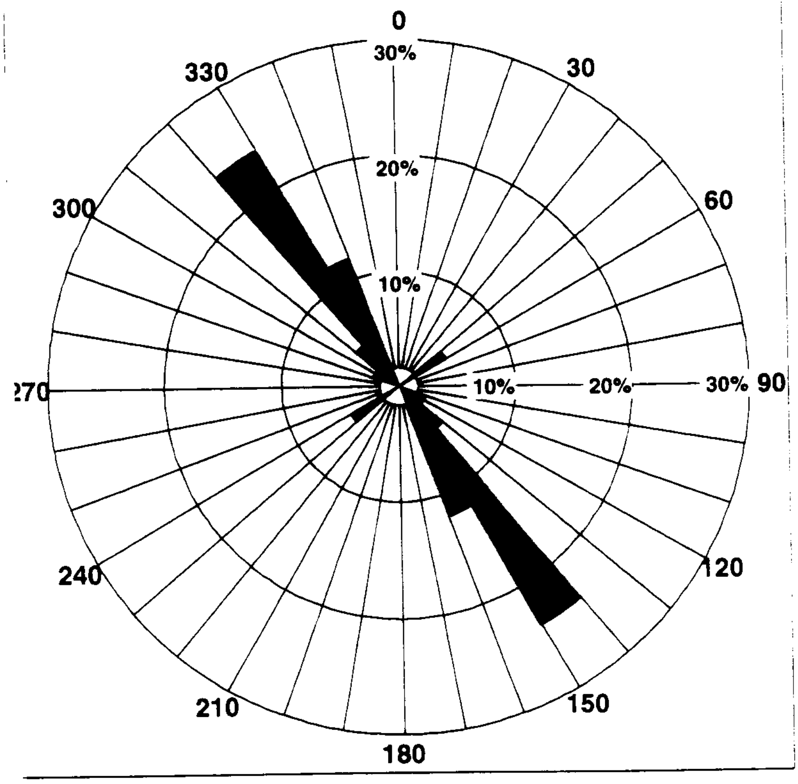


Figure G-1 Gordon-1 Borehole Breakout (black) and Drilling Induced Fracture (pink) strike plot. Mean strike orientation for Borehole Breakouts is 052°-232° and 144°-324° for Drilling Induced Fractures.

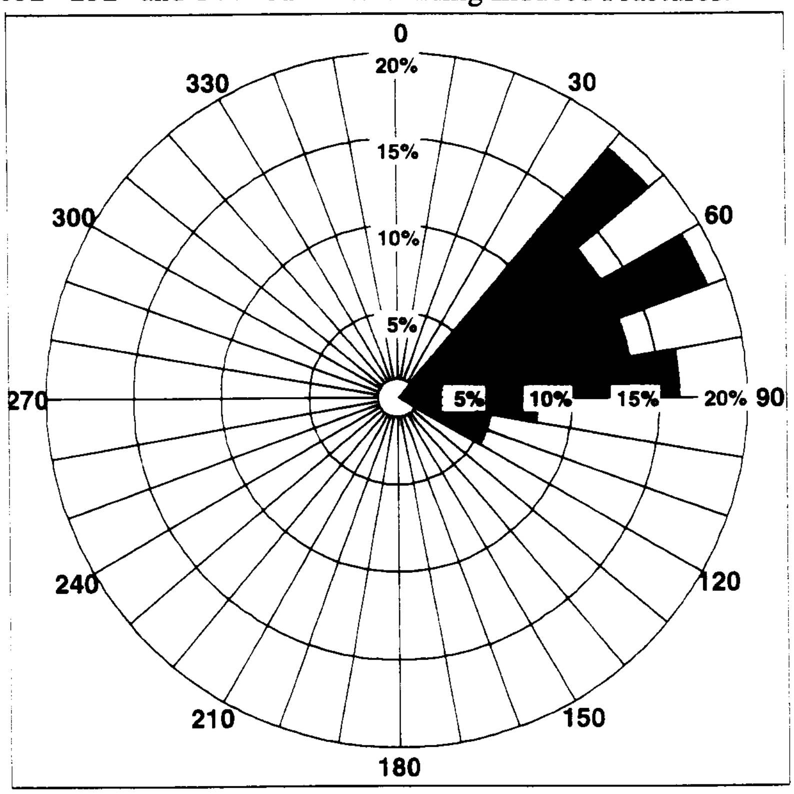


Figure G1-2 Gordon-1 Casterton Formation Shale bed boundary dip histogram. Mean dip orientation is 8.0°/071°.

PE905779

This is an enclosure indicator page.
The enclosure PE905779 is enclosed within the container PE905781 at this location in this document.

The enclosure PE905779 has the following characteristics:

ITEM_BARCODE = PE905779
CONTAINER_BARCODE = PE905781
NAME = Fracture Strike Plot, sheet 2 of 3, for Gordon-1
BASIN = OTWAY BASIN
PERMIT = PEP/119
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Fracture Strike Plot, 2of 3, (from WCR) for Gordon-1
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W1191
WELL_NAME = GORDON-1
CONTRACTOR =
CLIENT_OP_CO =

(Inserted by DNRE - Vic Govt Mines Dept)

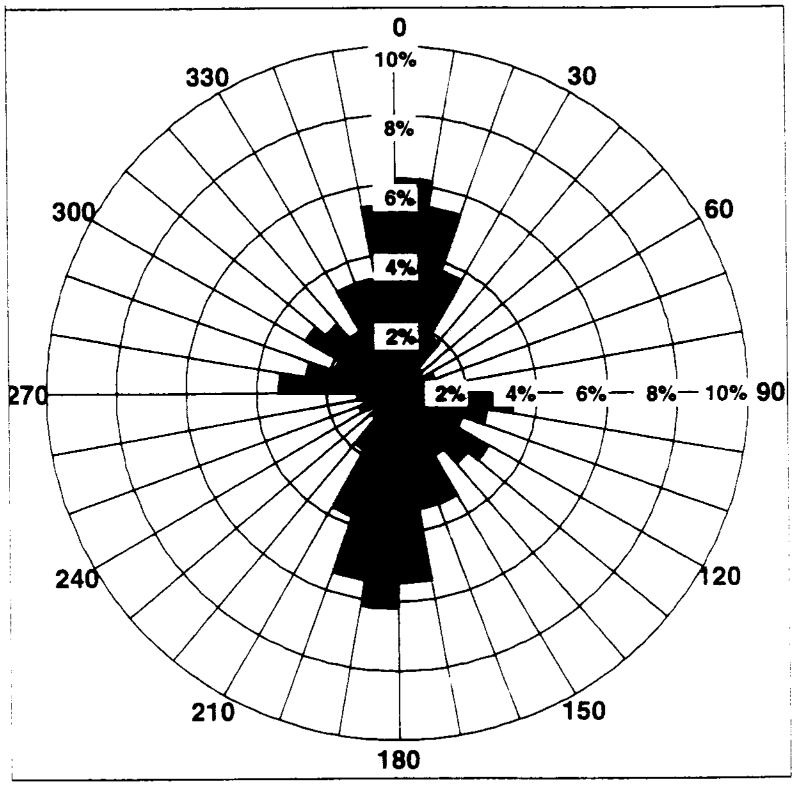


Figure G1-3 Gordon-1 High Angle Conductive (HACC) natural fracture strike plot.

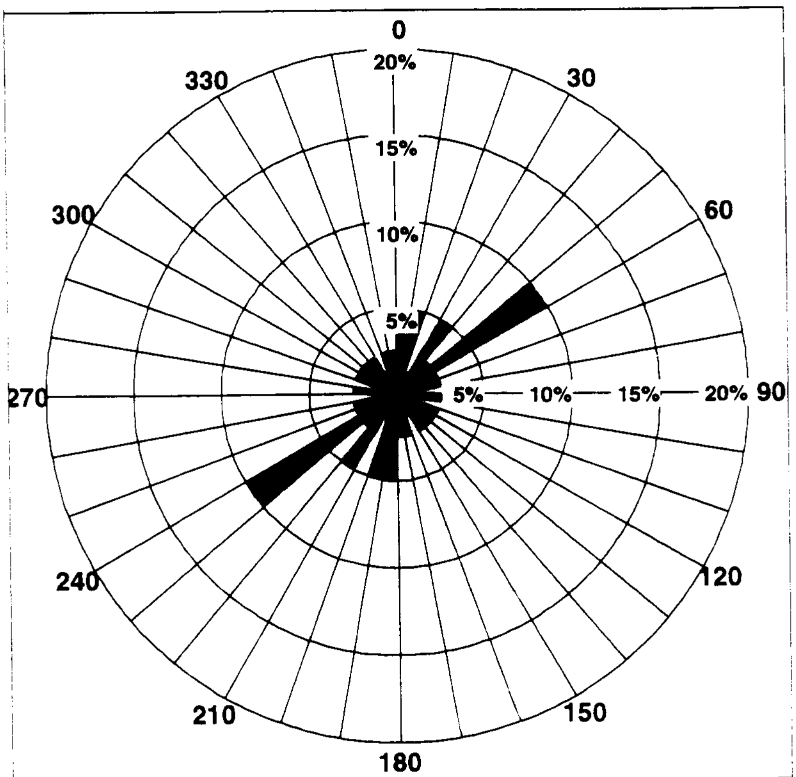


Figure G1-4 Gordon-1 Vertical Conductive natural fracture strike plot.

PE905780

This is an enclosure indicator page.
The enclosure PE905780 is enclosed within the container PE905781 at this location in this document.

The enclosure PE905780 has the following characteristics:

ITEM_BARCODE = PE905780
CONTAINER_BARCODE = PE905781
NAME = Fracture Strike Plot, sheet 3 of 3, for Gordon-1
BASIN = OTWAY BASIN
PERMIT = PEP/119
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Fracture Strike Plot, 3 of 3, (from WCR) for Gordon-1
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W1191
WELL_NAME = GORDON-1
CONTRACTOR =
CLIENT_OP_CO =

(Inserted by DNRE - Vic Govt Mines Dept)

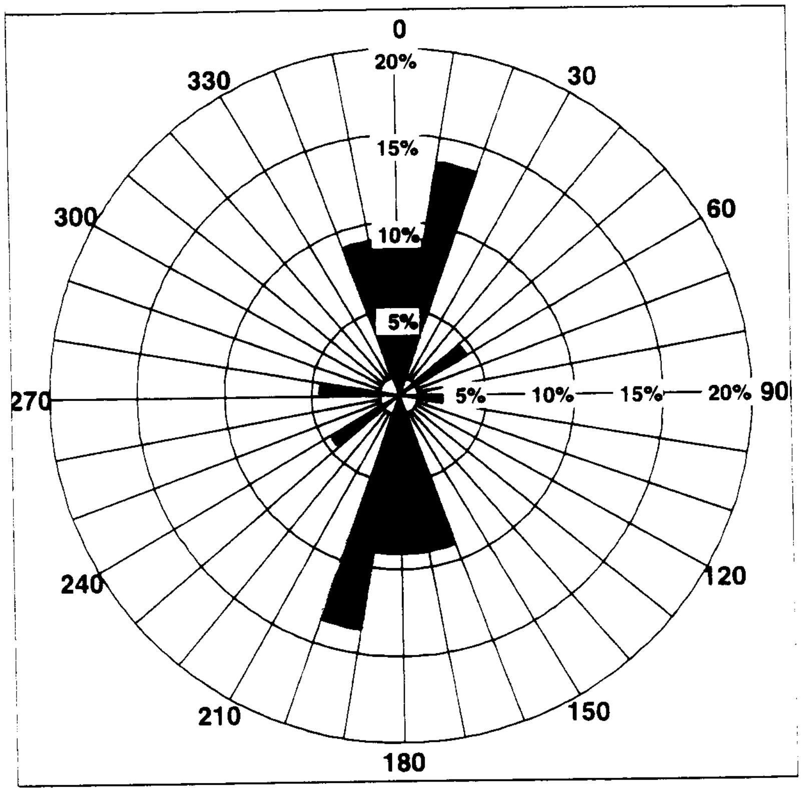


Figure G1-5 Gordon-1 Resistive natural fracture strike plot.

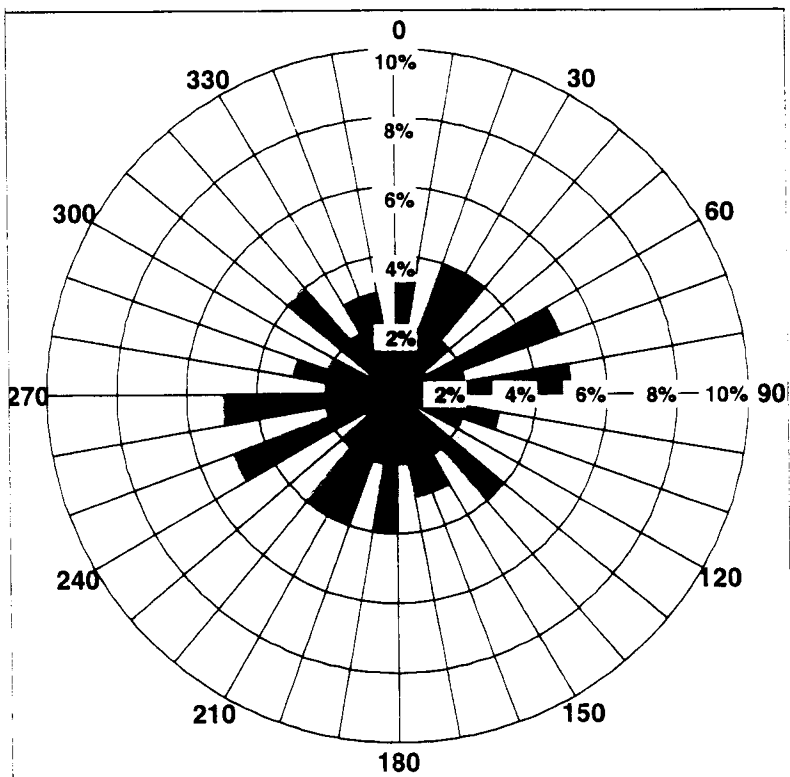


Figure G1-6 Gordon-1 Low Angle natural fracture strike plot.

PE604423

This is an enclosure indicator page.
The enclosure PE604423 is enclosed within the container PE905781 at this location in this document.

The enclosure PE604423 has the following characteristics:

ITEM_BARCODE = PE604423
CONTAINER_BARCODE = PE905781
NAME = Scaled FMI Interpretation, 2 fo 2, (scale 1:20) for Gordon-1
BASIN = OTWAY BASIN
PERMIT = PEP/119
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = Scaled FMI Interpretation, scale 1:20, (from WCR) for Gordon-1
REMARKS =
DATE_CREATED = 29/04/97
DATE_RECEIVED = 30/07/98
W_NO = W1191
WELL_NAME = GORDON-1
CONTRACTOR = SCHLUMBERGER
CLIENT_OP_CO = SANTOS LTD/CULTUS

(Inserted by DNRE - Vic Govt Mines Dept)

PE604424

This is an enclosure indicator page.
The enclosure PE604424 is enclosed within the container PE905781 at this location in this document.

The enclosure PE604424 has the following characteristics:

```
     ITEM_BARCODE = PE604424
CONTAINER_BARCODE = PE905781
             NAME = Scaled FMI Interpretation, 1 fo 2,
                    (scale 1:20) for Gordon-1
            BASIN = OTWAY BASIN
           PERMIT = PEP/119
             TYPE = WELL
          SUBTYPE = WELL_LOG
      DESCRIPTION = Scaled FMI Interpretation, scale 1:20,
                    (from WCR) for Gordon-1
          REMARKS =
     DATE_CREATED = 29/04/97
    DATE_RECEIVED = 30/07/98
             W_NO = W1191
        WELL_NAME = GORDON-1
       CONTRACTOR = SCHLUMBERGER
     CLIENT_OP_CO = SANTOS LTD/CULTUS
```

(Inserted by DNRE - Vic Govt Mines Dept)

PE604419

This is an enclosure indicator page.
The enclosure PE604419 is enclosed within the container PE905781 at this location in this document.

The enclosure PE604419 has the following characteristics:

ITEM_BARCODE = PE604419
CONTAINER_BARCODE = PE905781
NAME = Fracture Attribute Log, 1 of 2, for Gordon-1 (1:20)
BASIN = OTWAY BASIN
PERMIT = PEP/119
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = Fracture Attribute Log, scale 1:20, (from WCR) for Gordon-1
REMARKS =
DATE_CREATED = 29/04/97
DATE_RECEIVED = 30/07/98
W_NO = W1191
WELL_NAME = GORDON-1
CONTRACTOR = SCHLUMBERGER
CLIENT_OP_CO = SANTOS

(Inserted by DNRE - Vic Govt Mines Dept)

PE604420

This is an enclosure indicator page.
The enclosure PE604420 is enclosed within the container PE905781 at this location in this document.

The enclosure PE604420 has the following characteristics:

ITEM_BARCODE = PE604420
CONTAINER_BARCODE = PE905781
NAME = Fracture Attribute Log, 2 of 2, for Gordon-1 (1:20)
BASIN = OTWAY BASIN
PERMIT = PEP/119
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = Fracture Attribute Log, scale 1:20, (from WCR) for Gordon-1
REMARKS = shows different veiws to 1st Fracture Attributed Log
DATE_CREATED = 29/04/97
DATE_RECEIVED = 30/07/98
W_NO = W1191
WELL_NAME = GORDON-1
CONTRACTOR = SCHLUMBERGER
CLIENT_OP_CO = SANTOS

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE I: 1 : 200 COMPOSITE LOG

PE604422

This is an enclosure indicator page.
The enclosure PE604422 is enclosed within the container PE905781 at this location in this document.

The enclosure PE604422 has the following characteristics:

```
     ITEM_BARCODE = PE604422
CONTAINER_BARCODE = PE905781
             NAME = Composite Well Log for Gordon-1
            BASIN = OTWAY BASIN
           PERMIT = PEP/119
             TYPE = WELL
          SUBTYPE = COMPOSITE_LOG
      DESCRIPTION = Composite Well Log (enclosure 1 from
                    WCR) for Gordon-1
          REMARKS =
     DATE_CREATED = 3/05/97
    DATE_RECEIVED =
             W_NO = W1191
        WELL_NAME = GORDON-1
       CONTRACTOR = SANTOS
     CLIENT_OP_CO = SANTOS
```

(Inserted by DNRE - Vic Govt Mines Dept)

ENCLOSURE II: 1 : 500 MUDLOG

PE604421

This is an enclosure indicator page.
The enclosure PE604421 is enclosed within the container PE905781 at this location in this document.

The enclosure PE604421 has the following characteristics:

ITEM_BARCODE = PE604421
CONTAINER_BARCODE = PE905781
NAME = Formation Evaluation Log /Mudlog for Gordon-1
BASIN = OTWAY BASIN
PERMIT = PEP/119
TYPE = WELL
SUBTYPE = MUD_LOG
DESCRIPTION = Formation Evaluation Log (enclosure 2 from WCR) for Gordon-1
REMARKS =
DATE_CREATED = 26/04/97
DATE_RECEIVED =
W_NO = W1191
WELL_NAME = GORDON-1
CONTRACTOR = HALIBURTON
CLIENT_OP_CO = SANTOS/CULTUS

(Inserted by DNRE - Vic Govt Mines Dept)