Department of Primary Industries and Energy
Bureau of Mineral Resources, Geology and Geophysics

Australian Petroleum Accumulations Report 4

ADAVALE BASIN, QUEENSLAND

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Resource Assessment Division

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FOREWORD

This is the fourth in a series of reports prepared by the Bureau of Mineral Resources, Geology & Geophysics (BMR) to present data on Australian petroleum accumulations. Each characterises the petroleum found so far in a particular sedimentary basin, and presents the data together with notes on the basin's setting, stratigraphy, structure, traps, reservoir and source rocks, petroleum characteristics, reserves, and any production developments. The data presented are designed as a ready reference to those concerned with petroleum exploration and development in Australia.

The first three reports in this series covered the Amadeus, Bass and Gippsland basins, and reports on the Bonaparte, Otway, Perth, Surat, Bowen, Eromanga, and Cooper basins are scheduled for publication within the next two years.

L.C. Ranford
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ABSTRACT

The Adavale Basin, in south-central Queensland, contains two dry gas accumulations, Gilmore and Log Creek, discovered in 1964 and 1965. The accumulations occupy fold-related traps in Middle Devonian clastic rocks of the Log Creek Formation and the Lissoy Sandstone.

The basin's estimated initial recoverable reserves as at 31 December 1986 comprised 589 x 10^6 m^3 (20.8 x 10^9 ft^3) of sales gas, all in the Gilmore accumulation. The Gilmore gas accumulation was declared economic in August 1987, and gas production is expected to commence in early 1989. Production so far has comprised 10.4 x 10^6 m^3 (366 x 10^6 ft^3) of raw gas, used in the drilling of nearby extension wells.

INTRODUCTION

This report summarises information on the petroleum accumulations found in the Adavale Basin up to 31 March 1987. It also describes the basin's setting, exploration history, structure and traps, reservoir and source rocks, nature of petroleum, and petroleum reserves and production.

The objectives of the report are:

- to provide the distribution and characteristics of petroleum accumulations in the Adavale Basin;
- to provide assistance for exploration for additional reserves; and
- to facilitate basic geological, geophysical and geochemical research.

The data presented in this report were drawn from continuing petroleum exploration programs in the Adavale Basin and its overlying basins.

BASIN SUMMARY

Setting and stratigraphy

The Adavale Basin (locality map, Plate 1) is an entirely concealed sub-surface basin, approximately 850 km west-northwest of Brisbane in south central Queensland. The preserved areal extent of the basin is 66 000 km^2, including the Warrabin and Barcoo troughs.

The basin overlies a basement of early Palaeozoic metamorphic and igneous rocks of the Lachlan or Thompson Fold Belts (Heikkila, 1966; Slanis & Netzel, 1967; Auchincloss, 1976; Murray & Kirkegaard, 1978; Day & others, 1983). During the Early and Middle Devonian, the basement rocks were overlain by volcanics and continental clastics, and by marine clastics deposited in a westerly-transgressive sea (Galloway, 1970; Paten, 1977; Price, 1980). This early marine deposition was succeeded by more restricted marine and evaporite deposition in a regressive sea, and by continental clastics, during the Middle and Late Devonian and possibly into the Early Carboniferous. Seismic data suggest that the total thickness of strata in the basin may be as much as 8500 m (Passmore & Sexton, 1984).

The basin is overlain by 1000 to 3000 m of younger sedimentary rocks of the Carboniferous to Triassic Galilee Basin in the east; the Permian to Triassic Cooper Basin in the west; and the Jurassic to Cretaceous Eromanga Basin which spreads over the Galilee and Cooper Basins.

The Adavale Basin's major stratigraphic units and their maximum intersected thicknesses are shown in Figure 1; Figure 2 is a stratigraphic cross-section through the basin.

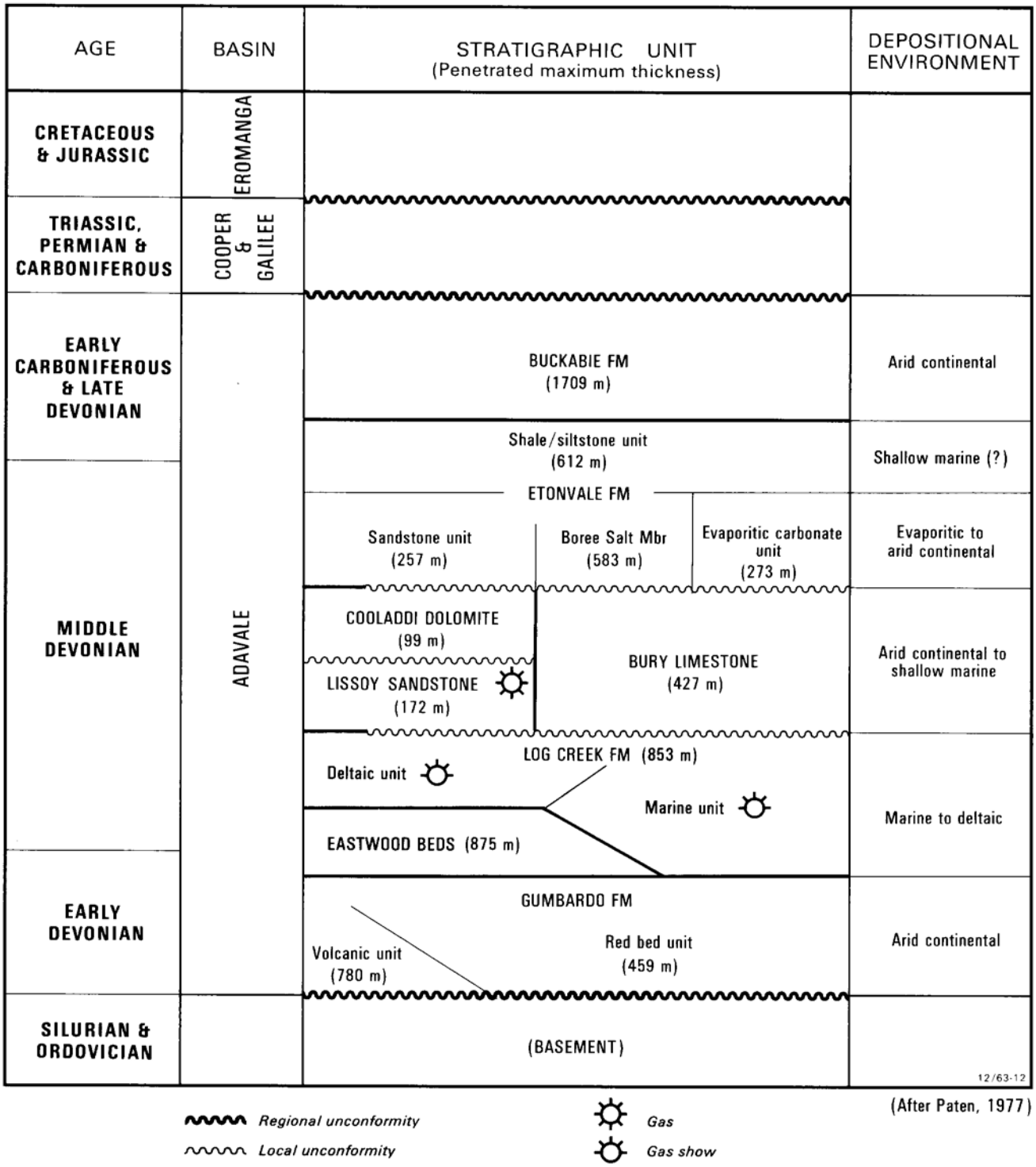

Figure 1. Stratigraphy (After Paten, 1977).

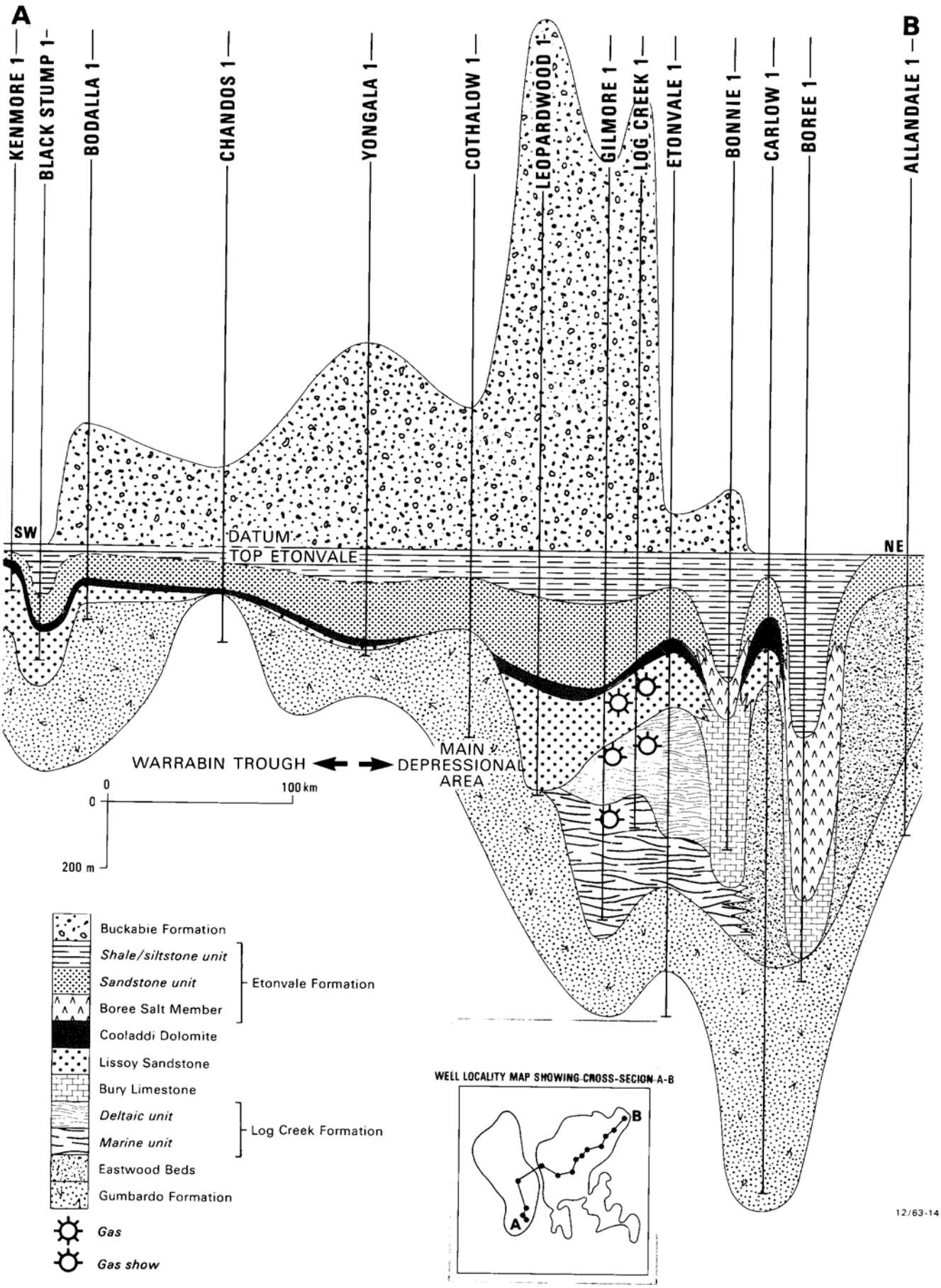

Figure 2. Stratigraphic cross-section through the Adavale Basins.

Exploration history

The Phillips and Sunray Group established the Adavale Basin setting by comprehensive seismic surveys during the late 1950s (Tanner, 1967; Allen, 1973).

Petroleum exploration drilling commenced in 1961, the main target being the Middle Devonian clastic sequences. Since then, over 60 exploration wells have been drilled into the basin (Hawkins, 1985), but most were designed to test the overlying Eromanga or Cooper Basin sequences, and thus did not provide data relevant to the petroleum potential of the Adavale Basin.

During the late 1970s, Mines Administration Pty Ltd reinterpreted much of the then available seismic and well data, and identified new potential reef reservoirs, mainly within the Bury Limestone (Paten, 1977).

During 1980 to 1982, BMR covered a considerable area of the basin with regional seismic reflection profiles and some regional wide-angle seismic reflection/refraction profiles. Passmore & Sexton (1984) interpreted these data and discussed the petroleum geology of the basin; and Finlayson & others (1987) made a compilation of the seismic data.

Petroleum accumulations

Natural gas was first discovered in 1964 in the Gilmore No. 1 well (Lewis & Kyranis, 1965), and another discovery was made in 1965 in the Log Creek No. 1 well (Kyranis & McDonagh, 1966). Elsewhere insignificant petroleum shows were recorded in Quilberry No. 1, Yongala No. 1, Leopardwood No. 1 and Bodalla No. 1 wells (Paten, 1977). The economic status of all discoveries is expressed in terms defined in the Glossary (Page 21).

Details of each accumulation are tabulated in the 'Petroleum Accumulations Summaries' on later pages, and in Plate 1.

Structure and traps

The present extent of the Adavale Basin is the remnant of a more widespread basin, which was uplifted and eroded in the Carboniferous. The erosion truncated the sequence and resulted in division of the basin into two major structural domains with southeasterly extension of troughs and

embayments (Pinchin & Senior, 1982; Wake-Dyster & others, 1983; Pinchin & Anfiloff, 1986).

The major structures (Fig. 3) are a series of northeast- and northwest-trending reverse faults to the east and the west of the Canaway Ridge, the major north-trending basement high. The faults are interpreted as being the result of crustal shortening events caused by processes deep within the lithosphere (Finlayson & others, 1987). Significantly, it is the basement highs associated with these faults that are seen by the exploration industry as being the most prospective drilling targets for petroleum in the Adavale Basin and its overlying basins.

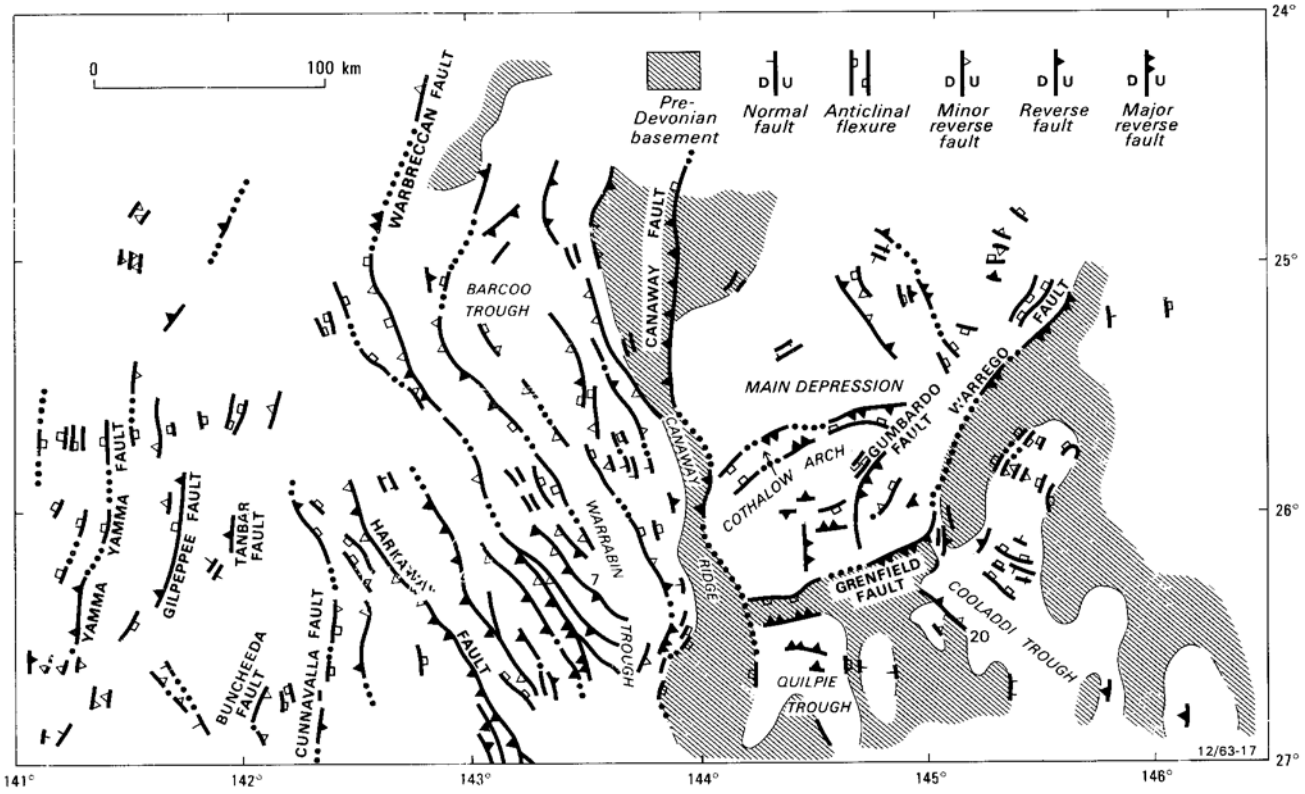

Figure 3. Generalised structure and faults, Adavale Basin region (after Finlayson & others, 1987).

The Gilmore and Log Creek accumulations occupy fold-related traps within the Middle Devonian clastic sequences. Both accumulations are part of a large northeast-trending subsurface anticlinal culmination bounded by subparallel and transverse faults (Heikkila, 1966).

Porosity and permeability

The petroleum-bearing units generally lack significant porosity and permeability. Potential producing zones may, as a result, be dependent upon permeability derived from natural or induced fractures.

The Lissoy Sandstone and the Log Creek Formation are proven gas-bearing units. They are restricted to the east of the Canaway Ridge, in the main depressional area and in the southeasterly troughs, although an equivalent of the Lissoy Sandstone exists in the Warrabin Trough (Fig. 2).

The Lissoy Sandstone consists of thin sandstones interbedded with stringers of carbonate and shale. Its porosity at the Gilmore field ranges from 5 to 15 per cent (Benstead, 1972). Its permeability, however, is generally low, although some exceptionally permeable intervals, up to 800 millidarcies, are attributed to locally developed fractures. The net thickness of porous sandstone ranges from 30 m to 79 m.

The Log Creek Formation is interpreted as deltaic and marine (Paten, 1977). The gas-bearing units are mainly in the deltaic part; they are generally tight and interbedded with thin and lenticular shale.

The cap rocks are the Cooladdi Dolomite, and intra-formational shale, and impervious sandstone beds within the Lissoy Sandstone and the Log Creek Formation

Source rocks and maturation

Total organic carbon (TOC) values from the sequence are generally less than 1.0 per cent (Passmore & Sexton, 1984): the TOC richness is rated as poor to fair for the Eastwood beds and the Log Creek Formation and the Etonvale Formation; the Bury Limestone and Cooladdi Dolomite are rated as good to very good.

Vitrinite reflectance data (Fig. 4) show that most of the sequence is at present either in the oil generation zone or the thermally-derived gas generation zone (Passmore & Sexton, 1984), and that present thermal maturity bears little relationship to present depth of burial.

Vitrinite is the predominant visual kerogen type (Passmore & Sexton, 1984); thus the sequence is more favourable for gas than oil.

A combined assessment of organic richness, thermal maturity, and kerogen type rates the source rocks, mainly from the main depressional area of the basin, as fair to good for gas and poor for oil.

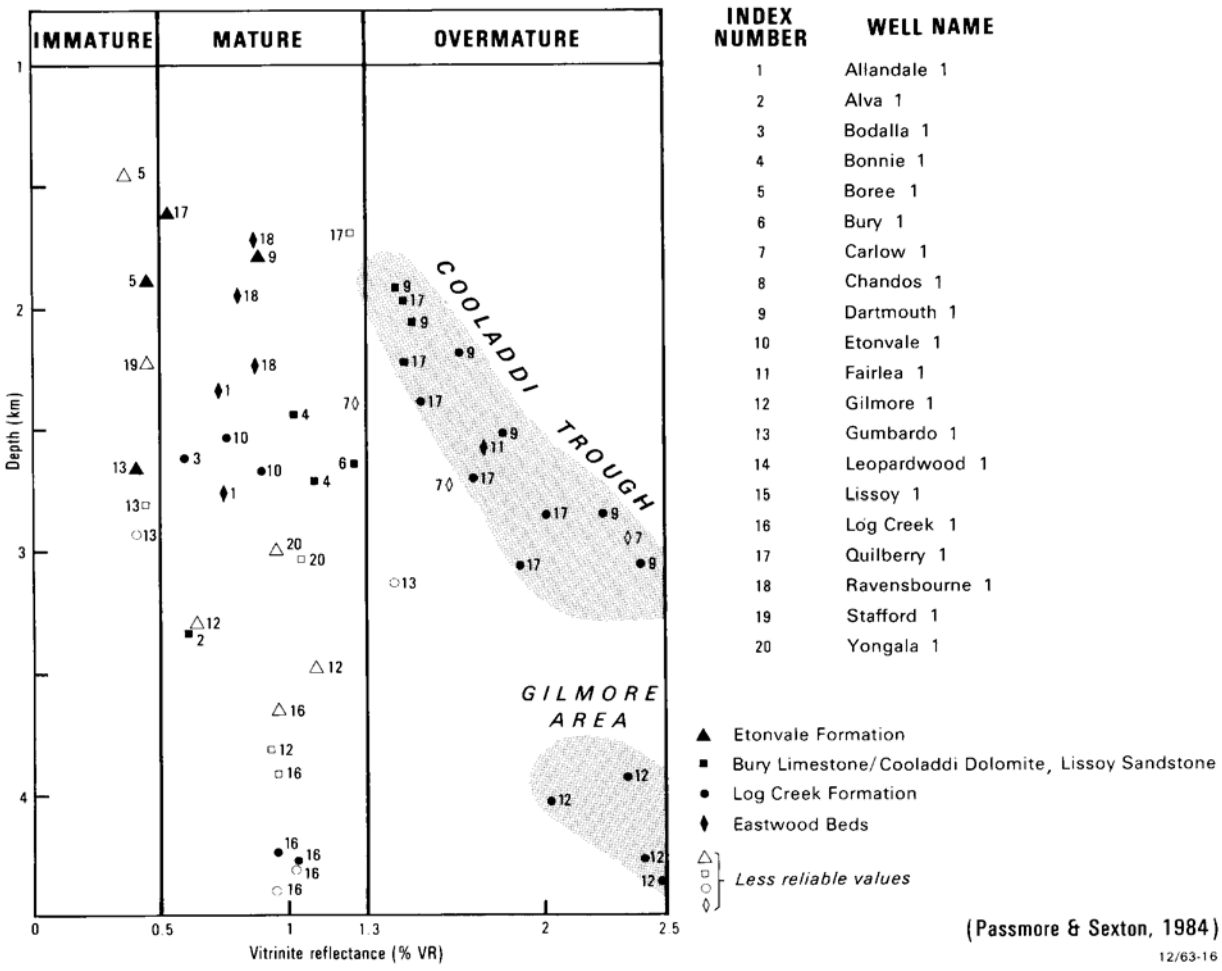

Figure 4. Thermal maturity plot (After Passmore & Sexton, 1984).

Petroleum types

Both the Gilmore and Log Creek accumulations consist of dry gases (Plate 1). Table 1 lists the characteristics of the Gilmore gas (no gas analysis is available for the Log Creek accumulation).

Reserves

Estimated initial recoverable reserves for the Adavale Basin as at 31 December 1986 comprised 589 x 10^6 m^3 (20.8 x 10^9 ft^3) of sales gas (Queensland Department of Mines, 1986; BMR, 1987). All of the reserves comprise those of the Gilmore accumulation, which was declared economic in

August 1987. A recent study, including a production test carried out in 1987, reportedly estimated the probable reserves at 5.322 x 10^9 m^3 (188 x 10 x 10^9 ft ^{3}), (The Aust. Fin. Review, 14 April 1987).

TABLE 1. NATURAL GAS ANALYSIS.

Accumulation:	Gilmore
Petroleum-bearing unit:	Lissoy Sandstone
Components	Mol. %
methane	88.60
ethane	2.50
propane	0.32
iso-butane	0.05
n-butane	0.03
iso-pentane	0.02
n-pentane	trace
hexanes +	0.07
nitrogen & oxygen	5.60
carbon dioxide	2.80
hydrogen sulphide	0.00
	99.99

After Lewis & Kyranis (1965)

Production and development

An amount of 10.4 x 10^6 m^3, of raw gas was used to drill extension wells into the Gilmore accumulation (Beddoes, 1973).

In 1986, a feasibility study was begun, into the potential for developing the Gilmore gas reserves for manufacturing ammonium nitrate in a proposed plant at Blackall, 100 km to the north (Randal, 1987). The project would entail building a pipeline from the Gilmore accumulation to Blackall, and gas production is expected to commence in early 1989.

PETROLEUM ACCUMULATIONS SUMMARIES

NOTES ON DEVELOPMENTS

GILMORE: a forgotten gas accumulation may be commercial . . . . .

The Gilmore field in the Adavale Basin is "in the middle of not much", admitted the managing director of permit participant Monarch Petroleum NL. But the Du Pont Corporation of the US is prepared to invest $40 million in an ammonium nitrate plant there if gas flows are sufficient, he said.

Operator Northern Michigan Exploration Co. (Nomeco) has reported a flow test on the Gilmore 3 well of 382,000 cubic metres of gas per day through a 12.5 mm choke.

Although the well and its two successful predecessors were drilled in the mid 1960s, this is the first serious attempt in more than 20 years to investigate the field's commercial potential, a Nomeco statement said.

After The Sydney Morning Herald*, 4 April 1987*

GILMORE: the gas accumulation declared commercial . . . . . .

A $40 million ammonium nitrate plant at Blackall in central Queensland is to proceed, following the announcement yesterday that all joint venture partners had signed an agreement.

The project will involve the construction of ammonia, nitric acid and ammonium nitrate production facilities, as well as the construction of a 140 km long gas pipeline from the Gilmore accumulation.

Natural gas from the Gilmore accumulation would provide both the raw material and energy source for the Blackall plant, which should be in operation by 1989.

After The Australian Financial Review*, 14 August 1987*

PETROLEUM ACCUMULATIONS SUMMARY SHEET

ACCUMULATION: *Gilmore*

COMPILATION DATE: *28/8/87*

OPERATOR: *Northern Michigan Exploration Company*

TYPE: *Gas*

COMMERCIAL STATUS: *Economic and undeveloped*

LOCATION: *900 km west-northwest of Brisbane, Queensland*

STATE: *Queensland*

PETROLEUM TITLE(S): *ATP 172P*

DISCOVERY WELL: *Gilmore No.1 (Lewis & Kyranis, 1965)*
- latitude: *25º21'38"* longitude: *144º48'38"*
- discovery: *gas*
- date total depth reached: *October 1964*

NUMBER OF WELLS DRILLED: *4* exploration
Nil development

STRUCTURE: *Anticline: northeast trending; domal; bounded to the south and to the east by subparallel and transverse faults (Structure map, Plate 1)*
- areal closure: *39 sq.km*
- vertical closure: *183 m*

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

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

DRIVE MECHANISM: ? *Gas expansion*

PRODUCTION COMMENCED: *Nil, but raw gas was used to drill extension wells*

PRODUCTION INFRASTRUCTURE: *Nil*

TRAP

TRAP 1: *Lissoy Sandstone*

DISCOVERY WELL: *Gilmore No.1*

CONTENTS: *Gas*

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: *Lissoy Sandstone*

PETROLEUM CONTENTS: *Gas*
PRODUCTION STATUS: *Nil*
FORMATION: *Lissoy Sandstone*
AGE: *Middle Devonian*
TRAPPING MECHANISM: *Structural; fold-related*
LITHOLOGY: *Sandstone: massive; in parts interbedded with shale, siltstone and minor conglomerate; arid continental to marginal marine*
DEPTH TO TOP OF PETROLEUM-BEARING UNIT : *3642 m BKB*
POROSITY: *Up to 15%; average 8%*
PERMEABILITY: *0.1 to 1500 md; generally < 1.0md*
TEMPERATURE GRADIENT: *3.1 ºC/100m*
PRESSURE GRADIENT: *11 300 Pa/m*

TRAP

TRAP 2: *Log Creek Formation*

DISCOVERY WELL: *Gilmore No.1*

CONTENTS: *Gas*

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: *Deltaic unit*

PETROLEUM CONTENTS: *Gas*
PRODUCTION STATUS: *Nil*
FORMATION: *Log Creek Formation*
AGE: *Middle Devonian*
TRAPPING MECHANISM: *Structural; fold-related*
LITHOLOGY: *Sandstone: dolomitic in parts; interbedded with carbonaceous and micaceous shale and siltstone; minor conglomerate*
DEPTH TO TOP OF PETROLEUM-BEARING UNIT : *3813 m BKB*
POROSITY: *Low*
PERMEABILITY: *Very low*
TEMPERATURE GRADIENT: *3.1 ºC/100m*
PRESSURE GRADIENT: *11 300 Pa/m*

PETROLEUM-BEARING UNIT 2: *Marine unit*

PETROLEUM CONTENTS: *Gas*
PRODUCTION STATUS: *Nil*
FORMATION: *Log Creek Formation*
AGE: *Middle Devonian*
TRAPPING MECHANISM: *Structural; fold-related*
LITHOLOGY: *Sandstone: calcareous and carbonaceous; interbedded with calcareous and carbonaceous shale and siltstone*
DEPTH TO TOP OF PETROLEUM-BEARING UNIT : *4065 m BKB*
POROSITY: *< 4%*
PERMEABILITY: *< 4 md*
TEMPERATURE GRADIENT: *3.1 ºC/100m*
PRESSURE GRADIENT: *11 300 Pa/m*

PETROLEUM ACCUMULATIONS SUMMARY SHEET

ACCUMULATION: *Log Creek*

COMPILATION DATE: *22/4/87*

OPERATOR: *Northern Michigan Exploration Company*

TYPE: *Gas show*

COMMERCIAL STATUS: *Uneconomic and undeveloped*

LOCATION: *900 km west-northwest of Brisbane, Queensland*

STATE: *Queensland*

PETROLEUM TITLE(S): *ATP 172P*

DISCOVERY WELL: *Log Creek No.1 (Kyranis & McDonagh, 1966)*
- latitude: *25º15'56"* longitude: *144º54'37"*
- discovery: *gas*
- date total depth reached: *May 1965*

NUMBER OF WELLS DRILLED: *1* exploration
Nil development

STRUCTURE: *Anticline: northeast trending; bounded to the southeast by a parallel fault (Structure map, Plate 1)*
- areal closure: *7 sq.km*
- vertical closure: *100 m*

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

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

DRIVE MECHANISM: *? Gas expansion*

PRODUCTION COMMENCED: *Nil, but raw gas was used to drill extension wells*

PRODUCTION INFRASTRUCTURE: *Nil*

TRAP

TRAP 1: *Lissoy Sandstone*

DISCOVERY WELL: *Log Creek No.1*

CONTENTS: *Gas*

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: *Lissoy Sandstone*

PETROLEUM CONTENTS: *Gas*
PRODUCTION STATUS: *Nil*
FORMATION: *Lissoy Sandstone*
AGE: *Middle Devonian*
TRAPPING MECHANISM: *Structural; fold-related*
LITHOLOGY: *Sandstone: massive; in parts interbedded with shale, siltstone and minor conglomerate; marginal marine*
DEPTH TO TOP OF PETROLEUM-BEARING UNIT : *4007 m BKB*
POROSITY: *Up to 17%*
PERMEABILITY: *0.1 to 150 md; generally < 1.0 md*
TEMPERATURE GRADIENT: *3.8 ºC/100m*
PRESSURE GRADIENT: *Not available*

TRAP

TRAP 2: *Log Creek Formation*

DISCOVERY WELL: *Log Creek No.1*

CONTENTS: *Gas*

PETROLEUM-BEARING UNIT(S)

PETROLEUM-BEARING UNIT 1: *Deltaic unit*

PETROLEUM CONTENTS: *Gas*
PRODUCTION STATUS: *Nil*
FORMATION: *Log Creek Formation*
AGE: *Middle Devonian*
TRAPPING MECHANISM: *Structural; fold-related*
LITHOLOGY: *Sandstone: calcareous; interbedded with carbonaceous and micaceous shale and siltstone; minor conglomerate*
DEPTH TO TOP OF PETROLEUM-BEARING UNIT : *4240 m BKB*
POROSITY: *5%*
PERMEABILITY: *0.1 md*
TEMPERATURE GRADIENT: *3.1 ºC/100m*
PRESSURE GRADIENT: *10 800 Pa/m*

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The manuscript was typed by Dorothy Leonard and re-typed by Annette Barker.

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GLOSSARY

Accumulation: Any petroleum find irrespective of its commercial viability. An accumulation may comprise a single petroleum trap or multiple traps all grouped on, or related to, the same individual geological structure and/or stratigraphic position.

Economic Accumulation: a petroleum accumulation which has been declared commercial by the operator.

Natural Gas: a mixture of hydrocarbons and non-hydrocarbons which exist in the gaseous state in underground rock formations.

Petroleum: a gaseous and/or liquid mixture of many hydrocarbons and hydrocarbon compounds occurring naturally in rocks.

Petroleum-bearing unit: an interval, containing petroleum, that can be distinguished on one or more characters (e.g lithology, stratigraphic zone, etc.).

Sales gas: a mixture of methane and ethane, and up to 3% of carbon dioxide.

Subeconomic accumulation: a petroleum accumulation deemed by the operator to have sufficient petroleum reserves for potential production, but not yet declared economically viable.

Trap: any geological condition (structural or stratigraphic, or both) which prevents the vertical or lateral movement of petroleum.

Uneconomic accumulation: a petroleum accumulation (generally a show only) deemed by the operator to be volumetrically insignificant and most probably non-recoverable.

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

COMPILED BY S. MIYAZAKI AND S. OZIMIC IN CO-OPERATION WITH QUEENSLAND GEOLOGICAL SURVEY, (MARCH 1987).

DRAWN BY J. M. JENKINS

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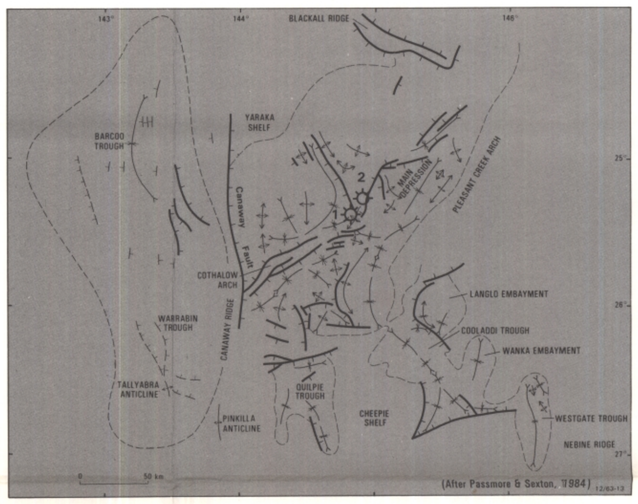
AUSTRALIAN PETROLEUM ACCUMULATIONS

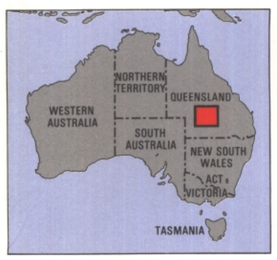
ADAVALE BASIN

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

STATUS	ECONOMIC AND UNDEVELOPED	UNECONOMIC AND UNDEVELOPED
LOCALITY MAP NUMBER	1	2
ACCUMULATION	GILMORE	LOG CREEK
TRAP	Lissoy Sandstone; Log Creek Formation	Lissoy Sandstone; Log Creek Formation
PETROLEUM-BEARING UNIT	Lissoy Sst; Deltaic Unit; Marine Unit	Lissoy Sst; Deltaic Unit
PETROLEUM CONTENT	Gas; Gas show	

LOCALITY AND STRUCTURE MAP





STRATIGRAPHY

AGE	BASIN	STRATIGRAPHIC UNIT (Penetrated maximum thickness)	DEPOSITIONAL ENVIRONMENT
CRETACEOUS & JURASSIC	EROMANGA		
TRIASSIC, PERMIAN & CARBONIFEROUS	COOPER & GALILEE		
EARLY CARBONIFEROUS & LATE DEVONIAN	ADAVALE	BUCKABIE FM (1709 m)	Arid continental
MIDDLE DEVONIAN	ADAVALE	Shale/siltstone unit (612 m); ETONVALE FM: Sandstone unit (257 m), Boree Salt Mbr (583 m), Evaporitic carbonate unit (273 m); COOLADDI DOLOMITE (99 m); LISSOY SANDSTONE (172 m); BURY LIMESTONE (427 m); LOG CREEK FM (853 m): Deltaic unit, Marine unit; EASTWOOD BEDS (875 m)	Shallow marine (?); Evaporitic to arid continental; Arid continental to shallow marine; Marine to deltaic
EARLY DEVONIAN	ADAVALE	GUMBARDO FM: Volcanic unit (780 m), Red bed unit (459 m)	Arid continental
SILURIAN & ORDOVICIAN	ADAVALE	(BASEMENT)	

(After Paten, 1977)

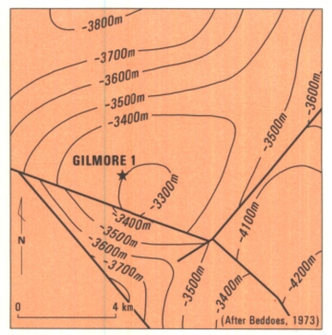
Regional unconformity

Local unconformity

STRUCTURES

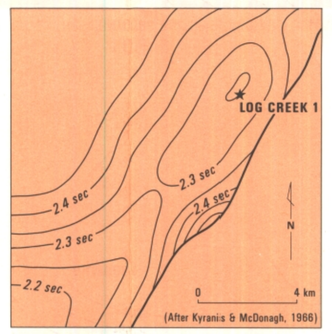
GILMORE

STRUCTURE CONTOURS ON TOP OF COOLADDI DOLOMITE



LOG CREEK

TIME-STRUCTURE CONTOURS ON TOP OF COOLADDI DOLOMITE



★ *Discovery well*

Fault

PETROLEUM RESERVES AND PRODUCTION

REMAINING RECOVERABLE RESERVES	as of	31	12	86
Gas (Sales)		578.6 x $10^9 m^3$		
LPG				
Condensate				
Oil				
CUMULATIVE PRODUCTION	as of	31	12	86
Gas (Sales)		10.4 x $10^9 m^3$		
LPG				
Condensate				
Oil				

Comments

Raw gas was used to drill extension wells in the 1960s.