Great Australian Bight: Well Audit

Prepared by

Barry E. J. Messent
Bast Enterprises Pty Ltd

for

Southern Margin Frontiers
Petroleum & Marine Division
Australian Geological Survey Organisation

AGSO Record 1998/37

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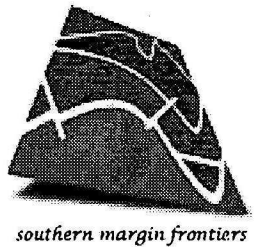

southern margin frontiers

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EXECUTIVE SUMMARY

A well audit of twelve wells in the vicinity of the Great Australian Bight was carried out to assess the cause of failure of the wells. Well completion reports were the dominant source of data. Two seismic lines per well were also used to assist in the review.

The wells audited for this report are listed below:

Apollo 1	Echidna 1	Mercury 1
Borda 1	Gemini 1/1A	Platypus 1
Columbia 1	Greenly 1	Potoroo 1
Duntroon 1	Jerboa 1	Vivonne 1

The wells failed for a variety of reasons. The lack of a valid structural test contributed to the failure of more than 50% of the wells. With more modern seismic acquisition and processing techniques this risk will be significantly reduced in the future. An understanding of the risk associated with breaching in the Eyre Sub-Basin is required.

The wells in the Polda Trough — Columbia 1, Gemini-1/1A and Mercury-1 — are interpreted to have failed due to the lack of a viable source in the area. For the remaining wells, source was not the dominant issue; failure was due to a combination of other factors. A greater understanding of timing of generation and migration pathways in the area is required.

The reservoir risk varies across the study area. Excellent reservoirs are present in the Potoroo and Pidinga formations. The upper sections of the Wigunda Formation have excellent reservoir quality in the Duntroon Basin. The Platypus and Ceduna formations, where present, contain good reservoirs, but a greater understanding of sandstone distribution is required. Depth to burial is a concern due to the immaturity of the Platypus and Ceduna sandstones and its influence on porosity reduction.

Caprock seal is not perceived as a major risk except in the shallow sections. The Nullarbor Limestone Formation has potential to seal, but seal capacity analysis suggests that the height of an oil column may be limited.

TABLE OF CONTENTS

INTRODUCTION

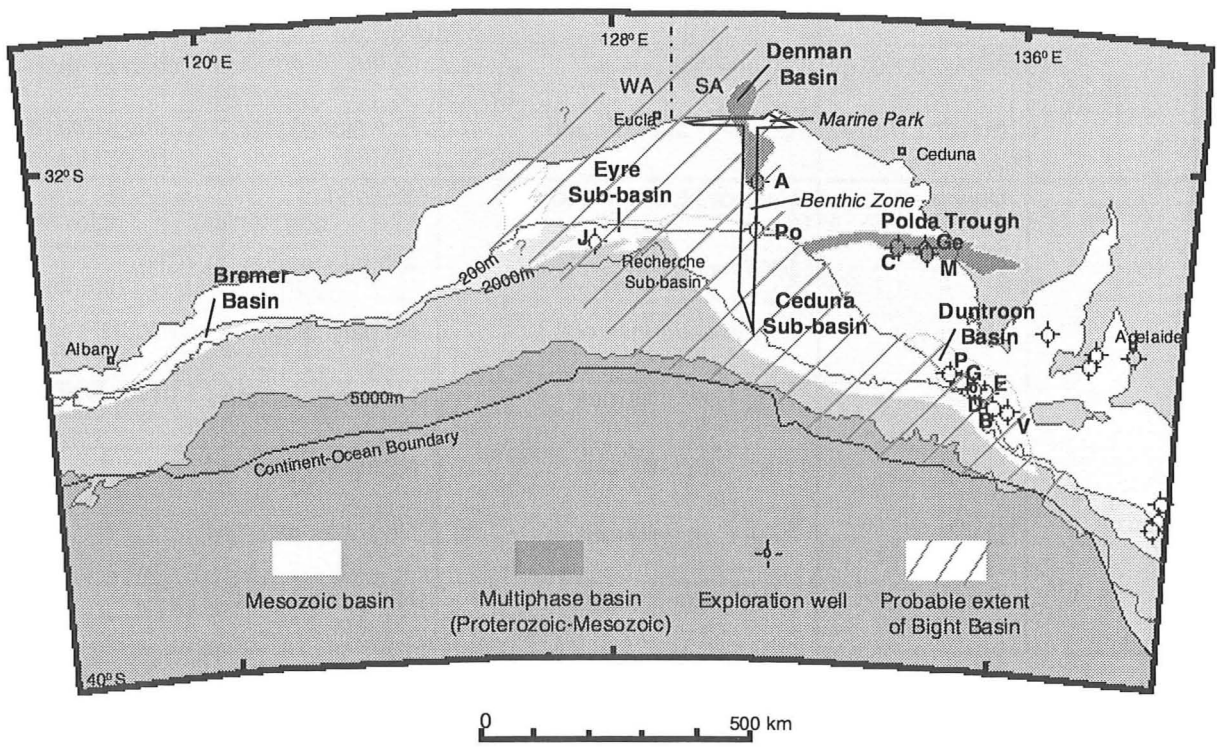
The project was initiated to assess the cause of failure for petroleum exploration wells in the vicinity of the Great Australian Bight (see location map). Twelve wells were reviewed:

Apollo 1	Echidna 1	Mercury 1
Borda 1	Gemini 1/1A	Platypus 1
Columbia 1	Greenly 1	Potoroo 1
Duntroon 1	Jerboa 1	Vivonne 1

Data used for the assessment include the well completion reports in conjunction with two seismic lines per well (where available), and the published papers noted in the references. Each well summary includes a tabulation of basic well data such as location, formation tops and shows, followed by a pre-drill and post-drill prognosis.

Hydrocarbon shows were compiled using AGSO database codes as listed in Appendix 1. Abbreviations used in the report are given in Appendix 2.

In an attempt to ensure uniformity across the area, the formation names used in some of the reports were modified following the stratigraphic scheme proposed by Smith and Donaldson (1994) and Messent et al (1996) for the Duntroon Basin. The scheme is preliminary and may require modification when more detailed analyses are carried out and the data are integrated within a regional sequence stratigraphic model. The stratigraphic scheme used in this report is summarised in the Table overleaf.



A - Apollo 1
B - Borda 1
C - Columbia 1
D - Duntroon 1
E - Echidna 1
G - Greenly 1
Ge - Gemini 1
J - Jerboa 1
M - Mercury 1
P - Platypus 1
Po - Potoroo 1
V - Vivonne 1

Summary Stratigraphic Scheme

Group	Formation	Series	Zone
Eucla	Nullarbor	Late Eocene to Recent	upper *N. asperus* - Recent
	Wilson Bluff	Mid - Late Eocene	lower-middle *N. asperus*
	Upper Pidinga	Mid-Eocene	lower *N. asperus*
Bight	Lower Pidinga	Early Paleocene to mid-Eocene	*L. balmei* – lower *N. asperus*
	Potoroo	Campanian to Maastrichtian	*N. senectus* – *T. longus*
	Wigunda	Cenomanian to Santonian	*A. distocarinatus* – *T. apoxyexinus*
Duntroon	Platypus	Cenomanian	*A. distocarinatus*
	Ceduna	Albian	*P. pannosus*
	Upper Borda	Barremian to Albian	*C. hughesi* – *C. paradoxus*
	Lower Borda	Berriasian to Hauterivian	*C. australiensis* – *F. wonthaggiensis*
	Neptune	Berriasian	*C. australiensis*
	Echidna	Tithonian to Berriasian	*R. watherooensis* –*C. australiensis*
	Unnamed	Callovian to Kimmeridgian	*M. florida*
	Polda	Middle Jurassic	?J6 (No reports in WCR)
	Unnamed	Permo-Carboniferous	No palynology data in WCR
	Unit4	?Pre-Carboniferous	No zones reported
	Unit 3	?Pre-Carboniferous	No zones reported
	Unit 2	?Pre-Carboniferous	No zones reported
	Unit 1	?Pre-Carboniferous	No zones reported

WELL: APOLLO-1

BASIN: DENMAN BASIN

WELL SUMMARY

Operator:	Outback Oil Co	**Date Spudded:**	07-OCT-75
Type:	Exploration	**Rig Released:**	15-OCT-75
Status:	P & A - dry	**Open File (Basic):**	15-OCT-77
Spheroid:		**Open File (Interp):**	15-OCT-80
Ref Datum:		**Projection:**	
Latitude:	- 32° 32' 15.99"	**KB (m):**	8.5
Longitude:	130° 51' 13.00"	**WD (m):**	74.1
Map:	SI52-04	**TD (mKB):**	876.0
Seismic Line 1:	DE-128	**Seismic Line 2:**	
AGSO File:	75/159		

Stage	Formation	Zone	Dominant Lithology	Fm Top (mKB/mSS)	Thickness (m)	TWT (ms)
?Miocene – Recent	Nullarbor	?	lst	82.6/74.1	?	
Mid-Late Eocene	?Wilson Bluff	*G. mlozea mlozea*	lst	?	?	
Early Eocene	Lower Pidinga	*S. linaperta, S. frantosa*	glauc sst	378.6/370.1	46.9	
Aptian to basal Albian	Upper Borda	*H. audax, T. kurillinensis S.kattarensis*	clst, sst, sltst	425.5/417.0	356	
Permian	Unnamed	?	clst, sst	781.5/773.0	81.1	
Archean	Basement		Granite	862.6/854.1	+13.7	

SHOWS:

No shows were reported.

CAUSE OF FAILURE:

The cause of failure is interpreted to be the lack of a mature source in the area, lack of seal for most of the potential reservoirs and possible lack of structure.

WELL: APOLLO-1

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The Apollo prospect was one of a number of anticlines within a northwest-southeast trending graben. The initial interpretation suggested a shift of the anticlinal axis between deep and shallow horizons indicating major cross-faulting, and possibly shearing.

The area of closure was mapped at about 15 km^2, with approximately 74 m of relief. There was also interpretation of possible bright spots and DHIs.

Target Horizon

The age of the target horizon was unclear.

Seismic Quality

Within the area, there was 1342 km of 1972 vintage and 608 km of 1967 vintage seismic data. The grid across the Apollo feature was approximately 13 km^2. In the shallow section, the data quality was good overall, but very poor below a bright reflector (now known to be granite basement).

Geological Interpretation

Reservoir

The target horizon was interpreted to be a sandstone build-up or bioherm, which covered an area of about 51km^2. The sedimentary section in this area was believed to be between 1675m-1825m in thickness.

Seal

Little was known on the seal potential.

Source

Little was known on the source potential.

Migration

Little was known on the migration pathways.

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The top of granitic basement was above the mapped target horizon.

Target Horizon

The target horizon was within basement and was most likely a multiple.

Geological Interpretation

Reservoir

Excellent reservoir sandstones are present in the Pidinga Formation sandstones. The sandstones are fine- to coarse-grained, dominantly medium to coarse, glauconitic and argillaceous in part.

In addition, sandstones are present within the Upper Borda Formation, however their distribution is uncertain.

Seal

There appears to be an inadequate seal for most of the potential reservoir sections. The most effective seal for basal Permian sandstones that onlap the granitic basement, would be Permian claystones and the basal section of the Upper Borda Formation.

Hydrocarbon Shows

No shows were encountered.

Source

The shallow depth to basement precludes generation of any potentially viable source rocks that may be in the area. No geochemical analyses were reported.

Migration

There was no migration into the structure.

Cause of Failure

The cause of failure is interpreted to be the lack of a mature source in the area. Even if source rocks were present, there is a lack of seal for most of the potential reservoirs, and possible lack of structure.

WELL: BORDA-1

BASIN: DUNTROON

WELL SUMMARY

Operator:	BHP Petroleum	**Date Spudded:**	24-APR-93
Type:	Exploration	**Rig Released:**	28-MAY-93
Status:	P & A –dry	**Open File (Basic):**	28-MAY-95
Spheroid:	ANS	**Open File (Interp):**	28-MAY-98
Ref Datum:	AGD84	**Projection:**	UTM
Latitude:	-35° 50' 40.70"	**KB (m):**	25.3
Longitude:	135° 41' 15.00"	**WD (m):**	156.7
Map:	SI53-15	**TD (mKB):**	2800
Seismic Line 1:	DH92-169, SP 1223	**Seismic Line 2:**	
AGSO File:	93/363		

Stage	Formation	Zone	Dominant Lithology	Fm Top (mKB/mSS)	Thickness (m)	TWT (ms)
E Miocene-E Pliocene	Nullarbor	*NP22*-Recent	lst	182/157	1418	209
Mid-Late Eocene	Wilson Bluff	*NP16-NP19*	lst, marl	1600/1575	546	
Paleocene	Lower Pidinga	*L. balmei*	sst, clst	2146/2121	317	1404
Campanian-Maastrichtian	Potoroo	*T. lilliei* - upper *T. longus*	clst, sst	2463/2438	>337	1589
TD				2800/2775		

SHOWS

No shows were reported.

CAUSE OF FAILURE

The most likely cause of failure is the lack of a suitable conduit for migration from the Upper Borda Formation source rocks into the Pidinga Formation reservoirs.

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The Borda feature was mapped as a four-way dip anticline broken by a minor fault to the southwest. The trap formed during the late Eocene to Early Oligocene. Closure was by structural dip to the west and south, and by marl infill of a Pidinga Fm channel to the east and north.

Target horizon

The Base Wilson Bluff seismic marker defined the structure.

Seismic Quality

A seismic grid of 1km by 1km, with good seismic data quality down to the Base Wilson Bluff level defined the prospect. Beneath the Wilson Bluff level, data quality deteriorated significantly resulting in a lower confidence in both the horizons mapped and the depth conversion of the underlying target zones.

Geological Interpretation

Reservoir

The target horizon was the sandstone beneath the Base Wilson Bluff seismic marker.

Seal

The Wilson Bluff marls and calcareous siltstones would provide seal for the reservoirs. The Wilson Bluff Fm is at its thickest in the vicinity of the Borda-1 well. The channel, which defines the east and north of the trap, is filled with marls and calcareous siltstones of the Wilson Bluff Fm.

Source

No source rocks were expected in the well. Mature source rocks of the Upper Borda Fm were anticipated beneath and to the south of the well location. TOC values averaging up to 5.5% had been encountered in claystones at Echidna-1. In addition, coals of the Upper Borda Fm were also expected to have source rock potential.

Migration

Migration of hydrocarbons from the Upper Borda Formation relied on vertical migration, via faults, through the thick Wigunda Formation claystone section.

WELL: BORDA 1

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The well is believed to have tested a valid structure. The structural mapping was similar pre- and post-drill.

Target horizon

At the primary target, the base of the Wilson Bluff Formation, the well was 64 m deep to prognosis, primarily due to a high velocity, chert-rich sequence from 1230-1439 mKB.

Depth velocities were derived from a single layer model using water, Tertiary carbonates and pre-Tertiary clastics. Interval velocities were calculated by Dix's equation from smoothed stacking velocities. The following table shows that depth errors are due mainly to velocity problems and horizon mis-picks.

ERRORS DUE TO HORIZON PICKS

HORIZON	PREDICTED TWT (ms)	ACTUAL TWT (ms)	PREDICTED DEPTH (mSS)	ACTUAL DEPTH (mSS)	ERROR (m)
Base WB	1412	1404	2133	2121	-12
Base Pid	1438	1589	2176	2438	+262
Base Pot	1734	NP	2703	NP	?+300

ERRORS DUE TO VELOCITY

TWT (ms)	PREDICTED DEPTH (mTVDSS)	ACTUAL DEPTH AT PREDICTED TWT (m)	DEPTH ERROR (m)	ERROR (%)
857	990	995	+5	0.5
1137	1505	1532	+27	1.8
1330	1975	1953	-22	1.1
1412	2185	2133	-52	2.4
1508	2335	2295	-40	1.7
1734	2750	2703	-47	1.7

Geological Interpretation

Reservoir

Reservoirs are of excellent quality in the Lower Pidinga and Potoroo Formations. Good permeabilities are also inferred. Depositional environments are interpreted to be near-shore marine.

The Pidinga Formation sandstones, intersected at 2146-2295 mKB, are dominantly light grey to light brownish grey, medium-grained quartz sandstones.

The Potoroo Formation sandstones are medium- to coarse-grained in the upper section, becoming lithic towards the base of the well.

A summary of the net reservoir intervals is given in the table below. The following cut-offs were used, Vsh=50%, Porosity=12%.

FORMATION	DEPTH (mKB)	GROSS (m)	NET (m)	N/G (%)	Av. POROSITY (%)
lower Pidinga	2146-2295	149	148.5	100	20
	2295-2463	168	157.7	94	19
Potoroo	2463-2559	96	72	75	21
	2559-2605	46	4.1	9	18
	2605-2668	63	2.5	4	21
	2668-2785	117	55.6	47	16
	2785-2790	5	4	80	20

Seal

Seal is provided by the marls and calcareous siltstones of the Wilson Bluff Formation. Seal analyses suggest oil columns in the order of 120-175 m could be contained, with a maximum of 650m, near Borda-1.

The Potoroo Formation contains marine claystones which have the potential to act as intra-formational seals.

Hydrocarbon Shows

No shows were encountered. Background gas commenced at about 2108 mKB and averaged 0.02-0.03 %C_1 throughout the remainder of the well.

Source

No source rocks were intersected in the well. Source rock analyses from the Potoroo Formation suggest marginal to moderate potential for hydrocarbon generation and expulsion. Throughout the basin, this formation is perceived to be predominantly immature. Good source rocks are interpreted to occur in the Upper Borda Formation.

The formation temperature, at 2800 mKB, is approximately 98 °C.

Migration

Migration was predicted to be vertical via faults from the Upper Borda Formation to the Pidinga Formation reservoirs. However, the Wigunda Formation is interpreted to be relatively thick in this area and consists of predominantly claystones. It is therefore likely that the faults are sealing within the catchment area of Borda-1 rather than providing a migration pathway.

Cause of Failure

The most likely cause of failure is the lack of a suitable conduit for migration from the Upper Borda Formation source rocks to the Pidinga Formation reservoirs.

WELL: COLUMBIA-1

BASIN: POLDA TROUGH

WELL SUMMARY

Operator:	Aust Occidental Petroleum	**Date Spudded:**	07 FEB 82
Type:	Exploration	**Rig Released:**	10 APR 82
Status:	P & A - dry	**Open File (Basic):**	10 APR 84
Spheroid:		**Open File (Interp):**	10 APR 87
Ref Datum:		**Projection:**	
Latitude:	-33° 29' 38.90"	**KB (m):**	17
Longitude:	133° 42' 4.49"	**WD (m):**	74
Map:	S153-06 ELLISTON	**TD (mKB):**	2168
Seismic Line 1:	81-08, SP900	**Seismic Line 2:**	
AGSO File:	81/1400		

Stage	Formation	Zone	Dominant Lithology	Fm Top mKB/mSS	Thickness (m)	TWT (ms)
Quaternary	Unnamed	?	silty & shelly sand	91/74	21	
?Late Eocene to Quaternary	?Nullarbor	No data (based on Jerboa-1)	not sampled	112/95	158	
Middle Jurassic	Polda	?J6 (No reports in WCR)	sst	270/253	436	
Permo-Carboniferous	Unnamed	No reports in WCR	boulder clst, sst	706/689	65	647 Blue
?Pre-Carboniferous	Unnamed/ Unit4	No ages reported	red sltst, sst, clst	771/754	182	
	Unit 3	No ages reported	sst, minor slst, lst	953/936	333	
	Unit 2	No ages reported	red brown sltst	1286/1269	415	
	Unit 1	No ages reported	sst	1701/1684	467	1170 Brown

SHOWS

No shows were reported.

CAUSE OF FAILURE

The most likely cause of failure is the lack of a mature source in the catchment area of the structure.

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The Columbia structure was interpreted as a north-northwest-trending horst block of pre-Jurassic age. The base Jurassic unconformity surface draped the structure creating a low relief, fault-independent closure. Later rejuvenation, which had ceased by the end of the Cretaceous, was also interpreted.

Closure was interpreted from the base Jurassic down.

Target Horizon

The target seismic horizon was the base Jurassic seismic marker (55 m closure, area 15 km^2). Within the horst block, closure was fault-dependent. At the base ?Ordovician, closure was approximately 540 m, covering an area of 18.5 km^2 .

Seismic Quality

The seismic was shot in 1981. The seismic quality above the base Jurassic horizon is moderate; below poor. There is a lack of reflection continuity below the interpreted base Ordovician, which precluded detailed mapping.

Geological Interpretation

Reservoir

The target was sandstones within the interbedded sandstone/claystone sequence below the base Jurassic seismic marker. The age of the section was tentatively interpreted as ?Cambrian to ?Ordovician.

Seal

Top seal was a significant risk due to the sandy nature of the Jurassic section intersected in Gemini-1A. However, it was hoped that basalt would also be present to reduce the seal risk. Furthermore, the Cambrian–Ordovician section was expected to be an interbedded sandstone and claystone section with the potential for intra-formational seals.

Fault seal was a potential risk.

Source

Source was interpreted to be from the interbedded claystones in the Cambrian–Ordovician section. The section was anticipated to be thermally mature.

Migration

The structure would be sourced locally with short distance migration.

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The structure was drilled in a near crestal location at the base Jurassic seismic marker and was a valid test.

Within the horst block, dips were higher than expected (5-10°) suggesting there is greater complexity within the horst block than anticipated.

Target Horizon

The base Jurassic was intersected at 706 mKB (689 mSS), 36 m (0.053 ms) high to prognosis. This difference was the result of a mispick in the crestal location rather than velocity. There is still a mapped closure at this horizon.

The "?base Ordovician pick" (Brown horizon) was an intra-formational pick of unknown age. This correlated with the top of Unit 1. The pick was 99m deep to prognosis (1684 mSS versus prognosis of 1585 mSS). The interval velocity between the base Jurassic pick and "?base Ordovician pick (Brown horizon)" was higher than anticipated (approximately 4900 m/s against prognosed, 4500 m/s).

The "?Base Cambrian" (Purple Horizon) was not intersected.

Geological Interpretation

Reservoir

The Jurassic section contained excellent quality reservoirs with porosities in excess of 25%. The SP deflection suggests good permeabilities.

Below the base Jurassic seismic marker, an interbedded sandstone and claystone section was intersected. Sandstone units up to 40 m in thickness are present above 1200 mKB, with porosities in the order of 19 %. The SP log again suggests good permeabilities.

Thick sandstone units (up to 250m thick) with very high net to gross are present below 1700. Porosities are in the in the order of 10-15%. The SP deflection indicates the sands are permeable.

Seal

At the base Jurassic horizon, the caprock is a risk. The trap is dependent on an underlying Permo-Carboniferous shale unit, which is approximately 20 m thick at Columbia-1. It has been interpreted to be present in all 3 wells drilled in the basin.

Deeper in the section, thick siltstone successions (in excess of 300 m) are present to provide seals for the deeper reservoirs.

Hydrocarbon Shows
No shows were encountered in the well.

Source
No source rocks were determined in the well. At TD (2168 mKB), the formation temperature was approximately 72 °C. At the well any potential source rocks are immature.

Away from the well location, the pre- Jurassic section thickens, suggesting there may be potential for source rock development in localised grabens.

Source is the dominant risk in this area.

Migration
The structure could only have been filled from a local catchment area within the Polda Basin.

Cause of Failure

The most likely cause of failure is the lack of a mature source in the catchment area of the structure.

WELL: DUNTROON-1

BASIN: DUNTROON

Operator:	BP Petroleum Development Australia	**Date Spudded:**	11-JAN-86
Type:	Exploration	**Rig Released:**	05-MAR-86
Status:	P & A - dry	**Open File (Basic):**	05-MAR-88
Spheroid:		**Open File (Interp):**	05-MAR-91
Ref Datum:	AGD66	**Projection:**	
Latitude:	-35° 35' 27.04"	**KB (m):**	26.8
Longitude:	135° 20' 59.83"	**WD (m):**	144.0
Map:	SI53-15	**TD (mKB):**	3515.6
Seismic Line 1:	D83-24 SP1420	**Seismic Line 2:**	
AGSO File:	85/904		

Stage	Formation	Zone	Dominant Lithology	Fm Top mKB/mSS	Thickness (m)	TWT (ms)
Late Eocene to Recent	Nullarbor	?	lst	170.8/144	1146.2	
? Late Eocene	Wilson Bluff	?	lst, sst, marl	1317/1290.2	313	
Eocene	Pidinga	mid *M. diversus* to mid *N. asperus*	sst	1630/1603.2	203	
Campanian to Maastrichtian	Potoroo	*N. senectus* – upper *T. longus*	sst, clst	1833/18062	277	
Turonian to Santonian	Wigunda	*P. mawsonii* – upper *T. apoxyexinus*	clst, sst	2110/2083.2	431	
Cenomanian	?Platypus	? *A. distocarinatus*	sst, clst	2541/2524.2	24	
Albian	Ceduna	upper *C. paradoxa* – *P. pannosus*	sst, clst, coal	2565/2538.2	382.5	
Aptian to Albian	Upper Borda	*C. hughesi* – upper *C. paradoxa*	clst, sst, coal	2923.5/2896.7	+592	

SHOWS

DEPTH (mKB)	Formation	Lithology	Code	Comments
3061	Upper Borda	sst	L1	Mod bri yel flu
3200	Upper Borda	sst	L1	Dull yel flu
Coals			-	Dull yel sl str cut, dull blu-wh cut flu

CAUSE OF FAILURE

The cause of failure is not clear. There is considerable doubt as to the validity of the structure mapped, and the source potential near the well is limited. The absence of a suitable migration pathway has also contributed to the failure of the well.

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The structure (previously known as the Numbat Prospect) was interpreted to be a Mesozoic tilted fault block formed at the confluence of a major synthetic and antithetic fault system. The trap is fault-dependent and forms part of a series of stepped terraces separated by down-to-basin growth faults. The trap was interpreted to be the largest structure in the area and occurs on the footwall. Structural development is interpreted to have started during the Early Tertiary.

Target Horizon

BP mapped eight horizons over the prospect. The target horizon was the top Platypus Formation (Pink Horizon) which had a generally strong reflection. The good seismic reflectivity may be due to the presence of coals, near the top of the formation. Growth faulting was interpreted to be present. The top of the Platypus Formation was predicted at 2490 mSS.

Potential oil-in-place estimates at the primary target were 712 MMbbls with reserves of 177 MMbbls (25%). If gas, 0.99 tcf was likely to be present (recoverable, 0.64 tcf).

Seismic Quality

The quality of the 1983/1984 seismic is poor below the Base Wilson Bluff horizon. Over the prospect, interpretation was carried out on 1.25 km grid spacing.

Geological Interpretation

Reservoir

A similar section to Platypus-1 was envisaged, with deltaic sandstones of the Platypus Formation forming the primary target. Net to gross of about 75% was expected in the top 100m of reservoir. The sandstones were likely to be very fine to medium-grained and argillaceous in part. Porosities in the range of 17-28% were predicted, with a mean of 22-24%.

The secondary targets were sandstones within the Upper Borda Formation equivalent. Reservoir quality was perceived as a major risk at this target.

Seal

The Wigunda Formation claystone would provide the top seal for the Platypus Formation.

Source

Source was anticipated to be Albian to Cenomanian coals of the Upper Borda to Platypus formations. Expulsion was believed to have occurred in the Tertiary, after trap development.

Migration
Migration was anticipated to be from the south and west of the structure.

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure
The quality of the seismic suggests that any interpretation will have risks associated with it. A major concern is the determination of faults and their orientation. There is, therefore, a degree of uncertainty as to whether there is closure at the location.

Target Horizon
The top of the Platypus Formation was intersected at 2541 mKB, 24 m high to prognosis.

Geological Interpretation

Reservoir
All reservoirs were water wet.

The primary target, the Platypus and Ceduna Formations, consists of massive grey, fine- to medium-grained, siliceous and calcareous cemented, quartz sandstones. Siltstone and mudstone interbeds occur throughout. Minor coal beds occur towards the base. Sandstones are occasionally present in the basal section of the Wigunda Formation (2467-2482 mKB).

Porosity over the interval 2467-2590 mKB ranged between 17% and 27% in the better quality sands. However, effective net sandstone (based on logs) is low — 22 m over 123 m (18%).

Core data over the interval 2751.5-2769.8 mKB, in the Ceduna Formation, showed a variation in porosity of between 8.9% and 22.1%, with permeabilities in the order of 0.1-422 mD.

Seal
The Wigunda Formation forms an excellent top seal. However, there has been no comment on cross-fault seal in the reports.

Hydrocarbon Shows
Gas readings were low throughout the drilling of the well. The maximum gas recorded was 0.52%C_1 which was associated with the coals. Minor shows were encountered in the well as listed below.

WELL: DUNTROON-1

DEPTH (mKB)	Formation	Lithology	Code	Comments
3061	Upper Borda	sst	L1	Mod bri yel flu
3200	Upper Borda	sst	L1	Dull yel flu
Coals			-	Dull yel sl str cut, dull blu-wh cut flu

Source

The coals are interpreted to have excellent potential to source gas with some waxy condensate. Any oil expulsion is likely to occur in the gaseous phase at temperatures of about 150°C.

Fm	Lithology	TOC% Range	TOC% Av	HI Range	HI Av	S_2 Range	S_2 Av	Log %net
Platypus	clst	1.2- 1.3	1.3	138-142	140	1.7- 1.8	11.8	-
	coal	66.0-67.0	66.5	97-200	149	65.0-132.0	99.0	-
Ceduna	clst	1.1- 1.7	1.4	131-164	152	1.7- 2.5	2.0	72.0
	coal	32.6-68.8	55.0	120-253	192	8.0-143.0	109.0	2.0
Upper Borda	clst	1.3- 6.9	2.3	78-188	169	1.8- 3.9	2.9	78.0
	coal	35.7-69.1	56.5	183-316	256	80.2-218.0	137.0	3.5

(from Smith and Donaldson, 1995)

The maximum, recorded temperature was 115.5 °C at 3515 mKB. The geochemical data suggests ca. 120 °C.

Migration

Migration was interpreted to be from the south or west. The quality of the source rocks in the immediate vicinity of the well is limited and the major migration pathway is likely to be from the south. Some complexity is involved due to the number of fault zones. The well may have been drilled in a shadow zone.

Cause of Failure

The cause of failure is not clear. There is considerable doubt as to the validity of the structure mapped, and the source potential near the well is limited. The absence of a suitable migration pathway has also contributed to the failure of the well.

WELL: ECHIDNA 1

BASIN: DUNTROON

Operator:	Shell Development (Australia)	**Date Spudded:**	16-JAN-72
Type:	Exploration	**Rig Released:**	17-MAR-72
Status:	P & A – dry	**Open File (Basic):**	17-MAR-74
Spheroid:		**Open File (Interp):**	17-MAR-77
Ref Datum:	AGD66	**Projection:**	
Latitude:	-35° 36' 15.00"	**KB (m):**	30
Longitude:	135° 37' 12.00"	**WD (m):**	169
Map:	SI53-15	**TD (mKB):**	3832
Seismic Line 1:		**Seismic Line 2:**	
AGSO File:	N/A		

Stage	Formation	Zone	Dominant Lithology	Fm Top mKB/mSS	Thickness (m)	TWT (ms)
?Mid-Late Eocene to Recent	Nullarbor	Zonule L to Recent	lst	199/169	973	
?Mid-Late Eocene	Wilson Bluff	?Zonule M	marl	1172/1142	30	
? Mid- Eocene	Upper Pidinga	No age data	sst	1202/1172	98	
?Maastrichtian	Potoroo	?upper *T. longus*	clst	1300/1270	18	
Barremian-Aptian	Upper Borda	lower *C. hughesi*	clst, sltst, coals	1318/1288	192	
Valanginian-Hauterivian	Lower Borda	*F. wonthaggiensis*	clst, sltst, coals	1510/1480	1510	
Berriasian	Neptune	*C. australiensis*	clst, sltst, coals	3020/2990	570	
Berriasian	Echidna	lower *C. australiensis*	clst, sltst, coals	3590/3560	+242	

SHOWS

Depth (mKB)	Formation	Lithology	Code	Comments
2648/2652	Lower Borda	Thin i/b sst	L1	Black soft bituminous material, lt brn str cut, yel cut flu

CAUSE OF FAILURE

The quality of the original seismic is poor. It is likely that there is not a valid trap at the well location. In addition, no reservoir is present at the primary target horizon.

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The feature was a large, approximately east–west-trending domal structure mapped on a 'phantom' horizon believed to be possibly the Jurassic/Cretaceous boundary. It was interpreted as a mid-basin high. Seismically, the high is characterised by a general absence of reflectors.

Target Horizon

The principal objective was to appraise the lowermost Mesozoic section, which was interpreted to occur at a relatively shallow depth. The anticipated age of the sediments was interpreted to be Jurassic, at a depth of approximately 3800 m.

The secondary target was truncated sandstones of interpreted Upper Cretaceous age at an anticipated depth of about 1340 m.

Seismic Quality

The original seismic quality on which siting of the well was based, is poor. Later seismic has shown an improvement, but at depth, the seismic quality would still be classified as poor.

Geological Interpretation

Reservoir

The primary objective (Jurassic sandstones) was believed to have a high net to gross. The reservoir was related to Shell's "Deep Mesozoic" mapping horizon.

The secondary target, an upper Cretaceous sandstone reservoir, was below Shell's "A" mapping horizon.

Seal

The top seal for the primary target would be provided by Cretaceous shales, in excess of 1800 m in thickness.

Seal of the secondary target would be provided by Eocene calcareous claystones and limestones, interpreted to be equivalent to the Wilson Bluff Formation.

Source

There is no comment in the report.

Migration

There is no comment in the report.

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure

Following the post-well evaluation, the operator interpreted the Echidna structure as a broad faulted dome superimposed on the larger scale mid-basin high. The main development phase was believed to have occurred in late Cretaceous to early Tertiary. It was also estimated that up to about 1500 m of sediment was eroded from the dome in early Tertiary times.

Nonetheless, the poor quality seismic data suggest that alternative interpretations are possible. Therefore, there is risk associated with the interpretation.

Target Horizon

The primary target, Shell's "Deep Mesozoic" mapping horizon, equates to the top of the Echidna Formation (3639 mKB) and was approximately 180m shallow to prognosis. This was due to abnormally slow velocities in the Neptune Formation, as a result of overpressuring in the claystones.

The secondary target horizon, Shell's "A" seismic marker horizon, was approximately 90m shallow to prognosis.

Geological Interpretation

Reservoir

At the primary target horizon, beneath Shell's "Deep Mesozoic" mapping horizon (top Echidna Formation), no reservoirs were encountered.

At the secondary target horizon, beneath Shell's "A" seismic marker horizon, mainly coarse, clean sandstones were intersected. They are interpreted to be of Eocene age (Pidinga Formation). Porosities are high, 20-30%, with excellent inferred permeabilities and high net to gross.

The predicted late Cretaceous section (Potoroo Formation) is only 10m thick and is a claystone. Within the claystone section, there are occasional thin, discrete sandstone beds (approximately 2-3 m thick) with porosities varying between 13% and 23%. Overall, their net to gross is very low (2.5%) and they do not form a viable target in this vicinity.

Seal

The Cretaceous section consists of predominantly claystones and siltstones with occasional sandstones and coals. There is overpressuring in the Neptune Formation over the interval, 3230 mKB to 3940 mKB. There is adequate seal near the well.

Hydrocarbon Shows

Background gas readings commence at about 500mKB (C_1 only) and are present throughout the well. Above about 3000m, the readings are generally less than 1Mppm, and below, 1-5000ppm. C_2 is also present from about 2600m, and does not exceed 100ppm for the well.

Depth (mKB)	Formation	Lithology	Code	Comments
2648/2652	Lower Borda	Thin i/b sst	L1	Black soft bituminous material, lt brn streaming cut, yellow cut fluorescence

Source

Rock-Eval data are summarised in the table below, showing that claystones and coals of the Upper Borda Formation have good to very good source potential for hydrocarbon generation.

Formation	Lithology	TOC% Range	TOC% Av	HI Range	HI Av	S_2 Range	S_2 Av	Log %net
Upper Borda	clst	1.0-19.9	5.5	76-264	146	0.6- 8.0	4.2	90
	coal	24.8-47.2	32.4	1124-275	210	38.7-89.0	67.0	6.5
Lower Borda	clst	0.5- 1.3	0.7	43-148	105	0.3- 1.3	0.7	

(from Smith & Donaldson, 1995)

Migration

There is little evidence to suggest that there has been any significant migration through the well location.

Cause of Failure

The quality of the original seismic is poor. It is likely that there is not a valid trap at the well location. In addition, no reservoir is present at the primary target horizon.

WELL: GEMINI-1/1A

BASIN: POLDA TROUGH

Operator:	Outback Oil Co	**Date Spudded:**	18-OCT-75
Type:	Exploration	**Rig Released:**	01-NOV-75
Status:	P & A-dry	**Open File (Basic):**	01-NOV-77
Spheroid:		**Open File (Interp):**	01-NOV-80
Ref Datum:		**Projection:**	
Latitude:	-33° 28' 44.00"	**KB (m):**	8.5
Longitude:	134° 12' 4.00"	**WD (m):**	68
Map:	S153-06 ELLISTON	**TD (mKB):**	-1 : 362 -1A: 894
Seismic Line 1:	71-16, SP815	**Seismic Line 2:**	
AGSO File:	75/160		

Stage	Formation	Zone	Dominant Lithology	Fm Top mKB/mSS	Thickness (m)	TWT (ms)
Quaternary	Unnamed	?	not to surface	?		
?Late Eocene to Quaternary	?Nullarbor	no data (based on Jerboa-1)	?lst	?		
Middle Jurassic	Polda	?J6 (no reports in WCR)	sst, clst, sltst, coal	285/276.5	556	
Permo-Carboniferous	Unnamed		sst, clst, slst with igneous rock fragments	841/832.5	>53.5	
TD				894/885.5		

SHOWS

No shows were reported.

CAUSE OF FAILURE:

The most likely cause of failure is a lack of adequate seal in the Jurassic section and, possibly, the lack of an adequately mature source.

WELL: GEMINI-1

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The Gemini structure was approximately 25km^2 in area with about 180m of closure. Pre-drill, there were two targets: A NNE–SSW-trending anticlinal feature was mapped as a possible Cretaceous pick at ~800 ms. A deeper horizon ('Deep Seismic Reflection Horizon'), was mapped at about 1600 ms. The anticlinal feature was orientated approximately east–west. The structure was partly fault controlled.

There was no discussion on the influence of salt movement on structural development.

Target Horizon

The target horizons were unknown but up to about 2440 m of sediments were expected (from aeromagnetic data).

Seismic Quality

Down to the seismic marker at ~800 ms (at the intersection of lines 107 and 128), the quality is adequate. Below this seismic marker, the seismic quality is poor.

Geological Interpretation

Reservoir

The anticipated section was unknown. The nearest well was a shallow water bore (~140 m) about 80 km east of the well location, in the eastern onshore portion of the Polda Basin.

Seal

The anticipated section was unknown.

Source

The anticipated section was not known.

Migration

There was no discussion on migration.

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The shallower horizon was intersected at 856.5 mKB. It is probable that a valid structure is present at this horizon. The deeper horizon was not penetrated.

Target Horizon

The shallow target horizon had been interpreted as possibly Cretaceous in age. Post-drill, the seismic marker is interpreted to be the Base Jurassic, which can be mapped over the entire basin.

Geological Interpretation

Reservoir

Sandstone reservoirs were intersected in the Jurassic. The section consists of an interbedded sequence of unconsolidated sandstones, siltstones, claystones and coals. In the sandstones, porosities greater than 30% are present, especially over the interval 396–701 mKB. The sandstones were deposited in a non-marine environment.

Seal

Associated with the Jurassic sandstone reservoirs are interbedded claystones. Individual beds are up to approximately 80 m thick. The sediments were deposited in a non-marine environment. The probability of a claystone extending across the field and providing an effective seal is moderate.

Hydrocarbon Shows

No shows were encountered in the well.

Source

The only source rocks of any note are present in a bituminous coal unit, intersected over the interval 752-762 mKB in the Jurassic section.

At TD (894 mKB), BHT is approximately 61°C. The section is therefore immature.

Migration

There is no discussion on migration.

Comments

Initially, the interpretation suggested the well had reached TD in a granite or syenite. The granite interpretation suggested an Archean age, whereas the syenite interpretation inferred a possible Proterozoic origin. However the subsequent drilling of Mercury-1 and Columbia-1 indicates that the ?Permo-Carboniferous section, immediately below the base Jurassic unconformity, is a boulder bed. It is possible that Gemini-1 reached TD in a granite or syenite boulder rather than economic basement.

Cause of Failure

The most likely cause of failure is a lack of adequate seal in the Jurassic section and possibly, the lack of an adequately mature source.

WELL: GREENLY-1

BASIN: DUNTROON

Operator:	BHP PETROLEUM	**Date Spudded:**	04 JUN 93
Type:	Exploration	**Rig Released:**	14 AUG 93
Status:	P & A -Dry	**Open File (Basic):**	04 AUG 95
Spheroid:	ANS	**Open File (Interp):**	04 AUG 98
Ref Datum:	AGD84	**Projection:**	UTM
Latitude:	-35° 28' 42.62"	**KB (m):**	25
Longitude:	134° 55' 48.04"	**WD (m):**	156.1
Map:	SI53-14	**TD (mKB):**	4860
Seismic Line 1:	DH92-113 SP 1185	**Seismic Line 2:**	DH91-168 SP ~2500
AGSO File:	93/3743		

Stage	Formation	Zone	Dominant Lithology	Fm Top mKB/mSS	Thickness (m)	TWT (ms)
mid Eocene to Recent	Nullarbor	base upper *N. asperus*	lst	181/156	1639	204
mid Eocene	Wilson Bluff	*NP19-NP16*	calc clst	1820/1795	49	1277
Paleocene	Pidinga	*L. balmei*	sst	1869/1844	167	1305
Cenomanian to Maastrichtian	Potoroo	upper *N. senectus* to upper *T. longus*	sst, clst	2036/2011	993	1409
Cenomanian to Campanian	Wigunda	upper *A. distocarinatus* to upper *N. senectus*	clst, sst	3028/3004	1732	2019
Cenomanian	Platypus	lower *A. distocarinatus*	clst, sst	4770/4736	>90	2915

SHOWS

Depth (mKB)	Formation	Lithology	Code	Comments
3430-4542	Wigunda	sst	L1, L2	tr brn yel pp to 60%flu, diff dull to bri blu wh solv cut, rr
4770-4818	Platypus	sst	L1	tr-10%yel-grn pp flu, grn-yel cut
4209 (RFT)	Wigunda		L3/G3	Recovered oil as surface scum and water/oil mixture; gas recovered.

CAUSE OF FAILURE

The most likely cause of failure is a combination of poor reservoir quality and the lack of closure at the target horizon. The structural interpretation was in error and the well was drilled on the down-thrown block of a major fault. The target horizon was in excess of 2000m deep to prognosis.

WELL: GREENLY-1

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The structure was interpreted as a simple rollover anticlinal feature with only minor crestal faulting. The well was predicted to test the trap in a crestal location at moderate depths (1812 ms TWT).

Target Horizon

The primary target was the basal sandstone of the Wigunda Fm (Wombat Sandstone).

Seismic Quality

The structure was defined by a 1 km by 2 km grid of poor to fair quality seismic data. Data quality is good to the base of the carbonates (Base Wilson Bluff seismic marker) but deteriorates rapidly below, due mainly to the low signal to noise ratio and ray path complications as a result of faulting in the area. For the interpretation three vintages of seismic were used — 1984, 1991, and 1992.

Geological Interpretation

Reservoir

The primary target was defined as basal transgressive sandstones of the Wigunda Formation.

Seal

The vertical seal would be provided by the deltaic claystones of the Wigunda Formation. As there was only minor faulting, cross-fault seal was not expected to be a major risk.

Source

Source was interpreted to be the Upper Borda Formation and possibly the Platypus Formation. Source was considered to be a significant risk.

Migration

Migration was predicted to have occurred vertically and from the south.

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure

There was a significant mispick in the seismic interpretation and in the interpreted location of the major fault.

WELL: GREENLY-1

The well was drilled in the hanging wall of a tilted fault block. There was some doubt as to the orientation of the fault. In the well completion report it is mapped as ESE–WNN trending. An analysis of all the data suggests other orientations are possible.

Target Horizon

An analysis of the tables below illustrate the problems encountered in picking target horizons.

ERRORS DUE TO HORIZON PICKS

Horizons	PREDICTED TWT (ms)	ACTUAL TWT (ms)	PREDICTED DEPTH (mSS)	ACTUAL DEPTH (mSS)	ERROR (m)
Base Wilson Bluff	1280	1280	1803	1803	0
Base Pidinga	1376	1409	1956	2011	+55
Base Potoroo	1500	2019	2158	3003	+845
Base Wigunda	1812	2917	2653	4750	+2097
Base Platypus	2236	3401	3401	>4835	>+1434

ERRORS DUE TO VELOCITY

TWT (ms)	PREDICTED DEPTH (mTVDSS)	ACTUAL DEPTH AT PREDICTED TWT (m)	DEPTH ERROR (m)	ERROR (%)
1280	1844	1803	-41	2.3
1376	2000	1956	-44	2.2
1500	2202	2158	-44	2.0
1812	2704	2653	-51	1.9
2236	3485	3401	-84	2.5

Geological Interpretation

Reservoir

The deltaic sandstones of the Platypus Formation were the primary target.

The presence of the basal transgressive sandstones is debatable. The top of the Platypus Formation occurs at approximately 4770 mKB. The section consists of siltstones and claystones with occasional sandstones (net to gross, 8%) and coals. The sandstones vary from well-sorted medium-grained litharenites and feldspathic litharenites (SWC, petrology, quartz content approximately 50%) to argillaceous, very fine- to fine-grained sandstones with traces of lithic fragments (cuttings). Carbonate cementation, authigenic kaolinite pore filling and deformation of lithic fragments has significantly reduced porosity and permeability.

Porosity is approximately 7%. From RFT pretests and petrological descriptions, permeability is low.

Late Cenomanian (upper *A. distocarinatus*) sandstones of the Wigunda Formation are classified as subarkose, sublitharenite and quartzarenite, i.e. the rock fragment content has reduced from approximately 30% to about 5% as compared with the Platypus Formation, with a subsequent increase in the quartz percentile from about 50% to 80%+. The feldspar content varies from about 4% to 16%. The change in composition is due to either a change in energy conditions resulting in destruction of the rock fragments or change in provenance. Through the late Cretaceous, there appears to be a gradual change in provenance from a low-grade metamorphic, sedimentary and volcanic-dominated to a more granite-dominated source.

Permeabilities in Santonian (lower *T. apox*yexinus) and older reservoirs are uniformly low (+/- 10 mD). Late Santonian (upper *T. apoxyexinus*) and younger reservoirs have good to excellent permeabilities (in range of 200-500 mD).

The major diagenetic processes that caused a reduction in porosity in the Wigunda Formation are quartz overgrowths and authigenic kaolinite formation, as well as varying amounts of cementation or replacement by carbonates.

The Potoroo and Pidinga sandstones have excellent reservoir characteristics.

Seal

Vertical seal is not an issue at Greenly-1. The regional seal for the base Wigunda and Platypus sandstones is provided by the deltaic and shallow marine claystones of the Wigunda Formation. The basal Potoroo sandstones would be sealed by shallow marine claystones. The limestones of the Nullarbor Limestone seal the late Potoroo and Pidinga reservoirs, however, there may be a limitation as to the hydrocarbon column height that could be contained. A significant risk at Greenly-1 is fault seal. At the base Wigunda and Platypus levels, and at the Potoroo and Piginda horizons, there is probable juxtaposition of sand on sand across the fault.

Hydrocarbon Shows

Depth (mKB)	Formation	Lithology	Code	Comments
3430-3445	Wigunda	sst	L1	tr brn yel pp flu, diff dull blu wh solv cut
3445-3450	Wigunda	sst	L1	tr brn yel pp flu, no cut
3515-3525	Wigunda	sst	L1	Brn yel-wh pp flu w diff brn yel to bluish cut
3595-3610	Wigunda	sst	L1	Brn yel-wh pp flu w diff brn yel to bluish cut
3683 (SWC)	Wigunda	sst	L1	10% yel wh flu, mky cut
3685 (SWC)	Wigunda	sst	L1	60% yel wh flu, mky cut
3660-3695	Wigunda	sst	L1 (G1 670m)	Mod brn yel-grn pp, yel wh cut
3754	Wigunda	sst	L1	5% dull org pp flu, no cut
3753-3762	Wigunda	sst	L1	Rare blu wh pp flu, no cut

WELL: GREENLY-1

Depth (mKB)	Formation	Lithology	Code	Comments
3905(SWC)	Wigunda	sst	L1	50-10% org pp flu, no cut
3906 (SWC)	Wigunda	sst	L1	tr org pp flu, wh –yel-wh cc
3911 (SWC)	Wigunda	sst	L1	10% dull org flu, no cut
4101 (SWC)	Wigunda	arg sst	L2	60% blu-grn glu, blu-wh cut
4102 (SWC)	Wigunda	sst	L1	tr-5% dull org pp flu, no cut
4107.5 (SWC)	Wigunda	sst	L1	60% yelwh flu, yel-wh cut
4113 (SWC)	Wigunda	sst	L1	50% dull org flu, yel-org cut
4112,4111,4110, 4109, 4108 (SWC)	Wigunda	sst	L1	tr org pp flu, no cut flu
4104-4116	Wigunda	sst	L2	tr-5% yel-wh flu, yel-wh cut. Sw~90%
4155-4161	Wigunda	sst	L1	5-10% yel-wh flu, yel-wh cut
4161(SWC)	Wigunda	sst	L1	10% patchy dull yel & wh flu, dull cc
4161.6 (SWC)	Wigunda	sst	L2	100% wh yel-wh flu, yel-wh cut, yel-org stain & hc odour
4182-4191	Wigunda	sst	L1	1-2% wk blu-wh flu, wh cut
4245-4248	Wigunda	sst	L1	tr pp dull org & wh flu, no cut with rr
4263-4269	Wigunda	sst	L1	tr dull yel-wh flu, no cut with rr
4314-4320	Wigunda	sst	L1	tr dull yel & org pp flu, no cut rr
4329-4383	Wigunda	sst	L1	tr dull yel & org pp flu, yel-wh cut
4452-4473	Wigunda	sst	L2	tr-10% blu-wh to yel flu, wh to yel-wh cut Sw ~50%
4456 (SWC)	Wigunda	sst	L1	10% blu-grn flu, blu-wh cut
4457 (SWC)	Wigunda	sst	L1	30% blu-grn flu, blu-wh cut
4463.5 (SWC)	Wigunda	arg sst	L2	50% blu-grn flu, blu-wh cut
4464 (SWC)	Wigunda	arg sst	L2	60% blu-grn flu, blu-wh cut
4467 (SWC)	Wigunda	arg sst	L1	tr blu-grn flu, no cut
4532 (SWC)	Wigunda	arg sst	L1	tr blu-grn flu, no cut
4521-4542	Wigunda	sst	L2	20% yel & org patchy flu, yel wh cut. Sw ~60% in sst
4770-4779	Platypus	sst	L1	tr-5% blu- mky-wh flu, mky-wh cut
4775.5 (SWC)	Platypus	sst	L1	10% blu-grn flu, no cut
4797 (SWC)	Platypus	sltst	L1	10% dull org flu blu-mky wh cut
4803 (SWC)	Platypus	intlam sltst/sst	L1	sst 60% brn blu grn flu, no cut
4813 (SWC)	Platypus	sst	L1	tr-5% blu-grn pp flu
4815 (SWC)	Platypus	sst	L1	10% blu-grn flu, blu wh cut
4817.5 (SWC)	Platypus	sltst	L1	30% dull org flu, no cut
4806-4818	Platypus	sst	L1	tr-10% yel-grn pp flu, grn-yel cut
4209 (RFT)	Wigunda		L3/G3	Recovered oil as surface scum and water/oil mixture; gas recovered.

Source

The well did not intersect the interpreted major source rock for the area, the Upper Borda Fm.

The top of the oil window is at about 3600mKB and is still within the oil window at TD. Log derived, extrapolated BHTs are as follows:

95°C at 3740 mKB

120°C at 4200 mKB

136.5°C at 4800 mKB

The Potoroo Fm and most of the Wigunda Fm have marginal gas potential. The basal Wigunda Fm (4706 m – 4771 mKB) has moderate potential for oil and gas. The Platypus Fm has excellent potential for oil and gas over the interval 4828 m to 4849 mKB.

Migration

Biomarker analyses from a shale at 4706 mKB and a coal at 4849 mKB have similarities with oil extracts analysed from 3685 mKB and 4160.5 mKB. It is interpreted that these oils have been generated from similar, though not identical organic facies. The differences are due mainly to variations in the input of higher plant derived organic source material.

The show at 4113 mKB is believed to represent a mixture of migrated oil and coaly, in-situ organic matter present in the reservoir.

Cause of Failure

The most likely cause of failure is a combination of poor reservoir quality and a lack of closure at the target horizon. The well was drilled on the down-thrown block of a major fault. The target horizon was in excess of 2000m deep to prognosis.

WELL: JERBOA-1

BASIN: EYRE

Operator:	Esso Explor. & Prod.	**Date Spudded:**	03-APR-80
Type:	Exploration	**Rig Released:**	29-APR-80
Status:	P & A-dry	**Open File (Basic):**	29-APR-82
Spheroid:		**Open File (Interp):**	29-APR-85
Ref Datum:		**Projection:**	
Latitude:	- 33° 30' 14.83"	**KB (m):**	10.4
Longitude:	127° 36' 2.75"	**WD (m):**	760.5
Map:	SI52-06	**TD (mKB):**	2537.5
Seismic Line 1:		**Seismic Line 2:**	
AGSO File:	80/564		

Stage	Formation	Zone	Dominant Lithology	Fm Top mKB/mSS	Thickness (m)	TWT (ms)
Late Eocene to Recent	Nullarbor	*G. semilinvoluta*?	lst	771/761	284	
Mid- Late Eocene	Wilson Bluff	*T. rohi - G. semilinvoluta*	lst	1077/1045	49	
Mid-Eocene	Upper Pidinga	?	sst	1104/1094	44	
Cenomanian	Platypus	*D. dispersum*	clst, sltst, sst	1148/1138	452	1374
Albian	Ceduna	*P. ludbrookiae*	clst, sltst	1600/1590	35	1795
Barremian – Albian	Upper Borda	*C. hughesii*	clst, sltst, sst	1635/1625	465	
Valanginian-Hauterivian	Lower Borda	*C. stylosus*	clst, sltst	2100/2090	147	
Berriasian	Neptune	*C. stylosus*	sst, sltst	2247/2237	76	
Tithonian	Echidna	*C. variverrucatus*	clst	2323/2313	102	
Callovian-Kimmeridgian	Unnamed	*M. florida*	clst, sst	2425/2415	84	
	Basement		metasediments	2509/2499		

SHOWS

Depth (mKB)	Formation	Lithology	Code	Comments
2480	Unnamed Middle to Late Jurassic	sst	L1	GOI, 6.6%
2480	Unnamed Middle to Late Jurassic	sst	G0	C_{1-4} at top of reservoir

CAUSE OF FAILURE

The most likely cause of failure for the well is breaching of the trap following the accumulation of the hydrocarbon column.

WELL: JERBOA-1

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The Eyre Sub-Basin of the Bight Basin is a small transtensional basin bounded to the north and northwest by shallow basement. The sub-basin comprises two major half-grabens. Faulting within the deeper southern half graben resulted in isolated basement horsts, of which the Jerboa prospect was the most prominent.

Closure at the Neocomian to Jurassic section was to be provided by drape over the basement fault blocks.

Target Horizon

The primary target horizon was a sandstone unit of Cretaceous age with a prognosed depth to top of the unit of 2180 mKB. Flat spots were interpreted within the sand-prone section (2.32 – 2.38 s TWT).

Seismic Quality

The Jerboa Prospect was identified on a regional seismic grid (4 km grid spacing) shot as part of the N–S/E–W - oriented E79A seismic survey. An additional grid (2 km grid spacing) was shot in a NW–SE orientation to detail the prospect. Seismic quality was good.

Geological Interpretation

Reservoir

The proposed reservoir was Cretaceous sandstones below approximately 2180 mKB. The primary reservoir was expected to consist of basal transgressive sandstones, preserved on the basement block, with the sandstones being medium- to coarse-grained, moderately sorted, with reasonable porosity.

Seal

Seal was to be provided by thick, late Cretaceous claystones overlying the reservoir units.

Source

Source quality was considered as speculative. The Otway Basin, which has generated oil and gas, was used as an analogue. Seismic sequence interpretation suggested that a restricted marine environment was likely and therefore the potential to preserve organic matter from oxidisation.

It was anticipated that in the deeper sections of the graben, maturity for oil generation should have been reached.

Migration

Migration would be lateral and up-dip along either of the bounding faults. Shallow horizons would be entirely dependent on migration up faults.

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure

Recently reprocessed seismic data indicates that, although located on the footwall of a major half graben-bounding fault, Jerboa was drilled within the hanging wall of a smaller fault, with an offset of less than approximately 150 m. Nevertheless, Jerboa-1 is interpreted as a valid structural test of drape over the basement horst block. The simple drape structure is modified by numerous small scale faults penetrating the section from the top of the footwall block to the base Tertiary unconformity.

Depth prediction to the top of the Upper Borda Formation was accurate to 0.5%. Below this level, the error in depth prediction increased to approximately 5%. The increase in the error occurred as a result of differences in predicted to actual lithologies, resulting in lower than anticipated interval velocities.

Target Horizon

The seismic horizon for the top of the reservoir (Esso's unit H) is equivalent to the top Lower Borda Formation.

Geological Interpretation

Reservoir

Reservoirs with moderate to good porosity are present in the Lower Borda and Neptune formation, and the unnamed Mid–Late Jurassic section.

The Lower Borda reservoir was intersected at 2135.5–2160.5 mKB (25 m), with 12.5 m net sandstone and an average porosity of 16.9% (0–24.9%). On the basis of thin section examination, the reservoirs are classified as argillaceous, arkosic sandstones. There has been significant secondary porosity enhancement (dissolution of intergranular clays and feldspars).

The Neptune Formation contains two reservoir sections; (a) 2249.5–2262 mKB (12.5 m) with 12 m net and an average porosity of 20.4% (9.5–26.2%), and (b) 2283.5–2322 mKB (39 m) with 38.5 m net and an average porosity of 23.8% (8.6–30.8%).

The unnamed Mid–Late Jurassic section comprises reservoirs over the interval 2439.5–2487 mKB (47.5 m) with 37.5 m net and an average porosity of 18% (10–28.5%).

In all the reservoirs, porosity is influenced by the argillaceous content. With an increase in clay content, the porosity is proportionally reduced. The reservoirs had a salinity of approximately 22,000 ppm NaCl equivalent.

Seal

Thick claystone units occur above all reservoirs. The Platypus to Upper Borda formations act as an effective regional seal with deeper reservoirs being sealed by intra-formational units.

Hydrocarbon Shows

There was background gas of C_1 (at 1570 mKB) and C_2 (at 2095 mKB) during the drilling of the well. However, the readings were low throughout (<1000 ppm C_1 and <50 ppm C_2). The Lower Borda and Neptune Formation reservoirs had no shows. The unnamed Mid to Late Jurassic section had C_{1-4} with 1500 ppm C_1, which decreased to approximately 20 ppm at the base of the reservoir. C_2 was low, less than 50 ppm with trace C_{3-4}.

Recent work by AGSO/CSIRO in assessing fluorescing oil inclusions from the Jerboa-1 well, suggests the presence of a palaeo-oil column in the basal sandstone (2440–2508 mKB) of the unnamed ?Callovian to Kimmeridgian unit. The sample analysed for oil inclusions was from 2470–2480 mKB and gave a GOI of 6.6%. The inclusions were in healed fractures in detrital quartz. The value is consistent with known values within a palaeo-oil column of potentially greater than 40m. In addition, analysis of a sample from 2140–2150 mKB produced a GOI reading of 0.1%. The oil inclusions occur pervasively throughout fragments of cement, suggesting oil was migrating through the sandstone during the cementation process.

Depth (mKB)	Formation	Lithology	Code	Comments
2480	Unnamed Middle to Late Jurassic	sst	L1	GOI, 6.6%
2480	Unnamed Middle to Late Jurassic	sst	G0	C_{1-4} at top of reservoir

Source

Overall, the section penetrated in Jerboa-1 has moderate source rock characteristics for hydrocarbon generation. The Total Organic Content is relatively low throughout the section; a significant proportion of the Lower Borda to Jurassic section contains amorphous material, which could be suitable for hydrocarbon generation. A summary of TOC data is given below:

Formation	Av TOC (%)	Range (%)
Platypus	0.86	0.68-1.33
Ceduna	1.16	1.16
Upper Borda	1.06	0.90-1.17
Lower Borda	1.52	0.99-2.23
Neptune	1.33	0.78-2.32
Echidna	1.57	1.12-2.22
Unnamed Mid to Late Jurassic	2.60	1.70-5.46

The vitrinite reflectance at 2490 mKB is 0.51%. The BHT at 2507 mKB is estimated to be 67 °C, which equates to an average gradient of approximately 3.6 °C/100m. At the well location, any source rocks are immature to marginally mature, but the Jurassic section is likely to be mature in the deeper parts of the half-graben.

Migration

The presence of a GOI value of 6.6% from quartz fractures in the Echidna Formation reservoir indicates that hydrocarbons have passed through the structure.

Cause of Failure

The most likely cause of failure for the well is breaching of the trap following the accumulation of the hydrocarbon column.

WELL: MERCURY-1

BASIN: POLDA TROUGH

Operator:	Australian Occidental Petroleum	**Date Spudded:**	27-NOV-81
Type:	Exploration	**Rig Released:**	1-FEB-82
Status:	P & A - dry	**Open File (Basic):**	1-FEB-84
Spheroid:		**Open File (Interp):**	1-FEB-87
Ref Datum:		**Projection:**	
Latitude:	-33° 33' 47.272"	**KB (m):**	16
Longitude:	134° 14' 113.981"	**WD (m):**	77
Map:	S153-06 ELLISTON	**TD (mKB):**	3251
Seismic Line 1:	81-02 SP235	**Seismic Line 2:**	
AGSO File:	81/1192		

Stage	Formation	Zone	Dominant Lithology	Fm Top mKB/mSS	Thickness (m)	TWT (ms)
Quaternary	Unnamed	?	sands	93/77	17	
? Late Eocene to Quaternary	?Nullarbor	No data (based on Jerboa-1)	not sampled	110/94	177	
Middle Jurassic	Polda	?J6 (No reports in WCR)	sst, clst, sltst, coal	288/271	511	
Permo-Carboniferous	Unnamed		boulder clay	799/782	87	
? Pre-Carboniferous	Unnamed Unit4	No ages reported	redbrown sltst, sst, lst	886/870	?	
	Unit 3	Not able to define				
	Unit 2	Not able to define				
	Unit 1	No ages reported	sst, clst	3135/3119	>116	

SHOWS

No shows were reported.

CAUSE OF FAILURE

The most likely cause for failure is the absence of an adequate source in the vicinity.

WELL: MERCURY-1

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The structure is defined by a large anticlinal culmination overlying an elongate salt pillow. Above the salt, approximately 600 m of sediments were interpreted to be within closure.

Target Horizon

The primary target was the interpreted reservoirs below the Base Jurassic seismic horizon. The secondary target was defined by a small closure interpreted to have been set up by a deep rotated fault block.

Seismic Quality

The seismic quality is moderate above the Base Jurassic seismic marker, and poor below.

Geological Interpretation

Reservoir

The primary target was prognosed sandstone reservoirs beneath the Blue (Base Jurassic) seismic marker.

Seal

Intra-formational claystones would provide seal.

Source

No reports are available on pre-drill assessment of source.

Migration

No reports are available on pre-drill assessment of migration.

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The structure developed over a major salt swell with areas of closure ranging from 44 km^2 at the base Jurassic, to 24 km^2 near the top of the salt. The closure height increased with depth, from 265 m at the Base Jurassic to 365 m near the top of the salt.

Above the salt, the well was a valid structural test.

Below the salt there was significant uncertainty as to the validity of any structure mapped.

Target Horizon

The target horizon was sandstone reservoirs beneath the Base Jurassic unconformity. The unit was intersected at 799 mKB (783 mSS) and the top of the salt at 1393 mKB (1377 mSS).

The salt was distributed over 3 broad intervals, 1393–2555 mKB, 2612–2666 mKB, and 2824–3100 mKB. Below the top of the salt, the well was drilled primarily for stratigraphic purposes.

Geological Interpretation

Reservoir

The Polda Formation (Jurassic section) had excellent reservoir characteristics. The sandstones are poorly consolidated and porosities in excess of 30% are interpreted.

Below the Base Jurassic seismic marker, there are two zones of interest in the ?Ordovician to ?Cambrian section:

i) 960–982 mKB. This unit tentatively correlates to Unit 4 observed in Columbia-1. Porosity averages about 15% with a maximum of 18%. Associated with these sands there was significant mud-cake buildup and a negative SP deflection suggesting permeability. Additional sandstone beds are present, however the sandstones appear to be tight.
ii) 3135–3251 mKB. This unit tentatively correlates with Unit 1 observed in Columbia-1. The section is comprised of two sandstone bodies, 3135–3185 mKB and 3220–3251 mKB (TD). Porosities up to 13% are interpreted from logs. The sandstones are fine- to medium-grained and moderately sorted, with an argillaceous matrix.

Seal

The sandstone reservoirs described above are sealed by interbedded siltstone and claystone sequences and, for (ii), salt.

No adequate seal is present in the Jurassic section.

Hydrocarbon Shows

No shows were encountered

Source

No source rocks of any consequence were intersected in the well. From a cutting sample taken over the interval 1600–1610 mKB, TOC was approximately 0.06%.

At 3251 mKB, the BHT is 89 °C, indicative of a low temperature gradient for the area. Below the Base Jurassic unconformity, the temperature gradient is 1.7°C/100m, and 4.4 °C/100m above. This was interpreted as being a result of lower heat flows within the indurated red bed and salt sequence underlying the Jurassic.

Migration

The structure is situated to trap any locally expelled hydrocarbons. Adequate maps to discuss migration are not available.

Cause of Failure

The most likely cause for failure is the absence of an adequate source near the trap.

WELL: PLATYPUS-1

BASIN: DUNTROON

Operator:	Shell Development Aus	**Date Spudded:**	21/3/72
Type:	Exploration	**Rig Released:**	27/4/72
Status:	P&A-dry	**Open File (Basic):**	21/4/74
Spheroid:		**Open File (Interp):**	27/4/77
Ref Datum:		**Projection:**	
Latitude:	-35° 25' 10"	**KB (m):**	30
Longitude:	134° 49' 27.7"	**WD (m):**	158
Map:	SI53-15	**TD (mKB):**	3893
Seismic Line 1:	70-527 SP342	**Seismic Line 2:**	
AGSO File:	N.A.		

Stage	Formation	Zone	Dominant Lithology	Fm Top mKB/mSS	Thickness (m)	TWT (ms)
Late Eocene to Recent	Nullarbor	?	lst	188/158	1452	
Eocene	Upper Pidinga	?	sst	1640/1610	41	
Campanian to Maastrichtian	Potoroo	*N. senectus* to upper *T. longus*	clst, sst	1681/1651	480	
Cenomanian to Santonian	Wigunda	*A. distocarinatus* to upper *T. apoxyexinus*	clst, sst	2161/2131	735	
Albian to Cenomanian	Platypus	*P. pannosus* to *A. distocarinatus*	sst, clst, coal	2896/2866	472	
Albian	Ceduna	upper *C. paradoxus*	sst, clst, coal	3368/3338	402	
Albian	Upper Borda	Lower *C. paradoxus*	clst, sst, coal	3770/3740	+123	

SHOWS

No shows were reported.

CAUSE OF FAILURE

There is a limited seismic grid over the feature and the quality of the seismic is poor to moderate at depth. The original interpretation of the presence of a valid structure at Platypus is therefore optimistic. The lack of a valid structure at the well location is seen as the probable cause of failure.

WELL: PLATYPUS-1

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

A fault-related closure was mapped. The fault trend was approximately east-west.

Target Horizon

Three horizons were mapped, 'Top Eocene', 'A' and 'D'. The primary target was the 'D' horizon, interpreted as an intra-Upper Cretaceous pick beneath the top reservoir, which was expected at 2377 mKB.

The secondary target was the 'A' horizon, equivalent to predicted top Paleocene at 1615 mKB.

Seismic Quality

The prospect was defined from a broad grid of approximately 8,800 km of seismic. Down to the base of the carbonates, the seismic quality is good. Below the carbonates, the quality is poor to moderate.

Geological Interpretation

Reservoir

The primary target was the Upper Cretaceous section, which was anticipated to be dominantly sandy.

The secondary target was a sandstone at the top of the predicted Paleocene section.

Seal

Seal for the primary and secondary targets would be provided by claystones of the Paleocene and Eocene. Clastic deposition was expected below the shallow Oligocene-Miocene section.

Source

There is no comment on the source.

Migration

There is no comment on migration.

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure

As mapped by Shell, there is a small, independent closure near the well, at the 'D' horizon. There is also in excess of 100 ms of fault dependant closure. However,

in view of the limited seismic grid over the feature and the poor quality of the seismic at this horizon, there is concern on the validity of the interpretation.

Target Horizon

The 'D' horizon would currently be defined as the top of the basal Wigunda Formation sandstones, which were intersected at 2871 mKB.

Secondary targets were the Pidinga and Potoroo Formation sandstones beneath the late Eocene carbonates. The section was approximately 12 m deep to prognosis.

Geological Interpretation

Reservoir

The primary reservoirs are the basal sandstones of the Wigunda Formation and the sandstones of the Platypus Formation. The sandstones are fine- to medium-grained and slightly argillaceous, interbedded with siltstones, claystones and coal. The net to gross for the interval is approximately 40% with porosities in the range 15-24%. Formation salinity is approximately 15,000 ppmNaCl equivalent.

The secondary target, the Pidinga and Potoroo Formations are fine- to very coarse-grained, unconsolidated sandstones, with porosities in the order of 30%. The net to gross for the Pidinga/ Potoroo section is approximately 58%. Formation salinity is approximately 70,000 ppm NaCl equivalent.

Seal

The seal for the primary target is the thick claystone unit of the Wigunda Formation.

The seal for the Pidinga/ Potoroo reservoir is provided by overlying crystalline limestones and cherty packstones.

Hydrocarbon Shows

There were no shows of any significance, as shown below. Background gas readings remained low throughout with an average of about 300-400ppmC_1 in the Platypus and Ceduna section. Coals showed an increase to 1-2000ppm C_1.

Source

The summary of Rock-Eval data given below shows that rocks with fair to very good source potential are present within the Albian to Cenomanian succession.

Formation	Lithology	TOC% Range	TOC% Av	HI Range	HI Av	S_2 Range	S_2 Av	Log %Net
Platypus	clst	1.1-19.3	5.7	22-206	117	0.3- 29.1	7.5	44
	coal	30.3-54.0	42.0	69-253	152	25.0-135.0	51.0	7
Ceduna	clst	1.4- 3.7	2.3	52-140	86	0.9- 4.3	2.2	49
	coal	25.6-57.7	40.9	130-222	155	29.8-151.0	64.6	4
Upper Borda	clst	0.8- 8.0	3.1	29-224	119	0.5- 12.8	3.4	86
	coal	24.3-61.6	42.9	96-345	232	38.3-165.0	98.0	9

(from Smith and Donaldson, 1995)

Migration

There is no evidence from the limited well data that there has been migration into the structure from the surrounding area.

Cause of Failure

There is a limited seismic grid over the feature and the quality of the seismic is poor to moderate at depth. The original interpretation of the presence of a valid structure at Platypus is therefore optimistic. The lack of a valid structure at the well location is seen as the probable cause of failure.

WELL: POTOROO-1

BASIN: CEDUNA SUB-BASIN

Operator:	Shell Development Aus	**Date Spudded:**	07-MAR-75
Type:	Exploration	**Rig Released:**	29-APR-75
Status:	P&A-dry	**Open File (Basic):**	29-APR-77
Spheroid:		**Open File (Interp):**	29-APR-80
Ref Datum:		**Projection:**	
Latitude:	- 33° 23' 13.57"	**KB (m):**	9
Longitude:	130° 46' 06.90"	**WD (m):**	261
Map:	SI52-08	**TD (mKB):**	2924
Seismic Line 1:	SA73-135	**Seismic Line 2:**	SA73-713/1588
AGSO File:	75/152		

Stage	Formation	Zone	Dominant Lithology	Fm Top mKB/mSS	Thickness (m)	TWT (ms)
Oligocene to Recent	Nullarbor	J2 to Present	lst	270/261	530	
Mid-Late Eocene	Wilson Bluff	T11 to P15/16	lst, chert, sst	800/791	142	
Mid-Eocene	Upper Pidinga	T11	sst	942/933	133	
?Campanian - Maastrichtian	Potoroo	*T. longus*	sst, clst, coals	1075/1066	175	
Cenomanian - Santonian	Wigunda	*A. distocarinatus* to *T. apoxyexinus*	clst, sst, coal	1250/1241	551	
Cenomanian	Platypus	*A. distocarinatus*	clst, sltst, sst, coal	1801/1792	634	
Albian	Ceduna	upper *C. paradoxa* to *P. pannosus*	sltst, clst, sst	2435/2426	152	
Albian	Upper Borda	upper *C. paradoxa*	sltst, sst, lst, coal	2587/2578	173	
Valanginian - Hauterivian	Lower Borda	lower *F. wonthaggiensis*	sst, clst, lst	2760/2751	55	
?Pre-Cambrian	Basement		granite	2815/2806	+109	

SHOWS

DEPTH (mKB)	Formation	Lithology	Code	Comments
2128-2132	Platypus	Coal	G1	18,000ppm C_1

CAUSE OF FAILURE

The primary cause of failure is the lack of reservoir at the primary target horizon, the Platypus Formation.

WELL: POTOROO-1

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

A dip closure against a large, basement-involved fault was originally mapped. The closure was bounded to the north by a major east-west trending fault. There was closure within the Cretaceous section.

Target Horizon

The target horizon was an interval of strong seismic events of similar reflection character to that of the "Platypus" sands observed in Platypus-1.

Five horizons were mapped, a Tertiary (mid-Eocene) horizon, three Cretaceous horizons, and basement. Depth conversion was carried out using a linear velocity distribution.

Seismic Quality

Pre-1973 data gave a broad grid of 7–15 km spacing, which was infilled with 402 km of 24 fold, 48 trace airgun data. The quality of the data is poor to moderate.

Geological Interpretation

Reservoir

The primary target was the non-marine to paralic sandstones observed in the Platypus-1 well.

Seal

Seal would be provided by mid to Late Cretaceous claystones.

Source

Source was interpreted to be the claystones and coals within the Aptian to Cenomanian section.

Migration

There is no comment on migration.

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure

Fault and dip closure was interpreted throughout the Cretaceous. A saddle controlled closure to the east. To the west the closure is dependent on the continuation of the major fault defining the structure. Area of closure was approximately 60 km^2.

Target Horizon

The Tertiary marker (A) is approximately 70 m below the carbonates. Unlike the Duntroon Embayment, the velocity character between the Tertiary carbonates and clastics shows a gradual change rather than a sharp reversal.

Within the Cretaceous section, all mapped horizons showed a similar configuration. There was a velocity change across the structure from north to south.

Geological Interpretation

Reservoir

At the primary target horizon, Base Wigunda/Top Platypus, no reservoir sandstones were encountered. An interbedded mudstone, siltstone and occasionally dolomitic section was penetrated. However, at the base of the section, above the granitic basement, approximately 120 m of very fine- to very coarse-grained, dominantly fine- to medium-grained, well sorted to occasionally silty sandstone (2692-2814 mKB) occurs. Porosity varies between 9% and 25%.

Seal

Within the Cretaceous section there is an abundance of claystones and interbedded siltstones to provide a seal for any reservoirs.

Hydrocarbon Shows

No fluorescence was observed in the cuttings or sidewall cores. During the drilling of the well, only C_1 was noted, with a trace of C_2. The gas readings varied between 500-4000ppm from below the top of the Wigunda to TD. Higher readings were occasionally noted, e.g. 6000ppm at 1902–1906 mKB associated with a 4 m thick coal

DEPTH (mKB)	Formation	Lithology	Code	Comments
2128-2132	Platypus	Coal	G1	18,000ppm C_1

Source

There is no discussion of the source rock potential in the well completion report. However, the presence of coaly matter below the Wigunda Formation indicate potential for hydrocarbon generation.

Migration

There has been no migration into the structure.

Cause of Failure

The primary cause of failure is the lack of reservoir at the primary target horizon, the Platypus Formation.

WELL: VIVONNE-1

BASIN: DUNTROON

Operator:	BHP Petroleum	**Date Spudded:**	19-AUG-93
Type:	Exploration	**Rig Released:**	12-SEP-93
Status:	P & A – dry	**Open File (Basic):**	12-SEP--95
Spheroid:	ANS	**Open File (Interp):**	12-SEP-98
Ref Datum:	AGD84	**Projection:**	UTM
Latitude:	- 35° 53' 34.38"	**KB (m):**	25
Longitude:	136° 00' 44.89"	**WD (m):**	137
Map:	SI53-15	**TD (mKB):**	3000
Seismic Line 1:		**Seismic Line 2:**	
AGSO File:	93/5012		

Stage	Formation	Zone	Dominant Lithology	Fm Top mKB/mTVDSS -deviated-	Thickness (mTVT)	TWT (ms)
Early Miocene-Early Pliocene	Nullarbor	NP22-Recent?	lst	162/137	721.5	177
Mid-Late Eocene	Wilson Bluff	NP16-NP19	lst, marl	884/858.5	176	747
?Paleocene	Upper Pidinga	Indeterminate	sst	1060/1034.5	79	839
?Paleocene	Lower Pidinga	Indeterminate	sst	1140/1113.5	103.2	--
Campanian - ?Maastrichtian	Potoroo	Top: barren *N. senectus*	sst	1248/1216.7	108.5	976
Barremian-Aptian	Upper Borda	*C. hughesii*	clst, minor sst	1368/1325.2	1104.9	1044
Valanginian-Hauterivian	Lower Borda	upper *F. wonthaggiensis*	clst, minor sst	2573/2430.1	418+	1795

SHOWS

No shows reported.

CAUSE OF FAILURE:

The most likely cause of failure is the lack of a suitable migration pathway for hydrocarbons sourced from the Upper Borda Formation and, possibly, the relationship between timing of structuring and hydrocarbon expulsion from Echidna Formation source rocks.

WELL: VIVONNE-1

PRE-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The Vivonne feature is a tilted fault block created by a NW–SE trending antithetic fault to a major fault north of the prospect, with mapped closure at all levels beneath the Base Tertiary (Base Pidinga Fm). The structure is complicated by a shale diapir at depth.

Target Horizon

The primary target was the late Cretaceous Potoroo Formation. Secondary targets were expected in the Lower Borda Formation, and the Tertiary Upper Pidinga Formation.

Seismic Quality

The feature was defined by a 1.5 km x 2 km grid. Data quality is good down to the base Wilson Bluff Formation. Beneath the Wilson Bluff Formation, data quality is good within the fault blocks, but deteriorates due to low signal to noise ratio and complex faulting. There was high confidence in the time interpretation at the primary target. However, with increasing depth, confidence decreased.

Geological Interpretation

Reservoir

The primary targets were the sandstones of the Upper Pidinga and Potoroo Formations beneath the Base Wilson Bluff Formation, between approximately 1030 mKB and 1160 mKB.

A relatively thin Upper Borda Formation was expected (1185–1274 mKB), underlain by a relatively thick Lower Borda Formation.

Seal

Seal would be provided by the Wilson Bluff Formation for the primary target. For secondary targets, intra-formational claystones would act as the vertical seal.

Source

The Upper Borda Formation was assumed to be the dominant source to charge the reservoir. However, near the well, the source rocks of the Upper Borda Formation were predicted to be immature.

Probable lacustrine sediments of the Echidna Formation were considered to be an alternative source.

Migration

For the Upper Borda Formation, migration would be from the south, beyond the current shelf edge in the 'Outer Basin'. For the Echidna Formation, migration would be from the 'Inner Basin'.

WELL: VIVONNE-1

POST-DRILL PROGNOSIS

Geophysical Interpretation

Structure

The stratigraphic section encountered in Vivonne-1 was significantly different to prediction, highlighting the difficulty in correlating horizons across bad data zones and across faults in an under-explored basin. The pre-drill Base Upper Borda Formation and Debban Horizon (local BHP name) represent the structure, post drill, at Base Upper Borda and Base Lower Borda respectively.

The well is interpreted to have been a valid structural test.

Target Horizon

The primary targets, the Pidinga and Potoroo sandstones, were 13m high to prognosis, the error due to minor velocity variations.

The proposed secondary targets, sandstones within the Lower Borda Formation, were not present.

Depth conversion was derived from a simple layer-cake model using water, Tertiary carbonates and pre-Tertiary clastics. Interval velocities were calculated by Dix's equation from smoothed stacking velocities. Velocity errors were generally less than 4%, except in the shallow section. Errors due to velocity and horizon mis-picks are tabulated below.

ERRORS DUE TO HORIZON PICKS

HORIZONS	PREDICTED TWT (ms)	ACTUAL TWT (ms)	PREDICTED DEPTH (mSS)	ACTUAL DEPTH (mSS)	ERROR (m)
Base WB	850	840	1048	1035	-13
Base Pid	872	980	1076	1223	+147
Base Pot	965	1045	1201	13117	+116
Base UB	1025	1922	1290	2652	+1362
DEBBAN	1740	NP	2336	NP	-

ERRORS DUE TO VELOCITY

TWT (ms)	PREDICTED DEPTH (mTVDSS)	ACTUAL DEPTH AT PREDICTED TWT (mTVDSS)	DEPTH ERROR (m)	ERROR (%)
747	820	897	+77	8.6
850	1005	1048	+43	4.1
965	1160	12011	+41	3.4
1025	1249	1290	+41	3.2
1275	1620	1609	-11	0.7
1740	2435	2336	-99	4.2

Geological Interpretation

Reservoir

The primary target sandstones of the Pidinga and Potoroo Formations have excellent reservoir qualities. Depositional environment is interpreted as near-shore marine.

The Upper Pidinga Formation sandstones consist of clear to translucent, medium-grained, well-sorted, quartz sandstones.

The Lower Pidinga Formation consists of light grey to brownish grey, medium- to coarse-grained, well-sorted sandstones with minor glauconite pellets. The sandstones have excellent porosities and permeabilities.

The Potoroo Formation reservoirs consist of interbedded sandstones, argillaceous sandstones and claystones. The sandstone is fine- to medium-grained, well-sorted, with good inferred porosity and permeability. The argillaceous sandstone is brownish-grey and medium- to coarse-grained.

A summary of the net reservoir intervals is given in the table below. The following cut-offs were used, Vsh=50%, Porosity=15%.

Formation	Depth (mKB)	Gross (m)	Net (m)	N/G %	Av. Por %
Upper Pidinga	1059.5-1138.4	80	79.6	99	30
Potoroo	1140.0-1360.0	220	206.7	94	28

Water salinity within the Pidinga and Potoroo Formation was approximately 43000 ppm NaCl.

Seal

Seal for the primary horizon is provided by the Wilson Bluff Formation. In the vicinity of Vivonne-1, the seal capacity of the Wilson Bluff Formation varies due to variations in the texture and composition of the rocks and subsequent variations in secondary porosity development; specifically, patchy development of secondary moldic porosity associated with recrystallisation of matrix and bioclasts. Dependant on oil density, the likely oil column that could be contained is 2–20m with an upside of 300m.

There is a moderate risk associated with vertical seal in this area.

Hydrocarbon Shows

No shows were encountered. Background gas was present from 1372 mKB to TD. C_1 varied between 0.01 and 0.2%, C_2 and C_3 began at 2800 mKB and varied between 0.04% and 0.06%.

Source

The Lower and Upper Borda formations were analysed for source potential. Approximately 70% of samples analysed had TOC values greater than 0.9%. The data showed a predominance of mainly gas-prone Type II/III to Type III organic matter in the non-coal-bearing samples (HI<150), with more oil prone character in the coal-bearing samples. However, this is not conclusive, because organic petrological analyses indicate high vitrinite content in the coals, and relatively higher percentages of oil-prone liptinite/exinite (Type II) macerals in the non-coal bearing samples.

Thermal maturity interpretations vary slightly. Vitrinite reflectance data suggest early maturity at TD; Rock-Eval (Tmax and PI) data indicate immaturity at TD.

Pyrolysis-GC analysis of two coal-bearing samples yielded approximately 50% dry gas, plus roughly equal amounts of wet gas, condensate and oil.

Migration

There are potentially two sources to feed the Vivonne feature, the Echidna and Upper Borda formations. However, the distribution of the source-rich intervals of the Echidna Formation is unknown at present and therefore the comments noted below are tentative.

The Echidna Formation, based on maturation modelling, is likely to have expelled and migrated hydrocarbons prior to development of the structure.

The Upper Borda Formation is probably immature throughout most of the 'Inner Basin'. Consequently, migration would be required from the south. Complexity in the migration pathway has probably prevented any migration to the structure.

Cause of Failure

The most likely cause of failure is the lack of a suitable migration pathway for hydrocarbons sourced from the Upper Borda Formation and, possibly, the relationship between timing of structuring and hydrocarbon expulsion from Echidna Formation source rocks.

SUMMARY OF RESULTS

The majority of the wells drilled in the Great Australian Bight region have a significant risk associated with the structural interpretation because of the poor quality of the seismic data available at the time of drilling. This is interpreted to be a major cause for the lack of success in the area to date.

The wells drilled in the Polda Trough have a major source risk due to the oxidation of the sediments. Wells drilled in the 'Inner Basin' of the Duntroon Basin have risks associated with both migration risk and structural development in relation to the timing of expulsion. There is, nevertheless, significant encouragement from Greenly-1 to suggest a petroleum system is active in the Duntroon Basin.

Apart from the Polda Tough, it is apparent that source does not present a major risk in the area. Recent additional analyses from Jerboa-1 suggest that Jurassic rocks may also provide a source in the Bight Basin.

The cause of failure of the wells in the Great Australian Bight region is summarised below:

EXPLANATION FOR WELL FAILURES

WELL	STRUCTURE	SOURCE	MIGRATION	RESERVOIR	SEAL
Apollo-1	X	X			X
Borda-1			X		
Columbia-1		X			
Duntroon-1	X	X	X		
Echidna-1	X			X	
Gemini-1		X			X
Greenly-1	X			X	
Jerboa-1	X				
Mercury-1		X			
Platypus-1	X				
Potoroo-1				X	
Vivonne-1			X		

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Mercury-1: Australian Occidental Petroleum, 1981, Mercury 1 Well Completion Report, 81/1192.

Platypus-1: Shell Development Australia, 1972, Platypus 1 Well Completion Report.

Potoroo-1: Shell Development Australia, 1975, Potoroo 1 Well Completion Report, 75/152.

Vivonne-1: BHP Petroleum, 1993, Vivonne 1 Well Completion Report, 93/5012.

APPENDIX 1: Codes for Hydrocarbon Shows

Code	Description	Comment
G1	Gas indication	Anomalously high gas readings
G2	Strong gas indication	Anomalously high gas reading and other indication, e.g. core, logs or shakers.
G3	Gas show	Gas flowed on tests.
G4	Potential gas zone	Gas show with convincing log anomaly or other indication
G5	Proven gas zone	Sustained gas flow on test, or RFT & log anomaly or pressure data, proving an accumulation (no economic implications).
L1	Oil indication	Fluorescence or cut.
L2	Strong oil indication	Fluorescence or cut & other oil indication, e.g. log anomaly.
L3	Oil show	Oil recovered from core, test, mud.
L4	Potential oil zone	Oil show with convincing log anomaly.
L5	Proven oil zone	Oil flow on test, or RFT & log anomaly proving an accumulation (no economic implications).

APPENDIX 2: List of Abbreviations

Abbreviation	Explanation
arg	argillaceous
Aust.	Australian
av	average
BHT	bottom hole temperature
blu	blue
bri	bright
brn	brown
calc	calcareous
cc	crush cut
clst	claystone
DHI	direct hydrocarbon indicator, undifferentiated
diff	differentially
flu	fluorescence
Fm	Formation
glauc	glauconite
GOI™	Grains with Oil Inclusions
grn	green
KB	Kelly Bushing
hc	hydrocarbons
HI	Hydrogen Index (mg hc / g TOC)
i/b	interbedded
intlam	interlaminated
lt	light
lst	limestone
Lwr	Lower
mD	millidarcy
mky	milky
mod	moderate
mKB	metres below Kelly Bushing/Rotary Table
ms	milliseconds
mSS	metres sub sea (mean sea level)
mTVDSS	metres true vertical depth below mean sea level
mTVT	meters true vertical thickness
N/G	net to gross
NS	no show
org	orange
P & A	plugged and abandoned
pp	pinpoint
pres	present
RFT	repeat formation tester
rr	residual ring
resid.	residual
s	seconds
sl	slight
slst	siltstone
solv	solvent

Abbreviation	Explanation
SP	shotpoint
str	streaming
sst	sandstone
Sw	water saturation
SWC	side wall core
S_2	measure of the amount of free hydrocarbons present in the rock
TD	total depth
TOC	total organic carbon (weight %)
tr	trace
TWT	two-way time
Vsh	volume of shale
w	with
WCR	well completion report
WD	water depth
wh	white
wk	weak
yel	yellow