DEPARTMENT OF
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# BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS



RECORD 1975/78



## SUMMARY OF OIL SEARCH ACTIVITIES IN AUSTRALIA AND PAPUA NEW GUINEA DURING 1973

by

Evelyn Nicholas

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# INTRODUCTION

This Record is largely a summary of the results of subsidized drilling and geophysical operations carried out under the Commonwealth Petroleum Search Subsidy Act 1959-1973 (PSSA) during 1973, and released to the public on or before 31 December 1974. It also contains brief details of unsubsidized drilling operations in 1973, and the results of a small number of subsidized operations completed in 1972 and released too late for inclusion in the previous Record in this series (Bur. Miner. Resour. Aust. Rec 1973/216.) A later Record will summarize the remaining 1973 subsidized operations as well as operations carried out in 1974.

Except where indicated the interpretation of the data is that of the author or authors of the final reports submitted under the terms of PSSA. Inconsistencies between stratigraphic nomenclature used by Companies and that in current useage have been indicated.

The names of the operating companies and the Bureau of Mineral Resources (BMR) file numbers of the 1973 subsidized operations are included in Tables 18 and 19. File numbers of earlier subsidized operations are given in the text.

Unsubsidized geophysical surveys are not included in this Record because details of these operations are not consistently reported in the press and the locations of those which are reported are not always available.

# ADAVALE BASIN

There was no petroleum exploration drilling in the Adavale Basin in 1973. One subsidized seismic survey was carried out.

## SUBSIDIZED GEOPHYSICS

The Mount Edinburgh seismic survey was carried out in the Blackall-Windorah area of central western Queensland where the Eromanga Basin overlies the Permian/Triassic Galilee Basin and the Middle Devonian to Lower Carboniferous Adavale Basin east of the Canaway Ridge and the Permian/Triassic Cooper Basin west of it. The survey covered three separate areas: one on the eastern side of the Adavale Basin; another on the western side of the Adavale Basin near the Canaway Ridge; and the other over the northeast margin of the Cooper Basin.

In the eastern area, good stratigraphic control was provided by Alva No. 1 (BMR file, 72/2633). The primary objective was postulated Middle Devonian reefs. Four horizons were mapped on good quality data: 'Blythesdale' (top Upper Jurassic to Cretaceous Hooray Sandstone); top Permian; top Boree Salt Member of Middle Devonian Etonvale Formation; and top Bury Limestone Member of Middle Devonian Log Creek Formation. Horizons identified but not mapped were: base Permian; top D2 Member of Etonvale Formation; and base Bury Limestone Member of Log Creek Formation. A closure apparently related to a minor horst was mapped on the top Bury Limestone horizon. There was no indication of reef development.

On the western side of the Adavale Basin, the aim was to provide more detail on a closure against a north-trending fault associated with the Canaway Ridge, indicated by the Gallipoli seismic survey (BMR file 72/2666). Two horizons were mapped: top of 'Blythesdale', and an unidentified deep event. Two east-west lines over the 'closure' failed to confirm its existence, and the fault was shown not to extend as far north as previously thought.

Over the northeast margin of the Cooper basin, the same two horizons were mapped. The maps show a general westerly dip. The two small high areas have little, if any closure, and are not considered to warrant further exploration at this stage.

## AMADEUS BASIN

The only petroleum exploration well drilled in 1973 was Palm Valley No. 3, an unsubsidized well. It was an appraisal well financed by a subsidiary of the Pacific Lighting Company of California. An initial flow rate of 3 MMcfD was obtained from drill-stem tests. This was later increased to 5 MMcfD after the reservoir section (lower Palaeozoic Pacoota Sandstone) was hydraulically fractured.

# BASS BASIN

Four dry holes were drilled in 1973; only one of them, Narimba No. 1, was subsidized. There was one subsidized geophysical survey.

## SUBSIDIZED DRILLING

Narimba No. 1 (Table 1) penetrated good reservoir sandstone in the Eastern View Group, which was intersected 30 m higher than predicted. The spore-pollen sequence consists of early to middle Eocene zones, and no major palynological break was found in the succession between 1783 m and 3283 m. The structural trap tested by the well lies on trend with and to the northwest of the Pelican structure, from which Pelican 1 and 2 (1970-2) produced good shows of wet gas from the Eastern View Group. The lack of hydrocarbons in the equivalent stratigraphic section in Narimba No.1 indicates that the wet gas of Pelican does not extend to the northwest past the saddle separating the two structural traps.

## UNSUBSIDIZED DRILLING

No indications of hydrocarbons were reported from the three unsubsidized wells - Dondu No. 1, Konkon No. 1, and Yurongi No. 1. All available details are given in Table 18.

## SUBSIDIZED GEOPHYSICS

The Flinders seismic survey was part of Esso/BHP's continuing effort to record reliable reflection data from below the Palaeocene-Eocene Eastern View Group. It was designed to provide regional coverage on the southwest flank of the basin, and to detail five structures - Toolka, Aroo, Kalperri, Jerra Jerra, and Paipan - outlined by previous surveys.

TABLE 1 : STRATIGRAPHIC TABLE, NARIMBA No. 1

| AGE | UNIT | Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| MIOCENE | | | | 235 - 710m Calcarenite, grey to white, soft, abundant shell bryozoan and coral fragments<br>710 - 859m Calcirudite, soft, grey to white, some shell and bryozoan fragments |
| | Middle Miocene (Seismic Mkr.) | 872 | 503 | |
| OLIGOCENE | Oligocene (Seismic Mkr.) | 1375 | 280 | 859-1451m Mudstone, grey to grey brown, soft, some bryozoan, foram, and shell fragments, some limestone streaks<br>1451-1655m Shale, brown, calcareous, limestone and calcarenite fragments |
| EOCENE | 'Upper Eocene shale' | 1655 | 138 | 1655-1793m Shale, brown, firm, calcareous, some large forams, trace pyrite |
| | Eastern View Group | 1793 | 255 | 1793-1817m Siltstone, tan to grey green, hard, dolomitic, pyritic, glauconitic |
| | *Proteacidites asperopolus (Seismic Mkr.) | 2048 | 187 | 1817-2079m Interbedded sandstone, siltstone, shale, and coal<br>2079-2089m Siltstone, brown argillaceous, coaly, dolomitic |
| | *Upper Malvacipollis diversus (Seism. Mkr.) | 2235 | 296 | 2089-3354m Interbedded sandstone, siltstone, shale and coal |
| | *Lower M. diversus | 2531 | 307 | |
| | *Intra-L.M. diversus (Seis. Mkr.) | 2838 | 516+ | |
| | | TD3354 | | |

Notes
* Within Eastern View Group

The desired improvement in data quality from the deeper levels did not materialize. Three horizons were contoured in depth: Yellow horizon (top Eastern View Group); Red horizon (within Eastern View Group), and Blue horizon (deep horizon, not identified.). The deep horizon could be mapped in only the Aroo area. Only one of the three refraction profiles recorded in conjunction with the seismic work produced satisfactory results; recording a high velocity refractor (3,600m/sec.) at a depth of about 1830 m.

The survey has provided closer seismic control over the five structures. On the Aroo anticline more than 120 m of vertical closure is indicated on the Blue horizon. On the Toolka anticline, closure was mapped on both the Red and Yellow horizons; on the Yellow horizon the southern part of the closure is distorted by a presumed volcanic body. Kalperri is mapped as a broad anticline with a minimum closure of 60 m at the Red horizon, and as a narrower structure elongated in a northwesterly direction on the Yellow. Jerra Jerra was confirmed as a small fault-controlled closure on the Red horizon. At Paipan, a closed anticline was mapped at both the Yellow and Red seismic horizons, but here the interpretation is hampered by the presence of presumed volcanic bodies.

A terrace mapped previously west of Cormorant No. 1 well (unsubsidized well, 1970) was also investigated. The lack of deep reflections is thought to be probably due to relatively shallow basement in this area. A notable feature in the Eastern View Group is the presence of a number of discontinuous very high-amplitude reflections which are interpreted to be from igneous intrusive sills.

## BONAPARTE GULF BASIN

One unsubsidized well was completed in 1973 and one subsidized well was in progress at the end of the year, both offshore. There was one subsidized geophysical operation.

### SUBSIDIZED DRILLING

North Hibernia No. 1 (Table 2), which was completed in 1974, was located on the northern side of the Ashmore-Sahul Block to test the hydrocarbon potential of a large northeast-trending fault-controlled anticline detailed by the Sahul-Ashmore (BMR file, 71/667) and the Prudhoe-Hibernia seismic (BMR file, 72/2530) surveys. The primary drilling objective was the Upper Triassic fluvio-deltaic sequence.

The well encountered no significant indication of hydrocarbons. Electric-log analysis indicated that all porous zones were 100 percent water saturated. However, some points of geological significance emerged from the drilling. A thick limestone unit which had not been predicted was encountered in the Upper Triassic (Norian-Carnian); the top of this unit was identified as corresponding to the 'Q' seismic horizon. The well also penetrated a thin Lower Cretaceous (Aptian-Neocomian) sequence; Ashmore Reef No. 1, about 65 km to the south, encountered no rocks of this age. The Upper Cretaceous sequence is apparently conformable from Albian to Maestrichtian. The well has given the first confirmation of Triassic volcanicity in the area, and an evaporite sequence is the first recording of Triassic evaporites on the Northwest Shelf. The absence of Jurassic strata confirmed that the Ashmore-Sahul Block was emergent for most, if not all, of the Jurassic.

## UNSUBSIDIZED DRILLING

Swan No. 1 was located about 260 km northwest of Cape Bougainville. Hydrocarbons were not reported, and the well was plugged and abandoned as a dry hole.

## SUBSIDIZED GEOPHYSICS

Quins seismic and gravity survey was carried out in the onshore Port Keats area of the basin. It was designed to delineate structural traps on the downthrown side of the Moyle River Fault. The seismic data obtained was, at best, fair in quality. Very poor reflections were obtained along the fault. Two horizons were mapped on the downthrown side: Horizon 2 (top Microconglomeratic Member of the Lower Permian Kulshill Formation); Horizon 4 (top Member 3 of the Lower Carboniferous Milligan Beds. An isochron map between Horizons 2 and 4 was presented). The Proterozoic basement (Horizon 5) was mapped on the upthrown side.

Gravity readings were made every 400 m along seven east-west lines, and every 600 m along two north-south lines. Five fault-controlled structures were mapped but not well-defined, the largest having an areal closure of at least 60 $km^2$. Five features were tentatively interpreted as possible small salt plugs or salt infiltration along fault planes.

TABLE 2 : STRATIGRAPHIC TABLE, NORTH HIBERNIA NO. 1

| AGE | | UNIT | Depth(m)R.T. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|---|
| Sea bed | | | 46 | | |
| | | | | 269 | No samples |
| | MIDDLE MIOCENE | | 315 | 267 | Calcarenite with dolomite at base of unit |
| | BASAL MIDDLE MIOCENE | | 582 | 224 | Calcarenite, locally re-crystallized and minor calcisiltite |
| | EARLY MIOCENE TO BASAL AQUITANIAN | | 806 | 270 | Calcisiltite and calcarenite grading to marl and calcar-eous calystone below 1024 m |
| | OLIGOCENE | | 1076 | 197 | Marl and calcareous claystone grading to calcilutite with depth |
| TERT-IARY | EARLY OLIGOCENE TO MIDDLE EOCENE | | 1273 | 111 | Argillaceous calcilutite and minor marl |
| | MIDDLE EOCENE | Bathurst | 1384 | 177 | Calcilutite with chert and minor calcareous claystone |
| | EARLY EOCENE | Island | 1561 | 41 | Calcilutite grading to marl with depth |
| | LATE TO MIDDLE PALAEO-CENE | Formation | 1602 | 62 | Marl grading to calcilutite with depth |
| | | | 1664 | | |

| AGE | UNIT | | Depth(m)R.T. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|---|
| UPPER | MAESTRI-CHTIAN TO TURONIAN | | | 232 | Calcilutite, locally argillaceous |
| | CENOMANIAN TO ALBIAN | | 1896 | 62 | Marl and calcareous claystone |
| EARLY CRET. | APTIAN TO LATE NEO-COMIAN | Petrel Fm. | 1958 | 25 | Sandstone |
| TRIASS-IC | RHAETO-NORIAN | | 1983 | 433 | Interbedded sandstone, clay-stone, siltstone, coal and minor limestone |
| | NORIAN-CARNIAN | | 2416 | 1584 | Interbedded limestone, sand-stone, siltstone and clay-stone with an evaporite sequence at 2550 m and minor volcanics below 2800 m |
| | | | T.D. 4000 | | |

The results of the Calder Evans marine seismic survey (BMR file, 72/3038) were released in 1973. The project (BOCAL 72-E) was designed to provide better definition of four prospects - Anson, Evans Shoal, South Lynedoch, and Cootamundra - outlined by previous seismic surveys. In Heron No. 1, (BMR file, 71/623) the only well drilled to date in the survey area, several gas shows were recorded in the Upper Cretaceous and Upper Jurassic sequences.

About 385 km of the earlier seismic data were incorporated in the interpretation. Three horizons were mapped: horizon M - near base Tertiary; horizon P - near base Upper Cretaceous; and horizon T - near top Triassic? Isochron maps of the M-P and P-T intervals were also produced. The use of Maxipulse energy source and longer cables (3200 m) in the 72-E project resulted in better quality data than previously obtained. All four structures were upgraded as a result of the new data. Evans Shoal and South Lynedoch were detailed sufficiently for well sites to be located, but more work will be necessary to evaluate the Anson and Cootamundra prospects.

The earlier seismic work defined the Cootamundra prospect as a possible stratigraphic trap on the northern flank of the Bathurst Terrace, where Permian, Triassic, and Jurassic fluvio-deltaic sandstone reservoirs may pinch out against a major fault scarp and be sealed by Upper Jurassic marine shales. The new data indicate a number of faults downthrown to the north and possible associated stratigraphic traps along the northern margin of the Bathurst Terrace. These traps would provide a shallower prospective section than at Heron or at Evans Shoal and South Lynedoch. Further seismic work will probably be carried out in the Cootamundra area before a well site is chosen.

## BOWEN BASIN

Four subsidized wells were drilled, and one subsidized seismic survey was carried out during the year. There was no unsubsidized drilling.

### SUBSIDIZED DRILLING

The four wells (Table 3) were drilled on the Roma Shelf where the overlying Surat Basin contains the main gas-producing (Lower Jurassic) reservoirs of the Roma area.

However, the primary drilling targets were within the Permian/Triassic Bowen Basin. Wells that penetrated the Bowen Basin but were drilled primarily to test reservoirs within the Surat Basin are dealt with under the heading 'Surat Basin'.

Banoona South was drilled to test the hydrocarbon potential of the Triassic Showgrounds Sandstone, which, after the Jurassic Precipice Sandstone, is the most productive horizon on the Roma Shelf. The well was located on a southerly plunging anticline about 2 km updip from Sunnybank West No. 1 (1968), which encountered 8.5 m of porous and permeable sandstone with good shows of oil and gas. Banoona South No. 1 encountered 7 m of Showgrounds Sandstone with fair porosity and permeability, but only gas and water was produced from drill-stem tests.

The SE Roma Basement Drilling Project was a three-well program (Paddy Ward No. 1, Blue Hills No. 1, and Six Mile No. 1) designed to evaluate the petroleum potential of Permian basal valley-fill sediments in east-trending basement valleys delineated by the Lorelle seismic survey (see under 'Subsidized Geophysics'). Paddy Ward No. 1 was drilled on an upfaulted block in the axial region of the Coonardoo Valley; Blue Hills No. 1 in the axial region of the Lakemore Valley; and Six Mile No. 1 on a major basement high on the northern side of the Coonardoo Valley. The main target was possible prospective sandstone units in the Tinowon and Muggleton Formations; the Triassic sequence was a secondary target. No significant indications of hydrocarbons were recorded. Although sandstone units were intersected in the target zone they were characterized in all three wells by low porosity and permeability. The main cause of the low permeability was abundant clay matrix.

TABLE 3 : STRATIGRAPHIC TABLES, BOWEN BASIN

| AGE | UNIT* | PADDY WARD NO. 1<br>Depth (m) K.B. | Thickness (m) | LITHOLOGY |
|---|---|---|---|---|
| | Roma Fm. | Surface | 124.7+ | Silty shale, glauconitic siltstone |
| CRETACEOUS | Blythesdale Fm. | 128.0 | 442.0 | Sandstone, siltstone, shale |
| | Transition Mb. | 128.0 | 147.0 | Shale, siltstone, silty sandstone |
| | Mooga Mb. | 275.0 | 72.5 | Quartzose sandstone |
| | Fossilwood Mb. | 347.5 | 155.5 | Sandstone, siltstone, minor shale |
| | Gubberamunda Mb. | 503.0 | 67.0 | Quartzose sandstone, rare pink garnets |
| | Injune Creek Beds | 570.0 | 448.0 | Siltstone, shale, coal, minor sandstone |
| JURASSIC | Hutton Sst. | 1018.0 | 214.0 | Quartzose sandstone, minor siltstone and shale |
| | Evergreen Fm. | 1232.0 | 104.6 | Siltstone, minor shale and sandstone |
| | Evergreen Resistivity Marker | 1254.3 | | |
| | Boxvale Sst. Mb. | 1279.3 | 4.6 | Fine-grained quartzose sandstone |
| | Precipice Sst. | 1336.6 | 13.7 | Fine-grained silty, quartzose sandstone |
| | Moolayember Fm. | 1350.3 | 82.3 | Fine-grained silty quartzose sandstone and siltstone |
| TRIASSIC | Rewan Fm. | 1432.6 | 112.7 | Grey, green, orange, quartzose sandstone. |

PADDY WARD NO. 1

| AGE | UNIT* | Depth (m) K.B. | Thickness (m) | LITHOLOGY |
|---|---|---|---|---|
| | Bandanna Fm. | 1545.3 | 63.1 | Carbonaceous shale, siltstone, sandstone, black coal, and tuff |
| | Black Alley Shale | 1608.4 | 31.4 | Hard grey siltstone, soft white tuff |
| | Winnathoola Coal Mb. | 1626.4 | 7.0 | Dull black coal, carbonaceous shale |
| PERMIAN | Tinowon Fm. | 1639.8 | 54.9 | Grey siltstone, shale, minor sandstone and coal |
| | Mantuan *Productus* Bed | 1639.8 | 18.3 | Grey fossiliferous siltstone |
| | Wallabella Coal Mb. | 1672.7 | 12.8 | Bright black brittle coal, locally pyritic |
| | Muggleton Fm. (equiv.) | 1694.7 | 42.7 | Pyritic siltstone and shale, minor siltstone and shale |
| DEVONIAN | Timbury Hills Fm. | 1737.4 | 20.4 | Very fine-grained siliceous sandstone, grey siliceous siltstone |
| | | T.D. 1758 | | |

**BLUE HILLS NO. 1**

| AGE | UNIT* | Depth (m) K.B. | Thickness (m) | LITHOLOGY |
|---|---|---|---|---|
| | Roma Fm. | Surface | 57.6+ | Silty shale, glauconitic siltstone |
| | Blythesdale Fm. | 61.0 | 417.6 | Sandstone, siltstone, shale |
| CRETACEOUS | Transition Mb. | 61.0 | 91.4 | Siltstone, shale, silty sandstone |
| | Mooga Mb | 152.4 | 106.7 | Quartzose sandstone |
| | Fossilwood Mb. | 259.1 | 158.5 | Sandstone, siltstone |
| | Gubberamunda Mb. | 417.6 | 61.0 | Quartzose sandstone, rare pink garnets |
| | Injune Creek Beds | 478.6 | 478.5 | Siltstone, shale, coal, minor sandstone |
| | Hutton Sandstone | 957.1 | 210.3 | Quartzose sandstone, minor siltstone and shale |
| JURASSIC | Evergreen Fm. | 1167.4 | 115.8 | Siltstone, minor shale and sandstone |
| | Evergreen Resistivity Marker | 295.1 | | |
| | Boxvale Sst. Mb | 1234.2 | 3.7 | Fine grained, quartzose sandstone |
| | Precipice Sst. | 1283.2 | 18.3 | Fine to medium silty quartzose sandstone |
| | Moolayember Fm. | 1301.5 | 80.8 | Very fine to fine quartzose sandstone |
| TRIASSIC | Showgrounds Sst. | 1382.3 | 16.7 | Very coarse-grained quartzose sandstone |
| | Rewan Fm. | 1399.0 | 75.6 | Orange, green, quartzose sandstone, minor orange, green siltstone |

BLUE HILLS NO. 1

| AGE | UNIT* | Depth (m) K.B. | Thickness (m) | LITHOLOGY |
|---|---|---|---|---|
| | Bandanna Fm. | 1474.6 | 76.2 | Carbonaceous shale, black coal, tuff |
| | Black Alley Shale | 1550.8 | 31.1 | Siltstone, carbonaceous shale |
| | Winnathoola Coal Mb. | 1569.7 | 6.7 | Dull black shaley coal |
| | Tinowon Fm. | 1581.9 | 76.1 | Siltstone, shale, minor sandstone, coal |
| PERMIAN | Mantuan *Productus* Bed | 1581.9 | 21.3 | Pyritic, locally calcareous siltstone |
| | Wallabella Coal Mb. | 1613.9 | 35.1 | Dull black shaley coal, minor sandstone |
| | Muggleton Fm (equiv.) | 1658.0 | 61.7 | Fine to coarse quartzose sandstone, minor coal |
| DEVONIAN | Timbury Hills Fm. | 1719.7 | 16.2+ | Very fine-grained quartzose sandstone and grey, green siltstone |

T.D. 1736

| AGE | UNIT* | SIX MILE NO. 1 Depth (m) K.B. | Thickness (m) | LITHOLOGY |
|---|---|---|---|---|
| | Roma Fm. | Surface | 88.1+ | Silty shale, glauconitic sandstone |
| CRETACEOUS | Blythesdale Fm. | 91.4 | 432.9 | Sandstone, siltstone, shale |
| | Transition Mb. | 91.4 | 126.5 | Shale, siltstone, silty sandstone |
| | Mooga Mb. | 217.9 | 74.7 | Quartzose sandstone |
| | Fossilwood Mb. | 292.6 | 181.4 | Sandstone, siltstone, minor shale |
| | Gubberamunda Mb | 474.0 | 50.3 | Quartzose sandstone, rare pink garnets |
| | Injune Creek Beds | 524.3 | 424.9 | Siltstone, shale, coal, minor sandstone |
| JURASSIC | Hutton Sst. | 949.2 | 268.8 | Quartzose sandstone, minor siltstone and shale |
| | Evergreen Fm. | 1218.0 | 80.5 | Siltstone, minor shale and sandstone |
| | E.R. Marker | 1210.7 | | |
| | Boxvale Sst. Mb | 1242.1 | 3.0 | Fine-grained quartzose sandstone |
| | Precipice Sst. | 1298.5 | 10.6 | Fine to coarse quartzose sandstone and siltstone |
| | Moolayember Fm. | 1309.1 | 77.7 | Quartzose sandstone, siltstone, shale |
| TRIASSIC | Showgrounds Sst. | | | |
| | Rewan Fm. | 1386.8 | 73.2 | Orange, green quartzose sandstone, minor green siltstone |

SIX MILE NO. 1

| AGE | UNIT* | Depth (m) K.B. | Thickness (m) | LITHOLOGY |
|---|---|---|---|---|
| | Bandanna Fm. | 1460.0 | 61.0 | Carbonaceous shale, black coal, tuff |
| | Black Alley Shale | 1521.0 | 33.5 | Hard grey siltstone, soft white tuff |
| | Winnathoola Coal Mb. | 1538.3 | 11.0 | Dull black coal |
| PERMIAN | Tinowon Fm. | 1554.5 | 58.8 | Siltstone, shale, minor sandstone, coal |
| | Mantuan Productus Bed | 1554.5 | 18.3 | Fossiliferous siltstone, shale |
| | Wallabella Coal Mb. | 1581.9 | 26.0 | Dull black coal |
| | Muggleton Fm. (equiv.) | 1613.3 | 14.3 | Siltstone, shale, pyritic sandstone |
| DEVONIAN | Timbury Hills Fm. | 1627.6 | 11.3+ | Grey, green siltstone, phyllitic surfaces |
| | | T.D.1638 | | |

| AGE | UNIT* | BANOONA SOUTH NO. 1 Depth (m) K.B. | Thickness (m) | LITHOLOGY |
|---|---|---|---|---|
| | Roma Fm. | Surface | 237.4+ | Siltstone, shale, minor quartzose sandstone |
| CRETACEOUS | Blythesdale Fm. | 240.8 | 512.1 | Quartzose sandstone, minor siltstone and shale |
| | Mooga Mb. | 367.3 | 121.9 | Quartzose sandstone, minor siltstone and shale |
| | Fossilwood Mb. | 489.2 | 154.8 | Quartzose sandstone, minor shale and siltstone |
| | Gubberamunda Mb | 644.0 | 108.9 | Fine to coarse quartz sandstone |
| JURASSIC | Injune Creek Beds | 752.9 | 465.1 | Sandstone, shale, siltstone, coal |
| | Hutton Sst. | 1218.0 | 182.5 | Fine to coarse quartz sandstone |
| | Evergreen Fm. | 1400.5 | 109.7 | Siltstone, minor shale, and sandstone |
| | Boxvale Sandstone Mb. | 1449.2 | 5.5 | Siltstone |
| | Precipice Sst. | 1510.3 | 1.5 | Fine to coarse quartzose sandstone |
| | Moolayember Fm. | 1511.8 | 128.6 | Sandstone, siltstone, and shale |
| TRIASSIC | Showgrounds Sst. | 1640.4 | 7.0 | Coarse-grained quartzose sandstone |
| | Rewan Fm. | 1647.4 | 2.7+ | Coarse-grained varicoloured sandstone |

* Nomenclature used by Mines Administration Pty Ltd

## SUBSIDIZED GEOPHYSICS

The results from three 1972 surveys released after July 31, 1973 are included in this section.

The Lorelle seismic survey (BMR file, 72/2593) was carried out in an area immediately south of the Warrego Highway near the town of Wallumbilla. It was a detailed survey on the eastern flank of the Roma Shelf to explore for stratigraphic traps at the base of the Permian. Utilizing 6-fold C.D.P. coverage, the survey produced higher quality data than previously achieved in the area. Five seismic horizon and three isochron maps were produced:

Near top Lower Jurassic Evergreen Formation
Near top Upper Permian Blackwater Group ( Bandanna Formation)
   Near top Winathoola Coal Member
   Near top Wallabella Coal Member
Basement
Time interval Evergreen Formation to Blackwater Group
Time interval Blackwater Group to basement
Time interval Wallabella Coal Member to basement

Reflection quality is generally good. Horizons have been tied to four wells - Lorelle No. 1 (BMR file, 63/1204), Sunnybank No. 1 (BMR file, 62/1087), Wallumbilla South No. 1 (unsubsidized 1967), and Wallabella No. 1 (BMR file, 64/4010) - where sonic information is available. The only reliable basement reflection recorded was from the Devonian Timbury Hills Formation, i.e., west of Bundella No. 1 (unsubsidized 1968). In the east, Carboniferous volcanics giving very poor reflection data have been mapped as basement, using well control where available.

The survey has produced a significant improvement in data quality and valuable additional information on the Permian sequence. In the east the Permian has a regional dip to the southeast, similar to the overlying Jurassic section. In the west four basement valley systems - the Sunnybank, the Coonardoo, the Pickanjinnie, and the Latemore - have been delineated, and the Wallumbilla South High, on which Wallumbilla Nos 1 to 4 wells were drilled, has been further defined. The high is divided into a series of structural blocks by north-northwest-trending faults. Each of the wells has been drilled on separate fault blocks.

The Yuleba Creek seismic survey (BMR file, 72/3332) was located about 400 km northwest of Brisbane, and 40 km east of Roma, on the western flank of the Taroom Trough. The permit area (ATP 195P) lies immediately to the east of that in which the Lorelle seismic survey was carried out. The objectives were to provide a tie between existing seismic coverage in 195P and the Lorelle survey, and map Permian and basement reflectors. A secondary objective was to compare the shallow-hole compositing recording technique with the digital C.D.P. technique used in the Lorelle survey. The shallow-hole technique proved to be unsuitable, and single deep-hole recording was employed with analogue instruments, followed by digital processing. The results were found to be similar to those obtained by digital recording in the Lorelle survey. The horizons mapped were: base of Jurassic; top of Permian; and middle Permian. Isochron maps of the top Permian to middle Permian, and the base Jurassic to top Permian intervals were prepared. The base Jurassic horizon is a weak discontinuous event probably near the top of the Evergreen Formation. Both Permian horizons are strong reflectors, but no continuous event could be correlated with basement. The survey consisting of only one traverse did not add significantly to the seismic coverage of the permit. A possible structural lead indicated within the Permian sequence was further investigated in 1973 by the Rocky Creek seismic survey using the same recording technique but achieving a longer spread length by off-end shooting into a one-mile spread. This produced a slight improvement in reflection quality from the Permian sequence. The data from the upper two horizons were integrated and tied to the earlier data, but the middle Permian horizon was mapped on the new data only because of the presence of interfering multiples on the data from the earlier survey. The structural lead was not confirmed. The maps show a general easterly dip, and, on the middle Permian horizon, possible small displacement faults, which, however, in the absence of stratigraphic control, may equally well be interpreted as due to facies changes. The survey has consequently downgraded the prospectivity of the area.

The Yambugle seismic survey was carried out in an area about 48 km south of the Roma gas field, where the Surat Basin overlies the Bowen Basin close to its western margin. Previous seismic work had indicated a basement low lying to the west of Yambugle No. 1 (1969). The aims of the Yambugle Survey were to provide more information on the structural configuration of this low and delineate any stratigraphic or structural traps associated with it.

Three horizons were mapped on generally fair quality data: Lower Jurassic Evergreen Formation (about 30 m below formation top); top Permian Kianga Formation (i.e. top Blackwater Group); and top Devonian Timbury Hills Formation. Isochron maps of the intervals between the Evergreen Formation and each of the other two mapped horizons were also presented.

Both aims of the survey were achieved. The Blackwater Group crops out on the western flank of the Yambugle low, and the Triassic Wandoan Formation thins rapidly updip from the Permian zero isochron. A drill site was recommended to test the sandstone of the lower Wandoan Formation adjacent to the Permian subcrops, an optimum position for the accumulation of hydrocarbons generated in the Permian source rocks.

The Burton Downs seismic, gravity, and magnetic survey (BMR file, 72/2924) was carried out in the Isaac River area about 70 km southeast of Mackay and about 32 km northwest of the town of Nebo. The area is part of the structural unit referred to as the Folded Zone (Malone, 1964*) of the Bowen Basin. The survey was designed to investigate the subsurface expression of two large north-northwest-trending anticlines - the Hillalong in the north, and the Burton Downs farther south - mapped from surface outcrop of Permian and Triassic rocks.

In the Hillalong area, the survey failed to produce usable seismic data and no conclusions were reached concerning the nature of the anticline in the subsurface.

In the Burton Downs area the quality of the reflection data varied from fair to very poor, and was poor over the anticline. One horizon, interpreted as near the base of the Permian Upper Bowen Coal Measures, was mapped. The Burton Downs anticline lies to the east of a major north-south fault. East-west turnover was confirmed at the northern and southern ends, but in the centre of the structure there is a data gap.

The gravity data show a small Bouguer anomaly 'high' over the Burton Downs anticline, but no other features of value to the interpretation of the area. The magnetic data show very little variation over the area, which suggests the absence of igneous intrusions. Two refraction probes failed to record from basement, and gave maximum velocities of about 5200 m/sec. This refractor conforms to the reflection horizon mapped in the Burton Downs area.

*Malone, E.J., 1964 - Depositional evolution of the Bowen Basin. J. geol. Soc. Aust., 11(2), 263-82.

The next desirable step in the exploration of the area is considered to be the drilling of a well on the eastern flank of the Burton Downs anticline.

## BREMER BASIN

The unsubsidized well, Kendenup No. 1 is the first petroleum exploration well to be drilled in this area, regarded as one of low prospectivity. Published information indicates less than 100 m of Eocene sediments overlying Precambrian basement. The well was drilling at the end of 1973, but has since been abandoned prematurely at 112 m as a result of unsuccessful fishing operations.

## BROWSE BASIN

Two wells, Londonderry No. 1 (unsubsidized) and Yampi No. 1 (subsidized) were drilled in 1973. Subsidized geophysical work comprised one project of the Mermaid-Cartier seismic survey.

### SUBSIDIZED DRILLING

Yampi No. 1 (Table 4) was the first well to be drilled in the central Browse Basin. It was located on an easterly trending anticline truncated to the east and south by two right-angled normal faults. Structural closure was mappable on only one horizon, which proved to be the top of the Jurassic volcanics - not the main Triassic unconformity interpreted from earlier seismic data. All the main geological units were deeper than predicted and a previously unidentified seismic horizon was shown to be within the Lower Permian. Significant geological results were the proving of at least 4072 m of Cainozoic, Mesozoic, and Palaeozoic sediments, including Middle Jurassic volcanics, in the centre of the basin. Numerous regional unconformities were recognized in the Mesozoic and Tertiary. Red-brown claystone and siltstone below the Middle Jurassic volcanics may be the stratigraphic equivalent of Lower Jurassic redbeds in the Canning and Bonaparte Gulf Basins.

Numerous minor hydrocarbon shows were recorded from 1640 m to total depth, but formation interval tests of the most promising produced only water and mud. Residual oil was present in a core from the Middle Jurassic sequence.

TABLE 4 : STRATIGRAPHIC TABLE, YAMPI NO. 1

| AGE | | Depth(m)R.T. | /Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| | Sea bed | 104 | 408 | No samples before marine riser installed |
| | | 408 | | |
| | PLIOCENE TO MIDDLE MIOCENE | | 262 | Sandstone, dolomite, calcarenite |
| | | 670 | | |
| TERT- | EARLY TO MIDDLE MIOCENE | | 119 | Calcisiltite, calcarenite, sandstone, minor dolomite |
| | | 789 | | |
| | EOCENE? | | 153 | Sandstone, minor coal |
| IARY | | 942 | | |
| | PALAEOCENE? | | 72 | Sandstone, minor coal |
| | | 1014 | | |
| | CAMPANIAN | | 381 | Sandstone, claystone, siltstone |
| | | 1395 | | |
| LATE | SANTONIAN | | 82 | Siltstone, claystone |
| | | 1477 | | |
| CRET. | CONIACIAN | | 72 | Siltstone |
| | | 1549 | | |
| | ALBIAN | | 283 | Marl, claystone, minor sandstone |
| | | 1832 | | |

TABLE 4 (CONT)

| AGE | | Depth(m)R.T. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| EARLY | APTIAN | | 392 | Sandstone, claystone/shale, siltstone |
| | | 2224 | | |
| CRET. | NEOCOMIAN | | 346 | Claystone, siltstone, calcilulite, trace sandstone |
| | | 2570 | | |
| LATE | TITHONIAN | | 536 | Sandstone, conglomerate, siltstone, claystone |
| | | 3106 | | |
| JURASSIC | KIMMERIDGIAN-OXFORDIAN | | 29 | Claystone, siltstone, minor sandstone |
| | | 3135 | | |
| MIDDLE JURASSIC | CALLOVIAN TO BAJOCIAN | | 324 | Claystone, siltstone, sandstone Volcanics (3304-3390m) Sandstone, minor claystone |
| | | 3459 | | |
| EARLY? JURASSIC | AGE INDETERMINATE | | 128 | Sandstone, claystone |
| | | 3587 | | |
| LATE TRIASSIC | NORIAN TO CARNIAN | | 183 | Sandstone, claystone, minor siltstone |
| | | 3770 | | |
| EARLY | AGE INDETERMINATE | | 250 | Sandstone, siltstone, claystone, trace dolomite |
| | | 4020 | | |
| PERMIAN | SAKMARIAN TO KUNGURIAN | | 156+ | Siltstone, claystone, sandstone |
| | | T.D. 4176 | | |

UNSUBSIDIZED DRILLING

No significant hydrocarbon shows were reported from Londonderry No. 1

SUBSIDIZED GEOPHYSICS

Project 73-H of the Mermaid-Cartier seismic survey was primarily designed to obtain regional seismic data over the deeper water parts of the Browse Basin, thereby essentially completing the reconnaissance cover of BOCAL's permit areas. Semidetailed control was also obtained in shallower water areas, mainly northeast and south of Scott Reef, where earlier work had indicated interesting structural leads.

Generally fair-quality data were obtained between the sea bottom and about 2.5 seconds below it; a deterioration in data quality at greater depth was apparently due mainly to considerable multiple interference and lack of energy return. Fault definition, and correlation and resolution of seismic events was reasonably good in only the first 1.5 seconds.

Four horizons were mapped: horizon E ( near base Miocene); horizon X ( near base Tertiary); horizon D (intra-Upper Cretaceous unconformity), and horizon T (near top Triassic unconformity).

The maps show a major anticlinal trend passing through Scott and Seringapatam Reefs and extending northeastwards. A number of closures are mapped along this trend. In addition, a number of other seismic anomalies were mapped, including a prominent intrusive-type feature. However, the most prospective are in water depths greater than 300m and all require more accurate definition.

## CANNING BASIN

Six subsidized wells (Table 5), two offshore, were drilled in 1973. One unsubsidized well was drilled offshore. There were eight onshore and two offshore seismic surveys.

SUBSIDIZED DRILLING

Offshore

Fitzroy Trough

Wamac No. 1 was located 70 km from the coast in the offshore extension of the Fitzroy Trough. The Wamac structure is one of a number of seismically defined Palaeozoic 'highs' in the area. The seismic data indicated a thick Palaeozoic sequence, which may extend into the early Triassic and be truncated by the major intra-Triassic unconformity (seismic event 'T'). Before Wamac No. 1 was drilled, stratigraphic control was provided by the offshore well Lacepede No. 1A (BMR file 72/426), 17.5 km to the north-northwest, and the onshore well Tappers Inlet (BMR file 71/301), 122km to the east-northeast.

K-Ar dating gives a minimum Early Triassic age for the dolerite intrusions encountered below 2244m. Collapse of fragments and blocks into the well during the drilling of the lower sill resulted in its premature abandonment. No hydrocarbon shows were recorded. The presence of igneous intrusions and the diagenetic effect on upper Palaeozoic sediments indicates the need for a re-appraisal of the other Palaeozoic structures in the area. The age of the pre-'T' sequence is in doubt because of the poor preservation of the microfossils: Wass & Price suggested that the sequence contains Permian sediments, and Lister, Lower Carboniferous to Devonian (Palaeontological appendices, Well Completion Report). Sedimentation appears to have been mainly continental. Occasional marine incursion is indicated by thin bands of bryozoal limestone, and the presence of spinose acritarchs in microfossil assemblages at 1970 m and 2594 m. Mesozoic sediments were deposited mainly in marine to coastal environments. Deltaic sediments are prominent in the Jurassic sequence.

Bedout Sub-basin

Keraudren No. 1 was the second well to be drilled in the Bedout Sub-basin and the first to test a central basin sequence. The first well drilled, Bedout No. 1 (BMR file 71/435), was located about 70 km to the north-northwest.

The drilling enabled the further definition of the seismic marker horizons. The horizon predicted to be the base of the Tertiary carbonate sequence proved to be the base of the Upper Cretaceous Toolonga Calcilutite equivalent. The horizon at the top of the Upper Jurassic sandstone sequence was intersected at 1539 m - not 1326 m as predicted from the seismic records, which were probably of poor quality at this level. The well did not reveal the significance of the intra-Jurassic seismic marker, except to confirm that it probably originates from near the top of the thick Jurassic sandstone sequence. The 'top' Triassic marker in Keraudren No. 1 is the top of the Triassic sandstone, 100 m lower than the top of the Triassic. An intra-Triassic marker is considered the probable equivalent of the top of the early Middle Triassic claystone at 3630 m.

Although the well confirmed Triassic, Jurassic, and Lower Cretaceous thick porous sandstones, there were no indications of hydrocarbons. The prospectiveness of the immediate area is also downgraded by the lack of suitable source and cap rock, and by data obtained from the high-resolution dipmeter. The Keraudren prospect was mapped on the Palaeozoic basement and intra-Triassic seismic horizon as a structurally closed northward tilting fault wedge. The Lower Jurassic and Triassic sequences display monotonous structural dips of $2^{\circ}$ to $4^{\circ}$ to the northwest, with only minor deviations. The dipmeter patterns give no suggestion of faulting near the well

A number of points of stratigraphic interest emerged from the drilling: the Upper to Middle Triassic section of the central Bedout Sub-basin is at least 1384 m thick; the well contains a suspected Tertiary/Cretaceous unconformity which was not present in Bedout No. 1; the Lower Cretaceous Broome Sandstone equivalent is thicker (185 m) than in Bedout No. 1 (47 m); a multicoloured claystone which spans the Triassic/Jurassic boundary is similar to a Lower Jurassic claystone in Bedout No. 1; the uppermost Middle Triassic sequence is lithologically similar to a Middle Triassic carbonate unit penetrated by Cossigny No. 1 in the Beagle Sub-basin of the Carnarvon Basin; and an intra-Upper Jurassic unconformity, believed to be angular, separates Tithonian from Oxfordian to Callovian sediments, i.e. the Kimmeridgian and most of the Oxfordian are missing - this evidence, and that from Bedout No. 1, supports the theory that the Late Jurassic appears to have been the major period of structural disturbance in the Bedout Sub-basin.

## Onshore

### Lennard Shelf

Mimosa No. 1 was located on the southern edge of the Lennard Shelf to test a seismically defined structure originally interpreted as a Middle to Late Devonian carbonate platform. The primary target was the Pillara Limestone, which has shown good porosity in other wells drilled on the shelf.

The sequence down to the base of the Lower Carboniferous Laurel Formation was generally as predicted, but the Upper Devonian to Lower Carboniferous sediments were considerably different. Instead of the massive back-reef 'Nullara Limestone' and the underlying sandstone of the Napier Formation the well encountered a more seaward section consisting of the Luluigui and the Clanmeyer Formations. The unconformity at 2376 m, predicted to be the top of the Pillara Limestone, proved to be the top of a predominantly clastic sequence of sandstone, siltstone, and shale which persisted to total depth. Palaeontological evidence indicates a Frasnian age for this sequence, which has not previously been recognized either in outcrop or in the subsurface. In terms of age it is equivalent to the Napier Formation.

Minor oil-staining was encountered in tight sandstone within the Clanmeyer Formation. Significant gas shows associated mainly with siltstone and very fine-grained sandstone were encountered below the unconformity at 2376 m with some oil stain and fluorescence. The discovery of this thick Upper Devonian sequence has upgraded the hydrocarbon prospects on the Lennard Shelf, particularly in the area between Mimosa No. 1 and Meda No. 1 (BMR file 62/1022), 56 km to the northwest, in which good late Devonian carbonate reservoirs were proved.

A point of stratigraphic interest to emerge from the drilling is that palynological evidence indicates that the Liveringa Formation extends unusually high into the Permian and there is no definite evidence of a disconformity between it and the early Triassic Blina Shale.

The absence of a carbonate bank necessitated the reinterpretation of the seismic data. Only one of several alternatives is included in the well completion report: the Mimosa structure is a local culmination on a southeasterly plunging regional anticline that parallels the Pinnacle Fault system to the southwest; northeast dip from the Mimosa culmination is towards a major low-angled normal fault downthrown to the southwest, placing a thick Ordovician-Permian sequence against Precambrian metasediments.

## Pinnacle Fault Zone

Mt Hardman No. 1 was drilled on a downthrown block within the Pinnacle Fault Zone, which separates two structural provinces - the Lennard Shelf to the northeast and the Fitzroy Trough to the southwest. The primary objective was the Lower Carboniferous Laurel Formation. Encouraging oil and gas shows have been recorded from this formation in wells drilled on the western Lennard Shelf and from its correlative in wells drilled in the Fitzroy Trough. The drilling proved the potential sandstone reservoirs to be limited to several thin (2 m or less) beds above 1214 m and between 1590 and 1660 m, and a 60 percent water saturation is indicated on wire-line log parameters. Porosity is low and estimated permeability poor. Poor to fair gas shows were recorded, and some oil stain and fluorescence were observed in the cuttings. The Upper Devonian sequence which was the second objective yielded no indications of hydrocarbons. A high-velocity unit predicted from seismic data to lie at about 2682 m is interpreted from cuttings and wire-line logs to be carbonate beds intersected at about 2680 m.

The well penetrated the thickest sequence drilled to date of Carboniferous Grant Formation. At least 278 m - and possibly all - of the Cuncudjerie Member is of Late Carboniferous age. The Grant Formation ('Binda Member'*) and the Nura Nura Member of the Poole Sandstone appear to be conformable. The Nura Nura Member (micaceous siltstone) is lithologically different from the calcareous sandstone and sandy limestone of the type section (about 35 km due west), and is more akin to the underlying 'Binda' and Dora Members of the Grant Formation; palynological evidence places it as upper Grant Formation, or Nura Nura Member of the Poole Sandstone.

Broome Platform

Thangoo No. 2 was primarily a test of the hydrocarbon potential of the Ordovician Willara Formation in a seismically defined faulted anticline about 8 km southeast of Thangoo Nos 1 and 1A (BMR file 62/1054). In the earlier wells oil shows were recorded in the Permian Grant and the Ordovician Goldwyer Formations, in addition to the Willara Formation.

The only indication of hydrocarbons in Thangoo No. 2 was a minor oil show recorded in 2 m of fine-grained sandstone at the top of the Cuncudgerie Member of the Grant Formation.

The drilling provided evidence of a disconformity at the base of the Goldwyer Formation: a thin (1 m) bed of unconsolidated poorly sorted sandstone overlies the Willara Formation, and cavernous porosity in the upper part of the Willara Formation is probably the result of solution channelling by meteoric water. Similar cavernous zones occur in the earlier Thangoo wells. The siltstone/shale unit (106 m) overlying the basal sandstone in the Goldwyer Formation in Thangoo No. 2 has thinned from 163 m in Goldwyer No. 1, about 64 km to the west.

* Wapet informal name.

## Kidson Sub-basin

Contention Heights No. 1 was drilled near the southeastern margin of the sub-basin to investigate the reservoir potential of the sandstones of the Ordovician Middle and Lower Formations. The well was located 43 km southeast of Wilson Cliffs No. 1 (BMR file 68/2011), in which all the potential reservoirs in the Ordovician were tight and impermeable. It was hoped that the reservoir and hydrocarbon potential would improve closer to the sub-basin margin, but in fact no significant shows of oil or gas were recorded during the drilling. Log evaluation indicated that all the reservoirs were water-saturated; low salinities in the Permian sequence and the Devonian Tandalgoo Red Beds indicate that these formations have been flushed whereas the salinities in the Ordovician section shows a high degree of maturation (oil diagenesis zone) but is low in quantity. In the Noonkanbah Formation and the Poole Sandstone the organic material has a similar degree of maturation and is more plentiful, but lignitic in nature.

Palynological data suggest a probable Devonian age for the Mellinjerie Limestone and the Tandalgoo Red Beds, but as in other wells in the Canning Basin no diagnostic assemblages were found in the Carribuddy Formation. The three formations thin rapidly between the Wilson Cliffs and Contention Heights wells, indicating the proximity of Contention Heights to the Devonian? palaeoshoreline. The attenuation of the Ordovician sequence towards the southeast is not as marked as that of overlying Devonian. The Lower Permian sequence in the southern Kidson Sub-basin shows a gradual thickening towards the southeast, although the uppermost unit, the Noonkanbah Formation, is truncated in a southeasterly direction by the basal? Mesozoic unconformity. The boundaries between the Poole Sandstone and the Grant Formation, the Tandalgoo Red Beds and the Carribuddy Formation, and the Goldwyer and Middle Formations are gradational. The Carribuddy Formation evaporite unit (Unit B), found in Kidson No. 1 in the central part of the Kidson Sub-basin, was absent from Contention Heights No. 1.

## UNSUBSIDIZED DRILLING

The offshore well East Mermaid No. 1 was the only unsubsidized drilling operation in 1973. It was the second well to be drilled by Shell in Australian waters using the deep-water drillship Sedco 445; the first was Lynedoch No. 1

TABLE 5 : STRATIGRAPHIC TABLES, CAN?ING BASIN

| AGE | | UNIT | WAMAC NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|---|
| | | sea bed | 85 | | |
| TERTIARY | RECENT TO MIOCENE | | | | No samples to 375 m |
| | | | 357 | | |
| CRETACEOUS | LATE CRETACEOUS | Toolonga Calcilutite | 375 | 48 | Marl |
| | | | 405 | | |
| | APTIAN | | | 161 | Claystone |
| | | | 566 | | |
| | | | | 141 | Claystone, silty, minor sandstone |
| | | | 707 | | |
| | | | | 35 | Sandstone, argillaceous, glauconitic |
| | | | 742 | | |
| | | | | 202 | Sandstone |
| | EARLY APTIAN | | 944 | | |
| | | | | 56 | Siltstone |
| | | | 1000 | | |
| | BARREMIAN | | | 72 | Sandstone to siltstone and claystone |
| | | | 1072 | | |
| | 'BERRIASIAN' | | | | |
| JURASSIC | TITHONIAN | | | 253 | Claystone |
| | | 'Jc' seismic horizon | 1325 | | |
| | --- ? --- | | | 279 | Sandstone, minor claystone |
| | | | 1604 | | |
| | BATHONIAN -BAJOCIAN | | | 185 | Sandstone, minor claystone, siltstone, coal |
| | | | 1789 | | |
| | | | | 175 | Sandstone, claystone/coal, siltstone |
| | | 'T' seismic horizon | 1964 | | |
| ? | | | | 107 | Claystone |
| | | | 2071 | | |
| LATE PALAEOZOIC | | | | 164 | Sandstone, minor claystone |
| | | | 2235 | | |
| | | | | 132 | Sandstone, minor claystone, dolerite, trace limestone |
| | | | 2367 | | |
| | | | | 104 | Dolerite |
| | | | 2471 | | |
| | | | | 121 | Sandstone, minor claystone, dolerite, trace limestone |
| | | | 2592 | | |
| | | | | 64½ | Shale, hard |
| | | | 2656½ | | |
| | | | | 69½ | Sandstone, claystone, dolerite |
| | | | 2726 | | |
| | | | | 38 | Dolerite, fractured |
| | | | T.D. 2764 | | |

| AGE | | UNIT | KERAUDREN NO. 1 Depth(m)R.T. | Thickness (m) | LITHOLOGY |
|---|---|---|---|---|---|
| | | sea bed | 125 | | |
| | | | | | No samples |
| | | | 527 | | |
| | EARLY TERTIARY (Undiff.) | | | 73 | Calcarenite, sandstone, minor claystone |
| | --- ? --- | | 600 | | ? |
| LATE CRETACEOUS | Maestrichtian? -late Santonian | Toolonga Calcilutite Equivalent | 739 | 205 | Siltstone, minor claystone Calcilutite |
| | | | 805 | | |
| | Early Santonian | | | 10 | Marl |
| | | | 815 | | |
| | Coniacian- Turonian | | | 28 | Claystone, minor siltstone |
| | | | 843 | | |
| | Cenomanian- Albian | | | 222 | |
| | | | 1065 | ? | ? |

TABLE 5 (CONT.)

| AGE | UNIT | KERAUDREN NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| EARLY CRETACEOUS (Aptian - | | | 335 | Claystone with sandstone |
| late Neocomian) | Broome Sandstone equivalent | 1215 | | Sandstone, basal claystone |
| ? | | 1400 | | |
| (early Neocomian) | | | 45? | Claystone |
| | | 1445? | | |
| LATE JURASSIC (Tithonian) | | | 94? | |
| | | 1539 | | |
| (Oxfordian-Callovian) | | | 4 | Claystone, sandstone |
| | | 1543 | | |
| MIDDLE JURASSIC | | | 107? | Sandstone, minor claystone, rare siltstone and coal |
| ? | | 1650? | | |
| EARLY JURASSIC | | 2301 | 810? | Multicoloured claystone, rare sandstone |
| | | 2460 | | |
| LATE TRIASSIC | | 2568 | 341 | Sandstone, minor claystone, rare coal |
| | | 2801 | | |
| M. TRIASSIC (Landinian) | | 2960 | 829 | Claystone, calcilutite, minor sandstone, rare siltstone; Sandstone, minor claystone and siltstone |
| | | 3630 | | |
| (early Landinian - Anisian) | | | 214 | Claystone with sandstone |
| | | T.D. 3844 | | |

| AGE | UNIT | Mimosa No. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| EARLY TRIASSIC | Blina Shale | Surface(4) | 114 | Surface-15 m: Grey clay, lightly ironstained. Scattered chert pebbles at surface. 15-118m: Very argillaceous siltstone |
| ? | -Disconformity | ? | | ? |
| PERMIAN | Liveringa Fm. | 118 | 264 | Interbedded mainly fine-grained sandstone and siltstone, grading to shale in part |
| " | Noonkanbah Fm. | 382 | 198 | Mainly dark grey to black shale. Minor sandstone and siltstone stringers. Clayey towards base |
| " | Poole Sst. | 580 | 81 | Mainly medium to very coarse sandstone and interbedded siltstone and shale. |
| | Nura Nura Mb. | 661 | 14 | Traces of hard black coal in minor fine-grained sandstone. Nura Nura Mb. is mainly siltstone with a sandstone interbed |
| " | Grant Fm. | | | |
| | 'Binda Mb.' | 675 | 188 | Mainly massive loose medium to coarse sand. Bryozoan? fossil fragments |
| | Dora Mb. | 863 | 83? | Mainly light grey shale in upper part. Sand increases and becomes dominant below 915 m |
| | Cuncudgerie Mb. | 946? | 142? | Mainly massive very fine to fine sandstone with abundant clay matrix. Bottom 14 m mainly shale and siltstone |
| EARLY CARB. | Laurel Fm. | 1088 | 112 | Massive limestone, calcilutite, and calcisiltite. Intermediate shale interval |
| EARLY to LATE CARB. | Luluigui Fm. | 1200 | 349 | 1200-1252 m: Mainly limestone<br>1252-1373 m: Mainly limestone, very finely crystalline with common interbeds of calcilutite, and minor calcisiltite. |

| AGE | UNIT | Mimosa No. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| EARLY to LATE CARB. | | | | 1373-1549 m: Interbedded limestone, calcilutite calcisiltite, and shale grading to siltstone |
| LATE DEVONIAN | Clanmeyer Fm. | 1549 | 827 | 1549-1605 m: Mixed lithologies; marks transition from top of Clanmeyer Fm. to the Luluigui Fm. Mainly very fine-grained to silty sandstone, and shale<br>1605-2376 m: Monotonous sequence of shale and siltstone, with thinly inter-bedded very fine-grained silty sandstone |
| | Frasnian 'Unit A' (equivalent in age to lower part of Napier Fm. | 2376<br><br>T.D. 4117 | 1741+ | 2376-2394 m: Massive limestone<br>2394-2923 m: Siltstone, very argillaceous, and shale. Common interbeds and inter-laminae of mainly very fine to fine sandstone ranging to very coarse. Becomes almost as common as siltstone below 2615 m<br>2923-3374 m: Mainly clear to light grey and brown very fine to medium, and often coarse to very coarse sandstone with interbedded brown siltstone. Trace of brown limestone<br>3374-3565 m: Mainly siltstone grading to shale in part. Minor thin sandstone beds<br>3565-4117 m: Mainly very fine to fine sandstone with interbedded siltstone grading to minor shale. Very minor limestone clasts containing corals and stromatoporoids noted at 4090 m are possibly clasts of Pillara Limestone or its correlative eroded and redeposited |

| AGE | UNIT | MT HARDMAN NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| EARLY PERMIAN | Liveringa Fm. | surface | 5 | Sand |
| | | | 9 | Sandstone |
| | Noonkanbah Fm. | 14 | 311 | Siltstone |
| | Poole Sst. | 325 | 76 | Sandstone, siltstone |
| | Nura Nura Mb. | 401 | 12 | Siltstone |
| | Grant Fm. | | | |
| | 'Binda Mb.' | 413 | 217 | Sandstone |
| | Dora Mb. | 630 | 57 | Siltstone |
| LATE CARBONIFEROUS | Cuncudgerie Mb. | 687 | 381 | Sandstone |
| EARLY CARBONIFEROUS -LATE DEVONIAN | Laurel Fm. correlative | 1068 | 1241 | Siltstone, sandstone, carbonates |
| LATE DEVONIAN | Luluigui Fm. | 2309 | 1050+ | Siltstone, carbonates, claystone, sandstone |
| | | T.D. 3360 | | |

| AGE | UNIT | THANGOO NO. 2 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| RECENT | Surface sand | surface | 7? | Ferruginous sand |
| EARLY CRETACEOUS | Broome Sst. | 12? | 65? | Sandstone (no sample) |
| LATE JURASSIC | Jarlemai Siltstone | 77 | 118 | Claystone |
| " | Alexander Formation | 195 | 53 | Siltstone, sandstone, claystone |
| " | Wallal Sst. | 248 | 174 | Sandstone |

TABLE 5 (CONT.)

| AGE | UNIT | TILANGOO NO. 2 | | LITHOLOGY |
|---|---|---|---|---|
| | | Depth(m)K.B. | Thickness(m) | |
| EARLY PERMIAN | Grant Fm. | 422 | 366 | |
| | 'Binda Mb' | 422 | 36 | Silty sandstone |
| | Dora Mb. | 458 | 87 | Sandy clayey siltstone |
| | Cuncudgerie Mb. | 545 | 243 | Sandstone, claystone, siltstone |
| M. ORDOVICIAN | Goldwyer Fm. | 788 | 125 | Limestone, siltstone, shale, sandstone |
| EARLY ORDOVICIAN | Willara Fm. | 913 | 454 | Limestone, shale |
| " | Nambeet Fm. | 1367 | 71 | Sandstone, shale |
| PRECAMBRIAN | Basement | 1438 | | Gneiss |
| | | T.D. | 1472 | |

| AGE | UNIT | Contention Heights No. 1 | | LITHOLOGY |
|---|---|---|---|---|
| | | Depth(m)K.B. | Thickness(m) | |
| RECENT | Undiff. | 4.6 | 9.1 | Unconsolidated aeolian sands |
| MESOZOIC | Undiff. | 13.7 | 74.1 | Unconsolidated white coarse-grained sandstone overlying white medium-grained sandstone and siltstone. Basal unit of yellow, red, and brown siltstone grading to fine-grained sandstone and clay |
| | Noonkanbah Fm. | 87.8 | 86.9 | Lignitic shales and clay becoming sandy with depth |
| | Poole Sst. | 174.7 | 222.5 | Medium to very coarse unconsolidated to poorly consolidated sandstone |
| EARLY | Grant Fm. Member 1 | 397.2 | 78.3 | Sandstone as above but with higher percentage of igneous and metamorphic rock fragments and feldspar |
| PERMIAN | Member 2 | 475.5 | 357.2 | Medium to very coarse sandstone grading to fine in part. Minor interbeds of calcareous shale towards top and black shale at base |
| DEVONIAN | Mellinjerie Lst. | 832.7 | 17.8 | Ferruginous shale dolomitic in part, and dolomitic shale. Minor dolomicrite and rare dolosparite |
| | Tandalgoo Red Beds | 850.5 | 60.6 | Mainly very fine to fine red sandstone grading to medium and coarse in part |
| | Carribuddy Fm. Unit A | 911.1 | 141.1 | Gradational boundary with above. Ferruginous dolomitic shale and clay. Interbedded fine-grained sandstone above 944.9 m. |
| DEVONIAN? | Unit C | 1052.2 | 227.4 | Shale and clay. Top of unit taken at point where non-ferruginous fraction predominates |
| | Units(D?) + E | 1279.6 | 63.1 | 15 m of mainly medium-grained ferruginous sandstone at top, overlying sequence of interbedded shale and siltstone |
| | ? | | | |
| ORDOVICIAN | Goldwyer Fm. | 1342.7 | 237.7 | Dolomicrite, dolomitic shale and siltstone, with minor fine-grained dolomitic sandstone to 1412.8 m, overlying 41.2 m of very fine to fine sandstone, siltstone, and shale with a calcaro-dolomitic cement. Remaining section comprises calcareous, plastic clay, and silty pyritic shale with thin micrite bands containing a brachiopod and bivalve fauna, and at the base, clay and fine-grained sandstone |
| | Middle Fm. | 1580.4 | 93.0 | 1580-1609.3 m: Mainly white to light grey fine-grained sandstone with minor dark grey shale and siltstone. 1609.3-1673.4 m: Sandstone, light grey, medium-grained, silicified, minor dolomitic cement increasing markedly towards base; and fine-grained sandstone with minor interbedded dark grey shale and siltstone |
| | Lower Fm. | 1673.4 | 117.3+ | 1673.4-204.2 m : Sandstone, white to light grey, fine-grained, with interbedded medium-grained sandstone containing minor interbedded grey shale and siltstone. 204.2 - 266.7 m : Sandstone, light grey to beige, medium-grained, coarsening with depth with interbedded dark grey shale and siltstone |
| | | T.D. 1790.7 | | |

in the Money Shoal Basin. East Mermaid was located in 388 m of water 274 km west of Broome. Although hydrocarbons were not reported, the drilling has provided valuable stratigraphic control.

## SUBSIDIZED GEOPHYSICS

Ten seismic surveys were completed or in progress in 1973. The results of nine of these, and of two 1972 surveys released after July 31 1973, are given in this section.

### Onshore

The Liveringa Ridge (325) seismic survey (BMR file, 72/2938) was located in the northwest Canning Basin about 40 km east of Broome, and covered parts of the Fitzroy Trough and Jurgurra Terrace tectonic provinces. Before this survey, seismic control in the Fitzroy Trough was sparse, and one of the objectives was to provide additional control between the previous widely spaced lines. Other aims were to tie the data obtained in the Fitzroy Trough to wells on the Jurgurra Terrace, and to investigate structural leads indicated by the Oscar seismic survey (BMR file 70/765) in the transitional zone between the two provinces.

The data obtained, which varied in quality from good to questionable, were combined with all available data from previous seismic surveys in the area, and maps were produced on two horizons: top Permian upper Grant Formation, and base lower Grant Formation (pre-Permian unconformity). The horizons were identified at Logue No. 1 (BMR file, 71/479) and tied to Doran No. 1 (BMR file, 68/2033) and Frome Rocks Nos 1 and 2 (BMR files, 62/1029 and 62/1033). The maps show a series of northwest-trending faults (downthrown to the northeast) separating the Fitzroy Trough from the Jurgurra Terrace. The project area is traversed by five, mainly northwest-trending, major anticlinal trends: four are pre-Permian; the other post-Permian. Logue No. 1, Doran No. 1, and the Frome Rocks wells tested closures on one of these on the Jurassic Terrace. The two structural leads indicated by the Oscar seismic survey are reinterpreted as separate features on two different intersecting axes.

The Liveringa 2 (365) seismic survey was designed to further delineate the structures mapped by the Liveringa Ridge (325) survey, and to clarify the structural relationship between the Logue area on the Jurgurra Terrace and the Liveringa area in the Fitzroy Trough. Three horizons were mapped: horizon A - top upper Grant Formation (Permian); horizon B - base lower Grant Formation (pre-Permian unconformity); horizon C - near top Devonian. An isochron map of interval B-C was prepared. The data quality was fair on horizon A, but deteriorated with depth. Data from previous surveys were incorporated for the interpretation. Three of the major anticlinal trends (pre-Permian) mapped in the earlier surveys were confirmed, and two of these further delineated. The survey enabled structural trends to be projected into the Liveringa area from the Logue area on the Jurgurra Terrace.

The Doran seismic survey followed the Liveringa Ridge survey to mature a well site on the Doran structure, a closure on the same anticlinal trend as those tested by Logue No. 1 and the Frome Rocks wells. Doran No. 1, drilled in 1968, reached total depth in the Lower Carboniferous Laurel Formation. The objectives for future drilling will be Upper Devonian carbonates.

Three horizons were mapped on fair-to-poor-quality data: horizon A - top upper Grant Formation (Permian); horizon B - base lower Grant Formation (pre-Permian unconformity); and horizon C - near top Devonian. A possible well site was defined at the apex of the structure, which, on horizon B, is mapped as a large roughly east-west-trending anticline with a minimum vertical closure of 0.400 seconds and an areal extent of at least 50 $km^2$. A deterioration in the record quality over the crest of the structure, together with the proximity of the Frome Rocks salt dome, suggests that the Doran structure may be the result of salt movement. However, gravity data show it as a positive gravity anomaly, and the company concludes that the Doran structure is the result of the growth of Devonian reefs.

The Lennard Shelf aeromagnetic survey (BMR file, 72/1019) covered a very large area of the northern Canning Basin. It was a detailed, high sensitivity aeromagnetic survey utilizing a Geometrics G 804 proton precession magnetometer with both analogue and digital recording, and covered 31 571 km on an approximate 2 x 8 km rectangular grid. The large survey area is divided into three blocks for purposes of interpretation, labelled from northwest to southeast as Block B, Block A, and Block C.

In Block B, the magnetic intensity map shows a series of southeast-trending anomalies in the north of the area, one of which corresponds roughly with the Oscar Ridge. A large circular anomaly in the southern part of the area was interpreted as due to an intra-basement source at a depth of about

10 km under the Fitzroy Trough. The interpreted depth-to-basement contours show magnetic basement deepening to the southwest from near zero depth to almost 10 000 m in several steps defined by the southeasterly trending Oscar and Pinnacle Faults. The area is further dissected by a series of northeasterly trending faults. Depth estimates to basement are generally in fairly good agreement with borehole data.

In Block A, the dominant feature on the magnetic intensity map is a large southeasterly trending belt of anomalies corresponding roughly to the Oscar Range and the Oscar Range Fault on its southwest side. As in Block B, the depth to basement increases towards the southwest in a series of steps corresponding to the Lennard Shelf, the Laurel Terrace, and the Fitzroy Trough, with average depths to basement of 650 m, 2800 m, and 6500 m respectively. The Oscar Range Fault separates the Lennard Shelf from the Laurel Terrace, and the Pinnacle Fault separates the terrace from the Fitzroy Trough.

In Block C the magnetic intensity map shows a strong southeasterly trend of magnetic anomalies roughly following the Pinnacle Fault in the southeast of the survey area. There is a greater area of relatively shallow basement than in Blocks A and B owing to the southwesterly displacement of the Pinnacle Fault (and consequently the Fitzroy Trough). Northeasterly trending faults have also produced a large offset between the Laurel Terrace on Block A and the Gogo Shelf on Block B. These two shelf areas are about the same width, and have similar average depths to basement.

The Collins II seismic survey was located 150 km south-southeast of Derby, mainly on the Mid-basin Platform (Broome Platform) and partly on the Jurgurra Terrace. The quality of previous seismic data for the area is poor, particularly from below the base Permian unconformity, and consequently the structure was inadequately defined. The Collins II survey comprised two southwesterly trending traverses, one running through the structure tested by Matches Springs No. 1 (BMR file, 69/2023) drilled on the Jurgurra Terrace, and a parallel line 24 km to the west over three other possible structural highs. The survey was designed to provide reconnaissance infill data on the westerly line, and to determine whether Matches Springs No. 1 was located in an optimum structural position. A secondary objective was to determine whether a maximum-effort seismic program would improve the quality of the data obtained from below the base Grant Formation seismic horizon. To this end, an experimental program preceded the survey to determine the most appropriate technique.

Six-fold and 12-fold data were recorded along the two traverses. The quality of the data was superior to that obtained by the earlier mainly single-fold analogue surveys, but there was still a pronounced deterioration beneath the base Grant Formation. The interpretation incorporated 552 km of data from previous surveys. Three horizons were mapped: horizon A - base of Grant Formation; horizon B - base of Pillara Formation (Devonian); and horizon C - top of Nita Formation (Ordovician). Horizon A is regarded as fairly reliable, except close to faults and where it comes close to the surface. The underlying horizons are considered very unreliable over the northern part of the survey area, but fairly reliable to the south. The results (on horizon A) indicated that Matches Springs No. 1 was not located in an optimum structural position. A more favourable position would have been on a closed anticline about 5 km to the south. However, this structure is not considered large enough to be recommended for drilling without further seismic control. The survey provided increased control on several anticlinal features mapped by the earlier surveys. No new structural features were mapped. The report recommends that no further seismic work should be undertaken in the area unless field recording and processing techniques can be improved sufficiently to enable accurate mapping of the Devonian and Ordovician sections which contain the primary hydrocarbon objectives.

The Crossland III (358) seismic survey was located in the central part of the Canning Basin 270 km southeast of Broome. Its objective was to provide semidetailed control on a large low-relief anticline indicated by the East Canning seismic survey (BMR file, 72/975).

Fair to good quality data were obtained and three horizons mapped: horizon A - base Grant Formation; horizon B - near top Ordovician; and horizon C - near top Willara Formation (Ordovician); isochron maps were presented of the intervals A-B and B-C. Five roughly northwest trending anticlines were delineated on which nine closures were indicated. The closures were mapped on all horizons but generally with greatly reduced dips on the deeper two. Before a well site is selected, or further seismic work undertaken, a depth map based on reliable velocity information is considered a necessary prerequisite, in order to establish the validity of the apparent closures which might result from velocity anomalies caused by salt solution in the Devonian evaporite sequence.

Barbwire 2 (361) seismic survey was carried out in the central-eastern part of the Canning Basin to detail structures on the Barbwire Terrace indicated by previous seismic surveys, and to generally improve structural control in the area. About 62 km of data from earlier surveys was reprocessed and used in the interpretation. The quality of the new data was generally fair. The quality of the old data was not significantly improved by reprocessing. Two horizons were mapped: horizon A - base Grant Formation (pre-Permian unconformity); and horizon B - top Ordovician Goldwyer Formation. Three anticlines were partly delineated on horizon B. Further work will be required to prove closure. Extensive faulting was also mapped at this level.

The Sahara II (357) seismic survey was carried out in the central-southern part of the Canning Basin over the south-western part of the Kidson Sub-basin. It consisted of one seismic line, 64 km long, extending from Sahara No. 1 well (BMR file, 64/4129) in a northwesterly direction along the trend of the Chirit Anticline. This structure was indicated by previous geophysical work but poorly defined. It is controlled by the Chirit Fault, which extends to the northwest from the Kidson Sub-basin to the Willara Sub-basin (about 320 km) and has a throw of at least 600 m. The aim of the Sahara II survey was to provide seismic control along the strike of the Chirit structural trend and locate possible closures. The quality of the data obtained was generally good particularly near Sahara No. 1 well, in the southeastern part of the survey area. Toward the northwest, deterioration in quality is associated with surface sand dunes. The data was incorporated with data from previous surveys to produce contour maps on three horizons: horizon A - near base Grant Formation (pre-Permian unconformity); horizon B - near base Tandalgoo Red Beds (Devonian); and horizon C - near top Willara Formation. The upper two horizons were tied to Sahara No. 1. Horizon C, which was not penetrated by Sahara No. 1, was identified on reflection character and velocity data derived from Munro No. 1 (BMR file, 72/846). The report includes an isochron map of interval B - C. The Chirit anticlinal trend was shown to extend to the southeast and a strike dip in excess of 0.8 seconds in this direction was confirmed. Closure was established in several places along the axis, but dip across the axis will need confirmation by further seismic work.

The Jones Range-Hall Range seismic survey was carried out in the northeastern part of the Canning Basin. It comprised two projects - the Jones Range (364) and the Hall Range (370).

The Jones Range Project was carried out over a northeast-plunging positive gravity anomaly - The Jones Arch - separating the Fitzroy Trough from the Gregory Sub-basin. It was designed to define a well site on the Jones Range structure mapped by the East Canning seismic survey (BMR file, 72/975), following which a well was recommended. The data obtained was of poor to fair quality. Two horizons were mapped: horizon A - pre-Permian unconformity; and horizon B - near top Devonian; an isochron map was prepared of the interval between the two. The Jones Range structure is mapped as a large closed anticline with more than 500 $km^2$ of areal and up to 880 milliseconds of vertical closure on horizon B, the Devonian carbonates being the prospective sequence. Jones Range No. 1 was drilled in 1974; it was plugged and abandoned as a dry well at 2540 m.

The Hall Range (370) Project was located on the Barbwire Terrace to detail an anticline mapped by the East Canning seismic survey. The pre-Permian unconformity was also mapped in this area. The other horizon mapped was horizon C - near top Ordovician Willara Formation. Three closures were mapped along the anticlinal axis. A well site was recommended to test the largest, a fault-controlled structure with 100 $km^2$ of areal and 60 milliseconds of vertical closure on horizon C, the Ordovician being the prospective section in this case.

The Thornton seismic survey was an extensive regional survey carried out near the northeastern margin of the basin. Previous seismic control comprises only 26 km of poor-quality data recorded by the Balgo-Lake Betty seismic survey (BMR file, 63/1533). The Billiluna-Helena aeromagnetic survey (BMR file, 71/422), and gravity surveys by BMR (1952-60 and 1968), indicated the main structural features of the area, which are from north to south: the northwest trending Billiluna Shelf, Betty Terrace, Gregory Sub-basin, Crossland Platform, and Helena Platform. The primary objective of the Thornton survey was to obtain good seismic control over these major structural features. It was also hoped that possible stratigraphic or structural traps, particularly reefs, would be discovered.

The quality of the data obtained was variable, reflecting the geological complexity of the area. Interpretation of the data is hampered by the lack of stratigraphic control, and the difficulty of correlating the seismic horizons across the major fault zones. Consequently the maps produced give only a broad picture of the structural and stratigraphic relation. The Company mapped three horizons, identified by extrapolation to Wilson Cliffs No. 1 (BMR file 68/2011) - 48 km to the south - as base of Grant Formation, top of Carribuddy

Formation, and basement. The upper horizon reflected little of the major structural trends, but these were well marked on the two deeper horizons. A number of anticlines were mapped on the top of Carribuddy Formation horizon, some of which were interpreted as possible reefs on the basis of the results of a detailed velocity survey which indicated a marked increase in interval velocity at the level of the postulated reefs.

The data from the Thornton seismic survey is currently being interpreted by the Basins Study Group, BMR. They are in broad agreement with the Company interpretation for the area north of the Gregory Sub-basin, but their interpretation is expected to differ significantly in the southern part of the survey area particularly in terms of horizon identification.

## Offshore

The Jaubert seismic and magnetic survey was carried out in the Bedout Sub-basin to detail the Jaubert structure discovered by the Bedout-Broome Swell seismic survey (BMR file, 72/2616). The survey area lies along the eastern margin of the Bedout Sub-basin. The data quality was good, and two horizons - top of the Triassic, and top of the Permian - were contoured in depth and an isopach map presented of the interval between the two. A Varian proton precession magnetometer was towed throughout the survey. A detailed velocity analysis was obtained from the reprocessing of about 50 km of data from both the Jaubert and the Bedout-Broome Swell surveys.

The survey has provided an accurate definition of the Jaubert Structure, which it has established as a drillable prospect with an estimated 36 $km^2$ of areal and 100 m of vertical closure at the top Triassic horizon. On both mapped horizons the Jaubert Structure appears as a low-relief fault-induced fold fragmented into south-dipping fault wedges. As the faults do not intersect horizons above the top Triassic, the major structural movement in this part of the Bedout Sub-basin is inferred to have been during the Late Triassic. Within the 36 $km^2$ closure there are four separate culminations mapped to the west of the main feature. The total magnetic intensity map shows a well developed magnetic anomaly south-west of the Jaubert feature which is almost coincident with two of these. The Company considers the magnetic anomaly results from a deep basement complex effect and not from igneous material in the sedimentary section.

Project 73-G of the Mermaid-Cartier seismic survey was designed to give regional reconnaissance coverage of the deeper-water area of the offshore Canning Basin, and, in conjunction with Project 73-H (see Browse Basin), to tie previous work by Shell Development (Australia) Pty Ltd in the Rowley Shoals area to BOCAL's work around Scott Reef in the Browse Basin.

Four horizons were mapped on fair to poor-quality data: horizon X (near base Tertiary); horizon D (top Toolonga Calcilutite); horizon T (near top Triassic unconformity); and horizon 'Deep Form' (simplest of several 'pre-T' events). The deepest horizon, which is based on data of variable and often poor quality, has been included only to indicate the structure at the pre-Mesozoic level and is not intended to be regarded as a map of one discrete horizon. The contours on the upper three horizons broadly follow the established tectonic elements. Considerably more additional structural deformation is shown in the northern part of the project area on horizon T. Two large 'highs' occur just inshore of the continental slope, and areas of block-faulting occur along the Leveque Margin structural trend. Increased seismic control could be expected to show local closure. The two areas of structural interest are separated by a broad sloping terrace. On horizon 'Deep Form' a series of 'highs' run from near Rowley Shoals northwards along the edge of the continental shelf. This trend has not yet been mapped in sufficient detail to determine whether it continues into the Browse Basin or terminates at a deep cleft in the shelf mapped just south of Scott Reef. As on horizon T, an inner arc of structural 'highs' occurs along the seaward side of the Leveque Margin. At this level in the northern part of the project area the two series of highs are separated by a deep trough.

In summary, the survey has delineated two subparallel areas of structural interest, one lying along the outer edge of the continental shelf, and the other along the outer edge of the Leveque Margin structural trend. The areas are separated in the pre-Mesozoic by a deep trough, and in the Mesozoic by a broad sloping terrace.

## CARNARVON BASIN

Seven subsidized wells, four offshore, were completed in 1973 (Table 6). Four offshore and three onshore subsidized seismic surveys were carried out.

# SUBSIDIZED DRILLING

## Offshore

### Barrow Sub-basin

West Tryal Rocks No. 1 was located about 75 km northwest of Barrow Island. It was drilled on a seismically defined large fault block in Triassic sediments, with drape closure provided by Cretaceous and Tertiary sediments. The structure lies on the southwest extension of the Rankin Platform from the Dampier Sub-basin. North Tryal Rocks No. 1 (BMR file 72/2069) tested a similar structure on the same trend about 40 km to the northeast, and encountered non-commercial quantities of gas in the Late Triassic to Early Jurassic Mungaroo Beds - the main producing horizon in the wells drilled by BOCAL on the Rankin Trend.

West Tryal Rocks No. 1 encountered good hydrocarbon shows during drilling in the Mungaroo Beds. The well was suspended until the drill-ship *Dalmahoy* arrived to carry out a testing program that would determine the nature of the hydrocarbons and the exact net pay. A preliminary estimate from log analysis indicated 90 m of possible hydrocarbon pay. The *Dalmahoy* did not test the well, but was used to drill West Tryal Rocks No. 2, which was spudded in September 1974 about 3.6 km northeast of No. 1 well, and 130 m structurally higher. Good gas shows were reported in the Mungaroo Beds. On drill-stem testing of the interval 3435m-3450m, gas was produced through a ½" surface choke at rates between 9 and 11 MMcfD, plus condensate at a rate of 150 b.p.d. A drill-stem test of the interval 3295m-3308m produced gas at a rate of 15.4 MMcfD through a ½" surface choke, plus condensate at a rate of 221 b.p.d.

Comparison of the sequence in West Tryal Rocks No. 1 with that in North Tryal Rocks No. 1 shows an increase in thickness of the Early Jurassic part of the Mungaroo Beds from about 3 m to 59 m. Glauconite in the upper part of the Mungaroo Beds indicates a marine influence in the Late Triassic to Early Jurassic. The underlying part of the unit consists of alluvial plain sediments. The sandstone units in the Mungaroo Beds are similar to those in wells drilled on the Rankin Platform with decreasing porosity towards the bottom owing to silicification. Palaeontological evidence indicates a predominantly non-marine depositional environment for the Muderong Shale in the Aptian and a near-shore marine environment in the Neocomian, which are typical for this unit.

The Palaeocene to early Eocene Cardabia Group and the Miocene Cape Range Group are characterized by outer continental shelf sediment as in North Tryal Rocks No. 1, in contrast to the BOCAL wells in the Dampier Sub-basin in which inner continental shelf sediments predominate.

Dampier Sub-basin

Rosemary No. 1 was drilled at the southern end of a southwest trending structural high known as the Rosemary-Legendre Trend which lies in the central part of the sub-basin. The Rosemary structure, a fault block in Jurassic sediment draped by Cretaceous and Tertiary sediments, was detailed by the Montebello-Turtle marine seismic survey (BMR file 72/509). The prospective horizons on the trend are in the Lower Cretaceous/Upper Jurassic Barrow Beds and in the Triassic sequence. Legendre No. 1 (BMR file 68/2016) drilled at the northern end of it, encountered non-commercial quantities of 47$^{o}$ API gravity oil in lower Neocomian sediments.

Rosemary No. 1 encountered a very thin Tertiary sequence. The Jurassic sequence was almost complete, and the Triassic sequence, predicted to lie below 3457 m, was not intersected. The seismic horizon at 1098 m does not represent the Toolonga Calcitutite as predicted, but probably represents the major intra-Cretaceous unconformity cutting out the Santonian to Turonian beds. The lowermost Neocomian and uppermost Tithonian beds are absent. Below the unconformity, Tithonian sandstone was encountered at the top of a Jurassic sequence within a horst block dipping at about 5$^{o}$ to the southwest. Well developed potential reservoirs were intersected in sandstone of Tithonian to Kimmeridgian age below a potential seal of Neocomian claystone. High gas readings were obtained during drilling, but five Formation Interval Tests and electric log interpretation showed all zones to be water-bearing.

Eaglehawk No. 1 (BMR file 72/3177) and Egret No. 1 tested separate fault blocks on the Rankin Platform, immediately to the east of the North Rankin gas/condensate field. Both wells were oil discoveries. In Eaglehawk No. 1 the uppermost Triassic Mungaroo Beds contained crude oil with a specific gravity between 29.3$^{o}$ and 30$^{o}$ API on drill-stem testing between 2750 m and 2766 m, oil was produced at a rate of 1645 b.p.d., accompanied by gas at a rate of 0.141 MMcfD through 3/4 inch bottom-hole and 5/8-inch surface chokes. In Egret No. 1, 7 km to the east, crude oil of 39$^{o}$ API gravity was recovered for the top sand in the Tithonian sequence, the first occurrence of oil in Upper Jurassic sediment located to date in the Dampier Sub-basin. On drill-stem testing between 3119 m and 3129 m, oil was produced at a rate of 2729 b.p.d., accompanied by gas at a rate of 2.37 MMcfD through 3/4-inch surface choke.

Although in both wells the stratigraphic sequence is generally similar to that encountered in other wells on the Rankin Platform, the drilling has provided some additional geological information. The Cretaceous sequence in Eaglehawk No. 1 is very condensed. In the Upper Cretaceous, the Toolonga Calcilutite is only 17 m thick, and the entire Lower Cretaceous 10 m. The basal Tertiary unit of fine-grained glauconitic sandstone and siltstone in the North Rankin wells is represented in Eaglehawk by the very thin clastic unit immediately above the regional middle Palaeocene/Upper Cretaceous unconformity. The unconformity between the Oligocene and upper Eocene is thought to be equivalent to that encountered in wells in the Beagle Sub-basin, but it represents a much shorter time break. The Cretaceous sequence in Egret is considerably thicker than in Eaglehawk. The Toolonga Calcilutite is 58 m and the thickness from the top of this unit to the base of the Upper Cretaceous is 148 m compared with 39 m in Eaglehawk.

Hauy No. 1, completed in 1972 (BMR file 72/3186), was a shallow test of a possible stratigraphic trap on the northeast margin of the sub-basin. No hydrocarbons were detected. Points of geological interest are the conformable contact between the Albian and the Aptian, which in other wells drilled in the sub-basin has been unconformable, and the absence of Jurassic and lower Neocomian strata.

Beagle Sub-basin

Cossigny No. 1, drilled in 1972 (BMR file, 72/3063), was the third well to be drilled in the sub-basin. It was located on a large east-west-trending fault-induced structure on the southern margin, adjacent to the northeast flank of the De Grey Nose. Picard No. 1 (BMR file, 72/2710) was located on the Jarman-Picard anticlinal trend which forms the northern boundary of the sub-basin, and Sable No. 1 on an apparent northeasterly extension from the Dampier Sub-basin of the Rankin Platform.

No significant hydrocarbons were recorded in Cossigny No. 1. The wireline logs indicate that the entire section penetrated was water-saturated. The well provided further information on the extent of Middle and Lower Jurassic, and also Upper Triassic sedimentary rocks in the sub-basin. It was the first well to penetrate a Middle Triassic sequence; this sequence was lithologically similar to the Upper Triassic and Jurassic sequences in the Picard and Sable wells, except for the presence of the distinctive carbonate unit in Cossigny No. 1. The disconformity between the lower Eocene and the basal upper Palaeocene has not previously been palaeontological defined in either the Beagle or Dampier Sub-basins. The lower Maestrichtian to Campanian sequence (Miria Marl equivalent) is thicker (246 m) than in Sable No. 1 (15 m), and Picard No. 1 (129 m).

Ronsard No. 1 was the only well drilled in the Beagle Sub-basin in 1973. It was located 40 km to the north-east of Sable No. 1, on the same major structural trend, to test a fault-controlled Jurassic horst block with draped closure persisting to the D seismic horizon (Toolonga Calcilutite). No significant hydrocarbon shows were recorded but the well provided valuable stratigraphic control. As in Sable No. 1 a major unconformity separates the Lower Cretaceous from the Lower Jurassic sequence. The Albian/Aptian unconformity, which is of regional significance, has only previously been recorded in the sub-basin in Picard No. 1. The intra-Upper Cretaceous unconformity has not previously been recorded in the sub-basin.

## Onshore

### Barrow Sub-basin

Barrow Deep No. 1 was a deep test (4877 m) of the sequence below the Late Jurassic and Cretaceous oil-producing horizons on Barrow Island. It was located about 1.3 km south of Barrow No. 1 (2983 m), the previous deepest well on the island. Interpretation of deep structure on Barrow Island has been limited by technical difficulties in obtaining good quality seismic data and the lack of deep well control. The well was predicted to intersect possible sandstone reservoirs in Triassic to Lower Jurassic rocks in an interpreted deep horst block. However, drilling was abandoned in Middle Jurassic rocks when the well entered an over-pressured zone and it became impossible to obtain a mud weight gradient sufficient to match the formation pressure over the open hole.

The well discovered significant accumulations of gas, and gas condensate in three separate sandstone reservoirs within the Middle Jurassic Dingo Claystone. The areal extent of the reservoirs is undefined. Recent seismic work indicating a total thickness of 4572 m of Jurassic sediment near Barrow

Island, and the stratigraphic information gained from Barrow Deep No. 1, shows that pre-Jurassic rocks must lie at depths below 6580 m. The area seems to have been a major depocentre from Early Jurassic to Neocomian; thinning of strata due to structural growth is not apparent until the Aptian.

The bottom-hole temperature (about 350$^{\circ}$F) and pressure (95500 kPa) indicate that commercial quantities of hydrocarbons are unlikely to occur in rocks below this depth.

Gascoyne Sub-basin

Tamala No. 1, on the southern shores of Shark Bay, and Kalbarri No. 1, 85 km to the southeast, were drilled to investigate the sediments in two of four sedimentary troughs interpreted from geophysical data to lie along the coast in this area of the Gascoyne Sub-basin.

Apart from the absence of Eocene sediments, and the presence of the Turonian Alinga Formation, the sequence penetrated to the base of the Cretaceous in Tamala No. 1 is similar to that in Dirk Hartog No. 17B, drilled on Dirk Hartog Island in 1956. The Silurian Dirk Hartog Formation in Tamala No. 1 has closer lithological affinities with that in Yaringa No. 1 and Hamelin Pool Nos 1 and 2, 97 km to the northeast, than to the type section in Dirk Hartog No. 17B. Traces of gas were observed between 869 m and 911 m.

The top of the Siluro-Devonian Tumblagooda Sandstone was encountered 1000 m higher than predicted, and the expected lower Mesozoic sediments were not encountered. Lower Mesozoic sediments were also absent from Kalbarri No. 1, and the Tumblagooda Sandstone was 164.6 m higher than predicted. The drilling has thrown doubt on the validity of the geophysical interpretation of the area and the results will be incorporated into a reappraisal of the geophysical data.

## UNSUBSIDIZED DRILLING

### Offshore

All the unsubsidized drilling was offshore.

Dampier Sub-basin

Four wells were drilled on the Rankin Platform. Dockrell No. 1 and Lambert No. 1 were new field discoveries. Dockrell No. 1 is a potential gas, condensate, and oil producer, and Lambert No. 1, completed in 1974, a potential oil producer.

TABLE 6: STRATIGRAPHIC TABLES, CARNARVON BASIN

| AGE | UNIT | WEST TRYAL ROCKS No. 1 Depth(m)R.T. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| RECENT TO LATE MIOCENE | Undifferentiated Carbonates | 150 | 1163 | Calcarenite, calcilutite, and calcisiltite |
| MIDDLE MIOCENE TO OLIGOCENE | Cape Range Group | 1313 | 616 | Mainly calcilutite, calcisiltite, calcarenite with some chalk and marl, and rare dolomite and chert |
| LATE TO MIDDLE EOCENE | Giralia Calcarenite equivalent | 1929 | 211 | Calcisiltite, limestone, chalk and marl with some claystone and chert, and a basal sandstone |
| EARLY EOCENE TO PALAEOCENE | Cardabia Group | 2140 | 119 | Mainly marly calcilutite with minor limestone, chalk, claystone, and calcisiltite, and a basal glauconitic sandstone |
| LATE CRETACEOUS | Toolonga Calcilutite equivalent | 2259 | 33 | Sandy calcilutite grading to marly sand with depth, on clay stone grading into a basal sandstone |
| LATE TO EARLY CRETACEOUS | Gearle Siltstone equivalent | 2292 | 297 | Claystone to marly calcilutite to shale with depth, glauconite common |
| EARLY CRETACEOUS | Windalia Radiolarite equivalent | 2589 | 38 | Mainly glauconitic siltstone and shale with rare interbeds of claystone and marl |
| | Muderong Shale | 2627 | 606 | Mainly soft clay grading to claystone with interbeds of shale siltstone, limestone, and lignite |
| EARLY JURASSIC TO LATE TRIASSIC | Mungaroo Beds | 3233 | 633+ | Mainly sandstone and claystone with some shale and siltstone |
| | | T.D. 3866 | | |

| AGE | UNIT | ROSEMARY NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| | | 10 | | Sea Level |
| | | | 64 | |
| | | 74 | | Sea Bed |
| | | | 397 | No samples recovered |
| | | 471 | | |
| CRETACEOUS (EARLY MAESTRICHTIAN) | Miria | | 552 | Sandstone and claystone with minor dolomite |
| | | 1023 | | |
| (CAMPANIAN) | Marl | | 75 | Claystone |
| | | 1098 | | |
| (CENOMANIAN) | | | 186 | Claystone with minor coal |
| | | 1284 | | |
| (CENOMANIAN-ALBIAN) | Winning | | 202 | Claystone |
| | | 1486 | | |
| (APTIAN) | Group | | 342 | Claystone with minor sandstone |
| | | 1828 | | |
| (BASAL APTIAN-NEOCOMIAN) | | | 119 | Sandstone with minor claystone |
| | | 1947 | | |
| (LATE NEOCOMIAN) | | | 213 | Claystone with minor sandstone and dolomite |
| | | 2160 | | |
| (EARLY NEOCOMIAN) | Barrow Beds | | 47 | Claystone with minor sandstone |
| | | 2207 | | |
| JURASSIC (LATE TITHONIAN) | Barrow Beds | | 71 | Sandstone |
| | | 2278 | | |
| (EARLY TITHONIAN) | 'Dampier' | | 125 | Sandstone |
| | | 2403 | | |
| (KIMMERIDGIAN) | Beds | | 49 | Sandstone |
| | | 2452 | | |
| (KIMMERIDGIAN-OXFORDIAN) | | | 159 | Claystone with minor sandstone |
| | ................. | 2611 | | |

TABLE 6 (CONT.)

| AGE | UNIT | ROSEMARY NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| (OXFORDIAN) | | | 87 | Claystone and siltstone with minor sandstone |
| | | 2698 | | |
| (CALLOVIAN) | 'Legendre' Beds | | 421 | Claystone with minor siltstone and sandstone |
| | | 3119 | | |
| (CALLOVIAN-BATHONIAN) | | | 23 | Claystone, siltstone, and sandstone |
| | | 3142 | | |
| (BATHONIAN-BAJOCIAN) | 'Enderby' | | 226 | Sandstone, claystone, and siltstone with minor coal |
| | | 3368 | | |
| (TOARCIAN) | Beds | | 541 | Sandstone with interbedded claystone and siltstone with minor coal |
| | | T.D. 3909 | | |

| AGE | UNIT | EAGLEHAWK NO. 1 Depth(m)R.T. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| | | 13 | | Sea level |
| | | 133 | | Sea bed |
| TERTIARY (PLIOCENE) | | | | No samples |
| | | 429 | 1226 | |
| (MID-MIOCENE) | | | | Sandstone, calcarenite, calcirudite, dolomite |
| | | 1359 | | |
| (MID-MIOCENE) (BURDIGALIAN) | | | 251 | Calcarenite, calcisiltite Calcilutite, marl |
| | | 1610 | | |
| (AQUITANIAN) | | | 103 | Calcisiltite, calcilutite, marl |
| | | 1713 | | |
| (BASAL AQUITANIAN) (UPPER OLIGOCENE) | | | 85 | Calcilutite |
| | | 1798 | | |
| (OLIGOCENE) | | | 322 | Calcisiltite, marl, claystone |
| | | 2120 | | |
| (LATE & MID-EOCENE) | Giralia Calcarenite equivalent | | 110 | Calcilutite, claystone, chert |
| | | 2230 | | |
| (EARLY EOCENE) | | | 201 | Marl, claystone |
| | Cardabia | 2431 | | |
| (LATE PALAEOCENE) | | | 134 | Marl, claystone, calcilutite |
| | Group | 2565 | | |
| (BASAL U. PAL.) (M. PALAEOCENE) | | | 17 | Marl, claystone, glauconitic sandstone |
| | | 2582 | | |
| LATE CRETACEOUS (LATE MAESTRICHTIAN) | | | 23 | Calcilutite, marl |
| | Miria | 2605 | | |
| (MID-MAEST.) | | | 15 | Marl, claystone |
| | | 2620 | | |
| (EARLY MAEST.) | Marl | | 59 | Marl, claystone |
| | | 2679 | | |
| (LATE CAMPANIAN) | | | 22 | Marl |
| | | 2701 | | |
| (EARLY CAMPANIAN) | Toolonga | | 9 | Calcilutite |
| | | 2710 | | |
| (SANTONIAN) | Calcilutite | | 3 | Calcilutite |
| | | 2713 | | |

TABLE 6 (CONT.)

| AGE | UNIT | EAGLEHAWK NO. 1 Depth(m) R.T. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| (BASAL SANTONIAN) | | | 4 | |
| | | 2717 | | Calcilutite, marl |
| (CONIACIAN) | | | 8 | |
| | | 2725 | | |
| (TURONIAN) | Winning | | 6 | Calcilutite, marl |
| | | 2731 | | |
| (LATE & MID-CENOMANIAN) | | | 6 | Calcilutite, marl |
| | | 2737 | | |
| (BASAL CENOMANIAN) (ALBIAN) | Group | | 3 | Calcilutite, marl |
| | | 2740 | | |
| EARLY CRETACEOUS (APTIAN) (NEOCOMIAN) | | | 10 | Claystone |
| | | 2750 | | |
| UPPER TRIASSIC (RHAETO-NORIAN) | Mungaroo Beds | | 740 | Sandstone, claystone, siltstone, coal |
| | | T.D. 3490 | | |

| AGE | UNIT | HAUY NO. 1 Depth(m) R.T. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| | | 30 | | Sea level |
| | | 96 | | Sea bed<br>No samples before marine riser run |
| | | 259 | | |
| AGE INDETERMINATE | | | 107 | Dominantly claystone with inter-bedded dolomite and minor sandstone overlying limestone |
| | | 366 | | |
| | | | 126 | No returns - probably limestone? |
| ? | ? | 492 | ? | ? |
| LATE CRETACEOUS (ALBIAN) | | | 63 | Dominantly claystone and siltstone with minor sandstone |
| | | 555 | | |
| EARLY CRETACEOUS (APTIAN) | ? | 556 | ? ? | |
| | | 592 | 63 | |
| ? | ? | 619 | ? ? | Dominantly sandstone with interbedded siltstone underlying greensand |
| LATE NEOCOMIAN) | | | 61 | |
| | | 680 | | |
| M. TRIASSIC | | 782 | | Dominantly claystone with minor sandstone and siltstone |
| | ? | 791 | ? ? | |
| | | 793 | | Dominantly sandstone with minor claystone |
| EARLY TRIASSIC | ? | 794 | ? ? | |
| | | 805 | | |
| AGE INDETERMINATE | | | 20 | Altered fine to medium grained basic igneous rocks |
| | | TD 825 | | |

| AGE | *UNIT | COSSIGNY NO. 1 Depth(m) R.T. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| | | 125(sea bed) | | |
| | | | | No samples before marine riser run |
| | | 433 | | |
| TERTIARY (PLIOCENE-LATE MIOCENE) | | | 128 | Dominantly calcisiltite with calcilutite, calcarenite, and minor dolomite |
| | | 561 | | |
| | | 625 | | |
| (LATE-MID MIOCENE) | | | 326 | Dominantly dolomite with calcarenite, calcilutite, calcisiltite, recrystallized limestone, and minor sandstone |
| | | 887 | | |
| (MID MIOCENE-BURDIGALIAN) | | | 188 | |
| | | 1075 | | |
| (LATE-MID-EOCENE | Giralia Calcarenite | | 139 | Calcisiltite and calcilutite with beds of chert |
| | | 1214 | | |
| (EARLY EOCENE) | Cardabia | | 65 | |
| | | 1279 | | |
| (BASAL LATE - PALAEOCENE) | Gp. | | 52 | Marl and claystone with minor calcisiltite and calcilutite |
| | | 1331 | | |
| CRETACEOUS (EARLY MAESTRICHTIAN -CAMPANIAN) | Miria Marl | | 246 | |
| | | 1577 | | |
| (SANTONIAN) | Toolonga Calcilutite | | 69 | Calcilutite |
| | | 1646 | | |
| (BASAL SANT. -TURONIAN) | Winning Gp. | | 151 | Claystone and minor marl |
| | | 1797 | | |
| M. JURASSIC | | | 318 | Claystone |
| | Legendre Fm. | 2115 | | |
| EARLY JURASSIC (TOARCIAN) | | | 179 | Dominantly massive sandstone, mainly fine-grained and moderately well sorted, with minor claystone, siltstone, and coal |
| | | 2294 | | |
| EARLY LATE TRIASSIC | Mungaroo | | 446 | |
| | | 2740 | | |
| | Beds | | | |
| | | 2874 | | Dolomite and recrystallized limestone |
| M. TRIASSIC | | 2940 | 464 | |
| | | | | Dominantly sandstone with claystone and siltstone and minor coal |
| | | TD 3204 | | |

* Unit names have been interpreted from the ages and lithologies supplied by the Company.

TABLE 6 (CONT.)

EGRET NO. 1

| | AGE | *UNIT | Depth(m) R.T. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|---|
| SEA LEVEL | | | 13 | | |
| SEA BED | | | 131 | | |
| | BURDIGALIAN TO PLIOCENE | | 442<br>1364 | 1233 | No samples<br>Calcarenite, sandstone, dolomite |
| | BURDIGALIAN | | | 190 | Calcarenite, calcilutite, calcisiltite |
| | | | 1553 | | |
| | AQUITANIAN | | | 154 | Calcilutite, calcisiltite |
| | | | 1707 | | |
| TERTIARY | OLIGOCENE | Cape Range Gp | | 358 | Calcisiltite, calcilutite, and minor calcarenite, marl, claystone |
| | | | 2065 | | |
| | LATE & MIDDLE EOCENE | | | 71 | Calcilutite with 15-40% chert |
| | | Giralia | 2136 | | |
| | MIDDLE EOCENE | Calcarenite equivalent | | 9 | Claystone |
| | | | 2145 | | |
| | EARLY EOCENE | | | 211 | Marl, claystone |
| | | | 2356 | | |
| | LATE PALAEOCENE | Cardabia Group | | 137 | Marl, minor calcilutite and claystone |
| | | | 2493 | | |
| | BASAL LATE PAL. MID-PALAEOCENE | | | 96 | Marl, minor claystone<br>Siltstone and glauconitic sandstone |
| | | | 2589 | | |
| | LATE MAESTRICHTIAN | | | 27 | Calcilutite, marl, claystone |
| | LATE - MIDDLE MAESTRICHTIAN | Miria | | 13 | Marl, claystone |
| LATE | EARLY MAESTRICHTIAN | Marl | | 79 | Marl, minor claystone |
| | | | 2708 | | |
| CRETACEOUS | LATE CAMPANIAN | | | 50 | Marl |
| | | | 2758 | | |
| | EARLY CAMPANIAN | Toolonga Calcilutite | | 13 | Calcilutite |
| | | | 2771 | | |
| | SANTONIAN | | | 33 | Calcilutite |
| | | | 2804 | | |
| | BASAL SANTONIAN | | | 12 | Calcilutite, marl |
| | | | 2816 | | |
| | CONIACIAN | | | 17 | |
| | | | 2833 | | |
| | TURONIAN | Winning | | 11 | Marl |
| | | | 2844 | | |
| | LATE & MIDDLE CENOMANIAN | | | 24 | Marl |
| | | | 2868 | | |
| | BASAL CENOMANIAN ALBIAN | Group | | 38 | Calcilutite, marl |
| | | | 2906 | | |
| EARLY | APTIAN AND LATE NEOCOMIAN | | | 75 | Claystone |
| | | | 2981 | | |
| CRETACEOUS | EARLY NEOCOMIAN | Legendre | | 114 | Claystone, minor siltstone |
| | | | 3095 | | |
| LATE JURASSIC | TITHONIAN | Fm. | | 203 | Sandstone, claystone, minor siltstone |
| | | | 3298 | | |
| LATE TRIASSIC | RHAETO-NORIAN | Mungaroo Beds | | 360 | Sandstone, claystone |
| | | | T.D. 3658 | | |

* Unit names have been interpreted from the ages and lithologies supplied by the Company.

TABLE 6 (CONT.)

| AGE | | *UNIT | RONSARD NO. 1 Depth(m) R.T./Thickness(m) | | LITHOLOGY |
|---|---|---|---|---|---|
| SEA BED | | | 170 | | |
| | | | | 325 | No samples before marine riser installed |
| | | | 495 | | |
| TERTIARY | EARLY PLIOCENE | | | 158 | Calcilutite |
| | | | 653 | | |
| | LATE MIOCENE TO BURDIGALIAN | | | 696 | Calcarenite, dolomite |
| | | | 1349 | | |
| | AQUITANIAN | | | 279 | Calcarenite, calcilutite with minor calcisiltite |
| | | | 1628 | | |
| | OLIGOCENE | Cape Range Gp | | 57 | Calcarenite, calcilutite |
| | | | 1685 | | |
| | LATE TO MIDDLE EOCENE | Giralia Calcarenite equivalent | | 126 | Calcilutite, calcisiltite |
| | ? | ? ? | ? 1811 ? | ? | ? ? ? |
| | EARLY EOCENE | | | 19 | Marl, claystone |
| | | | 1830 | | |
| | LATE PALAEOCENE | Cardabia | | 25 | Marl, claystone |
| | | | 1855 | | |
| | MIDDLE PALAEOCENE | Group | | 65 | Marl |
| | | | 1920 | | |
| | EARLY PALAEOCENE | | | 39 | Marl, claystone |
| | | | 1959 | | |
| LATE CRETACEOUS | LATE MAESTRICHTIAN | Miria Marl | | 47 | Marl, claystone |
| | | | 2006 | | |
| | EARLY MAESTRICHTIAN | | | 34 | Marl, claystone |
| | | | 2040 | | |
| | CAMPANIAN | Toolonga Calcilutite | | 155 | Claystone, marl, calcilutite |
| | | | 2195 | | |
| | SANTONIAN | | | 20 | Calcilutite |
| | | | 2215 | | |
| | CONIACIAN | Winning Group | | 10 | Marl |
| | | | 2225 | | |
| | ALBIAN | | | 31 | Claystone, marl, calcilutite |
| | | | 2256 | | |
| EARLY CRETACEOUS | EARLY APTIAN TO LATE NEOCOMIAN | Winning Group | | 38 | Claystone |
| | | | 2294 | | |
| EARLY JURASSIC | TOARCIAN | Legendre | | 472 | Sandstone, claystone |
| | | | 2766 | | |
| | PRE-TOARCIAN | Fm. | | 82 | Sandstone, claystone |
| | | | T.D. 2848 | | |

* Unit names have been interpreted from the ages and lithologies supplied by the Company.

| AGE | UNIT | BARROW DEEP NO. 1 Depth(m)K.B./Thickness(m) | | LITHOLOGY |
|---|---|---|---|---|
| TERTIARY (MIOCENE) | Trealla Limestone | 8 | 7? | Limestone, richly fossiliferous (forams, gastropods, and pelecypods), and sand |
| (EOCENE) | Giralia Calcarenite | 15 | 117 | Limestone, calcarenitic in part, sand and siltstone |
| (EOCENE) (TO PALAEOCENE) | Cardabia Group | 132 | 68 | Fossilferous calcilutite coarsening with depth to calcarenite |
| LATE CRETACEOUS (SANTONIAN-CAMPANIAN) | Toolonga Calcilutite | 200 | 68 | Chalk with minor beds of calcarenite grading to calcisiltite with depth, and limestone |

TABLE 6 (CONT.)

| AGE | UNIT | BARROW DEEP NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| (CENOMIAN-TURONIAN) | Upper Gearle Siltstone | 268 | 39 | Highly petroliferous sequence of glauconitic siltstone grading to mudstone with minor beds of calcarenite, calcisiltite, limestone, and chalk |
| MIDDLE CRETACEOUS (ALBIAN-CENOMANIAN) | Lower Gearle Siltstone | 307 | 298 | Highly petroliferous sequence of siltstone with minor beds of calcarenite, limestone and sandstone with siderite at depth |
| EARLY CRETACEOUS (ALBIAN & APTIAN) | Windalia Radiolarite | 605 | 12 | Siltstone with minor interlaminations of sandstone containing rare brown siderite |
| (APTIAN) | Muderong Shale Windalia Sand Member | 617 | 228 | Main oil-producing horizon of the Barrow I. field. Petroliferous sandstone at top underlain by shale |
| (APTIAN-NEOCOMIAN) | Muderong Greensand Member | 845 | 40 | Sandstone and greenstone glauconitic unit with calcite and dolomite cements, generally low permeability, light petroliferous odour |
| (NEOCOMIAN) | Barrow Group | 885 | 1100 | Deltaic sandstones ranging from fine to very coarse and conglomeritic, interbedded with shales and siltstones Hydrocarbons have been produced from 6 separate intervals but most of the reservoir sands are thin or discontinuous |
| LATE TO MIDDLE JURASSIC | Dingo Claystone | 1985 | 2665 | Hydrocarbon generative sequence of marine claystones, siltstone, and shale |
| | Dupuy Sand Member | 1985 | 192 | Thick sandy interval with beds of shale, siltstone, claystone, and carbonates |
| | | T.D. 4650 | | |

| AGE | UNIT | TAMALA NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| QUATERNARY (PLEISTOCENE) | Coastal Limestone | Surface(4) | 34+ | White fine to medium calcarenite with minor quartz sandstone |
| TERTIARY (PALAEOCENE) | Upper Cardabia Group | 38 | 122 | White to yellow glauconitic calcarenite with abundant fossil fragments and soft calcareous glauconitic mudstone |
| LATE CRETACEOUS (CAMPANIAN) (SANTONIAN) | Toolonga Calcilutite | 160 | 183 | Fossiliferous calcarenite, calcareous glauconitic mudstone, argillaceous calcilutite |
| EARLY CRETACEOUS (TURONIAN) | Winning Group Alinga Fm. | 343 | 16 | Calcareous shale, glauconitic mudstone, minor chert |
| (ALBIAN) | Windalia Radiolarite | 359 | 14 | Hard siliceous slightly calcareous shale, in part very glauconitic |
| (APTIAN) | Muderong Shale | 373 | 5 | Shale, brown to blue and hard, or light grey and fissile, with trace of brown chert |
| (APTIAN) | Birdrong Sandstone | 378 | 20 | Light grey sandstone and coarse-grained loose quartz |
| UNKNOWN (DEVONIAN?) | Unknown Fm. | 398 | 27 | Grey to orange to red-brown sandstone with calcareous cement, thin shale beds |
| SILURIAN (LLANDOVERIAN-LUDLOVIAN) | Dirk Hartog Fm. | 425 | 693 | Dolomite and limestone with interbedded siltstone and mudstone |
| SILURO-ORDOVICIAN (LLANDOVERIAN-ASHGILLIAN) | Tumblagooda Sandstone | 1118 | 107+ | Fine-grained white to red-brown sandstone with thin shale beds |
| | | T.D. 1225 | | |

TABLE 6 (CONT.)

| AGE | UNIT | KALBARRI NO. 1 Depth(m)K.B. | /Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| QUATERNARY (PLEISTOCENE) | Coastal Limestone | Surface(4) | 16+ | Surface sand grading into soft sandstone with calcareous cement; numerous crinoid fragments |
| LATE CRETACEOUS (CAMPANIAN) (SANTONIAN) | Toolonga Calcilutite | 20 | 104 | Sandstone, glauconitic calcareous mudstone, soft chalky calcilutite; briozoan fragments common |
| EARLY CRETACEOUS (APTIAN) | Winning Group (Birdrong Sandstone) | 124 | 58 | Grey sandstone, interbedded siltstone; some briozoan and shell fragments; glauconitic in basal parts |
| SILURIAN (LUDLOVIAN-LLANDOVERIAN) | Dirk Hartog Formation | 182 | 99 | Finely interbedded argillaceous dolomite and dolomitic shale, some sandstone beds. |
| SILURO-ORDOVICIAN (LLANDOVERIAN-ASHGILLIAN) | Tumblagooda Sandstone | 272 | 1268+ | Largely pink to red-brown sandstone with thin beds of shale, siltstone, and anhydrite |
| | | T.D. 1540 | | |

Goodwyn Nos 3 and 4 were drilled as appraisal wells on the Goodwyn structure. Goodwyn No. 4 is a potential gas-condensate producer, as are the first two wells drilled, but Goodwyn No. 3, which is fault-separated from the main structure, discovered both oil and gas. Angel No. 3 and Nelson Rocks No. 1 were drilled on other major structural trends in the sub-basin. Angel No. 3 - a gas-condensate discovery - was an appraisal well on the Angel structure located at the north-eastern end of the Madeleine-Dampier Trend. Nelson Rocks No. 1 was a dry well drilled at the northeastern end of the Rosemary-Legendre Trend.

The results of drill-stem testing, etc. are given in Table 6a.

Beagle Sub-basin

Poissonnier No. 1 was the only unsubsidized well drilled in this area. There were no reports of hydrocarbons.

## SUBSIDIZED GEOPHYSICS

### Onshore

The Norwegian 2 seismic survey was carried out on the west coast of the North West Cape. It was designed to investigate the onshore extension of a major northeast-trending structural high - the Norwegian Bay structure - mapped offshore, and to establish east dip on the structure. Incorporating previously shot data, two horizons were mapped: horizon A - base of Muderong Shale (base Cretaceous, i.e., Neocomian unconformity), and horizon B - near top Triassic. An isochron map of the A-B interval, i.e., the whole Jurassic sequence, was also presented. Data quality was good down to horizon A, but deteriorated to fair below it. The survey indicated the possibility of easterly dip onshore, but further work will be required to confirm it. This will involve the shooting of east-west lines in shallow water from as close to the shore as possible to tie existing onshore and offshore seismic lines.

The Murat seismic survey was carried out in the northern part of the North West Cape. It was designed to improve control on the onshore southwestern flanks of two northeast-trending fault-controlled anticlines (structures A and B) mapped previously offshore in Exmouth Gulf. The major structure (A) is centred to the northeast of Exmouth; it is controlled by two roughly parallel northeast-trending normal faults downthrown to the west: the Paterson Fault on

TABLE 6a: DRILL-STEM TESTS, DOCKRELL NO. 1, LAMBERT NO. 1, GOODWYN Nos 3 & 4, ANGEL NO. 3

| Well Name | bottom-hole choke | Surface choke | Interval (m) | Gas flow | Oil recovery b.p.d. | A.P.I. gravity | Condensate b.p.d. | Water b.p.d. |
|---|---|---|---|---|---|---|---|---|
| Angel No. 3 | $\frac{5}{8}$" | $\frac{1}{2}$" | 2739.5-2748 | 8.81 MMcfD | | | 282 | |
| Dockrell No. 1 | $\frac{3}{4}$" | $\frac{3}{8}$" (restricted) | 3004-3008.5 | 1.9 MMcfD | 1869 | | | |
| | $\frac{5}{8}$" | $\frac{3}{4}$" | 2987-2995 | 13.117 MMcfD | | 50.6° | 755 | 7.4 |
| Goodwyn No. 3 | $\frac{3}{4}$" | $\frac{1}{2}$" | 3015.1-3026 | 2.7 MMcfD | 2730 | 41.7° | | |
| | | | 2985.8-2993.7 | | | | | 2478 |
| | $\frac{3}{4}$" | $\frac{3}{4}$" | 2878.8-2891.3 | 17.262 MMcfD | | 59.9° | 1179 | |
| Goodwyn No. 4 | $\frac{3}{4}$" | $\frac{5}{8}$" | 2898-2898.6 | 10.85 MMcfD | | | 557 | |
| | | | 2855.9-2902.6 | 17.12 MMcfD | | | 825 | |
| Lambert No. 1 | | | 3101-3106 | 91 McfD | 374 | 51° | | 382 |

the eastern flank, and the Cape Range Fault on the western flank. Structure B is a smaller anticline located 20 km to the south of A, and is also controlled by the Paterson and Cape Range Faults. Prospective Lower Jurassic to Cretaceous sediments are believed to occur at drillable depths on the two structures. The Murat survey produced data ranging in quality from fair to good but deteriorating with depth. About 38 km of earlier data was reprocessed and used in the interpretation. The horizons mapped were: horizon A - near base Tertiary; horizon B - near Muderong Shale (Cretaceous); and horizon C - near top Triassic?. Isochron maps of the intervals A-B and B-C were also submitted.

The new data confirmed closure to the southwest of structures A and B, and provided further definition of the Cape Range and associated faults. A new closure, structure C, was outlined. The reprocessed data was not sufficiently improved to provide any additional information on the deep section.

The Barrow 3 (363) seismic survey consisted of one, roughly north-south-trending line along the axis of the anticline that constitutes Barrow Island. It was designed to provide structural information that would enable possible follow-up wells to Barrow Deep No. 1 (see under 'Subsidized Drilling', 'Onshore', 'Barrow Sub-basin') to be located. Barrow Deep No. 1 was located on the highest culmination of the anticline. The Vibroseis energy source used resulted in some improvement in data quality, which, however, still only ranged from poor at the extremities of the line to fair in the centre over the more elevated interior of the island. Previously recorded data was incorporated to provide maps on two horizon: horizon A - near base Dupuy Formation (Upper Jurassic); and horizon B - Middle Jurassic seismic reflector; an isopach map of the interval between them was prepared. Improved structural definition was obtained, and five fault-controlled closures were defined, in addition to that tested by Barrow Deep No. 1.

## Offshore

### Dampier and Beagle Sub-basins

The De Grey Nose marine seismic survey was designed to further examine the stratigraphic trap potential along the southeastern (inshore) margins of the Dampier and Beagle Sub-basins. It was carried out in two adjacent project areas near the De-Grey Nose, a northwest-trending basement high at the western end of the Pilbara Shelf that effectively separates the Dampier and Beagle Sub-basins. Project 73-D comprised 199 line-km in the Dampier Sub-basin, and 73-F 179 line-km in the Beagle Sub-basin. The quality of the data obtained from the sequence over shallow-basement was fairly good, but deteriorated to the northwest, where basement plunges rapidly to the northwest along a northeast-trending hingeline.

Four horizons were mapped: horizon X - near base Tertiary; horizon F - intra-Cretaceous (near Albian/Aptian boundary); horizon Y - near base Cretaceous; and horizon B - top basement. Stratigraphic control was provided by Hauy No. 1 (BMR file, 72/3186) and De Grey No. 1 (BMR file, 71/616), drilled on the Pilbara Shelf and De Grey Nose respectively, and Cossigny No. 1 (BMR file, 72/3036), drilled in the Beagle Sub-basin (horizon X only). Isochron maps of the intervals between horizons F and Y, and horizons F and B, were also produced. The contours show the sedimentary sequence overlying shallow basement in the southeast and thickening rapidly across the northeast-trending hingeline which is strongly faulted. The Tertiary and Cretaceous sediments pinch out against shallow basement in the shelf area, and Jurassic and Cretaceous sediments are thought to subcrop over deeper basement below the base Cretaceous unconformity (horizon Y), although data quality is too poor for good definition of these offlap relations. The survey showed that the closure on the Hauy prospect, mapped on horizon F, is smaller than mapped in earlier surveys, and that Hauy No. 1 was not drilled within it. The Forestier prospect indicated by earlier surveys was detailed but not considered worth further investigation at present. A large structural/stratigraphic trap was indicated in the far northeast of the 73-F project area, and recommended for further investigation.

The Steamboat Spit seismic survey (BMR file, 72/3253) comprised two projects, 73-B and 73-C, in the Dampier Sub-basin, and one project, 73-E, in the Beagle Sub-basin.

Project 73-B, Angel: The project was designed to define further drill sites on the Angel structure - a large fault-controlled anticline at the northeastern extremity of the Madeleine-Dampier anticlinal trend. Four horizons were mapped: horizon X - near base Tertiary; horizon D - near top Toolonga Calcilutite (Cretaceous); horizon Y - near intra - Neocomian unconformity; and horizon 'Deep Form' (roughly Upper Jurassic in the Angel area). An isochron map of the X-D interval was also prepared. The project provided clarification of the complex faulting in the Angel field. A structural trap to the south of those tested by Angel Nos 1 and 2 (BMR file, 71/617 and 72/857) was detailed and tested by Angel No. 3 (see under 'Unsubsidized

Drilling', 'Offshore', 'Dampier Sub-basin'). A new potential trap named the Pueblo structure was detailed on the northwest flank of the Angel field and is considered to be a drillable prospect.

Project 73-C, Dampier: The project was primarily an investigation of possible structural leads in Early Cretaceous and older strata lying mainly to the south of the Rankin Platform. A secondary objective was to gain a more detailed knowledge of the Legendre anticlinal trend to the northeast of Legendre Nos 1 and 2 (BMR files, 68/2016 and 70/769). The horizons mapped were those mapped in Project 73-B.

Horizon X is a strong and continuous reflector to the north and south of the Rankin Platform, but generally weak and lacking continuity over the structurally high fault blocks on the platform. The map shows a series of gentle depressions paralleling the northwest margin of the Rankin Platform. At its southwestern end a structural depression known as the Kendrew Trough parallels the southern margin of the Rankin fault block and the eastern margin of the Goodwyn Fault block. The horizon shows regional northwest dip and no faulting to the south of the Rankin Platform. Horizon D is also a strong seismic event over most of the area. It is weaker to the northwest of the Rankin Platform possibly owing to thinning of the Toolonga Calcilutite. On the south-eastern side of the platform the horizon shows a regional northwesterly dip, and terracing and occasional dip reversal over the Madeleine-Dampier anticlinal trend. The map shows structural closure on the Legendre anticlinal trend to the northeast of Legendre No. 2. Horizons Y and 'Deep Form' are mapped on poor quality data. On horizon Y the Madeleine-Dampier anticlinal trend is delineated by a series of closed structural highs. The northwestern flank is cut by a series of north-easterly and east-northeasterly trending faults which also affect the Kendrew Trough. The Lewis Trough which parallels the Madeleine-Dampier Trend on its southeastern flank appears as a major feature on this horizon. The closures are mapped on the Legendre Trend, the largest lying immediately to the northeast of Legendre No. 2. The 'Deep Form' horizon is related to a major unconformity inshore of the Rankin Platfrom which is dated as intra-Callovian (Late Jurassic) in Madeleine No. 1 and Dampier No. 1. The Rankin Platform, Kendrew Trough, Madeleine-Dampier Trend, Lewis Trough, and Legendre Trend are all evident on this horizon. The project has further delineated the Montebello, Steamboat, South Rankin, Bank, and Nelson Rocks structures. Nelson Rocks at the northeastern end of the Legendre Trend was defined as a drillable prospect.

Project 73-E, Outer Beagle area: The objective of this project was to provide reconnaissance coverage of the deeper-water areas of the Beagle Trough. Again the horizons mapped are X, D, Y, and 'Deep Form'. Data quality was improved, and a generally reliable structural outline of the area was obtained. A number of structures have been detailed, but only one, Depuch, to drillable status.

## CLARENCE-MORETON BASIN

The only petroleum exploration activity was the drilling of Hogarth No. 4, on appraisal well in the Hogarth gas field. The first two wells in the field had good gas shows in the Triassic-Jurassic Marburg Formation. Hogarth No. 4 was completed in June 1974. Information released to the press states that the drilling has confirmed the extension of the Hogarth gas field. Electric log analysis has indicated a greater thickness of producing sands than the first two wells. Plans to supply gas from Hogarth No. 2 to the Dairy Co-operative in Casino were announced in 1973.

## COOPER BASIN

One subsidized seismic survey was carried out, and three subsidized wells drilled in 1973 (Table 7). All the wells were hydrocarbon discoveries.

### SUBSIDIZED DRILLING

Kanowana No. 1 was drilled in the South Australian part of the Cooper Basin. It was located on a small seismically defined anticline in the Patchawarra Trough - a regional low lying to the northwest of the prominent northeast-trending Gidgealpa-Merrimelia-Innaminka-high trend. The Kanowana structure has a vertical closure of about 600 m and an area of about 5 $km^2$ at the Patchawarra Formation coal marker horizon. Hydrocarbon shows were numerous throughout the Patchawarra Formation and the well has been completed as a potential gas/condensate producer. Production is possible from several sandstone beds within the Patchawarra Formation.

Stratigraphically the well is typical of wells drilled in the Patchawarra Trough. Dipmeter plots suggest that the bulk of the Permian sediments were deposited by southerly and

TABLE 7 : STRATIGRAPHIC TABLE, COOPER BASIN

| AGE | UNIT | KANOWANA NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| RECENT-TERTIARY | Unnamed | Surface | | Sand and clay |
| LATE CRETACEOUS | Winton Fm. | - | 1675 | Claystone, some coal, minor siltstone, sandstone, and quartz grains |
| EARLY CRETACEOUS | *Tambo-Roma Fm. | - | | Claystone/shale, minor coal, subordinate siltstone and sandstone |
| | *Transition Zone | 1680 | 62 | Fine sandstone, siltstone, shale |
| LATE JURASSIC | *Mooga Mb. | 1742 | 289 | Sandstone with subordinate shale and siltstone |
| LATE-MID-JURASSIC | Birkhead Fm. | 2031 | 72 | Sandstone, siltstone, shale |
| MID-EARLY JURASSIC | Hutton Sandstone | 2103 | 236 | Sandstone, minor siltstone and shale, rare coal |
| EARLY TRIASSIC | Nappamerri Fm. | 2339 | 203 | Sandstone, siltstone, minor shale |
| | Gidgealpa Gp | | | Sandstone, carbonaceous shale and siltstone, coal |
| LATE-EARLY PERMIAN | Toolachee Fm. | 2542 | 117 | |
| | Epsilon Fm. | ? | | |
| EARLY PERMIAN | Murteree Fm. | 2659 | 21 | Shale |
| | Patchawarra Fm. | 2680 | 379 | |
| | 'Coal Marker' | 2865 | | |
| | Tirrawarra Fm. | 3059 | 31 | Sandstone, minor conglomerate and shale |
| | Merrimelia Fm. | 3090 | 31+ | Hard siltstone, fine tight sandstone |
| | | T.D. 3121 | | |

*Company usage

| AGE | UNIT | DURHAM DOWNS NO. 1 Depth(m)K.B. | Thickness (m) | LITHOLOGY |
|---|---|---|---|---|
| LATE TO EARLY CRETACEOUS | Winton Fm. | Surface | 783 | Sandstone, minor mudstone, coal |
| EARLY CRETACEOUS | *Tambo Fm. | 788 | 260 | Mudstone, minor sandstone |
| | *Toolebuc Limestone | 1048 | 58 | Shale, fossil fragments, coal |
| | *Roma Fm. | 1106 | 324 | Shale, minor sandstone |
| EARLY CRETACEOUS TO LATE JURASSIC | *Transition Beds | 1430 | 96 | Shale, siltstone, ferruginous sandstone |
| LATE JURASSIC | *Mooga Mb. | 1526 | 147 | Sandstone, minor shale |
| | Westbourne Fm. | 1673 | 127 | Sandstone, siltstone, shale |
| | Adori Sandstone | 1800 | 33 | Sandstone |
| LATE TO MIDDLE JURASSIC | Birkhead Fm. | 1833 | 63 | Shale, siltstone, minor sandstone |
| MIDDLE TO EARLY JURASSIC | Hutton Sandstone | 1896 | 249 | Sandstone, minor shale |
| EARLY TO MIDDLE TRIASSIC | Nappamerri Fm. | 2145 | 327 | Siltstone, sandstone, shale |
| LATE PERMIAN | Toolachee Fm. | 2472 | 100 | Shale, sandstone, coal |
| | 'P' Horizon | 2482 | - | Coal |
| EARLY PERMIAN | Patchawarra Fm. | 2572 | 59 | Sandstone, siltstone, shale, coal, |
| | Undifferentiated Lower Permian | 2631 | 53 | Sandstone, shale, minor coal |
| LATE CARBONIFEROUS TO EARLY PERMIAN | Merrimelia Fm. | 2684 | 20 | Sandstone, shale |
| ORDOVICIAN | Unnamed Basement | 2704 | 38 + (logs) | Metamorphosed shale |
| | | T.D. 2750 | | |

*Company usage

| AGE | | UNIT | WOLGOLLA NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|---|
| QUATERNARY, TERTIARY, & LATE TO EARLY CRETACEOUS | | *Undifferentiated Recent to Roma Fm. inclusive | Surface | 1216 | Mudstone, shale, siltstone, sandstone, minor coal |
| EARLY CRETACEOUS TO LATE JURASSIC | | *Transition Beds | 1220 | 79 | Sandstone, shale |
| LATE JURASSIC | | *Mooga Mb. | 1299 | 274 | Sandstone, siltstone, shale |
| LATE TO MIDDLE JURASSIC | | Birkhead Fm. | 1573 | 21 | Shale, siltstone, coal |
| MIDDLE TO EARLY JURASSIC | | Hutton Sandstone | 1594 | 55 | Sandstone, shale |
| MIDDLE TO EARLY TRIASSIC | | Nappamerri Fm. | 1649 | 68 | Shale, siltstone, sandstone |
| LATE PERMIAN | | Toolachee Fm. | 1717 | 150 | Sandstone, siltstone, shale coal |
| | | 'P' Horizon | 1732 | | |
| EARLY PERMIAN | Gidgealpa Gp. | Daralingie Beds | 1867 | 10 | Shale, siltstone, sandstone, coal |
| | | Roseneath Shale | 1877 | 57 | Shale |
| | | Epsilon Fm. | 1934 | 36 | Siltstone, shale, minor sandstone, coal |
| | | Murteree Shale | 1970 | 30 | Shale |
| | | Patchawarra Fm. | 2000 | 20 | Sandstone, shale, minor coal |
| PRE-PERMIAN | | Granitic Basement | 2020 | 40+ | Granite |
| | | | T.D. 2060 | | |

* Company usage

TABLE 8: DRILL-STEM TESTS, KANOWANA NO. 1, DURHAM DOWNS NO. 1, WOLGOLLA NO. 1

| Well Name | bottom-hole choke | surface choke | interval (m) | gas flow MMcfD | condensate |
|---|---|---|---|---|---|
| Kanowana No. 1 | | 7/16" | 2794 - 2850 | 8.5 | 140' water and 60' 40° A.P.I. condensate |
| Durham Downs No. 1 | | | 2501 - 2530 | 89.0 | |
| | | | 2534 - 2574 | 2.94 | 5' condensate and 508' gas cut watery mud |
| Wolgolla No. 1 | | 7/16" | 2012 - 2040 | 1.9 | |

southwesterly flowing streams. In the absence of the Roseneath Shale, which separates the Toolachee and Epsilon Formations in many Cooper Basin wells, the boundary between these two lithologically similar formations cannot be determined until palynological data are available.

Durham Downs No. 1 was a gas discovery drilled in Queensland in the northeastern part of the Cooper Basin. The drilling has shown the similarity between the Permian sequence in this part of the basin and that in the South Australian part to the southwest, where the majority of the hydrocarbon discoveries to date have been made. The identification in the Durham Downs area of the Toolachee Formation, which has generally the best porosity, permeability, and production figures in the South Australian fields, and the fact that it is hydrocarbon-bearing has greatly upgraded the prospectiveness of the northeastern part of the basin. Detailed sampling of the Toolebuc Limestone equivalent has provided control at a great distance from outcrop. No distinct limestone facies is developed.

Wolgolla No. 1, also drilled in Queensland, was a gas discovery located about 140 km south-southwest of Durham Downs No. 1. The Wolgolla anticline is a basement high draped by Permian sediments which thin over it. The greatest thinning is in the Patchawarra Formation, and the gas reservoir is in the basal sandstone. The thin Patchawarra Formation is correlated with the upper water-filled part of this formation in Roseneath No. 1 (BMR file 69/2036), about 8 km to the north-northwest. In the Roseneath well the lower unit is gas-producing and is believed to pinch out on the flanks of both the Roseneath and Wolgolla structures, and is predicted to be present, and gas-filled, immediately down-dip from Wolgolla No. 1.

## SUBSIDIZED GEOPHYSICS

The Mudlankie seismic survey was carried out over a large area in the southeastern part of the Cooper Basin in South Australia. Previous work in the area had indicated that to obtain good-quality data particularly from below the 'P' (top Permian) horizon, it was necessary to use digital recording and processing with a high percentage of multiplicity, and that Vibroseis was the most effective energy source. The program was carried out in six separate areas using these techniques. The results in the various areas will be dealt with separately but in general it can be said that the quality of the data obtained was mainly good, and superior to that obtained in earlier surveys. Some earlier data were incorporated into the interpretation. Three horizons were contoured in depth: horizon C - 'Transition Beds' (Lower Cretaceous); horizon P - first coal at or near top of Permian Gidgealpa Group; and horizon Y - near the base of the Gidgealpa Group. Isopach maps of the C-P and P-Y interval were also presented. Horizon C and P are strong continuous horizons over most of the survey area, but horizon Y becomes very poor and discontinuous in places.

Patchawarra East: Located in the northern part of the survey area, the program was designed to provide control where seismic coverage was sparse, and define possible closed structures revealed by previous surveys. Three relatively low relief structures lying to the northwest of the axis of the Patchawarra Trough were detailed, one of which, the Beantree Prospect, showed 15 m of vertical closure over ½ $km^2$ on the P horizon, the closure increasing with depth. Drilling of the Beantree Prospect was recommended to provide control for the identification of seismic reflections below horizon P.

Merinna (Merrimelia - Innamincka): An area to the northeast of the Gidgealpa gas field. Part of the program located in the northeastern part of the Merinna area was designed to define the edge of the Permian section on the Packsaddle anticline and provide information on possible fault traps on the flanks. The rest of the program, over the southwestern part of the Merinna area was designed to delineate a small structure (Swan Lake) on the flank of the Gidgealpa-Merrimelia anticlinal trend. The survey clarified Permian stratigraphy over the Packsaddle anticline. The Permian sequence on the northwestern flank of the northeast-trending structure terminates against a major fault. On the southwest flank, a more gradual thinning of the Permian is caused mainly by the truncation of older sediments by younger. The survey has therefore demonstrated the structures potential for combination structural/stratigraphic traps particularly on the southeast flank. The Swan Lake Prospect was shown to have an areal closure of only about 1 $km^2$ at the level of horizon Y.

Namur (Nappacoongee - Murteree): Located in the central eastern part of the survey area, the program had a number of objectives related to the Nappacoongee-Murteree anticlinal trend. In the Nappacoongee area the program investigated the thickness of the Permian sequence over the crest of the anticline. One of the objectives was to determine whether the anticline covers sufficient area to justify the drilling of a well updip from Nappacoongee No. 1 (BMR file, 65/4172). The northeasterly extent of the anticlinal trend was also investigated. Three possible closures mapped by previous surveys, one to the northwest of Nappacoongee and two between the Big Lake and Della gas fields at the southeastern end of the trend, were detailed. The survey achieved a great improvement in data quality on the Nappacoongee anticline where a high proportion of earlier records were unusable. The data did not justify the drilling of a well on the crest, but further high-quality seismic work is considered justifiable on the flank of the structure to provide more stratigraphic and structural definition.

Patchawarra Central: The program was designed as a further investigation of the Permian sequence towards the northwestern margin of the basin. Two previously mapped possible closures west of the Tirrawarra field were further investigated, and one line on the southwestern flank of the Tirrawarra structure was programmed to provide control northwest of Tirrawarra No. 2 (unsubsidized, 1971) on possible faulting and its relation to hydrocarbon accumulation in the Tirrawarra and Patchawarra Formations (Gidgealpa Group). The line on the southwestern flank of the Tirrawarra structure provided good-quality data from the base of the Gidgealpa Group, but indicated that additional lines would be of value to further define the relation between the faulting and the Patchawarra and Tirrawarra Formations. The survey has indicated that further work will be required to define the pinch-out of the Permian sequence on the northwest margin of the basin. The two closures west of the Tirrawarra structure will also require further definition to establish the extent of areal and vertical closure.

Moomba: The new data have provided much better information on the lower part of the Gidgealpa Group than previously obtained from single-fold data. However, since the Group thickens rapidly into the structural lows, and the present well control is restricted to structural highs, good stratigraphic control depends on the drilling of a well down the flank of the Moomba structure. A program of five lines was carried out on the northwestern and western flanks of the Moomba gas field primarily to increase the previous sparse control for the definition of the productive limits of the field.

Burke-Dullingari: A program was carried out to provide further definition of the Burke and Dullingari structures located to the southeast of Nappacoongee. The Vibroseis data has considerably improved the reliability of the reflections from the lower part of the Gidgealpa Group, and indicated the value of further utilization of the technique on the two structures.

## EROMANGA BASIN

### SUBSIDIZED DRILLING

Ban Ban No. 1 was located in the Longreach area, where the structural features are an east-west-trending basement high (Yaraka Shelf) and the northern extremity of the Cannaway Fault, which is here represented by a series of step faults downthrown to the west. The well was drilled on one of the fault blocks about 12 km east of Stormhill No. 1 (BMR file 69/2007) on an adjacent block. Stormhill No. 1 encountered 20 m of presumed Permian rocks under a normal Eromanga Basin sequence, before entering basement. Ban Ban No. 1 penetrated a similar Eromanga Basin sequence (Table 9) underlain by 55 m of coarse-grained sandstone with minor interbedded shale interpreted as presumed Permian, before entering low-grade metamorphic basement rocks. No palaeontological evidence was presented to support a Permian age for the coarse-grained sandstone. A minor gas show was recorded at the top of this sandstone sequence, but only fresh water was recovered on drill-stem testing.

### UNSUBSIDIZED DRILLING

One well, Manfred No. 1 was drilled (see Table 18). There were no reports of hydrocarbon.

## EUCLA BASIN

The Scorpion Bight gravity and seismic refraction survey was carried out in 1973. There was no drilling activity.

The objective of the geophysical survey was to delineate the onshore extension of one of a number of north-east-trending troughs mapped offshore by previous seismic work. The trough, 8 km wide and about 1980 m deep was mapped near Scorpion Bight by the Offshore Eyre seismic survey (71/34). The Scorpion Bight Survey was designed to determine the possible nature of the sediments within the trough from refraction velocities with the object of locating an onshore stratigraphic test well.

The gravity data show a Bouguer anomaly low of about 10 mGal about 16 km wide extending inland northeasterly for about 32 km where its width is reduced to about 8 km. The refraction data show a high velocity layer of about 5640-7000 m/s interpreted as basement in a trough that coincides with the gravity

TABLE 9 : STRATIGRAPHIC TABLE, BAN BAN NO. 1

| AGE | UNIT | Depth(m)K.B./Thickness(m) | | LITHOLOGY |
|---|---|---|---|---|
| | Rolling Downs Gp | | | |
| LATE TO EARLY CRETACEOUS | Winton Fm. | Surface | 122 | Sandstone, siltstone, and mudstone |
| EARLY CRETACEOUS | Mackunda Fm. | 122 | 72 | Sandstone, siltstone, and mudstone |
| | Allaru Mudstone | 194 | 335 | " " " |
| | Toolebuc Limestone | 529 | 32 | Limestone and shale |
| | Wallumbilla Fm. | 561 | 200 | Shale |
| EARLY CRETACEOUS TO LATE JURASSIC | Hooray Sandstone | 761 | 211 | Sandstone and shale |
| | Injune Creek Gp. | | | |
| LATE JURASSIC | Westbourne Fm. | 972 | 64 | Shale and siltstone |
| | Adori Sandstone | 1036 | 41 | Sandstone and shale |
| MIDDLE JURASSIC | Birkhead Fm. | 1077 | 80 | Shale and siltstone |
| EARLY JURASSIC | Hutton Sandstone | 1157 | 150 | Sandstone |
| PERMIAN? | Unnamed | 1307 | 55 | Sandstone and shale |
| UNKNOWN | Basement | 1362 T.D. 1378 | 16+ | Phyllite |

low and is estimated to have a maximum depth of about 1830 m. The trough is an onshore extension of the offshore trough mapped in the Offshore Eyre seismic survey. A low velocity layer (3960 - 4570 m/s) at about 900 m is interpreted as a thin lava flow.

## GALILEE BASIN

There was no drilling activity in 1973. A subsidized seismic survey was carried out, and the results of a survey completed late in 1972 released.

The Belyando seismic survey (BMR file, 72/2935) was located in central-western Queensland near the eastern margin of the Galilee Basin. Lake Galilee No. 1 (BMR file, 64/4074), which produced 3 m of 45$^{o}$ API gravity oil from the base of the Permian and Triassic Galilee Basin sequence, was drilled 24 km to the west of the permit area (ATP 194P). Palynological evidence indicates that the pre-Permian sequence is contemporaneous with the Adavale Basin sequence (pre-Famennian Devonian) to the southwest, and not with the Famennian and Lower Carboniferous sequence in the Drummond Basin which crops out in the eastern part of the survey area. This fact greatly enhances the petroleum prospectivity of the area in view of the proved hydrocarbon potential of the Adavale Basin (Gilmore gas field).

The Belyando survey was designed to confirm and extend the information provided by the Galilee Basin seismic and gravity survey carried out by BMR in 1971 (Harrison, Anfiloff & Moss, 1975), which indicated a zone of faulting or intense folding at the margin between the Galilee and Drummond Basins and established the presence of a thick Permian sequence to the west of it. This zone, which in the survey area follows a roughly north-south stretch of the Belyando River, has been named the Belyando Feature (Vine, 1972) and has been interpreted as a major basement fracture zone.

Fair to good-quality data were produced by the Belyando survey. Four horizons were mapped: horizon P - top of Permian coal measures; top of Upper Devonian sequence?; top of Lower Devonian sequence?; and base of Lower Devonian sequence?. Isochron maps of the Upper Devonian and Lower Devonian sequences were also produced. Data from the BMR survey are incorporated in the interpretation. The results show that the Galilee Basin sequence thins and shallows rapidly to the east and appears to extend as far as the

Belyando Feature. The seismic sections suggest that the Drummond Basin sequence does not extend west of the feature. Tie to Lake Galilee No. 1 indicates that the thick (> 3000 m) pre-Permian sequence underlying the Galilee Basin to the west of the Belyando Feature is correlatable with the Adavale Basin sequence and is consequently an attractive petroleum prospect, particularly as there is evidence of possible structural traps and of possible reef development within this sequence. Further seismic work was recommended.

The Wokingham Creek seismic survey was located in an area which lies to the west and north of the town of Winton in central Queensland. Previous geophysical work and one well, Lovelle Downs No. 1 (BMR file, 72/2669), had defined a western sub-basin of the Galilee Basin on the northwestern, downthrown side of the Cork Fault. The aim of the Wokingham Creek survey was to provide increased seismic control in the sub-basin, by providing reconnaissance coverage from the centre to the northern margin, and detailed coverage of the structure mapped by previous surveys in an area about 16 km to the north of Lovelle Downs No. 1. The reconnaissance work included a tie-line to the Corfield No. 1 well (BMR file, 62/1207), located 100 km northeast of Lovelle Downs No. 1.

Three horizons were contoured: orange horizon - near top Jurassic; blue horizon - top Permian; and purple horizon - basement. The detailed work north of Lovelle Downs No. 1 has defined a large low-relief symmetrical anticline considered to have formed by the draping of Galilee Basin and Eromanga Basin sediments over a Palaeozoic basement high. Southerly, easterly, and westerly dips are well defined at the Permian level, but northerly dip needs confirmation. The regional reconnaissance lines to the north have indicated two possible structural leads in the Wetherby-Corfield area which are considered worthy of further detailing.

HARRISON, P.L., ANFILOFF, W., & MOSS, F.J., 1975 - Galilee Basin seismic and gravity survey, 1971. Bur. Miner. Resour. Aust. Rep. 177.

VINE, R.R., 1972 - Relationship between the Adavale and Drummond Basins. APEA J., 12(1), 58-61.

## GEORGINA BASIN

The only petroleum exploration activity was the drilling of the subsidized well Ethabuka No. 1. The well was suspended in December because of flooding. Drilling was resumed in September 1974 and the well was plugged and abandoned prematurely at 1960 m, before the target horizons were intersected. This resulted from an unsuccessful attempt to deviate the well after the failure of a fishing operation.

## GIPPSLAND BASIN

Two subsidized and eight unsubsidized wells were drilled, all offshore. One marine seismic survey was completed.

### SUBSIDIZED DRILLING

The results of two 1972 offshore wells released after 31 July 1973 are included in this section (Table 10).

Marlin No. A-24 and Marlin No. 4 were drilled on the Marlin structure to investigate the hydrocarbon potential of the Palaeocene part of the Latrobe Group. The Marlin gas field produces from sandstone reservoirs of Eocene age at the top of the group.

The Marlin structure is a southwest-trending anticline intersected by major west-northwest-trending faults. Mapped at the level of the Palaeocene sands it consists of four distinct fault blocks denoted from northeast to southwest 'A', 'B', 'C', and 'D'. The exploration well Marlin 1 (BMR file 65/4183) and the development well Marlin A-6 (drilled 1972) found hydrocarbons in the Palaeocene in the 'C' block.

Marlin No. A-24 was drilled in the 'D' block, south of the Marlin A platform, as a directional well from the platform, at an average angle of $40^{\circ}$ 30'. It was a combination development and exploration well. Only the exploratory part - below 1968 m (M.D., K.B.) - was subsidized, and on completion the well was plugged back to 1817 m M.D. as a shallower pool gas producer.

The exploratory drilling established the presence of gas and oil in the 'D' fault block. The net thickness of gas sands is estimated as 77 m (T.V.D.) in fifteen zones between 216 m and 2507 m (T.V.D., b.s.l.). A 1.5 m gas cap and 16 m (T.V.D.) of net oil sand was encountered between 2674 and 2679 m (T.V.D., b.s.l.). The gas sand at 2161 m was not present in other wells drilled in the Marlin structure. Both the A-6 oil sand and the A-6 gas sand were 72 m and 119 m higher respectively than predicted from the seismic data. Further detailed study of the data has shown an essentially unchanged fault pattern, but has indicated that the well was drilled on a local closure that does not show on the seismic lines, which pass between 1 km and 2 km from the well.

Marlin No. 4 was drilled about 4 km east of the Marlin A Platform in the 'B' fault block. It encountered one major and four minor gas-bearing sandstone intervals giving a total net thickness of 16 m; 12 m lie within the gross interval 2371 m and 2391 m, and the balance is distributed between the remaining minor sandstone horizons. No gas/water contacts were observed, and no oil-bearing sands intersected.

The well penetrated the Marlin Channel, a submarine canyon of late Eocene age first penetrated in 1969 by Turrum No. 1 after which the Turrum Formation is named.

The Palaeocene part of the Latrobe Group that is in the Marlin structure is designated the Turrum field. Each fault block contains hydrocarbon-bearing sands at different depths. The current interpretation of the field is that there is no communication between reservoirs in adjoining blocks.

Cobia No. 1 (BMR file 72/2703) was located to the west of the Mackerel field and to the southwest of the Halibut field to test a low-relief anticline mapped on the seismic horizon at the top of the Latrobe Group. No closure was indicated on the isochron map, but a depth map, prepared by the use of interpreted average velocities to the seismic horizon, indicated a closed anticline with about 35 m of relief.

The well had to be drilled about 9 m downdip on the western flank of the structure because the crest of the anticline is directly below the Kingfish-Halibut oil pipeline. The sequence was as anticipated (Table 10) except for the intersection of the Gurnard Formation at the top of the Latrobe Group. The formation was previously unknown in the immediate area, but is widespread elsewhere in the basin, most commonly on the flanks of structures and in topographic lows. In Cobia No.1, palynological and palaeontological evidence indicates an early Oligocene age for the Gurnard Formation.
The well discovered a gross oil column in the top of the Latrobe Group extending for 23 m from the base of the Gurnard Formation to the oil-water contact.

A net effective reservoir of 5.5 m plus another 4.9 m of possible net effective reservoir are estimated. The sands do not appear to be continuous with those in either the Halibut or Mackerel fields. The commercial potential of the Cobia structure is seriously downgraded by the thin effective oil column and its apparent small areal extent. Any further drilling will depend on the results of additional velocity analyses and seismic interpretation.

Morwong No. 1 (72/3225) was drilled to test a combined structural stratigraphic trap against the eastern side of the Marlin Channel between the Marlin and Tuna fields. The channel cuts the northeasterly-plunging nose of the Marlin anticline. The trap is formed by the truncation of the Palaeocene and Eocene sediments of the Latrobe Group by the impermeable shale and marl infilling the channel. The well was located on the same fault block as Turrum No. 1 (unsubsidized 1969), and so that it might test the downdip limits of the gas reservoir in that well.

The sequence penetrated (Table 10) was as predicted to the top of the Latrobe Group, which was intersected 55 m deeper than predicted from seismic data. Palynological evidence indicates that it consists of Palaeocene sediments overlain by thin, eroded lower Eocene sediments. Although good reservoir sands were present in the Latrobe Group, no hydrocarbons were indicated. Neither the sands nor the coals could be correlated with those in Turrum 1.

## UNSUBSIDIZED DRILLING

With the exception of Sole No. 1 drilled by Shell, all the drilling was by the ESSO/BHP partnership.

The Mackerel field was declared commercial after the drilling of Mackerel No. 4, with an estimated 200 million barrels of economically recoverable oil. The field is expected to be in production by 1976.

Kingfish No. 4 was drilled in the Kingfish oil field which has been in production since 1971. The well was said to have confirmed the structural and stratigraphic predictions for the western part of the field.

TABLE 10: STRATIGRAPHIC TABLES, GIPPSLAND BASIN

MARLIN No. A-24

| AGE | UNIT | Depth(m) K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| EOCENE | Latrobe Gp | 1582 MD<br>1393 TVD | 590 | Interbedded pyritic siltstone and carbonaceous shale, scattered interbeds of sandstone, coal beds |
| PALAEOCENE | | 2368 MD<br>1983 TVD | 743+ | 2368-2624 m: Interbedded carbonaceous siltstone and fine-grained sandstone, minor shale and coal beds<br>2624-3310m: Interbedded carbonaceous shale and siltstone and sandstone, numerous coal beds; sands are gas-bearing to 3173 m, oil-bearing from 3310 to 3234 m, and water-bearing below that<br>3310-3349m: Interbedded micaceous pyritic siltstone and silty clay-choked tight sandstone |
| | | 3354 TD.<br>2727 TVD | | |

MD - measured depth

TVD - True vertical depth

MARLIN No. 4

| AGE | UNIT | Depth(m) K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| | Water Depth | 71 | | |
| MIOCENE | Gippsland Fm.<br>Mid-Miocene Marker | 1602 | | Fossiliferous calcarenite, marl, and mudstone to the top of the Latrobe Group |
| | Lakes Entrance Fm. | 1643 | 180 | |
| EOCENE | Latrobe Gp.<br>Turrum Fm. | 1823 | 67 | Pyritic shales and siltstones |
| | Latrobe coarse clastics | 1890 | 732+ | Interbedded sandstones, shales and coals to total depth; 12 m of net gas sand between 2371 and 2391 m and an additional 4 m of net gas sand in three horizons between 2197 and 2303 m; no oil-bearing sands encountered |
| PALAEOCENE | Turrum 'Gas Sand' | 2258 | | |
| | Marlin A-6 'Oil Sand' | 2496 | | |
| | | T.D.<br>2622 | | |

COBIA No. 1

| AGE | UNIT | Depth(m) K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| | SEA LEVEL | 10 | | |
| PLIO-PLEISTOCENE | SEA FLOOR | 83 | 152 Appr. | |
| MIOCENE | Gippsland Fm. | ? | 2000 Appr | 259 - 866m: Limestone, grey and brown, loosely consolidated<br>866-1817 m: Marl, grey-white, fossiliferous, trace glauconite and pyrite<br>1817-2232 m: Marl and shale, grey calcareous, fossiliferous, traces of pyrite and glauconite |
| OLIGOCENE | Lakes Entrance Fm. | 2232 | 150 | 2232-2341 m: Shale, grey, bentonitic, trace pyrite, and marl<br>2341-2382 m: Shale, grey micaceous, fossiliferous, very glauconitic at base |
| | Latrobe Group<br>Gurnard Fm. | 2382 | 212+ | 2382-2385 m: Siltstone, green, argillaceous, with abundant glauconite and pyrite |

ABLE 10 (CONT.)

| AGE | UNIT | COBIA No. 1 Depth(m) K.B. | /Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| EOCENE PALAEOCENE | Undifferentiated Latrobe Gp. | 2425 | 169+ | 2385–2594m: Shale, grey, silty; siltstone, tan, very glauconitic; sandstone, white to tan, occasionally glauconitic and pyritic in part; coal, minor interbeds, brittle |
| | | T.D. 2594 | | |

| AGE | UNIT | MORWONG No. 1 Depth(m) K.B. | /Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| | | 10 (sea level) | 63 | Water |
| RECENT-MIOCENE | Gippsland Fm. | 73 | 1570 | Calcarenite, marl, mudstone, and shale beds |
| MID-MIOCENE | | 1643 | 10 | Shale, grey, calcareous, and fossiliferous, becoming silty towards base |
| EARLY EOCENE - MID-PALAEOCENE | Latrobe Gp. | 1653 | 786+ | Interbedded sandstone and siltstone with minor coal passing down into an inter val (1746 to 2439 m) which is dominantly siltstone with minor sands and thin coal horizons. Bleeding gas from sandstone and coal down to 1798 m. |
| | | T.D. 2439 | | |

Hydrocarbon shows were reported from Flounder No. 4, but not from the remaining four wells. ESSO/BHP have applied for production licenses for the Flounder oil field and the Snapper gas field (Press statement, July 10 1974).

## SUBSIDIZED GEOPHYSICS

The North East Furneaux marine seismic survey was located in the offshore Gippsland Basin to the northeast of the Furneaux Group. It covered parts of the adjoining petroleum exploration titles VIC/P2 and P4, and T/1P and 4P in Victorian and Tasmanian waters. The objectives were to detail an easterly-plunging anticline in VIC/P4, and to investigate a basement high between VIC/P4 and T/1 P, for possible structural or stratigraphic traps in the Latrobe Valley Group on its flanks. Both structures were indicated by earlier seismic surveys. The North East Furneaux survey comprised both reflection and refraction recording.

Good-quality data were obtained on the reflection sections and three horizons were contoured in depth: horizon A - within the Miocene; horizon B - top Latrobe Valley Group; and horizon C - basement. Isopach maps of the intervals A-B and B-C were also prepared. A high-velocity refractor corresponding to basement was recorded on some of the refraction traverses. No substantial structures were discovered at the top of the Latrobe Group and no stratigraphic pinch-outs within the group were located. However, the reflection sections show that the Latrobe Group thins to the west and that the older units onlap the basement, indicating the possibility of stratigraphic traps within the Latrobe Group.

## MONEY SHOAL BASIN

Australia's first deep-sea petroleum exploration well, Lynedoch No. 1 (unsubsidized) was drilled in 236.5 m of water by the deep-water drill-ship Sedco 445 for Shell Development (Australia) Pty Ltd. The well was drilled to a depth of 3967 m, and, although there were no reports of hydrocarbons, the well has great stratigraphic importance as only the second exploratory test in the basin, the first being Money Shoal No. 1, drilled by Shell in 1971.

## MURRAY BASIN

The Menindee regional seismic survey was carried out in 1973. There were no drilling operations.

The seismic survey was located in western New South Wales south of Wilcannia. The program was designed to delineate the parts of the Palaeozoic infra-basins (Bancannia Trough, Menindee Trough, Blantyre Trough) that underlie the Murray Basin in the survey area.

Generally fair-quality data were obtained, except in areas where high velocity sediments appear to be near the surface. Four horizons were mapped, but cannot be identified or correlated between the three infra-basins with any confidence. Tentative identifications are: horizon A - Upper Devonian; horizon C - Middle-Lower Devonian; horizon D - Cambro-Ordovician; and horizon E - economic basement. The survey has provided considerable structural information on the three Palaeozoic infra-basins. It has indicated the possibility of a fault-controlled closure (Snake Flat anomaly) west of the Mount Emu No. 1 well (BMR file 69/2038), in the Blantyre Trough.

## NGALIA BASIN

The subsidized Mount Gurner gravity survey was carried out along the southwestern margin of the basin. There was no drilling activity during the year.

The survey was programmed to delineate east-west fault trends, the results to form a basis for the location of future seismic work. The results are presented as a series of gravity profiles and as a Bouguer anomaly map incorporating data from previous surveys. The map shows a uniform gravity field over the basin, and anomalies near the southern margin. The Company has delineated an east-west fault trend interpreted on rather sparse evidence as defining the southern limit of Palaeozoic deposition,aand four positive features, of which it considers two worthy of seismic evaluation.

## OTWAY BASIN

Seven wells and four seismic surveys were completed during the year. The results of the Tartwaup seismic survey, which was completed in 1974, were not released by 31 December 1974.

## SUBSIDIZED DRILLING

Three subsidized wells were drilled onshore in the Gambier Embayment in South Australia.

Diamond Swamp No. 1 and Beachport East No. 1 were located in the Penola-Beachport area on structures defined by the Esso 069A (BMR file, 69/3003) and 071A (BMR file, 71/74) seismic surveys. The target horizon was the Lower Cretaceous Pretty Hill Sandstone, interpreted to overlie Palaeozoic basement. This unit had good reservoir characteristics in two wells previously drilled in the area - Lake Eliza No. 1 (BMR file, 69/2027) and Lucindale No. 1 (BMR file, 69/2034).

Mapped on the target horizon, the Diamond Swamp structure is an arcuate northwest-trending anticline faulted on the northwest flank by a series of normal faults downthrown to the north. It has about 100 $km^2$ of areal and 457 m of vertical closure. Mapped on the same horizon, the Beachport East structure is an east-west-trending horst with over 156 $km^2$ of areal and 366 m of vertical closure.

Both wells encountered a basement-derived 'breccia' interpreted as the lateral equivalent of the Pretty Hill Sandstone. Hydrocarbons were not indicated, but log interpretation indicated that the interval was water-saturated. The lack of hydrocarbons in the two wells is thought to be most likely attributable to the lack of adequate source rocks or to insufficient depth of burial.

The Douglas Point No. 1 well was located in the Gambier trough, which contains a thick succession of Upper Cretaceous sediments in contrast to the Beachport-Penola area, which was structurally high at this time.

The well was designed to test sandstone units in the Tertiary Dilwyn and Pebble Point Formations and Upper Cretaceous Curdies Formation. The location was predicted to be on a large closed anticline interpreted from limited seismic data and from the outcrop pattern of submarine exposures of Gambier Limestone in Umpherstone Bay. The drilling indicated that this interpretation is incorrect. The Cretaceous/Tertiary unconformity was intersected 300 m lower than predicted. The structurally low position of the well means that the lack of hydrocarbons neither proves nor disproves the possibility that hydrocarbons may have accumulated 'on structure' in the area. The sediments in the lower part of the Dilwyn Formation represent a deeper-water facies, and the Pebble Point Formation is less well developed, than the equivalent sediments in Mt Salt No. 1 well (BMR file, 62/1401), located to the north-northeast.

North Eumeralla No. 1 was drilled in the onshore Victorian part of the Otway Basin about 32 km northeast of Portland. It was located on a seismically defined dip-fault combination trap in the Tyrendarra Embayment, as a test of the Lower Cretaceous Otway Group.

The ten previous wells drilled in the two onshore Frome/Shell permit areas which extend along the coast from the South Australian border to the eastern end of the Otway Ranges failed to find commercial accumulations of hydrocarbons, although potential reservoirs were present in the Tertiary, and Upper and Lower Cretaceous sequences.

The tenement holders no longer consider the Tertiary and uppermost Cretaceous reservoirs prospective in the permit areas; the basal Upper Cretaceous Waarre Sandstone is regarded as having low prospectivity; and the basal Lower Cretaceous was considered to have been tested at insufficient depth. Consequently the 1973 drilling was designed as the beginning of a possible three-well program to test it at greater depth than in previous wells. However, no significant indications of hydrocarbons were detected. The basal Cretaceous Geltwood Beach Formation is a sequence of interbedded sandstone, siltstone, and shale, with about 120 m of net sandstone which was 100 percent water-saturated on electric log analysis. The Upper Cretaceous and Tertiary reservoirs were also water-flushed. The drilling has therefore downgraded the other two Lower Cretaceous prospects in the area (Terka and Yambak), and confirmed the low prospectivity of the Upper Cretaceous and Tertiary sequence.

The well has provided useful information for the interpretation of seismic data. Basement was intersected roughly 610 m higher than predicted. Intra-basement reflections appear to originate from within the low grade Palaeozoic? metamorphic rocks that constitute basement in the area.

## UNSUBSIDIZED DRILLING

### Onshore

Lake Eliza No. 2, the only unsubsidized well to be drilled onshore, was located in the Gambier Embayment 4 km north of Lake Eliza No. 1 (BMR file 69/2027), which encountered gas

TABLE 11: STRATIGRAPHIC TABLES, OTWAY BASIN

DIAMOND SWAMP NO. 1

| AGE | UNIT | Depth(m) K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| MIOCENE - OLIGOCENE | Gambier Limestone | Surface | 235 | Drilled without returns |
| EOCENE - PALAEOCENE | Knight Gp (terrestrial) | 235 | 219 | Massive coarse quartz sandstone with some lignite |
| LATE CRETACEOUS | Sherbrook Gp (terrestrial) | 454 | 168 | Massive coarse quartz sandstone |
| EARLY CRETACEOUS | Otway Gp (marine) | 622 | 737 | Interbedded siltstone shale and sandstone, and lignite |
| | 'Diamond Swamp breccia' (marine) | 1359 | 106 | Breccia of quartz and phyllite in a matrix of shale and siltstone, some sandstone |
| PALAEOZOIC | Basement | 1465 | - | Quartzite and phyllite |
| | | T.D. 1595 | | |

BEACHPORT EAST NO. 1

| AGE | UNIT | Depth(m) K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| MIOCENE - OLIGOCENE | Gambier Limestone | Surface | 191 | Limestone, fossiliferous and glauconitic, and argillaceous calcilutite |
| EOCENE - PALAEOCENE | Knight Gp | 191 | 213 | Unconsolidated sand with some siltstone |
| LATE CRETACEOUS | Sherbrook Gp | 404 | 183 | Unconsolidated sand with common pyritic coating; shale and lignite |
| EARLY CRETACEOUS | Otway Gp | 587 | 820 | Interbedded siltstone, shale and sandstone; lignite |
| | 'Breccia' | 1381 | 26 | Breccia of phyllite casts in a matrix of siltstone |
| PALAEOZOIC | Basement | 1407 | - | Phyllite and quartzite |
| | | T.D. 1429 | | |

DOUGLAS POINT NO. 1

| AGE | UNIT | Depth(m) K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| TERTIARY | Glenelg Gp | | | |
| | Gambier Limestone | 3 | 318 | Fossiliferous limestone with interbedded sandstone, chert, and marl |
| | Bucoleuch Gp | 321 | 37 | Glauconitic marl and ferruginous sandstone |
| | Wangerrip Gp | | | |
| | Dilwyn Fm. | 358 | 639 | Interbedded clay, silt, and sand |
| | Pebble Point Fm. | 997 | 8 | Sand with carbonaceous material and traces of pyrite |
| LATE CRETACEOUS | Curdies Fm. | 1005 | 202+ | Sand interbedded with sandstone, with minor interbeds of silt and siltstone |
| | | T.D. 1207 | | |

TABLE 11 (CONT.)

| AGE | UNIT | NORTH EUMERALLA NO. 1 Depth(m) K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| TERTIARY | Heytesbury Gp (sh. marine) | | | |
| (MIOCENE TO OLIGOCENE?) | Port Campbell Limestone | D.F. | 91 | Limestone |
| (MIOCENE TO OLIGOCENE?) | Gellibrand Marl | 91 | 244 | Marl, minor limestone |
| (OLIGOCENE? TO LATE EOCENE) | Clifton Fm. | 335 | 34 | Sandstone, marl, limestone |
| | Wangerrip Gp (sh.mar. to paralic) | | | |
| (EARLY EOCENE) | Dilwyn Fm. | 369 | 427 | Sandstone, minor siltstone, coal |
| (PALAEOCENE) | Pebble Point Fm. | 796 | 86 | Oolitic sandstone, minor siltstone |
| CRETACEOUS | Sherbrook Gp (sh.mar. to paralic) | | | |
| (SANTONIAN TO CONIACIAN) | Curdies Fm. | 882 | 63 | Sandstone, siltstone, coal |
| | Paaratte Fm. | 945 | 33 | Pellety sandstone and siltstone |
| | Belfast Mudstone | 978 | 32 | Silty mudstone |
| | Otway Gp (continental) | | | |
| (ALBIAN TO APTIAN) | Eumeralla Fm. | 1010 | 1215 | Mudstone, siltstone, minor lithic sandstone, coal |
| | Seismic Unconformity | | | |
| (APTIAN) | | | | |
| (APTIAN TO NEOCOMIAN) | Geltwood Beach Fm. | 2225 | 472 | As for Eumeralla Fm., but sandstone contains a higher percentage of quartz |
| PALAEOZOIC | Basement | 2697 | 43 | Weathered zone |
| | | 2740 | | Meta-arkose |
| | | T.D. 2968 | | |

and water in the basal Cretaceous Pretty Hill Sandstone. The well was abandoned after drill-stem tests of the Pretty Hill Sandstone produced gassy salt water.

### Offshore

Neptune 1 and Trumpet 1, drilled at the western end of the basin about 60 km southwest of Cape Jaffa, were dry holes.

## SUBSIDIZED GEOPHYSICS

### Onshore

The Otway Coastal Strip seismic survey was carried out in the areas extending from Heywood in the west to Port Campbell in the east, namely: North Eumeralla, Pleasant Park/Terka/Yambuk, and Port Campbell. The program was designed to confirm and detail seismic anomalies indicated by previous surveys, the objective section being the Lower Cretaceous Pretty Hill Sandstone. Record quality varied between the three areas but was generally slightly better than that obtained previously.

The North Eumeralla area lies in the Tyrendarra Embayment, between the southern tip of the Dartmoor Ridge and the axis of the embayment. Record quality was good, and two horizons - basement and Lower Cretaceous intra-Eumeralla Formation - were mapped. The intra-Eumeralla horizon is interpreted as an unconformity. The North Eumeralla prospect was confirmed and detailed as a fault-controlled high. North Eumeralla No. 1 was drilling at the end of 1973, and was subsequently plugged and abandoned as a dry hole in 1974.

The Pleasant Park/Terka/Yambuk area is also located in the Tyrendarra Embayment between the western flank of the Warrnambool High and the axis of the embayment. Record quality was poor at the deeper levels. The intra-Eumeralla horizon was mapped over all three prospects but the contours are less reliable at Yambuk. At Terka and Pleasant Park a seismic event interpreted as the top of the Pretty Hill Sandstone was contoured. At Yambuk, only dips could be indicated on this horizon. Basement? was also contoured over Pleasant Park and over part of Terka and Yambuk. The three prospects were shown to lie on the downthrown side of a major fault downthrown to the south. Pretty Hill No. 1 was drilled on the northern block. On all three prospects, closure to the north is by faulting. Further detailing is required to confirm their suitability for drilling. The Port Campbell area is located near the coast in the middle of the Port Campbell Embayment. Only poor-quality data were produced owing to bad weather. Two horizons were mapped - one identified as the intra-Eumeralla Formation and the other, tentatively, as the top of the Pretty Hill Sandstone. Closure was not confirmed on the Port Campbell prospect at the postulated 'top Pretty Hill Sandstone' level. A review of older data revealed a new prospect - the Ross Creek - on which further seismic work was recommended.

The Ross Creek seismic survey was carried out in an area located about 15 km to the east of Port Campbell. It was a detailed survey designed to define a well site on a structural trap mapped by previous surveys in the Port Campbell Embayment. The seismic data in this area show the sediments thickening rapidly southwards, and a complex pattern of basement faulting. The reservoir objective, the Lower Cretaceous Pretty Hill Sandstone, overlies basement and is sealed by the impermeable Eumeralla Formation. The Ross Creek prospect is located on an upthrown block with closure provided by the east-west-trending bounding fault. The survey was designed to provide control along the fault and confirm closure. Fair-quality data was obtained and three horizons mapped: near top Otway Group: intra-Eumeralla Formation; and top of basement. Closure was confirmed, and Ross Creek No. 1 was spudded in February 1974. The well was plugged and abandoned as a dry hole.

## Offshore

The Cape Otway marine seismic and magnetic survey was designed to improve on the quality of previous seismic data and define the structure within the Lower Cretaceous Otway Group offshore from Cape Otway. The area lies at the southwestern limit of the Otway Ranges which are the topographic expression of a major structural high. Earlier offshore seismic data, although of poor quality, suggested that a culmination may occur offshore. A magnetometer was towed throughout the Cape Otway survey and three sonobuoy refraction probes recorded. An improvement was obtained in the quality of the seismic data. Four horizons were contoured on fair-quality data: base Tertiary; base Sherbrook Group (base Upper Cretaceous); intra-Otway Phantom; and lower Otway horizon. The phantom horizon is based on a set of reflections ranging from 0.300 to 0.400 seconds above the lower Otway horizon. Isochron maps were produced of the intra-Otway to lower Otway interval. Numerous east-northeast-trending faults were mapped, of which the four major are: on the western side of the Cape Otway high; the offshore continuation of the Castle Cove Fault; a set of faults to the west of the onshore

Crowes Anticline; and the offshore projection of the Barham Fault from Apollo Bay. The map on the lower Otway horizon indicates an offshore extension of the major onshore structural features. The Cape Otway High plunges offshore to a depth of 1500 m to 1800 m at the permit boundary (VIC/P10), and the structural trend along the Castle Cove Fault to more than 3000 m. Two closures mapped on this horizon are: the Castle Cove structure with a possible vertical closure of 300 m and an areal extent of 40 $km^2$, and the Princetown Anticline with a possible vertical closure of 760 m and an areal extent of 52 $km^2$. Further work will be required to detail the two structures. The Otway Group pinches out to the east of Cape Otway apparently against the western edge of a palaeobasement high. The total magnetic intensity map shows a zone of high magnetic intensity along the crest of the Cape Otway High indicating shallow basement. To the east of a boundary through Cape Otway the map shows a series of strong north-northeast-trending magnetic lineations with rapid variation of intensity, in contrast to the western side where there are no rapid changes. This change of character in the magnetic data is reflected in the results of the refraction probes, which indicate that depth to a high-speed refractor (5000 m/s) is about 1650 m to the east of the boundary and 1950 m to the west.

The Cape Nelson to Cape Otway seismic survey was a follow-up of the Portland-King Island seismic survey (BMR file, 72/3020), which was the first to give reliable reflection from within the Mesozoic sequence, and which outlined two structural leads. The objectives of the 1973 survey were to regionally map the structure within the Mesozoic sequence, and to follow up the structural leads from the early survey. In addition it was programmed to map the section in deep water out to the boundaries of the permits.

The fairly good-quality reflection data were integrated with those from the Portland-King Island survey. Two horizons were mapped: Blue Horizon - top of Sherbrook Group/base of Wangerrip group unconformity (Upper Cretaceous/Palaeocene unconformity), and Red Horizon: - top of Otway Group/base of Sherbrook Group unconformity (Lower/Upper Cretaceous unconformity).

The Blue Horizon is fairly reliable, except in the western part of the survey area, where the distinctive character is lost. Structurally it shows offshore dip and some channelling, and three closed highs that may warrant further investigation were indicated. The Red Horizon is less reliable; it shows two distinct areas: a shallow complexly faulted platform in the east, and a deeper trough in the central and western part of the survey area. Five possible structural traps were indicated on the platform. The horizon is much less easily picked in the trough where the Upper and Lower Cretaceous may be conformable. The mapped horizon may well be shallower than the top of the Otway Group. The refraction profile gave a velocity of 5154 m/s for the Red Horizon.

## PERTH BASIN

Four seismic surveys and one gravity survey were completed, and one subsidized well drilled during the year.

### SUBSIDIZED DRILLING

Lake Preston No. 1 (Table 12) was located about 113 km south of Perth as a test of a seismically defined faulted anticline on the Hervey Ridge - a major basement high separating the Bunbury Trough to the south from the Dandaragan Trough to the north. The culmination was interpreted to have 457 m of vertical and 130 $km^2$ of areal closure.

The primary objective was the Permian Sue Coal Measures, and a secondary objective the basal Triassic Sabina Sandstone. The well was also designed to provide stratigraphic control, particularly for the Permian and Lower Triassic sequences. The Sue Coal Measures yielded subcommercial gas in Whicher Range No. 1 (BMR file, 68/2005), in the Bunbury Trough. Gas production is obtained from the Permian Irwin River Coal Measures in the Dongara gas field about 425 km to the north. The Sabina Sandstone was regarded as the southern equivalent of the Lower Triassic sequence (Yardarino Sandstone, Kockatea Shale, Woodada Formation) which occurs in the northern part of the basin. The Yardarino Sandstone is a producing horizon in the Dongara and nearby Mondarra and Yardarino gas fields.

The well penetrated the predicted stratigraphic sequence, but there were no significant hydrocarbon shows in either of the target horizons. Study of the lithological units, and analysis of porosity and coal rank data, indicate that 762-914 m of sediment were eroded off the Hervey Ridge as a result of basement uplift in the Neocomian. It appears that little or no Yarragadee Formation, and only about 762 m of Cattamarra Coal Measures, may have been deposited on the crest of the ridge.

TABLE 12 : STRATIGRAPHIC TABLE LAKE PRESTON NO. 1

| AGE | UNIT | Depth (m) | Thickness (m) | Lithology |
|---|---|---|---|---|
| HOLOCENE | Surface sand | 5 | 19 | Calcareous sand |
| PLEISTOCENE | 'Coastal Limestone' | 24 | 18 | Calcarenite, calcilutite |
| EARLY CRETACEOUS | Warnbo Gp Leederville Sandstone | 42 | 70 | Sandstone, claystone, clay |
| M. JURASSIC | Cockleshell Gully Fm. Eneabba Mb | 112 | 1107 | Sandstone, claystone, siltstone, clay |
| LATE-EARLY TRIASSIC | Lesueur Sandstone | 1219 | 2255 | Sandstone, (siltstone, claystone, coal) |
| LATE PERMIAN - EARLY TRIASSIC | Sabina Sandstone | 3474 | 561 | Sandstone, siltstone, claystone |
| ? | ? | ? | ? | ? ? |
| LATE PERMIAN | Sue Coal Measures | 4035 | 530 | Sandstone, siltstone, shale, coal, claystone |
| | | T.D. 4565 | | |

The boundary between the Lesueur Sandstone and Sabina Sandstone is gradational. The boundary was picked at the point where a change in wireline log characteristics coincides with the appearance of the first green-grey fine-grained sandstone and siltstone, which is characteristic of the Sabina Sandstone in wells in the Bunbury Trough (Sue No. 1 - BMR file 65/4186, Whicher Range No. 1 - BMR file 68/2005, Wonnerup No. 1 - BMR file 71/929). The unit is younger than predicted - mainly upper Upper Permian and appears to become younger northwards, being Triassic in Sue No. 1, in the southern Bunbury Trough. The Permian-Triassic boundary lies within the Sabina Sandstone, and the top of the Sue Coal Measures has been picked at the top of the siltstone bed in which the first Permian coals occur. The sandstone units have poor reservoir characteristics: they are thinner and generally more argillaceous than in Wonnerup No. 1, and have an estimated average porosity of 3 percent. The coal measures contain many coal beds up to 3 m thick and the unit continues to be regarded as a good potential source rock. However, it remains a prospective sequence in the southern Perth Basin only where the maximum depth of burial has not exceeded 4500 - 4800 m.

## SUBSIDIZED GEOPHYSICS

### Onshore

#### Coolcalalaya Sub-basin

In the Coolcalalaya gravity survey area, about 80 km northeast of Geraldton, 2535 new gravity stations were spaced at 4/5 km intervals on an irregular grid of traverses about 8 km to 16 km apart. No wells have been drilled in the sub-basin. The stratigraphy inferred from wells drilled in surrounding parts of the Perth and Carnarvon Basins is a thick Permian sequence underlying a relatively thin Jurassic and Triassic sequence, and overlying Silurian, Devonian, and Carboniferous sediments. The objectives of the survey were to determine the thickness of the sediments and to locate anomalies which may be of structural significance.

The results are presented as 1:50 000 Bouguer anomaly maps and a 1:250 000 composite map; contour intervals are 1 mGal and 5 mGal respectively. The maps show five north-south-orientated structural trends. From east to west these are: a steep gradient corresponding to the Darling Fault; an elongated gravity minimum corresponding to a thick sedimentary sequence estimated to be between 4000 m and 6000 m in thickness; a gradient corresponding to the faulted flank of a structurally high zone; a zone characterized by parallel maxima and minima trends; and a zone of thinning sediments on the eastern flank of the Ajana-Wandagee basement block. The gravity contours correlate well with the BMR magnetic maps of the area.

Dandaragan Trough

The Coomallo 2 seismic survey, on the western flank of the Dandaragan Trough, was designed to detail structures associated with the Coomallo anticlinal trend which were mapped by the Coomallo seismic survey (BMR file, 71/928). The quality of the data obtained was fairly poor although the Vibroseis technique employed gave better results than the earlier survey using explosives as an energy source. The horizons mapped were: horizon A - Yarragadee Formation (Upper Jurassic); horizon B - near top Cattamarra Coal Measures Member of the Lower Jurassic Cockleshell Gully Formation; and horizon C - Donkey Creek Coal within the Cattamarra Coal Measures Member. The survey confirmed the existence of two roughly north-south-trending faults with a trough between them. The Coomallo prospect on the upthrown side of the eastern fault was shown to have insufficient north-south closure to be of economic interest, and an anticline on the downthrown side of the fault also shows only small closure. The survey resulted in a downgrading of the Coomallo prospect. No drill site could be strongly recommended, but if a test well is to be drilled the closure on the downthrown side of the fault is considered to be the best location.

The Mullering seismic survey was carried out near Lancelin and Moora, about 125 km north of Perth. Extensive outcrops of Coastal Limestone and the structural complexity of the area have severely hampered attempts to obtain usable seismic data. The Mullering survey, employing modern techniques, was an attempt to overcome the problem. It was designed to establish a regional seismic grid over an area where Lower Triassic formations are believed to occur at prospective depths, and to investigate previously mapped anticlinal structures. The results were again seriously affected by the widespread cover of Coastal Limestone. The best-quality data were only fair, and no data were recorded in some areas. Maps were prepared on three horizons: horizon A - within the Yarragadee Formation (Upper Jurassic); horizon B - top Cattamarra Coal Measure Member of the Cockleshell Gully Formation (Lower Jurassic); horizon C - near basement, and of the intervals A-B and B-C. About 410 km of previous data were reprocessed and incorporated in the interpretation. The survey mapped a number of north-south anticlinal trends on which fourteen local closures on horizon B were indicated, most of these being to some degree fault-controlled. Definition is inadequate because of the poor quality of the data. As the anticlines plunge to the south the Cattamarra Formation is beyond economic depth on closures in the southern part of the survey area. Despite the recording problems in the area, the survey has provided useful information and indicated a number of prospective structures that could be matured to drillable status with further seismic control.

The Rockingham seismic survey was carried out over the southern part of the Dandaragan Trough in an area extending from the southern suburbs of the Perth metropolitan area in the north to Mandurah in the south. The survey employed Vibroseis as an energy source in an effort to improve on the poor-quality data previously obtained in the area owing to the occurrence of Coastal Limestone. Although an improvement was achieved on three of the four lines shot over Coastal Limestone, the general quality of the data obtained by the Rockingham survey was only fair to poor. The objectives were to evaluate the structure of the southern part of the Dandaragan Trough; to search for potential structural traps and a possible southern extension of the Gingin-Bullsbrook trend found to the north of the survey area, and to reprocess old data in order to improve the stratigraphic correlation between the two wells in the area, Cockburn No. 1 (BMR file, 67/4251) and Pinjarra No. 1 (BMR file, 65/4176). Maps were produced on four horizons: horizon A - Lower Cretaceous unconformity; horizon B - near top Cattamarra Coal Measures Member of the Cockleshell Gully Formation; horizon C - near top Eneabba Member of the Cockleshell Gully Formation; and horizon D - near top Lesueur Sandstone (Upper Triassic). The maps incorporated all previous data. The horizons were tied to Pinjarra No. 1 in the south, and Cockburn No. 1 (horizons A and B only) in the north. The improved data obtained from the reprocessing of older data around Pinjarra No. 1 has improved the reliability of stratigraphic correlations between the two wells. A large number of generally north-south-trending faults were mapped. On horizons C and D an anticlinal axis which may be a continuation of the Gingin-Bullsbrook trend was indicated. Further seismic work was recommended along this trend to establish north-south closure.

The Warradong II seismic survey was carried out over a small area about 430 km north of Perth and 16 km southeast of Dongara. It was designed to define the crestal part of the southeast-trending Warradong anticline and confirm southwest closure, and to define the saddle between the Warradong structure and Eneabba No. 1 to the southeast; both features have been mapped in earlier surveys. Two horizons -

base Kockatea Shale (Lower Jurassic) and Donkey Creek Coal (within Cattamarra Coal Measures Member), - and the interval between them were mapped. The results were integrated with about 240 km of data from previous surveys. The quality of the data varied from fair to good on the shallower horizons, but deteriorated with depth. The Warradong structure was defined as a southeast-plunging anticline closed to the southwest by the Eneabba fault. Three additional closures separated by two saddles were indicated on the upthrown side of the south-southeast-trending Eneabba fault lying between and on trend with the Warradong anticline and the closure on which Eneabba No. 1 was drilled.

## SURAT BASIN

Four wells were drilled during 1973; all of them were subsidized. The two subsidized seismic surveys carried out had objectives in the underlying Bowen Basin (see above ).

### DRILLING

The results of one unsubsidized well, and of eight subsidized wells released after 31 July 1973, are included in this section (Table 13). Except for two wells, Moree Nos 1 and 2, drilled at the southern end of the basin, all the drilling was in areas around the previously discovered oil and gas fields. This activity was stimulated by the removal of the 'exclusion circles' in March 1972.

Moree No. 1 (BMR file, 72/3223), and Moree No. 2 were located 209 km and 40 km respectively north of Moree. Structurally, the area lies at the southern end of the Taroom Trough (Bowen Basin). Three seismically defined north-trending anticlines are developed in the Jurassic sequence of the overlying Surat Basin. Moree No. 1 was located in the synclinal area between two of these, the Gil Gil and the Garah, and Moree No. 2 was drilled on the Garah structure. Both wells were designed to evaluate the hydrocarbon potential of the Jurassic Hutton Sandstone in a stratigraphic pinch-out near the interpreted zero edge.

The drilling showed the Hutton Sandstone to be absent in Moree No. 1, and although it was present in Moree No. 2 it proved to be water-saturated. The thinning of the sandstone - only 13 m between Garah No. 1 (BMR file, 66/4199), 7 km to the north, and Moree No. 2 - was less than predicted. The lack of any indication of hydrocarbons in the Hutton Sandstone downgrades the possibility that a trap may exist to the south updip from the location of Moree No. 2.

In 1972, LSG of Australia Inc. began a drilling program in an area about 24 km east-southeast of Condamine. The program was primarily designed to test the hydrocarbon potential of the '58-0' (basal sand of the Jurassic Precipice Sandstone) close to the zero isopach. Wells drilled previously in the area had encountered generally flushed Precipice Sandstone. The wells drilled in the 1972-73 program were drilled in areas believed, as a result of studies of formation water salinities and water saturation, not to be flushed.

Sawpit Gully No. 1 (BMR file, 72/2912), the first well in the program, and the first by the Company in Australia, was located on a seismically defined anticline near the zero edge of the '58-0' sand. The target horizon, together with potential reservoirs in the Hutton Sandstone and Evergreen Siltstone were found to be water-saturated. Analysis of a core taken in the '58-0' sand showed a trace of oil saturation at the top of the core which may indicate that the reservoir has been flushed, or that a trap may exist further updip. However, on the present structural interpretation, such a trap would be too small to be commercially significant.

The remaining three wells in the program, Rockwood No. 1 (BMR file, 72/3013), Rockwood No. 2 (unsubsidized, 1972), and Rockwood North No. 1 were located about 64 km north-northwest of Sawpit Gully No. 1 and about 32 km southwest of Chinchilla. The Marmadua seismic survey (BMR file, 72/2003) confirmed the presence of a basement high, the Undulla Nose, in this area, and provided control on the zero isopach of the '58-0' sand near the Rockwood wells.

Rockwood No. 1 intersected about 6 m of gas-bearing sand ('58-0' sand) with the lithological characteristics of a channel sand. A reservoir analysis carried out by H.J. Gruy and Associates indicated only a small reservoir about 80 x 375 m and an in-place gas volume of from 28-51 MMcf.

Rockwood No. 2 was drilled as a step-out about 1 km south of No. 1 and 30 m structurally lower. In this well, the '58-0' sand proved to be water-wet. A drill-stem test between 1218.6 m and 1232.6 m recovered 1152 m of gas-cut fresh water.

After the identification of the '58-0' sand as a channel sand in Rockwood No. 1, further study of the seismic and well data resulted in the interpretation of a thicker development of the sand in a larger channel to the east. Rockwood North was sited towards the centre of this channel, about 5 km northeast and updip from Rockwood No. 1. The channel sand was encountered as predicted but its reservoir properties were very poor. On drill-stem testing through a 3/4" surface and a 1/2" bottom-hole choke, 4.5 m of oil and 21 m of heavily oil-cut mud were recovered. No water was produced, thus validating the theory that the trap had not been flushed by meteoric water.

The Jandowae Drilling Project (BMR file 72/937) was a three-well program designed primarily as a stratigraphic test of the Precipice Sandstone near its zero isopach in the northeastern part of the basin. The wells were located near Chinchilla and Jandowae, where Surat Basin sediments thicken on either side of a north-trending basement 'high' - the Kogan Ridge. Stockyard Creek No. 1, located about 45 km north-northeast of Chinchilla, was drilled in the western syncline; the two Jandowae wells were drilled in the eastern syncline about 12 km northwest and 16 km southwest of Jandowae. All the wells failed to intersect the Precipice Sandstone and the zero isopach consequently lies to the south of the well locations. A point of stratigraphic importance is the identification of the Westgrove Member at the top of the Evergreen Formation. This unit is characterized by the presence of oolites and was first described in the western Surat Basin, where it is considerably thinner. Other sandstone units recognized in the west were also identified in the three wells.

The four remaining wells were drilled on the Roma Shelf on the western side of the basin; all of them penetrated the sediments in the underlying Taroom Trough, but the primary drilling targets were within the overlying Surat Basin section.

Pleasant Hills No. 17 (BMR file 72/3019) was drilled to further investigate the Roma gas field discovered in 1968. The Pleasant Hills structure is formed by the drape of Bowen and Surat Basin sediments over an irregular basement high composed of Roma Granite. The well was sited on the northeast flank of the structure to test the Precipice Sandstone at a location updip from Pleasant Hills No. 16, where the unit was porous and permeable but water-filled. A gas pool is present in Precipice Sandstone on the northwest flank of the structure. The drilling proved the basal Jurassic to be much thinner than predicted, and impermeable. It has been postulated that the area between the Pleasant Hills structure and the Hutton-Wallumbilla Fault was a depositional low during the Early Jurassic. A revision of the palaeotopography of the Precipice Sandstone depositional surface based on palynological data from sidewall cores, and subsequent correlation with surrounding wells, has shown that there is no major drainage system or development of Precipice Sandstone on the eastern flank similar to that on the western flank of the structure.

The drilling provided additional information on the Permian-Triassic sequence, which proved to be thicker than predicted, but, as in Pleasant Hills Nos 7, 9, and 16 - also drilled on the eastern flank - there was no significant thickness of porous and permeable Showgrounds Sandstone. This unit, which is a producing horizon on the western flank of the Pleasant Hills structure, is apparently unprospective on the eastern flank.

Minmi No. 1 (BMR file, 72/3064), 7 km northeast of Roma, was drilled on a small seismically defined closure on a generally southeasterly anticlinal trend. The primary objective was the Precipice Sandstone. Yanalah No. 2 (1964) drilled 2 km downdip from Minmi No. 1 intersected porous and permeable but water-saturated Precipice Sandstone.

Minmi No. 1 also intersected porous and permeable but water-saturated Precipice Sandstone. The Triassic Moolayember Formation was the only part of the Bowen Basin section (Taroom Trough) present in the well. A sandstone within this unit proved to be water-filled and to have low permeability.

The Precipice Sandstone (21 m) was considerably thicker than in Yanalah No. 2 (9 m) and the best porosity and permeability was in the upper part. The Triassic/Jurassic boundary is placed between 1113 m and 1114 m on palynological evidence.

Fairfield West No. 1 was located 34 km southeast of Roma and 4.3 km south of the nearest well in the Bony Creek gas field (Bony Creek No. 12). The primary target was the Precipice Sandstone and a secondary objective the Showgrounds Sandstone. Before drilling, the well location was interpreted to be a small culmination on the southern extension of the northwest-trending Bony Creek anticlinal axis, defined by the Sunnybank-Wallumbilla seismic survey (BMR file, 63/1503). The drilling proved the seismic interpretation to be incorrect. At both mapped seismic horizons - Evergreen Resistivity Member and base Mesozoic - the well location was considerably lower than at Bony Creek No. 12. There were no indications of hydrocarbons in the Precipice Sandstone, which was fine-grained and argillaceous, and the Showgrounds Sandstone was absent.

Bindango No. 1 was located 39 km west of Roma on the western flank of the Roma Shelf, where only two other wells had previously been drilled - the nearest being Hodgson No. 1, 22 km away.

TABLE 13 : STRATIGRAPHIC TABLES, SURAT BASIN

| AGE | UNIT | MOREE NO. 1 Depth(m) | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| QUATERNARY-TERTIARY | Unnamed | surface | 91.44 | Fluvial sands, varicoloured clay |
| EARLY CRETACEOUS | Rolling Downs Gp Griman Creek Fm. | 91.44 | 115.82 | Interbedded fine-grained sandstone, shale, and siltstone |
| | Surat Siltstone | 207.26 | 171.9 | Grey, green shale and siltstone with interbedded fine-grained sandstone and minor limestone |
| | Wullumbilla Fm. Creena Mb. | 379.47 | 94.18 | Grey to brown and black carbonaceous shale and siltstone interbedded with fine to medium carbonaceous sandstone and coal |
| | Doncaster Mb. | 473.66 | 188.98 | Interbedded fine-grained glauconitic sandstone and grey-green shale and siltstone, minor limestone |
| | Bungil Fm. | 662.64 | 153.01 | Sandstone, fine to medium and occasionally coarse-grained, interbedded with carbonaceous shale and siltstone |
| | Mooga Sst. | 815.65 | 26.82 | Sandstone, fine to very coarse; minor siltstone and shale |
| LATE JURASSIC | Orallo Fm. | 842.47 | 39.32 | Siltstone and shale, grey to brown, and sandstone, fine-grained, carbonaceous. |
| | Gubberamunda Sst. | 881.79 | 157.87 | Sandstone, grey, white, brown, medium to coarse, pebbly; minor shale and siltstone |
| MIDDLE JURASSIC | Walloon Coal Measures | 1039.67 | 22.56 | Shale, grey, brown, red-brown, and siltstone grading to sandstone; coal |
| TRIASSIC | Wandoan Fm. | 1062.23 | 85.34+ | Grey, brown, dark grey carbonaceous shale and siltstone; coal |
| | | T.D. 1148 | | |

| AGE | UNIT | MOREE NO. 2 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| QUATERNARY TERTIARY | Unnamed | surface | 69.79 | Fluvial sands, varicoloured clay |
| EARLY CRETACEOUS | Rolling Downs Gp Griman Creek Fm. | 73.15 | 210.00 | Sandstone, fine-grained, tan, grey-green, minor carbonaceous inclusions, minor glauconite; interbedded shale, darkbrown to black, grading to coal |
| | Surat Siltstone | 283.15 | 98.14 | Interbedded shale and siltstone, grey, carbonaceous, with some interbedded sandstone, grey, fine-grained; minor glauconite; minor limestone near base, tan-brown, micritic, grading to calcareous shale |

TABLE 13 (CONT.)

| AGE | UNIT | MOREE NO. 2 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| EARLY CRETACEOUS | Wallumbilla Fm. Coreena Mb. | 381.3 | 92.66 | Shale, brown to black, carbonaceous, grading to coal and coaly shale, interbedded with fine-grained sandstone, green to tan; minor carbonaceous laminae, and siltstone, tan-grey to grey green |
| | Doncaster Mb. | 473.96 | 166.12 | Sandstone, tan, grey to grey-green, fine-grained, minor glauconite, with shale, mainly brown, carbonaceous, and siltstone, tan-grey to grey-green |
| | Bungil Formation | 640.08 | 157.89 | Sandstone, grey, very fine to medium near the top, grading to very fine-grained towards the base, interbedded with siltstone, grey, tan, and shale, brown, carbonaceous |
| | Mooga Sandstone | 797.97 | 21.03 | Sandstone, grey to white, very fine to coarse with minor interbedded shale and siltstone, grey to tan, carbonaceous |
| LATE JURASSIC | Orallo Formation | 819 | 82.91 | Interbedded siltstone and shale, light grey, tan to brown, and dark grey, with sandstone, grey to tan, minor white, fine, medium, and coarse |
| | Gubberamunda Sst. | 901.9 | 155.75 | Mainly medium and coarse grey-white sandstone |
| MIDDLE JURASSIC | Walloon Coal Measures | 1057.66 | 88.39 | Shale, grey-brown, carbonaceous, interbedded with siltstone, grey-tan-brown, and sandstone, mainly very fine to fine grey to grey-green. Unit interpreted as slightly tuffaceous near the base |
| EARLY JURASSIC | Hutton Sandstone | 1146.05 | 60.96 | Mainly medium to coarse friable sandstone, minor interbedded siltstone and shale |
| TRIASSIC | Wandoan Fm. | 1207.01 | 14.33+ | Thinly interbedded sandstone, grey and tan, very fine to fine, and siltstone, grey, minor carbonaceous laminae |
| | | T.D. 1221.9 | | |

| AGE | UNIT | ROCKWOOD No. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| M. JURASSIC-EARLY CRETACEOUS | 'Blythesdale Fm'* | surface | 328.57 | Sandstone, very fine to coarse, grading to and interbedded with siltstone with minor interbedded shale; coal between 240 m and 270 m; basal sandstone, medium to coarse |
| | 'Walloon Fm'** | 328.57 | 371.86 | Siltstone, grey, carbonaceous, and shale grading to coal; minor interbedded fine-grained sandstone |
| EARLY JURASSIC | Eurombah Fm? | 700.43 | 38.41 | Interbedded grey to grey-green siltstone and very fine-grained sandstone |
| | Hutton Sandstone | 738.84 | 248.71 | Sandstone, white to grey, very fine to coarse, with interbedded siltstone, brown, grey-green; minor interbedded shale and coal |
| | Evergreen Fm. | 987.55 | 142.65 | Sandstone, white, grey to grey-green, fine to coarse, with interbedded brown, and grey-green siltstone; minor interbedded shale |
| | Precipice Sst. | 1130.27 | 69.2 | Sandstone, fine, medium, and coarse, with interbedded siltstone and minor shale. '58-O' sand occurs over interval 1189.32 to 1195.73 |
| CARBONIFEROUS | 'Kuttung Fm' | 1199.39 | 6.71+ | As in Sawpit Gully No. 1 |
| | | T.D. 1206 | | |

TABLE 13 (CONT.)

| AGE | UNIT | ROCKWOOD NORTH NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| M. JURASSIC - EARLY CRETACEOUS | Blythesdale Fm.* | Surface | 295.96 | As in Rockwood No. 1 |
| | Walloon Fm.** | 295.96 | 439.22 | " " " " " |
| EARLY JURASSIC | Hutton Sandstone | 735.18 | 278.89 | Above 862.58 m: Sandstone, white, light grey, very fine to coarse, and pebbly, grading to and interbedded with grey-green siltstone, grading to sandstone and carbonaceous shale 862.58-996.7 m: Siltstone grading to very fine-grained sandstone; interbedded shale Below 996.7 m: Sandstone, medium to very coarse |
| | Evergreen Fm. | 1014.1 | 140.51 | Mainly shale, dark grey and brown, carbonaceous, grading to and interbedded with grey-green siltstone |
| | Precipice Sst. | 1154.58 | 90.53 | 1154.6-1190.24 m: Sandstone, white, light grey, very fine to coarse, grading to and interbedded with brown siltstone; minor shale 1190.24-1232.9 m: Mainly siltstone with interbedded very fine-grained sandstone 1232.9-1245.11 m: Mainly sandstone, grey, medium to very coarse ('58-0' sand') |
| CARBONIFEROUS | 'Kuttung Fm' | 1245.11 | 6.1+ | As in Rockwood No. 1. Oil was bleeding from fractures in the top 2.44 m |
| | | T.D. 1251 | | |

| AGE | UNIT | SAWPIT GULLY NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| M. JURASSIC - EARLY CRETACEOUS | 'Blythesdale Fm'* | Surface | 621.80 | Sandstone, very fine to coarse, with minor interbedded siltstone and shale |
| | 'Walloon Fm'** | 621.80 | 372.77 | Siltstone, tan to grey, and carbonaceous shale grading to coal; minor interbedded fine to medium sandstone |
| EARLY JURASSIC | Hutton Sandstone | 994.56 | 215.49 | Sandstone, white to grey, very fine to coarse-grained interbedded with siltstone, brown, grey-green, minor interbedded shale and coal |
| | Evergreen Fm. | 1210.1 | 191.41 | Sandstone, white, grey, tan, very fine to coarse, with interbedded grey to grey-green siltstone grading to very fine grained sandstone as above; minor interbedded shale |
| | Precipice Sandstone | 1401.47 | 55.47 | 1433.47-1456.94 - Basal '58-0' sand, fine, medium, and coarse, grading into overlying very fine-grained sandstone with interbedded shale and siltstone; top 10 m: fine to medium grey to grey-green sandstone |
| CARBONIFEROUS | 'Kuttung Fm' | 1456.9 | 6.4+ | Altered tuffaceous sandstone, highly sheared |
| | | T.D. 1463 | | |

* Probably comprises Springbok Sandstone to Mooga Sandstone (Exon & Vine, 1970)

** Walloon Coal Measures of Exon & Vine (1970)

* ** EXON, N.F., and VINE, R.R., 1970 - Revised nomenclature of the Blythesdale sequence. Qld. Govt. Min. J., 820, 49-52

TABLE 13 (CONT.)

JANDOWAE DRILLING PROJECT

| AGE | UNIT | Stockyard Creek No.1 Depth(m)K.B. | Stockyard Creek No.1 Thickness(m) | Jandowae West No.1 Depth(m)K.B. | Jandowae West No.1 Thickness(m) | Jandowae South No.1 Depth(m)K.B. | Jandowae South No.1 Thickness(m) | LITHOLOGY |
|---|---|---|---|---|---|---|---|---|
| | Brigalow | 0 – 9.14 | 9.14 | 0 – 85.34 | 85.3 | 0 – 91.44 | 91.44 | |
| | alluvials | 0 – 9.14 | 9.14 | 0 – 9.14 | 9.14 | 0 – 36.58 | 36.58 | Red, yellow, brown sandy clays |
| CAINOZOIC | | | | 9.14–27.43 | 45.72 | 36.58–91.44 | 54.86 | Rust-coloured, sandy, clayey gravel |
| | | | | 57.91–85.34 | | | | |
| | | | | 27.43–57.9 | | | | Basalt flows |
| | Walloon Coal Measures | | | | | 91.44 | 57.00 | Grey carbonaceous shale grading to siltstone; traces coal throughout |
| | Hutton Sst. | 9.14 | 151.49+ | 85.34 | 186.24 | 148.44 | 249.93 | Interbedded medium to coarse light grey sandstone and grey siltstone; minor interbedded shale and fine-grained sandstone; carbonaceous material and traces of coal occur throughout |
| JURASSIC | Evergreen Fm. | 160.63 | 205.13 | 271.58 | 181.35 | 398.37 | 204.22 | Mainly light grey siltstone, shaly in lower half; interbedded grey-green, fine to medium lithic sandstone; flattened oolites 50–20 m above base |
| | Westgrove Ironstone | 160.63 | 66.45 | 271.58 | 64.92 | 398.37 | 61.87 | |
| | Boxvale Sst. | 231.65 | 20.12 | 336.5 | 16.76 | 460.25 | 21.34 | Light grey fine to medium sandstone; coarser and porous towards base |
| | L. Evergreen | 252.1 | 113.7 | 353.26 | 99.67 | 481.58 | 121.07 | Grey carbonaceous siltstone interbedded with light grey fine-grained calcareous lithic sandstone |
| | D. Sand* | 346.86 | 3.66 | 445.01–452.93 | | 570–582.17 | | |
| | Basement | 365.76 | 49.33+ | 452.93 | 16.76+ | 602.59 | 13.41+ | |
| | | 365.76–406 Argillite | | Granite | | Greenschist | | |
| | | 406–415.14 Tuff | | | | | | |
| | | (Carboniferous) | | (Triassic) | | (L. Palaeozoic) | | |
| | | T.D.415 | | T.D.470 | | T.D.616 | | |

* The D. Sand (Mines Administration) is the Moonie 5628 Sand (U. Precipice Sandstone of Union-Kern), a good marker over most of the basin.

| AGE | UNIT* | Pleasant Hills No.17 Depth(m) | Pleasant Hills No.17 Thickness (m) | Minmi No. 1 Depth(m) | Minmi No. 1 Thickness (m) | Fairfield West No.1 Depth(m) | Fairfield West No.1 Thickness (m) | Bindango No. 1 Depth(m) | Bindango No. 1 Thickness (m) | LITHOLOGY |
|---|---|---|---|---|---|---|---|---|---|---|
| EARLY CRETACEOUS | Roma Fm. | | | | | Surface | 219.76+ | Surface | 130.76+ | Argillaceous glauconitic siltstone, shale |
| | Blythesdale Fm. | Surface | 189.28+ | Surface | 369.12+ | 223.11 | 456.59 | 134.11 | 347.47 | |
| | Transition Mb. | | | Surface | 60.66+ | 223.11 | 112.78 | 134.11 | 100.28 | Sandstone, siltstone, shale |
| MIDDLE JURASSIC– TO EARLY CRETACEOUS | Mooga Mb. | Surface | 11.89+ | 64.01 | 107.6 | 335.89 | 116.43 | 234.39 | 51.21 | Quartzose sandstone |
| | Fossilwood Mb. | 15.24 | 119.79 | 171.6 | 135.03 | 452.32 | 158.5 | 285.6 | 124.05 | Sandstone |
| | Gubberamunda Mb. | 135.03 | 57.61 | 306.63 | 65.84 | 610.82 | 68.88 | 409.65 | 71.93 | Sandstone, siltstone, minor shale |
| | Injune Creek Beds | 192.63 | 482.5 | 372.47 | 388.62 | 679.7 | 381 | 481.58 | 313.64 | Siltstone, shale, coal, sandstone |
| EARLY JURASSIC | Hutton Sst. | 675.13 | 214.58 | 761.1 | 199.03 | 1060.7 | 191.41 | 795.22 | 228.3 | Quartzose sandstone, minor siltstone and shale |
| | Evergreen Fm. | 889.71 | 114.3 | 960.12 | 132.59 | 1252.12 | 138.68 | 1023.52 | 95.1 | Siltstone, sandstone, minor shale |
| | Boxvale Sst. Mb. | 931.47 | 1.83 | 1022.3 | 18.3 | 1333.5 | 6.4 | 1057.05 | 9.45 | Fine-grained quartzose sandstone |
| | Precipice Sst. | 1004.01 | 10.06 | 1092.71 | 20.73 | 1390.8 | 16.15 | 1118.62 | 25 | Quartzose sandstone, some siltstone |

TABLE 13 (CONT.)

| AGE | UNIT* | Pleasant Hills No. 17 Depth(m) | Pleasant Hills No. 17 Thickness (m) | Minmi No. 1 Depth(m) | Minmi No. 1 Thickness (m) | Fairfield West No.1 Depth(m) | Fairfield West No.1 Thickness (m) | Bindango No. 1 Depth(m) | Bindango No. 1 Thickness (m) | LITHOLOGY |
|---|---|---|---|---|---|---|---|---|---|---|
| TRIASSIC | Moolayember Fm. | 1014.07 | 38.1 | 1113.43 | 10.67 | 1406.96 | 46.94 | 1143.61 | 76.5 | Quartzose sandstone, siltstone and minor shale |
| | Showgrounds Sst. | 1052.17 | 6.4 | | | | | | | Coarse-grained quartzose sandstone and siltstone |
| | Rewan Fm. | 1058.57 | 74.07 | | | | | | | Quartzose lithic sand-stone, and siltstone |
| PERMIAN | Bandanna Fm. | 1132.64 | 15.85+ | | | | | | | Shale, siltstone, and coal |
| DEVONIAN | Timbury Hills Fm. | | | 1124.1 | 22.86+ | 1453.9 | 19.2+ | 1220.1 | 5.49+ | Metasediments and phyllite |

* Nomenclature used by Mines Administration Pty Ltd

Seismic interpretation of the structure in the Bindango area indicates the south-plunging Bindango Syncline, containing Mesozoic sediments, bounded by Permian/Triassic erosional scarps and faults. The well was drilled at the updip end of the syncline to evaluate the reservoir potential of the basal Mesozoic sequence which was predicted to be thicker than on the surrounding Roma Shelf. This prediction proved to be correct. 25 m of Precipice Sandstone and 76.5 m of Moolayember Formation were encountered compared with 17 m and 19 m in Hodgson No. 1. There were no significant indications of hydrocarbons. Minor gas shows were recorded from thin coal seams within the Injune Creek Beds. Minor gas shows recorded in the Hutton Sandstone, the Boxvale Sandstone Member of the Evergreen Formation, and the Precipice Sandstone are attributed to solution gas. The Boxvale Sandstone has good porosity and permeability. Two potential reservoir units occur within the Precipice Sandstone. The upper unit with fair and the lower with low porosity. Both appear to have low permeability. The Moolayember Formation contains thin sandstone intervals with low porosity and permeability. Estimations of porosity and water saturation were based on electric and velocity log data. The Jurassic reservoirs were estimated to be water-filled.

The basal part of the Moolayember Formation is interpreted as 'valley fill' derived from the underlying Timbury Hills Formation. This, together with the absence of a Permian sequence, suggests that the basement depression is the result of Middle Triassic faulting. The fault-bounded Arbroath Trough to the south contains 1122 m of Permian sediments overlain by Precipice Sandstone. The difference in the sedimentary sequences in the Arbroath Trough and the Bindango Syncline indicates that the two features are not genetically related.

## SYDNEY BASIN

Three wells, two subsidized and one unsubsidized were drilled in 1973.

### SUBSIDIZED DRILLING

The Bringelly Project was a program of stratigraphic drilling carried out in the Liverpool-Camden area to test the sands in the lower part of the Narrabeen Group, in which channel sands were encountered during a program of coal

TABLE 14: STRATIGRAPHIC TABLES, SYDNEY BASIN

| AGE | UNIT | BRINGELLY NO. 1 Depth(m) K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| RECENT TO TERTIARY | Unnamed | Surface | 9 | Quartzose sand and weathered shale |
| M. TRIASSIC | Wianamatta Gp | 9 | 39 | Shale and minor sandstone |
| | Hawkesbury Sandstone | 48 | 184 | Sandstone with minor quartz overgrowths and fair to good porosity |
| EARLY TRIASSIC | Narrabeen Gp. | 232 | 459 | |
| | Newport Fm. | 232 | 30 | Quartzose, sandstone, with medium to abundant matrix |
| | Garie Fm. | 262 | 4 | Claystone, grey-green, and siltstone |
| | Bald Hill Claystone | 266 | 56 | Claystone, brick-red, siltstone and sandstone |
| | Colo Vale Sandstone | 322 | 278 | Sandstone, medium and conglomeratic, lithic and quartzose |
| | Wombarra Fm. | 600 | 54 | Shale, with interbedded siltstone and minor sandstone |
| | Coal Cliff Sandstone | 654 | 8 | Sandstone, lithic conglomeratic, bright yellow fluorescence |
| LATE PERMIAN | Beauchamp Falls shale equ. | 662 | 29 | Shale, micaceous and carbonaceous in part, and minor sandstones |
| | Illawarra Coal Measures | 691 | 13 | |
| | Bulli Coal | 691 | 6 | Coal, black, and shale, black carbonaceous |
| | | T.D. 704 | | |

| AGE | UNIT | BRINGELLY NO. 2 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| M. TRIASSIC | Wianamatta Gp | Surface | 102 | Shales, dark grey, silty and carbonaceous with minor coal |
| | Hawkesbury Sandstone | 102 | 190 | Sandstone, fine to medium, quartzose |
| EARLY TRIASSIC | Narrabeen Gp | 292 | 457 | |
| | Newport Fm. | 292 | 31 | Micaceous siltstone and interbedded quartzose sandstone |
| | Garie Fm. | 323 | 8 | Claystone, grey-green, hard, conchoidal fracture |
| | Bald Hill Claystone | 331 | 38 | brick-red claystone interbedded with quartzose sandstone |
| | Colo Vale Sandstone | 369 | 306 | Sandstone fine and quartzose, becoming coarse, conglomeratic and lithic with depth |
| | Wombarra Fm. | 675 | 43 | Siltstone interbedded with lithic sandstone |
| | Coal Cliff Sandstone | 718 | 7 | Sandstone coarse to conglomeratic, kaolin matrix common |
| ? ? | ? | ? | ? | ? ? |
| LATE PERMIAN | Beauchamp Falls shale equ. | 725 | 24 | Siltstone and claystone dominant with interbedded sandstone and shale |
| | Illawarra Coal Measures | 749 | 11+ | |
| | Bulli Coal | 749 | 9 | Coal, black, bright to dull, grading to carbonaceous shale, basal sandstone |
| | | T.D. 760 | | |

exploration drilling carried out in the area by the NSW Department of Mines in 1972 (Cobbitty Nos 1-4). Preliminary studies carried out by Bridge Oil NL before the siting of the Bringelly wells included wireline logging of the Cobbitty holes, and a revision of the structure maps on the seismic horizon at the top of the Illawarra Coal Measures (Bulli seam). The wireline logs indicated that the reservoir characteristics of the sands were better in the structurally lower holes. A northwest-trending graben was defined, bounded on the west by the Nepean Fault Zone, which it intersects at an angle of $45^{o}$.

Bringelly No. 1 was located 0.4 km east (on the downthrown side) of the Nepean Fault on the southwest flank of the structure, and Bringelly No. 2 in a stratigraphically lower position on the northwest flank.

The wells intersected a normal stratigraphic sequence for the area (Table 14). Sands were common in the lower part of the Narrabeen Group, but were generally tight and impermeable. Only minor gas shows were encountered. The drilling was followed by an extensive re-evaluation of the geological data which resulted in a decision not to proceed with the originally planned program of five wells.

## UNSUBSIDIZED DRILLING

Longley No. 1 was located near Wyong in the Gosford district. Gas shows were reported between 557.8 m and 617 m, and a 1.8 m section of core at 893 m contained condensate. North West Oil and Minerals has announced that, in view of the indication of hydrocarbons in Longley No. 1, another well will probably be drilled in the area, and Longley No. 1 may then be deepened to the base of the Permian.

## CAPE VOGEL BASIN

The Popondetta seismic survey (BMR file, 72/2389) was carried out in the northern part of the basin near Popondetta. It was designed as a reconnaissance survey to confirm the existence of a thick sedimentary sequence indicated by aeromagnetic data. The work comprised recording along the Mambari and Kumusu rivers to the north of Popondetta, and land recording along the roads between Popondetta and the coast.

The land work produced fair to poor quality reflection data on which one horizon was contoured. The map indicated a general northeasterly dip and three possible structual highs: to the east and to the northeast of Popondetta, and offshore near Buna. The onshore part of the basin is estimated to contain about 2750 m of sediments.

Only a small part of the river work produced usable data. A sedimentary sequence similar to the one to the south, but thinner and with a general southerly dip, was indicated.

## MOREHEAD BASIN

The Morehead reconnaissance seismic survey was carried out in 1973. There were no drilling operations.

The seismic survey covered an area in western Papua near the Irian Jaya border between latitude 8$^{o}$ south and Torres Strait. The program was designed to determine the structure of the area, and whether basement structures intepreted from earlier seismic refraction data are evident in the overlying sediments.

The quality of the data was generally fair, including that obtained by the Geoflex technique which was used for part of the survey. Two horizons - base Tertiary and near base Mesozoic - were mapped, and an isopach map of the interval between the two produced. The survey showed that the basin contains a maximum of about 3650 m of Mesozoic and Tertiary sediments in the survey area. The data mainly verified the extension of the basement structure into the overlying sediments. Two anticlinal trends cross the area from east to west, and a large number of predominantly east-west-trending normal faults downthrown to the south, were mapped.

## NORTHERN NEW GUINEA BASINS

Two subsidized wells, Bongos No. 1 and Keram No. 1 (Table 14) were drilled in 1973. There was no subsidized geophysical activity.

Bongos No. 1 was located near the eastern end of the Bongos Anticline, a large east-southeast-trending surface anticline south of the Torricelli Mountains in the Sepik Sub-basin. A thick Tertiary sequence based on surface geological data was predicted. However, the Yimi aeromagnetic survey (BMR file 72/323) indicated that the anticline corresponds to a magnetic anomaly, with depth to magnetic basement estimated at about 1070 m.

TABLE 15: STRATIGRAPHIC TABLES. NORTHERN NEW GUINEA BASINS

KERAM NO. 1

| AGE | UNIT | Depth | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| RECENT-PLEISTOCENE | | Surface | 9 | Soft clay and interbedded sandstone with iron oxide cement |
| PLEISTOCENE-PLIOCENE | Anungum Fm. | 9 | 441 | Siltstone, brown to blue, grading down into sandstone interbedded with blue-grey mudstone and minor bands of lignite |
| PLIOCENE | Josephstaal Mudstone | 450 | 492 | Interbedded light to mid-grey glauconitic sandstone and bentonitic mudstone which becomes the dominant lithology with depth |
| PLIOCENE | Urasiki Sandstone | 942 | 150 | Mainly blue to grey fine to coarse glauconitic sandstone, with soft grey mudstone predominant in the lower levels |
| | | seismic Horizon 1 | | |
| LATE MIOCENE | Korogopa Fm. | 1092 | 84 | Dense white limestone overlying calcareous massive shale which in places grades to very argillaceous limestone |
| | | seismic Horizon 2 | | |
| M. MIOCENE | Keram Fm. | 1176 | 281 | Massive white to grey to tan limestone, occasionally chalky and pyritic, becoming slightly argillaceous with few shale laminae in the lower half |
| M. MIOCENE | Yip Fm. | 1457 | 226 | Thick white to grey argillaceous limestone with no porosity interbedded with blue to grey calcareous shale |
| M. MIOCENE | Buten Fm. | 1683 | 192 | Interbedded grey to green sandstone becoming conglomeratic towards the base and grey to black pyritic shale |
| M. MIOCENE | Yamen Fm. | 1875 | 100 | Mainly dark grey calcareous shale with some limestone, siltstone, and sandstone |
| PRE-MID-MIOCENE | Angang Fm. | 1975 | 13 | Sandstone, poorly sorted, argillaceous, calcareous, pyritic, and containing ironstone nodules |
| | | seismic Horizon 3 | | |
| EARLY JURASSIC | Basement | 1988 | 7+ | Dolerite, dark grey, coarsely crystalline, with high-angle veins containing quartz and calcite |
| | | T.D. 1995 | | |

BONGOS NO. 1

| AGE | UNIT | Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| | | 126 | | Mean sea level |
| M. PLIOCENE? | Nanu Fm. | | 106 | Mainly siltstone and clay with minor glauconitic sandstone |
| | | 232 | | |
| EARLY PLIOCENE | Ipe Fm. | | 18 | Medium grey-green soft calcareous mudstone with abundant macrofossils and microfossils |
| | | 250 | | |
| EARLY PLIOCENE | Korp Beds | | 27 | Glauconitic calcareous sandstone and grey-green siltstone with rare mudstone stringers |
| | | 277 | | |
| LATE MIOCENE | Keang River Beds | | 43 | Mainly sandstone, conglomerate, and grit, with interbedded blue-green mudstone |
| | | 320 | | |

TABLE 15 (CONT.)

| AGE | UNIT | BONGOS NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| EARLY MIOCENE | Economic Basement | | 468 | Dark grey to black indurated siltstone and shale with minor sandy patches and quartzite; beds are heavily fractured, commonly infilled with calcite and pyrite, and stained with limonite |
| | | 788 | | |
| OLIGOCENE? | Basement | | 648+ | Volcanics, tuffaceous sandstone, and injected serpentinite |
| | | T.D. 1436 | | |

The drilling confirmed the geophysical interpretation, and has consequently downgraded the prospectiveness of other anticlinal features in the area, with the exception of the Mai Mai anticline, where a shallow magnetic basement is not indicated and seismic evidence indicates more than 2000 m of Tertiary sediments.

Keram No. 1 was located about 180 km southeast of Bongos No. 1, in the Ramu Sub-basin. The limited seismic work in the Keram area had shown three persistent reflectors which could not be confidently related to the stratigraphic column established in areas of outcrop, and two northwest-trending anticlines separated by a deep syncline. The older part of the sequence was faulted and apparently absent from the crest of the structures, and no closure was demonstrated. Keram No. 1 was drilled as a stratigraphic test on the more prominent of the two structures so as to encounter all three continuous seismic reflectors, and also to investigate an isolated strong reflector thought to represent a reef limestone.

The well is the first ever drilled to basement in the Ramu Sub-basin and has established the stratigraphic sequence in the western part. Down to seismic horizon 1 a reasonable correlation could be made with the sequence cropping out on the southwestern flank of the Adelbert Range, and the stratigraphic names used there have been applied in the well. The sequence below the upper seismic horizon has been regarded as a new sequence in the absence of any definite correlation between it and the fragmentary outcrop of older sedimentary rocks. The names used are informal. The three main seismic horizons were easily identified with defined lithological changes in the well, and the upper two were intersected very close to the predicted depth. The deepest horizon, identified as top of basement, was intersected about 150 m lower than predicted. A band of dense limestone intersected at 1586 m in the Yip Formation is correlated with the seismic event which was thought to indicate a reef. The only indications of hydrocarbons were good gas shows recorded during drilling in the Urasiki Sandstone.

## PAPUAN BASIN

Two subsidized wells were drilled, and four subsidized geophysical surveys carried out in 1973. The results of one of the geophysical surveys, the Bamu gravity and magnetic were not released at December 31, 1974.

## SUBSIDIZED DRILLING

Lake Murray Nos 1 and 2 (Table 16) were located in western Papua between Lake Murray and the Upper Fly River. The subsurface geology was previously known only from geophysical data - the nearest deep well being Aramia No. 1 (1955), about 130 km to the southeast.

The wells were drilled on a large regional high separating the Morehead Basin from the Kutubu Trough. They were located on a culmination with 52 $km^2$ areal and 97.5 m vertical closure defined by the Upper Fly River-Lake Murray seismic survey (see below), to test the hydrocarbon potential of the Mesozoic section. Lake Murray No. 2 was 2.6 km downflank from Lake Murray No. 1.

The only Mesozoic sediments in the wells were of Early Cretaceous age, indicating that the regional basement high was emergent during the Jurassic and most of the Cretaceous.

In Lake Murray No. 1 there were significant indications of gas from four separate zones during drilling: an upper one in Miocene limestone, and the remainder in the Lower Cretaceous section. On drill-stem testing, the upper zone yielded fresh water with dissolved methane. Poor hole conditions prevented testing of a zone at 1685 m and one between 1664 m and 1662.7 m but a drill-stem test of the zone between 1677.9 m and 1681 m yielded dry gas at a rate of 284 McfD. This is the first actual flow of gas obtained from wells in this part of western Papua. The Lower Cretaceous sequence was thinner and considerably more argillaceous than in Aramia No. 1. There were no indications of hydrocarbons in Lake Murray No. 2, which intersected a basal Cretaceous Sandstone (not present in Lake Murray No. 1) that had good reservoir characteristics but was salt-water-filled.

Seismic work has indicated the existence of basement highs in the area between Lake Murray No. 1 and Aramia No. 1, and consequently the possible presence of stratigraphic and structural traps. The drilling enabled the two most persistent seismic horizons in the Lake Murray area to be identified as base Tertiary and basement.

A date of 1403 m.y. (Precambrian) was obtained for the quartz diorite basement rock by the K/Ar method. The Company considers this age to be excessive and due to extraneous $Ar^{40}$ incorporated in the amphibole at the time of metamorphism.

TABLE 16: STRATIGRAPHIC TABLES, PAPUAN BASIN

| AGE | UNIT | LAKE MURRAY NO. 1 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| RECENT-PLEISTOCENE | Lake Murray Beds | Surface | 31 | Clay with limonite nodules passing down into argillaceous sand |
| PLIOCENE | - | 31 | 384 | Fossiliferous carbonaceous mudstone with interbeds of unconsolidated glauconitic sandstone |
| PLIO-MIOCENE | Transition | 415 | 48 | Calcareous mudstone and sandstone grading into arenaceous limestone in places; transition from open marine to shoreline environment |
| LATE MIOCENE | | 463 | 458 | Calcarenite to calcirudite, dolomitic at depth |
| M. MIOCENE | | 921 | 121 | Calcarenite, richly fossiliferous |
| EARLY MIOCENE | | 1042 | 192 | Calcarenite fine to coarse fossiliferous, with fossils more abundant towards the base |
| EARLY CRETACEOUS | Shale | 1234 | 429 | Mainly soft mudstone firming into a shale below 1524 m |
| | Shale & Sandstone | 1663 | 74 | Mainly shale with fine interbeds of siltstone and sandstone; good gas shows from sandstone between 1633 m and 1686 m |
| PALAEOZOIC? | Basement | 1737 | 28+ | Quartz diorite |
| | | T.D. 1765 | | |

| AGE | UNIT | LAKE MURRAY NO. 2 Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|---|
| RECENT-PLEISTOCENE | Lake Murray Beds | Surface | 37 | Clay with limonite nodules passing down into argillaceous sand |
| PLIOCENE | - | 37 | 409 | Soft carbonaceous fossiliferous mudstone with interbeds of argillaceous glauconitic unconsolidated sandstone |
| PLIO-MIOCENE | Transition | 446 | 57 | Calcareous fossiliferous mudstone with minor calcareous sandstone, becoming in places an arenaceous limestone or coquina |
| LATE MIOCENE | | 503 | 444 | Calcarenite to calcirudite composed of fossil fragments; dolomitization from 686 m increases with depth |
| M. MIOCENE | | 947 | 112 | No samples - probably calcarenite with abundant fossils and a clear calcite cement |
| EARLY MIOCENE | | 1059 | 204 | No samples - probably calcarenite, richly fossiliferous towards the base |
| | Shale | 1263 | 485 | Plastic mudstone firming with depth to a fissile shale; minor sandstone bands |
| EARLY CRETACEOUS | Shale & Sandstone | 1748 | 124 | Grey glauconitic shale with finely interbedded tight glauconitic sandstone, basal limestone bands |
| | Basal Sandstone | 1872 | 43 | Calcarenite interbedded with shale at top, changing to massive white-grey sandstone with kaolin cement and becoming an arkose at depth |
| PALAEOZOIC? | Basement | 1915 | 9+ | Deeply weathered finely crystalline diorite |
| | | T.D. 1934 | | |

## SUBSIDIZED GEOPHYSICS

### Onshore

The Upper Fly River-Lake Murray seismic and gravity survey preceded the drilling of Lake Murray Nos 1 and 2. It was a follow-up of the Fly, Strickland, and Aramia Rivers seismic survey (BMR file, 70/899), which indicated a number of small structural closures along the Fly River, and a large regional high between the Fly River and Lake Murray. The 1973 survey was designed to investigate these features. Three horizons were mapped on generally fair to good-quality seismic data: seismic horizon A was interpreted as an horizon near the top of the Miocene limestone; horizon B, at or near the top of the Mesozoic depending on its location in the survey area; and horizon C, just above basement or in some areas as a basement event. Isochron maps of the A-B and B-C intervals were also presented. The survey confirmed the existence of a northwest-trending regional basement high between the Fly River and Lake Murray, separating the Morehead Basin from the Kutubu Trough. A number of structural closures were delineated along the high; one of them was recommended for drilling and subsequently tested by Lake Murray Nos 1 and 2. In these wells horizons B and C proved to be base Tertiary and basement respectively. The gravity results showed a high degree of correlation with the seismic results, in terms of both the large-scale regional high and the localized culminations. The survey was a major contribution to petroleum exploration in the Papuan Basin. The utilization of digital recording and helicopter transport resulted in the completion of an extensive network of seismic coverage of sufficiently good quality to enable drill sites to be located.

The Kiwai seismic survey was a combined shallow-water marine and land program carried out in the estuaries of the Fly and Bamu Rivers of western Papua. The area lies near the southwestern flank of the Papuan Basin where Mesozoic and Tertiary sediments thin against the Cape York-Oriomo basement high. A number of northwest-trending intra-Mesozoic anticlines were indicated by earlier seismic work. One, extending from Abo Island to Magobu Island was drilled by Magobu No. 1 (BMR file, 70/581) to test the hypothesis that the anticlinal trend coincides with an intra-Mesozoic strand line where massive lenticular sand bodies may have developed. The well confirmed the postulate, by penetrating two massive northwest-trending barrier sand complexes of Early Cretaceous and Middle Jurassic age. The Kiwai survey was designed to obtain close seismic control over the southwestern part of the survey area, and reconnaissance coverage over the northeastern part. However, the quality of the data obtained was generally poor, particularly on land. The Fly River delta - combining fast flowing shallow water, heavily timbered swampy islands, shifting mud banks, and unchartered waters - is an intrinsically difficult area from which to obtain seismic data. The poor-quality data obtained on land appears to have been due to the effect of the unusually dry weather on the recording techniques employed. The three horizons mapped were identified at Magobu Island No. 1 as: horizon B - top Cretaceous; horizon B' - base Cretaceous marine shale, and horizon C - basement (Carboniferous? volcanics in the well). Isochron maps B-B' and B'-C were also presented. In the northern part of the survey area a shallow horizon identified as 'top Miocene limestone' could be picked, but became too shallow in the southern part. The reliability of the maps is limited by the generally poor quality of the data, and further seismic work will be necessary to produce a reliable structural picture. The maps showed a regional dip to the northeast, and a northwesterly trending anticline with three culminations passing through Magobu Island. A possible small closure was indicated near Kuragimin Island and another south of Diribi Island.

## Offshore

The Western Gulf of Papua seismic survey was designed to extend reconnaissance coverage in the western and northwestern part of the Gulf, and to further investigate previous seismic indications of possible hydrocarbon traps associated with structures in the Mesozoic and in the Miocene limestone reefs. The survey included a pilot scheme for the reprocessing of previous Australasian Petroleum Company records to see whether Mesozoic and basement reflections could be recognized. If successful, the reprocessed older records would provide a useful guide for the placement of future seismic traverses.

However, only marginal improvement was obtained on the Mesozoic and basement horizons, the only real improvement being on the Miocene horizon. The quality of the new data obtained was generally fair to good to the base of the Tertiary but generally poor at deeper levels. The four horizons mapped were: top of Miocene carbonate; base of Tertiary; intra Mesozoic; and basement. On the upper horizon, the most promising regional feature is the edge of the Miocene limestone shelf which extends roughly southwards from the mouth of the Paibuna River and marks the transition zone between shallow-water shelf limestone to the west and deep-water carbonates to the east. Positive anomalies believed to be reefal in origin occur along the western side of the boundary, one near the mouth of the Paibuna River. Farther west and southwest the upper horizon is only mildly disturbed, but to the east of the boundary it exhibits greater relief. In the Era Bay-Bevan Sound area the survey confirmed previous interpretation of the Era Bay Feature as an arcuate Miocene atoll-reef complex overlying Eocene shelf limestone. The underlying base Tertiary horizon shows a similar structural pattern. The maps on the intra-Mesozoic and basement horizons, although generally less reliable, did confirm the presence of the Era Bay structure and further defined faulted anticlinal structures in the Turamu River and Goaribari-Ibibubari Islands area. Additional structures were indicated in the Fly River Delta, but these will require further detailing.

## TROBRIAND BASIN

Two subsidized wells (Table 17) were drilled, and one subsidized seismic survey was carried out in 1973.

Goodenough No. 1 was the first well to be drilled in the Trobriand Basin - a seismically defined deep east-trending trough with numerous small structures associated with major anticlinal trends running parallel to the northern and southern margins (Trobriand Island Marine Seismic survey, BMR file, 72/822). The well was drilled on the southern flank of the basin on a structure defined by the Trobriand Island detail seismic survey (BMR file 72/3268) to test the hydrocarbon potential of possible sandstone and carbonate units within the Miocene sequence. No reservoir rocks were intersected.

The well has, however, provided a stratigraphic sequence for the southern part of the basin. The intra-Pliocene unconformity is based on faunal evidence. Planktonic foraminifera from a sidewall core at 2811.8 m indicates a marine depositional environment.

Nubiam No. 1 was drilled on a seismically defined structural high bordering the northern side of the basin. The seismic anomaly was interpreted as Miocene to Pliocene reefal limestone, which was the primary drilling target. The geophysical interpretation proved to be incorrect. No reefal limestone was intersected and there were no significant indications of hydrocarbons. Good correlation was established with Goodenough No. 1: the Pliocene is finer grained in Nubiam No. 1, where limestones indicate a greater marine influence. A marked increase in the gamma-ray log at 780 m appears to be related to an abundance of muscovite, and might

TABLE 17: STRATIGRAPHIC TABLES, TROBRIAND BASIN

| AGE | GOODENOUGH NO. 1<br>Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|
| RECENT-<br>PLEISTOCENE | 40 | 213 | Reefal carbonate |
| PLEISTOCENE | 253 | 277 | Marl and carbonate |
| PLIOCENE | 530 | 654 | Coarse clastics with basic igneous and metamorphic rock fragments |
| EARLY PLIOCENE-<br>LATE MIOCENE | 1184 | 105 | Shale, grey-green, no effective porosity |
| " | 1289 | 196 | Interbedded sandstone, grey to green argillaceous, with igneous rock fragments, and shale, grey to green, arenaceous, with lignite |
| LATE MIOCENE | 1485 | 614 | Shale, grey to brown or green, no effective porosity |
| LATE-MID MIOCENE | 2099 | 186 | Interbedded marl and shale |
| M. MIOCENE | 2285 | 269 | Interbedded shale, marl and tuff |
| " | 2554 | 61 | Tuff, white, medium to coarse, ferromags and igneous rock fragments common |
| UNKNOWN<br>(MID-EARLY MIOCENE?) | 2615 | 220 | Weathered volcanics, basalt and volcanoclastics |
| | T.D.<br>2835 | | |

| AGE | NUBIAM NO. 1<br>Depth(m)K.B. | Thickness(m) | LITHOLOGY |
|---|---|---|---|
| RECENT-<br>PLEISTOCENE | 40 | 310 | Bioclastic limestone |
| PLIOCENE | 350 | 430 | Interbedded micaceous shale, siltstone, sandstone and sandy limestone |
| LATE MIOCENE-<br>EARLY PLIOCENE | 780 | 318 | Interbedded fine-grained sandstone, siltstone, shale, and lignite |
| LATE MIOCENE | 1098 | 517 | Shale, grey-green, no effective porosity, with minor limestone and marl, basal tuff |
| LATE-MID-MIOCENE | 1615 | 317 | Interbedded marl, limestone and tuff |
| M. MIOCENE | 1932 | 116 | Marly shale |
| ? | ? | | ? ? |
| M. MIOCENE | 2048 | 242 | Interbedded shale, marl, and tuff |
| ? | ? | | ? ? |
| M. MIOCENE | 2290 | 77 | Volcanoclastics |
| | T.D.<br>2367 | | |

reflect the first exposure to erosion of the micaceous metamorphic rocks on Goodenough and Fergusson Islands. The presence of tuff in the Miocene sequence suggests that the well was closer to contemporaneous volcanic activity than Goodenough No. 1.

## SUBSIDIZED GEOPHYSICS

The Kiriwina detail marine seismic survey was carried out in the northeastern part of the basin. The primary objective was to increase seismic control across buried reefs interpreted from earlier seismic work on and fringing a plateau in the northeastern part of the basin, and to search for additional evidence of the presence of reefs in the area. A secondary objective was to extend regional control by using a floating cable in shallow-water areas inaccessible with a streamer cable.

Only one horizon, the strongest and most continuous of the deeper reflections, was mapped, using the new and all previously recorded reflection data. Five anticlines were mapped, and four areas of possible reefal development indicated. Nubiam No. 1 was drilled to test one of the interpreted reefs. The floating-cable data, although inferior to that obtained with a streamer cable, was sufficiently good to allow evaluation of the sedimentary sequence in the shallow-water areas.

## ACKNOWLEDGMENT

The author is grateful to Dianne Cronk and L.K. Rixon for their assistance in the preparation of tables.

TABLE 18: WELLS DRILLING IN 1973

| BASIN<br>COMPANY<br>Well Name<br>BMR file no. if subsidized | Latitude South<br>Longitude East<br>° | ' | " | 1:250 000<br>Sheet<br>Area | Elevation (metres)<br>GL/WD<br>DF/KB/RT | | Date Spudded<br>TD Reached | | | TD (metres)<br>at 31.12.73 | Status at 31.12.73 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AMADEUS<br>MAGELLAN PETROLEUM<br>AUSTRALIA LIMITED | | | | | | | | | | | |
| Palm Valley No. 3 | 24 | 00 | 25 | G 53/1 | GL | 921.7 | 5 | 1 | 73 | 2408.2 | Completed as a shut-in |
| | 132 | 36 | 58 | | KB | 926.6 | 1 | 3 | 73 | | gas well |
| BASS<br>ESSO EXPLORATION AND<br>PRODUCTION INC. | | | | | | | | | | | |
| Dondu No. 1 | 39 | 59 | 12 | J 55/14 | WD | 82.0 | 30 | 5 | 73 | 2926.9 | PA |
| | 146 | 13 | 03 | | KB | 9.8 | 28 | 6 | 73 | | |
| Konkon No. 1 | 39 | 12 | 20 | J 55/13 | WD | 70.1 | 13 | 5 | 73 | 1537.1 | PA |
| | 145 | 03 | 40 | | KB | 9.8 | 27 | 5 | 73 | | |
| Narimba No. 1 | 40 | 16 | 18 | K 55/2 | WD | 77.1 | 31 | 8 | 73 | 3353.7 | PA |
| BMR file 73/251 | 145 | 43 | 54 | | KB | 9.8 | 1 | 10 | 73 | | |
| Yurongi No. 1 | 39 | 55 | 32 | J 55/14 | WD | 82.9 | 3 | 7 | 73 | 2438.4 | PA |
| | 146 | 15 | 59 | | KB | 9.8 | 14 | 7 | 73 | | |
| BONAPARTE GULF<br>ARCO AUSTRALIA LTD | | | | | | | | | | | |
| Swan No. 1 | 12 | 11 | 17 | D 51/3 | WD | 109.1 | 20 | 12 | 72 | 3284.2 | PA |
| | 124 | 29 | 34 | | KB | 34.1 | 30 | 1 | 73 | | |

TABLE 18. (Continued)

| BASIN<br>COMPANY<br>Well Name<br>BMR file no. if subsidized | Latitude South<br>Longitude East<br>° | ' | " | 1:250 000<br>Sheet<br>Area | Elevation (metres)<br>GL/WD<br>DF/KB/RT | | Date Spudded<br>TD Reached | | | TD (metres)<br>at 31.12.73 | Status at 31.12.73 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B.O.C. of AUSTRALIA LTD | | | | | | | | | | | |
| North Hibernia No. 1 | 11 | 40 | 19 | C 51/15 | WD | 32.9 | 10 | 10 | 73 | 3678.0 | In progress |
| BMR file 73/262 | 123 | 19 | 29 | | KB | 13.1 | | - | | | |
| BOWEN | | | | | | | | | | | |
| ASSOCIATED AUSTRALIAN RESOURCES NL | | | | | | | | | | | |
| S.E. Roma Basement Valley Project | | | | | | | | | | | |
| Blue Hills No. 1 | 26 | 36 | 28 | G 55/12 | GL | 328.9 | 3 | 9 | 73 | 1742.2 | PA |
| BMR file 73/249 | 149 | 04 | 05 | | KB | 332.2 | 20 | 9 | 73 | | |
| Paddy Ward No. 1 | 26 | 42 | 05 | G 55/12 | GL | 302.1 | 18 | 10 | 73 | 1757.8 | PA |
| BMR file 73/249 | 149 | 06 | 50 | | KB | 305.4 | 1 | 11 | 73 | | |
| Six Mile No. 1 | 26 | 39 | 40 | G 55/12 | GL | 313.0 | 28 | 9 | 73 | 1637.1 | PA |
| BMR file 73/249 | 149 | 04 | 20 | | KB | 316.4 | 13 | 10 | 73 | | |
| SOUTHERN UNION ENERGY PTY LTD | | | | | | | | | | | |
| Banoona South No. 1 | 26 | 55 | 19 | G 55/12 | GL | 270.7 | 2 | 2 | 73 | 1650.2 | PA |
| BMR file 73/201 | 149 | 08 | 48 | | KB | 274.0 | 12 | 2 | 73 | | |
| BREMER | | | | | | | | | | | |
| SILFAR OIL AND GAS SEARCH COMPANY PTY LTD | | | | | | | | | | | |
| Kendenup No. 1 | 34 | 29 | 36 | I 50/11 | GL | 168.2 | 19 | 12 | 73 | 60.9 | In progress |
| | 117 | 45 | 22 | | KB | 159.4 | | - | | | |
| BROWSE | | | | | | | | | | | |
| B.O.C. OF AUSTRALIA LTD | | | | | | | | | | | |
| Londonderry No. 1 | 13 | 36 | 53 | D 51/8 | WD | 91.0 | 28 | 9 | 73 | 1145.1 | PA |
| | 124 | 30 | 43 | | RT | 13.1 | 6 | 10 | 73 | | |

TABLE 18. (Continued)

| BASIN<br>COMPANY<br>Well Name<br>BMR file no. if subsidized | Latitude South<br>Longitude East<br>° | ' | " | 1:250 000<br>Sheet<br>Area | Elevation (metres)<br>GL/WD<br>DF/KB/RT | | Date Spudded<br>TD Reached | | | TD (metres)<br>at 31.12.73 | Status at 31.12.73 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Yampi No. 1 | 14 | 33 | 32 | D 51/11 | WD | 91.1 | 3 | 6 | 73 | 4176.1 | PA |
| BMR file 73/214 | 123 | 16 | 34 | | RT | 13.1 | 16 | 9 | 73 | | |
| CANNING | | | | | | | | | | | |
| AMAX PETROLEUM (AUSTRALIA) INC. | | | | | | | | | | | |
| Wamac No. 1 | 17 | 14 | 26 | E 51/5 | WD | 75.9 | 6 | 8 | 73 | 2764.2 | PA |
| BMR file 73/246 | 121 | 29 | 29 | | RT | 10.1 | 8 | 10 | 73 | | |
| AUSTRALIAN AQUITAINE PETROLEUM PTY LTD | | | | | | | | | | | |
| Contention Heights No. 1 | 22 | 25 | 36 | F 52/9 | GL | 418.5 | 15 | 8 | 73 | 1790.7 | PA |
| BMR file 73/230 | 127 | 13 | 31 | | RT | 422.8 | 24 | 9 | 73 | | |
| HEMATITE PETROLEUM PTY LTD | | | | | | | | | | | |
| Keraudren No. 1 | 18 | 54 | 27 | E 50/12 | WD | 95.1 | 31 | 8 | 73 | 3844.1 | PA |
| BMR file 73/240 | 119 | 09 | 15 | | RT | 30.5 | 13 | 12 | 73 | | |
| SHELL DEVELOPMENT (AUSTRALIA) PTY LTD | | | | | | | | | | | |
| East Mermaid No. 1 | 17 | 10 | 01 | E 50/8 | WD | 387.7 | 14 | 6 | 73 | 4067.6 | PA |
| | 119 | 49 | 21 | | RT | 17.4 | 9 | 10 | 73 | | |
| WEST AUSTRALIAN PETROLEUM PTY LTD | | | | | | | | | | | |
| Mimosa No. 1 | 17 | 44 | 58 | E 51/8 | GL | 53.7 | 17 | 6 | 73 | 4116.9 | PA |
| BMR file 73/233 | 124 | 35 | 00 | | KB | 58.5 | 17 | 8 | 73 | | |
| Mt Hardman No. 1 | 18 | 00 | 38 | E 51/12 | GL | 112.0 | 6 | 9 | 73 | 3360.1 | PA |
| BMR file 73/259 | 124 | 54 | 48 | | RT | 117.0 | 6 | 11 | 73 | | |
| Thangoo No. 2 | 18 | 26 | 32 | E 51/10 | GL | 187.6 | 9 | 5 | 73 | 1472.2 | PA |
| BMR file 73/218 | 122 | 54 | 33 | | RT | 193.0 | 3 | 5 | 73 | | |

TABLE 18. (Continued)

| BASIN<br>COMPANY<br>Well Name<br>BMR file no. if subsidized | Latitude South<br>Longitude East<br>° | ' | " | 1:250 000<br>Sheet<br>Area | Elevation (metres)<br>GL/WD<br>DF/KB/RT | | Date Spudded<br>TD Reached | | | TD (metres)<br>at 31.12.73 | Status at 31.12.73 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CARNARVON | | | | | | | | | | | |
| B.O.C. OF AUSTRALIA LTD | | | | | | | | | | | |
| Angel No. 3 | 19 | 32 | 30 | E 50/14 | WD | 67.1 | 27 | 4 | 73 | 3779.8 | Secured as an offshore |
| | 116 | 37 | 43 | | RT | 9.5 | 21 | 6 | 73 | | gas well |
| Dockrell No. 1 | 19 | 47 | 17 | E 50/14 | WD | 110.0 | 30 | 6 | 73 | 3895.0 | Secured as an offshore |
| | 115 | 46 | 47 | | RT | 29.9 | 17 | 8 | 73 | | oil and gas well |
| Egret No. 1 | 19 | 30 | 23 | E 50/14 | WD | 118.9 | 24 | 12 | 72 | 3657.6 | Secured oil discovery |
| BMR file 72/3357 | 116 | 20 | 50 | | RT | 12.5 | 16 | 5 | 73 | | well |
| Goodwyn No. 3 | 19 | 44 | 09 | E 50/14 | WD | 118.9 | 16 | 12 | 72 | 3657.6 | Secured as an offshore |
| | 115 | 52 | 40 | | RT | 30.2 | 8 | 2 | 73 | | oil and gas well |
| Goodwyn No. 4 | 19 | 41 | 38 | E 50/14 | WD | 129.8 | 24 | 2 | 73 | 3632.3 | Secured as an offshore |
| | 115 | 50 | 54 | | RT | 30.2 | 7 | 6 | 73 | | gas well |
| Lambert No. 1 | 19 | 27 | 24 | E 50/14 | WD | 122.0 | 13 | 11 | 73 | 3476.2 | In progress |
| | 116 | 29 | 23 | | KB | 10.1 | | - | | | |
| Nelson Rocks No. 1 | 19 | 33 | 37 | E 50/14 | WD | 74.9 | 30 | 6 | 73 | 2189.9 | PA |
| | 116 | 51 | 19 | | RT | 10.1 | 30 | 7 | 73 | | |
| Poissonnier No. 1 | 19 | 18 | 31 | E 50/15 | WD | 82.9 | 20 | 12 | 73 | 1042.1 | In progress |
| | 118 | 09 | 20 | | RT | 29.9 | | - | | | |
| Ronsard No. 1 | 19 | 08 | 31 | E 50/15 | WD | 160.0 | 12 | 10 | 73 | 2848.1 | PA |
| BMR file 72/3330 | 117 | 09 | 39 | | KB | 10.1 | 11 | 11 | 73 | | |
| Rosemary No. 1 | 19 | 57 | 16 | E 50/14 | WD | 65.4 | 13 | 11 | 72 | 3909.1 | PA |
| BMR file 72/3127 | 116 | 20 | 41 | | RT | 9.5 | 26 | 3 | 73 | | |

TABLE 18. (Continued)

| BASIN<br>COMPANY<br>Well Name<br>BMR file no. if subsidized | Latitude South<br>Longitude East<br>° | ' | " | 1:250 000<br>Sheet<br>Area | Elevation (metres)<br>GL/WD<br>DF/KB/RT | | Date Spudded<br>TD Reached | | | TD (metres)<br>at 31.12.73 | Status at 31.12.73 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OCEANIA PETROLEUM PTY LTD | | | | | | | | | | | |
| Kalbarri No. 1 | 27 | 16 | 01 | G 50/13 | GL | 129.2 | 11 | 9 | 73 | 1539.5 | PA |
| BMR file 72/3358 | 114 | 06 | 27 | | KB | 133.2 | 2 | 10 | 73 | | |
| Tamala No. 1 | 26 | 38 | 48 | G 49/12 | GL | 2.7 | 4 | 4 | 73 | 1225.3 | PA |
| BMR file 72/3358 | 113 | 38 | 04 | | KB | 7.0 | 6 | 5 | 73 | | |
| WEST AUSTRALIAN PETROLEUM PTY LTD | | | | | | | | | | | |
| Barrow Deep No. 1 | 20 | 50 | 07 | F 50/1 | GL | 38.4 | 16 | 9 | 72 | 4650.0 | Completed as a potential |
| BMR file 72/2862 | 115 | 22 | 56 | | KB | 46.6 | 19 | 6 | 73 | | gas producer |
| West Tryal Rocks No. 1 | 20 | 13 | 45 | F 50/1 | WD | 137.8 | 23 | 10 | 72 | 3866.4 | Secured. Hydrocarbon |
| BMR file 72/3108 | 115 | 02 | 04 | | RT | 12.2 | 4 | 3 | 73 | | show |
| CLARENCE-MORETON | | | | | | | | | | | |
| CLARENCE OIL AND MINERALS CO. | | | | | | | | | | | |
| Hogarth No. 4 | 28 | 54 | 45 | H 56/2 | GL | 274.9 | 6 | 8 | 73 | 651.4 | In progress |
| | 152 | 51 | 26 | | | | | - | | | |
| COOPER | | | | | | | | | | | |
| DELHI INTERNATIONAL OIL CORPORATION | | | | | | | | | | | |
| Durham Downs No. 1 | 27 | 04 | 56 | G 54/15 | GL | 106.9 | 2 | 9 | 73 | 2749.6 | Completed as a potential |
| BMR file 73/229 | 141 | 47 | 27 | | KB | 111.3 | 1 | 10 | 73 | | gas producer |
| Wolgolla No. 1 | 28 | 10 | 49 | H 54/3 | GL | 134.3 | 19 | 10 | 73 | 2059.5 | Completed as a potential |
| BMR file 73/207 | 141 | 18 | 55 | | KB | 138.7 | 1 | 11 | 73 | | gas producer |
| VAMGAS NL | | | | | | | | | | | |
| Kanowana No. 1 | 27 | 47 | 57 | G 54/14 | GL | 30.5 | 9 | 12 | 72 | 3122.7 | Completed as a potential |
| BMR file 72/3282 | 139 | 58 | 42 | | KB | 35.8 | 8 | 1 | 73 | | gas producer |

TABLE 18. (Continued)

| BASIN<br>COMPANY<br>Well Name<br>BMR file no. if subsidized | Latitude South<br>Longitude East<br>° | ' | " | 1:250 000<br>Sheet<br>Area | Elevation (metres)<br>GL/WD<br>DF/KB/RT | | Date Spudded<br>TD Reached | | | TD (metres)<br>at 31.12.73 | Status at 31.12.73 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EROMANGA | | | | | | | | | | | |
| HENRY B. KELSEY | | | | | | | | | | | |
| Ban Ban No. 1 | 24 | 07 | 56 | G 54/4 | GL | 294.6 | 26 | 7 | 73 | 1402.7 | PA |
| BMR file 73/243 | 143 | 42 | 14 | | KB | 208.0 | 4 | 8 | 73 | | |
| Manfred No. 1 | 23 | 04 | 15 | F 54/16 | GL | 231.0 | 12 | 8 | 73 | 1192.7 | PA |
| | 143 | 57 | 40 | | KB | 234.4 | 19 | 8 | 73 | | |
| GEORGINA | | | | | | | | | | | |
| ALLIANCE OIL DEVELOPMENT AUSTRALIA NL | | | | | | | | | | | |
| Ethabuka No. 1 | 23 | 41 | 20 | F 54/13 | GL | 125.6 | 22 | 9 | 73 | 1960.5 | In progress |
| BMR file 73/224 | 138 | 25 | 30 | | KB | 120.4 | | - | | | |
| GIPPSLAND | | | | | | | | | | | |
| ESSO EXPLORATION AND PRODUCTION AUSTRALIA INC. | | | | | | | | | | | |
| Flounder No. 4 | 38 | 18 | 25 | J 55/11 | WD | 119.5 | 28 | 12 | 72 | 2623.7 | PA |
| | 148 | 29 | 45 | | DF | 9.7 | 24 | 1 | 73 | | |
| Kingfish No. 4 | 38 | 35 | 55 | J 55/11 | WD | 75.9 | 25 | 10 | 73 | 2509 | PA |
| | 148 | 05 | 45 | | KB | 9.6 | 11 | 11 | 73 | | |
| Mackerel No. 4 | 38 | 30 | 52 | J 55/11 | WD | 83.2 | 11 | 2 | 73 | 2651.8 | PA |
| | 148 | 18 | 55 | | KB | 9.8 | 10 | 5 | 73 | | |
| Marlin No. 4 | 38 | 14 | 24 | J 55/11 | WD | 61.3 | 5 | 10 | 73 | 2621.6 | PA |
| BMR file 73/216 | 148 | 16 | 03 | | KB | 9.8 | 21 | 10 | 73 | | |
| Marlin No. A 24 | 38 | 13 | 55 | J 55/11 | WD | 61.0 | 19 | 5 | 73 | 3351.3 | Suspended as deeper pool discovery - completed as a future shallower pool gas producer |
| BMR file 73/209 | 148 | 13 | 10 | | KB | 27.4 | 16 | 6 | 73 | | |

TABLE 18. (Continued)

| BASIN<br>COMPANY<br>Well Name<br>BMR file no. if subsidized | Latitude South<br>Longitude East<br>° | ' | " | 1:250 000<br>Sheet<br>Area | Elevation (metres)<br>GL/WD<br>DF/KB/RT | | Date Spudded<br>TD Reached | | | TD (metres)<br>at 31.12.73 | Status at 31.12.73 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pike No. 1 | 38 | 46 | 30 | J 55/11 | WD | 73.8 | 16 | 7 | 73 | 2133.6 | PA |
| | 147 | 56 | 59 | | KB | 9.8 | 25 | 7 | 73 | | |
| Stonefish No. 1 | 38 | 15 | 03 | J 55/12 | WD | 114.9 | 26 | 7 | 73 | 3188.6 | PA |
| | 148 | 33 | 36 | | KB | 9.8 | 25 | 8 | 73 | | |
| HEMATITE PETROLEUM PTY LTD | | | | | | | | | | | |
| Bullseye No. 1 | 38 | 35 | 30 | J 55/11 | WD | 58.5 | 24 | 11 | 73 | 2369.2 | PA |
| | 147 | 33 | 59 | | KB | 9.8 | 3 | 12 | 73 | | |
| Dart No. 1 | 38 | 08 | 13 | J 55/12 | WD | 121.3 | 16 | 11 | 73 | 1220 | PA |
| | 148 | 55 | 27 | | KB | 9.8 | 22 | 11 | 73 | | |
| SHELL DEVELOPMENT (AUSTRALIA) PTY LTD | | | | | | | | | | | |
| Sole No. 1 | 38 | 07 | 01 | J 55/12 | WD | 128.9 | 28 | 1 | 73 | 1128.7 | PA |
| | 149 | 02 | 04 | | KB | 9.8 | 8 | 2 | 73 | | |
| MONEY SHOAL | | | | | | | | | | | |
| SHELL DEVELOPMENT (AUSTRALIA) PTY LTD | | | | | | | | | | | |
| Lynedoch No. 1 | 9 | 51 | 43 | G 52/7 | WD | 236.5 | 14 | 2 | 73 | 3967.0 | PA |
| | 130 | 18 | 45 | | DF | 11.3 | 3 | 6 | 73 | | |
| OTWAY | | | | | | | | | | | |
| ESSO EXPLORATION AND PRODUCTION AUSTRALIA INC. | | | | | | | | | | | |
| Neptune No. 1 | 37 | 18 | 13 | J 54/5 | WD | 35.4 | 27 | 12 | 73 | 54.9 | In progress |
| | 139 | 44 | 09 | | RT | 9.8 | | - | | | |
| Trumpet No. 1 | 37 | 05 | 47 | J 54/5 | WD | 49.4 | 11 | 12 | 73 | 2256.1 | PA |
| | 139 | 24 | 42 | | KB | 9.8 | 26 | 12 | 73 | | |

TABLE 18 (Continued)

| BASIN<br>COMPANY<br>Well Name<br>BMR file no. if subsidized | Latitude South<br>Longitude East<br>° | ' | " | 1:250 000<br>Sheet<br>Area | Elevation (metres)<br>GL/WD<br>DF/KB/RT | | Date Spudded<br>TD Reached | | | TD (metres)<br>at 31.12.73 | Status at 31.12.73 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GENERAL EXPLORATION COMPANY OF AUSTRALIA PTY LTD | | | | | | | | | | | |
| Douglas Point No. 1 | 38 | 01 | 33 | J 54/10 | GL | 2.9 | 23 | 5 | 73 | 1206.7 | PA |
| BMR file 73/226 | 140 | 35 | 44 | | KB | 5.5 | 18 | 6 | 73 | | |
| Lake Eliza No. 2 | 37 | 13 | 13 | J 54/6 | GL | 9.1 | 31 | 8 | 73 | 1158.2 | PA |
| | 139 | 59 | 08 | | KB | 13.4 | 10 | 9 | 73 | | |
| JOHN HENRY RESOURCES PTY LTD | | | | | | | | | | | |
| Beachport East No. 1 | 37 | 27 | 00 | J 54/6 | GL | 12.2 | 14 | 8 | 73 | 1428.6 | PA |
| BMR file 73/220 | 140 | 05 | 10 | | KB | 16.8 | 24 | 8 | 73 | | |
| Diamond Swamp No. 1 | 37 | 21 | 46 | J 54/6 | GL | 10.7 | 14 | 7 | 73 | 1595.0 | PA |
| BMR file 73/221 | 140 | 23 | 23 | | KB | 14.9 | 7 | 8 | 73 | | |
| SHELL DEVELOPMENT (AUSTRALIA) PTY LTD | | | | | | | | | | | |
| North Eumeralla No. 1 | 38 | 09 | 51 | J 54/11 | GL | 54.9 | 30 | 11 | 73 | 1937.0 | In progress |
| BMR file 73/275 | 141 | 53 | 30 | | KB | 63.4 | | - | | | |
| PERTH | | | | | | | | | | | |
| WEST AUSTRALIAN PETROLEUM PTY LTD | | | | | | | | | | | |
| Lake Preston No. 1 | 32 | 55 | 13 | I 50/2 | GL | 10.2 | 20 | 12 | 72 | 4565.0 | PA |
| BMR file 72/3302 | 115 | 39 | 39 | | RT | 14.7 | 6 | 3 | 73 | | |
| SURAT | | | | | | | | | | | |
| ASSOCIATED AUSTRALIAN RESOURCES NL | | | | | | | | | | | |
| Bindango No. 1 | 26 | 27 | 55 | G 55/11 | GL | 415.7 | 5 | 1 | 73 | 1226.2 | PA |
| BMR file 72/3184 | 148 | 24 | 55 | | KB | 419.1 | 10 | 1 | 73 | | |
| Fairfield West No. 1 | 26 | 48 | 22 | G 55/12 | GL | 338.3 | 17 | 1 | 73 | 1474.6 | PA |
| BMR file 72/3363 | 149 | 01 | 05 | | KB | 341.7 | 25 | 1 | 73 | | |

TABLE 18. (Continued)

| BASIN<br>COMPANY<br>Well Name<br>BMR file no. if subsidized | Latitude South<br>Longitude East<br>° | ' | " | 1:250 000<br>Sheet<br>Area | Elevation (metres)<br>GL/WD<br>DF/KB/RT | Date Spudded<br>TD Reached | | | TD (metres)<br>at 31.12.73 | Status at 31.12.73 |
|---|---|---|---|---|---|---|---|---|---|---|
| L.S.G. AUSTRALIA INC. | | | | | | | | | | |
| Rockwood North No. 1 | 25 | 56 | 44 | G 56/9 | GL 310.9 | 10 | 8 | 73 | 1251.2 | PA |
| BMR file 73/247 | 150 | 23 | 44 | | KB 300.2 | 23 | 8 | 73 | | |
| MAYFAIR MINERALS INC. | | | | | | | | | | |
| Moree No. 2 | 29 | 06 | 11 | H 55/8 | GL 185.3 | 12 | 6 | 73 | 1221.9 | PA |
| BMR file 73/232 | 149 | 43 | 26 | | KB 188.7 | 26 | 6 | 73 | | |
| SYDNEY | | | | | | | | | | |
| BRIDGE OIL NL | | | | | | | | | | |
| Bringelly (Project NSW) No. 1 | 33 | 57 | 27 | I 56/5 | GL 63.2 | 8 | 7 | 73 | 704.4 | PA gas trace too small |
| BMR file 72/236 | 150 | 38 | 18 | | KB 67.3 | 28 | 7 | 73 | | to measure |
| Bringelly No. 2 | 33 | 59 | 51 | I 56/5 | GL 71.7 | 28 | 7 | 73 | 760.5 | Completed as a water |
| BMR file 72/236 | 150 | 45 | 16 | | KB 75.8 | 7 | 8 | 73 | | well |
| NORTH WEST OIL AND MINERALS CO. NL | | | | | | | | | | |
| Longley No. 1 | 33 | 21 | - | I 56/5 | GL 276.5 | 16 | 1 | 73 | 1031.1 | PA |
| | 151 | 17 | 30 | | KB - | 4 | 7 | 73 | | |
| PAPUA NEW GUINEA | | | | | | | | | | |
| NORTHERN NEW GUINEA | | | | | | | | | | |
| CONTINENTAL OIL COMPANY OF AUSTRALIA LIMITED | | | | | | | | | | |
| Keram No. 1 | 4 | 23 | 06 | B 55/1 | GL 11.9 | 28 | 12 | 73 | 283.5 | In progress |
| BMR file 73/254 | 144 | 09 | 23 | | KB 15.9 | | - | | | |
| GENERAL CRUDE OIL COMPANY OF AUSTRALIA LIMITED | | | | | | | | | | |
| Bongos No. 1 | 3 | 43 | 54 | A 54/16 | GL 121.9 | 13 | 8 | 73 | 1436.2 | PA |
| BMR file 71/767 | 142 | 38 | 25 | | KB 125.9 | 11 | 9 | 73 | | |

TABLE 18. (Continued)

| BASIN<br>COMPANY<br>Well Name<br>BMR file no. if subsidized | Latitude South<br>Longitude East<br>° | ' | " | 1:250 000<br>Sheet<br>Area | Elevation (metres)<br>GL/WD<br>DF/KB/RT | | Date Spudded<br>TD Reached | | | TD (metres)<br>at 31.12.73 | Status at 31.12.73 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PAPUAN | | | | | | | | | | | |
| CONTINENTAL OIL COMPANY OF AUSTRALIA LIMITED | | | | | | | | | | | |
| Lake Murray No. 1 | 7 | 10 | 04 | B 54/15 | GL | 22.9 | 16 | 8 | 73 | 1765.1 | PA gas show |
| BMR file 73/235 | 141 | 19 | 04 | | KB | 27.1 | 10 | 9 | 73 | | |
| Lake Murray No. 2 | 7 | 09 | 19 | B 54/15 | GL | 33.5 | 12 | 10 | 73 | 1933.7 | PA |
| BMR file 73/265 | 141 | 20 | 18 | | KB | 37.5 | 24 | 10 | 73 | | |
| TROBRIAND | | | | | | | | | | | |
| AMOCO AUSTRALIA EXPLORATION COMPANY | | | | | | | | | | | |
| Goodenough No. 1 | 8 | 57 | 51 | C 56/1 | WD | 27.4 | 24 | 7 | 73 | 2834.9 | PA |
| BMR file 73/223 | 150 | 19 | 49 | | KB | 12.2 | 11 | 6 | 73 | | |
| Nubian No. 1 | 8 | 43 | 23 | C 56/1 | WD | 27.7 | 25 | 6 | 73 | 2366.5 | PA |
| BMR file 73/238 | 150 | 47 | 44 | | KB | 12.2 | 2 | 8 | 73 | | |

TABLE 19: GEOPHYSICAL OPERATIONS DURING 1973

| BASIN<br>OPERATING COMPANY<br>Survey name<br>BMR file no. | Permit<br>1:250 000<br>Sheet Area | Duration | Extent |
|---|---|---|---|
| **ADAVALE BASIN** | | | |
| HARTOGEN EXPLORATIONS PTY LTD | | | |
| Mount Edinburgh seismic<br>BMR file 73/202 | ATP 183<br>G54-8<br>G55-5 | 2.5.73<br>7.6.73 | 160 km 4-fold and 6-fold CDP |
| **AMADEUS BASIN** | | | |
| MAGELLAN PETROLEUM (NT) PTY LTD. | | | |
| Central Amadeus seismic<br>BMR file 73/215 | OP 175, 178<br>F52-16<br>F53-13/14<br>G52-4<br>G53-1/2 | 3.7.73<br>25.4.74 | 893 km 12-fold CDP |
| Gardiner Range Gravity<br>BMR file 73/242 | OP 175, 178<br>F52-16<br>F53-13<br>G52-4<br>G53-1 | 1.10.73<br>11.1.74 | 970 stations on 262.6 km of line stations every 280 m |
| **BASS BASIN** | | | |
| HEMATITE PETROLEUM PTY LTD | | | |
| Flinders seismic<br>BMR file 73/258 | T/4P, T/3P<br>J55-13/14<br>K55-2 | 3.9.73<br>10.11.73 | 502 km 24-fold CDP and 95.6 km 48-fold CDP |
| **BONAPARTE GULF BASIN** | | | |
| AUSTRALIAN AQUITAINE PETROLEUM PTY LTD | | | |
| Quins seismic and gravity<br>BMR file 73/237 | OP 162<br>D52-11/15 | 12.8.73<br>30.9.73 | 116.6 km reflection 6-fold CDP<br>Gravity measurements at intervals of 400 m on E-W lines and 600 m on N-S lines |
| **BOWEN BASIN** | | | |
| HARTOGEN EXPLORATION PTY LTD | | | |
| Yambugle seismic<br>BMR file 73/203 | ATP 145 P<br>G55-12/16 | 16.11.73<br>22.11.73 | 29.93 km 4-fold CDP analog |
| TRICENTROL AUSTRALIA LTD | | | |
| Rocky Creek seismic<br>BMR file 73/270 | ATP 195 P<br>G55-12 | 11.11.73<br>19.12.73 | 75.6 km of 6-fold and 3-fold CDP |
| Yuleba Creek seismic<br>BMR file 72/3332 | ATP 195P<br>G55-12 | 17.1.73<br>22.2.73 | 9.7 km subsurface 6-fold CDP |

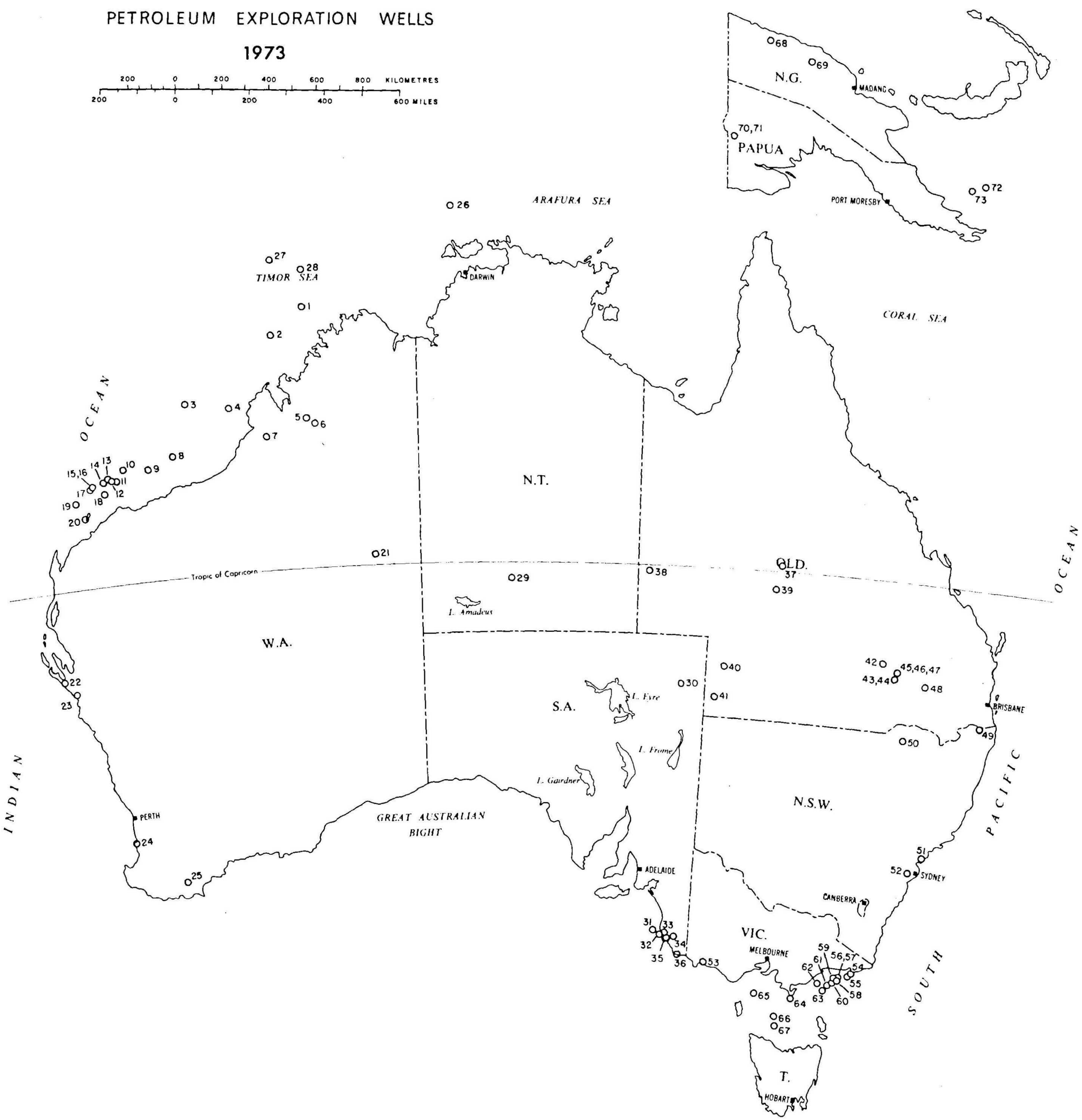
| BASIN | Permit | Duration | Extent |
| --- | --- | --- | --- |
| **BROWSE BASIN** | | | |
| B.O.C. OF AUSTRALIA LTD<br>Mermaid Cartier seismic<br>Project 73-H<br>BMR file 73/204 | WA-33, 34, 35, 37-P<br>NT/P5, P13<br>D51-2/3/5/6/7 | 28.2.73<br>16.4.73<br>(whole survey) | 3215.5 km 24-fold CDP |
| **CANNING BASIN** | | | |
| ASSOCIATED AUSTRALIAN OILFIELDS NL<br>Thornton seismic<br>BMR file 72/3362 | EP 58, 59<br>E52-13<br>F52-1/5/9 | 29.7.73<br>31.1.74 | 671.7 km 24-fold data |
| B.O.C. OF AUSTRALIA LTD<br>Mermaid Cartier seismic<br>Project 73-G<br>BMR file 73/204 | WA-30, 31, 32, 33-P<br>D51-9/10/13/14<br>E51-1/5 | See Browse Basin | 1646.4 km 24-fold CDP |
| HEMATITE PETROLEUM PTY LTD<br>Jaubert marine seismic and magnetometer<br>BMR file 73/212 | WA-29-P<br>E50-12<br>E51-9 | 9.3.73<br>12.3.73 | 175.4 km<br>24-fold CDP |
| WEST AUSTRALIAN PETROLEUM PTY LTD<br>Barbwire II (361) seismic<br>BMR file 73/263 | EP13, 19, 43<br>E51-16<br>E52-13 | 16.9.73<br>15.10.73 | 97 km 600 %<br>54 km 1200%<br>reflection<br>62 km reprocessing |
| Collins II (362) seismic<br>BMR file 73/248 | EP 37<br>E51-11 | 5.8.73<br>21.8.73 | 56 km 6-fold and 12-fold data |
| Crossland III (358) seismic<br>BMR file 73/244 | EP 18<br>E51-15/16 | 21.7.73<br>3.8.74 | 110.2 km 6-fold CDP |
| Doran (360) seismic<br>BMR file 73/267 | EP7<br>E51-11 | 19.10.73<br>2.11.73 | 12.4 600%<br>60 km 1200%<br>CDP reflection |
| Jones Range-Hall Range seismic projects<br>BMR file 73/255 | EP 17, 43, 44<br>E51-16 | 23.8.73<br>15.9.73 | 9.5 km 1200%<br>112.2 km 600% |
| Liveringa 2 seismic<br>BMR file 73/271 | EP 5<br>E51-7/11 | 4.11.73<br>8.11.73 | 30.9 km 6-fold CDP |
| Sahara II (357) seismic<br>BMR file 73/234 | EP 15<br>F51-3/7 | 5.7.73<br>15.7.73 | 64 km 6-fold CDP |
| **CARNARVON BASIN** | | | |
| B.O.C. OF AUSTRALIA LTD<br>De Grey Nose marine seismic<br>BMR file 73/213 | WA-1-P<br>E50-14/15 | 14.3.73<br>21.3.73 | 608.3 km 24-fold coverage |
| Steamboat Spit seismic<br>BMR file 72/3253 | WA-1, 29-P<br>F50-7/8/10/11 12/13/14 | 23.11.72<br>4.1.73 | 2639.3 km<br>24-fold CDP |

| MOREHEAD BASIN | Permit | Duration | Extent |
|---|---|---|---|
| TEXACO OVERSEAS PETROLEUM COMPANY<br>Morehead Reconnaissance seismic<br>BMR file 73/241 | P-55<br>C54-3 | 10.8.73<br>20.12.73 | 365.3 km 12-fold CDP reflection |
| **PAPUAN BASIN** | | | |
| BP PETROLEUM DEVELOPMENT AUSTRALIA PTY LTD<br>Lavani seismic and gravity<br>BMR file 73/279 | P46<br>B54-7 | 30.12.73<br>28.3.74 | 70.6 km of 12-fold CDP reflection. 674 refraction shots and 437 gravity stations |
| CONTINENTAL OIL COMPANY OF AUSTRALIA<br>Upper Fly River-Lake Murray seismic and gravity<br>BMR file 72/2422 | P43<br>B54-11/15 | 11.7.73<br>18.1.73 | 356.6 km of six fold CDP, 8.5 km of refraction and 766 gravity stns |
| ENDEAVOR OIL COMPANY NL<br>Bamu gravity and magnetic survey<br>BMR file 73/276 | L6, 7<br>B54-16<br>C54-4 | 13.12.73<br>16.5.74 | 1586 new gravity stations and 135 new magnetic stations |
| Kiwai land and marine seismic<br>BMR file 72/2783 | L6, 7<br>C54-4 | 15.9.72<br>26.1.73 | 600.3 km of single fold (4-fold vertically stacked) shallow water data 43.5 km of 6-fold CDP land data |
| PHILLIPS AUSTRALIAN OIL COMPANY<br>Western Gulf of Papua seismic<br>BMR file 73/273 | P36, 39, 67, 69<br>B54-16<br>B55-13<br>C54-4 | 15.1.73<br>6.12.73 | 177 km sum-2 12 fold coverage |
| **TROBRIAND BASIN** | | | |
| AMOCO AUSTRALIA EXPLORATION COMPANY<br>Kiriwina Detail marine seismic<br>BMR file 73/228 | PNG/15P<br>G56-1 | 17.5.73<br>23.5.73 | 325.1 km CDP (aquapulse) |

| BASIN | Permit | Duration | Extent |
|---|---|---|---|
| OTWAY BASIN | | | |
| ALLIANCE OIL DEVELOPMENT AUSTRALIA NL<br>Tartwaup seismic<br>BMR file 73/245 | PEL8<br>J54-6 | 14.10.73<br>22.1.74 | 302.3 km 12-fold CDP and 5.8 km of 24-fold CDP |
| HEMATITE PETROLEUM PTY LTD<br>Cape Nelson to Cape Otway seismic<br>BMR file 73/257 | VIC/P6, 7<br>T/3P<br>J55-10/11/12/15/16 | 14.9.73<br>22.10.73 | 2894 km of sum-3 24-fold CDP |
| INTERSTATE OIL LIMITED<br>Cape Otway marine seismic & magnetic<br>BMR file 73/266 | VIC/P10<br>J54-8/12 | 11.11.73<br>16.11.73 | 408.7 km 24-fold CDP reflection |
| SHELL DEVELOPMENT (AUSTRALIA) PTY LTD<br>Otway Coastal strip seismic<br>BMR file 73/200 | PEP 5, 6<br>J54-11 | 14.1.73<br>16.6.73 | 235.6 km 12-fold CDP |
| Ross Creek seismic<br>BMR file 73/264 | PEP6<br>J54-12 | 26.11.73<br>1.12.73 | 12 km 12-fold CDP vibroseis reflection |
| TEXACO OVERSEAS PETROLEUM COMPANY<br>Weam seismic<br>BMR file 73/284 | P55<br>C54-3/7 | 10.1.74<br>30.6.74 | 345.6 km of 12-fold CDP reflection |
| PERTH BASIN | | | |
| SUNNINGDALE OILS PTY LTD<br>Coolcalalaya gravity<br>BMR file 72/3303 | EP69<br>G50-13<br>H50-1 | 30.4.73<br>29.9.73 | 2535 stations |
| WEST AUSTRALIAN PETROLEUM PTY LTD<br>Coomallo 2 seismic<br>BMR file 73/206 | EP21<br>H50-9 | 8.2.73<br>17.2.73 | 35.4 km of 12-fold and 24-fold CDP |
| Mullering seismic<br>BMR file 73/208 | EP24<br>H50-9 | 18.2.73<br>10.5.73 | 196 km of 600% and 1200% CDP coverage 410 km reprocessed old line |
| Rockingham seismic<br>BMR file 72/3179 | EP25<br>I50-2 | 17.11.72<br>5.2.73 | 156 km 1200% and 1400% |
| Warradong II seismic<br>BMR file 73/211 | EP 21, 23<br>PL1<br>H50-5 | 8.3.73<br>14.3.73 | 47 km of detailed 6-fold |

| BASIN | Permit | Duration | Extent |
| --- | --- | --- | --- |
| WEST AUSTRALIAN PETROLEUM PTY LTD<br>Barrow 3 seismic<br>BMR file 73/227 | EP40<br>F50-1 | 17.5.73<br>3.6.73 | 16 km 2400%<br>CDP |
| Murat (356) seismic<br>BMR file 73/231 | EP41<br>F49-12/16<br>F50-9/30 | 14.6.73<br>30.6.73 | 43 km 1200%<br>CDP |
| Norwegian 2(359) seismic<br>BMR file 73/274 | EP41<br>F49-12 | 13.11.73<br>14.11.73 | 5.3 km reflection |
| COOPER BASIN<br>DELHI INTERNATIONAL OIL CORPORATION<br>Mudlankie seismic<br>BMR file 73/219 | PEL5, 6<br>ATP 66, 67P<br>G54-13/14/15<br>H54-1/2/3 | 1.5.73<br>5.10.73 | 628.5 km 12-fold and 112.0 km 6-fold digital vibroseis |
| EUCLA BASIN<br>COASTAL PETROLEUM NL<br>Scorpion Bight gravity and refraction seismic<br>BMR file 72/3276 | EP71<br>I52-1 | 5.1.73<br>20.1.73 | 109 gravity stns and 18.2 km of analog seismic |
| GALILEE BASIN<br>HEMATITE PETROLEUM PTY LTD<br>Wokingham Creek seismic<br>BMR file 73/239 | ATP166P<br>F54-8/11/12 | 5.7.73<br>13.8.73 | 16.9 km 600%<br>167.0 km 300%<br>137.3 km 100% |
| GIPPSLAND BASIN<br>MAGELLAN PETROLEUM AUSTRALIA LTD<br>North East Furneaux marine seismic<br>BMR file 73/225 | VIC./P24<br>T/1P, 4P<br>J55-11/12/16 | 22.5.73<br>23.5.73 | 169.0 km<br>24-fold CDP<br>59.5 km<br>refraction |
| MURRAY BASIN<br>BEAVER EXPLORATION AUSTRALIA NL<br>Menindee Regional seismic<br>BMR file 73/250 | PEL193, 197<br>H54-15/16<br>I54-3/4 | 3.9.73<br>2.11.73 | 227.7 km 6-fold<br>CDP analog |
| NGALIA BASIN<br>MAGELLAN PETROLEUM AUSTRALIA LTD<br>Mt Gurner gravity<br>BMR file 73/222 | OP165<br>F52-12 | 26.7.73<br>1.9.73 | 776 stations over 229 km of line |

# AUSTRALIA AND PAPUA NEW GUINEA
# PETROLEUM EXPLORATION WELLS
# 1973




Note; Unless otherwise stated, well location refers to No. 1 well

| | | | |
|---|---|---|---|
| 1 | Londonderry, W. A. | 38 | Ethabuka, Qld |
| 2 | Yampi, W. A. | 39 | Ban Ban, Qld |
| 3 | East Mermaid, W.A. | 40 | Durham Downs, Qld |
| 4 | Wamac, W.A. | 41 | Wolgolla, Qld |
| 5 | Mimosa, W.A. | 42 | Bindango, Qld |
| 6 | Mt Hardman, W.A. | 43 | Banoona South, Qld |
| 7 | Thangoo 2, W.A. | 44 | Fairfield West, Qld |
| 8 | Keraudren, W.A. | 45 | Blue Hills, Qld |
| 9 | Poissonier, W.A. | 46 | Paddy Ward, Qld |
| 10 | Ronsard, W.A. | 47 | Six Mile, Qld |
| 11 | Nelson Rocks, W.A. | 48 | Rockwood North, Qld |
| 12 | Angel 3, W.A. | 49 | Hogarth 4, N.S.W. |
| 13 | Lambert, W.A. | 50 | Moree 2, N.S.W. |
| 14 | Egret, W.A. | 51 | Longley, N.S.W. |
| 15 | Goodwyn 3, W.A. | 52 | Bringelly 1-2, N.S.W. |
| 16 | Goodwyn 4, W.A. | 53 | North Eumeralla, Vic. |
| 17 | Dockrell, W.A. | 54 | Sole, Vic. |
| 18 | Rosemary, W.A. | 55 | Dart, Vic. |
| 19 | West Tryal Rocks, W.A. | 56 | Marlin 4, Vic. |
| 20 | Barrow Deep, W.A. | 57 | Marlin A-24, Vic. |
| 21 | Contention Heights, W.A. | 58 | Stonefish, Vic. |
| 22 | Tamala, W.A. | 59 | Flounder 4, Vic. |
| 23 | Kalbarri, W.A. | 60 | Mackerel 4, Vic. |
| 24 | Lake Preston, W.A. | 61 | Kingfish 4, Vic. |
| 25 | Kendenup, W.A. | 62 | Bullseye, Vic. |
| 26 | Lynedoch, N.T. | 63 | Pike, Vic. |
| 27 | North Hibernia, N.T. | 64 | Yurongi, Tas. |
| 28 | Swan, N.T. | 65 | Konkon, Tas. |
| 29 | Palm Valley 3, N.T. | 66 | Dondu, Tas. |
| 30 | Kanowana, S.A. | 67 | Narimba, Tas. |
| 31 | Trumpet, S.A. | 68 | Bongos, PNG |
| 32 | Neptune, S.A. | 69 | Keram, PNG |
| 33 | Lake Eliza 2, S.A. | 70 | Lake Murray, PNG |
| 34 | Diamond Swamp, S.A. | 71 | Lake Murray 2, PNG |
| 35 | Beachport East, S.A. | 72 | Nubiam, PNG |
| 36 | Douglas Point, S.A. | 73 | Goodenough, PNG |
| 37 | Manfred, Qld | | |

*B.M.R. Petroleum Exploration Branch, 1974*

X AUS-1-15R

AUSTRALIA AND PAPUA NEW GUINEA

# GEOPHYSICAL OPERATIONS

UNDER PETROLEUM SEARCH SUBSIDY ACT 1959 - 1973

## 1973


S SEISMIC

S1 Thornton, W.A.
S2 Mermaid-Cartier, W.A.
S3 Jaubert, W.A. (& Magnetic)
S4 Barbwire 2, W.A.
S5 Collins II, W.A.
S6 Crossland III, W.A.
S7 Doran, W.A.
S8 Jones Range-Hall Range, W.A.
S9 Liveringa 2, W.A.
S10 Sahara II, W.A.
S11 De Grey Nose, W.A.
S12 Steamboat Spit, W.A.
S13 Barrow 3, W.A.
S14 Murat, W.A.
S15 Norwegian 2, W.A.
S16 Scorpion Bight, W.A. (& Gravity)
S17 Coomallo 2, W.A.
S18 Mullering, W.A.
S19 Rockingham, W.A.
S20 Warradong II, W.A.
S21 Central Amadeus, N.T.
S22 Quins, N.T. (& Gravity)
S23 Mudlankie, S.A.
S24 Tartwaup, S.A.
S25 Mt Edinburgh, Qld
S26 Yambugle, Qld
S27 Wokingham Creek, Qld
S28 Rocky Creek, Qld
S29 Yuleba Creek, Qld
S30 Menindee, N.S.W.
S31 Ross Creek, Vic.
S32 Otway Coastal Strip, Vic.
S33 Cape Ctway, Vic. (& Magnetic)
S34 Cape Nelson-Cape Otway, Vic. & Tas.
S35 North East Furneaux, Vic. & Tas.
S36 Flinders, Tas.
S37 Morehead, PNG
S38 Upper Fly River-Lake Murray, PNG (& Gravity)
S39 Kiwai, PNG
S40 Western Gulf of Papua, PNG
S41 Kiriwina, PNG

G GRAVITY

G1 Coolcalalaya, W.A.
G2 Mount Gurner, N.T.
G3 Gardiner Range, N.T.
G4 Bamu, PNG (&Magnetic)

B.M.R. Petroleum Exploration Branch, 1974

X AUS-I-16R