

**BENARIS PETROLEUM N.V.** (ABN No. 82 113 569 029)

Registered office : DGJ Melbourne Pty Ltd, RACV Tower, 485 Bourke Street, Melbourne, VIC 3000, AUSTRALIA

**SEISMIC INTERPRETATION REPORT**  
**POST PEEJAY 2D/3D SEISMIC SURVEY**  
**EXPLORATION PERMIT T/39P**  
**OFFSHORE BASS BASIN, TASMANIA**

---

*Report prepared by:*  
*Jennifer Baird*  
*Exploration Consultant*  
*Adenmere Pty Ltd*  
*Waterton Hall*  
*Rowella 7270, Tasmania*  
*Australia*  
*March 2007.*



*Report prepared for:*  
*UT Energy Services Sdn Bhd*  
*Kuala Lumpur*  
*Malaysia*

## Table of Contents

|                                       | Page Number |
|---------------------------------------|-------------|
| Introduction                          | 3           |
| Permit History                        | 3           |
| Exploration History                   | 5           |
| Geology and Hydrocarbon Prospectivity | 8           |
| Seismic Data and Data Quality         | 10          |
| Seismic Interpretation and Mapping    | 12          |
| Mapped Area                           | 12          |
| Seismic Data Interpreted              | 12          |
| Interpretation Methodology            | 12          |
| Horizons Mapped                       | 13          |
| Depth Conversion                      | 15          |
| Prospects and Leads                   | 16          |
| Volumetrics                           | 17          |
| Conclusions and Recommendations       | 18          |
| Disclaimer                            | 19          |
| Selected References                   | 20          |
| Author                                | 21          |
| Acknowledgements                      | 21          |
| List of Enclosures                    | 22          |
| Enclosures                            | 22          |

---

## List of Figures

|  | Page Number |
|--|-------------|
| Figure 1: T/39P Permit Location Map  | 3           |
| Figure 2: Work Programme   | 4           |
| Figure 3: Work commitments summary   | 4           |
| Figure 4: Pre-bid Mapping of the PeeJay Lead   | 6           |
| Figure 5: Pelican Field Well Results   | 7           |
| Figure 6: Squid-1 and Tasmanian Devil-1 Well Results                                     | 7           |
| Figure 7: T/39P 2D seismic data, pre the PJ2D/3D seismic surveys                         | 11          |
| Figure 8: T/39P current seismic data set   | 11          |
| Figure 9: Lithostratigraphy of the Bass Basin showing mapped horizons                    | 13          |
| Figure10: Comparison of Gippsland and Bass Basin lithostratigraphies                     | 15          |
| Figure 11: Seismic Line tqh-127 showing the stratigraphic position of volcanic flows 1-3 | 15          |
| Figure 12: Depth map (Top Upper Eastern View Coal Measures) used to calculate volumes    | 17          |

## INTRODUCTION

This interpretation report provides documentation of the Seismic Interpretation conducted in T/39P and has been prepared for submission to Mineral Resources Tasmania as part of the requirements of the PSLA following the acquisition and processing by Benaris of the PeeJay 2D/3D Seismic Surveys.

Benaris have gathered all of the available seismic data in T/39P and assembled same as a digital data set by:

- purchasing the Fugro Spec Seismic Reprocessing of the post 1983 data set within the permit area together with adjacent tie lines to the important wells;
- gathering and scanning pre 1983 seismic data from paper copies supplied by Mineral Resources Tasmania; and,
- Acquisition and processing of the PeeJay 2D and 3D seismic surveys.

This data was loaded onto a Kingdom project in Melbourne and interpretation has been completed.

## PERMIT HISTORY

Benaris Petroleum NV ("Benaris") accepted the offer of T/39P on November 2, 2004, and the permit was officially awarded on December 6, 2004.

The permit (Figure 1) is located offshore to the north of Tasmania within the Bass Basin, and covers an area of approximately 2,660km<sup>2</sup> or 40 graticular blocks. Water depth ranges from 74 - 82 metres across the permit area. There have been no wells drilled in the permit to date, however, the adjacent Durroon-1, Squid-1, Chat-1, Tasmanian Devil-1 wells and Pelican field all flank the boundaries of the permit area. Highlighted on the following map is the location of Yolla development, the Pelican Field, the Yolla pipeline, and the Alinta TasGas pipeline route

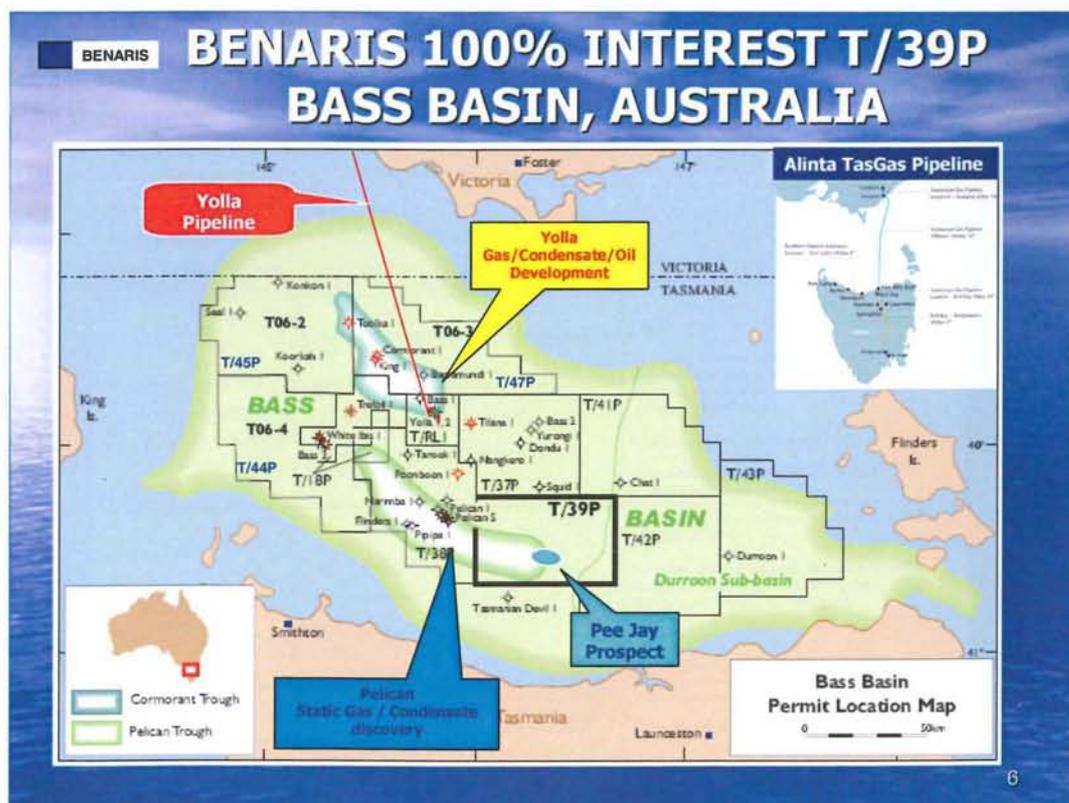


Figure 1: T/39P Permit Location Map

Benaris were awarded the permit on the basis of the following minimum work commitments (Figure 2):

| BASS BASIN T/39P  |  |  |
|---|--|--|
| TASMANIA OFFSHORE T/39P (Bass Basin)                          |  |  |
| Year  | Minimum Work Commitment  | Min Est Expenditure (A\$million)   |
| <b>Primary Term</b>   |  |  |
| 1<br>(Ended 5/12/05)  | Purchase ~2,000km 2D seismic data available from Fugro. G&G studies and Data Evaluation. Additional reprocessing as required. Reinterpret Aeromag and / or gravity over permit area. | 1.5  |
| 2<br>(Ended 5/12/06)  | Minimum 1,001 km 2D seismic, seismic processing, mapping, interpretation   | 2.5  |
| 3<br>(Ends 5/12/07)   | G&G studies  | 1.5  |
| <b>Total</b>  |  | <b>5.5</b>   |
| <b>Secondary Term</b>   |  |  |
| 4   | 155 sq km 3D (pending outcome of 2D) G&G   | 3.5  |
| 5   | Well planning<br>Drill one well  | 11.0   |
| 6   | Well post-mortem, contingent follow up seismic   | 3.0  |
|   |  | <i>Note: Options available to withdraw at the end of Years 3, 4, 5 and 6</i> |
|   |  | <b>17.5</b>  |
| <b>Permit currently in Q1, Year 3 ending December 5, 2007</b> |  |  |

Figure 2: Work Programme., Note: Options available to withdraw at the end of Years 3, 4, 5 and 6

Since being awarded the permit Benaris have fulfilled all commitments and the permit is in good standing. A summary of the work committed and compiled is shown on Figure 3:

| PERMIT YEAR   | WORK PROGRAMME   | ACTUAL WORK COMPLETED   |
|---|--|---|
| <b>PRIMARY TERM</b>   |  |   |
| YEAR 1<br>Ended Dec 5, 2005   | Purchase ~2,000km 2D seismic data available from Fugro.<br>G&G studies and Data Evaluation<br>Additional reprocessing as required.<br>Reinterpret Aeromagnetic and / or gravity data over permit area. | All available seismic data in permit and adjacent well ties purchased from Fugro or scanned from hardcopy.<br>Preliminary permit wide seismic interpretation completed confirming validity of PeeJay Lead. PJ2D/3D seismic program defined and stakeholder consultation undertaken.<br>Frogtech aeromag studies completed.<br>Completed 203Km <sup>2</sup> of PJ3D and 330kms PJ2D seismic program acquisition. |
| YEAR 2<br>Ended Dec 5, 2006   | Acquire minimum 1,001 km 2D seismic.<br>Seismic processing.<br>Seismic interpretation, mapping   | PJ2D and PJ3D processing completed finals delivered mid March 2006.<br>Interpretation and mapping of Pee Jay prospect completed. Volumetrics assessed. Velocity interpretation for permit completed.<br>AVO study initiated.<br>Basin modelling study initiated   |
| YEAR 3<br>Ending Dec 5, 2007  | G&G studies  | Regional mapping and prospect generation continues.<br>Basin modelling studies continuing.<br>AVO study completed, Inversion planned.<br>Document PeeJay-1 drilling location and farm out.  |
| <b>The DA has formally advised that the PJ2D and PJ3D seismic acquisition in year 1 meets the year 2 work obligations</b> |  |   |

Figure 3: Work commitments summary

## **EXPLORATION HISTORY**

Under the guidance of Lewis G Weeks, a petroleum consultant, and retired Exploration Manager from Exxon Corporation, Hematite Petroleum Pty Ltd (now BHPP) was awarded a permit covering the entire Bass Basin in 1960.

An aeromagnetic survey was flown in 1961 and subsequent regional 2D seismic surveys in 1962-63 provided data for basic geological concepts to be developed. Esso commenced exploration under a sole risk farmin agreement in 1965. (Benaris contracted FrOGTek to conduct a re-evaluation of the available Aeromagnetic and Gravity data and to integrate this data with available seismic <sup>1</sup>.)

Early exploration by Esso / BHPP, and subsequently by BHPP alone (through the period 1965-82), concentrated on the largest structures that could be identified at the top of, and within the Eastern View Group. Some nineteen (19) wells were drilled during this period. Both intra-formational and top porosity targets were interpreted to be similar to those in Gippsland where large oil and gas accumulations are found.

All of the wells were drilled on seismic data, which is considered today to be of poor quality. The majority of the wells were unsuccessful, as they are now interpreted to have been either drilled off structure or were not valid structural tests.

This initial phase of exploration resulted in the discovery of:

- non-commercial bio-degraded oil at Cormorant (recovered by wireline test); and,
- the undeveloped Pelican gas / condensate field.

The stacked clastic gas reservoirs at Pelican are not at the top of porosity but occur within the intra Eastern View Formation. Abnormally high formation pressures are in part due to structural inversion which is reflected in poor reservoir quality.

Exploration in the Bass Basin subsequently declined as interest waned, consequently exploration funds became firmly focussed on the Gippsland Basin following significant early Esso/BHP successes.

From 1980, the Bass Strait Oil and Gas Group and the Bridge Oil/ Weaver Oil consortiums led exploration in the basin. Amoco Exploration and Production Company and Sagasco Resources Ltd (now Origin Energy) farmed into the Bass Strait Oil and Gas permits and recorded extensive 2D seismic before drilling the successful Yolla-1 gas discovery in 1985.

An aeromagnetics survey and 3D seismic was recorded in 1993, but the successful Yolla-2 appraisal well was not drilled until 1998 largely because of market perception concerns.

Another hiatus occurred after the Barramundi-1 well was drilled by Globex Far East in 1999. This well was plugged and abandoned without encountering any hydrocarbons. Since then, Origin discovered gas condensate at Trefoil, and drilled the Yolla-3 and 4 development wells in 2004.

The announcement by Origin that oil was tested in Yolla-4 which was tested at an estimated flow rate of 4,000 bopd was considered very significant by Benaris pre-bid because the oil is reservoired at or near the top of the Eastern View Formation within mapped closure. Previously oil was tested from a similar level in Yolla-1.

It is understood that Cormorant-1 is the only other "produced" oil in the basin<sup>2</sup> and it is once again reservoired at the top of the Eastern View reservoir within mapped closure.

Early exploration focussed on large traps at this level and "smaller" features were overlooked.

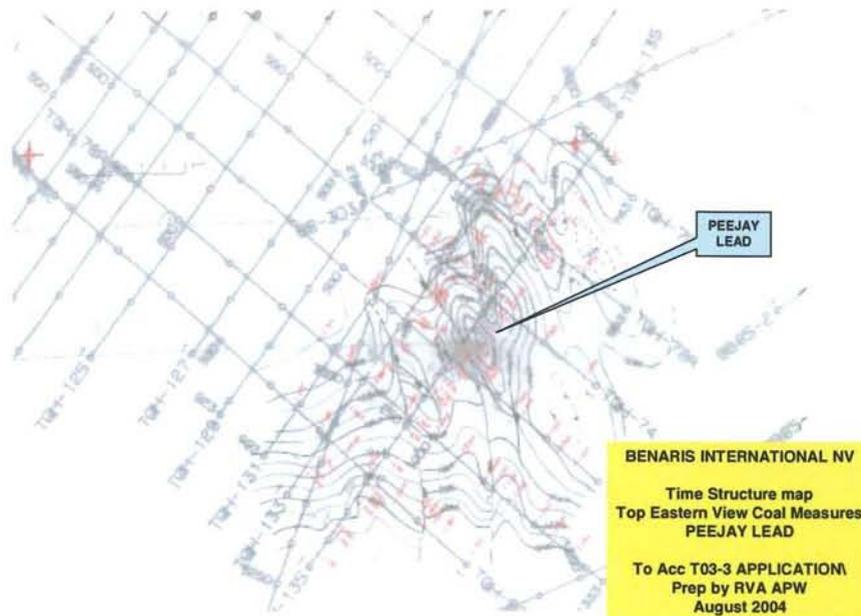
---

<sup>1</sup> Refer: "Teasdale J. October 2005, Bass Basin T/39P Permit Structural Model and SEEBASE™ Study for Benaris Petroleum"

<sup>2</sup> Cormorant-1 was drilled by Esso / BHP and biodegraded 21 degree API oil was wire-line tested in the well at the Top of the Eastern View reservoir.

Benaris were attracted to the area during the 2003 bid round when three (3) blocks in the Bass Basin were made available by the Federal Government for work program bid. At the time very little activity was occurring in the basin and the only areas under lease were the Retention / Production Lease over the Yolla Gasfield held by Origin Energy and partners, and the adjacent permit T/18P containing the White Ibis-1 gas discovery.

T03-3 was selected following preliminary interpretation and mapping by Benaris consultants (Figure 4) after dialogue with Tasmanian consulting geologist John ("PJ") Davidson<sup>3</sup>. The mapping showed at least one feature believed to be an early structure with mapped closure at the top of the Eastern View Formation.



**Figure 4: Pre-bid Mapping of the PeeJay Lead**

After the block was awarded to Benaris, the area was re-interpreted by Ron Angove prior to design of the PJ2D/3D seismic surveys<sup>4</sup>

Pre-bid, the only 3D seismic survey recorded in the basin was the Yolla 3D recorded in 1993-94. The basin was crying out for "state of art" exploration. Many of the problems experienced previously resulted from:

- poor 2D seismic data quality and inadequate seismic control given the size of the features present; and,
- accurate interpretation being beyond the capability of the 2D seismic method.

There are still no wells drilled within the confines of the T/39P block. The Pelican gas / condensate discovery with four (4) subsequent appraisal wells is located to the west of the permit.

A summary of the results of the Pelican wells is tabulated below (Figure 5):

<sup>3</sup> The PeeJay 2D and 3D Seismic Surveys and the PeeJay Prospect has been named after John ("PJ") Davidson in recognition of his assistance in locating the un-drilled lead pre-bid.

<sup>4</sup> Angove R A & Whittle A P, May 2005. "Technical Note, Seismic Interpretation Status, Tasmania T/39P, offshore Bass Basin, SE Australia" (Benaris, In-house report).

| BENARIS  |  |   |   |           |           |
|--|--|---|---|-----------|-----------|
| BASS BASIN T/39P   |  |   |   |           |           |
| SUMMARY OF PELICAN GASFIELD WELLS DRILLED TO THE WEST OF T/39P |  |   |   |           |           |
| Well Name  | Pelican-1  | Pelican-2   | Pelican-3   | Pelican-4 | Pelican-5 |
| Drilled  | 1970   | 1972  | 1972  | 1979      | 1985      |
| Operator   | Esso   | Esso  | Esso  | BHPP      | Amoco     |
| Water Depth  | 76.5   | -   | 80.2  | -         | 77.0      |
| KB (metres)  | 30.5   | -   | 9.8   | -         | 22.3      |
| Total Depth (KB)   | 3178.4   | 3068  | 2906.9  | 3051      | 4267      |
| Well Status  | P&A  | P&A   | P&A   | P&A       | P&A       |
| SUMMARY ANALYSIS OF RESULTS OF PELICAN WELLS                   |  |   |   |           |           |
| Well Name  | Play Type and Structure  | Shows and validity  | Comments  |           |           |
| Pelican-1  | Early Paleocene Late Cretaceous sandstones in a faulted anticline.                                     | Valid. Recovered gas and condensate from 12 FIT tested sandstones | Interbedded sandstones had porosity ~20% and perme of ~20md. Pressure below 200bar K&L.   |           |           |
| Pelican-2  | * Note: Pelican-3 was a step out of a northern fault block and the reservoir came in low to prognosis. | Valid. gas condensate shows                                       |   |           |           |
| Pelican-3  |  | Valid. minor gas shows in Paleocene                               |   |           |           |
| Pelican-4  |  | Valid. gas condensate shows                                       |   |           |           |
| Pelican-5  |  |   | DSST-4, 3143-1113 4.58mmd/4, 5inch choke. 3rd FTTP<br>DSST-5, 2809-2813 1mmd gas and condensate.<br>DSST-6, 2780-2790 5.6mmd/6, 302-4412x41, 879mmd. 5inch choke CB and FTTP. |           |           |

Figure 5: Pelican Field Well Results

Two unsuccessful wells were drilled by Weaver Oil *et al.*;

- Squid-1, lying immediately to the north; and,
- Tasmanian Devil-1, lying immediately to the south.

Both of these wells were dry holes and details follow (Figure 6):

| BENARIS   |  |   |
|---|--|---|
| BASS BASIN T/39P                                      |  |   |
| SUMMARY OF WEAVER OIL WELLS DRILLED ADJACENT TO T/39P |  |   |
| Well Name   | Squid-1  | Tasmanian Devil-1   |
| Drilled   | 1984   | 1984  |
| Water Depth   | 80.5   | 73.8  |
| KB Depth in metres                                    | 22.3   | 21.9  |
| Total Depth (KB)                                      | 2925 (2918m TVD)   | 863.7 in Oligocene Basalts  |
| Play type and Structure                               | Eastern View Group sandstones and Oligocene sandstones in a faulted anticline.                                       | Eastern View Group sandstones in a high side fault closure            |
| Shows validity and status                             | No shows original mapping has seismic diffractions that may have been misinterpreted as faulting.                    | No shows. Invalid as did not reach objective                          |
| Comments  | First test of Oligocene sandstone wedge. Interpreted to have laterally discontinuous sandstones and timing problems. | Section quite different to prognosis, age dating may be questionable. |
| Classification  | P&A as a dry hole  | P&A as a dry hole   |

Figure 6: Squid-1 and Tasmanian Devil-1 Well Results.

Chat-1 was drilled by Bridge Oil *et al.* and is also located to the north of the block providing further stratigraphic control.

The most recent prior exploration within the permit area was carried out by Cue Energy, when they held the much larger T28/P during the mid to late 1990's. Seismic was committed during year 2 with a well in year 3 as part of the agreed work programme, but this field work was never conducted. Mapping of the seismic in the permit was done on old paper sections available at the time. The PeeJay structure was identified by Cue and mapped as a prospect (Sorrell) within the Eastern View Coal Measures<sup>5</sup>. The prospect was mapped to have a closure area of 32.8km<sup>2</sup>, which is slightly larger than the current mapping, and was assessed to contain potential recoverable volumes of 99mmbo and 139bscf of gas.

A semi-detailed seismic grid had been recorded over the feature by Amoco in 1985 as part of their TQH survey, so presumably the feature was too small to be attractive at the time, which was after the discovery of Yolla with the drilling by Amoco of Yolla-1 in 1985.

## **GEOLOGY AND HYDROCARBON PROSPECTIVITY**

A comprehensive summary of the Bass Basin is included in a report compiled by J E Blevin of Geoscience Australia as part of the output from the Western Tasmanian Regional Minerals Program at Geoscience Australia in 2003<sup>6</sup>. This was available prior to the Benaris bid for T03-3.

There has been no attempt in this report to repeat their excellent geological description of the basin, which clearly and adequately describes the petroleum system. The intent of this document is to capture key points related to potential in support of the ongoing work program.

Geoscience Australia's assertions in relation to the Bass Basin Hydrocarbon System, can be summarized as follows:

- *Reservoir*
  - Good quality sandstone reservoirs occur in the Eocene to Paleocene section and porosity averages 15-25% decreasing fairly moderately down to ~2,700m.
- *Source and Maturation*
  - Potential source rocks are non-marine and include Late Cretaceous to Eocene coals and carbonaceous claystones.
  - Coals in the Upper Eastern View section have high hydrogen indices and contain abundant exinite and vitrinite.
  - The basin wide onset of oil maturation occurs at ~2,700m with overpressure generally occurring below this depth.
- *Seal*
  - The Upper Eocene Demons Bluff Formation is a marginal marine shale facies and provides an excellent seal at the top Eastern View level although it is not present in the south-eastern portion of the basin.
  - Intra-formational seals are demonstrated in the nearby Pelican gas field.
- *Hydrocarbons*
  - The Bass Basin oils have a terrestrial source affinity and are geochemically similar to Gippsland Basin oils.

The intracratonic Bass Basin is one of a series of basins located along the southern margin of Australia that were formed as a result of the Early Cretaceous-Early Tertiary rifting between Australia and Antarctica, and were subsequently modified by late Tertiary compression.

---

<sup>5</sup> Refer: "Blackburn GJ and Baird JG, November 1995, *Petroleum Potential of T/28P Durroon Basin,*" prepared by for Cue Energy Ltd"

<sup>6</sup> Refer: "Blevin J E (Compiler) *Petroleum Geology of the Bass Basin, Interpretation Report Geoscience Australia Record 2003/19*"

The progressive dissection of Gondwanaland occurred through at least five separate seafloor spreading episodes. The basin was initiated by northeast- southwest extension largely during the Early Cretaceous and the extensional stage was followed by a Late Cretaceous to Pliocene subsidence phase and a later stage compressional overprinting.

Major northwest to southeast longitudinal normal faults occurred in the Early Cretaceous rifting phase and created asymmetric depressions, which dominated sediment accommodation until early Eocene. Thereafter regional sag occurred more or less uninterrupted until present day. Basin inversion occurred in some areas during the Miocene forming structures, which are the key exploration targets along the southern margin.

The Pelican, Yolla, Dondu, White Ibis and Cormorant Troughs are the major depocentres within the western part of the Bass Basin. The Durroon Sub-basin lies to the southeast, and is structurally differentiated from the western part of the Bass Basin by the north-south trending Chat Discontinuity (or Chat Accommodation Zone), which is thought to represent the boundary between Proterozoic and Paleozoic basement terrains. The Bass Basin west of the Chat Accommodation Zone is referred to by Geoscience Australia as the "Cape Wickham Sub-basin". T39/P lies at the eastern end of the Pelican Trough, and to the west of the Chat Accommodation Zone (Figure 2).

The stratigraphic succession within Bass is only known from well control, however this well information, combined with available regional seismic data, allows correlation of sub-cropping rocks and well bores from the genetically similar adjacent Otway and Gippsland Basins.

Basement in the basin may be as old as Cambrian and when encountered in the Bass-2 and Bass-3 wells was slightly metamorphosed and age dated as early Paleozoic or perhaps Cambrian.

The early Cretaceous Otway Group was encountered in the Durroon-1 well as a 1,200m succession of argillaceous sediments similar to the Otway Group and the Strzelecki Groups of the Otway and Gippsland Basins respectively.

These early Cretaceous sediments were rapidly deposited and generally poorly sorted and filling locally subsiding depressions that contain up to 3,000m of section in the Durroon Trough. The Lower Cretaceous is considered to have very poor prospectivity compared with the Upper Cretaceous sediments, which overlay this section unconformably.

The Upper Cretaceous is informally divided into Upper and Lower subdivisions and the Upper *L.balmei*/ Lower *M.diversus* biostratigraphic boundary is used as a convenient break. Both subdivisions are composed of siliclastics but the Upper subdivision contains a greater percentage of coal and thicker sandstone intervals with marginally better reservoir properties and no known abnormal formation pressures.

The target in the T/39P block is within the Upper Eastern View and average reservoir characteristics from core data for the subdivisions of the Eastern View in the Southern Bass Basin are as follows:

| <b>SUMMARY OF RESERVOIR CHARACTERISTICS FOR SOUTHERN BASS BASIN WELLS*</b> |                                       |  |
|--|---------------------------------------|--|
| <i>Formation/ Group</i>  | <i>Porosity Range<br/>(Average %)</i> | <i>Permeability Range<br/>(Average mD)</i> |
| Upper Eastern View Group   | 7.7-37.4<br>(17.7%)                   | .01-1600<br>(76.1 mD)                      |
| Lower Eastern View Group   | 7.7-36.3<br>(17.6%)                   | .01-1230<br>(66.4Md)                       |
| Otway Group  | 6.8-26.9<br>(13.6%)                   | .01-310<br>(14.3Md)                        |

\* (After Blackburn & Baird, 1995)

The Demons Bluff Formation was deposited at the conclusion of the Eocene as a result of marine transgression over a vast area, providing a regional top seal except in the southeast portion of the basin and in the Durroon-1 well where the unit is a sandstone facies.

The basin thereafter continued to subside as Australia separated from Antarctica and sedimentation changed from a restricted, to full circulation regime. Mostly fine-grained marine sediments were deposited in the low relief topography. Eustatic low stands within the Oligocene, formed channelised sequences such as the sand filled channel intersected at Squid-1. Intermittent structural movement along faults produced drape structures.

## **SEISMIC DATA AND DATA QUALITY**

### ***Pre-2004 seismic data:***

Approximately 2,083 km of post 1983 vintage data, and the same amount of pre 1983 seismic data are present within T/39P (Figure 7). The majority of the post 1983 data was purchased from Fugro. This data was reprocessed from the original field tapes. A moderately good 2D (only) seismic grid is formed by the lines over the permit, and well ties are adequate to the Pelican area and to other nearby wells. Average grid spacing is ~ 2.5 km x 2.5 km. In some areas, 5 km to 10 km between seismic control is not uncommon.

The pre 1983 data was sourced from Mineral Resources Tasmania and Geoscience Australia and the paper copies scanned by Newave Geophysical in Sydney. Newave supplied the digital data set together with the navigation data.

Much of the data-set purchased from Fugro was drawn from a number of tapes of different post 1983 vintages that they acquired from the Geoscience Australia's Villawood tape repository. Fugro completely reprocessed from field tapes through to final migrated stack. Fugro also post stack reprocessed other data where gather tapes or final stack tapes were available and where original field tapes were either lost, unusable due to tape condition, or of a format that is not now easily transcribable.

The Fugro dataset extends over much of the area within T/39P and to the west towards the Pelican discovery in the neighbouring T/38P operated by the Cue Energy "Galveston Mining" led joint venture. The Fugro data is not unexpectedly, the superior publicly available dataset in T/39P and elsewhere within the Bass Basin.

The several vintages of data included within the Fugro dataset have all been processed to a standard final migrated input and phase matching and mistie analyses procedures applied. Consequently a well balanced dataset with consistent character is available for interpretation. Conversely other (pre 1983) data within the permit which has not been reprocessed consists of a mixture of un-migrated and migrated data having different phased outputs, (*i.e.*: zero vs. minimum phase), and a variety of different applied processing routines.

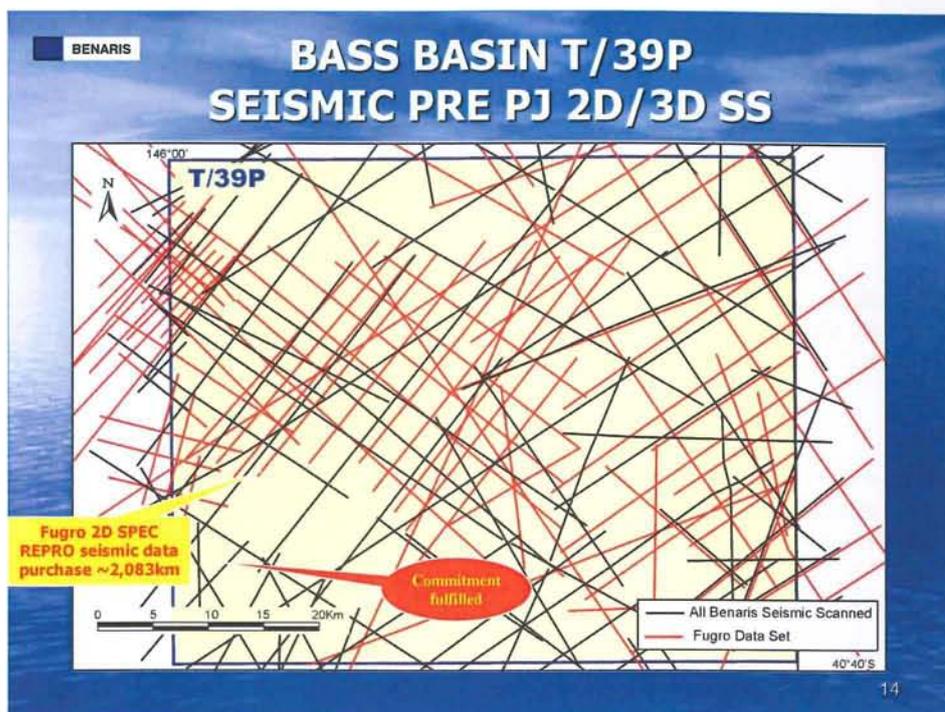


Figure 7: T/39P 2D seismic data, pre the PJ2D/3D seismic surveys

Consequently, the poor data quality of these 2D strike and dip outputs, results in common data mis-ties, and dips can only be honoured with these lines. Frequencies within the Fugro dataset appear balanced and amplitudes well matched from line to line.

**Benaris PJ2D and PJ3D surveys:**

In 2005, PGS acquired 196 km<sup>2</sup> (full fold) of the PJ3D survey and 330 line km (full fold) of the PJ2D survey on behalf of Benaris Petroleum NV (Figure 8).

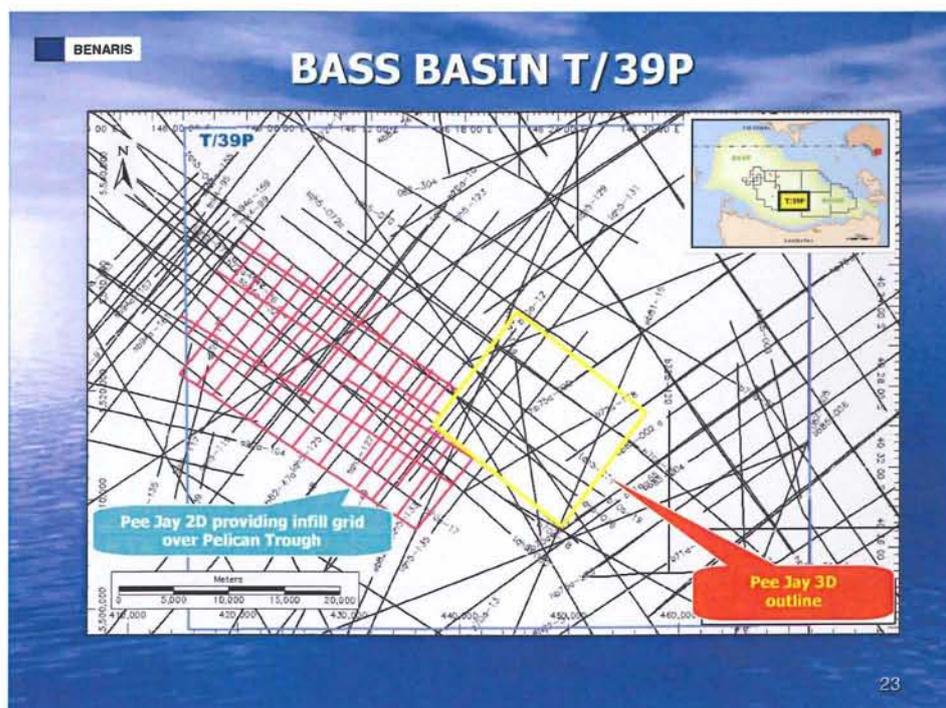


Figure 8: T/39P current seismic data set, highlighting the PJ2D/3D seismic surveys acquired by Benaris.

Processing of both surveys by PGS in Perth was completed by March 2006, and interpretation started soon after. Data quality is good and imaging of faults has improved over previous surveys. Details of the acquisition and processing have been recorded in reports submitted previously to Mineral Resources Tasmania<sup>7</sup>.

## **SEISMIC INTERPRETATION AND MAPPING**

### *Mapped Area*

There are no wells drilled to date within the T39/P block, so well ties were made outside this area. As a result the mapped area extends for 10-20 kilometres outside the permit area on all sides. It should be stressed that only a selection of lines were available outside the permit area and thus less structural detail in mapping is possible.

### *Seismic Data Interpreted*

All the above seismic data was interpreted across the areas of the T/39P permit and neighbouring areas where lines extend out of the permit. The Pelican feature was also mapped (albeit basically due to the low line density of tie line data purchased by Benaris), to provide control for parts of the Pelican closure that may extend into this permit.

### *Interpretation Methodology*

Mapping of the newly acquired surveys, reprocessed and scanned data was done to produce an improved interpretation which was undertaken on a phase matched (as far as possible) dataset on the workstation. Maps up to this date had been done using paper sections, and did not have the benefit of modern 3D and 2D data.

Mapping then concentrated on defining the geometry of reservoir-seal pairs at the top of the Eastern View Coal Measures. The top of the regional seal (Demons' Bluff Fm.) and the top of the main reservoir section (Upper Eastern View Coal Measures) were interpreted initially to gain a regional structure map of the permit and surrounding areas. Volcanic units close to these two horizons were also mapped in detail to determine their effect on underlying velocities (and therefore depth maps). Several other horizons within the Eastern View Coal Measures were interpreted to gain an idea of depositional variation across the permit. Lower horizons (*Lower M. diversus/L. balmei* to Top Otway Gp. inclusive), were interpreted later to try and determine if the adjacent Pelican feature extended into the T39/P block.

---

### *Refer:*

*"PGS Geophysical November 2005, Acquisition Report Bass Strait PJ2D and 3D prepared for Benaris Petroleum"*

*"Murray D and Doughty R November 2005, Final Supervision Report for the Data Acquisition Operations of the PJ 3D and 2D Marine Seismic Surveys conducted for Benaris Petroleum prepared by Enquest"*

*"PGS Data Processing May 2006, Data Processing Report 3D and 2D Seismic Surveys Block T/39P Bass Strait Australia prepared for Benaris Petroleum NV"*

**Horizons Mapped**

Fourteen (14) horizons were mapped (see Table below) across the 3D and 2D grid in the area (where possible). In most cases the unconformable surfaces (sequence boundaries) are picked as a zero crossing, while flooding surfaces were generally picked as troughs. Phase differences were noted between the scanned lines and the rest of the data.

| BASS BASIN T/39P SUMMARY OF SEISMIC PICKS |                    |                     |                      |
|---|--------------------|---------------------|----------------------|
| Horizon Name                              | Approximate Age    | Surface Type        | Maps produced        |
| Seafloor                                  | Present Day        |                     | Two Way Time & Depth |
| Miocene Marker                            | Mid-Late Miocene   | Max. flooding surf. | Two Way Time & Depth |
| Top Angahook Fm.                          | Mid Oligocene      | Max. flooding surf. | Two Way Time & Depth |
| Top Demons Bluff Fm.                      | Mid-Late Eocene    | Sequence Boundary   | Two Way Time & Depth |
| Top Upper Eastern View Fm.                | Mid-Eocene         | Max. flooding surf. | Two Way Time & Depth |
| Intra Upper Eastern View Fm.              | early Mid-Eocene   | Sequence Boundary   | Two Way Time & Depth |
| Base Upper Eastern View Fm.               | Early Eocene       | Sequence Boundary   | Two Way Time & Depth |
| Lower M. diversus                         | Early-Eocene       | Sequence Boundary   | Two Way Time & Depth |
| Top Durroon Fm                            | Campanian          | Sequence Boundary   | Two Way Time         |
| Intra Durroon Unc.                        | Turonian-Santonian | Sequence Boundary   | Two Way Time         |
| Top Otway Group                           | Cenomanian         | Sequence Boundary   | Two Way Time         |
| Volcanic_1                                | Oligocene          | Top of Volc. Unit?  | Two Way Time         |
| Volcanic_2                                | Late Eocene        | Top of Volc. Unit?  | Two Way Time         |
| VolcanicEV_3                              | Mid-Eocene         | Top of Volc. Unit?  | Two Way Time         |

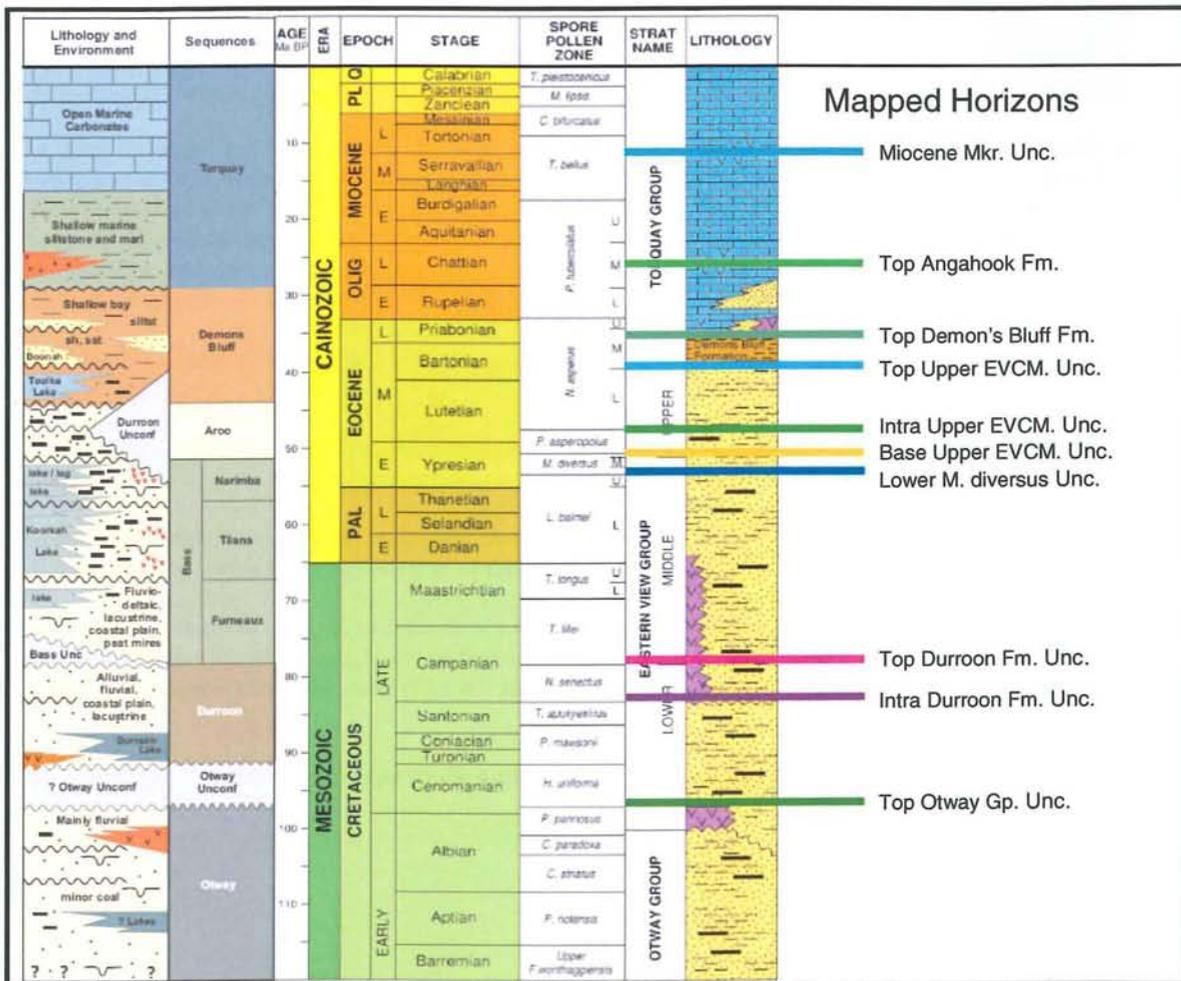


Figure 9: Lithostratigraphy of the Bass Basin showing mapped horizons (lithostratigraphy based on GA report).

Figure 9 shows the horizons marked onto the composite lithostratigraphy produced by Geoscience Australia (GA). It is interesting to note that within the same publication there is not agreement on the top or the base of the Demons' Bluff formation. The Durroon Formation is labelled as the Lower Eastern View Fm. in one of the lithostratigraphic charts.

The lower three horizons have only been mapped recently, (Top Durroon, Intra Durroon and Top Otway Group), and maps produced in two-way-time only. To date, these levels have not been depth converted, and they may remain problematic as there are no nearby well penetrations (apart from Durroon-1) to calibrate the depth conversion.

The oldest event mapped to date is an unconformity at the Top of the Otway Group equivalent. This is picked solely on character, and similarities with the nearby Otway and Gippsland Basins. The event represents a marked angular unconformity.

Within the overlying Durroon Fm. (sometimes labelled as Lower Eastern View Group in GA report), there is an unconformity that is thought to be roughly equivalent with the top of the Emperor Group from the adjacent Gippsland Basin (Longtom unconformity). This unconformity has been mapped as the intra-Durroon Fm. Unc. based on character.

The top of the Durroon Fm. is intersected at Durroon-1, however, this well does not tie any of the lines on the grid interpreted, and is mapped based on character and comparisons with previous mapping tied to Durroon-1 (Baird & Blackburn, 1995). This event is unconformable in some areas.

An event at the Lower *M.diversus* and *L.balmei* boundary was mapped within the permit, which gives a depth structure map at approximately the same level as hydrocarbons were encountered in the Pelican-1 and Pelican-5 wells.

An event at the base of the upper Eastern View Coal Measures is mapped which is unconformable in areas.

The 'Intra Eastern View Coal Measures seismic event' ("Intra EVCM") ties close to hydrocarbon shows and gas/condensate reservoirs elsewhere in the Bass Basin (*e.g.*: Yolla-1). It is also interesting to note that this event is time equivalent to the unconformity at the top of the Latrobe Group in the Gippsland Basin (Figure 10). Unlike the Gippsland Basin, this event does not seem to have had the same amount of associated uplift at the basin margins, and does not have as much section missing. This event represented the end of coal dominated sediments, to sandier facies above.

The 'Near Top Eastern View Coal Measures seismic event' ("Near Top EVCM") is interpreted to tie close to the top of the reservoir section.

The Top of the Demons' Bluff Fm. represents the top seal, except towards the far south-east, where it is thought to be silty.

The Miocene marker and Top of the Angahook Fm. were mapped to provide control for thermal modelling work being undertaken across this southern part of the basin.

The volcanic units were mapped in order to see where they may have had an effect on velocities of units mapped below them, and especially to see their effect on the mapped prospects. They lie in three main bodies which are within and above the main reservoir level at the top of the Upper Eastern View Coal Measures (Figure 11).

Two Way Time structure maps of the above horizons are included as Enclosures 1-9 at the back of this report.

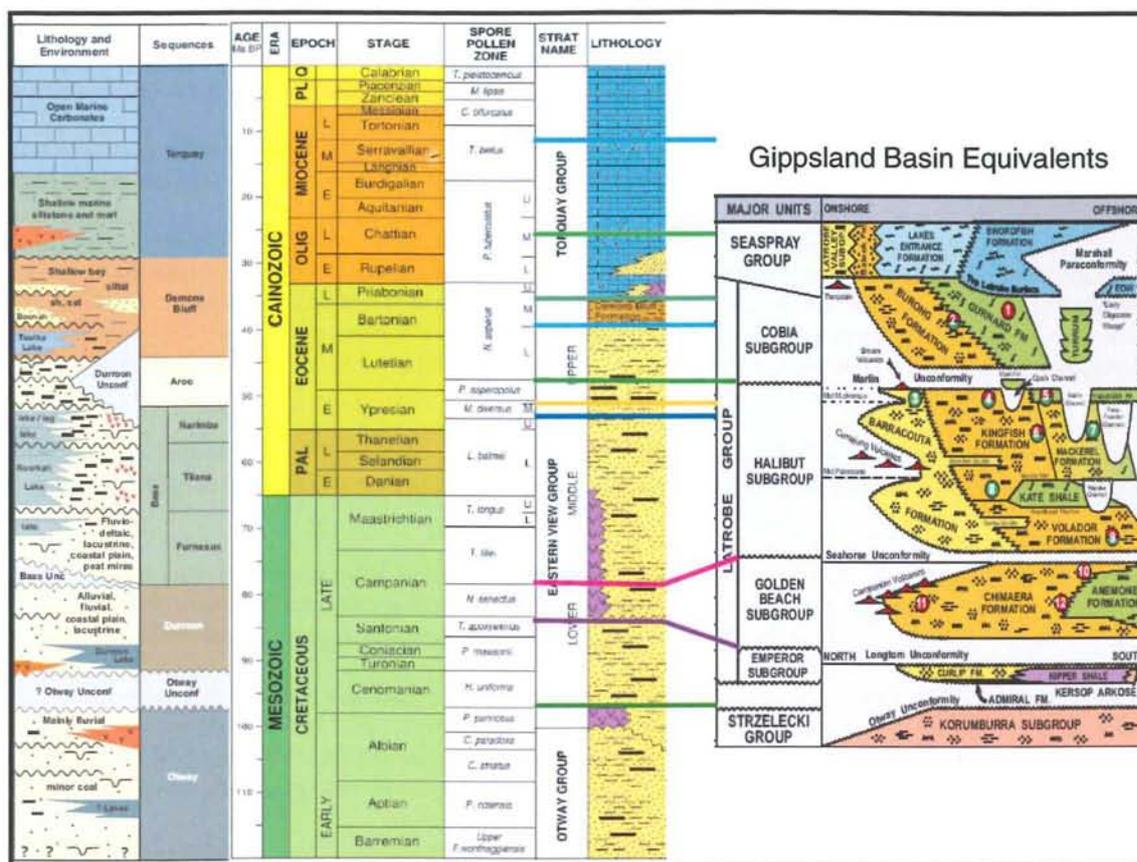


Figure 10: Comparison of Gippsland and Bass Basin lithostratigraphies

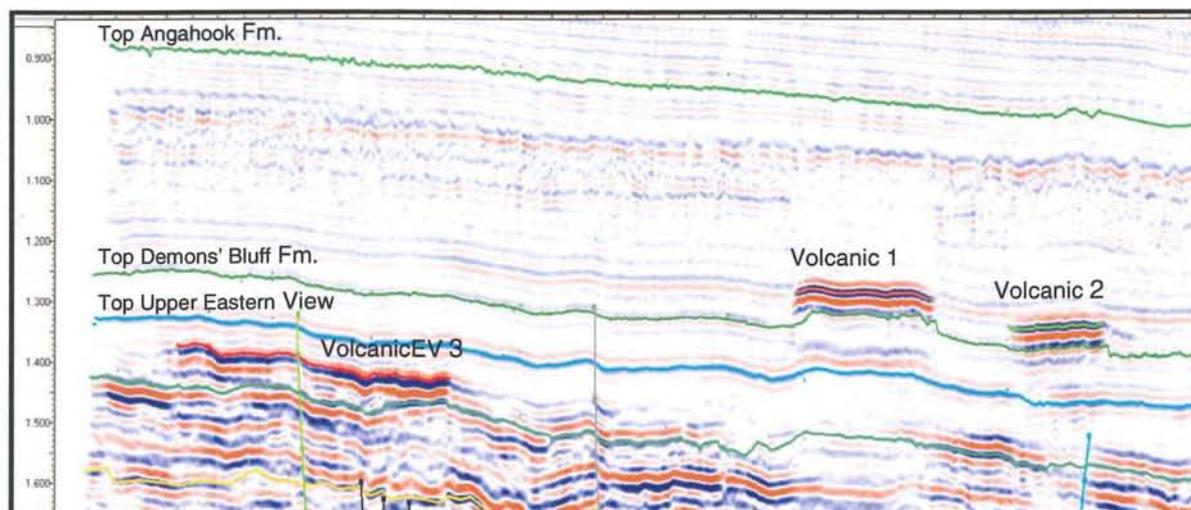


Figure 11: Seismic Line tqh-127 showing the stratigraphic position of volcanic flows 1-3.

**Depth Conversion**

Depth conversion of the gridded two-way-time maps was sub-contracted to Mr Ian Ward (Basian Enterprises Pty Ltd) and completed in October 2006. Mr Ward has extensive experience in depth conversion particularly in the adjacent Gippsland Basin and is deemed by Industry to be an 'expert' in depth conversion methodology.

Dense velocity analysis picks were available for the newly-acquired Benaris 2D and 3D data, and this was used with the well velocities from Dondu-1, Pelican 1-5, Poonboon-1, Nangkero-1 and Squid-1.

The supplied time grids were extrapolated to cover a uniform area. No changes were made to these except for the water bottom grid, which was redone using only well tops and the new Benaris seismic data? The water bottom two-way-time map was found to mistie between the older and new surveys

RMS velocity grids were constructed from the time grids for each horizon, with the dense velocity analysis data files. Grid values were only calculated at velocity analysis locations.

The resultant "depth" grids were smoothed using depth complexity constraining. This method is an iterative process that uses the shape or complexity of the time grids to determine how much smoothing of the depth grid is required. The aim is to produce a final depth grid that is the same magnitude of complexity or less, than the time grid converted to depth using a simple velocity function (*e.g.*: constant velocity). The "smoothed" RMS velocity grids from this process were Dix-corrected to produce un-calibrated average velocity grids.

Interval velocities computed from these grids, combined with interval velocities derived from the well tops supplied, and the seismic ties, were used to extrapolate and interpolate the interval velocities over the entire grid area.

Some small adjustments were made to the supplied well tops in order to produce acceptable interval velocity fields. Dondu-1 was excluded altogether. Depth and time grids from this process underwent a second depth complexity constraining process, and were then calibrated to the adjusted well tops.

The production of final maps was undertaken using Petrosys. Two-way-time maps have been made of all the mapped horizons (Enclosures 1-9). Average velocity (Enclosures 10-14) and resultant depth maps have been produced for all horizons except the volcanic units and the lowest three horizons (Enclosures 15-28). The lower three horizons are mainly to provide assistance for mapping hydrocarbon drainage and migration pathways.

#### ***Prospects and Leads***

Tilted fault blocks exist with four-way dip/fault closure in the Upper Eastern View Coal Measures. Similarly combination fault/dip closures exist at lower levels through the section. Lower horizons (Top Durroon to Top Otway Group) are only mapped in two-way-time, but still show closures towards the western side of the permit towards the Pelican field.

One sizeable prospect (PeeJay), and numerous smaller leads exist at the top of the Eastern View Coal Measures within T39/P. In general, large closures do not exist at this level (or at the Intra-upper Eastern View Coal Measures) as is the case in the adjacent Gippsland Basin. This is possibly due to much less Miocene inversion of the pre-existing fault trends. In this respect, PeeJay is unique in being probably the largest untested, upper Eastern View closure in the basin. Faulted and four-way dip closure exists at PeeJay from the Top of the Demons' Bluff Fm. (seal) to within the lower part of the Eastern View Coal Measures. Closure may exist at the top of the Durroon Fm., however, this horizon has not been depth converted. In two-way-time this lower horizon seems to spill up to the northeast and towards the margins of the basin.

Hydrocarbon migration into the PeeJay structure can be seen to be derived from the trough to the northeast of the permit near Poonboon-1 and Nangkero-1. The Pelican Trough may also provide a source of hydrocarbons into the PeeJay feature.

Enclosure 25 shows that overlying volcanics flowed around the main prospect (PeeJay), as this is likely to have been a positive topographic feature during the time of volcanic extrusion. Depth conversion sensitivities were run in order to see the effect of the volcanic flows on the depth conversion of underlying horizons. A difference map (Enclosure 29) at the Top Upper Eastern View horizon, shows the number of metres difference between the RMS velocity converted depth map, and a map derived from just using the well velocities. In effect, this shows the number of metres difference that the volcanics have had on the final depth map. From this map it can be seen that the volcanics have had only a small impact on depth conversion and made less than 5 metres difference over most of the PeeJay structure. There is some pull-up due to the volcanics in the region immediately to the south of the PeeJay feature to the south of the bounding fault. It is considered that if anything the effect of the volcanics in relation to the depth conversion is to understate the volume of the PeeJay feature.

Other smaller leads exist in the T/39P block within the Eastern View Coal Measures, and there is also a large closure at the *Lower M. diversus/L. balmei* level. This closure in the northwest of the permit may be an extension of the greater Pelican closure. There is also considerable closure at the deep Top Durroon Fm. in two-way-time (enclosure 23). Pelican-5 has hydrocarbons at approximately the same level as both these horizons.

Other possible leads exist at the Top Durroon Fm. where large tilted fault blocks are present with elongate closures.

**VOLUMETRICS**

The only volumetrics computed as part of this study are for the PeeJay prospect and have been presented here in terms of depth, area and gross rock volume. These volumes were computed from depth maps at the

- Top UEVCM (Figure 12)
- Intra UEVCM
- Base UEVCM

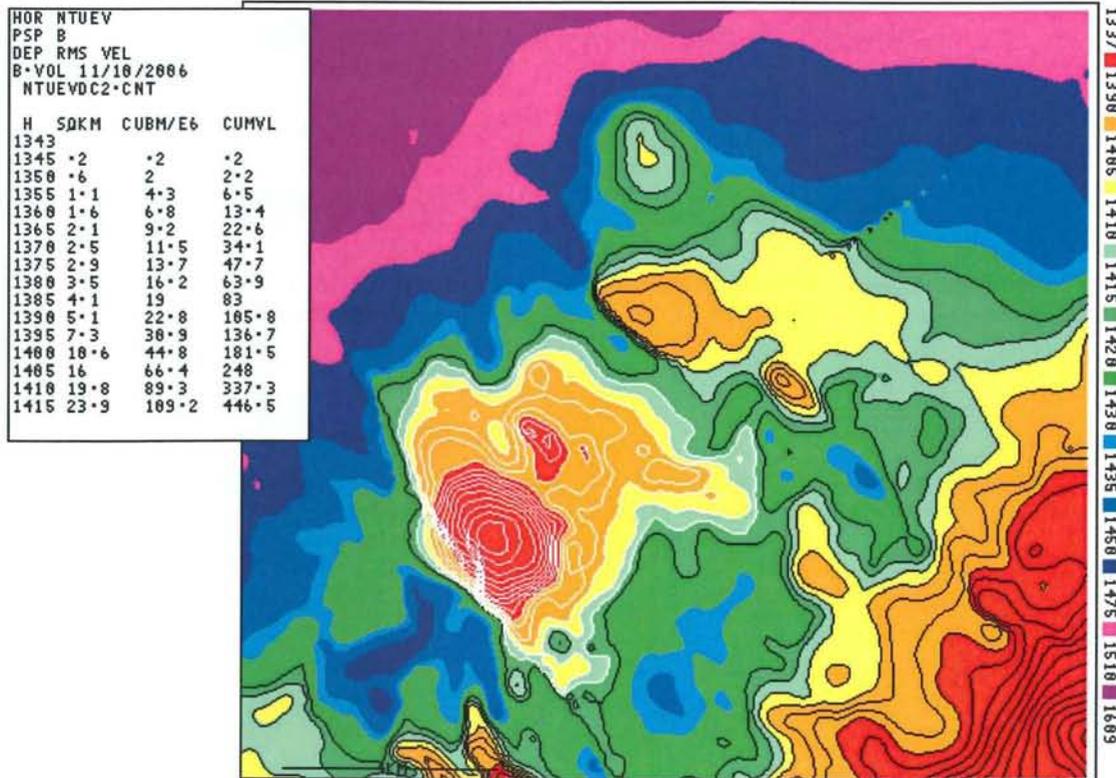


Figure 12: Depth map (Top Upper Eastern View Coal Measures) used to calculate volumes, showing a total Gross Rock Volume of 446.5 metres<sup>3</sup> (area of closure=23.9km<sup>2</sup>) and a 72 metre column.

No maps have been used to generate volumes for the equivalent gas pay in Pelican which is below the Base UEVCM.

These volumes were then provided to Mr Peter Cameron (ResourceInvest Pty Ltd) who made an independent assessment of the oil and gas potential<sup>8</sup>.

The volumes were provided for input into the assessment in terms of depth increments and incremental gross rock volumes and can be summarised as follows.

<sup>8</sup> Refer: "Cameron P J of ResourceInvest Pty Ltd, February 7, 2007 Volumetric Appraisal of the PeeJay Prospect, for Benaris International"

ResourceInvest then computed a range of volumes focussing on 100% trap fill for each horizon and the numbers are summarised for the “full to spill case” are shown on the following table.

| <b>PEEJAY PROSPECT VOLUMETRICS</b> |            |            |            |
|------------------------------------|------------|------------|------------|
| <b>(Full to spill case)</b>        |            |            |            |
|                                    | <i>P90</i> | <i>P50</i> | <i>P10</i> |
| <b>Top EVC</b>                     |            |            |            |
| GIP (bcf)                          | 366        | 440        | 521        |
| Sales Gas (rec)                    | 245        | 298        | 360        |
| OIP (mmb)                          | 207        | 251        | 301        |
| Oil recoverable                    | 90         | 112        | 140        |
| <b>Intra EVC 1540</b>              |            |            |            |
| GIP (bcf)                          | 216        | 253        | 294        |
| Sales Gas (rec)                    | 143        | 172        | 204        |
| OIP (mmb)                          | 117        | 138        | 161        |
| Oil recoverable                    | 50         | 62         | 75         |
| <b>Base Upper EVC 1710</b>         |            |            |            |
| GIP (bcf)                          | 110        | 142        | 176        |
| Sales Gas (rec)                    | 69         | 90         | 113        |
| OIP (mmb)                          | 59         | 76         | 95         |
| Oil recoverable                    | 23         | 30         | 39         |

An assessment was also made on a partial fill case but of interest here is that the “size of the container” is sufficient for significant accumulations considering that the deeper Pelican gas condensate reservoirs have not been assessed.

#### CONCLUSIONS AND RECOMMENDATIONS

As a result of the interpretation of newly acquired 3D and 2D seismic data, the T/39P permit has been up-graded in relation to exploration potential, with a significant prospect (PeeJay) delineated. Other prospects have been identified (some at deeper levels) which need further work to fully define.

By: Jennifer Baird

March 2007

**DISCLAIMER**

*Benaris Petroleum N V and its related bodies corporate, and their advisers and respective agents, Directors, Officers and employees:*

- Do not warrant or represent the origin, validity, accuracy, completeness, currency or reliability of or accept any responsibility for errors or omissions in the information and data contained in this document.*
- Disclaim and exclude all liability (to the extent permitted by law) for all losses, claims, damages, demands, costs and expenses of whatever nature arising in any way out of or in connection with the Information (or any accompanying or other information), its accuracy, completeness or by reason of reliance by any person on any of it; and:*
- Do not have any obligation to advise any person if any of them becomes aware of any inaccuracy in or omission from the Information (or any accompanying or other information).*

**SELECTED REFERENCES**

Blackburn GJ and Baird JG., Nov 1995 "Petroleum Potential of T/28P Durroon Basin, Tasmania" prepared for Cue Energy

Blevin J E (Compiler), 2003, "Petroleum Geology of the Bass Basin, Interpretation Report" prepared by Geoscience Australia Record 2003/19"

Cameron P J., February 7, 2007, "Volumetric Appraisal of the PeeJay Prospect" prepared by ResourceInvest Pty Ltd for Benaris International

Murray D and Doughty R, November 2005, "Final Supervision Report for the Data Acquisition Operations of the PJ 3D and 2D Marine Seismic Surveys conducted for Benaris Petroleum" prepared by Enquest

PGS Geophysical, November 2005, "Acquisition Report Bass Strait PJ2D and 3D" prepared for Benaris Petroleum

PGS Data Processing, May 2006, "Data Processing Report 3D and 2D Seismic Surveys Block T/39P Bass Strait Australia" prepared for Benaris Petroleum NV.

Teasdale J., October 2005, "Bass Basin T/39P Permit Structural Model and SEEBASE™ Study" prepared for Benaris Petroleum

## **AUTHOR**

Jennifer Baird has a B.Sc (Hons) and Ph.D from Monash University. She spent three years as a staff geologist with Shell Australia, before becoming a consultant. For the past fourteen years Jennifer has worked through her company (Adenmere Pty Ltd) for clients including BHP Petroleum, Benaris Petroleum, Cue Energy, Essential Petroleum, Esso, Lakes Oil, Mobil, Nexus Energy, Tap Oil, Karoon Gas, Woodside, Santos and Shell. These assignments included seismic interpretation and mapping, depth conversions, geochemistry and biostratigraphy reviews, basin and gazettal reviews, farm-in and farm-out preparation and evaluations, and well post-mortems. A two-year period co-running a consultancy was undertaken during this time, which provided out-sourced seismic interpretation (sequence stratigraphy based) that resulted in multi-client reports and study group projects covering many Australian and S.E. Asian petroleum provinces. Clients included most of the companies now actively exploring in Australia. Jennifer established ResourceInvest Pty Ltd with Peter Cameron in 2001 and maintains an active technical role in geological and geophysical consulting within the oil & gas industry, as well as involvement in broader based resource company research. Jennifer is a Member of the Petroleum Exploration Society of Australia.

## **ACKNOWLEDGEMENTS**

Assistance in compiling of this report has been given by the following consultants at Benaris and their help has been valuable: Ron Angove, Victoria Fitzgerald and Andy Whittle.

## List of Enclosures

| Enclosure Number  | Page Number |
|---|-------------|
| <b>Two Way Time Maps</b>  |             |
| 1: Two Way Time Structure Map, Seafloor   | E-1         |
| 2: Two Way Time Structure Map, Miocene Mkr.   | E-2         |
| 3: Two Way Time Structure Map, Top Angahook Fm.   | E-3         |
| 4: Two Way Time Structure Map(Detail PJ 3D area), Top Demons' Bluff Fm.   | E-4         |
| 5: Two Way Time Structure Map(Detail PJ 3D area), Near Top Upper Eastern View Fm.   | E-5         |
| 6: Two Way Time Structure Map(Detail PJ 3D area), Intra Upper Eastern View Fm.  | E-6         |
| 7: Two Way Time Structure Map(Detail PJ 3D area), Base Upper Eastern View Fm.   | E-7         |
| 8: Two Way Time Structure Map(Detail PJ 3D area), Lower <i>M. diversus/L. balmei</i> Mkr.   | E-8         |
| 9: Two Way Time Structure Map, Lower <i>M. diversus/L. balmei</i> Mkr.  | E-9         |
| 10: Two Way Time Structure Map, Top Durroon Fm.   | E-10        |
| <b>Average Velocity Maps</b>  |             |
| 11: Average Velocity Map, Top Demons' Bluff Fm.   | E-11        |
| 12: Average Velocity Map, Miocene Marker  | E-12        |
| 13: Average Velocity Map, Top Angahook Fm.  | E-13        |
| 14: Average Velocity Map, Near Top Upper Eastern View Fm.   | E-14        |
| 15: Average Velocity Map, Intra Upper Eastern View Fm.  | E-15        |
| 16: Average Velocity Map, Base Upper Eastern View Fm.   | E-16        |
| 17: Average Velocity Map, Lower <i>M. diversus/L. balmei</i> Mkr.   | E-17        |
| <b>Depth Maps</b>   |             |
| 18: Depth Structure Map, Water Bottom.  | E-18        |
| 19: Depth Structure Map, Miocene Mkr.   | E-19        |
| 20: Depth Structure Map, Top Angahook Fm.   | E-20        |
| 21: Depth Structure Map, Top Demons' Bluff Fm.  | E-21        |
| 22: Depth Structure Map, Near Top Upper Eastern View Fm.  | E-22        |
| 23: Depth Structure Map, Intra Upper Eastern View Fm.   | E-23        |
| 24: Depth Structure Map, Base Upper Eastern View Fm.  | E-24        |
| 25: Depth Structure Map, Lower <i>M. diversus/L. balmei</i> Mkr.  | E-25        |
| 26: Depth Structure Map(Detail PJ 3D area), Near Top Upper Eastern View Fm.   | E-26        |
| 27: Depth Structure Map(Detail PJ 3D area), Near Top Upper Eastern View Fm.,<br>showing extent of overlying volcanic bodies 1 and 2     | E-27        |
| 28: Depth Structure Map(Detail PJ 3D area), Intra Upper Eastern View Fm.  | E-28        |
| 29: Depth Structure Map(Detail PJ 3D area), Base Upper Eastern View Fm.   | E-29        |
| 30: Depth Structure Map(Detail PJ 3D area), Lower <i>M. diversus/L. balmei</i> Mkr.   | E-30        |
| 31: Difference Map, Depth (metres), between RMS and well velocity function<br>depth conversion methods, Near Top Upper Eastern View Fm. | E-31        |