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Seismic Interpretation and Mapping of the Vic/P41 Oscar 3D (GAP04D) Seismic Survey

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Bass Strait Oil Company Ltd.

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Executive Summary

Bass Strait Oil Company Ltd (BAS) is operator and joint venturer of Vic/P41. This report documents the seismic interpretation of the GAP04D Oscar 3D survey shot in Vic/P41, which was incorporated into a regional interpretation of the permit over an existing database of 3340km of 2D seismic. The location of the survey is shown on figure 1.

The survey was undertaken by WesternGeco for Apache Energy Northwest Pty Ltd (under an agreement with Bass Strait Oil Company Limited). The objective of the survey was to improve the structural definition of the leads identified in VIC/P41. The Oscar 3D (GAP04D) was the first 3D survey undertaken in the area of Vic/P41. It covers approximately 575 CMP km^2 and was acquired between 17 February and 1 March 2005 using the m/v Western Trident. WesternGeco in Perth processed the survey between March and August 2005.

Seven wells have been drilled in Vic/P41 and Vic/RL3 previously from Sole-1 in 1973 to Northright-1 in 2001, with Dart-1, Hammerhead-1, Shark-1 and Whaleshark-1 in between. Sole is an undeveloped gas discovery. None of the other wells was a valid test. Only Hammerhead-1 and Shark-1 fall in the Oscar 3D area. These wells and others surrounding the area of interest were used for well seismic correlation of the key reservoir and seal pair units of the Latrobe Group / Lakes Entrance, the Volador Formation / Kate Shale and the volcanics at the top of the Golden Beach Subgroup / sandstones of the Chimaera Formation (see stratigraphic summary for the Gippsland Basin on figure 2). The seismic events mapped are the Top Latrobe Event, Top Kate Shale and Top Golden Beach (soft). Time and depth maps were generated for these three horizons to identify structural prospects and leads. The enclosures of this report include these mapped events in time and depth, and four large scale seismic lines through the area are also included.

The key structural elements of the permit are the Rosedale Fault, which strikes east-west through the north of the Oscar 3D area, before swinging southeast in the east of the 3D area. This major basin forming fault separates the Northern Terrace from the Central Deep to the south. The fault is the approximate subcrop edge of the Golden Beach Subgroup and thus there is a marked thickening of the Latrobe Group to the south of this fault.

The structural interpretation has confirmed the existence of a number of prospects and leads. The most significant prospects identified are all confined to the Oscar 3D and are Kipling, Benchley West, Benchley East, Cotton, Oscar West and Oscar East. A number of other higher risk or less areally extensive prospects are also mapped at Cotton West, Cotton Southwest, Oscar Southwest I and II, Oscar North and Oscar Northwest. The Updip Hammerhead Lead is also identified on the northwest corner of the Oscar 3D. Leads mapped on the existing 2D seismic data are also described, with Scorpion being a significant closure.

Introduction

This report documents the seismic interpretation and mapping of the Oscar 3D (GAP04D) acquired in Vic/P41 in the offshore Gippsland Basin by Bass Strait Oil Company Ltd, the permit operator. The survey was acquired from 17 February to 1 March 2005. The work is incorporated into a regional interpretation of the Vic/P41 permit with the existing 2D seismic database. The area of interest is shown on Figure 1.

Database

The database of well and seismic is shown on enclosure 1.

Oscar 3D

The Oscar 3D, VIC/P41 (Gippsland Basin) Marine Seismic Survey was conducted in Bass Strait, Victoria by WesternGeco, under client project number GAP04D by Apache Energy Northwest Pty Ltd for Bass Strait Oil Company Limited (BAS). The objective of the project was to improve the structural definition of the leads identified in VIC/P41. These leads extend from the Kipper oil and gas field to the west and south of the Sole gas field to the north.

The survey consists of approximately 575 CMP km^2 or 24583.2 linear CMP kilometres of data. The field data were acquired by WesternGeco (m/v Western Trident) between 17 February and 1 March 2005. Data processing was carried out between 21 March and 25 August 2005 by WesternGeco in Perth.

The key acquisition parameters of the survey are indicated in Table 1 below.

<u>Recording</u>	
Recording type:	MSX
Recording medium, format:	3590B cartridge, SEGD 8058, Revision 1
Record length:	5120 ms
Sample rate:	2 ms
Low cut filter:	2 Hz, 12 dB/octave
High cut filter:	206 Hz, 264 dB/octave
<u>Source</u>	
Source type:	Tuned sleevegun array
Number of source arrays:	2
Source array separation:	50 m
Shotpoint interval:	18.75 m flip/flop (37.5 m/array)
Array volume per source:	3000 cu in
Operating pressure:	2000 psi
Source depth:	7 m

Number of sub-arrays/source: 4
Sub-array separation: 6 m
Number of airguns/sub-array: 8
Sub-array length: 15.1 m
Nominal CMP fold: 64

Streamer
Streamer type: MSX solid streamer
Number of streamers: 8
Group length: 17.75 m
No. of hydrophones/group: 14
Group interval: 12.5 m
Hydrophone sensitivity: 13.8 v / bar
Streamer length: 4800 m
Streamer depth: 8 m
Streamer separation: 100 m
Number of groups/streamer: 384
Nearest offset (nominal): 238 m

Navigation
Primary navigation system: Cnav
Secondary navigation system: Fugro Multifix 4
Tertiary navigation system: Trinav GPS 2.6

Table 1 – Oscar 3D (GAP04D) survey acquisition parameters

The data were processed through a prestack sequence consisting of 2 passes of SWATT, Tau-P linear noise attenuation, DBS, 3D bin regularisation by interpolation, 3D PreStack Time Migration, Radon multiple attenuation. On the whole, three passes of velocity analyses were performed; 1st pass at 1 km x 1 km grid, 2nd and 3rd pass were at 0.5 km x 0.5 km grid. The data were full offset stacked and angle stacked with final (3rd pass) picked velocities then followed by poststack crossline trace interpolation from 25 m to 12.5 m.

Two lines GAP04D1152P1001 (shallow water) and GAP04D1648P1043 (deep water) were chosen by BAS as primary test line and verification line respectively. The primary test line was firstly tested with all the confirmed production parameters derived from the Moby 3D survey (acquired concurrently in Vic/P47 for BAS) for reconfirmation. Occasionally, additional testing for additional test lines were carried out to further improve the data quality when necessary. Testing was performed concurrently with the production.

The Oscar 3D was loaded to BAS' Geoquest workstation and ties checked with the intersecting 2D seismic data. The recent GBS02 survey, acquired for BAS in 2002 tied very well. The older G92A 2D well tie survey acquired in 1992 also showed good ties. As these two 2D surveys are believed from experience to be zero phased SEG normal

displays, the Oscar 3D was considered to be well phase matched and located with correct polarity.

The following 3D seismic volumes for the Oscar 3D were loaded; unfiltered PSTM, filtered and scaled PSTM, near offsets PSTM, mid offsets PSTM and far offsets PSTM. The filtered and scaled version was used for the main interpretation, although amplitude anomalies could be examined on the unscaled version as required. The velocity functions used to derive the angle mutes were calculated from the smoothed final velocity field. The 'nears', 'mids' and 'fars' angle stacks were loaded to allow a subjective inspection of AVO effects. The 3 angle stack volumes generated were:

Near: 0^O - 14^O
Mid: 14^O - 28^O
Far: 28^O - 42^O

Time slices were generated at intervals of 20msec for use in the interpretation.

2D surveys

The following 2D seismic data were loaded;
GBS02 survey
GEBR01 survey
GEBR99 survey
G94A northern lines (shared from another project)
G92A survey
GS91A survey
G89A survey
GS88B survey
GH88A survey
BMR87 2 lines
GS 82A survey
GS81A survey
GS73A selected lines reprocessed 1988

All surveys in the permit area were analysed for misties in correlation with the reliable G92A regional survey. No significant misties were observed, and consequently no mistie corrections were applied. Some seabed inconsistencies were observed during correlation, which were attributed to the sea bottom topography surveys in deep water areas.

The G94A 2D seismic lines, present to the west of Vic/P41, were interpreted to extend trends and closures along the Rosedale Fault falling outside of the permit. Comparisons with the G92A regional survey showed misties in the data. Mistie analyses were then performed on the survey, and an average bulk shift of 30 ms was applied to each line in the G94A survey.

Well to seismic correlation

The following well data were loaded for well to seismic correlation, representing all wells drilled in the permit area and surrounds.
Dart-1
Hammerhead-1
Kipper-1 (outside area of interest, to the west)
Northright-1
Shark-1
Sole-1
Whaleshark-1

Additional wells were used for mapping at Basker-1, Basker South-1, Manta-1, Gummy-1, Chimaera-1, Admiral-1, Leatherjacket-1, Sweep-1 and Wahoo-1, although no checkshot data were loaded for these.

Wireline logs were loaded for the wells Hammerhead-1, Shark-1, Whaleshark-1 & Kipper-1. Wireline logs for Dart-1, Sole-1 and Northright-1 were reviewed on paper sections. Check shot data were loaded for all wells from the well completion report. Sonic logs were calibrated to the check shot data with some minor drifts observed and corrected.

Synthetic seismograms have been generated for the following wells in order to improve the well to seismic correlation and the suitability of events mapped; Hammerhead-1, Kipper-1, Shark-1, & Whaleshark-1. For the two wells Shark-1 and Hammerhead-1 in the Oscar 3D area synthetics were generated by convolving a wavelet extracted from the first 2000msec of the 3D at the intersecting and nearby traces. The resulting synthetics are included as figures 3 & 4.

Well results

These wells are those within Vic/P41 and the Sole retention lease Vic/RL3.

Sole-1

Spud date:	1973
Operator:	Shell
Objective:	Top Latrobe (Eocene Latrobe Valley Formation sandstones)
Total depth:	1129 m
Total depth formation:	Strzelecki Group
Results:	Plugged and abandoned as gas discovery

Sole-1 was drilled to test an anticline associated with a right-lateral shear system, and a vertical closure of 280' was mapped at Top Latrobe. Lithologies similar to those of the Latrobe Group penetrated at Wahoo-1 were expected, and it was expected that oil would be found, since the prospect was located in an interpreted oil-prone part of the basin. Drilling confirmed (Esso's) structural interpretation, and the Latrobe lithologies penetrated were similar to those predicted. However, gas rather than oil was found, with some residual oil staining apparent in the gas column, and to a point 25 metres immediately below the gas/water contact. The base of the oil staining coincides closely with the structural spill-point.

Dart-1

Spud date:	1974
Operator:	Esso
Objective:	Top Latrobe
Total depth:	1219 m
Total depth formation:	Strzelecki Group *(C.hughesii)*
Results:	No hydrocarbon shows encountered

Dart-1 was a follow-up well to Sole-1, targeting a separate culmination at Top Latrobe, defined by an abnormally high amplitude response on seismic. The well encountered no hydrocarbon shows. The formation depths were generally as predicted, although the Top Latrobe was approximately 30 metres deeper, due to a faster velocity in the section than interpreted from seismic velocity analysis. The Latrobe section contained excellent reservoir sands, whose unconsolidated nature resulted in a decrease in interval velocity and formation density when compared to the overlying Gippsland marls. The combination of these effects generates a large negative reflection coefficient and was responsible for the high amplitude seismic event at the Top Latrobe.

Hammerhead-1

Spud date:	1982
Operator:	Shell
Objective:	Top Latrobe
Total depth:	2130 m
Total depth formation:	Emperor Subgroup
Results:	No significant hydrocarbon shows

Hammerhead-1 tested a potential upper Latrobe trap on the southern, basinward side of the Rosedale Fault System. Seismic interpretation showed a large closure of up to 25 km^2. Late Cretaceous-early Palaeocene (Latrobe) lower coastal plain source rocks with

oil and gas potential were predicted to be present, as well as the possibility of Cretaceous (Strzelecki) mature gas source rocks.

The predicted lithologies were fairly accurate, although intra Latrobe seals were not well developed. No significant hydrocarbon shows were encountered in the well. The well, drilled as a vertical well, left the downdip lower Latrobe and Golden Beach sections untested as it passed into the upthrown block before they were reached.

Shark-1

Spud date:	1989
Operator:	Shell
Objective:	Top-Intra Golden Beach Group
Total depth:	3518 m
Total depth formation:	Emperor Subgroup (*P. mawsonii*)
Results:	No significant hydrocarbon shows

The primary objective of Shark-1 was to test alluvial sandstones in a downthrown fault trap at top and intra-Golden Beach Group levels. Top seal was expected to be provided by weathered volcanic rocks. The drill depths to the seismic markers are in very close agreement with the predicted depths, and the lithological and stratigraphical sequences encountered in the well were mostly as anticipated from regional mapping. The Latrobe Group consisted of a typical transgressive sequence from upper coastal plain to estuarine, however, the lowermost Latrobe Group comprised more upper coastal plain facies than the expected lower coastal plain facies. Instead of the expected weathered basalts, the top Golden Beach is marked by a tuffaceous pyroclastic sequence interbedded with sandstones and claystones. No significant hydrocarbon shows were encountered. Shell attributed failure to a lack of hydrocarbon charge, although seismic interpretation on the Oscar 3D indicates a lack of structural closure at top Latrobe, top Kate Shale and Golden Beach levels.

Whaleshark-1

Spud date:	1992
Operator:	Esso
Objective:	Top Latrobe
Total depth:	2870 m
Total depth formation:	Latrobe Siliciclastics (*T. longus*)
Results:	No hydrocarbons encountered

The objective of Whaleshark-1 was to test the hydrocarbon potential of a Top Latrobe Group erosional remnant, interpreted to have 105m of mapped four way dip closure. The Top Latrobe Group was intersected 140 metres lower than predicted. It was found that the Top Latrobe was interpreted pre-drill to be 50msec too high, and that the interval velocity used to the top of the Latrobe during pre-drill mapping was too slow. The

predicted top seal of the Lakes Entrance Formation was also much thinner than anticipated, and the predicted reservoir interval (Upper *T. Longus* sands) was intersected 217 metres lower than expected. No hydrocarbons were encountered in Whaleshark-1. The well results can be explained by; 1) the well was drilled outside closure at the top of porosity level; 2) reduced thickening and abundant faulting of the Lakes Entrance Formation makes it an ineffective top seal, or; 3) lack of access to mature source rocks since trap formation. Lack of closure is now considered the likely cause of failure.

Northright-1

Spud date:	2001
Operator:	Eagle Bay Resources
Objective:	Top Latrobe
Total depth:	391 m
Total depth formation:	Strzelecki Formation
Results:	No hydrocarbon shows encountered

The objective of Northright-1 was to test the integrity and hydrocarbon potential of a reverse fault structural trap set up at the top of the Latrobe Group reservoir. The fault trap was against a major east-west trending basin margin fault and updip from the known oil and gas accumulations of Sole and Leatherjacket.

The Latrobe Group sandstone was prognosed to be sealed by marls of Tertiary Lakes Entrance Formation and underlain by secondary objective sandstones of Late Cretaceous Golden Beach Group. The prognosed formation top depths closely match the actual depths. Early Cretaceous sandstone, litharenite and volcanics of the Strzelecki Group form the basement and underlie a Latrobe Group fluvial channel/flood and coastal plain sequence. Northright-1 did not encounter any hydrocarbon shows or significant gas concentration in either the primary or secondary reservoir objectives. It was plugged and abandoned upon reaching the Strzelecki Group. A lack of top or lateral fault seal is suggested to be reason for failure.

Seismic Interpretation

The seismic interpretation project was undertaken in IESX and Geoframe 4.2 with mapping in Petrosys PC.

The seismic events were mapped from the two wells intersecting the Oscar 3D, Hammerhead-1 and Shark-1. The resulting interpretation was compared with that on the intersecting 2D lines and regional wells, although some misties are always expected between 2D and 3D surveys due to out of plane effects prevalent on 2D data.

Prior to horizon interpretation faults were interpreted in a dip, or xline direction, at every 40^{th} xline and then interpolated and interpreted to every 20^{th} inline. This led to a

consistent fault style and better fault correlation. Fault polygons were interpreted for the three key horizons for use in mapping. The dip attribute proved very useful in mapping fault polygons (see Top Latrobe Event dip attribute on Fig. 5).

The three key horizons, Top Latrobe Event, Top Kate Shale and Top Golden Beach (soft) were interpreted on every 20th inline and xline.

The Top Latrobe event is a regionally correlatable event which was mapped as a 'soft kick' or trough correlating to a negative acoustic impedance contrast occurring very close to the base of the Lakes Entrance Formation. This event was then correlated between the wells Hammerhead-1 and Shark-1, and also picked with some confidence from intersecting 2D seismic lines to the wells Dart-1 and Sole-1. An accurate tie to Whaleshark-1 in the deeper water to the south was too problematic due to the erosion of the Latrobe Group by canyon incision and the rugose bathymetry. The Top Latrobe was tied into the Basker/Manta 3D and well data with a small jump correlation across the coverage gap. Data quality was good at the Top Latrobe Event and mapping undertaken to a high level of confidence.

The Top Kate Shale event is evident as a downlap surface and correlates with Shark-1 and Hammerhead-1 as a positive acoustic impedance contrast and so was mapped as a 'hard kick' or peak on this SEG normal dataset. It was chosen as an event for interpretation as it is regionally correlatable and is a significant shale sequence and hence a potential seal unit to the underlying Volador Formation sandstones. It was correlated from Hammerhead-1 to Shark-1 through the Oscar 3D. It was then extrapolated to every 20th inline and xline. The interpretation was problematic in places due to the event merging with downlapping events above. This created some noise where it was autotracked as it tended to pick the downlapping events and such noise is evident on the final maps at this level. These ENE-WSW oriented inflections on the TWT and depth maps, are also apparent on the amplitude attributes. It can be assumed that this is the orientation of the progradational downlap for sedimentation during the Paleocene.

A near top Golden Beach Event "Top Golden Beach Soft" was interpreted by correlating the Campanian volcanic sequence encountered in Shark-1. The volcanic sequence in Shark-1 gave only a fair correlation on the synthetic, probably due to the occurrence of interbedded sediments within the volcanics. However, the strong event at the top Campanian volcanics, and the trough beneath, could be correlated regionally from wells at Basker/Manta and Kipper; these ties correlate with the event at Shark-1. This sequence was not encountered in Hammerhead-1 as the well drilled through the Rosedale Fault from the southern down to the upthrown northern fault block before encountering it. The event is a 'soft kick' correlated to a negative acoustic impedance contrast near the base of the volcanic sequence. This was selected over the Top Golden Beach volcanics for two reasons; it is more correlatable due to the irregular nature of the top volcanics in places, and because the event was more likely to be useful for future identification of AVO and amplitude anomalies related to any underlying hydrocarbon filled sandstones. The mapping of this event was assisted by its brightness and the laterally extensive nature of the Campanian volcanics across the Oscar 3D (and regionally in the Gippsland Basin at

the top of the Golden Beach Subgroup). Bright events deeper in the sequence are likely to be related to volcanic intrusives within the Golden Beach Subgroup as similarly observed in the Basker/Manta area, offering potential for additional reservoir and seal pairs.

All three horizons were then autotracked over the entire 3D area using Geoquest's ASAP autotracker. Autotracking was undertaken in each fault block to avoid erroneous tracking across faults.

A seabottom event was interpreted as a hardkick for depth conversion. The event was well represented on seismic as waterdepth varies from 120m in the northwest to 520m in the southeast of the survey area and source/cable offsets were not an issue for such depths.

A top Emperor Subgroup event was interpreted on some inlines and xlines. It was correlated to Shark-1 in the Central Deep area south of the Rosedale Fault, as it contains the only suitable intersection (Hammerhead-1 intersected the sequence through a fault plane). The steep angular Longtom Unconformity is evident beneath the Golden Beach Subgroup and overlying the Emperor Subgroup. It is clear that Shark-1 did not penetrate a complete Golden Beach Subgroup sequence due to the presence of a fault (see Fig. 6). North of the Rosedale Fault the Halibut Subgroup unconfomrably overlies the Strzelecki Group, and this event is a top Strzelecki event. No maps were generated for this event as it was too problematic to interpret across the area of interest.

Mapping was undertaken in Petrosys. Every 4th CDP for each inline was exported, for the horizons, Seabed, Top Latrobe, Top Kate Shale and Top Golden Beach (soft).

Mapping

The data were exported to Petrosys PC. Every fourth CDP and every inline were exported for the 3D data.

TWT data were gridded using a least squares algorithm and a grid dimension of 100 by 100 m. Two-way time structure maps were generated with faults for the following horizons:

- Top Latrobe Group
- Top Kate Shale
- Top Golden Beach Subgroup

The TWT grids for the Oscar 3D and the 2D data were merged graphically without feathering to avoid introducing an arbitrary dip at the merge which would be unrepresentative of the geology.

These events are shown as enclosures 2 through 4.

Depth Conversion

Depth conversion was undertaken for the following layers:

- Seabed
- Top Latrobe Group
- Top Kate Shale
- Top Golden Beach Subgroup

3D depth conversion

The Oscar 3D final stacking velocity data were used for the depth conversion of the horizons in the 3D area below the seabottom event. The seabottom was depth converted using a constant velocity of 1500m/s and corrected to the well data.

Three passes of velocity analyses were performed on the Oscar 3D; the first pass on post stack gathers at 1 X 1km, the second pass used the first pass for targeted PSTM of the velocity lines at 500 X 500m and the third pass used a full PSTM and 3D CMP sort, before velocity analyses at 500 X 500m. A comparison of the semblance of the three velocity analyses is shown at a typical identical velocity pick for all three passes on figure 7. The significant improvement in semblance quality between, 1st and 2nd, then 3rd passes is clearly evident. A significant Vrms velocity inversion is not evident although a relatively minor interval velocity inversion is evident at around 1.3sec TWT. This represents the transition between carbonates of the Gippsland Limestone and more shaley sediments of the Lakes Entrance Formation beneath.

In order to load the stacking velocity data into Petrosys the Western 3D format was first converted to a format with transposed inlines and xlines, then converted to a 'pseudo 2D' format by Petrosys Pty Ltd that is compatible with their software. Interval velocity points were determined from the stacking velocities for the following horizon intervals; Seabed to Top Latrobe, Seabed to Top Kate Shale and Seabed to Top Golden Beach. Examination of the velocity data indicated that there were no strong lateral velocity variations in the Tertiary section (except some moderate variations with bathymetry described below). This is often an issue in the Gippsland Basin due to the existence of submarine canyon sequences with laterally varying velocities. Such canyon sequences are not prominent in the Oscar 3D area and are not considered problematic for the depth conversion. However, in the south of the survey area the bathymetry indicates that canyon incision is occurring at the present day with a rugose sea bottom topography evident. The interval velocity data points were gridded using a minimum curvature algorithm and heavy Bartlett smoothing to reduce high frequency noise. When compared with the bathymetry profile the resultant velocity grids had no significant variation in the shallow water areas to the north. However, the canyon incised area to the south had a significant correlation with higher velocity values, which is a lateral velocity variation. This is to be expected as there is a strong compaction trend in the near surface sediment, with velocity increasing significantly with depth. The shallower slower material would be

removed in the canyon areas leading to higher interval velocities. However, this poses a measure of uncertainty to depth closures, such as the Oscar Prospects, beneath present day canyon areas such as the 'Oscar Canyon'.

The resulting interval velocity values were compared to the actual well velocities for the intervals in Hammerhead-1 and Shark-1 derived from the drift corrected sonics for calibration. For the Seabottom to Top Latrobe interval velocity the well velocities were exactly 93.8% of the seismic velocities for both well. This consistent ratio suggests a high confidence in the validity of the stacking velocity data down to the Top Latrobe. This ratio was then applied to the interval velocity grid to calibrate to well data. For the Seabottom to Top Kate Shale interval there was more variability between the ratio of well to seismic velocity from 90.8 to 95.6%; suggesting lower confidence in this deeper zone; an average of 93.2% was used. For the Seabottom to Top Golden Beach interval the ratio was only available at Shark-1, the only penetration to this level. A value of 95.2% was measured and used to calibrate the interval velocity grid to well data. The depth conversion for the three horizons was undertaken in a layer cake approach by using these calibrated velocities and adding to seabottom depth. The depth converted horizons are shown in enclosures 5 to 8.

2D depth conversion

For the 2D data the lack of suitable stacking velocity data necessitated a different depth conversion approach that was based on well velocity data. A seawater velocity of 1500m/s was used, more representative of the deeper water areas of Vic/P41.

Examination of the velocity depth trends for the wells in the region show a linear trend of velocity increasing with depth down to the top of the Latrobe group. A velocity depth trend was determined from Hammerhead-1, Shark-1, Whaleshark-1 and Kipper-1:

$$V = 2020 + 0.59 Z$$ (Z is depth in metres from mean sea level)

This was used to depth convert the top Latrobe Group reservoir level and resulted in depth conversion values accurate to less than 4% at the wells. The residual error was gridded and corrected to produce a depth map conformable with the well data.

In order to depth convert down to the Top Kate Shale and Top Golden Beach seismic events a second velocity depth trend was determined from the Hammerhead-1, Shark-1, Whaleshark-1 and Kipper-1 well data with the equation;

$$V=2600 +0.27 Z$$

As for the Top Latrobe, this was used to depth convert down to these two deeper horizons, and the residual error, which was less than 2% and 0.5%, respectively, was corrected resulting in depth maps conformable to well data.

The depth grids for the Oscar 3D and the existing 2D data were merged graphically without feathering to avoid introducing an arbitrary dip at the merge which would be unrepresentative of the geology. Depth structure maps have been produced for the following horizons:

- Sea bottom (bathymetry)
- Top Latrobe Group
- Top Kate Shale
- Top Golden Beach

These are included as enclosures 5 through 8.

Structural setting

The Gippsland Basin is bounded along the northern margin by the Rosedale and Lake Wellington fault systems, and along the southern margin by the Darriman and Foster fault systems. The Rosedale Fault strikes east-west through the northern part of the Oscar 3D. These tectonic elements define the northern and southern platforms and terraces as well as the Central Deep depocentre. The Central Deep is located south of the Rosedale Fault in the Oscar 3D area with the Northern Terrace in the north.

An isopach map of the Seaspray Group (see Fig. 8) shows a southerly thickening profile from 900 to 1800m except where broken by the "Oscar Canyon" which has incised into the continental shelf just west of Shark-1 (see bathymetry map in Enclosure 5). Oscar Canyon incision has removed up to 200m of Seaspray Group sediments and strikes in a NW to SE orientation into the shelf edge that itself strikes WSW-ESE through the Oscar 3D area. Some other minor canyons incise the continental shelf break through the area.

The Top Latrobe Group depth structure map on Enclosure 6 shows a regional southerly dip from 1000m in the north of the Oscar area to a maximum of just over 2000m in the south. Only minor faults are evident with throws of less than 50m. These appear to be re-activated earlier faults and are oriented WNW-ESE except in the northeast of the survey area where NW-SE en echelon faults are evident. The lack of significant faulting is consistent with the view that the Seaspray Group was deposited under post rift thermal subsidence with minimal extension. The Top Latrobe Event dip attribute (Fig. 5) suggests a more continuous fault style at this level. This is related to peneplanation at top Latrobe Group with the underlying fault throw being more significant than at top Latrobe.

An isopach map of the sequence from the Top Latrobe to the top Golden Beach (see Fig. 9) shows the intersection of a NW-SE and an east west structural grain. Examination of the Top Kate Shale depth map (Enclosure 7) shows a NW-SE striking faults with the exception of the east-west oriented Rosedale Fault in the north. This fault style would suggest a purely extensional style. At the level of the Top Golden Beach Subgroup (Enclosure 8) the fault style is en echelon with an east-west and NW-SE orientation and a more transtensional style. It is therefore assumed that the earlier east-west faults are

related to the second phase of Gippsland Basin rifting that led to the thick accumulation of Emperor Subgroup sediment with some re-activation during the Golden Beach Subgroup deposition in the Santonian to Campanian. Some transtensional extension was evident during this period. The later more NW-SE faulting was related to a more NE-SW oriented extension due to margin sag post rift in the early Tertiary. The major basin forming faults of the Rosedale Fault and those further south along trend with Basker/Manta strike east-west and downthrow to the south, except in the far northeast of the survey area in the constraining bend where the Cotton Prospect is identified. It is this east-west faulting which produces the major thickening of the Emperor and Golden Beach subgroups and to a lesser extent the younger Latrobe Group sections. Due to the predominant southerly dip of the reservoir / seal sequences identified it is the major east-west faults that set up trapping geometries, along the Rosedale Fault and along the Oscar prospects. The en echelon trapping geometry in Cotton is comparable to that in the Kipper Field and may be significant.

Prospects and Leads

A number of prospects and leads are currently identified from the depth mapping and are described below, and shown on figure 10. The prospects are restricted to the features defined on the Oscar 3D data, all 2D defined features being leads. Four seismic sections are included as enclosures 9 through 12. These lines highlight significant prospects and their location is shown on figure 11.

Kipling Prospect

Kipling is a downthrown fault closure along the Rosedale Fault mapped at Top Golden Beach level. It is analogous to the Kipper Field. The Rosedale Fault appears to form en echelon pairs of faults, which do not provide a pure fault closure, indicating a fault seal risk, however the Golden Beach Subgroup sequence appears to be subcropping in an east-west trend between faults. The eastern culmination of Kipling is shown on the traverse strike line on the Oscar 3D in enclosure 9. Its eastern edge and Rosedale Fault closure is shown on xline 1500 in enclosure 11. Hammerhead-1 drilled into the upthrown fault block before testing this mapped closure at this level. Top seal is interpreted to be provided by volcanics equivalent to those drilled in Kipper-1. High amplitude events on seismic at this level suggest their presence. Poorly developed or absent Golden Beach reservoirs poses a risk due to their proximity to subcrop.

An areal and vertical closure of 20.1km^2 and 260m respectively has been mapped in Vic/P41 and permit area Vic/P55. The culmination is at about 1460m in Vic/P41, with a spill point around 1720m to the west in Vic/P55, albeit on poor quality 2D seismic coverage.

Benchley West and East Prospects

The Benchley Lead defined on 2D is clearly separated into two prospects, Benchley West and East, by a significant NW-SE striking fault downthrowing to the west. The prospects form downthrown fault closures along the Rosedale Fault mapped at both Golden Beach

and Kate Shale levels. It is evident on the northern strike traverse in enclosure 9. At Golden Beach level, closure on the Benchley West Prospect is inferred by the Rosedale Fault, structural dip into a fault to the west and the separating fault to the east. Benchley East requires closure on the Rosedale Fault and the separating fault only. However, at Kate Shale level this western fault is required to seal. This lateral fault seal is a significant risk at the Kate Shale level, due to the high net to gross predicted in the Halibut Subgroup. Poorly developed or absent Golden Beach reservoirs pose a risk due to their proximity to subcrop. The areal closure mapped at Golden Beach level is 5.5km^2 in Benchley West and 9.9km^2 in Benchley East. Culminations are 1500 and 1420m respectively with spills of 1720 and 1750m, and 220 and 330m of vertical closure respectively.

Cotton, Cotton West and Cotton Southwest Prospects

The Cotton prospects are mapped at Top Kate Shale and Top Golden Beach levels and form downthrown fault closures along the Rosedale Fault, and along a parallel fault to the south. The Rosedale Fault forms a constraining bend at Cotton, where it turns from an east west strike to NW-SE. This is a similar structural style to that at Kipper. The isopach of the Cobia and Halibut subgroups (Fig. 9) shows a greater thickness of these sequences compared to over Kipling and Benchley, and seismic character suggests a Golden Beach sequence is present. This augurs well for prospective reservoir and seal units within closure. Seismic facies suggest potential intraformational seals within this Latrobe section from marine shales, which could provide for stacked pay. The traverse strike line enclosure 9 shows Cotton and Cotton West, with the thicker Latrobe Group sequence evident. The xline 2960 on enclosure 12 shows the Cotton Southwest Prospect with a Golden Beach sequence evident; in addition the large throw on the Rosedale Fault shows potential for fault seal at Cotton, due to juxtaposition of more intra-Latrobe Group reservoir seal pairs against tight Strzelecki Group rocks in the upthrown block. Cotton has a lower fault seal risk against the Rosedale Fault, when compared to Cotton West where fault seal has a high risk as closure is also required against a minor NW-SE striking splay of the Rosedale Fault. Cotton Southwest is a smaller feature formed by rollover into a fault parallel to the Rosedale Fault. An areal and vertical closure of 7.2km^2 and 230m at Top Golden Beach level is evident at the Cotton Prospect, with a culmination of 1960m and a spill point of 2190m towards Cotton Southwest. In Cotton West an areal and vertical closure of 8.9km^2 and 300m at Top Golden Beach level occurs, with a culmination of 1700m and a spill point around 2000m where the minor splay fault has a diminished throw. An areal and vertical closure of 4.9km^2 and 20m at Top Golden Beach level is evident at the Cotton Southwest Prospect, with a culmination of 2125m and a spill point of 2145m towards the west. Further depth conversion work is recommended for Cotton Southwest to reduce structural risk on this subtle feature.

Oscar Prospects

The Oscar Prospects are a number of tilted fault closures at Top Golden Beach level, along trend from the Basker/Manta/Gummy oil and gas fields. A strike and dip line through Oscar is shown on enclosures 10 and 11. Significant fault throws are evident on

east-west striking faults with top Golden Beach throws of over 100m at Oscar West and over 60m at Oscar East. These faults also offset the Halibut Subgroup and offer fault seal potential in the lower sequence there, although a lack of intraformational seals is a risk for this shallower play. However, the thickening evident on the Cobia and Halibut subgroups isopach map (Fig. 9) across this fault may also allow a more marine environment to develop and provide potential for more marine shale sealing units to develop. Bright events on seismic on both near and far offset gathers within the interpreted Golden Beach Subgroup sequence are believed to be Campanian volcanic intrusives, which by analogy with Basker and Manta, may provide intra-formational seals. Some AVO response on the offset stacks has also been observed on Oscar prospects within the Halibut Subgroup sequence and future quantitative AVO analysis may identify potential DHI's if structural concordance is determined for these. Although less significant in areal closure to the closures along the Rosedale Fault, these prospects are considered relatively low risk by analogy with the Basker/Manta accumulations. The significant thickening of the Golden Beach and Halibut subgroups, together with better marine shale sequences and intrusives suggest stacked pay may be likely if successful. The rugose seabottom topography above these prospects poses a depth conversion risk and further work is required to reduce this. Vertical and areal closures for the prospects Oscar West, Oscar East, Oscar Southwest I and Oscar Southwest II are 140m and 7.9km^2, 110m and 9.4km^2, 35m and 2.3km^2, and 70m and 2.7km^2 with culminations at 2460, 2490, 2690 and 2680m respectively. Minor closures are also mapped at Oscar North and Oscar Northwest.

Junger Lead

The Junger Lead is a downthrown fault closure at Top Latrobe and Top Kate Shale levels, east of the Sole Gas Field. It was defined on the existing 2D seismic database. Lateral fault seal is a significant risk, although the same fault is interpreted to seal in Sole. At Top Latrobe level the structural closures are relatively small. At Top Kate Shale level, vertical and areal closures of 215m and 24km^2 have been mapped, with a culmination at 880m. Seismic coverage on this lead is currently very poor.

Wilde Lead

The Wilde Lead is a Top Latrobe truncation and fault trap, partly analogous to the Fortescue Field. It was defined on the existing 2D seismic database, the coverage of which is currently very poor, although areal closure could potentially be over 100km^2. Significant lateral seal risks exist over this lead.

Scorpion Lead

Scorpion is a faulted anticline/upthrown fault block closure, originally mapped by Shell Australia as a top Latrobe closure and then Eagle Bay Resources, and confirmed by BAS's own mapping. It has a significant depth conversion risk and is in a water depth of about 530m. BAS identify the existence of a significant areal closure of 7.6km^2 at Top Kate Shale level and 5.3km^2 at Top Golden Beach level, although a significant part of the

closure extends into Vic/P49 towards the south. The culmination at Top Kate Shale level is at 2210m and 2650m at Top Golden Beach level.

Barramundi Lead

Barramundi is a faulted anticline lead evident at Top Kate Shale and Top Golden Beach levels, mapped by Shell Australia in 1989 as a top Latrobe anticlinal closure. It is inadequately defined with the available 2D seismic. It has a significant depth conversion risk and is in a water depth of about 530m. Further 2D seismic definition is required on this lead.

Updip Hammerhead Lead

The Rosedale Fault splays into two parallel faults striking WNW-ESE. Hammerhead-1 tested a fault closure on the southern one. The northern fault block remains untested and is referred to as Updip Hammerhead Lead here. Although mapping of 2D data is inadequate to the west in Vic/P55, three-way dip is likely to combine with the fault identified to produce a potential downthrown fault closure. The plunging nose strikes from Sole-1, through Dart-1 and this lead. This lead is predominantly in Vic/P41 and an areal closure of 7.4km^2 with a culmination at 1400m is mapped at the Top Kate Shale level. A significant fault seal risk is likely as this sequence has relatively little intra-formational sealing potential as evident at Hammerhead-1, although a similar fault closure and sequence contains the Leatherjacket oil accumulation only 10km northwest of this location.

Summary

The Oscar 3D (GAP04D) was the first 3D survey undertaken in the area of Vic/P41. It was acquired over approximately 575 CMP km^2 between 17 February and 1 March 2005 using the m/v Western Trident. WesternGeco in Perth processed the survey between March and August 2005. The 3D data were loaded into an existing database of over 3340km of 2D seismic data and 17 wells.

The Oscar 3D seismic data is of a good quality and tied well in shallower water depths with the existing 2D data. Mapping was undertaken of the key events for determining prospectivity, being the Top Latrobe Group, the top of the Kate Shale and the near top of the Golden Beach Subgroup. Other events were mapped locally. The TWT interpretation of the 3D was merged in the regional 2D interpretation. Likewise this was done with the depth conversion. The Oscar 3D was depth converted using a layer cake approach using a fixed water velocity to the seabottom and then stacking velocity data to derive interval velocity grids to the three deeper events, calibrated to the two wells in the 3D area. The 2D data were depth converted using compaction trends and resulting functions of linearly increasing velocity with depth.

The 3D interpretation confirmed that neither of the two wells over the 3D area, Hammerhead-1 and Shark-1, were valid tests. Hammerhead-1 had a lack of intra-formational seals in the Latrobe Group penetrated, and did not reach the Golden Beach play which remains untested downdip of the well. Shark-1 failed due to a lack of structural closure at any reservoir level.

The structural interpretation has confirmed the existence of a number of prospects and leads. The most significant prospects identified are all confined to the Oscar 3D and are Kipling, Benchley West, Benchley East, Cotton, Oscar West and Oscar East. A number of other higher risk or less areally extensive prospects are also mapped at Cotton West, Cotton Southwest, Oscar Southwest I and II, Oscar North and Oscar Northwest. The Updip Hammerhead Lead is also identified on the northwest corner of the Oscar 3D. Leads mapped on the existing 2D seismic data are also described, with Scorpion being a significant closure.