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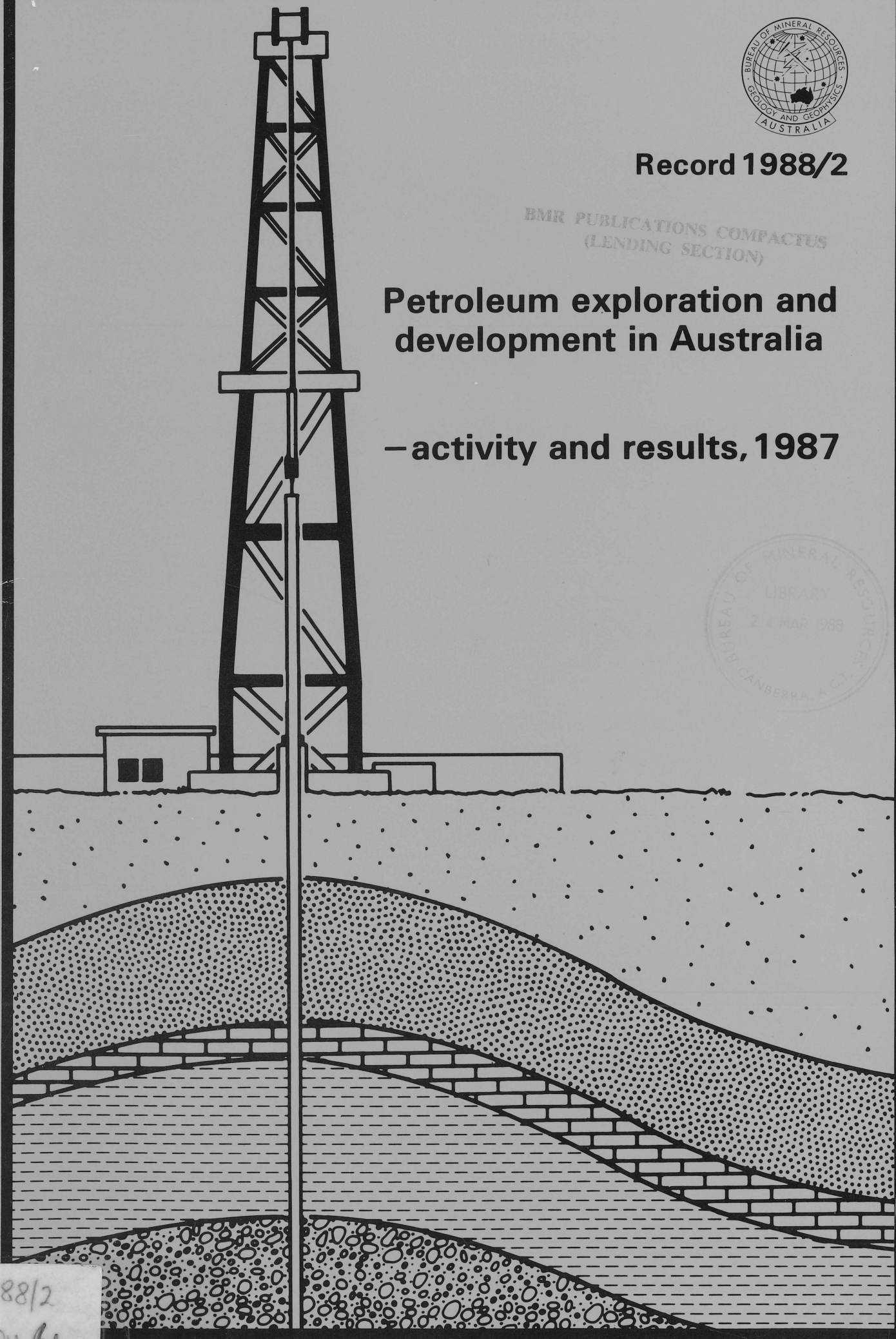
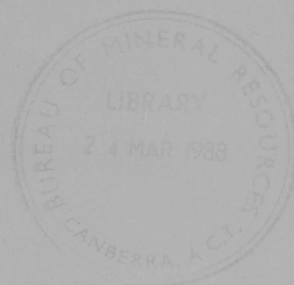


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Petroleum exploration and development in Australia

— activity and results, 1987



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**Petroleum exploration and development in Australia
– activity and results, 1987**

**Compiled by the Petroleum Branch, Resource Assessment Division,
Bureau of Mineral Resources, Geology and Geophysics, Canberra**



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INTRODUCTION

This report has been prepared by the staff of the Petroleum Branch of the Resource Assessment Division of BMR. The functions of the Petroleum Branch include the monitoring of petroleum exploration and development activity, the preparation of estimates of petroleum reserves and resources and their availability through time, and the provision of technical advice in relation to Commonwealth legislation and policies concerning petroleum exploration and production.

The report provides a preliminary summary of petroleum exploration and development activity in Australia during 1987. It also summarises BMR's assessment of Australia's identified petroleum resources (reserves) and undiscovered petroleum resource potential.

In addition to a summary of activity in 1987 in each of the major onshore and offshore sedimentary basins, the report includes a list of the major events in the history of the Australian petroleum industry and a summary of the wells and metres drilled to the end of 1987.

1987 IN RETROSPECT

Expenditure on petroleum exploration and development activity in Australia dropped substantially in 1987. However the levels of petroleum exploration and development drilling increased, in contrast to the sharp fall in these activities which occurred during 1986 as a result of the worldwide decline in crude oil prices. The number of onshore exploration and development wells increased significantly compared to 1986, with exploration concentrated in low-risk areas with ready access to markets. The major reduction in expenditure was due to a reduction in the number of exploration wells drilled offshore to about half of the 1986 level, however, offshore development drilling remained at the same level as 1986. Seismic survey activity in 1987 also fell below the 1986 level, to less than half the number of line kilometres recorded in 1985.

The highest proportion of exploration wells, wells to test extensions of fields and appraisal wells, were drilled in the Cooper/Eromanga and Bowen/Surat Basins. Other onshore basins which were actively explored were the Arckaringa, Canning, Carnarvon, Galilee, Gunnedah, Murray, Officer, Otway, Pedirka and Perth Basins. Most exploration wells drilled offshore were in the Bonaparte and Carnarvon Basins; other offshore wells were drilled in the Browse and Gippsland Basins. Onshore seismic surveys were mainly in the Cooper/Eromanga, Bowen/Surat and Canning Basins and offshore most surveys were in the Bonaparte, Browse and Carnarvon Basins.

Sixty-one oil, gas and condensate discoveries were made during 1987; 21 oil, 19 gas, seven oil and gas, seven gas/condensate and four oil/gas/condensate were made onshore, and one oil, one gas and one oil/gas/condensate discoveries were made offshore. Additions to demonstrated resources resulting from discoveries were insignificant compared to revisions of resources in known fields, and to changes resulting from production. Extension/appraisal wells in the Challis and Skua fields upgraded the potential of the Bonaparte Basin; appraisal drilling in the Saladin field produced a record Australian oil flow from an exploration well; and appraisal drilling of the Kipper gas accumulation found in 1986 resulted in the discovery of an oil accumulation below the gas column. Development wells completed onshore were mainly in the Cooper/Eromanga Basins; other development wells were drilled in the Bowen/Surat and Canning Basins. Offshore development wells were drilled mainly in the Gippsland Basin, at Jabiru in the Timor Sea area and in the

Gippsland Basin during the year, and plans have been announced for the development of other small oil fields in the basin. Major development projects which were already under construction continued: these included the construction of the second phase of the North West Shelf gas project to supply liquefied natural gas to Japan, and establishment of facilities for the enhanced oil recovery project in the Tirrawarra and Moorari fields in the Cooper Basin in South Australia. Contracts have been let for project management and engineering work on the pipeline to supply gas from the Denison Trough to Gladstone.

Plans were announced to develop the Saladin field in the Carnarvon Basin and the Challis field in the Timor Sea. Other developments, which have been proposed, include construction of a gas separation plant at Darwin for the production of LNG and helium, construction of an ammonium nitrate plant at Blackall, Queensland to be supplied with gas from the Gilmore gas field in the Adavale Basin, and duplication of sections of the Roma-Brisbane pipeline.

PETROLEUM GEOLOGY, RESOURCES AND PRODUCTION

Geology

Sedimentary rocks ranging in age from Proterozoic to Cainozoic underlie about 4.3 million km² or about one half of the land area of Australia, and about another 2 million km² of the continental shelf (Fig. 1). Forty-eight sedimentary basins are presently recognised, 20 of which lie wholly or partly offshore.

Proterozoic and early-mid Palaeozoic basins occur mainly in the central and western parts of the continent and in some places extend offshore. Basins that have developed during the late Palaeozoic and Mesozoic underlie large areas of eastern Australia, and extend onshore and offshore around the continental margins. Tertiary strata overlie many of the older basins. The Tertiary basins, and basins that continued to develop into the Tertiary, are mostly distributed along the southern coastline.

Australia's petroleum reservoirs range in age from Precambrian to early Tertiary. Most of the oil resources discovered so far are in offshore early Tertiary reservoirs in the Gippsland Basin. The petroleum reservoirs in the Carnarvon and Browse Basins are Mesozoic, and both Mesozoic and Permian reservoirs exist in the Bonaparte Basin. Onshore, petroleum occurs in Jurassic and Cretaceous reservoirs in the Eromanga Basin, and Jurassic reservoirs in the Surat Basin. The reservoirs are of Permian and Triassic age in the Perth, Bowen, and Cooper Basins, and in the Canning and Adavale Basins which are of Permian and Devonian, and Devonian age respectively. Late Precambrian to late Ordovician reservoirs occur in the Amadeus Basin.

The early-mid Palaeozoic reservoirs in the Amadeus and Adavale Basins are in shallow-marine sedimentary sequences. However, most of Australia's petroleum resources have been discovered in Tertiary, Mesozoic, and late Palaeozoic sequences that were deposited in marginal marine or non-marine environments and which commonly contain extensive coal measures.

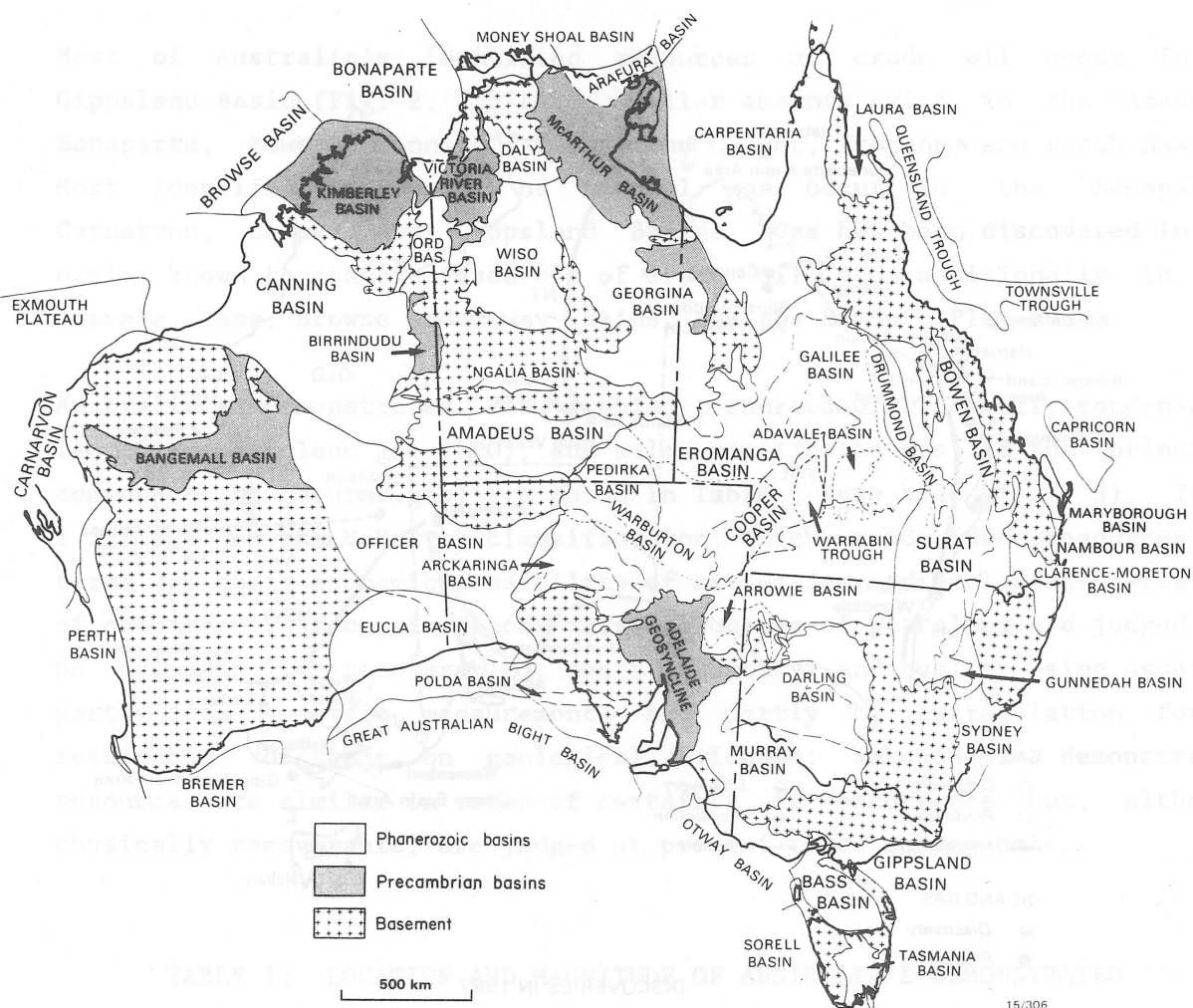
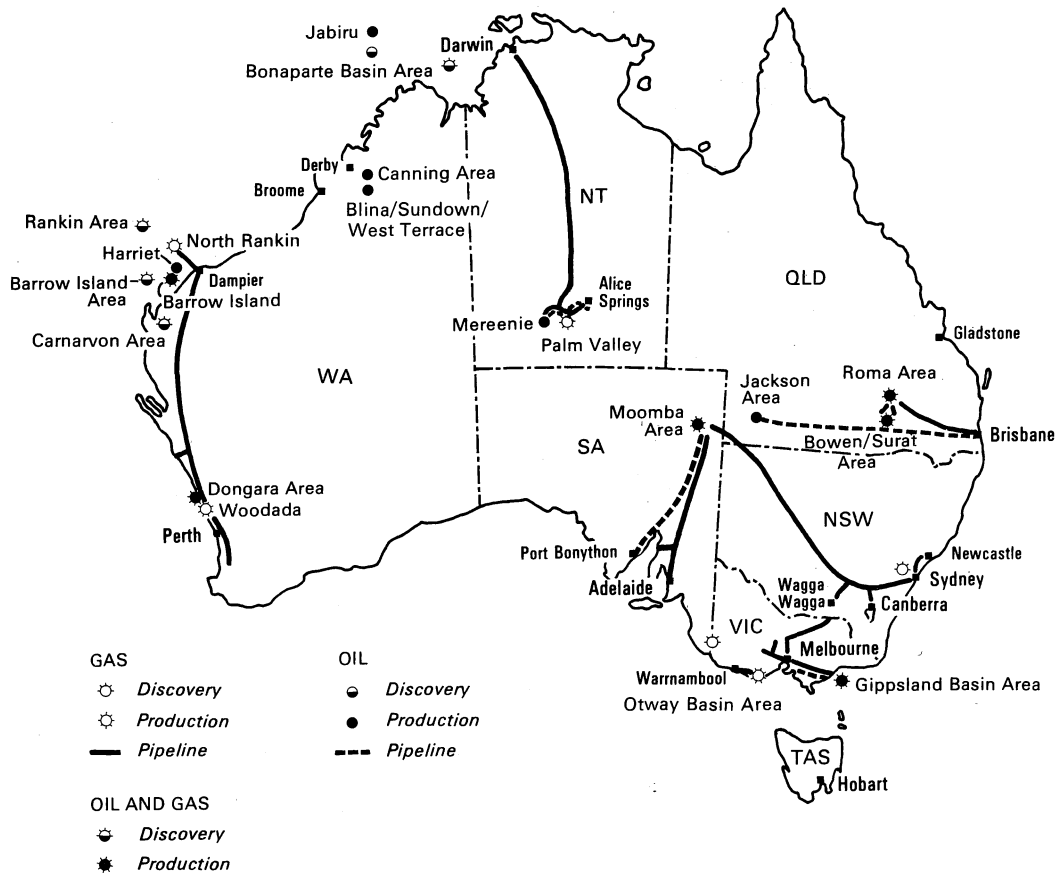


Fig. 1. Australia's sedimentary basins. Basement denotes regions generally unprospective for petroleum - mainly areas underlain by crystalline rocks or by tightly folded or metamorphosed strata. The dashed lines are boundaries of concealed basins; locally relationships are complex, e.g. the Galilee Basin overlies the Adavale Basin and underlies the Eromanga Basin.



DISCOVERIES IN 1987

Jackson Area	Bowen/Surat Area	Moomba Area	Gippsland Basin Area
○ Challum 4	● Borah Creek 5	○ Balcaminga	● Kipper 2
○ Chookoo 6	○ Burgoyne	○ Bungee	○ Patricia
● Cranston	○ Caneon	○ Cowralli 2	○ Remora
● Cuddapan	● Cockatoo	○ Deina	Canning Area
○ Dingera	● Harbour	○ Dieri	● Janpam Nth
● Jackson Sth 7	○ Kanaloo	○ Gidgealpa 27	● Lloyd
○ Judga	○ Kungarri	○ Keena	Carnarvon Area
○ Karmona East 2	● McWhirter East	○ Kerna	○ Rosette
○ Karri	○ Merroombil	○ Kurunda	● Parrot Hill
○ Marengo	● Mindagabie	○ Lake MacMillan	Otway Basin Area
● Maxwell	○ North Colgoon	○ Mawson	○ Katnook
● Monler	○ Rednook	○ Pelican	● Windermere
● Mooliampah West	○ Wingnut	● Pintari Nth	
● Mugginullah	○ Winnathoola 2	○ Pirraminta	
● Naccowlah Sth 10	○ Yarrabend 5	○ Taylor Sth	
● Tickalara 3	● Yellowbank Creek Nth	○ Toolachee 39	
● Toby	○ Yuranigh	○ Waukatanna	
● Ufouria			

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Fig. 2. Location of oil and gas production, pipelines and discoveries in 1987.

Resources

Most of Australia's identified resources of crude oil occur in the Gippsland Basin (Fig. 2, Table 1); smaller amounts exist in the Amadeus, Bonaparte, Bowen, Canning, Carnarvon, Cooper, Eromanga and Perth Basins. Most identified resources of natural gas occur in the Bonaparte, Carnarvon, Cooper and Gippsland Basins. Gas has been discovered in all basins known to contain resources of crude oil and additionally in the Adavale, Bass, Browse and Otway Basins, and the Exmouth Plateau.

Australia's demonstrated recoverable resources of crude oil, condensate, liquefied petroleum gas (LPG), and sales gas ('sales gas' is the principal component of natural gas) are shown in Table 1 (see also Figure 3). Table 1 is based on the McKelvey classification, which subdivides resources in terms of their economic feasibility of extraction and geological certainty of occurrence. Economic demonstrated resources of petroleum are judged to be economically recoverable, their quantity and quality being assessed partly from specific measurements and partly by extrapolation for a reasonable distance on geological evidence; subeconomic demonstrated resources are similar in terms of certainty of occurrence but, although physically recoverable, are judged at present to be subeconomic.

TABLE 1. LOCATION AND MAGNITUDE OF AUSTRALIA'S DEMONSTRATED RECOVERABLE PETROLEUM RESOURCES, 30 JUNE 1987

Basin	Crude Oil ($\times 10^6 \text{ m}^3$)	Condensate ($\times 10^6 \text{ m}^3$)	LPG ($\times 10^6 \text{ m}^3$)	Sales Gas ($\times 10^9 \text{ m}^3$)
Economic Demonstrated Resources				
Amadeus & Bonaparte	11	5	11	73
Bowen/Surat	*	*	*	2
Carnarvon & Canning	21	85	27	477
Cooper/Eromanga	16	7	12	82
Gippsland	183	22	46	193
Otway	-	*	-	*
Perth	*	*	-	4
Total	231	118	97	832

Basin	Crude Oil ($\times 10^6 \text{ m}^3$)	Condensate ($\times 10^6 \text{ m}^3$)	LPG ($\times 10^6 \text{ m}^3$)	Sales Gas ($\times 10^9 \text{ m}^3$)
Subeconomic Demonstrated Resources				
Adavale	-	-	-	1
Amadeus	*	*	*	10
Bowen/Surat	-	*	*	5
Cooper/Eromanga	2	1	2	17
Gippsland, Bass	16	8	5	58
Perth, Carnarvon, Browse, Bonaparte	13	54	5	1316
Total	31	64	12	1406

* refers to volumes less than 1

Exploration Potential

BMR completed a comprehensive re-assessment of Australia's undiscovered crude oil and sales gas resources in 1986, and made an assessment of undiscovered condensate in 1987.

The oil assessment indicates an 80 percent chance of finding at least another $190 \times 10^6 \text{ m}^3$ (1200×10^6 barrels) of crude oil and a 20 percent chance of finding more than another $460 \times 10^6 \text{ m}^3$ (2900×10^6 barrels). The average of the estimate is $380 \times 10^6 \text{ m}^3$ (2400×10^6 barrels) of crude oil. The gas assessment indicates an 80 percent chance of finding at least another $400 \times 10^9 \text{ m}^3$ (14 TCF) of sales gas and a 20 percent chance of finding more than another $820 \times 10^9 \text{ m}^3$ (29 TCF). The average of the assessment is $650 \times 10^9 \text{ m}^3$ (23 TCF).

The condensate assessment indicates an 80 percent chance of finding at least another $60 \times 10^6 \text{ m}^3$ (380×10^6 barrels) of condensate and a 20 percent chance of finding more than another $110 \times 10^6 \text{ m}^3$ (700×10^6 barrels). The average of the assessment is $90 \times 10^6 \text{ m}^3$ (550×10^6 barrels).

The assessments refer to the oil and gas resources remaining to be discovered in Australia's Phanerozoic sedimentary rocks as at May 1986. They include the resources of all onshore and offshore areas, except for Australia's remote offshore territories.

Production

Commercial production of oil began in Australia in 1964, from the Moonie field in the Surat Basin (Fig. 1, Tables 2 and 3; see also Fig. 3). Production from Barrow Island (Carnarvon Basin) began in 1967, and from Bass Strait (Gippsland Basin) in 1969. The Gippsland Basin is the major source of petroleum liquids in Australia and with the completion of a liquids pipeline from Moomba to Stony Point in 1982 and the Jackson to Moonie pipeline in 1983, the Cooper/Eromanga Basin is presently the nation's second largest liquids producer.

Natural gas was first delivered to Brisbane, Melbourne, and Adelaide in 1969 from the Surat, Gippsland, and Cooper Basins respectively. In 1983 the Palm Valley field in the Amadeus Basin began supplying gas to the Alice Springs power station, and in 1984 North West Shelf gas reached the Perth market to supplement the gas from the Dongara field (Perth Basin) which first supplied gas to Perth in 1971. Since 1976 Sydney has received gas from the Moomba and adjoining fields (Cooper Basin). Other major centres, particularly in Victoria and New South Wales, have also been connected to gas supplies. A 1600 km gas pipeline from Palm Valley supplies gas to the Channel Island power station at Darwin, to Tennant Creek, and to Katherine.

In 1986-87, Australia's crude oil and condensate production was $31.5 \times 10^6 \text{ m}^3$ (198.2×10^6 barrels), corresponding to an average rate of about 86 000 m^3/d (540 000 bbls/d); this was 0.7 percent less than production for the previous year. Production from the Bass Strait fields decreased from 81 percent in the previous year to 78 percent of Australia's total production. This is mainly a reflection of the continuing depletion of the Kingfish and Halibut fields.

Australia's production of sales gas increased by 2.8 percent compared to the preceding year while the production of LPG decreased by 2.2 percent. Imports of crude oil and other refinery feedstock in 1986-87 were valued at \$1 004 million, 16 percent less than the value of imports in 1985-86.

TABLE 2. COMMERCIAL PRODUCTION OF PETROLEUM IN AUSTRALIA, 1986-87(a)

Basin	Crude Oil ($\times 10^6 \text{ m}^3$)(c)	Condensate ($\times 10^6 \text{ m}^3$)(c)	LPG ($\times 10^6 \text{ m}^3$)(c)	Natural Gas (b) ($\times 10^9 \text{ m}^3$)(c)
Amadeus	0.16	-	-	0.13
Bonaparte	0.77	-	-	-
Bowen/Surat	0.08	0.07	0.08	0.52
Canning	0.05	-	-	-
Carnarvon	1.62	0.50	-	2.95
Cooper/Eromanga	3.04	0.73	0.96	5.36
Gippsland	23.70	0.74	2.88	5.28
Perth	<u>0.01</u>	<u>-</u>	<u>-</u>	<u>0.43</u>
Total	29.43	2.04	3.92	14.67(d)

Source: Bureau of Resource Economics, Department of Resources & Energy.

(a) Fiscal year ending 30 June 1987. (b) Commercial sales plus field and plant usage. (c) $1 \text{ m}^3 = 6.29 \text{ barrels (liquids), } 35.315 \text{ ft}^3 \text{ (gas)}$. (d) Production of sales gas was $13.40 \times 10^9 \text{ m}^3$.

TABLE 3. CUMULATIVE COMMERCIAL PRODUCTION OF PETROLEUM
IN AUSTRALIA TO 30 JUNE 1987

Basin	Crude Oil ($\times 10^6 \text{ m}^3$)	Condensate ($\times 10^6 \text{ m}^3$)	LPG ($\times 10^6 \text{ m}^3$)	Natural Gas (a) ($\times 10^9 \text{ m}^3$)
Amadeus	0.43	-	-	0.19
Bonaparte	0.75	-	-	-
Bowen/Surat	3.99	0.32	0.17	6.10
Canning	0.20	-	-	-
Carnarvon	36.01	1.07	0.06	9.88
Cooper/Eromanga	9.92	3.37	5.12	48.85
Gippsland/Otway	356.80	10.03	43.14	68.63
Perth	<u>0.15</u>	<u>0.06</u>	<u>-</u>	<u>12.18</u>
Total	408.25	14.84	48.49	145.81

(a) Commercial sales plus field and plant usage.

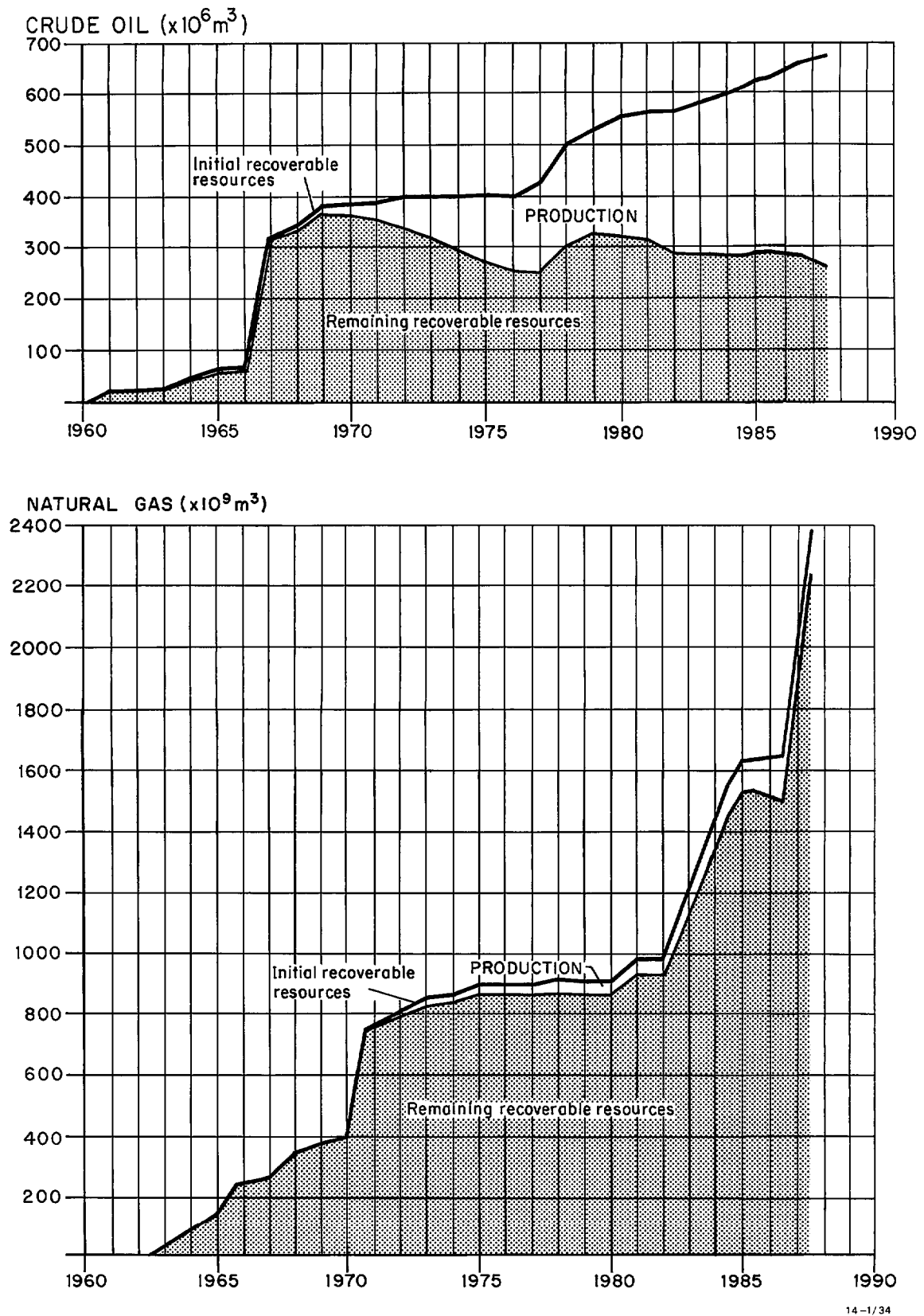


Fig.3 Australia's demonstrated recoverable resources of crude oil and natural gas. Remaining recoverable resources at 30 June 1987 were: crude oil 261 million m^3 ; (natural gas) sales gas 2238 billion m^3 .

SUMMARY OF PETROLEUM EXPLORATION IN 1987

Statistics relating to petroleum exploration and development activity in recent years are given in Table 4 and Figure 4. Discoveries of petroleum in 1987 are listed in Table 5.

Preliminary data indicate that about \$350 million were spent on exploration in 1987, compared with \$429 million in 1986 and \$774 million in 1985. A total of 282 wells were drilled in 1987 of which exploration drilling accounted for 226 wells. Of these exploration wells, 211 (93 percent) were onshore and 15 (7 percent) were offshore.

Onshore exploration drilling was concentrated in the Galilee/Cooper/Eromanga and Bowen/Surat Basins, in which 83 percent of the onshore exploration wells were drilled. Other onshore exploration wells were drilled in the Arckaringa (1 well), Canning (19 wells), Carnarvon (4 wells), Gunnedah (1 well), Murray (1 well), Officer (3 wells), Otway (11 wells), Pedirka (1 well) and Perth (2 wells) Basins. Onshore exploration drilling resulted in 21 oil discoveries, 19 gas discoveries, seven oil and gas discoveries, seven gas/condensate discoveries and four oil/gas/condensate discoveries. In addition, extensions to known fields in the Bowen/Surat, Canning, Cooper/Eromanga, Otway and Perth Basins were proved by appraisal drilling.

The Cooper/Eromanga Basins region continued to be the most active onshore exploration area in 1987 and included 35 of the 58 onshore petroleum discoveries. Other onshore petroleum discoveries were in the Bowen/Surat (17), Canning (2), Carnarvon (2) and Otway (2) Basins.

Offshore exploration drilling was undertaken in the Bonaparte (5 wells), Browse (1 well), Carnarvon (6 wells) and Gippsland (3 wells) Basins. Offshore exploration drilling resulted in one oil, one gas and one oil/gas/condensate discoveries. In addition extension/appraisal drilling was carried out in the Bonaparte, Carnarvon and Gippsland Basins at Challis, Skua, Saladin and Kipper fields. The appraisal drilling at the Challis field has further upgraded the commercial potential of the field and enhanced the prospectivity of the area. Appraisal drilling of the Skua oil field, located in the same general area, also indicated additional potentially recoverable oil. At the Saladin oil and gas field

in the Carnarvon Basin, appraisal drilling resulted in an oil flow at a stabilised rate of $1\,795\text{ m}^3/\text{d}$ (11 290 bbls/d), which is the largest oil flow recorded in Australia from an exploration well.

Further appraisal drilling at the Kipper field in the Gippsland Basin confirmed the gas accumulation discovered in 1986 and also indicated the presence of an oil accumulation below the gas column.

Preliminary figures for seismic survey activity in 1987 (Table 4) indicate that a total of 41 097 line kilometres was surveyed - 24 889 line km offshore and 16 208 line km onshore. These figures are 22 percent and 8 percent lower than in 1986 respectively.

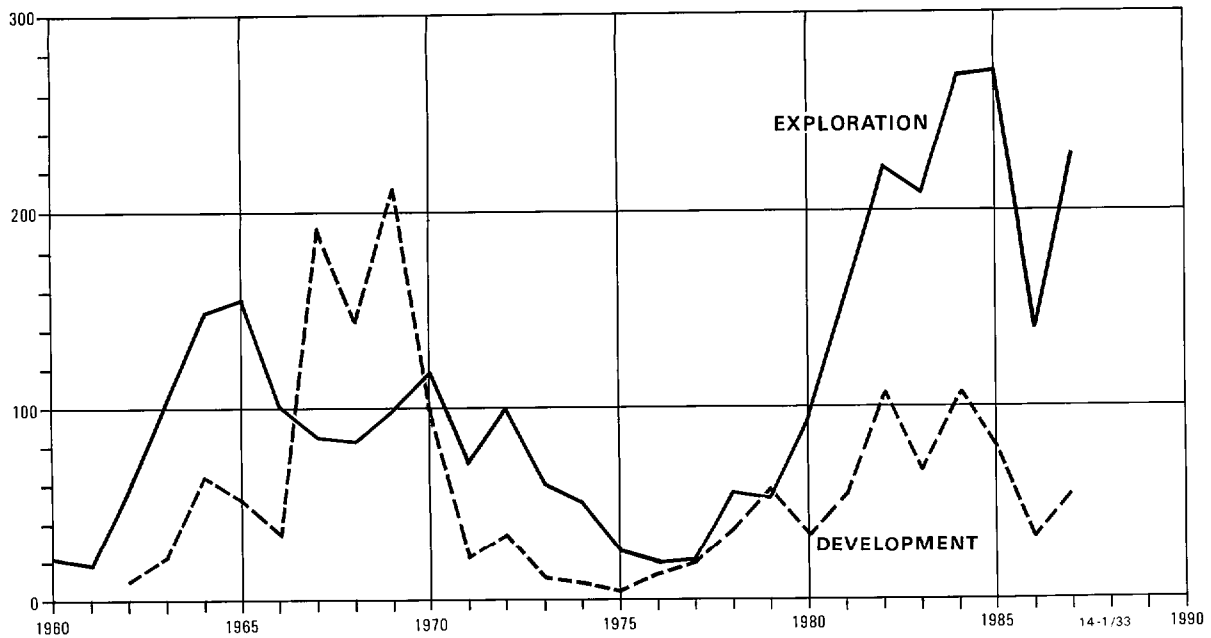
The total number of drilling rigs in Australia at the end of 1987 was 51, the same as at the end of 1986. The number of land rigs, including those used on offshore production platforms, decreased to 45 at the end of 1987. The number of offshore drilling vessels increased to six at the end of 1987, which was two more than at the end of 1986. The availability of onshore and offshore drilling rigs is not expected to be a factor limiting exploration drilling in 1988.

TABLE 4. PETROLEUM EXPLORATION AND DEVELOPMENT EXPENDITURE
AND ACTIVITY, 1976-87

Exploration expenditure (\$ million)		Development (including production) expenditure (\$ million)	Seismic surveys (line-km)	Exploration wells drilled	Development wells drilled
1976	49	94	94200	19	13
1977	82	114	11600	21	20
1978	112	216	44421	55	37
1979	222	236	41539	52	57
1980	290	358	55445	94	33
1981	458	944	74438	158	55
1982	957	1263	95253	221	108
1983	731	1022	38761	209	66
1984	748	734	61941	264	109
1985	784	1065	90169	270	94
1986	429	936	47353	139	37
1987(a)	350	750	41097	226	56

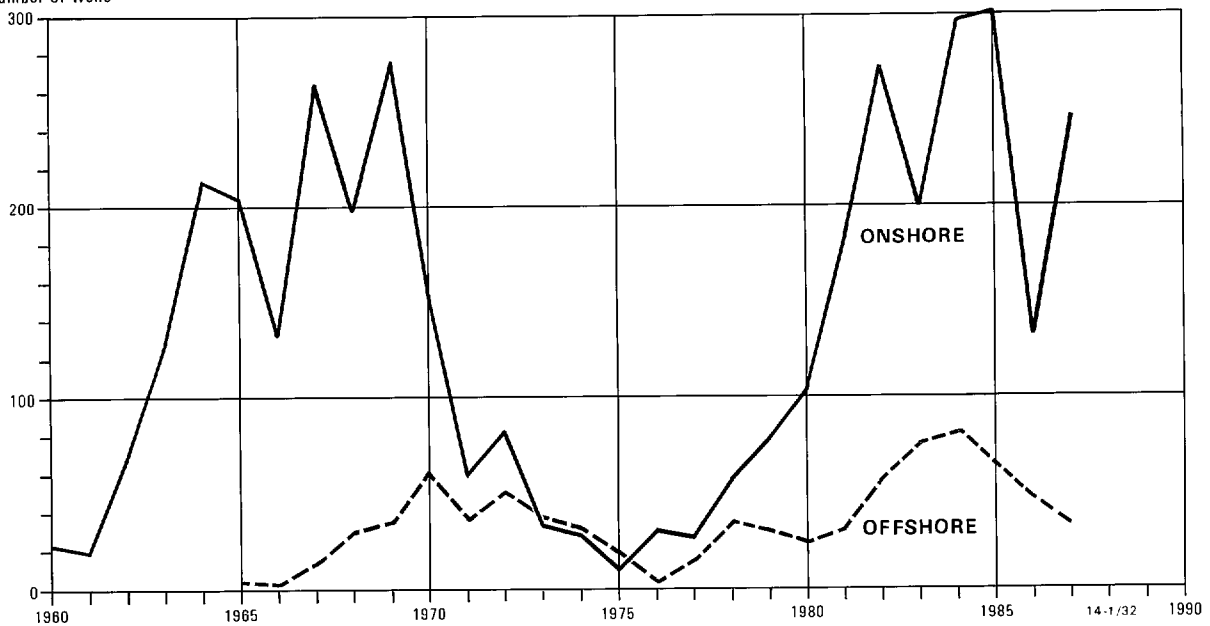
(a) Preliminary

Number of wells



Petroleum exploration and development wells drilled in Australia

Number of wells



Petroleum wells drilled onshore and offshore in Australia

Fig.4 Petroleum exploration and development, onshore and offshore wells drilled in Australia 1960-1987.

SUMMARY OF PETROLEUM DEVELOPMENT IN 1987

Development drilling activity was about 50 percent higher than the 1986 level. A total of 56 development wells were drilled, 36 onshore and 20 offshore. Development and production expenditure in 1987 is estimated to be about \$750 million.

A total of 36 onshore development wells were completed; one each in the Canning Basin and Bowen/Surat Basins and thirty-four in the Cooper/Eromanga Basins. Twenty offshore development wells were completed; one each at South Pepper, North Herald and North Rankin, three at Jabiru and seven each at Flounder and Snapper fields.

Queensland

An agreement has been signed by participants in the Blackall Ammonium Nitrate Joint Venture for the construction of a \$40 million ammonium nitrate plant near Blackall in central Queensland. The plant is expected to be operational by early 1989 and involves the construction of ammonia, nitric acid and ammonium nitrate production facilities. A 140 km gas pipeline from the Gilmore gas field in the Adavale Basin will supply both the energy source and raw material to produce 80 000 tonnes of ammonium nitrate per annum.

The Queensland Government awarded major contract work for project management and pipeline engineering for major work associated with the planned State gas pipeline project. The proposed project will connect Queensland Alumina Limited's refinery at Gladstone with the Denison Trough gas fields via a 560 km, 250 mm pipeline. A second stage to link the Denison Trough to the Surat Basin fields and to the Roma-Brisbane pipeline, also has been proposed.

Plans were announced to duplicate sections of the Roma-Brisbane natural gas pipeline. It is proposed to construct seven looped sections at 54 km intervals for a total looped length covering 71 km, about one-sixth of the total length of the pipeline. It is expected that the looped sections will increase the capacity of the line by about 10 percent and also increase the ability of the six compressor stations along the pipeline to deliver additional throughput. The first stage (section) is expected to be completed by mid-1988.

Victoria

The Bream oil and gas production platform jacket was installed in about 60 m of water in July. The platform will have provision for 27 wells. The 32 km pipeline linking the Bream platform to the West Kingfish platform has been completed, and the first oil is scheduled to be produced in March 1988. Bream is the thirteenth platform established in Bass Strait; the field has estimated reserves of 35 million barrels. Other fields in the area are currently being evaluated for development; by the end of the year plans were announced for the development of the small Whiting, Tarwhine and Seahorse oil fields at a cost of \$A238 million. The Whiting field will feature a five-well unmanned mini-platform located in about 53 m of water about midway between the Barracouta and Snapper fields. Oil will be pumped to the Snapper platform for processing before being pumped to shore. The Tarwhine and Seahorse fields will be developed with remote controlled sub-sea well heads that will be linked by pipelines to the Barracouta platform. Production is expected to begin in 1990 at a rate of 8 500 bbls/d.

South Australia

An enhanced oil recovery project commenced at the Tirrawarra and Moorari fields in the Cooper Basin using ethane as the miscible fluid. Construction of a 43 km pipeline linking the Bookabourdie and Bimbaya fields to Tirrawarra at a cost of \$22 million has commenced.

Western Australia

Construction continued for the second phase of the North West Shelf gas project planned to supply liquefied natural gas (LNG) to Japan by October 1989. When completed the LNG phase will cost approximately \$A9 800 million, and a further \$5 000 million will be spent on the construction of seven LNG tankers and LNG handling facilities in Japan. LNG production will peak at 6.0 million tonnes/year in 1995 and supply gas at least until 2009. A second offshore production platform is to be installed on the Goodwyn field to supplement production at the North Rankin 'A' platform. As a result of further testing and appraisal drilling at the North Rankin and Goodwyn fields the Joint Venture partners have confirmed condensate reserves of about $55.5 \times 10^6 \text{ m}^3$.

Development drilling has commenced at North Herald and South Pepper oil fields south of Barrow Island. It is planned to bring these fields on stream with five wells utilising one sub-sea completion and two small steel platforms to support the well heads. The operator has estimated oil reserves to be about $0.6 \times 10^6 \text{ m}^3$ to $1.0 \times 10^6 \text{ m}^3$ (4 to 6 million barrels) in each field and expect the fields to produce oil at a rate of about $1\,300 \text{ m}^3/\text{d}$ (8 000 bbls/d). Plans were announced to develop the Saladin oil field, also near Barrow Island. Four small platforms will supply crude oil to production facilities on nearby Thevenard Island. Recoverable oil reserves of about $3.2 \times 10^6 \text{ m}^3$ (20 million barrels) and a predicted peak production rate of $4\,800 \text{ m}^3/\text{d}$ (30 000 bbls/d) for at least six years have been estimated by the operator.

Northern Territory

A second well on the Jabiru oil field commenced production in August bringing total daily production from the field to a rate of about $4\,600 \text{ m}^3/\text{d}$ (29 000 bbls/d). Current plans are to bring on stream two more wells following successful appraisal drilling. Reserves in the field were estimated by the operator to be at least $4.0 \times 10^6 \text{ m}^3$ (25 million barrels). The Challis oil field, south of the Jabiru field in the Timor Sea, is to be developed at a cost of \$170 million. Production is expected to start in late 1989; well heads on the sea bed will be connected to a moored production/storage barge and a vessel with production and processing facilities accommodated on deck.

Following the completion of the 1 600 km gas pipeline from the Amadeus Basin to Darwin, plans have been made for the construction of a gas separation plant at Darwin. By the end of 1988 the plant will produce liquefied petroleum gas and provide Australia's only source of helium. Negotiations with overseas clients for the supply of LNG from the Bonaparte Gulf oil and gas fields are continuing.

MAJOR ACTIVITIES IN 1987

Onshore Basins

Arckaringa/Eromanga Basin (SA)

Hanns Knob No. 1 was plugged and abandoned early in the year without encountering significant hydrocarbons. It was the final well in Delhi's drilling program in the basin.

Bowen/Surat Basins (Qld, NSW)

There was a significant increase in drilling activity in the basins; particularly in the third quarter of the year when 28 wells were drilled. Fifty-two of the 65 wells drilled were new field wildcats. Most of the 14 successful wildcats found gas pools; several small discoveries were not completed for future production. Discoveries were primarily in the Lower Jurassic and Triassic formations that are currently producing oil and gas in the basins. The gas potential of the Upper Permian Blackwater Group has been demonstrated in the Kungarri and Yuranigh fields.

Activity continues to be concentrated mainly in Queensland along the western flank of the Taroom Trough, and in the overlying northern Surat Basin. Only one small discovery was made on the eastern flank of the Taroom Trough in 1987. Wells drilled in the less densely explored parts of the basins were unsuccessful in the search for hydrocarbons.

The two wells, Chester No. 1 and Collyblue No. 1, drilled in New South Wales, were plugged and abandoned without hydrocarbon shows.

Appraisal drilling in the Merroombil and Taylor fields was also unsuccessful.

The first of three holes planned to test the feasibility of recovering methane from coal beds in the northern Bowen Basin, has been completed: Broadmeadows No. 1, recovered methane and fractured coal from a DST.

Canning Basin (WA)

Fifteen new field wildcat wells were drilled, of which Lloyd No. 1 was an oil discovery. Janpam North No. 1, drilled 10 km northwest of the Blina oil field, was suspended for further evaluation after a DST recovered oil from Devonian carbonates. All other wells were plugged and abandoned.

Lloyd No. 1 drilled 4 km north of the West Terrace oil discovery, produced 40.4° API oil at a maximum rate of 62.3 m³/d (392 bbls/d) on DST from the Carboniferous Anderson Formation. This was the first recovery of oil from this formation in the basin. Long term production testing of the well is in progress.

Four extension/appraisal wells were drilled. West Terrace No. 2 was perforated in the Middle Grant Formation and produced oil at 7.9 m³/d (50 bbls/d) on test. Lloyd No. 2 encountered minor hydrocarbons and was plugged and abandoned. Dodonea No. 2 and Blina No. 7 were also plugged and abandoned.

Carnarvon Basin (WA)

Three new field wildcat wells, Sharon No. 1, Parrot Hill No. 1 and Rosette No. 1 were drilled. Sharon No. 1, drilled on the Peedamullah Shelf, flowed gas from the Mardie Greensand Formation at a rate too small to be measured. The well has been suspended for further evaluation. Parrot Hill No. 1, located 4 km southwest of Rough Range No. 1, was suspended for further evaluation after encountering a thin oil zone within the basal Muderong Shale and top Birdrong Sandstone. Rosette No. 1 was drilled as a deviated well from Varanus Island to test an offshore closure near the Harriet oil field. Oil at a maximum rate of 27 m³/d (170 bbls/d), gas at a rate of 520 000 m³/d (18 million ft³/d) and condensate at a rate of 82.3 m³/d (518 bbls/d) were recovered from the top Barrow Group. The well has been suspended for further evaluation.

Rough Range No. 1 drilled in 1954 and shut-in as an uneconomic oil discovery, was re-entered during 1987 and logged using modern tools. The well has been suspended for evaluation.

Cooper/Eromanga Basins (Qld, SA)

Exploration activity remained high but the number of wildcat wells

decreased while appraisal and development drilling increased. Fifty-seven of the 126 wells drilled were wildcats. Most of the gas and gas/condensate discoveries were made in the Cooper Basin sedimentary sequence and most of the oil discoveries were in the Eromanga Basin sequence. Several wells discovered multiple pools but not all zones were completed for future production. Several new pools were found in previously discovered fields.

Drilling was concentrated in the southern half of the Cooper Basin and overlying Eromanga Basin, close to previous discoveries or producing fields.

Cuddapan No. 1 made a minor oil discovery in the Cadna-Owie Formation, and demonstrated oil potential in the Eromanga Basin sediments above the northwestern part of the Cooper Basin. A new pool oil discovery in Naccowlah South No. 10 is the first oil discovery in the Toolachee Formation in this field. The discovery upgrades the potential of the eastern end of the field. The oil recovered from the Toolachee and Patchawarra Formations in Challum No. 4 provides strong support for the presence of oil legs below the gas pools in these formations.

Eromanga Basin (Qld, SA, NT, NSW)

Four exploration wells drilled in the Eromanga Basin outside that part covering the Cooper and Galilee Basins were plugged and abandoned after failing to find significant hydrocarbons. Rangoon No. 1 and Pint Pot No. 1 were drilled on the Maneroo Platform north of the Cooper Basin, and Cacoory No. 1 and Carella Creek North No. 1 were sited west of the Cooper Basin in Queensland. The Queensland Department of Mines (QDM) continued its stratigraphic drilling program completing three wells west of the Northern Cooper Basin. QDM also drilled a fourth well on the Thargomindah Shelf south of the Cooper Basin to investigate Jurassic and Cretaceous channelling in the Eromanga Basin.

Galilee/Eromanga Basins (Qld)

Three wells were drilled into the southern Galilee Basin to test the Eromanga and Galilee Basin sequences where they overlies the Adavale Basin. All were plugged and abandoned without discovering hydrocarbons. No significant hydrocarbons were reported in Elvo No. 1, which was drilled in the Lovelle Depression in the northern Galilee Basin.

Gunnedah Basin (NSW)

Nyora No. 1, an exploration well drilled as a follow-up to the Wilga Park gas discovery, was plugged and abandoned without reporting any hydrocarbon shows.

Murray Basin (NSW, SA, Vic)

Cooltong No. 1, drilled in the Renmark Trough in the western part of the basin, was plugged and abandoned in the Devonian without finding hydrocarbons.

Officer Basin (SA,WA)

Three exploration wells were drilled in the eastern part of the basin: the wells were fully cored. Of these, Karrlaya No. 1 reported minor oil shows, but the reservoir proved to be too tight for testing.

Otway Basin (Vic, SA)

Eleven exploration wells were drilled in the Otway Basin. In the Tyrendarra Embayment, Windermere No. 1 discovered oil in the Heathfield Sandstone within the Early Cretaceous Eumeralla Formation, and was suspended for further testing. In the Port Campbell Embayment, oil shows were reported in the Early Cretaceous Pretty Hill Sandstone Formation in Tirrengowa No. 1 which was plugged and abandoned. Most activity was in the Gambier Embayment, where seven wells were drilled. Hydrocarbon shows were recorded in Camelback No. 1 (SA), Henke No. 1 (Vic), and Wilson No. 1 (Vic), but in the other four wells, Fahley No. 2 (Vic), Killarney No. 1 (SA), McNamara No. 1 (SA), and Squatter No. 1 (Vic), there were no indications of hydrocarbons. Katnook No. 1, drilled in the Penola Trough in South Australia, discovered gas in the Eumeralla Formation (?). The well flowed gas at a rate of $110\,435\text{ m}^3/\text{d}$ (3.9 million ft^3).

Pedirka Basin (SA, NT)

Mt Hammersley No. 1 was drilled late in the year: it is the first well drilled in the basin in two years. The well was plugged and abandoned without finding hydrocarbons.

Perth Basin (WA)

Two wells were drilled in the northern part of the Perth Basin. Mt Horner West No. 1, drilled as a new field wildcat 4.5 km west of the Mt Horner oil field, did not encounter any hydrocarbons and was plugged and abandoned. Mt Horner No. 7 was drilled as an extension/appraisal well, 400 m northeast of Mt Horner No. 5. A DST of part of the Jurassic Cockleshell Gully Formation flowed 6.4 m^3 (40 bbls) of 34.5° API oil over a two and one half hour period. The well has been suspended for further evaluation.

TABLE 5. DISCOVERIES OF PETROLEUM IN 1987 (a)

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS
ONSHORE							
Bowen/Surat	Borah Creek No. 5	Hartogen	Qld	Oil	Basal Wandoan Fm	NPD	Recovered 27 m ³ of oil. Completed only for oil in the basal Wandoan.
	Burgoyne No. 1	CSR	Qld	Gas	Precipice Ss	NFD	DST flowed 2 266 m ³ /d gas. P & A.
	Caneon No. 1	CSR	Qld	Gas	Precipice Ss	NFD	Completed only in Precipice Ss.
				Gas	Evergreen Fm	NFD(b)	Flowed 7 928.8 m ³ /d.
	Cockatoo No. 1	Sydney Oil	Qld	Oil	Showgrounds Ss	NFD	Recovered 2 1 of oil. P & A.
	Harbour No. 1	Sydney Oil	Qld	Oil	Showgrounds Ss	NFD	Suspended. DST recovered 1.32 m ³ oil.
	Kanaloo No. 1	Hartogen	Qld	Gas	Evergreen Fm	NFD	Cased & suspended.
	Kungarri No. 1	Hartogen	Qld	Gas	Blackwater Gp	NFD	Cased & suspended.
	McWhirter East No. 1	Sydney Oil	Qld	Oil	Showgrounds Ss	NFD	Cased & suspended.

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS
Bowen/Surat (Cont.)	Merroombil No. 1	Bridge	Qld	Gas/Cond	Showgrounds Ss	NFD	Cased & suspended for gas/cond. production.
	Mindagabie No. 1	Sydney Oil	Qld	Oil	Evergreen Fm	NFD	Cased & suspended as a possible future producer.
	North Colgoon No. 1	Hartogen	Qld	Gas	Basal Evergreen Fm	NFD	Cased & suspended as a possible future producer.
	Rednook No. 1	Crusader	Qld	Gas/Cond	Showgrounds Ss	NFD	Completed for gas only in the Showgrounds Ss.
				Oil/Gas	Rewan Fm	NFD(b)	Flowed 9 300 m ³ gas. Recovered 0.16 m ³ oil.
	Wingnut No. 1	CSR	Qld	Gas	Precipice Ss	NFD	Completed in Precipice Ss and Showgrounds Ss.
				Gas	Showgrounds Ss	NFD	
	Winnathoola No. 2	CSR	Qld	Gas	Moolayember Fm	NFD(b)	DST flowed 849.5 m ³ /d.
					Rewan Fm	NPD	DST flowed 2 266 m ³ /d. P & A.
	Yarrabend No. 5	Bridge	Qld	Gas	Wandoan Ss	NPD(b)	DST flowed ₃ 11 326.8 m ³ /d. Well completed in Evergreen Fm.

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS
Bowen/Surat (Cont.)	Yellowbank Creek North No. 1	Sydney Oil	Qld	Oil	Showgrounds Ss	NFD	Flowed 1.7 m ³ /d. To be completed.
	Yuranigh No. 1	Hartogen	Qld	Gas	Blackwater Gp	NFD	Flowed 183 000 m ³ /d from DST. Cased & suspended for future completion.
	Janpam North No. 1	Home Energy	WA	Oil	Gumhole Fm	NFD	DST recovered oil. Suspended for further evaluation.
	Lloyd No. 1	Home Energy	WA	Oil	Anderson Fm	NFD	Flowed 62.3 m ³ /d. Testing for production.
Carnarvon	Parrot Hill No. 1	Ampol	WA	Oil	Birdrong Ss	NFD	Recovered 0.79 m ³ on DST. Suspended for further evalu- ation.
	Rosette No. 1	Bond	WA	Oil/Gas Cond	Barrow Gp	NFD	Suspended for further evaluation

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS
Cooper/Eromanga	Balcaminga No. 1	Santos	SA	Gas	Tirrawarra Ss	NFD	DST flowed 15 700 m ³ /d. Cased & suspended.
	Bungee No. 1	Santos	SA	Gas	Patchawarra Fm	NFD	DSTs flowed 90 600 & 11 600 m ³ /d. Cased & suspended.
	Challum No. 4	Delhi	Qld	Oil/Gas	Patchawarra Fm	NPD	Recovered 1.5 m oil. Well completed for gas in Patchawarra & Toolachee Fms.
	Chookoo No. 6	Delhi	Qld	Oil/gas	Basal Jurassic	NPD	DSTs flowed 223 000 & 125 000 m ³ /d gas, 39 m ³ /d oil from basal Jurassic and 22 m ³ /d condensate from Hutton Ss. Cased & suspended as a future oil/gas producer in both the basal Jurassic & the Hutton Ss.
	Cowralli No. 2	Santos	SA	Gas	Patchawarra Fm	NPD	DSTs flowed 47 000 & 45 300 m ³ /d. Cased & suspended.
	Cranston No. 1	Hartogen	Qld	Oil	Birkhead Fm	NFD	DST recovered 51.2 m ³ /d. Cased & suspended.

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS
Cooper/Eromanga (cont.)							
	Cuddapan No. 1	Delhi	Qld	Oil	Cadna-Owie Fm	NFD	DST recovered 79 m of oil. P & A.
	Deina No. 1	Santos	SA	Gas/Cond	Patchawarra Fm	NFD	DST flowed 201 000 m ³ /d gas & 35 m ³ /d conden- sate. Cased & Sus- pended as a future gas/condensate producer.
	Dieri No. 1	Delhi	SA	Gas	Patchawarra Fm	NFD	DST flowed 28 000 m ³ /d. P & A.
	Dingera No. 1	Delhi	Qld	Gas	Toolachee Fm	NFD	Completed only as gas well in Toolachee Fm.
				Oil	Westbourne Fm	NFD(b)	DST recovered 927 m oil.
				Oil	Birkhead Fm	NFD(b)	DST recovered 0.6 m oil.
	Gidgealpa No. 27	Delhi	SA	Oil/Gas	Poolowanna Fm	NPD	DST flowed 198 m ³ /d oil & 793 m ³ /d gas. Completed as a Poolowanna oil well.

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS
Cooper/Eromanga (Cont.)							
	Jackson South No. 7	Delhi	Qld	Oil	Hutton Ss	NPD	Cased & suspended.
	Judga No. 1	Delhi	Qld	Gas/Cond	Patchawarra Fm	NFD	DST flowed 203 800 m ³ /d gas, 60 m ³ /d condensate.
				Gas/Cond	Toolachee Fm	NFD	DST flowed 7 900 m ³ /d gas & 5 m ³ /d condensate. Cased & suspended for completion as a Patchawarra/Toolachee gas/condensate producer.
	Karmona East No. 2	Delhi	Qld	Gas	Patchawarra Fm	NPD	DST flowed at a maximum rate of 79 000 m ³ /d. Cased & suspended as a future producer in the Patchawarra & the Toolachee Fms.
	Karri No. 1	Delhi	Qld	Gas/Cond	Patchawarra Fm	NFD	DST flowed 290 000 m ³ /d.
				Oil	Basal Jurassic	NFD	DST recovered 971 m oil. Cased & suspended for oil & gas production

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS
Cooper/Eromanga (Cont.)							
	Keena No. 1	Delhi	SA	Gas	Toolachee Fm	NFD	DST flowed 79 300 m ³ /d. Cased & suspended.
	Kerna No. 1	Delhi	SA	Gas/Cond	Epsilon Fm	NPD	DST-1 flowed 237 900 m ³ /d gas. DST-2 flowed 235 000 m ³ /d gas & 4 m ³ /d condensate. Cased & suspended only as a future gas producer.
	Kurunda No. 1	Delhi	SA	Gas/Cond	Patchawarra Fm	NFD	DST flowed 45 307 m ^{3a} /d gas.
				Gas/Cond	Tirrawarra Ss	NFD	Completed for gas only in Patchawarra Fm & Tirrawarra Ss.
				Gas	Toolachee Fm	NFD (b)	
	Lake MacMillan No. 1	Delhi	SA	Gas/Cond	Toolachee Fm	NFD	DST flowed 147 000 m ³ /d gas & 87.3 m ³ /d condensate.
				Gas	Patchawarra Fm	NFD	Cased & suspended for production from Toolachee and Patchawarra Fms.

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS
Cooper/Eromanga (Cont.)							
	Marengo No. 1	Delhi	Qld	Gas	Toolachee Fm	NFD	Completed for gas only in Toolachee Fm.
				Oil	Adori Ss	NFD(b)	DST recovered small quantity of oil.
	Mawson No. 1	Delhi	SA	Oil	Poolowanna Fm	NFD	Completed for oil in Poolowanna Fm.
				Gas/Cond	Patchawarra Fm	NFD(b)	DST flowed 167 000 m ³ /d and 65 m ³ /d condensate & 28 600 m ³ /d gas & a small quantity of condensate respectively from two Patchawarra Fm sands.
				Gas/Cond	Tirrawarra Ss	NFD(b)	DST flowed 184 600 m ³ /d gas and recovered 61.6 m of condensate.
	Maxwell No. 1	Pancontinental	Qld	Oil	Murta Mbr	NFD	DST flowed 4 m ³ oil. Cased & suspended.
	Monler No. 1	Hartogen	Qld	Oil	Westbourne Fm	NFD	DST flowed 47.4 m ³ /d Cased & suspended.

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS
Cooper/Eromanga (Cont.)							
	Mooliampah West No. 1	Delhi	Qld	Oil Oil	Birkhead Fm Murta Mbr	NFD NFD	Recovered 15 m oil from Birkhead Fm & 6 m muddy oil from Murta Mbr. P & A.
	Mugginanullah	Hartogen	Qld	Oil	Murta Mbr	NFD	Recovered 0.3 m ³ oil. P & A.
	Naccowlah South No. 10	Delhi	Qld	Oil	Toolachee Fm	NPD	Completed for production. First Permian oil in field.
	Pelican No. 1	Santos	SA	Oil	Namur Ss	NFD	DST flowed 108 m ³ /d.
				Gas	Tirrawarra Ss	NFD	DST flowed 76 500 m ³ /d.
				Gas	Patchawarra Fm	NFD	DST flowed 65 000 m ³ /d. Cased & sus- pended as oil & gas producer.
	Pintari North No. 1	Santos	SA	Oil	Namur Ss	NFD	DST flowed 114.5 m ³ /d. Cased & suspended.
	Pirraminta No. 1	Santos	SA	Gas	Nappamerri Fm	NFD	DST flowed 20 000 m ³ /d. Cased & suspended.

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS	
Cooper/Eromanga								
(Cont)	Taylor South No. 1	Santos		Gas/Cond	Gas/Cond	Tirrawarra Ss	NFD	DST flowed 184 000 m ³ /d gas & 10.5 m ³ /d condensate. Sus- pended for gas/ condensate production.
	Tickalara No. 3	Delhi	Qld	Oil	Murta Mbr		NPD	Flowed oil and recovered 1149 m oil in the drill string.
				Oil	Adori Ss		NPD	DST flowed 215 m ³ /d. Cased & suspended for oil production.
	Toby No. 1	Delhi	Qld	Oil	Cadna-Owie Fm		NFD	DST recovered 652 m.
				Oil	Hutton Ss		NFD	DST recovered 943 m.
				Oil	Basal Jurassic		NFD	DST recovered 1320 m.
				Gas	Patchawarra Fm		NFD	DST flowed 19 250 m ³ /d gas. Cased & sus- pended for oil & gas production.
	Toolachee No. 39	Santos	SA	Gas	Patchawarra Fm		NPD	DSTs flowed 11 900 & 17 000 m ³ /d Cased & suspended.

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS
Cooper/Eromanga (Cont)	Ufouria No. 1	Command	Qld	Oil	Murta Mbr	NFD	Recovered 0.2 m ³ . P & A.
	Waukatanna No. 1	Santos	SA	Gas	Patchawarra Fm	NFD	DSTs flowed 90 624 & 3 965 m ³ /d. Cased & suspended.
Otway	Katnook No. 1	Ultramar	SA	Gas	Eumeralla Fm(?)	NFD	Flowed 110 435 m ³ /d. Cased & suspended.
	Windermere No. 1	Minora	Vic	Oil	Heathfield Ss	NFD	Recovered 3.3 m ³ . Cased & suspended.

BASIN	WELL NAME	OPERATOR	STATE	NATURE OF DISCOVERY	PRODUCING FORMATION	CLASSI- FICATION	REMARKS
OFFSHORE							
Gippsland	Kipper No. 2	Esso	Vic	Oil	Latrobe Gp	NPD	Oil leg discovered below gas column found in Kipper No. 1. P & A.
	Patricia No. 1	Lasmo	Vic	Gas	Latrobe Gp	NFD	Flowed gas at 680 000 m ³ /d. Cased & suspended.
	Remora No. 1	Esso	Vic	Oil/Gas/ Cond.	Latrobe Gp	NFD	RFTs recovered small quantities of oil, gas & condensate. P & A.

(a) Preliminary, subject to revision.

(b) Not completed for production in formation shown.

Note: A discovery is defined here as a well from which any measureable amount of oil or gas has been recovered; no consideration of commerciality is implied. In previous years some discoveries which recovered only small amounts of hydrocarbons were not included in this table.

Offshore Basins

Bonaparte/Browse Basins (WA,NT)

Four new field wildcat wells, Asterias No. 1, Drake No. 1, Snowmass No. 1 and Gryphaea No. 1 were drilled. Apart from minor shows in Snowmass No. 1, no hydrocarbons were encountered and all four wells were plugged and abandoned. Oliver No. 1 spudded in November and was still drilling at the end of the year.

One extension/appraisal well was drilled in each of the Challis and Skua oil fields. Three development wells, one of which was a redrill, were completed in the Jabiru oil field.

Carnarvon Basin (WA)

Three new field wildcat wells, Glennie No. 1, Somerville No. 1 and Kybra No. 1 were plugged and abandoned without encountering any significant hydrocarbons. Glennie No. 1 was drilled as an offshore well within inland waters.

Saladin No. 3 was completed as a successful extension/appraisal well in the Saladin oil field. Testing of the well produced an Australian record oil flow of 1 795 m³/d (11 290 bbls/d) from the top Barrow Group.

Three development wells, North Herald No. 3, South Pepper No. 5 and North Rankin A13, were completed. North Herald No. 3 was drilled as a deviated hole with horizontal completion through the Barrow Group pay section. The well flowed an estimated 1 192 m³/d (7 500 bbls/d) through a 1" choke on production test. North Rankin A13 was the last of a series of gas development wells to be drilled from the North Rankin A platform.

Although Saladin No. 3, North Herald No. 3, South Pepper No. 5 and Glennie No. 1 were drilled in offshore waters, these wells are located in onshore permits which are administered under the Western Australian Petroleum Act, 1967.

Two extension/appraisal wells were drilled in the Talisman oil field: both wells failed to encounter hydrocarbons and were plugged and abandoned.

Gippsland Basin (Vic, Tas)

Three exploration wells were drilled in the northern part of the Gippsland Basin. Kipper No. 2 was a successful appraisal of the gas accumulation discovered by Kipper No. 1 in 1986, and it also encountered an oil accumulation below the gas column. Patricia No. 1 was suspended for future gas production after discovering recoverable reserves estimated by the operator to be $3.4 \times 10^9 \text{ m}^3$. The best flow obtained during production testing was a rate of $680\,000 \text{ m}^3/\text{d}$. In Remora No. 1, oil, gas and condensate were recovered from formation tests, but no production tests were carried out.

Development drilling continued from the Flounder and Snapper platforms. Seven wells were drilled in each field. Six of the Snapper wells were redrills: development drilling has now been completed on that platform.

APPENDIX 1
WELLS AND METRES DRILLED - AUSTRALIA 1971-87
WELLS DRILLED

Year	Exploration			Development			Totals	
	Onshore	Offshore	Sub-total	Onshore	Offshore	Sub-total	For Year	Cumulative
To 1971	1 450	105	1 555	772	77	849	-	2 404
1972	62	38	100	21	12	33	133	2 537
1973	29	31	60	5	6	11	71	2 608
1974	20	31	51	8	-	8	59	2 667
1975	6	19	25	4	-	4	29	2 696
1976	16	3	19	13	-	13	32	2 728
1977	8	13	21	18	2	20	41	2 769
1978	33	22	55	24	13	37	92	2 861
1979	31	21	52	48	9	57	109	2 970
1980	77	17	94	26	7	33	127	3 097
1981	142	16	158	41	14	55	213	3 310
1982	177	44	221	95	13	108	329	3 639
1983	160	49	209	40	26	66	275	3 914
1984	221	43	264	71	38	109	373	4 287
1985	227	43	270	76	18	94	364	4 651
1986	111	28	139	17	20	37	176	4 827
1987*	211	15	226	36	20	56	282	5 109

* Preliminary figures subject to revision

AUSTRALIA - METRES DRILLED - HISTORICAL

Year	Exploration		Development		Yearly	Cumulative
	Onshore	Offshore	Onshore	Offshore		
Year	Onshore	Offshore	Onshore	Offshore	Yearly	Cumulative
To 1971	1 903 594	332 854	786 015	195 107	-	3 217 570
1972	107 002	117 429	47 365	23 643	295 439	3 513 009
1973	50 301	80 616	11 347	9 644	151 908	3 664 917
1974	37 206	84 078	15 531	-	136 815	3 801 732
1975	12 579	35 658	10 351	-	58 588	3 860 320
1976	32 393	15 119	24 863	-	72 375	3 932 695
1977	23 675	36 827	44 508	6 419	111 429	4 044 124
1978	52 709	56 900	56 332	42 493	208 434	4 252 558
1979	59 635	76 424	44 110	36 612	216 781	4 469 339
1980	137 296	62 012	41 337	27 142	267 787	4 737 126
1981	277 258	45 126	77 602	34 473	434 459	5 171 585
1982	324 288	128 213	154 030	28 379	634 910	5 806 495
1983	273 571	137 472	82 019	86 425	579 487	6 385 982
1984	403 329	113 486	147 294	137 645	801 754	7 187 736
1985	406 967	105 145	125 190	59 816	697 118	7 884 854
1986	204 107	62 093	27 926	65 211	359 337	8 244 191
1987*	403 116	39 828	73 601	55 212	571 757	8 815 948

* Preliminary figures subject to revision

APPENDIX 2

EVENTS IN PETROLEUM EXPLORATION, DEVELOPMENT AND PRODUCTION IN AUSTRALIA

- 1839 Commander Stokes discovers "bitumen", Victoria River NT.
- 1885 Gas discovered in Narrabeen Nos 1 and 2 during search for coal in Sydney Basin, NSW.
- 1892 First exploration drilling for petroleum: Alfred Flat, Coorong area, SA.
- 1900 Roma (Qld) No. 2 town water bore encounters natural gas.
- 1907 First gas appraisal well in Roma, Qld, caught fire in 1908 and extinguished with difficulty.
- 1908 Roma streets lit by gas for 10 days.
- 1920 Rewards offered by the Commonwealth and New South Wales Governments for the discovery of petroleum in commercial quantities.
- 1924 Lakes Entrance oil field discovered (Vic).
- 1926 Petroleum exploration subsidised by the Commonwealth Government for the first time, under the Petroleum Prospecting Act of 1926.
- 1928 Condensate produced commercially in small quantities at Roma.
- 1930 Shafts sunk at Lakes Entrance (Vic) to mine heavy oil
- 1936 Petroleum exploration subsidised by the Commonwealth Government under the Petroleum Oil Search Act of 1936.
- 1953 Rough Range No. 1 (WA) flows oil 550 barrels per day.
- 1954 AAO finds gas in the Hospital Hill field, Roma, Qld.
- 1956 BMR aeromagnetic program in Bass Strait indicates existence of sedimentary basin offshore Gippsland (Vic).

- 1957 Commonwealth Government introduces Petroleum Search Subsidy scheme.
- 1958 BMR seismic survey indicates possible drilling targets at Cabawin and Moonie, Qld.
- 1959 Frome-Broken-Hill's Port Campbell No. 1 (Vic) produces strong gas flow on test.
- 1960 Associated Group discovers Timbury Hills and Pickanjinnee gas fields near Roma, Qld.
- 1961 Cabawin No. 1 (Qld), drilled by Union-AOG, discovers significant gas and condensate. Moonie No. 1 (Qld) discovers oil. First sustained commercial use of natural gas in Australia at Roma from Hospital Hill and Timbury Hills gas fields.
- 1963 Associated Group discovers the Richmond oil and gas field near Roma.
- 1964 First offshore well in Australia, Esso Gippsland Shelf No. 1 (later renamed Barracouta No. 1) discovers gas drilling in 46 m of water offshore Victoria (Bass Strait). Santos's Gidgealpa No. 2 discovers gas in the Cooper Basin, SA. Wapet's Barrow Island No. 1 (WA) and Yardarino No. 1 (Perth Basin, WA) discover oil. Mereenie No. 1 (NT) discovers oil and gas. Moonie oil field starts commercial production.
- 1965 Palm Valley No. 1 (NT) discovers gas. Gingin No. 1 (WA) discovers gas.
- 1966 Delhi-Santos discovers the Moomba gas field in Cooper Basin (SA) and Esso/BHP discovers the Marlin gas field offshore Victoria. Dongara No. 1 (WA) discovers gas in the Perth Basin.
- 1967 Esso/BHP discovers major oil fields at Halibut and Kingfish in Bass Strait.
- 1968 Esso/BHP discover the Tuna oil and gas field in Bass Strait. Mondarra No. 1 (WA) discovers gas. Petroleum (Submerged Lands) Act 1967 come into force on 1 April.

- 1969 Roma-Brisbane gas pipeline operational in March. Melbourne supplied with natural gas from Bass Strait fields in April. Adelaide supplied with natural gas from Gidgealpa/Moomba in November. Crude oil production commenced in Bass Strait fields. Esso/BHP discovers Mackerel oil field in Bass Strait.
- 1970 Bridge Oil discovers Tirrawarra oil and gas field in the Cooper Basin SA, and the Boxleigh gas field in the Bowen Basin, Qld.
- 1971 The North Rankin and Scott Reef gas fields and the Rankin and Goodwyn gas and condensate fields on the North West Shelf discovered. Natural gas production from the Dongara field for Perth, Kwinana, and Pinjarra commenced in October. Walyering No. 1 (WA) discovers gas.
- 1972 Esso/BHP discovers the Cobia oil field NW of the Mackerel oil field in Bass Strait. Delhi/Santos discovers the Dullingari and Della gas fields in the Cooper Basin. Mondara, Gingin, and Walyering fields began supplying gas into Perth-Kwinana-Pinjarra pipeline.
- 1974 Operations under the terms of the Petroleum Search Subsidy Act terminated with effect from 30 June.
- 1975 Commonwealth Government's "new" oil pricing policy announced on 14 September.
- 1977 Esso/BHP drills Cobia No. 2 in Bass Strait and prepares the well for completion as Australia's first sub-sea completion.
- 1978 Wapet announces further Barrow Island drilling spurred on by "new" oil policy. Delhi/Santos discovers oil in Strzelecki No. 3 in the Eromanga Basin (SA). In Bass Strait Esso Fortescue Nos 2 and 3 confirms Fortescue field discovery and Seahorse No. 1 discovers oil.
- 1979 Beach Petroleum discovers gas at North Paaratte No. 1 onshore in the Otway Basin. Exploration in the deep water on the Exmouth Plateau starts and Esso makes a major gas discovery in Scarborough No. 1 in 912 m of water. Oil production begins from Cobia No. 2 subsea completion.

- 1980 Beach Petroleum finds gas in Grumby No. 1 and Wallaby Creek No. 1 in the Otway Basin (Vic). Gas discovered at Woodada No. 1 in the Perth Basin (WA).
- 1981 Hudbay Oil discovers oil in West Seahorse No. 1 in Bass Strait. Esso discovers oil in Yellowtail No. 1 and Tarwhine No. 1 in Bass Strait. Delhi finds oil in Jackson No. 1 in Eromanga Basin, Qld. Home discovers oil in Blina No. 1, Canning Basin (WA), and Wapet makes a major offshore gas discovery at Gorgon No. 1 in the offshore Carnarvon Basin (WA). In all there are 8 oil and 20 gas discoveries.
- 1982 North West Shelf gas project construction phase commences. Major gas discovery in deep water at North Scott Reef. Production commenced from Woodada gas field in Perth Basin. Home discovers oil in Sundown No. 1 in Canning Basin.
- 1983 BHP discovers Jabiru oil field in the Bonaparte Basin. Palm Valley (NT) gas supply to Alice Springs commences. First commercial oil production from Blina field (WA). Significant oil discoveries in Harriet No. 1 and South Pepper No. 1, North Herald No. 1, Chervil No. 1 and South Chervil No. 1 near Barrow Island (WA). First shipment of liquids from Cooper/Eromanga Basins to Port Bonython facility in SA. First production of Fortescue oil (Vic). Further oil discoveries in Jackson area (Qld).
- 1984 Record year for total wells drilled - 373. Significant offshore discoveries in Challis, Talisman and Lenita wells. Numerous small oil and gas discoveries in Cooper/Eromanga Basins and) - record flows from Wancoocha No. 2. Oil and gas discoveries in Gippsland Basin at Tuna, Grunter, Manta, Chimaera, West Fortescue and Veilfin. First phase North West Shelf gas completed - Perth market supplied. Oil production commenced from Jackson to Moonie and Mereenie to Alice Springs. Cooper Basin Liquids Scheme completed (oil, LPG, condensate).

- 1985 Record year for exploration drilling - 270 wells. Cooper/Eromanga Basins record 29 discoveries of oil and gas or both. Significant offshore gas discoveries at Saladin and Montague in the Carnarvon Basin. Oil and gas at Angelfish, Snapper, Whiptail and Whiting in the Gippsland Basin and at Yolla in the Bass Basin. Construction of LNG phase on North West Shelf commenced. New development plans for Bass Strait fields announced - construction of Bream platform underway.
- 1986 Major fall in price of crude oil early in year to half 1985 level results in reduction in exploration and development activities and expenditure. Construction of Palm Valley to Darwin natural gas pipeline completed. Warrnambool supplied by natural gas from nearby North Paaratte gas field in onshore Otway Basin, Vic. Work commenced on Australia's first enhanced oil recovery project at Tirrawarra, SA.
- 1987 Extension/appraisal drilling at Challis and Skua upgrades potential of Bonaparte Basin. Record Australian exploration well flow produced from Saladin oil field. Bream production platform installed - thirteenth in Bass Strait. Enhanced oil recovery project established in the Tirrawarra and Moorari fields.