DEPARTMENT OF
~~NATIONAL RESOURCES~~
NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1979/79

PETROLEUM EXPLORATION BRANCH

SUMMARY OF ACTIVITIES

1979

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PETROLEUM ASSESSMENT SECTION

During 1979 D.J. Forman completed editing and supervised drafting of plates and figures for a record on the petroleum geology of the Canning Basin.

Several meetings of Standing Group No 2 of the National Energy Advisory Committee were attended and contributions were prepared for the crude oil supply chapter of a report entitled 'Liquid fuels: longer term needs, prospects and issues' and for an update of a report on Australia's Energy Resources. A considerable amount of time was spent in preparing advice on the selection of consultants for the NERDDP-funded minimum economic reservoir size project and in discussions with the consultants and cooperating companies and government organisations.

Basin Assessment Sub-section

Vacant staff positions necessitated an amalgamation of the two groups, and some curtailment of the program planned for 1979.

The major effort was in the following areas:-

(1) Continued assessment of undiscovered petroleum resources, and development of methodology for this purpose, and for supply forecasting.

(2) Source rock studies.

(3) A field project in the Darling Basin to define suitable sites for a source-rock drilling program, and the subsequent drilling of two holes.

(4) The determination of minimum economic reservoir size for various locations, onshore and offshore, as a function of oil prices (NERDDP-funded project).

(5) Preparation of contributions to the ESCAP Atlas of Stratigraphy (IGCP Project 32).

(6) Preparation of the Canning Basin Study for issue as a BMR Record.

In the area of resource assessment, the first assessment of Australia's total undiscovered petroleum resources, made by the Petroleum Assessment Section in November 1977, was revised in the light of the

results of subsequent exploration. A paper on Australia's natural gas resources, which included the revised estimate of undiscovered gas resources, was delivered by E. Nicholas at the Fertiliser Raw Materials Resources Workshop, held at the East-West Center in Hawaii on 20-24 August. The revised estimates for oil and gas are presented in Plate 1.

Further work was done on the assessment of the hydrocarbon potential of the Sahul Platform, Bonaparte Gulf Basin, following the preliminary assessment made in 1978, and the group assisted two exploration companies to assess onshore areas. The 'prospect by prospect method' was used to assess the hydrocarbon potential of a number of structures on the Exmouth Plateau. A computer program developed in 1978 to forecast future oil production from potential discoveries was modified during the year, and predictions supplied to the Energy Policy Division. Information on undiscovered petroleum resources was supplied to the National Energy Advisory Committee and discussions relating to the assessment of undiscovered gas resources were held with The Pipeline Authority.

The source rock study program, which began in 1977 in cooperation with CSIRO, continued throughout the year. About 250 core samples from selected wells, onshore and offshore, were submitted for source rock analysis and vitrinite reflectance determination, to Robertson Research, AMDEL, and CSIRO (source-rock analysis only).

During the year, the results of source rock analyses in the Canning, Eromanga, Bowen (Denison Trough), Galilee, Carpentaria, and Bass Basins, were incorporated into publications or BMR Records, by BMR authors, or by BMR authors in cooperation with officers of the Queensland Geological Survey, and CSIRO.

In the onshore Canning Basin (Burne & others, 1979) the Ordovician of the Broome Arch and other areas, the Devonian and Lower Carboniferous of the margins of the Fitzroy Trough and adjacent terraces, and the Permian of the Fitzroy Graben probably contain mature oil source rocks. However, in the wells sampled, the organic carbon content is relatively low. Of the 100 samples analysed, only eighteen had an organic carbon content greater than 0.5 percent, and in fifty-five samples it was less than 0.2 percent. The unexplored southeast Fitzroy Graben is suggested as an area with potential for future successful exploration.

Source-rock analyses in the onshore Carpentaria Basin (Passmore, 1979), indicate that although with the exception of the Toolebuc Formation, the basin rocks are often a poor oil source, and generally immature, in some of the deeper wells organic matter in the Cretaceous Gilbert River and Wallumbilla Formations and in the Middle Jurassic section of the Helby Beds is in the very early stages of hydrocarbon generation. With greater depth of burial and/or additional heat source these units may generate liquid hydrocarbons. The offshore area, where these units may have attained a greater depth of burial, is currently attracting company interest.

In the central Eromanga Basin (Senior, 1979), the Jurassic and Lower Cretaceous sections have been shown to contain fair to very good source rocks for oil. About half of the sequence is marginally mature, or mature, depending on depth and variation in geothermal gradient.

A preliminary interpretation of source rock analyses in the Early Tertiary Eastern View Coal Measures of the Bass Basin (Lockwood & Nicholas, in prep.), indicates that the sequence contains good source rocks for oil, and in the coaly sections, source rock for oil and gas. The results to date show that much of the sequence is in the very earliest stages of hydrocarbon generation, and that the deeper levels tested, although mature, are at an earlier stage of maturity than indicated from the data of Kantsler & others (1978).

In the Galilee Basin (K. Jackson, pers. comm.) source rocks are rather rare. Those present are characterised by low total organic content, and low organic extract, indicating poor potential for hydrocarbon generation.

In the Denison Trough of the Bowen Basin (K. Jackson, pers. comm.) the Permian sequence, particularly the Cattle Creek Formation, and Reids Dome Beds, contain rocks with fair to good source potential. Much of the section is mature, and some parts of the Reids Dome Beds overmature.

All the results obtained by the source rock study project to date have been distributed to the relevant State Mines Departments; those which have not yet been reported on by BMR to be held on a restricted basis.

Extraction of data from source rock study reports, including company reports, for inclusion in the data base of the IMAGE computer reference system, has continued, and an Operation Instruction prepared as a BMR Record.

Members of the Basin Assessment and Petroleum Technology Sections attended a meeting at the CSIRO Mineral Research Laboratories in North Ryde, to discuss the progress of the source-rock project, and areas of possible future cooperation. An important outcome of the meeting has been the setting up of mutually acceptable arrangements for the future exchange of source-rock data between BMR and CSIRO.

Field reconnaissance work in the Darling Basin was undertaken in cooperation with Geological Branch. Two drill sites were located where potential source rocks of Early Devonian age are predicted to occur at depths less than 300 m. The drilling program is planned for the November-December period. The first hole will be drilled close to the previously drilled petroleum exploration well, Berangabah No. 1 about 150 km southwest of Cobar, to obtain core of the Early Devonian sequence penetrated by the well. The second hole will provide stratigraphic control on the previously undrilled southern margin of the Blantyre Trough, and test the current interpretation of the geology based on seismic data.

The Minimum Economic Reservoir Size project was carried out in cooperation with consultants hired with funds provided by a NERDDP grant. Cooperation was obtained from oil companies, State Geological Surveys, and The Pipeline Authority in the provision of basic data. The consultants' report, including estimates for six or seven areas, is expected within the year.

The preparation of contributions to the ESCAP Atlas of Stratigraphy continued throughout the year. A detailed summary of the year's work is given in the annual summary of activities for the Geological Branch, which provided supervision and professional editing. The resulting reports are included in the Appendix herein. During 1979 the project was integrated with the source-rock studies program, and the results of source-rock analyses in the Carpentaria Basin were included in a BMR Record prepared from the atlas contribution for that basin.

One of the most important objectives for the year was to complete the preparation of the detailed Canning Basin study report. Professional editing was completed, and text, plates, and figures corrected and amended as required. The study was forwarded to the editors for production, initially as a BMR Record.

Other activities included monitoring of exploration activity on the Exmouth Plateau, revision of the preliminary geothermal gradient map produced in 1978 (a map and a list of geothermal gradients at well locations has been prepared), and a study of the petroleum potential of the Eastern View Coal Measures in the Bass Basin. It was necessary to narrow the original scope of these three projects owing to the constraints imposed by the reduction in staff numbers.

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.

Technical comments and recommendations were prepared for Oil and Gas Division on applications for new permits offshore Australia. Approximately 50 applications were dealt with during the year. Comments were also prepared on applications for renewal of offshore permits.

Officers of the Sub-section were involved in studies of the Halibut/Fortescue area of the Gippsland Basin with a view to providing advice to the Department on the classification of the oil in the Fortescue area.

During the twelve months ended 31 October 1979, nineteen exploratory wells were drilled in offshore Australia; of these, fourteen were new-field wildcats and five were extension wells (see Table 1 and Plate 2). Eleven of these wells were drilled in waters adjacent to Western Australia, five in waters off Victoria, one off Tasmania and two

off the Northern Territory. The average depth of wells off Western Australia was 3395 m, off Victoria 2659 m, off Tasmania 3050 m, and off the Northern Territory 3182 m. In total 55 053 m of drilling was completed with an average depth of 3160 m for the eighteen wells drilled.

Three development wells were completed on the Mackerel 'A' platform and six development wells were completed on the Tuna 'A' platform; both platforms are in the Gippsland Basin, Victoria.

Three significant oil wells were drilled offshore during the year. These wells, Fortescue Nos. 2, 3, and 4, were drilled by Hematite Petroleum Pty Ltd and Esso Exploration and Production Australia Inc in the Gippsland Basin, Victoria.

Table 1

Offshore Exploration Drilling Operations,
Completed 1 November 1978 to 31 October 1979

Operator	Well	Total Depth (m)	Status
Esso Exploration and Production Aust. Inc.	Fortescue No. 2	2650	P & A
	Fortescue No. 3	2625	P & A
	Fortescue No. 4	2603	P & A
	Investigator No. 1	3246	P & A
	Rockling No. 1	2684	P & A
	Zeewulf No. 1	3500	P & A
	Threadfin No. 1	2735	P & A
West Australian Petroleum Pty Ltd	Campbell No. 1	2750	P & A
	Sultan No. 1	3620	P & A
Woodside Petroleum Development Pty Ltd	Pueblo No. 1	3485	P & A
	Finucane No. 1	3300	P & A
	Goodwyn No. 5	3048	P & A
	Woodbine No. 1	3502	P & A
Getty Oil Development Company Ltd	Tamar No. 1	2862	P & A
Arco Australia Ltd	Grebe No. 1	3000	P & A
Hudbay Oil (Australia) Ltd	Gandara No. 1	4361	P & A
Stirling Petroleum N.L.	Bruce No. 1	2168	P & A
Hematite Petroleum Pty Ltd	Pelican No. 4	3050	P & A
Phillips Australian Oil Co.	Jupiter No. 1	5000	P & A

Goodwyn No. 5 was drilled as a confirmation well in the Goodwyn gas field on the Northwest Shelf, and Pelican No. 4 was drilled as a confirmation well in the Pelican gas and condensate field in the Bass Basin, Tasmania. Two wells, Investigator No. 1 and Zeewulf No. 1 were drilled in deep water by a dynamically positioned drillship for Esso Exploration and Production Australia Inc., and Hematite Petroleum Pty Ltd on the Exmouth Plateau, Western Australia. Phillips Australian Oil Co. also drilled a well, Jupiter No. 1, on the Exmouth Plateau with a dynamically positioned drillship. All three wells were plugged and abandoned after encountering minor gas shows.

During the year nineteen marine seismic surveys were carried out in waters adjacent to Western Australia and Queensland. The total coverage of the surveys was approximately 36 221 line kilometres. In addition a marine gravity survey of 4810 line kilometres was completed in Western Australian waters.

The Sub-section continued to give technical advice to the Northern Territory Designated Authority. In April an officer of the Sub-section inspected Woodbine No. 1 offshore drilling operation in Northern Territory waters, and had discussions with officers of the Department of Mines and Energy, Darwin about offshore operations. The offshore drilling operation Grebe No. 1 in Northern Territory waters, was inspected in June.

An officer visited Alice Springs in May for discussions with Northern Territory authorities regarding the sampling of crude oil from East Mereenie No. 4 well. He witnessed the sampling of this well in June, as technical representative for the Northern Territory.

Officers of the Sub-section continued to act as technical advisers on petroleum exploration to the Papua New Guinea Government.

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 customers' requests for copies of PSSA material. With the advertising of new offshore title areas and the renewed interest in onshore Australian exploration the work load in this area has continued to increase.

Archives: The Sub-section continued to liaise with Australian Archives about the storage and retrieval of petroleum search magnetic tapes and other data. Technical advice was provided as required.

Offshore Index: Lack of availability of staff both in the Offshore Sub-section and the ADP Applications Section has hampered progress in conversion of the index from the INFOL system to the Hewlett-Packard IMAGE system, but the conversion is nearing completion.

Core and Cuttings Laboratory: During the year, BMR personnel made 170 visits to the laboratory. Representatives from 15 consulting organisations, oil and mining companies made 36 visits. Officers from universities and State Government Departments made 44 visits.

Staff attended to visitors' requests to examine 523 wells. Visitors borrowed 5635.79 metres of core, 51 190 cuttings samples, 100 seismic shot hole samples and 76 open file sample analysis reports.

Samples were received from a total of 162 offshore company wells and BMR drill holes, and from other sources. These samples amounted to 5881.8 metres of core, 17 695 cuttings, and 286 cored cuttings samples. Six cartons of seismic shot hole samples were received from the BMR Denison Trough survey. All receivals were checked and discrepancies resolved.

The gathering, checking and recording of information on the year's drilling operations was carried out on index, accession and summary cards, registers and well files.

About 30 laboratory analysis reports were received during the year. These were checked against samples borrowed for discrepancies, registered and filed.

Core and cuttings samples from a total of 207 company offshore and BMR drill holes were registered, amounting to 3133.42 metres of core and 12 750 cuttings samples. The grand total of registered samples held in the laboratory is now 1 193 564 samples.

Two diamond saws operated for 68 man days slabbing 332 metres of core from Mount Isa No. 1 and Darwin wells. Many surface rock samples were cut to size for chemical analysis and thin sectioning for various research projects. Twenty-seven thin sections were made for BMR officers.

During the year the remaining storage space in the compactus units was filled. It then became necessary to use temporary storage. The purchase of materials handling equipment solved many problems in transporting large quantities of materials, and resulted in a faster handling of samples. Painting of the Core and Cuttings Laboratory was carried out by contract.

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 fulfil completely their appropriate functions.

Mr J.A.W. White, Chief Petroleum Technologist, updated a paper for the National Energy Advisory Committee on Exploration for Oil and Gas in Australia to include the latest information and forecasts. Several meetings of the Oil Shale Committee were convened and chaired during the year. A review of BMR's past, present and recommended future involvement in oil shale was compiled and two records on oil shale were prepared.

Considerable time was spent on a critical examination of draft Directions proposed under the Petroleum (Submerged Lands) Act and for the Northern Territory under the terms of the onshore Petroleum (Prospecting and Mining) Ordinance 1954-1960. Assistance was also given to Papua New Guinea on the preparation of new onshore Directions under their Petroleum Act 1977, and to Fiji under their Petroleum (Exploration and Exploitation) Act 1978. Work continued on the evaluation of new prospects on Barrow Island to determine whether 'new' oil or 'old' oil prices would be appropriate. During the year, classifications were recommended for some 32 new Barrow Island wells. J. White visited West Australian Petroleum Pty Ltd in Perth and the Barrow Island field to review production metering and gauging methods and equipment and to inspect new development drilling operations.

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 Administration of the Northern Territory

on any scientific or technical matters arising in connection with the exploration for and production of petroleum in the Northern Territory.

As an Inspector under the Petroleum Act 1977 of Papua New Guinea, a visit was made to Goari No. 1 well between 6 and 10 November 1978.

A meeting of the Task Group and Inter Departmental Committee on the future supply of electricity in the Northern Territory was attended and a submission to the Task Group prepared. A major effort was put into various studies and evaluation regarding an application by Esso-BHP for 'new' oil pricing for oil in the Fortescue area.

The Section received some 126 visits from individuals and groups during the year together with 6 students and one trainee from Malaysia 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, liquefied petroleum gas (LPG), and natural gas, together with cumulative production and remaining recoverable reserves were prepared and published in the relevant Petroleum Newsletters Nos. 75, 76, 77, and 78 (currently in preparation). There have been numerous requests for comment from the Department in respect of Foreign Investment applications where these concern petroleum exploration and development companies, titles, etc.

Petroleum Engineering and Drilling Engineering comments were prepared on several drilling projects on the Exmouth Plateau.

The annual collection of petroleum exploration, development, and production expenditure and geological and geophysical activities was undertaken, and the results will be published in Petroleum Newsletter No. 78 (in preparation). They are being further analysed and will be published in detail in the Petroleum chapter of the Australian Mineral Industry Annual Review, 1978. There has been a marked increase from the various Divisions of the Department for information and/or statistics in

connection with the work of NEAC and in connection with an energy policy paper; in particular graphs on exploration activity and reserves and production were prepared (plates 3 to 6).

In summary, the results of this survey show that there was a 12% increase in exploration drilling expenditure in 1978 over 1977; this was mainly due to the increase in offshore exploration drilling from 13 wells completed in 1977 compared to 23 in 1978, and in onshore exploration drilling from 8 in 1977 to 33 in 1978. Geological and geophysical exploration activity in 1978 in terms of crew months of work together with a comparison with 1977 are given in Table 2. There has been a noticeable increase in the level of these activities in 1978, with the exception of Geological surveys which decreased markedly, and land magnetic work of which none was reported for the 3rd year running.

Table 2

Level of Geological and Geophysical Activity, 1978

Survey	Unit of Work	1977	1978
Land Seismic	Crew months	11.91	35.66
Marine Seismic	Crew months	5.18	21.11
Gravity Surveys	Crew months	2.0	2.41
Geological Surveys	Crew months	28.3	3.5
Magnetic Land	Line km	nil	nil
Aero	Line km	nil	5048
Shipborne	Line km	758	3053

Total petroleum exploration expenditure in Australia in 1978 was $116.5 million; reflecting an increase in exploration expenditure of 35.3 percent over 1977 when the expenditure was $86.1 million.

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

(i) The Petroleum Newsletter (Quarterly) Nos. 74, 75, 76, and 78, including monthly drilling rig activity and quarterly statistics.

(ii) A breakdown of petroleum exploration, development, and production in Petroleum Newsletter No. 78 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 1978. A similar map to show the position as at 1 January 1979 is at the printers and the map showing the position as at 1 July 1979 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 industry and professional journals is maintained on a subject and author basis.

Petroleum Technology Laboratory

The laboratory experienced a busy year with increased internal demand for its services. Of particular overall interest in the laboratory was the participation with other members of the Branch in the investigation of the Fortescue reservoir in Gippsland; petrophysical training of an employee from Malaysian National Oil Company (Petronas) for 3 months; and the preparation of a tentative agreement for possible leasing of the reservoir fluid analysis (PVT) equipment because of the continued inability to staff this facility within the laboratory.

Petroleum and Source Rock Geochemistry Group: The principle investigations involved source-rock and gas analysis studies of samples from boreholes in the Georgina Basin to assist the Georgina Basin Project, the characterisation of oils from the Gippsland Basin, Fortescue, Cobia and Halibut fields, and further geochemical studies of oil and source-rock samples from the Galilee Basin.

Other limited geochemical studies were carried out on samples from the Darling Basin (total organic carbon) and the Pedirka Basin (hydrocarbon isotopic and kerogen analysis).

Equipment rationalisation occupied considerable time during the year with development of the canned cuttings "head space" gas analysis apparatus being foremost. This equipment is now operational,

with the first series of sealed containers (Goari No. 1 well) analysed. Steps are being taken to computerise output to minimise data handling. The single temperature Curie point pyrolyzer was also made operational in conjunction with a flame ionisation chromatograph. The programmed temperature pyrolyzer is still being modified and will be in operation in 1980. With adequate staffing, these new techniques will speed up our geochemical analysis, which in the past has been limited by classical time-consuming extraction technology. A new total organic carbon analyser to be put on stream in 1980 should also help in increased output.

Additional minor work during the year involved investigation of hydrocarbon product contamination for the Department of Capital Territory and analysis of oil shale samples through the Australian Coal Industry Research Laboratories. Further work was also undertaken on storage of geochemical data on the "Image" computer system with a user guide in preparation.

During the year, Dr Jackson participated with other branch officers in interpretation of source-rock data supplied by contractors and in ongoing program discussions with personnel of the CSIRO Fuel Geoscience Group at North Ryde. Dr Jackson also participated in a petroleum geochemical symposium at North Ryde and gave a talk on "Canned Cuttings Analysis"; he also lectured at the BMR Symposium on "Geochemistry as Applied to Exploration". Meetings were held in Adelaide with officers from South Australian Mines Department and AMDEL and at Melbourne University on contract work and mutual problems in petroleum geochemistry. An international conference on environmental biogeochemistry was attended by Dr Jackson in Canberra during August.

Petrophysics: Work was carried out during the year on the reasons for low oil recovery in the north end of the Moonie oil field. This involved clay content studies and oil displacement tests on core samples from three wells, and indicated a probable poor natural water drive in that portion of the field, combined with some indication of mobile clays in the pore system (less pronounced in the south). No significant amounts of expanding bentonitic type clays were noted.

Assistance was provided to the reservoir engineering group in improving interpretation of electric log derived porosities in the North Rankin reservoir. Porosity-formation factor plots from core

electrical resistivity measurements enabled a more representative cementation factor to be determined. The main problem appeared to be accessory minerals, principally siderite, in the formation.

Gas recovery tests by water drive were conducted on samples from two Cooper Basin fields, the Namur and Moomba gas reservoirs. Gas and water porosity-permeability tests were conducted for the Department of Mines and Energy, Northern Territory on water-bore samples. In addition, tests on semi-consolidated sediments from the Baas Becking environmental tank and from their work in Spencer Gulf were subjected to water permeability tests using specially developed core holders.

In routine core testing (porosity, permeability, density, fluid saturations) the majority of the work conducted was for other parts of the Bureau, notably the Geological and Geophysical Branches. However, core analysis was also conducted for State Mines Departments, the Australian National University, on samples received from drilling operations under the Petroleum (Submerged Lands) Act, and to a minor extent for industry. Of particular interest in these core studies was a series of whole core samples from the Georgina Basin (Mount Whelan No. 2) subjected to whole core analysis for the Georgina Basin Project. These cores contain a substantial number of large pore vugs restricting any routine plug analysis. Further work on additional whole core samples from Mount Whelan 1 and 2 are expected to continue in the coming year. The total number of samples for routine core analysis during the year was 575.

In drilling mud investigations, three independent evaluations of commercially available bentonites were conducted for industry in the light of increasing costs and demands for bentonitic type drilling clays.

Other areas of interest involving the petrophysical group was a two-day petrophysical training session given to students of the Sydney University Reservoir Engineering School, in addition to the three-month petrophysical training for the Petronas employee from Malaysia.

During the year, Messrs Duff and McKay gave a (BMR) lecture on their work on the Moonie enhanced-recovery project from 1978. Mr McKay attended a symposium on enhanced oil recovery at Sydney University and gave a lecture on possible enhanced recovery applications in Australia.

Reservoir Engineering Sub-section

Australia's petroleum reserves on land and offshore were published quarterly in Petroleum Newsletter Nos. 75, 76, 77, and 78 (in press). 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 1979 are given in Table 3. These data differ from previous reporting since the discovered but not yet producing reserves are not included in these estimates.

The purpose of this change is to bring the information presented here in line with Table 1 of the Petroleum Newsletter. Data in Table 2 of the Petroleum Newsletter give discovered but not yet declared commercial oil and gas reserves and are uncertain and subject to major revisions.

Table 3

Economic Petroleum Reserves

	Initial Reserves	Cumulative Production	Remaining Reserves
Crude oil	$461.83 \times 10^6 m^3$	$206.77 \times 10^6 m^3$	$255.06 \times 10^6 m^3$
Condensate	$42.56 \times 10^6 m^3$	$3.67 \times 10^6 m^3$	$38.88 \times 10^6 m^3$
LPG	$98.39 \times 10^6 m^3$	$20.03 \times 10^6 m^3$	$78.36 \times 10^6 m^3$
Natural Gas	$366.95 \times 10^9 m^3$	$47.31 \times 10^9 m^3$	$319.64 \times 10^9 m^3$

Economic petroleum reserves are defined as those expected to be recovered and produced under natural or primary drive conditions. Secondary recovery of oil is included in the reserves only if the process has already been started. The recoveries are based on estimates of the original hydrocarbons in place, established 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 there is a high degree of uncertainty in the input parameters.

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 Bream, Pelican and Seahorse fields. The Flounder and Hapuku fields are currently being studied. A considerable effort by the group was taken up in evaluation of the Halibut, West Halibut, Fortescue and Cobia petroleum occurrences. One of the principal efforts has been to monitor the development in technology on methodology of estimating oil and gas reserves; this includes wire-line log interpretation and computer techniques, as well as new mathematical approaches.

The technology of methanol, ammonia, and urea production continues to be monitored with a view to convert remotely located gas to a product easily transported.

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 was seconded to the Departmental Task Group on Oil Supplies for eight weeks.

I. Donald and M. Ellis attended a 3-day course on the Hewlett-Packard 9825A calculator.

S. Ozimic attended the APEA Conference in Perth, and presented the following paper:

'Petrological and Petrophysical Study of Permian Arenites for Potential Subsurface Storage of Natural Gas, Sydney Basin, New South Wales, Australia', APEA J. 19(1) 1979, 115–130.

Drilling Engineering Sub-section

Plant and Equipment: On the completion of the 1978 Bowen Basin Seismic field party one A.E.C. Leyland 1000 gallon water tanker was returned to Brisbane for disposal and two A.E.C. Leyland 1000 gallon tankers were stacked in Roma, Qld. Two Inter 600-gallon water tankers were returned to the ACT to replace the two A.E.C. Leylands stacked in Roma. All drilling units plus drilling and camping equipment from other parties was returned to the ACT.

On the completion of the 1978 field parties the three remaining drilling units to be modified were dismantled. Leyland 400 on-deck motors, plus chain, sprocket drives and shafts were removed.

Two new transfer boxes were assembled into the Mack prime-mover transmissions. Modifications were carried out to the rig and compressor drives and the installation of a gearbox to give variable mud-pump speeds when coring, which gives greater efficiency and time saving as the pump liners do not have to be changed when high drilling or coring revolutions are desired.

All drilling rigs were modified by BMR drilling personnel in the work shop at Fyshwick and were ready for field work by the end of March 1979.

All Mayhew drilling rigs have now been modified and are driven by the Mack prime-mover engine. The chassis and rig-gross weight is estimated at 3000 kg less than before the modifications were carried out, improving vehicle traction and reducing overall maintenance.

Specifications for the supply of water tankers to replace the existing A.E.C. 1000-gallon tankers previously submitted to Division of Transport and Storage have now been approved by the Contracts Board and are presently being assembled by the successful tenderer in Brisbane.

Workshop (Fyshwick, ACT): Extensions and modifications to the existing workshop were completed late November 1978. The extensions have proved to be a worthy addition as all repairs and modifications can now be carried out under cover and by our own personnel.

The Department of Housing and Construction carried out the machining of equipment and supplied material for modifications and repairs to plant and equipment throughout the year.

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

5 - Mayhew 1000 Drilling Rigs mounted on Mack R6-85 RS chassis
3 - 1000-gallon water tanks on A.E.C. Militant chassis
1 - 1000-gallon water tank on A.E.C. Militant chassis in Brisbane (for disposal)
1 - 1000-gallon water tank on A.E.C. Militant chassis in ACT (for disposal)
2 - 600-gallon water tankers mounted on International 1600 chassis
1 - "Gemco" 210B "Tandem Trailer" mounted Auger/diamond Drill rig
4 - 6-ton 4-wheel drill trailers.

Drilling Operations: In the year ending 31 October 1979, the Drilling Sub-section provided eleven drilling parties in support of various BMR field activities. Drilling and diamond coring operations took place in the ACT and NSW, diamond over-coring in NSW for stress measurements, drilling and diamond coring in the Alice Springs and McArthur River areas of the NT, diamond coring in the Rum Jungle and Alligator Rivers (NT) areas, seismic shot hole drilling in NSW, Daly Waters (NT) and Bowen Basin (Qld). Personnel were provided for the Barrier Reef program.

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 1978 to 31 October 1979.

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

Table 4

BMR Drilling Operations 1 November 1978 to 31 October 1979

BRANCH AND SECTION	PROJECT AREA OF OPERATION	FROM	TO	NO. OF HOLES	METRES DRILLED	METRES CORED	DRILLED & CORED	NO. OF CORES	AVERAGE CORE RECOVERY (%)	TIME SPENT-HRS OPERATING DRILLING	TIME SPENT-HRS OPERATING CORING	TIME SPENT-HRS OPERATING * TOTAL	AVERAGE PENETRATION RATE METRES/HR DRILLING	AVERAGE PENETRATION RATE METRES/HR CORING	AVERAGE DEPTH OF HOLE (METRES)	TRAVELLING TIME (HOURS) **
GEOLOGICAL																
Metalliferous	Alligator River	26-06-79	16-10-79	50	550.48	503.52	1054.00	160	95.96	162.00	224.00	386.00	3.39	2.24	21.08	8.00
	Stuart Point															
	Rum Jungle (NT)	30-10-78	23-11-78	1	30.48	220.07	250.55	72	100.00	14.00	123.50	137.50	2.17	1.76	250.55	-
	Camooweal															
Sedimentary & Engineering Hydrology	Alice Springs	4-05-79	11-10-79	12	369.25	1297.80	1667.05	273	93.39	90.00	580.50	670.50	4.10	2.23	138.92	25.00
	McArthur River (NT)															
	ACT/NSW	26-02-79	22-06-79	13	18.05	495.05	513.10	375	84.68	12.00	302.00	314.00	1.50	1.63	39.46	107.50
GEOPHYSICAL																
Regional	ACT/NSW (Stress Measurements)	14-02-79	28-03-79	7	83.30	25.48	108.78	49	100.00	31.50	26.50	58.00	2.64	.96	15.54 + 2 for 1½ - 7.77	30.50
Seismic (Land)	Gundary Plains (NSW)	19-03-79	9-04.79	52	735.95	-	735.95	-	-	82.00	-	82.00	8.97	-	14.15	20.50
	Denison Trough (QLD)	26-10-78	2-11-78	235	9621.00	-	9621.00	-	-	214.00	-	214.00	44.95	-	40.94	85.00
	Bowen Basin (QLD)	23-07-79	25-10-79	1153	43681	-	43681.00	-	-	1249.50	-	1249.50	34.95	-	37.88	369.00
TOTALS		1-11-78	25-10-79	1523	55089.51	2541.92	57631.43	949	94.80	1855.00	1256.50	3111.50	29.69	2.02	37.84	645.50

SUMMARY:-

Total metres drilled 55089.51
" " cored 2541.92
" " drilled & cored 57631.43
" number of holes 1523
" " " cores cut 949
Average core recovery 94.80%

*"Total Operating 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.

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APPENDIX

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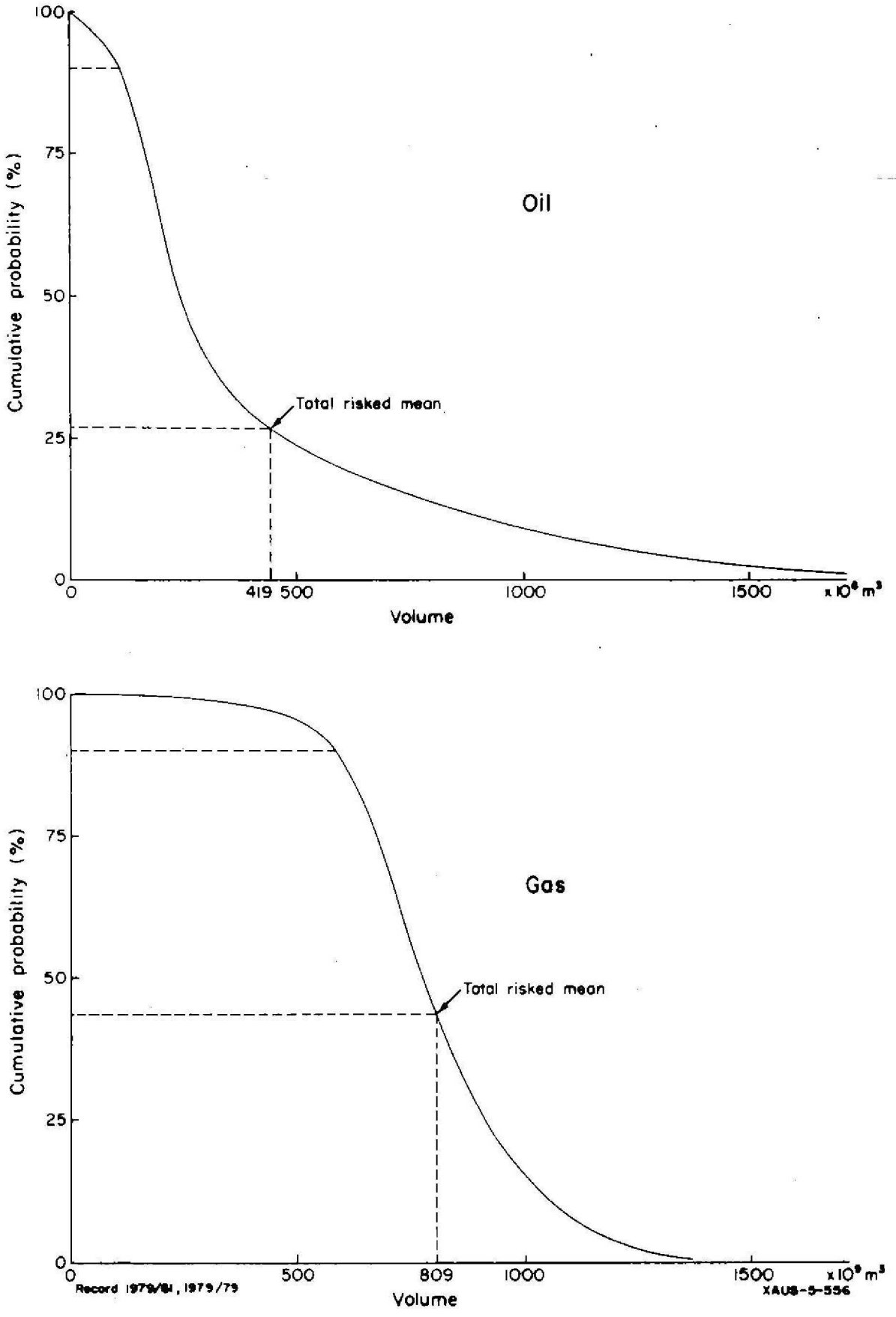


Plate 1 Australia, undiscovered recoverable oil and gas resources, estimated May 1979

AUSTRALIA

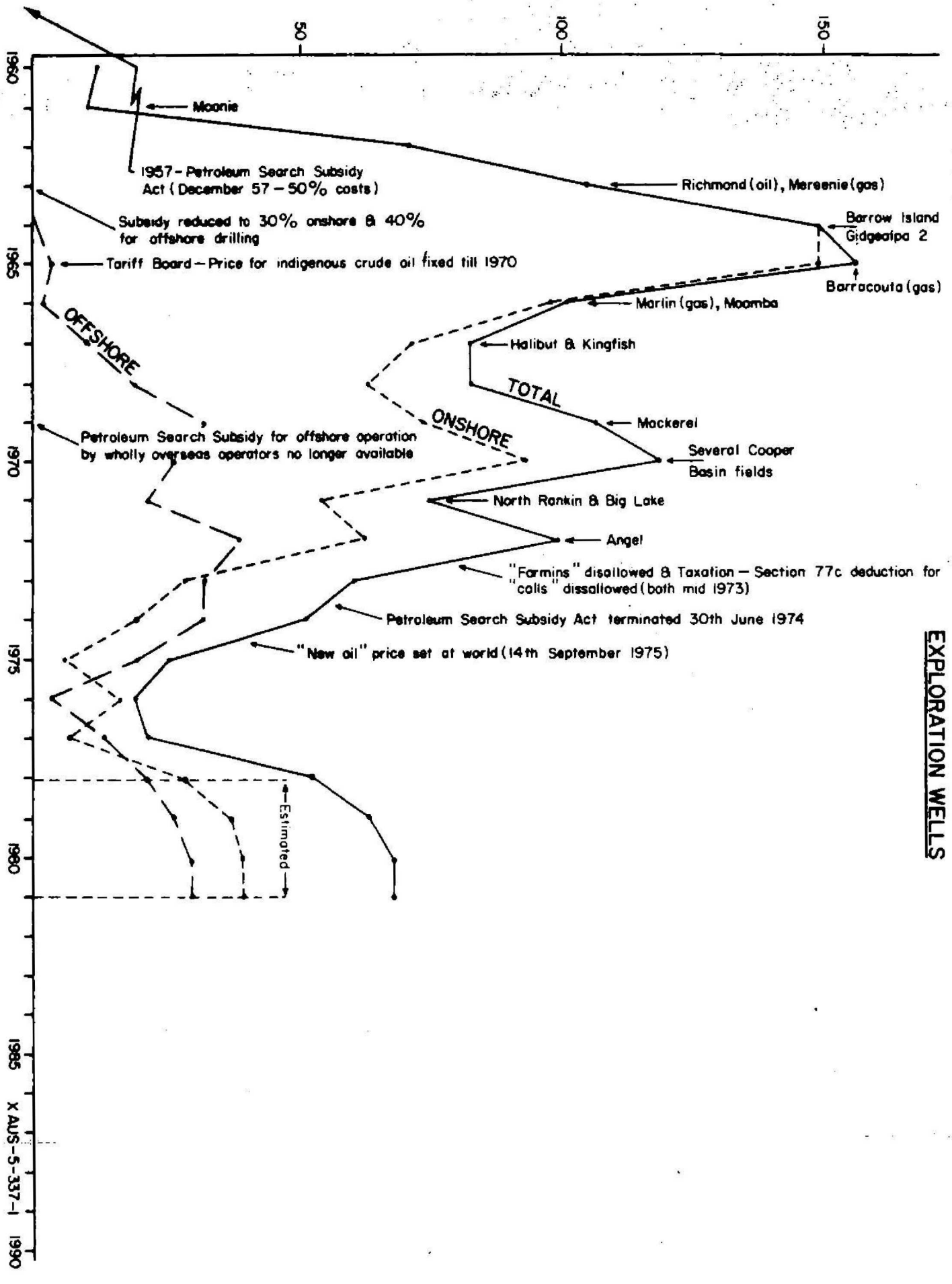
OFFSHORE EXPLORATION DRILLING OPERATIONS

Completed 1·11·78 – 31·10·79

1. Fortescue 2 Vic.
2. Finucane I WA
3. Fortescue 3 Vic.
4. Rockling I Vic.
5. Threadfin I Vic.
6. Goodwyn 5 WA
7. Zeewulf I WA
8. Fortescue 4 Vic.
9. Sulton I WA
10. Tamar I WA
11. Pueblo I WA
12. Campell I WA
13. Pelican 4 Tas.
14. Gandara 1 WA
15. Grebe I NT
16. Woodbine I NT
17. Investigator I WA
18. Bruce I WA
19. Jupiter I WA

XAUS-1-140-2

Plate 2

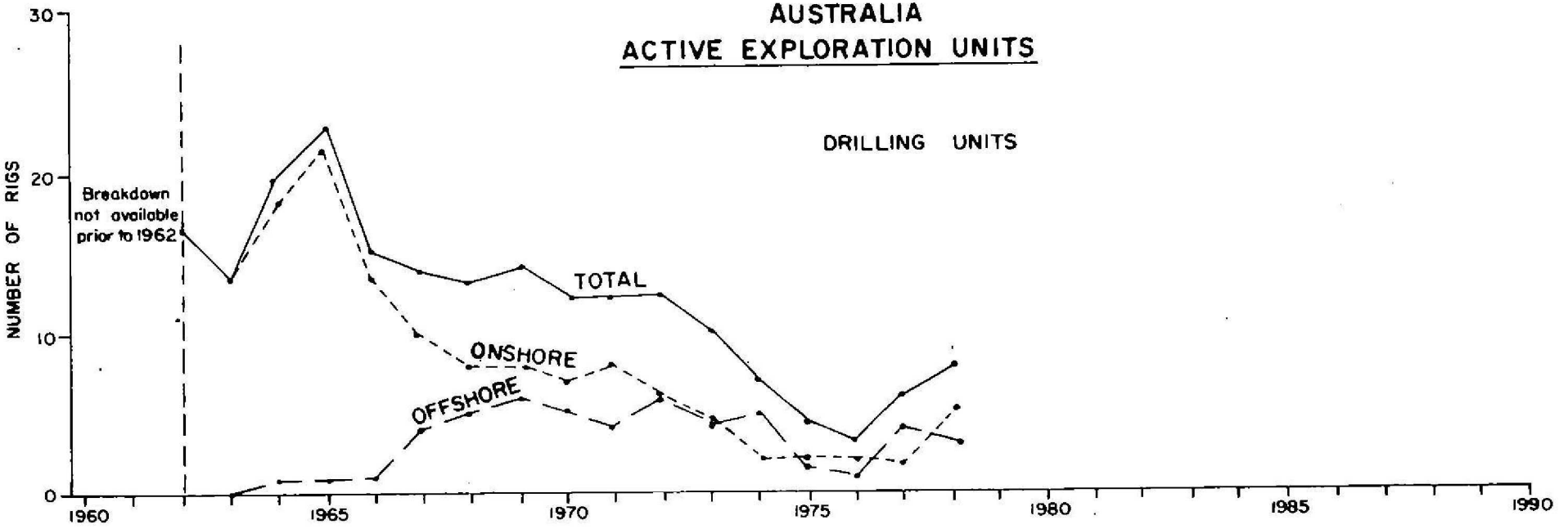


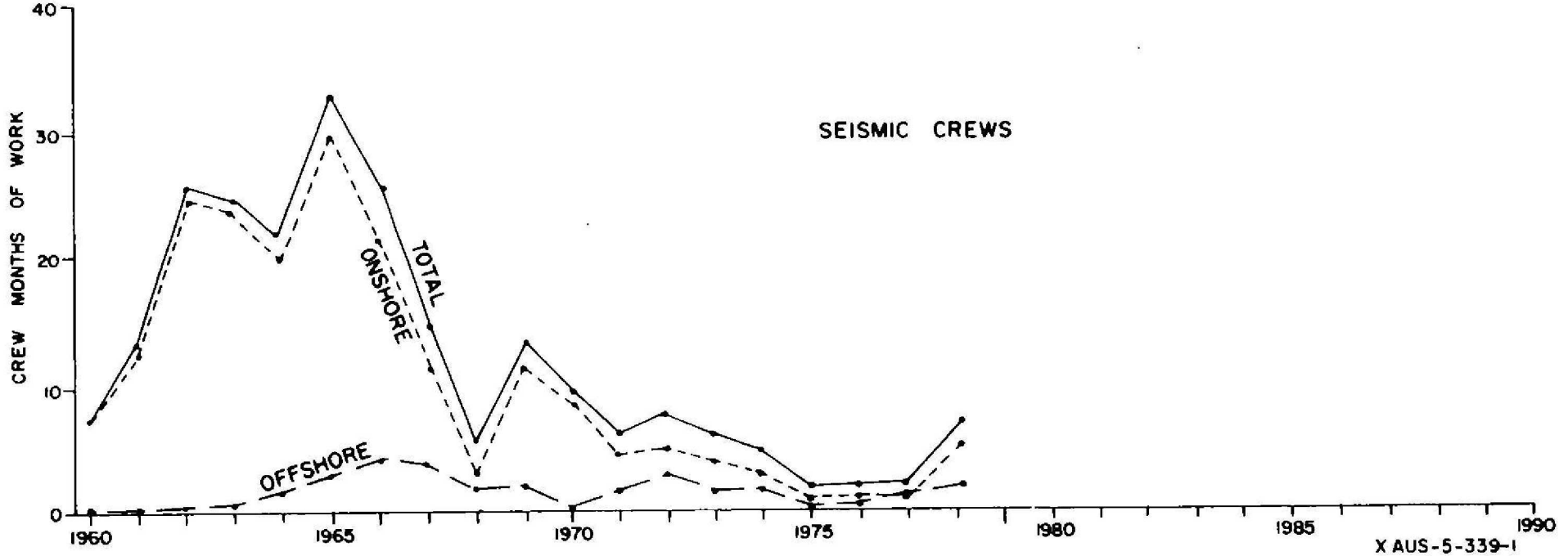
AUSTRALIA
EXPLORATION WELLS

X AUS-5-337-I

PLATE 3

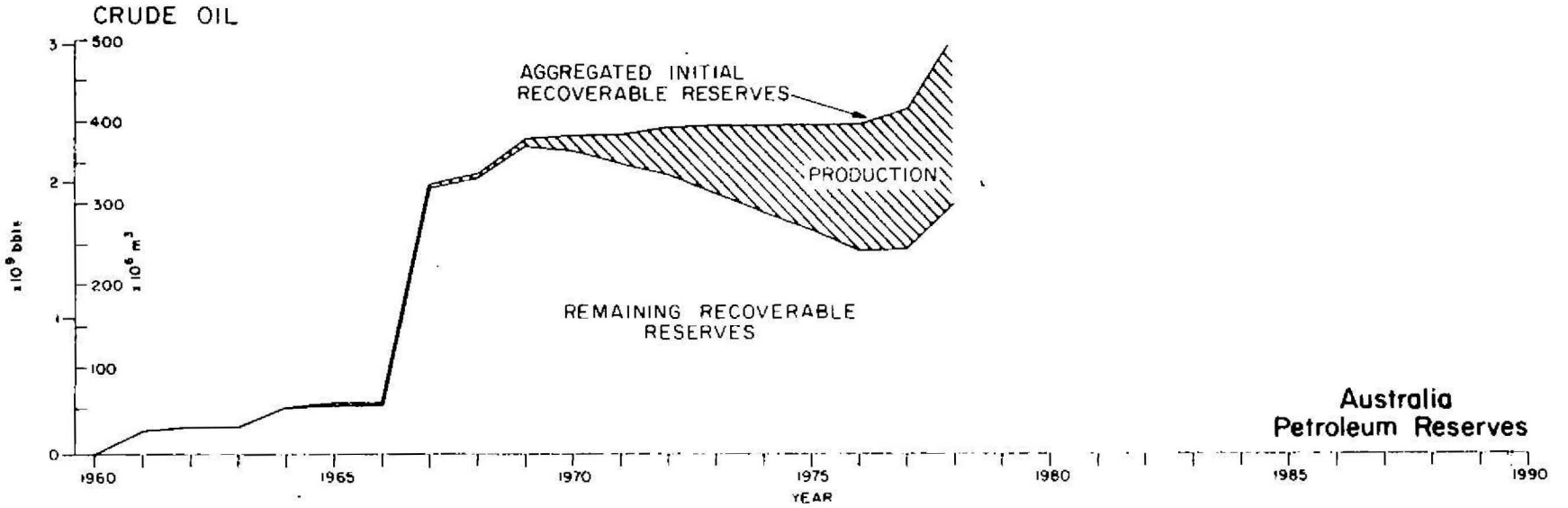
AUSTRALIA
ACTIVE EXPLORATION UNITS





X AUS-5-339-1

PLATE 4



Australia
Petroleum Reserves

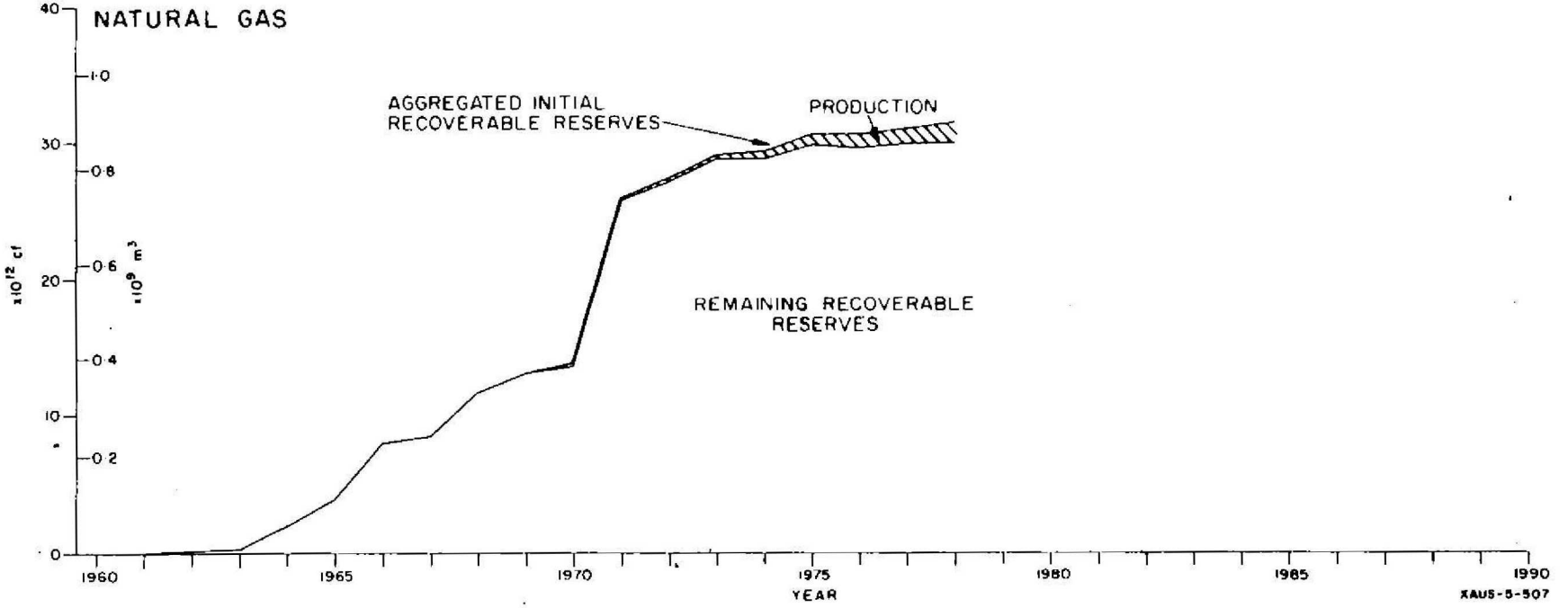
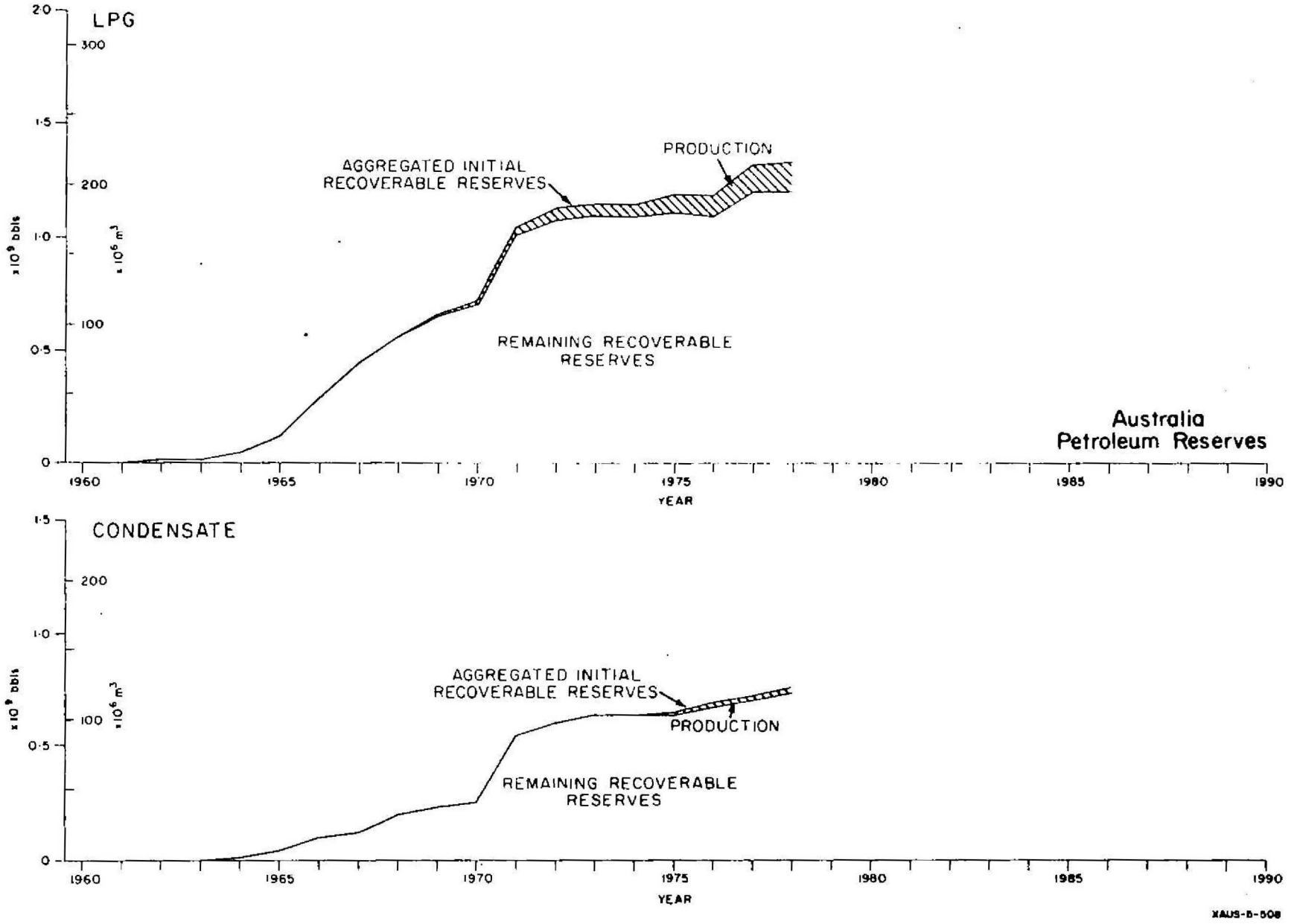


PLATE 5



Australia
Petroleum Reserves

PLATE 6