PeeJay-1

WELL COMPLETION REPORT

INTERPRETIVE DATA

T/39P

BASS BASIN, OFFSHORE NORTHERN TASMANIA

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December 2009

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SEISMIC:	Survey:	PJ3D (2005)
LOCATION:	InLine:	1206
	CDP:	922

PERMIT: T/39P
BASIN: Offshore Bass Basin
PARTICIPANTS:
Beach Petroleum Ltd (Manager Drill Ops) : 50%
Benaris Petroleum N.V I (Permit Operator): 50%

SURFACE	Latitude:	40º 29’ 47.9079” S
LOCATION:	Longitude:	146º 21’ 35.4578” E
	Easting:	445 754.686mE
	Northing:	5 516 921.312mN
	Datum:	GDA94
	Spheroid:	GRS80
	Map Grid:	MGA 94
	Projection:	UTM Zone 55, CM 147

WELL DESIGNATION:	Exploration
STATUS:	Plugged and Abandoned
STRUCTURE TYPE:	Anticline
RIG NAME AND TYPE:	Seadrill West Triton Jack-Up MODU
RIG CONTRACTOR:	Atlas Drilling (S) PTE LTD

TOTAL DEPTH:	(mMD)	(mTVDSS)
Driller:	2183.0	2148.9
Logger:	N/A	
ELEVATION:	Datum:	MSL
	RT-ASL (MSL):	34.15m
	WD (MSL):	78.0m
	RT-ML:	112.2m

HOLE SIZES:	Size	Interval (mMD)
	914mm (36”)	112.2 - 218.0m
	406mm (16”)	218.0 - 810.0m
	311mm (12 ¼”)	810.0 - 2183.0m
CASING:	Size	Shoe (mMD)
	762mm (30”)	206.4
	508mm (20”)	215.8
	340mm (13 3/8”)	804.1
SPUD DATE:	18:30hrs	15/11/2008
REACHED TD:	16:30hrs	27/11/2008
RIG RELEASED:	15:00hrs	04/12/2008

LWD LOGS

DATE	HOLE SIZE	RUN NUMBER	MEASUREMENT	INTERVAL
18-19/11/2008	406mm (16”)	1	GR-D&I-Shear DT-Comp DT	218.0 - 810.0m
21-23/11/2008	311mm (12 ¼”)	2	GR-APWD-D&I-Resistivity-Shear DT-Comp DT-Density-Neutron-Caliper	810.0 – 1454.0
24-28/11/2008	311mm (12 ¼”)	3	GR-APWD-D&I-Ring, Bit, Button Resistivitys-Shear DT-Comp DT-Density-Neutron-Caliper	1454.0 – 2183.0

WIRELINE LOGS

LOG TYPE	SUITE/RUN	INTERVAL mRT	BHT/TIME
No wireline logs were obtained			

DRILL STEM TESTING

TEST	TEST INTERVAL	FLOW RATE	CHOKE	FWHP
No drill stem tests were conducted				

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CEMENT PLUGS			
PLUG	**INTERVAL**	**CEMENT TYPE**	**CEMENT VOLUME**
1	1260 – 1360m	Abandonment	84 bbls
2	704 – 834m	Abandonment	70 bbls
3	120 – 185m	Abandonment	160 bbls

FORMATION	PROGNOSED DEPTHS		ACTUAL DEPTHS		Diff.
	mMDRT	mTVDSS	mMDRT	mTVDSS	High/Low
Recent Carbonates & Torquay Group	112.0	-78.0	112.0	-78.0	-
Lower Torquay Group	1134.0	-1100.0	1171.0	-1137.0	37m L
Demons Bluff Formation	1296.0	-1262.0	1254.0	-1220.0	42m H
Upper Eastern View Group	1367.0	-1333.0	1325.0	-1291.0	42m H
Middle Eastern View Group	1634.0	-1600.0	1600.0	-1566.0	34m H
Total Depth	2134.0	-2100.0	2183.0	-2149.0	

1 WELL SUMMARY

The PeeJay-1 exploration well is located in Permit T/39P in the Bass Basin, approximately 50km from the north coast of Tasmania in 78 metres of water. It was proposed to test a simple robust anticlinal structure located on the south-eastern margin of the Pelican Trough in the south central Bass Basin.

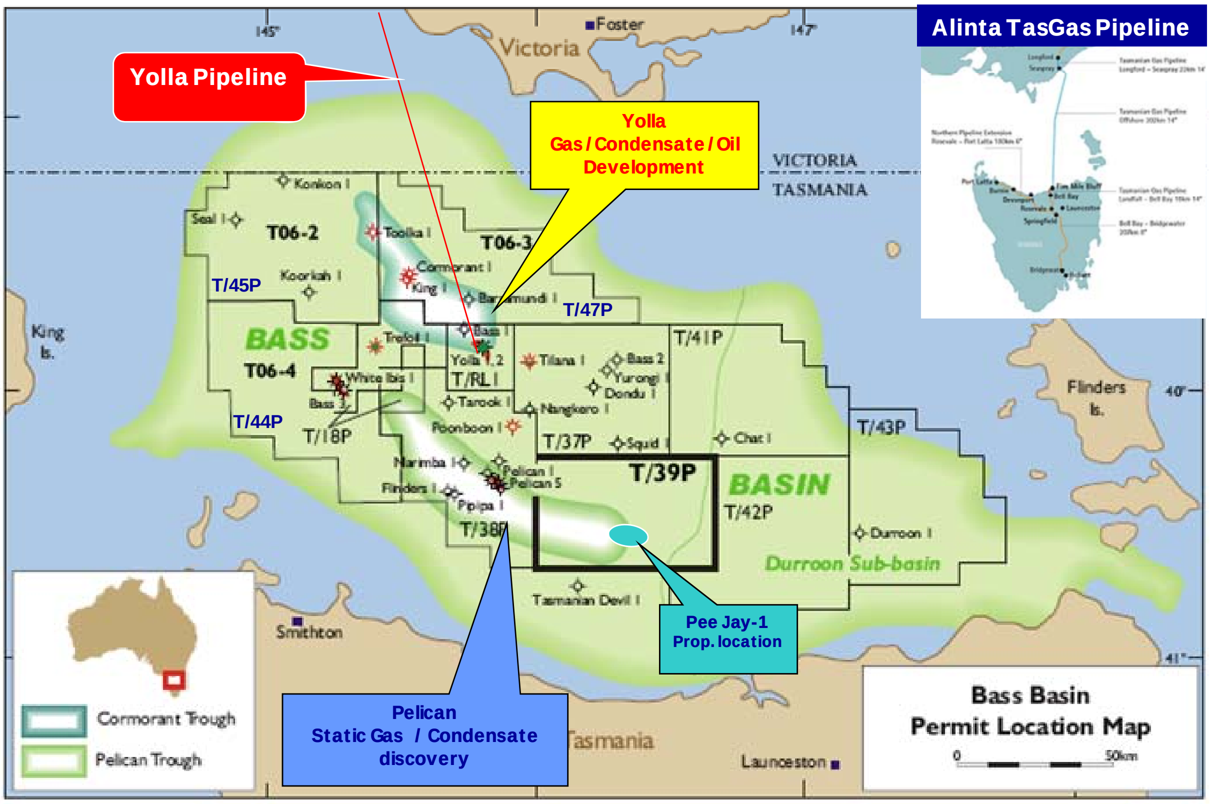

Figure 1: Location T/39P and PeeJay-1 Petroleum Exploration Well

The well was designed as a vertical well targeting oil in the Early to Middle Eocene age Upper Member of the Eastern View Group as its primary objective. Excellent quality sandstones at this level are present at Cormorant-1 and Yolla-1 where they are described as being fine to coarse grained. Yolla-1 intersected a 10 metre oil leg underlying a 20 metre gas cap in the Upper Eastern View Group.

The secondary objective was oil or condensate rich gas in the Late Cretaceous to Early Eocene Middle Eastern View Group. This has been the main target for exploration in the basin, hosting commercial volumes of liquids rich gas at Yolla, potentially commercial volumes of gas at White Ibis and Trefoil and sub-commercial accumulations at Cormorant and Pelican.

Seismic mapping at near top Upper Eastern View Group indicated that the PeeJay structure has approximately 82 metres of structural relief and encloses an area of 23.9 km^2. Although the structure is well placed at the distal end of a very large drainage area that extends into the Pelican Trough where Eastern View Group sediments are mature and generating hydrocarbons, technical analysis suggested that charge was the key risk element.

The West Triton jack-up rig came on contract to the Joint Venture for the tow to PeeJay-1 at 16:00hrs on 13 October 2008 and was towed 148 nautical miles to location where it was soft pinned at 24:00hrs on 14 October 2008. During pre-load operations two horizontal braces were observed to be damaged and consequently the rig was re-floated and moved to a more appropriate location to undertake repairs.

The rig arrived back at the PeeJay-1 location after the repairs, at 01:20hrs on 12 November 2008 and was pinned back in the original spudcan holes, jacked up to 3.5m air gap, and all three legs preloaded to 100% which was held for 12 hours without further incident.

The well was spudded at 18:30hrs on 15 November 2008 with a 26” bit and a 36” hole opener, and the well was drilled to section TD at 218mMDRT before the 30” conductor string was run and cemented at 206.4mMDRT.

A 16” BHA with MWD was made up and drilled from 218 metres to section TD at 810 metres without incident before the 13 3/8” casing was run and cemented with a shoe depth of 804mMDRT.

A 12 ¼” BHA (Run 3) was made up comprising resistivity, sonic and density-neutron LWD tools and drilled with a KCl/Polymer mud system to 1,453 metres before the BHA was pulled out of hole for a bit change due to slow ROP. The well was then drilled to final well TD of 2183mMDRT with no hole problems.

No wireline logging was conducted as it was considered sufficient information was available from the real time and recorded LWD data.

Reservoir quality throughout the Upper Eastern View Group is interpreted to be good. Logs indicate porosities of sands to be from 19 to 26 percent. No zones of significant hydrocarbons were identified from logs, substantiating the lack of significant shows during drilling. The reservoir quality of the Middle Eastern View Group is interpreted to be moderate to good with average porosities of sands ranging from 13 to 20 percent. Minor elevated mud gas readings were recorded and hydrocarbon fluorescence was noted while drilling through sands within the upper Middle Eastern View Group. Logs indicate that no moveable hydrocarbons are present within the Middle Eastern View interval.

The well was plugged and abandoned with 4 cement plugs, and the 30 inch conductor was cut at 113.0mMDRT (1 metre below the seabed) and recovered to surface.

The rig was then secured for rig move and 2.15 days were spent waiting on weather before jacking down operations commenced. The rig was released 1nm from location at 15:00hrs 4 December 2008.

2 GEOLOGICAL DISCUSSION

2.1 Previous Exploration

The Bass Basin is a moderately explored basin with 36 wells (including PeeJay-1) drilled since 1965 with a density of approximately one well per 1200 km^2. Exploration of the basin commenced in the early 1960s with permits awarded to Hematite Petroleum Pty Ltd (BHP) and Esso Exploration and Production Australia Ltd. Esso drilled the first well in the basin, Bass-1, in 1965, and from 1966 to 1974 drilled an additional 15 wells in the basin without seeing commercial success. Non-commercial gas and condensate accumulations were discovered at Pelican-1 and Pelican-2, and gas shows were recorded at Bass-3, Cormorant-1, Pelican-3, Poonboon-1, Toolka-1A, and Aroo-1.

The drilling of Yolla-1 by Amoco Australia in 1985 resulted in the first commercially significant discovery in the basin. This well encountered approximately 30 metres of net gas pay in stacked sands over a 278 metre depth interval in Middle Eastern View

Group. The well also penetrated a gross column of 31 metres of hydrocarbon (20.4 metre gas cap overlying a 10.1 metre light oil leg) in the Upper Eastern View Group.

In 1998, Boral Energy Resources Ltd and partners drilled two wells in the central Bass Basin – Yolla-2 and White Ibis-1. Yolla-2 confirmed a commercial gas resource at Yolla and White Ibis-1, a crestal test over a large basement high up-dip of Bass-3, encountered a smaller gas accumulation with a thin oil rim. Yolla- 3 and 4 were subsequently drilled during field development in 2003.

Prior to the drilling of PeeJay-1, Trefoil-1 was the most recent exploration well drilled in the basin, discovering a potentially commercial gas- condensate accumulation in 2004. Trefoil-2 was being drilled by Origin at the time of writing of this report.

Development of the Yolla gas field by Origin Energy and Joint Venture partners between 2003 and 2006 represents the initial phase of the BassGas Project which also includes plans for developing the White Ibis (1998) and Trefoil gas – condensate fields. First production of hydrocarbons from Yolla was in late 2005.

Details of the distances to the closest offset wells to PeeJay-1 are listed in Table 1 below:

Table 1: Nearest Offset Wells

Well	Distance From PeeJay-1	Direction
Pelican wells 1 to 5	45 km	north-west
Squid-1	35 km	north
Tasmanian Devil-1	30 km	south-west
Yolla wells 1 to 4	75 km	north-west
Flinders-1	60 km	west north-west

2.2 Structural History of the Bass Basin

The Bass Basin was initially formed as a failed arm of the Southern Margin Rift System that developed through the opening of the Southern Ocean (separation of Antarctica from Australia) and the opening of the Tasman Sea (separation of the Lord Howe Rise Complex from Australia).

The basin is underlain by a series of north-west to south-east half-grabens that have undergone varying amounts of extension. Five major tectonic events are recognised by Cummings et al (2004):

1. A Late Jurassic - Early Cretaceous (Barremian) Southern Ocean Rifting Phase associated with Southern Ocean rifting (initial separation of Antarctica from Australia);

2. A Late Cretaceous (Turonian - Campanian) Tasman Rifting phase (separation of the Lord Howe Rise Complex from Australia);

3. Campanian - Maastrichtian oblique extension associated with the continuing separation of Antarctica from Australia;

4. Paleocene - Middle Eocene oblique rifting mainly affecting the north-eastern part of the basin, and

5. Oligocene - Miocene compressional reactivation dominated by right-lateral wrench deformation and localised inversion (mainly in the north of the basin) of Cretaceous - Middle Eocene rift structures.

Uplift with localised inversion related to Oligocene-Miocene reactivation appears to be restricted to the northern part of the basin. Oligocene-Miocene deformation in the southern (T/39P) part of the basin is evident as right lateral strike slip reactivation of deep seated basement involved structures. Seal and trap integrity risk can in places be attributed to structures that have undergone inversion.

In the Yolla and White Ibis fields, access to mature source rocks is interpreted to be provided by large displacement faults that linked the Upper Eastern View Coal Measure Group reservoirs with deeper mature source rocks.

2.3 Regional Geology

The Bass Basin contains sediments that range in age from Early Cretaceous and possibly latest Jurassic to Recent (Figure 2) that rest unconformably on pre-rift Mesozoic and Palaeozoic rocks.

Several stratigraphic nomenclature schemes have been proposed for the basin, one of the more recent of these integrating biostratigraphy, sequence and seismic stratigraphy to identify accommodation cycles (Cummings *et al*, 2002). The stratigraphy of the basin remains to be standardised amongst explorers in the basin. A. D. Partridge (Biostrata Pty Ltd) has proposed a subdivision of the Bass Basin's stratigraphic succession that is significantly more 'detailed' than that currently being used by explorers.

The discussion below follows more commonly used lithostratigraphic nomenclature.

Eastern View Group (Early Cretaceous- Middle Eocene)

A threefold stratigraphic subdivision of the Eastern View Group (also referred to as the Eastern View Coal Measures) is recognized, the units being poorly defined and identified predominantly by a relative abundance of coal, and by age.

Differentiation of the Eastern View Group into Members or more ideally Formations has historically proven difficult throughout the Bass Basin. Variation within the Group is gradational, with no well defined departures in lithology. Work undertaken by Cummings *et al.* (2004) and Partridge (2002) is leading towards formalisation of a more appropriate and definitive breakdown of the stratigraphic succession of the Bass Basin and the Eastern View Group in particular. A report detailing the Palynological Analysis that was undertaken by Biostrata Pty Ltd is included in this report as Appendix 1.

Partridge (2002) has proposed a completely revised stratigraphic division for the Group, dividing the Upper Eastern View Member, for example, into three formations. This breakdown has not been adopted for this report, but formation tops assigned by Partridge are included in his report (Appendix 1).

The Eastern View Group is thickest in the centres of the main toughs, reaching a total thickness of in excess of 5500 metres, but thins markedly towards the basin margins. The Lower Eastern View remains largely unexplored and consequently unknown due to its depth of burial.

The Eastern View Group comprises interbedded sandstone, siltstone, claystone and coal, the coals being sparse in the Upper Eastern View Group but becoming more abundant towards and in the Middle Eastern View Group *M. diversus* and L. *balmei* zones. The contact between the top of the Eastern View Group and the overlying Demons Bluff Formation is lithologically gradational with siltstone gradually becoming sandier towards the base of the Demons Bluff Formation and eventually grading into very fine to coarse grained, moderately to well sorted, quartz sandstones. The top of the Eastern View may be picked from a change in the resistivity baseline and a small decrease in gamma ray response.

Sandstones of the upper Eastern View Group are proven petroleum-bearing units, having been tested by the Cormorant-1 and Yolla-1 wells where the unit comprises very fine to coarse-grained sandstones with minor clay matrix. Nevertheless, the unit has not been seen as a conventional reservoir target in the basin due to lack of structure at this level. Porosity in the Upper Eastern View Group sands ranges up to 30 percent; permeabilities average about 75mD but can exceed a Darcy.

The Middle Eastern View Group and in particular *L.balmei* zone has been the primary reservoir target in the basin, hosting commercial volumes of liquids rich gas at Yolla, potentially commercial volumes liquids rich gas at White Ibis-1 and Trefoil-1, significant but non-commercial accumulations at Cormorant-1 and Pelican and abundant shows in several other wells including Bass-1, Aroo-1 and Ponboon-1. Where well developed, sandstones in both the Upper and Middle members reach 10 - 50 metres in thickness and tend to be predominantly medium to coarse grained, with moderately good sphericity and sorting. The sandstones are mainly siliceous, but in places have moderate calcareous or dolocalcareous cement. Glauconite (often abundant), thin dolomitic streaks and micropyrite seem to be inherent to the Group.

Eastern View sediments were deposited in a variety of terrestrial, paralic and shallow marine environments, the area covered by T/39P receiving sediment input from both Tasmania and the Australian mainland. The Eastern View Group at PeeJay-1 is interpreted by Partridge as being "remote from the marine influence entering the basin in the north-west, and consequently, the Middle Eocene to Paleocene portion of the Eastern View Group drilled in PeeJay-1, appears to be composed entirely of fluvial and deltaic facies."

Demons Bluff Formation (Middle - Late Eocence)

The Demons Bluff Formation is an overall transgressive-regressive succession that was deposited during a phase of thermal subsidence. The formation ranges in thickness up to 130 metres. The Demons Bluff Formation is an important regional seal for the Eastern View Group.

At Flinders-1 and Pipipa-1, the Formation comprises argillaceous, dark brown, pyritic siltstones and shales that are slightly carbonaceous and occasionally calcareous. At Pelican-5, the Formation consists of moderately calcareous, dark brownish claystone, which grades to shale in part, with minor interbedded limestone, siltstones and silty sandstones. The boundary with the overlying Torquay Group across the basin is gradational and indistinct, as is the boundary with the underlying Eastern View Group.

Torquay Group (Middle Eocence to Recent)

The Torquay Group sequence consists of a lower argillaceous succession of marine mudstones and marls up to 650 metres thick, overlain by a calcarenite-dominated succession up to 900 metres thick that were probably deposited as reefal detritus in a shelfal, back reef environment. Volcanics, both intrusives and extrusives, are common in the lower unit.

At nearby wells Flinders-1 and Pipipa-1, the upper part of the Torquay Group is 900 metres thick and comprises predominantly skeletal limestone, largely unconsolidated, interbedded with minor calcareous siltstone and marl. The limestone varies from white to grey, and is predominantly a calcarenite but occasionally grades to calcilutite, in particular towards the base of the interval. The unit consists mainly of bryozoan and foraminiferal fragments with occasional pelecypod and echinoid fragments and minor quartz. The calcilutite is grey green and glauconitic. The marl is grey, very silty in part and friable. At Pelican-5, up to 25 percent of intergranular calcite cement is present.

The lower interval of the Torquay Group, referred to by some as the Angahook Formation, is 400 metres in thickness at Pipipa-1 and nearly 500 metres in thickness at Pelican-5. At Pipipa-1, the unit is dominated by siltstone interbedded with minor shale and rare light brown in colour dolomite. The siltstones are argillaceous and occasionally carbonaceous. There is a general increase in the proportion of clay and silt towards the base of this interval. At Pelican-5, the unit comprises calcareous claystones with minor thin beds of bioclastic limestones.

3 STRATIGRAPHY

3.1 Predicted vs Actual

Table 2 below summarises the predicted versus actual formation tops for PeeJay-1. RT is 34.2 metres above mean sea level.

Table 2: PeeJay-1 Predicted vs Actual Formation Tops Summary

FORMATION	PROGNOSED DEPTHS		ACTUAL DEPTHS		Diff.
	mMDRT	mTVDSS	mMDRT	mTVDSS	High/Low
Recent Carbonates & Torquay	112.0	-78.0	112.0	-78.0	-
Lower Torquay Group	1134.0	-1100.0	1171.0	-1137.0	37m L
Demons Bluff Formation	1296.0	-1262.0	1254.0	-1220.0	42m H
Upper Eastern View Group	1367.0	-1333.0	1325.0	-1291.0	42m H
Middle Eastern View Group	1634.0	-1600.0	1600.0	-1566.0	34m H
Total Depth	2134.0	-2100.0	2183.0	-2149.0	

3.2 Stratigraphic Summary

The stratigraphic section encountered in PeeJay-1 is summarised below and tops are tabulated in Table 2. For reference, a generalised Bass Basin stratigraphic column is provided as Figure 2. The detailed lithological description of the section encountered is contained in the PeeJay-1 Basic Data Report. Note that the depth for the 'Middle Member' of the Eastern View Group, as based on palynological analysis undertaken by Alan Partridge (Biostrata Pty Ltd), is significantly deeper (1750mMD vs. 1600mMD) to that shown in the table above and in the text below.

Differentiation of the Eastern View Group into 'Members' or more ideally 'Formations' has proven difficult throughout the Bass Basin. Variation within the Group is gradational and with no well defined departures in lithology. Work undertaken by Cummings *et al.* (2004) and Partridge (2002) is leading towards formalisation of a more definitive and appropriate breakdown of the stratigraphic succession of the Bass Basin and the Eastern View Group in particular. A report detailing the Palynological Analysis that was undertaken by Biostrata Pty. Ltd. is included in this report as Appendix 1.

All depths reported in this Well Completion Report are measured depth relative to the rotary table (MDRT) unless otherwise stated.

3.2.1 Recent Carbonates and Upper Torquay Group

Depth:	112.0 to 1171.0mMDRT (-78.0 to -1137.0mTVDSS)
Thickness:	1059.0 m
Age:	Oligocene to Recent
Depositional Environment:	Marine

From 112.0 to 810.0m not described.

CLAYSTONE with interbedded LIMESTONE from 810.0 to 960.0m:

CLAYSTONE: (30-90%) Medium grey to olive grey, moderately calcareous, slightly silty, common fine to medium calcareous sand, trace white calcite spar inclusions, trace carbonaceous material, soft, plastic, massive to amorphous.

LIMESTONE: (10-70%) Biocalcarenite, pale yellow brown to light brown grey, fine to medium, micritic, common coralline fragments, common medium to coarse, white calcite, spar, brittle, hard in part, fair porosity, no fluorescence.

Massive CLAYSTONE with minor interbedded LIMESTONE from 960.0 to 1015.0m:

CLAYSTONE: (90%) Medium dark grey to olive grey, moderately to locally very calcareous grades to calcilutite in part, slightly silty, trace carbonaceous material, marly texture, soft, plastic, massive to amorphous.

LIMESTONE: (10%) Biocalcarenite, light brown grey to pale yellow brown, fine to medium, coarse in part, micritic, coarse to very coarse calcite spar, common coralline fragments, brittle, moderately hard to hard in part, fair porosity, no fluorescence.

Massive CLAYSTONE with trace interbedded LIMESTONE from 1015.0 to 1171.0m:

CLAYSTONE: (100%) medium grey to olive grey, minor medium dark grey, rare bluish grey, slightly to dominantly moderately calcareous, locally slightly silty, rare Foraminifera, rare carbonaceous material, trace micro pyrite, soft to locally firm, plastic in part, minor amorphous to dominantly sub blocky.

LIMESTONE: (Tr) Calcarenite to Calcisiltite, white to very light grey, rarely dolomitic, common medium to coarse calcite spar, occasionally coralline fragments, brittle to hard in part, blocky, nil to poor porosity, no shows.

3.2.2 Lower Torquay Group

Depth:	1171.0 to 1254.0mMDRT (-1137.0 to --220.0mTVDSS)
Thickness:	83.0 m
Age:	Middle Eocene to Oligocene

Depositional Environment: Marine

Interbedded CLAYSTONE, SILTSTONE, SANDSTONE with trace LIMESTONE:

CLAYSTONE: (Tr-70%) olive grey to medium dark grey, non to very slightly calcareous, rare nodular pyrite, minor disseminated pyrite, soft to plastic in part, sub blocky to rarely blocky in part, commonly grading to Siltstone in part.

SILTSTONE: (0-60%) brownish grey, very slightly carbonaceous, slightly arenaceous in part, slightly calcareous, soft, subblocky.

SANDSTONE: (5-50%) transparent to translucent, common yellow brown staining, fine, very well sorted, angular to well rounded, dominantly subangular-subround, spherical, no visible cement, no visible matrix, common to abundant brown and black lithic grains, loose, good inferred porosity, no shows.

LIMESTONE: (0-10%) Calcisiltite, yellow brown, off white, trace to common Bryozoa, trace coralline, microcrystalline, brittle to hard, fair visible porosity in part, no shows.

3.2.3 Demons Bluff Formation

Depth:	1254.0 to 1325.0mMDRT (-1220.0 to -1291.0mTVDSS)
Thickness:	71.0 m
Age:	Middle to Late Eocene
Depositional Environment:	Marine

Massive CLAYSTONE with minor interbedded SILTSTONE:

CLAYSTONE: (90-100%) Medium dark grey to dark grey, light brownish grey, non to very slightly calcareous, trace pyritic, slightly silty in part, soft, plastic to minor subblocky in part, firm to moderately hard in part.

SILTSTONE: (O-10%) Medium dark grey to dark grey, non to very slightly calcareous, trace pyritic, rare Foraminifera, argillaceous in part, grading to Claystone in part, soft to firm, rare to trace plastic, dominantly subblocky, trace blocky.

3.2.4 Upper Eastern View Group

Depth:	1325.0 to 1600.0mMDRT (-1291.0 to -1566.0mTVDSS)
Thickness:	275 m
Age:	Middle Eocene
Depositional Environment:	Terrestrial to Shallow Marine

Interbedded SANDSTONE and CLAYSTONE from 1325.0 to 1390.0m:

SANDSTONE: (30-70%) Light olive grey, transparent to translucent quartz grains, fine, very rare granules, dominantly well sorted, subangular to subrounded, spherical, weak calcareous cement, minor dolomitic cement, minor argillaceous and silty matrix, minor friable aggregates, dominantly loose, common shell fragments in part, trace nodular pyrite, fair inferred porosity, poor to fair visible porosity, no shows.

CLAYSTONE: (30-70%) Brownish grey, non to very slightly calcareous, trace pyritic, trace Foraminifera, soft, amorphous.

Interbedded SANDSTONE and CLAYSTONE with minor COAL from 1390.0 to 1429.0m:

SANDSTONE: (60-70%) Quartzose, medium light to medium grey, very fine to fine, subangular, well sorted, weak calcareous cement, abundant, argillaceous matrix, trace lithic fragments, friable, very poor porosity, no fluorescence.

CLAYSTONE: (30-40%) Brown grey to olive black, very silty, common very fine quartz sand, slightly micromicaceous, soft, slightly dispersive, massive.

COAL: (0-10%) Black, subbituminous, dull lustre, earthy texture, firm, blocky.

SANDSTONE with interbedded CLAYSTONE from 1429.0 to 1454.0m:

SANDSTONE: (40-100%) Quartzose, clear to translucent, frosted, light olive grey in part, fine to medium, coarse in part, subangular to angular, poor to moderate sorting, locally strong dolocalcareous cement, trace light brown argillaceous matrix in part, trace muscovite, common coarse smoky quartz, rare nodular pyrite, friable to predominantly disaggregated, fair to good porosity, very poor to nil porosity in hard aggregates, 1450-1454m 100% moderately bright pale yellow gold mineral fluorescence only, no cut, no stain.

CLAYSTONE: (0-60%) Dark grey to dusky blue, slightly calcareous, locally silty, slightly micromicaceous, trace fossil fragments, trace calcite infill, smooth texture in part, plastic to firm, blocky to subfissile.

Massive SANDSTONE with interbedded CLAYSTONE and COAL from 1454.0m to 1600m:

SANDSTONE: (40-100%) Quartzose, clear to translucent, frosted, light grey, medium to very coarse, angular to subrounded, poor sorting, locally strong dolocalcareous cement, occasionally sideritic cement, common smoky/milky quartz, trace nodular pyrite, occ quartz overgrowths, hard aggregates in part, disaggregated in part, poor to predominantly fair to good porosity, 1454-56m & 1559-80m up to 100% moderately bright pale yellow gold mineral fluorescence only, no cut, no stain.

CLAYSTONE: (0-60%) Dark grey to dusky blue, slightly calcareous, locally silty, slightly micromicaceous, trace fossil fragments, trace calcite infill, smooth texture in part, plastic to firm, blocky to subfissile.

COAL: (0-80%) Black to grey, subbituminous, dull to subvitreous lustre, slightly argillaceous in part, brittle, blocky, subfissile in part.

3.2.5 Middle Eastern View Group

Depth:	1600.0 to 2183.0mMDRT (-1566.0 to -2149.0mTVDSS) - *note Alan Partridge top 'Middle Eastern View (top Narimba) at 1750 metres*
Thickness:	583 m
Age:	Late Cretaceous to Middle Eocene
Depositional Environment:	Terrestrial to Shallow Marine - fluvial-lacustrine-deltaic

Massive SANDSTONE with interbedded COAL and CLAYSTONE from 1600.0 to 1665.0m:

SANDSTONE: (40-100%) Quartzose, clear to translucent, frosted, coarse to very coarse, angular to subround, moderately sorted, clean, trace pyrite cement in part, occasionally quartz overgrowths, trace smoky quartz, disaggregated, good porosity, fluorescence – see hydrocarbon summary Section 4.

CLAYSTONE: (0-40%) Dark grey to olive black, slightly calcareous in part, occasionally slightly silty, trace carbonaceous specks, slightly micromicaceous, soft to firm, massive to subfissile in part.

COAL: (0-20%) Black, bituminous, subvitreous to vitreous lustre, subconchoidal fracture, brittle, blocky to occasionally fissile.

Massive SANDSTONE with interbedded CLAYSTONE and COAL from 1665.0 to 1730.0m:

SANDSTONE: (20-100%) Quartzose, clear to translucent, frosted, medium to predominantly coarse to very coarse, angular to subangular, poor sorting, locally strong dolocalcareous cement, trace siliceous cement, trace pyritic cement and nodular pyrite, trace muscovite, occasionally coaly fragments, common fractured very coarse/granular milky quartz float, locally kaolinitic inclusions, trace quartz overgrowths, hard aggregates, predominantly disaggregated, poor porosity, fluorescence – see hydrocarbon summary Section 4.

CLAYSTONE: (0-80%) Brown black to olive grey, slightly calcareous, silty in part, trace carbonaceous specks, slightly micromicaceous, firm, blocky to subfissile in part.

COAL: (0-10%) Black, bituminous, subvitreous to vitreous lustre, subconchoidal fracture, brittle, blocky to occasionally fissile.

Cyclic succession of SANDSTONE, CLAYSTONE and COAL from 1730.0 to 1915.0m:

SANDSTONE: (20-100%) Quartzose, clear to translucent, frosted, light brown grey in part, medium to coarse, angular to subrounded, poor to moderate sorting, weak calcareous cement in part, predominantly clean, trace nodular pyrite, trace carbonaceous fragments, disaggregated, fair to good porosity, no fluorescence.

CLAYSTONE: (0-50%) Brown grey to olive grey, very silty grading to argillaceous siltstone in part, arenaceous in part, slightly calcareous, micromicaceous, trace lithic fragments, occasionally carbonaceous specks, soft, occasionally firm, massive to blocky.

COAL: (0-80%) Black to grey black in part, bituminous, subvitreous lustre, argillaceous in part, occasionally resin inclusions, platy to subconchoidal fracture, subvitreous to occasionally vitreous lustre, brittle, blocky to subfissile in part.

Interbedded SANDSTONE and CLAYSTONE with COAL seams from 1915.0 to 1963.0m:

SANDSTONE: (10-70%) Quartzose, clear to translucent, frosted, fine to coarse, angular to subround, poor sorting, slightly calcareous cement, silty/argillaceous matrix, trace nodular pyrite, common coarse milky quartz float, friable to predominantly disaggregated, poor to fair porosity, no fluorescence.

CLAYSTONE: (20-90%) Light brown grey to light olive grey, slightly silty/arenaceous, trace carbonaceous specks/stylolites, micromicaceous, soft to plastic, massive.

COAL: (0-90%) Black, bituminous, subvitreous lustre, subconchoidal to uneven fracture, brittle, blocky.

Massive CLAYSTONE with interbedded and interlaminated SANDSTONE and COAL from 1963.0 to 2041.0m:

SANDSTONE: (0-20%) Lithic arenite, light brown grey to pale yellow brown, fine to medium, subangular, moderately well sorted, argillaceous/silty matrix, trace lithic fragments, micaceous, friable, very poor to nil porosity, no fluorescence.

CLAYSTONE: (60-100%) Brown grey to olive grey, slightly calcareous, silty/arenaceous, occasionally lithic fragments, micromicaceous, trace carbonaceous material, soft, firm, massive, blocky in part.

COAL: (0-20%) Black to grey black, bituminous, dull lustre, locally argillaceous, platy fracture, brittle, blocky to predominantly fissile.

IGNEOUS INTRUSIVE from 2041.0 to 2104.0m:

DOLERITE: (100%) Dark greenish grey to olive grey, stained, coarse crystalline, welded grain boundaries, very fine ground mass in part, crystal assemblage includes, plagioclase, quartz, hornblende and olivine, hard, blocky.

Massive CLAYSTONE with interbedded/interlaminated COAL and SANDSTONE from 2104.0 to 2183.0m:

SANDSTONE: (0-80%) Quartzose, clear, translucent, frosted, medium dark grey to olive grey, very fine to fine, becomes medium to very coarse with depth, subangular to subround, well sorted, becomes moderately sorted with depth, weak calcareous cement, silty/argillaceous matrix in part, trace muscovite, common medium quartz float, trace lithic fragments trace nodular pyrite, friable to disaggregated, very poor porosity. See show summary above.
CLAYSTONE (20-100%) Medium dark grey to dark green grey, brown grey in part, occasionally slightly calcareous, slightly silty, micromicaceous, trace carbonaceous specks, soft to firm in part, massive to blocky.

COAL (0-20%) Black, bituminous, vitreous lustre, subconchoidal to uneven fracture, brittle to hard in part, blocky.

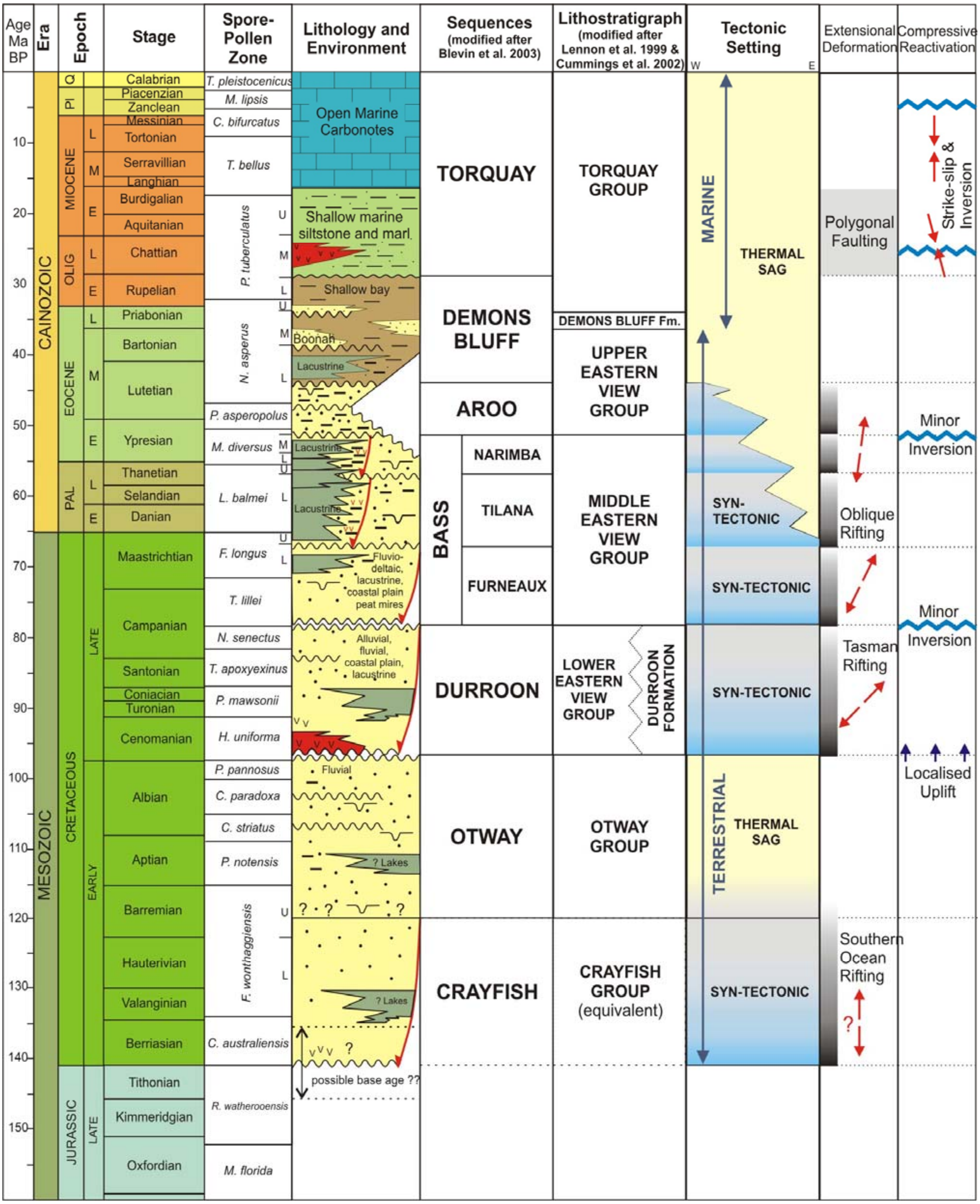

Figure 2: Generalised Stratigraphy of the Bass Basin (Cummings et al 2004)

4 HYDROCARBONS

Hydrocarbon detection via gas chromatograph and cuttings descriptions commenced from the beginning of the 12 ¼” hole at 810mMDRT.

Hydrocarbon shows recorded during drilling operations consisted of minor elevated mud gas readings from 1600 to 1700mMD and fluorescence shows from 1615 to 1624mMD (Trace: moderately bright yellow direct fluorescence, very slow dull yellow white streaming cut fluorescence, no staining); 1634 to 1639mMD (20 % bright yellow fluorescence, no cut fluorescence. 5% dull yellow direct pin point fluorescence, diffuse milky cut fluorescence, no stain); 1639 to 1654mMD (Up to 80% moderately bright yellow pin point direct fluorescence, diffuse milky cut fluorescence, no staining) [refer PeeJay-1 Mudlog Log; Enclosure 1].

Formation evaluation consisted of mudlogging and Logging While Drilling (LWD). No wireline logs were run at Total Depth. Log Interpretation (Appendix 2) indicates no moveable hydrocarbons are present in PeeJay-1.

5 GEOPHYSICAL DISCUSSION

5.1 Pre-drill Mapping

The PeeJay Prospect was interpreted as a relatively simple four-way dip closed anticline defined by modern 2D and 3D seismic data.

At the top of the Upper Eastern View Group (the primary objective of the well) the lowest closing contour for the structure was interpreted at 1415 mss, defining 23.9 km^2 of closure with 82 metres of vertical relief. PeeJay-1 is located near the southwestern limit of the closure where the structure is most pronounced and where it was interpreted that the well would intersect the top Upper Eastern View at a near-crestal position at 1,333 metres ss. A northeast - southwest trending fault zone defines the southwestern limit of the closure, but considerable closure was mapped independent of faulting.

The PeeJay Prospect exhibits early structural development as evidenced by a thinning of the Demons Bluff Formation and younger units across the crest of the structure, and by the presence of volcanics on the flanks but not over the crest of the feature (Figure 4).

PeeJay-1 provided a key test of a well defined, high relief, structural roll-over at the level of the Upper Eastern View Group, a stratigraphic interval which few wells drilled in the basin have targeted.

5.2 Post-drill Mapping

PeeJay-1 intersected the Demons Bluff Formation and the Upper Eastern View Group 42 metres high to prediction and the Middle Eastern View Group 34 metres high to prediction. Other than elevation, the interpreted structural configuration of the PeeJay feature post the drilling of the well remains essentially unchanged from the predrill interpretation. The PeeJay feature remains as a large, closed, anticlinal feature and is still seen to provide a competent trapping mechanism (Figure 3). The interpretation of pre-drill fault intersections remains unchanged.

The dolerite intersected at 2,041 mMD was not obvious from seismic data prior to drilling PeeJay-1.

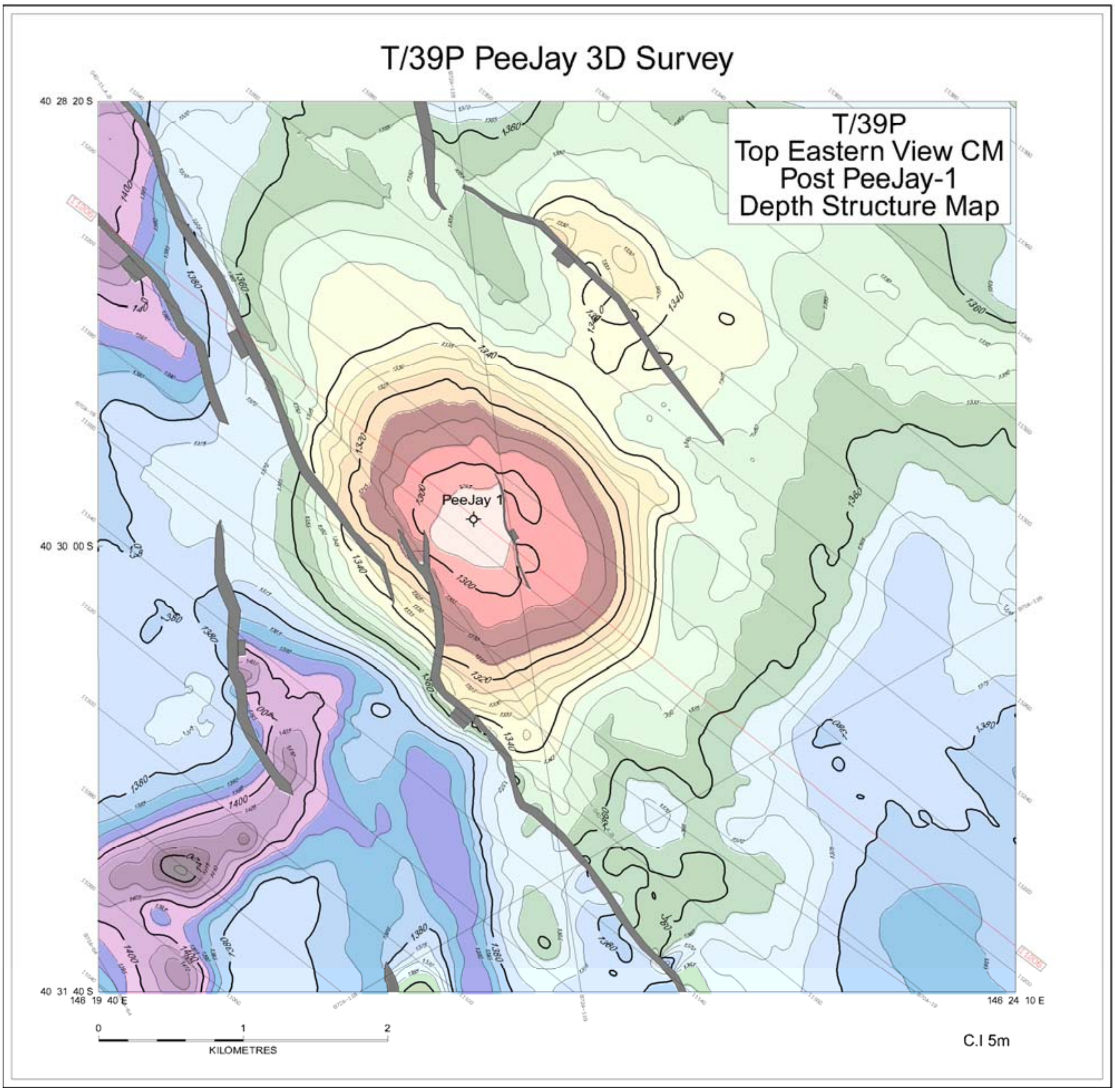

Figure 3: PeeJay post-drill Depth Structure at Near Top Eastern View Group

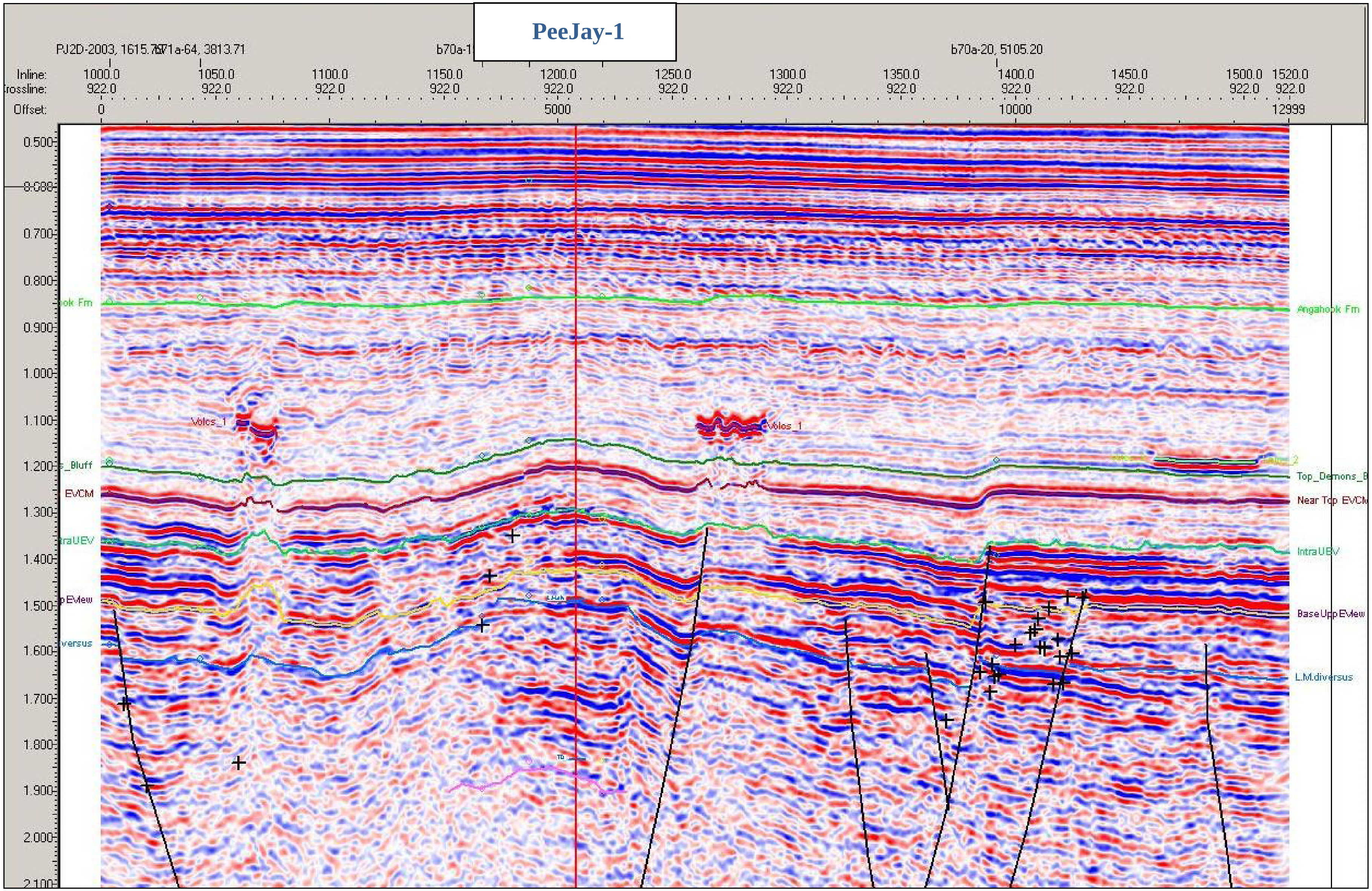

Figure 4: PJ3D Crossline 922 through PeeJay-1 location

6 CONTRIBUTIONS TO GEOLOGICAL CONCEPTS AND CONCLUSIONS

6.1 Reservoir

The fluvio-deltaic sandstones of the Upper Member of the Eastern View Group provided the primary reservoir objective for PeeJay-1. Over much of the Bass Basin, reservoir properties of the sands in the Upper Eastern View are similar to those of sands of the Middle Eastern View, although exploration of the basin has targeted Middle Eastern View Group reservoirs. Sands for both the Middle and Upper Eastern View Members are interpreted to have been deposited in a variety of terrestrial, paralic and shallow marine environments.

Yolla-1 penetrated a gross hydrocarbon column of 31 metres comprising a wet gas cap of 20.4 metres overlying a 10.6 metre oil leg in “excellent porous sands” of the uppermost Upper Eastern View Group succession. Log derived porosities within the interval vary between 17 percent and 30 percent, and high permeabilities are indicated.

The Upper Eastern View Member at PeeJay-1 proved to be a sandstone dominated sequence with minor interbedded claystone and coal. Porosities within the sands reach 30 percent and average 25 percent and up to nearly 29 percent for the better developed sandstones. Several sandstone intervals reach 25 metres in thickness (refer to Section 3.2.4 and enclosed Composite Log - Enclosure 2).

Sandstones of the Upper Member of the Eastern View Group at PeeJay-1 are quartzose, generally fine to medium grained, but in part very fine and coarse to very coarse grained, subangular to subround and commonly spherical. Sandstones progressively grade from being dominantly poorly sorted in the lower part of the unit to well sorted in the upper part of the unit. Dolomitic cement is present throughout the Upper Eastern View, being locally strong in the lower part of the interval. Trace 'nodular' pyrite is present throughout the interval.

The Middle Member of the Eastern View Group at PeeJay-1 also proved to be dominated by sandstones with thin claystone and coal interbeds (refer to Section 3.2.5). Individual sands tend to be thicker than those of the Upper Eastern View, but exhibit lower porosities and permeabilities. Average porosities for the Middle Eastern View Group sands at PeeJay-1 range from 15 percent up to about 28 percent.

Sandstones of the Middle Eastern View Group at PeeJay-1 are quartzose, medium to course to very coarse grained, angular to subround, moderately to poorly sorted and generally clean. Pyrite is present throughout the interval, both as nodules and as a cement, but is present only in trace amounts. Locally, and in particular in the uppermost part of the unit, a strong dolocalcareous cement is present. Commonly, the sandstones have a weak calcareous cement. In places there is common fractured, coarse to very coarse to granular, milky quartz.

Hydrocarbon shows recorded during drilling operations consisted of minor elevated mud gas readings from 1600 metres to 1700 metres MD and fluorescence shows within the intervals 1615-1624mMD and 1634-1654mMD. Hydrocarbon fluorescence shows were confined to the Middle Eastern View Group. Petrophysical analysis (Appendix 2) indicates all of the sands in both the Upper Eastern View and the Middle Eastern View to be water saturated. No moveable hydrocarbon zones were intersected by the well.

6.2 Source and Migration

The primary risk for PeeJay-1 was assessed to be charge limited. To date, no commercial hydrocarbon accumulations have been encountered within sands the Upper Eastern View Group and no commercial oil accumulations have been encountered in the basin. Commercial volumes of gas have been encountered at Yolla and potentially at Trefoil and White Ibis in the Middle Eastern View Group and a 10.1 metre column of oil below a 20 metre gas cap is present in the Upper Eastern View at Yolla.

In the Yolla and White Ibis fields, access to mature source rocks is interpreted to be provided by large displacement faults that linked the 'shallower' Eastern View Coal Measure Member reservoirs with deeper mature source rocks, the intersected Eastern View Group sediments being immature at Yolla (Yolla-1). The maximum measured Vitrinite Reflectance (R^o) value at Yolla-1 was 1.06% (mean 0.97) at a depth of 2731mMD, but this is near the base of a massive dolerite intrusion. The vitrinite reflectance (R_o) mean at 3028m is 0.56% (maximum reading 0.63%). Total Depth for Yolla-1 is 3351 mMD.

Gas has previously been considered the primary hydrocarbon target for the basin, but PeeJay was considered to represent one of the best opportunities in the basin for a commercial oil accumulation.

Minor elevated mud gas readings were recorded within both the lower Upper Eastern View Group and upper Middle Eastern View Group at PeeJay-1 and hydrocarbon fluorescence was noted while drilling through sands within the upper Middle Eastern View Group.

Three cuttings samples from PeeJay-1 were investigated for fluid histories using CSIRO Petroleum's GOI™ (Grains containing Oil Inclusions) fluid inclusion analysis (Appendix 3). One of the samples is from the lower Torquay Group, the other two are from the uppermost Upper Eastern View Group. Each of the three samples contained one to two oil inclusions per thousand grains, indicating there was 'palaeo-oil' at all three sample depths. The oil inclusions are in healed fractures through detrital quartz. Those grains without diagenetic fractures do not test for the presence of palaeo-oil. Differentiation between a palaeo-oil zone and a migration pathway cannot be determined on the information at hand. Likewise potential volumes of oil that might be involved, be it large or very small, cannot be assessed. The oil inclusion assemblages have near-white fluorescence which is considered to be associated with mid-range API gravity values. The samples also have uniformly small gas bubbles:

> "consistent with trapping of liquid oil. One of the assemblages has near -blue fluorescence and a large variance in the volume of the gas bubble consistent with trapping of gas and oil in inclusions."

The primary source rocks in the Bass Basin are interpreted to lie within the Palaeocene Middle Eastern View Group and consist of interbedded coals (up to 25 metres thick), and fluvio-deltaic and lacustrine shales. Geochemical analyses have shown that these source rocks have generated both gaseous and liquid hydrocarbons. Deeper sediments of the Otway Group may also contribute, but little is known about this Group and they are not generally considered a primary candidate for hydrocarbon generation.

The Eastern View Group (Upper, Middle and Lower) is interpreted to reach a total thickness of in excess of 5500 metres in the centre of the basin, but thins markedly towards the basin margins. The Lower Eastern View Group remains largely unexplored and consequently unknown due to its depth of burial, but is expected to provide additional and perhaps the primary source potential for the basin. The underlying Otway Group may also add additional source potential.

Vitrinite Reflectance readings were obtained for four sets of cuttings samples from PeeJay-1 (Appendix 4). The mean reflectance value obtained from the deepest sampled interval (sample interval 2182 - 2183 mMD at total depth of the well - Middle Eastern View Group) is 0.58 percent. The sample is dominated by coal with a small volume of dispersed organic matter and consisted predominantly of Vitrinite with lesser Inertinite and Liptinite. Mean Vitrinite Reflectance values of up to 0.68 percent (higher for Inertinite) were interpreted for the other samples. Reflectance values of in excess of 1.0 percent are considered necessary for effective oil expulsion, in particular from coals which tend to have a high retention after generation.

Geochemical analysis and modelling has determined that the basin-wide onset of oil generation occurs at depths of between 2500 to 3300 metres; peak generation and expulsion at deeper depths.

Mature, oil generative, Eastern View Group sediments are present within the PeeJay drainage area, but long distance migration, both lateral and vertical, is required to charge the Upper Eastern View sands within the PeeJay anticline. The presence of fluorescence in Upper and Middle Eastern View Group sandstones suggests oil was generated within the PeeJay drainage area and that a small volume was able to migrate into the PeeJay closure and into Upper Eastern View Group reservoirs. It may be that the oil originated from the deeper intervals at the PeeJay-1 location, migrating up fault planes. It may be that potential source rocks are lean and that migration distances from mature source rocks are too great to have been efficient.

In the deeper parts of the basin, Middle and Upper Eastern View Group coals are interpreted to have entered the oil generation window at the time of and following deposition of the sealing Demons Bluff Formation; i.e. after major trap forming structural events of the Late Cretaceous and Early Eocene. In shallower parts of the basin these source rock units continued to enter the oil expulsion window during and after Miocene structural reactivation events. PeeJay is interpreted as being a relatively early structure that has remained a valid hydrocarbon trapping mechanism through subsequent phases of basin deformation.

6.3 Seals

Shaly facies within the Demons Bluff Formation and the overlying Torquay Group should provide a competent seal for the Upper Eastern View Group reservoirs at PeeJay. Intraformational shales within the Upper Eastern View Group and upper Middle Eastern View Group are not as well developed as were expected.

Although not believed to be the case, failure to encounter hydrocarbons at PeeJay may be attributed, at least in part, to ineffective seal. It may be that small, crestal faults are more pervasive than seismic suggests.

7 TEMPERATURE

The maximum temperature recorded for PeeJay-1 was 77^{O}C (TD). No static temperatures were obtained and consequently this temperature must only be considered to be an indicative temperature. No wireline temperature surveys were run in PeeJay-1, however MWD/LWD logs recorded the following maximum temperatures:

Logging Tool String	Max Depth (m)	Max Temp (deg C)	Circulating Hours
SonicVISION	810.0	18	21.25
ArcVISION-SonicVISION-SadnVISION	1454.0	40	27.70
GeoVISION-SonicVISION	2183.0	77	85.40

8 EASTERN VIEW GROUP INTRUSIVES

A 63 metre thick volcanic sill was intersected towards the base of the well, within the Middle Eastern Group interval (2041 - 2104mMD). Such intrusions are common to the basin. A sample of drill cuttings obtained from PeeJay-1 was submitted by Carol Bacon, Mineral Resources Tasmania, to MRT Mineralogical / Petrology Laboratory for identification (Appendix 5).

The submitted material was determined to be probably a dolerite, but as some of the sample is fine grained, it has elements of being basaltic. A lack of olivine suggests the sample is not a typical Tasmanian basalt and secondary minerals are more typical of dolerites or weakly metamorphosed basaltic rocks.

A sample (interval 2083 - 2086m) was submitted by the Joint Venture to CSIRO for whole rock K - Ar dating. An age of 42.46Ma ±1.8 Ma was determined for the mafic material (Appendix 6).

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INTERPRETATIVE DATA.
Palynological analysis of cuttings samples between 910-20 and 2182-83 metres in PeeJay-1, offshore Bass Basin.

by

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Summary

Twenty cuttings samples have been analysed from the bottom 1270 metres penetrated in the PeeJay-1 well drilled by Beach Petroleum Ltd in permit T/39P in the offshore Bass Basin. The analysis has identified spore-pollen zones ranging in age from Early Miocene to Paleocene, and microplankton zones ranging in age from Early Miocene to late Middle Eocene, and this data has been combined with the cuttings lithologies and electric logs to subdivide the succession according to the latest stratigraphic terminology (Table 1). Extensive caving of Oligocene-Miocene dinocysts from the Torquay Group were also recorded in most of the Eastern View Group samples.

Table 1. Summary of palynological zones and stratigraphy in PeeJay-1.

Age	STRATIGRAPHY: Lennon *et al.* (1999)		STRATIGRAPHY: Partridge (2002b)		Spore-Pollen Zones (Microplankton Zones)	Depths mKB
Early Miocene to Late Oligocene	**TORQUAY GROUP**		**TORQUAY GROUP** 804† to 1013m		Middle *P. tuberculatus* Zone (*X. echiniferum* Zone)	910 to 950m 910 to 950m
Early Oligocene			**DEMONS BLUFF GROUP**	**Angahook Formation** 1013 to 1180m	Lower *P. tuberculatus* Zone (?*F. leos* Zone) Upper *N. asperus* Zone (?*F. leos* Zone to *P. comatum* Acme)	at 1110-15m (at 1110-15m) at 1155-60m (at 1155-60m)
Early Oligocene				**Squid Sandstone** 1180 to 1253m	Not Sampled	
Late Eocene	**Demons Bluff Formation**			**Anglesea Formation** 1253 to 1325m	Upper *N. asperus* Zone (*P. comatum* Acme) Middle *N. asperus* Zone	at 1255-60m (at 1255-60m) 1285 to 1315m
late Middle to Late Eocene	**EASTERN VIEW COAL MEASURES**	**UPPER**		**Boonah Sandstone** 1325 to 1390m	Lower *N. asperus* Zone (*D. heterophlycta* Zone)	1375 to 1483m (at 1375-78m)
Middle Eocene			**EASTERN VIEW GROUP**	**Poonboon Formation** 1390 to 1555m	Lower *N. asperus* Zone	1456 to 1483m
Early Eocene				**Cormorant Formation** 1555 to 1750m	*P. asperopolus* Zone to Upper *M. diversus* Zone	1561 to 1669m
Early Eocene to Paleocene		**MIDDLE**		**Narimba Formation** 1750 to 2041m	Middle *M. diversus* Zone Lower *M. diversus* Zone *L. balmei* Zone	at 1759-62m 1813 to 1933m at 2011-14m
Miocene?				**Dolerite Intrusion** 2041 to 2104m	Not Sampled	
Paleocene				**Narimba Formation** 2104 to 2183mTD	*L. balmei* Zone	2113 to 2183m

† Top of Torquay Group can only be confirmed to base of 13-3/8" casing shoe at 804m.

Introduction

Palynological analysis has been conducted on twenty cuttings samples over the bottom 1270 metres of the Cenozoic succession penetrated in the PeeJay-1 well drilled by Beach Petroleum Ltd in permit T/39P in the offshore Bass Basin. The objective of the study was to provide age dating of the succession penetrated using palynology.

A summary of the palynological zones, stratigraphic formations and ages determined in PeeJay-1 is provided in Table 1. Zones assignments, zone confidence ratings, and zone identification criteria for individual samples are provided in Table 2. Basic sample data comprising the lithologies and weights of samples processed are provided in Table 3. Basic assemblage data comprising the visual yields and palynomorph concentrations on the slides, the preservation of the palynomorph, and the number of species of spore-pollen and microplankton recorded from individual samples are given in Table 4. All palynological slides prepared are listed in Table 5. Finally, the distribution of all species identified are plotted on the accompanying StrataBugs™ range chart.

Materials and Methods: The cuttings samples analysed were selected and forwarded by geologists at Beach Petroleum Ltd directly to Core Laboratories Australia Pty Ltd, in Perth, for laboratory processing. The prepared palynological slides were received by the author for analysis on 3rd June 2009. Initial results of their microscope analysis were provided in three Provisional Palynological Report issued between the 20th and 28th July 2009.

The PeeJay-1 well was been drilled using the KCl-PHPA-Polymer drilling mud additive, and because this additive has previously caused difficulties with the laboratory extraction of the palynomorphs (resulting in low concentrations and poor palynomorphs on the microscope slides), some modifications to the industry standard processing procedure have been employed. Firstly, larger quantities of sample (ie. 35 to 50 gram, average 38 grams) were selected and then subjected to an initial soaking and washing in a detergent/solvent to dilute and remove the polymer mud additive. Secondly, as an extra precaution, the samples were all processed using a modification of the standard processing stream whereby the dispersed organic-matter (kerogen) and undissolved mineral matter remaining after the initial dissolution of the samples in hydrofluoric acid are oxidised with nitric acid **before** the density separation using zinc bromide solution. This modified procedure was specified to counteract processing difficulties caused by the impregnation of the palynomorphs with micron-size pyrite crystals, and any residual effects of the polymer drilling mud additive. Finally, the amount of oxidation given to the residues was increased with 3:00 minutes applied to the shallowest nine samples, and 4:00 minutes applied to the deepest eleven samples.

The microscope analysis consisted of an initial count of at approximately 150 palynomorphs to determine the proportion of spores and pollen to all types of organic-walled microplankton, as well as the relative proportions of spores, gymnosperm pollen and angiosperm pollen, within this count. Once these initial proportions were established and separately recorded, the slides were further scanned to record rare species, and to increase the number of specimens of either spore-pollen or microplankton in the counts for those samples with the most skewed assemblages.

Results: An average of 38 grams per sample was processed to give moderate to high organic-residue yields. The concentration of the palynomorphs in the residues based on examination of the prepared slides is typically moderate to high. In general, the preservation of palynomorphs is poor to fair, with relatively few samples containing well-preserved specimens. In contrast, the *in situ* palynomorphs recovered from the two samples adjacent to the dolerite intrusion are extremely poorly preserved because they are highly carbonized. Varying amounts of cavings are present in all the cuttings samples, with the samples from the sandy Early Eocene section judged to be the most detrimentally effected with caved palynomorphs constituting over 35% of the recorded assemblages. Across all samples the diversity of spores and pollen was moderate to high ranging from 18 to 50 species per sample (average 32+ species), while the diversity of microplankton recorded was low to moderate ranging from 4 to 23+ species (average 10+ species). Note however, that the recorded diversity of the microplankton within the Eastern View Group is mostly made up of species caved from the marine Demons Bluff and Torquay groups.

Description of Range Chart: The palynomorphs identified in the samples are documented on the accompanying StrataBugs™ range chart which displays the recorded species proportional to the sample depths, and in terms of either their percentage or absolute abundances. The palynomorphs recorded are also split between different groups. The first biostratigraphic panel on the chart is for the categories of spore-pollen, comprising the sum of all angiosperm-pollen, gymnosperm-pollen, and spores in the initial count. The next three panels labelled Spores, Gymnosperms Pollen and Angiosperm Pollen display the percentage abundances of the individual species within these three categories. The following panel for categories of microplankton (labelled MP%) displays the percentage abundance of selected groups of organic-walled microplankton groups, and is followed by panel for individual Microplankton species. The latter are expressed in absolute abundance as many MP specimen counts are too low to meaningfully display this data as percentage abundance. The final panel is for all Other palynomorph categories and species recorded, expressed as a percentage of the total spore-pollen and other palynomorphs in the count. The following codes or abbreviations apply to the individual species occurrences and abundances on the range chart:

Numbers	=	Percentage or Absolute abundances
+	=	Species outside of count
C	=	Caved species
R	=	Reworked species
?	=	Questionable identification of species.

Author citations for most of the recorded spore-pollen species can be sourced from the papers by Dettmann (1963), Dettmann & Playford (1968), Helby *et al.* (1987), Macphail (1999), Partridge (1973) and Stover & Partridge (1973) while the author citations for the microplankton species can be sourced from the indexes for dinocysts and other organic-walled microplankton prepared by Fensome *et al.* (1990) and Williams *et al.* (1998). Manuscript species names and combinations are indicated by “sp. nov.” or “comb. nov.” on the range charts.

Additional panels on the left side of the chart provide a depth scale, columns for the suggested stratigraphy according to Lennon et al. (1999) and Partridge (2002b), a lithological profile, selected electric logs, and the identified spore-pollen and microplankton zones. The picks for the palynological zone boundaries are wherever possible the actual samples analysed, but sometimes arbitrary log depths need to be added between samples so that there is sufficient space available in the columns for the zone names to be legibly printed on the charts. The lithological profile is plotted in terms of the percentages of "shale & limestone", "coal", "sand" and "dolerite" derived from the detailed cuttings descriptions. This display uses the electric log plotting function within the StrataBugs™ program, which only allows four curves (ie. lithologies) to be plotted in a single panel, and only provides a restricted selection of colours. Notwithstanding these limitations the resultant panel displays an approximate sand**:**shale ratio, which are far more informative than what can be achieved by using the program’s standard graphical procedure for displaying lithologies. Note also that the "shale & limestone" category represents the sum of all the fine-grained mudstone, claystone, siltstone and carbonate lithologies in the cuttings descriptions.

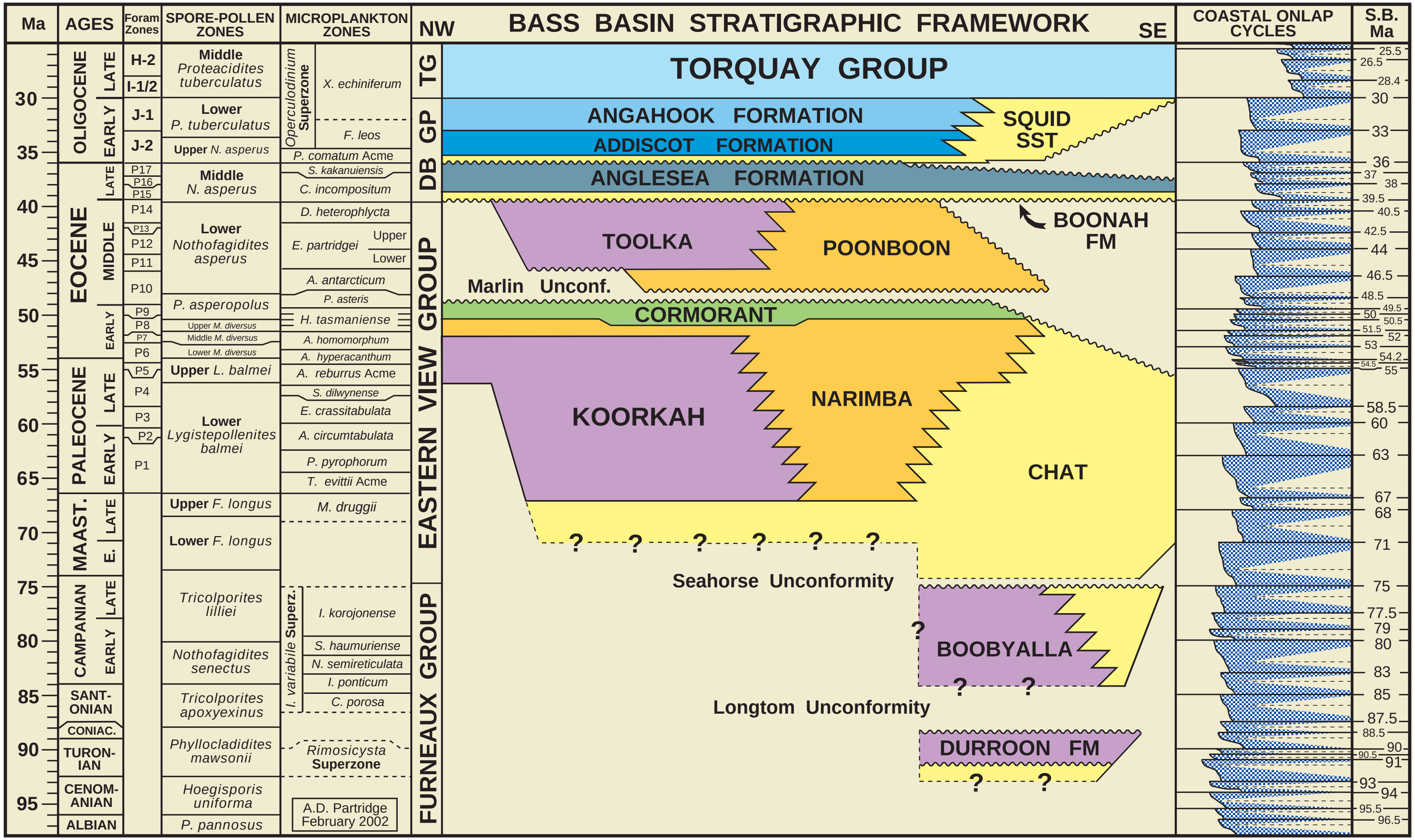

Figure 1. Stratigraphic framework for Bass Basin proposed by Partridge (2002b). Palynological and foraminiferal zones correlated to timescale of Haq *et al*. (1987). Demons Bluff Group abbreviated to DB GP, and Torquay Group to TG. Except for those labelled as formations new unit names are informal, as is Furneaux Group.

Geological Comments

The section analysed in PeeJay-1 effectively extends from the base of the 13-3/8 inch casing shoe at 804m to the TD of the well at 2183mMD. Subdivision of this 1379 metres of open hole section is summarised in Table1, according to the generalised stratigraphic terminology of Lennon *et al.* (1999; fig.3), and the more detailed nomenclature of Partridge (2002b; fig.3). The former terminology only distinguishes the marine Torquay Group, a thin restricted marine Demons Bluff Formation and a very broad Eastern View Coal Measure. The latter, more detailed nomenclature, carries into the Bass Basin proper the recent changes proposed in the Torquay Sub-basin by Holdgate *et al.* (2001), and recognises a number of additional informal formations within the Eastern View Group (Figure 1; which was originally published as figure 4.3 *in* Blevin, 2003). The following discussion of the stratigraphic units recognised in Peejay-1 is in descending stratigraphic order, and in terms of the more detailed subdivisions advocated by Partridge (2002b), with reference made to the earlier scheme of Lennon *et al.* (1999) where that is appropriate.

TORQUAY GROUP

The Torquay Group, over the open hole section being investigated in Peejay-1, is identified as extending from the base of the casing shoe at 804m to the bottom of consistent limestone lithologies in the cuttings descriptions at about 1020m, later adjusted to the electric log break at 1013m. This section has a Late Oligocene to Miocene age, and conforms to the original concept of the group proposed by Raggatt & Crespin (1955). In contrast, the Torquay Group as applied by Lennon *et al.* (1999) includes Early Oligocene section which was included in the original concept of the Demons Bluff Formation by Raggatt & Crespin (1955). Insufficient detail is available in the lithological descriptions, electric log profiles and palynology results to further subdivide the group into the component Jan Juc and Puebla formations established in the onshore Torquay Subbasin. The two shallowest samples analysed in PeeJay-1 at 910-20m and 940-50m are from the Torquay Group and both give earliest Miocene ages. They contain very similar assemblages and there is no evidence to support a zone boundary or time break between the two samples. It is therefore not possible to confidently tie the seismic marker purportedly identified between the samples with the global cycle charts of Haq *et al.* (1987). The best guess is that this seismic horizon would approximate the Top of Oligocene and thus should correlate to the 25.5 Ma sequence boundary (see Figure 1).

DEMONS BLUFF GROUP

Originally defined as the Demons Bluff Formation by Raggatt & Crespin (1955), this unit was later raised to the rank of group by Holdgate *et al.* (2001), and extended to incorporate the underlying Boonah Sandstone formation. The latter terminology was adopted and extended to the much larger Bass Basin by Partridge (2002b). Four formation are identified in this group in PeeJay-1 and these are discussed below in order of increasing stratigraphic age. The Demons Bluff Formation as recognised by Lennon *et al.* (1999) is equivalent to only the Anglesea Formation (Table 1).

Angahook Formation — 1013 to 1180 metres: The interval of light to dark grey, and slightly to moderately calcareous claystones between the base of consistent limestone and top of the youngest sandstones in the cuttings descriptions is here assigned to the Angahook Formation. This unit could grade into the older Addiscot Formation, but as no clear lithological break can be identified in the cuttings descriptions it is considered more appropriate to equate the latter unit with the underlying Squid Sandstone. The two cuttings analysed from this unit give good Early Oligocene ages. The shallower at 1110-15m is confidently assigned to the Lower *P. tuberculatus* Zone, while the deeper at 1155-60m is somewhat less confidently assigned to the top of the Upper *N. asperus* Zone.

Squid Sandstone — 1180 to 1253 metres: The appearance of yellow-brown stained sandstone in the cuttings descriptions at 1180m is taken as the top of the Squid Sandstone proposed by Partridge (2002a). The unit is considered approximately equivalent to the Addiscot Formation. Although no samples were analysed from the unit the occurrence of Upper *N. asperus* Zone age assignments in samples a short interval above, and from immediately below the bottom of the unit confirms a basal Oligocene age for the whole unit.

Anglesea Formation — 1253 to 1325 metres: The interval of dominantly dark grey "plastic" claystones in the cuttings descriptions between 1255 and 1372m (later adjusted to 1253 to 1325m on the electric logs) is correlated with the Anglesea Formation. Most previous papers on the basin, including Lennon *et al.* (1999), would equate this interval with the entire Demons Bluff Formation, in the Torquay Sub-basin. In other wells in the Bass Basin this organic-rich facies is known to contain a mixture of both spectacular and dismal palynological assemblages, largely depending on how successfully they have been processed in the laboratory. Unfortunately, the three samples analysed from this unit in PeeJay-1 are from the poorer end of the spectrum as they gave only moderately diverse assemblages (relative to other wells), in which the important index species are very rare. The presence of the Upper *N. asperus* Zone age in the sample at 1255-60m is consistent with what has been found in Squid-1 (Partridge, 2002a). The next deeper sample at 1285-90m, with an equally good assemblage, and the bottom sample at 1312-15m with the poorest assemblage are assigned to the Late Eocene Middle *N. asperus* Zone.

Boonah Sandstone — 1325 to 1390 metres: The return of sandstone lithologies in the cuttings at 1327m marks the top of the Boonah Sandstone. This unit has been considered part of the "Eastern View Coal Measures" by Lennon *et al* (1999) and most earlier authors, but is now assigned to the Demons Bluff Group as it lacks coals but consistently contains marine dinocysts, and is therefore interpreted to have been deposited in a "restricted" marine environment. The base of the unit in other wells has either been picked at the base of predominant sandstone lithology, or at the best log break immediately above the shallowest coal. In PeeJay-1 the occurrence of interpreted *in situ* marine dinocysts in the sample at 1375-78m belonging to the *D. heterophlycta* Zone favours the latter method for picking the base of the unit in this well. Such a pick is also more consistent with the thickness of the Boonah Sandstone observed in adjacent wells (Text-tables 1-2).

EASTERN VIEW GROUP

The Eastern View Group in the Bass Basin is interpreted by Partridge (2002b) as a mixed succession of coal measures and lacustrine sediments. The latter can either be of long duration palaeolakes represented by thick shaly succession depauperate in coals (eg. Koorkah and Toolka formations), or thinly bedded paralic lagoonal facies interbedded with the coal measures (eg. Cormorant Formation). These palaeolakes are non-marine in the Late Cretaceous and through most of the Paleocene but gradually become more marine through the latest Paleocene and Eocene. The environmental setting of these younger palaeolakes is best thought of as "restricted" marine or lagoonal as the basin was not permanently connected to the open ocean until the deposition of the Demons Bluff Group in the Late Eocene. The Eastern View Group has been subdivided into a number of informal formations by Partridge (2002b) which are summarised in Figure 1. These formations are notionally "time-rock" or allostratigraphic units[1] and consequently do not strictly conform to the *Australian Code of Stratigraphic Nomenclature 1964.*

[1] **Allostratigraphic unit:** Defined in *Third Edition — Glossary of Geology* (Bates & Jackson, 1987, p.17) as a mappable stratiform body of sedimentary rocks that is defined and identified on the basis of its bounding discontinuities.

Where PeeJay-1 is located in the south-eastern portion of the basin the well is remote from the marine influence entering the basin in the north-west, and consequently, the Middle Eocene to Paleocene portion of the Eastern View Group drilled in Peejay-1, appears to be composed entirely of fluvial and deltaic facies. All the marine microplankton found in the samples are interpreted to be caved from the Demons Bluff and Torquay groups. The only possible exception is the enigmatic *Paralecaniella indentata* which has been reported from other probable non-marine sections in the Bass Basin. However, this species still could still be caving down-the-hole. The only species that is indisputably *in situ* is the algal cyst *Circulisporites parvus*. This form is most typical of ephemeral local ponds and small lakes in non-marine environments and therefore is entirely consistent with the postulated fluvial and deltaic depositional environments. In terms of the stratigraphic terminology advocated by Lennon *et al.* (1999) the portion of the Eastern View Group drilled in Peejay-1 is equivalent to the Middle and Upper parts of their Eastern View Coal Measures.

Text-table 1: Formations Tops in selected wells in south-central Bass Basin.

TOPS (metres MD)	Narimba-1	Poonboon-1	Pelican-1	Pelican-2	Pelican-3	PeeJay-1	Squid-1
Squid Sandstone	1643	1730	1619	1653	1649	1180	1549
Anglesea Formation	1652	1755	1635	1673	1668	1253	1785
Boonah Sandstone	1793	1892	1755	1797	1789	1325	1852
Poonboon Formation	1857	1994	1897	1899	1907	1390	1927
Cormorant Formation	2044	2197	2161	2179	2047	1555	2205
Narimba Formation†	2580	2495	2491	2563	2289	1750	2576
Top *L. balmei* Zone	3358	2670	3067	2992	2418	1953	2630

† Upper portion of Narimba Formation belonging to Early Eocene *M. diversus* Zone.

Text-table 2: Thickness of formations in selected wells in south-central Bass Basin.

THICKNESS (metres)	Narimba-1	Poonboon-1	Pelican-1	Pelican-2	Pelican-3	PeeJay-1	Squid-1
Squid Sandstone	9	25	16	20	19	73	236
Anglesea Formation	141	137	120	124	121	72	67
Boonah Sandstone	64	102	142	102	118	65	75
Poonboon Formation	187	203	264	280	140	165	278
Cormorant Formation	536	298	330	384	242	195	371
Narimba Formation†	778	175	576	429	129	203	203

† Upper Narimba Formation belonging to Early Eocene *M. diversus* Zone.

Identification of the formations in the Eastern View Group is based on combining the palynological results. and a comparison with the stratigraphic successions encountered in the nearest adjacent wells as summarised in Text-tables 1 & 2. Three formation are identified within the Eastern View Group in PeeJay-1 and these are discussed below in order of increasing stratigraphic age:

Poonboon Formation — 1390 to 1555 metres: The interval from the shallowest coal to the base of major sandstone unit between 1510 and 1555m is assigned to the Poonboon Formation. Of the two samples analysed from this unit only the shallower at 1456-59m is believed to be representative yielding a good Lower *N. asperus* Zone. In contrast, the deeper sample at 1480-83m consists of 80% coal, and the dominance of this lithology has resulted in a highly biased or skewed assemblage which is not particularly diagnostic. The boundary between the Poonboon and Cormorant formations is considered by the author to correlate with the Marlin Channel unconformity in the Gippsland Basin (Figure 1). In PeeJay-1 the best lithological position for the equivalent sequence boundary would be at the base of the major sand between 1510 and 1555m.

Cormorant Formation — 1557 to 1750 metres: The next coal measures package from 1555 to 1675m, and the underling sandstone package from 1675 to 1750m, are assigned to the Cormorant Formation. The palynological assemblages recovered from the three samples in this interval are noteworthy in lacking key index species, and they were originally assigned to the Lower *N. asperus* Zone in the Provisional Reports. However, comparison with the formation thicknesses in the nearest adjacent wells indicated that this interpretation was unreasonable and further microscope study found enough evidence to reassign the samples to the *P. asperopolus* to Upper *M. diversus* zone interval. The bottom of this formation is correlated with the unconformity at the base of the Tuna-Flounder Channel in the Gippsland Basin.

Narimba Formation — 1750 to 2183 metres: The remaining 370 metres of sedimentary section down to TD (excluding the 63 metre thick dolerite intrusion) is assigned to the Narimba Formation. The Early Eocene part of this formation from 1750 to ~1954m notably contains a higher percentage of sand and coal in PeeJay-1 relative to the underlying Paleocene portion of the formation which is clearly more shaly. This change in grain-size of the sediment supply is interpreted to be a proximal expression of the initial opening up of the Bass Basin to marine influence at approximately the end of the Paleocene. The access of marine waters to the basin is argued to have increased the overall energy within the depositional system as well as allowing some of the fines to escape out of the basin. The finer grain-size of the Paleocene sediments in PeeJay-1 also suggest that lacustrine facies typical of the Koorkah Formation could occur deeper in the sedimentary succession at this locality.

DOLERITE INTRUSION

The igneous rock identified as a dolerite between 2041 and 2104m, is interpreted to be an intrusive based on the carbonization of the spore-pollen extracted from cuttings samples on either side of the unit. The shallower cuttings at 2011-14m, which is ~30 metres above the intrusion displays TAI (Thermal Alteration Index) values of >2.5 to 3.0, while the deeper cuttings at 2113-16m only 10 metres below the intrusion has higher values of more than 3.0 based on the colour of the spore-pollen using the empirical scale of Staplin (1969, 1977). These TAI values indicate that a narrow zone of sediments adjacent to the intrusion are sufficiently mature for the generation of hydrocarbons. These two assemblages also contain lighter coloured palynomorphs with TAIs of <2.0, which comprised between 25 and 40% of the assemblages and are obviously caved. The age of these intrusive rocks in PeeJay-1 is most likely Miocene based on the presence of extensive extrusive volcanics in that part of the section throughout the Bass Basin.

Biostratigraphy

The samples analysed in PeeJay-1 are classified according to the spore-pollen zonation originally established for the Gippsland Basin by Stover & Evans (1974) and Stover & Partridge (1973), and this scheme was adapted to the Bass Basin in an early study by Partridge (1973). The parallel microplankton zonation was originally outlined by Partridge (1975, 1976) but has not yet been formally published. The most recent accessible summary for both schemes is provided in the latest edition of the *Geology of Victoria* was prepared by Partridge & Dettmann (2003), while their correlation with latest Geologic Time Scale of Gradstein *et al.* (2004) is in accord with the chart prepared by Partridge (2006b).

Proteacidites tuberculatus spore-pollen Zone, and
Operculodinium microplankton Superzone
Interval: 910-20 to 1110-15 metres
Age: Oligocene to Miocene.

The two shallowest cuttings in this interval are dominated by microplankton (average 96%), while in the third and deepest sample at 1110-15m the microplankton (at 36%) are secondary to the spore-pollen. In all three samples the spore-pollen assemblages are dominated by *Nothofagidites* pollen (average 36%) with *Cyathidites* spp. (average 12%) and *Haloragacidites harrisii* (average 10%) the next most abundant. The occurrence of the spore *Cyathidites subtilis* in the two shallower samples confirm they belong to the Middle *P. tuberculatus* Zone, while the joint occurrence of spores *Cyatheacidites annulatus* and *Tripunctisporis maastrichtiensis*, and the angiosperm pollen *Granodiporites nebulosus* in the deepest sample assigns it to the Lower *P. tuberculatus* Zone.

The associated microplankton assemblages are dominated by *Spiniferites* spp. making all three samples consistent with the *Operculodinium* Superzone. This superzone is characteristic of the Oligocene to Recent marine carbonate successions present in all three Bass Strait basins but detailed knowledge of the microplankton succession and subdivision into formal zones is still very provisional. Accepting this caveat, the occurrence of *Operculodinium janduchenei* in association with *Xenicodinium echiniferum* (a senior synonym of the *Protoellipsodinium simplex* ms) in the two shallower samples is currently considered diagnostic of the upper part of the *Xenicodinium echiniferum* Zone. While a younger zone assignment is precluded by absence of *Tuberculodinium vancampoae*. The deepest sample at 1110-15m is considered no younger than the *Fromea leos* Zone based on the presence of *Glyphanodinium facetum*, which was not recorded above this zone in the recent study of Groper-1 by Partridge (2006a).

Dinocysts from *Operculodinium* Superzone are also recorded as caved species in all samples from the deeper Eastern View Group. The samples between 1813-16m and 1930-33m are the most contaminated with over one-third of their recorded assemblages interpreted as caved.

Upper _Nothofagidites asperus_ spore-pollen Zone, and
Phthanoperidinium comatum microplankton Acme
Interval: 1155-60 to 1255-60 metres
Age: Early Oligocene.

The definition of the Upper *N. asperus* Zone is based on negative criteria. It lies above the youngest occurrences of species that become extinct at the top of the older Middle *N. asperus* Zone, and below the oldest occurrences of species whose first appearances mark the base of the younger *P. tuberculatus* Zone. The two samples at 1155-60m to 1255-60m meet these criteria. Both spore-pollen assemblages are dominated by *Nothofagidites* spp. (average 52%), with secondary abundances of *Haloragacidites harrisii* (average 12%), *Podocarpidites* spp. (average 11%) and *Cyathidites* spp. (average 9%). The only species that can be considered distinctive of the two assemblages are *Aglaoreidia qualumis* and *Beaupreaidites elegansiformis* which are both frequent with abundances of 1 to 2%.

Both samples also conform to the *Phthanoperidinium comatum* Acme, based on the common to abundant occurrence of *Phthanoperidinium eocenicum* which constitutes 8% of the microplankton count at 1155-60m and 55% at 1255-60m. However, as the zone species *Phthanoperidinium comatum* was only recorded from the deeper sample, the shallower sample could still belong to the younger *Fromea leos* Zone. Other noteworthy microplankton in the samples are the presence of the fresh-water colonial algae *Pediastrum* at 1155-60m, and the dinocysts *Deflandrea phosphoritica* and *Arachnodinium antarcticum* at 1255-60m. All three species were recorded by Partridge (2002a) at the equivalent stratigraphic level in Squid-1.

Middle *Nothofagidites asperus* spore-pollen Zone
Interval: 1285-90 to 1312-15 metres
Age: Late Eocene.

The top sample at 1285-90m is no younger than the Middle *N. asperus* Zone based on youngest occurrences of the angiosperm pollen *Proteacidites adenanthoides* and *P. pachypolus* which do not range above this zone (or the top of the Eocene), while an age no older than the upper part of this zone is confirmed by the presence of *Proteacidites rectomarginis*, which has its oldest occurrence within the top half of the zone. Overall, the assemblage is dominated by *Nothofagidites* spp. (31%) with secondary *Haloragacidites harrisii* (21%) and *Cyathidites* spp. (9%). The bottom sample at 1312-15m is a much leaner assemblage (as is often the case with samples from the Anglesea Formation), and is assigned to the zone solely based on its stratigraphic superposition, as it lacks any diagnostic index species. The much lower assemblage count from the bottom sample is dominated by *Nothofagidites* spp. (49%) and *H. harrisii* (25%).

The associated microplankton in both samples are not diagnostic and are interpreted to be mostly caved from the overlying *P. comatum* Acme zone.

Lower *Nothofagidites asperus* spore-pollen Zone
Interval: 1375-78 to 1480-83 metres, possibly extending to 1561-64 metres
Age: Middle Eocene.

In the original concept of the parent *N. asperus* Zone proposed by Stover & Evans (1974; p.60) the base of the zone was identified by a sudden and dramatic increase in the abundance of the pollen of *Nothofagidites* spp. and corresponding sharp decline in the relative abundance of *Haloragacidites harrisii*. To supplement this original concept Stover & Partridge (1973; p.241-242) provided a list of species whose oldest occurrences are close to the base of the zone (eg. *Nothofagidites falcatus*, *Tricolpites simatus* and *Tricolporites leuros*), and a corresponding list of species whose youngest occurrences (extinctions) are at the top of the next older *P. asperopolus* Zone (eg. *Myrtaceidites tenuis*, *Proteacidites ornatus* and *Intratriporopollenites notabilis*). Unfortunately, neither of these formal criteria can be applied with any degree of confidence to the cuttings analysed in PeeJay-1. The change from assemblages with conspicuous abundances of *H. harrisii* to those with high *Nothofagidites* spp. is too diffuse (possibly as a consequence of cavings in the cuttings), while the most important index species have simply not been consistently found on the slides available for analysis. Because of these difficulties each of the assemblages are discussed separately below:

The shallowest sample in the interval at 1375-78m is no older than the Lower *N. asperus* Zone based on the presence of *Proteacidites recavus* and *Rugulatisporites trophus*. In contrast, the occurrence of *Proteacidites rectomarginis* is considered anomalous and is probably caved. Overall the assemblage displays equal abundances of *Nothofagidites* spp. and *H. harrisii* at about 16%. A position near the top of the zone is nevertheless supported by the occurrence of the dinocyst *Deflandrea heterophlycta* which is the marker for the late Middle Eocene *D. heterophlycta* Zone.

The composition of the next cuttings at 1456-59m is much more typical of the Lower *N. asperus* Zone with *Nothofagidites* spp. at 51%, markedly more abundant than *H. harrisii* at only 6%. However, none of the key index species were found in this sample, and none of the associated dinocysts are of any help as they all appear to be caved.

The third sample assigned to the zone at 1480-83m is even more problematic, primarily because the recorded lithology is 80% coal which has yielded skewed facies assemblage dominated by nondescript small species of *Proteacidites* spp. (38%), and abundant spores of *Laevigatosporites ovatus* (34%), neither of which are zone diagnostic. Again, no key zone index species were found, and while *Nothofagidites* spp. at 9%, is certainly more abundant than *H. harrisii* at 4%, neither are particularly prominent. This sample is still assign to the Lower *N. asperus* Zone, but with a very low confidence rating.

The deepest sample potentially belonging to Lower *N. asperus* Zone is the cuttings at 1561-64m which is dominated by *Proteacidites* spp. at 32%, and the large spore *Cyathidites splendens* at 17%. While *Nothofagidites* spp. at 11%, is again significantly more abundant than *H. harrisii* at 4%, neither are particularly prominent. The most conspicuous aspect of this assemblage is the common occurrence of *Proteacidites leightonii* at 7%. Abundance of this species are generally only typical of the basal part of the Lower *N. asperus* and the older *P. asperopolus* zones. Furthermore, some of the specimens of *P. leightonii* are morphologically transitional to *Proteacidites ornatus* and have questionably been referred to the latter species on the range chart. Because *P. ornatus* does not usually range above the *P. asperopolus* Zone, this older zone assignment is equally likely. Other features suggestive of the latter Early Eocene zone are the common occurrence of *Dicotetradites clavatus* (8%) and the youngest occurrences in PeeJay-1 of the species *Dryptopollenites semilunatus* and *Ephedra notensis*.

***Proteacidites asperopolus* to Upper *Malvacipollis diversus* spore-pollen Zones**
Interval: 1597-1600 to 1666-69 metres, probably extending up to 1561-64 metres
Age: Early Eocene.

The most diagnostic species of these two zones are *Proteacidites pachypolus*, *P. asperopolus* and *Myrtaceidites tenuis*, but unfortunately none of these three species were found in this interval in PeeJay-1. This is both surprising and atypical, and identification of these two zones consequently has to rely on secondary index species.

The sample at 1597-1600m is best assigned to the *P. asperopolus* Zone based on the youngest occurrence of *Intratriporopollenites notabilis*, which usually does not range above this zone and the oldest occurrence of *Sapotaceoidaepollenites rotundus*, which does not range below the zone. Supporting this zone assignment is the youngest occurrence of frequent *Proteacidites grandis* (3%) and the presence of questionable *Proteacidites ornatus*. The overall composition of the assemblage is also consistent with the zone pick as the assemblage is dominated by *Haloragacidites harrisii* at 33%, while *Nothofagidites* spp. are very much secondary at 12%. However, caution needs to be used when relying on these abundances as the lithology of this cuttings is recorded as 30% coal, and assemblages from coals within the Lower *N. asperus* Zone can have high abundances of *H. harrisii*.

In contrast, the composition of the deeper sample at 1666-69 metres is most similar to the Lower *N. asperus* Zone with abundant *Nothofagidites* spp. at 32%, while *H. harrisii* at 11% is very much secondary. The sample also contains the oldest occurrence of the index species *Nothofagidites falcatus*, yet lacks any species known to be restricted to the Early Eocene. Consequently, if the overlying sample at 1597-1600m is accepted as belonging to the *P. asperopolus* Zone, the bulk of this deeper sample must be considered caved. Therefore the best that can be said about this sample is that it has a potential age range of extending from Lower *N. asperus* Zone to Upper *M. diversus* Zone.

Middle *Malvacipollis diversus* spore-pollen Zone
Sample at: 1759-62 metres
Age: Early Eocene.

The Middle *M. diversus* Zone is defined as the interval from the oldest occurrences of one or more of the species *Proteacidites ornatus, P. tuberculiformis* and *P. xestoformis* ms to the oldest occurrences of *Proteacidites pachypolus* and/or *Myrtaceidites tenuis*. The sample at 1759-62m, which is assigned to this zone, contains *Proteacidites ornatus* and lacks younger index species. Although no single species dominates the assemblage there are several species that are common. In order of abundance these are *Laevigatosporites ovatus* (14%), *Podocarpidites* spp. (13%), *Proteacidites* spp. (12%) and *Dilwynites granulatus* and *Nothofagidites* spp. both at 10%. The assemblage also shows affinity with the underlying Lower *M. diversus* Zone with frequent *Proteacidites grandis* (3%) and *Malvacipollis* spp. (2%). Microplankton at 4.5% are minor in the assemblage and are equally split between caved Oligo-Miocene dinocysts and the *in situ* algal cyst *Circulodinium parvus*.

Lower *Malvacipollis diversus* spore-pollen Zone
Interval: 1813-16 to 1930-33 metres
Age: Early Eocene.

The Lower *M. diversus* Zone is readily distinguished from the *L. balmei* Zone by an abrupt change from gymnosperm to angiosperm pollen dominated assemblages, while the top of the zone is usually placed at the sample immediately below the oldest occurrences of the key index species diagnostic of the younger Middle and Upper subdivisions, as there are few species which actually go extinct in the Lower subdivision. However, the Lower *M. diversus* Zone can be characteristic by the additional criteria of the frequent to common occurrences of *Malvacipollis diversus, M. subtilis*, and *Proteacidites grandis*, while *Haloragacidites harrisii* tends to gradually increase in abundance through the zone. In contrast, pollen of *Nothofagidites* spp. are generally rare.

In PeeJay-1 assignment of the three samples to the Lower *M. diversus* Zone is complicated by the fact that between 35% and 45% of the assemblages are comprised of caved specimens. Most of the caved palynomorphs are Oligo-Miocene dinocysts from the Torquay and upper Demons Bluff groups, but it likely that a large proportion of the *Nothofagidites* pollen recorded in the shallower two samples are also caved. However, the common occurrences of *Proteacidites grandis* (average 5%) and *Malvacipollis* spp. (average >2%) are considered diagnostic of the zone. Other diagnostic feature are the youngest occurrence of *Peninsulapollis gillii* recorded at 1930-33m, while *Haloragacidites harrisii* increases from 4% in the bottom sample to 8% in the top sample.

***Lygistepollenites balmei* spore-pollen Zone**
Interval: 2011-14 to 2182-83 metres
Age: Paleocene.

The bottom three samples analysed can all be assigned to *L. balmei* Zone based on the overall similarity of their assemblages, which are dominated by gymnosperm pollen (average 68%). The species *Podocarpidites* spp. (average 38%) and *Phyllocladidites mawsonii* (average 22%) are the most abundant gymnosperm pollen, while *Nothofagidites endurus* (average 12%) is the most abundant angiosperm pollen. No other species have average abundances of more than 5%. Zone index species are exceptionally rare with the youngest occurrence of *Gambierina rudata* recorded at 2113-16m and the youngest occurrences of *Lygistepollenites balmei* and *Australopollis obscurus* recorded in the bottom hole cuttings. The whole interval may be no older than the Upper subzone based on the occurrence of a single specimen of *Proteacidites grandis* in the deepest cuttings, but as no other index species for the Upper subzone were recorded the confidence in such an assignment is extremely low.

One reason for the paucity of zone index species is that the two shallower samples are close to the dolerite intrusion in the well and the assemblages from these samples are highly carbonized and poorly preserved making the search for, and identification of, the index species very difficult. These samples also contain obvious downhole cavings which make up a minimum of 25% to 50% of the assemblages.

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Table 2. Interpretative palynological data from PeeJay-1, Bass Basin.

Sample Type	Depth metres	Spore-Pollen Subzones (Microplankton Subzones)	CR	Comments and Key Species Present
Cuttings	910-920m	Middle *P. tuberculatus* Zone (*Operculodinium* Superzone and *X. echiniferum* Zone)	D3 D3	MP >95% of combined SP + MP count; dominated by *Spiniferites* spp. at 60%, and *Lingulodinium* sp. at 15% of MP count.
Cuttings	940-950m	Middle *P. tuberculatus* Zone (*Operculodinium* Superzone and *X. echiniferum* Zone)	D3 D3	MP >97%; dominated by *Spiniferites* spp. at 61%. FADs of dinocyst *Operculodinium janduchenei* and the spore *Cyathidites subtilis.*
Cuttings	1110-1115m	Lower *P. tuberculatus* Zone (*Operculodinium* Superzone and probable *F. leos* Zone)	D1 D5	MP >35%; dominated by *Spiniferites* spp. at 63%. LADs of dinocyst *Glyphanodinium facetum*, spore *Tripunctisporis maastrichtiensis*, and angiosperm pollen *Granodiporites nebulosus*.
Cuttings	1155-1160m	Upper *N. asperus* Zone (possible *F. leos* Zone or *P. comatum* Acme)	D4 D4	MP 12%; dominated by *Spiniferites* spp. at 55%, with *Phthanoperidinium eocenicum* at 8%. Spore-pollen assemblage contains *Proteacidites rectomarginis, P. stipplatus* and local LAD of angiosperm pollen *Aglaoreidia qualumis.*
Cuttings	1255-1260m	Upper *N. asperus* Zone (*P. comatum* Acme)	D4 D3	MP 17%; dominated by *Phthanoperidinium* spp. at >50%, and containing LAD of index species *Phthanoperidinium comatum.*
Cuttings	1285-1290m	Middle *N. asperus* Zone (caved? *P. comatum* Acme)	D4 D5	MP <10%; dominated by *Phthanoperidinium* spp. at ~50% of MP count. LADs of *Proteacidites adenanthoides* and *P. pachypolus.*
Cuttings	1312-1315m	Middle *N. asperus* Zone (caved? *P. comatum* Acme)	D5 D5	Lean assemblage with <50 palynomorphs per slide. MP 27%; but most interpreted as caved. SP assemblage dominated by *Nothofagidites* spp. at 47%, and *Haloragacidites harrisii* at 25%.
Cuttings	1375-1378m	Lower *N. asperus* Zone (*D. heterophlycta* Zone)	D4 D3	MP 15%; with FAD of *Deflandrea heterophlycta*. SP equally dominated by *Nothofagidites* spp. and *Haloragacidites harrisii* at ~16%.
Cuttings	1456-1459m	Lower *N. asperus* Zone	D4	SP dominated by *Nothofagidites* spp. at 51%, with *Haloragacidites harrisii* only 6%. MP only 7%; with all species CAVED.
Cuttings	1480-1483m	Lower *N. asperus* Zone	D5	Cuttings comprised of 80% coal gave a skewed assemblage dominated by *Proteacidites* spp. at 38%, and *Laevigatosporites ovatus* at 34%. MP only 3%; with all species CAVED.
Cuttings	1561-1564m	Lower *N. asperus* Zone to *P. asperopolus* Zone	D5	Assemblage dominated by *Proteacidites* spp. at 32% (including *Proteacidites leightonii* 7%); with LADs of common *Dicotetradites clavatus* (8%), and questionable *Proteacidites ornatus.* MP only 3%, with most species CAVED.
Cuttings	1597-1600m	*P. asperopolus* Zone	D4	LAD of *Intratriporopollenites notabilis* and FAD of *Sapotaceoidaepollenites rotundus* in skewed assemblage dominated by *Haloragacidites harrisii* at 33%, and *Proteacidites* spp. 16%. MP <2%, with most specimens CAVED.

Table 2. Interpretative palynological data from PeeJay-1, Bass Basin (cont.).

Sample Type	Depth metres	Spore-Pollen Subzones (Microplankton Subzones)	CR	Comments and Key Species Present
Cuttings	1666-1669m	Lower *N. asperus* Zone to Upper *M. diversus* Zone	D5	*Nothofagidites* spp. 32% (including FAD of *Nothofagidites falcatus*), versus *H. harrisii* 11%; without presence of any known Early Eocene index species. MP ~15% but all species CAVED.
Cuttings	1759-1762m	Middle *M. diversus* Zone	D2	FAD of *Proteacidites ornatus* with presence of *Intratriporopollenites notabilis* confirms zone assignment. *Nothofagidites* spp. and *H. harrisii* are equally common at 10%. MP 4.5% mostly CAVED, with *in situ* MP only 1.3%.
Cuttings	1813-1816m	Lower *M. diversus* Zone	D2	Common *Proteacidites grandis* (7%) and frequent *Malvacipollis subtilis* (4%) confirm zone pick in assemblage which is est. >40% caved. MP >30%, with all species CAVED.
Cuttings	1894-1897m	Lower *M. diversus* Zone	D2	Common *Proteacidites grandis* (7%) and frequent *Malvacipollis subtilis* (3%), confirms zone pick. MP >30%, with all species CAVED.
Cuttings	1930-1933m	Lower *M. diversus* Zone	D2	FADs of frequent *Haloragacidites harrisii* (4%) and *Proteacidites grandis* (3%) confirm base of zone in assemblage which is est. >35% CAVED.
Cuttings	2011-2014m	*L. balmei* Zone	D4	Carbonized *in situ* assemblage dominated by gymnosperm pollen *Phyllocladidites mawsonii* (36%), *Podocarpidites* spp. (27%), with angiosperm pollen *Nothofagidites endurus* (11%). Caved non-carbonized palynomorphs >25% of total combined count. Caved MP common at 7%.
Cuttings	2113-2116m	*L. balmei* Zone	D3	LAD of *Gambierina rudata* confirms zone pick. Very poor assemblage with ~40% indeterminate palynomorphs, 30% carbonized SP, and 20% caved Oligo-Miocene dinocysts, and 10% caved (light-coloured) spore-pollen specimens.
Cuttings	2182-2183m	*L. balmei* Zone	D2	LAD of zone index *Lygistepollenites balmei* in assemblage dominated by gymnosperm pollen *Podocarpidites* spp. (32%) and *Phyllocladidites mawsonii* (22%). MP 5%, mostly CAVED.

FAD & LAD = First and Last 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 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 without key zone species.
E	Junk basket	**5**	**Very low confidence:**	Low diversity assemblage without key zone species.

Table 3. Basic sample data for PeeJay-1, offshore Bass Basin.

Sample Type	Depth metres	Lithology	Weight grams
Cuttings	910-20m	Claystone 70%, dark grey, slightly calcareous; Limestone 30%, light yellow-brown, biocalcarentite	35.9
Cuttings	940-50m	Claystone 90%, med-dark grey, slightly calcareous, soft & plastic: Limestone 10%, yellow-brown grey, fine-medium.	36.1
Cuttings	1110-15m	Claystone 100%, med-olive grey, slightly-moderately calcareous.	35.9
Cuttings	1155-60m	Claystone 100%, medium grey, non to slightly calcareous	35.8
Cuttings	1255-60m	Claystone 100%, medium-dark grey, non to slightly calcareous	35.5
Cuttings	1285-90m	Claystone 100%, medium-dark grey, non to slightly calcareous	36.0
Cuttings	1312-15m	Claystone 100%, medium-dark grey, non to slightly calcareous	35.1
Cuttings	1375-78m	Claystone 80%, brownish grey, non to slightly calcareous; Sandstone 10%, olive grey, quartzose	36.0
Cuttings	1456-59m	Claystone 100%, brown grey to yellow brown, slightly arenaceous, trace carbonaceous flecks.	35.8
Cuttings	1480-83m	Coal 80%, sub-bituminous; Sandstone 20%, quartzose, medium-coarse, white calcite(?) cement.	35.3
Cuttings	1561-64m	Claystone 90%, yellow-brown to medium grey, slightly calcareous; Sandstone 10%, quartzose, fine-coarse; trace Coal.	35.5
Cuttings	1597-1600m	Claystone 60%, yellow-brown grey to med. grey, sl. calcareous; Coal 30%; Sandstone 10%, quartzose, medium-coarse.	35.1
Cuttings	1666-69m	Claystone 80%, brown-olive grey, slightly calcareous; Sandstone 20%, quartzose, med-coarse, frequent pyrite.	36.0
Cuttings	1759-62m	Claystone 60%, light-brown to olive grey, slightly calcareous; Coal 30%; Sandstone 10%, quartzose, medium-coarse.	35.8
Cuttings	1813-16m	Claystone 60%, blue-grey, tr. yellowish brown, slightly calcareous; Sandstone 40%, quartzose, med-coarse.	35.7
Cuttings	1894-97m	Claystone 90%, brown-olive grey, grading to siltstone, sl. calc.; Sandstone 40%, quartzose, med-crs, tr. pyrite; trace Coal.	35.1
Cuttings	1930-33m	Claystone 90%, brown-grey to black, arenaceous; Sandstone 10%, quartzose, med-crs; trace Coal.	35.7
Cuttings	2011-14m	Claystone 100%, brown-olive grey, slightly calcareous.	49.7
Cuttings	2113-16m	Claystone 100%, dark grey-black, silty/arenaceous.	48.3
Cuttings	2182-83m	Claystone 70%, brown-black to olive grey, sl. calcareous; Coal 20%; Sandstone 10%, quartz, fine-medium, trace pyrite.	48.9
		Average Sample Weight Processed:	**37.6**

Note: The Weight in grams column gives the sample weights recorded by the processing laboratory.

Table 4. Basic palynological assemblage data for PeeJay-1, Bass Basin.

Sample Type	Depth metres	Visual Yield	Palynomorph Concentration	Palynomorph Preservation	No. SP Species	No. MP Species
Cuttings	910-20m	Moderate	High	Poor	23+	23+
Cuttings	940-50m	Moderate	High	Poor-Fair	19+	23+
Cuttings	1110-15m	Moderate	High	Poor-Fair	48+	14+
Cuttings	1155-60m	Moderate	High	Fair-Good	36+	18+
Cuttings	1255-60m	High	High	Poor	37+	14+
Cuttings	1285-90m	Moderate	Moderate	Poor	36+	11+
Cuttings	1312-15m	Moderate	Low	Very Poor	18+	9+
Cuttings	1375-78m	Moderate	Moderate	Poor-Good	50+	9+
Cuttings	1456-59m	High	High	Poor-Fair	30+	9+
Cuttings	1480-83m	Moderate	Moderate	Poor-Fair	20+	4+
Cuttings	1561-64m	High	High	Poor-Fair	42+	8+
Cuttings	1597-1600m	Moderate	High	Poor-Fair	41+	5+
Cuttings	1666-69m	Moderate	Moderate	Poor-Fair	37+	8+
Cuttings	1759-62m	High	High	Poor-Fair	34+	6+
Cuttings	1813-16m	Moderate	Moderate	Poor-Fair	31+	12+
Cuttings	1894-97m	Moderate	Moderate	Poor-Fair	30+	6+
Cuttings	1930-33m	Moderate	Moderate	Poor-Fair	33+	9+
Cuttings	2011-14m	High	Moderate	Very Poor	28+	5+
Cuttings	2113-16m	Moderate	Moderate	Very Poor	18+	6+
Cuttings	2182-83m	High	Moderate	Poor	34+	4+
				Average:	**32+**	**10+**

Table 5. Palynological slides from PeeJay-1, offshore Bass Basin.

No.	Depth Metres	Sample Type	Catalogue Number	Core Lab. Prep. No.	Description
1	910-20	Cuttings		11035	Oxidised Slide 1
2	910-20	Cuttings		11035	Oxidised Slide 2
3	910-20	Cuttings		11035	Oxidised Slide 3
4	940-50	Cuttings		11036	Oxidised Slide 1
5	940-50	Cuttings		11036	Oxidised Slide 2
6	940-50	Cuttings		11036	Oxidised Slide 3
7	1110-15	Cuttings		11037	Oxidised Slide 1
8	1110-15	Cuttings		11037	Oxidised Slide 2
9	1110-15	Cuttings		11037	Oxidised Slide 3
10	1155-60	Cuttings		11038	Oxidised Slide 1
11	1155-60	Cuttings		11038	Oxidised Slide 2
12	1155-60	Cuttings		11038	Oxidised Slide 3
13	1255-60	Cuttings		11039	Oxidised Slide 1
14	1255-60	Cuttings		11039	Oxidised Slide 2
15	1255-60	Cuttings		11039	Oxidised Slide 3
16	1255-60	Cuttings		11039	Oxidised Slide 4
17	1285-90	Cuttings		11040	Oxidised Slide 1
18	1285-90	Cuttings		11040	Oxidised Slide 2
19	1285-90	Cuttings		11040	Oxidised Slide 3
20	1312-15	Cuttings		11041	Oxidised Slide 1
21	1312-15	Cuttings		11041	Oxidised Slide 2
22	1312-15	Cuttings		11041	Oxidised Slide 3
23	1375-78	Cuttings		11042	Oxidised Slide 1
24	1375-78	Cuttings		11042	Oxidised Slide 2
25	1375-78	Cuttings		11042	Oxidised Slide 3
26	1456-59	Cuttings		11043	Oxidised Slide 1
27	1456-59	Cuttings		11043	Oxidised Slide 2
28	1456-59	Cuttings		11043	Oxidised Slide 3
29	1480-83	Cuttings		11044	Oxidised Slide 1
30	1480-83	Cuttings		11044	Oxidised Slide 2
31	1480-83	Cuttings		11044	Oxidised Slide 3
32	1561-64	Cuttings		11045	Oxidised Slide 1
33	1561-64	Cuttings		11045	Oxidised Slide 2
34	1561-64	Cuttings		11045	Oxidised Slide 3
35	1597-1600	Cuttings		11046	Oxidised Slide 1
36	1597-1600	Cuttings		11046	Oxidised Slide 2
37	1597-1600	Cuttings		11046	Oxidised Slide 3
38	1666-69	Cuttings		11047	Oxidised Slide 1
39	1666-69	Cuttings		11047	Oxidised Slide 2
40	1666-69	Cuttings		11047	Oxidised Slide 3
41	1759-62	Cuttings		11048	Oxidised Slide 1
42	1759-62	Cuttings		11048	Oxidised Slide 2
43	1759-62	Cuttings		11048	Oxidised Slide 3

Table 5. Palynological slides from PeeJay-1, offshore Bass Basin (cont.).

No.	Depth Metres	Sample Type	Catalogue Number	Core Lab. Prep. No.	Description
44	1813-16	Cuttings		11049	Oxidised Slide 1
45	1813-16	Cuttings		11049	Oxidised Slide 2
46	1813-16	Cuttings		11049	Oxidised Slide 3
47	1894-97	Cuttings		11050	Oxidised Slide 1
48	1894-97	Cuttings		11050	Oxidised Slide 2
49	1894-97	Cuttings		11050	Oxidised Slide 3
50	1930-33	Cuttings		11051	Oxidised Slide 1
51	1930-33	Cuttings		11051	Oxidised Slide 2
52	1930-33	Cuttings		11051	Oxidised Slide 3
53	2011-14	Cuttings		11093	Oxidised Slide 1
54	2011-14	Cuttings		11093	Oxidised Slide 2
55	2011-14	Cuttings		11093	Oxidised Slide 3
56	2113-16	Cuttings		11094	Oxidised Slide 1
57	2113-16	Cuttings		11094	Oxidised Slide 2
58	2113-16	Cuttings		11094	Oxidised Slide 3
59	2182-83	Cuttings		11095	Oxidised Slide 1
60	2182-83	Cuttings		11095	Oxidised Slide 2
61	2182-83	Cuttings		11095	Oxidised Slide 3

Well Name : PeeJay-1

Operator : Beach Petroleum Ltd — Spudded : 15 November 2008
Well Code : PEEJAY-1 — Completed : 04 December 2008
Lat/Long : 40°29' 47.90"S 146°21' 35.45"E
Interval : 890m - 2210m — INTERPRETATIVE Range Chart
Scale : 1:5000 — Sample interval 910-20m to 2182-83m
Chart date : 29 August 2009 — Microscope analysis by Alan D. Partridge

PeeJay-1

Biostrata Pty Ltd
AUSTRALIA

Attachment to Biostrata Report 2009/15A

PeeJay-1
Petrophysics Report
T/39P Tasmania

Petrophysicist: A. Cernovskis

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Revision	Date	Issued by	Approved by
0	November 09	Angie Cernovskis	

SUMMARY

PeeJay-1 drilled by Beach Petroleum Ltd spudded on 15 November 2008 and drilled to a total depth of 2183mMDRT (-2148.9mTVDSS). The well path was vertical.

Hydrocarbon shows recorded during drilling operations consisted of minor elevated mud gas reading 1600-1700mMD and fluorescence shows 1615-1624mMD; 1634-1639mMD; 1639-1654mMD, (refer PeeJay-1 Mudlog Log; Well Completion Report Basic Data). Formation evaluation consisted of Logging While Drilling (LWD).

This report presents an interpretation of the LWD open-hole wireline logs, the methods used and results obtained.

Note that all depths quoted in this report are logged mMDRT unless otherwise specified.

CONCLUSIONS

The results of the log analysis are presented in Table 1 with reservoir statistics calculated based the following cut-offs: PHIE >8% and VCLAY <50% cut-off.

The results of this analysis indicate there were no moveable hydrocarbon zones intersected by the well.

PeeJay-1 Petrophysics Summary

PEEJAY-1								
PETROPHYSICAL SUMMARY								
Date		**7-Dec-08**						
Depth Reference		**Measured Depth**						
Vclay estimate from		**GR_RAB**						
Porosity estimate from		**DTCO**						
SW		**Simandoux eqn; Rw 40kppm NaClequivalent; a=1, m=2, n=2**						
Net Pay Based on Cutoffs:								
Vclay		**50%**						
PHIE		**8%**						
SWE		**n/a**						
Formation	**DEPTH**		**THICKNESS**		**AVERAGE PARAMETERS**			**Comments**
			Reservoir		**Matrix**			
	Top	**Bottom**	**GROSS**	**NET**	**Vclay**	**PHIE**	**SWE**	
	mMD	**mMD**	**mMD**	**mMD**	**%**	**%**	**%**	
U Eastern View Gp	1325.0	1384.9	59.9	34.9	27.3	24.5	100.0	
	1385.0	1454.9	69.9	33.3	30.6	23.2	100.0	
	1455.0	1459.9	4.9	0.0				
	1460.0	1470.9	10.9	10.4	18.2	25.4	100.0	
	1471.0	1484.9	13.9	0.0				
	1485.0	1498.4	13.4	13.4	5.8	28.9	100.0	
	1498.5	1504.9	6.4	0.0				
	1505.0	1515.5	10.5	10.5	7.9	28.7	100.0	
	1515.6	1518.9	3.3	0.0				
	1519.0	1553.4	34.4	31.4	15.0	27.1	100.0	
	1553.5	1567.4	13.9	0.0				
	1567.5	1572.9	5.4	5.4	29.4	21.6	100.0	
	1573.0	1582.4	9.4	0.0				
	1582.5	1584.9	2.4	1.8	18.0	25.5	100.0	
	1585.0	1587.4	2.4	0.0				
	1587.5	1591.9	4.4	4.0	21.3	24.1	100.0	
	1592.0	1599.9	7.9	0.0				
M Eastern View Gp	1600.0	1663.9	63.9	53.2	10.3	25.1	100.0	SST; Mnr increase in mud gas; HC Flu in cuttings 1615-1624mMD; 1634-1639mMD; 1639-1654mMD; Water Saturated
	1664.0	1667.9	3.9	0.0				
	1668.0	1697.9	29.9	8.5	6.7	25.8	100.0	
	1698.0	1700.9	2.9	0.0				
	1701.0	1724.4	23.4	12.4	7.2	24.8	100.0	
	1724.5	1729.4	4.9	0.0				
	1729.5	1754.9	25.4	20.6	17.5	23.1	100.0	
	1755.0	1764.9	9.9	0.0				
	1765.0	1795.9	30.9	30.9	20.8	21.6	100.0	
	1796.0	1812.4	16.4	0.0				
	1812.5	1816.9	4.4	2.0	38.7	16.8	100.0	
	1817.0	1832.4	15.4	0.0				
	1832.5	1837.4	4.9	4.1	24.0	20.8	100.0	
	1837.5	1840.9	3.4	0.0			100.0	
	1841.0	1860.4	19.4	17.5	30.7	19.1	100.0	
	1860.5	1868.9	8.4	0.0				
	1869.0	1882.9	13.9	13.8	24.5	20.5	100.0	
	1883.0	1922.9	39.9	3.7	35.6	17.2	100.0	
	1923.0	1926.9	3.9	1.9	29.8	18.5	100.0	
	1927.0	1930.9	3.9	0.0				
	1931.0	1934.9	3.9	3.6	28.1	19.8	100.0	
	1935.0	1942.4	7.4	0.0				
	1942.5	1948.9	6.4	5.3	36.1	17.6	100.0	
	1949.0	2032.9	83.9	5.5	42.5	15.1	100.0	
	2033.0	2039.9	6.9	4.2	40.3	15.4	100.0	
Volcanics	2040.0	2104.9	64.9	0.0				
	2105.0	2166.9	61.9	7.5	41.4	15.9	100.0	

Table 1. PeeJay-1 Petrophysical Summary and Reservoir Summation

DATA

LWD services for formation evaluation were provided by Schlumberger. A full listing of the tool specifications and data acquired is available in the Well Completion Report (Basic Data). Table 2 lists the tools used and curves selected for use in this interpretation.

Table 2. PeeJay-1 listing of tools run and logs used for interpretation

Schlumberger LWD Tools	Run 2	8-1/4" arcVISION; 8-1/4" sonicVISION; 8-1/4" sadnVISION	
Top mMD	810		
Bottom mMD	1454		
Curve Selection	DEPT	.M	: Bit Depth 2hz
	ROP5_RM	.M/HR	: Rate of Penetration, Averaged over Last 5ft
	GR_ARC	.GAPI	: ARC Gamma Ray
	TAB_DEN	.HR	: Density Time After Bit
	TAB_ARC_RES	.HR	: ARC Resistivity Time After Bit
	P16H	.OHMM	: ARC Phase-Shift Resistivity 16-in. at 2 MHz
	P22H	.OHMM	: ARC Phase-Shift Resistivity 22-in. at 2 MHz
	P28H	.OHMM	: ARC Phase-Shift Resistivity 28-in. at 2 MHz
	P34H	.OHMM	: ARC Phase-Shift Resistivity 34-in. at 2 MHz
	P40H	.OHMM	: ARC Phase-Shift Resistivity 40-in. at 2 MHz
	A16H	.OHMM	: ARC Attenuation Resistivity 16-in. at 2 MHz
	A22H	.OHMM	: ARC Attenuation Resistivity 22-in. at 2 MHz
	A28H	.OHMM	: ARC Attenuation Resistivity 28-in. at 2 MHz
	A34H	.OHMM	: ARC Attenuation Resistivity 34-in. at 2 MHz
	A40H	.OHMM	: ARC Attenuation Resistivity 40-in. at 2 MHz
	TNPH	.PU	: Thermal Neutron Porosity (Ratio Method) in Selected Lithology
	RHOB	.G/C3	: Bulk Density
	DRHO	.G/C3	: Bulk Density Correction
	PEF	.B/E	: Photoelectric Factor
	HORD	.IN	: Horizontal Hole Diameter
	VERD	.IN	: Vertical Hole Diameter
Schlumberger LWD Tools	**Run 3**	**8-1/4" GeoVISION; 8-1/4" sonicVISION; 8-1/4" sadnVISION**	
Top mMD	1440		
Bottom mMD	2183		
Curve Selection	DEPT	.M	: Bit Depth 2hz
	ROP5_RM	.M/HR	: Rate of Penetration, Averaged over Last 5ft
	GR_RAB	.GAPI	: RAB Gamma Ray
	TAB_DEN	.HR	: Density Time After Bit
	TAB_RAB_RING	.HR	: Ring Resistivity Time After Bit
	RES_RING	.OHMM	: Ring Resistivity
	RES_BD	.OHMM	: Deep Button Resistivity
	RES_BM	.OHMM	: Medium Button Resistivity
	RES_BS	.OHMM	: Shallow Button Resistivity
	RES_BIT	.OHMM	: Bit Resistivity
	TNPH	.PU	: Thermal Neutron Porosity (Ratio Method) in Selected Lithology
	RHOB	.G/C3	: Bulk Density
	DRHO	.G/C3	: Bulk Density Correction
	PEF	.----	: Photoelectric Factor
	HORD	.IN	: Horizontal Hole Diameter
	VERD	.IN	: Vertical Hole Diameter
	DTCO	.US/F	:DT Compressional processed by Schlumberger
	GR	.GAPI	: Gamma Ray R1 R2 R3 spliced

Deviation
Vertical well path.

Mud Parameters
Listed in Table 3.

Table 3. Peejay-1 Mud Parameters

	LWD Run 2	LWD Run 3
Mud Type	KCL/PHPA/Polymer	KCL/PHPA/Polymer
Mud Wt g/cc	1.138	1.138
Rm	0.1254 @ 21.8 deg C	0.0925 @ 21.8 deg C
Rmf	0.1118 @ 21.3 deg C	0.0892 @ 21.3 deg C
Rmc	0.2670 @ 21.6 deg C	0.1516 @ 21.9 deg C
Potassium	3.66%	3.76%
BHT degC		82
Hole Size inches	12.25	12.25

Log Quality
During drilling operations in Run 2 the tool experienced high shocks and vibration. The arcVISION tool experienced 7-8 hours of shock level 3. Fine tuning of RPM and WOB was performed in order to mitigate these shocks and vibrations but the tool continued to experience shocks.

At 1454m MD due to insufficient ROP it was decided to POOH for a bit change. After completing checks on LWD tools damage was found on the threads of the sadnVISION and the sonicVISION tools.

In Run 3 the sadnVISION tool was run in Recorded Mode only due to a broken sub and the button resistivities failed. When laying out BHA, it was found that the stabilizer of the sadnVISION and sonicVISION tools wear band was worn out.

Across Run 2 and Run 3 the borehole size is generally greater than 12.25” (bit size). The caliper logs (HORD and VERD) indicate variable borehole breakout across coal horizons and the poorer reservoir quality sandstone units.

The quality of the log data from the pad tools i.e. the density (large DRHO corrections) and the neutron has been adversely affected across the intervals with borehole breakout, the sonic log quality is generally satisfactory. The density and neutron logs were excluded from the log selection and interpretation methodology in the final analysis.

No vertical depth corrections were undertaken as depth alignment is satisfactory.

Data Processing
The sonic was processed externally by Schlumberger, this data was used for the interpretation.

Coring
No conventional cores were cut.
No MSCT coring.

Formation Testing
No Formation Testing

INTERPRETATION

Logs Used

The primary logs used in the interpretation were:

From 1325-1440mMDRT; Gamma Ray (GR spliced R1 R2 R3); Caliper (HORD, VERD); Sonic (DTCO); Neutron (TNPH), Density (RHOB, TNPH, PEF, DRHO); Resistivity (P40H, P34H, P28H, P22H, P16H).

From 1440-2167mMDRT; Gamma Ray (GR spliced R1 R2 R3); Caliper (HORD, VERD); Sonic (DTCO); Neutron (TNPH), Density (RHOB, TNPH, PEF, DRHO); Resistivity (RES_RING).

Temperature

The maximum recorded temperature was 82degC and a temperature gradient of 3.7degC/100m was used for this interpretation.

Formation Water Salinity

The PHIT-RT cross plot across the interval 1640-1664mmMD supports the use of formation water salinity of 40,000ppm NaCl equivalent to calculate water saturation, refer Figure 2.

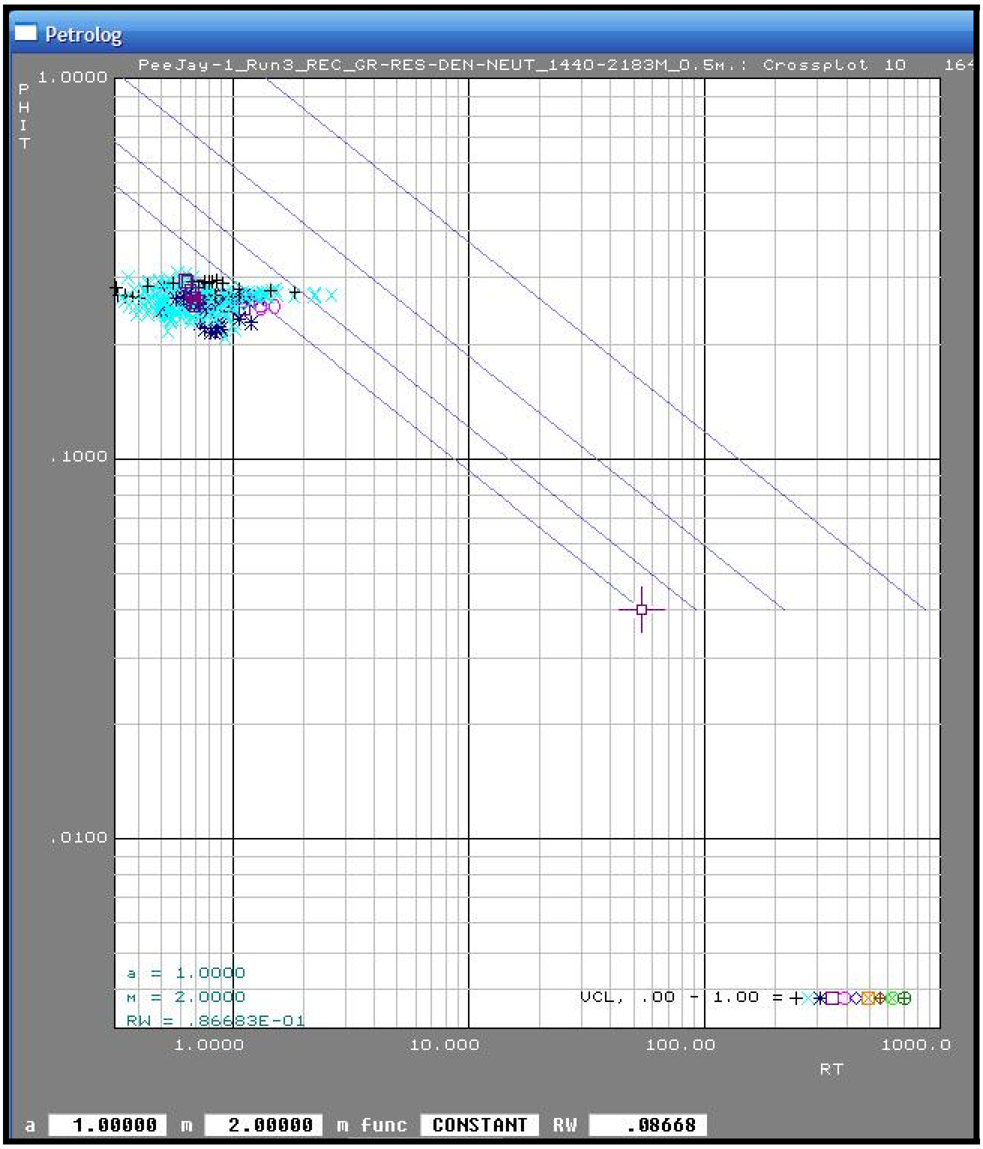

Figure 2. PHIT-RT crossplot 1640-1664mMD

Hydrocarbon Identification
All zones were solved for oil. Hydrocarbon shows recorded during drilling operations consisted of minor elevated mud gas reading 1600-1700mMD and fluorescence shows 1615-1624mMD; 1634-1639mMD; 1639-1654mMD, (refer Peejay-1 Mudlog Log; Well Completion Report Basic Data).

Clay Volume, Porosity and Water Saturation
Log analysis was carried out using PETROLOG software (Crocker Data Systems). A deterministic Complex Lithology (CPX) module was constructed for this interpretation to compute Vclay, Porosity (PHIT and PHIE) and Water Saturation (SWT, SWE).

The methodologies used for the solve processes and input parameters are set out in Table 4. The interval 1428.6-2167mMD was selected for interpretation as the interval has a full suite of log data .

Table 4. Complex Lithology Module Solve Processes and Input Parameters

CPX Solve Processes		
Vclay	GR min-mac method	
Porosity	Sonic - Raymer-Hunt-Gardiner Algorithm	
Water Saturation	Simandoux equation where: SWe = (a*Rw/(2.0*PHIE**m))*(SQRT((VCL/RCL)**2.0 + 4.0*PHIE**m/(a*Rw*RT))-VCL/RCL)	
Analysis Parameters		
Depth Reference Index	MD	
R.T. m	34.15	
T.D. m	2183	
Log Processing Interval mMD	1325-2167.0	
Sampling Rate (m)	0.1	
Input Parameters		
	Zone 1	**Zone 2**
Processing Interval (mMD)	1325-1460	1460-2167
Bit Size (inch)	12.25	12.25
Rw @ 25° C	0.16	0.16
Rw Salinity ppm	40,000	40,000
RHOH (g/cc)	0.8	0.8
RHOF (g/cc)	1	1
RHOMA (g/cc)	2.65	2.65
GR clean (API)	25	40
GR clay (API)	90	170
R clay (ohm-m)	6	6
RHOB clay (g/cc)	n/a	n/a
PHIN clay (v/v)	n/a	n/a
DT clay (msec/ft)	100	100
a	1	1
m	2	2
n	2	2

RESULTS AND DISCUSSION

Due to over gauge bore hole, a simple model was constructed for this interpretation using the gamma ray minimum-maximum method to calculate vclay and porosity was calculated from the processed sonic log.

The results of the log analysis are presented in Table 1 with reservoir statistics calculated based on cut-offs PHIE >8% and VCLAY <50%.

No hydrocarbons were intersected by the well.

A 1:200 scale plot of the interpretation results is presented in Appendix 1

PEEJAY-1

Complex Lithology Model

Company	BEACH PETROLEUM
Well Name	PEEJAY-1
Field	WILDCAT
Country	AUSTRALIA
State	TASMANIA
Province	N/A
County or Rig name	N/A
Field Location	T/39P TAS
Permanent Datum	MSL
Elevation of RT	-34.15 M
Elevation Log Zero	-34.15 M
Log measured from	RT
Service company	SCHLUMBERGER D&M
Number of runs	3
Spud Date	15 NOVEMBER 2008
TD Date	17 NOVEMBER 2008
Log date	24-NOV-2008
Date computed	11-11-09
Date plotted	11-11-2009
Time plotted	12:21:24

PETROLOG SOFTWARE Revision 9.50

GOI Determinations at PeeJay-1 Exploration Well, Bass Basin

Peter J. Eadington
CSIRO Petroleum Confidential Data Transmission

September 2009

Beach Petroleum Ltd

Commercial-in-confidence

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EXECUTIVE SUMMARY

Fluid history investigations were made on samples from PeeJay-1 exploration well, Bass Basin using CSIRO Petroleum's GOI™ (Grains containing Oil Inclusions) fluid inclusion technique including mapping of the visual attributes of oil inclusion assemblages. Three of four samples from PeeJay-1 exploration well were prepared as fluid inclusion thin sections. The 1180-1185 m sample appears to be friable mud rock and after cleaning to remove drilling mud there was insufficient quartz grains to make a thin section.

Three samples from 1185-1190 m, 1324-1330 m, and 1330-1336 m contain one to two oil inclusions per thousand grains, with GOI values of <0.1% to 0.1%. This result indicates there was palaeo-oil at all three sample depths. The palaeo-oil saturation is not well constrained because the proportion of grains with diagenetic fluid inclusions cannot be readily determined, as outlined below.

The samples are very fine to fine sand with traces of quartz overgrowth and very few aqueous diagenetic fluid inclusions at the quartz overgrowth boundary. The oil inclusions decorate healed fractures through detrital quartz, and those grains without diagenetic inclusions do not test for the presence of palaeo-oil. Visible light microscopy does not differentiate trails of aqueous diagenetic inclusions in quartz clasts from those trails of inclusions inherited from the plutonic provenance. Cathodoluminescence by SEM will identify some healed diagenetic fractures, but not necessarily all. A low abundance of oil inclusions may be in part due to a low abundance of diagenetic fluid inclusions but the magnitude of the effect cannot be quantified. This precludes identification of palaeo-oil zone or migration pathway.

Three of the four oil inclusion assemblages have near-white visual fluorescence which is associated with mid-range API gravity values, possibly 35° to 45°, and uniformly small gas bubbles consistent with trapping of liquid oil. One of the oil inclusion assemblages has near-blue fluorescence and large variance in the volume of the gas bubble consistent with trapping of gas and oil in inclusions.

INTRODUCTION

CSIRO was commissioned by Beach Petroleum to investigate the hydrocarbon charge history in four samples from the PeeJay-1 exploration well, Bass Basin. This was implemented using CSIRO Petroleum's GOI™ (Grains containing Oil Inclusions) fluid inclusion technique including mapping of the visual attributes of oil inclusion assemblages.

Objectives

The objective of this study was to evaluate the samples for evidence of oil migration or accumulation.

Sample Description & Preparation

Cuttings samples (Table 1) from PeeJay-1 containing drilling mud were cleaned by repeated solvent extraction and hydrogen peroxide digestion with paddling to remove the sticky mud by sliding grains within the sticky sludge. Three of the samples yielded several grams of sand and were prepared as 80 micron thick fluid inclusion thin sections. Petrography relevant to interpretation of oil inclusion data was acquired. In cuttings with observations are restricted to disaggregated grains and precludes comments on rock fabric. The 1180-1185 m sample appears to be friable mud rock and after cleaning to remove drilling mud there was insufficient quartz grains to make a thin section.

All depths in this report are referenced in measured depth (mMD) relative to the Rotary Table (RT) unless otherwise indicated. Where one depth is written it is the lower depth of the cuttings interval.

Table 1: Description of samples from PeeJay-1.

Well Name	CSIRO No	Depth (mMD)	Depth (mMD)	Determinations	Description	Sample Type	Formation	Fluid Zone
PeeJay-1	132979	1180	1185	none	friable mudrock	cuttings	Oligocene	water
PeeJay-1	132980	1185	1190	GOI, ats, petrog	very fine sand	cuttings	Oligocene	water
PeeJay-1	132981	1324	1330	GOI, ats, petrog	fine sand	cuttings	Demons Bluff	water
PeeJay-1	132982	1330	1336	GOI, ats, petrog	very fine sand	cuttings	Demons Bluff	water

PETROGRAPHY

The cuttings samples from PeeJay-1 are mostly disaggregated grains. In the 1330-1336 m sample the grains have internal fractures and the grain surfaces have impact damage from human intervention, either during drilling or sample preparation to separate quartz grains from the drilling mud. The intact grains indicate grain sizes from very fine sand to fine sand (Table 2).

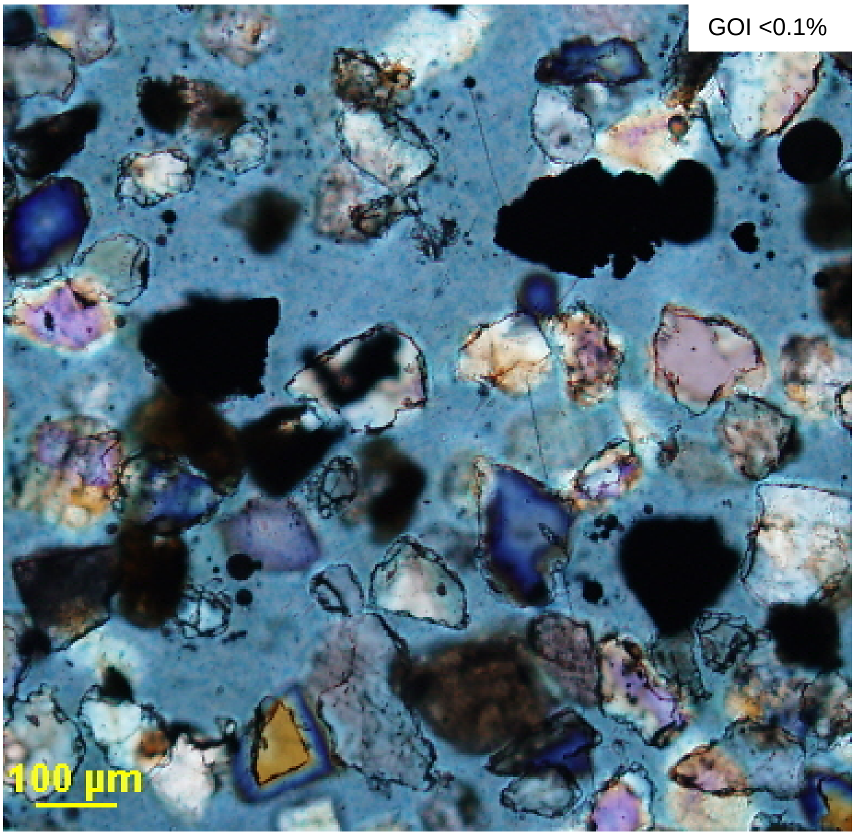
The quartz and feldspar grains are very fine to fine grainsize with only traces of quartz overgrowth. (Figure 1, Figure 2, Figure 3). There are few diagenetic fluid inclusions associated with overgrowth. Two of the samples have siderite cement which appears is moulded on abraded sedimentary clasts (Figure 4). Two of the samples have framboidal pyrite as well as granular pyrite that appears to be late cement.

Table 2 Selected petrographic features of samples from PeeJay-1

Well	Sample No.	Depth upper (mMD)	Depth lower (mMD)	Grain Size	Fabric	Grain Contacts	Visual Porosity (Ø)	Detrital Matrix	QO	Other Auth. Cements
Peejay 1	132980	1185	1190	vf sand	na (cuttings)	na (cuttings)	na (cuttings)	na (cuttings)	trace	pyrite fine siderite with clay particles
Pejay 1	132981	1324	1330	f sand	na (cuttings)	na (cuttings)	na (cuttings)	na (cuttings)	not seen	
Peejay 1	132982	1330	1336	vf sand	na (cuttings)	na (cuttings)	na (cuttings)	na (cuttings)	trace	siderite, pyrite

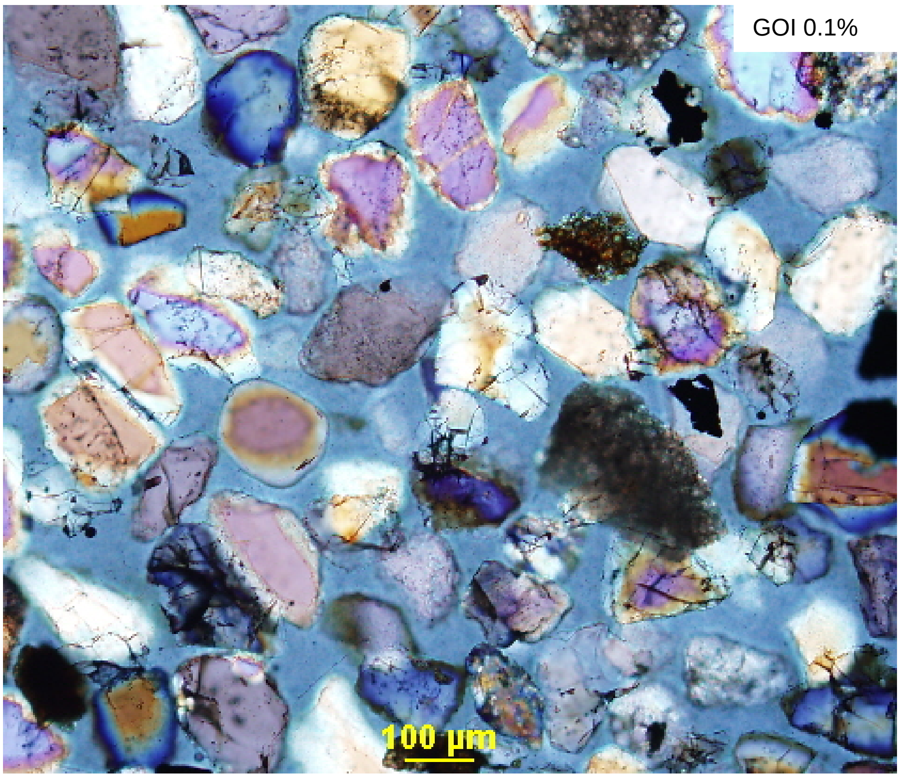
Fabric, G= grain-support, M= matrix-support. Grain Contact, Pt = point, Pl = planar. Visual Porosity, negligible (0-5%), poor (5-10%), fair (10-15%), good (15-20%), very good (20%+). QO = quartz overgrowth (show abundance), trace (tr or 2), minor (min or 3), moderately abundant (mod or 4), abundant (abund or 5) Other Cement (show mineral(abundance)), CC() = carbonate cement, K = kaolin(), S = siderite(), AC = authigenic clay(). In parentheses () write abundance. Negligible (neg or 1), trace (tr or 2), minor (min or 3), moderate (mod or 4), major (maj or 5).

Figure 1 PeeJay-1 1185-1190 m Very fine grained quartz.



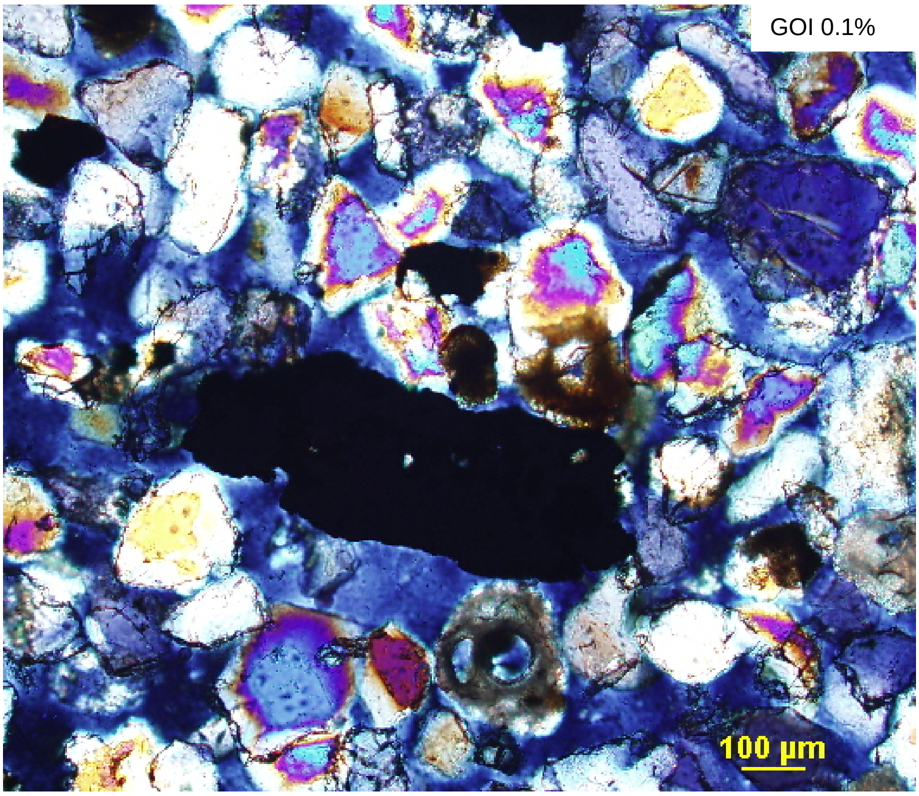
132980 Peejay pt 2 10X petrog part X polar .jpg Transmitted light image, 80 micron-thick thin section. Detail in the images is better seen if the page zoom is set to 200%.

Figure 2 PeeJay-1 1324-1330 m Fine grained quartz.



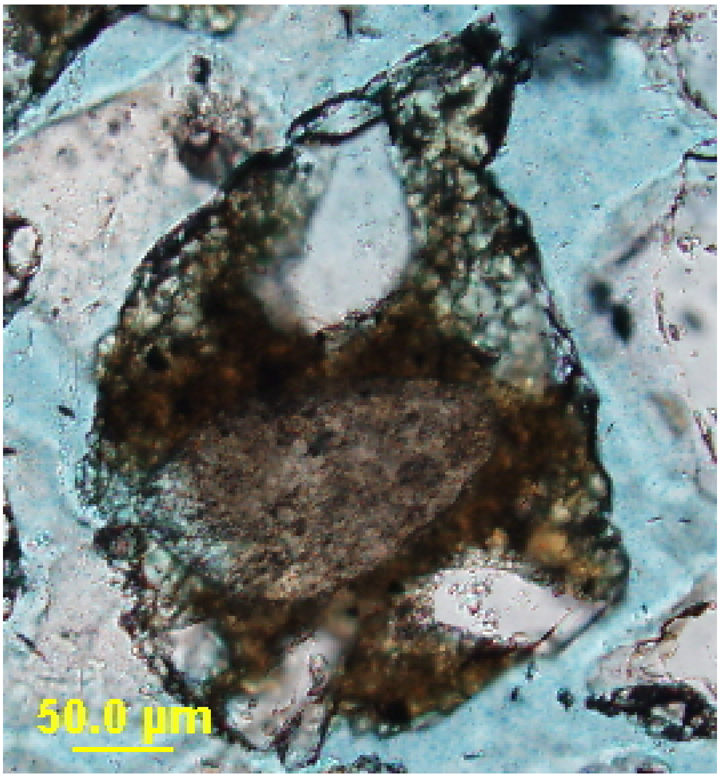
132981 Peejay pt 2 10X petrog part X polar .jpg
Transmitted light image, 80 micron-thick thin section.

Figure 3 PeeJay-1 1330-1336 m Fine grain quartz grains and pyrite grain (large opaque)



132982 Peejay pt 6 10X petrog pyr part X polar .jpg Transmitted light image, 80 micron-thick thin section. Detail in the images is better seen if the page zoom is set to 200%.

Figure 4 PeeJay-1 1330-1336 m Fine siderite cement between clasts



132982 Peejay pt 5 20X siderite TL .jpg
Transmitted light image, 80 micron-thick thin section.

HYDROCARBON PETROGRAPHY

Methods

Grains in oil reservoirs often contain one or more oil inclusions that collectively constitute oil inclusion assemblages (OIAs). Grains containing oil inclusions (GOI™) is the proportion of reservoir grains that contain one or more OIA. A typical OIA is a trail of oil inclusions aligned along a healed fracture in a detrital mineral.

Three different oil inclusion assemblages that form a superposition sequence are: fracture trails of oil inclusions that terminate at a quartz overgrowth boundary, those that transect an overgrowth, and oil inclusions at the quartz overgrowth boundary.

Fluorescence colour, location in the grain, and size of the gas bubble are three of eight attributes assigned to OIAs in GOI determinations. Ten different locations within mineral grains were recorded. The fluorescence colour of single oil inclusions was recorded as near-blue, near-white, or near-yellow, and the fluorescence colour of OIAs was recorded as uniform in one colour class or including several colour classes. Measuring fluorescence spectra quantifies the fluorescence colours of selected inclusions for evaluating API gravity and major constituents.

The GOI™ technique is a petrographic point counting method that records the number of quartz and feldspar grains containing Oil Inclusions expressed as a percentage of the total number of those grains in each sample (Lisk and Eadington, 1994; Eadington et al., 1996). A computer controlled microscope stepping stage is used to determine the number of quartz grains containing oil inclusions by partitioning the fluid inclusion thin section into approximately 2000 Fields of View (FOV), each 0.5 x 0.5 mm.

There are three methods for counting GOI. The number of FOV and tracks scanned is determined on a sample-by-sample basis by reference to counting statistics associated with the random selection of grains.

1. The Square Grid (GOI_SG) scan protocol applies to samples where preliminary examination suggests an elevated GOI (>5%) is likely. Square fields of view (0.5 mm x 0.5 mm) are selected at random and a count made of the total grains and grains containing oil inclusions. Typically hundreds of grains are counted.

2. The Rectangular Grid (GOI_RG) scan protocol applies to samples where preliminary examination suggests a low GOI (<5%) is likely. Grains containing oil inclusions are counted in randomly selected rectangular fields and grains counted in a sub-set of the fields used to compute the total number of grains scanned. Typically thousands of grains are counted.

3. The Point Grid (GOI_PG) count protocol applies to samples where preliminary examination shows that 200X magnification is not adequate to detect and identify oil inclusions due to their small size or high fluorescence background. This technique uses 500X magnification for positive identification of oil inclusions. Grains and associated oil inclusions are counted on a grain-by-grain basis. Typically one to two hundred grains are counted.

Oil Inclusion Attributes

The intra-grain location of oil inclusion assemblages (OIAs) was recorded to test for superposition relationships as indicators of a sequence of hydrocarbon fluids in the reservoir rocks. The fluorescence colour of OIAs were classified by visual assignment on a three colour scheme of uniform near-blue, uniform near-white, or uniform near-yellow fluorescence. Also OIAs with inclusions having variant fluorescence colours were recorded as blue to white, white to yellow or blue to white. The volume proportion of gas bubble in inclusions is a useful indicator of the presence of gas at the time oil was trapped. Sometimes groups of inclusions with variant fluorescence also have variant volume proportion of gas bubble with a covariance associating the two attributes.

GOI Results

Table 3 GOI data for PeeJay-1

Well Name	Depth	GOI	Grains with Oil Inclusions	grains scanned	count protocol
Peejay 1	1185 - 1190 m	<0.1%	1	4178	GOI_RG
Peejay 1	1324 - 1330 m	0.1%	1	1897	GOI_RG
Peejay 1	1330 - 1336 m	0.1%	1	1787	GOI_RG

Numbers in this table are based on a defined set of grains selected randomly.

Attributes of Oil Inclusion Assemblages

Attributes of oil inclusion assemblages (OIAs) address the physical and fluorescence properties of inclusion oil for the whole sample. To increase the number of data points attributes of OIAs include data for grains randomly selected in the GOI determination plus data for OIAs that were seen in additional grains during the GOI determination.

Table 4 Location of Oil Inclusion Assemblages in samples from PeeJay-1.

Well Name	Depth	GOI	1 UNKOWN	2 FRACTURE IN DETRITAL QTZ	3 QOB	4 WITHIN OG	5 FRAC TRANSECTING QO	6 FRAC TERMINATING AT QO	7 PENETRATIVE FRAC	8 FELDSPAR(DETRITAL)	9 FELDSPAR OVERGROWTH
Peejay 1	1185 - 1190 m	<0.1%		1							
Peejay 1	1324 - 1330 m	0.1%		2							
Peejay 1	1330 - 1336 m	0.1%		1							

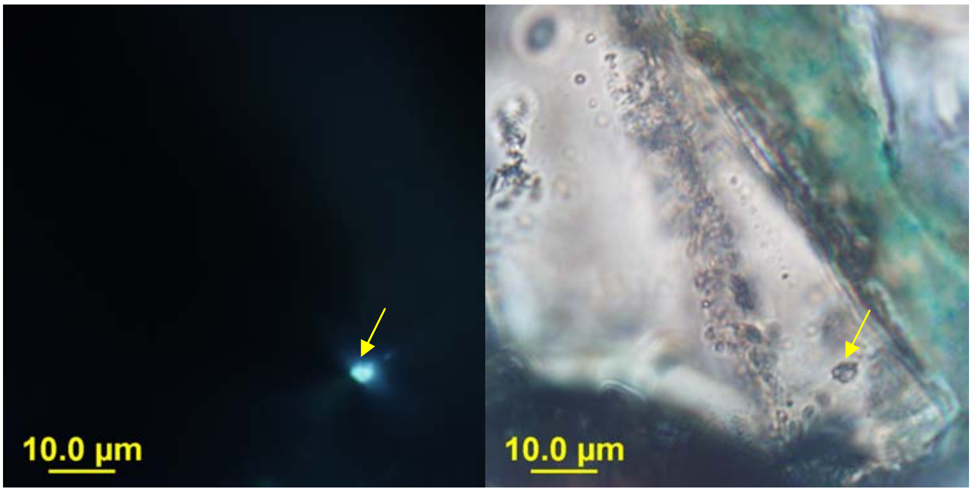
Table 5: Fluorescence colour of oil inclusion assemblages in samples from PeeJay-1.

Well Name	Depth	GOI	1 BLU & NEAR BLU	2 WHITE & NEAR WHITE	3 YELLOW & NEAR YELLOW	4 BL WH VARIANT	5 WH YE VARIANT	6 BL YE VARIANT
Peejay 1	1185 - 1190 m	<0.1%		1				
Peejay 1	1324 - 1330 m	0.1%	1	1				
Peejay 1	1330 - 1336 m	0.1%		1				

Table 6 Volume proportion of gas bubble in oil inclusion assemblages from PeeJay-1

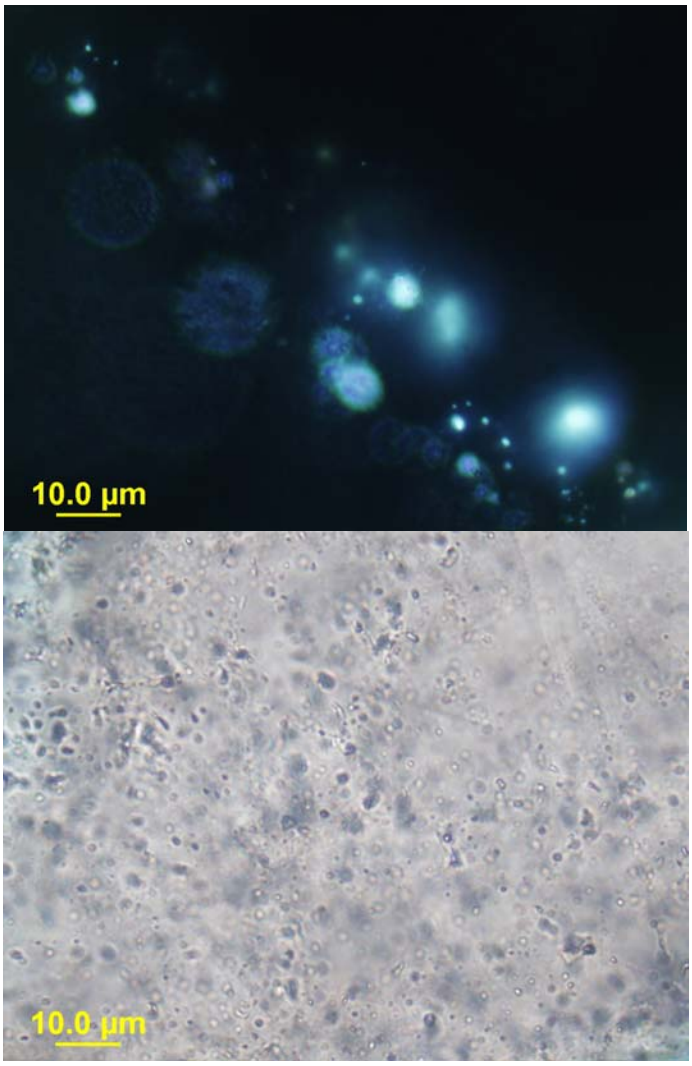
Well Name	Depth	GOI	grains/areas scanned	SMBUBLSV	LRBUBLSV	LRG VAR	COVAR COL
Peejay 1	1185 - 1190 m	<0.1%	4178	1			
Peejay 1	1324 - 1330 m	0.1%	1897	1		1	
Peejay 1	1330 - 1336 m	0.1%	1787	1			

Figure 5 PeeJay-1 1185-1190 m Fluorescing oil inclusions.



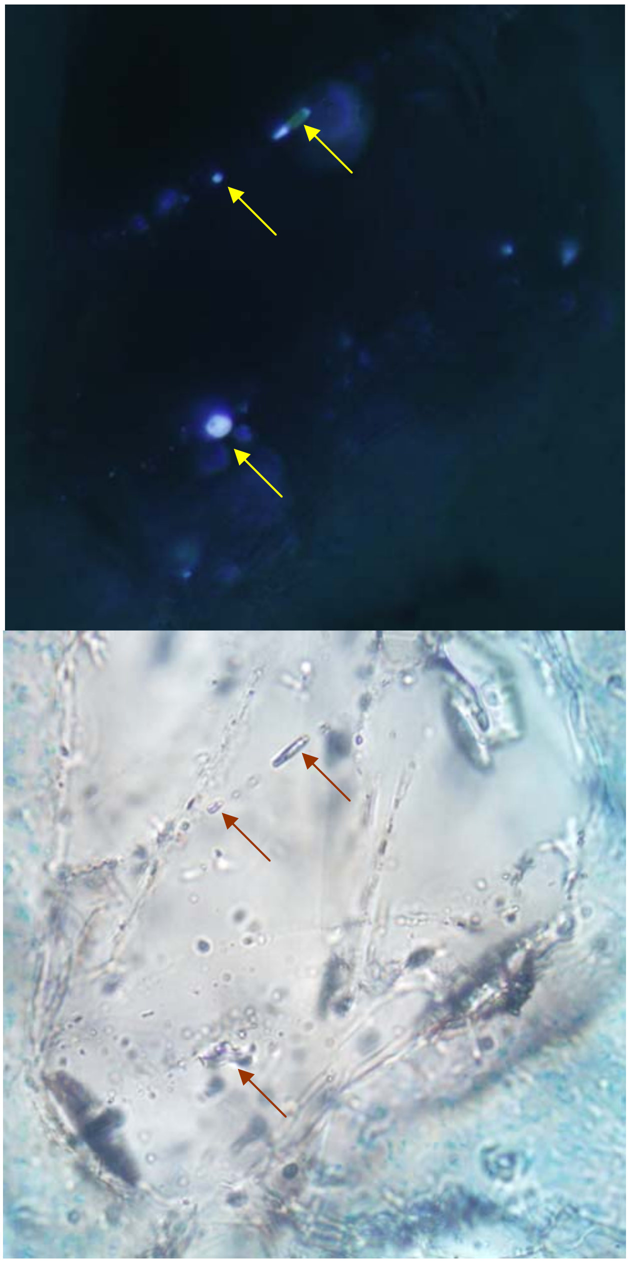
132980 Peejay pt 1 100X OI FL .jpg Fluorescence and transmitted light images. Detail in the images is better seen if the page zoom is set to 200%

Figure 6 PeeJay-1 1324-1330 m Fluorescing oil inclusions.



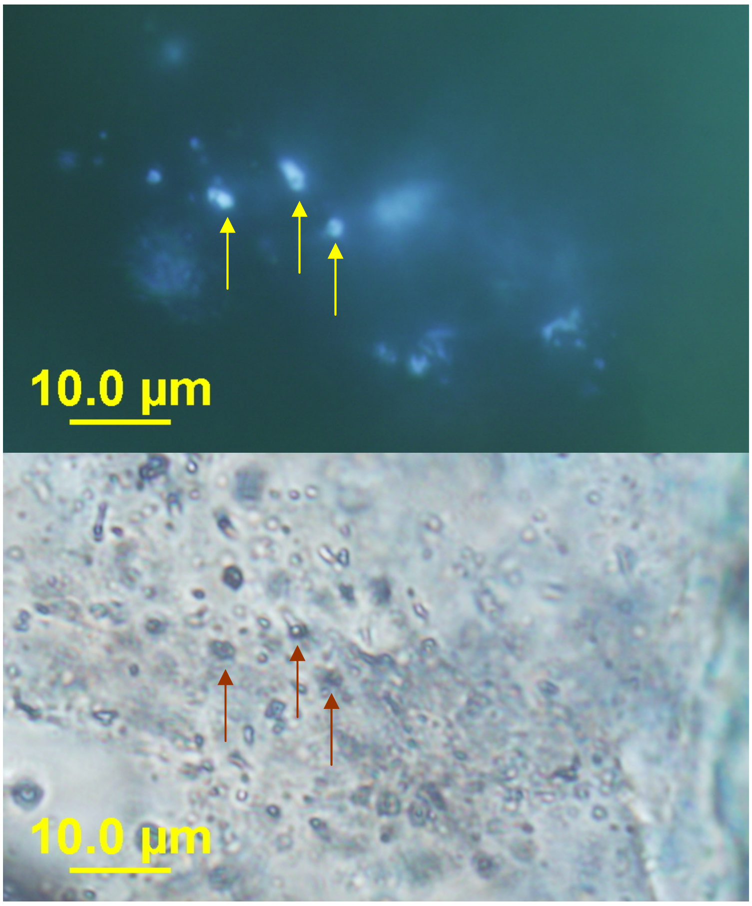
132981 Peejay pt 2 100X OI FL .jpg Fluorescence and transmitted light images.

Figure 7 PeeJay-1 1324-1330 m Fluorescing oil inclusions.



Two of the inclusions are oil-water inclusions with sub-spherical oil phase and small gas bubbles. One of the inclusions has a large gas bubble and rim of fluorescing oil. 132981 PeeJay-1 pt 36 100x OI FL .jpg Fluorescence and transmitted light images, similar scale as other photomicrographs of oil inclusions. Detail in the images is better seen if the page zoom is set to 200%.

Figure 8 PeeJay-1 1330-1336 m Fluorescing oil inclusions.



The many non-fluorescing aqueous fluid inclusions include some with igneous or metamorphic origin as well as some that may be diagenetic, but they cannot be differentiated using optical microscopy. 132982 Peejay pt 2 100X OI FL .jpg Fluorescence and transmitted light images. Detail in the images is better seen if the page zoom is set to 200%

PALAEO-OIL SATURATION

Palaeo-oil Saturation from GOI Data

Palaeo-oil zones can be mapped using the GOI™ (Grains containing Oil Inclusions) technique (Eadington et al., 1996), complemented by the OMI technique (Liu & Eadington 2003). OMI is an interpolating algorithm that is used to examine the extent to which the variance in GOI can be explained by the buoyancy and capillary properties of the reservoir.

GOI values in producing oil zones vary widely from <0.1% to about 95%. Samples with GOI values >5% are only from producing oil zones, from palaeo-oil zones recognised by solid fluorescence, or from locations that can reasonably be expected to have been in closure. Such GOI data usually show stratification that reflects buoyant confinement of oil. GOI values >5% have not been measured in samples where closure and high oil saturation are unlikely to have occurred. Consequently GOI values >5% can be readily identified as palaeo-oil zone by empirical comparison.

GOI values between <0.1% and 5% also occur in current oil zone and the reverse logic that values <5% indicate there was no palaeo-oil zone is not valid. The significance of GOI values <5% can be investigated by petrographic techniques and by using the OMI interpolating algorithm.

In some samples there are time and depth windows for frequent formation of fluid inclusions and outside this window the frequency of formation of fluid inclusions may have been too low to record high oil saturation by oil inclusion abundance. GOI values <5% may also result from low oil saturation on account of high displacement pressure, from low buoyancy pressure at the base of the oil zone, or an inhibition on trapping oil when fluid inclusions form due to wettability between the oil and mineral.

GOI values between <0.1% and 5% can be evaluated using the OMI technique which indicates continuity between GOI values that exceed 5% and sample depths with lower values of GOI. This can be used to extrapolate to the base of the buoyancy gradient to locate the palaeo-oil water contact.

Fluid inclusions that contain formation water indicate low oil saturation at the time the inclusions formed and it is useful to know the abundance of diagenetic fluid inclusions. Aqueous inclusions in quartz overgrowth are detected in transmitted light, but cathodoluminescence is needed to image quartz cement and the diagenetic aqueous inclusions that fill the aperture of healed fractures. Samples that contain very few diagenetic fluid inclusions are not a satisfactory test of palaeo-oil saturation.

The GOI technique does not test for gas, and the possibility of gas or gas-condensate accumulation is not evaluated directly by the data.

OIL MIGRATION AT PEEJAY-1

Three samples from 1185-1190 m, 1324-1330 m, and 1330-1336 m (Figure 9) contain one to two oil inclusions (Figure 5, Figure 6, Figure 7, Figure 8) per thousand grains, with GOI values of <0.1% to 0.1% (Table 3). This result indicates there was palaeo-oil at all three sample depths. The palaeo-oil saturation is not well constrained because the proportion of grains with diagenetic fluid inclusions cannot be readily determined, as outlined below.

The samples are very fine to fine sand (Figure 1, Figure 2, Figure 3) with traces of quartz overgrowth and very few aqueous diagenetic fluid inclusions at the quartz overgrowth boundary. The oil inclusions decorate healed fractures through detrital quartz, and those grains without diagenetic fractures do not test for the presence of palaeo-oil. Igneous and metamorphic quartz grains contain trails of aqueous inclusions and in sedimentary grains visible light microscopy does not differentiate these from trails of aqueous diagenetic inclusions. High resolution cathodoluminescence by SEM will identify some healed diagenetic fractures, but not necessarily all. A low abundance of diagenetic fluid inclusions contributes to a low abundance of oil inclusions but the magnitude of the effect cannot be quantified. This precludes identification of palaeo-oil zone or migration pathway.

Samples from Yolla-1 from 1817 m to 1838 m in the current oil zone have GOI values ≤0.3% which was attributed to a low abundance of diagenetic fluid inclusions (Kempton et al., 2005). If samples from PeeJay-1 similarly have a low abundance of diagenetic fluid inclusions then the GOI abundance without knowing the abundance of aqueous diagenetic fluid inclusions precludes differentiation between palaeo-oil zone or migration pathway.

Three of the four oil inclusion assemblages have near-white fluorescence (Figure 10) which is associated with mid-range API gravity values, possibly 35° to 45°, and uniformly small gas bubbles (Figure 11) consistent with trapping of liquid oil. One of the oil inclusion assemblages has near-blue fluorescence and large variance in the volume of the gas bubble consistent with trapping of gas and oil in inclusions.

Figure 9 The GOI log for PeeJay-1

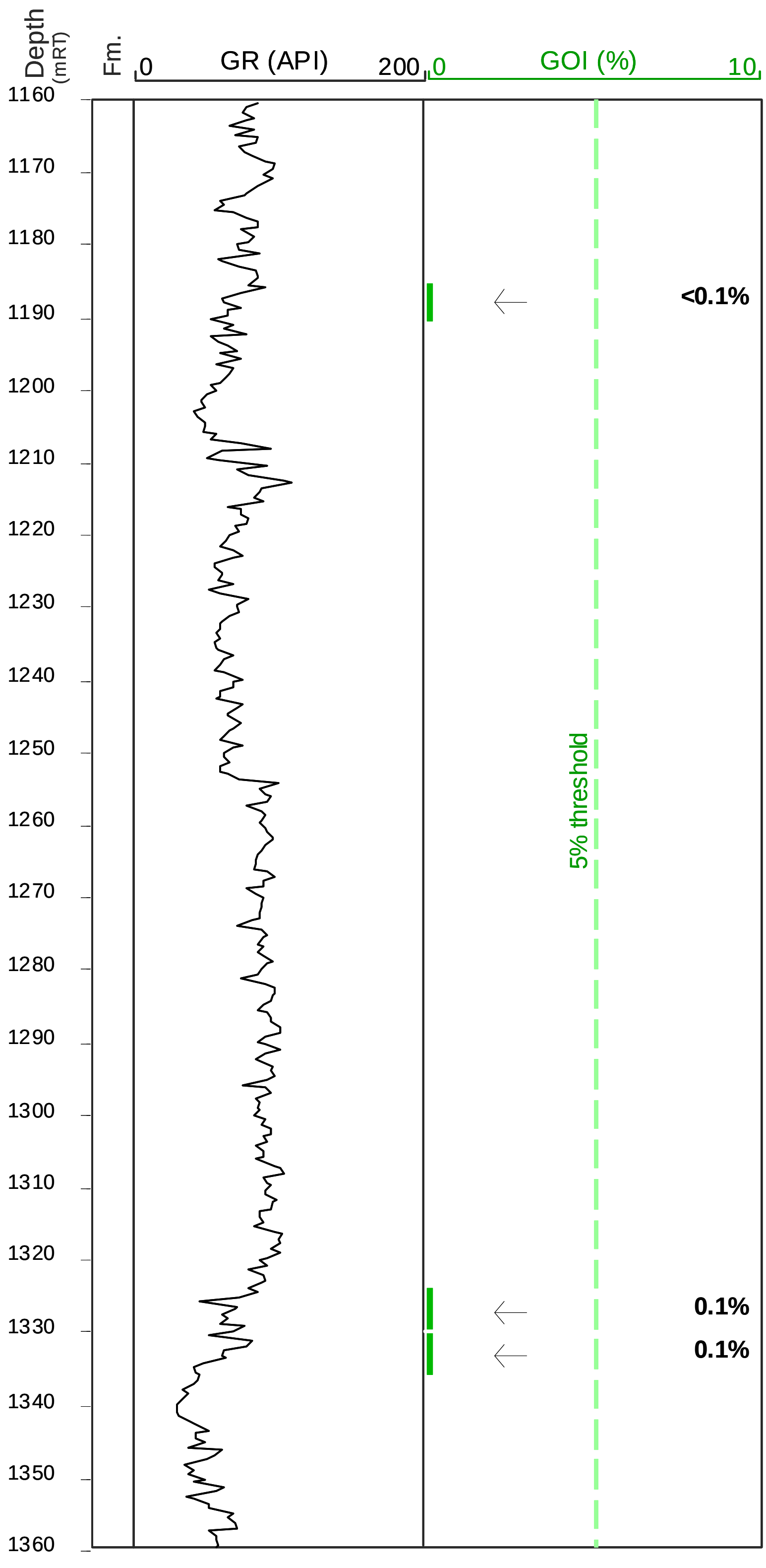
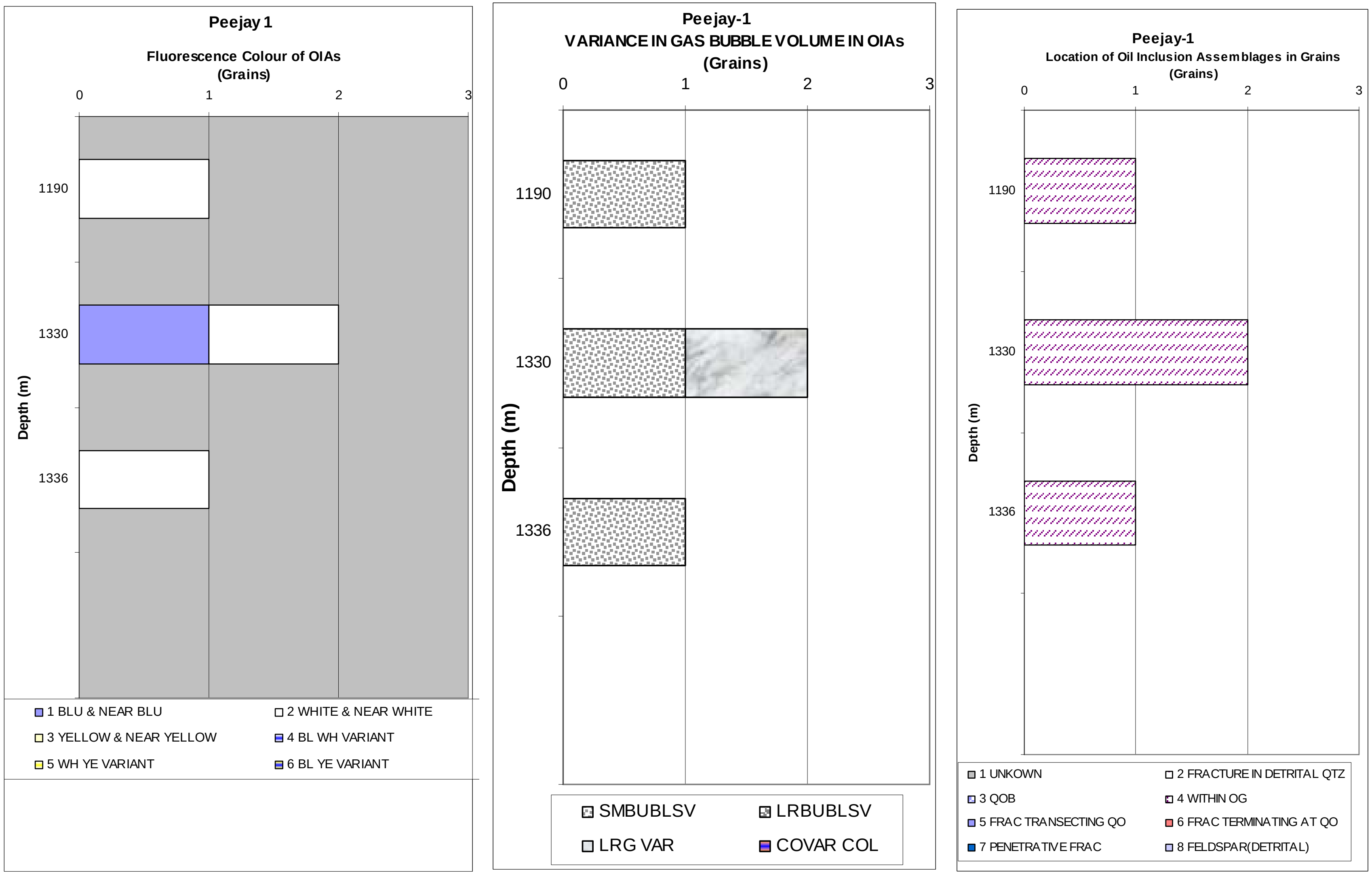
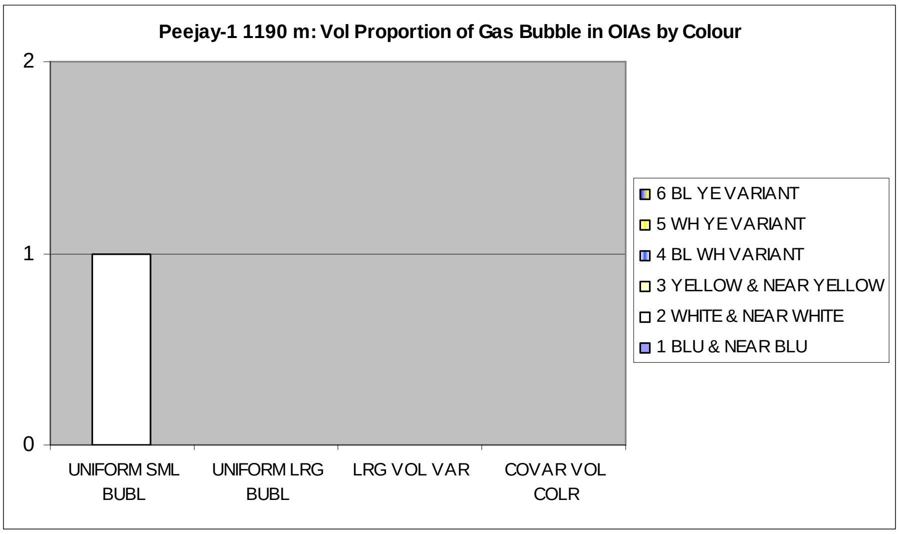


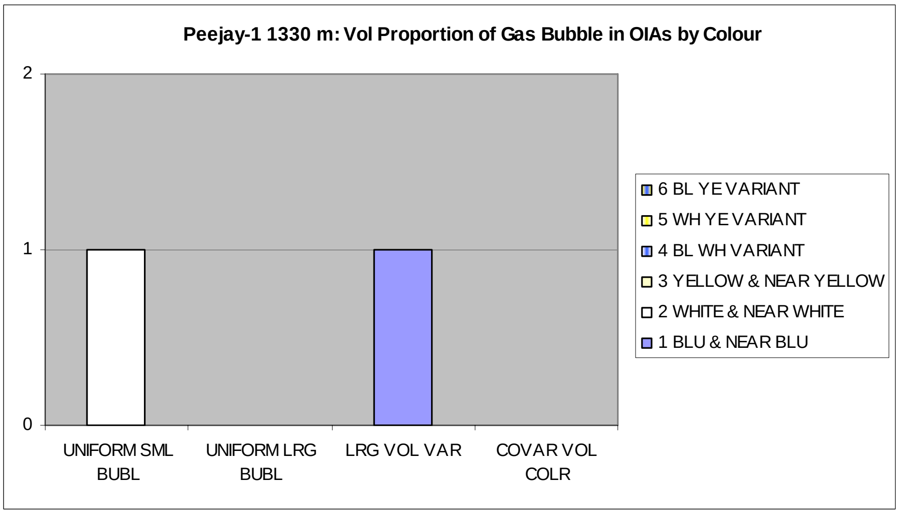
Figure 10 Attributes of Oil Inclusion Assemblages from PeeJay-1: Fluorescence colour, volume proportion of gas bubble, and inclusion location.

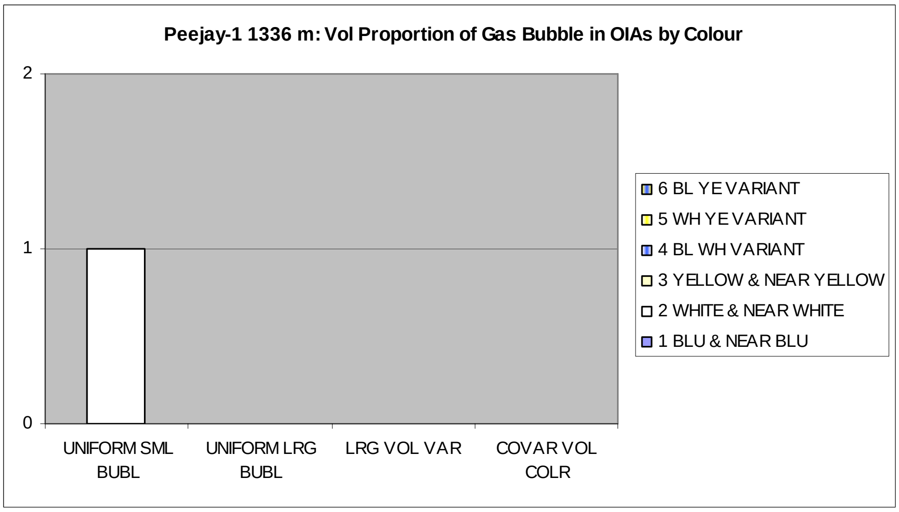


Increasing the page zoom to 150% gives improved resolution of the graphs and text. Column 4 (Unknown Location) is not shown in the depth log of intra grain location.

Figure 11 PeeJay-1 Fluorescence colour in relation to volume proportion of gas bubble in oil inclusions.







CONCLUSIONS

At PeeJay-1 three samples from 1185-1190 m, 1324-1330 m, and 1330-1336 m contain one to two oil inclusions per thousand grains, with GOI values of <0.1% to 0.1%. This result indicates there was palaeo-oil at all three sample depths. The palaeo-oil saturation is not well constrained because the proportion of grains with diagenetic fluid inclusions cannot be readily determined, and this precludes identification of palaeo-oil zone or migration pathway.

Three of the four oil inclusion assemblages have near-white fluorescence which is associated with mid-range API gravity values, possibly 35° to 45°, and uniformly small gas bubbles consistent with trapping of liquid oil. One of the oil inclusion assemblages has near-blue fluorescence and large variance in the volume of the gas bubble consistent with inclusions that trapped of oil and gas.

REFERENCES

Kempton, R.H., Liu, K., Boreham, C. and Eadington, P.J. 2005. Hydrocarbon migration and accumulation in the Middle to upper Eastern view Coal Measures of the bass Basin, Tasmania: evidence from GOI™, QGF and QGF-E. *CSIRO Petroleum, Open File Report with Geoscience Australia.*

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PEEJAY-1

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
0.10			0.40		Coal	0.70			1.00			1.30			1.60			1.90			2.20			2.50		
0.11			0.41	1C		0.71			1.01			1.31			1.61			1.91			2.21			2.51		
0.12			0.42			0.72			1.02			1.32			1.62			1.92			2.22			2.52		
0.13			0.43			0.73			1.03			1.33			1.63			1.93			2.23			2.53		
0.14			0.44	2C,1	↑	0.74			1.04			1.34			1.64			1.94			2.24			2.54		
0.15			0.45		DOM	0.75			1.05			1.35			1.65			1.95			2.25			2.55		
0.16			0.46	1C,2		0.76			1.06			1.36			1.66			1.96			2.26			2.56		
0.17			0.47	1		0.77			1.07			1.37			1.67			1.97			2.27			2.57		
0.18			0.48	4C,1		0.78			1.08			1.38			1.68			1.98			2.28			2.58		
0.19			0.49	1C		0.79			1.09			1.39			1.69			1.99			2.29			2.59		
0.20			0.50			0.80			1.10	2	↑	1.40			1.70			2.00			2.30			2.60		
0.21			0.51	2C		0.81			1.11		Inert	1.41			1.71			2.01			2.31			2.61		
0.22			0.52	1C,1		0.82			1.12			1.42			1.72			2.02			2.32			2.62		
0.23			0.53			0.83			1.13			1.43			1.73			2.03			2.33			2.63		
0.24			0.54	2		0.84			1.14	1		1.44			1.74			2.04			2.34			2.64		
0.25			0.55		DOM	0.85			1.15			1.45			1.75			2.05			2.35			2.65		
0.26			0.56	1	↓	0.86			1.16			1.46			1.76			2.06			2.36			2.66		
0.27			0.57			0.87			1.17			1.47			1.77			2.07			2.37			2.67		
0.28			0.58	1C		0.88			1.18			1.48			1.78			2.08			2.38			2.68		
0.29			0.59	1C		0.89			1.19			1.49			1.79			2.09			2.39			2.69		
0.30			0.60			0.90			1.20			1.50	1		1.80			2.10			2.40			2.70		
0.31			0.61		Coal	0.91			1.21			1.51			1.81			2.11			2.41			2.71		
0.32			0.62	1C	↓	0.92			1.22			1.52			1.82			2.12			2.42			2.72		
0.33			0.63			0.93			1.23			1.53			1.83			2.13			2.43			2.73		
0.34			0.64			0.94			1.24			1.54			1.84			2.14			2.44			2.74		
0.35			0.65			0.95			1.25			1.55		Inert	1.85			2.15			2.45			2.75		
0.36			0.66			0.96			1.26			1.56	1	↓	1.86			2.16			2.46			2.76		
0.37			0.67			0.97			1.27			1.57			1.87			2.17			2.47			2.77		
0.38			0.68			0.98			1.28			1.58			1.88			2.18			2.48			2.78		
0.39	1C	↑	0.69			0.99			1.29			1.59			1.89			2.19			2.49			2.79		

VITRINITE 0.8%		INERTINITE 0.1%						LIPTINITE 0.3%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor 0.3	Cut <0.1	Sub	Res <0.1	Ld <0.1	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L2575.....Well Name...BEACH PETROLEUM, ,……PEEJAY-1.. Depth..1954-1957m......... .... SampleType....Ctgs...
Date. ..10/04/2009. Op..SPR......... FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\ANAVRW09.doc

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0.11			0.41			0.71			1.01		Inert	1.31			1.61			1.91			2.21			2.51		
0.12			0.42			0.72	1		1.02			1.32	2		1.62			1.92			2.22			2.52		
0.13			0.43			0.73			1.03			1.33			1.63			1.93			2.23			2.53		
0.14			0.44			0.74			1.04			1.34			1.64	1		1.94			2.24			2.54		
0.15			0.45			0.75		FGV	1.05			1.35			1.65			1.95			2.25			2.55		
0.16			0.46	1	↑	0.76	1	↓	1.06			1.36	1		1.66			1.96			2.26			2.56		
0.17			0.47	1	FGV	0.77			1.07			1.37			1.67			1.97			2.27			2.57		
0.18			0.48			0.78			1.08			1.38			1.68			1.98	1		2.28			2.58		
0.19			0.49	1		0.79			1.09			1.39			1.69			1.99			2.29			2.59		
0.20			0.50	2		0.80			1.10			1.40			1.70			2.00			2.30			2.60		
0.21			0.51			0.81			1.11			1.41			1.71			2.01			2.31			2.61		
0.22			0.52	1		0.82			1.12			1.42			1.72			2.02			2.32			2.62		
0.23			0.53	1		0.83			1.13			1.43			1.73			2.03			2.33			2.63		
0.24			0.54			0.84			1.14			1.44			1.74			2.04			2.34			2.64		
0.25			0.55			0.85			1.15			1.45			1.75			2.05			2.35			2.65		
0.26			0.56	2		0.86			1.16			1.46			1.76			2.06			2.36			2.66		
0.27			0.57	1		0.87			1.17			1.47			1.77			2.07			2.37			2.67		
0.28			0.58	1		0.88			1.18			1.48	1		1.78			2.08			2.38			2.68		
0.29			0.59	1		0.89			1.19			1.49			1.79			2.09			2.39			2.69		
0.30			0.60	3		0.90			1.20			1.50			1.80			2.10			2.40			2.70		
0.31			0.61	1		0.91			1.21			1.51			1.81			2.11			2.41			2.71		
0.32			0.62	1		0.92			1.22			1.52			1.82			2.12			2.42			2.72		
0.33			0.63	1		0.93			1.23			1.53			1.83			2.13			2.43			2.73		
0.34			0.64	2		0.94			1.24			1.54			1.84			2.14			2.44			2.74		
0.35			0.65			0.95			1.25			1.55			1.85			2.15			2.45			2.75		
0.36			0.66			0.96			1.26			1.56			1.86			2.16			2.46			2.76		
0.37			0.67	1C,2		0.97			1.27			1.57			1.87			2.17			2.47			2.77		
0.38			0.68			0.98			1.28			1.58			1.88			2.18			2.48			2.78		
0.39			0.69			0.99			1.29			1.59			1.89			2.19			2.49		Inert	2.79		

VITRINITE 0.3%		INERTINITE 0.1%						LIPTINITE <0.1%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor <0.1	Cut	Sub	Res	Ld <0.1	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L2576.....Well Name...BEACH PETROLEUM, ,……PEEJAY-1.. Depth..1984-1987m......... .... SampleType....Ctgs...
Date. ..10/04/2009. Op..SPR......... FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\ANAVRW09.doc

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0.11			0.41			0.71	1C,1		1.01			1.31			1.61			1.91			2.21			2.51		
0.12			0.42			0.72	4C	DOM	1.02			1.32			1.62			1.92			2.22			2.52		
0.13			0.43			0.73	1	↓	1.03			1.33			1.63			1.93			2.23			2.53		
0.14			0.44			0.74	2C		1.04			1.34			1.64			1.94			2.24			2.54		
0.15			0.45			0.75			1.05			1.35			1.65			1.95			2.25			2.55		
0.16			0.46			0.76			1.06			1.36			1.66			1.96			2.26			2.56		
0.17			0.47			0.77	1C		1.07			1.37			1.67			1.97			2.27			2.57		
0.18			0.48			0.78	1C		1.08			1.38			1.68			1.98			2.28			2.58		
0.19			0.49			0.79			1.09			1.39			1.69			1.99			2.29			2.59		
0.20			0.50			0.80			1.10			1.40			1.70			2.00			2.30			2.60		
0.21			0.51			0.81			1.11			1.41			1.71			2.01			2.31			2.61		
0.22			0.52			0.82			1.12			1.42			1.72			2.02			2.32			2.62		
0.23			0.53			0.83			1.13			1.43			1.73			2.03			2.33			2.63		
0.24			0.54	1C	↑	0.84			1.14			1.44			1.74			2.04			2.34			2.64		
0.25			0.55		Coal	0.85			1.15			1.45			1.75			2.05			2.35			2.65		
0.26			0.56			0.86			1.16			1.46			1.76			2.06			2.36			2.66		
0.27			0.57	2C		0.87		Coal	1.17			1.47			1.77			2.07			2.37			2.67		
0.28			0.58			0.88	1C	↓	1.18			1.48			1.78			2.08			2.38			2.68		
0.29			0.59	1C		0.89			1.19			1.49			1.79			2.09			2.39			2.69		
0.30			0.60	1C,1	↑	0.90			1.20			1.50			1.80			2.10			2.40			2.70		
0.31			0.61		DOM	0.91			1.21			1.51			1.81			2.11			2.41			2.71		
0.32			0.62	1C		0.92			1.22			1.52			1.82			2.12			2.42			2.72		
0.33			0.63			0.93			1.23			1.53			1.83			2.13			2.43			2.73		
0.34			0.64	1C		0.94			1.24			1.54			1.84			2.14			2.44			2.74		
0.35			0.65	2C		0.95			1.25			1.55			1.85			2.15			2.45			2.75		
0.36			0.66	2C		0.96			1.26			1.56			1.86			2.16			2.46			2.76		
0.37			0.67			0.97			1.27			1.57			1.87			2.17			2.47			2.77		
0.38			0.68	2C,2		0.98			1.28			1.58			1.88			2.18			2.48			2.78		
0.39			0.69	2C		0.99			1.29			1.59			1.89			2.19			2.49			2.79		

VITRINITE 0.7 %		INERTINITE <0.1%						LIPTINITE 0.3%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor 0.3	Cut <0.1	Sub	Res	Ld <0.1	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L2577.....Well Name...BEACH PETROLEUM, ,……PEEJAY-1.. Depth..2170-2173m......... .... SampleType....Ctgs...
Date. ..10/04/2009. Op..SPR......... FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\ANAVRW09.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
0.10			0.40			0.70	1C,1	↓	1.00			1.30			1.60			1.90			2.20			2.50		
0.11			0.41			0.71			1.01			1.31			1.61			1.91			2.21			2.51		
0.12			0.42			0.72			1.02			1.32			1.62			1.92			2.22			2.52		
0.13			0.43			0.73			1.03			1.33			1.63			1.93			2.23			2.53		
0.14			0.44			0.74			1.04			1.34			1.64			1.94			2.24			2.54		
0.15			0.45	1C,1	↑	0.75			1.05			1.35			1.65			1.95			2.25			2.55		
0.16			0.46		C/dom	0.76			1.06			1.36			1.66			1.96			2.26			2.56		
0.17			0.47			0.77			1.07			1.37			1.67			1.97			2.27			2.57		
0.18			0.48	1C		0.78			1.08			1.38			1.68			1.98			2.28			2.58		
0.19			0.49			0.79			1.09			1.39			1.69			1.99			2.29			2.59		
0.20			0.50			0.80			1.10			1.40			1.70			2.00			2.30			2.60		
0.21			0.51			0.81			1.11			1.41			1.71			2.01			2.31			2.61		
0.22			0.52	1C		0.82			1.12			1.42			1.72			2.02			2.32			2.62		
0.23			0.53	2C		0.83			1.13			1.43			1.73			2.03			2.33			2.63		
0.24			0.54	2C		0.84			1.14			1.44			1.74			2.04			2.34			2.64		
0.25			0.55	2C		0.85			1.15			1.45			1.75			2.05			2.35			2.65		
0.26			0.56	2C		0.86			1.16			1.46			1.76			2.06			2.36			2.66		
0.27			0.57	3C,1		0.87			1.17			1.47			1.77			2.07			2.37			2.67		
0.28			0.58	2C,1		0.88			1.18			1.48			1.78			2.08			2.38			2.68		
0.29			0.59			0.89			1.19			1.49			1.79			2.09			2.39			2.69		
0.30			0.60	3C		0.90			1.20			1.50			1.80			2.10			2.40			2.70		
0.31			0.61	1C		0.91			1.21			1.51			1.81			2.11			2.41			2.71		
0.32			0.62			0.92			1.22			1.52			1.82			2.12			2.42			2.72		
0.33			0.63			0.93			1.23			1.53			1.83			2.13			2.43			2.73		
0.34			0.64			0.94			1.24			1.54			1.84			2.14			2.44			2.74		
0.35			0.65	1C		0.95			1.25			1.55			1.85			2.15			2.45			2.75		
0.36			0.66			0.96			1.26			1.56			1.86			2.16			2.46			2.76		
0.37			0.67	1C		0.97			1.27			1.57			1.87			2.17			2.47			2.77		
0.38			0.68	2C		0.98			1.28			1.58			1.88			2.18			2.48			2.78		
0.39			0.69		C/dom	0.99			1.29			1.59			1.89			2.19			2.49			2.79		

VITRINITE 8.0 %		INERTINITE 2.5%						LIPTINITE 1.5%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor 1.3	Cut 0.1	Sub	Res <0.1	Ld 0.1	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L2578.....Well Name...BEACH PETROLEUM, ,……PEEJAY-1.. Depth..2182-2183m......... .... SampleType....Ctgs...
Date. ..10/04/2009. Op..SPR......... FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\ANAVRW09.doc

R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range	R	No Read	Pop Range
0.10			0.40			0.70			1.00			1.30			1.60			1.90			2.20			2.50		
0.11			0.41			0.71			1.01			1.31			1.61			1.91			2.21			2.51		
0.12			0.42			0.72			1.02			1.32			1.62			1.92			2.22			2.52		
0.13			0.43			0.73			1.03			1.33			1.63			1.93			2.23			2.53		
0.14			0.44			0.74			1.04			1.34			1.64			1.94			2.24			2.54		
0.15			0.45			0.75			1.05			1.35			1.65			1.95			2.25			2.55		
0.16			0.46			0.76			1.06			1.36			1.66			1.96			2.26			2.56		
0.17			0.47			0.77			1.07			1.37			1.67			1.97			2.27			2.57		
0.18			0.48			0.78			1.08			1.38			1.68			1.98			2.28			2.58		
0.19			0.49			0.79			1.09			1.39			1.69			1.99			2.29			2.59		
0.20			0.50			0.80			1.10			1.40			1.70			2.00			2.30			2.60		
0.21			0.51			0.81			1.11			1.41			1.71			2.01			2.31			2.61		
0.22			0.52			0.82			1.12			1.42			1.72			2.02			2.32			2.62		
0.23			0.53			0.83			1.13			1.43			1.73			2.03			2.33			2.63		
0.24			0.54			0.84			1.14			1.44			1.74			2.04			2.34			2.64		
0.25			0.55			0.85			1.15			1.45			1.75			2.05			2.35			2.65		
0.26			0.56			0.86			1.16			1.46			1.76			2.06			2.36			2.66		
0.27			0.57			0.87			1.17			1.47			1.77			2.07			2.37			2.67		
0.28			0.58			0.88			1.18			1.48			1.78			2.08			2.38			2.68		
0.29			0.59			0.89			1.19			1.49			1.79			2.09			2.39			2.69		
0.30			0.60			0.90			1.20			1.50			1.80			2.10			2.40			2.70		
0.31			0.61			0.91			1.21			1.51			1.81			2.11			2.41			2.71		
0.32			0.62			0.92			1.22			1.52			1.82			2.12			2.42			2.72		
0.33			0.63			0.93			1.23			1.53			1.83			2.13			2.43			2.73		
0.34			0.64			0.94			1.24			1.54			1.84			2.14			2.44			2.74		
0.35			0.65			0.95			1.25			1.55			1.85			2.15			2.45			2.75		
0.36			0.66			0.96			1.26			1.56			1.86			2.16			2.46			2.76		
0.37			0.67			0.97			1.27			1.57			1.87			2.17			2.47			2.77		
0.38			0.68			0.98			1.28			1.58			1.88			2.18			2.48			2.78		
0.39			0.69			0.99			1.29			1.59			1.89			2.19			2.49			2.79		

VITRINITE %		INERTINITE %						LIPTINITE -%								OIL DROPS	BITUMEN
TV	DV	Sfus	Scler	Fus	Macr	ID	Micr	Spor	Cut	Sub	Res	Ld	Bituminite	Telalginite	Lamalginite	Oil cut	

Sample Number..L2575.....Well Name...BEACH PETROLEUM, ,……PEEJAY-1.. Depth..1954-1957m......... .... SampleType....Ctgs...
Date. ..10/04/2009. Op..SPR......... FGV - First Generation Vitrinite, RV - Reworked Vitrinite, BTT - Bituminite, B - Bitumen, Inert - Inertinite, Cav - Cavings, DA - Drilling Mud Additives MICR D:\RWORK.ms6\ANAVRW09.doc

KK #	Depth (m)	$\overline{R}_{V}max$	Range	SD	N	**PEEJAY-1** Sample description including liptinite fluorescence, maceral abundances, mineral fluorescence
						Demons Bluff 1254m
						Upper Eastern View 1325m
						Middle Eastern View 1600m
L2575	1954-957	0.49	0.39-0.62	0.061	16	Sparse sporinite and rare liptodetrinite yellow to orange, rare resinite yellow, rare cutinite dull orange. (Claystone> argillaceous siltstone>carbonate>coal>shaly coal. Coal common, V>L>I, duroclarite>vitrite>clarite. Shaly coal rare, V>L, clarite. Dom sparse, L>V>I. Liptinite and vitrinite sparse, inertinite rare. Fungal sclerotinite present in some coals indicating that they are Tertiary coals. Mineral fluorescence weak to moderate orange. Iron oxides rare. Pyrite rare.)
Ctgs	V in dom	0.50	0.44-0.56	0.041	9	
	$\overline{R}_{I}max$	1.28	1.10-1.56	0.206	5	
L2576	1984-987	0.67	-	-	1	Rare sporinite and liptodetrinite orange to dull orange. (Claystone> argillaceous siltstone>coal. Coal rare, V, vitrite. Dom sparse, V>I>L. Vitrinite sparse, inertinite rare to sparse liptinite rare. Low reflecting vitrinite particles discordant with bedding are abundant and probably are mud contaminants. These particles are ignored when assessing maceral abundances. Mineral fluorescence weak to moderate orange. Iron oxides rare. Pyrite rare.)
Ctgs	V in dom	0.59	0.46-0.76	0.077	25	
	$\overline{R}_{I}max$	1.49	1.00-2.50	0.433	10	
						Intrusion 2021-2104m
L2577	2170-173	0.68	0.54-0.88	0.073	26	Sparse sporinite and rare liptodetrinite dull orange to weak brown, rare cutinite dull orange. (Claystone> argillaceous siltstone>sandstone>coal>igneous rocks>shaly coal. Coal common, V>I>L, vitrite>duroclarite>clarite. Shaly coal rare, V>L, clarite. Dom sparse, L>V>I. Liptinite sparse, vitrinite and inertinite rare. The igneous rocks cavings are a minor component, ~< 1%. Mineral fluorescence weak to moderate orange. Iron oxides rare. Pyrite sparse.)
Ctgs	V in dom	0.68	0.60-0.73	0.044	5	
L2578	2182-183	0.58	0.45-0.70	0.060	25	Common sporinite and sparse liptodetrinite orange to dull orange, sparse cutinite dull orange, rare resinite orange. (Claystone> coal>shaly coal>igneous rocks. Coal abundant to major V>I>L, duroclarite>vitrite>clarite. Coal comprises about 10% of the sample and approximate maceral composition on mineral free basis vitrinite 70%; inertinite 20%; liptinite 10%. Shaly coal common, V>L>I, clarite. Dom rare, L>V>I. All three maceral groups rare. The igneous rocks cavings are a minor component, ~< 1%. Mineral fluorescence weak to moderate orange. Iron oxides rare. Pyrite rare.)
Ctgs	V in dom	0.58	0.45-0.70	0.088	4	
						TD2183m

First line presents vitrinite reflectance data for vitrinite in coal, and the second line vitrinite reflectance data for vitrinite present in the sample as dispersed organic matter (dom).

12 April 2009

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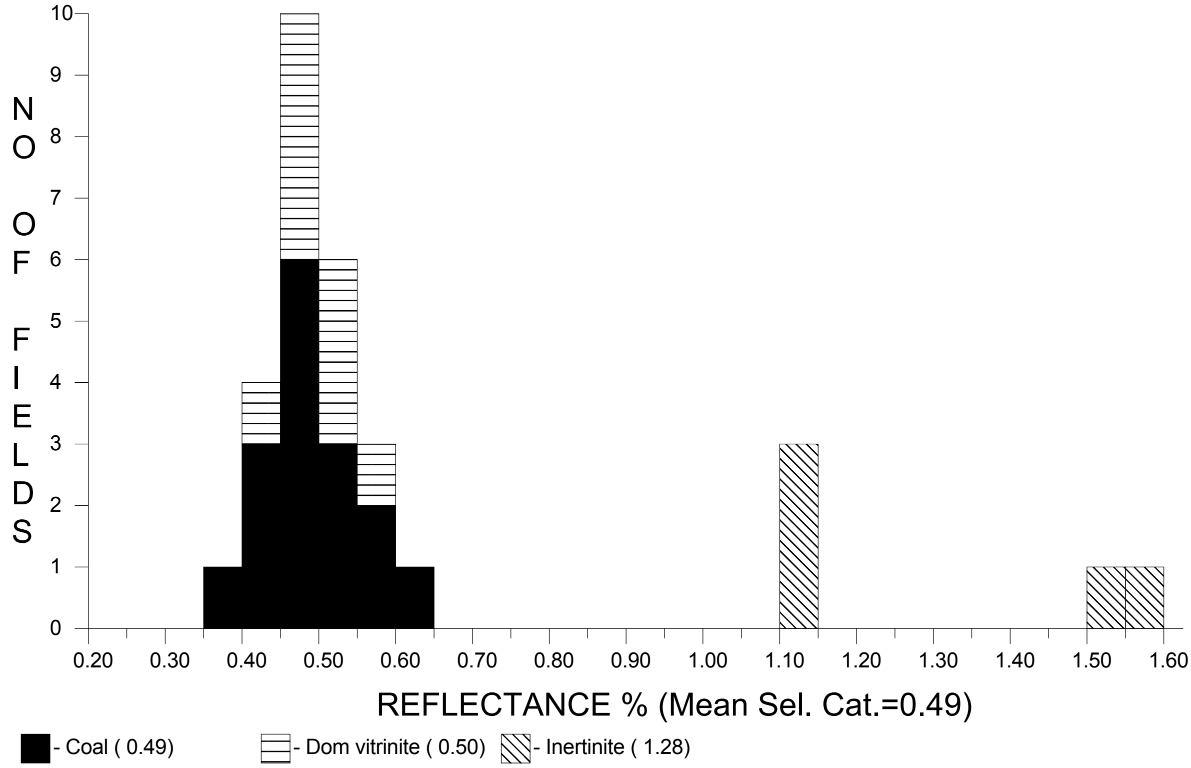
PEEJAY-1, 1954-1957m, Ctgs (L2575)



Category	No. of Readings	Mean	Standard Deviation
Coal	16	0.49	0.061
Dom vitrinite	9	0.50	0.041
Inertinite	5	1.28	0.206
Total:	30	0.63	0.309

Selected categories: Coal, Dom vitrinite,

No. of readings:	25
Mean of selected categories:	0.49
Standard deviation of selected categories:	0.055

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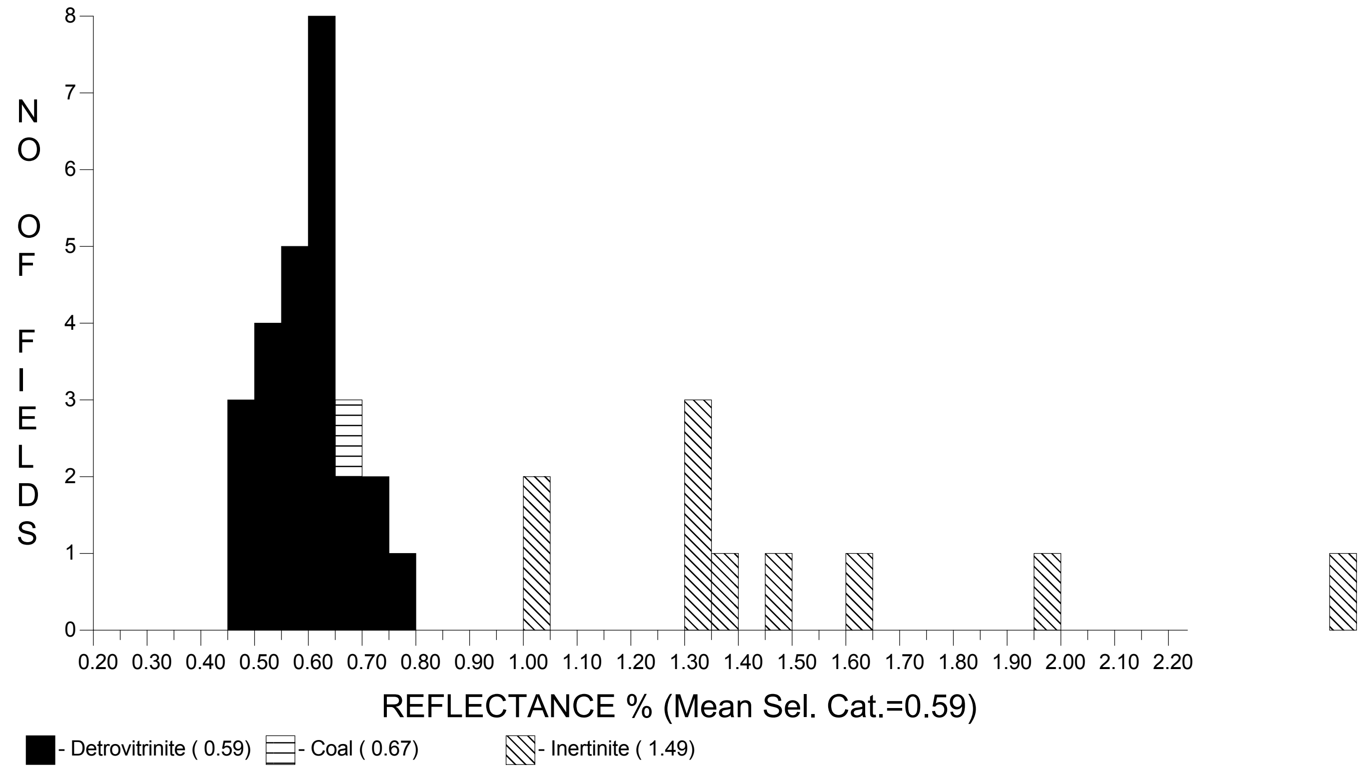
BEACH, PEEJAY-1, 1984-1987m, Ctgs (L2576)



Category	No. of Readings	Mean	Standard Deviation
Detrovitrinite	25	0.59	0.077
Coal	1	0.67	0.000
Inertinite	10	1.49	0.433
Total:	36	0.84	0.466

Selected categories: Detrovitrinite,

No. of readings:	25
Mean of selected categories:	0.59
Standard deviation of selected categories:	0.077

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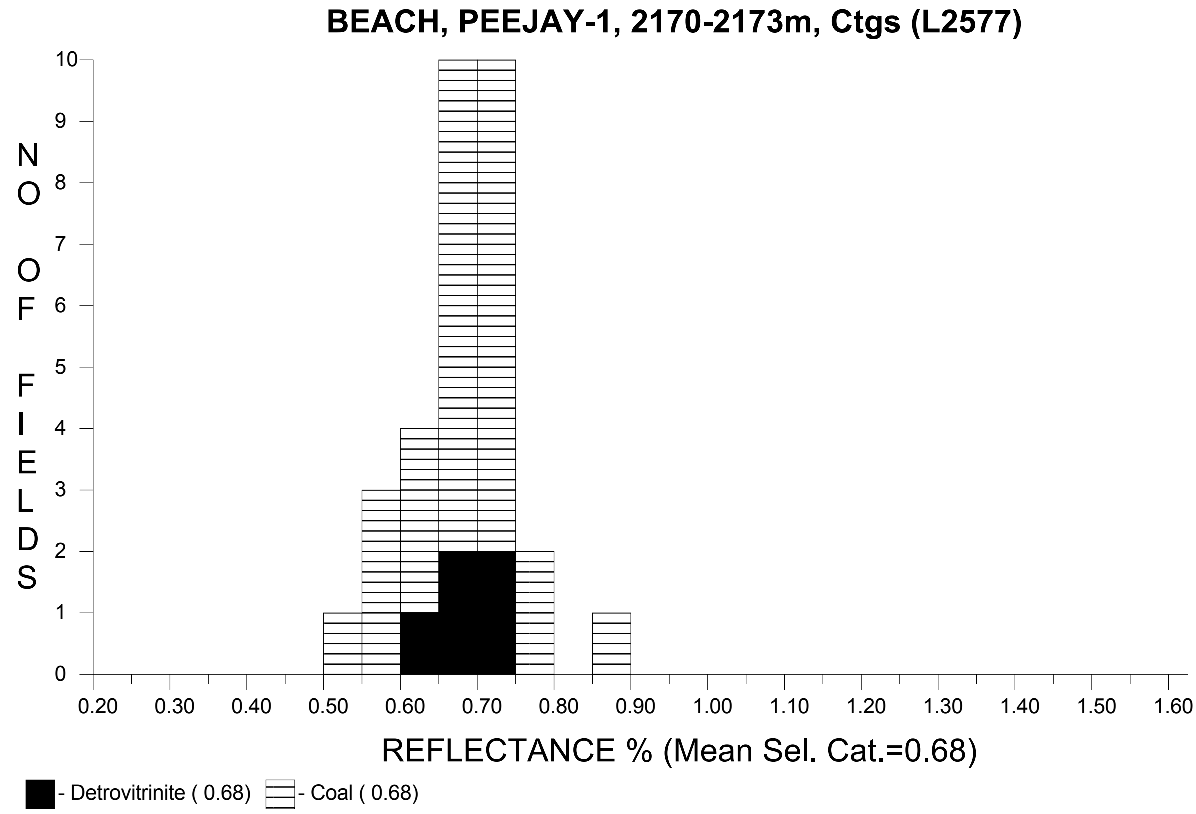

Category	No. of Readings	Mean	Standard Deviation
Detrovitrinite	5	0.68	0.044
Coal	26	0.68	0.073
Total:	31	0.68	0.069

Selected categories: Detrovitrinite,

No. of readings:	5
Mean of selected categories:	0.68
Standard deviation of selected categories:	0.044

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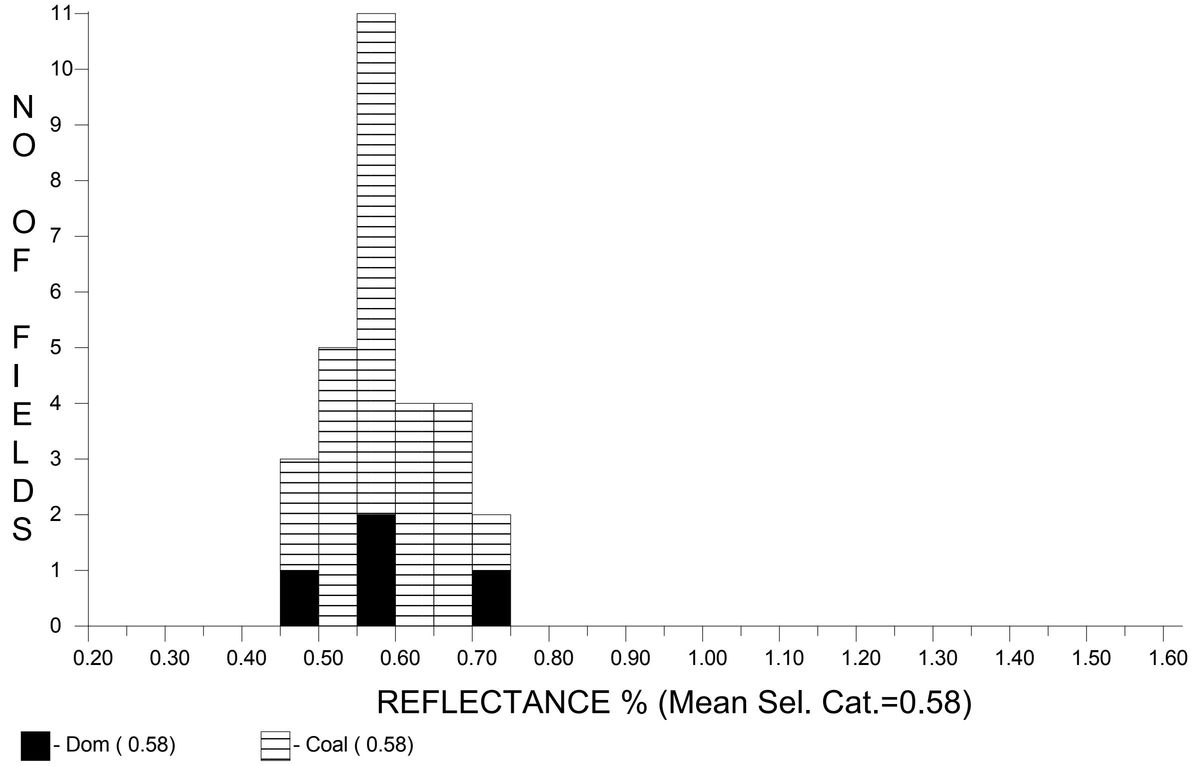
BEACH, PEEJAY-1, 2182-2183m, Ctgs (L2578)



Category	No. of Readings	Mean	Standard Deviation
Dom	4	0.58	0.088
Coal	25	0.58	0.060
Total:	29	0.58	0.065

Selected categories: Dom,

No. of readings:	4
Mean of selected categories:	0.58
Standard deviation of selected categories:	0.088

Sample testing, Peejay 1 DDH, Bass Strait

MRT Mineralogical/Petrology Laboratory

JOB M09/017:,

R.S. Bottrill and R. N. Woolley
20/03/09

Summary

The samples submitted are probably altered dolerite , with abundant clayey material.

Introduction

One sample of drill cuttings, taken by Carol Bacon from the Peejay 1 petroleum drillhole was submitted for identification. It was prepared and examined by XRD (X-Ray diffraction), and stereo-microscopic techniques in our laboratories, and the report is enclosed.

Table 1: sample details.

Reg. No.	DDH/depth(m)	Field No.
G401981	Peejay 1, 2077-2080m	-

Stereomicroscopy

The sample was examined by stereomicroscopy and found to contain a mixture of soft grey-brown clay and grey-green to pale grey, mottled chips of mafic rock to about 1 cm in size. The material appears to be a medium grained mafic rock, with plagioclase and pyroxene crystals to about 1-2mm in some chips, although some is much finer. No olivine could be identified. Some chips contains abundant fine grained white secondary material – probably carbonates and zeolite-facies minerals.

XRD Analysis

The sample was analysed by XRD and found to contain a mixture of clay minerals, quartz and mafic minerals, and some low to medium temperature calcic and magnesian alteration minerals.

The clays are mostly smectite (probably montmorillonite) and minor mica (illite). The main mafic minerals are plagioclase, ilmenite and clinopyroxene; no olivine could be detected. There are some zeolite-facies minerals that appear to represent altered mafics: chlorite, talc, analcime, calcite, pectolite, xonotlite and gyrolite.

Discussion and Interpretation

These rock chips indicate a mixture of mafic material and clays; the latter may represent clayey sediment and may include some quartz silt.

The mafic material is probably a dolerite, but some is quite fine grained and appears basaltic. The lack of olivine, however, suggests it is not a typical Tasmanian basalt. The secondary minerals, including talc, xonotlite and pectolite are more typical of dolerites or weakly metamorphosed basaltic rocks, but the evidence is not definitive.

Disclaimers

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This and other data collected in MRT laboratories may enter the MRT databases but every attempt will be made to ensure it remains closed file and not be available externally, unless at your request.

DEPARTMENT OF INFRASTRUCTURE ENERGY AND RESOURCES

Mineral Resources Tasmania

Client: C. Bacon
Sample Location: Bass Strait
Job Number: M017/09
Analysis: Approximate Mineralogy
Method: X-Ray Diffraction

Results (approx wt %)

Reg. No.	*Description*	*25%-35%*	*15%-25%*	*10%-15%*	*5%-10%*	*2%-5%*	*<2%*
G401981	Peejay 1, 2077-2080	Plagioclase, Smectite	Clinopyroxene, Quartz	Chlorite	Mica	Ilmenite, Talc*	Analcime, Calcite, Pectolite, Xonotlite, Gyrolite

* 9.4Å peak, not affected by acid treatment or heating to 550C
Pectolite, Xonotlite and Gyrolite identified in hand-picked white material

Peak overlap (e.g. Chlorite and Kaolinite) may interfere with identifications and quantitative calculations
Amorphous minerals (such as hydrous iron oxides) and minerals present in trace amounts may not be detected.

RNWoolley

Analyst: R.N. Woolley
Date: 12 March 2009

CSIRO Confidential Report No. 09-044
July 2009

Whole rock K-Ar dating of sample PEEJAY-1 (2083-2086m) for Beach Petroleum.

Horst Zwingmann and Andrew J. Todd

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TABLE OF CONTENTS

Summary

This report summarizes the K-Ar data of one whole rock split separated from cuttings from well PEEJAY-1- 2083-2086m for Beach Petroleum.

A whole rock split of sample PEEJAY-1- 2083-2086m yields a K-Ar age of 42.4 ± 1.8 Ma corresponding to a Palaeogene-Eocene-Lutetian origin.

1. Introduction

In May 2009 Mrs Janet Skinner from Beach Petroleum provided one cutting sample from well PEEJAY-1 (2083-2086m) for conventional whole rock K-Ar dating and cutting thin section petrography. Sample information is summarized in Table 1 and Plate 1. Handpicking of volcanic material and rock crushing was required prior to conventional K-Ar dating.

2. K-Ar dating

Detailed accounts of the conventional K-Ar dating technique have been given by Dalrymple & Lanphere (1969), Faure (1986) and Dickin (1995). Briefly, the ages of rocks or minerals can be determined by measuring the amount of the argon isotope, ^{40}Ar, in the rocks or in individual minerals relative to the potassium content. ^{40}Ar is produced by the decay of an isotope of potassium, ^{40}K. The rocks generally contain negligible amounts of argon when they are formed, although small amounts of atmospheric argon may adhere to the samples, which can be corrected for, using the atmospheric $^{40}Ar/^{36}Ar$ ratio of 295.5. Thus, by measuring the ratio of ^{40}Ar to ^{40}K, and knowing the decay rate of ^{40}K, it is possible to calculate the time since the rock or mineral formed.

3. Sample preparation

Samples cuttings were washed with deionised water and dried at 60º C overnight. Ca. 1 gr of volcanic cutting material was handpicked under a bin-ocular. The separate were subsequently crushed with a shatter box (Siebtechnik ring grinder with chrome steel barrel) to 750 micron.

4. Thin section petrography

Representative cutting sample chips were imbedded in UN1866 Resin Solution (Valspar). The resin was poured into a circular mould containing the cutting chips. After the resin had hardened the mould was cut and the piece extracted glued with Araldite to a glass slide. Subsequently, the mounted chips were ground to 30-micron thickness and a cover slip placed over the ground down slide. Petrographic investigation was done using a Zeiss Axioplan Universal microscope. Digital images were obtained using a Leica DFC 320 digital camera.

5. K-Ar analytical procedures

Potassium content was determined in duplicate by atomic absorption (Varian Spectra AA 50) using Cs at 1000 ppm concentration for ionisation suppression. Two approximately 50 mg sample aliquots were dissolved with HF and HNO_3 (see for example Heinrichs & Herrmann, 1990). The samples once in solution were diluted to 0.3 to 1.5 ppm K for the atomic absorption analysis. The pooled error of duplicate K determination of all samples and standards is better than 2 %. The K blank was measured at 0.41ppm = 0.000041% K.

Ar isotopic determinations were performed using a procedure similar to that described by Bonhomme *et al*. (1975). Samples were pre-heated under vacuum at 80°C for several hours to reduce the amount of atmospheric Ar adsorbed onto the mineral surfaces during sample handling. Argon was extracted from the separated mineral fractions by fusing samples within a vacuum line serviced by an on-line ^{38}Ar spike pipette. The isotopic composition of the spiked Ar was measured with a high sensitivity on-line VG3600 mass spectrometer. The ^{38}Ar spike was calibrated against international standard biotite GA1550 (McDougall & Roksandic, 1974). After fusion of the sample in a low blank Heine resistance furnace, the released gases were subjected to a two-stage purification procedure with a CuO getter for the first step, two Ti getters and a SORB-AC getter for the second step. Blanks for the extraction line and mass spectrometer were systematically determined and the mass discrimination factor was determined periodically by airshots. Ca. 30 mg of sample material was required for Argon analyse. During the course of the study one international standard GLO and one airshots were analysed. The results are summarised in Table 2. The error for Argon analyses is below 1.00 % and the ^{40}Ar/^{36}Ar value of the airshot yielded 295.59 ± 0.32. The K-Ar ages were calculated using ^{40}K abundance and decay constants recommended by Steiger and Jäger (1977). The age uncertainties take into account the errors during sample weighing, ^{38}Ar/^{36}Ar and ^{40}Ar/^{38}Ar measurements and K analysis. K-Ar age errors are within 2 sigma uncertainty.

6. Petrography results

Sample: 1152

Two varieties of rock chips can be recognized in this sample, namely gabbro and crystal-vitric tuff.

Classification **Gabbro**

Clast group A : Description

This consists of an interlocking aggregate of semi-euhedral to euhedral **clinopyroxene** (cpx), slightly altered zoned euhedral **plagioclase** (Pl) and semi-euhedral **opaque minerals** (Op) surrounded by radiating aggregates of secondary **chlorite** and mixed-layer clay (Plate). One relict **olivine** crystal also is present and small, slender crystals of **apatite** also occur. Alteration of cpx crystals to **a mixed-layer clay (chlorite-smectite?)**[1] is a feature (Plate).

Mineral	**%(approx.)**	**Grain size**
Cpx	50	0.2x0.24-2x2.8mm
Plagioclase	45	0.2x0.88-0.72x1.4mm
Opaques	5	0.04x0.06mm

Note: % given includes altered crystals; ~25% of the rock is altered.

Other gabbro clasts exhibit greater alteration and may contain fibrous illite and fine grained opaque minerals as additional alteration phases. Cpx is the only relict magmatic phase remaining.

Classification **Crystal-vitric tuff**

Clast Group B: Description: This appears to be an altered **crystal-vitric tuff** containing small, scattered grains of subangular **quartz,** altered **shards**, minor **opaque** minerals and uncommon **plagioclase.** Altered, slightly distorted blades of **biotite** and **muscovite**? are also present. The groundmass consists of a **mixed-layer clay** (illite-smectite? I/S) and minor calcite. The latter plus **opaque minerals** also replace the shards.

Mineral	**%(approx.)**	**Grain size**
Quartz	5	0.018x0.019-0.045x0.055mm
Biotite	5	0.013x0.1-0.18x0.15mm
Opaques	5	0.005x0.005-0.013x0.028mm
Shards	10	Commonly 0.008mm in width & variable in length; largest 0.025x0.138mm
Groundmass	75	

Other clasts have slightly more groundmass.

Thin section images are summarized on Plate 2.

7. K-Ar dating results

Based on petrographic results only gabbro cutting splits were selected for K-Ar dating. The K-Ar dating results are summarised in Table 3 and are referred to the Phanerozoic timescale of Gradstein et al. (2004). Radiogenic ^{40}Ar content is 31 % indicating negligible atmospheric Ar contamination and reliable analytical conditions. K concentration value is 1.1 % in accordance with whole rock K concentrations (internal CSIRO database).

- A whole rock split of sample PEEJAY-1- 2083-2086m yields a K-Ar age of 42.4 ± 1.8 Ma corresponding to a Palaeogene-Eocene-Lutetian origin.

8. References

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Appendix

Table 1: Client sample info and CSIRO ID

From: Janet Skinner <Janet.Skinner@beachpetroleum.com.au>
Date: Tue, 12 May 2009 10:45:57 +0800
To: zwi006 <Horst.Zwingmann@csiro.au>
Subject: PeeJay sample for age dating

Hello Horst
A 20 gram sample of cuttings from the interval 2083-2086m in PeeJay-1 was sent to you yesterday by Challenger Geological Services so you expect to see it in the next day or so. As discussed by telephone would you please date the sample which the wellsite described as containing 100% Dolerite. I understand you will need to make a thin section first from the cuttings.

Kind regards
Janet

Janet Skinner
Beach Petroleum
Level 1, 25 Conyngham Street
Glenside SA 5065
Ph (08) 8338 2833

Sample received 15/05/2009

Client ID	**CSIRO ID**
PeeJay-1 -2083-2086m	**1152 WR**

Table 2: K-Ar dating standard and air-shot data

CSIRO ID standard	K [%]	Rad. 40Ar [mol/g]	Rad. 40Ar [%]	Age [Ma]	Error [Ma]	% difference from re-commended reference age
LP6-100	8.37	1.9260E-09	97.73	128.02	1.91	+0.09

International standard references: LP6 Odin et al. (1982).

Airshot ID	40Ar/36Ar	+/-
AS82-AirS-3	295.59	0.32

Recommended 40Ar/36Ar value: 294.5 (Steiger & Jäger, 1977)

Table 3: K-Ar dating results Beach Petroleum, 07-2009

Client ID well - depth	CSIRO ID	K [%]	Rad. 40Ar [mol/g]	Rad. 40Ar [%]	Age [Ma]	Error [Ma]	Gradstein et al. 2004 timescale
PEEJAY-1- 2083-2086m	1152 WR	1.09	8.1218E-11	30.89	42.46	1.79	Palaeogene-Eocene-Lutetian

Plate 1: Cutting sample image

Plate 2: Thin section images