

# **YOLLA 2 WELL PROPOSAL T/RL1**



**T/RL 1  
BASS BASIN  
TASMANIA**



## SUMMARY

It is proposed to drill the Yolla 2 appraisal well in the retention lease T/RL1 at cdp 878 of seismic line 465 to a total depth of between 3300 metres and 3700 metres subsea. The Yolla 2 well will appraise the gas, oil and condensate discovery made by Yolla 1.

The Yolla 1 well was drilled in the offshore Bass Basin permit T14/P in 1985. The well was located near crestally on a Top Eastern View Coal Measures anticlinal structure, coincident with a distinctive seismic amplitude anomaly, and discovered an oil/gas and condensate pool at this level. A 35 metre hydrocarbon column was intersected which produced 11.8 MMCFD of gas with 892 BPD of condensate, and 1.02 MMCFD gas with 302BPD of oil from two separate drill stem tests. The well drilled a further 1000 metres prior to intersecting gas/condensate bearing sands of Early Eocene-Palaeocene age. One of these sands tested gas at 15.1 MMCFD and condensate at 580 BPD.

A detailed 3D seismic survey acquired in 1994, was subsequently used to more fully understand the structural picture, and define potential appraisal well locations.

The 3D seismic data has defined significant hydrocarbon potential exists above those already intersected by the Yolla 1 well:

- The structure is compartmentalised by faults. If these are hydrocarbon sealing then a large accumulation may exist to the northwest.
- The Yolla structure appears to have been in place since the Early Cretaceous, so potential exists for sands to thicken downdip.
- Additional Late Palaeocene section not encountered in Yolla 1, may be onlapping the basaltic extrusives encountered in the base of the well.
- The Top EVCM structure may be considerably larger than indicated by the time closure.

The Yolla 2 well is located downdip of the Yolla 1 well in the Yolla Main fault compartment. It will appraise the Palaeocene to Early Eocene sequence penetrated in Yolla 1, and test the potential for onlapping reservoirs.

Yolla 2 will address 423 BCF of OGIP, from the deeper reservoirs, but will not impact on Top EVCM reserves as it is interpreted to be outside closure at this level.

Main risks are perceived to be reservoir quality and continuity, and hydrocarbon column heights.

## CONTENTS

<b>SUMMARY</b>	<b>1</b>
<b>WELL DATA CARD</b>	<b>4</b>
<b>1.0 INTRODUCTION</b>	<b>5</b>
<b>1.1 Geographical Location</b>	<b>5</b>
<b>1.2 Permit Details</b>	<b>5</b>
<b>1.3 Previous Exploration</b>	<b>6</b>
<b>1.4 Regional Geology</b>	<b>6</b>
<b>2.0 PROSPECT DESCRIPTION</b>	
<b>2.1 Introduction</b>	<b>8</b>
<b>2.2 Structure</b>	<b>9</b>
<b>2.3 Reservoir</b>	<b>9</b>
<b>2.4 Seals</b>	<b>10</b>
<b>2.5 Source Rocks, Maturation and Migration</b>	<b>11</b>
<b>3.0 SEISMIC INTERPRETATION</b>	<b>11</b>
<b>3.1 Data, Data Quality</b>	<b>11</b>
<b>3.2 Structural Mapping</b>	<b>11</b>
<b>3.3 Depth Conversion</b>	<b>12</b>
<b>4.0 WELL LOCATION</b>	<b>12</b>
<b>4.1 Primary Objective</b>	<b>12</b>
<b>4.2 Secondary Objective</b>	<b>12</b>
<b>4.3 Predicted Stratigraphy</b>	<b>13</b>
<b>5.0 RESERVES</b>	<b>16</b>
<b>6.0 REFERENCES</b>	<b>17</b>

**TABLE 1**  
**PROSPECT SUMMARY**

<b>WELL NAME</b>	Yolla 2	
<b>LOCATION</b>	Seismic	: Inline465 SP/CDP 878
	Latitude	: 39° 51' 33.82"S
	Longitude	: 145° 48' 38.53"E
	Northing	: 5 587 156
	Easting	: 398 272
	2350 metres @169° from Yolla 1	
<b>PERMIT</b>	T/RL 1, Offshore Bass Basin	
<b>INTEREST HOLDERS</b>	Boral Energy Resources Ltd	35.5%
	Premier Petroleum (Aust) Ltd	40.5%
	Galveston Mining Corp. Pty Ltd	14.0%
	Boral Energy Northwest Ltd	5.0%
	Santos Ltd	5.0%
<b>TYPE OF WELL</b>	Appraisal	
<b>ANTICIPATED SPUD</b>	April 1998	
<b>ELEVATION</b>	Water Depth :	78m
	Kelly Bushing :	TBA
<b>PROPOSED TD</b>	3300mSS (Contingent 3700mSS)	
<b>PRIMARY OBJECTIVE</b>	Intra-Eastern View Coal Measures sandstones of Palaeocene to Early Eocene age	
<b>SECONDARY OBJECTIVE</b>	Possible sandstones of Palaeocene-Late Cretaceous age, onlapping the volcanics intersected in the base of Yolla 1	

## 1 INTRODUCTION

Yolla 2 is a step-out appraisal well designed to test the continuity and quality of hydrocarbon-bearing reservoirs down-dip of Yolla 1 within the Yolla Main fault compartment.

### 1.1 Geographical Location

The proposed well, Yolla 2, is to be drilled in the offshore Bass Basin in the Retention Lease T/RL 1, which is situated approximately 220 km south-southeast of Melbourne and 120 km north of Tasmania (Figure 1). Yolla 2 will be located approximately 2350 metres south of Yolla 1. The proposed pre-spud geographical coordinates are presented in Table 1.

### 1.2 Permit Details

The proposed Yolla 2 will be located in T/RL 1 which was granted on 7 May 1991 to a Joint Venture with Boral Energy Resources Limited as operator. The Retention Lease was renewed for a further period of five years on 5 December 1996. The current interest holders are shown in Table 1. Whilst Boral Energy Resources Limited is the Joint Venture Operator, Premier Petroleum (Aust) Limited will operate the drilling of Yolla 2.

The work commitment attached to T/RL 1, as detailed in the Yolla Retention Lease documentation, for the current term is as follows:

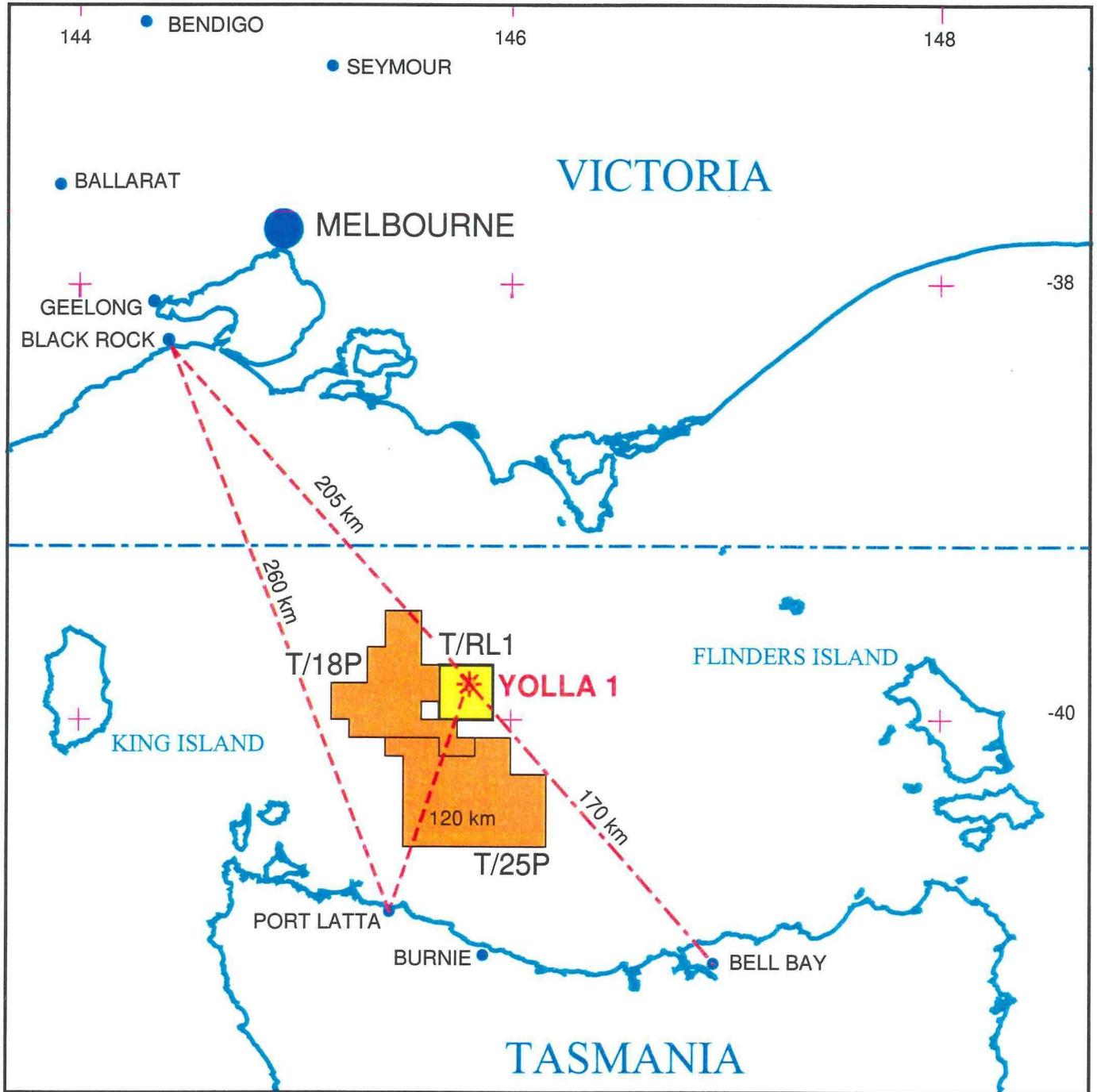
1.2.1 "The Lessee shall carry out further studies in order to identify a satisfactory market for the gas contained in the Yolla field."

1.2.2 "The Lessee shall drill a delineation well within the lease following the signing of a contract for the supply of natural gas from the Yolla field."

Yolla 2 therefore is additional to this commitment due to the need to appraise the field prior to being able to sign a contract for the supply of Yolla gas.

An active work program is in place with possible activities, dependent on ongoing success, listed below:

<b>Work Program – T/RL 1</b>	
1998	Yolla 2 and Yolla 3
1999	Yolla 4
2000	Development



# BASS BASIN TASMANIA POSSIBLE PIPELINE ROUTES

### 1.3 Previous Exploration

The first well drilled in T/RL 1 was the ESSO-operated Bass 1, which spudded in 1965. This was also the first well to be drilled in the Bass Basin. The primary objective of Bass 1 was to investigate a seismic feature thought to be a carbonate reef within Tertiary limestones. At the objective level the well intersected Tertiary extrusive igneous rocks. Drilling continued into the upper Eastern View Coal Measures (EVCM) to a total depth of 2352m whereupon the well was plugged and abandoned as a dry hole.

Bass 1 is considered to have been an invalid test at the top EVCM level based on modern seismic data.

The second well drilled in the permit was the AMOCO-operated Yolla 1, which spudded in 1985. This well was drilled to evaluate mapped closure at the top EVCM and deeper levels. The well reached a total depth of 3347m and intersected hydrocarbons at two intervals within the EVCM. Yolla 1 was subsequently cased and tested.

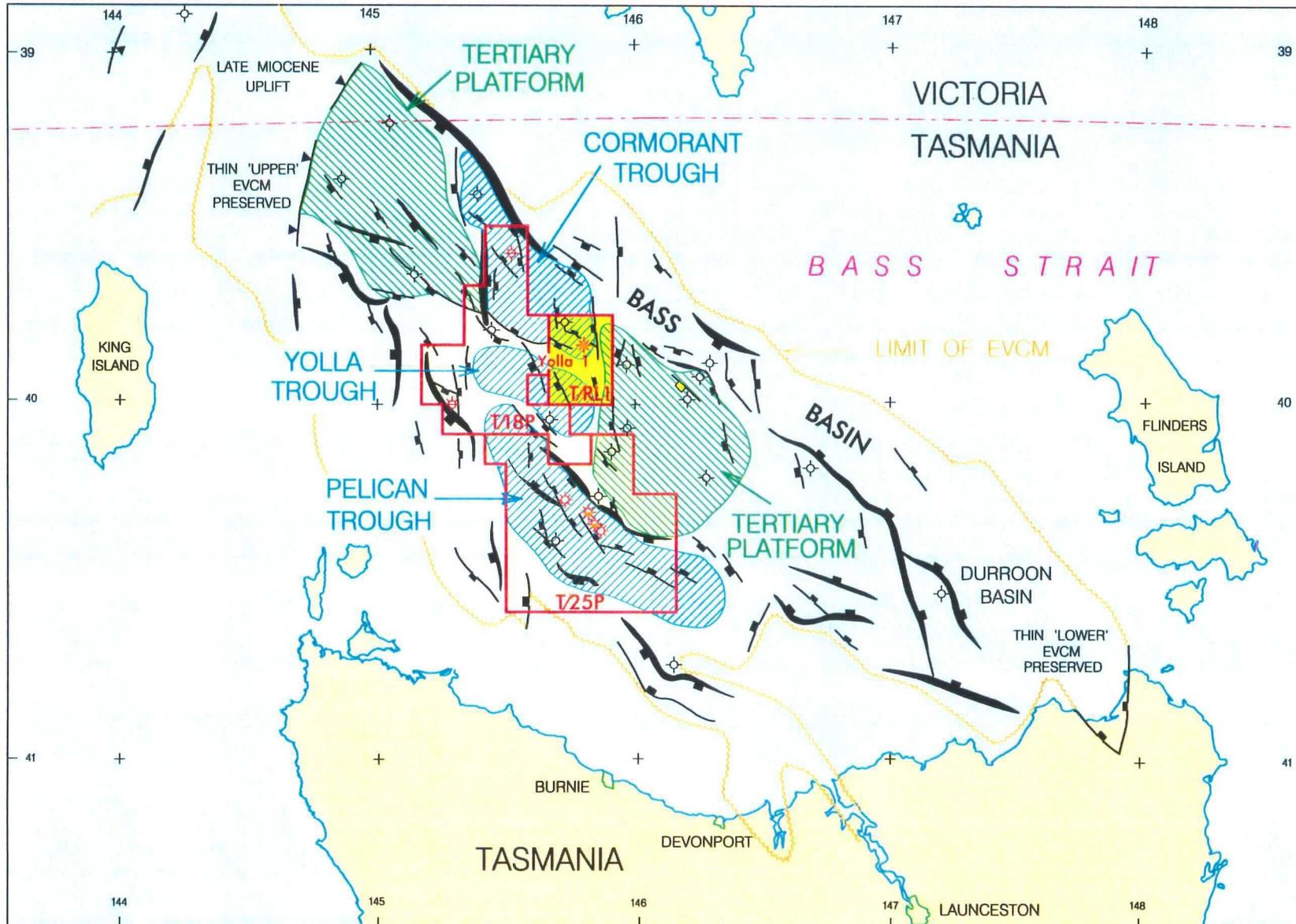
Four DST's were carried out in Yolla 1. DST 1 over the interval 2809.1 – 2824.6m (Palaeocene age, intra-EVCM) flowed gas at 15.1 MMCFD and condensate at 580 BPD. A skin damage of 13.5 is calculated for the test indicating an AOF of 308 MMCFD. DST 1 tested one of seven sand units that are all interpreted to be gas/condensate bearing and which form the basis for the potential development of the Yolla field.

DST 2 over the interval 1830 – 1835.2m (Eocene age, top EVCM) flowed gas at 2.2 MMCFD and water at 1675 BPD. The water was interpreted to be sourced via channeling behind casing and the perforations were squeezed off before DST 2A was conducted over the interval 1833.2 – 1833.8m. DST 2A flowed gas at 1.02 MMCFD and oil at 302 BPD. DST 3 over the interval 1813 – 1833.1 flowed gas 11.8 MMCFD and condensate at 892 BPD. The hydrocarbon trap present at the top EVCM is volumetrically smaller than the Palaeocene trap, but may be economic when produced with the deeper reservoirs.

Subsequent to the drilling of Yolla 1, approximately 880km of modern 2D seismic were acquired between 1982 and 1992. A 260 sq. km 3D seismic survey was acquired in 1994 covering the greater Yolla structure. Interpretation of these data has led to the identification of several appraisal locations including Yolla 2 proposed here.

### 1.4 Regional Geology

The Bass Basin is located offshore in southeastern Australia between Victoria and Tasmania (Figure 2). It is one of a series of basins along the southern margin of Australia that were formed as a result of Early Cretaceous rifting between Australia and Antarctica and, to a lesser extent, Tasman Sea rifting.



**BASS BASIN - TASMANIA  
TECTONIC ELEMENTS  
MAP**

The Bass Basin is a failed intracratonic rift basin with structural features which highlight three separate phases of evolution: (1) initial northeast-southwest extension during the Early Cretaceous, (2) Late Cretaceous to Pliocene thermal subsidence, and (3) Miocene compression. The Pelican, Yolla and Cormorant Troughs comprise the major depocentres in the Bass Basin (Figure 2). These are fault-bounded half-grabens that progressively developed via growth faulting during the active rifting and thermal subsidence phases of basin evolution. The dominant structural trend in the basin is northwest-southeast, highlighted by the orientation of the major faults and troughs (Figure 2).

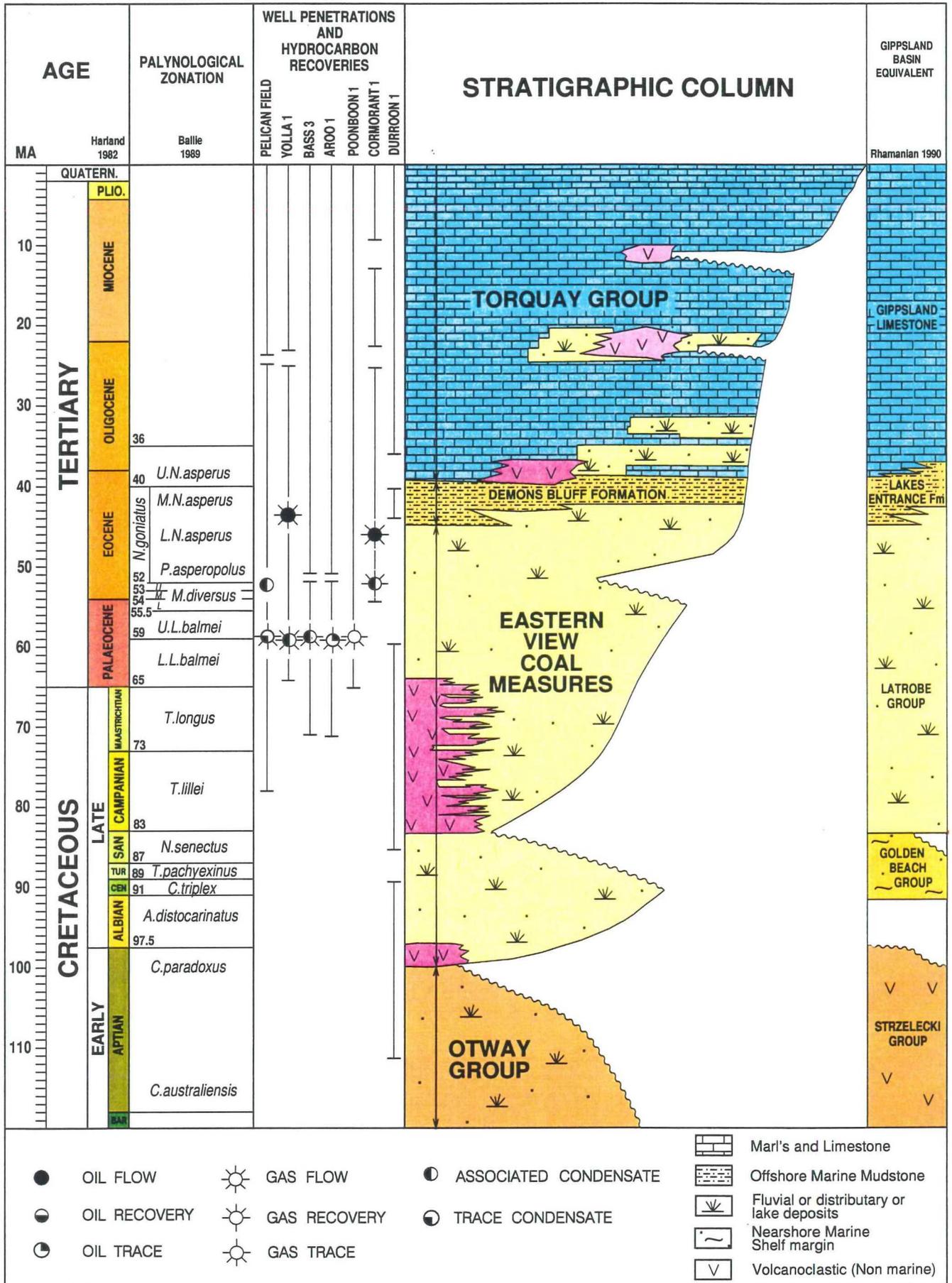
The stratigraphic succession in the Bass Basin comprises sediments ranging in age from Lower Cretaceous to Recent (Figure 3). The Lower Cretaceous Otway Group rests unconformably on pre-rift Palaeozoic black shales and quartzites and consists of clastic, volcanoclastic, fluvial and deltaic sediments ranging from coarse sands through to shales and coals. The Otway Group has not been penetrated in T/RL 1 and the nearest well control is provided by Duroon 1 located approximately 140km to the southeast, which intersected some 1500m of sequence. The Otway Group is viewed as being less prospective than the overlying EVCM within T/RL 1.

Overlying the Otway Group are the prospective Lower Cretaceous to Upper Eocene Eastern View Coal Measures which comprise a thick sequence of sandstones, siltstones, shales and coals deposited in predominantly fluvial, deltaic and lacustrine environments occasionally subject to marine incursions. Seismic data suggests that the EVCM are over 4000m thick in the troughs. The EVCM thins markedly toward the basin margins and exhibits both onlap onto basement and erosional truncation.

In a broad sense, the EVCM can be subdivided into three sequences separated by intraformational unconformities. The lowermost sequence of EVCM sediments is largely unexplored due to its depth of burial. This sequence is bounded by mappable unconformities which occur at the base of the EVCM (top Otway Group) and within the *N.senectus* zone suggesting that this sequence is, in part, the stratigraphic equivalent of the Golden Beach Group in the Gippsland Basin. Seismic data indicates that in some areas the lower EVCM or Golden Beach Group equivalent sequence is top-sealed by volcanics which provides the possibility of play styles similar to the Kipper oil and gas field in the Gippsland Basin.

The middle sequence of EVCM sediments is bounded by the basal *N.senectus* unconformity and an unconformity at the base of the upper *M.diversus* zone. Deposition during the *T.longus* and *L.balmei* zones was controlled by compaction-induced tectonic subsidence. The upper part of this sequence has been penetrated by the Bass 1 and Yolla 1 wells and contains the major gas accumulation encountered by the latter. The middle EVCM sequence is now the major focus for play identification and forms the primary target for Yolla 2.

# BASS BASIN - TASMANIA STRATIGRAPHIC COLUMN



The uppermost sequence of EVCM sediments lie between the base of the upper *M. diversus* unconformity and the top of the formation. Mapping has highlighted a change in the tectonic regime to that of a simple sag basin characterised by only minor faulting. The lack of structure diminishes the probability of suitable plays at this level, although an oil and gas accumulation is present at Yolla 1 and significant oil and gas shows were recorded in Cormorant 1 in T/18P. This is in contrast with the Gippsland Basin where most major oil and gas fields are trapped in the upper Latrobe Group, the stratigraphic equivalent of the EVCM.

Conformably overlying the EVCM is the Late Eocene Demons Bluff Formation. Lithologically this unit consists of a sequence of fine grained carbonaceous shales and silts deposited in an open marine environment. The unit has an average thickness over the basin of approximately 120m, but thins toward the basin margins. The Demons Bluff Formation provides a regional top seal to hydrocarbons reservoided in the top-most sands of the EVCM as demonstrated at Yolla 1.

The Demons Bluff Formation is overlain by the Oligocene to Pliocene age Torquay Group which broadly consists of a basal sequence of marls and calcareous shales which grade upwards into a sequence of bioclastic limestones. The Angahook Formation forms a distinct but geographically localised basal unit of the Torquay Group. Angahook Formation sediments have not been identified in all wells drilled in the Bass Basin and appear to represent reworked volcanoclastics and terrigenous sediments proximal to Miocene volcanoes, comprising a mix of interbedded volcanoclastic, sandstones, claystones and dolomitic limestones. Deposition of the Angahook Formation occurred from Lower Oligocene to Lower Pliocene. Sediments belonging to this formation have been identified in outcrop along the Torquay Embayment in southern Victoria and were identified in Yolla 1 where it has been divided into four separate seismically mappable units.

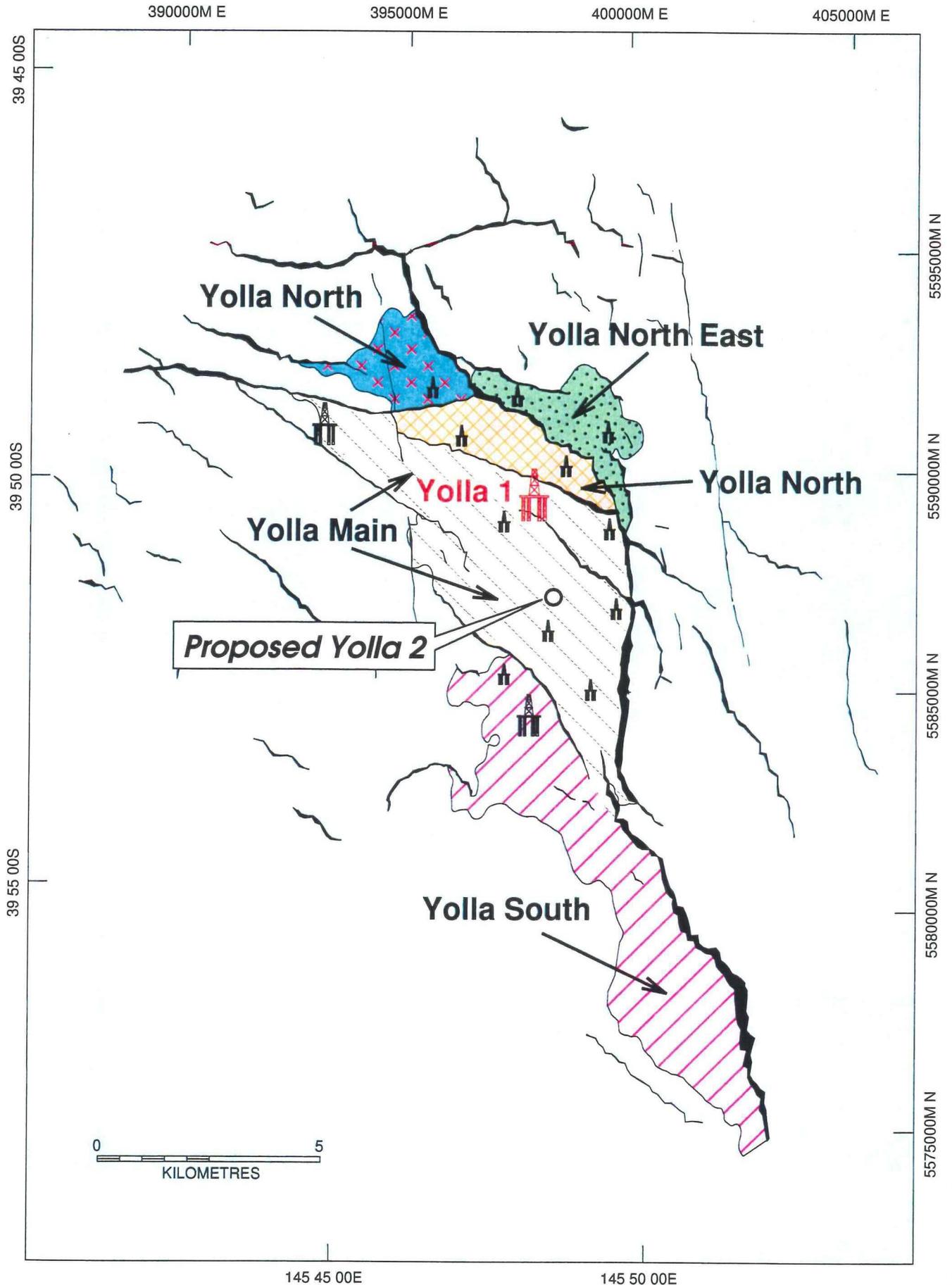
The Torquay Group ranges in thickness from approximately 450m around the basin margins to about 1000m in the Cormorant area. In addition to extrusive igneous rocks associated with basal and intra-EVCM unconformities, intrusive and extrusive igneous rocks of Oligocene to Miocene age have been intersected in a number of wells drilled in the Bass Basin. Seismic data allow the mapping of the shallow volcanic rocks with a high level of confidence, in contrast to the intrusives and deeper extrusives which are difficult to image.

## **2 PROSPECT DESCRIPTION**

### **2.1 Introduction**

The Yolla field is a simple fault bounded structure lying over a prominent Early Cretaceous ridge on the flanks of the Cormorant Trough (Figure 2). The field is compartmentalised by the faults at deeper levels into four main areas (Figure 4). Yolla 2 will test sands of Palaeocene to Early Eocene age in a downdip location in the largest compartment, which contains the original discovery well.

# YOLLA STRUCTURE FAULT COMPARTMENTS



## 2.2 Structure

The basic structural architecture of the Bass Basin was established during the Early Cretaceous rifting phase related to the pull apart of the Australian and Antarctic plates. A deep structural ridge, underlying Yolla, was probably formed at this time, and remained a positive structural feature throughout the deposition of the EVCM. Drape and compaction form the dominant structural mechanisms with faults showing growth and increasing intensity with depth.

The deep basalts encountered in the base of Yolla 1, probably sit on the Late-Cretaceous to Early-Tertiary boundary, and are related to a widespread volcanic episode at that time. Similar extrusives are found in the nearby Tilana 1 well, and on the opposite side of the Cormorant Trough at Aroo 1. It is anticipated that the basalts are deeper than 4000 metres at the Yolla 2 location. By the Top EVCM a quiet structural period commenced, and continued throughout the deposition of the marine shale Demon's Bluff Formation, and the early part of the Torquay Group limestones, shales and marls, until the Oligocene/Miocene unconformity boundary. At this time, the Cormorant Trough was structurally inverted, which was accompanied in the Yolla area by the development of a massive volcanic complex. Volcanoes were formed, and the seismic data indicate a long history of multiple and overlapping cones and eruptions. While some of the Palaeocene age faults show signs of reactivation and may have formed feeder conduits for the volcanic material, the majority of material was sourced up through a north-south trending fault system that dominates the structural picture from the Late Oligocene onwards. A second phase of this same episode was the intrusion of igneous material into the EVCM, forming thick sills like the dolerites encountered in the Yolla 1 and Tilana 1 wells.

The probable mechanism for this period is the intrusion of a sub-volcanic magma chamber, that in its pre-eruption stage causes doming and uplift of the overlying Cormorant Trough.

Following this concentration of activity during the Early Miocene, there remained a quiet period structurally throughout the deposition of the remaining part of the Torquay Group limestones, that has continued to the present day.

## 2.3 Reservoir

The primary target reservoirs in Yolla 2 are intra-Eastern View Coal Measure sandstones of Palaeocene to Early Eocene age. The top Upper *L balmei* and top Lower *L balmei* palynological zone boundaries are anticipated within this sequence. Seven main sandstones were intersected within this sequence at Yolla 1 and contain up to four separate hydrocarbon columns (Zones 1A, 1B, 2 and 3).

The sandstones were not cored in Yolla 1 and therefore their description here is based largely on cuttings and wireline data from Yolla 1 and from the nearest correlatable core data at Tilana 1 (approximately 16 kms to the south east).

The sandstones typically show an upward decrease in gamma-ray log response representative of upward coarsening sandstones. The sandstones are interpreted to be near shore and shoreface sandstones which formed in a strandplain setting and were deposited adjacent to a large wave affected lake or restricted sea.

At Tilana 1 the core is interpreted to represent a range of depositional settings including, lagoon fill, vegetated aeolian dune, beach backshore, through to tidal channel and the shoreface swash/backwash zone of a beach ridge.

The sandstones at Yolla 1 consist of mainly medium grained sandstone and are occasionally fine to very coarse grained. Cementation occurs with white and tan coloured clays. Relict feldspars, mica and abundant carbonaceous matter are observed.

Data on the lateral continuity of gross sand packages and the intervening shales and claystones is limited to regional correlation with wells such as Tilana 1 and Aroo 1 which is good, although individual sandstone packages show variation in thickness and quality. Yolla 2 will provide the first relatively close spaced well control on the distribution of these reservoirs.

The target sandstones at Yolla 1 range in gross thickness from 2-46 metres as shown in the table below together with their anticipated depths at Yolla 2:

Zone/Sand	Yolla 1		Thickness (m)	Yolla 2 Approximate Top (mSS)
	Top (mKB)	Base (mKB)		
Z1AS2720	2718	2729	11	-2747
Z1BS2755	2755	2768	13	-2782
Z1BS2809	2809	2832	23	-2833
Z1BS2844	2840	2852	12	-2862
Z2S2873	2871	2882	11	-2891
Z3S2952	2952	2954	2	-2968
Z3S2973	2973	3019	46	-2988

Deeper reservoirs of similar type may occur in sediments which onlap the basal volcanics that were intersected in Yolla 1, these form an important secondary target at Yolla 2.

## 2.4 Seals

The Palaeocene to Early Eocene reservoired hydrocarbons at Yolla 1 are top sealed by relatively thick intra-formational shales.

At Yolla 1 the first significant hydrocarbons in this sequence (Zone 1A) were intersected following penetration of an igneous sill between 2584 and 2651 mKB and intra-formational shales extending down to 2718 mKB. Whilst the igneous sill may contribute to the ultimate top seal to the Palaeocene and Early Eocene gas-condensate bearing reservoirs at Yolla, the most likely top seal is the shale unit beneath it.

Further intra-formational top seals for each of the other hydrocarbon columns (Zones 1B, 2 and 3) are provided by similar thick shale units.

Two types of shales are recognised. The first is lighter coloured and very silty with moderate amounts of organic material. These shales often grade to siltstones which are very argillaceous, micaceous and contain abundant carbonaceous matter as finely disseminated particles and wispy coaly bands. The second is darker coloured, less silty and very organic rich, occasionally grading to lignite. Occasional thin fine-grained sandstones are present as inter-beds.

Lateral sealing along the major bounding faults of the Yolla structure is provided by juxtaposition of sandstones against intra-Eastern View Coal Measures shales on the downthrown side of the faults and generation of fault plane seals by shale gouge.

If onlapping sediments to the basal volcanics intersected in Yolla 1 are developed at the Yolla 2 location it is anticipated that the onlapping section may contain a similar development of intra-formational shales. Such shales are observed at equivalent stratigraphic levels in Aroo 1 and Koorkah 1.

## **2.5 Source Rocks, Maturation and Migration.**

The existence of hydrocarbons at Yolla 1 has proven the source, maturation and migration of an effective charge to the Yolla structure.

Source rock typing at Yolla 1 suggests that the shallow top EVCM oil accumulation was sourced from Palaeocene or older (Late Cretaceous) source rocks. These source rocks are also likely to have contributed to the gas and condensate accumulation in the primary target (Palaeocene and Early Eocene) at Yolla 2.

Such source rocks are mature for gas generation in the Yolla trough located to the south west of the Yolla structure and in particular the Yolla Main fault compartment. There is therefore a very simple migration route from the source kitchen to the prospect. Migration is likely to have occurred within the Palaeocene to Early Eocene shoreface and strandplain sandstones which act as both reservoir and conduit beds for the Yolla accumulations.

## **3 SEISMIC INTERPRETATION**

### **3.1 Data Quality**

A 260 square kilometre 3D seismic survey was acquired over the Yolla oil-gas-condensate field during February 1994. These data were acquired by Western Geophysical, and comprised 13,766 subsurface line kilometres of 30 fold data, with a 12.5\*25 metre bin size. The in-line direction of 33.33 degrees was chosen to provide the best conditions for imaging the secondary fault system that lies perpendicular to the in-lines, and which are an essential component in forming the structural closure over the Yolla Field.

The Yolla 3D seismic survey has provided an excellent quality data set. Faults are generally clearly imaged, with distinctive correlatable events throughout the section. Some distortion and loss of data occurs beneath the thick coaly sequence of the Middle M.diversus section of the EVCM, and which can be further complicated by the presence of intrusive ore bodies. These latter are difficult to identify and map on the seismic data, as shown by Figure 5.

The area to the north and east of the main Yolla fault compartment, is overlain by extensive extrusive volcanic deposits of Miocene/Oligocene age. These cause considerable disruption of the data, not only in terms of velocity pushdown and pull-up effects (Figure 6), but also in the continuity and consistency of individually mapped events. Fortunately none of these occur at the Yolla 2 location, but do have relevance to the overall mapped areal closure of the Top EVCM reservoirs.

### **3.2 Structural Mapping**

Twelve seismic horizons were correlated in detail over the Yolla 3D data set. These are highlighted in Table 2, with the EVCM markers illustrated on the seismic section of Figure 5.

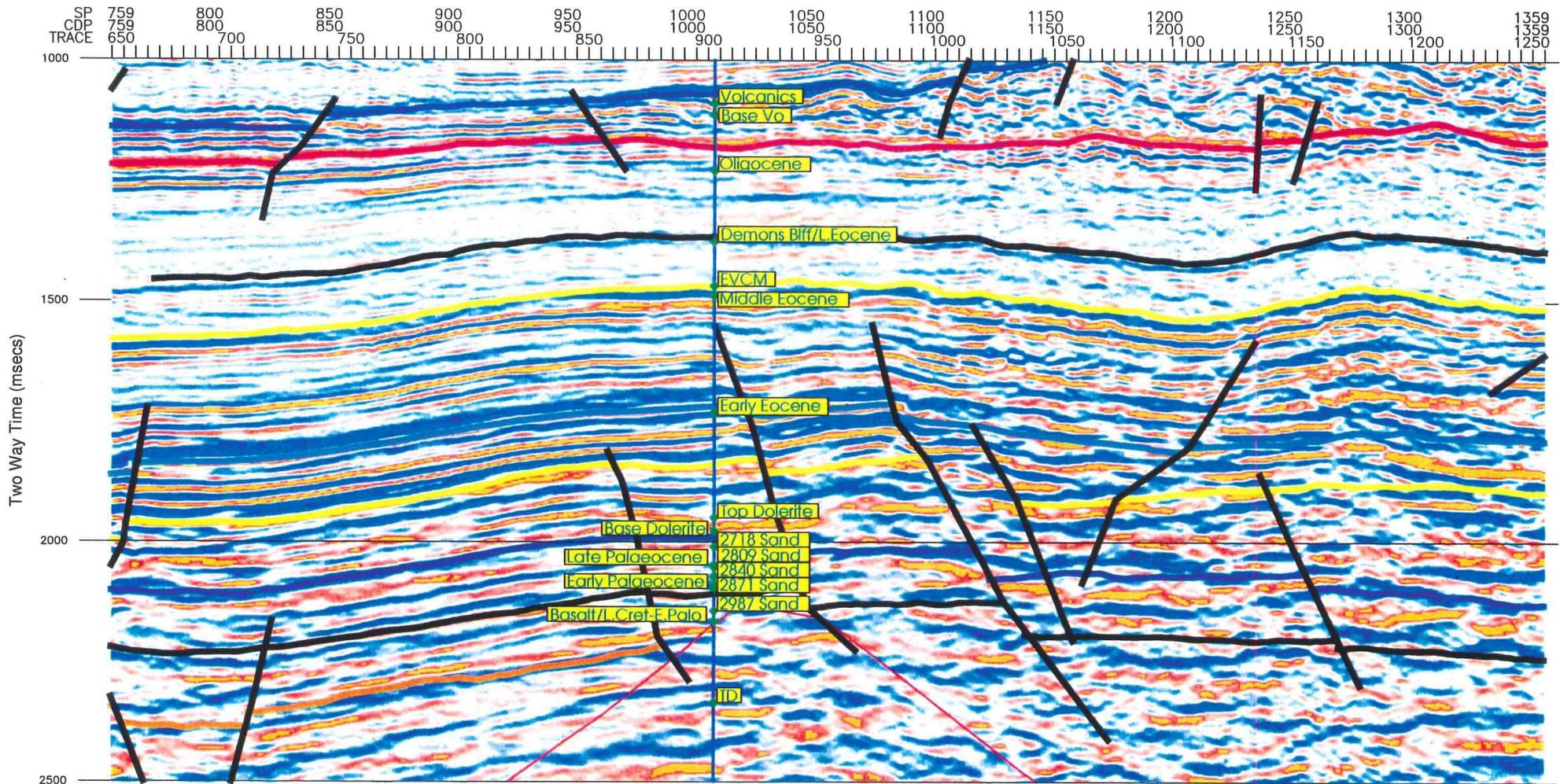
The structure at the top of the EVCM sequence is a large anticline with minor faulting. As shown by Figure 7, the crest of the EVCM closure lies 1 kilometre to the northeast of the Yolla 1 well. Yolla 2 lies 86 metres downdip of Yolla 1, and 2350 metres to the south-southeast. Yolla 2 is located outside closure at this level.

Figure 8 shows structure at the Near Top 2718 Sand mapped horizon, which represents the top of the primary targeted sequence in Yolla 2. Structure at this level shows closure on the upthrown side of two major intersecting fault systems. This horizon intersects the Yolla 1 well 39 metres above the first sand of the Early Eocene pay sequence, and it is anticipated to be intersected 42 metres deeper at the Yolla 2 location.

# SEISMIC IN-LINE 530 - DIP LINE THROUGH YOLLA 1

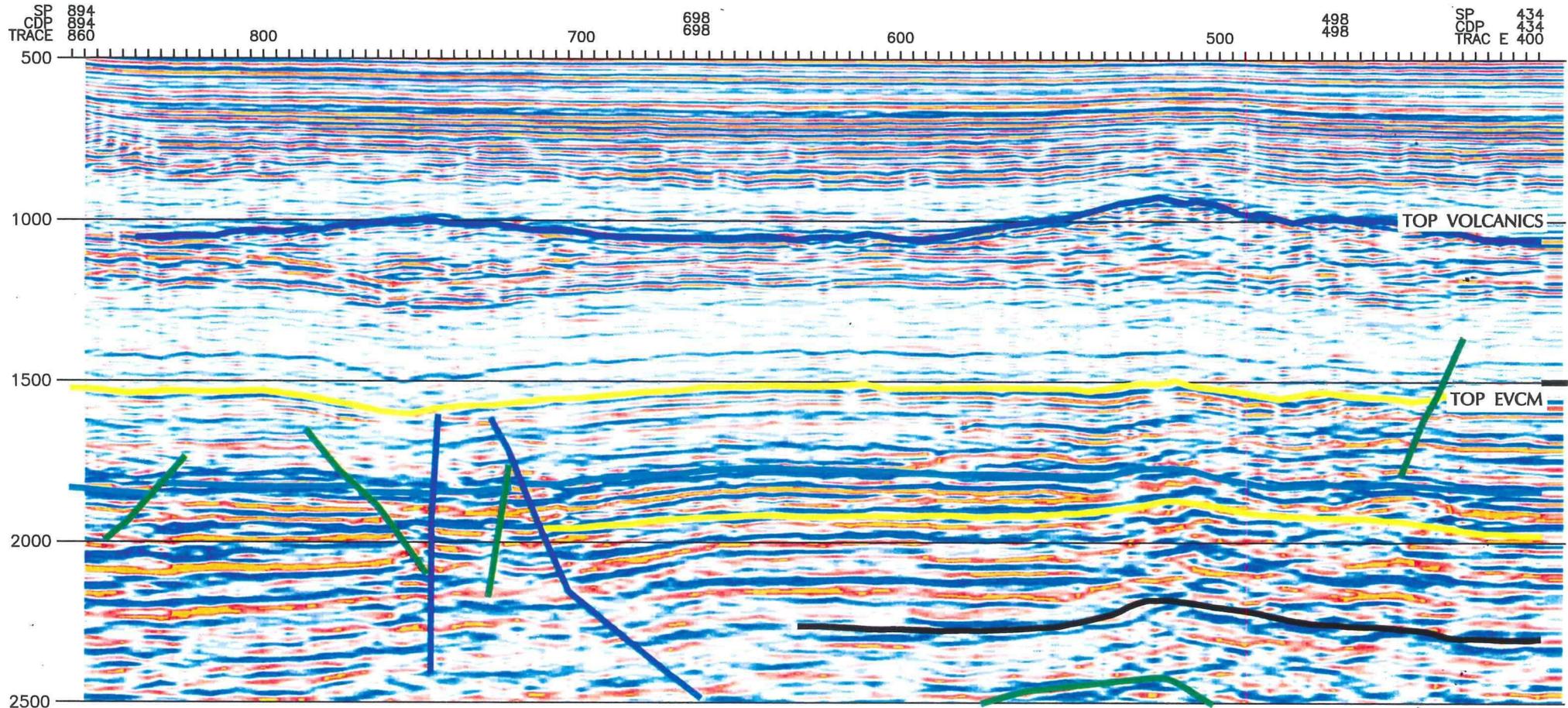


## YOLLA 1



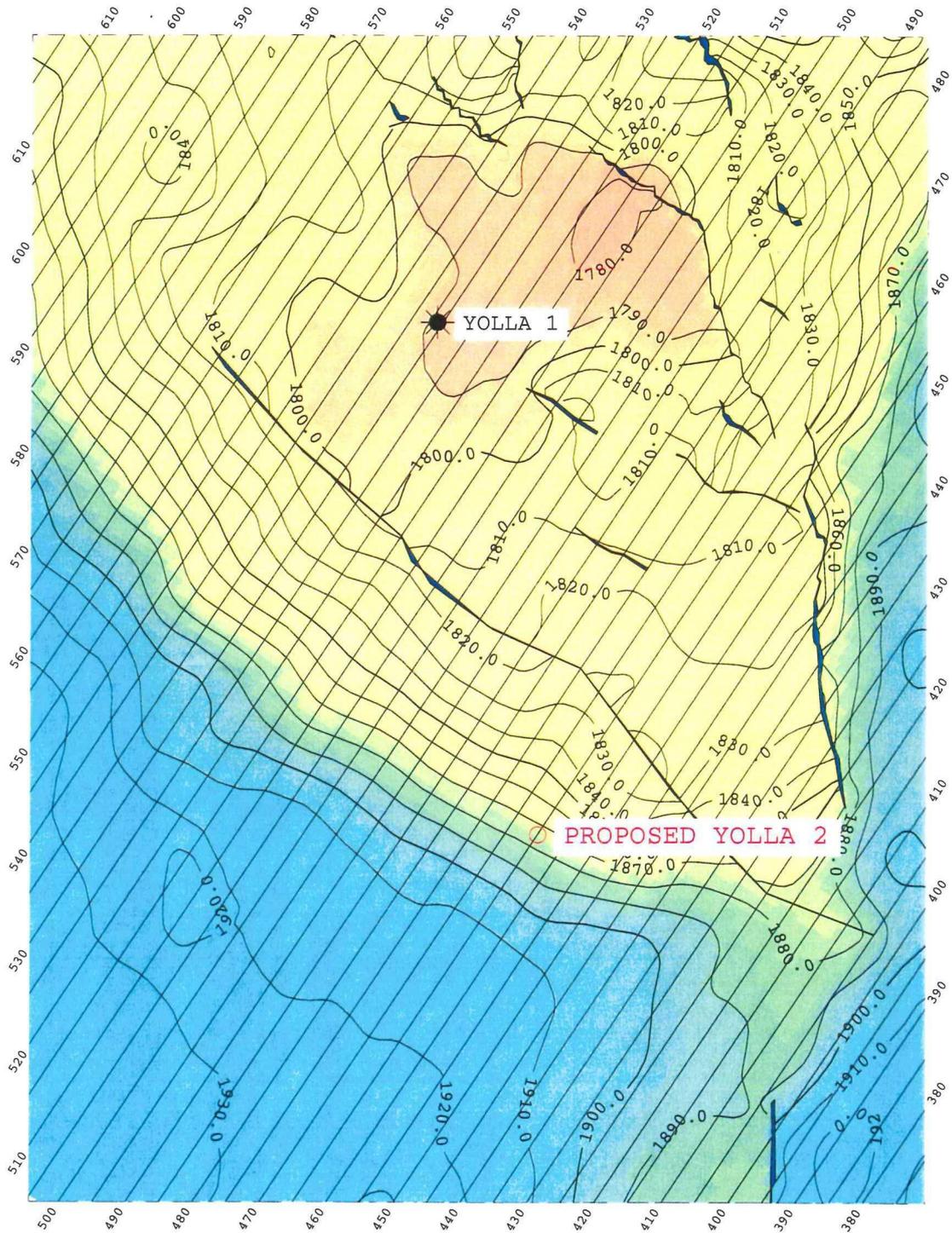
# T/RL1 BASS BASIN TASMANIA

## Push Down Beneath Volcanic Interval, Cross-line 1220



Cross-Line CDP=1220 MIGRATED

# TRL1

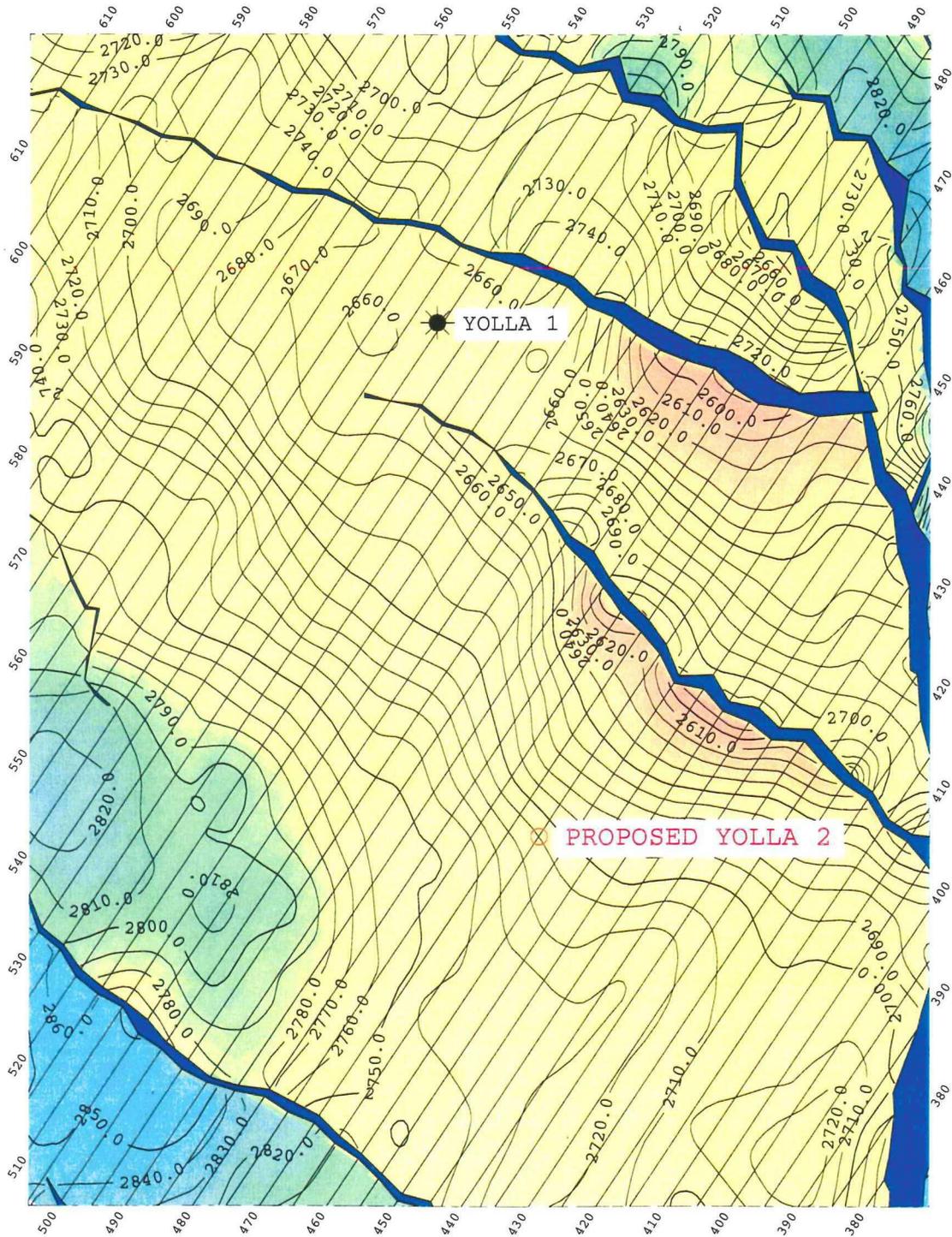


TOP EASTERN VIEW COAL MEASURES  
DEPTH STRUCTURE



FIGURE 7

# TRL1



NEAR TOP 2718 SAND  
DEPTH STRUCTURE



FIGURE 8

**TABLE 2  
YOLLA2 DEPTH PROGNOSIS**

STRATIGRAPHIC LEVEL	YOLLA 1 - (KB=11.1 metres)				YOLLA 2	
	Depth KB (metres)	Depth Subsea (metres)	Two-way-Time (seconds)	Thickness (metres)	Depth Subsea (metres)	Thickness (metres)
Seafloor/Torquay Group	90.8	-79.7		962	-78	1004
Mid Miocene*	569.1	-558.0	0.501		-567	
Lower Mid Miocene*	815.1	-804.0	0.683		-815	
Angahook Formation - Unit 1	1053.0	-1041.9		184	-1082	198
Top Miocene Volcanics (seismic)*	1219.1	-1208.0	1.070		-1268	
Angahook Formation - Unit 2	1237.0	-1225.9		68	-1280	44
Top Volcanics (logs)	1240.0	-1228.9	1.092		--	
Base Volcanics (Logs)	1268.0	-1256.9	1.115		--	
Angahook Formation - Unit 3	1305.0	-1293.9		135	-1324	146
Base Miocene Volcanics (seismic)*	1365.1	-1354.0	1.181		-1363	
Angahook Formation - Unit 4	1440.0	-1428.9		228	-1470	404
Demons Bluff Formation	1668.1	-1657.0	1.378	131	-1720	154
Top Eastern View Coal Measures*	1799.1	-1788.0	1.470	391	-1874	399
Top EVCM bright spot	1831.6	-1820.5	1.489		--	
Early Eocene*	2190.1	-2179.0	1.718	185	-2273	179
Middle M.diversus*	2375.1	-2364.0	1.837	304	-2452	258
Top Igneous Intrusive	2584.1	-2573.0	1.950		--	
Base Igneous Intrusive	2650.9	-2639.8	1.978		--	
Near Top 2718 sand*	2679.1	-2668.0	1.991	227	-2710	215
2718 sand	2718.0	-2706.9	2.013		-2747	
2808 sand	2808.0	-2796.9	2.052		-2832	
Early Palaeocene*	2906.1	-2895.0	2.108	126	-2925	300
2972.5 sand	2972.5	-2961.4	2.139		-2988	
Deep Seismic Onlap Event*	NI	NI	NI		-3225	
Top Basalt*	3032.1	-3021.0	2.167	319+	>4000m?	
TD TD(Proposed)	3351.1	-3340.0			(-3300)	
TD TD(Contingent)					(-3700)	

**LOCATION DATA**

Seismic	Seismic Inline	465
	sp/cdp	878

Rectangular	Easting	398272
	Northing	5587156

Geographic	Latitude	39 51 33.82S
	Longitude	145 48 38.53E

YOLLA 2 LOCATED 2350 METRES @169 DEGREES FROM YOLLA 1

\*=mapped events

The mapped Early Palaeocene seismic marker lies within a thick shale, 66 metres above the Zone 3 reservoirs intersected in the Yolla 1 well. The structure is shown by the map of Figure 9, and is very similar in form to the Near Top 2718 Sand level. Yolla 2 is predicted to lie 30 metres deeper at this level.

Figure 10 shows structure on a deep seismic event, that is interpreted to onlap the volcanic cone of Cretaceous/Early Tertiary basalts intersected in Yolla 1. This is a strong seismic reflector with an amplitude response that roughly conforms to structural closure. This can be interpreted to represent a gas-filled sand, of probably Palaeocene age, that was not intersected in the Yolla 1 well. It is predicted that this event will be encountered at -3225 metres sub-sea, in Yolla 2.

### **3.3 Depth Conversion**

The depth conversion technique most favoured here is that done by utilising the well-based interval velocity information. The well derived interval velocities, as shown in Table 3, are combined with the interpreted seismic time thicknesses, which are summed in turn to produce the depth data. The nearby Tilana 1 and Bass 1 wells showed similar interval velocity data, indicating a very stable velocity field throughout the area. The only interval that is interpreted to impact significantly on the depth conversion process is the Miocene extrusives sequence, and a model was developed to account for the observed velocity affects.

As illustrated in Figure 11, a replacement velocity was determined for the volcanics interval at specific points, based on the observed push down or pull up affect, and the thickness of the extrusive material. This technique produced a complex velocity field, as shown in Figure 12, with individual volcanoes exhibiting both fast and slow velocity characteristics.

Seismic stacking velocities were also investigated, with DIX interval velocities calculated for each level. However, due to the distortion of the stacking velocity data near the volcanic extrusives, these data were ignored (Figure 13).

## **4 WELL LOCATION**

The Yolla 2 well is located in the Yolla Main Fault compartment, 2.35 kilometres south of Yolla 1. Yolla 2 is located between 30 and 42 metres downdip at the primary objective levels. Figure 14 shows seismic in-line 465, with the proposed location at shotpoint 878.

### **4.1 Primary Objective**

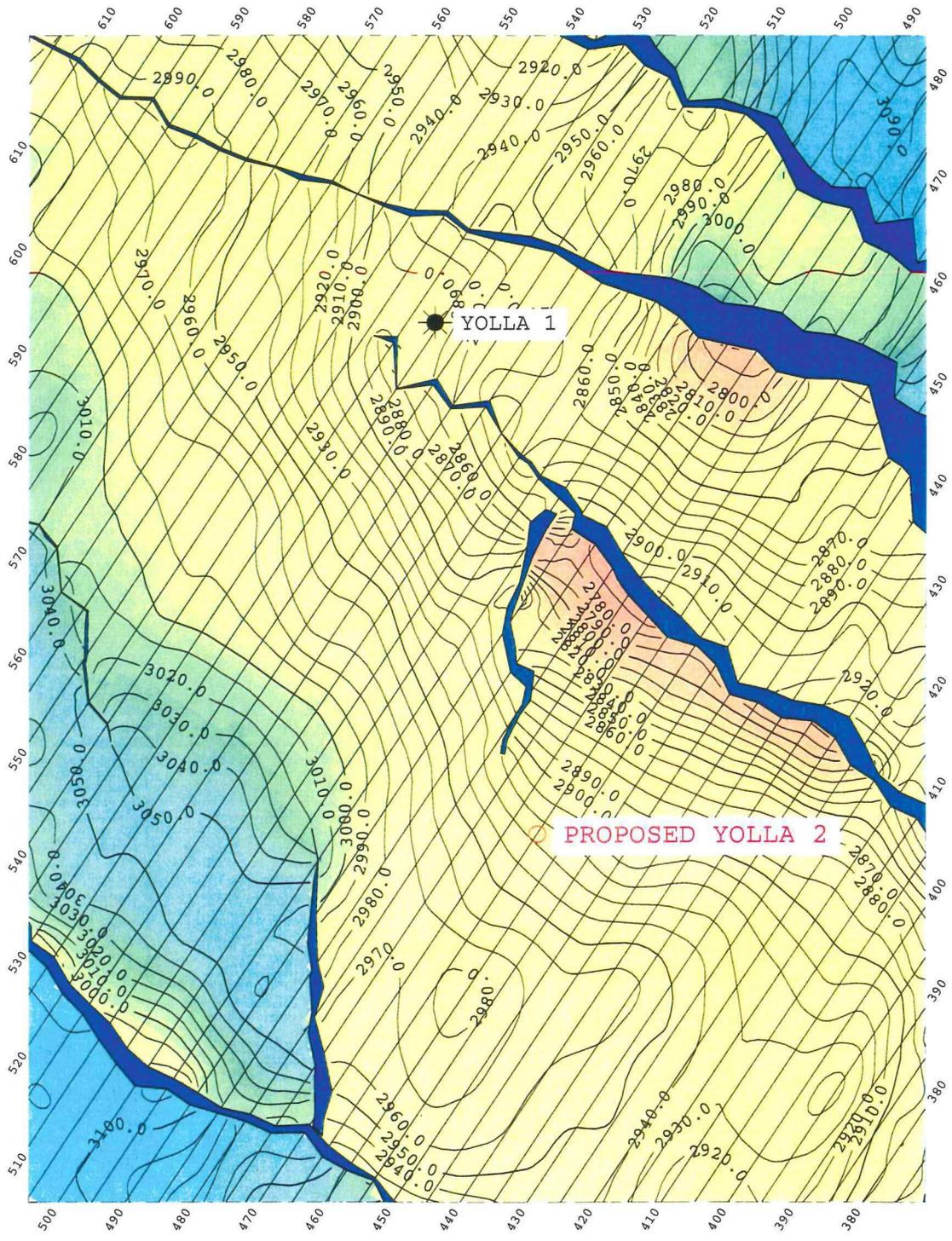
The primary objective of the Yolla 2 well is to appraise the gas and condensate bearing reservoirs of the Palaeocene to early Eocene sequence penetrated in Yolla 1.

The location has been optimised to enable the evaluation of hydrocarbons in all zones, and to recover a water sample and obtain water gradient pressure data from the base of Zone 3 sands. This location was also chosen to add significantly to the understanding of the areal distribution of reservoirs and associated data.

### **4.2 Secondary Objective**

The well is located to test the potential for reservoirs onlapping the basal extrusives intersected in Yolla 1. A further objective was to choose a location that would be optimally sited to allow a sidetrack option to the well in the success case where no water is encountered. This location lies within 800 metres horizontal reach of a further 60 metres of structural closure, which lies well within safe operating capabilities.

TRL1

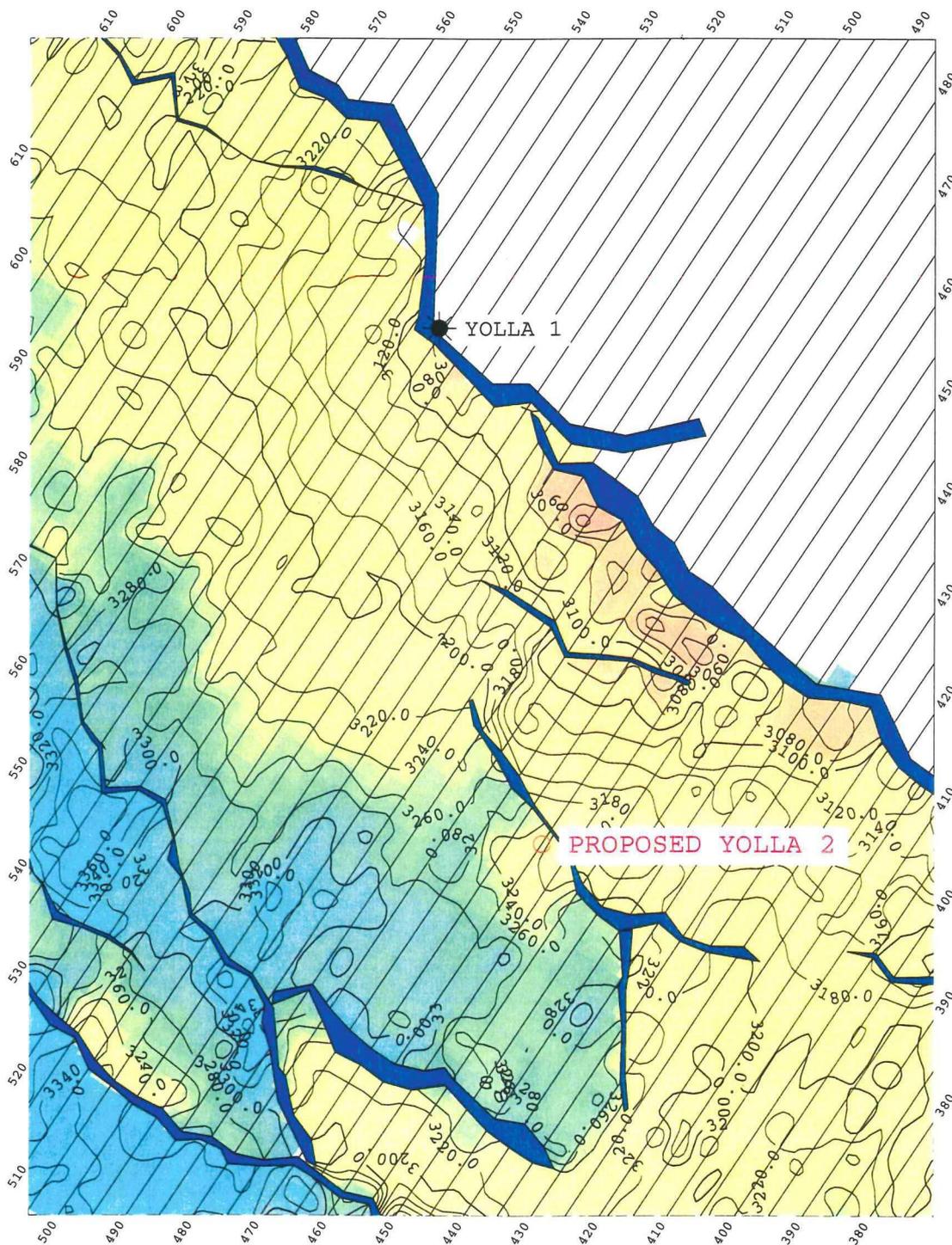
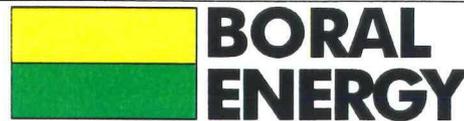


NEAR TOP EARLY PALAEOCENE  
DEPTH STRUCTURE



FIGURE 9

# TRL1

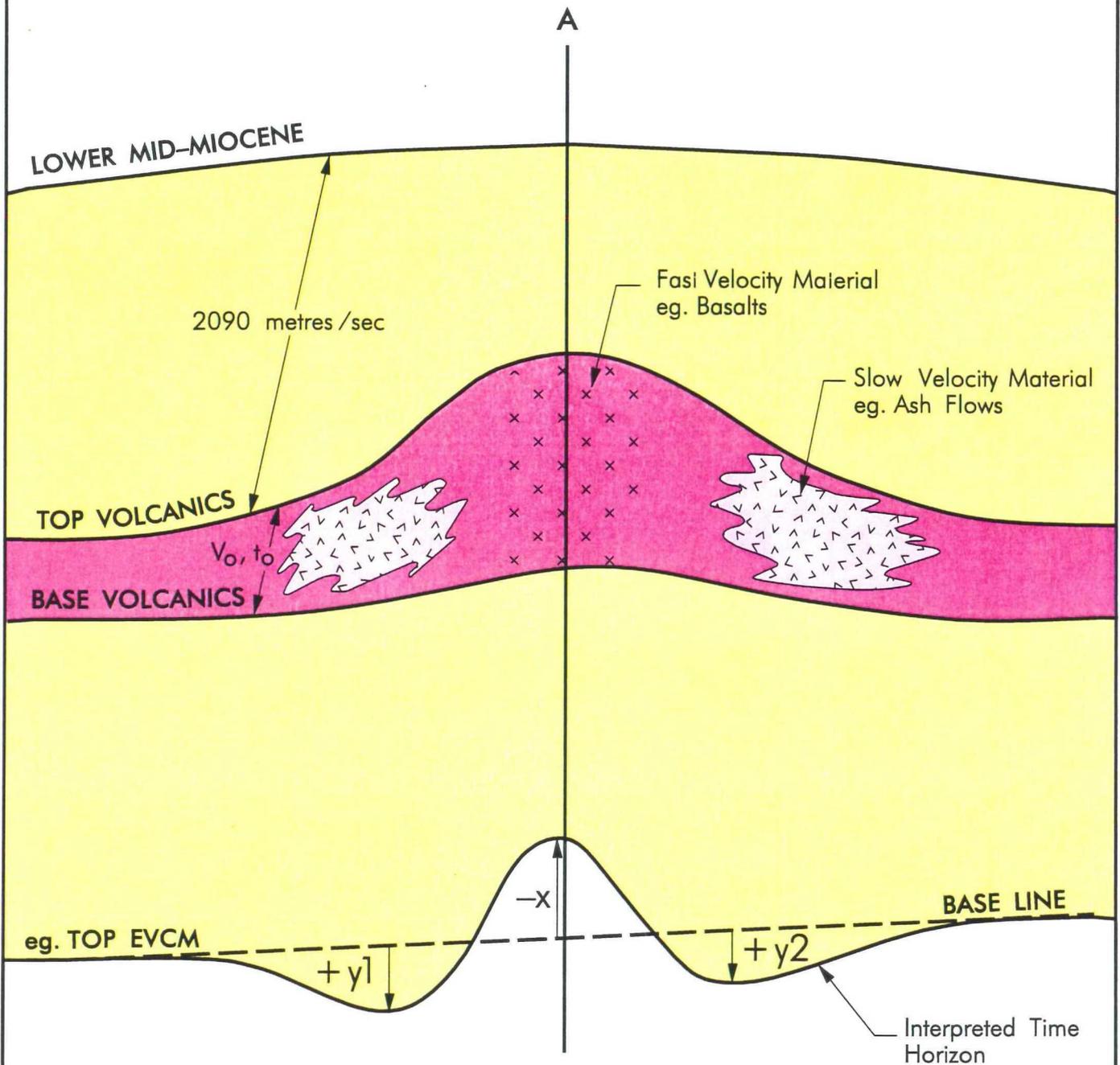


DEEP SEISMIC ONLAP EVENT  
DEPTH STRUCTURE



FIGURE 10

# CALCULATION OF VOLCANIC VELOCITY MODEL



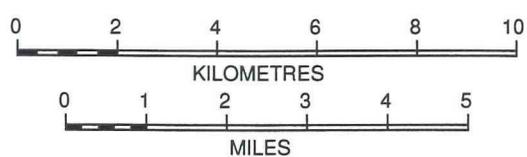
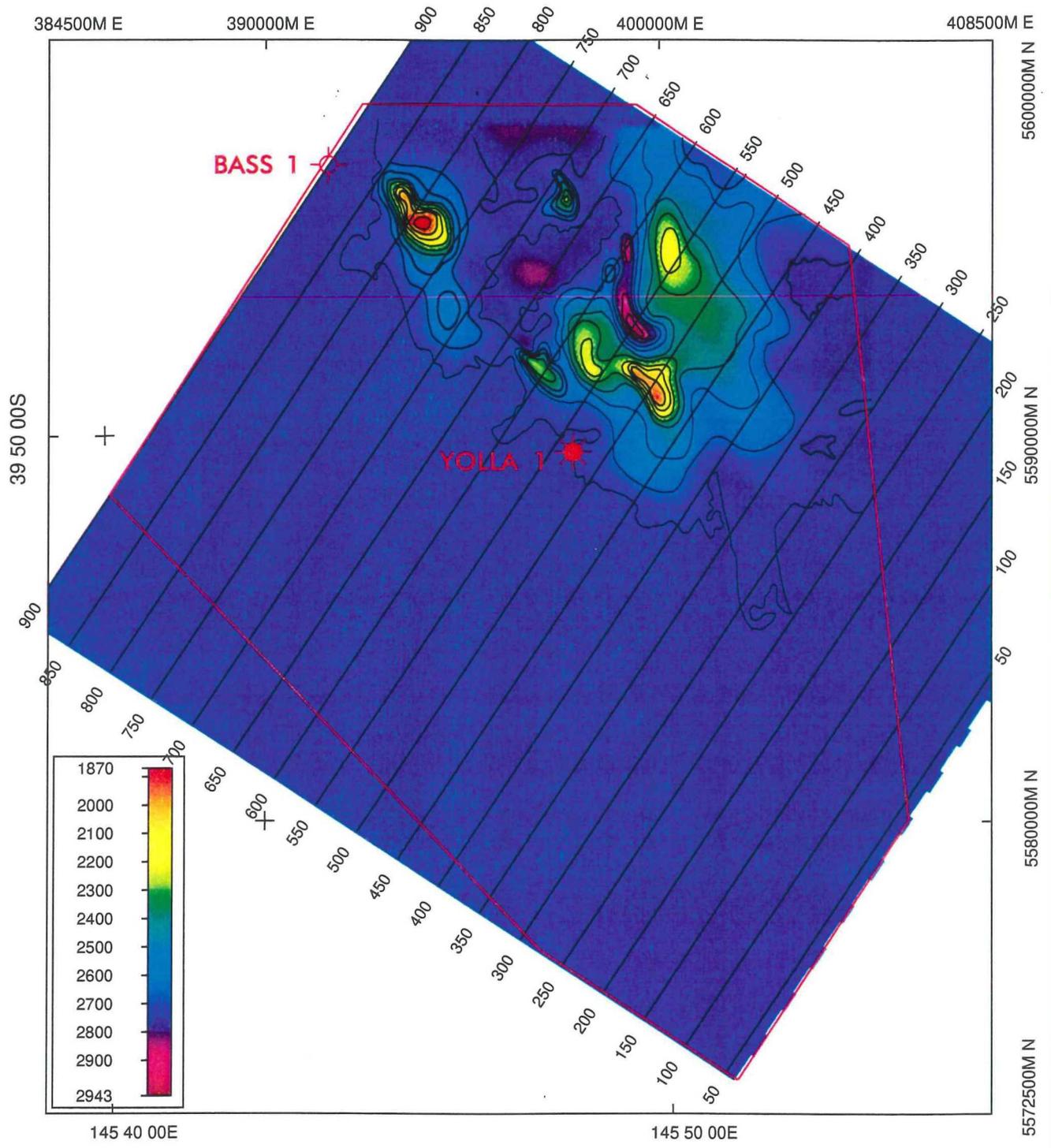
$x, y$  = Observed pull up or push down away from base line  
 $V_0, t_0$  = Interval velocity and time thickness of volcanic pile

for example, at position A:

$$V_0 \times t_0 = 2090 (t_0 + x)$$

$$V_0 = 2090 (t_0 + x) / t_0$$

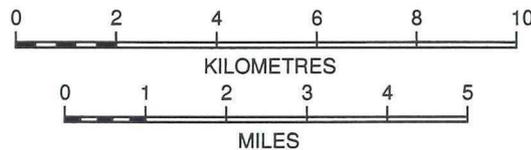
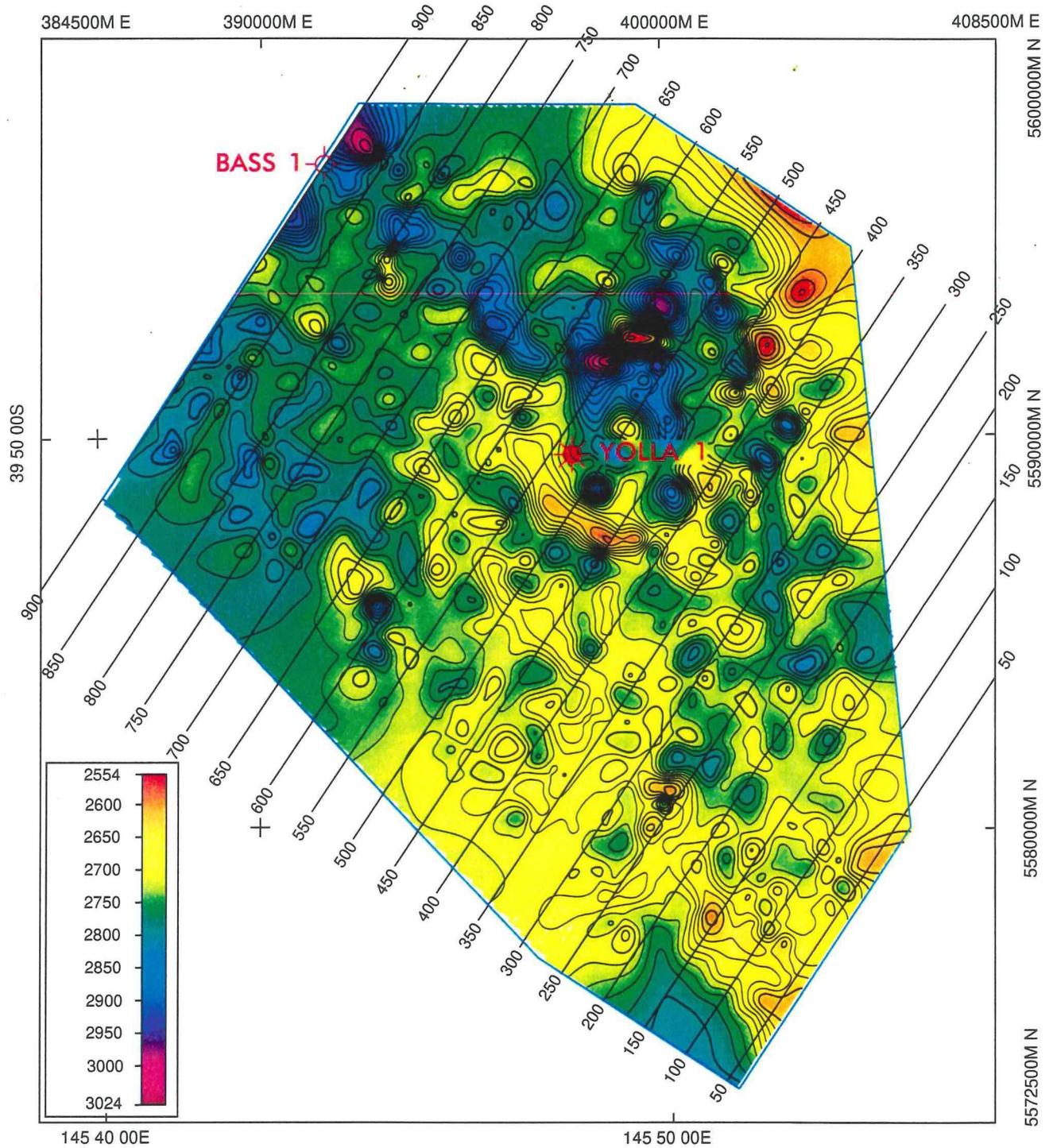
$V_0$  = the interval velocity required to cause the  $x$  millisecond pull up when compared to the surrounding medium velocity of 2090 m/sec, and interval thickness of  $t_0$  milliseconds



UNIVERSAL TRANSVERSE MERCATOR PROJECTION  
AUSTRALIAN NATIONAL SPHEROID  
CENTRAL MERIDIAN 147 00 00E

T/RL1 BASS BASIN TASMANIA

**MIOCENE VOLCANICS INTERVAL VELOCITY MODEL**



UNIVERSAL TRANSVERSE MERCATOR PROJECTION  
 AUSTRALIAN NATIONAL SPHEROID  
 CENTRAL MERIDIAN 147 00 00E

**TRL1 BASS BASIN TASMANIA**  
**NEAR TOP 2718 SAND,**  
**RMS STACKING VELOCITY FIELD**

PROPOSED  
YOLLA 2



SEISMIC IN-LINE 465  
YOLLA 2 LOCATION

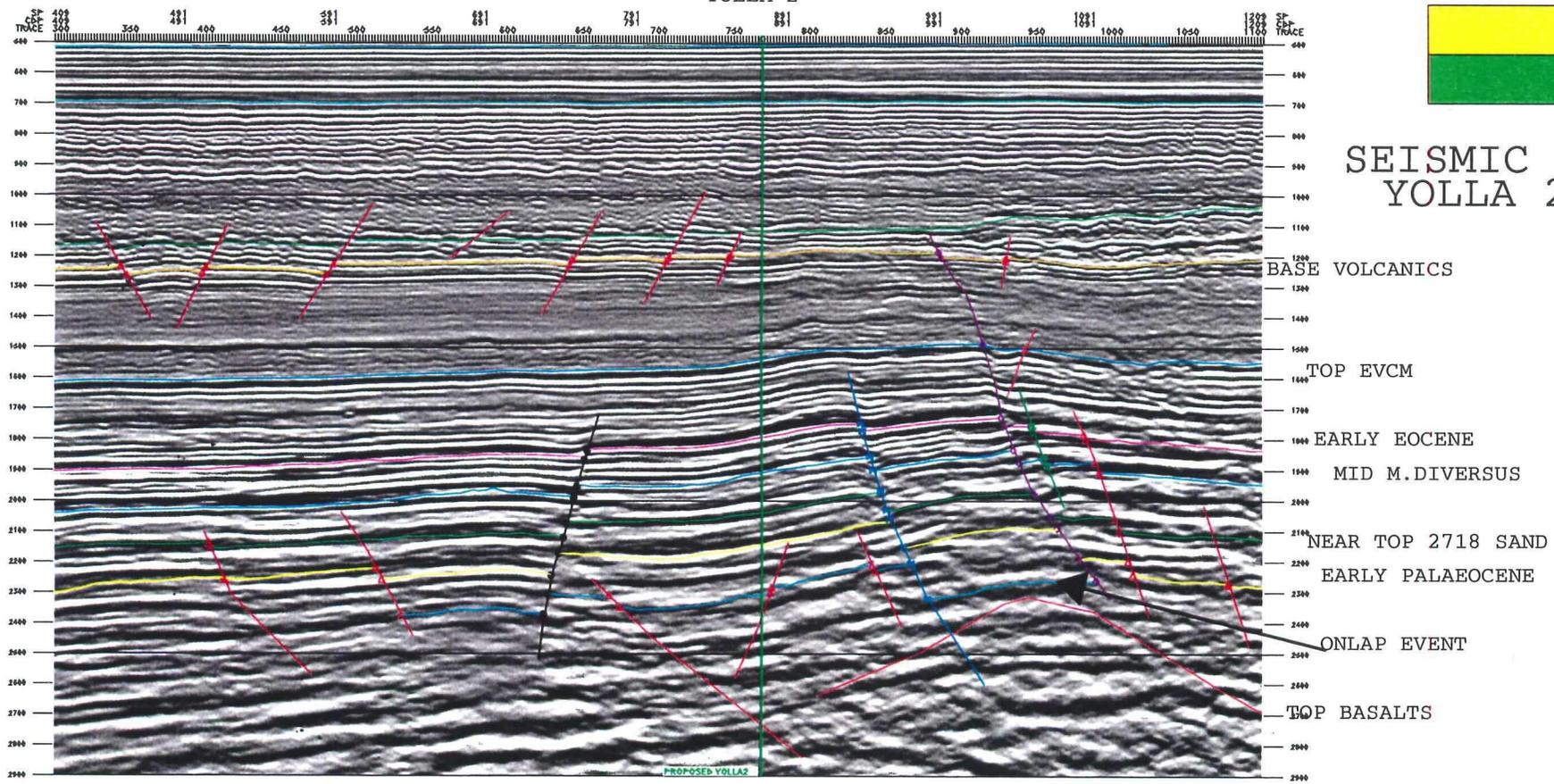


FIGURE 14

Table 3  
YOLLA 1 INTERVAL VELOCITIES

Seismic Event	Depth Sub-Sea (Metres)	Interval Velocity (Metres/Second)
Seafloor	-68.6	2495
Mid-Miocene	-558	2690
Lower Mid-Miocene	-804	2090
Top Miocene Volcanics	-1208	Varying
Base Miocene Volcanics	-1354	2990
Top EVCM	-1788	3130
Early Eocene	-2179	3110
Middle M.diversus	-2364	3950
Near Top 2718 Sand	-2668	3880
Early Palaeocene	-2895	3900
Deep Seismic Onlap event	NI	3900
Top Basalts	-3021	

### 4.3 Predicted Stratigraphy

The predicted stratigraphy for Yolla 2 is shown in Table 2 compared with the stratigraphic section intersected at Yolla 1.

The following lithological descriptions of the anticipated stratigraphic section are based on data from Yolla 1. Note that depths relating to Yolla 1 are in metres KB whilst the prognosed depths for Yolla 2 are quoted in metres subsea (mSS).

#### ***Torquay Group (78 – 1082 mSS)***

The Torquay Group is Early Miocene to present day in age. It is composed of an upper carbonate section and a lower claystone section, the change in rock type being transitional below approximately 700 metres. Large (2cm.), loosely cemented fossils and fossil debris consisting dominantly of bryozoa, coral spicules and forams are expected to dominate the upper 440 metres. Below this fragment size may decrease with depth to generally less than 0.25cm. with the section grading from calcirudites to biocalcarenes and to calcarenites at about 535 metres and then to calcilitites from about 685 to 720 metres. Abundant fragments of light to medium green pelletal glauconite and finely crystalline clear to white calcite infilling pores and cavities are expected. Loose grains of quartz silt may occur below 500 metres.

As grain size decreases with depth, micrite and clay will increase. The rocks at Yolla 1 were extremely soft and dispersive in the drilling fluid creating by about 720 metres a light grey clayey micritic ooze with abundant fine to coarse grained calcareous grains and fragments.

The clay content is anticipated to increase below 730 metres where the rock may grade to a very calcareous claystone. These very soft and dispersive light green-grey claystones are anticipated to continue to the base of the Torquay Group. Calcareous content at Yolla 1 decreased slowly to approximately 15% at 880 metres as both micrite, fossil and grain fragments diminished. Occasional mica flakes and trace amounts of clear, fine grained quartz sand are possible below about 765 metres. Trace amounts of dark green glauconite pellets and very fine grained black specs (heavy minerals?) occurred throughout the section at Yolla 1. The claystones became slightly consolidated below 945 metres.

Palaeontological analysis at Yolla 1 indicates that above 700 metres the sediments resulted from high energy winnowing of biogenic sands in water depths of 30 to 100 metres. The section below 700 metres was deposited in 90 to 140 metres of water where calcareous sediments were winnowed off a nearby bryozoan bank with associated clay influx.

#### ***Angahook Formation (1082 – 1720 mSS)***

The Angahook Formation was deposited from Earliest Oligocene to Early Miocene and can be divided into four lithological units based on its penetration at Yolla 1. The upper three units were deposited in the Early Miocene, whilst the lowermost unit, separated by a hiatus, was deposited in the Earliest Oligocene.

The uppermost unit (predicted between 1082 – 1280 mSS) may consist primarily of light coloured, slightly calcareous claystones which become firmer with depth and develop fissility. Sections may occasionally become quite silty (upto 15%) with trace amounts of fine to medium grained quartz sand, especially below about 1180 metres). Minor amounts of mica and pyrite occur throughout the section and finely disseminated carbonaceous material appears below 1180 metres at Yolla 1.

The second unit ( predicted between 1280 – 1324 mSS) is anticipated to consist of volcano-clastic material, sandstones and claystones with minor amounts of siltstone, especially at the base. The claystones are likely to be similar to those of the uppermost unit and may contain abundant embedded quartz silt and sand with small foraminifera. The volcanics at Yolla 1 were white to bluish grey and mottled with abundant alteration to clays and calcite and variable amounts of pyrite. They represent highly altered pyroclastics. Loose fine to coarse grained quartz was associated with the volcanoclastics but the first well developed sandstones in Yolla 1 only occurred below 1260 metres. These were fine to coarse grained, with rounded to angular quartz sands, well cemented, with clays, calcite and silica. They contained lithic grains, mafics, chert pebble fragments and pyritic nodules.

The third unit (predicted between 1324 – 1470 mSS) is expected to consist primarily of sandstones with minor interbedded claystones. The sandstones at Yolla 1 were dominantly very fine to fine grained with abundant clay and calcite cement. They were generally very silty and commonly graded to siltstones. Also they contained abundant pyrite, glauconite, carbonaceous material and occasional mica below about 1385 metres. Finely interbedded brown and grey-brown, soft claystones which contained variable amounts of embedded quartz silt and sand were intersected at Yolla 1. These interbeds were generally slightly pyritic and had moderate amounts of carbonaceous matter.

The lowermost unit of the Angahook Formation (predicted between 1470 – 1720 mSS) is expected to consist of thin stringers of medium to dark reddish-brown sandy dolomites and dolomitic limestones below approximately 1600 metres interbedded with fine grained dolomitic quartz sandstones and medium brown, silty and sandy claystones. Abundant biogenic pyrite, which has undergone almost total oxidation to limonite, occurs in this unit suggesting a period of exposure and suggesting that the top of the unit is an unconformity.

Deposition of this unit is envisaged to be on a shallow continental shelf (30 – 100 metres water depth) in high-energy conditions.

#### ***Demons Bluff Formation (1720 – 1874 mSS)***

The Demons Bluff Formation, of Late Eocene age, is dominantly a claystone section with thin interbeds of sandstone and dolomitic limestone. The claystones become characteristically darker and more reddish brown with depth becoming almost black near the base. Arenaceous content, carbonaceous material, mica and pyrite also increase with depth. The sandstones are reddish-brown, very fine to fine grained and contain abundant reddish-tan clay matrix, with calcite and dolomite cements. A trace amount of medium green glauconite is also present.

Palaeontologically, the top of the Demons Bluff Formation corresponds with the occurrence of distinct, fine grained, grey coloured specimens of morphologically simple arenaceous foraminifera and pyritic tubes and discs of biogenic origin. The unit was deposited in a barred basin, marginal marine environment in up to 30 metres of water.

#### ***Eastern View Coal Measures (1874 mSS – TD)***

The section of Eastern View Coal Measures penetrated at Yolla 1 ranged in age from Late Eocene to Early Palaeocene. The upper contact was gradational with the Demons Bluff Formation where the dark brown silty claystones become siltier and sandier and finally grade into clean, very fine grained sandstones of the EVCM.

The first sand package at Yolla 1 consisted of very fine-grained, angular, well sorted, very friable sandstone with minor amounts of non-calcareous clay matrix material. It contained abundant light green glauconite and had occasional dolomitic streaks. The sand package below this showed a marked increase in very fine micropyrrite, glauconite, mica and relict feldspars. Medium to coarse grained loose quartz also occurs as well as the first coals approximately 80 metres into the formation.

Palaeontological analyses and sedimentological analysis of the core at Yolla 1 suggest that the depositional environments vary from nearshore marine above to marginal marine below.

A thick section of interbedded sandstones, coals and shales was next penetrated at Yolla 1 from 1898 to 2801 metres ranging in age from Middle to Early Eocene. The base of this section at 2801 metres in Yolla 1 marks the Early Eocene to Late Palaeocene boundary.

Two types of sandstones were recognised in cuttings from Yolla 1. One was very fine grained, angular, moderately sorted and friable and contained abundant white to tan clay matrix and variable amounts of mica, glauconite (?) and abundant dark brown to black carbonaceous and organic material as finely disseminated particles, wisps and micro-laminations. This sandstone occasionally graded to silty and became more argillaceous. The other sandstone type ranged from fine to very coarse grained, with medium to coarse grain sizes dominant. It was completely unconsolidated, with angular to rounded, clear to milky quartz occasionally exhibiting minor quartz overgrowths. Relict feldspar crystals were observed in trace amounts.

Abundant coal was intersected especially between 2150 and 2350 metres in Yolla 1. The coals were of bituminous grade, black, glossy, hard and brittle with a conchoidal, blocky and lamellar fracture. Occasionally embedded in the coals were fine pyrite blebs and streaks, white calcite veinlets and micro-laminations of fine grained sand. Locally, the coals become argillaceous and grade into lignitic shales.

Interbedded with the coals and sandstones at Yolla 1 are dark brown to black shales that are generally moderately soft to hard, fissile, non-calcareous and relatively brittle. At Yolla 1 they contained variable amounts of carbonaceous and coaly material, silt, sand, mica and pyrite, whilst many fragments exhibited micro-laminations of sand and coal.

Between 2207 and 2780 metres in Yolla 1 several thin stringers of reddish-brown, very hard and brittle, arenaceous, microcrystalline dolomite were penetrated. These occur entirely within the Early Eocene.

Palynological analyses of samples from Yolla 1 suggest that the depositional environments for the interval of EVC to 2801 metres is marginal marine with occasional nearshore marine influences, especially within the Early Eocene, Upper *M. diversus* palynological zone. The Middle Eocene, *P. asperopolus* palynological zone is very coaly and was deposited in a non-marine lagoonal environment.

The next package of sediments from 2801 to 3031 metres in Yolla 1 ranged in age from Late to Early Palaeocene. The sequence consists of interbedded sandstones, shales and siltstones with minor thin coals and interbedded clayey sandstone with pyroclastics at the base. Two distinct types of shales are present in Yolla 1, one light coloured and very silty with moderate amounts of organic material, the other darker coloured, less silty and very organic rich, occasionally grading to lignite. The lighter coloured shales often graded into siltstones, which were very argillaceous, micaceous and contained abundant carbonaceous material as finely disseminated particles and wispy, coaly bands. Occasionally the siltstones contained abundant fine sand and graded to argillaceous sandstones.

The sandstones ranged from fine to very coarse-grained but were dominantly medium grained and well-cemented with white and tan clays and contained relict feldspars, mica and abundant carbonaceous matter.

The coals were rare and typically thin and of lignitic to sub-bituminous grade, with abundant finely disseminated pyrite and bands of resinous material.

Occasional pyroclastics were mottled light grey and white and very soft, consisting mostly of clays and relict feldspars in a flow banded texture.

Palynological determinations at Yolla 1 suggest that the depositional environment for most of the section is non-marine lacustrine, based on the lack of dinoflagellates other than *Morkallacysta*.

The thick igneous intrusive intersected within the EVCM at Yolla 1 (2584 – 2651 metres) is not predicted at Yolla 2, although the presence of intrusions which cannot be identified on seismic data within the EVCM is a possibility.

Underlying the EVCM sediments penetrated at Yolla 1 is a thick sequence of basaltic volcanic extrusives. Yolla 2 will test the hypothesis that these volcanics are of limited aerial extent. Hence an objective of the well is to test whether sediments including hydrocarbon bearing sandstone reservoirs are present at a depth equivalent to the basal extrusives of Yolla 1. Interpretation of seismic data suggests that there is a possibility of sedimentary section onlapping the basal volcanics at the Yolla 2 location. If sediments exist they are likely to be similar to the sequences encountered in the Early Palaeocene at Yolla 1 and may be of Late Cretaceous to Early Palaeocene age.

If volcanics are intersected they are anticipated to be of similar type to the basal volcanics in Yolla 1. At Yolla 1 they consisted of a thick sequence of amygdaloidal basalts. The basalt varied from relatively fresh to extremely altered with carbonates, chlorites, silica and zeolite alteration products. The basalts were commonly fractured and veined, possibly due to prolonged exposure between flows.

A further possibility at Yolla 2 is that a sequence of interbedded sediments and igneous extrusives might occur, similar to the succession penetrated in Tilana 1.

K/Ar dating of a relatively fresh sample of basalt gave a minimum age of 54.1 Ma, the true age being probably Late Cretaceous to Early Palaeocene.

## **5 RESERVES**

Deterministic volumetric calculations for the Yolla Main fault compartment demonstrate that the Yolla 2 well could increase Category 1 OGIP volumes from 131 BCF to between 236 BCF (conservative petrophysics) and 352 BCF (most likely petrophysics) in the known gas-condensate bearing reservoirs of Palaeocene to Early Eocene age.

*Category 1 OGIP is defined as that volume of gas located up dip of the individual lowest known gas occurrences in the well and excluding any gas that may occur below the level of the most-likely-gas water contacts for the field.*

Category 2 OGIP addressed by Yolla 2 is between 276 BCF (conservative petrophysics) and 423 BCF (most-likely petrophysics).

*Category 2 OGIP is defined as that volume of gas located up dip of the lowest known gas level for each group of connected sandstones (that is those sandstones which form part of each hydrocarbon column).*

The maximum volume of gas left up dip of a dry Yolla 2 is currently interpreted to range between 151 BCF (conservative petrophysics) and 238 BCF (most-likely petrophysics).

Additional potential in possible deeper onlapping sediments will also be targeted at Yolla 2. It is not anticipated that the top EVCM will be within closure at the Yolla 2 location and therefore no adjustments to top EVCM volumes are likely as a result of drilling this well.

**6      REFERENCES**

"1994 YOLLA 3D SEISMIC SURVEY, DATA ACQUISITION AND PROCESSING REPORT, T/RL 1 TASMANIA" Sagasco Resources Ltd., internal report.

"YOLLA 3D SEISMIC DATA INTERPRETATION", 1995, Boral Energy Resources Ltd., internal report.