

THE OFFER

Two new petroleum exploration licences (PEL) in the Otway Basin are being offered by the South Australian Government on the basis of work program bidding:

- OT2004-A covers 1421 km² (351 135 acres)
- OT2004-B covers 268 km² (66 224 acres)

These bid blocks contain proven plays and seismically defined prospects.

Previous exploration data and reports are readily available from PIRSA in digital format, including:

- well completion reports
- GIS datasets including wells, seismic, tenements, pipelines
- seismic survey shot point location data
- seismic survey reports and archive stack data (SEGY format)
- digital well logs
- velocity survey check shot information
- structure maps and datasets
- PEPS database with production, well, seismic and engineering data
- company prospectivity reports.

OTWAY BASIN

The Otway Basin is one of the best known and most actively explored of the series of Mesozoic rift basins that span the southern coastline of Australia. The Otway has a number of proven anticlinal and fault-block play types. Both oil and gas have been found in the basin, but gas with gas liquids dominates accumulations found to date. Seismic studies have shown that its structural evolution is analogous to basins such as the Tucano–Reconcauo Basin of Brazil, and the Gabon and Cabinda Basins of the west coast of Africa. Each of these basins has been found to contain at least one giant oilfield.

The onshore extent of the Otway Basin covers southeastern South Australia and southwestern Victoria; the offshore extent adjoins South Australia, Victoria and Tasmania. The Otway Basin covers 59 650 km² in South Australia (9650 km² onshore). It formed in Jurassic through Cretaceous time and is covered by Tertiary Gambier Basin deposits. Structural trends are a composite of Jurassic through Cretaceous extension (associated with rifting between the Antarctic and Australian plates) and post-Cretaceous faulting and uplift (some associated with volcanic activity).

The Otway Basin contains over 9000 m of Jurassic–Late Cretaceous fluvial, lacustrine and deltaic sediments overlain by Cainozoic marine carbonates and fluviodeltaic clastics. Onshore petroleum exploration targets occur 1500–4000 m deep. The basin produces commercial gas and CO₂ in South Australia, with a number of oil shows recorded and a recovery of 2000 bbl of oil. In South Australia, 76 exploration and appraisal wells have been drilled, and over 9935 km of 2D seismic and 485 km² of 3D seismic onshore and 21 081 km of 2D seismic offshore recorded.



BIDS CLOSE 4.00 pm
Thursday 30 September 2004
Australian Central Standard Time

A free acreage release CD will be available from mid-March 2004. To order:

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OTWAY BASIN SOUTH AUSTRALIA ACREAGE RELEASE BLOCKS OT2004-A and B

March 2004



MINERALS
& ENERGY



PROVEN HYDROCARBON PROVINCE

In South Australia, commercial CO₂ was discovered in Caroline 1 in 1968, but it was not until 1987 that the first commercial gas discovery was made at Katnook, followed by discovery of the Ladbroke Grove Field in 1989, both Early Cretaceous plays. Five gas fields have now been discovered in the Otway Basin in South Australia and total original sales gas reserves are estimated at 127 PJ (120 x 10¹² Btu). Uneconomic oil was discovered at Killanoola 1 in 1998 and Jacaranda Ridge 1 in 1999.

The 2003, onshore Otway Basin production totalled 8.5 PJ of gas, 6047 kL of condensate and 19 608 t of CO₂ (estimated at end of calendar year).

The lack of early exploration success in the state may be attributed to poor-quality seismic data prior to the early 1980s, and a poor understanding of structure and stratigraphic relationships in the Robe and Penola Troughs. Good modern seismic coverage now exists over the offshore and most of the onshore parts of the basin, and stratigraphic relationships are better understood. Large gas discoveries offshore Victoria include Minerva 1 and La Bella 1 (1994), Geographe (2001) and Casino 1 (2002). The Thylacine 1 (2001) discovery is in Tasmanian waters. In addition, a number of small onshore gas fields have recently been discovered in the Port Campbell area of Victoria. These discoveries have focused attention on Late Cretaceous plays.

EXECUTIVE SUMMARY

Two petroleum exploration licence areas OT2004-A and B are being offered in the Otway Basin on the basis of work-program bidding. Bidding closes at 4.00 pm on Thursday 30 September 2004, and the winning bid will be announced within a month of the close.

Otway Basin gas supplies markets in the cities of Adelaide and Melbourne via a recently completed pipeline network. Identified initial reserves were 76.9 PJ (72.8 x 10¹² Btu) sales gas in five fields. Cumulative production for the Otway is as follows:

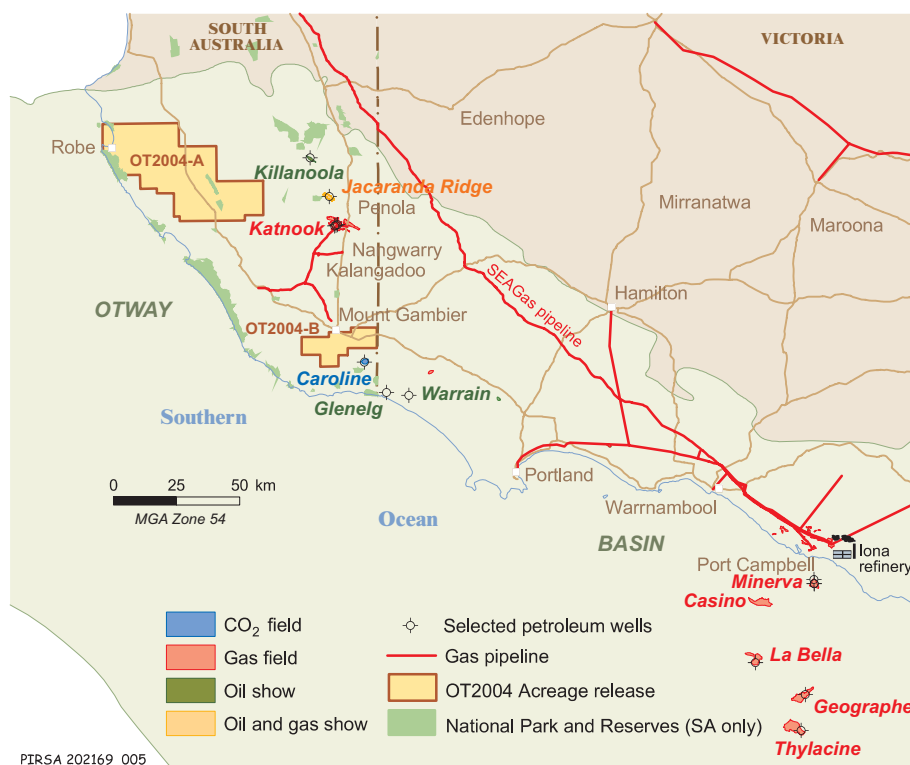
- 40.52 PJ (38.4 x 10¹² Btu) of sales gas
- 45 376 kL (285 415 bbl) of condensate
- 670 574 t of saleable CO₂ from Caroline 1

PETROLEUM GEOLOGY

The oldest unit is presumed to be the Jurassic Casterton Formation, a volcanic and shale unit that may occur in the deeper parts of the Robe and Penola Troughs. The oldest sequence known in South Australia is the Early Cretaceous Crayfish Group, which fills half grabens. The Pretty Hill Formation is a braided fluvial sandstone that occurs in the deepest parts of the troughs. This is followed by fluvio-lacustrine shale and siltstone (Laira Formation), which in turn is overlain by the braided fluvial Katnook Sandstone.

The Crayfish Group is unconformably overlain by the Eumeralla Formation, which is a fluvial siltstoneshale sequence with some minor coal and meandering fluvial sandstone units, deposited during the sag phase of the basin. The Windermere Sandstone is a regionally extensive transgressive sand unit which overlays the Crayfish unconformity and thickens within the Early Cretaceous troughs.

The Late Cretaceous Sherbrook Group overlies the Otway Supergroup as a deltaic wedge that rapidly thickens to the south. In the northern part of the basin, it comprises a thin, coarse sandstone that represents a condensed equivalent of the Copa, Waarre, Flaxman, Belfast, Paaratte and Timboon units found to the south. From Belfast Mudstone to Timboon Sandstone, the sequence represents a prograding delta, with early marine influence and deep water submarine slope fans along the outer margin.



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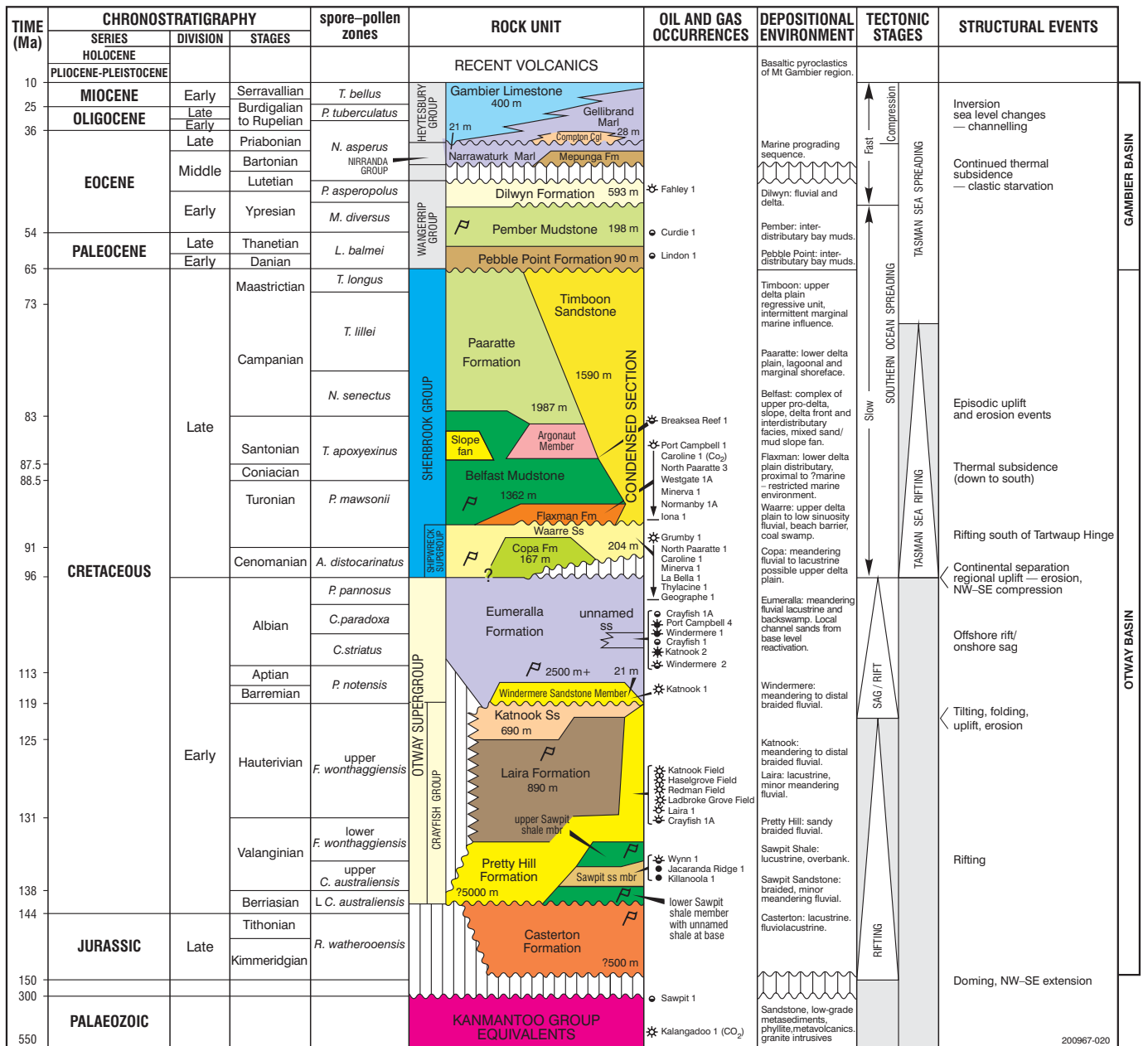
Otway Basin in South Australia and Victoria showing petroleum infrastructure and National Parks.

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SOURCE ROCKS

Source rocks are capable of producing both gas and oil and the present day temperature gradient is moderate, averaging ~2.73.6°C/100 m depth. The source for the gas in the Katnook and Ladbroke Grove Fields is either an unpenetrated shale beneath the Pretty Hill Formation (Casterton Formation equivalent), or possibly the Laira Formation, as it is mature for gas at Katnook Field depth. In South Australia, oil is produced in negligible amounts from Caroline 1 and in 1992 heavy crude was recovered from Sawpit 1 over a 32 m interval below 2514 m. The oil is presumably sourced from Otway Supergroup sediments. In 1994, Wynn 1 recorded the first oil flow in the Otway Basin. Both Killanoola 1 (1998) and Jacaranda Ridge 1 (1999) discovered oil but are currently deemed uneconomic. Both produced ~160 kL (1000 bbl) on test.

The Eumeralla Formation is not deep enough in the northern portion of the basin to be a source and shallow northern targets would rely on long-range migration, which may be impeded by the high density of eastwest faults. However, to the south, where thick Sherbrook sediments occur, the Eumeralla could be a source for Waarre and Flaxman targets. The Belfast Mudstone is a relatively poor gas-prone source rock, and is only marginally mature (VR = 0.6%), even in the deepest wells drilled to date. The CO₂ in Caroline Field has a volcanic source (based on isotopic data), assumed to be from the Holocene Mount Gambier volcanic chain, which trends northwest through the Tantanoola Trough. Carbon dioxide from a magmatic source has also been noted in Ladbroke Grove Field and Kalangadoo 1. The Caroline 1 well is the single most profitable well in South Australia.



Geological summary of the Otway Basin in South Australia. The subdivision of the Pretty Hill Formation into upper and lower Sawpit shale and Sawpit sandstone members is informal.

RESERVOIRS

The main gas reservoir in the South Australian sector of the onshore Otway Basin is the Pretty Hill Formation, which in the Katnook Field has porosities in excess of 25%, permeabilities in excess of 1000 mD, and has flowed over 451 000 m³/day (16.01 mmcf) gas on test. Reservoir permeability does not appear to decrease with increasing depth of burial, although only the upper part of the Pretty Hill Formation is generally of good quality. Reservoir quality in the Windermere Sandstone Member is excellent in the Katnook Field. Victorian production and limited South Australian log data indicate that reservoir quality is excellent for the Late Cretaceous Waarre, Flaxman and intra-Belfast units.

TRAPS

Early Cretaceous targets (OT2004-A)

In the northern part of the basin, where exploration is for Otway Supergroup targets, Pretty Hill Formation reservoirs of the fields in the Penola Trough comprise complex, steep sided, eastwest tilted fault blocks, with the Laira Formation acting as the seal. Common palaeohydrocarbon columns have been intersected and leakage is probably caused by the creation of structural permeability across the regional seal.

The location of leakage depends on the interaction between the seal, associated faults, and the regional stress field. Traps for Windermere reservoirs comprise much lower relief domes (close to the resolution limit of seismic mapping) that are generally unfaulted, and sealed by the Eumeralla Formation. The base Eumeralla seal is likely to improve towards the southwest. Considerable potential exists for stratigraphic traps, either as meandering fluvial channels in the Eumeralla Formation (as in the Katnook Field), or as pinch-outs of the Pretty Hill Formation to the north.

Late Cretaceous targets (OT2004-B)

The FlaxmanWaarre units have proven to be excellent gas reservoirs in the Victorian portion of the basin, and in South Australia contain the Caroline CO₂ field. Traps are generally northeast-tilted fault blocks, bounded by closely spaced rift parallel faults.

UNDISCOVERED RESOURCES

The Otway Basin in South Australia is an immature exploration province, with high potential for further discoveries. Although gas discoveries to date are relatively modest in size (average recoverable reserve per field is ~23 PJ (21 bcf)), some discoveries in the offshore Victorian portion of the basin are an order of magnitude larger (up to 350 PJ (~321 bcf) in the Minerva Field and ~0.8 tcf in the Thylacine discovery). Oil discoveries have only recently been made, and there

is considerable potential for significant oil discoveries in the future.

Table 1 summarises the undiscovered potential for recoverable sales gas resources in the key plays of the onshore South Australian portion of the basin.

PLAY	UNDISCOVERED POTENTIAL PJ (~bcf)		
	Probability that the ultimate potential will exceed the stated value:		
	90%	50%	10%
Waarre–Flaxman	30 (27)	150 (137)	560 (513)
Crayfish	120 (110)	680 (623)	2330 (2135)
Total	180 (165)	900 (825)	2760 (2530)

Table 1: Undiscovered recoverable sales gas resources of the onshore South Australian portion of the Otway Basin

INFRASTRUCTURE AND TRANSPORT

Epic Energy owns and operates a 46 km long, 150 mm diameter gas pipeline from the Katnook gas processing plant to the Apcel paper mill at Snuggery, 7 km southeast of Millicent. A second gas pipeline, also 150 mm diameter and 19 km long, runs from this line to Mount Gambier. A third gas pipeline, of 50 mm diameter, runs from Katnook 4.5 km to the Safries potato chip factory. The pipelines were constructed in 1990 and have a maximum operating pressure of 10 000 kPa (1450 psi). A fourth gas pipeline, 12 km long and 89 mm diameter, was constructed in the second half of 2000, connecting Kalangadoo to the Nangwarry timber mill. None of these pipelines has compression installed.

Gas from producing wells in the Katnook, Haselgrove and Redman Gas Fields is piped to a gas treatment plant located 300 m southeast of Katnook 1 and built in 1991. The plant is operated by Origin Energy Resources, as operator for the joint venture, and supplies ~2.8 PJ (2.6 bcf) of gas per year to local domestic and industrial markets. The gas requires a minimum of processing to yield sales gas, which is then sold at the pipeline outlet from the Katnook plant.

The main gas customers are the Kimberly Clark paper mill near Millicent, the Safries potato chip factory near Penola, and domestic and industrial customers in Mount Gambier that were previously supplied tempered LPG via a reticulation network. Condensate is stored onsite at the Katnook Plant before transportation by road tanker and sale.

Opportunities created for small power stations in the more competitive electricity market, and strategic location of the Ladbroke Grove Field adjacent to the main

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electricity link between Adelaide and Victoria, led to Origin Energy using the high CO₂ gas to fire an 80 MW power station. The power station utilises an advanced turbine design capable of burning the low-quality gas. The station began supplying power into the national electricity grid in January 2000. With both turbines operating, annual production is estimated to exceed 4 PJ (~3.7 bcf) of gas.

In January 2004, commercial gas flows commenced in the SEA Gas Pipeline which links Adelaide to gas fields in the Victorian part of the Otway Basin, and effectively 'closes the pipeline loop' of Adelaide–Moomba–Sydney–Melbourne–Adelaide. This \$500 million project will create more competition amongst gas wholesalers and provides greater security of supply for South Australia. The SEA Gas Pipeline has a capacity of 140 PJ/y and will roughly double gas transport capacity into South Australian markets.

LAND ACCESS

National parks and reserves

There are a number of national parks and other areas of remnant native vegetation in the area, in some of which exploration is permitted, and in others their small size makes it possible to work around them. The reserves have been created to conserve the best examples of vegetation and landforms in the region. There are three types of South Australian reserves – conservation parks, national parks, and regional reserves. The conditions of access vary from park to park, based upon the type of reserve classification, the activity proposed and its likely impact on the environment.

Heritage and native title

In South Australia, it is an offence to disturb or destroy Aboriginal sites, objects or remains. Standard procedures for determining the presence of Aboriginal heritage prior to the commencement of activities have been determined. These procedures involve consulting with the relevant Aboriginal organisation and maintaining a watch for sites, objects or remains during activities. Generally the sites are no larger than a few hundred square metres and are easily avoided. Since inception of the *Aboriginal Heritage Act 1988*, there have been no conflicts between Aboriginal heritage sites and exploration or production activities in South Australia.

Licence holders are encouraged to develop a dialogue with regard to Aboriginal heritage and related matters with Aboriginal people having associations with their licence area. Native title may be applicable on non-freehold land. There are currently no native title applications over prospective areas, and native title is not likely to be a significant issue in the Otway Basin area, as most land is freehold or permanent leasehold.

A number of other sites of heritage significance such as historic buildings and structures and geological monuments occur in the region. These are indicated on environmental sensitivity maps held by PIRSA. The majority of the sites are small and easily avoided by exploration activities.

Associated Facilities Licences

Associated Facilities Licences (AFLs) are now available under the *Petroleum Act 2000*. These allow explorers to establish facilities or undertake surface surveys (e.g. seismic surveys) in proximity to petroleum exploration, retention and production licences. AFLs are typically used to enable the recording of full-fold seismic control within a PEL by recording tails of seismic lines outside the licence area.

CLIMATE AND LAND USE

The climate in the South-East is characterised by mild, dry summers and cold, wet winters; consequently, exploration activities are generally conducted in the summer and autumn months of December through to April. However, with advanced preparation of sites it is possible to conduct drilling activities year round.

The main land use in the area is mixed farming ranging from sheep and cattle grazing to crops and wine grapes. Forestry is another major land user, with extensive *Pinus radiata* and native plantations across the region. The South-East is characterised by a near-surface unconfined aquifer which is the main water supply for landholders and the city of Mount Gambier, and requires consideration while conducting exploration activities.

BIDDING AND AWARD PROCESS

Winning bidders will be selected on the basis of the total five-year work program bid. The work program must be completed within the overall area of the PEL. It must include a statement of exploratory operations the applicant proposes to carry out in the first five-year licence term. It is expected that at least one petroleum exploration well would be included in the program.

Bids will be assessed using the philosophies expressed in *Selecting the winning bid*. The specific scoring scheme is detailed in the *OT2004 Bid Assessment Policy*. **Copies of both documents are included on this CD.** In general, it is important to note that the timing of well drilling and seismic or other data acquisition will be taken into account.

Key assessment criteria include:

- the number of exploration wells to be drilled in the petroleum exploration licence, their timing and anticipated targets
- the number of years the applicant is prepared to guarantee the program
- the extent to which proposed wells are supported by seismic data
- the amount and nature of seismic surveying to be carried out and its timing
- other data acquisition (e.g. gravity, aeromagnetic or geochemical surveys)
- seismic reprocessing to be carried out.

In the case of cascading bids (i.e. multiple or hybrid bids by one applicant or joint venture), only the highest bid will be considered.

The Minister will announce the winning bidders, together with details of the work program, by mid-October 2004.