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Petroleum and Minerals Review Conference
18 -19 March, 1987

Speaking notes: Petroleum exploration and development
in Australia, 1986 - an overview.

by

J A W White

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PETROLEUM AND MINERALS REVIEW CONFERENCE

18-19 MARCH 1987

PETROLEUM EXPLORATION AND DEVELOPMENT IN AUSTRALIA, 1986

J A W WHITE

1986 was a year of trauma for the petroleum exploration and development industry in Australia and indeed one can forecast that the industry will never be quite the same again.

The sharp drop in the price of crude oil at the beginning of the year led to a rapid drop in exploration activity, a drop in crude oil production in some areas and a re-evaluation by many companies of their exploration philosophy.

Exploration activity dropped very considerably compared with the previous year, although still comparing favourably with the average level through the 1970s. During 1986, 140 exploration wells were drilled, compared with 270 in 1985. Onshore exploration wells drilled were down by 50% and offshore 35%. On the development side, a total of 35 wells were drilled, compared with 94 in 1985. Onshore development wells were down by 80% and offshore up by 11%.

Seismic survey activity also decreased during the year by around 50%.

This dramatic downturn in activity brought about an immediate reaction in diverse parts of the industry. Many companies reduced their staff by up to 40% and some contractors decided to terminate their operations in Australia altogether. Fortunately, the industry has now stabilised to some extent with a limited amount of hiring of professionals taking place. However, the indications are that exploration activity will only respond positively to a higher crude oil price sustained over several months. I believe that such a response is now occurring.

Important discoveries were made at Kipper in the Gippsland Basin, Challis in the Bonaparte Basin and in the offshore Carnarvon Basin, the drilling of Saladin No. 2 confirmed the existence of a significant accumulation of oil. I would also like to mention the success achieved in Papua New Guinea with the discovery and delineation of a major oilfield at Iagifu.

Exploration

During the year, exploration tended to be concentrated around established production areas, and very few wells were drilled in previously unexplored parts of the country.

The volume of natural gas discovered in 1986 easily exceeded production during that period although in the case of crude oil, the reverse was the case.

A discussion of exploration activity last year can be found in our hand-out publication 'Petroleum exploration and development in Australia - activity and results, 1986' and I do not intend to elaborate on this.

What I would like to cover are some of the more important discoveries during the year and their significance.

Challis
Kipper
Saladin
Taylor
Kidman
Iagifu

Development

The most significant development project completed during the year was, without doubt, the construction and commissioning of a natural gas pipeline from Palm Valley in Central Australia to Darwin. This massive undertaking, which included the laying of 1512 km of 324/356 mm pipe, was completed ahead of schedule in spite of adverse unseasonal weather conditions during much of the construction period.

The pipeline will be used to convey natural gas from the Palm Valley and Mereenie fields to the Channel Island power station in Darwin and should provide a reliable supply of electricity to Darwin and the surrounding district at a price insulated from the price fluctuations of imported diesel oil.

One beneficial side effect will be to provide valuable additional pressure data on the Palm Valley gas field enabling a better assessment to be made of the gas reserves of this important field.

An important decision made during the year concerns the agreement by the Queensland Government to permit the export of gas from Southwest Queensland to Moomba at a rate of approximately 35 BCF per year for 10 to 15 years. Negotiations are now in progress which, one hopes, will stimulate the development of the several gas fields in Southwest Queensland and also encourage exploration for natural gas in the area now that a market has been defined.

In Victoria, natural gas is now being supplied to the Warrnambool area from two wells in the North Paaratte field; this indicates the potential for more small scale natural gas schemes of this nature elsewhere in Australia.

Offshore, work is in hand on the North Rankin gas production platform to recycle natural gas to the reservoir after stripping off natural gas liquids (condensate) for injection into the main gas pipeline to the gas plant on the Burrup Peninsula. Liquids so produced will prove a valuable additional source of revenue to the producers and should increase the ultimate recoverable reserves of condensate from this giant natural gas field.

On the oil side, the approval to go ahead with the Tirrawarra enhanced oil recovery project must be welcomed. This field has relatively large volumes of crude oil in place in the reservoir but relatively low porosities and permeabilities and a heterogeneous rock fabric indicated poor primary recovery.

Originally it was envisaged to inject carbon dioxide in a miscible flood project. This gas, derived as a waste product from the Moomba plant would swell the oil and reduce its viscosity and interfacial tension. However, for a number of reasons, it was decided to use ethane as the injected fluid. The ethane will markedly reduce the viscosity of the oil and will be available later as a saleable product once the oil has been recovered. Other fields in the area may benefit from this type of stimulation.

In Bass Strait, work is well in hand with the installation of the Bream production platform. Development drilling is expected to commence in July 1987 with first production of crude oil in December this year. As many as six old 'dead' producers on the Snapper platform may be redrilled and completed to drain oil, which would not otherwise be produced, from the L1 reservoir.

To the north and west, the development of BHP's Challis oilfield is under active consideration with the possibility of a somewhat similar production system to that developed for Jabiru.

Wesminco are currently investigating methods to develop North Herald and South Pepper - relatively small accumulations close to Barrow Island. Development may be based on the use of a jack-up drilling unit sited at South Pepper as a production station and a satellite well at North Herald.

I believe it is a very clear message that innovative technology is the key to all the developments that I have been discussing. Using the technology of ten years ago, I doubt that any of these projects would have got off the ground. The link between production and exploration should not be overlooked - cheaper, more efficient production methods can make exploration more attractive, significantly reducing the minimum economic reservoir size and hence enabling smaller prospects to be drilled.

Perhaps one of the best indicators of how we are going in the industry is to look at our balance of petroleum from new discoveries compared with our production during the year.

This slide illustrates that we are not finding enough oil to cover production but on the natural gas side, we are doing reasonably well. The column marked adjustments covers revisions of existing fields, with most of the changes being upwards as possible reserves are converted to probable or proved as additional appraisal drilling is carried out.

Scientific Work

BMR's 'Rig Seismic' geophysical and geological survey vessel has continued to cover Australia's continental margins with a series of multi-role cruises. In addition to multi-channel seismic reflection surveys, gravity and magnetic surveys have been carried out and considerable sea-bed sampling and heat-flow measurements taken.

This slide shows the areas covered by recent surveys.

Of considerable interest are the new results from Northeast Australia which have demonstrated a thick variegated sedimentary section with marked structural elements. Water depth is generally deep in the area but nevertheless there are many parts of this area where water depths would not preclude exploration drilling.

More emphasis is now being given to heat flow measurements, facilitated by a new design of heat flow probe which is both more accurate and more rugged than earlier probes.

Considerable additional funding was awarded last year to enhanced oil recovery research projects under the Government's National Energy Research Development and Demonstration Programs. The University of New South Wales received the largest grant : BMR also received funds for a project involving the quantitative assessment of the potential for enhanced oil recovery in Australia.

One project, also funded last year, has recently had a bad set-back with the death of Dr Bohdan Bubela. Dan, as he was always known, had become a world leader in microbiological enhanced oil recovery methods and his absence will inevitably delay research work in this potentially important area.

Future Exploration and Development Activity

For 1987 we forecast a significant increase in onshore exploration drilling compared with the previous year; 145 wells as against last year's 112. In all other categories we expect a decrease, with offshore exploration halving to 14 wells, compared with 28 in 1986 and development drilling declining from 15 onshore in 1986 to only 7 in 1987 and offshore down from 20 to 9 wells. Overall we estimate 175 wells will be drilled in 1987, by coincidence, the same number as were drilled last year.

Seismic survey activity is expected to decline to about two-thirds of last year's level.

The trend that we have seen in recent years whereby exploratory drilling will be concentrated in known producing areas will continue. We expect very little drilling activity onshore in Western Australia, Victoria, New South Wales, Tasmania and Northern Territory. Most drilling will be concentrated in the Cooper and Eromanga basins of South Australia and Queensland, with a few wells in the Bowen-Surat basins of Queensland and the Otway Basin in South Australia and Victoria. More emphasis will be given to proving up additional dedicated reserves of natural gas with a reduced emphasis on exploration for crude oil.

Offshore, we expect exploration to be carried out in the Bonaparte and offshore Carnarvon Basins.

The release of considerable additional acreage in late January this year should provide encouragement for new explorers to participate in offshore ventures here and indeed, we are witnessing one overseas major oil company commencing a long term strategic program offshore Western Australia. Let us hope their efforts are crowned with success.

Thank you.

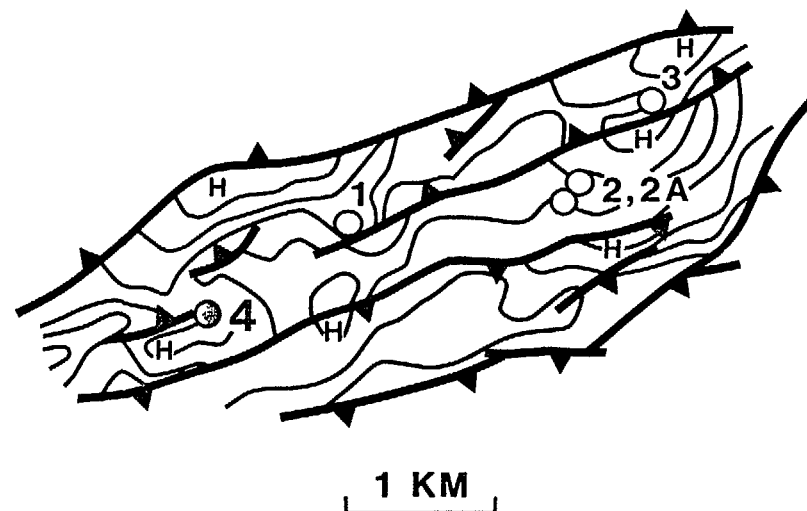
CHALLIS OIL FIELD

The Challis oil field, discovered by BHP's Challis No. 1 well which spudded on 2 October 1984 is located 22 km south of Jabiru and was sited to test possible Triassic and Jurassic sands on an upthrown horst block, overlain unconformably by the Early Cretaceous Bathurst Island Formation. The discovery well intersected a net oil column of 21 metres within Middle to Late Triassic sands, and recorded a maximum flow of 4700 BOPD when tested. The well has been suspended.

Three appraisal wells, Challis Nos 2A, 3 and 4 were drilled in 1986 to evaluate the potential of the field. Drilling results confirmed the presence of at least three separate Triassic sand reservoirs within a complexly faulted horst block. Production tests from these wells recorded maximum flow rates of 9380 BOPD for Challis No. 2A, 9989 BOPD for Challis No. 3 and 2853 BOPD for Challis No. 4. Poor seismic resolution beneath the Cretaceous unconformity and complicated faulting make it difficult to predict reservoir distribution, but recent press reports suggest that the Challis field may contain recoverable reserves of 50 million barrels.

The discovery and evaluation of Challis as a follow up to the Jabiru discovery has demonstrated that complexly faulted horst blocks along the margins of the Vulcan Graben, particularly where Triassic or Jurassic sands lie unconformably under the Cretaceous Bathurst Island Formation; form viable exploration targets for future exploration. No development plans for Challis have been indicated to date, but it is likely that a single point mooring system similar to that used at Jabiru may be employed to develop the field.

LITH	WELL (mKB)	STRAT	AGE
	111.0		
	419.0	UNDIFF	MIO
	738.0	HIBERNIA BEDS	EOC
	989.0	WOODBINE BEDS	PALAEO
	1391.5	BATHURST ISLAND FM	CRET
	TD1700.0	MALITA FM ?	TRI



CHALLIS 4
BHP AC/P4

BMR 87/296

KIPPER NO. 1

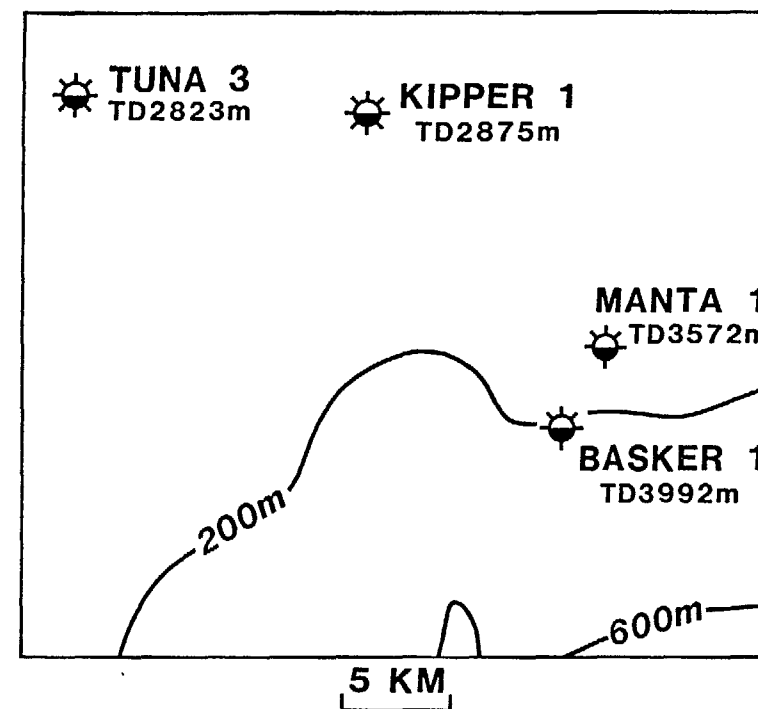
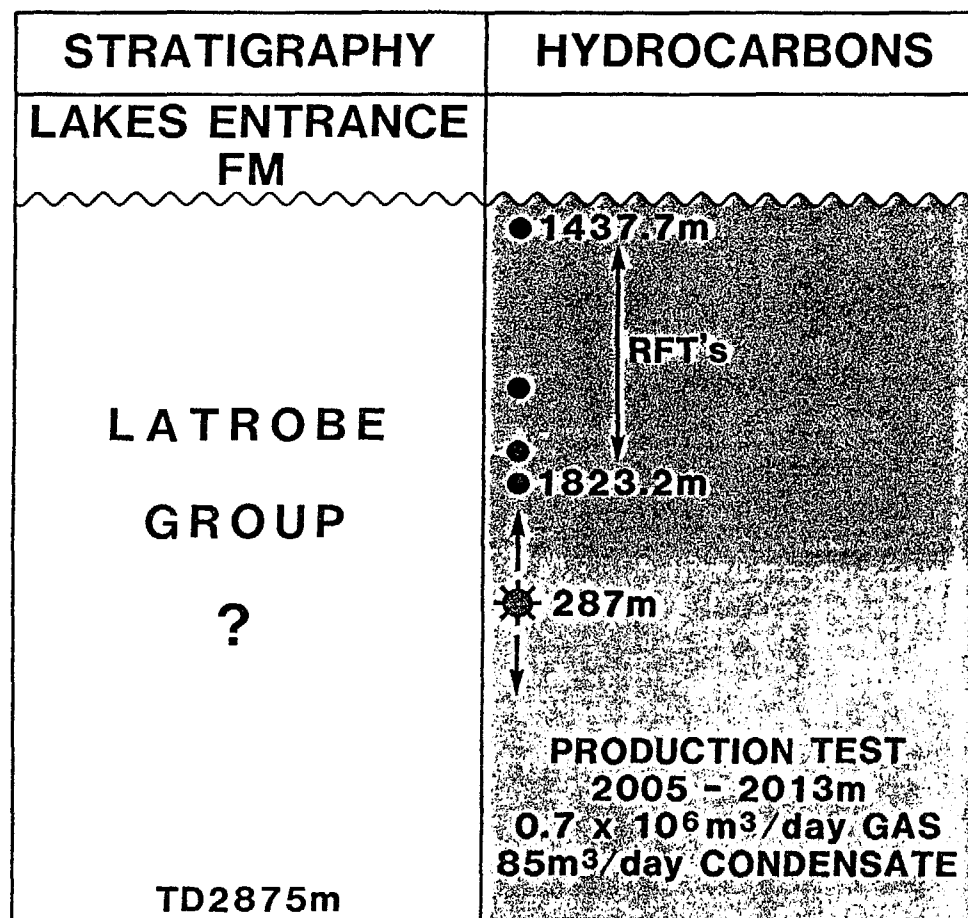
The Kipper No. 1 well discovered a major gas accumulation in the Gippsland Basin in March 1986. This was the first major discovery in the basin since that of the Fortescue oil accumulation in 1978.

Kipper No. 1 was located in the eastern area of the basin in water 95 metres deep. The well was drilled by Esso as part of a farm-in arrangement with Shell and co-venturers who have made small discoveries in the eastern area in recent years (Manta & Basker).

Kipper No. 1 tested a structural trap with objectives at both top and intra-Latrobe Group levels. Pre-drill geophysical interpretation of the size of the areal closure and the thickness of the Latrobe Group, indicated that the structure was unlikely to contain very large reserves. However the well encountered a gross gas column of 287 metres within the Latrobe Group and a minor oil accumulation at top Latrobe Group level. A production test in the upper part of the gas column achieved a gas flow of 24.9 million cubic feet (0.7 million m³) per day, accompanied by condensate (54.6° API) at a rate of 533 barrels (85 m³) per day.

The unexpectedly large size of the gas column is due to the fact that the Latrobe Group proved to be significantly thicker than had been predicted at the well location.

Although only partially evaluated at the moment, the Kipper discovery is expected to make a significant addition to the recoverable reserves of natural gas in the Gippsland Basin, with resultant important implications for the future supply and demand situation in southeastern Australia. The discovery also highlights the possibility of further substantial discoveries in prospects similar to Kipper in the eastern Gippsland Basin.



KIPPER 1
ESSO, BHP/SHELL
VIC/P19

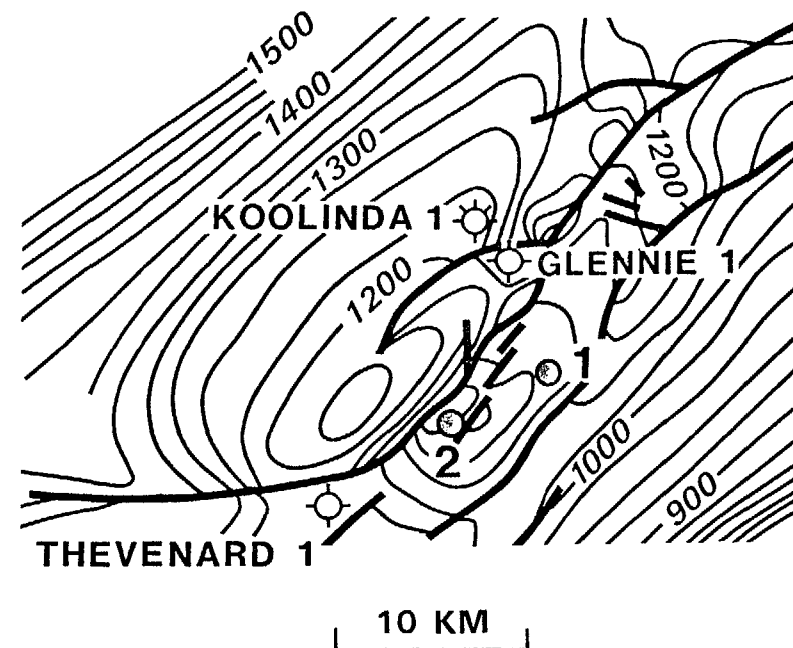
SALADIN OIL FIELD

WAPET's Saladin No. 1 well located about 100 km south of Barrow Island, spudded on 6 June 1985, and was sited to test Early Cretaceous Barrow Group sands within a fault-controlled anticline. The well intersected a net oil column of 11 metres within the top part of the Barrow Group, and recorded a maximum flow of 5950 BOPD when tested. The well has been suspended.

An appraisal well, Saladin No. 2, spudded on 15 November 1986 to test the central part of the Saladin structure. The well intersected the main target interval within the Barrow Group close to the predicted depth, and a production test over part of that interval produced a maximum flow of 10 975 BOPD before the well was suspended.

Recent press reports suggest that the Saladin field may contain recoverable reserves of 25 million barrels of oil. Although the field is located close to Thevenard Island in only 15 metres of water, there is still some doubt as to whether the field will prove to be economically viable. WAPET is planning further appraisal wells to test the extent of the field.

LITH	WELL (m KB)	STRAT	AGE
			TERT
			LATE CRET
	432.0		
	864.0	LOWER GEARLE SILTSTONE	EARLY CRETACEOUS
	959.0	WINDALIA RAD	
	1115.8	MUDERONG SH	
	1392.5	BARROW GROUP	
		DINGO CYST (DUPUY MEMBER)	LATE JURASS
	TD1830.0m		



SALADIN 2
WAPET WA-24P,
TP/3, EP65(R2)

BMR 87/295

TAYLOR NO. 1

Bridge Oil's Taylor No. 1 new-field wildcat well was drilled in April 1986. It is in PL 16 in the Surat and Bowen Basins, 115 km southeast of Roma, in southeastern Queensland. Its primary objective was the Triassic Showgrounds Sandstone in the Bowen Basin sequence.

Taylor No. 1 discovered gas with condensate in the Showgrounds, and oil within the interpreted Late Carboniferous/Early Permian Kuttung Formation. A production test of the oil accumulation in May 1986, demonstrated that commercial production was not achievable. The well is presently shut in and will be recompleted in the Triassic Showgrounds as a gas producer at a later date.

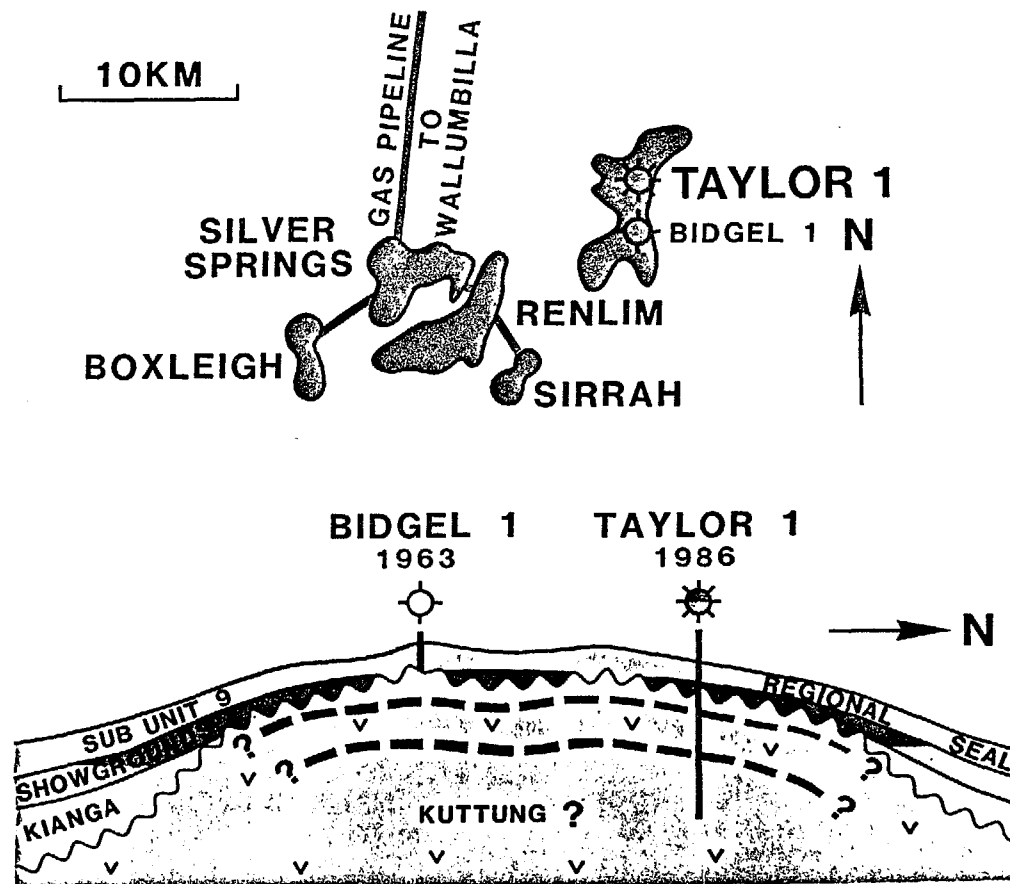
Drill-stem tests over the Showgrounds Sandstone yielded flows of gas/condensate. Drill-stem test 3 over the interval 1998 to 2011 m flowed gas at 609 000 m³/day (21.5 x 10⁶ cu. ft/day) on a 1 inch choke with a wellhead flow pressure of 940 p'sig. This rate is a record for the Bowen Basin.

The field can easily be linked by pipeline to Bridge's LPG separator plant near Wallumbilla. Nearby fields currently linked to the facility are Silver Springs, Boxleigh, Renlim and Sirrah. Sales gas can be transported to Brisbane via the Roma to Brisbane pipeline, and condensate can be trucked to Moonie for transport via the Moonie to Brisbane pipeline.

A field appraisal well is scheduled to be drilled later this year.

The Taylor discovery is particularly encouraging, in that, although it was made in a basin with a long history of successful exploration, initial evaluation indicates that it is potentially one of the largest gas fields in the basin.

LITH	WELL (mKB)	STRAT	AGE
	1950	WANDOAN	MIDDLE TRIASSIC
	1975		
		SUB UNIT 9	
	2000	SHOWGROUNDS	
	2025	KUTTUNG VOLCANICS	EARLY PERMIAN/ LATE CARBONIFEROUS
	2050		
	2075		



TAYLOR 1 PL-16 QLD

BMR 87/343

KIDMAN NO. 5

Delhi's Kidman No. 5 well is in the Toolachee block of PELs 5 & 6, northeastern South Australia. It was drilled in November 1986 as an appraisal well to assess the Permian Toolachee and Patchawarra reservoirs at the northwestern end of the Kidman field, with secondary objectives in the Nappamerri and Epsilon Formations.

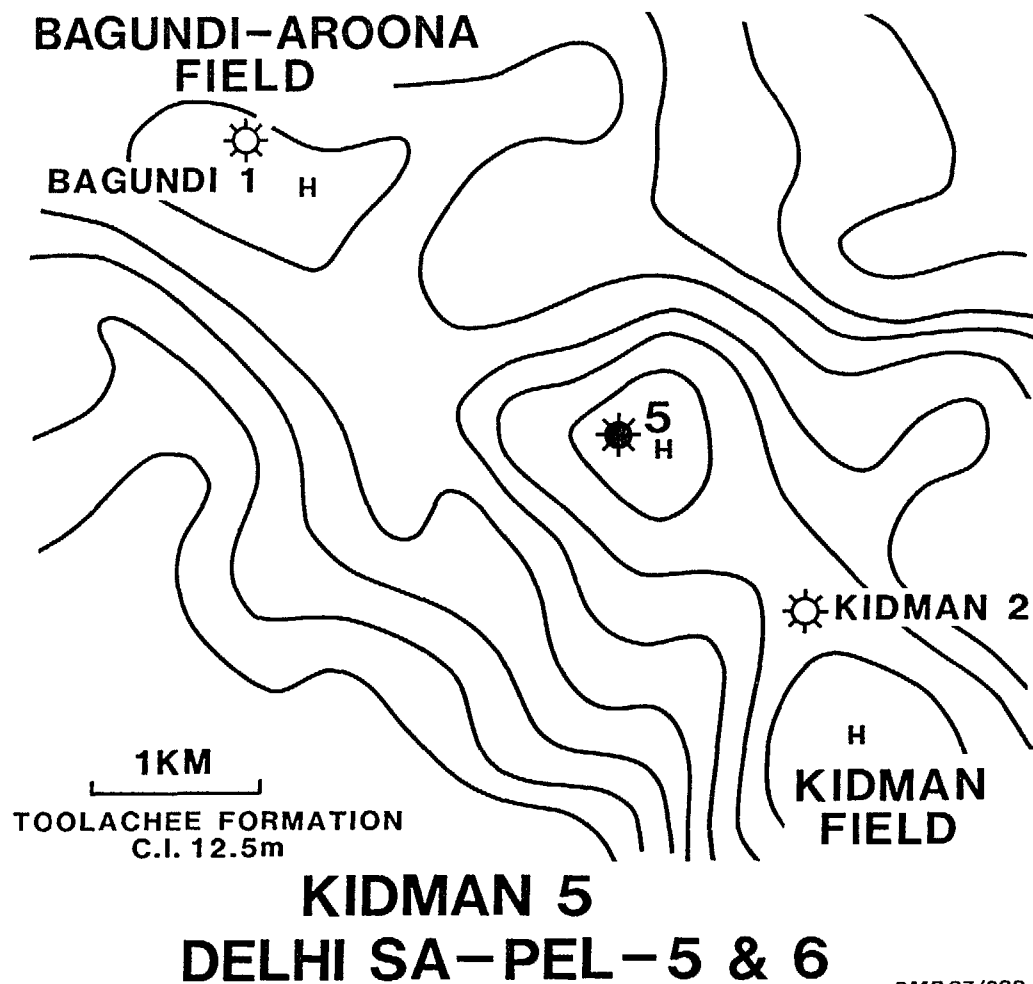
The well recorded good flow rates of gas and condensate from drill-stem tests: 232 000 m³/day (8.3 x 10⁶ ft³/day) of gas and 45.8 kl/day (288 bbl/day) of condensate from the Toolachee Formation, and 104 000 m³/day (3.7 x 10⁶ ft³/day) of gas with 18.3 kl/day (115 bbl/day) of condensate from the Patchawarra Formation. The Patchawarra find was a new pool discovery.

The well identified 1.01 x 10⁹ m³ (36 x 10⁹ ft³) proved and probable gas reserves, increasing the field reserves by approximately 50 percent. Production can be tied into the current gas gathering system to Moomba.

The well has proven the continuation of the productive Permian reservoirs to the northwestern part of the field, and has demonstrated that the Kidman field is connected to, and comprises one elongate field with the Bagundi-Aroona field.

The well is a good example of the additions to reserves that may come from appraisal drilling even in this (by Australian standards) mature area. It made a significant contribution to the additional reserves needed by Delhi, Santos and their partners to meet their long term commitments to the New South Wales market, after which future reserves may be available to supply other markets.

LITH	WELL (m KB)	STRAT	AGE
	1944	NAPPAMERRI	TRIASSIC
	2060	TOOLACHEE	LATE PERMIAN
		(ROSENEATH)	
	2142	EPSILON	EARLY PERMIAN
		MURTEREE	
	2198	PATCHAWARRA	(LATE CARB)
		MERRIMELIA	

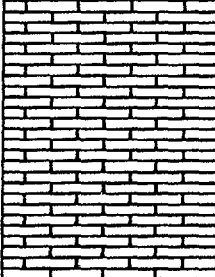
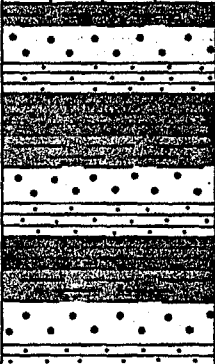



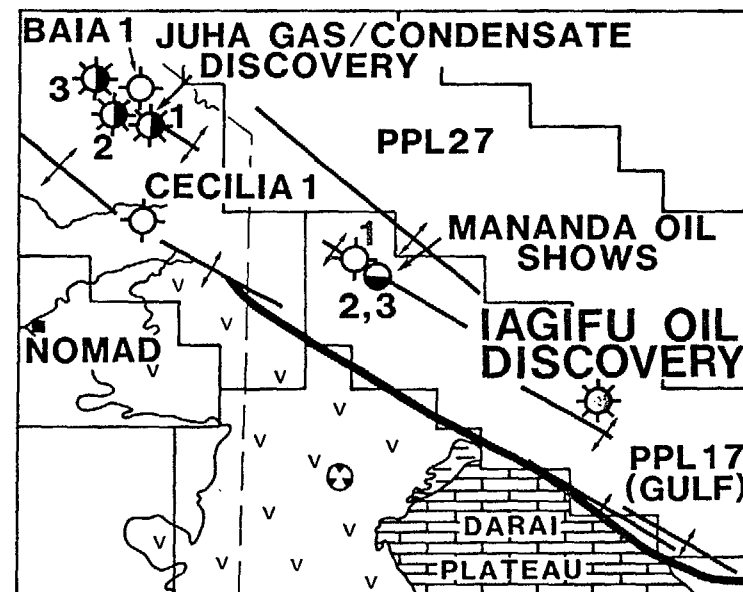
IAGIFU OIL FIELD

The Iagifu oil field in the Southern Highlands of Papua New Guinea was discovered in early 1986 by Iagifu 2X well, following the failure of Iagifu IS to reach the target zone because of mechanical difficulties. The wells were drilled to test the Iagifu anticline, which measures some 25 km by 5 km and has more than 400 m of topographic relief. The oil reservoir is in the Late Jurassic/Early Cretaceous Toro sandstone.

Iagifu 2X, and the appraisal well Iagifu 3X located about 3 km away, both flowed oil at the rate of about 3500 BOPD. A second appraisal well, Iagifu 4 has been drilled, but the results of testing this well are not yet available. Certain press statements have alluded to recoverable reserves of between 240 and 510 million barrels although the results of drilling Iagifu 4 may downgrade this figure significantly.

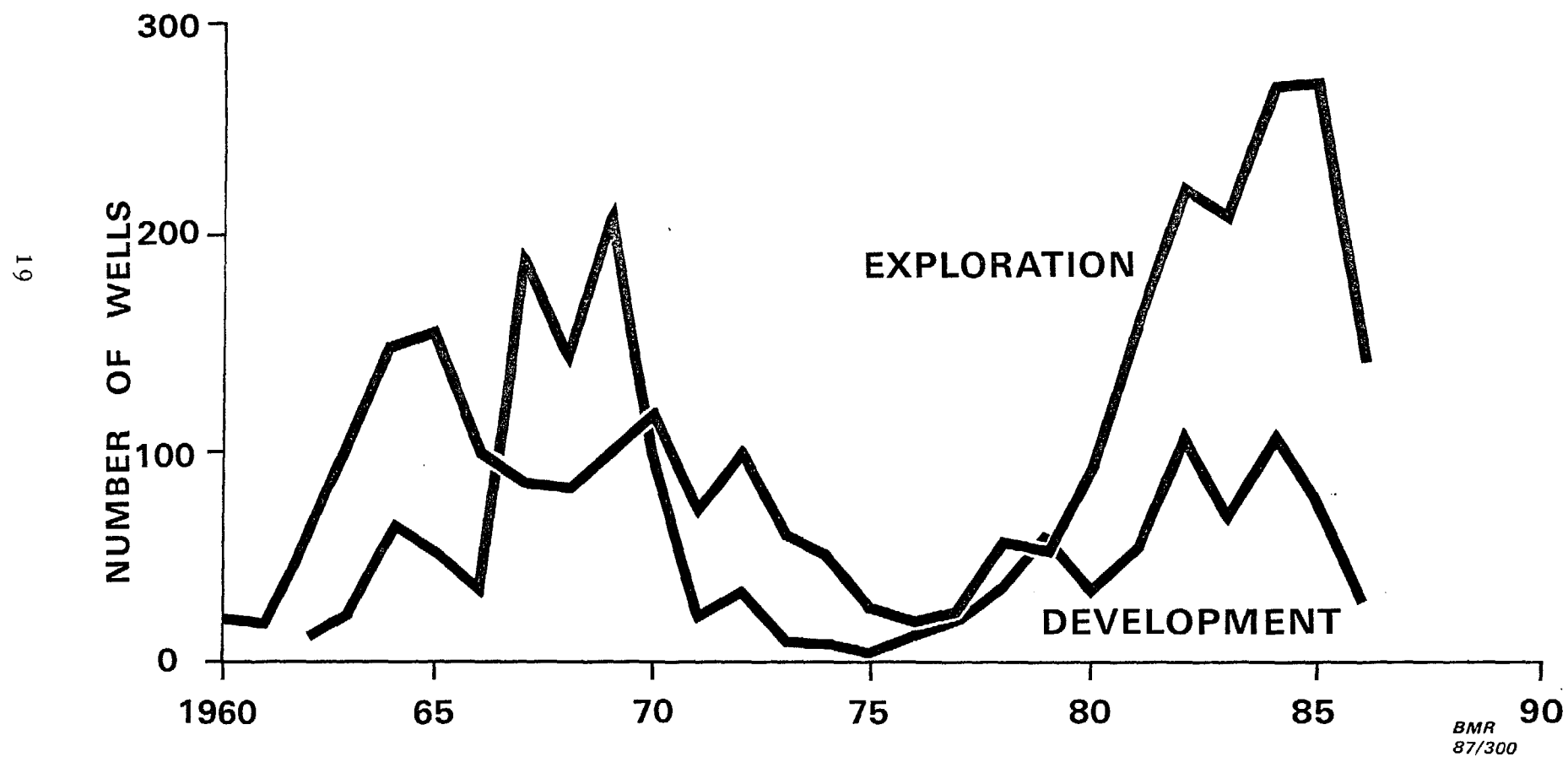
The Iagifu discovery is significant because it confirms the oil potential of the PNG highlands, where there have previously been encouraging discoveries of oil in the Juha and Mananda structures and where there are about a dozen other large structures which remain to be tested. The area is remote from markets and the logistics for development are difficult. Further appraisal work is required and the development of Iagifu, if it proceeds, could take up to four years. Nevertheless, the future of the Southern Highlands as an oil-producing region in the medium term now seems assured.

LITH	WELL (M)	STRAT	AGE
		DARAI	MIOCENE
	(3) 2585	IERU	CRETACEOUS
		TORO	JUR - ASSIC



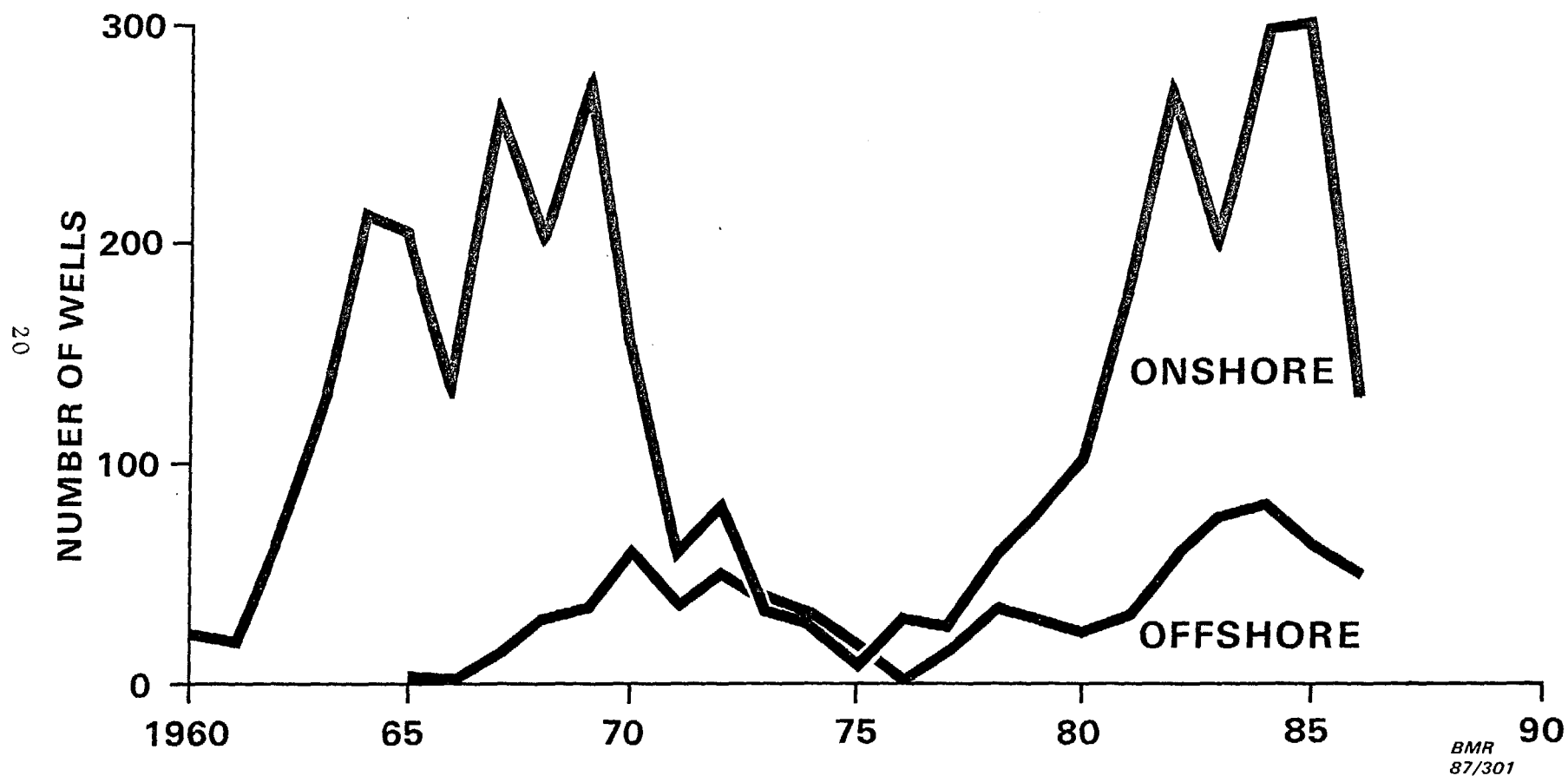
IAGIFU PPL-17 PNG

PETROLEUM EXPLORATION AND DEVELOPMENT WELLS DRILLED IN AUSTRALIA 1960-1986

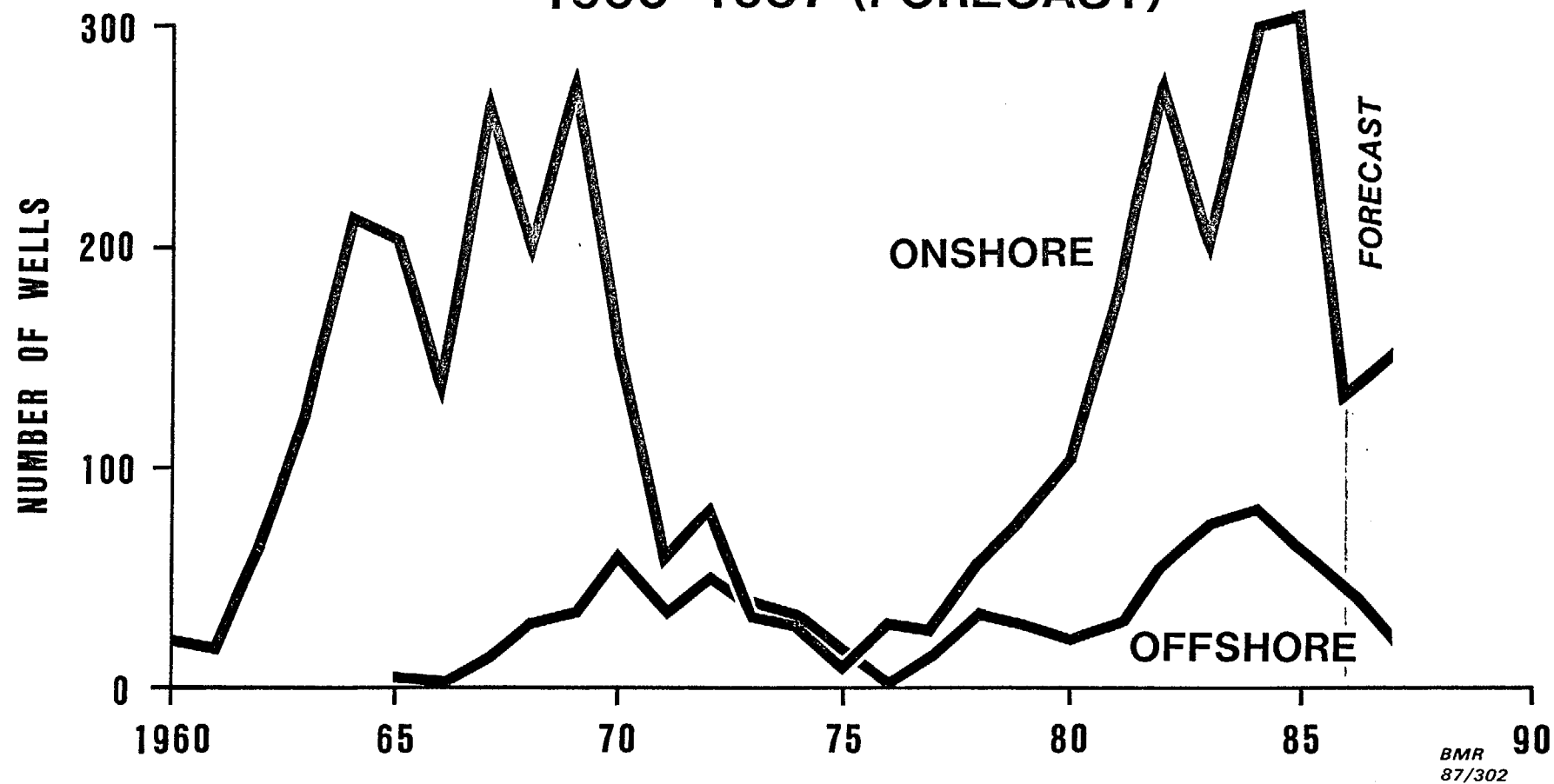


PETROLEUM ONSHORE AND OFFSHORE WELLS DRILLED IN AUSTRALIA

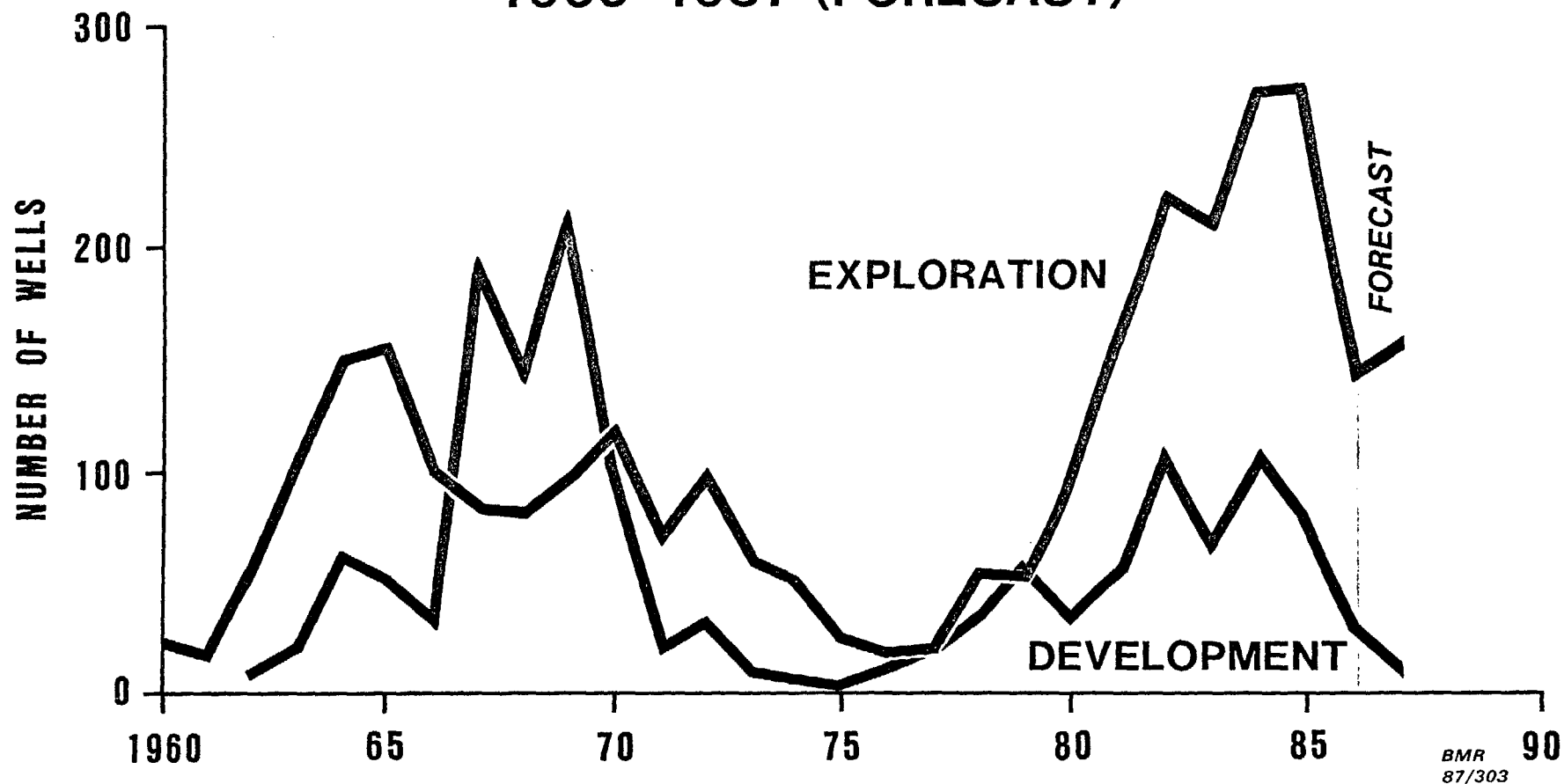
1960-1986

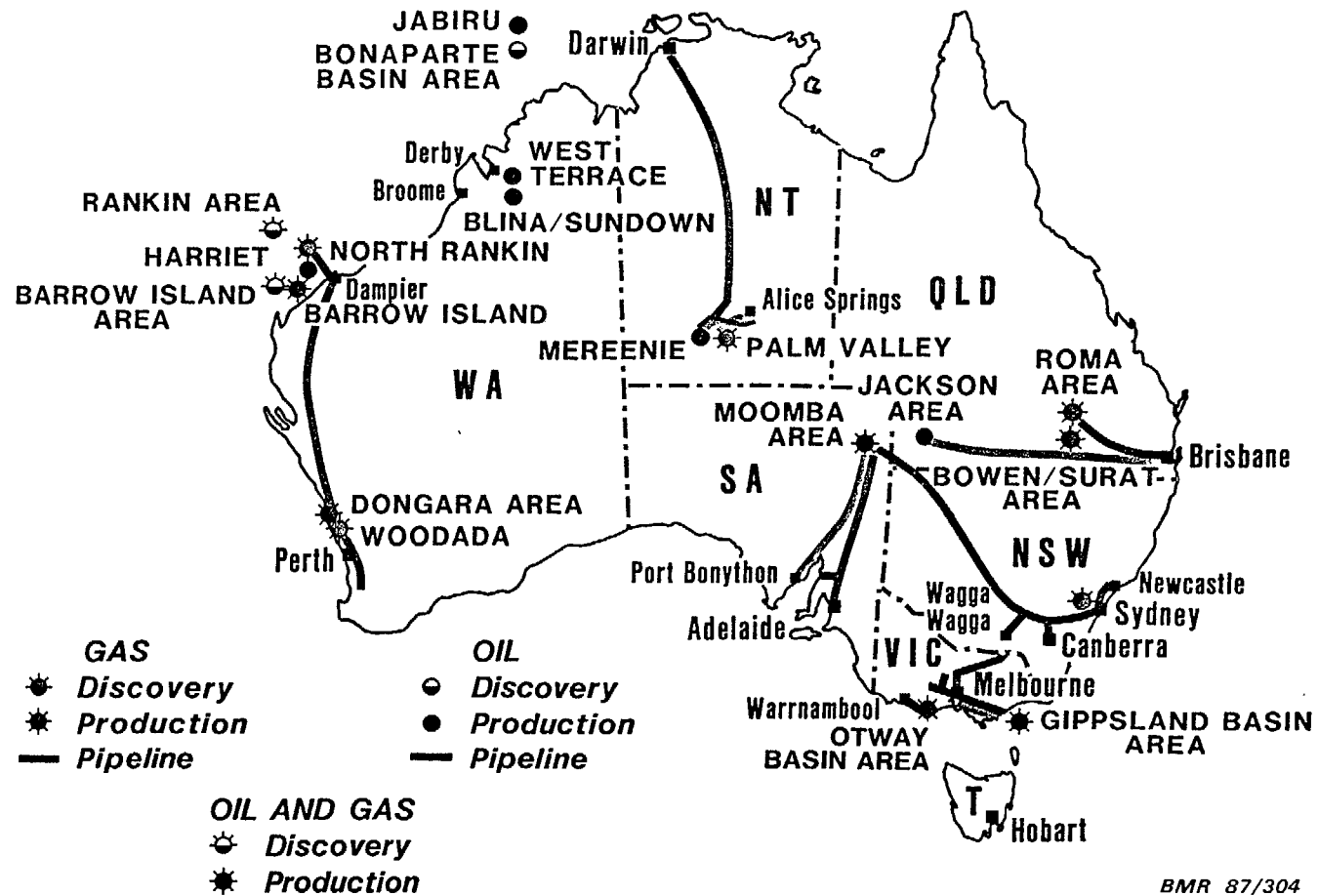


PETROLEUM DRILLING ACTIVITY ONSHORE AND OFFSHORE 1960-1987 (FORECAST)

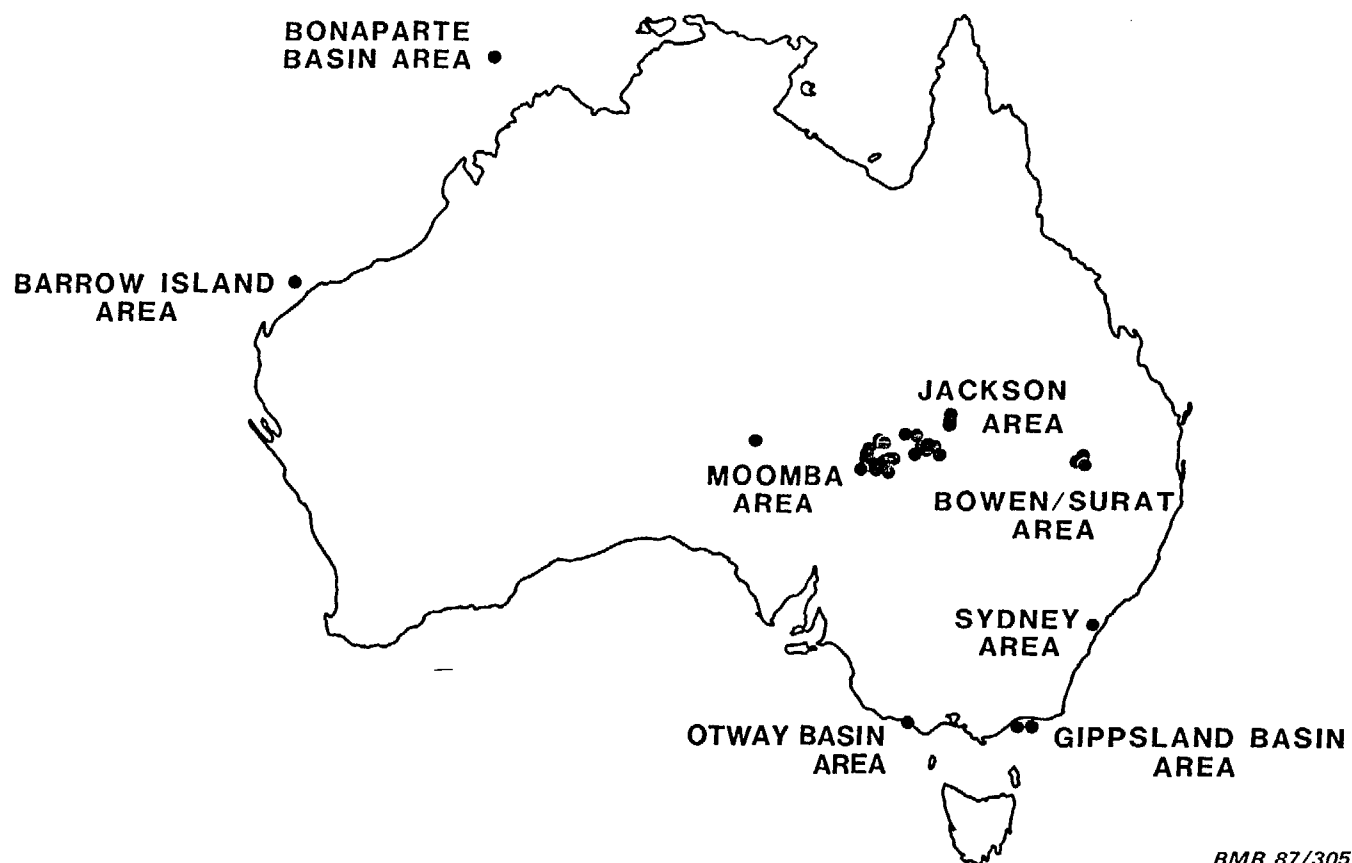


PETROLEUM DRILLING ACTIVITY EXPLORATION AND DEVELOPMENT 1960-1987 (FORECAST)

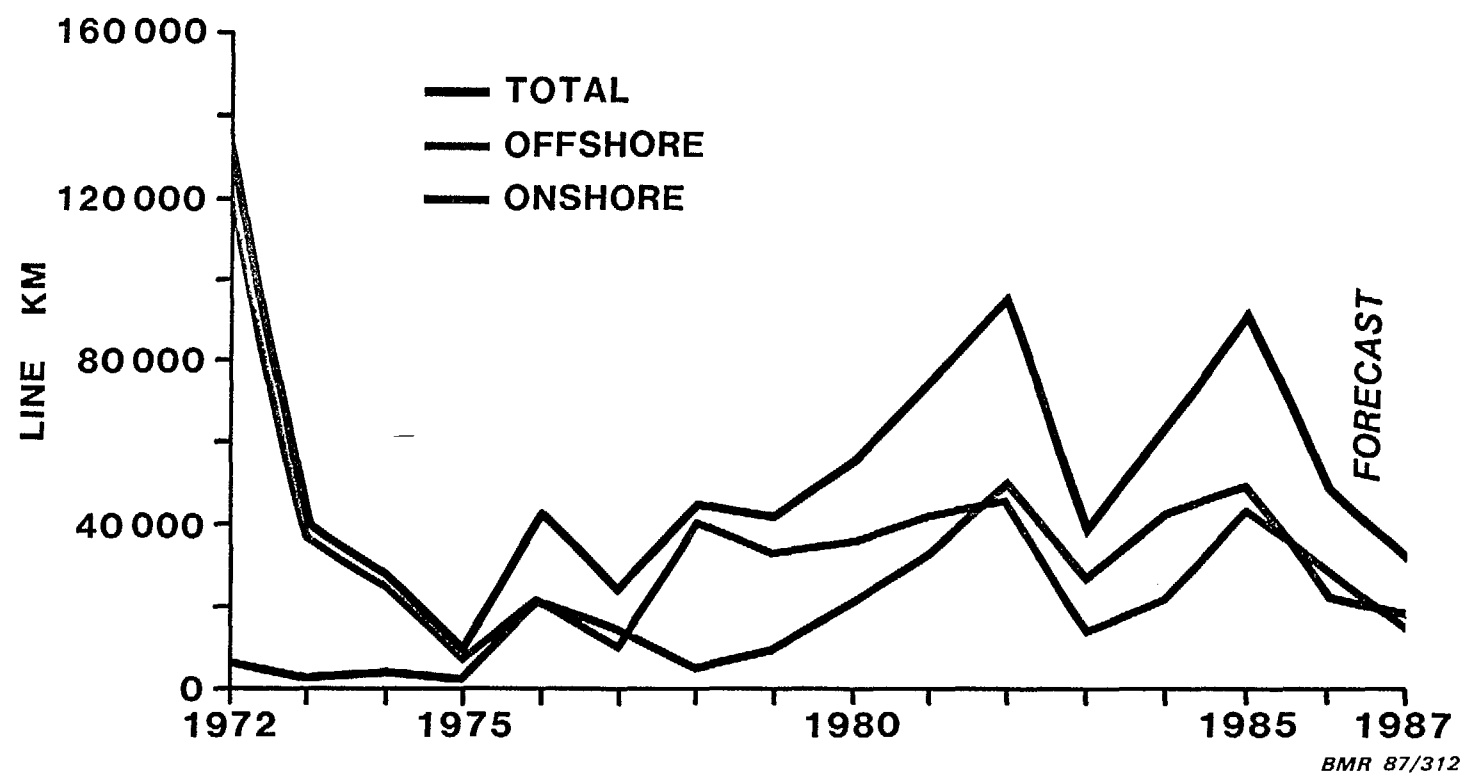




FIELD DISCOVERIES IN 1986



SEISMIC SURVEY ACTIVITY 1972-1987 (FORECAST)



AUSTRALIA'S RECOVERABLE PETROLEUM RESERVES

	RESERVES AT 1 JULY 1985	PRODUCTION	DISCOVERIES	ADJUSTMENTS	RESERVES REMAINING AT 30 JUNE 1986
OIL (X10 ⁶ KL)	271.77	-29.76	+2.76	+33.62	278.39
CONDENSATE (X10 ⁶ KL)	111.25	-1.91	+1.45	+7.58	118.37
LPG (X10 ⁶ KL)	97.49	-4.01	+0.38	+16.08	109.94
SALES GAS (X10 ⁹ M ³)	1522.37	-14.28	+18.91	-32.13	1494.87

BMR 87/344