BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1984/21

RECORD

The future outlook for petroleum in Australia in 1984 - speaking notes and slides.(Paper presented at Petroleum and Minerals Review Conference, March 1984).

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Petroleum and Minerals Review Conference March 1984

The future outlook for petroleum in Australia in 1984

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Mr Chairman, ladies, and gentlemen:

At the end of this talk I will be presenting an estimate of possible future production of crude oil to the year 2000. This estimate suggests that there is a good chance that Australian oil production will rise about 30 percent between now and 1989 and will plateau at about this level before beginning to decline in 1996.

Before presenting the estimate, however, I want to discuss some of the areas that our research has taken us into. For instance, the starting point for any estimate of future production from undiscovered fields is an assessment of the amounts of oil or gas that remain to be discovered; and I will be presenting BMR's most recent assessments of undiscovered oil and gas potential today. We need to know where the undiscovered oil might occur, the size distribution of the undiscovered fields, and the order in which the fields are likely to be discovered. We also need to know how many wells are likely to be drilled each year and the success rate of that drilling.

Slide 1,(2)

While most of my talk is about Australia's undiscovered oil, I intend to start with a few brief comments on the distribution of our undiscovered gas resources and the implications of this for future supplies. This slide summarises the results of our new assessment of Australia's undiscovered gas potential. The vertical axis shows percent cumulative probability and the horizontal axis shows the amounts of undiscovered gas in trillions of cubic feet. The graphs show the probability of discovering at least the amount of gas shown and the average of the assessment.

By way of comparison, it will help you to remember that we already have large remaining demonstrated resources of about 36 trillion cubic feet of sales gas in Australia. Our assessment of undiscovered conventional gas potential onshore is shown in brown. The average amount of this assessment is 3.5 trillion cubic feet, a small part of which occurs in the Cooper Basin, the supply source for Sydney and Adelaide. This compares with a projected shortfall between supply and demand for the Sydney and Adelaide market requirements to the year 2005 of about two to three trillion cubic feet.

There are significant amounts of unconventional gas already identified in tight sands in the Cooper Basin, and these have the potential to meet some at least of the shortfall. There is doubt, however, about the economics of their production.

If the identified tight gas sands cannot be developed economically, the assessment suggests that Sydney and Adelaide may eventually have to look offshore for future supplies. The average for onshore plus offshore to the 200 m contour is 20 trillion cubic feet. The average total potential, onshore and all offshore, including deep water, is 38 trillion cubic feet.

Slide 3,(4) Our previous assessment of Australia's undiscovered oil potential was carried out in 1980 and the new assessment, which is summarised here, was carried out at BMR late in 1983, following the oil discovery at Jabiru No. 1A in the Bonaparte Basin. The vertical axis on the diagram shows percent cumulative probability and the horizontal axis shows the amounts of undiscovered oil in millions of barrels. The graphs show the probability of finding at least the amount of oil shown and the average of the assessment.

Our assessment of undiscovered oil potential, onshore, is shown brown, and offshore potential is shown blue; the uppermost curve shows the total assessment for Australia. The assessment indicates an 80 percent chance of finding at least 1900 million barrels of oil - that is double the amount included in our previous assessment at the 80 percent probability level and about the same amount again as our remaining identified resources - and the assessment indicates a 20 percent chance of finding at least 3900 million barrels of oil - about the same as the previous assessment. The average of the new assessment is 3000 million barrels, which is a modest increase on the 2600 million barrels of the earlier assessment.

Slide 5,(6) This slide shows nine of Australia's most prospective areas ranked in order of their prospectivity for oil. They are ranked in terms of their risked mean, which is the average value of their assessed undiscovered crude oil potential multiplied by the chance that further crude oil discoveries will be made. It indicates our assessment of the importance of the sedimentary basins off the north-west coast of Australia.

The values of the risked mean for the Bonaparte, Carnarvon, and Browse Basins have all been increased in the light of the exploration results over the last few years. Those of the Gippsland, Eromanga, and Canning Basins have been decreased somewhat, because discoveries have been smaller than we expected in 1980. Nevertheless, the rankings for the various basins are still very similar to those of the previous assessment.

Slides 7,8 These two slides have been resurrected from the talk I gave here two years ago. They show a part of the analysis required to determine the likely distribution of our undiscovered petroleum resources. Australia's sedimentary rocks, deposited over the last 600 million years, have been divided into four major sequences. However, we will be considering only the two youngest sequences today: the older of these, shown on your left, includes all Upper Carboniferous to Upper Triassic sediments, and the youngest, shown on the right, includes all Upper Triassic to Recent sediments.

Both these maps show the present day distribution of the sedimentary rocks in the sequence (they occur in the white or coloured areas). Areas where the sediments are mature for generation of hydrocarbons are coloured green and in the slide on the right areas of thick sediments which should be mature for hydrocarbon generation are shown by cross hatching.

The slides also show how much oil and gas was known to be reservoired in those areas at that time and totals are shown at the bottom. One important point I made in 1982 was that although similar amounts of gas (16 and 17 TCF) had been found in each sequence, by far the greater amount of the oil had been found in the younger sequence. As you can see, about 50 million barrels had been identified in the older sequence, compared to 3230 million barrels in the younger sequence, and it was thought that, although both sequences were prospective for gas, the greater part of our undiscovered oil would be found in the younger sequence. And it was expected that discoveries would be made in one of the green or cross hatched areas. The discovery of a large oil field in Jurassic sediments at Jabiru No. 1A in the Vulcan Sub-basin of the Bonaparte Basin is consistent with this reasoning.

Slides 9,(10) At last year's conference, I pointed out that the results of oil or gas exploration in some parts of Australia can be modelled by assuming (a) that the sizes of the undiscovered fields have a log-normal distribution, which means that there are few large fields and a much greater number of small fields, and (b) that the probability of discovery of each field is proportional to some power of its size which we call lambda.

When this model is applied to Australian data, we find that in a number of areas the probability of discovery of a field is roughly proportional to the square root of its size (ie $\lambda = .5$). This diagram shows the result of a computer run where the discovery of the same 100 fields has been repeatedly simulated using this model. For each iteration the computer records the size of the first field discovered, then the second, and so on. After a large number of iterations the computer plots out the logarithm of the average size of the fields in each rank and the logarithms of the values of their first and third quartiles. Because the logarithms of the average field sizes in this plot fall nearly on a straight line, we can use projections of the straight line to give us an indication of undiscovered petroleum resources and the number of wells required to discover them. We can also use this model to help predict the field sizes and the order in which they may be discovered in areas where a discovery has not yet been made.

Our studies of Australian data have also shown that the success rate often remains fairly constant during exploration of a region. The combination of constant success rate and the tendency to find the larger fields early, enables us to predict that most of the resources will be discovered early by a small amount of drilling and that later drilling will discover only a small proportion of the resources. Of course, there are very few prospective areas of Australia without a few wells in them, and we have to ask what are their prospects now for major oil discoveries? I think if we are looking for large oil fields we must look for:-

(a) Areas that have not been explored for one reason or another.

(b) Areas in which exploration has been hampered by poor seismic data.

(c) Areas of difficult geology.

(d) Areas with subtle traps and stratigraphic traps.

Slides 11,(12) The number of new-field wildcats to be drilled in each year of the estimate is another factor to consider when attempting to estimate supply from undiscovered petroleum resources. As part of our investigations, we have looked at the possibility of correlating the number of new-field wildcats drilled each year with various other statistical data. However, the only statistically valid correlation we have found is between new-field wildcat wells drilled and total foreign investment - with a lag of about one year.

This relationship is indicated on this diagram where the number of new-field wildcats drilled annually is shown in blue and total foreign investment in constant 1975/76 dollars, is shown in red. The annual amount of oil in new-field discoveries is also plotted in green on this diagram, and I think you can see a very broad correlation with the other two.

lides 13,14
3]

The correlation between the number of new-field wildcat wells drilled and the annual amounts of oil or gas discovered is more obvious locally. On these two slides the level of annual gas discoveries is shown in red and the number of new-field wildcat wells drilled is shown in blue. The Roma area on the left shows a classic correlation between the two, with the number of new-field wildcats drilled lagging somewhat behind the annual amounts of gas discovered.

A somewhat different picture can be seen in the adjacent areas of the Bowen and Surat Basins. If oil discoveries were shown we would see that the first peak of drilling followed the discovery of the Moonie field and then fell of as only a few more significant oil discoveries were made. Reasonable-size gas discoveries were not made until the early to mid 1970's and these were neglected, for economic reasons, until the late 1970's. The cycle of drilling that followed correlates well with the level of gas discoveries, but there is no corresponding correlation with the level of exploration in the Roma area.

Therefore, we can say that discoveries have a significant influence on the distribution of drilling activity throughout Australia and perhaps on the overall level, but we lack any information that may help us to make an accurate prediction of overall levels of petroleum exploration in the future.

Slides 15,(16)

This slide shows our estimate of possible future supply and demand for crude oil, condensate, and LPG to the year 2000. The vertical axis is in millions of barrels per year and the horizontal axis ranges from 1960 to 2000. The lower graph shows historic production from identified fields from 1960 to the end of 1983, and provides a

forecast of production from then on. The upper curve shows consumption of crude oil, condensate, and LPG from 1960 to the end of 1983 and provides a forecast of demand from there on. Most of this information has been compiled within the Policy Division of the Department.

To this we have added the estimate of production from undiscovered fields - shown blue - based on the 50 percent probability estimate that at least 2600 million barrels of crude oil remain to be discovered. We consider that about 1800 million barrels of this oil could be discovered and brought into production by the year 2000.

We have broken up the 1800 million barrels into the main areas in which we think it occurs and then we have further broken these amounts up into field sizes. Then we have estimated the discovery order of the fields and the timing of their discovery to arrive at a discovery schedule. This schedule suggests that over 50 percent of the 1800 million barrels of undiscovered oil will be discovered in the next five years. Finally we estimated the lead time from discovery to production and the likely production rates to arrive at this production schedule.

The estimate of production from undiscovered fields shown is more optimistic than the one published last year because we now consider that a larger amount of crude oil will be found during the period covered and because we consider lead times for a part of the undiscovered oil will be shorter than previously estimated. If the production schedule is borne out, we can expect that production will rise about 30 percent between now and 1989 and will plateau at about this level before beginning to decline in 1996.

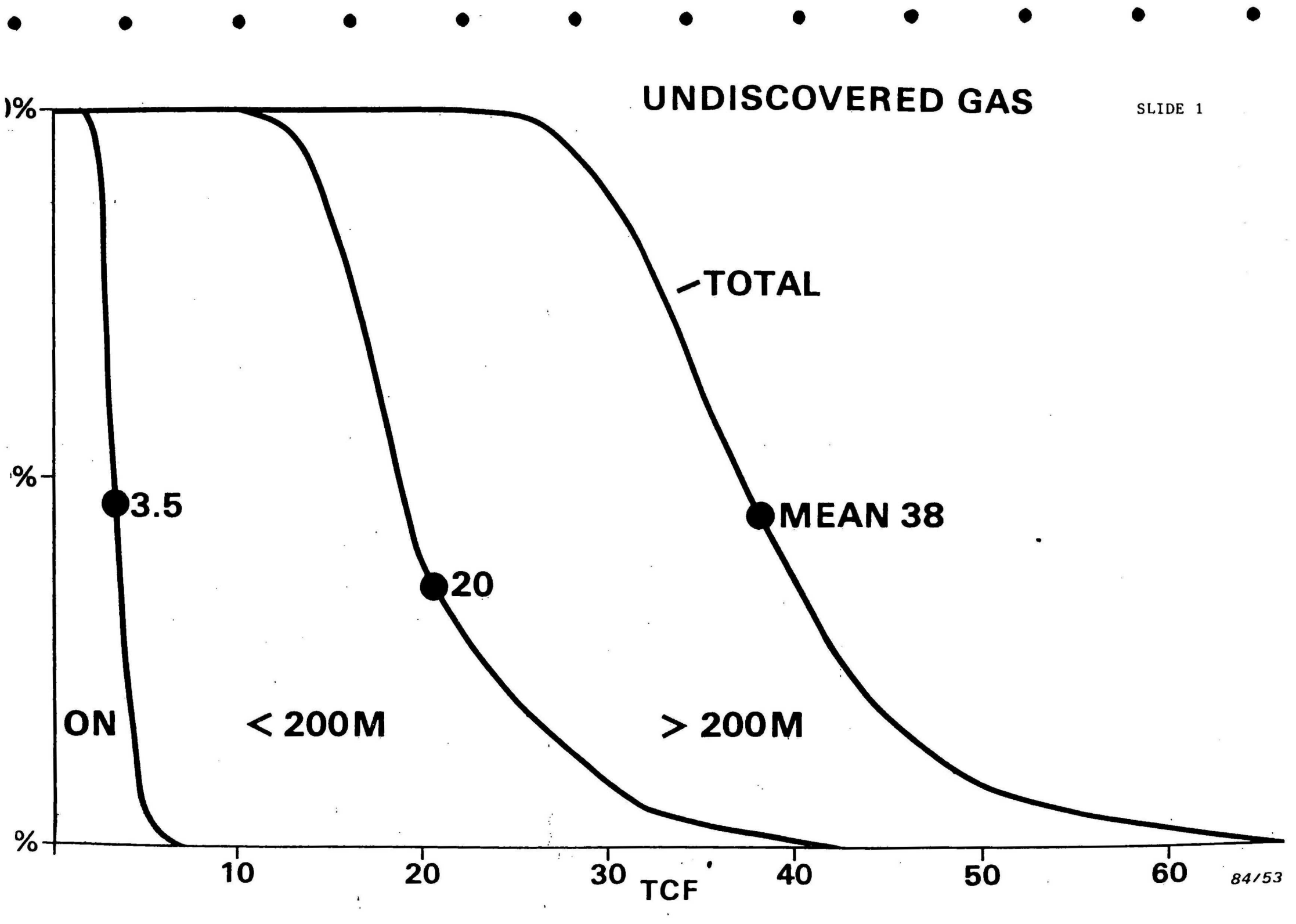
I do emphasise, however, that the production schedule assumes vigorous exploration leading to the discovery over the next five years of 1000 million barrels of crude oil off the northwest coast and further economic discoveries in the Eromanga and Gippsland Basins.

In summary, a new assessment of Australia's prospectivity for oil and gas was prepared in BMR towards the end of 1983. The gas assessment suggests limited further potential for conventional gas discoveries onshore and accentuates the importance, onshore, of tight gas sands, if they can be developed economically.

The discovery of oil at Jabiru No. 1A and other discoveries off the northwest coast have confirmed our assessment of the high potential of this area and, in our view, increases the probability of discovering additional crude oil fields. We now consider there is an 80 percent probability of discovering at least another 1900 million barrels of crude oil.

Assuming our 50 percent probability estimate, that we will find at least 2600 million barrels of oil and that 1800 million barrels of this will be found before the year 2000, we consider there is a good chance that oil production could rise about 30 percent between now and 1989 and could plateau at about this level before beginning to decline in 1996.

I wish to thank my colleagues in BMR and in particular Evelyn Nicholas and Russel Temple for assistance with preparing the assessment and the production schedule, and I thank Alan Hinde for carrying out all the computer programming associated with this work.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> 200M
10
20
30
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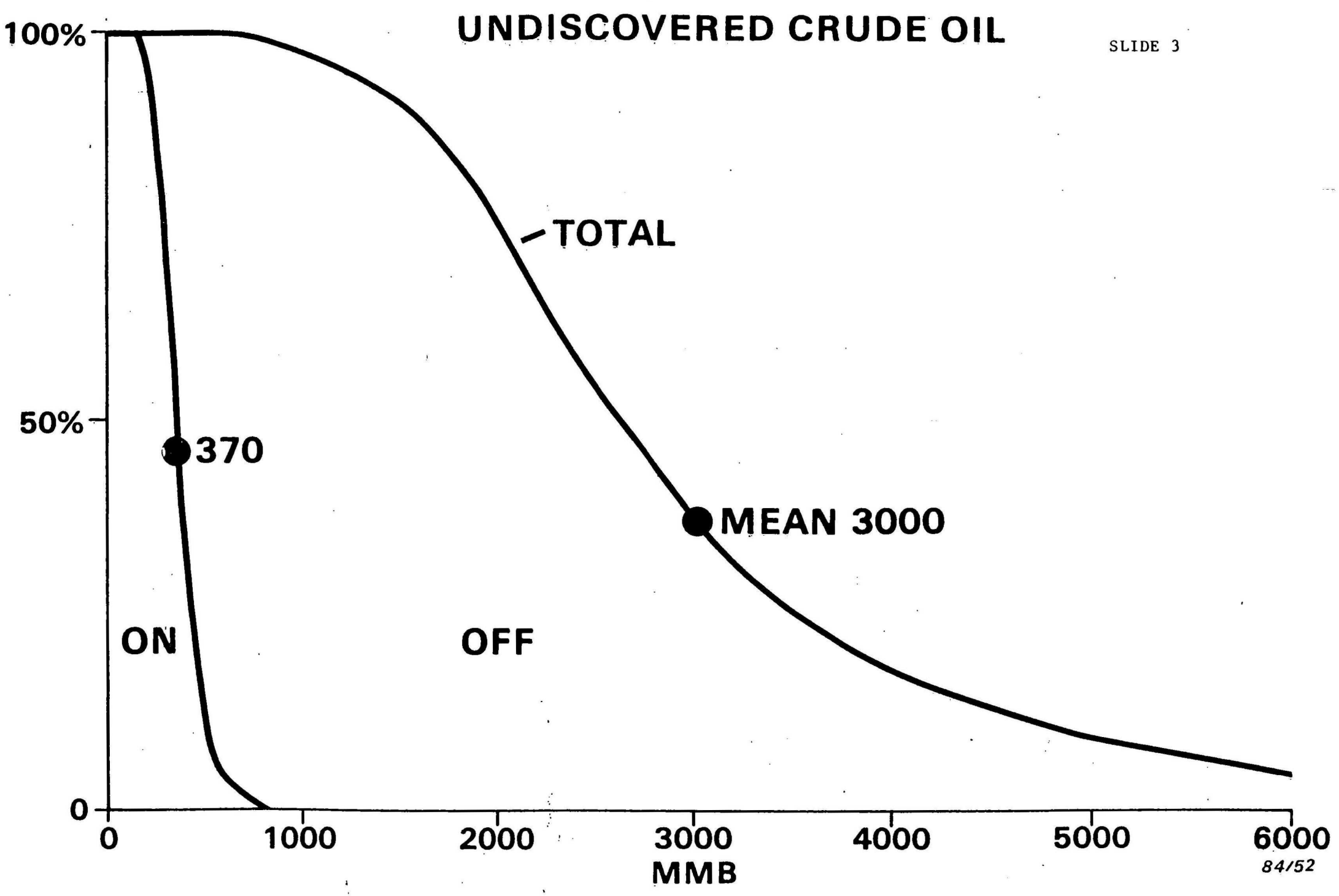
50
60
TCF
84/53


UNDISCOVERED CRUDE OIL
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50%
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TOTAL
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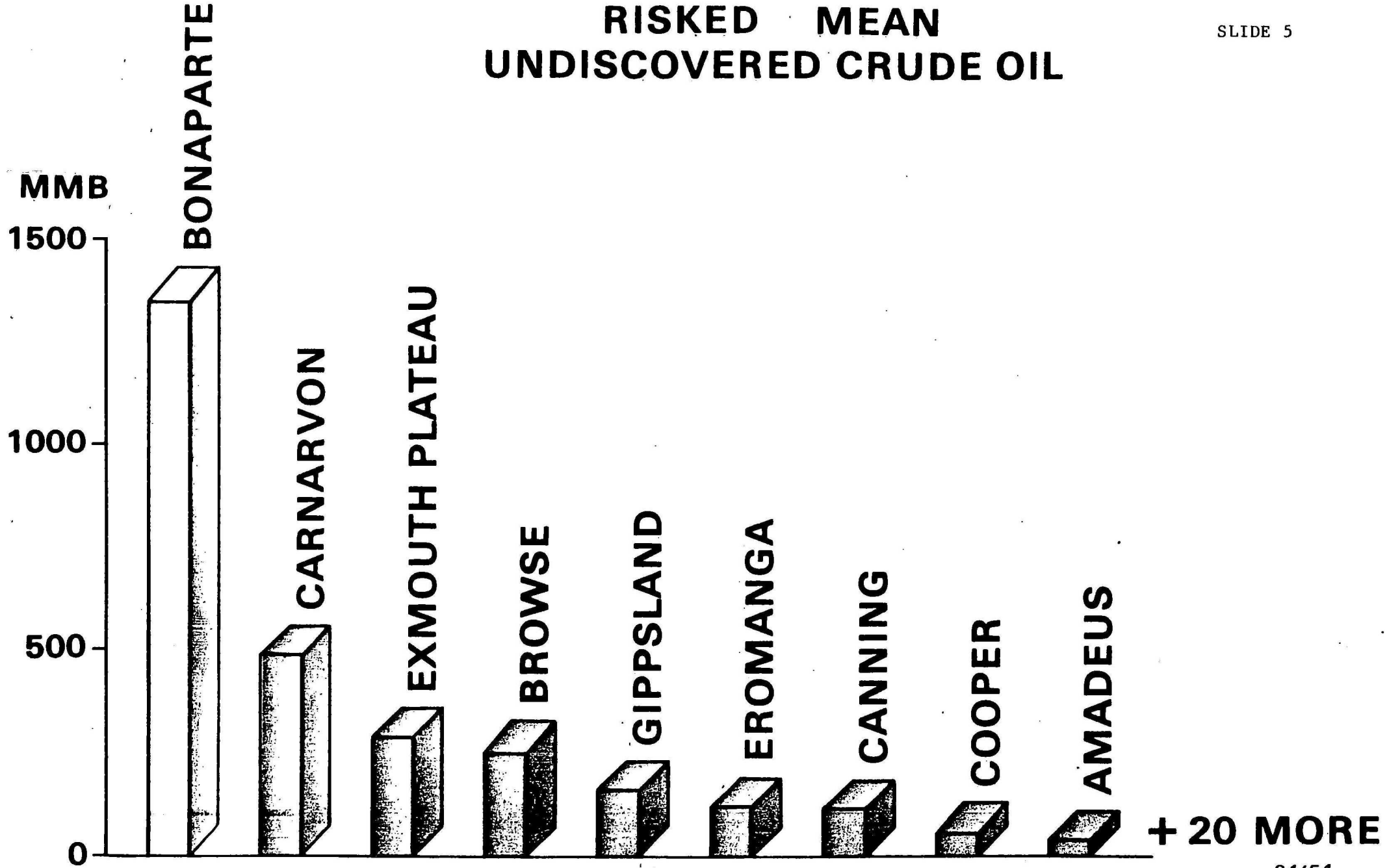
RISKED MEAN UNDISCOVERED CRUDE OIL

SLIDE 5



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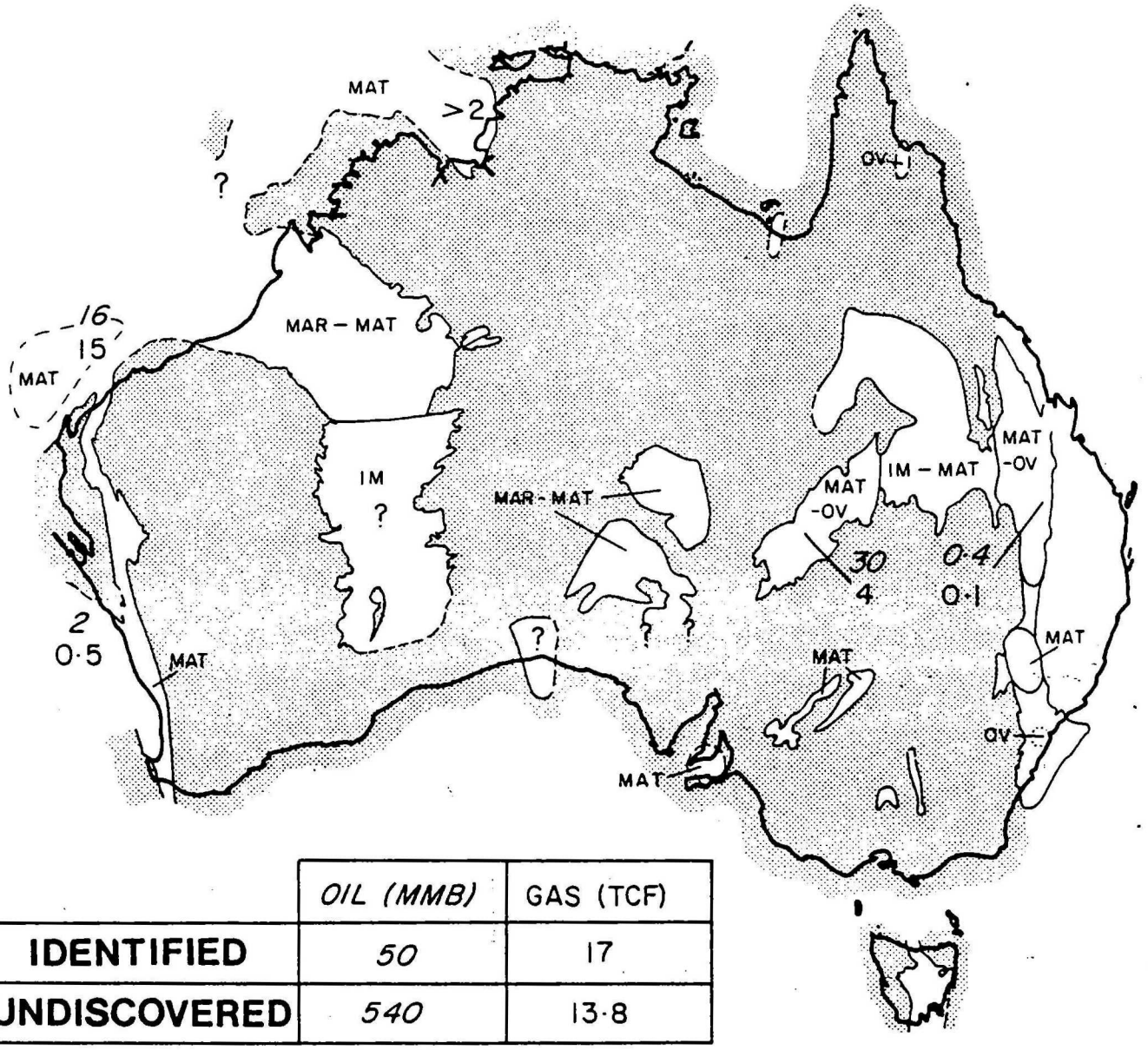

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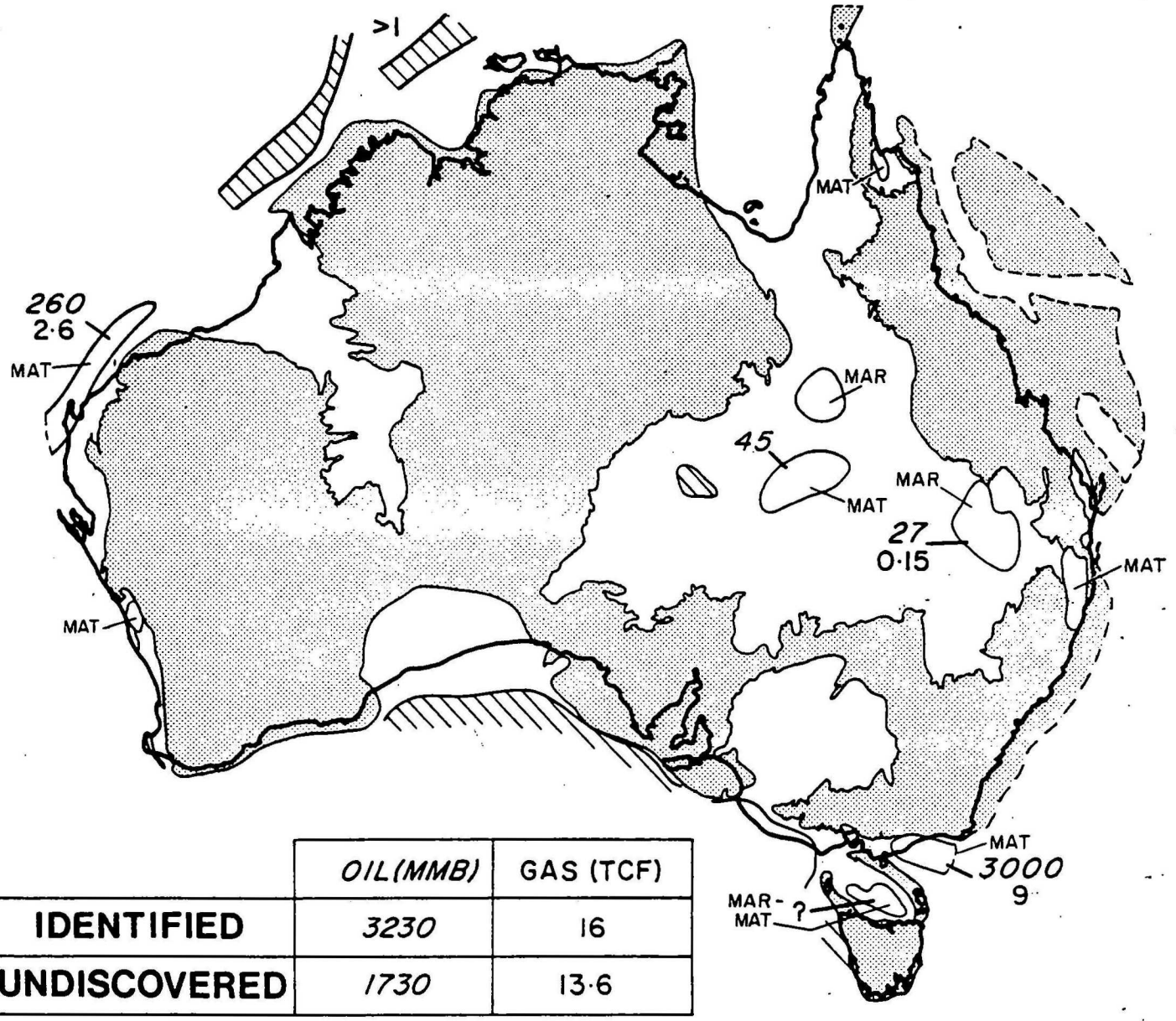

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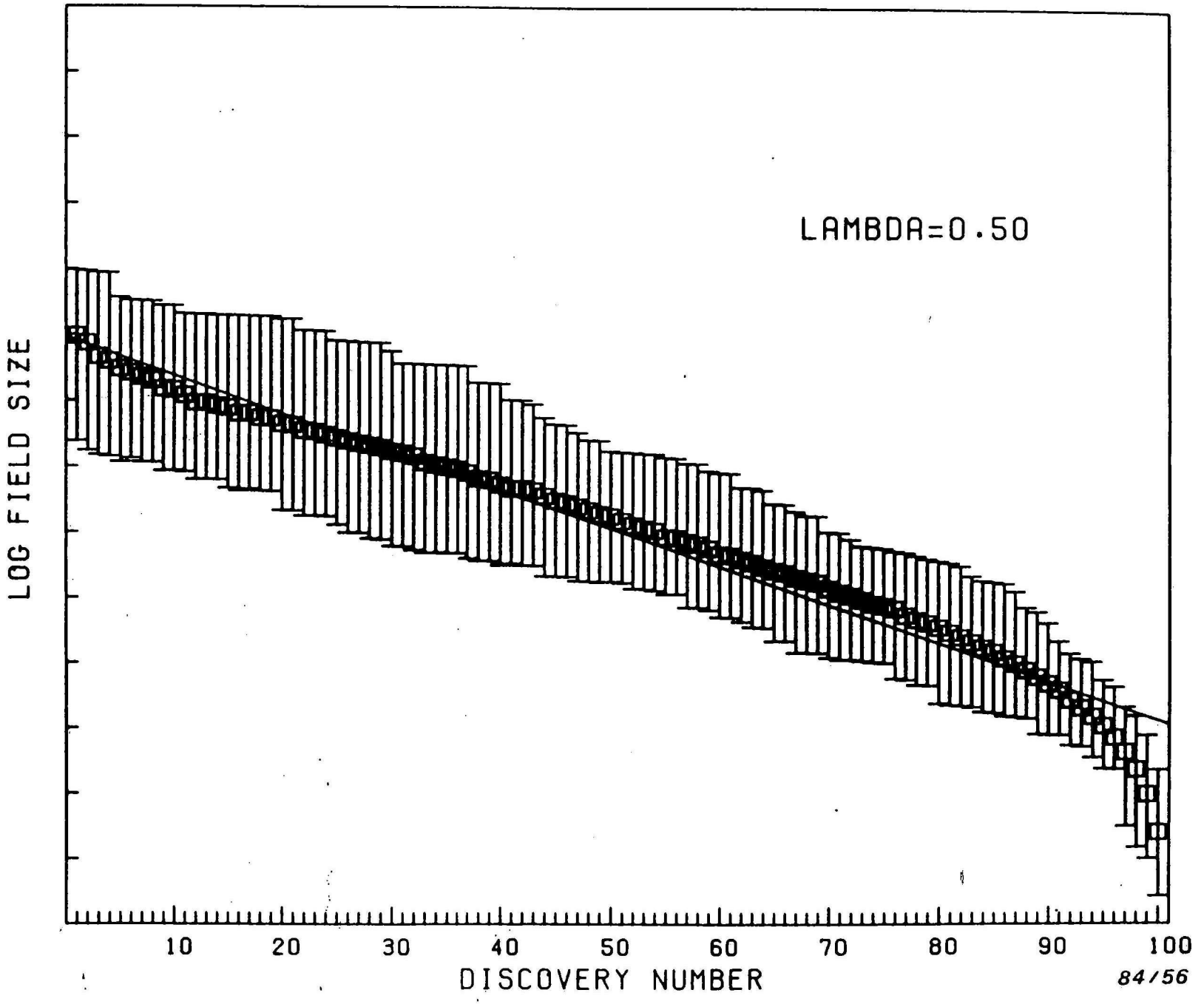
SLIDE 9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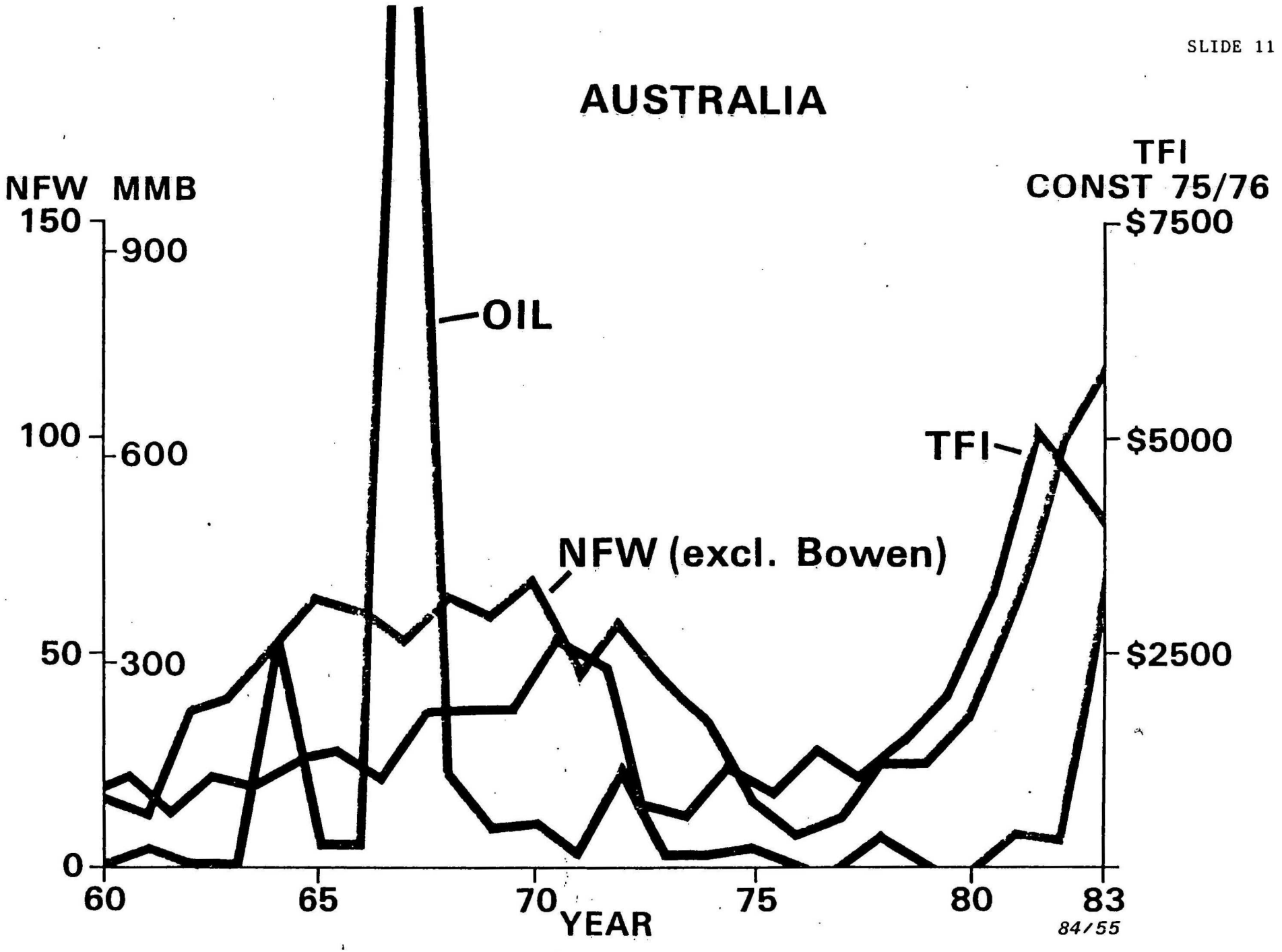
84/56


AUSTRALIA
NFW MMB
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NFW (excl. Bowen)
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YEAR
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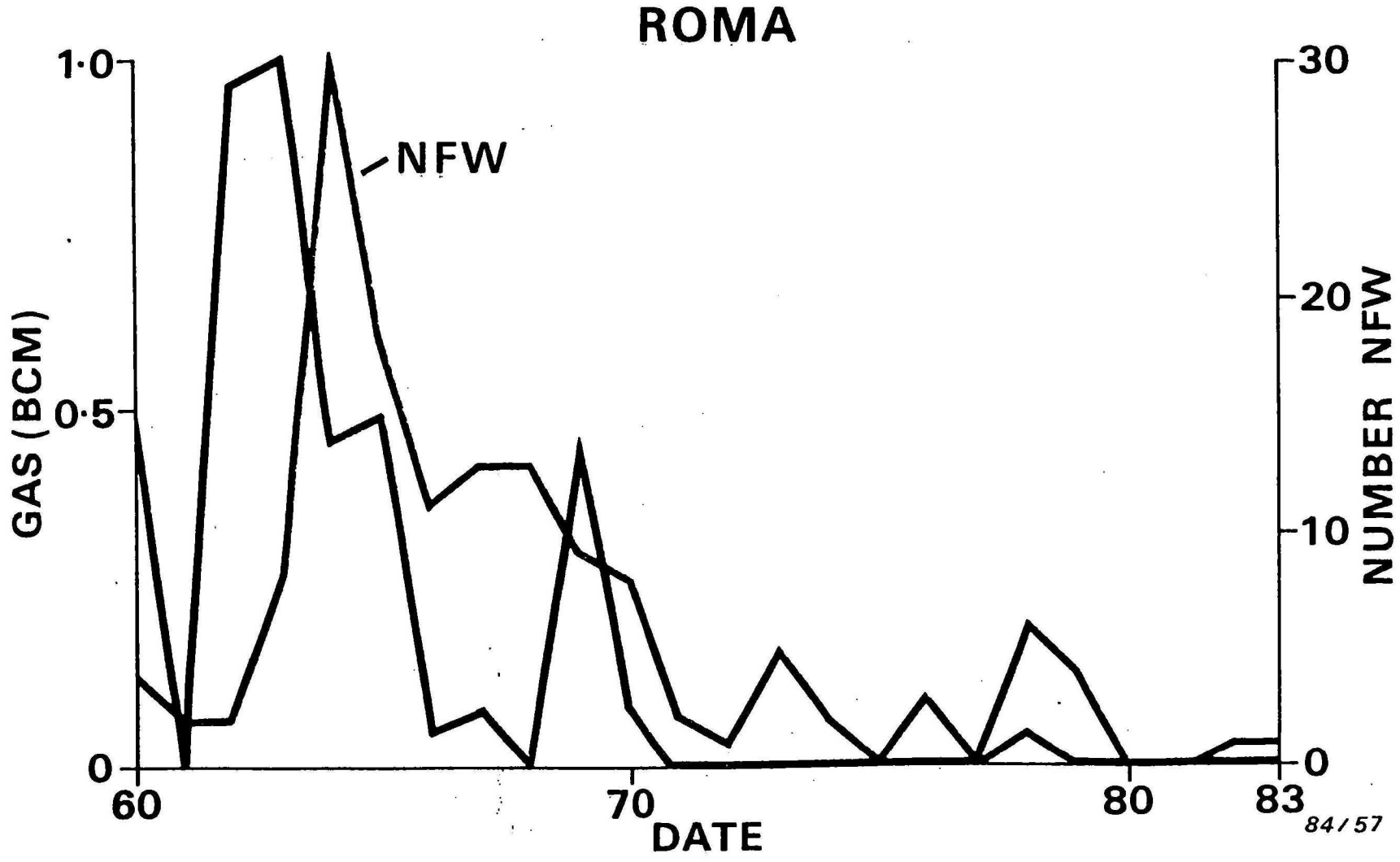
SLIDE 13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GAS (BCM)
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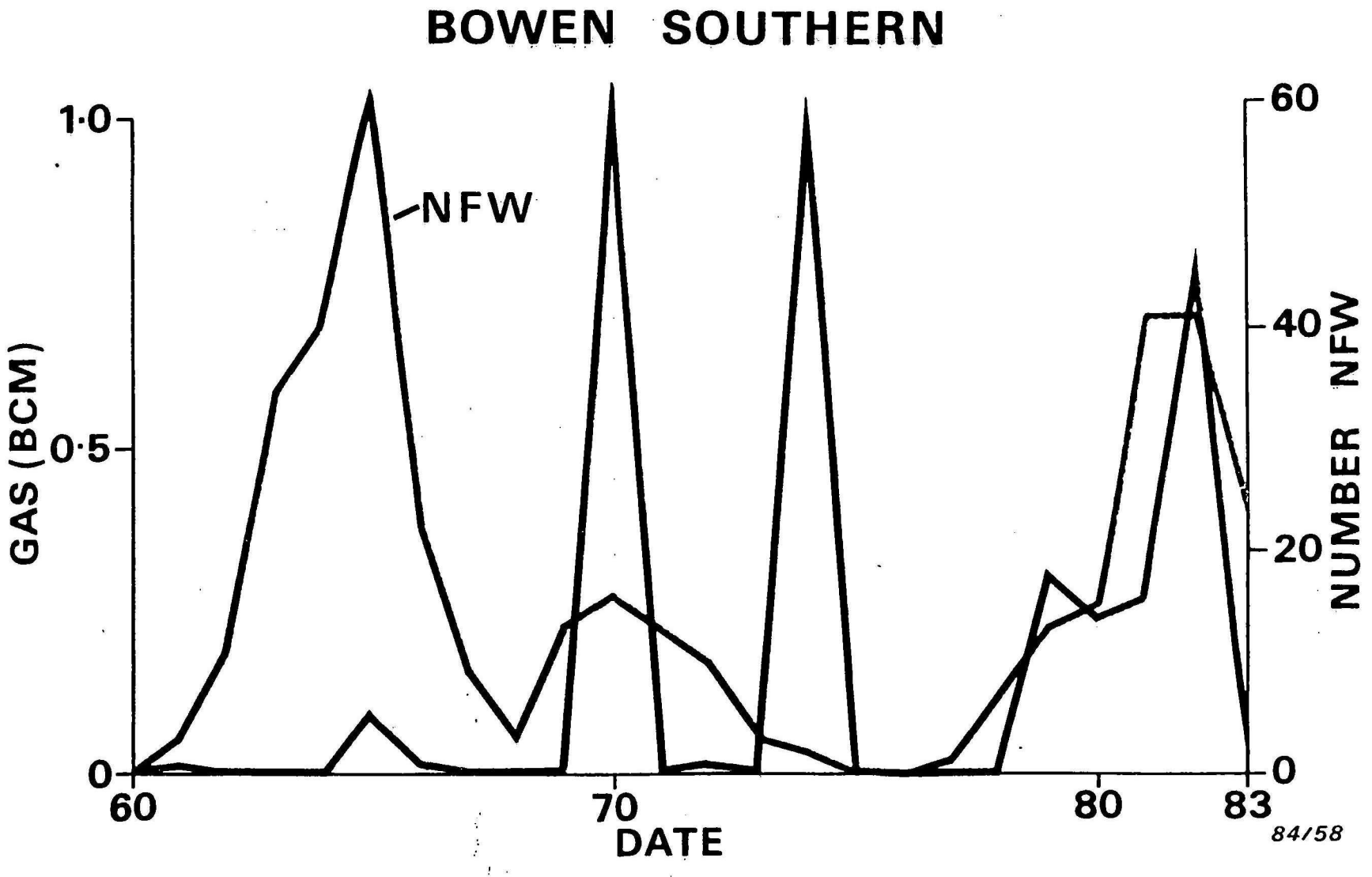
SLIDE 14


BOWEN SOUTHERN
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CRUDE OIL AND CONDENSATE SUPPLY AND DEMAND