BASS STRAIT OIL COMPANY Ltd
ACN 008 694 817

Melville-1

Well Completion Report

Volume 2: Interpretive Data

(Derived)

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1. INTRODUCTION

Melville-1 was situated in the central portion of the Victorian permit VIC/P42 which is situated in the Gippsland Basin of Bass Strait, approximately 80 kilometres south of Lakes Entrance (Figure 1). The well was spudded on 17th October 2001 and was drilled to test a culmination on the faulted anticline of the Melville Structure, within seismic events beneath the Latrobe Siliciclastics. These events were interpreted to be interbedded sandstones and shales of the Golden Beach Subgroup.

The primary objective of the well was to identify potential hydrocarbon volumes within the Golden Beach Subgroup. This involved assessing the validity of the mapped structural closure, assessing reservoir quality, and investigating potential compartmentalisation, aquifer support and oil quality variations.
The secondary objective of the well was to evaluate the hydrocarbon potential and obtain geological information from the Latrobe Siliciclastics. No definitive closures had been mapped at the well location (for this secondary objective), but subtle drape and downthrown fault closures were defined along strike and to the southwest over the Melville South area. Geological information on the distribution of reservoirs and seals assisted in delineation of other leads.

CDR-GR LWD logs were acquired in the 12 ¼” interval (1438-2706m), while both ARC-GR LWD logs and PEX-HALS-DSI wireline logs were acquired in the 8 ½” interval (2706-3445m).
Quick-look evaluations of the 12 ¼” and 8 ½” logs, as well as a more detailed evaluation of the 8 ½” wireline logs, were done to identify any potential hydrocarbon bearing intervals.

The well was plugged and abandoned on 18th November 2001.

2. GEOLOGICAL SETTING

2.1 Regional Stratigraphy

The evolution of the Gippsland Basin, displayed on Figure 2, is related to three major tectonic events (Smith *et al*., 2000):

- An initial Early Cretaceous extensional phase resulted in the formation of a main rift, bounded by the Lake Wellington, Foster and Cape Everard Fault systems. This initial rift was filled by the Strzelecki Group of sediments that consist of volcanoclastic-rich, non-marine greywackes, mudstones and minor coals.
- A second rifting-phase, associated with the development of the Tasman Sea rift, in the Cenomanian to Early Campanian, created the Rosedale and Darriman Fault systems. Sediments of the Emperor and Golden Beach Subgroups were deposited in this rift.
- A pronounced phase of tectonism and associated volcanism during the early Campanian period contributed to the major throws now seen on intra Golden Beach Subgroup faults and caused prominent basin subsidence. The Latrobe Siliciclastics (Late Campanian to Early Oligocene) were deposited in a non-marine, estuarine to back-barrier/lagoonal environment in the west, progressing through coastal plain/delta front to fully marine deposition in the east over the bulk of the gazettal areas. Numerous marine incursions inundated the basin from the southeast. Rifting had ceased by Late Maastrichtian time and the basin continued to deepen due to sediment loading and thermal subsidence. In the offshore areas, sedimentation became increasingly dominated by marine processes. The rate of sediment supply gradually decreased as the basin subsequently evolved from a fault-controlled depression into a marginal sag. Compressional tectonism overprinted the basin from the Early Eocene to Early Miocene.

2.2 Melville Structure

The Melville Structure lies on the southern margin of the Central Deep, in the Gippsland Basin, downthrown from the Darriman Fault. No closure is evident at the top of the Latrobe Group level, which exhibits a uniform northeasterly dip and no velocity pull-up associated with Miocene channeling.

An unconformity interpreted at the base of the Latrobe Siliciclastics, was the interpreted top of the target sequence and post dates trap formation. It was interpreted to overlie the Golden Beach Subgroup, or perhaps Latrobe Siliciclastics or older sediments. Well correlation was over long distance and prone to error.

The Melville Prospect was originally mapped (pre-drill) at the objective intra Golden Beach level as two higher areas within a larger faulted anticline closure with an apparent reversed (scissors) fault hading to the north which bisects this rollover into two subordinate rollovers (Melville north and south). The well was located on the northern closure (Melville north). This rollover feature is formed by a major northwards hading fault along the southern margin (see Figures 3 and 4). A major southwards hading antithetic fault occurs towards the north. It is unknown whether the structure was formed by a period of inversion or transpression along this basin margin, or as an accommodation structure within the rollover. However, within the interpreted Golden Beach Subgroup, the displacement on this fault often changes from a reverse to a normal style (scissors fault) and some growth within Golden Beach was interpreted.

Beneath the Melville Structure, a strong seismic event around 2300msec TWT (see seismic line on Figure 5) was interpreted to be a volcanic unit beneath the Golden Beach Subgroup, tentatively ascribed to the Emperor Subgroup. The sequence beneath this strong seismic event may then have been Emperor Subgroup and therefore potential reservoirs (by analogy with Kipper). However, the well location was not within mapped closure at this level.

2.3 Prognosed Reservoirs and Seals

The objective sequence identified on seismic within Melville-A was interpreted to be the Golden Beach Subgroup. Alternatively it was believed this Golden Beach sequence in Melville-A may actually be a lower section of the Latrobe Siliciclastics, similar to that encountered in Helios-1.

In the lower Latrobe Siliciclastics sequences, massive coarsening upwards units of estuarine, coastal barrier and shoreface origin of approximately 25 metres thick occur. They are commonly stacked with net/gross ratios over 80%, and porosities of between 18% to 27%. In the lower and upper coastal plain facies reservoir quality deteriorates with lower net/gross ratios (30% to 50%) and porosities in the 10% to 22% range. Intra Latrobe seals are provided by marine shales or coastal plain shales and siltstones. Lower coastal plain facies of low net/gross contain numerous shale units which although thin and discontinuous can be effective intra-formational seals (e.g. Tuna, Turrum, Wirrah, Barracouta, Snapper, Flounder, Basker and Manta). Although their discontinuous nature suggests that they do not have integrity as cross-fault seals.

In general, the Golden Beach Subgroup consists of two facies groups: sandstones and minor shales were deposited as part of an extensive fluvial system near the basin margins, representing proximal rejuvenated rift fill. Because the earliest sediment fill was derived from locally emerging highs, this clastic unit was expected to be laterally extensive. Subsequent sediment input was from the north and northwest of the basin and resulted initially in a major delta system across the Eastern Graben (Smith, 1999). The deltaic environment was progressively backstepping as thick marine shales were deposited in the graben. On the southern margin, sediment input was lower with fully marine sections developed in close proximity to basin margin faults (e.g. Anemone-1A, Pisces-1, Archer-1). Marine shales, identified in Anemone-1A and Archer-1 (Smith, 1999) represented the first basinwide marine incursions in the southeastern part of the basin. Seismic interpretation suggested a correlation of these shales with the thick marine section in the Eastern Graben. Their distribution was also interpreted to extend through the Melville area of Vic/P42. A distinct intra Campanian (80 Ma) unconformity, recognised across many parts of the basin, marked the termination of Golden Beach Subgroup sedimentation.

Data for reservoir quality in the Golden Beach Subgroup is sparse and quality highly variable. Shell (1989) compiled available core data from a number of wells and showed average core porosities varied from 8.9% in Wirrah-3 at 3074 to 3075 metres brt to 21% in Kipper-2 at 2087 to 2177 metres brt. Maximum porosities were up to 29% with 8.7D permeability. The Golden Beach Subgroup lithostratigraphy of the Melville area was expected to be very similar to that along the downthrown margin Darriman fault trend at Archer and Anemone. In Anemone-1A unusually high porosities up to 23% from 4498-4748mss, are observed in marine sandstones of the Golden Beach Subgroup (Smith, 1999). Average porosities of 15% or greater exist down to 4500 metres. Other examples of more marine sandstones in the Golden Beach Subgroup exist, with average porosities in Basker-1 of 22% (2163-2866mss), Volador 21% (3000-3525mss) and Manta-1 of 22% (2013-2567mss). Good reservoir porosities were expected around Melville, where the objective sequence was expected to be between 2300 ('intra Latrobe') and 3319 metres (top volcanic unit).

Extensive marine shale seals were predicted in the objective Golden Beach Subgroup, by analogy along trend from Archer-1. Sequence stratigraphic mapping (Smith *et al*, 2000) interpreted the marine facies of the Golden Beach Subgroup as trending into the central eastern area of Vic/P42. Archer-1 is significant in that a total of 17 stacked oil and gas pay zones were penetrated through the lower Latrobe and Golden Beach Subgroup in the well, separated by these marine shale units.

2.4 Prognosed Hydrocarbon Kitchen

Samples of source rocks from the Gippsland Basin are heavily biased towards the Latrobe Siliciclastics as penetrations of the Golden Beach Subgroup were restricted to the basin margin. Source rocks of dominantly landplant origin occur throughout the Latrobe Group sequence, with high TOC values (>2%) and moderate to high hydrogen indices (mode 250mgHC/g. org.C). The source potential of the Golden Beach Subgroup was poorly documented due to a lack of penetrations. Recent work by Smith (1999) suggests that the rocks of the Golden Beach Subgroup are the dominant source for the oil and gas accumulations, due more in part to issues of maturity than source rock quality. Oil mature kitchens within the Golden Beach were mapped to the northeast of Melville-1 coincident with the Kingfish Field kitchen area.

3. WELL EVALUATION

3.1 Prognosis versus Actual

Melville-1 was drilled within prognosis (see Figure 3) at top Latrobe and top Golden Beach Subgroup. However the top of the Emperor Subgroup was encountered 297 metres high to prognosis. The volcanics at the total depth of the well were interpreted (pre-drill) to be extrusive volcanics of the the top of the Emperor Subgroup. They were encountered within prognosis, but are now believed to be intrusives of (possibly) Campanian age within the Emperor Subgroup.

The top Emperor Subgroup encountered in the well can be correlated (post-drill) to an unconformity on seismic (see Figure 5). The interpreted “intra Golden Beach A and B” seismic events which were mapped as forming closure are now interpreted to represent intra Emperor Subgroup seismic events.

An unexpected sequence of 16.5 metres of extrusive basalt was encountered at the top of the Golden Beach Subgroup.

3.2 Lithostratigraphy

All depths are in metres below derrick floor.

<u>Seabed/Gippsland Limestone (100.0-1525.0m)</u>

The Gippsland Limestone consists primarily of calcareous claystone with minor sandstone interbeds. The claystone contains subblocky, rare to trace quartz grains, rare to trace glauconite, and trace pyrite, foraminifera and siderite. The sandstone contains loose, fine grained, subrounded to rounded, subspherical to spherical, well sorted quartz grains and trace foraminifera.

<u>Lakes Entrance Formation (1525.0-2214.0m)</u>

The Lakes Entrance Formation consists predominantly of calcareous claystone, with very minor siltstone and sandstone interbeds. The claystone is predominantly soft to firm, occasionally moderately hard, occasionally dispersive, subblocky to blocky, with trace amounts of pyrite, dolomite, crystalline calcite, glauconite, foraminifera, carbonaceous material and very fine to medium quartz grains. The siltstone is soft to moderately hard, subblocky to blocky with trace disseminated pyrite and trace foraminifera. The sandstone contains medium to coarse, moderately well sorted, predominantly subrounded to rounded, subspherical to spherical quartz grains, trace nodular pyrite and trace foraminifera.

<u>Gurnard Formation (2214.0-2232.0m)</u>

The Gurnard Formation consists of calcareous claystone with sandstone and minor siltstone interbeds. The Claystone contains glauconite aggregates, nodular pyrite, and medium to coarse grained, well rounded iron stained quartz. The sandstone contains coarse to very coarse grained, minor medium, subrounded to rounded, minor angular, moderate to high sphericity, poorly sorted quartz with an argillaceous matrix, while the siltstone contains very fine subangular, subspherical quartz grains and rare glauconite in a calcareous clay matrix.

<u>Latrobe Siliciclastics (2232.0-2847.0m MD)</u>

The Latrobe Siliciclastics consist predominantly of sandstones with interbedded claystones and siltstones. The sandstones contain coarse to very coarse grained, subangular to well-rounded, moderate to high sphericity, typically poorly sorted quartz, with rare to minor silica cement, pyrite cement and quartz overgrowths. The claystones typically contain dispersive, generally amorphous, calcareous, quartz silt, with trace carbonaceous material, pyrite, and trace to rare very fine to fine quartz grains. The siltstones contain subfissile, micaceous, common to abundant carbonaceous material and laminae, very fine quartz grains, some fine pyrite, trace calcite cement and typically grade to carbonaceous siltstone, except for at the base of the formation, where they grade to a silty claystone. Minor coals were identified within the interval, and the shales show a constant 50-50 mix of kaolinite and illite clays.

Golden Beach Subgroup (2847.0-3022.0m MD)

The Golden beach Subgroup is predominantly sandstone-rich, with relatively even amounts of siltstone and claystone. The sandstones generally contain very fine to granule sized grains, predominantly medium to coarse grained, common fractured very coarse and granule size, angular to subangular, rarely subrounded, moderate sphericity, poorly sorted quartz and rare feldspar, rare to minor silica cement, minor quartz overgrowths, rare pyrite cement, rare white argillaceous matrix, and trace carbonaceous fragments.
The siltstones are made up of firm to hard, subfissile, micaceous, common to abundant carbonaceous streaks and laminae, common very fine quartz grains and rare pyrite.
The claystones commonly contain very firm to moderately hard silt, minor very fine disseminated pyrite and nodular pyrite and rare carbonaceous streaks. At the top of the formation is a 16.5 metre volcanic unit, which is probably extrusive due to the lack of alteration evidence in the side wall cuttings.

Moderately firm and blocky trace coals were described from the cuttings.

Emperor Subgroup (3022.0-3345.0m MD)

The Emperor Subgroup consists predominantly of siltstone, interbedded with claystone and sandstone. The siltstones generally have a friable to very hard, quartzose, minor to abundant clay matrix, common to abundant carbonaceous streaks, minor to common disseminated very fine quartz sand, sometimes micaceous and trace pyrite. The silstones at the base of the formation begin to show more common occurrences of lithic grains. The claystones are made up of firm to moderately hard, blocky to subblocky quartz silt, minor to common carbonaceous material and trace disseminated pyrite. The sandstones generally contain very fine to medium grained, angular to subangular, subspherical, poorly sorted quartz, minor to common silica cement, nil to rare calcite cement, minor to common quartzose and carbonaceous silt matrix, minor argillaceous matrix in part, rare to common medium grained carbonaceous fragments, rare to minor lithic grains, trace coarse mica, and trace coarse pyrite.
The bottom 15 metres of the subgroup contains volcanics and altered claystones. The alteration apparent in the side wall samples and reported by Alan Partridge, suggests that these volcanics are intrusive.

Numerous coals were identified within the formation, described from the cuttings as hard, blocky and brittle.

3.3 Reservoirs and Seals

Effective reservoirs for hydrocarbons were encountered in the Latrobe Siliciclastics and Golden Beach subgroups (see Table 1). The Emperor Subgroup included sandstones that are relatively tight and offered only marginal reservoir potential.

A sandstone (2215 – 2223m) within the Gurnard Formation was interpreted to be tight and calcareous. These are interpreted as marine sandstones, with marine dynocysts occurring in the underlying shales.

Sandstones within the Latrobe Siliciclastics appear to be massive 10 to 20 metre beds with a coarsening upward GR log character, probably of fluvio-deltaic origin. These have good reservoir characteristics with porosities over 20% on occasion.

Marine incursions are inferred throughout the upper sequence with the appearance of marine plankton within 5 to 25 metre thick shale units, offering significant intraformational sealing potential for reservoirs within the upper Latrobe Siliciclastics.

A thick 32 metre marine shale from 2626 to 2658 metres is interpreted (Partridge, see Appendix A) to be the recently defined “Kate Shale” and would represent an excellent regional (and fault) seal for reservoirs beneath.

A large proportion of calcite (10 to 25% by matrix volume) occurs within sandstones of the Latrobe Siliciclastics, which decreases to less than 10% in the lower section of the formation. Very few coals are evident in the sequence. Clay content from log evaluation is related to shale, implying a paucity of lithic grains within the sandstones.

Beneath 2658 metres a more nonmarine sequence is inferred and marine microplankton interpreted to be absent (samples are interpreted as cave-in or contamination). Sandstones are massively bedded (5 -20m) while shale beds are predominantly less than 5 metres thick and interpreted to be of nonmarine origin and laterally discontinuous.

At the top of the Golden Beach Subgroup a 16.5 metre thick sequence of extrusive volcanic basalts and tuffs occur. These represent a potential sealing unit for underlying reservoirs.

The Golden Beach Subgroup sediments are nonmarine in origin with a serrated log profile with high net/gross sandstones. No extensive shale units occur offering no intraformational sealing potential. Reservoir quality is good with porosities of up to 22% at 3014 metres.

The amount of calcite within the Golden Beach Subgroup is less than that for the Latrobe Siliciclastics, suggesting a more nonmarine depositional setting.

Coals are more abundant. The high net/gross and lack of marine shales indicates no intraformational sealing potential within the Golden Beach Subgroup at Melville-1. However, reservoir quality is good. Sandstones are interpreted to be of a more fluvial origin.

The Emperor Subgroup is entirely nonmarine with evidence of lacustrine fossil assemblages. The sandstones present are absent of calcite and relatively dirty which results in their being tight or having very low porosities. The sequence has a very low net/gross (5.5%), which may also be a function of using a reservoir summation with cut-offs of Vclay <40% and Porosity >5%. The Emperor Subgroup has some minor potential as potential reservoirs for gas. Some sealing potential is evident due to the high proportion of shale, although the regional Kipper Shale is not evident in Melville 1.

Table 1.

Formation/ Subgroup	Depth - MD		Gross Interval	Net / Gross	Average $ø_e$	Average S_w
	From	To				
Gurnard Formation	2214.0	2232.0	18.0	--	--	100.0 %
Latrobe Siliciclastics	2232.0	2847.0	615.0	66.9 %	16.4 %	100.0 %
Golden Beach Subgroup	2847.0	3022.0	175.0	68.0 %	13.7 %	100.0 %
Emperor Subgroup	3022.0	3325.0	303.0	5.5 %	9.3 %	100.0 %

3.4 Source Rocks

Burial history and source rock maturation analyses were performed by BSOC. Different models were tested, where the main parameter varied was heat flow with geological time.

With a constant heat flow of 65 mW/m^2 (i.e. a failed rift model), based on the present day geothermal gradient of 34.8^{o}C/km, the modeling overestimated the Vitrinite Reflectance (VR) data from the Melville-1 well (Figure 6). However, using a constant heat flow of 60 mW/m^2, the modeled VR profile from Melville-1 only slightly underestimated the maturity for the Latrobe Siliciclastics, and the data were generally accurate for the Golden Beach Subgroup (Figure 7).

The onset of the oil window occurs at a depth of approximately 3000 metres in Melville-1 for Golden Beach Subgroup source rocks. This would have commenced oil generation at approximately 8Ma (See modeled decompacted burial and maturity history on Figure 8).

Numerous coal and carbonaceous siltstones and shales are described in cuttings and SWCs from the Latrobe Siliciclastics, Golden Beach and Emperor subgroups and all are potential source rocks.

3.5 Hydrocarbons

No significant hydrocarbon bearing intervals were identified from logs in any of the formations evaluated. No significant hydrocarbon shows were identified in cuttings and gas readings remained negligible. Side wall samples showed trace fluorescence shows, in several sandstones of the lower Latrobe Siliciclastics (no SWS were taken in the upper part), Golden Beach and Emperor subgroups. Some of these shows exhibited blooming cuts and residual rings. These minor shows are most probably indicators of residual hydrocarbons migrating through the well location.

4. IMPLICATIONS OF WELL RESULTS

Melville-1 failed to encounter hydrocarbons due to a lack of structural closure and lack of intraformational sealing development within the objective Golden Beach Subgroup.

The interpreted intra Golden Beach A and B seismic events, which were mapped (pre-drill) in structural closure, were correlated (post-drill) with events within the Emperor Subgroup. No significant potential reservoir/seal pairs were encountered within the penetrated Emperor Subgroup sequence.

The Golden Beach Subgroup was evidently thinner than prognosed and, whilst exhibiting good (non-marine) reservoir sandstones, lacked intraformational sealing potential and was not interpreted within closure.

The Latrobe Siliciclastics exhibits good reservoir and intraformational sealing potential at Melville-1, but was not drilled within a mapped structural closure.

The sparse hydrocarbon shows suggest that the well is located within the regional migration front from the oil kitchens beneath Kingfish.

5. REFERENCES

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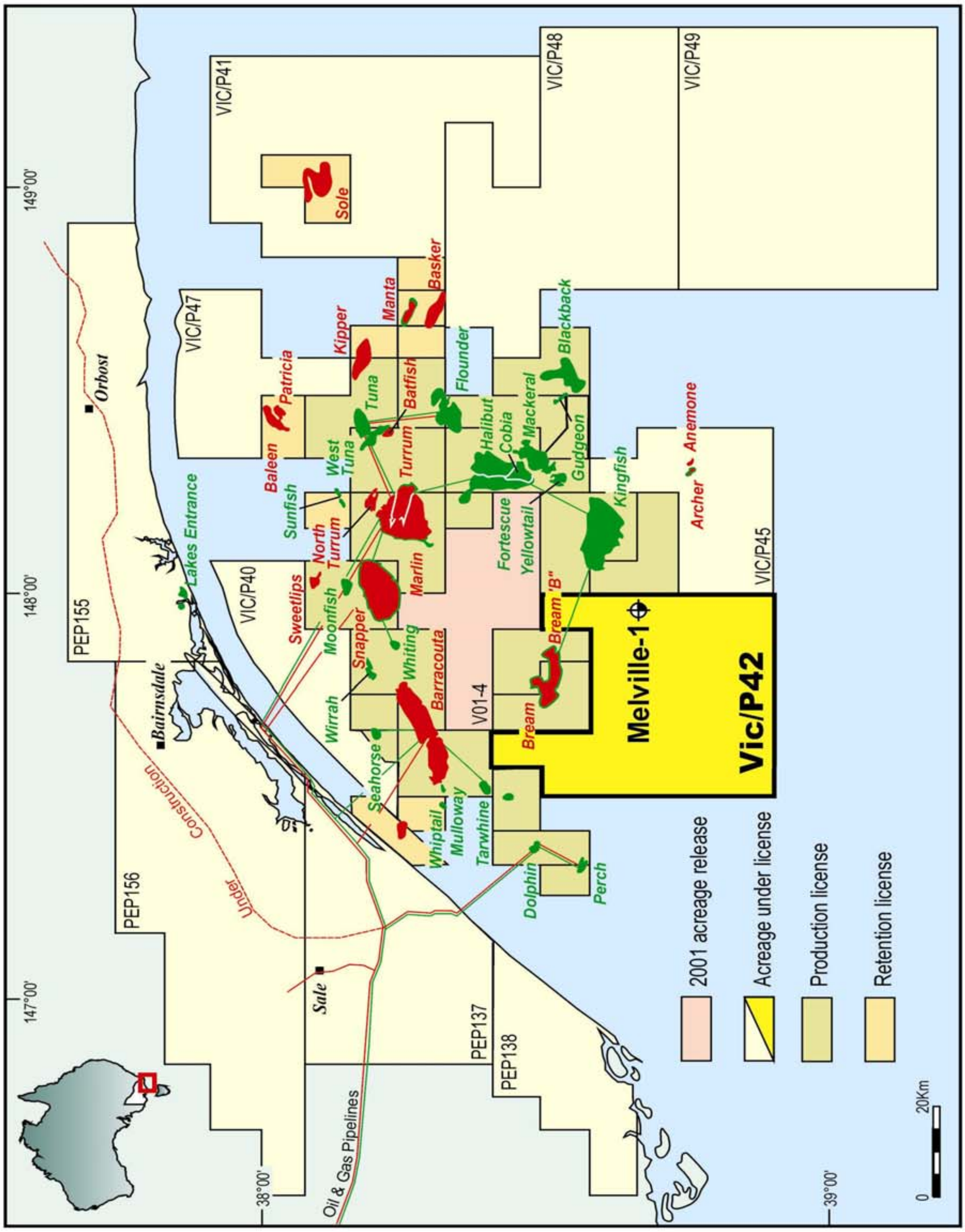
SMITH, M.A., BERNECKER, T., LIBERMAN, N., MOORE. D.H., WONG. D. 2000. Petroleum prospectivity of the deep-water gazettal areas V00-3 and V00-4, southeastern Gippsland Basin,Victoria, Australia. *Victorian Initiative for Minerals and Petroleum Report* 65. Department of Natural Resources and Environment.

FIGURES



BASS STRAIT Oil — Oil for Australians	Report : Melville-1 WCR	Melville-1 Well Completion Report
	Date: May 2002	VIC/P42 Location Map
	Drawing: MEL_WCR_Fig01	FIGURE 1

Figure 1

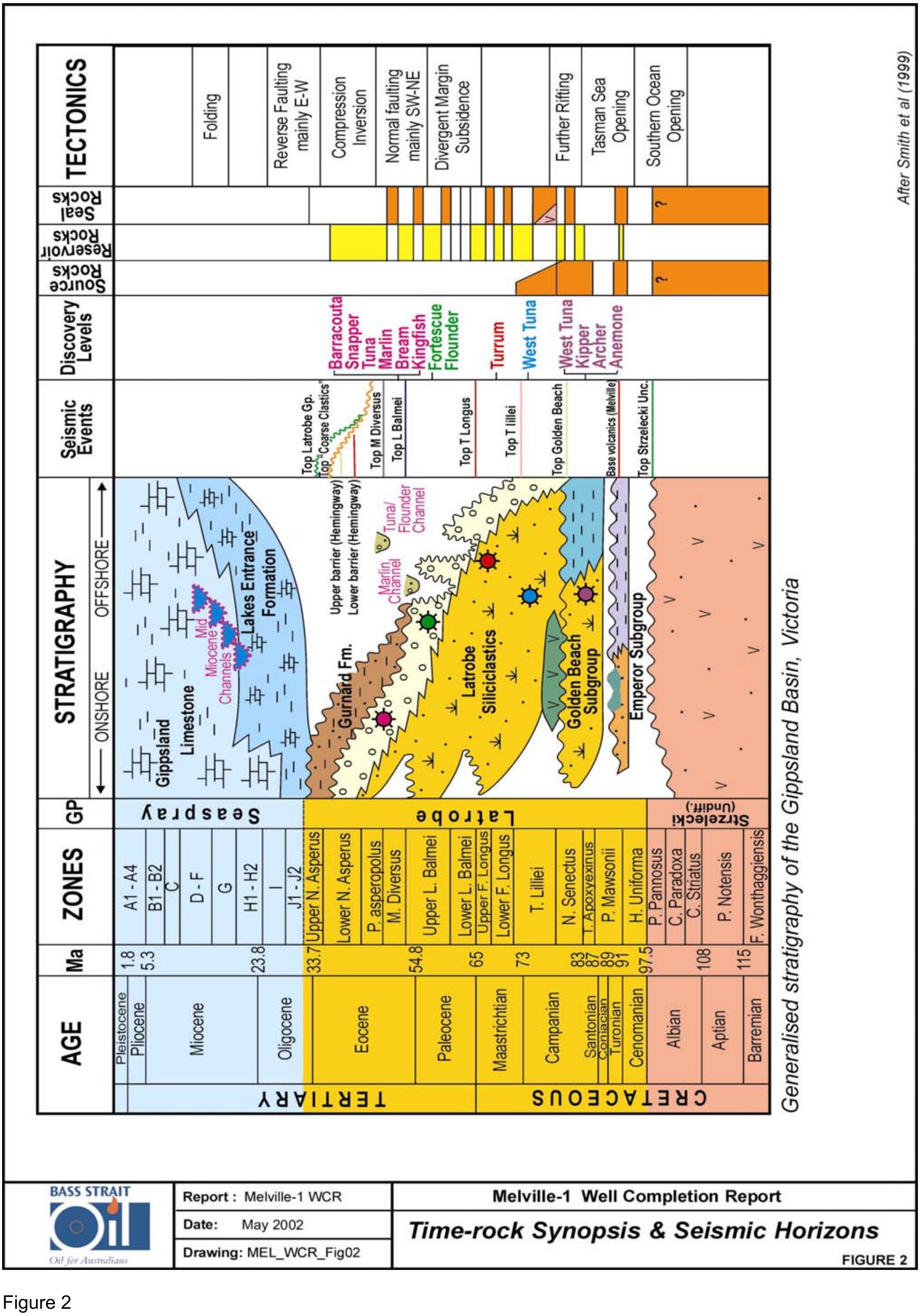
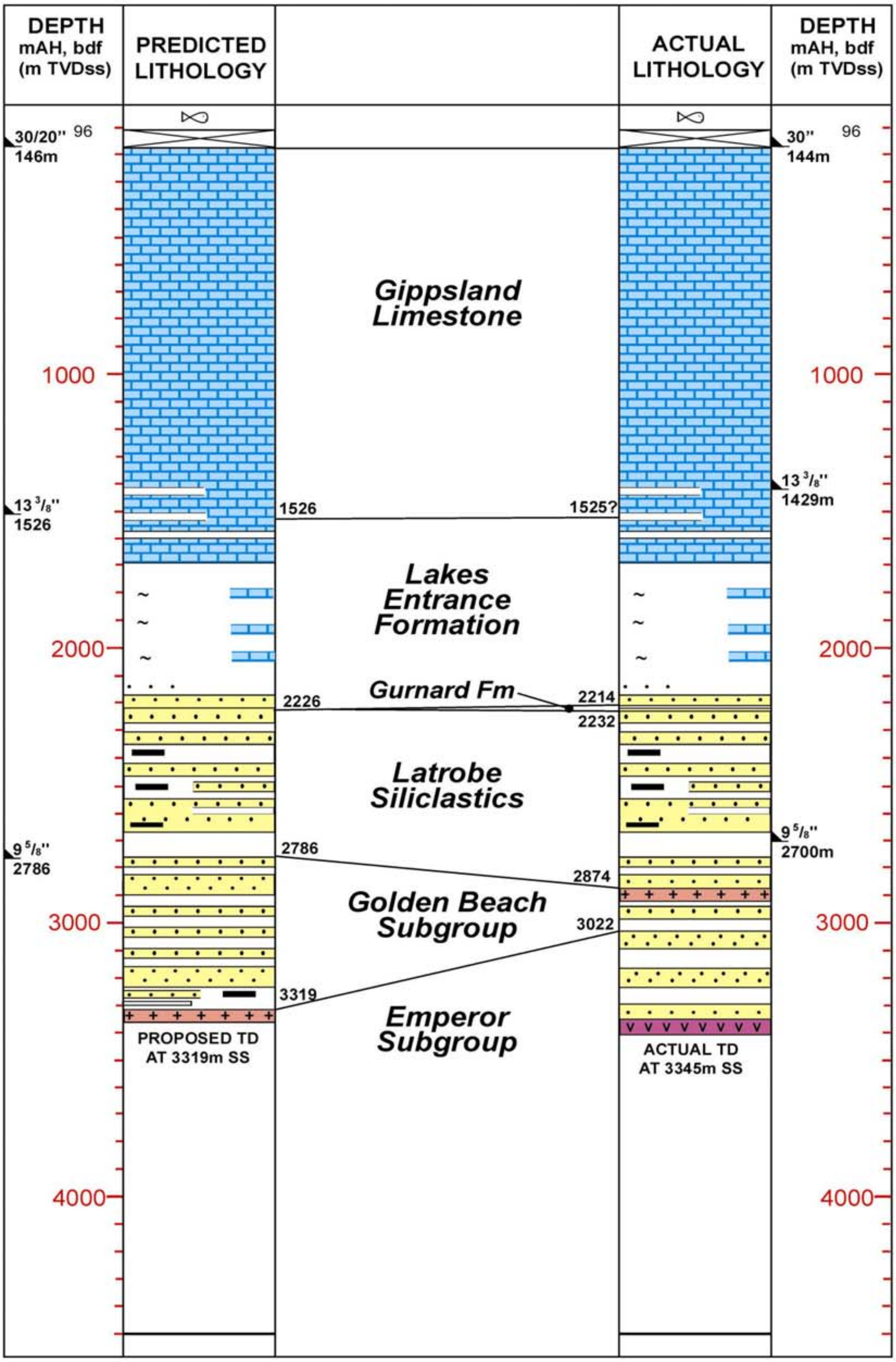
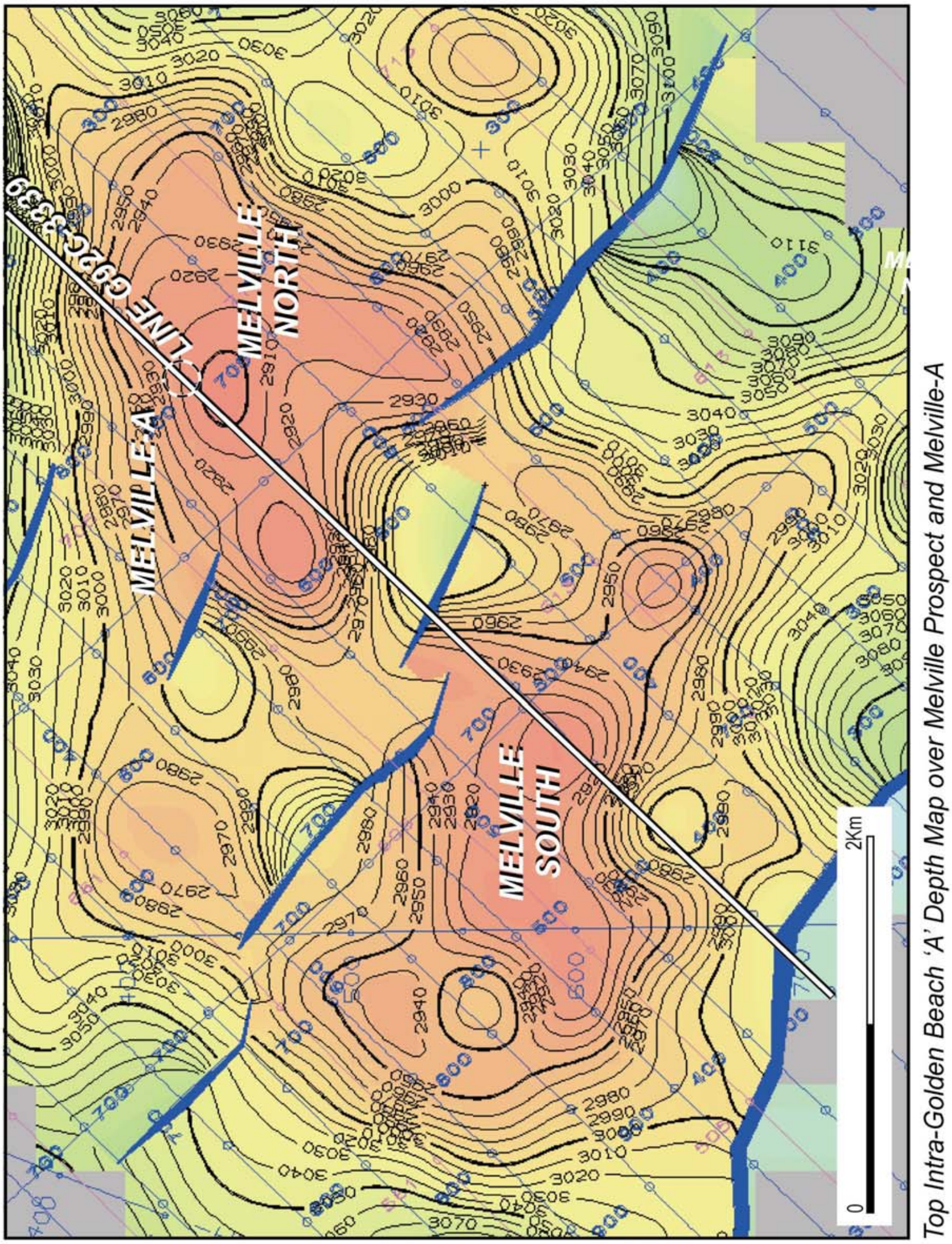

Generalised stratigraphy of the Gippsland Basin, Victoria
After Smith et al (1999)
AGE
Ma
ZONES
GP
STRATIGRAPHY
Seismic Events
Discovery Levels
Source Rocks
Reservoir Rocks
Seal Rocks
TECTONICS
BASS STRAIT Oil
Oil for Australians
Report : Melville-1 WCR
Date: May 2002
Drawing: MEL_WCR_Fig02
Melville-1 Well Completion Report
Time-rock Synopsis & Seismic Horizons
FIGURE 2

Figure 2



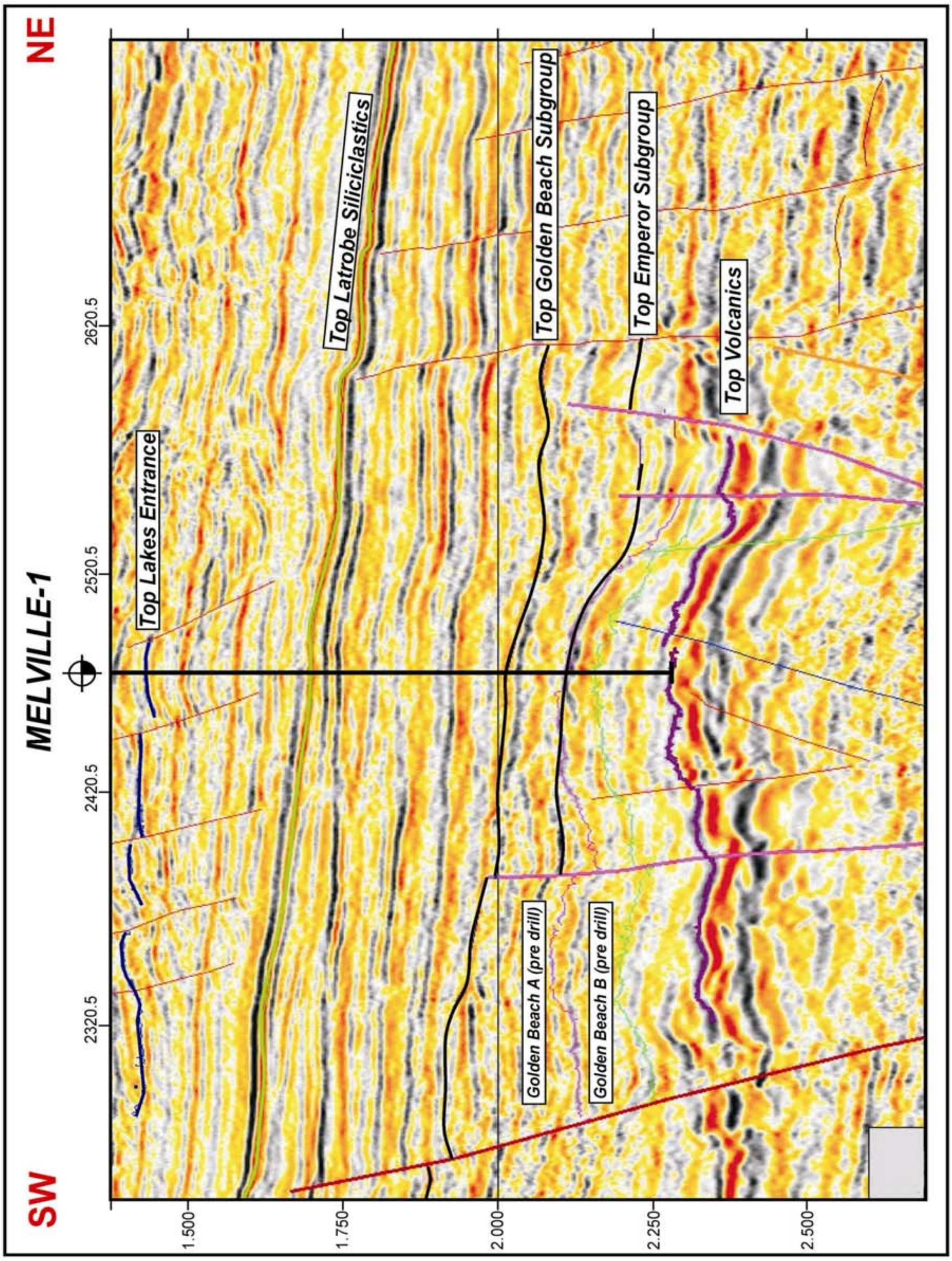
BASS STRAIT Oil — Oil for Australians	Report :Melville-1 WCR	Melville-1 Well Completion Report
	Date: May 2002	Melville-1 Predicted Vs Actual Stratigraphy
	Drawing:MEL_WCR_Fig03	FIGURE 3

Figure 3



BASS STRAIT OIL — Oil for Australians	Report : Melville-1 WCR	Melville-1 Well Completion Report
	Date: May 2002	***Depth map to intra-Golden Beach A event (pre-drill)***
	Drawing: MEL_WCR_Fig04	**FIGURE 4**

Figure 4



BASS STRAIT Oil — Oil for Australians	Report : Melville-1 WCR	Melville-1 Well Completion Report
	Date: May 2002	***Seismic line G92C-3339 through Melville-1***
	Drawing: MEL_WCR_Fig05	**FIGURE 5**

Figure 5

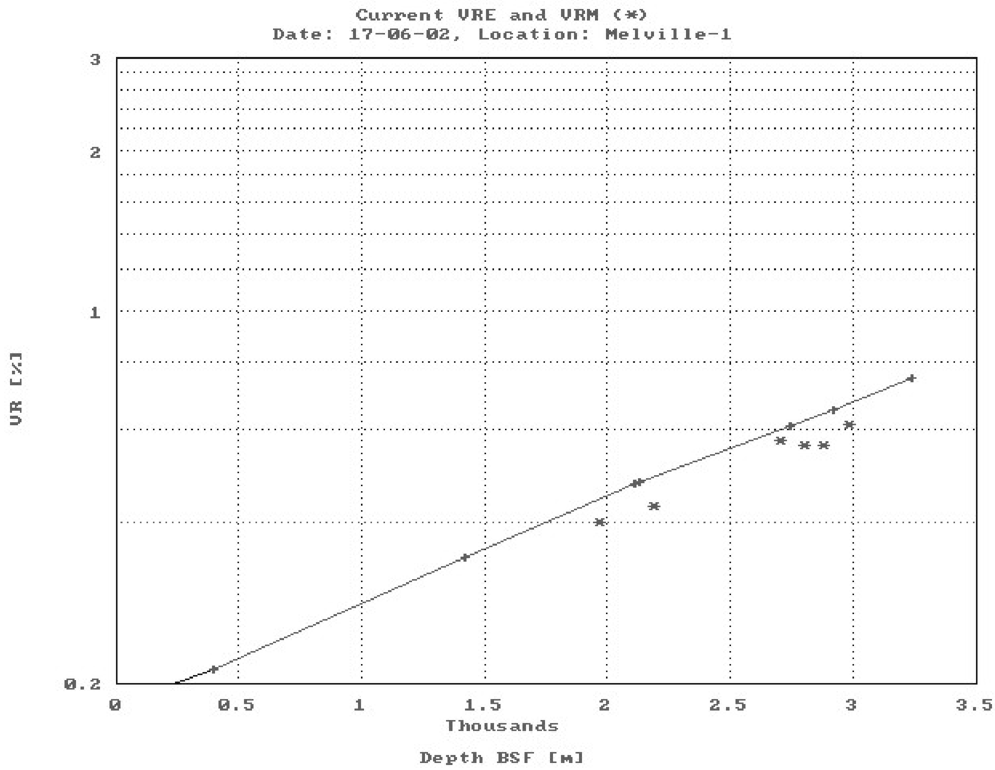


Figure 6 Modelled VR for the present day with a constant heat flow of 65 mW/m^2 (Note, asterix denotes the measured VR).

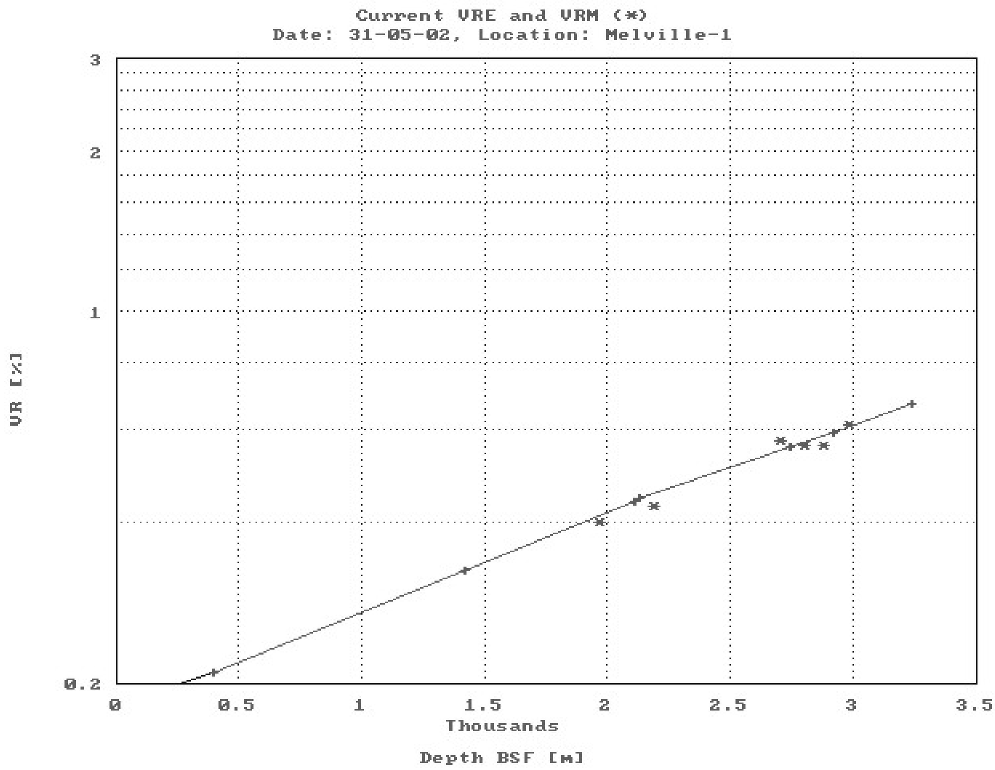


Figure 7 Modelled VR for the present day with a constant heat flow of 60 mW/m^2 (Note, asterix denotes the measured VR).

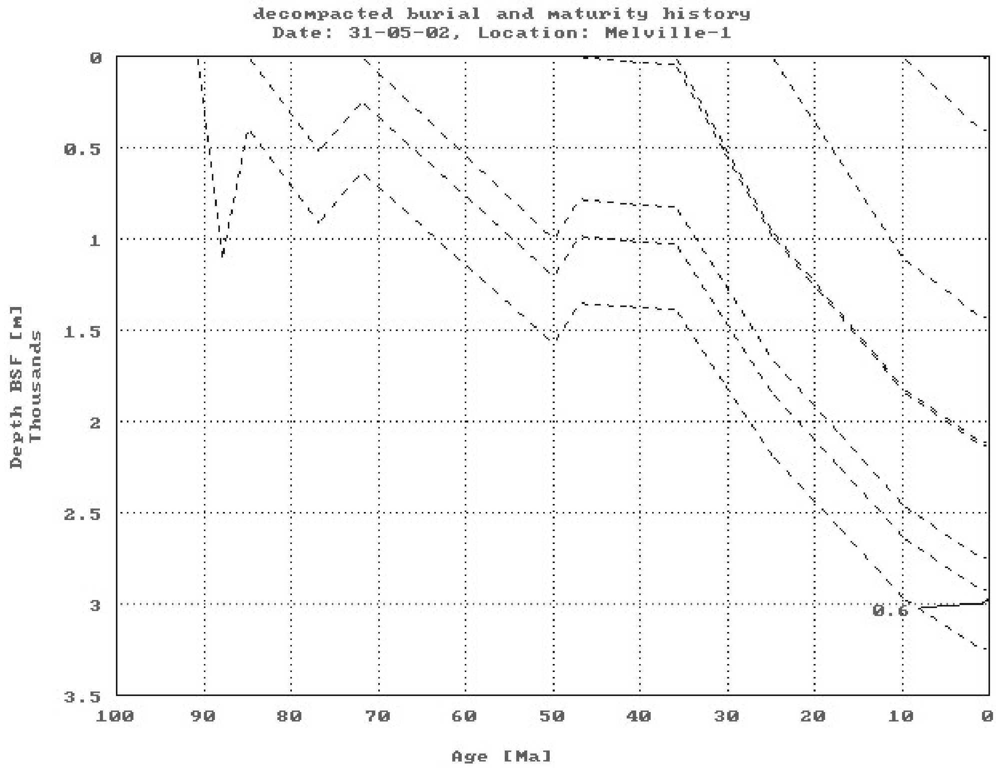


Figure 8 Burial history curve produced at a constant heat flow of 60 mW/m^2.

APPENDICES

Appendix A

Palynological analysis of Melville–1, offshore Gippsland Basin.

by

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Biostrata Report 2002/01

18th January 2002

INTERPRETATIVE DATA

Summary.

Twenty-three cuttings and five sidewall cores were analysed in Melville–1 over an 1100 metre interval extending from 2230m to within 20 metres of the T.D. Results of the analyses are summarised in the following table:

Table 1. Stratigraphic and Palynological Summary of Melville–1

AGE	**STRATIGRAPHY**	PALYNOLOGY	**DEPTHS (mKB)**
Recent to Oligocene	**SEASPRAY GROUP** Undifferentiated 100 to 2215m	NOT ANALYSED	
Early Oligocene	"Early Oligocene Wedge" 2215 to 2232m	*P. tuberculatus* SP Zone and *Operculodinium* MP Superzone	2230m
	LATROBE GROUP Cobia Subgroup		
Late? to Middle Eocene	Gurnard Formation 2232 to 2286m	*D. heterophlycta* MP Zone *E. partridgei* MP Zone	2260m 2270 to 2280m
	Halibut Subgroup		
Early Eocene to Paleocene	Kingfish Formation 2286 to 2626m	Lower *M. diversus* SP Zone and *A. homomorphum* MP Zone Upper *L. balmei* SP Zone *A. reburrus* MP Acme Zone Lower *L. balmei* SP Zone	2310m 2360 to 2380m 2485 to 2605m
Paleocene to Maastrichtian	Kate Shale 2626 to 2658m	Lower *L. balmei* SP Zone and *T. evittii* MP Acme Zone	2640m
Maastrichtian	Volador Formation 2658 to 2847m	Upper *F. longus* SP Zone Lower *F. longus* SP Zone	2690 to 2755m 2820 to 2841.5m
	Golden Beach Subgroup		
Campanian?	Campanian volcanics 2847 to 2863.5m	NOT ANALYSED	
Campanian	Chimaera Formation 2863.5 to 2972m	*N. senectus* SP Zone	2880-2960m
Santonian?	"Transition beds" 2972 to 3022m	*T. apoxyexinus* SP Zone to *P. mawsonii* SP Zone	2975.5m
	Emperor Subgroup		
Coniacian to Turonian	Curlip Formation 3022 to 3330m	*P. mawsonii* SP Zone	3030 to 3185m
Campanian?	Intrusive volcanics 3330 to 3345mTD	NOT ANALYSED	

SP = Spore-Pollen; MP = Microplankton

Introduction.

The palynological analysis performed on Melville–1 is based on thirteen cuttings samples initially prepared as urgent or rush palynological preparations while the well was drilling, and an additional ten cuttings and five sidewall cores given normal palynological processing after the well had reached Total Depth. Initial results on the urgent samples were provided in Provisional Reports #1 and #2 issued on 2nd and 13th November 2001, while the additional samples, and further observations on the rush samples were provided in Provisional Reports #3 to #5 issued between 24th November and 21st December 2001.

The palynological samples are restricted to the Latrobe Group, except for the shallowest cuttings sample at 2230m which was found to contain an assemblage from the basal Seaspray Group. The analysis is also limited to cuttings down to the casing shoe at 2700m as no sidewall cores were shot in the 12–1/4 inch open-hole prior to setting the 9–5/8 inch casing. Average spacing between the cuttings in the upper part of the Latrobe Group is 39 metres. Below the casing point the thirteen productive samples (10 cuttings and 5 sidewall cores) analysed provide an effective average sample spacing of >50 metres.

Although the overall results of the palynological analysis is considered good, with only two samples ultimately proving to be age indeterminate, significant problems were encountered in the laboratory processing of the cuttings samples caused by the use of a KCl/PHPA/Glycol mud system. The PHPA mud additive reacted adversely with the organic matter during the palynological processing resulting in extremely low recovery of organic matter and palynomorphs in the initial processing. Eight of the cuttings therefore needed to be reprocessed to achieve workable and reliable assemblages. Samples initially given urgent or rush processing and those that were reprocessed are indicated on Tables 2 and 3.

Because of the processing difficulties the cuttings generally only gave low to moderate organic residue yields, containing low concentrations of palynomorphs, whereas most sidewall cores gave high yields and moderate to high concentrations of palynomorphs. Overall the palynomorph preservation was poor to fair and only occasionally good. Notwithstanding the low yields and poor preservation moderate to high diversity spore-pollen assemblages were recorded from most samples and moderate diversity microplankton assemblages from eight cuttings samples in the upper part of the Latrobe Group (Table 3).

Geological Discussion.

The samples analysed in Melville–1 are classified according to the spore-pollen zonation scheme original proposed by Stover & Evans (1974) and Stover & Partridge (1973) and subsequently refined and modified by Partridge (1999). Eight of samples also contain marine microplankton assemblages which are diagnostic of the parallel microplankton scheme originally proposed by Partridge (1975, 1976), and substantially refined and modified by Partridge (1999).

Based on discussions with Ian Reid (Chief Operations Geologist) the palynological results were integrated with lithological descriptions and the available electric logs to identify the subgroup and formation nomenclature for the Latrobe Group shown on Table 1. The stratigraphic nomenclature used is that proposed by Partridge (1999), and partly published in Bernecker & Partridge (2001). The portion of the section penetrated in Melville–1 that is reviewed in the following discussion consists of the basal 17 metres of the Seaspray Group and a 1113 metres section of the Latrobe Group.

Seaspray Group: The distinctive electric log character from 2215 to 2232m at the base of Seaspray Group in Melville–1, which in the sample at 2230m is dominate by marine dinocysts of the *Operculodinium* Superzone, is interpreted to correspond to the enigmatic "Early Oligocene Wedge". This informal unit is represented by a gamma ray low opposite a high resistivity log from 2215 to 2222m, overlying a gamma ray peak from 2222 to 2232m, and has been used in unpublished reports on the Gippsland Basin since the late 1970s. The following brief description of the unit has recently been provided by Partridge (2001: Appendix ***in*** Bernecker & Partridge):

> *The Early Oligocene Wedge (EOW) is an informal term used for the interval below the seismic pick for the top-of-Latrobe down to the best lithological pick for the boundary between calcareous sediments of the Seaspray Group and the non-calcareous Gurnard Formation, or, if the latter is not present, the quartz sandstones of the older Kingfish Formation. The unit exists because the top-of-Latrobe seismic mapping surface actually corresponds to a position within the basal part of the Seaspray Group. This subtle discrepancy does not matter when mapping across the top of major structures where the EOW is typically missing, but becomes increasingly important on the flanks of structures where it is common to find extra interposed section. Unfortunately, the lack of consistent lithological and electric log character precludes the description of the EOW as a formal member or formation of the Seaspray Group.*

The section 2215 to 2232m in Melville–1 can also be correlated with the EOW in the Edina–1 well where it is located between 2242 and 2278m. The latter interval displays a similar electric log character, and is characterised by grey coloured, highly calcareous claystones and sandstones, which overlie distinctive brick red claystones and sandstones between 2278 and 2294m (see Edina–1 — Composite Well Log).

Latrobe Group: The top of the Latrobe Group in Melville–1 is interpreted to lie below the sample at 2230m containing a rich microplankton assemblage (MP 63%[1]) belonging to the *Operculodinium* Superzone, and above the reddish-brown to reddish-orange claystone and yellowish-orange quartz sandstones recorded in the cuttings. These coloured sediments are interpreted to indicate subaerial exposure with weathering and possible erosion at the top of the underlying Latrobe Group. Unfortunately, the precise horizon at which the red and yellow coloured sediments occur in the well is not clear from the cuttings descriptions because these are only available over a composite interval from 2220 to 2240m. Therefore the boundary between the groups is placed at 2232m on the gamma ray log.

The Latrobe Group in Melville–1 is subdivided into four subgroups and six named formation and two or three informal units or members (Table 1). The boundaries between the subgroups are significant regional unconformities that are identified in Melville–1 by missing palynological zones.

Cobia Subgroup: The uppermost subgroup in Melville–1 is only represented by a moderate thickness of Gurnard Formation (54 metres) which spans the entire Middle to Late Eocene and may extend into the basal Oligocene. The formation can be subdivided into an informal lower unit from 2257 to 2286m, which has the characteristic high gamma ray signature of the Gurnard Formation, and an informal upper member from 2232 to 2257m with a markedly lower gamma ray signature. The lower unit contains the *D. heterophlycta* and *E. partridgei* microplankton Zones and is Middle Eocene in age. The upper unit has not been sampled and the predominance of red and yellow colouration in the cuttings description suggests it is probably oxidised and potentially unsuitable for palynology. The low gamma ray signature and red and yellow colouration of the sediments is atypical of most "top of Latrobe" sections in the Gippsland Basin but equivalence is suggested with

[1] MP% is percentage of microplankton in combined spore-pollen and microplankton count.

the distinctive brick red claystones and sandstones between 2278 and 2294m in Edina–1. By superposition the upper unit has an age range of Late Eocene to basal Oligocene.

Halibut Subgroup: Three formations can be identified in this subgroup. The uppermost unit is the 340 metre thick Kingfish Formation comprised of interbedded sandstones, shales and thin coals of mixed paralic and non-marine environments. This overlies a 32 metre thick marine Kate Shale between 2626 and 2658m, and a 162 metre thick non-marine Volador Formation. The latter can be distinguished from the Kingfish Formation in Melville–1 by a lack of coals.

These three formations seemingly represent continuous deposition from within the Maastrichtian (Lower *F. longus* Zone), to within the Early Eocene (Lower *M. diversus* Zone). Part or all of the Middle/Upper *M. diversus* and *P. asperopolus* Zones missing at the top of the subgroup are a manifestation of the Marlin Unconformity. Similarly, the absence of the *T. lilliei* Zone and probably upper part of the *N. senectus* Zone between the Halibut and underlying Golden Beach Subgroup are a manifestation of the Seahorse Unconformity (Bernecker & Partridge, 2001).

Golden Beach Subgroup: Melville–1 penetrates only 175 metres of the Golden Beach Group which is all assigned to the Chimaera Formation. The 16.5 metres thick volcanic unit at the top of the interval is treated as a unnamed member of the Chimaera Formation (Bernecker & Partridge, 2001). The bottom 50 metres is referred to informal "Transition beds", and is only included in the formation based on electric log character. The palynological data from the sidewall core at 2975.5m is equivocal and would equally favour assignment of this basal interval to the underlying Curlip Formation.

Aside from the disputed age of the "Transition beds" the Chimaera Formation in Melville–1 seems to represent only the lower part of the *N. senectus* Zone. This would give the Seahorse Unconformity at the top of the subgroup a duration of up to 7 million years and the Longtom Unconformity a the top of the underlying Emperor Subgroup a duration of up to 5 million years.

Emperor Subgroup: Melville–1 penetrates at least 323 metre of section that can be assigned to the Emperor Subgroup. The presence of thin coals, recorded in the cuttings descriptions but poorly resolved on the sonic log, and the absence of the unusual lacustrine algal cysts diagnostic of the *Rimosicysta* Superzone from the palynological preparations suggest that the interval is younger than the Kipper Shale and should be assigned to the Curlip Formation (Bernecker & Partridge, 2001). Unfortunately, key spore-pollen index species are very rare in the palynological assemblages and therefore it was not possible to apply the new subzone terminology for the *P. mawsonii* Zone established in the Otway Basin (Partridge, 2001).

Intrusive volcanics: The deepest sidewall core examined at 3328m did not yield a datable assemblage because the organic matter was carbonized. The sample has a TAI (Thermal Alteration Index) of >3 on the colour scale for spore-pollen developed by Staplin (1969, 1977), and is therefore interpreted to be thermally mature or metamorphosed. As the sidewall core is only two metres above the basaltic volcanics at the bottom of Melville–1 these deeper volcanics are interpreted to be intrusive rather than extrusive, and therefore they may be the same age as the Campanian volcanics penetrated higher in the well. Similar relationships between extrusive and intrusive basaltic igneous rocks in the Upper Cretaceous have recently been described from the northern margin of the Gippsland Basin by O'Halloran & Johnstone (2001).

Biostratigraphy.

Details of zone assignments, confidence ratings and key species occurrences are given in Table 2, with basic palynomorph data provided in Table 3, and the distribution and abundance of the spore-pollen and other palynomorphs arranged alphabetically in Tables 4 to 6. Author citations for spore-pollen species can mostly be sourced from Dettmann (1963), Helby *et al.*, (1987) and Stover & Partridge (1973), and for microplankton species from Fensome *et al.* (1990) and Williams *et al.*, (1998). Species names followed by "ms" are unpublished manuscript names.

***Proteacidites tuberculatus* spore-pollen Zone and**
***Operculodinium* microplankton Superzone**
Sample at: 2230 metres
Age: Early Oligocene.

The shallowest cuttings sample analysed is dominated by marine microplankton (63% of combined SP & MP count) characteristic of the Seaspray Group. The assemblage conforms to the broad *Operculodinium* Superzone with a dominance amongst the dinocysts of *Spiniferites* species (41%) and *Operculodinium centrocarpum* (11%), and the presence of the key index species *Protoellipsodinium simplex* ms and *Pyxidinopsis pontus* ms. The associated spore-pollen are no older than the *P. tuberculatus* Zone based on the presence of the spores *Cyatheacidites annulatus* and *Foveotriletes crater* in accordance with the original definition of Stover & Partridge (1973). No Eocene palynomorphs were recorded in the assemblage. The dominance of chorate dinocysts is interpreted as diagnostic of an open-marine environment of deposition.

***Deflandrea heterophlycta* and**
***Enneadocysta partridgei* microplankton Zones**
Interval: 2260 to 2280 metres
Age: Middle Eocene.

The three samples over this twenty metre interval all gave low residues yields which contained low concentrations of palynomorphs. The assemblages consist predominantly of marine microplankton with the dominance of *Spiniferites* spp. suggesting that a considerable proportion of the recorded specimens are caved from the overlying Seaspray Group. Notwithstanding this problem, key Middle Eocene index species diagnostic of the lower part of the Gurnard Formation were recorded in all three samples. The presence of *Deflandrea heterophlycta* and *Paucilobimorpha inaequalis* (= *Tritonites inaequalis* Marshall & Partridge 1988) at 2260m is diagnostic of the *D. heterophlycta* Zone, while the presence of *Enneadocysta partridgei* Stover & Williams 1995 in the two deeper samples and *Paucilobimorpha tripus* (= senior synonym of *Tritonites tricornus* Marshall & Partridge 1988) in the middle sample at 2270m is diagnostic of the *E. partridgei* Zone. The latter zone has previously been reported as the informal *Areosphaeridium australicum* Zone, and that zone name can be found in many Gippsland Basin reports and on stratigraphic charts and timescales (eg. Young & Laurie, 1996; chart 12).

The spore-pollen were a secondary component in the three assemblages and were not diagnostic of any zone, but are nevertheless consistent with the equivalent Lower *N. asperus* Zone.

The dominance of chorate dinocysts and occurrence of small acritarchs associated with poor spore-pollen assemblages in combination favour a open-marine depositional environment for the Gurnard Formation.

Lower *Malvacipollis diversus* spore-pollen Zone and
***Apectodinium homomorphum* microplankton Zone**
Sample at: 2310 metres
Age: Early Oligocene.

The cuttings sample at 2310m had to be reprocessed before it could be confidently assigned to a zone. The spore-pollen assemblage is dominated by angiosperm pollen of *Proteacidites* pollen (20%) and *Haloragacidites harrisii* (15%), and can be assigned to the Lower *M. diversus* Zone by the frequent presence of *Proteacidites grandis* (4%) and absence of younger or older index species.

The associated microplankton assemblage is assigned to the new *A. homomorphum* Zone, defined as the interval between the LAD (Last Appearance Datum) of *Apectodinium hyperacanthum* and the FAD (First Appearance Datum) of *Homotryblium tasmaniense* (Partridge, 1999). In Melville–1 this zone is characterised by the abundant occurrence of the eponymous species *Apectodinium homomorphum* (28% of MP count) in association with *Deflandrea dartmooria* (8%) and *Muratodinium fimbriatum* (Table 4).

A shallow paralic environment of deposition is favoured for this sample based on the dominance of the genera *Apectodinium* and *Spinidinium/Vozzhennikovia* (which are proximochorate dinocysts), and the reported occurrence of coal in the cuttings descriptions.

Upper *Lygistepollenites balmei* spore-pollen Zone and
***Apectodinium reburrus* microplankton Acme Zone**
Interval: 2360 to 2380 metres
Age: Late Paleocene.

The two assemblages are dominated by gymnosperm pollen (average 58%), and contain common *Lygistepollenites balmei* (average 7%). The LAD of the eponymous species at 2360m and the FAD of *Proteacidites annularis* at 2380m assign these two cuttings samples to the Upper *L. balmei* Zone. The abundant occurrence of the manuscript species *Apectodinium reburrus* at 2380m, where it comprises 23% of the combined SP + MP count also assign the interval to the *A. reburrus* Acme Zone of Partridge (1999). The latter name replaces the former Paleocene *A. homomorphum* Acme Zone of Partridge (1975, 1976), which was based on an incorrect identification of *Apectodinium homomorphum*. The new zone is defined as the interval from the oldest consistent and abundant occurrence of *A. reburrus* to the FAD of *Apectodinium hyperacanthum.*

A shallow paralic environment of deposition is also favoured for this interval based on the dominance of proximochorate dinocysts and consistent presence of coal (est. 5%) in the cuttings descriptions.

Lower *Lygistepollenites balmei* spore-pollen Zone
Interval: 2485 to 2640 metres
Age: Early Paleocene.

Five cuttings samples are assigned to the Lower *L. balmei* Zone. The three deeper cuttings are given higher confidence ratings based on the LAD of the index species *Proteacidites angulatus* at 2585m, while the two shallowest samples are assigned to the subzone based on the absence of younger index species. All samples are dominated by gymnosperm pollen (average 64%) with *Podocarpidites* spp. dominant (average 28%) and *Lygistepollenites balmei* usually common (average 7%). Other common gymnosperm pollen are *Phyllocladidites mawsonii* (average 17%) and *Lygistepollenites florinii* (average 4%).

The shallowest cuttings at 2485m and 2535m lack microplankton and are therefore interpreted as non-marine. The sample at 2585m contains an essentially monospecific assemblage of the colonial algae *Amosopollis cruciformis* Cookson & Balme 1962 and is interpreted to represent a fresh to brackish lacustrine or lagoonal environment. The two deepest samples contain marine microplankton assemblages. The shallower at 2605m is dominated by proximochorate dinocysts of *Spinidinium* and/or *Vozzhennikovia* and contained a single specimen of *Alisocysta margarita*. The latter species ranges through the *Palaeoperidinium pyrophorum*, *Alisocysta circumtabulata* and *Eisenackia crassitabulata* microplankton Zones of Partridge (1999). The deeper sample at 2640m is assigned to the *T. evittii* Acme Zone originally described in Helby *et al.* (1987).

Trithyrodinium evittii **microplankton Acme Zone**
Sample at: 2640 metres
Age: Early Paleocene.

The cuttings sample at 2640m needed to be reprocessed before sufficient specimens were obtained to enable confident zone identification. Microplankton comprise about one-third of the assemblage and the common occurrence of *Trithyrodinium evittii* (8% of MP count) in an assemblage dominated by *Paralecaniella indentata* (26%), and associated with common *Hystrichosphaeridium tubiferum* (18%) and *Deflandrea speciosus* (11%), is consistent with other occurrences of this zone in the Gippsland Basin. The presence of this zone in Melville–1 is the principal reason the interval 2626 to 2658m on the gamma ray log is assigned to the Kate Shale.

Forcipites longus **spore-pollen Zone**
Interval: 2690 to 2841.5 metres
Age: Maastrichtian.

The LADs of *Forcipites longus*, *Nothofagidites senectus*, *Proteacidites clinei* ms, *P. reticuloconcavus* ms and *Tricolpites confessus* in the cuttings sample at 2690m identify the top of the *F. longus* Zone and top of the Cretaceous in Melville–1, and the FAD of the eponymous species in the sidewall core at 2841.5m indicates the section immediately above the volcanics is no older than this zone. The interval is further divided into Upper and Lower *F. longus* Subzones based on the FAD of *Tripunctisporis maastrichtiensis* at 2780m and the LAD of *Battenipollis croccodilus* ms at 2820m. The intervening cuttings sample at 2755m is assigned to the Upper subzone based on the greater abundance of *Gambierina rudata* (6%) relative to *Nothofagidites* pollen (2%). The assemblages are generally dominated by *Podocarpidites* spp. (average 21%), *Proteacidites* spp. (average 7.5%), and variable abundances of *Phyllocladidites mawsonii* (range 2 to 13%). *Gambierina rudata* is common (average 8.5%) in the Upper subzone while *Nothofagidites* spp. is common (average 7%) in the Lower subzone. Finally, in the bottom sidewall core at 2841.5m the distinctive *Battenipollis sectilis* and closely similar *B. croccodilus* ms when combined represent 11% of the spore-pollen count.

Marine microplankton are only recorded in the cuttings, and as only species that are also found higher in the well were recorded their presence is interpreted to represent either cavings or sample contamination. The moderate abundances of microplankton reported in the counts is considered largely an artifact of the low recovery of palynomorphs and low assemblage counts. Only the algal cysts *Circulisporites parvus* and *Amosopollis cruciformis* can confidently be interpreted as *in situ*. Based on these observations the entire Maastrichtian interval between the base of the Kate Shale at 2658m, to the top of the Campanian volcanics at 2847m is interpreted as non-marine.

***Nothofagidites senectus* spore-pollen Zone**
Interval: 2880 to 2960 metres
Age: Early Campanian.

The three cuttings samples assigned to the *N. senectus* Zone gave low residue yields which contained low concentrations of palynomorphs. In addition, the cuttings sample at 2865m (from immediately below the Campanian volcanics) was processed twice but failed to yield sufficient palynomorphs for zone identification. The productive samples are assigned to the zone on the LAD of *Forcipites sabulosus*, presence of *Nothofagidites senectus* and absence of *Tricolporites lilliei*. The low abundance of *Nothofagidites* (<3%) suggests that only the lower part of the zone is represented. The assemblages are dominated by *Podocarpidites* spp. (average 24%) and *Phyllocladidites mawsonii* (average 17%). Angiosperm pollen are only common in the shallowest cuttings at 2880m where *Proteacidites* pollen represents 18% of the count. In contrast, spores of *Gleicheniidites circinidites* are common (average 18%) in the two deeper cuttings. No *in situ* microplankton were recorded and therefore the interval is interpreted as non-marine.

No evidence is seen in the samples for the presence of the *Tricolporites lilliei* Zone, which is interpreted to be missing at the Seahorse Unconformity separating the Halibut and Golden Beach Subgroups in Melville–1.

***Phyllocladidites mawsonii* spore-pollen Zone**
Interval: 3030 to 3185 metres
Age: Turonian to Coniacian

Four cuttings and the sidewall core at 3039m are assigned to the *P. mawsonii* Zone based on the gross composition of the assemblages and rare presence of key index species. The assemblages are dominated by the gymnosperm pollen *Podocarpidites* (average 37%) and *Trichotomosulcites subgranulatus* (average 11%), and spores of *Cyathidites* (average 8%) and/or *Gleicheniidites circinidites* (average 10%), while angiosperm pollen are generally rare (average <2%). The eponymous species *Phyllocladidites mawsonii* is recorded from all samples and *Verrucosisporites admirabilis* ms in most samples, while other index species are only recorded in individual samples (*Appendicisporites distocarinatus* at 3185m, *Laevigatosporites musa* ms, at 3155m and *Cyatheacidites tectifera* at 3039m).

Microplankton in the samples are restricted to rare specimens of the algal cyst *Circulisporites parvus* de Jersey 1962, and the colonial algae *Amosopollis cruciformis* Cookson & Balme 1962, both of which are known to occur in non-marine lacustrine environments. Missing however, from the assemblages, are any of the suite of unusual algal cysts described from the Kipper Shale by Marshall (1989), that have subsequently been referred to the *Rimosicysta* Superzone by Partridge (1999). Further, none of the samples show significant abundances of *Dilwynites* pollen which have been interpreted as the manifestation of Neves effects in the Kipper Shale (Partridge, 1999). The absence of both these features suggests the Emperor Subgroup section in Melville–1 is either a non-marine lateral facies of the Kipper Shale, or is younger than the Kipper Shale and therefore belongs to the Curlip Formation (Partridge ***in*** Bernecker & Partridge, 2001).

The sidewall core at 2975m contains an assemblage of very similar composition to those assigned to the *P. mawsonii* Zone. Index species recorded include *Appendicisporites distocarinatus*, *Laevigatosporites musa* ms, and *Verrucosisporites admirabilis* ms. However, the assemblage could belong to younger *Tricolporites apoxyexinus* Zone based on the presence of a single specimen of the younger index species *Latrobosporites amplus*. Alternatively, this latter species could be out-of-place as suggested by the presence of caved species such as *Battenipollis croccodilus* ms, *Tricolporites* *lilliei* and possibly *Forcipites sabulosus,* which are all obvious contaminants. However, as the electric log character of the interval 2972 to 3022m most closely resemble the overlying Chimaera Formation the sample is assigned to an informal "Transition beds" unit (Table 1), in which the *P. mawsonii* Zone component of the assemblage is interpreted to be reworked from the underlying Curlip Formation.

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INTERPRETATIVE DATA

Table 2. Interpretative data for Melville–1, Gippsland Basin.

Sample Type	Depths	Spore-Pollen (Microplankton) Zones	CR *	MP%	Key Species Occurrences
Cuttings †	2230m	*P. tuberculatus* (*Operculodinium* Superzone)	D2 D2	63%	FADs of spores *Cyatheacidites annulatus* and *Foveotriletes crater* in assemblage dominated by dinocyst *Spiniferites* spp.
Cuttings	2260	(*D. heterophlycta*)	D2	est. 30%	LAD of dinocyst *Deflandrea heterophlycta* and FAD of *Paucilobimorpha inaequalis*
Cuttings †	2270m	(*E. partridgei*)	D2	est. 30%	LADs of *Enneadocysta partridgei* and acritarch *Paucilobimorpha tripus*
Cuttings †	2280m	(*E. partridgei*)	D3	est. 30%	FAD of dinocyst *Enneadocysta partridgei*
Cuttings †	2310m	Lower *M. diversus* (*A. homomorphum*)	D2 D2	26%	Frequent *Proteacidites grandis* associated with LADs of dinocysts *Apectodinium homomorphum* and *Deflandrea dartmooria*
Cuttings	2360m	Upper *L. balmei* (*A. reburrus* Acme)	D1 D3	5.5%	LADs of *Lygistepollenites balmei* and dinocyst *Apectodinium reburrus* ms.
Cuttings	2380m	Upper *L. balmei* (*A. reburrus* Acme)	D2 D3	23%	FADs of *Proteacidites annularis* and dinocyst *Apectodinium reburrus* ms.
Cuttings #	2485m	Lower *L. balmei*	D4	NP	LAD of consistent *Gambierina rudata* in assemblage dominated by *Phyllocladidites mawsonii* at 38% of SP count.
Cuttings #	2535m	Lower *L. balmei*	D5	NP	Low yielding sample with tentatively identified *Proteacidites angulatus*
Cuttings #	2585m	Lower *L. balmei*	D2	15%	LAD of *Proteacidites angulatus*. Associated monospecific assemblage of the colonial algal cyst *Amosopollis cruciformis* suggests lacustrine or lagoonal palaeoenvironment.
Cuttings	2605m	Lower *L. balmei*	D2	20%	Paralic assemblage containing LAD of dinocyst *Alisocysta margarita*
Cuttings †	2640m	Lower *L. balmei* (*T. evittii* Acme)	D2 D3	31%	Marine assemblage with common *Trithyrodinium evittii*
Cuttings #†	2690m	Upper *F. longus*	D1	<5%	LADs of *Forcipites longus, Grapnelispora evansii* and *Tricolpites confess*
SWC 29	2755m	Upper *F. longus*	B1	NRIC	FAD of *Tripunctisporis maastrichtiensis* associated with common *Gambierina rudata* (9%)
Cuttings #	2780m	Upper *F. longus*	D4	<10%	Assignment to Upper subzone based on *Gambierina* (6%) > *Nothofagidites* (2%)
Cuttings #†	2820m	Lower *F. longus*	D2	<2%	LAD of *Battenipollis croccodilus* ms.
SWC 25	2841.5m	Lower *F. longus*	D2	<1%	FAD of *Forcipites longus* associated with common *Battenipollis croccodilus* ms (6%)
Cuttings †	2865m	Indeterminate		NP	Non-diagnostic low yielding sample.

Continued…

Table 2. Interpretative data for Melville–1, Gippsland Basin (continued).

Sample Type	Depths	Spore-Pollen (Microplankton) Zones	CR *	MP%	Key Species Occurrences
Cuttings #†	2880m	*N. senectus*	D2	NRIC	LAD of *Forcipites sabulosus*
Cuttings #	2915m	*N. senectus*	D2	<1%	Non-marine "mire" assemblage with common *Phyllocladidites mawsonii* at 20% and *Gleicheniidites circinidites* at 19%.
Cuttings #†	2960m	*N. senectus*	D3	1.6%	FAD of *Nothofagidites senectus*
SWC 17	2975m	*T. apoxyexinus* to *P. mawsonii* Zones	D4	<1%	Mixture of index species suggests either contamination or reworking within assemblage.
Cuttings #	3030m	*P. mawsonii*	D2	NRIC	Non-marine assemblage dominated by *Podocarpidites* at 41%.
SWC 15	3039m	*P. mawsonii*	D2	NRIC	*Cyatheacidites tectifera* common (6.5%)
Cuttings #	3075m	*P. mawsonii*	D5	NRIC	*Phyllocladidites mawsonii* present in assemblage dominated by *Podocarpidites* (58%)
Cuttings #	3155m	*P. mawsonii*	D2	<1%	Megaspores *Arcellites disciformis* and *Balmeisporites holodictyus* present.
Cuttings #	3185m	*P. mawsonii*	D2	NRIC	FADs of *Phyllocladidites mawsonii, Appendicisporites distocarinatus* and *Verrucosisporites admirabilis* ms.
SWC 4	3328m	Indeterminate		NP	Organic residue carbonized and overmature with TAI >3.

Codes & Abbreviations

Samples given urgent palynological processing
† Samples re-processed to improve yields.
NRIC = Microplankton not recorded in count.
NP = Microplankton not present in recorded assemblage.
Spore & Pollen % = abundance expressed as % of SP count only.
Microplankton % = abundance of microplankton as % of SP + MP count.
LAD & FAD = Last & First Appearance Datums.

*CR = Confidence Ratings used in STRATDAT database and applied to Table 2.

Alpha codes: Linked to sample		**Numeric codes:** Linked to fossil assemblage		
A	Core	**1**	**Excellent confidence:**	High diversity assemblage recorded with key zone species.
B	Sidewall core	**2**	**Good confidence:**	Moderately diverse assemblage recorded with key zone species.
C	Coal cuttings	**3**	**Fair confidence:**	Low diversity assemblage recorded with key zone species.
D	Ditch cuttings	**4**	**Poor confidence:**	Moderate to high diversity assemblage recorded without key zone species.
E	Junk basket	**5**	**Very low confidence:**	Low diversity assemblage recorded without key zone species.

Appendix B

Vitrinite Reflectance Analyses
Gippsland Basin

by

Alan C. Cook

GIPPSLAND BASIN, **MELVILLE-1, p 1**

KK # Ref #.	Depth (m) /Type	$\overline{R}_{v}$max	Range	N	Sample description including liptinite fluorescence, maceral abundances, mineral fluorescence
					Lakes Entrance Formation
T8368	2060-2070	0.40	0.26-0.50	15	Rare lamalginite yellow to orange. (Calcareous claystone>
Ctgs	$\overline{R}_{I}$max	0.98	0.64-1.31	7	carbonate. Dom sparse, V=L>L. Vitrinite and inertinite sparse, liptinite rare. Fossil fragments abundant. Mineral fluorescence pervasive orange to dull orange. Iron oxides rare. Pyrite common.)
					Latrobe Siliciclastic Formation
T8369	2280-2290	0.43	0.32-0.53	9	Rare lamalginite yellow. (Carbonate>sandstone>calcareous
Ctgs	$\overline{R}_{I}$max	0.71	-	1	claystone. Dom rare, V>I>L. All three maceral groups rare. Fossil fragments sparse. Reworked vitrinite rare. Mineral fluorescence absent. Iron oxides major. Pyrite sparse.)
T8370	2804	0.57	0.51-0.63	16	Rare sporinite and lamalginite orange. (Siltstone>claystone.
SWC-#26	$\overline{R}_{I}$max	1.31	0.89-1.90	15	Dom abundant, I>V>L. Inertinite abundant, vitrinite sparse, liptinite rare. Mineral fluorescence pervasive orange to dull orange. Iron oxides sparse. Pyrite abundant.)
					Golden Beach Subgroup
T8371	2901.5	0.56	0.53-0.59	2	Rare liptodetrinite yellow to orange. (Sandstone>carbonate.
SWC-#21	$\overline{R}_{I}$max	1.40	1.20-1.64	5	Dom rare, I>V>L. All three maceral groups rare. Mineral fluorescence patchy moderate orange to dull orange. Iron oxides rare. Pyrite sparse.)
T8372	2975.5	0.56	0.54-0.56	4	Rare lamalginite orange, rare cutinite dull orange. (Carbonate>
SWC-#17	$\overline{R}_{I}$max	1.44	1.05-1.98	15	calcareous siltstone. Dom abundant, I>>L>V. Inertinite abundant, liptinite and vitrinite rare. Mineral fluorescence pervasive moderate orange to dull orange. Iron oxides sparse. Pyrite major.)
					Emperor Subgroup
T8373	3084.3	0.61	0.51-0.69	10	Fluorescing liptinite absent. (Siltstone>> carbonate>“coal”.
SWC-#13	$\overline{R}_{I}$max	1.38	0.93-2.15	14	“Coal” sparse, vitrite probably represents rafted logs. Dom abundant, I>>V. Inertinite abundant, liptinite and liptinite absent. A single grain of natural coke, R 2.28%, is present, isotropic and presumably from mud cake. Mineral fluorescence weakly patchy moderate orange to weak dull orange. Iron oxides common. Pyrite sparse.)

The upper two samples are from units that tend to have a low content of organic matter but they contained sufficient vitrinite to show that these units are immature. The four sidewall samples are from units that typically contain abundant organic matter but the horizons sampled have low organic matter contents relatively to those normally found. The silty and sandy units also contain reworked wood and peat fragments. The reworking can result in higher than average vitrinite reflectance values, but the process of reworking is also associated with the selective loss of some types of tissues and the selective preservation of tissues transitional to liptinite macerals resulting in below average vitrinite reflectance values.

The data indicate that the section from 2800 m down is oil mature. The interval covered by the SWC samples is relatively thin and the data do not appear to provide an indication of the maturation gradient within the Golden Beach to Emperor interval.

The deepest sample contains a single but large grain of natural coke. This coke is isotropic and has a reflectance of 2.28%. It appears to have been formed from a coal that lacked inertinite. The coke and the main part of the sample are not coeval and the coke is best interpreted as coming from mud cake. Cokes are sometimes used as minor components of mud additives but it is unlikely that a natural coke would have this origin. This suggests that a coked horizon exists within the Melville-1 section. The mineral fluorescence and the absence of fluorescing liptinite in the deepest sample may be due to very minor contact alteration but any alteration has had a major effect on the vitrinite reflectance values.

ACC Wednesday, 6 March 2002

ATTACHMENTS

1. Well Index Sheet
2. Formation Evaluation Results
3. Composite Well Log