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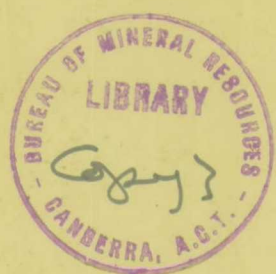
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COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

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REVIEW OF
GEOPHYSICAL EXPLORATION
FOR OIL
IN AUSTRALIA AND NEW GUINEA
TO THE END OF 1958



by

N.G. CHAMBERLAIN and C.A. MADDERN

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ABSTRACT

A review is given of the exploration in the search for oil carried out by Government and private organisations in Australia and New Guinea.

The information presented deals mainly with exploration by geophysical methods. The extent of the geophysical exploration for oil in the various sedimentary basins is illustrated by maps showing the location of gravity, seismic and aeromagnetic surveys carried out up to December, 1958. The more important results of the Bureau's geophysical surveys are discussed briefly. The geological and drilling activities are given in summary form.

1. INTRODUCTION

This record was originally prepared as part of the background information compiled by the Bureau of Mineral Resources, Geology and Geophysics, for presentation at a Symposium on the Development of Petroleum Resources of Asia and the Far East. The Symposium was convened by the United Nations Economic Commission for Asia and the Far East, and was held at New Delhi in December, 1958.

The information presented here is concerned mainly with the geophysical exploration for oil, and includes a considerable amount of material provided by the Mines Departments of New South Wales, Queensland and South Australia and by the following private companies:- West Australian Petroleum Pty.Ltd., Australasian Petroleum Co. Pty.Ltd., Mines Administration Pty.Ltd., and Frome-Broken Hill Pty.Ltd. The co-operation of these organisations in the project is gratefully acknowledged.

Acknowledgement is also due to Mr. M.A. Condon, Assistant Chief Geologist of the Bureau, whose notes on the geological side of the exploration have been incorporated in the text.

2. GENERAL STATUS OF OIL EXPLORATION

Exploration carried out in Australia in the search for oil comprises the work of private companies and government authorities. Oil exploration companies hold concessions to explore for oil in all States and Territories except Tasmania and the Australian Capital Territory. Government authorities are carrying out geological work in relation to oil exploration in Western Australia, South Australia, Queensland and the Northern Territory.

From geological mapping completed to date, thirteen major basins and approximately ten minor basins have been identified in the Australian mainland. In Papua-New Guinea three basins have been identified. The basins are shown in outline in Plate 1.

A single producing well, discovered at Rough Range, Western Australia, in 1953 has not resulted in the discovery of an oil field. Oil and gas shows have been reported from all States and Territories. Dry gas shows are reported from New South Wales.

Geological information in most areas gives only the broadest outline; in no areas are geological conditions known precisely enough for scientific location of drilling sites or for following indications when found. Regional geological information is reasonably satisfactory in Sydney Basin, Carnarvon Basin and Fitzroy Basin, although even there geological detail is not satisfactory.

Government geologists mainly carry out the regional surveys; Company geologists carry out detailed surveys of surface structure mainly for locating drilling sites. All regional work and much detailed work is based on aerial photographs which are used as field maps. Palaeontologists play an important part in determining the age of the strata.

The information given here deals mainly with exploration by geophysical methods. In this work, the major contribution by a government authority has been that of the Commonwealth Bureau of Mineral Resources, Geology & Geophysics, whose Geophysical Section has been actively engaged in the geophysical investigation of sedimentary basins since 1946. The South Australian Government maintains a smaller geophysical organisation which has conducted geophysical surveys for oil in that State.

The administration of petroleum prospecting ordinances is constitutionally the function of the States and is exercised through the States Mines Departments except in the Northern Territory and Papua-New Guinea, which are administered by the Commonwealth. In the provision of geophysical services the Bureau co-operates with the State Departments and maintains close liaison with most of the oil exploration companies.

In the following discussion, the separate sedimentary basins are dealt with in turn. The accompanying plans Plates 2 to 4 show the areas investigated by gravity, seismic and aeromagnetic methods respectively. The surveys indicated represent the work of several government authorities and many private companies. A list of these organisations is shown and reference numbers on the maps are used to indicate the general location of the geophysical activities of each organisation.

3. GREAT ARTESIAN BASIN

Attention has been drawn to the oil possibilities of this vast area by considerable flows of natural gas and small quantities of oil found in many of the bores, particularly those in the Roma area, drilled since 1900. None of the gas shows has developed into commercial supplies.

An exploration campaign conducted by Shell (Queensland) Development Pty. Ltd., between 1940 and 1951 in Central and Southern Queensland, included geological mapping, aerial photography and a reconnaissance gravity survey comprising 1,000 stations and covering an area of 192,000 square miles. Scout drilling was also carried out. In 1950, a test bore was drilled at Morella, 100 miles north of Roma, to a depth of 4,634 feet to test the Permian beds, which are considered to offer the best possibilities of oil and gas production. The bore encountered gas in non-commercial quantities and small showings of oil. The company abandoned its search after a test seismic refraction traverse by the Bureau across an anticlinal structure near Comet showed a high velocity refractor at a depth of approximately 3,000 feet, which was interpreted as basement (Smith, 1951).

The first area investigated by the Bureau was in the Frome Embayment, which forms a south-western extension of the Great Artesian Basin (Dooley, 1948). Gas had been found in many bores in this area. Gravity and magnetic surveys were made over an area 8 miles square and along about 150 miles of traverses. The gravity survey of the Embayment was later continued by Frome-Broken Hill Co. Pty. Ltd. as a reconnaissance finally covering approximately 15,000 square miles. From this geophysical work it was concluded that not more than 2,000 feet of Recent, Cretaceous and thin Jurassic sediments were present resting on old rocks. The Cootabarrow bore, put

down to test the gas possibilities, bottomed in pre-Cambrian at 1,450 feet. Small quantities of methane were noted.

In the Roma area, about 3,000 to 4,000 feet of Mesozoic sediments overlie a basement of granite and metamorphic rocks. A reconnaissance gravity and ground magnetic survey was made by the Bureau in 1947 and 1948 covering an area of 4,000 square miles, with a semi-detailed survey over 250 square miles within this area (Dooley, 1950). The purpose of the surveys was to obtain information on basement topography.

The conclusions drawn from the survey were that the major gravity and magnetic anomalies are not associated with basement topography but are probably due to variations of rock type within the basement. Two residual gravity anomalies were isolated as being related to high basement features and were recommended for seismic investigation.

Seismic surveys subsequently carried out by the Bureau in 1949 and 1950 confirmed a small closure near one of the gravity anomalies but no definite closure was shown near the other anomaly (Dooley, 1954). A bore drilled by Associated Australian Oilfields N.L. to test the first anomaly showed no appreciable gas or oil. The geological equivalent of the oil and gas sands was found to have low porosity and to be unsuitable as a reservoir rock. This Company has since drilled additional holes in the Roma area, some of which gave promise of gas on a commercial scale, and has completed a detailed gravity survey of 400 square miles to the north-east of Roma in the search for favourable drilling targets.

In 1952 and 1953, further seismic work was carried out by the Bureau at Roma to determine whether any structures were associated with the known occurrences of gas and oil (Williams, 1955). No evidence of an anticline or basement high was found at the two localities investigated and no drilling could be recommended as a result of this work. An experimental seismic survey by the Bureau near Surat proved the applicability of both refraction and reflection methods but gave no confirmation of a large anticlinal structure inferred from surface geological mapping. (Morton and Robertson).

In 1957 the Bureau completed a semi-detailed gravity survey of an area of approximately 1,600 square miles in the Comet-Rolleston area north of Roma. (Oldham, 1958). From the results, the position of the axis of the Comet Anticline has been more accurately established and it is expected that the southern extension of the anticline contains a much thicker sequence of sedimentary rocks than that known near Comet; the thicker sequence may include lower Permian horizons considered favourable for oil occurrence. The gravity survey of this area has been extended by the gravity reconnaissance of an area of 1,400 square miles carried out by Associated Freney Oil Fields N.L.

Gravity surveys, mainly reconnaissance, have been made in the Longreach and Quilpie areas by other oil exploration companies.

In the south-western part of the Basin lying in South Australia, Santos Ltd. have completed gravity surveys of several areas and the Bureau has made trial seismic investigations at two localities. Near Oodnadatta a reflection traverse, 25 miles long, was shot across an anticlinal structure (Smith and Lodwick). The results confirmed the structure with slight dips and a depth of Mesozoic section to 2,000 feet. Multiple geophone arrangements were found to be essential at all points and pattern shooting was necessary at some, especially on the duricrust which is up to 20 feet thick.

Near Haddon Downs, a 15 mile long reflection traverse was shot across the Mt. Howie anticlinorium and a 10 mile long refraction traverse was shot along the strike of a syncline between two anticlinal trends (Smith and Lodwick). Pattern shots and multiple geophone arrangements were used with considerable success. A sedimentary section of at least 8,000 feet and possibly 12,000 feet was recorded. The depth to the base of the Mesozoic section along the refraction traverse is approximately 6,600 feet.

Companies holding Authorities to Prospect have been responsible for reconnaissance aeromagnetic surveys of several large areas of the Basin in Queensland. These include two areas totalling 20,000 square miles north-west of Longreach (Central Queensland Petroleum Pty. Ltd. and Trans-Pacific Corporation), an area of 7,000 square miles near Tambo (Oil Structure Surveys Ltd.) and the St. George area of 20,000 square miles south of Roma (Australian Oil and Gas Corporation Ltd.).

A broad aeromagnetic reconnaissance covering the central and south-western portion of the basin and extending into South Australia, and consisting of widely spaced traverses totalling 5,000 miles, has been carried out by the Bureau.

4. GEORGINA BASIN

The Bureau's gravity survey of this basin was commenced in 1957 and is continuing. A reconnaissance survey of 20,000 square miles in the Queensland portion of the basin has been completed and showed the north-south trend in the structural features associated with the Duchess Fault to the east. In the western part of the area surveyed gravity anomalies, possibly indicating anticlinal and synclinal features, were indicated.

5. GIPPSLAND BASIN

Oil was first noted in bores in East Gippsland in 1924, since when more than 100 bores have been drilled in search for oil in the region. Near Lakes Entrance, small quantities of oil have been produced from glauconitic and other sands near the base of the Tertiary section. Here the Tertiary rocks about 1,200 feet thick rest on Palaeozoic rocks of a type probably not favourable to the genesis or occurrence of oil. West of Lakes Entrance the Tertiary section increases in thickness to about 4,000 feet but the lower beds are unfavourable for retention of oil.

Considerable use has been made of geophysical methods to investigate the size, depth and shape of the basin. Following a gravity reconnaissance survey by Robert H. Ray Co. of Texas in 1949, the Bureau carried out additional gravity work, which was extended to South Gippsland to give a complete gravity coverage of the basin. An aeromagnetic survey was made of about 5,000 square miles in Central and East Gippsland in 1951 and was later extended to cover over 11,000 square miles of the off-shore area extending seawards for 50 miles. (McCarthy, 1952, Goodeve, 1956).

These surveys showed the main tectonic features of the basin and indicated probable deepening of the basin to the south and south-east. Several high gravity anomalies were found, some of which coincide with magnetic anomalies. Two of these, one on the north side of Lake Wellington, the other in the Parish of Darriman were subsequently tested by reflection seismic surveys.

The seismic survey near Lake Wellington proved a section of about 3,500 feet of Tertiary sediments but showed no structure favourable for oil retention. (Vale, 1952). The survey at Darriman showed a section of about 6,000 feet with strong folding of the strata. (Garrett, 1955). An anticlinal structure was indicated with probable closure in two places. A bore drilled by Frome Lakes Pty. Ltd. to test the structure penetrated 4,200 feet of Tertiary sediments and 500 feet of underlying Jurassic without showings of gas or oil. Near the coast, south of Darriman several bores were drilled by Woodside (Lakes Entrance) Oil Co., N.L.

6. PIRIE-TORRENS BASIN

Exploration of this basin, in which Tertiary sandstone and siltstone overlie Cambrian dolomite, has been carried out by Santos Ltd. and the South Australian Department of Mines. Geophysical work comprises a gravity survey and a short seismic survey. Twenty structural holes have been drilled by the Company. Shows of oil and gas in both Tertiary and Cambrian sediments have been reported.

7. MURRAY BASIN

Interest in the oil possibilities of this basin is mainly due to the large extent of Marine Tertiary rocks it contains. In the Nelson Bore completed in 1946 Tertiary sediments were shown to exceed 7,299 feet in thickness.

Geophysical exploration of the basin has been carried out by the Bureau, the South Australian Department of Mines, Australian Oil and Gas Corporation Ltd. and Frome-Broken Hill Pty. Ltd. The work includes reconnaissance gravity and magnetic surveys, and aeromagnetic survey and seismic investigations.

Gravity surveys indicate a probable thickness of sediments near the Nelson bore of about 10,000 feet and north-east of Nelson a thickness of about 12,000 feet of which 9,000 feet is probably Tertiary. On the coastal strip near Portland a few gravity highs occur and some may represent anticlines. (Wiebenga).

The south-eastern part of the basin is largely covered by basaltic lava flows. In 1956 the Bureau made an experimental seismic survey near Heywood, primarily to ascertain if reflections from deeper sediments could be recorded through a surface basalt flow (Lodwick and Vale, 1958). In basalt-free areas good reflections were recorded from depths to 11,000 feet. In basalt covered areas techniques were developed to give satisfactory reflections using single shot holes, although the reflection quality was improved when pattern and air shooting were used. The results of tests were sufficiently encouraging to warrant further seismic work and on the basis of the results, the lease holding company, Frome-Broken Hill Pty. Ltd., is continuing seismic investigations in the basin.

8. SYDNEY BASIN

The Sydney Basin extends about 100 miles north, south and west from Sydney. The known sedimentary section comprises Triassic and Permian rocks, the lithology and thickness of the pre-Permian rocks underlying the basin being unknown.

Exploration by the Australian Oil and Gas Corporation Ltd. has included complete coverage of the basin by aeromagnetic surveys, detailed gravity work over an area of 1,250 square miles and drilling of several bores.

In 1957 experimental seismic tests were made by the Bureau to ascertain if reflection methods are applicable in this basin (Robertson, 1958). Twelve miles of traversing in four areas of different geological formations were shot and fair quality reflections were obtained from depths to 14,000 feet. Special techniques involving geophones and pattern shooting were found to be necessary in some places. The dips recorded indicated that structures suitable for accumulation of gas or oil may exist at depth but insufficient seismic work was completed to definitely prove the existence of any such structures.

Strong dry gas showings have been encountered in some of the test bores drilled by Australian Oil and Gas Co. and are considered to be encouraging as to the possibility of gas production on an economic scale.

9. IPSWICH-CLARENCE BASIN

The outcropping rocks in the basin are Triassic and Jurassic, so far as known, all of freshwater origin. These are underlain by Permian rocks in the north and west and elsewhere by pre-Permian rocks. Natural gas was recorded in two bores, one put down in 1902, the other in 1933. Geophysical exploration to date consists of a reconnaissance aeromagnetic survey covering an area of approximately 4,000 square miles, which was carried out for Australian Oil and Gas Corporation Ltd.

10. MARYBOROUGH BASIN

In this small basin, situated north and south of Maryborough, Queensland, the Lucky Strike Drilling Co. has drilled two bores each over 8,000 feet deep and has investigated known anticlines by gravity and seismic methods.

11. CARPENTARIA BASIN

The basin contains a large area of marine Cretaceous rocks which are believed to be underlain in places by an arenaceous sequence of Jurassic age and elsewhere by basement rocks ranging from Devonian to Pre-Cambrian. Within the basin outcrops are sparse and geophysical methods of exploration are essential.

Much of the basin has been covered by regional and semi-detailed gravity surveys, including an area of 500 square miles comprising the Wellesley Islands Group. These surveys have been done by the companies holding Authorities to Prospect in the area - Australian Associated Oilfields N.L., Associated Freney Oilfields N.L. and Frome Broken Hill Pty.Ltd. Results from the drilling of stratigraphic holes at Wyaaba, Karumba and Weipa have been disappointing in showing a relatively thin Mesozoic section of 2,500 to 3,000 feet thick.

Aeromagnetic surveys of a reconnaissance nature have been made in the Weipa area and over the submerged part of the basin between Arnhem Land and Cape York Peninsula and New Guinea. The gravity surveys on the mainland have been supplemented by an underwater gravity traverse in the Gulf of Carpentaria undertaken by the Bureau. The Bureau is also engaged in a programme of seismic work using both reflection and refraction techniques. The aim of this work is to determine the general structure of the basin from its western to its eastern margin, to investigate in detail possible structures indicated by positive gravity anomalies and to determine the structural position of the stratigraphic bores at Wyaaba and Karumba.

12. EUCLA BASIN

Tertiary rocks crop out over a large part of the basin but are of little interest as an oil prospect. Cretaceous rocks have been recorded in water bores in the southern part of the basin and also occur around part of the north-west margin of the Basin. Water bores drilled along the Trans-Continental Railway line show basement at shallow depths ranging from 1,000 to 1,300 feet.

The geophysical work carried out to date comprises two east-west regional gravity traverses, (Gunson and van der Linden, 1956) gravity reconnaissance near the eastern margin of the basin and a reconnaissance aeromagnetic survey (Quilty and Goodeve, 1958). The gravity anomalies recorded on the regional traverses are believed to be mainly due to density variations in the rocks forming the basement and gave no reliable information about the thickness of the sedimentary section.

The aeromagnetic survey consisted of widely spaced traverses totalling 5,500 miles between Kalgoorlie, Oodnadatta and Ceduna. The results confirmed that the sedimentary section is thin over most of the Eucla Basin, but gave evidence of a fairly deep trough north of the Basin. In general, the geophysical results are not encouraging for further exploration of this Basin.

13. BONAPARTE GULF BASIN AND ORD RIVER BASIN.

The present knowledge of the subsurface stratigraphy and structure of these Basins is not adequate for a reliable assessment of the oil possibilities. However, the results of investigations carried out to date appear to justify further exploration.

A geological reconnaissance of the region was completed by the Bureau in 1952 (Traves, 1955) and more recently Associated Australian Oilfields N.L. and Westralian Oil Ltd. have done detailed geological mapping in their concessions in the Northern Territory portion of the Bonaparte Gulf Basin.

Geophysical investigations have been made in the Bonaparte Gulf Basin and comprise detailed and reconnaissance gravity surveys over a large part of the basin, (Thyer and Stott, - (an aeromagnetic survey of the basin with extension seawards to 40-60 miles off-shore and seismic surveys.

The seismic surveys were undertaken by the Bureau in 1956 to obtain regional information concerning the thickness of the sedimentary rocks and the tectonics of the basin and to test the applicability of seismic methods in the Region (Robertson, 1957). One seismic traverse 40 miles long in the Carlton sub-basin (which forms the western part of the Bonaparte Gulf Basin) failed to record reflections or refractions over half its length; from most of the remainder, reflections were obtained and indicated the existence of about 20,000 feet of sedimentary rocks with steep dips in places. A general dip to the north-east was recorded.

The Burt Range sub-basin to the south was also investigated by seismic traverses totalling 30 miles. A maximum thickness of sediments of 14,000 feet was indicated, with dips up to 40° in places. Over a geologically mapped structure known as the Spirit Hill Anticline, scarcity of reflections made it impossible to prove or disprove whether this structure exists at depth.

The seismic results indicate that the rocks have been folded to a considerable extent and give evidence of unconformities within the sedimentary section. The seismic reflection method proved successful in indicating geological structure at depth in most of the areas tested.

Gravity readings were made along all the seismic traverses to assist in the interpretation and were extended to connect with other gravity work which has been carried out by Associated Australian Oilfields N.L. and Westralian Oil Ltd.

14. CANNING AND FITZROY BASINS.

The Fitzroy Basin forms a trough about 300 miles long on the north-eastern edge of the larger Canning Basin. A major tectonic feature, the Fenton Fault forms the south-western boundary of the Fitzroy Basin. The two basins may be regarded as a single area of sedimentation.

Attention was first drawn to the oil possibilities of the Fitzroy Basin by the discovery of traces of oil in water bores put down in the early 20's. The oil occurred in rocks, later shown to be of Ordovician age. Devonian rocks, which are highly fossiliferous and contain many reef structures, crop out extensively along the north-eastern margin of the basin. In a bore drilled by Associated Freney Oilfields N.L. about 30 miles basin-wards from this margin, Devonian rocks were encountered at 6,900 feet and showed traces of oil and bituminous material. It is likely that the Devonian rocks have a wider extension into

the deeper parts of the basin beneath the Carboniferous and Permian rocks. Permian rocks cover a large portion of the Fitzroy Basin and also of the Canning Basin.

Much of the exploration in the Fitzroy Basin has been directed towards investigating domes mapped in the Permian rocks. This investigation has included the drilling of several deep bores, which, however, have not found oil.

Since 1952, a considerable amount of geophysical work has been done in these areas, particularly in the Fitzroy Basin. The aims have been mainly to determine the broader structural features of the basin and to investigate in detail some of the geologically mapped dome structures. During 1955 and 1956, a programme of shallow drilling for stratigraphic information was undertaken by the Bureau at selected sites in the Fitzroy Basin.

Gravity reconnaissance surveys have been carried out over a period of several years and have now covered an area of 150,000 square miles embracing both the Fitzroy and Canning Basins. In the central part of the Canning Basin helicopter transport was used successfully by geological and gravity survey parties (Veevers, 1957).

In the marginal areas of the basins, the gravity results have proved valuable in revealing the main tectonic features (Wiebenga and van der Linden, 1953). The central part of the Canning Basin, although relatively featureless at the surface, reveals a very impressive pattern of gravity anomalies, including several trough zones considered to contain sediments of unforeseen thickness, which may provide scope for future exploration. (Waterlander, -).

Several of the dome structures mapped at the surface have been investigated by seismic surveys. At the Nerrima Dome, the seismic results gave evidence of much faulting in the section down to 7,000 feet but showed no correlation between the structure at depth and that at the surface. (Vale, Smith and Garrett, 1953). At the Poole Range Dome, seismic work showed a total thickness of sediments of about 20,000 feet and confirmed the persistence of the structure at depth. (Smith, 1955, Williams, 1956). Seismic results over the Deep Well anticline near Myroodah revealed that the anticlinal structure becomes more pronounced at depth and extends down to approximately 24,000 feet. (Williams, 1955).

In the coastal region, where Mesozoic rocks crop out but where little was known concerning the underlying section, seismic surveys have been made at several localities by West Australian Petroleum Pty Ltd., and the Bureau (Vale and Williams, 1955; Vale and Smith, 1956; Smith - ;) to determine the thickness and attitude of the sediments. A sedimentary section ranging in thickness from 6,000 to over 16,000 feet was proved.

In 1954 a series of aeromagnetic traverses was flown across the Canning and Fitzroy Basins, with closer concentration of flight lines along the coastal strip and over selected areas of the Fitzroy Basin (Quilty, -). This was followed by a systematic aeromagnetic survey by West Australian Petroleum Pty. Ltd. covering approximately the western half of the Canning Basin. The results of the aeromagnetic surveys confirm evidence from other methods that basement depths on the Fitzroy Basin exceed 20,000 feet in the deeper parts. Elsewhere the aeromagnetic work has provided useful information concerning the basement topography

and together with the results from the gravity method has been a valuable guide in siting scout drill holes for stratigraphic information.

The West Australian Petroleum Pty.Ltd. continues to be actively engaged in seismic and gravity surveys in various parts of the Canning and Fitzroy Basins with the aim of locating future deep drilling sites.

15. CARNARVON BASIN

For many years Commonwealth government geologists have given high priority to the Carnarvon Basin as an oil prospect. A thick sequence of sedimentary rocks ranging from Middle Devonian to Permian are known in outcrop in the eastern part of the basin and includes rocks which would be suitable for origin, retention and accumulation of oil. A systematic campaign of exploration has been in progress since 1948. In December 1953, oil was discovered by West Australian Petroleum Pty.Ltd. in a lower Cretaceous formation in a bore at Rough Range, but subsequent detailed testing of the area has not resulted in the discovery of an oil field. The origin of the oil in the Rough Range bore is doubtful. Deep drilling has afforded proof that oil may occur in Palaeozoic rocks.

Geophysical exploration commenced in 1950, with a gravity reconnaissance survey by the Bureau (Chamberlain, Dooley and Vale, 1954). This was continued in later years by the Bureau and West Australian Petroleum Pty.Ltd., and now covers the whole basin area of 70,000 square miles.

The main gravity anomalies over the basin reveal two large troughs trending approximately north to north-west separated by a north-south basement ridge. The eastern trough, where the sediments are estimated to reach a thickness of 10,000 to 15,000 feet, may correspond to the main axis of sedimentation of the Palaeozoic basin. The western trough includes the areas in which a large number of anticlines have been mapped in Mesozoic and Tertiary rocks. In the southern part of the basin outcropping Pre-Cambrian crystalline rocks and their northward extension indicated by gravity results separate the western part of the Basin from a deep narrow trough which continues southwards to link the Carnarvon with the Perth basin.

Seismic surveys were first used in 1951 with test surveys in the Cape Range and over the Giralalia Anticline. The latter survey showed the anticline to exist only to an unconformity at about 3,000 feet, interpreted as the unconformity between Mesozoic and Palaeozoic sediments. The survey showed the seismic method to be applicable to the investigation of possible oil-bearing structures in the basin and that seismic investigation would be a pre-requisite of the selection of deep drilling sites. More recently West Australian Petroleum Pty.Ltd. have carried out seismic surveys amounting to over 500 miles of traversing, aimed mainly at investigating the anticlines mapped in Tertiary and Cretaceous sediments in the coastal area, particularly in the Cape Range and Rough Range areas.

During 1956 and 1957 aeromagnetic surveys were made of approximately 50,000 square miles, the survey being extended in places to 90 miles off-shore. The aeromagnetic results have supplemented and confirmed information given by the gravity reconnaissance concerning the main structural features of the basin.

16. PERTH BASIN

The Perth Basin, which occupies the coastal strip of Western Australia south of Geraldton has only recently become of interest as an oil prospect. Pre-Cambrian rocks form its eastern boundary and Mesozoic and younger rocks crop out within it. Little is known of the sub-surface geology. Geophysical surveys, initiated by the Bureau in 1949, have been an important factor in drawing attention to the oil possibilities of the area.

In 1949 and 1951, two east-west gravity traverses in the area north of Perth, made primarily in connection with ground water investigations, showed evidence of a major fault along the eastern boundary of the basin and indicated a very great thickness of sediments underlying the coastal plain. Subsequently a gravity survey covering the whole basin and extending inland up to 150 miles from the coast was completed by the Bureau in 1952 (Thyer and Everingham, 1956).

The outstanding feature of these gravity results is a negative anomaly of large magnitude and arial extent forming a trough about 400 miles long and 55 miles wide. Steep gravity gradients on the eastern flanks of the anomaly suggest the existence of faults, which have resulted in the relatively light sediments lying adjacent to the denser basement rocks and indicate that the major part of the anomaly is due to an accumulation of sediments, which at their maximum development may be about 30,000 feet thick. This is a much greater thickness of sediments than was formerly suspected. In view of the proximity to the Indian Ocean, there is every possibility that marine transgressions, with accompanying sedimentation including deposition of source beds for oil, have occurred during the history of the basin.

To further investigate the sedimentary section and in particular to verify, if possible, the interpretation of the gravity anomaly in terms of a thick sedimentary section, seismic reflection traverses were surveyed across the basin from east to west at several selected places. Near Gin Gin, 45 miles north of Perth, the seismic work showed a sedimentary section exceeding 17,000 feet and a deep-seated anticline for which no evidence exists at the surface (Vale, 1956). Seismic traverses across the basin south of Perth proved sediments to a depth of at least 16,000 feet (Smith and Moss, - Vale and Moss, -). In the eastern side, steeply dipping reflections were recorded apparently coming from within the pre-Cambrian rocks. Reflections from the sediments indicate a dip towards the east. Additional seismic and detailed gravity surveys have been made in the area north of Perth by West Australian Petroleum Pty Ltd.

In 1957 an aeromagnetic survey was carried out over the entire basin with some traverses being extended up to 100 miles off-shore in order to trace a basement ridge thought to represent the western edge of the basin.

17. PAPUA - NEW GUINEA

Since the discovery of an oil seepage at Upoi in Papua in 1912, very considerable effort has been expended in the search for oil in Papua. Much of this exploration has been concentrated in the geological structure

known as the Aure Trough, where drilling has proved the existence of at least 15,000 feet of Tertiary rocks.

Between 1912 and 1936 geological exploration and test drilling were carried out, mainly around the eastern side of the Gulf of Papua. Up to 1920, this work was conducted by the Commonwealth Government, with some financial assistance from the British Government. From 1920 to 1929 the operations were conducted by the Anglo-Persian Oil Company for the Commonwealth Government. Since 1923, several private companies have engaged in geological and geophysical work and scout boring. Test drilling has been done in thirteen different localities.

In 1936, Island Exploration Company Pty Ltd., and in 1938, Australasian Petroleum Company Pty. Ltd. commenced the search on a large scale and have together spent over £30 million in their search. These companies and others are still engaged in exploration for oil. Between 1936 and 1938 gravity surveys, with Holweck pendulums and torsion balance, were made in the area between the Fly and Purari Rivers. Surveys by gravimeter have since covered large areas in southern and western Papua, the main ones being Delta and Morehead areas each approximately 3,000 square miles and the Komewu area of about 750 square miles. Reconnaissance gravity traverses have been run in many of the intervening areas and have been extended to include the Fly and Strickland River basins. Gravity surveys have also been made in the coastal strip on the east of the Gulf of Papua and in the Upper Sepik area of New Guinea.

Seismic surveys, commenced in 1937, were interrupted by the War. Since the War, seismic work mainly refraction has been carried out on a large scale. The Delta area has been investigated by 146 miles of refraction traverses and the Morehead area by 436 miles. The seismic method has been used also in other areas between the Delta and the Fly River, the total traversing amounting to several hundred miles. The water areas of the Delta were investigated by a marine seismic survey, which was commenced in 1957 and amounted to 1,140 miles of traverses.

In 1953 an aeromagnetic survey, covering over 35,000 square miles was completed in western Papua. In the exploration for oil in western Papua, more than 20,000 square miles have been aerially photographed and geological and topographical maps prepared from the photographs.

18. PETROLEUM EXPLORATION SUMMARY

The amount of petroleum exploration in Australia during the period 1946 to 1958, is shown in the following two tables :-

State	YEAR													PARTY MONTHS TOTAL
	46	47	48	49	50	51	52	53	54	55	56	57	58	
W.A.														
Geol.	4	4	7	15	20	15	20	30	46	44	25	13	-	243
Geoph.	-	-	-	-	3	10	15	30	40	55	45	45	35	278
S.A.														
Geol.	-	-	-	6	6	6	-	-	10	10	10	10	5	63
Geoph.	6	10	-	7	5	-	-	-	-	-	10	15	-	53
Vict.														
Geol.	-	-	-	6	6	6	-	-	2	7	5	10	10	52
Geoph.	-	-	-	5	5	5	6	6	10	10	5	3	5	60
N.S.W.														
Geol.	-	-	-	-	-	-	-	-	20	10	10	10	10	60
Geoph.	-	-	-	-	-	-	-	-	12	14	5	5	-	36
Q'ld.														
Geol.	5	10	10	10	-	-	-	-	10	5	10	15	20	85
Geoph.	5	10	10		-	-	-	-	25	12	-	5	10	77
N.T.														
Geol.											5	10	10	25
Geoph.											5	-	3	8

Total Geological 528

Geophysical 512

SUMMARY OF EXPLORATION DRILLINGDURING THE PERIOD 1946 - 1958

<u>State</u>	<u>No. of Bores</u>	<u>Total Footage</u>	<u>Systems Drilled</u>
West Aust.	72	245,338	Tertiary Cretaceous Permian Carboniferous Devonian Ordovician
South Aust.	50	44,172	Tertiary Cretaceous Jurassic Permian Cambrian
Victoria	19	49,269	Tertiary
New South Wales	24	45,513	Jurassic Triassic Permian Devonian
Queensland	33	134,982	Cretaceous Jurassic Triassic Permian
Total	198	519,274	

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20. LIST OF ORGANISATIONS WHICH HAVE DONE
GEOPHYSICAL EXPLORATION.

1. Bureau of Mineral Resources, Geology & Geophysics,
Department of National Development.
2. Department of Mines, South Australia.
3. West Australian Petroleum Pty. Ltd.
4. Frome Broken Hill Co Pty. Ltd.
5. Associated Australian Oilfields N.L.
6. Associated Freney Oilfields N.L.
7. Australian Oil and Gas Corporation.
8. Oil Structure Surveys Ltd.
9. Trans Pacific Corporation.
10. Central Queensland Petroleum Pty. Ltd.
11. Catawba Corporation.
12. Santos Ltd.
13. Murray Basin Oil Syndicate.
14. Zinc Corporation.
15. Lucky Strike Drilling Co.
16. Lakes Oil Ltd.
17. Shell (Q'ld.) Development Pty. Ltd.
18. Longreach Oil Ltd.
19. Westland Oil Co.
20. L.H. Smart Oil Exploration Pty. Ltd.
21. Tallyabra Oil Pty Ltd.
22. Australasian Petroleum Co. Pty. Ltd.
23. Island Exploration Co. Pty Ltd.
24. Papuan Apinaipi Petroleum Co. Ltd.
25. Enterprise of New Guinea Gold and Petroleum Development N.I.
26. University of Sydney, Department of Geology and Geophysics.
(C.E. Marshall and H. Narain).

E.C.A.F.E SYMPOSIUM ON PETROLEUM RESOURCES, ASIAN AREA

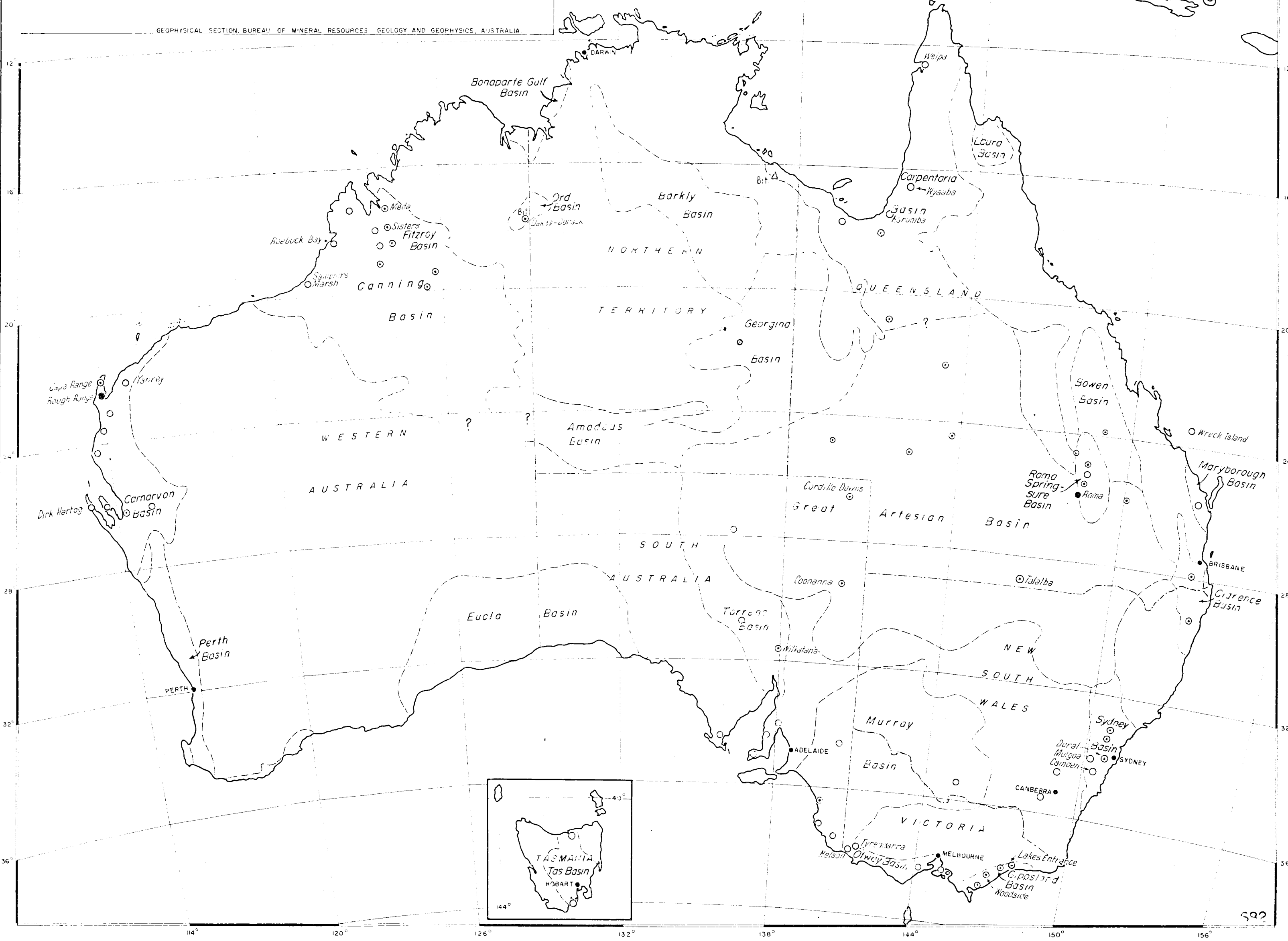
AUSTRALIA AND NEW GUINEA SHOWING SEDIMENTARY BASINS AND REPORTED OCCURRENCES OF OIL AND GAS

SCALE IN MILES
0 100 200 400 600

LEGEND

- No reported show of oil and/or gas in bore
 - ⊙ Oil and/or gas show in bore
 - Oil or gas well
 - △ Oil or gas seepage
 - Bit. Bitumen
- NOTE: Symbols relate to areas, not necessarily to individual bores

GEOPHYSICAL SECTION, BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS, AUSTRALIA



E.C.A.F.E SYMPOSIUM ON PETROLEUM RESOURCES, ASIAN AREA

AUSTRALIA AND NEW GUINEA SHOWING GRAVITY SURVEYS TO PERIOD ENDING DECEMBER 1958

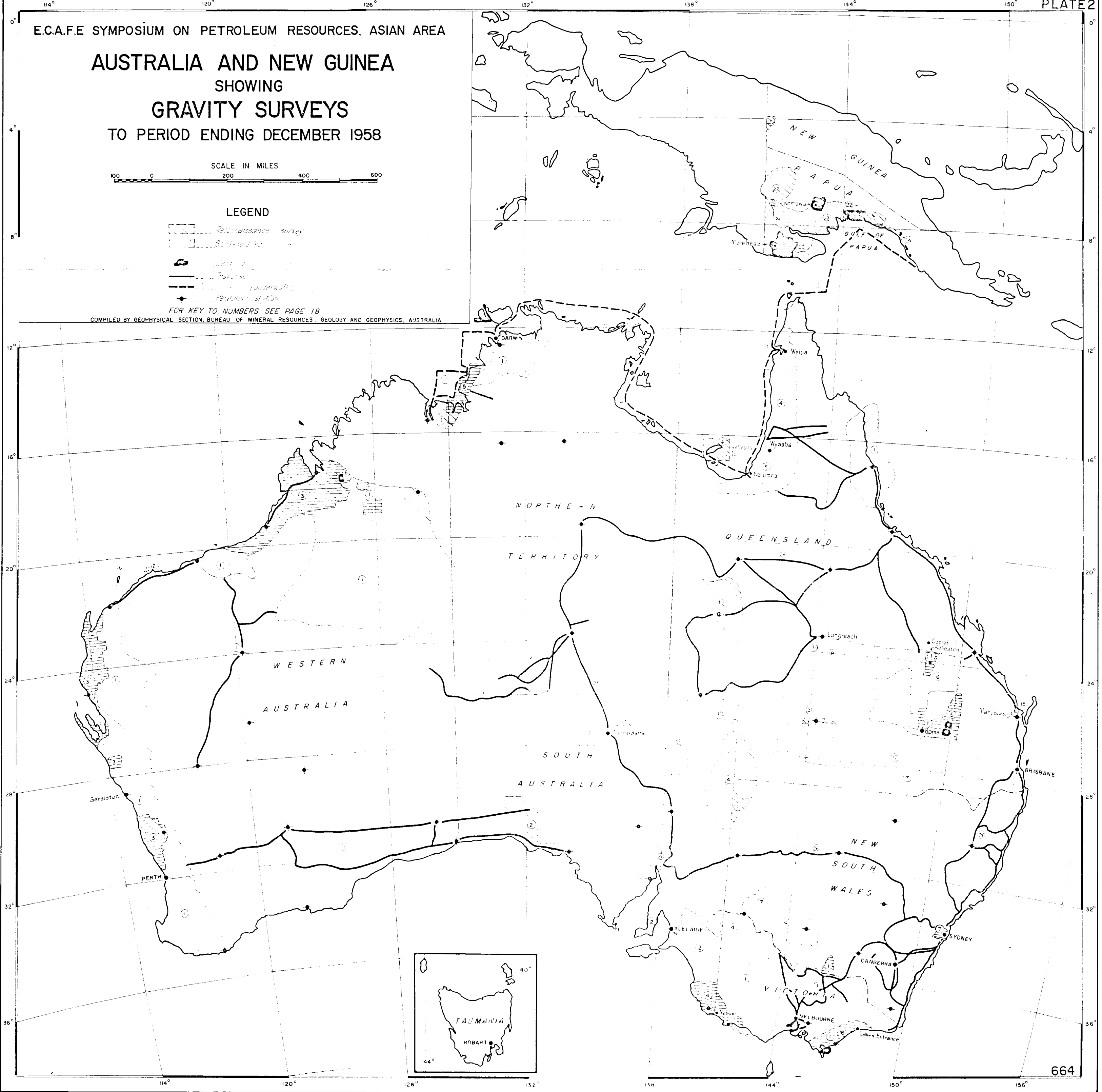
SCALE IN MILES
0 100 200 400 600

LEGEND

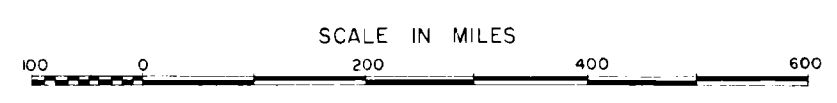
- Reconnaissance survey
- Surveyed for
- Definite
- Potential
- Interpretation
- Reference station

FOR KEY TO NUMBERS SEE PAGE 18

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E.C.A.F.E SYMPOSIUM ON PETROLEUM RESOURCES, ASIAN AREA
AUSTRALIA AND NEW GUINEA
 SHOWING
SEISMIC SURVEYS
 TO PERIOD ENDING DECEMBER 1958

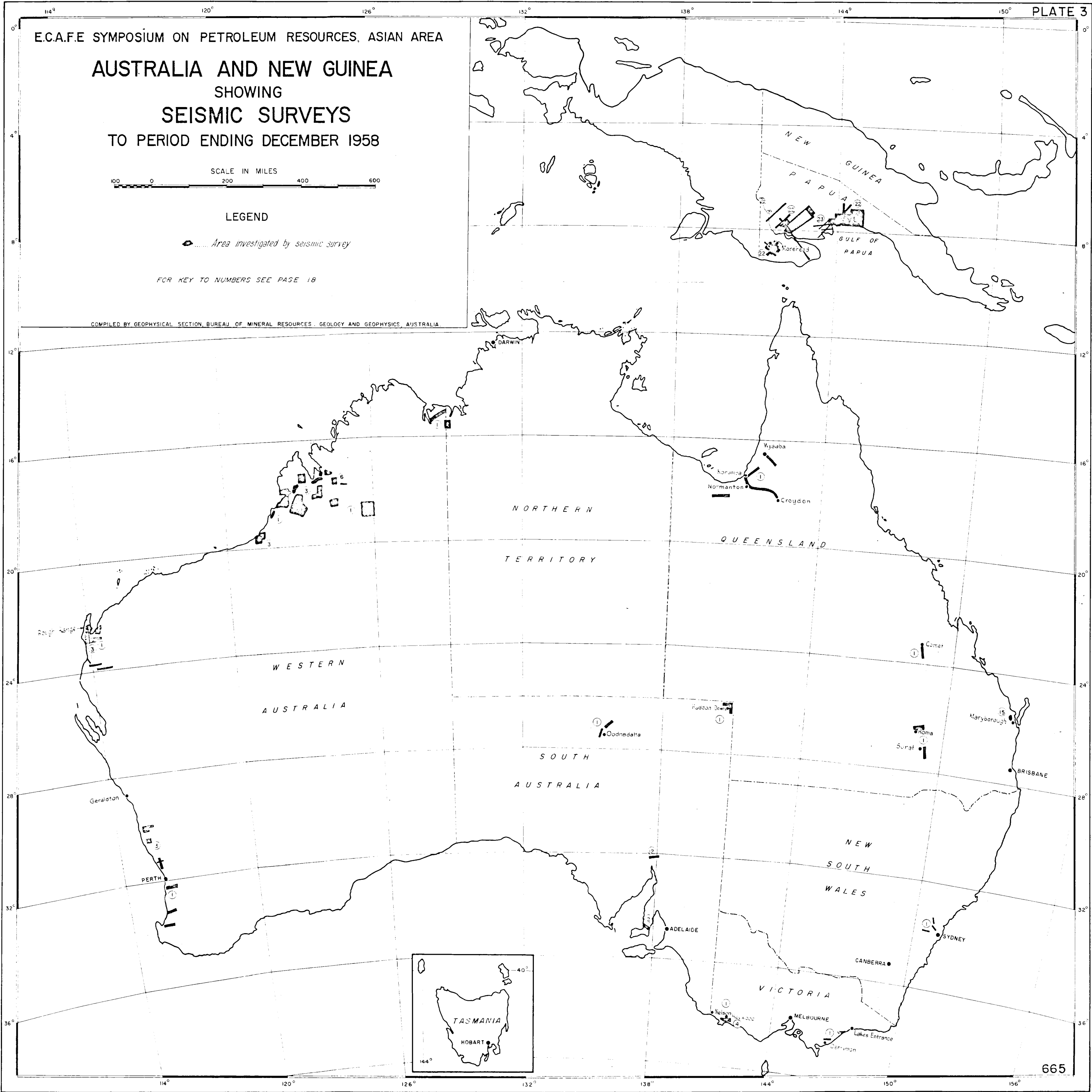


LEGEND

Area investigated by seismic survey

FOR KEY TO NUMBERS SEE PAGE 18

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E.C.A.F.E SYMPOSIUM ON PETROLEUM RESOURCES, ASIAN AREA

AUSTRALIA AND NEW GUINEA SHOWING AEROMAGNETIC SURVEYS TO PERIOD ENDING DECEMBER 1958

SCALE IN MILES
100 0 200 400 600

LEGEND

Areas covered by aeromagnetic survey
Aeromagnetic traverse

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