SOUTH AUSTRALIA

OF-94A-D OFFICER BASIN INVITATION FOR APPLICATIONS

April 1994

DEPARTMENT OF
MINES AND ENERGY

EXECUTIVE SUMMARY

FOUR BLOCKS ON OFFER IN OFFICER BASIN.

Four areas, OF94-A to OF94-D in the east Officer Basin of South Australia are available for licence application. One area lies within Pitjantjatjara Land, two are within Maralinga Land and one is outside the lands.

Applications are invited by Friday, 30 September 1994.

One third (100 000 sq km) of the Officer Basin is in western South Australia with the remainder in Western Australia. The Stuart Highway and Australian National Railway provide access to the eastern part of the basin. The nearest township, Marla, is 1 000km northwest of Adelaide and 400km south of Alice Springs.

Most of the prospective basin in South Australia lies within the Pitjantjatjara and Maralinga Aboriginal lands. Both groups are willing to collaborate in petroleum exploration, provided due recognition is given to their close cultural ties with the land and the requirements of the relevant Land Rights Acts are met.

The Officer Basin contains up to 7km of Neoproterozoic and Cambro-Ordovician sediments and the present geometry of the basin was imposed by the Late Devonian Alice Springs Orogeny. Structural highs range from anticlines in troughs to thrust sheets which form prominent ridges on seismic and aeromagnetic data. There is little topographic expression of these structures.

Oil shows have been recorded in wells drilled for both oil and minerals, only five of which exceed 2 000m depth. Fair to good petroleum source potential is evident in two Cambrian and three Neoproterozoic units. The presence of Proterozoic oil in Cambrian reservoirs is proof of the generation and migration of oil in this basin.

Sandstone reservoirs, few of which have been drilled within structural closure, are numerous. Seven have been studied from the base of the Neoproterozoic to the Early Ordovician; darcy permeability and porosity in excess of 15 percent are common.

Seventeen structural leads and prospects have been identified on the most recent seismic interpretation which ties vintage and reprocessed seismic to a new 378km grid in the east Officer Basin.

MESA has prepared new, comprehensive reports on stratigraphy, structure, petrophysics, burial history and seismic interpretation.

The Government of South Australia has a solid record of support and encouragement for natural resources exploration and development:

- The onshore petroleum exploration and production licensing process is simple and inexpensive.
- Reasonable work program commitments are expected.
- The responsible development of hydrocarbon discoveries is a State priority.
- There are established procedures for negotiating licences in Aboriginal land.

State royalty and Federal taxation structures offer an economically competitive environment for petroleum risk expenditures.

There is no set form for licence applications. The application should be accompanied by a proposed 5 year work program, a $2 000 fee, details of the technical and financial resources of the applicant and a map of the application area.

Licence enquires and applications should be addressed to Bob Laws, Director Oil Gas and Coal Division, Department of Mines and Energy, South Australia, PO Box 151, Eastwood 5063 South Australia, Telephone (IAC)* 618 274 7612, Facsimile (IAC)* 618 373 3269.

Applications should be marked
'Strictly Confidential'

Technical enquires should be directed to David Gravestock, Principal Geologist at the same address, Telephone (IAC)* 618 274 7633, Facsimile (IAC)* 618 373 3269.
(* Dial the appropriate International Access Code).

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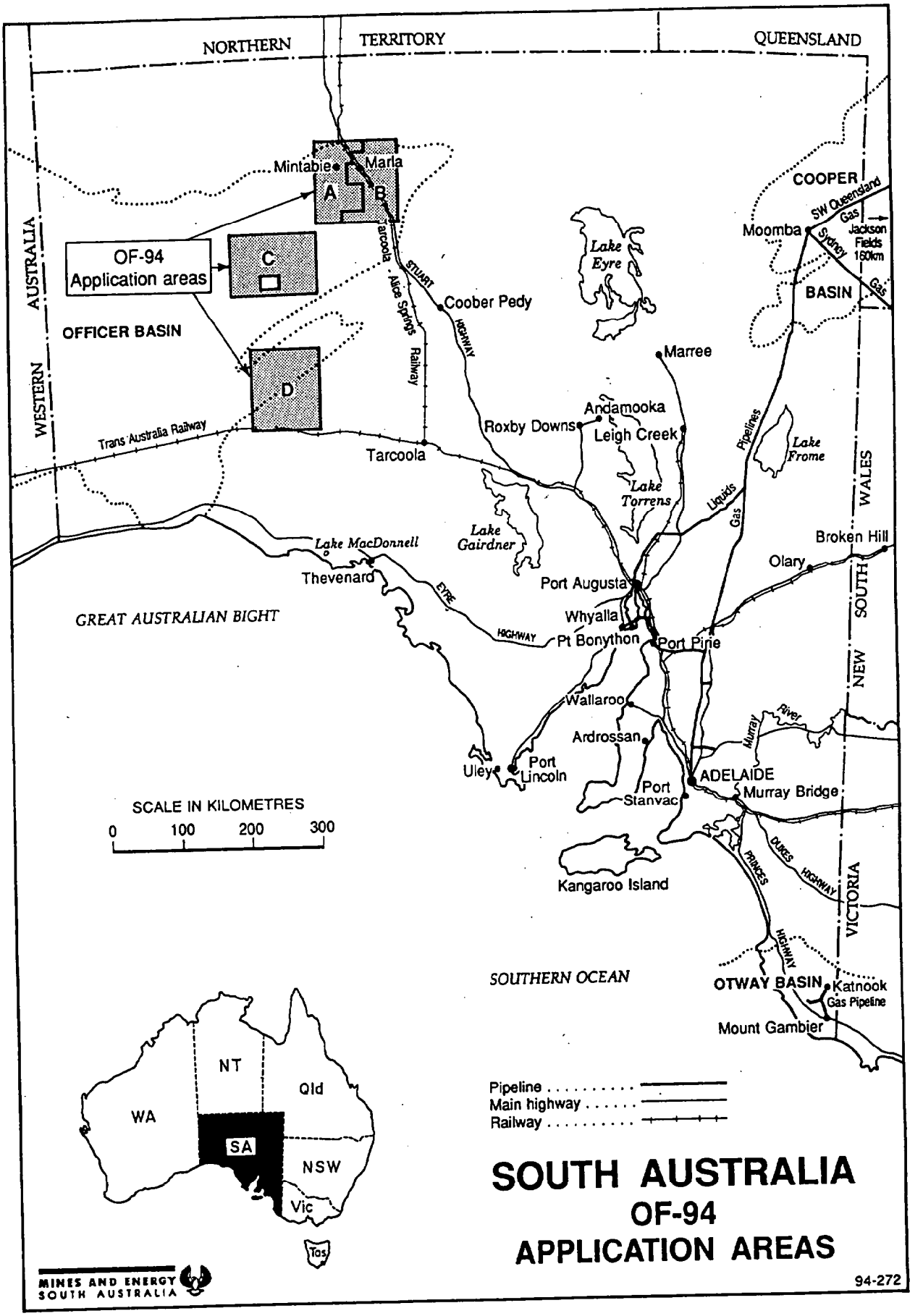
NORTHERN TERRITORY
QUEENSLAND
WESTERN AUSTRALIA
NEW SOUTH WALES
VICTORIA
Mintabie
Marla
A
B
C
D
OF-94
Application areas
OFFICER BASIN
Arcoola
Alice Springs
STUART HIGHWAY
Railway
Coober Pedy
Trans Australia Railway
Tarcoola
Lake Eyre
Marree
COOPER
BASIN
SW Queensland Gas
Sydney
Jackson Fields 160km
Gas
Moomba
Andamooka
Roxby Downs
Leigh Creek
Pipelines
Lake Frome
Lake Torrens
Liquids Gas
Lake Gairdner
Lake MacDonnell
Thevenard
EYRE HIGHWAY
GREAT AUSTRALIAN BIGHT
Port Augusta
Whyalla
Pt Bonython
Port Pirie
Broken Hill
Olary
Wallaroo
Ardrossan
Murray River
Uley
Port Lincoln
Port Stanvac
ADELAIDE
Murray Bridge
SCALE IN KILOMETRES
0 100 200 300
Kangaroo Island
DUKES HIGHWAY
PRINCES HIGHWAY
SOUTHERN OCEAN
OTWAY BASIN
Katnook Gas Pipeline
Mount Gambier
NT
Qld
WA
SA
NSW
Vic
Tas
Pipeline
Main highway
Railway
SOUTH AUSTRALIA
OF-94
APPLICATION AREAS
MINES AND ENERGY SOUTH AUSTRALIA
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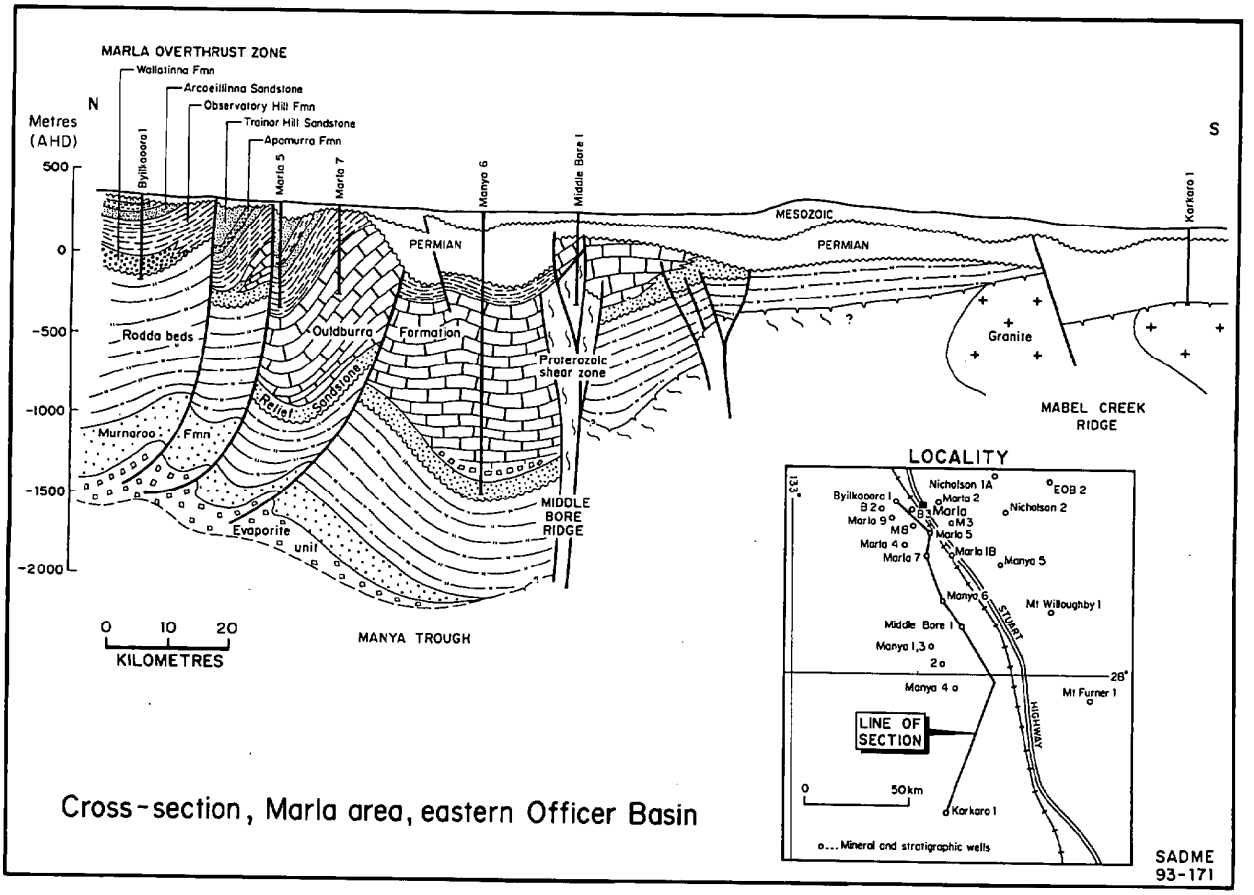

Cross-section, Marla area, eastern Officer Basin

SOUTH AUSTRALIAN FACTS

Population	:	1,461,700
Area	:	984,377 km^2 (380 070 square miles).
1993 Oil and Condensate Production	:	1.59 million m^3 (10 million bbls).
1993 LPG production	:	478,000 tonnes (5.6 million bbls).
1993 Sales Gas Production	:	180.6 PJ (171.2 BCF)
Producing Wells	:	316 gas, 225 oil
Total Seismic Onshore/Offshore	:	112,500 km/ 98,000 km
1993 Onshore exploration expenditure	:	A$ 37 million
1993 Offshore exploration expenditure	:	A$ 31 million
Producing Basins	:	Cooper (Permian gas, oil); Eromanga (Jurassic oil); Otway (Cretaceous gas)
Company Tax (Federal)	:	33% of annual net profits
Onshore Royalty Regime (State)	:	10% of wellhead value
Offshore Royalty Regime (Federal)	:	Resource Rent Tax of 40 % on profits once ROR achieved.
Onshore Crude Oil Excise (Federal)	:	Sliding scale on oil fields over 30 million bbls of up to 35% of selling value. No excise on gas, LPG or condensate.
Environmental Requirements	:	Code of environmental practice and declaration of environmental factors for all operations (model codes available).
Aboriginal Land Access Requirements	:	"Compensation" Agreement (example in Appendix 4), Access Agreement (example in Appendix 5).
Oil, Condensate and LPG Regulation	:	Free market.
Gas	:	Free market, unsatisfied demand, State purchasing "authorities", deregulation/privatisation imminent.

OF-94 SUMMARY SHEET

Area A	-	**6 220 km² (1,527,000 acres).**
Area B	-	**6 400 km² (1,571,000 acres).**
Area C	-	**9 150 km² (2,246,000 acres).**
Area D	-	**10 630 km² (2,609,000 acres).**
AGE OF SEDIMENTS	-	Neoproterozoic to Ordovician.
THICKNESS OF SEDIMENTS	-	Up to : 4 km (Area A), 1.5 km (Area B), 2.5 km (Area C), 1.0 km (Area D).
DEPTH TO TARGET ZONES	-	200 - 3000 m.
BASIN TYPE	-	Polyphase : sag - extensional - compressional.
DEPOSITIONAL SETTING	-	Fluvio-lacustrine (alkaline playa) to shallow marine.
REGIONAL STRUCTURE	-	Early pop-up fault blocks, late thrust sheets.
SOURCE ROCKS	-	Dey-Dey Mudstone, Mena Mudstone (Neoproterozoic), Ouldburra Formation, Observatory Hill Formation (Cambrian).
RESERVOIRS	-	Fluvial, deltaic and marine sandstones.
TRAPS	-	Hanging wall and detached anticlines, footwall pinchouts, salt structures, tilted fault blocks.
DEPTH TO OIL/GAS WINDOW	-	Variable, not known with certainty.
EXPECTED HYDROCARBONS	-	Gas with significant liquids potential. Numerous oil bleeds from Observatory Hill Formation.
NUMBER OF WELLS (Area A)	-	Two (ave. depth 652 m, maximum depth 807 m).
NUMBER OF WELLS (Area B)	-	Nineteen (ave. depth 626 m, maximum depth 1 765 m).
NUMBER OF WELLS (Area C)	-	Seven (ave. depth 1 587 m, maximum depth 2 363 m).
NUMBER OF WELLS (Area D)	-	Seven (ave. depth 355 m, maximum depth 710 m).
SEISMIC COVERAGE (Area A)	-	527 line km.
SEISMIC COVERAGE (Area B)	-	1 281 line km.
SEISMIC COVERAGE (Area C)	-	1 419 line km.
SEISMIC COVERAGE (Area D)	-	96 line km.
PREVIOUS TENEMENT HOLDERS IN THE GENERAL AREA	-	Continental Oil Co. of Australia (1969-1971), Exoil N.L. (1962-1969, 70-71, 71-73), Planet Exploration Co. Pty Ltd (1972-1973), Oilmin N.L. (1973-1974, 75-76), Shell Development (Australia) Pty Ltd (1974-1975), Comalco Aluminium Ltd (1983-1989), CRA Exploration Pty Ltd (1983-1987), Amoco Australia Petroleum Co. (1985-1987).

GEOLOGICAL SETTING

The Neoproterozoic-Devonian Officer Basin, with a history spanning 450 million years, is largely hidden beneath the vegetated dunes of the Great Victoria Desert in south-central Australia. The basin extends west to east 1 100km from longitude 124° E in Western Australia to longitude 135°E in South Australia. From north to south it extends from latitudes 24°S to 31°S, a distance of 770km. Total area is 375 000km^2 of which the eastern one third (100 000km^2) is in South Australia (Fig.1). It is the third largest onshore sedimentary basin in Australia.

Evolution of the basin is complex. Four major tectonic events have shaped the depositional and structural architecture, operating along different trends and affecting different parts of the basin through time. These are:

- The Fraser-Musgrave Orogen, Mesoproterozoic in age, forming the basin floor and oriented southwest to northeast;
- the Paterson-Musgrave Orogen, terminal Neoproterozoic (550-600Ma), transpressional, oriented northwest to southeast and affecting the north and east parts of the basin;
- the Delamerian Orogen, latest Cambrian (490-500Ma), northwest to southeast and causing uplift of the northeast part of the basin;
- the Alice Springs Orogen, latest Devonian to Early Carboniferous (Mississippian), east-west, compressional, causing an estimated 30km of crustal shortening and producing the overthrust architecture evident on seismic sections in the northern part of the basin.

Sedimentary architecture reflects these controls, as shown by depositional wedges which thickened northwest in the Neoproterozoic, northeast in the Cambrian and north in the Ordovician and Devonian (there is no Silurian rock record in South Australia).

The present day structural framework of the basin is asymmetric as a result of these influences (Fig.1). The deepest and thickest sediments, 7km or more, are in the Birksgate sub-basin and Munyarai Trough adjacent to the northern structural margin which is terminated by the Mesoproterozoic Musgrave Block. These structural lows are separated by the enigmatic Nurrai Ridge, a positive gravity and magnetic anomaly which has no apparent structural elevation, at least at its southern extremity where it has been crossed by one recent seismic line. The southeast basin is a flat to gently dipping platform - the Murnaroo Platform - whose northwest margin descends into the Munyarai Trough. This appears to have had three components during the mildly extensional late Neoproterozoic phase of deposition: an inner shelf, a mid-shelf ridge and an outer shelf. Foundering of the inner shelf and mid-shelf ridge during the Cambrian gave rise to the Manya Trough, the northeast trending main locus of deposition prior to the Delamerian Orogeny. The poorly known Tallaringa Trough was a parallel low in which Cambrian sediments accumulated adjacent to the Archaean-Paleoproterozoic Gawler Craton which forms the southeast margin of the Officer Basin. These troughs are separated by the parallel Nawa, Middle Bore and Ammaroodinna Ridges which were paleohighs accentuated by the Alice Springs Orogeny.

Permian and Mesozoic sediments onlap the northeastern and southern margins of the basin and, as a result, these regions where former connections with other ancient basins are severed or hidden, remain poorly known.

It is fair to say that only in the last decade have we been able to obtain enough data, largely through the exploration of Comalco and Amoco, to begin to understand the basin. With the acquisition of 900km of new seismic data in 1993, re-examination of available seismic and well data and a quantum leap in correlation using acritarch biostratigraphy, it is now possible to evaluate the petroleum potential of the Officer Basin.

STRATIGRAPHY

Stratigraphy of the east Officer Basin and a rock-relation diagram linking the Birksgate sub-basin, Munyarai Trough and Murnaroo Platform are shown on Figures 2 and 3. Details of each unit are available in the reports cited in the bibliography. The sediment packages of immediate interest - the Willouran, Marinoan and Cambrian - are described very briefly below.

Willouran-The Saline Supergiant

The oldest rocks in the cover sequence, the Pindyin Sandstone and Alinya Formation were deposited in the (present day) southern reaches of a saline supergiant continental sag basin that might have been up to 2 million sq km in area. The section ranges from 200m to at least 600m thick. Outcrops are sparse, Giles-1 is the only well intersection at present, but the formations are widespread on seismic evidence. Correlated units in Western Australia are the Townsend Quartzite, Browne and Lefroy beds; in the Amadeus Basin, Northern Territory, the Heavitree Quartzite and Bitter Springs Formation are equivalents. Salt in the Alinya sabkha facies formed a major decollement for the propagation of thrust faults; salt structures (swells, pillows and salt walls) occur on the outer (northwest) margin of the Murnaroo Platform. The acolian-fluvial Pindyin Sandstone has excellent reservoir potential and the sabkha facies of the Alinya contains gas-prone source rocks (see below).

Marinoan-The Marine Connection

The Marinoan sedimentary sequences from the Tarlina to the Punkerri Sandstone (Fig.3) record the transition from fluvio-deltaic to fully marine conditions in the Officer Basin. Deposited in a mildly extensional regime, the sediments are widespread with most units being at least partially intersected by wells on the Murnaroo Platform. Munyarai-1 and Birksgate-1, the only deep wells in the major depocentres, where 4km or more were deposited, have partly intersected these sequences. Formations of the Ungoolya Group are dominated by muddy dolomitic siltstones with minor limestones in the Munyarai Trough, whereas sandy sediments and limestones characterise the Birksgate sub-basin.

A major canyon cutting event reflects early uplift on the mid-shelf ridge of the Murnaroo Platform. These movements, which also affected the Adelaide Geosyncline to the east, were precursors of the transpressional Petermann Ranges Orogeny. A shift in depocentres from the Munyarai Trough to the Birksgate sub-basin resulted from this uplift.

The Tarlina Sandstone and Murnaroo Formation constitute fair to good reservoirs; lean but widespread potential source rocks occur in the Dey-Dey and Mena Mudstones.

Cambrian-From Epeiric Sea to Alkaline Playa

Foundering of the mid-shelf ridge and inner shelf resulted from strain release after the Petermann Ranges Orogeny. Early Cambrian aeolian, fluvial, salina and epeiric sea deposits of the Relief Sandstone and Ouldburra Formation accumulated in the Manya and Tallaringa Troughs. These sediments exceed 1100m thickness in Manya-6 and have been intersected

primarily in mineral drillholes in the Marla Overthrust Zone in the eastern part of the basin. Wilkinson-1 in the Tallaringa Trough reached total depth in the Relief after intersecting more than 500m of these sediments, including oil-prone source rocks in the Ouldburra. A similar, though thinner section with 'petroliferous shale' was drilled in KD-1, 65 km southwest of Wilkinson-1. The overlying Observatory Hill Formation rose to prominence in 1979 with the discovery in Byilkaoora-1 stratigraphic well of oil generated *in situ* in alkaline playa lake carbonates. This formation hosts the richest source rocks known in the Officer Basin. Fluvial, paralic and marine conditions are recorded in the overlying formations which principally comprise arkosic sandstones and interbedded mudrocks. Potential reservoirs have been identified (see below).

Ordovician and Devonian - The Calm Before the Storm

Ordovician and Devonian rocks locally exceed 1000m in thickness and were probably up to 3km thick. The Ordovician is sandstone dominated while the Devonian, intersected only in Munyarai-1, is characterised by freshwater lacustrine deposits (with fish fossil fragments) and evaporative red beds. These rocks are important indicators of a northward thickening sediment wedge which buried Cambrian strata to petroleum generative depths. The Ordovician and Devonian are structurally concordant with the underlying rocks and were deformed with them by the advancing thrust sheets that signalled the Alice Springs Orogeny. Excellent potential reservoirs exist in the Ordovician Mount Chandler Sandstone, but unless structurally sealed beneath hanging wallrocks, they are at risk from Permian erosion.

SOURCE ROCKS

Oil shows in the Officer Basin occur in six different formations and belong to four genetically distinct oil families, implying the existence of multiple effective source rocks.

Hydrocarbon source potential is detailed in reports by Dr D. McKirdy (University of Adelaide). Source and reservoir potential of the Ouldburra carbonates form the research topic of Ph.D. candidate Mr M. Kamali at the National Centre for Petroleum Geology & Geophysics.

Total Organic Carbon (TOC) values in Giles-1 (Area 94OF-C) Alinya Formation (6 samples from 1238 to 1266m) range up to 0.62 per cent (mean 0.36 per cent) in the 35m thick sabkha facies. Organic richness is poor to fair, kerogen is gas-prone and maturation levels correspond to the oil generation window. Molecular biomarkers indicate eukaryotic algal and bacterial sources. The same molecular fossil assemblage is found in oil extracted from the much younger Murnaroo Formation and Relief sandstones. Methylphenanthrene index measurements suggest these oils are relatively late expulsion products. The Alinya Formation, from one well alone, thus justifies further investigation as a potential source rock.

Two units, the Dey-Dey and Mena Mudstones at the base and top of the Neoproterozoic Ungoolya Group have TOC values that range up to 1.47 per cent (87 samples, mean 0.28 per cent). The richest samples are from transgressive and late highstand systems tracts but sampling has been random as shown by the low mean value. Highest values are from drillhole Lake Maurice West, 130km west of area 94OF-D and the same distance southwest of area 940F-C. Extracts from oil bleeds indicate a marine source from sterane distributions; molecular assemblages are similar to those reported from Oman and Siberia.

The Cambrian Ouldburra Formation, primarily an epeiric sea carbonate has variable TOC values from 0.04 to 1.87 per cent. The richest potential source beds are thin (~ 1m) but widespread and appear to be concentrated in sabkha and highstand sediments. Kerogen is of poor quality and mature to overmature in the northeast part of the basin (Areas OF94-A, B),

but good quality Type II kerogen in the main oil generative window (VRcalc = 0.8%) occurs in Wilkinson-1 and KD-2A in the Tallaringa Trough (Area OF94-D). One sample from Manya-6 appears to be stained by migrated hydrocarbons.

A quite distinct oil family occurs in the non-marine, alkaline playa lake sediments of the Observatory Hill Formation. Nine mineral drillholes recorded oil bleeds and oil stains in vugs and fractures from depths as shallow as 200m below surface. TOC values of the host carbonate range from 0.5 to 1.4 per cent, calculated vitrinite reflectance places the Byilkaoora-1 intersection in the oil window (VRcalc = 0.9-1.0). The playa lake facies (Parakeelya Alkali Member) extends for 200 km along the Manya Trough, reaching the surface at Observatory Hill-1 (Fig. 1).

RESERVOIR ROCKS

Sandstone reservoirs are primary exploration targets due to their thickness and wide extent.

Comalco's exploration concentrated on evaporites in the Marla area (94OF-A and B). In the Munta area (94OF-C) their search for petroleum was centred chiefly on the Ungoolya Group siltstones which, it was hoped, had significant fracture porosity. This did not eventuate. Only two wells (Giles-1, Ungoolya-1) targeted anticlinal closures. Current interpretation suggests these wells were drilled off-structure.

In-house reservoir studies have defined porosity-permeability relationships from core samples for each of the seven sandstone reservoirs in the east Officer Basin. These are shown in Figure 9. Wireline log porosity and Vshale have also been calculated. Porosity-depth investigations indicate that the depth of burial immediately post-dating the Alice Springs Orogeny (i.e. Early Carboniferous or Mississippian) was a major factor in determining loss of primary porosity. Summaries of the reservoir characteristics of each formation are given below.

The clean, aeolian Pindyin Sandstone at the base of the section in Giles-1 (porosity 3.8 - 22.5%, mean 11.8%; permeability 0.04 - 1538 md, mean 48 md) is widespread, outcropping on the north margin of the Birksgate sub-basin.

The alluvial-tidal-shallow marine Tarlina Sandstone disconformably overlies the Alinya Formation on the Murnaroo Platform (porosity 9.0 - 19.6%, mean 15.9%; permeability 0.16 - 4.5 md, mean 1.2 md). It is arkosic with calculated Vshale of 5 to 25 per cent.

The Murnaroo Formation was deposited in similar environments and occurs on the Murnaroo Platform and east of the Manya Trough (porosity 1.2 - 18.8%, mean 14%; permeability 0.01-213 md, mean 20 md). It is feldspathic, micaceous and locally glauconitic.

The Relief Sandstone disconformably overlies the Proterozoic in the Manya Trough. Aeolian, fluvial and tidal facies are related to marine lowstand-highstand cycles. Porosity is variable and related to burial depths reached during the Alice Springs Orogeny. Footwall situations average 2.9 per cent, hanging wall situations 6.7 per cent, and areas distant from the Marla Overthrust Zone average 16.4 per cent, with permeability up to 8 darcies resulting from dissolution of clay and carbonate cements.

Relief-type sandstones are interbedded with Ouldburra lowstand deposits (porosity 1-23%, permeability 0.01 - 596 md). Intercrystalline porosity and permeability of Ouldburra dolomites are superior (6-23%, 23-1640 md) thus this unit has both source and reservoir potential.
The Cambrian Arcoeillinna and Trainor Hill Sandstones extend through the Manya and Munyarai Troughs and onto the Murnaroo Platform. The Arcoeillinna is an immature, muddy

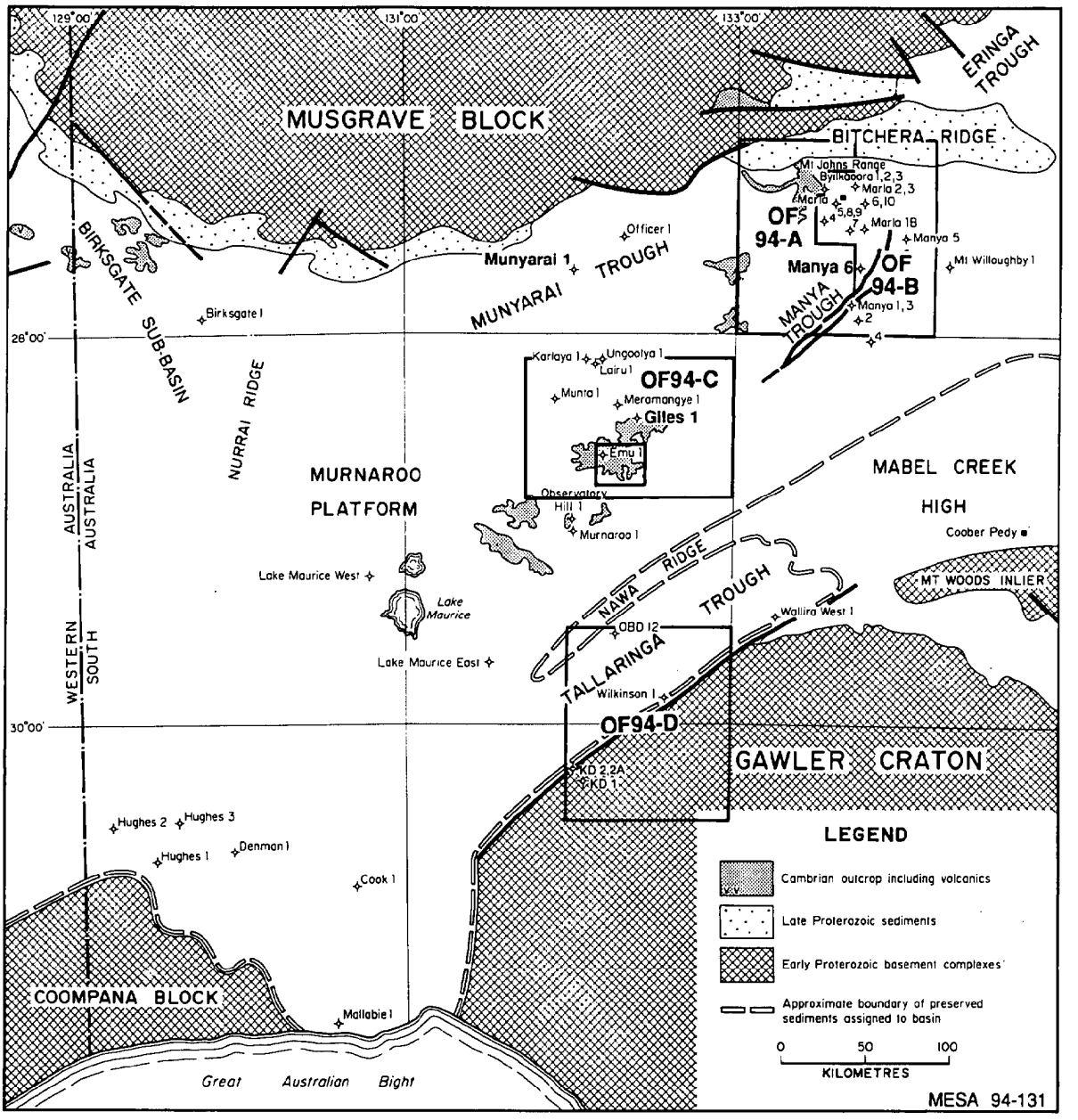

Figure 1. Principal geological features, Officer Basin SA

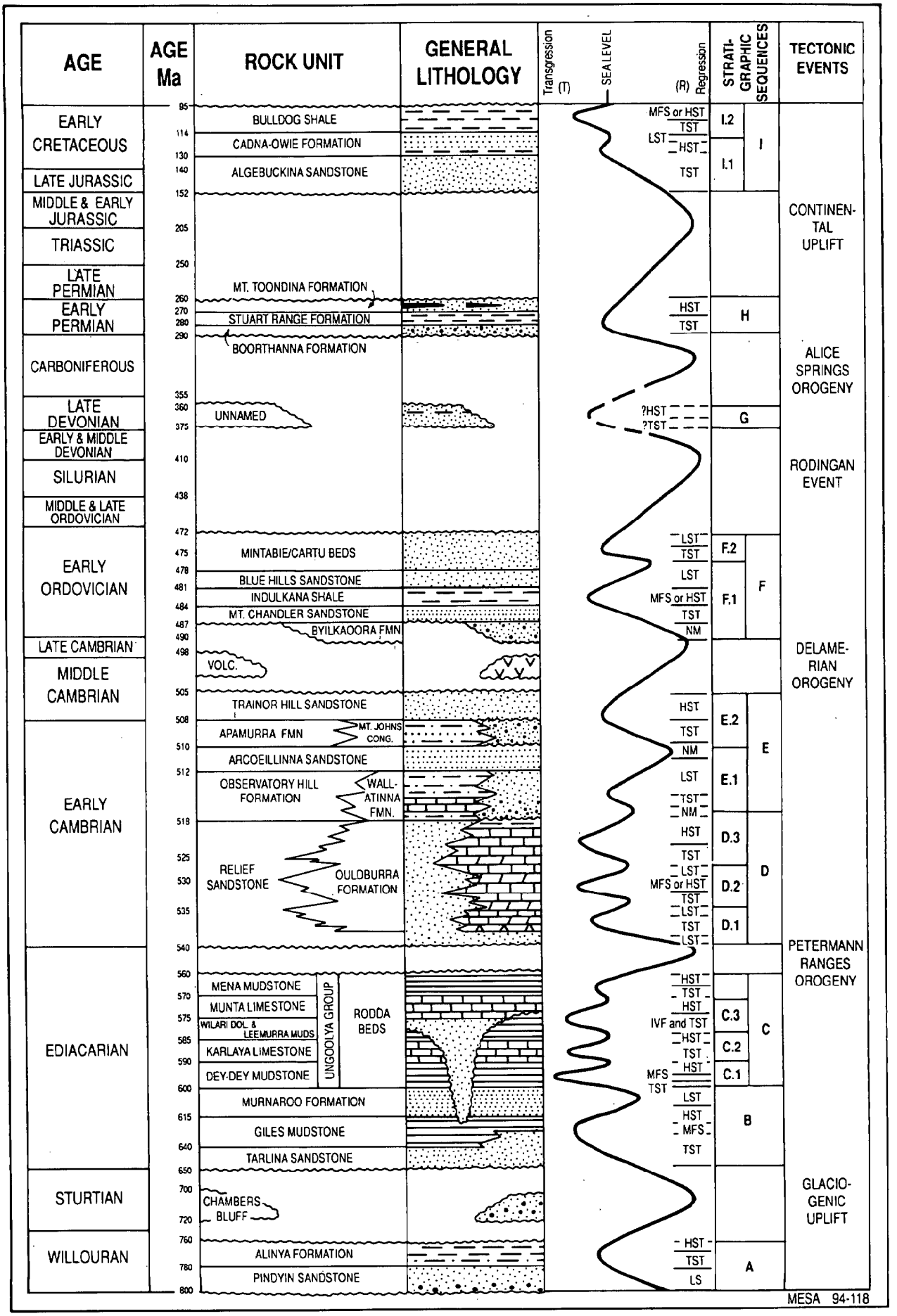

Figure 2. Generalised stratigraphic column, sequences and sea level curve, eastern Officer Basin (not to scale)

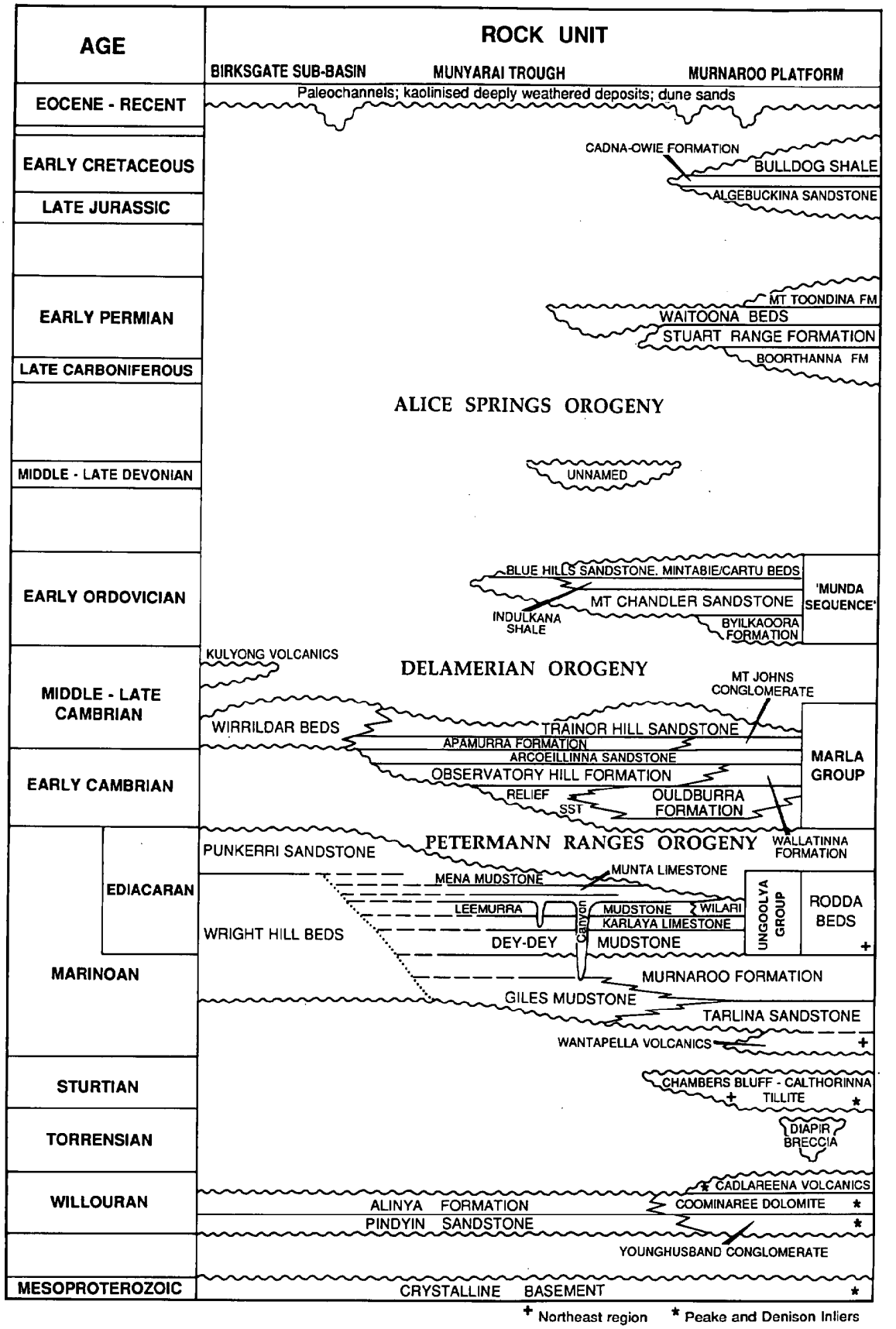

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Figure 3 Stratigraphic column, central and east Officer Basin.

micaceous arkose with poor to excellent reservoir properties. Average porosity is high (>13%) and permeability ranges from 0.1 to 1700 md.

The Trainor Hill Sandstone is fine grained, usually quartzose, with average porosity of 15 per cent and permeability in the tens to hundred millidarcy range. Thickness of this sandstone is variable owing to Delamerian erosion.

The Ordovician Mount Chandler Sandstone (porosity 12.7 - 19.7%, permeability 0.26 - 238 md) is a clean quartzose sandstone. Reservoir potential is good but due to its stratigraphic position the Mount Chandler risks lack of seal resulting from Permian erosion. However, it presents an excellent footwall target in overthrust zones.

PROSPECTS AND LEADS

This study has identified at least 17 prospects and leads.

Approximate areas of prospects and leads are shown on Table 1. These prospects and leads are identified by Base Cambrian (BC; interplay of Cambrian and upper Proterozoic reservoirs and seals) and Basement (B; interplay of Proterozoic reservoir and seals) closures. These closures can be further divided into four main trap types, examples of which are shown in Figures 4 to 8:

1. **Extensional Structures**

Pre-Ordovician structuring in the basin appears to be primarily extensional. In areas of the basin this structuring appears to have remained even through the major compressive forces of the Alice Springs Orogeny.

Prospect 10 is an example of this type of play. A complete Proterozoic sequence is interpreted in the "Cadney Park" prospect and is sealed by Cambrian shales. The prospect is a fault controlled anticline where throw is often large enough to juxtapose reservoir and seal. The Murnaroo Formation is the most likely reservoir with local sourcing coming from the Dey-Dey and Mena Mudstones. The Willouran reservoir source pair of the Pindyin/Alinya Formations is also interpreted to be present and to form the same structural trap in the prospect.

2. **Compressive Structures**

Cambrian reservoirs are most likely to be located in thrust-associated anticlines and strike-slip structures produced during the Alice Springs Orogeny. In the Munta area decollement appears to have occurred within the Proterozoic evaporites of the Alinya Formation, whilst as the sequence thins to the east the faulting produces large overthrust structures as part of the Marla Overthrust Zone.

Prospect 6 is a good example of both footwall roll-over and hanging wall anticlines. The Precambrian sequence is thin and primary reservoirs are the Relief, Arcoeillinna and Trainor Hill Sandstones. Source is predicted from the Ouldburra Formation with sealing being provided intraformationally.

3. **Salt Related Structures**

The interpretation has identified a diapiric salt wall again associated with structuration during the Alice Springs Orogeny. Salt movement was initially along major reactivated faults and the "wall" has its greatest expression in the southwestern Munta region.

Prospect 2 is a diapiric anticline associated with this "wall". The Proterozoic sequence is interpreted to be present with the sub-salt anticline mainly expressed in the Willouran sediments. Hence it is predicted that the primary reservoirs will be the Murnaroo, Tarlina and Pindyin Sandstones. Source is most likely from the Alinya, Dey-Dey and Mena Formations. Salt will form the updip seal with the Ouldburra Formation forming the regional seal over the prospect.

4. **Stratigraphic Traps**

There are various subcrop type stratigraphic traps as well as intraformational facies changes. In this region of such large structural movements most of the stratigraphic traps will have a structural component to them.

Prospect 4 demonstrates the subcrop of the pre Ungoolya Group stratigraphy by an intra Ungoolya unconformity. In the northwestern Munta region this erosional surface is canyon-like and is filled with fine sands but at the head of the canyons the palaeorelief structures are capped by the muds of the upper Ungoolya Group. Here the primary reservoir would be the Murnaroo Formation with source coming from the Alinya Formation evaporitic sequence.

Table 1. Prospects and Leads (Note 1 km^2 = 245.5 acres)

No.	Mapped Horizon	Trap Type	Closure	
			Areal (km^2)	Vertical (msec)
1	BC	2	183	100
2	BC	3	24	60
3	BC	3	16	50
4	BC	4	54	70
5	BC	2	98	50
6	BC	2	51	100
7	BC	2	57	70
8	BC	1	18	30
9	BC	2	39	50
10	BC	1	48	70
11	BC	2	51	200
12	BC	2	299	300
13	BC	1	206	50
14	B	2	51	50
15	B	2	153	50
16	B	2	185	70
17	B	2	119	50

UNDISCOVERED POTENTIAL

The petroleum potential of the East Officer Basin has been estimated to have a 50% chance of ultimately being more or less than 5 TCF of gas or 1.8 billion barrels of oil.

The undiscovered (speculative) hydrocarbon potential of the east Officer Basin was calculated in 1992 using a Monte Carlo simulation. The results, shown in Table 2, were based on vintage seismic and minimal reservoir data. Sufficient information now exists to revise the speculative reserves, and the values shown on Table 1 are provided as a rough guide only.

Table 2: Undiscovered (speculative) reserves

Productive Horizon	Probability that the basin reserves will exceed the stated value. 90%	50%	10%
OBSERVATORY HILL (Molyes Chert Marker Bed)			
Sales Gas (BCF)	6	61	243
Recov. Oil (MMSTB)	4	20	67
RELIEF SANDSTONE			
Sales Gas (BCF)	294	2699	9268
Recov. Oil (MMSTB)	189	883	2480
MURNAROO SANDSTONE			
Sales Gas (BCF)	249	2425	8774
Recov. Oil (MMSTB)	173	805	2546
*TOTAL Sales Gas (BCF)	523	5152	18459
*TOTAL Recov. Oil (MMSTB)	451	1823	4896

* Note: Totals are not arithmetic additions of individual plays, as they are the subject of an independent Monte Carlo simulation.

BCF = Billion (10^9) cubic feet
MMSTB = Million stock tank barrels

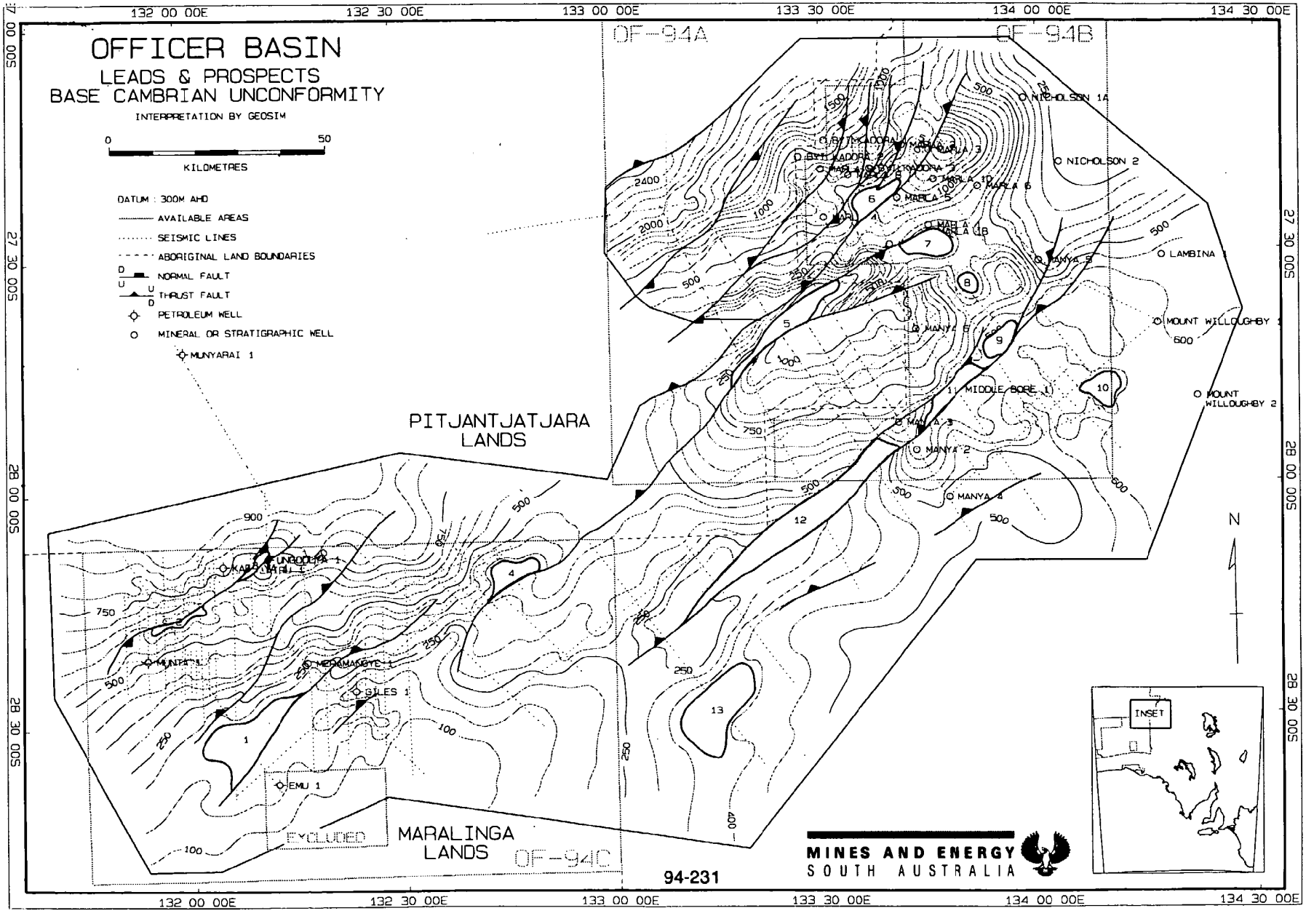
OFFICER BASIN
LEADS & PROSPECTS
BASE CAMBRIAN UNCONFORMITY
INTERPRETATION BY GEOSIM
0
50
KILOMETRES
DATUM : 300M AHD
AVAILABLE AREAS
SEISMIC LINES
ABORIGINAL LAND BOUNDARIES
NORMAL FAULT
THRUST FAULT
PETROLEUM WELL
MINERAL OR STRATIGRAPHIC WELL
MUNYARAI 1
OF-94A
OF-94B
OF-94C
PITJANTJATJARA
LANDS
MARALINGA
LANDS
EXCLUDED
NICHOLSON 1A
NICHOLSON 2
LAMBINA 1
MOUNT WILLOUGHBY 1
MOUNT WILLOUGHBY 2
MIDDLE BORE 1
MANYA 1
MANYA 2
MANYA 3
MANYA 4
MANYA 5
MANYA 6
MARLA 1
MARLA 1B
MARLA 2
MARLA 3
MARLA 4
MARLA 5
MARLA 6
MARLA 7
BYTHYKADDRA 1
BYTHYKADDRA 2
BYTHYKADDRA 3
KADDARI 1
UNDOOLYA 1
HUNTA 1
HENMASKYE 1
GILES 1
EMU 1
INSET
N
94-231
MINES AND ENERGY
SOUTH AUSTRALIA
132 00 00E
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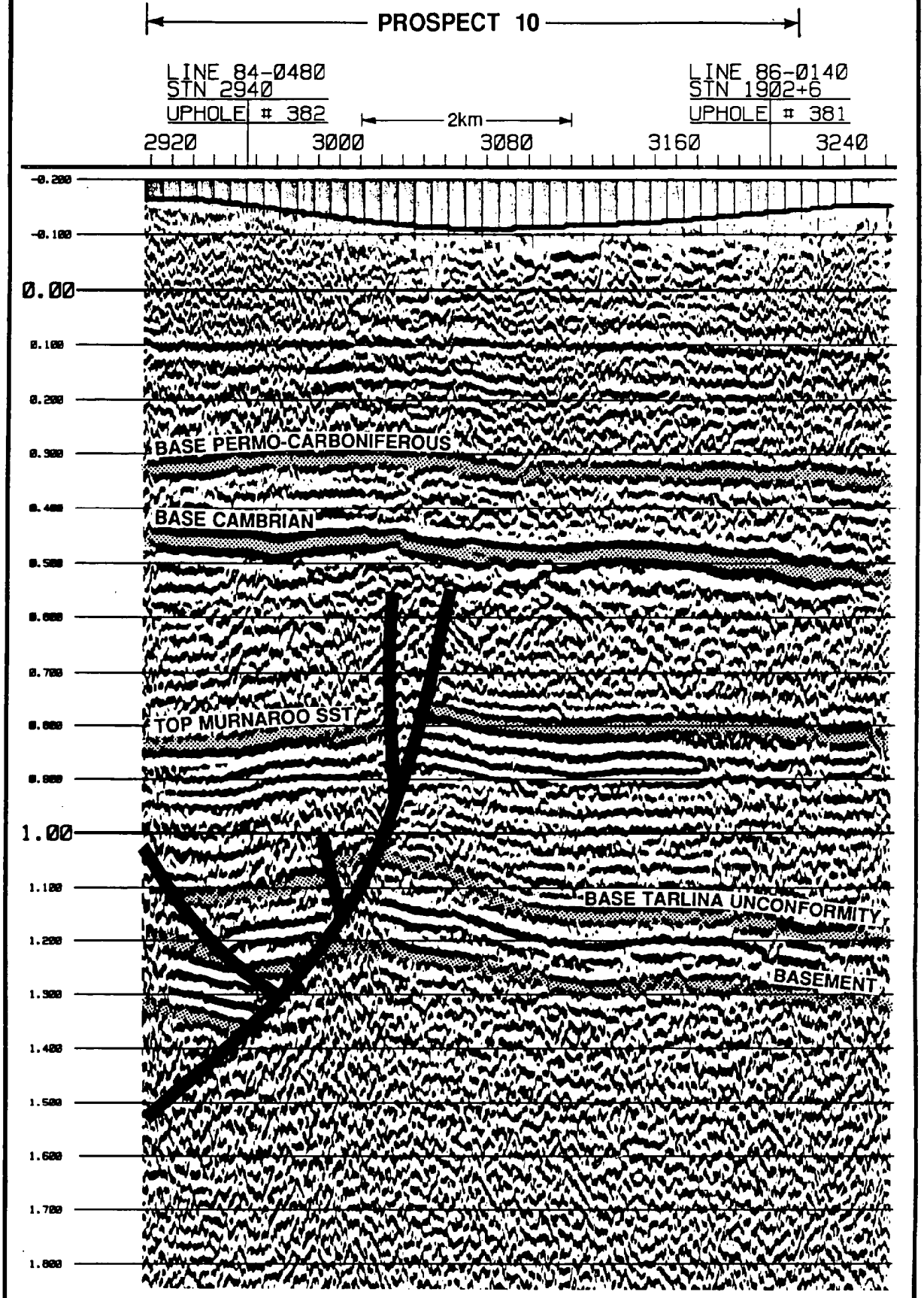
Figure 4.



EASTERN OFFICER BASIN

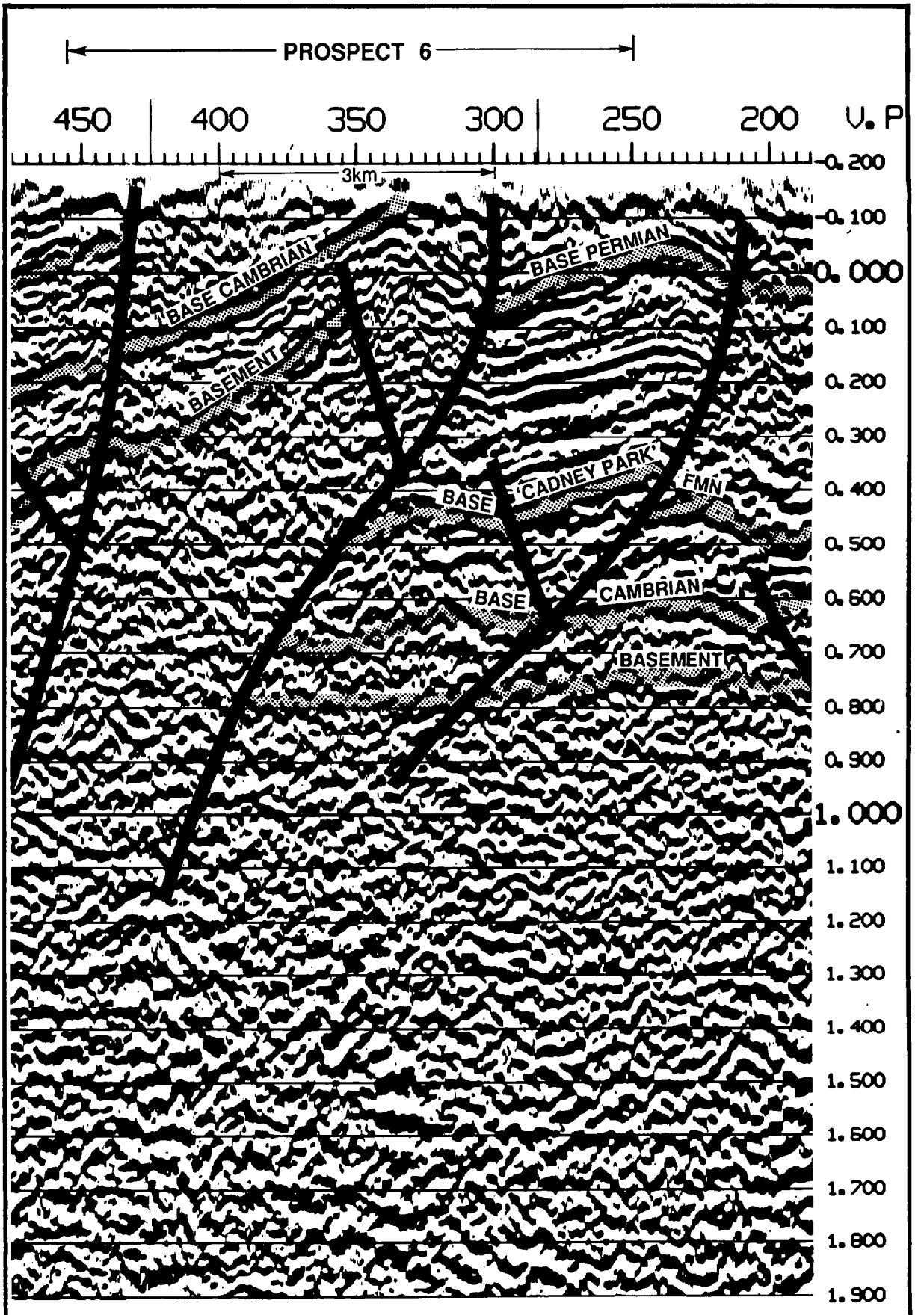
PROSPECT 10

LINE 86-0480

MINES AND ENERGY SOUTH AUSTRALIA

94-227

Figure 5.



EASTERN OFFICER BASIN

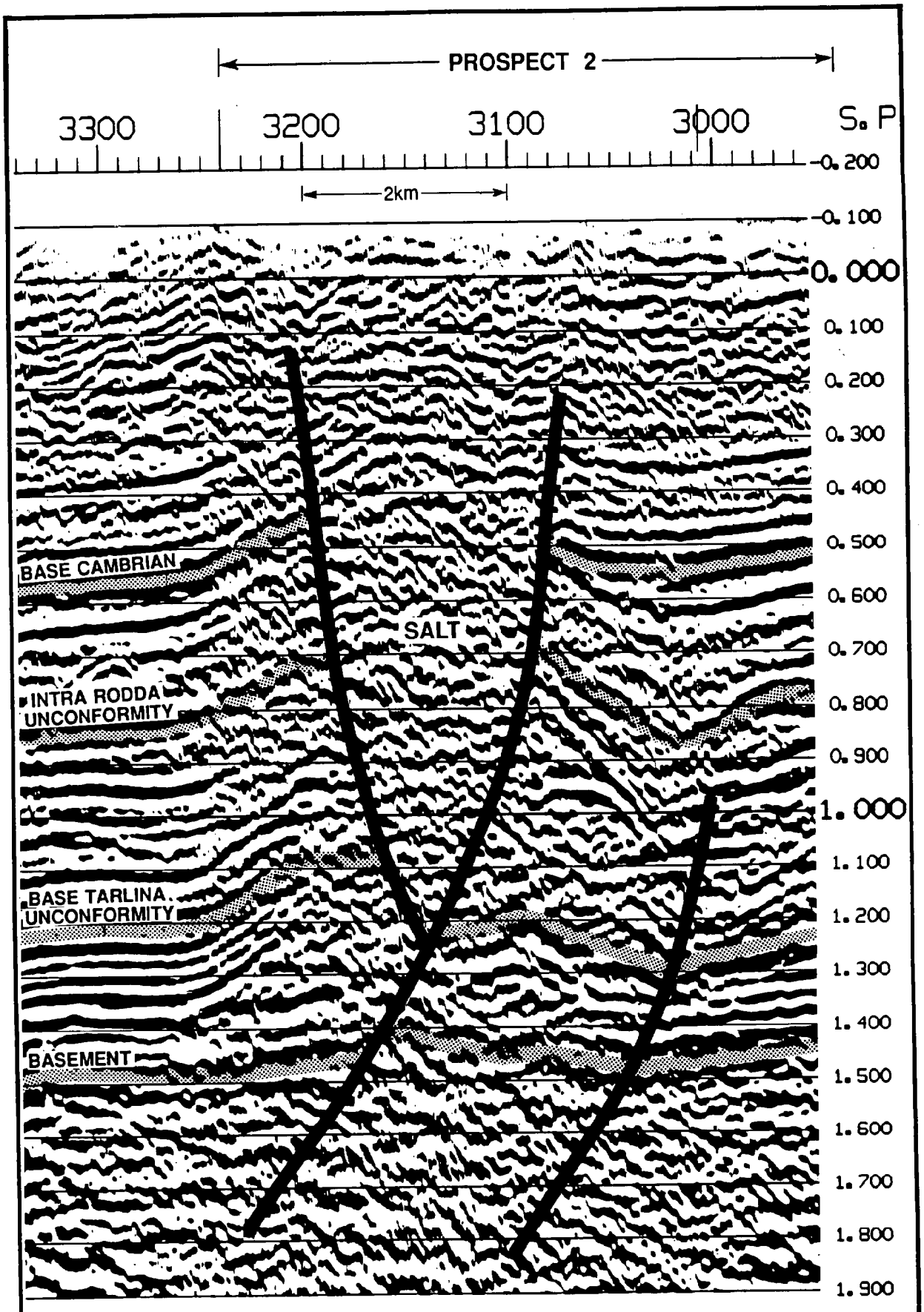
PROSPECT 6

LINE 86-0096

MINES AND ENERGY SOUTH AUSTRALIA

94-228

Figure 6.



EASTERN OFFICER BASIN

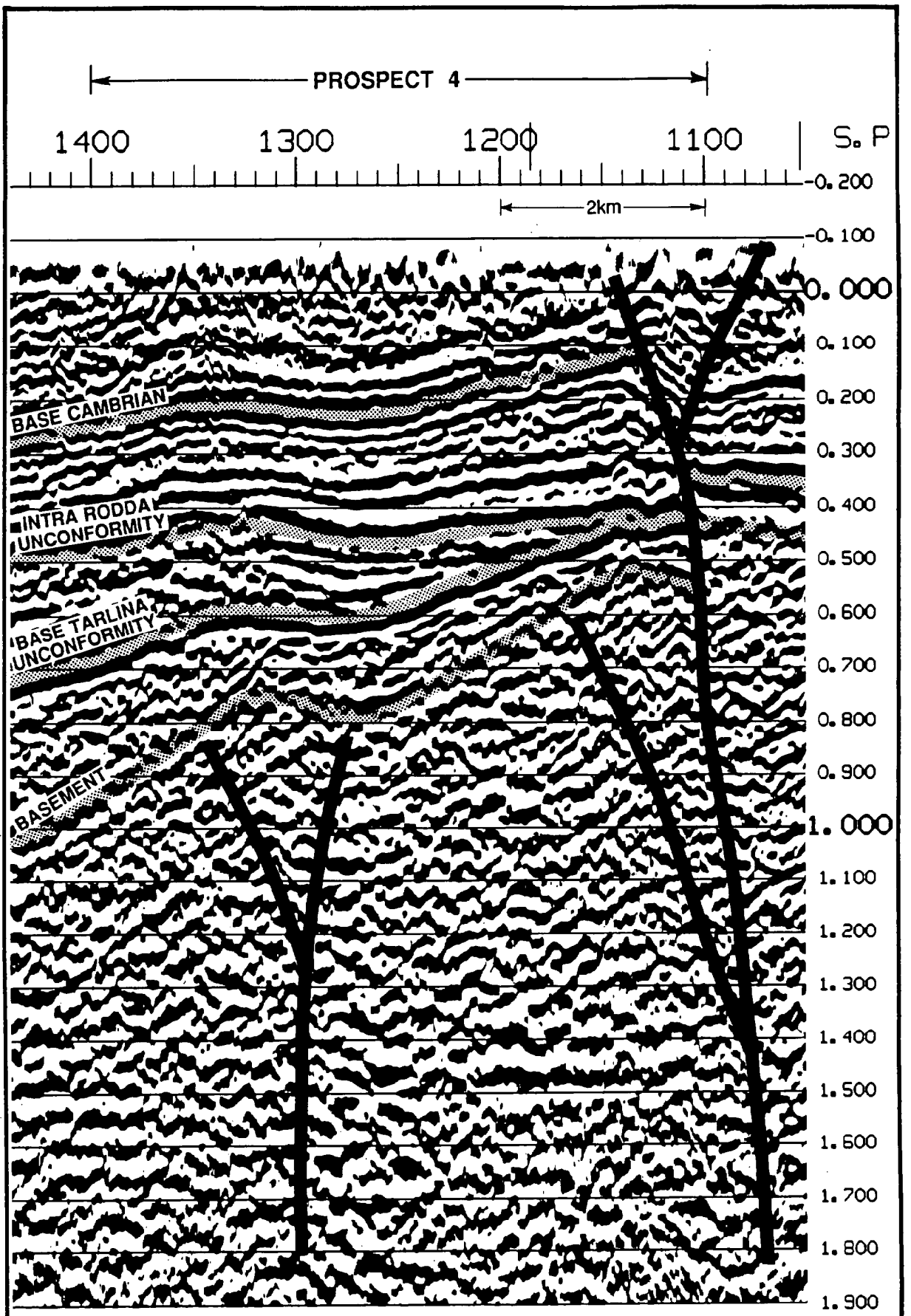
PROSPECT 2

LINE 86-106

MINES AND ENERGY SOUTH AUSTRALIA

94-229

Figure 7.



EASTERN OFFICER BASIN

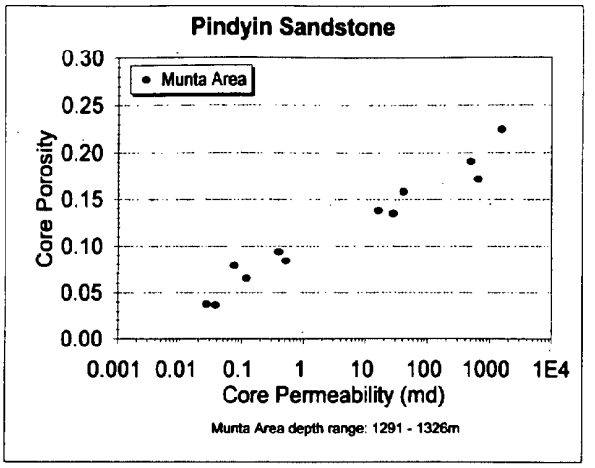
PROSPECT 4

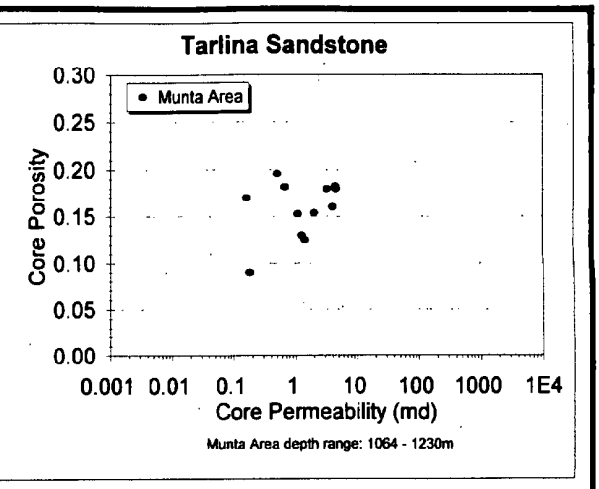
LINE 86-0044

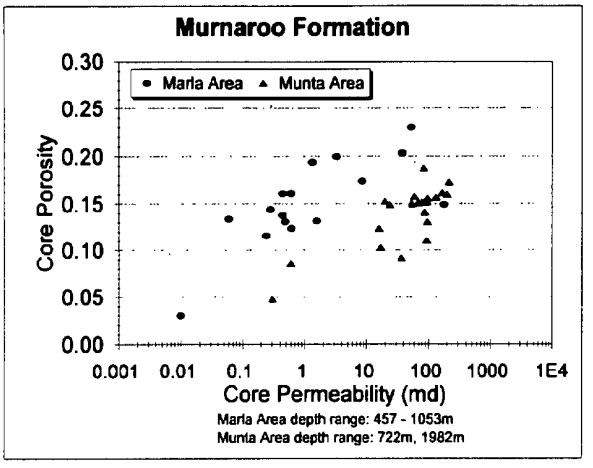
MINES AND ENERGY SOUTH AUSTRALIA

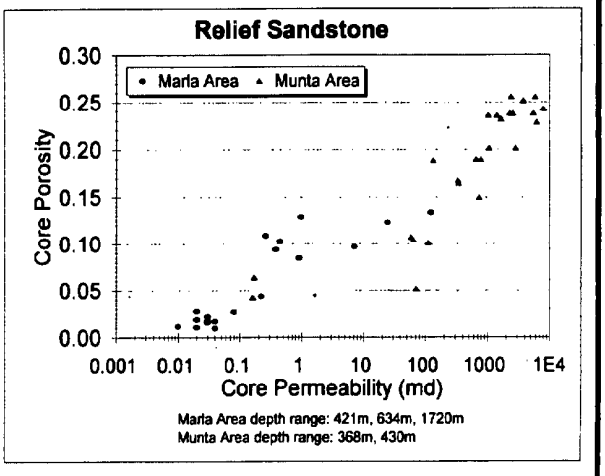
94-230

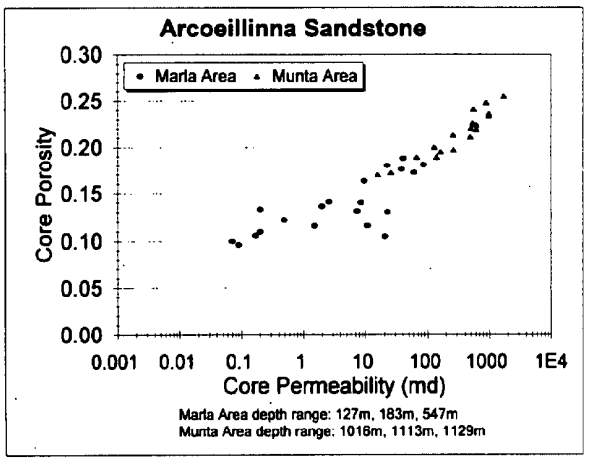
Figure 8.

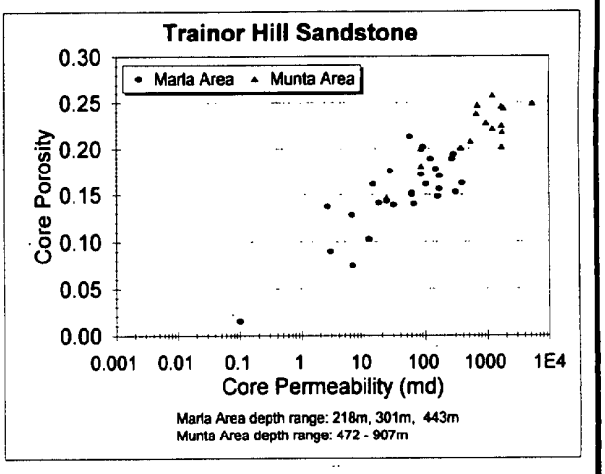












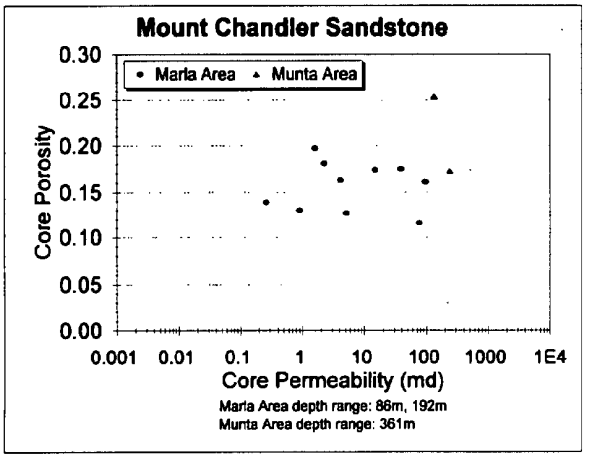


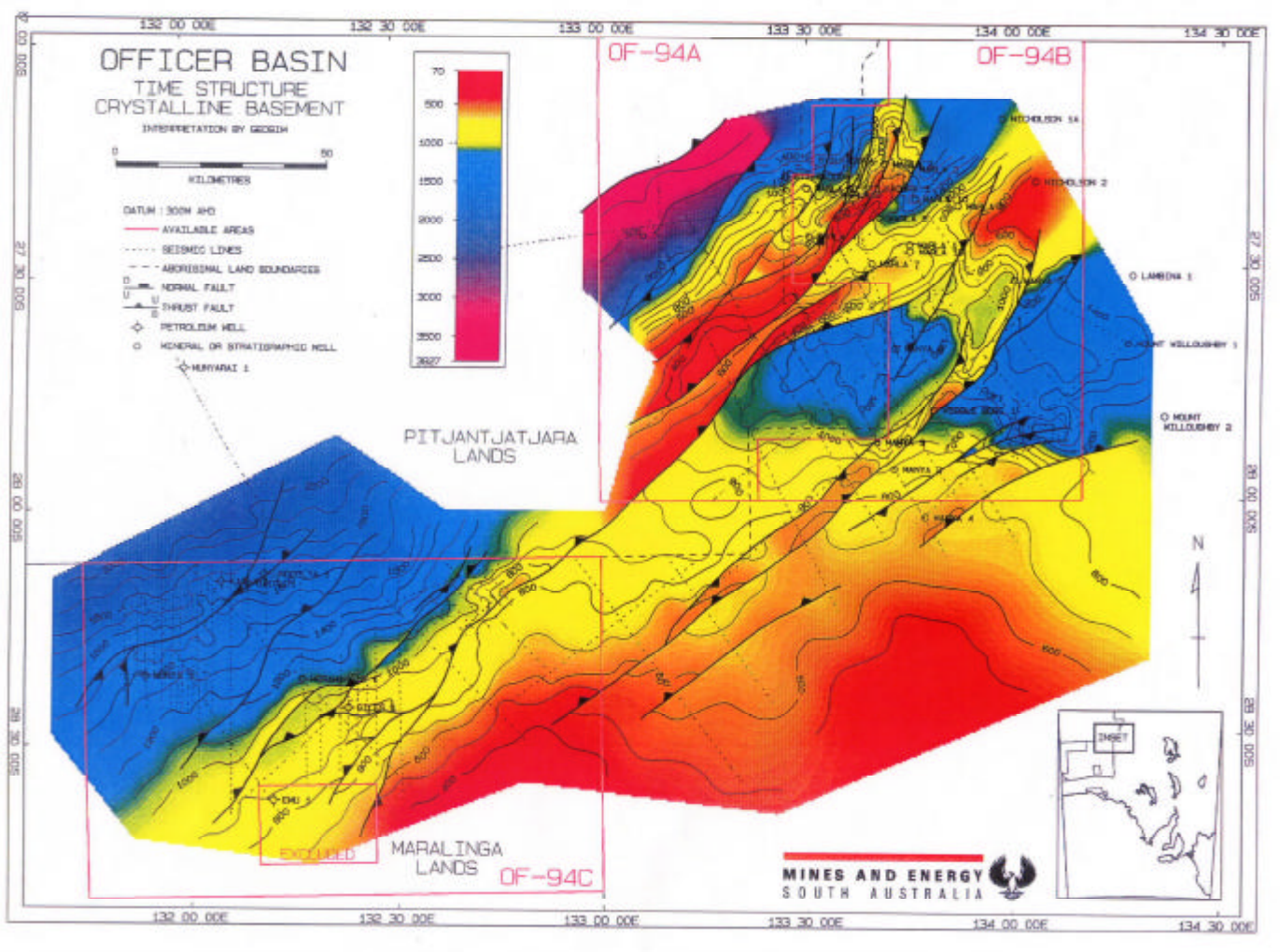
Figure 9

OFFICER BASIN SANDSTONES POROSITY PERMEABILITY CROSSPLOTS

Marla area covers block OF-94B
Munta area covers block OF-94C

MINES AND ENERGY SOUTH AUSTRALIA

94-271


OFFICER BASIN
TIME STRUCTURE
CRYSTALLINE BASEMENT
INTERPRETATION BY GEOSIM
0
50
KILOMETRES
DATUM : 300M AHD
AVAILABLE AREAS
SEISMIC LINES
ABORIGINAL LAND BOUNDARIES
NORMAL FAULT
THRUST FAULT
PETROLEUM WELL
MINERAL OR STRATIGRAPHIC WELL
MUNYARAI 1
70
500
1000
1500
2000
2500
3000
3500
3927
OF-94A
OF-94B
OF-94C
PITJANTJATJARA
LANDS
MARALINGA
LANDS
EXCLUDED
NICHOLSON 1A
NICHOLSON 2
LAMBINA 1
MOUNT KILLOUGHBY 1
MOUNT KILLOUGHBY 2
EMU 1
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SOUTH AUSTRALIA
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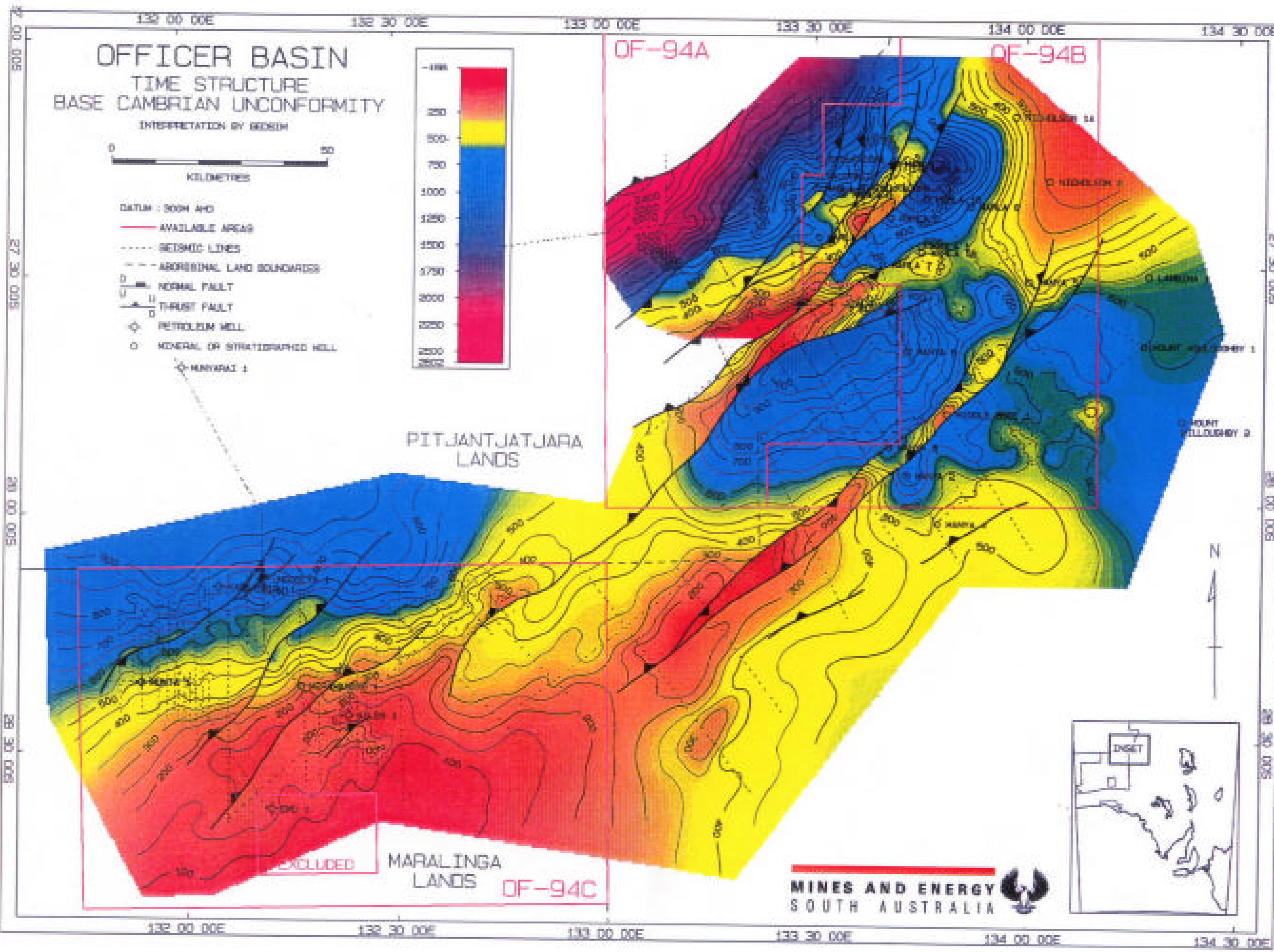

OFFICER BASIN
TIME STRUCTURE
BASE CAMBRIAN UNCONFORMITY
INTERPRETATION BY GEOSIM
KILOMETRES
DATUM : 300M AHD
AVAILABLE AREAS
SEISMIC LINES
ABORIGINAL LAND BOUNDARIES
NORMAL FAULT
THRUST FAULT
PETROLEUM WELL
MINERAL OR STRATIGRAPHIC WELL
MUNYARAI 1
OF-94A
OF-94B
OF-94C
PITJANTJATJARA LANDS
MARALINGA LANDS
EXCLUDED
NICHOLSON 1A
NICHOLSON 2
LAMBINA 1
MOUNT WILLOUGHBY 1
MOUNT WILLOUGHBY 2
INSET
132 00 00E
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134 30 00E
MINES AND ENERGY
SOUTH AUSTRALIA

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* indicates new reports

APPENDIX 1

ADMINISTRATIVE GUIDELINES FOR PETROLEUM EXPLORATION AND PRODUCTION TENEMENTS

ONSHORE EXPLORATION GUIDELINES

Petroleum Act, 1940

The area to which this Act applies covers all of onshore SA exclusive of Commonwealth Lands; it extends south to the State Territorial Sea Baseline and includes the waters of Spencer and St Vincent Gulfs.

	ONSHORE PETROLEUM EXPLORATION	Petroleum Act Reference
Title of Tenement	Petroleum Exploration Licence (PEL)	
Who Can Apply	An individual, a body corporate (ie. a company) or an unincorporated association of person's and bodies corporate (ie. a joint venture involving several persons and/or companies). A foreign corporation applicant must be registered under the provisions of the Corporations Law.	6(1)
	Where application is made on behalf of a company, the application must be made under the company seal.	41(b)&(c)
When Application Can be Made	Initial licence - at any time over any area not already under licence.	6(1a)
	Renewal of licence - not less than 3 months before existing licence is due to expire.	18(5b)
Maximum Area	26 000 km^2	15(1)
Application Fee	For initial application - $2 000 For each renewal - $1 000	7(2) 7(2)
Bond (to ensure compliance with licence conditions)	$15 000 minimum. Amount required is specified in letter of offer. Bond may be in the form of cash, cheque or bank guarantee.	13(1)
Term of Licence	Initial term - 5 years Each renewal (to a maximum of 3) - 5 years	15(2) 15(2)
Annual Rental Payable	Initial 5 year licence term - 24 c/km^2	18c(a)
	First renewal (2nd 5 year licence term) - 36 c/km^2	18c(b)
	Second renewal (3rd 5 year licence term) - 48 c/km^2	18c(c)
	Third & final renewal (4th 5 year licence term) - 60 c/km^2	18c(d)

Minimum Work Commitments	As negotiated with applicant after application (which must contain a proposed 5 year work program) has been received.	
Minimum Expenditure Commitments	Initial 5 year licence term - first two years - $16 per sq. km per year - last three years - $24 per sq. km per year.	17(1)(a) 17(1)(b)
	First renewal (2nd 5 year licence term) - $100 per sq. km per year.	18a(1)(a)
	Second renewal (3rd 5 year licence term) - $125 per sq. km per year.	18a(1)(b)
	Third & final renewal (4th 5 year licence term) - $150 per sq. km per year.	18a(1)(c)
Area to be Relinquished on each Renewal	25% of original licence area. This is in addition to any areas voluntarily surrendered during each 5 year licence term.	18(2)
Fee for Minister's Consent to Dealings in Licence	$1 000 per transaction (document).	42(3)
Fee for Inspection of Register	$100	Reg.13(2)
Fee for Copy or Extract from Register	$1 per page	Reg.13(4)
Method of Application	Letter of application addressed to the Director-General, MESA (there is no prescribed form).	7(1)
	Attached to the application should be:	
	(1) full names and addresses of the party/ parties making the application, including (where applicable) the percentage interests of the various parties.	
	(2) two copies of a map and description of the area being applied for.	7(3)
	(3) a table showing the work intended to be carried out, and the estimated cost of that work, during each year of the five year licence term. (Expenditure estimates should satisfy the minimum expenditure commitments set out in Sections 17 and 18.)	7(3a)
	(4) particulars of the technical qualifications and expertise available to the applicant party/parties (e.g. qualifications and experience of employees, consultants retained etc.).	7(4)
	(5) particulars of the financial resources available to the applicant party/parties to carry out the proposed terms and conditions of the licence. (In the case of a company application, this is generally supplied in the form of a copy of the company's most recent Annual Report.)	7(4)
	(6) the $2 000 application fee. Where the application is made on behalf of a company, the application must be made under the company seal.	7(2) 41(b)&(c)

Penalty for Non-Payment of Annual Rental Fees	All fees are payable in advance. If fees are not paid by the due date, a fine of 10% is imposed and in addition, interest accrues at the rate of 6% per annum. If any fee is in arrears for 3 months or more, the licence may be cancelled.	83(1)&(2)
Licence Variations	Only on application by the licensee, the Minister may at any time during the term of the licence, vary or revoke a condition of the licence or attach new conditions to the licence.	17(3)
Environmental Conditions	As set out in the Regulations. Any special conditions will be outlined in the letter of offer attached to the licence.	
Surrenders (Partial or Whole of Licence)	The Act requires the licensee to: (1) apply to the Minister for permission to surrender (2) give 3 months notice in writing (3) pay all outstanding fees (4) pay all outstanding monies and wages to workmen and employees.	 38(1) 38(1)(a) 38(1)(b) 38(1)(c)
	Surrenders are only permitted if the licensee has fulfilled all the terms and conditions of the licence up to and including the year in which the application to surrender is lodged.	38(2a)
	Licensees are required to lodge all outstanding data on their licences and carry out the cleanup and rehabilitation of their licence areas (where necessary) as a condition of surrender.	
	Surrenders are effective from the end of the appropriate year of the term of the licence (unless specified otherwise).	38(2b)
Required Notice for Approval to Undertake Work in Licence Area	Three months notice is required to arrange necessary clearances with other Government Agencies. This is carried out by MESA on the licensee's behalf.	
Required Notice of Entry to Landholders	No risk of damage to land or improvements thereon - 14 days. Risk of damage to land or improvements thereon - 28 days.	51(1) 51(1)
Gazettals	Gazettals occur on: (1) grant of licence (2) surrender of licence (3) cancellation of licence.	 6(2) 71(1)
Suspension and Cancellation	The Act provides for suspension and/or cancellation for failure to comply with licence conditions.	87a(1)

All monetary amounts are subject to review. Current 1 March 1993.

APPENDIX 2

OVERVIEW OF THE PITJANTJATJARA LAND RIGHTS ACT 1981, AS IT RELATES TO MINING AND PETROLEUM DEVELOPMENT IN SOUTH AUSTRALIA

Background

- Anangu Pitjantjatjara is a body corporate incorporated pursuant to the Act (Section 5(1));
- All Pitjantjatjaras being members of the Pitjantjatjara, Yankunytjatjara and Ngaanyatjarra people and traditional owners of the lands or part thereof are members of Anangu Pitjantjatjara;
- Anangu Pitjantjatjara is the owner in fee simple of the whole of the Pitjantjatjara Lands:
- Decisions of Anangu Pitjantjatjara are made by way of resolution at bi-monthly meetings of its Executive Board or alternate bi-monthly general meetings. The daily running of Anangu Pitjantjatjara is controlled by the Director (Mr Gary Lewis);
- Proposals to access the Pitjantjatjara lands for any purpose are always referred initially to the Director. He then seeks the opinion of the Executive Board which invariably informs him that the traditional owners must be consulted. After consultation the decision of the traditional owners is referred back to the Executive Board or monthly general meeting for ratification;
- Anangu Pitjantjatjara has the power to enter into contracts (Section 6(2)(d) and receive and disburse monies (Section 6(2)(f));
- The functions of Anangu Pitjantjatjara in relation to the management, use and control of the lands are to protect the interests of traditional owners (Section 6(1)(a) and (b));
- Before carrying out or authorising any proposal relating to the development or use of any portion of the lands the traditional owners having interest in that portion of the lands shall be consulted and no decision shall be made until Anangu Pitjantjatjara is satisfied that the traditional owners understand, have expressed their views, and have consented to the proposal (Section 7).

The Pitjantjatjara Land Rights Act, 1981 makes the following provisions with respect to activities under the Mining and Petroleum Acts:

1. Section 21(1) provides that all minerals under the Mining Act 1971, and the Petroleum Act 1940 are vested in the Crown.

2. Section 21(1) also indicates that the provisions of Section 20 only replace those sections of the Mining and Petroleum Acts which deal with entry, and associated matters such as compensation and exempt land. In this way the integrity of the Mining and Petroleum Acts is maintained, but provisions specifically appropriate to the Pitjantjatjara land are provided in the Act.

3. A company wishing to obtain a petroleum or mining tenement within the land applies first to the Minister for Mines and Energy. If the company is considered to be technically and financially sound it will be directed under Section 20(3) to negotiate with Anangu Pitjantjatjara to determine the terms and conditions under which it can enter the lands. Concurrently, under Section 21(2) the tenement application will be progressed in the usual manner by the Department of Mines and Energy, but the tenement may not be granted until permission under Section 20 has been obtained. Anangu Pitjantjatjara will generally only deal with one proposal in relation to an exploration tenement at any one time.

4. In the negotiations with Anangu Pitjantjatjara for entry, if agreement is reached within the terms of the Act the Minister for Mines and Energy will proceed to the granting of a tenement. It is important to note in this context that Section 21(4), expressly forbids payments, or the giving of considerations, to Anangu Pitjantjatjara except as specified in Section 24(2): *A payment or consideration...must be reasonably proportioned to the disturbance to the lands, the Pitjantjatjara people, and their ways-of-life, that has resulted or is likely to result from the grant of the relevant mining tenement.*

5. Should the negotiations with Anangu Pitjantjatjara for entry end in disagreement, or if no agreement has been reached by the end of 120 days, Section 20(8-10) allows that the dispute may be referred by the applicant to an arbitrator who will be a Judge of the Supreme Court of a State or Territory, or the Federal Court of Australia, or the High Court of Australia. The arbitrator will determine the dispute in line with Section 20(15), having regard to:

(a) the effect of the grant of the mining tenement upon -

(i) the preservation and protection of Pitjantjatjara ways-of-life, culture and tradition;

(ii) the interests, proposals, opinions and wishes of the Pitjantjatjara people in relation to the management, use and control of the lands;

(iii) the growth and development of Pitjantjatjara social, cultural and economic structures;

(iv) freedom of access by Pitjantjatjaras to the lands and their freedom to carry out on the lands rites, ceremonies and other activities in accordance with Pitjantjatjara traditions;

(b) the suitability of the applicant to carry out the proposed mining operations and his capacity, in carrying out those operations, to minimise disturbance to the Pitjantjatjara people and the lands;

(c) the preservation of the natural environment;

and

(d) the economic and other significance of the operations to the State and Australia.

The arbitrator's decision will be binding on the applicant, Anangu Pitjantjatjara, and the Government. Nevertheless, it is still the over-riding responsibility of the Minister for Mines and Energy to determine, in the final event, whether or not he is prepared to grant the mining or petroleum tenement incorporating the arbitrated conditions, should the arbitrator's decision allow this.

6. With the present state of geological and geophysical knowledge of the area scheduled in the Act to comprise the land, all initial applications for tenements will relate to exploration. It is intended that the procedures set out in Sections 20-24 would apply equally to the application for subsequent titles as for the initial exploration title. It is accepted that it is the responsibility of a company when the initial application for an exploration tenement is made, to explain as far as practicable to Anangu Pitjantjatjara the potential consequences should the exploration be successful.

7. The implications have yet to be examined of a company assigning portion of its interest in a tenement within the lands to another party, or securing finance against the asset represented by their mining tenement. On the other hand, the powers given to Anangu Pitjantjatjara as a corporate body are sufficient for it to participate in mining ventures on its own account.

8. The Act in Section 22(1) provides that royalties paid in respect of petroleum and minerals recovered from the land are to be paid into a separate fund maintained by the Minister for Mines and Energy. Of these moneys, one-third up to a prescribed limit to be fixed by regulation will be paid to Anangu Pitjantjatjara, another third to the same limit is to be paid to the Minister for Aboriginal Affairs to be applied towards the health, welfare and advancement of the Aboriginal inhabitants of the State generally, and the last third is to be paid into the General Revenue of the State, plus any excess above that set by regulation for the first and second thirds.

APPENDIX 3

OVERVIEW OF THE MARALINGA TJARUTJA LAND RIGHTS ACT, 1984, AS IT RELATES TO MINING AND PETROLEUM DEVELOPMENT IN SOUTH AUSTRALIA

Background

- Maralinga Tjarutja (MT) is a body corporate incorporated pursuant to the Act (Section 4(1));
- Traditional owners of the lands or part thereof are members of MT;
- MT is the owner in fee simple of the whole of the Lands;
- Decisions of MT are exercised by way of the Council of MT;
- MT has the power to enter into contracts (Section 5(2)(d) and receive and disburse monies (Section 5(2)(f));
- The functions of MT in relation to the management, use and control of the lands are to protect the interests of traditional owners (Section 5(1)(a) and (b)).

The Maralinga Tjarutja Land Rights Act, 1984 makes the following provisions with respect to activities under the Mining and Petroleum Acts:

1. Section 23(1) provides that all minerals under the Mining Act 1971, and the Petroleum Act 1940 are vested in the Crown.

2. Section 23(1) also indicates that the provisions of Section 21 only replace those sections of the Mining and Petroleum Acts which deal with entry, and associated matters such as compensation and exempt land. In this way the integrity of the Mining and Petroleum Acts is maintained, but provisions specifically appropriate to the MT land are provided in the Act.

3. A company wishing to obtain a petroleum or mining tenement within the land applies first to the Minister for Mines and Energy. If the company is considered to be technically and financially sound it will be directed under Section 21(3) to negotiate with MT to determine the terms and conditions under which it can enter the lands. Concurrently, under Section 23(2) the tenement application will be progressed in the usual manner by the Department of Mines and Energy, but the tenement may not be granted until permission under Section 21 has been obtained.

4. In the negotiations with MT for entry, if agreement is reached within the terms of the Act the Minister for Mines and Energy will proceed to the granting of a tenement. It is important to note in this context that Section 23(4), expressly forbids payments, or the giving of considerations, to MT except as specified in Section 26(2): *Subject to subsection (3), a payment or consideration...must be reasonably proportioned to the disturbance to the lands, the traditional owners, and their ways-of-life, that has resulted or is likely to result from the grant of the relevant mining tenement.*

5. Should the negotiations with MT for entry end in disagreement, or if no agreement has been reached by the end of 120 days, Section 21(10-12) allows that the dispute may be referred by the applicant to an arbitrator who will be a Judge of the Supreme Court of a South Australia or the High Court, the Federal Court of Australia, or a legal practitioner of not less than ten years standing appointed by the Minister for Mines and

Energy as arbitrator. The arbitrator will determine the dispute in line with Section 21(19), having regard to:

(a) the effect of the grant of the mining tenement upon -

(i) the preservation and protection of ways-of-life, culture and tradition of the traditional owners;

(ii) the interests, proposals, opinions and wishes of the traditional owners in relation to the management, use and control of the lands;

(iii) the growth and development of social, cultural and economic structures of the traditional owners;

(iv) freedom of access by traditional owners to the lands and their freedom to carry out on the lands rites, ceremonies and other activities in accordance with their traditions;

(b) the suitability of the applicant to carry out the proposed mining operations and his capacity, in carrying out those operations, to minimise disturbance to the traditional owners and the lands;

(c) the preservation of the natural environment;

and

(d) the economic and other significance of the operations to the State and Australia.

The arbitrator's decision will be binding on the applicant, MT and the Government. Nevertheless, it is still the over-riding responsibility of the Minister for Mines and Energy to determine, in the final event, whether or not he is prepared to grant the mining or petroleum tenement incorporating the arbitrated conditions, should the arbitrator's decision allow this.

6. With the present state of geological and geophysical knowledge of the area scheduled in the Act to comprise the land, all initial applications for tenements will relate to exploration. It is intended that the procedures set out in Sections 21-26 would apply equally to the application for subsequent titles as for the initial exploration title. It is accepted that it is the responsibility of a company when the initial application for an exploration tenement is made, to explain as far as practicable to MT the potential consequences should the exploration be successful.

7. The implications have yet to be examined of a company assigning portion of its interest in a tenement within the lands to another party, or securing finance against the asset represented by their mining tenement. On the other hand, the powers given to MT as a corporate body are sufficient for it to participate in mining ventures on its own account.

8. The Act in Section 24(1) provides that royalties paid in respect of minerals recovered from the land are to be paid into a separate fund maintained by the Minister for Mines and Energy. Of these moneys, one-third up to a prescribed limit to be fixed by regulation will be paid to MT, another third to the same limit is to be paid to the Minister for Aboriginal Affairs to be applied towards the health, welfare and advancement of the Aboriginal inhabitants of the State generally, and the last third is to be paid into the General Revenue of the State, plus any excess above that set by regulation for the first and second thirds.

APPENDIX 4

AMOCO-AP OIL JOINT OPERATING AGREEMENT (JOA) SUMMARY

1 NOVEMBER 1985

EASTERN OFFICER BASIN AREA
SOUTH AUSTRALIA

Amoco Australia Petroleum Company (AMOCO)
Crusader Resources N L (CRUSADER)
Quadrant Energy Development Limited (QUADRANT)
and
A P Oil Pty Limited (AP)

Details of the JOA are confidential, but in broad terms the JOA makes the following provisions:

SUMMARY OF PROVISIONS

(1) The JOA related to operations under Petroleum Exploration Licence 29 (PEL 29) granted on 1 November 1985 and also made certain provisions for operations under any ensuing petroleum production licence. Almost all of the provisions of the JOA are considered to be normal provisions in a JOA.

(2) The above parties had the following Participating Interests in PEL 29:

AMOCO	50%
CRUSADER	15%
QUADRANT	15%
AP OIL	20%
	100%

(3) AP's interest was a Carried Interest until such time as AP elected to either acquire a 20% Participating Interest or to take a 10% Net Profits Interest (election required no later than 90 days after notification of intention to apply for a production licence).

(4) Whilst the A P interest was a Carried Interest, obligations and liabilities under PEL 29 would be apportioned as follows:

AMOCO	62.50%
CRUSADER	18.75%
QUADRANT	18.75%
AP OIL	0.00%
	100.00 %

(5) Until such time as A P elected to acquire a 20% Participating Interest by paying 40% of costs to date adjusted by a to be agreed cost of finance factor, A P would have no interest in property acquired under the Joint Account.

(6) AMOCO was the initial Operator appointed to conduct operations under PEL 29.

(7) All parties with a Participating Interest of not less than 5%, including AP, had one representative on the Operating Committee. The Voting Interest of A P was defined as 10% on the Operating Committee whilst A P's interest remained a Carried Interest. As a general rule, decisions of the Operating Committee in the affirmative required two or more parties with a combined Voting Interest of at least 65%. If A P elected to convert to a 20% Participating Interest, A P would be entitled to its full 20% vote on the Operating Committee.

(8) The JOA makes specific provisions relative to an Access/Cooperation Agreement between Anangu Pitjantjatjara and parties to the JOA.

APPENDIX 5

SUMMARY OF ACCESS AGREEMENT
ANANGU PITJANTJATJARA - MINISTER OF MINES AND ENERGY

Negotiations with the AP Council commencing in December 1992 resulted in an Access Agreement being signed at an AP Council meeting at Umuwa on 31 May 1993 for a MESA seismic survey in the eastern Officer Basin. The Access Agreement was signed between Anangu Pitjantjatjara and the Minister for Mines and Energy.

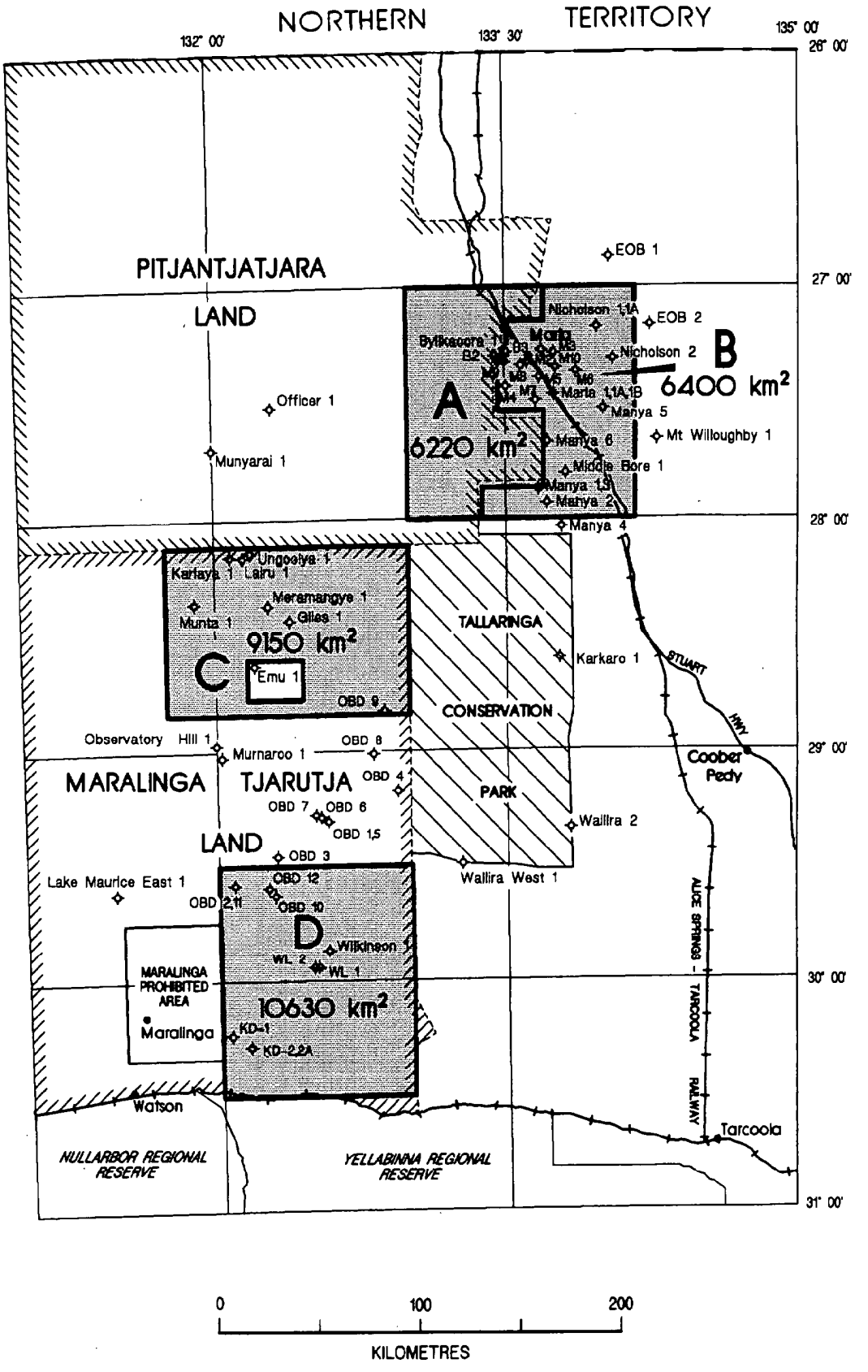
The Access Agreement is very similar to agreements signed into effect in October and November 1992, enabling access for seismic work by AGSO on both the Pitjantjatjara and Maralinga Lands.

The agreements make the following provisions:

- The Minister wishes to undertake geological work on land vested in AP pursuant to the Pitjantjatjara Land Rights Act, 1981.
- The Minister and AP wish to ensure that the work does not interfere with any site of cultural, spiritual or social significance to Aboriginal persons traditionally responsible for those areas of the land where work is to be done.
- AP will issue permits for members of the work crew to enter the land.
- Prior to so doing, AP will constitute a Scouting Team to undertake an anthropological assessment of the work area.
- This team will advise the Minister's representative of changes required in the work programme to avoid sites of significance, and will approve areas where work can be done.
- Once the work area has been approved and the main seismic crew enters the Land, AP will appoint an Aboriginal Liaison Officer to liaise between the crew, Anangu Pitjantjatjara and the Minister's representative.
- The Minister will provide notification to AP of progress with the work and any variation to the work programme.
- The Minister will ensure as far as possible that the location of any water fit for human or livestock consumption discovered as a result of drilling will be made known to AP, and that up to four such boreholes will be completed such that they can be equipped with pumps.
- The Minister will reimburse AP for expenses incurred in the employment of members of the Scouting Team (including the anthropologist) and the Liaison Officers.

Both AGSO and MESA seismic surveys were undertaken with a high level of mutual cooperation and respect between the Pitjantjatjara and Maralinga people and officers of MESA and AGSO.

A copy of the Access Agreement is available on request.



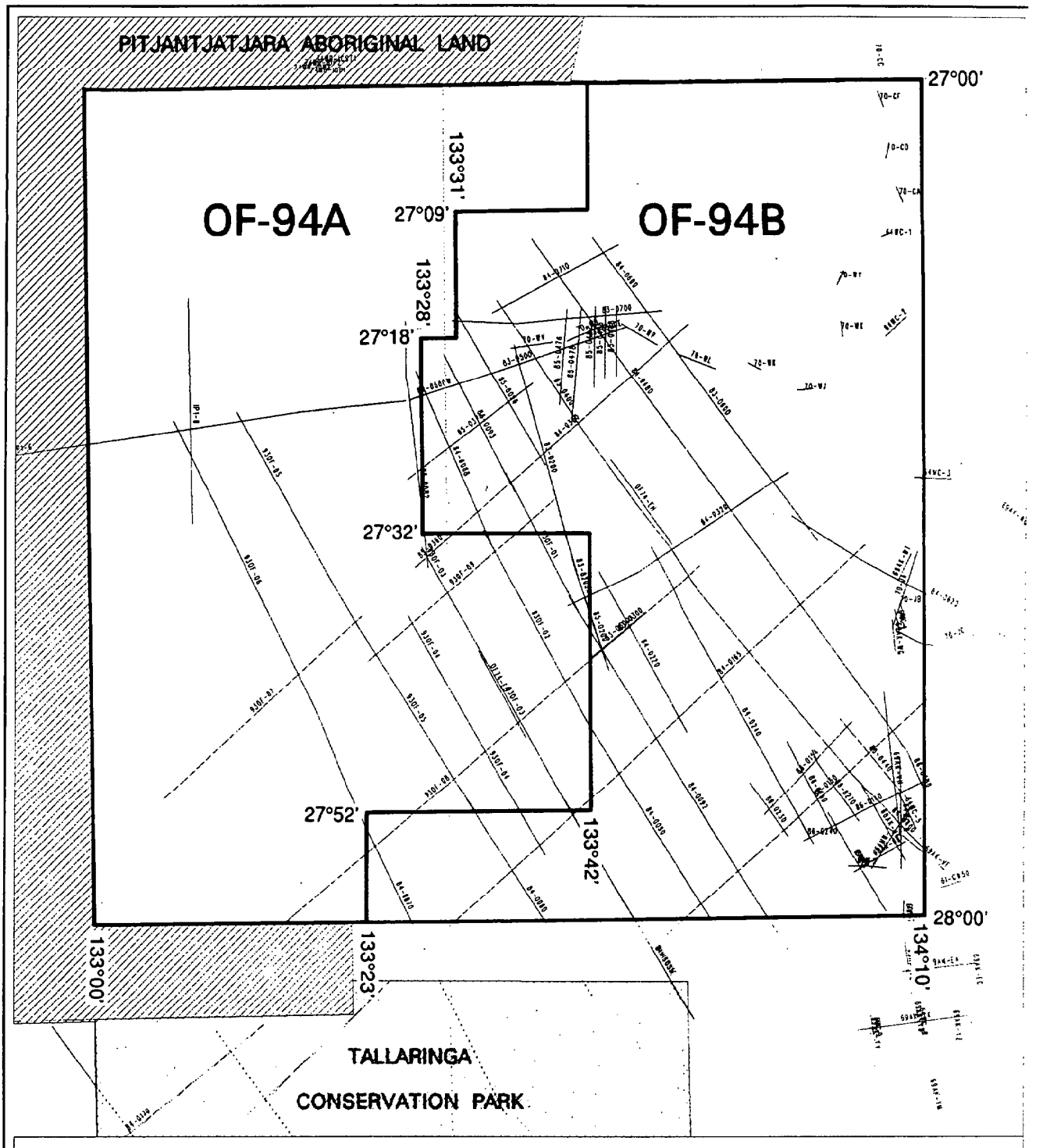
EASTERN OFFICER BASIN

PEL OF-94 APPLICATION AREAS

MESA 94-242

MINES AND ENERGY
SOUTH AUSTRALIA

QD-DORA 5948QLDTA



MINES AND ENERGY
SOUTH AUSTRALIA

SCALE 1:750,000

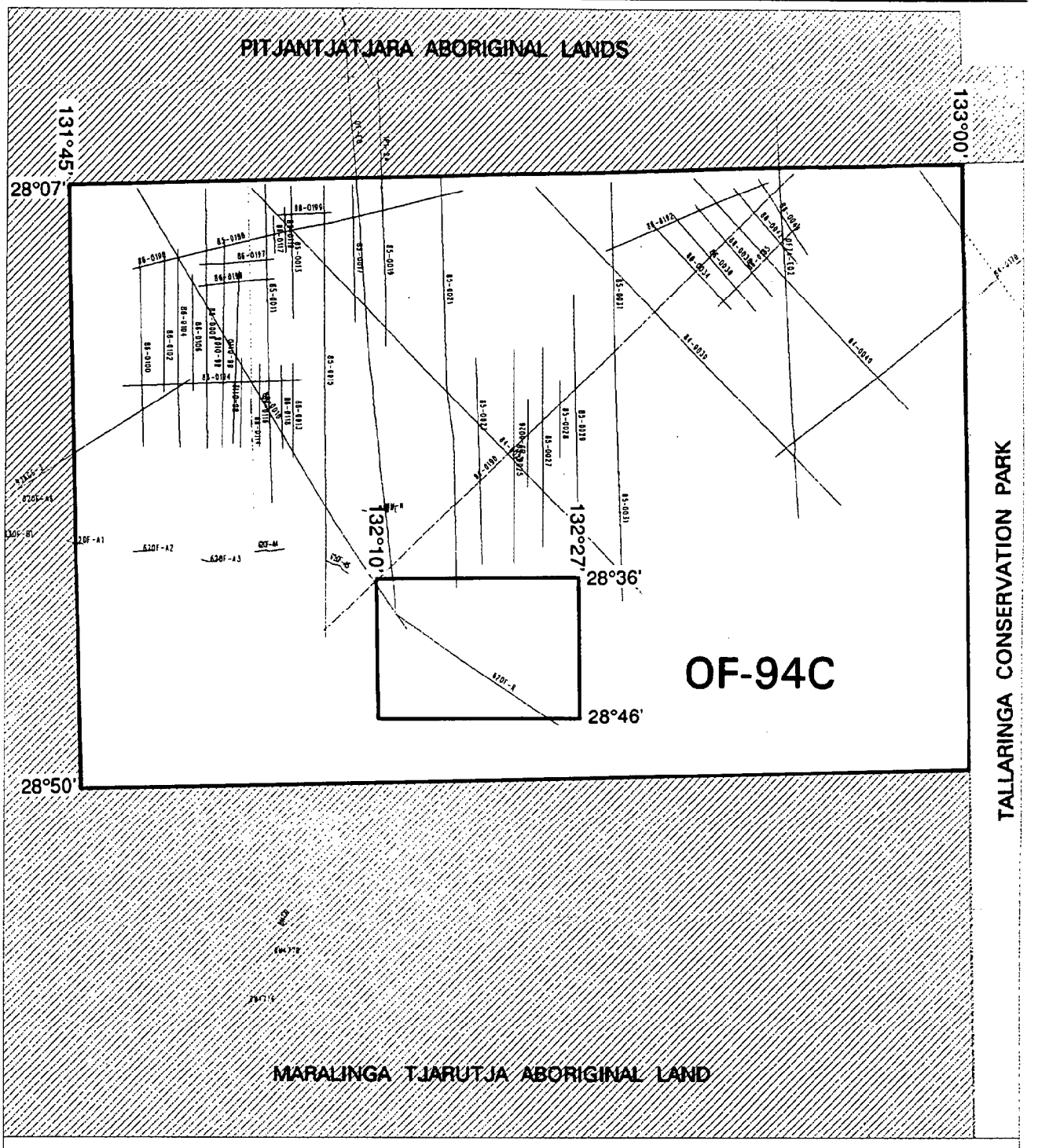
EASTERN OFFICER BASIN

PELs OF-94A and OF-94B

APPLICATION AREAS

Produced from ARC/INFO databases by Petroleum Geophysics

Plotted on March 09, 1994



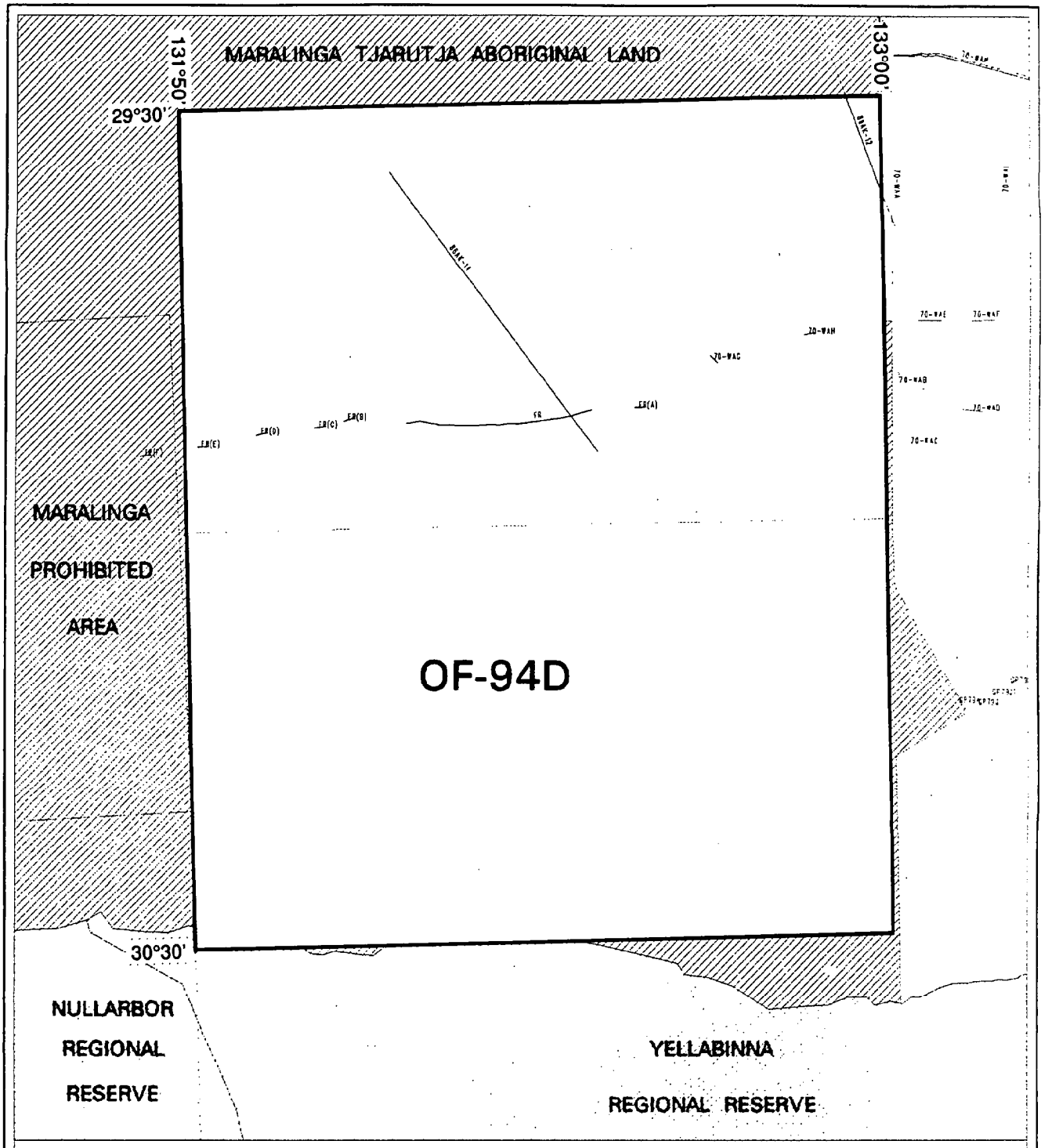
MINES AND ENERGY
SOUTH AUSTRALIA

SCALE 1:750,000

EASTERN OFFICER BASIN
PEL OF-94C
APPLICATION AREA

Produced from ARC/INFO databases by Petroleum Geophysics

Plotted on March 09, 1994



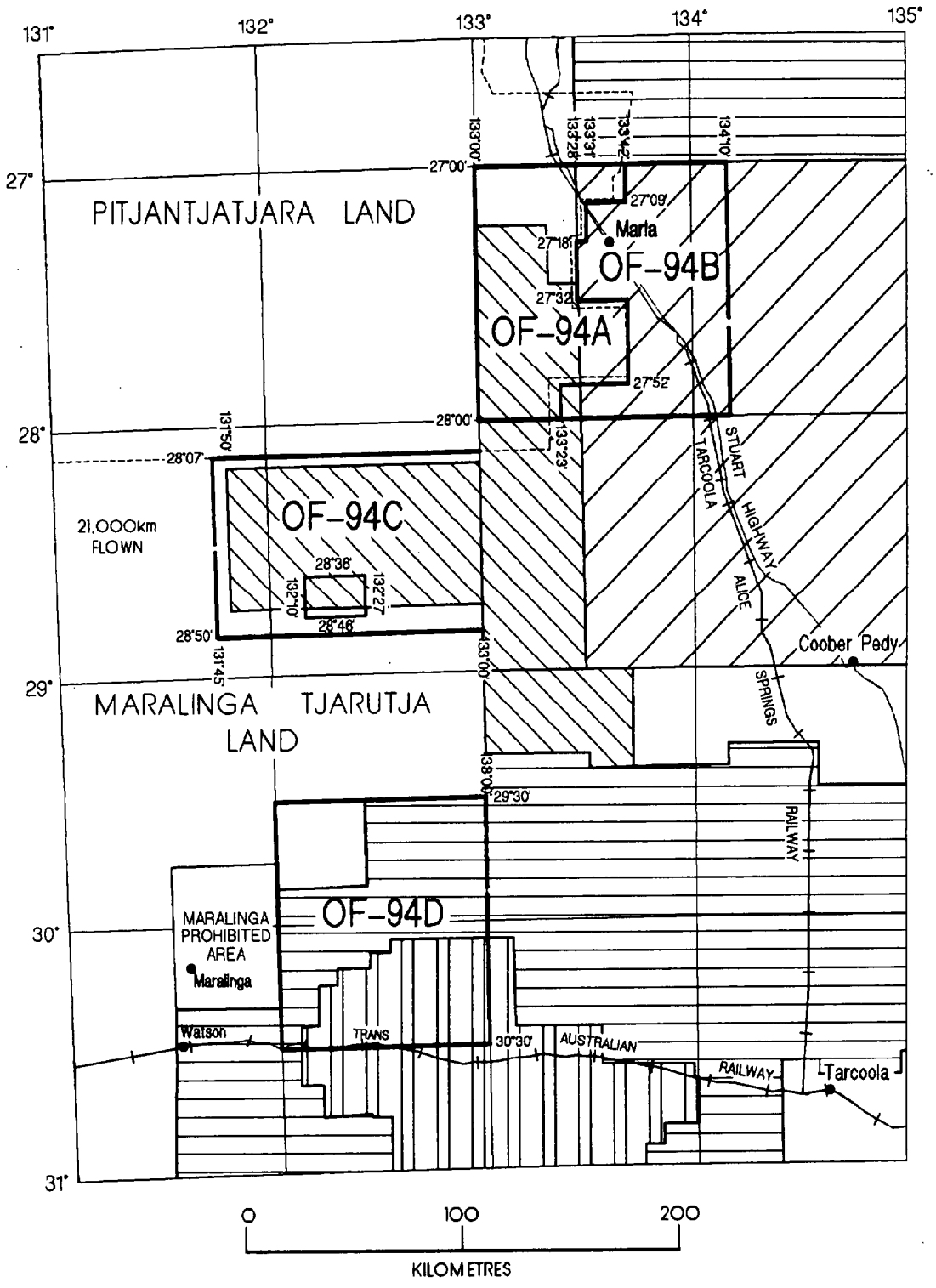
MINES AND ENERGY
SOUTH AUSTRALIA

SCALE 1:750,000

EASTERN OFFICER BASIN
PEL OF-94D
APPLICATION AREA

Produced from ARC/INFO databases by Petroleum Geophysics

Plotted on March 08, 1994



1981 company
(Height 70m/Spacing 300m)

1992 AGSO
(Height 80m/Spacing 400m)

1993 SAEI surveys
(Height 80m/Spacing 400m)

1994 SAEI
(Height 80m/Spacing 400m)

EASTERN OFFICER BASIN
AEROMAGNETIC DATA COVERAGE

MESA 94-274

MINES AND ENERGY
SOUTH AUSTRALIA

QD-DORA 5948DG.DTA

APPENDIX 6

OPEN FILE DATA

General

Open file data are held in archival storage at MESA in several forms. Information is generally held in Envelopes (Env.), Report Books (R.B.), Well Completion Reports (usually referred to as Envelopes) and Mineral Resources Reviews (MRR). Microfiche or hard data are available on request.

Eight new, significant reports are available from MESA. These are indicated in the Selected References and are listed below:

*GRAVESTOCK, D.I. & SANSOME, A., 1994 - Geology of the Officer Basin, South Australia. South Australian Department of Mines & Energy, open file Envelope 8591 (unpublished).

*HOSKINS, D.V., 1994 - OF93 (Wallatinna) seismic survey. Final operations report. South Australian Department of Mines & Energy, open file Envelope 8591 (unpublished).

*HOUGH, L.P., 1994 - Operations report for 1993 Wallatinna gravity and magnetic survey (93EZ). South Australian Department of Mines & Energy, open file Envelope 8591 (unpublished).

*MACKIE, S.M., 1994 - Summary of seismic interpretation, Marla and Munta areas, Officer Basin. South Australian Department of Mines & Energy, open file Envelope, 8638 (unpublished).

*MOUSSAVI-HARAMI, R., 1994 - Burial history analysis of the east Officer Basin, South Australia. A preliminary study. South Australian Department of Mines & Energy, open File Envelope 8591 (unpublished).

*SUKANTA, U., 1993 - Sedimentology, sequence stratigraphy and palaeogeography of Marinoan sediments in the eastern Officer Basin, South Australia. Flinders University of South Australia, Ph.D. Thesis (unpublished).

*ZANG, W., (in prep.a). - Early Neoproterozoic sequence stratigraphy and acritarch biostratigraphy, eastern Officer Basin, South Australia. Precambrian Research.

*ZANG, W., (in prep.b) - Pindyin Sandstone and Alinya Formation: two early Neoproterozoic lithological units in the Officer Basin, South Australia. South Australian Geological Survey, Quarterly Notes.

Wireline Logs

Wireline logs have not been run in a number of the Officer Basin mineral wells. Those that have been recorded are not to A.P.I. standard. Paper prints and transparencies of logs that have been recorded are available from the department at any scale requested.

Information on Digital log data is available from MESA or directly from:

Wiltshire Geological Services
13 St Andrews Avenue
Mount Osmond S.A. 5064
Telephone (618) 379 3246
Facsimile (618) 379 7732

Aeromagnetic Data

The Airborne Geophysical Survey Index database operates on a PC through the SUPERBASE 4 and MAPINFO software packages. Colour images of total magnetic intensity, grey-scale images of magnetic gradient and flight line plots are available on digital 'PCX' files for selected surveys. The 'PCX' images are for sale.

Enquires may be directed to:

Mr Terry Crabb
South Australian Department of Mines & Energy
P.O. Box 151
EASTWOOD, SOUTH AUSTRALIA 5063
Telephone (618) 274 7619
Facsimile (618) 373 3269

World Geoscience Aeromagnetic Data Package

World Geoscience Corporation of Perth, Western Australia, has recorded an aeromagnetic survey over the West Marla and Munta areas of the Officer Basin. This survey covers seismic grids acquired by Comalco in the mid - 1980s and the western part of the OF-93 seismic grid acquired in 1993 for MESA. The eastern part of this grid, and adjacent seismic recorded by Comalco, are on the WINTINNA 1:250 000 sheet where AGSO flew an aeromagnetic survey in 1993.

World Geoscience Corporation will interpret and market the west Marla/Munta dataset in June/July 1994.

The Data Interpretation Package will integrate all open file MESA datasets, namely magnetics, radiometrics, gravity, seismic and drillhole information.

Enquires may be directed to:

Mr R.P. Timmins
World Geoscience Corporation Ltd.
65 Brockway Road
FLOREAT, WESTERN AUSTRALIA 6014
Telephone (619) 383 7833
Facsimile (619) 383 7166

CENTRALIAN SUPERBASIN - PROTEROZOIC EXPLORATION
(PETROCONSULTANTS NON-EXCLUSIVE REPORTS)

The Officer Basin is only one of a series of basins which, in the Neoproterozoic, occupied a single extensive depression, the **Centralian Superbasin.** This enormous depositional system covered some 2 million sq km of central-western Australia, an area almost double the size of the North Sea and Texas combined, and includes the Amadeus, Georgina, Ngalia, Officer and Savory Basins.

Petroconsultants has produced a non-exclusive report describing in detail for the first time, the geology and hydrocarbon potential of the entire Centralian Superbasin. The study incorporates considerable new unpublished research data and interpretations relating to tectonic development, biostratigraphy, sequence stratigraphy, palaeogeography and geochemistry of both the Neoproterozoic and early Palaeozoic sediments.

The Superbasin was disrupted about 600 million years ago by a massive central uplift and then dissected by a late Palaeozoic orogeny to form the present structural basins. Recognition of the

integrity of the original regional depositional system in the Neoproterozoic allows the stratigraphy of relatively well known areas to be extrapolated to predict that of areas that are poorly known. The predictions can be tested using new results from sequence stratigraphy, isotope chemostratigraphy and acritarch biostratigraphy. Parts of the Superbasin contain a thick succession of early Palaeozoic sediments which are now better known as a result of detailed sequence stratigraphy studies. Source rock and reservoir rock distributions in both the Neoproterozoic and Palaeozoic can now be more confidently predicted. Hundreds of new TOC analyses were available to the authors of the report.

The Amadeus Basin oil and gas fields confirm the presence of commercial hydrocarbons in the Superbasin, and serve as a guide to evaluate potential in the lesser known component basins. The report also compares the geology of the Superbasin with that of some prolific productive basins in Oman, China and Eastern Siberia.

The principal author, well known Proterozoic geology specialist Dr. Malcolm Walter, has recently completed another study for Petroconsultants describing the ***"Special Techniques for the Investigation of Proterozoic Basins"****. This handbook reviews the latest research, much of which is unpublished, on selected topics such as acritarch and stromatolite biostratigraphy, chemostratigraphy, geochronology and magnetostratigraphy, organic geochemistry and maturation techniques, as well as sequence stratigraphic and geophysical methodology.*

Both reports were produced by Petroconsultants Sydney office and are also available through any of the Petroconsultants offices in Geneva, Houston, London and Singapore.

Petroconsultants Australasia
Level 4
39 Chandos Street
St. LEONARDS, NEW SOUTH WALES 2065
Telephone (612) 901 3577
Facsimile (612) 901 3636

DATA AVAILABLE FOR PURCHASE

The cost of data is nominal, i.e. cost of reproduction plus a small handling/freight charge.

To place orders for data please complete the Document Storage Centre Request form at the rear of this brochure, and Fax to (IAC)* 618 3798133 or (08) 379 8133 within Australia.

(* Dial the appropriate International Access Code).

AREA OF-94A

1. Well Completion Reports.

Well	Year	TD(m)	MESA Information Source
Byilkaoora-1	1979	496.7	RB 79/115
Byilkaoora-2	1982	806.7	Env. 3938: 436-487

Drillholes and seismic upholes less than 200 m deep are not included.

2. Seismic Lines.

Survey	Line
74 OF01	OF74-ED
80 OF01	MINISOSIE
83 OF01	83-0200
83 OF01	83-0300
83 OF01	83-0700
83 OF02	83-0200A
84 OF01	84-0070*
84 OF01	84-0080
84 OF01	84-0085*
84 OF01	84-0088
84 OF01	84-0090
84 OF01	84-0092*
84 OF01	84-0165
84 OF01	84-0320
84 OF01	84-0360
84 OF01	84-0500W
85 OF01	85-0082*
85 OF01	85-0200
85 OF01	85-0360
85 OF01	85-0370
87 OF01	IP1-6
87 OF01	IP1-8
93 OF02	93OF-01
93 OF02	93OF-02

93 OF02	93OF-03
93 OF02	93OF-04
93 OF02	93OF-05
93 OF02	93OF-06
93 OF02	93OF-07
93 OF02	93OF-08
93 OF02	93OF-09

Pre 1983 Seismic recorded is **38.7 km**
Post 1983 Seismic recorded is **487.9 km**
Total seismic recorded within Area OF-94A is **526.6 km**.
Note * Part of these lines have been reprocessed in 1994 for MESA.

AREA OF-94B

1. Well Completion Reports.

Well	Year	TD(m)	MESA Information Source
Byilkaoora-3	1982	698	Env. 3938: 550-595
Manya-2	1980	646	Env. 6259: 3-35
Manya-3	1980	812.9	Env. 6259: 36-114
Manya-5	1982	1333.3	Env. 6259: 137-180
Manya-6	1982	1764.7	Env. 6259: 181-264
Marla-1A	1979	215.3	RB 80/22; RB 80/79
Marla-1B	1979	379.4	RB 80/22; RB 80/79
Marla-2	1984	352.2	Env. 3938: 596-610
Marla-3	1984	650	Env. 3938: 615-640
Marla-4	1984	424.1	Env. 3938: 641-654
Marla-5	1984	649.9	Env. 3938: 655-672
Marla-6	1984	702.5	Env. 3938: 673-704
Marla-7	1984	543	Env. 6259: 265-314
Marla-8	1985	446.8	Env. 3938: 705-720
Marla-9	1985	435.8	Env. 3938: 721-733
Marla-10	1985	775.7	Env. 3938: 737-759
Middle Bore-1	1985	557.6	Env. 6259: L-CD
Nicholson-1A	1981	1103.1	Env. 3938: 491-543: 1264-1299
Nicholson-2	1981	814.5	Env. 6259:361-390; 3938: 1300-1303

Drillholes and seismic upholes less than 200 m deep are not included.

2. Seismic Lines. (Area OF-94B continued).

Survey	Line
64 AK01	64MW-1
64 AK01	64MW-2
64 AK01	64WC-1
64 AK01	64WC-2
64 AK01	64WC-3
64 AK01	64WC-4
64 AK01	64WC-5
64 AK01	64WC-6
64 AK01	64WC-7
68 AK01	68AK-UA
68 AK01	68AK-UB
68 AK01	68AK-UC
69 AK01	69AK-VF
69 AK01	69AK-VH
69 AK01	69AK-WG
69 AK01	69AK-WT
70 AK02	70-CA
70 AK02	70-CD
70 AK02	70-CF
70 AK02	70-JA
70 AK02	70-JB
70 AK02	70-JC
70 AK02	70-WJ
70 AK02	70-WK
70 AK02	70-WL
70 AK02	70-WP
70 AK02	70-WU
70 AK02	70-WV
70 AK02	70-WX
70 AK02	70-WY
74 OF01	OF74-EH
80 OF01	MINISOSIE
83 OF01	83-0200
83 OF01	83-0300
83 OF01	83-0400
83 OF01	83-0500
83 OF01	83-0600
83 OF01	83-0700
83 OF02	83-0200A
83 OF02	83-0300A*
84 OF01	84-0070*
84 OF01	84-0080
84 OF01	84-0085*
84 OF01	84-0088
84 OF01	84-0090
84 OF01	84-0092*
84 OF01	84-0150
84 OF01	84-0165
84 OF01	84-0220
84 OF01	84-0240
84 OF01	84-0320
84 OF01	84-0360
84 OF01	84-0400
84 OF01	84-0480
84 OF01	84-0500E
84 OF01	84-0500W
84 OF01	84-0600
84 OF01	84-0620
84 OF01	84-0710
85 OF01	85-0082*
85 OF01	85-0093*
85 OF01	85-0096
85 OF01	85-0200
85 OF01	85-0370
85 OF01	85-0476
85 OF01	85-0478
85 OF01	85-0482
85 OF01	85-0486
85 OF01	85-0488
86 OF01	86-0140
86 OF01	86-0154
86 OF01	86-0230
86 OF01	86-0240
86 OF01	86-0250
86 OF01	86-0270
86 OF01	86-0440
86 OF01	86-0480
93 OF02	93OF-01
93 OF02	93OF-02
93 OF02	93OF-03
93 OF02	93OF-04
93 OF02	93OF-08
93 OF02	93OF-09

Pre 1983 Seismic recorded is **435.4 km**
Post 1983 Seismic recorded is **845.7 km**
Total seismic recorded within Area OF-94B is **1281.1 km.**
Note * Part of these lines have been reprocessed in 1994 for MESA.

AREA OF-94C

1. Well Completion Reports.

Well	Year	TD(m)	MESA Information Source
Emu-1	1963	417.9	Env. 362; RB 724
Giles-1	1985	1326.8	Env. 6547
Karlaya-1	1987	2363.3	Env. 7040
Lairu-1	1987	2039.6	Env. 7041
Meramangye-1	1984	690.6	Env. 6259: 315-347
Munta-1	1987	2075	Env. 7090
Ungoolya-1	1985	2192.6	Env. 6764

Drillholes and seismic upholes less than 200 m deep are not included.

2. Seismic Lines.

Survey	Line
62 OF01	62OF-A1
62 OF01	62OF-A2
62 OF01	62OF-A3
62 OF01	62OF-A4
62 OF01	62OF-A5
62 OF01	62OF-R
66 OF02	OF-EO
66 OF02	OF-MM-E
66 OF02	OF-MM-N
74 OF01	OF74-EQ2
84 OF01	84-0010
84 OF01	84-0020
84 OF01	84-0030
84 OF01	84-0040
84 OF01	84-0050
84 OF01	84-0170
84 OF01	84-0190
85 OF01	85-0009
85 OF01	85-0011
85 OF01	85-0013
85 OF01	85-0015
85 OF01	85-0017
85 OF01	85-0019
85 OF01	85-0021
85 OF01	85-0023
85 OF01	85-0025
85 OF01	85-0026
85 OF01	85-0027
85 OF01	85-0028
85 OF01	85-0029
85 OF01	85-0031
85 OF01	85-0198
86 OF01	86-0013
86 OF01	86-0034
86 OF01	86-0036
86 OF01	86-0038
86 OF01	86-0042
86 OF01	86-0044
86 OF01	86-0100
86 OF01	86-0102
86 OF01	86-0104
86 OF01	86-0106
86 OF01	86-0108
86 OF01	86-0110
86 OF01	86-0112
86 OF01	86-0114
86 OF01	86-0116
86 OF01	86-0117
86 OF01	86-0118
86 OF01	86-0119
86 OF01	86-0185
86 OF01	86-0192
86 OF01	86-0194
86 OF01	86-0196
86 OF01	86-0197
86 OF01	86-0198
86 OF01	86-0199
87 OF01	IP1-2A
93 OF01	93AGS-3

Pre 1983 Seismic recorded is **147.8 km**
Post 1983 Seismic recorded is **1271.5 km**
Total seismic recorded within Area OF-94C is **1419.3 km**.

AREA OF-94D

1. Well Completion Reports.

Well	Year	TD(m)	MESA Information Source
KD-1	1982	456	Env. 4161
KD-2A	1982	342	Env. 4161
OBD-10	1981	244	Env. 3887
OBD-11	1981	232.7	"
OBD-12	1981	474.4	"
Wilkinson-1	1978	710	RB 79/88
WL-2	1981	520	Env. 3965

Drillholes and seismic upholes less than 200 m deep are not included.

2. Seismic Lines.

Survey	Line
70 AK02	70-WAG
70 AK02	70-WAH
74 AK01	FR
74 AK01	FR(A)
74 AK01	FR(B)
74 AK01	FR(C)
74 AK01	FR(D)
74 AK01	FR(E)
86 AK01	86AK-12

Pre 1983 Seismic recorded is **35.8 km**
Post 1983 Seismic recorded is **60.2 km**
Total seismic recorded within Area OF-94D is **96 km**.

South Australian Department of Mines and Energy

DOCUMENTS STORAGE CENTRE

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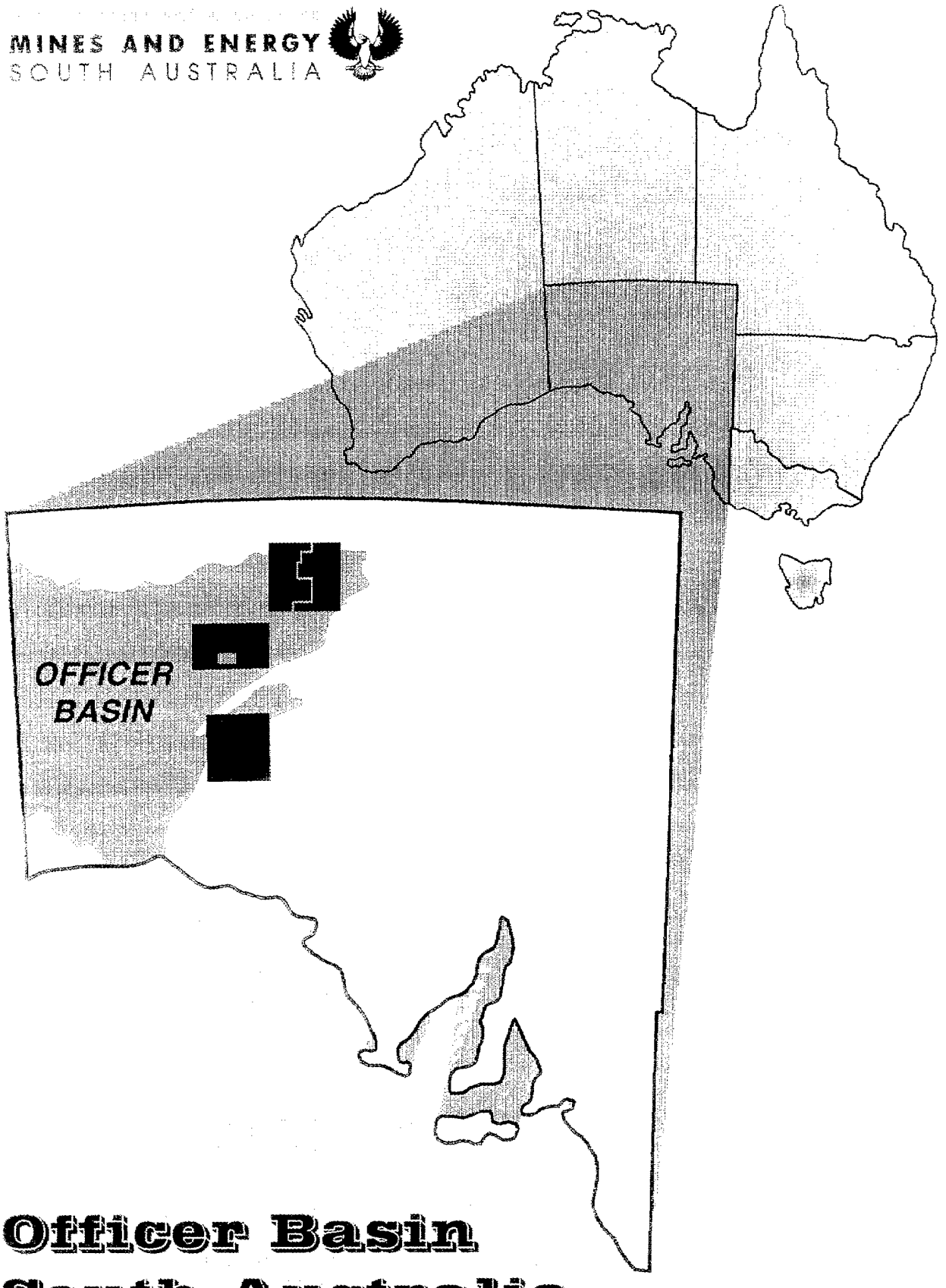

Officer Basin South Australia Application Areas

April 1994