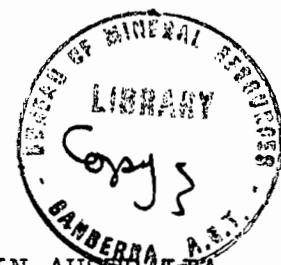


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DEPARTMENT OF NATIONAL DEVELOPMENT.
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STATUS OF PETROLEUM EXPLORATION IN AUSTRALIA

by

M.A. Condon.

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

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Abstract

No commercial oilfield has been discovered in Australia but this must be related to the very small amount of exploration that has been undertaken and the deficiencies in knowledge about the sedimentary basins. Outcrop geology of the sedimentary basins of Australia is known only to regional reconnaissance detail and the limits of few basins are precisely known.

The complete stratigraphic sequence and its variations are known adequately in few basins and the geological history in none.

Only about 1 million feet of exploration drilling has been completed in the whole of Australia and Papua New Guinea with a total basin area of about 1,480,000 square miles.

The regional structure is indicated but not precisely established in the Fitzroy Basin, Carnarvon Basin and Perth Basin (W.A.), Great Artesian Basin, Sydney Basin (N.S.W.) and Papua Basin (P.N.G.).

Much of the structure, both regional and local, is of the synchronous type and surface anticlines do not necessarily continue downwards below unconformities.

Petroleum source beds are shown to be known in many basins but the geological conditions for accumulation have not been established. Much more information is required on the relationships among sedimentation, structure, and possible migration paths of oil.

This paper was prepared, at invitation, for presentation to the Atlantic City meeting of the American Association of Petroleum Geologists in April, 1960.

Australia has no oil-field. Why? Because a hole has not been drilled in the right place. About half of Australia's three million square miles and two-thirds of Papua-New Guinea's 184,000 square miles are covered by unmetamorphosed sedimentary rocks of which a large proportion is marine. Every system from Cambrian to Tertiary is represented and in some basins (e.g. Carnarvon and Canning) a large proportion of the column survives. Regional and local structure is similar to that of producing areas elsewhere. Rocks commonly regarded as source rocks, and adequate reservoir rocks are known. Oil seepages are very few but oil shows in bores are numerous and widespread. Why, then, has the search been unsuccessful up to date?

Geologically, probably the main reason is the lack of precise information on the stratigraphy and geological history; almost every bore drilled has produced new information on

stratigraphy and/or structure. The regional outcrop geology is now fairly well established in most of the major basins but the subsurface geology is little known because of the few bores and very small amount of seismic survey. A summary of the present state of knowledge, including a bibliography, is given by B.M.R.A. (1960). As only part of the present information and problems can be given here only a few basins, that can be regarded as typical, will be described.

The Papua Basin contains Permian, Mesozoic and Tertiary sediments in shelf, basin and geosynclinal facies and includes tectonic environments ranging from epeirogenic, with drape and compaction folding, to strongly orogenic with pseudo-diapiric folding, and high and low-angle thrust faulting. The regional structure, original and tectonic, has been outlined for the Upper Tertiary and suggested for the Mesozoic and Lower Tertiary but the precise locations of the hinge-lines are not established. Gas has been found in both Tertiary limestone and Cretaceous sandstone, and oil in thrust-faulted Tertiary limestone, but there is no market for the gas and no commercial pool of oil has been found. The main exploration problems include the discovery of areas where the Tertiary limestone has adequate cover and porosity-permeability, and where the Mesozoic sequence has adequate sands. Basins which have similar tectonic histories include the North New Guinea Basin and the Maryborough Basin (Queensland).

The Great Artesian Basin contains continental and marine Mesozoic sediments in shelf and basin facies. The Triassic seems to be confined to the north-eastern part of the basin but Jurassic and Cretaceous sediments extend practically throughout the basin which has a surface area of about 510,000 square miles. About 13,000 artesian water bores have been drilled mainly to the Lower Cretaceous aquifer and a few oil bores have been drilled in structurally high locations. The broad regional structure is suggested but even the trend of some of the basement ridges is not known with certainty. The Mesozoic basin is known to be divided by structural highs into a number of large subsidiary basins but the relations among original relief, sedimentation and tectonic structure are not established. Limited seismic surveys indicate that some of the large gentle surface anticlines persist in depth, commonly with increase in structural relief downwards (of the supratenuous type); others are indicated to be drape structures over topographic highs on the pre-Mesozoic unconformity. The only thick marine sequence is the Lower Cretaceous and this is mainly shale. Apart from the aquifer at the base which may not have received much oil from the overlying shale there is a good sand, up to about 400 feet thick, in the middle of the marine shale; this would seem to be the most promising target within the Mesozoic sequence. It is known, however that the pre-Mesozoic unconformity cuts Permian, Carboniferous, Devonian, Ordovician and Cambrian sediments. Mesozoic sands (Lower Cretaceous marine and Jurassic and Triassic continental) in contact with this unconformity may receive oil and gas migrating from the older rocks. The limits of the various pre-Mesozoic sequences are not known and very little is known of their stratigraphy or structure. The Lower Palaeozoic sequence probably is confined to the western part of the basin and the Upper Palaeozoic to the eastern. The Devonian may be represented in many parts. Seismic surveys have indicated good anticlines in the pre-Mesozoic sediments in some places. Some of these are concordant with Mesozoic anticlines, others unrelated. There is generally an angular unconformity ranging from very slight to very great

between the Mesozoic and pre-Mesozoic rocks. The oil exploration of the Great Artesian Basin is at a very early stage so that the outstanding present problem is the obtaining of data, both at outcrop and subsurface. Seismic surveys and drilling are required to establish regional structure and stratigraphy of both the Mesozoic and pre-Mesozoic sequences. The low regional dips in the Mesozoic make essential the obtaining of adequate data on the pressure-flow characteristics of the various sands: hydrodynamic migration and traps may be of limiting importance in this structural province. Basins that in some important respects are similar to the Great Artesian Basin include the western part of the Papua Basin, Carpentaria Basin, Murray Basin, Gippsland Basin, Otway Basin, Perth Basin, western part of Carnarvon Basin and southern part of Canning Basin.

The Carnarvon Basin (Western Australia) contains ? Proterozoic, lower and upper Palaeozoic, Jurassic, Cretaceous and Tertiary marine sediments in shelf and basin facies. The outcrop sequence is established on a regional scale and the Mesozoic-Tertiary sequence is known in subsurface in a general way (bores in eight areas 10 to 50 miles apart). The sub-Mesozoic areal geology is not established except at a few of these bores. The Palaeozoic sequence is very little known in subsurface except at a few unrelated bores. The relations among original relief, sedimentation and tectonic structure are indicated but not established in detail. The main regional structure is indicated by geology, gravity, seismic surveys and drilling but detail is lacking. Several potential reservoir formations are indicated at outcrop and in bores but only the Lower Cretaceous sand has been test drilled and that only in a few places. The thick Permian marine glacial sequence is hard to drill and has been regarded as non-prospective. It does, however, contain many rich fossil beds, good marine shales and good reservoir beds. It has not been tested on a closed structure. Present problems include the lack of subsurface data on the whole sequence, especially the Palaeozoic, the discovery of areas where, with good cover, the possible reservoir beds are permeable, the determination of the sub-Mesozoic areal geology to indicate where oil may have migrated out of the older sequence into the sands of the Mesozoic; the location of structural targets in the Palaeozoic; the search for subsurface reefs in the Devonian and Carboniferous. Other basins of similar type include Fitzroy Basin, Bonaparte Gulf Basin, Perth Basin and, in part, Sydney Basin.

The total exploration, and even the exploration of any one basin, is very inadequate. Even today in many areas the effort is too thinly spread or sporadic. Many of the State governments grant very large concessions for long periods with the results that large areas are held but not investigated at all and the investigation of a particular area is not continued to the point where either success is achieved or the operator is willing to abandon the area. The Commonwealth Government is subsidizing drilling and geophysical surveys that are expected to provide new information; this information is to be published 12 months after the completion of the individual project. This has already resulted in a great increase in company seismic surveying, although the total is still very small. Only ten bores are being drilled or prepared for drilling at this date; only two of these are test wells from the viewpoint of having definite stratigraphic and structural targets.

REFERENCE

- B.M.R.A., 1960 Summary of oil-search activities in Australia and New Guinea to the end of 1958. Bur. Min. Resour. Aust. Rep. 11A. (in press).