DEPARTMENT OF MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1976/94

PETROLEUM EXPLORATION BRANCH
SUMMARY OF ACTIVITIES
1.11.75 to 31.10.76

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CONTENTS

Regional Studies Group

The group was engaged throughout the year on the preparation of regional reviews of petroleum exploration and prospects in various basins and areas.

A review of the Arafura Sea/Gulf of Carpentaria region was completed through the editing stage and sent to the printers in August 1976. Although geological and geophysical exploration of the Arafura Sea/Gulf of Carpentaria region has been carried out for more than fifteen years, significant gaps remain in knowledge of the region. There is a need for further seismic work in the eastern Arafura Sea and the Gulf of Carpentaria and for stratigraphic wells in these areas and also in the pre-Mesozoic graben located northeast of the Cobourg Peninsula. At the present time it seems that, overall, the petroleum prospects of the region are not promising. Some possible hydrocarbon traps have been indicated within the Calder Graben and on its margins. In that area the petroleum prospectivity is considered fair, but over the remainder of the vast Arafura Sea/Gulf of Carpentaria region the prospectivity must be regarded as poor.

Editing within the Branch was completed for a review of the Perth Basin. This medium-sized basin contains large thicknesses of sediments known to include suitable source, reservoir, and cap rocks. It has been explored for petroleum more or less continuously since 1949 and there is a large body of geological and geophysical information available from both onshore and offshore. Gas has been discovered in modest but commercial quantities onshore in the northern part of the basin, but elsewhere exploration efforts have been disappointing.

The prospectivity of the basin as a whole is regarded as fair. The most prospective areas are believed to be offshore, particularly in the Abrolhos Sub-basin in the north, where only one well has so far been drilled. Only eleven wells have been drilled in the whole of the extensive offshore area of the basin to date, so that some areas are still poorly known. Several attractive, undrilled structures are known offshore and it is likely that many other prospects exist. Onshore, improvement in seismic techniques, providing better definition of structures, would greatly increase the chances of success.

A review of the Carnarvon Basin was completed by the authors to the stage where it required Branch approval and editing. The Carnarvon Basin is a large, disparate basin which has been explored almost continuously for petroleum since about 1950. Despite WAPET's early apparent success in Rough Range No. 1 well in 1953, exploration onshore has been disappointing and most of the onshore part of the basin must be regarded as having fairly low prospectivity. However, much of the southern Carnarvon Basin onshore is lacking both seismic coverage and drilled holes and it cannot therefore be said to have been adequately explored.

Since the 1960s exploration of the northern, offshore portion of the basin has proceeded steadily, making this one of the most intensely prospected areas in Australia. Significant discoveries have been made at Barrow Island, on the Rankin Platform, and elsewhere in the Barrow and Dampier Sub-basins and further discoveries, possibly related to existing finds, may be expected. By contrast, the southern offshore portion of the basin on the continental shelf seems to be less favourable geologically for petroleum accumulation and has been less intensively explored. But as large areas with appreciable sediment thicknesses are devoid of a single well they can scarcely be dismissed as unprospective at this stage.

Reconnaissance geophysical surveys have indicated that deep-water areas on the outer margin of the continental shelf and on the Exmouth Plateau hold considerable promise of petroleum prospects in the future.

A first draft of a review of the Great Australian Bight region was completed. The region studied included the Eucla Basin, Great Australian Bight Basin (including the Duntroon Embayment), Bremer Basin, Polda Basin, Eyre/Encounter Bay Shelf, and Gulf St Vincent area. Because of apparent low prospectivity much of the region has been only sparsely explored. This is the case with the Eucla Basin and the Eyre/Encounter Bay Shelf, which together make up a large part of the region, but whose petroleum prospects are very poor both onshore and offshore. The Gulf St Vincent area has been relatively well explored because of its proximity to the Adelaide market, but its prospects seem little better. The offshore part of the Polda Basin (Elliston Graben) has been intensively explored because geophysical results seemed to indicate that it was one of the few offshore areas where there was a considerable thickness of sediments in relatively shallow water. However,

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the drilling of one well in this basin has severely downgraded prospects by showing that the prospective section is much thinner than expected.

The southeastern part of the Great Australian Bight on the continental shelf seemed to offer good prospects, with considerable sediment thicknesses in operable water depths. Shell Development have done extensive seismic surveying in the area and have drilled three unsuccessful wells. Nevertheless, most or all of the necessary conditions for the occurrence of petroleum are present in the area, which is now considered to have poor to moderate prospects. As deep-water drilling and production become more feasible in the future some of the deeper-water areas in the Bremer Basin, on the Eyre and Ceduna Terraces, and in the Duntroon Embayment will warrant more detailed exploration.

A first draft of a review of the Gippsland Basin was also completed in 1976. In this basin, exploration results to date have indicated that the most prospective part lies offshore in the central deep area of the basin.

Since the initial discovery of gas in 1965 by Australia's first offshore well (Barracouta No. 1) the major targets have been Eocene sands in structural-stratigraphic traps immediately below the major Eocene/Oligocene unconformity. Exploration has now reached the stage when most of these traps have been tested and attention over the past few years has been directed towards an assessment of the prospectivity of deeper sediments within the Late Cretaceous to Eocene section, in which significant discoveries have been made in the Turrum, Flounder, and Tuna fields.

The prospectivity of the eastern part of the central basin, which extends into deep water, has yet to be evaluated. The prospective section probably comprises mainly Upper Cretaceous sediments over much of this area.

During the year a start was also made on reviews of the Bass and Otway Basins. Because of a change in proposed functions of the Regional Studies Group, some time was spent studying methods for the assessment of undiscovered petroleum resources. The group's information systems on petroleum exploration activities and sedimentary basins were maintained.

E. Nicholas contributed to the preparation of a paper on the tectonic implications of the Phanerozoic basins of Australia, which was presented at the 1976 International Geological Congress.

The group co-operated with A. Mond, Geological Branch, on the preparation of a stratigraphic correlation chart for the Carnarvon Basin according to the requirements of ESCAP.

Records and reports in preparation by the group are listed below.

Records and Reports (in prep.)

Robertson, C.S., Cronk, D.K., Nicholas, E., & Townsend, D.G. - A review of petroleum exploration and prospects in the Arafura Sea/Gulf of Carpentaria region. Bur. Miner. Resour. Aust. Rep.

Robertson, C.S., Nicholas, E., & Townsend, D.G. - A review of petroleum exploration and prospects in the Perth Basin. Bur. Miner. Resour. Aust. Rep.

Robertson, C.S., Cronk, D.K., Lockwood, K.L., & Mayne, S.J. - A review of petroleum exploration and prospects in the Carnarvon Basin. Bur. Miner. Resour. Aust. Rep.

Robertson, C.S., Lockwood, K.L., & Nicholas, E. - A review of the petroleum exploration and prospects in the Gippsland Basin. Bur. Miner. Resour. Aust. Rep.

Robertson, C.S., Cronk, D.K., Mayne, S.J., & Townsend, D.G. - A review of petroleum exploration and prospects in the Great Australian Bight region. Bur. Miner. Resour. Aust. Rep.

Detailed Basin Studies Group

D.W. Wales was appointed supervisor, commencing on 7 October 1975. The Canning Basin study continued to be the major activity of the group. Other activities included the preparation of a variety of papers, some of which were not directly related to the Canning Basin study, as well as a review of data for the investigation of other basins. J.D. Gorter of the group and R.S. Nicoll (Geological Branch) jointly wrote "Reptilian fossils from Windjana Gorge, Western Australia" which has been submitted to the Royal Society, W.A. for publication.

R.V. Burne presented two papers at the 25th I.G.C. in Sydney in August 1976 entitled "Submarine Fans and Their Hydrocarbon Potential"

and the "Origin of Salt Deposits in the Canning Basin, W.A.". R. Burne spent one month on field work in the Canning Basin in September.

A first draft of the Canning Basin study is expected to be completed by the end of 1976 with publication tentatively scheduled for 1979. In the past year the group has analysed each structure mapped by the group in order to assess its petroleum potential through a careful appraisal of the sedimentary rocks present in any given location, their attitude, lithology, level of organic maturity, reservoir properties, sealing capacity, and timeliness of closure. Notwithstanding that the Canning Basin has suffered an adverse geological history with regard to petroleum entrapment especially in the number and stratigraphic position of regional unconformities and in the relatively late period of major tectonism the detailed analysis of all structures has shown that the major problems onshore are the lack and unreliability of seismic data, especially at depth, in and adjacent to the Fitzroy Graben, and offshore the major problem is the general lack of a regionally-sealed laterally-persistent reservoir.

Several areas have been outlined where further local evaluation is warranted involving, depending on the area, re-processing of seismic data, and additional seismic surveying, eventually leading up to the possible testing of structures with the drill. Of interest is the result of a frequency analysis of seismic records from the Lennard Shelf where a number of very small, undrilled pinnacle reefs have been detected.

Although a number of wells have been drilled offshore, there have been few encouraging signs to date. Major problems are the suspected relatively low level of organic metamorphism achieved by Jurassic and younger rocks, the strong possibility that the majority of structural closures nearly all fault controlled are too young to entrap Early Mesozoic oil, the lack of large, simple anticlines in prospective section, and the paucity of pre-Jurassic unconformity seismic data. However, if techniques for gathering deeper seismic data improve and drilling technology advances to allow operations in water depths exceeding those of existing control, it is probable that new drilling targets will emerge in this part of the Canning Basin. Such targets will centre on an appraisal of the Lower Triassic - Upper Permian section closer inshore and an expected greatly-increased thickness of Jurassic rocks farther offshore.

Other than the possibility of reefing on the Lennard Shelf, the group has been unable to locate any specific stratigraphic plays in any part of the basin, perhaps largely because of the lack of closely-spaced drill control and the virtual absence of high-resolution seismic data.

Papers prepared

J.D. Gorter - Reptilian fossils from Windjana Gorge, W.A., submitted to the Royal Society, W.A. for publication.

R.V. Burne - Submarine fans and their hydrocarbon potential, 25th I.G.C., Abstracts.

R.V. Burne - Origin of salt deposits in the Canning Basin, W.A., 25th I.G.C., Abstracts.

Petroleum Resource Assessment Group

The Petroleum Resource Assessment Group was formed in April and May of 1976. Its objective is to make an assessment of Australia's total inferred, hypothetical, and speculative petroleum resources. Since its inception the group has researched the available methods of resource assessment and has developed the necessary methodology and computer programs to apply the 'prospect by prospect' method. A Record setting out the details of this method is in preparation and is listed below.

The group has commenced a preliminary assessment of the Northwest Shelf. Two areas in the Bonaparte Gulf Basin, the Beagle Sub-basin, and some prospects in the Dampier Sub-basin have been assessed. The results of each study have been discussed with the petroleum exploration companies operating in the areas and have been recorded in confidential draft reports.

Record (in prep.)

Riesz, E.J. - SIMULAT, a computer program for the 'prospect by prospect' method of estimating oil and gas resources. Bur. Miner. Resour. Aust. Rec.

P(SL)A Section

Petroleum Search Subsidy Act

The petroleum search subsidy scheme, introduced in 1957, was terminated on 30 June 1974. During the period under review, all payments

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of subsidy were finalized. The total expenditure during the 12 months was $94 190 on one onshore drilling operation and one geophysical survey, both located in Queensland.

The expenditure under the Petroleum Search Subsidy Act during the financial year 1975/76 was $186 235. Of this amount, $92 045 was paid for offshore operations. The total expenditure by the Commonwealth in petroleum search subsidies was $139 480 145 on 654 drilling operations and 977 geophysical surveys.

Work continued on the preparation of a comprehensive report on the subsidy scheme.

Petroleum (Submerged Lands) Act

The examination, indexing, and storage of data and reports received under the Act continued during the year. Applications to carry out operations under the Act, and final reports on operations were also examined, and comments prepared. A register of relinquished and vacant offshore areas, and the availability of basic data with respect to these areas, was maintained.

During the twelve months ended 31 October 1976, only five wells were drilled in offshore Australia (see Table I and Plate 1). They were all located in waters adjacent to Western Australia. The average depth of these wells was 3105 m.

Significant shows of hydrocarbons were reported from two of these offshore wells. Spar No. 1 was drilled by West Australian Petroleum Pty Limited in the Barrow Sub-basin of the Carnarvon Basin. A drillstem test of the interval 2621-2630 m flowed gas at a rate of approximately 311 485 m^3/d with 40 m^3/d condensate. Testing was through a $\frac{1}{2}$-inch surface choke. Tidepole No. 1, drilled by BOCAL Pty Ltd in the Dampier Sub-basin, was completed as a suspended potential oil/gas/condensate producing well. During a drillstem test of the interval 3335-3343 m, the well flowed 36° API gravity oil at the rate of 527 m^3/d. The oil was accompanied by gas at the rate 153 m^3/d. Twelve Formation Interval Tests over the interval 3477-2961 m were also run in the well, two of which recovered oil and gas, and eight recovered gas and condensate.

During the year, 14 marine seismic surveys were carried out in waters adjacent to Western Australia (10), Victoria (1), Northern Territory (2), and South Australia (1). The total coverage of these marine surveys was 10 323 km (6414 miles).

Offshore Index. Work continued on the development of a computer-based file of drilling and geophysical work, using the INFOL system for storage and retrieval of data. All offshore wells and about 100 geophysical surveys have now been indexed in the form of punched cards. Because of difficulties and escalating costs associated with the INFOL system, serious consideration is now being given to transferring the index to the Hewlett-Packard IMAGE system. It has been decided to include archival holdings of data in the index, probably as a sub-set; and it is hoped to expand the system to include State Mines Departments' holdings, and also to include onshore data eventually.

Assessments. A small group within the Section completed the assessment of the petroleum potential of offshore permit areas and recommended work programs for the second five-year term of the permits as the title-holders applied for renewal of their titles. In the case of the Northern Territory offshore permits, technical advice on work programs was given to the Department of the Northern Territory, and the Section has participated with officers of that Department and the Offshore and International Division of the Department of National Resources in discussions with title-holders on the renewal of their titles. Confidential reports on this assessment work have been prepared. Reviews and revisions of the assessments are being made as new data become available.

The group also continued with the assessment of applications for the variation of existing work programs and expenditure requirements of offshore permits, mainly for the Northern Territory. Applications for new Permit areas have been reviewed and comments prepared. Requests continue to be received from the Department of National Resources for advice on the petroleum potential of areas and the significance of new discoveries.

During the latter part of the year, the group commenced a detailed interpretation of data from the Tuna structure in the Gippsland Basin and from the Scott Reef structure on the Northwest Shelf. Velocity analyses are being interpreted to enable volumetric estimates of the possible reserves of these structures to be made. Computerised methods are being developed to facilitate the interpretation.

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Core and Cuttings Laboratory. During the year, BMR personnel made 195 visits to the laboratory. Representatives from 23 consulting organisations, oil and mining companies made 78 visits. The facilities of the laboratory were used for a total of 262 man days.

Packing, transportation, and documentation materials were provided for three BMR field parties, and for 13 operations in the Canberra area. 4100 core bags, 1400 cuttings bags, and 1250 core boxes were supplied.

A total of 253 thin sections, 142 slabbed sections, 40 slabbed and polished sections, and 50 encapsulated specimens of Amadeus Basin dune sands were prepared. The core slabbing equipment was used to section 961 metres of core during the year. Most of this core was from the Georgina Basin.

5813 core samples and 5359 cuttings samples from 19 drilling operations were received during the year. A total of 39 747 core samples from 327 wells, and 9461 cuttings samples from 165 wells were registered. The store at the laboratory now contains 1 064 798 fully registered samples.

Table I

Offshore Drilling Operations, Australia, completed 1 November 1975 - 31 October 1976

Operator	Well	Total Depth Metres	Feet	Status
	Western Australia			
BOCAL Pty Ltd	Lewis-1	265	869	Plugged and abandoned for mech. reasons
	Lewis-1A	3400	11 155	dry; plugged and abandoned
	Tidepole-1	3491	11 453	Suspended oil/gas /condensate producer
	Withnell-1	4650	15 256	Dry; plugged and abandoned
West Australian Petroleum Pty Limited	Spar-1	3721	12 208	Gas/condensate plugged and abandoned

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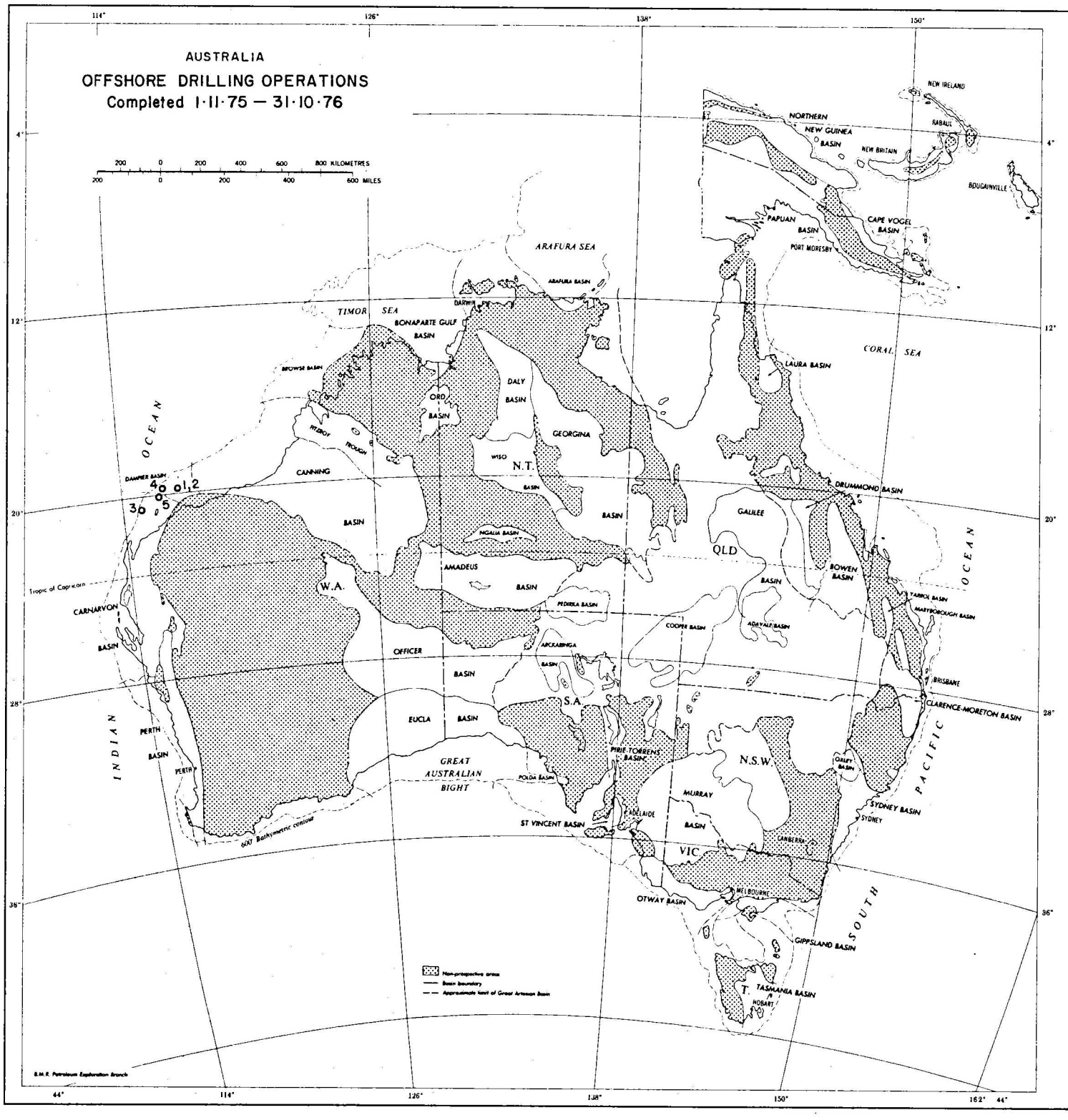
PLATE 1

AUSTRALIA
OFFSHORE DRILLING OPERATIONS
Completed 1·11·75 — 31·10·76



Note: Unless otherwise stated, well location refers to No.1 well

1 Lewis, W.A.
2 Lewis-1A, W.A.
3 Spar, W.A.
4 Tidepole, W.A.
5 Withnell, W.A.

Record No. 1976/94

XAUS-1-138

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