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Australian Petroleum Accumulations Report 7
Browse Basin

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Petroleum Resource Assessment Branch

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FOREWORD

This is the seventh in a series of reports prepared by the Bureau of Mineral Resources, Geology & Geophysics (BMR) presenting data on Australia's identified petroleum resources. Each report describes the petroleum accumulations found in a particular sedimentary basin, and presents information on basin setting, stratigraphy, structure, traps, reservoir and source rocks, petroleum characteristics, reserves, development and production. The six published reports in this series cover the Amadeus, Bass, Gippsland, Adavale, Bonaparte and Otway Basins. Reports on the Canning, Surat-Bowen, Carnarvon, Perth, Eromanga, and Cooper Basins are scheduled for future publication.

Paul E. Williamson
Assistant Director
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ABSTRACT

As at 30 June 1991 the Browse Basin, located along the North West Shelf of the Australian mainland, was known to contain a total of three subeconomic and three uneconomic accumulations of petroleum all of which remain undeveloped. All have been discovered during intermittent periods of exploration drilling which has taken place since the late 1960's.

The Scott Reef, Brecknock and Brewster accumulations contain a very large volume of gas reserves which are currently uneconomic to develop because of the logistics of developing gas reserves in deep water at a significant distance to landfall (300 km).

INTRODUCTION

This report summarises technical information on the petroleum and non-petroleum accumulations found in the Browse Basin up to 30 June 1991. The report contains a brief overview of the geology of the Browse Basin and describes the location and significance of all known petroleum accumulations.

The nature of the Browse Basin sequence, and the petroleum accumulations found to date, indicate that additional petroleum resources are likely to be discovered. The known petroleum accumulations are a major potential resource and highlight the potential of the basin to satisfy some of the nation's energy and industrial resource requirements in the next century.

BASIN SUMMARY

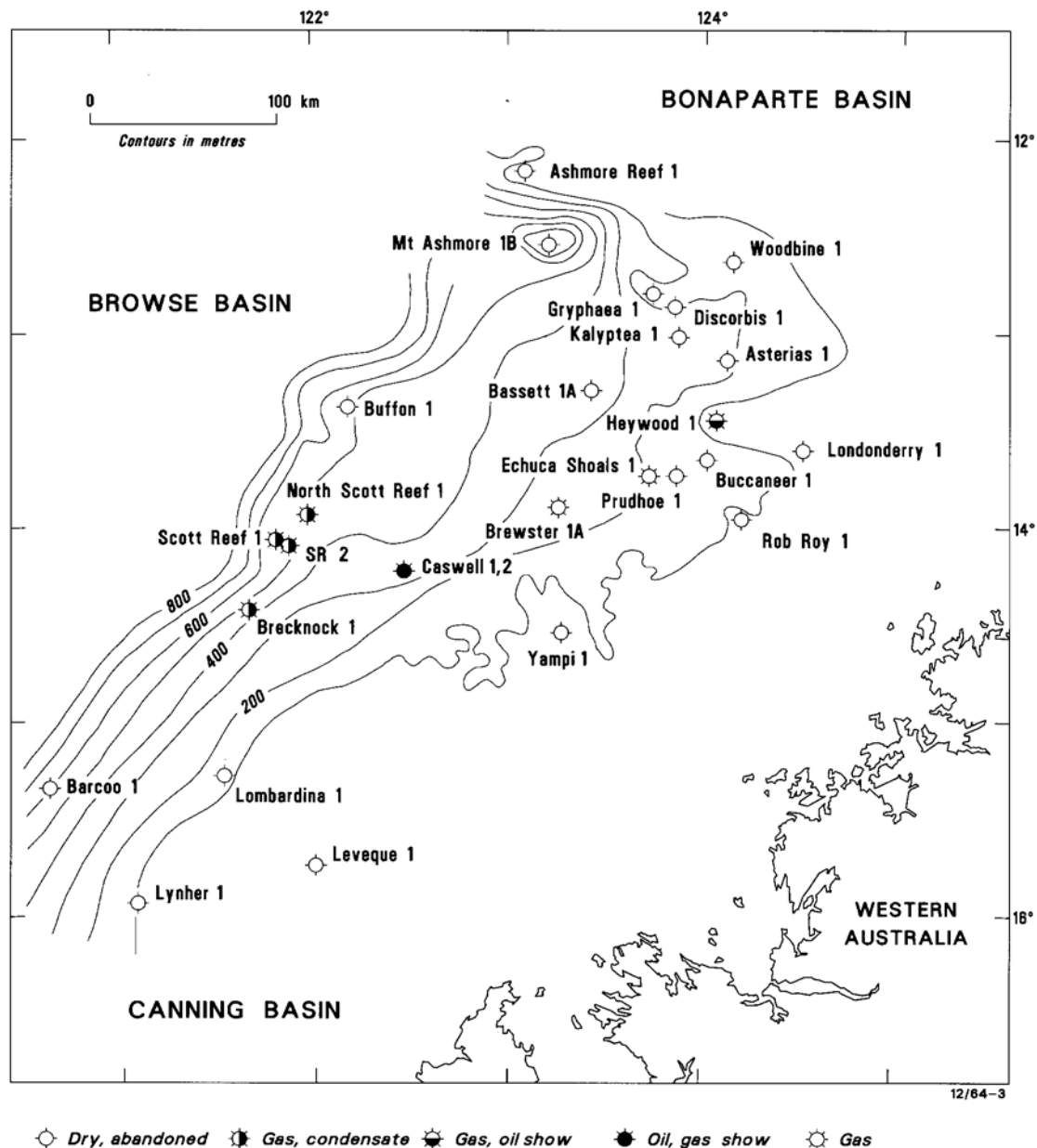
Basin setting

The Browse Basin lies offshore of the northwest margin of the Australian mainland in water depths from 20 metres to more than 2000 metres. The basin contains sediments of Permian to Quaternary age whose maximum thickness is 12 kilometres (Fig. 1).

The eastern margin of the basin comprises the Yampi Shelf, which consists of an eastward-thinning sequence of Mesozoic and younger sediments less than 2 kilometres thick. The southern part of the basin comprises the Leveque Shelf - an offshore extension of the Kimberley Block, overlain by Mesozoic and younger sediments which increase in thickness towards the centre of the basin. The Leveque Shelf separates the Browse Basin proper from the adjacent Fitzroy Graben and Rowley Sub-basin of the Canning Basin (Crostella, 1976).

The Browse Basin extends westwards from the Yampi Shelf into a fault-related structure, the Prudhoe Terrace, which contains several large, basinward normal-fault systems. The central part of the basin contains thick Permian and younger sediments. On the northwest and western margins of the basin, the sedimentary fill thins around a major basement high feature, the Seringapatam Rise. To the west of this feature, the Scott Plateau comprises the oceanward margin of the basin (Stagg, 1978).

Figure 1. Location map of petroleum exploration wells drilled and accumulations discovered in the Browse Basin.



The northern basin boundary coincides with a bathymetric change evident on the southern parts of the Ashmore Block, the Vulcan Sub-basin and the Londonderry Arch (Williams & others, 1973). This break in slope is due to Late Cretaceous and Tertiary subsidence of the Browse Basin relative to adjacent structural elements of the Bonaparte Basin.

In total, the Browse Basin occupies an area of approximately 185 000 square kilometres, comprised mainly of the outer Scott Plateau (80 000 square kilometres), the central Browse Basin and adjacent terraces (80 000 square kilometres) and the Yampi Shelf (25 000 square kilometres) (Crostella, 1976; Stagg, 1978). The drilling density is 0.2 wells/1000 km².

Basin development and stratigraphy

The Browse Basin was initiated as an intracratonic basin in the Late Carboniferous-Early Permian, during an episode of extensional fault movement prior to the main Mesozoic break-up of Gondwana. Upper Carboniferous deltaic and shallow marine sediments are present on the Prudhoe Terrace and Yampi Shelf (Rob Roy 1 well), and seismic data indicate that older Palaeozoic sediments are present beneath the central Browse Basin and Scott Plateau (Allen & others, 1978; Bradshaw & others, 1988; Stagg, 1978).

The Permian sequence in the Browse Basin (Fig. 2) is likely to be similar to that in the Carnarvon, Canning and Bonaparte Basins - predominantly clastic with glacial or glacio-marine facies at the base, overlain by shallow marine, deltaic, and terrestrial sandstone and shale sequences (Lavering, 1985). The Late Permian Mount Goodwin Formation along the eastern basin margin is thin and comprises marine claystone and siliciclastics. It wedges out toward the east, as indicated by seismic and well data (Willis, 1988).

The Triassic Sahul Group unconformably overlies the Permian on the eastern side of the basin. As elsewhere on the North West Shelf, a thick sequence of marine claystone of Scythian to Anisian age is also present. A fluvio-deltaic sequence of Carnian and Norian age developed along the eastern margin of the Browse Basin. A regressive sequence of the same age in the northern part of the basin comprises a basal sequence of shelf carbonate and shale which grades upwards into deltaic sandstone and shale. The western part of the basin contains Late Landinian marine-shelf claystone and limestone, overlain by deltaic clastics and dolomite.

Toward the end of the Triassic, major block-faulting occurred prior to continental break-up (Bint 1988). The Lower and Middle Jurassic Troughton Group overlies a major unconformity surface on top of faulted Triassic and older sequences. The Lower and Middle Jurassic Plover Formation was deposited as a rift-fill sequence of fluvio-deltaic to marginal-marine sandstone, shale, claystone and carbonate in areas of active subsidence.

Subsequent arching and erosion in the Middle Jurassic (Callovian) removed the Plover Formation and older units from elevated regions such as the Ashmore Block and Londonderry High (Fig. 3).

Block-faulting and volcanism in the late Middle Jurassic terminated rift-fill deposition. This was succeeded, in the central and eastern parts of the basin, by the Late Jurassic Flamingo Group and Ashmore Group which comprise deltaic and fluvial sandstones. To the west, the sandstones grade into marine shale and volcanics which overlie part of the Ashmore Block (Fig. 3). The Late Jurassic sequence onlaps a major unconformity surface throughout the basin which is particularly evident over major basement highs (Mory, 1988).

In the northeastern part of the basin part of the Flamingo Group sequence, defined by Mory (1988), is present in an extension of the Malita Graben as the 1500 metre-thick Swan Formation. Flamingo Group sedimentation commenced during the Oxfordian (Late Jurassic) in subsiding depocentres, transgressing over 'highs' and shelf areas, such as the Londonderry High and related features during the Tithonian (latest Jurassic) (Mory, 1988).

An unconformity of Valanginian age truncates the Flamingo Group, separating its lower and middle parts from an upper unit, the Sandpiper Sandstone. This sequence passes into marine shelf shale in the central and western parts of the basin. Fluvial sandstone comprises part of the Sandpiper Sandstone sequence on the Ashmore Block (Mory, 1988).

Cretaceous open marine conditions were well established from the Valangian to Aptian, as evidenced by the deposition of greensand and radiolarian, glauconitic and calcareous claystone which comprises the basal part of the Bathurst Island Group. These lithofacies were deposited on an extensive marine shelf with low clastic sediment supply. The western margin of the Ashmore Block was emergent during this period.

Figure 2. Stratigraphic units of the Browse Basin and occurrence of petroleum accumulations.

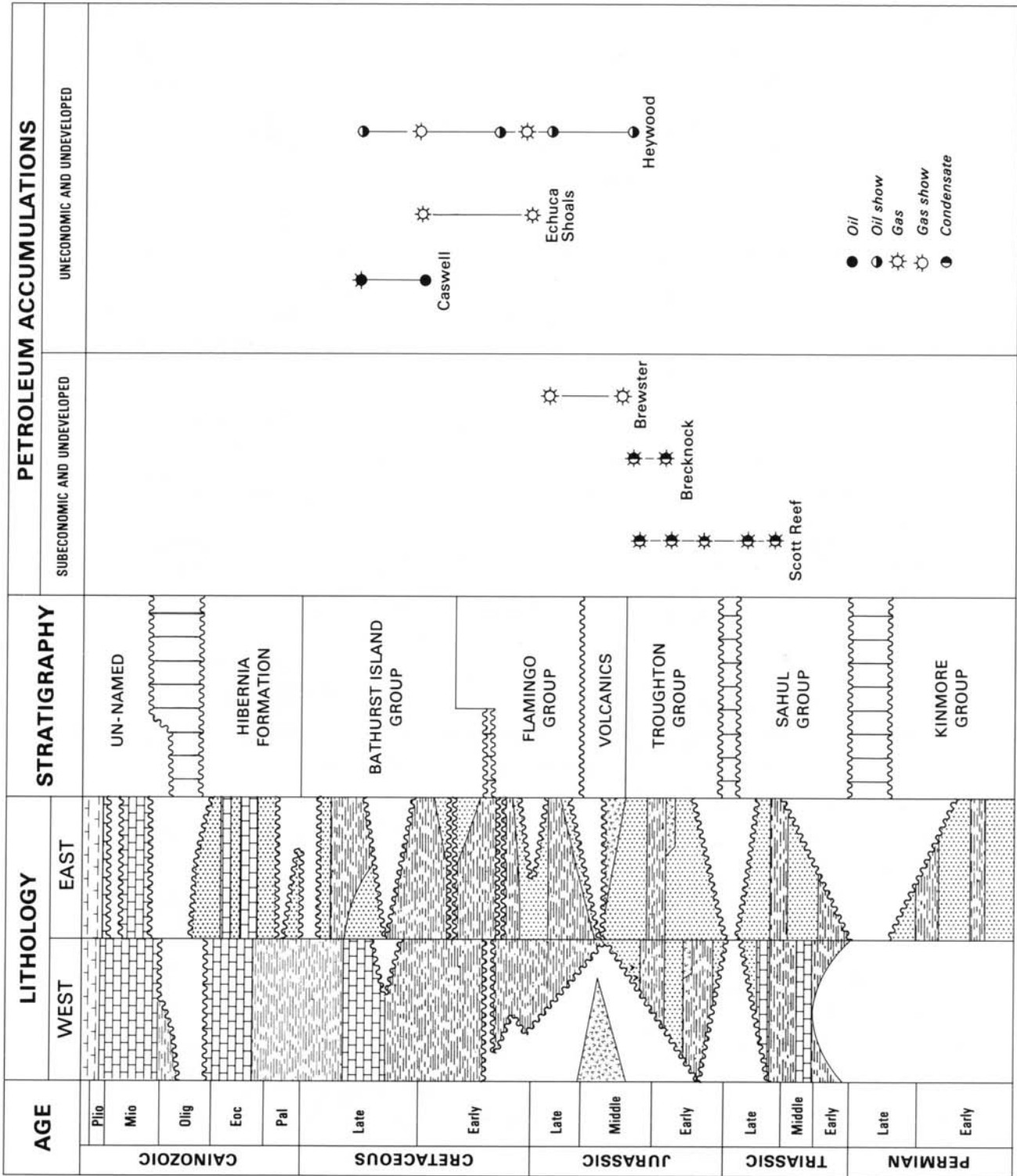
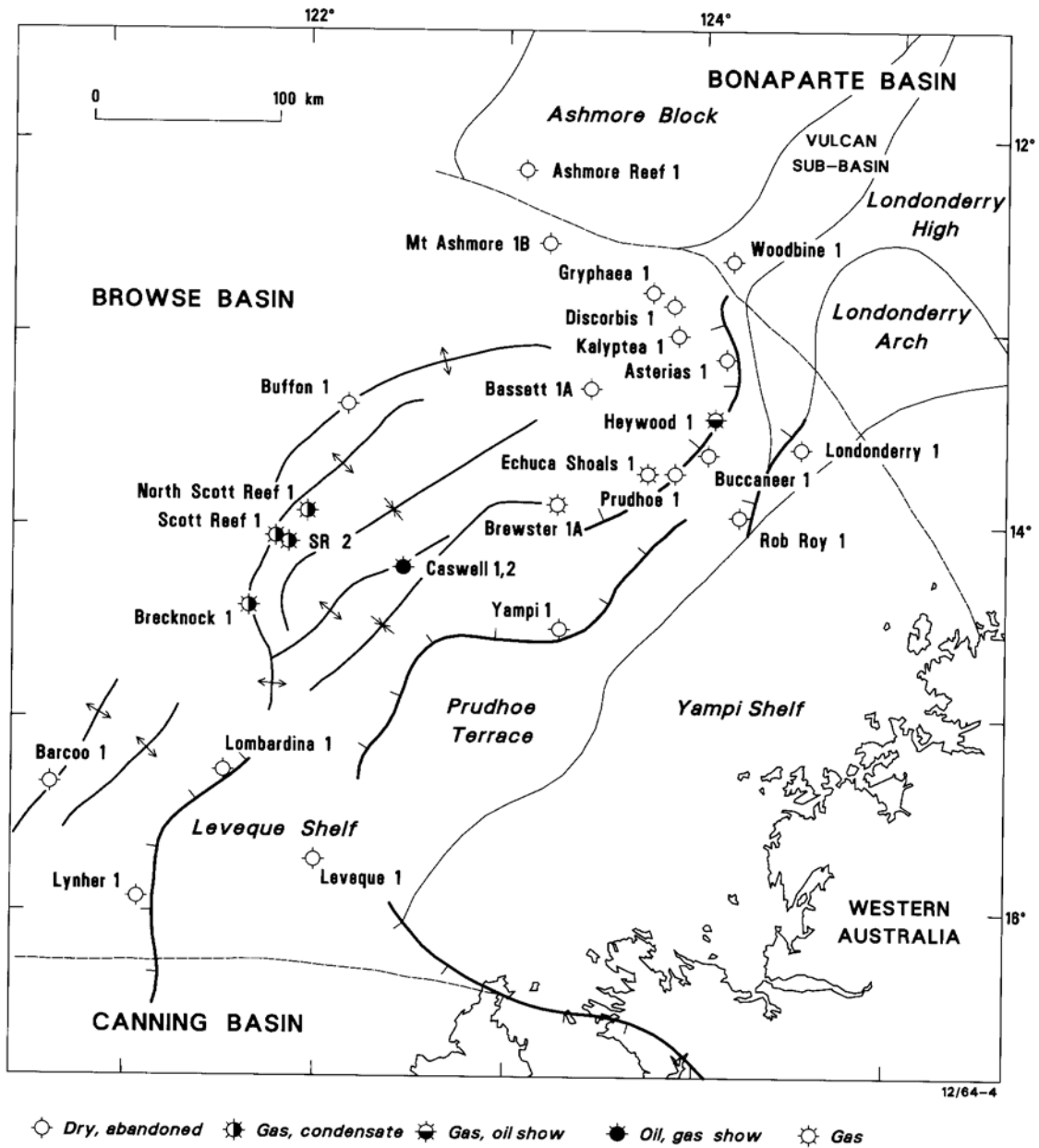


Figure 3. Structural elements of the Browse Basin and location of wells drilled.



Widespread deposition of marine siltstones and claystones of the Bathurst Island Group occurred during the Albian (Early Cretaceous) to Maastrichtian (Late Cretaceous). Concurrently, a calcareous marine shelf formed on the outer basin margin as the level of clastic input declined, but in the central basin and northwards into the Vulcan Sub-basin up to 2000 metres of fine clastic sediments were deposited (Mory, 1988). During the Campanian to Maastrichtian a series of lenticular sandstone bodies were deposited northwards from the Yampi Shelf into the Vulcan Sub-basin and on the Ashmore Block. Mory (1988) considers these sandstones to be possibly subtidal, but in the Puffin wells they may be slope-deposited turbidites.

By the Early Cainozoic the basin had developed into a carbonate shelf on the outer margin with interbedded sandstone units shorewards in the central and eastern parts of the basin. The Cainozoic sequence ranges in thickness from 200 metres in the east to over 1000 metres in the Scott Reef 1 well to the west.

In the Oligocene, uplift and consequent erosion occurred over much of the eastern part of the shelf and continued carbonate sedimentation was restricted to the outer part of the shelf area. During the Late Cainozoic subsidence on the outer shelf increased and resulted in deposition of thick prograding wedges of carbonate. The outer limits of the Late Miocene shelf are currently in water depths of up to 1000 metres, except in the vicinity of large reef complexes such as Scott Reef where reef growth has kept pace with the rate of subsidence (Willis, 1988).

Petroleum exploration

Twenty four petroleum exploration wells have been drilled in the Browse Basin and adjacent parts of the Bonaparte Basin (Lavering & Ozimic, 1988; 1989) commencing with Ashmore Reef 1 well in 1967 (Appendix 1). This well did not intersect any hydrocarbon-bearing sequences but did confirm that a thick sedimentary sequence was present which ranged from Tertiary to Triassic in age. The well had apparently intersected a faulted anticline which lacked adequate seal (Willis, 1988).

The Leveque 1 and Lynher 1 wells were drilled in 1970 on and near the margin of the Leveque Shelf. Both wells failed to encounter significant indications of hydrocarbons. The Leveque 1 well, on the southern part of the shelf (total depth of 889 metres), intersected a thin Mesozoic sequence

overlying Precambrian basement. Post-drilling results indicate that no structural closure was present at the well location. The Lynher 1 well tested a faulted anticline near the margin of the shelf. Over 2700 metres of Tertiary, Cretaceous and Permian sediments were intersected by the well but no major hydrocarbon indications were recorded. Willis (1988) suggested that this was due to thermal immaturity of the sequence and recent development of the structure.

In 1971 the largest geological prospect identified to date in the basin, the Scott Reef structure, was tested by drilling of the Scott Reef 1 well which intersected the southern crest of a faulted anticline in Jurassic and Triassic sequences at a depth of over 4500 metres. Subsequently acquired data suggest that the structure actually comprises several faulted reservoirs, sealed by overlying Late Jurassic and Early Cretaceous marine claystone. The well intersected gas/condensate-bearing reservoirs in both Jurassic and Triassic sequences.

Between 1971 and 1978 a total of nine new-field wildcat wells were drilled (Appendix 1) but only two minor petroleum accumulations were discovered - Heywood in 1974 and Caswell in 1977. In 1979, the Brecknock 1 well intersected gas-bearing reservoirs of Middle and Early Jurassic age in an anticline located southwest of Scott Reef on the same structural trend. Two additional wells, Barcoo 1 in 1979 and Buffon 1 in 1980, failed to discover significant hydrocarbon accumulations.

In 1980 the Brewster 1 well intersected gas-bearing reservoirs of Late to Middle Jurassic age in the northeastern part of the basin (Figs. 1 to 3). The North Scott Reef 1 and Caswell 2 wells were drilled in 1982 and 1983, before the Echuca Shoals 1 well intersected gas shows in Cretaceous and Jurassic sequences. In early 1990 the Buccaneer 1 well intersected the Late Jurassic to Early Cretaceous sequence in a fault-closed trap adjacent to a major basinal fault system. The well was plugged and abandoned as a dry hole.

The three major petroleum accumulations discovered to date in the Browse Basin have been identified by only eight wildcat wells which have penetrated valid traps at the base Cretaceous level (Bathurst Island Group) (Willis, 1988). The overall drilling density for the Browse Basin is 0.2 wells/1000 km², compared with 3.1 wells/1000 km² for Gippsland (new field wildcats only).

According to Willis (1988), many potential traps remain to be tested, particularly in the central main part of the basin where water depths range from 200 to 500 metres. Hydrocarbons may be trapped in this part of the basin but the chances of early commercial development are considered to be remote (Willis, 1988). Factors critical to the lack of development to date include the depth of water, distance from landfall and the gas-prone nature of accumulations discovered.

Petroleum accumulations

The term 'petroleum accumulation' as used in this report refers to an oil or gas pool or a group of oil and/or gas pools known by a single name.

The most significant petroleum accumulations discovered to date are the Scott Reef, Brecknock and Brewster gas/condensate accumulations. All are reservoired in the Triassic and Jurassic, or Jurassic sequences (Fig. 2). The remaining noteworthy accumulations, Caswell, Echuca Shoals and Heywood, lack the size and economic potential of the first group but do demonstrate the potential of the Mesozoic sequence to source and reservoir petroleum accumulations.

Subeconomic and undeveloped accumulations

Accumulation	Discovery well	Year drilled
Scott Reef (gas/condensate)	Scott Reef 1	1971
Brecknock (gas/condensate)	Brecknock 1	1979
Brewster (gas)	Brewster 1	1980

While these accumulations are undeveloped they represent a major part of Australia's subeconomic demonstrated sales gas, liquefied petroleum gas (LPG) and condensate resources (BMR, 1989).

Scott Reef

The Scott Reef (Fig. 4) accumulation comprises gas and condensate reservoired at a depth of over 4500 metres (KB), in Triassic and Lower and Middle Jurassic reservoir units (Troughton and Sahul Groups). A net vertical thickness of 24 metres of gas-bearing reservoir is evident in Scott Reef 1 well and 66 metres in North Scott Reef 1 well (Willis, 1988; Bint, 1988). Although no net reservoir is indicated in Scott Reef 2 well (Bint, 1988) the well did intersect an extended gas/water transition zone (Willis, 1988). Condensate comprises a minor part of the Scott Reef

accumulation as the gas is relatively lean and contains a limited quantity of hydrocarbons more complex than pentane. Some carbon dioxide is evident in North Scott Reef 1 well (Woodside, 1982).

Brecknock

The Brecknock accumulation is 40 kilometres south-southwest of Scott Reef (Fig. 1) in water up to 543 metres deep. It consists of a gas/condensate accumulation present in Middle Jurassic reservoirs (Troughton Group). The reservoirs are at a depth of 3800 metres and the reservoir interval exhibits porosities of approximately 17 percent (Willis, 1988). A net gas thickness of approximately 68 metres is evident in the well (Willis, 1988). Repeat formation tests of the gas-bearing reservoir recovered samples of gas and condensate but production testing of the accumulation was prevented by mechanical difficulties (Willis, 1988).

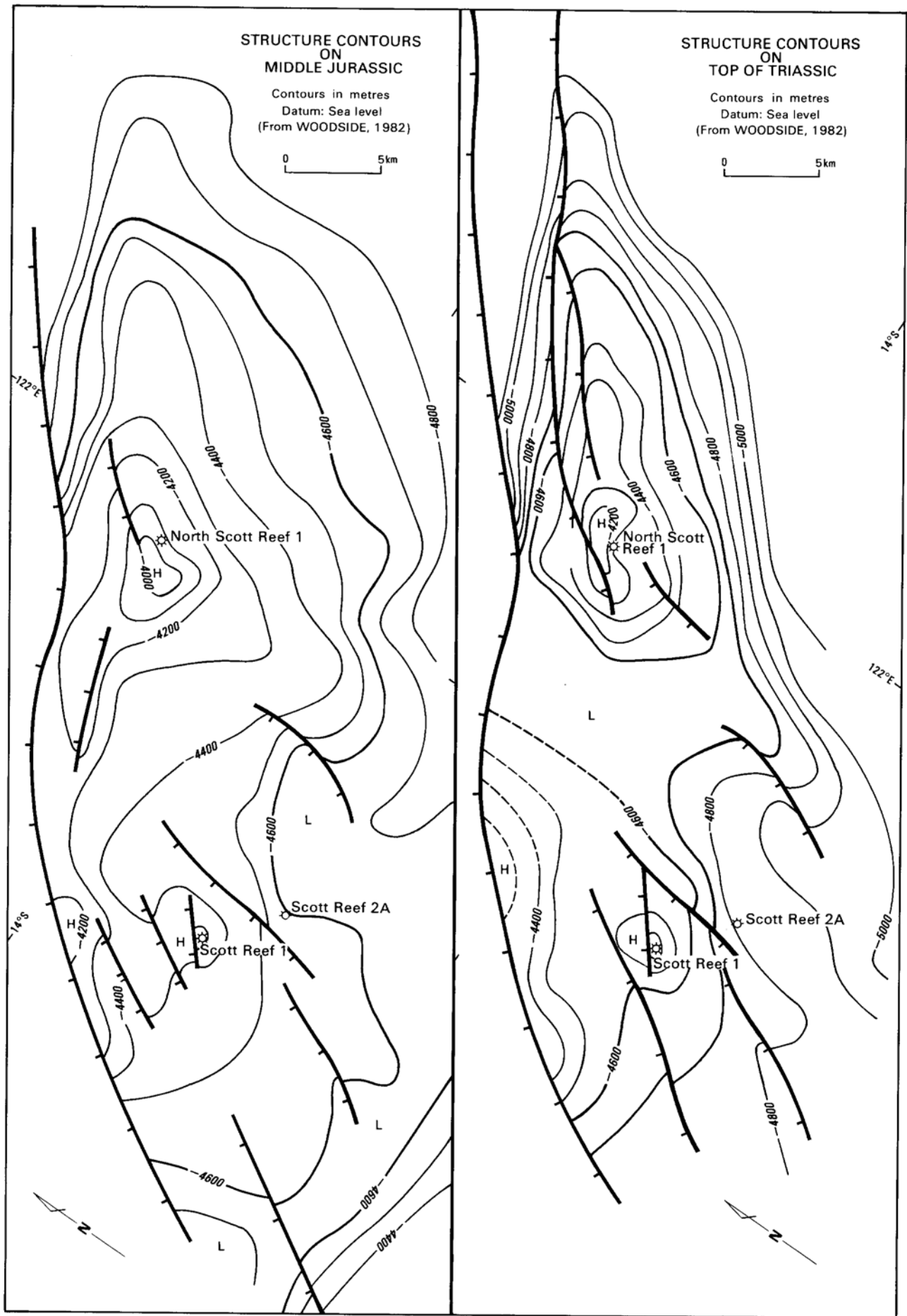
Brewster

The Brewster accumulation is present in the central part of the basin 150 kilometres east-northeast of Scott Reef. The accumulation comprises two gas-bearing intervals, one in the Flamingo Group (3942-4172 metres (KB)) and another in the Troughton Group (4456-4703 metres (KB)). Wireline log data indicate that up to 160 metres of net gas-bearing reservoir is present in the upper sequence where porosities range from 7 percent to 12 percent. Up to 90 metres of net gas-bearing reservoir is present in the lower sequence with porosities of less than 12 percent and reduced permeability readings (Willis, 1988).

The remaining accumulations in the basin comprise those which contain small, discrete and measurable quantities of hydrocarbons, and they are significant only as an indication of petroleum occurrence rather than resource potential.

Uneconomic and undeveloped accumulations

Accumulation	Discovery well	Year drilled
Caswell (oil)	Caswell 1	1977
Echuca Shoals (gas)	Echuca Shoals 1	1983
Heywood (oil & gas shows)	Heywood 1	1974



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The traps and petroleum-bearing units in which all these accumulations occur are shown in Plate 1. Detailed technical data on each accumulation are given in the 'Petroleum accumulations summaries' section of this report. The stratigraphic position and geographic locations of each accumulation are shown in Figures 1, 2 and 3.

Structure and petroleum traps

The Browse Basin (Fig. 3) began to develop during the Permian, initially as an area of subsidence into which Permo-Triassic sediments was deposited. Immediately north of the Browse Basin is the Ashmore Platform, an uplifted Permo-Triassic terrain. Normal block-faulting in the Late Triassic was possibly responsible for the formation of the Ashmore Block and other major tectonic elements within the Bonaparte and Browse Basins (Lavering & Ozimic, 1989).

The major structural elements in the basin (Fig. 3) include major anticlinal and synclinal features. Anticlinal features are elongate, with Late Jurassic and younger units drape-folded over extensively block-faulted Lower to Middle Jurassic and Triassic sequences. Synclinal features are areas in which considerable thicknesses of Tertiary, Cretaceous and Late Jurassic sequences are preserved. The locations of a number of these features are shown in Figure 3.

Willis (1988) classified structures in the basin as being early-, intermediate- and late-formed traps, according to the amount of structural tilt in block-faulted sequences underlying each feature. The degree of tilting is dependent on the timing of block faulting affecting the Triassic or Early to Middle Jurassic sequences which underlie potential traps in the Late Jurassic and Cretaceous sequences.

Structures formed in the Tertiary and Late Cretaceous tend to exhibit a symmetry, as all sequences have similar heights of vertical closure in the case of anticlinal features, e.g. Mt Ashmore 1 well (Fig. 17, Willis, 1988). In addition, Late Tertiary and recent faults generally penetrate to the sea floor, although rejuvenation of older fault systems may also do this (Wormald, 1988).

The major potential petroleum traps are likely to be in the central part of the basin where Early and Middle Jurassic fault, faulted-anticline

and possible stratigraphic traps may be present (Willis, 1988). Structures in this area are optimally sited with respect to mature source rocks. While potential petroleum-bearing structures may be present in Cretaceous and younger sequences, they are likely to have a higher risk with respect to required maturity and source potential.

Willis (1988) suggests that the majority of potential traps developed by the Late Cretaceous. The presence of many complex tensional fault patterns related to Tertiary to Recent tilting of the outer basin margin represents a real risk of seal failure and leakage.

Reservoir sequences

The major petroleum accumulation in the basin, Scott Reef, comprises gas/condensate reservoired in Upper Triassic and Lower to Middle Jurassic sequences. The reservoirs are sandy dolomite (Sahul Group - Upper Triassic) and sandstone (Troughton and Sahul Groups), sealed vertically by overlying Upper Jurassic marine claystone (Troughton Group).

The Triassic sequence, in particular the Sahul Group, is considered to have some reservoir potential but because of depth of burial, over 5000 metres, reservoir quality may be poor over much of the basin (Willis, 1988). Where the sequence is present at relatively shallow depths along the eastern flank of the basin, a lack of overlying vertical seal between the Triassic and Lower-Middle Jurassic is likely to limit prospectivity of the sequence. Porosities in both the Triassic and younger reservoirs in Scott Reef range from 12 to 16 percent (Crostella, 1976).

The Early to Middle Jurassic sandstone units (Troughton Group) are either fluvio-deltaic or nearshore marine in origin and have widely-ranging porosities. Low porosities are due to a combination of original depositional fabric and subsequent diagenesis (Willis, 1988). The major reservoirs in Scott Reef (including North Scott Reef 1 well), Brecknock and Brewster, are all sealed by Upper Jurassic or Lower Cretaceous transgressive marine claystone (Bathurst Island or Flamingo Groups).

Upper Jurassic and Lower Cretaceous marine sequences contain regressive sandstone units, some of which are gas-bearing in the Brewster 1 well. Younger Cretaceous sandstone units in Bassett 1 and Caswell 1 wells could have potential as reservoir units.

Late Cretaceous and Tertiary sandstone units in the central and eastern parts of the basin lack seal potential but have good porosities and permeabilities.

Porosity and permeability data are available from nine of the 23 wells drilled in the basin (Figs. 5 & 6). These data are taken from an Australia-wide BMR database of porosity-permeability readings (PORPERM) published in 1990. The data show that the porosity of all sequences (including potential reservoirs) rarely exceeds 25 percent (Fig. 5). Indeed, below depths of approximately 2000 metres subsea, porosity readings average 15 percent, decreasing to 10 percent below 4000 metres (Fig. 5).

Few of the samples analysed have permeabilities exceeding 100 millidarcys (Figure 6). Most samples from depths greater than 2000 metres have permeabilities of less than 10 millidarcys.

Depositional environments of reservoirs

The wireline log character and lithology of the major petroleum-bearing units of the Scott Reef and Brecknock accumulations are shown in Figures 7 and 8. In addition to lithology and the contents of the major petroleum-bearing units, the figures also show the interpreted sedimentary environments in which each sequence was deposited.

Regional studies (eg. Allen & others, 1978) suggest that the Triassic (Sahul Group) gas-bearing sequence intersected by the Scott Reef 1 well was deposited under marine-shelf to paralic conditions. The presence of recrystallised limestone, dolomite and clastic sediments containing bryozoa, brachiopods and crinoid remains confirms this.

Two major depositional settings are envisaged for the Jurassic sequence (mainly Troughton Group) in the Scott Reef area according to Allen & others (1978): marine in the lower part of the sequence (Scott Reef 1, 2A and North Scott Reef 1 wells) to non-marine in the upper part.

In the North Scott Reef 1 well the lower part of Troughton Group comprises a marine-shelf sequence of poorly-sorted sandstone, limestone and siltstone. From the lithology and wireline log data, we interpret a major delta complex prograding over the marine-shelf sediments. This sand-rich deltaic system forms the major Jurassic petroleum-bearing reservoir. The sporadic occurrence of major deltaic sand bodies is probably due to

Figure 5. Cross-plot of porosity readings versus depth of burial for core samples collected from Browse Basin wells.

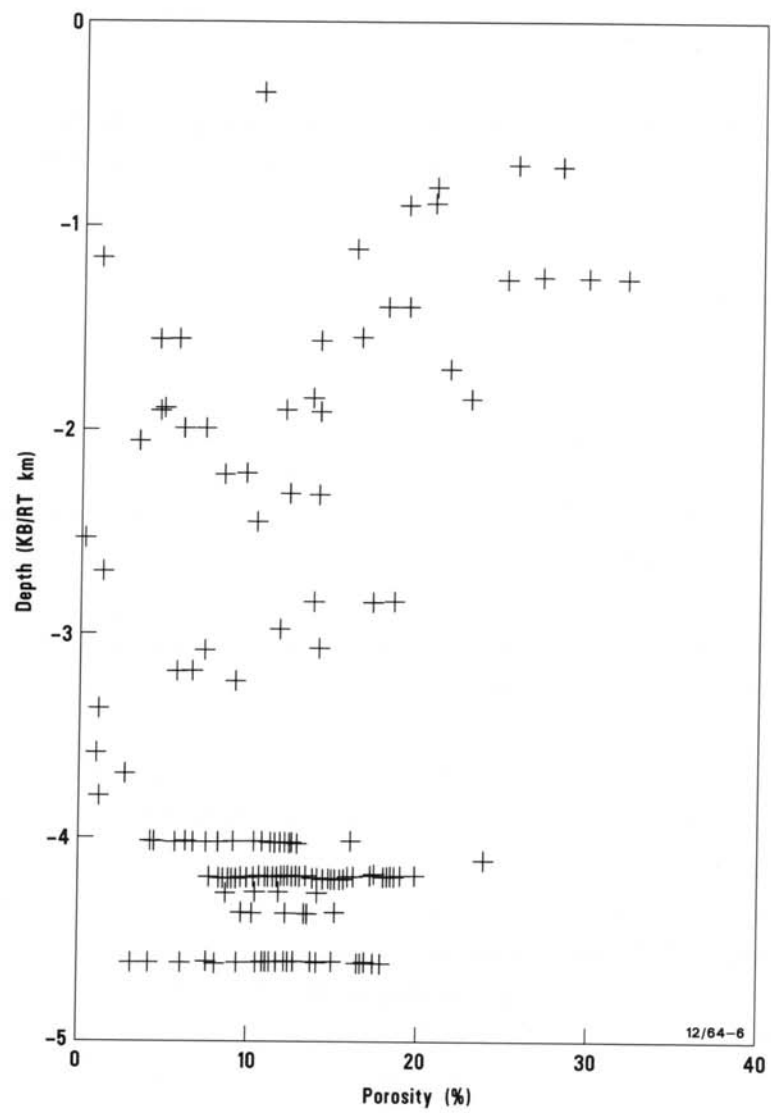
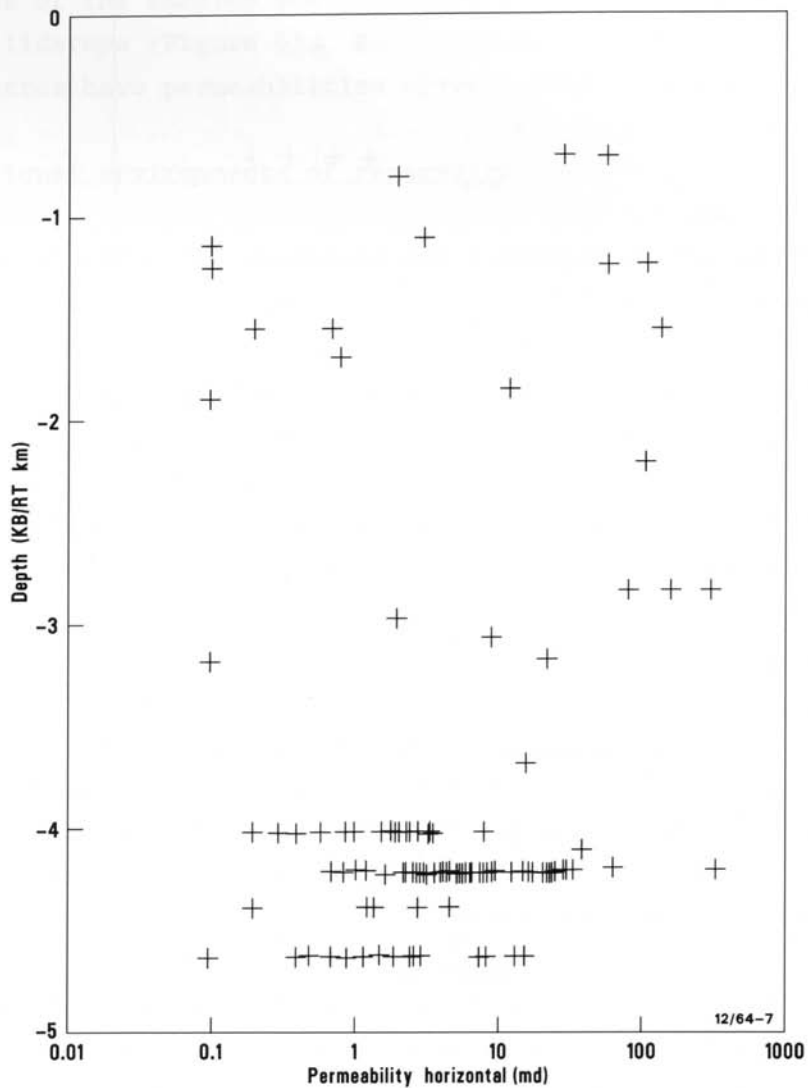


Figure 6. Cross-plot of permeability readings versus depth of burial for core samples collected from Browse Basin wells.



periodic relocation ('switching') of the delta system(s). Marine-shelf conditions resumed as deltaic progradation switched.

Locally, in the area immediately around the North Scott Reef 1 well, renewed progradation in the Middle Jurassic took the form of a deltaic-alluvial fan complex derived from local volcanic source material. A major coarsening-upwards sequence is evident on the gamma-ray log in this well (Fig. 7). Basin-wide subsidence in the Late Jurassic to Early Cretaceous resulted in a return to marine-shelf conditions (Flamingo Group) and continued subsidence resulted in increased water depth until the end of the Cretaceous (Bathurst Island Group).

The Jurassic sequence intersected by the Brecknock 1 well has some features similar to the Troughton Group in the North Scott Reef 1 well. In Brecknock 1, a deltaic sequence in the lower part of the Troughton Group comprises two delta lobes separated by a thin marine-shelf sequence. The succeeding lobe is part of a major sand-rich delta system similar to that in the North Scott Reef 1 well.

The alluvial fan and delta system in the Troughton Group in the North Scott Reef 1 well does not extend to Brecknock 1 well where marine-shelf conditions prevailed from the Late Jurassic and into the Early Cretaceous (Fig. 8). Part of the Flamingo Group at Brecknock 1 was also deposited in marine-shelf conditions but changed from combined clastic and carbonate deposition to carbonate-dominated deposition (Bathurst Island Group) during the Cretaceous.

Source rocks and maturity

Petroleum source rocks in the Browse Basin occur mainly in Early to Middle Jurassic marine and fluvio-deltaic sediments which were deposited during rifting, and Cretaceous epicontinental marine sediments - specifically the Troughton, Flamingo and Bathurst Island Groups.

According to Willis (1988), the total organic carbon (TOC) contents of over 200 samples collected throughout the basin are generally low in most shaly sequences (less than 4 percent). Much of the organic matter consists of vitrinite and inertinite. The richest source rocks are Late Jurassic to Early Cretaceous in age, and are confined to the main basinal depocentres - areas not adequately tested by existing wells. Additional source potential

Figure 7. Wireline log character and sedimentary environments of the Triassic, Jurassic and Cretaceous sediments intersected by North Scott Reef 1.

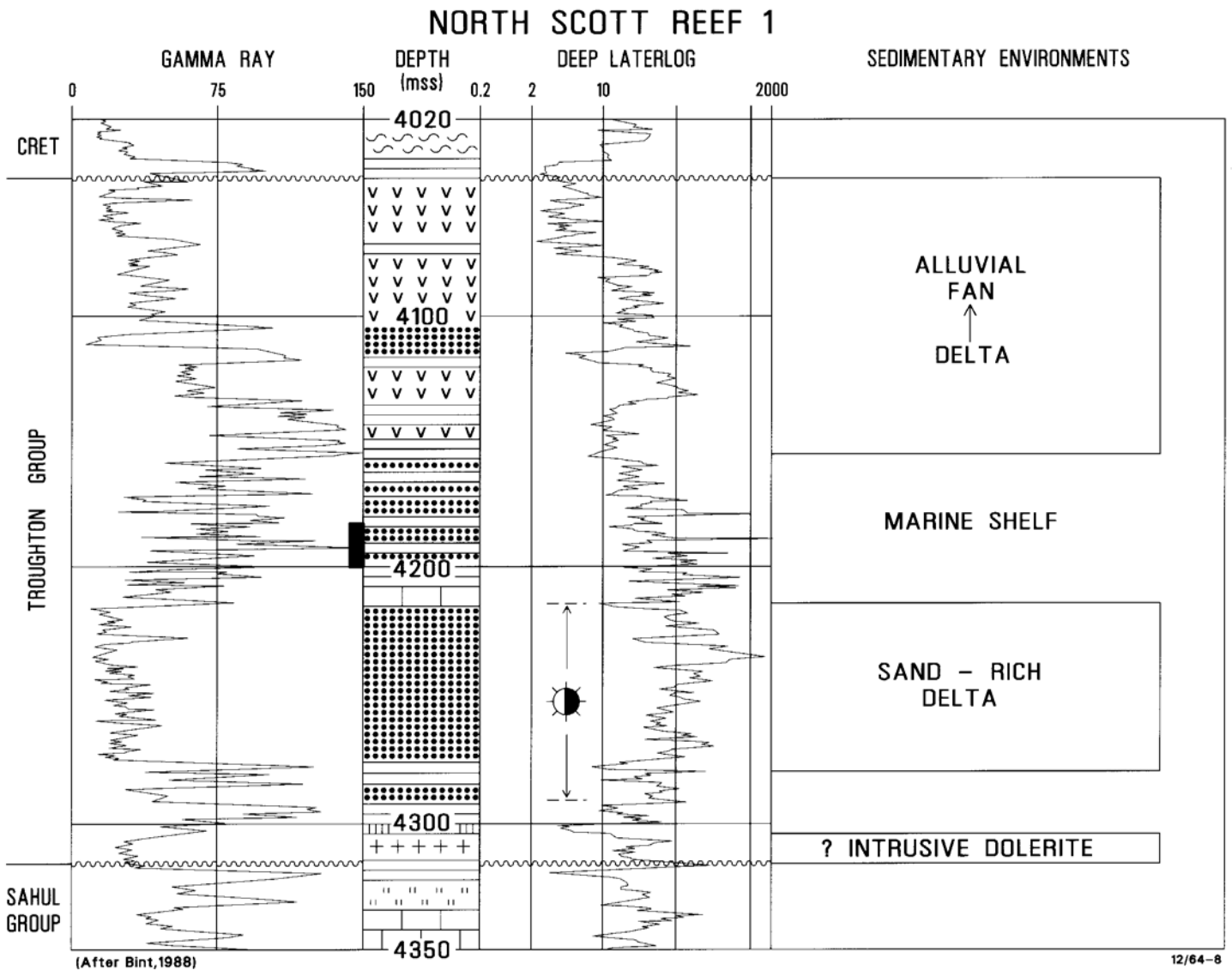
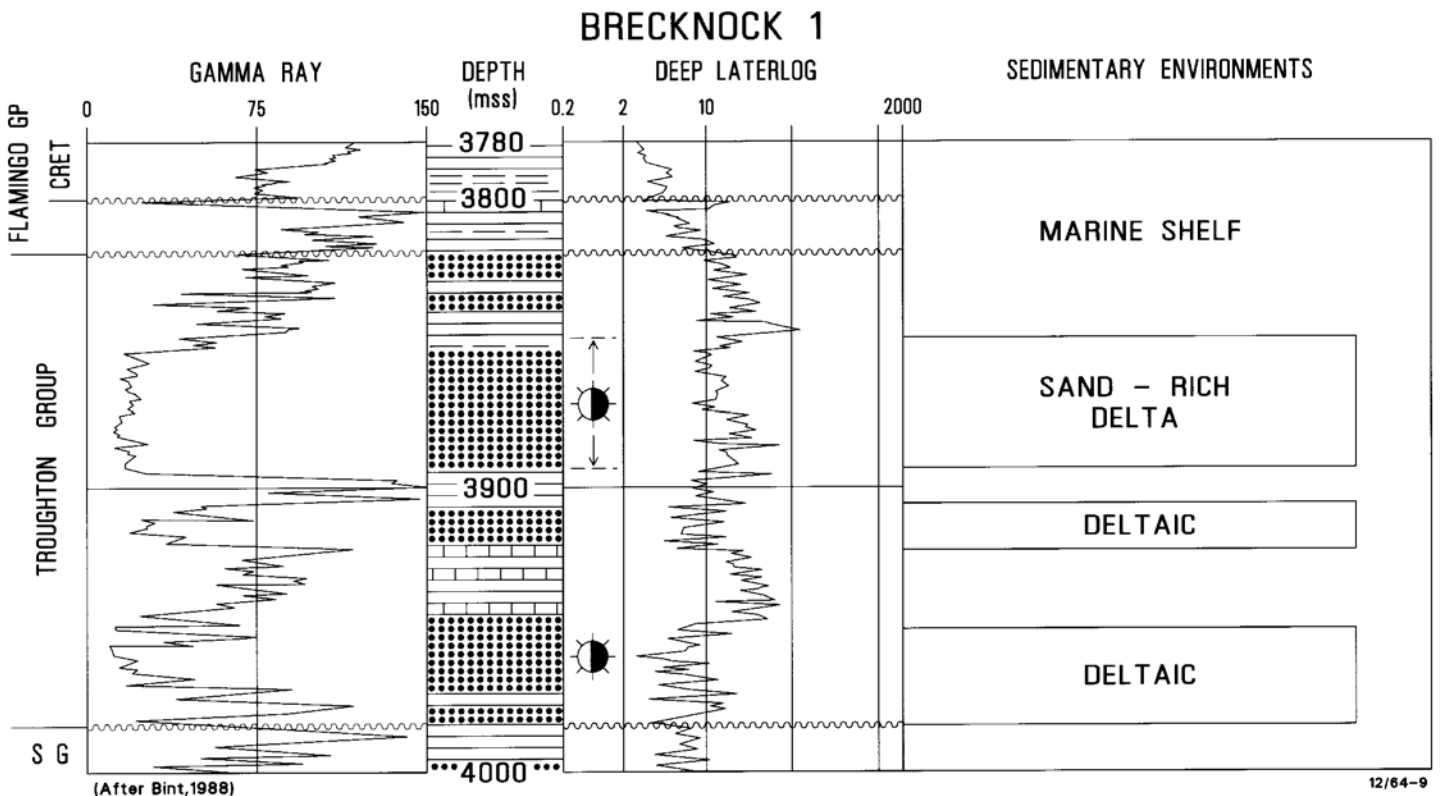


Figure 8. Wireline log character and sedimentary environments of the Triassic, Jurassic and Cretaceous sediments intersected by Brecknock 1.



is likely to be in the TOC-rich parts of the Troughton, Flamingo and Bathurst Island Groups which, where sampled, had an average of 1.5 to 2 percent total organic carbon (Willis, 1988).

Present geothermal gradients in the basin range from 2°C to 3.5°C per 100 metres and data presented by Willis (1988) suggest that the youngest part of the Bathurst Island Group is now oil-mature in the central and northwestern parts of the basin. The older Early Cretaceous part of the same group is mature over a wider area, and the Troughton and Flamingo Groups are apparently now oil-mature over much of the basin. The post-Early Cretaceous timing of hydrocarbon migration indicates that all petroleum generation from the post-Triassic sequence is likely to have occurred since the Early Cretaceous seal was deposited and is still taking place (Willis, 1988). Thus maturation risk is low, making exploration success more dependent on the quality of sealing units and fault-seals.

Petroleum types

The Scott Reef accumulation has the largest gas reserves of any single accumulation currently known in Australia in water depths of less than 200 m. Condensate has also been produced from the accumulation during testing with flows of around 55 to 77 M³ a day. The condensate is straw yellow in colour and has a specific gravity of 49° to 54° API.

The Scott Reef gas contains between 79 to 95 percent of methane, 4.4 to 7.5 percent of ethane and propane, and up to 2 percent of heavier hydrocarbons (Table 1). Up to 10.8 percent of the gas in samples collected from North Scott Reef 1 well consists of carbon dioxide (Woodside, 1982; Bint, 1988).

The Brecknock accumulation when analysed was found to contain 93 percent methane, 5 percent ethane and less than 2 percent propane, butane and pentane with no measurable quantities of heavier hydrocarbons (Table 1).

Table 1. Analyses of natural gases in Browse Basin petroleum accumulations (in Mole %)

	Scott Reef 2A	North Scott Reef 1	Brecknock 1	Brecknock 1
Methane	95.2	79.42	93.73	93.308
Ethane	3.81	5.22	5.06	5.428
Propane	0.74	2.3	0.95	0.915
i-Butane	0.11	0.44	0.16	0.164
n-Butane	0.07	0.41	0.08	0.129
i-Pentane	0.16	0.18	0.01	0.059
n-Pentane	-	0.12	-	-
Hexane	-	0.16	-	-
Heptanes+	-	0.61	-	-
H ₂ S	-	-	-	-
CO ₂	-	10.83		
depth:	4613 m (m KB)	4041 (m SS)	3890 (m KB)	3847 (m KB)

Data from Woodside (1977b, 1979a, 1979b & 1982).

Petroleum reserves and development potential

BMR (1989) estimates that the Browse Basin contains non-commercial reserves of condensate (31.80 million kilolitres), LPG (23.3 million kilolitres) and sales gas (489 billion cubic metres) - all of which are in the Scott Reef, Brecknock and Brewster accumulations. No reserves are currently identified for other accumulations in the basin.

Development of the known accumulations has been hindered by the relative remoteness of the region from land (300 km) and considerable water depths (0-500m), unlike much of the Carnarvon Basin. When development of the known accumulations takes place in future, it is likely that purpose-designed floating facilities or deep-water structures will be used, with pipeline connection to processing facilities on the nearest landfall. Market prices for gas, LPG or condensate will determine the timing of future development of Scott Reef, or other accumulations.

PETROLEUM ACCUMULATIONS SUMMARIES

PETROLEUM ACCUMULATIONS SUMMARY SHEET

ACCUMULATION: Scott Reef

COMPILATION DATE: 21/05/90

OPERATOR: B.O.C.Australia Limited

TYPE: Gas/condensate

COMMERCIAL STATUS: Subeconomic and undeveloped

LOCATION: Approximately 289 km from the mainland on Scott Reef Atoll, W.A;
water depth varies from 0-500 metres.

STATE: Western Australia

PETROLEUM TITLE(S): WA-33-P

FIRST DISCOVERY WELL: Scott Reef 1 (B.O.C.Aust, 1971)
- latitude: 14°04'33" - longitude: 121°49'28"
- discovery: gas/condensate
- total depth: 4730.0 m
- date total depth reached: May 1971

NUMBER OF WELLS DRILLED: - exploration & appraisal: 3
- development: Nil

STRUCTURE: Faulted anticline: northeast-southwest trending
- areal closure: 900 sq. km
- vertical closure: 559 m

SUBDIVISION OF PETROLEUM ACCUMULATION:
- number of traps: 2
- number of petroleum-bearing units: 5

NUMBER AND TYPE OF PRODUCING ZONES: - gas: Nil - gas/condensate: Nil
- gas/oil: Nil - oil: Nil

DRIVE MECHANISM: Not available

PRODUCTION COMMENCED: Nil

PRODUCTION INFRASTRUCTURE: Nil

TRAP

TRAP 1: Troughton Group

DISCOVERY WELL(S): Scott Reef 1

CONTENTS: Gas/condensate

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: Plover Fm

PETROLEUM CONTENTS: Gas/condensate

PRODUCTION STATUS: Undeveloped

FORMATION: Troughton Group (Plover Fm)

AGE: Mid - Jurassic

LITHOLOGY: Sandstone: interbedded siltstone; minor pyrite; claystone and dolomite

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 4299.2 m - 4305.3 m B.R.T.

POROSITY: Up to 19%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM-BEARING UNIT 2: Plover Fm

PETROLEUM CONTENTS: Gas/condensate

PRODUCTION STATUS: Undeveloped

FORMATION: Troughton Group (Plover Fm)

AGE: Mid - Jurassic

LITHOLOGY: Sandstone: interbedded siltstone; minor pyrite; claystone and dolomite

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 4340.0 m - 4346.4 m B.R.T.

POROSITY: Up to 17%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM-BEARING UNIT 3: Malita Fm

PETROLEUM CONTENTS: Gas/condensate

PRODUCTION STATUS: Undeveloped

FORMATION: Troughton Group (Malita Fm)

AGE: Early - Middle Jurassic

LITHOLOGY: Sandstone: interbedded siltstone; minor pyrite; claystone; and
dolomite

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 4351.3 m - 4354.0 m B.R.T.

POROSITY: Up to 17%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

TRAP

TRAP 2: Sahul Group

DISCOVERY WELL(S): Scott Reef 1

CONTENTS: Gas/condensate

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: Sahul Gp.

PETROLEUM CONTENTS: Gas/condensate

PRODUCTION STATUS: Undeveloped

FORMATION: Sahul Group

AGE: Late Triassic

LITHOLOGY: Sandstone: silty; claystone; and dolomite

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 4361.6 m - 4367.7 m B.R.T.

POROSITY: Up to 17%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM-BEARING UNIT 2: Sahul Gp.

PETROLEUM CONTENTS: Gas/condensate

PRODUCTION STATUS: Undeveloped

FORMATION: Sahul Group

AGE: Late Triassic

LITHOLOGY: Sandstone: silty; claystone; and dolomite

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 4379.7 m - 4387.8 m B.R.T.

POROSITY: Up to 17%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM ACCUMULATIONS SUMMARY SHEET

ACCUMULATION: Brecknock

COMPILATION DATE: 21/05/90

OPERATOR: Woodside Petroleum Development Pty.Ltd.

TYPE: Gas/condensate

COMMERCIAL STATUS: Subeconomic and undeveloped

LOCATION: Approximately 40 km southwest of Scott Reef accumulation, W.A;
water depth ranges from 500-750 metres.

STATE: Western Australia

PETROLEUM TITLE(S): WA-33-P

FIRST DISCOVERY WELL: Brecknock 1 (Woodside, 1980)
- latitude: 14°26'13" - longitude: 121°40'21"
- discovery: gas/condensate
- total depth: 4300.0 m
- date total depth reached: November 1979

NUMBER OF WELLS DRILLED: - exploration & appraisal: 1
- development: Nil

STRUCTURE: Faulted anticline:
- areal closure: 331 sq. km
- vertical closure: Not available

SUBDIVISION OF PETROLEUM ACCUMULATION:
- number of traps: 1
- number of petroleum-bearing units: 2

NUMBER AND TYPE OF PRODUCING ZONES: - gas: Nil - gas/condensate: Nil
- gas/oil: Nil - oil: Nil

DRIVE MECHANISM: Not available

PRODUCTION COMMENCED: Nil

PRODUCTION INFRASTRUCTURE: Nil

TRAP

TRAP 1: Troughton Group

DISCOVERY WELL(S): Brecknock 1

CONTENTS: Gas/condensate

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: Plover Fm

PETROLEUM CONTENTS: Gas/condensate

PRODUCTION STATUS: Undeveloped

FORMATION: Troughton Group (Plover Fm)

AGE: Mid - Jurassic

LITHOLOGY: Sandstone: siltstone; and claystone

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 3841.5 m B.R.T.

POROSITY: Up to 11%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM-BEARING UNIT 2: Plover Fm

PETROLEUM CONTENTS: Gas/condensate

PRODUCTION STATUS: Undeveloped

FORMATION: Troughton Group (Plover Fm)

AGE: Mid - Jurassic

LITHOLOGY: Sandstone: siltstone; and claystone

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 3852.0 m - 3890.0 m B.R.T.

POROSITY: Up to 20%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM ACCUMULATIONS SUMMARY SHEET

ACCUMULATION: Brewster

COMPILATION DATE: 21/05/90

OPERATOR: Woodside Petroleum Development Pty.Ltd.

TYPE: Gas

COMMERCIAL STATUS: Subeconomic and undeveloped

LOCATION: Approximately 150 km east-northeast of Scott Reef, W.A; water depth 250m.

STATE: Western Australia

PETROLEUM TITLE(S): WA-35-P

FIRST DISCOVERY WELL: Brewster 1A (Woodside, 1981)
- latitude: 13°54'49" - longitude: 123°15'28"
- discovery: gas
- total depth: 4703.0 m
- date total depth reached: December 1980

NUMBER OF WELLS DRILLED: - exploration & appraisal: 1
- development: Nil

STRUCTURE: Anticline: northeast trending; low relief anticlinal feature
- areal closure: 141 sq. km
- vertical closure: Not available

SUBDIVISION OF PETROLEUM ACCUMULATION:
- number of traps: 2
- number of petroleum-bearing units: 2

NUMBER AND TYPE OF PRODUCING ZONES: - gas: Nil - gas/condensate: Nil
- gas/oil: Nil - oil: Nil

DRIVE MECHANISM: Not available

PRODUCTION COMMENCED: Nil

PRODUCTION INFRASTRUCTURE: Nil

TRAP

TRAP 1: Flamingo Group

DISCOVERY WELL(S): Brewster 1A

CONTENTS: Gas

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: Flamingo Gp.

PETROLEUM CONTENTS: Gas

PRODUCTION STATUS: Undeveloped

FORMATION: Flamingo Group

AGE: Late Jurassic

LITHOLOGY: Sandstone; claystone; and siltstone

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 3942.0 m - 4172.0 m B.R.T.

POROSITY: 7 to 12%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

TRAP

TRAP 2: Troughton Group

DISCOVERY WELL(S): Brewster 1A

CONTENTS: Gas

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: Plover Fm

PETROLEUM CONTENTS: Gas

PRODUCTION STATUS: Undeveloped

FORMATION: Troughton Group (Plover Fm)

AGE: Mid-Jurassic

LITHOLOGY: Sandstone; claystone; and siltstone

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 4456.0 m - 4675.0 m B.R.T.

POROSITY: Less than 12%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM ACCUMULATIONS SUMMARY SHEET

ACCUMULATION: Caswell

COMPILATION DATE: 21/05/90

OPERATOR: Woodside Petroleum Pty.Ltd.

TYPE: Oil and gas

COMMERCIAL STATUS: Uneconomic and undeveloped

LOCATION: Approximately 410 km north of Broome, W.A; water depth 345m.

STATE: Western Australia

PETROLEUM TITLE(S): WA-34-P

FIRST DISCOVERY WELL: Caswell 1 (Woodside, 1978)

- latitude: 14°14'28" - longitude: 122°28'03"
- discovery: gas
- total depth: 4097.0 m
- date total depth reached: January 1978

SECOND DISCOVERY WELL: Caswell 2 (Woodside, 1984)

- latitude: 14°14'33" - longitude: 122°28'10"
- discovery: oil and gas
- total depth: 5000.0 m
- date total depth reached: October 1983

NUMBER OF WELLS DRILLED: - exploration & appraisal: 2
- development: Nil

STRUCTURE: Anticline: northeast-southwest trending
- areal closure: 119 sq. km
- vertical closure: Not available

SUBDIVISION OF PETROLEUM ACCUMULATION:

- number of traps: 1
- number of petroleum-bearing units: 2

NUMBER AND TYPE OF PRODUCING ZONES: - gas: Nil - gas/condensate: Nil
- gas/oil: Nil - oil: Nil

DRIVE MECHANISM: Not available

PRODUCTION COMMENCED: Nil

PRODUCTION INFRASTRUCTURE: Nil

TRAP

TRAP 1: Bathurst Island Group

DISCOVERY WELL(S): Caswell 1 and Caswell 2

CONTENTS: Oil and gas

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: Bathurst Is.Gp

PETROLEUM CONTENTS: Oil with a show of gas

PRODUCTION STATUS: Undeveloped

FORMATION: Bathurst Island Group

AGE: Early - Mid Cretaceous

LITHOLOGY: Sandstone: silty; interbedded; with marl and micrite

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 3264.7 m B.R.T. (No.2)

POROSITY: Up to 20%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM-BEARING UNIT 2: Bathurst Is.Gp

PETROLEUM CONTENTS: Oil

PRODUCTION STATUS: Undeveloped

FORMATION: Bathurst Island Group

AGE: Early Cretaceous

LITHOLOGY: Claystone: with minor sandstone and siltstone

TRAPPING MECHANISM: Stratigraphic

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 3607.0 m - 3611.0 m B.R.T.

POROSITY: Up to 17%

PERMEABILITY: Up to 1.0 md

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM ACCUMULATIONS SUMMARY SHEET

ACCUMULATION: Echuca Shoals

COMPILATION DATE: 21/05/90

OPERATOR: Woodside Offshore Petroleum Pty.Ltd.

TYPE: Gas

COMMERCIAL STATUS: Uneconomic and undeveloped

LOCATION: Near to the north eastern margin of the Browse Basin, W.A; water depth 194m.

STATE: Western Australia

PETROLEUM TITLE(S): WA-35-P

FIRST DISCOVERY WELL: Echuca Shoals 1 (Woodside, 1984)
- latitude: 13°45'01" - longitude: 123°43'25"
- discovery: gas
- total depth: 4365.0 m
- date total depth reached: February 1984

NUMBER OF WELLS DRILLED: - exploration & appraisal: 1
- development: Nil

STRUCTURE: Faulted anticline: southwest-northeast trending
- areal closure: Not available
- vertical closure: Not available

SUBDIVISION OF PETROLEUM ACCUMULATION:
- number of traps: 2
- number of petroleum-bearing units: 3

NUMBER AND TYPE OF PRODUCING ZONES: - gas: Nil - gas/condensate: Nil
- gas/oil: Nil - oil: Nil

DRIVE MECHANISM: Not available

PRODUCTION COMMENCED: Nil

PRODUCTION INFRASTRUCTURE: Nil

TRAP

TRAP 1: Bathurst Island Group

DISCOVERY WELL(S): Echuca Shoals 1

CONTENTS: Gas

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: Bathurst Is.Gp

PETROLEUM CONTENTS: Gas show

PRODUCTION STATUS: Undeveloped

FORMATION: Lower Bathurst Island Group

AGE: Early Cretaceous

LITHOLOGY: Sandstone: with minor interbedded siltstone; and claystone

TRAPPING MECHANISM: Structural and possibly stratigraphic

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 3331.0 - 3352.5 m B.R.T.

POROSITY: Average of 12%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

TRAP

TRAP 2: Flamingo Group

DISCOVERY WELL(S): Echuca Shoals 1

CONTENTS: Gas

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: Flamingo Gp.

PETROLEUM CONTENTS: Gas

PRODUCTION STATUS: Undeveloped

FORMATION: Flamingo Group

AGE: Late Jurassic (Tithonian)

LITHOLOGY: Claystone: minor interbedded siltstone grading to sandstone

TRAPPING MECHANISM: Structural/stratigraphic

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 3382.5 - 3486.5 m B.R.T.

POROSITY: Average of 15%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM-BEARING UNIT 2: Flamingo Gp.

PETROLEUM CONTENTS: Gas

PRODUCTION STATUS: Undeveloped

FORMATION: Flamingo Group

AGE: Late Jurassic (Tithonian)

LITHOLOGY: Sandstone: and interbedded siltstone

TRAPPING MECHANISM: Structural/stratigraphic

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 3634.0 m - 3673.5 m B.R.T.

POROSITY: Up to 15%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM ACCUMULATIONS SUMMARY SHEET

ACCUMULATION: Heywood

COMPILATION DATE: 21/05/90

OPERATOR: B.O.C.of Australia Limited

TYPE: Oil and gas show

COMMERCIAL STATUS: Uneconomic and undeveloped

LOCATION: Northeast margin of the Browse Basin, W.A. water depth 35m.

STATE: Western Australia

PETROLEUM TITLE(S): WA-37-P

FIRST DISCOVERY WELL: Heywood 1 (B.O.C.Australia, 1974)

- latitude: 13°27'45" - longitude: 124°04'00"
- discovery: oil and gas
- total depth: 4572.0 m
- date total depth reached: June 1974

NUMBER OF WELLS DRILLED: - exploration & appraisal: 1
- development: Nil

STRUCTURE: Fault

- areal closure: 248 sq. km
- vertical closure: Not available

SUBDIVISION OF PETROLEUM ACCUMULATION:

- number of traps: 3
- number of petroleum-bearing units: 6

NUMBER AND TYPE OF PRODUCING ZONES: - gas: Nil - gas/condensate: Nil
- gas/oil: Nil - oil: Nil

DRIVE MECHANISM: Not available

PRODUCTION COMMENCED: Nil

PRODUCTION INFRASTRUCTURE: Nil

TRAP

TRAP 1: Bathurst Island Group

DISCOVERY WELL(S): Heywood 1

CONTENTS: Oil and gas

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: Bathurst Is.Gp

PETROLEUM CONTENTS: Oil show

PRODUCTION STATUS: Undeveloped

FORMATION: Bathurst Island Group

AGE: Early - Mid Cretaceous

LITHOLOGY: Sandstone: claystone; with thin interbeds of greensand

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 3148.0 m B.R.T.

POROSITY: Not available

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM-BEARING UNIT 2: Bathurst Is.Gp

PETROLEUM CONTENTS: Gas show

PRODUCTION STATUS: Undeveloped

FORMATION: Bathurst Island Formation

AGE: Early - Mid Cretaceous

LITHOLOGY: Sandstone: siltstone; claystone with thin bands of greensand

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 3299.0 m B.R.T.

POROSITY: Up to 16%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

TRAP

TRAP 2: Flamingo Group

DISCOVERY WELL(S): Heywood 1

CONTENTS: Oil and gas

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: Upper Flamingo Gp.

PETROLEUM CONTENTS: Oil show

PRODUCTION STATUS: Undeveloped

FORMATION: Flamingo Group

AGE: Late Jurassic - Early Cretaceous

LITHOLOGY: Sandstone: claystone; with minor siltstone

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 3422.0 m B.R.T.

POROSITY: Up to 16%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM-BEARING UNIT 2: Middle Flamingo Gp.

PETROLEUM CONTENTS: Gas

PRODUCTION STATUS: Undeveloped

FORMATION: Flamingo Group

AGE: Late Jurassic - Early Cretaceous

LITHOLOGY: Sandstone: claystone; with minor siltstone

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 4065.0 m B.R.T.

POROSITY: Up to 10%

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

PETROLEUM-BEARING UNIT 3: Lower Flamingo Gp.

PETROLEUM CONTENTS: Oil show

PRODUCTION STATUS: Undeveloped

FORMATION: Flamingo Group

AGE: Late Jurassic

LITHOLOGY: Sandstone: claystone; with minor siltstone

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 4147.0 m B.R.T.

POROSITY: Not available

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

TRAP

TRAP 3: Troughton Group

DISCOVERY WELL(S): Heywood 1

CONTENTS: Oil

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: Plover Fm

PETROLEUM CONTENTS: Oil show

PRODUCTION STATUS: Undeveloped

FORMATION: Troughton Group (Plover Fm)

AGE: Middle Jurassic

LITHOLOGY: Sandstone; siltstone; claystone; and minor coal

TRAPPING MECHANISM: Structural

DEPTH TO TOP OF PETROLEUM-BEARING UNIT: 4320.0 m B.R.T.

POROSITY: Not available

PERMEABILITY: Not available

TEMPERATURE GRADIENT: Not available

RESERVOIR PRESSURE: Not available

APPENDIX 1

BROWSE BASIN - SUMMARY OF DRILLING RESULTS

Well	Spud date	Water depth (m)	Level reached		Hydrocarbon indicators	Remarks
			Age	Depth subsea (m)		
Leveque 1	1970	77	Precambrian	889	None	No structural closure
Lynher 1	1970	58	Permian	2715	None	Very strong relief. Thermally immature
Scott Reef 1	1971	50	Triassic	4720	M. Jurassic/ Triassic section gas-bearing	Gas discovery
Rob Roy 1	1972	102	Precambrian	2276	None	Stratigraphic test
Yampi 1	1973	91	Permian	4163	High gas readings, fluorescence, traces of residual oil	No structural closure
Londonderry 1	1973	90	Precambrian	1132	None	Stratigraphic test
Heywood 1	1974	35	L. Jurassic	4562	High gas readings, intermittent fluorescence	Sited on seismic velocity anomaly
Lombardina 1	1974	175	E. Jurassic	2825	Fluorescence indications of residual hydrocarbons	Young feature. Failure of fault seal
Prudhoe 1 structural	1974	175	Permian	3292	None	No closure
Scott Reef 2, 2A	1977	55	E. Jurassic	4812	M. Jurassic section in gas transition zone	-
Caswell 1 reach due	1977	345	E. Cret.	4089	Flowed oil from fractured shale	Did not objective to technical problems

Well	Spud date	Water depth (m)	Level reached		Hydrocarbon indicators	Remarks
			Age	Depth subsea (m)		
Bassett 1, 1A	1978	364	L. Cret.	2698	None	Relies on fault seal. Thermally immature
Woodbine 1	1979	189	L. Triassic	3502	None	No structural closure
Brecknock 1	1979	543	L. Triassic	4289	Objective section gas-bearing	Gas discovery
Barcoo 1	1979	720	L. Triassic	5098	None	No structural closure
Buffon 1	1980	533	E. Jurassic	4777	High gas readings from objective section	Objective section proved to be volcanics
Brewster 1, 1A	1980	250	M. Jurassic	4695	Objective section gas-bearing	Indicated gas discovery
North Scott Reef 1	1982	422	L. Triassic	4762	L. Jurassic/Triassic section gas-bearing	Gas discovery
Caswell 2	1983	344	M. Jurassic	4983	Upper Cret. sand oil-bearing	Step-out well
Echuca Shoals 1	1983	194	Jurassic Perm.-Trias.	4000	Jurassic units gas-bearing	Gas discovery
Gryphaea 1	1987	200	M. Triassic	3950	Hydrocarbon shows in Maastrichtian, Valanginian & Triassic	Poor reservoir development
Asterias 1	1987	194	L. Jurassic	4400	Shows in Jurassic	Lack of good seal
Discorbis 1	1989	202	Jurassic	4196	Shows in Cretaceous & Jurassic	Timing of migration unknown
Kalyptea 1	1989	214	Cretaceous	4575	Minor hydrocarbon traces.	

Modified from Willis (1988).

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DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

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AUSTRALIAN PETROLEUM ACCUMULATIONS

BROWSE BASIN

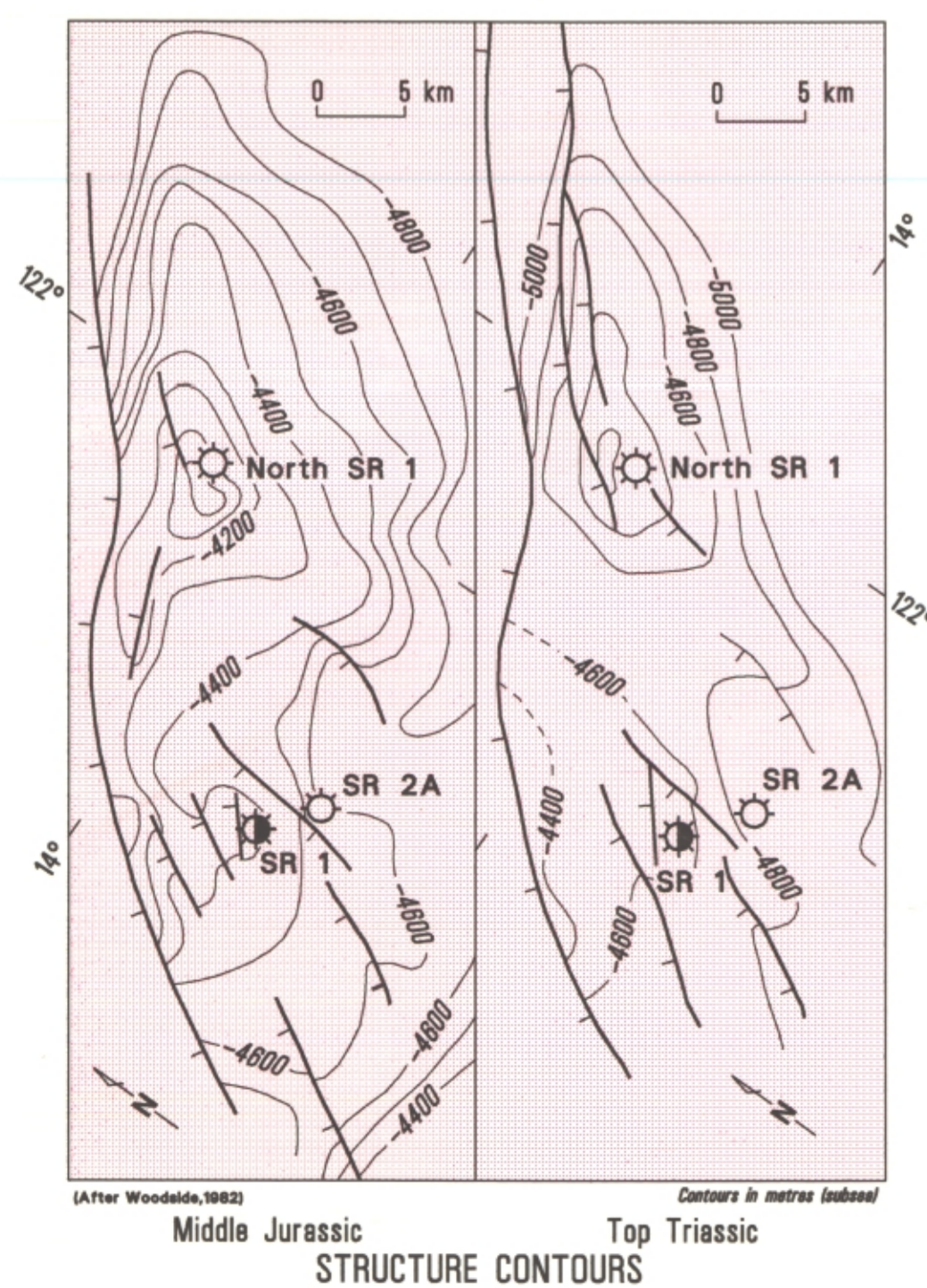
PLATE 1

BMR
GEOLOGY AND
GEOPHYSICS
AUSTRALIA

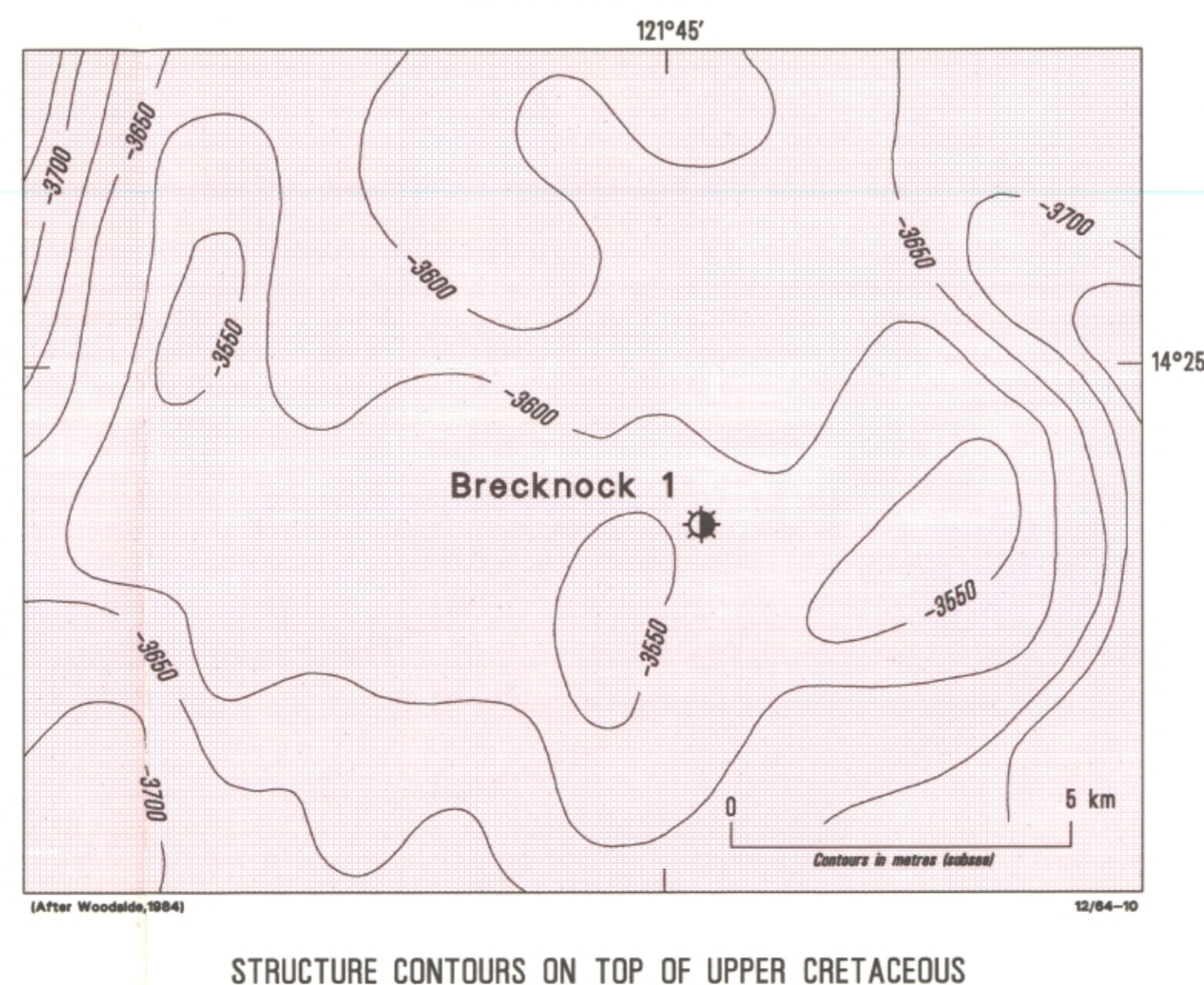


STATUS	SUBECONOMIC AND UNDEVELOPED			UNECONOMIC AND UNDEVELOPED					
LOCALITY MAP NUMBER	1	2	3	4	5	6			
ACCUMULATION	SCOTT REEF		BRECKNOCK	BREWSTER	CASWELL	ECHUCA SHOALS +	HEYWOOD +		
TRAP	Troughton Group		Troughton Group	Flamingo Group	Troughton Group	Bathurst I Group	Bathurst I Group	Flamingo Group	Troughton Group
PETROLEUM-BEARING UNIT	Plover Fm Plover Fm Malita Fm		Plover Fm Plover Fm	Plover Fm	Plover Fm	Plover Fm	Plover Fm	Plover Fm	Plover Fm
PETROLEUM CONTENT	Gas		Gas/Condensate	Gas	Oil	Oil/gas show	Gas show	Oil show	Oil show

SCOTT REEF

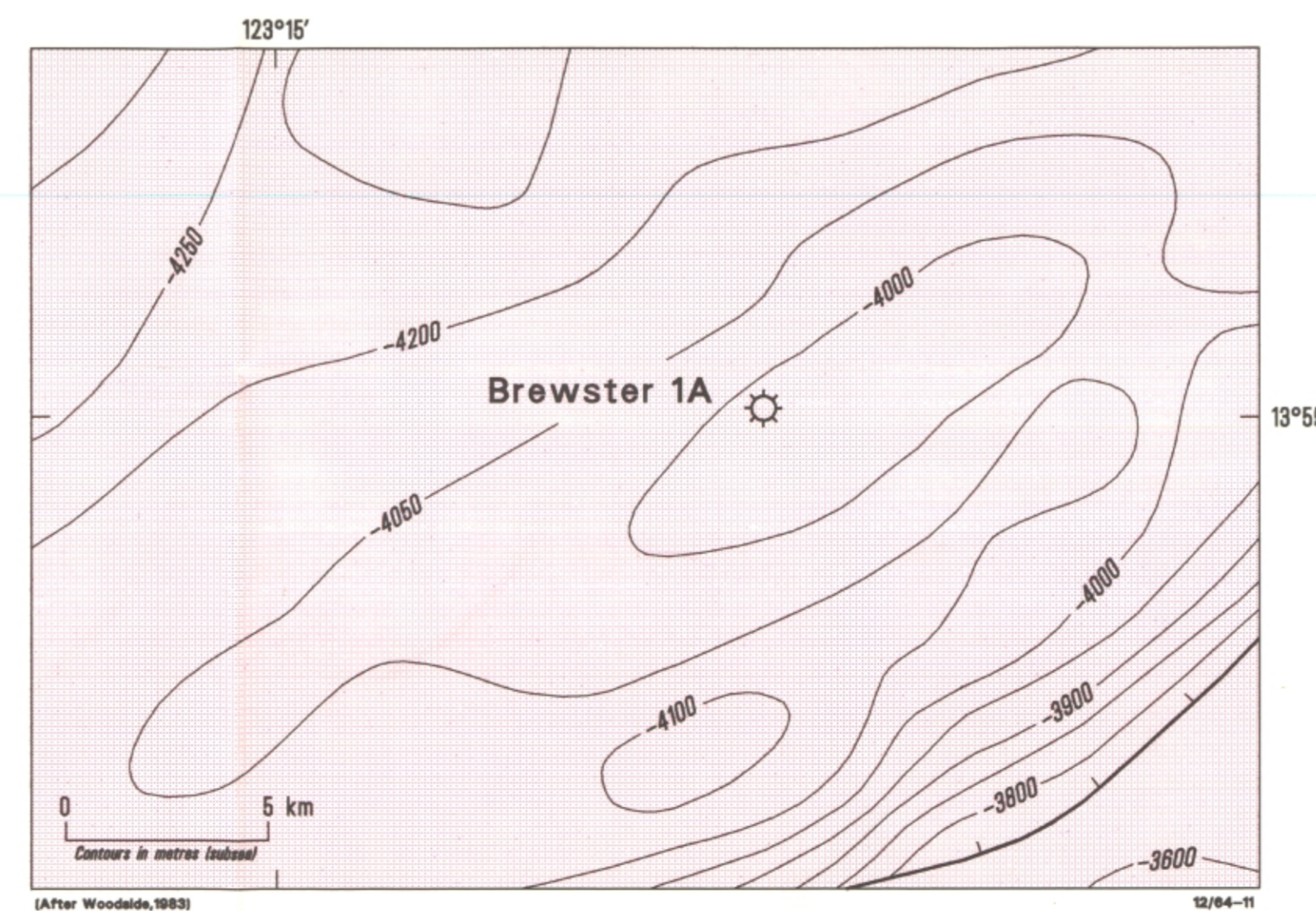


BRECKNOCK



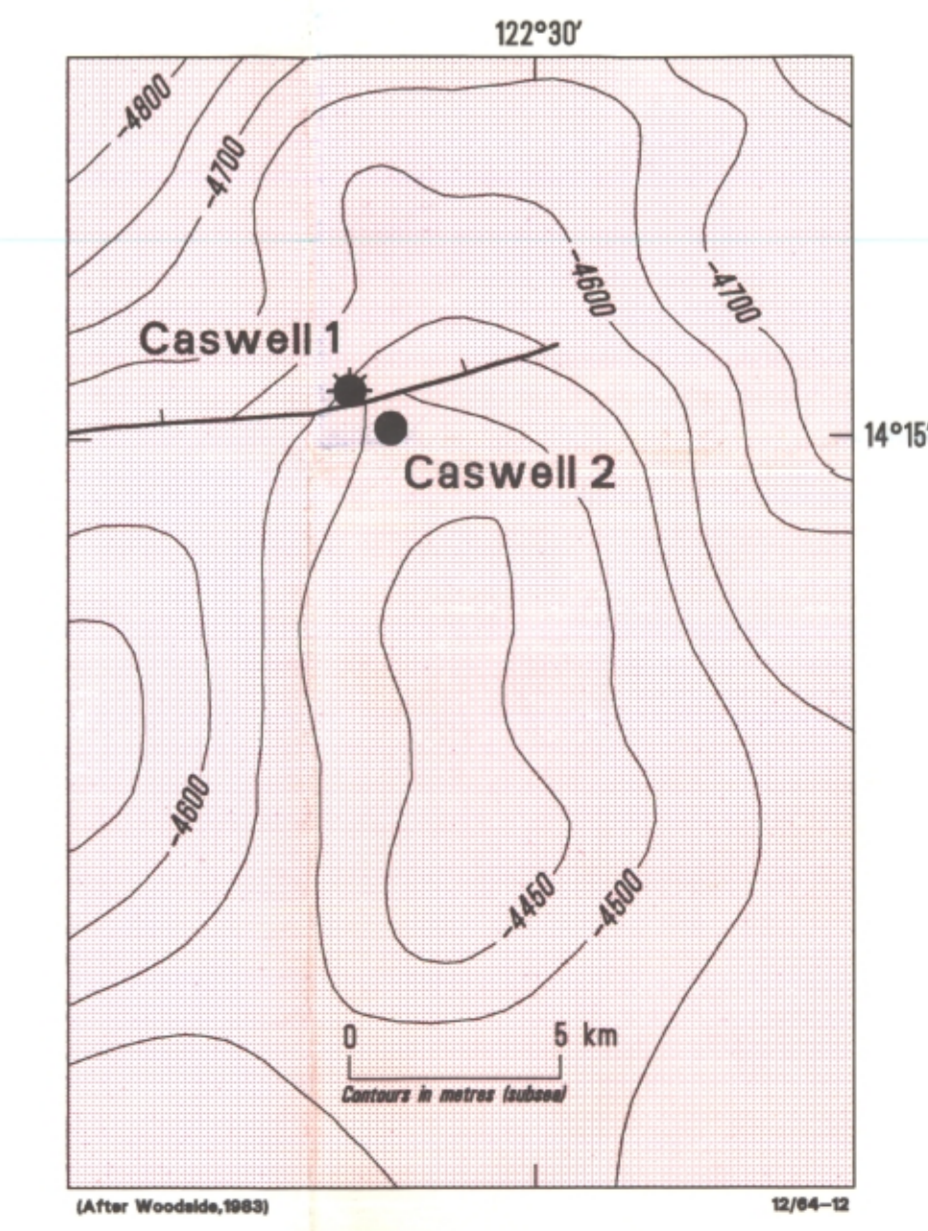
STRUCTURE CONTOURS ON TOP OF UPPER CRETACEOUS

BREWSTER



STRUCTURE CONTOURS ON TOP OF UPPER JURASSIC

CASWELL



STRUCTURE CONTOURS ON TOP OF UPPER JURASSIC

PETROLEUM RESERVES AND PRODUCTION

(The estimates listed below are for the whole of the basin and not only for the accumulations shown on this Plate)

REMAINING RECOVERABLE RESERVES	as at	30	6	91
Gas (Sales)	488 x 10 ⁶ m ³			
LPG	28.3 x 10 ⁶ kL			
Condensate	31.8 x 10 ⁶ kL			
Oil				
CUMULATIVE PRODUCTION	as at	30	6	91
Gas (Sales)				
LPG				
Condensate				
Oil				

- + No relevant structure map available
- * Stratigraphic units not resolved

