# PETROFINA EXPLORATION AUSTRALIA S. A.



INTERPRETATIVE

FINA

# ANEMONE - 1,1A

## WELL COMPLETION REPORT

INTERPRETATIVE

VOLUME 2

# INTERPRETATIVE

WELL COMPLETION REPORT ANEMONE-1,1A

VOLUME II

INTERPRETATIVE DATA



INTERPRETATIVE

# WELL COMPLETION REPORT ANEMONE-1/1A

## INTERPRETATIVE DATA

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## SUMMARY

Exploration wells Anemone-1 and sidetrack Anemone-1A were located in Licence VIC/P20 in the Gippsland Basin offshore Victoria, south-eastern Australia. The wells represent the second of a four well drilling commitment on VIC/P20 to be fulfilled before 23 July 1990. Joint venture partners for the operation were:

| | | |
|---|---|---|
| Petrofina Exploration Australia S.A. | 30% | (Operator) |
| Japex Gippsland Limited | 30% | |
| Overseas Petroleum and Investment Corporation | 30% | |
| Bridge Oil Limited | 10% | |

The objective of the wells was to evaluate the hydrocarbon potential of Maastrichtian and Campanian aged Latrobe Group sandstones in a fault-dependent structural closure. After poor shows in the Maastrichtian, Top Campanian and Campanian "1" Sandstones, it was decided to deepen the well from the original prognosed TD of 4200m to 4750m. Moderate shows were encountered at Top Campanian "2" sandstone level which were later fully evaluated with RFTs. The well continued on through 250m of siltstone before encountering gas rich sandstone sequence at 4525m. High gas levels made it necessary to increase the mudweight, before drilling on to 4609m where the drillstring became stuck and the well plugged back to 3896m. The well was sidetracked and eventually TD'd at 4775m. Two tests were carried out with disappointing results and the well was plugged and abandoned as a non-commercial gas and condensate discovery on 20 October 1989.

# WELL DATA SUMMARY - ANEMONE-1/1A

| | |
|---|---|
| **WELL:** | Anemone-1/1A |
| **PERMIT:** | VIC/P20, Gippsland Basin, Australia |
| **OPERATOR:** | Petrofina Exploration Australia S.A. |
| **LATITUDE:** | 38°45'52.46" S |
| **LONGITUDE:** | 148°19'48.63" E<br>5,708,493.7 N |
| **UTM:** | 615,565.6 E |
| **KBE:** | 27m |
| **WD:** | 231m |
| **TYPE OF RIG:** | Semi-Submersible |
| **NAME:** | Zapata Arctic |
| **CONTRACTOR:** | Zapata Off-Shore Company |
| **OBJECTIVES:** | Coastal plain and deltaic Intra-Campanian and Maastrichtian Sandstones |
| **SPUD DATE:** | 29 May 1989 |
| **DATE REACHED TD:** | 15 July 1989 (Anemone-1) |
| **DATE COMMENCED SIDETRACK:** | 26 July 1989 (Anemone-1A) |
| **DATE REACHED TD:** | 4 September 1989 (Anemone-1A) |
| **DATE PLUGGED & ABANDONED:** | 20 October 1989 |
| **DRILLED DEPTH:** | Anemone-1 4609m (driller)<br>Anemone-1A 4775m (driller) |
| **WELL STATUS:** | Plugged and Abandoned.<br>Non-commercial gas-condensate discovery |

Table 1 to follow

## TABLE 1

**Formation and Seismic Tops, Anemone-1,1A**

| Horizon | Depth (RKB)m | Depth (SS)m | TWT sec |
|---|---|---|---|
| Sea Floor/ Gippsland Limestone | 258 | (-231) | 0.308 |
| Lakes Entrance Fm | 1317 | (-1290) | 1.142 |
| Intra Lakes Entrance | 2197 | (-2170) | 1.787 |
| Gurnard | 2581 | (-2554) | 2.051 |
| Palaeocene/Latrobe | 2677 | (-2650) | 2.113 |
| Maastrichtian/UK5 | 2760 | (-2733) | 2.165 |
| Selene Sandstone/UK4 | 3111 | (-3084) | 2.370 |
| Campanian | 3198 | (-3171) | 2.417 |
| UK3 | 3422 | (-3395) | 2.541 |
| UK3.1 | 3742 | (-3715) | 2.708 |
| UK2 | 3925 | (-3898) | 2.787 |
| Campanian Sst '1' | 4042 | (-4015) | 2.843 |
| Campanian Sst '2' | 4199 | (-4172) | 2.915 |
| Santonian | 4287 | (-4260) | 2.954 |
| Santonian Sandstone | 4525 | (-4498) | 3.072 |
| UK1 | 4617 | (-4590) | 3.118 |
| Total Depth | 4775 | (-4748) | 3.192 |

INTERPRETATIVE

# ANEMONE-1,1A RESERVES ESTIMATE FOR THE SANTONIAN SANDSTONES

## INTRODUCTION

Extremely high gas readings were encountered during drilling shallow marine sandstones below 4525m down to TD (4775m).

When this section of hole was subsequently logged, log quality was found to be extremely poor due to badly washed out conditions in the well. The first log evaluation using these logs assumed a formation water salinity of 22000 ppm NaCl which is comparable to formation water salinities found in stratigraphically shallower reservoirs in the Gippsland Basin.

However, on completion of DST # 1 (Perforations: 4599m-4618m and 4629m-4652m), recovered formation water samples showed that the salinity was in the order of 10000 ppm NaCl and that the Rw had been underestimated in the original evaluation. Using the correct Rw, log analysis results still indicated the presence of hydrocarbons, but in much lower saturations. These low saturations are now interpreted as being essentially irreducible gas saturation. This was confirmed by both DST # 1 and DST # 2 (4599m-4652m and 4535m-4545m) which yielded gas condensate and water in DST # 1 and only water in DST # 2.

## RESERVES

Reserves have been calculated assuming a gross reservoir thickness of 4525mbkb (top of reservoir) down to 4750m where the reservoir becomes extremely tight and silty.

The reservoir parameters used in the computation were taken from the final log evaluation. As mentioned earlier, log quality over this section is very poor such that:

(a) the Resistivity log could not be corrected for invasion hence LLD = Rt was used in the computation.

(b) only the sonic log could be used as a porosity tool and certainly yields optimistic results.

(c) Bg is derived from a recombined DST sample. No constant GOR was noted during testing hence the proportion used in the recombination might not be a true reservoir sample. However, the fact that the recombined sample has a dew point of 5550 psi and a Bg of 0.00366 which compares closely to the compositionally similar Angler RFT sample at 4226mbkb (5545 psi and 0.00373), indicates that the Bg used here is probably reasonable.

Table 1 below lists reservoir parameters and results.

**Table 1**

**RESERVOIR PARAMETERS AND RESERVES FOR SANTONIAN SANDSTONE**

| TOP mbkb | BOTTOM mbkb | THICKNESS m | BULK ROCK VOLUME ($10^6 m^3$) | N/G (%) | POR. (%) | Sw (%) | Bg | GIP BCF |
|---|---|---|---|---|---|---|---|---|
| 4525 | 4750 | 225 | 1513 | 11 | 17.7 | 55.2 | 0.00366 | 127 |

## CONCLUSION

(i) Reservoir parameters used in calculations are unreliable.

(ii) Most of the calculated GIP is probably irreducible.

(iii) On the basis of point (ii), the recovery factor and hence recoverable reserves must be extremely small.

# APPENDIX 1

APPENDIX 1

**WELL COMPLETION REPORT**

**ANEMONE-1,1A**

INTERPRETATIVE DATA

# A P P E N D I X 1

STRATIGRAPHY

PE905433

This is an enclosure indicator page.
The enclosure PE905433 is enclosed within the container PE902140 at this location in this document.

The enclosure PE905433 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE = | PE905433 |
| CONTAINER_BARCODE = | PE902140 |
| NAME = | Anemone 1-1A Stratigraphic Column (App. 1) |
| BASIN = | GIPPSLAND |
| PERMIT = | VIC/P20 |
| TYPE = | WELL |
| SUBTYPE = | STRAT_COLUMN |
| DESCRIPTION = | Anemone 1-1A Stratigraphic Column |
| REMARKS = | |
| DATE_CREATED = | 30/11/89 |
| DATE_RECEIVED = | 22/01/90 |
| W_NO = | W997 |
| WELL_NAME = | Anemone-1 |
| CONTRACTOR = | Petrofina Exploration Australia S.A |
| CLIENT_OP_CO = | Petrofina Exploration Australia S.A |

(Inserted by DNRE - Vic Govt Mines Dept)

# APPENDIX 2

APPENDIX 2

WELL COMPLETION REPORT

ANEMONE-1,1A

INTERPRETATIVE DATA

# A P P E N D I X 2

## LOG ANALYSIS OF THE HYDROCARBON BEARING FORMATIONS

## OF THE LATROBE GROUP

PETROFINA EXPLORATION AUSTRALIA S.A.

# Log Analysis of
# The Hydrocarbon Bearing Formations
# of the Latrobe Group in
# Anemone-1,1A

GL/89/027
JMQ/AH/sw:kl
23 October 1989

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# 1. SUMMARY AND CONCLUSIONS

A total of 2090m of wireline logs, covering the entire Latrobe Group at Anemone-1,1A have been evaluated. The analysis covers the interval from 2670m (5m above Top Latrobe Unconformity) to 4775m (TD).

The conclusions are:

(a) The presence of hydrocarbons has been confirmed in three zones within the Campanian, and one zone in the Santonian intervals. These zones and their characteristics are listed in Table 1 below.

(b) Two intervals, both in the Campanian, show major seal potential. The first, from 4144-4198m, is a shale/siltstone unit which seals the gas/condensate bearing Campanian "1" Sandstones. The second is also a shale/siltstone unit from 4244m to 4525m and seals the gas/condensate bearing Santonian Sandstones.

(c) Abundant siltstone units 5-20m thick occur in the upper Campanian section between 3425m to 3605m. These are interbedded with sandstones with good reservoir potential. Assuming that hydrocarbon charging is not a problem, the lack of hydrocarbons in any of these sandstones could suggest that the argillaceous units lack lateral continuity, giving them a poor seal potential.

(d) The porosity versus depth plot (Fig. 1) shows that moderate effective porosity of 17% can be expected down to 4250m in favourable sandy facies. The porosities in the Santonian Sandstone have been ignored because of petrographic evidence suggesting that a major fraction of the effective porosity in these sands is secondary in nature.

## 2. INTRODUCTION

This report presents the results of Petrofina's log analysis over the entire Latrobe Group Section in Anemone-1,1A. The aims of this work were to assess the reservoir and seal potential of the Latrobe Group at Anemone-1,1A, with special emphasis on the zones with hydrocarbon shows detected while drilling.

The computations were performed using LOGCALC 2 software, using environmentally corrected wireline logs. As with the previous Petrofina log analysis performed on wells in the VIC/P20 area (Tringham and Questiaux, 1988; Questiaux, 1989), a shaley sand model was used with water saturations derived from the Indonesian equation.

Reservoir parameters were selected separately for each zone and Rw values were automatically corrected during computation for temperature changes with depth. Results are presented on a zone by zone basis and include a summary of results for quick reference (Table 3). A listing of reservoir and log analysis parameters, and detailed tabulated results from each of the hydrocarbon bearing zones are included as Appendices 1 and 2. Graphic output logs of the results include a 1:500 scale display for the entire Latrobe Group (Encl. 1), and a 1:200 scale display of the four zones where hydrocarbon saturations have been observed and computed (Encls. 2 to 5).

The log quality is good down to 4520m, with few washouts or rugose hole sections. Below 4520m however, in the 6" diameter section, the hole was extremely washed out and the log quality is adversely affected. The MSFL and LDT logs for most part read mud properties, making the correction for invasion impossible. Hence, Rt over this interval is equal to LLD corrected for borehole effects only. Similarly, the LDC could not be used for porosity determination, relying only on the CNL and Sonic logs over this interval.

No fewer than five intermediate logging runs were required to log the entire well, and as a result of overlap problems some gaps occur in the logs, but are mainly restricted to zones of little or no interest. Due to hole problem in the 6" section the upper 5m of the Santonian Sandstones, 4525-4530m, could not be logged with the LDT-CNL tool and logs are only available down to 4740m or 35m above TD.

## 3. METHOD

All log analysis calculations were done by computer using LOGCALC 2 software from Scientific Software-Intercomp Inc., Denver.

Briefly summarized below is the method employed for the log evaluation:

(i) The final edited logs received from Schlumberger at the end of the well were loaded into LOGCALC 2, and quality controlled.

(ii) The Gamma Ray, density and neutron logs were then corrected for borehole effects, and the resistivity logs corrected for invasion to give the true Rt.

(iii) Reservoir parameters were then selected for each zone, and by means of an iterative process, modified until results became internally consistent (good match between various porosity curves computed from the separate logs) and satisfied the constraints from the wellsite data (Vshale, mineralogy, hydrocarbon shows, etc.).

(iv) Where applicable, sensitivity runs were performed to evaluate the effect of parameter variations. Results from the sensitivity runs over the Campanian "2" Sandstones and the Santonian Sandstones are presented in Tables 4 and 5.

## 4. PARAMETERS, CUTOFFS AND ANALYSIS OPTIONS

The key reservoir parameters used in the log analysis are listed in Table 2 and the full list of parameters for the four hydrocarbon bearing zones are contained in Appendix 1.

### 4.1 Formation Water Resistivity (Rw)

No formation water samples were obtained for the first three zones analysed and Rw values therefore had to be indirectly derived. The only formation water sample collected was from the interval 4599m to 4652m during DST #1, providing an accurate Rw for the Santonian sandstone. For the other zones Rw were indirectly derived, using as a first appoximation, values similar to those from Angler-1, and then modified these until Ro and Rt curves closely matched in known water bearing sandstones. Rwa estimations were also considered in Rw determination. The output logs (Encls. 1 to 5) show Ro and Rt plotted together in the same track. In water bearing sandstones these curves overlay each other, while in hydrocarbon bearing sandstones Rt reads higher than Ro, the separation between the two curves being a function of the hydrocarbon saturation. Table 2 lists the Rw values at the base of each zone.

4.2 Matrix and Reservoir Parameters

Selected matrix parameters range from 2.64 g/cc to 2.67 g/cc and 61 μs/ft to 52 μs/ft (Table 2). The variations in the matrix parameters reflect the variation in mineralogy within the sandstones. Preliminary petrographic work has indicated that the Latrobe Group sandstones at Anemone-1, like Angler-1, originate from a granitic source, and contain highly variable proportions of feldspars, micas and calcareous or dolomitic cement.

The shale and coal parameters were selected for each zone from the logs, while mud properties and temperatures were taken from the log headers. Bottom hole temperatures for each run were first corrected for static borehole conditions. Table 2 includes a list of the shale parameters for each zone.

4.3 Analysis

A shaley sand analysis was selected because of the complete gradation of sandstone to shale within the Latrobe Group. For the Intra-Campanian, Campanian "1" and Campanian "2" sandstones Vshale determinations were made using both the GR and Density Neutron cross-plots, with LOGCALC 2 selecting the lowest computed Vshale from either. Porosities were calculated using the three standard porosity curves, while the effective porosity (Phie) was computed from the density neutron porosity and sonic porosity curves unless either of these are flagged by bad hole condition. The computed porosity curves, together with Phie, are displayed on the output logs (Encls. 1 to 5). Because of the extremely bad hole conditions in the Santonian Sandstones only the CNL and Sonic logs were used for porosity determination.

4.4 Cutoffs

Cutoff values used were:

(i) porosity > 6%; Vshale < 40% for gross reservoir sandstone

(ii) porosity > 6%; Vshale < 40% and Sw < 50% for net reservoir sandstone in the Intra-Campanian, Campanian "1" and Campanian "2" sandstones

(iii) porosity > 6%; Vshale < 40% and Sw < 65% for net reservoir sandstone in the Santonian sandstone

## 5. LOG ANALYSIS RESULTS

Overall Anemone-1,1A contains 662.8m of gross reservoir, representing a 32% gross sandstone/gross interval ratio. Average porosities by zone range from 11.4% to 23.2%. Four zones, listed in Table 1, were found to be hydrocarbon bearing with only the lower two zones containing significant amounts of net hydrocarbon sandstones. Results for each zone are summarised in Tables 1 and 3 while detailed listings are included in Appendix 2. Similarly reservoir parameters used in the computation are summarised in Table 2 and listed in detail in Appendix 1.

### 5.1 Intra-Campanian Sandstone (Zone 1; 3325-3386m)

This interval of thinly bedded sandstones, siltstones and coal stringers had gas shows of 0.4% to 0.6% total gas observed in the sandstones with hydrocarbon iC4 the heaviest component detected in the gas. No fluorescence or cut was recorded in the cuttings. The log analysis indicates the presence of a 5m thick sandstone from 3363-3368m with an Sw of around 60%, while the other sandstones show near 100% water saturation (Encl. 2). The RFT pressure measurements over this interval show a water gradient of 0.441 psi/ft. The conclusions are that the hydrocarbon shows are related to residual gas sourced in situ from the abundant coal beds. Maturity levels at that depth are of the order of 0.47% Ro which is sufficient to generate hydrocarbons if exudatinite type macerals are present in the coals, as was the case in the lower Maastrichtian section at Angler-1.

5.2 Campanian "1" Sandstones (Zone 2; 4042-4140m)

Moderate gas shows of 0.1% to 0.4% total gas were recorded over this interval with an isolated peak of 1.5%. This gas was overall dry with the heaviest hydrocarbons detected being 0.07% of C3, associated with the 1.5% gas peak. Pale yellow to dull orange fluorescence with poor to good yellow cut was noted both in siltstones and sandstones within the upper 20m of this interval.

The log analysis indicates water saturation of around 70% in all the sandstones, confirming the presence of hydrocarbons. RFT results on the other hand show a clear water gradient of 0.440 psi/ft. The conclusions are that the hydrocarbons shows in these sandstones are similarly to zone 1, related to residual hydrocarbon saturations.

5.3 Campanian "2" Sandstones (Zone 3; 4198-4244m)

This sequence of interbedded sandstones and siltstones is the shallowest interval in Anemone-1,1A to contain significant net reservoirs. The sandstones produced good gas shows of up to 3% total gas while drilling, with C3 the heaviest hydrocarbon detected. Weak pale yellow to gold fluorescence yielding very slow yellow cut was noted in some of the sandstones.

The RFT measurements show a gas gradient of 0.184 psi/ft, which when extrapolated to a water line indicate a possible GWC at 4331m. 31.25 $ft^3$ of gas (C1 = 77%; C2 = 13%; C3 = 6.6%, iC4 = 0.4%; nC4 = 0.5%), 5.9 litres of mud filtrate and 150 ml of light oil emulsion was collected at 4230.5m from the 2 3/4 gallon chamber of the RFT tool.

The presence of gas as the hydrocarbon phase is confirmed by the density neutron cross-plot (Figs. 2 and 3) and a dew point of 5180 psig established from PVT analysis on the segregated sample.

Unlike the upper zones, there was a significant discrepancy between the sonic and density porosity curves when using standard sandstone matrix parameters. The sonic porosity was significantly higher than the density porosity, requiring a $\Delta t$ matrix of 57 μsec/ft and a Rho matrix of 2.67 g/cc to match the two porosity traces.

Preliminary results from petrographic work on the sandstone cuttings in this interval, indicate a mineralogical assemblage consistent with a granitic source. This produces a complex mineralogy, rich in orthoclase feldspars, micas and clay minerals. An M + N plot (Fig. 4) shows how the bulk of the points plot well outside the main mineralogical end points in a sector which indicates a strong shale or clay effect on the matrix parameters. Because of this uncertainty in the matrix parameters, 15 sensitivity runs were performed, using $\Delta t$ matrix and $\Delta$Rhob matrix conformable with a matrix made up essentially of a mixture of feldspars and quartz. Rw was also varied using a pessimistic 0.19 ohm-m (10,000 ppm NaCl) and an optimistic 0.085 ohm-m. Results show a wide range of net reservoir thickness from 3.7m to 20.1m (Table 4), but a narrower range of porosities and saturations (porosities: 11.4% to 14.4%; Sw: 43.5% to 36.2%).

5.4 Santonian Sandstones (Zone 4; 4525-4775m)

This interval was encountered both in Anemone-1 and the sidetrack Anemone-1A. In Anemone-1 the mud gas increased rapidly from 0.08% C1 to 15% C1 and 0.1% C2 when entering these sandstones. At 4585m the mud gas increased further to around 30% C1; 3% C2; 0.02% C3 and traces iC4. Bright green to yellow fluorescence with fast to instantaneous bluish white cut occurred throughout the interval 4525-4609m (Anemone-1 TD). Small amounts of light oil/condensate were found in the drilling mud during circulation after reaching TD. The marked change in the gas composition below 4585m and the presence of the liquid hydrocarbon in the mud was interpreted as a possible gas-oil contact at that level.

Gas shows were similar in Anemone-1A, but lower than Anemone-1 due to the higher mud density used during drilling. C3 was the heaviest hydrocarbon recorded apart from an iC4 peak of 0.1% at 4586m, thought to be the result of swabbing. Below 4620m gas values dropped sharply (C1 = 0.3% - 0.02%; no C2 +) due to an increase in mud weight (1.48 SG). An isolated gas peak of 20% total gas was recorded in a 3m thick sandstone unit at 4734m. Heavier hydrocarbons up to 0.03% iC4 were recorded with the peak. Fluorescence and cut were similar to those found in Anemone-1, but extended only from 4525-4585m and again from 4630-4645m.

In view of the good hydrocrabon shows and the high hydrocarbon saturations computed from the logs it was decided to perform a production test on these sandstones. Two DSTs were carried out and results are briefly summarized below:

DST #1

Perforations: 4599-4618m

4629-4652m

Results: Flow Rates

1. Condensate : 120-150 bpd (gravity 0.78 SG)
2. Water : 120-140 bpd (NaCl = 10,000 ppm)
3. Gas : 0.8-1.0 mmscf (gravity = 0.94)
(air = 1)
(C1/Ct = ±80%)

The conclusions drawn from DST #1 were:

(i) Sandstones have very low permeability

(ii) Hydrocarbon saturations are close to residual saturations, resulting in a mixed production of gas/condensate and water.

(iii) Formation water salinity is much lower than originally expected.

(iv) The depth and high pressure in the reservoir (9600-9900 psi at 4600m) and the low mud weights used while drilling this section, contributed to misleadingly high mud gas readings.

DST #2

Perforations: 4535-4545m (DST #1 perforation isolated by bridge plug)

Results: Flow Rates

1. Water : 60 bpd
2. Gas : Traces of gas at surface
3. Condensate : None

An important result from DST #1 was the unusual freshness of the formation water. Since the Santonian Sandstones are interpreted as a marine sequence and that marine sandstones higher up in this well and in the other VIC/P20 wells usually contain saline formation water, an Rw of 0.07 was used in the log evaluation before the test.

Using a cutoff of Sw < 65%; Vshale of < 40% and Phie < 6%, yielded net reservoir thickness of 90m; with an average porosity of 16.5% and an average Sw of 40%. This result seemed reasonable in view of the excellent shows noted while drilling. However, using the true Rw of 0.16 ohm-m at the reservoir temperature and using a $\Delta$t matrix of 61 μsec/ft which is equivalent to a ± 50% orthoclase and 50% quartz matrix as indicated from the petrography, yielded the much lower results listed in Table 1. Six sensitivity runs, using various $\Delta$t matrix equivalent to a range of possible ratios of orthoclase and quartz in the matrix yeilded 12.8m to 38.6m of net reservoir thickness (Table 5) with a porosity range of 17.6% to 18.1% and a Sw range of 54.2% to 55.3%.

It must be noted that the logs are badly affected by the hole conditions. This made it impossible to correct the resistivity curve for invasion, while the density log was so badly affected that it could not be used in the computations. The sonic log was similarly affected by the hole condition, resulting in some anomalously low $\Delta t$ readings in the badly washed out sections and thus yielding relatively high porosities. This problem is clearly illustrated in a 5m thick sandstone from 3530-3535m (Encl. 5) where the sonic log is essentially reading mud and the computed porosities are abnormally high. Preliminary results from the petrographic studies on cuttings samples suggest that a large fraction of the effective porosity is secondary porosity resulting from the leaching of feldspars. In the absence of core data, the log evaluation will remain ambiguous in terms of porosity and water saturation.

## 6. REFERENCES

**QUESTIAUX, J.M.** (1989). Log Analysis of The Latrobe Group in Anger-1
Petrofina Exploration Australia S.A., Unpublished Company Report
GL/89/023

**TRINGHAM, M.E. and QUESTIAUX, J.M.** (1988). A Log Analysis of the Latrobe and Strzelecki Group in the Wells of the VIC/P20 Area
Petrofina Exploration Australia S.A., Unpublished Company Report
GL/88/006

A2 figures 1, 2, 3 and 4 to follow

ANEMONE-1 &1A
DEPTH VERSUS POROSITY PLOT
LATROBE GROUP (2600-4750M)
SCALE 1:10000

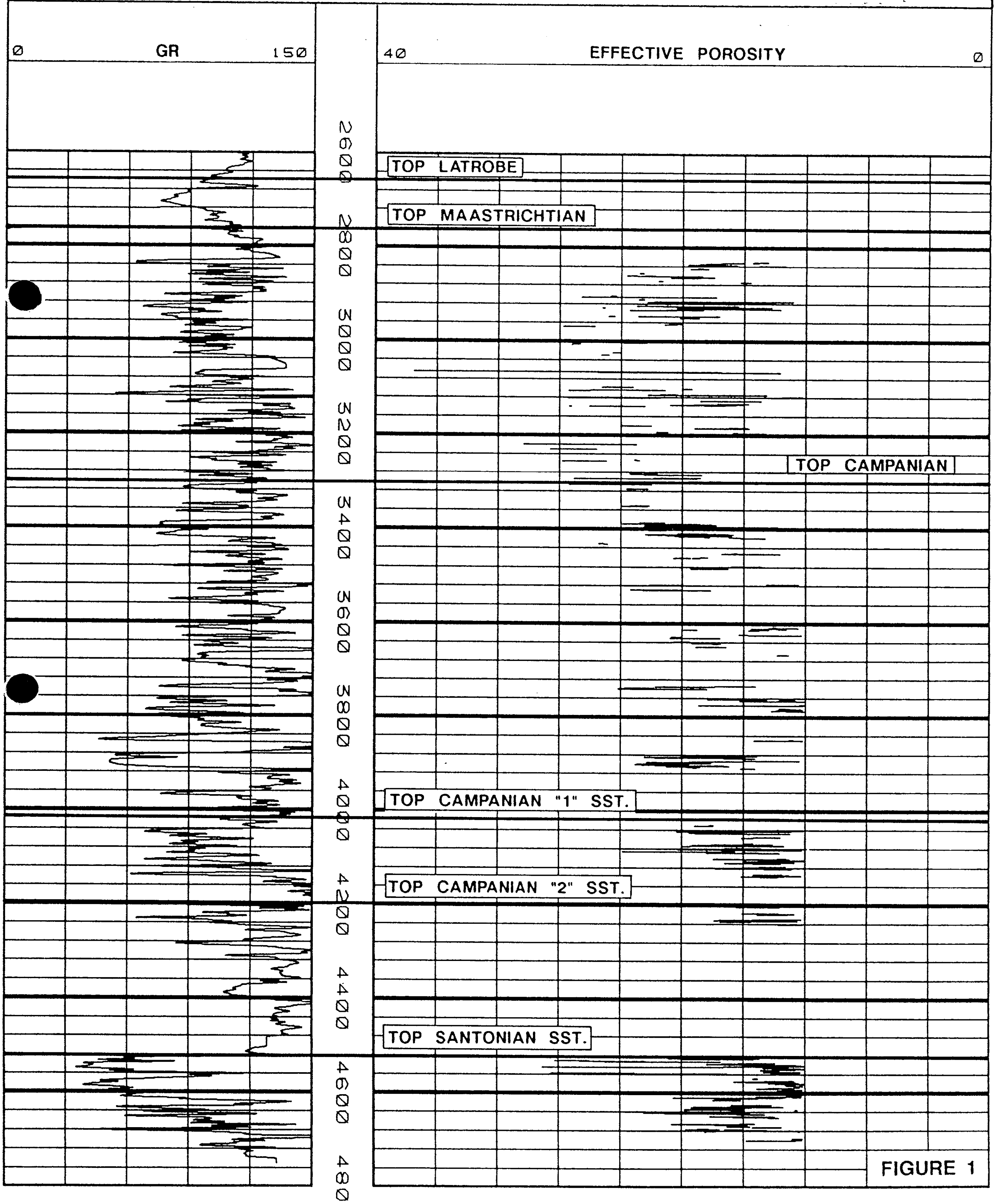
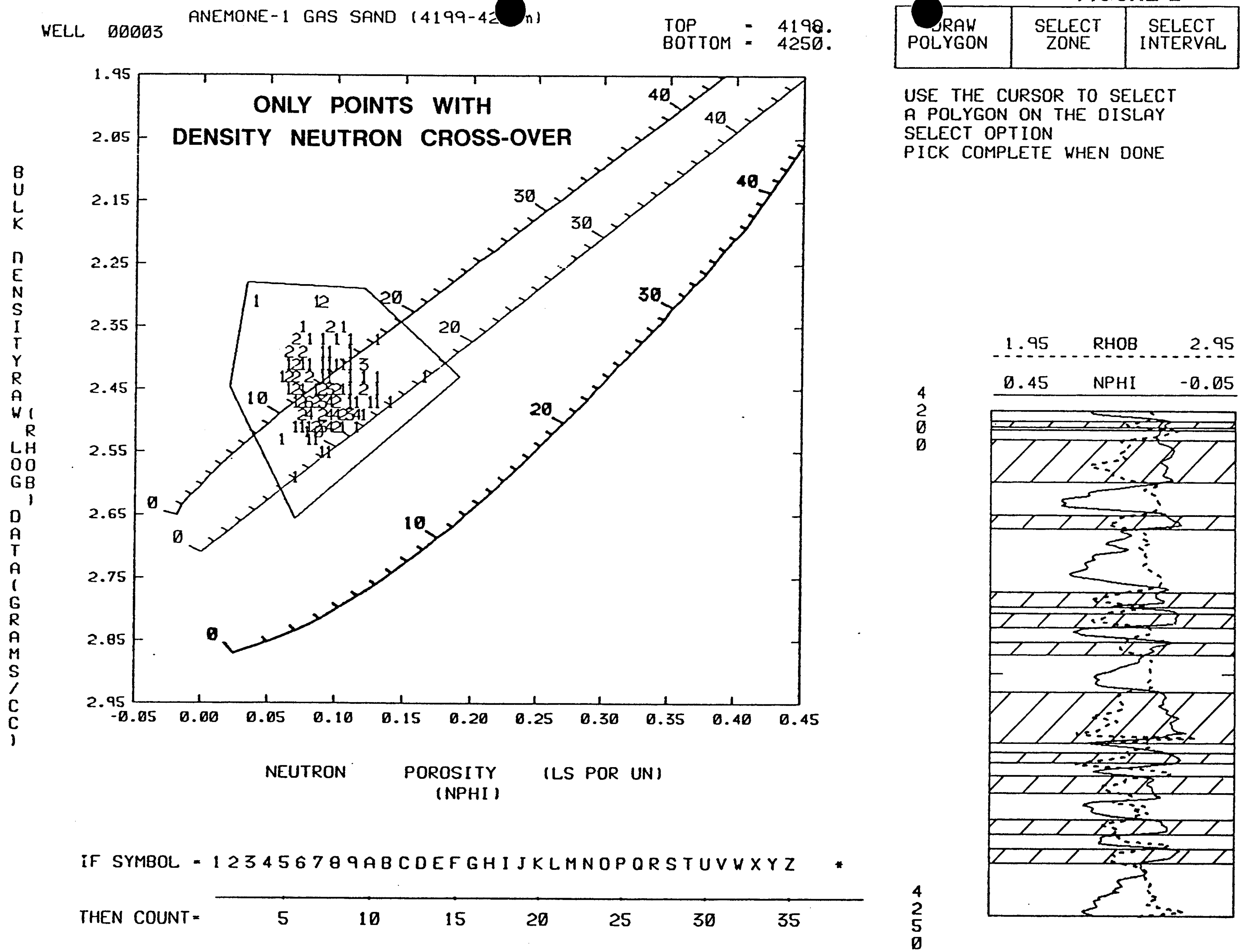



FIGURE 1

FIGURE 2



WELL 00003
ANEMONE-1 GAS SAND (4199-42 m)
TOP - 4198.
BOTTOM - 4250.
DRAW POLYGON
SELECT ZONE
SELECT INTERVAL
USE THE CURSOR TO SELECT
A POLYGON ON THE DISLAY
SELECT OPTION
PICK COMPLETE WHEN DONE
ONLY POINTS WITH
DENSITY NEUTRON CROSS-OVER
BULK DENSITY RAW (RHOB) LOG DATA (GRAMS/CC)
NEUTRON POROSITY (LS POR UN) (NPHI)
1.95 RHOB 2.95
0.45 NPHI -0.05
4200
4250
IF SYMBOL - 1 2 3 4 5 6 7 8 9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z *
THEN COUNT= 5 10 15 20 25 30 35

**FIGURE 3**

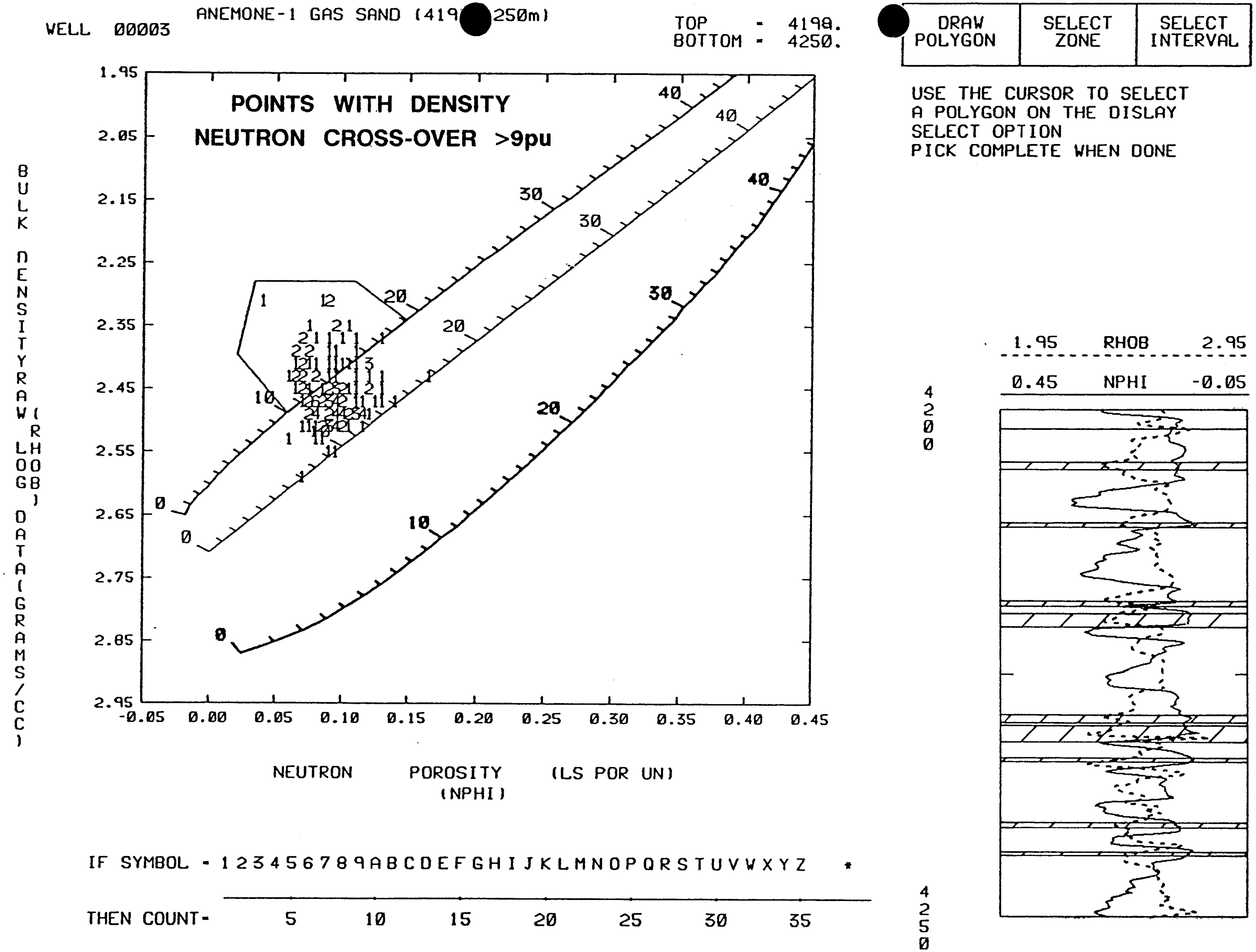
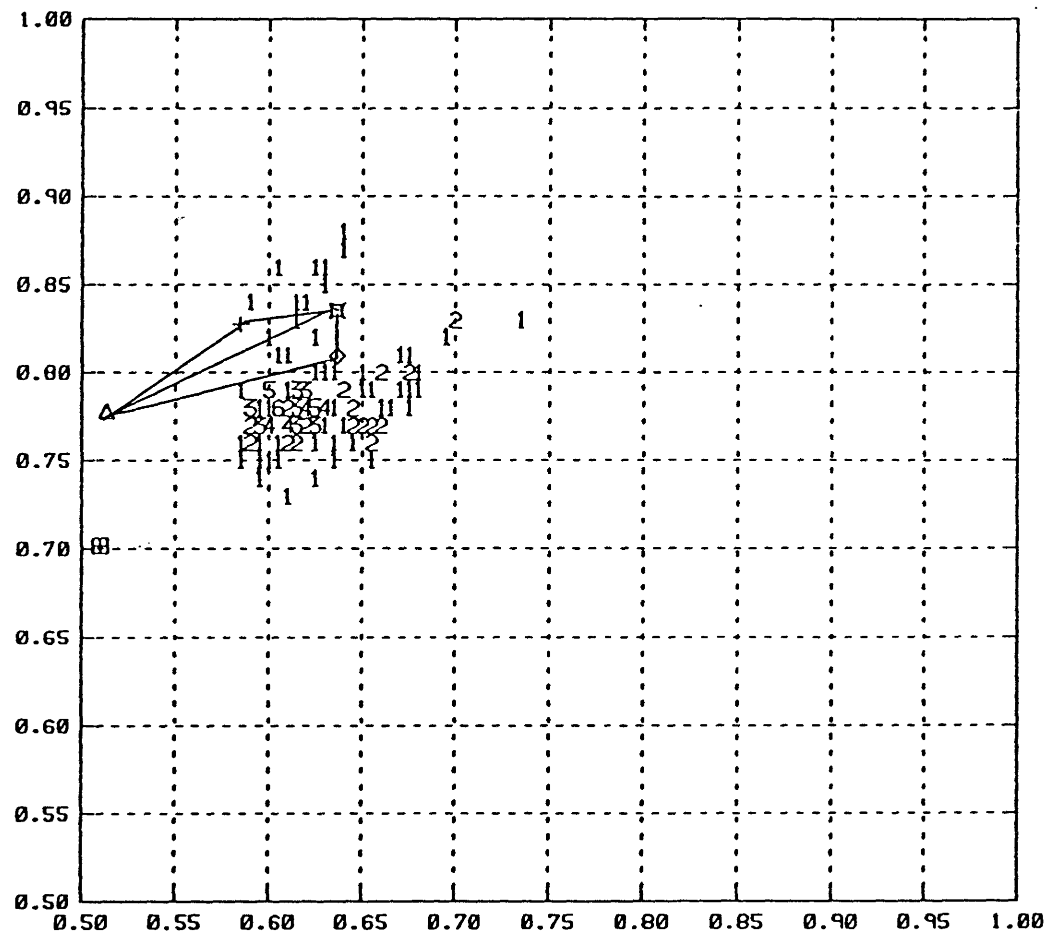

WELL 00003
ANEMONE-1 GAS SAND (419[illegible]250m)
TOP - 4198.
BOTTOM - 4250.
DRAW POLYGON
SELECT ZONE
SELECT INTERVAL
USE THE CURSOR TO SELECT
A POLYGON ON THE DISLAY
SELECT OPTION
PICK COMPLETE WHEN DONE
POINTS WITH DENSITY
NEUTRON CROSS-OVER >9pu
BULK DENSITY RAW LOG DATA (RHOB) (GRAMS/CC)
1.95
2.05
2.15
2.25
2.35
2.45
2.55
2.65
2.75
2.85
2.95
-0.05 0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
NEUTRON POROSITY (NPHI) (LS POR UN)
1.95 RHOB 2.95
0.45 NPHI -0.05
4200
4250
IF SYMBOL - 1 2 3 4 5 6 7 8 9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z *
THEN COUNT- 5 10 15 20 25 30 35

FIGURE 4

WELL 00003

ANEMONE-1 M & N PLOT (4195-4250m)

TOP = 4195.
BOTTOM = 4250.




M - N (CNL)

□ DOLOMITE(1)
○ DOLOMITE(2)
△ DOLOMITE(3)
\+ CALCITE
◇ SILICA(1)
⌑ SILICA(2)
⊕ GYPSUM
⊞ ANHYDRITE

FLUID DENSITY?
GM/CC (1.0) 1.
FLUID TRANSIT TIME?
MICROSECS/FT (189) 189.

IF SYMBOL - 1 2 3 4 5 6 7 8 9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z *

THEN COUNT- 5 10 15 20 25 30 35

A2 Tables 1, 2, 3, 4 and 5 to follow

TABLE 1

ANEMONE-1,1A SUMMARY OF HYDROCARBON BEARING ZONES

| INTERVAL | RESERVOIR TYPE | HYDROCARBON TYPE | COMMENTS |
|---|---|---|---|
| 3325-3386m Intra-Campanian Sandstone | Thinly bedded sandstones within a siltstone and coal sequence | gas | Low hydrocarbon saturations. Moderate gas shows while drilling. Average porosity = 20.7% Average Sw = 82.5% RFT indicates a water gradient of 0.441 psi/ft |
| 4042-4140m Campanian "1" Sandstone | Interbedded sequence of sandstones and siltstones | gas | Low hydrocarbon saturations. Moderate gas shows while drilling. Pale yellow fluorescence with poor to good cut in siltstones and sandstones within upper 20m of section. Average porosity = 13.9% Average Sw = 75.6% RFT indicates water gradient of 0.440 psi/ft |
| 4198-4244m Campanian "2" Sandstone | Interbedded sequence of sandstones and siltstones | gas/ condensate | 18.8m of net gas reservoir Sandstone. Average porosity = 12.8%, Sw = 35.7%. RFT shows gas gradient of 0.184 psi/ft with an extrapolated GWC @ 4331m. RFT fluid sample @ 4230.5m recovered 31.25ft$^3$ gas, 5.9 litres mud filtrate and 150ml light oil emulsion |
| 4525-4775m Santonian Sandstone | Thickly bedded sandstones with minor siltstone interbeds | gas/ condensate | 24.2m of net reservoir sandstone. Average porosity = 17.7%, Sw = 55.2%. Strong gas shows while drilling. Condensate, gas and water produced from DST #1 (4599-4618m and 4629-4652m). Only water produced from DST #2 (4535-4545m) |

## TABLE 2
## ANEMONE-1,1A ZONATION AND KEY RESERVOIR PARAMETERS

| ZONE | INTERVAL (m) Top | Bottom | PARAMETER SET NAME | Rw @ BOTTOM OF ZONE (ohm-m) | GR Matrix (API) | GR Shale (API) | Rho Shale (g/cc) | PhiN Shale (pu) | Δt Shale (μs/ft) | Res Shale (ohm-m) | Rho Matrix (g/cc) | Δt Matrix (μs/ft) | Cp | Rho Fluid (g/cc) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PALAEOCENE | 2677 | 2760 | PALC | 0.12 | 70 | 120 | 2.53 | 33 | 90 | 2.2 | 2.62 | 58 | 1.4 | 1 |
| UPPER T.LONGUS | 2760 | 2810 | MAAS1 | 0.12 | 70 | 120 | 2.53 | 33 | 90 | 2.2 | 2.62 | 58 | 1.3 | 1 |
| MIDDLE T.LONGUS | 2810 | 2850 | MAAS2 | 0.11 | 65 | 150 | 2.50 | 27 | 82 | 9 | 2.66 | 58 | 1 | 1 |
| LOWER T.LONGUS | 2850 | 3325 | MAAS3 | 0.13 | 50 | 150 | 2.48 | 27 | 79 | 9 | 2.66 | 56 | 1 | 1 |
| INTRA-CAMP SST (Z1) | 3325 | 3386 | Z1 | 0.10 | 50 | 155 | 2.50 | 21 | 79 | 9 | 2.67 | 57 | 1 | 1 |
| INTRA-CAMPANIAN | 3386 | 3517 | CAMP1 | 0.10 | 60 | 155 | 2.55 | 25 | 76 | 12 | 2.66 | 56 | 1 | 1 |
| INTRA-CAMPANIAN | 3517 | 3790 | CAMP2 | 0.10 | 65 | 160 | 2.55 | 24 | 75 | 12 | 2.66 | 55 | 1 | 1 |
| INTRA-CAMPANIAN | 3790 | 3830 | CAMP3 | 0.12 | 60 | 155 | 2.50 | 24 | 75 | 15 | 2.67 | 57 | 1 | 1 |
| INTRA-CAMPANIAN | 3830 | 4025 | CAMP4 | 0.12 | 48 | 150 | 2.50 | 20 | 65 | 19 | 2.67 | 57 | 1 | 1 |
| CAMPANIAN "1" SST (Z2) | 4025 | 4198 | Z2 | 0.10 | 50 | 155 | 2.50 | 21 | 79 | 9 | 2.67 | 57 | 1 | 1 |
| CAMPANIAN "2" SST (Z3) | 4198 | 4250 | Z3 | 0.10 | 47 | 170 | 2.60 | 22 | 71 | 20 | 2.67 | 60 | 1 | 0.9 |
| UPPER SANTONIAN | 4250 | 4525 | SANT1 | 0.10 | 47 | 160 | 2.58 | 25 | 73 | 17 | 2.67 | 60 | 1 | 1 |
| SANTONIAN SST (Z4) | 4525 | 4740 | Z4 | 0.16 | 38 | 180 | 2.73 | 15 | 65 | 25 | - | 61 | 1 | 0.95 |

Cp = Compaction factor

**TABLE 3**

**ANEMONE-1,1A SUMMARY OF LOG ANALYSIS RESULTS**

| ZONE | INTERVAL (m) Top | INTERVAL (m) Bottom | THICKNESS (m) | GROSS RESERVOIR THICKNESS (m) | GROSS RESERVOIR THICKNESS/GROSS INTERVAL THICKNESS | AVERAGE PHIE (%) | AVERAGE Sw (%) | NET RESERVOIR THICKNESS (m) | AVERAGE PHIE (%) | AVERAGE Sw (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| PALAEOCENE | 2677 | 2760 | 83 | 4.0 | 0.05 | 22.5 | 97.2 | 0 | - | - |
| UPPER T.LONGUS | 2760 | 2810 | 50 | 25.9 | 0.52 | 23.2 | 99.9 | 0 | - | - |
| MIDDLE T.LONGUS | 2810 | 2850 | 40 | 16.8 | 0.42 | 17.4 | 99.0 | 0 | - | - |
| LOWER T.LONGUS | 2850 | 3198 | 348 | 140.2 | 0.40 | 19.4 | 96.8 | 0 | - | - |
| UPPER CAMPANIAN (UK4) | 3198 | 3325 | 127 | 45.1 | 0.36 | 20.4 | 97.0 | 0 | - | - |
| INTRA-CAMPANIAN SST (Z1) | 3325 | 3386 | 61 | 11.1 | 0.18 | 20.7 | 82.5 | 0.8 | 22.3 | 44.9 |
| INTRA-CAMPANIAN (UK3/T.LILLEI) | 3386 | 3920 | 534 | 216.4 | 0.40 | 15.1 | 95.9 | 0 | - | - |
| INTRA-CAMPANIAN (UK2/SENECTUS) | 3920 | 4042 | 122 | 16.8 | 0.14 | 13.6 | 88.9 | 0 | - | - |

## TABLE 3 (continued)
## ANEMONE-1,1A SUMMARY OF LOG ANALYSIS RESULTS

| ZONE | INTERVAL (m) Top | Bottom | THICKNESS (m) | GROSS RESERVOIR THICKNESS (m) | GROSS RESERVOIR THICKNESS/GROSS INTERVAL THICKNESS | AVERAGE PHIE (%) | AVERAGE Sw (%) | NET RESERVOIR THICKNESS (m) | AVERAGE PHIE (%) | AVERAGE Sw (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| CAMPANIAN "1" SST (Z2) | 4042 | 4140 | 98 | 51.4 | 0.52 | 13.9 | 75.6 | 1.7 | 11.6 | 45.0 |
| INTRA-CAMPANIAN (UK2/SENECTUS) | 4140 | 4198 | 58 | 0 | - | - | - | 0 | - | - |
| CAMPANIAN "2" SST (Z3) | 4198 | 4244 | 46 | 24.6 | 0.53 | 11.3 | 41.8 | 18.8 | 12.8 | 35.7 |
| UPPER SANTONIAN | 4244 | 4525 | 281 | 0 | - | - | - | 0 | - | - |
| SANTONIAN SST (Z4) | 4525 | 4740* | 215 | 110.5 | 0.51 | 13.8 | 73.3 | 24.2 | 17.7 | 55.2 |

* SANTONIAN SST calculations done to 4740m only; equivalent to maximum depth at which valid wireline logs are available.

## TABLE 4

## ANEMONE-1,1A RESULTS OF SENSITIVITY RUN IN GAS ZONE OF CAMPANIAN '2' SANDSTONE (4198-4244m)

Cut offs: Sw <50%; Vshale <40%; Phie >6%

| RUN # | Rw @ BOTTOM OF ZONE (ohm-m) | Rho Fluid (g/cc) | /\t Mat (µs/ft) (ohm-m) | Rhob Mat (g/cc) | Thickness of Net Sandstone (m) | Average Porosity (%) | Average Sw (%) |
|---|---|---|---|---|---|---|---|
| 1 | 0.085 | 0.95 | 60 | 2.60 | 14.9 | 10.9 | 37.3 |
| 2 | 0.085 | 0.95 | 59 | 2.64 | 18.3 | 11.3 | 36.2 |
| 3 | 0.085 | 0.95 | 57 | 2.67 | 20.6 | 11.9 | 35.0 |
| 4 | 0.085 | 0.95 | 56 | 2.68 | 21.3 | 12.7 | 34.7 |
| 5 | 0.085 | 0.95 | 55 | 2.70 | 22.1 | 12.9 | 33.7 |
| 6 | 0.10 | 0.95 | 60 | 2.60 | 11.7 | 11.4 | 39.0 |
| 7 | 0.10 | 0.95 | 59 | 2.64 | 15.0 | 11.8 | 38.1 |
| 8 * | 0.10 | 0.95 | 57 | 2.67 | 18.8 | 12.8 | 37.5 |
| 9 | 0.10 | 0.95 | 56 | 2.68 | 19.4 | 13.0 | 37.2 |
| 10 | 0.10 | 0.95 | 55 | 2.70 | 20.1 | 13.3 | 36.2 |
| 11 | 0.19 | 0.95 | 60 | 2.60 | 3.7 | 13.7 | 43.3 |
| 12 | 0.19 | 0.95 | 59 | 2.64 | 6.5 | 13.8 | 43.5 |
| 13 | 0.19 | 0.95 | 57 | 2.67 | 7.9 | 14.2 | 42.2 |
| 14 | 0.19 | 0.95 | 56 | 2.68 | 8.5 | 14.3 | 42.1 |
| 15 | 0.19 | 0.95 | 55 | 2.70 | 10.8 | 14.4 | 42.0 |

* Run #8 taken as most likely case

Rw = 0.19 @ 236°F, is equivalent to a water salinity of 10,000 ppm (same salinity as for Santonian Sandstones)

## TABLE 5

## ANEMONE-1,1A RESULTS OF SENSITIVITY RUN IN GAS ZONE OF SANTONIAN SANDSTONE (4525-4740m)

Cut offs: Sw <65%; Vshale <40%; Phie >6%

| RUN # | Rw @ BOTTOM OF ZONE (ohm-m) | Rho Fluid (g/cc) | $\Delta$t Mat (µs/ft) (ohm-m) | Thickness of Net Sandstone (m) | Average Porosity (%) | Average Sw (%) |
|---|---|---|---|---|---|---|
| 1 | 0.16 | 0.95 | 65 | 12.8 | 18.1 | 54.2 |
| 2 | 0.16 | 0.95 | 63 | 16.9 | 17.9 | 54.3 |
| 3 * | 0.16 | 0.95 | 61 | 24.2 | 17.7 | 55.2 |
| 4 | 0.16 | 0.95 | 59 | 33.8 | 17.5 | 55.4 |
| 5 | 0.16 | 0.95 | 58 | 38.6 | 17.6 | 55.3 |

* Run #3 taken as most likely case

Run #1 equivalent to ±70% ORTHOCLASE and 30% QUARTZ

Run #5 equivalent to ±20% ORTHOCLASE and 80% QUARTZ

**NOTE**

Appendices and enclosures for this report have been previously sent.

SEE REPORT PE903131

# APPENDIX 3

APPENDIX 3

**WELL COMPLETION REPORT**

**ANEMONE-1,1A**

# INTERPRETATIVE DATA

# A P P E N D I X 3

# RFT INTERPRETATION

PETROFINA EXPLORATION AUSTRALIA S.A.

# ANEMONE-1,1A

# RFT ANALYSIS REPORT

JMQ/AH/kl
8 December 1989
GL/89/032

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## LIST OF ENCLOSURES

## 1. SUMMARY AND CONCLUSIONS

A total of 34 RFT pressure tests were carried out in Anemone-1,1A, covering the interval 3121m to 4243.8m BKB (Below kelly bushing). Of these, 30 were successful, including the recovery of one segregated sample at 4230.5m.

The conclusion of these tests are:

(i) The formation pressures measured in sandstones above 3965m display a normal water gradient of 0.441 psi/ft (1.02 SG, 8.5 lb/gal) (Encl. 1).

(ii) The sandstone reservoirs from 3965m to 4139m appear slightly over-pressured with a gradient of 0.473 psi/ft (1.09 SG, 9.1 lb/gal) (Encls. 1 and 2).

(iii) A gas gradient of 0.1835 psi/ft was measured in the interval from 4199m to 4243.8m (Encls. 1 and 2). No gas/water contact was intersected below 4243.8m, but by extrapolation of the gas and water gradients a possible GWC exists at 4331m (Encl. 2).

(iv) No oil gradients were recorded in this well.

(v) The hydrostatic mud gradient is constant at 0.488 psi/ft (1.13 SG, 9.4 lb/gal).

(vi) The hydrostatic mud overbalance ranges from a low of 568.4 psi over the moderately over-pressured sandstones below 3965m, to a high of 764.3 psi for sandstones above that depth.

## 2. INTRODUCTION

A total of 34 pressure tests were attempted at Anemone-1,1A over the interval 3121m to 4243.8m. Of these, three tests failed to seal, one test was dry and two tests showed signs of supercharging (Table 1, Encls. 1 and 2). Pressure sampling was carried out over the entire interval with 11 tests concentrated in the reservoir 4199m to 4243.8m (Campanian "2" Sandstones) where good hydrocarbon shows were recorded. The mud hydrostatic gradient was measured at 0.488 psi/ft (1.13 SG) (Encl. 1). A segregated sample was collected at 4230.5m and recovered 21.35 cu ft gas, 150 ml of liquid hydrocarbon and 5.9 litres of filtrate (see Table 1 for analytical details).

The RFT results are presented separately below for each of the hydrocarbon bearing zones identified from the log analysis evaluation of the Latrobe Group (Questiaux and Hodgson, 1989).

## 3. ZONE I (3325-3386m) INTRA CAMPANIAN SANDSTONE

This interval is characterized by thinly bedded sandstones, siltstones and coal stringers. Gas shows of between 0.4% and 0.6% total gas were recorded in the sandstones with iC4 the heaviest hydrocarbon detected. No fluorescence or cut was noted in the cuttings. The log analysis results for this zone indicate the presence of predominantly water-bearing sandstones with Sw of 82.5%. The RFT pressure measurements over this interval show a water gradient of 0.441 psi/ft (Encl. 1), confirming water as the dominant fluid in the reservoir. The low hydrocarbon saturations computed in these sandstones, together with the shows while drilling, are indicative of residual hydrocarbon saturation.

RFT pressure readings above and below this zone from 3121m to 3739m, fall on the same 0.441 psi/ft gradient (Encl. 1) and indicate a uniform pressure regime over this 600m interval.

One measurement at 3907m is 238 psi higher than expected from this trend. No shows were recorded at that depth and the RFT measurement showed a low permeability (8 md), indicating that this anomalous pressure reading is the result of supercharging rather than a hydrocarbon buoyancy effect.

## 4. ZONE II (4042-4140m) CAMPANIAN '1' SANDSTONE

This zone comprises a sequence of well developed sandstones with subordinate siltstone interbeds. Only moderate gas shows of between 0.1 and 0.4% total gas were recorded with one isolated peak of 1.5%. Overall the gas was dry with only a trace of C3 detected. Traces of pale yellow to dull orange fluorescence with a poor to good cut were noted in cuttings within the upper 20m of the section. Log analysis indicates water saturations averaging 70% in the sandstones, confirming the presence of some hydrocarbons. However, the pressure gradient established from the RFT for this interval is 0.473 psi/ft, equivalent to a slightly over-pressured water gradient. The log analysis has discounted salinity as the reason for this higher-than-normal pressure gradient, with the over-pressure interpreted as the result of undercompaction. As for Zone I, this interval is essentially water-bearing with some low residual hydrocarbon saturations.

The change of gradient between 3740m and 3960m may correspond to an unconformity between these two depths, possibly coinciding with the Top UK3.1 (Encl. 2).

## 5. ZONE III (4198-4244m) CAMPANIAN '2' SANDSTONE

This interval covers a sequence of interbedded sandstones and siltstones from which good gas shows of up to 3% total gas were recorded together with common pale yellow-gold fluorescence with slow yellow cut noted in the sandstone cuttings.

The RFT pressure measurements show a gas gradient of 0.1835 psi/ft (Encls. 1 and 2) over the entire interval. This gas gradient is supported by the log analysis which shows a clear gas effect on the density neutron cross-plot. A sample taken at 4230.5m yielded 21.35 cu ft of gas (C1 = 77%, C2 = 13%, C3 = 6.6%, iC4 = 0.4%, nC4 = 0.5%, $CO_2$ = nil, $H_2S$ = nil), 5.9 litres of filtrate and 150 ml of liquid hydrocarbons, indicating that the hydrocarbon is a retrograde gas condensate.

The RFT measurements show that Anemone-1,1A did not intersect a gas-oil or gas/water contact in the Campanian "2" Sandstone (Encls. 1 and 2), and confirmed a gas column only down to 4244m. However, a likely gas/water contact for these has been derived using the following reasoning:

> The RFT pressure measurements in the sandstones from 3907m to 4139m show a slightly over-pressured water gradient of 0.473 psi/ft (Encls. 1 and 2). A simple extrapolation of that trend allows the gas gradient of 0.1835 psi/ft to intersect this water gradient at 4303m, indicating a possible gas/water contact at that level. However, Enclosure 2 shows that the over-pressured sandstones from 3907-4139m are isolated by shales both above and below this interval. In fact 55m of tight siltstone/shale separates these over-pressured sandstones and the Campanian "2" Sandstones below them (Encl. 2) making communication between the two unlikely. On this basis, the 0.473 psi/ft water gradient established in the 3907m to 4139m, interval should not be extrapolated into the Campanian "2" Sandstone. In view of the similarity between the two sandstones, it is likely that undercompaction has also taken place in the Campanian "2" Sandstones. An interval (water) pressure gradient of 0.473 psi/ft has therefore been assumed for the Campanian "2" Sandstone, intersecting the normal water gradient of 0.441 psi/ft at the top of the reservoir (4199m). This is schematically illustrated on Figure 2 and in detail on Figure 1 and Enclosure 2. Using this model, a possible gas/water contact can be established at 4331m.

## 6. REFERENCES

**QUESTIAUX, J.M. and HODGSON, A.J.** (1989). Log Analysis of the Hydrocarbon Bearing Formations of the Latrobe Group in Anemone-1,1A Petrofina Exploration Australia S.A., Unpublished Company Report GL/89/027

A3 table 1 to follow

## TABLE 1

ANEMONE-1A RFT SURVEY INTERMEDIATE LOGGING RUN

| | LEVEL | DEPTH M BKB | DEPTH ft BKB | HYDROSTATIC PRESSURE PSI | HYDRO. GRADIENT PSI/ft | FORMATION PRESSURE PSIG | FORMATION GRADIENT PSI/ft | Kh md | DELTA PRESSURE | DEPTH ft SUBSEA |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 3121.00 | 10239.38 | 5115.60 | 0.4996 | 4459.80 | 0.4394 | 1200 | 655.80 | -10150.80 |
| | 2 | 3171.00 | 10403.42 | 5196.30 | 0.4995 | 4529.30 | 0.4391 | 220 | 667.00 | -10314.84 |
| | 3 | 3251.00 | 10665.88 | 5324.90 | 0.4992 | 4638.30 | 0.4385 | 1050 | 686.60 | -10577.30 |
| | 4 | 3350.00 | 10990.68 | 5483.60 | 0.4989 | 4777.80 | 0.4382 | 400 | 705.80 | -10902.10 |
| | 5 | 3364.00 | 11036.61 | 5505.20 | 0.4988 | 4802.00 | 0.4386 | 100 | 703.20 | -10948.03 |
| | 6 | 3365.50 | 11041.53 | 5506.00 | 0.4987 | 4803.40 | 0.4385 | 210 | 702.60 | -10952.95 |
| | 7 | 3368.50 | 11051.37 | 5510.30 | 0.4986 | 4807.60 | 0.4385 | 200 | 702.70 | -10962.79 |
| | 8 | 3416.00 | 11207.21 | 5587.10 | 0.4985 | 4875.90 | 0.4385 | 42 | 711.20 | -11118.63 |
| | 9 | 3665.00 | 12024.13 | 5990.20 | 0.4982 | 5247.80 | 0.4397 | 126 | 742.40 | -11935.55 |
| | 10 | 3739.00 | 12266.91 | 6111.50 | 0.4982 | 5349.50 | 0.4393 | 214 | 762.00 | -12178.33 |
| | 11 | 3907.00 | 12818.09 | 6387.60 | 0.4983 | 5662.70 | 0.4448 | 8 | 724.90 | -12729.50 |
| | 12 | 3965.00 | 13008.37 | 6482.80 | 0.4984 | 5718.80 | 0.4426 | 298 | 764.00 | -12919.79 |
| | 13 | 4031.00 | 13224.90 | 6589.80 | 0.4983 | 5825.50 | 0.4435 | 117 | 764.30 | -13136.32 |
| | 14 | 4044.00 | 13267.56 | 6596.15 | 0.4972 | 5843.25 | 0.4434 | 72 | 752.90 | -13178.97 |
| | 15 | 4055.50 | 13305.28 | 6615.70 | 0.4972 | 5861.60 | 0.4435 | 11 | 754.10 | -13216.70 |
| | 16 | 4065.00 | 13336.45 | 6631.20 | 0.4972 | 5884.00 | 0.4441 | 12 | 747.20 | -13247.87 |
| | 17 | 4074.50 | 13367.62 | 6646.90 | 0.4972 | 5893.13 | 0.4438 | 80 | 753.77 | -13279.04 |
| | 18 | 4081.00 | 13388.94 | 6653.05 | 0.4969 | 5903.40 | 0.4439 | 66 | 749.65 | -13300.36 |
| | 19 | 4139.00 | 13579.23 | 6746.80 | 0.4968 | 5990.87 | 0.4441 | 74 | 755.93 | -13490.65 |
| * | 20 | 4201.50 | 13784.28 | 6847.60 | 0.4968 | 6189.70 | 0.4519 | 18 | 657.90 | -13695.70 |
| | 21 | 4203.60 | 13791.17 | 6852.40 | 0.4969 | 6188.30 | 0.4516 | 28 | 664.10 | -13702.59 |
| * | 22 | 4209.50 | 13810.53 | 6860.00 | 0.4967 | Dry | | | | -13721.95 |
| * | 23 | 4217.20 | 13835.79 | 6874.20 | 0.4968 | 6193.70 | 0.4505 | 108 | 680.50 | -13747.21 |
| | 24 | 4219.30 | 13842.68 | 6874.70 | 0.4966 | 6192.95 | 0.4503 | 62 | 681.75 | -13754.10 |
| * | 25 | 4222.00 | 13851.54 | 6878.50 | 0.4966 | S.F. | | | | -13762.96 |
| * | 26 | 4222.40 | 13852.85 | 6877.40 | 0.4965 | 6309.00 | 0.4584 | | 568.40 | -13764.27 |
| * | 27 | 4227.50 | 13869.58 | 6892.20 | 0.4969 | 6207.30 | 0.4504 | | 684.90 | -13781.00 |
| | 28 | 4229.30 | 13875.49 | 6894.40 | 0.4969 | 6203.85 | 0.4500 | | 690.55 | -13786.91 |
| + | 29 | 4230.50 | 13879.42 | 6895.50 | 0.4968 | 6204.90 | 0.4499 | | 690.60 | -13790.84 |
| * | 30 | 4233.70 | 13889.92 | 6904.70 | 0.4971 | S.F. | | | | -13801.34 |
| * | 31 | 4234.00 | 13890.91 | 6904.90 | 0.4971 | S.F. | | | | -13802.33 |
| | 32 | 4236.70 | 13899.77 | 6903.40 | 0.4967 | 6207.10 | 0.4494 | 26 | 696.30 | -13811.18 |
| | 33 | 4241.00 | 13913.87 | 6910.15 | 0.4966 | 6210.00 | 0.4492 | 38 | 700.15 | -13825.29 |
| | 34 | 4243.80 | 13923.06 | 6914.50 | 0.4966 | 6212.15 | 0.4490 | 15 | 702.35 | -13834.48 |

* For sample points taken following Measurement @ 4243.8m, Pressure readings are +1.0 psi higher.

\+ Sample recovered from 2 3/4 gallon chamber contained:
21.35 cu ft gas  C1 = 77%  C2 = 13%  C3 = 6.6%  lC4 = 0.4%  nC4 = 0.5%  CO2 = nil  H2S = nil
5.9 litres of filtrate and 150 ml light oil emulsion

Composition:

| | | |
|---|---|---|
| Cl- | = | 13,500 ppm |
| SO3 2- | = | 60 mg/l |
| Ca2+ | = | 520 mg/l |
| Nitrates | = | 0.352 mg/l |
| Resistivity | = | 0.287 |

The drilling mud composition was:

| | | |
|---|---|---|
| Cl- | = | 13,000 ppm |
| SO3 2- | = | 80 g/l |
| Ca2+ | = | 560 g/l |
| Nitrates | = | none added |
| Resistivity | = | 0.284 |

Sample in 1 gallon chamber preserved.
From the compositions, the fluid sample is probably mostly mud filtrate.
The oil emulsion on top of the sample is too small to measure specific gravity.
It is light green in colour with a very volatile smell and is probably condensate.

A3 fig's 1 and 2 to follow.

# SCHEMATIC REPRESENTATION OF GWC
## IN CAMPANIAN "2" SST - ANEMONE-1,1A

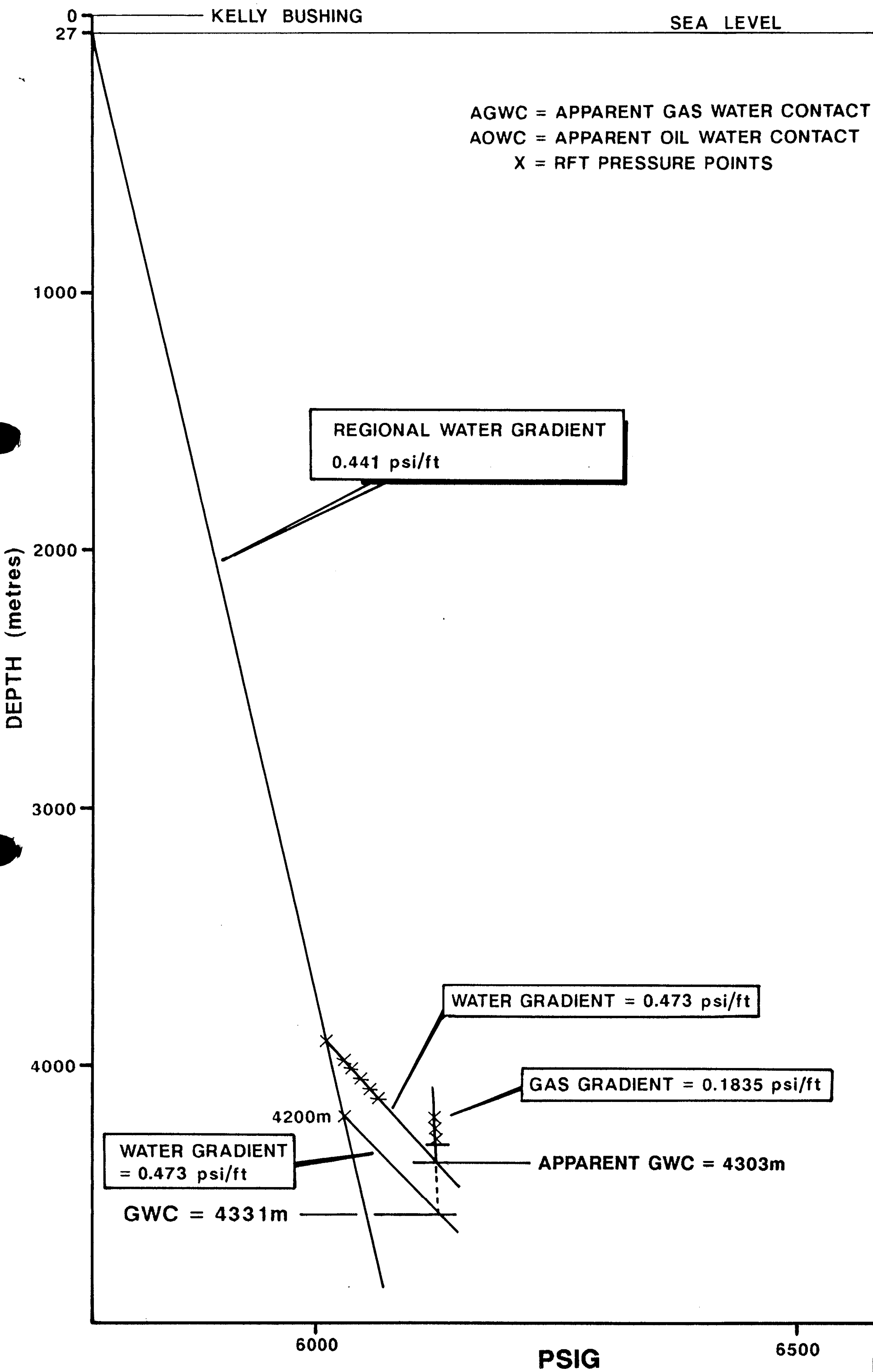
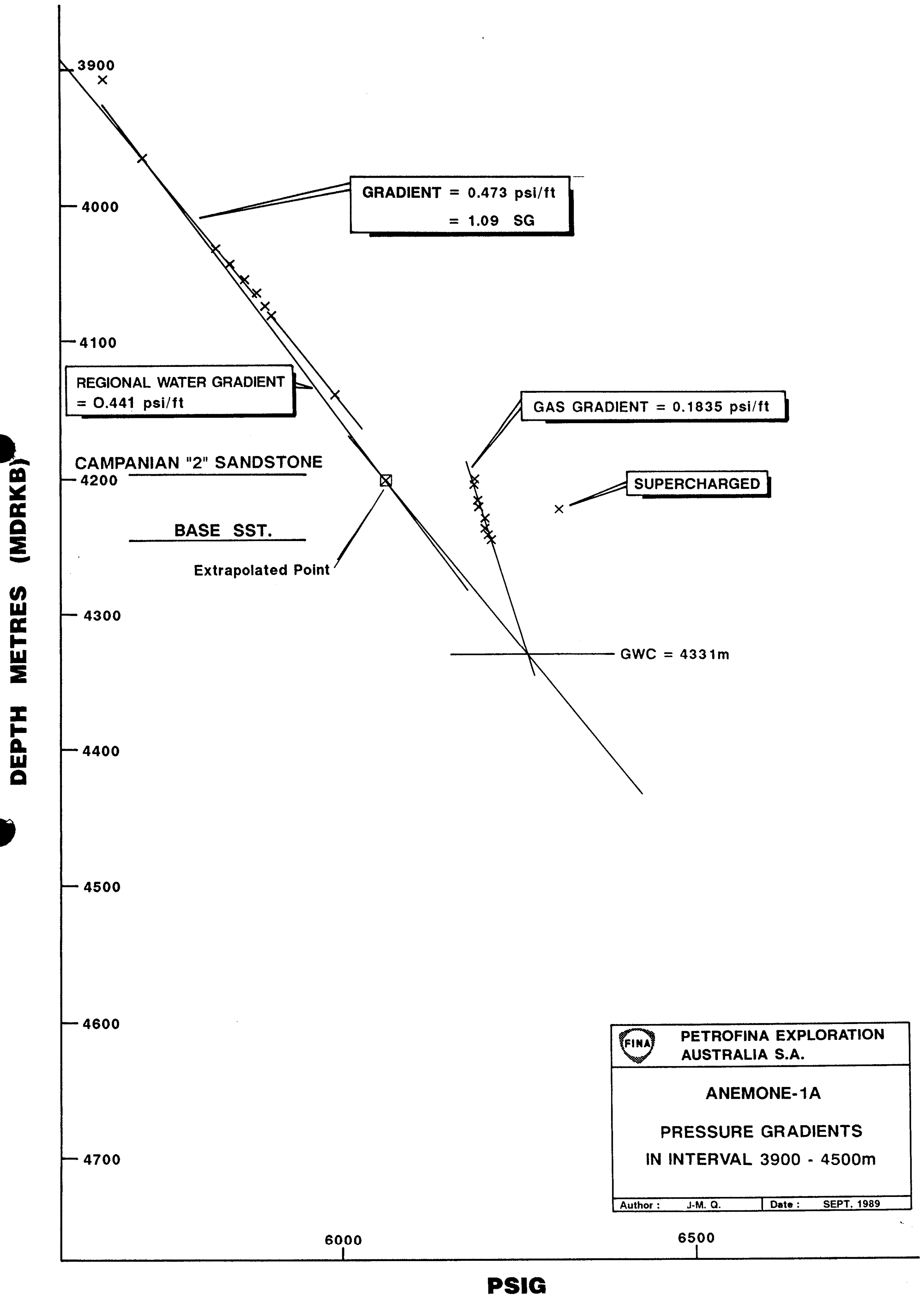



FIGURE 1

G 358A (R.F.T.)

J-M. Q. SEPT. 89




PETROFINA EXPLORATION AUSTRALIA S.A.

ANEMONE-1A

PRESSURE GRADIENTS IN INTERVAL 3900 - 4500m

| Author : J-M. Q. | Date : SEPT. 1989 |
|---|---|

FIGURE 2

G 356A (R.F.T.)

PE600989

This is an enclosure indicator page.
The enclosure PE600989 is enclosed within the container PE902140 at this location in this document.

The enclosure PE600989 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE = | PE600989 |
| CONTAINER_BARCODE = | PE902140 |
| NAME = | RFT Interval |
| BASIN = | GIPPSLAND |
| PERMIT = | |
| TYPE = | WELL |
| SUBTYPE = | RFT |
| DESCRIPTION = | RFT Interval |
| REMARKS = | |
| DATE_CREATED = | 30/11/1989 |
| DATE_RECEIVED = | 22/01/1990 |
| W_NO = | W997 |
| WELL_NAME = | Anemone-1 |
| CONTRACTOR = | Petrofina Exploration |
| CLIENT_OP_CO = | Petrofina Exploration |

(Inserted by DNRE - Vic Govt Mines Dept)

PE600990

This is an enclosure indicator page.
The enclosure PE600990 is enclosed within the container PE902140 at this location in this document.

The enclosure PE600990 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE | = PE600990 |
| CONTAINER_BARCODE | = PE902140 |
| NAME | = RFT Interval |
| BASIN | = GIPPSLAND |
| PERMIT | = |
| TYPE | = WELL |
| SUBTYPE | = RFT |
| DESCRIPTION | = RFT Interval |
| REMARKS | = |
| DATE_CREATED | = 30/11/1989 |
| DATE_RECEIVED | = 22/01/1990 |
| W_NO | = W997 |
| WELL_NAME | = Anemone-1 |
| CONTRACTOR | = Petrofina Exploration |
| CLIENT_OP_CO | = Petrofina Exploration |

(Inserted by DNRE - Vic Govt Mines Dept)

# APPENDIX 4

APPENDIX 4

WELL COMPLETION REPORT

ANEMONE-1,1A

INTERPRETATIVE DATA

APPENDIX 4

RESERVES CALCULATIONS

PETROFINA EXPLORATION AUSTRALIA S.A.

# Reserves Calculations for

# Campanian "2" Sandstones

# Anemone-1,1A

GL/89/025
JMQ/sw/kl
14 December 1989

## CONTENTS

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## LIST OF TABLES



## LIST OF FIGURES



## LIST OF ENCLOSURES

## 1. INTRODUCTION

The Campanian "2" Sandstones occur in the interval 4199m to 4244m at Anemone-1,1A. Excellent gas shows were encountered over this interval while drilling, together with minor dull yellow fluorescence and cut. The log evaluation over this interval (Questiaux and Hodgson, 1989) indicates 24.6m of gross reservoir sandstone, of which 18.8m is net (Vshale <40%; Phie >6%; Sw <50%). The average porosity and water saturation in the net reservoir are 13.9% and 34.4% respectively, while the gross reservoir thickness to gross interval thickness ratio is 53%.

## 2. HYDROCARBON TYPE

A total of 11 successful RFT measurements were taken in the reservoir section in order to establish a hydrocarbon pressure gradient. Figure 1 shows a plot of these points. Although there is some scatter of the points, a gas gradient of 0.1835 psi/ft can be established. The presence of gas was confirmed both by the log analysis work, and the RFT sample taken at 4230.5m. This sample yielded 21.35 cu ft of gas (C1=77%; C2=13%; C3=6.6%; iC4=0.4%; nC4=0.5%; $CO_2$=nil; $H_2S$=nil); 5.9 litres of filtrate and 150 ml of liquid hydrocarbon.

## 3. GAS-WATER CONTACT

No gas-water contact was intersected in the Campanian "2" Sandstones. The well only confirmed gas down to 4244m. However, using the RFT data it has been possible to derive a possible gas-water contact at 4331m. The derivation of the GWC is explained in the RFT report (Questiaux and Hodgson, 1989).

## 4. OIL-WATER CONTACT

Although the presence of oil in the Campanian "2" Sandstone has not been proved in this well, it was decided to calculate possible oil reserves in these sandstones assuming an oil leg below 4250m. Taking a light oil of 47° API, similar to the oil found at Kingfish and neighbouring fields, a pressure gradient of 0.3464 psi/ft can be expected in the oil column. Extrapolating this gradient from 4250m (Fig. 2), an oil-water contact can be established at 4433m, which is still within structural closure (Encl.1).

## 5. RESERVE CALCULATIONS

Reserves have been calculated using three possible models:

i) Gas down to 4244m

ii) Gas down to 4331m (GWC)

iii) Gas down to 4250m (GOC) and
Oil down to 4433m (OWC)

This is illustrated on a depth/area plot (Fig. 4).

The bulk rock volume has been calculated using the Top UK1 depth map, a marker which is 418m deeper than the top of the Campanian "2" Sandstones, but which from seismic evidence is conformable with these sandstones. A uniform reservoir thickness of 46m has been used in all computations.

The results and the main reservoir parameters are listed in Table 1 below:

A4 table 1 to follow

# TABLE 1

## RESERVES SUMMARY

| | CASE 1 | CASE 2 | CASE 3 |
|---|---|---|---|
| Top of Structure (m BKB) | 4120 | 4120 | 4120 |
| Closing Contour (m BKB) | 4244 | 4331 | 4433 |
| Area of Closure ($km^2$) | 3.64 | 9.8 | 16.1 |
| Reservoir Thickness | 46m | 46m | 46m |
| Bulk Rock Volume ($10^6 m^3$) | 126.0 | 350.6 | 138.0 (gas zone)<br>578.2 (oil zone) |
| GWC (m BKB) | - | 4331 | - |
| GOC (m BKB) | - | - | 4250 |
| OWC (m BKB) | - | - | 4433 |
| Porosity (%) | 13.9 | 13.9 | 13.9 |
| Sw (%) | 34.4 | 34.4 | 34.4 |
| N/G | 0.53 | 0.53 | 0.53 |
| Bg * | 303 | 303 | 303 |
| Bo | - | - | 1.4 |
| GIP (BCF) | 65.2 | 181.3 | 71.7 |
| OIP (MMBBL) | - | - | 125.5 |
| Recovery Factor GAS | 0.7 | 0.7 | 0.7 |
| **Reserves GAS (BCF)** | 45.6 | 126.9 | 50.2 |
| Recovery Factor OIL | - | - | 0.35 |
| **Reserves OIL (MMBBL)** | | | 43.9 |

Kelly Bushing Elevation = 27m

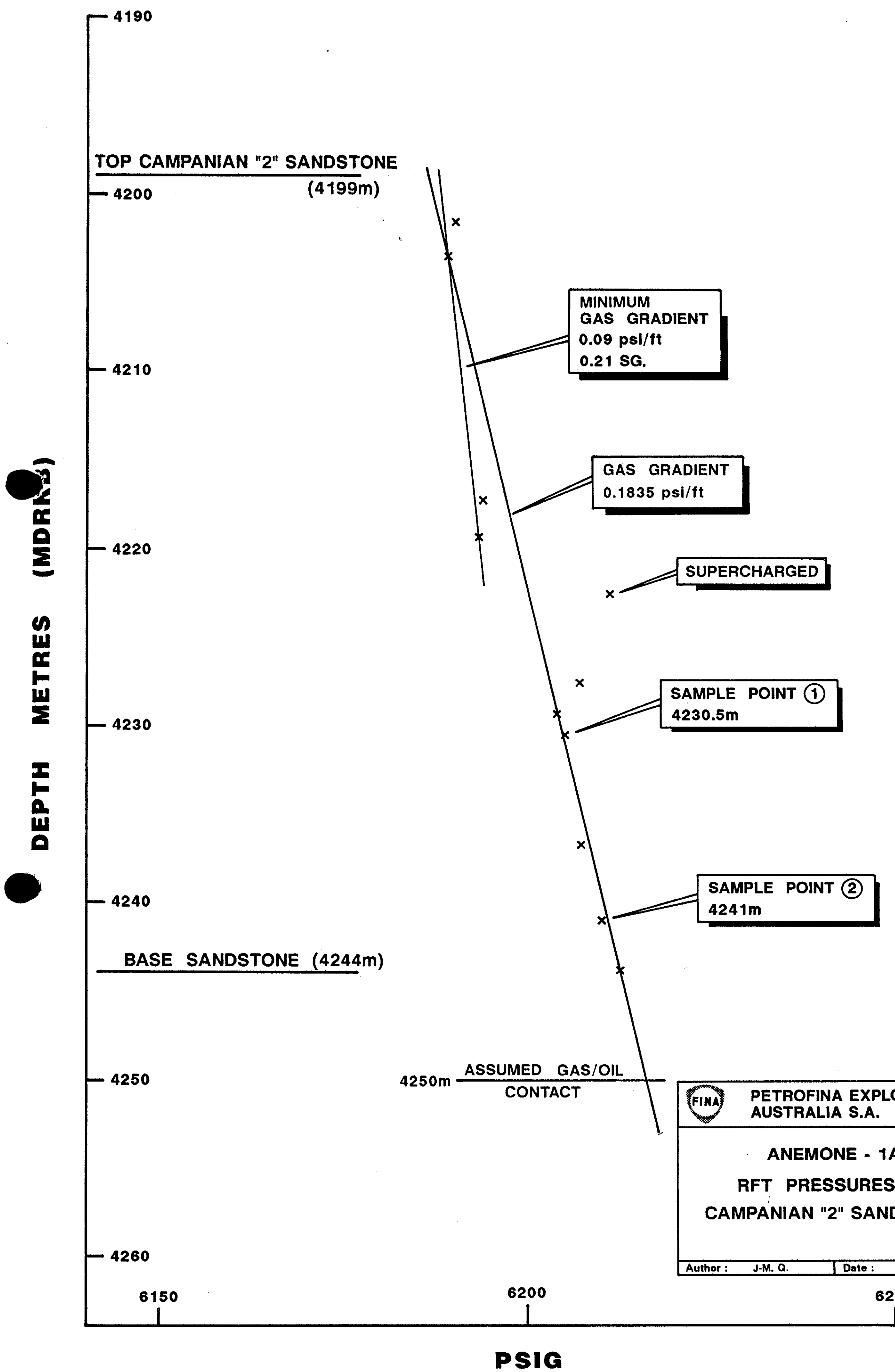
* From Petrolab Report: Anemone-1,1A RFT Sample at 4230.5m

## 6. REFERENCES

**QUESTIAUX, J.M. and HODGSON, A.** (1989). Log Analysis of the Hydrocarbon Bearing Formations of the Latrobe Group in Anemone-1,1A. Petrofina Exploration Australia S.A., Unpublished Company Report GL/89/027

**QUESTIAUX, J.M. and HODGSON, A.** (1989). Anemone-1,1A RFT Analysis Report. Petrofina Exploration Australia S.A., Unpublished Company Report GL/89/032

A4 fig's 1,2 and 3 to follow




PETROFINA EXPLORATION AUSTRALIA S.A.

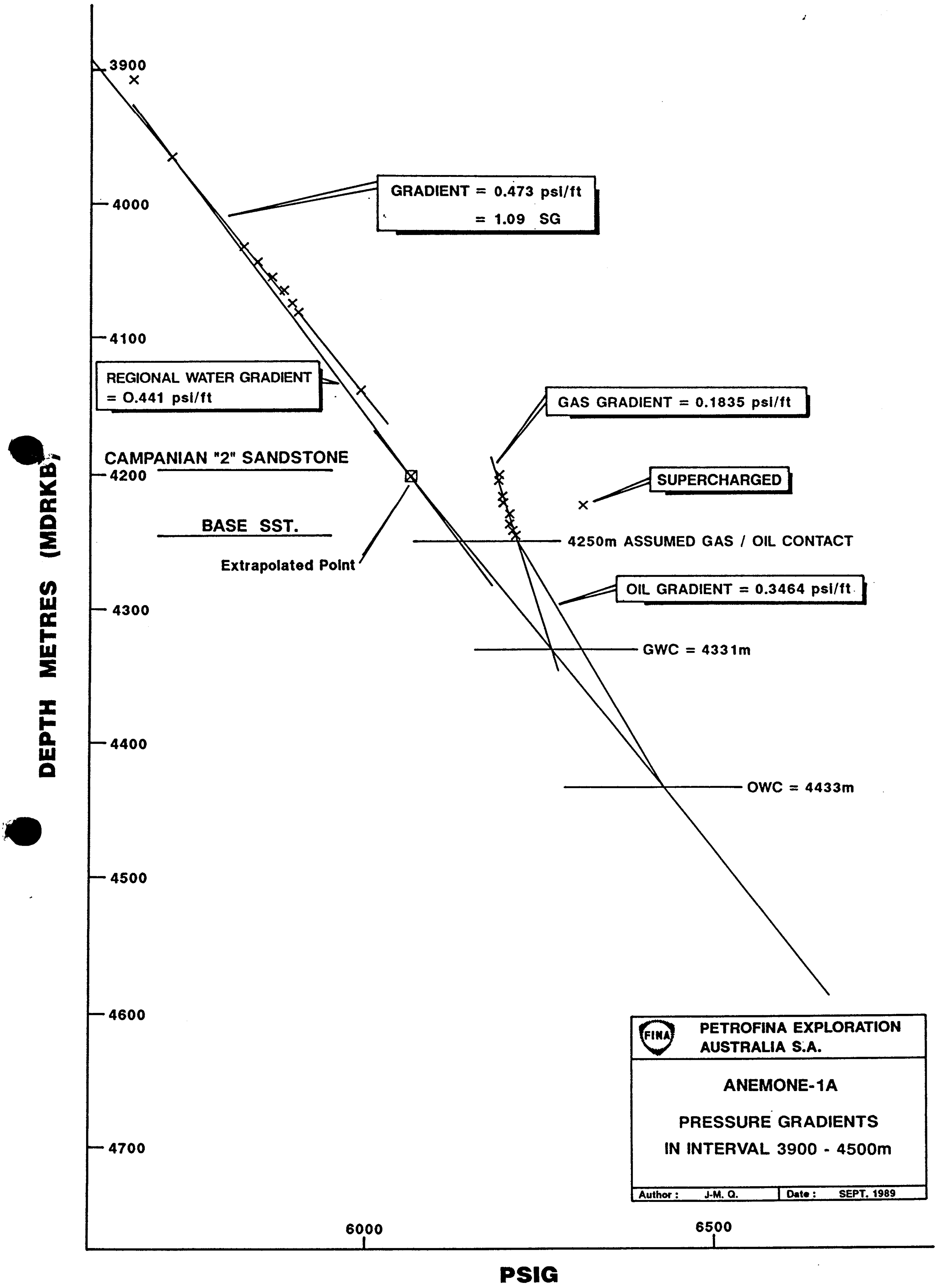
ANEMONE - 1A

RFT PRESSURES IN CAMPANIAN "2" SANDSTONE

| Author : J-M. Q. | Date : 15/8/89 |
|---|---|

G 357

FIGURE 1




PETROFINA EXPLORATION AUSTRALIA S.A.

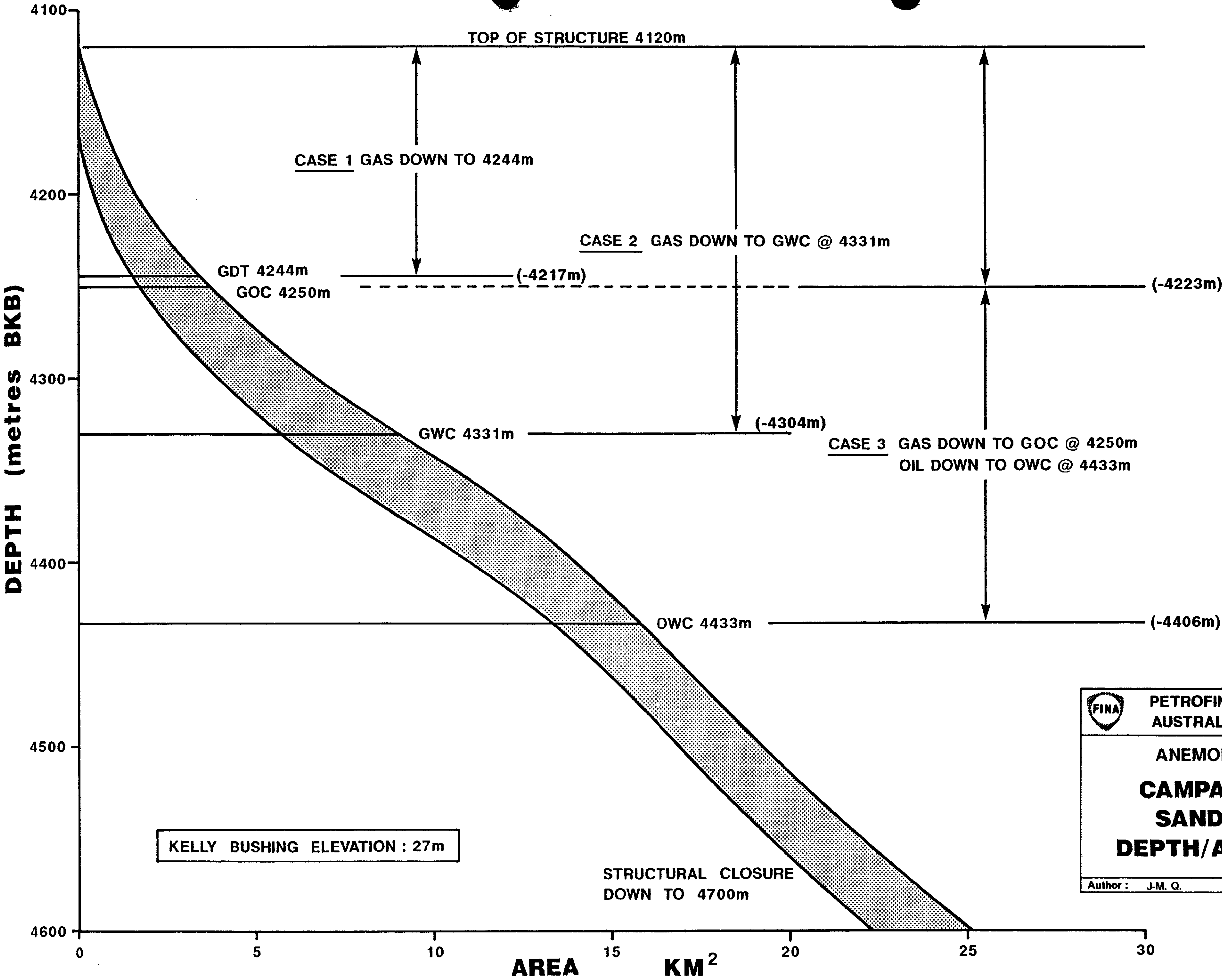
ANEMONE-1A

PRESSURE GRADIENTS IN INTERVAL 3900 - 4500m

| Author : | J-M. Q. | Date : | SEPT. 1989 |
|---|---|---|---|

G 356

**FIGURE 2**




PETROFINA EXPLORATION AUSTRALIA S.A.

ANEMONE - 1/1A

**CAMPANIAN "2" SANDSTONE DEPTH/AREA PLOT**

Author : J-M. Q. | Date : OCT. 89

**FIGURE 3**

G 359

PE902141

This is an enclosure indicator page.
The enclosure PE902141 is enclosed within the container PE902140 at this location in this document.

The enclosure PE902141 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE = | PE902141 |
| CONTAINER_BARCODE = | PE902140 |
| NAME = | Top Campanian 2 Sandstones (Isopached from top UK 1) - Depth |
| BASIN = | GIPPSLAND |
| PERMIT = | |
| TYPE = | SEISMIC |
| SUBTYPE = | ISOPACH_MAP |
| DESCRIPTION = | Top Campanian 2 Sandstones (Isopached from top UK 1) - Depth |
| REMARKS = | |
| DATE_CREATED = | 31/07/1989 |
| DATE_RECEIVED = | 22/01/1990 |
| W_NO = | W997 |
| WELL_NAME = | Anemone-1 |
| CONTRACTOR = | Petrofina Exploration |
| CLIENT_OP_CO = | Petrofina Exploration |

(Inserted by DNRE - Vic Govt Mines Dept)

# APPENDIX 5

APPENDIX 5

# WELL COMPLETION REPORT

## ANEMONE-1,1A

## INTERPRETATIVE DATA

## A P P E N D I X   5

## DST INTERPRETATION

# TEST RESULTS

## DST #1

Perforations: 4599-4618m
4629-4652m (6 shot/ft 60° offset)

Results : Flow Rates

| | | | |
|---|---|---|---|
| 1. | Condensate | : | 120-150 bpd (gravity 0.78 SG) |
| 2. | Water | : | 120-140 bpd (NaCl = 10,000 ppm) |
| 3. | Gas | : | 0.8-1.0 mmscf (gravity = 0.94) (air = 1) (C1/Ct = ±80%) |
| 4. | WHIP | : | 250-350 psi |
| | Drawdown | : | >4700 psi |
| | Reservoir Pressure | : | 9600-9900 psi |
| | Permeability | : | 0.25-2.0 md |
| | Skin Effect | : | Probably Nil |

## DST #2

Perforations: 4535-4545m (6 shot/ft 60° offset)
(DST #1 isolated by bridge plug)

Results : Flow Rates

| | | | |
|---|---|---|---|
| 1. | Water | : | 60 bpd |
| 2. | Gas | : | RTSTM |
| 3. | Condensate | : | None |
| 4. | WHIP | : | 10 psi |
| | Reservoir Pressure | : | 8870 psi (BHSIP) |

## ANEMONE-1A

## DST 1
## TRANSIENT PRESSURE TESTING

The perforated intervals 4599-4629 mkb and 4618 - 4652 mkb were tested as indicated in Figure 1.

The main results are summarised in Table 1 but some comments should be added.

1. **Initial Pressure:**

   The initial reservoir pressure at 4600m is estimated between 9600 and 9900 psi. Because the static gradient below the pressure gauges at the time of the first shut-in is unknown it is not possible to estimate the initial pressure with more precision.

   The equivalent mud density required to balance this pressure would be 1.47 to 1.52 gr/cc. Therefore the reservoir was, at least partially, drilled underbalanced if all the sands had the same equivalent pressure. This could explain the high gas content in the mud and to a certain extent could be the reason for the largely washed out hole.

2. **Formation Permeability and Skin**

   All the interpretations were carried out assuming gas condensate bearing sands and consequently the gas pseudo-pressure function, m(p) was used.

   A test was done with the main build-up, by assuming a volatile oil reservoir, and a permeability of 0.08 md was obtained from the Horner type plot.

   It must be emphasized that the permeabilities and skin factors listed in Table 1 should be read as order of magnitude. Due to the very low permeability the time required to reach the infinite acting region was very long. However, the derivative analysis seems to confirm that the permeability is around 0.2 md.

   Any turbulence effect was neglected. That effect is significant in low permeability formations but in this case the rate is small.

   The calculated skins vary from slightly negative (-0.3 and -2.6; in semi-log and Horner plots of last build-up) to around 8 to 9 in the derivative plots. We think that the last figures are more reliable as the permeability reduction close to the wellbore due to the liquid drop out and any eventual partial penetration effect (if only part of shots reached the formation) will justify a positive skin.

3. **Radius of Investigation:**

   The radius of investigation is small, maybe around 60 ft. This is due to the low permeability and high total compressibility.

No boundary effects were observed. The calculated lower extrapolated pressure in the last build-up, which could indicate reservoir depletion, should be interpreted with caution due to the insufficient build-up time.

4. **Conclusions:**

We suggest that the pressure history between 27 September and the end of the main build-up on 1 October be interpreted using a generalised superposition function. This work will be done by Petrofina Brussels with the INTERPRET Software (SCI-Intercomp). However, we feel confident to say that the tested interval in DST 1 has a very low permeability (approx. 0.2 md) and low to nil damage due to drilling fluids.

David Sousa
5 October 1989

A5 table 1 to follow

# ANEMONE - 1A ; DST 1
## SUMMARY OF TRANSIENT PRESSURE ANALYSIS

| | | | | |
|---|---|---|---|---|
| GAUGE | 75188 | 73033 | 71532 | 74907 |
| DEPTH (m) | 4267.8 | 4267.8 | 4299.3 | 4299.3 |
| **1st SHUT IN** | | | | |
| P* (psia) | 9115 | 9224 | 9164 | 9164 |
| **MAIN DRAWDOWN** | | | | |
| Semilog analysis | | | | |
| KH (mdft) | 4.63 | 9.73 | | |
| K (md) | 0.06 | 0.13 | | |
| Skin | 0.1 | 5.2 | | |
| Radius invest. (ft) | 59 | 85 | | |
| Derivative analysis | | | | |
| KH (mdft) | 13 | 13.8 | | |
| K (md) | 0.18 | 0.18 | | |
| Skin | 9.4 | 9.6 | | |
| **MAIN BUILD-UP** | | | | |
| Semilog analysis | | | | |
| KH (mdft) | 3.9 | 3.9 | | |
| K (md) | 0.05 | 0.05 | | |
| Skin | -0.3 | -0.3 | | |
| Radius invest. (ft) | 54 | 54 | | |
| Horner analysis | | | | |
| KH (mdft) | 0.99 | 0.97 | | |
| K (md) | 0.01 | 0.01 | | |
| Skin | -2.6 | -2.7 | | |
| Radius invest. (ft) | 27 | 27 | | |
| P* (psia) | 8341 | 8369 | | |
| Derivative analysis | | | | |
| KH (mdft) | 10.1 | 10.1 | | |
| K (md) | 0.14 | 0.14 | | |
| Skin | 8.7 | 8.7 | | |

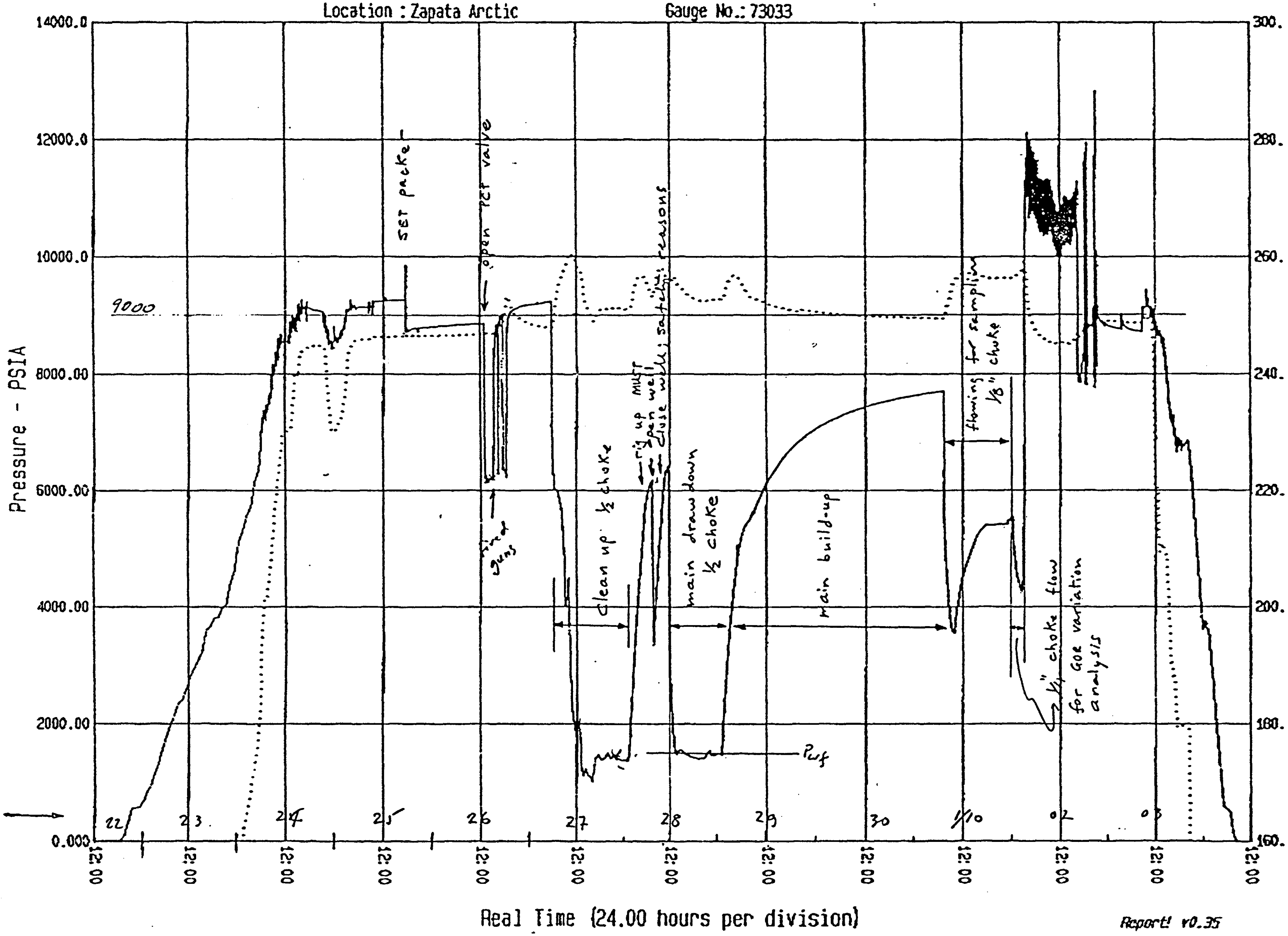
A5 fig 1 to follow

EXAL RESERVOIR SERVICES LTD.

Customer : Petrofina Australia
Well No. : Anemone # 1A
Test No. : DST # 1
Location : Zapata Arctic

Engineer : J.Walker
Date : 22/09/89
Recorder : Memory Gauge
Gauge No.: 73033

Comments : Gauge depth = 4267. Rkb




Report! v0.35

FIGURE 1

## ANEMONE 1A - DST 2

The sandstone interval 4535-4545m was perforated with Schlumberger tubing conveyed guns (6 shots/ft - 60° phasing) on 8 October 1989 at 1500 hrs. The wellhead shut-in pressure at 1605 hrs, just before opening the well, was 2230 psi (BHSIP = 8870 psi). After a 10 minute flow the well was closed (at PCT and choke manifold) for the night for safety reasons.

On 9 October at 0548 hrs the well was opened at the PCT and choke manifold for unloading and clean up. The static wellhead pressure before opening at choke manifold was 1500 psi and was still increasing. After opening the well the WHFP dropped quickly to zero psi.

After 27 hours clean up the well was producing at an average rate of 60 bbl/day water-cushion water. The wellhead pressure was around 10 psi and the cumulative water recovery was 73.4 bbl or approximately 66% of total wellbore and tubing volume. The unloading rate was practically constant and no increasing gas rate was observed (only some gas bubbling was observed in the bubble hose).

In view of the performance of the well during the clean up Schlumberger was rigged up to take bottom samples and record the pressure gradient in order to determine the nature of formation fluids being produced.

**Pressure Gradient Recorded with Well Flowing:**

| Depth (mkb) | Gradient (gr/cc) | Depth (mkb) | Gradient (gr/cc) | Depth (mkb) | Gradient (gr/cc) |
|---|---|---|---|---|---|
| 100 | 1.0 | 4020 | 0.95/0.99 | 4450-4500 | 1.04 |
| 500 | 1.33 | 4060-4070 | 1.0 | 4420-4500 | 1.04 |
| 1000 | 1.23 | 4070-4080 | 0.81 | | |
| 2000 | 1.19 | 4080-4090 | 1.0 | | |
| 3000 | 1.08 | 4090-4100 | 0.83 | | |
| 4010 | 1.07 | 4130-4150 | 0.93 | | |

**Two samples were taken at 3904mkb and 4428mkb and were analysed on the rig giving the following results:**

| | Sample 1 @ 3904mkb | Sample 2 @ 4428mkb | Mud Filtrate |
|---|---|---|---|
| Pressure | 5788 psi | 6536 psi | - |
| Temperature | 111.1°C | 130.7°C | - |
| Resistivity at 55°F | 0.697 m | 0.694 m | - |
| pH | 7.17 | 7.47 | 10.7 |
| pf/mf | 0/5.4 | 0/5.5 | 0.25/0.50 |
| $HCO_3^-$ | 108 meg/l | 110 meg/l | - |
| $Cl^-$ | 4000 mg/l | 4000 mg/l | 15,500 mg/l |
| $Ca^{2+}$ | 60 ppm | 100 ppm | 400 ppm |
| $Mg^{2+}$ | 61 ppm | 24.4 ppm | 0 |

**NOTE:** For full documentation of DST results, see Anemone-1,1A Final Well Report, Volume II (Drilling and Engineering).

# APPENDIX 6

WELL COMPLETION REPORT

ANEMONE-1,1A

INTERPRETATIVE DATA

APPENDIX 6

SEDIMENTARY INTERPRETATION LOG

PETROFINA EXPLORATION AUSTRALIA S.A.

# Sedimentological Interpretation of the Latrobe Group in Anemone-1

GL/89/037
PL/NGG/kl
22 December 1989

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## LIST OF FIGURES



## LIST OF ENCLOSURES



## LIST OF TABLES

## 1. INTRODUCTION

A detailed sedimentological study of the Latrobe Group has been carried out at Anemone-1. The section studied is from 2677m (Top Latrobe Group) to 4775m (TD), a thickness of 2194m.

All available wireline logs were used in this study, including the MSD processed dipmeter log. Results from sidewall cores, cuttings descriptions and palynological results were also integrated in this work. The interpretation has been compiled as a sedimentological log (Enclosure 1), incorporating the composite log, the MSD dipmeter log (tadpoles and SHDT resistivity traces), and the sedimentary interpretations. The Latrobe Group has been divided into 10 distinct intervals, each of which is described below (Section 3).

## 2. LATROBE GROUP SEDIMENTARY INTERPRETATION

Three main depositional environments have been identified in the Latrobe Group at Anemone-1. These are shallow marine, deltaic and lower coastal plain environments, similar to those previously described in the other wells situated in the Central Deep in VIC/P20 (Questiaux and Tringham 1988/89). Figure 1 schematically illustrates a typical log for the four depositional environments and their sub-environments, while Table 1 summarizes their main diagnostic features.

## 3. WELL INTERPRETATION RESULTS

### 3.1 4775m (TD) - 4525m (Santonian Sandstone)

The Top Santonian sandstone interval can be sub-divided into two units. The lower unit, up to 4630m, shows a general upward-coarsening trend, with lower delta front siltstones at the base grading up to upper delta front sandstones.

A marine transgression at 4630m marks the base of the second unit, with pro-delta siltstones directly above the unconformity passing rapidly upward into massive stacked stream mouth bar sandstones.

The interval as a whole shows an upward-coarsening trend indicating a regressive depositional phase dominated by compositionally and texturally immature sandstones with high feldspathic contents.

Reservoir properties of this interval have been greatly affected by diagenesis, especially by recrystallisation of the feldspars, and almost no primary porosity is preserved.

No dipmeter data was run on this interval.

### 3.2 4525m - 4199m (Late Santonian-Early Campanian inc. Campanian Sandstone "2")

An important marine transgressive unit, dating from late Santonian time, marks the base of this interval, comprising offshore siltstones deposited directly above and effectively sealing the stream mouth bar sandstones. The base of this transgressive unit is possibly marked by a thin coastal sandstone from 4533.5m up to 4525m, although this bed has been included with the Santonian sandstone on the interpreted log.

Towards the top of this interval, the siltstone unit grades into a sequence of interbedded siltstones and poorly developed lower to upper shoreface sandstones.

The dipmeter indicates a uniform eastward structural dip of 10° to 14° and displays no clear depositional trends.

3.3 4199m - 4042m (Campanian Sandstone "1")

This interval is a continuation of the underlying regressive unit, except for a minor transgressive sand at the base.

Environments are similar to those of the underlying interval, passing upward from massive offshore siltstone to upper shoreface or even shoreface sandstone. Palynological data suggests that the upper part of this interval could be non-marine.

The siltstones at the base seal the underlying sandstones, and the sandstones at the top have good reservoir potential.

The dipmeter displays blue and red depositional patterns in the upper part with a general trend to the east.

3.4 4042m - 3912m (Intra-Campanian)

The base of this interval marks a renewed minor intra-Campanian transgression, which restored a more marine environment to the Anemone area.

The sediments in this interval differ from those in the interval below, being made up of alternating siltstones and sandstones which may have been deposited by turbidity currents. These beds show a general increase in thickness and grain size upward, while upward-coarsening is indicated also in individual beds.

Depositional dips show a mixture of blue and red patterns trending to the northeast.

3.5 3912m - 3734m (Intra-Campanian)

This interval is characterised at the base by two massive sandstone units fining up into pro-delta siltstones. These have been interpreted as transgressive sands which were deposited following a major tectonic event. Depositional dips are not obvious in the sands but a possible northward dip is suggested.

The upper part of this interval consists of stacked, upward-coarsening sequences of lower delta plain siltstones to upper delta front and stream mouth bar sandstones.

Thin well cemented sandstone beds are present throughout the interval. These are interpreted as shelf deposits and may indicate a break in sedimentation allowing time for cementation near the seabed.

Depositional dips in the upper part of the interval trend toward the northeast.

The entire interval is characterised by a large terrestial palynomorph input.

3.6 <u>3734m - 3217m (Late Campanian)</u>

This thick upper Campanian interval, corresponding to the T.lilliei zone, shows the upward-coarsening characteristic of a regressive depositional phase.

From the base up to 3240m, the interval consists of a thick sequence of offshore and lower shoreface siltstones interbedded with minor lower and upper shoreface sandstones. Structural dip is low and blue and red patterns are rare, trending from southwest to southeast.

A massive upper shoreface sandstone developed from 3420m up to 3387m shows herring-bone cross bedding trending ESE and WNW. This sandstone is capped by a sequence of siltstones and coals deposited in lower coastal plain marshes interbedded with point bar and back-shore sandstones.

In this lower coastal plain environment the dipmeter displays blue and red patterns deposited without a well-defined trend.

3.7 3217m - 3111m (Selene Sandstone)

The top of the Campanian is marked by a transgressive shallow marine siltstone, directly above an unconformity, grading rapidly upwards into upper shoreface sandstones (Selene Sandstone).

The interval as a whole shows an upward-coarsening character indicative of a regressive depositional phase.

The dipmeter shows no clear pattern, except perhaps for a few cross bedded blue patterns at the top.

3.8 3111m - 2840m (Intra-Maastrichtian)

This intra-Maastrichtian interval is a continuation of the underlying regressive cycle, with only marginal marine influence present during deposition. Sedimentary units alternate between non-marine coastal plain siltstones and coals and deltaic stream mouth bar sandstones.

Sedimentary dips trend to the northwest, changing to WSW near the top of the interval.

3.9 2840m - 2760m (Late Maastrichtian)

A transgressive marine sandstone marks the base of this interval, and passes rapidly upward to pro-delta and lower delta front siltstones. Overall the interval shows a marked upward-coarsening, indicating a regressive depositional phase.

Sedimentary dips show a mixture of blue and red patterns trending to the northwest.

3.10 2760 - 2677m (Palaeocene)

This interval comprises a thin transgressive marine sandstone at the base, overlain by a massive siltstone sequence deposited in an offshore to lower shoreface environment.

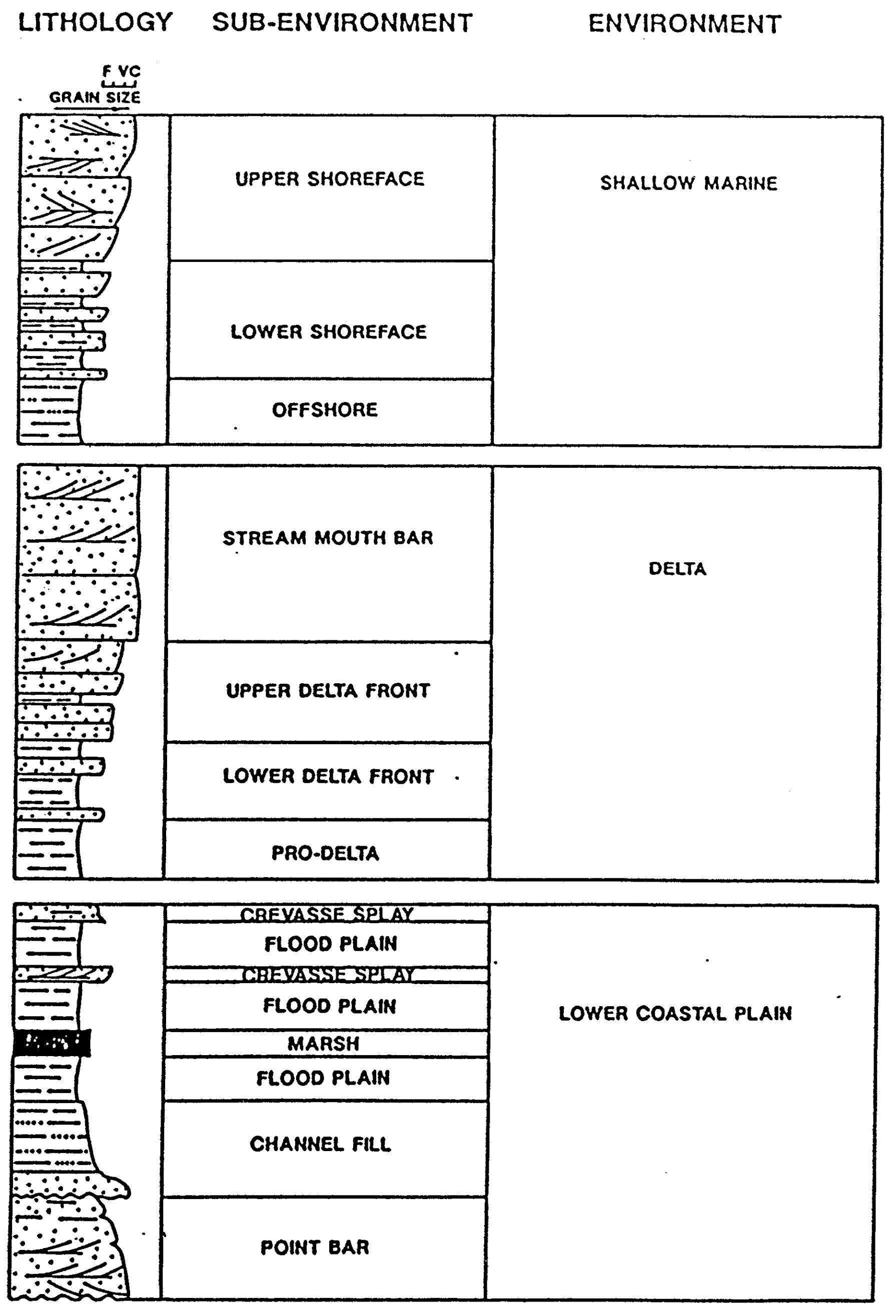
This sequence shows a general upward-coarsening in the lower and middle parts, and upward-fining in the upper part.

Sedimentary dips show no clear trend.

A6 fig 1 to follow

FIGURE 1

# LATROBE DEPOSITIONAL ENVIRONMENTS



## 4. CONCLUSION

The sedimentary facies in the Maastrichtian at Anemone-1 were as predicted, with shallow marine shoreface units directly below the Top Latrobe Unconformity, grading downward to a mixture of non-marine coastal plain and coastal sequences. Compared to Angler-1 and the other wells in the region, coal beds were less developed in Anemone-1.

The entire Campanian section was drilled, and was found to be predominantly shallow marine as in Angler-1. The Campanian is composed of stacked cyclic units indicating rapid transgressive phases followed by more prolonged regressive phases. The base of each sequence comprises lower shoreface or offshore siltstones, coarsening upward to upper shoreface sandstones and, in some intervals, lower delta plain sandstones, siltstones and coals. This succession presents a number of good reservoirs sealed by marine siltstones.

The top of Santonian was penetrated at 4289m at the base of the lowest Campanian transgressive/regressive cycle. The Santonian comprises upper delta front and stream mouth bar sandstones. Unfortunately the reservoir potential of these sandstones has been adversely affected by diagenesis and especially by recrystallisation of the feldspars.

## 5. REFERENCES

Questiaux, J.M. and Tringham, 1988, A Sedimentological Interpretation of the Latrobe Group in Wells of the VIC/P20 area, Petrofina Exploration Australia S.A., Unpublished Report.

A6 table 1 to follow

**TABLE 1**

**SUMMARY OF SEDIMENTARY ENVIRONMENTS**

| MAIN ENVIRONMENT | SUB-ENVIRONMENT | LITHOLOGY | DIAGNOSTIC FEATURES AND LOG RESPONSE | DIAGNOSTIC SEDIMENTARY STRUCTURES | GEODIP/CLUSTER TRENDS |
|---|---|---|---|---|---|
| SHALLOW MARINE | UPPER SHOREFACE | **Sandstone** (med-crse) | Massive Bedding<br>c.u. Cycles | Trough X-Bedding | Blue and Red Patterns<br>Diverse Trends |
| | LOWER SHOREFACE | **Sandstone** (f-crse)<br>Siltstone<br>Shale | Interbedded<br>c.u. Cycles | Hummocky X-Bedding | As above |
| | OFFSHORE | Siltstone<br>**Shale** | Thin bedded siltstones<br>Thick shales | Ripples Bioturbation | Green Pattern |
| DELTA | STREAM MOUTH BAR | **Sandstone** (med-crse) | Blocky Log Pattern<br>Massive Bedding<br>c.u. Cycles | Sharp Bases<br>Trough X-Bedding | Blue and Red Patterns<br>Unimodal Trends |
| | UPPER DELTA FRONT | **Sandstone** (f-med)<br>Siltstone | Interbedded<br>c.u. Cycles | Trough X-Bedding<br>Parallel Lamination | As above |
| | LOWER DELTA FRONT | Sandstone (f)<br>**Siltstone**<br>Shale | Interbedded<br>c.u. Cycles<br>Individ. Sandstones f.u. | Ripples<br>Parallel Lamination | Green Pattern |
| | PRO-DELTA | Siltstone<br>**Shale** | Thin Bedded Siltstone<br>Thick Shales | Ripples Bioturbation | Green Pattern |
| LOWER COASTAL PLAIN | FLOOD PLAIN | **Shale** (coaly)<br>Siltstone | | Parallel Lamination<br>Root Bioturbation | Green Pattern |
| | MARSH | **Coal**<br>Shale (coaly) | High Resistivity & Sonic<br>Low Density | | None |
| | CREVASSE SPLAY | **Sandstone** (f-med)<br>Siltstone | c.u. or f.u. Cycles<br>Thin Bedded, Spikey | Trough X-Bedding | Blue or Red Patterns<br>Unimodal Trends |
| | CHANNEL FILL | Shale<br>**Siltstone**<br>Sandstone (v.crse-f) | f.u. Cycles | Sharp Erosional Base<br>Trough X-Bedding in Sandstone | Red Pattern<br>Diverse Trends |
| | POINT BAR | Siltstone<br>**Sandstone** (v.crse-f) | f.u. Cycles | Sharp Erosional Base<br>Trough X-Bedding | Red and Blue Trends<br>Diverse Trends |

PE600991

This is an enclosure indicator page.
The enclosure PE600991 is enclosed within the container PE902140 at this location in this document.

The enclosure PE600991 has the following characteristics:

```
     ITEM_BARCODE = PE600991
CONTAINER_BARCODE = PE902140
             NAME = Sedimentary Interpretation Log
            BASIN = GIPPSLAND
           PERMIT =
             TYPE = WELL
          SUBTYPE = WELL_LOG
      DESCRIPTION = Sedimentary Interpretation Log
          REMARKS =
     DATE_CREATED =
    DATE_RECEIVED = 22/01/1990
             W_NO = W997
        WELL_NAME = Anemone-1
       CONTRACTOR = Petrofina Exploration
     CLIENT_OP_CO = Petrofina Exploration
```

(Inserted by DNRE - Vic Govt Mines Dept)

# APPENDIX 7

APPENDIX 7

# WELL COMPLETION REPORT

## ANEMONE-1,1A

## INTERPRETATIVE DATA

## A P P E N D I X 7

## PETROGRAPHY REPORT

**NOTE:** Petrography report will be sent immediately when available.

# APPENDIX 8

APPENDIX 8

**WELL COMPLETION REPORT**

**ANEMONE-1,1A**

**INTERPRETATIVE DATA**

**A P P E N D I X   8**

**COMPOSITE LOG**

See Vol III WCR

PE601645

This is an enclosure indicator page.
The enclosure PE601645 is enclosed within the container PE902140 at this location in this document.

The enclosure PE601645 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE = | PE601645 |
| CONTAINER_BARCODE = | PE902140 |
| NAME = | Composite Well log: Anemone 1, 1a |
| BASIN = | GIPPSLAND |
| PERMIT = | VIC/P20 |
| TYPE = | WELL |
| SUBTYPE = | COMPOSITE_LOG |
| DESCRIPTION = | Composite well log: Anemone 1 &1A |
| REMARKS = | |
| DATE_CREATED = | 20/10/89 |
| DATE_RECEIVED = | 1/12/89 |
| W_NO = | W997 |
| WELL_NAME = | Anemone-1 |
| CONTRACTOR = | Petrofina Exploration Australia S.A |
| CLIENT_OP_CO = | Petrofina Exploration Australia S.A |

(Inserted by DNRE - Vic Govt Mines Dept)

**NOTE:** The Anemone-1,1A composite log has been previously sent and should be included here.