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Petroleum Exploration Activity Report and Predictions

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ABSTRACT

In 1969, there were indications of increasing exploration activity onshore in Australia. This is expected to continue and strengthen during 1970.

The results obtained during 1969 were not very encouraging although gas reserves were increased and there was one significant new gas discovery. There were no large oil discoveries.

Exploration expenditure is expected to be about the same as for the last two years, but with an increased percentage to be spent onshore.

The present level of expenditure is not likely to be sufficient to find the reserves necessary to achieve continuing self-sufficiency for Australia.

INTRODUCTION

This paper is based largely on information kindly supplied by exploration companies whose co-operation is gratefully acknowledged. It is presented with the permission of the Director of the Bureau of Mineral Resources, Department of National Development, Canberra.

RECENT LEVEL OF ACTIVITY

There are two ways of obtaining an indication of the level of exploration activity. One is by considering annual expenditures and the other by considering the number of active exploration units.

The annual expenditures show an increase from about $65 million in 1965 and 1966 to $71 million in 1967 and to $88 million in 1968, the last year for which I have final figures. I suspect that the figure for 1969 was about the same as that for 1968. The figures I have quoted include private enterprise expenditure plus all government expenditures and refer to exploration only. There are, of course, large additional amounts which have been spent on development and production.

Figure 1 shows the number of active drilling rigs and seismic crews, both onshore and offshore, since July 1965 when exploration was at its peak.

The graph of land seismic crews shows an alarming drop from nearly 40 during the second half of 1965 to less than 10 during mid-1968. Since then there has been a steady but significant increase, but considerably more exploration effort is required if we are to get back to the 1965 level.

Marine seismic activity has shown a steady decline since the peak late in 1966 and there is still not much sign of recovery.

The use of drilling rigs on land has shown quite a fluctuation but since dropping to 8 late in 1966 has averaged about that figure ever since. Again I must emphasize that I am considering exploration activity only. There are signs, however, that the situation is improving.

The use of offshore rigs increased steadily during 1967 and has remained reasonably constant during the last two years.

When the cost of the various operations is taken into account these graphs show us why expenditure on exploration increased from 1966 to 1968 while the number of active units decreased.

Seismic costs vary considerably with the degree of complexity in field recording and in processing of the data. Considerable variation also results, particularly on land surveys, with locality and surface conditions. However a reasonable approximation is that the cost per mile onshore is about double that offshore, but, on a per month basis, the offshore costs may be 6 to 10 times those for onshore surveys because of the higher rates of production.

Offshore drilling rigs cost about $8 million per year each to operate and land rigs may cost about one-quarter of this.

Looking again at Figure 1 we would expect a decrease in expenditure on seismic work between 1966 and 1968 because the number of crews, both land and marine, decreased. Some of this decrease in expenditure could be offset by the increasing use of digital recording and processing which are quite expensive.

The number of drilling rigs on land also dropped and the only increase was in the number of offshore rigs, which increased from one to an average of about five. Because of the high cost of offshore drilling this increase of four offshore rigs was sufficient to compensate for the decrease in the other activities and also to account for the increase in exploration expenditure of over $20 million per annum between 1966 and 1968. I have neglected general increases in costs which have been quite modest over the period.

RESULTS IN 1969

(a) Geophysics

During 1969, although the greater number of geophysical surveys were carried out onshore, the greater mileage and expenditure were associated with offshore surveys.

In general, and particularly onshore, most of the work was directed towards detailing structural leads which were found during the year or which had been known previously. However, further large offshore areas, mainly on the north-west shelf and in the Timor Sea, were covered by reconnaissance seismic surveys.

In the offshore areas extensive use was made of energy sources other than conventional explosives in the seismic surveys. These alternate sources of energy are cheaper than conventional explosives and in many areas give quite comparable results.

Land seismic surveys were carried out in most of the basins on the continent and in Papua and New Guinea. Many of these have turned up drillable locations which give promise of further onshore drilling activity in the future.

The use made of other geophysical methods was again rather limited. A few surveys using the gravity method alone were carried out but the most frequent use of the technique was in conjunction with seismic surveys. By attaching a gravity party to a seismic crew to take readings along the seismic lines the gravity data can be obtained quite cheaply. In many areas the additional information is a definite aid to interpretation and the small additional cost is well justified.

Of the aeromagnetic surveys carried out, the largest amount of work was in Western Australia where the method was used for offshore reconnaissance.

(b) Drilling

Many of the basins in Australia received some drilling during the year but it cannot be claimed that the results were very encouraging, although at least 95% of the wells drilled were based on seismic evidence. Many of the wells penetrated good reservoirs which unfortunately contained no hydrocarbon accumulations, and the only oil discovery was in the Dongara area of Western Australia. However, gas reserves were increased and there was one significant new discovery.

This was at Petrel No. 1, 150 miles west of Darwin in the offshore portion of the Bonaparte Gulf Basin, which blew out when at a depth of 13,057 feet in what is thought to be marine Permian sediments. The flow rate has not been measured but there is little doubt that a large reservoir exists. The top of the Permian sequence occurred at 11,366 feet, and its thickness is unknown. Paleocene, Cretaceous, Jurassic and Triassic sediments were also drilled in this well; but in Lacrosse No. 1, which was the first offshore well in the Bonaparte Gulf Basin, Jurassic and Cretaceous sediments were absent.

Other wells on the shelf off the coast of Western Australia encountered minor shows of hydrocarbons but no substantial flows were recorded; some sands with good reservoir properties were found (e.g. in the upper part of the Barrow Group in Anchor No. 1) and valuable stratigraphic information was obtained. Perhaps the most significant well was Gage Roads No. 1 in the Perth Basin, which recovered oil from the "Gage Sandstone Member" of the Lower Cretaceous South Perth Formation. Two tests were made - No. 1A, over the intervals 5775-81 feet and 5790-5804 feet, recovered 40 bbls of 37° oil and 82 bbls of water; No. 2A, over the interval 5838-47 feet, recovered 58.5 bbls of 41° oil and 25 bbls of salt water. The porosity of the "Gage Sandstone Member" exceeded 25%, and permeabilities reached 1132 md, averaging 350 md. This is the first oil recovered from Lower Cretaceous sediments of the Perth Basin and adds interest to the search in this area.

Pendock ID No. 1 entered Lower Carboniferous below the Cretaceous at about 3500 feet and entered the equivalent of the Dirk Hartog Limestone at 6000 feet. This result disproved the presence of a thick Mesozoic section which could reasonably have been expected in this area.

The results of drilling in the Otway Basin were again disappointing, in terms of hydrocarbon discoveries, but the section encountered in the wells is sufficiently encouraging to maintain interest in the area. In particular, the presence of good thicknesses of the Lower Cretaceous Pretty Hill Sandstone or its equivalent has been interpreted from seismic work and confirmed by drilling, and although the Sandstone did not yield hydrocarbons during 1969, it remains an interesting target in the Otway Basin.

In the offshore Gippsland Basin the presence of oil and gas in the Snapper structure was confirmed, and Barracouta No. 3 (located 3½ miles WSW of Barracouta Platform) confirmed the previous interpretation of the size and shape of the Barracouta Field. Bream No. 2, 20 miles W of Kingfish Field encountered "oil below 5900 feet" and "hydrocarbon shows below 8900 feet".

Anchor Cay No. 1 was drilled in the Papuan Basin to a total depth of 11,888 feet and terminated in Lower Cretaceous - Jurassic sediments. No hydrocarbons were recorded but good potential reservoirs occur in the Miocene sequence, and porous sands were found near the top of the Lower Cretaceous - Jurassic section. Of interest also in this well was the discovery of massive pinnacle reefs of Pliocene age, whereas the Pliocene rocks in other wells in the general area have consisted of mudstone. Early in 1969, Pasca A No. 2, also in the offshore Papuan Basin, produced 17.2 MMcfd of gas plus 1375 bbls per day of condensate from an open-hole DST (7210-48 feet) of the top of a Miocene reef.

The outstanding results onshore were in the Surat, Cooper and Perth Basins.

The gas reserves in the Roma district were increased considerably by further drilling in the Pleasant Hills area, and new gas discoveries were made at Grafton Range and Mooga, while minor oil discoveries were made at Kincora. Of interest in the Pleasant Hills area was the discovery of a new reservoir in the Jurassic Injune Creek Beds: a sandstone in this unit produced 0.75 MMcfd of gas at a depth of less than 900 feet in Pleasant Hills No. 8A. Eight wells were completed as gas producers in the Grafton Range area, and two wells in the nearby Mooga area were similarly completed. In all cases, producing zones are at depths less than 4000 feet.

The discoveries of gas at Toolachee and Roseneath in the Cooper Basin increase the probability of further major gas fields being found in the Basin. Both discoveries were made in the Permian Gidgealpa Formation.

Drilling in the Dongara area of Western Australia resulted in further good flows of gas, and three wells produced oil. Six wells near Dongara produced gas at rates ranging from 6 to 10 MMcfd, from depths of

about 5500 feet, and in the nearby Mondarra area one well produced gas at a rate of 2.5 MMcfd, from a depth of about 9000 feet. These results, together with the proximity of the area to Perth, give rise to hope that another of Australia's capital cities may be supplied with natural gas in the not too distant future, and also that another oil field may be developed onshore.

Drilling in the Adavale, Eromanga, Bowen and Murray Basins was disappointing and did little to enhance the prospects in these areas.

EXPLORATION IN 1970

It appears that the exploration expenditure in 1969 will be in the vicinity of $90 million, about the same level of expenditure as we have seen for the last two years. There will, however, be a slightly different distribution between onshore and offshore exploration with a higher percentage being spent onshore than previously. I expect onshore exploration to account for close to 40% of the total exploration expenditure in 1970, which is significantly higher than it has been.

I expect the main change to be increased geophysical activity onshore. There will be a small amount of gravity and aeromagnetic work done as usual but the main increase will be in seismic crews. I would not be surprised to see 25 or more crews in the field at various times throughout the year. As we have not had this number of active crews since 1966, this is quite a significant change in exploration emphasis.

In 1969, about 75 exploration wells were drilled onshore and I expect that we will see this number, or perhaps a few more, in 1970. With the increase in seismic work it is reasonable to expect this number to increase further in future years.

Offshore activity will probably continue at about the same level as previously. I can see no reason to expect that the average number of marine seismic crews will increase above the one or two which have been employed for the last 12 months. There could be a little less offshore drilling activity because of a decrease in the number of offshore rigs later in the year. We could get down to four rigs operating as compared with five or six during 1969.

My estimate for exploration expenditure in 1970, being about the same as for the previous two years, indicates that the expenditure has reached a level which is not likely to be increased very much under the existing circumstances. The question then is, is this level of expenditure adequate for Australia's needs?

IS THE PRESENT LEVEL OF ACTIVITY ADEQUATE?

The expenditure on exploration in 1970 will probably amount to something like $90 million. This is a large amount of money, but is it large enough to establish and maintain self-sufficiency for Australia?

Taking into account the total exploration expenditure in Australia and Papua and New Guinea to date and the amount of oil which has been found, the average finding cost works out to about 35 cents per barrel. This figure allocates the total cost to oil and ignores the gas which has been found.

It must be emphasized that, in Australia's present situation, even one year without a discovery increases the average finding cost for oil by about 5 cents per barrel. The finding cost in any one year is subject to a much wider variation.

If the finding cost continues at about 35 cents per barrel, the expenditure in 1970 will result in the discovery of some 250 million barrels of oil. This is greater than the production of indigenous crude will be and is, in fact, greater than the local consumption.

It is however, important to remember that Australia's consumption is increasing at a substantial rate and to achieve and maintain total self-sufficiency it may be necessary to find some 10,000 million barrels of oil in the next 20 years. At the present average finding cost of 35 cents per barrel this will require an average annual expenditure of about $175 million during this period, which is about double the present rate.

It is difficult to see this type of expenditure being forthcoming unless further major discoveries are made, even with continuing Government incentives.

TENEMENT POSITION

There are two main factors relating to tenements which are having or could have a large effect on the level of exploration.

First, there are many companies with applications pending for tenements offshore from Queensland. I understand that these companies are prepared to commit substantial sums of money to explore the areas, so that many additional millions of dollars will be spent on exploration if and when the titles are granted.

The other important factor is the number of farmouts which are being given. In particular this is noticeable in the Cooper and Surat Basins, but it is by no means restricted to these.

The farmouts appear to be the main reason for increased onshore activity. There were existing targets available for drilling but further geophysics is being done so that the increased drilling activity should continue for a year or two more at least.

CONCLUSIONS

In 1970, there will be a swing back to onshore exploration, particularly seismic work. This has been caused largely by the newer companies taking farmouts.

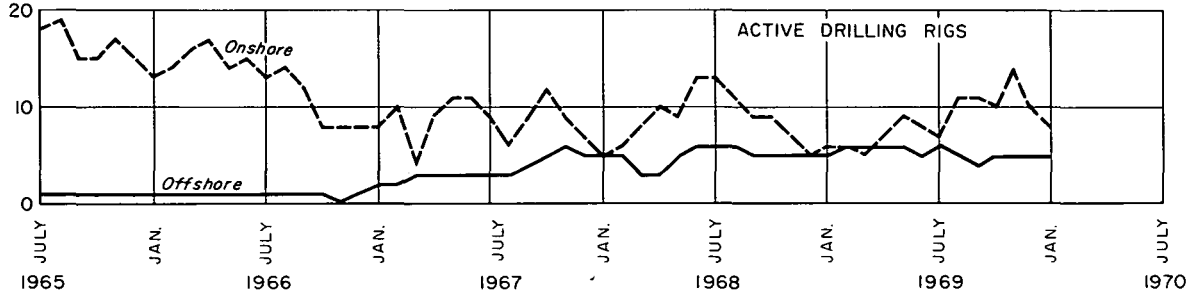
However, even with the additional capital that has become available, the annual expenditure on exploration is not increasing significantly. This additional capital has been sufficient to keep the expenditure at about the same level despite the absence of recent large oil discoveries.

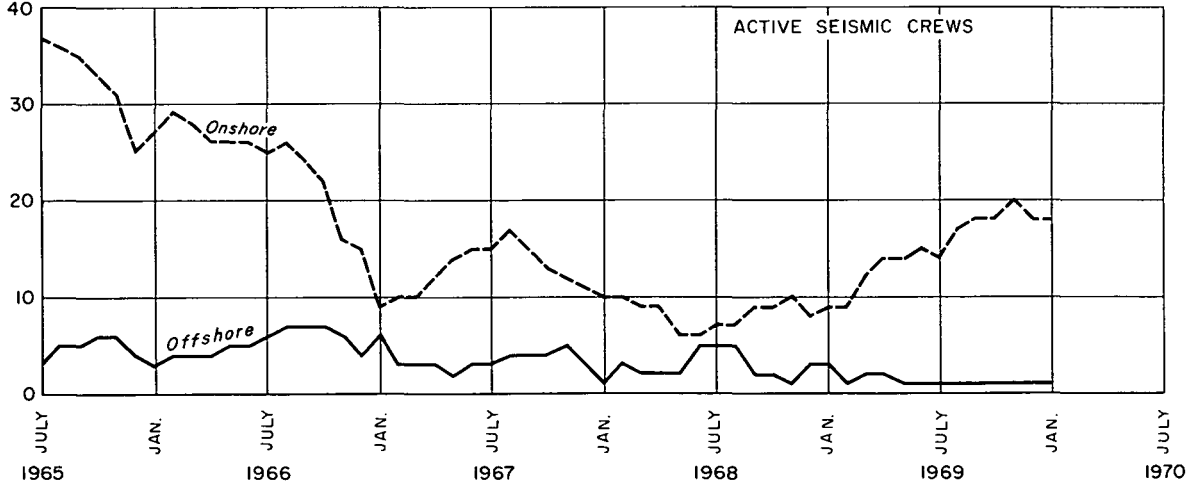
It is unlikely that the level of expenditure will increase unless further large oil discoveries are made and, unless this happens, there will not be enough exploration carried out to find the quantities of reserves necessary for Australia to achieve and maintain self-sufficiency.

Fig. 1

PETROLEUM EXPLORATION ACTIVITY

IN AUSTRALIA AND PAPUA – NEW GUINEA





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