DEPARTMENT OF NATIONAL RESOURCES

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1978/95

PETROLEUM EXPLORATION BRANCH

SUMMARY OF ACTIVITIES

1978

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INTRODUCTION

The functions of the Petroleum Exploration Branch are to study sedimentary basins and estimate their potential resources of petroleum, calculate the reserves of oil and gas fields and assess the economics of their development, investigate the properties of petroleum reservoirs and fluids, undertake geochemical studies of the origin and accumulation of petroleum and assemble and distribute information on the petroleum exploration and development industries. The results of this work form the basis for technical advice to the Government and the petroleum industry on the future availability of petroleum resources and provides the technical background for policy formulation on their management. The Branch is also responsible for providing the technical advice and information necessary for the administration of the Petroleum (Submerged Lands) Act and to this end monitors and reports on offshore operations, assesses the prospectivity of exploration permits, advises on the granting of titles and the conditions to be attached to them, and provides inspectors for operations in the Northern Territory.

To perform these functions satisfactorily it is essential that the Petroleum Exploration Branch remains informed about the methods and technology being used and developed in the petroleum exploration industry. Developments in offshore technology in particular have been rapid in the last few years as exploration has moved into deeper water; these developments are of particular relevance to Australia because many of our most attractive prospects are in water depths greater than 200 metres, and our most prospective potential petroleum province, the Exmouth Plateau, lies in water depths greater than 800 metres.

Mr E.R. Smith, acting Assistant Director, Petroleum Exploration Branch, made a visit to the United States of America and Canada between 5 May 1978 and 12 June 1978 for the main purpose of updating BMR's knowledge of the latest developments in petroleum exploration and development technology. The focal point of the visit was attendance at the Offshore Technology Conference in Houston from 8-11 May; this conference, which was first held in 1969, has become the largest petroleum based conference held in the world. Following the conference, visits were arranged to various oil companies, geophysical contractors, drilling contractors, manufacturers, etc. mainly in the Houston area, although visits were also made in the Los Angeles area and at Vancouver.

Three applications were made to the National Energy Research, Development and Demonstration Council (NERDDC) for assistance to implement important projects which the Branch cannot undertake with its present staffing level. The projects are:

(1) Evaluation of Minimum Economic Reservoir Size for Oil and Gas Fields at various locations.

(2) Establishment of a PVT facility for reservoir fluid analysis.

(3) Hire of computer programs for Reservoir Simulation Models.

PETROLEUM ASSESSMENT SECTION

Late in 1977, D.J. Forman visited various government and private organisations in Canada and the United States of America, primarily to investigate methods that may be used in Australia to estimate undiscovered hydrocarbons. By comparison with the United States and Canada, the Australian Government is fortunate in having access to a high proportion of petroleum exploration data and for this reason it was recommended that the Section continue to use the more reliable prospect by prospect method and that it should also develop the play method used by the Geological Survey of Canada.

A considerable amount of time was spent in preparing material for Standing Group No. 2 of the National Energy Advisory Committee - mainly in preparing recommendations for improving the assessment of Australia's energy resources. D.J. Forman presented a talk at the BMR Symposium on petroleum resource assessment methods and a paper on Australia's petroleum resources at the Earth Resources Foundation seminar. He also delivered part of a course on the economics of exploration and production in the petroleum industry in the Department of Chemical Engineering at the University of Sydney.

Basin Assessment Group 1

Activities included assessment of undiscovered petroleum resources, development of methodology for estimating undiscovered hydrocarbons, methodology and supply forecasting, source rock studies, oil shale studies, preparation of a temperature gradient map, regional studies, and editing of last year's assessment reports.

The oil potential of four structures in the Upper Cretaceous Play in the Browse Basin and the southern portion of the Vulcan sub-basin of the Bonaparte Gulf Basin has been assessed. As part of this study the assessment of the Lower Jurassic/Triassic play in the Browse Basin completed last year was updated.

The group assisted personnel in Geological Branch to assess the undiscovered petroleum resources in the Georgina (Toko syncline) and the Ngalia basins and assisted two exploration companies to assess the resources of two onshore basins.

The group also co-operated in the rapid assessment of Australia's

undiscovered petroleum resources conducted by C.S. Robertson and produced a forecast of future oil supply from undiscovered resources (see Fig. 1).

Development of methods for estimating undiscovered petroleum resources continued during 1978. A program was written for the Play method of the Geological Survey of Canada and several programs were written to add probability distributions of undiscovered petroleum resources using Monte Carlo simulation. A brief note was prepared for the BMR Journal about the relationship between log-log and log-normal field size distributions which have been used in assessment of undiscovered petroleum resources.

The program of source rock and temperature studies which was undertaken in co-operation with CSIRO last year continued throughout the year. About 100 samples from selected onshore wells were submitted for determination of the following parameters:-

Total Organic Carbon
Extractable organic matter
Hydrocarbon content
Gas chromatography
Vitrinite reflectance

A paper on the 1977 results of the BMR/CSIRO geochemical studies was presented at the BMR symposium in May 1978.

An IMAGE cross-reference computer file has been set up in co-operation with the ADP section which will enable a more efficient use of this basic data.

A draft map of uncorrected geothermal gradients obtained from bottom hole temperature data from all available wells was completed.

The group kept a watching brief on oil shale and submitted 38 samples of oil shale for Fischer assay by the Australian Coal Industry Research Laboratory. The chapter on oil shale was updated for the Australian Mineral Industry Annual Review, 1977. A field trip was made to inspect oil shale deposits at Rundle and elsewhere in southeast Queensland.

Regional reviews of geology, geophysics, and petroleum potential of the Laura Basin, offshore Papuan Basin (Queensland portion), Torres Shelf area, and the Halifax Basin were completed. The Halifax Basin report has been accepted in the Queensland Government Mining Journal and the Laura, Papuan, Torres report will be submitted to the same journal.

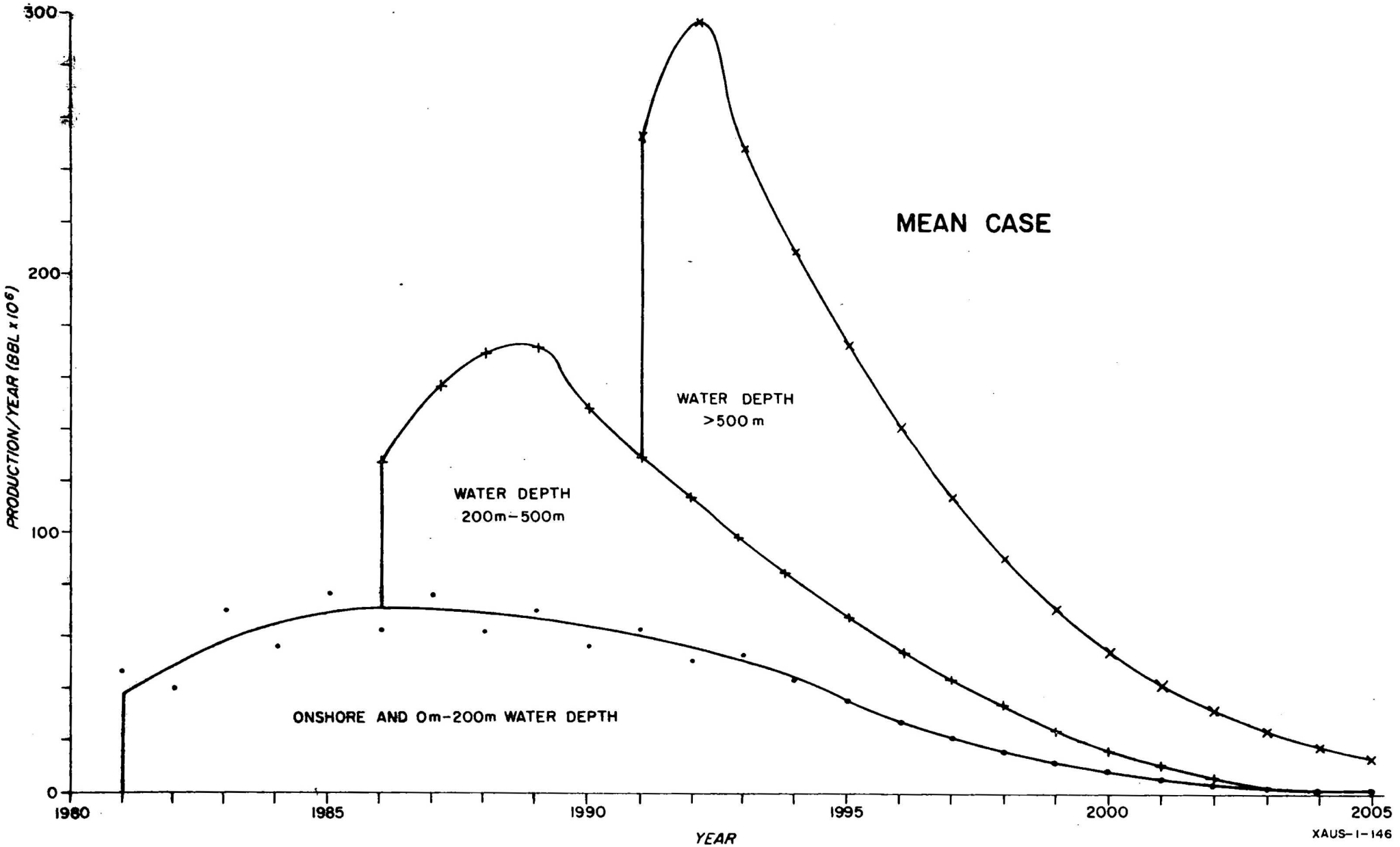


Fig.1 Australia potential oil supply from undiscovered fields

A number of draft reports resulting from the previous year's petroleum resource assessment program were edited and submitted as confidential records.

Basin Assessment Group 2

Much of the group's effort was devoted to completion and professional editing of a number of regional reviews of petroleum exploration and prospects which had previously been prepared in draft form. Some studies directed towards assessment of the undiscovered petroleum resources of Australia were undertaken. Comments and recommendations on applications by petroleum companies for offshore title areas in the regions which had been reviewed by the group were prepared. One of the group supervised and edited the work of V. Passmore and C.M. Brown on the ESCAP Stratigraphic Atlas project.

Regional reviews of the petroleum exploration and prospects of the Perth Basin (Open File and In Confidence versions), the Carnarvon Basin (Open File and In Confidence versions), and the Otway Basin region were forwarded to the editors and it is expected that four other reviews will be completed as Records by the end of 1978.

Assessments of the undiscovered resources of eleven petroleum prospects in the Gippsland, Bass, and Otway Basins were carried out using the 'prospect by prospect' method. Assistance was provided to Messrs A. Wells and F.J. Moss for an assessment of the undiscovered petroleum resources of the Ngalia Basin. A preliminary estimate of the undiscovered petroleum resources of the whole of Australia was completed and issued as Record 1978/45. This assessment was based on current knowledge of about 40 basins and areas onshore and offshore around Australia, but the results are preliminary as many of the prospects, plays, and basins have still not been assessed in detail. The assessment resulted in mean estimates of 410 million cubic metres (2.6 billion barrels) of undiscovered oil and 920 billion cubic metres (32 trillion cubic feet) of undiscovered gas. It is considered that the greater part of Australia's undiscovered petroleum resources are concentrated in only a relatively few basins and areas. Approximately 84 percent of undiscovered oil and 74 percent of undiscovered gas are expected to occur offshore.

Offshore Sub-section

Petroleum (Submerged Lands) Act: The receipt, 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 performed in offshore title areas were examined and technical comments were prepared. A register of relinquishment and vacant offshore areas, and the availability of basic data with respect to these areas, was maintained.

The Sub-section continued to give technical advice to the Northern Territory Designated Authority. Recommendations were made on the advertising of vacant Northern Territory areas and Lots 1 to 7 were advertised as being available in the Northern Territory Government Gazette in December 1977 (closing date 31 March 1978). Relinquishment packages in reproducible form were assembled and numerous requests for these data were handled through the Government Printer. Applications for these Lots were received and technical comments and advice were prepared for the Designated Authority.

Technical comments and recommendations were also prepared for Oil and Gas Division on applications for new permits offshore Australia.

During the twelve months ended 31 October 1978, twenty three exploratory wells were drilled in offshore Australia; of these, twenty one were new-field wildcats, one was a new pool test, and one was a stepout well (see Table 1 and Plate 1). Fifteen of the wells were drilled in waters adjacent to Western Australia, five in waters off Victoria, and three off the Northern Territory. The average depth of wells off Western Australia was 2924 m, off Victoria 2219 m, and off Northern Territory 2231 m. In total 61 641 m of drilling was completed with an average depth of 2680 m for the twenty three wells drilled.

Eleven development wells were completed on the Mackerel 'A' platform and one development well was commenced on the Tuna 'A' platform; both platforms are in the Gippsland Basin, Victoria.

Two significant oil wells were drilled offshore during the year. Both wells, Seahorse No. 1 and West Halibut No. 1, were drilled by Esso Exploration and Production Australia Inc. in the Gippsland Basin and secured as oil wells.

During the year twenty two marine seismic surveys were carried out in waters adjacent to Western Australia, Northern Territory, and Victoria. The total coverage of the surveys was approximately 39 000 line-kilometres.

Table 1

Offshore Exploration Drilling Operations,
Completed 1 November 1977 to 31 October 1978

Operator	Well	Total Depth (m)	Status
Esso Exploration and Production Aust. Inc.	Houtman No. 1	3860	P & A
	Fortescue No. 1	2691	P & A
	Sweep No. 1	900	P & A
	Seahorse No. 1	2304	Secured
	West Halibut No. 1	2577	Secured
	Batavia No. 1	2941	P & A
	Flounder No. 6	2621	P & A
Woodside Petroleum Ltd	Caswell No. 1	4097	P & A
	Miller No. 1	3520	P & A
	Bassett No. 1	949	P & A
	Bassett No. 1A	2706	P & A
	Brigadier No. 1	4292	P & A
West Australian Petroleum Pty Ltd	Hermite No. 1	3300	P & A
	Peel No. 1	3714	P & A
	Bungedi No. 1	3096	P & A
	Koolinda No. 1	3732	P & A
	Mermaid No. 1	1271	P & A
	Geelvink No. 1	1268	P & A
	Geelvink No. 1A	3053	P & A
Arco Australia Limited	Plover No. 3	1219	P & A
	Frigate No. 1	1585	P & A
	East Swan No. 1	3039	P & A
Woodside Petroleum Ltd/ Union Oil Development Corporation	Jarman No. 1	2906	P & A

Offshore Index: Restriction on funds, staff shortages, and work loads have prevented any further work on this project. It is hoped to transfer the index from the INFOL system to the Newlett-Packard IMAGE system in the near future and to include archival data and other priority data on the files.

Assessments: Revised assessments of petroleum prospectivity were made as more data came to hand and as comments were required on applications for new petroleum title areas. Time was spent in technically editing existing assessment reports and all reports have now been submitted to the Editor for issue as 'In Confidence' records. Advice was given to Oil and Gas Division and the Department of Northern Territory on technical matters.

In November an officer of the Sub-section visited the 'Southern Cross' offshore drilling rig for an inspection visit whilst it was moored in Moreton Bay, Brisbane, prior to drilling three wells in the Bonaparte Gulf. Officers also visited East Swan No. 1 and Bassett No. 1 drilling operations in the Northern Territory to inspect and report under the Petroleum (Submerged Lands) Act. In August and September an officer of the Sub-section visited Port Moresby and Goari No. 1 as an inspector on behalf of the PNG Government. Assistance has also been provided in preparing drilling directions for Papua New Guinea.

One officer visited the well-head recovery operations in the Gippsland Basin during October 1978.

Petroleum Search Subsidy Act: The Group met requests by visitors and BMR officers for information on and access to PSSA reports and other material. Assistance was given to the Australian Government Publishing Service with respect to customer's requests for copies of PSSA material. With the advertising of new offshore title areas and the renewed interest in onshore Australian exploration there has been an increasing work load in this area.

Archives: Excessive delay was experienced by private companies in the retrieval of petroleum search magnetic tapes from the Commonwealth Archives repository at Villawood, N.S.W. during the year. Two officers visited Villawood to examine the technical problems and to advise on how the delays may be reduced. The main problem is an inadequate documentation of much of the material submitted.

Core and Cuttings Laboratory: During the year, BMR personnel made 239 visits to the laboratory. Representatives from consulting organisations and petroleum and mining companies made 64 visits. Visitors from universities and other Government departments made 41 visits.

Documentation, packing, and transportation materials for field samples were provided for BMR field parties and petroleum companies engaged in offshore drilling operations. 1966 collapsible core boxes and clips, 8150 core bags, and 13 050 cuttings bags were supplied.

During the year 343 m of core were slabbed from the Hay River, Boulia, and Canberra sheet areas. The core slabbing machinery was used for 50 man-days.

2581 m of core and 12 053 cuttings samples were received and

2701 m of core and 6265 cuttings samples were added to the register during the year. The Core and Cuttings Laboratory now holds a total of 1 149 480 fully registered items.

The entire palaeontology collection was relocated during the year to allow additional space for storage of samples and the sample receivals area was reorganised to accommodate larger intakes of material.

A listing of destructive analysis reports held at the Core and Cuttings Laboratory was prepared for a BMR record.

PETROLEUM TECHNOLOGY SECTION

During the year under review, the Section carried out its established functions, with the exception of the PVT Laboratory which has no filled staff positions and was therefore unable to operate. Other groups were understaffed to some extent and were not all able to fulfill completely their appropriate functions.

Mr J.A.W. White, Chief Petroleum Technologist, revised a paper for the National Energy Advisory Committee on Exploration for Oil and Gas in Australia based upon updated information and forecasts. Several meetings of the Oil Shale Committee were convened and chaired during the year.

Considerable time was spent on a critical examination of various draft Directions proposed under the Petroleum (Submerged Lands) Act and on several overseas offshore drilling regulations, including those of Papua New Guinea and Spitzbergen. Work continued on the evaluation of new prospects on Barrow Island to determine whether 'new' oil or 'old' oil prices would be appropriate.

Several meetings of the Oil Advisory Committee were convened and attended by Mr White. The Oil Advisory Committee is a statutory body set up under the Petroleum (Prospecting and Mining) Ordinance 1954-1966 and has the function of advising the Administrator or the Minister for the Northern Territory on any scientific or technical matters arising in connection with the exploration for and production of petroleum in the Northern Territory.

A visit as Inspector under the Petroleum (Submerged Lands) Act 1973 was made to East Swan No. 1, Bonaparte Gulf, N.T.

The Section received some 120 visits from individuals and groups during the year together with 18 students whose main interest was in the laboratories. Many ad hoc enquiries from organisations and individuals were handled.

Industry and Economics Group

Petroleum Economics and Statistics: Material prepared in response to questions from industry, the public, and Parliamentary enquiries has continued to be updated and revised. In addition, quarterly assessments of the recoverable reserves of crude oil, condensate, plant products, liquified petroleum gas (LPG), and natural gas, together with cumulative production and remaining recoverable reserves were prepared and published in the relevant Petroleum Newsletters Nos. 71, 72, 73, and 74 (currently in preparation).

The annual collection of petroleum exploration, development, and production expenditure and geological and geophysical activities was completed, analysed, and the results published in Petroleum Newsletter No. 74. They have been further analysed and will be published in detail in the Petroleum chapter of the Australian Mineral Industry Annual Review, 1977.

In summary, the results of this survey show that there was a doubling in exploration drilling expenditure in 1977 over 1976; this was mainly due to a 330 percent increase in offshore exploration drilling from only 3 wells completed in 1976 compared to 13 in 1977. Geological and geophysical exploration activity in 1977 in terms of crew months of work together with a comparison with 1976 are given in Table 2.

Table 2

Level of Geological and Geophysical Activity, 1977

Survey	Unit of Work	1976	1977
Land Seismic	Crew months	19.5	11.91
Marine Seismic	" "	8.26	5.18
Gravity Surveys	" "	2.5	2.0
Geological Surveys	" "	23.5	28.3
Magnetic Land	Line km	nil	nil
Aero	" "	nil	nil
Shipborne	" "	8651	758

Total petroleum exploration expenditure in Australia in 1977 was $86 111 778; reflecting an increase in exploration expenditure of 58.7 percent over 1976 when the expenditure was $54 257 007.

The Section prepared for publication and distribution the following documents:-

(i) The Petroleum Newsletter (Quarterly) Nos. 71, 72, 73 and 74, including monthly drilling rig activity and quarterly statistics.

(ii) A breakdown of petroleum exploration, development, and production activity and expenditure for 1977 presented in Petroleum Newsletter No. 74 and in the Petroleum Chapter of the AMI Annual Review.

(iii) Statistics, and information on petroleum exploration, production, and resources, etc. in Australia for various publications such as World Oil, Oil and Gas Journal, year books, and pamphlets.

(iv) The Petroleum Exploration and Development Titles Map and Key showing the position as at 1 July 1977. A similar map to show the position as at 1 January 1978 is at the printers and the map showing the position as at 1 July 1978 is in preparation.

A library of index cards containing details on each well drilled is maintained for quick reference, as is reference material on the corporate structure of individual companies engaged in petroleum activities. An index to articles of interest in the various trade and professional journals is maintained on a subject and author basis.

Petroleum Technology Laboratory

Several points of general interest occurred. One of these was a visit by laboratory and other BMR staff to the CSIRO Mineral Research Laboratories in North Ryde, to discuss hydrocarbon programs and areas of mutual co-operation which may be possible. A return visit by MRL scientists to the BMR also occurred; a proposed study by the Baas Becking laboratory on biological techniques of enhanced recovery is one area of co-operative effort which may occur if NERDDC funds are forthcoming. Source rock studies may also be mutually expanded in the future.

Petrophysics: Completion of the Moonie enhanced (polymer) recovery

project occupied the major effort of this group during the year. The work involved development of some innovative equipment to minimize mechanical and chemical degradation of the polymers during flooding. Apparatus to properly evaluate the viscosity characteristics of polymers was also built.

The study showed that additional oil can be produced by polymer injection in Moonie after natural depletion by water displacement, and particularly when mobile oil is present. However, a field pilot study would be required to determine if the process would have practical and economic application to the Moonie field. This is particularly important in Moonie where the strong edge water drive may have adverse effects on additives such as polymers.

The group also carried out studies of the water storage and flow capacity of sedimentary beds overlying a coal seam in the Gregory open cut coal field in Queensland. Another project involved the gas recovery characteristics by water drive of core plugs from the Della gas reservoir in the Cooper Basin.

Minor studies were also undertaken for the Engineering Geology Section, Gravity Section and the Baas Becking laboratory. These involved porosity and density studies to identify the source of buckling in the marble covering on the National Library; permeability, porosity and density tests to aid gravity interpretation, particularly in the Pine Creek area, N.T.; and fluid permeability tests of sediments and algal material from the CSIRO environmental test tank at Fyshwick.

In routine core analysis, porosity, permeability and density tests were conducted on 409 samples during the year including some work for the Queensland Geological Survey. Samples of formation water were also tested from the East Swan No. 1 well in the Bonaparte Gulf Basin, while a drilling fluid foaming agent was evaluated for possible use in water well drilling in the Northern Territory.

Petroleum and Source Rock Geochemistry Group: The main project involved completion of the analytical work on the Galilee Basin, with a report currently in progress. A start was also made on the Georgina source rock project with completion expected about mid 1979.

Additional limited source rock studies were carried out on a small number of samples from the Officer Basin, the Cooper Basin and the

Browse Basin. Organic carbon determinations were conducted on samples from the Pine Creek area of the Northern Territory for the Geophysical Branch, to evaluate the relationship between carbon content and mineralization in these samples.

With the appointment in February of a petroleum geochemist with overseas major industry experience, a significant task undertaken was a complete reorganization of the laboratory with regards to equipment and analytical techniques. The previous classical source rock methods using solvent extraction of core material will in the future be covered mainly by pyrolysis - F.I.D. chromatography using both cores and cuttings, and by measurement of light to medium range hydrocarbon content in canned drill cuttings. These methods will enable much greater speed and frequency of analysis, thus improving output and interpretation.

Hydrocarbon contamination studies in Canberra city also played a significant part in the group's activities. These involved further investigations with respect to the hydrocarbon leakage in the environs of the Center Cinema theatre and analysis of a hydrocarbon leak into the basement drainage sump of the NRMA building. Additional studies were made on hydrocarbons from various building drains and areas of the lake surface in the Kingston area. A "hydrocarbon seep" from a property in western NSW was also evaluated.

Other studies for the year involved work for the Commonwealth Police to assist in identification of certain material; organizing 39 oil shale samples for analysis of oil content by Australian Coal Research Laboratories; and the training (for one week) of a chemist from Australian Mineral Development Laboratories in application of petroleum geochemistry used by our laboratory. The group also participated with other sections of the branch in setting up a data storage and retrieval system for internally and externally generated source rock information.

Dr Jackson participated with officers of the Branch in interpreting source rock data obtained by the CSIRO for the resource assessment group. He also assisted this group in application of interpreted data.

Reservoir Engineering Sub-section: Australia's petroleum reserves on land and offshore were published quarterly in Petroleum Newsletter Nos. 71, 72,

73, and 74. The estimates of petroleum reserves are classified as crude oil, condensate, liquified petroleum gas (LPG), and natural gas. For the most part they are based on company estimates, verified whenever practicable by the Reservoir Engineering Sub-section or on assessments and reservoir studies carried out by the Sub-section. Included in the statements of reserves are those in the proved and probable categories considered to be recoverable by current methods and known techniques. Australia's estimated petroleum reserves at 30 June 1978 are given in Table 3.

Table 3

Petroleum Reserves

	Initial Reserves	Cumulative Production	Remaining Reserves
Crude oil	482.70 x $10^6 m^3$	182.92 x $10^6 m^3$	299.78 x $10^6 m^3$
Condensate	119.08 x $10^6 m^3$	2.68 x $10^6 m^3$	116.40 x $10^6 m^3$
LPG	210.95 x $10^6 m^3$	18.65 x $10^6 m^3$	192.30 x $10^6 m^3$
Natural gas	881.52 x $10^9 m^3$	39.51 x $10^9 m^3$	842.01 x $10^9 m^3$

Reserves of hydrocarbons are defined as those expected to be recovered and produced under natural or primary conditions. Secondary recovery of oil is also included in the reserves only if the process has already been started. The recoveries are based on estimates of the original hydrocarbons in place, expected recovery drive mechanisms, and the rate of production at the estimated economic limit.

The Reservoir Engineering Sub-section has continued its work of estimating petroleum reserves. It uses a probabilistic approach in cases of one or two well fields. The Monte Carlo simulation method of estimating reserves has been adapted for use in those reservoirs where the degree of uncertainty of any of the input parameters is high.

As more wells are drilled and more data become available, the early estimates of original hydrocarbons in place are regularly revised.

Expected rates of production for a given field are calculated from well and reservoir data and assumed markets. The projected flow rates are cut-off when the estimated economic limit of production is reached. In the absence of economic data an arbitrary cut-off of flow rates is assumed.

The Reservoir Engineering Sub-section's activities in the past year have been mainly concentrated on the detailed study and assessment of the petroleum reserves of the Whicher Range and Pelican fields. The Bream field is currently being studied.

Technology of methanol, ammonia, and urea production are being monitored with a view to convert remotely located gas to a product easily transported. A study on gas hydrates was also prepared.

The computer program for wire-line log interpretation has been expanded to include many more options. Field data recorded on magnetic tape are now copied on the BMR computer system and up to 250 sample points of data can be translated at a time. Other programs have been written in support of this effort.

A pilot study was conducted on use of wire-line logs as an aid to source rock evaluation.

Numerous routine and ad hoc enquiries including support for the NEAC and AMEC studies covered reservoir information, reserve estimates, and reserve classifications.

L.E. Kurylowicz attended a 2-day course on 'Subsurface Facies Analysis' given by Dr R.C. Selley on 9, 10 March in Melbourne for the Petroleum Exploration Association of Australia (PESA).

L.E. Kurylowicz attended a 2-week course on 'Mineral Economics' given by Dr B. McKenzie between 14-25 August in Canberra for the Australian Mineral Foundation.

I. Donald attended a 1-week in-house report writing course.

L.E. Kurylowicz attended a 2-half days course on 'Geostatistics' given in the BMR by Mr P. Raftery of BHP.

S. Ozimic visited various gas storage sites while on an overseas visit to France and England.

Drilling Engineering Sub-section

Plant and Equipment: On the completion of 1977 Alligator River/Pine Creek (N.T.) field party, all party vehicles and drilling equipment were placed in the BMR Darwin workshop and compound at Winnellie.

The Mack Truck agent in Darwin modified the rear suspension of the Mack chassis by replacing the "walking beam" with conventional springs. This modification has now been carried out on all five Mack trucks and the vibrations previously experienced have been eliminated.

On the completion of the 1977 Seismic field party program, one Mayhew drilling unit mounted on a Mack chassis was delivered to "Bourne Engineering" (Brisbane) for modifications to be carried out under contract to the specifications of the drilling sub-section for the installation of a transfer box into the prime-mover transmission, removal of the Leyland 400 on-deck motor, modifications to the rig and compressor drives and the installation of a gear box to give variable mud-pump speeds when coring.

The unit was inspected on completion and is presently working on the 1978 Seismic operations.

One other drilling unit was partially modified by drilling personnel in the first quarter of 1978 by removing the Leyland 400 on-deck motor and modifying the rig and compressor drives. This unit and the modification and installation of a further two transfer cases to the last two drilling units still to be modified, will be carried out by BMR personnel later in the year.

On completion of these modifications, all drilling rigs will be driven by the prime-mover engine.

Specifications for the supply of tankers to replace the existing A.E.C., 1000 gal tankers were submitted to the Division of Transport and Stores and should be finalised later this year.

Two mechanics were loaned to BMR's Administrative Section from February to March to carry out repairs and servicing of vehicles in Darwin (N.T.).

Workshop (Fyshwick A.C.T.): Extensions and modifications to the existing workshop were commenced mid July 1978 and should be completed mid November 1978. The work comprises the construction of a covered workshop area enabling future repairs to be carried out under cover.

Vehicles and Plant: The current vehicle and plant strength is:-

5 - Mayhew 1000 rigs mounted on Mack R685RS chassis

1 - "GEMCO" 210B "Tandem Trailer" mounted auger/diamond rig
5 - 1000 gal water tanks on A.E.C. Militant chassis
4 - 6 ton 4 wheel drill trailers

Drilling Operations: In the year ending October 1978, the Drilling Sub-section provided seven drilling parties in support of various BMR field activities. Drilling and diamond coring operations took place in the ACT and NSW, in support of Geological Engineering studies. Diamond coring and drilling for stratigraphic information was carried out in the Alligator River/Pine Creek areas (N.T.) and in the Georgina Basin Qld.

Drilling in support of the Bowen Basin Seismic Survey was also undertaken.

The five Mayhew 1000 drills and one Gemco drilling unit were used to carry out the operations.

Table 4 summarises the drilling and coring activities during the period 1 November 1977 to 31 October 1978.

Technical Services: During the year a number of period contracts for the supply of replacement parts, drilling bits, core-heads and contracts for water tanks, drilling rig modifications and other consumable stores were prepared or revised by the Sub-section and forwarded through the Division of Transport and Stores to the Contracts Board.

Table 4

BMR Drilling Operations 1 November 1977 to 31 October 1978

BRANCH AND SECTION	PROJECT AREA OF OPERATION	FROM	TO	NO. OF HOLES	DRILLED	CORED	DRILLED & CORED	NO. OF CORES	AVERAGE CORE RECOVERY (%)	TIME SPENT-HRS OPERATING DRILLING	(TOTAL TIME) CORING	TOTAL*	AVERAGE PENETRATION RATE METRES/HR DRILLING	CORING	AVERAGE DEPTH OF HOLE (METRES)	TRAVELLING TIME (HOURS) **
GEOLOGICAL																
Metalliferous	Alligator River (N.T.) Mary River, Mataranka	6-7-78	20-10-78	28	1680.67	86.99	1767.66	51	96.31	165.00	88.25	253.25	10.18	1.01	63.23	47.5
Sedimentary	Georgina Basin (QLD)	7-6-78	21-7-78	4	61.00	318.50	379.50	112	96.00	10.00	128.50	138.50	6.10	2.47	94.87	1.5
	Duchess	4-8-78	10-8-78	2	154.30	25.30	179.60	33	78.50	14.50	18.00	32.50	10.64	1.40	89.80	1.0
	Georgina Basin "Gemco" Drill	3-11-77	18-11-77	1	9.20	90.20	99.40	35	100.00	8.00	81.00	89.00	1.15	1.11	199.40	-
	Mt Whelan	1-11-77	5-11-77	1	-	28.00	28.00	10	50.00	-	18.00	18.00	-	1.55	28.00	-
Engineering Geology & Hydrology	ACT/N.S.W.	31-1-78	14-6-78	11	26.80	372.73	399.53	261	94.08	5.50	436.50	442.00	4.87	1.17	36.32	7.50
GEOPHYSICAL																
Observatories & Regional	(S.W/N.S.W. ("Stress (Measurements"	6-2-78	9-3-79	18	67.05	21.76	88.81	37	100.00	45.50	49.00	94.50	1.47	2.25	4.93	22.50
	("Heat Flow"	13-3-78	10-4-78	1	172.20	4.08	176.28	4	100.00	45.00	14.00	59.00	3.82	3.43	176.28	14.50
Seismic (Land)	(Goulburn ((N.S.W.)	17-4-78	5-5-78	95	1346.00	-	1346.00	-	-	59.50	-	59.50	22.62	-	14.16	43.50
	(Georgina (Basin (QLD)	1-11-77	11-11-77	141	4788.36	-	4788.36	-	-	125.50	-	125.50	14.24	-	33.96	73.50
	(Denison (Trough (QLD)	7-7-78	25-10-78	968	44964.00	-	44964.00	-	-	963.00	-	963.00	46.69	-	46.45	292.50
TOTALS		1-11-77	25-10-78	1270	53269.58	947.56	54217.14	543	89.36	1441.50	833.25	2274.75	36.95	1.13	42.69	456.50

SUMMARY:- Total metres drilled 53269.58
" " cored 947.56
" " drilled & cored 54217.14
" number of holes 1270
" " " cores cut 543
Average core recovery 89.36%

* "Total Operatine Time"
This includes
(a) Time actually drilling & coring
(b) Running in & pulling out of hole
(c) Changing bits & recovering core
(d) Reaming hole
(e) Running & cementing casing
(f) Borehole survey time

It excludes
(a) Maintenance time
(b) Time spent on repairs
(c) Travelling time

**"Travelling Time" only refers to travel between locations, camps, etc. within an operation area.
It does not include positioning time (travel) between base (Canberra) and the operational area or between operational areas.

APPENDIX

REPORTS PREPARED IN PETROLEUM EXPLORATION BRANCH

Petroleum Assessment Section

Publications

The Phanerozoic sedimentary basins of Australia and their tectonic implications. Symposium: The structure of Australia and variations in tectonic style. Doutch, H.F. and Nicholas, E. Tectonophysics 48, 365-388.

Australia's petroleum resources in Australia's Mineral Energy Resources - Assessment and Potential. Forman, D.J. Proceedings of the Earch Resources Foundation Seminar, May 1978.

Triassic environments in the Canning Basin, Western Australia. Gorter, J.D. BMR Journal of Australian Geology and Geophysics 3, 25-33.

Reptilian fossils from Windjana Gorge, Western Australia. Gorter, J.D. and Nicoll, R.S. Journal of the Royal Society of Western Australia 6064, 97-104.

Can rank size 'laws' be used for undiscovered petroleum and mineral assessments? Riesz, E.J. BMR Journal of Australian Geology and Geophysics, 3, 254-256.

? Halifax Basin, Queensland. Smart J. and Rasidi, J.S. Queensland Government Mining Journal, 80, 150-156.

? The geology and petroleum potential of the Laura Basin, Torres Shelf and Papuan Basin, Queensland. Smart, J. and Rasidi, J.S. Queensland Government Mining Journal, 83, 267-279.

Records (issued)

A preliminary estimate of the undiscovered petroleum resources of Australia. Robertson, C.S. 1978/45 (In confidence).

Petroleum resource assessment methods in North America. Forman, D.J. 1978/77 (internal use only).

Preliminary assessment of the hydrocarbon potential of the Sahul Platform, Bonaparte Gulf Basin, Northern Territory and Western Australia. Forman, D.J. and Riesz, E.J. 1978/30 (In confidence).

SIMULAT, a computer program for the prospect by prospect method of estimating petroleum resources using Monte Carlo simulation. Riesz, E.J. 1978/2.

Records (in preparation)

A preliminary assessment of the Tithonian play in the Dampier Sub-basin and Rankin Trend. Forman, D.J. and McAvoy, W.J. (In confidence).

A preliminary assessment of the recoverable hydrocarbon potential of the Vulcan Sub-basin, Bonaparte Gulf Basin, Northern Territory. Forman, D.J. and McAvoy, W.J. (In confidence).

A preliminary assessment of the recoverable hydrocarbon potential of the Barrow Sub-basin, Western Australia. Gorter, J.D., McAvoy, W.J. and Riesz, E.J. (In confidence).

An assessment of the recoverable hydrocarbon potential of the Browse Basin, Western Australia. Gibson, D.L., Gorter, J.D. and Riesz E.J. (In confidence). 1979/3

A review of petroleum exploration and prospects in the Arafura Sea - Gulf of Carpentaria region. Robertson, C.S., Cronk, D.K., Nicholas, E. and Townsend, D.G. 1978/49.

A review of petroleum exploration and prospects in the Perth Basin. Robertson, C.S. Nicholas, E. and Townsend, D.G. 1977/63 (In confidence).

A review of petroleum exploration and prospects in the Perth Basin. Robertson, C.S., Nicholas, E. and Townsend, D.G. 1978/66

A review of petroleum exploration and prospects in the Carnarvon Basin. Robertson, C.S., Cronk, D.K., Lockwood, K.L., and Mayne, S.J. 1977/21 (In confidence).

A review of petroleum exploration and prospects in the Carnarvon Basin. Robertson, C.S., Cronk, D.K., Lockwood, K.L., and Mayne, S.J. 1978/47.

A review of petroleum exploration and prospects in the Otway Basin region. Robertson, C.S., Cronk, D.K., Mayne, S.J. and Townsend, D.G., 1978/91.

A review of petroleum exploration and prospects in the Gippsland Basin. Robertson, C.S., Lockwood, K.L., Nicholas, E. and Soebarkah, H., ~~in prep.~~ (In confidence). 1978/111

A review of petroleum exploration and prospects in the Gippsland Basin. Robertson, C.S., Lockwood, K.L., Nicholas, E., and Soebarkah, H. ~~in prep~~. 1978/110

A review of petroleum exploration and prospects in the Bass Basin. Robertson, C.S., Lockwood, K.L., and Nicholas, E. in prep. (In confidence). 1979/21

A review of petroleum exploration and prospects in the Bass Basin. Robertson, C.S., Lockwood, K.L., and Nicholas, E., in prep.

A review of petroleum exploration and prospects in the Great Australian Bight region. Robertson, C.S., Cronk, D.K., Mayne, S.J., and Townsend, D.G., in prep. 1979/20

A review of petroleum exploration and prospects in the Officer Basin region. Robertson, C.S., Lockwood, K.L., Mayne, S.J., and Townsend, D.G., in prep.

An appraisal of petroleum exploration and development title areas Q/1P, Q/2P, Q/3P, Q/4P, Q/5P, Q/6P, Q/7P, Q/8P, Q/9P, Q/10P, Q/11P and Q/12P, offshore Queensland. McAvoy, W.J. and Temple, P.R. 1978/90 (In confidence).

An appraisal of petroleum exploration and development title areas SA-2-P and SA-8-P, offshore Otway Basin, South Australia. McAvoy, W.J. and Temple, P.R. 1978/36 (In confidence).

An appraisal of petroleum exploration and development title areas SA-4P, SA-5P, SA-6P, SA-7P, SA-10P, and SA-11P, Great Australian Bight, South Australia. McAvoy, W.J. and Temple, P.R. 1978/35 (In confidence).

An appraisal of petroleum exploration and development title areas WA-15-P, WA-16-P, WA-17-P, WA-18-P and WA-19-P, offshore Bonaparte Gulf Basin, Western Australia. McAvoy, W.J. and Temple, P.R. 1978/39 (In confidence).

An appraisal of petroleum exploration and development title areas WA-29-P, WA-30-P, WA-31-P and WA-32-P, offshore Canning Basin Western Australia. McAvoy, W.J. and Temple, P.R. 1978/42 (In confidence).

An appraisal of petroleum exploration and development title areas NT/P2, NT/P7, NT/P8, NT/P9, NT/P10, NT/P13, NT/P14, NT/P15, offshore Bonaparte Gulf Basin, Northern Territory. McAvoy, W.J. and Temple, P.R. 1978/79 (In confidence).

An appraisal of petroleum exploration and development title areas NT/P11, NT/P12, NT/P4, NT/P6, NT/P19 and WA-36-P, offshore Bonaparte Gulf Basin, Northern Territory and Western Australia. Riesz, E.J. and Temple, P.R. 1978/49 (In confidence).

A listing of destructive analyses reports held at the Core and Cuttings Laboratory, Fyshwick. Staunton, J.S., in prep. 78/92

Petroleum Technology Section

Records (issued)

An overview of gas hydrates. Donald, I. and Stillwell, K.L. 1978/13.

LOG1: A computer program to solve for porosity and water saturation. Kurylowicz, L.E. 1978/3.

Petroleum source rock potential from wire-line logs. Kurylowicz, L.E. 1978/37.

Puffin Field, Bonaparte Gulf Basin, N.T. Estimated recoverable reserves as at 1/3/77. Kurylowicz, L.E. 1978/6 (In confidence).

A regression analysis on North Rankin No. 5 - core porosity against log porosity. Kurylowicz, L.E. 1978/72 (In confidence).

GAS: a computer program to predict gas well deliverability. Kurylowicz, L.E. and Stillwell, K.L. 1978/5.

"Enhanced Recovery of Petroleum - Applications to Australia". McKay, B.A. and White, J.M. 1978/43.

Pelican Field, Bass Basin, Tasmania. Estimated recoverable reserves as at 31/12/77. Ozimic, S., and Donald, I. 1978/26 (In confidence).

Troubadour Field, Bonaparte Gulf Basin, NT: Estimated recoverable reserves as at 31/3/78. 1978/27 (In confidence).

Sunrise Field, Bonaparte Gulf Basin, NT: Estimated recoverable reserves as at 31/3/78. Ozimic, S. 1978/27 (In confidence).

Records (in preparation)

Whicher Range Field, Perth Basin, W.A. Estimates recoverable reserves as at 31/3/78. Ozimic, S., and Donald, I. (in preparation).

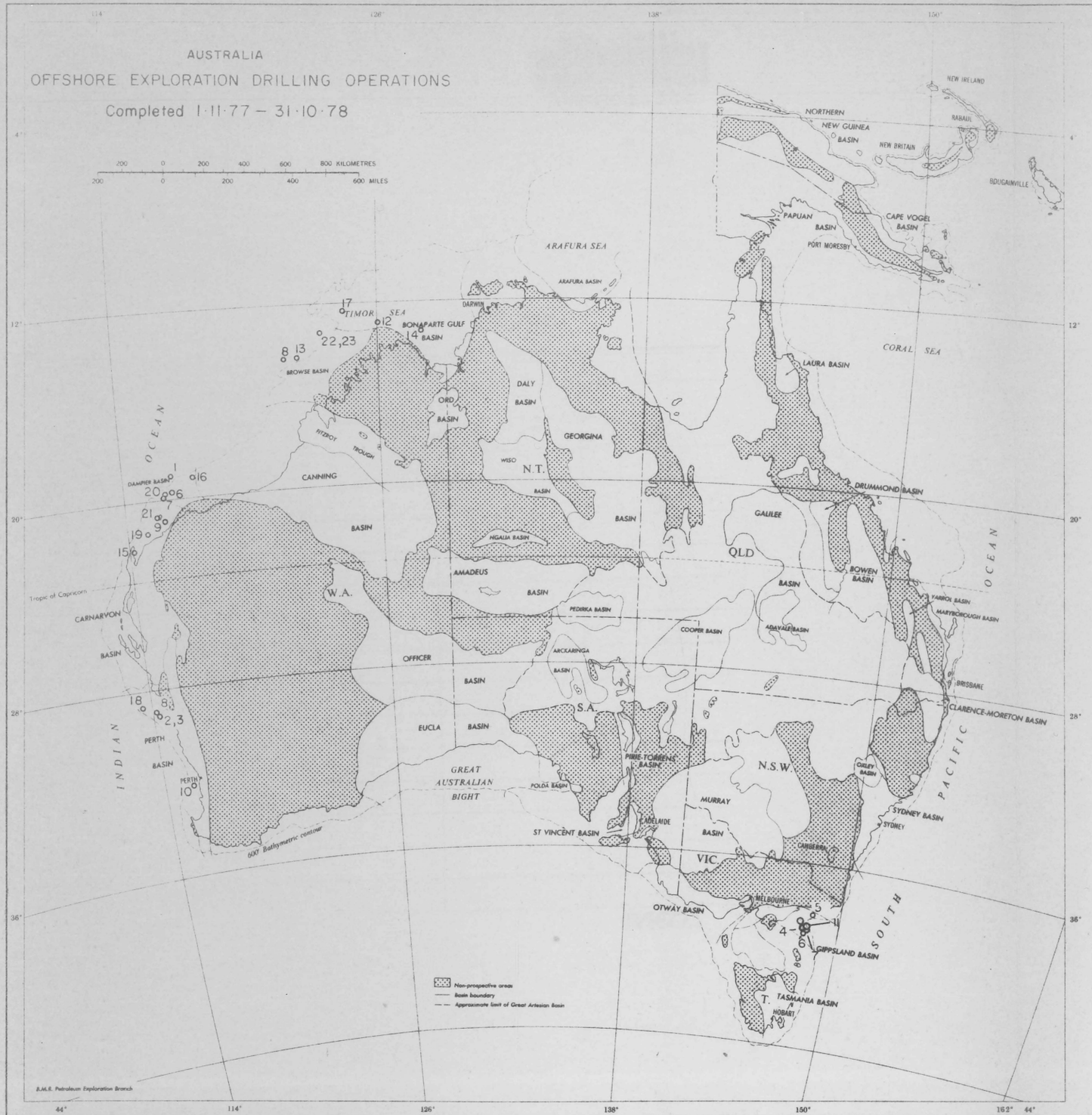
"Application of Enhanced Recovery to the Moonie Oilfield, Queensland", McKay, B.A. and Duff, P.G.

Report on the analysis of hydrocarbons in seepage fluids from the Centre Cinema Theatre and a comparison with the analysis of petrols sold in the area. McKay, B.A. and Horvath, Z.

AUSTRALIA

OFFSHORE EXPLORATION DRILLING OPERATIONS

Completed 1·11·77 – 31·10·78



1. Brigadier No.1, W.A.
2. Geelvink No.1, W.A.
3. Geelvink No.1A, W.A.
4. Fortescue No.1, Vic
5. Sweep No.1, Vic
6. Seahorse No.1, Vic
7. West Halibut No.1, Vic
8. Batavia No.1, W.A.
9. Hermite No.1, W.A.
10. Peel No.1, W.A.
11. Flounder No.6, Vic
12. Plover No.3, W.A.
13. Caswell No.1, W.A.
14. Frigate No.1, W.A.
15. Bundegi No.1, W.A.
16. Jarman No.1, W.A.
17. East Swan No.1, N.T.
18. Houtman No.1, W.A.
19. Koolinda No.1, W.A.
20. Miller No.1, W.A.
21. Mermaid No.1, W.A.
22. Bassett No.1, N.T.
23. Bassett No.1A, N.T.